Operation Manual

TH2848 Series
Precision Impedance Analyzer

V1.4@202412

Catalogs

Chapter 1 Out-of-the-box Installation

This chapter describes the checks you must perform when you receive the unit and the conditions you must know and have before installing and using the unit.

1.1 Unpacking and Inspection

Product Model	TH2848-02	TH2848-02L	TH2848-05	TH2848-10
Maximum Test Frequency	4Hz~2MHz	4Hz~2MHz	4Hz~5MHz	4Hz~10MHz
Maximum AC Voltage	0Vrms - 20Vrms 0Arms - 100mArms	0Vrms - 2Vrms 0Arms - 20mArms	0Vrms - 20Vrms 0Arms - 100mArms	0Vrms - 20Vrms 0Arms - 100mArms
Maximum DC Bias Voltage	0V - ±40V 0mA - ±100mA	0V - ±10V 0mA - ±100mA	0V - ±40V 0mA - ±100mA	0V - ±40V 0mA - ±100mA
Analysis Function	Piezoelectric Admittance Circle Test Dielectric Constant Test	None	Piezoelectric Admittance Circle Test Dielectric Constant Test	Piezoelectric Admittance Circle Test Dielectric Constant Test
Independent Voltage Source	-10V ~ +10V, Minimum resolution 1mV (output internal resistance 100Ω)			
Test Parameter	Cp, Cs, Lp, Ls, Rp, Rs, X, G, B, |Z|, |Y|, D, Q, θd, θr, Rd, Vac, Iac			
Signal Source Output Impedance	100Ω, ±1% @1kHz			
Rd Test Signal	Voltage: 100mV - 1V, resolution: 100μV (Current: 0mA - 10mA, resolution: 1μA)			
Display	10.1" capacitive touch screen, 1280x800			
Measurement Accuracy	Basic accuracy 0.05% (see instruction manual for details)			
Multi-function Parameter List Scanning	201 points, Scanning Parameters: Measurement Parameters, Test Frequency, AC Voltage, AC Current, DC BIAS Voltage, DC BIAS Current Dielectric constant measurement function is implemented based on the parameter settings of each point in this list.			
Graphic Scan Analysis	Frequency, ACV, ACI, DCVBIAS, DCIBIAS 51/101/201/401/801 points can be selected, the scanning graph can be stored in internal FLASH, external USB or uploaded to the host computer. The combination of parameters can be freely selected. The general condition setting is realized with a piezoelectric admittance circle test function common trace scan.			
Common Function	Serial and parallel equivalent mode, test cable length: 0m/1m Average: 1-255 times, calibration: open circuit, short circuit, load Range selection: auto, manual, trigger mode: continuous, single, trigger delay: 0-60s, keyboard lock function			
Special Function	4 parameters in any combination, simultaneous testing, one-key screenshot and one-key record function, embedded help system			
Comparator	10-speed sorting, PASS/FAIL indication and Bin counting function			
Storage	The machine has 8GB of storage space, and after deducting the space occupied by the system, users have about 6GB of available space.			

	The USB memory stick is used to store setting files, data log files and picture files.

Thank you for purchasing and using our products. After unpacking, you should first check that the instrument has not been damaged in transit. We do not recommend switching on the instrument if it is damaged.

Then check the contents against the packing list in the last chapter. If there is any discrepancy, please contact our company or the distributor as soon as possible to protect your rights.

1.2 Power Connection

Supply voltage range: 100 ～ 120 Vac or 198 ～ 242 Vac. (Related to rear panel power settings)

Supply frequency range: 47 Hz ～ 63 Hz.

Power supply range: not less than 80 VA.

The power input phase line L, zero-line N and ground line E should be the same as the power plug of this instrument.

This instrument has been carefully designed to reduce interference caused by AC power input, but it should still be used in a low-noise environment as much as possible. If it is unavoidable, please install a power filter.

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WARNING: In order to prevent leakage of electricity from harming the instrument or people, the user must ensure that the ground wire of the power supply is reliably connected to earth.

1.3 Fuse

The device is equipped with a fuse at the factory, and the user should use the fuse provided by the company.

Warning: Before turning on the power, check that the position of your fuse matches the supply voltage range.

1.4 Environment

Please do not use the device in dust, vibrating, direct sunlight or corrosive atmosphere.

The instrument should be used under normal operating conditions at a temperature of 0°C to 40°C and a relative humidity of ≤75%; therefore, please use the instrument under these conditions as much as possible to ensure measurement accuracy.

The rear panel of this tester is equipped with a heat dissipation device to prevent the internal temperature from rising. To ensure good ventilation, do not block the left and right ventilation holes to maintain the accuracy of the instrument.

This instrument has been carefully designed to reduce interference caused by AC power input. However, it should be used in a low-noise environment as much as possible. If this is unavoidable, please install a power filter.

If the instrument is not to be used for a long time, please store it in its original box or similar box in a ventilated room with a temperature of 5℃~40℃ and a relative humidity of not more than 85%RH. The air should not contain harmful impurities that may corrode the instrument, and direct sunlight should be avoided.

The instrument, especially the test leads connected to the measured part, should be kept away from strong electromagnetic fields to avoid interference with the measurement.

1.5 Using the Test Fixture

Please use the test fixture or test cable supplied by our company. **If you use a test fixture or test cable made by yourself or another company, the measurement results may be inaccurate.** The instrument test fixture or test lead should be kept clean, and the pins of the DUT should be kept clean to ensure good contact between the DUT and the fixture.

Connect the test fixture or cable to the four test terminals Hcur, Hpot, Lcur, and Lpot on the front panel of the instrument. For DUTs with shielded enclosures, the shield can be connected to the instrument ground "⊥".

Note: If no test fixture or test cable is installed, the instrument will display an unstable measurement result.

1.6 Preheating

To ensure accurate measurement, the instrument should be turned on and allowed to warm up for at least 15 minutes.

Do not turn the instrument on and off frequently to avoid causing internal data confusion.

1.7 Safety Requirements

The measuring instrument is a Class I safety instrument.

It complies with the safety requirements of Directive 2006/95/EC

EN 61010-1:2010+A1:2019 Safety requirements for electrical equipment for measurement, control, and laboratory use

Insulation Resistance:

Under reference operating conditions, the insulation resistance between the power terminal and the case shall be no less than 50MΩ.

Under hot and humid conditions during transportation, the insulation resistance between the power terminals and the case shall be no less than 2MΩ.

Dielectric Strength:

Under reference operating conditions, the power terminals and the case shall withstand an alternating voltage of 1.5kV at a frequency of 50Hz for 1 minute. There shall be no breakdown or arcing.

Leakage Current:

The leakage current shall not exceed 3.5mA (AC RMS).

1.8 Electromagnetic Compatibility

Electromagnetic Compatibility Requirements

Conforms to Directive 2004/108/EC Electromagnetic Compatibility Requirements

EN 61326-1:2021 Electromagnetic compatibility requirements for electrical equipment for measurement, control and laboratory use

CISPR 11:2015+A1:2016+A2:2019 Radiated and conducted emissions, Group 1, Class A

EN 61000-4-2:2009 Electrostatic discharge immunity

EN 61000-4-3:2020 Radiated, radio frequency, electromagnetic field immunity

EN 61000-4-4:2012 Electrical fast transient/burst immunity

EN 61000-4-5:2014+A1:2017 Power line surge immunity

EN 61000-4-6:2014 Conducted radio frequency immunity

EN 61000-4-11:2020 Immunity to voltage drops and interruptions

EN 61000-3-2:2019+A1:2021 Harmonic emission for AC power supply lines

EN 61000-3-3:2013+A1:2019+A2:2021 Voltage variations, fluctuations and flicker

1.9 Other Features of the Instrument

Power consumption: Power consumption ≤130VA.

Overall dimensions (W*H*D): 430mm*177mm*265mm.

Weight: About 11kg.

Chapter 2 Overview

This chapter describes the basic operating characteristics of the TH2848 series instrument. Please read this chapter carefully before using the TH2848 series instrument so that you can quickly learn how to operate it.

2.1 Front Panel Description

Figure 2-1 provides a brief description of the TH2848 front panel.

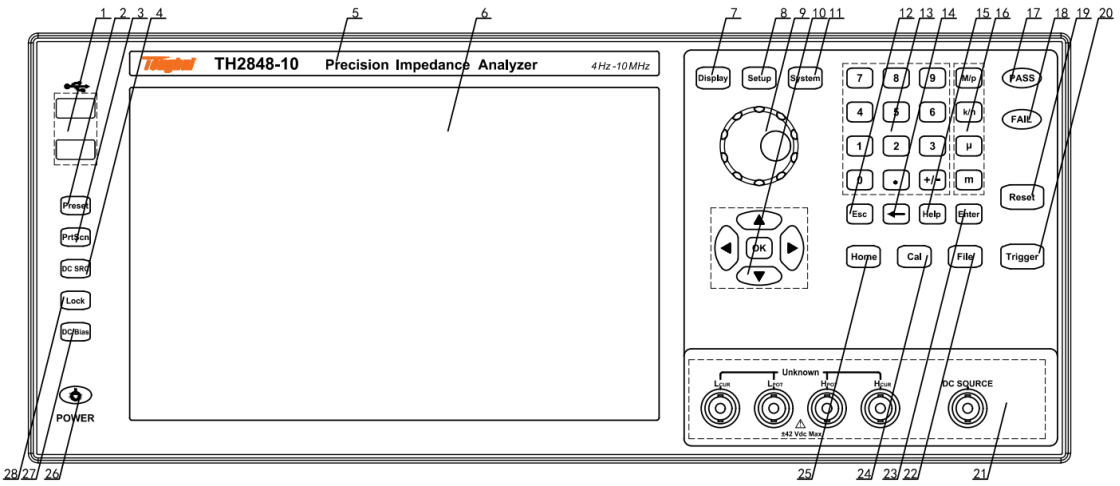


Figure 2-1. Front Panel Description

Label	Name	Meaning
1	USB HOST Interface	Equipped with two USB HOST interfaces for connecting USB flash drives to store and retrieving files, and for connecting devices such as mice, keyboards and scanners. Note that only one USB flash drive can be inserted at a time.
2	[Preset] key	Preset key: Press [Preset] to reset the machine to factory default settings.
3	[PrtScn] key	Screenshot key: Save an image of the current interface to a USB flash drive.
4	[DC SRC] key	Independent power source output key: Output status is indicated by LED status
5	Trademarks & Models	Instrument trademarks and models
6	LCD	1280x800 colour LCD capacitive touch screen display showing test results, test conditions, etc.
7	[Display] menu key	Press [Display] to enter the test display page corresponding to the instrument function.
8	[Setup] menu key	Press [Setup] to enter the test setting page corresponding to the instrument function.

9	Knob with confirmation function	Move the cursor to select and set parameters. The middle confirm key is used to terminate data input and confirm and save the data entered by the knob.
10	Cursor key and OK key	The cursor keys consist of up (↑), down (↓), left (←) and right (→) and are used to move the cursor between fields on the LCD display. When the cursor is moved to a field, the field is highlighted on the LCD display. The middle of the cursor keys is the OK key, which has a similar function to the [Enter] key.
11	[System] menu key	Press [System] key to enter the system setting page.
12	[Esc] key	Exit key.
13	Numeric key	The numeric keys are used to enter data into the instrument. The numeric keys consist of the number keys [0] to [9], the decimal point [.], and the [+/-] keys.
14	[←] key	Backspace key. Press this key to delete the last digit of the entered value.
15	[Help] key	Help key: Press the [Help] key and the [Help] key will light, and the display will show the meaning of the function and operating instructions at the location of the cursor. If you press the [Help] key again, the [Help] key goes out and the instruction window disappears.
16	Quantum key	The magnitude key is used to enter the magnitude of the corresponding parameter.
17	PASS indicator	Test pass LED indicator
18	FAIL indicator	Test fail LED indicator
19	[Reset] key	Press the [Reset] key to trigger a pause after triggering.
20	[Trigger] key	When the instrument trigger mode is set to single mode, you can press this key to manually trigger the instrument.
21	Testing (UNKNOWN)	Four-terminal test terminal for connecting the four-terminal test fixture or test cable to measure the device under test. High-side current excitation (Hcur). High-side voltage sampling (Hpot). Low-side voltage sampling (Lpot). Low-side current excitation (Lcur). And DC independent voltage source output port
22	[File] key	This function key is used to quickly enter the file management interface.
23	[Enter] key	The [Enter] key is used to terminate data entry and confirm and save the data displayed in the input line.
24	[Cal] key	It is also used to execute the shortcut key for user calibration.
25	[Home] key	The [Home] key is used to switch between the different function pages that are frequently used.

26	Power switch (POWER)	Power switch. The instrument is red in standby mode and green in ON mode. Press and hold the power switch to turn off the instrument.
27	[DC Bias] key	The [DC BIAS] key is used to enable or disable the DC bias power supply output. Press the [DC BIAS] key, and the [DC BIAS] key will light up to indicate that the DC bias output is enabled; press the [DC BIAS] key again, and the [DC BIAS] key will go out to indicate that the DC bias output is disabled. On some non-test screens where DC BIAS cannot be added, pressing this key will have no effect.
28	[LOCK] key	Press the [LOCK] key, and the [LOCK] key will light up, indicating that the current panel key function is locked. Press the [LOCK] key again, and the [LOCK] key will go out, indicating that the keyboard lock status is released. If the password function is set to "ON", you need to enter the correct password to unlock the keyboard, otherwise the keyboard lock cannot be released. When the appliance is controlled via RS232, USB_Device, Lan, etc., the [LOCK] button will be lit. Press the [LOCK] button again, and the [LOCK] button will go out, indicating that the local keyboard lock has been disabled.
Table 2-1		

2.2 Rear Panel Description

Figure 2-2 provides a brief description of the TH2848 rear panel.

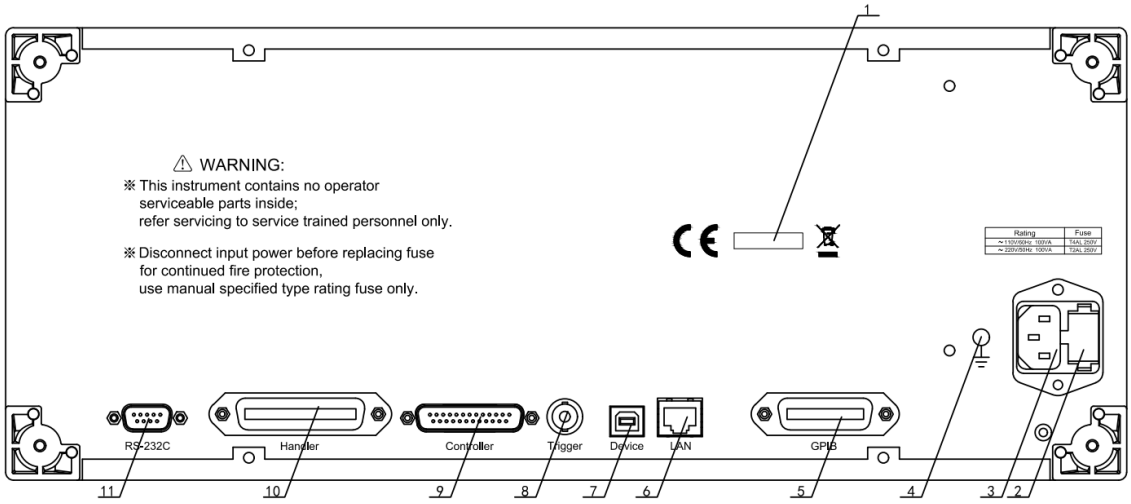


Figure 2-2.

Label	Name	Meaning
1	Nameplate	Indicates the production date, instrument number, manufacturer and other information.
2	Fuse holder	Used to install the power supply fuse to protect the instrument. The direction of the fuse can be switched to 110V/220V.
3	Power socket	Used to input AC power.

		Warning: Before powering on, you should check whether the position of your fuse matches the supply voltage range.
4	Grounding terminal	This terminal is connected to the instrument case. It can be used to protect or shield the ground connection.
5	GPIB interface	Realizes GPIB communication
6	LAN interface	Network interface for control and communication with network systems
7	USB Device interface	USB communication interface for online communication with a computer.
8	TRIGGER interface	It can be connected to an external trigger device such as a foot control.
9	Controller	Reserved interface
10	HANDLER interface	Sorting output of test results
11	RS232C serial interface RS485 differential interface	Pins 2, 3, and 5 are used for the RS232 serial communication interface for online communication with a computer. Pins 1 and 4 are used for the RS485 differential A/B bus interface

Table 2-2

2.3 Display Area Definition

This series utilizes a 10.1-inch capacitive touch panel display. The display is divided into the following display areas, see Figure 2-3.

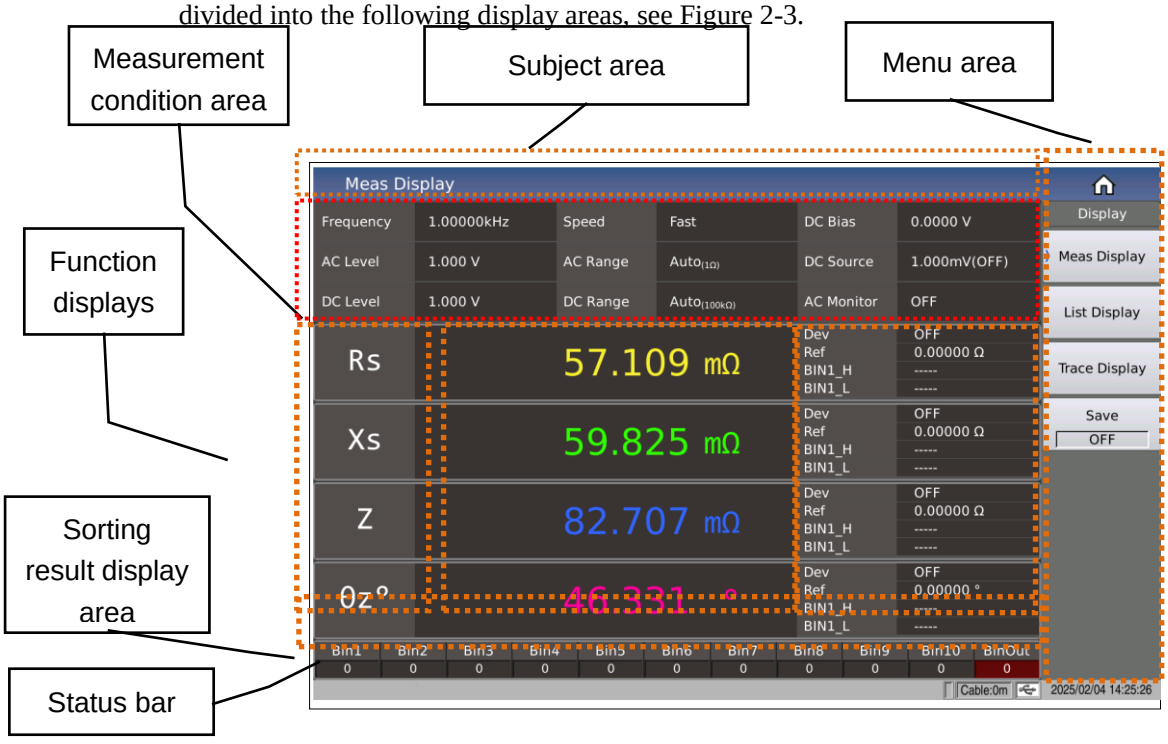


Figure 2-3 Display Area

The page is composed of the following elements: the title area, the measurement conditions area, the 4-parameter result display area, the sorting result display area, the menu area, the title area, and the status bar.

2.4 Main Menu Buttons and Corresponding Displayed Pages

2.4.1 Display Main Menu Keys [Display]

Used to access the component measurement display page. The main start button for the function menus of capacitance, resistance, inductance, and impedance measurement. The function pages in this section are (use the “touch screen” to select the following page functions, same below):

<Meas Display>

<List Display>

<Trace Display>

<Save>

2.4.2 Parameter Setting Main Menu Keys [Setup]

Used to access the various setting screens for component testing. The function pages in this section are:

<Meas Setup>

<Limit Setup >

<List Setup >

<Trace Setup >

<User Corr>

<Handler>

2.4.3 System Setting Main Menu Keys [System]

Used to access the system settings homepage. Mainly about communication settings, user management settings, and Handler’s settings. The function pages in this section are:

<System Info>

<Message>

<System Check>

<Licence>

2.5 Basic Operation

The basic operation is as follows:

Use the menu keys ([Display],[Setup],[System]) and the touchscreen to select the page you want to display.

Use the cursor keys ([←], [→], [↑], [↓]), the rotary knob or simply touch the screen to move the cursor to the area you want to set. When the cursor is moved to an area, the area is highlighted to indicate that it is the area that can be set.

The function of the corresponding soft key for the field in which the cursor is currently located is displayed in the “soft key field”. Select and press the desired soft key. The number keys, the [←] and [Enter] keys are used for data entry. After a number key has been pressed, you can end data entry by pressing the [←] or [Enter] key.

2.6 Power On and Power Off

Plug in the three-wire power plug. Note: The supply voltage and frequency must comply with the above requirements. The power input phase wire L, neutral wire N, and ground wire E must be the same as the phase wire, neutral wire, and ground wire on the power plug of this instrument.

This series of instruments uses a soft switch. After being plugged into a three-wire power supply, some of the indicators on the front panel will flash for a few seconds. After a few seconds, the power button will light up red, and other buttons with LED indicators will turn off.

Power on: Press the power button in the lower left corner of the front panel to turn on the instrument and display the startup screen. After the instrument starts up, the power button will light up green. This series of instruments has a power button with memory function.

Figure 2-6 shows the startup screen, which also displays the company logo, the model number of the instrument, and the software version number (Ver 1.0.0).

(Figure 2-6 Power-up Screen)

Power off: After the appliance has been used, if you need to turn it off, press and hold the power button in the lower left corner of the front panel to turn it off. After the appliance is turned off, the power button will light up red, and the appliance will be in standby mode. If the appliance is not going to be used for a long time, disconnect the power cord and store the appliance in the environment specified in 1.4.

Note: This series of products is set with a **factory password, which is 2848**. The user can reset the password as needed during use. For details, see the Password item on the <System Settings> page.

Chapter 3 Functional Module Description

3.1 <Measurement Display> Page

When the instrument is in the bridge function, press the [Display] menu key, and the <Measurement display> screen will be displayed on the screen. As shown in Figure 3-1-1:

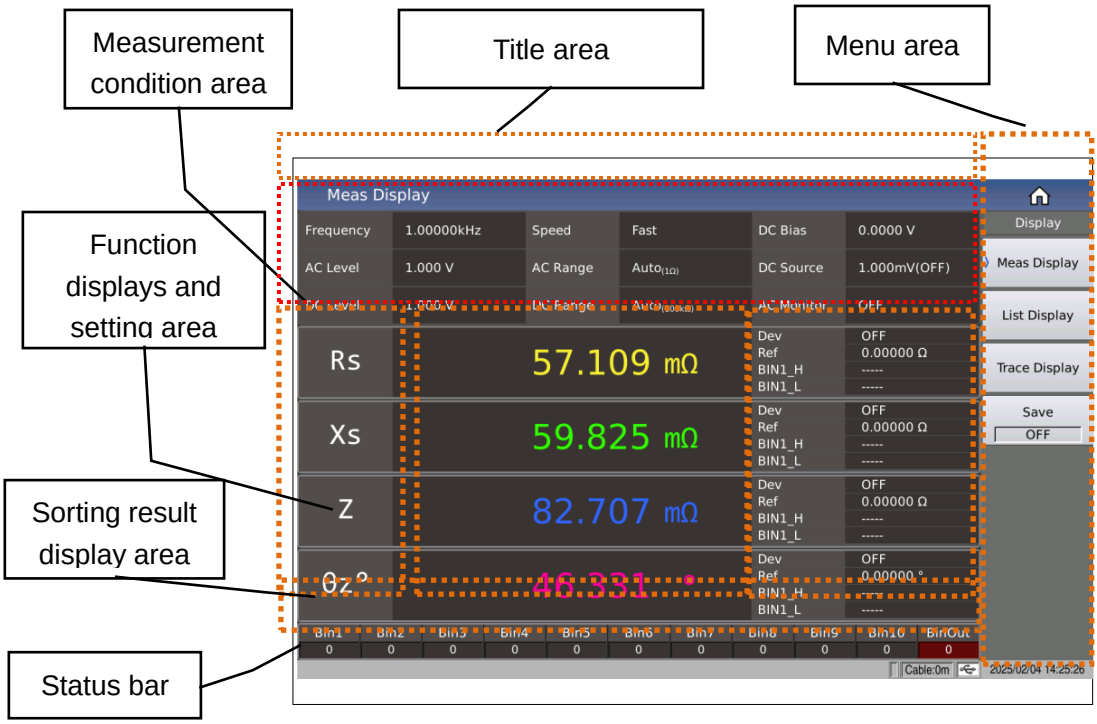


Figure 3-1-1 Measurement Display

The page is composed of the following elements: the title area, the measurement conditions area, the 4-parameter result display area, the sorting result display area, the menu area, the title area, and the status bar.

3.1.1 Common Measurement Conditions

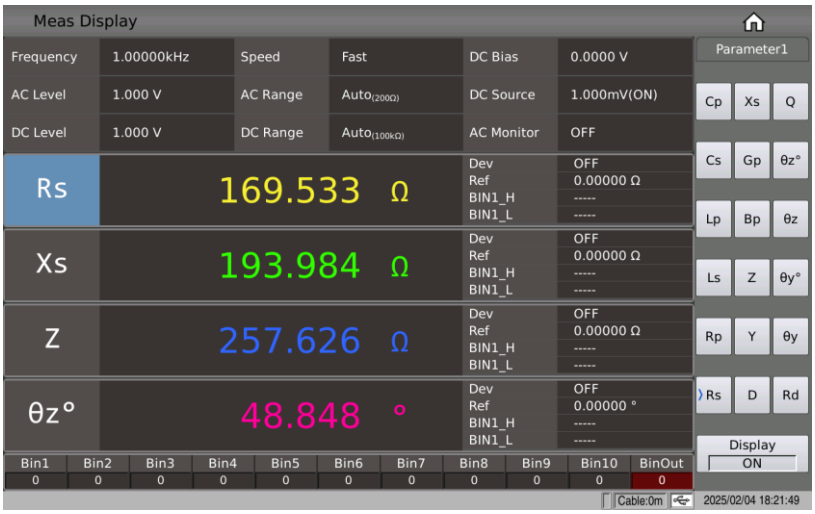
There are 9 cursor fields in the measurement conditions area of this display page:

Frequency	Speed	DC Bias
AC Level	AC Range	DC Source
DC Level	DC Range	AC Monitor

Each control function field is described in detail on the <Meas Setup> page.

3.1.2 Test Function

Touch the parameter name in the test result area to display a selection menu for the corresponding test function in the right-hand menu area. Touch the corresponding selection in the menu to complete the function setting for the specified parameter and display the test result. The menu is displayed as shown in Fig. 3-1-2:



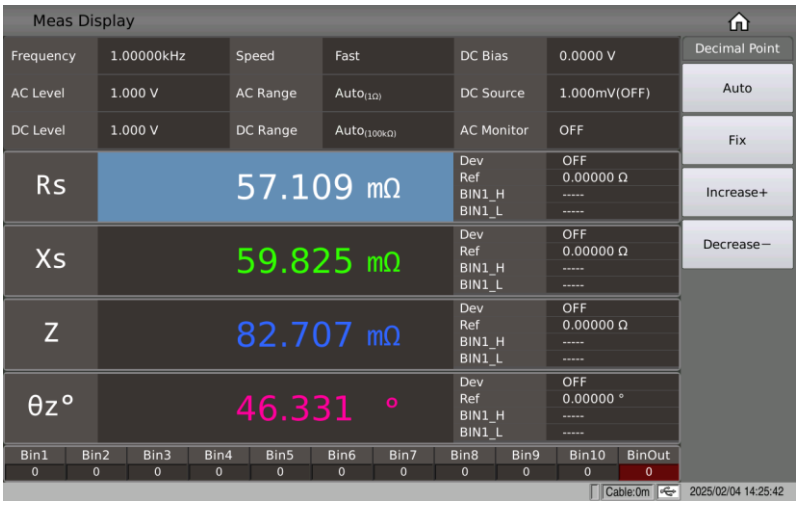
(Figure 3-1-2 Parameter Function Setting)

3.1.3 Decimal Point Position

Parameter setting attribute: enumeration type.

The decimal point position is directly related to the resolution of the result display, and it is also intuitive to see the relative stability of the result.

The principle of position movement is to ensure that the number of significant digits remains the same, while moving the decimal point left or right by a certain number of positions. As shown in Figure 3-1-3:



(Figure 3-1-3 Decimal Point Position Shift)

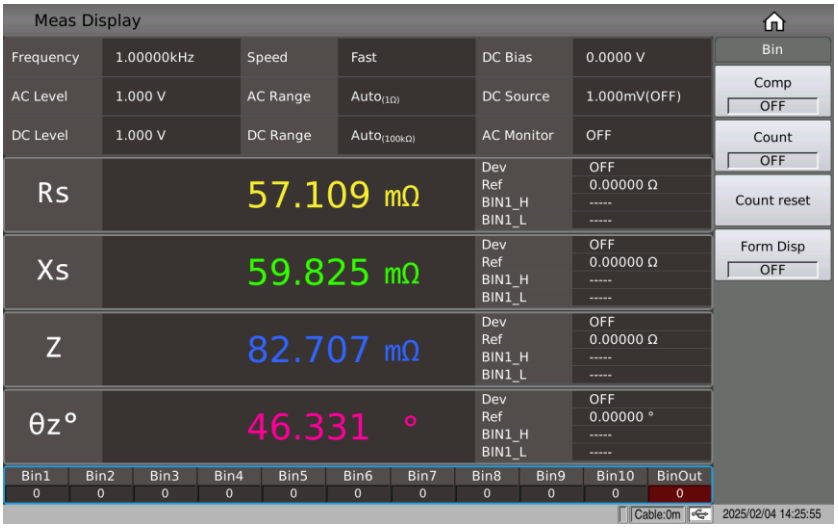
Optional settings:

Menu options	Function Description
Auto	Default setting, i.e. automatic display of the decimal point position
Fixed	Used to fix the current decimal point position in automatic mode
Increase	Shift decimal point position left
Decrease	Shift decimal point position right

Note: The decimal point position lock function will automatically be cancelled and return to the floating decimal point display in the following cases: the test function is changed; the deviation mode is changed.

3.1.4 Bin Sorting Results Display

After touching or moving the cursor to the sorting result display area, the corresponding menu will involve some sorting controls, such as the Compare switch, Count switch, and Count reset; as shown in Figure 3-1-4:



(Figure 3-1-4 Bin Sorting Shortcut Settings)

3.1.4.1 Compare Switch

The built-in comparison function of this series can divide the tested components into up to 11 bins (BIN1 to BIN10 and BIN OUT). Ten sets of high and low limits can be set, and the high and low limits of each bin, which contains four parameters, can be set independently. If one of the multiple parameters does not participate in the

comparison, the corresponding high and low limits can be cleared. When the parameters of the tested component participating in the comparison are within the limits of the bin, the corresponding file is found. The sorting results can be output to an automatic testing system via the HANDLER interface to automatically sort the test results. These limit settings can only be set on the **<Limit Setup>** page.

The comparison function can be set to ON or OFF. The default status is OFF.

3.1.4.2 Bin Count Function

Used to record the count value displayed for each Bin.

The counting function can be set to ON or OFF. The default setting is OFF.

3.1.4.3 Count Reset

It clears the counting result of the current sorting file, resetting the file count to 0, i.e. for restarting the count.

3.1.5 Save Test Results on USB Flash Drive

Use a USB flash drive to save the test results.

The test results and formats that can be saved are as follows:

Time,P1,P2,P3,P4,BIN

---- corresponds to the test time, parameter 1~4 results and sorting results respectively.

The statuss involved in data saving are:

Save switch.

Save path prompt, the default path bit: “usb/CSV/” path.

The naming rule for the file name is rx+machine number+date, for example: rx-SN12345678-20210811.csv.

3.2 <List Display> Page

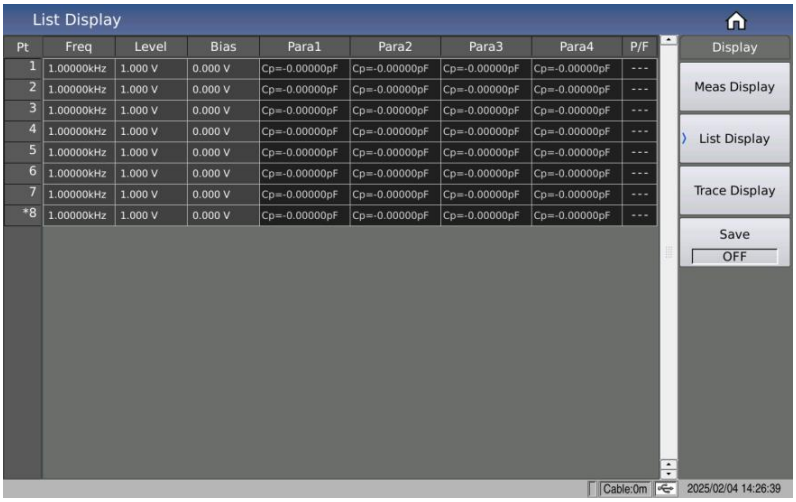
In the **<List Setup> page**, you can enter the test frequency, test level, DC bias, trigger delay time, the independent function corresponding to the 4 parameters, the four independent parameters, and the high and low limit values corresponding to each list sweep test point for up to 201 points. These test points will be automatically scanned and tested, and the test results will be compared with their corresponding limit values.

The list display involves two display effects:

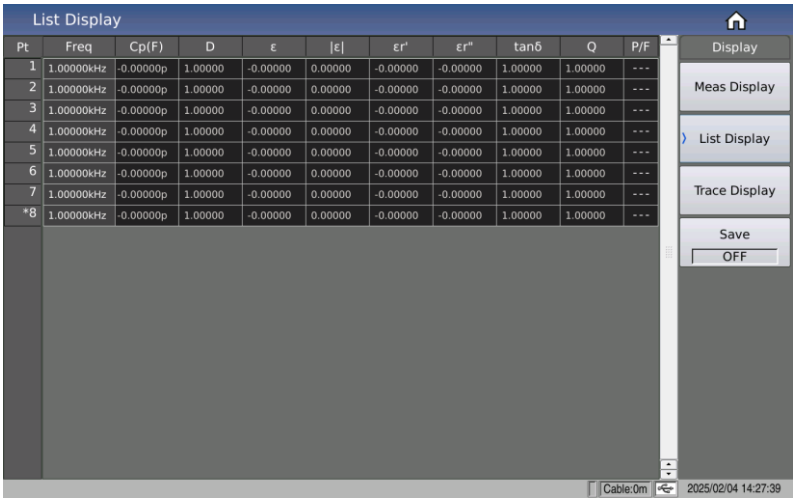
1) The list display for the regular 4 impedance parameters, as shown in Figure 3-2-1.
2) The dielectric multi-parameter display effect designed for the dielectric constant solution, as shown in Figure 3-2-2.

(Note: TH2848-02L has no dielectric test function).

In this display page test points will be automatically scanned and tested, and the test results will be compared with the limit values. During the list scan test, the leftmost symbol "*" indicates the current sweep test point. The display is shown in Figure 3-2-1:



(Figure 3-2-1 List Display - Impedance Four Parameters)



(Figure 3-2-2 List Display - Dielectric Constant Test)

The dielectric constant test switch is in the corresponding list setting page, as well as the setting of the relevant dielectric test conditions.

The P/F (for PASS/FAIL) on the far-right side is used to indicate the comparison

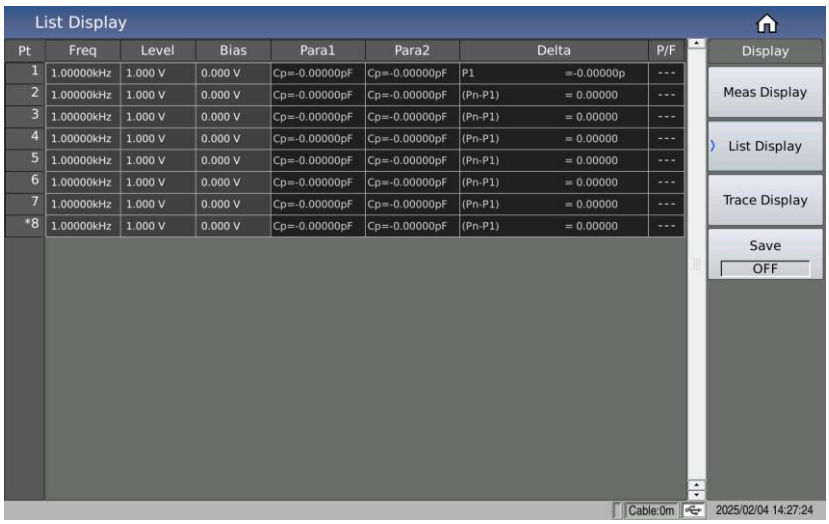
result for the current point:

Uncompared display: "---"

PASS display: PASS (green)

FAIL display: FAIL (red)

If the difference mode is turned on, the measurement results of parameter 3 and parameter 4 are not displayed, and the difference calculation results of parameter 1 are displayed, as shown in Figure 3-2-3:



(Figure 3-2-3 List Display - Difference Mode)

3.2.1 USB Flash Drive Data Save

Save the test results using a USB flash drive. The test results that can be saved and the format are as follows:

Time,pt ,para1-4,P1,P2,P3,P4,COMP

--- corresponding to the test time, point index, 4-parameter function, parameter 1~4 results, and comparison results respectively

The statuss involved in data saving are:

Save switch.

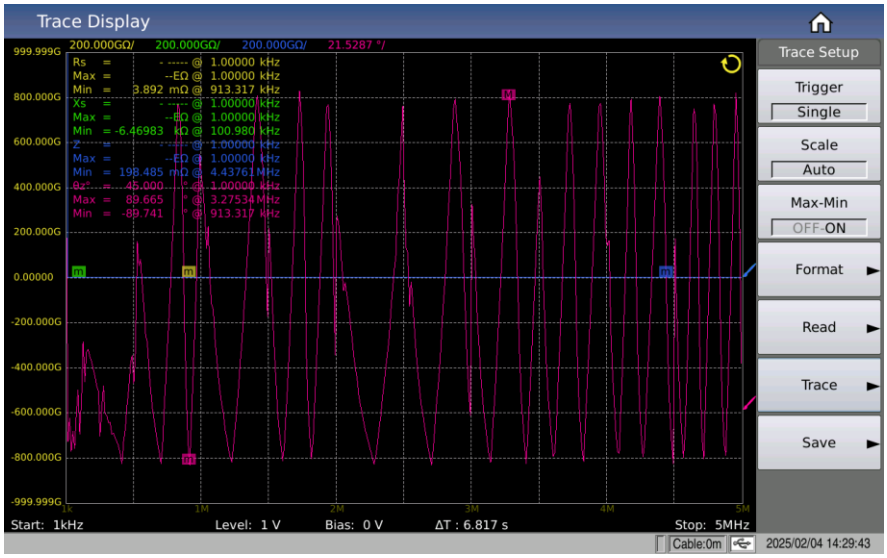
Save path prompt, default path bit: under the path “usb/CSV/”.

The naming rule for the file name is list+machine number+date, e.g. list-SN12345678-20210811.csv.

3.3 <Trace Sweep> Page

Press the menu key [Display], then press the soft key trace display to enter the <Trace Display> page.

As shown in Figure 3-3-1:

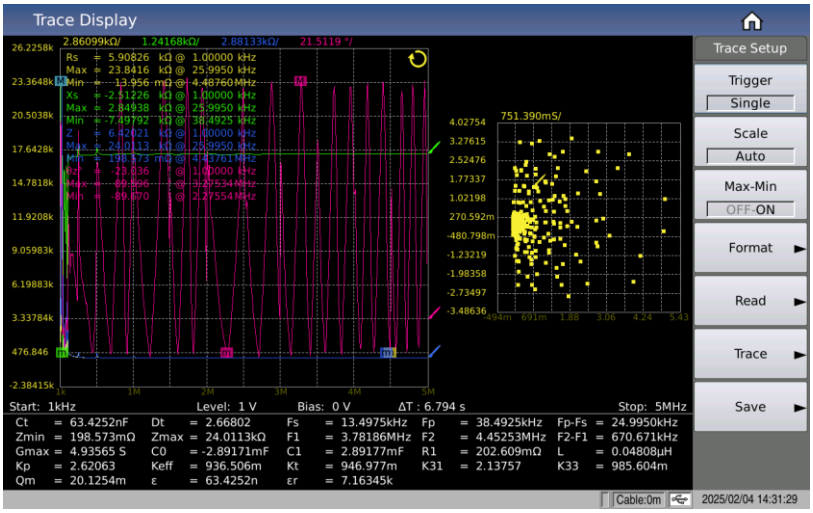


(Figure 3-3-1 Trace Display)

This display function page performs an automatic scanning measurement on the measured component in a manner conditionally incremental manner within the user-preset mode range, scanning each time at 51, 101-, 201-, 401- or 801-point frequencies in a linear or logarithmic manner, dynamically displaying on the LCD screen the response reace of the primary and secondary parameters of the measured component as they change with the mode conditions. The result at any point within the scanning range can be read on the screen. The maximum and minimum measured values of the tested component within the sweep range and the corresponding test conditions are also displayed.

Note: After the user has set the sweep conditions, the [Trigger] key on the front panel must be pressed to start scanning. Pressing the [Reset] key once pauses the test and pressing it again will reset the sweep.

In addition, based on trace sweep, some models in this series integrate piezoelectric testing solutions, as shown in Figure 3-3-2. The piezoelectric test switch can be found at the bottom of the trace setting page, including the piezoelectric test condition settings.



(Figure 3-3-2 Trace Display - Piezoelectric Test)

3.3.1 Trigger

For the trigger method used to quickly set the trace, refer to the trigger settings on the measurement settings page.

3.3.2 Scale

It is used to automatically set the Y-axis coordinate range corresponding to the trace. In the automatic mode, the scale range of the Y-axis will be dynamically adjusted according to the size range of the test results to ensure that all the plotted traces are within the display range.

It is recommended that when the tested part is relatively stable, you can first let the scale automatically select a relatively appropriate scale range and then set it to fixed. Then, you can manually press the up and down arrow keys to fine-tune the display range according to the actual situation.

Parameter setting attribute: enumeration type.

Parameter options:

Speed	Number of Tests
Auto	Automatic scale adjustment
Fixed	The scale is fixed, but can be adjusted manually

3.3.3 Max-Min Value

It is used to turn on or off the display of the maximum and minimum values of the parameter test results.

3.3.4 Coordinate Format

A line type used to set the interval between the X and Y axis coordinates. The ordinates of parameters 1/2/3/4 can be set separately so that they are displayed in corresponding line types respectively.

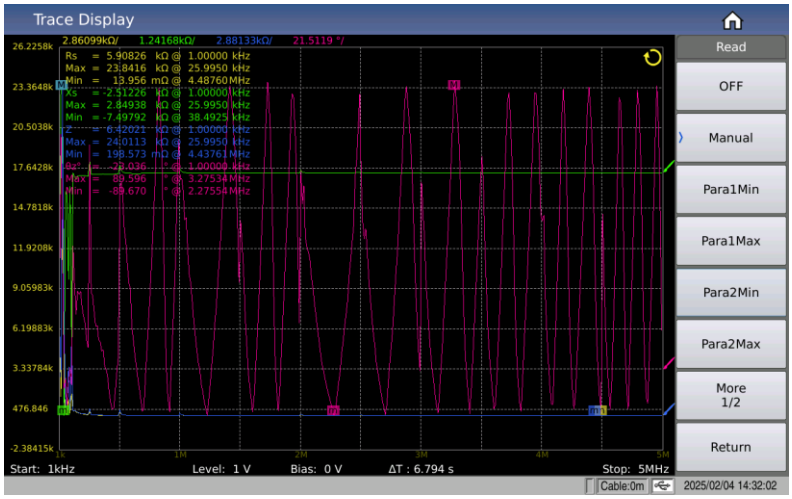
Value Description:

Coordinate Parameter Options	Linear
Horizontal axis	Linear
	Logarithms
Parameter 1/2/3/4 Vertical axis	Linear
	Logarithms

3.3.5 Read Function

It is used to set the conditions for cursor reading.

Cursor: a red line that can be moved by turning the knob or pressing the left and right keys to observe the test results of different parameters under the same scanning conditions. As shown in Figure 3-3-3:



(Figure 3-3-3 Reading Cursor Display Effect)

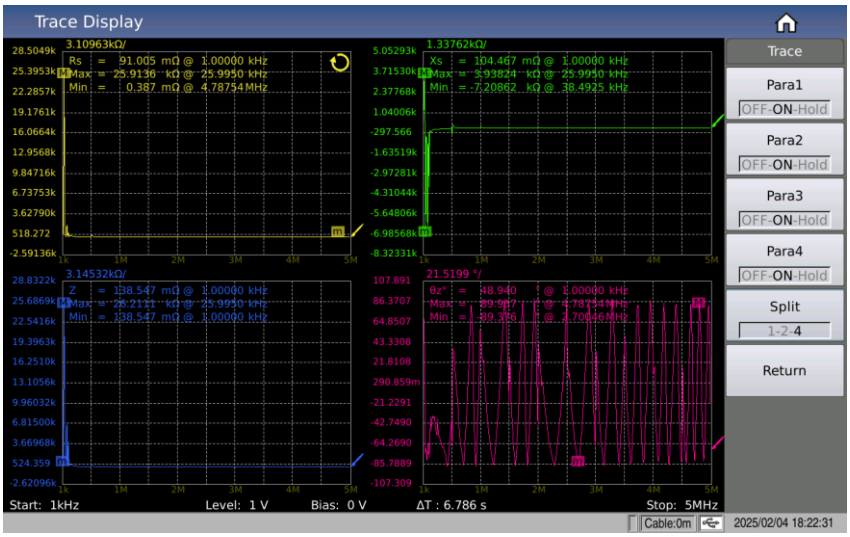
Value Description:

Read Parameter Options	Meaning
OFF	No cursor display
Manual	Manual adjustment of the cursor (knob and left and right keys)

Parameter 1/2/3/4 Min.	Automatic tracking of the minimum or maximum value position of parameter 1/2/3/4
Parameter 1/2/3/4 Max.	

3.3.6 Trace Function

The submenu of the trace button allows you to quickly set the sweep points of the trace, switch the display of the four-parameter trace on and off, and the split-screen effect of the trace display and other related functions, as shown in Figure 3-3-4:



(Figure 3-3-4 Trace Button Setting Menu)

3.3.6.1 Parameter Switch

A toggle switch is used to turn a specified parameter on or off, or to keep the current status unchanged.

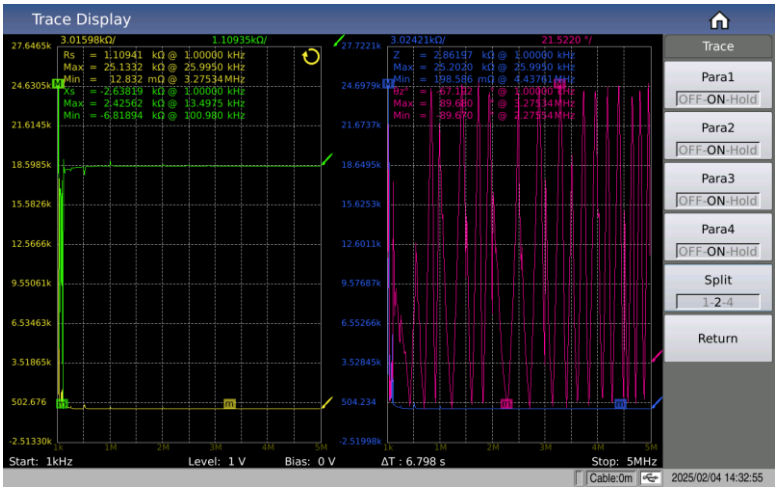
3.3.6.2 Split Screen

The split screen effect is displayed in a trace. The split screen options available are:

Split Screen	Description
1-split screen	All traces are displayed in the same graph window
2-split screen	4 parameters are grouped in pairs and displayed in corresponding graph windows
4-split	4 parameters are displayed independently in their own graph

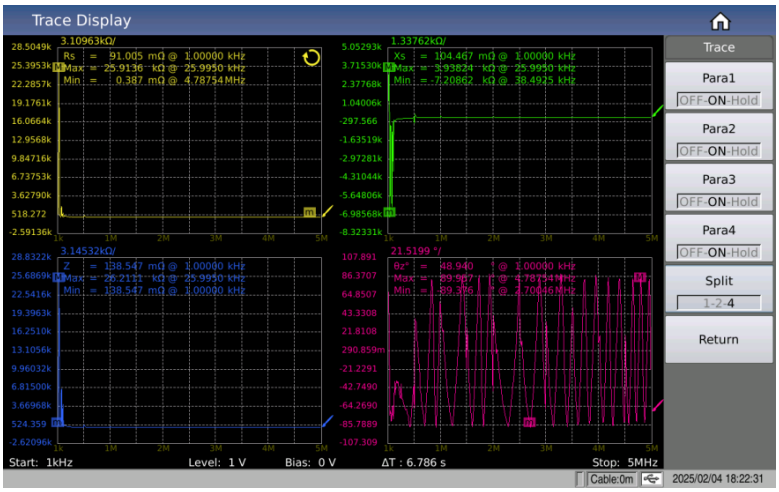
screen	windows

The 2-split screen display effect is shown in Figure 3-3-5:



(Figure 3-3-5 Display Effect - 2 Split Screen)

The 4-split screen display effect is shown in Figure 3-3-6:



(Figure 3-3-6 Display Effect - 4 Split Screen)

3.3.7 USB Flash Drive Data Save

Use a USB flash drive to save test results. The test results that can be saved and the format are as follows:

Time,pt ,x,P1,P2,P3,P4,COMP

---- corresponds to the test time, point index, x-axis size, and parameter 1~4 results, respectively.

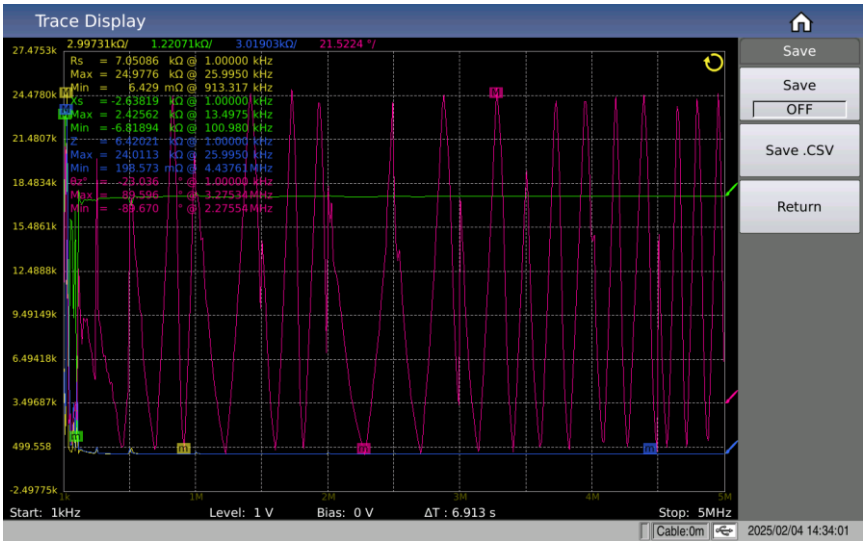
The statuss involved in data saving are:

Save switch.

Save path prompt, the default path bit: “usb/CSV/” path.

The naming rule of the file name is, rx+machine number+date, such as: trace-SN12345678-20210811.csv.

Used to save the trace data to the USB flash disk, the function menu is shown in Figure 3-3-7:



(Figure 3-3-7 Save Setting Menu)

It is used to set whether test result data needs to be saved continuously.

When continuous saving is turned on, the naming rule for the file name is trace + machine number + date, e.g., trace-SN12345678-20210811.csv.

For a single save, the naming convention for the file name is, trace-trg + machine number + date, e.g., trace-trg-SN12345678-20210811.csv.

3.3.8 Other Test Results

When the user selects the scanning parameters of frequency and impedance, the instrument will automatically display some parameters of the ultrasonic device. The specific parameters are as follows:

Static capacitance Ct: the static capacitance value at 1 kHz.

Static capacitance Dt: the capacitance loss value at 1 kHz.

Minimum impedance Zmin and its corresponding frequency fs, (point m on the screen).

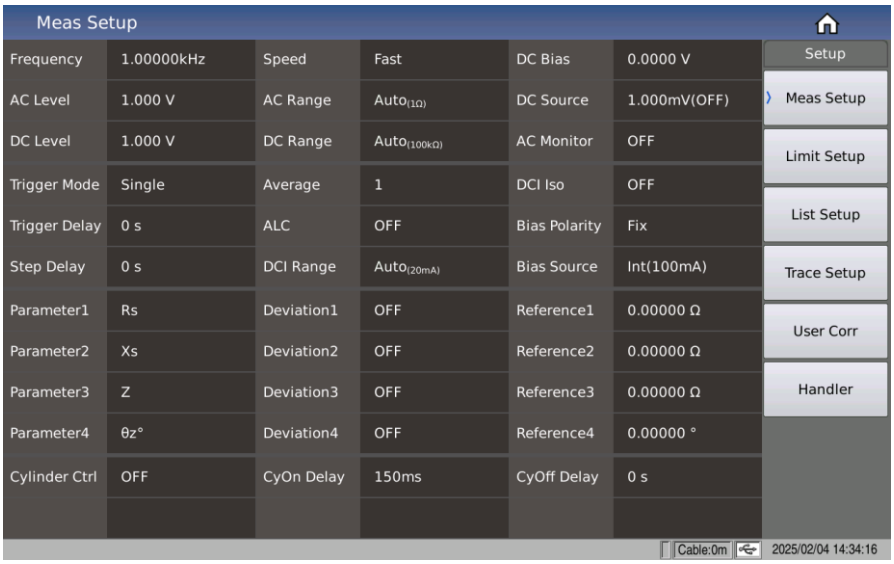
Maximum impedance Zmax and its corresponding frequency fp, (point M on the screen).

ΔF = fp - fs

$$k_p \approx \sqrt{\frac{f_p - f_s}{f_s} \times 2.51} \qquad Q_m \approx \frac{f_p^2}{2\pi f_s Z_{\min} C^T (f_p^2 - f_s^2)}$$

3.4 <Measurement Settings> Page

Press the menu key [Setup] to enter the <Meas Setup> page. As shown in Figure 3-4-1:



(Figure 3-4-1 Measurement Settings)

3.4.1 Test Function

Parameter setting attribute: enumerated type.

Four parameters of the impedance element can be measured simultaneously within one measurement cycle. The following parameters can be measured:

Parameter Name	Parameter Meaning	Parameter Name	Parameter Meaning
Cp	Equivalent parallel capacitance	Cs	Equivalent series capacitance
Lp	Equivalent parallel inductance	Ls	Equivalent series inductance
Rp	Equivalent parallel resistance EPR	Rs	Equivalent series resistance ESR
Gp	Conductance	Bp	Susceptance
Z	Impedance	Y	Admittance
D	Loss factor	Q	Quality factor

θz°	Angle of impedance	θz	Arc of impedance
θy°	Angle of admittance	θy	Arc of admittance
X	Reactance	Rd	DC resistance

Measurement function parameter setting operation steps: touch (or use the cursor keys to move the cursor to) the parameter name area corresponding to the test result and select the setting in the right soft key area according to the displayed optional parameters.

There is no combination limit for the four parameters, and any combination can be selected.

The display switch of the four parameters can be set independently: that is, when the display switch corresponding to the parameter is turned off, the corresponding result area will display OFF instead of the test result. The display switch function can be set in the parameter setting area of the measurement display page.

3.4.2 Frequency

Parameter setting attribute: numeric input.

The maximum frequency range of this series of instruments is from 4 Hz to 10 MHz, and the minimum resolution is 0.001 Hz.

Note: The frequency range supported by specific models is different. For details, please refer to the instrument selection guide. Here is a brief comparison:

Instrument Series Model	Frequency Support Range
TH2848-02 TH2848-02L	4Hz~2MHz
TH2848-05	4Hz~5MHz
TH2848-10	4Hz~10MHz

Frequency range and test frequency points

Frequency Range (F)	Test Frequency Points	Resolution
4Hz≤ F≤ 99.999Hz	20.0000Hz, 20.0001Hz 99.9999Hz	0.0001Hz
100Hz≤ F≤ 999.9Hz	100.000Hz, 100.001Hz 999.999Hz	0.001Hz
1kHz≤ F≤ 9.999kHz	1.0000kHz, 1.00001kHz 9.99999kHz	0.01Hz

10kHz≤ F≤ 99.99kHz	10.0000kHz, 10.0001kHz 99.9999kHz	0.1Hz
100kHz≤ F≤ 999.9kHz	100.000 kHz, 100.001 kHz.....1MHz	1Hz
1MHz≤ F≤ 10MHz	1.00000 MHz, 1.00001 MHz.....10MHz	10Hz

Test frequency setting operating steps:

Touch directly or use the arrow keys to move the cursor to the frequency field.

There are two ways to set the test frequency on the stand-alone machine:

Alternatively, use the number keys to enter directly.

Use the soft key area (follow the prompts to increase and decrease the frequency enumeration).

Add ++

This soft key is for coarse frequency adjustment. Each time you press it, the frequency increases by 20 Hz to the next 10 times the frequency point. The following frequency points can be set with this soft key: 4 Hz, 20 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz, 2 MHz, 5 MHz and 10 MHz.

Add +

This soft key is for fine adjustment of the frequency. Each time you press it, the frequency increases to the next higher frequency point. Typical frequency points (not exhaustive) that can be set with this soft key are as follows:

Typical Frequency/Hz									
			4	20	30	40	50	60	80
100	120	150	200	250	300	400	500	600	800
1 k	1.2 k	1.5 k	2 k	2.5 k	3 k	4 k	5 k	6 k	8 k
10 k	12 k	15 k	20 k	25 k	30 k	40 k	50 k	60 k	80 k
100 k	120 k	150 k	200 k	250 k	300 k	400 k	500 k	600 k	800 k
1 M	1.2 M	1.5 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M
9 M	10 M								

3.4.3 Power Level

Test levels are divided into AC and DC levels.

AC levels are mainly used for AC LCR testing.

DC levels are mainly used for DC resistance testing.

3.4.3.1 AC level

Parameter setting attribute: numeric input.

The test level is set using the root mean square value of a sine wave signal. The sine wave signal has a frequency that is the test frequency and is generated by the instrument's internal oscillator. Both the test voltage value and the test current value can be set.

AC level range:

Specific Series Model	AC Level Limited Frequency	AC Voltage Range	AC Current Range
TH2848-02	[4Hz,1MHz]	[0V,20V]	[0A,100mA]
	(1MHz,2MHz]	[0V,15V]	[0A,100mA]
TH2848-02L	[4Hz,2MHz]	[0V,2V]	[0A,20mA]
TH2848-05	[4Hz,1MHz]	[0V,20V]	[0A,100mA]
	(1MHz,2MHz]	[0V,15V]	[0A,100mA]
	[2MHz,5MHz]	[0V,2V]	[0A,20mA]
TH2848-10	[4Hz,1MHz]	[0V,20V]	[0A,100mA]
	(1MHz,2MHz]	[0V,15V]	[0A,100mA]
	(2MHz,5MHz]	[0V,2V]	[0A,20mA]
	(5MHz,10MHz]	[0V,1V]	[0A,10mA]

Note: There is a linear relationship between the voltage level and the current level, which is constrained by internal resistance. ACV = 100 * ACI.

The output internal resistance of the signal source is fixed at 100Ω.

AC voltage resolution: minimum 0.1mV, four significant digits displayed.

AC Voltage (Vrms)	Resolution (Vrms)
[0m,0.2)	0.1m
[0.2,0.5)	0.2m

[0.5,1)	0.5m
[1,10)	1m
[10,20]	10m

AC current resolution: minimum 1uA, four significant digits displayed.

AC Current (Arms)	Resolution (Arms)
[0,2m)	1μ
[2m,5m)	2μ
[5m,10m)	5μ
[10m,100m]	10μ

---------- ---------- ---------- ----------

Note: The test current set is the output current value when the measured end is short-circuited. The test voltage set is the output voltage value when the measured end is open.

---------- ---------- ---------- ----------

The automatic level control function can achieve constant voltage or current measurement. The automatic level control function (automatic level domain) can be set to ON from the <Meas Setup> screen. When the automatic level control function is turned on, a "*" is displayed after the current level value.

Test level setting operation steps:

Touch the AC level corresponding area, the menu area will display the level type switching function and the addition of smaller functions. You can modify and adjust according to the menu prompts or directly enter the numeric keys to achieve value modification.

---------- ---------- ---------- ----------

Note: When you need to switch the test level between current and voltage, you must use the menu area.

---------- ---------- ---------- ----------

3.4.3.2 DC Level

Parameter setting attribute: numeric input.

Test conditions as direct current resistance (RD).

DC level range:

Internal Resistance	Dc Voltage Range
100Ω	[0.1V,1V]

DC level resolution: minimum 0.1mV, four significant digits displayed.

	Level Range	Resolution
Voltage	[0.1,1] Vrms	0.1mV
Current	[0,10] mA	1μA

3.4.4 Speed

Parameter setting attribute: enumerated type.

The actual measurement speed is determined by the following factors:

Integration time (A/D conversion).

Number of averages (the number of times the average of consecutive measurement results is taken).

Measurement delay (the time from start-up to start of measurement).

In general, slower measurements produce more stable and accurate results.

There are three measurement speeds to choose from: FAST, MED and SLOW.

The measurement times in the table below are based on the following conditions:

The four-parameter test function does not include the Rd test

The range is the locked range

AC monitoring: OFF

Trigger delay: 0s

Step delay: 0s

Automatic level control: OFF

Number of averages: 1

Measurement time (ms) (DC bias OFF)

	Measurement Speed	Test Frequency	
		1kHz	1MHz
1	Fast	19.8ms	2.58ms
2	Medium	110ms	90ms
3	Slow	252ms	220ms

3.4.5 Range

The measurement range is divided into an AC measurement range and a DC measurement range. The AC measurement range is used to test AC LCR parameters, and the DC measurement range is used to test DC resistance.

3.4.5.1 AC Range

Parameter setting attribute: enumerated type.

The test range is selected based on the impedance value of the LCR component under test.

15 AC measurement ranges: 0.1 Ω, 1 Ω, 10 Ω, 20 Ω, 50 Ω, 100 Ω, 200 Ω, 500 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ, 50 kΩ, 100 kΩ.

Steps for setting the measurement range:

Use the cursor keys to move the cursor to the range field. The following soft keys will be displayed on the screen.

AUTO This soft key is used to set the range to AUTO mode.

HOLD This soft key is used to switch the range from AUTO mode to HOLD mode. When the range is set to HOLD mode, the range will be locked at the current test range. The current test range will be displayed in the range field on the screen.

↑(+) This soft key is used to increase the range in HOLD mode.

↓(-) This soft key is used to decrease the range in HOLD mode.

Use the soft keys to set the test range.

3.4.5.2 DC Range

Parameter setting attribute: enumerated type.

13 DC test ranges: 10Ω, 20Ω, 50Ω, 100Ω, 200Ω, 500Ω, 1kΩ, 2kΩ, 5kΩ, 10kΩ,

20kΩ, 50kΩ, 100kΩ.

When measuring RD, two voltage cycles are measured for both positive and negative voltages.

Test range setting operating steps: same as AC range setting description.

---------- ---------- ---------- ----------

Note: When the user sets the DC range to HOLD, the DCI range and AC range are also automatically set to HOLD; when the user sets the DC range to AUTO, the DCI range and AC range are also automatically set to AUTO.

Note: If DCR measurement starts while DC bias is on, DC bias will be automatically switched off. If the measurement parameters contain RD and (Lp or Ls), DC bias cannot be switched on, otherwise an error message will appear.

---------- ---------- ---------- ----------

3.4.5.3 DCI Range

DC bias current range. Before setting the DCI range, make sure that the DCI isolation DC bias isolation is turned on.

Type	Measurement Range				
Standard Configuration	20μA	200μA	2mA	20mA	100mA

---------- ---------- ---------- ----------

Note: When the user sets the DC range to HOLD, the DCI range and AC range are also automatically set to HOLD. When the user sets the DC range to AUTO, the DCI range and AC range are also automatically set to AUTO. The DCI range cannot be changed when DCI isolation is OFF.

---------- ---------- ---------- ----------

DC bias current range setting procedure:

Use the cursor keys to move the cursor to the DCI range field. The following soft keys will be displayed on the screen.

AUTO This soft key is used to set the range to AUTO mode.

HOLD This soft key is used to switch the range from AUTO mode to HOLD mode. When the range is set to HOLD mode, the range will be locked at the current test range. The current test range is displayed in the range field on the screen.

↑(+) This soft key is used to increase the range in HOLD mode.

↓(-) This soft key is used to decrease the range in HOLD mode.

3.4.6 DC Bias

Parameter setting attribute: numeric input.

It involves related settings such as offset source selection, offset type selection, numeric size range setting, etc.

3.4.6.1 Bias Source

This series comes standard with two internal bias sources or external bias options, with the corresponding options and input ranges as follows:

Note: The limit value is limited to: Vosc× √2×1.15 + Vdc×1.002 < 42V

Where, Vosc indicates the effective value of the AC level output

Bias Source	Bias Type	Input Range
Internal (Voltage, current, and internal resistance are related to Ohm's law)	Voltage	-10V~ 10V (TH2848-02L) -40V~ 40V (TH2848-02/ TH2848-05/ TH2848-10)
	Current	-100mA~100mA
External TH1778	Current	0~120A Determined by external bias current source

3.4.6.2 Bias Type

When using an internal bias source, either the optional bias current mode or bias voltage mode can be selected, and the maximum setting size is constrained by internal resistance.

Parameter setting attribute: numeric input.

Provides a built-in DC bias voltage of -40V to +40V.

Press the [DC Bias] key on the front panel to allow the set DC bias output. When the DC bias is allowed to output, the [DC Bias] key will be lit.

Note: The numerical size limits of the DC bias plus AC test level are as follows:

Set Value		Limit Value
DC Bias	AC Test Signal Level	
Vdc (V)	Vosc (Vrms)	Vosc×√2×1.15 + Vdc×1.002 < 42V
Vdc (V)	Iosc (Arms)	Iosc×√2×115 + Vdc×1.002 < 42V
Idc (A)	Vosc (Vrms)	Vosc×√2×1.15 + Idc×100.2 < 42V
Idc (A)	Iosc (Arms)	Iosc×√2×115 + Idc×100.2 < 42V

3.4.7 DC Source

The series comes standard with an independent voltage source output for quick commissioning in different application scenarios.

Parameter setting attribute: numeric input type.

Users can set the DC voltage output from the DC source output terminal in the range of -10V to 10V. The minimum resolution is 1mV.

After setting the value to be output, the output is switched on and off by pressing the DC SRC button on the panel, and the corresponding LED is displayed when the output is on.

3.4.8 AC Monitoring Function

Parameter setting attribute: enumerated type.

AC monitoring is mainly for AC level monitoring and does not involve DC bias level monitoring for the time being.

The level monitoring function allows you to monitor the actual voltage across the DUT or the actual voltage and current flowing through the DUT. The voltage monitoring value and current monitoring value are displayed in the corresponding button area on the <Meas Display> page. When it is turned off, it displays OFF, and when it is turned on, it displays the result of the monitored voltage and current.

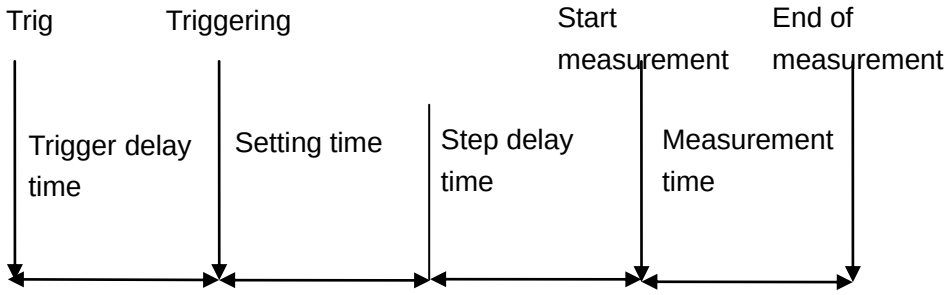
Settable status: ON/OFF, respectively indicating whether the level monitoring function is switched on/off.

Note: The instrument's calibration function has an impact on the level monitoring function. Therefore, when the calibration data changes, the level monitoring values will also change. Changes in the ON/OFF status of the calibration function open/short/load will also have an impact on the level monitoring values.

3.4.9 Trigger

It mainly involves the trigger method, trigger delay, and step delay settings.

Schematic diagram of trigger delay time and step delay time:



(Note: The setting time in the figure is the preparation time for the instrument to measure the signal source control, range switching, etc.)

3.4.9.1 Trigger Mode

Parameter setting attribute: enumerated type.

The selection of the trigger mode determines the trigger condition for the instrument test. This series provides two trigger modes that can be set:

Continuous trigger: continuously repeat the test

Single trigger: each time the [Trigger] key on the front panel is pressed, each time the HANDLER interface receives a positive pulse trigger signal, or each time a remote command gives a trigger command, a test is performed.

---------- ---------- ---------- ----------

Note: If a trigger signal is received while a test is in progress, the trigger signal will be ignored. Therefore, the trigger signal must be sent after the test is complete. When triggering from the optional HANDLER interface, set the trigger mode to Single Trigger.

This series is fully compatible with other trigger modes and previous setting commands of similar products, without any need to consider system compatibility.

---------- ---------- ---------- ----------

3.4.9.2 Trigger Delay

Parameter setting attribute: numeric input.

The trigger delay is the delay between the instrument being triggered and the measurement starting.

The trigger delay can be set from 0s to 60s with a minimum resolution of 1 ms.

The trigger delay is useful when the instrument is used in an automated test system. When the instrument is triggered via the HANDLER interface, the trigger delay ensures that the DUT is reliably connected to the test terminal.

3.4.9.3 Step Delay

Parameter setting attribute: numeric input.

The step delay is the delay time before the test signal is output each time a measurement is taken.

The step delay time can be set from 0s to 60s, with a minimum resolution of 1ms.

---------- ---------- ---------- ----------

Note: There are two step delays in RD measurement, because voltage in both the positive and negative directions need to be applied, and there are two measurement cycles. So, the actual step delay time is twice as long.

---------- ---------- ---------- ----------

3.4.10 Average

Parameter setting attribute: numeric input.

The averaging function calculates the average of the results of two or more tests.

The number of times the average can be set to a range of 1 to 255, with a minimum resolution of 1.

Note: In addition to the regular averaging setting, this series also provides a switch for sliding average for continuous testing. Sliding average is only used for continuous testing on the normal measurement display page, and its effect will achieve the ultimate stability when the current stability is stable. The depth of sliding is preset to 8 times and cannot be changed.

3.4.11 Auto Level Control

Parameter setting attribute: enumerated type.

The automatic level control function can adjust the actual test level (the voltage across the DUT or the current flowing through the DUT) as close as possible to the set test level value. Using this function ensures that the test voltage or current across the DUT remains constant.

When the automatic level control function is used, the set range of the test level is limited according to the AC level description.

---------- ---------- ---------- ----------

Note: When the constant level function is active, if the level setting exceeds the above range, the constant level function will be automatically set to OFF. The current level setting is generally considered to be a non-constant level value.

---------- ---------- ---------- ----------

The constant level function is set to ON or OFF to turn the automatic level control function on or off, respectively.

3.4.12 Internal Resistance

The internal resistance of the signal source is fixed at 100Ω.

3.4.13 DCI Isolation

Parameter setting attribute: enumerated type.

The bias current isolation function (DCI isolation) can prevent the influence of direct current on the test input circuit. The **DCI isolation** domain can set the bias current isolation function ON or OFF. When the bias current isolation function is set to ON, the bias current flowing through the DUT can reach 100 mA. When the bias current isolation function is set to OFF, the allowable bias current value flowing through the DUT is shown in Table 3-1. If the bias current flowing through the DUT exceeds the value in Table 3-1, the instrument will not be able to perform a normal test.

Table 3-1 Maximum DC Bias Current

Test Range	10 Ω	30 Ω	100 Ω	300 Ω	1 kΩ	3 kΩ	10 kΩ	30kΩ	100 kΩ
Maximum Current	2 mA				1 mA	300 μA	100 μA	30 μA	10 μA

---------- ---------- ---------- ----------

Note: When the bias current isolation function is turned on, it has an impact on the accuracy of the test. Therefore, when testing high impedance components at low frequencies and small bias currents, the bias current isolation function should be set to OFF.

---------- ---------- ---------- ----------

3.4.14 Bias Polarity

The automatic bias polarity control function is suitable for testing variable capacitance diodes. The internal bias (approximately 1V) is used to identify the

connection status of the diode and internally control the polarity of the DC bias, so that the diode is reverse biased. When AUTO mode is selected, the DC bias voltage is followed by a "*" prompt.

For example, when the connection of the varactor diode is as shown in Figure 3-1, after the correct connection of the diode is recognized, the specified DC bias is applied. Conversely, when the connection of the varactor diode is as shown in Figure 3-2, the reverse connection of the diode is recognized, and a DC bias with the opposite polarity to the specified setting is applied. This function eliminates the need to check the polarity of the varactor diode before connecting it to the UNKNOWN terminal.

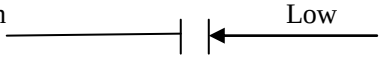
---------- ---------- ---------- ----------

Note: When the DC bias function is turned off (OFF) and the automatic bias control function is set to AUTO, the automatic bias polarity control function is invalid.

---------- ---------- ---------- ----------

Variable capacitance diode (normal polarity)

High Low



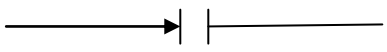
The bias voltage added to the varactor diode is the same as the set bias voltage (+ on the high side and - on the low side).

Results for:

Bias Voltage Setting	Bias voltage for practical applications
1V	1V
10V	10V

Variable capacitance diode (opposite polarity)

High Low



The bias voltage added to the varactor diode is the opposite of the set bias voltage (high end is -, low end is +).

Results for:

Bias Voltage Setting	Bias voltage for practical applications
1V	-1V

10V	-10V

3.4.15 Deviation and Reference

3.4.15.1 Bias Mode

Parameter setting attribute: enumerated type.

The deviation test function can directly display the deviation value instead of the actual test value on the screen. The deviation value is equal to the current actual test value minus the preset reference value. Using this function, you can easily observe the changes in the parameters of the measured component with temperature, frequency, bias, and other conditions.

The instrument provides two deviation test methods as follows:

Δ mode (absolute deviation mode)

The deviation currently displayed is the difference between the measured value of the tested component and the set reference value. The formula for calculating the Δ deviation is as follows:

$\Delta = X-Y$

where X: the current measured value of the tested component.

Y: the preset reference value.

1) Δ % mode (percentage deviation mode)

The deviation currently displayed is the percentage error obtained by dividing the difference between the measured value of the test piece and the set reference value by the reference value. The formula for calculating the Δ% deviation is as follows:

$\Delta\% = (X-Y)/Y \times 100\ [\%]$

where X: the current measured value of the device under test.

Y: the preset reference value.

If the reference value is 0, the test result shows Inf;

3.4.15.2 Deviation reference value

Parameter setting attribute: numeric input type.

Used as a reference value for calculating deviations from the test result.

Reference value setting method:

Regular numeric input.

3) automatic recording after measurement: select the **measurement of** the corresponding menu area, a test will be performed, and the test result will be recorded as the parameter value.

3.4.16 Cylinder

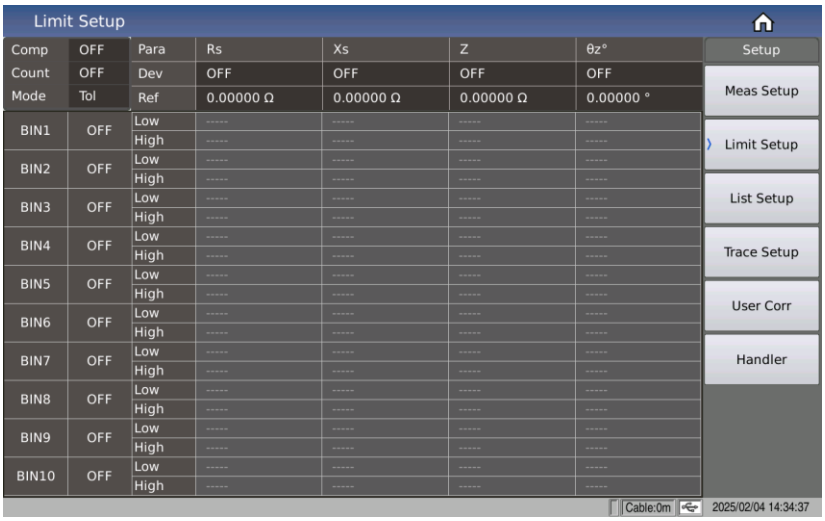
Parameter setting attribute: enumerated type.

The cylinder is mainly related to the cylinder control switch and the cylinder on/off delay setting.

3.5 <Limit Setup> Page

Press the menu key [Setup], then press the soft key Limit Setting to enter the <Limit Setup> page.

As shown in Figure 3-5-1:



(Figure 3-5-1 Limit Settings)

On this page, you can set the instrument comparator function.

You can set 10 limit levels, and the measured results can be sorted into up to 11 bins (BIN1 to BIN10 and BIN OUT).

Compare ON/OFF (comparison function switch)

Count ON/OFF (comparison counting switch)

Mode (comparison function limit mode)

Parameters (test parameters)

Deviation (deviation mode)

Reference (reference value in deviation mode, i.e. nominal value)

Switching for each sorting bin

Lower limit value for each bin (**Low**)

Upper limit value for each bin (**High**)

3.5.1 Compare Switch

Parameter setting attribute: enumerated type.

Setting Items	Meaning
OFF	Turn off the comparison function
ON	Turn on the compare function

3.5.2 Compare Count Switch

Parameter setting attribute: enumerated type.

Setting Items	Meaning
OFF	Turn off the comparison counting function
ON	Turn on the compare counting function

3.5.3 Comparison Function Limit Mode

The comparison function offers the following two modes for setting the limit parameters. As shown in Figure 3-3.

Tolerance method

In tolerance mode, the deviation from the nominal value (set in the **nominal** field) is set as the comparison limit. There are two types of deviation: percentage deviation and absolute deviation.

Continuous mode

In continuous mode, the range of test values is used as the comparison limit. The comparison limits must be set in ascending order.

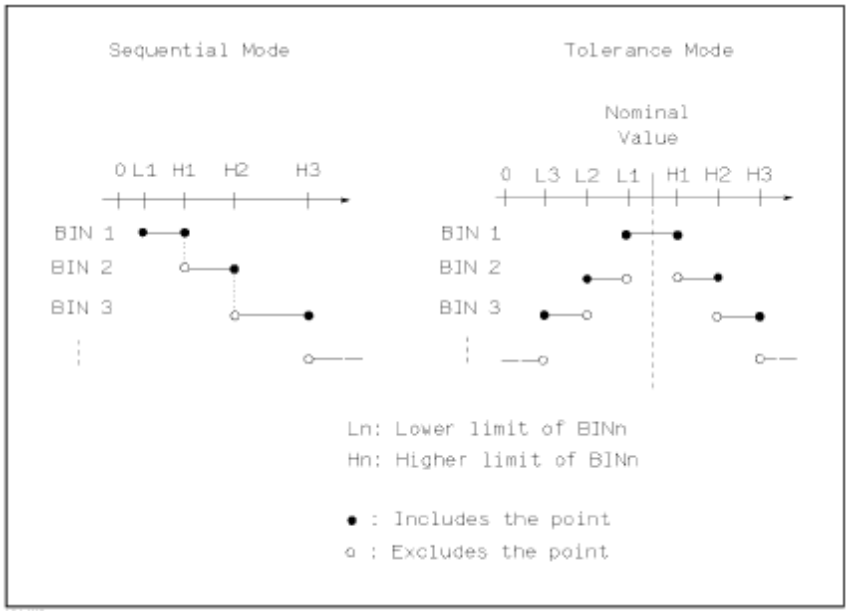


Figure 3-5-2 Tolerance and Continuous Methods

Note: When setting the limit values for tolerance mode, the error ranges must be set from smallest to largest. If the maximum error range is set for BIN1, all measured parts will be sorted into BIN1.

In tolerance mode, the lower limit does not have to be smaller than the nominal value, and the upper limit does not have to be larger than the nominal value. The limit ranges of the individual bins can be either non-continuous or overlapping.

3.5.4 Comparison Parameters

The comparison parameters use the same four parameters as the measurement settings, i.e. they are consistent with the four parameters measured; the sorting parameters can be modified on the measurement display page or the measurement settings page.

3.5.5 Deviation and reference

Refer to the measurement settings page for the settings of deviation and reference. The meaning of the parameters here is exactly the same as that of the measurement settings.

3.5.6 Bin Switch

Parameter setting attribute: enumerated type.

Set the independent comparison switch for the specific sorting bin:

Setting Items	Meaning
OFF	Turn off the comparison function for the specified file
ON	Turn on the comparison function for the specified file

When the corresponding sorting bin is off, the sorting process will skip the limit comparison of this sorting.

3.5.7 High and low Limits

As the main basis for parameter comparison.

If the high and low limits of the corresponding file are not set, it indicates that the parameter under the corresponding file does not participate in the comparison, that is, the test result does not affect the comparison result; if only one lower limit or upper limit is set, it has the effect of unilateral comparison.

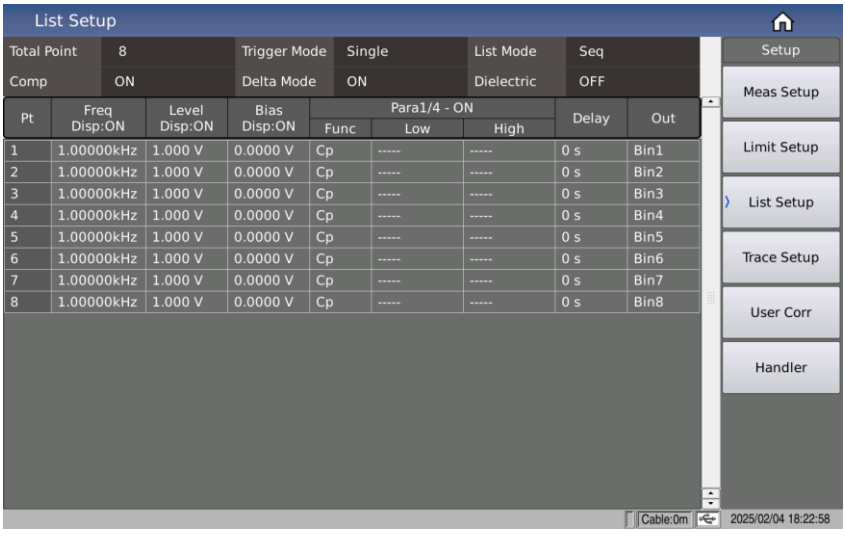
Parameter setting attribute: numeric input type.

Note: When only the upper or lower limit is set for the high and low limits, it is considered a unilateral comparison.

3.6 <List Setup> Page

Press the menu key [Setup] and then the soft key list settings to enter the <List Setup> page.

As shown in Figure 3-6-1:



(Figure 3-6-1 List Settings)

The list sweep function can automatically sweep the test frequency, test level, and

bias voltage for up to 201 points. The following list sweep parameters can be set on the <List Setup> page:

Total points (total points to be scanned)

Trigger mode

List mode (sweep mode)

Sweep conditions (frequency [Hz], level [V], level [I], bias [V] and bias [I])

Parameter function (function)

Parameter high and low limits

Single-point delay (delay [s])

3.6.1 Points

Set the number of points to be scanned for list sweep, value range 1~201.

Parameter setting attribute: input type.

3.6.2 Trigger Mode

Same as the trigger mode on the measurement settings page.

After the normal trigger list sweep, the user can interrupt the list sweep process by pressing the Reset button:

One Reset enters the pause status, and the current point sweep continues after another trigger.

Two Resets enter the reset status, and the sweep starts from the first point after another trigger.

3.6.3 List Mode

Set the list sweep mode to sequence mode or single-step mode.

Parameter setting attribute: enumerated type.

Sequence mode	If trigger is active, sequentially sweep from first point to last point
Single-step mode	If trigger is active, only step through one point at a time

Note: The effect of the list mode is mainly reflected in the single trigger mode, if it is a continuous trigger mode, the test process of the two modes will be visually different.

3.6.4 Comparison

This series provides a switch setting for list comparison in order to adapt to scenarios where comparison output is not required and only list data needs to be collected. This switch is turned on by default for compatibility with the use of previous products in the same category.

That is, when this switch is on, the list will determine and output the comparison signal; otherwise, it will only perform other operations such as data testing and storage and will not involve comparison-related operations.

The high and low limits of the parameters are used as the main basis for parameter comparison. If the difference mode is enabled, the P/F result will be displayed by comparing the high and low limits of the difference of parameter 1. Parameter 2 will only be used to display the measurement result and will not be involved in the comparison. If the dielectric constant is enabled, the P/F result will be displayed by comparing the parameters that have been enabled.

Parameter setting attribute: enumerated type.

Setting Items	Meaning
OFF	Turn off the comparison function
ON	Turn on the comparison function

In addition, unlike the list sorting output of similar digital bridges in the past, the output pins of this series of upgraded Handlers are customizable, that is, each list point can have a custom output pin, which indicates that the same sorting pin is not limited to comparing the output of points 1 to 10, and can be controlled by a combination of multiple points. For example, if the output options for the first and second points are both Bin1, then the status output of Bin1 is determined by the comparison status of these two points: both qualified are considered as qualified, and one unqualified is considered as unqualified. and a sorting signal is given from the specified sorting pin in the failed status. The specific output mode of the sorting signal is still determined by the definition in Chapter 3.9 Handler Settings.

3.6.5 Dielectric Constant

This series, except for the -02L series which does not have an integrated piezoelectric and dielectric constant solution, comes with a dielectric constant test function as standard. This function is based on the original list scan, and the dielectric constant test is compatible with the point frequency test and the multi-frequency test.

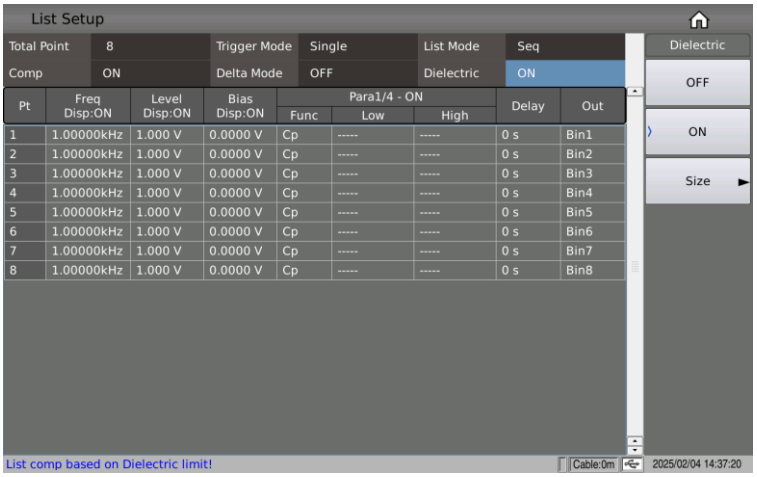
The setting method is to determine whether the frequency setting results in the list are the same or different, and there is no barrier to use.

Above the list settings, you will see the dielectric constant switch setting item. Move the cursor here, and the corresponding menu will allow you to select the corresponding switch settings, as well as the size settings for related parameters, such as diameter, area, depth, and the limit and test calculation switches for dielectric-related parameters.

After the dielectric constant switch is turned on, the test results displayed on the list page will no longer show the previous test results of the four parameters, but will be dominated by the new dielectric constant display, and the comparison result will also be determined by the relevant calculated parameters of the dielectric constant, which is independent of the conventional four-parameter setting.

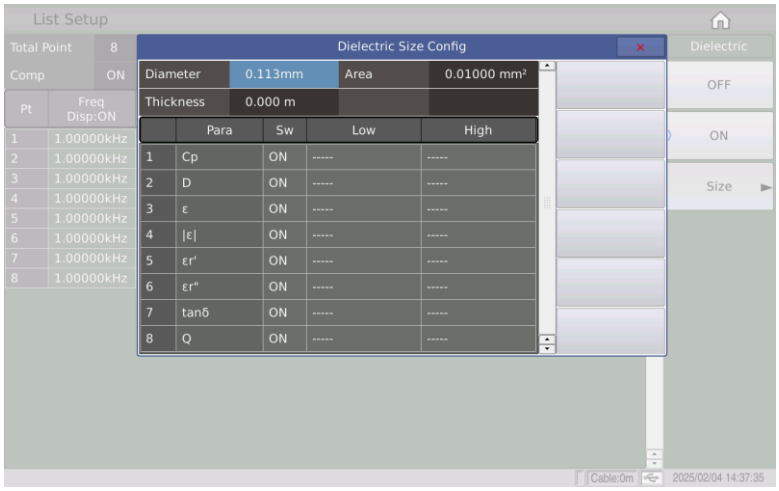
The entry for setting the formula conditions related to the dielectric constant is in the menu of the dielectric constant switch:

As shown in Figure 3-6-2 below:



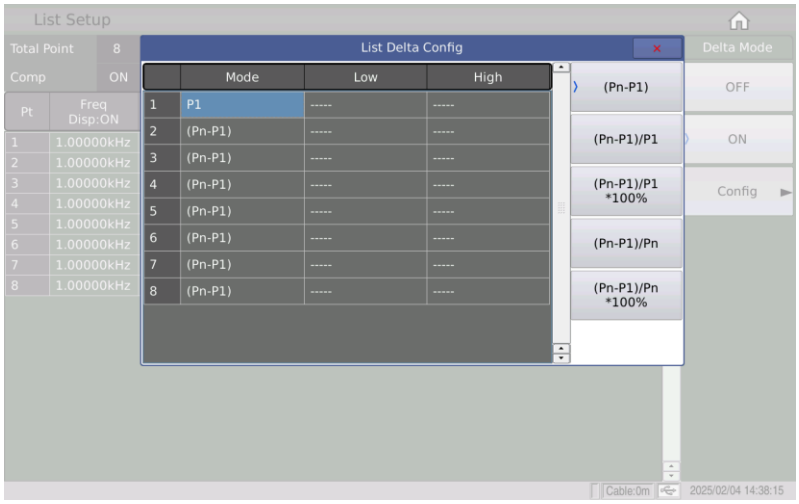
(Figure 3-6-2 Dielectric Constant Display Menu)

The size menu at the menu bar is the entry point for dielectric-related adjustment settings, including diameter/area, thickness, and comparison limit. As shown in Figure 3-6-3:



(Figure 3-6-3 Dielectric Constant Setting Menu)

3.6.6 Difference Mode



(Figure 3-6-4 Difference Mode Configuration)

For list sweep of parameter 1, the sweep point n (n ranges from 1 to 201) is compared with the parameter 1 measured value of scan point 1 or scan point 2 by difference.

When the comparison switch in section 3.6.4 is turned on, if the difference mode is not turned on, the list display page is as shown in Figure 3-2-1 in section 3.2, and the pass/fail result output is based on the high and low limit comparison results of the measured data of parameters 1 to 4.

When the comparison switch in section 3.6.8 is turned on, and the difference mode is turned on, the list display page is as shown in Figure 3-2-3 in section 3.2, and the difference value calculation result is displayed at the same time. The pass/fail result is output based on the comparison result of the difference value.

Note: The difference mode and the dielectric constant switch cannot be turned on at the same time. Turning on one of them will automatically turn off the other.

3.6.7 Sweep Condition

Frequency, level, and bias can be set independently or through a quick setting that makes one of these conditions relatively regular.

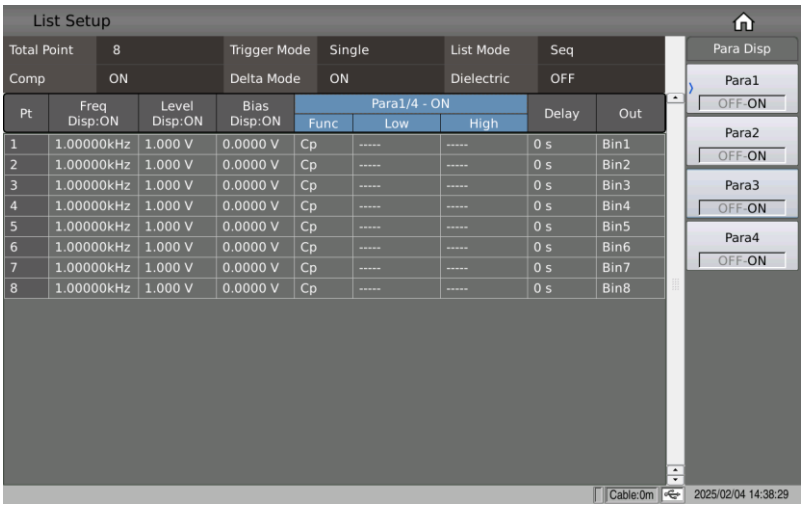
If you are only concerned about the impact of a change in one condition on the tested component, you can set the other test conditions to the same result through quick setting, for example, a linear change in frequency with fixed level and bias.

For the frequency, level and bias in the sweeping conditions, you can choose whether to display them on the test page. Touch the corresponding title area of the parameter and then select ON or OFF in the corresponding menu.

3.6.7.1 Parameter Function

The four parameter functions can be set independently or through a quick setting so that one of the conditions remains relatively consistent.

Since the high and low limit effects are too long when setting the limits of the 4-parameter setting, a parameter display menu is used to set the function and high and low limits of one of the parameters. The parameter display menu here is only used to select the parameter index that is currently being set and has no direct relationship to whether the parameter is measured.



(Figure 3-6-5 List Parameter Display Menu)

3.6.7.2 Parameter High and Low Limits

The high and low limits of the parameters can be set independently of each other or in a relationship with each other using quick settings.

3.6.7.3 Delay Time

The **delay time** parameter indicates the delay time between the completion of each scanning step and the next scanning measurement. It is mainly used to connect an external offset source (such as the TH1778) and set the delay time required to accommodate the external offset source. (Note: The delay here can be added to the delay in the measurement settings interface.)

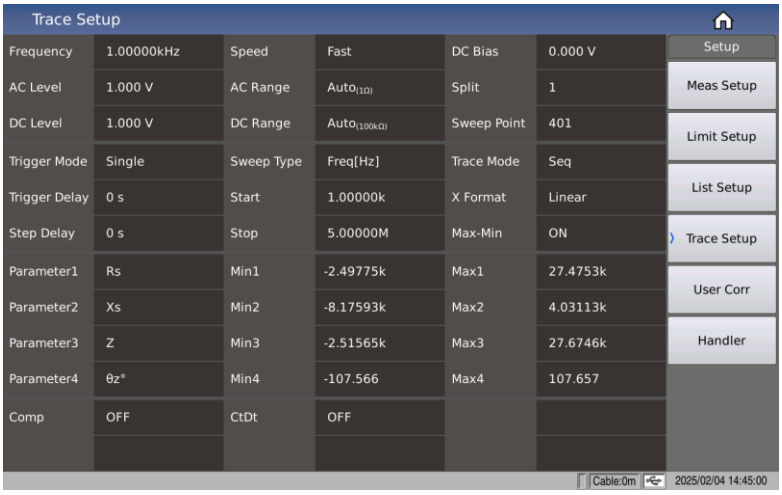
3.6.7.4 Sorting Output

As mentioned above, this series of instruments, based on previous similar impedance test instruments, handles list sorting as a custom upgrade, that is, on the basis of a limited number of output pins, flexible custom control of the list sorting pins is realized.

Since there are only Bin1~Bin10 output pins, in the previous processing, the comparison failure signal of the first 10 points in the list is used as the sorting signal for these 10 output pins by default. After the modification of this series, the default status is still compatible with this mode of output control, i.e., the first 10 points correspond to Bin1~Bin10 outputs; and the improved part of the upgrade is that the user can map the comparison results of any point to the output of any Bin pin according to their actual usage, or map multiple points together to the output of the same Bin pin, giving full play to the ultimate flexibility of list sorting.

3.7 <Trace Setup> Page

Press the menu key **[Setup],** then press the soft key **Trace Setup** to enter the**<Trace Setup>** page. As shown in Figure 3-7-1:



(Figure 3-7-1 Trace Settings)

This display function page is used to complete the setting of the parameters for trace sweep measurement, including split screen, number of sweep points, sweep type, start condition, stop condition, trace mode, X Foramt, Max-min value switch, four

parameters, display range of ordinate, trace comparison, piezoelectric test, etc.

3.7.1 General Test Conditions

Frequency, level, speed, range, bias, trigger, delay, etc. all belong to the general test conditions, and their meanings and setting methods are exactly the same as those described in the Measurement Settings page.

3.7.2 Trace Four Parameters

The four parameters of trace are used to specify the result parameters of trace sweep, i.e., the test results under certain conditions are plotted as traces.

The four parameters of the trace and the four parameters of the conventional component test are independent of each other and have no direct correlation, and the optional parameters can be selected except that RD is not selectable, and all other parameters can be selected.

The four parameters correspond to four traces, each trace has an independent display switch, display scale and independent vertical coordinate scale, but share the same horizontal coordinate scale (depending on the same scanning conditions, i.e., characterize the results of different parameters under the same scanning conditions).

3.7.3 Split Screen

For trace display effects, three split-screen displays are available:

Split Screen	Description
1-split screen	All traces are displayed in the same plot window
2-split screen	The four parameters are grouped together and displayed in their respective plotting windows
4-split screen	The four parameters are displayed independently in their own plotting windows.

3.7.4 Sweep Points

Here is to set the number of points to be scanned, there are 51, 101, 201, 401, 801 five groups can be selected.

3.7.5 Sweep Type

Sweep type is mainly used to set the conditions of trace sweep, i.e., plotting the test results according to this selected condition parameter, so it involves the type of

condition parameter, the start size and the end size of the condition change.

3.7.5.1 Sweep Type

Set the main conditions corresponding to the sweep trace, i.e., frequency [Hz], level [V], level [A], bias [V], bias [A].

Sweep Type	Description	Linear	Logarithms
Frequency [Hz]	The corresponding parameter result is recorded after the condition changes within the specified interval (between start and stop) in a linear or logarithmic relationship.	√	√
Level [V]		√	×
Level [A]		√	×
Bias [V]		√	×
Bias [A]		√	×

3.7.5.2 Starting Condition

Selecting a sweep type corresponds to setting the start size and stop size of the condition, i.e., the start and end points of the trace.

3.7.6 Trace Mode

Set the trqce sweep mode and take value sequence mode or single-step mode.

Parameter setting attribute: enumerated type.

Sequence Mode	With a valid trigger, sweep sequentially from the first point to the last point.
Single-step Mode	With a valid trigger, only one point is stepped through the test at a time.

Note: The effect of the trace mode is mainly reflected in the single trigger mode, if it is a continuous trigger mode, the test process of the two modes will be visually different.

3.7.7 X Format

This area is used to change how the sweep is coordinated, mainly for horizontal coordinates.

Linear	The sweep condition parameter is linearly distributed over the start and stop ranges.
Logarithms	The sweep condition parameter is distributed in a logarithmic manner with a base of 10 in the start and stop ranges.

Note: Only the case log mode of the sweep frequency is valid.

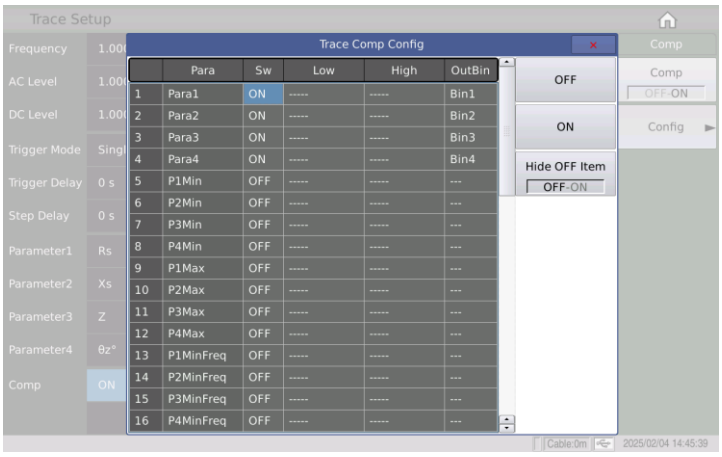
3.7.8 Max-Min Value

Set on or off:

ON	The maximum and minimum values of the parameter trace results are displayed.
OFF	The maximum and minimum values of the parameter trace results are not displayed.

3.7.9 Trace Comparison

It provides comparison functions for trace data, including comparison of the range of the entire parameter, comparison of the maximum value of the specified trace, comparison of the horizontal coordinate corresponding to the maximum value, and comparison of parameters related to piezoelectric testing.



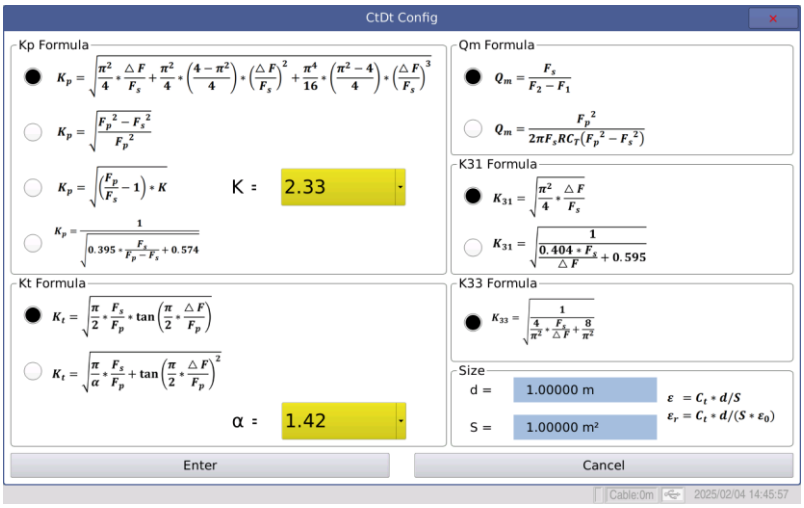
(Figure 3-7-2 Trace Comparison Limit Setting)

3.7.10 CtDt Piezoelectric Test

This series, in addition to the -02L model, comes standard with piezoelectric ceramic test solutions for the entire system, involving Kp, Qm, Kt, Q31, K33, and CtDt and other related parameters, and switching on also involves independent plotting of the conductivity circle diagram, full-screen display of the relevant parameters, and

programmable comparative settings for the full parameters.

As shown in Figure 3-7-2:



(Figure 3-7-3 CtDt Piezoelectric Test Conditions)

The related parameter nomenclature is explained below:

Notation	Meaning	Notation	Meaning
C_t	Free capacitance (capacitance value $_{Cs}$ tested at 1kHz frequency)	C_0	Static capacitance of the oscillator (C0=Ct-C1)
D_t	Free loss (capacitance value D tested at 1kHz frequency)	C_1	Dynamic capacitance at oscillator resonance
F_s	Series resonance frequency: resonance frequency of the series path in the equivalent circuit of the piezoelectric oscillator	R_1	Dynamic resistance: the reciprocal of the conductance at the point of minimum impedance
F_p	Parallel resonance frequency: resonance frequency of the parallel path in the equivalent circuit of the piezoelectric oscillator	L_1	Dynamic inductance
F_p-F_s	Difference between series resonance frequency and parallel resonance frequency	K_p	Planar electromechanical coupling coefficient, reflecting the electromechanical coupling effect of polarization and electrical excitation along the thickness direction of thin wafer-type ceramics when vibrating in radial expansion and contraction
Z_{min}	Minimum impedance, anti-resonance impedance	K_{eff}	Effective electromechanical coupling coefficient
Z_{max}	Maximum impedance, anti-resonance impedance	K_t	Thickness-stretching electromechanical coupling coefficient, reflecting the polarization and electrical excitation of thin sheet-type ceramics along the thickness direction, and the parameter of the electromechanical coupling effect for thickness-stretching vibration

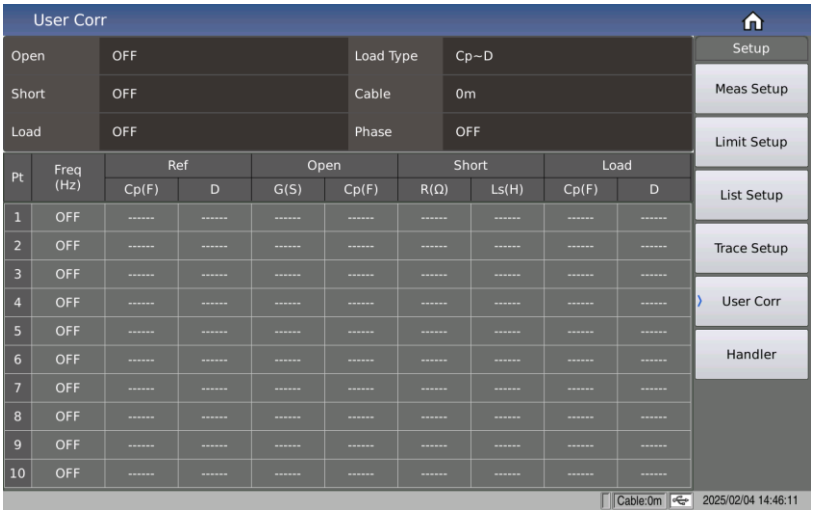
F_1	Oscillator half-power point F_1	K_{31}	Transverse electromechanical coupling coefficient, reflecting the polarization and electrical excitation of elongated strip-type ceramics along the thickness direction, and the parameter of the electromechanical coupling effect for length-stretching vibration
F_2	Oscillator half-power point F_2	K_{33}	Longitudinal electromechanical coupling coefficient, reflecting the polarization and electrical excitation of a long, thin ceramic rod along its length, and serving as a parameter for the electromechanical coupling effect of length expansion and contraction vibrations
F_2-F_1	F_2-F_1	Q_m	Mechanical quality factor, indicating the degree of oscillator efficiency
G_{max}	Maximum conductance	ε	Dielectric constant: reflects the dielectric properties of the material
d	Dielectric thickness	ε_r	Relative dielectric constant: ratio of the dielectric constant to the permittivity of free space
S	Electrode area		

3.8 <User Correction> Page

The**<User Corr>** page provides 10 user **Points**. In the **Freq** range, you can set whether to enable the calibration data corresponding to the point. After enabling, manually enter the frequency corresponding to the calibration, and then use the soft key **Open** to perform open-circuit zeroing, short-circuit zeroing, and load calibration for the currently set frequency.

Press the menu key [Setup], press the soft key User Corr to enter the <User Corr> page.

As shown in Figure 3-8-1:



(Figure 3-8-1 User Correction)

The open, short and load correction functions on the<User Corr> page can be used to eliminate distributed capacitance, parasitic impedance and other measurement errors.

Two calibration methods are provided:

Calibration Method	Description
Full Frequency Calibration	Open and short circuit correction is performed for all frequency points using the insertion method.
Point Frequency Calibration	Open, short and load calibrations are performed for the currently set frequency point.

The following measurement control parameter setting fields can be set on the **<User Corr>** page.

Open circuit calibration (**Open**), short circuit calibration (**Short**), load calibration (**Load**), cable length selection (**Cable**), load type, point frequency calibration switch, reference value, etc.

---------- ---------- ---------- ----------

Note: The rule for user calibration is that if the open circuit or short circuit is ON, and the measurement frequency corresponding to the point frequency correction is open, the data of the point frequency calibration is used preferentially.

---------- ---------- ---------- ----------

3.8.1 Open Circuit Calibration

The open-circuit calibration function can eliminate errors caused by stray admittances (G, B) connected in parallel with the measured component, as shown in Figure 3-8-2.

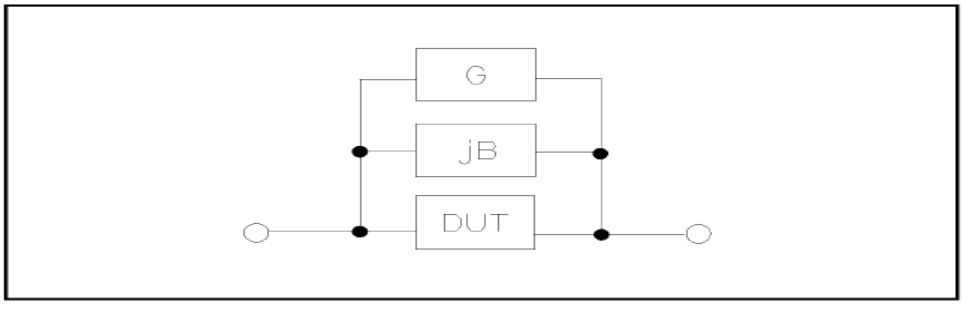


Figure 3-8-2 Stray Admittance

Use the following two open-circuit calibration data:

Regardless of the current frequency setting, perform an open-circuit calibration test on all the following fixed frequency points. In addition to the following frequency points, the instrument can calculate the open-circuit calibration data for different test ranges at all test frequencies using difference based on the open-circuit calibration data at the following frequency points. Move the cursor to the **Open** field and use the soft key **Meas Open** to perform a full frequency open circuit zero. The fixed frequency points are as follows (some models may be limited due to differences in the frequency range, and the fixed frequency points are as follows) TH2848-02L/TH2848-02 has a maximum test frequency of 2MHz, TH2848-05 to 5MHz, and TH2848-10 to 10MHz.

Open-circuit calibration function operating steps:

Open-circuit correction includes full-frequency open-circuit correction using the insertion method and single-frequency open-circuit correction for the set frequency point. Perform the following steps: Use the insertion method to perform full-frequency open-circuit correction. For details on single-frequency open-circuit correction, see the "Load correction" operating instructions.

Move the cursor to the **Open** field, and the following soft keys will be displayed in the screen's soft key area.

Operating Function	Description
OFF	Turns off the open circuit correction function. In subsequent measurement processes, no open circuit correction will be calculated.
ON	To make open circuit correction effective, it will be calculated in subsequent measurement processes. If the frequency setting is OFF, the open circuit correction data for the current frequency calculated using the insertion method will be used for open circuit correction calculation. If the frequency setting is ON and the current test frequency is equal to the corresponding frequency, the open circuit correction data for the corresponding frequency will be used for open circuit correction calculation.
Meas Open	The open-circuit admittance (capacitance and inductance) at the fixed frequency points mentioned above will be measured. Open-circuit full-frequency correction takes about 75 seconds. The following soft keys are displayed during open-circuit full-frequency correction.

DCR Open	The open-circuit resistance will be measured using the DC resistance function.
NOTE: Connect the test fixture to the instrument test terminal. The fixture is open and not connected to any component under test.	

3.8.2 Short Circuit Calibration

The short-circuit calibration function eliminates the error caused by the parasitic impedance (R, X) in series with the component under test. As shown in Figure 3-8-2.

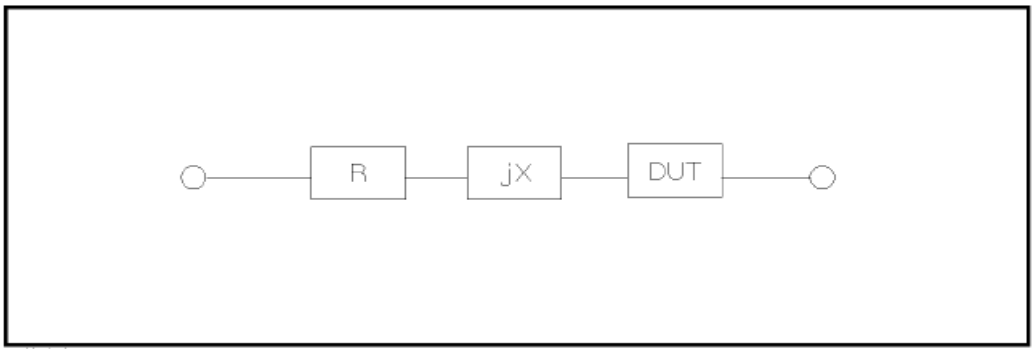


Figure 3-8-2 Parasitic Impedance 1

The following two short-circuit calibration data are used:

Regardless of the current frequency setting, short-circuit calibration is performed at the fixed frequency points mentioned above. In addition to the fixed frequency points mentioned above, the short-circuit calibration data for other frequencies is calculated using difference to obtain short-circuit calibration data for different test frequencies in different ranges. Move the cursor to the **Short** field and use the soft key **Meas Short** to perform full frequency short circuit clearing. The fixed frequency points are the same as those described for open circuit calibration.

Short-circuit calibration function operating steps:

Short-circuit calibration includes full-frequency short-circuit calibration using the insertion method and single-frequency short-circuit calibration for the set frequency point. Perform the following operating steps: Use the insertion method to calibrate short-circuits for the full frequency range. For details on single frequency short-circuit calibration, see the “Load calibration” operating instructions.

Move the cursor to the **Short** setting field, and the following soft keys will be displayed in the screen soft key area.

Operating Function	Description
OFF	Turn off the short-circuit correction function. In

	subsequent measurement processes, no short-circuit correction calculation will be performed.
ON	To enable short-circuit correction, a short-circuit correction calculation will be performed in subsequent measurement processes. If the specified frequency settings are all OFF, the short-circuit correction data for the current frequency calculated using the insertion method will be used for the short-circuit correction calculation. If the specified frequency settings are ON and the current test frequency is equal to the corresponding frequency, the short-circuit correction data for the corresponding frequency will be used for the short-circuit correction calculation.
Meas Short	Connect the test fixture to the instrument test terminal. Short-circuit the test fixture with a shorting piece. Press the soft key **Meas Short** to measure the short-circuit parasitic impedance (resistance and reactance) at the above fixed frequency point. Short-circuit full-frequency correction takes about 75 seconds. The following soft keys are displayed on the screen during short-circuit full-frequency correction.
DCR Short	The short-circuit resistance will be measured using the DC resistance function.

3.8.3 Load Calibration

The load calibration function uses a transfer factor between the actual measured value and the standard reference value at the set frequency point to eliminate other measurement errors. This indicates that open circuit, short circuit and load calibration can be performed at the set frequency point. Before setting the standard reference value, the reference value must be set in the corresponding field of the **Ref**. When the cursor is moved to **Freq or Ref**, the screen displays the soft key **Load**. Press the **Load** soft key to perform a load calibration test on the standard.

Load calibration function switch options:

Operating Function	Description
OFF	Invalidate load correction test data at the current set

	frequency
ON	Validate load correction test data at the current set frequency

3.8.4 Load Type

When load correction is performed, the reference value of the standard device must be entered beforehand. The test parameters for the reference value should be consistent with the set load correction test function.

The load correction function uses the transfer coefficient between the actual measured value and the standard reference value at the set frequency point to eliminate other test errors. The load correction test function is only used to calculate the transfer coefficient.

This series classifies load types into three categories:

Load Type
Ls~Rs
Ls~Q
Cp~D

3.8.5 Cable Length Selection

Currently available cable lengths are 0 m, 1 m, 2 m, and 4 m. The instrument comes with 0 m and 1 m cable calibration data. 2 m and 4 m cable calibration data need to be specially customized by the customer.

The factory default is 0m calibration.

3.8.6 Phase Calibration

The system has default built-in phase correction data according to the cable length. When the phase correction is turned off, the default built-in phase correction data is used. The phase correction switch is mainly used to provide a correction entry for users' special on-site usage scenarios. Generally, it is sufficient to use the system's built-in data, i.e., to keep the phase correction switch turned off.

3.8.7 Point Frequency Operation

Follow the steps below to perform an open/short/load calibration test on the set frequency point.

Move the cursor to the **Freq** setting field. The following soft keys will be displayed.

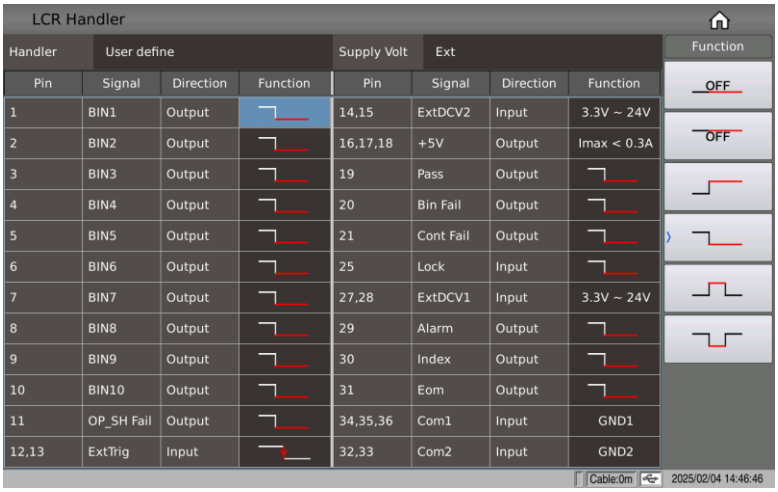
Operating Function	Description
OFF	Invalidate the open/short/load correction test data at the current set frequency
ON	Validate the open/short/load calibration test data at the current set frequency, and the frequency setting field displays the previously set open/short/load calibration frequency
Meas Open	Perform an open calibration test at the current frequency
Meas Short	Perform a short calibration test at the current frequency
Meas Load	Perform a load calibration test at the current frequency
Meas Phase	Perform a phase calibration test at the current frequency
Clear Line	Clear the calibration data at the current frequency

3.8.7.1 Steps for Load Calibration

Move the cursor to the **Freq** setting field and set the frequency to be calibrated.

1. Open the test fixture and press the soft key **Open** to perform an open-circuit calibration for the currently set frequency.
2. Short-circuit the test fixture and press the soft key **Short** to perform a short-circuit calibration for the currently set frequency.
3. Prepare a standard device for measurement, move the cursor to the **Load type** setting field, and set the type of functional parameter to be measured for the standard device.
4. Move the cursor to the corresponding **Freq** field, connect the standard device to the test fixture, and press the soft key **Load** to perform a load calibration. The actual measurement result of the standard device is displayed in **Load.**

3.9 Handler Settings



(Figure 3-9-1 Handler Settings)

The input and output I/O interfaces are active low by default, and the trigger mode can be changed as needed.

The interface voltage has two options: external and internal.

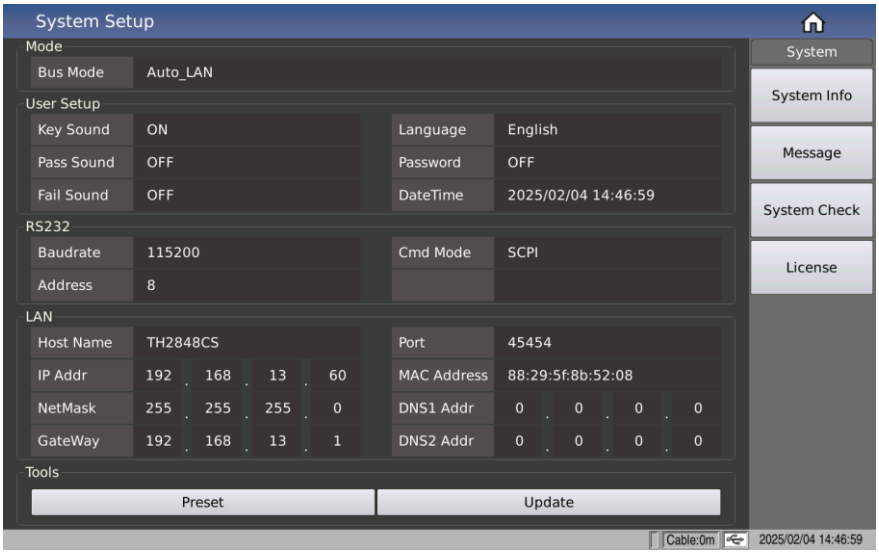
For details of the Handler interface, see Chapter 8 Handler Interface Description.

Chapter 4 System Settings and File Management

4.1 <System Settings> Page

Press the menu key [System] to enter the <System Settings> page.

As shown in Figure 4-1-1:

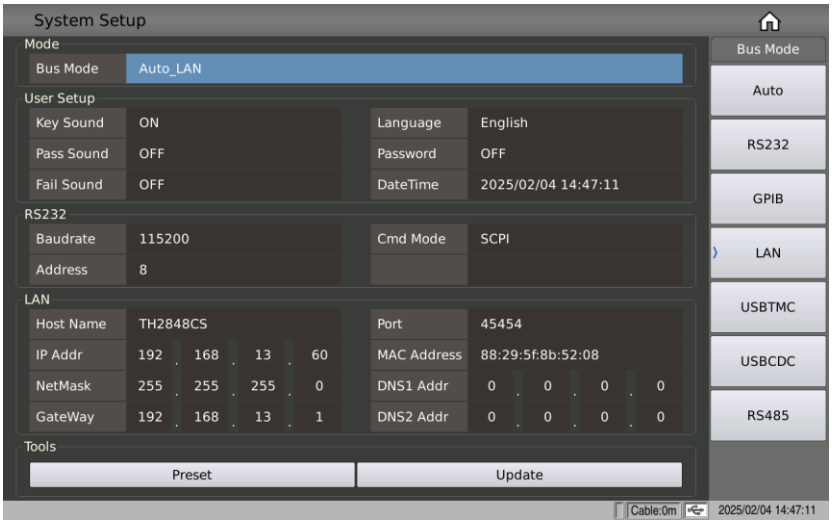


(Figure 4-1-1 System Settings)

This function page displays most of the system settings menu, including the instrument function, pass sound, pass sound, fail sound, system language, password setting, bus mode, bus address, baud rate, time, etc.

4.1.1 Bus Mode

The bus mode is used to select the communication method used by the instrument.



(Figure 4-1-1-1 System Settings)

The following options are available:

Auto	Automatic selection of RS232/LAN/USB communication mode based on external signal input
RS-232	The selection of these three modes involves relay switching, so in automatic mode, it can only automatically switch to the communication mode that was last used.
RS-485	
GPIB	
LAN	10M/100M Self-adaptive
USB Device	USBCDC
	USBTMC

When using the RS-485 or GPIB interface, the bus address set in RS-232 is used as the local address.

4.1.2 User Settings

4.1.2.1 Key Sound

Parameter type: enumerated type.

Parameter Options	Description
ON	Turn on the key sound
OFF	Turn off the key sound

4.1.2.2 Pass Sound

Parameter type: enumerated type.

Parameter function: This area is used to control and display the sound mode when the instrument's measurement comparison result is a qualified product.

Parameter Options	Description
ON	Select no audible alarm
Two shorts	Select two low, short beeps
Low and long	Select one long, low beep
High and short	Select one short, high beep
High and long	Select one long, high beep

4.1.2.3 Fail Sound

Parameter type: enumerated type.

Parameter function: This area is used to control and display the alarm sound mode when the instrument's measurement comparison result is a defective product.

Parameter Options	Description
ON	Select no audible alarm
Two shorts	Select two low, short beeps
Low and long	Select one long, low beep
High and short	Select one short, high beep
High and long	Select one long, high beep

4.1.2.4 System Language

Parameter type: enumerated type.

Parameter function: This area is used to control and display the current instrument's operating language mode.

Parameter Options	Description
English	Select English operating language
Chinese	Select Chinese operating language

4.1.2.5 Password

Parameter type: enumerated + input type

Parameter function: This area shows the current password protection mode.

Parameter Operation Options	Description
OFF	Turn off password protection
Lock System	Turn on password protection, including file protection and power-on password
Lock Files	Used for user file protection
Lock Setup	Used to restrict the tester's modification of the settings file
Modify	This soft key is used to change the password. To change the password, press this key, enter the new password according to the on-screen instructions, enter the new password again after entering it on the keyboard, and then confirm the new password. The password change is now complete.

Note: The factory default password is 2848.

4.1.2.6 Time

The system time can be modified when you move to the time field.

4.1.3 RS232 Serial Port Settings

The serial port's general settings are: 8 data bits, 1 stop bit, no parity bit.

4.1.3.1 Baud Rate

Parameter type: enumerated type.

Parameter function: Used to select the baud rate of the RS232 interface built into the instrument.

Selectable	
4800	9600
19200	38400
57600	115200

4.1.3.2 Bus Address

Parameter type: input type.

Parameter function: Used to control and display the RS485, GPIB interface and Modbus bus address of the current instrument.

Value range: 1~32

4.1.3.3 Command Mode

Parameter type: enumerated type.

Parameter functions: The configurable command modes are SCPI commands and ModeBus command protocols.

Parameter Options	Description
SCPI	Uses the universal ascii string command protocol
ModBus	Uses the ModBus command protocol

For details, see the chapter 11 Communication Command Reference.

4.1.4 LAN

Configure the corresponding address parameters according to the specific properties of the connected local area network and then plug in the network cable on the back panel to use the network port for communication.

To modify the relevant address parameters, simply double-click the corresponding address display window to bring up the numeric keypad. Enter the correct network configuration on the numeric keypad and click OK to exit the keypad and complete the modification.

If the connected network device (router or switch) supports automatic IP assignment, you can click the Auto Config button in the display window to try automatic configuration. The configuration will take a few seconds, so do not operate the machine during the process. If it is not supported, you need to manually assign the address. If automatic configuration fails, you may get the local loopback IP address, that is, 127.0.0.1. At this time, you can click the Default button in the display window to restore the default configuration, and then fine-tune the settings based on the default configuration. You can consult your company's network technical engineer for the address parameters of the network configuration.

Default port number: 45454

Default factory IP: 192.168.22.209

Default factory gateway: 192.168.22.1

4.1.5 Tools

4.1.5.1 Preset

To facilitate customer use, the instrument can be initialized to a known and consistent starting status.

Standardized initialization of software operation design

To solve the problem of inconsistent settings when the instrument leaves the factory

	English Menu	Chinese Menu	Definition	Command
1	CLEAR SETTING	Clear settings	Restore the following parameters to their factory default settings: a. Parameters set via front panel operation b. Parameters set via SCPI commands	*RST
2	CLEAR SET &CORR	Clear settings &User Calibration	Restore the following parameters to their factory default settings: a. Parameters set via front panel operation b. Parameters set via SCPI commands c. Power-on/off power-down protection parameters d. Clear user calibration data	:SYST:PRES
3	FACTORY DEFAULT	factory setting	Restore the following parameters to their factory default settings: a. Parameters set via the front	:SYS:DEFT

			panel b. Parameters set via SCPI commands c. Power-down protection data d. Clear user zeroing data e. Clear user-saved files	

Note: Parameters that cannot be initialized

The initialization operation does not allow the system calibration data to be cleared.

The real-time clock date and time cannot be cleared or initialized.

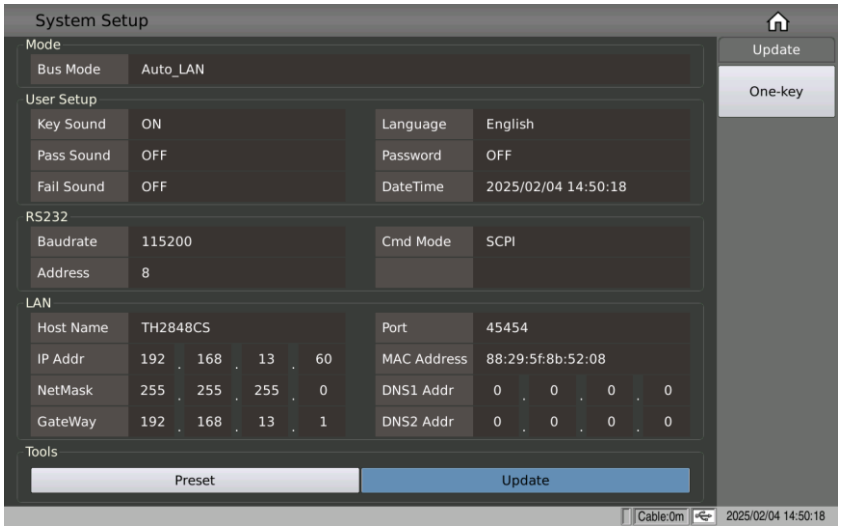
For a detailed list of recovered parameters, see the appendix table later.

4.1.5.2 Software Upgrade

This function is mainly used for software version upgrade and maintenance. This series of machines are designed with multiple CPUs, and for user convenience, a one-key upgrade operation is provided. After operating the one-key upgrade, the user only needs to follow the prompts and wait for about 30 seconds. After the upgrade is complete, the instrument will automatically restart, and after restarting, you can return to this menu to check whether the software version is the latest version after the upgrade.

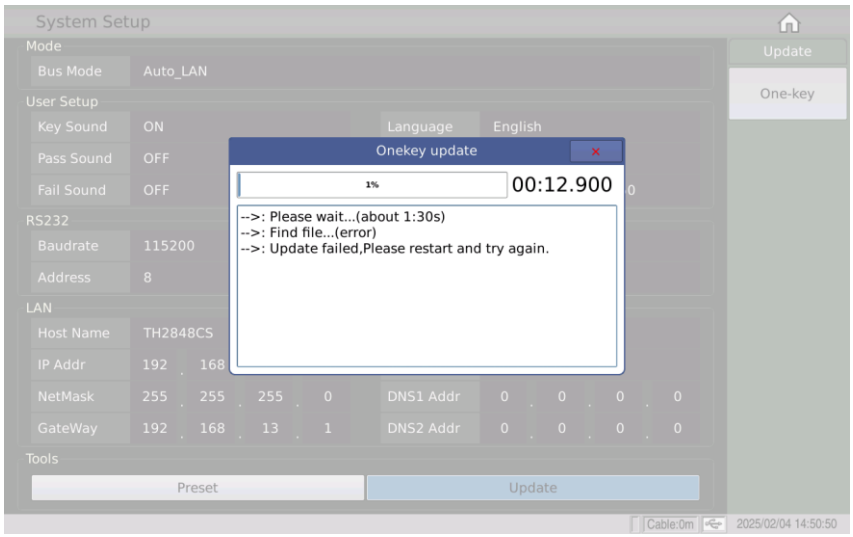
The instrument provides multiple ways to upgrade for the convenience of users, including directly upgrading the specified file in the file system management list; or using the default upgrade path, that is, the “usb/update2848.sec” file to perform an upgrade, that is, placing the upgrade file update2848.sec in the root directory of the USB flash drive, and the operation menu will send instructions to the instrument to perform a one-click upgrade operation; or using our own PC tool to upgrade the specified file on the PC.

The menu display is shown in Figure 4-1-2:



(Figure 4-1-2 Upgrade Menu)

The dynamic prompt window for one-click upgrade is shown in Figure 4-1-3:

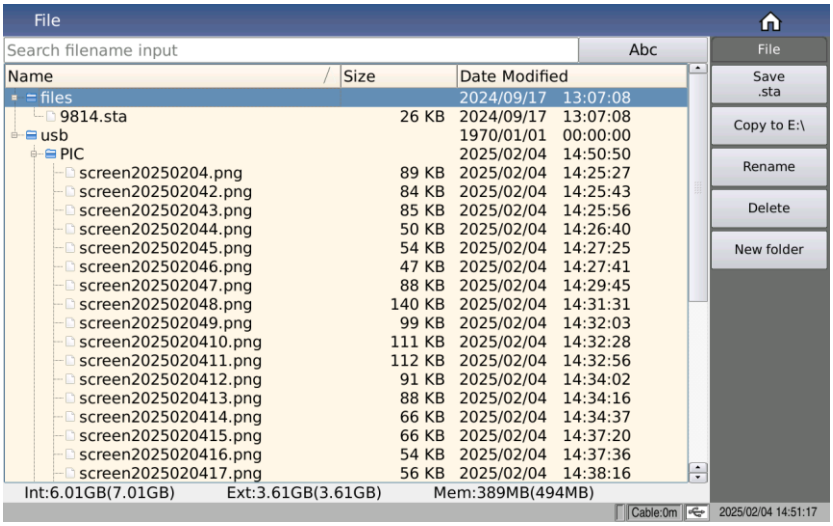


(Figure 4-1-3 Upgrade Waiting Prompt)

4.2 <File management>

Because this series is equipped with an embedded system, user-set parameters can be easily stored in the form of a file inside the system or on an external USB flash drive. When using the same settings in the future, the user does not need to reset these parameters. Simply load the corresponding file and the previously set parameters will be available. This greatly saves the user time repeatedly setting parameters and improves production efficiency.

Press the soft key [File Management] to enter the <File Management> function page. As shown in Figure 4-2-1:



(Figure 4-2-1 File Management)

4.2.1 USB Flash Drive Management Performance

As mentioned above, this series comes standard with a USB HOST interface, which can be used with an external USB flash drive as a storage medium, thereby breaking through the limitations of the internal storage size of the instrument. These files can also be copied to an IBM PC or compatible desktop or laptop computer with a USB interface, thereby achieving unlimited expansion.

USB storage devices (USB flash drives) that support the following features are supported:

USB 2.0 compliant

File format: FAT16 or FAT32 (formatted with Microsoft Windows operating system)

4.2.2 Introduction to Save/Recall Functions

This section provides information on the store/recall function. The store/recall function allows the user to save instrument configuration information to the internal flash memory or external USB flash drive of the instrument, and to recall it from the internal flash memory or external USB flash drive of the instrument. Test results and screenshots can only be saved to an external USB flash drive.

Symbol Description:

files: internal files.

usb: external files.

The following table 4-1 describes the available saving methods and their purposes:

Savingn Methods		whether it can be called	Purpose
Type	File Format		
LCR Setup File	*.sta	Yes	Save the instrument's LCR test configuration status
Save Screenshot	*.png	No	Save a screenshot of the instrument
Test Data	*.csv	No	Save the test data

Table 4-1 Saving Methods and Purposes

4.2.3 Basic Menu Operations for File Management

The following methods can be used to perform various operations on files:

The up and down arrow keys on the directional pad and the knob can be used to move the file cursor up and down, while the left and right arrow keys on the directional pad can be used to expand or collapse the current path.

Click to select the file name to be operated on, and the following operations can be performed according to the display in the toolbar on the right of the screen:

Save.sta

The default menu is the corresponding file save menu. When the focus of the file list is under the files path, the measurement setting file will be saved under the root directory of the files file after the file name is input.

Copy to E:\

When the cursor is in the corresponding path of files, the file or folder corresponding to the cursor will be copied to the root directory of usb.

Note: If the file to be copied is a file, when a file with the same name exists in usb, the file in the usb path will be overwritten; if the file to be copied is a folder, please make sure that no folder with the same name exists in the root directory of usb, otherwise the copy will fail.

Copy to I:\

When the cursor is in the path corresponding to the USB, copy the file or folder corresponding to the cursor to the root directory of the file.

Delete

The instrument will delete the file at the cursor location.

Load

Load the settings file specified by the file index to reconfigure the instrument's parameter settings.

Rename

Rename the name of the file or folder at the cursor location.

Note: The provided root directory is not allowed to be modified.

New Folder

Create a new folder directory at the current cursor position; you can save new test files in the new folder directory.

4.2.4 File Management Operating Steps

Move cursor: the up and down arrow keys and the knob can be used to move the cursor.

Expand and contract: the left and right arrow keys can be used to expand and contract the folder.

4.2.4.1 File Save

Move the cursor to the folder you want to save the settings file to or to any file inside the folder, and the corresponding menu area will display the file menu.

Load (this menu will be displayed if it is a loadable file type)

Save

Copy to E:\

Rename

Delete

New Folder

Press the Save soft key and the numeric keypad will be displayed for entering the file name. The file name extension is automatically generated and does not need to be entered.

After entering OK, the settings file will be generated in the current directory with the specified name.

4.2.4.2 Load File

When the cursor is moved to the loadable file type, the menu displays the same as above.

Move the cursor to the file position to be loaded in the file list. Or directly enter the file number.

Press the **Load** soft key and the following confirmation dialog box will be displayed.

Load

Cancel

Press **No** to cancel the current loading operation and return to step 1.

Press **Load** to confirm, and the currently selected file will be loaded. After loading is complete, the corresponding measurement display page will be returned to intelligently.

4.2.4.3 File Copy

Move the cursor to the folder or file you want to copy, and the menu area will display .

Copy to E:\

Copy to I:\

Press the button to copy to E:, and the file will be copied to the root directory of the external storage USB flash drive.

Press the button to copy to I:, and the file will be copied to the root directory of the internal storage.

Note: Please ensure that your USB flash drive meets the standards described in this section and is not write-protected.

Chapter 5 Performe LCR Measurement Operations and Examples

5.1 "Correction" Operation

To perform the correction operation (open/short correction is required to prevent stray impedance from affecting measurement accuracy), the user can use either of the following two methods.

5.1.1 Sweep Correction

Press the menu key [Cal] and the instrument will display the <User Corr> screen.

- Move the cursor to the **Open** area. OFF, ON and Meas open, DCR Open will be displayed in the soft key area.

Keep the test fixture in the open status and press the Meas open key to perform the open circuit calibration until the status message prompt area displays that the open circuit calibration is complete.

Press the ON key to turn on the open correction function of the instrument.

Insert the shorting clip (TH26010) into the test fixture.

- Move the cursor to the **Short** area. OFF, ON and Meas Short, DCR short will be displayed in the soft key area.

Press the key full frequency short circuit clear to perform short circuit correction, until the status information prompt area displays short circuit calibration complete.

Press the key ON to turn on the short correction function of the instrument.

- Move the cursor to the **Load**. ON and OFF are displayed in the soft key area.

Press Off to switch off the load calibration function of the instrument.

- Move the cursor to the **Freq** area. ON, OFF, Open, Short and Load Correction are displayed in the soft key area.

Press Off to switch off the point frequency calibration function of the current calibration point **Freq**.

5.1.2 Point Frequency Correction

Suppose that the user is currently using a test frequency of 5.5 kHz.

Press the menu key [Cal], and the instrument will display the <User Zero> screen.

Move the cursor to the **Freq** area. ON, OFF and Open, Short and Load will be displayed in the soft key area.

Press the key ON to turn on the **Freq** area's point frequency zero function.

Press the button to enter the specified frequency value 5.5k. The **Freq** value field will then change to 5.5000kHz (the same as the test frequency).

Leave the test fixture open and press the soft key Open to perform an open circuit calibration.

Insert the shorting piece (TH26010) into the test fixture.

Press the soft key Short Circuit to perform a short circuit calibration.

5.2 Correct Connection of the Component Under Test

The instrument has four test terminals: H_{CUR} (current sampling high-end Hc), L_{CUR} (current sampling low-end Lc), H_{POT} (voltage sampling high-end Hp), L_{POT} (voltage sampling low-end Lp) and a shielding terminal corresponding to each test terminal.

The shielded terminals are used to reduce the influence of stray capacitance to ground and to reduce electromagnetic interference. During measurement, Hc, Hp, Lc and Lp should be connected to the leads of the component under test to form a complete four-terminal measurement, so as to reduce the influence of the leads and connection points on the test results (especially loss measurements). In particular, when testing low-impedance components, the voltage sampling terminals Hp and Lp should be connected to the lead terminals of the component to prevent lead resistance from being added to the measured impedance. The principle of this connection is that the voltage measured by Hp and Lp should be the actual voltage present on the measured component.

In other words, it is best not to connect Hc, Hp, Lp and Lc before connecting them to the lead terminals of the measured component, otherwise the test error will increase.

If the contact point and lead resistance Rlead are much smaller than the measured impedance (e.g. Rlead<Zx/1000, requiring an error influence of less than 0.1%), then Hc, Hp and Lp, Lc can be connected together and then connected to both ends of the component under test (two-terminal measurement).

When performing some measurements with high accuracy requirements, it is much better to use a measuring fixture than to use test leads (Kelvin clip supplied with the instrument). Kelvin test leads can provide good measurement results when tested at 10 kHz, but beyond 10 kHz, Kelvin test leads can hardly meet the test requirements. This is because at high frequencies, the change in the gap between the leads directly changes the stray capacitance and inductance of the test terminal, and it is always difficult to fix the test leads.

Therefore, test fixtures should be used as much as possible when measuring at higher frequencies. If test fixtures cannot be used due to limited conditions, the status of the test leads when the instrument is reset should be as consistent as possible with the test.

Whether you use the test fixture supplied with the instrument, a Kelvin test cable or a user-made fixture, the following requirements should be met.

The distributed impedance must be minimized, especially when measuring high-impedance components.

The contact resistance must be minimized.

The contacts must be able to be shorted and opened. Shorting and opening the “0” can easily reduce the effect of the test fixture distributed impedance on the measurement. For an open circuit, the test terminals should be spaced the same distance apart as when connected to the device under test. For a short circuit, a short-circuit plate with low impedance should be connected between the test terminals, or Hc and Lc should be connected directly, Hp and Lp directly, and then the two connected together.

Note: When the component under test is a polarized device, before testing, be sure to connect the “high potential terminal” to the terminal marked “+” or Hc or Hp on the front panel, and connect the “low potential terminal” to the terminal marked “-” or Lc or Lp on the front panel.

Warning: When measuring a polarized component, please discharge it first to avoid damaging the instrument.

5.3 Eliminating the effects of stray impedance

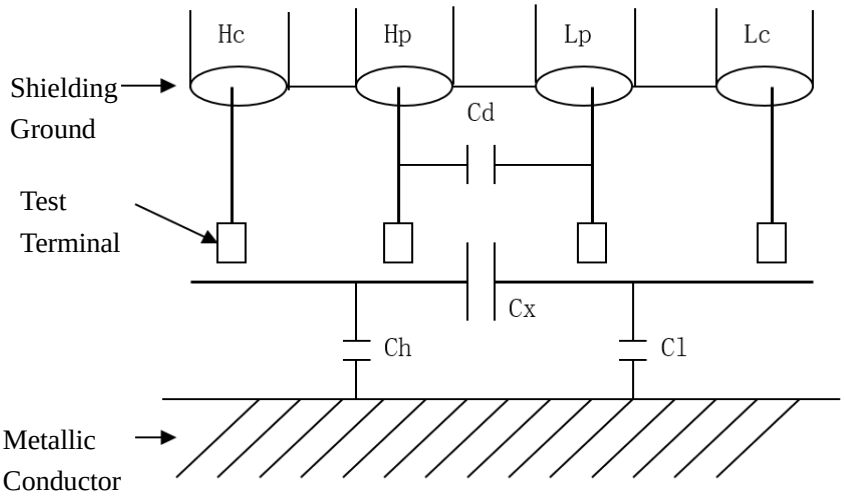


Figure 5-1 Schematic Diagram of the Effect of Stray Capacitance

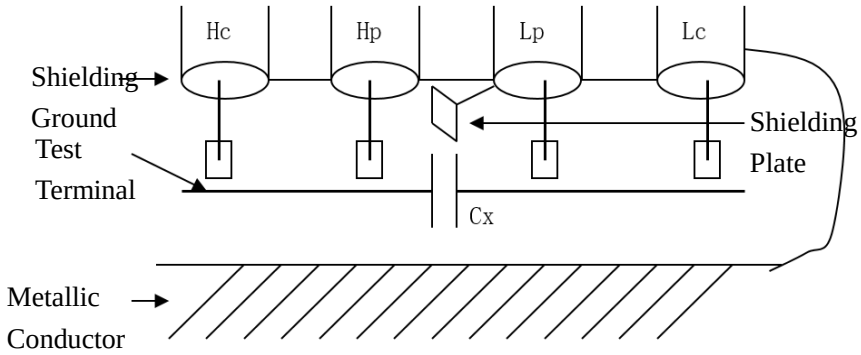


Figure 5-2 Schematic Diagram of the Method of Eliminating the Effect of Stray Capacitance

When DUT is a high impedance (such as a small capacitor), the influence of stray capacitance cannot be ignored. Figure 5-1 shows an example of measuring DUT using four-terminal measurements. In the figure, Cd is connected in parallel with Cx. When there is a conductive plate located under the DUT, the capacitance Ch and Cl are connected in series and then also connected in parallel with Cx, which will produce errors in the measurement results. If a grounded conductor is placed between the high and low terminals of the test, Cd can be minimized. At the same time, if the ground terminal is connected to the underlying conductor plate, the influence of Ch and Cl will be eliminated.

When the DUT has low impedance (e.g. small inductance and large capacitance), a large current will flow through the measurement lines Hc and Lc. Apart from the influence of the contact resistance of the test terminals, **the electromagnetic coupling between the measurement lines becomes the main source of measurement error**. If the coupling is not well eliminated, it will have an unexpected impact on the test results. Generally speaking, the contact resistance affects the resistive part of the test impedance, while the electromagnetic coupling affects the reactive part of the test impedance. The test terminal can use a **four-terminal pair** connection method, so that the current flowing through Hc and Lc and the current flowing through each of their shielded terminals with equal magnitude but opposite direction cancel each other out, better eliminating the influence of mutual inductive coupling on the test results.

5.4 Test Inductance Quick Operation Example

5.4.1 Test Condition

Function: Ls-Q

Frequency: 5.5kHz

Level: 1.5Vrms

Internal resistance: 100Ω

5.4.2 Steps

Switch on the device, see the section “Power On” in the chapter “Panel Description and Basic Operation”

Basic parameter setting.

Press the menu key [Display] to bring the display to the <Measurement Display> page.

Move the cursor to the parameter name area, the optional parameters are in the soft key area on the right side of the screen.

Press key Ls to select Ls test function.

Move the cursor to the frequency area. This area is currently displayed as 1.0000kHz, the frequency size can be modified as required.

Move the cursor to the Level area. The current display in this area is 1.000V.

Press the menu key [Setup] to go to the <Measurement Settings> page.

Move the cursor to the internal resistance area, at this time 100Ω, and 30Ω will be displayed in the soft key area on the right side of the screen.

Press the key 100Ω to select 100Ω signal source internal resistance.

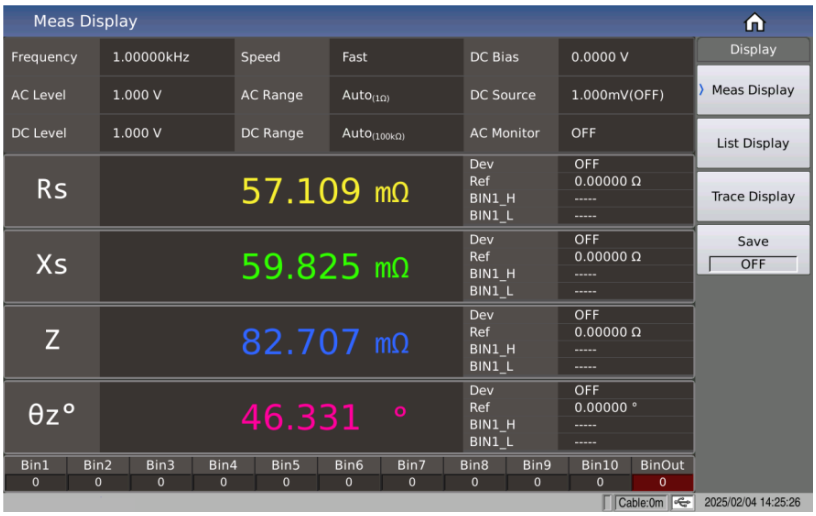
Attach the test fixture (TH26005) to the test terminal.

Perform the zeroing operation (Open/Short correction is required to prevent stray impedance from affecting the measurement accuracy), (see 5.1.2 “Point Frequency Correction” in this chapter).

Insert the inductor under the test into the test fixture.

Perform the measurement operation.

Press the menu key [Display] to bring the display to the <Measurement Display> page. The instrument will continuously test and put the test result in the center of the page. As shown in the figure below:



(Figure 3-1-1 Measurement display)

If you find that the test results are obviously incorrect, please:

Check whether the inductor under test is reliably connected to the test fixture.

Check that the test fixture is reliably connected to the test side of the instrument.

Re-perform a reliable open/short calibration.

✱**Note**: When the user is using the sweep open/short calibration, the spot frequency calibration function must be turned OFF, refer to “Correction Operation” in this chapter.

5.5 Quick Example of Multi-Frequency List Sweep Test Capacitor Operation

5.5.1 Test Condition

Function: Cp, D

Level: 1Vrms

Other parameters are listed below:

Frequency	Comparison Parameters	Lower Limit	Upper Limit
1kHz	Cp (capacity)	325.0nF	333.0nF

10kHz	D (depletion)	0.0001	0.0003
100kHz	D (depletion)	0.0060	0.0100

Signal: HIGH LONG

Alarm mode: OUT (when exceeding the difference)

5.5.2 Steps

To turn on the power, see the section "Power ON" in the chapter "Panel Description and Getting Started".

5.5.2.1 Basic Parameter Setting

Press the key [Display] to bring the display to the <Meas Display> page.

The current parameter name area shows Cp, D, and the level area shows 1.000 V.

Press [Setup] to display the instrument to the <Measurement Setup> page. Meas Setup, User Corr, Limit Setup, List Setup and File Management are displayed in the soft key area.

Press the key List Setup to display to the <List Setup> page.

Press the rotary key to move the cursor to the parameter area of sweep point 1 to modify the test conditions of the current point, including frequency, level, Bias, limit, delay and etc.

5.5.2.2 Alarm Setting

Press [System] to display to the <System Setup> page.

Move the cursor to the Fail Sound area. This area is currently displayed as High Long.

Attach the test fixture (TH26005) to the test side of the unit.

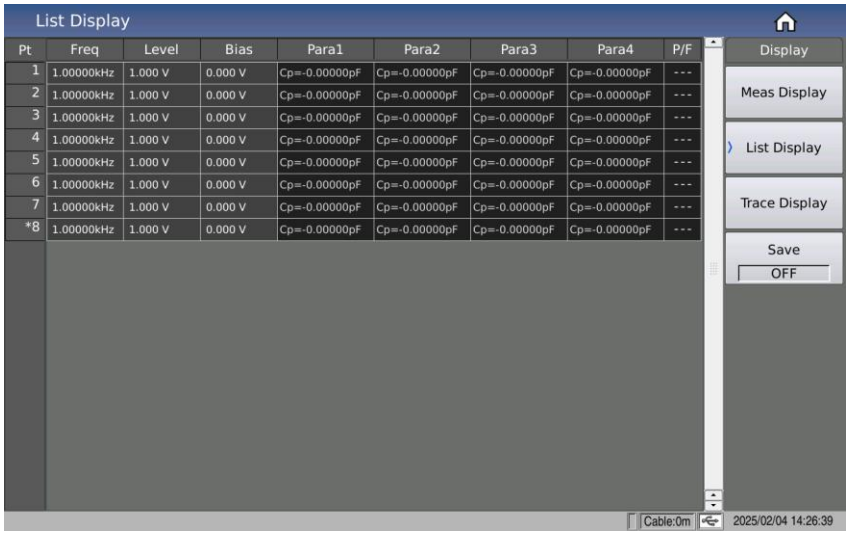
Perform the correction operation (open/short correction is required to prevent stray impedance from affecting the measurement accuracy), (see 5.1.1 “Sweep Correction” in this chapter).

Insert the capacitor under the test into the test fixture.

Execute the measurement operation

Press key [Display], and then press key List Sweep to display the unit to the <List Display> page. The instrument will continuously scan the test and display the test and comparison results on the page and sound an alarm when the comparison result is

PASS or FAIL. This is shown in the figure below:



(Figure 3-2-1 tabular display)

If you find that the test results are obviously incorrect, please:

Check that the device under test is reliably connected to the test fixture.

Check that the test fixture is reliably connected to the test end of the instrument.

Re-perform a reliable open/short correction.

✱**Note**: When the user is using the sweep open/short calibration, the spot frequency calibration function must be selected as OFF, refer to “Correction Operation” in this chapter.

5.6 Example of Load Correction Operation

5.6.1 Operation Steps

Assume that the user is now using the following test conditions:

Frequency: 100kHz Cp standard value: 11nF D standard value: 0.0005

Press [Cal] and the instrument will display the <User Zero> page.

Move the cursor to the **Load** area. ON and OFF will be displayed in the soft key area.

Press the key ON to turn on the load calibration function of the instrument.

Move the cursor to the Load Type area, Ls-Rs, Ls-Q, Cp-D, will be displayed in the soft key area on the right side of the screen.

Press key Cp-D to select the Cp-D parameter.

Move the cursor to the frequency area. ON, OFF, Open, Short and Load are displayed in the softkey area.

Press key ON to turn on the point frequency calibration function for the frequency corresponding to the current calibration point.

Input correction frequency (100k), reference A (11nF), reference B (0.0005)

Move the cursor to the frequency area. On, Off, Open Circuit Clear, Short Circuit Clear and Load Calibration will be displayed in the softkey area.

Keep the test fixture open to keep hands or other sources of interference away from the test fixture. Press the soft key OPEN to perform an open circuit calibration.

Insert the shorting tab (TH26010) into the test fixture so that the shorting tab makes reliable contact with the test fixture's reed.

Press the soft key SHORT to execute short circuit calibration.

Insert the user's standard capacitor into the test fixture so that the pins of the standard capacitor make reliable contact with the reed of the test fixture.

Press the softkey Load to execute load calibration.

5.6.2 Precautions

Since the software version of the instrument may be inconsistent, the soft key information and status information displayed by the instrument may be inconsistent with this book, but it should not affect the user's understanding.

Load correction is only valid for the same specification device, and load calibration must be redone after changing the specification.

Chapter 6 Performance & Testing

6.1 Measurement Function

6.1.1 Measurement parameters and symbols

Parameter Name	Parameter Meaning	Parameter Name	Parameter Meaning
Cp	Equivalent parallel capacitance	Cs	Equivalent series capacitance
Lp	Equivalent parallel inductance	Ls	Equivalent series inductance
Rp	Equivalent parallel resistance EPR	Rs	Equivalent series resistance ESR
Gp	Conductance	Bp	Susceptance
Z	Impedance	Y	Admittance
D	Loss factor	Q	Quality factor
θz°	Angle of impedance	θz	Arc of impedance
θy°	Angle of admittance	θy	Arc of admittance
X	Reactance	Rd	DC resistance

6.1.2 Measurement Combinations

Four parameters can be selected arbitrarily, regardless of primary and secondary parameters.

6.1.3 Math Operation

The measured value is compared with a programmable nominal value using the absolute deviation ΔABS and the percentage deviation Δ%.

6.1.4 Equivalence Mode

Series, parallel

6.1.5 Range

Auto, manual (hold, increase, decrease)

6.1.6 Trigger

Single, continuous.

Continuous: The unit under test is measured continuously and the results are output and displayed.

Single: Press the “TRIGGER” button on the panel, the instrument's HANDLER interface receives an “start” signal from the outside, use a foot switch or use a bus trigger command to make the instrument perform a measurement and output and display the results. It is normally in a waiting status.

6.1.7 Delay Time

Trigger delay: the time from measurement trigger to start of measurement. It can be programmed in 1 ms steps from 0 to 60 seconds.

Step delay: the delay time from test signal output to measurement. It can be programmed in 1 ms steps from 0 to 60 seconds.

6.1.8 Test Terminal Connection Method

Four-terminal measurements are used.

Hcur: Current Sampling High-End Lcur: Current Sampling Low-End

Hpot: Voltage Sampling High-End Lpot: Voltage Sampling Low-End

6.1.9 Measurement Speed (at frequencies >= 10 kHz)

Fast: approx. 130 times/second (2.56ms/time)

Medium: about 11 times/second (90ms/time)

Slow: about 4 times/second (220ms/time)

Medium and fast speeds are slowed down by measurements at frequencies less than 10 kHz.

6.1.10 Average

255 Programmable.

Add a sliding average independent switch setting.

6.1.11 Display Bits

6 digits, maximum display number 999999

6.2 Test Signal

6.2.1 Test Signal Frequency

Test signal is sine wave, frequency accuracy: 0.01%

Test frequency range

4Hz to 2MHz (TH2848-02/TH2848-02L)

4Hz to 5MHz (TH2848-05)

4Hz to 10MHz (TH2848-10)

Minimum resolution: 0.01Hz

6.2.2 Signal Mode

Normal: The test voltage is set on the measurement display page as the voltage of the open circuit at the measuring terminal, and the voltage at the measuring terminal may be smaller than the set voltage during measurement.

Constant level: The internal level is automatically adjusted to make the voltage on the measured part consistent with the set voltage.

6.2.3 Test Signal Level

	Mode	Range	Accuracy	Step
Voltage	Normal Constant	5mVRMS - 2VRMS 10mVRMS - 1VRMS	±(10% x setpoint + 2mV) ±(6% x setpoint + 2mV)	100μV
Current	Normal Constant	5OμARMS - 20mARMS 100μARMS - 10mARMS	± (10% x setpoint + 10μARMS) ± (6% x setpoint + 10μARMS)	1μA

6.2.4 Output Impedance

100Ω ±2%

6.2.5 Test Signal Level Monitor

Mode	Range	Frequency	Accuracy
Voltage	5mVRMS - 2VRMS	≤1MHz	±(3% x reading + 0.5mVrms)
		>1MHz	±(6% x reading + 0.1mV)
Current	50μARMS - 20mARMS	≤1MHz	± (3% x reading + 5μA)
		>1MHz	± (6% x reading + 1μA)

6.2.6 Maximum range of measurement display

Parameters	Measurement Display Range
L, Lk	0.00001μH ~ 99.9999kH
C	0.00001pF ~ 9.99999F
Z, R, X, DCR	0.00001Ω ~ 99.9999MΩ
Y, B, G	0.00001μs ~ 99.9999S
D	0.00001 ~ 9.99999
Q	0.00001 ~ 99999.9
θ	Deg -179.999 °~ 179.999 ° Rad -3.14159 ~ 3.14159

6.2.7 DC Bias Power Supply

0V - ±40V Minimum resolution: 0.5mV, Accuracy: 1% x set voltage + 5mV

0mA - ±100mA Minimum resolution: 5μA, Accuracy: 5% x set voltage + 50μA

6.3 Measurement Accuracy

Measurement accuracy encompasses measurement stability, temperature coefficient, linearity, measurement repeatability and calibration difference error.

Measurement accuracy of the instrument must be checked under the following conditions:

Warm-up time: ≥ 30 minutes

Test cable length: 0m, 1m, 2m, 4m

After warming up, open and short circuits are correctly cleared to “0”.

DC bias is in “OFF” position.

Instrument range working in “AUTO” to select the correct measurement range.

6.3.1 Accuracy of |Z|, |Y|, L, C, R, X, G, B

The accuracy Ae of |Z|, |Y|, L, C, R, X, G, B is expressed by the following equation:

$$A_e = \pm [A + (K_a + K_{aa} + K_b \times K_{bb} + K_c) \times 100 + K_d] \times K_e [\%]$$

A: See Figures 6-3 and 6-4

K_a: Impedance scaling factor (see Table B)

K_{aa}: Cable length factor (see Table C)

K_b: Impedance scaling factor (see Table B)

K_{bb}: Cable length factor (see Table D)

K_c: Calibration difference factor (see Table E)

K_d: Cable length factor (see Table G)

K_e: Temperature factor (see Table H)

L, C, X, B Accuracy conditions: D_x (D measurement) ≤ 0.1

R, G Accuracy conditions: Q_x (Q measurement) ≤ 0.1

When $D_x \geq 0.1$, for L, C, X, B, the accuracy factor A_e should be multiplied by $\sqrt{1+D_x^2}$.

When $Q_x \geq 0.1$, for R and G, the accuracy factor A_e should be multiplied by $\sqrt{1+Q_x^2}$.

The accuracy of G shall be used only for G-B measurement combinations.

6.3.2 D Accuracy

D, the accuracy D_e is given by the following equation:

$$D_e = \pm \frac{A_e}{100}$$

The above equation is used only if $D_x \leq 0.1$.

When $D_x > 0.1$, D_e should be multiplied by $(1 + D_x)$.

6.3.3 Q Accuracy

Q accuracy is given by the following equation:

$$Q_e = \pm \frac{Q_x^2 \times D_e}{1 \mu Q_x \times D_e}$$

Here, Q_x is the measured value of the measured Q, and D_e is the accuracy of D.

This accuracy is used under $Q_x \times D_e < 1$.

6.3.4 θ Accuracy

θ accuracy is given by the following equation:

$$\boldsymbol{\theta e} = \frac{180}{\pi} \times \frac{A_e}{100} \text{ [deg]}$$

$$\boldsymbol{\theta e} = \frac{A_e}{100} \text{ [rad] (radians)}$$

6.3.5 G Accuracy

When D_x (measured D value) ≤ 0.1

G accuracy is given by the following equation:

$G_e = B_x + D_e$ [S]

$$B_x = 2\pi f C_x = \frac{1}{2\pi f L_x}$$

Here, B_x is the value of the measured B [S].

C_x is the value of the measured C [F].

L_x is the value of the measured L [H].

D_e is the accuracy of D.

f is the test frequency.

The above G accuracy is only used in the combination of C_p-G and L_p-G measurements.

6.3.6 Rp Accuracy

When D_x (measured D value) ≤ 0.1

R_p accuracy is given by the following equation:

$$R_p = \frac{R_{px} \times D_e}{D_x \mu D_e} \quad [\Omega]$$

Here, R_{px} is the value of the measured R_p [S].

D_x is the value of the measured D [F].

D_e is the accuracy of D.

6.3.7 Rs Accuracy

When D_x (measured D value) ≤ 0.1

R_s accuracy is given by the following equation:

$$R_{se} = X_x \times D_e \ [\Omega]$$

$$X_x = 2\pi f L_x = \frac{1}{2\pi f C_x}$$

Here, X_x is the value of the measured X [S].

C_x is the value of the measured C [F].

L_x is the value of the measured L [H].

D_e is the accuracy of D.

f is the test frequency.

6.3.8 Accuracy Factor

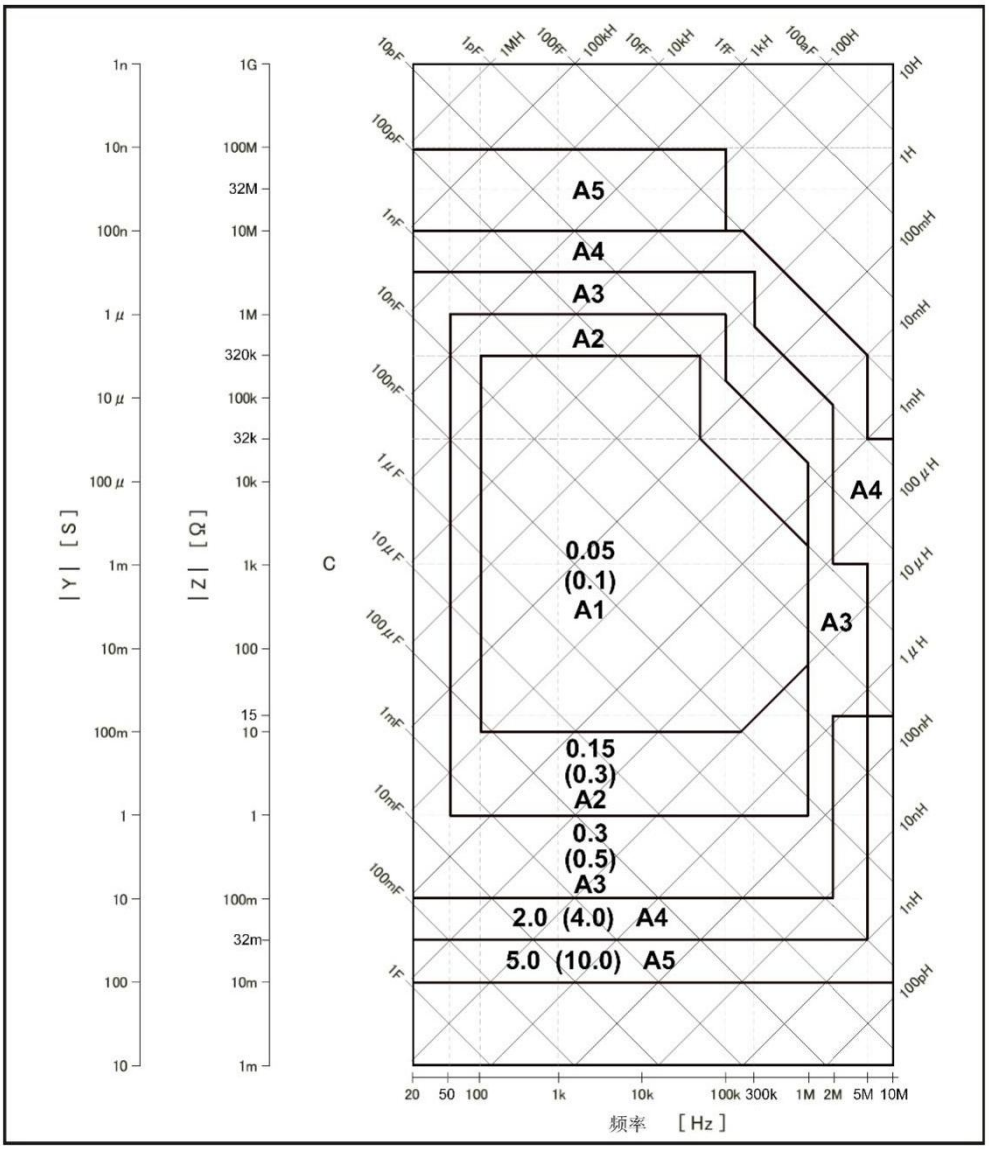


Figure 6-1 Basic Accuracy A (2-1)

Note: The A values in Figure 6-1 are only used for V_s test signal voltage is 1Vrms signal level, depending on the frequency, the impedance/capacitance/inductance of the measured parts, is divided into a number of basic measurement accuracy graph box. (If on the boundary line, select the value of the smaller A) Each picture box includes the high and low two basic measurement accuracy A value, the high and low value distinction based on the measurement speed. Other signal levels are shown in Figure 6-2.

For example, the middle box contains 0.05 (upper)/ (0.1) (lower) when $V_s = 1V_{rms}$, under other same conditions:

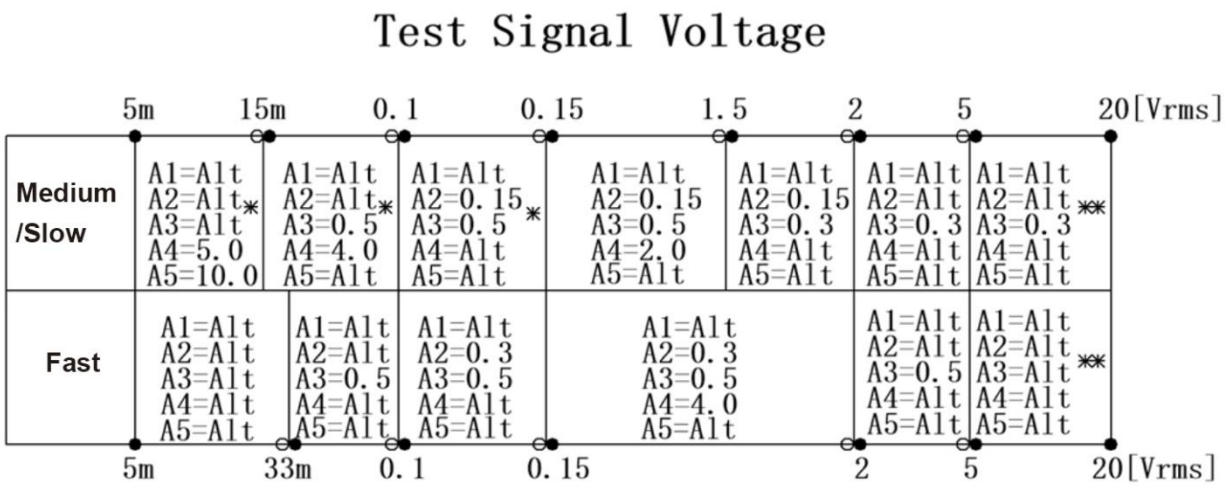
0.05 ---- Measurement speed is the A-value for medium and slow speed.

(0.1) ---- Measurement speed is the A-value for fast speed.

6.3.8.1 Table A Level Correction Factors Alt

When V_s is not 1Vrms, the A-values calculated for the corresponding Alt values can be found using Figure 6-2: Figures different A1, A2, A3, A4, A5 versus Alt. The following table lists the relationship between the A values corresponding to different test voltages and Alt at fast, medium and slow speeds:

Table A: Basic Accuracy A versus Level Correction Factor Alt



In the “ * ” box in the above table:

When fm <100Hz, the A value is the corresponding value in the above table multiplied by 2.5.

For 100Hz≤ fm <300Hz, the A value is the corresponding value in the above table multiplied by 2.

In the “ * * ” box in the above table, when all the following measurement conditions are met, the A value is the corresponding value in the above table plus 0.15.

Test frequency: 100Hz< fm ≤10MHz

Test signal voltage: 5Vrms< Vs ≤20Vrms

DUT: Inductor, |Zm|<200Ω (|Zm|: DUT impedance)

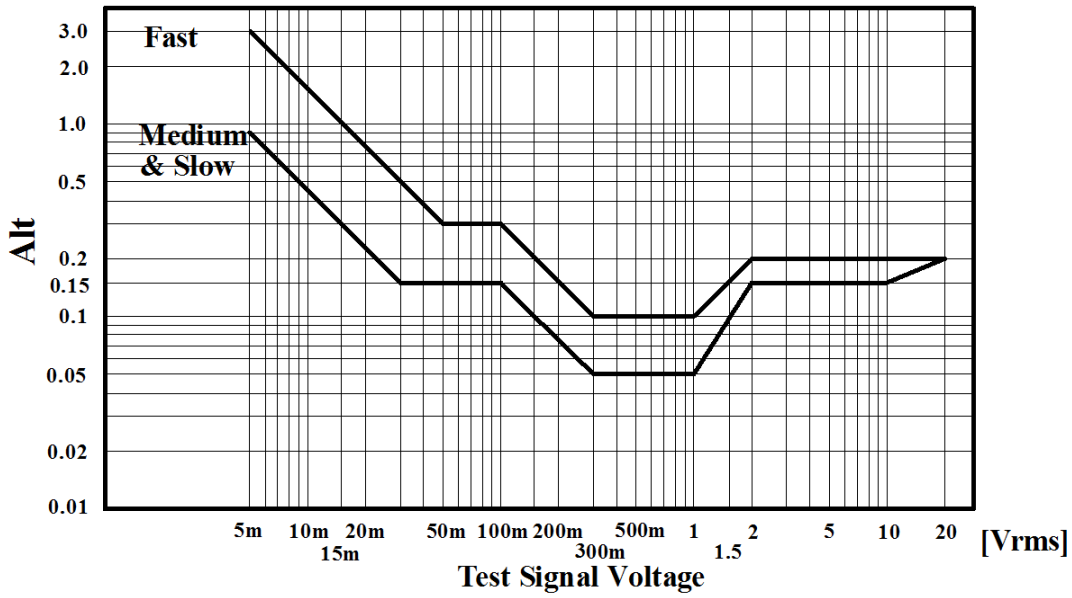


Figure 6-4 Basic Accuracy A (2-2)

6.3.8.2 Table B Impedance Scaling Factors K_a, K_b

Speed	Frequency	K_a	K_b
Medium Slow	f_m < 100Hz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{200}{V_s})(1+\sqrt{\frac{100}{f_m}})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\frac{70}{V_s})(1+\sqrt{\frac{100}{f_m}})$
	100Hz≤ fm ≤100kHz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{200}{V_s})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\frac{70}{V_s})$
	100kHz< fm ≤300kHz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(2+\frac{200}{V_s})$	$\lvert Z_m\rvert(3\times10^{-9})(1+\frac{70}{V_s})$
	300kHz< fm ≤10MHz	$(\frac{1\times10^{-3}}{\lvert Z_m\rvert})(3+\frac{200}{V_s}+\frac{V_s^2}{10^8})$	$\lvert Z_m\rvert(10\times10^{-9})(1+\frac{70}{V_s})$
Fast	f_m <100Hz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{400}{V_s})(1+\sqrt{\frac{100}{f_m}})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\frac{100}{V_s})(1+\sqrt{\frac{100}{f_m}})$
	100Hz≤ fm ≤100kHz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\frac{400}{V_s})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\frac{100}{V_s})$
	100kHz< fm ≤300kHz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(2+\frac{400}{V_s})$	$\lvert Z_m\rvert(6\times10^{-9})(1+\frac{100}{V_s})$
	300kHz< fm ≤10MHz	$(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert})(3+\frac{400}{V_s}+\frac{V_s^2}{10^8})$	$\lvert Z_m\rvert(20\times10^{-9})(1+\frac{100}{V_s})$

f_m: Test frequency [Hz]
$|Z_m|$: Impedance of the measured part [Ω]
V_s: Test signal voltage [mV_{rms}]

K_a and K_b are the low impedance and high impedance increasing factors, respectively.

K_a is negligible when the impedance is greater than 500Ω; K_b is negligible when the impedance is less than 500Ω.

6.3.8.3 Table C Cable Length Factor Kaa

Test Signal Voltage	Cable Length			
	0m	1m	2m	4m
≤2V_{rms}	0	0	$Ka/2$	Ka
>2V_{rms}	0	$\frac{2\times10^{-3}\times f_m^{\,2}}{\lvert Z_m\rvert}$	$\frac{(1+5\times f_m^{\,2})\times10^{-3}}{\lvert Z_m\rvert}$	$\frac{(2+10\times f_m^{\,2})\times10^{-3}}{\lvert Z_m\rvert}$
f_m: Test frequency [Hz] $\lvert Z_m\rvert$: Impedance of the measured part [Ω] K_a: Impedance scaling factor				

6.3.8.4 Table D Cable Length Factor Kbb

Test Signal Frequency	Cable Length			
	0m	1m	2m	4m
Fm ≤100kHz	1	$1+5\times_{f(m)}$	$1+10\times_{f(m)}$	$1+20\times_{f(m)}$
100kHz< fm ≤300kHz	1	$1+2\times_{f(m)}$	$1+4\times_{f(m)}$	$1+8\times_{f(m)}$
300kHz< fm ≤10MHz	1	$1+0.5\times_{f(m)}$	$1+1\times_{f(m)}$	$1+2\times_{f(m)}$
f_m: Test frequency [MHz]				

6.3.8.5 Table E Calibration Difference Factor Kc

Test Frequency	K_c
Direct Calibration Frequency (see Table E)	0
Other Frequencies	0.0003

6.3.8.6 Table F Direct Calibration Frequency

			20	25	30	40	50	60	80	[Hz]
100	120	150	200	250	300	400	500	600	800	[Hz]
1	1.2	1.5	2	2.5	3	4	5	6	8	[kHz]
10	12	15	20	25	30	40	50	60	80	[kHz]
100	120	150	200	250	300	400	500	600	800	[kHz]

1	1.2	1.5	2	3	4	5	6	7	8	[MHz]
9	10									[MHz]

There is a total of 59 frequency points shown in Table F. (The highest frequency to 2MHz has 51 points up to 2MHz, the highest frequency to 5MHz has 54 points, and the highest frequency to 10MHz has 59 points)

6.3.8.7 Table G Cable Length Factor Kd

Test Signal Level	Cable Length		
	1m	2m	4m
$\leq 2V_{rms}$	$2.5 \times 10^{-4} (1 + 50 \times f_m)$	$5 \times 10^{-4} (1 + 50 \times f_m)$	$1 \times 10^{-3} (1 + 50 \times f_m)$
$>2V_{rms}$	$2.5 \times 10^{-3} (1 + 16 \times f_m)$	$5 \times 10^{-3} (1 + 16 \times f_m)$	$1 \times 10^{-2} (1 + 16 \times f_m)$
f_m: Test frequency [MHz]			

6.3.8.8 Table H Temperature Factor Ke

Temperature (℃)	5	8	18	28	38	
K_e	6	4	2	1	2	4

6.3.9 DC Resistance DCR Accuracy

$A(1+R_x/5M\Omega+16m\Omega/R_x)$ [%] $\pm 0.2m\Omega$

At medium and slow speeds, A=0.25

At fast speed, A=0.5

Here, R_x is the measured resistance.

6.4 Performance Testing

6.4.1 Working Conditions

Each test shall be performed under the reference operating conditions of Chapter 1. This test only includes the test of the main part of the instrument indicators. The user may perform the tests under the specified conditions according to the indexes listed in this manual. The performance test should work under the preheating conditions specified in Chapter 1.

6.4.2 The test apparatus and equipment are shown in the following table

Serial Number	Instrument Name		Technical Requirement
1	Standard capacitors	100pF	0.02% Loss D is known
		1000pF	
		10000pF	
		10nF	
		0.1uF	
		1uF	
2	AC Standard resistors	10Ω	0.02%
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	DC Standard resistors	0.1Ω	0.02%
		1Ω	
		10Ω	
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
4	Standard inductors	100μH	0.02%
		1mH	
		10mH	
		100mH	
5	Frequency meter		(0 ~ 1000) MHz
6	Digital multimeter		0.5%

7	Insulation resistance meter	500V Class 10
8	Pressure leakage tester	0.25kW (0 ~ 500) V

6.4.3 Function Check

The instrument's function keys, display, terminals, etc. should be able to work normally, and the functions are correct.

6.4.4 Test Signal Level

Place the digital multimeter in the AC voltage range, with one of the test rods connected to the H_{CUR} terminal of the meter and the other test rod connected to the ground terminal. Change the level to: 10mV, 20mV, 100mV, 200mV, 1V, 2V, and the readings should be in accordance with the requirements of this chapter on the test signal level.

6.4.5 Frequency

Connect the frequency meter ground terminal to the ground terminal of the instrument. Connect the frequency meter test terminal to the H_{CUR} terminal of the capacitance meter test terminal. Change the frequency to: 20Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz, 300kHz, 1MHz, 2MHz, 5MHz, 10MHz, and the reading of the frequency meter should meet the requirements of this chapter on the frequency of the test signal.

6.4.6 Measurement Accuracy

The measuring instrument has more measuring parameters, the basic measuring parameters are R, L, C, D. The rest of the parameters can be calculated from the above parameters, so the accuracy measurement is mainly on R, L, C, D.

6.4.7 Capacitance C, Loss D Accuracy

Function: C_p-D

Test Frequency: 100Hz 1kHz 10kHz 100kHz Separate tests

Level: 1V

Range: AUTO

Bias: 0V

Speed: Slow

Short-circuit and open circuit clearing should be performed before testing. Connect the standard capacitor 100pF, 1000pF, 10nF, 0.1uF, 1uF, change the frequency, the error between the instrument reading and the standard value of the capacitance C should be within the permissible error range specified in this chapter on the accuracy of C, and the loss D should be within the permissible error range specified in this chapter on the accuracy of D.

6.4.8 Inductance L Accuracy

Test conditions:

Function: L_s-Q

Test Frequency: 100Hz 1kHz Separate Tests

Level: 1V

Range: AUTO

Bias: 0V

Speed: Slow

Short circuit and open circuit clearing should be performed before testing. Connect the standard inductor 100μH, 1mH, 10mH, 100mH, change the frequency, the error between the instrument reading and the standard value should be within the permissible error range specified in this chapter on L accuracy.

6.4.9 Impedance Z Accuracy

Test conditions:

Function: Z-θ

Test Frequency: 100Hz 1kHz 10kHz 100kHz Separate Tests

Level: 1V

Range: AUTO

Bias: 0V

Speed: Slow

Short-circuit and open circuit clearing should be performed before testing. Connect the AC standard resistor 10Ω, 100Ω, 1kΩ, 10kΩ, 100kΩ, change the frequency, the error between the instrument reading and the standard value should be

within the permissible error specified in this chapter on |Z|accuracy within the range.

6.4.10 DC Resistance DCR Accuracy

Test conditions:

Function: DCR

Test frequency: -----

Level: -----

Range: AUTO

Bias: -----

Speed: Slow

Before testing, the short circuit should be cleared. When a DC standard resistor of 0.1 Ω, 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ, or 100 kΩ is connected, the error between the instrument reading and the standard value should be within the allowable error range specified in this chapter for DCR accuracy.

Chapter 7 Command Reference

7.1 GPIB Common Command

●*RST ●*TRG ●*IDN ●*TST

●*ESE ●*SRE ●*ESR ●*STB

●*OPC ●*CLS

◆ Description: Used to reset the instrument.

Syntax:

*RST

◆ Description: Used to trigger an instrument measurement and return the measurement result.

Syntax:

*TRG

<table>
<tr><td colspan="2">Test Page</td><td colspan="2"></td></tr>
<tr><td rowspan="4">LCR Bridge</td><td>Component Testing</td><td colspan="2">Parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, sorting result

e.g. 1.12345E2, 1.23456E-2,1.11023E2, -1.12345E2,1
where the sorting results are taken as follows:
<table><tr><td>Sorting Results</td><td>Description</td></tr><tr><td>0</td><td>OUT</td></tr><tr><td>1~10</td><td>Bin 1~10</td></tr></table>
NOTE: The <Bin Number> data will only be displayed if the instrument comparison function is set to ON.</td></tr>
<tr><td rowspan="2">List Sweep</td><td>Single-step Mode</td><td>Point index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, comparison result

e.g. 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2,1
where the comparison results are taken as follows:
<table><tr><td>Comparison Results</td><td>Description</td></tr><tr><td>0</td><td>Non-comparative</td></tr><tr><td>1</td><td>PASS</td></tr><tr><td>Other</td><td>FAIL</td></tr></table></td></tr>
<tr><td>Sequence Mode</td><td>After all point tests are complete, all point data is returned in the same format as above.</td></tr>
<tr><td rowspan="2">Trace Sweep</td><td>Single-step Mode</td><td>Point index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result

e.g. 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2</td></tr>
<tr><td>Sequence Mode</td><td>After all point tests are complete, all point data is returned in the same format as above.</td></tr>
</table>

◆ Description: Used to return the ID of the instrument.

Syntax:

*IDN?

Return:

<model>,<firmware>,<sn>

Return Parameters	Meaning
model	Machine model (e.g. TH2848)
firmware	Software version number (e.g. V1.0.0)
sn	Instrument serial number (e.g. sn12345678)

7.2 SCPI Command

You can check the company website www.tonghui.com.cn.

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based instrument command language for test and measurement instruments. SCPI commands are based on a hierarchical structure (also known as a tree system). In this system, the relevant commands are grouped under a common node or root, which forms a subsystem.

According to the command syntax, most commands (and some parameters) are represented in a mixed case. Capital letters indicate abbreviated commands. For shorter program lines, you can send commands in abbreviated form. For better readability of the program, you can send commands in long form.

Note: To avoid misunderstandings about abbreviated commands, we try to avoid excessive abbreviation in the description of commands. Most command descriptions are directly described in abbreviated form.

Grammatical Conventions:

[SOURce[1|2]:]VOLTage:UNIT {VPP|VRMS|DBM}

[SOURce[1|2]:]FREQuency:CENTer {<frequency>|MINimum|MAXimum|
DEFault}

Note: Command syntax conventions:

The curly brackets ({ }) enclose the parameter options for the given command string. The curly brackets are not sent with the command string.

The vertical bar (|) separates multiple parameter options for the given command string. For example, in the above command, {VPP|VRMS|DBM} indicates that you can specify “VPP”, “VRMS” or “DBM”. The vertical bar is not sent with the command string.

The angle brackets (<>) in the second example indicate that a value must be

specified for the parameter in brackets. For example, in the above syntax, the parameter in the angle brackets is <frequency>. The angle brackets are not sent with the command string. You must specify a value for the parameter (e.g. “FREQ:CENT 1000”), unless you select one of the other options shown in the syntax (e.g. “FREQ:CENT MIN”).

Some syntax elements (such as nodes and parameters) are enclosed in square brackets ([ ]). This indicates that the element is optional and can be omitted. The angle brackets are not sent with the command string. If no value is specified for an optional parameter, the instrument selects the default value. In the above example, “SOURce[1|2]” indicates that you can refer to source channel 1 by “SOURce” or “SOURce1”, or “SOUR1” or “SOUR” to refer to source channel 1. Furthermore, since the entire SOURce node is optional (in square brackets), you can also refer to channel 1 by omitting the SOURce node altogether. This is because channel 1 is the default channel for the SOURce language node. On the other hand, to refer to channel 2, you must use “SOURce2” or “SOUR2” in the program line.

^END: EOI (end) signal for the IEEE-488 bus.

NR1: Integer, e.g. 123

NR2: Fixed point, e.g. 12.3

NR3: Floating point, e.g. 12.3E+5

NRf: Contains NR1, NR2, NR3

Bool: Can be 1 or 0, or equal to ON or OFF

SPD: string program data, string parameter enclosed in single or double quotes

CPD: character program data, discrete program parameter, accepts short and long format

SRD: string response data, string parameter enclosed in single or double quotes

CRD: character response data, returns discrete data, only returns abbreviated form

Expr: channel list, group list or mathematical expression

NL: newline character, integer 10, terminator for string input and output

7.2.1 DISPlay Display Command Set

- Description: Control page switching

Syntax:

:DISP:PAGE?

:DISP:PAGE< PageName>

Parameter: The meaning of the values of PageName is described in Table 9-1 below:

PageName Value	Meaning	Query Return Content
MEASurement	Measurement Display	MEASurement
LIST	List Display	LIST
TSMEas	Trace Display	TSMEas
MSETup	Measurement Settings	MSETup
LTABle	Limit Setting	LTABle
LSETup	List Settings	LSETup
TSSEtup	Trace Settings	TSSEtup
CSETup	UserCorrection Settings	CSETup
SYSTem	System Settings	SYSTem
FLISt	File List	FLISt

Table 9-1 Meaning of PageName

Example:

:DISP:PAGE MEAS ---- enters the measurement display page

:DISP:PAGE MSET ---- enters the measurement Setup page

:DISP:PAGE? ---- returns the currently displayed page, refer to the table above for its contents.

7.2.2 FREQuency Command Set

◆ Description: Used to set the measuring frequency of the instrument

Syntax:

:FREQ?

:FREQ <float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:FREQ 1200 ---- sets the frequency to 1200Hz

:FREQ 1200HZ ---- sets the frequency to 1200Hz

:FREQ 1.2K ---- sets the frequency to 1200Hz

:FREQ? ---- returns the current frequency

7.2.3 VOLTage Voltage Command Set

7.2.3.1 AC Voltage

- Description: Used to set the AC voltage of the instrument

Syntax:

:VOLT?

:VOLT< float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:VOLT 1.2 ---- sets the AC voltage to 1.2V

:VOLT? ---- returns the current AC voltage

7.2.3.2 DC Voltage

- Description: Used to set the DC voltage of the instrument

Syntax:

:VOLT:DC?

:VOLT:DC< float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:VOLT:DC 0.8 ---- sets the DC voltage to 0.8V

:VOLT:DC? ---- returns the current DC voltage

7.2.4 CURRent Current Command Set

- Description: Used to set the measurement level current of the instrument

Syntax:

:CURR?

:CURR< float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:CURR 0.01 ---- sets the measurement level to 10mA

:CURR? ---- returns the current level current

7.2.5 APERture Speed Average Command Set

The APERture subsystem command set is mainly used to set the speed of the measurement, the average number of times used in the measurement. Characters? can query the speed of the current measurement, the average number of times used in the measurement.

◆ Description: Sets the speed and average number of measurements of the instrument

Syntax:

:APER?

:APER< FAST | MED | SLOW>[,int]

Parameters:

FAST ---- Fast

MED ---- Medium

SLOW ---- Slow

int ---- indicates the size of the integer, value 1 ~ 255.

Example:

:APER FAST ---- sets the test speed to fast

:APER MED ---- sets the test speed to medium

:APER SLOW ---- sets the test speed to slow

:APER FAST,2 ---- sets the test speed to fast and averages 2 times.

7.2.6 OUTPut Bias Source Command Set

7.2.6.1 Bias Source

◆ Description: Sets the DC bias source of the instrument

Syntax:

:OUTP:HPOW?

:OUTP:HPOW< INT| EXT>

Parameters:

INT ---- internal 40V/100mA bias source

EXT ---- external bias current source

Example:

:OUTP:HPOW INT ---- sets internal 100mA bias current source

:OUTP:HPOW EXT ---- sets the external bias current source

:OUTP:HPOW? ---- returns the bias current source mode

7.2.6.2 DCI Isolation

◆ Description: Sets the DC isolation function switch of the instrument

Syntax:

:OUTP:DC:ISOL?

:OUTP:DC:ISOL< 0|1|ON|OFF >

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:OUTP:DC:ISOL 0 ---- turns off DC isolation

:OUTP:DC:ISOL 1 ---- turns on DC isolation

:OUTP:DC:ISOL? ---- returns the DC isolation function switch status

7.2.7 BIAS Bias Command Set

The BIAS subsystem command set is mainly used to set the internal bias voltage, bias switch of the instrument.

7.2.7.1 Status Switch

- Description: Sets the bias switch of the instrument

Syntax:

:BIAS:STAT?

:BIAS:STAT< 0|1|ON|OFF >

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:BIAS:STAT 0 ---- turns off DC bias

:BIAS:STAT 1 ---- turns on DC bias

:BIAS:STAT? ---- returns the DC bias switch status

7.2.7.2 Bias Voltage

- Description: Sets the internal bias voltage of the instrument

Syntax:

:BIAS:VOLT?

:BIAS:VOLT< float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:BIAS:VOLT 1.2 ---- sets the DC bias voltage to 1.2V

:BIAS:VOLT? ---- returns the current DC bias voltage

7.2.7.3 Bias Current

- Description: Used to set the bias current of the instrument

Syntax:

:BIAS:CURR?

:BIAS:CURR< float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:BIAS:CURR 0.01 ---- sets the bias current to 10mA

:BIAS:CURR? ---- returns the current bias current

7.2.7.4 Bias Polarity

- Description: Sets the bias polarity of the instrument

Syntax:

:BIAS:POL:AUTO?

:BIAS:POL:AUTO< 0|1|AUTO|FIX >

Parameters:

0|AUTO ---- AUTO

1| FIX ---- FIX

Example:

:BIAS:POL:AUTO 0 ---- sets bias polarity to auto

:BIAS:POL:AUTO 1 ---- sets bias polarity to fixed

:BIAS:POL:AUTO? ---- returns the bias polarity status

7.2.8 TRIGger Command Set

The TRIGger subsystem command set is used to set the trigger source for the instrument, the delay time after triggering, and to trigger instrument measurements.

- Description: Triggers the instrument to measure once

Syntax:

:TRIG

Parameters:

Example:

:TRIG ---- triggers the instrument to measure once

7.2.8.1 Trigger Mode

- Description: Sets the trigger source mode of the instrument

Syntax:

:TRIG:SOUR?

:TRIG:SOUR< CONT | SING>

Parameters:

:CONT ---- Continuous

:SING ---- Single

Example:

:TRIG:SOUR CONT ---- sets continuous trigger

:TRIG:SOUR SING ---- sets single trigger

:TRIG:SOUR? ---- returns the trigger mode

7.2.8.2 Trigger Delay

◆ Description: Sets the trigger delay time of the instrument

Syntax:

:TRIG:DEL?

:TRIG:DEL <float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:TRIG:DEL 0 ---- sets the trigger delay to 0

:TRIG:DEL 1ms ---- sets the trigger delay to 1ms

:TRIG:DEL 1 ---- sets the trigger delay to 1s

:TRIG:DEL? ---- returns the trigger delay

7.2.9 AMPLitude Auto Level Command Set

◆ Description: Used to set the automatic level control (ALC) switch of the instrument

Syntax:

:AMPL:ALC?

:AMPL:ALC< 0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:AMPL:ALC 0 ---- turns off the auto level control function

:AMPL:ALC 1 ---- turns on the auto level control function

:AMPL:ALC? ---- returns the automatic level control status

7.2.10 Output RESister Internal Resistance Command Set

◆ Description: Sets the output internal resistance mode of the instrument

Syntax:

ORES?

:ORES< 100|30>

Parameters:

100 ---- sets the output internal resistance of the instrument to 100Ω

30 ---- sets the output internal resistance of the instrument to 30Ω

Example:

:ORES 100 ----sets the output internal resistance of the instrument to 100Ω.

:ORES 30 ----sets the output internal resistance of the instrument to 30Ω.

:ORES? ----returns the output internal resistance of the instrument

7.2.11 FUNCtion Command Set

The FUNCtion subsystem command set is mainly used to set the measurement "function", range, current and voltage monitoring switch, mode selection for deviation display, nominal setting, etc.

7.2.11.1 Function Parameters

- Description: Sets the "Function" parameter of the instrument.

Syntax:

:FUNC:IMP[1|2|3|4]?

:FUNC:IMP <para1,para2,para3,para4>

:FUNC:IMP< 1|2|3|4> <para>

:FUNC:IMPSW< 0|1>,< 0|1>,< 0|1>,< 0|1>

:FUNC:IMPSW?

Parameters:

para1,para2,para3,para4 ---- indicates the name of the optional function parameter, the value is taken as below:

Parameter Name	Parameter Meaning	Parameter Name	Parameter Meaning
CP	Equivalent parallel capacitance	CS	Equivalent series capacitance
LP	Equivalent parallel inductance	LS	Equivalent series inductance
RP	Equivalent parallel resistance EPR	RS	Equivalent series resistance ESR
GP	Conductance	BP	Susceptance
Z	Impedance	Y	Admittance

D	Loss factor	Q	Quality factor
ZTD/DZ	θz° Angle of impedance	ZTR/RZ	θz Arc of impedance
YTD/DY	θy° Angle of admittance	YTR/RY	θy Arc of admittance
X	Reactance	RD	DC resistance

Example: :FUNC:IMP CP,CS,LP,LS ---- Sets four parameter functions at the same time

:FUNC:IMP1 RP ---- sets parameter 1 to RP

:FUNC:IMP2 RS ---- sets parameter 1 to RS

:FUNC:IMP3 Z ---- sets parameter 1 to Z

:FUNC:IMP4 Y ---- sets parameter 1 to Y

:FUNC:IMP1? ---- query parameter 1 function

:FUNC:IMP2? ---- query parameter 2 function

:FUNC:IMP3? ---- query parameter 3 function

:FUNC:IMP4? ---- query parameter 4 function

:FUNC:IMP? ---- query four-parameter functions

:FUNC:IMPSW 1,1,0,0 ---- sets four-parameter switches (ON, ON, OFF, OFF)

:FUNC:IMPSW 1,0,0,0 ---- sest four-parameter switches (ON, OFF, OFF, OFF, OFF)

:FUNC:IMPSW 1,1,1,1 ---- sets four-parameter switches (ON, ON, ON, ON)

:FUNC:IMPSW? ---- query four-parameter switches (returns such as "1,0,0,0")

7.2.11.2 AC Range

- Description: Sets the AC range of the instrument

Syntax:

:FUNC:IMP:RANG?

:FUNC:IMP:RANG <float>

Parameters:

float ---- indicates the size of the floating-point number, which is determined by the equivalent resistance of the tested part.

Example:

:FUNC:IMP:RANG 1k ---- selects the optimum range for 1kΩ equivalent resistance

:FUNC:IMP:RANG 1000 ---- selects the optimum range for 1kΩ equivalent resistance

:FUNC:IMP:RANG 1200 ---- selects the optimum range for 1.2kΩ equivalent resistance

:FUNC:IMP:RANG? ---- returns the current AC range

- Description: Sets the range of the instrument to auto

Syntax:

:func:imp:rang:auto?

:FUNC:IMP:RANG:AUTO< 0 | 1 | OFF | ON>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:FUNC:IMP:RANG:AUTO 0 ---- fixed AC range

:FUNC:IMP:RANG:AUTO 1 ---- auto AC Range

:FUNC:IMP:RANG:AUTO? ---- returns the AC range auto status

7.2.11.3 DC Range

- Description: Sets the DC range of the instrument

Syntax:

:FUNC:DCR:RANG?

:FUNC:DCR:RANG <float>

Parameters:

float ---- indicates the size of the floating-point number, which is determined by the equivalent resistance of the tested part.

Example:

:FUNC:DCR:RANG 1k ---- selects the optimal range for 1kΩ DCR

:FUNC:DCR:RANG 1000 ---- selects the optimal range for 1kΩ DCR

:FUNC:DCR:RANG 1200 ---- selects the optimal range for 1.2kΩ DCR

:FUNC:DCR:RANG? ---- returns the current DC range

7.2.11.4 VI Monitoring

- Description: Sets the voltage monitoring switch of the instrument

Syntax:

:FUNC:SMON:VDC?

:FUNC:SMON:VDC< 0 | 1 | OFF | ON>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:FUNC:SMON:VDC 0 ---- turns off voltage monitoring

:FUNC:SMON:VDC 1 ---- turns on voltage monitoring

:FUNC:SMON:VDC? ---- returns the voltage monitoring switch status

◆ Description: Sets the current monitor switch of the instrument

Syntax:

:FUNC:SMON:IDC?

:FUNC:SMON:IDC< 0 | 1 | OFF | ON>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:FUNC:SMON:IDC 0 ---- turns off current monitoring

:FUNC:SMON:IDC 1 ---- turns on current monitoring

:FUNC:SMON:IDC? ---- returns the current monitoring switch status

7.2.11.5 Deviation and Reference

◆ Description: Sets the deviation measurement mode of the instrument

Syntax:

:FUNC:DEV[1|2|3|4]:MODE?

:FUNC:DEV[1|2|3|4]:MODE< ABS | PER| OFF>

Parameters:

ABS ----Δ Absolute deviation

PER ----Δ% Percentage deviation

OFF ---- OFF

Example:

:FUNC:DEV1:MODE ABS ---- sets parameter 1 absolute deviation

:FUNC:DEV2:MODE PER ---- sets parameter 2 percentage deviation

:FUNC:DEV3:MODE OFF ---- turns off parameter 3 deviation mode

:FUNC:DEV:MODE OFF,PER,ABS,OFF ---- sets the four-parameter deviation mode at the same time

:FUNC:DEV2:MODE? ---- returns the deviation mode of parameter 2

:FUNC:DEV:MODE? ---- returns the four-parameter deviation

modes

◆ Description: Sets the deviation nominal value of the instrument

Syntax:

:FUNC:DEV[1|2|3|4]:REF?

:FUNC:DEV[1|2|3|4]:REF <float>

:func:dev<1|2|3|4>:ref:fill

Parameters:

float ---- indicates the size of floating-point data

Example:

:FUNC:DEV1:REF 10 ---- sets parameter 1 deviation reference to 10

:FUNC:DEV2:REF:FILL ---- measures once, the result of parameter 2 is used as the deviation reference.

:FUNC:DEV4:REF? ---- returns the deviation reference value of parameter 4

:FUNC:DEV:REF? ---- returns the deviation reference value of the four-parameter

:FUNC:DEV:REF 10,11,12,13 ---- sets the four-parameter deviation reference value at the same time

7.2.11.6 Step Delay

◆ Description: Sets the step delay time of the instrument

Syntax:

:FUNC:SDEL?

:FUNC:SDEL <float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

MIN ---- sets the minimum settable size

MAX ---- sets the maximum settable size

Example:

:FUNC:SDEL 0 ---- sets the step delay to 0

:FUNC:SDEL 1ms ---- sets the step delay to 1ms

:FUNC:SDEL 1 ---- sets the step delay to 1s

:FUNC:SDEL? ---- returns the step delay size

7.2.12 COMParator Command Set

The COMParator subsystem command set is used to set the file comparator function, including the setting of the comparison switch and the setting of the limit list.

7.2.12.1 COMP Comparison Switch

◆ Description: Sets the comparison function on or off of the instrument

Syntax:

:COMP?

:COMP< 0|1|ON|OFF >

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:COMP 0 ---- sets the comparison function OFF

:COMP 1 ---- sets the comparison function ON

:COMP? ---- returns the comparison function switch status

7.2.12.2 COUNt Count Switch

◆ Description: Sets the comparison count function on or off of the instrument

Syntax:

:COMP:COUN?

:COMP:COUN< 0|1|ON|OFF >

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:COMP:COUN 0 ---- sets the comparison count function OFF

:COMP:COUN 1 ---- sets the comparison count function ON

:COMP:COUN? ---- returns the comparison count function switch status

◆ Description：Queries bin count comparison result

Syntax:

:COMP:COUN:DATA?

Parameters:

Example:

:COMP:COUN:DATA? ---- returns the count results of each bin

◆ Description：Clears all bin count results

Syntax:

:COMP:COUN:CLE

Parameters:

Example:

:COMP:COUN:CLE ---- clears all bin count results

7.2.12.3 MODE Limit Mode

◆ Description: Sets the comparison limit mode of the instrument

Syntax:

:COMP:MODE?

:COMP:MODE< TOL|SEQ>

Parameters:

TOL ---- tolerance mode

SEQ ---- continuous mode

Example:

:COMP:MODE TOL ---- sets the comparison limit to tolerance mode

:COMP:MODE SEQ ---- sets the comparison limit to continuous mode

:COMP:MODE? ---- returns the comparison limit mode

7.2.12.4 TOL:BIN Limit Value

◆ Description: Sets the high and low limit values for each level of the comparison function error mode (this function is only valid when the limit mode is set to error mode). You can query the high and low limit values for each level of the current instrument settings.

Syntax:

:COMP:TOL:BIN<n ?>

:COMP:TOL:BIN<n> < lowA,highA>[...][,lowD,highD]

Parameters:

n ---- bin number index, value 1~10

lowA ---- indicates the floating-point size of the lower limit of parameter 1

highA ---- indicates the floating-point size of the upper limit of parameter 1

lowD ---- indicates the floating-point size of the lower limit of parameter 4

highD ---- indicates the floating-point size of the upper limit of parameter 4

Example:

:COMP:TOL:BIN1 1,2 ---- sets the high and low limits of the first parameter of 1st bin to [1,2]

:COMP:TOL:BIN3 1,2,3,4 ---- sets the high and low limits of the first two parameters of the 3rd bin to [1,2],[3,4]

:COMP:TOL:BIN10 1,2,3,4,5,6,7,8 ---- sets the high and low limits of the 10th four-parameters

:COMP:TOL:BIN1? ---- returns the high and low limits corresponding to the four-parameters of the 1st bin

7.2.12.5 SEQ:BIN Limit Value

◆ Description: Sets the high and low limit data for the continuous mode of the comparison function (this function is only valid when the limit mode is set to continuous mode). You can query the high and low limit values for each level of the current instrument settings.

Syntax:

:COMP:SEQ:BIN[A|B|C|D]?

:COMP:SEQ:BIN[A|B|C|D]< lo1>[,hi1,hi2,....hi10]

Parameters:

A|B|C|D ---- specifies which of the four parameters it refers to.

lo1 ---- floating-point size of the lower limit of 1st bin

hi1...hi10 ---- floating-point size of the upper limit of each bin

Example:

:COMP:SEQ:BIN 1,2,3,4,5 ---- sets the 1st parameter lo1,hi1,hi2,hi3,hi4

:COMP:SEQ:BINA 1,2,3,4,5 ---- same as above

:COMP:SEQ:BINB 1,2,3,4,5,6 ---- sets the 2nd parameter lo1,hi1,hi2,hi3,hi4,hi5

:COMP:SEQ:BINC 1,2,3,4,5,6,7,8,9,10,11 ---- sets the high and low limits of the full range of 3rd parameter.

:COMP:SEQ:BIN? ---- returns the high and low limits of parameter 1 bin 1 and the upper limits of the remaining bins

:COMP:SEQ:BINA? ---- same as above

:COMP:SEQ:BINB? ---- returns the high and low limits of parameter 2 bin 1 and the upper limit of the remaining bins

:COMP:SEQ:BINC? ---- returns the high and low limits of parameter 3 bin 1 and the upper limit of the remaining bins

:COMP:SEQ:BIND? ---- returns the high and low limits of parameter 4 bin 1 and the upper limit of the remaining bins

7.2.12.6 CLRar Clear Form

◆ Description: Used to clear the limit setting data of each bin of the limit setting.

Syntax:

:COMP:BIN:CLE

Parameters:

Example:

:COMP:BIN:CLE ---- clears the table of limit data

7.2.12.7 BIN:SW Bin Switch

◆ Description：Sets the specified bin comparison function on or off.

Syntax:

:COMP:BIN<n>:SW?

:COMP:BIN:SW< 0|1|ON|OFF >

Parameters:

n ---- bin number index, value 1~10

0|OFF ---- OFF

1| ON ---- ON

Example:

:COMP:BIN1:SW 0 ---- sets bin 1 comparison function OFF
:COMP:BIN2:SW 1 ---- sets bin 2 comparison function ON
:COMP:BIN10:SW? ---- returns bin 10 comparison function switch status

7.2.13 LIST Command Set

The LIST subsystem command set is mainly used to set the list scanning measurement function, the setting of the scanning points, the setting of the scanning mode, and the setting of the scanning comparison limit.

7.2.13.1 TOTAL Scanning Points

◆ Description: Sets the total number of points of the list scanning

Syntax:
:LIST:TOTAL?
:LIST:TOTAL <int>
Parameters:
int ---- scanning total number of points, value 1~201
Example:
:LIST:TOTAL 8 ---- sets the number of list scanning points to 8
:LIST:TOTAL 201 ---- sets the number of list scanning points to 201
:LIST:TOTAL? ---- returns the number of list scanning points

7.2.13.2 MODE List Mode

◆ Description: Sets the list scanning mode of the instrument

Syntax:
:LIST:MODE?
:LIST:MODE< SEQ | STEP>
Parameters:
SEQ ---- continuous
STEP ---- single-step
Example:
:LIST:MODE SEQ ---- sets the continuous scanning mode
:LIST:MODE STEP ---- sets the single-step scanning mode
:LIST:MODE? ---- returns the list scanning mode

7.2.13.3 COMP List Comparison Switch

◆ Description: Sets the list scanning comparison switch

Syntax:
:LIST:COMP?
:LIST:COMP <0|1|OFF|ON>
Parameters:

0|OFF ---- indicates turn off the list comparison

1| ON ---- indicates turn on the list comparison

Example:

:LIST:COMP 0 ---- sets to turn off the list comparison

:LIST:COMP 1 ---- sets to turn on the list comparison

:LIST:COMP? ---- queries the list comparison switch status

7.2.13.4 LISTDELTA Difference Mode

◆ Description：Sets the difference mode switch of the list scanning parameter 1

Syntax:

:LISTDELTA:SWitch?

:LISTDELTA:SWitch <0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1|ON ---- ON

Example:

:LISTDELTA:SWitch 0 ---- sets the list scanning difference mode ON

:LISTDELTA:SWitch OFF ---- sets the list scanning difference mode OFF

:LISTDELTA:SWitch? ---- queries the list scanning difference mode current status

◆ Description: sets the difference mode of parameter 1 for each scanning point when the list scanning difference mode is on.

Syntax:

:LISTDELTA:MODE[n]?

:LISTDELTA:MODE[n] < mode>

Parameters: <n> value 1~201 (scanning total number of points)

<mode> value 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

0 ---- mode (Pn-P1)

1 ---- mode (Pn-P1)/P1

2 ---- mode (Pn-P1)/P1*100%

3 ---- mode (Pn-P1)/Pn

4 ---- mode (Pn-P1)/Pn*100%

5 ---- mode (Pn)

6 ---- mode (Pn-P2)/P2

7 ---- mode (Pn-P2)/P2*100%

8 ---- mode (Pn-P2)/Pn

9 ---- mode (Pn-P2)/Pn*100%

Example:

:LISTDELTA:MODE2 0 ---- sets the list scanning difference mode ON and the difference mode of scanning point 2 is (Pn-P1), i.e. P2-P1

:LISTDELTA:MODE2? ---- queries the current difference mode of the list scanning point 2

◆ Description：Sets the difference lower limit corresponding to the scanning point difference mode when the list scanning difference mode is on.

Syntax:

:LISTDELTA:LOW[n]?

:LISTDELTA:LOW[n] <value>

Parameters: <n> value 3 ~ 201 (scanning total number of points)

<value> value type NRf

Example:

:LISTDELTA:MODE3 0 ---- sets the list scanning difference mode ON, and the difference mode of scanning point 3 is (Pn-P1) , i.e. P3-P1

:LISTDELTA:LOW3 -1 ---- sets the list scanning difference mode ON according to the previous command, and the difference mode of scanning point 3 is (P3-P1), and the lower limit of this difference is -1, and its unit is the same as parameter 1.

:LISTDELTA:LOW3? ---- queries the lower limit of the current difference mode of list scanning point 3

◆ Description：Sets the difference upper limit corresponding to the scanning point difference mode when the list scanning difference mode is on.

Syntax:

:LISTDELTA:HIGH[n]?

:LISTDELTA:HIGH[n] <value>

Parameter: <n> value 1~201 (scanning total number of points)

<value> value type NRf

Example:

:LISTDELTA:MODE3 0 ---- sets the list scanning difference mode ON, and the difference mode of scanning point 3 is (Pn-P1), i.e. P3-P1

:LISTDELTA:HIGH3 10 ---- sets the list scanning difference mode ON according to the previous command, and the difference mode of scanning point 3 is (P3-P1), and the lower limit of this difference is 10, and its unit is the same as parameter 1.

:LISTDELTA:HIGH3? ---- queries the upper limit of the current difference mode of list scanning point 3

7.2.13.5 LISTDIE Dielectric Constant

◆ Description: Sets the dielectric constant switch of the list scanning

Syntax:

:LISTDIE:SWitch?

:LISTDIE:SWitch <0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1|ON ---- ON

Example:

:LISTDIE:SWitch 0 ---- sets the list scanning difference mode ON

:LISTDIE:SWitch OFF ---- sets the list scanning difference mode OFF

:LISTDIE:SWitch? ---- queries the list scanning difference mode current status

◆ Description: Sets the thickness of the piezoelectric material for list scanning

Syntax:

:LISTDIE:THICKness?

:LISTDIE:THICKness < value>

Parameters:

<value> value type NRf, unit default m

Example:

:LISTDIE:THICKness 0.2 ---- sets the thickness of the list scanning piezoelectric material to 0.2m

:LISTDIE:THICKness? ---- queries the thickness of the list scanning piezoelectric materials

◆ Description: Sets the diameter of the piezoelectric material for list scanning

Syntax:

:LISTDIE:DIAMeter?

:LISTDIE:DIAMeter < value>

Parameters:

<value> value type NRf, unit default m

Example:

:LISTDIE:THICKness 0.2 ---- sets the diameter of the list scanning piezoelectric material to 0.2m

:LISTDIE:THICKness? ---- queries the diameter of the list scanning piezoelectric materials

◆ Description: Sets the area of the piezoelectric material for list scanning

Syntax:

:LISTDIE:AREA?

:LISTDIE:AREA < value>

Parameters:

<value> value type NRf, unit default m^2

Example:

:LISTDIE:AREA 0.2 ---- sets the area of the list scanning piezoelectric material to $0.2m^2$

:LISTDIE:AREA? ---- queries the area of the list scanning piezoelectric materials

◆ Description: Sets a individual switch for each parameter of the list scanning dielectric constant.

Syntax:

:LISTDIE:FUNCSW?

:LISTDIE:FUNCSW[n] < switch1,switch2,...>

Parameters:

n takes values 1 ~ 8, indicating each parameter of the dielectric constant for rows 1 ~ 8

1: Parameter Cp

2: Parameter D

3: Parameter ε

4: Parameter |ε|

5: Parameter εr'

6: Parameter εr"

7: Parameter tanδ

8: Parameter Q

<switch> 0|1, indicates the switch

Note: n starts at a few and is followed by a switch for m data, indicating that the measurement is turned on for the parameter starting at the nth row and for the parameter m-1 rows down from the nth row (up to 8 data)

Example:

:LISTDIE:FUNCSW2 0,1,0,1 ---- sets from parameter D, D OFF, ε ON, |ε| OFF, εr'ON

:LISTDIE:FUNCSW? ---- queries the individual switch of each parameter of dielectric constant

◆ Description：Sets the lower limit of different dielectric constants when a parameter of the list scanning dielectric constant is ON

Syntax:

:LISTDIE:LOW[n]?

:LISTDIE:LOW[n] <value>

Parameters:

n takes values 1 ~ 8, indicating each parameter of the dielectric constant for rows 1 ~ 8

1: Parameter Cp

2: Parameter D

3: Parameter ε

4: Parameter |ε|

5: Parameter εr'

6: Parameter εr"

7: Parameter tanδ

8: Parameter Q

<value> value type NRf

Example:

:LISTDIE:FUNCSW3 1 ----ε ON

:LISTDIE:LOW3 1.3 --- sets ε parameter ON according to the previous command, and the lower limit of the comparison judgment of the ε parameter is 1.3

:LISTDIE:LOW3? ---- queries the lower limit of the ε parameter

◆ Description：Sets the upper limit of different dielectric constants when a parameter of the list scanning dielectric constant is ON

Syntax:

:LISTDIE:HIGH[n]?

:LISTDIE:HIGH[n] <value>

Parameters:

n takes values 1 ~ 8, indicating each parameter of the dielectric constant for rows 1 ~ 8

1: Parameter Cp

2: Parameter D

3: Parameter ε

4: Parameter |ε|

5: Parameter εr'

6: Parameter εr''

7: Parameter tanδ

8: Parameter Q

<value> value type NRf

Example:

:LISTDIE:FUNCSW3 1 ----ε ON

:LISTDIE:HIGH3 5.3 --- sets ε parameter ON according to the previous command, and the upper limit of the comparison judgment of the ε parameter is 5.3

:LISTDIE:HIGH3? ---- queries the upper limit of the ε parameter

7.2.13.6 DISP Parameter Display Switch

◆ Description：Sets the display switch of the list scanning four-parameters

Syntax:

:LIST:DISP:PARA?

:LIST:DISP:PARA< 0|1>,< 0|1>,< 0|1>,< 0|1>

Parameters:

0|OFF ---- indicates turn off the display, and do not display, do not save, do not report data

1| ON ---- indicates turn on the display

Example:

:LIST:DISP:PA 1,0,0,0 ---- sets the list four-parameters to turn on only the first

:LIST:DISP:PARA 1,1,0,0 ---- sets the list four-parameters to turn on the first two

:LIST:DISP:PARA? ---- queries the list four-parameters display

open status

◆ Description：Sets the list scanning frequency display switch

Syntax:

:LIST:DISP:FREQ?

:LIST:DISP:FREQ< 0|1>

Parameters:

0|OFF ---- indicates turn off the display

1| ON ---- indicates turn on the display

Example:

:LIST:DISP:FREQ 1 ---- sets the list frequency display ON

:LIST:DISP:FREQ 0 ---- sets the list frequency display OFF

:LIST:DISP:FREQ? ---- queries the list frequency display open status

◆ Description：Sets list scanning AC level display switch

Syntax:

:LIST:DISP:ACLV?

:LIST:DISP:ACLV< 0|1>

Parameters:

0|OFF ---- indicates turn off the display

1| ON ---- indicates turn on the display

Example:

:LIST:DISP:ACLV 1 ---- Sets the list AC level display ON

:LIST:DISP:ACLV 0 ---- sets the list AC level display OFF

:LIST:DISP:ACLV? ---- queries the list AC level display open status

◆ Description: Sets the list scanning bias display switch

Syntax:

:LIST:DISP:BIAS?

:LIST:DISP:BIAS< 0|1>

Parameters:

0|OFF ---- indicates turn off the display

1| ON ---- indicates turn on the display

Example:

:LIST:DISP:BIAS 1 ---- sets the list bias display ON

:LIST:DISP:BIAS 0 ---- sets the list bias display OFF

:LIST:DISP:BIAS? ---- queries the list bias display open status

7.2.13.7 CLEar Clear

◆ Description: Clear the setting data of all scanning points

Syntax:

:LIST:CLE [n|ALL]

Parameters:

n ---- specifies the corresponding point of the list, value 1 ~ 201
ALL ---- specifies all points of the list]

Example:

:LIST:CLE ---- clears the setting data of all scanning points
:LIST:CLE ALL ---- clears the setting data of all scanning points
:LIST:CLE 5 ---- clears the setting data of point 5

7.2.13.8 FREQuency Frequency

◆ Description：Sets the scanning point frequency, sets the frequency size of a number of points starting from the nth point

Syntax:

:LIST:FREQ[n]?
:LIST:FREQ[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point
f_n ---- scan point n floating-point size
f_{n+1} ---- scan point n+ 1 floating-point size
f_{n+2} ---- scan point n+2 floating-point size
f... ---- scan point...floating-point size

Example:

:LIST:FREQ 20,30,40 ---- sets the frequency of the first 3 points
:LIST:FREQ1 20,30,40,1k,2k ---- sets the frequency of the first 5 points
:LIST:FREQ6 20,30,40,1k,2k ---- sets the frequency of 6 ~ 10 points
:LIST:FREQ25 20k ---- sets the frequency of the 25th point
:LIST:FREQ? ---- returns the frequency of all scanning points
:LIST:FREQ4? ---- returns the frequency of point 4

7.2.13.9 VOLTage Voltage

◆ Description：Sets the scanning point test level, sets the voltage level for a number of points starting from the nth point

Syntax:

:LIST:VOLT[n]?
:LIST:VOLT[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point
f_n ---- scan point n floating-point size
f_{n+1} ---- scan point n+ 1 floating-point size
f_{n+2} ---- scan point n+2 floating-point size
f... ---- scan point...floating-point size

Example:

:LIST:VOLT 1,2,3 ---- sets the voltage of the first 3 points
:LIST:VOLT 1,2,3,4,2 ---- sets the voltage of the first 5 points

:LIST:VOLT6 1,2,3,4,5 ---- sets the voltage of 6 ~ 10 points
:LIST:VOLT25 20 ---- sets the voltage of point 25
:LIST:VOLT? ---- returns the voltage of all scanning points
:LIST:VOLT4? ---- returns the voltage of point 4

7.2.13.10 CURRent Current

◆ Description：Sets the scanning point test level, sets the current level for a number of points starting from the nth point

Syntax:

:LIST:CURR[n]?
:LIST:CURR[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point
f_n ---- scan point n floating-point size
f_{n+1} ---- scan point n+ 1 floating-point size
f_{n+2} ---- scan point n+2 floating-point size
f... ---- scan point...floating-point size

Example:

:LIST:CURR 0.01,20m,30m ---- sets the current of the first 3 points
:LIST:CURR 1m,2m,3m,4m,2m ---- sets the current of the first 5 points
:LIST:CURR6 1m,2m,3m,4m,5m ---- sets the current of 6 ~ 10 points
:LIST:CURR25 20m ---- sets the current of point 25
:LIST:CURR? ---- returns the current of all scan points
:LIST:CURR4? ---- returns the current of point 4

7.2.13.11 BIAS Bias Voltage

◆ Description：Sets the scanning point bias voltage, sets the bias voltage for a number of points starting from the nth point

Syntax:

:LIST:BIAS:VOLT[n]?
:LIST:BIAS:VOLT[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point
f_n ---- scan point n floating-point size
f_{n+1} ---- scan point n+ 1 floating-point size
f_{n+2} ---- scan point n+2 floating-point size
f... ---- scan point...floating-point size

Example:

:LIST:BIAS:VOLT 1,2,3 ---- sets the bias voltage of the first 3 points
:LIST:BIAS:VOLT6 1,2,3,4,5 ---- sets the bias voltage of 6~10 points
:LIST:BIAS:VOLT? ---- returns the bias voltage of all scan points
:LIST:BIAS:VOLT4? ---- returns the bias voltage of point 4

7.2.13.12 BIAS Bias Current

◆ Description：Sets the scanning point bias current, sets the bias current for a number of points starting from the nth point

Syntax:

:LIST:BIAS:CURR[n]?

:LIST:BIAS:CURR[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point

f_n ---- scan point n floating-point size

f_{n+1} ---- scan point n+ 1 floating-point size

f_{n+2} ---- scan point n+2 floating-point size

f... ---- scan point...floating-point size

Example:

:LIST:BIAS:CURR 1m,2m,3m ---- sets the bias current of the first 3 points

:LIST:BIAS:CURR6 1m,2m,3m,4m,5m ---- sets the bias current of 6 ~ 10 points

:LIST:BIAS:CURR? ---- returns the bias current of all points

:LIST:BIAS:CURR4? ---- returns the bias current of point 4

7.2.13.13 FUNCtion Parameter Function

◆ Description：Sets the "Function" parameter of the specified point of the list scanning.

Syntax:

:LIST:FUNC:IMP<n ?>

:LIST:FUNC:IMP<n> <para1,para2,para3,para4>

Parameters:

n ---- specifies the index of the scanning point, value 1 ~ 201

para1,para2,para3,para4 ---- indicates the name of the optional function parameter, the value is taken as below:

Parameter name	Parameter Meaning	Parameter name	Parameter Meaning
CP	Equivalent parallel capacitance	CS	Equivalent series capacitance
LP	Equivalent parallel inductance	LS	Equivalent series inductance
RP	Equivalent parallel	RS	Equivalent series

	resistance EPR		resistance ESR
GP	Conductance	BP	Susceptance
Z	Impedance	Y	Admittance
D	Loss factor	Q	Quality factor
ZTD	θz° Angle of impedance	ZTR	θz Arc of impedance
YTD	θy° Angle of admittance	YTR	θy Arc of admittance
X	Reactance	RD	DC resistance

Example:

:LIST:FUNC:IMP1 CP,CS,LP,LS ---- sets the four-parameter function of point 1

:LIST:FUNC:IMP5 CP,CS,LP,LS ---- sets the four-parameter function of point 5

:LIST:FUNC:IMP100 CP,CS,LP,LS---- sets the four-parameter function of the 100th point

:LIST:FUNC:IMP1? ---- returns the four-parameter function of point 1

◆ Description：Sets the function of the list scanning the specified parameter for a number of points starting from the nth point

Syntax:

:LIST:FUNC:IMP<A|B|C|D><n ?>

:LIST:FUNC:IMP<A|B|C|D><n> <$p_{(n)}$>[,p_{n+1},p_{n+2},$p_{(n+3)}$....]

Parameters:

A|B|C|D ---- indicates that one of the four-parameters is specified

n ---- specifies the index of the scanning point, value 1 ~ 201

p_n ---- scan point n function name, (refer to the table above)

p_{n+1} ---- scan point n+ 1 function name

p_{n+2} ---- scan point n+2 function name

p... ---- scan points...function name

Example:

:LIST:FUNC:IMPA CP,CS,LP ---- sets the parameter function of points 1 ~ 3 of the 1st parameter

:LIST:FUNC:IMPB5 CP,CS ---- sets the parameter function of points 5 ~ 6 of the 2nd parameter

:LIST:FUNC:IMPC? ---- returns the all-points parameter functions of the 3rd parameter

:LIST:FUNC:IMPD11? ---- returns the 11th point parameter function of the 4th parameter

◆ Description：Linear setup list scanning function for specified parameters

Syntax:

:LIST:FUNC:LIN<A|B|C|D> <start,stop,para>

Parameters:

A|B|C|D ---- indicates one of the four-parameters is specified

start ---- specifies the starting point of the setting, value 1 ~ 201

stop --- specifies the end point of the setting, value 1 ~ 201

para ---- function name (refer to the table above)

Example:

:LIST:FUNC:LINA 1,15,LP ---- sets the function of the 1st parameter 1~15 points to LP

:LIST:FUNC:LINB 5,201,CP ---- sets the function of the 2nd parameter 5~ 201 points to CP

:LIST:FUNC:LIND 3,15,LP ---- sets the function of the 4th parameter 3~ 15 points to LP

7.2.13.14 BAND Limit

◆ Description：Sets limit data in specified point list scanning setup forms

Syntax:

:LIST:BAND<n>?

:LIST:BAND<n> OFF

:LIST:BAND<n> <A|B|C|D,lo,hi>

Parameters:

n ---- specifies the index of the scanning point, value 1 ~ 201

A|B|C|D ---- indicates one of the four-parameters is specified

lo ---- specifies the lower limit of the parameter corresponding to the point

hi ---- specifies the upper limit of the parameter corresponding

to the point

Example:

:LIST:BAND1 OFF ---- clears the limit data of four-parameters at point 1

:LIST:BAND2 A,1,2 ---- sets the function of the 2nd parameter 5 ~ 201 point to CP

:LIST:BAND201 D,1.1,2.2 ---- sets the function of the 4th parameter 3 ~ 15 points to LP

:LIST:BAND9? ---- returns the high and low limits of the four-parameters of point 9,loA,hiA...

7.2.13.15 DELay Delay

◆ Description：Sets the scan point test delay time, sets the delay time for a number of points starting with the nth point

Syntax:

:LIST:DEL[n]?

:LIST:DEL[n] <$f_{(n)}$>[,f_{n+1}][,f_{n+2}]...

Parameters:

n ---- starts at the nth point

f_n ---- scan point n floating-point size

f_{n+1} ---- scan point n+ 1 floating-point size

f_{n+2} ---- scan point n+2 floating-point size

f... ---- scan point...floating-point size

Example:

:LIST:DEL 0.01,20m,30m ---- sets the test delay of the first 3 points

:LIST:DEL 1m,2m,3m,4m,2m ---- sets the test delay of the first 5 points

:LIST:DEL6 1m,2m,3m,4m,5m ---- set the test delay time of 6 ~ 10 points

:LIST:DEL25 20m ---- sets the test delay of point 25

:LIST:DEL? ---- returns the test delay of all scan points

:LIST:DEL4? ---- returns the test delay of point 4

7.2.14 TRACE Trace Command Set

7.2.14.1 POINT Scanning Points

◆ Description: Sets the number of LCR trace sweep points

Syntax:

:TSSE:POINT?

:TSSE:POINT <51|101|201|401|801>

Parameters:

51 ---- indicates scanning 51 points

101 ---- indicates scanning 101 points

201 ---- indicates scanning 201 points

401 ---- indicates scanning 401 points
801 ---- indicates scanning 801 points

Example:

:TSSE:POINT 51 ---- sets the LCR to scan 51 points
:TSSE:POINT 101 ---- sets the LCR to scan 101 points
:TSSE:POINT 201 ---- sets the LCR to scan 201 points
:TSSE:POINT 401 ---- sets the LCR to scan 401 points
:TSSE:POINT 801 ---- sets the LCR to scan 801 points
:TSSE:POINT? ---- queries the LCR scan points

7.2.14.2 MODE Scan Parameter Type

- Description: Sets the type of LCR trace sweep parameters

Syntax:

:TSSE:MODE?
:TSSE:MODE <FREQ|VOLT|CURR|BVOL|BCUR>

Parameters:

Enumerated string parameters

Example:

:TSSE:MODE FREQ ---- sets the LCR scan parameter to frequency
:TSSE:MODE VOLT ---- sets the LCR scan parameter to voltage
:TSSE:MODE CURR ---- sets the LCR scan parameter to current
:TSSE:MODE BVOL ---- sets the LCR scan parameter to bias voltage
:TSSE:MODE BCUR ---- sets the LCR scan parameter to bias current
:TSSE:MODE? ---- queries the LCR scan parameter type

7.2.14.3 SWEEP Range

- Description: Sets the LCR trace sweep range (start and end points)

Syntax:

:TSSE:SWEEP?
:TSSE:SWEEP <float,float>

Parameters:

float ---- floating-point string format, like "3.14159"

Example:

:TSSE:SWEEP 1,100 ---- sets the LCR sweeping start and end points
:TSSE:SWEEP? ---- queries the LCR sweeping start and end points

7.2.14.4 SMODE Sweep Mode

- Description: Sets the LCR trace sweep mode

Syntax:

:TSSE:SMODE?
:TSSE:SMODE <SEQ|STEP>

Parameters:

SEQ ---- sequemce mode
STEP ---- step mode

Example:

:TSSE:SMODE SEQ ---- sets the LCR sweep mode to sequence
:TSSE:SMODE STEP ---- sets the LCR sweep mode to step
:TSSE:SWEEP? ---- queries the LCR sweep mode

7.2.14.5 Format Mode

◆ Description：Sets the LCR trace format mode

Syntax:

:TSSE:FORMat?
:TSSE:FORMat <LIN|LOGX>

Parameters:

LIN ---- linear coordinates
LOGX ----X axis logarithm

Example:

:TSSE:FORM LIN ---- sets LCR scanning format to linear
:TSSE:FORM LOGX ---- sets the LCR scanning format to logarithm
:TSSE:FORM? ---- queries the LCR scanning format mode

7.2.14.6 Limit Switch

◆ Description: Sets the LCR trace limit switch

Syntax:

:TSSE:LIMIt?
:TSSE:LIMIt <OFF|0|ON|1>

Parameters:

Example:

:TSSE:LIMI 0 ---- sets the LCR scanning limit switch to OFF
:TSSE:LIMI OFF ---- sets the LCR scanning limit switch to OFF
:TSSE:LIMI 1 ---- sets the LCR scanning limit switch to ON
:TSSE:LIMI ON ---- sets the LCR scanning limit switch to ON
:TSSE:LIMI? ---- queries the LCR scanning limit switch status

7.2.14.7 Function Parameter

◆ Description：Sets the "Function" parameter of LCR scanning.

Syntax:

:TSSE:IMP[1|2|3|4]?
:TSSE:IMP <para1,para2,para3,para4>
:TSSE:IMP< 1|2|3|4> <para>

Parameters:

para1,para2,para3,para4 ---- indicates the name of the optional function parameter, the value is taken as below:

Parameter name	Parameter Meaning	Parameter name	Parameter Meaning
CP	Equivalent parallel capacitance	CS	Equivalent series capacitance
LP	Equivalent parallel inductance	LS	Equivalent series inductance
RP	Equivalent parallel resistance EPR	RS	Equivalent series resistance ESR
GP	Conductance	BP	Susceptance
Z	Impedance	Y	Admittance
D	Loss factor	Q	Quality factor
ZTD/DZ	θz° Angle of impedance	ZTR/RZ	θz Arc of impedance
YTD/DY	θy° Angle of admittance	YTR/RY	θy Arc of admittance
X	Reactance	RD	DC resistance

Example:

:TSSE:IMP CP,CS,LP,LS ---- Sets the four-parameter functions at the same time

:TSSE:IMP1 RP ---- sets parameter 1 to RP

:TSSE:IMP2 RS ---- sets parameter 1 to RS

:TSSE:IMP3 Z ---- sets parameter 1 to Z

:TSSE:IMP4 Y ---- sets parameter 1 to Y

:TSSE:IMP1? ---- queries parameter 1 function

:TSSE:IMP2? ---- queries parameter 2 function

:TSSE:IMP3? ---- queries parameter 3 function

:TSSE:IMP4? ---- queries parameter 4 function

:TSSE:IMP? ---- queries the four-parameter function

7.2.14.8 Trace Comparison

- Description: Sets the LCR trace comparison switch

Syntax:

:TSSE:COMP:SWitch?

:TSSE:COMP:SWitch <OFF|0|ON|1>

Parameters:

Example:

:TSSE:COMP:SWitch 0 ---- sets the LCR scan comparison switch to off

:TSSE:COMP:SWitch OFF ---- sets the LCR scan comparison switch to off

:TSSE:COMP:SWitch 1 ---- sets the LCR scan comparison switch to on

:TSSE:COMP:SWitch ON ---- sets the LCR scan comparison switch to on

:TSSE:COMP:SWitch? ---- queries the LCR scan comparison switch status

7.2.14.9 Piezoelectric Conductivity Test

◆ DESCRIPTION: Sets the test switch of LCR trace piezoelectric conductivity

Syntax:

:TSSE:CTDT:SWitch?

:TSSE:CTDT:SWitch <OFF|0|ON|1>

Parameters:

Example:

:TSSE:CTDT:SWitch 0 ---- sets the LCR scanning piezo switch to OFF

:TSSE:CTDT:SWitch OFF ---- sets the LCR scanning piezo switch to OFF

:TSSE:CTDT:SWitch 1 ---- sets the LCR scanning piezo switch to ON

:TSSE:CTDT:SWitch ON ---- sets the LCR scanning piezo switch to ON

:TSSE:CTDT:SWitch? ---- queries the LCR scanning piezo switch status

7.2.14.10 Planar Electromechanical Coupling Coefficient Kp and Mechanical Quality Factor Qm

◆ Description：Sets the LCR trace piezoelectric conductivity test open, sets the planar electromechanical coupling coefficient Kp and the mechanical quality factor Qm

Syntax:

:TSSE:CTDT:KPQM?

:TSSE:CTDT:KPQM < 0/1/2/3> ,<0/1>,<0/1/2/3/5>

Parameters: see section 3.7.11 for details

The first digit <0/1/2/3> indicates the calculation formula for selecting the

planar electromechanical coupling coefficient Kp

The second digit <0/1> indicates the calculation formula for selecting the mechanical quality factor Qm

The third digit <0/1/2/3/5> indicates the size of the k-value for selecting the calculation of Kp in Equation 3: 0 for 2.33, 1 for 2.46, 2 for 2.51, 3 for 2.53, and 5 for 2.55

Example:

:Tsse:Ctdt:Kpqm 0,1,2 ---- sets the plane electromechanical coupling coefficient Kp calculated by Equation 1 and the mechanical quality factor Qm by Equation 2, and the value of k is 2.51

:TSSE:CTDT:KPQM? ---- queries Kp, Qm & k

7.2.14.11 Thickness Expansion Electromechanical Coupling Coefficient Kt, Transverse Electromechanical Coupling Coefficient K31 and Longitudinal Electromechanical Coupling Coefficient K33

◆ Description：Sets the LCR trace piezoelectric conductivity test open, sets the thickness expansion electromechanical coupling coefficient Kt, the transverse electromechanical coupling coefficient K31, and the longitudinal electromechanical coupling coefficient K33.

Syntax:

:TSSE:CTDT:KtK31K33Kta?

:TSSE:CTDT:KtK31K33Kta < 0/1> ,<0/1>,<0>,<0/1>

Parameters: see section 3.7.11 for details

The first digit <0/1> indicates the calculation formula for selecting the thickness expansion electromechanical coupling coefficient Kt

The second digit <0/1> indicates the calculation formula for selecting the transverse electromechanical coupling coefficient K31

The third digit <0> indicates the calculation formula for the longitudinal electromechanical coupling coefficient K33

The fourth digit <0/1> indicates the size of the α-value for the calculation of Kt in Equation 2: 0 for 1.42 and 1 for 2.

Example:

:TSSE:CTDT:KtK31K33Kta 0,1,0,1 ---- sets the thickness expansion electromechanical coupling coefficient Kt calculated by Equation 1, the transverse electromechanical coupling coefficient K31 calculated by Equation 2 with the longitudinal electromechanical coupling coefficient K33, and the value of α is 2

:TSSE:CTDT:KtK31K33Kta? ---- queries Kt, K31 & K33, α

7.2.14.12 Dielectric Thickness D and Electrode Area S

◆ Description：Sets the LCR trace piezoelectric conductivity test open, sets the dielectric thickness D and electrode area S

Syntax:

:TSSE:CTDT:SizeDS?

:TSSE:CTDT:SizeDS < value1.value2>

Parameters: see section 3.7.11 for details

<value1> value type NRf, unit default m

<value2> value type NRf, unit default m^2

Example:

:TSSE:CTDT:SizeDS 0.1,0.05 ---- sets the dielectric thickness D to 0.1m and the electrode area S to $0.05m^2$

:TSSE:CTDT:SizeDS? ---- queries the dielectric thickness D and electrode area S

7.2.15 Handler Command Set

7.2.15.1 LCR Handler Command Set

◆ Description：Sets the LCR Handler mode

Syntax:

:HAND:STAT?

:HAND:STAT <0|1|2|OFF|ON|BUS>

Parameters:

0|OFF ---- indicates default

1| ON ---- indicates customized

2| BUS ---- indicates bus control

Example:

:HAND:STAT 0 ---- sets the HANDLE mode to the default

:HAND:STAT OFF ---- sets the HANDLE mode to the default

:HAND:STAT 1 ---- sets the HANDLE mode to custom

:HAND:STAT ON ---- sets the HANDLE mode to custom

:HAND:STAT BUS ---- returns the HANDLE mode to bus controlling high and low outputs

◆ Description：Sets the LCR Handler custom output control

Syntax:

:HAND:STAT:OFFLO <...>

:HAND:STAT:OFFHI <...>

:HAND:STAT:LVLO <...>

:HAND:STAT:LVHI <...>

:HAND:STAT:PUHI <...>

:HAND:STAT:PULO <...>

Parameters:

<...> The values of the formal parameter are in list format, e.g., 1,2,4,7,14,24, etc., corresponding to the position of the table displayed by the instrument.

Example:

:HAND:STAT:OFLO 1,3,5,9 ---- sets the 1,3,5,9 index function to constant low

:HAND:STAT:OFHI 1,3,5,9 ---- sets the 1,3,5,9 index function to constant high

:hand:stat:lvlo 1,3,5,9 ---- sets the 1,3,5,9 index function to be active low

:HAND:STAT:LVHI 1,3,5,9 ---- sets the 1,3,5,9 index function to be active high

:HAND:STAT:PUHI 1,3,5,9 ---- sets the 1,3,5,9 index function to be active high pulse

:HAND:STAT:PULO 1,3,5,9 ---- sets the 1,3,5,9 index function to be active low pulse

◆ Description: Sets the LCR Handler bus output control

Syntax:

:HAND:OUTP:LVHI <...>

:HAND:OUTP:LVLO <...>

Parameters:

<...> The values of the formal parameter are in list format, e.g., 1,2,4,7,14,24, etc., corresponding to the position of the table displayed by the instrument.

Example:

:HAND:LVHI:LVHI 1,3,5,9 ---- sets 1,3,5,9 to output high level in bus mode

:HAND:LVLO:LVLO 1,3,5,9 ---- sets 1,3,5,9 to output low level in bus mode

7.2.16 FETCh? Command Set

7.2.16.1 General Query Test Results

◆ Description：Queries the result of the last measurement in the current test mode

Syntax:

:FETCh? ---- returns the test result of the parameter

Parameters:

Example:

<table>
<tr><td colspan="2">Test Page</td><td></td></tr>
<tr><td>LCR Bridge</td><td>Component Test</td><td>Parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, sorting result

e.g. 1.12345E2, 1.23456E-2,1.11023E2, -1.12345E2,1
where the sorting results are taken as follows:
<table>
<tr><td>Sorting Results</td><td>Description</td></tr>
<tr><td>0</td><td>Exceedingly poor</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td><table><tr><td>1~10</td><td>Bin 1~10</td></tr></table>

NOTE: The <bin number> data will only be displayed if the instrument comparison function is set to ON.</td></tr>
<tr><td></td><td>List Scan</td><td>Returns the test results of the current test point,

Point index, parameter 1 results, parameter 2 results, parameter 3 results, parameter 4 results, comparison results

e.g. 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2,1
where the comparison results are taken as follows:<table><tr><th>Comparison Results</th><th>Description</th></tr><tr><td>0</td><td>Non-comparative</td></tr><tr><td>1</td><td>Qulified</td></tr><tr><td>Other</td><td>Unqulified</td></tr></table></td></tr>
<tr><td></td><td>Trace Sweep</td><td>Returns the test results of the current test point,

Point index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result

e.g. 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2</td></tr>
</table>

- Description：Queries the test level monitoring result

Syntax:

:FETCh:SMON:VAC? ---- returns the AC voltage monitoring results
:FETCh:SMON:IAC? ---- returns the AC current monitoring results
:FETCh:SMON:VDC? ---- returns the DC bias voltage monitoring result
:FETCh:SMON:IDC? ---- returns the DC bias current monitoring result

7.2.16.2 Automatic Return Data

Description: Automatically returns to test result settings (no state is saved after powering off)

Syntax:

:FETCh:AUTO <? |0|OFF|1|ON|2>

Parameters:

? ---- indicates that query the auto-return status

0|OFF ---- indicates that turn off the auto-return status

1|ON ---- indicates that the test result will be returned automatically at the end of the triggered test. The result format is the same as FETCH?.

2 ---- indicates that the end state is returned after the trigger test result, and the result is not returned directly

Returns "Trig Eom\n" indicating the end of the test

Example:

:FETCh:AUTO? ---- queries auto-return setting status

:FETCh:AUTO 0 ---- turns off the trigger auto-return setting

:FETCh:AUTO 1 ---- returns test data automatically after the end of the trigger

:FETCh:AUTO 2 ---- returns the end status after the end of the trigger

7.2.16.3 Query List Scan Results

◆ Description：Queries list scanning results

Syntax:

:FETCh:LIST:PARA<1|2|3|4>? ---- returns list specified parameters test results for all points

:FETCh:LIST:PT<1~201>? ---- returns test results of all parameters of the list at the specified point

:FETCh:LIST:COMP[1~201]? ---- returns the comparison result of the specified point of the list

:FETCh:LIST[1~201]? ---- returns the four-parameter and comparison results for all points of the list

Example:

:FETCh:LIST:PARA1? ---- returns test results for list scan parameter 1

:FETCh:LIST:PARA2? ---- returns test results for list scan parameter 2

:FETCh:LIST:PARA3? ---- returns test results for list scan parameter 3

:FETCh:LIST:PARA4? ---- returns test results for list scan parameter 4

:FETCh:LIST:PT5? ---- returns test results of the test at point 5 for all parameters

:FETCh:LIST:COMP? ---- returns comparison results of all list points

:FETCh:LIST:COMP4? ---- returns comparison results at point 4 of the list

:FETCh:LIST? ---- returns four-parameter results for all list points

E.g. P1.1,P1.2,P1.3,P1.4,P1.cmp,P2.1 ....

:FETCh:LIST3? ---- returns the four-parameters and

comparison results of point 3 of the list

Note: Multiple pieces of data are separated by commas. If the display of parameters is turned off, there will be no data content in the middle of the separator.

7.2.16.4 Query Trace Sweep Results

◆ Description：Query trace sweep results

Syntax:

:FETCh:TRACE:X[1~801]? ---- returns the horizontal coordinates of the trace sweep

:FETCh:TRACE:Y<1|2|3|4>? ---- returns the test results for the specified trace (all points)

:FETCh:TRACE:PT<1~801>? ---- returns the result at the specified point (x,y1,y2,y3,y4)

:FETCh:TRACE:MARK?---- returns the result at all trace cursors (x,y1,y2,y3,y4)

:FETCh:TRACE:YMAX<1|2|3|4>? ---- returns the maximum value of the specified trace (x,y)

:FETCh:TRACE:YMIN<1|2|3|4>? ---- returns the minimum value of the specified trace (x,y)

Example:

:FETCh:TRACE:X? ---- returns a list of all the transverse data for a trace sweep

:FETCh:TRACE:X5? ---- returns the horizontal coordinates of point 5 of the trace sweep

:FETCh:TRACE:Y1? ---- returns test results for trace sweep Y 1

:FETCh:TRACE:Y2? ---- return test results for trace sweep Y 2

:FETCh:TRACE:Y3? ---- returns test results for trace sweep Y 3

:FETCh:TRACE:Y4? ---- returns test results for trace sweep Y 4

:FETCh:TRACE:PT5? ---- returns the result of all traces at point 5

:FETCh:TRACE:MARK? ---- returns the result at the trace cursor (x,y1,y2,y3,y4)

:FETCh:TRACE:YMAX1? ---- returns the maximum value of trace 1 (x,y)

:FETCh:TRACE:YMAX2? ---- returns the maximum value of trace 2 (x,y)

:FETCh:TRACE:YMAX3? ---- returns the maximum value of trace 3 (x,y)

:FETCh:TRACE:YMAX4? ---- returns the maximum value of trace 4 (x,y)

:FETCh:TRACE:YMIN1? ---- returns the minimum value of trace 1 (x,y)

:FETCh:TRACE:YMIN2? ---- returns the minimum value of trace 2 (x,y)

:FETCh:TRACE:YMIN3? ---- returns the minimum value of trace 3 (x,y)

:FETCh:TRACE:YMIN4? ---- returns the minimum value of trace 4 (x,y)

7.2.16.5 Query Piezoelectric Admittance Parameters

◆ Description：Query trace sweep results

Syntax:

:FETCh:CTDT:ALL? ---- returns test results of the trace sweep of piezoelectric admittance for all parameters

:FETCh:CTDT:Gx? ---- returns test results of trace sweep GB trace (Figure 3-3-2, rightmost yellow circle) for all horizontal coordinates of the conductance G

:FETCh:CTDT:By? ---- returns test results of trace sweep GB trace (Figure 3-3-2, rightmost yellow circle) for all vertical coordinates of the capacitance B

7.2.17 CORRection User Zero Command Set

The CORRection subsystem command set is used to set the user zeroing function, open circuit, short circuit, and load calibration settings.

7.2.17.1 OPEN Open Circuit Correction

◆ Description: Performs preset test point open circuit clearing

Syntax:

:CORR:OPEN [ACK]

Parameters:

Example:

:CORR:OPEN ---- Performs open-circuit clearing operation on preset points without return

:CORR:OPEN ACK ---- performs an open-circuit clearing operation on the preset point

Open circuit returns 1 for success and 0 for failure

◆ Description: Sets the open circuit correction switch status

Syntax:

:CORR:OPEN:STAT?

:CORR:OPEN:STAT< 0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:CORR:OPEN:STAT 0 ---- sets the open-circuit clearing status to OFF

:CORR:OPEN:STAT 1 ---- sets the open-circuit clearing status to ON

:CORR:OPEN:STAT? ---- returns open-circuit clearing switch status

7.2.17.2 SHORt Short Circuit Correction

◆ Description: Performs preset test point short-circuit clearing

Syntax:

:CORR:SHOR [ACK]

Parameters:

Example:

:CORR:SHOR ---- performs a short-circuit clearing operation on the preset point without return

:CORR:SHOR ACK ---- performs a short-circuit clearing operation on the preset points.

Open circuit returns 1 for success and 0 for failure

◆ Description: Sets the short circuit correction switch status

Syntax:

:CORR:SHOR:STAT?

:CORR:SHOR:STAT< 0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:CORR:SHOR:STAT 0 ---- sets the short-circuit clearing status to OFF

:CORR:SHOR:STAT 1 ---- sets the short-circuit clearing status to ON

:CORR:SHOR:STAT? ---- returns short-circuit clearing switch status

7.2.17.3 LOAD Load Correction

◆ Description: Sets the load correction switch status

Syntax:

:CORR:LOAD:STAT?

:CORR:LOAD:STAT< 0|1|ON|OFF>

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:CORR:LOAD:STAT 0 ---- sets the load correction status to off

:CORR:LOAD:STAT 1 ---- sets the load correction status to on

:CORR:LOAD:STAT? ---- returns load correction switch status

7.2.17.4 TYPE Load Type

:LOAD:TYPE is used to set the measured combination parameters for instrument load calibration. The character? can be used to query the current combination parameter type, as follows:

◆ Description: Used to set the measured combination parameters for instrument load correction

Syntax:

:CURR:TYPE?

:CURR:TYPE <para>

Parameters:

para ---- indicates the name of the optional function parameter. Value:

Parameter Name	Parameter Meaning
LSRS	LS-RS
LSQ	LS-Q
CPD	CP-D

Example:

:CORR:LOAD:TYPR LSRS ---- sets the load type to LS-RS

:CORR:LOAD:TYPR LSQ ---- sets the load type to LS-Q

:CORR:LOAD:TYPR CPD ---- sets the load type to CP-D

:CORR:LOAD:TYPR? ---- returns the load type

7.2.17.5 LENGth Cable Length

◆ Description: Sets the calibration cable length of the instrument

Syntax:

:CORR:LENG?

:CORR:LENG< 0|1>

Parameters:

0|1 ----0 meter, 1 meter

Example:

:CORR:LENG 0 ---- sets the cable length to 0 meter

:CORR:LENG 1 ---- sets the cable length to 1 meter

:CORR:LENG? ---- returns the cable length

7.2.17.6 CLEar Clear User Calibration Data

◆ Description: Clear user calibration data

Syntax:

:corr:cle [pt]

Parameters:

[pt] ---- indicates that the parameter can be omitted, and pt takes a value in the range of 1~10, indicating the specified calibration point index

Example:

:CORR:CLE ---- clears all user calibration data

:CORR:CLE 1 ---- clears the correction data of the user correction 1st point

:CORR:CLE 2 ---- clears the correction data of the user correction 2nd point

:CORR:CLE 4 ---- clears the correction data of the user correction 4th point

:CORR:CLE 10 ---- clears the calibration data of the user correction 10th point

7.2.17.7 DATA Query User Data

◆ Description：Query user calibration zero data

Syntax:

:CORR[:USE]:DATA[n]?

Parameters:

n---- value 1 ~ 10, indicating the index of the nth point frequency clearing point

Example:

:CORR:DATA? ---- returns the open, short, and load correction values for all setpoints <open1 A>,<open1 B>,<short1 A>,<short1 B>,<load1 A>,<load1 B>,<open2 A&gt ;,<open2 B>,<short2 A>,<short2 B>,<load2 A>,<load2 B>,.....

:CORR:DATA1? ---- returns the calibration clear data for the first point: Point Index (1), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

:CORR:DATA2? ---- returns the calibration clear data for the first point: Point Index (2), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

:CORR:DATA3? ---- returns the calibration clear data for the first point: Point Index (3), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

:CORR:DATA10? ---- returns the calibration clear data for the first point: Point Index (10), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

◆ Description：Query the operation time of user correction

Syntax:

:CORR:DATE <LAST|OPEN|SHORT|DCR|DCROPEN|DCRSHORT>

:CORR:DATE<n> <OPEN|SHORT|LOAD>

Parameters:

DATE<n> ----n indicates the nth frequency point

LAST ---- indicates the time of the most recent clear operation

OPEN/SHORT/LOAD ---- indicates open circuit clearing/short circuit clearing/load correction, respectively

DCR/DCROPEN/DCRSHORT --- indicates DCR last/open/short correction, respectively

Example:

:CORR:DATE LAST ---- queries the time of the most recent clearing operation

:CORR:DATE OPEN ---- queries the time of full frequency open circuit clearing operation

:CORR:DATE SHORT ---- queries the time of full frequency short-circuit clearing operation

:CORR:DATE DCR ---- queries the time of the most recent DCR clearing operation

:CORR:DATE DCROPEN ---- queries the time of DCR open-circuit clearing operation

:CORR:DATE DCRSHORT ---- queries the time of DCR short-circuit clearing operation

:CORR:DATE1 LAST ---- queries the time of the most recent point frequency 1 clearing operation

:CORR:DATE2 OPEN ---- queries the time of the point frequency 2 open circuit clearing operation

:CORR:DATE3 SHORT ---- queries the time of the point frequency 3 short-circuit clearing operation

:CORR:DATE10 LOAD ---- queries the time of the point frequency 10 load correction operation

Note: The format of the returned data is "yyyy-MM-dd hh:mm:ss", and "----" indicates the date is invalid, i.e., no zeroing performed.

7.2.17.8 SPOT<n>Specific Frequency Point

- Description：Sets the switch status of specified frequency point

Syntax:

:CORR:SPOT<n>:STAT?

:CORR:SPOT<n>:STAT< 0|1|ON|OFF>

Parameters:

n ---- frequency point index subscript, value 1 ~ 10

0|OFF ---- OFF

1| ON ---- ON

Example:

:CORR:SPOT1:STAT 0 ---- sets frequency point 1 status off

:CORR:SPOT3:STAT 1 ---- sets frequency point 3 status on

:CORR:SPOT10:STAT? ---- returns frequency point 10 status switch

◆ Description: Used to specify the measurement frequency at a given frequency point

Syntax:

:CORR:SPOT<n>:FREQ?

:CORR:SPOT<n>:FREQ <float | MIN | MAX>

Parameters:

float ---- indicates the size of floating-point data

Example:

:CORR:SPOT1:FREQ 1200 ---- sets the frequency to 1200Hz

:CORR:SPOT2:FREQ 1100HZ ---- sets the frequency to 1100Hz

:CORR:SPOT3:FREQ 1.2K ---- sets the frequency to 1200Hz

:CORR:SPOT4:FREQ? ---- returns the frequency size of frequency point 4

◆ Description: Performs open-circuit calibration for specific frequency points of the instrument (frequency 1, frequency 2 .....)

Syntax:

:CORR:SPOT<n>:OPEN [ACK]

Parameters:

Example:

:CORR:SPOT1:OPEN ---- performs open circuit correction for frequency point 1

:CORR:SPOT2:OPEN ---- performs open circuit correction for frequency point 2

:CORR:SPOT10:OPEN ---- performs open circuit correction for frequency point 10, no return

:CORR:SPOT10:OPEN ACK ---- performs open-circuit correction for frequency point 10

Open circuit returns 1 for success, 0 for failure

◆ Description: Performs short-circuit correction for specific frequency points of the instrument (frequency 1, frequency 2 .....)

Syntax:

:CORR:SPOT<N>:SHOR [ACK]

Parameters:

Example:

:CORR:SPOT1:SHOR ---- performs short-circuit correction for frequency point 1

:CORR:SPOT2:SHOR ---- performs short-circuit correction for frequency point 2

:CORR:SPOT10:SHOR ---- performs short-circuit correction for frequency point 10, no return

:CORR:SPOT10:SHOR ACK ---- performs short-circuit correction for frequency point 10

Open circuit returns 1 for success, 0 for failure

◆ Description: Performs load calibration reference values for specific frequency points of the instrument (frequency 1, frequency 2 .....)

Syntax:

:CORR:SPOT<n>:LOAD:STAN?

:CORR:SPOT<n>:LOAD:STAN <refA,refB>

Parameters:

refA ---- floating-point size of refA

refB ---- floating-point size of refB

Example:

:CORR:SPOT1:LOAD:STAN 1.1,1.2 ---- load correction reference value for frequency point 1

:CORR:SPOT2:LOAD:STAN 1.1,1.2 ---- load correction reference value for frequency point 2

:CORR:SPOT10:LOAD:STAN? ---- returns load correction reference value for frequency point 10

◆ Description: Performs load calibration on specific frequency points of the instrument (frequency 1, frequency 2 .....)

Syntax:

:CORR:SPOT<n>:LOAD [ACK]

Parameters:

Example:

:CORR:SPOT1:LOAD ---- performs load correction for frequency point 1

:CORR:SPOT2:LOAD ---- performs load correction for frequency point 2

:CORR:SPOT10:LOAD ---- returns frequency point 10 to perform load correction, no return

:CORR:SPOT10:LOAD ACK ---- returns frequency point 10 to perform load correction

Open circuit returns 1 for success, 0 for failure

7.2.18 MassMEMory Command Set

The MassMEMory subsystem command set is used to save and load files.

7.2.18.1 LOAD Load

◆ Description: Used to load saved files

Syntax:

:MMEM:LOAD?

:MMEM:LOAD <file>

Parameters:

file ---- specifies the path to load the file, the relative complete file path or the index number of the internal fixed file, value 1 ~ 50

The index number corresponds to the file as follows:

Index Number	1 ~ 50
LCR digital bridge mode	LCR.sda/LCR2.sda in the internal files root directory ....

Example:

:MMEM:LOAD 1 ---- loads the file with path LCR.sta

:MMEM:LOAD 9 ---- loads the file with path LCR9.sta

:MMEM:LOAD sss.sta ---- loads the file with path files/sss.sta

:MMEM:LOAD files/sss.sta ---- loads the file with path files/sss.sta

:MMEM:LOAD usb/sss.sta ---- loads the file with path usb/sss.sta

:MMEM:LOAD? ---- returns the pathname of the file to be loaded

7.2.18.2 STORe Store

◆ Description: Used to save the current instrument settings to a file

Syntax:

:MMEM:STOR <n>[,file]

Parameters:

n ---- used to match the default file name for saving

file ---- specifies the name of the file to be saved

The index number corresponds to the default file as follows:

Index Number	1~50
LCR digital bridge mode	LCR.sda/LCR2.sda in the internal files root directory ....

Example:

:MMEM:STOR 1 ---- saves the file of LCR.sta (in LCR mode)
:MMEM:STOR 9 ---- saves the file of LCR9.sta (in LCR mode)
:MMEM:STOR5,sss.sta ---- saves the file with path sss.sta
:MMEM:STOR5,files/sss.sta ---- saves the file with path files/sss.sta
:MMEM:STOR5,usb/sss.sta ---- saves the file with path usb/sss.sta

7.2.19 SYSTem System Setup Command Set

The SYSTem subsystem command set is mainly used to set system-related parameter functions.

7.2.19.1 Bus Mode

◆ Description: Sets the command mode of the communication interface

Syntax:

:SYST:BUSMODE?
:SYST:BUSMODE <RS232| GPIB|LAN|USBTMC|USBCDC|RS485|AUTO>

Parameters:

AUTO ---- selects the communication interface automatically
Other ---- locks the communication interface to the command communication interface

Example:

:SYST:BUSMODE? ---- queries the current communication interface mode
:SYST:BUSMODE RS232 ---- sets the bus communication to the fixed RS232 interface
:SYST:BUSMODE GPIB ---- sets the bus communication to the fixed GPIB interface
:SYST:BUSMODE LAN ---- sets the bus communication to the fixed LAN interface
:SYST:BUSMODE USBTMC ---- sets the bus communication to the fixed USBTMC interface

:SYST:BUSMODE USBCDC ---- sets the bus communication to the fixed USBCDC interface

:SYST:BUSMODE RS485 ---- sets the bus communication to the fixed 485 interface

:SYST:BUSMODE AUTO ---- sets the bus communication to automatic interface mode

7.2.19.2 Beeper Sound

◆ Description: Sets the key beep mode

Syntax:

:SYST:BEEP?

:SYST:BEEP< OFF|ON|0|1 >

Parameters:

0|OFF ---- OFF

1| ON ---- ON

Example:

:SYST:BEEP? ---- queries the current key beep setting

:SYST:BEEP 0 ---- sets the key beep mode to OFF

:SYST:BEEP OFF ---- sets the key beep mode to OFF

:SYST:BEEP 1 ---- sets the key beep mode to ON

:SYST:BEEP ON ---- sets the key beep mode to ON

◆ Description: Sets the sorting pass beep mode

Syntax:

:SYST:BEEP:PASS?

:SYST:BEEP:PASS< OFF|TwoShort|LowLong|HighShort|HighLong>

Parameters:

OFF ---- OFF

The other options are: two short, low long, high short, high long

Example:

:SYST:BEEP:PASS? ---- queries the current pass beep settings

:SYST:BEEP:PASS OFF ---- sets pass mode to OFF

:SYST:BEEP:PASS TS ---- sets the pass mode to two short

:SYST:BEEP:PASS LL ---- sets the pass mode to low long

:SYST:BEEP:PASS HS ---- sets the pass mode to high short

:SYST:BEEP:PASS HL ---- sets the pass mode to high long

◆ Description: Sets the sorting fail beep mode

Syntax:

:SYST:BEEP:FAIL?

:SYST:BEEP:FAIL< OFF|TwoShort|LowLong|HighShort|HighLong>

Parameters:

OFF ---- OFF

The other options are: two short, low long, high short, high long

Example:

:SYST:BEEP:FAIL? ---- queries the current fail beep settings
:SYST:BEEP:FAIL OFF ---- sets the fail mode to off.
:SYST:BEEP:FAIL TS ---- sets the fail mode to two short.
:SYST:BEEP:FAIL LL ---- sets the fail mode to low long.
:SYST:BEEP:FAIL HS ---- sets the fail mode to high short.
:SYST:BEEP:FAIL HL ---- sets the fail mode to high long.

7.2.19.3 Time and Date

- Description: Sets system time and date

Syntax:

:SYST:DATETIME?
:SYST:DATETIME <year, month, day, hour, minute, second>

Parameters:

Year ---- range of values 2018 ~ 2999

Example:

:SYST:DATETIME? ---- queries current system time and date
:SYST:DATETIME 2021,11,08,12,35,56 ---- sets 2021-11-08 12:35:56

7.2.19.4 RS232 Configuration

- Description: Sets baud rate

Syntax:

:SYST:RS232:BAUD?
:SYST:RS232:BAUD< 4800|9600|19200|38400|57600|115200>

Parameters:

Example:

:SYST:RS232:BAUD? ---- queries RS232 baud rate
:SYST:RS232:BAUD 4800 ---- sets RS232 baud rate to 4800
:SYST:RS232:BAUD 9600 ---- sets RS232 baud rate to 9600
:SYST:RS232:BAUD 19200 ---- sets RS232 baud rate to 19200
:SYST:RS232:BAUD 38400 ---- sets RS232 baud rate to 38400
:SYST:RS232:BAUD 115200 ---- sets RS232 baud rate to 115200

- Description: Sets the instrument bus address

Syntax:

:SYST:RS232:ADDR?
:SYST:RS232:ADDR< 1~32>

Parameters:

Example:

:SYST:RS232:ADDR? ---- queries the instrument bus address
:SYST:RS232:ADDR 1 ---- sets the instrument bus address to 1
:SYST:RS232:ADDR 2 ---- sets the instrument bus address to 2

:SYST:RS232:ADDR 32 ---- sets the instrument bus address to 32

◆ Description: Sets the instrument communication command mode

Syntax:

:SYST:RS232:CMDMODE?

:SYST:RS232:CMDMODE< SCPI|MODBUS>

Parameters:

Example:

:SYST:RS232:CMDMODE? ---- queries instrument command mode

:SYST:RS232:CMDMODE SCPI ---- sets the instrument command mode to SCPI

:SYST:RS232:CMDMODE MODBUS ---- sets the command mode to MODBUS

7.2.19.5 LAN Configuration

◆ Description: Sets the LAN port number

Syntax:

:SYST:LAN:PORT?

:SYST:LAN:PORT<int>

Parameters:

int---- value range consult the network management, recommended 1 ~ 65536, the factory default value of 45454

Example:

:SYST:LAN:PORT? ---- queries the LAN port number

:SYST:LAN:PORT 45454 ---- sets the LAN port number

◆ Description: Sets the LAN port dhcp

Syntax:

:SYST:LAN:UDhcPc

Parameters:

Example:

:SYST:LAN:UDP? ---- sets the instrument to automatically acquire the network configuration once

◆ Description: Sets the LAN port IP address

Syntax:

:SYST:LAN:IPADdress?

:SYST:LAN:IPADdress <192.168.22.209>

Parameters:

Example:

:SYST:LAN:IPAD? ---- queries LAN port IP address

:SYST:LAN:IPAD 192.168.22.209 ---- sets the LAN port IP address

◆ Description: Sets the LAN port gateway address

Syntax:

:SYST:LAN:GATeway?

:SYST:LAN:GATeway <192.168.22.1>

Parameters:

Example:

:SYST:LAN:GAT? ---- queries LAN port gateway address

:SYST:LAN:GAT 192.168.22.1 ---- sets LAN port gateway address

◆ Description: Sets the LAN port gateway address

Syntax:

:SYST:LAN:GATeway?

:SYST:LAN:GATeway <192.168.22.1>

Parameters:

Example:

:SYST:LAN:GAT? ---- queries LAN port gateway address

:SYST:LAN:GAT 192.168.22.1 ---- sets the LAN port gateway address

◆ Description: Sets the LAN port subnet mask address

Syntax:

:SYST:LAN:SMASK?

:SYST:LAN:SMASK < 255.255.255.0>

Parameters:

Example:

:SYST:LAN:SMASK? ---- queries LAN port subnet mask address

:SYST:LAN:SMASK 255.255.255.0 ---- sets the LAN port subnet mask address

◆ Description：Sets the LAN port DNS address

Syntax:

:SYST:LAN:DNS?

:SYST:LAN:DNS < 255.23.12.0>,< 255.23.14.1>

Parameters:

The DNS addresses at both ends indicate the primary and secondary DNS addresses, respectively.

Example:

:SYST:LAN:DNS? ---- queries the LAN port DNS address

:SYST:LAN:DNS 255.23.12.0,255.23.14.1 ---- sets the LAN port DNS address

◆ Description：Queries LAN port MAC

Syntax:

:SYST:LAN:MAC?

Parameters:

Example:

:SYST:LAN:MAC? ---- queries LAN port MAC address

7.2.19.6 Upgrade Command

◆ Description: Commands control the instrument to perform upgrade operations

Syntax:

:SYST:UPDATE APP

Parameters:

Example:

:SYST:UPDATE APP ----Command control instrument to call the default file in the USB flash drive to upgrade

Note: In addition, we have software for upgrading the instrument with host computer control, which can be used to issue upgrade files directly from the host computer and perform the upgrade operation without a USB flash drive (convenient for customers as a second upgrade option). By default, the issued upgrade file is stored in the internal memory of the device, for example, update2848.sec. Since the size of the upgrade file may increase in the future, users can periodically delete this file.

7.3 Modbus Commands

7.3.1 Command Format

The command format is based on the internal version 2.0 standard, as described in more detail below:

7.3.1.1 Write Command

➢ Send Format:

Instrument Address	Function Code	Address High	Address Low	Register Number High	Register Number Low	Byte Count	Data Byte 1	...	Data Byte N	CRC Low	CRC High

➢ Return Format:

Instrument Address	Function Code	Address High	Address Low	Register Number	Register Number	CRC Low	CRC High

				High	Low		

a) Instrument Address

This refers to the local address of the instrument, which can be set in the bus address of the system settings interface of the instrument. The value range is: 1~31

b) Function Code: 0x10

This command can write one or more data, so its code is: 0x10

c) Address High and Address Low

This refers to the storage address of the data in the instrument. The address can be the actual storage address or a mapped address.

d) Register Number High and Register Number Low

Indicate the number of registers to be written in this operation. Each register is 2 bytes in size

e) Byte Count

Indicates the total number of bytes to be written in this operation

f) Data byte 1 ~ Data byte n

Indicates the data content to be written to the instrument.

g) CRC High and CRC Low

CRC 16-bit checksum, we use the look-up table method for CRC checksum

- Example: For details of the specific commands and the function setting relationships, see the appendix table ModeBus Command Function Comparison Table (Section 9.3.3).

Set the voltage range to range 2 (i.e. 300V). The storage address of the voltage range parameter in the instrument is 0x0003, and the instrument bus address is 8

Then the command is:

0x08	0x10	0x00	0x03	0x00	0x01	0x01	0x02	C5	FD

The third-to-last digit corresponds to the two-digit index value of the voltage, which is of type char and occupies one byte.

The return information is as follows:

0x08	0x10	0x00	0x03	0x00	0x01	0XF1	0x50

7.3.1.2 Read Command

- Send Format:

Instrument Address	Function Code	Address High	Address Low	Register Number High	Register Number Low	CRC Low	CRC High

Instrument Address	Function Code	Byte Count	Data Byte 1	.....	Data Byte n	CRC Low	CRC High

- Return Format:

The function code is: 0x03

- Example: For details of the specific commands and function setting relationships, see the appendix table ModeBus Command Function Comparison Table (Section 9.3.3).

To read the test value of the voltage in the current mode, the storage address is 0x00A0 and the instrument number is 8

Then send the command:

0x08	0x03	0x00	0xA0	0x00	0x02	0xC4	0xB0

The return information is:

0x08	0x03	0x04	Data Byte 1	.....	Data Byte 4	CRC Low	CRC High

7.3.2 CRC16 Calculation Method – Look-up Table Method

a) First define two 256-byte checksum tables

// CRC high byte value table

```
const BYTE chCRCHTalbe[] =                    // CRC high byte value table
 {
 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41.
```

```
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40.
0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41.
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40
};



// CRC low byte value table

const BYTE chCRCLTalbe[ ] =
{
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E.
0x0a, 0xca, 0xcb, 0x0b, 0xc9, 0x09, 0x08, 0xc8, 0xd8, 0x18, 0x19, 0xd9,
0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC.
0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38.
0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF.
0x2d, 0xed, 0xec, 0x2c, 0xe4, 0x24, 0x25, 0xe5, 0x27, 0xe7, 0xe6, 0x26.
0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1.
0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4.
0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB.
0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA.
0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5.
0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0.
0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97.
0x55, 0x95, 0x94, 0x54, 0x9c, 0x5c, 0x5d, 0x9d, 0x5f, 0x9f, 0x9e, 0x5e.
0x5a, 0x9a, 0x9b, 0x5b, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89.
0x4b, 0x8b, 0x8a, 0x4a, 0x4e, 0x8e, 0x8f, 0x4f, 0x8d, 0x4d, 0x4c, 0x8c.
```

```
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83.
0x41, 0x81, 0x80, 0x40
};
```

b) Then calculate

```
WORD CRC16(BYTE* pchMsg, WORD wDataLen)
{
    BYTE chCRCHi = 0xFF; // high CRC byte initialization
    BYTE chCRCLo = 0xFF; // low CRC byte initialization
    WORD wIndex; // CRC index in cycle

  while (wDataLen--)
    {
        // Calculate the CRC
        wIndex = chCRCLo ^ *pchMsg++ ;
        chCRCLo = chCRCHi ^ chCRCHTalbe[wIndex] ;
        chCRCHi = chCRCLTalbe[wIndex] ;
    }

   return ((chCRCHi << 8) | chCRCLo) ;)
}
```

7.3.3 Command Function Comparison Table

7.3.3.1 General Measurement Correlation

<table>
<tr><th>Instrument bus Address</th><th>Function Code</th><th>Command Address</th><th>Number of Data Bytes Number of Registers</th><th>Data Item</th><th>Data Content</th><th rowspan="2">Command Function Meaning</th></tr>
<tr><td>Instrument Address</td><td>Read/ Write</td><td>High + Low</td><td>High + Low</td><td>Data Item</td><td>Setting value corresponding to the address</td></tr>
<tr><td>1~31</td><td>R</td><td>0x0000</td><td></td><td></td><td></td><td>Query the instrument IDN and return the instrument model, e.g. “TH2840”</td></tr>
<tr><td></td><td>R/W</td><td>0x0001</td><td>0x0001~ 0x0004</td><td>1~4</td><td>0x01~0x</td><td>function with the following parameter values:
<table>
<tr><td>0</td><td>CP</td><td>6</td><td>Xs</td><td>12</td><td>Q</td></tr>
<tr><td>1</td><td>CS</td><td>7</td><td>Gp</td><td>13</td><td>dZ</td></tr>
<tr><td>2</td><td>LP</td><td>8</td><td>Bp</td><td>14</td><td>rZ</td></tr>
<tr><td>3</td><td>LS</td><td>9</td><td>Z</td><td>15</td><td>dY</td></tr>
<tr><td>4</td><td>RP</td><td>10</td><td>Y</td><td>16</td><td>rY</td></tr>
<tr><td>5</td><td>RS</td><td>11</td><td>D</td><td>17</td><td>RD</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x0002</td><td>0x0004</td><td>4</td><td>float</td><td>Frequency</td></tr>
<tr><td></td><td>R/W</td><td>0x0003</td><td>0x0001</td><td>1</td><td>0~3</td><td>Speed
<table>
<tr><td>0</td><td>FAST</td></tr>
<tr><td>1</td><td>MED</td></tr>
<tr><td>2</td><td>SLOW</td></tr>
<tr><td>3</td><td>SFAST</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x0004</td><td>0x0001</td><td>1</td><td>0~1</td><td>Trigger
<table>
<tr><td>0</td><td>CONT</td></tr>
<tr><td>1</td><td>SINGLE</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x0005</td><td>0x0001</td><td>1</td><td>0~1</td><td>Constant level
<table>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>ON</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x0006</td><td>0x0004</td><td>4</td><td>float</td><td>Trigger delay:0 ~ 60.000s</td></tr>
<tr><td></td><td>R/W</td><td>0x0007</td><td>0x0004</td><td>4</td><td>float</td><td>Step delay:0 ~ 60.000s</td></tr>
<tr><td></td><td>R/W</td><td>0x0008</td><td>0x0001</td><td>1</td><td>0~1</td><td>Voltage monitoring
<table>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>ON</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x0009</td><td>0x0001</td><td>1</td><td>0~1</td><td>Current monitoring
<table>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>ON</td></tr>
</table></td></tr>
<tr><td></td><td>R/W</td><td>0x000A</td><td>0x0005</td><td>5</td><td>float+char</td><td>AC level float+0/1(v/i)</td></tr>
<tr><td></td><td>R/W</td><td>0x000B</td><td>0x0001</td><td>1</td><td>0~14</td><td>AC range</td></tr>
</table>

						0 100k 5 2k 10 50 1 50k 6 1k 11 20 2 20k 7 500 12 10 3 10k 8 200 13 0.1 4 5k 9 100
	R/W	0x000C	0x0005	5	float+char	DC bias float+0/1(v/i)
		0x000D				xx
	R/W	0x000E	0x0001	1	1~256	Average
	R/W	0x000F	0x0001	1	0~1	BIAS polarity 0 Auto 1 Fixed
	R/W	0x0010	0x0001	1	0~14	DC range Parameter setting comparison table same as AC range
	R/W	0x0011	0x0004	4	float	DC level
		0x0012				xx
	R/W	0x0013	0x0001	1	0~1	DCI isolation 0 OFF 1 ON
	R/W	0x0014	0x0001	1	0~2	Deviation 1 0 OFF 1 ABS 2 PER
	R/W	0x0015	0x0001	1	0~2	Deviation 2 0 OFF 1 ABS 2 PER
	R/W	0x0016	0x0004	4	float	Reference 1
	R/W	0x0017	0x0004	4	float	Reference 2
	R/W	0x1000	0x0001	1	0~2	Deviation 3 0 OFF 1 ABS 2 PER
	R/W	0x1001	0x0001	1	0~2	Deviation 4 0 OFF 1 ABS 2 PER
	R/W	0x1002	0x0004	4	float	Reference 3
	R/W	0x1003	0x0004	4	float	Reference 4
	R/W	0x0019	4*n	4*n	float*n	Reference value, set 1 ~ 4 reference values n takes values from 1 to 4, i.e. you can set 1, 2, 3 or 4 reference values at the same time.

4)

- Multi-parameter batch read and write (relative to the measurement-related parameters above)

<table>
<tr><td>Function Code</td><td>Command Address</td><td>Number of Data Bytes Number of Registers</td><td>Data Item</td><td>Data Content</td><td colspan="10" rowspan="2">Command Function Meaning</td></tr>
<tr><td>Read/ Write</td><td>High + Low</td><td>High + Low</td><td>Data Item</td><td>Setting value corresponding to the address</td></tr>
<tr><td>R/W</td><td>0x1020</td><td>n</td><td>2n</td><td>...</td><td colspan="10">Batch read/write measurement-related parameter settings</td></tr>
<tr><td></td><td></td><td colspan="10">The n register (1~n) parameters correspond as follows:
<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Function 1</td><td>Function 2</td><td>Function 3</td><td>Function 4</td><td>Function 1 switch</td><td>Function 2 switch</td><td>Function 3 switch</td><td>Function 4 switch</td><td colspan="2">Frequency</td></tr>
<tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>AC level type</td><td colspan="2">AC voltage</td><td colspan="2">AC current</td><td colspan="2">DC level</td><td>Speed</td><td>Range auto switch</td><td>AC range</td></tr>
<tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
<tr><td>DC range</td><td>Trigger mode</td><td colspan="2">Trigger delay</td><td colspan="2">Step delay</td><td>Average number of times</td><td>Bias source</td><td>Bias output status</td><td>Bias polarity</td></tr>
<tr><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td><td>37</td><td>38</td><td>39</td><td></td></tr>
<tr><td>DC bias type</td><td colspan="2">DC bias voltage</td><td colspan="2">DC bias current</td><td>Deviation mode 1</td><td>Deviation mode 2</td><td>Deviation mode 3</td><td>Deviation mode 4</td><td></td></tr>
<tr><td>40-41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td></tr>
<tr><td>Reference 1</td><td colspan="2">Reference 2</td><td colspan="2">Reference 3</td><td colspan="2">Reference 4</td><td>Constant level switch</td><td>DCI isolation</td><td>Voltage monitoring switch</td></tr>
<tr><td>51</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Current monitoring switch</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
Remarks:</td></tr>
</table>

- One register corresponds to two bytes in length.
- For a detailed explanation of register parameters and value ranges, see the previous section of this chapter or the description of measurement setup parameters.
- The data length corresponding to the write operation must be twice the number of registers.
- The data length corresponding to the write operation must be twice the number of registers.

The number of registers that can be read or written can be set to any value from 1 to 45, and the instrument response always starts from 1, and cannot be read or written from the middle.

Function Code	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
R/W	0x1021	n	2n	...	Batch read/write measurement-related parameter settings

The n register (1~n) parameters correspond as follows:

1	2	3	4	5	6	7	8	9	10
Function 1	Function 2	Function 3	Function 4	Function 1 switch	Function 2 switch	Function 3 Switch	Function 4 Switch	AC level type	Speed
11	12	13	14	15	16	17	18	19	20
Range auto switch	AC range	DC range	Trigger mode	Average number of times	Bias source	Bias output status	Bias polarity	DC bias type	Deviation mode 1
21	22	23	24	25	26	27			
Deviation mode 2	Deviation mode 3	Deviation mode 4	Constant level switch	DCI isolation	Voltage monitoring switch	Current monitoring switch			
28	29	30	31	32	33	34	35	36	37
Frequency		AC voltage		AC current		DC level		Trigger delay	
38	39	40	41	42	43	44	45	46	47
Step delay		DC bias voltage		DC bias current		Reference 1		Reference 2	
48	49	50	51						
Reference 3		Reference 4							

		Remarks: ● One register corresponds to two bytes in length. ● For a detailed explanation of register parameters and value ranges, see the previous section of this chapter or the description of measurement setup parameters. ● The data length corresponding to the write operation must be twice the number of registers. ● The data length corresponding to the write operation must be twice the number of registers. The number of registers that can be read or written can be set to any value from 1 to 45, and the instrument response always starts from 1, and cannot be read or written from the middle.

7.3.3.2 Comparison Settings Related

Instrument Bus Address	**Function Code**	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Instrument Address	Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
	R/W	0x001A	0x0001	1	0~1	Comparison mode 0 TOL 1 SEQ
		0x001B				xx
	R/W	0x001C	0x0001	1	0~1	Comparison switch 0 OFF 1 ON
	R/W	0x001D	0x0004	4	float	Bin 1 lower limit
	R/W	0x001E	0x0004	4	float	Bin 1 upper limit
	R/W	0x001F	0x0004	4	float	Bin 2 lower limit
	R/W	0x0020	0x0004	4	float	Bin 2 upper limit
	R/W	0x0021	0x0004	4	float	Bin 3 lower limit
	R/W	0x0022	0x0004	4	float	Bin 3 upper limit
	R/W	0x0023	0x0004	4	float	Bin 4 lower limit
	R/W	0x0024	0x0004	4	float	Bin 4 upper limit
	R/W	0x0025	0x0004	4	float	Bin 5 lower limit
	R/W	0x0026	0x0004	4	float	Bin 5 upper limit
	R/W	0x0027	0x0004	4	float	Bin 6 lower limit
	R/W	0x0028	0x0004	4	float	Bin 6 upper limit
	R/W	0x0029	0x0004	4	float	Bin 7 lower limit
	R/W	0x002A	0x0004	4	float	Bin 7 upper limit

	R/W	0x002B	0x0004	4	float	Bin 8 lower limit
	R/W	0x002C	0x0004	4	float	Bin 8 upper limit
	R/W	0x002D	0x0004	4	float	Bin 9 lower limit
	R/W	0x002E	0x0004	4	float	Bin 9 upper limit
	R/W	0x002F	0x0004	4	float	Bin 10 lower limit
	R/W	0x0030	0x0004	4	float	Bin 10 upper limit
	R/W	0x1004	0x0006	6	char+ char+ float	Bin 1 ~ 10 lower limits Byte meaning: bin index 0 ~ 9 abcd index 0 ~ 3 float is the size of the value
	R/W	0x1005	0x0006	6		Gear 1~10 upper limit Byte meaning: bin index 0~9 abcd index 0~3 Float is the size of the value

7.3.3.3 List Settings Related

Function Code	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
R/W	0x0050	0x0001	1	1~201	List scanning points
R/W	0x0051	0x0001	1	0~1	List scanning method 0 SEQ 1 STEP
R/W	0x0052				
R/W	0x0053	0x0001	1	0~200	Index position of scanning points in current settings
R/W	0x0054				
R/W	0x0055	0x0004	4	float	Frequency of list scanning points
R/W	0x0056	0x0005	5	float+char	AC level of list scanning points +0/1(v/i)
R/W	0x0057				
R/W	0x0058	0x0005	5	float+char	DC bias of list scanning points +0/1(v/i)
R/W	0x005A	0x0001~ 0x0004	1~4	0~	Function, the parameter comparison table is as follows: 0 CP 6 X 12 Q 1 CS 7 G 13 dZ 2 LP 8 B 14 rZ 3 LS 9 Z 15 dY 4 RP 10 Y 16 rY 5 RS 11 D 17 RD
R/W	0x005C	0x0004	4	float	Step delay of list scanning points

<table>
<tr><td>R/W</td><td>0x1006</td><td>0x0006</td><td>6</td><td rowspan="2">char+
char+
float</td><td>Lower limit of the list scanning points
Byte meaning: point index 0 ~ 200
abcd index 0 ~ 3
float is the size of the value</td></tr>
<tr><td>R/W</td><td>0x1007</td><td>0x0006</td><td>6</td><td>Upper limit of list scanning points
Byte meaning: point index 0 ~ 200
abcd index 0 ~ 3
float is the size of the value</td></tr>
<tr><td>R</td><td>0x100B</td><td>9*n</td><td></td><td></td><td>Read list of all test results
The number of registers read is n times the number 9 (i.e. n points)
The data for a single point is composed as follows:<table><tr><td>2Reg</td><td>2Reg</td><td>2Reg</td><td>2Reg</td><td>1Reg</td></tr><tr><td>P1</td><td>P2</td><td>P3</td><td>P4</td><td>cmp</td></tr></table></td></tr>
<tr><td>R</td><td>0x100C
0x100D
0x100E
0x100F</td><td>2*n</td><td></td><td></td><td>Read the list of specified parameters 1/2/3/4 test results
The number of registers read is n times the number 9 (i.e. n points)
The data for a single point is composed as follows:<table><tr><td>2Reg</td></tr><tr><td>Pn</td></tr></table></td></tr>
<tr><td>R</td><td>0x1010</td><td>n</td><td></td><td></td><td>Read list comparison results
The number of registers read is n (i.e., n points)
The data for a single point is composed as follows: cmp takes values 0/1/2/...
0 - not compared, 1 ---- pass, others ---- fail<table><tr><td>1Reg</td></tr><tr><td>cmp</td></tr></table></td></tr>
<tr><td rowspan="2">R/W</td><td rowspan="2">0x1011</td><td>4</td><td>8</td><td>short(0~ 3)</td><td>Setting the data magnitude returned by the four-parameters of the list
The 4 words correspond to the four-parameter reported magnitude settings respectively.
Value: 0---- default absolute data size.
1 ---- data x 10^3 reported after.
2---- data x 10^6 reported after.</td></tr>
<tr><td colspan="5">Example:
Write 08 10 10 11 00 04 08 00 00 00 00 00 00 00 00 00 00 7D D0 ---- Sets all four parametric levels to 0
Write 08 10 10 11 00 04 08 00 01 00 01 00 01 00 01 C0 D0 ---- Sets all four parametric levels to 1
Write 08 10 10 11 00 04 08 00 02 00 02 00 02 00 02 07 D1 ---- Sets all four parameter levels to 2</td></tr>
<tr><td>R/W</td><td>0x3000</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Frequency of batch read/write list scanning points
(Write registers start at point pt; read registers start at point 0)
The first register u16 indicates the starting index pt and takes the value 0 ~ 200.
The data of the write register is composed as follows:</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>1Reg</td><td>2Reg</td><td>2Reg</td><td>...</td><td>2Reg</td></tr>
<tr><td>Starting point pt</td><td>f[pt]</td><td>f[pt+1]</td><td>...</td><td>f[pt+n-1]</td></tr>
</table>
The data of the read register is composed as follows:
<table>
<tr><td>2Reg</td><td>2Reg</td><td>...</td><td>2Reg</td></tr>
<tr><td>f[0]</td><td>f[1]</td><td>...</td><td>f[n-1]</td></tr>
</table>
</td></tr>
<tr><td>R/W</td><td>0x3001</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Level voltage of batch read/write list scanning points
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x3002</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Level current of batch read/write list scanning points
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x3003</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Bias voltage of batch read/write list scanning points
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x3004</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Bias current of batch read/write list scanning point
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x3005</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Step delay of batch read/write list scanning points
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x3006
0x3007
0x3008
0x3009</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Upper limit of batch read/write list scanning points
The address corresponds to the four-parameter relationship as follows:
<table>
<tr><td>0x3006</td><td>0x3007</td><td>0x3008</td><td>0x3009</td></tr>
<tr><td>Parameter 1 (A)</td><td>Parameter 2 (B)</td><td>Parameter 3 (C)</td><td>Parameter 4 (D)</td></tr>
</table>
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x300A
0x300B
0x300C
0x300D</td><td>W(1+2n)
R(2n)</td><td>W(1+2n)
R(2n)</td><td>W(u16)+
n float</td><td>Lower limit of batch read/write list scanning points
The address corresponds to the four-parameter relationship as follows:
<table>
<tr><td>0x300A</td><td>0x300B</td><td>0x300C</td><td>0x300D</td></tr>
<tr><td>Parameter 1 (A)</td><td>Parameter 2 (B)</td><td>Parameter 3 (C)</td><td>Parameter 4 (D)</td></tr>
</table>
Read/write description same as address 0x3000 frequency description</td></tr>
<tr><td>R/W</td><td>0x300E
0x300F
0x3010
0x3011</td><td>W(1+n)
R(n)</td><td>W(1+n)
R(n)</td><td>W(u16)+
n u16</td><td>Functions of batch read/write list scanning points
The address corresponds to the four-parameter relationship as follows:
<table>
<tr><td>0x300E</td><td>0x300F</td><td>0x3010</td><td>0x3011</td></tr>
<tr><td>Parame</td><td>Parame</td><td>Parame</td><td>Parame</td></tr>
</table></td></tr>
</table>

					ter 1 (A) | ter 2 (B) | ter 3 (C) | ter 4 (D) (Write registers start at point pt; read registers start at point 0) The first register u16 indicates the starting point index pt and takes values 0 ~ 200. The data of the write register is composed as follows: 1Reg | 1Reg | 1Reg | ... | 1Reg Starting point pt | func[pt] | func[pt+1] | ... | func[pt+n-1] The data of the read register is composed as follows: 2Reg | 2Reg | ... | 2Reg func[0] | func[1] | ... | func[n-1] Function, parameter comparison table below func: 0 CP 6 X 12 Q 1 CS 7 G 13 dZ 2 LP 8 B 14 rZ 3 LS 9 Z 15 dY 4 RP 10 Y 16 rY 5 RS 11 D 17 RD Function data are in hexadecimal

7.3.3.4 Trace Settings Related

Instrument Bus Address	**Function Code**	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Instrument Address	Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
	R/W	0x0090	0x0001	1	0~1	LCR trace ---- Scale 0 AUTO 1 HOLD
	R/W	0x0092	0x0001	1	0~1	LCR trace ---- Coordinates 0 Linear 1 Log
	R/W	0x0094	0x0001	1	0~1	LCR trace ---- Trace mode 0 SEQ 1 STEP
	R/W	0x0096	0x0001	1	0~4	LCR trace ---- Points

						0 51 1 101 2 201 3 401 4 801
	R/W	0x0097	0x0001	1	0~1	LCR trace ---- Limit 0 OFF 1 ON
	R/W	0x0098	0x0001	1	float	LCR trace ---- start size
	R/W	0x0099	0x0001	1	float	LCR trace ---- end size

7.3.3.5 User Clear Related

Instrument Bus Address	**Function Code**	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Instrument Address	Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
	R/W	0x0031	0x0001	1	0~3	Open circuit function 0 OFF 1 ON 2 Full Frequency Open Circuit Clear 3 DCR Clear
	R/W	0x0032	0x0001	1	0~3	Short circuit function 0 OFF 1 ON 2 Full Frequency Short Circuit Clearing 3 DCR Clear
	R/W	0x0033	0x0001	1	0~1	Load function
	R/W	0x0034	0x0001	1	0~1	Cable length
	R/W	0x0035				
	R/W	0x0036	0x0001	1	0~9	Calibration point
	R/W	0x0037	0x0004	4	float	Frequency setting
	R/W	0x0038	0x0001	1	0~4	Frequency point switch 0 OFF 1 ON 2 Single-frequency

						<table><tr><td></td><td>open circuit clear</td></tr><tr><td>3</td><td>Single-frequency short circuit clear</td></tr><tr><td>4</td><td>Single-frequency load</td></tr></table>
	R/W	0x0039	0x0004	4	float	Reference A for calibration points
	R/W	0x003A	0x0004	4	float	Reference B for calibration points

7.3.3.6 System Settings Related

Instrument Bus Address	**Function Code**	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Instrument Address	Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
	W	0x0040	0x0001	1	1	Initiate test (Trigger key function)
	W	0x0041	0x0001	1	1	Stop test (Reset key function)
	R	0x0042				Read results
	R/W	0x0043	0x0001	1	char (computing)	Page switch, the char parameter value range is as follows:<table><tr><td>0</td><td>Measurement</td><td>1</td><td>List</td></tr><tr><td>2</td><td>Trace</td><td>3</td><td>Measurement settings</td></tr><tr><td>4</td><td>Limit settings</td><td>5</td><td>List settings</td></tr><tr><td>6</td><td>Trace settings</td><td>7</td><td>System settings</td></tr><tr><td>8</td><td>File management</td><td>9</td><td>User zeroing</td></tr><tr><td>10</td><td>Handler</td><td></td><td></td></tr></table>
	R/W	0x0045	0x0001	1	0~1	Key signal<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr></table>
	R/W	0x0046	0x0001	1	0~4	Pass signal<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>Two Shorts</td></tr><tr><td>2</td><td>Two Long</td></tr><tr><td>3</td><td>High and Short</td></tr><tr><td>4</td><td>High and Long</td></tr></table>
	R/W	0x0047	0x0001	1	0~4	Fail signal

						0 OFF 1 Two Shorts 2 Two Long 3 High and Short 4 High and Long
	R/W	0x0048	0x0001	1	0~1	Display language 0 English 1 Chinese
	R/W	0x004E	0x0001	1	0~2	Bias source 0 100mA 2 External TH1778

7.3.3.7 File Related

Instrument Bus Address	**Function Code**	**Command Address**	**Number of Data Bytes Number of Registers**	**Data Item**	**Data Content**	Command Function Meaning
Instrument Address	Read/ Write	High + Low	High + Low	Data Item	Setting value corresponding to the address	
Test Data Save Switch						
	W	0x1008	0x0001	1	char(0~1)	Test result of USB flash drive save switch settings 0 OFF 1 ON
	W	0x1009	0x0001	1	char(0~1)	List results of USB flash drive save switch settings 0 OFF 1 ON
	W	0x100A	0x0001	1	char(0~1)	Trace results of USB flash drive save switch settings 0 OFF 1 ON
Configuration File Loading Recalls						
	R/W	0x2005	0x0001	2	char(0~50)	Load the specified file in the internal files directory Value range of n: 0 ~ 50 Specify files in the files root directory in the following format: LCR bridge: lcr1.sta, lcr2.sta. LCR3.sta, **LCRn.sta** **Read this register** is indicated to query

						whether there is an internal file is loaded, if so, return the data in the presence of the corresponding size of n (2 bytes length). If there is no internal file is loaded, then no n return, and return: 08 **03 00** F0 F2
	W	0x2006	0x0001	2	char(0~50)	Load the specified file in the usb directory of the flash drive Value range of n: 0 ~ 50 Specify the file in the usb root directory in the same format as above.

Chapter 8 Handler Interface Usage Notes

The TH2848 series testers provide users with a Handler interface, which is mainly used for the output of sorting results. When the instrument is used in an automatic component sorting test system, the interface provides the contact signal with the system and the sorting result output signal. The sorting result output corresponds to the 10-speed output of the comparator. The Handler interface is designed to be flexible, and all output signal states are defined according to the requirements of the application using different operating programs.

8.1 Technical Description

Table 1 shows the technical description of the HANDLER interface for this series.

Output signal: low active, open collector output, opto-isolated Output Discriminant Signal: Bin Comparison Function: pass bin number, overdifferential bin, and failed status List Scan Comparison Function: IN/OUT of each scanning point and pass/fail of the whole comparison result INDEX: End of AD conversion EOC: End of one measurement and comparison Alarm: Instantaneous power-down detection notification Input Signal: Optical isolation Keylock: front panel keypad lock External Trigger: pulse width ≥ 1μS

Table 1 Technical Description

8.2 Operating Instructions

8.2.1 Introduction

This chapter provides information including: the use of Handler interface signal lines and the necessary description of electrical characteristics.

8.2.2 Signal Line Definition

The HANDLER interface uses three types of signals: comparison output, control input and control output. The signal lines for the file comparison function and the list scan comparison function are defined as different comparison output signals and control input signals, respectively. The following are the signal definitions of the

HANDLER interface when using the file compare function or the list scan compare function.

Comparison Function Signal Lines

The comparison function signals are defined as follows:

- Comparion output signals:

/BIN1 - /BIN9 , /AUX , /OUT , /PHI (main parameter high), /PLO (main parameter low), /SREJ (sub-parameter fail). See Figure 1.

- Control output signals:

/INDEX (analog measurement completion signal), /EOM (end-of-measurement and comparison data valid signal), /ALARM (instrument power-down signal).

- Control input signals:

/EXT.TRIG (external trigger signal) and /Keylock (keyboard lock).

The signal assignments and brief descriptions of the above contacts are shown in Table 2 and Figure 2, and the timing diagram is shown in Figure 3.

Table 2 Signal Assignments for the Contact of the Bin Comparison Function:

Pin Number	Signal Name	Description
1 2 3 4 5 6 7 8 9 10 11	/BIN1 /BIN2 /BIN3 /BIN4 /BIN5 /BIN6 /BIN7 /BIN8 /BIN9 /OUT /AUX	Sorting bin results All /BIN (stall signal) outputs are open collector outputs.
12 13	/EXT.TRIG	External trigger: When the trigger mode is set to EXT.TRIG (external trigger), the instrument is triggered by a rising-edge pulse signal applied to this pin.
14 15	EXT.DCV2	External DC voltage 2: DC power supply pin for signals optically

		coupled within the instrument (/EXT_TRIG, /KeyLock; /ALARM, /INDEX, /EOM).
16 17 18	+5V	Internal instrument power supply +5V: It is generally not recommended for users to use the internal power supply of the instrument. If it must be used, please ensure that the current used is less than 0.3A and keep the signal line away from interference sources.
19	/PHI	Main parameters high: The measurement result is greater than the upper limit value in BIN1 to BIN9. (See Figure 1)
20	/PLO	Main parameters low: The measurement result is less than the lower limit value in BIN1 to BIN9. (See Figure 1)
21	/SREJ	Sub-parameters fail: The measurement result is out of the range of the high and low limits of the sub-parameter. (See Figure 1)
22 23 24	NC NC NC	Not connected
25	/KEY LOCK	When this line is active, all front panel function keys of the instrument are locked and no longer function.
27 28	EXT.DCV1	External DC voltage 1: Pull-up DC power supply pin for signals opto-coupled within the instrument (/BIN-/BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ).
29	/ALARM	/ALARM is active when a power failure occurs.
30	/INDEX	The /INDEX signal is valid when the analog measurement is complete, and the instrument is ready to connect the next device under test (DUT) at the UNKNOWN test terminal. However, the comparison result signal is not valid until /EOM is valid. (See Figure 3)
31	/EOM	End of measurement (End of

		Measurement): This signal is valid when the measurement data and comparison results are valid. (See Figure 3)
32,33	COM2	Reference ground for external power supply EXTV2
34,35,36	COM1	Reference ground for external power supply EXTV1

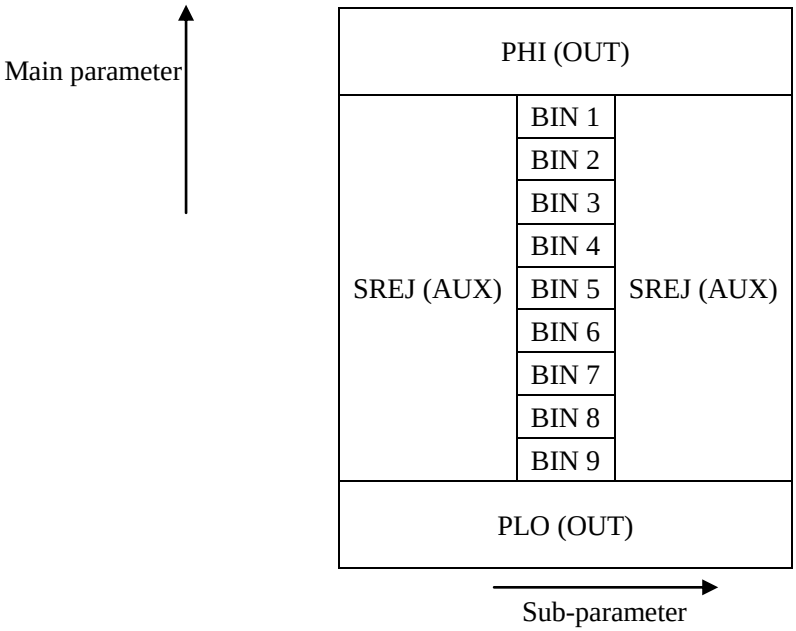


Figure 1: Example of the Signal Assignment Area for the File Comparison Function/PHI,/PLO,/SREJ

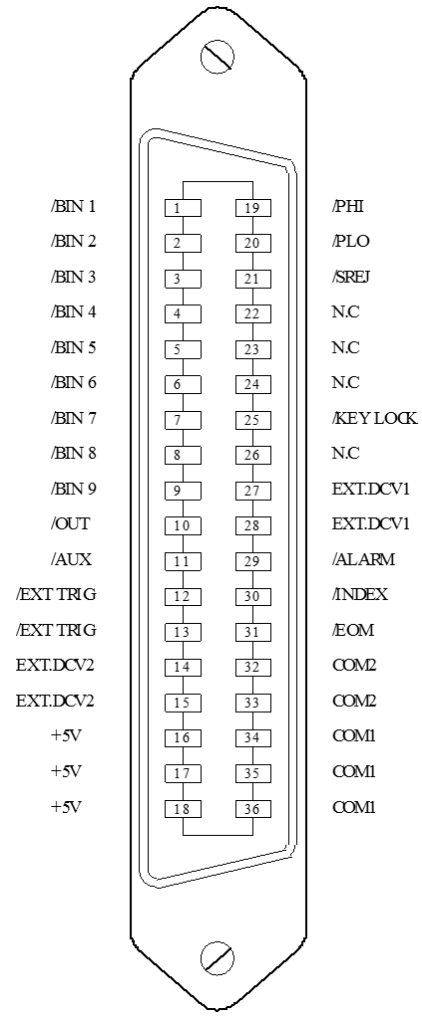
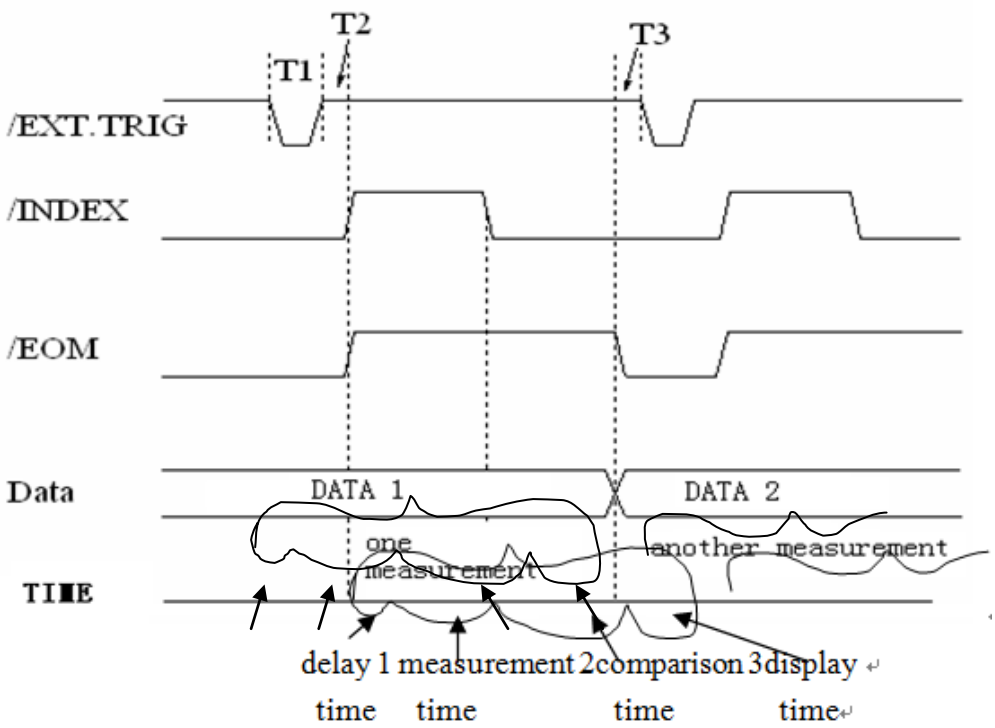


Figure 2 HANDLER Connection Interface Pin Definitions

Note: In the figure, the signal conditions of /BIN1 - /BIN9, /OUT, /AUX, /PHI, /PLO and /SREJ are different in the list scanning comparison function and the bin comparison function.



Time	Minimum	Maximum
T1 Trigger pulse width	1us	---
T2 Measurement start delay time	200us	Display time[3] + 200us
T3 Trigger after /EOM output Waiting time	0us	---

1. The measurement time refers to the operating instructions of this instrument.
2. The typical comparison time is about 1ms.
3. The typical display time of each display page is as follows:
   Component measurement display page (MEAS DISPLAY): Approx. 8ms
   BIN NO. DISPLAY: Approx. 5ms
   BIN COUNT DISPLAY: Approx. 0.5ms

List Sweep Comparison Function Signal Lines

The list scan comparison function signal definition is different from the definition in the bin comparison function. The definition is as follows:

- Comparison output signals:

/BIN1 - /BIN9 and /OUT signal indicate the IN/OUT (pass or fail) judgment for each scan point. See Figure 4. The /AUX signal indicates the PASS/FAIL judgment (one or more failures in the list during a sweep)

These signals are output when a scan measurement is complete.

- Control output signals

/INDEX (analog measurement completion signal) and /EOM (End of measurement signal).

The timing when /INDEX and /EOM are active is as follows (different in the bin comparison function):

- Continuous sweep mode (SEQ sweep mode):

The /INDEX signal is asserted when the analog measurement is complete at the last sweep point. The /EOM signal is asserted when all comparison results are valid after the entire list sweep measurement is complete.

- Step sweep mode (STEP sweep mode):

The /INDEX signal is asserted when the analog measurement at each sweep point is complete. The /EOM signal is asserted when each measurement and comparison is complete.

The signal contact assignments and brief descriptions for the list sweep function can be found in Table 3 and Figure 2 (the pin definitions for the list sweep comparison function are the same as those for the bin comparison function). The timing diagram is shown in Figure 5.

Table 3 List Sweep Comparison Function Contact Assignment Table

pin number	signal name	Description
1	/BIN1	Scan point 1 is out of limits
2	/BIN2	Scan point 2 is out of limits
3	/BIN3	Scan point 3 is out of limits
4	/BIN4	Scan point 4 is out of limits
5	/BIN5	Scan point 5 is out of limits
6	/BIN6	Scan point 6 is out of limits
7	/BIN7	Scan point 7 is out of limits
8	/BIN8	Scan point 8 is out of limits
9	/BIN9	Scan point 9 is out of limits
10	/OUT	Scan point 10 is out of limits
11	/AUX	/AUX is asserted when there is one or more failures in the list
30	/INDEX	Sequential Sweep Mode (SEQ): The /INDEX signal is asserted at the end of the analog measurement at the last step, and the UNKNOWN test point of the instrument can be connected to the next device under test (DUT). However, the comparison result signal is valid only until /EOM is asserted. (See Figure 5) Step Sweep Mode (STEP): The /INDEX signal is asserted after the analog measurement at

		each scan point has been completed. However, the comparison result signals are only valid until /EOM is asserted. (See Figure 5)
31	/EOM	End of measurement: Sequential Sweep Mode (SEQ): The /EOM signal is asserted after the entire list scan measurement has been completed and all comparison results are valid. (See Figure 5) Step SWEEP mode (STEP): The /EOM signal is declared valid after each scan point has been measured and all comparison results are valid. The comparison result signal is not valid until the /EOM of the last scan point is valid (see Figure 5).
(sth. or sb) else		The definitions are the same as the comparison function. See Table 2

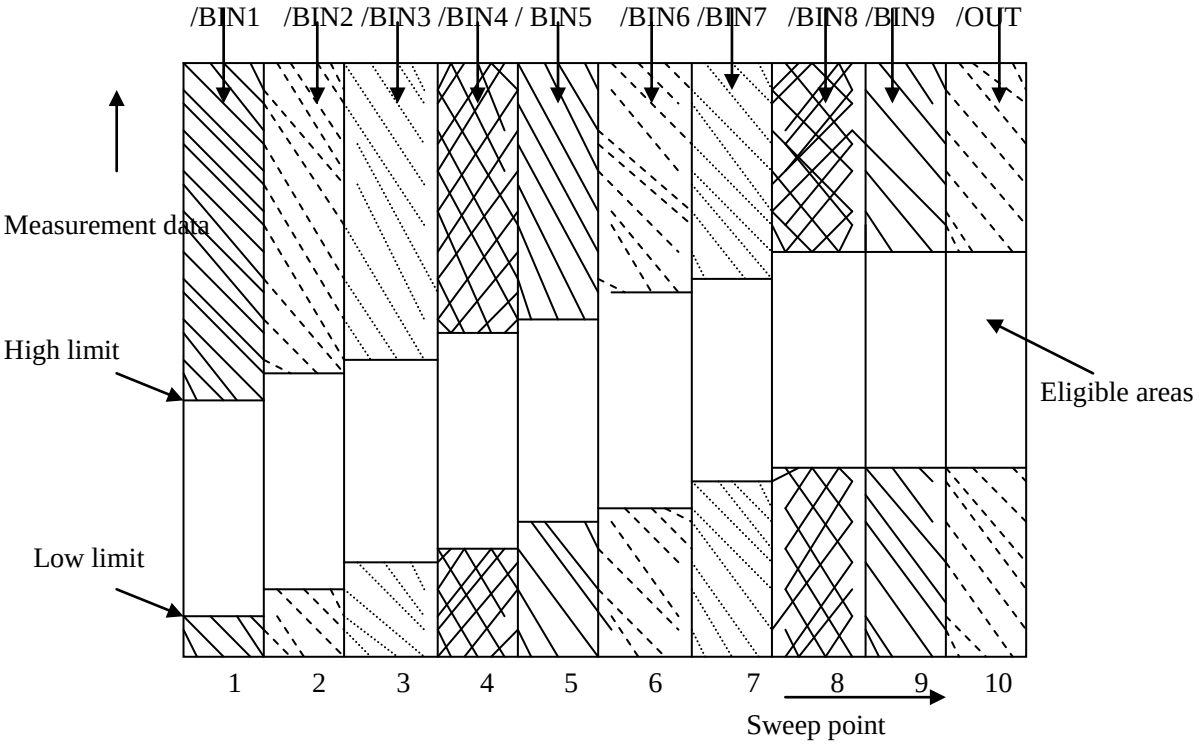
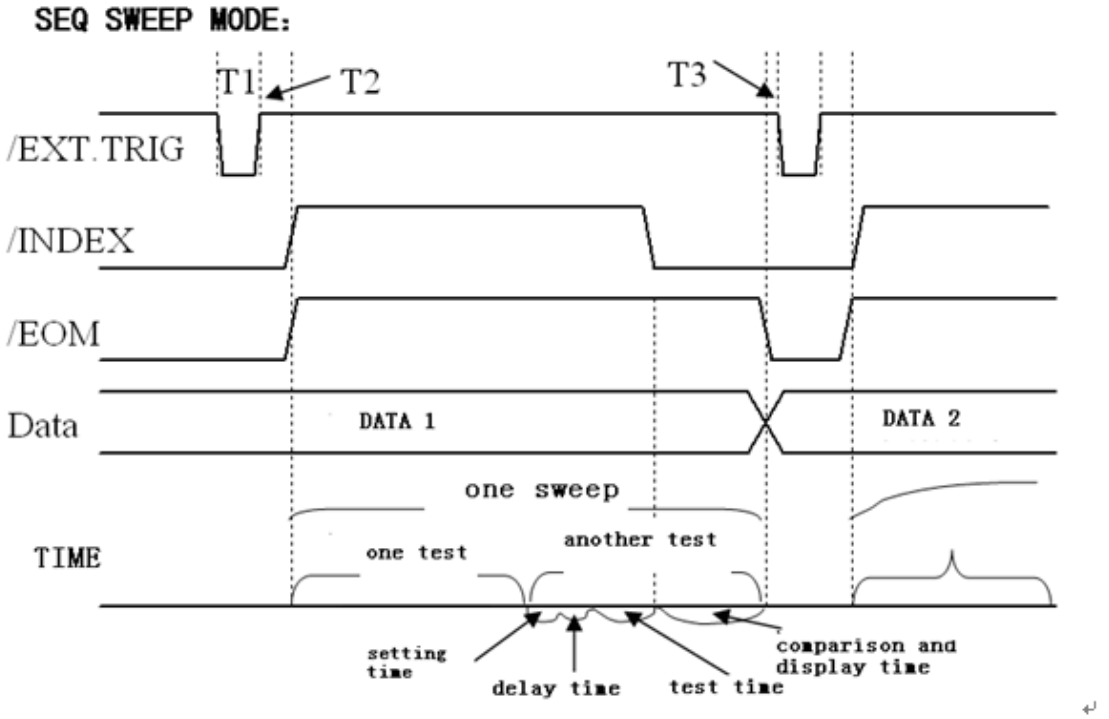
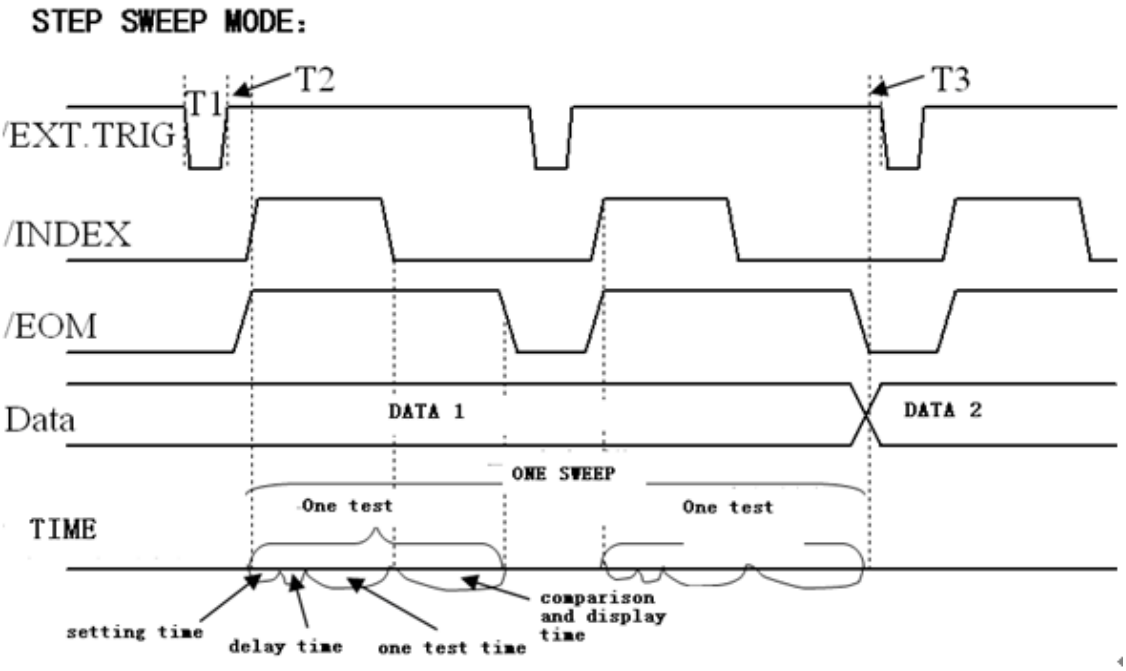


Fig. 4 Example of Signal Area for List Scan Comparison Function





Attention:

The setting time includes the switch time for correcting the data.

The comparison and display time is about 4.5ms; T1, T2, T3 see Figure 3.

8.2.3 Electrical Characteristics

As mentioned earlier, the meaning of some signals differs between the comparison function and the list scan comparison function. However, the electrical characteristics of these signals are the same in both operations, so the following description also applies to the bin comparison function and the list scan function.

DC isolated outputs each DC output (pins 1 to 16) is output isolated via an open collector optocoupler. The output voltage of each line is set by a pull-up resistor on the HANDLER interface board. The pull-up resistor is connected to the internal supply voltage (+5V) or to an external supply voltage (EXTV: +5V) via a jumper.

The electrical characteristics of the DC isolated outputs are divided into two types, as shown in Table 4.

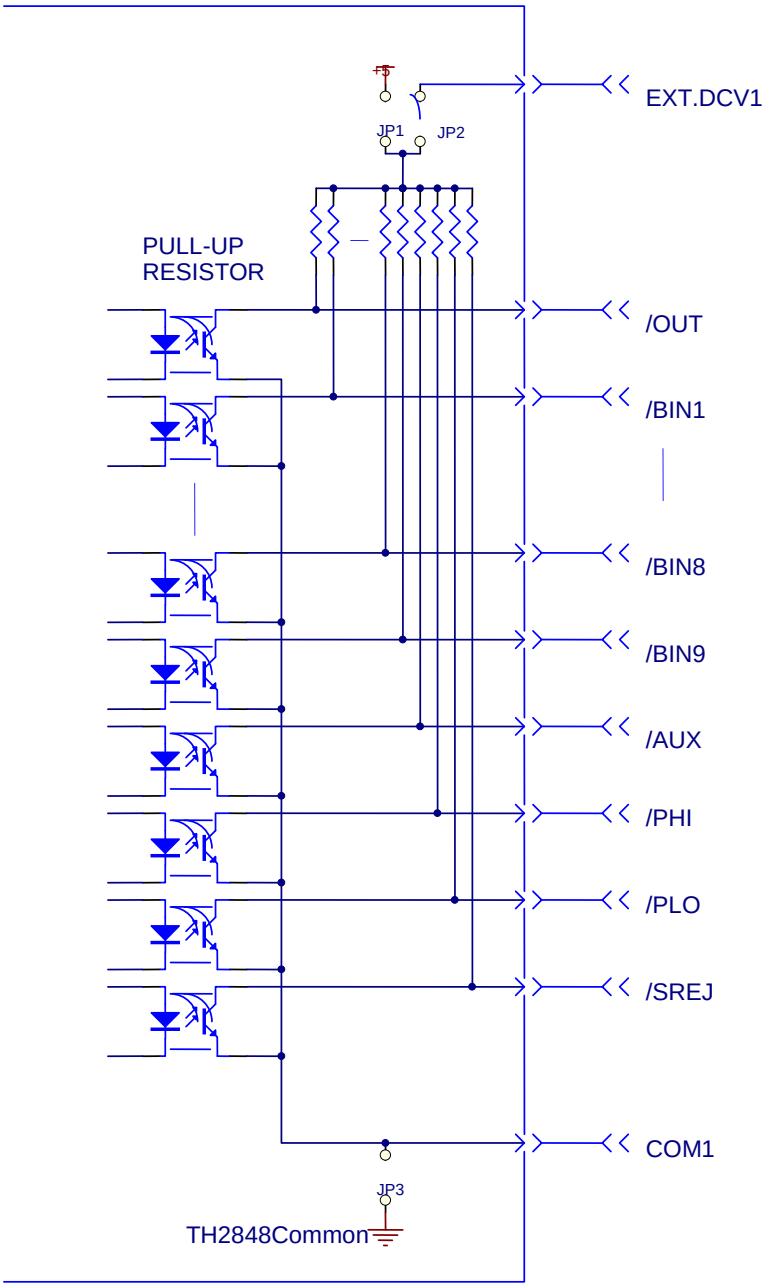
Table 4 Electrical Characteristics of DC Isolated Outputs

Output Signal	Output Rated Voltage		Maximum Current	Circuit Reference Ground
	LOW	HIGH		
Comparison Signal /BIN1 - /BIN9 /AUX /OUT /PHI /PLO	≤0.5V	+5V~ +24V	6mA	Internal pull-up voltage: Measuring instrument ground External voltage (EXTV1): COM1
Control Signal /INDEX /EOM /ALARM	≤0.5V	+5V~ +24V	5mA	Internal pull-up voltage: Measuring instrument ground External voltage (EXTV2): COM2

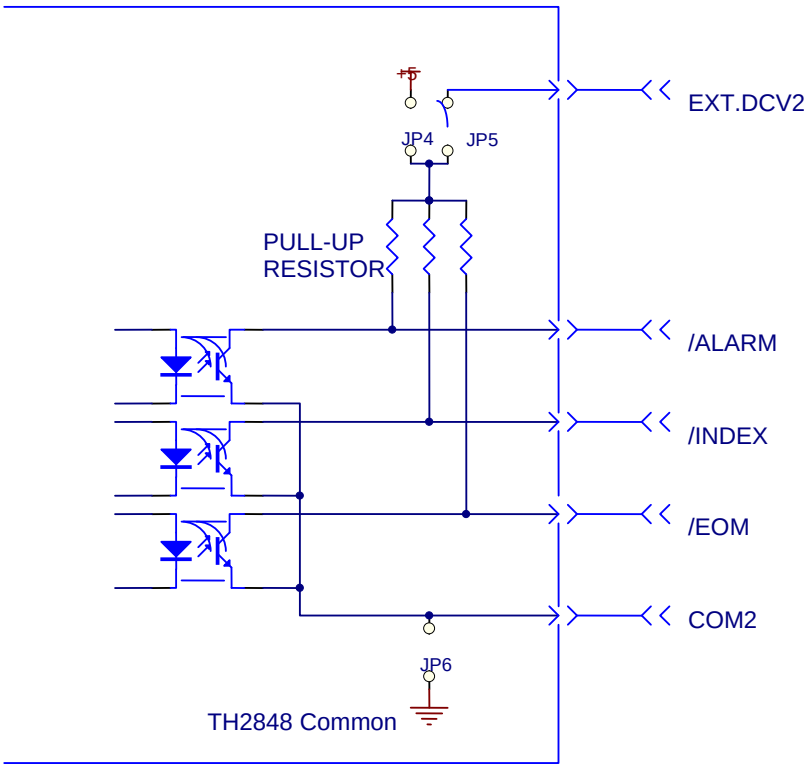
Simplified diagrams of the output signals can be found in the figures (comparator signals) and (control signals).

8.2.4 HANDLER Interface Board Circuits

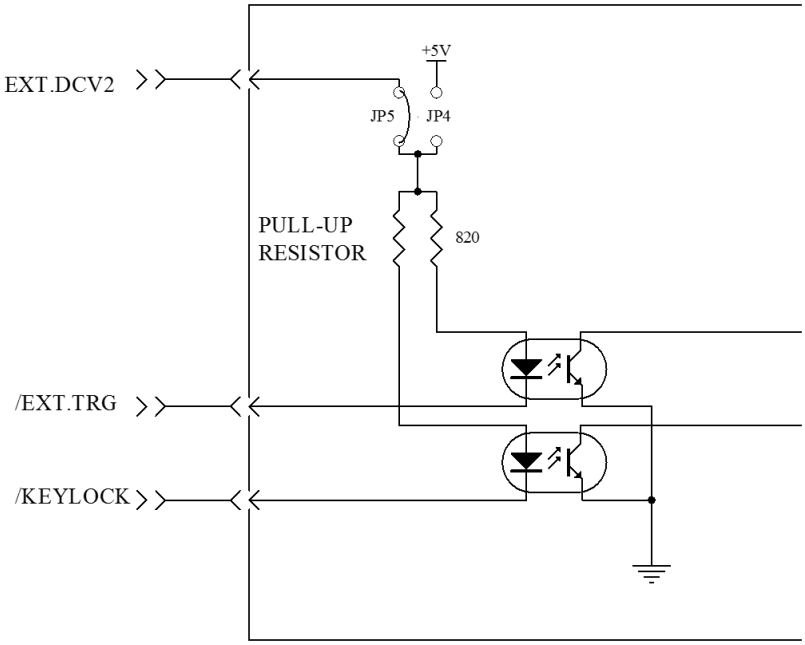
Comparison Resul Signal Output Circuit



Control Signal Output Circuit



Control Signal Input Circuit



8.2.5 Operation

After installing the HANDLER interface board, use the HANDLER interface to set the limit list for using the comparison function or set the list scan list for using the list scan comparison function. Then set the HANDLER interface to enable

OUTPUT/INPUT signals. The following operating procedures are the steps for using the HANDLER interface comparison function or list scan comparison function.

Comparison Function Setting Steps

The following operating procedures are the steps for using the HANDLER interface comparison function.

1. Press the [Limit Setup] soft key to enter the **<Limit List Setup>** page.
2. Set the nominal value of the bin count and the bin limit in the **<Limit List Setup>** menu. For details, see the corresponding chapter.
3. Use the keyboard cursor keys to highlight the cursor bar on the screen at "Compare", and the following will be displayed in the "Soft Key" display area (i.e., the menu option area):
   - ON
   - OFF
4. Select the [ON] soft key to enable the comparison function.
5. Press the [**DISP**] key to enter the**<Meas Display>** page, and then select the [bin number display] or [bin count] soft key to enter the corresponding page to measure the device under test (DUT); in this step, the user can refer to the [**DISP**] menu key instructions to set the count, accessories, and other functions of the device under test (DUT).

Note: The comparison function ON/OFF setting can also be set in the**<Bin Count Display>** page.

List Scan Comparison Function Setting Steps

The following operating steps are for using the list scan comparison function of the HANDLER interface.

1. Press the [List Setup] soft key to enter the**<List Sweep Setup>** page.
2. In the**<List Sweep Setup>** menu, set the scanning method, scanning frequency points, reference quantity and high and low limits. For details, see the description of the [**DISP**] menu key.
3. Press the [**DISP**] soft key to enter the**< Meas Display>** page and select the [List Display] soft key to enter the**<List Sweep Display>** page. For a description of this page, see the description of the [**DISP**] menu key.

Note: Using the HANDLER interface can improve measurement speed.

1. Set the range to the range of the largest capacitance you can measure. For example, if you can measure up to 10 uF, first, let the instrument automatically select the range to measure 10 uF, and then lock this range.
2. On the**<Meas Setup>** screen, set Monitor V: OFF and Monitor I: OFF.
3. Place it on the**< Count Display>** screen for testing.

Chapter 9 Appendice

9.1 Warranty

Warranty period: The warranty period of one year shall be calculated from the date of shipment of the instrument purchased from the Company by the user unit, and from the date of shipment of the instrument purchased from the operating department. Warranty should be issued with the instrument warranty card. During the warranty period, if the instrument is damaged due to improper operation by the user, the maintenance cost shall be borne by the user. The instrument is responsible for lifelong maintenance by the Company.

Maintenance of the instrument requires professional and technical personnel to carry out maintenance; maintenance, please do not replace the internal components of the instrument without authorization; maintenance of the instrument, the need to re-measure the calibration, so as not to affect the accuracy of the test. Due to the user blind maintenance, replacement of instrument components caused by damage to the instrument is not covered by the warranty, the user should bear the maintenance costs.

The instrument should be protected from sunlight and humidity and should be used correctly in the environment described in 1.4.

If the instrument is not used for a long time, it should be sealed in the factory box.

DISCLAIMER: The Company may make improvements and enhancements to the performance, functions, software, structure, appearance, accessories, packaging, and manuals of this product without notice! If this causes doubt, please contact our company.