SOURCETRONIC
We love electrons

SOURCETRONIC — Quality electronics for service, lab and production

User Manual

ST2840 Automatic Transformer Test System

Contents

Announcement

This manual may not contain all information about the delivered device. In the course of ongoing technical improvements, performance data, functions and their designations, internal structure, external appearance, accessories and packaging may be changed without further notice. If you notice any deviations from this manual on the basis of the device you have received, please inform us. If you have any questions, please do not hesitate to contact us at www.sourcetronic.com/shop/en.

1 Out of Box Audit

Thank you for choosing our product – if you have any questions after reading this manual, please feel free to contact Sourcetronic. When you receive the product, some inspections are needed before installation.

1.1 Inspect the Package

Inspect the shipping container for damage after unpacking it. It is not recommended to use the instrument if the container is damaged.

If the contents do not conform to the packing list, please notify us or your seller.

1.2 Power Connection

1) Power-supplying voltage range: 100~120Vac or 198~242Vac. This depends on the power setup of the rear panel.

2) Power-supplying frequency range: 47~63Hz.

3) Power-supplying power range: up to 130VA.

4) Power supplying input phase line L, zero line N, ground lead E should be the same as the power plug of the instrument.

5) Although the instrument is able to reduce the interference caused by AC power terminal input, we still recommend it be used in a low-noise environment, or, if this is not possible, with an input filter.

Warning!
Make sure the supply line is always reliably grounded; otherwise, leakage may cause injury to the user or damage to the product!

1.3 Fuse

Please use the fuse that is pre-installed in the instrument.

Warning!
Make sure the fuse position matches your power supply voltage range!

1.4 Environment

1)   Please do not operate the instrument in an environment where it will be subjected to strong vibrations, dust, direct sunlight or corrosive air.

2)   The normal working temperature is 0°C~40°C with a relative humidity of ≤ 75%, so the instrument should be used under these conditions to guarantee its accuracy.

3)   There is a heat abstractor on the rear panel to avoid the inner temperature rising – to ensure good ventilation, please do not obstruct the left and right vents.

4)   Although the instrument is specifically designed the reduce the noise caused by AC power, an environment with low interference is still recommended. If this is not possible, please make sure to use an input filter.

5)   Please store the instrument at a temperature ranging between 5°C~40°C, with a relative humidity of <85% RH, and ensure a non-corrosive environment. If the instrument will not be used for a time, please have it properly packed with its original box or a similar box for storing.

6)   The instrument, especially the test cables, should be kept as far away as possible from any strong electro-magnetic field, to avoid interference during measurement.

1.5 Use of Test Fixture

Please only use the included or additionally purchased original cables, as **foreign cables may lead to incorrect measurements**. The test fixture or cable should be kept clean, as well as the DUT pin, to ensure a good connection between the DUT and fixture.

Connect the fixture or cables to the four test terminals Hcur, Hpot, Lcur, Lpot on the front panel. For a DUT with shielding, connect it to the ground connection "⊥".

Note: If neither test fixture nor cables have been connected, the instrument will display an unstable measurement result.

1.6 Warm-Up

1)   To guarantee an accurate measurement, the instrument should be given a warm-up time of no less than 30 minutes.

2)   Please not switch the instrument on and off unnecessarily; this may affect measurement accuracy.

1.7 Other Features

1)   Dimensions (W*H*D):

ST2840A, ST2840B, ST2840AX, ST2840BX: 430mm*177mm*265mm;

ST2840NX: 430mm*177mm*405mm

2)   Weight: ST2840A, ST2840B, ST2840AX, ST2840BX are about 11kg; ST2840NX is about 17 kg.

2 Introduction

This chapter details the basic operation features of ST2840 Automatic Transformer Test Systems. Please read this chapter carefully before using your device.

2.1 Introduction to the Front Panel

Figure 2-1 shows the front panel of ST2840 series instruments.
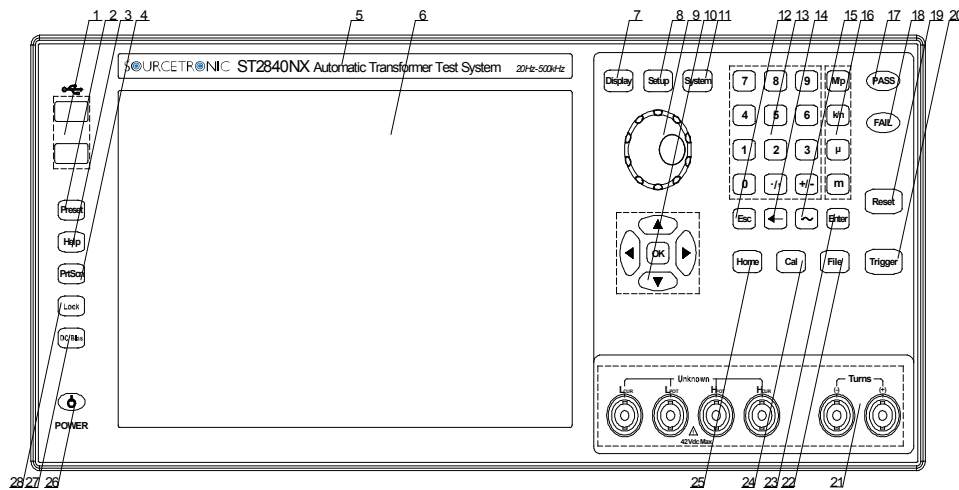
Figure 2-1 Front Panel

1) **USB Host Interface**

   ST2840 is equipped with two USB host interfaces, which can be used to connect USB storage to save and load files from, or to connect to devices such as a mouse, keyboard, or scanner. Note that only one USB storage device can be inserted at a time.

2) **[PRESET]**

   Press this key to restore the instrument to its factory default settings.

3) **[HELP]**

   Upon pressing this key it lights up, and the display will pop up information and operation instructions regarding the element the cursor is located at. If you press the same key again, the light will go out, and the pop-up window will close.

4) **[PRTSCN]**

   Press this key to save a screenshot of the current interface to the inserted USB device.

5) **Brand and Model**

   Details the brand and model number.

6) **LCD Liquid Crystal Display**

   1280x800 color LCD capacitive touch screen, showing the measurement results and settings.

7) [DISP]

Press this key to enter the measurement display page of the corresponding function (bridge, transformer measurement, transformer scan, focus scan).

8) [SETUP]

Press this key to enter the measurement settings page of the corresponding function (bridge, transformer measurement, transformer scan).

9) Knob With Confirmation Function

Move the cursor, select and set parameters. The button in the middle is used to conclude data input and confirm.

10) Cursor Keys and [OK] Key

The cursor keys are composed of up (↑), down (↓), left (←) and right (→), which are used to move the cursor between different areas on the LCD display page. When the cursor moves to a certain area, that area will be highlighted on the LCD screen. The middle of the cursor keys is the [OK] key; its function is similar to the [ENTER] key.

11) [SYSTEM]

Press this key to access the system setup page.

12) [ESC]

"Escape" key.

13) Numeric Keys

The numeric keys are composed of the digits [0] to [9], a decimal point [./,] and [+/-] keys; they are used to input data directly.

14) [←]

Backspace key. Press this key to delete the last digit of the entered value.

15) [∼]

This key is used for the continuous input of pins (transformer scan only).

16) Magnitude Key

Press this key to input the magnitude of the corresponding parameter.

17) PASS Indicator

LED indicator that shows the measurement has concluded successfully.

18) FAIL Indicator

LED indicator that shows the measurement has failed.

19) [RESET]

While in a list scan or trace scan of the bridge, press this key to pause the scan, and press the [TRIGGER] key to continue the scan from where it previously paused. While in an automatic transformer scan, press the [RESET] key to end the scan; the next trigger will start from the beginning.

20) [TRIGGER]

When the trigger mode is set to single mode, press this key to start a measurement cycle.

21) Test Terminals (UNKNOWN)

Four-teminal test pairs are used to connect a four-terminal test fixture or cable to the DUT.

The terminals are as follows:

- Hcur

- Hpot

- Lpot

- Lcur

Transformer Secondary Test Terminal (TURNS)

(+) = Secondary (+) terminal

(-) = Secondary (-) terminal

Note: ST2840A and ST2840B have no transformer secondary test terminal.

22) [FILE]

Press this key to access the <File Manage> page.

23) [ENTER]

Press this key to conclude data input, confirm, and save the data currently displayed in the input line.

24) [CAL]

Shortcut keys to perform user calibrations.

25) [HOME]

Press this key to switch between the instrument's different functions such as the electric bridge, the transformer single-group test, and the transformer scan.

26) POWER

Power switch. The button is lit up in red while in standby mode and green while powered on. To shut down the instrument, press and hold the power switch.

27) [DC BIAS]

This key is used to enable or disable the output of 0~100mA, ± 40V, 0~2A DC bias source. If you press this key, it will light up, indicating that the DC bias output is enabled; if you press the same key again, the light will go out, indicating that the DC bias output is now disabled. In some non-measurement screens where DC bias cannot be applied, pressing this button will have no response.

28) [LOCK]

If you press this key, it will light up, indicating that the key functions of the current panel are locked; if you press the same key again, the light will go out, indicating that the keyboard lock state is released. If the password function is set to ON, the correct password must first be entered when unlocking the keyboard. When the instrument is controlled by RS232, USB_Device, Lan port, etc., the [LOCK] button is also active and lit up. In this case, too, you can unlock by pressing [LOCK] again.

2.2 Introduction to the Rear Panel

The rear panels of the different models of ST2840 series instruments vary slightly. The detailed description of the rear panel layout of ST2840A, ST2840B, ST2840AX, ST2840BX will be introduced in 2.2.1 and the detailed description of the rear panel layout of ST2840NX will be introduced in 2.2.2.

2.2.1 Rear Panel Description 1

Figure 2-2 briefly describes the rear panel of ST2840A, ST2840B, ST2840AX, and ST2840BX.
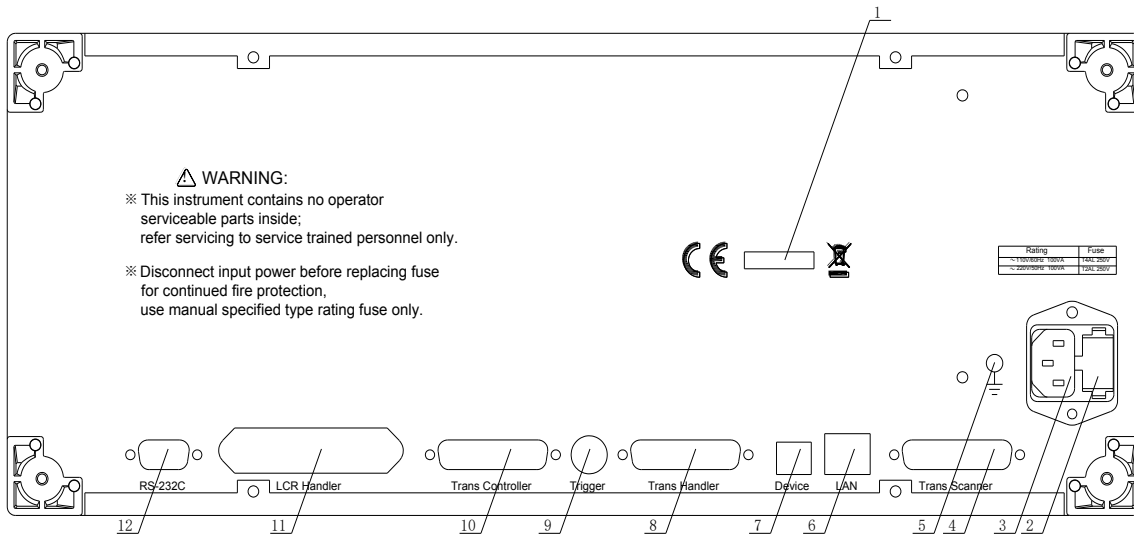
Figure 2-2 Rear Panel

1)   Nameplate

Contains information regarding production date, instrument number, manufacturer, etc.

2)   Fuse Base

This is used to install a power fuse, protect the instrument, and switch 110V/220V by changing the core's direction.

3)   Power Socket

Input AC power.

Warning!
⚠ Before connecting, make sure that the position of the fuse corresponds to the supply voltage used!

4)   TransScanner Interface

You can control the transformer scanning box via the TransScanner interface. It is compatible with ST1901 and ST1831 scanning boxes, but different scanning boxes require different connection cables.

Note: ST2840A and ST2840B have no transformer scan function, so for them, this interface cannot be used.

5) **Ground Terminal**

This terminal is connected to the chassis of the instrument. It can be used to protect or shield ground connections.

6) **LAN Interface**

The LAN interface is used to control and communicate within network systems.

7) **USB Device Interface**

The USB device interface can be used to communicate with the PC.

8) **TransHandler Interface**

The Handler interface of the transformer scan is used to realize the organized output of the transformer scan results.

9) **Trigger Interface**

External trigger devices such as foot control can be connected here.

10) **TransController Interface**

The Handler extension interface of the transformer scan. When the number of sorting signals of the transformer scanning Handler interface is insufficient, this interface can be used to expand the sorting signal and realize the organized output of the transformer scan results.

11) **LCR Handler Interface**

The Handler interface can realize the organized output of measurement results. This interface is used to sort the results of single-group measurements of the bridge and the transformer.

12) **RS232C Serial Interface**

The serial communication interface is used for online communication with the computer.

2.2.2 Rear Panel Description 2

Figure 2-3 briefly describes the rear panel of ST2840NX.
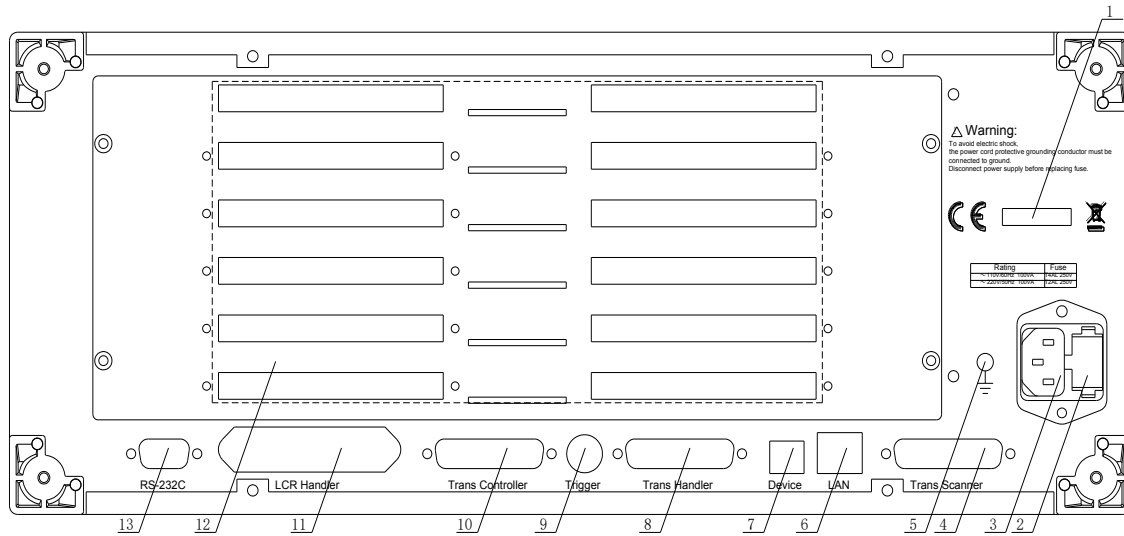
Figure 2-3 Rear Panel

1)   Nameplate

Contains information regarding production date, instrument number, manufacturer, etc.

2)   Fuse Base

This is used to install a power fuse, protect the instrument, and switch 110V/220V by changing the core's direction.

3)   Power Socket

Input AC power.

Warning!	
⚠	Before connecting, make sure that the position of the fuse corresponds to the supply voltage used!

4)   TransScanner Interface

The TransScanner interface is used to control the transformer scanning box. It is compatible with ST1901 and ST1831 scanning boxes, but note that different scanning boxes will require different connection cables.

5)   Ground Terminal

This terminal is connected to the chassis of the instrument. It can be used to protect or shield ground connections.

6)   LAN Interface

The LAN interface is used to control and communicate within network systems.

7)   USB Device Interface

The USB device interface can be used to communicate with the PC.

8)   TransHandler Interface

The Handler interface of the transformer scan is used to realize the organized output of the transformer

scan results.

9)   Trigger Interface

External trigger devices such as foot control can be connected here.

10) TransController Interface

The Handler extension interface of the transformer scan. When the number of sorting signals of the

transformer scanning Handler interface is insufficient, this interface can be used to expand the sorting

signal and realize the organized output of the transformer scan results.

11) LCR Handler Interface

The Handler interface can realize the organized output of measurement results. This interface is used

to sort the results of single-group measurements of the bridge and the transformer.

12) Scanning Cable Interface

The scanning cable interface uses a FRC-50P horn socket.

13) RS232C Serial Interface

The serial communication interface is used for online communication with the computer.

2.3 Introduction to the Display Areas

ST2840 series instruments use a 10.1-inch capacitive touch screen; the content displayed on the screen is

divided into the following display areas:
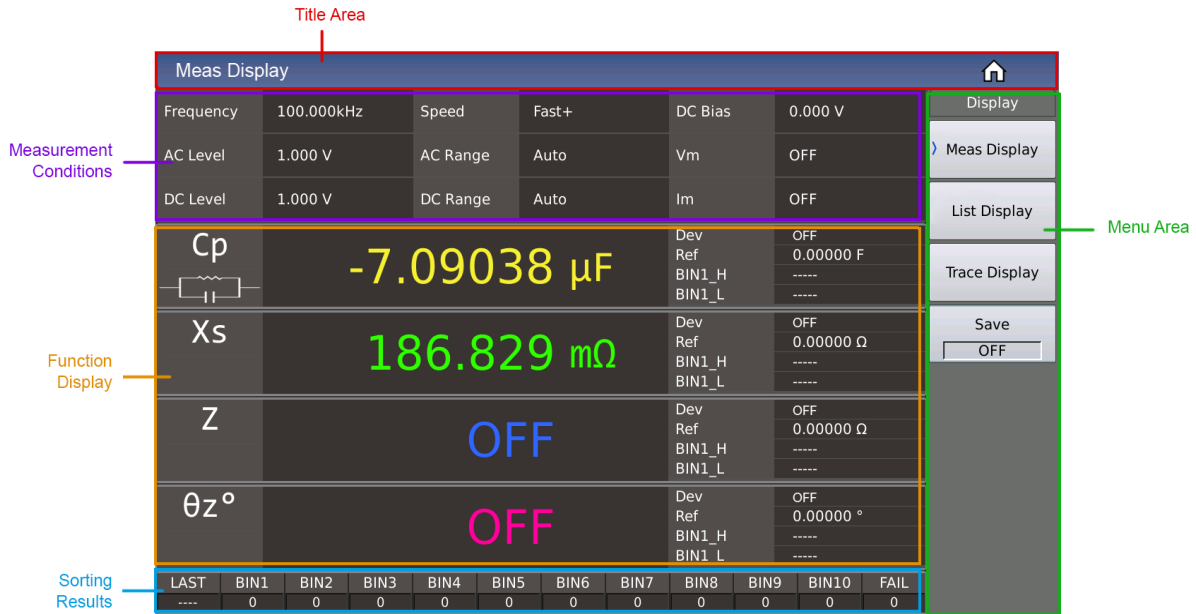
Figure 2-4 Display Areas

The elements shown on this page include:

- Title,

- Measurement Conditions (Settings),

- Four-Parameter (Function) Result Display,

- Sorting Results,

- Menu.

2.4 Main Menu Keys and Their Corresponding Pages

2.4.1 [DISP]

When the LCR function is active, press this key to access the LCR measurement display page. Use the touch screen to select from the following function pages:

<Meas Display>

<List Display>

<Trace Display >

<Save>

When the transformer measurement function is active, press this key to access the transformer test display page. The following function pages are available here:

<Save>

When the transformer scan function is active, press this key to access the transformer scan display page. The following function pages are available here:

<Pri.>

<Load Std>

<Deviation>

<Speed>

<Test Fail>

<Focus>

<Split>

<Save>

2.4.2 [SETUP]

When the bridge function is active, press this key to access the setting screen of the component test. The following function pages are available here:

<Meas Setup>

<Limit Setup>

<List Setup>

<Trace Setup>

<User Corr>

<Handler>

When the transformer measurement function is active, press this key to enter each setting screen of the transformer test. The following function pages are available here:

<Single Setup>

<User Corr>

<Handler>

When the transformer scan function is active, press this key to enter each setting screen of the transformer scan. The following function pages are available here:

<Trans ID>

<Pin To Fixture>

<Pin Setup>

<Condition>

<Copy>

<Handler Mode>

<Stat>

<Tools>

2.4.3 [SYSTEM]

Press this key to enter the system settings homepage, which concerns communication settings, user management settings, and Handler settings. The following function pages are available here:

<System Info>

<Message>

<System Check>

2.5 Basic Operation

The basic operation principles of ST2840 series instruments are as follows:

- Use the menu keys ([DISP], [SETUP], [SYSTEM]) and soft keys to select pages.

- Use the cursor keys ([←][→][↑][↓]), knob or directly touch the screen to move the cursor between areas on the screen. When the cursor moves to a certain area, that area will be highlighted. This is where you can now configure settings.

- The soft key functions corresponding to the area the cursor is currently located in will be displayed in the soft key area of the screen. Press the desired soft key to select it. The numeric keys, [←], magnitude keys and the [ENTER] key are used for data input. After pressing a numeric key, you can press the confirmation key or [ENTER] to conclude the data input.

2.6 Power ON/OFF

Plug in the three-wire power supply.

Caution!
⚠️ Keep the power-supply voltage and frequency conform to above specifications. Power input phase line L, zero line N, ground line E should be the same as that of the instrument!

ST2840 series instruments use soft switches.

After plugging in the three-wire power supply, some indicators on the front panel flash briefly. After a few seconds, the power button lights up red, and any other buttons with LED indications go out.

Power On: Press the power switch in the lower left corner of the front panel to turn on the instrument and display the startup screen. Once the instrument is started, the power button lights up green. The power button of ST2840 series instruments has a memory function.

Power Off: If needed, press and hold the power button in the lower left corner of the front panel to turn off the instrument. Upon doing so, the power button lights up red, and the instrument enters standby mode. If you are planning not to use the instrument for an extended period of time, please disconnect the power cord and store the instrument in an appropriate environment as described in chapter 1.4.

Note: This product series comes with a pre-set default password, which is **2840**. You can of course change the password according to your own needs. For details, please refer to chapter 4.1.2.5 of this user manual.

3 Description of the LCR Function Module

3.1 <Meas Display>

When the LCR function is active, press [DISP] to access the <Meas Display> page, as shown in the following figure:
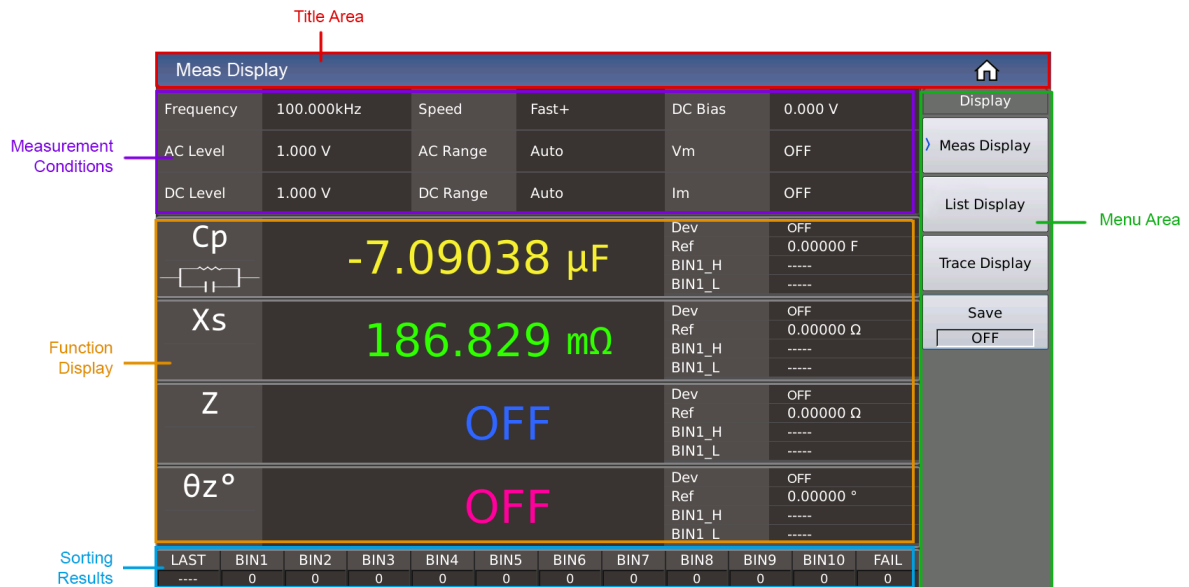
The elements shown on this page include:

- Title,

- Measurement Conditions (Settings)

- Four-Parameter (Function) Result Display,

- Sorting Results,

- Menu.

3.1.1 Common Measurement Settings

There are 9 cursor areas in the measurement settings area of this display page, namely:

- Frequency

- Speed

- DC Bias,

- AC Level

- AC Range

- Vm

- DC Level

- DC Range

- Im

Each of these settings will be described in further detail in the <Meas Setup> chapter of this user manual.

3.1.2 Measurement Function

Touch the position of the parameter name in the measurement result area, and you can see the selection menu of the corresponding measurement function in the right menu area. Touch the corresponding selection area of the menu to complete setting the specified parameter.

The menu display is shown in the following figure:
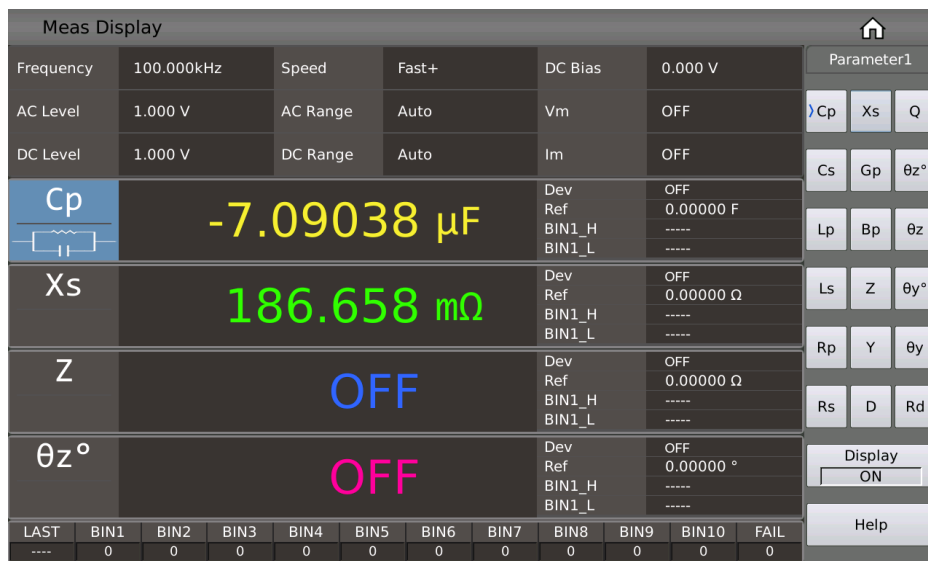
Figure 3-1 Parameter Function Setting

3.1.3 Decimal Point Position

Parameter Type: select from list

The position of the decimal point has a direct relationship with the resolution of the result displayed; this way, the relative stability of the result can also be seen intuitively.

The principle of moving the position is to ensure that the number of digits remains unchanged, with a certain decimal point on the left and right, as shown in the following figure:
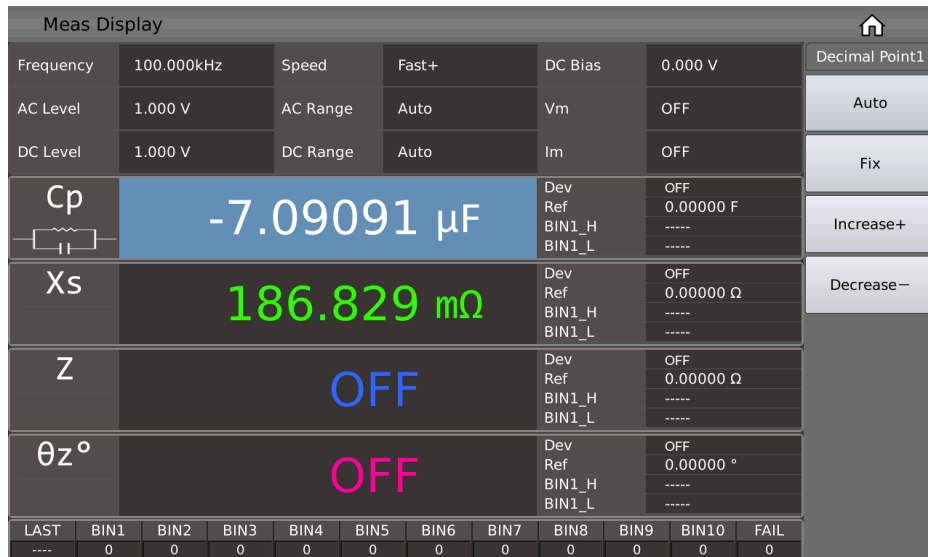
Figure 3-2 Moving the Decimal Point

Setting Options:

Setting	Description
Auto	The default setting, which automatically adjusts the position of the decimal point
Fix	Lock the current decimal point position while otherwise in auto mode
Increase+	Move the decimal point to the left
Decrease-	Move the decimal point to the right

Note: In the following cases, the decimal point position lock function will be automatically cancelled and restored to the floating decimal point display state:

• The measurement function is changed;

• The deviation mode is changed.

3.1.4 Display Results of BIN Sorting

After touching or moving the cursor to the field that displays sorting results, the corresponding menu will offer some settings for the sorting, such as turning on/off the comparison and counting function, or resetting the count; as shown in the following figure:
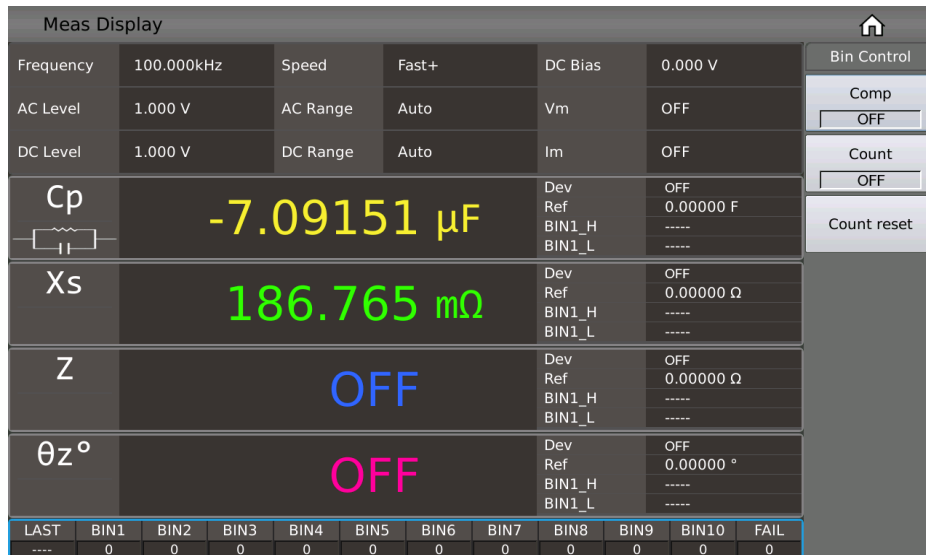
Figure 3-3 Quick Settings for BIN Sorting

3.1.5 Comparison Function

ST2840 series instruments come with a built-in comparison function that allows the DUT to be assigned to one of up to ten sorting bins (BIN1 to BIN9 and BIN OUT). Ten sets of upper and lower limits can be set, and the upper and lower limits of each file containing four parameters can be set independently.

If one or more parameters are not to be included in the comparison, the corresponding upper and lower limits can be cleared.

If the parameters of the DUT that are included in the comparison are all within the range of the BIN limit, the corresponding BIN is found. The results can be output to the automatic test system via the Handler Interface.

These limit settings can only be configured on the <Limit Setup> page.

Parameter Type: ON/OFF; the default setting is OFF.

3.1.6 BIN Count Function

This function is used to record and display the count value of each BIN.

Parameter Type: ON/OFF; the default setting is OFF.

3.1.7 Count Reset

Restart counting by clearing the count value of the current BIN, so that the BIN count is reset to 0.

3.1.8 Save Bridge Measurement Results to USB Flash Drive

Use the USB flash drive to save the bridge measurement results.

The results and settings that can be saved include the following:

- Time

- P1

- P2

- P3

- P4

- BIN

(These correspond, in order, to the test time, parameter 1~4 result, BIN result.)
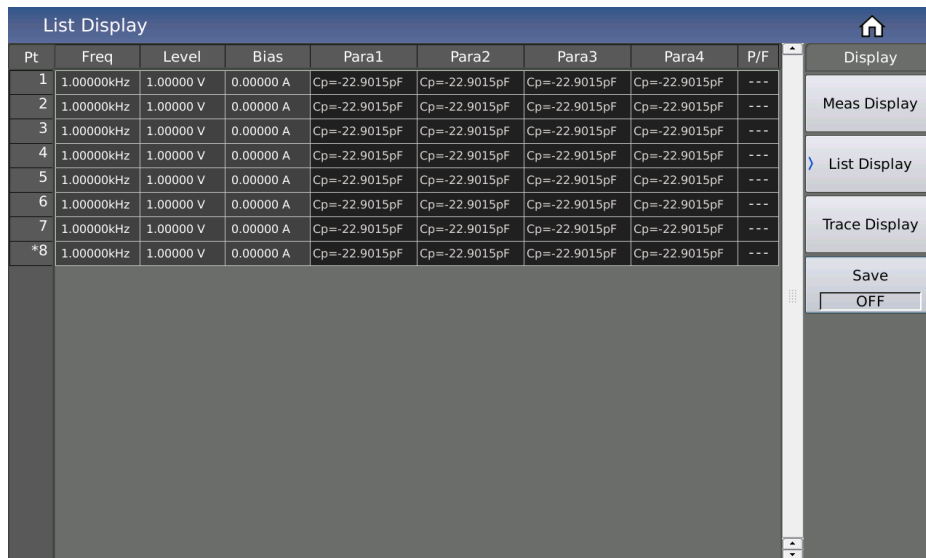
The operation steps to save your data are as follows:

- Choose [Save];

- "Save path" prompt; default path location: "usb/CSV/" path;

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

3.2 <List Display>

On the <List Display> page, you can enter up to 201 points of measurement frequency, as well as measurement level, DC bias, trigger delay, independent functions corresponding to four parameters, four independent parameters, and upper and lower limits for each list sweep measurement point. These measurement points will be automatically scanned and measured, and the measurement results will be compared with their respective limit values.

During the list sweep measurement cycle, the leftmost symbol * indicates the current sweep measurement point.

Pt	Freq	Level	Bias	Para1	Para2	Para3	Para4	P/F
1	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
2	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
3	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
4	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
5	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
6	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
7	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -
*8	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -

Display: Meas Display | List Display | Trace Display | Save OFF

Figure 3-4 List Display

The P/F on the far right (representing PASS/FAIL) is used to indicate the comparison result of the current point:

- No Comparison Display: "---"

- Comparison successfully completed: PASS (green)

- Comparison failed: FAIL (red)

3.2.1 Save List Sweep Measurement Results to USB Flash Drive

Use the USB flash drive to save the measurement results. The measurement results and formats that can be saved are as follows:

- Time

- PT

- Para1-4

- P1

- P2

- P3

- P4

- COMP

(These correspond, in order, to test time, point index, 4 parameter function, parameter 1~4 result, comparison result.)

The operation steps to save your data are as follows:

- Choose [Save];

- "Save path" prompt; default path location: "usb/CSV/" path;

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

3.3 <Trace Display>

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

Figure 3-5 Trace Display

On this page, each scan will perform automatic measurement of the component under test at 51, 101, 201, 401 or 801 frequency points, in a linear or logarithmic manner and with increasing conditions within the user preset mode range. The instrument displays a dynamic response curve of the main and secondary parameters of the component under test with changes of the mode conditions on the LCD screen.

The result of any point within the scanning range can be read on the screen. Simultaneously, the maximum and minimum measurement values and corresponding measurement settings within the scan range will be displayed.

Note: After you have configured the scan settings, you must press the [TRIGGER] key on the front panel to begin the scan. Press the [RESET] key once to pause the measurement, and press it again to reset and rescan.

3.3.1 Trigger

This setting is used to define the trigger mode of the curve; please refer to the corresponding section in the <Meas Setup> chapter for details.

3.3.2 Scale

This setting is used to automatically define the Y-axis coordinate range corresponding to the curve. When it's set to Auto mode, the Y-axis scale range will be dynamically adjusted with the size range of the measurement result to ensure that the drawn curve is within the display range;

It is recommended that when the DUT is relatively stable, you let the scale automatically select a relatively suitable scale range, and then choose Fix to lock it in. Then you can manually press the up and down direction keys to fine-tune the display range according to your own requirements.

Parameter Type: select from list

Setting Options:

Setting	Description
Auto	The scale will adjust automatically.
Fix	The scale is fixed (i.e. will not change on its own), but can still be adjusted manually.

3.3.3 Read

This setting is used to configure the behavior of the cursor (displayed as a red line) on the screen.

You can view the measurement results of different parameters under the same scanning condition by turning the knob or using the left and right keys.

Figure 3-6 Read Cursor Display Effect

Setting Options:

Setting	Description
OFF	Cursor is not displayed.
Manual	Manually adjust the cursor (knob; left and right keys).
Para1Min	Automatically track the minimum or maximum value position of parameter 1/2/3/4.
Para1Max	
Para2Min	
Para2Max	
Para3Min	
Para3Max	
Para4Min	
Para4Max	

3.3.4 Trace

Via the submenu of the curve button, you can quickly choose the sweep points of the curve, whether to hide or show the parameter on the curve for each of the four parameters, how to split the screen between multiple curves, as well as other related settings.
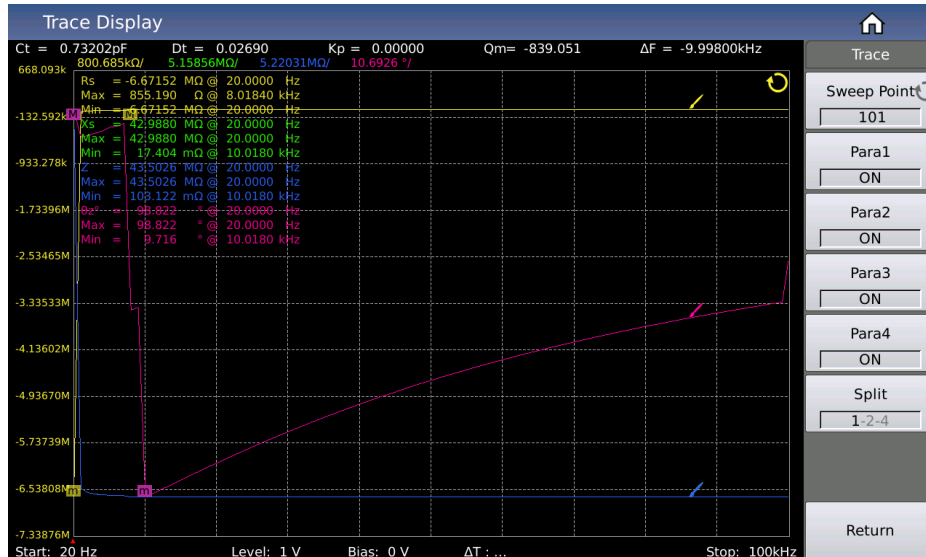
Figure 3-7 Curve Settings Menu

3.3.5 Sweep Point

This setting defines the number of points the instrument scans within the start and end conditions. The system lets you choose the number of measurement points between five settings: 51, 101, 201, 401, and 801. The more scan points you select, the more precise the image will be drawn, but the scan will also take longer. The system default setting is **201**.

3.3.6 Parameters 1~4 ON/OFF

These ON/OFF switches are used to include or not include the specified parameter in the displayed curve.

3.3.7 Split

This setting lets you choose how to divide the screen to display multiple curves, or not to divide it at all.

Setting Options:

Setting	Description
1-Split / None	All curves are displayed in the same drawing window.
2-Split	Four parameters are grouped in pairs and displayed in two drawing windows.
4-Split	Four parameters are all displayed independently in their own separate drawing windows.

Figure 3-8 showcases what the 2-split screen effect looks like, and Figure 3-9 shows the 4-split screen effect.
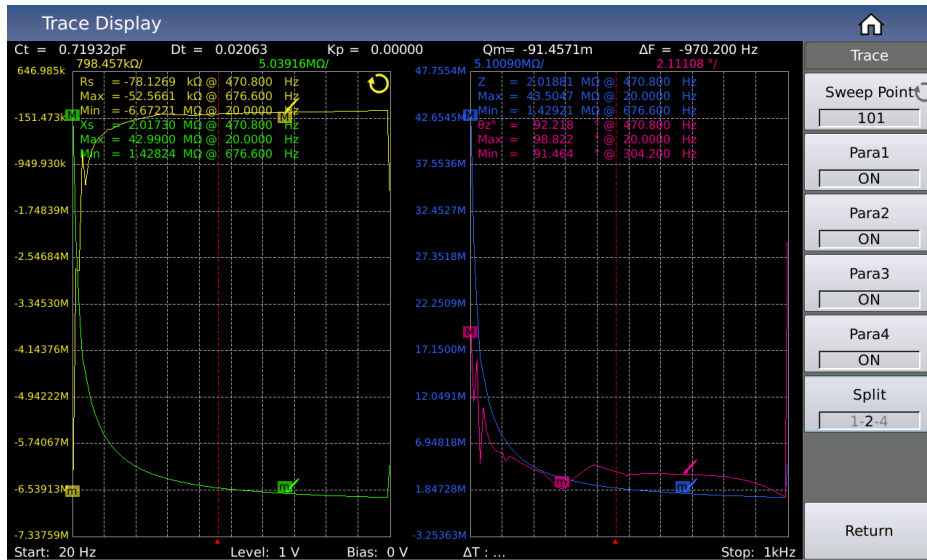
Figure 3-8 Display Effect of 2-Split Screen
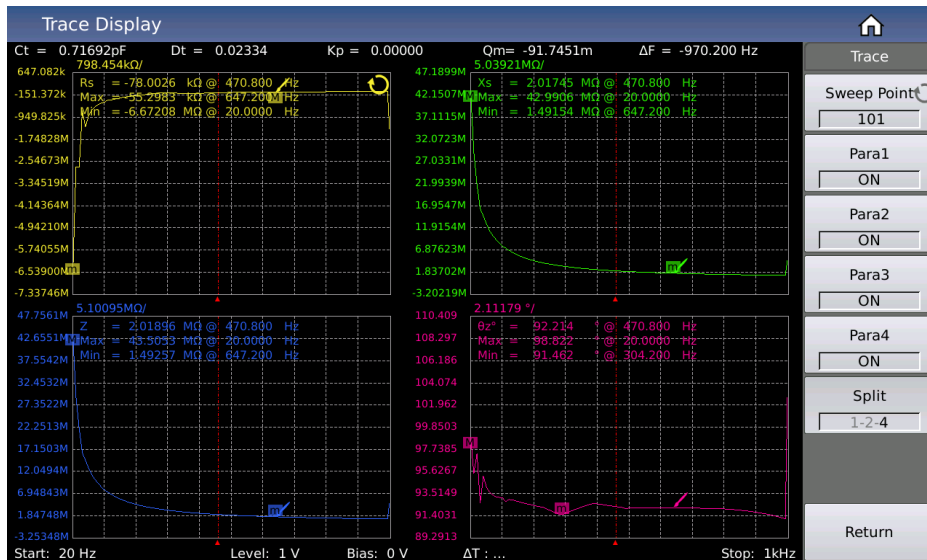
Figure 3-9 Display Effect of 4-Split Screen

3.3.8 Save Measurement Results to USB Flash Drive

Use the USB flash drive to save the measurement results and curve settings. The results and settings that can be saved are as follows:

- Time

- PT

- X

- P1

- P2

- P3

- P4

- COMP

(These correspond, in order, to test time, point index, x-axis size, parameter 1~4 result.)

The operation steps to save your data are as follows:

- Choose [Save];

- "Save path" prompt; default path location: "usb/CSV/" path;

- The naming rule of the file name is rx+machine number+date,

  such as: trace-SN12345678-20210811.csv,
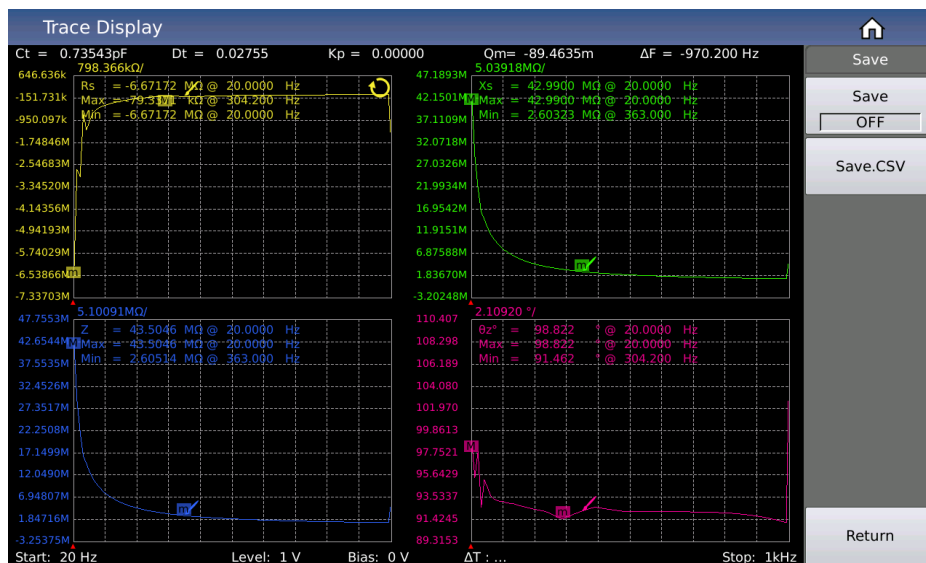
Figure 3-10 Save Settings Menu

Choose whether to continuously save the measurement result data:

- When set to continuous saving, the naming rule of the file name is trace + machine number + date,

  such as: trace-SN12345678-20210811.csv,

- For a single save, the naming rule of the file name is trace-trg + machine number + date,

  such as: trace-trg-SN12345678-20210811.csv.

3.3.9 Other Measurement Results

When you select the scan parameters to be frequency and impedance, the instrument will automatically display some specific parameters of the ultrasonic device. These parameters are as follows:

- Static Capacitance C_t: static capacitance value at 1kHz.

- Static Capacitance D_t: the capacitance loss value at 1kHz.

- The minimum impedance Z_{min} and its corresponding frequency f_s, (point m on the screen).

- The maximum impedance Z_{max} and its corresponding frequency f_p, (point M on the screen).

$Δ_F = f_p – f_s$

$$k_p \approx \sqrt{\frac{f_p - f_s}{f_s} \times 2.51}$$

$$Q_m \approx \frac{f_p^2}{2\pi f_s Z_{min} C^T (f_p^2 - f_s^2)}$$

3.4 <Meas Setup>

Press [SETUP] to access the <Meas Setup> page as shown below:

Meas Setup							Setup
Frequency	1.00000kHz	Speed	Fast	DC Bias	0.000 V		❯ Meas Setup
AC Level	1.000 V	AC Range	Auto	Vm	OFF		
DC Level	1.000 V	DC Range	Auto	Im	OFF		Limit Setup
Trigger Mode	Single	Average	1	DCI Iso	OFF		List Setup
Trigger Delay	0 s	ALC	OFF	Bias Polarity	Auto		
Step Delay	0 s	Rsou	100Ω	Bias Source	100mA(40V)		Trace Setup
Parameter1	Rs	Deviation1	OFF	Reference1	0.00000 Ω		User Corr
Parameter2	Xs	Deviation2	OFF	Reference2	0.00000 Ω		
Parameter3	Z	Deviation3	OFF	Reference3	0.00000 Ω		Handler
Parameter4	θz°	Deviation4	OFF	Reference4	0.00000 °		

Figure 3-11 Measurement Setup Page

3.4.1 Measurement Function

Parameter Type: select from list

The four parameters of the impedance element can be measured at the same time in one measurement cycle. The measurable parameters are as follows:

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	Rs	Equivalent Series Resistance
Gp	Conductance	Bp	Susceptance
Z	Absolute Value of Impedance	Y	Absolute Value of Admittance
D	Loss Factor	Q	Quality Factor
θz°	Impedance Degree	θz	Impedance Radian
θy°	Admittance Degree	θy	Admittance Radian
X	Reactance	Rd	DC Resistance

Operation Steps to Set the Measurement Function Parameters:

Touch (or use the cursor keys to move the cursor to) the parameter name area corresponding to the measurement result, and select the setting in the soft key area on the right according to the displayed optional parameters.

There is no restriction on the combination of the four parameters, meaning you can choose whichever combination you want.

The display status of the four parameters can each be set independently, that is, when any parameter's display switch is turned off, that parameter's corresponding area on the screen will simply display OFF instead of a measurement result. This function to turn on/off the parameter display can be set in the parameter setting area on the measurement display page.

3.4.2 Frequency

Parameter Type: numeric input

The maximum range of the measurement frequency of this series is from 20Hz to 2MHz, and the minimum resolution is: 0.001Hz.

Note: The specific models have different frequency ranges they support. For further details, please refer to the instrument selection guide. Here is a very basic comparison:

Specific Instrument Model	Supported Frequency Range
ST2840A, ST2840AX, ST2840NX	20Hz~500kHz
ST2840B, ST2840BX	20Hz~2MHz

Frequency Range and Measurement Frequency Point:

Frequency Range (F)	Measurement Frequency Point	Resolution
20Hz<= 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	100.000kHz, 100.001 kHz […] 1MHz	1Hz
1MHz<= F<=2MHz	1.00000MHz, 1.00001 MHz […] 2MHz	10Hz

Operation Steps to Set the Measurement Frequency:

Directly touch or use the arrow keys to move the cursor to the frequency field;

There are two methods to set the frequency:

1)   Use the number keys to directly input a specific value;

2)   Use the soft keys (according to the given prompts) to increase and decrease the frequency until you reach the desired value.

3.4.3 Level

The measurement level is divided into AC level and DC level;

•   AC level is mainly used for AC LCR measurements;

•   DC level is mainly used for DC resistance measurements.

3.4.3.1 AC Level

Parameter Type: numeric input

The measurement level is defined by the effective value of the measurement sine wave signal. The frequency of the sine wave signal is the measurement frequency, which is generated by the internal oscillator of the instrument. You can set either the voltage value or the current value.

Voltage Level Range: 5mV~20V.

Current Level Range: 50uA~100mA

Note: There is a linear constraint relationship of internal resistance between the voltage level and the current level. (For example, the current level corresponding to 30Ω internal resistance is 166.7μA~66.67mA, and the current level corresponding to 100Ω internal resistance is 50μA~100mA).

When the measurement function is set to DCR, 30Ω or 100Ω can be selected as the signal source output impedance.

Voltage Level and Resolution:

Voltage Level (V$_{rms}$)	Resolution
[5m,1)	1mV
[1,20]	10mV$_{rms}$

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

The automatic level control (ALC) function can realize constant voltage or current measurement; it can be enabled on the <Meas Setup> page. When the ALC function is enabled, a * sign will be displayed after the current level value.

Operation Steps to Set the Measurement Level:

Select the AC level area on the screen. The menu area now displays the option to switch level type and add smaller functions; you can modify and adjust your choices according to the menu prompts, or you can use the numeric keys to directly enter the desired value.

Note: If you need to switch the measurement level between current and voltage, you must use the menu area on the touch screen.

3.4.3.2 DC Level

Parameter Type: numeric input

As a measurement condition for DC resistance (RD).

DC Level Range:

Internal Resistance	DC Level Range	
30Ω	0.1V~2V	
100Ω	4 parameters are all RD	0.1V~20V
	Other	0.1V~2V

Level Voltage and Resolution:

Voltage Level (V$_{rms}$)	Resolution
[0.1,1]	1mV
(1,20]	10mV

3.4.4 Speed

Parameter Type: select from list

The measurement speed is mainly determined by the following factors:

- Integration time (A/D conversion);

- Average times (the number of measurements used to obtain the average value of the continuous measurement results);

- Measurement delay (the time that passes between the trigger impulse until the measurement begins);

- Display time of measurement results.

Generally speaking, when measuring slowly, the measurement result will be more stable and accurate.

You can choose between four measurement speeds: FAST+, FAST, MED and SLOW. See the description in section 8.1.9 for further details.

3.4.5 Range

The range is divided into AC range and DC range. The AC range is used to measure AC LCR parameters, and the DC range is used to measure DC resistance.

Parameter Type: select from list

The measurement range is selected according to the impedance value of the LCR component under test.

AC Measurement Range: 0.1Ω, 1Ω, 10Ω, 20Ω, 50Ω, 100Ω, 200Ω, 500Ω, 1kΩ, 2kΩ, 5kΩ, 10kΩ, 20kΩ, 50kΩ, 100kΩ.

DC Measurement Range: 0.1Ω, 1Ω, 10Ω, 20Ω, 50Ω, 100Ω, 200Ω, 500Ω, 1kΩ, 2kΩ, 5kΩ, 10kΩ, 20kΩ, 50kΩ, 100kΩ.

Operation Steps to Set the Measurement Range:

Use the cursor keys to move the cursor to the Range field. The screen will display the following soft keys:

- **Auto:** This soft key is used to set the range to AUTO (automatic) 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 in the currently selected measurement range, which will be displayed in the range field of the screen.

- **Increase +:** This soft key is used to increase the range in HOLD mode.

- **Decrease –:** This soft key is used to decrease the range in HOLD mode.

Use the soft keys to set the measurement range.

3.4.6 DC Bias

Parameter Type: numeric input

This involves selecting bias source and type, setting the digital size range, as well as other related settings.

3.4.6.1 Bias Source

ST2840 series instruments come equipped with two types of internal bias source or external biases for selection. The corresponding options and input ranges are as follows:

Bias Source	Bias Type	Input Range
Internal 100mA (Voltage, current, internal resistance are related to Ohm's law.)	Voltage	-40V~40V
	Current	-100mA~100mA
Internal 2A	Current	0~2A
External ST1778	Current	0~120A (Determined by the external bias source)

3.4.6.2 Bias Type

When you are using the internal bias source of 100mA, you can choose between the bias current mode or the bias voltage mode, and the maximum setting size is restricted by the relationship of the internal resistance.

Parameter Type: numeric input

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

Press the [DC BIAS] key on the front panel to enable the set DC bias output. When the DC bias output is enabled, the [DC BIAS] button will be lit.

3.4.6.3 DC Isolation

Parameter Type: select from list

The bias current isolation function can prevent the influence of DC current on the measurement input circuit. The isolation function can be turned on or off using the ISO domain.

On the single measurement page (measurement display), the ISO switch control is determined by your individual settings. During list sweep and trace sweep measurement functions, when the current is above a certain level, it is automatically controlled by the set current.

Note: After the bias current isolation function is turned on, it will affect the test accuracy. Therefore, when measuring high-impedance components under low frequency and small bias current conditions, the bias current isolation function should be set to OFF.

Bias Polarity

3.4.7 Level Monitoring Function

Parameter Type: select from list

The level monitoring function allows you to monitor the actual voltage across the DUT or the actual voltage and current values flowing through the DUT.

The voltage monitoring value is displayed in the Vm monitoring field on the <Meas Disp> page; the current monitoring value is displayed in the Im monitoring field on the <Meas Disp> page.

Parameter Type: ON/OFF.

Note: The calibration function of the instrument has an influence on the level monitoring function. Therefore, when the correction data changes, the level monitoring value also changes. Turning on or off the open-circuit/short-circuit/load correction functions will also affect the level monitoring value.

3.4.8 Trigger

This outlines the trigger mode, trigger delay, and step delay settings.

Schematic diagram of trigger delay time and step delay time:
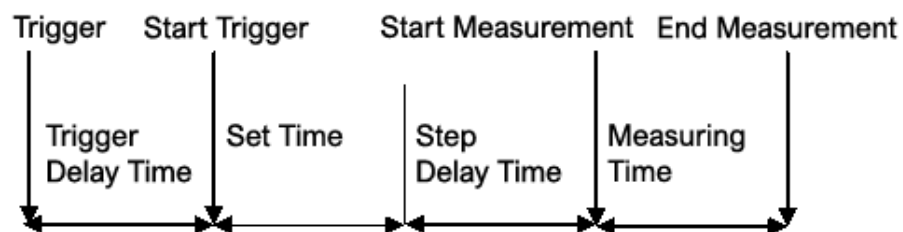
Note: The set time in the figure is the preparation time for the signal source control of the instrument measurement, range switching, etc.

3.4.8.1 Trigger Mode

Parameter Type: select from list

The choice of trigger mode determines the trigger condition of the instrument test. This series provides two different trigger modes to choose from:

1)   Continuous Trigger: continuously repeating measurements

2)   Single Trigger: Each time you press the [TRIGGER] key on the front panel, and each time the Handler Interface receives a positive pulse trigger signal or remote command, a trigger command is given, and a single measurement is taken.

Note: If, during measuring, another trigger signal is received, this signal will be ignored. Therefore, the trigger signal needs to be sent again after the measurement is completed.

When you need to trigger from the optional Handler Interface, set the trigger mode to single trigger mode.

3.4.8.2 Trigger Delay

Parameter Type: numeric input

Trigger delay refers to the delay time from when the instrument is triggered to the start of measurement.

The trigger delay time setting range is 0s~60s, and the minimum resolution is 1ms.

This function can be particularly useful when the instrument is used in an automatic test system. When the instrument is triggered by the Handler Interface, the trigger delay time can ensure reliable contact between the DUT and the test terminal.

3.4.8.3 Step Delay

Parameter Type: numeric input

The step delay is the delay time from the output of the measurement signal to each measurement.

The step delay time setting range is 0s~60s, and the minimum resolution is 1ms.

Note: There are *two* step delays in the RD measurement (because the voltage in the positive and negative directions needs to be added), so there are two measurement cycles. This means the *total* step delay time is twice the time you set here.

3.4.9 Average

Parameter Type: numeric input

The average function calculates the average of the results of 2 or more tests.

The number of averages can be set from 1~255, and the minimum resolution is 1.

3.4.10 Automatic Level Control

Parameter Type: select from list

The automatic level control function can adjust the actual measurement level (the voltage at both ends of the DUT or the current flowing through the DUT) to the set measurement level value as much as possible. Using this function can ensure that the test voltage or current at both ends of the DUT remains constant.

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 currently set level value is generally regarded as a non-constant level value.

Parameter Type: ON/OFF.

3.4.11 Source Resistance

When using the internal 100mA bias current, the output of the signal source has an output resistance, and the output signals of other bias current modes are not output through this internal resistance.

Parameter Type: select from list

The internal resistance can be selected from 100Ω or 30Ω, and the default is 100Ω.

When measuring inductance, in order to compare data with other types of testers, it is necessary to ensure the same output resistance value.

Note: When using the <u>internal 100mA</u> bias current output, 100Ω internal resistance is recommended by default.

3.4.12 Deviation and Reference

3.4.12.1 Deviation Mode

Parameter Type: select from list

The deviation measurement function can make the deviation value (instead of real test value) be directly displayed on the screen. The deviation value is equivalent to the real test value subtracting the pre-set reference value. This function brings great convenience to observe variations of component parameters with temperature, frequency, bias.

The instrument provides two deviation test modes as below:

Δ (Absolute Deviation Mode)

The deviation currently displayed is the difference between the test value of the DUT and the preset reference value. The formula of calculating ΔABS is as below:

$$\Delta = X - Y$$

Where:

- X is the test value of DUT

- Y is the preset reference value.

Δ% (Percentage Deviation Mode)

The deviation currently displayed is the percentage of the difference between the test value of DUT and the preset reference value divided by the reference value. Its calculating formula is as below:

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

Where:

- X is the test value of DUT.

- Y is the preset reference value.

If the reference value is 0, the measurement result shows Inf.

3.4.12.2 Deviation Reference Value

Parameter Type: numeric input

This is the reference value used to calculate the deviation of the measurement result.

3.4.12.3 Reference Value Setting Method

1) Regular numerical input;

2) Automatic recording after measurement: Select the measurement function in the corresponding menu area of the reference, a test will be executed, and the measurement result will be recorded here as the parameter value.

3.5 <Limit Setup>

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

Figure 3-12 Limit Setup Page

The comparator function of the instrument can be set on this page.

10 BIN limits can be set, and the measured results can be sorted into up to 11 BINs (BIN1 to BIN10 and BIN OUT).

- Comparison ON/OFF (comparison function switch)

- Count ON/OFF (comparison count switch)

- Mode (comparison function limit mode)

- Parameters (test parameters)

- Deviation (deviation mode)

- Reference (reference value in deviation mode, namely nominal value)

- Switches for each sorting BIN

- Lower limit value of each BIN (Low)

- Upper limit value of each BIN (High)

3.5.1 Comparator Function

Parameter Type: select from list

Parameter Type: ON/OFF

3.5.2 Compare Count Switch

Parameter Type: select from list

Parameter Type: ON/OFF

3.5.3 Comparator Function Limit Mode

The comparison function provides the following two parameter limit setting modes, as shown in the figure below:

Tolerance Mode

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

Sequential Mode

In sequential mode, the test value range is used as the comparison limit value. The comparison limit value must be set in ascending order.
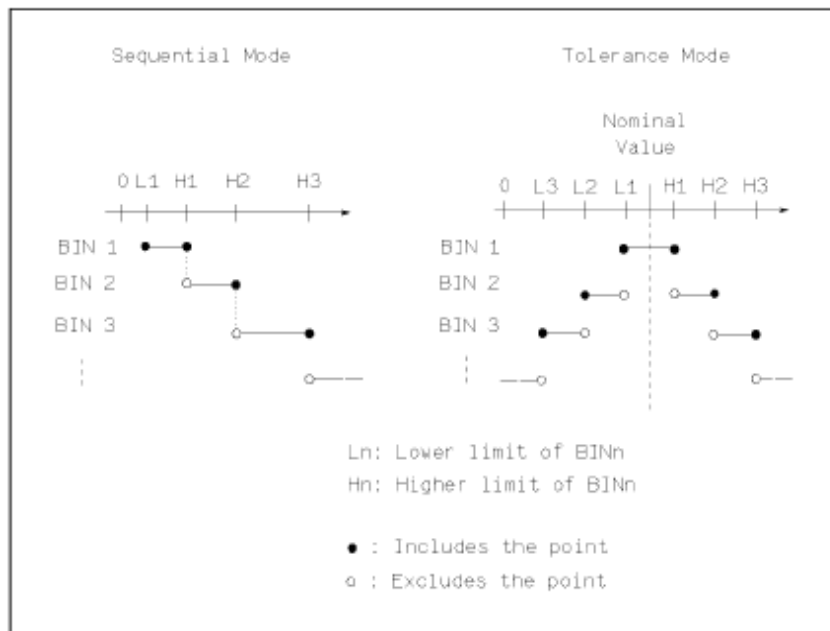
Figure 3-5-2 Tolerance Mode and Sequential Mode

Note: When setting the limit value in tolerance mode, the error range must be set from small to large. If the error range set by BIN1 is the largest, then all the measured parts will be sorted into BIN1 file.

In tolerance mode, the lower limit does not have to be less than the nominal value, and the upper limit does not have to be greater than the nominal value. The limits of each BIN can be discontinuous or overlapping.

3.5.4 Compare Parameters

Comparing parameters adopt the four measurement parameters; the sorting parameters can be modified on the measurement display page or the measurement setting page.

3.5.5 Deviations and References

Refer to the setting of the deviation and reference on the measurement settings page; the meaning of the parameter here is exactly the same.

3.5.6 BIN Switch

Parameter Type: select from list

Set the independent comparison switch of the specific sorting BIN:

Parameter Type: ON/OFF

When the corresponding sorting BIN is OFF, the sorting process will skip this sorting limit comparison.

3.5.7 High/Low Limit

As the main basis for parameter comparison.

If the upper and lower limits of the corresponding BIN are not set, it indicates that the parameter in the corresponding BIN does not participate in the comparison, that is, the measurement result does not affect the comparison result.

Parameter Type: numeric input

Note: When only the upper or only the lower limit is set, it is regarded as a unilateral comparison.

3.6 <List Setup>

Press [SETUP] and then [List Setup] to enter into the <List Setup> page as shown below.

Figure 3-13 List Setup

The list sweep function can perform auto sweep test for the measurement frequency, measurement level or bias voltage of 201 points.

On the <List Setup> page, the following list sweep parameters can be set:

- Total Point

- Trigger Mode

- List Mode (sweep mode)

- Sweep Condition (frequency [Hz], level [V], level [I], bias [V], bias [I])

- Parameter Function

- High/Low Limit (HIGH, LOW)

- Single Point Delay (DELAY[s])

3.6.1 Total Point

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

Parameter Type: select from list

3.6.2 Trigger Mode

This is the same as the trigger mode on the measurement settings page.

After the list sweep is triggered normally, the user can interrupt the list sweep process by pressing the [RESET] button:

- Press [RESET] once to pause, and continue scanning at the current point at the next trigger;

- Press [RESET] twice to reset, and restart scanning from the first point at the next trigger.

3.6.3 List Mode

Set the list sweep mode, choosing between sequential mode or single-step mode.

Parameter Type: select from list

Sequential Mode

Upon receiving a trigger signal, the instrument will sweep sequentially from the first point to the last point;

Single-Step Mode

Upon receiving a trigger signal, only one point can be tested at a time.

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

3.6.4 Sweep Condition

Frequency, level, and bias can be set independently, and can also be quickly set to make one of the conditions remaining relatively regular.

If you are only concerned about the impact of one condition change on the DUT, you can quickly set other measurement conditions to the same result, such as a linear change in frequency, and a fixed level and bias.

Regarding the frequency, level and bias in the sweep condition, you can choose whether to display it on the test page, touch the title area corresponding to the parameter, and then select ON or OFF on the corresponding menu.

3.6.5 Parameter Function

Four parameter functions, all of which can be set independently, and can also be quickly set to make one of the conditions relatively consistent.

Figure 3-14 List Parameter Display Menu

3.6.6 High/Low Limit

The upper and lower limits of the parameters can be set independently, and can also be set quickly to make the settings have a specific ratio.

3.6.7 Delay

The delay parameter indicates the delay time from the completion of each sweep step measurement to the next sweep measurement. It is mainly used to connect an external bias source (such as ST1778) to adapt to the delay time setting required by the external bias source.

Note: The delay here can be accumulated with the delay in the measurement setting interface.

3.7 <Trace Setup>

Press [SETUP] and then [Trace Setup] to enter into the <Trace Setup> page.

Figure 3-15 Trace Setup

This display function page is used to complete the setting of trace sweep measurement parameters, including split, sweep point, sweep type, start condition, stop condition, trace mode, X Format, Max-Min switch, 4 parameters, and Y display range, etc.

3.7.1 Common Measurement Settings

Frequency, level, speed, range, offset, trigger, delay, etc. are all common measurement conditions, and their meaning and setting method are exactly the same as the description on the measurement settings page.

3.7.2 Sweep Parameters

The 4 sweep parameters are used to specify the result parameters of the trace sweep, that is, to draw the measurement results under certain conditions into a curve;

The sweep parameters and the conventional component 4 test parameters are independent of each other and not directly related. Optional parameters can be selected, except for RD.

The sweep parameters correspond to 4 curves; each curve has independent display switch, display scale and independent ordinate scale, but share the same abscissa scale.

3.7.3 Spilt

For the curve display effect, 3 kinds of split screen display are available:

Split	Description
1-Split / None	All curves are displayed in the same drawing window
2-Split	4 parameters are grouped in pairs and displayed in the corresponding drawing window
4-Split	4 parameters are displayed independently in their respective drawing windows

3.7.4 Sweep Point

This is the number of points to be scanned. There are five groups of 51, 101, 201, 401, 801 to choose from.

3.7.5 Sweep Type

The sweep type is mainly used to set the conditions of the trace sweep, that is, to plot the measurement results according to the selected condition parameters, so it involves the type of condition parameters, the start size and the stop size of the condition change.

Set the main conditions corresponding to the sweep curve, namely frequency [Hz], level [V], level [A], bias [V], bias [A];

Sweep Type	Description	Linear	Logarithmic
Freq[Hz]		√	√
Level [V]	The condition changes within the specified interval (between start and stop), and record the corresponding parameter results after changing in a linear or logarithmic relationship	√	×
Level[A]		√	×
Bias[V]		√	×
Bias[A]		√	×

3.7.5.1 Starting Conditions

After selecting the sweep type, set the start size and stop size of the corresponding conditions; that is, the start and stop points of the trace sweep.

3.7.6 Trace Mode

Set the trace sweep mode to either sequential mode or single-step mode.

Parameter Type: select from list

Sequential Mode

Upon receiving a trigger signal, the instrument will sweep sequentially from the first point to the last point;

Single-Step Mode

Upon receiving a trigger signal, only one point can be tested at a time.

Note: The effect of the trace mode is mainly reflected in single trigger mode. If the instrument is in 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 the coordinate mode of sweep, mainly for the abscissa.

Linear

The sweep condition parameters are linearly distributed within the start and stop ranges;

Logarithmic

The sweep condition parameters are distributed in a logarithmic manner with the base 10 within the start and stop ranges.

Note: The logarithmic mode is only valid in the case of sweeping frequency.

3.7.8 Max/Min

Parameter Type: ON/OFF

- ON: Display the maximum and minimum values of the parameter curve results

- OFF: Do not display the maximum and minimum values of the parameter curve results

3.7.9 Ordinate Range Setting

The ordinate range is used to limit the drawing range of trace sweep.

The instrument defaults to automatic coordinates. Only when the user locks the coordinates, this item needs to be set manually. Similarly, the maximum value should be greater than the minimum value; otherwise an error message will be displayed.

3.8 User Correction

10 user PT are provided on the <User Corr> page. In the Freq domain, you can set whether the calibration data of the corresponding point is turned on. After turning on, manually enter the frequency corresponding to the calibration, and then use the soft key [Open] to execute open-circuit correction, short-circuit correction, and load correction for the set frequency.

Press the menu key [SETUP], and press the soft key [User Corr] to access the <User Corr> page.

See the following figure:

Figure 3-16 User Correction

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

Two correction methods are provided:

Correction Mode	Description
Full Frequency Correction	Use insertion method to execute open-circuit and short-circuit correction of all frequency points
Point Frequency Correction	Execute open-circuit, short-circuit and load correction of the current set frequency point

The following measurement control parameter setting domains can be set on the <User Corr> page:

• Open-Circuit Correction (Open)

• Short-Circuit Correction (Short)

• Load Correction (Load)

• Cable Length Selection (Cable)

- Load Type

- Point Frequency Correction Switch

- Reference Value; etc.

3.8.1 Open-Circuit Correction

The open-circuit correction function can eliminate the error caused by the stray admittance (G, B) connected in parallel with the component under test, as shown in the figure below:
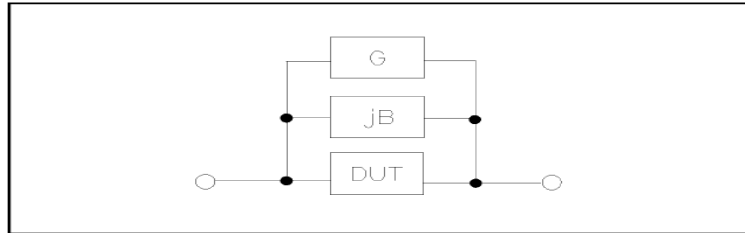
Figure 3-17 Stray Admittance

The following two open-circuit correction data are used:

Regardless of the frequency you currently set, perform an open-circuit correction test on all the following fixed frequency points. In addition, based on the open-circuit correction data at the following frequency points, the instrument can calculate all open-circuit correction data of different measurement ranges which corresponds to all test frequencies by using the interpolation calculation method. Move the cursor to the Open field, and use the soft key [Meas Open] to execute the full frequency open-circuit correction. The fixed frequency points are as follows (some models will be limited due to different frequency ranges).

20 Hz	25 Hz	30 Hz	40 Hz	50 Hz
60 Hz	80 Hz	100 Hz	120 Hz	150 Hz
200 Hz	250 Hz	300 Hz	400 Hz	500 Hz
600 Hz	800 Hz	1 kHz	1.2 kHz	1.5 kHz
2 kHz	2.5 kHz	3 kHz	4 kHz	5 kHz
6 kHz	8 kHz	10 kHz	12 kHz	15 kHz
20 kHz	25 kHz	30 kHz	40 kHz	50 kHz
60 kHz	80 kHz	100 kHz	120 kHz	150 kHz
200 kHz	250 kHz	300 kHz	400 kHz	500 kHz
600 kHz	800 kHz	1MHz	1.1MHz	1.2MHz
1.3MHz	1.4MHz	1.5MHz	1.6MHz	1.7MHz
1.8MHz	1.9MHz	2MHz		

Operation Steps to Use the Open-Circuit Correction Function:

Open-circuit correction includes full frequency open-circuit correction using interpolation calculation method, and single frequency open-circuit correction for the set frequency point. Carry out the following steps to perform open-circuit correction for full frequency using the insertion calculation method. For details about single-frequency open-circuit correction, please refer to the "Load Correction" operating instructions.

Move the cursor to the Open setting field, and the following soft keys are displayed in the soft key area of the screen.

- **OFF:** Turn off the open-circuit correction function. The calculation of open-circuit correction will no longer be carried out in the subsequent measurement process.

- **ON:** Turn on the open-circuit correction function, and the correction calculation will be performed in the subsequent test process. If the frequency settings are all OFF, the open-circuit correction calculation uses the correction data of the current frequency calculated by the interpolation method. If the frequency is set to ON, and the current measurement frequency is equal to the corresponding frequency, the correction data of the corresponding frequency will be used for the calculation of the open-circuit correction.

- **Meas Open:** The open admittance (capacitance and inductance) at the above fixed frequency point will be measured. The open-circuit full-frequency correction takes about 75s.

- **DCR Open:** The open-circuit resistance measurement under the DC resistance function will be performed.

Note: Connect the test fixture to the test terminal of the instrument. The fixture is open and not connected to any component under test.

3.8.2 Short-Circuit Correction

The short-circuit correction function of ST2840 series instruments can eliminate errors caused by spurious inductance (R, X) in serial with DUT, as shown in the following figure:
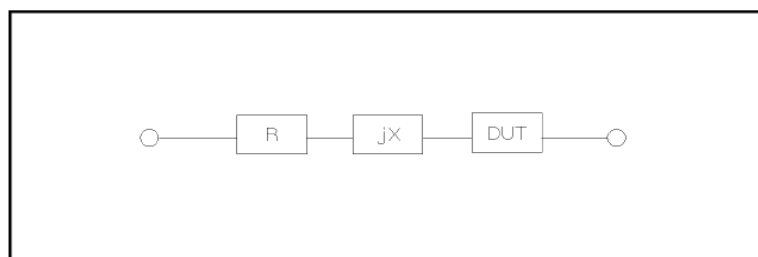
Figure 3-18 Spurious Inductance

The following two short-circuit correction data is used:

Regardless of the frequency you currently set, perform a short-circuit correction test on all the following fixed frequency points. In addition, based on the short-circuit correction data at the following frequency points, the instrument can calculate all short-circuit correction data of different measurement ranges which corresponds

to all test frequencies by using the interpolation calculation method. Move the cursor to the Short field, and use the soft key [Meas Short] to execute the full frequency short-circuit correction. The fixed frequency point is the same as the open-circuit correction.

Operation Steps to Use the Short-Circuit Correction Function:

The short-circuit correction includes the full-frequency short-circuit correction using the insertion calculation method and the single-frequency short-circuit correction for the set frequency point. Perform the following steps to perform short-circuit correction at full frequency using the insertion calculation method. For details on single-frequency short-circuit correction, please refer to the "Load Correction" operating instructions.

Move the cursor to the short-circuit setting field, and the following soft keys are displayed in the soft key area of the screen.

- **OFF:** Turn off the short-circuit correction function. The calculation of short-circuit correction will no longer be carried out in the subsequent measurement process.

- **ON:** Turn on the short-circuit correction function, and the correction calculation will be performed in the subsequent test process. If the frequency settings are all OFF, the short-circuit correction calculation uses the correction data of the current frequency calculated by the interpolation method. If the frequency is set to ON, and the current measurement frequency is equal to the corresponding frequency, the correction data of the corresponding frequency will be used for the calculation of the short-circuit correction.

- **Meas Short:** Connect the test fixture to the test terminal of the instrument. Short-circuit the test fixture with a short-circuit strip. Press the soft key [Meas Short], and the parasitic impedance (resistance and reactance) at the above fixed frequency point will be measured. The short-circuit full-frequency correction takes about 75s.

- **DCR Short:** The short-circuit resistance measurement under the DC resistance function will be performed.

3.8.3 Load Correction

The load correction function uses the transfer coefficient between the actual test value at the set frequency point and the standard reference value to eliminate other test errors. It can be seen that open circuit, short circuit and load correction can be performed at the set frequency point. Before setting the standard reference value, the reference value must be set in the reference value corresponding field. When the cursor moves to Freq or Ref, the screen displays the soft key [Load]. Press the [Load] key to perform a load correction test on the standard.

Parameter Type: ON/OFF

- **OFF:** Deactivate the load calibration test data under the current set frequency.

- **ON:** Activate the load calibration test data under the current set frequency.

3.8.3.1 Load Type

When performing load correction, the reference value of the standard device must be input in advance.

The test parameters of the reference value should be consistent with the set load correction measurement function. The load correction function uses the transfer coefficient between the actual test value at the set frequency point and the standard reference value to eliminate other test errors. The load correction measurement function is only used to calculate the transfer coefficient.

This series categorizes the load types into 3 categories:

- Ls~Rs

- Ls~Q

- Cp~D

3.8.4 Cable

The cable length currently available is 0m and 1m. The factory default is 0m.

3.8.5 Point Frequency Operation

Follow the steps below to perform an open/short/load correction test on the set frequency point. Move the cursor to the frequency setting area. The screen will display the following soft keys:

- **OFF:** Deactivate the open-circuit/short-circuit/load correction data at the currently set frequency.

- **ON:** Activate open-circuit/short-circuit/load correction data at the currently set frequency; the frequency setting field then displays the originally set open-circuit/short-circuit/load correction frequency.

- **Open:** Perform an open-circuit correction at the current frequency.

- **Short:** Perform a short-circuit correction at the current frequency.

- **Load:** Perform a load correction at the current frequency.

Operation Steps to Use the Load Correction:

1) Move the cursor to the Freq setting area, and set the frequency to be calibrated.

2) Open the test fixture, and press the soft key [Open] to perform open-circuit correction for the current set frequency.

3) Short-circuit the test fixture and press the soft key [Short] to perform short-circuit correction for the current set frequency.

4) Prepare a measurement standard device, move the cursor to the Load Type setting field, and set the type of function parameters that the standard device needs to measure.

5) Move the cursor to the corresponding frequency setting domain, connect the standard device to the test fixture, press the soft key [Load], and the instrument will perform a load calibration. The actual measurement result of the standard device is displayed on the load.

4 System and File

4.1 <System Setup>

Press the menu key [SYSTEM] to enter the <System Setup> page.
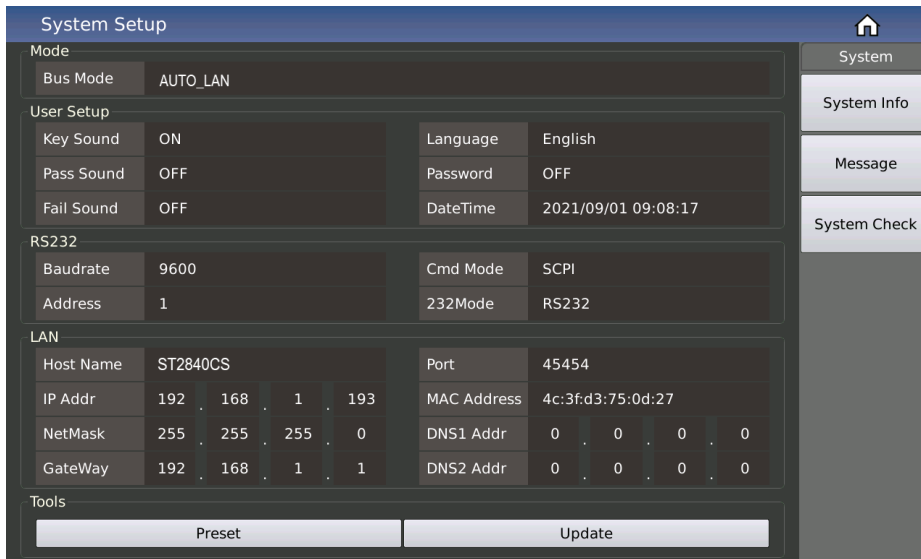
Figure 4-1 System Setup

4.1.1 Mode Setup

Bus Mode: The bus mode is used to select the communication mode of the instrument.

The options are as follows:

AUTO	Automatically select the RS232/LAN/USB communication mode according to the external signal input
RS232	RS232
	External 485
	External GPIB
LAN	–
USB Device	USBCDC
	USBTMC

Note: The Sourcetronic GPIB option must be installed to support the GPIB mode.

When using the RS485 or GPIB interface, the bus address under the RS232 setting will be used as the local address.

4.1.2 User Setup

4.1.2.1 Key Sound

Parameter Type: select from list

Setting Options: ON/OFF

4.1.2.2 Pass Sound

Parameter Type: select from list

This parameter is used to control and display the sound mode when the measurement comparison result of the instrument is qualified.

Setting Options:

- OFF

- Two Short

- Low Long

- High Short

- High Long

4.1.2.3 Fail Sound

Parameter Type: select from list

This parameter is used to control and display the alarm sound mode when the measurement comparison result of the instrument is defective.

Setting Options:

- OFF

- Two Short

- Low Long

- High Short

- High Long

4.1.2.4 Language

Parameter Type: select from list

This parameter is used to control and display the operating language currently set on the instrument.

Setting Options: English/Chinese

4.1.2.5 Password

Parameter Type: select from list type + input type

This parameter shows the current password protection mode.

Setting Options:

- **OFF:** Turn off password protection

- **Lock System:** Activate password protection, including file protection

- **Lock File:** File protection for users

- **Lock Setup:** used to restrict modifications on the settings file

- **Modify:** This soft key is used to change the password. After pressing this button, enter the new password according to the prompt on the screen. After inputting from the keyboard, the screen prompts to confirm the new password, repeat the new password, and the password modification is completed.

Note: The factory default password is **2840**.

4.1.2.6 Date/Time

Here you can modify the system time and date.

4.1.3 RS232

The general setting parameters of the serial port are: 8 data bits, 1 stop bit, no parity bit.

4.1.3.1 Buad Rate

Parameter Type: select from list

This parameter is used to select the baud rate of the built-in RS232 interface of the instrument.

Setting Options:

- 4800

- 9600

- 19200

- 38400

- 57600

- 115200

4.1.3.2 Address

Parameter Type: numeric input

This parameter is used to control and display the RS485, GPIB interface and Modbus address.

Value Range: 1~32

4.1.3.3 Cmd Mode

Parameter Type: select from list

This parameter is used to set the command mode with SCPI command and modbus command protocol.

Setting Options:

- **SCPI:** Adopt general ASCII string command protocol

- **Modbus:** Adopt modbus command protocol

For a more detailed introduction, please refer to Chapter 9 Command Reference.

4.1.4 LAN

Configure the corresponding address parameters according to the specific attributes of the connected LAN, and plug in the network cable on the rear panel to use the network port for communication.

If you need to modify the relevant address parameters, you can directly double-click the corresponding address display window to pop up the numeric keyboard, enter the correct network configuration on the numeric keyboard, and click OK to exit the keyboard to complete the modification;

If the connected networking equipment (router or switch) supports the automatic IP allocation function, you can directly click the automatic configuration button in the display window to try the automatic configuration. The configuration takes a few seconds. Do not operate the machine during the configuration process. If the equipment does not support it, you need to manually assign the setting address.

If the automatic configuration fails, you may get the loopback IP address of the machine, that is, 127.0.0.1; at this time, you can click the default setting button in the display window to restore the default configuration, and then start again on the basis of the default configuration. Just make fine adjustments, and you can consult the company's network technical engineer to obtain the address parameters of the network configuration.

Default Port Number: 45454

The host name generally corresponds to the instrument model.

4.1.5 Tools

4.1.5.1 Preset

For the convenience of customers, the instrument can be initialized to a known unified initial state.

Standardize initial software operation design .

In order to solve the problem of inconsistent setting status when the instrument leaves the factory.

	English Menu	Description	Command
1	CLEAR SETTING	Restore the following parameters to the factory default settings: a. Parameters set through front panel operation b. Parameters set by SCPI commands	*RST
2	CLEAR SET & CORR	Restore the following parameters to the factory default settings: a. Parameters set through front panel operation b. Parameters set by SCPI commands c. Power-off protection parameters d. Clear user correction data	:SYST:PRES
3	FACTORY DEFAULT	Restore the following parameters to the factory default settings: a. Parameters set through front panel operation b. Parameters set by SCPI commands c. Power-down protection data d. Clear user reset data e. Clear files saved by users	:SYS:DEFT

Note: Parameters that cannot be initialized:

- The initialization operation is not allowed to clear the system calibration data.

- The real-time clock date and time are not allowed to be cleared or initialized.

4.1.5.2 Update

This function is used for software version upgrade and maintenance. ST2840 series instruments are designed with multiple CPUs. For your convenience, a one-key option to update firmware is provided. After the one-key update, you need to wait only about 2 minutes (refer to the prompts on the screen). After the update is completed, the instrument will automatically restart. After restarting, you can return to this menu to check that the software version you are now using is the latest version.

The update menu is shown in Figure 4-2:
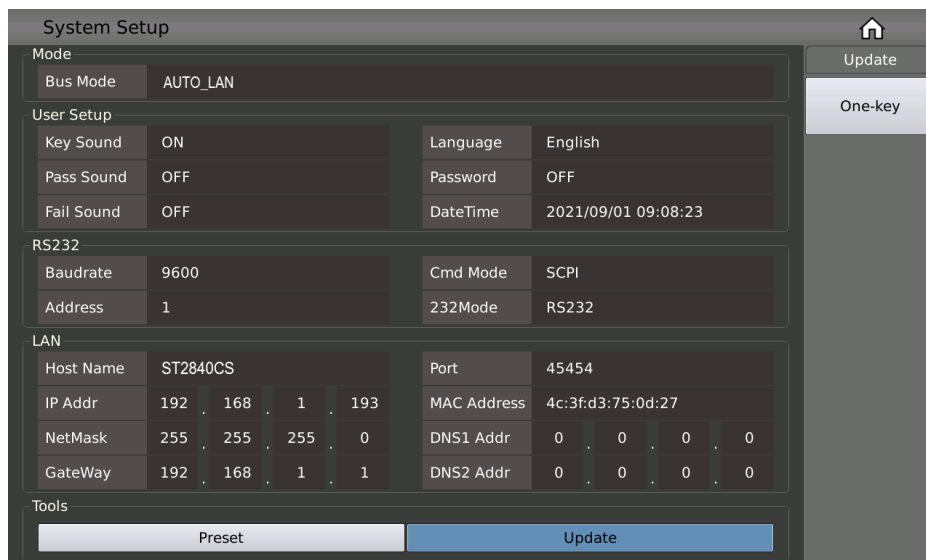
Figure 4-2 Update Menu

The dynamic prompt window of the one-click upgrade is shown in Figure 4-3:
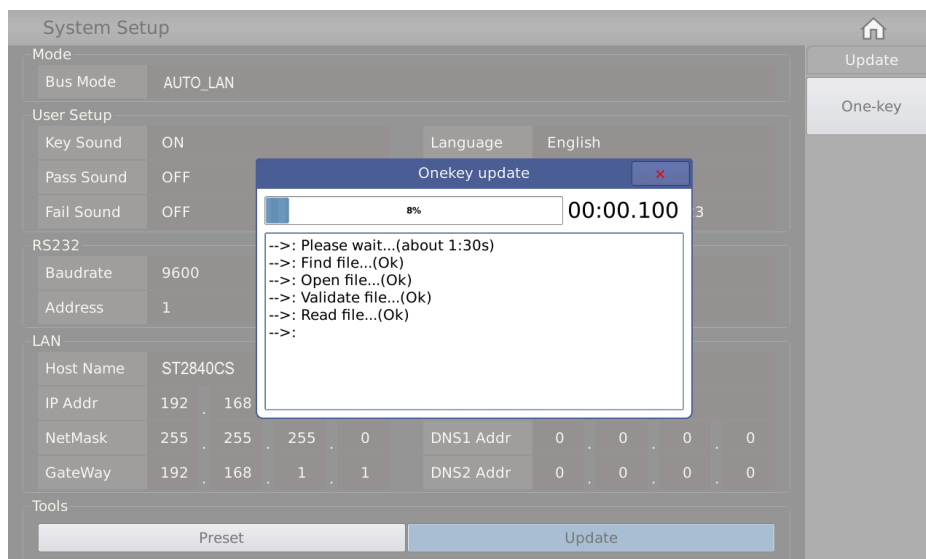
Figure 4-3 Update Pending Prompt

4.2 <File>

As your instrument is equipped with an embedded file system, it can be very convenient to store the custom-set parameters as a file, either in the system's internal drive or on an external USB drive. This way you won't have to re-configure the parameters next time if you want to use the same settings again; you can simply load the corresponding file, saving you time and improving efficiency.

Press the soft key [FILE] to enter the <File> function page.
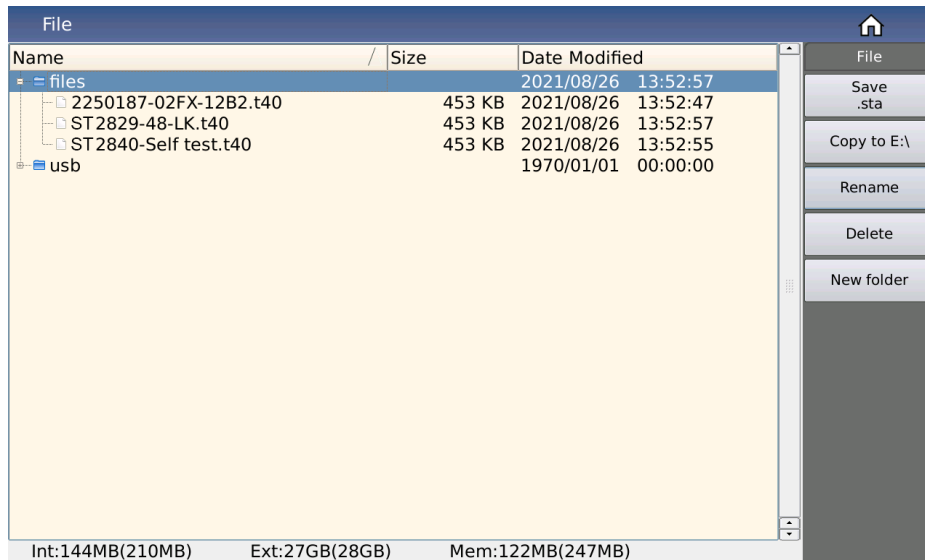
Figure 4-4 File Function Page

4.2.1 USB Drive Performance Management

As mentioned above, this series comes equipped with a USB host interface. An external USB flash drive can be used as a storage medium, thus breaking the limitation of the internal storage size of the instrument. You can also copy these files to an IBM PC with a USB interface or a desktop computer or Notebook computers compatible with it, so as to achieve unlimited expansion.

Supports USB storage devices (USB flash drives) that fulfil the following criteria:

* Compliant with USB 2.0 standard

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

4.2.2 Introduction to the Save/Load Function

Using the save/load function, you can save configuration information either to the device's own internal drive or to an external USB flash drive, and in turn load files from there.

Note: Measurement results and screenshots can only be saved to the external USB flash drive.

Setting Options:

- **File:** internal file;

- **USB:** external file

The following table explains the available storage methods and their uses:

Storage Method		Loadable	Usage
Type	**File Format**		
LCR Settings	*.sta	Yes	Save the LCR measurement configuration status.
Transformer Single-Group Settings	*.trt	Yes	Save the transformer single-group measurement configuration status.
Transformer Sweep Settings	*.t40	Yes	Save the transformer sweep measurement configuration status.
Screenshot	*.png	No	Save a screenshot of the display.
Measurement Data	*.csv	No	Save measurement data

4.2.3 Basic Menu Operations of File Management

The various operations on the file are as follows:

The up and down keys and the knob of the arrow keys are used to move the file cursor up and down, and the left and right keys of the arrow keys are used to operate the expanded state of the current path;

Click to select the file name to be operated, and the operation can be performed as follows according to the toolbar on the right side of the screen:

Save .sta/.trt/.t40

Depending on the current measurement, this refers to the LCR mode, the transformer single group mode, and the transformer sweep mode. The default menu is the corresponding file save menu. When the cursor is on the files path, the measurement will be carried out after inputting the file name. The settings file is saved in the root directory.

Copy to E:

When the cursor is on an internally stored file or folder, this will copy it to the USB root directory.

Note: If you are copying a single file, it will overwrite any file of the same name in the USB path; if you are copying a folder, please make sure that there is no folder with the same name in the USB root directory, otherwise it will cause the error message "Copy Failed".

Copy to I:

When the cursor is on a file or folder stored on the USB device, this will copy it to the internal root directory.

Delete

Delete the file or folder at the cursor's position.

Load

Load the settings file specified by the file index to re-configure the parameter settings of the instrument.

Rename

Rename the file or folder at the cursor's position.

Note: The root directory provided is not modifiable.

New Folder

Create a new folder directory at the current cursor location; you can save a new test file in the newly created folder directory.

4.2.4 Operation Steps for File Management (Save/Load)

Move the cursor using the up and down arrow keys and the knob; expand and zoom in and out using the left and right arrow keys of the arrow keys.

Save File

Move the cursor to the folder or any file in the folder where you want to save the settings file, and the corresponding menu area will display the file menu:

- Load (If it is a loadable file type)

- Save

- Copy to E:\

- Rename

- Delete

- New folder

Press the [Save] soft key, the screen will display a numeric keyboard to input the file name. The file name suffix is automatically generated, so only the first part of the file name needs to be input manually. After the input is confirmed, your file should show up in the directory.

4.2.4.1 Load File

When you move the cursor to a loadable file in the file list or directly enter the file number of a loadable file, this option will be displayed.

Press the [Load] soft key, and the following confirmation dialog box will be displayed on the screen:

- Load

- Cancel

Pressing the soft key [Cancel] will cancel the current loading operation and return you to the previous screen. If you confirm by pressing [Load], the currently selected file is loaded. After loading, the instrument will automatically return to the corresponding measurement display page.

4.2.4.2 Copy File

When you move the cursor to the folder or file to be copied, the menu area will display:

- Copy to E:\

- Copy to I:\

Press the key [Copy to E:\] to copy the file to the root directory of the external storage USB disk of the instrument.

Press the key [Copy to I:\] to copy the file to the internal root directory of the instrument.

Note: Please make sure that your USB flash drive meets the standards described in this section and is <u>not</u> set to read-only mode (write-protected).

5 Execute LCR Measurement and Some Examples

5.1 Corrections

You can select one of two correction modes (applied to the entire list via sweep mode or applied to one specific frequency point) to execute an open-circuit or short-circuit correction; this will help prevent the stray impedance from affecting test accuracy.

5.1.1 Sweep Correction

- Press the menu key [CAL] and the instrument will display the <Correction> page.

- Move the cursor to the Open zone. ON, OFF, [Meas Open] and [DCR Open] will be displayed in the soft key zone.

- Keep the test fixture be in the open status, then press [Meas Open] to execute an open-circuit correction until the prompt information zone displays that open-circuit correction is finished.

- Press ON to turn on the open-circuit correction function.

- Insert the short plate (ST26010) to the test fixture.

- Move the cursor to the Short zone. ON, OFF, [Meas Short] and [DCR Short] will be displayed in the soft key zone.

- Press [Meas Short] to execute the short-circuit correction till the prompt information zone displays that the short-circuit correction is finished.

- Press ON to turn the short-circuit correction function.

- Move the cursor to the Load zone. ON, OFF will be displayed in the soft key zone.

- Press OFF to turn off the load correction function.

- Move the cursor to the Freq zone, ON, OFF, [Meas Open], [Meas Short] and [Meas Load] will be displayed in the soft key zone.

- Press OFF to turn off the point-frequency correction function of Freq.

5.1.2 Point-Frequency Correction

This function will yield better results in single-frequency test.

If the measurement frequency is 5.5kHz…

- Press the menu key [CAL] and the instrument will display the <Correction> page.

- Move the cursor to the Freq zone, ON, OFF, [Meas Open], [Meas Short] and [Meas Load] will be displayed in the soft key zone.

- Press ON to turn on the point-frequency correction function of Freq.

- Press the key to input the specified frequency size of 5.5k. The frequency area will be changed to 5.5000kHz (the same as the measurement frequency).

- Keep the test fixture open and press [Meas Open] to execute an open-circuit correction.

- Insert the short plate (ST26010) to the test fixture.

- Press [Meas Short] to execute a short-circuit correction.

5.2 Correct Connection of DUT

The instrument has Hcur (current sampling high end Hc), Lcur (current sampling low end Lc), Hpot (voltage sampling high end Hp), Lpot (voltage sampling low end Lp) and a total of four pairs of test terminals corresponding to the shielding end of each test terminal.

Each terminal contains a shielding layer whose function is to reduce the influence of the ground stray capacitance and the interference of the electromagnetic field.

In the process of measuring, Hcur, Hpot and Lpot, Lcur should be connected with DUT lead to form a complete 4-terminal measurement, thus reducing the effect of the lead and the connection points on the measurement results (especially the dissipation measurement). When measuring low-ohm components, Hpot, Lpot should be connected to the lead terminal so as to avoid the impedance being added to the lead impedance; the connection principle is that the Hpot and Lpot test should be the actual existed voltage on DUT.

Note: In other words, before connecting to DUT, it is not recommended to connect Hcur, Hpot with Lpot, Lcur, as doing so will increase test error!

If the connection point and the lead resistance R lead are far weaker than the tested impedance (for example: $R_{lead}<Z_x/1000$, the accuracy error is required to be less than 0.1%), before connecting to DUT, it is recommended to connect Hcur, Hpot and Lpot, Lcur (two terminal test).

In a test with a high accuracy requirement, using a Kelvin test fixture (standard accessory) will gain better results than using test leads. When a Kelvin test lead is used under 10kHz, a better measurement result can be obtained. However, when the frequency is higher than 10kHz, it cannot meet the measurement demand. At a high frequency, the change of the clearance between test leads will directly change stray capacitance and inductance on test terminals – this problem is unavoidable because the test leads cannot be fixed in a position.

So, at a high frequency, a test fixture should be used if possible. If there is no test fixture available or none can be used, the status of test leads should be the same in the processes of correction and test.

No matter the standard Kelvin test fixture or Kelvin test leads or user-made fixture is used, the following requirements should be met:

- Distribution impedance must be reduced to a minimum especially when measuring high impedance components.

- Contact resistance must be reduced to a minimum.

- Short-circuit and open-circuit must be available between contact points. Open-circuit and short-circuit correction can easily reduce the influence of distribution impedance of the test fixture on measurement. For open-circuit correction, the clearance between test terminals should be the same as that when they connect with DUT. For short-circuit correction, the short plate of low impedance should be connected between test terminals. Another way is to directly connect Hc with Lc or Hp with Lp, then connect both.

Note: When the DUT is a polarity component, before measuring, the high potential terminal should be connected to the terminal with mark "+", "Hc" or "Hp" and the low terminal should be connected to the terminal with mark "-", "Lc" or "Lp".

Warning!	
⚠	Before measuring, please discharge the tested polarity component so as to avoid the damage to the instrument.

5.3 Eliminate the Influence of Stray Impedance
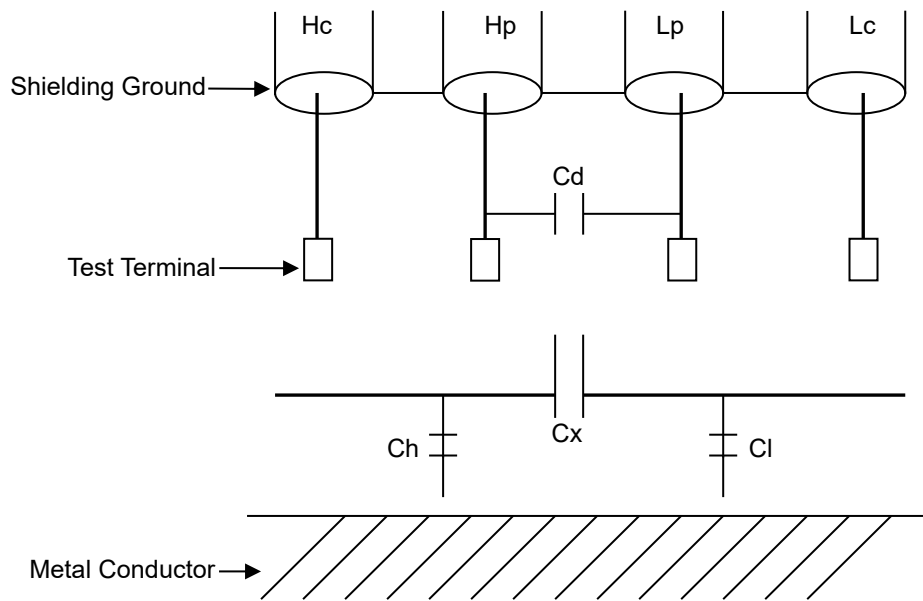
Figure 5-1 Influence of Stray Impedance (Problem)
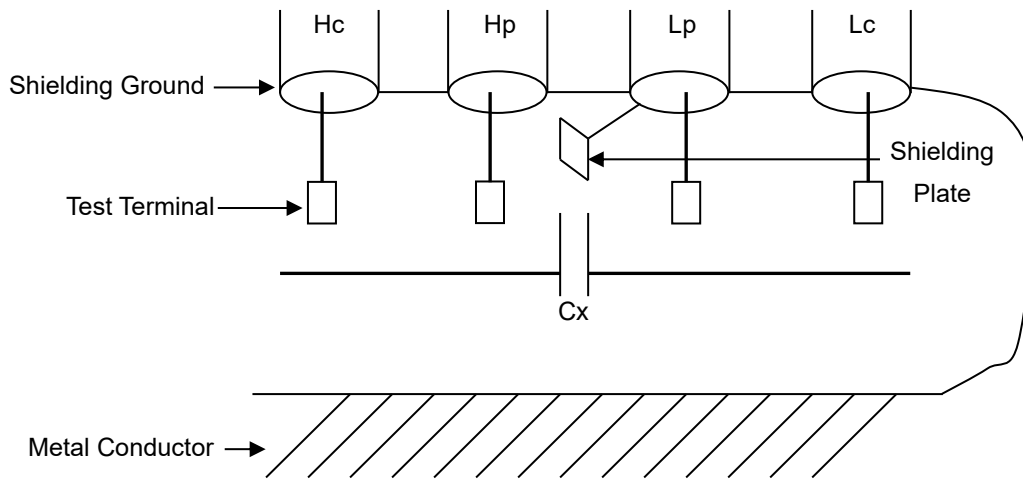
Figure 5-2 Influence of Stray Impedance (Solution)

When the DUT has high impedance (such as small capacitance), the influence of stray capacitance cannot be ignored. Figure 5-1 is an example of the use of 4 terminal pair measurement. In this figure, Cd is connected with Cx in a parallel way and when a conductance plate is positioned under DUT, capacitance Ch will connect with Cx in parallel after connecting with Cl in series; this way the measurement result will have errors. If a ground conductor is installed between high and low terminals, Cd can be reduced to minimum. Meanwhile if the ground terminal is connected to the conductance plate, the influence of Ch and Cl will be eliminated.

When the DUT is low impedance (such as small inductance, large capacitance), a large current will flow through the test leads Hc and Lc. In this case, **electromagnetic coupling between test leads becomes the main source of test errors**, except for the influence of the contact resistance on test terminals. If this coupling cannot be eliminated, it will bring unexpected influence on measurement results.

Generally, contact resistance affects the resistance of impedance and electromagnetic affects the reactance of impedance. Test terminals can adopt a 4-terminal-pair (4TP) connection method.

With a 4TP connection, the currents flow though Hc and Lc are equal in value and opposite in direction compared to those flowing through each shielding terminals (the current reflow from Hc to shielding layer). This way, the magnetic fields produced by these currents can be mutually offset and further eliminate the influence of mutual inductance coupling on measurement results.

5.4 Example: Testing Inductance

5.4.1 Measurement Settings

Function: Ls-Q

Frequency: 5.5kHz

Level: 1.5Vrms

Internal impedance: 100Ω

5.4.2 Operation Steps

- Turn on the instrument.

- Set basic parameters.

- Press [DISP] to enter into the <Meas Display> page.

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

- Press Ls to select Ls measurement function.

- Move the cursor to Freq, the current frequency is 1.0000kHz. The frequency can be modified as needed.

- Move the cursor to Level, the current displayed level will be 1.000V.

- Press [SETUP] to enter into the <Meas Setup> page.

- Move the cursor to R_{sou} zone, 100Ω and 30Ω will be displayed in the soft key zone.

- Press 100Ω to select 100Ω as the signal internal impedance.

- Connect the test fixture (ST26005) to the test terminals.

- Perform a correction (to avoid the influence of stray impedance on measurement accuracy, an open-circuit/short-circuit correction is needed)

- Mount the tested inductance to the test fixture.

- Execute test operation.

- Press [DISP] to enter into the <Meas Display> page. The instrument will continuously test and put the measurement result in the center of the page.
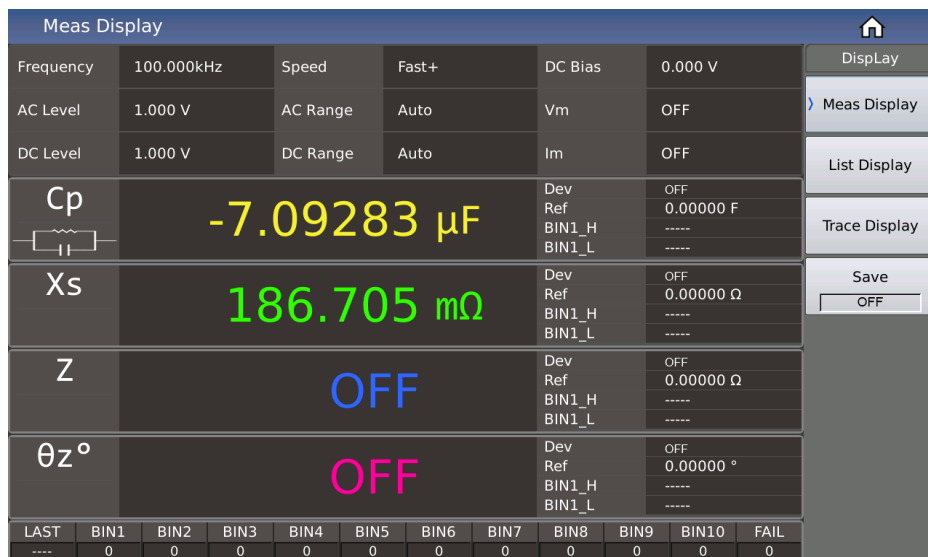
If the measurement result is obviously incorrect, please check the following items.

a)   Check the tested inductance is in good connection with the test fixture or not.

b)   Check the test fixture is in good connection with the test terminals of the instrument or not.

c)   Redo the open-circuit/short-circuit correction.

Note: When the sweep open-circuit/short-circuit correction is used, the point-frequency correction function should be set to OFF.

5.5 Example: Testing Capacitance by Multi-Frequency List Sweep

5.5.1 Measurement Settings

Function: Cp, D

Level: 1Vrms

Other Parameters:

Frequency	Comparison Parameter	Low Limit	High Limit
1kHz	Cp (capacitance)	325.0nF	333.0nF
10kHz	D (dissipation)	0.0001	0.0003
100kHz	D (dissipation)	0.0060	0.0100

Sound: High Long

Alarm Mode: OFF

5.5.2 Operation Steps

Turn on the instrument.

Set Basic Parameters:

•   Press [DISP] to enter into the <Meas Display> page.

•   The Parameter zone is currently displayed as Cp, D and the Level zone is 1.000V.

•   Press [SETUP] to enter into the <Meas Setup> page, meanwhile the following soft keys will be displayed in the soft key zone: [Meas Setup], [User Corr], [Limit Setup], [List Setup] and [FILE].

•   Press the [List Setup] button to enter into the <List Setup> page.

•   Press the knob to move the cursor to the parameter area of sweep point 1, modify the measurement conditions of the current point, including Frequency, Level, Bias, Limit, Delay, etc.

Sound Setup:

- Press [SYSTEM] to enter into the <System Setup> page.

- Move the cursor to the Fail Sound zone to select [High Long].

- Mount the test fixture (ST26005) to the test terminals of the tester.

- Execute correction function (To avoid the influence of the stray impedance on the measurement accuracy, an open-circuit/short-circuit correction is needed).

- Insert the tested capacitor to the test fixture.

Execute Test Operations:

Press [DISP] and then [List Sweep] to enter into the <List Sweep Display> page. The instrument will test continuously and then display the test and the comparison results on page. If the comparison result is PASS or FAIL, there is a sound alarm.

Pt	Freq	Level	Bias	Para1	Para2	Para3	Para4	P/F	Display
1	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	Meas Display
2	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	
3	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	
4	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	〉 List Display
5	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	
6	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	Trace Display
7	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	
*8	1.00000kHz	1.00000 V	0.00000 A	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	Cp=-22.9015pF	- - -	Save / OFF

List Display

If the measurement result is obviously incorrect, please check the following items:

a) Check the tested inductance is in good connection with the test fixture or not.

b) Check the test fixture is in good connection with the test terminals of the instrument or not.

c) Redo the open-circuit/short-circuit correction.

Note: When the sweep open-circuit/short-circuit correction is used, the point-frequency correction function should be set to OFF.

5.6 Example: Load Correction

5.6.1 Operation Steps

Assume the following measurement conditions:

Frequency: 100kHz.

Cp Standard Value: 11nF

D Standard Value: 0.0005

- Press [CAL], the instrument will display the <User Corr> page.

- Move the cursor to Load, the following soft keys will be displayed in the soft key zone: ON and OFF.

- Press ON to turn on the load correction function.

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

- Press [Cp-D] to select the Cp-D function.

- Move the cursor to Freq zone, the following soft keys will be displayed in the soft key zone: ON, OFF, [Open], [Short] and [Load].

- Press ON to turn on the point-frequency correction function of the corresponding Freq in current correction point.

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

- Move the cursor to Freq zone, the following soft keys will be displayed in the soft key zone: ON, OFF, [Open], [Short] and [Load].

- Hold the test fixture be in open status and keep user's hands or other interference source be far away from the test fixture. Press the soft key [Open] to execute an open-circuit correction.

- Insert the short plate (ST26010) into the test fixture. Please ensure that the short plate and the reeds of the test fixture have good contact.

- Press the soft key [Short] to execute a short-circuit correction.

- Insert a standard capacitance into the test fixture. Please ensure that the pins of the standard capacitance have good connection with the reeds of the test fixture.

- Press the soft key [Load] to execute a load correction.

Note:

- Because of the different software editions, the soft keys and status information may be different form this book, but it may not affect users' understanding.

- The load correction is only valid for the components with the same specification. If the specification is changed, it is required to redo load correction.

6 Transformer Single-Machine Test

6.1 Circuit for Transformer Single-Machine Test

6.1.1 Some Transformer Parameters
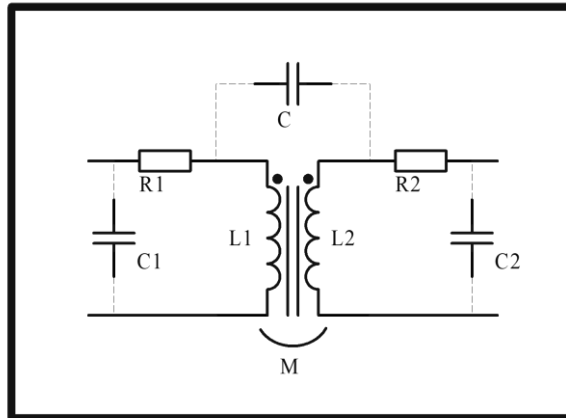
6.1.2 Transformer Single Test Circuit and TURN Test
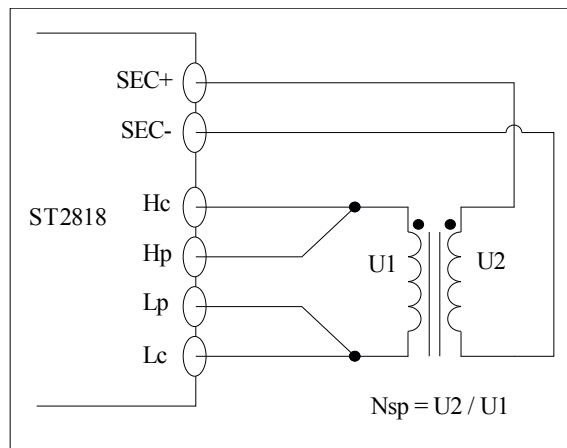
On ST2840X, TURN test has 4 display modes:

- Ns: Np   = U2/U1

- Np: Ns   = U1/U2

- Ns   = Np*U2/U1

- Np   = Ns*U1/U2

The above U1 and U2 are the values automatically measured by the instrument, and the values of Np and Ns need to be set by the user in advance on the corresponding turns ratio parameters on the <Single Setup> page.

We recommend you put the winding group with more turns in primary winding rate; the reasons are as follows:

1) Due to the influence of output internal resistance (30, 100), when the primary inductance is too small, the distributed voltage signal is small and the transformer gets weak energy. As the test cable and relay will attenuate some energy, the stability and the accuracy of test will be affected.

2) If the primary signal is enlarged, the secondary winding of the winding with more turns will generate higher voltage which may beyond the acceptable range thus affecting the test accuracy.

3) If the winding group with more turns is put in primary class, then the transformer can get higher energy thus the two problems above can be avoided.

6.1.3 Transformer Leakage Inductance Test

When using the circuit discussed in the last section to execute an automatic sweep test on the leakage inductance of primary inductance L1, the instrument will automatically use the relay to short the secondary winding of the transformer so as to test the leakage inductance. There is inevitably magnetic leakage from transformer secondary winding to inner relay, so this area will necessarily have some error of leakage inductance.

If you want to obtain an accurate leakage value, please short the secondary winding of the transformer based on the figure below.
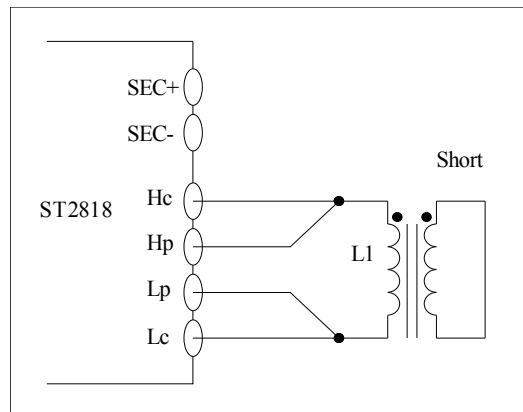
6.1.4 Capacitance Test Between Windings of Transformer
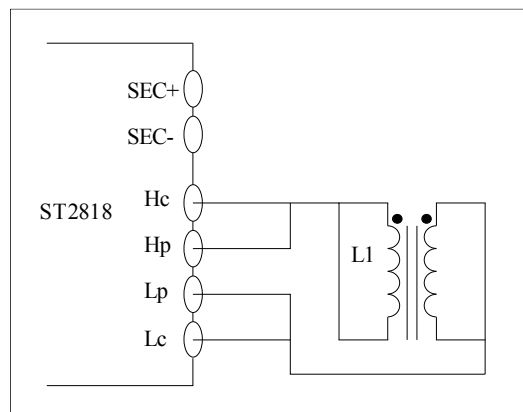
6.2 <Transformer Single Setup>

Press the shortcut key [HOME] to enter the function selection interface, as shown in Figure 6-1-1.

Single Setup														
Trigger		Continue		Speed		Fast		Test Mode		Seq		Parameter		
Rsou		100Ω		Bias Source		100mA(40V)		Comp		OFF		⟩ Ls	Lp	Lk
Para	Freq(Hz)	Level(V)	Other		Dev	Nominal	Low	High	Delay	Avg	Meas	Cs	Cp	Zx
Ls	1.0000k	1.000	DCV : 1.000 V		OFF	0.0000 H	-----	-----	0 s	1	OFF			
Lp	1.0000k	1.000	DCV : 1.000 V		OFF	0.0000 H	-----	-----	0 s	1	OFF	Rs	Rp	Rd
Lk	1.0000k	1.000			OFF	0.0000 H	-----	-----	0 s	1	OFF			
Cs	1.0000k	1.000			OFF	0.0000 F	-----	-----	0 s	1	OFF	D	Q	dZ
Cp	1.0000k	1.000			OFF	0.0000 F	-----	-----	0 s	1	OFF			
Zx	1.0000k	1.000	DCV : 1.000 V		OFF	0.0000 Ω	-----	-----	0 s	1	OFF	Ns	Ns:Np	
Rs	1.0000k	1.000			OFF	0.0000 Ω	-----	-----	0 s	1	OFF	Np	Np:Ns	
Rp	1.0000k	1.000			OFF	0.0000 Ω	-----	-----	0 s	1	OFF			
Rd		1.000			OFF	0.0000 Ω	-----	-----	0 s	1	ON	Move Up		
D	1.0000k	1.000			OFF	0.0000	-----	-----	0 s	1	OFF	Move Down		
Q	1.0000k	1.000	DCV : 1.000 V		OFF	0.0000	-----	-----	0 s	1	OFF			
dZ	1.0000k	1.000	DCV : 1.000 V		OFF	0.0000 °	-----	-----	0 s	1	OFF	Help		

Figure 6-1 Single Setup

Move the cursor to the Single Setup area or directly touch the single group setting area to access the <Single Setup> page.

This display function page is used to set transformer measurement parameters.

6.2.1 Trigger

See the trigger description in the LCR measurement setup chapter.

6.2.2 Speed

See the speed description in the LCR measurement setup chapter.

6.2.3 Test Mode

Move the cursor to the Test Mode area; the soft key zone will display [Seq] and [Step].

• If you press [Seq], the Test Mode zone will display Seq, which means the instrument is in single trigger mode. Trigger once, the instrument will sweep the transformer parameter circularly.

• If you press [Step], the Test Mode zone will display Step, which means the instrument is in single trigger mode. Trigger once, the instrument will sweep the transformer parameter one time.

6.2.4 R_{sou}

6.2.4 R$_{sou}$

Move the cursor to the R$_{sou}$ area; the menu area on the right side of the screen will display [100Ω] and [30Ω].

- If you press [100Ω], the internal resistance area will display 100Ω, which means the output impedance of the instrument is 100 Ω.

- If you press [30Ω], the internal resistance area will display 30 Ω, which means the output impedance of the instrument is 30 Ω.

Please refer to the detailed introduction of output impedance.

6.2.5 Bias Source

Move the cursor to the bias source area; the menu area on the right side of the screen will display: [100mA (40V)], [2A].

- If you press [100mA(40V)], the bias source area will display 100mA(40V), which means that the 100mA(40V) bias source is selected. The bias source can output a maximum voltage of 40V when in voltage mode, and the maximum output current is 100mA when in current mode.

- If you press [2A], the bias source area will display 2A, which means that the 2A bias constant current source is selected, and the bias source can output a maximum of 2A current in no voltage mode.

The setting here only selects the bias source and cannot set the actual output bias value. The actual output bias value needs to be set in the row where the actual test parameters are located.

For a detailed introduction of the bias source, please refer to the bias description in the LCR measurement setup chapter.

6.2.6 Comp

Move the cursor to the Comparison area; the menu area on the right side of the screen will display OFF and ON.

- If you press OFF, the comparison field will display OFF, which means that the comparison is turned off, and no sorting results will be output during the test. The PASS and FAIL lights on the front panel are off, the comparison column corresponding to the transformer measurement display interface will display "---", and the Handler interface sorting signal line has no sorting signal output.

- If you press ON, the comparison field will display ON, which means that the comparison is turned on, and the sorting result will be output during the test. The PASS or FAIL light on the front panel will be on, the comparison column corresponding to the transformer measurement display interface will display PASS or FAIL, and the Handler interface sorting signal line has a sorting signal output.

Refer to Chapter 10 Description for Handler for further details.

6.2.7 Parameter Setup

The parameter setting area is shown in Figure 6-1, with 12 rows and 11 columns.

Each row corresponds to a parameter, and up to 12 parameters can be selected for measurement; each column corresponds to a setting item of the corresponding parameter.

The 11 columns are:

- Parameter

- Frequency

- Level

- Other

- Deviation

- Nominal Value

- Lower Limit

- Upper Limit

- Delay

- Average

- Measurement

The parameter column is to select the parameter that needs to be measured. Move the cursor to the parameter column in each row. There are 16 measurement parameters for selection, namely:

• Ls	• Rs	• Ns
• Lp	• Rp	• Ns:
• Lk	• Rd	• Np
• Cs	• D	• Np:
• Cp	• Q	
• Zx	• dZ	

In the menu bar on the right, in addition to the 16 parameters that can be selected, there are [Move Up], [Move Down] and [HELP] options.

- The Frequency column is to set the measurement frequency corresponding to each measurement parameter. Rd is the DC test, so the Frequency column corresponding to this parameter is empty.

- The Level column is the measurement level corresponding to each measurement parameter.

- The Other column is the unique test items for some measurement parameters.

- The four columns of Deviation, Nominal Value, Lower Limit and Upper Limit constitute the sorting settings of the parameters. The three options are Deviation Mode, Δ and Δ%, which respectively represent data read-only mode, absolute deviation mode, and percentage deviation mode.

- The Delay column sets the delay time of the corresponding parameter, this delay time is added before the measurement.

- The Average column sets the average times of the corresponding parameters. Increasing the average times can increase the stability of the parameter test.

- The Measurement column is the measurement switch of the corresponding parameter. ON means that this parameter is included in the measurement, and OFF means that this parameter will not be measured.

6.3 <Single Display>

Press the menu key [DISP] to enter the <Single Display> page. As shown below:

Single Display						⌂
Para	Freq(Hz)	Level(V)	Other	Value	Comp	Display
Rd		1.0000		98.590mΩ	----	Save
						OFF

Figure 6-2 Single Display

Each row of this page shows the level, frequency, measurement result, sorting result of each parameter of the transformer. The menu bar on the right side of the screen has [Display] and [Save] options. Press [Save] to save the measurement results to the USB flash drive.

6.3.1 Save the Measurement Results of a Single Set of Transformers on the USB Flash Drive

Use the USB flash drive to save the measurement results. The measurement results and formats that can be saved are as follows:

- Time

- PT

- Para

- Val

- COMP

(These correspond, in order, to test time, point index, parameter name, parameter result, comparison result.)

The operation steps to save your data are as follows:

- Choose [Save];

- "Save path" prompt; default path location: "usb/CSV/" path;

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

7 Transformer Auto Scanning Test

7.1 Introduction to the Scan Measurement Function

ST2840NX can rely on an internal scan board or use an external ST1901/ST1806/ST1831 transformer scan box to form a transformer automatic test system; ST2840AX/ST2840BX can only use an external scan box to form a test system (no internal scan board).

Note: If there is no functional difference, ST2840X will be used to replace the above three model descriptions.

At present, the test items that can be provided in the automatic scanning test of transformers include:

- The Number of Turns (TURN)

- Phase (PHASING)

- Inductance (Lx)

- Quality Factor (Q)

- Leakage Inductance (LK)

- Stray Capacitance (Cx)

- Impedance (Zx)

- AC Impedance (ACR)

- DC Impedance (DCR)

- Balance (BALANCE)

- Short-Circuit Test (PIN-SHORT)

- Current Bias (DCI-BIAS)

etc.

ST2840X can realize the automatic conversion between transformer pins and fixture pins, automatic test time of rescan interval setup, multi-group primary winding test, multi-group leakage test, deviation compensation for test values, PASS and FAIL count for measurement result, save and load function for test parameter, repeat test for FAIL product, etc. Also, it can test several transformers at the same time.

7.2 Install and Connect the Scanning Test System

Automatic transformer test system is the connection of ST1901/ST1806/ST2831 and ST2840X, and the connection steps are as follows:

Use 36PIN double-headed cable (ST26016 transformer test control cable) to connect the SCANNER socket on the rear panel of ST1901/ST1806/ST2831 and the SCANNER socket on the rear panel of ST2840X as shown in the following figure.

Warning!
⚠️ Do not plug the cable with electricity! Keep the direction of the cable to be routed correctly.
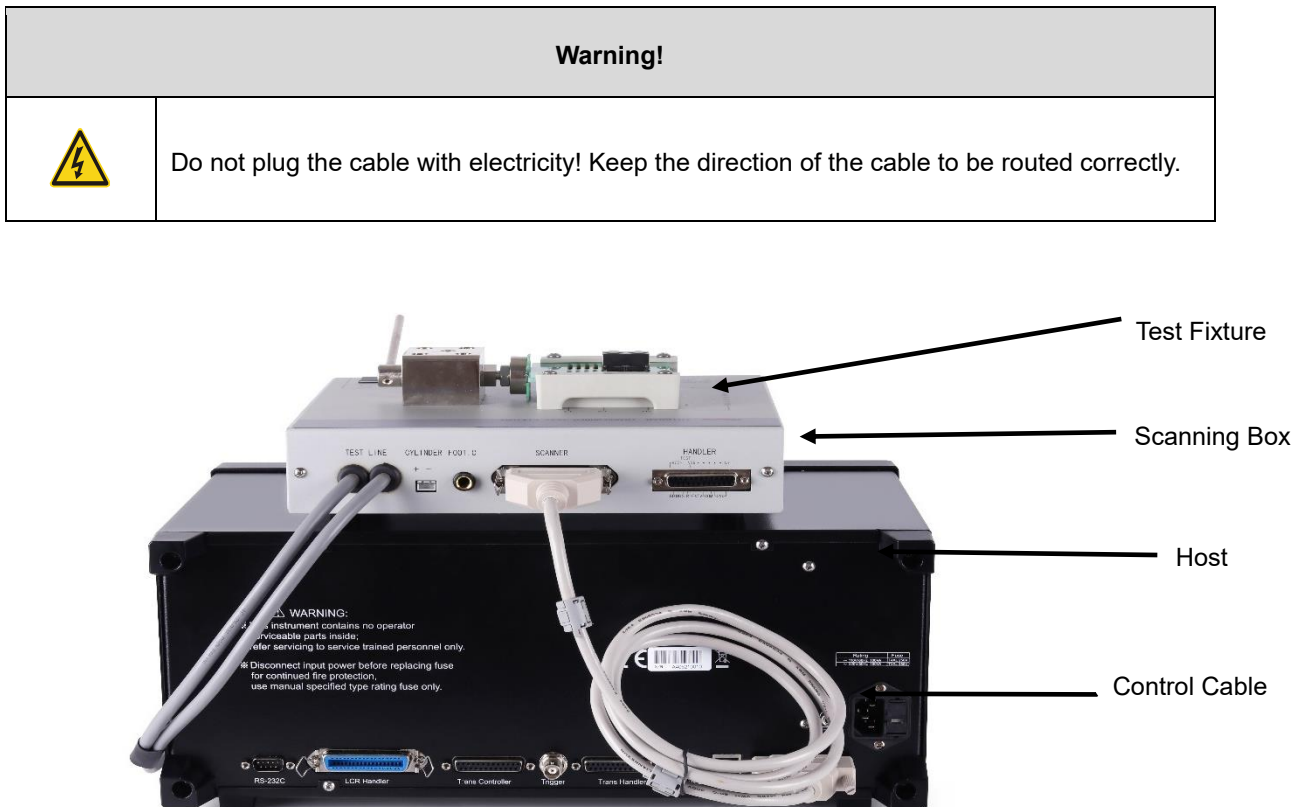
If it is necessary to use the foot switch, connect the foot switch to the FOOT.C interface on the rear panel of the test fixture.

Note: Once the foot switch is used, the [START] button on the test fixture will not work.

If the scanning box is ST1901A, connect the trachea to the valve controller.

Connect ST1901L 6-terminal scanning box to the corresponding terminal on the front panel of ST2840X and lock it as shown in the following figure.
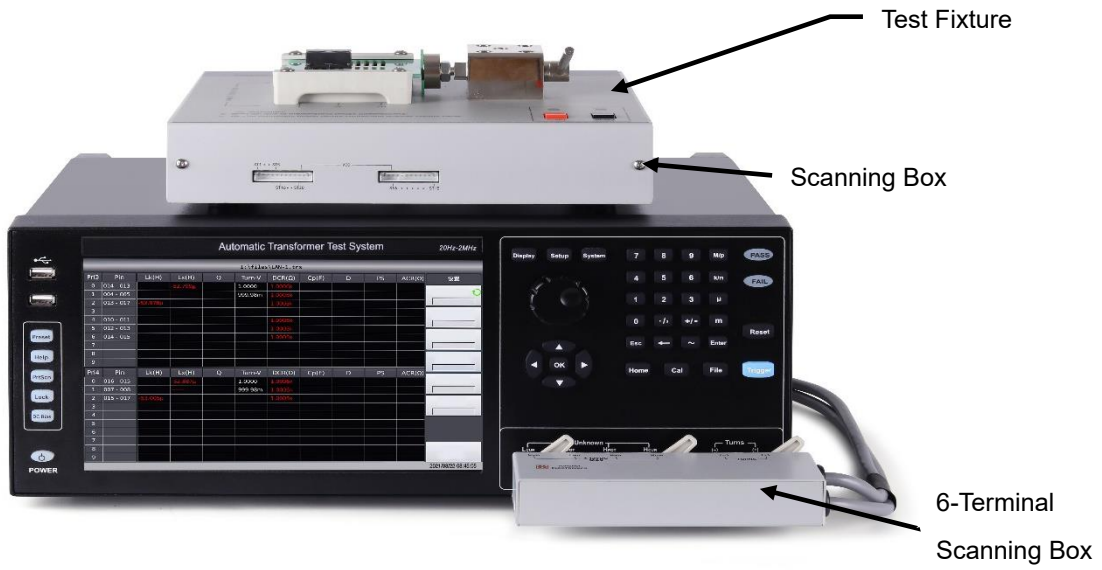
Connect the scanning test cable to ST2840X.

7.3 Front Panel of Scanning Box
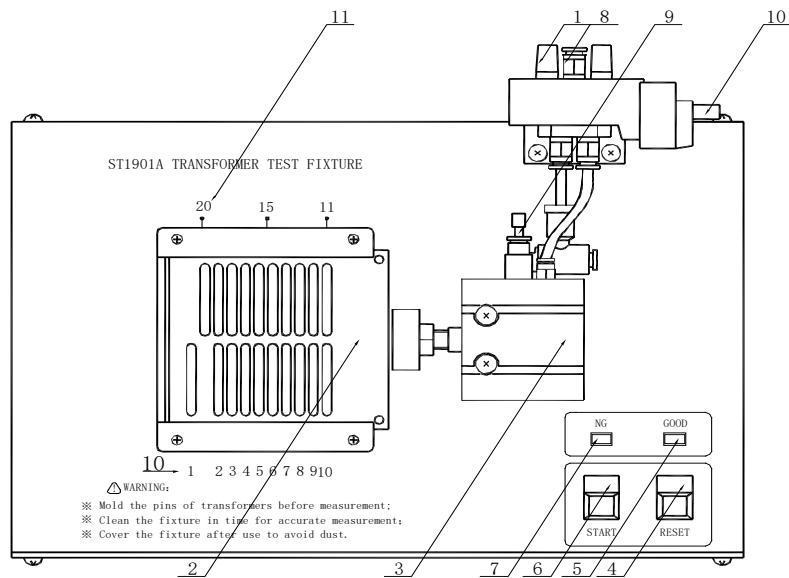
ST1901A

7.3.1 Introduction to Each Number on the Front Panel

1) Silencer

This is a silencer used for noise reduction and dust proof (only for ST1901A).

2) Test Fixture

This fixture is flexible and replaceable.

3) Cylinder

This is the main driving force for ST1901A; For ST1901B/ST1831, the motive force is from a manual push rod.

4) RESET Button

When pressing this button, all tests will be terminated and the instrument will recover to the original preparing test state.

5) GOOD Indicator

If the specified measurement results meet the preset requirements, this indicator will light up, which indicates that the tested device is GOOD.

6) START Button

Used to control the test. If you press this button, the instrument will start its measurement.

7) NG Indicator

If one or two measurement results cannot meet to the preset requirements, this indicator will light up, which indicates that the tested device is NOT GOOD.

8) Inlet of the Air Pipe

This is the connection interface connecting with external air pipe. Note: It is recommended to install a water filtering device between the inlet and the inlet valve so as to improve the service life of the cylinder and the inlet valve. (This inlet is unavailable for ST1901B/ST1831.)

9) Speed Control Knob

The knob is used to adjust the driving speed of the cylinder. (Unavailable for ST1901B/ST1831.)

10) Control Socket of Air Valve Controller (Electromagnetic Valve)

The switch for controlling ST1901A and the cylinder. The power is DC24V. There is no such controller in ST1901B/ST1831.

11) Fixture Pin Number

In the figure above, 1~20/24 is the corresponding pin number.

7.4 Rear Panel of Scanning Box
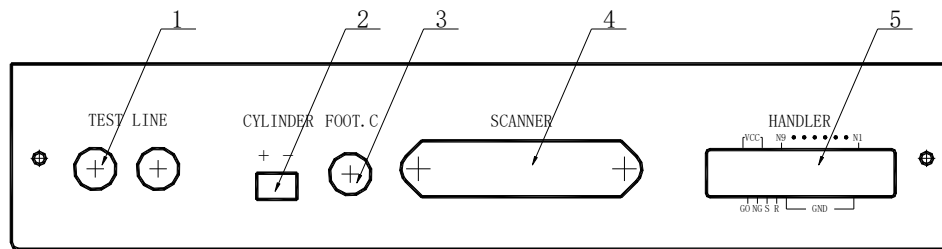
7.4.1 Introduction to Each Number on the Rear Panel

1) **Test Line**

   Inlet port of the test cable, ST1901L 6-terminal test box is connected to inner part of ST1901A/B through this line.

2) **Cylinder**

   24V DC voltage output terminal, providing the working voltage for ST1901A solenoid valve.

3) **Foot. C**

   Used to connect footswitch.

4) **Scanner**

   Signal control port. Use ST26016 control cable to connect the scanning box with ST2840X via the Scanner port.

5) **Handler**

   Handler port. Refer to chapter 7.5 for further instructions.

Note: There is a hole in the left panel of ST1901A/B; here, the inner adjustable potentiometer can be used to adjust the volume of the beep.

7.5 Handler Interface

Timing diagram of the Handler signal:
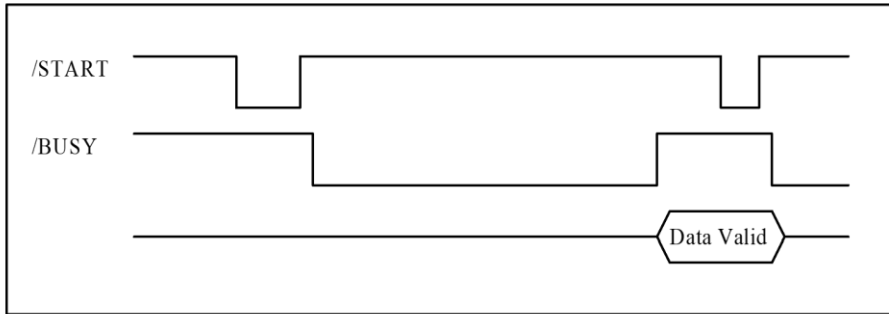
7.5.1 Distribution and Connection Diagram for Handler

The distribution and external circuit of Handler signal pin:
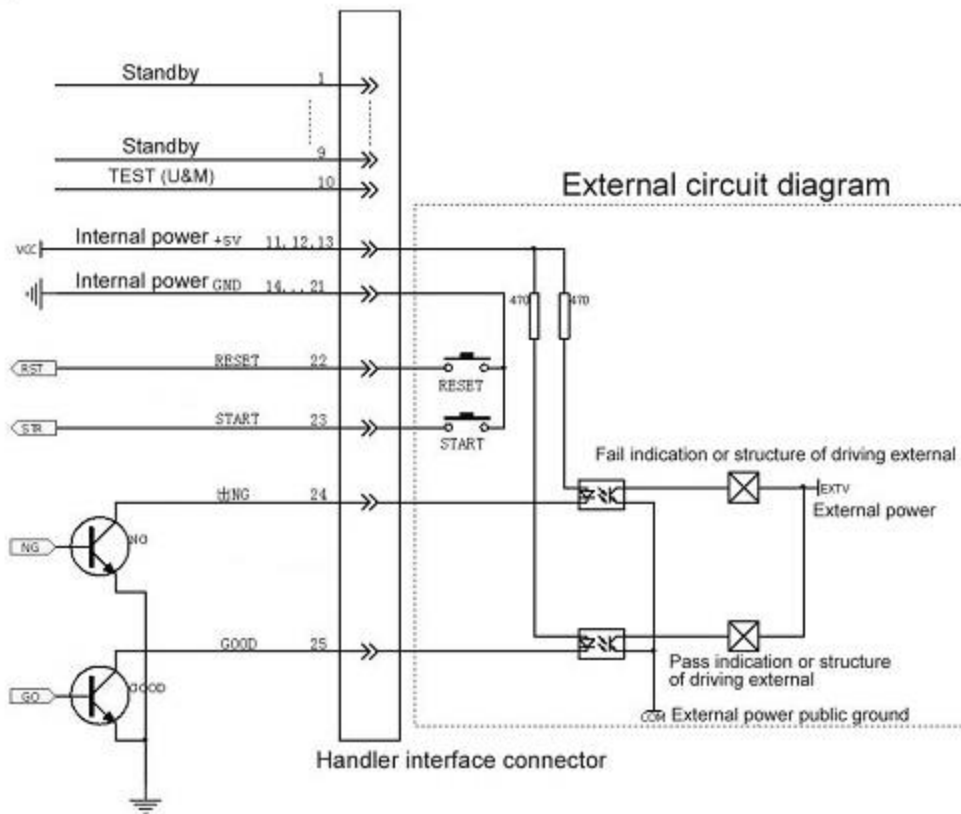
7.6 Example of Transformer

In order to understand the operation of a transformer scanning test, the setting figures listed in the following chapters are based on the sample below.
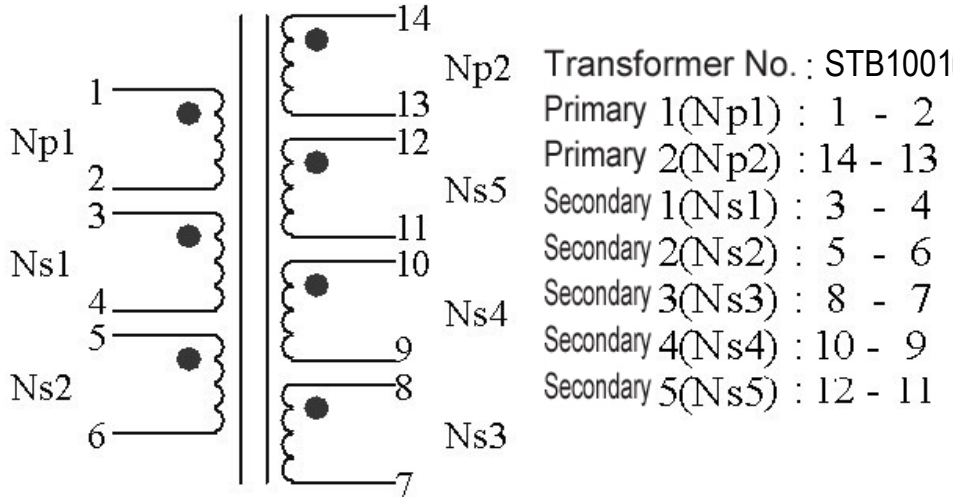
More detailed information will be described in later sections.

7.7 Clear Settings

Before configuring new transformer ID measurement settings, you must clear the unpredictable data that may exist in the memory of the instrument and prevent unpredictable errors during the test of the newly configured measurement settings. The method is as follows:

On any transformer sweep function page, press the button [PRESET] on the left side of the front panel to select the function [Clear Settings].
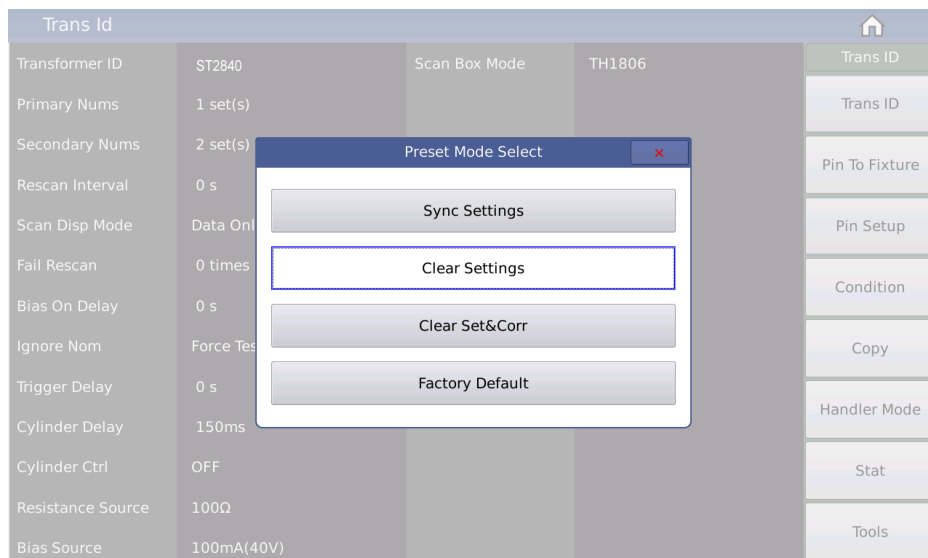
You can also reset the transformer setting parameters by restarting the instrument.

7.8 <Transformer ID>

When the instrument function is Trans Scan, press the [SETUP] button above the knob to enter the <Trans ID> page.
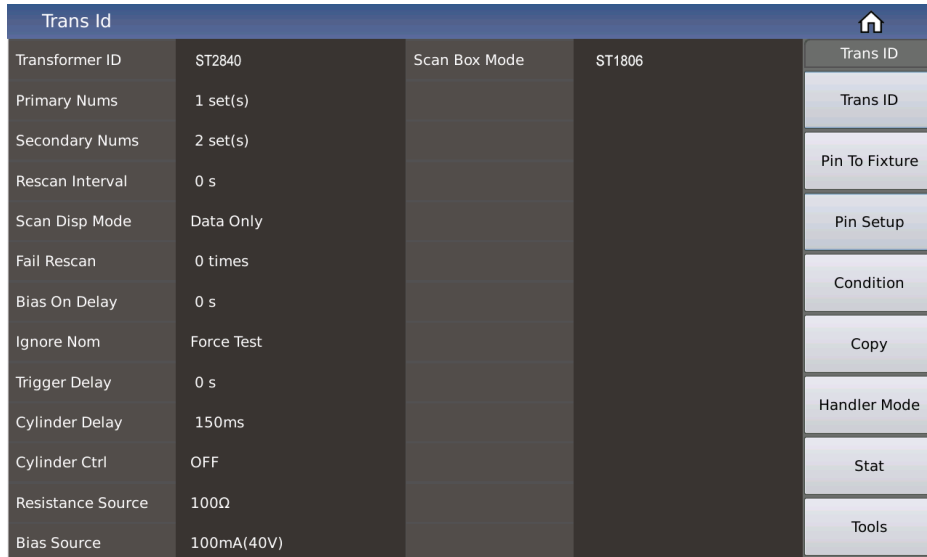
7.8.1 Transformer ID

You can input the transformer ID to be tested in this area. The setting method is as follows:

Press the menu function [Input], select the desired character in the soft keyboard, press [ESC] to cancel, press [ENTER] to apply the entered transformer ID.

7.8.2 Primary Nums

You can input the number of transformer primary groups in this area. For transformers with multiple cores, multiple PRIs may be set. The primary numbers range from 1~60.

7.8.3 Secondary Nums

You can input the number of transformer secondary groups in this area. The secondary numbers range from 1~9.

7.8.4 Rescan Interval

In this area, you can enter the interval time for automatic continuous measuring.

The range of automatic test interval is 0~60s; 0 means no automatic continuous test.

7.8.5 Scan Disp Mode

This area is used to set the overall judgement display options, and is used to control the display mode of the results during the scanning test of the transformer. There are 3 modes:

- **Data Mode**

    This means that the test data of each parameter is displayed one by one during the scanning process, but there is no general PASS/FAIL large-character display, which is convenient for users to view.

- **Judge Results Mode**

    This means that the test data of each parameter is displayed one by one during the scanning process, and the total PASS/FAIL is displayed in large characters after it is finished.

- **Fail List**

    This means that the test data of each parameter is displayed one by one during the scanning process, and the unqualified parameters and their limit settings are displayed in the center of the screen after it is finished.

7.8.6 Fail Rescan

This area is used to set the number of retests for defective products. It is used to set the number of retests in order to prevent a certain parameter from being defective due to interference during the automatic scanning test process, thereby increasing the yield of good products.

Remeasurement Range of Defective Products: 0~9 times.

7.8.7 Bias on Delay

This area is used to set the delay when applying DC current bias test.

Current Bias Delay Range: 0~60s; 0 means no delay.

7.8.8 Ignore Nom

This area overlaps 2 functions, one is to ignore the nominal value for measuring, and the other is the deviation deduction limit. All are related to the nominal value. They are as follows:

- **FORCE DEV**

  When this option is selected, you will not be restricted by the set nominal value (STD) when deducting deviation. That is, it can be deducted when the deviation between the test value and the set nominal value (STD) is large, for example if you insert the wrong pin of the transformer.

- **FORCE TEST**

  When this option is selected, as long as the winding pin is set, the parameter to be tested for the winding can be measured without setting the nominal value. This can be convenient in order to measure and observe when you do not know the nominal value of the transformer sample. This option is, however, most often not used.

- **SKIP TEST LMTED DEV**

  When this option is selected, it means that the pin position of the winding is set but the nominal value of the parameter to be tested is not set; thus the parameter to be tested will not be measured during the test. The mode will be limited by the nominal value when the deviation is deducted. If your test value deviates greatly from the set nominal value (STD), the deduction will not succeed.

7.8.9 Trigger Delay

This area is used to set the delay time from when the instrument is triggered to the start of the sweep test.

Delay Range: 0~60s; 0 means no delay.

7.8.10 Cylinder CTRL

This area is used to set the switch of cylinder 24V power.

- **ON:** Output of 24V cylinder power is allowed during scanning.

- **OFF:** Output of 24V cylinder power is forbidden during scanning.

- **FAIL HOLD:** the test is stopped when a defective product is encountered during scanning.

- **FAIL LOCK:** the test is stopped when a defective product is encountered during scanning, and the system is locked.

7.8.11 Scan Box Mode

This area is used to set the test fixture used when the instrument scans.

- **Internal**: This means that the internal scanning board of the instrument is used in the test, which is only equipped with ST2840NX.

- **ST1831**: This means that the ST1831 scan box is used in the test.

- **ST1806**: This means that the ST1806 scan box is used in the test, which is compatible with the ST1901 scan box.

Note: This function needs to be correctly selected corresponding to the fixture used. Inconsistent selection will cause the instrument to fail to obtain correct measurement results.

7.8.12 Resistance Source

ST2840X provides two output resistances to choose from: 100Ω or 30Ω.

When measuring inductance, in order to compare data with other types of testers, it is necessary to ensure the same output resistance value.

When measuring some magnetic cores with very high permeability, use 100Ω internal resistance to reduce the degree of polarization of the magnetic core, which can improve the accuracy and stability of the test.

Note: When using bias current output, the default is 100Ω.

7.8.13 Bias Source

The bias source function is used to select the DC bias source used by the instrument. The transformer scan only provides two bias sources as follows:

- **100mA (40V) Mode:** The transformer scan test uses a DC bias source (0～100mA).

- **2A Mode:** The transformer scan test uses a DC bias source (0～2A).

Note: When the DC bias source is enabled, only 100Ω output resistance can be used.

7.9 Trans Pin to Fixture

On the <Trans ID> page, press the menu key [Trans Pin], it will jump to the <Trans Pin To Fixture> page.

This page is used to connect the pin of the transformer to the pin of the test fixture, and to convert the pin number into a custom pin label.

7.9.1 Pin-to-Fixture Setup

The default state of the instrument when the instrument is turned on is such that the transformer pins correspond to the fixture pins one-to-one. Normally, when using the internal scanning board of the instrument, you only need to connect the transformer pins to the fixture pins on the rear panel of the instrument one-to-one and it can be tested; the external scanning test box (ST1831, ST1806, etc.) can be connected according to 1~20/24 marked on the front of the test box. If you use the above setting method, you can skip the pin to fixture setup here. The figure below is the corresponding relationship between the sample transformer pin 1and the fixture pin 2.

The manual setting method is as follows:

1) Click any cell of the transformer pin in the table, the menu bar will display related menu functions;

2) Select the function to [Clear All FRC Pins] to clear the default settings;

3) Press the function key to [Allocate] and change the Allocate function option from Auto to Manual.

4) When manually allocating, move the cursor to the corresponding fixture pin position and input the corresponding transformer pin.

Note: Input 0 to clear the corresponding pin input.

When the Allocate function is set to Auto, it will automatically +1 the number of pins at the transformer pin where the first number is entered, until the input box of the last transformer pin.

Trans Pin To Fixture [home]

| 【A】+【B】 | 【C】+【D】 | 【E】+【F】 | 【G】+【H】 | 【I】+【J】 | 【K】+【L】 | Trans Pin |

Row													Buttons
FRC【A】	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	Allocate / Manual
Trans Pin		001	002	003	004	005	006	007					Clear FRC Pins
Pin Label	001	002	003	004	005	006	007	008	009	010	011	012	Clear All FRC Pins
FRC【A】	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	
Trans Pin	008	009	010	011	012	013	014						
Pin Label	013	014	015	016	017	018	019	020	021	022	023	024	
FRC【B】	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	
Trans Pin													
Pin Label	025	026	027	028	029	030	031	032	033	034	035	036	
FRC【B】	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	
Trans Pin													
Pin Label	037	038	039	040	041	042	043	044	045	046	047	048	

7.9.2 Pin Label Setup

The transformer pin label function can convert a transformer pin that was originally only represented by numbers into a transformer pin represented by custom numbers or letters, as shown below:

Trans Pin To Fixture [home]

| 【A】+【B】 | 【C】+【D】 | 【E】+【F】 | 【G】+【H】 | 【I】+【J】 | 【K】+【L】 | Pin Label |

Row													Buttons
FRC【A】	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A11	A12	Input
Trans Pin		001	002	003	004	005	006	007					Default Item Label
Pin Label	P01	P02	P11	P12	P21	P22	P32	P31	P42	P41	P52	P51	Default FRC Labels
FRC【A】	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	Default All FRC Labels
Trans Pin	008	009	010	011	012	013	014						
Pin Label	P62	P61	015	016	017	018	019	020	021	022	023	024	
FRC【B】	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	
Trans Pin													
Pin Label	025	026	027	028	029	030	031	032	033	034	035	036	
FRC【B】	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	
Trans Pin													
Pin Label	037	038	039	040	041	042	043	044	045	046	047	048	

After setting the transformer pin label and related measurement conditions, it can be displayed in the PIN (pin) column in the transformer measurement interface as a custom transformer pin label (to be updated).

7.10 Pin Setup

Press the function key [Pin Setup] on the <Trans ID> page, and it will go to the <Trans Pin> page. This page is used to set the pins of each winding of the transformer, connect the pins in series, and connect in parallel. Please see the following example transformer and its pin setting screen:
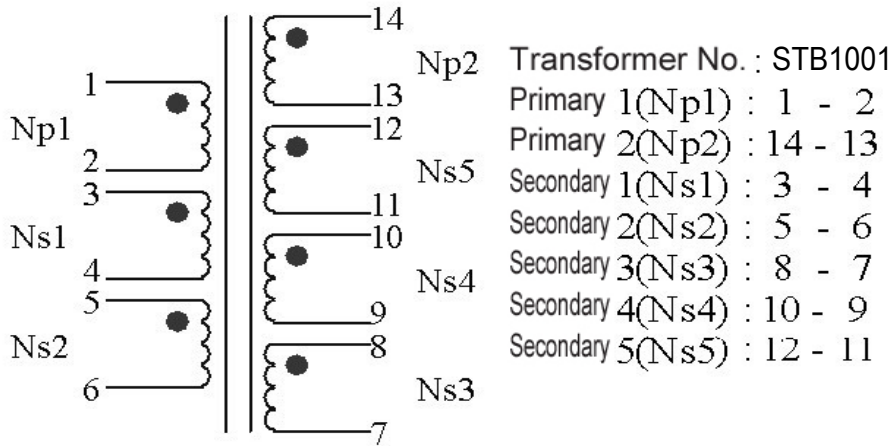
7.10.1 Trans Pin Setup

The following is the pin setting screen of PRI: A1 (PRI: A1 is used for Np1 as the primary winding):

The following is the pin setting screen of PRI: A2 (PRI: A2 is used for Np2 as the primary winding):
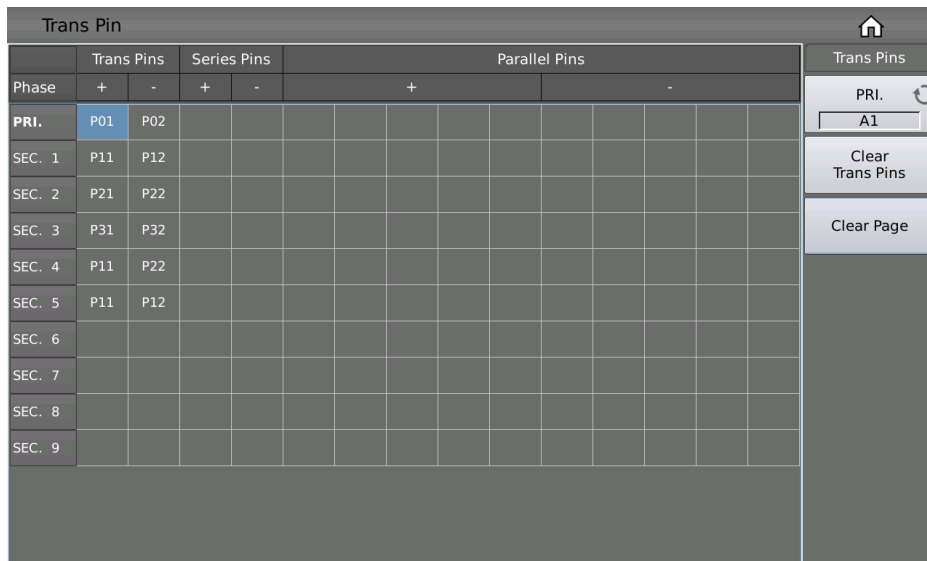
7.10.2 Series Pins Setup

Before setting the transformer series pin, you need to confirm the parameters of the series test. For example, the Lx inductance needs to set the series pin. You can select the function Lx in the parameter menu bar, and then input the series pin.

Below is the short-circuit pin setting when series transformers Ns1 and Ns2 test Lx.
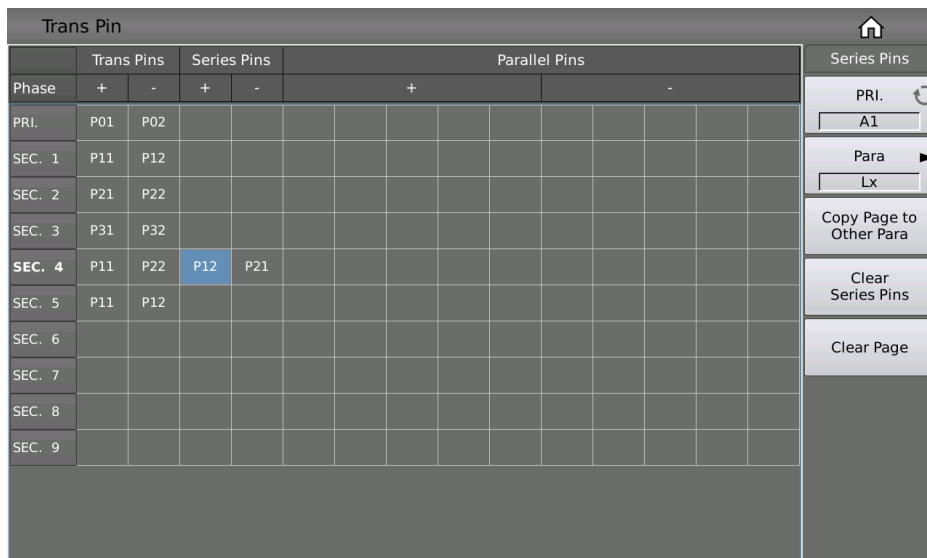
Below is the short-circuit pin setting when series transformers Ns1 and Ns2 test TURN.

Trans Pin								Series Pins
	Trans Pins		Series Pins		Parallel Pins			PRI. ↻
Phase	+	-	+	-	+		-	A1
PRI.	P01	P02						Para ▶
SEC. 1	P11	P12						Turn
SEC. 2	P21	P22						Copy Page to Other Para
SEC. 3	P31	P32						
SEC. 4	P11	P22	P12	P21				Clear Series Pins
SEC. 5	P11	P12						
SEC. 6								Clear Page
SEC. 7								
SEC. 8								
SEC. 9								

7.10.3 Parallel Pins Setup

Before setting the transformer parallel pins, you need to confirm the parameters for parallel measuring. For example, the TURN ratio needs to set the parallel pins. You can select the function [Turn] in the parameter menu bar, and then input the parallel pins.

The following figure shows the short pin setup of the "+" and "–" terminal when example parallel transformers Ns1 and Ns2 tests:

Trans Pin								Parallel Pins
	Trans Pins		Series Pins		Parallel Pins			PRI. ↻
Phase	+	-	+	-	+		-	A1
PRI.	P01	P02						Para ▶
SEC. 1	P11	P12						Turn
SEC. 2	P21	P22						Copy Page to Other Para
SEC. 3	P31	P32						
SEC. 4	P11	P22	P12	P21				Clear Parallel Pins
SEC. 5	P11	P12		P21		P22		
SEC. 6								Clear Page
SEC. 7								
SEC. 8								
SEC. 9								

7.11 <Trans Condition>

This page contains two tables:

The upper table is the parameter test condition table, which is mainly used to set the parameters and measurement conditions of the transformer under test. The parameters that can be measured are:

- Turn (number of turns)

- Phase (phase)

- Lx (inductance)

- Q (quality factor)

- L.K. (leakage inductance)

- Cx (distributed capacitance between turns)

- D (loss)

- Zx (Impedance)

- ACR (AC resistance)

- DCR (DC resistance)

- PS (pin short-circuit detection)

- BAL (balance)

You can also change the scan order of each parameter and set the measurement frequency, test voltage, test mode, etc. of each parameter.

The lower table is the parameter limit setting table, which is mainly used to set the nominal value and upper and lower limits of each parameter for sorting.

Trans Condition									⌂
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	Turn
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		PRI. ↻
Dev	OFF	OFF	OFF	OFF	OFF	OFF	OFF			A1
Average	1	1	1	1	1	1	1	1		Turn Mode ▶
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		Turn_V
Equ		Series	Series	Parallel		Series				
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON		

Turn	Pins	Phase	Std(T)	Low	High	Short Pins
0	P01-P02	+	1.0000			
1	P11-P12	+				
2	P21-P22	+				
3	P31-P32	+				
4	P11-P22	+				
5	P11-P12	+				
6		+				
7		+				
8		+				
9		+				

7.11.1 Frequency, Voltage, Switch and Scanning Sequence

There are multiple parameter variables corresponding to each parameter: frequency, level, deviation, average, delay, equivalence, scan sequence and switch. Touch or move the cursor to the corresponding setting area and modify the corresponding parameters according to the menu prompts to meet user needs.

Note:

- **Frequency Range:** 20Hz~2MHz.

- **Measurement level:** 5mV~20V.

- **Deviation:** OFF or Δ%; this parameter is used to set the sorting method, the same as the limit mode of ST2829X series.

    - OFF: The measurement results are sorted directly according to the set upper and lower limits.

    - Δ%: The difference between the test value and the nominal value divided by the nominal value will be sorted according to the set upper and lower limits.

- **Average Times:** 1~255. Perform multiple tests according to the set average times, and display the results after calculating the average value. This function can also be used to adjust the measurement speed of a single parameter.

- **Delay:** 0~60s, the delay between the trigger test and the test. This function can improve the stability and accuracy of the test.

- **Equivalence:** series, parallel.

- **Sequence:** the default number of the scanning sequence is 1~9 from left to right, you can enter the number 1~8 to change, and BAL is fixed as the last item 9.

- **Switch:** If you choose ON, the corresponding parameter is active, otherwise the corresponding parameter is inactive.

7.11.2 TURN Measurement Conditions Setup

On the <Trans Conditions> page, touch or move the cursor to the Turn column of the test condition table to set the Turn parameters.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k			
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V	
Dev	OFF	OFF	OFF	OFF	OFF	OFF	OFF		
Average	1	1	1	1	1	1	1	1	
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s	
Equ		Series	Series	Parallel		Series			
Sequence	1	2	3	4	5	6	7	8	9
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON

Turn	Pins	Phase	Std(T)	Low	High	Short Pins
0	P01-P02	+	1.0000			
1	P11-P12	+				
2	P21-P22	+				
3	P31-P32	+				
4	P11-P22	+				
5	P11-P12	+				
6		+				
7		+				
8		+				
9		+				

Menu (right side): Turn / PRI. A1 / Turn Mode ▶ Turn_V

7.11.2.1 Turn Mode

When touching the TURN setting area or moving the cursor to the TURN setting area, the TURN mode can be set in the menu on the right.

ST2840X test TURN can choose the following 8 modes:

- **TURN_v**   = primary standard value * secondary voltage/ primary voltage. This mode is used test transformer turn number.

- **TURN**   = primary standard value * secondary turn/primary turn. When the primary inductance is small, using this mode can test the turn number more accurately. But when measuring magnetic core with high magnetic conductivity the data will be unstable in this mode due to the polarized magnetic core.

- **VOLT**   = primary test voltage * secondary voltage / primary voltage

- **Vs:Vp**   = secondary voltage / primary voltage

- **Ns:Np**   = secondary turn / primary turn

- **TURN_L**   = inductance ratio mode

- **Np:Ns**   = primary turn / secondary turn

- **Lp:Ls**   = primary inductance / secondary inductance

It is recommended to put the windings with multi-turns in the primary turn ratio; the reasons are as follows:

1)   By the influence of output internal resistance (30Ω; 100Ω), when the primary inductance is small, the distributed voltage signal will also be small and the energy the transformer gets is therefore weak. The test cable and the relay will attenuate a part of the energy, so stability and accuracy will be affected.

2) If the primary signal is forcibly enlarged, then the voltage generated by secondary multi-winding will be high and it may be over the range of the instrument and thus further affect the test accuracy.

3) If the winding with multi-turns is put in primary test, then the energy of the transformer will be strong and the two problems above can be ignored.

7.11.2.2 Turn Limits Setup

The Turn Limit setting table is used to set the nominal value, upper and lower limits, phase and short-circuit pins of each winding of the transformer.

Touch the Turn Limit setting table, or move the cursor to the Turn Limit setting area, and use the number keys, the corresponding magnification or the [ENTER] key to set.

The magnification corresponding to TURN is M, k, μ, m, and the [ENTER] key is x1.

7.11.2.3 Turn Phase Setup

When setting the limit of the number of turns, you can set the secondary winding phase for sorting; "+" means the same direction, and "–" means the opposite direction.

The phase of the primary winding is used as the reference phase and cannot be modified. When the measured phase of the secondary winding is inconsistent with the phase set here, it will be judged as unqualified.

The default setting of the instrument is opposite to the primary phase, which means the phase is unqualified.

Trans Condition										⌂
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	Turn
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	OFF	OFF	OFF	OFF	OFF	OFF			Turn Mode ▶
Average	1	1	1	1	1	1	1	1		Turn_V
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		Phase
Equ		Series	Series	Parallel		Series				-
Sequence	1	2	3	4	5	6	7	8	9	Clear Turn Table
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Turn	Pins	Phase	Std(T)	Low	High	Short Pins	
0	P01-P02	+	1.0000				
1	P11-P12	-	200.00	198.00	202.00		Copy↓↓
2	P21-P22	+					
3	P31-P32	+					
4	P11-P22	+					
5	P11-P12	+					
6		+					
7		+					
8		+					
9		+					

7.11.2.4 Turn Ratio Short Pins

When setting the turn ratio short pins, you can use soft keys . and ~ to input multiple pins; the maximum number of pins can be saved here is 48.

Example:

- Input a discontinuous number "1, 3, 5, 7, 9" and press the soft key . to separate each number; press [ENTER] to confirm. The final data displayed in the table is (1, 3, 5, 7, 9).

- Input a continuous number of "1, 2, 3, 4, 5, 6, 7, 8, 9", first input the number "1", then press the soft key ~, finally input "9", press the [ENTER] key to confirm. The final data displayed in the table is (1~9).

Note: The maximum number of turns ratio short pins is 48 and some pins after the excess will be ignored.

- Input part of continuous numbers and discontinuous numbers "1, 2, 3, 4, 5, 7, 9" (the continuous part is the same as step 2, the discontinuous part is the same as step 1); press [ENTER] to confirm. The final data displayed in the table is (1~5,7,9).

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Turn
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	OFF	OFF	OFF	OFF	OFF	OFF				
Average	1	1	1	1	1	1	1	1			Turn Mode ►
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Turn_V
Equ		Series	Series	Parallel		Series					Clear Turn
Sequence	1	2	3	4	5	6	7	8	9		Table
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Turn	Pins	Phase	Std(T)	Low	High	Short Pins	Copy↓↓
0	P01-P02	+	1.0000				
1	P11-P12	-	50.000	48.000	52.000	P21~P31	
2	P21-P22	+	50.000	48.000	52.000		
3	P31-P32	+	30.000	28.000	32.000		
4	P11-P22	+	100.00	96.000	104.00		
5	P11-P12	+					
6		+					
7		+					
8		+					
9		+					

7.11.3 Lx Measurement Conditions Setup

On the <Trans Condition> page, touch or move the cursor to the Lx column of the test condition table to set the Lx parameters.

7.11.3.1 Lx Limit Setup

The Lx limit setting table is used to set the Lx standard value, upper and lower limits, bias, multi-frequency, multi-level, Q standard value and Q upper and lower limits of each transformer winding.

Touch the Lx limit setting table, or move the cursor to the Lx limit setting area, and use the number keys, the corresponding magnification or the [ENTER] key to set.

The magnification corresponding to Lx is p, n, μ, m, and the [ENTER] key is x1.

7.11.3.2 Add DC Bias to Lx

The instrument can use a built-in DC bias source of 100mA or 2A. When setting the current value, you can set a maximum value of 2A for the sake of compatibility of storage files.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lx
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear Lx Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Copy↓↓
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Lx	Pins	Std(H)	Low	High	**Bias**	Freq(Hz)	Level	Q-STD	Q-Low	Q-High
0	P01-P02	1.0000m	-5.0000	5.0000	8mA					
1	P11-P12	300.00µ	-5.0000	5.0000						
2	P21-P22	300.00µ	-5.0000	5.0000						
3	P31-P32	220.00µ	-5.0000	5.0000	8mA					
4	P11-P22	1.0000m	-5.0000	5.0000						
5	P11-P12	300.00µ	-5.0000	5.0000						
6										
7										
8										
9										

7.11.3.3 Lx Multi-Frequency Setup

If you need to use different frequencies to test different Lx pins of the transformer, in the transformer Lx limit setting table, touch or move the cursor to the Lx frequency area. After inputting the frequency in this area, the frequency here will be automatically used during the test. If the parameter is not set, the frequency of Lx in the test condition table will be used.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lx
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear Lx Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Copy↓↓
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Lx	Pins	Std(H)	Low	High	Bias	**Freq(Hz)**	Level	Q-STD	Q-Low	Q-High
0	P01-P02	1.0000m	-5.0000	5.0000	8mA					
1	P11-P12	300.00µ	-5.0000	5.0000						
2	P21-P22	300.00µ	-5.0000	5.0000						
3	P31-P32	220.00µ	-5.0000	5.0000	8mA					
4	P11-P22	1.0000m	-5.0000	5.0000						
5	P11-P12	300.00µ	-5.0000	5.0000		20.0000k				
6										
7										
8										
9										

7.11.3.4 Lx Multi-Level Setup

If you need to use different levels to test different Lx pins of the transformer, in the transformer Lx limit setting table, touch or move the cursor to the Lx level area. After inputting the level in this area, the test will automatically use this. If the parameter is not set, the Lx level in the test condition table will be used.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lx
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			PRI.
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				A1
Average	1	1	1	1	1	1	1	1			Clear Lx Table
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			
Equ		Series	Series	Parallel		Series					Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Lx	Pins	Std(H)	Low	High	Bias	Freq(Hz)	Level	Q-STD	Q-Low	Q-High
0	P01-P02	1.0000m	-5.0000	5.0000	8mA					
1	P11-P12	300.00µ	-5.0000	5.0000			500mV			
2	P21-P22	300.00µ	-5.0000	5.0000						
3	P31-P32	220.00µ	-5.0000	5.0000	8mA					
4	P11-P22	1.0000m	-5.0000	5.0000						
5	P11-P12	300.00µ	-5.0000	5.0000		20.0000k				
6										
7										
8										
9										

7.11.3.5 Q Limit Setup

On the <Trans Condition> page, touch or move the cursor to the Q-STD, Q-Low and Q-High to set.

Note: The Q value test switch is set at the Lx switch.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lx
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			PRI.
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				A1
Average	1	1	1	1	1	1	1	1			Clear Lx Table
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			
Equ		Series	Series	Parallel		Series					Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON			

Lx	Pins	Std(H)	Low	High	Bias	Freq(Hz)	Level	Q-STD	Q-Low	Q-High
0	P01-P02	1.0000m	-5.0000	5.0000	8mA			10.000	9.0000	
1	P11-P12	300.00µ	-5.0000	5.0000			500mV	10.000	9.0000	
2	P21-P22	300.00µ	-5.0000	5.0000				10.000	9.0000	
3	P31-P32	220.00µ	-5.0000	5.0000	8mA			10.000	9.0000	
4	P11-P22	1.0000m	-5.0000	5.0000						
5	P11-P12	300.00µ	-5.0000	5.0000		20.0000k				
6										
7										
8										
9										

7.11.4 Lk Measurement Conditions Setup

On the <Trans Condition> page, touch or move the cursor to the Lk column of the test condition table to set the Lk parameters.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lk
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear Lk Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Copy↓↓
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Lk	Pins	Std(H)	Low	**High**	Freq(Hz)	Level	Short Pins
0	P01-P02	10.000μ	0.0010μ	12.000μ			
1	P11-P12						
2	P21-P22						
3	P31-P32						
4	P11-P22						
5	P11-P12						
6							
7							
8							
9							

7.11.4.1 Lk Limit Setup

The Lk limit setting table is used to set the Lk standard value, upper and lower limits, multi-frequency, multi-level, and short-circuit pins of each winding of the transformer.

Touch the Lk limit setting table, or move the cursor to the Lk limit setting area, and use the number keys, the corresponding magnification or the [ENTER] key to set.

The magnification corresponding to Lk is p, n, μ, m, and the [ENTER] key is x1.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Lk
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear Lk Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Copy↓↓
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Lk	Pins	Std(H)	Low	**High**	Freq(Hz)	Level	Short Pins
0	P01-P02	10.000μ	0.0010μ	12.000μ			
1	P11-P12						
2	P21-P22						
3	P31-P32						
4	P11-P22						
5	P11-P12						
6							
7							
8							
9							

7.11.4.2 Lk Multi-Frequency Setup

If you need to use different frequencies to test different Lk pins of the transformer, in the transformer Lk limit setting table, touch or move the cursor to the frequency area of Lk. After inputting the frequency in this area, the frequency here will be automatically used during the test. If the parameter is not set, the frequency of Lk in the test condition table will be used.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k			
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V	
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF		
Average	1	1	1	1	1	1	1	1	
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s	
Equ		Series	Series	Parallel		Series			
Sequence	1	2	3	4	5	6	7	8	9
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON

Lk	Pins	Std(H)	Low	High	**Freq(Hz)**	Level	Short Pins
0	P01-P02	10.000μ	0.0010μ	12.000μ	20.0000k		
1	P11-P12						
2	P21-P22	10.000μ	0.0010μ	12.000μ			
3	P31-P32						
4	P11-P22						
5	P11-P12						
6							
7							
8							
9							

Lk / PRI. / A1 / Clear Lk Table / Copy↓↓

7.11.4.3 Lx Multi-Level Setup

If you need to use different levels to test different Lk pins of the transformer, in the transformer Lk limit setting table, touch or move the cursor to the Lk level area. After inputting the level in this area, the test will automatically use this. If the parameter is not set, the level of Lk in the test condition table will be used.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k			
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V	
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF		
Average	1	1	1	1	1	1	1	1	
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s	
Equ		Series	Series	Parallel		Series			
Sequence	1	2	3	4	5	6	7	8	9
Switch	ON	ON	ON	ON	ON	ON	ON	ON	

Lk	Pins	Std(H)	Low	High	Freq(Hz)	**Level**	Short Pins
0	P01-P02	10.000μ	0.0010μ	12.000μ	20.0000k		
1	P11-P12						
2	P21-P22	10.000μ	0.0010μ	12.000μ		500mV	
3	P31-P32						
4	P11-P22						
5	P11-P12						
6							
7							
8							
9							

Lk / PRI. / A1 / Clear Lk Table / Copy↓↓

7.11.4.4 Lk Turn-Ratio Short Pins

When setting the leakage inductance short pins, you can use the soft keys . and ~ to input multiple pins; the maximum number of pins can be saved here is 48.

Example:

- Input a discontinuous number "1, 3, 5, 7, 9" and use the soft key . to separate each number, press [ENTER] to confirm, the final data displayed in the table is (1, 3, 5, 7, 9).

- Input a continuous number of "1, 2, 3, 4, 5, 6, 7, 8, 9", first input the number "1", then press the soft key ~, finally input "9", press the [ENTER] key to confirm. The final data displayed in the table is (1~9).

Note: The maximum supported number of leakage inductance short pins is 48, and excess pins will be ignored.

- Input part of continuous numbers and non-continuous numbers "1, 2, 3, 4, 5, 7, 9", the continuous part is the same as step 2, the discontinuous part is the same as step 1, press [ENTER] to confirm. The final data displayed in the table is (1~5, 7, 9).

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	Lk
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			Clear Lk Table
Average	1	1	1	1	1	1	1	1		
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		
Equ		Series	Series	Parallel		Series				Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Lk	Pins	Std(H)	Low	High	Freq(Hz)	Level	Short Pins
0	P01-P02	10.000μ	0.0010μ	12.000μ	20.0000k		P11~P12
1	P11-P12						
2	P21-P22	10.000μ	0.0010μ	12.000μ		500mV	P01~P12,P32~P31
3	P31-P32						
4	P11-P22						
5	P11-P12						
6							
7							
8							
9							

7.11.5 Cx Measurement Conditions Setup

On the <Trans Condition> page, touch or move the cursor to the Cx column of the test condition table to set the Cx parameters.

7.11.5.1 Cx Limit Setup

The following figure shows the example transformer. Test the capacitance between two turns: Np1 and Np2.
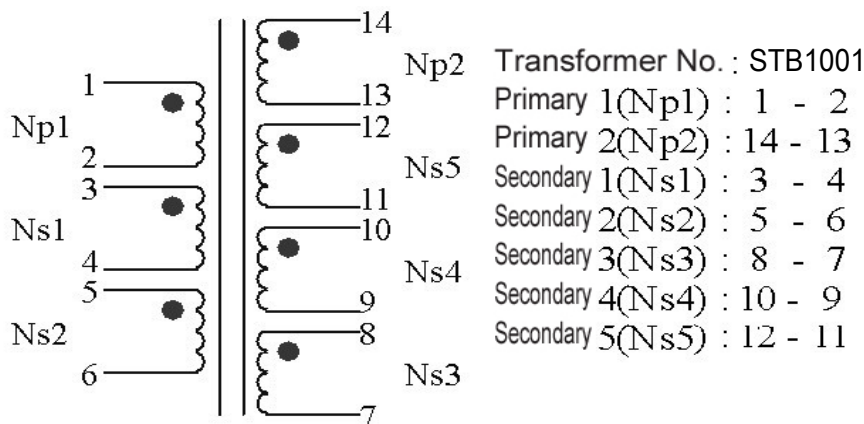
The Cx limit setting table is used to set the positive and negative pins of Cx, short pins, nominal value, upper and lower limit, multi-frequency, multi-level, and D value limit.

Due to the large number of table parameters, one page cannot display all the setting parameters. Here, you can move the cursor left and right, or directly swipe the limit setting table on the screen to display the incomplete parameter settings.

Touch the Cx limit setting table, or move the cursor to the Cx limit setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to Cx is p,n,µ,m, and the [ENTER] key is x1.

Cx Pin(+), Pin(-) and Short Pins

When setting the Cx short pins, you can use the soft key . and ~ to input multiple pins, where a maximum of

24 pins can be saved.

Example:

- Input a segment of discontinuous numbers "1, 3, 5, 7, 9", use the soft key . to separate each number,

  press the [ENTER] key to confirm. The final data displayed in the table is (1, 3, 5, 7, 9).

- Input a continuous number of "1, 2, 3, 4, 5, 6, 7, 8, 9", first input the number "1", then press the soft key

  ~, and finally input "9", press the [ENTER] key to confirm. The final data displayed in the table is (1~9).

Note: The maximum number of Cx pins and short pins supported is 24, and excess pins will be ignored.

- Input part of consecutive numbers and non-consecutive numbers "1, 2, 3, 4, 5, 7, 9", the continuous part
  is the same as step 2, the non-consecutive part is the same as step 1, press the [ENTER] key to confirm.
  The final data displayed in the table is (1~5, 7, 9).

Trans Condition										⌂
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	**Cx**
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI. ↻
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			Clear Cx Table
Average	1	1	1	1	1	1	1	1		
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		Copy↓↓
Equ		Series	Series	Parallel		Series				
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Cx	Pins(+)	Pins(-)	Short Pins	Std(F)	Low	High	Freq(Hz)
0	P01~P02	P62~P61		10.000p	8.0000p	12.000p	
1							
2							
3							
4							
5							
6							
7							
8							
9							

7.11.5.2 Cx Multi-Frequency Setup

If you need to use different frequencies to test different Cx pins of the transformer, in the transformer Cx limit setting table, touch or move the cursor to the frequency area of Cx. After inputting the frequency in this area, the frequency here will be used automatically during the test. If the parameter is not set, the frequency of Cx in the test condition table will be used.

Trans Condition										⌂
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	**Cx**
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI. ↻
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			Clear Cx Table
Average	1	1	1	1	1	1	1	1		
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		Copy↓↓
Equ		Series	Series	Parallel		Series				
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Cx	Pins(+)	Pins(-)	Short Pins	Std(F)	Low	High	Freq(Hz)
0	P01~P02	P62~P61		10.000p	8.0000p	12.000p	
1	P11~P12	P52~P51		10.000p	8.0000p	12.000p	12.0000k
2							
3							
4							
5							
6							
7							
8							
9							

7.11.5.3 Cx Multi-Level Setup

If you need to use different levels to test different Cx pins of the transformer, in the transformer Cx limit setting table, touch or move the cursor to the level area of Cx. After inputting the level in this area, it will be used automatically during the test. If the parameter is not set, the level of Cx in the test condition table will be used.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		Cx
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI. ↻
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear Cx Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			Copy↓↓
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Cx	Short Pins	Std(F)	Low	High	Freq(Hz)	Level	D-Std	D-Low	D-High
0		10.000p	8.0000p	12.000p					
1		10.000p	8.0000p	12.000p	12.0000k	500mV			
2									
3									
4									
5									
6									
7									
8									
9									

7.11.5.4 D Limit Setup

In the transformer Cx limit setting table, touch or move the cursor to D-Std, D-Low and D-High of Cx to set.

Note: The D value test switch is set at the Cx switch.

7.11.6 Zx Measurement Conditions Setup

On the <Trans Condition> page of the transformer scan, touch or move the cursor to a column of Zx in the test condition to set the Zx parameters.

7.11.6.1 Zx Limit Setup

The Zx limit setting table is used to set the Zx standard value, upper and lower limit, bias, multi-frequency and multi-level.

Touch the Zx limit setting table, or move the cursor to the Zx limit setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to Lk is M, k, µ, m, and the [ENTER] key is x1.

Trans Condition										Zx
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			
Average	1	1	1	1	1	1	1	1		Clear Zx Table
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		
Equ		Series	Series	Parallel		Series				Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Zx	Pins	Std(Ω)	Low	**High**	Bias	Freq(Hz)	Level	Short Pins
0	P01-P02	628.00	600.00	800.00				
1	P11-P12							
2	P21-P22							
3	P31-P32							
4	P11-P22							
5	P11-P12	300.00	280.00	320.00				
6								
7								
8								
9								

7.11.6.2 Add DC Bias to Zx

The instrument can use a built-in DC bias source of 100mA or 2A. When setting the current value, you can set a maximum value of 2A for the sake of compatibility with the storage file.

Trans Condition										Zx
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			
Average	1	1	1	1	1	1	1	1		Clear Zx Table
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		
Equ		Series	Series	Parallel		Series				Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

Zx	Pins	Std(Ω)	Low	High	**Bias**	Freq(Hz)	Level	Short Pins
0	P01-P02	628.00	600.00	800.00	8mA			
1	P11-P12							
2	P21-P22							
3	P31-P32							
4	P11-P22							
5	P11-P12	300.00	280.00	320.00				
6								
7								
8								
9								

7.11.6.3 Zx Multi-Frequency Setup

If you need to use different frequencies to test different Zx pins of the transformer, in the transformer Zx limit setting table, touch or move the cursor to the frequency area of Zx. After inputting the frequency in this area, the frequency here will be used automatically during the test. If the parameter is not set, the frequency of Zx in the test condition table will be used.

7.11.6.4 Zx Multi-Level Setup

If you need to use different levels to test different Zx pins of the transformer, in the transformer Zx limit setting table, touch or move the cursor to the level area of Zx. After inputting the level in this area, it will be used automatically during the test. If the parameter is not set, the level of Zx in the test condition table will be used.

7.11.7 ACR Measurement Conditions Setup

On the <Trans Condition> page of the transformer scan, touch or move the cursor to a column of ACR in the test condition table to set the ACR parameters.

	Turn	Lx	Lk	Cx	Zx	**ACR**	DCR	PS	BAL		ACR
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			
Equ		Series	Series	Parallel		Series					
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Acr	Pins	Std(Ω)	Low	High	Freq(Hz)	Level
0	P01-P02					
1	P11-P12					
2	P21-P22					
3	P31-P32					
4	P11-P22					
5	P11-P12					
6						
7						
8						
9						

7.11.7.1 ACR Limit Setup

The ACR limit setting table is used to set the standard value, upper and lower limit, multi-frequency and multi-level of ACR.

Touch the ACR limit setting table, or move the cursor to the ACR limit setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to ACR is M, k, μ, m, and the [ENTER] key is x1.

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL		ACR
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k					PRI.
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V			A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF				Clear ACR Table
Average	1	1	1	1	1	1	1	1			
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s			
Equ		Series	Series	Parallel		Series					Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9		
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON		

Acr	Pins	Std(Ω)	Low	**High**	Freq(Hz)	Level
0	P01-P02	11.000	10.000	12.000		
1	P11-P12					
2	P21-P22					
3	P31-P32					
4	P11-P22					
5	P11-P12	6.0000	5.0000	10.000		
6						
7						
8						
9						

7.11.7.2 ACR Multi-Frequency Setup

If you need to use different frequencies to test different ACR pins of the transformer, in the transformer ACR limit setting table, touch or move the cursor to the frequency area of ACR. After inputting the frequency in this area, the frequency here will be used automatically during the test. If the parameter is not set, the frequency of the ACR in the test condition table will be used.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k			
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V	
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF		
Average	1	1	1	1	1	1	1	1	
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s	
Equ		Series	Series	Parallel		Series			
Sequence	1	2	3	4	5	6	7	8	9
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON

ACR — PRI. — A1 — Clear ACR Table — Copy↓↓

Acr	Pins	Std(Ω)	Low	High	Freq(Hz)	Level
0	P01-P02	11.000	10.000	12.000		
1	P11-P12					
2	P21-P22					
3	P31-P32					
4	P11-P22					
5	P11-P12	6.0000	5.0000	10.000	5.00000k	
6						
7						
8						
9						

7.11.7.3 ACR Multi-Level Setup

If you need to use different levels to test different ACR pins of the transformer, in the transformer ACR limit setting table, touch or move the cursor to the ACR level area. After inputting the level in this area, it will be used automatically during the test. If the parameter is not set, the ACR level in the test condition table will be used.

Trans Condition

	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k			
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V	
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF		
Average	1	1	1	1	1	1	1	1	
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s	
Equ		Series	Series	Parallel		Series			
Sequence	1	2	3	4	5	6	7	8	9
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON

ACR — PRI. — A1 — Clear ACR Table — Copy↓↓

Acr	Pins	Std(Ω)	Low	High	Freq(Hz)	Level
0	P01-P02	11.000	10.000	12.000		
1	P11-P12					
2	P21-P22					
3	P31-P32					
4	P11-P22					
5	P11-P12	6.0000	5.0000	10.000	5.00000k	500mV
6						
7						
8						
9						

7.11.8 DCR Measurement Conditions Setup

On the <Trans Condition> page of the transformer scan, touch or move the cursor to a column of DCR in the test condition table to set DCR parameters.

7.11.8.1 DCR Limit Setup

The DCR limit setting table is used to set the standard value, upper and lower limit of DCR.

Touch the DCR limit setting table, or move the cursor to the DCR limit setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to DCR is M, k, μ, m, and the [ENTER] key is x1.

7.11.9 PS Measurement Conditions Setup

On the <Trans Condition> page of the transformer scan, touch or move the cursor to a column of PS in the test condition table to set PS parameters.

7.11.9.1 PS Limit Setup

The PS limit setting table is used to set the positive and negative pins and upper and lower limits of PS.

Touch the PS limit setting table, or move the cursor to the PS limit setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to PS is M, k, μ, m, and the [ENTER] key is x1.

The default lower limit of PS is 10kΩ.

Note: In general measuring, the upper limit does not need to be set, that is, there is no upper limit.

7.11.9.2 PS Test Pin Setup

This page is used to set the shorted pins. In the process of auto scanning test, the instrument will test DCR of each set pin and make comparison with the PS low limit set on PS limit setup page.

The following figure shows the example transformer and its setup page of pin short test.
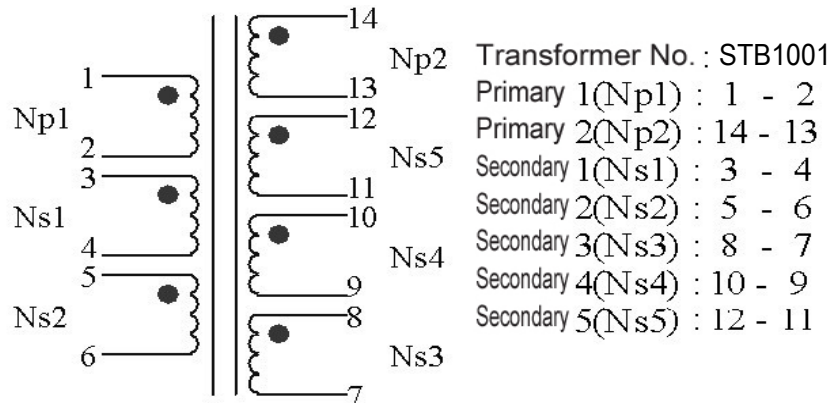
When setting the positive and negative pins of PS, you can use the soft key . and ~ to input multiple pins, where a maximum of 12 pins can be saved.

Example:

- Input a segment of discontinuous numbers "1, 3, 5, 7, 9", use the soft key . to separate each number, press the [ENTER] key to confirm. The final data displayed in the table is (1, 3, 5, 7, 9).

- Input a continuous number "1, 2, 3, 4, 5, 6, 7, 8, 9", first input the number "1", then press the soft key ~, and finally input "9", press the [ENTER] key to confirm. The final data displayed in the table is (1~9).

Note: The maximum number of PS positive and negative pins supported is 12, and excess pins will be ignored.

- Input part of continuous numbers and non-consecutive numbers "1, 2, 3, 4, 5, 7, 9", the continuous part is the same as step 2, the non-continuous part is the same as step 1, press [ENTER] key to confirm. The final data displayed in the table is (1~5, 7, 9).

Trans Condition										🏠
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	**PS**
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI. ↻
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			Clear PS Table
Average	1	1	1	1	1	1	1	1		
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		
Equ		Series	Series	Parallel		Series				Copy↓↓
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

PS	PS +	PS -	Low	High
0	P02	P11	10.000k	
1	P12	P21	10.000k	
2	P31	P42	10.000k	
3	P41	P52	10.000k	
4	P51	P62	10.000k	
5	P01~P02	P52~P51	10.000k	
6			10.000k	
7			10.000k	
8			10.000k	
9			10.000k	

7.11.10 BAL Measurement Conditions Setup

On the <Trans Condition> page of the transformer scan, touch or move the cursor to a column of BAL in the test condition table to set BAL parameters.

Trans Condition										🏠
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	**BAL**	**BAL**
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				PRI. ↻
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		A1
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			BAL Switch
Average	1	1	1	1	1	1	1	1		ON
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		
Equ		Series	Series	Parallel		Series				
Sequence	1	2	3	4	5	6	7	8	9	
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

BAL	B1	B2	Abs	Formula	Std	Low	High
0			ON	|Lx1-Lx2|			
1			ON	|Lx1-Lx2|			
2			ON	|Lx1-Lx2|			
3			ON	|Lx1-Lx2|			
4			ON	|Lx1-Lx2|			
5			ON	|Lx1-Lx2|			
6			ON	|Lx1-Lx2|			
7			ON	|Lx1-Lx2|			
8			ON	|Lx1-Lx2|			
9			ON	|Lx1-Lx2|			

7.11.10.1 BAL Test Setup

BAL (Balance) is a parameter used to compare the consistency of the two windings of a transformer. BAL upper and lower limits, balance windings, absolute values, and balance formulas can be set.

Touch the BAL table, or move the cursor to the BAL test setting area, and use the numeric keys, corresponding magnification or [ENTER] key to set.

The magnification corresponding to BAL is p,n,μ,m, and the [ENTER] key is x1.

7.11.10.2 BAL Absolute Value Setup

In the equation used to judge the balance of the two windings, to set whether the final result is compared with the absolute value.

For example, for the equation Lx1–Lx2:

- When the absolute value switch is ON, the equation will be converted to |Lx1–Lx2|, and the result will be the absolute value of Lx1–Lx2 compared with the set upper and lower limits;

- When the absolute value switch is OFF, the equation will be converted to Lx1–Lx2, the result will be directly compared with the upper and lower limits set, and the result can be positive or negative.

7.11.10.3 BAL Equation Setup

Currently, there are 5 equations to choose from, which are as follows:

- Lx1–Lx2

- DCR1–DCR2

- DCR1–DCR2

- DCR1–DCR2

- DCR1–DCR2

When the absolute value switch is changed, it will affect the final result of this equation.

Trans Condition										BAL
	Turn	Lx	Lk	Cx	Zx	ACR	DCR	PS	BAL	
Freq(Hz)	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k	10.0000k				Lx1-Lx2
Level	1 V	300mV	300mV	300mV	300mV	300mV	2 V	2 V		
Dev	OFF	Δ%	OFF	OFF	OFF	OFF	OFF			DCR1-DCR2
Average	1	1	1	1	1	1	1	1		
Delay	0 s	0 s	0 s	0 s	0 s	0 s	0 s	0 s		Lk1-Lk2
Equ		Series	Series	Parallel		Series				
Sequence	1	2	3	4	5	6	7	8	9	Lk1/Lk2
Switch	ON	ON	ON	ON	ON	ON	ON	ON	ON	

BAL	B1	B2	Abs	Formula	Std	Low	High	Lx1/Lx2
0	P01-P02	P11-P12	OFF	Lx1-Lx2				Return
1			ON	|Lx1-Lx2|				
2			ON	|Lx1-Lx2|				
3			ON	|Lx1-Lx2|				
4			ON	|Lx1-Lx2|				
5			ON	|Lx1-Lx2|				
6			ON	|Lx1-Lx2|				
7			ON	|Lx1-Lx2|				
8			ON	|Lx1-Lx2|				
9			ON	|Lx1-Lx2|				

7.11.11 Handler Mode Function

After a scan test, the Handler outputs the final sorting signal according to the settings here.

There are currently three sorting modes:

- **Default:** Output unqualified signals according to the parameters shown in the signal column in the table.

- **X30:** According to the page in the table, a group of two pages will output the unqualified signal.

- **X12:** According to the page in the table, a group of five pages will output the unqualified signal.

Handler Mode										Handler Mode
Handler Mode	X30				Interface		Handler - 1			Default
Pin	Signal	Page	Direction	Function	Pin	Signal	Page	Direction	Function	X30
1	FAIL_01	A1-A2	Output		11,12 13	+5V	N/A	Output	Imax=0.3A	
2	FAIL_02	A3-A4	Output		14,15 16,17	GND	N/A	Output	GND	X12
3	FAIL_03	A5-B1	Output		18	24V-	N/A	Output	Cylinder -	
4	FAIL_04	B2-B3	Output		19	EXT_GND	N/A	Input	GND_EXT	
5	FAIL_05	B4-B5	Output		20	24V+	N/A	Output	Cylinder +	
6	FAIL_06	C1-C2	Output		21	EXT_VCC	N/A	Input	3.3V ~ 24V	
7	FAIL_07	C3-C4	Output		22	EXT_RESET	N/A	Input		
8	FAIL_08	C5-D1	Output		23	EXT_START	N/A	Input		
9	FAIL_09	D2-D3	Output		24	FAIL_ANY	ALL	Output		
10	TEST	N/A	Output		25	PASS_ALL	ALL	Output		

7.11.12 Parameter Copy Function

After setting the setting parameters of the transformer A board, such as Pin-to-Fixture, Transformer Pins and measurement conditions, use the parameter copy function to automatically copy the parameters of the A board to the B~L boards. Doing so can save the time of repeatedly re-configuring the parameters of the B~L board.

7.11.13 Statistics Page

On the transformer scan setting page, press the function key [Statistics], it will jump to the <Statistics> page.

Trans Stat					Trans Statistics
	Pass	Fail	SUM		Trans ID
Turn					
Lx					Pin To Fixture
Lk					
Cx					Pin Setup
Zx					
ACR					Condition
DCR					
PS					Copy
BAL					
Whole					Handler Mode
					Stat
					Tools

The page states the following:

- **[PASS]** indicates the pass times of each parameter of L.K.~DCR.

- **[PASS]+[WHOLE]:** In one measurement, all parameters that need to be measured in L.K.~DCR are qualified, then [PASS] corresponds to the value of [WHOLE] (total qualified column) plus 1.

- **[FAIL]** Indicates the fail times of each parameter of L.K.~DCR.

- **[FAIL]+[WHOLE]:** In one measurement, if one or more parameters to be measured in L.K.~DCR are unqualified, then [FAIL] corresponds to the value of [WHOLE] (total unqualified column) plus 1.

- **[SUM]** indicates the total measurement times of a measurement parameter;

- **[SUM]+[WHOLE]** indicates the total number of measurements, which is equal to the total number of pass times and the total number of fail times.

7.12 <Trans Scan>

After all settings are completed, directly press the [DISP] key to enter the <Trans Scan> page. Before starting the test, it is usually best to press the [FILE] key to enter the <File Management> page, and save the settings for future use. For details, see Chapter 4.2 <File>.

After saving the file, enter the <Trans Scan> page.

If you are only using the internal scanning board, just press the [TRIGGER] key on the front panel to trigger the test. If you are using a scan box, make sure that the host and scan box are installed and connected correctly. Now you can place the transformer to be tested on the test fixture and press the [START] button on the scan box to start the scan. The test value will be displayed on the screen. If the test is defective, the test value is displayed in red.

The instrument will display the scan data and the final PASS/FAIL according to the settings of the scan result display on the <Trans ID> page.

During scanning, if a particular pin of Lx or Zx is set to add DC bias current, the instrument will automatically add the corresponding DC bias current and light the [DC BIAS] button.

7.12.1 Each Display Zone under This Page

PIN Area

The area below the column displays the pins of each winding, but the pins of Cx are not displayed in this area. If you need to check, you can press the [DISPLAY] key, and the pins will be displayed in the cell of the measurement result. (Only the 1st of the positive and negative pins is displayed.)

Each Parameter Measurement result Display Area (TURN, Lx, Q, LK, Cx, D, ZX, ACR, DCR, PS, BAL)

When all parameters are turned on, you can press the left and right keys or touch left and right to slide to view the not all displayed parameter.

7.12.2 Function Keys under This Page

- **[TRIGGER]** is used to start the instrument for scan measuring.

- **[RESET]** is used to interrupt an ongoing scan test.

- **[KEYLOCK]** locks the keyboard. After locking the keyboard, the user can also perform other operations such as scan test, but the parameter settings cannot be modified. This function can be used to prevent testers from changing or deleting the set measurement conditions by mistake. Shut down after locking the keyboard, the current test file will be called automatically next time it is turned on. **[FILE]** is used to enter the file management page.

- **[CAL]** is used to tuen on the open-circuit test fixture scanning correction function, as shown in the figure below:

At this time, put an open-circuit transformer sample with the same pin position as the product under test on the test fixture, and then press the soft key [Meas Open], and the instrument will perform an open-circuit correction on the test fixture. This function can improve the test accuracy of small inter-turn capacitance and large inductance (>300mH level), and can also improve the open circuit value of DCR and PS.

High frequency open circuit can improve the test accuracy at high frequency.

[CAL] Turn on the short-circuit test fixture scan correction function:

At this time, put a short-circuit transformer sample with the same pin as the product under test on the test fixture, and then press the soft key [Meas Short], and the instrument will perform a short-circuit correction on the test fixture. This function can improve the test accuracy of small DC resistance and small inductance.

After the open and short-circuit correction, if you want to use the clear data in the test, you need to open the corresponding switch.

7.12.3 PRI Page-Turning Function

In the transformer scan measurement test interface, after measuring a transformer with multiple primary windings, you can switch the primary (PRI) page with the knob to view the measurement results, and the untested pages will be ignored directly.

Press the Knob key and the Primary (PRI) page will return to the A1 page.

7.12.4 Pin Display Function for Stray Capacitance

After measuring the stray capacitance, press the Display key to view some pins of the current stray capacitance.

7.12.5 BAL Balance Parameter Display

After the scan is over, press the [DISP] key to switch to display the result value between the two windings of the BAL.

7.13 <File> Page of Transformer Scan

7.13.1 Transformer Scan Setup File (*.t40)

The internal space of the instrument can save a certain number of scan settings files (*.t40 files); the number is determined by the remaining internal storage space. The scan settings files can also be displayed/operated through an external storage USB flash drive, and supports large-capacity USB flash drives (FAT32 format) read and write functions.

All setting data on the following pages will be saved or loaded in the form of files, called *.t40 files.

- <Trans ID>

- <Pin to Fixture>

- <Pin Setup>

- <Trans Condition>

- <Trans Deviation>

- < Handler Mode>

- Some menu functions in <Trans Scan Test>

7.13.1.1 USB Drive Manage Performance

As mentioned above, the ST2840X is equipped with a USB HOST interface as standard, which can use an external USB flash drive as a storage medium, thus breaking through the storage limitation of the internal settings files of the instrument, and can also copy these files to an IBM PC with a USB interface or a compatible desktop, computer, notebook computer, so as to achieve unlimited expansion.

ST2840X supports the following USB mass storage devices (USB flash drives):

- Compliant with USB 2.0 standard

- Capacity: 2GB/4GB/8GB/16GB/32GB

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

7.13.2 Operation Steps for File Management

7.13.2.1 View Existing Files

- Click the [+] before the folder icon, or click the folder and right-click to view all the files in this folder.

- Files saved in the root directory can be viewed directly by turning the knob counterclockwise. Follow the steps below to save control setup parameters to a file.

- First set all the control parameters of the desired page.

- Press the soft key [FILE] to enter the file management page.

- When you move the cursor to any file or folder, the menu will display the following:

    - Save.t40

- • Copy to E:\

- • Rename

- • Delete

- • New folder

- Select Save.t40 to save the settings file.

- After pressing the save soft key, the screen will display the soft keyboard.

- Enter characters as the file name and press OK to save, press Esc to cancel saving the file.

  - • When saving a file with the same file name, the "File Existing" dialog box will pop up. Select Overwrite to overwrite the file with the same name; select Rename to re-enter the file name; select Cancel to cancel the saving of this file.

- Press the [DISP] key to enter the transformer scan test page.

- Follow the steps below to load control setup parameters from a file.

- Press the soft key [FILE] to enter the file management page.

- Selecting the .t40 file you want to load will display the following menu:

  - • Load

  - • Save.40

  - • Copy to E:

  - • Rename

  - • Delete

  - • New folder

- Press the [Load] soft key and the screen will display the following menu:

  - • Load

  - • Cancel

- Pressing [Cancel] will cancel the current load operation and return to step 1.

- Press [Load] and the currently selected file will be loaded. At the same time, you will enter the <Trans Scan> page.

7.13.3 Transformer Deviation-Deduction

If you have the standard samples of untested transformer, and its data of each test can serve as the measurement standard, the deviation-deduction function is available.

The operation of deviation function is listed below:

- According to the set method, enter the <Trans Scan> page after setting parameter.

- Put standard transformer to test fixture and lock it, press [START] in scan box several times to get a stable test value;

- Press [Deviation] to enter the <Trans Deviation> page.

Trans Deviation										
Para		Turn	Lx	Q	Lk	Cx	D	Zx	ACR	DCR
High(%)		300	300	300	3k	300	300	300	300	500
Low(%)		-60	-60	-60	-90	-60	-60	-60	-60	-60
Mode		OFF	DIV	OFF	OFF	OFF	OFF	OFF	OFF	SUB
PRI.	P01-P02		1							1
SEC.1	P11-P12		1							1
SEC.2	P21-P22		1							1
SEC.3	P31-P32		1							1
SEC.4	P11-P22		1							
SEC.5	P11-P12		1							
SEC.6										
SEC.7										
SEC.8										
SEC.9										

Dev value
PRI.
A1
Deviation
OFF
Test & Load
Reset Column
Item
ON
Exit

- Set [Deviation] to ON ;

- Set the correction parameter switch to DIV or SUB ;

- Set the high and low limits allowed for deduction of each parameter;

- Press [Deviation] to perform the correction, and return to the <Trans Scan> page.

- After the deduction is successful, if the user triggers the test again, the measured value displayed by the instrument will be the same as the value of the standard product.

- If you need to check the deviation value used by each parameter at this time, just return to the <Trans Deviation> page to check.

Trans Deviation										
Para		Turn	Lx	Q	Lk	Cx	D	Zx	ACR	DCR
High(%)		300	300	300	3k	300	300	300	300	500
Low(%)		-60	-60	-60	-90	-60	-60	-60	-60	-60
Mode		OFF	DIV	OFF	OFF	OFF	OFF	OFF	OFF	SUB
PRI.	P01-P02		-2.169m							-250m
SEC.1	P11-P12		-97.391μ							-110m
SEC.2	P21-P22		-373.54μ							-110m
SEC.3	P31-P32		1							1
SEC.4	P11-P22		1							
SEC.5	P11-P12		1							
SEC.6										
SEC.7										
SEC.8										
SEC.9										

Dev value
PRI.
A1
Deviation
21/12/16 14:56
Test & Load
Reset Column
Item
ON
Exit

Note: When modifying the DIV value, it can not be be revised as 0.

If you need to save the deduction value, press the soft key [FILE] to enter the file management page, and follow the on-screen prompts to save the file so that the same transformer can be measured after the next restart.

7.14 Focus

The focus function makes it easier to repeat the test between the specified windings or between the specified parameters.

On the <Trans Scan> page, turn on the [Focus] switch, and then click the parameter you want to test repeatedly.

Click on the cell; when its background turns blue, it is in the selected state. At this time, press the [TRIGGER] key to measure the data of this cell;

Click the parameter title to focus scan the parameter selected;

Trans Scan				I:\files\GuideBook.t40					
A1	Pin	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Balance
0	P01-P02			1.3597p					
1	P11-P12			2.6370p					
2	P21-P22								
3	P31-P32								
4	P11-P22								
5	P11-P12								
6									
7									
8									
9									
A2	Pin	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Balance
0	P61-P62								
1	P11-P12								
2	P21-P22								
3	P31-P32								
4	P41-P42								
5	P51-P52								
6									
7									
8									
9									

Setup

Pri.
A1,A2

Load Std
OFF

Deviation
21/12/16 14:56

Speed
Fast

Test Fail
Continue

Focus
ON

Split
2-1

Save
OFF

Click [Pin] to focus scan all the data to be tested on a page.

Trans Scan					I:\files\GuideBook.t40					
A1	Pin	Turn-V	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Bala
0	P01-P02	1.0000	-2.1207m	-3.1603	1.7227p	18.903k	1.3441M	-750.00m	3.9015M	
1	P11-P12	214.21m	506.68µ	-5.7133	3.1118p	1.7123M	1.3831M	110.00m	499.97k	
2	P21-P22	145.66m	1.2787m	-6.1429		1.5351M	1.3367M	110.00m	3.2010M	
3	P31-P32								--.---M	
4	P11-P22								1.0999M	
5	P11-P12								--.---M	
6										
7										
8										
9										
A2	Pin	Turn-V	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Bala
0	P61-P62									
1	P11-P12									
2	P21-P22									
3	P31-P32									
4	P41-P42									
5	P51-P52									
6										
7										
8										
9										

Setup

Pri.
A1,A2

Load Std
OFF

Deviation
21/12/16 14:56

Speed
Fast

Test Fail
Continue

Focus
ON

Split
2-1

Save
OFF

7.15 Split

When there are few transformer test parameters, and multiple transformers need to be tested at the same time, the split function can be modified to meet the test requirements.

The split functions are:

- 2-1
- 3-1
- 4-1
- 2-2
- 3-2
- 4-2.

The default setting is **2-1**. If the table does not display all parameters, you can touch the corresponding table and slide left and right to view it, or press the left and right soft keys to view it directly.

Trans Scan — I:\files\GuideBook.t40

A1	Pin	Turn-V	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Bala
0	P01-P02	1.0000	-382.87µ	-9.6958	001 - 013	11.633k	1.3556M	-750.00m	002 - 003	001-002:
1	P11-P12	207.97m	553.68µ	-9.4669	003 - 011	1.6621M	1.3588M	-890.00m	004 - 005	
2	P21-P22	146.96m	1.2310m	-4.5691		1.3641M	1.5967M	110.00m	008 - 009	
3	P31-P32								010 - 011	
4	P11-P22								012 - 013	
5	P11-P12								001 - 011	
6										
7										
8										
9										

A2	Pin	Turn-V	Lx(H)	Lk(H)	Cp(F)	Zx(Ω)	ACR(Ω)	DCR(Ω)	PS	Bala
0	P61-P62	1.0000	-308.00m	-3.9079		1.6634M	1.4570M	8.4071M		
1	P11-P12	208.45m	-1.6171	-3.4051		1.4998M	1.4758M	6.6955M		
2	P21-P22	143.30m	-3.5710	-2.8760		1.5548M	1.5063M	-1.0000		
3	P31-P32									
4	P41-P42									
5	P51-P52									
6										
7										
8										
9										

Setup | Pri. A1,A2 | Load Std OFF | Deviation OFF | Speed Fast | Test Fail Continue | Focus OFF | Split 2-1 | Save OFF

Trans Scan — I:\files\GuideBook.t40

A1	Pin	Turn-V	Lx(H)	Lk(H)	Cp(	---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(
0	P01-P02	1.0000	-2.1207m	-3.1603	1.722	0					
1	P11-P12	214.21m	506.68µ	-5.7133	3.111	1					
2	P21-P22	145.66m	1.2787m	-6.1429		2					
3	P31-P32					3					

A2	Pin	Turn-V	Lx(H)	Lk(H)	Cp(	---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(
0	P61-P62					0					
1	P11-P12					1					
2	P21-P22					2					
3	P31-P32					3					

---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(	---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(
0						0					
1						1					
2						2					
3						3					

---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(	---	Pin	Turn-V	Lx(H)	Lk(H)	Cp(
0						0					
1						1					
2						2					
3						3					

Setup | Pri. A1,A2 | Load Std OFF | Deviation 21/12/16 14:56 | Speed Fast | Test Fail Continue | Focus ON | Split 4-2 | Save OFF

7.16 Frequently Asked Questions and Answers on Transformer Scans

7.16.1 High and Low Limits

During measuring, you find the test value of transformer is obviously and seriously unqualified, but the judge table still displays that the parameter is qualified.

Reason: You have only set the standard value (STD) but not the high/low limit, or just set one of the high/low limit values.

Solution: Set high and low limits.

7.16.2 Measurement Item Loss

During measuring, you find some parameter such as (Lx) is set to be tested, but the parameter is not tested and no data displays.

Reason: You have only set [√ / x] to √, but have not set a standard value on the parameter menu. Simultaneously, "Ignore STD Test" is set to "FORCE DEV" on [Trans ID].

Solution:

- Set "Ignore STD Test" to "FORCE TEST".
- Set the standard value on parameter limit setup menu.

7.16.3 Measurement Interruption

The instrument only tests the test parameter in the first several value groups; the last ones are not tested.

Reason 1: When setting the pin position, you have only configured the first groups of pins, but have not configured one or more pin group in the middle; thus the left groups will not be used in measuring.

Reason 2: On [Trans Scan], you have set "Test Fail" to "STOP", meaning that when any parameters are invalid, the test will not be performed.

Solution:

- Set "Test Fail" to "CONTINUE".
- Reset the blank pin on parameter limit setup menu or set "Ignore STD" to "FORCE TEST".

7.16.4 Poor DCR Accuracy

If the sheet metal is oxygenized, torn or deformed, or you made a fixture without applying the 4-cable test method, it will cause DCR deviation.

Solution:

- Keep the sheet metal intact, so it can be in good contact with the transformer pin.
- Use 4-cable measurement.
- Use deviation deduction.

7.16.5 Poor Lk Accuracy

If the sheet metal is oxygenized, torn or deformed, or the lead resistance of a user-made test fixture is too large, it will cause Lk deviation.

Solution:

- Keep the sheet metal intact, so it can be in good contact with the transformer pin.
- Use 4-cable measurement.
- Use deviation deduction.

7.16.6 Inaccurate TURN

For transformers with low magnetic permeability magnetic-core, the number of windings is not the same as that of real winding because the inductor will take some ACR voltage.

Solution: Use the TURN mode to test winding.

7.16.7 Unstable TURN

For a transformer with high magnetic permeability magnetic-core, test winding will be unstable.

Solution:

- Use the TURN_V mode to test winding (voltage-turn mode).
- Use deviation deduction.

7.16.8 Difference Between the First and the Second Lx

Because a transformer with high magnetic permeability magnetic-core is polarized while measuring DCR or TURN, the measurement results of the first and the second Lx test will be quite different.

Solution: Use 100Ω internal resistance when measuring DCR or TURN.

7.16.9 Poor Stability of Cx and Zx Open Test Data

If the shielding and ground of test system is not good, it will cause the test value to be unstable when measuring Cx or Zx.

Solution: Through a thick metal lead, connect the ground poles of the instrument and the scan box as well as the metal frame of the test fixture together, and ground reliably.

7.16.10 DCR and PS Open Cannot Increase Indefinitely

Due to the existence of circuit distribution parameter, an infinite size cannot be displayed when measuring DCR or PS open; this is a normal phenomenon. If you do wish to display it, execute the sweep open-circuit correction function on the test fixture.

7.17 User-Made Test Fixture

There are many kinds of transformers, which means our company can't offer a test fixture to each transformer. This requires the user to make a test fixture based on some specific principles.

The following must be kept in mind when making a test fixture:

1) Use the 4-cable measurement method to extend the test cable. Don't use a 5.0mm test fixture to hold the test lead.

2) Use a multi-strand lacquer cable with good tenacity as your test extension cable, and use the stands as much as possible to minimize cable resistance.

3) Use high frequency test, and reduce the distribution parameter within the extension cable; don't use a ribbon cable to extend.

4) It is better to use a metal frame which is connected to the ground pole through a thick metal lead.

7.17.1 Use ST1801-EXT2A-OUT to Make Test Fixture

For this, you should purchase the ST1801-EXT2A extension ground board from our company. The figure below also shows the connection of using 2 spring thimble to make test probe.

ST1801-EXT2A-OUT

Double-row pin, which can be inserted into the relay board of the scan box.

Double-row bonding pad, which can install sockets or directly be soldered with leads.

Original wiring on printed circuit

Extension cable

Spring thimble
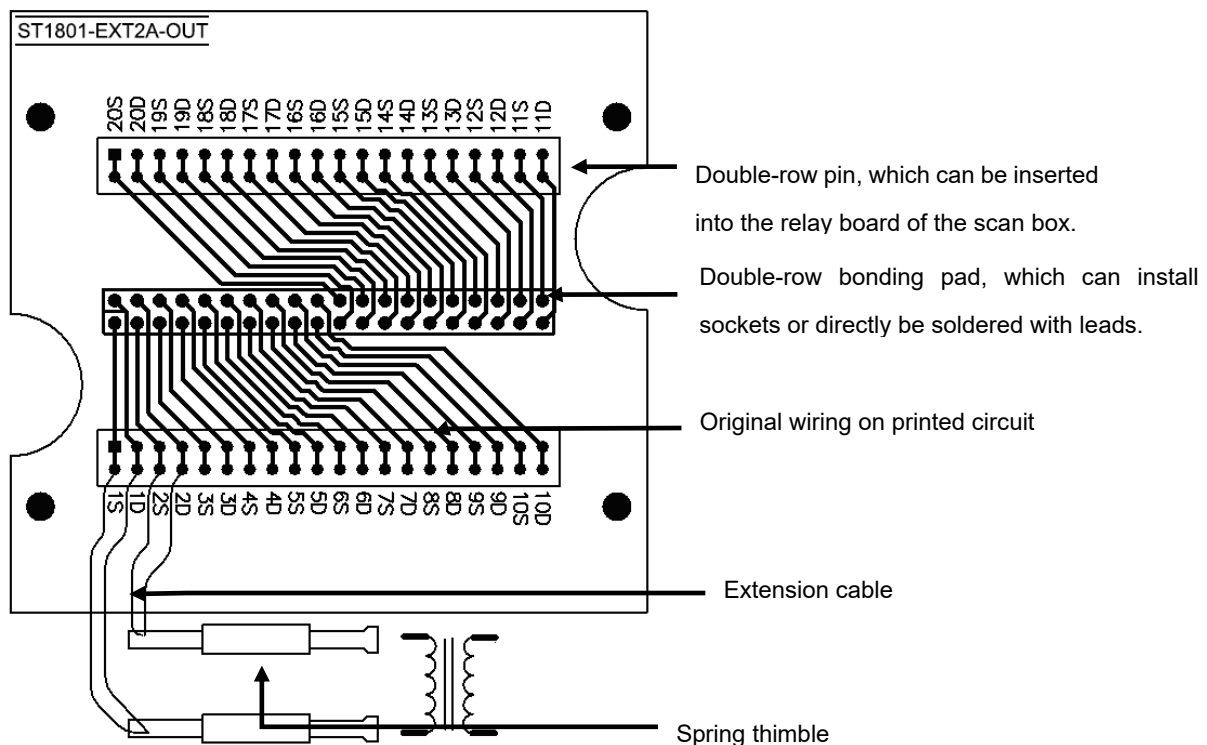
The principle of 4-cable measurement is that the test cable of DRIVE and SENSE should be divided. In this figure, 1D means the drive terminal of pin1, 1S means the sense terminal of pin1.

7.17.2 Example of Using ST1801-EXT11A(5.0)-B Pin Signal
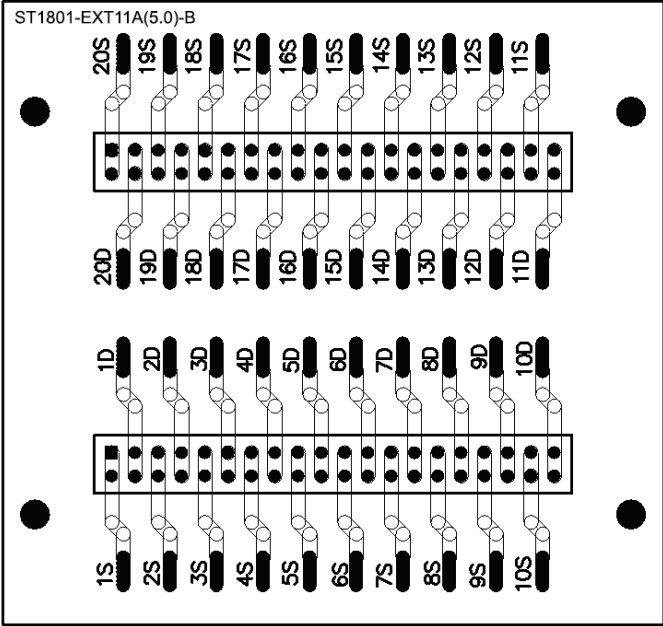
8 Performance and Test

8.1 Measurement Function

8.1.1 Parameter and Symbol

8.1.1.1 LCR Module

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	Rs	Equivalent Series Resistance
Gp	Conductance	Bp	Susceptance
Z	Absolute Value Of Impedance	Y	Absolute Value Of Admittance
D	Loss Factor	Q	Quality Factor
$\theta z°$	Impedance Degree	θz	Impedance Radian
$\theta y°$	Admittance Degree	θy	Admittance Radian
X	Reactance	Rd	DC Resistance

8.1.1.2 Transformer Single-Group Module

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	Rs	Equivalent Series Resistance
D	Loss Factor	Q	Quality Factor
Zx	Absolute Value Of Impedance	Rd	DC Resistance
Lk	Leakage Inductance	dZ	Impedance Angle
Ns	Secondary Turn	Ns:Np	Secondary Turn/Primary Turn
Np	Primary Turn	Np:Ns	Primary Turn/Secondary Turn

8.1.2 Measurement Combination

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

8.1.3 Mathematical Operation

Operation between the measurement value and the programmable nominal value:

- Absolute Deviation ∆ABS

- Percent Deviation ∆%

8.1.4 Equivalent Mode

- Series

- Parallel

8.1.5 Range

- Auto

- Manual (hold, increase and decrease)

8.1.6 Trigger

- **Single:** Press the "TRIGGER" key on the panel, have the Handler Interface of the instrument receive an external start signal, use the foot switch or use the bus trigger command to make the instrument perform a single measurement and output the result and display it, usually in a waiting state.

- **Continuous:** Continuously measure the DUT and output the results for display.

8.1.7 Delay Time

- **Trigger Delay:** the time between the trigger and the beginning of the measurement. 0~60s; programmable; 1ms resolution

- **Step Delay:** the delay time before the measurement signal is output to the measurement. 0~60s; programmable; 1ms resolution.

8.1.8 Connection Modes of Test Terminals

ST2840X adopts a 4-terminal measurement method:

- **Hcur:** Current sample high terminal

- **Lcur:** Current sample low terminal

- **Hpot:** Voltage sample high terminal

- **Lpot:** Voltage sample low terminal

8.1.9 Measurement Speed

- **Fast+:** about 1800 measurements/s (0.55ms/measurement)

- **Fast:** about 300 measurements/s (3.3ms/measurement)

- **Medium:** about 11 measurements/s (90ms/measurement)

- **Slow:** about 4 measurements/s (240ms/measurement)

The fast+, fast and medium speed will slow down when the frequency is below 10kHz.

8.1.10 Average

255; programmable.

8.1.11 Digits Displayed

6 digits; with a max. display of 999999.

8.2 Measurement Signal

8.2.1 Measurement Signal Frequency

The measurement signal is a sine wave.

Accuracy: 0.01%

Frequency Range:

- 20Hz~500kHz (ST2840A/ST2840AX/ST2840NX)

- 20Hz~2MHz (ST2840B/ST2840BX)

Min. Resolution: 1mHz

8.2.2 Signal Mode

- **Normal:** During measuring, the voltage across test terminals may be less than the preset voltage on the measurement display page.

- **Constant Level:** Internal auto adjustment ensures the voltage of DUT corresponds with preset voltage.

8.2.3 Measurement Signal Level

	Mode	Freq	Range	Accuracy	Resolution
Voltage	Normal Constant Level	≤1MHz	5mV$_{rms}$~20V$_{rms}$	±10%×(preset value+2mV)	100μV
		>1MHz	5mV$_{rms}$~15V$_{rms}$	±6%×(preset value+2mV)	
Current	Normal Constant Current	20~2MHz	50μA$_{rms}$~100mA$_{rms}$	±10%×(preset value+10μA$_{rms}$)	1μA

8.2.4 Output Impedance

Choose between 30Ω±4% or 100Ω ±2%.

8.2.5 Monitor for Measurement Signal Level

	Frequency	Range	Accuracy
Voltage	≤1MHz	5mV$_{rms}$~20V$_{rms}$	± (3% × reading + 0.5mV)
	>1MHz	5mV$_{rms}$~15V$_{rms}$	± (6% × reading + 0.5mV)
Current	≤1MHz	50μA$_{rms}$~100mA$_{rms}$	± (3% × reading + 5μA)
	>1MHz	50μA$_{rms}$~100mA$_{rms}$	± (6% × reading + 5μA)

8.2.6 Maximum Measurement Display Range

Parameter	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
Turns Ratio	(1:0.001)~(1000:1)

8.2.7 DC Bias Voltage Source

Range	Resolution	Accuracy
0V~±40V	1mV	1% × preset voltage + 5mV
0mA~±100mA	10μA	–

8.2.8 2A Bias Current Source

Range	Resolution	Accuracy (I > 5mA)
0-2A	1mA	± (2% × set value + 2mA)

8.3 Measurement Accuracy

Measurement accuracy includes:

- Stability

- Temperature Coefficient

- Linear Degree

- Test Repeatability

- Calibration Inter-Error

Any examination of the instrument's accuracy should be under the following circumstances:

- Warm-up time ≥ 60min

- Cable: 0m, 1m

- Correct open-circuit and short-circuit correction after warming up

- DC bias is in the position of OFF

- The range is set to AUTO to select the correct measurement range

8.3.1 Accuracy of│Z│,│Y│, L, C, R, X, G, B

The accuracy A_e of │Z│,│Y│, L, C, R, X, G and B is expressed as:

$$A_e = \pm [A_L \times A + (K_a + K_b + K_c) \times 100 + K_d + K_f] \times K_e \quad [\%]$$

A: Basic Measurement Accuracy (Figure 8-1)

A_L: Level Correction Factor (Table 8-1; Figure 8-2)

K_a: Impedance Rate Factor (Table 8-2; Table 8-3)

K_b: Impedance Rate Factor (Table 8-2; Table 8-4)

K_c: Calibrated Interpolating Factor (Table 8-5)

K_d: Cable Length Factor (Table 8-7)

K_e: Temperature Factor (Table 8-8)

K_f: Scan Fixture Modification Factor (no scan fixture: K_f = 0; scan fixture: K_f = 0.2)

L, C, X, B Accuracy A_e, using condition: D_x (test value of D) ≤ 0.1

R, G Accuracy A_e using condition: Q_x (test value of Q) ≤ 0.1

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

When $Q_x \geq 0.1$, the accuracy factor A_e of R, G is to be multiplied by $\sqrt{1 + Q_x^2}$

8.3.2 D Accuracy

The accuracy of D is defined as:

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

This formula is only available when $D_x \leq 0.1$. When $D_x > 0.1$, D_e should be multiplied by $(1+D_x)$

8.3.3 Q Accuracy

The accuracy of Q is defined as:

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

Where…

- Q_x is the value of the tested Q;

- D_e is the accuracy of D.

The formula should be used when $Q_x \times D_e < 1$.

8.3.4 Θ Accuracy

The accuracy of θ is defined as:

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

8.3.5 G Accuracy

When D_x (value of the tested D) ≤ 0.1, the accuracy of G is defined as:

$$G_e = B_x \times D_e \qquad [S]$$

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

Where…

- B_x is the value of the tested B with the unit [S];

- C_x is the value of the tested C with the unit [F];

- L_x is the value of the tested L with the unit [H];

- D_e is the accuracy of D;

- F is the measurement frequency.

8.3.6 Rp Accuracy

When D_x (value of the tested D) ≤ 0.1, the accuracy of R_p is defined as:

$$R_{pe} = \pm \frac{R_{px} \times D_e}{D_x \mp D_e} \qquad [\Omega]$$

Where…

- R_{px} is the value of the tested R_p with the unit [S];

- D_x is the value of the tested D with the unit [F];

- D_e is the accuracy of D.

8.3.7 Rs Accuracy

When D_x (value of the tested D) ≤ 0.1, the accuracy of R_s is defined as:

$$R_s = X_x \times D_e \qquad [\Omega]$$

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

Where…

- X_x is the value of the tested X with the unit [S];

- C_x is the value of the tested C with the unit [F];

- L_x is the value of the tested L with the unit [H];

- D_e is the accuracy of D;

- F is the measurement frequency

8.3.8 DCR Accuracy

A (1 + R_x / 5MΩ + 16mΩ/R_x) [%] ± 0.2mΩ

At medium and slow measurement speed, A = 0.25

At fast measurement speed, A = 0.5

Here, R_x is the measured resistance.

8.3.9 Lk Accuracy

Inductance L accuracy + 0.2%

8.3.10 Turns Ratio Accuracy

$\pm A_t \times A_r (1 + 1\Omega / Z_p + 1 / Q) [\%] \pm 0.002$

At medium and slow measurement speed, $A_t = 0.25$

At fast measurement speed, $A_t = 0.5$

Where…

- Z_p is the impedance of the measured primary inductance;

- A_r is the correction value of the measurement signal accuracy in Figure B.

This accuracy index is used when the coupling coefficient of the transformer under test is 1 or close to 1.

8.3.11 Accuracy Factor
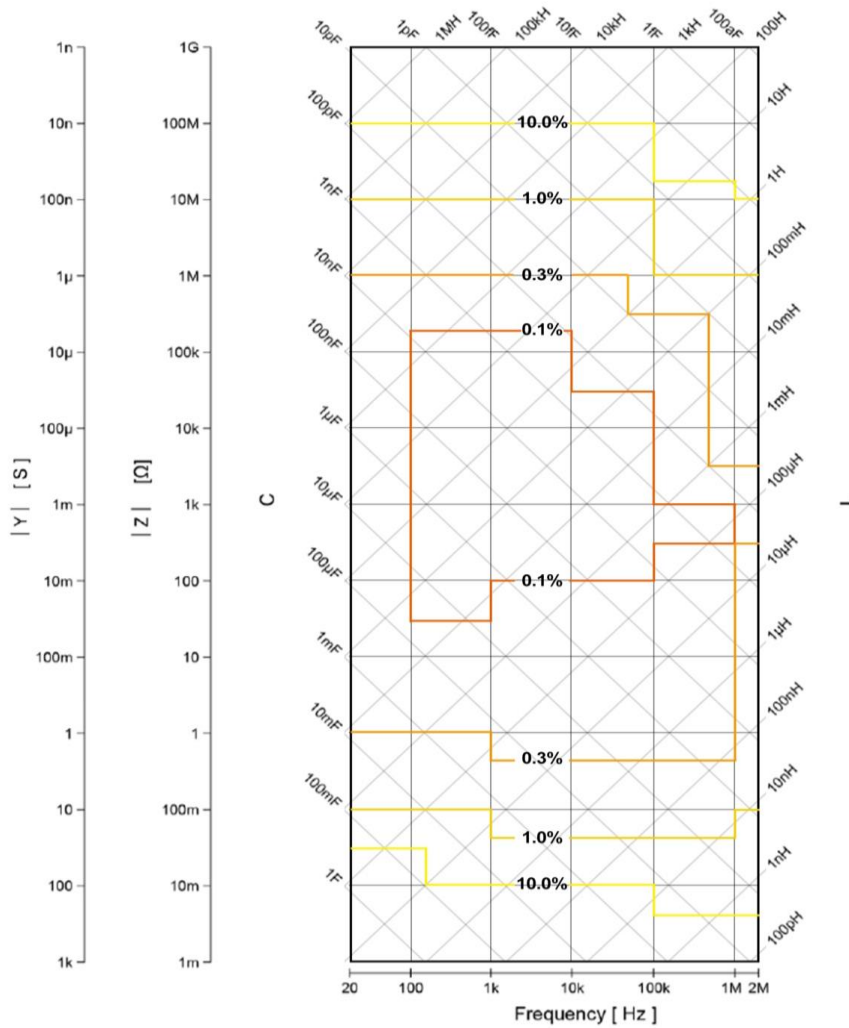
Figure 8-1 Basic Measurement Accuracy Factor A

The basic accuracy A can be read from the diagram as follows:

Determine the intersection point of the straight line corresponding to the expected measured value with the measuring frequency. Two numbers are assigned to the outlined subarea in which this crossing point is located. At slow and medium measurement speeds the upper and at fast measurement speeds the lower of the two numbers is the value of A we are looking for.

The basic measurement accuracy factor A is applicable to a measurement level range of 500mV$_{rms}$~1.0V$_{rms}$. When exceeding this range, determine A as outlined above, then select the value of A$_L$ according to the table and/or figure below. The final value is then obtained by calculating A$_L$ × A.

Here, V$_s$ is the measurement signal voltage.

Table 8-1 Correction Factor A$_L$

Measurement Signal Voltage V$_s$ (V$_{rms}$)				
[50m,5m]	[200m,50m)	[500m,200m)	[1,500m)	[10,1)

2.5×50mV$_{rms}$ / V$_s$	2.5	500mV$_{rms}$ / V$_s$	1	2

Figure 8-2 shows the correction factor A$_L$ described in the table above in a visual format:
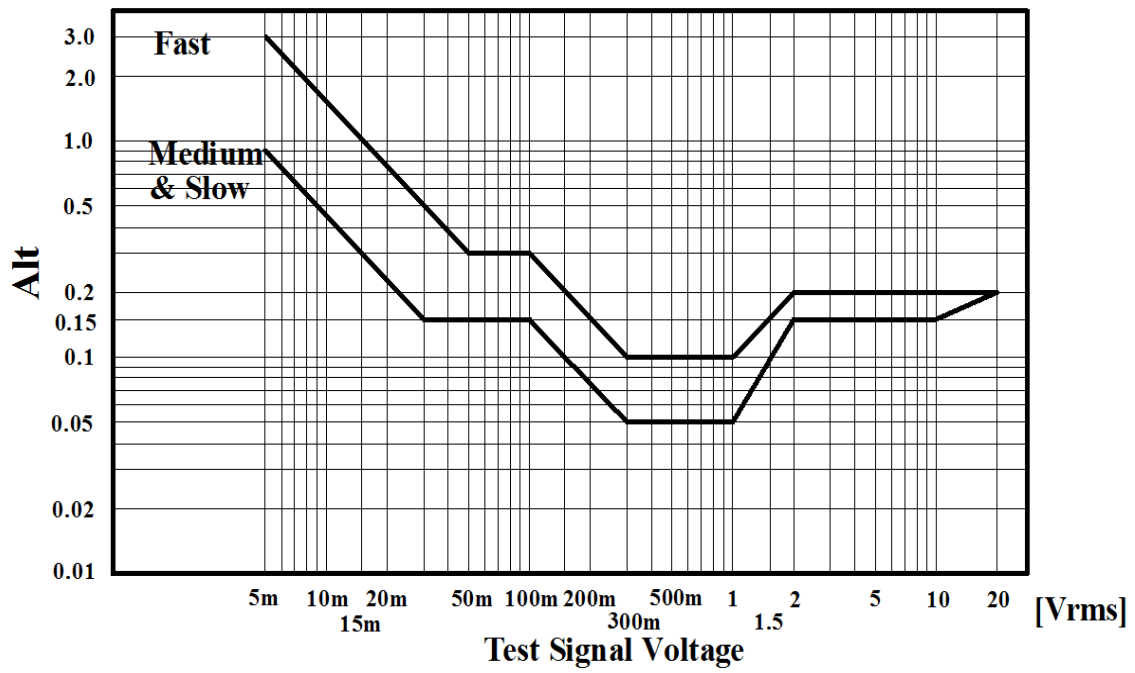
Figure 8-2 Correction Factor A$_L$ Curve

Table 8-2 Impedance Rate Factors K_a and K_b

Speed	Frequency	K_a	K_b
Medium Slow	$f_m \leq 1.2\text{kHz}$	$(\dfrac{1\times10^{-3}}{|Z_m|})(1+\dfrac{200}{V_s})\sqrt{\dfrac{100}{f_m}}$	$|Z_m|(0.3\times10^{-9})(1+\dfrac{70}{V_s})\sqrt{\dfrac{100}{f_m}}$
	$1.2\text{ kHz} < f_m \leq 8\text{kHz}$	$(\dfrac{1\times10^{-3}}{|Z_m|})(1+\dfrac{200}{V_s})$	$|Z_m|(1\times10^{-9})(1+\dfrac{70}{V_s})$
	$8\text{kHz} < f_m \leq 150\text{kHz}$		$|Z_m|(3\times10^{-9})(1+\dfrac{70}{V_s})$
	$150\text{kHz} < f_m \leq 1\text{MHz}$	$(\dfrac{1\times10^{-3}}{|Z_m|})(3+\dfrac{200}{V_s})$	$|Z_m|(10\times10^{-9})(1+\dfrac{70}{V_s})$
Fast	$f_m \leq 1.2\text{kHz}$	$(\dfrac{2.5\times10^{-3}}{|Z_m|})(1+\dfrac{400}{V_s})\sqrt{\dfrac{100}{f_m}}$	$|Z_m|(0.6\times10^{-9})(1+\dfrac{100}{V_s})\sqrt{\dfrac{100}{f_m}}$
	$1.2\text{kHz} < f_m \leq 8\text{kHz}$	$(\dfrac{2.5\times10^{-3}}{|Z_m|})(1+\dfrac{400}{V_s})$	$|Z_m|(2\times10^{-9})(1+\dfrac{100}{V_s})$
	$8\text{kHz} < f_m \leq 150\text{kHz}$		$|Z_m|(6\times10^{-9})(1+\dfrac{100}{V_s})$
	$150\text{kHz} < f_m \leq 1\text{MHz}$	$(\dfrac{2.5\times10^{-3}}{|Z_m|})(2+\dfrac{400}{V_s})$	$|Z_m|(20\times10^{-9})(1+\dfrac{100}{V_s})$

Where…

- f_m is the measurement frequency; its unit is [Hz];

- The unit of the tested impedance is [Ω];

- The unit of the measurement signal voltage is [mV$_{rms}$].

For impedances above 500Ω, K_a is negligible, and only K_b is used; for impedances below 500Ω, K_b is negligible, and only K_a is used.

Note: When the cable length is extended, K_a should have the following value added.

Table 8-3 Added Values to K_a Based on Cable Length L

Cable Length L [m]	Added Value to K_a
0	0
1	0.0005
2	0.0010

Note: At the same time, when the cable length is extended, K_b should be multiplied the following value.

Table 8-4 Multiplied Values to Kb Based on Cable Length

Cable Length L [m]	$f_m \leq 100kHz$	$100kHz < f_m \leq 300kHz$	$300kHz < f_m \leq 1MHz$
0	1	1	1
1	$1 + 5 \times f_m$	$1 + 2 \times f_m$	$1 + 0.5 \times f_m$
2	$1 + 10 \times f_m$	$1 + 4 \times f_m$	$1 + 1 \times f_m$

Here, f_m is the measurement frequency and its unit is [MHz].

The calibration correction data are linearly interpolated between the measured frequency points (Table 8-5). The interpolation correction factor K_c indicates the deviation between the interpolated data and the real measurement deviation between the calibration points.

Table 8-5 Calibrated Interpolating Factor K_c

Measurement Frequency	K_c
Direct calibrated frequency (listed inTable 8-6)	0
Other frequency	0.0003

Table 8-6 Direct Calibrated 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	700	800	900	[kHz]
1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2		[MHz]

There are 60 frequencies listed in Table 8-6.

Note: The highest frequency of ST2840A/AX/NX is up to 500kHz and the highest frequency of ST2840B/BX is up to 2MHz.

Table 8-7 Cable Length Factor K_d

Measurement Signal Level	Cable Length L		
	1m	2m	4m
$\leq 2\ V_{rms}$	$2.5 \times 10^{-4}\ (1+50 \times f_m)$	$5 \times 10^{-4}\ (1+50 \times f_m)$	$1 \times 10^{-3}\ (1+50 \times f_m)$
$> 2\ V_{rms}$	$2.5 \times 10^{-3}\ (1+16 \times f_m)$	$5 \times 10^{-3}\ (1+16 \times f_m)$	$1 \times 10^{-2}\ (1+16 \times f_m)$

Here, f_m is the measurement frequency and its unit is [MHz].

Table 8-8 Temperature Factor K_e

Temperature (°C)	K_e
0~18	4
18~28	1
28~40	4

8.4 Safety Requirements

The devices of the ST2840 series correspond to protection class I.

8.4.1 Insulation Resistance

Under normal operating conditions, the insulation resistance between the power terminal and the device housing must not be less than 50MΩ.

In case of increased humidity, the insulation resistance between the voltage terminal and the device housing must not be less than 2MΩ.

8.4.2 Insulation Intensity

Under normal operating conditions, the device can withstand a voltage of 1.5kV AC 50Hz between the mains connection and the device housing for at least 1 minute without voltage drop or flashover.

8.4.3 Leakage Current

The leakage current should not exceed 3.5mA (AC effective value).

8.4.4 Electromagnetic Compatibility:

- Transient sensitivity, based on the requirement of GB6833.4.

- Conductive sensibility, based on the requirement of GB6833.6.

- Radiated interference, based on the requirement of GB6833.10.

8.5 Performance Testing

8.5.1 Operating Conditions

All measurements should take place under the specific operating conditions listed in this manual, including an appropriate warm-up time (see Chapter 1.6). Only primary indexes are listed in this section.

8.5.2 Used Instruments and Devices

No.	Instrument/Device		Specification
1	Standard Capacitor	100pF	0.02% D is known
		1000pF	
		10000pF	
		10nF	
		0.1uF	
		1uF	
2	Standard Resistor AC	10Ω	0.02%
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	Standard Resistor DC	0.1Ω	0.02%
		1Ω	
		10Ω	
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
4	Standard Inductor	100µH	0.02%
		1mH	
		10mH	
		100mH	
5	Frequency Counter		(0~1000) MHz
6	Digital Multimeter		0.5%
7	Insulation Resistance Meter		500V; 10 levels
8	High Voltage Tester		0.25kW (0~500)V

8.5.3 Basic Functionality Check

Ensure that function keys, display, interfaces, etc. are operating normally.

8.5.4 Test the Signal Level

Connect a multimeter in the AC voltage setting between Hcur and the ground. Set the measurement level to 10mV, 20mV, 100mV, 200mV, 1V, 2V, 10V and 20V, and check that the reading is within the limits given in this chapter.

8.5.5 Test the Frequency

Connect a frequency meter between the ground terminal and Hcur. Set the frequency to 20Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz, 500 kHz, 1MHz and 2Mhz, and check that the reading is within the limits given in this chapter.

8.5.6 Test the Measurement Accuracy

R, L, C and D are the basic parameters, therefore the measurement accuracy is mainly defined by them.

8.5.6.1 Accuracy of C and D

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
C_p-D	• 100Hz • 1kHz • 10kHz • 100kHz	1V	AUTO	0V	Slow

Open-circuit and short-circuit correction should be performed before measurement. Connect your standard capacitors of 100pF, 1000pF, 10nF, 0.1uF and 1uF and measure them at the different frequencies. Check that the deviation between the readings and the standard values of C and D is within the limits given in this chapter.

8.5.6.2 Accuracy of L

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
L_s-Q	• 100Hz • 1kHz	1V	AUTO	0V	Slow

Open-circuit and short-circuit correction should be performed before measurement. Connect your standard inductors of 100μH, 1mH, 10mH and 100mH and measure them at the different frequencies. Check that the deviation between the reading and the standard value of L is within the limits given in this chapter.

8.5.6.3 Accuracy of Z

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
Z-θ	• 100Hz • 1kHz • 10kHz • 100kHz	1V	AUTO	0V	Slow

Open- and short-circuit correction should be performed before measurement. Connect your AC standard resistors of 10Ω, 100Ω, 1kΩ, 10kΩ and 100kΩ and measure them at the different frequencies. Check that the deviation between the reading and the standard value of |Z| is within the limits given in this chapter.

8.5.6.4 Accuracy of DCR

Function	Measurement Frequency	Level	Range	Bias	Speed
DCR	–	–	AUTO	–	Slow

Short-circuit correction should be performed before measurement. Connect your DC standard resistors of 0.1Ω, 1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ and 100kΩ and measure them at the different frequencies. Check that the deviation between the reading and the standard value of DCR is within the limits given in this chapter.

9 Command Reference

9.1 GPIB Common Commands

- *RST
- *TRG
- *IDN
- *TST

- *ESE
- *SRE
- *ESR
- *STB

- *OPC
- *CLS

The *RST command resets the instrument.

For example: WrtCmd ("*RST")

The *TRG command triggers the measurement and then sends the result.

For example: WrtCmd ("*TRG")

Test Page		
LCR Meter	Component Testing	Parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, the sorting results. **Example:** 1.12345E2, 1.23456E-2, 1.11023E2, -1.12345E2,1 The sorting results take the following values: | **Sorting Results**	**Description**
---	---
0	BIN OUT
1~10	BIN 1~10	 **Note:** The \<BIN\> data will only be displayed when the instrument compare function is turned ON.
	List Sweep Single-Step	Clike index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, the comparison results. **Example:** 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2,1 The comparison results take the following values: | **Comparison Results**	**Description**
---	---
0	No Comparison
1	PASS
Other	FAIL	

		Sequence	Data will be returned after all points have been tested. The data format is the same as above.
	Trace Sweep	Single-Step	Clike index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, **Example:** 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2
		Sequence	Data will be returned after all points have been tested. The data format is the same as above.
Transformer	Single Test	Single-Step	Serial number index, parameter name, parameter result comparison result, **Example:** 2,lx,1.12345E2,1 The comparison results take the following values:
		Sequential	Data will be returned after all points have been tested. The data format is the same as above.

The comparison results table:

Comparison Results	Description
0	No Comparison
1	PASS
Other	FAIL

The *IDN? query returns the instrument ID.

Query Syntax: *IDN?

Return Format: <model>,<firmware>,<sn>

Where…

- <model>   Instrument Model (ST2840)

- <firmware>   Firmware Version (VER1.0.0)

- <sn>   Instrument serial number (sn12345678)

9.2 SCPI Command

SCPI (Standard Command for Programmable Instruments) is an ASCII-based instrument command language used in test and measurement instruments. SCPI commands are based on a hierarchical structure (also known as a tree system).

In this system, related commands are grouped under a common node or root, thus forming a subsystem.

According to the command syntax, most commands (and some parameters) are represented by a mixture of uppercase and lowercase letters. Uppercase letters indicate the abbreviation of the command.

For shorter program lines, you can send commands in abbreviated format; if you want better program readability, you can send long format commands.

Grammatical Conventions:

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

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

Note: Command Syntax Conventions

- Braces (curly brackets) **{ }** contain the parameter options for the given command string. Braces are not sent with the command string.

- A vertical bar **|** separates multiple parameter selections for a given command string. For example, in the above command, {VPP|Vrms|DBM} means you can specify "VPP", "Vrms" or "DBM". The bars are not sent with the command string.

- The angle brackets **< >** in the second example indicate that you must specify a value for the parameter inside these brackets. For example, in the above syntax statement, the parameter in angle brackets is <frequency>. Angle brackets are not sent with the command string. You must specify a value for the parameter (for example "FREQ: CENT 1000") unless you choose another option (such as "FREQ: CENT MIN") that appears in the syntax.

- Some syntax elements (such as nodes and parameters) are enclosed in square brackets **[ ]**. This means that the element is optional and can be omitted. Square brackets are not sent with the command string. If no value is specified for the optional parameter, the instrument will choose the default value. In the above example, "SOURce[1|2]" means that you can refer to source channel 1 by "SOURce" or "SOURce1", or "SOUR1" or "SOUR". Also, since the entire SOURce node is optional (in square brackets), you can also refer to channel 1 by completely omitting the SOURce node. This is because channel 1 is already 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**: The EOI (end) signal of the IEEE-488 bus.

The abbreviations and shorthands used in this manual are as follows:

- NR1: integer, e.g.:123

- NR2: fix-point number, e.g.: 12.3

- NR3: floating-point number, e.g.: 12.3E+5

- NL: carriage key, integer: 10

- ˆEND: EOI signal in IEEE-488

Subsystem commands of this series of instruments:

- DISPlay

- ORESister

- TRIGger

- CORRection

- FREQuency

- BIAS

- INITiate

- COMParator

- VOLTage

- FUNCtion

- FETCh?

- Mass MEMory

- CURRent

- LIST

- ABORT

- TRAN

- AMPLitude

- APERture

- STATus

9.2.1 DISPlay Subsystem Commands

Used to ontrol page switching.

Command Syntax:

:DISP:PAGE?

:DISP:PAGE <PageName>

Parameter: The meaning of the value of PageName is shown in the following table.

Page Name	Meaning	Query Return Content
MEASurement	Measurement Display	MEASurement
LIST	List Display	LIST
TSMEas	Trace Sweep Display	TSMEas
MSETup	Measurement Setup	MSETup
LTABle	Limit Setup	LTABle
LSETup	List Setup	LSETup
TSSEtup	Trace Setup	TSSEtup
CSETup	Correction Setup	CSETup
SYSTem	System Setup	SYSTem
FLISt	File List	FLISt
TMDisp	Transformer Single Group Measurement Display	TMDisp
TTSet	Transformer Single Group Measurement Setup	TTSet
TSDisp	Transformer Scan Test Page	TSDisp
TSID	Transformer Scan ID Page	TSID
TSP2P	Transformer Pin To Fixture Page	TSP2P
TSPTO1831	–	TSPTO1831
TSPTO1901	–	TSPTO1901
TSP	Transformer Pin Page	TSP
TSCON	Transformer Test Condition Page	TSCON
TSDEV	Transformer Deviation Deduction Page	TSDEV
TSCOPY	Transformer Quick Setup	TSCOPY
TSSTAT	Transformer Statistics Page	TSSTAT
TSTOOL	Transformer Tool Page	TSTOOL
TSBOXSELF	Scan and Self-Test Page	TSBOXSELF
TSHAND	Transformer Sorting Setup	TSHAND

Example:

:DISP:PAGE MEAS   Enter the measurement display page;

:DISP:PAGE MSET   Enter the measurement setup page;

:DISP:PAGE?   Return the currently displayed page, please refer to the table above.

9.2.2 FREQuency Subsystem Commands

Used to set the measurement frequency of the instrument.

Command Syntax:

:FREQ?

:FREQ <float | MIN | MAX>

Parameter:

float   Represents the floating-point data

MIN   Set the minimum possible value

MAX   Set the maximum possible value

Example:

:FREQ 1200   Set the frequency to 1200Hz;

:FREQ 1200HZ   Set the frequency to 1200Hz;

:FREQ 1.2K   Set the frequency to 1200Hz;

:FREQ?   Return the current frequency.

9.2.3 VOLTage Subsystem Commands

9.2.3.1 AC Voltage

Used to set the AC voltage of the instrument

Command Syntax:

:VOLT?

:VOLT <float | MIN | MAX>

Parameter:

float   Represents the floating-point data

MIN   Set the minimum possible value

MAX   Set the maximum possible value

Example:

:VOLT 1.2   Set the AC voltage to 1.2V;

:VOLT?   Return the current AC voltage;

9.2.3.2 DC Voltage

Used to set the DC voltage of the instrument.

Command Syntax:

:VOLT:DC?

:VOLT:DC < float | MIN | MAX>

Parameter:

float   Represents the floating-point data

MIN   Set the minimum possible value

MAX   Set the maximum possible value

Example:

:VOLT:DC 1.2   Set the DC voltage to 1.2V;

:VOLT:DC?   Return the current DC voltage

9.2.4 CURRent Subsystem Commands

Used to set the measurement level current of the instrument.

Command Syntax:

:CURR?

:CURR < float | MIN | MAX>

Parameter:

float   Represents the floating-point data

MIN   Set the minimum possible value

MAX   Set the maximum possible value

Example:

:CURR 0.01   Set the measurement level to 10mA

:CURR?   Return the level current

9.2.5 AMPLitude Subsystem Commands

Used to set the measurement speed and average times of the instrument.

Command Syntax:

:APER?

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

Parameter:

FAST+	Fast+
FAST	Fast
MED	Medium
SLOW	Slow
int	Represent the value of the integer, ranging from 1 to 255

Example:

:APER FAST+	Set the measurement speed to fast+
:APER FAST	Set the measurement speed to fast
:APER MED	Set the measurement speed to medium
:APER SLOW	Set the measurement speed to slow
:APER FAST,2	Set the measurement speed to fast, and average 2 times

9.2.6 OUTPut Subsystem Commands

9.2.6.1 Bias Source

Used to set the DC bias source of the instrument.

Command Syntax:

:OUTP:HPOW?

:OUTP:HPOW <INT | OPT | EXT>

Parameter:

INT	Internal 100mA bias source
OPT	Internal 2A bias source
EXT	External bias source

Example:

:OUTP:HPOW INT	Set the internal 100mA bias source
:OUTP:HPOW OPT	Set the internal 2A bias source

:OUTP:HPOW EXT   Set the external bias source

:OUTP:HPOW?   Return the bias source mode

9.2.6.2 DC Isolation

Used to set the DC isolation function switch of the instrument

Command Syntax:

:OUTP:DC:ISOL?

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

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:OUTP:DC:ISOL 0   Turn OFF DC isolation

:OUTP:DC:ISOL 1   Turn ON DC isolation

:OUTP:DC:ISOL?   Return the DC isolation function status

9.2.7 BIAS Subsystem Commands

The :BIAS subsystem commands are mainly used to set the internal bias voltage and the bias status.

9.2.7.1 Status Switch

Used to enable or disable the DC bias.

Command Syntax:

:BIAS:STAT?

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

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:BIAS:STAT 0   Turn OFF the DC bias

:BIAS:STAT 1   Turn ON the DC bias

:BIAS:STAT?   Return the DC bias status

9.2.7.2 Bias Voltage

Set the internal bias voltage of the instrument

Command Syntax:

:BIAS:VOLT?

:BIAS:VOLT <float | MIN | MAX>

Parameter:

float	Represents the floating-point data
MIN	Set the minimum possible value
MAX	Set the maximum possible value

Example:

:BIAS:VOLT 1.2	Set the DC bias voltage to 1.2V;
:BIAS:VOLT?	Return the current DC bias voltage

9.2.7.3 Bias Current

Used to set the bias current of the instrument.

Command Syntax:

:BIAS:CURR?

:BIAS:CURR < float | MIN | MAX>

Parameter:

float	Represents the floating-point data
MIN	Set the minimum possible value
MAX	Set the maximum possible value

Example:

:BIAS:CURR 0.01	Set the bias current to 10mA;
:BIAS:CURR?	Return the current bias current

9.2.7.4 Bias Polarity

Used to set the bias polarity of the instrument.

Command Syntax:

:BIAS:POL:AUTO?

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

Parameter:

0|AUTO   AUTO

1|FIX   FIX

Example:

:BIAS:POL:AUTO 0   Set the bias polarity to AUTO

:BIAS:POL:AUTO 1   Set the bias polarity to FIX

:BIAS:POL:AUTO?   Return bias polarity status

9.2.8 TRIGger Subsystem Commands

9.2.8.1 Trigger Command

Used to trigger a singular measurement.

Command Syntax:

:TRIG

Example:

:TRIG   Trigger the instrument to measure once

9.2.8.2 Trigger Mode

Used to set the trigger source mode of the instrument.

Command Syntax:

:TRIG:SOUR?

:TRIG:SOUR<CONT | SING>

Parameter:

:CONT   Continuous

:SING   Single

Example:

:TRIG:SOUR CONT   Set to continuous trigger

:TRIG:SOUR SING   Set to single trigger

:TRIG:SOUR?   Return the trigger mode

9.2.8.3 Trigger Delay

Used to set the trigger delay time of the instrument.

Command Syntax:

:TRIG:DEL?

:TRIG:DEL<float | MIN | MAX>

Parameter:

float	Represents the floating-point data
MIN	Set the minimum possible value
MAX	Set the maximum possible value

Example:

:TRIG:DEL 0	Set the trigger delay to 0;
:TRIG:DEL 1ms	Set the trigger delay to 1ms;
:TRIG:DEL 1	Set the trigger delay to 1s;
:TRIG:DEL?	Return the trigger delay time.

9.2.9 AMPLitude Auto Level Subsystem Commands

Used to turn on or off the automatic level control (ALC) function of the instrument.

Command Syntax:

:AMPL:ALC?

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

Parameter:

0	OFF	OFF
1	ON	ON

Example:

:AMPL:ALC 0	Turn OFF automatic level control
:AMPL:ALC 1	Turn ON automatic level control
:AMPL:ALC?	Return the automatic level control function status

9.2.10 Output RESister Internal Resistance Subsystem Commands

Used to set the output resistance mode of the instrument.

Command Syntax:

:ORES?

:ORES<100|30>

Parameter:

100	Set the output resistance of the instrument to 100Ω
30	Set the output resistance of the instrument to 30Ω

Example:

:ORES 100	Set the output resistance of the instrument to 100Ω
:ORES 30	Set the output resistance of the instrument to 30Ω
:ORES?	Return the output internal resistance of the instrument

9.2.11 FUNCtion Subsystem Commands

9.2.11.1 Function Parameter

Used to configure the "function" parameters of the instrument.

Command 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?

Parameter:

para1, para2, para3, para4   Indicate the optional function parameter name, the value is as follows:

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	RS	Equivalent Series Resistance
GP	Conductance	BP	Susceptance
Z	Absolute Value of Impedance	Y	Absolute Value of Admittance
D	Loss Factor	Q	Quality Factor
ZTD/DZ	Θz° Impedance Degree	ZTR/RZ	Θz Impedance Radian
YTD/DY	Θy°Admittance Degree	YTR/RY	Θy Admittance Radian
X	Reactance	RD	DC Resistance

Example:

:FUNC:IMP CP,CS,LP,LS	Set 4 parameter functions at the same time
:FUNC:IMP1 RP	Set parameter 1 to RP
:FUNC:IMP2 RS	Set parameter 1 to RS
:FUNC:IMP3 Z	Set parameter 1 to Z
:FUNC:IMP4 Y	Set parameter 1 to Y
:FUNC:IMP1?	Return the function of parameter 1
:FUNC:IMP2?	Return the function of parameter 2
:FUNC:IMP3?	Return the function of parameter 3
:FUNC:IMP4?	Return the function of parameter 4
:FUNC:IMP?	Return the functions of the 4 parameters
:FUNC:IMPSW 1,1,0,0	Set the switches of 4 parameter (on, on, off, off)
:FUNC:IMPSW 1,0,0,0	Set the switches of 4 parameter (on, off, off, off)
:FUNC:IMPSW 1,1,1,1	Set the switches of 4 parameter (on, on, on, on)
:FUNC:IMPSW?	Return the switches of 4 parameter (returns such as "1,0,0,0")

9.2.11.2 AC Range

Used to set the AC range of the instrument.

Command Syntax:

:FUNC:IMP:RANG?

:FUNC:IMP:RANG <float>

Parameter:

float	Indicates the floating point number, refer to the value of the equivalent resistance of the DUT

Example:

:FUNC:IMP:RANG 1k	Select the best range for 1kΩ equivalent resistance
:FUNC:IMP:RANG 1000	Select the best range for 1kΩ equivalent resistance
:FUNC:IMP:RANG 1200	Select the best range for 1.2kΩ equivalent resistance
:FUNC:IMP:RANG?	Return the current AC range

9.2.11.3 AC Auto Range

Used to turn on/off the AC range auto mode of the instrument.

Command Syntax:

:FUNC:IMP:RANG:AUTO?

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

Parameter:

0	OFF	(AUTO mode) OFF
1	ON	(AUTO mode) ON

Example:

:FUNC:IMP:RANG:AUTO 0	Set the AC range mode to FIX
:FUNC:IMP:RANG:AUTO 1	Set the AC range mode to AUTO
:FUNC:IMP:RANG:AUTO?	Return the AC range auto mode status

9.2.11.4 DC Range

Used to set the DC range of the instrument.

Command Syntax:

:FUNC:DCR:RANG?

:FUNC:DCR:RANG <float>

Parameter:

float   Indicates the floating point number, refer to the value of the equivalent resistance of the DUT

Example:

:FUNC:DCR:RANG 1k   Select the best range for 1kΩDCR

:FUNC:DCR:RANG 1000   Select the best range for 1kΩDCR

:FUNC:DCR:RANG 1200   Select the best range for 1.2kΩDCR

:FUNC:DCR:RANG?   Return the current DC range

9.2.11.5 VI Monitoring

Used to turn on/off the voltage monitoring of the instrument.

Command Syntax:

:FUNC:SMON:VAC?

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

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:FUNC:SMON:VAC 0   Turn OFF voltage monitoring

:FUNC:SMON:VAC 1   Turn ON voltage monitoring

:FUNC:SMON:VAC?   Return the voltage monitoring status

9.2.11.6 Current Monitoring

Used to turn on/off the current monitoring of the instrument

Command Syntax:

:FUNC:SMON:IAC?

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

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:FUNC:SMON:IAC 0   Turn OFF current monitoring

:FUNC:SMON:IAC 1   Turn ON current monitoring

:FUNC:SMON:IAC?   Return the current monitoring switch status

9.2.11.7 Deviation and Reference

Used to set the deviation measurement mode of the instrument.

Command Syntax:

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

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

Parameter:

ABS   Δ Absolute deviation

PER   Δ% percent deviation

OFF   OFF

Example:

:FUNC:DEV1:MODE ABS   Set parameter 1to absolute deviation

:FUNC:DEV2:MODE PER   Set parameter 2 to percentage deviation

:FUNC:DEV3:MODE OFF   Turn OFF the deviation mode of parameter 3

:FUNC:DEV:MODE OFF,PER,ABS,OFF   Set the deviation modes of 4-parameters at the same time

:FUNC:DEV2:MODE?   Return the deviation mode of parameter 2

:FUNC:DEV:MODE?   Return the deviation modes of 4-parameters

9.2.11.8 Reference Value

Used to set the reference value of the deviation of the instrument.

Command Syntax:

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

:FUNC:DEV[1|2|3|4]:REF <float>

:FUNC:DEV<1|2|3|4>:REF:FILL

Parameter:

float   Represents the floating-point data

Example:

:FUNC:DEV1:REF 10	Set the deviation reference of parameter 1 to 10
:FUNC:DEV2:REF:FILL	Measure once, the result of parameter 2 is used as the deviation reference value
:FUNC:DEV4:REF?	Return the deviation reference value of parameter 4
:FUNC:DEV:REF?	Return the deviation reference values of 4 parameters
:FUNC:DEV:REF 10,11,12,13	Set the deviation reference values of the 4-parameters at the same time

9.2.11.9 Step Delay

Used to set the step delay time of the instrument.

Command Syntax:

:FUNC:SDEL?

:FUNC:SDEL<float | MIN | MAX>

Parameter:

float	Represents the floating-point data
MIN	Set the minimum possible value
MAX	Set the maximum possible value

Example:

:FUNC:SDEL 0	Set the step delay to 0;
:FUNC:SDEL 1ms	Set the step delay to 1ms;
:FUNC:SDEL 1	Set the step delay to 1s;
:FUNC:SDEL?	Return the step delay value;

9.2.12 COMParator Subsystem Commands

9.2.12.1 COMP Comparator Function

Used to turn on/off the comparison function of the instrument.

Command Syntax:

:COMP? :COMP<0|1 | ON|OFF >

Parameter:

0	OFF	OFF
1	ON	ON

Example:

:COMP 0   Turn OFF the comparison function

:COMP 1   Turn ON the comparison function

:COMP?   Return the comparison function status

9.2.12.2 COUNt Counting Function

Used to turn on/off the comparison counting function of the instrument.

Command Syntax:

:COMP:COUNT?

:COMP:COUN<0|1 | ON|OFF >

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:COMP:COUN 0   Turn OFF the comparison count function

:COMP:COUN 1   Turn ON the comparison count function

:COMP:COUN?   Return the comparison count function status

9.2.12.3 Query the BIN Count Comparison Result

Command Syntax:

:COMP:COUN:DATA?

Parameter:

Example:

:COMP:COUN:DATA?   Return the count result of each BIN

9.2.12.4 Clear All BIN Count Results

Command Syntax:

:COMP:COUN:CLE

Parameter:

Example:

:COMP:COUN: CLE   Clear all count results

9.2.12.5 Limit Mode

Used to set the instrument's comparison limit mode.

Command Syntax:

:COMP:MODE?

:COMP:MODE<TOL|SEQ>

Parameter:

TOL   Tolerance mode

SEQ   Sequential mode

Example:

:COMP:MODE TOL   Set the comparison limit to tolerance mode

:COMP:MODE SEQ   Set the comparison limit to sequential mode

:COMP:MODE?   Return the compare limit mode

9.2.12.6 Tolerance Mode Limit Values

Used to set the upper and lower limit values of each BIN in the tolerance mode of the comparison function (this function is accessible when the limit mode is set to tolerance mode).

Command Syntax:

:COMP:TOL:BIN<n>?

:COMP:TOL:BIN<n><lowA,highA>[…][,lowD,highD]

Parameter:

n   BIN number index, the value is 1~10

lowA   Represents the floating-point number of low limit of parameter 1

highA   Represents the floating-point number of high limit of parameter 1

lowD   Represents the floating-point number of low limit of parameter 4

highD   Represents the floating-point number of high limit of parameter 4

Example:

:COMP:TOL:BIN11,2   Set the upper and lower limits of the first parameter of BIN 1 to [1,2];

:COMP:TOL:BIN31,2,3,4   Set the upper and lower limits of the first two parameters of BIN 3 to [1,2],[3,4];

:COMP:TOL:BIN101, 2, 3, 4, 5, 6, 7, 8   Set the upper and lower limits of 4 parameters of 10 BINs;

:COMP:TOL:BIN1?   Return the upper and lower limits corresponding to the 4 parameters of BIN 1.

9.2.12.7 Sequential mode Limit Values

Used to set the upper and lower limit data of the sequential mode of the comparison function (this function is accessible when the limit mode is set to sequential mode).

Command Syntax:

:COMP:SEQ:BIN[A|B|C|D]?

:COMP:SEQ:BIN[A|B|C|D] <lo1>[,hi1,hi2,….hi10]

Parameter:

A|B|C|D	Indicates the corresponding number of parameters in the 4 parameters,
lo1	Represents the floating point data of the lower limit of BIN 1
hi1…hi10	Represents the floating-point numbers of the upper limit of each BIN

Example:

:COMP:SEQ:BIN1,2,3,4,5	Set the first parameter lo1,hi1,hi2,hi3,hi4;
:COMP:SEQ:BINA1,2,3,4,5	Same as above;
:COMP:SEQ:BINB1,2,3,4,5,6	Set the second parameter lo1,hi1,hi2,hi3,hi4,hi5;
:COMP:SEQ:BINC1,2,3,4,5,6,7,8,9,10,11	Set the upper and lower limits of the third parameter of each BIN
:COMP:SEQ:BIN?	Return the upper and lower limits of parameter 1, BIN 1 and the upper limits of other BINs
:COMP:SEQ:BINA?	Same as above; default
:COMP:SEQ:BINB?	Return the upper and lower limits of parameter 2, BIN 1, and the upper limits of other BINs
:COMP:SEQ:BINC?	Return the upper and lower limits of parameter 3, BIN 1 and the upper limits of other BINs
:COMP:SEQ:BIND?	Return the upper and lower limits of parameter 4, BIN 1 and the upper limits of other BINs

9.2.12.8 Clear Table

Used to clear the limit setting data of each BIN.

Command Syntax:

:COMP:BIN:CLE

Example:

:COMP:BIN:CLE	Clear the limit data in the table

9.2.12.9 BIN Comparison Function

Used to turn on/off the comparison function of a specified BIN.

Command Syntax:

:COMP:BIN<n>:SW?

:COMP:BIN:SW<0|1 | ON|OFF >

Parameter:

n	BIN number index, the value is 1~10
0	OFF	OFF
1	ON	ON

Example:

:COMP:BIN1:SW 0	Turn OFF the comparison function of BIN 1
:COMP:BIN2:SW 1	Turn ON the comparison function of BIN 2
:COMP:BIN10:SW?	Return the BIN10 comparison function status

9.2.13 LIST Subsystem Commands

9.2.13.1 Total Sweep Points

Used to set the total number of scan points in the list.

Command Syntax:

:LIST:TOTAL?

:LIST:TOTAL <int>

Parameter:

int	The total number of scan points; the value range is 1~201

Example:

:LIST:TOTAL 8	Set the list sweep points to 8
:LIST:TOTAL 201	Set the list sweep points to 201
:LIST:TOTAL?	Return the number of sweep points in the list

9.2.13.2 List Mode

Used to set the list sweep mode of the instrument.

Command Syntax:

:LIST:MODE?

:LIST:MODE<SEQ | STEP>

Parameter:

SEQ	Sequential

STEP   Single-Step

Example:

:LIST:MODE SEQ   Set to Sequential mode

:LIST:MODE STEP   Set to Single-Step Mode

:LIST:MODE?   Return the list sweep mode

9.2.13.3 Clear

Used to clear the setting data of all sweep points.

Command Syntax:

:LIST:CLE [n|ALL]

Parameter:

n   Specify the corresponding point of the list, the value is 1~201

ALL   Specify all points in the list

Example:

:LIST:CLE   Clear the setting data of all sweep points

:LIST:CLE ALL   Clear the setting data of all sweep points

:LIST:CLE 5   Clear the setting data of point 5

9.2.13.4 Sweep Point Frequency

Used to set the sweep point frequency / set the frequency of several points starting from the nth point.

Command Syntax:

:LIST:FREQ[n]?

:LIST:FREQ[n] <fn>[,fn+1][,fn+2]…

Parameter:

n   Start from the nth point

f_n Represents the floating-point number of sweep point n

f_{n+1} Represents the floating-point number of sweep point n+1

f...   Represents the floating-point number of sweep point …

Example:

:LIST:FREQ 20,30,40   Set the frequency of the first 3 points;

:LIST:FREQ1 20,30,40,1k,2k   Set the frequency of the first 5 points;

:LIST:FREQ6 20, 30, 40, 1k, 2k   Set the frequency of 6~10 points;

:LIST:FREQ25 20k   Set the frequency of the 25th point;

:LIST:FREQ?   Return the frequency of all sweep points;

:LIST:FREQ4?   Return the frequency of point 4.

9.2.13.5 Sweep Point Voltage

Used to set the sweep point measurement level / set the voltage of several points starting from the nth point

Command Syntax:

:LIST:VOLT[n]?

:LIST:VOLT[n] <fn>[,fn+1][,fn+2]…

Parameter:

n	Start from the nth point
f_n	Represents the floating-point number of sweep point n
f_{n+1}	Represents the floating-point number of sweep point n+1
f...	Represents the floating-point number of sweep point n…

Example:

:LIST:VOLT 1,2,3,4,2   Set the voltage of the first 5 points;

:LIST:VOLT6 1,2,3,4,5   Set the voltage of 6~10 points;

:LIST:VOLT25 20   Set the voltage of the 25th point;

:LIST:VOLT?   Return the voltage of all sweep points;

:LIST:VOLT4?   Return the voltage of point 4;

9.2.13.6 Sweep Point Current

Used to set the sweep point current / set the current value of several points starting from the nth point.

Command Syntax:

:LIST:CURR[n]?

:LIST:CURR[n] <fn>[,fn+1][,fn+2]…

Parameter:

n   Start from the nth point

f_n Represents the floating-point number of sweep point n

f_{n+1} Represents the floating-point number of sweep point n+1

f...   Represents the floating-point number of sweep point n…

Example:

:LIST:CURR 1m, 2m, 3m, 4m, 2m   Set the current of the first 5 points;

:LIST:CURR6 1m, 2m, 3m, 4m, 5m   Set the current of 6~10 points;

:LIST:CURR25 20m   Set the current of the 25th point;

:LIST:CURR?   Return the current of all sweep points;

:LIST:CURR4?   Return the current of point 4;

9.2.13.7 Bias Voltage

Used to set the sweep point bias voltage / set the bias voltage of several points starting from the nth point

Command Syntax:

:LIST:BIAS:VOLT[n]?

:LIST:BIAS:VOLT[n] <fn>[,fn+1][,fn+2]…

Parameter:

n   Start from the nth point

f_n Represents the floating-point number of sweep point n

f_{n+1} Represents the floating-point number of sweep point n+1

f...   Represents the floating-point number of sweep point n…

Example:

:LIST:BIAS:VOLT 1,2,3   Set the bias voltage of the first 3 points;

:LIST:BIAS:VOLT6 1,2,3,4,5   Set the bias voltage of 6~10 points;

:LIST:BIAS:VOLT?   Return the bias voltage of all sweep points;

:LIST:BIAS:VOLT4?   Return the bias voltage of point 4;

9.2.13.8 Bias Current

Used to set the sweep point bias current / set the bias current of several points starting from the nth point.

Command Syntax:

:LIST:BIAS:CURR[n]?

:LIST:BIAS:CURR[n] <fn>[,fn+1][,fn+2]…

Parameter:

n	Start from the nth point
f_n	Represents the floating-point number of sweep point n
f_{n+1}	Represents the floating-point number of sweep point n+1
f...	Represents the floating-point number of sweep point n…

Example:

:LIST:BIAS:CURR 1m, 2m, 3m   Set the bias current of the first 3 points;

:LIST:BIAS:CURR6 1m, 2m, 3m, 4m, 5m   Set the bias current of 6~10 points;

:LIST:BIAS:CURR?   Return the bias current of all points;

:LIST:BIAS:CURR4?   Return the bias current of point 4;

9.2.13.9 List Sweep Function Parameters

Used to set the function parameters of the specified point of the list sweep.

Command Syntax:

:LIST:FUNC:IMP<n>?

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

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 201
para1,para2,para3,para4	Indicates the optional function parameter name, the value is as follows:

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	RS	Equivalent Series Resistance
GP	Conductance	BP	Susceptance
Z	Absolute Value of Impedance	Y	Absolute Value of Admittance
D	Loss Factor	Q	Quality Factor
ZTD/DZ	Θz° Impedance Degree	ZTR/RZ	Θz Impedance Radian
YTD/DY	Θy°Admittance Degree	YTR/RY	Θy Admittance Radian
X	Reactance	RD	DC Resistance

Example:

:LIST:FUNC:IMP1 CP,CS,LP,LS   Set the 4 parameter functions of point 1

:LIST:FUNC:IMP5 CP,CS,LP,LS   Set the 4 parameter functions of point 5

:LIST:FUNC:IMP100 CP,CS,LP,LS   Set the 4 parameter functions of the 100th point

:LIST:FUNC:IMP1?   Return the 4-parameter functions of point 1

9.2.13.10 Specified Parameters

Used to set the function of list sweep specified parameters / set the function of several points starting from the nth point.

Command Syntax:

:LIST:FUNC:IMP<A|B|C|D><n>?

:LIST:FUNC:IMP<A|B|C|D><n><pn>[,pn+1,pn+2,pn+3….]

Parameter:

A|B|C|D   Indicate that one of the 4 parameters is specified

n   Specify the index of the sweep point, ranging from 1 to 201

p_n The function name of sweep point n, (refer to the table above)

p_{n+1} The function name of sweep point n+1

p_{n+2} The function name of sweep point n+2

p…   The function name of sweep point n…

Example:

:LIST:FUNC:IMPA CP,CS,LP	Set the parameter function of point 1~3 of the first parameter
:LIST:FUNC:IMPB5 CP,CS	Set the parameter function of point 5~6 of the second parameter
:LIST:FUNC:IMPC?	Return all point parameter functions of the third parameter
:LIST:FUNC:IMPD11?	Return the parameter function of the 11th point of the fourth parameter.

9.2.13.11 Linear Setting of the Specified Parameter

Command Syntax:

:LIST:FUNC:LIN<A|B|C|D><start,stop,para>

Parameter:

A|B|C|D	Indicate that one of the 4 parameters is specified
start	Specify the starting point of the setting, the value is 1~201
stop	Specify the end point of the setting, the value is 1~201
para	Function name (refer to the table above)

Example:

:LIST:FUNC:LINA 1,15,LP	Set the function of point 1~15 of the first parameter to LP
:LIST:FUNC:LINB 5,201,CP	Set the function of point 5~201 of the second parameter to CP
:LIST:FUNC:LIND 3,15,LP	Set the function of point 3~15 of the fourth parameter to LP

9.2.13.12 Limit

Used to set the limit data at the specified point in the list sweep setting table

Command Syntax:

:LIST:BAND<n>?

:LIST:BAND<n> OFF

:LIST:BAND<n><A|B|C|D,lo,hi>

Parameter:

n	Specify the index of the sweep point, ranging from 1 to 201
A|B|C|D	Indicate that one of the 4 parameters is specified
lo	The lower limit of the parameter corresponding to the specified point
hi	The upper limit of the parameter corresponding to the specified point

Example:

:LIST:BAND1 OFF   Clear the limit data of the 4parameters of point 1

:LIST:BAND2 A,1,2   Set the function of point 5~201 of the second parameter to CP

:LIST:BAND201 D,1.1,2.2   Set the function of point 3~15of the 4th parameter to LP

:LIST:BAND9?   Return the upper and lower limits of the 4 parameters of point 9, loA, hiA…

9.2.13.13 Measurement Delay

Used to set the measurement delay of the sweep point / set the delay time of several points starting from the nth point.

Command Syntax:

:LIST:DEL[n]?

:LIST:DEL[n] <fn>[,fn+1][,fn+2]…

Parameter:

n   Start from the nth point

f_n Represents the floating point number of the sweep point n

f_{n+1} Represents the floating point number of the sweep point n+1

f_{n+2} Represents the floating point number of the sweep point n+2

f...   Represents the floating point number of the sweep point…

Example:

:LIST:DEL 0.01, 20m, 30m   Set the measurement delay of the first 3 points;

:LIST:DEL 1m, 2m, 3m, 4m, 2m   Set the measurement delay of the first 5 points;

:LIST:DEL6 1m, 2m, 3m, 4m, 5m   Set the measurement delay of 6~10 points;

:LIST:DEL25 20m   Set the measurement delay of the 25th point;

:LIST:DEL?   Return the measurement delay of all sweep points;

:LIST:DEL4?   Return the measurement delay of point 4.

9.2.14 TRACE Subsystem Commands

9.2.14.1 Sweep Points

Used to set the number of LCR curve scan points.

Command Syntax:

:TSSE:POINT?

:TSSE:POINT <51|101|201|401|801>

Parameter:

51	…means scanning 51 points
101	…means scanning 101 points
201	…means scanning 201 points
401	…means scanning 401 points
801	…means scanning 801 points

Example:

:TSSE:POINT 51	Set LCR to scan 51 points
:TSSE:POINT 101	Set LCR to scan 101 points
:TSSE:POINT 201	Set LCR to scan 201 points
:TSSE:POINT 401	Set LCR to scan 401 points
:TSSE:POINT 801	Set LCR to scan 801 points
:TSSE:POINT?	Return the LCR sweep points

9.2.14.2 Sweep Type

Used to set the sweep parameter type of the LCR curve.

Command Syntax:

:TSSE:MODE?

:TSSE:MODE <FREQ|VOLT|CURR|BVOL|BCUR>

Parameter: string parameter, select from list

Example:

:TSSE:MODE FREQ	Set the LCR sweep parameter to frequency
:TSSE:MODE VOLT	Set the LCR sweep parameter to voltage
:TSSE:MODE CURR	Set the LCR sweep parameter to current
:TSSE:MODE BVOL	Set LCR sweep parameter as bias voltage
:TSSE:MODE BCUR	Set LCR sweep parameter as bias current
:TSSE:MODE?	Return the LCR sweep parameter type.

9.2.14.3 Sweep Range

Used to set the LCR sweep range (start and stop points).

Command Syntax:

:TSSE:SWEEP?

:TSSE:SWEEP <float,float>

Parameter:

float   Represents floating-point string format data, such as "3.14159";

Example:

:TSSE:SWEEP 1,100   Set the LCR sweep start and stop point

:TSSE:SWEEP?   Return the LCR sweep start and stop point

9.2.14.4 Sweep Mode

Used to set the LCR sweep mode.

Command Syntax:

:TSSE:SMODE?

:TSSE:SMODE <SEQ|STEP>

Parameter:

SEQ   Sequential

STEP   Single-Step

Example:

:TSSE:SMODE SEQ   Set the LCR sweep mode to Sequential Mode

:TSSE:SMODE STEP   Set the LCR sweep mode to Single-Step Mode

:TSSE:SWEEP?   Return the LCR sweep mode

9.2.14.5 Coordinate Mode

Used to set the LCR curve coordinate mode.

Command Syntax:

:TSSE:FORMat?

:TSSE:FORMat <LIN|LOGX>

Parameter:

LIN   Linear coordinates

LOGX   X-axis logarithm

Example:

:TSSE:FORM LIN   Set the LCR sweep coordinate as linear coordinates

:TSSE:FORM LOGX   Set the LCR sweep coordinate as the X axis logarithm

:TSSE:FORM?   Return the LCR sweep coordinate mode

9.2.14.6 Max-Min

Used to turn on/off the LCR curve max-min function.

Command Syntax:

:TSSE:LIMIt?

:TSSE:LIMIt <OFF|0|ON|1>

Parameter:

Example:

:TSSE:LIMI 0   Turn OFF the LCR sweep limit

:TSSE:LIMI 1   Turn ON the LCR sweep limit

:TSSE:LIMI?   Return the LCR sweep limit status

9.2.14.7 LCR Sweep Function Parameters

Used to set the LCR sweep function parameters.

Command Syntax:

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

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

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

Parameter:

para1,para2,para3,para4   Indicates the optional function parameter name, the value is as follows:

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	RS	Equivalent Series Resistance
GP	Conductance	BP	Susceptance
Z	Absolute Value of Impedance	Y	Absolute Value of Admittance
D	Loss Factor	Q	Quality Factor
ZTD/DZ	Θz° Impedance Degree	ZTR/RZ	Θz Impedance Radian
YTD/DY	Θy°Admittance Degree	YTR/RY	Θy Admittance Radian
X	Reactance	RD	DC Resistance

Example:

:TSSE:IMP CP,CS,LP,LS   Set 4 parameter functions at the same time

:TSSE:IMP1 RP   Set parameter 1 to RP

:TSSE:IMP2 RS   Set parameter 1 to RS

:TSSE:IMP3 Z   Set parameter 1 to Z

:TSSE:IMP4 Y   Set parameter 1 to Y

:TSSE:IMP1?   Return parameter 1 function

:TSSE:IMP2?   Return parameter 2 function

:TSSE:IMP3?   Return parameter 3 function

:TSSE:IMP4?   Return parameter 4 function

:TSSE:IMP?   Return the 4-parameter function

9.2.15 Handler Subsystem Commands

9.2.15.1 Handler Mode

Used to set the LCR Handler mode.

Command Syntax:

:HAND:STAT?

:HAND:STAT <0|1|2|OFF|ON|BUS>

Parameter:

0 | OFF   …means default

1 | ON   …means custom

2 | BUS   …means bus control

Example:

:HAND:STAT 0   Set the Handler Mode to default;

:HAND:STAT OFF   Set the Handler Mode to default;

:HAND:STAT 1   Set the Handler Mode to custom;

:HAND:STAT ON   Set the Handler Mode to custom;

:HAND:STAT BUS   Return the Handler Mode to BUS.

9.2.15.2 Custom Output

Used to control the LCR Handler custom output.

Command Syntax:

:HAND:STAT:OFfLO <…>

:HAND:STAT:OFfHI <…>

:HAND:STAT:LVLO <…>

:HAND:STAT:LVHI <…>

:HAND:STAT:PUHI <…>

:HAND:STAT:PULO <…>

Parameter:

<…> is a list format, such as 1, 2, 4, 7, 14, 24, etc., corresponding to the table position displayed by the instrument.

Example:

:HAND:STAT:OFLO 1,3,5,9   Set the 1,3,5,9 index function to a constant low level;

:HAND:STAT:OFHI 1,3,5,9   Set the index function of 1,3,5,9 to a constant high level;

:HAND:STAT:LVLO 1,3,5,9   Set the index function of 1,3,5,9 to an active low level;

:HAND:STAT:LVHI 1,3,5,9   Set the index function of 1,3,5,9 to an active high level;

:HAND:STAT:PUHI 1,3,5,9   Set the index function of 1,3,5,9 to an active high pulse;

:HAND:STAT:PULO 1,3,5,9   Set the index function of 1,3,5,9 to an active low pulse;

9.2.15.3 Bus Output

Used to control the LCR Handler bus output.

Command Syntax:

:HAND:OUTP:LVHI <…>

:HAND:OUTP:LVLO <…>

Parameter:

<…> is a list format, such as 1, 2, 4, 7, 14, 24, etc., corresponding to the table position displayed by the instrument.

Example:

:HAND:LVHI:LVHI 1,3,5,9   Set 1,3,5,9 to high level output in bus mode;

:HAND:LVLO:LVLO 1,3,5,9   Set 1,3,5,9 to low level output in bus mode;

9.2.16 FETCh? Subsystem Commands

9.2.16.1 General Query: Measurement Results

Return the result of the most recent measurement in the currently selected measurement mode.

Command Syntax:

:FETCh?   Return the measurement result of the parameter

Example:

Test Page		
LCR Meter	Component Testing	Parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, sorting results. Example: 1.12345E2, 1.23456E-2, 1.11023E2, -1.12345E2,1 The sorting results take the following values: | Sorting Result	Description | |---|---| | 0 | BIN OUT | | 1~10 | BIN 1~10 | **Note:** The \<BIN\> data will only be displayed when the instrument's comparison function is turned ON.
	List Sweep	Clike index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, comparison results: Example: 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2,1 The comparison results take the following values:

Comparison Results	Description
0	No Comparison
1	PASS
Other	FAIL

	Trace Sweep	Clike index, parameter 1 result, parameter 2 result, parameter 3 result, parameter 4 result, Example: 2,1.12345E2,1.23456E-2,1.11023E2,-1.12345E2
Transformer	Single Test	Serial number index, parameter name, parameter result comparison result, Example: 2,lx,1.12345E2,1 The comparison results take the following values:
	Scan	

Comparison Results	Description
0	No Comparison
1	PASS
Other	FAIL

9.2.16.2 Query Measurement Level Monitoring Results

Command Syntax:

:FETCh:SMON:VAC?   Return the voltage monitoring result

:FETCh:SMON:IAC?   Return the current monitoring result

9.2.16.3 Query List Sweep Results

Command Syntax:

:FETCh:LIST:PARA<1|2|3|4>?   Return the measurement result of the specified parameter in list sweep

:FETCh:LIST:PT<1~201>?   Return the result of all parameters in the list at the specified point

Example:

:FETCh:TRACE:PARA1?   Return the measurement result of list sweep parameter 1

:FETCh:TRACE:PARA3?   Return the measurement result of the list sweep parameter 3

:FETCh:TRACE:PT5?   Return the result of all parameters at point 5

9.2.16.4 Query Trace Sweep Results

Command Syntax:

:FETCh:TRACE:X[1~801]?   Return the abscissa of the trace sweep

:FETCh:TRACE:Y<1|2|3|4>?   Return the measurement result of the specified curve (all points)

:FETCh:TRACE:PT<1~801>?   Return the result of the specified point (x,y1,y2,y3,y4)

:FETCh:TRACE:MARK?   Return the results at the cursor of all traces (x, y1, y2, y3, y4)

:FETCh:TRACE:YMAX<1|2|3|4>? Return the maximum value (x,y) of the specified curve

:FETCh:TRACE:YMIN<1|2|3|4>?   Return the minimum value (x,y) of the specified curve

Example:

:FETCh:TRACE:X?   Return a list of all the abscissa data of the trace sweep

:FETCh:TRACE:X5?   Return the abscissa of the 5th point of the trace sweep

:FETCh:TRACE:Y1?   Return the measurement result of trace curve 1

:FETCh:TRACE:Y2?   Return the measurement result of trace curve 2

:FETCh:TRACE:Y3?   Return the measurement result of trace curve 3

:FETCh:TRACE:Y4?   Return the measurement result of trace curve 4

:FETCh:TRACE:PT5?   Return the result of all curves at point 5

:FETCh:TRACE:MARK?   Return the result at the curve cursor (x, y1, y2, y3, y4)

:FETCh:TRACE:YMAX1?   Return the maximum value of curve 1 (x,y)

:FETCh:TRACE:YMAX2?   Return the maximum value of curve 2 (x,y)

:FETCh:TRACE:YMAX3?   Return the maximum value of curve 3 (x,y)

:FETCh:TRACE:YMAX4?   Return the maximum value of curve 4 (x,y)

:FETCh:TRACE:YMIN1?   Return the minimum value of curve 1 (x,y)

:FETCh:TRACE:YMIN2?   Return the minimum value of curve 2 (x,y)

:FETCh:TRACE:YMIN3?   Return the minimum value (x,y) of curve 3

:FETCh:TRACE:YMIN4?   Return the minimum value of curve 4 (x,y)

9.2.17 CORRection Subsystem Commands

9.2.17.1 Execute Open-Circuit Correction

Used to execute preset measurement point open-circuit correction.

Command Syntax:

:CORR:OPEN [ACK]

Example:

:CORR:OPEN   Perform the open-circuit correction on the preset point, no return

:CORR:OPEN ACK   Perform the open-circuit correction on the preset point

Return 1 for success and 0 for failure.

9.2.17.2 Open-Circuit Correction Function

Used to turn on/off the open-circuit correction function.

Command Syntax:

:CORR:OPEN:STAT?

:CORR:OPEN:STAT <0|1 | ON|OFF>

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:CORR:OPEN:STAT 0   Turn OFF the open-circuit correction function

:CORR:OPEN:STAT 1   Turn ON the open-circuit correction function

:CORR:OPEN:STAT?   Return the open-circuit correction function status

9.2.17.3 Execute Short-Circuit Correction

Used to execute preset measurement point short-circuit correction.

Command Syntax:

:CORR:SHOR [ACK]

Example:

:CORR:SHOR   Perform short-circuit correction on preset point, no return

:CORR:SHOR ACK   Perform short-circuit correction on preset point

Return 1 for success and 0 for failure.

9.2.17.4 Short-Circuit Correction Function

Used to turn on/off the short-circuit correction function.

Command Syntax:

:CORR:SHOR:STAT?

:CORR:SHOR:STAT <0|1 | ON|OFF>

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:CORR:SHOR:STAT 0   Turn OFF the short-circuit correction function

:CORR:SHOR:STAT 1   Turn ON the short-circuit correction function

:CORR:SHOR:STAT?   Return the short-circuit correction function status

9.2.17.5 Load Correction Function

Used to turn on/off the load correction function.

Command Syntax:

:CORR:LOAD:STAT?

:CORR:LOAD:STAT <0|1 | ON|OFF>

Parameter:

0 | OFF   OFF

1 | ON   ON

Example:

:CORR:LOAD:STAT 0   Turn OFF the load correction function

:CORR:LOAD:STAT 1   Turn ON the load correction function

:CORR:LOAD:STAT?   Return the load correction function status

9.2.17.6 Load Type

Used to set the measured combination parameter function for load correction.

Command Syntax:

:CURR:TYPE?

:CURR:TYPE <para>

Parameter:

para   Indicate the optional function parameter name; the value is as follows:

Parameter Name	Parameter Meaning
LSRS	LS-RS
LSQ	LS-Q
CPD	CP-D

Example:

:CORR:LOAD:TYPR LSRS   Set the load type to LS-RS

:CORR:LOAD:TYPR LSQ   Set the load type to LS-Q

:CORR:LOAD:TYPR CPD   Set the load type to CP-D

:CORR:LOAD:TYPR?   Return the load type

9.2.17.7 Cable Length

Used to set the correction cable length of the instrument.

Command Syntax:

:CORR:LENG?

:CORR:LENG <0|1>

Parameter:

0|1|2|4   0m, 1m

Example:

:CORR:LENG 0   Set the cable length to 0 meter

:CORR:LENG 1   Set the cable length to 1 meter

:CORR:LENG?   Return the cable length

9.2.17.8 Clear User Correction Data

Command Syntax:

:CORR:CLE [pt]

Parameter:

[pt]   …means that the parameter can be omitted, the value range of pt is 1~10, indicating the specified correction point index

Example:

:CORR:CLE   Clear all user correction data

:CORR:CLE 1   Clear the correction data of the first point calibrated by the user

:CORR:CLE 2   Clear the correction data of the second point calibrated by the user

:CORR:CLE 4   Clear the correction data of the 4th point calibrated by the user

:CORR:CLE 10   Clear the correction data of the 10th point calibrated by the user

9.2.17.9 Query the User Correction Data

Command Syntax:

:CORR[:USE]:DATA[n]?

Parameter:

n   The value is 1~10, which indicates the index of nth of dot frequency clearing point

Example:

:CORR:DATA?   Return the open circuit value, short circuit value, load correction value of all set points

<open1 A>,<open1 B>,<short1 A>,<short1 B>,<load1 A>,<load1 B>,<open2 A>,<open2 B>,<short2 A>,<short2 B>, <load2 A>,<load2 B>,…

:CORR:DATA1?   Return the correction data of 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?   Return the correction data of the second point:

Point Index (2), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

:CORR:DATA3?   Return the correction data of the third point:

Point Index (3), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

:CORR:DATA10?   Return the correction data of the tenth point:

Point Index (10), Frequency, Open A, Open B, Short A, Short B, Load A, Load B, Reference A, Reference B

9.2.17.10 Query the Operation Time of User Correction

Command Syntax:

:CORR:DATE <LAST|OPEN|SHORT|DCR|DCROPEN|DCRSHORT>

:CORR:DATE<n> <OPEN|SHORT|LOAD>

Parameter:

DATE<n>	n indicates the nth frequency point
LAST	Indicates the time of the last clearing operation
OPEN/SHORT/LOAD	Represents open-circuit correction/short-circuit correction/load correction respectively
DCR/DCROPEN/DCRSHORT	Indicates the last DCR/DCR open-circuit correction/DCR short-circuit correction respectively

Example:

:CORR:DATE LAST	Return the time of the last correction operation
:CORR:DATE OPEN	Return the time of full frequency open-circuit correction operation
:CORR:DATE SHORT	Return the time of the full-frequency short-circuit correction operation
:CORR:DATE DCR	Return the time of the last DCR correction operation
:CORR:DATE DCROPEN	Return the time of DCR open-circuit correction operation
:CORR:DATE DCRSHORT	Return the time of the DCR short-circuit correction operation
:CORR:DATE1 LAST	Return the time of the last point frequency 1 correction operation
:CORR:DATE2 OPEN	Return the time of point frequency 2 open-circuit correction operation
:CORR:DATE3 SHORT	Return the time of point frequency 3 short-circuit correction operation
:CORR:DATE10 LOAD	Return the time of point frequency 10 load correction operation

Note: The format of the returned data is "yyyy-MM-dd hh:mm:ss", and a return of "   " indicates that the date is invalid; that is, the correction operation has not been performed.

9.2.17.11 Specified Frequency Point

Used to turn on/off the the specified frequency point.

Command Syntax:

:CORR:SPOT<n>:STAT?

:CORR:SPOT<n>:STAT <0|1 | ON|OFF>

Parameter:

n	Subscript of frequency point index, value 1~10
0 | OFF	OFF
1 | ON	ON

Example:

:CORR:SPOT1:STAT 0	Turn OFF frequency point 1
:CORR:SPOT3:STAT 1	Turn ON frequency point 3
:CORR:SPOT10:STAT?	Return the status of frequency point 10

9.2.17.12 Measurement Frequency

Used to specify the measurement frequency of the frequency point.

Command Syntax:

:CORR:SPOT<n>:FREQ?

:CORR:SPOT<n>:FREQ <float | MIN | MAX>

Parameter:

float	Represents the floating-point data

Example:

:CORR:SPOT1:FREQ 1200	Set the frequency to 1200Hz;
:CORR:SPOT2:FREQ 1100HZ	Set the frequency to 1100Hz;
:CORR:SPOT3:FREQ 1.2K	Set the frequency to 1200Hz;
:CORR:SPOT4:FREQ?	Return the frequency of frequency point 4

9.2.17.13 Open-Circuit Correction at Specific Frequency

Used to execute an open-circuit correction at specific frequency points (frequency 1, frequency 2, etc.).

Command Syntax:

:CORR:SPOT<n>:OPEN

Example:

:CORR:SPOT1:OPEN	Perform open-circuit correction at frequency point 1
:CORR:SPOT2:OPEN	Perform open-circuit correction at frequency point 2
:CORR:SPOT10:OPEN	Perform open-circuit correction at frequency point 10

Return 1 for success and 0 for failure.

9.2.17.14 Short-Circuit Correction at Specific Frequency

Used to execute a short-circuit correction at specific frequency points (frequency 1, frequency 2, etc.).

Command Syntax:

:CORR:SPOT<n>:SHOR

Example:

:CORR:SPOT1:SHOR	Perform short-circuit correction at frequency point 1
:CORR:SPOT2:SHOR	Perform short-circuit correction at frequency point 2
:CORR:SPOT10:SHOR	Perform short-circuit correction at frequency point 10

Return 1 for success and 0 for failure.

9.2.17.15 Reference Values for Load Correction at Specific Frequency

Used to set the load correction reference values for specific frequency points (frequency 1, frequency 2, etc.).

Command Syntax:

:CORR:SPOT<n>:LOAD:STAN?

:CORR:SPOT<n>:LOAD:STAN <refA,refB>

Parameter:

refA	Represents the floating point data of reference A
refB	Represents the floating point data of reference B

Example:

:CORR:SPOT1:LOAD:STAN 1.1,1.2	The reference value for load correction at frequency point 1
:CORR:SPOT2:LOAD:STAN 1.1,1.2	The reference value for load correction at frequency point 2
:CORR:SPOT10:LOAD:STAN?	Return the reference value for load correction of frequency point 10

9.2.17.16 Load Correction at Specific Frequency

Used to execute a load correction at specific frequency points (frequency 1, frequency 2, etc.).

Command Syntax:

:CORR:SPOT<n>:LOAD

Example:

:CORR:SPOT1:LOAD	Perform load correction at frequency point 1
:CORR:SPOT2:LOAD	Perform load correction at frequency point 2
:CORR:SPOT10:LOAD	Perform load correction at frequency point 10

Return 1 for success and 0 for failure.

9.2.18 Mass MEMory Subsystem Commands

The Mass MEMory subsystem commands are used to save and load files.

9.2.18.1 Load

Used to load saved files.

Command Syntax:

:MMEM:LOAD?

:MMEM:LOAD <file>

Parameter:

file	Specifies the path of the file to be loaded, relatively complete file path or the index number of the internal file fixed file, ranging from 1 to 50;

The corresponding relationship between the index number and the file is as follows:

Index Number	LCR Mode	Transformer Single-Group Mode	Transformer Scan Mode
1~50	LCR.sda/LCR2.sda… in the root directory of internal files	TRT.trt/TRT2.trt… in the root directory of internal files	ST2840.t40/ST28402.t40… in the root directory of internal files

Example:

:MMEM:LOAD 1	Load the file with the path LCR.sta
:MMEM:LOAD 9	Load the file with the path LCR9.sta
:MMEM:LOAD sss.sta	Load the file with the path files/sss.sta
:MMEM:LOAD files/sss.sta	Load the file with the path files/sss.sta
:MMEM:LOAD usb/sss.sta	Load the file with the path usb/sss.sta
:MMEM:LOAD?	Return the path name of the file to load

9.2.18.2 Store

Used to save the current instrument settings to a file.

Command Syntax:

:MMEM:STOR <n>[,file]

Parameter:

n	For use with the default saved file naming
file	Specifies the name of the file to save

The corresponding relationship between the index number and the default file is as follows:

Index No.	LCR Mode	Transformer Single-Group Mode	Transformer Scan Mode
1~50	LCR.sda/LCR2.sda… in the root directory of internal files	TRT.trt/TRT2.trt… in the root directory of internal files	ST2840.t40/ST28402.t40… in the root directory of internal files

Example:

:MMEM:STOR 1   Save LCR.sta file (in LCR mode)

:MMEM:STOR 9   Save LCR9.sta file (in LCR mode)

:MMEM:STOR5,sss.sta   Save a file with the path sss.sta

:MMEM:STOR5,files/sss.sta   Save a file with the path files/sss.sta

:MMEM:STOR5,usb/sss.sta   Save a file with the path usb/sss.sta

9.2.19 TRAN Subsystem Commands

The TRAN subsystem commands are mainly used to set transformer parameters, such as turn-ratio, primary inductance, leakage inductance, stray capacitance, impedance, AC impedance, DC resistance, working mode and limits of each parameter.

9.2.19.1 Test Mode

Used to set the single group test mode.

Command Syntax:

:TRT:MODE?

:TRT:MODE<SEQ | STEP>

Parameter:

SEQ   Sequential

STEP   Single-Step

Example:

:TRT:MODE SEQ   Set to sequential mode

:TRT:MODE STEP   Set to single-step mode

:TRT:MODE?   Return the single group test mode

9.2.19.2 Single-Group Comparison Function

Used to turn on/off the single-group comparison function

Command Syntax:

:TRT:COMP?

:TRT:COMP <OFF|0|ON|1>

Parameter:

OFF | 0   OFF

ON | 1   ON

Example:

:TRT:COMP 0   Turn OFF the comparison function

:TRT:COMP 1   Turn ON the comparator function

:TRT:COMP?   Return the single-group comparison function status

9.2.19.3 Function Parameters

Used to set the function parameters of a single group of specified points

Command Syntax:

:TRT:FUNC<n>?

:TRT:FUNC<n><para>

Parameter:

n   Specifies the index of the scan point, ranging from 1 to 12

para   Indicates the optional function parameter name, the value is as follows:

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	RS	Equivalent Series Resistance
D	Loss Factor	Q	Quality Factor
ZX	Absolute Value of Impedance	RD	DC Resistance
LK	Leakage Inductance	DZ	Impedance Degree
NS	Primary Turn	NSNP	Primary Turn / Secondary Turn
NP	Secondary Turn	NPNS	Secondary Turn / Primary Turn

Example:

:TRT:FUNC1 CP	Set the CP function parameter of point 1
:TRT:FUNC5 NS	Set the NS function parameter of point 5
:TRT:FUNC12NSNP	Set the NSNP function parameter of point 12
:TRT:FUNC1?	Return the function parameters of point 1

9.2.19.4 Frequency

Used to set the sweep point frequency.

Command Syntax:

:TRT:FREQ<n>?

:TRT:FREQ<n><fn>

Parameter:

n	Start from the nth point
f_n	Represents the floating-point number of sweep point n

Example:

:TRT:FREQ1 20	Set the frequency of point 1
:TRT:FREQ6 1k	Set the frequency of point 6
:TRT:FREQ12 20k	Set the frequency of point 12
:TRT:FREQ4?	Return the frequency of point 4

9.2.19.5 Level

Used to set the measurement level (voltage) of the sweep point.

Command Syntax:

:TRT:LEV<n>?

:TRT:LEV<n><fn>

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 12
f_n	Represents the floating-point number of sweep point n

Example:

:TRT:LEV1 0.5	Set the voltage of point 1
:TRT:LEV6 2.5	Set the voltage of point 6
:TRT:LEV4?	Return the voltage of point 4

9.2.19.6 Bias Voltage

Used to set the bias voltage of the sweep point.

Command Syntax:

:TRT:BIAS:VOLT<n>?

:TRT:BIAS:VOLT<n><fn>

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 12
fn	Represents the floating-point number of sweep point n

Example:

:TRT:BIAS:VOLT1 1.2	Set the bias voltage of point 1
:TRT:BIAS:VOLT6 1.5	Set the bias voltage of point 6
:TRT:BIAS:VOLT4?	Return the bias voltage of point 4

9.2.19.7 Bias Current

Used to set the bias current of the sweep point.

Command Syntax:

:TRT:BIAS:CURR<n>?

:TRT:BIAS:CURR<n><fn>

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 12
f_n	Represents the floating-point number of sweep point n

Example:

:TRT:BIAS:CURR1 1m	Set the bias current of point 1;
:TRT:BIAS:CURR6 5m	Set the bias current of point 6;
:TRT:BIAS:CURR4?	Return the bias current of point 4

9.2.19.8 Turn Ratio Relative Reference Value

Used to set the relative reference value under the turn ratio function.

Command Syntax:

:TRT:TURN<n>?

:TRT:TURN<n><fn>

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 12
f_n	Represents the floating-point number of sweep point n

Example:

:TRT:TURN1 1	Set the relative reference value of point 1 to 1 turn;
:TRT:TURN610	Set the relative reference value of point 6 to 10 turns;
:TRT:TURN4?	Return the relative reference value of point 4.

9.2.19.9 Deviation

Used to set the deviation comparison mode of the instrument.

Command Syntax:

:TRT:DEV<n>?

:TRT:DEV<n><ABS|PER|OFF>

Parameter:

ABS	Δ Absolute Deviation
PER	Δ% Percent Deviation
OFF	OFF

Example:

:TRT:DEV1 ABS	Set the comparison mode of point 1 to absolute deviation
:TRT:DEV2 PER	Set the comparison mode of point 2 to percent deviation
:TRT:DEV3 OFF	Turn OFF the deviation of the comparison function at point 3
:TRT:DEV2?	Return the deviation mode of comparison function at point 2

9.2.19.10 Nominal Value

Used to set the nominal value of the deviation.

Command Syntax:

:TRT:NOM<n>?

:TRT:NOM<n><float>

Parameter:

float	Represents the floating-point number

Example:

:TRT:NOM1 10.2	Set the comparison nominal value of point 1 to 10.2
:TRT:NOM2 2.3	Set the comparison nominal value of point 2 to 2.3
:TRT:NOM3 62.5	Turn OFF the comparison nominal value of point 3 to 62.5
:TRT:NOM2?	Return the comparison nominal value of point 2.

9.2.19.11 Lower Limit

Used to set the instrument's lower limit for the comparison function.

Command Syntax:

:TRT:LOW<n>?

:TRT:LOW<n><float>

Parameter:

float	Represents the floating-point number

Example:

:TRT:LOW110.2	Set the comparison lower limit of point 1
:TRT:LOW2 2.3	Set the comparison lower limit of point 2
:TRT:LOW3 62.5	Turn OFF the comparison lower limit of point 3
:TRT:LOW2?	Return the comparison lower limit of point 2

9.2.19.12 Upper Limit

Used to set the instrument's upper limit for the comparison function.

Command Syntax:

:TRT:HIGH<n>?

:TRT:HIGH<n><float>

Parameter:

float	Represents the floating-point number

Example:

:TRT:HIGH110.2	Set the comparison upper limit of point 1
:TRT:HIGH2 2.3	Set the comparison upper limit of point 2
:TRT:HIGH3 62.5	Turn OFF the comparison upper limit of point 3
:TRT:HIGH2?	Return the comparison upper limit of point 2

9.2.19.13 Average

Set the average number of sweep points

Command Syntax:

:TRT:AVG[n]?

:TRT:AVG[n] <int>

Parameter:

n   Specifies the index of the sweep point, ranging from 1 to 12

int   The average number of sweep points n, ranging from 1 to 255

Example:

:TRT:AVG1 1   Set the average number of point 1;

:TRT:AVG2 5   Set the average number of point 2;

:TRT:AVG6 20   Set the average number of point 6;

:TRT:AVG4?   Return the average number of point 4.

9.2.19.14 Delay

Used to set the sweep points' measurement delay.

Command Syntax:

:TRT:DEL[n]?

:TRT:DEL[n] <fn>

Parameter:

n   Specifies the index of the sweep point, ranging from 1 to 12

f_n Represents the floating-point number of the sweep point

Example:

:TRT:DEL1 0.01   Set the measurement delay of point 1;

:TRT:DEL2 3m   Set the measurement delay of point 2;

:TRT:DEL6 5m   Set the measurement delay of point 3;

:TRT:DEL4?   Return the measurement delay of point 4.

9.2.19.15 Include/Exclude Sweep Point

Used to turn on/off measurement of any particular sweep point.

Command Syntax:

:TRT:STAT[n]?

:TRT:STAT[n] <OFF|0|ON|1>

Parameter:

n	Specifies the index of the sweep point, ranging from 1 to 12
OFF | 0	OFF
ON | 1	ON

Example:

:TRT:STAT2 0	Turn OFF the measurement function at point 2
:TRT:STAT8 1	Turn ON the measurement function at point 8
:TRT:STAT12?	Return the measurement function status at point 12.

9.2.20 SYSTem Subsystem Commands

The SYSTem subsystem command set is mainly used to set system-related parameter functions.

9.2.20.1 Bus Mode

Used to set the command mode of the communication interface.

Command Syntax:

:SYST:BUSMODE?

:SYST:BUSMODE <RS232|LAN|USBTMC|USBCDC|AUTO>

Parameter:

AUTO	Automatically select the communication interface
Others	Lock the communication interface to a particular communication mode

Example:

:SYST:BUSMODE?	Return the current communication interface mode
:SYST:BUSMODE RS232	Set the bus communication as a fixed RS232 interface
:SYST:BUSMODE LAN	Set the bus communication as a fixed LAN interface
:SYST:BUSMODE USBTMC	Set the bus communication as the fixed USBTMC interface
:SYST:BUSMODE USBCDC	Set the bus communication as the fixed USBCDC interface
:SYST:BUSMODE AUTO	Set the bus communication to the automatic interface mode

9.2.20.2 Key Sound

Used to turn on/off the keypress sound

Command Syntax:

:SYST:BEEP?

:SYST:BEEP <OFF|ON|0|1>

Parameter:

0 | OFF	OFF
1 | ON	ON

Example:

:SYST:BEEP?	Return the current key sound setup
:SYST:BEEP 0	Turn OFF the key sound
:SYST:BEEP 1	Turn ON the key sound

9.2.20.3 PASS Sound

Used to set the PASS sound effect.

Command Syntax:

:SYST:BEEP:PASS?

:SYST:BEEP:PASS <OFF|TwoShort|LowLong|HighShort|HighLong>

Parameter:

OFF   OFF

Others correspond respectively to two short, low long, high short, high long.

Example:

:SYST:BEEP:PASS?	Return the currently selected PASS sound effect
:SYST:BEEP:PASS OFF	Turn OFF the PASS sound effect
:SYST:BEEP:PASS TS	Set the PASS sound to two short
:SYST:BEEP:PASS LL	Set the PASS sound to low long
:SYST:BEEP:PASS HS	Set the PASS sound to high short
:SYST:BEEP:PASS HL	Set the PASS sound to high long

9.2.20.4 FAIL Sound

Used to set the FAIL sound effect.

Command Syntax:

:SYST:BEEP:FAIL?

:SYST:BEEP:FAIL <OFF|TwoShort|LowLong|HighShort|HighLong>

Parameter:

OFF   OFF

Others correspond respectively to two short, low long, high short, high long.

Example:

:SYST:BEEP:FAIL?   Return the currently selected FAIL sound effect

:SYST:BEEP:FAIL OFF   Turn OFF the FAIL sound effect

:SYST:BEEP:FAIL TS   Set the FAIL sound to two short

:SYST:BEEP:FAIL LL   Set the FAIL sound to low and long

:SYST:BEEP:FAIL HS   Set the FAIL sound to high and short

:SYST:BEEP:FAIL HL   Set the FAIL sound to high and long

9.2.20.5 DateTime

Used to configure the system's time and date.

Command Syntax:

:SYST:DATETIME?

:SYST:DATETIME <year, month, day, hour, minute, second>

Parameter:

Year   Value range 2018~2999

Example:

:SYST:DATETIME?   Return the currently defined system time and date

:SYST:DATETIME 2021,11,08,12,35,56   Set the date and time to: 2021-11-08 12:35:56

9.2.20.6 RS232 Configuration: Baud Rate

Used to set the baud rate.

Command Syntax:

:SYST:RS232:BAUD?

:SYST:RS232:BAUD <4800|9600|19200|38400|57600|115200>

Example:

:SYST:RS232:BAUD?   Return RS232 baud rate

:SYST:RS232:BAUD 4800   Set the RS232 baud rate to 4800

:SYST:RS232:BAUD 9600   Set the RS232 baud rate to 9600

:SYST:RS232:BAUD 19200   Set the RS232 baud rate to 19200

:SYST:RS232:BAUD 38400   Set the RS232 baud rate to 38400

:SYST:RS232:BAUD 115200   Set the RS232 baud rate to 115200

RS232 Configuration: Bus Address

Used to set the instrument's bus address.

Command Syntax:

:SYST:RS232:ADDR?

:SYST:RS232:ADDR <1~32>

Example:

:SYST:RS232:ADDR?   Return the bus address of the instrument

:SYST:RS232:ADDR 1   Set the instrument's bus address to 1

:SYST:RS232:ADDR 2   Set the instrument's bus address to 2

:SYST:RS232:ADDR 32   Set the instrument's bus address to 32.

9.2.20.7 Command Mode

Used to set the instrument's communication command mode.

Command Syntax:

:SYST:RS232:CMDMODE?

:SYST:RS232:CMDMODE <SCPI|MODBUS>

Example:

:SYST:RS232:CMDMODE?   Return the command mode of the instrument

:SYST:RS232:CMDMODE SCPI   Set the instrument command mode to SCPI

:SYST:RS232:CMDMODE MODBUS   Set the command mode to MODBUS

9.2.20.8 LAN Configuration: Port Number

Used to set the LAN port number.

Command Syntax:

:SYST:LAN:PORT?

:SYST:LAN:PORT<int>

Parameter:

int   Value Range: consult the network management, recommended 1~65536;

                                       the factory default value is 45454.

Example:

:SYST:LAN:PORT?   Return the port number of the LAN port

:SYST:LAN:PORT 45454   Set the LAN port number

9.2.20.9 LAN Configuration: Port DHCP

Used to set the LAN port DHCP.

Command Syntax:

:SYST:LAN:UDhcPc

Example:

:SYST:LAN:UDP?   Set the instrument to automatically obtain the network configuration once

9.2.20.10 LAN Configuration: IP Address

Used to set the IP address of the LAN port.

Command Syntax:

:SYST:LAN:IPADdress?

:SYST:LAN:IPADdress <192.168.22.209>

Example: :SYST:LAN:IPAD?   Return the IP address of the LAN port

:SYST:LAN:IPAD 192.168.22.209   Set the IP address of the LAN port

9.2.20.11 LAN Configuration: Gateway Address

Used to set the LAN port gateway address.

Command Syntax:

:SYST:LAN:GATeway?

:SYST:LAN:GATeway <192.168.22.1>

Example:

:SYST:LAN:GAT?   Return LAN port gateway address

:SYST:LAN:GAT 192.168.22.1   Set the LAN port gateway address

9.2.20.12 LAN Configuration: Subnet Mask Address

Used to set the subnet mask address of the LAN port.

Command Syntax:

:SYST:LAN:SMASK?

:SYST:LAN:SMASK <255.255.255.0>

Example:

:SYST:LAN:SMASK?   Return the subnet mask address of the LAN port

:SYST:LAN:SMASK 255.255.255.0   Set the subnet mask address of the LAN port □

9.2.20.13 LAN Configuration: DNS Address

Used to set the DNS address of the LAN port.

Command Syntax:

:SYST:LAN:DNS?

:SYST:LAN:DNS <255.23.12.0>,<255.23.14.1>

Parameter:

The DNS addresses at both ends represent the primary DNS address and the backup DNS address, respectively.

Example:

:SYST:LAN:DNS?   Return the DNS address of the LAN port

:SYST:LAN:DNS 255.23.12.0,255.23.14.1   Set DNS address of the LAN port

9.2.20.14 LAN Configuration: MAC Address

Used to query the MAC address of the LAN port.

Command Syntax:

:SYST:LAN:MAC?

Example:

:SYST:LAN:MAC?   Return the MAC address of the LAN port

9.2.20.15 Update Command

Used to update the system firmware.

Command Syntax:

:SYST:UPDATE APP

Example:

:SYST:UPDATE APP   Call the default file in the USB flash drive to upgrade

Note: In addition, we have the software for the host computer to control the firmware update of the instrument, which can directly send the update file from the host computer and perform the update without the need for a USB flash drive. The issued update file is stored by default in the internal storage of the instrument, such as update2840.sec. Considering that later update files may be relatively large, you can delete this file periodically.

9.3 Modbus Commands

9.3.1 Command Format

The command format is the internal version 2.0 standard; please refer to the following description for details.

9.3.1.1 Sending Format

Instrument address	Function code	High address	Low address	High registers	Low registers	Total number of bytes	Data byte 1	……	Data byte n	CRC Low	CRC High

9.3.1.2 Return Format

Instrument address	Function code	High address	Low address	High registers	Low registers	CRC Low	CRC High

Instrument Address:

This refers to the local address of the instrument, which can be set in the bus address of the instrument's system setting interface. The value range is 1~31.

Function Code:

This command can write one or multiple sets of data, so its code is **0x10**

High Address and Low Address:

This refers to the storage address of the data in the instrument, which can be a real storage address or a mapped address.

High Registers and Low Registers:

This indicates that the number of registers written in this operation and the size of each register is 2 bytes.

Total Number of Bytes:

This represents the total number of bytes written in this operation.

Data byte 1~Data Byte n:

Write these data content to the instrument.

CRC High and CRC Low:

CRC 16-bit check, we use the look-up table method for CRC check.

Example: The specific instruction and function setting relationship is detailed in the Appendix Table ModeBus command function comparison table (Section 9.3.3)

Assume you set the voltage range to **range 2** (ie 300V); the storage address of 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

Where, the countdown 3rd is corresponding to **20%** index value of voltage, the type is **char** and accounting for **1** byte.

The return information is as follows:

0x08	0x10	0x00	0x03	0x00	0x01	0XF1	0x50

9.3.2 Reading the Command

9.3.2.1 Sending Format

Instrument address	Function code	High address	Low address	High registers	Low registers	CRC Low	CRC High

9.3.2.2 Return Format

Instrument address	Function code	Total number of bytes	Data byte 1	……	Data byte n	CRC Low	CRC High

The function code is: **0x03**

Example: The specific instruction and function setting relationship is detailed in 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**, the instrument number is **8**.

Then the command is:

0x08	0x03	0x00	0xA0	0x00	0x02	0xC4	0xB0

The return information is as follows:

0x08	0x03	0x04	Data byte 1	……	Data byte 4	CRC Low	CRC High

9.3.3 CRC16 Calculation Method – Look-Up Table Method

1)   Define two 256-byte checklists

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
};
```

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
};
```

2)   Calculate

```
WORD CRC16(BYTE* pchMsg, WORD wDataLen)
{
        BYTE chCRCHi = 0xFF; // High CRC byte initialization
        BYTE chCRCLo = 0xFF; // Low CRC byte initialization
        WORD wIndex;            // Index in the CRC loop

while (wDataLen--)
        {
                // Calculate CRC
                wIndex = chCRCLo ^ *pchMsg++ ;
                chCRCLo = chCRCHi ^ chCRCHTalbe[wIndex];
                chCRCHi = chCRCLTalbe[wIndex] ;
        }

    return ((chCRCHi << 8) | chCRCLo) ;
}
```

9.3.4 Command Function Comparison Table

Instrument bus address	Function code	Command address	Number of data bytes	Data Number	Data byte	
Instrument address	Read/ write (R/W)	High+low	High+low	Data Number	The value corresponding to the address	Instruction function meaning
1~31	R	0x0000	–	–	–	Return the instrument IDN
	R/W	0x0001	0x0001~ 0x0004	1~4	0x01~0x	Function; the values are as follows: {table: 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	0x0002	0x0004	4	float	Frequency
	R/W	0x0003	0x0001	1	0~3	Speed 0 FAST 1 MED 2 SLOW 3 SFAST
	R/W	0x0004	0x0001	1	0~1	Trigger 0 CONT 1 SINGLE
	R/W	0x0005	0x0001	1	0~1	Constant level 0 OFF 1 ON
	R/W	0x0006	0x0004	4	float	Trigger delay: 0~60.000s
	R/W	0x0007	0x0004	4	float	Step delay: 0~60.000s
	R/W	0x0008	0x0001	1	0~1	Voltage monitoring 0 OFF 1 ON

	R/W	0x0009	0x0001	1	0~1	Current monitoring
						0 / OFF
						1 / ON
	R/W	0x000A	0x0005	5	float+char	AC Level float+0/1(v/i)
	R/W	0x000B	0x0001	1	0~14	AC range
	R/W	0x000C	0x0005	5	float+char	DC Bias float+0/1(v/i)
		0x000D	–	–	–	–
	R/W	0x000E	0x0001	1	1~256	Average
	R/W	0x000F	0x0001	1	0~1	BIAS polarity 0 / OFF 1 / ON
	R/W	0x0010	0x0001	1	0~14	DC 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 <table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ABS</td></tr><tr><td>2</td><td>PER</td></tr></table>
	R/W	0x1001	0x0001	1	0~2	Deviation 4 <table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ABS</td></tr><tr><td>2</td><td>PER</td></tr></table>
	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 The value of n is 1~4, that is, you can set 1, 2, 3 or 4 reference values at the same time
	R/W	0x001A	0x0001	1	0~1	Comparison mode <table><tr><td>0</td><td>TOL</td></tr><tr><td>1</td><td>SEQ</td></tr></table>
		0x001B	–	–	–	xx
	R/W	0x001C	0x0001	1	0~1	Comparison function <table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr></table>
	R/W	0x001D	0x0004	4	float	BIN 1 Low
	R/W	0x001E	0x0004	4	float	BIN 1 High
	R/W	0x001F	0x0004	4	float	BIN 2 Low
	R/W	0x0020	0x0004	4	float	BIN 2 High
	R/W	0x0021	0x0004	4	float	BIN 3 Low
	R/W	0x0022	0x0004	4	float	BIN 3 High
	R/W	0x0023	0x0004	4	float	BIN 4 Low
	R/W	0x0024	0x0004	4	float	BIN 4 High

	R/W	0x0025	0x0004	4	float	BIN 5 Low
	R/W	0x0026	0x0004	4	float	BIN 5 High
	R/W	0x0027	0x0004	4	float	BIN 6 Low
	R/W	0x0028	0x0004	4	float	BIN 6 High
	R/W	0x0029	0x0004	4	float	BIN 7 Low
	R/W	0x002A	0x0004	4	float	BIN 7 High
	R/W	0x002B	0x0004	4	float	BIN 8 Low
	R/W	0x002C	0x0004	4	float	BIN 8 High
	R/W	0x002D	0x0004	4	float	BIN 9 Low
	R/W	0x002E	0x0004	4	float	BIN 9 High
	R/W	0x002F	0x0004	4	float	BIN 10 Low
	R/W	0x0030	0x0004	4	float	BIN 10 High
	R/W	0x1004	0x0006	6	char+ char+ float	BIN 1~10 Low Byte meaning: BIN index 0~9; abcd index 0~3 float is the value
	R/W	0x1005	0x0006	6		BIN 1~10 High Byte meaning: BIN index 0~9; abcd index 0~3 float is the value
	R/W	0x0031	0x0001	1	0~1	Open-circuit correction <table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr><tr><td>2</td><td>Meas Open</td></tr><tr><td>3</td><td>DCR correction</td></tr></table>

	R/W	0x0032	0x0001	1	0~1	Short-circuit correction | 0	OFF
1	ON
2	Meas Short
3	DCR correction	
	R/W	0x0033	0x0001	1	0~1	Load correction 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 setup
	R/W	0x0038	0x0001	1	0~1	Point switch | 0	OFF
1	ON
2	Single frequency open-circuit correction
3	Single frequency short-circuit correction
4	Single frequency load correction	
	R/W	0x0039	0x0004	4	float	Reference A for calibration point
	R/W	0x003A	0x0004	4	float	Reference B for calibration point
	W	0x0040	0x0001	1	1	Start test (Trigger key function)
	W	0x0041	0x0001	1	1	Stop test (Reset key function)
	R	0x0042	–	–	–	Read the result

	R/W	0x0043	0x0001	1	char	Page switching; the value range of the parameter is as follows:

Page switching; the value range of the parameter is as follows:

0	Meas	1	List
2	Trace	3	Meas Setup
4	Limit Setup	5	List Setup
6	Trace Setup	7	System Setup
8	File	9	User Corr
10	Handler		
11	Single Test	12	Single Setup
15	TRS Scan	16	TRS id
17	Pin to fixture	18	1831 Scan
19	1901 Scan	20	Pin Setup
21	Condition Setup	22	Deviation deduction
23	Quick setup	24	Statistics
25	Tool	26	Scan self-test
27	Scan Hand		

	R/W	0x0045	0x0001	1	0~1	Keypress Sound

Keypress Sound

0	OFF
1	ON

	R/W	0x0045	0x0001	1	0~4	Pass Sound

Pass Sound

0	OFF
1	Two short
2	Two long
3	High short
4	High long

	R/W	0x0045	0x0001	1	0~4	Fail Sound
						<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>Two short</td></tr><tr><td>2</td><td>Two long</td></tr><tr><td>3</td><td>High short</td></tr><tr><td>4</td><td>High long</td></tr></table>
	R/W	0x0045	0x0001	1	0~1	Language <table><tr><td>0</td><td>English</td></tr><tr><td>1</td><td>Chinese</td></tr></table>
	R/W	0x004E	0x0001	1	0~2	Bias Source <table><tr><td>0</td><td>100mA</td></tr><tr><td>1</td><td>2A</td></tr><tr><td>2</td><td>External ST1778</td></tr></table>
	R/W	0x0050	0x0001	1	1~201	List sweep point
	R/W	0x0051	0x0001	1	0~1	List sweep mode <table><tr><td>0</td><td>SEQ</td></tr><tr><td>1</td><td>STEP</td></tr></table>
	R/W	0x0052	–	–	–	–
	R/W	0x0053	0x0001	1	0~200	The sweep point index position in the current setup
	R/W	0x0054	–	–	–	–
	R/W	0x0055	0x0004	4	float	Frequency
	R/W	0x0056	0x0005	5	float+char	AC Level +0/1(v/i)
	R/W	0x0057	–	–	–	–
	R/W	0x0058	0x0005	5	float+char	AC Level +0/1(v/i)
	R/W	0x005A	0x0001~ 0x0004	1~4	0~	Function; the values are as follows:

Function values:

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
	R/W	0x1006	0x0006	6	char+ char+ float	Low limit Byte meaning: point index 0~200 abcd index 0~3 float is the value
	R/W	0x1007	0x0006	6		High Limit Byte meaning: point index 0~200 abcd index 0~3 float is the value
	R/W	0x0090	0x0001	1	0~1	LCR Trace: Scale 0 — HOLD 1 — AUTO
	R/W	0x0092	0x0001	1	0~1	LCR Trace: Coordinate 0 — Linear 1 — Logarithm
	R/W	0x0094	0x0001	1	0~1	LCR Trace: Mode 0 — SEQ 1 — STEP
	R/W	0x0096	0x0001	1	0~4	LCR Trace: Point
	R/W	0x0097	0x0001	1	0~1	LCR Trace: Max-Min 0 — OFF 1 — ON
	R/W	0x0098	0x0001	1	0~4	LCR Trace: Start
	R/W	0x0099	0x0001	1	0~4	LCR Trace: Stop

10 Description for Handler

ST2840 series instruments provide users with a Handler interface, which is mainly used for the output of sorting results. When the automatic component sorting test system is used, this interface provides the communication signal with the system, as well as the sorting result output signal.

The BIN sorting and list sweep sorting of the bridge module uses the 57BR-4036L interface.

The transformer single group test sorting also uses the 57BR-4036L interface output.

The transformer scanning (built-in scanning board) sorting uses two DR-25P-bend hole interface output; and the transformer scanning (external scanning box) sorting uses the DR-25P-bend hole interface output that comes with the scanning box.

For the specific location of the interface, refer to the introduction of the rear panel given in Chapter 2. The Handler Interface design is flexible; upon using different operating procedures, all output signal states are defined according to the specific requirements.

10.1 BIN Sorting

The interface model provided by the BIN sorting instrument is 57BR-4036L, which provides /BIN1-/BIN10 ten-BIN sorting and total PASS and FAIL signals.

10.1.1 Technology Description

10.1.1.1 Output Signal

Active low, open collector, optoelectronic isolation.

Table 10-1 Output Signals

Signal	Overview
/BIN1-/BIN10 PASS, FAIL	Result output
/INDEX	"Analog measurement end" signal
/EOM	"End of all measurements" signal
/ALARM	Provides an alert when a momentary power failure or processor interface board reset is detected.

10.1.1.2 Input Signal

Optoelectronic isolation.

Table 10-2 Input Signals

Signal	Overview
/KEY_LOCK	Key lock (locks the front panel keyboard, including the touch screen)
/EXT_TRIG	External Trigger: pulsewidth ≥ 1μS

10.1.1.3 Signal Line Description

The Handler interface has 3 signals: comparison output, control output and control input. The following are the signal definitions of the Handler Interface when the BIN comparison function is used.

Compare Output Signal:

- /BIN1~/BIN10

- PASS

- FAIL

Control Output Signal:

- /INDEX (analog measurement end signal)

- /EOM (measurement end and comparison data valid signal)

- /ALARM (instrument power down signal).

Control Input Signal:

- /EXT.TRIG (external trigger signal)

- /Keylock

The interface diagram of the above pins is shown in Figure 10-1. See Table 10-3 for the signal assignment and brief description of the above pins. The timing diagram is shown in Figure 10-3.

Figure 10-1 Interface Diagram

Note: Figure 10-1 is just the interface definition of the BIN sorting, and the definition of the list sweep sorting and the transformer single test sorting are different.

Table 10-3 Signal Distribution Table for the Pins Comparison Function

Pin	Signal	Signal Direction	Description
1 2 3 4 5 6 7 8 9 10	/BIN1 /BIN2 /BIN3 /BIN4 /BIN5 /BIN6 /BIN7 /BIN8 /BIN9 /BIN10	Output	BIN sorting result. All /BIN outputs are open collector outputs.
11	Undefined	Output	Factory measurement signal, please do not connect.
12 13	/EXT.TRIG	Input	**External Trigger:** When the trigger mode is set to Single, your ST2840 instrument will be triggered by the positive-edge in this pin.
14 15	EXT.DCV2	Input	**External DC Voltage 2:** The DC provider pin for the optoelectronic coupling signal (/EXT_TRIG, /KeyLock, /ALARM, /INDEX, /EOM).
16 17 18	+5V	Output	**The Internal Power +5V:** It is not recommen-ded to use the internal power. If you do use the internal power, please ensure that the current is lower than 0.3A and that the signal line is far from the disturbance source.
19	/PASS	Output	As long as the measurement result is in any one of /BIN1~/BIN10, the output will be /PASS (see Figure 10-2).
20	/FAIL	Output	If the measurement result is not in any one of /BIN1~/BIN10, the output will be /FAIL (see Figure 10-2).
21 22 23 24	Undefined	Output	Factory measurement signal, please do not connect.

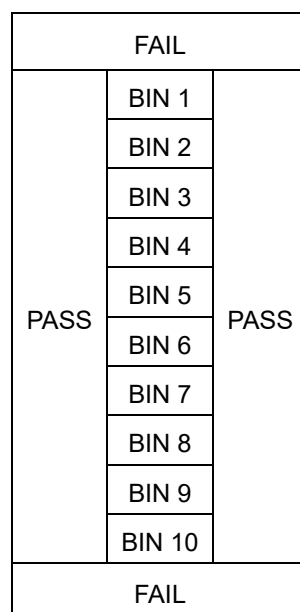| 25	/KEY LOCK	Input	When this single is effective, all the front panel function keys and touch screen of ST2840 are locked and no longer work.
27 28	EXT.DCV1	Input	**The External DC Voltage 1:** The pull-up DC power provider pin for optoelectronic coupling signal (/BIN~/BIN10, /PASS, /FAIL).
29	/ALARM	Output	Warning that the circuit has been interrupted.
30	/INDEX	Output	When the analog test is finished and the UNKNOWN terminal can be connected to another DUT, /INDEX is output. But the comparison signal is output until the /EOM signal.
31	/EOM	Output	**End Of Measurement:** Once the test data and the comparison results are output, this signal is also output.
32 33	COM2	–	The reference ground for external power EXTV2.
34 35 36	COM1	–	The reference ground for external power EXTV1.

FAIL		
	BIN 1	
	BIN 2	
	BIN 3	
	BIN 4	
PASS	BIN 5	PASS
	BIN 6	
	BIN 7	
	BIN 8	
	BIN 9	
	BIN 10	
FAIL		

Figure 10-2 Example of the Distribution Area of the Comparison Function Signals /PASS and /FAIL

Time	Minimum	Maximum
T1: trigger pulse-width	1us	---
T2: delay time	200us	Display time + 200us
T3: the trigger waiting time after /EOM output	0us	---

[1] For the measurement time, please refer to section 8.1.9;
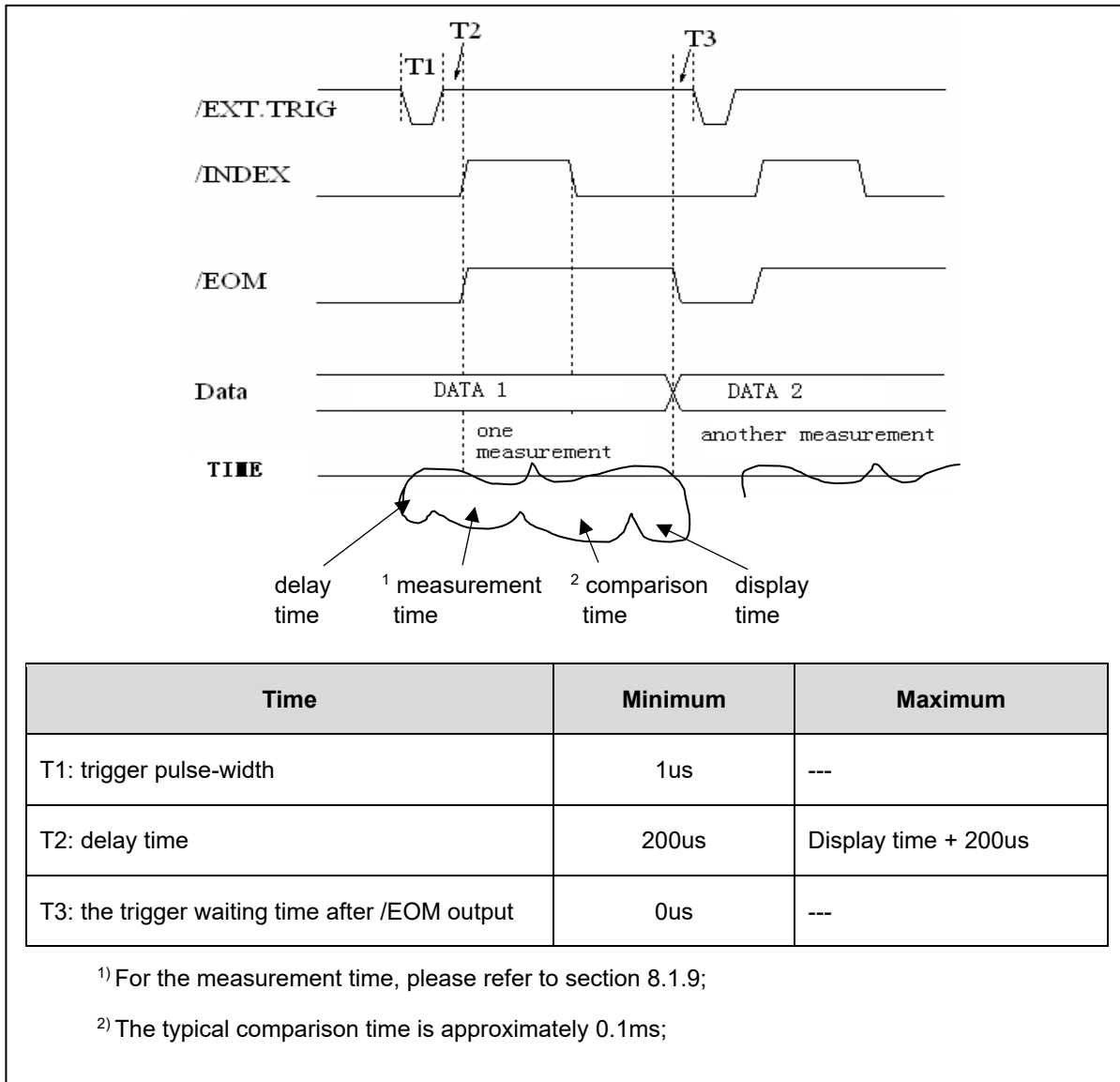
[2] The typical comparison time is approximately 0.1ms;

Figure 10-3 Timing Chart

10.1.2 Electrical Features

As it is shown above, the signal definition for the comparison and the list sweep comparison are different. But the electrical feature is same. So the description can be applied to BIN comparison and list sweep comparison.

10.1.2.1 DC Isolation Output Signal

Each DC output (pin 1 to 11, 19 to 24, and 29 to 31) is isolated via an open collector optocoupler output. The output voltage of each line is set by a pull-up resistor on the Handler Interface board. The pull-up resistor is connected with the internal supply voltage (+5V) or with the external supply voltage (EXTV: +5V-24V) by jumper.

The DC isolated output signal utilizes a dedicated electrical system which is independent of the control output signal. Therefore, the processor board has a common line for two separate circuits: COM1 and COM2.

The electrical characteristics of the DC isolated output are divided into two types (see Table 10-4). The output circuit configuration of the measurement result output signal is shown in Figure 10-5, and the output circuit configuration of the control output signal is shown in Figure 10-4.

Table 10-4 DC Isolation Output Electrical Features

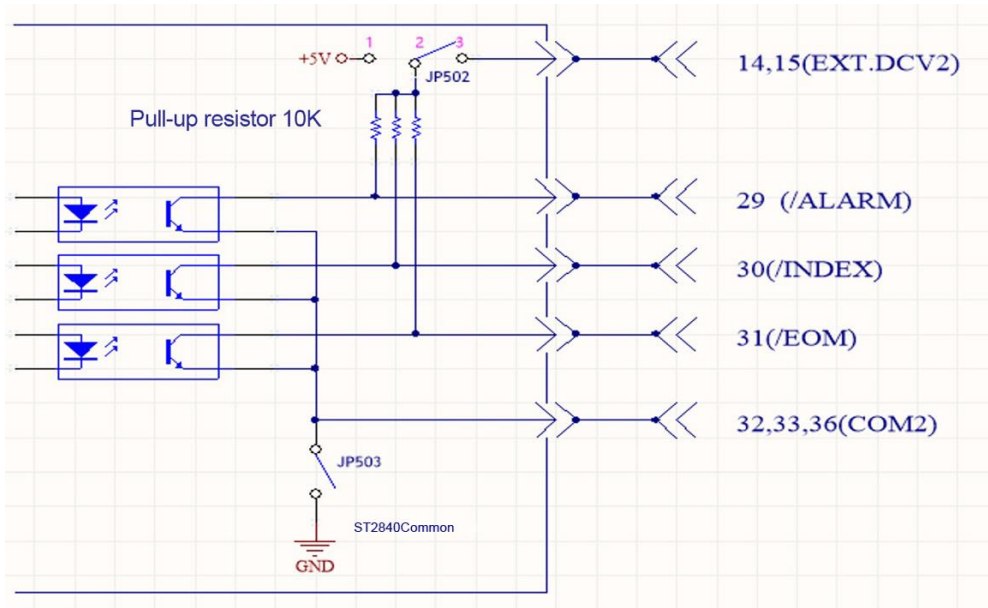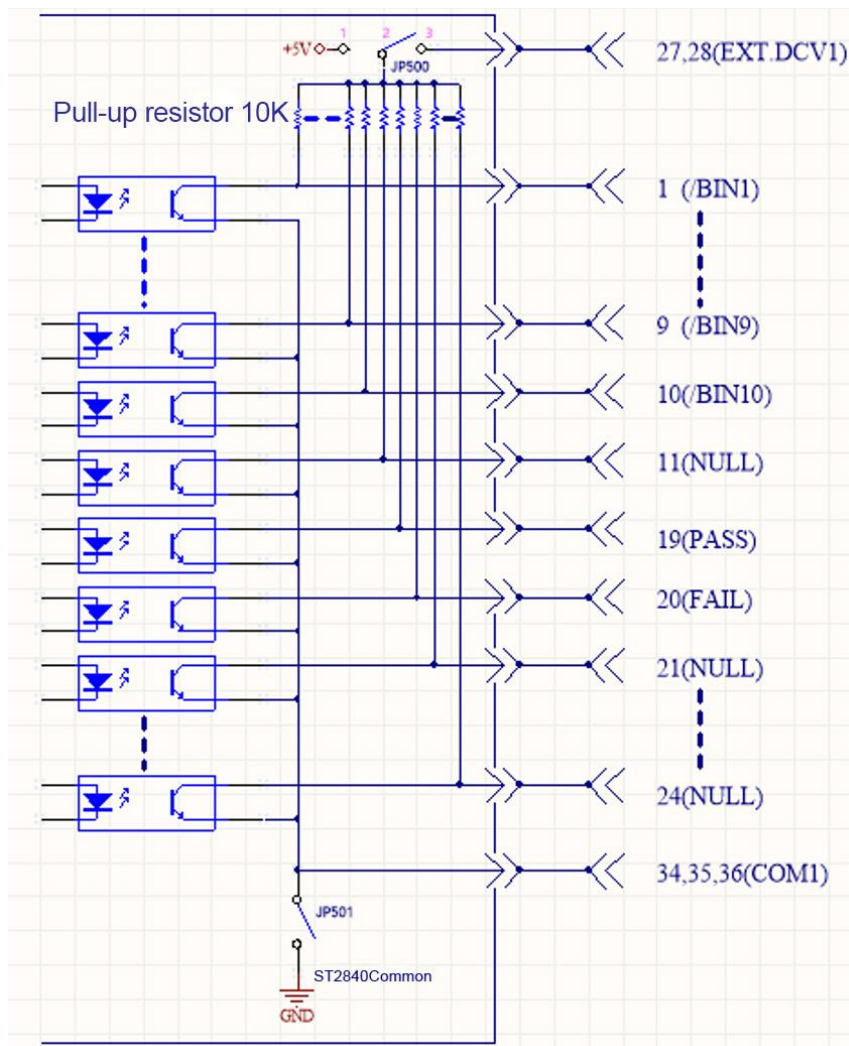| Output Signal	Output Rated Voltage		Maximum Current	Reference Ground for the Circuit
	LOW	HIGH		
Comparison Signal: • /BIN1~/BIN10 • /PASS • /FAIL	≤ 0.5V	+5V~+24V	6mA	Internal Pull-Up Voltage: ST2840 GND EXTV1: COM1
Control Signal • /INDEX • /EOM • /ALARM	≤ 0.5V	+5V~+24V	5mA	Internal Pull-Up Voltage: ST2840 GND EXTV2: COM2

Figure 10-4 Control Signal Output Circuit

Figure 10-5 Comparison Result Signal Output Circuit

10.1.2.2 DC Isolation Input Signal

DC isolation input signals include the /EXT_TRIG and /KEY_LOCK signals.

The /EXT_TRIG signal (pin 12 and pin 13) is input to the LED cathode side of the optocoupler.

The instrument is triggered when the signal increases from LOW to HIGH. The optocoupler LED (anode side) can be driven by an internal pull-up voltage (+5 V) or an external voltage (EXT.DCV2).

The /KEY_LOCK signal (pin 25) is input to the optocoupler LED (on the cathode side). As long as this is low level, the keys on the front panel of the instrument will all be locked. The optocoupler LED (anode side) can be driven by internal voltage (+5V) or external voltage (EXT.DCV2).

The input circuit configuration of the DC isolation input signal is shown in Figure 10-6.
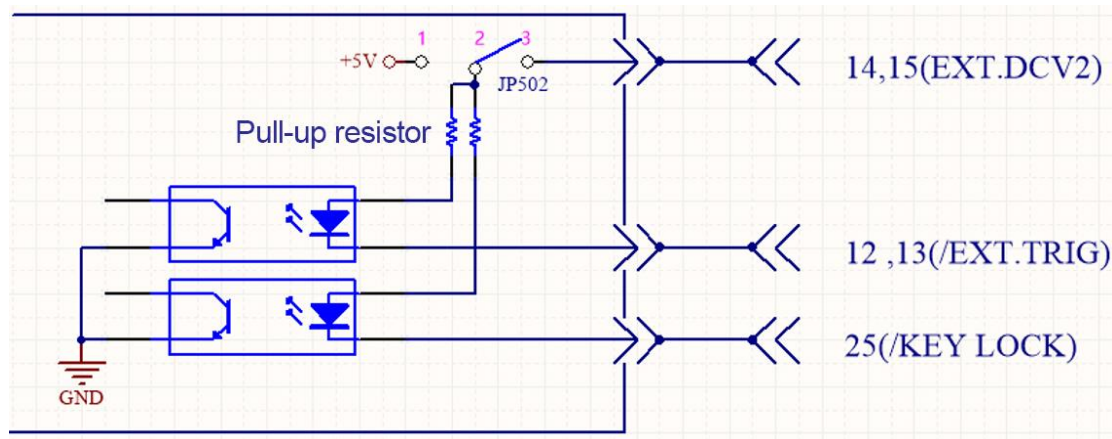

Figure 10-6 Input Signal Circuit Configuration

10.1.3 Handler Wiring Instructions of BIN Sorting

This section focuses on an example of the wiring between ST2840 and a typical PLC. The wiring example only introduces the wiring of two PLCs, that is, the PLC input circuit common anode and the PLC input circuit common cathode. For PLCs with other types of input circuits, please consult customer service for further assistance.

The PLC input circuit common anode means that the current flows in from the common terminal of the module and flows out from the input channel of the module, which is often referred to as the source wiring method.

The PLC input circuit common cathode means that the current flows in from the input channel of the module and flows out from the common terminal of the module, which is often referred to as the drain wiring method.

Figure 10-7 shows the PLC wiring diagram where the handler interface and input circuit are common anode when using BIN sorting, and Figure 10-8 shows the equivalent PLC wiring diagram where the handler interface and input circuit are common cathode.

The factory default of ST2840 series instruments is external power supply. That is, pins 2 and 3 of JP500 are short-circuited, pins 2 and 3 of JP502 are short-circuited, JP501 is open, and JP503 is open. Therefore, be sure to connect the power supply to the external power supply pin when using it.

If you need to use the internal power supply of the instrument, you need to change the jumper mode of JP500~JP503; please consult customer service for further information.

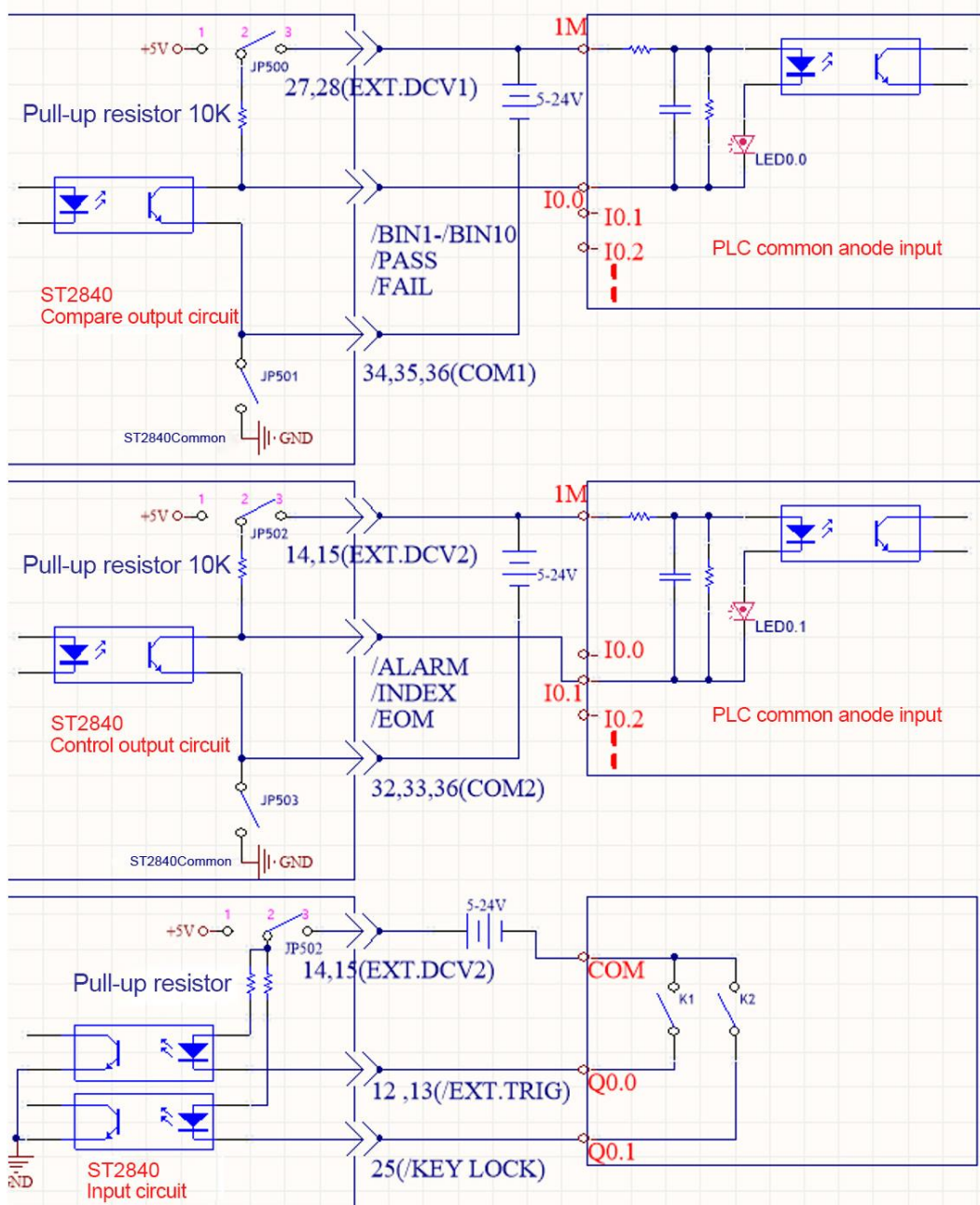| Warning!	
⚠	16, 17, and 18 are the 5V power supply inside the instrument and cannot be connected to any external power supply, otherwise the instrument will get damaged. Considering the anti-interference ability of the instrument, it is recommended to provide and use an external power supply as the pull-up power supply for the optocoupler.

Figure 10-7 PLC Wiring Diagram Where Handler Interface and Input Circuit Are Common Anode

EXT.DCV1 and EXT.DCV2 can use the same set of external power supplies, or they can use different sets of power supplies. The corresponding low end of EXT.DCV1 is COM1, and the corresponding low end of EXT.DCV2 is COM2. The input circuit and the control output circuit use the same group of power supplies, namely EXT.DCV2.

The wiring method provided in this figure is a typical connection method, and it needs to be flexibly applied according to the actual situation in practical application.
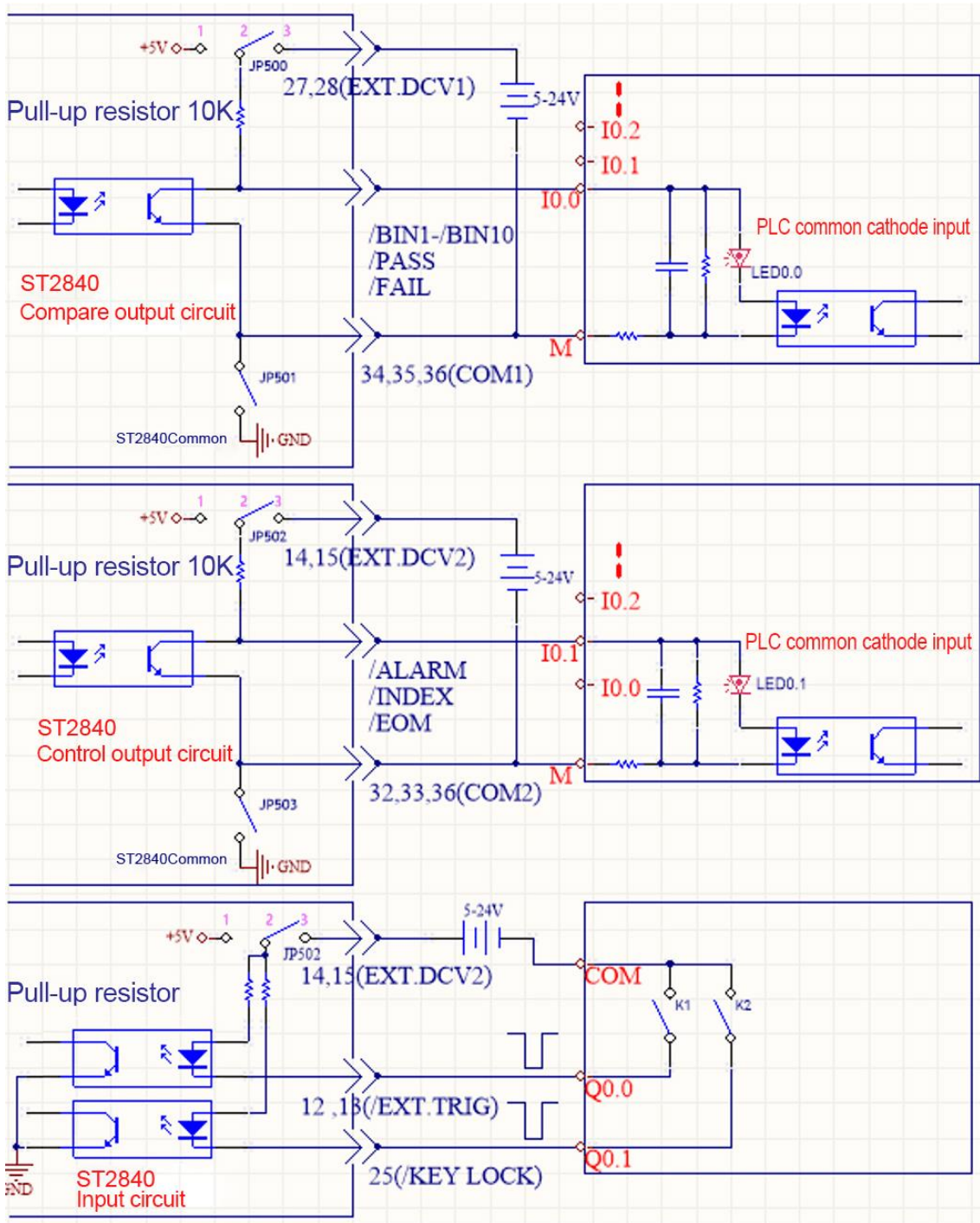
Figure 10-8 PLC Wiring Diagram Where Handler Interface and Input Circuit Are Common Cathode

10.1.4 Using Operations

After the Handler Interface is correctly wired to the PLC, set the limit list to use the comparison function. Then set the Handler Interface accordingly so that it can output/input signal.

10.1.4.1 Comparison Function Setting Procedure

The following operation steps are the steps of the comparison function using the Handler Interface (only for the functions of the automatic component analyzer).

• Press the [SETUP] key, select <Limit Setup> in the menu on the right side of the display, and enter the limit setup page.

• Move the cursor to "Comp", select ON in the menu area on the right side of the screen, and the comparator function will be enabled.

• Move the cursor to "Count", then select ON in the menu area on the right side of the screen, and the counting function will be enabled.

• Move the cursor to "Mode", then select "Tolerance" or "Continuous" in the menu area on the right side of the screen.

• Set the BIN sorting deviation type, reference value, BIN limit and related options on the <Limit Setup> page.

• Press [DISP] to enter the <Meas Display> page, and enter the corresponding page to measure the DUT.

Note: The ON/OFF of the comparison function and the ON/OFF of the counting function can also be set in the <Meas Display> page.

10.2 List Sweep

When using the list sweep sorting, the interface model provided by the instrument is 57BR-4036L (the same interface as the BIN sorting), and provides /FAIL1~/FAIL10 and the total /PASS and /FAIL signals.

10.2.1 List Sweep Sorting Logic

A maximum of 4 parameters can be set for each sweep point. The upper and lower limits of the corresponding parameter settings indicate that they participate in the sorting. If the upper and lower limits are not set, they are not considered in the sorting.

All the parameters considered in the sorting among the 4 parameters are qualified, indicating that the sweep point is qualified. As long as there is one unqualified sweep point, the sweep point is judged to be unqualified. In the list sweep display interface, the P/F column at the end of each sweep point will display PASS or FAIL, and the sweep points without upper and lower limits will be displayed at the corresponding P/F.

Sweep points 1~10 correspond to /BIN1~/BIN10 in sequence, and all are active low. The sorting results of sweep point 11 and subsequent sweep points do not have separate sorting signals. If all the sweep points with upper and lower limits are qualified, a total PASS signal will be output, and if one of the sweep points with upper and lower limits is set unqualified, a FAIL signal will be output. Sweep points that do not have upper and lower limits set do not participate in the sorting.

10.2.2 Technical Description

10.2.2.1 List Sweep Output Signal

Active low, open collector, optoelectronic isolation

Table 10-5 Output Signals

Signal	Overview
/BIN1~/BIN10 PASS, FAIL	Result output
/INDEX	"Analog Measurement End" signal
/EOM	"End of All Measurements" signal
/ALARM	Provides an alert when a momentary power failure or processor interface board reset is detected.

10.2.2.2 List Sweep Input Signal

The input signal is the same as for BIN sorting (see section 10.1.1.2).

10.2.2.3 Signal Line Definition

The list sweep sorting Handler Interface uses three signals: compare output, control input and control output. The following are the signal definitions of the Handler Interface when the list sweep sorting function is used.

The signal definition of the list sweep comparison function is different from that of the BIN comparison function. Its definition is as follows:

Comparison Output Signal:

- /FAIL1~/FAIL10

- PASS

- FAIL

The /FAIL1~/FAIL10 signal indicates the successful pass or the out-of-tolerance judgment of each sweep point, see Figure 10-9. The /PASS and /FAIL signals are indicated as total judgment signals. These signals will be output when a sweep measurement is completed.

Control Output Signal:

- /INDEX (analog measurement completion signal)

- /EOM (measurement end and comparison data valid signal)

- /ALARM (instrument power down signal)

SEQ Sweep Mode: The /INDEX signal registers after the analog measurement of the last sweep point is completed. The /EOM signal registers after each step of measurement and comparison is completed.

STEP Sweep Mode: The /INDEX signal registers after the analog measurement of each sweep point is completed. The /EOM signal registers after each step of measurement and comparison is completed.

The timing diagram is shown in Figure 10-10.

Control Input Signal: /EXT.TRIG (external trigger signal)

The interface diagram of the above pins is shown in Figure 10-1.

See Table 10-6 for the signal assignment and brief description of the above pins.

Table 10-6 Pin Distribution Table of the List Sweep Sorting Function

Pin	Signal	Signal Direction	Description
1	/FAIL1	Output	Out of the limit of sweep point1
2	/FAIL2		Out of the limit of sweep point2
3	/FAIL3		Out of the limit of sweep point3
4	/FAIL4		Out of the limit of sweep point4
5	/FAIL5		Out of the limit of sweep point5
6	/FAIL6		Out of the limit of sweep point6
7	/FAIL7		Out of the limit of sweep point7
8	/FAIL8		Out of the limit of sweep point8
9	/FAIL9		Out of the limit of sweep point9
10	/FAIL10		Out of the limit of sweep point10
11	Undefined	Output	Factory test, please do not use.
19	/PASS	Output	All points in the measurement result are passed, it is /PASS.
20	/FAIL	Output	As long as one point in the measurement result fails, it is /FAIL.
30	/INDEX	Output	**SEQ:** The /INDEX signal registers after the analog measurement of the last sweep point is completed, and the UNKNOWN test terminal of the ST2840 can be connected to the next device under test (DUT). However, the comparison result signal does not register until the /EOM signal (see Figure 10-10).

|			
			STEP: The /INDEX signal is asserted valid after the analog measurement of each sweep point is completed. However, the comparison result signal does not register until the /EOM signal (see Figure 10-10).
31	/EOM	Output	**End of Measurement** **Sequential Sweep Mode (SEQ):** The /EOM signal registers after the entire list sweep measurement is completed and all comparisons are done (see Figure 10-10). **Single-Step Sweep Mode (STEP):** The /EOM signal registers after each sweep point measurement is completed and all comparisons are done. The comparison result signal remains until the /EOM signal of the final sweep point (see Figure 10-10).
Other	–	–	The definition is the same as that of the comparison (see Table 10-3).
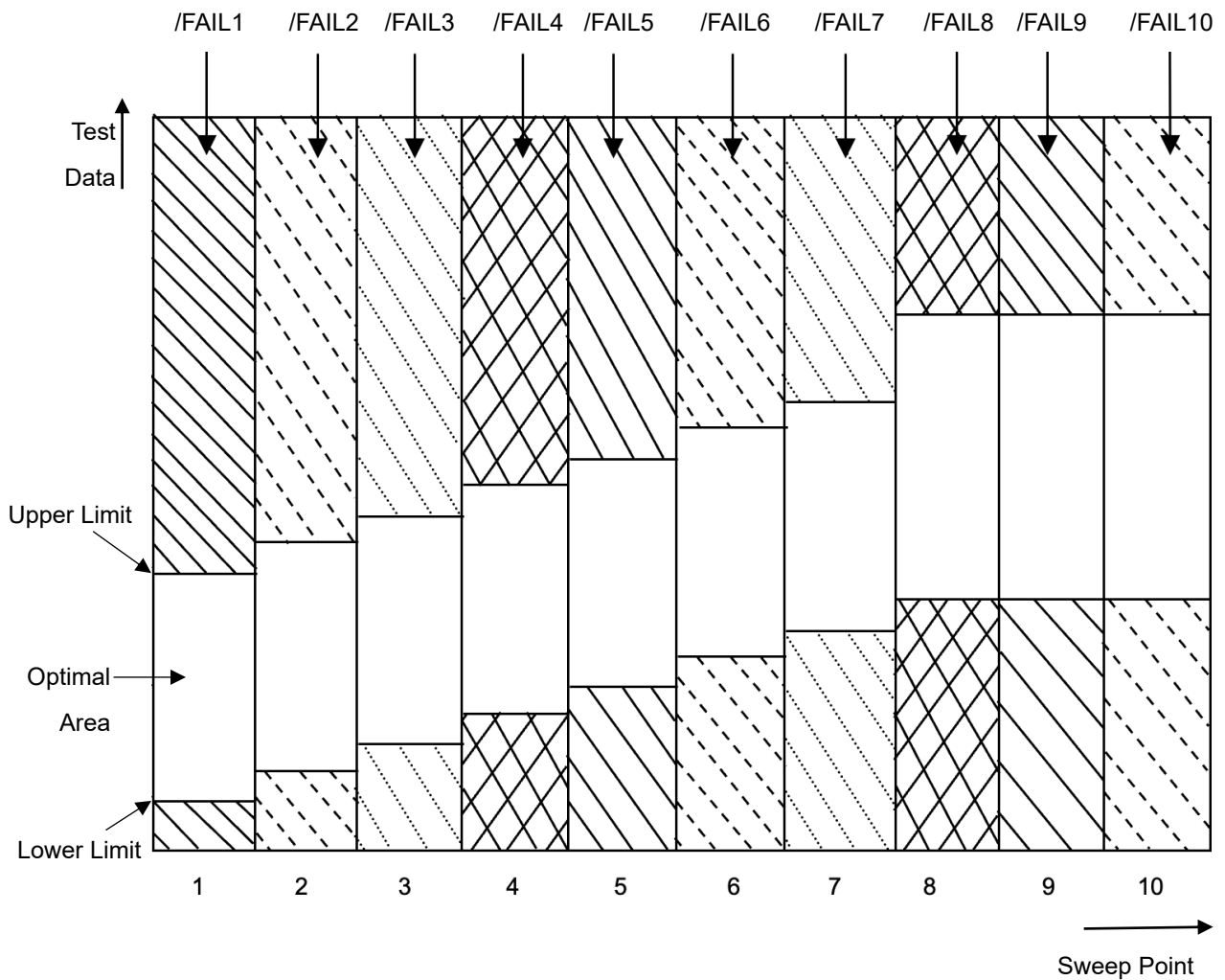
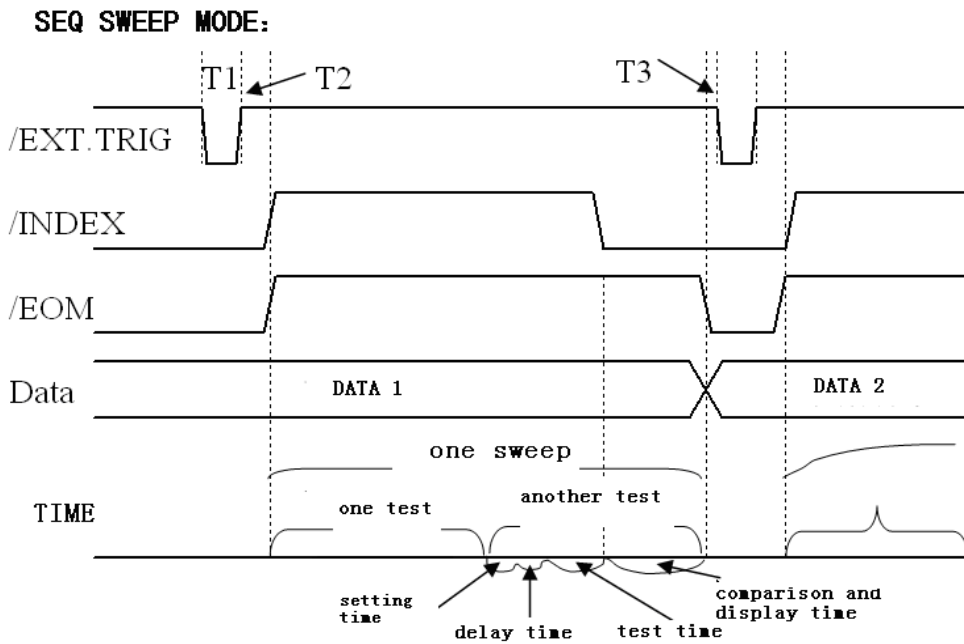Figure 10-9 Signal Area of the List Sweep Comparison
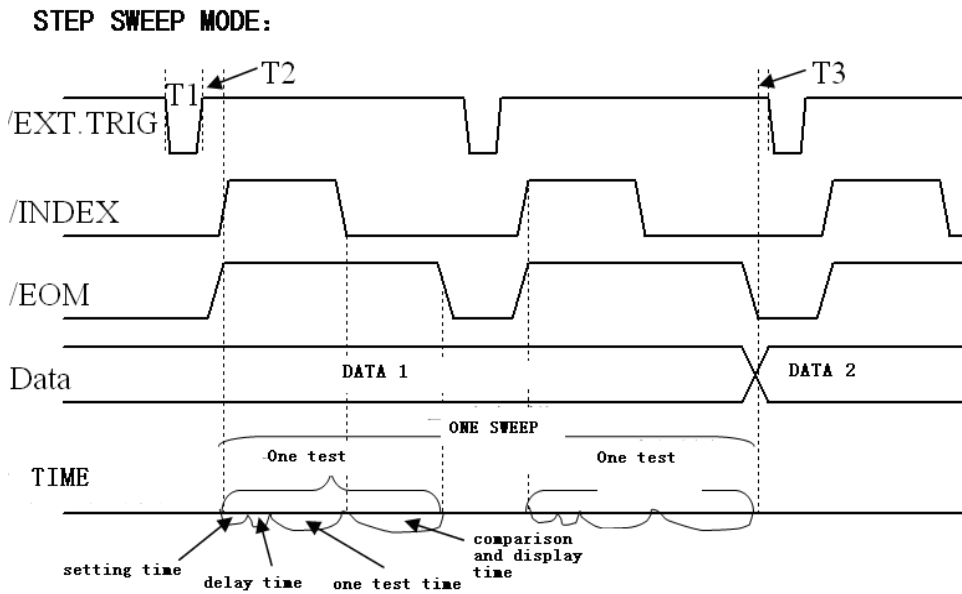

Figure 10-10 Timing Chart (Sequential Mode)

Figure 10-11 Timing Chart (Single-Step Mode)

Note:

- The setting time includes the correction ON/OFF time.

- The comparison and display time is 4.5ms approximately.

10.2.3 Electrical Features

The meanings of some signals in the list sweep comparison function and the BIN sorting function are different. However, the electrical characteristics of these signals are the same in both operations, so refer to 10.1.2 for a description of the electrical characteristics of the list sweep sorting function.

10.2.4 Wiring Instructions

The list sweep and BIN sorting share the same Handler Interface in the hardware circuit, and the electrical properties corresponding to the same pin numbers are exactly the same. It is essentially the same as the PLC wiring diagram. Therefore, for the wiring diagrams please refer to 10.1.3.

10.2.5 Using the List Sweep Comparison

Using the Handler Interface, set the high and low limits in the list sweep to use the comparison function. Then set the Handler Interface so that it can OUTPUT/INPUT signal. The following are the steps to take in order to use the Handler Interface list sweep comparison function.

10.2.5.1 List Sweep Compare Function Setting Steps

- Press the [SETUP] button and click [List Setup] in the menu on the right side of the screen to enter the <List Sweep Setup> page.

- In the <List Sweep Setup> menu, set the sweep method, sweep frequency point, reference value, upper and lower limits, etc.

- Press [DISP] to enter the <List Display> page. For a full description of this page, please refer to the section on the [DISP] menu key.

10.3 Transformer Single-Group Measurement

The interface model provided to sort transformer single measurement results is 57BR-4036L, which offers separate sorting of 12 parameters such as /FAIL1~/FAIL12, and the total /PASS and /FAIL signals.

10.3.1 Sorting Logic

The sorting signal of the first parameter in the single-group setting page corresponds to /FAIL1, the second parameter corresponds to /FAIL2, and so on; the last parameter corresponds to /FAIL12. During measurement, whichever parameter fails the corresponding sorting signal will change. If all parameters pass the test, the PASS signal is output; as long as a minimum of one parameter does not, the /FAIL signal is output.

10.3.2 Technical Description

10.3.2.1 Output Signal

Active low, open collector, optoelectronic isolation.

Table 10-7 Output Signals

Signal	Overview
/FAIL1~/FAIL12, /PASS, /FAIL	Result output
/INDEX	"Analog Measurement End" signal
/EOM	"End of All Measurements" signal
/ALARM	Provides an alert when a momentary power failure or processor interface board reset is detected.

10.3.2.2 Input Signal

Optoelectronic isolation.

Table 10-8 Input Signals

Signal	Overview
/KEY_LOCK	Key lock (locks the front panel keyboard, including the touch screen)
/EXT_TRIG	External Trigger: pulsewidth ≥ 1μS

10.3.2.3 Signal Line Definition

The Handler Interface of transformer single test uses three kinds of signals: comparison output, control input and control output. The following is the signal definition of the Handler Interface when using the transformer single measurement function.

Comparison Output Signal:

- /FAIL1~/FAIL12

- /PASS

- /FAIL

Control Output Signal:

- /INDEX (analog measurement end signal)

- /EOM (measurement end and comparison data valid signal)

- /ALARM (instrument power down signal)

Control Input Signal:

- /EXT.TRIG (external trigger signal)

- /Keylock

See Table 10-9 for the signal assignment and brief description of the above pins.

Table 10-9 The Signal Assignment of the Pins

Pin	Signal	Signal Direction	Description
1 2 3 4 5 6 7 8 9 10 11	/FAIL1 / FAIL2 / FAIL3 / FAIL4 / FAIL5 / FAIL6 / FAIL7 / FAIL8 / FAIL9 / FAIL10 / FAIL11	Output	Sorting result All /FAIL (failure signal) outputs are open collector outputs.
12 13	/EXT.TRIG	Input	**External Trigger:** When the trigger mode is set to single, the ST2840 is triggered by a falling edge pulse signal applied to this pin.
14 15	/EXT.DCV2	Input	**External DC Voltage 2:** The DC provider pin for the optoelectronic coupling signal (/EXT_TRIG, /KeyLock, /ALARM, /INDEX, /EOM)
16 17 18	+5V	Output	**The Internal Power +5V:** It is <u>not</u> recommended to use the internal power! If you do, please ensure that the current is lower than 0.3A and the signal line is far from the disturbance source.
19	/PASS	Output	As long as the measurement result is in any one of /FAIL1~/FAIL12, /PASS will be output.
20	/FAIL	Output	If the measurement result is not in any one of /FAIL1~/FAIL12, /FAIL will be output.
21	/ FAIL 12	Output	Sorting result of the 12th parameter

22 23 24	Undefined	Output	Factory measurement signal, please do not connect.
25	/KEY LOCK	Input	With this signal, all the front panel function keys and touch screen of ST2840 are locked and no longer work.
27 28	EXT.DCV1	Input	**The External DC Voltage 1:** The pull-up DC power provider pin for optoelectronic coupling signal (/BIN1~/BIN10, /PASS, /FAIL).
29	/ALARM	Output	Warning that the circuit has been interrupted.
30	/INDEX	Output	Indicates the analog test is finished and the UNKNOWN terminal can be connected to another DUT. The comparison signal remains effective until the /EOM signal.
31	/EOM	Output	**End Of Measurement:** This signal is output when the test data and comparison results are available.
32,33	COM2	–	The reference ground for external power EXTV2.
34,35,36	COM1	–	The reference ground for external power EXTV1.

10.3.3 Electrical Feature

The definition of some signals differs between the transformer single-measurement sorting function, the BIN sorting function and the list sweep sorting function, but the electrical properties of each pin number are exactly the same.

10.3.3.1 DC Isolation Output Signal

Each DC output (pins 1 to 11, 19 to 24, and 29 to 31) is isolated via an open collector optocoupler output. 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 either the internal supply voltage (+5V) or the external supply voltage (EXTV: +5V~24V) by jumper.

The DC isolation output signal utilizes a dedicated electrical system which is independent of the control output signal. Therefore, the processor board has a common line for two separate circuits: COM1 and COM2.

The electrical characteristics of the DC isolated output are divided into two types, see Table 10-10. The output circuit configuration of the measurement result output signal is shown in Figure 10-5, and the output circuit configuration of the control output signal is shown in Figure 10-4.

Table 10-10 Electric Features of the DC Isolation Output

Output Signal	Output Rated Voltage		Maximum Current	Reference Ground for the Circuit
	LOW	**HIGH**		
Comparison Signal: • /FAIL1~/FAIL12 • /PASS • /FAIL	≤ 0.5V	+5V~+24V	6mA	Internal Pull-Up Voltage: ST2840 GND EXTV1: COM1
Control Signal • /INDEX • /EOM • /ALARM	≤ 0.5V	+5V~+24V	5mA	Internal Pull-Up Voltage: ST2840 GND EXTV2: COM2

10.3.3.2 DC Isolation Input Signal

DC isolation input signals include the /EXT_TRIG and /KEY_LOCK signals.

The /EXT_TRIG signal (pin 12 and pin 13) is input to the LED cathode side of the optocoupler. The instrument is triggered when the signal increases from LOW to HIGH. The optocoupler LED (anode side) can be driven by an internal pull-up voltage (+5 V) or an external voltage (EXT.DCV2).

The /KEY_LOCK signal (pin 25) is input to the optocoupler LED (on the cathode side). As long as this is at low level, the keys on the front panel of the instrument will all be locked. The optocoupler LED (anode side) can be driven by an internal voltage (+5V) or an external voltage (EXT.DCV2).

The input circuit configuration of the DC isolation input signal is shown in Figure 10-6.

10.3.4 Wiring Instructions for Transformer Single-Group Measurement

The Handler's wiring operation for a single-group measurement of the transformer is exactly the same as the wiring method of the BIN sorting with the same pin number. The wiring diagram of the common anode PLC is shown in Figure 10-7, and the wiring diagram of the common cathode PLC is shown in Figure 10-8.

10.3.5 Using the Transformer Single-Group Measurement Function

After the Handler Interface is correctly connected to the PLC, the deviation mode can be selected in the deviation column on the single group setting page (Δ; Δ%).

The lower limit of each parameter can be set in the column corresponding to the lower limit, and the upper limit of each parameter can be set in the column corresponding to the upper limit.

The first parameter of the single group setting page corresponds to /FAIL1, the second parameter corresponds to /FAIL2, and so on; the twelfth parameter corresponds to /FAIL12. You can select ON in the comparison item on the single group setting page.

If the measurement switch of each parameter is set to ON, and the upper and lower limits are defined, then the parameter is considered in the sorting. Note that a parameter is not considered in sorting without setting its upper and lower limits.

10.4 Transformer Scan Handler Description

For the transformer scan, Handler uses two DR-25P sockets, namely Trans Handler and Trans Controller. It can provide up to 30 independent sorting signals NS1~NS30, in addition to PASS, NG, TEST and other signals.

10.4.1 Technical Description

10.4.1.1 Output Signal

Active low, open collector, optoelectronic isolation, ULN2003 Drive Enhancement.

Table 10-11 Output Signals

Signal	Overview
NS1~NS30, PASS, FAIL	Result output
/TEST	"All measurement end" signal

10.4.1.2 Input Signal

Active low, optoelectronic isolation.

Table 10-12 Input Signals

Signal	Overview
EXT_RESET	Reset signal
EXT_START	External trigger signal

10.4.1.3 Signal Line Definition

The Handler Interface of transformer scan uses three signals: compare output, control input, and control output. The following are the signal definitions of the Handler Interface when using this function:

Comparison Output Signals:

• /NS1~/NS30

• /PASS

• /FAIL

Control Output Signals:

• /TEST (analog measurement completion signal)

Control Input Signals:

• /EXT_START (external trigger signal)

• /EXT_RESET (reset signal)

See Table 10-13 (Trans Handler) and Table 10-14 (Trans Controller) for the signal assignments and brief description of the above pins.

Table 10-13 Signal Assignment of Transformer Scan Pins (Trans Handler)

Pin	Signal	Signal Direction	Description
1 2 3 4 5 6 7 8 9	NS1 NS 2 NS 3 NS 4 NS 5 NS 6 NS 7 NS 8 NS 9	Output	**Sorting Signal Line:** All NS outputs are collector outputs and have different definitions in different sorting modes.
10	/TEST	Output	**End Of Measurement:** This signal is output when the test data and comparison results are available.
11 12 13	+5V	Output	**The Internal Power +5V:** It is not recommended to use the internal power! If you do, please ensure that the current is lower than 0.3A and the signal line is far from the disturbance source.

14			
15	/GND	Output	–
16			
17			
18	24V-	Output	Cathode of cylinder power supply
19	/EXT_GND	Input	The reference ground for external power EXT_VCC
20	24V+	Output	Anode of cylinder power supply
21	/EXT_VCC	Input	**External DC Voltage:** The DC provider pin for the optoelectronic coupling signal (/NS1~/NS30, /PASS, /FAIL, /TEST)
22	/EXT_RESET	Input	Reset signal
23	/EXT_START	Input	External trigger signal
24	/FAIL	Output	
25	/PASS	Output	

Table 10-14 Signal Assignment of Transformer Scan Pins (Trans Controller)

Pin	Signal	Signal Direction	Description
1	/NS10		
2	/NS11		
3	/NS12		
4	/NS13		
5	/NS14		
6	/NS15		
7	/NS16		**Sorting Signal Line:**
8	/NS17	Output	All NS outputs are collector outputs and have different definitions
9	/NS18		in different sorting modes.
10	/NS19		
11	/NS20		
12	/NS21		
13	/NS22		
14	/NS23		
15	/NS24		

16	/NS25		
17	/NS26		
18	/NS27		
19	/NS28		
20	/NS29		
21	/NS30		
22 23	+5V	Output	**The Internal Power +5V:** It is <u>not</u> recommended to use the internal power! If you do, please ensure that the current is lower than 0.3A and the signal line is far from the disturbance source.
24 25	GND	Output	

10.4.2 Electrical Features

10.4.2.1 DC Isolation Output Signal

Each DC output (pins 1-10, 24, 25 of Trans Handler and pins 1-21 of Trans Controller) are isolated by optocoupler and output from the collector after ULN2003 drive enhancement. The output voltage of each line is related to the power supply voltage used. The high level of the internal power supply is 5V, and the high level of the external power supply is the external power supply voltage. Connect with internal supply voltage (+5V) or with external supply voltage (EXTV: +5V~24V) by jumper.

The DC isolated output signal utilizes a dedicated electrical system which is independent of the control output signal. Therefore, a common line for a separate circuit on the processor board: GND_EXT.

The electrical characteristics of the DC isolated output are divided into two types, see Table 10-15. The output circuit configuration of the measurement result output signal is shown in Figure 10-12, and the output circuit configuration of the control output signal is shown in Figure 10-13.

Table 10-15 DC Isolation Output Electrical Characteristics

Output Signal	Output Rated Voltage		Maximum Current	Reference Ground for the Circuit
	LOW	HIGH		
Comparison Signal: • /NS1~/NS30 • /PASS • /FAIL	≤ 0.5V	+5V~+24V	50mA	Internal Pull-Up Voltage: ST2840 GND External Voltage: GND_EXT

Control Signal • /TEST	≤ 0.5V	+5V~+24V	50mA	Internal Pull-Up Voltage: ST2840 GND External Voltage: GND_EXT

Pull-up resistor 10K

11,12,13(VCC)

21(VCC.EXT)

1 (NS1)

9 (NS9)

24(GOOD)

25(NG)

19(GND_EXT)

14,15,16,17(GND)

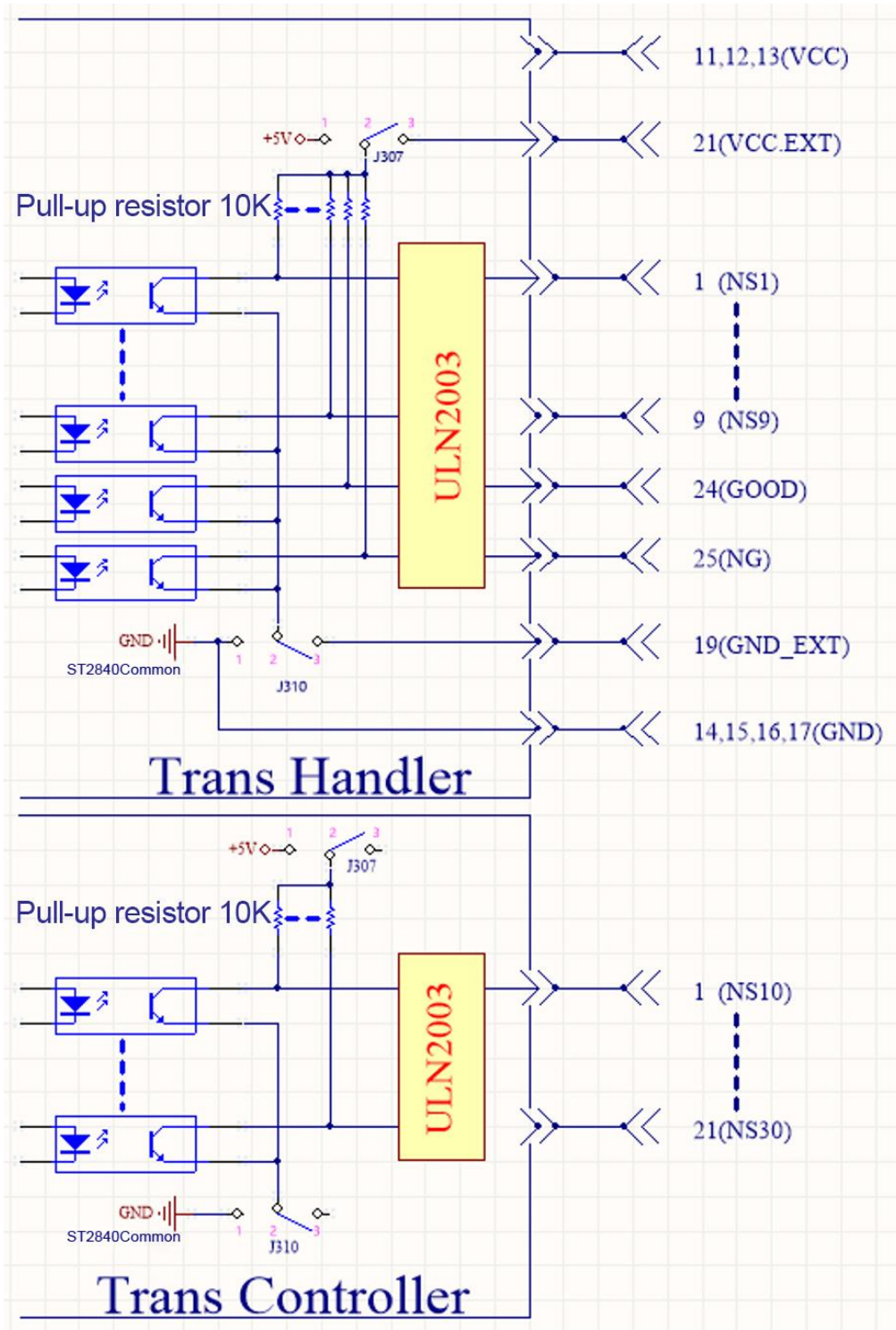**Trans Handler**

Pull-up resistor 10K

1 (NS10)

21(NS30)

Trans Controller

Figure 10-12 Comparison Result Signal Output Circuit
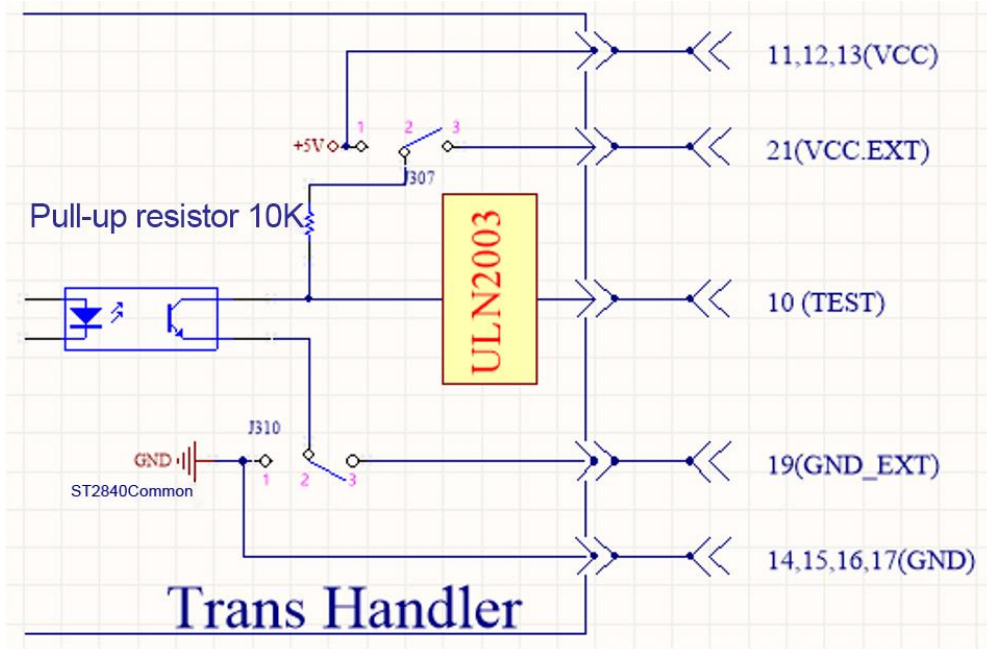
Figure 10-13 Control Signal Output Circuit

10.4.2.2 DC Isolation Input Signal

DC isolation input signals include EXT_RESET and EXT_START signals.

The EXT_RESET signal (pin 22 of the Trans Handler) is input to the optocoupler LED (on the cathode side). As long as this is at low level, the keys on the front panel of the instrument will all be locked. The optocoupler LED (anode side) can be driven by internal voltage (+5V) or external voltage (EXT_VCC).

The EXT_START signal (pin 23 of the Trans Handler) is input to the LED cathode side of the optocoupler. The instrument is triggered when the signal increases from LOW to HIGH. The optocoupler LED (anode side) can be driven by an internal pull-up voltage (+5 V) or an external voltage (EXT_VCC).

The input circuit configuration of the DC isolated input signal is shown in Figure 10-14.
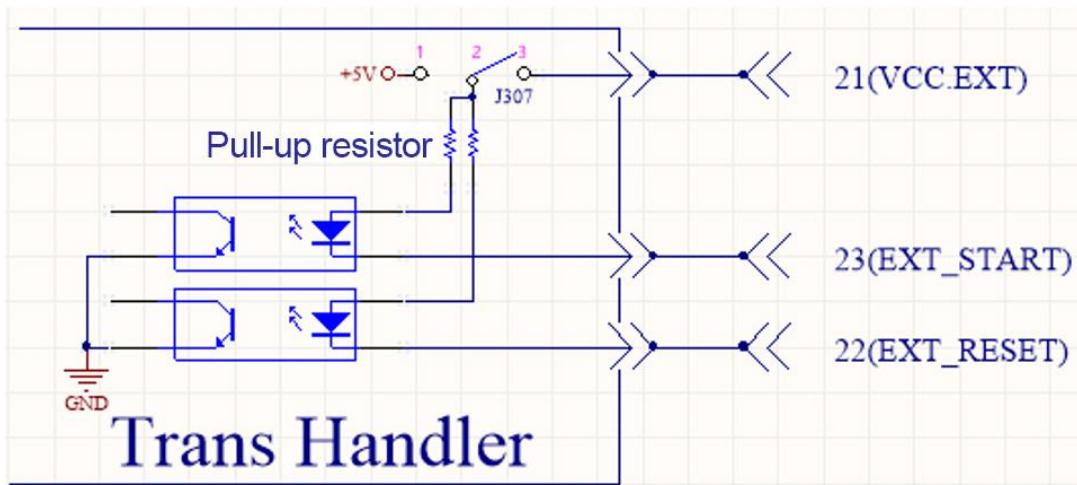
Figure 10-14 Control Input Circuit

10.4.3 Wiring Instructions for the Transformer Scan

This section focuses on the example of wiring between the sorting interface of ST2840 transformer scanning and a typical PLC. The wiring example only introduces the wiring of two PLCs, that is, the PLC input circuit common anode and the PLC input circuit common anode. For PLCs with other types of input circuits, please consult customer service.

The PLC input circuit common anode means that the current flows in from the common terminal of the module and flows out from the input channel of the module, which is often referred to as the source wiring method.

The PLC input circuit common cathode means that the current flows in from the input channel of the module and flows out from the common terminal of the module, which is often referred to as the drain wiring method.

When using transformer scanning and sorting, PLC wiring diagram where handler interface and input circuit are common anode is shown in Figure 10-15, and PLC wiring diagram where handler interface and input circuit are common cathode is shown in Figure 10-17.

The factory default of ST2840 series instrument is external power supply. That is, pins 2 and 3 of J307 are short-circuited, pins 2 and 3 of J310 are short-circuited, JP501 is open, and JP503 is open. Therefore, be sure to connect the power supply to the external power supply pin when using it.

If you need to use the internal power supply of the instrument, you need to change the jumper mode of J307 and J310. Please consult our customer support for further details.

| Warning! |
|---|
| 11, 12, 13 of Trans Handler and 22, 23 of Trans Controller are the 5V power supply inside the instrument and cannot be connected to any external power supply, otherwise the instrument will get damaged.

Considering the anti-interference ability of the instrument, it is recommended to provide and use an external power supply as the pull-up power supply of ULN2003. |
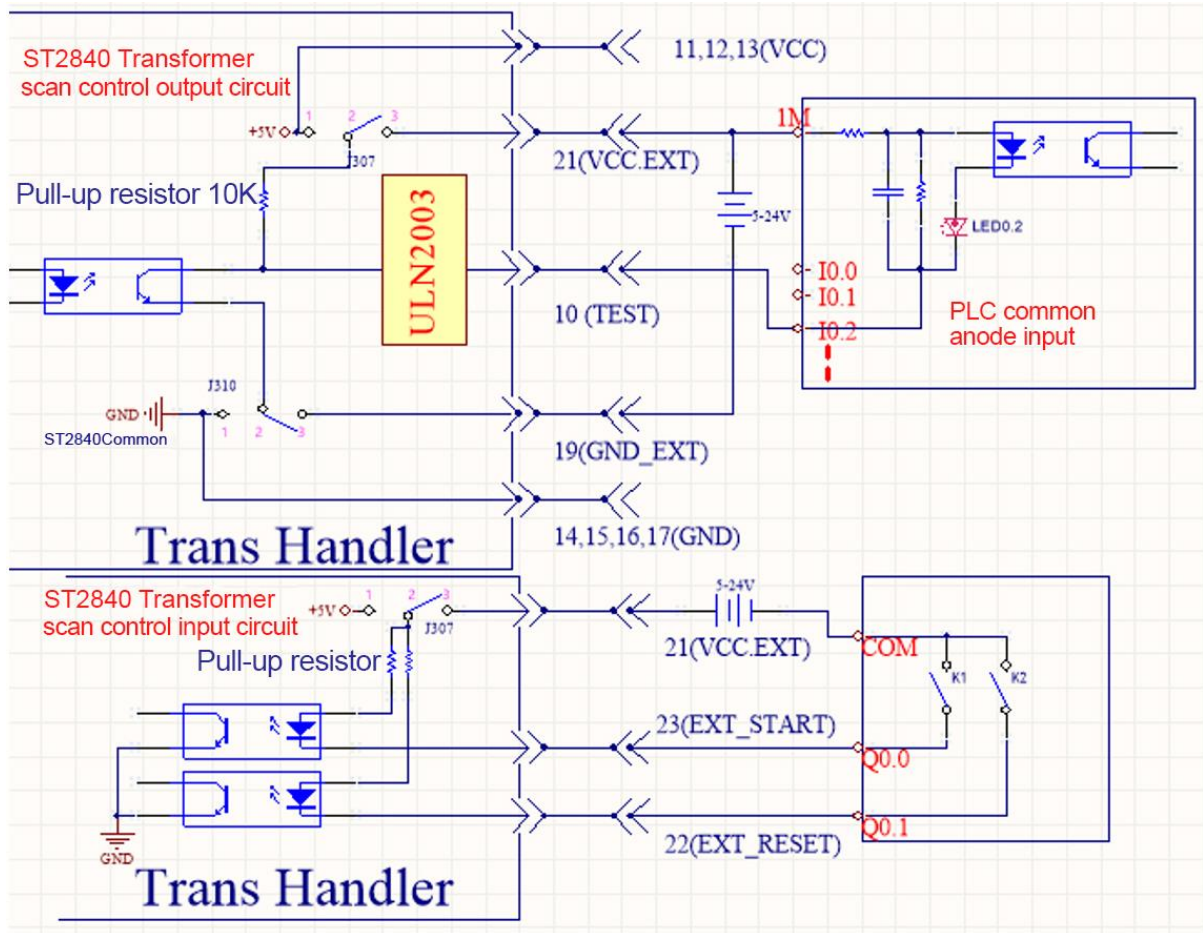
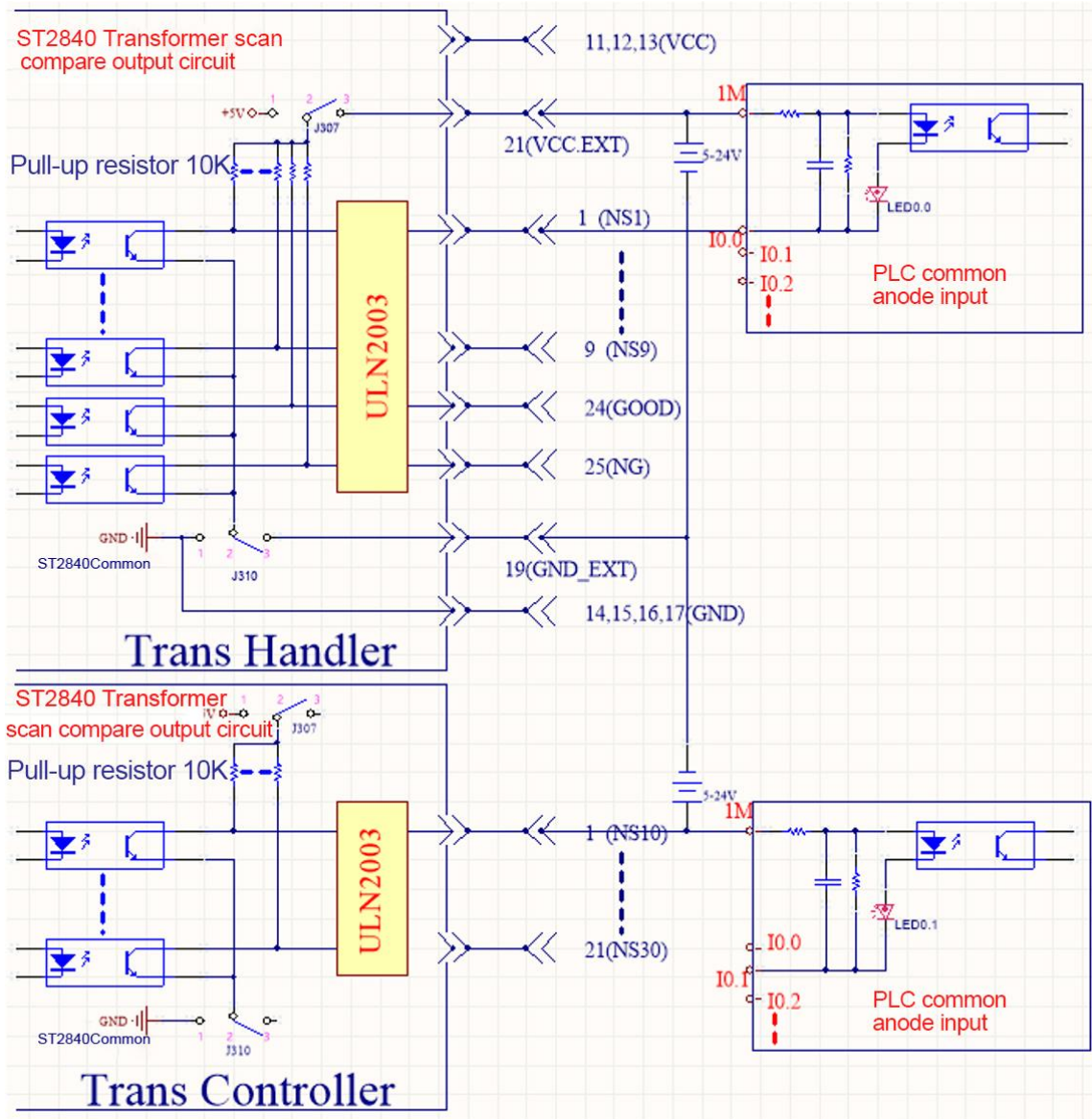Figure 10-15 PLC Wiring Diagram Where Handler Interface and Input Circuit Are Common Anode

Figure 10-16 PLC Wiring Diagram Where Handler Interface and Input Circuit Are Common Anode

The wiring method provided in this figure is a typical connection method, and it needs to be flexibly applied according to the actual situation in practical application.
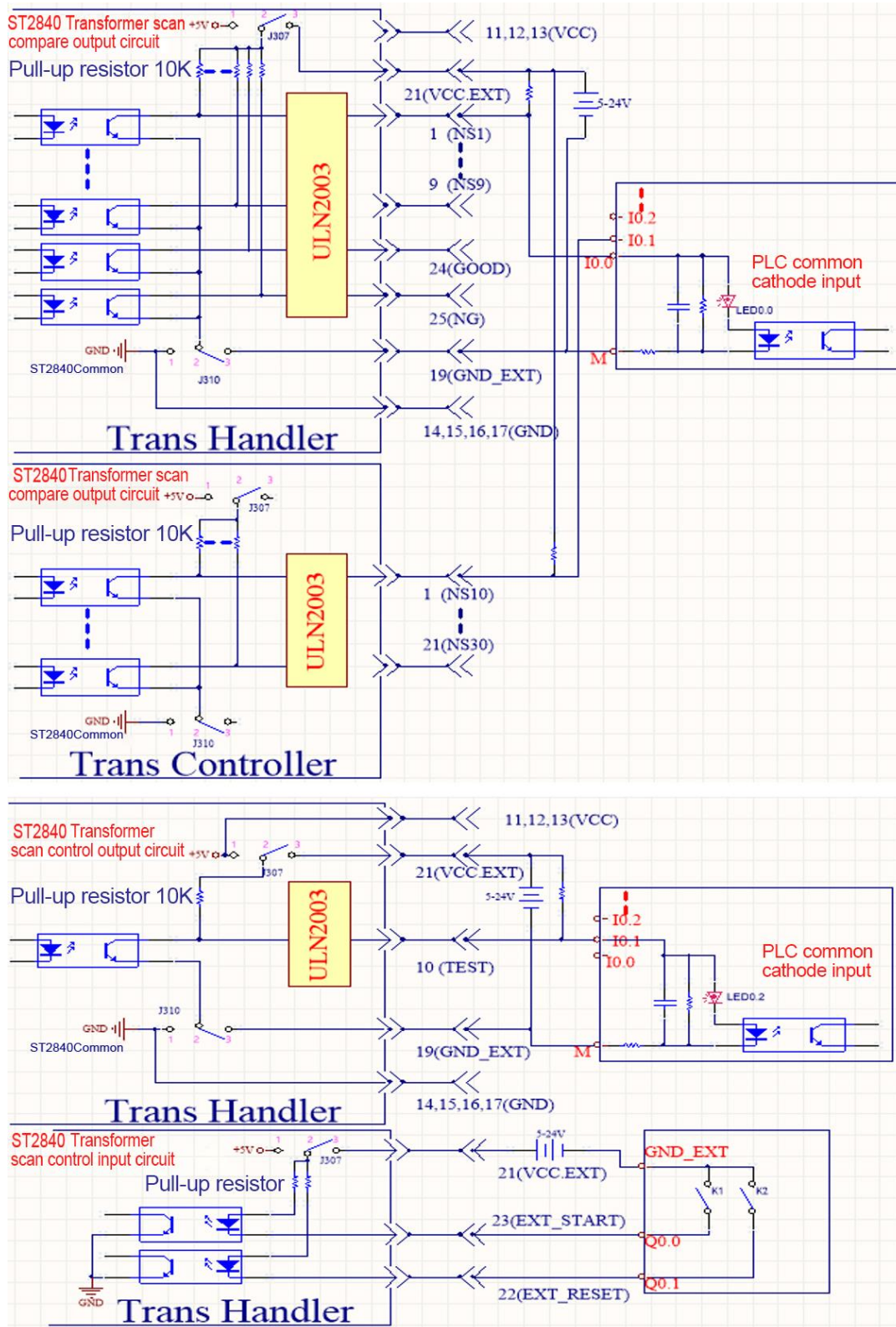
Figure 10-17 PLC Wiring Diagram Where Handler Interface and Input Circuit Are Common Cathode

10.4.4 Using the Transformer Scan Function

Transformer scan sorting is always on. The sorting modes are default, X12, and X30.

10.4.4.1 Sorting Mode Setup

After entering the Transformer Scan mode, press [Setup], and click [Handler Mode] in the menu bar on the right side of the display screen to enter the <Handler Mode> page.

There are also pin definitions corresponding to the different handler modes on this page.

10.5 Sorting of Scanning Fixtures

ST2840AX, ST2840BX and ST2840NX are compatible with ST1901, ST1831, ST1806 series scan boxes.

The ST1831 scan box pin definition is exactly the same as the Handler definition of the ST2840 built-in scan board.

C E