ONMEAS®

Rev.A1.0

AT9610

Combined 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, it may cause fire or potential electric shock hazard to the operator.

- The instrument operates abnormally.
- The instrument produces abnormal noise, odor, smoke, or flash during operation.
- During operation, the instrument generates high temperature or electric shock.
- The power cord, power switch, or power outlet is damaged.
- Foreign matter or liquid enters the instrument.

Safety Information

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

Disclaimer

Before using the instrument, please read the following safety information carefully. ONMEAS shall not be liable for any personal injury or property damage resulting from failure to comply with the following provisions.

Instrument Grounding To prevent electric shock, properly connect the power ground wire.

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 heavy 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 it. The instrument still retains an undischarged charge for some time after power-off, which may pose a risk of electric shock to persons.

Do Not Using the instrument in places with strong magnetic or electric fields; electromagnetic pulses may cause instrument malfunction and fire. Using the Instrument in a Strong Magnetic Field

Do Not
Using a Malfunctioning Instrument

If the instrument malfunctions, the hazards are unpredictable. Disconnect the power cord, do not use it again, and do not attempt to repair it yourself.

Do Not
Using the Instrument Other Than as Specified in This Manual

Used beyond the specified range, the protection provided by the instrument will be void.

Limited Warranty and Liability

ONMEAS Ltd. (hereinafter referred to as Onmeas) warrants that every AT9610 you purchase fully conforms to quality and metrology requirements. This warranty does not cover fuses, nor damage caused by negligence, misuse, contamination, accident, or abnormal conditions of use. This warranty applies only to the original purchaser and is non-transferable.

From the date of shipment, Onmeas provides a two-year free warranty, which also covers the VFD or LCD. Any instrument damage caused by improper user operation during the two-year warranty period shall be re-paired at the user's expense. From two years onward, for the lifetime of the instrument, Onmeas provides paid repair service. Replacement of the VFD or LCD is charged at the current cost price.

If you find the product damaged, contact Onmeas to obtain consent for return or replacement, then send the product to your dealer. Be sure to state the reason for the damage and prepay postage and insurance to the destination. For in-warranty repair or replacement, Onmeas bears the return shipping cost. For out-of-warranty repairs, Onmeas will estimate the repair cost and proceed only with your consent; all costs incurred shall be borne by the user, including the return shipping cost.

This warranty is the only warranty given by Onmeas and constitutes your sole remedy. Beyond it, there are no other express or implied warranties, including fitness for a particular purpose; all other warranties are expressly disclaimed. Neither Onmeas nor its agents has made any oral or written representation to establish a warranty or in any way to expand the scope of this warranty. For any special, indirect, incidental, or consequential damages or losses (including loss of data) arising from any cause beyond the specifications, Onmeas shall bear no liability whatsoever. If any provision conflicts with local laws, or where certain jurisdictions do not permit exclusion or limitation of implied warranties, local laws shall pre-vail; such provision may not apply to you. However, that ruling does not affect the validity or enforceability of the other provisions.

People's Republic of China
Jiangsu Province
Onmeas Ltd.
October 2009
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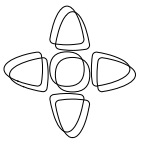
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1. Installation and Setup Guide



Thank you for purchasing our product! Read this chapter carefully before use. This chapter covers the following:

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

1.1 Packing List

Before using the instrument, please first:

1. Check the appearance of the product for damage, scratches, or other defects;
2. Check the instrument accessories against the packing list to make sure none are missing.

If damage is found or accessories are missing, contact the ONMEAS Instruments sales department or the dealer immediately.

1.2 Power Requirements

The AT9610 can only be used under the following power conditions:

Voltage: 220VAC (1±10%)

Frequency: 50Hz (1±10%)



WARNING: To prevent shock hazard, connect the power cord ground properly.
If the user has replaced the power cord, ensure that its ground is reliably connected.

1.3 Operating Environment

The AT9610 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 shock hazard, unplug the power cord before cleaning.

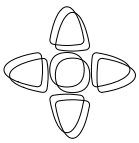
Use a clean cloth dampened with a little water to clean the case and panel.

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



This chapter covers the following:

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



This instrument generates a test high voltage of 5kV that can cause personal injury or even death. When operating the instrument, be extremely careful and observe the notes, warnings, and other instructions given in this chapter.

2.1 Workstation Arrangement

➢ Work Location

The work station must be located in an open area off the regular route of general personnel, so that non-workers stay away from the work station. The work station must be separated from other facilities and specially marked as the "high-voltage test workstation". During testing, a sign must be posted: "DANGER! Test in progress, non-staff must keep away!".

➢ Input Power

Ensure that the instrument is connected to electrical ground (earth) for safety. The work station power supply must have a separate switch, which should be installed at the station and specially marked, so that everyone can recognize it as the workstation's power switch. If an emergency occurs, the power can be switched off immediately, and then the incident can be handled.

➢ Work Area

Work tables or benches made of insulating material must be used, and no metal may be placed between the operator and the DUT. When designing the work area, the layout must never require the operator to reach across the DUT to operate the test instrument. The work area must be kept neat and clean. Place unused instruments and test leads in a fixed location. Make sure that all personnel can immediately distinguish the device under test, devices awaiting test, and devices already tested. The test station and its surroundings must contain no combustible or corrosive gases; do not use the tester near flammable materials.

2.2 Operator Requirements

➢ Personnel Qualifications

Operating this series of testers is hazardous; incorrect operation may cause personal injury, which may even be life-threatening. Therefore, users must be trained first and strictly follow the User Manual.

➢ Safety Rules

Operators must be given safety education and training at all times, so that they understand the importance of safe operation and operate the tester in accordance with the safety rules.

➢ Dress Code

Operators must not wear clothing with metal decorations, metal jewelry, watches, or the like; such metal items can easily cause acci-dental electric shock. Operators must wear insulated gloves when operating the tester.

➢ Medical Restrictions

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 Repeatedly

After switching off the power, make sure to wait several seconds or longer before switching it on again. Do not switch the power on/ off frequently; otherwise, the protective circuits of the instrument may not fully perform their protection functions. While the instrument is generating test voltage, do not switch off the power switch except in special or emergency situations.

☑ Do Not Short the Output Terminals to Ground

Take care with the high-voltage test leads of the instrument; do not let them short to a nearby AC power line already connected to ground, or to other nearby equipment (such as transmission equipment). If shorted, 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 has no external discharge function; connecting the output terminals to an external voltage may damage the instrument.

2.4 Precautions During Testing

✧ Operators must wear insulated gloves.

✧ If you temporarily leave the operating area or will not test immediately, the power must be switched off.

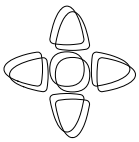
✧ During testing, it is absolutely forbidden to touch the test terminals of the instrument or the DUT, so as to avoid electric shock.

The operator must be able to fully control the control switches and remote switch of the tester. Remove the remote switch when it is not in use. Unqualified operators and unrelated personnel must stay away from the high-voltage test area.

✧ The safety ground terminal of this tester must be reliably connected to earth. Connect the high-voltage test leads only during testing; remove them promptly when not in use. Handle test leads (clips) by the insulated parts only; never directly touch the high-voltage output terminal (clip).

✧ If an abnormality occurs, immediately press the [Stop] key to stop the test and turn off the power

3. Overview



This chapter covers the following:

- Introduction
- Main Features

3.1 Introduction

Thank you for purchasing the AT9610 Comprehensive Electrical Safety Tester.

The AT9610 Comprehensive Electrical Safety 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 can measure all safety parameters of the DUT in real time, in as little as 4s, completing the three tests, especially meeting the production line's requirement for fast testing.

- Easy Operation

This series of testers uses a 5-inch color LCD; various physical keys and the numeric keypad allow you to quickly complete the setting of various test conditions and the tests, making operation easy; the large-screen display shows test information and data in greater detail on a single page.

- Intelligent Judgment

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

- Reliable Operation

The whole-machine circuit of this series of testers adopts multiple anti-interference measures and has strong interference immunity. It uses sinusoidal pulse width modulation (SPWM) technology to generate a 50Hz or 60Hz standard sine wave, driven to the output by high-power MOSFETs, achieving contactless regulation of high voltage, together with hardware and software protection, which greatly improves the reliability of the instrument.

- Safe Operation

Automatic overvoltage and overcurrent protection make operation even safer.

3.2 Main Features

1. AC/DC withstand voltage test, insulation resistance test, and arc detection combined in one multifunction instrument;
2. Charging current lower limit and DC open-circuit detection technologies;
3. DC fast discharge technology, completing fast discharge within 0.1s;
4. Up to 10 test groups can be stored and edited, with 16 steps per group;
5. Data logging, 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 modes, to meet different needs;
7. Supports RS232/RS485 and other communication methods.

4. Getting Started

This chapter covers the following:

- Front Panel - including an introduction to the keys and test terminals
- Rear Panel - introducing the power and port information
- Accessories - introducing the supplied accessories and how to connect them to the instrument
- Power-On - including the power-on self-test process and the instrument defaults
- Starting a Test - including how to connect to the test terminals

4.1 Front Panel

Fig. 4- 1 Front Panel

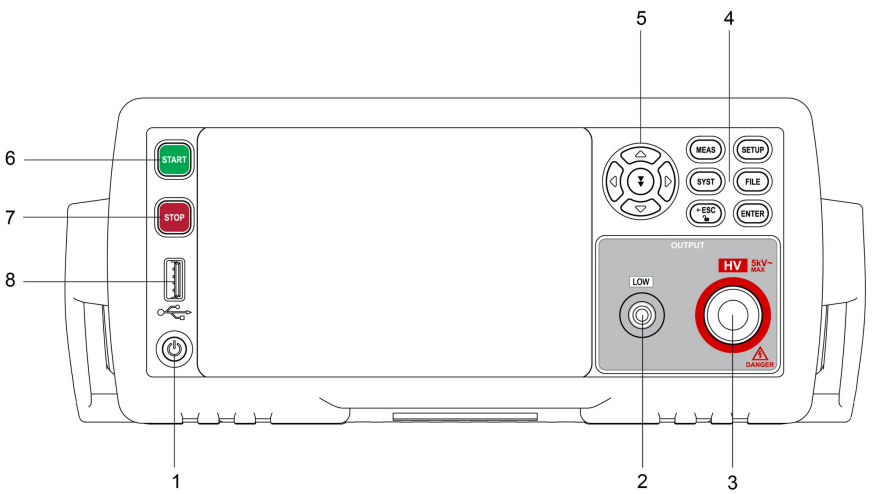


Table 4- 1 Front Panel Function Description

No.	Function
1	Power switch
2	Return terminal for the withstand voltage test; do not touch when the test light is on and high voltage is present.
3	High-voltage output terminal; do not touch when the test light is on and high voltage is present.
4	Function area keys: ● MEAS: Press this key to put the instrument into the ready-to-test state. ● SETUP: Press this key to enter the parameter settings screen. ● SYST: Press this key to enter the system settings screen. ● FILE: Press this key to enter the File Management screen.
5	Arrow keys: move the cursor on the screen; the middle 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 Disk Port

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

4.2 Rear Panel

Fig. 4- 2 Rear Panel

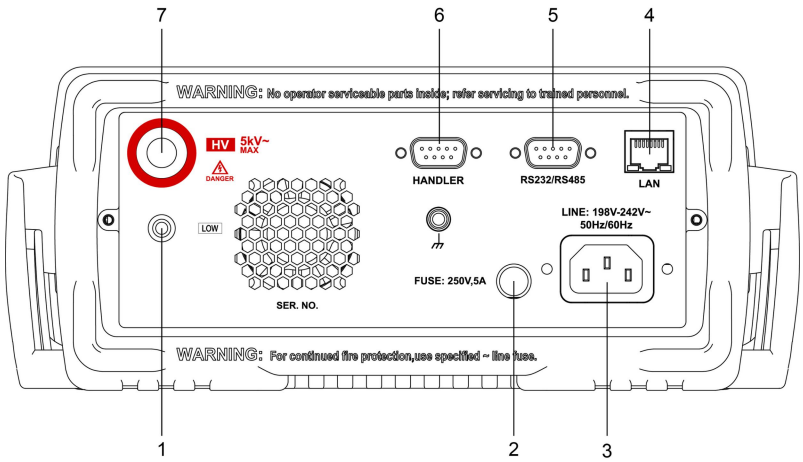


Table 4- 2 Rear Panel Function Description

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

4.3 Accessories

4.3.1 High-Voltage Test Clip (Standard)

During the withstand voltage test, clamp the high-voltage test clip onto the test point to perform the test.

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

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

Fig. 4- 3 High-Voltage Test Clip



4.3.2 High-Voltage Test Probe (Standard)

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

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

Fig. 4- 4 High-Voltage Test Rod



4.3.3 RS232 Communication Cable (Standard)

For serial communication: plug one end of the communication cable into the communication port on the rear panel and the other end into the computer serial port, and you can carry out online communication.

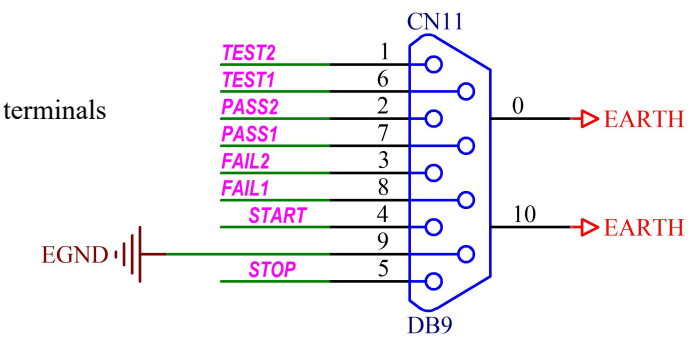
Fig. 4- 5 RS232 Communication Cable



4.3.4 DB9 Pin Handler Plug (Standard)

For Handler (PLC) control, the rear panel of the instrument provides a 9PIN Handler port; wire it to the controller according to the plug wiring diagram, and the instrument can then be controlled by the PLC for testing.

Fig. 4- 6 DB9 pin Handler plug wiring



4.4 Power-On

4.4.1 Powering On

At the lower left of the panel, the key marked " ⏻ " is the power switch. The instrument uses a program-controlled power switch; the power switch is a soft-touch electronic switch. The indicator light turns on, indicating that the instrument power is on.

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

4.4.2 First Power-On Test

After confirming that the instrument is intact and installed at the work position, inspect it as follows:

(1) Connect only the power cord of the instrument, with no other test leads connected, and switch on the tester;

(2) The instrument enters the <Measurement Display Page>; press the [Start] key directly to perform a test. If the test behavior is as described below:

a) In insulation resistance mode, at a voltage of 500V or above, the displayed insulation resistance is >50G; (indicating that the measured insulation resistance exceeds 50G);

b) In insulation resistance mode, at a voltage below 500V, the displayed insulation resistance is >10G; (indicating that the measured insulation resistance exceeds 10G);

c) The withstand voltage display shows a small breakdown current or a value of zero,

indicating that the instrument is basically normal;

(3) When the instrument is started for the first time, if there is no display, check and confirm that the power cord is securely connected;

i. If the instrument fails to start, keys give no response, or no relay actuation sound is heard during test startup;

ii. Please contact ONMEAS for technical support.

4.5 Preparing for Test

(1) Connect the high-voltage test probe (or red high-voltage test clip) to the L and N lines of the DUT;

(2) Connect the return circuit to the ground wire or the enclosure of the DUT

5. [Setup] Page

This chapter covers the following:

- Current Step Test Mode Settings
- AC Withstand Voltage Test Mode Parameters
- DC Withstand Voltage Test Mode Parameters
- Insulation Resistance Test Mode Parameters
- Editing Test Steps
- File Management - Saving and Recalling Test Programs

While the high-voltage output is stopped, simply press the [Setup] key and the instrument enters the main setup page.
SCPI Command: `DISP:PAGE SETUP`

5.1 Current Step Meas Mode Settings

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

Fig. 5- 1 Mode Settings



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

Step 1 Enter the <Measurement Settings> page;

Step 2 Use the cursor keys to select the [Function] field;

Step 3 Use the function keys to select.

Function Key	Function
AC Withstand Voltage	Sets the test mode of the current step to the AC withstand voltage test
DC Withstand Voltage	Sets the test mode of the current step to the DC withstand voltage test
Insulation Resistance	Sets the test mode of the current step to the insulation resistance test

5.2 AC Withstand Voltage Test Mode Parameters

Fig. 5- 2 [AC Withstand Voltage] Settings



Item	Input Range	Default	Description
Output Voltage	(50～5000)V	1000V	Output voltage during the AC withstand voltage test
Test Upper Limit	(lower limit~10.00)mA, Off	10.00mA	Breakdown current alarm upper limit
Test 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
Ramp-Up Time	(0.4～999.9)s	0.5s	The voltage ramps up within this period
Ramp-Down Time	(0.1~999.9)s, Off	0.5	The voltage ramps down within this period
Current Range	Auto, Fixed	Auto	Set the current range to automatic range switching or fixed range. If Auto is set, the instrument automatically selects the suitable current range; If Fixed is set, a value must be set for the test upper limit to determine the current ge, which serves to shorten the test time; if the upper limit is off, the instrument automatically select the maximum range of this mode.
Output Frequency	50Hz, 60Hz	50Hz	AC withstand voltage output frequency
Compensation Zeroing	Off, On, Auto Test	Off	Leakage current zeroing setting. Press the sidebar [Auto Test] key to have this analyzer automatically measure the leakage current of the test lead and the test fixture and perform zeroing; the DUT on the test lead must be removed first; The [Close] key on the sidebar can be used for clearing.
Arc Level	0～9	0	Alarm level for arc testing. The arc alarm level can be preset and judged; the preset range is levels 0 and 1~9; 0 turns off arc detection, 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

			I	20

5.3 DC Withstand Voltage Test Mode Parameters

Fig. 5-3 [DC Withstand Voltage] Settings



Item	Input Range	Default	Description
Output Voltage	(50~6000)V	1000V	Output voltage during the AC withstand voltage test
Test Upper Limit	(test lower limit~5mA), Off	5.00mA	Breakdown current alarm upper limit
Test Lower Limit	(0.1 uA ~ test 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
Ramp-Up Time	(0.4~999.9)s	0.5s	The voltage ramps up within this period
Ramp-Down Time	(0.1~999.9)s, Off	0.5	The voltage ramps down within this period
Current Range	Auto, Fixed	Auto	Set the current range to automatic range switching or fixed range. If Auto is set, the instrument automatically selects the suitable current range; If Fixed is set, a value must be set for the test upper limit to determine the current ge, which serves to shorten the test time; if the upper limit is off, the instrument automatically select the maximum range of this mode.
Arc Level	0~9	0	Alarm level for arc testing.
Compensation Zeroing	Off, On, Auto Test	Off	Leakage current zeroing setting. Press the sidebar [Auto Test] key to have this analyzer automatically measure the leakage current of the test lead and the test fixture and perform zeroing; the DUT on the test lead must be removed first; The [Close] key on the sidebar can be used for clearing.
Ramp-Up 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. It is used to detect whether the connection of the test lead or test fixture is normal, so as to ensure the correctness of the test results. During DC withstand voltage testing, the leakage current is usually very small, so it is difficult to use the leakage current lower limit as the basis for judging whether the connection of the test lead or test fixture is normal. 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 connection of the test lead or test fixture is normal.

			➢ To set the minimum charging current manually, enter the minimum charging current using the numeric keys. ➢ To set the minimum charging current automatically, first connect the instrument and theDUT with the test lead and fixture, and make sure the set output voltage and ramp-up time parameters are exactly the same as the data of the actual test to be performed.

5.4 Insulation Resistance Test Mode Parameters

Fig. 5-4 [Insulation Resistance] Settings



Item	Input Range	Default	Description
Output Voltage	(50～1000)V	1000V	Output voltage during the AC withstand voltage test
Test Upper Limit	(test lower limit~50GΩ), Off	Off	Insulation Resistance Alarm Upper Limit
Test Lower Limit	(1~test upper limit)MΩ, Off	1MΩ	Insulation Resistance Alarm Lower Limit
Test Time	(0.5~999.9)s, continuous test	1.0 s	Used as the test time for delayed judgment of insulation resistance
Ramp-Up Time	(0.4～999.9)s	0.5s	The voltage ramps up within this period
Ramp-Down Time	(0.1~999.9)s, Off	0.5	The voltage ramps down within this period
Current Range	Auto, Fixed	Auto	Set the current range to automatic range switching or fixed range. If Auto is set, the instrument automatically selects the suitable current range; If Fixed is set, a value must be set for the test upper limit to determine the current ge, which serves to shorten the test time; if the upper limit is off, the instrument automatically select the maximum range of this mode.
Charging Lower Limit	Off, Manual input (0.001-3.5)uA, Auto Test	Off	Minimum charging current setting for testing capacitive loads. It is used to detect whether the connection of the test lead or test fixture is normal, so as to ensure the correctness of the test results. During insulation testing, the leakage current is usually very small, so it is difficult to use the leakage current lower limit as the basis for judging whether the connection of the test lead or test fixture is normal. 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 connection of the test lead or test fixture is normal. To set the minimum charging current manually, enter the minimum charging current using the numeric keys. To set the minimum charging current automatically, first connect the instrument and the DUT with

			the test lead and fixture, and make sure the set output voltage and ramp-up time parameters are exactly the same as the data of the actual test to be performed.
Delayed Judgment Time	Off, Manual input (0.5-test time)	Off	Enter time t; the instrument judges the upper/lower limits 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

Fig. 5-5 [Edit Test Step] Settings



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

Step 1 Enter the <Settings> page

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

Step 3 Use the function keys to select

Function Key	Function
Insert	Insert a new test step after this step; the new step and the following steps shift later by one.
Delete	Delete the current test step; the following steps shift earlier by one.
New	Create a new test program
Previous Step	The page jumps to the display page of the step before the current step.
Next Step	The page jumps to the display page of the step after the current step.

5.6 File Management

When high-voltage output is stopped, press the function key [File] to enter the <File Management> page.
SCPI Command: `DISP:PAGE CATAlog`

Fig. 5-6 <File



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

- Select a file from the instrument memory or external USB flash drive [Memory]
- Recall a file at instrument startup [Power-On Recall]

5.6.1 Memory

The Memory function selects a file from the instrument memory or an external USB flash drive. Up to 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 function keys to select the source:

Function Key	Function
Internal Memory	Access instrument memory files
External Memory	Access external USB flash drive files

5.6.2 Power-On Recall

Recall FILE1 or the current file when the instrument is powered on.

■ **Select the file to be recalled automatically:**

Step 1 Enter the <File Management> page

Step 2 Use the cursor keys to select the [Power-On Recall] field

Step 3 Use the function keys to select the recall option:

Function Key	Function
Current File	Recall the last used file at power-on
File 1	Recall File 1 at power-on

5.6.3 File Operations

■ **Select the file operation:**

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 function keys to complete the operation:

Function Key	Function
Save	Save the user setting data to the currently selected file
Read	Recall the setting data from the currently selected file
Delete	Delete the selected file; the setting data is reset to default at the next power-on
Edit Description	Edit the file description

6.[Meas] Measurement Display Page

This chapter covers the following:

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

When 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.

Fig. 6-1 <Measurement Display> Page (ACWithstand Voltage as an Example)



On this screen, you can press [Start] to apply high voltage and measure the DUT. For safety and test accuracy, this page is for display only; parameters cannot be set with the keys (but parameters of the current step can be modified by touch). Its test parameters must be fully and correctly set on the settings screen. During testing, real-time test data is displayed; after the test ends and before the [STOP] key is pressed, the result of the last test is displayed.

After the measurement starts, two values are displayed in large font in the middle of the LCD screen:
The upper one is the high-voltage output, with the withstand voltage in kilovolt (kV).
The lower one is the measured current or insulation resistance at the test low end, in milliampere (mA), microampere (uA), megaohm (MΩ), or gigaohm (GΩ).

In the upper part of the LCD screen, two values are displayed in small font:
The left one displays the high-voltage test status (OFF, RISE, TEST, FALL), the result of the upper/lower limit

comparison (PASS, UPPER, LOWER), and the alarm status (ARC, SHORT, GFI, ERROR).

The right one is the remaining time of the corresponding step during the high-voltage test. If the user turns off the test time, it shows the time elapsed since entering the test state; the count stops accumulating once it exceeds 999.9. If the result is not "FAIL", the test status must be exited with [STOP]. The user can intuitively analyze the DUT's test condition. The unit is in seconds (S).

6.2 Test Result Description

Fig. 6-2 AC Withstand Voltage Measurement Screen



Fig. 6-3 DC Withstand Voltage Measurement Screen



Fig. 6-4 Insulation Resistance Test Screen



6.2.1 During the Test

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

6.2.2 Test Passed

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

6.2.3 When the Test Fails or an Error Occurs

When any test item fails or a fault occurs during testing, the high-voltage test light bar stays lit (red) and the buzzer sounds for two seconds, and the test screen displays "Failed".

Fig. 6-5 Test Failure



(1) Result judgment:

a) For the withstand voltage test, the result is judged at any time against the breakdown current upper limit;

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

(2) The following conditions will trigger test fault protection:

Insulation failure of the DUT during insulation resistance or withstand voltage testing;

Test Fail and Fault Protection Table	
Over Upper Limit	The measured value is greater than the set upper limit

Under Lower Limit	The measured value is less than the set lower limit
Charging Lower Limit	During DC withstand voltage/insulation resistance test, the current is below the minimum charging current setting
Arc	The current arc exceeds the upper limit value
Short	The instrument output current is greater than the internal current limit; this limit cannot be changed
Breakdown	Ground failure interrupt
Overvoltage	The output voltage far exceeds the set output voltage
Error	Power amplifier board error

Fig. 6-6 Test Abnormality







6.3 Step Results and Group Results Display

Result Display has two modes:

Mode	Description
Single-Step Test Result	After the test flow is completed, the screen 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 each step in the test group is displayed as a list

For details on selecting between the two modes, see [Result Display] in <System Settings>.

Fig. 6-7 Single-Step Result Display



Fig. 6-8 Group Test Result Display

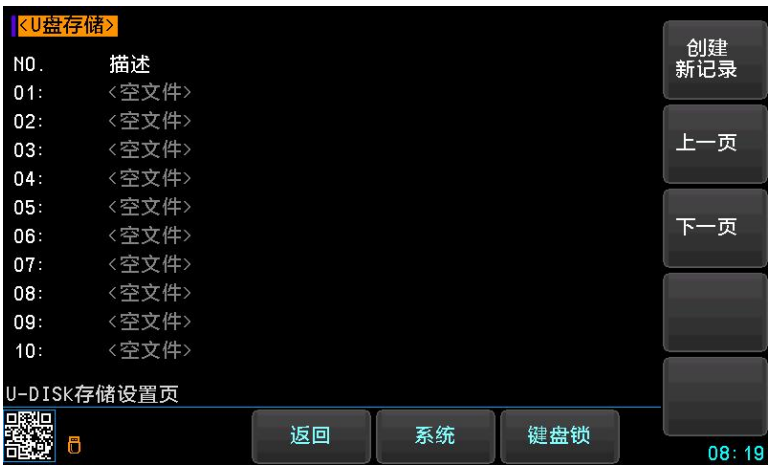


6.4 Data Logging

The instrument provides USB flash drive data logging. After a test is completed, the measured data is recorded in ".csv" file format, and users can open it directly with EXCEL software on a PC.

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

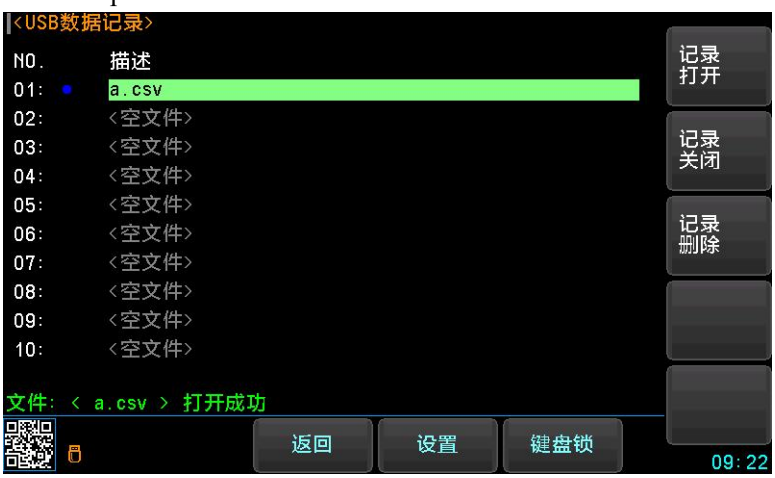
Fig. 6-9 <Data Logging> Page



On this page, tap the "Create New Record" box on the right sidebar to create and name a ".csv" file.

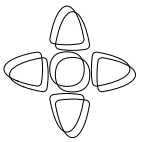
When you need to record measurement data in a table, tap the screen or use the cursor to select the created file and tap "Record On"; the instrument records every test automatically, and a prompt appears in the lower left corner of the screen after each successful record.

Fig. 6-10 Record Open



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

7. System Configuration



This chapter covers the following:

- System Configuration Page
- System Information Page

When the high-voltage output stops, 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 Tone
- Date/Time
- Account/Password
- Remote Control
- Baud Rate
- Communication Protocol
- Command Handshake
- Result Transmission
- Electric Shock Protection
- Error Codes
- Failure Mode
- Volume Setting
- Trigger Mode
- Result Display

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

Fig. 7-1 <System



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 function keys to select the language:

Function Key	Function
Chinese [CHN]	Chinese display
ENGLISH	English display

7.1.2 [Key Tone]

A sound is emitted when a key is pressed to alert the user to the key press, to avoid mis-operation.

Steps for setting the KEY BEEP:

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select [KEYBEEP].

Step 3 Use the function keys to select the language:

Function Key	Function
Off	The key prompt tone is turned off
On	The key prompt tone 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 function keys to set the date:

Function 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 function keys to set the clock:

Function Key	Function
Hour+	+1 hour
Hour-	-1 hour
Min+	+1 minute
Min-	-1 minute
Sec+	+1 second
Sec-	-1 second

7.1.4 [Account]

The instrument has two user modes for selection:

- Administrator - Except for the <System Service> page, all functions are open to the administrator, and the parameters set by the administrator, after a delay of 5 seconds, are saved in the system memory for loading at the next power-on.
- User - Except for the <System Service> and <File> pages, the user can operate all other functions, and the data modified by the user reverts to the valuesset 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 function keys to change:

Function Key	Function
Administrator	All functions except the <System Service> page are open If you forget the password, please contact our sales department.
User	Only the functions on the <System Service> page and <File> page can be operated; the data set 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 function keys to select:

Function 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 port. Once a signal change is detected on the RS-232 port, the instrument immediately communicates with the host at the set baud rate, and the keyboard is locked at the same time.

For correct communication, make sure the baud rate is set correctly; the host computer and the instrument cannot communicate correctly if their baud rates differ. The instrument RS-232 is programmed in SCPI language. The RS-232 configuration is as follows:

- Data bits: 8
- Stop bits: 1
- 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 function keys to select

Function Key	Function
9600	
19200	
38400	
57600	
115200	For communication with a computer host, this high baud rate is recommended.

7.1.7 [Command Handshake]

When the command handshake is on, all commands sent from the host to the instrument are returned to the host unchanged before the data is returned. When the command handshake is off, commands sent from the host 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 function keys to select

Function Key	Function
Off	Command handshake is not used. Unless there are special requirements, set the command handshake to
Off. On	

7.1.8 [Result Transmission]

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

Steps for setting [Result Transmission]:

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select the [Result Transmission] field;

Step 3 Use the function keys to select

Function Key	Function
FETCH	Use the FETCH? command to acquire all measured data
Auto	Automatically sent to the host after each test is completed

7.1.9 [Electric Shock Protection]

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

■ **Electric shock protection setting:**

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select the [Electric Shock Protection] field.

Step 3 Use the function keys to select:

Function Key	Function
Off	electric shock protection disabled
On	electric shock protection enabled

7.1.10 [Failure Mode]

The failure modes are of 2 types: "Abort" and "Continue".

■ **Failure mode setting:**

Step 1 Enter the <System Configuration> page

Step 2 Use the cursor keys to select the [Failure Mode] field.

Step 3 Use the function keys to select:

Function Key	Function
Continue	If a failed test step is encountered during the test (only over upper limit and over lower limit), the instrument will abort the current step and proceed to the next step.
Abort	If a failed test step is encountered during the test, the entire test flow is aborted immediately; pressing the "Start" key at this point will restart the entire test flow.

7.1.11 [Volume Setting]

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

■ **Beeper 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 function keys to select:

Function Key	Function
High	High-tone prompt when the test is completed or a test error occurs

Low	Low-tone prompt when the test is completed or a test error occurs
Off	No sound prompt when the test is completed or a test error occurs

7.1.12 [Trigger Mode]

Sets the control mode for the instrument to start a test; only the trigger signal in the current control mode is 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 function keys to select:

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

7.1.13 [Result Display]

The result display items are divided into two modes: Single-Step Test Result and 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 function keys to select:

Function Key	Function
Single-Step Test Result	After the test flow is completed, the screen 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 each step in the test group is displayed as a list

7.2 System Information Page

Enter the <System Configuration> page and press the function keys to select [System Information].
SCPI Command: `DISP:PAGE SYSTEMINFO`

The System Information Page has no user-configurable options.

Fig. 7-2 <System



8.Handler(PLC)

You will learn about the following:

- Handler (PLC) Interface
- Interface Principles

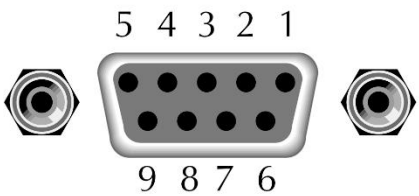
The instrument provides fully-featured interfaces. Through these interfaces, the instrument can conveniently implement automatic control functions with the user's system control components.

8.1 Handler (PLC) Interface

This series of testers is equipped with a 9 PIN to 25PIN adapter cable providing PLC remote control input/output signals (which can be connected to a PLC controller), as shown in the figure. These terminals match standard 25PIN D-type connectors and must be prepared by the user.

For best results, it is recommended to use shielded cable as the connection cable for control and output information. To prevent the shielded cables from forming a loop that would degrade the shielding effect, ground the shield at only one end of the shielded cable.

Fig. 8-1 Wiring Terminals



To use the HANDLER function, [Trigger Mode] in <System Configuration> of the instrument must be set to PLC; otherwise the HANDLER function is unavailable. When trigger mode is set to PLC, the "Start" key on the front panel will be disabled to avoid the danger of repeated starts.

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 measurement
	5	STOP Reset (stop) signal	When the STOP key is pressed, the instrument receives the remote input signal and stops measurement
Signal Output	6	TEST1	During instrument measurement, TEST1 and TEST2 are shorted; When the test is completed, TEST1 and TEST2 are open;
	1	TEST2	
	7	PASS1	When the test is passed, PASS1 and PASS2 are shorted
	2	PASS2	

	8	FAIL1	When the test fails, FAIL1 and FAIL2 are shorted
	3	FAIL2	

All input signals use digital (switch) inputs (such as PLC). Never connect any other voltage or current source; if another voltage or current source is connected, the internal control circuit of the instrument may be damaged or a misoperation may occur.

8.2 Interface Principles

Instrument interface principle

Fig. 8-2 Internal Circuit Structure of the Instrument Handler Interface

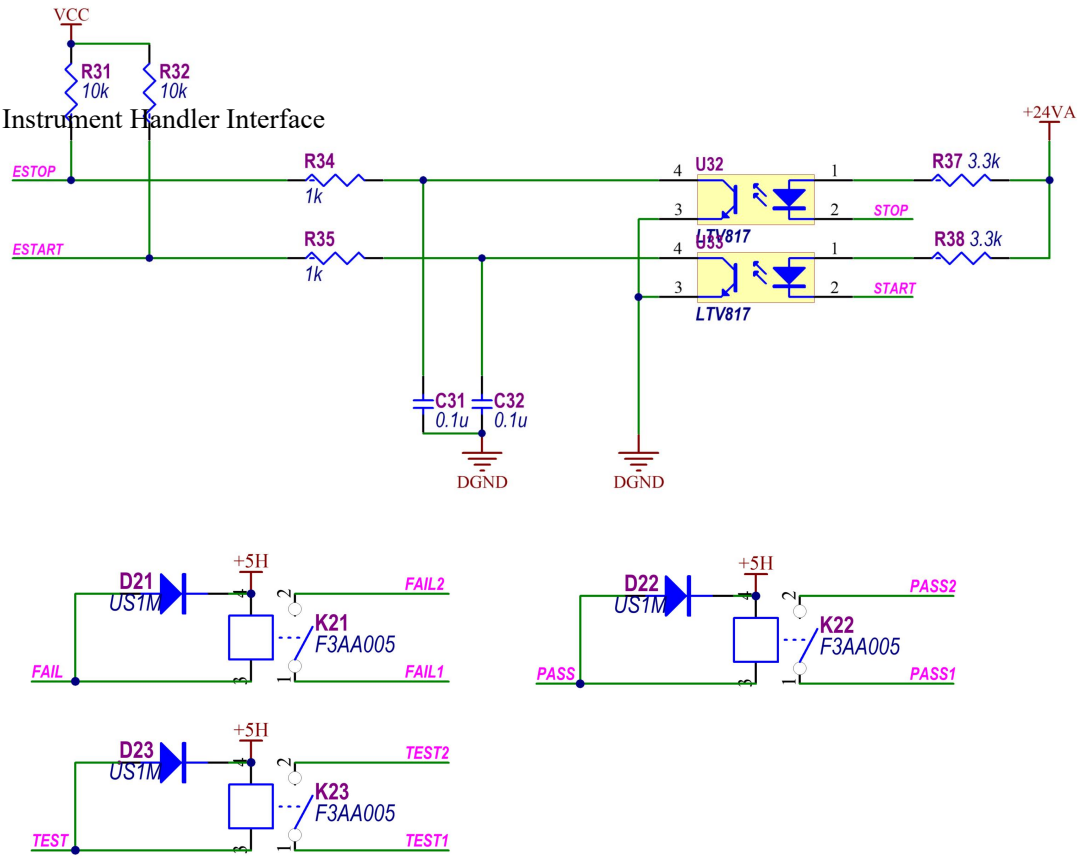
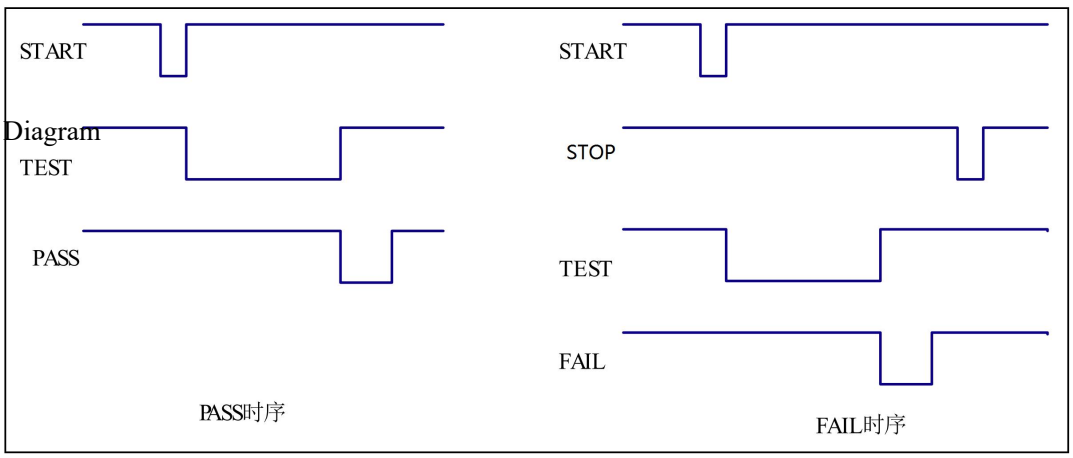


Fig. 8-3 PLC Timing



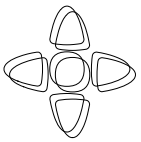
Diagram

Table 8-2 PLC Timing

Signal	Description
Starting a test via the PLC port	1. Check whether the TEST (test in progress) signal in the interface is active; a START signal may be sent only when the TEST (test in progress) signal is inactive. When the condition in item 1 is met, send a START signal with a width of 40ms~200ms (i.e. the switch closure time) to start the test. At any time, send a STOP signal with a width of 40ms~200ms (i.e. the switch closure time) to abort the test.
Stopping a test via the PLC port	
Signal output - test in progress	When the instrument is performing a test, the relay closes PIN10 and PIN22. After the test is completed the relay returns PIN10 and PIN22 to the open state.
Signal output - test passed	When the device under test passes the test, the relay closes PIN11 and PIN23, and the state is held. When another test program starts, or after the stop switch is pressed, the relay returns PIN11 andPIN23 to the open state. After the device under test fails, the relay closes PIN12 and PIN24, and the state is held. When another test program starts, or after the stop switch is pressed, the relay returns PIN12 andPIN24 to the open state.
Signal output - test failed	

Description

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. Using standard SCPI commands, users can also easily develop various acquisition systems suited to their own needs.

9.1 RS-232C

RS-232 is currently the widely adopted serial communication standard, also called the asynchronous serial communication standard, used for data communication between computers as well as between computers and peripherals. RS is the abbreviation for "Recommended Standard", and 232 is the standard number, officially published by the US Electronic Industries Association (EIA) in 1969; it specifies transmission one bit at a time over a 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 a 9-pin connector). The most commonly used RS-232 signals are shown in the table below:

Table 9-1 Common RS-232 Signals

Signal	Symbol	25-pin connector pin No.	9-pin connector pin No.
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, RS-232 also defines a minimal subset, which is the connection method adopted by this instrument.

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

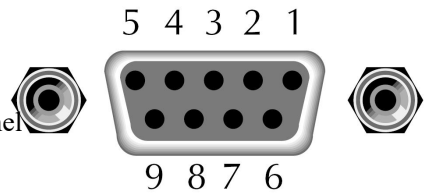
Signal	Symbol	9-pin connector pin No.
Transmitted Data	TXD	2
Received Data	RXD	3
Ground	GND	5

9.1.1 RS232C Connection

The RS-232 serial interface can be interconnected with the serial interface of a controller (e.g. a personal computer or industrial PC) via a straight-through DB-9 cable.

Note: The instrument cannot use a null modem cable.
You can make a 9-pin straight-through cable yourself or purchase one from ONMEAS.
For a 3-wire cable made by the user, note the following:
- When using the DB9 port built into the PC, you may need to short pins 4-6 and 7-8 of the computer-side DB-9 connector

Fig. 9-1 RS-232 Interface on the Rear Panel



Recommendation: To avoid electrical shock, turn off the instrument power before plugging/unplugging connectors.

- Instrument default communication settings:

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

9.2 Handshake Protocol

Since the instrument uses the minimal subset of the RS-232 standard and does not use hardware handshake signals, to reduce possible data loss or data errors in communication, the instrument can enable the software handshake. High-level language software engineers should strictly follow the handshake protocol below when developing communication software:

- The instrument command parser accepts only ASCII format, and command responses are also returned in ASCII code.
- **The command string sent by the host must terminate with NL('\n'); the instrument command parser begins executing the command string only after receiving the terminator.**

The instrument can enable command handshake: after receiving each character, the instrument immediately echoes it back to the host, and the host can continue sending the next character only after receiving the echoed character. Tip: If the host cannot receive the data returned by the instrument, try the following methods to solve the problem: 1. The software handshake is disabled; refer to the <System Settings> page of the instrument to enable it. 2. Serial port connection fault; check the cable connections. 3. The communication format of the high-level language program on the computer is wrong. Try checking whether the serial port number and communication format are correct, and whether the baud rate is the same as the instrument setting.
4. If the instrument is still parsing the previous command, the host cannot receive the response from the instrument either; try again later. <If the problem remains unresolved, consult an ONMEAS technical engineer immediately>

9.3 SCPI Language

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

See: The command parser built into the instrument parses the various command formats of users. Since the 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 to the same network, enabling remote control.

Enter the <System Configuration> page, select [LAN] with the function key or cursor keys, and click to switch to the <Remote Service LAN> page.

Fig. 9-2 Remote



Parameter	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 hipot tester and network devices
Subnet mask	Boundary separating the network address and the host address
Gateway	Device that connects different networks and forwards data

With the remote communication LAN function, you can connect the hipot tester to the LAN via the LAN port for remote communication and data exchange with other devices. The usage is as follows:

(1) Make sure the LAN port of the hipot tester is properly connected to a switch or router in the LAN;

(2) then configure the correct IP address, subnet mask and gateway on the <Remote Service LAN> page of the hipot tester, ensuring they are in the same network segment as other devices in the LAN.

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

10. SCPI Command Reference

This chapter covers the following topics:

- Command parser - learn 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 SCPI commands used by the instrument. With these SCPI commands, all instrument functions can be fully controlled.

10.1 Command String Parsing

The host can send a string of commands to the instrument; the command parser starts parsing after it captures the terminator (\n) or when the input buffer overflows.

For example:

Valid command string:

AAA:BBB CCC;DDD EEE;:FFF

The instrument command parser performs all command parsing and execution. Before writing programs, you must first understand its parsing rules.

10.1.1 Command Parsing Rules

1. The command parser parses and responds only to ASCII-coded data.
2. The SCPI command string must terminate with NL('\n' ASCII 0x0A); the command parser begins executing the command string only after receiving the terminator or on buffer overflow.
3. If command handshake is enabled, the command parser immediately echoes each received character back to the host, and the host can continue sending the next character only after receiving the echoed character.
4. When the command parser parses an error, it terminates parsing immediately and the current command is invalidated.
5. When the command parser parses a query command, it terminates parsing of the current command string and the characters after it are ignored.
6. The command parser parses command strings case-insensitively.
7. The command parser supports abbreviated command forms; see later sections for the abbreviation rules.

10.1.2 Notation and Definitions

This chapter uses some notation. These symbols are not part of the command tree; they only help to better understand the command strings.

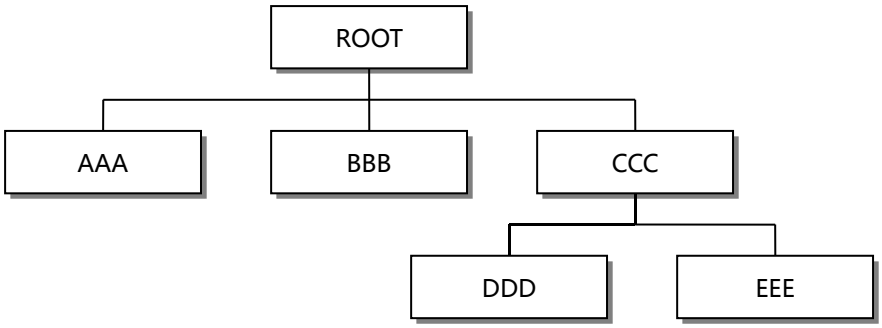
< >	Text in angle brackets denotes a parameter of the command
[ ]	Text in square brackets denotes an optional command
{}	When braces contain several parameter items, only one item may be selected
( )	The abbreviated form of a parameter is placed in parentheses
Uppercase letters	Abbreviated form of the 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); here the highest level is called the subsystem command. Only after a subsystem command is selected are its lower-level commands valid. SCPI uses a colon (:) to separate higher-level

mands and low-level commands.

Fig. 10-1 Command Tree Structure



Examples

ROOT:CCC:DDD ppp

ROOT Subsystem commands

CCC Second level

DDD Third level

ppp Parameter

10.2 Commands and Parameters

A command tree consists of commands and [parameters], separated by 1 space (ASCII: 20H).

Examples

AAA:BBB 1.234

Command [parameter]

10.2.1 Command

Command words can be in long form or abbreviated form; the long form helps engineers better understand the meaning of the command string, while the abbreviated form is suitable for writing.

10.2.2 Parameter

- Single-word command with no parameters.

  Example: AAA:BBB
- Parameters can be strings; their abbreviations still follow the "Command Abbreviation Rules" in the preceding section.

  Example: AAA:BBB 1.23
- Parameters can be numeric
  - <*integer*> Integer: 123, +123, -123
  - <*float*> Float

    1.<fixfloat>: fixed-point float: 1.23, -1.23

    2.<Scifloat>: float in scientific notation: 1.23E+4, +1.23e-4

    3.<mpfloat>: float with multipliers: 1.23k, 1.23M, 1.23G, 1.23u

Table 10-1 Multiplier Abbreviations

Numeric value	Metric prefix
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: Metric prefixes are not case-sensitive and are written differently from their standard names.

10.2.3 Separators

The instrument command parser accepts only the permitted separators; for any other separator, the parser generates an "Invalid 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 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 subsystem command order. All subsystems are listed below:

- DISPlay Display subsystem
- FUNCtion FUNCtion subsystem
- FETCh 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

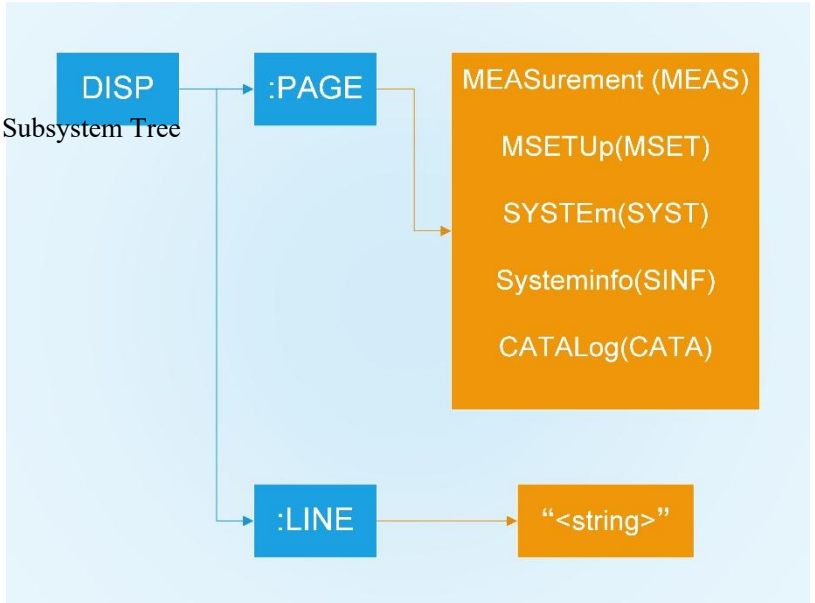
Common commands:

- 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.

Fig. 10-2 DISPlay Subsystem Tree



10.4.1 DISPlay:PAGE

DISP:PAGE is used to switch 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

For example: Send>disp:pagemset<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
```

For example: Send>disp:page?<NL>
Return>SETUP<NL>

10.4.2 DISP:LINE

DISP:LINE is used to display a string of text in the prompt bar at the bottom of the page. Up to 30 characters can be displayed.

Command Syntax: DISPlay:LINE <string>

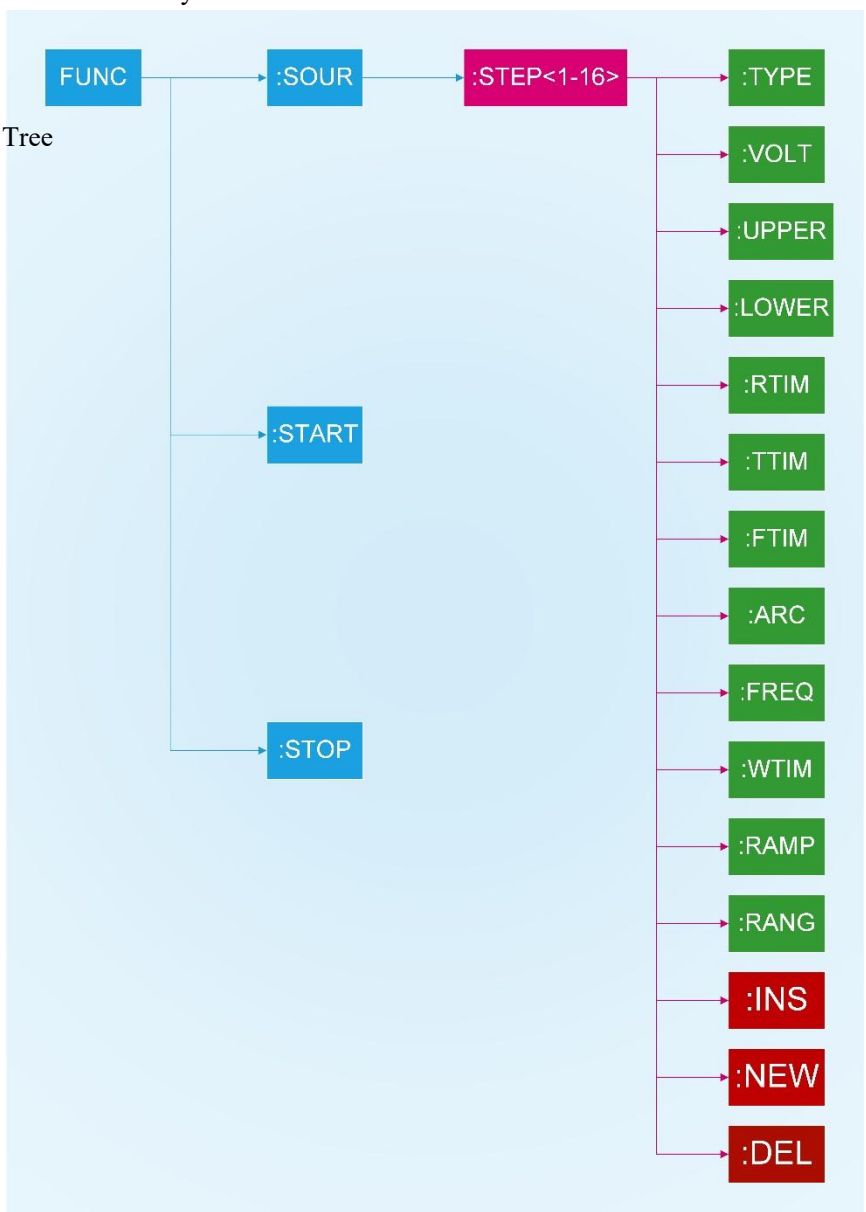
Parameters: <string> up to 30 characters

For example: Send>DISP:LINE"ThisisaComment."<NL>

10.5 FUNCtion Subsystem

Fig. 10-3 FUNCtion Subsystem

Tree



10.5.1 HV Start/Stop Command Set

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

Command Syntax: `FUNCtion:STARt`

For example: Send>FUNC:STARt<NL> //Start the test, functionally equivalent to the [START] key

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

Command Syntax: **`FUNCtion:STOP`**

For example: Send>FUNC:STOP<NL> //Stop the test, functionally equivalent to the [STOP] key

10.5.2 Test Step Command Set

FUNC:SOUR:STEP? Used to query the current test step and the total test steps.

Query Syntax: `FUNC:SOUR:STEP?`

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

For example: Send>FUNC:SOUR:STEP?<NL>
Return>STEP5-TOTAL11<NL>

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

Command Syntax: `FUNC:SOUR:STEP:INS`

For example: Send>FUNC:SOUR:STEP:INS<NL> //Add a new test item

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

Command Syntax: `FUNC:SOUR:STEP:DEL`

For example: Send>FUNC:SOUR:STEP:DEL<NL> //Delete the current test item

FUNC:SOUR:STEP1:NEW creates an empty test program for writing a brand-new test program.

Command Syntax: `FUNC:SOUR:STEP:NEW`

For example: Send>FUNC:SOUR:STEP:NEW<NL> //Create an empty test program

10.5.3 Function Parameter Command Set

FUNC:SOUR:STEP<1-16>:TYPE Within the existing test program (TOTAL), sets the function of the current test step.

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

For example: Send>FUNC:SOUR:STEP5:TYPEIR<NL> //With total steps ≥5, set 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 of the current test step.

Command Syntax: `FUNC:SOUR:STEP<1-16>:VOLT <float>`

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

For example: Send>FUNC:SOUR:STEP5:VOLT1000<NL>//With total steps ≥5, set the voltage of step 5 to 1000V

Query Syntax: `FUNC:SOUR:STEP<1-16>:VOLT?`

Query Response: <float>:
ACW: 50 - 5000, with unit
DCW: 50 - 6000, with unit
IR: 50 - 1000, with unit

For example: Send>FUNC:SOUR:STEP5:VOLT?<NL>
Return>1000.00V<NL>

FUNC:SOUR:STEP<1-16>:UPPER Within the existing test program (TOTAL), sets the upper limit of the current test step.

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

Parameters: <float> (data unit mA / MΩ):
ACW: 0.01 - 10.00, without unit
DCW: 0.001 - 5.00, without unit
IR: 0, 0.1 - 5E4, without unit (0 means upper limit OFF)

For example: Send>FUNC:SOUR:STEP5:UPPER1<NL> //With total steps ≥5, set the upper limit of step 5 to 1mA

Query Syntax: `FUNC:SOUR:STEP<1-16>:UPPER?`

Query Response: <float>:
ACW: 0.01 - 10.00, with unit
DCW: 0.001 - 5.00, with unit
IR: OFF, 0.1 - 5E4, with unit

For 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 of the current test step.

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

Parameters: <float> (data unit mA / MΩ):
ACW: 0, 0.01 - 10.00, without unit (0 means lower limit OFF)
DCW: 0, 0.001 - 5.00, without unit (0 means lower limit OFF)
IR: 0.1 - 5E4, without unit

For example: Send>FUNC:SOUR:STEP5:LOWER0.1<NL>//With total steps ≥5, set the lower limit of step 5 to 0.1mA

Query Syntax: `FUNC:SOUR:STEP<1-16>:LOWER?`

Query Response: <float>:
ACW: OFF, 0.01 - 10.00, with unit
DCW: OFF, 0.001 - 5.00, with unit
IR: 0.1 - 5E4, with unit

For 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 ramp-up time of the current test step.

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

Parameters: <float> (data unit S):
Mixed float, 0, 0.1 - 999.9, without unit

For example: Send>FUNC:SOUR:STEP5:RTIM10<NL>//With total steps ≥5, set the ramp-up time of step 5 to 10s

Query Syntax: `FUNC:SOUR:STEP<1-16>:RTIM?`

Query Response: <float> (data unit S):
Mixed float, OFF, 0.1 - 999.9, with unit

For 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 of the current test step.

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

Parameters: <float> (data unit S):
Mixed float, 0, 0.5 - 999.9, without unit (0 means continuous test)

For example: Send>FUNC:SOUR:STEP5:TTIM10<NL>//With total steps ≥5, set the test time of step 5 to 10s

Query Syntax: `FUNC:SOUR:STEP<1-16>:TTIM?`

Query Response: <float> (data unit S):
Mixed float, OFF, 0.5 - 999.9, with unit

For 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 ramp-down time of the current test step.

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

Parameters: <float> (data unit S):
Mixed float, 0, 0.1 - 999.9, without unit

For example: Send>FUNC:SOUR:STEP5:FTIM10<NL>//With total steps ≥5, set the ramp-down time of step 5 to 10s

Query Syntax: `FUNC:SOUR:STEP<1-16>:FTIM?`

Query Response: <float> (data unit S):
Mixed float, OFF, 0.1 - 999.9, with unit

For 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 of the current test step.

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

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

For example: Send>FUNC:SOUR:STEP5:ARC1<NL>//With total steps ≥5, set 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

For example: Send>FUNC:SOUR:STEP5:ARC?<NL>
Return>LEVEL1<NL>

FUNC:SOUR:STEP<1-16>:FREQ Within the existing test program (TOTAL), sets the frequency of the current test step.

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

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

For example: Send>FUNC:SOUR:STEP5:FREQ60<NL>//With total steps ≥5, set the frequency of step 5 to 60Hz

Query Syntax: `FUNC:SOUR:STEP<1-16>FREQ?`

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

For example: Send>FUNC:SOUR:STEP5:FREQ?<NL>
Return>60HZ<NL>

FUNC:SOUR:STEP<1-16>:CHG sets the charging current lower limit of the current test step within the existing test program (TOTAL).

Command Syntax: `FUNC:SOUR:STEP<1-16>:CHG` **<float>**

Parameters: <float> (data unit S):
Mixed float, 0, 1 - 3500, without unit (DCW)
Mixed float, 0, 0.001 - 3.5, without unit (IR)
Not supported in ACW

For example: Send>FUNC:SOUR:STEP5:CHG10<NL>//With total steps ≥5, set the charging lower limit of step 5 to 10uA

Query Syntax: `FUNC:SOUR:STEP<1-16>: CHG?`

Query Response: <float> (data unit S):
Mixed float, OFF, 1 - 3500, with unit (DCW)
Mixed float, OFF, 0.001 - 3.5, with unit (IR)

For 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 current test step's ramp-up upper **limit.**

Command Syntax: **FUNC:SOUR:STEP<1-16>:RUPPER {ON,OFF}** **(available in DCW mode only)**

For example:	Send>FUNC:SOUR:STEP5:RUPPERON<NL> //With total steps >=5, set step 5 ramp-up upper limit on
Query Syntax:	FUNC:SOUR:STEP<1-16>:RUPPER?
Query Response:	{ON,OFF}

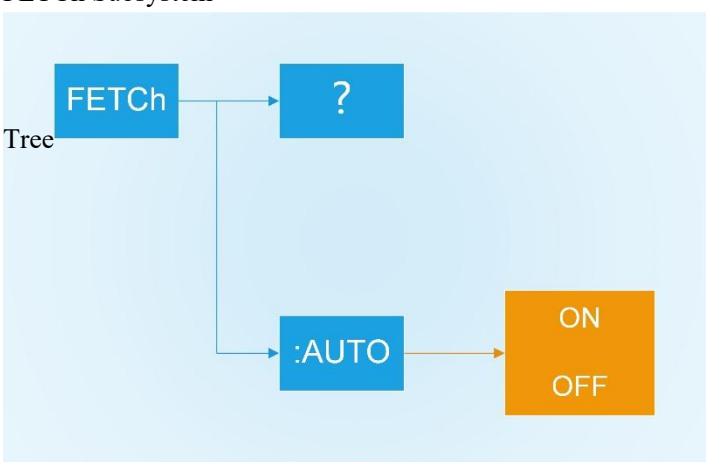
FUNC:SOUR:STEP<1-16>: RANG sets the range of the current test step within the existing test program (TOTAL).

Command Syntax:	FUNC:SOUR:STEP<1-16>:RANG <int> **(IR only)**
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)
For example:	Send>FUNC:SOUR:STEP5:RANG1<NL>//With total steps >=5, set 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
For 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 instrument's measurement results and the fetch mode setting.

Fig. 10-4 FETCh Subsystem Tree



FETCh:AUTO Sets whether the result of each measurement is returned.

Command Syntax:	FETCh:AUTO {ON,OFF}
For example:	Send>FETCh:AUTOON<NL> //Auto send of each measurement result
Query Syntax:	FETCh?
For example:	Send>FETC?<NL> Return> ACW,0.05kV,0.00mA,PASS;<NL> //The instrument returns each measurement result

10.7

FILE subsystem commands are used to perform file operations.

Fig. 10-5 FILE Subsystem Tree

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

10.7.1 FILE?

The FILE? command queries the file number used by the system.

Query Syntax: `FILE?`

Query Response: <int>:
Integer, 1 - 10, file number

For example: Send>FILE?<NL>
Return> 1<NL>

10.7.2 FILE:SAVE <n>

The FILE:SAVE command saves the user settings to the currently used file.

Command Syntax: `FILE:SAVE`

For example: Send>FILE:SAVE<NL>

The FILE:SAVE <n> command saves the user settings to the specified file.

Command Syntax: `FILE:SAVE` **`<n>`**

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

For example: Send>FILE:SAVE1<NL>

10.7.3 FILE:LOAD <n>

The FILE:LOAD command loads all user settings from the currently used file.

Command Syntax: `FILE:LOAD`

For example: Send>FILE:LOAD<NL>

The FILE:LOAD <n> command loads all user settings from the specified file.

Command Syntax: `FILE:LOAD` **`<n>`**

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

For example: Integer, 1 - 10,

10.7.4 FILE:DELete <n>

The FILE: DELete command deletes all user settings from the currently used file.

Command Syntax: `FILE: DELete`

For example: Send>FILE: DELete<NL>

The FILE: DELete <n> command deletes all user settings from the specified file.

Command Syntax: `FILE: DELete <n>`

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

For example: Send>FILE: DELete1<NL>

10.8 SYSTem Subsystem

The SYSTem subsystem is used to set system-related parameters.

Data set by the SYSTem subsystem will not be saved inside the instrument.

Fig. 10-6 SYSTem Subsystem Tree

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

10.8.1 SYSTem:LANGuage

Instrument language setting.

Command Syntax: `SYSTem:LANGuage {ENGLISH,CHINESE,EN,CH}`

For example: Send>SYST:LANGEN<NL> //Set English display

Query Syntax: `SYST:LANG?`

Query Response: `{ENGLISH,CHINESE}`

10.8.2 SYSTem:GFI

SYST:GFI sets the electric shock protection state.

Command Syntax: `SYSTem:GFI {ON,OFF}`

For example: Send>SYST:GFION<NL> //Set electric shock protection on

Query Syntax: `SYST:GFI?`

Query Response: `{ON,OFF}`

10.8.3 SYSTem:BEEP

SYST:BEEP sets the beeper switch.

Command Syntax: `SYSTem:BEEP {HIGH,LOW,OFF}`

For example: Send>SYST:BEEPOFF<NL> //Set beeper off

Query Syntax: `SYST:BEEP?`

Query Response: `{HIGH,LOW,OFF}`

10.9 WRITEPARA

WRITEPARA sets 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>
```

For example: Send>WP1,DCW,1000.0,1.0,0.5,0.5,5.0,1.0,0,1,1<NL>

//Set step 1 function to DCW, voltage 1000V, test time 1 second, ramp-up time 0.5 second, ramp-down time 0.5 second, upper

limit 5mA, lower limit 1mA, ARC level 0, charging lower limit 1uA, ramp-up upper limit on

Send>WP1,ACW,1000,1.0,0.5,0.5,1,0.1,0,0<NL>
//Set step 1 function to ACW, voltage 1000V, test time 1 second, ramp-up time 0.5 second, ramp-down time 0.5 second, upper limit 1mA, lower limit 0.1mA, ARC level 0, frequency 50Hz

Send>WP1,IR,1000,1.0,0.5,0.5,1000.0,1.0,1,1.0<NL>
//Set step 1 function to IR, voltage 1.0kV, test time 1 second, ramp-up time 0.5 second, ramp-down time 0.5 second, 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>

For 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: step 1~16

FUNC: test function ACW,DCW,IR

VOLT: test voltage value

CUR: ACW,DCW current value, IR resistance value

STATE: state

0->idle

3->voltage ramp-up
4->voltage test
5->voltage ramp-down
6->PASS Test Passed
7->SHORT short-circuit protection
8->ARC arc protection
9->GFI shock short
10->BREAKDOWN breakdown protection
11->ERROR Power amplifier board error
12->OV overvoltage protection
13->UPPER over upper limit
14->LOWER under lower limit
15->RISELOW ramp-up upper limit alarm

TIME: test time

For 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 state voltage ramp-down, test time 1.0 second, test finished

10.12 STEP

STEP sets the current test step

Command Syntax: `STEP <int>`

For example: Send>STEP1<NL> //Set the current step to 1

Query Syntax: `STEP?`

Query Response: `<step>,<totalstep>`

`Step:` Current step

Totalstep: total steps

10.13 INS

INS inserts a step

Command Syntax: `INS <int>`

For example: Send>INS1<NL> //Add a new step after step 1

Send>INS<NL> //Add a new step after the current step

10.14 DEL

DEL deletes a step

Command Syntax: `DEL <int>`

For example: Send>DEL1<NL> //Delete step 1

Send>DEL<NL> //Delete the current step

10.15

KEYLOCK sets the keyboard lock

Command Syntax: `KEYLOCK <ON,OFF>`

For example: Send>KEYLOCKON<NL> //Turn on the keyboard lock

10.16 IDN? Subsystem

Fig. 10-7 IDN? Subsystem Tree

The IDN? subsystem returns the instrument version.

Query Syntax: `IDN?`

Query Response: `<MODEL>,<Revision>,<SN>,< Manufacturer>`

For example: Send>IDN?<NL>

Return>Onmeas,AT9610,961007767001,A1.00<NL>

11. Modbus (RTU) Communication Protocol

This chapter covers the following topics:

- Data Format
- Function Codes
- Register
- Query response - format of the query response
- Command Reference

11.1 Data Format

We comply with the Modbus (RTU) communication protocol. The instrument responds to commands from the host computer and returns a standard response frame. Contact our sales department to obtain the ONMEAS instrument communication test tool, which contains Modbus communication debugging methods. It includes CRC-16 calculator and float converter to Modbus float format.

See:

11.1.1 Command Parsing Rules

Fig. 11-1 Modbus Command Frame

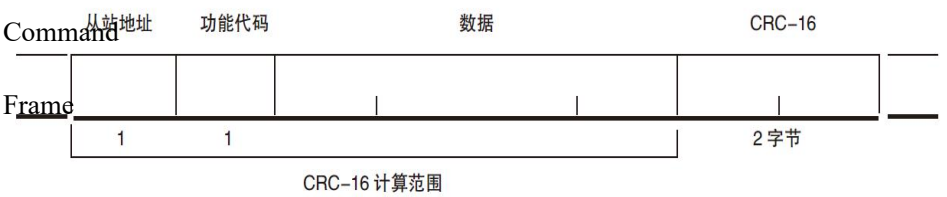


Table 11-1 Command Frame Description

	An idle interval of at least 3.5 character times is required
Slave address	1 byte Modbus can support 00~0x63 slaves Set to 00 for broadcast For instruments not equipped 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 with 10H 0x08: loopback test (used only for debugging) 0x10: write multiple registers
Data	Specifies register address, quantity, and content
CRC-16	2 bytes, low byte first

	CyclicRedundancy Check All data from the slave address to the end of data is calculated to obtain the CRC16 checksum
	An idle interval of at least 3.5 character times is required

11.1.2 CRC-16 Calculation

(1) Set the initial value of the CRC-16 register to 0xFFFF.

(2) XOR the CRC-16 register with the first data byte of the message and return the result to the CRC-16 register.

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

(4) If the bit shifted out of the LSB is 0, repeat step (3) (process the next shift). If the bit shifted out of the LSB is 1, then XOR the CRC register with 0xA001 and return the result to the CRC register.

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

(6) If message processing is not finished, XOR the CRC register with the next byte of the message and return the result to the CRC register, then repeat from step (3).

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

The following is a CRC calculation function 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 &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=CRC16LoXordata(i)'XOR each data value with the CRC register
        For flag = 0 To 7
            SaveHi = CRC16Hi
            SaveLo = CRC16Lo
            CRC16Hi = CRC16Hi \ 2       'Shift high right one bit
             CRC16Lo = CRC16Lo \ 2       'Shift low right one bit
            If((SaveHiAnd&H1)=&H1)Then'if the last bit of the high byte is 1
                CRC16Lo = CRC16Lo Or &H80    'then fill 1 in front after shifting the low byte right
            End If                  'otherwise fill 0 automatically
            If((SaveLoAnd&H1)=&H1)Then'if the LSB is 1, XOR it with the polynomial
                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 ONMEAS instrument communication test tool contains Modbus communication debugging methods, including a CRC-16 calculator.

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

Fig. 11- 2 Modbus Appended



11.1.3 Response Frame

Except for commands broadcast to slave address 00H, the instrument returns a response frame for other slave addresses.

Fig. 11- 3 Normal Response Frame

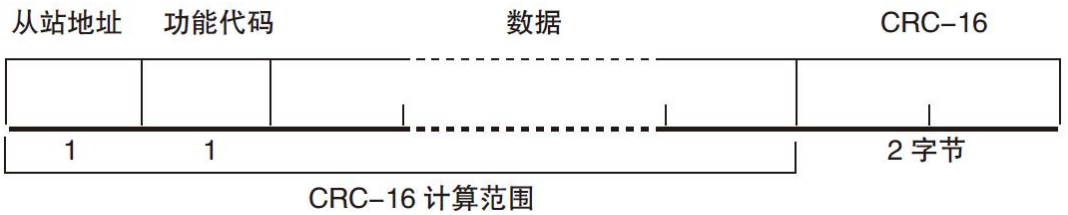


Fig. 11- 4 Exception Response Frame



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), e.g.: 0x03 OR 0x80 = 0x83
Error Codes	Exception code: 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 data is calculated to obtain the CRC16 checksum

11.1.4 No Response

In the following cases, the instrument performs no processing and gives no response, causing a communication timeout.

(1) Slave address error

(2) Transmission error

(3) CRC-16 error

(4) Byte-count error, for example: the total byte count for function code 0x03 must be 8, but the received count is less than 8 or greater than 8 bytes.

(5) Slave address 0x00 is the broadcast address; the instrument does not respond.

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 count or byte count error	3
0x04	Execution error	Invalid data: the written data is outside the allowed range	4

11.2 Function Codes

The instrument supports only the following function codes; an error frame is returned for any other function code.

Table 11- 4 Function Codes

Function Codes	Name	Description
0x03	Read Multiple Registers	Read multiple consecutive registers
0x04	Same as 0x03	Use 0x03 instead
0x08	Loopback Test	The received data is returned unchanged
0x10	Write Multiple Registers	Write multiple consecutive registers

11.3 Register

The instrument's registers are in 2-byte mode; 2 bytes must be written each time, e.g.: the test function register is 0x3000, the data is 2 bytes; write the value 0x0001 to set the test function to DCW mode.

Data:

The instrument supports the following value types:

(1) 1 register, 2-byte (16-bit) integer, e.g.: 0x64→00 64

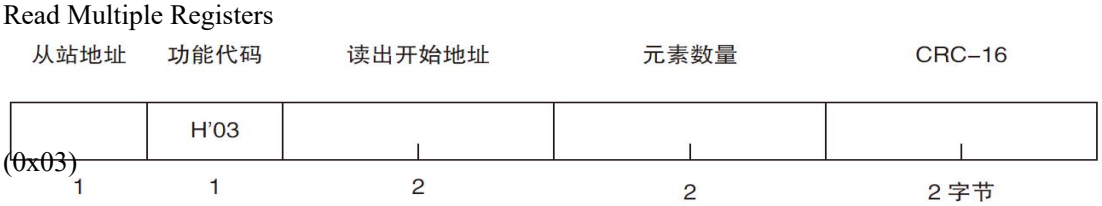
(2) 2 registers, 4-byte (32-bit) integer, e.g.: 0x12345678→12 34 56 78

(3) 2 registers, 4-byte (32-bit) single-precision float, 3.14→40 48 F5 C3

See: Our company's "ONMEAS Instrument Communication Test Tool" contains Modbus communication debugging methods. It includes a float converter.

11.4 Read Multiple Registers

Fig. 11- 5 Read Multiple Registers

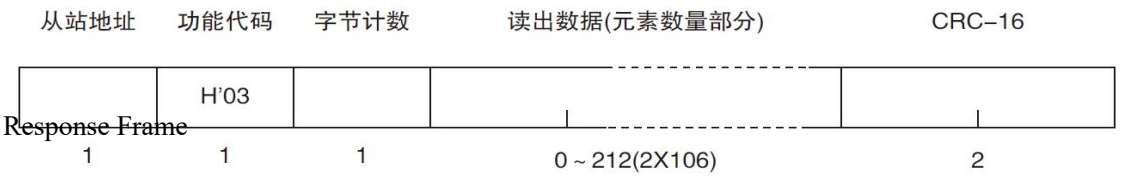


The function code for reading multiple registers is 0x03.

Table 11- 5 Read Multiple Registers

Name	Parameter	Description
	Slave address	Defaults to 01 when no RS485 address is specified
0x03	Function Codes	
	Start Address	Register start address, refer to the Modbus instruction set
	No. of Registers to Read 0001~006A(106)	Number of registers to read consecutively. Refer to the Modbus instruction set to ensure this range of register addresses exists; otherwise an error frame will be returned.
CRC-16	Checksum	

Fig. 11- 6 Read Multiple Registers (0x03)



Name	Parameter	Description
	Slave address	Returned unchanged
0x03 or 0x83	Function Codes	No exception: 0x03 Error code: 0x83
	Byte Count	= No. of Registers x 2 e.g.: 1 register returns 02
	Data	Data read
CRC-16	Checksum	

11.5 Write Multiple Registers

Fig. 11- 7 Write Multiple Registers

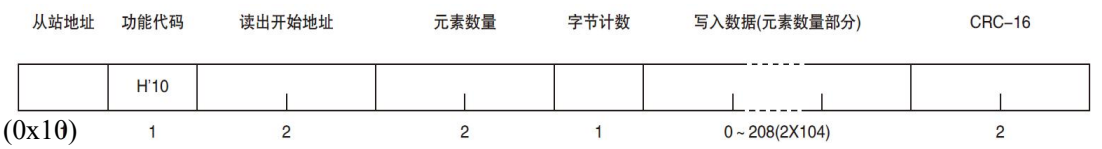


Table 11- 6 Write Multiple Registers

Name	Parameter	Description
	Slave address	Defaults to 01 when no RS485 address is specified
0x10	Function Codes	
	Start Address	Register start address, refer to the Modbus instruction set
	No. of Registers to Write 0001~0068(104)	Number of registers to read consecutively. Refer to the Modbus instruction set to ensure this range of register addresses exists; otherwise an error frame will be returned.
	Byte Count	= No. of Registers x 2
CRC-16	Checksum	

Fig. 11- 8 Write Multiple Registers (0x10)

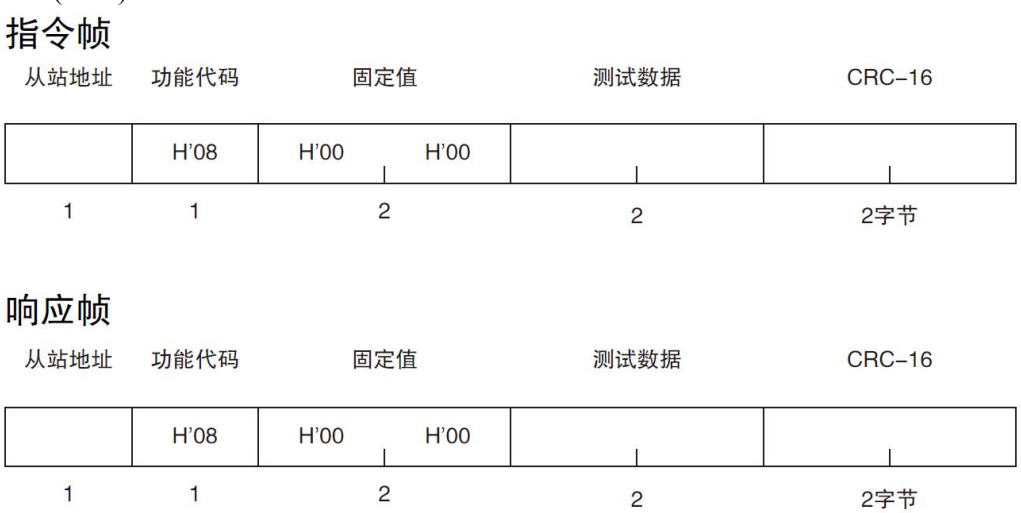


Name	Parameter	Description
	Slave address	Returned unchanged
0x10 or 0x90	Function Codes	No exception: 0x10 Error code: 0x90
	Start Address	
	No. of Registers	
	CRC-16 Checksum	

11.6 Loopback Test

Loopback test function code 0x08, used for debugging Modbus.

Fig. 11- 9 Echo Test (0x08)



Name	Parameter	Description
	Slave address	Returned unchanged
0x08	Function Codes	
	Fixed value	00 00
	Test data	Any value: e.g. 12 34
	CRC-16 Checksum	

For example:

Assume the test data is 0x1234:

指令：	01	08	00 00	12 34	ED 7C(CRC–16)
响应：	01	08	00 00	12 34	ED 7C(CRC–16)

12. Modbus (RTU) Instruction Set

This chapter covers the following topics:

- Register overview - learn all register addresses used by 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 SCPI commands used by the instrument. With these SCPI commands, all instrument functions can be fully controlled.

12.1 Register Overview

The following lists all register addresses used by the instrument; any address not in the table returns error code 0x02.

Table 12- 1 Register Overview

Register Address	Name	Numeric value	Description
Read-only register settings			
2000	Voltage Result	4-byte float	Read-only register, data occupies 2 registers
2002	Current Result	4-byte float	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 e.g.: 0002 00 02 Indicates total steps is 2, current step is 2
Setup 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 float	Read/write register, data occupies 2 registers
3003	Test Time	4-byte float	Read/write register, data occupies 2 registers
3005	Ramp-Up Time	4-byte float	Read/write register, data occupies 2 registers
3007	Ramp-Down Time	4-byte float	Read/write register, data occupies 2 registers
3009	Test Upper Limit	4-byte float	Read/write register, data occupies 2 registers
300B	Test Lower Limit	4-byte float	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 supports IR mode only
300E	Test Range	0000: 1uA range 0001: 10uA range 0002: 100uA range 0003: 1mA range	Read/write register, data occupies 1 register Write mode supports IR mode only
300F	Arc Level	0000: LEVEL0	Read/write register, data occupies 1 register

		0001: LEVEL1 … 0005: LEVEL9	This function supports ACW and DCW modes
3010	AC Frequency	0000: 50Hz 0001: 60Hz	Read/write register, data occupies 1 register This function supports ACW mode only
3011	Charging Lower Limit	4-byte float	Read/write register, data occupies 2 registers This function supports DCW and IR modes
3013	Ramp-Up Upper Limit	0000: On 0001: Off	Read/write register, data occupies 1 register This function supports DCW mode only
System screen read/write functions			
3100	System Language	0000: English 0001: Chinese	Read/write register, data occupies 1 register
3101	Key Tone	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 Transmission	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	Electric Shock Protection	0000: Off 0001: On	Read/write register, data occupies 1 register
310A	Failure Mode	0000: Continue 0001: Abort	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	Read/write register, data occupies 1 register

		0001: Step test result	
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 0001: Setup screen 0002: System screen 0003: File screen 0004: Data log screen 0005: Combined display screen 0006: System info screen 0007: LAN screen	Write register, data occupies 1 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 single default test item	Write register, data occupies 1 register
4004	File Management	Function: 0000: Delete current file 0001: File save 0002: File read File number: 0001~000A	Write register, data occupies 2 registers e.g.: 0000 00 01 means deleting the first file
4006	Charging Lower Limit	Auto test: 0001	Write register, data occupies 1 register
4007	Compensation Zeroing	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**	**20**	**00**	**00**	**02**	**CF**	**CB**
	Read	Register		No. of Registers		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**	**20**	**02**	**00**	**02**	**6E**	**0B**
	Read	Register		No. of Registers		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 Recall File Number Register [2004]

Read

1	2	3	4	5	6	7	8
01	**03**	**20**	**04**	**00**	**01**	**CE**	**0B**
	Read	Register		No. of Registers		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**	**20**	**05**	**00**	**02**	**DF**	**CA**
	Read	Register		No. of Registers		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 means total steps, the second part 00 01 means current step; i.e., the current step is [01-01].

12.3 Setup Screen Read/Write Registers

12.3.1 Test Function Register [3000]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**30**	**00**	**00**	**01**	**02**	**00**	**00**	**96**	**53**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**30**	**00**	**00**	**01**	**0E**	**C9**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**30**	**00**	**00**	**01**	**8B**	**0A**
	Read	Register		No. of Registers		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 Voltage Setting Register [3001]

Write (set voltage to 1kV)

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

Response:

1	2	3	4	5	6	7	8
01	10	30	01	00	02	1F	08
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	30	01	00	02	9A	CB
	Read	Register		No. of Registers		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	Register		No. of Registers		Bytes	Data				CRC	

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	30	03	00	02	3B	0B
	Read	Register		No. of Registers		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 Ramp-Up Time Register [3005]

Write (set ramp-up 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	Register		No. of Registers		Bytes	Data				CRC	

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	30	06	00	02	2B	0A
	Read	Register		No. of Registers		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 Ramp-Down Time Register [3007]

Write (set ramp-down 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	Register		No. of Registers		Bytes	Data				CRC	

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	30	07	00	02	7A	CA
	Read	Register		No. of Registers		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 Test Upper Limit Register [3009]

Write (set ACW current step test 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	Register		No. of Registers		Bytes	Data				CRC	

Response:

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

Note: ACW mode in mA, input range: (0.01~10)mA

DCW mode in mA, input range: (0.0001~5)mA

IR mode in MΩ, input range: (1~50000)MΩ

Read

1	2	3	4	5	6	7	8
01	03	30	09	00	02	1B	09
	Read	Register		No. of Registers		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 Test Lower Limit Register [300B]

Write (set ACW current step test 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	Register		No. of Registers		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	10	30	0B	00	02	3F	0A
		Register		No. of Registers		CRC	

Note: ACW mode in mA, input range: (0.01~10)mA

DCW mode in mA, input range: (0.0001~5)mA

IR mode in MΩ, input range: (1~50000)MΩ

Read

1	2	3	4	5	6	7	8
01	03	30	0B	00	02	BA	C9
	Read	Register		No. of Registers		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 current step test range mode to AUTO)

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

Response:

1	2	3	4	5	6	7	8
01	10	30	0D	00	01	9F	0A
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	30	0D	00	01	IA	C9
	Read	Register		No. of Registers		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 in IR mode only

12.3.9 Test Range Register [300E]

Write (set current step test range mode to Range_1uA)

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

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	30	0E	00	01	EA	C9
	Read	Register		No. of Registers		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 in IR mode only

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	Register		No. of Registers		Bytes	Data		CRC	

Response:

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

Read

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

Response:

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

Read

1	2	3	4	5	6	7	8

01	03	30	10	00	01	8A	CF
	Read	Register		No. of Registers		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 Charge Lower Limit Register [3011]

Write (set 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	Register		No. of Registers		Bytes	Data				CRC	

Response:

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

Read

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

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	30	13	00	01	7A	CF
	Read	Register		No. of Registers		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 Interface Read/Write Register

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	Register		No. of Registers		Bytes	Data		CRC	

Response:

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

Read

1	2	3	4	5	6	7	8
01	03	31	00	00	01	8A	F6
	Read	Register		No. of Registers		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 Tone Register [3101]

Write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	01	00	01	02	00	00	87	42
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	01	00	01	5E	F5
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	01	00	01	DB	36
	Read	Register		No. of Registers		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	31	02	00	01	02	00	00	87	71
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	02	00	01	AE	F5
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	02	00	01	2B	36

	Read	Register	No. of Registers	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**	**31**	**03**	**00**	**01**	**02**	**00**	**00**	**86**	**A0**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**03**	**00**	**01**	**FF**	**35**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**03**	**00**	**01**	**7A**	**F6**
	Read	Register		No. of Registers		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**	**31**	**04**	**00**	**01**	**02**	**00**	**00**	**87**	**17**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**04**	**00**	**01**	**4E**	**F4**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**04**	**00**	**01**	**CB**	**37**
	Read	Register		No. of Registers		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**	**31**	**05**	**00**	**01**	**02**	**00**	**00**	**86**	**C6**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**05**	**00**	**01**	**1F**	**34**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**05**	**00**	**01**	**9A**	**F7**
	Read	Register		No. of Registers		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**	**31**	**06**	**00**	**01**	**02**	**00**	**00**	**86**	**F5**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**06**	**00**	**01**	**EF**	**34**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**06**	**00**	**01**	**6A**	**F7**
	Read	Register		No. of Registers		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 Send Register [3107]

Write

1	2	3	4	5	6	7	8	9	10	11
01	**10**	**31**	**07**	**00**	**01**	**02**	**00**	**00**	**87**	**24**
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	**10**	**31**	**07**	**00**	**01**	**BE**	**F4**
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	**03**	**31**	**07**	**00**	**01**	**3B**	**37**
	Read	Register		No. of Registers		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	31	08	00	01	02	00	00	87	DB
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	08	00	01	8E	F7
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	08	00	01	0B	34
	Read	Register		No. of Registers		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 Shock Protection Register [3109]

Write

1	2	3	4	5	6	7	8	9	10	11
01	10	31	09	00	01	02	00	00	86	0A
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	09	00	01	DF	37
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	09	00	01	5A	F4
	Read	Register		No. of Registers		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	31	0A	00	01	02	00	00	86	39
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	0A	00	01	2F	37
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	0A	00	01	AA	F4
	Read	Register		No. of Registers		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	31	0B	00	01	02	00	00	87	E8
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	0B	00	01	7E	F7
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	0B	00	01	FB	34
	Read	Register		No. of Registers		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	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	0C	00	01	CF	36
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	0C	00	01	4A	F5
	Read	Register		No. of Registers		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	31	0D	00	01	02	00	00	87	8E
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	31	0D	00	01	9E	F6
		Register		No. of Registers		CRC	

Read

1	2	3	4	5	6	7	8
01	03	31	0D	00	01	1B	35
	Read	Register		No. of Registers		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 Register

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	Register		No. of Registers		Bytes	Data		CRC	

Response:

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

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

12.5.2 Interface Switching Register [4001]

Write (switch to measurement screen)

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

Response:

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

12.5.3 Keypad 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	Register		No. of Registers		Bytes	Data		CRC	

Response:

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

Response:

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

12.5.5 File Management Register [4004]

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

1	2	3	4	5	6	7	8	9	10	11	12	13
01	10	40	04	00	02	04	00	00	00	01	02	5F
	Write	Register		No. of Registers		Bytes	Data				CRC	

Response:

1	2	3	4	5	6	7	8
01	10	40	04	00	02	15	C9
		Register		No. of Registers		CRC	

12.5.6 Charge Lower Limit Register [4006]

Write (charging lower limit auto test on)

1	2	3	4	5	6	7	8	9	10	11
01	10	40	06	00	01	02	00	01	26	32
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	40	06	00	01	F4	08
		Register		No. of Registers		CRC	

12.5.7 Compensation Zeroing Register [4007]

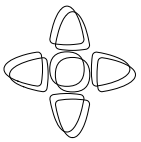
Write (compensation zeroing auto test on)

1	2	3	4	5	6	7	8	9	10	11
01	10	40	07	00	01	02	00	01	27	E3
	Write	Register		No. of Registers		Bytes	Data		CRC	

Response:

1	2	3	4	5	6	7	8
01	10	40	07	00	01	A5	C8
		Register		No. of Registers		CRC	

13. Specifications



You will learn about the following:

- Technical Specifications
- General Specifications
- Environmental Requirements
- Dimensions

13.1 Technical Specifications

The following data measured under these conditions:

Temperature: 23°C±5°C

Humidity: 65% R.H.

Warm-up time: >60 minutes

Calibration interval: 12 months

13.2 General Specifications

AT9610 Combined Electrical Safety Tester NEW		
Test Function	Test Item	
AC Withstand Voltage Test	Rated Output	5kVac/10mA
	Actual Output Capacity	50VA, ≥90%
	AC Voltage Output	Range: (50~5000)V, resolution: 10V, accuracy: ±(2%×set value+5V)
	Output Frequency	50Hz / 60Hz, accuracy: ±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~10.00)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: 0.00~3.50/3.00~10.00 mA, resolution: 0.01 mA Accuracy: ±(2%×reading+5 digits)
	Ramp-Up Time	Range: (0.4~999.9)s, resolution: 0.1s, accuracy: ±(0.2%×set value+1 digit)
	Ramp-Down 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 arc function off
	Current Compensation	0.000~10.00mA, total current+compensation current<10mA, auto

DC Withstand Voltage Test	Rated Output	6kVdc / 5mA
	Actual Output Capacity	30VA, ≥90%
	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: 1.0~350.0/300~3500/3000~9999μA/5mA, Resolution: 0.1/1/10μA/0.01mA, judgment error: ±(2%×reading+5 digits)
	Ramp-Up 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
	Ramp-Down 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 arc function off
	Current Compensation	(0~200.0)μA, auto/manual
	Ramp-Up Upper Limit Current	On/Off; 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
Insulation Resistance 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)
	Fall Voltage	Not less than 90% of rated voltage, fall 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) 1000~2000,±(12%×set value+2 digits) (500-2500V), 1~199,±(2%×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) 1000~2000,±(12%×reading+2 digits) (500-2500V), 1~199,±(2%×reading+2 digits), 200~999,±(5%×reading+2 digits) 1000~9999,±(15%×set value+2 digits)
	Ramp-Up Time	Range: (0.4~999.9)s Resolution: 0.1s Accuracy: ±0.2%×set value+1 digit

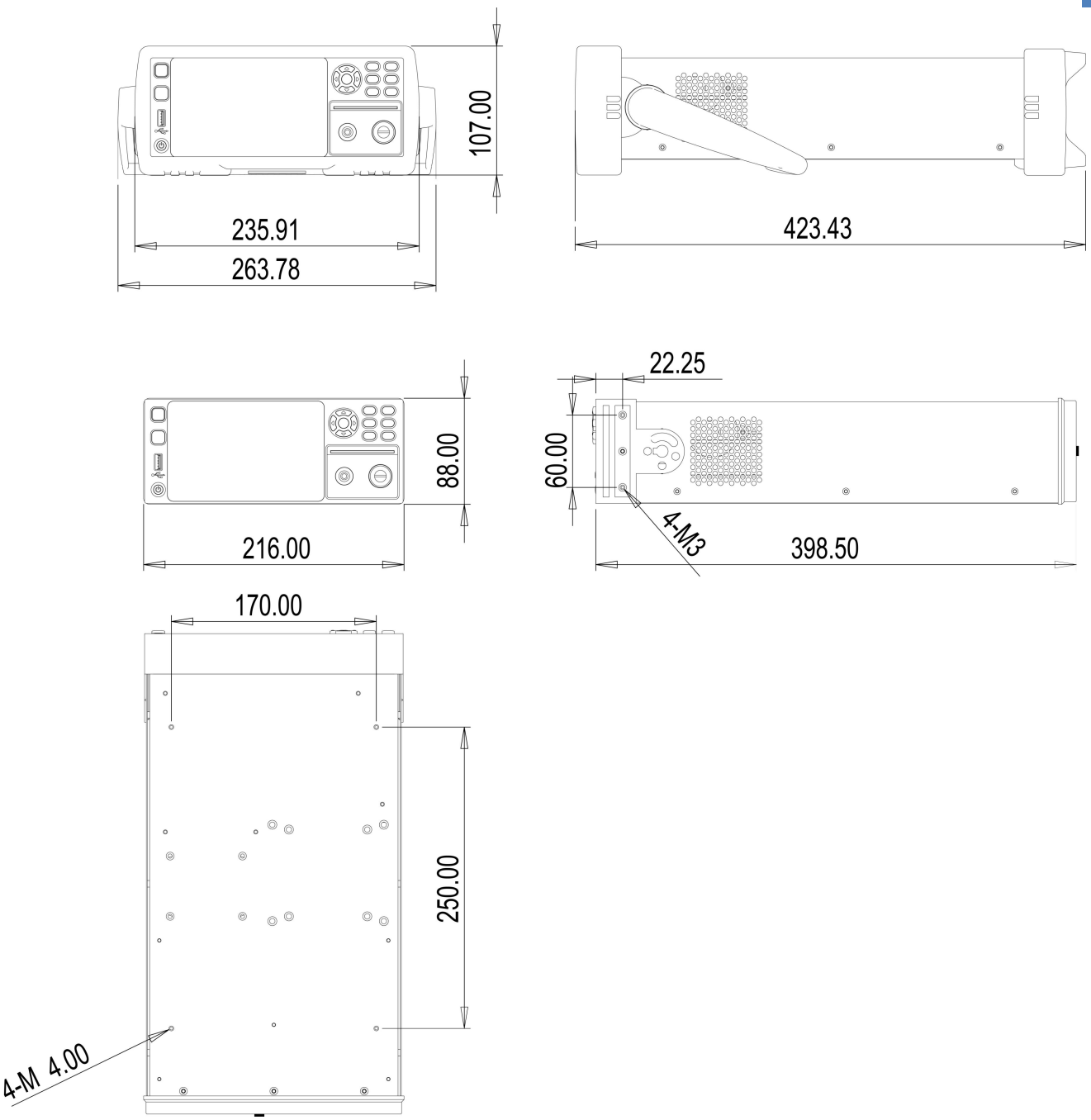
	Delayed Judgment Time	Range: (0.5~999.9)s, unlimited Resolution: 0.1s Accuracy: ±0.2%×set value+1 digit
	Ramp-Down Time	Range: Off, (0.1~999.9)s Resolution: 0.1s Accuracy: ±0.2%×set value+1 digit
	Discharge Time	≤200ms
	Charging Lower Limit Current	(0.001~3.500)μA, auto/manual
	General Features	
External Interfaces		USB-HOST, RS232/RS485, HANDLER, LAN, alarm light port, external remote-control port
Dimensions		Overall dimensions (mm): 263.78(W)x107(H)x398.5(D)
Weight		8kg

13.3 Environmental Requirements

Environment:	Rating:	Temperature 18°C~28°C	Humidity 65% RH
	Operation:	Temperature 10°C~40°C	Humidity 10~80% RH
	Storage:	Temperature 0°C~50°C	Humidity 10~90% RH
Power:	Supply voltage: 220Vac, maximum tolerance: ±10%		Supply frequency: 50Hz/60Hz, maximum tolerance: ±5%
Fuse:	250V 10A slow-blow		
Weight:	Approx. 8.6 kg.		

13.4 Dimensions

(schematic unit: mm)



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