ONMEAS®

Rev.A1.0

AT9620

Comprehensive Electrical Safety Tester



User Manual

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Operation Video

Safety Precautions

Warning Danger:If any of the following abnormal conditions occurs, stop operation immediately and disconnect the power cord. Contact the ONMEAS sales department immediately for repair. Otherwise, a fire may occur or the operator may be exposed to a potential electric shock hazard.

- The instrument operates abnormally.
- The instrument produces abnormal noise, odor, smoke, or flashes during operation.
- The instrument generates high temperature or electric shock during operation.
- The power cord, power switch, or power socket is damaged.
- Foreign matter or liquid has entered the instrument.

Safety Information

Warning Danger: To avoid possible electric shock and ensure personal safety, follow the guidelines below during operation.

Disclaimer	Please read the following safety information carefully before using the instrument. ONMEAS assumes no liability for any personal injury or property damage caused by the user's failure to comply with the following provisions.
Instrument Grounding	To prevent electric shock hazard, connect the power ground wire properly.
Do Not Using the Instrument in an Explosive Gas Environment	Do not use the instrument in an environment containing flammable or explosive gases, vapors, or excessive dust. Using any electronic equipment in such an environment poses a risk to personal safety.
Do Not Opening the Instrument Enclosure	Non-professional maintenance personnel must not open the instrument enclosure in an attempt to repair the instrument. Charge that has not been fully discharged may remain inside the instrument for some time after it is switched off, which may cause an electric shock hazard to persons.
Do not Using this instrument in a strong magnetic field environment	If the instrument is damaged, potential hazards will be unpredictable.Disconnect the power cable immediately, do not continue using the device, and do not attempt to repair it by yourself.
Do Not Using an Instrument Operating Abnormally	If the instrument is not operating normally, the hazards are unpredictable. Disconnect the power cord, do not use the instrument again, and do not attempt to repair it yourself.
Do Not Using the Instrument Beyond the Methods Specified in This Manual	Beyond the specified scope, the protective measures provided by the instrument will become ineffective.

Limited Warranty and Limitation of Liability

Onmeas Ltd. (hereinafter referred to as Onmeas) warrants that every AT9620 you purchase is fully compliant in terms of quality and metrology. This warranty does not cover the fuse, nor damage caused by negligence, misuse, contamination, accident, or abnormal conditions of use. This warranty applies only to the original purchaser and is not transferable.

From the date of shipment, Onmeas provides a one-year free warranty, which also covers the VFD or LCD. If the instrument is damaged due to improper operation by the user within the one-year free warranty period, the repair costs shall be borne by the user. From one year after shipment until the end of the instrument's service life, Onmeas will provide repair services for a charge. For replacement of the VFD or LCD, the cost will be charged at the current cost price.

If the product is found damaged, contact Onmeas to obtain authorization for return or replacement. Then deliver the product to your dealer for return or exchange. Be sure to state the cause of the damage and prepay the postage and insurance to the destination. For repair or replacement of a product within the warranty period, Onmeas will bear the return shipping costs. For repair of a product not covered by the warranty, Onmeas will provide an estimate of the repair costs and will carry out the repair only after obtaining your consent; all costs arising from the repair shall be borne by the user, including the return shipping costs.

This warranty is the only warranty provided by Onmeas and is your sole remedy; apart from it, there are no other express or implied warranties (including the warranty of fitness for a particular purpose), and all other warranties are expressly disclaimed. Neither Onmeas nor its agents has made any oral or written representation to establish a warranty or to expand the scope of this warranty in any way. Onmeas shall not be liable for any special, indirect, incidental, or consequential damage or loss (including loss of data) arising from any cause beyond the specifications. If any provision of this warranty conflicts with local laws or regulations, or if certain jurisdictions do not allow the exclusion or limitation of implied warranties, local laws and regulations shall prevail, and that provision may therefore not apply to you. However, such a ruling shall not affect the validity and enforceability of the other provisions.

People's Republic of China
Jiangsu Province
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1. Installation and Setup

Thank you for purchasing our company's product! Please read this chapter carefully before use.
In this chapter you will learn the following:

- Main Functions Packing List
- Power Requirements
- Operating Environment
- Cleaning
- Fuse Replacement

1.1 Packing List

Before formally using the instrument, please first:

1. Inspect the appearance of the product for defects such as damage or scratches;

2. Check the instrument accessories against the packing list for any missing items.

If there is damage or missing accessories, contact the ONMEAS instrument sales department or your dealer immediately.

1.2 Power Requirements

The AT9620 can only be used under the following power conditions:

Voltage: 220VAC (1±10%)

Frequency: 50Hz (1±10%)



Warning: To prevent electric shock hazard, connect the power ground wire properly
If the user replaces the power cord, ensure that the ground of the power cord is reliably connected.

1.3 Operating Environment

The AT9620 must be used under the following environmental conditions:

Temperature: 0°C~55°C

Humidity: below 70% RH at 23°C

1.4 Cleaning

To prevent electric shock hazard, disconnect the power cord before cleaning.

Use a clean cloth moistened with a small amount of clean water to clean the enclosure and panel.

Do not clean the interior of the instrument.



Note: Do not use solvents (such as alcohol or gasoline) to clean the instrument.

2. Safety Rules

In this chapter you will learn the following:

- Workstation Arrangement
- Operator Requirements
- Prohibited Operations
- Precautions During Testing



This instrument generates a 5kV test voltage high enough to cause personal injury or even death. When operating the instrument, you must exercise extreme caution and observe the cautions, warnings, and other instructions given in this chapter.

2.1 Workstation Arrangement

➢ Working Position

The workstation must be located in an open area away from regular personnel traffic, keeping non-operating staff away from the workstation. The workstation must be separated from other facilities and marked with "**High-Voltage Test Workstation**". During testing, the following sign must be posted: "**DANGER! TEST IN PROGRESS. NO UNAUTHORIZED PERSONNEL!**".

➢ Input Power

Make sure the **instrument is connected to electrical ground (earth)** to ensure safety. The workstation power supply must have its own switch, installed in a conspicuous place at the workstation entrance and specially marked so that everyone can identify it as the workstation power switch. In an emergency, switch off the power immediately before entering to deal with the situation.

➢ Workplace

Use **a work desk or bench made of insulating material**; no metal is allowed between the operator and the DUT. When designing the workplace, **it must be avoided that the operator has to reach across the DUT to operate the tester**. The workplace must be kept tidy and clean. Store unused instruments and test leads in a fixed place, and make sure all personnel can immediately distinguish the item under test, items awaiting test, and items already tested. The test station and its surroundings must be free of flammable and corrosive gases; do not use the tester near flammable materials.

2.2 Operator Requirements

➢ Personnel Qualifications

Operating this series of testers is hazardous; misoperation may cause personal injury, which may even be
life-threatening. Personnel must therefore be trained before use and strictly follow this User's Guide.

➢ Safety Rules

Operators must be given continuous safety education and training so that they understand the importance of safe operation and follow the safety
rules when operating the tester.

➢ Clothing Requirements

Operators must not wear clothing with metal decorations, metal jewelry, or watches; such metal ornaments can easily cause
accidental electric shock. When operating the tester, operators must wear **insulating gloves**.

➢ Medical Requirements

This series of testers must never be operated by persons with heart disease or by persons wearing a heart rate regulator or cardiac pacemaker.

2.3 Prohibited Operations

✓ Do Not Switch the Power On and Off Continuously

After switching off the power switch, make sure to wait several seconds or longer before switching it on again. Do not switch the power switch on and off repeatedly at short intervals; otherwise, the protective devices of the instrument may not fully perform their protective functions. Do not switch off the power while the instrument is generating a test voltage, except under special or emergency circumstances.

✓ Do Not Short the Output Terminals to Ground

Take care with the high-voltage test leads of the instrument; do not allow them to short-circuit to a nearby AC power line that is already connected to ground or to other nearby equipment (such as conveying equipment). If a short circuit occurs, the enclosure of the instrument may become charged with dangerous high voltage.

✓ Do Not Connect External Voltage to the Test Terminals

Do not connect any external voltage to the output terminals of the instrument. In the non-discharge state, the instrument is not capable of discharging externally, and connecting the output terminals to an external voltage may damage the instrument.

2.4 Precautions During Testing

✧ The operator must wear insulating gloves.

✧ If you temporarily leave the operating area or will not perform a test immediately, switch off the power.

✧ During testing, it is strictly prohibited to touch the test terminals of the instrument or the DUT, so as to avoid electric shock.

✧ Operators must be fully in control of the tester's control switch and remote-control switch. When the remote-control switch is not in use,
remove it. Unqualified operators and unrelated personnel must stay away from the high-voltage test area.

✧ The protective earth terminal of this tester must be reliably connected to the ground. Connect the high-voltage test leads only when testing;
remove them promptly when not in use. When handling the test leads (clips), hold them by the insulated part; directly
touching the high-voltage output terminals (clips) is strictly prohibited.

✧ In case of any abnormality, immediately press the [Stop] key to stop the test and switch off the power.

3. Overview

In this chapter you will learn the following:

- Introduction
- Main Features

3.1 Introduction

Thank you for purchasing the AT9620 comprehensive electrical safety compliance tester.

The AT9620 comprehensive electrical safety compliance tester integrates multiple test functions, including electric strength (AC/DC withstand voltage) and insulation resistance, and is important testing equipment for electrical appliance manufacturers and quality inspection departments.

- Fast Testing

With a high-speed microprocessor as its control core, this series of testers measures the electrical safety parameters of the DUT in real time and can complete three tests in as little as 4s, fully meeting the requirements of production lines for rapid testing.

- Easy Operation

This series of testers uses a 5-inch color LCD screen. Various test conditions can be set and tests performed quickly using the physical keys and the numeric keypad, making operation simple; the large screen can display test information and data in greater detail on a single page.

- Intelligent Judgment

This series of testers features intelligent upper and lower limit judgment, can automatically identify defective products, and provides audible and visual alarms.

- Reliable Operation

The circuitry of this series of testers adopts multiple anti-interference measures and provides strong anti-interference capability. It adopts sinusoidal pulse width modulation (SPWM) technology to generate a standard 50Hz or 60Hz sine wave; the output is driven by high-power MOS transistors, achieving contactless adjustment of the high voltage, and both hardware and software protections are provided, greatly improving the reliability of the instrument.

- Safe Use

Automatic overvoltage, overcurrent protection for safer operation.

3.2 Main Features

1. AC/DC withstand voltage testing, IR (insulation resistance) testing, and arc detection combined in one instrument;
2. Charging lower limit and DC open-circuit detection technology;
3. DC fast discharge technology, completing fast discharge within 0.1s;
4. Up to 10 test groups can be stored and edited, with 16 test steps per group;
5. Data logging function with a built-in date chip and support for USB flash drive storage;
6. Flexible product test control, with a choice of 2 handling methods for failed steps and 2 test result display methods,to meet different needs;
7. Support for multiple communication methods such as RS232/RS485.

4. Getting Started

In this chapter you will learn the following:

- Getting to know the front panel — an introduction to the keys and test terminals
- Rear panel — an introduction to the power and interface information
- Accessories — an introduction to the supplied accessories and how to connect them to the instrument
- Power-on startup — including the power-on self-test process and instrument defaults
- Starting a test — including how to connect to the test terminals

4.1 Front Panel Overview

Figure 4- 1 Front Panel

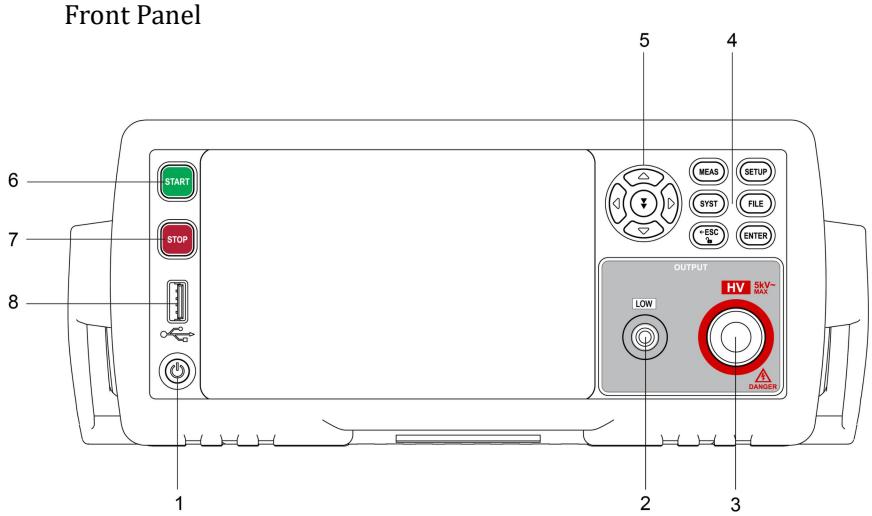


Table 4- 1 Front Panel Function Description

No.	Function
1	Power switch
2	Return terminal of the withstand voltage test; do not touch it when the Test lamp is lit and high voltage is being output.
3	High-voltage output terminal; do not touch it when the Test lamp is lit and high voltage is being output.
4	Function area keys: ● MEAS, press this key to set the instrument to the ready-to-test state. ● SETUP, press this key to enter the parameter setting screen. ● SYST, press this key to enter the system configuration screen. ● FILE, press this key to enter the file management screen.
5	Arrow keys, used to move the cursor on the screen; the center key can be used to enter data.
6	Start key: used to start the current test
7	Stop key: used to stop the current test
8	USB drive interface

Note: On some models, the output terminal (2) and return terminal (3) of the withstand voltage test are located on the rear panel of the instrument; refer to the actual instrument.

4.2 Rear Panel Overview

Figure 4- 2 Rear Panel

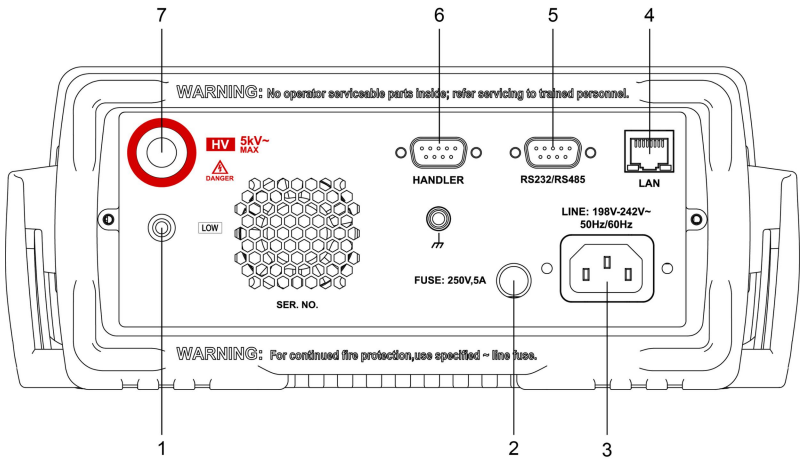


Table 4- 2 Rear Panel Function Description

No.	Function
1	Rear-panel return terminal of the withstand voltage test
2	Fuse (5A) socket
3	Power socket
4	LAN communication interface
5	RS232/RS485 communication interface
6	HANDLER (PLC) communication interface
7	Rear-panel high-voltage output terminal

4.3 Accessories

4.3.1 High-Voltage Test Clips (Standard)

When performing the withstand voltage test, clamp the high-voltage test clips onto the test points to perform the test.

Red high-voltage test clip: connects to the high-voltage output terminal on the front panel or rear panel

Black high-voltage test clip: connects to the return terminal of the withstand voltage test on the front panel or rear panel

Figure 4- 3 High-Voltage Test Clips



4.3.2 High-Voltage Test Probe (Standard)

During the withstand voltage test, use the high-voltage test probe to spot-test test points that are difficult to clamp.

High-voltage test probe: connects to the high-voltage output terminal on the front or rear

panel

Figure 4- 4 High-Voltage Test Probe



4.3.3 RS232 Communication Cable (Standard)

Used for serial communication. Plug one end of the communication cable connector into the communication interface on the rear panel and the other end into the serial port of the computer to perform online communication.

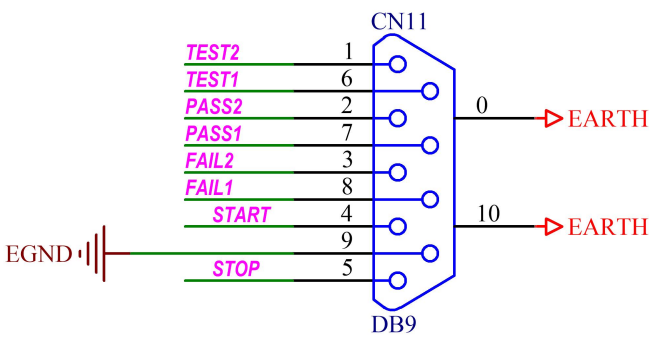
Figure 4- 5 RS232 Communication Cable



4.3.4 DB9 Male Handler Plug (Standard)

Used for Handler (PLC) control. The rear panel of the instrument uses a 9PIN Handler interface; connect the controller according to the plug terminal diagram, and the instrument can then be controlled by the PLC to perform tests.

Figure 4- 6 DB9 Male Handler Plug Pinout



4.4 Power-On Startup

4.4.1 Powering On

The key marked " " at the lower left of the panel is the power switch. The instrument uses a programmable power switch; the power switch is a soft-touch electronic switch.
The indicator lights up, indicating that the instrument is powered on.

Note: the interval between power-on and power-off must be greater than 1s;

4.4.2 Initial Power-On Test

After confirming that the instrument is intact and installed in its working position, check it according to the following steps:

(1) Connect only the power cord of the instrument without connecting any other test leads, and turn on the power switch of the tester;
(2) After the instrument enters the <Measurement Display page>, press the [Start] key directly to perform a test. If the test status is as follows:
a) In IR mode, at a voltage of 500V or above, the displayed insulation resistance is >50G; (indicating that the measured insulation resistance exceeds 50G)
b) In IR mode, at a voltage below 500V, the displayed insulation resistance is >10G; (indicating that the measured insulation resistance exceeds 10G)
c) The withstand voltage test displays a small breakdown current or a zero value
then the instrument is basically normal;
(3) When the instrument is turned on for the first time, if there is no display, check and confirm that the power cord is properly connected;
i. During test startup, if phenomena such as failure to start, no key response, or no sound of relay actuation occur;
ii. please seek technical support from ONMEAS.

4.5 Preparing for Testing

(1) Connect the high-voltage test probe (or red high-voltage test clip) to the L, N lines of the DUT;
(2) The test circuit is connected to the ground wire or the enclosure of the DUT

5. [Setup] Page

In this chapter you will learn the following:

- Test Mode Setting of the Current Step
- ACW Test Mode Parameter Settings
- DCW Test Mode Parameter Settings
- IR Test Mode Parameter Settings
- Editing Test Steps
- File Management — Saving and Recalling Test Programs

When the high-voltage output is stopped, simply press the [Setup] key, and the instrument will enter the main setup page.
SCPI Command: **DISP:PAGE SETUP**

5.1 Test Mode Setting of the Current Step

The instrument allows the test mode of the current step to be set.

Figure 5- 1 Test Mode Setting



■ **Steps for setting the test mode of the current step:**

Step 1 Enter the <Measurement Setup> page;
Step 2 Use the cursor keys to select the [Function] field;
Step 3 Use the soft keys to select.

Soft key	Function
ACW	Sets the test mode of the current step to the ACW test
DCW	Sets the test mode of the current step to the DCW test
IR	Sets the test mode of the current step to the IR test

5.2 ACW Test Mode Parameter Settings

Figure 5- 2 [ACW] Settings



Item	Input Range	Default Value	Description
Output Voltage	(50~5000)V	1000V	Output voltage in the ACW test
Upper Limit	(Lower Limit~10.00)mA, Off	20.00mA	Breakdown current alarm upper limit
Lower Limit	(0.01~Upper Limit) mA, Off	Off	Breakdown current alarm lower limit
Test Time	(0.5~999.9)s, Continuous test	1.0 s	Test time of the current step
Rise Time	(0.4~999.9)s	0.5s	The set voltage ramps up over this time period
Fall Time	(0.1~999.9)s, Off	0.5	The set voltage ramps down over this time period
Current Range	Auto, Fixed	Auto	Sets the current range to automatic ranging or a fixed range. If set to Auto, the instrument automatically selects the appropriate current range; If set to Fixed, a value must be set for the Upper Limit to determine the current range, which can shorten the test time. If the Upper Limit is turned off, the instrument automatically selects the maximum range of this mode.
Output Frequency	50Hz, 60Hz	50Hz	ACW output frequency
Zero Compensation	Off, On, Auto Test	Off	Leakage current zeroing setting. Press the sidebar [Auto Test] key directly to have the analyzer automatically measure the leakage current values of the test leads and test fixture and perform zeroing; the DUT must first be removed from the test leads; Press the sidebar [Off] key to clear.
ARC Level	0~9	0	Alarm level of the arc test. The arc alarm level can be preset and discriminated. The presetting range is 0, 1~9; 0 means that the arc detection function is turned off, and level 9 is the most sensitive. The peak current corresponding to each alarm level is shown in the table below:

ARC Alarm Level (Level)	Threshold Peak Current (mA)
9	2.8
8	5.5
7	7.7
6	10
5	12
4	14

			3	16
			2	18
			1	20

5.3 DCW Test Mode Parameter Settings

Figure 5- 3 [DCW] Settings



Item	Input Range	Default Value	Description
Output Voltage	(50~6000)V	1000V	Output voltage in the ACW test
Upper Limit	(Lower Limit~5mA), Off	10.00mA	Breakdown current alarm upper limit
Lower Limit	(0.1 uA ~Upper Limit), Off	Off	Breakdown current alarm lower limit
Test Time	(0.5~999.9)s, Continuous test	1.0 s	Test time of the current step
Rise Time	(0.4~999.9)s	0.5s	The set voltage ramps up over this time period
Fall Time	(0.1~999.9)s, Off	0.5	The set voltage ramps down over this time period
Current Range	Auto, Fixed	Auto	Sets the current range to automatic ranging or a fixed range. If set to Auto, the instrument automatically selects the appropriate current range; If set to Fixed, a value must be set for the Upper Limit to determine the current range, which can shorten the test time. If the Upper Limit is turned off, the instrument automatically selects the maximum range of this mode.
ARC Level	0~9	0	Alarm level of the arc test.
Zero Compensation	Off, On, Auto Test	Off	Leakage current zeroing setting. Press the sidebar [Auto Test] key directly to have the analyzer automatically measure the leakage current values of the test leads and test fixture and perform zeroing; the DUT must first be removed from the test leads; Press the sidebar [Off] key to clear.
Rise Upper Limit	Off, On	Off	
Charging Lower Limit	Off, Manual input (1-3500)uA, Auto Test	Off	Minimum charging current setting, for testing capacitive loads. Used to detect whether the test leads or test fixture are properly connected, so as to ensure the correctness of

			the test results. Since the leakage current during the DCW test is usually very small, it is difficult to use the lower limit of the leakage current as the basis for judging whether the test leads or test fixture are properly connected. Since the DUT actually has some capacitance, the charging current of the DUT can be detected and used as the basis for checking whether the test leads or test fixture are properly connected. To set the minimum charging current value manually, enter the minimum charging current value with the numeric keys. To set the minimum charging current value automatically, first connect the instrument and the DUT with the test leads or fixture, and make sure that the set Output Voltage and Rise Time parameters are exactly consistent with the data of the test to be actually performed later.

5.4 IR Test Mode Parameter Settings

Figure 5- 4 [IR] Settings



Item	Input Range	Default Value	Description
Output Voltage	(50~1000)V	1000V	Output voltage in the ACW test
Upper Limit	(Lower Limit~50GΩ), Off	Off	Insulation resistance alarm upper limit
Lower Limit	(1~Upper Limit)MΩ, Off	1MΩ	Insulation resistance alarm lower limit
Test Time	(0.5~999.9)s, Continuous test	1.0 s	Test time used for delayed judgment of the insulation resistance
Rise Time	(0.4~999.9)s	0.5s	The set voltage ramps up over this time period
Fall Time	(0.1~999.9)s, Off	0.5	The set voltage ramps down over this time period
Current Range	Auto, Fixed	Auto	Sets the current range to automatic ranging or a fixed range. If set to Auto, the instrument automatically selects the appropriate current range; If set to Fixed, a value must be set for the Upper Limit to determine the current range, which can shorten the test time. If the Upper Limit is turned off, the instrument automatically selects the maximum range of this mode.
Charging	Off,	Off	Minimum charging current setting, for testing

Lower Limit	Manual input (0.001-3.5)uA, Auto Test		capacitive loads. Used to detect whether the test leads or test fixture are properly connected, so as to ensure the correctness of the test results. Since the leakage current during the insulation test is usually very small, it is difficult to use the lower limit of the leakage current as the basis for judging whether the test leads or test fixture are properly connected. Since the DUT actually has some capacitance, the charging current of the DUT can be detected and used as the basis for checking whether the test leads or test fixture are properly connected. To set the minimum charging current value manually, enter the minimum charging current value with the numeric keys. To set the minimum charging current value automatically, first connect the instrument and the DUT with the test leads or fixture, and make sure that the set Output Voltage and Rise Time parameters are exactly consistent with the data of the test to be actually performed later.
Delayed Judgment Time	Off, Manual input (0.5-Test Time)	Off	Enter the time t; the instrument performs the upper/lower limit judgment at time t after the IR test starts. If the entered time is greater than the Test Time, it is meaningless.

5.5 Editing Test Steps

Figure 5- 5 [Edit Test Steps] Settings



■ **Steps for setting the test mode of the current step:**

Step 1 Enter the <Setup> page

Step 2 Use the cursor keys to select the [Test Step] field; a test step is indicated as: total number of test steps - number of the step currently being set

Step 3 Use the soft keys to select

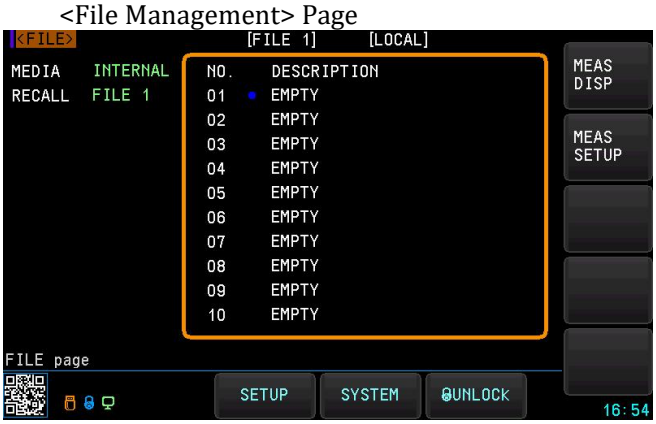
Soft key	Function
Insert	Adds a new test step after this step; the new step and the subsequent steps are shifted back by one position.
Delete	Deletes the current test step; the subsequent steps are shifted forward by one position.
New	Creates a new test program
Previous	The page jumps to the display page of the step before the current step.
Next	The page jumps to the display page of the step after the current step.

5.6 File Management

When the high-voltage output is stopped, press the soft key [File] to enter the <File Management> page.

SCPI Command: **DISP:PAGE CATAlog**

Figure 5- 6 <File Management> Page



On this page, place the cursor on the corresponding field to set the following controls:

- Select a file from the instrument's internal memory or an external USB drive [**Memory**]
- Recall a file at instrument startup [**Power-On Recall**]

5.6.1 Memory

The Memory function selects files from the instrument memory or the external USB flash drive. A maximum of 10 files can be accessed.

■ **Steps for changing the Memory**

Step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select [Memory]
Step 3 Use the soft keys to select the source:

Soft key	Function
Internal Memory	Accesses the files in the instrument memory
External USB Drive	Accesses the files on the external USB flash drive

5.6.2 Power-On Recall

The instrument recalls FILE1 or the current file at power-on.

■ **To select the automatically recalled file:**

Step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select the [Power-On Recall] field
Step 3 Use the soft keys to select the recall option:

Soft key	Function
Current File	Recalls the file last used at power-on
File 1	Recalls File 1 at power-on

5.6.3 File Operations

■ **To select the file operations:**

Step 1 Enter the <File Management> page
Step 2 Use the cursor keys to select a file (file names from 1~10)
Step 3 Use the soft keys to complete the operations:

Soft key	Function
Save	Saves the user setting data to the currently selected file

Read	Recalls the setting data from the currently selected file
Delete	Deletes the selected file, and the setting data is reset to the default values at the next power-on
Modify Description	Modifies the file description

6. [Meas] Page

In this chapter you will learn the following:

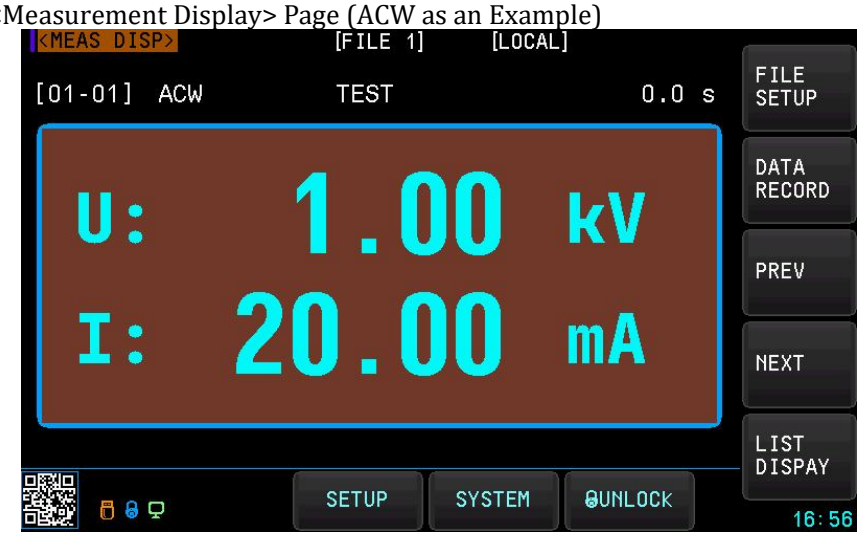
- Measurement Display Page Description
- Test Result Description
- Step Result and Group Result Display

When the high-voltage output is stopped, press the [Meas] key to enter the <Measurement Display> page.
SCPI Command: **DISP:PAGE MEAS**

6.1 Measurement Display Page Description

Press the [Meas] key to enter the <Measurement Display> page.

Figure 6- 1 <Measurement Display> Page (ACW as an Example)



In this screen you can press [**Start**] to apply high voltage to the DUT. For safety and measurement accuracy, this page is for display only; **parameters cannot be set from the keys** (**but the parameters of the current step can be modified via touch**). Its test parameters must be properly and completely configured in the setup page. Real-time test data is displayed during the test; after the test ends and before the [**Stop**] key is pressed, the results of the last test are displayed.

After a measurement is started**, the center of the instrument LCD** displays two values in large font:
The upper one is the high-voltage output voltage; for the withstand test it is in kilovolts (kV).
The lower one is the measured current at the low side of the test, or the insulation resistance, in milliamperes (mA), microamperes (uA), megohms (MΩ),
or gigohms (GΩ).

The upper part of the instrument LCD displays two values in small font:
the left one shows the high-voltage test status (OFF, RISE, TEST, FALL) and the result of the upper/lower limit comparison (PASS, UPPER, LOWER) and the alarm status (ARC, SHORT, GFI, ERROR).
the right one shows the time remaining in the corresponding step during the high-voltage test. If the user has turned off the test time, the test time displays
the time elapsed since entering the test state; this counter stops accumulating beyond 999.9. If the result is not "FAIL", the test state must be exited with [**Stop**] to exit. The user can directly analyze the test condition of the DUT. The unit is seconds (s).

6.2 Test Result Description

Figure 6- 2 ACW Measurement Screen



Figure 6- 3 DCW Measurement Screen

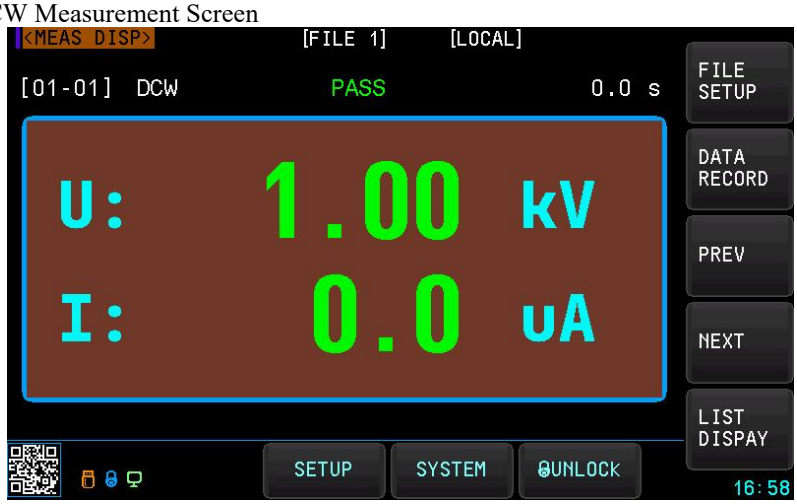
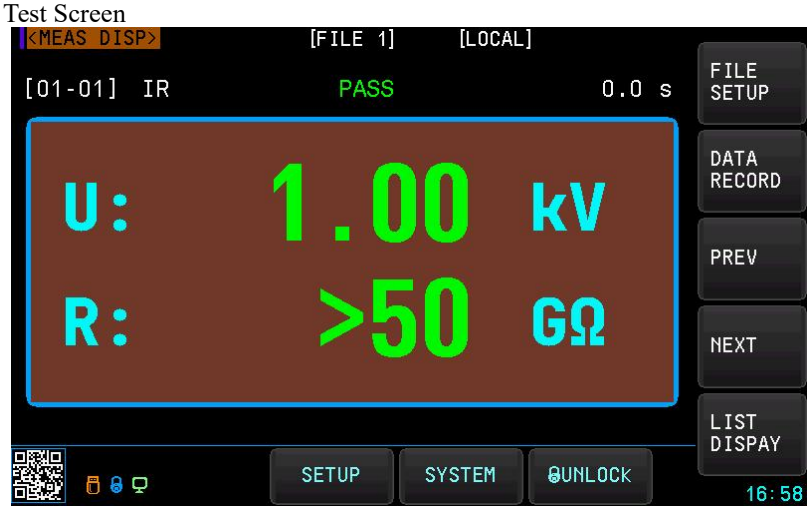


Figure 6- 4 IR Test Screen



6.2.1 During the Test

At this time, the Stop key light is on, and the high-voltage test light bar (red) on the front panel lights up during the test.

6.2.2 Test Passed

When all test items pass, the high-voltage test light bar on the front panel goes off, the buzzer gives a short beep, and the test interface displays "PASS".

6.2.3 Test Failed or Abnormality Occurred

When any test item fails or an abnormality occurs during the test, the high-voltage test light bar stays on (red), the buzzer sounds for two seconds, and the test interface displays "FAIL".

Figure 6- 5 Test Failed



(1) Judgment of measurement results:

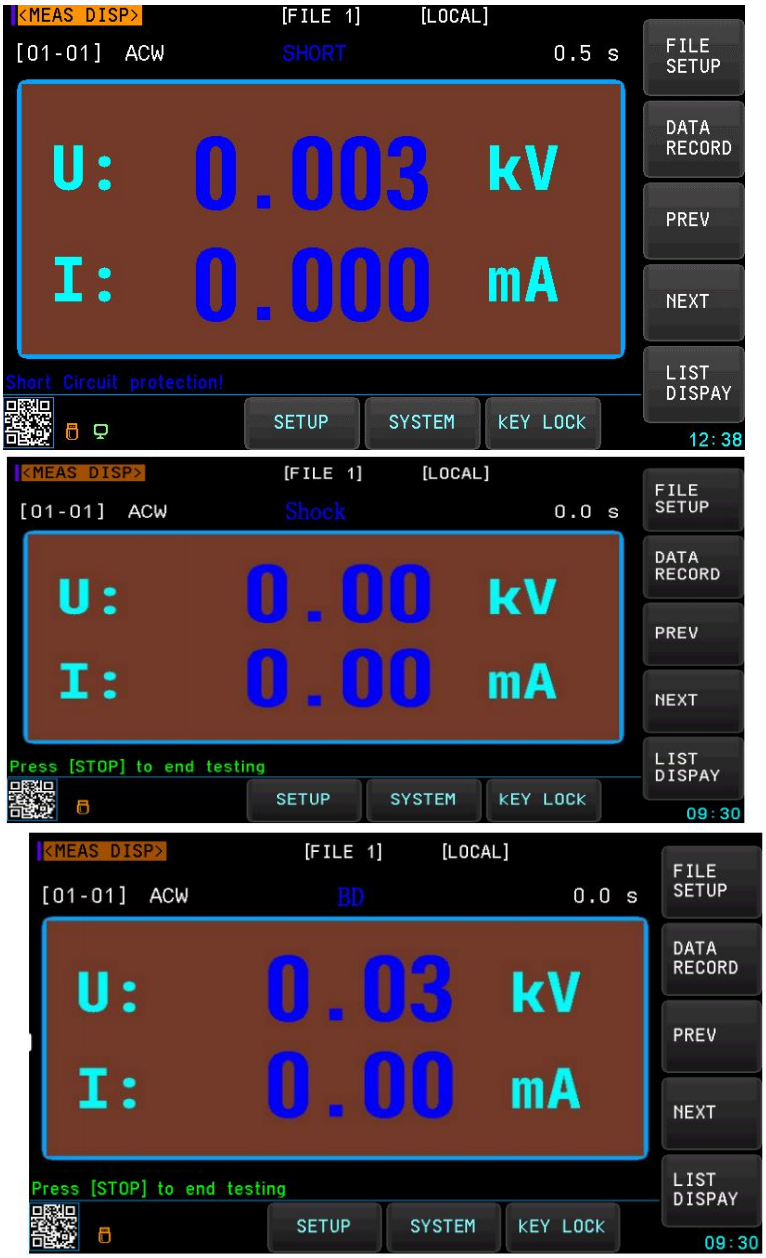
a) For the upper limit of the breakdown current in the withstand voltage test, the measurement result is judged at all times;

b) For the insulation test, the judgment result is given only near the end of the test time;

(2) The following conditions cause the test abnormality protection:
Insulation failure of the DUT during the insulation and withstand voltage tests;

Test FAIL and abnormality protection description table	
Above upper limit	The measured value is greater than the set upper limit value
Below lower limit	The measured value is less than the set lower limit value
Charging Lower Limit	During the DCW/IR test, the current is lower than the minimum charging current setting
Arc	The current arc exceeds the upper limit value
Short circuit	The output current of the instrument is greater than the internally set current limit, and this limit cannot be changed
Breakdown	Ground fault interruption
Overvoltage	The output voltage is far greater than the set output voltage
Error	Power amplifier board error

Figure 6- 6 Test Abnormality



6.3 Step Result and Group Result Display

The result display is divided into two modes:

Mode	Description
Step Test Result	After the test flow is completed, the test result remains on the failed step or the first step
Group Test Result	After the test flow is completed, the test result of every step in the test group is presented in a list

For the selection between the two modes, see [Result Display] in <System Setup>.

Figure 6- 7 Single-Step Result Display

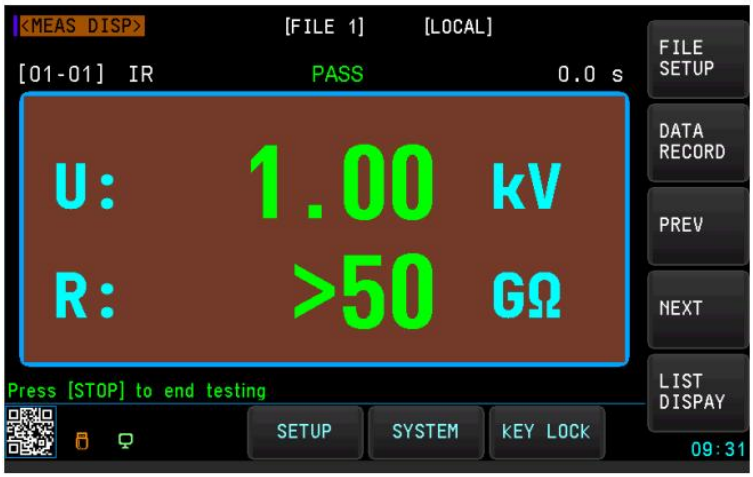


Figure 6- 8 Group Test Result Display

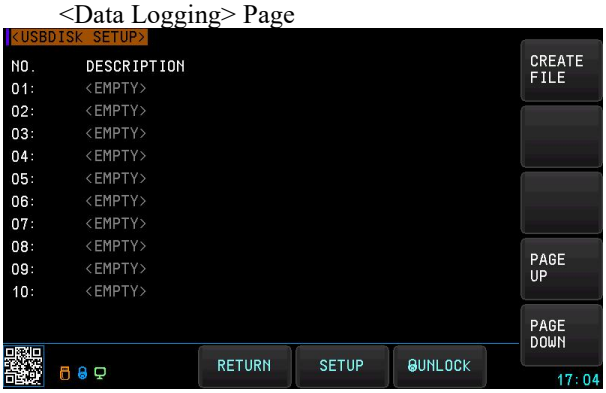


6.4 Data Logging

The instrument provides the USB flash drive data logging function; after the test is completed, the data measured by the instrument is recorded in the ".csv" file format, which users can open directly with EXCEL software on a PC.

On the main <Measurement Display> page, use the soft keys to enter the <Data Logging> page.

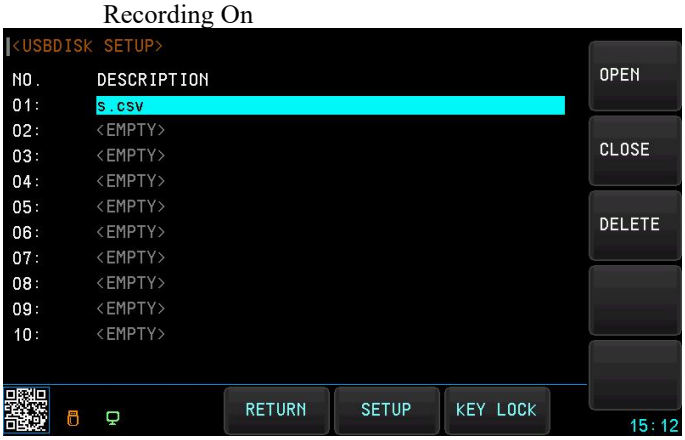
Figure 6- 9 <Data Logging> Page



On this page, tap the "Create New Record" function box on the right sidebar to create a ".csv" file and name it.
When the user needs to record measurement data in a spreadsheet, tap the screen or use the cursor to select a created file. After "Record On" is tapped, the instrument automatically records each set of test

data, and a corresponding prompt appears in the lower left corner of the screen at each successful recording.

Figure 6- 10 Recording On



Note: if the [STOP] button is pressed during a test, the instrument will not record the data of that test.

7. System Configuration

In this chapter you will learn the following:
- System Configuration Page
- System Information Page

When the high-voltage output is stopped, press the [System] key to enter the <System Configuration> page.
SCPI Command: **DISP:PAGE SYSTEM**

7.1 System Configuration Page

The System Configuration page includes the following settings:
- Language
- Key Beep
- Date/Time
- Account/Password
- Remote Control
- Baud Rate
- Communication Protocol
- Command Handshake
- Result Sending
- GFI Protection
- Error Codes
- Fail Mode
- Volume Setting
- Trigger Mode
- Result Display

All settings on the System Configuration page except [Result Display] are automatically saved in the system and automatically loaded at the next power-on.

Figure 7- 1 <System Configuration> Page



7.1.1 [System Language]

Communication command:**SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}**
The instrument supports two languages: Chinese and English.

■ **Steps for changing the language**

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select [LANGUAGE].
Step 3 Use the soft keys to select the language:

Soft key	Function
Chinese [CHN]	Chinese display
ENGLISH	English display

7.1.2 [Key Beep]

A sound is emitted when a key is pressed, to remind the user that a key has been pressed and prevent accidental operation.

Step of setting the KEY BEEP:

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select [KEY BEEP].
Step 3 Use the soft keys to select the language:

Soft key	Function
Off	The key beep is turned off
On	The key beep is turned on

7.1.3 [Date and Time]

The instrument uses a 24-hour clock.

■ **To change the date:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Date] field.
Step 3 Use the soft keys to set the date:

Soft key	Function
Year+	+1 year
Year-	-1 year
Month+	+1 month
Month-	-1 month
Day+	+1 day
Day-	-1 day

■ **To change the clock:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Clock] field.
Step 3 Use the soft keys to set the clock:

Soft key	Function
Hour+	+1 hour
Hour-	-1 hour
Minute+	+1 minute
Minute-	-1 minute
Second+	+1 second
Second-	-1 second

7.1.4 [Account]

The instrument provides two user modes for selection:

- Administrator – All functions except the <System Service> page are open to the administrator, and the parameters set by the administrator are saved in the system memory after a delay of 5 seconds, so that they can be loaded at the next power-on.
- User – All functions except the <System Service>, <File> pages can be operated by the user, and the data modified by the user is restored to the values set by the administrator at the next power-on.

■ **To change the account:**

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select the [Account] field.
Step 3 Use the soft keys to change:

Soft key	Function
Administrator	All functions except the <System Service> page are open If the password is forgotten, please call the sales department of our company.
User	Functions other than those on the <System Service> page and the <File> page can be operated, and the configured data cannot be saved.

7.1.5 [Password]

■ **Administrator password setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Account] field.
Step 3 Use the soft keys to select:

Soft key	Function
Change Password	Enter a numeric password of up to 8 digits
Delete Password	The administrator will not be password-protected

7.1.6 [Baud Rate]

The instrument has a built-in RS-232 interface. When the instrument senses a signal change on the RS-232 interface, it immediately communicates with the host computer at the set baud rate, and the keyboard is locked at the same time.
To ensure correct communication, confirm that the baud rate is set correctly; the host computer and the instrument cannot communicate correctly if their baud rates are different.
The RS-232 interface of the instrument is programmed using the SCPI language.
The RS-232 configuration is as follows:

- Data bits: 8 bits
- Stop bits: 1 bit
- Parity: None
- Baud rate: configurable

■ **To set the baud rate:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Baud Rate] field;
Step 3 Use the soft keys to select

Soft key	Function
9600	
19200	
38400	
57600	
115200	For communication with the host computer, it is recommended that you use this high baud rate.

7.1.7 [Command Handshake]

When the Command Handshake is turned on, all commands sent by the host computer to the instrument are returned to the host computer unchanged, and data is returned only afterwards.
When the Command Handshake is turned off, commands sent by the host computer to the instrument are processed immediately.

■ **Steps for setting the Command Handshake:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Command Handshake] field;
Step 3 Use the soft keys to select

Soft key	Function

Off	The Command Handshake is not used. Unless there are special requirements, set the Command Handshake to Off.
On	

7.1.8 [Result Sending]

The instrument supports automatically sending data to the host computer. After each test is completed, the data is automatically sent to the host computer without the host computer sending the FETCH? command.
After each test is completed, the instrument sends the test result and the comparator result to the host computer; for the format, refer to the FETCH? subsystem.

Steps for setting [Result Sending]:

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Result Sending] field;
Step 3 Use the soft keys to select

Soft key	Function
FETCH	Use the command FETCH? to obtain all measurement data
Auto	Automatically sent to the host computer after each test is completed

7.1.9 [GFI Protection]

A safety measure used to prevent electric shock caused by human contact with electric current.

■ **GFI Protection setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [GFI Protection] field.
Step 3 Use the soft keys to select:

Soft key	Function
Off	The GFI protection function is turned off
On	The GFI protection function is turned on

7.1.10 [Fail Mode]

The Fail Mode is divided into 2 types, "Stop", "Continue".

■ **Fail Mode setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Fail Mode] field.
Step 3 Use the soft keys to select:

Soft key	Function
Continue	During testing, when a failed test step (limited to above upper limit and below lower limit) is encountered, the current test step is aborted and the next test step is performed
Stop	During testing, when a failed test step is encountered, the entire test process is aborted immediately; pressing the "Start" key at this point restarts the entire test process

7.1.11 [Volume Setting]

Sets the volume of the instrument buzzer, mainly used to give a prompt when a test is completed or a test is abnormal.

■ **Volume Setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Volume Setting] field.
Step 3 Use the soft keys to select:

Soft key	Function
High	High-tone prompt when a test is completed or a test is abnormal
Low	Low-tone prompt when a test is completed or a test is abnormal
Off	No sound prompt when a test is completed or a test is abnormal

7.1.12 [Trigger Mode]

Sets the control mode for starting a test on the instrument; only trigger signals in the current control mode are accepted.

■ **Trigger Mode setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Trigger Mode] field.
Step 3 Use the soft keys to select:

Soft key	Function
Local	Controlled by the [Start] key on the front panel of the instrument
PLC	Controlled by the control signal from HANDLER
Bus	Controlled by commands sent via RS232/485

7.1.13 [Result Display]

Result display items are divided into two modes: Step Test Result, Group Test Result.

■ **Result Display setting:**

Step 1 Enter the <System Configuration> page
Step 2 Use the cursor keys to select the [Result Display] field.
Step 3 Use the soft keys to select:

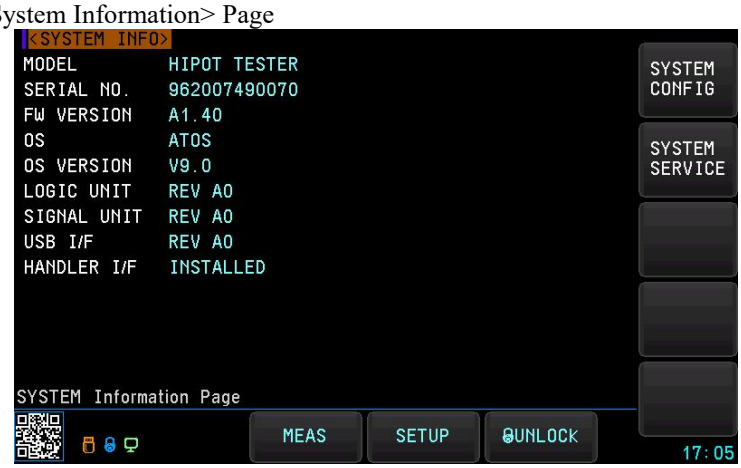
Soft key	Function
Step Test Result	After the test process is completed, the display stays on the test result of the failed step or the first step
Group Test Result	After the test flow is completed, the test result of every step in the test group is presented in a list

7.2 System Information Page

Enter the <System Configuration> page and press the soft key to select [System Information].
SCPI Command: **DISP:PAGE SYSTEMINFO**

The System Information page has no user-configurable options.

Figure 7-2 <System Information> Page



8. Handler(PLC)

You will learn about the following:

- Handler (PLC) interface
- Interface Principle

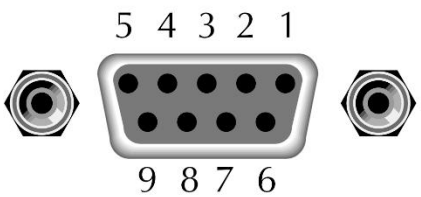
The instrument provides users with fully functional interfaces. Through these interfaces, the instrument can conveniently perform automatic control functions with the control components of the user system.

8.1 Handler (PLC) Interface

This series of testers is equipped with a 9 PIN to 25 PIN adapter cable, which provides PLC remote-control input/output control signals (it can be linked to a PLC controller), as shown in the figure. These connection terminals mate with the standard 25 PIN D-type connector, which must be provided by the user.

To achieve the best results, shielded cables are recommended as the connecting cables for control and output information. To prevent the shielded cables from forming a loop that would degrade the shielding effect, ground the shield mesh at only one end of the shielded cable.

Figure 8- 1 Wiring Terminals



To use the HANDLER function, the instrument's **<System Configuration> [Trigger Mode] must be set to PLC**, otherwise the HANDLER function is not available; when the trigger mode is set to PLC, the [Start] key on the front panel is disabled to avoid the danger of repeated triggering.

Table 8- 1 PLC Port Pin Definitions

Input/Output	Pin	Name	Description
Signal Input	4	START Start signal	When the START key is pressed, the instrument receives the remote input signal and starts the measurement
	5	STOP Reset (Stop) signal	When the STOP key is pressed, the instrument receives the remote input signal and stops the measurement
Signal Output	6	TEST1	During instrument measurement, TEST1 and TEST2 are short-circuited; When the test is completed, TEST1 and TEST2 are open;
	1	TEST2	
	7	PASS1	When the test passes, PASS1 and PASS2 are short-circuited
	2	PASS2	
	8	FAIL1	When the test fails, FAIL1 and FAIL2 are short-circuited
	3	FAIL2	

All input signals use switch inputs (such as PLC); never connect any other voltage or current source, otherwise the internal control circuit of the instrument will be damaged or malfunction.

8.2 Interface Principle

■ Instrument interface schematic

Figure 8- 2 Internal Circuit Structure of the Handler Interface

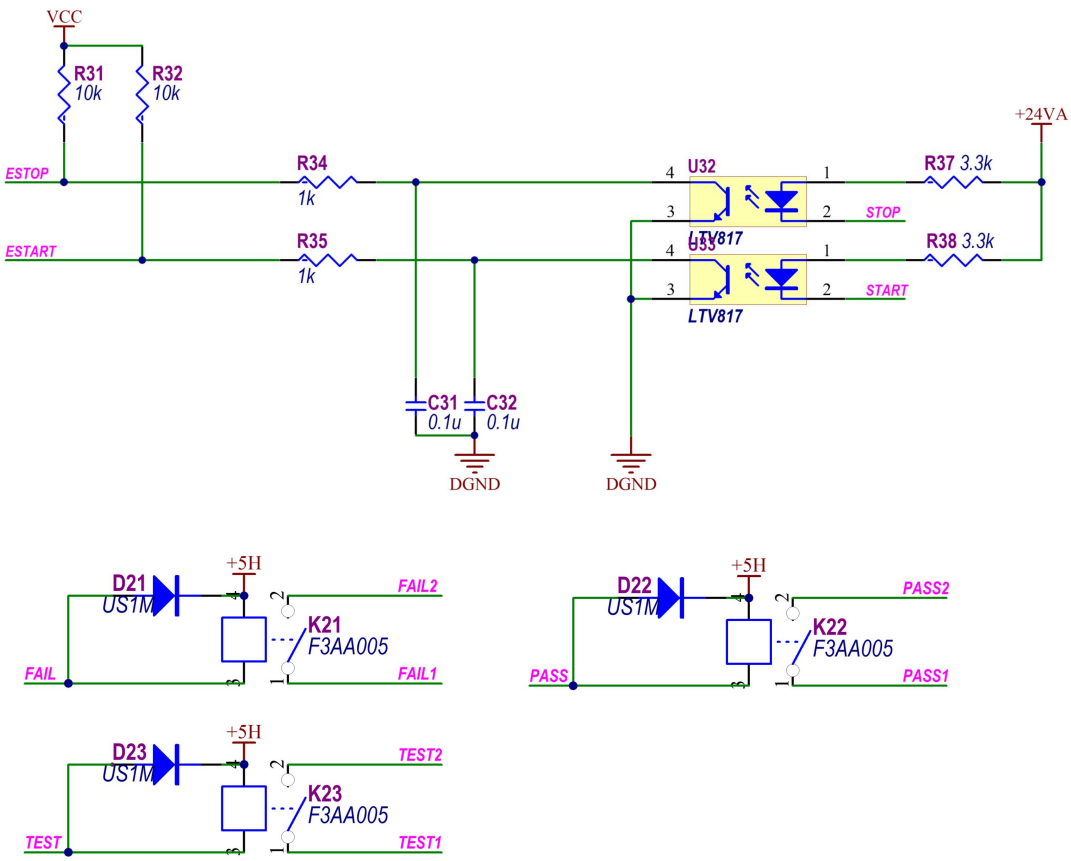


Figure 8- 3 PLC Timing Diagram

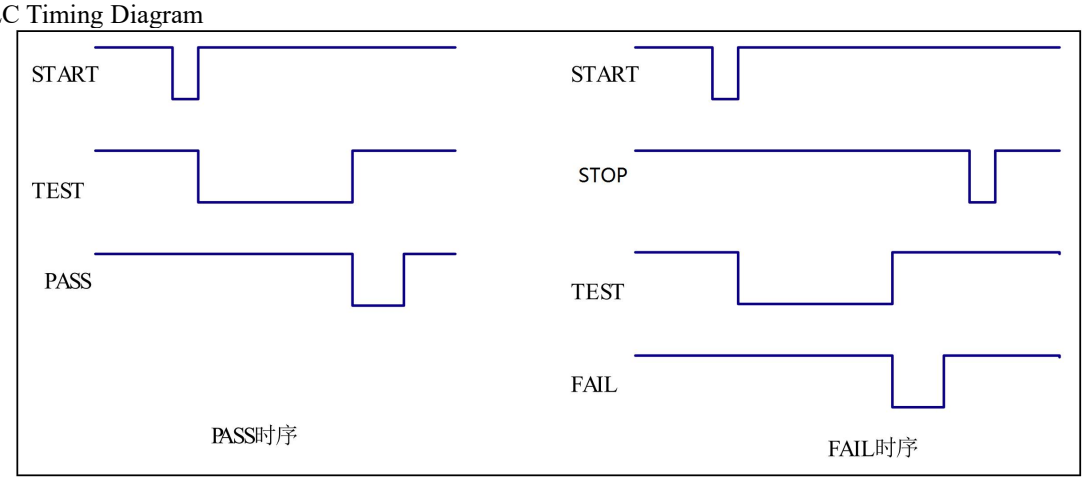


Table 8- 2 PLC Timing Description

Signal	Description

Starting a test via the PLC port	1. Check whether the TEST (testing) signal in the interface is active; the START signal may be sent only when the TEST (testing) signal is inactive. 2. When the provisions of item 1 are met, send a START signal with a width of 40ms~200ms (i.e., the switch contact closure time) to start the test.
Stopping a test via the PLC port	At any time, send a STOP signal with a width of 40ms~200ms (i.e., the switch contact closure time) to stop the test.
Signal output—testing	When the instrument performs a test, the relay connects PIN10 and PIN22. After the test is completed, the relay returns PIN10 and PIN22 to the open state.
Signal output—test passed	When the DUT passes the test, the relay connects PIN11 and PIN23 and holds the state. When another test program starts testing, or after the stop switch is pressed, the relay returns PIN11 and PIN23 to the open state.
Signal output—test failed	After the DUT fails the test, the relay connects PIN12 and PIN24 and holds the state. When another test program starts testing, or after the stop switch is pressed, the relay returns PIN12 and PIN24 to the open state.

9. Remote Communication

You will learn about the following:

- Introduction to the RS-232 interface
- RS-232 connection
- Selecting the baud rate
- Software protocol

The instrument uses the RS-232 interface (standard configuration) to communicate with a computer and perform all instrument functions. With standard SCPI commands, users can also conveniently develop various data acquisition systems of their own.

9.1 RS-232C

RS-232 is a serial communication standard widely used today, also called the asynchronous serial communication standard, used for data communication between computers and between computers and peripherals. RS is the English abbreviation of "Recommended Standard" (recommended standard), and 232 is the standard number. This standard was officially published in 1969 by the Electronic Industries Association (EIA) of the United States; it specifies that data is transmitted one bit at a time over a single data line.

The configuration of most serial ports is usually not strictly based on the RS-232 standard: each port uses a 25-pin connector (computers today mostly use 9-pin connectors). The most commonly used RS-232 signals are shown in the table:

Table 9- 1 Common RS-232 Signals

Signal	Symbol	25-pin connector pin number	9-pin connector pin number
Request to Send	RTS	4	7
Clear to Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted Data	TXD	2	3
Received Data	RXD	3	2
Ground	GND	7	5
Request to Send	RTS	4	7

In addition, RS232 also has a minimum subset, which is the connection method adopted by the instrument.

Table 9- 2 Minimum Subset of the RS-232 Standard

Signal	Symbol	9-pin connector pin number
Transmitted Data	TXD	2
Received Data	RXD	3
Ground	GND	5

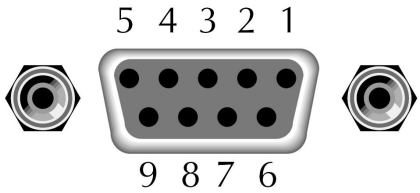
9.1.1 RS232C Connection

The RS-232 serial interface can be interconnected with the serial interface of a controller (for example, a personal computer or an industrial computer) through a straight-through DB-9 cable.



Note: The instrument cannot use a null modem cable.
You can make a 9-wire **straight-through** cable yourself, or purchase one from ONMEAS.
Note the following for a user-made 3-wire cable:
·When using the DB9 port built into the PC, pins 4-6 and 7-8 of the DB-9 connector (male) on the computer side may need to be shorted

Figure 9- 1 RS-232 Interface on the Rear Panel



Recommendation: To avoid electric shock, turn off the power of the instrument when plugging or unplugging connectors.

- Default communication settings of the instrument:

Transmission mode: Full-duplex asynchronous communication with start and stop bits
Data bits: 8 bits
Stop bits: 1 bit
Parity: None

9.2 Handshake Protocol

Since the instrument uses the minimum subset of the RS-232 standard and does not use hardware handshake signals, the instrument can enable software handshake to reduce possible data loss or data errors during communication. High-level language software engineers should develop the computer communication software strictly according to the following handshake protocol:

- The command parser of the instrument accepts only ASCII format, and command responses are also returned as ASCII codes.
- **The command string sent by the host computer must end with NL(' \n'), and the command parser of the instrument starts executing the command string only after receiving the terminator**.
- The instrument can enable the Command Handshake: after receiving each character, the instrument immediately sends that character back to the host computer, and the host computer can send the next character only after receiving this returned character.

Tip: If the host computer cannot receive the data returned by the instrument, you can try the following methods to resolve the problem:

1. The software handshake is turned off; refer to the <System Settings> page of the instrument to turn it on.
2. Serial port connection fault; check the cable connections.
3. The communication format of the high-level language program on the computer side is incorrect. Try checking whether the serial port number and the communication format are correct, and whether the baud rate is the same as that set on the instrument.
4. If the instrument is parsing the previous command, the host computer cannot receive a response from the instrument either; please wait and try again.

<If the problem still cannot be solved, immediately consult the ONMEAS technical engineers>

9.3 SCPI Language

SCPI (Standard Commands for Programmable Instruments) is a universal command set for test instruments adopted by ONMEAS. SCPI, also known as TMSL (Test and Measurement System Language), was developed by Agilent Technologies as an extension of IEEE488.2 and has been widely adopted by test equipment manufacturers to date.

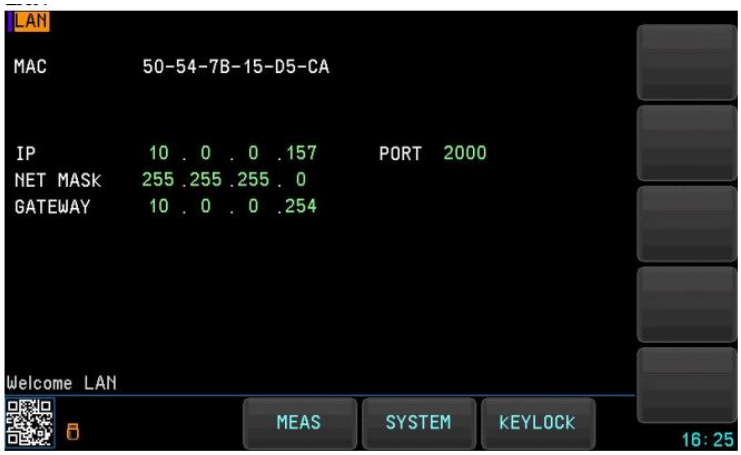
The built-in command parser of the instrument is responsible for parsing the various command formats entered by the user. Since the command parser is based on the SCPI protocol but is not fully consistent with SCPI, read the "SCPI Command Reference" chapter carefully before starting work.

9.4 LAN

To facilitate remote control of the instrument, the instrument provides users with the LAN function. LAN is a local area network connection method that allows your computer and the instrument to be connected through the same network, realizing the remote control function.

Enter the <System Configuration> page, use the soft keys or cursor keys to select [LAN], and click to switch to the <Remote Service LAN> interface.

Figure 9- 2 Remote Service LAN



Parameters	Description
MAC Address	Physical address, used to uniquely identify the device
IP Address	Logical address, used for locating and communicating on the network
Port	Connection point between the withstand voltage tester and network devices
Network Mask	The dividing line used to separate the network address from the host address
Gateway	A device that connects different networks and forwards data

Through the remote communication LAN function, you can connect the withstand voltage tester to a local area network via the LAN port to achieve remote communication and data exchange with other devices. The usage method is as follows:

(1) Ensure that the LAN port of the withstand voltage tester is properly connected to a switch or router in the local area network,

(2) configure the correct IP address, network mask, and gateway in the <Remote Service LAN> interface of the withstand voltage tester, ensuring that it is in the same network segment as other devices in the local area network,

(3) open the network connection assistant, set the protocol type as well as the IP address and port number, and click Connect to start communication.

10. SCPI Command Reference

This chapter includes the following topics:

- Command Parser — understand some rules of the command parser.
- Command Syntax — rules for writing command lines
- Query Syntax — rules for writing query commands
- Query Response — format of the query response
- Command Reference

This chapter provides all the SCPI commands used by the instrument. Through these SCPI commands, all functions of the instrument can be fully controlled.

10.1 Command String Parsing

The host computer can send a string of commands to the instrument, and the command parser of the instrument starts parsing after detecting the terminator (\n) or an input buffer overflow.

Example: Valid command string:

AAA:BBB CCC;DDD EEE;:FFF

The command parser of the instrument is responsible for the parsing and execution of all commands. Before writing a program, you must first understand its parsing rules.

10.1.1 Command Parsing Rules

1. The command parser only parses and responds to ASCII code data.
2. **The SCPI command string must take NL(' \n' ASCII 0x0A) as its terminator**, and the command parser starts executing the command string only after receiving the terminator or when the buffer overflows.
3. If Command Handshake is enabled, the command parser immediately sends each received character back to the host computer; the host computer can continue to send the next character only after receiving this echoed character.
4. After parsing an error, the command parser immediately terminates parsing and the current command becomes invalid.
5. After parsing a query command, the command parser terminates parsing of the current command string, and the subsequent string is ignored.
6. The command parser is not case-sensitive when parsing command strings.
7. The command parser supports abbreviated command forms; for the abbreviation specifications, refer to the following chapters.

10.1.2 Symbol Conventions and Definitions

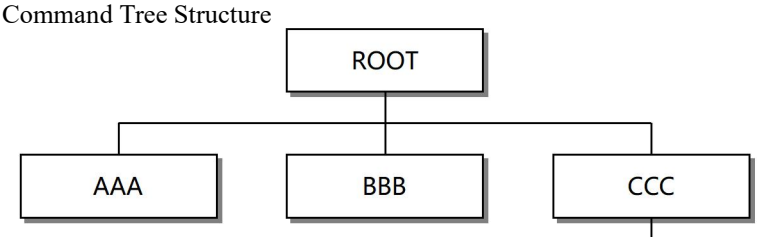
This chapter uses some symbols that are not part of the command tree; they are only intended to facilitate a better understanding of command strings.

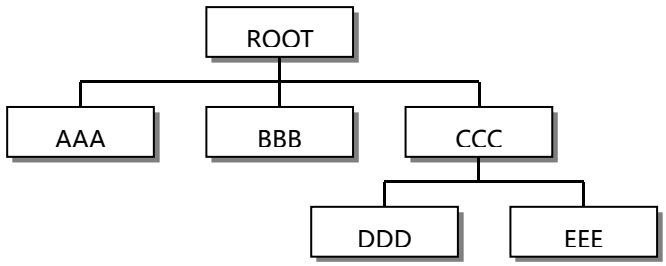
<>	The text in angle brackets indicates the parameter of the command
[ ]	The text in square brackets indicates an optional command
{}	When the braces contain several parameter items, only one item can be selected from them
( )	The abbreviated form of a parameter is placed in parentheses
Uppercase letters	Abbreviated form of the command

10.1.3 Command Tree Structure

SCPI commands adopt a tree structure and can extend down three levels (Note: the command parser of this instrument can parse down any number of levels). The highest level here is called the subsystem command. Only after a subsystem command is selected are the commands below it valid. SCPI uses the colon (:) to separate higher-level commands from lower-level commands.

Figure 10- 1 Command Tree Structure





Example: ROOT:CCC:DDD ppp
ROOT Subsystem command
CCC Second level
DDD Third level
ppp Parameter

10.2 Commands and Parameters

A command tree consists of **a command and [parameters]**, separated by one space (ASCII: 20H).

Example: AAA:BBB 1.234
Command [Parameters]

10.2.1 Commands

Command words can be in long form or abbreviated form. The long form makes it easier for engineers to understand the meaning of the command string; the abbreviated form is convenient for writing.

10.2.2 Parameters

- A command with a single command word and no parameters.
  Example: AAA:BBB
- The parameter can be in the form of a string, and its abbreviation rules still follow the "command abbreviation rules" in the previous section.
  Example: AAA:BBB 1.23
- The parameter can be in numeric form
  - <*integer*> Integer 123, +123, -123
  - <*float*> Floating-point number
    1. <fixfloat>: fixed-point floating-point number: 1.23, -1.23
    2. <Scifloat>: floating-point number in scientific notation: 1.23E+4, +1.23e-4
    3. <mpfloat>: floating-point number expressed with a multiplier: 1.23k, 1.23M, 1.23G, 1.23u

Table 10- 1 Multiplier Abbreviations

Numeric value	Multiplier
1E18 (EXA)	EX
1E15 (PETA)	PE
1E12 (TERA)	T
1E9 (GIGA)	G
1E6 (MEGA)	MA
1E3 (KILO)	K
1E-3 (MILLI)	M
1E-6 (MICRO)	U
1E-9 (NANO)	N
1E-12 (PICO)	P
1E-15 (PEMTO)	F
1E-18 (ATTO)	A

Tip: The multipliers are not case-sensitive, and their notation differs from the standard names.

10.2.3 Separators

The command parser of the instrument only accepts the permitted separators; for any other separator, the command parser will generate an "Invalid separator(illegal separator)" error. These separators include:

; Semicolon, used to separate two commands.
Example: AAA:BBB 100.0;CCC:DDD

: Colon, used to separate command trees or to restart the command tree.
Example: AAA:BBB:CCC 123.4;:DDD:EEE 567.8

? Question mark, used for queries.
Example: AAA?

□ Space, used to separate parameters.
Example: AAA:BBB□1.234

10.3 Command Reference

All commands are interpreted in the order of subsystem commands; all subsystems are listed below

- DISPlay Display subsystem
- FUNCtion Function subsystem
- FETCh Result fetch subsystem
- FILE File Management subsystem
- SYSTem System subsystem
- WRITEPARA Write parameter settings
- READPARA Read parameter settings
- READDATA Read test data
- STEP Switch step settings
- INS Add step settings
- DEL Delete step settings
- KEYLOCK Set keyboard lock

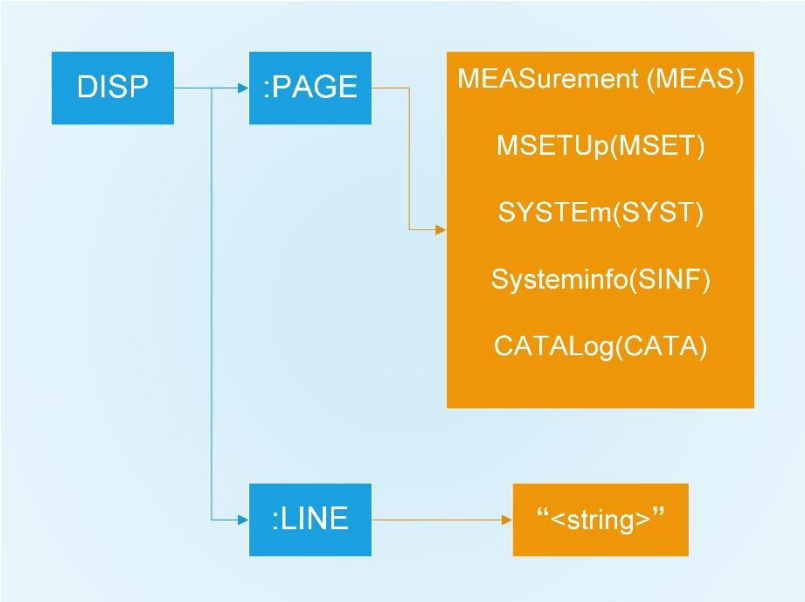
Common commands:

- IDN? Instrument information query subsystem

10.4 DISPlay Subsystem

The DISPlay subsystem can be used to switch between different display pages or to display a string of text on the page prompt bar.

Figure 10- 2 DISPlay Subsystem Tree



10.4.1 DISPlay:PAGE

DISP:PAGE switches to the specified page.

Command syntax: **DISPlay:PAGE <page name>**

Parameters: <page name> includes:

MEASurement	Measurement display page
MSETUp	Setup page
SYSTem	System Configuration Page
SYSTEMINFO(SINF)	System Information Page
CATALog(CATA)	File Management page

Example: Send> **disp:page mset**<*NL*> //Switch to the setup page

Query syntax: **DISP:PAGE?**

Query response: **<page name> abbreviation**
ACW MEAS
DCW MEAS
IR MEAS
SETUP
SYST
SINF
CATA

Example: Send> **disp:page?** <*NL*>
Return> **SETUP** <*NL*>

10.4.2 DISP:LINE

DISP:LINE displays a string of text on the prompt bar at the bottom of the page. The text can display up to 30 characters.

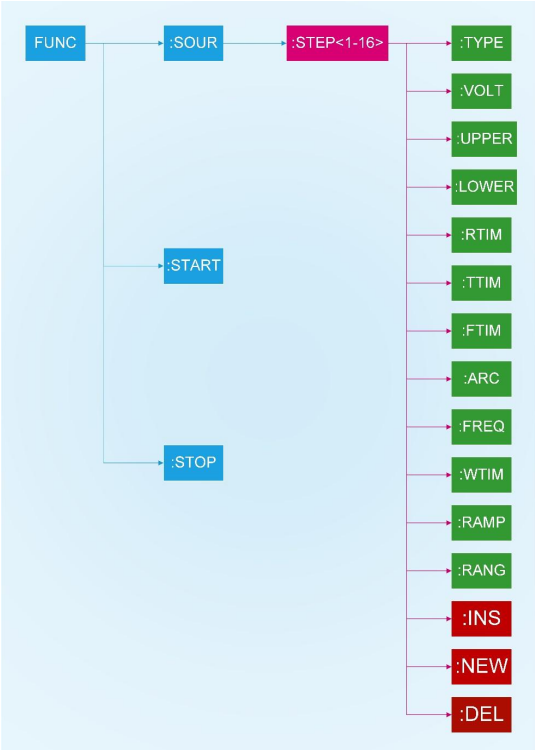
Command syntax: **DISPlay:LINE <*string*>**

Parameters: **<string>** up to 30 characters

Example: Send> **DISP:LINE "This is a Comment."** <*NL*>

10.5 FUNCtion Subsystem

Figure 10- 3 FUNCtion Subsystem Tree



10.5.1 High-Voltage Start/Stop Commands

FUNC:START is used to **Start**the high-voltage test.

Command syntax: **FUNCtion:STARt**

Example: Send> **FUNC:STARt**<*NL*> //Starts the test, functionally equivalent to the [Start] key

FUNC:STOP is used to **Stop**the high-voltage test.

Command syntax: **FUNCtion:STOP**

Example: Send> **FUNC:STOP**<*NL*> //Stops the test, functionally equivalent to the [Stop] key

10.5.2 Test Step Commands

FUNC:SOUR:STEP? is used to **Query**the current test step and the total number of test steps.

Query syntax: **FUNC:SOUR:STEP?**

Query response: **Current step - total steps**
STEP <1-16> - TOTAL <1-16>

Example: Send> **FUNC:SOUR:STEP?**<*NL*>
Return> **STEP 5 - TOTAL 11** <*NL*>

FUNC:SOUR:STEP1:INS within the existing test program (TOTAL) **adds** a new test item.

Command syntax: **FUNC:SOUR:STEP:INS**

Example: Send> **FUNC:SOUR:STEP:INS** <*NL*> //Adds a new test item

FUNC:SOUR:STEP1:DEL within the existing test program (TOTAL), **Delete** the current test item.

Command syntax: **FUNC:SOUR:STEP:DEL**

Example: Send> **FUNC:SOUR:STEP:DEL** <*NL*> //Deletes the current test item

FUNC:SOUR:STEP1:NEW**New** an empty test program, used to write a brand-new test program.

Command syntax: **FUNC:SOUR:STEP:NEW**

Example: Send> **FUNC:SOUR:STEP:NEW** <*NL*> //Creates a new empty test program

10.5.3 Function Parameter Commands

FUNC:SOUR:STEP<1-16>: TYPE Within the existing test program (TOTAL), sets the **Function**.

Command syntax: **FUNC:SOUR:STEP<1-16>:TYPE {ACW,DCW,IR}**

Example: Send> **FUNC:SOUR:STEP5:TYPE IR**<NL> //With the total number of steps ≥5, sets the function of step 5 to IR

Query syntax: **FUNC:SOUR:STEP<1-16>:TYPE?**

Query response: **{ACW,DCW,IR}**

FUNC:SOUR:STEP<1-16>: VOLT Within the existing test program (TOTAL), sets the **Voltage**.

Command syntax: **FUNC:SOUR:STEP<1-16>:VOLT <float>**

Parameters: **<float>**(data unit is V):
When the function is ACW : 50 - 5000, without unit
When the function is DCW : 50 - 6000, without unit
When the function is IR: 50 - 1000, without unit

Example: Send> **FUNC:SOUR:STEP5:VOLT 1000**<NL> //With the total number of steps ≥5, sets the Voltage of step 5 to 1000V

Query syntax: **FUNC:SOUR:STEP<1-16>:VOLT?**

Query response: **<float>**:
When the function is ACW : 50 - 5000, with unit
When the function is DCW : 50 - 6000, with unit
When the function is IR : 50 - 1000, with unit

Example: Send> **FUNC:SOUR:STEP5:VOLT?**<NL>
Return> **1000.00 V**<NL>

FUNC:SOUR:STEP<1-16>: UPPER Within the existing test program (TOTAL), sets the **Upper Limit**.

Command syntax: **FUNC:SOUR:STEP<1-16>:UPPER <float>**

Parameters: **<float>**(data unit is mA / MΩ):
When the function is ACW : 0.01 - 10.00, without unit
When the function is DCW : 0.001 - 5.00, without unit
When the function is IR : 0, 0.1 - 5E4, without unit (where 0 indicates the Upper Limit is OFF)

Example: Send> **FUNC:SOUR:STEP5:UPPER 1**<NL> //With the total number of steps ≥5, sets the Upper Limit of step 5 to 1mA

Query syntax: **FUNC:SOUR:STEP<1-16>:UPPER?**

Query response: **<float>**:
When the function is ACW : 0.01 - 10.00, with unit
When the function is DCW : 0.001 - 5.00, with unit
When the function is IR : OFF, 0.1 - 5E4, with unit

Example: Send> **FUNC:SOUR:STEP5:UPPER?**<NL>
Return> **1.000mA** <NL>

FUNC:SOUR:STEP<1-16>: LOWER Within the existing test program (TOTAL), sets the **Lower Limit**.

Command syntax: **FUNC:SOUR:STEP<1-16>:LOWER <float>**

Parameters: **<float>**(data unit is mA / MΩ):
When the function is ACW : 0, 0.01 - 10.00, without unit (where 0 indicates the Lower Limit is OFF)
When the function is DCW : 0, 0.001 - 5.00, without unit (where 0 indicates the Lower Limit is OFF)
When the function is IR : 0.1 - 5E4, without unit

Example: Send> **FUNC:SOUR:STEP5:LOWER 0.1**<NL> //With the total number of steps ≥5, sets the Lower Limit of step 5 to 0.1mA

Query syntax: **FUNC:SOUR:STEP<1-16>:LOWER?**

Query response: **<float>**:
When the function is ACW : OFF, 0.01 - 10.00, with unit
When the function is DCW : OFF, 0.001 - 5.00, with unit
When the function is IR : 0.1 - 5E4, with unit

Example: Send> **FUNC:SOUR:STEP5:LOWER?**<NL>
Return> **0.100mA** <NL>

FUNC:SOUR:STEP<1-16>: RTIM Within the existing test program (TOTAL), sets the **Rise Time**.

Command syntax: **FUNC:SOUR:STEP<1-16>:RTIM <float>**

Parameters: **<float>**(data unit is S):
Mixed floating-point number, 0, 0.1 - 999.9, without unit

Example: Send> **FUNC:SOUR:STEP5:RTIM 10**<NL> //With the total number of steps ≥5, sets the Rise Time of step 5 to 10s

Query syntax: **FUNC:SOUR:STEP<1-16>:RTIM?**

Query response: **<float>**(data unit is S):
Mixed floating-point number, OFF, 0.1 - 999.9, with unit

Example: Send> **FUNC:SOUR:STEP5:RTIM?**<NL>
Return> **10.0s** <NL>

FUNC:SOUR:STEP<1-16>: TTIM Within the existing test program (TOTAL), sets the **Test Time**.

Command syntax: **FUNC:SOUR:STEP<1-16>:TTIM <float>**

Parameters: **<float>**(data unit is S):
Mixed floating-point number, 0, 0.5 - 999.9, without unit (0 indicates continuous testing)

Example: Send> **FUNC:SOUR:STEP5:TTIM 10**<NL> //With the total number of steps ≥5, sets the Test Time of step 5 to 10s

Query syntax: **FUNC:SOUR:STEP<1-16>:TTIM?**

Query response: **<float>**(data unit is S):
Mixed floating-point number, OFF, 0.5 - 999.9, with unit

Example: Send> **FUNC:SOUR:STEP5:TTIM?**<NL>
Return> **10.0s** <NL>

FUNC:SOUR:STEP<1-16>: FTIM Within the existing test program (TOTAL), sets the **Fall Time**.

Command syntax: **FUNC:SOUR:STEP<1-16>:FTIM <float>**

Parameters: **<float>**(data unit is S):
Mixed floating-point number, 0, 0.1 - 999.9, without unit

Example: Send> **FUNC:SOUR:STEP5:FTIM 10**<NL> //With the total number of steps ≥5, sets the Fall Time of step 5 to 10s

Query syntax: **FUNC:SOUR:STEP<1-16>:FTIM?**

Query response: **<float>**(data unit is S):
Mixed floating-point number, OFF, 0.1 - 999.9, with unit

Example: Send> **FUNC:SOUR:STEP5:FTIM?**<NL>
Return> **10.0s** <NL>

FUNC:SOUR:STEP<1-16>: ARC Within the existing test program (TOTAL), sets the **ARC Level**.

Command syntax: **FUNC:SOUR:STEP<1-16>:ARC < *int* >**

Parameters: **< int>**:
Integer, 0 - 9, without unit (**not available under IR** ; 0 = OFF)

Example: Send> **FUNC:SOUR:STEP5:ARC 1**<NL> //With the total number of steps ≥5, sets the ARC Level of step 5 to 1

Query syntax: **FUNC:SOUR:STEP<1-16>ARC?**

Query response: **<int>**:
Integer, OFF, 1 - 9, with unit

Example: Send> **FUNC:SOUR:STEP5:ARC?**<NL>
Return> **LEVEL 1** <NL>

FUNC:SOUR:STEP<1-16>: FREQ Within the existing test program (TOTAL), sets the **Frequency**.

Command syntax: **FUNC:SOUR:STEP<1-16>:FREQ < *int* >**

Parameters: **< int>**:
Integer, 50 / 60, without unit (**available only under ACW**)

Example: Send> **FUNC:SOUR:STEP5:FREQ 60**<NL> //With the total number of steps ≥5, sets the Frequency of step 5 to 60Hz

Query syntax: **FUNC:SOUR:STEP<1-16>FREQ?**

Query response: **<int>**:
Integer, 50 / 60, with unit

Example: Send> **FUNC:SOUR:STEP5:FREQ?**<NL>
Return> **60HZ** <NL>

FUNC:SOUR:STEP<1-16>: CHG Within the existing test program (TOTAL), sets the **Charging Lower Limit**.

Command syntax: **FUNC:SOUR:STEP<1-16>:CHG <float>**
Parameters: **<float>**(data unit is S):
Mixed floating-point number, 0, 1 - 3500, without unit (**DCW**)
Mixed floating-point number, 0, 0.001 - 3.5, without unit (**IR**)
Not supported under ACW
Example: Send> **FUNC:SOUR:STEP5:CHG 10**<NL> //With the total number of steps ≥5, sets the Charging Lower Limit of step 5 to 10uA
Query syntax: **FUNC:SOUR:STEP<1-16>: CHG?**
Query response: **<float>**(data unit is S):
Mixed floating-point number, OFF, 1 - 3500, with unit (**DCW**)
Mixed floating-point number, OFF, 0.001 - 3.5, with unit (**IR**)
Example: Send> **FUNC:SOUR:STEP5: CHG?**<NL>
Return> **10.0uA** <NL>

FUNC:SOUR:STEP<1-16>: RUPPER Within the existing test program (TOTAL), sets the **Rise Upper Limit**.

Command syntax: **FUNC:SOUR:STEP<1-16>:RUPPER {ON,OFF} (only DCW has this function)**
Example: Send> **FUNC:SOUR:STEP5:RUPPER ON**<NL> //With the total number of steps ≥5, sets the Rise Upper Limit of step 5 to ON
Query syntax: **FUNC:SOUR:STEP<1-16>:RUPPER?**
Query response: **{ON,OFF}**

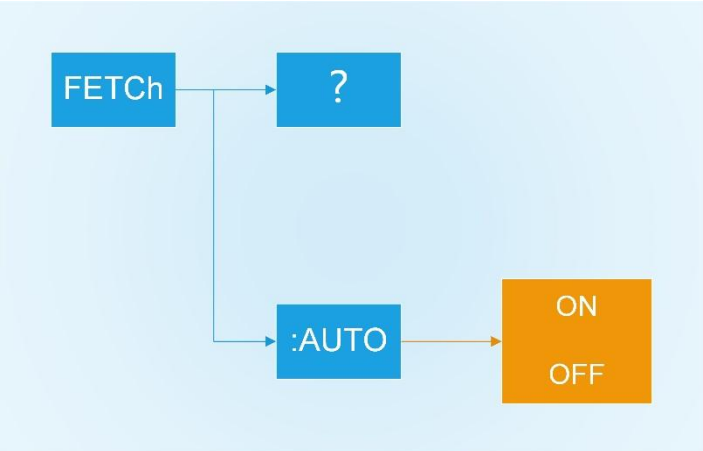
FUNC:SOUR:STEP<1-16>: RANG Within the existing test program (TOTAL), sets the **Range**.

Command syntax: **FUNC:SOUR:STEP<1-16>:RANG <int> (only IR has this function)**
Parameters: **<int>**:
Integer, 0~ 5, without unit (where 0 is AUTO mode, 1 is NOM mode, 2 is 1mA, 3 is 100uA, 4 is 10uA, 5 is 1uA)
Example: Send> **FUNC:SOUR:STEP5:RANG 1**<NL> //With the total number of steps ≥ 5, sets the range of step 5 to 5mA
Query syntax: **FUNC:SOUR:STEP<1-16>:RANG?**
Query response: **<int>**:
Integer, NOM/AUTO, Range_1uA~Range_1mA, with unit
Example: Send> **FUNC:SOUR:STEP5:RANG?**<NL>
Return> **NOM: Range_1mA** <NL>

10.6 FETCh Subsystem

The FETCh subsystem command set is used to obtain the measurement results of the instrument and the settings of the acquisition mode.

Figure 10- 4 FETCh Subsystem Tree



FETCh:AUTO Sets whether the instrument returns the result of each measurement.

Command syntax: **FETCh:AUTO {ON,OFF}**

Example: Send> **FETCh:AUTO ON**<NL> //Automatic sending of each measurement result

Query syntax: **FETCh?**

Example: Send> **FETC?** <NL>
Return> **ACW,0.05kV,0.00mA,PASS;** <NL> //The instrument returns each measurement result

10.7 FILE Subsystem

The FILE subsystem commands are used to perform file operations.

Figure 10- 11 FILE Subsystem Tree

FILE	*:SAVE*	*<File NO.>*
	:LOAD	*<File NO.>*
	:DELete	*<File NO.>*

10.7.1 FILE?

The FILE? command is used to query the file number used by the system.

Query syntax: **FILE?**

Query response: **<int>**:
Integer, 1 – 10, file number

Example: Send> **FILE?**<NL>
Return> **1**<NL>

10.7.2 FILE:SAVE <n>

The FILE:SAVE command is used to save the user settings to the file currently in use.

Command syntax: **FILE:SAVE**

Example: Send> **FILE:SAVE**<NL>

The FILE:SAVE <n> command is used to save the user settings to the specified file.

Command syntax: **FILE:SAVE <n>**

Parameters: **<int>**:
Integer, 1 - 10,

Example: Send> **FILE:SAVE 1**<NL>

10.7.3 FILE:LOAD <n>

The FILE:LOAD command is used to load all user settings from the file currently in use.

Command syntax: **FILE:LOAD**

Example: Send> **FILE:LOAD**<NL>

The FILE:LOAD <n> command is used to load all user settings from the specified file.

Command syntax: **FILE:LOAD <n>**

Parameters: **<int>**:
Integer, 1 - 10,

Example: Send> **FILE:LOAD 1**<NL>

10.7.4 FILE:DELete <n>

The FILE: DELete command is used to delete all user settings from the file currently in use.

Command syntax: **FILE: DELete**

Example: Send> **FILE: DELete** <NL>

The FILE: DELete <n> command is used to delete all user settings from the specified file.

Command syntax: **FILE: DELete <n>**

Parameters: **<int>**:
Integer, 1 - 10,

Example: Send> **FILE: DELete 1**<NL>

10.8 SYSTem Subsystem

The SYSTem subsystem is used to set system-related parameters.
Data set with the SYSTem subsystem will not be saved inside the instrument.

Figure 10- 5 SYSTem Subsystem Tree

SYSTem	*:LANGuage*	*{ENGLISH,CHINESE,EN,CH}*
	:GFI	*{ON,OFF}*
	:BEEP	*{ON,OFF}*

10.8.1 SYSTem:LANGuage

Sets the instrument language.

Command syntax: **SYSTem:LANGuage {ENGLISH,CHINESE,EN,CH}**

Example: Send> **SYST:LANG EN**<NL>//Set to English display

Query syntax: **SYST:LANG?**

Query response: **{ENGLISH,CHINESE}**

10.8.2 SYSTem:GFI

SYST:GFI is used to set the GFI protection status.

Command syntax: **SYSTem:GFI {ON,OFF}**

Example: Send> **SYST:GFI ON**<NL> //Set GFI protection to On

Query syntax: **SYST:GFI?**

Query response: **{ON,OFF}**

10.8.3 SYSTem:BEEP

SYST:BEEP is used to set the beep switch.

Command syntax: **SYSTem:BEEP {HIGH,LOW,OFF}**

Example: Send> **SYST:BEEP OFF**<NL> //Set the beep to Off

Query syntax: **SYST:BEEP?**

Query response: **{HIGH,LOW,OFF}**

10.9 WRITEPARA

WRITEPARA is used to set step parameters

Command syntax: **WP <STEP,ACW,VOLT,TIME,RISETIME,FALLTIME,HIGH,LOW,ARC,FREQ>**
WP

<STEP,DCW,VOLT,TIME,RISETIME,FALLTIME,HIGH,LOW,ARC,CHG,RUPPER>
WP <STEP,IR,VOLT,TIME,RISETIME,FALLTIME,HIGH,LOW,RANGEMODE,CHG>

Example: Send> **WP 1,DCW,1000.0,1.0,0.5,0.5,5.0,1.0,0,1,1***<NL>*
//Set step 1 function to DCW (DC withstand voltage), voltage 1000V, test time 1 s, rise time 0.5 s, fall time 0.5 s, upper limit 5mA, lower limit 1mA, ARC Level 0, charging lower limit 1uA, rise upper limit On

Send> **WP 1,ACW,1000,1.0,0.5,0.5,1,0.1,0,0***<NL>*
//Set step 1 function to ACW (AC withstand voltage), voltage 1000V, test time 1 s, rise time 0.5 s, fall time 0.5 s, upper limit 1mA, lower limit 0.1mA, ARC Level 0, frequency 50Hz

Send> **WP 1,IR,1000,1.0,0.5,0.5,1000.0,1.0,1,1.0***<NL>*
//Set step 1 function to IR (insulation resistance), voltage 1.0kV, test time 1 s, rise time 0.5 s, fall time 0.5 s, upper limit 1000MΩ, lower limit 1MΩ, range mode NOM , charging lower limit 1uA

10.10 READPARA

Query syntax: **RP? <STEP>**

Query response: **<ACW>,<VOLT>,<TIME>,<RISETIME>,<FALLTIME>,<HIGH>,<LOW>,<ARC>,<FREQ>**
<DCW>,<VOLT>,<TIME>,<RISETIME>,<FALLTIME>,<HIGH>,<LOW>,<ARC>,<CHG>,<RUPPER>
<IR>,<VOLT>,<TIME>,<RISETIME>,<FALLTIME>,<HIGH>,<LOW>,<RANGEMODE>,<CHG>

Example: Send> **RP? 1** *<NL>*
Return> **DCW,300.00,1.0,0.5,0.5,10.0000,1.0000,0,0.0,0***<NL>*

10.11 READDATA

Query syntax: **RD? <STEP>**

Query response: **<STEP>,<FUNC>,<VOLT>,<CUR>,<STATE>,<TIME>,<LOAD>**
STEP: step1~16
FUNC: test functionACW,DCW,IR
VOLT: test voltage value
CUR: ACW,DCW: current value; IR: resistance value
STATE: status
0->Idle

3->Voltage rising
4->voltage testing
5->voltage falling
6->PASS Test passed
7->SHORT Short-circuit protection
8->ARC Arc protection
9->GFI GFI (ground fault)
10->BREAKDOWN Breakdown protection
11->ERROR Power amplifier board error
12->OV Overvoltage protection
13->UPPER Above upper limit
14->LOWER Below lower limit
15->RISELOW Rise upper-limit alarm
TIME: test time

Example: Send> **RD? 1** *<NL>*
Return> **1,DCW,0.30,0.00u,6,5,1.0,0***<NL>*
//Test step 1, test function DCW, voltage 1.000kV, current 1.79uA, test result PASS, test status voltage falling, test time 1.0 s, test completed

10.12 STEP

STEP is used to set the current test step

Command syntax: **STEP <int>**

Example: Send> **STEP 1**<NL> //Set the current step to 1

Query*Syntax:* **STEP?**

Query response: **<step>,<totalstep>**
Step: Current step
Totalstep: Total number of steps

10.13 INS

INS is used to add a step

Command syntax: **INS <int>**

Example: Send> **INS 1**<NL> //Add a new step after step 1
Send> **INS**<NL> //Add a new step after the current step

10.14 DEL

DEL is used to delete a step

Command syntax: **DEL <int>**

Example: Send> **DEL 1**<NL> //Delete step 1
Send> **DEL**<NL> //Delete the current step

10.15 KEYLOCK

KEYLOCK is used to set the keyboard lock

Command syntax: **KEYLOCK <ON,OFF>**

Example: Send> **KEYLOCK ON**<NL> //Turn on the keyboard lock

10.16 IDN? Subsystem

Figure 10- 12 IDN? Subsystem Tree

IDN?	

The IDN? subsystem is used to return the version number of the instrument.

Query syntax: **IDN?**

Query response: **<MODEL>,<Revision>,<SN>,< Manufacturer>**

Example: Send> **IDN?** <NL>
Return> **Onmeas,AT9620,962007767001,A1.00**<NL>

11. Modbus (RTU) Protocol

This chapter includes the following topics:

- Data Format
- Function Codes
- Registers
- Query Response — format of the query response
- Command Reference

11.1 Data Format

We follow the Modbus (RTU) communication protocol. The instrument will respond to commands from the host computer and return a standard response frame.

You can contact the sales department of our company to obtain the ONMEAS communication test tool, which contains Modbus communication debugging methods. It includes a CRC-16 calculator and conversion of floating-point numbers to the Modbus floating-point format.

11.1.1 Command Parsing Rules

Figure 11- 1 Modbus Command Frame



Table 11- 1 Command Frame Description

	At least 3.5 character times of silence required
Slave address	1 byte Modbus can support 00~0x63 slaves Specified as 00 for broadcast In instruments not fitted with the RS485 option, the default slave address is 0x01
Function Codes	1 byte 0x03: Read multiple registers 0x04: =03H, not used 0x06: Write single register, can be replaced by 10H 0x08: Echo Test (used only for debugging) 0x10: Write multiple registers
Data	Specifies the register address, quantity, and content
CRC-16	2 bytes, low byte first CyclicRedundancy Check All data from the slave address to the end of the data is calculated to obtain the CRC16 check code
	At least 3.5 character times of silence required

11.1.2 CRC-16 Calculation Method

(1) Set the initial value of the CRC-16 register to 0xFFFF.
(2) Perform an XOR operation on the CRC-16 register and the first byte of the message, and

return the calculation result to the CRC register.

(3) Fill the MSB with 0 and shift the CRC register right by 1 bit.

(4) If the bit shifted out from the LSB is “0”, repeat step (3) (process the next shift). If the bit shifted out from the LSB is “1”, perform an XOR operation on the CRC register and 0xA001, and return the result to the CRC register.

(5) Repeat steps (3) and (4) until 8 bits have been shifted.

(6) If the message has not been fully processed, perform an XOR operation on the CRC register and the next byte of the message, return the result to the CRC register, and repeat from step (3).

(7) Append the calculated result (the value of the CRC register) to the message starting from the low-order byte.

The following is a CRC calculation function written in VB:

```
Function CRC16(data() As Byte) As Byte()
    Dim CRC16Lo As Byte, CRC16Hi As Byte   'CRC register
    Dim CL As Byte, CH As Byte        'Polynomial code &HA001
    Dim SaveHi As Byte, SaveLo As Byte
    Dim i As Integer
    Dim flag As Integer
    CRC16Lo = &HFF
    CRC16Hi = &HFF
    CL = &H1
    CH = &HA0
    For i = 0 To UBound(data)
      CRC16Lo = CRC16Lo Xor data(i) 'Each data byte is XORed with the CRC register
      For flag = 0 To 7
        SaveHi = CRC16Hi
        SaveLo = CRC16Lo
        CRC16Hi = CRC16Hi \ 2      'High byte shifted right by one bit
            CRC16Lo = CRC16Lo \ 2      'Low byte shifted right by one bit
        If ((SaveHi And &H1) = &H1) Then 'If the last bit of the high byte is 1
          CRC16Lo = CRC16Lo Or &H80    'Then 1 is filled at the front of the low byte after the right shift
        End If            'Otherwise it is automatically filled with 0
        If ((SaveLo And &H1) = &H1) Then 'If the LSB is 1, perform an XOR operation with the polynomial code
          CRC16Hi = CRC16Hi Xor CH
          CRC16Lo = CRC16Lo Xor CL
        End If
      Next flag
    Next i
    Dim ReturnData(1) As Byte
    ReturnData(0) = CRC16Hi       'CRC high byte
    ReturnData(1) = CRC16Lo       'CRC low byte
    CRC16 = ReturnData
End Function
```

See: Our company's “ONMEAS communication test tool“” contains Modbus communication debugging methods. It includes a CRC-16 calculator.

The calculated CRC-16 data needs to be appended to the end of the command frame, for example: 1234H:

Figure 11- 2 Modbus Appended CRC-16 Value



11.1.3 Response Frame

Unless it is a command broadcast with the slave address 00H, the instrument will return a response frame for any other slave address.

Figure 11-3 Normal Response Frame

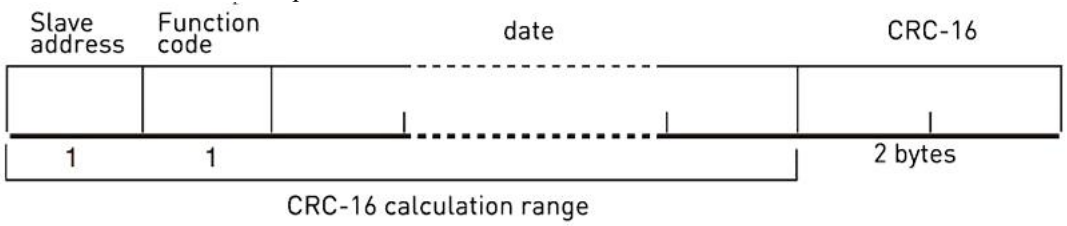


Figure 11-4 Exception Response Frame

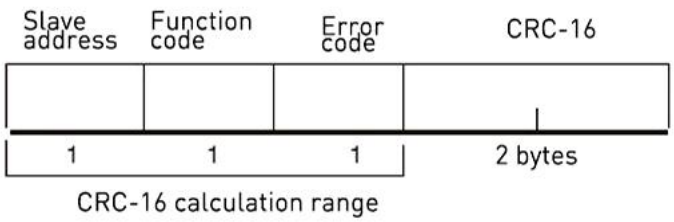


Table 11-2 Exception Response Frame Description

Slave address	1 byte The slave address is returned as is
Function Codes	1 byte The function code of the command frame is logically ORed with BIT7 (0x80), for example: 0x03 OR 0x80 = 0x83
Error Codes	Exception codes: 0x01 Function code error (function code not supported) 0x02 Register error (register does not exist) 0x03 Data error 0x04 Execution error
CRC-16	2 bytes, low byte first CyclicRedundancy Check All data from the slave address to the end of the data is calculated to obtain the CRC16 check code

11.1.4 No Response

In the following cases, the instrument will not perform any processing and will not respond, resulting in a communication timeout.

(1) Slave address error
(2) Transmission error
(3) CRC-16 error
(4) Digit count error, for example: the total digit count for function code 0x03 must be 8, while the received count is less than 8 or greater than 8 bytes.
(5) When the slave address is 0x00, it represents the broadcast address and the instrument does not respond.

11.1.5 Error Codes

Table 11-3 Error Code Description

Error Codes	Name	Description	Priority
0x01	Function code error	Function code does not exist	1
0x02	Register error	Register does not exist	2
0x03	Data error	Register quantity or byte count error	3

0x04	Execution error	Invalid data, the written data is not within the allowed range	4

11.2 Function Codes

The instrument supports only the following function codes; for other function codes, an error frame will be returned.

Table 11- 4 Function Codes

Function Codes	Name	Description
0x03	Read Multiple Registers	Read data from multiple consecutive registers
0x04	Same as 0x03	Please use 0x03 instead
0x08	Echo Test	The received data is returned as is
0x10	Write Multiple Registers	Write multiple consecutive registers

11.3 Registers

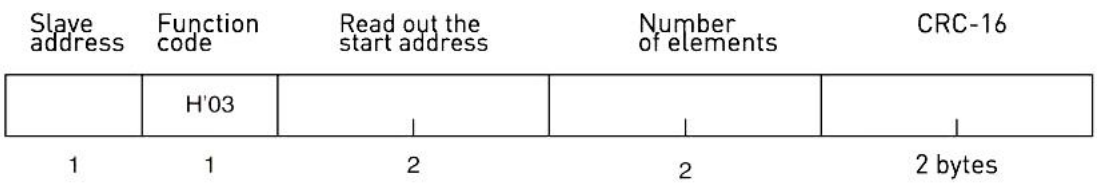
The registers of the instrument are in 2-byte mode, that is, 2 bytes must be written each time. For example: the register for setting the test function is 0x3000, the data is 2 bytes, and writing the value 0x0001 sets the test function to DCW mode.

Data:
The instrument supports the following types of values:
(1) 1 register, double-byte (16-bit) integer, for example: 0x64 → 00 64
(2) 2 registers, four-byte (32-bit) integer, for example: 0x12345678 → 12 34 56 78
(3) 2 registers, four-byte (32-bit) single-precision floating-point number, 3.14 → 40 48 F5 C3

Our company's “ONMEAS communication test tool“” contains Modbus communication debugging methods. It includes a floating-point converter.

11.4 Read Multiple Registers

Figure 11- 5 Read Multiple Registers (0x03)

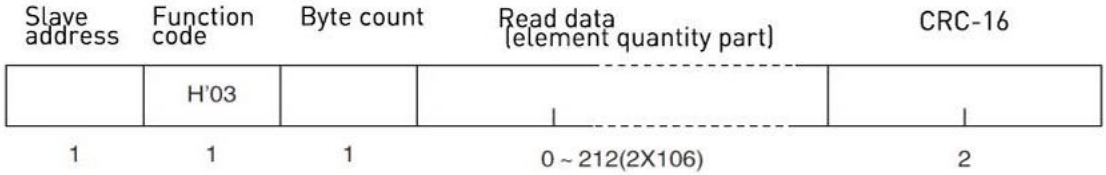


The function code for reading multiple registers is 0x03.

Table 11- 5 Read Multiple Registers

Name	Parameters	Description
	Slave address	When no RS485 address is specified, the default is 01
0x03	Function Codes	
	Starting address	Starting register address, please refer to the Modbus instruction set
	Number of registers to read 0001~006A (106)	Number of registers to read consecutively. Please refer to the Modbus instruction set to ensure that these register addresses all exist, otherwise an error frame will be returned.
CRC-16	Check Code	

Figure 11- 6 Read Multiple Registers (0x03) Response Frame



Name	Parameters	Description
	Slave address	Returned as is
0x03 or 0x83	Function Codes	No exception: 0x03 Error code: 0x83
	Number of bytes	= Number of registers x 2 For example: 1 register returns 02
	Data	Data read
CRC-16	Check Code	

11.5 Write Multiple Registers

Figure 11- 7 Write Multiple Registers (0x10)

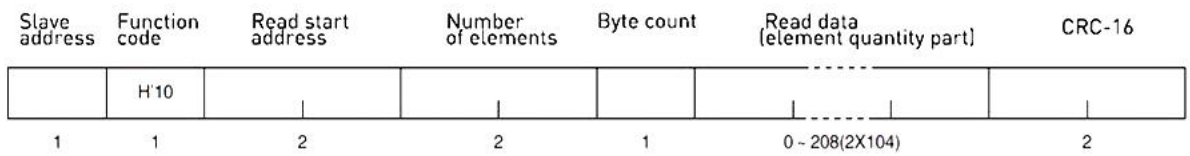
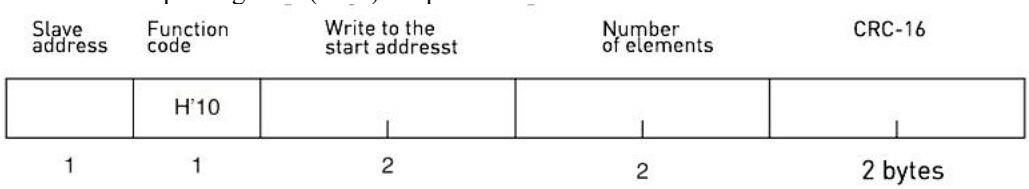


Table 11- 6 Write Multiple Registers

Name	Parameters	Description
	Slave address	When no RS485 address is specified, the default is 01
0x10	Function Codes	
	Starting address	Starting register address, please refer to the Modbus instruction set
	Number of registers to write 0001~0068 (104)	Number of registers to read consecutively. Please refer to the Modbus instruction set to ensure that these register addresses all exist, otherwise an error frame will be returned.
	Number of bytes	= Number of registers x 2
CRC-16	Check Code	

Figure 11- 8 Write Multiple Registers (0x10) Response Frame

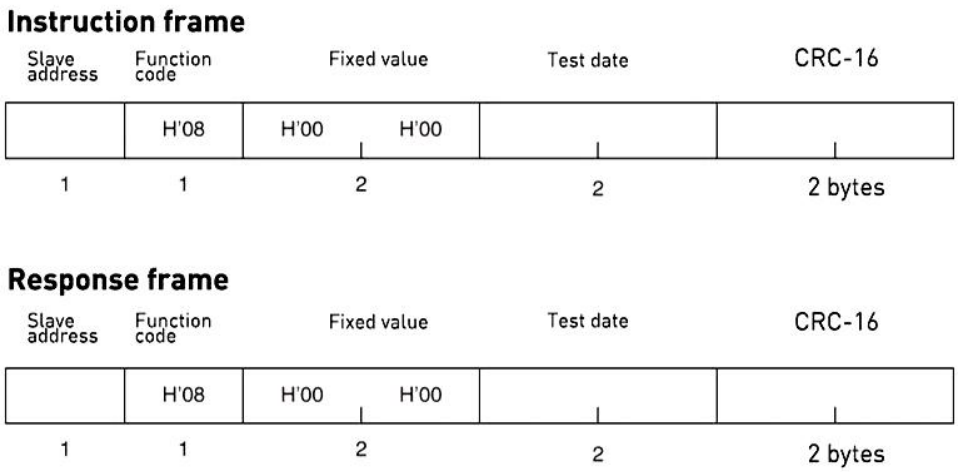


Name	Parameters	Description
	Slave address	Returned as is
0x10 or 0x90	Function Codes	No exception: 0x10 Error code: 0x90
	Starting address	
	No. of Regs	
	CRC-16 Check Code	

11.6 Echo Test

The function code of the Echo Test is 0x08, which is used for debugging Modbus.

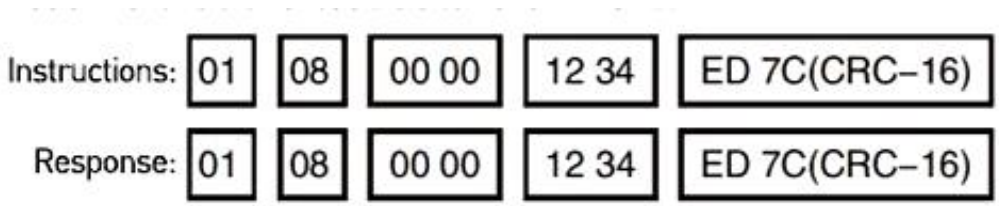
Figure 11- 9 Echo Test (0x08)



Name	Parameters	Description
	Slave address	Returned as is
0x08	Function Codes	
	Fixed value	00 00
	Test data	Any value: for example 12 34
	CRC-16Check Code	

Example:

Assume the test data is 0x1234:



12. Modbus (RTU) Command Set

This chapter includes the following topics:

- Register Overview — understand all register addresses used in the MODBUS instruction set
- Command Syntax — rules for writing command lines
- Query Syntax — rules for writing query commands
- Query Response — format of the query response
- Command Reference

This chapter provides all the SCPI commands used by the instrument. Through these SCPI commands, all functions of the instrument can be fully controlled.

12.1 Register Overview

The following lists all register addresses used by the instrument. Any address not in the table will return error code 0x02.

Table 12- 1 Register Overview

Register Address	Name	Numeric value	Description
Read-Only Register Settings			
2000	Voltage Result	4-byte floating-point number	Read-only register, data occupies 2 registers
2002	Current Result	4-byte floating-point number	Read-only register, data occupies 2 registers
2004	Recall File Number	2-byte integer	Read-only register, data occupies 1 register
2005	Total Steps - Current Step	4-byte integer	Read-only register, data occupies 2 registers Example: 00 02 00 02 indicating that the total number of steps is 2 and the current step is 2
Setting Screen Read/Write Functions			
3000	Test Function	0000: ACW 0001: DCW 0002: IR	Read/Write register, data occupies 1 register
3001	Test Voltage	4-byte floating-point number	Read/Write register, data occupies 2 registers
3003	Test Time	4-byte floating-point number	Read/Write register, data occupies 2 registers
3005	Rise Time	4-byte floating-point number	Read/Write register, data occupies 2 registers
3007	Fall Time	4-byte floating-point number	Read/Write register, data occupies 2 registers
3009	Upper Limit	4-byte floating-point number	Read/Write register, data occupies 2 registers
300B	Lower Limit	4-byte floating-point number	Read/Write register, data occupies 2 registers
300D	Range Mode	0000: Auto range 0001: Fixed range	Read/Write register, data occupies 1 register Write mode only supports IR mode
300E	Test Range	0000: 1uA range 0001: 10uA range 0002: 100uA range	Read/Write register, data occupies 1 register

		0003: 1mA range	Write mode only supports IR mode
300F	ARC Level	0000: LEVEL0 0001: LEVEL1 … 0005: LEVEL9	Read/Write register, data occupies 1 register This function supports ACW and DCW modes
3010	AC Frequency	0000: 50Hz 0001: 60Hz	Read/Write register, data occupies 1 register This function only supports ACW mode
3011	Charging Lower Limit	4-byte floating-point number	Read/Write register, data occupies 2 registers This function supports DCW and IR modes
3013	Rise Upper Limit	0000: On 0001: Off	Read/Write register, data occupies 1 register This function only supports DCW mode
System Screen Read/Write Functions			
3100	System Language	0000: English 0001: Chinese	Read/Write register, data occupies 1 register
3101	Key Beep	0000: On 0001: Off	Read/Write register, data occupies 1 register
3102	Remote Control	0000: RS232 0001: RS485 0002: LAN	Read/Write register, data occupies 1 register
3103	Baud Rate	0000: 9600 0001: 19200 0002: 38400 0003: 57600 0004: 115200	Read/Write register, data occupies 1 register
3104	Communication Protocol	0000: SCPI 0001: MODBUS	Read/Write register, data occupies 1 register
3105	Command Handshake	0000: Off 0001: On	Read/Write register, data occupies 1 register
3106	Station Number	0000: 00 (broadcast) 0001: 01 … 000F: 15	Read/Write register, data occupies 1 register
3107	Result Sending	0000: FETCH 0001: Auto	Read/Write register, data occupies 1 register
3108	Error Codes	0000: Off 0001: On	Read/Write register, data occupies 1 register
3109	GFI Protection	0000: Off 0001: On	Read/Write register, data occupies 1 register
310A	Fail Mode	0000: Continue 0001: Stop	Read/Write register, data occupies 1 register
310B	Volume Setting	0000: High 0001: Low 0002: Off	Read/Write register, data occupies 1 register
310C	Trigger Mode	0000: Local 0001: PLC 0002: Bus	Read/Write register, data occupies 1 register
310D	Result Display	0000: Group Test Result 0001: Step Test Result	Read/Write register, data occupies 1 register
Instrument Control Functions			
4000	Start/Stop Test	0000: Stop test 0001: Start test	Write register, data occupies 1 register
4001	Switch Screen	0000: Test Screen	Write register, data occupies 1

		0001: Setting Screen 0002: System Screen 0003: File Screen 0004: Data Logging Screen 0005: Comprehensive Display Screen 0006:System Information Screen 0007: LAN Screen	register
4002	Keyboard Lock	0001: Lock keyboard	Write register, data occupies 1 register
4003	Test Step	0000: Add a new test item 0001: Delete a new test item 0002: Restore to a single default test item	Write register, data occupies 1 register
4004	File Management	Function: 0000: Delete current file 0001: Save file 0002: Read file File number: 0001~000A	Write register, data occupies 2 registers Example: 00 00 00 01 indicating that the first file is deleted
4006	Charging Lower Limit	Auto test: 0001	Write register, data occupies 1 register
4007	Zero Compensation	Auto test: 0001	Write register, data occupies 1 register

12.2 Read-Only Registers

12.2.1 Voltage Result Register [2000]

Read

1	2	3	4	5	6	7	8
01	**03**	**2 0**	**0 0**	**00**	**02**	**CF**	**CB**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**BB**	**B7**	**BC**
01	03	Bytes	Data				CRC-16	

12.2.2 Current Result Register [2002]

Read

1	2	3	4	5	6	7	8
01	**03**	**2 0**	**0 2**	**00**	**02**	**6E**	**0B**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4			5	6	7
01	**03**	**04**	**00**	**00**	**00**	**00**	**FA**	**33**
01	03	Bytes	Data				CRC-16	

12.2.3 Loaded File Number Register [2004]

Read

1	2	3	4	5	6	7	8
01	**03**	**2**	**0**	**00**	**01**	**CE**	**0B**

		0	**4**				
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
01	03	Bytes	Data		CRC-16	

12.2.4 Current Step Register [2005]

Read

1	2	3	4	5	6	7	8
01	**03**	**2 0**	**0 5**	**00**	**02**	**DF**	**CA**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	5	6	7
01	**03**	**02**	**00**	**02**	**00**	**02**	**DA**	**32**
01	03	Bytes	Data				CRC-16	

Note: The data is split into two parts, the first part 00 01 indicates the total number of steps, the second part 00 01 indicates the current step; that is, the current step is [01-01].

12.3 Setup Page Read/Write Registers

12.3.1 Test Function Register [3000]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 0**	**0 0**	**00**	**01**	**02**	**00**	**00**	**96**	**53**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 0**	**0 0**	**00**	**01**	**0E**	**C9**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 0**	**O 0**	**00**	**01**	**8B**	**0A**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.3.2 Set Voltage Register [3001]

Write (set voltage to 1kV)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**0 1**	**00**	**02**	**04**	**44**	**7A**	**00**	**00**	**53**	**4B**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 0**	**0 1**	**00**	**02**	**1F**	**08**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8

01	**03**	**30**	**01**	**00**	**02**	**9A**	**CB**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.3 Test Time Register [3003]

Write (set test time to 1s)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**03**	**00**	**02**	**04**	**3F**	**80**	**00**	**00**	**EA**	**47**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**03**	**00**	**02**	**BE**	**C8**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**03**	**00**	**02**	**3B**	**0B**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.4 Rise Time Register [3005]

Write (set rise time to 1s)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**05**	**00**	**02**	**04**	**3F**	**80**	**00**	**00**	**6A**	**6D**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**05**	**00**	**02**	**5E**	**C9**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**06**	**00**	**02**	**2B**	**0A**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.5 Fall Time Register [3007]

Write (set fall time to 1s)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**07**	**00**	**02**	**04**	**3F**	**80**	**00**	**00**	**EB**	**B4**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**07**	**00**	**02**	**FF**	**09**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**O7**	**00**	**02**	**7A**	**CA**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.6 Upper Limit Register [3009]

Write (set ACW current step upper limit to 1mA)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**09**	**00**	**02**	**04**	**3F**	**80**	**00**	**00**	**6A**	**38**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**09**	**00**	**02**	**9E**	**CA**
		Registers		No. of Regs		CRC	

Note: In ACW mode the unit is mA, input range: (0.01~20) mA
In DCW mode the unit is mA, input range: (0.0001~10) mA
In IR mode the unit is MΩ, input range: (1~50000) MΩ

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**09**	**00**	**02**	**1B**	**09**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.7 Lower Limit Register [300B]

Write (set ACW current step lower limit to 1mA)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**0B**	**00**	**02**	**04**	**3F**	**80**	**00**	**00**	**EB**	**E1**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3**	**0**	**00**	**02**	**3F**	**0A**

		0	**B**				
		Registers		No. of Regs		CRC	

Note: In ACW mode the unit is mA, input range: (0.01~20) mA
In DCW mode the unit is mA, input range: (0.0001~10) mA
In IR mode the unit is MΩ, input range: (1~50000) MΩ

Read

1	2	3	4	5	6	7	8
01	**03**	**3 0**	**0 B**	**00**	**02**	**BA**	**C9**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7	8	9
01	**03**	**04**	**3F**	**80**	**00**	**00**	**F7**	**CF**
01	03	Bytes	Data				CRC-16	

12.3.8 Range Mode Register [300D]

Write (set the current step test range mode to AUTO)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 0**	**0 D**	**00**	**01**	**02**	**00**	**00**	**97**	**4E**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 0**	**0 D**	**00**	**01**	**9F**	**0A**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 0**	**0 D**	**00**	**01**	**1A**	**C9**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
01	03	Bytes	Data		CRC-16	

Note: This function is valid only in IR mode

12.3.9 Test Range Register [300E]

Write (set the current step test range mode to Range_1uA)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0 E**	**00**	**01**	**02**	**00**	**00**	**97**	**7D**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 0**	**0 E**	**00**	**01**	**6F**	**0A**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 0**	**0 E**	**00**	**01**	**EA**	**C9**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

Note: This function is valid only in IR mode

12.3.10 ARC Level Register [300F]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**0F**	**00**	**01**	**02**	**00**	**00**	**96**	**AC**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**0F**	**00**	**01**	**3E**	**CA**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**0F**	**00**	**01**	**BB**	**09**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.3.11 AC Frequency Register [3010]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**10**	**00**	**01**	**02**	**00**	**00**	**94**	**C3**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**10**	**00**	**01**	**0F**	**0C**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**10**	**00**	**01**	**8A**	**CF**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.3.12 Charging Lower Limit Register [3011]

Write (set the charging lower limit to 100uA in DCW mode)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**30**	**11**	**00**	**02**	**04**	**42**	**C8**	**00**	**00**	**F2**	**E8**
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**11**	**00**	**02**	**1E**	**CD**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**11**	**00**	**02**	**9B**	**0E**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4			5	6	7
01	**03**	**04**	**42**	**C8**	**00**	**00**	**6F**	**B5**
01	03	Bytes	Data				CRC-16	

12.3.13 Rise Upper Limit Register [3013]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**13**	**00**	**01**	**02**	**00**	**00**	**94**	**F0**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**13**	**00**	**01**	**FF**	**0C**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**13**	**00**	**01**	**7A**	**CF**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4 System Page Read/Write Registers

12.4.1 System Language Register [3100]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**00**	**00**	**01**	**02**	**00**	**00**	**86**	**93**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**00**	**00**	**01**	**0F**	**35**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**O0**	**00**	**01**	**8A**	**F6**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**

01	03	Bytes	Data	CRC-16

12.4.2 Key Beep Register [3101]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 1**	**00**	**01**	**02**	**00**	**00**	**87**	**42**
	Wri te	Registers		No. of Regs		Byte s	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 1**	**00**	**01**	**5E**	**F5**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 1**	**00**	**01**	**DB**	**36**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.3 Remote Control Register [3102]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 2**	**00**	**01**	**02**	**00**	**00**	**87**	**71**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 2**	**00**	**01**	**AE**	**F5**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 2**	**00**	**01**	**2B**	**36**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.4 Baud Rate Register [3103]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 3**	**00**	**01**	**02**	**00**	**00**	**86**	**A0**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 3**	**00**	**01**	**FF**	**35**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 3**	**00**	**01**	**7A**	**F6**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.5 Communication Protocol Register [3104]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 4**	**00**	**01**	**02**	**00**	**00**	**87**	**17**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 4**	**00**	**01**	**4E**	**F4**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 4**	**00**	**01**	**CB**	**37**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**01**	**79**	**84**
01	03	Bytes	Data		CRC-16	

12.4.6 Command Handshake Register [3105]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 5**	**00**	**01**	**02**	**00**	**00**	**86**	**C6**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 5**	**00**	**01**	**1F**	**34**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 5**	**00**	**01**	**9A**	**F7**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.7 Station Number Register [3106]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3**	**0**	**00**	**01**	**02**	**00**	**00**	**86**	**F5**

		1	**6**							
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 6**	**00**	**01**	**EF**	**34**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 6**	**00**	**01**	**6A**	**F7**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.8 Result Sending Register [3107]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 7**	**00**	**01**	**02**	**00**	**00**	**87**	**24**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 7**	**00**	**01**	**BE**	**F4**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 7**	**00**	**01**	**3B**	**37**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.9 Error Code Register [3108]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 8**	**00**	**01**	**02**	**00**	**00**	**87**	**DB**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 8**	**00**	**01**	**8E**	**F7**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 8**	**00**	**01**	**0B**	**34**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7

01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.10 GFI Protection Register [3109]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 9**	**00**	**01**	**02**	**00**	**00**	**86**	**0A**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 9**	**00**	**01**	**DF**	**37**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O 9**	**00**	**01**	**5A**	**F4**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.11 Fail Mode Register [310A]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 A**	**00**	**01**	**02**	**00**	**00**	**86**	**39**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 A**	**00**	**01**	**2F**	**37**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O A**	**00**	**01**	**AA**	**F4**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.12 Volume Setting Register [310B]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 B**	**00**	**01**	**02**	**00**	**00**	**87**	**E8**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 B**	**00**	**01**	**7E**	**F7**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O B**	**00**	**01**	**FB**	**34**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.13 Trigger Mode Register [310C]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**0C**	**00**	**01**	**02**	**00**	**00**	**86**	**5F**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 C**	**00**	**01**	**CF**	**36**
		Registers		No. of Regs		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O C**	**00**	**01**	**4A**	**F5**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.4.14 Result Display Register [310D]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**3 1**	**0 D**	**00**	**01**	**02**	**00**	**00**	**87**	**8E**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**3 1**	**0 D**	**00**	**01**	**9E**	**F6**
		Registers		No. of Regs			C R C

Read

1	2	3	4	5	6	7	8
01	**03**	**3 1**	**O D**	**00**	**01**	**1B**	**35**
	Read	Registers		No. of Regs		CRC	

Response:

1	2	3	4	5	6	7
01	**03**	**02**	**00**	**00**	**B8**	**44**
01	03	Bytes	Data		CRC-16	

12.5 Instrument Control Registers

12.5.1 Start/Stop Test Register [4000]

Write (stop test)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**00**	**00**	**01**	**02**	**00**	**00**	**E7**	**94**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**00**	**00**	**01**	**14**	**09**
		Registers		No. of Regs		CRC	

Note: The trigger mode must first be set to [BUS]

12.5.2 Page Switching Register [4001]

Write (switch to the measurement page)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**01**	**00**	**01**	**02**	**00**	**00**	**E6**	**45**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**01**	**00**	**01**	**45**	**C9**
		Registers		No. of Regs		CRC	

12.5.3 Keyboard Lock Register [4002]

Write (lock)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**02**	**00**	**01**	**02**	**00**	**01**	**27**	**B6**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**02**	**00**	**01**	**B5**	**C9**
		Registers		No. of Regs		CRC	

12.5.4 Test Step Register [4003]

Write (add a test scheme to the existing steps)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**40**	**03**	**00**	**01**	**02**	**00**	**00**	**E7**	**A7**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**40**	**03**	**00**	**01**	**E4**	**09**
		Registers		No. of Regs		CRC	

12.5.5 File Management Register [4004]

Write (delete the first file: the data consists of two values, 00 00 indicates the delete function, 00 01 indicates the first file)

1	2	3	4	5	6	7	8	9	10	11	12	13
01	**10**	**40**	**0**	**00**	**02**	**04**	**00**	**00**	**00**	**01**	**02**	**5F**

			4									
	Write	Registers		No. of Regs		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**4 0**	**0 4**	**00**	**02**	**15**	**C9**
		Registers		No. of Regs		CRC	

12.5.6 Charging Lower Limit Register [4006]

Write (enable the charging lower limit auto test)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**0 6**	**00**	**01**	**02**	**00**	**01**	**26**	**32**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**4 0**	**0 6**	**00**	**01**	**F4**	**08**
		Registers		No. of Regs		CRC	

12.5.7 Zero Compensation Register [4007]

Write (enable the zero compensation auto test)

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**4 0**	**0 7**	**00**	**01**	**02**	**00**	**01**	**27**	**E3**
	Write	Registers		No. of Regs		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**4 0**	**0 7**	**00**	**01**	**A5**	**C8**
		Registers		No. of Regs		CRC	

13. Specifications

You will learn about the following:

- Technical Specifications
- General Specifications
- Environmental Requirements
- Dimensions

13.1 Technical Specifications

The following data are measured under the following conditions:

Temperature condition: 23℃±5℃

Humidity condition: 65% R.H.

Warm-up time: >60 minutes

Calibration interval: 12 months

13.2 General Specifications

AT9620 Comprehensive Electrical Safety Compliance Tester NEW		
Test Function	Test Name	
ACW Test	Rated Output	5kVac/20mA
	Actual Output Capacity	100VA, ≥90%
	AC Voltage Output	Range: (50 ~ 5000) V, resolution: 10V, accuracy: ±(2% × set value +5V)
	Output Frequency	50Hz / 60Hz, precision: ±0.1Hz
	Output Waveform Distortion	Resistive load: <2%
	Output Regulation	±(2% × set value +5V)
	Short-Circuit Current	>30mA
	AC Voltage Measurement	Range: (0.05 ~ 5.00) kV, resolution: 0.01kV, accuracy: ±(1.5% × reading +1 digit)
	Current Upper Limit Setting	Range: (lower limit~20.00) mA, resolution: 0.01mA, judgment error: ±(2% × set value +5 digits)
	Current Lower Limit Setting	Range: (0.01~upper limit) mA, resolution: 0.01mA, judgment error: ±(2% × set value +5 digits)
	AC Current Measurement	Range: 0.00~3.50/3.00~20.00 mA resolution: 0.01 mA Accuracy: ±(2% × reading +5 digits)
	Rise Time	Range: (0.4~999.9) s, resolution: 0.1s, accuracy: ±(0.2% × set value +1 digit)
	Fall Time	Range: (0.1~999.9) s, resolution: 0.1s, accuracy: ±(0.2% × set value +1 digit)
	Duration	Range: unlimited, (0.5~999.9), resolution: 0.1s, accuracy: ±(0.2% × set value +1 digit)
	Arc Detection	1~9 (9 most sensitive), 0 means the arc function is off
	Current Compensation	0.000~20.00mA, total current + compensation current <20mA, auto
	Rated Output	6kVdc / 10mA
	Actual Output Capacity	60VA, ≥90%

DCW Test	DC Voltage Output	Range: (0.05 ~ 6.00) kVdc, resolution: 10V, accuracy: ±(2% × set value +5V)
	Output Ripple	<5% (6kV/1mA resistive load)
	Output Regulation	±(2% × set value +5V), no load to full load
	Current Upper Limit Setting	Range: (1~9999) μA/5mA, resolution: 1μA/0.01mA, Judgment error: ±(2% × set value +5 digits)
	Current Lower Limit Setting	Range: (1~upper limit) μA, resolution: 1μA, judgment error: ±(2% × set value +5 digits)
	DC Current Measurement	Range: 1.0~350.0/300~3500/3000~9999 μA/10mA, Resolution: 0.1/1/10μA/0.01mA, judgment error: ±(2% × reading +5 digits)
	Rise Time	Range: (0.4 ~999.9) s Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Duration	Range: (0.5~999.9) s, unlimited Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Fall Time	Range: Off, (0.1~999.9) s Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Arc Detection	1~9 (9 most sensitive), 0 means the arc function is off
	Current Compensation	(0 ~200.0) μA, auto, manual
	Rise Upper Limit Current	On/Off, the upper limit current is 12mA when on
	Charging Lower Limit Current	(1~3500) μA, auto, manual
	Discharge Time	≤200ms
	Maximum Capacitive Load	1uF<1kV, 0.75uF<2kV, 0.5uF<3kV, 0.08uF<4kV, 0.04uF<6kV
IR Test	Rated Output	1kVdc/50GΩ
	DC Voltage Output	Range: (50 ~ 1000) Vdc, resolution: 1V, accuracy: ±(2% × set value +5V)
	DC Voltage Measurement	Range: (50 ~ 1000) Vdc, resolution: 10V, accuracy: ±(2% × reading +5V)
	Voltage Drop	Not lower than 90% of the rated voltage, drop resistance 10MΩ (1% of range)
	Resistance Upper Limit Setting Resistance Lower Limit Setting	Range: (1 MΩ~50GΩ), resolution: 1MΩ Judgment error: (100-499) V, 1~1000, ±(8% × set value +2 digits) 200~999, ±(5% × set value +2 digits) 1000~9999, ±(15% × set value +2 digits)
	Insulation Resistance Measurement	Range: (1 ~9999) MΩ, resolution: 1MΩ Judgment error: (100-499) V, 1~1000, ±(8% × reading +2 digits) 200~999, ±(5% × reading +2 digits) 1000~49999, ±(15% × set value +2 digits)
	Rise Time	Range: (0.4 ~999.9) s Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Delayed Judgment Time	Range: (0.5~999.9) s, unlimited Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Fall Time	Range: Off, (0.1~999.9) s Resolution: 0.1s Accuracy: ±0.2% × set value +1 digit
	Discharge Time	≤200ms
	Charging Lower Limit Current	(0.001~3.500) μA, auto, manual

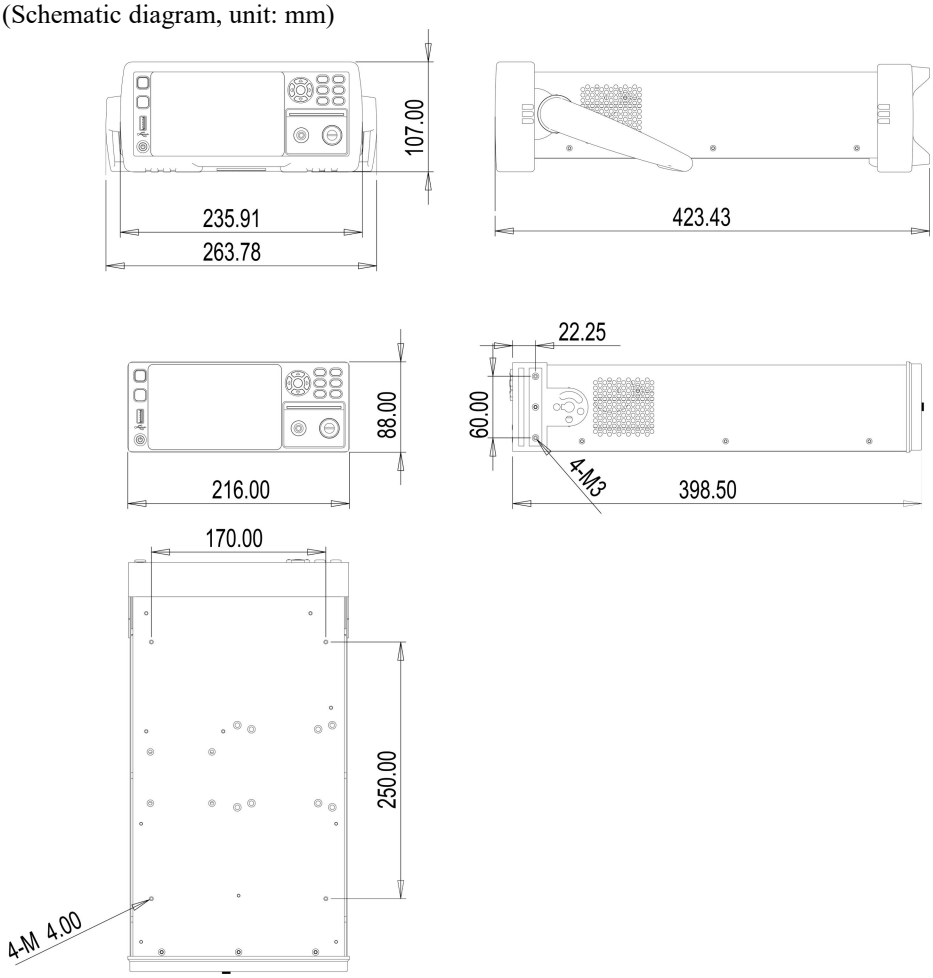
General	
External Interfaces	USB-HOST, RS232/RS485, HANDLER, LAN, alarm lamp interface, external remote-control interface
Dimensions	Outer dimensions (mm): 263.78(W)x107(H)x398.5(D)
Weight	8kg

13.3 Environmental Requirements

Environment:	Specifications:	Temperature 18℃~28℃ Humidity ≤ 65% RH
	Operation:	Temperature 10℃~40℃ Humidity 10~80% RH
	Storage:	Temperature 0℃~50℃ Humidity 10~90% RH
Power:	Supply voltage: 220VAC, maximum allowable error: ±10%	
Power frequency:	50Hz/60Hz, maximum allowable error: ±5%	
Fuse:	250V 10A slow-blow	
Weight:	Approx. 8.6 kg.	

13.4 Dimensions

(Schematic diagram, unit: mm)



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