TH9010 Series

Multi-channel Hipot Tester

Operation　Manual

Tonghui Electronic Co.,Ltd.

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Content

Chapter 1 Unpacking and Installing

This chapter tells some of the check points that must be performed after you receive the instrument and things you must know before installing the instrument.

1.1 Precautions for Use

Be sure to follow the rules below when using the instrument:
- **Do not use the instrument in flammable air**

To prevent burning or explosion, do not use the instrument near alcohol, thinner and other flammable materials, or in air with high concentrations of these gases.
- **Avoid exposing the instrument to high temperatures and direct sunlight**

Do not place the instrument where it is hot or where the temperature changes drastically.

Operating temperature range: 5℃ to +35℃

Storage temperature range: -20℃ to +60℃
- **Avoid wet environment**

Do not place the instrument in a boiler, humidifier or high humidity environment with water.

Operating humidity range: 20% to 80%RH (dew condensation is not allowed)

Storage humidity range: <90%RH (dew condensation is not allowed)

Water condensation can cause the circuit to malfunction. The instrument can only be used when the environment is completely dry.
- **Do not place the instrument in an environment with corrosive gas or dust**

Do not use the instrument in an environment where corrosive gases such as sulfuric acid, fog, dirt and dust or the like are present. This can corrode wires, connectors, and create hidden dangers or connection defects that can cause malfunctions, failures, and even fires.
- **Do not use the instrument in a poorly ventilated area**

The instrument has a forced air cooling system. Please allow enough space for the side and rear air vents to ensure air circulation.
- **Do not use the instrument on a sloping surface or in a rocking place**

If the instrument is placed on a non-horizontal surface or shaken, the instrument may slip and damage the instrument.
- **Do not use the instrument where there is a strong magnetic field or electric field effect**

Use the instrument where there is a strong magnetic field or electric field. Electromagnetic pulses can cause a malfunction in the instrument.
- **Do not use the instrument near sensitive measuring instrument or receiver**

Operation in a location subject, may cause such equipment be affected by noise generated by the tester. At a test voltage exceeding 3 kV, corona discharge may be generated to produce substantial amounts of RF broadband emissions between grips on the test lead wire. To minimize this effect, secure a sufficient distance between alligator clips. In addition, keep the alligator clips and test lead wire away from the surfaces of conductors (particularly sharp metal ends).

1.2 Precautions when moving

When moving or transporting the instrument, be aware of the following precautions:
- **Turn off the power switch before moving**

  Moving with the power switch on will cause electric shock and damage.

● **Disconnect all cables before moving**

Moving the instrument without disconnecting the cable may result in damage to the cable or drop the instrument during handling it.

1.3 Connecting AC Power Cables

The power cord is supplied by Tonghui along with the instrument. **Do not use an AC power cord that is not included with the instrument.**

Connection order:

1. Make sure the power supply is within the power cord range of the instrument.
2. Determine the nominal value of the instrument fuse, the fuse box is installed in the correct position (power supply)
3. Make sure the instrument's power switch is off
4. AC power cord is connected to the AC LINE (AC power cable) end of rear panel.
5. Please use the supplied AC power cord, or the AC power cord selected by the qualified professionals
6. Plug in an AC outlet

1.4 Grounding

⚠ **Warning**

Please make sure to connect the instrument to an electrical ground (safety ground, earth).

If the grounding of the power outlet is not connected to the peripherals or the ground of nearby commercial wires, the instrument is not directly connected to the earth, and the chassis of the instrument is charged with an excessively high voltage, which is very dangerous.

The instrument is a Class II device (the device is protected from electric shock in addition to the basic insulation). However, there is still the possibility of electric shock if there is no proper grounding.

To ensure safety, it is important to ensure that the instrument is grounded.

  Select at least one of the following two available methods to ground:

1. The power cord is connected to a single-phase, three-wire power outlet. Make sure that the socket's ground wire is securely connected to the ground.

2. Connect the protective terminal of the rear panel to the ground through a grounding bar (a copper wire or copper bar with a reliable connection to the ground which a production line is equipped). Have a dedicated engineer select, make, and install the ground cable. Ensure that the ground connection is correct and reliable.

Safe ground
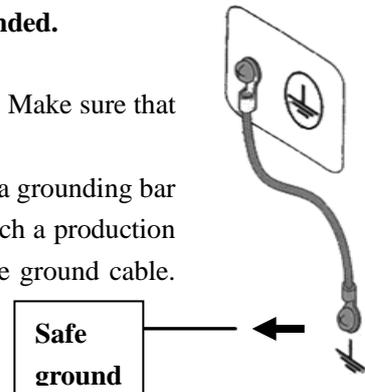
1.5 Operation Check

⚠ **Warning:** During the normal operation, please use **INTERLOCK** to ensure the safety.

When using this tester in a cramped working space, make a box-like structure for the DUT; when testing a complicated large-scale DUT: provide a cover or other means for the DUT to prevent electric shock, cutting off the output when the cover is opened. It is also recommended that an enclosure be provided around the operating area and that output be cut off every time the door is opened, to keep the workplace safe and secure.

When the power switch is turned on, all the lights on the front panel lit on and begins a self-check to make sure all indicators are working to ensure safety. It is particularly dangerous to conduct testing when the **DANGER** indicator (high voltage hazard during testing) is damaged.

⚠**Be Careful**：After turning off the power switch, wait a few seconds after turning it on again.

Repeated on/off power supplies that do not have sufficient time intervals are detrimental to the instrument.

Checking Order

1. Make sure that the allowable range of the supply voltage is the same as the input voltage range set by the fuse box.
2. Make sure that the AC power cord is connected to the AC LINE end of the rear panel.
3. Plug the power cord into an AC outlet
4. Turn on the power switch and make sure that the indicators on the front panel are fully lit on and the panel displays the startup screen.
5. The following screen display the AC withstand voltage test (AC) parameter interface of (SETUP) interface
6. Turn off the power switch

Start Up Screen:

Tonghui	**Share The Future Technology**
TH9010	
Parallel Multi-Unit Hipot Tester	
VERSION ： 1.0.9 Copyright(c)2017	
http//www.tonghui.com.cn	
Changzhou Tonghui Electronic Co . ， Ltd.	
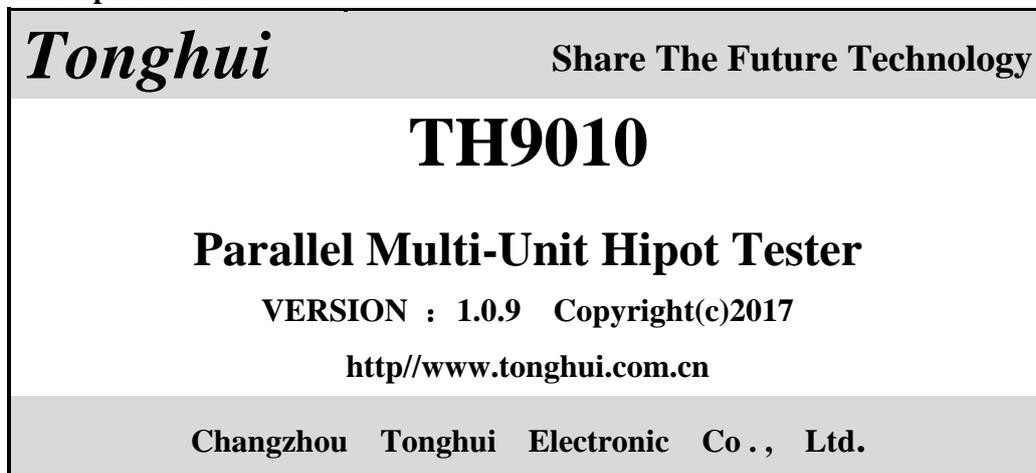
1.6 **Other Characteristics**

(1)Power consumption: power consumption < 1000VA

(2) Dimensions (W*H*D): 430mm*175mm*630mm;

(3) Weight: about 35kg.

Input Voltage	Frequency Range	Fuse (Slow Melting)	Rated Power
90V-240V	47-63Hz	15A	1200VA

Chapter 2 Precautions on Handling

This chapter describes the precautions to be followed in the handling of this tester. When using the tester, take utmost care to ensure safety.

⚠ **WARNING: The tester derives a 5 KV test high voltage, care must be taken when operating the instrument and follow the cautions, warnings, and other instructions given in this chapter.**
Keep them in mind to avoid accidents.

2.1 Prohibited Operation Behavior

● **Please do not turn on/off the power repeatedly.**
After turning OFF the power switch, be sure to allow several seconds or more before turning it ON again. Do not turn on/off power switch repeatedly, if you do this, the protectors of the tester may not be able to render their protective functions properly. Do not turn OFF the power switch when the tester is delivering test voltage, you may do this only in case of emergency.

● **Do not short the output terminal to the earth ground**
Be careful not to short-circuit the high-voltage test leads of the instrument with nearby AC LINE (AC power cord) or other nearby equipment (such as transmission equipment). If it is shorted, the chassis of the instrument will be filled with dangerous high voltages.
Make sure that the protective ground terminal is connected with the ground wire, by doing so, even if the HIGH VOLTAGE terminal is short-circuited to the ground, the instrument chassis will not be charged with high voltage and there is no danger.
Please make sure to connect the protective ground terminal with the ground wire in correct and reliable way, for details, please refer to "Chapter 1.5 Grounding".

Note: The term "AC LINE" is used herein to refer to the power cord used by the instrument. It is a wire that connects commercial power or power generated by power generation to the power supply of the instrument.

● **Do not connect external voltage to the test terminal**
Do not apply a voltage from any external device to the output terminals of the tester. The tester does not have an external discharge function in the non-discharge state, connecting the output to an external voltage can damage the instrument.

2.2 Actions When in Emergency

In case of an emergency (such as electric shock hazard or burning of DUT) while the tester's high voltage output is not cut off, take the following actions. You may do either (a) or (b) first, but be sure to do both:

a. Turn OFF the power switch of the tester.
b. Unplug the instrument from the power cord receptacle

2.3 Precautions in Testing

■ **Wearing Insulation Gloves**

When handling the tester, be sure to wear insulation gloves in order to protect yourself against high voltages, even though, it is forbidden to touch the live conductor by hand when high voltage test is conducting.

■ **Stop (Pause) Test**

To change the test conditions, please press the STOP once first, this will take the tester out of the test preparation state and ensure that the DANGER lamp is off. If need to take a break or leave the test location, please switch off the power, to prevent the accidental contact with the start switch and cause a safety hazard.

■ **Charged Items During High Voltage Testing**

During the test, the high voltage output terminals, the high voltage test lead wires, the high voltage probes, the DUT, and the conductors exposed to them are all charged with dangerous high voltage power. Do not approach or touch these conductors during testing.

⚠ **Warning**: **Do not touch the alligator clip on the test line. When the instrument is in the test state, the rubber skin on the alligator clip is not insulated enough; it is very dangerous to touch it!**

■ **Precautions after switching off the high voltage output**

If you have to touch the DUT, test leads, probes or output terminals and surrounding areas for reconnection or other reasons, make sure the following two points:

(a) Confirm that the operating status displayed by the instrument is not the test status.

(b) The DANGER light is off.

■ **Remote Control Warning**

Be very careful when operating the tester in remote control mode, because the start and stop of high voltage is remote controlled, the operator can not know the actual working state of the tester through the interface. **Please pay special attention to the reliability of remote control connection:**

1.「**STOP**」key, must be connected reliably,「**STOP**」key must be pressed before changing the DUT.

2. When working in a crowded work environment, the remote control switch must have a interlock「**INTLOCK**」and the high voltage indicator. Disconnect the interlock 「**INTLOCK**」before changing the DUT.

The protection method ensures that the DUT, the test leads, the probe, the output, and the surrounding area are never touched when the test voltage is output.

2.4 High Voltage Test Warning

⚠ **Warning**: In high voltage testing, test lead wires, probes and DUT are all charged with high voltage. The tester is equipped with a discharge circuit, but some time it still requires to discharge after the output is cut off. There is a danger of electric shock during discharge. To avoid electric shock, make sure that the DUT, the test leads, the probe, and the output terminal with high voltage do not touch anything other than the test component. If you may be exposed to these, make sure the

DANGER light is off and remove the hidden danger.

As soon as the output is cut off, the tester's discharge circuit starts forced discharging. Do not disconnect the DUT during a test or prior to the completion of discharging.

Under normal circumstances, it can be guaranteed that the test circuit voltage will be within the safe voltage range at the end of discharge.

When the capacitance of the DUT is too large or the structure of the DUT is special, the discharge may be incomplete; the test method must be changed by the technician to ensure complete discharge.

☺ **Discharge time:**

Computational formula of discharge time: t = -In (30 / U) $\times$R$\times$C

t: discharge time

30: discharge residue safety voltage 30V

U: test set voltage

R: discharge impedance of the DUT, approx. 10KΩ

C: capacitance of the DUT

Generally, only the DC type high voltage test needs to be discharged, and the length of the discharge time depends on the nature of the DUT.

During the test, if it ends normally, the voltage will drop to zero according to the voltage drop time. If the test fails, the discharge of the DUT is achieved by the secondary side of the transformer (approximately 10k resistor), it takes approximately 0.05S for a 1uF capacitor with a high voltage of 6000V to be discharged to 30V. The fixed discharge time of the instrument is 0.2S to ensure the discharge of the device is completed.

2.5 Handling for Dangerous State of Faulty Tester

Typical possible dangerous conditions of the instrument are described below, the most dangerous of which is the occurrence of "high voltage at the output and the instrument is out of control". When this happens, please immediately turn OFF the power switch and unplug the AC power cable from the AC line receptacle.

Immediately keep far away from the instrument and confirm no risk of the test circuit by the technical personnel; or keep the instrument still for more than one hour and confirm no output voltage in the test terminal.

Remove the relevant connecting lines and send the instrument back to us for maintenance.

⚠ **Warning**：

Keep away from the instrument after turning off the power and prevent other people from approaching. Do not immediately disassemble the test circuit. Immediately call our distributor or agent.

High voltage may remain in the interior of the instrument. It is hazardous for an unqualified person to attempt to troubleshoot any tester problem.

2.6 Conditions for ensuring long-time trouble-free working

Due to the dimension, weight, and actual use of the instrument, the voltage generation module of the instrument has a small heat dissipation design. Therefore, the instrument is recommended for use in the following ranges. If the fan has been in continuous operation for 30 minutes, the instrument must be suspended; otherwise the amplifier output module may burn out due to overheating.

Prerequisites for withstanding voltage test

Ambient temperature	Maximum Output Power		Suspend Time	Output Time Limit
t≤40℃	AC	>6mA	At least =the output time	Up to 1 minute
		<4mA	No requirement	Can Continuous output
	DC	>3mA	At least =the output time	Up to 1 minute
		<2mA	At least=Charging Wait Time (WAIT TIME)	Can Continuous output

Note: Test time >= output time >= (voltage rise time + test time + voltage fall time)

2.7 Daily inspection

In order to avoid accidents, at least the following points must be guaranteed before using:

1. The input power of the instrument is in compliance with the specifications, and the power supply of the instrument is configured correctly.
2. The instrument is reliably connected to the earth.
3. The test cable material is intact, no cracks, split and breakage.
4. The instrument is not connected to the test cable. The test is started under the default conditions and the test can be completed successfully.
5. When connecting the test line to start the test, the low voltage terminal of the test line is in contact with the high voltage terminal of the test line, and the instrument can generate a FAIL signal.

Chapter 3 Panel Description

This chapter describes the basic operating characteristics of the TH9010 Series instruments. Before using the TH9010 Series instruments, please read this chapter in detail so that you can quickly learn the operation of the TH9010 Series.

3.1 Front Panel

Figure 3-1 gives a brief description of the front panel.
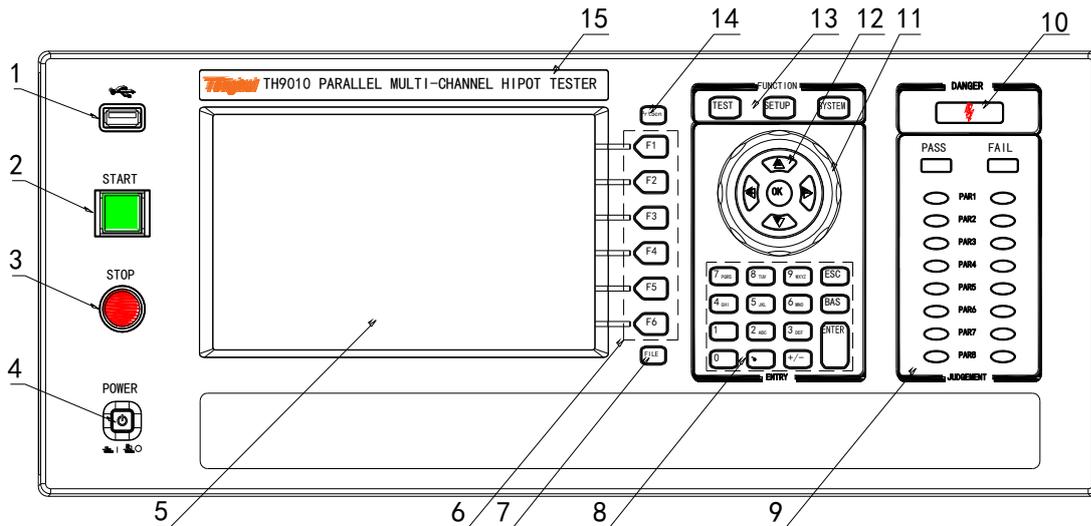
Figure 3-1 Front panel description

3.1.1 USB Interface

It is used to connect an external USB memory.

3.1.2 Start Button

It is used to start the test and once the test starts, the DANGER indicator lights up.

3.1.3 Stop Button

The stop button is used to stop the test; it can also be used to cancel the PASS, FAIL and other prompt states.

3.1.4 POWER

Power switch. Before the operator turns on the power for the first time, check the power supply type of the instrument and the connection of the test lead.

3.1.5 LCD Display

800×600TFT dot matrix liquid crystal display, display setting interface, measurement interface, etc.

3.1.6 Shortcut Function Key

Functional operating area on the right side of the LCD, by default, it is F1-F6 from top to bottom,

achieving quick operation.

3.1.7 File Function Key

It is used to save existing settings to the internal storage area of the instrument.

3.1.8 Numeric keypad

It is used to enter data for test parameters and modify the current set parameters.

3.1.9 Indicator Area

● **FAIL**

In the test, when a test data exceeds the setting, the instrument judges that the test failed, FAIL indicator is on.

The upper indicator is the overall "FAIL" indicator and the lower indicators are for the test units. When any test unit indicates "FAIL", the overall test result is "FAIL".

● **PASS**

After the test, no test data exceeding the initial setting was found, and the instrument judges that the test passed, PASS indicator is on.

In the case of the test timing function is off (TIME OFF), the test can only end with 'STOP', no PASS judgment.

The upper headlight is the overall "PASS" indicator and the lower indicators are for the test units. When any test unit indicates "PASS", the overall test result is "PASS".

3.1.10 High voltage indication and Work instruction

This light is on when the instrument is ready for high voltage testing or when performing high voltage testing.

Note: When the light is on, the operator should stay away from the high voltage tester, test cable and the tested items to prevent electric shock.

3.1.11 Cursor control switch

The arrow keys are used to select the items to be modified, and the OK button is used to confirm that the current project needs to be changed and the modification is completed.

3.1.12 Code switch and knob

Work together with cursor control switch to implement the parameters modification

3.1.13 Test function area (FUNCTION)

Select the working state of the instrument: including test status, test parameter setting status, and system parameter setting status.

● **TEST**

Press this button to light and the instrument enters the ready test state; **only in this state the instrument is allowed to start the high voltage test.**

● **SETUP**

Press the button to light and the instrument enters the parameter setting interface; **only in this state the instrument will modify the test parameters.**

● **SYSTEM**

Press this button to light and display the system setting interface (SYSTEM); **it is used to configure parameters not related to test but related to the test system, such as display, communication, etc.**

3.1.14 Copy

COPY the picture of the current screen to the USB memory, which must be pre-plugged into the front panel jack.

3.1.15 Instrument Model Label

TH9010/A Parallel Multi-Unit Hipot Tester

3.2 Rear Panel

Figure 3-2 gives a brief description of the rear panel.
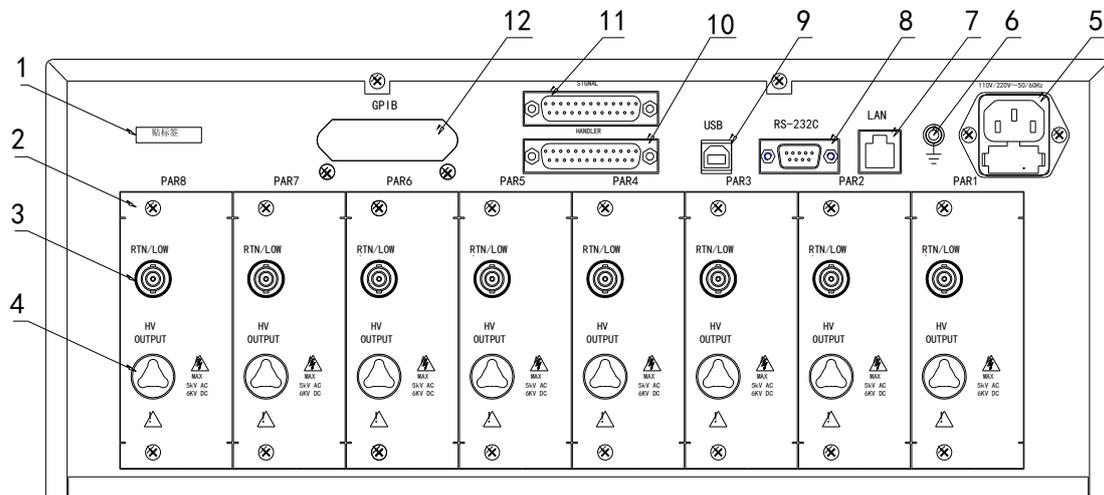
Figure 3-2 Rear panel description

3.2.1 Product Name Plate

Information code for product model and date of manufacture

3.2.2 Test unit output module

Parallel high-voltage output control module, 8 for TH9010 and 4 for TH9010A. Each module is independent of each other and can test a single DUT.
Note: Do not connect different test units to the same DUT, otherwise there will be unpredictable risks.

3.2.3 Test low terminal, test current return terminal (one per test unit)

Test low terminal of parallel high voltage test interface; all test low terminals have loop ground, please pay attention to distinguish when conducting parallel test wiring. Wrong connection will cause wrong judgment of the instrument and unpredictable risk.

3.2.4 High voltage output terminal (one per test unit)

High voltage output terminal of high voltage test interface.

3.2.5 Power socket: self-contained fuse box

For input AC power, please use the voltage within the specified input voltage range of the instrument. Please use the power cord that comes with the instrument.

3.2.6 Protective ground terminal

The three-pin power socket that is plugged into the instrument power supply cannot guarantee reliable connection to the earth, and then it must be connected to a reliable ground bar from here.
Note: **Do not use the instrument without connecting to the ground. Otherwise, the instrument chassis may be charged and there is a danger of electric shock.**

3.2.7 LAN Interface

LAN communication interface to communicate with the computer.

3.2.8 RS232C serial interface

Serial communication interface to communicate with the computer. See Chapter 6 for the communication command set.

3.2.9 USB serial communication interface

To communicate with the computer, the computer can control the instrument with the control instruction set through this interface. See Chapter 6 for the communication command set.

3.2.10 HANDLER interface

Control and output interface for connecting the instrument to external control devices, there are default mode and custom function mode, some pin functions can be customized.

3.2.11 SINGLE interface

Interface for outputting dedicated signals, currently used to connect multiple scan controllers

3.3 Multi-unit scanner description

Multi-channel scanners are equipped with multiple connection ports for each unit, used to connect multi-port products, in order to implement product multi-parameter testing. TH90101 is compatible with TH9010 and TH90101A with TH9010A.
Front panel picture:

3.3.1 EXTENSION: serial number of the current controller

Each host can expand 4 controllers, in the order of connection 1-4, the corresponding indicator will light when the instrument sends data.

Host Scan Chanel	Controller Serial Number	
1-4 Scan Chanel	#1 Controller	1-4 Scan Chanel
5-8 Scan Chanel	#2 Controller	1-4 Scan Chanel
9-12 Scan Chanel	#3 Controller	1-4 Scan Chanel
13-16 Scan Chanel	#4 Controller	1-4 Scan Chanel

3.3.2 UNIT n: Unit n

Input unit indication, light on indicates that the current unit of the host is working. An erected row of output ports is the scan terminal of the same port.

3.3.3 CH n: scan channel n

Scan channel connection indication, the red light indicates that this channel is connected to the high voltage input of the unit input; the green light indicates this channel is connected to the current feedback input of the unit input.

Note: One output of the controller is a double-wire output.

If you need to implement the CK (Contact Check) function, you need to connect the two ends to two different contact points on the same pin of the DUT, or can be connected to different pins connected via small impedance.

If you do not need to implement the CK (Contact Check) function, the withstanding voltage between the two wires of the same channel does not exceed 100V, please do not apply a high voltage signal here to avoid danger.

Rear panel picture:

3.3.4 SIGNAL IN/OUT: Control signal input (female) / output (male)

Control uses series control and the input terminal is connected to the host or the output signal that is switched through the controller. The output terminal is used to connect to the signal input terminal of the next controller, to achieve control signal switch.

3.3.5 UNIT n INPUT/OUTPUT: Unit n input / output

The input is connected to the output high voltage and current sampling of the corresponding unit of the host. The output is used to connect the input high voltage and current sampling of the corresponding unit of the next controller to realize the switching of the test voltage and current. The input / output terminals of the test voltage are actually connected inside the instrument and can be used interchangeably. The same is true for the current terminal.

3.3.6 Power Input

Connect the mains power supply to 100~240AC, 47-60Hz.

3.4 Instrument Performance Overview

The TH9010/A can provide 8/4 parallel test withstand voltage units, and the test units are independent of each other. The 8/4 unit means 8/4 times the safety test speed.
TH90101/A scan controller can extend 4 scan channels per test unit, and the TH9010/A can control up to 4 units. Used to connect test products with test endpoints no larger than 16. By connecting the matching test fixtures, the multi-parameter test can be completed once the product is placed.
The output of each test unit is the same: 5kVAC/10mA withstand voltage, 6kVDC/5mA withstand voltage, 1kVDC/5mA insulation resistance test.
Note: Each unit of test product must be strictly isolated. The reasons are as follows:
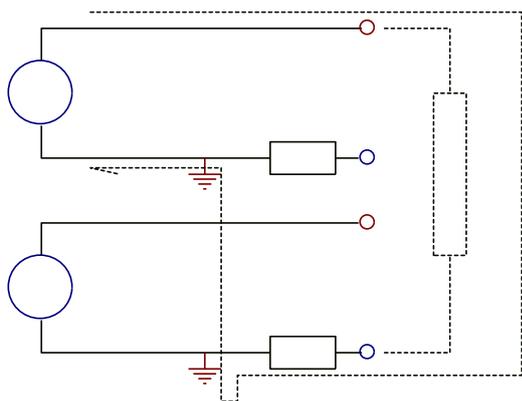
Because one point in the test low end of each unit structure is connected to the ground. Current is collected between the low end of the test and ground. The current loop of the high voltage of adjacent units can be achieved through the low end of the other units. The effect of this current on the measurement is as follows:

1. This current flows through the current sample, the current sample value of this path is counted.
2. This current is the ground current, two loop ground current misjudgments occur when GFI is turned on.
3. This current is too large to cause SHORT protection of the high voltage source and current

sampling circuit HI FAIL

The following is a detailed description of the test unit parameters:

The principle structure of the test unit: The high voltage module is a DA reference, controllable sine generator, PWM amplifier, 40 ~ 600Hz high voltage transformer boost, output voltage closed-loop control loop.

1. DA reference: Ensure that the output voltage amplitude can be programmed.
2. Controllable sine generator: it can be set to work at 50 or 60Hz when AC output, no longer limited by line voltage.
3. PWM power amplifier: high efficiency, good output performance and high sensitivity.
4. 40 ~ 600Hz high voltage transformer boost: for the power supply ripple problem of DC and Insulation Resistance test, this instrument produces 600Hz AC power, after rectification, a DC voltage is formed as a power source, to ensure that the DC power supply ripple is much smaller than the previous regulator type old withstand voltage meter
5. Output voltage closed-loop control: The load regulation rate is small and the test data is reliable.

Instrument software: multi-parameter continuous test, a variety of PC control functions.

TH9010 series are equipped with HANDLER, RS-232C, and USB, enabling the instrument to adapt to a variety of automated test systems that require high safety and reliability.

Test unit features:

■ **Four test functions—AC withstand voltage test, DC withstand voltage test, insulation resistance test, open short detection** When connected to the load, the instrument can continuously perform multi-parameter testing by editing the test file.

■ **Multi-unit scanning channel function (optional controller)**
TH9010/A with multi-channel controller TH90101/A can realize 4, 8, 12, 16 programmable scanning channels. Work with suitable test fixtures, programmable fast connection of components can be realized, the test speed of multi-parameter measurements can be multiplied.
Node connection check CK: The scan channel of the scan controller is a two-wire parallel structure, when the two-point connection is realized through the pin of the DUT, the instrument performs the test of the connection reliability of the test node by performing the continuity test.

■ **Test power**
Each high voltage module of the TH9010 series is a PWM power amplifier circuit and a 50VA high voltage transformer, to achieve AC: 5kV/10mA, DC: 6kV/5mA output, the distortion of the waveform is less than 3%. If the customer need to continuous current output, in order to ensure the reliability of the instrument, maximum output time is 60 seconds when working above 60% of rated output current. Within 60% to 40% of the rated output current, please pay attention to the continuous working time. Continuous operation is guaranteed below 40% of rated output current.
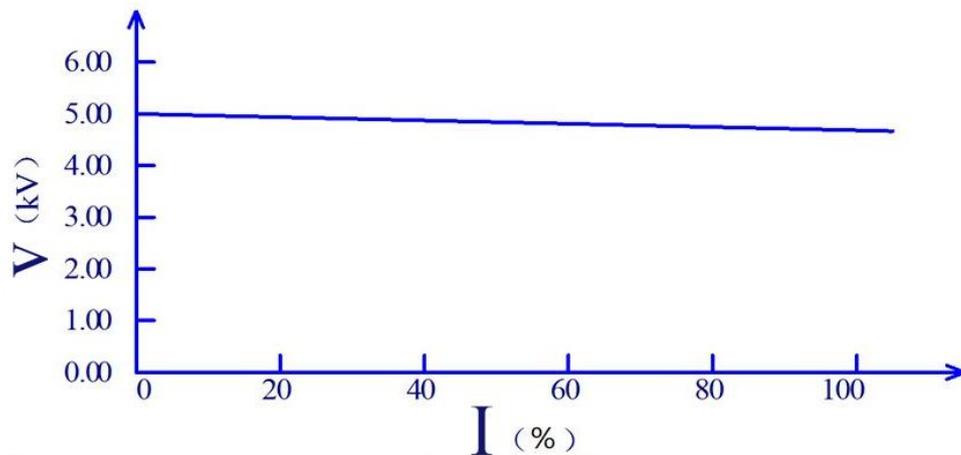
Figure 3-3　AC voltage load regulation

- **DC withstand voltage test 6kV/5mA**

  TH9010 Series provides DC withstand voltage test over a wide voltage range (maximum output DC 6kV). Automatic voltage adjustment of 600Hz frequency hardware, voltage load regulation rate ≤1%+10V.
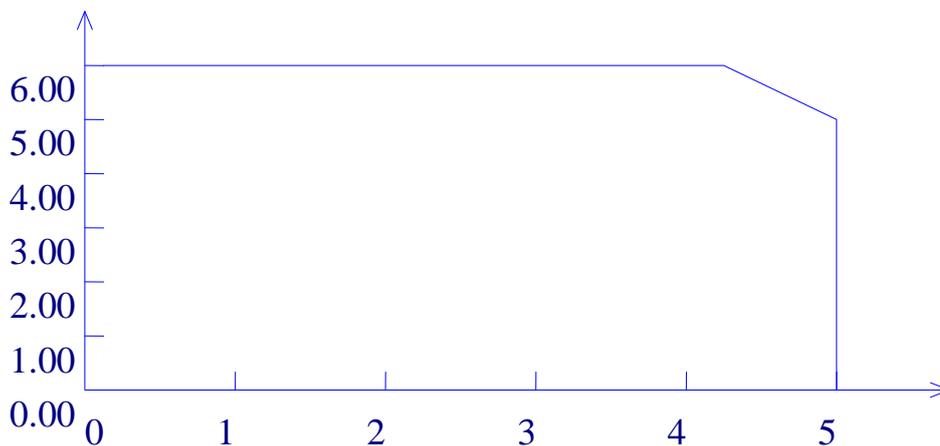
Figure 3-4　TH9010/A DC Voltage Output Range

- **Insulation resistance test 0.050kV to 1.000kV (1V resolution) / 0.1MΩ to 10.0GΩ, the maximum rated current is 5mA**

  Insulation resistance test range:

  When the voltage is less than 500V: 0.1MΩ ~ 100MΩ Accuracy is ± [10% reading + 5 digits]

  When the voltage is greater than 500V: 1MΩ ~ 100MΩ range accuracy is ± (5% reading + 5 digits), 100MΩ ~ 1GΩ range accuracy is ±(10% reading + 5 digits).

- **Open short circuit detection**: **Before starting high voltage, please determine whether or the DUT is reliable connected, to ensure that the high voltage test is accurate and safe.**

  Open short circuit detection can determine the distributed impedance current above 100PF, less than this value; the resolution of the current acquisition circuit of the instrument cannot accurately distinguish the open circuit and the test component connection.

- **RS-232C interface as standard**

  Except power conversion, key lock, other functions can be remotely controlled. Test conditions such as test voltage, judgment function, and test time in DC withstand voltage test,

AC withstand voltage test, and insulation resistance test can be remotely controlled. Test results can also be read from behind through remote control. The USB and RS-232C interfaces provide a stable and standardized standard test interface with PCs or other devices.

- **HANDLER interface for easy connection control**

  HANDLER interface: You can input **START, STOP** signal, and output **TEST, PASS, FAIL** signals. Can be connected to the foot switch easily, connect with simple test fixtures for safety interlocks, pneumatic controls, test indications, and more. Internal or external 24V power supply can be used as the output interface power supply for easy control and connection.

- **USB interface for backup**

  The instrument is equipped with a USB interface, which can save the test files written by the instrument and customer measurement files to an external USB flash drive, or load the files from a USB to the instrument to conveniently set the usage parameters and archiving scheme of the instrument in batches.

- **Test waiting time setting**

  The test waiting time can be set from 0.1s to 999.9s with a resolution of 0.1s. During this time, the instrument will output a test control signal to control the external device to ensure reliable test connection, and then start the high voltage test process.

- **Rise time control function**

  In AC withstand voltage test, DC withstand voltage test and insulation resistance test, the test voltage can slowly rise to the set value instead of providing the set voltage to the DUT immediately after starting the test. The voltage rise timecan be set from 0.1s to 999.9s with a resolution of 0.1s. TH9010 series meets various UL test standards and IEC withstand voltage test standards. (Rise time can be specified when the initial voltage is less than half of the test voltage and when the set test voltage is reached).

- **Drop time control function**

  In the qualification judgment of the AC withstand voltage test, the test voltage can be gradually reduced. The voltage drop time can be set between 0.1s and 999.9s with a resolution of 0.1s.

- **Discharge function**

  Usually the tested part is capacitive. At the moment when the DC withstand voltage test and the insulation resistance test are cut off, the DUT remains fully charged, therefore there is a danger of electric shock. The TH9010 series has a forced fast discharge function on the DUT after the DC withstand voltage test and insulation resistance test are completed.

- **Enhanced security**

  For improving safety, the TH9010 Series is equipped with many facilities and safety features, include safety outputs, discharge function and ground current detection. The so-called ground current detection is that when the return current of the ground high voltage test circuit is greater than 0.5mA through the chassis, high voltage output is cut off.

- **Higher test accuracy**

  TH9010 series voltage digital display, voltage test accuracy is $\pm(1\%$ reading + 5V) during withstand voltage test, voltage accuracy is $\pm(2\%$ reading + 5V) during insulation resistance test. The accuracy in the withstand voltage and current test is $\pm(2\%$ reading + 5 digits).

- **Current clear function**

  AC and DC withstand voltage test requires high voltage and high current sensitivity，the

current flowing through the stray capacitance of the test leads and fixtures will make the test inaccurate. The TH9010 series has a current clear function to offset the current fluctuation.

- **Easy operability**

    TH9010 series is easy to operate, ensuring that users do not have difficulty to use. The instrument lists all test parameters in the setting interface. Use the arrow keys to select a parameter from the LCD display interface, then use the function button to modify the parameters, customers can start to test after setting the data.

- **Files can be saved inside the instrument**: **20 files can be saved, and each file can have 20 test steps**

    It can edit 20 test files, corresponding to the various test project combinations required by customers, each file can have up to 20 test steps, the test procedure is any one of the AC withstand voltage test, the DC withstand voltage test, the insulation resistance test, and the open circuit short circuit determination, test conditions for each step are not related to each other; The stored file can be transferred to a computer or another similar instrument through an external USB in the file operation interface.

- **Multi-unit scan controller function description: (optional)**

    After the instrument is connected to the multi-unit scan controller, the instrument will have a corresponding scan channel value that can be set, the customer can set to connect the scan controller port with high voltage or current return terminal of the test unit as needed.

Contact inspection can be achieved:

Single-ended inspection: When connecting the test end of the instrument, connect the two test leads of the same port to two different positions on one of the pins of the DUT. The withstand voltage between the two contact points does not exceed 100V.

Double-ended inspection: When connecting the test end of the instrument, connect the two test leads of the two ports to two different positions of a pin of the DUT, or connect two pins with low impedance (several ohms to tens of ohms).

⚠ **Warning**:

The instrument uses a high voltage of 5kV AC / 6kV DC, do not touch the DUT and the test leads, there is a danger of electric shock.

Around the DUT, security measures such as fences should be provided.

When the safety measures such as the fence are not in a safe state, please disconnect the INT LOCK signal jumper to ensure the safety of the user.

To ensure safety, it is recommended to disconnect the INT LOCK signal jumper when high voltage is not required. When it is necessary to start the high voltage, be sure to carefully check the high voltage test cable and there is no sundry near the DUT which may affect safety.

Chapter 4 Basic operation

4.1 Interface structure overview

The following figure is the interface structure:
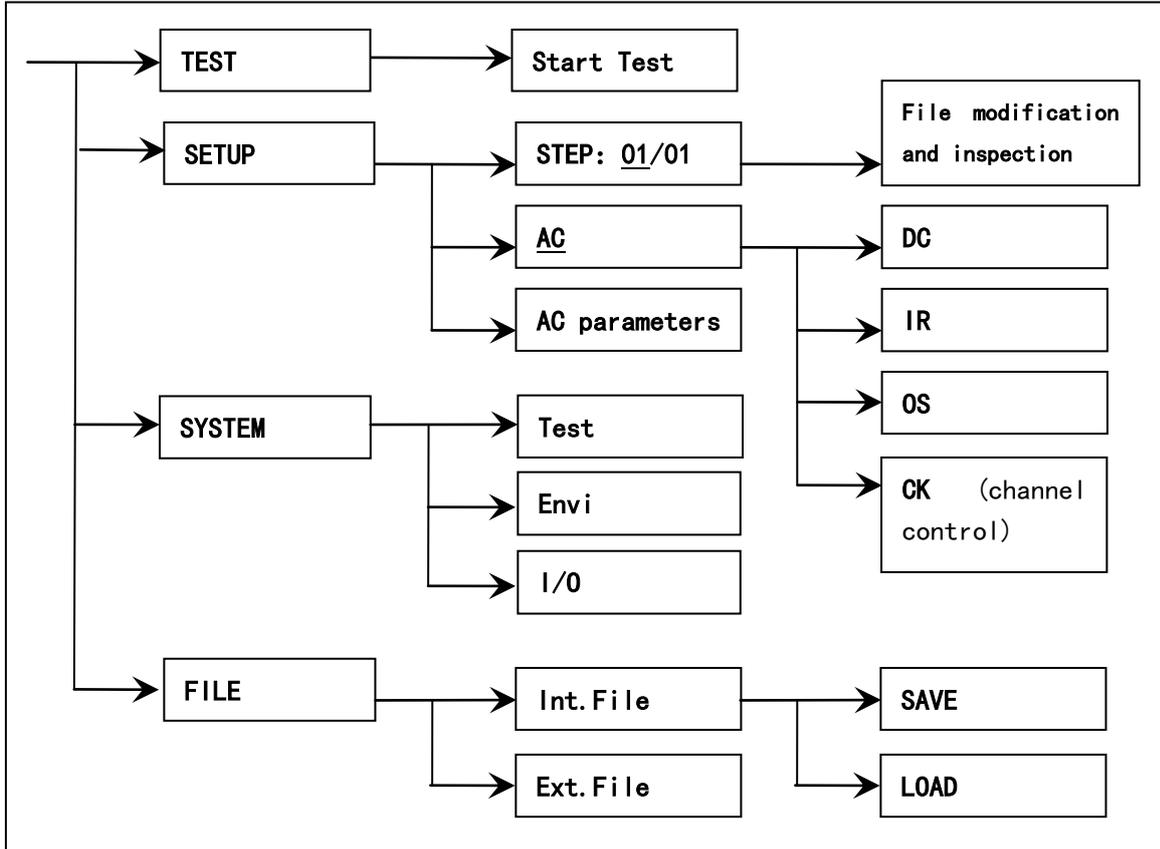
Figure 4-1 Operation Steps

Interface Instructions:

■ The first column of the interface structure is called according to the panel function button. TEST interface cannot modify parameters.

■ The second column of the interface structure is the parameter structure of the initial interface. For example, the SETUP interface defaults STEP 01/01: scenario step 1, total steps 1，AC: AC withstand voltage test interface, AC parameters: Other parameters are test parameters of AC withstand voltage.

■ The third column of the interface structure is the function switching interface. These features can be changed when some feature identifiers are selected in the second interface, the relevant parameters of this interface will change. For example if the AC is changed to DC, the instrument will change the AC withstand voltage test mode to the DC withstand voltage test mode, the 'AC parameter' of the current interface will change to the 'DC parameter' that the DC withstand voltage needs to be set.

Note: The instrument only saves data changes when switching interfaces. After modifying the data in the SETUP interface and SYSTEM interface, please switch the interface to

the "TEST" interface.

4.2 Panel function interface and parameter description

This section introduces the functional interface and related parameters of the instrument based on the software flow and interface correlation, to guide users to understand the function and use of the instrument.

- Instrument initial status description
    1. Turn on the instrument, it will self-test, query the existing unit and scan controller
    2. After booting, the system enters by default: TEST interface
    3. The default data is the test data when the last interface was switched before the last shutdown.
    4. The factory default setting of the instrument is single step, AC withstand voltage, default parameter status.

The interface switching of the instrument can be directly switched by using four function keys, they are:
- Measurement display (TEST): Start the high voltage test process.
- Measurement setup (SETUP): Modify the high voltage test procedure
- System interface (SYSTEM): Modify the conditions related to the instrument system
- File processing (FILE): Save and recall the set test file from the instrument storage area or USB

The basic function description of the button:

TEST (test key):	Let the instrument enter the test wait state, ready to start the high voltage test. (Power on defaults to this interface)
SETUP（setup key）:	This is the interface used to modify the current test file, test project, test parameters. The modification of the test file is completed in this interface.
SYSTEM（system key）:	Test safety and instrument operating mode related settings, it has little to do with test files. Press multiple times to switch the sub-interface.
FILE（file key）:	Test file save and call interface, it is related to data storage. Press multiple times to switch the sub-interface. **Note: Call may have a version mismatch problem.**
▼▲◀▶（direction key）:	In this interface, press the cursor up, down, left, and right.
Knob:	In this interface, move the cursor quickly in order.
F1~F6（soft key）:	Work with the right area contents of the soft key function displayed to achieve quick modification.
0~9（numeric keypad）:	Modify the data at the cursor position, please refer to the **information prompt area** at the bottom of the screen to determine the data input range.

Note: The instrument will **save the data modification only** when the **interface is switched.**
After modifying the data in the setup interface and system interface, you must switch the interface.
Please be careful not to **shut down directly** after modifying the data to avoid **data loss**.

4.2.1 Test Interface

The test interface is used to start the test process to test the DUT according to the existing requirements.

Use the "TEST" button to enter

The interface is as follows: (taking AC as an example)
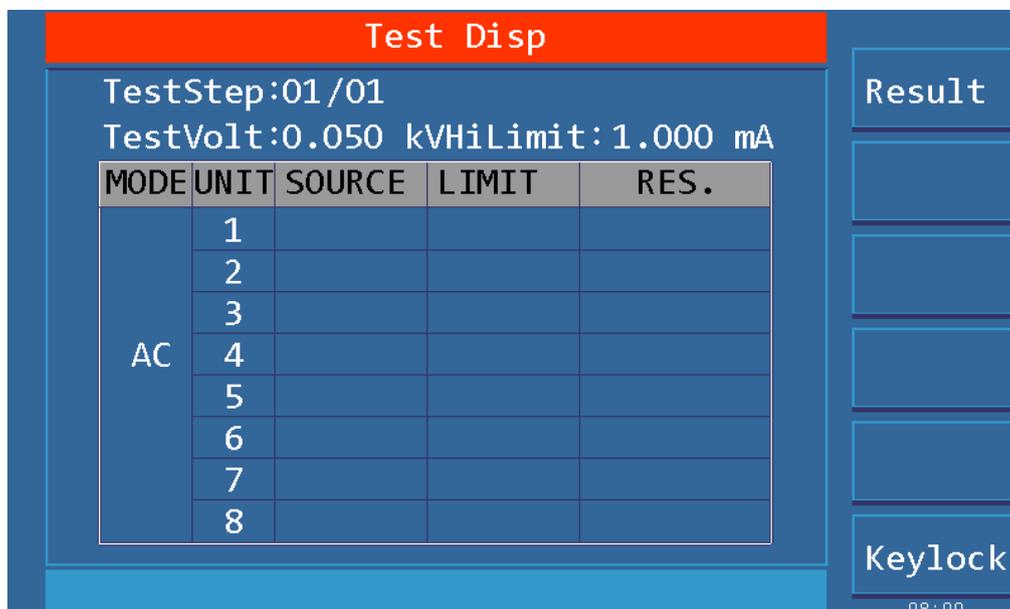
Figure 4.2.1 AC Test Interface

Note:

1. High-voltage measurement of the DUT can be started in the TEST interface. Parameters modification can not be done in this interface.
2. the instrument high voltage start must meet：The "INT LOCK" instrument online lock signal of the HANDLER interface is closed.（TH9010-IL plugged into the HANDLER interface）、the "STOP" button is not pressed , any "START" button is pressed.
3. Press ▼ (direction key) on this interface can quickly switch to the (SETUP) interface.
4. F6 function key can lock the key board, the instrument responds only to the INT LOCK, START, STOP, and F6 (unlock) keys after the keyboard is locked, note that the unlock operation is controlled by the password setting of the system environment interface.

After the measurement is started, the instrument displays the real-time test data displayed in the test. At FAIL, the instrument determines the working method according to the failure mode function. See the interface parameter description for details.

When all test steps are completed, PASS, the instrument will display the total PASS test result, after waiting for a certain period of time, it will automatically return to the test waiting state.

When all test steps are completed with FAIL, the instrument will display the FAIL test results. Press the STOP button to return to the test wait state.

4.2.2 Setup Interface

The SETUP interface is used to set test items according to the safety requirements of the product, and arrange the test sequence. **Press the "SETUP" button to enter**

Note: **After modifying the data in the SETUP interface, switch the interface to TEST and the instrument will save all data modifications. Please be careful not to shut down directly after modifying the data to avoid data loss.**

The interface is as follows:

```
                    Test Setup
                                                      ┌─────────┐
    TestStep:01 / 01        TestMode: AC              │   INS   │
                                                      ├─────────┤
    TestVolt:0.050 kV   Hi Limit:1.000 mA             │   DEL   │
    TestTime:  0.5 s    LowLimit:OFF                  ├─────────┤
    RiseTime:  0.5 s    ArcLimit:OFF                  │   NEW   │
    FallTime:  0.5 s    TestFreq:50 Hz                ├─────────┤
                                                      │   UP    │
                                                      ├─────────┤
                                                      │  DOWN   │
    Unit: 1   2   3   4   5   6   7   8               ├─────────┤
                                                      │  COPY   │
                                                      │   08:00 │
                                                      └─────────┘
```
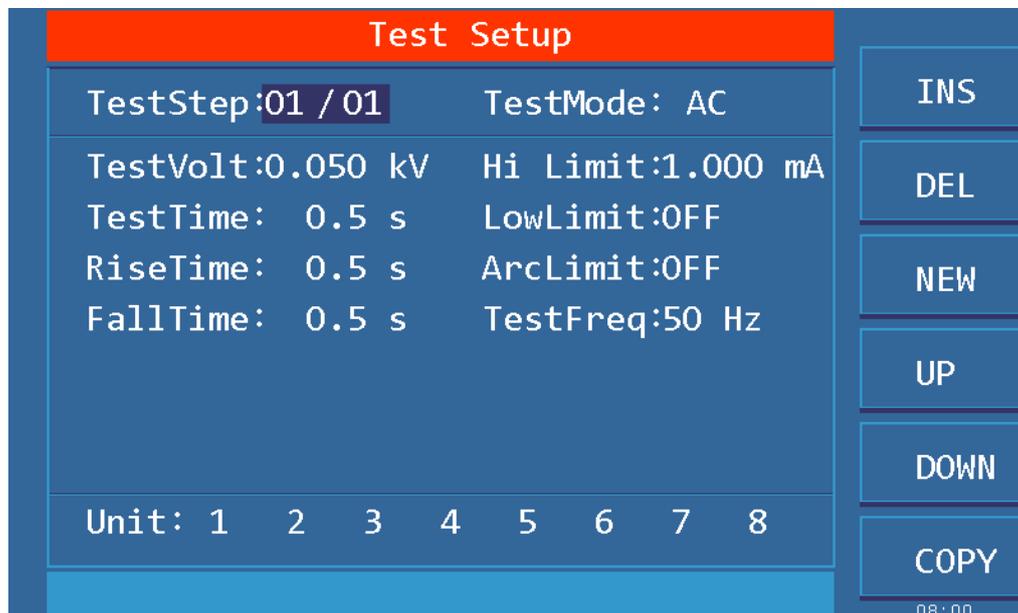
Figure 4.2.2 AC SETUP Interface

Test file modification instructions

STEP： <u>01/01</u>   Step number of the current project/Total number of steps

The test step value is the serial number of the current test item in the test file, that is, the order in which the test files are tested.

Project ID of the test file, the current parameter is nth step of the test file / total steps

Key	Fun.	Description
F1	INS	Add a new test step after the project, the test item for this step is the default. The current project and the following projects will be moved one bit later.
F2	DEL	Delete current test step and test item. the next step project will move forward one bit
F3	NEW	Create a new empty test file (STEP), the system will automatically create a new default step and test project.
F4	+	Access the parameters of the previous step of the current display step
F5	-	Access the parameters of the step after the current display step

Test items: AC withstand voltage (AC) The test item of the current test procedure is AC withstand voltage.

The test item of the current test procedure is AC withstand voltage, when the cursor is in this position, you can switch to DC, IR, OS items via F1~F4.

For the parameter modification of the test project, see "4.3 Test Project Interface and Parameter Description"

4.2.3 System Interface

The interface is as follows:

The system interface is to set some settings that are not related to the test project, but related to test

result processing, test process control, and instrument communication scheme.

Press the "SYSTEM" button to enter, press the "SYSTEM" button again to switch to the sub-interface.

Note: After modifying the data in the SETUP interface and SYSTEM interface, you must switch the interface to save all data modifications.

1. SYSTEM related sub-interface
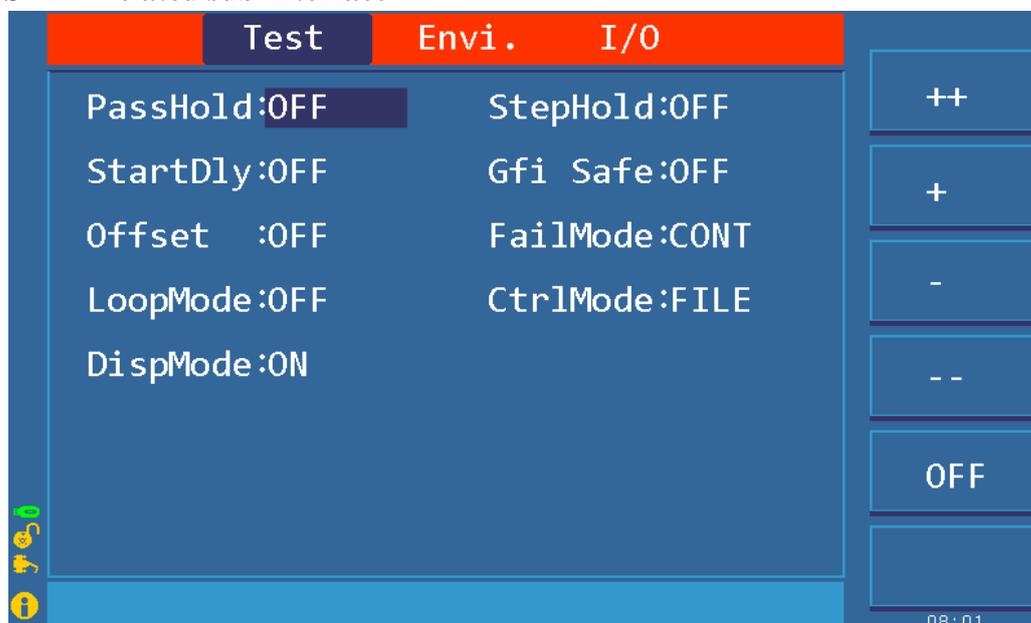
Figure 4.2.3.1 Test SYSTEM related interface

Interface parameter description:

Setting Mark	Parameter value	Description
PASS HOLD	OFF	OFF, PASS signal output time
	0.2～99.9S	When the test is passed, the hold time of the pass judgment.
STEP HOLD	OFF	OFF, waiting time between steps
	KEY	Pause, press 'START' key to start the next step
	0.1S～99.9S	Time to wait between steps during multi-step testing
STRT DLY	OFF	OFF, test wait time
	0.1~99.9S	Start and test the waiting time between the first item
GFI	ON, OFF	Ground current detection, enabled.
OFFSET	ON, OFF	Test data clear is enabled.
	GET	Get the existing status data as zero data.
FAIL MODE	STOP	If it fails, exit the test state directly.
	CONT	If it fails, continue the test and the results can be queried.
	PAUS	When the unit fails, the current unit test is suspended
LOOP MODE	ON, OFF	Perform an uninterrupted loop test on existing files.
CTRL MODE	FILE	The file ends and the interface output the test results.
	STEP	At the end of each step, the interface outputs a single step result.

2. Test environment related sub-interface

Figure 4.2.3.2 Test environment related interface

Interface parameter notes:

Password setting (PASS WORD): Set the key lock password, the instrument default password: 666666.

The F4 function key of the password setting state is the system firmware upgrade button, the firmware program must be inserted into the U disk of the instrument.

The F2 function key of the metering setting state is to restore to the factory default state.

3. Communication interface related sub-interface

Figure 4.2.3.3 Communication Interface Related Interface

Interface parameter notes:

1. RS485 uses RS232 interface, users need to use RS232-RS485 converter separately. The bus address is invalid in RS232 mode.

2. GPIB is an option, please confirm when purchasing the instrument.

4. HANDLER communication interface setting

Level type description:

1. High Level: Active high at output and the output interface optocoupler is open. (Test board indicator is off)

2. Low Level: Active low at output, output interface optocoupler is turned on. (Test board indicator is on)

3. High pulse: hold time of output is about 250mS for high level

4. Low pulse: hold time of output is about 250mS for low level

For detailed description of the signal, see **4.6 HANDLER** Interface Circuit Structure and Use

Figure 4.2.3.4 HANDLER Communication interface setting 1 related interface

Setting Mark	Description:
UNIT <n>-PASS:	When the unit test passes, the signal is valid.

Figure 4.2.3.5 HANDLER Communication interface setting 2 related interface

Setting Mark	Description
PASS	At the end of the test, the signal is valid when all unit tests pass.
FAIL	At the end of the test, the signal is valid when all unit tests fail.
BAK	Undefined(Backup)
WAIT	When the test is started, when there is no output at high voltage, the signal is valid.
READY	Non-test status of system idle, the signal is valid.
TEST	From pressing START to the end of the entire file test, the signal is valid.
DANGER	When there is high voltage output, the signal is valid.
PROG ERR	System malfunction, the signal is valid.

4.2.4 FILE storage interface

The file interface is used to save the edited test file, or call a previously edited test file.
Press the "FILE" button to enter, press the "FILE" button again to switch the sub-interface.

The internal file operation interface is indicated:
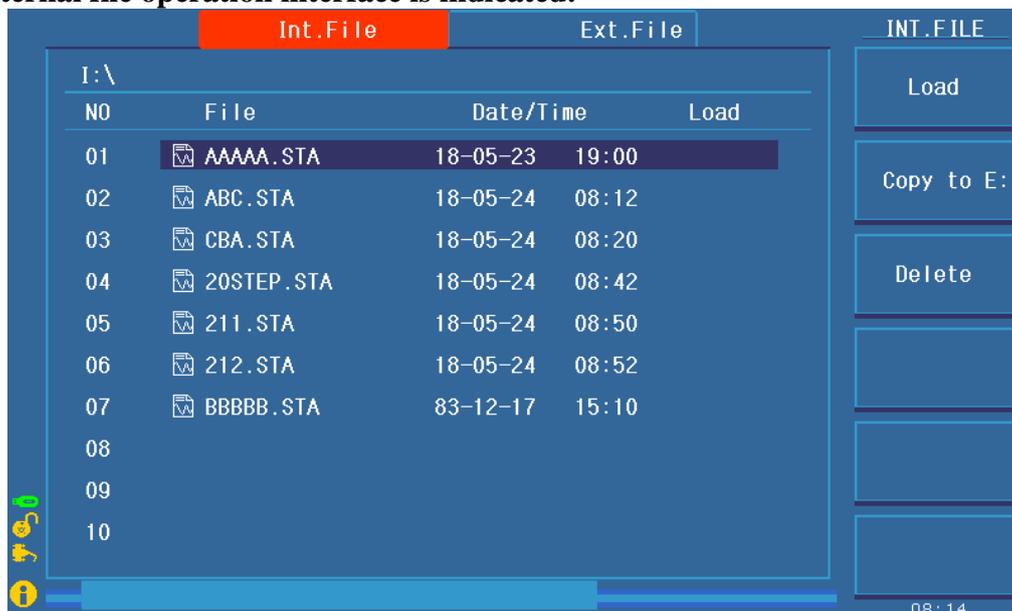
Figure 4.2.4.1 internal file operation interface

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The external file operation interface is indicated:
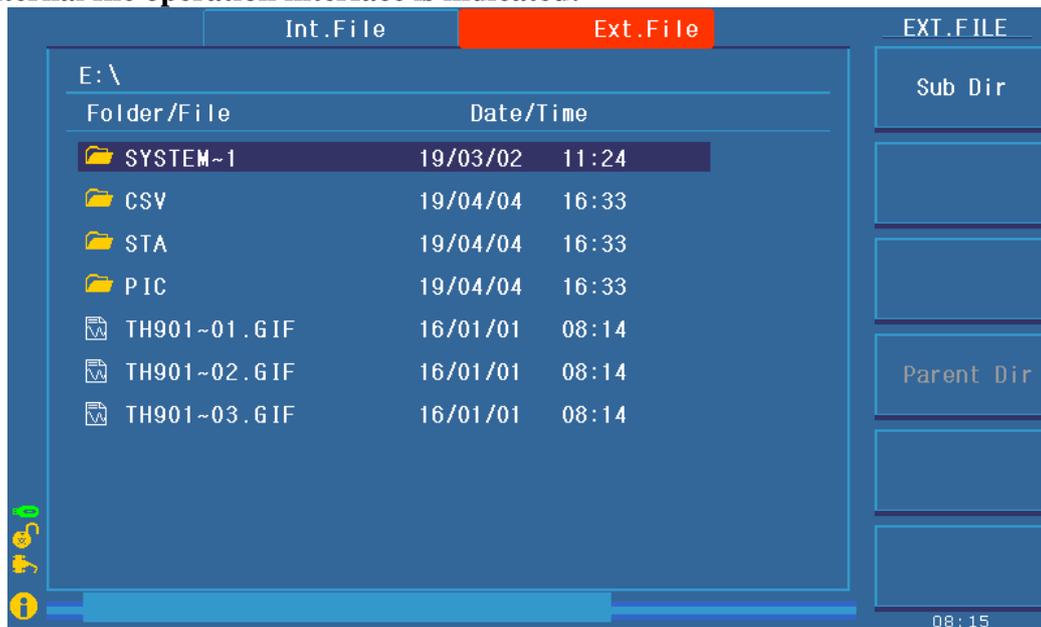
Figure 4.2.4.2 External file operation interface

Interface Description:

1 I: internal file. Storage area divided inside the instrument, save or call the test file
2 E: External U disk storage file. U disk to store, save or call test files, enable to use the current settings file on other instruments conveniently.
3 Internal copy to E:, The U disk is saved to the currently opened U disk directory by default, The default state is the root directory.

Note:

1. **Because the instrument system is simple, USB flash drive capacity should not exceed 8G; Store as few files or directories as possible, to avoid instrument reading failure.**
2. **Files** of different program versions may not be compatible, if the test conditions of the called file incomplete display, please **restore the factory settings** of the instrument, **re-edit** the new test file.

4.3 Test project interface and parameter description

This section describes the test function parameters of the setting interface and their meanings, to guide customers in setting relevant parameters.

Move the cursor to the test step, press "F1~F6" to modify the test file.

4.3.1 AC withstanding voltage test parameter setting

The setting interface is as follows:
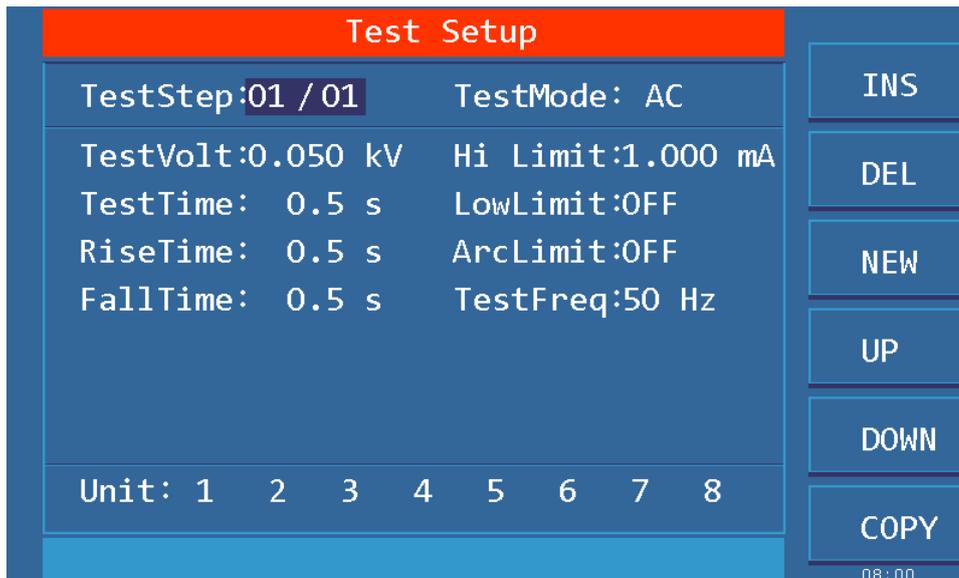
Figure 4.3.1 AC setting interface

AC withstanding voltage (AC) test parameter description:

VOLT：	0.050～5.000kV	AC high voltage test voltage value
UPPER：	0.001～20.00mA	TH9320 series AC withstand voltage current upper limit
	0.001～10.00mA	TH9010 series AC withstand voltage current upper limit
LOWR：	0.001～20.00mA	TH9320 series AC lower limit current value, must be less than the UPPER value
	0.001～10.00mA	TH9010 series AC lower limit current value, must be less than the UPPER value
	OFF	Lower limit is not required
ARC：	0.1～20.0 mA	AC arc current maximum allowable
	OFF	No arc is not required
TIME：	0.2~999.9S	AC withstand voltage test time, the test is end when the time is up
	OFF	Test time is not required
RISE：	0.1～999.9S	AC high voltage test voltage rise time
	OFF	Default=0.1S，Integration with test time
FALL：	0.1～999.9S	AC high voltage test voltage fall time
	OFF	Directly cut off voltage output at the end of the test. (**The DUT may be charged**)
FREQ：	50/60	AC working frequency

4.3.2 DC withstanding voltage test parameter setting

Move the cursor to the test mode, press "F1~F6" to modify the test mode of the current step.
The setting interface is as follows:
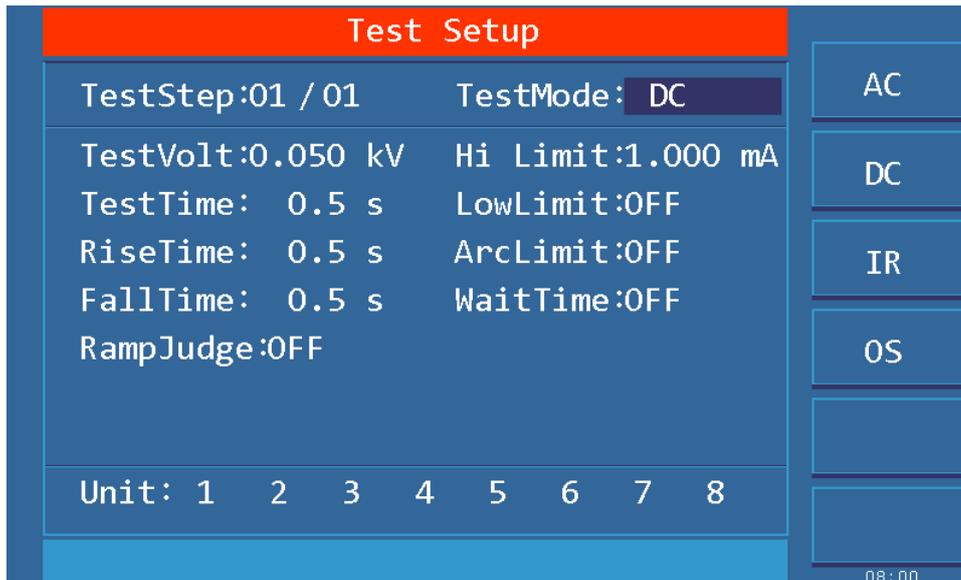
Figure 4.3.2 DC setting interface

DC withstand voltage (DC) test parameters are described below

VOLT：	0.050～6.000kV	High voltage test voltage value
UPPER：	0.1uA～10.00mA	Current upper limit
	0.1uA～5.00mA	Current upper limit
LOWR：	0. 1uA～10.00mA	Current lower limit, should be less than the UPPER limit
	0. 1uA～5.00mA	Current lower limit, should be less than the UPPER limit
	OFF	LOWR is not required
TIME：	0.1～999.9S	test time, the test is end when the time is up
	OFF	Unlimited test time
RISE：	0.1～999.9S	Test voltage rise time
	OFF	Default=0.1S，Integration with test time
FALL：	0.1～999.9S	Test voltage fall time
	OFF	End of test stop voltage output
WAIT：	0.1～999.9S	DC charging wait time
	OFF	Components do not need to be charged
ARC：	0.1～20.0 mA	maximum DC arc current
	OFF	ARC is not required
RAMP：	ON	When the voltage rises, to judge the current upper limit allowed
	OFF	Do not judge current upper limit

Note:
1. **After the DC test is over, the instrument will automatically perform a 0.2 second rapid discharge.**
2. **During the waiting time, the instrument does not judge the current upper limit, but the short circuit detection circuit is still working.**

4.3.3 IR Insulation resistance test parameter setting

Move the cursor to a test condition, press "F1~F6" to modify the current test condition or data.
The setting interface is as follows: (Figure 4.3.3)
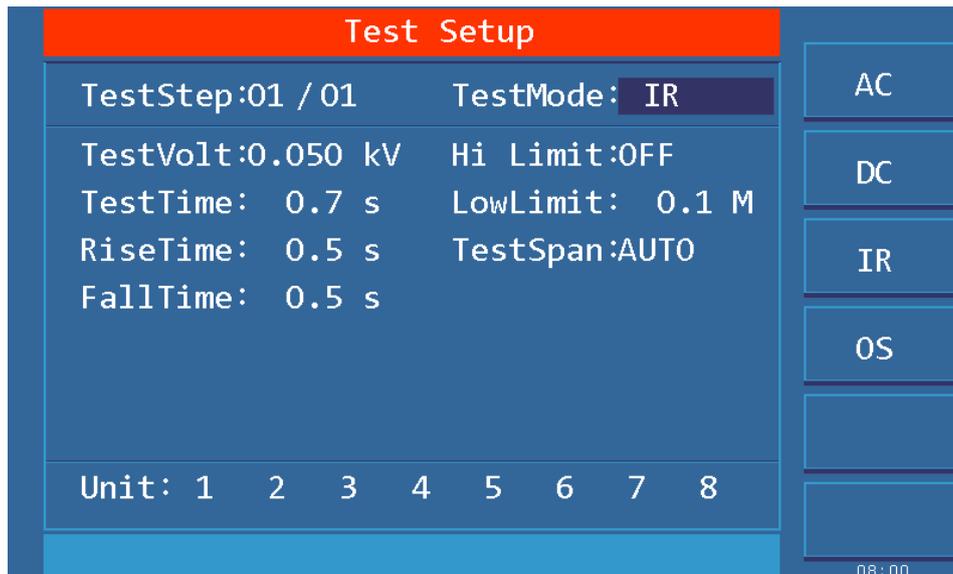
Figure 4.3.3 IR setting interface

IR test parameters are as follows:

VOLT：	0.050～1.000kV	Insulation test voltage value
UPPER：	0.1M～10.00G	Upper limit of IR
	OFF	Do not judge the UPPER limit of the insulation resistance
LOWR：	0.01M～10.0G	Lower limit of IR, should be less than Upper limit
TIME：	0.1～999.9S	IR test time
	OFF	Unlimited test time
RISE：	0.1～999.9S	Insulation voltage rise time
	OFF	Default=0.1S, Integration with test time
FALL：	0.1～999.9S	Insulation voltage fall time
	OFF	Directly cut off voltage output at the end of the test(The DUT may be charged)
RANG：	AUTO	Automatic range mode; Improve test accuracy
TH9320 series	2uA, 20uA, 200uA, 2mA, 10mA	Fixed range mode: can use I=U/R to estimate the range to speed up testing
TH9010 series	1uA, 10uA, 100uA, 1mA, 5mA	Fixed range mode: can use I=U/R to estimate the range to speed up testing

Note:
1. **The instrument judges the upper and lower limits at the end of the test. The current short limit is keeping working!**
2. **When in auto range, due to range switching, the minimum test time is 0.6S.**
3. **Due to current and voltage acquisition timing effects, voltage rise time and voltage fall time show significant deviations in resistance values, hereby explain for your reference.**

4.3.4 OS circuit test parameter setting

The setting interface is as follows:
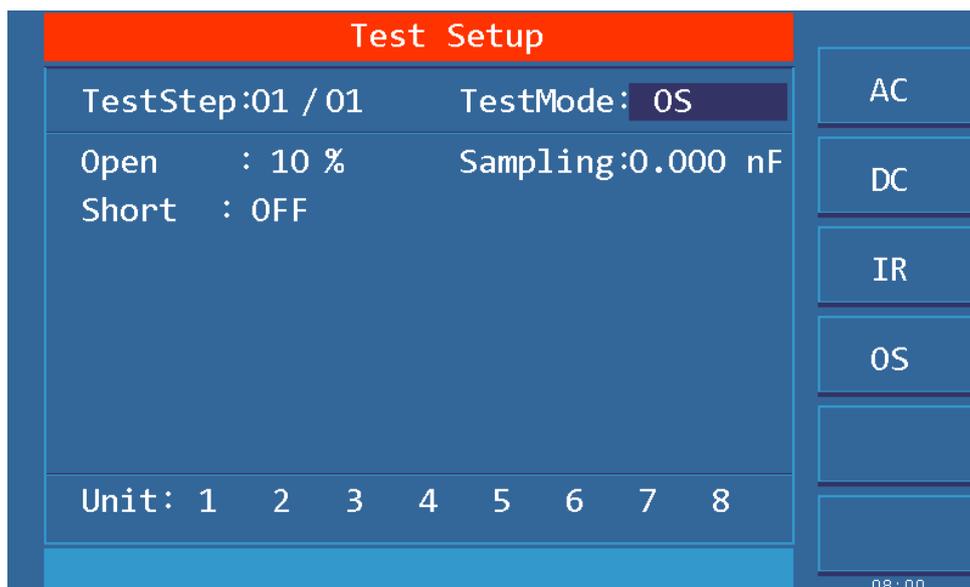
Figure 4.3.4 OS setting interface

Open short circuit detection (OS) test parameters are as follows

OPEN：	10%～100%, 1%	Open circuit determination threshold lower limit
SHRT：	OFF～100%～500% STEP: 10%	Short circuit determination threshold upper limit
STAN：	Previous Standard	Standard Value (check remark)
	GET	Get the current distribution parameter as the standard value

Remarks:

1. When the cursor is at the standard value (above figure) position, (F5) Function key position display (GET).

2. Press the (F5) function key at this time, the instrument enters the standard value sampling state. When sampling, the instrument will output a voltage of 100V to automatically obtain the current flowing through the DUT within 100 milliseconds. (There is voltage output when GET, be careful)

3. The capacitance value displayed by the instrument here is not the actual capacitance value, but the value of the sampled current after impedance conversion, which should be similar to the actual installed capacitance between the test terminals. (The sampled current is not just generated by the capacitor)

OPEN SHORT value setting: When the fixture's open circuit capacitance value >> component's open circuit capacitance value

Open value: greater than the value of the instrument not connected to the DUT, less than the minimum value of the connected DUT

Short value: Greater than the maximum value of the connected DUT, less than a larger value that may be caused by other defects.

Taking a coil as an example: Capacitance between coils is about 50P

1. Do not connect the DUT, "GET" test fixture open value ：STAN=10-20P, Confirm open circuit value 20P.
2. Connect multiple DUTs to record GET data range: STAN=50-70P to confirm

standard value 60P.

3. Connect multiple damaged DUTs to record GET data range: STAN >100P to confirm short value

Parameter setting calculation:

Assume that STAN is set to 60P.

Open value: Lower Limit＝20P/60P=33%, OPEN Upper Limit＝50P/60P=83%. Recommended to take 60%

Short value: Lower Limit＝70P/60P=117%, Upper Limit＝100P/60P=160%. Recommended to take 140%

4.3.5 S.CK Single-ended contact check parameter setting

It is valid to connect multi-channel scan box.

S.CK Function: to check if two test leads of a scan port are connected reliably. Generally, it is connected to the same pin of the DUT, if connected to the connected pins, not greater than 100V.

The setting interface is as follows:
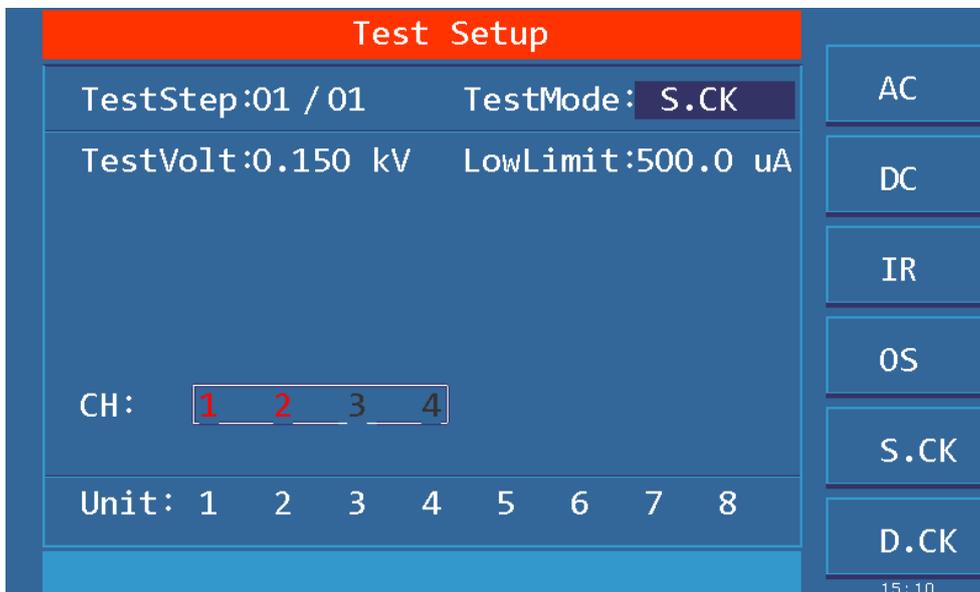
Figure 4.3.5 S.CK setting interface

Contact Check (S.CK) The test parameters are as follows:

VOLT：	0.50～0.500kV	High voltage test voltage value
UPPER：	0.1uA～5.00mA	Current upper limit
SCAN：	Red	This port performs contact check
	Gray	This port ignores contact check
UNIT：	White	This unit participates in the test
	Gray	This unit does not participates in the test

Description:

1. The actual current is related to the internal resistance of the test loop. The default is the preferred configuration

2. The test status is DC power open loop mode, setting parameters and test values are for reference only

3. All test points are checked in one test process, test time is configured by test points, after the test is over, the instrument will automatically perform a 0.2 second rapid discharge.

4. Total test time = 0.5S + 0.3S * N.

4.3.6 D.CK Double-ended contact check parameter setting

It is valid to connect multi-channel scan box.
D.CK Function: Is the two test leads with two scan ports connected reliably? Generally connected to the same pin of the DUT, it can only be used with the scan controller.
The setting interface is as follows:

Figure 4.3.6 D.CK setting interface

Contact Check (D.CK) the test parameters are as follows:

VOLT：	0.50～0.500kV	High voltage test voltage value.
UPPER：	0.1uA～5.00mA	Current upper limit.
SCAN：	Red	This port is connected to high voltage for contact inspection.
	Green	This port is connected to the test end for contact inspection.
	Gray	This port is open.
UNIT：	White	This unit participates in the test.
	Gray	This unit does not participates in the test.

Description:
1. The actual current is related to the internal resistance of the test loop. The default is the preferred configuration
2. The test status is DC power open loop mode, setting parameters and test values are for reference only
3. Can only achieve 1 pair of high and low end test at a time, after the test is over, the instrument will automatically perform a rapid discharge of 0.2 seconds.
4. **Total Test Time=0.7S**

4.4 Test function principle and instructions for use

This section takes the test process in order; introduce the principle and use of ground connection, ground current detection, arc detection and other tests.
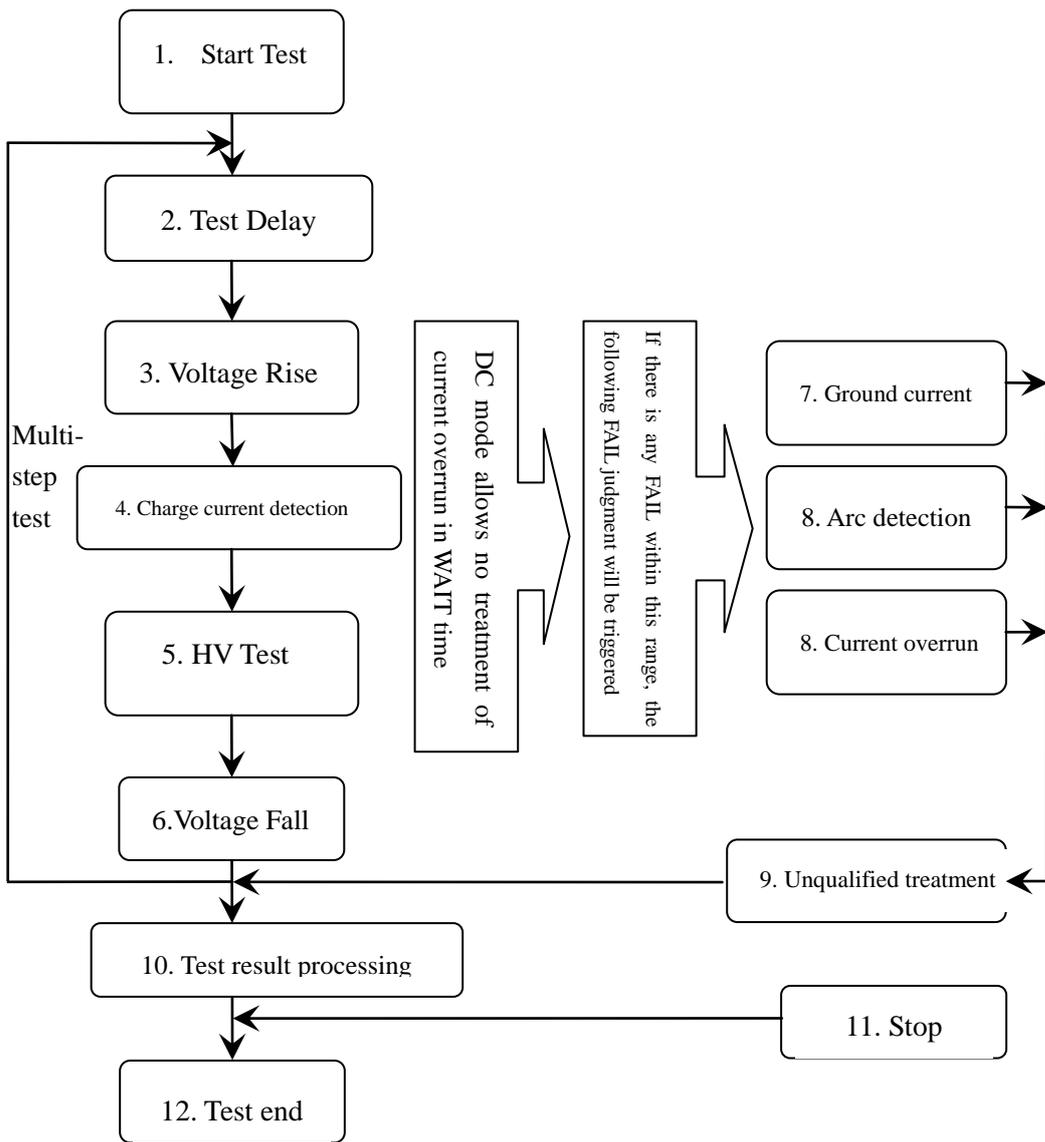
Instrument test flow diagram

Note:

1. When FAIL appears in a test unit, test of this test unit ends, instrument indicates FAIL format.
2. The test of one step is ended when all test units are FAIL, or when the test process for testing other test units ends.
3. At the end of the test step, if there is FAIL in the test unit, the next step of the instrument will be determined according to the setting mode of FAIL.
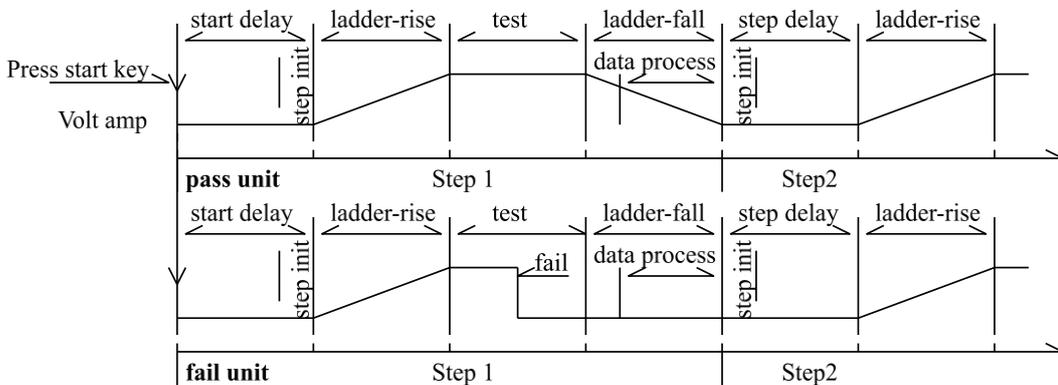
Instrument test timing diagram

4.4.1 Start Test

When the instrument is in test mode, check the test conditions and the connected parts are connected correctly. Press the START button to start the test.

4.4.2 Test Delay

After the test is started, the delay before the first step is delayed according to the set delay time of the system interface.The delay between multiple steps is delayed according to the items in the system interface.

4.4.3 Voltage Rise

Some of the characteristics of the DUT are sensitive to sudden changes in voltage and require this function.When the instrument starts to output, the output voltage is zero. When the voltage output starts, the instrument will control the output voltage to step up in 0.1S. The step boost value is determined according to the test voltage and voltage rise time ($\Delta V = V / (10 *)$. S)).If the voltage rise time (RISE OFF) is turned off, the default voltage rise time is 0.1 second, and the test time is automatically added, so that the test time minimum is 0.2S.If this value is too small, it may cause an error in the ARC or DC boosting determination. Please note.

4.4.4 DC boost decision

Whether the current upper limit determination function switch is activated during voltage rise is mainly used to avoid test misjudgment.
When the distribution capacitance is small, if the charging current of the capacitor is relatively small and does not cause a significant change in the current, the opening of the boosting determination can detect the poor performance of the DUT and reduce the probability of over current damage of the component.
When the step capacitance is large, the capacitor will have a charging process during the voltage rise. The current at this time may be much larger than the set upper limit of the measured current. If the boost determination is turned on, the upper limit misjudgment will be caused.If necessary, turn on the short-circuit threshold to reduce the short-circuit sensitivity and increase the charging current.

4.4.5 High Voltage Test

Perform high voltage test of the DUT. At this point, it should be possible to ensure that the test circuit is correct, and the test results are not affected by some special accompanying parameters. The display content is the actual withstand voltage and current required for the test.

4.4.6 Test Voltage Fall

As with the rise of the test voltage, it is determined by the characteristics of the DUT.When the high voltage test ends, the voltage falls, the instrument will control the output voltage fall in 0.1S units (the DC voltage will not decrease with the control voltage). The step-down value is determined according to the test voltage and voltage rise time ($\Delta V = - V / (10)$. *S)).If the voltage drop time (FAIL OFF) is turned off, the default voltage fall time is 0.1 second.At this time, the instrument does not make a test comparison judgment, the data is for reference only.When the voltage fall is over, the instrument will connect the test circuit to the AC withstand voltage mode. At this time, if the DC voltage falls, the device will discharge through the AC circuit of the instrument.

4.4.7 Ground Current Detection Function

Ground current detection is to detect the current flowing through the instrument chassis to prevent electric shock.When the high voltage is output, there is a current flowing from the voltage output terminal through the human body to the instrument chassis, which may cause very serious

consequences.

The instrument's ground current detection and judgment circuit response description:

- When local line current detection is enabled, the ground current is greater than 0.45mA and the ground current is over-limit.
- When judging the electric shock, the instrument will end the high voltage output within 0.3S and exit the test state.And display (GFI FAIL)

Note: The instantaneous output current of the instrument may be greater than 30 mA. If it is indeed an electric shock, it may cause the operator to stun or die.Therefore, it is recommended to turn on the ground current detection when the product allows.

4.4.8 Current Overrun and Arc Detection (ARC) Function

Current overrun classification: current lower limit, current upper limit, current overrun, arc detection.

- **Current lower limit judgment (LOW):** Generally used as a test for low-end disconnection, when the instrument is tested, the device will definitely have a certain leakage current, when the leakage current of the instrument test is less than the lower limit set current value, it is considered that the test fails (no device is connected), this function must be turned off if the measured component itself has a small leakage current. Judgment display (LOW FAIL) when overrun, this judgment is valid only in test mode, timed sampling, the rate is 100mS each time.
- **Current upper limit judgment (HIGH):** Most commonly used test current overrun judgment.When the instrument tests the equipment, the equipment will definitely have a certain leakage current. When the leakage current of the instrument test is greater than the upper limit set current value, it is considered that the equipment withstand voltage impedance is insufficient and the test fails. Judgment display (HI FAIL) when overrun, this judgment is valid only in test mode, timed sampling, the rate is 100mS each time.
- **Current limit determination:** Since the current sampling is judged to be slow, when the insulation collapses, the current changes rapidly, the sampling circuit cannot reflect in time, and the current peak exceeds the allowable output range of the instrument, which will trigger such over-limit judgment, Judgment display (SHORT FAIL) when overrun.Since the data cannot be collected after such current exceeds the limit, the output of the system is: the test result within 100mS before the current exceeds the limit.The current limit is twice the allowable output current of the instrument (1.5 times the peak value of AC).The fall time is invalid and **this judgment cannot be shielded.**
- **Arc Detection (ARC):** It is a very practical function for the measurement of coil components, it tests the local current oscillation caused by the instantaneous discharge of the local circuit in the high voltage test loop. Due to the superposition on the normal test current, the abrupt time is short, and the above ordinary current detecting circuit cannot make an appropriate judgment in response to the current change.The arc detection circuit filters out normal current values and only processes high speed current pulse changes.Since the low-pass filtering and the size of the arc are inherently random, this function can only estimate the extent of local sparking.Since the data cannot be collected after the current exceeds the limit, the output result at this time is the last test result when it is qualified. Judgment display (ARC FAIL) when overrun. ARC current test is qualitative analysis, the amount of size and test environment, test line distribution, etc., effect randomness is very large, pay attention when using.
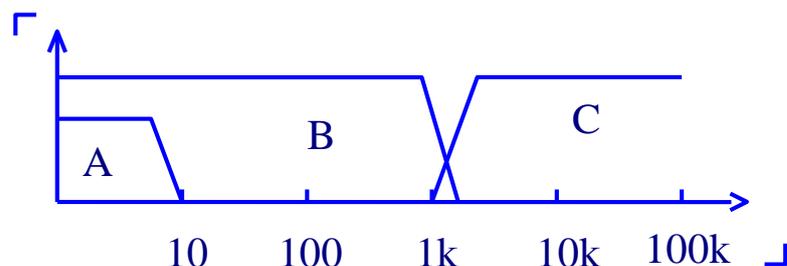
Comparison of frequency response of current overrun judgment and arc detection: (See the picture

above)

- ■ Area A in the figure: shows the circuit frequency response for current sampling. Because it is necessary to filter the ripple of the power supply frequency → AD sampling → calculate the test result → analyze whether the current exceeds the set limit. Within the test current range, the pulse width is greater than 100mS.
- ■ Area B in the figure: current fast response circuit.It only filters out high-frequency interference signals → voltage peak comparison → over-current peak signal lock, only do limit judgment.Larger than the instrument allowed output current, pulse width greater than 1mS.
- ■ Area C in the figure: arc detection circuit. The arc detection circuit only samples the amplitude of the sudden change in the current, and the signal high-pass filter removes the low frequency→voltage peak comparison→pulse lock. A sudden change edge in current near the set value, and the pulse width is about 1uS-1mS.

4.4.9 Failure Judgment

1. When the current exceeds the maximum output current that the instrument can withstand, or the instrument finds a safety hazard, the instrument will immediately cut off the voltage of the test circuit and wait for the instrument software to check the cause of the error and judge the failure.

2. If the test result exceeds the limit set by the test item, the instrument will judge that the test piece is unqualified. And immediately stop the current test, cut off the voltage output, and enter the processing procedure that the test result is unqualified.

3. When testing in multiple steps, so long as there is a step **FAIL**, the total test result is **FAIL**.

4.4.10 Test Result Processing

If the test process exceeds the limit, it is judged as unqualified, there are many test items, and the unqualified judgment processing mode is controlled by the system test mode. Otherwise, the instrument will display the failure judgment and category, waiting for the user to process.

After the test is over, there is no unqualified mark, and the test result is judged as (PASS). The pass judgment processing mode is controlled by SYSTEM PASS HOLD, and then ready to start the next step measurement or return to the test wait state.

In a multi-step test, the control signal output of the system is controlled by the **control mode**. Select FILE mode, then the test results will only be output when the entire file is tested. The end of the test is controlled by the **failure mode.** See the system option description for details.

From this state until the next project starts high pressure start, customers can use software to query test data and results.

4.4.11 STOP (Stop Measuring)

Press the STOP button in any state during the entire test, the instrument will automatically end the test, and there will be no test results to judge the output when the test is finished.

At the end of the test, the customer can use the software to query the test data.

4.4.12 OFFSET (The base is cleared)

Prior to testing, due to changes in the instrument's operating environment and test cable placement, some bases may appear during the instrument's no-load test. For customers who require accurate

measurement, they can be cleared by the SYSTEM interface. The specific steps are as follows:

    1. Set the current test conditions on the SETUP interface.

    2. Select the OFFSET item in the SYSTEM screen and set it to ON.

    3. Pressing GET will automatically start the high voltage test and zero the current test value.

    4. If the customer does not set the test time, then the test can be stopped with the STOP button.

Note:

Do not connect the product to the test terminal during GET. Clearing the product does not improve the actual test range of the instrument.

4.5 SCAN multi-cell multi-channel scanning controller structure and use

The structure of the TH90101/A controller is the high voltage relay matrix. The withstand voltage tester can directly control the matrix to realize the connection between the controller output and the output of the withstand voltage tester.

The TH90101 controller has 8 sets of test unit inputs, each of which corresponds to 4 scan output ports.

The TH90101A controller has 4 sets of test unit inputs, each of which corresponds to 4 scan output ports.

The TH9010/A withstand voltage meter can control up to 4 controllers, enabling 4*4=16 scan ports per test unit.

4.5.1 After adding multiple scan channels, the instrument will add SCAN (multiple) parameters

The number in the parameter indicates the corresponding output channel, and the color indicates the internal connection:

SCAN：	| 1 2 3 4 |	Connect 1 Scan Controller
	Black	Open Circuit State
	Red	It is connected to the high voltage end
	Green	It is connected to test end

4.5.2 Structural principle
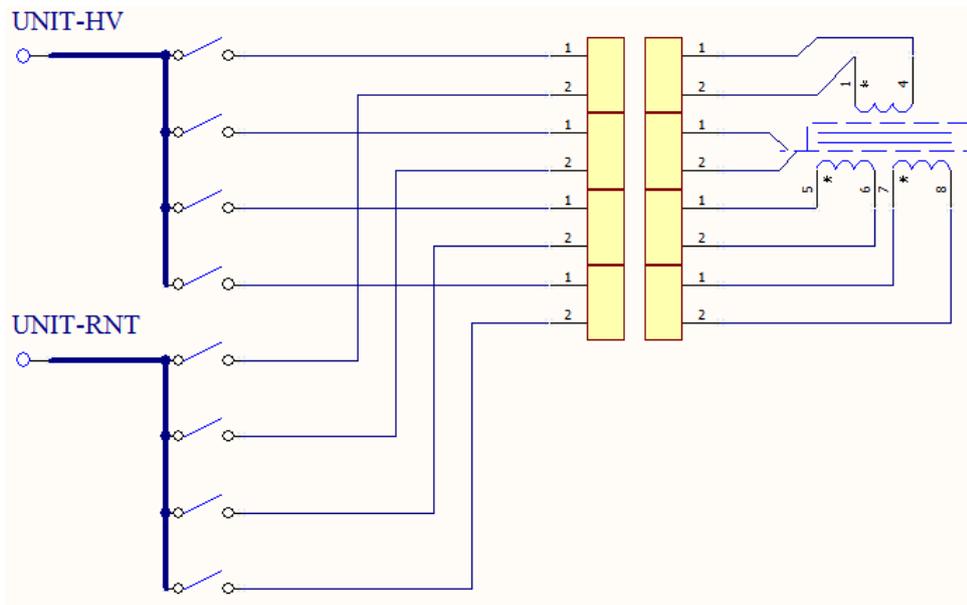
Description:

1. Multi-channel controller output port uses two-wire lead-out, can achieve single contact inspection

2. The contact check is similar to the DCR test. It is tested whether the two wires of the same port are connected. Due to the limited current resistance of the line itself, the test parameters are for reference only.

3. When the contact is inspected, the two leads of the same port cannot be directly shorted. Can be connected to different contacts of the same pin of the DUT; or two pins connected by resistors and inductors (see illustration).

When the port is not used as a contact check, the two wires can be short-circuited and connected to the DUT pin.

4.6 Structure and Use of HANDLER and SINGNAL Interface Circuit

4.6.1 Control Interface Theory

HANDLER interface and internal principle of SINGAL interface instrument. The interface signals are as follows:
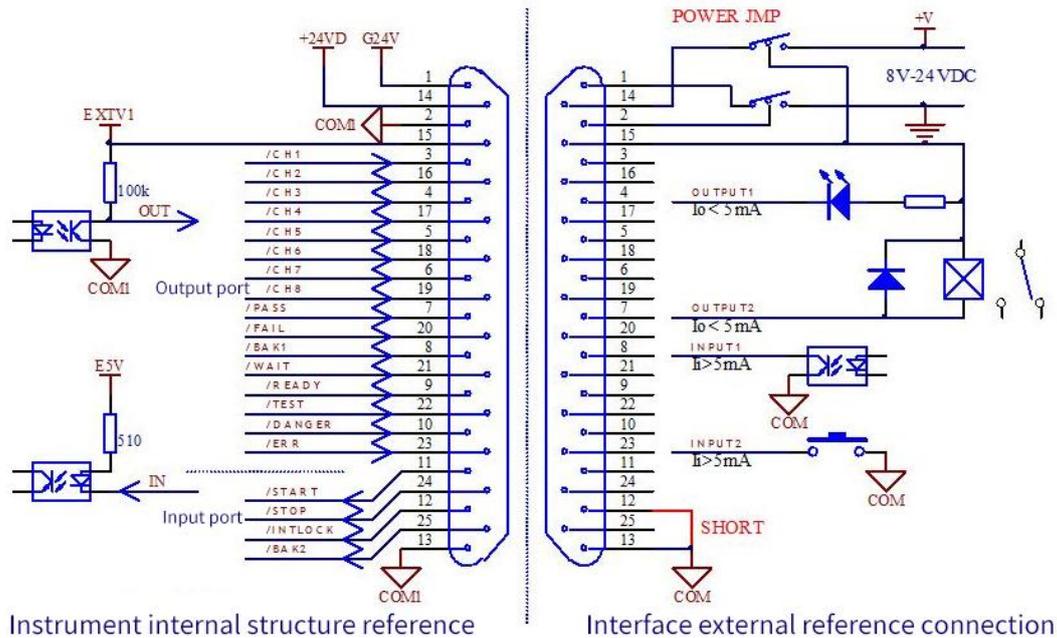
4.6.1 HANDLER interface structure

Description:

1. +24VD: +24Vdc power supply inside the instrument, COM1 at the low end. The **output current is 200mA**. When the POWER JMP is short-circuited, it provides a pull-up power supply for the output optocoupler, and an external LED can also be used for indication.

2. EXTV1: The external input port controls the power supply, and the low end is COM1. This pin can be connected to +24VD or an external 8-24V power supply. The internal current of the instrument is <50mA. **When this power supply is not connected**, the output optocoupler is only the **polar switch signal (C/E pole current direction)** on the secondary side of the optocoupler. **The input signal of the interface is invalid.**

3. E5V: Instrument input optocoupler power supply, generated by EXTV1 regulation. Used to give the input signal optocoupler power supply, the input signal is invalid when there is no such power supply.

4. INTLOCK: is the instrument online lock. **The instrument cannot start the high voltage output when disconnected here.**

5. The START and STOP signals form a remote input control. **Valid for shorting on COM1**

6. The TEST, PASS, FAIL, and DANGER signals form a remote output control, and the optocoupler pulls up the output signal. The specific effective state can be customized by the user, **the default is active low, and the optocoupler secondary side is turned on.**

The instrument is equipped with TH9010-IL at the factory. The connection method is short-circuited with the thick lead (POWER JMP) and (INTLOCK JMP) as shown above, and the other is left floating.

4.6.2 HANDLER Control Interface Main Signal Timing Description

Control interfaces are typically used for remote control and test synchronization or indication. The external connections of the interface are as follows:

HANDLER　Signal validity in coarsening（default mode）
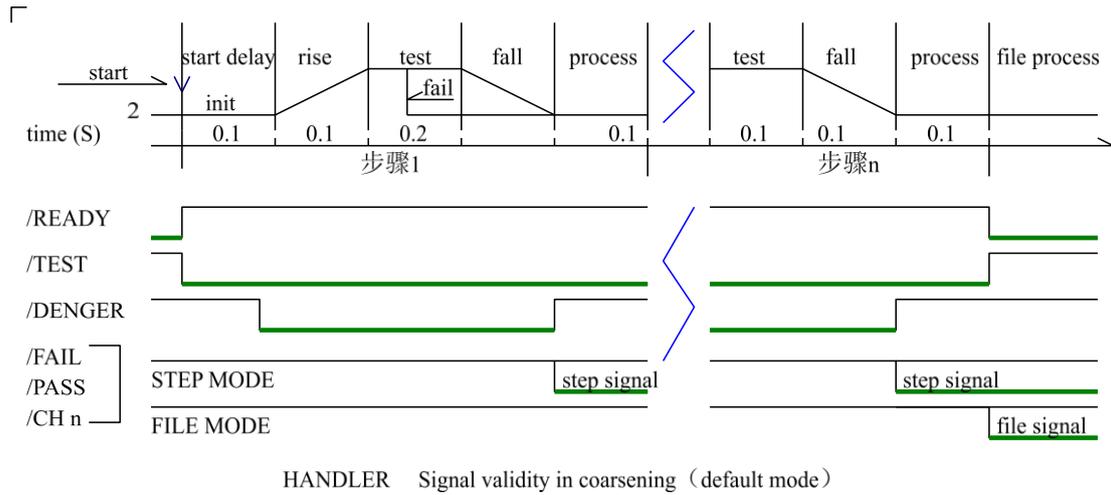
4.6.2 HANDLER interface timing diagram

4.7 File Storage Other interfaces and functions of the instrument

1. The USB DEV on the front panel is used to connect the USB flash drive for exporting and importing customer settings files and upgrading the instrument software.

2. The rear panel USB HOST has two working modes for connecting to the computer：

● USBTMC: Standard USB slave mode. Compatible with software format IEE488.

● USBVCOM: USB analog serial port mode, data format: 8.n.1. Compatible with software format IEE485.

3. RS232 is used to connect with the computer. The baud rate is shown in the system setting item, and the data format is 8.n.1. It is compatible with software format IEE485.

Chapter 5 Serial Port Commands Instruction

Brief Description of the Command Format:
1. The tester commands only describe the actual characters received or sent.
2. Command characters are all ASCII characters.
3. The data "<???>" of the command is an ASCII string. The default format of the system is integer or floating point number. The default data unit does not appear in the commands.
4. The command end must have an command end tag, and the default end tag is:
a) NL: new line, an integer of 10 (0x0A). An identifier for the end of a command, without this, the tester does not resolve the command.
b) ^END: EOI (end) signal of IEEE-488 bus.

Example of Multiple Commands to Simplify Sending:
FUNC：SOUR：STEP_1：AC：VOLT_1000；UPPC_1；TTIM_9.9；CH1_HIGH；CH2_LOW (NL^END)
FUNC：SOUR：STEP_INS (NL^END)
FUNC：SOUR：STEP_2：DC：VOLT_1000；UPPC_1；TTIM_9.9；CH1_HIGH；CH2_LOW (NL^END)
Note: In the above example, "_" is a space tag.

Subsystem commands of TH9010:
●DISPlay   ●FUNCtion
●SYSTem   ●MMEM   ●FETC

5.1 DISPlay Subsystem Commands

DISPlay subsystem commands are mainly used to set the instrument display page.
The :DISPlay? query returns to the current page.
Command Syntax: DISPlay:PAGE <page name>
Command Tree:

DISPlay: PAGE MEASurement   Set the display page to: measurement display page
             MSETup   Set the display page to: Measurement Setting Page
             SYSTem   Set the display page to: System Setting Page
             FLISt   Set the display page to: File List Page (FILE)

Command Syntax: DISPlay：PAGE <page name>
         Query syntax: ： DISPlay：PAGE?
         Return format: <page name><NL^END>

<page name> details as below:

MEASurement	Set the display page to: measurement display page
MSETup	Set the display page to: Measurement Setting Page
SYSTem	Set the display page to: System Setting Page
FLISt	Set the display page to: File List Page (FILE)

5.2 MMEM Subsystem Commands

MMEM: STOR   Store the current settings to a file stored internally as <filename>.

--Syntax:

   Command messag： MMEM：STOR ：STAT <file #>[，<file name>]

--Data<file #>：

   Data format： Integer

   Return Value： 1-20

   Data accuracy： 1

--Data<file name>：**[ ]**Internal is negligible

   Data format: characters

   Return Value： 1-15

MMEM:LOAD   **LOAD the internal file specified by the file name to the current.**

--Syntax:

   Command message: MMEM：LOAD ：STAT <file#>

--Data<file#>:

   Data format: Integer

   Return Value: 1-20

   Data accuracy: 1

5.3 FUNCtion Subsystem Commands

5.3.1 FUNCtion test, Stop instruction

Commands:

FUNC:	STARt	Start testing of the current test file
	STOP	Stop Test

5.3.2 FUNCtion File Editing Function Commands

Commands:

FUNC:	SOUR:	→	STEP	→	INS	Add a new test project
					NEW	Create a new empty test file
					DEL	Delete current test project
					UP	Previous test project
					DOWN	Next test project

5.3.3 FUNCtion Test Function, Test Parameter Commands

Commands:

```
FUNC： SOUR：  →  STEP<n>：  →  | AC：  →  | VOLT    <50-5000>
                                | DC：     | UPPC    <0.01-10.0>
                                | IR：      | LOWC    <0, 0.01-10.0>
                                | OS：      | TTIM    <0, 0.1-999.9>
                                | CK：      | RTIM    <0, 0.1-999.9>
                                | DK：      | FTIM    <0, 0.1-999.9>
                                           | ARC     <0, 0.1-20.0>
                                           | FREQ    <50, 60>
                                           | UNITx   <ON, OFF>
                                           | CHx     <HIGH, LOW, OPEN >


DC：  →  | VOLT    <50-6000>              IR：  →  | VOLT    <50-1000>
         | UPPC    <0.01-5.0>                      | UPPC    <0.01-5.0>
         | LOWC    <0, 0.01-5.0>                   | LOWC    <0, 0.01-5.0>
         | TTIM    <0, 0.1-999.9>                  | TTIM    <0, 0.1-999.9>
         | RTIM    <0, 0.1-999.9>                  | RTIM    <0, 0.1-999.9>
         | FTIM    <0, 0.1-999.9>                  | FTIM    <0, 0.1-999.9>
         | WTIM    <0, 0.1-999.9>                  | RANG    <0, 1-6>
         | ARC     <0, 0.1-20.0>                   | UNITx   <ON, OFF>
         | RAMP    <ON, OFF>                       | CHx     <HIGH, LOW, OPEN >
         | UNITx   <ON, OFF>
         | CHx     <HIGH, LOW, OPEN >


OS：  →  | OPEN    <10-100>               CK：  →  | VOLT    <100-500>
         | SHOT    <0, 100-500>                    | LOWC    <0.01-5.0>
         | GET                                     | UNITx   <ON, OFF>
         | STAN    <0.0-40.00>                     | CHx     <ON, OFF>
         | UNITx   <ON, OFF>
         | CHx     <HIGH, LOW, OPEN >    DK：  →  | VOLT    <100-500>
                                                  | LOWC    <0.01-5.0>
                                                  | UNITx   <ON, OFF>
                                                  | CHx     <HIGH, LOW, OPEN >
```

5.3.4 Specific Examples of Command Data Format

Commands for AC Setup Function

FUNC：SOURce：STEP<sn>：AC：VOLT   To set / inquiry about the voltage for ACW test.

   --Syntax:

        Command message: FUNC:SOUR:STEP   <sn>:AC:VOLT<voltage>

        Query message: FUNC:SOUR:STEP   <sn>:AC:VOLT?

   --Data<sn>: **(<sn> same below, no longer repeat)**

        Data format: integer

        Data range: 1~20

        Data accuracy: 1

--Data<voltage>:

>   Data format: integer
>
>   Data range: 50~5000
>
>   Data accuracy: 1
>
>   Data unit: V

--Example:

>   Set the voltage for ACW test in STEP1 as 1000V.
>
>   Command message: FUNC:SOUR:STEP 1:AC:VOLT 1000

--Return Message:

>   Query message: FUNC:SOUR:STEP 1:AC:VOLT?, returns to the current ACW
>   voltage in STEP 1, such as 1000.

FUNC: SOURce:STEP:AC:UPPC   To set/inquiry about the UPPER current for ACW test.

--Syntax:

>   Command message: FUNC:SOUR:STEP   <sn>:AC:UPPC<current>
>
>   Query message: FUNC:SOUR:STEP   <sn>:AC:UPPC?

--Data<current>:

>   Data format: float
>
>   Data range: 0.001 ~20.000 mA
>
>   Data accuracy: 0.001mA
>
>   Data unit: mA

--Example:

>   Set the upper current for ACW test in STEP1 as 1mA.
>
>   Command message: FUNC:SOUR:STEP 1:AC:UPPC 1

--Return Value:

>   Query message: FUNC:SOUR:STEP 1:AC:UPPC?
>
>   Return to the current limit of   ACW in STEP 1, such as 1

FUNC：SOURce：STEP <sn>：AC：LOWC To set /inquiry about the LOWER current for ACW test.
  (Syntax refer to **AC：UPPC**)

FUNC：SOURce：STEP <sn>：AC：TTIM   To set /inquiry about the TEST time for ACW test.

--Syntax:

>   Command message:FUNC：SOUR：STEP <sn>：AC：TTIM <time>
>
>   Query message: FUNC：SOUR：STEP <sn>：AC：TTIM?

--Data<time>:

>   Data format: float
>
>   Data range: 0～999.9   (0 is OFF)
>
>   Data accuracy: 0.1s
>
>   Data unit: s

--Example:

>   Set the TEST time for ACW test in STEP1 as 1s.
>
>   Command message: FUNC:SOUR:STEP 1:AC:TTIM 1
>
>   --Return Value:

Query message: FUNC:SOUR:STEP 1:AC:TTIM?

Return to the current test time of ACW in STEP 1, such as 1

FUNC：SOURce：STEP <sn>：AC：RTIM　　To set /inquiry about the RISE time for ACW test. (Syntax refer to **AC：TTIM**)

FUNC：SOURce：STEP <sn>：AC：FTIM　　To set /inquiry about the FALL time for ACW test. (Syntax refer to **AC：TTIM**)

FUNC：SOURce：STEP <sn>：AC：ARC　　To set /inquiry about the ARC upper current for ACW test.

　　--Syntax:

　　　　Command message: FUNC:SOUR:STEP　　<sn>:AC:ARC<current>

　　　　Query message:　　　FUNC:SOUR:STEP　　<sn>:AC:ARC?

　　--Data<current>:

　　　　Data format: float

　　　　Data range:　　0~20.0 mA　　　　(0 is OFF)

　　　　Data accuracy: 0.1mA

　　　　Data unit: mA

　　　--Example:

　　　　Set the ARC upper current for ACW test in STEP1 as 1mA.

　　　　Command message: FUNC:SOUR:STEP 1:AC:ARC 1

　　　--Return Message:

　　　　　Query message: FUNC：SOUR：STEP 1：AC：ARC?

　　　　　Return to the ARC current upper limit of ACW in STEP 1, such as 1.000

FUNC：SOURce：STEP <sn>：AC：FREQ　　To set /inquiry about the test frequency for ACW test.

　　--Syntax:

　　　　Command message: FUNC：SOUR：STEP <sn>：AC：FREQ<frequency>

　　　　Query message:　　　FUNC：SOUR：STEP <sn>：AC：FREQ?

　　--Data<frequency>:

　　　　Data format: character

　　　　Data range: 50/60

　　　　Data unit: Hz

　　--Example:

　　　　Set the test frequency for ACW test in STEP1 as 50Hz.

　　　　Command message: FUNC:SOUR:STEP 1:AC:FREQ:50

　　--Return Message:

　　　　Query message: FUNC:SOUR:STEP 1:AC:FREQ?

　　　　Return to the test frequency of ACW in STEP 1, such as 50.

FUNC：SOURce：STEP <sn>：AC：UNIT1　　To set /inquiry about the multiple channels for ACW test.

--Syntax:

Command message: FUNC：SOUR：STEP <sn>：AC：UNIT1 <channel switch>

Query message: FUNC：SOUR：STEP <sn>：AC：UNIT1?

--Data<channel>:

Data format: character

Data range: ON/OFF (0/1)

--Example:

Set UNIT1 of ACW in STEP 1 to ON

Command message: FUNC：SOUR：STEP 1：AC：UNIT1 ON/1

--Return Message:

Query message: FUNC：SOUR：STEP 1：AC：UNIT1?

Return to the UNIT 1's switch of ACW in STEP 1, such as ON

Note: Other channels are same, for example:

--Example:

Set UNIT2 of ACW in STEP 1 to OFF

Command: FUNC：SOUR：STEP 1：AC：UNIT2 OFF/0

--Return Message:

Query message: FUNC：SOUR：STEP 1：AC：UNIT2?

Return to the UNIT 2's switch of ACW in STEP 1, such as OFF

FUNC：SOURce：STEP<sn>：AC：CH1   To set /inquiry about the scan box for ACW test.

--Syntax:

Command message: FUNC：SOUR：STEP <sn>：AC：CH1 <scan method>

Query message: FUNC：SOUR：STEP <sn>：AC：CH1?

--Data<scan method>:

Data format: character

Data range: HIGH/LOW/OPEN

--Example:

Set CH1 of ACW in STEP 1 as HIGH

Command message: FUNC：SOUR：STEP 1：AC： CH1 HIGH

--Return Message:

Query message: FUNC：SOUR：STEP 1：AC： CH1?

Return to CH1 of ACW in STEP 1, such as HIGH

Note: Other scan methods are same, for example:

--Example:

Set CH2 of ACW in STEP 1 as LOW

Command message: FUNC：SOUR：STEP 1：AC： CH2 LOW

--Return Message:

Query message: FUNC：SOUR：STEP 1：AC： CH2?

Return to CH2 of ACW in STEP 1, such as LOW

Commands for DC Setup Function

FUNC：SOURce：STEP <sn>：DC：WTIM   To set /inquiry about the wait time for DCW test.
 (Syntax refer to **AC：TTIM**)

 FUNC：SOURce：STEP <sn>：DC：RAMP   To set/query the ramp state of DCW.
   --Syntax:
         Command message:
                        FUNC：SOUR：STEP <sn>：DC：RAMP：<ON/OFF> or <1/0>
         Query message:
                        FUNC：SOUR：STEP <sn>：DC：RAMP：?
   --Example:
        Set the status of RAMP of DCW in STEP 1 as：ON
        Command message: FUNC：SOUR：STEP 1：DC：RAMP ON
   --Return Message
        Query message: FUNC：SOUR：STEP 1：DC：RAMP?
        Return to RAMP status of DCW in STEP 1, such as ON

Commands for IR Setup Function

FUNC：SOURce：STEP <sn>：IR：UPPC   To set /inquiry about the UPPER resistance for IR test.
  --Syntax:
        Command message：FUNC：SOUR：STEP <sn>：IR：UPPC <resistance >
                         Query message：FUNC：SOUR：STEP <sn>：IR：UPPC?
   --Data< resistance>:
        Data format: float
        Data range: 0, 0.1~10000MΩ   (0 is OFF)
        Data accuracy: 0.1 MΩ
        Data unit: MΩ
    --Example:
        Set the upper resistance for IR test in STEP1 to 1 MΩ.
        Command message: FUNC：SOUR：STEP 1：IR：UPPC 1
   --Return Message:
        Query message: FUNC：SOUR：STEP 1：IR：UPPC
        Return to upper limit of IR in STEP 1, such as 1

FUNC：SOURce：STEP <sn>：IR：LOWC   To set /inquiry about the LOWER resistance for IR test.
   (Syntax refer to **IR：UPPC**)

FUNC：SOURce：STEP <sn>：IR：RANG   To set /inquiry about the RANG for IR test.
   --Syntax:
        Command message: FUNC：SOUR：STEP <sn>：IR：RANG <rang>
        Query message: FUNC：SOUR：STEP <sn>：IR：RANG?

--Data<range>:

        Data Format: Integer

        Data Range: 0~6 (0 is AUTO, 1 is 5mA, 2 is 1mA, 3 is 100uA,

                                    4 is 10uA, 5 is 1Ua, 6 is 0.1uA,)

--Example:

        Set the range for IR test in STEP 1 to: 5mA

        Command message: FUNC：SOUR：STEP 1：IR：RANG 1

--Return Message:

        Query message: FUNC：SOUR：STEP 1：IR：RANG?

        Return to test range of IR in STEP 1, such as 1

Commands for OS Setup Function

FUNC：SOURce：STEP <sn>：OS：OPEN   To set /inquiry about the OPEN rate for OS test.

  --Syntax:

        Command message: FUNC：SOUR：STEP <sn>：OS：OPEN<rate>

        Query message: FUNC：SOUR：STEP <sn>：OS：OPEN?

  --Data<rate>:

        Data format: integer

        Data range: 10~100

        Data accuracy: 1

  --Example:

        Set the OPEN rate for OS test in STEP1 as 50%.

        Command message: FUNC:SOUR:STEP 1:OS:OPEN 50

  --Return Message:

        Query message: FUNC:SOUR:STEP 1:OS:OPEN?

        Return value: 50

FUNC：SOURce：STEP <sn>：OS：SHOT   To set /inquiry about the SHOT rate for OS test.

  --Syntax:

        Command message: FUNC:SOUR:STEP   <sn>:OS:SHOT<rate>

        Query message: FUNC:SOUR:STEP   <sn>:OS:SHOT?

  --Data< rate>:

        Data format: integer

        Data range: 0~500   (0 is OFF)

        Data accuracy: 10

  --Example:

        Set the SHOT rate for OS test in STEP1 as 100%.

        Command message: FUNC：SOUR：STEP 1：OS：SHOT 100

  --Return Message:

        Query message: FUNC：SOUR：STEP 1：OS：SHOT?

        Return value: 100

FUNC:SOURce:STEP:OS:STAND   To set /inquiry about the STANDARD capacitance for OS

                                          test.

--Syntax:

    Command message: FUNC:SOUR:STEP　<sn>:OS:STAND<capacitance >

    Query message: FUNC:SOUR:STEP　<sn>:OS: STAND?

--Data< capacitance >:

    Data format:　float

    Data range:　　0.001 ~40.0nF

    Data accuracy: 0.001nF

    Data unit: nF

--Example:

    Set the standard capacitance for OS test in STEP1 to 1nF.

    Command message: FUNC:SOUR:STEP 1:OS:STAND 1

--Return Message:

    Query message: FUNC:SOUR:STEP 1:OS: STAND?

    Return value: 1.000

FUNC：SOURce：STEP <sn>：OS：GET　　　　Get current channel data as standard value.

    <u>*Note*</u>: ***The instrument will initiate an OS test to get the current port value as a standard. Please confirm that the port and test loop are configured correctly and pay attention to the test safety.***

Commands for CK Setup Function

FUNC：SOURce：STEP <sn>：CK：CH1　　　　To set/ query CK scan box.

(There are only two states for CHx at CK.)

    --Syntax:

        Command message: FUNC：SOUR：STEP <sn>：CK：CH1<scan type >

        Query message: FUNC：SOUR：STEP <sn>：CK：CH1?

    --Data< scan type >:

        Data format:　character

        Data range:　ON/OFF(1/0)

    --Example:

        Set CH1 of CK in STEP 1 to ON

        Command message: FUNC：SOUR：STEP 1：CK：　CH1 1

   --Return Message:

        Query message: FUNC：SOUR：STEP 1：CK：　CH1?

        Return value: ON

Note:

The CK function is used to check if the two leads are connected between the same test end.
The instrument automatically detects step by step when detecting multiple test ends.

Commands for DK Setup Function

FUNC：SOURce：STEP <sn>：DK：CH1　　　　To set/ query DK scan box

    --Syntax:

        Command message: FUNC：SOUR：STEP <sn>：DK：CH1<scan type >

        Query message: FUNC：SOUR：STEP <sn>：DK：CH1?

--Data< scan type >:

    Data format: character

    Data range: HIGH/LOW/OPEN

  --Example:

    Set CH1 of DK in STEP 1 to ON

    Command message:FUNC：SOUR：STEP 1：DK：CH1 HIGH

--Return Message:

    Query message: FUNC：SOUR：STEP 1：DK：CH1?

    Return value: HIGH

  Note: Other scanning equivalents, for example:

  --Example:

    Set CH2 of DK in STEP 1 to OFF

    Command message:FUNC：SOUR：STEP 1：DK：CH2 HIGH

  --Return Message:

    Query message: FUNC：SOUR：STEP 1：DK：CH2?

    Return value: HIGH

Note:

1. The DK function is used to check whether the two test terminals are connected. It is necessary to set one channel to be connected high, and one channel to be low to form a loop.

DK detection must be performed separately when multiple loops occur, otherwise it will be missed.

5.4 SYSTem Subsystem Commands

Commands:

```
SYSTem:  →  PASS    <0,0.1-99.9>
            STEP    <0,0.1-99.9>
            GFI     <ON, OFF>
            FAIL    < STOP/CONT/REST/NEXT>
            DELAy   <0,0.1-99.9>
            OFFSet  <ON/OFF/GET>
            CTRL    <STEP/FILE>
```

SYSTem: PASS   To set/ query the time of PASSHOLD

  --Syntax:

    Command message: SYST：PASS<time>

      Query message: SYST：PASS?

  --Data:

    Data format: float

    Data range: 0~99.9

    Data accuracy: 0.1

    Data unit: s

  --Example:

    Set PASSHOLD to 1.0s

    Command message:SYST：PASS 1

--Return Message:
  Query message: SYST：PASS?
  Return value: 1.000.

SYSTem：STEP   To set/ query the intervals of PASSHOLD **(please refer : SYST：PASS)**

SYSTem：GIF   To set /query about the status for GFI.
  --Syntax:
        Command message: SYST：GFI <ON/OFF> or <1/0>
          Query message: SYST：GFI?
  --Data<ON/OFF>
      Data format: character
      Data range: 0 (OFF), 1 (ON)
  --Example:
       Set GR CONT as ON
       Command message:SYST：GFI   ON or：SYST：GFI ：1
  --Return Message:
      Query message: SYST： GFI?
      Return value: 1

SYSTem：FAIL   To set /query about the state for AFTR FAIL.
  --Syntax:
      Command message: SYST：FAIL <0/1/2>
      Query message:SYST：FAIL?
  --Data< STOP/CONT/PAUS>
      Data format: character
      Data range: 0~3
  --Example:
       Set AFTR FAIL as STOP
       Command message:SYST：FAIL 0
  --Return Message:
      Query message: SYST： FAIL?
      Return value: 0

SYSTem：DELAy   To set /inquiry about the test delay time. (please refer : **SYST：PASS**)

SYSTem：OFFSet   To set /inquiry about the offset status.
  --Syntax:
        Command message: SYST： OFFS<ON/OFF/GET> or <1/0/G
        Query message:SYST： OFFS?
  --Data<ON/OFF/GET>:
      Data format: character
      Data range: 0 (OFF), 1 (ON), GET (get offset value)

--Example:

Set OFFS as ON

Command message: SYST： OFFS ON or：SYST： OFFS 1

--Return Message:

Query message: SYST： OFFS?

Return value: 1

--Get the current value directly:

Command message: SYST： OFFS GET

5.5 Other Commands

*IDN   Query instrument model, version information

Return Value: <manufacturer>, <model>, <firmware> <NL^END>

Here:

<manufacturer>   name (Tonghui)

<model>   model (such asTH9010)

<firmware>   firmware version (such as Version1.0.0)

For example: WrtCmd ("*IDN?");

FETCh   To fetch the measurement results

--Syntax:

Command message: FETCh：AUTO <ON/OFF> or <1/0>

Query message: FETCh?

--Data<ON/OFF> or <1/0>:

Data format: character

Data range: 0 (OFF), 1 (ON)

--Example:

To set automatically return the test data to ON

Command message:FETCh：AUTO ON or：FETCh：AUTO 1

--Return Message:

Query message: FETCh? Return to the result of the current measurement of the instrument.

Command: FETCh?

After the instrument receives this command, the instrument will automatically send out the test results until the end of the test.

Return format:

<u>Step</u>：<u>test project</u>：<u>test unit</u>，<u>test voltage(V)</u>，<u>test current(mA)</u>，<u>sorting result</u>；

<u>(1)</u>   <u>(1)</u>   <u>(2)</u>   <u>(2)</u>   <u>(2)</u>   <u>(3)</u>

<u>(1)</u>：The separator between the step and the project, between the project and the unit test data is (:)

<u>(2)</u>：The separator between the unit test data is (,). The separator between different unit data is (;)

<u>(3)</u>：The separator between steps is (; + space). The data terminator defaults to (0x0A).

Note:

1. All data is an integer or floating point number. The default unit is the same as the FUNC

instruction set.

    2. All characters are ASCII characters

For example: turn on UNIT1, UNIT3.

All test results are   STEP1：AC：1000V, test current 1mA, PASS.

                    STEP2：IR： 500V, test IR 100M, PASS.

Returned data format:

STEP1：AC：1, 1000, 1.000, PASS; 3, 1000, 1.000, PASS; (SPACE)

STEP2：IR：1, 500, 100.000, PASS; 3, 500, 100.000, PASS (0x0A)

Chapter 6 Appendix

1. Specific parameters

Model			TH9010 series single channel parameters
Withstanding voltage test			
Output Voltage	**AC**	**range**	0.050kV—5.000kV
		waveform	Sinusoidal Wave
		distortion	< 3%
		frequency	50, 60Hz selectable
		accuracy	±1%
		Output power	50VA (5.000kV 10mA)
		Voltage regulation	±(1.0% +50V) (rated power)
	DC	**range**	0.050 kV—6.00kV
		Source frequency	600Hz
		Output power	25VA (5.000kV 5mA)
		Voltage regulation	±(1.0% +100V) (rated power)
	Voltage resolution		1V
	Voltage output accuracy		±(2.0% reading+5V) (no load)
	Voltage generation method		DDS signal source plus PWM amplifier
Current test range	**AC**	**Current range**	0.001mA – 10mA
		SC current (moment)	>20 mA (setted output voltage >500V)
		Current resolution	0.001 mA
		Current accuracy	±(2% reading +5 digits)
		Actual current	OFF-0.001 mA-10mA
	DC	**Current range**	0.1uA – 5.00mA
		Current accuracy	±(2.0% reading +5 digits)
	Discharge Function		Automatic discharge after the test (DCW)
IR Test			
Output Voltage			0.050V – 1.000V
Voltage Resolution			1V
Voltage Accuracy			±(1.0% range+5V)
Max. Output Current			5mA
Max. Output Power			5VA (1000V/5mA)
Output instantaneous short circuit current			>10mA (Setted output voltage>500V)
Load Adjustment Rate			≤1% (rated power)
Ripple（1kV）			≤3% (1kV, no load)

Discharge Function	Automatic discharge after the test
Resistance Test Range	0.02MΩ– 10GΩ
Resistance display range (1000V)	5mA 0.2 MΩ-1 MΩ 1mA 1 MΩ-10 MΩ 100uA 10 MΩ-100 MΩ 10uA 100 MΩ-1GΩ 1uA 1GΩ-10GΩ
Accuracy of resistance measurement	≥500V 1MΩ– 100MΩ ±(5% range +5 digits) 100MΩ– 10GΩ±(10% range+5 digits) < 500V 0.1MΩ– 100MΩ±(10% range+5 digits) 1GΩ– 10GΩ for reference only no precision requirement
Accuracy of current measurement	±(2% range +5 digits) (After clearing)

ARC Detection		
Test Range	**AC**	1mA – 20mA
	DC	1mA – 20mA

Comparator		
Judgment method		Window comparison mode I_{low} ON: when $I_{low} < I_x < I_{upper}$, PASS; when $I_x \leq I_{lower}$ or $I_x \geq I_{upper}$, FAIL (condition $I_{lower} < I_{upper}$) I_{low} OFF: when $I_x < I_{upper}$, PASS; when $I_x \geq I_{upper}$, FAIL The insulation resistance discrimination method is the same as the above.
Current upper limit setting	AC	0.001mA – 10mA
	DC	0.1uA – 5mA
Current lower limit setting (LOWER OFF)	AC	0.001mA – 10mA
	DC	0.1uA –5mA
Resistance upper limit setting		OFF - 0.1MΩ - 10GΩ
Lower Resistance Limit Setting		0.01MΩ– 10GΩ (The minimum actual current of the lower limit shall not be greater than 5mA)
Discriminant output		PASS/FAIL LCD and LED display respectively, sound alarm

Parameter Setting	
Voltage rise time	0.1s – 999.9s
Voltage fall time	0s – 999.9s, (Effective only after voltage withstanding PASS)

Voltage waiting time	0.3s – 999.9s (Only DC withstand voltage, and meet (rise time < wait time < (rise time + test time))
Test time setting	0.3s – 999.9s (at TIMER ON)
Time Accuracy	±(0.2% set value+ 0.1s)
Measuring Function	
Keyboard lock	Prevent accidental modification of test conditions or prohibit modification of test conditions
Base Clearing Function	Current flowing through insulation resistance and distributed capacitance between output lines can be cleared
Start Wait Delay	At the beginning of the test (press **START**), output the high-voltage start signal, wait for a certain time, then start the high-voltage output.
Judgment of Current Overrange	The hardware quickly judges the insulation collapse, which is faster and safer than voltage sampling, reducing the impact damage to the product.
ARC Detection	Abrupt signal of sampling current, to determine the potential hidden dangers of the loop and the approximate scale
Ground current detection	Protect personal safety in case of accidental electric shock or leakage of high voltage to the outer shell
Alarm volume adjustment	OFF, High, Low
High Voltage Indication	Window Indicator and LED Light Indicator
Storage and Interface	
File Programming and Storage	Programmable 20 test files, 16 test steps can be set for AC, DC and insulation resistance in each file.
USB Interface	Yes
Boot parameter saving	The setting parameters are saved as default parameters, which can be automatically restored after the next boot.
Control interface	HANDLER, SINGAL
Communication interface	RS232C, USB

2. Model function correspondence table

	ACW	DCW	IR	OS	Test Unit	Scanning Module	S.CK	D.CK
TH9010	*	*	*	*	8channels	TH90101	*	*
TH9010A	*	*	*	*	4channels	TH90101A	*	*

Each scanning module provides four scanning channels for each unit and up to four scanning modules can be connected.

S.CK and D.CK are dedicated functions of the scanning module.

General Technical Indicators

General technical indicators		
Ambient Temperature and Humidity		0°C－40°C,　≤80%RH
Power		100V-242V　47.5-63Hz
Power consumption		≤1200VA
Dimension	TH9010	340mm×120mm×450mm
	TH9010A	340mm×120mm×450mm
Weight	TH9010	About 40kg
	TH9010A	About 25kg