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User Manual

LCR Meter ST2839 series

Contents

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 us. When you receive the product, some inspections are needed before installation.

1.1 Inspect the Package

After unpacking, you should first check that the instrument has not been damaged in transit. We do not recommend that you turn on the unit if it is damaged. If there is any discrepancy to the expected contents of your delivery, please contact our company or your local seller as soon as possible to protect your rights.

1.2 Power Connection

- **Power-Supplying Voltage Range:** 100 ~ 120V AC or 198 ~ 242V AC, depending on the power setup on the rear panel.
- **Power-Supplying Frequency Range:** 47 ~ 63Hz.
- **Power-Supplying Power Range:** <80VA.
- The power-supplying input phase line L, zero line N, ground lead E should be as same as the power plug of the instrument.

Although the instrument is able to reduce the interference caused by AC power terminal input, we still recommend it be used in a low-interference 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

- Please do not operate the instrument in an environment where it will be subjected to strong vibrations, dust, direct sunlight or corrosive air.
- 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.
- 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.
- Although the instrument is specifically designed to 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.
- 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 and no direct sunlight. 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.
- The instrument, especially the test cables, should be kept as far away as possible from any strong electromagnetic field, to avoid interference during measurement.

1.5 Use of Test Fixture

Please only use the included or additionally purchased original cables and test fixture, as **foreign ones 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 either the test fixture or cables have not 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 15 minutes.
2) Please do not switch the instrument on and off unnecessarily; this may affect measurement accuracy.

1.7 Other Features

Power: Consumption Power ≤ 80VA

Dimensions (W*H*D): 400mm × 132mm × 385mm

Weight: approx. 13kg

2 Basic Operation Features

This chapter details the basic operation features of ST2839 series instruments. Please read this chapter carefully before using your device.

2.1 Front Panel

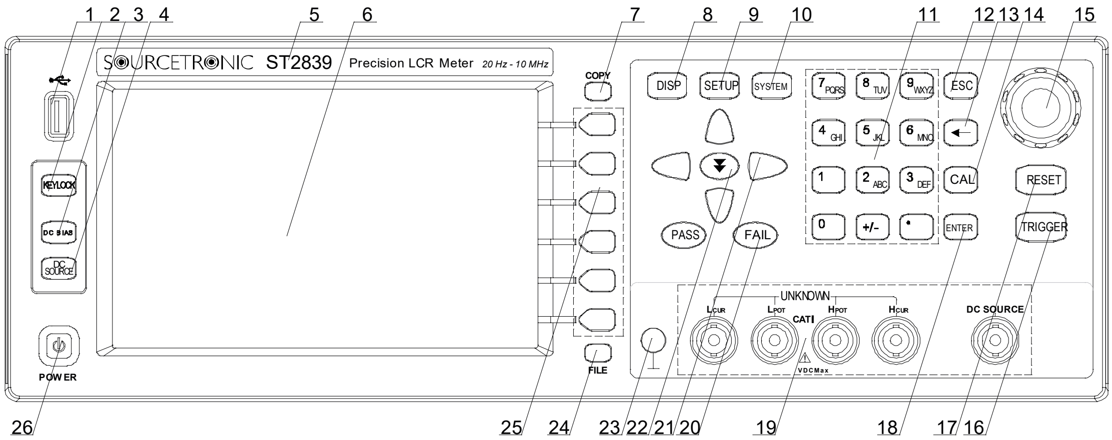


Figure 2-1 Front Panel

1) **USB HOST Interface**
Connect a USB storage device to save or load a specified file.

2) **[KEYLOCK]**
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, the [KEYLOCK] button is also active and lit up. In this case, too, you can unlock by pressing [KEYLOCK] again.

3) **[DC BIAS]**
This key is used to enable or disable the 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.

4) **[DC SOURCE]**
This button controls the DC voltage source (-10 ~ +10V) function. This function can extend the flexibility of DC control and biasing through independent output of the DC source port. For example, this can be used for the measurement of three-port devices.

5) **Brand and Model**
Details the brand and model number.

6) **LCD Liquid Crystal Display**
800 x 480 color TFT LCD screen, showing the measurement results and settings.

7) **[COPY]**
Copy the currently displayed page to USB memory.

8) [DISP]

Press this key to enter the measurement display page of the corresponding function.

9) [SETUP]

Press this key to enter the measurement settings page of the corresponding function.

10) [SYSTEM]

Press this key to access the system setup page.

11) Numeric Keys

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

12) [ESC]

"Escape" key.

13) [←]

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

14) [CAL]

Reserved.

15) Knob with Confirmation Function

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

16) [TRIGGER]

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

17) [RESET]

During automatic scanning, press the [RESET] button to end the scan. On other pages, this button has no function.

18) [ENTER]

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

19) 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

20) PASS/FAIL Indicator

LED indicators that show the measurement has either concluded successfully or failed.

21) Cursor Keys

Four cursor keys are used to move the cursor between the different areas of the display. When the cursor moves to an area, this area will be highlighted on the screen.

22) Arrow Key

This button enables the cursor to jump quickly between different areas.

23) Ground Terminal

The ground terminal is connected with the housing of the instrument and can be used to protect or shield the ground connection.

24) [FILE]

This key is used to enter the <File Management> interface.

25) Soft Keys

Six soft keys are available for selecting controls and parameters. The left side of each soft key displays the corresponding function definition. Function assignments vary depending on the currently displayed page.

26) [POWER]

Power switch.

2.2 Rear Panel

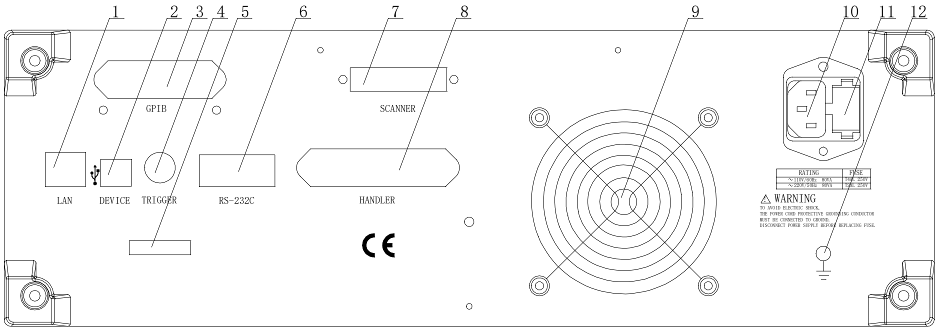


Figure 2-2 Rear Panel

1) LAN Interface

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

2) USB Device Interface

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

3) IEEE-488 Interface

The GPIB device interface can be used to communicate with the computer.

4) Trigger Interface

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

5) Nameplate

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

6) RS232 Interface

The serial communication interface can be used to communicate with the computer.

7) Scanner Interface

Reserved.

8) Handler Interface

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

9) Vents

Heat elimination, helps to maintain a normal operating temperature.

10) Power Socket

Input AC power.

11) Fuse Base

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

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

12) Ground Terminal

The ground terminal is connected with the housing of the instrument and can be used to protect or shield the ground connection.

2.3 Display Areas

ST2839 series instruments use a 65k, 7-inch TFT display; the content displayed on the screen is divided into the following display areas:

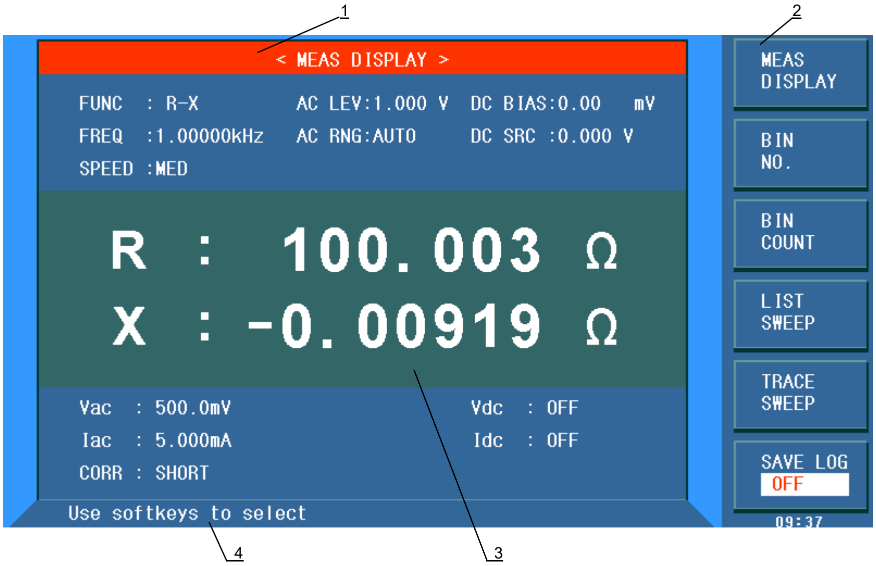


Figure 2-3 Display Areas

1) Page Title

Indicates the name of the currently displayed page.

2) Soft Keys

The area displays the function definition of the soft keys. The function assignment of the soft keys can differ based on the exact cursor position.

3) Measurement Results and Settings

This area displays measurement results and current measurement settings.

4) Help

This area displays additional information about the system and user data input.

2.4 Main Menu Keys and Corresponding Displayed Pages

2.4.1 [DISP]

When the LCR function is active, press this key to access the LCR measurement display page. From here, select any of the following soft keys:

- **<MEAS DISPLAY>**
- **<BIN NO.>**
- **<BIN COUNT>**
- **<LIST SWEEP>**
- **<TRACE SWEEP>**
- **<SAVE LOG>**

2.4.2 [SETUP]

When the LCR function is active, press this key to access the LCR measurement setup page. From here, select any of the following soft keys:

- **<MEAS SETUP>**
- **<CORRECTION>**
- **<LIMIT TABLE>**
- **<LIST SETUP>**
- **<TRACE SETUP>**
- **<TOOLS>**

2.4.3 [SYSTEM]

Press this key to access the system settings page. From here, select any of the following soft keys:

- **<SYSTEM SETUP>**
- **<LAN SETUP>**
- **<HANDLER SETUP>**
- **<CHANNEL SETUP>**
- **< DEFAULT SETTINGS>**
- **<SYSTEM RESET>**

2.5 Basic Operation

The basic operation principles of ST2839 series instruments are as follows:

1) Use the menu keys ([DISP], SETUP], [SYSTEM]) and soft keys to select pages.
2) Use the cursor keys ([←][→][↑][↓]) 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.
3) When the knob is in the non-input state, clockwise and anticlockwise rotation correspond respectively to the function of the [←] and [→] key. The confirmation button in the middle of the knob can be used for input and non-input status at the

position where the cursor can be changed. When in input state, clockwise and counterclockwise rotation of the knob can be used to switch the data at the cursor position.

4) 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, [←] and the [ENTER] key are used for data input.

5) After pressing a numeric key, the available unit soft keys will be displayed in the soft key area. You can choose a unit soft key or press [ENTER] to conclude the data input. When [ENTER] is used to terminate data inputting, the unit of data will be set to a default unit, such as Hz, V or A. For example, the default unit for frequency is Hz.

2.6 Start the Instrument

1) Plug in the three-wire power supply.

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

2) Press the power switch at the left corner on the front panel and then a boot screen will appear which displays the Source-tronic logo, instrument model and the version number of the software.

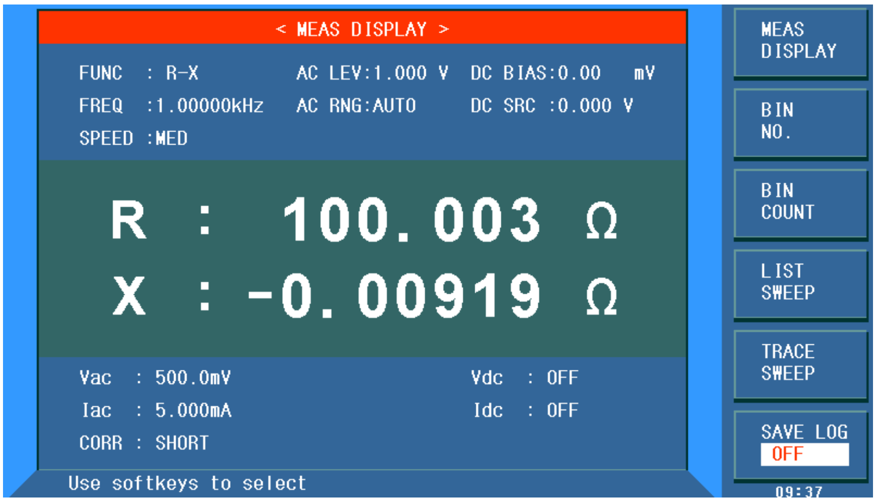
3) If the password protection function is on, users are required to input the password and then press [ENTER] to enter into the page of main menu.

Note: This product series comes with a pre-set default password, which is **2839**. You can of course change the password according to your own needs. For details, please see chapter 5.1.6 of this user manual.

3 Introduction to [DISP]

3.1 <MEAS DISPLAY>

Press [DISP] to access the <MEAS DISPLAY> page, as shown in the following figure:



On this page, the measurement result is displayed in upper-case characters. There are seven display areas on this page, corresponding to the following measurement parameters, which can be set here:

- Measurement Function (FUNC)
- Measurement Frequency (FREQ)
- Measurement Level (AC LEV) / (DC LEV in DCR function)
- Measurement Range (AC RNG) / (DC RNG in DCR function)
- Measurement Speed (SPEED)
- DC Bias (DC BIAS)
- DC Power Source (DC SRC)

Further details will be discussed later.

The measurement result / settings area shows information about measurement settings. These settings can be configured on the <MEAS SETUP> or <CORRECTION> pages.

- Signal Source Voltage / Current Monitoring (Vac, Iac)
- DC Source Voltage / Current Monitoring (Vdc, Idc)
- Open, Short, Load Correction ON/OFF Status (CORR)

3.1.1 Measurement Function

In one measurement period, ST2839 can measure two parameters for an impedance component; one primary parameter and one secondary parameter. The following parameters can be selected for measuring:

Primary Parameters:

- |Z| (Module of Impedance)
- |Y| (Module of Admittance)
- L (Inductance)
- C (Capacitance)

- R (Resistance)
- G (Conductance)
- DCR (DC Resistance)

Secondary Parameters:

- D (Dissipation Factor)
- Q (Quality Factor)
- Rs (Equivalent Series Resistance ESR)
- Rp (Equivalent Parallel Resistance EPR)
- X (Reactance)
- B (Admittance)
- θ (Phase Angle)
- Rd (DC Resistance)

Measurement results of primary and secondary parameters are displayed in uppercase characters, each in their respective line. The primary parameter displays in the upper line while the secondary parameter displays in the lower line.

Operation Steps for Configuring Measurement Function:

1) Move the cursor to the FUNC area. The following soft keys will be displayed on the screen:
   - **Cp—…→**
   - **Cs—…→**
   - **Lp—…→**
   - **Ls—…→**
   - **Z—…→**
   - ↓
2) If you press **Cp—…→**, the following parameters will be available to choose from:
   - **Cp-D**
   - **Cp-Q**
   - **Cp-G**
   - **Cp-Rp**
   - ←
3) Press the soft key corresponding to your desired parameter. Then press ← to return to the previous soft key menu.
4) If you press **Cs—…→**, the following parameters will be available to choose from:
   - **Cs-D**
   - **Cs-Q**
   - **Cs-Rs**
   - ←
5) Press the soft key corresponding to your desired parameter. Then press ← to return to the previous soft key menu.
6) If you press **Lp—…→**, the following parameters will be available to choose from:
   - **Lp-D**
   - **Lp-Q**
   - **Lp-G**

- **Lp-Rp**
- **Lp-Rd**
- **←**

7) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
8) If you press **Ls—…→**, the following parameters will be available to choose from:

- **Ls-D**
- **Ls-Q**
- **Ls-Rs**
- **Ls-Rd**
- **←**

9) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
10) If you press **Z—…→**, the following parameters will be available to choose from:

- **Z-d**
- **Z-r**
- **←**

11) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
12) If you press ↓, another set of soft keys will be shown.

- **Y—…→**
- **R—…→**
- **G-B**
- **DCR**
- **←**

13) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
14) If you press **Y—…→**, the following parameters will be available to choose from:

- **Y-d**
- **Y-r**
- **←**

15) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
16) If you press **R—…→**, the following parameters will be available to choose from:

- **R-X**
- **Rp-Q**
- **Rs-Q**
- **←**

17) Press the soft key corresponding to your desired parameter. Then press **←** to return to the previous soft key menu.
18) Press the **G-B** soft key to select the desired parameter.
19) Press the **DCR** soft key to select the desired parameter.

3.1.2 AC Measurement Range

The measurement range is selected based on the impedance value of the LCR component being measured.

The ST2839 has 15 test ranges: 0.1Ω, 1Ω, 10Ω, 20Ω, 50Ω, 100Ω, 200Ω, 500Ω, 1kΩ, 2kΩ, 5kΩ, 10kΩ, 20kΩ, 50kΩ, 100kΩ.

Operation Steps for Configuring Measurement Range:

1) Move the cursor to the RANGE area. The following soft keys will be displayed:
   - **AUTO:** Set the range mode to AUTO.
   - **HOLD:** Switch from AUTO mode to HOLD mode. When the range mode is set to HOLD, the range will be locked in the current measurement range. The current measurement range will be displayed in the RANGE area.
   - **↑ (+):** Increase the range while in HOLD mode.
   - **↓ (–):** Decrease the range while in HOLD mode.
2) Use the soft keys to configure the measurement range.

3.1.3 Measurement Frequency

The measurement frequency of ST2839 ranges from 20 Hz to 10 MHz with a minimum resolution of 0.001 Hz.

The corresponding frequencies of ST2839A ranges from 20 Hz ~ 5 MHz. The last bit of the displayed measurement frequency represents the resolution.

Frequency Range and Measurement Frequency Points:

Frequency Range (f)	Measurement Frequency Points	Resolution
20 Hz < f < 99.999 Hz	20.00 Hz, 20.001 Hz, …, 99.999 Hz	0.001 Hz
100 Hz < f < 999.99 Hz	100.0 Hz, 100.01 Hz, …, 999.99 Hz	0.01 Hz
1 kHz < f < 9.9999 kHz	1.000 kHz, 1.0001 kHz, …, 9.9999 kHz	0.1 Hz
10 kHz < f < 99.999 kHz	10.00 kHz, 10.001 kHz, …, 99.999 kHz	1 Hz
100 kHz < f < 999.99 kHz	100.0 kHz, 100.01 kHz, …, 999.99 kHz	10 Hz
1 MHz < f < 10 MHz	1 MHz, 1 MHz, …, 10 MHz	100 Hz

Operation Steps for Configuring Measurement Frequency:

ST2839 provides two methods for setting the measurement frequency. The first one is to use soft keys, and the other one is to input data by using numeric keys.

1) Move the cursor to the FREQ area. The following soft keys will be displayed:
   - **↑ (++):** This is a rough adjustment soft key used to increase the frequency. If you press this key, the frequency will go up one step in the following sequence: 20 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz and 2 MHz.
   - **↑ (+):** This is a fine adjustment soft key used to increase the frequency. If you press this key, the frequency will go up one step in the following sequences (the maximum frequency of ST2839A is 5 MHz, and the maximum frequency of ST2839 is 10 MHz):

20 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	5.5 MHz
25 Hz	120 Hz	1.2 kHz	12 kHz	120 kHz	1.2 MHz	6 MHz
30 Hz	150 Hz	1.5 kHz	15 kHz	150 kHz	1.5 MHz	6.5 MHz

40Hz	200Hz	2kHz	20kHz	200kHz	2MHz	7MHz
50Hz	250Hz	2.5kHz	25kHz	250kHz	2.5MHz	7.5MHz
60Hz	300Hz	3kHz	30kHz	300kHz	3MHz	8MHz
80Hz	400Hz	4kHz	40kHz	400kHz	3.5MHz	8.5MHz
	500Hz	5kHz	50kHz	500kHz	4MHz	9MHz
	600Hz	6kHz	60kHz	600kHz	4.5MHz	9.5MHz
	800Hz	8kHz	80kHz	800kHz	5MHz	10MHz

- ↓ **(–):** This is a fine adjustment soft key used to decrease the frequency. The selectable frequencies are the same as those described under ↑ **(+)**.
- ↓ **(– –):** This is a rough adjustment soft key used to decrease the frequency. The selectable frequencies are the same as those described under ↑ **(++)**.

2) Use the soft keys or the numeric keys to configure the frequency. When the numeric keys are used to input the desired frequency value, the available frequency units (**Hz**, **kHz** and **MHz**) are displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the frequency, the default unit is Hz.

3.1.4 AC Measurement Level

The measurement level is defined by the RMS 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 ~ 2V (measurement frequency exceeds 1MHz 5mV ~ 1V)

The corresponding current level mode value has a linear relationship with the internal resistance.

Note: If the measurement function is DCR, the item is DC level instead. For the specific DC level measurement parameters, please refer to the description of the <MEAS SETUP> interface.

Voltage Level and Resolution:

Voltage Level	Resolution
$5mV_{rms}$ ~ $100mV_{rms}$	$100\mu V_{rms}$
$100mV_{rms}$ ~ $1V_{rms}$	$1mV_{rms}$
$1V_{rms}$ ~ $2V_{rms}$	$10mV_{rms}$

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 enables 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. Refer to <MEAS SETUP> for more information.

Operation Steps for Configuring Measurement Level:

ST2839 provides two methods for setting the level of the measurement signal source. The first one is to use soft keys, while the second one is to input data with numeric keys.

1) Move the cursor to the LEVEL area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the level of the measurement signal source.
   - ↓ **(–):** Decrease the level of the measurement signal source.
2) Use the soft keys or the numeric keys to configure the measurement level. When the numeric keys are used to input the desired level, the available units (**mV**, **V**, **μA**, **mA** and **A**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the level, the default unit is V or A.

   Note: When you need to switch the level between current and voltage, numeric and unit soft keys must be used.

3.1.5 DC Bias

ST2839 provides an internal DC bias voltage of -40V ~ +40V.

Note: The numerical limits for the DC bias plus the AC measurement level are as follows:

Set Value		Limit Value
DC Bias	**AC Measurement Signal Level**	
V_{dc} (V)	V_{osc} (V_{rms})	$V_{osc} \times \sqrt{2} \times 1.15 + V_{dc} \times 1.002 < 42V$
V_{dc} (V)	I_{osc} (A_{rms})	$I_{osc} \times \sqrt{2} \times 115 + V_{dc} \times 1.002 < 42V$
I_{dc} (A)	V_{osc} (V_{rms})	$V_{osc} \times \sqrt{2} \times 1.15 + I_{dc} \times 100.2 < 42V$
I_{dc} (A)	I_{osc} (A_{rms})	$I_{osc} \times \sqrt{2} \times 115 + I_{dc} \times 100.2 < 42V$

Operation Steps for Configuring the DC Bias:

ST2839 provides two methods for setting the DC bias. The first one is to use soft keys, while the second one is to input data with numeric keys.

1) Move the cursor to the DC BIAS area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the output level of the DC bias.
   - ↓ **(–):** Decrease the output level of the DC bias.
2) Use soft keys or the numeric keys to configure the DC bias source. When the numeric keys are used to input the desired bias level, the available units (**mV**, **V**, **μA**, **mA** and **A**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the bias value, the default unit is V or A.

   Note: When you need to switch the DC bias level between current and voltage, numeric and unit soft keys must be used.
3) Press the [DC BIAS] key on the front panel to enable the DC bias output. While the DC bias function is enabled, the [DC BIAS] key will be lit up.

3.1.6 Measurement Speed

The measurement speed is mainly determined by the following factors:

- Integration Time (A/D conversion)
- Average Number of Measurements (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

The measurement time in the table below is based on the following conditions:

- Measurement Function is not Ls_Rdc, Lp_Rdc
- Range is locked
- DC Bias Voltage Level Monitoring: OFF
- DC Bias Current Level Monitoring: OFF
- Trigger Delay: 0 s
- Step Delay: 0 s
- Automatic Level Control: OFF
- Average Number of Measurements: 1
- Calibration: OFF
- DC Bias: OFF

Generally speaking, when measuring slowly, the measurement result will be more stable and accurate. You can choose between three measurement speeds:

Measurement Speed	Measurement Frequency						
	20 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
FAST	380 ms	100 ms	20 ms	7.7 ms	5.7 ms	5.6 ms	5.6 ms
MED	380 ms	180 ms	110 ms	92 ms	89 ms	88 ms	88 ms
SLOW	480 ms	300 ms	240 ms	230 ms	220 ms	220 ms	220 ms

Operation Steps for Configuring the Measurement Speed:

1) Move the cursor to the SPEED area. The following soft keys will be displayed:
   - **FAST**
   - **MED**
   - **SLOW**
2) Use the soft keys to configure the measurement speed.

3.1.7 DC Source

The DC voltage output from the DC source can be configured between -10 V ~ 10 V. The minimum resolution is 1 mV.

Operation Steps for Configuring the DC Source:

ST2839 provides two methods for setting the DC source. The first one is to use soft keys, while the second one is to input data with numeric keys.

1) Move the cursor to the DC SRC area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the DC source output level in steps of 1 mV.
   - ↑ **(++):** Increase the DC source output level in steps of the resolution in the table below.
   - ↓ **(–):** Decrease the DC source output level in steps of 1 mV.

- **↓ (– –):** Decrease the DC source output level in steps of the resolution in the table below.

0	
± 1mV ~ ± 9mV	1mV
± 10mV ~ ± 99mV	10mV
± 100mV ~ ± 999mV	100mV
± 1V ~ ± 9V	1V
10V	

2) Use the soft keys or the numeric keys to configure the measurement level. When the numeric keys are used to input the desired level, the available units (**mV**, **V**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the level, the default unit is V.

3.1.8 Decimal Point Position

ST2839 displays measurement results as 6 floating-point digits. The decimal point lock function can be used to make the instrument output the measurement result in a fixed way and thus change the number of displayed digits.

Operation Steps to Configure the Decimal Lock Function:

1) Move the cursor to the measurement result display area. The following soft keys will be displayed:
   - **DECIMAL AUTO:** Reset the decimal position of the primary or the secondary parameter measurement result to its default setting.
   - **DECIMAL HOLD:** Lock the decimal location of the primary parameter's measurement result.
   - **DECIMAL POSITION +:** Add one decimal point to the display.
   - **DECIMAL POSITION –:** Remove one decimal point from the display.
   - **FONT:** Choose between displaying the result in LARGE font, TINY font, or select OFF. When turned OFF, the measurement data will not be displayed, and only the measurement status can be seen with the pointer before the primary parameter.
2) Use the soft keys to configure the decimal lock function.

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;
- In a deviation test, the deviation test mode (Δ_{ABS}, $\Delta_{\%}$, OFF) is changed.

3.2 <BIN NO. DISP>

Press [DISP] first, then press the **BIN NO.** soft key to access the <BIN NO. DISP> page. On this page, BIN NO. is displayed in uppercase characters while the measurement result is displayed in lowercase characters.

The following control parameters can be configured here:

- Comparator Function ON/OFF (COMP)

There are two display areas on this page: BIN NO. DISP and COMP. Further detail on these will be given below.

The following measurement settings are displayed in the measurement result/settings area. These settings cannot be configured directly on this page but can be set via <MEAS SETUP>, <MEAS DISP> or <CORRECTION>.

- Measurement Function (FUNC)
- Measurement Frequency (FREQ)
- Measurement Level (AC LEV) / (DC LEV, in DCR function)
- Measurement Range (AC RNG) / (DC RNG, in DCR function)
- Measurement Speed (SPEED)
- DC Bias (DC BIAS)
- DC Source (DC SRC)
- Open, Short and Load Correction ON/OFF Status (CORR)

3.2.1 Comparator Function

ST2839 series instruments come with an inbuilt comparator function which can divide the DUT into up to 10 BINs (from BIN1 to BIN9 and BIN OUT). You can configure 9 pairs of primary parameter limit values and one pair of secondary BIN limits.

The BIN function and PASS/FAIL indication rules when COMP is ON can be seen in the table below.

When ST2839 has a Handler interface installed, the comparison result will be output into the automatic test system and auto-sorted. These limits can only be set on the <LIMIT TABLE SETUP> page.

You can enable or disable the comparator function from the COMP display area.

COMP ON	AUX ON	AUX OFF
Primary Parameter PASS Secondary Parameter PASS	BIN1 ~ BIN9 PASS	BIN1 ~ BIN9 PASS

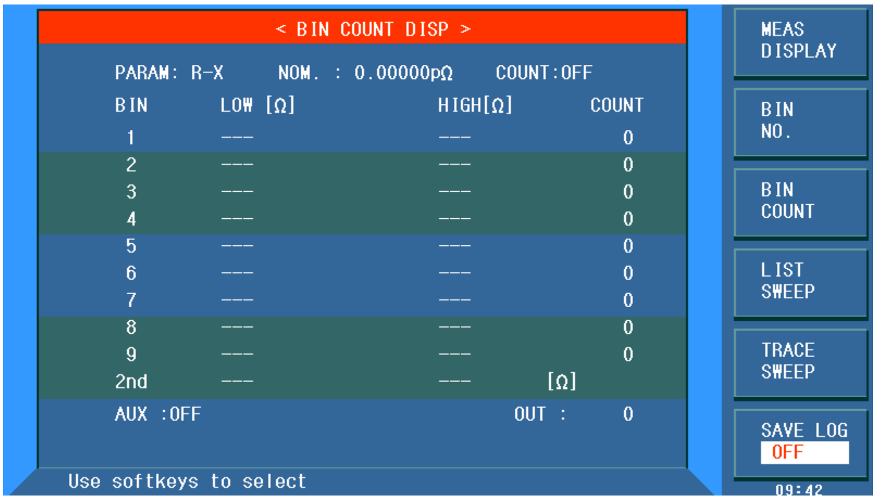
Primary Parameter FAIL Secondary Parameter PASS	BIN AUTO FAIL	BIN1 ~ BIN9 FAIL
Primary Parameter PASS Secondary Parameter FAIL	BIN AUX PASS	BIN OUT FAIL
Primary Parameter FAIL Secondary Parameter FAIL	BIN AUTO PASS	BIN AUTO FAIL

Operation Steps to Configure the Comparator Function:

1) Move the cursor to the COMP area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
2) Use the soft keys to enable or disable the comparator function.

3.3 <BIN COUNT DISP>

Press [DISP] first, then press the **BIN COUNT** soft key to access the <BIN COUNT DISP> page, which shows the count of each BIN.



The following control parameters can be set on the <BIN COUNT DISP> page.

- Count Function ON/OFF (COUNT)

The following measurement results and settings are displayed here. These settings cannot be configured directly on this page but can be set via the <LIMIT TABLE SETUP> page.

- Measurement Parameter (PARAM)
  The parameter area shows the function parameters. If you have selected the "Parameter Swap" comparison mode, the primary and secondary parameters will be displayed swapped. For example, "Cp-D" would then be displayed as "D-Cp". This means the current D is considered the primary parameter in the comparison, while Cp is considered the secondary parameter.
- Nominal Value (NOM)
  The nominal parameter is the nominal value for the BIN comparison.
- BIN Number (BIN)
  This area shows the BIN number of the limit list. 2nd refers to the secondary parameter limit.

- BIN Limit Value (HIGH/LOW)
  This area shows the upper and lower limit values of the limit list.
- BIN Count Value (COUNT)
  This area shows the count value of the current BIN.
- Auxiliary BIN Value (AUX)
  This area shows the count value of the auxiliary BIN.
- OUT BIN Value (OUT)
  This area shows the count value of the OUT BIN.

3.3.1 BIN Count Function

Operation Steps to Configure the BIN Count Function:

1) Move the cursor to the COUNT area. The following soft keys will be displayed:
   - **ON:** Enable the count function.
   - **OFF:** Disable the count function.
   - **RESET:** If you press this soft key, a message saying "Reset Count, Sure?" will be displayed in the Help area. Then the following soft keys will be displayed:
     - **YES:** Reset all BIN counts to 0.
     - **NO:** Cancel the reset operation.
2) Use the soft keys to configure the BIN count function.

3.4 <LIST SWEEP DISP>

Press [DISP] first, then press the **LIST SWEEP** soft key to access the <LIST SWEEP DISP> page.

Up to 201 measurement frequencies, measurement levels or DC bias values can be set here.

You can configure the upper and the lower limit values for each list sweep measurement point. The auto sweep measurement will be executed on these points, and their measurement results will be compared with their configured limits. During the list sweep measurement, "►" marks the current sweep point.

The following control parameters can be set here:

- Sweep Mode (MODE)

- Sequence Number (NO.)

List sweep points cannot be configured directly on this page, but can be set via <LIST SWEEP SETUP>.

3.4.1 Sweep Mode

The list sweep function of ST2839 offers automatic sweep measurements for up to 201 frequency points, measurement levels or DC bias values. Two sweep modes are available: **sequential mode** and **single-step mode**.

- In sequential mode, each press of the [TRIGGER] key will direct the instrument to automatically measure all list sweep points.
- In single-step mode, each press of the [TRIGGER] key will direct the instrument to measure only one list sweep point.

Note: When the trigger mode is set to INT, the sequential and single-step sweep modes will not be controlled by the [TRIGGER] key. When the trigger mode is set to MAN, [TRIGGER] can be used to trigger the list sweep measurement.

Operation Steps to Configure the List Sweep Mode:

1) Move the cursor to the MODE area. The following soft keys will be displayed:
    - **SEQ:** Set the sweep mode to sequential sweep mode.
    - **STEP:** Set the sweep mode to single-step sweep mode.
2) Use the soft keys to configure the list sweep mode.

3.4.2 Sequence Number

Operation Steps to Configure the Sequence Number:

1) Move the cursor to the NO. area. The following soft keys will be displayed:
    - **PAGE:** Enable page number switching. In this mode, the panel knob can switch between pages based on the page number.
2) Use the soft key to configure the sequence number display.

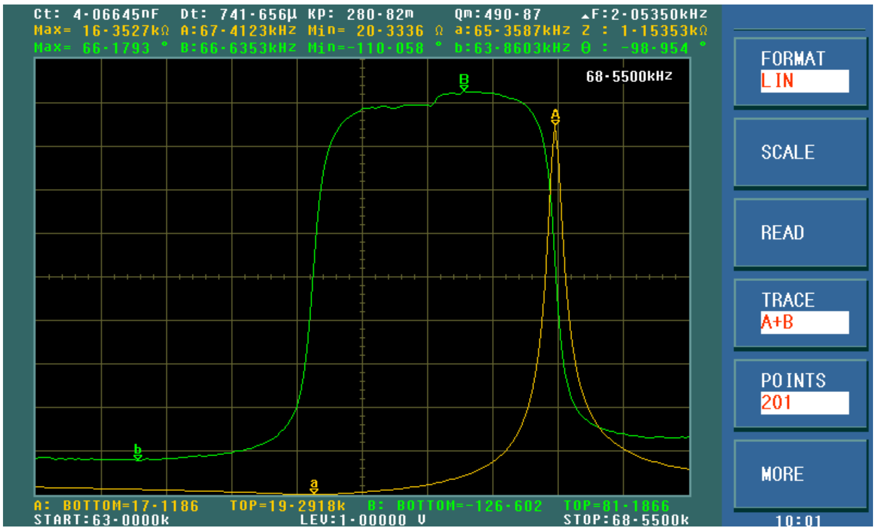
3.4.3 Display Parameters

Frequency, AC Level, DC Bias, Function, Main Parameter Result and Comparison Result are the default display parameters.

- FREQ: The frequency setting of this sweep point.
- AC LEV: The AC level setting of this sweep point.
- DC BIAS: The DC bias setting of this sweep point.
- FUNC: The set function parameters of this sweep point.
- RESULT-A: The sweep results of the primary parameter at this sweep point.
- CMP: The comparison result of the current sweep point against its limit values, displayed as "FAIL" or "PASS".

3.5 <TRACE SWEEP>

Press [DISP] first, then press the **TRACE SWEEP** soft key to access the <TRACE SWEEP> page.



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, within the user preset mode range. The LCD screen will dynamically display how the primary and secondary parameters of the measured components change with the mode and measurement conditions.

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 sweep 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.

3.5.1 Format

This setting is used to change the coordinate mode of the sweep.

- **LIN (Linear):** The vertical coordinate is linearly distributed.
- **LOG (Logarithmic):** The vertical coordinate is distributed in a logarithmic manner with the base 10.

3.5.2 Scale

This setting is used to adjust the display scale of the sweep curve.

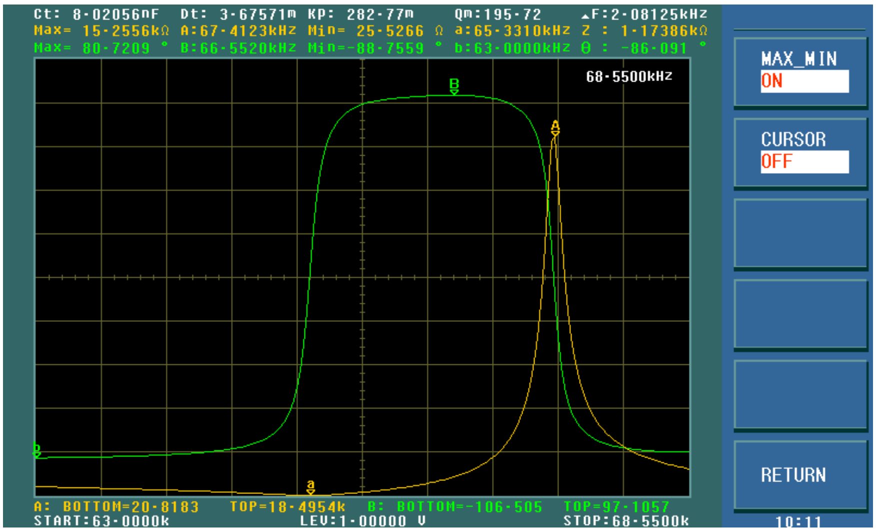
- **AUTO:** The scale will adjust automatically to fit the curve display area at this moment. After this adjustment, it switches back to HOLD mode.
- **HOLD:** The scale is fixed (i.e. will not change on its own), but can still be adjusted manually. To do so, the parameters A_{MIN}, A_{MAX}, B_{MIN} and B_{MAX} can be set on the <TRACE SWEEP SETUP> page.

3.5.3 Read

This setting is used to select whether or not to display the maximum and minimum values and the cursor.

Press this key to enter into the selection interface, where you can select ON/OFF for both MAX_MIN and the cursor. MAX_MIN refers to the limit value of the primary and secondary parameters, and the cursor is displayed as a red line.

You can observe the value of the primary and secondary parameters in the same frequency by turning the rotary knob.



3.5.4 Trace

This setting is used to choose which parameters to display.

- **TRACE A:** Display the primary parameters only.
- **TRACE B:** Display the secondary parameters only.
- **TRACE A+B:** Display the primary and secondary parameters simultaneously.

3.5.5 Points

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**.

3.5.6 Trigger

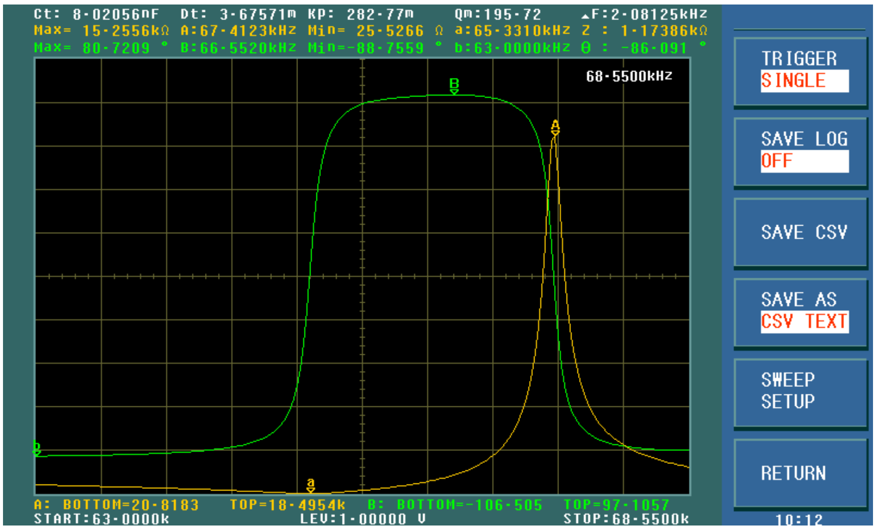
If you press **MORE** on the trace interface, the **TRIGGER** setting option will be displayed.

- **SINGLE:** Single trigger measurement mode.
- **CONTINUE:** Continuous measurement mode.

3.5.7 Save CSV & Save As

If you press **MORE** on the trace interface, the **SAVE CSV & SAVE AS** setting option will be displayed. After making your selection under **SAVE AS**, you can press **SAVE CSV** to save the data.

- **CSV TEXT:** Save the test results to excel form in *.CSV format.
- **CSV DATA:** Save the test results in scientific notation to excel form in *.CSV format.



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 value when C_t: 1kHz.
- Static capacitance value when D_t: 1kHz.
- The minimum impedance Z_{min} and its corresponding frequency f_s (point a on the screen).
- The maximum impedance Z_{max} and its corresponding frequency f_p (point A on the screen).

$$\Delta_F = f_p - f_s$$

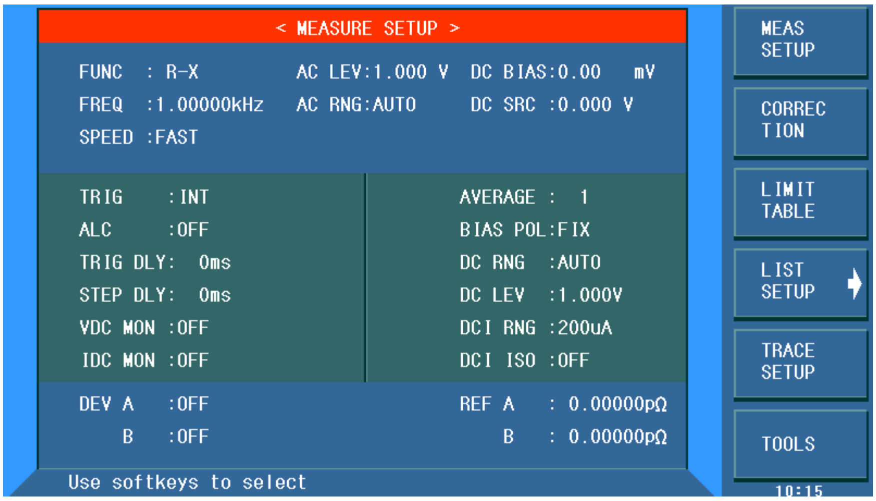
$$k_p \approx \sqrt{\frac{f_p - f_s}{f_s} \times 2.51}$$

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

4 Introduction to [SETUP]

4.1 <MEAS SETUP>

Press [SETUP] to access the <MEAS SETUP> page.



On this page, the following control parameters can be configured:

- Measurement Function (FUNC)
- Measurement Frequency (FREQ)
- Measurement Level (AC LEV)
- Measurement Range (AC RNG)
- Measurement Speed (SPEED)
- DC Bias (DC BIAS)
- DC Voltage Source (DC SRC)
- Trigger Mode (TRIG)
- Auto Level Control (ALC)
- Trigger Delay Time (TRIG DLY)
- Step Delay Time (STEP DLY)
- Average Number of Measurements (AVERAGE)
- Auto Bias Polarity (BIAS POL)
- DC Resistance Range (DC RNG)
- DC Resistance Voltage (DC LEV)
- DC Bias Range (DCI RNG)
- DC Bias Voltage Level Monitoring ON/OFF (VDC MON)
- DC Bias Current Level Monitoring ON/OFF (IDC MON)
- DC Bias Current Isolation ON/OFF (DCI ISO)
- Deviation Test Mode A (DEV A)
- Deviation Test Mode B (DEV B)
- Deviation Test Reference Value A (REF A)
- Deviation Test Reference Value B (REF B)

Some settings listed below are as same as those on the <MEAS DISP> page, so they are not explained again in this section, but others will be introduced briefly in the following sections.

- Measurement Function (FUNC)
- Measurement Frequency (FREQ)
- Measurement Level (AC LEV) / (DC LEV, in DCR function)
- Measurement Range (AC RNG) / (DC RNG, in DCR function)
- Measurement Speed (SPEED)
- DC Bias (DC BIAS)
- DC Voltage Source (DC SRC)

4.1.1 Trigger Mode

There are four trigger modes to choose from: INT (internal), MAN (manual), EXT (external) and BUS.

Operation Steps for Configuring the Trigger Mode:

(Follow these steps to set the trigger mode to anything other than BUS trigger mode. When set to this mode, each trigger command received by the IEEE488 interface will trigger one measurement. If BUS trigger mode is required, you must use the IEEE488 interface to send the TRIGger:SOURce BUS command to set it up.)

1) Move the cursor to the TRIGGER area. The following soft keys will be displayed:
   - **INT:** The instrument will take continuous and repeated measurements.
   - **MAN:** Each press of the [TRIGGER] key on the front panel will trigger one measurement.
   - **EXT:** Each positive impulse of the trigger signal received by the Handler interface will trigger one measurement.
2) Use the soft keys to configure the trigger mode.

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 the optional Handler Interface is used to trigger a measurement, the trigger mode must be set to EXT.

4.1.2 Automatic Level Control (ALC) Function

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. Using this function can ensure that the test voltage or current at both ends of the DUT remains constant.

When using this function, the measurement level can be set within the range below:

Constant Voltage Range: $5mV_{rms}$ ~ $1V_{rms}$

Constant Current Range: $5\mu A_{rms}$ ~ $10mA_{rms}$

Note: If the level setting exceeds the above range while the ALC function is active, the ALC function will be automatically disabled. The currently set level value is generally regarded as a non-constant level value.

Operation Steps for Configuring the ALC Function:

1) Move the cursor to the ALC area. The following soft keys are displayed:
   - **ON:** Enable the ALC function.
   - **OFF:** Disable the ALC function.
2) Use the soft keys to configure the ALC function.

4.1.3 Bias Current Isolation Function

The bias current isolation function can prevent the DC current from affecting the measurement input circuit. The function can be turned on or off via the DCI ISO area.

When the function is enabled, the bias current flowing through DUT can reach 100mA. When it's disabled, the bias current value allowed to flow through the DUT is listed in the table below. If the bias current flowing through the DUT exceeds this value, then the instrument can no longer function normally.

Measurement Range	10Ω	30Ω	100Ω	300Ω	1kΩ	3kΩ	10kΩ	30Ω	100kΩ
Max. Current	2mA	2mA	2mA	2mA	1mA	300μA	100μA	30μA	10μA

Note: After the bias current isolation function is turned on, it will affect the measurement accuracy. Therefore, when measuring under the conditions of a low frequency and bias current, the bias current isolation function should be turned off.

Operation Steps for Configuring the Bias Current Isolation Function:

1) Move the cursor to DCI ISO area. The following soft keys will be displayed:
   - **ON:** Enable the bias current isolation function.
   - **OFF:** Disable the bias current isolation function.
2) Use the soft keys to configure the bias current isolation function.

4.1.4 Averaging Function

The averaging function can calculate the average of two or more measurement results. The number of measurements can be set from 1 ~ 255.

Operation Steps for Configuring the Averaging Function:

1) Move the cursor to the AVERAGE area. The following soft keys are displayed:
   - **↑ (+):** Increase the number of measurements.
   - **↓ (–):** Decrease the number of measurements.
2) Use the soft keys to configure the average value, or use the numeric keys and [ENTER] to input it directly.

4.1.5 DC Bias Level Monitoring Function

The DC bias level monitoring function can monitor the actual voltage or current flowing through the DUT. The monitored voltage value is displayed in the VDC area on the <MEASURE DISP> page while the monitored current value is displayed in the IDC area.

Operation Steps for Configuring the Level Monitoring Function:

1) Move the cursor to the VDC MON area. The following soft keys will be displayed:
   - **ON:** Enable the voltage level monitoring.
   - **OFF:** Disable the voltage level monitoring.
2) Move the cursor to the IDC MON area. The following soft keys will be displayed:
   - **ON:** Enable the current level monitoring.
   - **OFF:** Disable the current level monitoring.
3) Use the soft keys to configure the voltage and current level monitoring function.

4.1.6 Trigger Delay

Trigger delay refers to the delay time from when the instrument is triggered to the start of the measurement. When using the list sweep measurement function, any set delay time will be applied to each individiual measurement point. 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.

Operation Steps for Configuring the Trigger Delay:

1) Move the cursor to the TRIG DLY area.
2) Use the numeric keys to input a delay time. After pressing a numeric key, the following unit soft keys will be displayed, which can replace [ENTER] to conclude the data input.
   - **msec**
   - **sec**

4.1.7 Step Delay

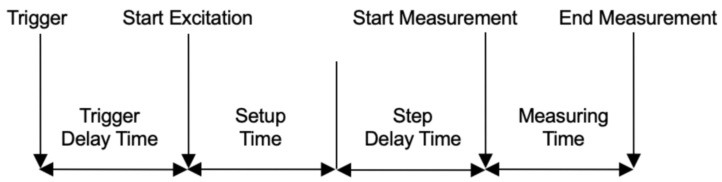
Step delay refers to the delay time from the output of the measurement signal to each measurement.

Operation Steps for Configuring the Step Delay:

1) Move the cursor to the STEP DLY area.
2) Use the numeric keys to input a delay time. After pressing a numeric key, the following unit keys will be displayed, which can replace [ENTER] to conclude the data input.
   - **msec**
   - **sec**

Note: There are *two* step delays in the DCR 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. Likewise, Ls-Rdc and Lp-Rdc measurements have three measurement cycles, so the *total* step delay time is three times the time set here.

Schematic Diagram:



Note: The setup time in the figure refers to the preparation time for the signal source control of the instrument measurement, range switching, etc.

4.1.8 DCI Range

You can set the range of the DCI. Make sure the DCI ISO is on before doing so.

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

Note: When the DC RNG is set to HOLD, the DCI RNG and AC RNG are also automatically set to HOLD. When the DC RNG is set to AUTO, the DCI RNG and AC RNG are also automatically set to AUTO. When the DCI ISO is OFF, DCI RNG cannot be changed.

Operation Steps for Configuring the DC Bias Current Range:

1) Move the cursor to the DCI RNG area. The following soft keys will be displayed:
   - **AUTO:** Set the range mode to AUTO.
   - **HOLD:** Switch from AUTO mode to HOLD mode. When the range mode is set to HOLD, the range will be locked in the current measurement range. The current measurement range will be displayed in the RANGE area.
   - ↑ **(+):** Increase the range while in HOLD mode.
   - ↓ **(–):** Decrease the range while in HOLD mode.
2) Use the soft keys to configure the DCI range.

4.1.9 DC Level

The level setting for DC resistance measurements. The range is between 100 mV ~ 2V.

Level Voltage and Resolution:

Voltage Level	Resolution
100 mV_{rms} ~ 1 V_{rms}	100 μV_{rms}
1 V_{rms} ~ 2 V_{rms}	1 mV_{rms}

Operation Steps for Configuring the DC Resistance Level:

ST2839 provides two methods to set the DC resistance level. The first one is to use soft keys, while the second one is to input data with numeric keys.

1) Move the cursor to the DC LEV area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the DC resistance level.
   - ↓ **(–):** Decrease the DC resistance level.
2) Use the soft keys or the numeric keys to configure the DC resistance level. When the numeric keys are used to input the desired DC level, the available units (**mV**, **V**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the bias value, the default unit is V.

4.1.10 DC Resistance Range

ST2839 series instruments have 13 measurement ranges: 10 Ω, 20 Ω, 50 Ω, 100 Ω, 200 Ω, 500 Ω, 1 kΩ, 2 kΩ, 5 kΩ, 10 kΩ, 20 kΩ, 50 kΩ, and 100 kΩ.

When in DCR measurement or DCR measurement in Ls-Rdc and Lp-Rdc, positive and negative voltages measure two cycles.

Note: When the DC RNG is set to HOLD, the DCI RNG and AC RNG are also automatically set to HOLD. When the DC RNG is set to AUTO, the DCI RNG and AC RNG are also automatically set to AUTO.

Note: If the DCR measurement is initiated while the DC bias is on, the DC bias will be automatically cut off. If the measurement parameters are Lp-Rdc and Ls-Rdc, the DC bias cannot be connected, otherwise an error message will appear.

Operation Steps for Configuring the DC Resistance Range:

1) Move the cursor to the DC RNG area. The following soft keys will be displayed:
    - **AUTO:** Set the range mode to AUTO.
    - **HOLD:** Switch from AUTO mode to HOLD mode. When the range mode is set to HOLD, the range will be locked in the current measurement range. The current measurement range will be displayed in the RANGE area.
    - **↑ (+):** Increase the range while in HOLD mode.
    - **↓ (–):** Decrease the range while in HOLD mode.
2) Use the soft keys to configure the DC resistance range.

4.1.11 Bias Polarity

The automatic bias polarity control function is suitable for measuring varactors. ST2839 can identify the diode's connection state through the internal bias (approx. 1V) and internally controls the polarity of the DC bias to add a reverse bias to the diode. When the AUTO mode is selected, there is a * indicator after the DC bias voltage.

For example, when the varactor diode is connected as shown in Figure 4-1, the ST2839 recognizes that the diode is properly connected and begins to add the specified DC bias.

Conversely, when the varactor is connected as shown in Figure 4-2, the ST2839 recognizes the reverse connection of the diode and adds a DC bias that is opposite to the specified polarity. This feature eliminates the need to check the polarity of the varactor diode before connecting it to the UNKNOWN terminal.

Note: When the DC bias function is turned off and the auto bias control function is set to AUTO, the auto bias polarity control function is disabled.

Variable Capacitance Diode (Normal Polarity):

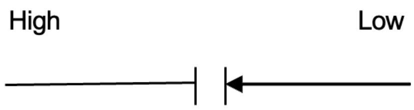


Figure 4-1 Normal Polarity

The bias voltage applied to the varactor is the same as the set bias voltage (high end is +, low end is –).

The result is as follows:

Set Bias Voltage	Applied Bias Voltage
1V	1V
10V	10V

Variable Capacitance Diode (Opposite Polarity):

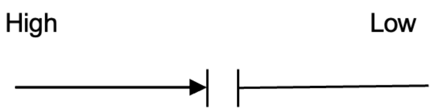


Figure 4-2 Opposite Polarity

The bias voltage applied to the varactor is opposite to the set bias voltage (high end is –, low end is +).

The result is as follows:

Set Bias Voltage	Applied Bias Voltage
1V	-1V
10V	-10V

Operation Steps for Configuring the Auto Bias Polarity Function:

1) Move the cursor to the BIAS POL area. The following soft keys will be displayed:
   - **AUTO:** Set the auto bias polarity mode to AUTO.
   - **FIX:** Set the auto bias polarity mode to FIX.
2) Use the soft keys to configure the auto bias polarity function.

4.1.12 Deviation Measurement Function

The deviation measurement function can directly display the deviation value on the screen (as opposed to the real measurement value). The deviation value is equivalent to the real measurement value subtracting the pre-set reference value. This function offers great convenience in terms of observing variations of component parameters with temperature, frequency, or bias, and can be used for primary parameters, secondary parameters, or both.

The instrument provides two deviation modes:

Δ_{ABS} (Absolute Deviation Mode): The deviation currently displayed is the difference between the measurement value of the DUT and the pre-set reference value. The formula for calculating Δ_{ABS} is as follows:

$$\Delta_{ABS} = X - Y$$

Where…

- X is the measurement value of the DUT.
- Y is the pre-set reference value.

$\Delta_{\%}$ (Percentage Deviation Mode): The deviation currently displayed is the percentage of the difference between the measurement value of the DUT and the pre-set reference value, divided by the reference value. The formula is as follows:

$$\Delta_{\%} = (X - Y) / Y \times 100\ [\%]$$

Where…

- X is the measurement value of the DUT.
- Y is the pre-set reference value.

Operation Steps for Configuring the Deviation Measurement Function

1) Move the cursor to the REF A area to input the reference value of the primary parameter. The following soft key will be displayed:
   - **MEAS:** When the reference component is connected with the test terminal, you should press **MEAS**. Then ST2839 will measure the reference component, and the result will be automatically input as the value of REF A.
2) Use **MEAS** or the numeric keys to input the reference value of the primary parameter.
3) Move the cursor to the REF B area to input the reference value of the secondary parameter. The following soft key will be displayed:

- **MEAS:** When the reference component is connected to the test terminal, you should press **MEAS**. Then ST2839 will measure the reference component, and the result will be automatically input as the value of REF B.

4) Use **MEAS** or the numeric keys to input the reference value of the secondary parameter. If the reference values of both the primary and secondary parameters have already been set in step 2), you can skip this step.

5) Move the cursor to the DEV A area. The following soft keys will be displayed:

- **ΔABS**
- **Δ%**
- **OFF**

6) Use the soft keys to configure the deviation mode of the primary parameter.

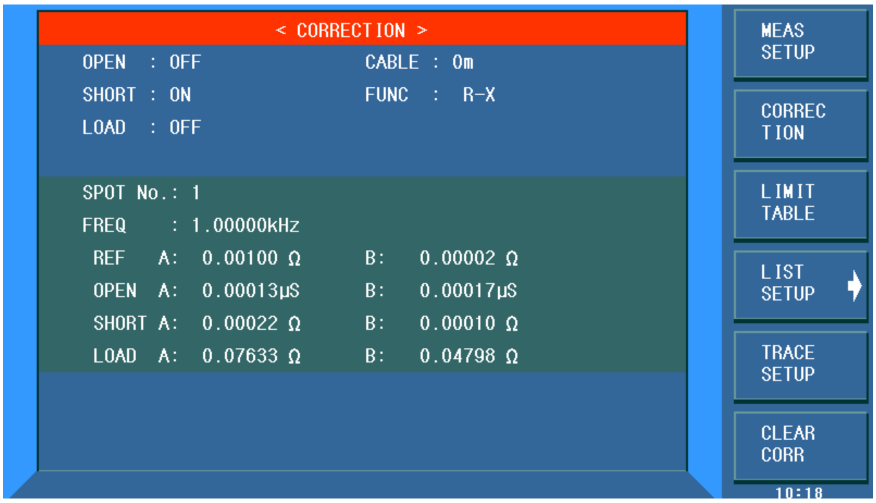
7) Move the cursor to the DEV B area. The following soft keys will be displayed:

- **ΔABS**
- **Δ%**
- **OFF**

8) Use the soft keys to configure the deviation mode of the secondary parameter.

4.2 <CORRECTION>

Press [SETUP] first, then press the **CORRECTION** soft key to access the <CORRECTION> page.



The open-circuit, short-circuit and load correction functions on the <CORRECTION> page can be used to eliminate distribution capacitance, spurious impedance and other measurement errors.

ST2839 series instruments offer two correction modes:

- Executing open-circuit and short-circuit corrections on all frequency points through the interpolation method.
- Executing open-circuit, short-circuit and load correction on a specific frequency point. The instrument offers frequency point correction of 201 points.

The following measurement control parameters can be set on the <CORRECTION> page:

- Open-Circuit Correction (OPEN)
- Short-Circuit Correction (SHORT)
- Load Correction (LOAD)
- Cable Length Selection (CABLE)

- Load Correction Measurement Function (FUNC)
- Frequency Point (SPOT NO.)
- Frequency of the Current Spot (FREQ)
- Reference Values of the Current Spot of Load Correction (REF A, REF B)
- Open-Circuit Value of the Current Spot (OPEN A, OPEN B)
- Short-Circuit Value of the Current Spot (SHORT A, SHORT B)
- Load Value of the Current Spot (LOAD A, LOAD B)

Each control function area will be introduced in the following paragraphs.

Besides the above setting areas, the <CORRECTION> page will also display the following monitoring areas. The monitoring areas are similar to the setting areas, but the monitoring areas can only provide information, so you cannot make changes here. The LOAD software can be selected for measuring in the FREQ setting area.

- Actual Measurement Results for Open-Circuit Correction (OPEN A, OPEN B)
- Actual Measurement Results for Short-Circuit Correction (SHORT A, SHORT B)
- Actual Measurement Results for Load Correction (LOAD A, LOAD B)

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

4.2.1 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.

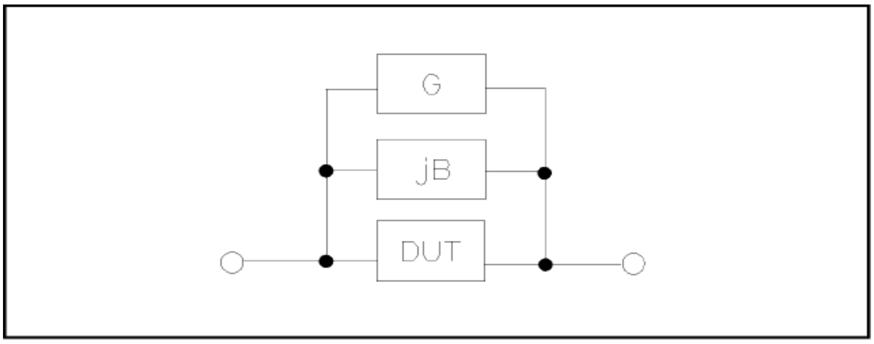


Figure 4-3 Stray Admittance

The following two kinds of open-circuit correction data are used:

1) Regardless of the frequency you currently set, the instrument will perform an open-circuit correction on all 68 fixed frequency points. In addition, based on the short-circuit correction data at these frequency points, the instrument can calculate all open-circuit correction data of different measurement ranges, which corresponds to all measurement frequencies, by using an imbedding algorithm. Move the cursor to the OPEN area, and use the soft key **MEAS OPEN** to execute the full frequency open-circuit correction. The highest measurement frequency of ST2839 is 10MHz (68 points); the highest measurement frequency of ST2839A is 5MHz (58 points).

The fixed frequency points are as follows (using ST2839 as an example):

20Hz	100Hz	1kHz	10kHz	100kHz	1MHz	5.5MHz
25Hz	120Hz	1.2kHz	12kHz	120kHz	1.2MHz	6MHz

30Hz	150Hz	1.5kHz	15kHz	150kHz	1.5MHz	6.5MHz
40Hz	200Hz	2kHz	20kHz	200kHz	2MHz	7MHz
50Hz	250Hz	2.5kHz	25kHz	250kHz	2.5MHz	7.5MHz
60Hz	300Hz	3kHz	30kHz	300kHz	3MHz	8MHz
80Hz	400Hz	4kHz	40kHz	400kHz	3.5MHz	8.5MHz
	500Hz	5kHz	50kHz	500kHz	4MHz	9MHz
	600Hz	6kHz	60kHz	600kHz	4.5MHz	9.5MHz
	800Hz	8kHz	80kHz	800kHz	5MHz	10MHz

2) The correction point can be set at SPOT NO. on the <CORRECTION> page. Move the cursor to FREQ to set the open-circuit correction frequency and then use the **MEAS OPEN** soft key to execute an open-circuit correction on the selected frequency.

Operation Steps for Using the Open-Circuit Correction Function:

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

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

2) Move the cursor to the OPEN area. The following soft keys will be displayed:

- **ON:** Turn on the open-circuit correction function, so that the instrument will perform an open-circuit correction in the subsequent measurement process. If FREQ is turned off, the open-circuit correction data of the current frequency will be calculated via imbedding algorithm. If FREQ is turned 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.
- **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.
- **MEAS OPEN:** The open admittance (capacitance and inductance) at 68 frequency points will be measured. The open-circuit full-frequency correction takes about 30s. During this process, the following soft key will be displayed:
    - **ABORT:** Terminate the current open-circuit correction. The original open-circuit correction data is retained unchanged.
- **DCR OPEN:** The open-circuit resistance measurement under the DC resistance function will be performed.

3) Use the soft keys to configure and execute the open-circuit correction.

4.2.2 Short-Circuit Correction

The short-circuit correction function can eliminate errors caused by spurious inductance (R, X) in serial with DUT, as shown in the figure below.

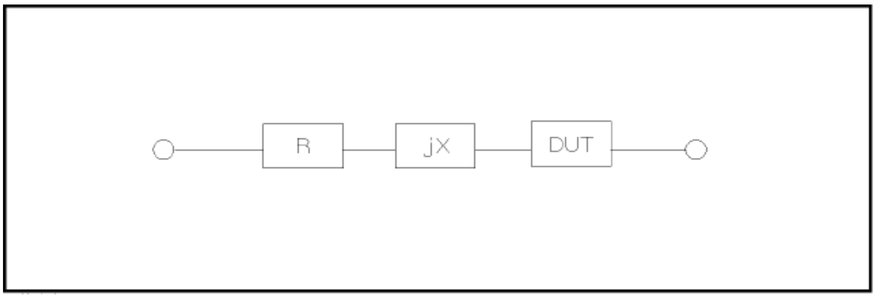


Figure 4-4 Spurious Inductance

The following two kinds of short-circuit correction data are used:

1) Regardless of the frequency you currently set, the instrument will perform a short-circuit correction on all 68 fixed frequency points. In addition, based on the short-circuit correction data at these frequency points, the instrument can calculate all short-circuit correction data of different measurement ranges, which corresponds to all measurement frequencies, by using an imbedding algorithm. Move the cursor to the SHORT area, and use the soft key **MEAS SHORT** to execute the full frequency short-circuit correction. The 68 fixed frequency points are the same as those listed for the open-circuit correction.
2) The correction point can be set at SPOT NO. on the <CORRECTION> page. Move the cursor to FREQ to set the short-circuit correction frequencies and then use the **MEAS SHORT** soft key to execute a short-circuit correction on the selected frequency.

Operation Steps for Using the Short-Circuit Correction Function:

Short-circuit correction includes the full-frequency short-circuit correction, and single frequency short-circuit correction for the set frequency point. Carry out the following steps to perform a full-frequency short-circuit correction. For details about single-frequency short-circuit correction, please refer to the "Load Correction" operating instructions.

1) Connect the test fixture to the test ports. Short-circuit the test fixture using a short plate.
2) Move the cursor to the SHORT area. The following soft keys will be displayed:
   - **ON:** Turn on the short-circuit correction function, so that the instrument will perform a short-circuit correction in the subsequent measurement process. If FREQ is turned off, the short-circuit correction data of the current frequency will be calculated via imbedding algorithm. If FREQ is turned 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.
   - **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.
   - **MEAS SHORT:** The short-circuit spurious impedances (resistance and reactance) at 68 frequency points will be measured. The short-circuit full-frequency correction takes about 30s. During this process, the following soft key will be displayed:
     - **ABORT:** Terminate the current short-circuit correction. The original short-circuit correction data is retained unchanged
   - **DCR SHORT:** The short-circuit resistance measurement under the DC resistance function will be performed.
3) Use the soft keys to configure and execute the short-circuit correction.

4.2.3 Load Correction

The load correction function uses the transfer coefficient between the actual measurement value at the set frequency point and the standard reference value to eliminate other measurement errors. Open-circuit, short-circuit and load correction can be performed at the set frequency point. The frequency can be set at FREQ, and the reference value can be set at the corresponding areas of REF A and REF B. The standard measurement function must be set at the FUNC area before setting the standard reference value. When the cursor moves to FREQ, the screen displays the soft key **MEAS LOAD**. Press this soft key to perform a load correction.

Operation Steps for Performing an Open-Circuit/Short-Circuit/Load Correction at Pre-Set Frequencies:

1) Move the cursor to the FREQ area. The following soft keys will be displayed:
   - **ON:** Make the open-circuit/short-circuit/load correction data available.
   - **OFF:** Make the open-circuit/short-circuit/load correction data unavailable.
   - **MEAS OPEN:** Execute an open-circuit correction at the current frequency.
   - **MEAS SHORT:** Execute a short-circuit correction at the current frequency.
   - **MEAS LOAD:** Execute a load correction at the current frequency.
2) Press the soft key **ON**. The original pre-set open-circuit/short-circuit/load correction frequency is displayed in the frequency setting area.
3) Use the numeric keys to input the correction frequency. After pressing any numeric key, the available unit keys (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the frequency value, the default unit is Hz.
4) Connect the test fixture to the test terminal.
5) Open the test fixture.
6) Press **MEAS OPEN** to perform an open-circuit correction at the currently set frequency. The measurement result (G, B) of the open-circuit correction will be displayed in the HELP area at the bottom of the screen.
7) Move the cursor to OPEN.
8) Press **ON** to perform the open-circuit correction calculation at the pre-set frequency in subsequent measurements.
9) Move the cursor to FREQ to set the required correction frequency.
10) Short-circuit the test fixture.
11) Press **MEAS SHORT** to perform a short-circuit correction at the currently set frequency. The measurement result (R, X) of the short-circuit correction will be displayed in the HELP area at the bottom of the screen.
12) Move the cursor to SHORT.
13) Press **ON** to perform the short-circuit correction calculation at the pre-set frequency in subsequent measurements.
14) Prepare a standard test component.
15) Move the cursor to FUNC.
16) Set the required function parameters.
17) Move the cursor to REF A.
18) Use the numeric keys and unit soft keys to input the primary reference value of the standard component.
19) Move the cursor to REF B.
20) Use the numeric keys and unit soft keys to input the secondary reference value of the standard component.
21) Move the cursor to the corresponding FREQ.

22) Connect the standard component to the test fixture.
23) Press **MEAS LOAD** to perform a load correction. The real measurement results of the standard component will be displayed in LOAD A and LOAD B.
24) Move the cursor to LOAD.
25) Press **ON** to perform the load correction calculation at pre-set frequencies in subsequent measurements.

4.2.4 Load Correction Reference Value

When performing load correction, the reference value of the standard component must be input in advance. The measurement parameters of the reference value should be consistent with the set load correction measurement function. The load correction function uses the transport coefficient between the actual measurement value at the set frequency point and the standard reference value to eliminate other measurement errors. The load correction function is only available for calculating the transport coefficient.

4.2.5 Single-Point Correction

Single-point correction refers to open-circuit/short-circuit/load correction at user-specified frequency points. Correction points can be set by software or keyboard digital input, ranging from 1 ~ 201.

Operation Steps for Configuring the Single-Point Correction:

1) Move the cursor to the SPOT NO. area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the value of the frequency point in increments of 1.
   - ↑ **(++):** Increase the value of the frequency point in increments of 10.
   - ↓ **(–):** Decrease the value of the frequency point in decrements of 1.
   - ↓ **(– –):** Decrease the value of the frequency point in decrements of 10.
2) Move the cursor to the FREQ area. The following soft keys will be displayed:
   - **ON:** Make the open-circuit/short-circuit/load correction data available.
   - **OFF:** Make the open-circuit/short-circuit/load correction data unavailable.
   - **MEAS OPEN:** Execute an open-circuit correction at the current frequency.
   - **MEAS SHORT:** Execute a short-circuit correction at the current frequency.
   - **MEAS LOAD:** Execute a load correction at the current frequency.
3) Use the numeric keys to input the correction frequency. After pressing any numeric key, the available unit keys (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. You can use one of these unit soft keys to input the unit and conclude data input. When using [ENTER] to input the frequency value, the default unit is Hz. In the OFF state, the frequency can also be input, and the frequency of the point can be updated. Upon switching it back ON, the updated frequency value can be refreshed.

4.2.6 Clear Correction Data

Operation Steps for Clearing the Correction Data:

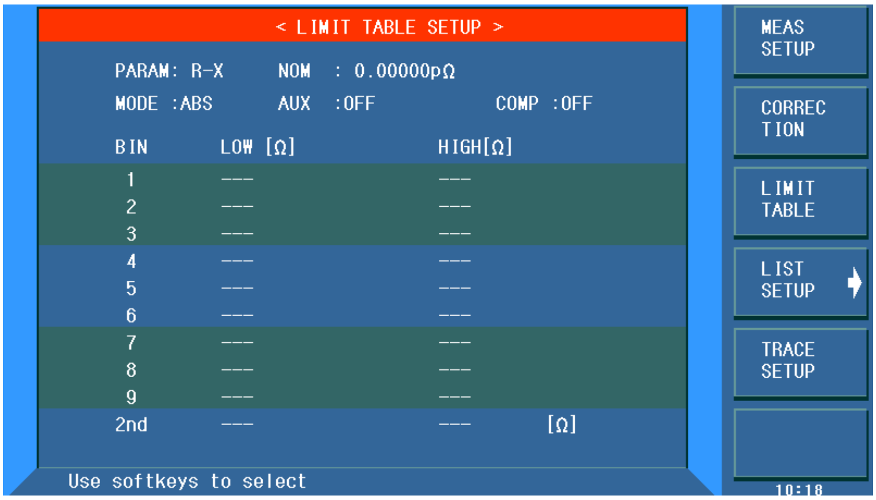
1) Press [SETUP] and then press the **CLEAR CORR** soft key. The following soft keys will be displayed:
   - **YES:** Start clearing all user correction data for 201 points. There are prompts in the information bar.
   - **NO:** Cancel.
2) Use the soft keys to clear the user correction data.

4.2.7 Cable Length Selection

The available cable length is 0m, 1m, 2m and 4m. The instrument comes with 0m and 1m cable calibration data. 2m and 4m cable calibration data requires special customization.

4.3 <LIMIT TABLE SETUP>

Press [SETUP] and then the **LIMIT TABLE** soft key to access the <LIMIT TABLE SETUP> page.



The comparator function of the instrument can be configured on this page. 9 BIN limits of primary parameters and one BIN limit of secondary parameters can be set, and the measured results can be sorted into up to 10 BINs (BIN 1 ~ BIN 9 and BIN OUT).

If the primary parameter of the DUT is within the limit range from BIN 1 ~ BIN 9, but the secondary parameter is outside the limit range, the DUT will be sorted into the AUX BIN. When the Handler interface is installed and used in an automatic sorting system, the comparator function will be especially useful.

The following limit parameters of the comparator function can only be set on the <LIMIT TABLE SETUP> page:

- Measurement Parameter (PARAM)
- Limit Mode of Comparator Function (MODE)
- Nominal Value (NOM)
- Auxiliary BIN ON/OFF (AUX)
- Comparator Function ON/OFF (COMP)
- Lower Limit of Each BIN (LOW)
- Upper Limit of Each BIN (HIGH)

4.3.1 Swap Parameters

This function can swap the primary and the secondary parameters in PARAM. For example, when the measurement parameter is Cp-D, the parameter swap function can change the measurement parameter to D-Cp. This way, 9 pairs of comparison limit values can be set for D, but only one pair for Cp.

Operation Steps for Configuring the Parameter Swap Function:

1) Move the cursor to the PARAM area. The following soft key will be displayed:
   - **SWAP PARAM:** Swap the primary and secondary parameters. Pressing this button again will swap the parameters back and recover the original setup.
2) Use the soft key to swap the parameters.

4.3.2 Limit Modes of the Comparator Function

The comparator function provides two parameter limit setting modes, as shown in the figure below.

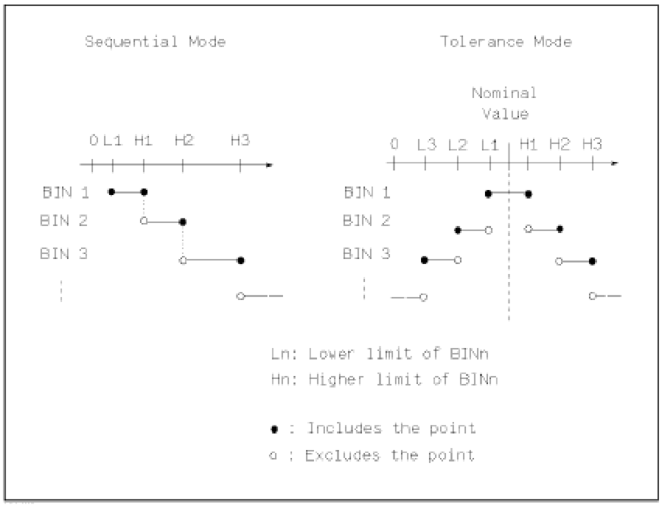


Figure 4-5 Sequential Mode and Tolerance Mode

- **Tolerance Mode:** In tolerance mode, the deviation value from the nominal value (the nominal value is set in the NOM area) is used as the comparison limit value. The deviation value has two modes: one is percentage deviation, and the other is absolute deviation.
- **Sequential Mode:** In sequential mode, the measurement value range is used as the comparison limit value. The comparison limit values must be set in ascending order, from smallest to largest.

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 BIN 1 is the largest, then all the measured parts will be sorted into BIN 1. 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.

Operation Steps for Configuring the Comparator Limit Mode:

1) Move the cursor to the MODE area. The following soft keys will be displayed:
   - **%TOL:** Set the limit mode to tolerance mode (percentage deviation).
   - **ABS TOL:** Set the limit mode to tolerance mode (absolute deviation).
   - **SEQ MODE:** Set the limit mode to sequential mode.
2) Use the soft keys to configure the limit mode.

4.3.3 Set Nominal Value of Tolerance Mode

When tolerance mode is selected as the limit mode of the primary parameter, it is necessary to set the nominal value. The nominal value can be any one within the display range. When sequential mode is selected, setting the nominal value is optional.

Operation Steps for Configuring the Nominal Value:

1) Move the cursor to NOM.
2) Use the numeric keys to input the nominal value. After pressing any numeric key, the available unit keys (**p**, **n**, **μ**, **m**, **k**, **M**) and ***1** will be displayed in the soft key area. You can use one of these soft keys to input the unit and conclude data input. When using [ENTER] to input the nominal value, the default unit is the same as that of the most recent input. When using ***1** to input the nominal value, the instrument will select F, H or Ω as the default unit of the nominal value based on the primary parameter.

4.3.4 Comparator Function ON/OFF

Operation Steps for Configuring the Comparator Function:

1) Move the cursor to the COMP area. The following soft keys will be displayed:
   - **ON:** Enable the comparator function.
   - **OFF:** Disable the comparator function.
2) Use the soft keys to configure the comparator function.

4.3.5 Auxiliary BIN ON/OFF

When the secondary parameters must be sorted, the limits of the secondary parameter can be set in HIGH and LOW of 2nd.

Three situations may occur in the process of secondary parameter sorting:

1) **On the <LIMIT TABLE SETUP> page, no lower/upper limit of the secondary parameter has been set**.
2) **On the <LIMIT TABLE SETUP> page, the lower/upper limit of the secondary parameter has been set, but the AUX function is disabled.**

   In this case, only those components whose secondary parameters are qualified can perform primary parameter sorting according to the sorting limits. If the secondary parameters are unqualified and the corresponding primary parameters are within the limit ranges, those components will be sorted into BIN OUT.
3) **On the <LIMIT TABLE SETUP> page, the lower/upper limit of the secondary parameters has been set and the AUX function is enabled**.

   If the primary parameter is outside the limit range, it is sorted into BIN OUT. If the primary parameter of the DUT is within the limit range but its secondary parameter is outside the limit range, the DUT will be sorted into the AUX BIN.

Note: When the secondary parameter only has a lower limit and the auxiliary BIN is enabled, if the primary parameter of the DUT is within the limit range and the secondary parameter is smaller than or equal to its lower limit value, the DUT will be sorted into the auxiliary BIN. When the secondary parameter only has an upper limit and the auxiliary BIN is enabled, if the primary parameter of the DUT is within the limit range and the secondary parameter is larger than or equal to its upper limit value, the DUT will be sorted into the auxiliary BIN.

Operation Steps for Configuring the Auxiliary BIN Function:

1) Move the cursor to the AUX area. The following soft keys will be displayed:
   - **ON:** Enable the auxiliary BIN.
   - **OFF:** Disable the auxiliary BIN.
2) Use the soft keys to configure the auxiliary BIN function.

4.3.6 Upper/Lower Limits

9 BIN limits of primary parameters and one BIN limit of secondary parameters can be set, and the measurement results can be sorted into up to 10 BINs (BIN 1 ~ BIN 9 and BIN OUT). The upper and lower limit values of the primary parameter can be set via HIGH and LOW of the BINs from BIN 1 to BIN 9. The limits of the secondary parameter can be set in HIGH and LOW of 2nd.

Operation Steps for Configuring the Limit Values:

1) Set PARAM and NOM in the comparator function menu and the limit MODE of the primary parameter.
2) Move the cursor to the LOW limit of BIN 1.

If you've selected tolerance mode, follow steps 3 ~ 6. If you've selected sequential mode, skip to step 7 ~ 11 instead.

3) Use the numeric keys to input the lower limit value. After pressing any numeric key, the available unit keys (**p**, **n**, **μ**, **m**, **k**, **M**) and ***1** will be displayed in the soft key area. You can use one of these soft keys to input the unit and conclude data input. When using [ENTER] to input the limit value, the default unit is the same as that of the most recent input. When using ***1** to input the limit value, the default unit will be F, H or Ω. After the input, the lower limit value of BIN 1 will automatically be set to – (absolute limit) and the upper limit will be + (absolute limit).

4) The cursor will automatically move to LOW of BIN 2. Repeat step 3 until the limits of BIN 9 are input. Then the cursor will automatically move to LOW of 2nd.

5) After inputting the lower limit of the secondary parameter, the cursor will automatically move to HIGH of 2nd.

6) Input the upper limit of the secondary parameter.

If you've selected sequential mode, follow these steps after step 2:

7) Use the numeric keys to input the lower limit value. After pressing any numeric key, the available unit keys (**p**, **n**, **μ**, **m**, **k**, **M**) and ***1** will be displayed in the soft key area. You can use one of these soft keys to input the unit and conclude data input. When using [ENTER] to input the limit value, the default unit is the same as that of the most recent input. When using ***1** to input the limit value, the default unit will be F, H or Ω.

8) After inputting the lower limit of BIN 1, the cursor will automatically move to HIGH of BIN 1. Input the upper limit of BIN 1.

9) The cursor will automatically move to HIGH of BIN 2. (In sequential mode, the lower limit of BIN 2 will be the upper limit of BIN 1.) Input the upper limit of BIN 2.

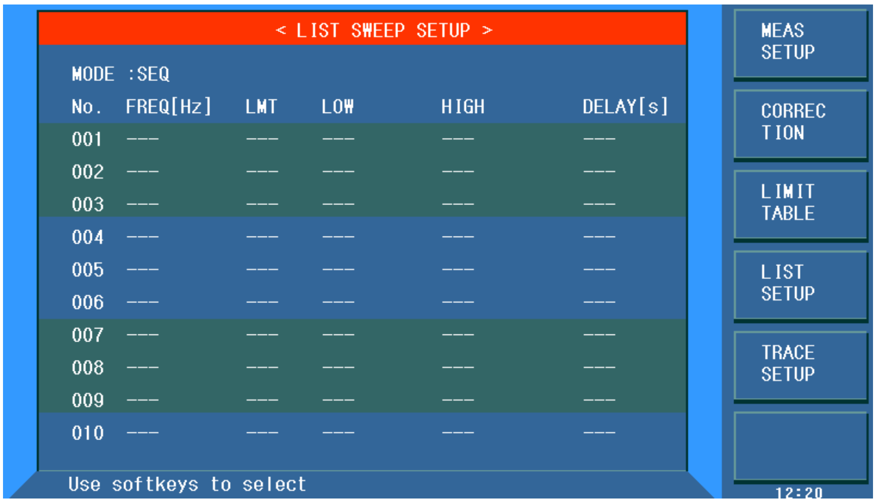
10) Repeat step 9 until the upper limit of BIN 9 is input. Then the cursor will automatically move to LOW of 2nd. Input the lower limit of the secondary parameter.

11) The cursor will automatically move to HIGH of 2nd. Input the upper limit of the secondary parameter.

Note: When the cursor is at HIGH and LOW position and in non-data input status, the software provides the function of clearing rows and clearing the table. Clearing the row clears the upper and lower limit data of the row where the cursor is currently located, and clearing the table clears all the data in the entire limit setting list, including BIN 1 ~ 9 and 2nd data.

4.4 <LIST SWEEP SETUP>

Press [SETUP], then press the **LIST SWEEP** soft key to access the <LIST SWEEP SETUP> page as shown below.



The list sweep function of ST2839 can perform auto sweep scans for the measurement frequency, measurement level or bias voltage of 201 points.

On the <LIST SWEEP SETUP> page, the following list sweep parameters can be set:

- Sweep Mode (MODE)
- Sweep Parameter Setup (Frequency [Hz], Level [V] or [A], Bias [V] or [A])
- Sweep Point Setup (Sweep Point)
- Selection of Limit Parameter (LMT)
- Upper/Lower Limit (HIGH, LOW)
- Single Point Delay (DELAY[s])

4.4.1 Mode

The mode menu is the same as the mode menu described on the <LIST SWEEP DISPLAY> page.

4.4.2 Sweep Parameter

Sweep parameters can be frequency [Hz], level voltage [V], level current [A], bias voltage [V] or bias current [A].

Operation Steps for Configuring the Parameters:

1) Move the cursor to the line following MODE. The following soft keys will be displayed:
    - **FREQ [Hz]**
    - **LEVEL [V]**
    - **LEVEL [A]**
    - **BIAS [V]**
    - **BIAS [A]**
2) Press one of the soft keys to select the list sweep parameter.

4.4.3 Sweep Parameter Setup

Move the cursor to the table to perform the setup of each sweep parameter: FREQ (HZ), LMT, HIGH, LOW and DELAY[s]. Use the numeric keys on the front panel to input the value of the measurement frequency/level/bias and the upper and lower limit used for the comparison, as well as the selected primary/secondary parameter. After setting, if some inputs end up being unnecessary, you can use "Delete Line" in the soft key area to delete the corresponding value.

At the bottom of the LMT area, Parameter A indicates that the primary parameters of the measurement result will be compared to the upper and lower limits of the table. Parameter B indicates that the secondary parameters of the measurement result will be compared to the upper and lower limits of the table. "---" means no comparison is active.

The soft key area has corresponding items. If you press the soft key **LMT A**, "A" will be displayed in the LMT area. If you press the soft key **LMT B**, "B" will be displayed in the LMT area. If you press the soft key **OFF**, the data in the LMT area and the corresponding upper and lower limits will be cleared and be displayed as "---".

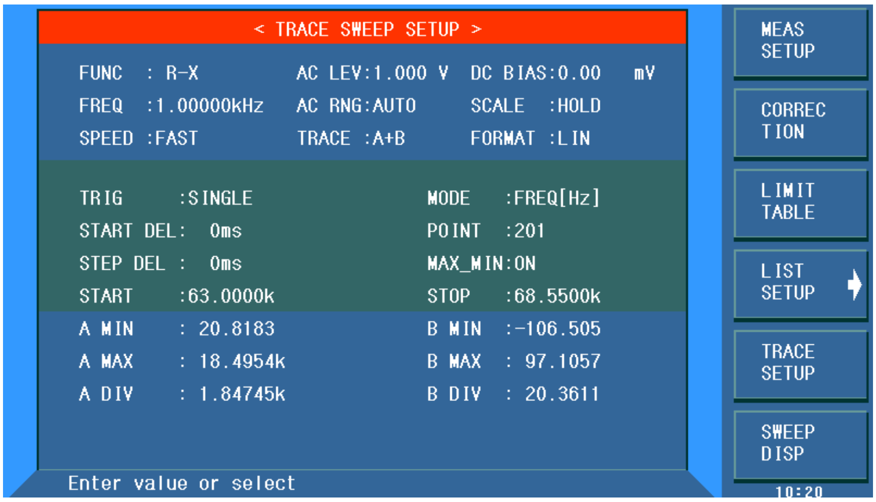
The DELAY parameter indicates the delay time from the last measurement of each sweep step to the next sweep measurement. When an external bias current source (such as ST1778) is connected, the delay time of the external bias current source can be used.

Note: The delay time will be accumulated with the delay time in the measurement display.

The 201 points correspond to 21 pages. Move the cursor to NO. or the Sweep Point area, press the soft key **PAGE** to highlight the arrow and use the rotary knob to switch the page. In the NO. area, press **CLEAR TABLE** to clear the data of all 201 points. In the Sweep Point area, press **FILL LINEAR** or **FILL LOG** to input the sweep point data automatically.

4.5 <TRACE SWEEP SETUP>

Press [SETUP], then press the **TRACE SETUP** soft key to access the <TRACE SWEEP SETUP> page.



The display function page is used for the setup of trace sweep measurement parameters, including FUNC, MODE, START, STOP and coordination range of primary and secondary parameters.

4.5.1 Function

The FUNC area is used to set the sweep function. As shown in the above figure, R (Resistance) is the primary sweep parameter and X (Reactance) is the secondary sweep parameter. For details, please see Chapter 3.1.1.

4.5.2 Level

The LEVEL area is used to set the sweep level. When MODE is not already set to LEVEL[V] or LEVEL[A], this setting will be used when in trace sweep measurement. For details, please see Chapter 3.1.4.

4.5.3 DC Bias

The DC BIAS area is used to set the sweep DC bias. When MODE is not already set to BIAS[V] or BIAS[A], this setting will be used when in trace sweep measurement. For details, please see Chapter 3.1.5.

4.5.4 Trace

The TRACE area is used to set the sweep display trace. As shown in the above figure, Trace A is R (resistance) and Trace B is X (reactance).

4.5.5 Range

The RANGE area is used to set the sweep measurement range. For details, please see Chapter 3.1.2.

4.5.6 Scale

The SCALE area is used to set the display scale of the sweep curve. For details, please see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**.

4.5.7 Frequency

The FREQ area is used to set the sweep frequency. When MODE is not already set to FREQ [Hz], this setting will be used when in trace sweep measurement. For details, please see Chapter 3.1.3.

4.5.8 Speed

The SPEED area is used to set the sweep speed. For details, please see Chapter 3.1.6.

4.5.9 Format

The FORMAT area is used to set the sweep format mode, LIN or LOG. For details, please see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**.

4.5.10 Trigger

The TRIG area is used to set the sweep trigger mode. SINGLE refers to single-trigger mode, while CONTINUE refers to continuous trigger mode.

4.5.11 Mode

The MODE area is used to set the sweep mode, including FREQ[Hz], LEVEL[V], LEVEL[A], BIAS[V] and BIAS[A].

4.5.12 Start Delay

The START DEL area is used to set the measurement delay when the bias source is ST1778, and the sweep mode is BIAS[A]. When the sweep starts or the slave machine of the bias source starts to superimpose the current, the measurement delay is enabled.

4.5.13 Point

The POINT area is used to set the number of sweep points, including 51, 101, 201, 401 and 801.

4.5.14 Step Delay

The STEP DEL area is used to set the delay time added in each sweep point.

4.5.15 Maximum and Minimum

The MAX MIN area is used to set whether or not to display the maximum and minimum value of the primary and secondary parameters.

4.5.16 Start

The START area is used to set the start conditions of the trace sweep.

Select the number you need among the numeric keys ([0 ~ 9], [+/–] and [.]) and press the [ENTER] key or select a corresponding unit soft key.

Note: When the cursor moves to START, STOP, A MIN, A MAX, B MIN, B MAX, **TRACE SWEEP** will be displayed in the soft key area. Press the corresponding soft key to access the <TRACE SWEEP DISP> page.

4.5.17 End

The END area is used to set the end condition of the trace sweep.

Select the number you need among the numeric keys ([0 ~ 9], [+/–] and [.]) and press the [ENTER] key or select a correspon-ding unit soft key.

Note: The END condition should be greater than the START condition, otherwise an error message will be displayed on the screen. Also, it should be less than the upper frequency limit (5MHz for ST2839A, 10MHz for ST2839).

4.5.18 Coordination Range Settiing

The coordination range includes A MIN, A MAX, B MIN, B MAX, which is the coordinate range of the primary and secondary parameters. This is used to formulate the frequency response curve drawing range.

Move the cursor to the corresponding area, select the number you need among the numeric keys ([0 ~ 9], [+/–] and [.]) and press the [ENTER] key or select a corresponding unit soft key.

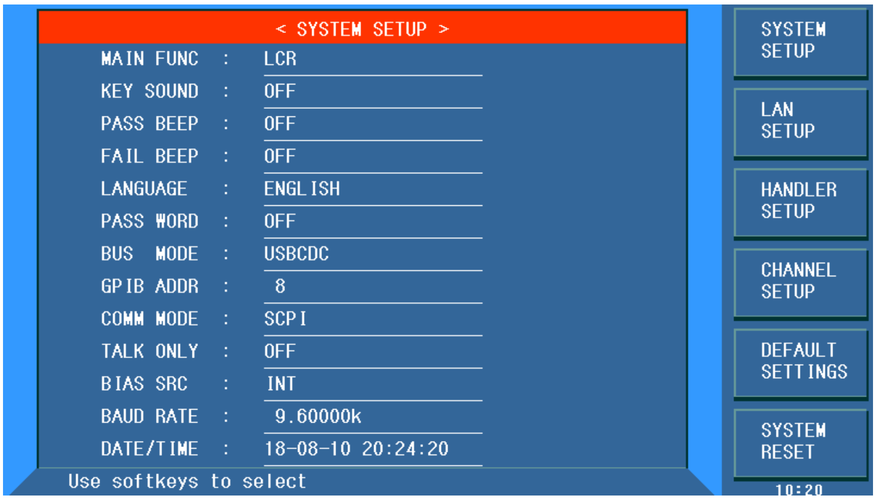
The instrument default is automatic coordinate. If you choose to lock the coordinate, manual setting is needed. As above, the MAX value should be greater than the MIN value, otherwise an error message will be displayed on the screen.

A DIV and B DIV indicate the range of each cell in the vertical coordinate. Adjusting the value can change the maximum and minimum value of the vertical coordinate. At the same time, the distribution situation of the trace in coordinate system will also be changed. This parameter can help observe and analyze the trend of the trace sweep.

5 Introduction to [SYSTEM] and [FILE]

5.1 <SYSTEM SETUP>

Press [SYSTEM], then press the **SYSTEM SETUP** soft key to access the <SYSTEM SETUP> page as shown below



On this page, most system setup items are displayed, such as:

- Instrument Main Functions (MAIN FUNC)
- Keypress Sound (KEY SOUND)
- PASS Signal (PASS BEEP)
- FAIL Signal (FAIL BEEP)
- Display Language (LANGUAGE)
- Password (PASS WORD)
- Bus Mode (BUS MODE)
- GPIB Address (GPIB ADDR)
- Communication Mode (COMM MODE)
- Talk-Only Function (TALK ONLY)
- Bias Source (BIAS SRC)
- Baud Rate (BAUD RATE)
- Date and Time Setting (DATE/TIME)

Note: After a parameter on this page is changed, it is automatically saved. After the next power-on, the last data set from before the last shutdown will be used.

5.1.1 Main Function

The MAIN FUNC area is used to control and display available instrument functions. Only LCR function is displayed.

5.1.2 Key Sound

The KEY SOUND area is used to control the key sound.

Operation Steps for Configuring the Key Sound:

1) Move the cursor to the KEY SOUND area. The following soft keys will be displayed:
   - **ON:** Enable to key sound.
   - **OFF:** Disable the key sound.
2) Use the soft keys to configure the key sound.

5.1.3 PASS Beep

The PASS BEEP area is used to control and display the beep mode when the test result is qualified.

Operation Steps for Configuring the PASS Beep:

1) Move the cursor to the PASS BEEP area. The following soft keys will be displayed:
   - **HIGH LONG:** Select a high and long beep sound.
   - **HIGH SHORT:** Select a high and short beep sound.
   - **LOW LONG:** Select a low and long beep sound.
   - **TWO SHORT:** Select two low and short beep sounds.
   - **OFF:** Disable the PASS beep function.
2) Use the soft keys to configure the PASS beep.

5.1.4 FAIL Beep

The FAIL BEEP area is used to control and display the beep mode when the test result is unqualified.

Operation Steps for Configuring the FAIL Beep:

1) Move the cursor to the FAIL BEEP area. The following soft keys will be displayed:
   - **HIGH LONG:** Select a high and long beep sound.
   - **HIGH SHORT:** Select a high and short beep sound.
   - **LOW LONG:** Select a low and long beep sound.
   - **TWO SHORT:** Select two low and short beep sounds.
   - **OFF:** Disable the FAIL beep function.
2) Use the soft keys to configure the FAIL beep.

5.1.5 Language

The LANGUAGE area is used to control and display the current language setting of the instrument.

Operation Steps for Configuring the Language Setting:

1) Move the cursor to the LANGUAGE area. The following soft keys will be displayed:
   - **ENGLISH**
   - **CHINESE**
2) Use the soft keys to configure the system language.

5.1.6 Password

The PASSWORD area is used to configure and display the password protection mode.

Operation Steps for Configuring the System Password:

1) Move the cursor to the PASSWORD area. The following soft keys will be displayed:
   - **OFF:** Disable the password protection.
   - **LOCK SYSTEM:** Enable the password protection function including file protection and start-up password.
   - **LOCK FILE:** Enable the password protection function to protect user files.
   - **MODIFY:** Change the password. Press **MODIFY** to input a new password. After inputting, a prompt will appear on the screen to confirm the new password. Input the new password again to confirm.
   - **LOCK SETUP:** Restrict modification of the setup files.
2) Use the soft keys to configure the system password.

Note: The default password is 2839.

5.1.7 Bus Mode

The BUS MODE area is used to select RS232C, GPIB, LAN, USBTMC or USBCDC for the bus mode.

Operation Steps for Configuring the Bus Mode:

1) Move the cursor to the BUS MODE area. The following soft keys will be displayed:
   - **RS232C**
   - **GPIB**
   - **LAN**
   - **USBTMC**
   - **USBCDC**
2) Use the soft keys to configure the required interface mode.

Note: GPIB must be installed before GPIB mode is available for this setting.

5.1.8 GPIB Address

The GPIB ADDR area is used to control and display the current GPIB address.

Operation Steps for Configuring the GPIB Address:

1) Move the cursor to the GPIB ADDR area. The following soft keys will be displayed:
   - **↑ (+):** Increase the GPIB address.
   - **↓ (–):** Decrease the GPIB address.
2) Use the soft keys to configure the GPIB address.

5.1.9 Talk-Only Function

The talk-only function is used to control the instrument to send each measurement result to the bus through its RS232C, GPIB, LAN, USBTMC or USBCDC interface. When the talk-only function is enabled, the instrument cannot be controlled by PC.

Operation Steps for Configuring the Talk Only Function:

1) Move the cursor to the TALK ONLY area. The following soft keys will be displayed:
   - **ON:** Enable the talk-only function.
   - **OFF:** Disable the talk-only function.
2) Use the soft keys to configure the talk-only function.

5.1.10 Bias Source

The BIAS SRC area is used to select the DC bias power.

Operation Steps for Configuring the DC Bias Source:

1) Move the cursor to the BIAS SRC area. The following soft keys will be displayed:
   - **INT Mode:** The standard DC bias voltage source ranges from -40V ~ 40V and the DC bias current source ranges from -100mA ~ 100mA.
   - **ST1778 Mode:** When the instrument adopts the external bias source to perform online measuremennts, this mode should be selected.
2) Use the soft keys to configure the DC bias source.

Note: For the ST1778 mode to be suppoted, ST1778 must be connected.

5.1.11 Baud Rate

The BAUD RATE area is used to select the baud rate of the RS232C interface. The available baud rate range of this instrument is 9.600k ~ 115.200k.

Operation Steps for Configuring the Baud Rate:

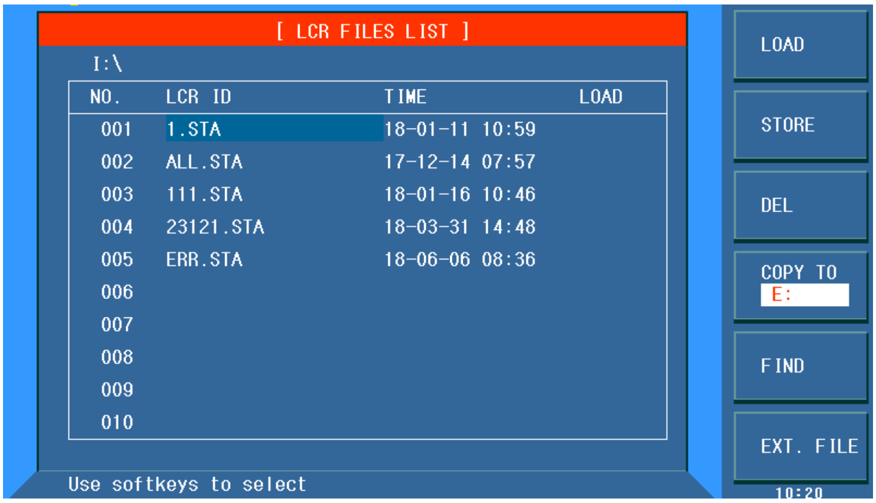
1) Move the cursor to the BAUD RATE area. The following soft keys will be displayed:
   - ↑ **(+):** Increase the baud rate.
   - ↓ **(–):** Decrease the baud rate.
2) Use the soft keys to configure the baud rate.

5.1.12 Date/Time

When changing the date/time setting, the user must input the password first.

5.2 <LCR FILES LIST>

ST2839 series instrument can save files of user-set parameters to the nonvolatile memory, so that in order to re-use the same settings in the future, you can load the corresponding file. This can save time on setting parameters and improve production efficiency. Press [FILE] to accesss the <LCR FILES LIST> page as shown below.



5.2.1 Setup File for Single-Group Component (*.STA)

Up to 40 setting files for different single groups of components (*.STA files) can be saved in the instrument, and more than 500 can be saved on an external USB drive (**Note:** The USB drive is an optional accessory).

Using the FILE MANAGE function on the file menus described here will allow you to save or load the following data:

- **Settings and Parameters on the <MEAS SETUP> Page**
    - Measurement Function
    - Measurement Frequency
    - AC Level
    - AC Range
    - Measurement Speed
    - DC Bias
    - Bias Source
    - Trigger Mode
    - ALC Function Settings
    - Trigger Delay Time
    - Step Delay Time
    - Averaging Function Settings
    - Bias Polarity Settings
    - DC Range
    - DC Level
    - DCI Isolation
    - VDC Monitoring
    - IDC Monitoring
    - Deviation Test Mode A

  - Deviation Test Mode B
  - Reference Value A
  - Reference Value B
- **Settings and Parameters on the <BIN COUNT DISP> Page**
  - BIN Count Settings
- **Settings and Parameters on the <LIMIT TABLE SETUP> Page**
  - Swap Parameters
  - Nominal Value
  - Comparison Mode (%$_{TOL}$/ABS$_{TOL}$/SEQ MODE)
  - Auxiliary BIN Setings
  - Comparator Function Settings
  - Upper and Lower Limit Values for Each BIN
- **Settings and Parameters on the <LIST SWEEP SETUP> Page**
  - Sweep Mode (SEQ/STEP)
  - List Sweep Parameters (Frequency/Level/Bias, etc.)
  - Measurement Points for All Sweep Parameters
  - Upper and Lower Limits of Primary and Secondary Parameters for All Measurement Points, incl. Limit Parameters
- **Current Display Page Format**

5.2.2 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 overcoming the limitation of the internal storage size of the instrument. You can also copy these files to an IBM PC or compatible desktop computer or laptop with a USB interface.

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

- Compliant with USB 1.0/1.1 standard
- Capacity: 32 MB / 256 MB / 2 GB / 4 GB
- File Format: FAT16 or FAT32 (formatted with Microsoft Windows operating system)

5.2.3 Operation Steps for File Management

5.2.3.1 Search for an Existing File

1) Turn the knob to view the files one by one.
2) Use the [←] and [→] keys to move from page to page.
3) Press the soft key **FIND**. Input the file name and then press [ENTER] to search the target file.
4) Input the number and press [ENTER] to jump directly to the page.

5.2.3.2 Save a File

1) Configure all your settings and parameters on the relevant pages.
2) Move the cursor to the <u>FILE MANAGE</u> area. The following soft keys will be displayed:
   - **LOAD**

- **SAVE**
- **DEL**
- **COPY TO E:**
- **FIND**
- **EXT**

3) Press **SAVE**. The following soft keys will be displayed:
   - **YES:** You will be prompted to input the file name.
   - **NO:** Cancel the save file operation and return to step 2.
4) Press **YES**. Use the numeric keys to name your file, then press [ENTER]. The instrument will now save your current settings and parameters to this file.

5.2.3.3 Load a File

1) Press [FILE MANAGE]. The file list as well as the same soft keys listed above are displayed.
2) In the file list, move the cursor to the position of the save file you wish to load, or input the file number directly.
3) Press **LOAD**. The following soft keys will be displayed:
   - **YES:** Load the currently selected file.
   - **NO:** Cancel the load file operation.
4) Press **YES**. The instrument will load the settings and parameters and return to the previous display page.

5.2.3.4 Copy a File to the USB Drive

1) Press [FILE MANAGE]. The file list as well as the same soft keys listed above are displayed.
2) In the file list, move the cursor to the position of the save file you wish to copy and press [ENTER] to confirm.
3) Press **COPY TO E:** to copy the file. While copying the files, the progress bar will indicate the process, and when it is complete, the progress bar will disappear.

Note: Please make sure that your USB flash drive meets the standards described in this section and has no read/write protection enabled.

6 Execute LCR Measurement and Some Examples

6.1 Corrections

You can select one of two correction modes (full-frequency correction or point-frequency correction) to execute an open-circuit or short-circuit correction; this will help prevent the stray impedance from affecting measurement accuracy.

6.1.1 Full-Frequency Correction

1) Press the menu key [SETUP], then the soft key **CORRECTION**. The instrument will display the <CORRECTION> page.
2) Move the cursor to the OPEN area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS OPEN**
3) Keep the test fixture open. Press **MEAS OPEN** to execute an open-circuit correction, and wait until the prompt information area displays that open-circuit correction is complete.
4) Press **ON** to turn on the open-circuit correction function.
5) Insert the short plate (ST26010) into the test fixture.
6) Move the cursor to the SHORT area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS SHORT**
7) Press **MEAS SHORT** to execute a short-circuit correction, and wait until the prompt information area displays that the short-circuit correction is complete.
8) Press **ON** to turn on the short-circuit correction function.
9) Move the cursor to the LOAD area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
10) Press **OFF** to turn off the load correction function.
11) Move the cursor to the FREQ area. The following soft keys will be displayed:
    - **ON**
    - **OFF**
    - **MEAS OPEN**
    - **MEAS SHORT**
    - **MEAS LOAD**
12) Press **OFF** to turn off the point-frequency correction function of FREQ.

6.1.2 Point-Frequency Correction

This option yields better results in single-frequency measurements.

Assume that the user is now using a test frequency of 5.5kHz…

1) Press the menu key [SETUP], then the soft key **CORRECTION**. The instrument will display the <CORRECTION> page.

2) Move the cursor to the OPEN area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS OPEN**
3) Press **ON** to turn on the open-circuit correction function.
4) Move the cursor to the SHORT area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS SHORT**
5) Press **ON** to turn on the short-circuit correction function.
6) Move the cursor to the LOAD area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS LOAD**
7) Press **OFF** to turn off the load correction function.
8) Move the cursor to the SPOT NO. area to select the calibration point.
9) Move the cursor to the FREQ area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS OPEN**
   - **MEAS SHORT**
   - **MEAS LOAD**
10) Press **ON** to turn on the point-frequency correction function of FREQ.
11) Press [5] [.] [5]. "+5.5" will be displayed in the prompt information area at the bottom of the screen, and the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. If you press **kHz**, the FREQ area will change to 5.5000kHz (the same as the measurement frequency).
12) Keep the test fixture open and press **MEAS OPEN** to execute an open-circuit correction.
13) Insert the short plate (ST26010) into the test fixture and press **MEAS SHORT** to execute a short-circuit correction.

6.2 Correct Connection of the DUT

ST2839 series instruments use four pairs of test terminals: Hcur, Hpot, Lcur, Lpot and the corresponding shielding terminal of each 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 the 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 measurement should be the actual voltage on the 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 measurement error!

If the connection point and the lead resistance R_{lead} are far weaker than the tested impedance (e.g.: $R_{lead} < Z_x / 1000$; 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 measurement).

In a measurement with a high accuracy requirement, using a Kelvin test fixture (standard accessory) will yield 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 if the test fixture or Kelvin test leads provided with the instrument or a 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.
- The contacts must be short-circuit and open-circuit capable. Open-circuit and short-circuit corrections can easily reduce the influence of distribution impedance of the test fixture on the measurement. For open-circuit correction, the gap between test terminals should be the same as that when they connect with the DUT. For short-circuit correction, a low-impedance short plate should be connected between the 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 labeled "+", "Hc" or "Hp" on the front panel, and the low terminal should be connected to the terminal labeled "–", "Lc" or "Lp" on the front panel.

Warning!	
	When measuring polarity components, please discharge them first to avoid damaging the instrument!

6.3 Eliminate the Influence of Stray Capacitance

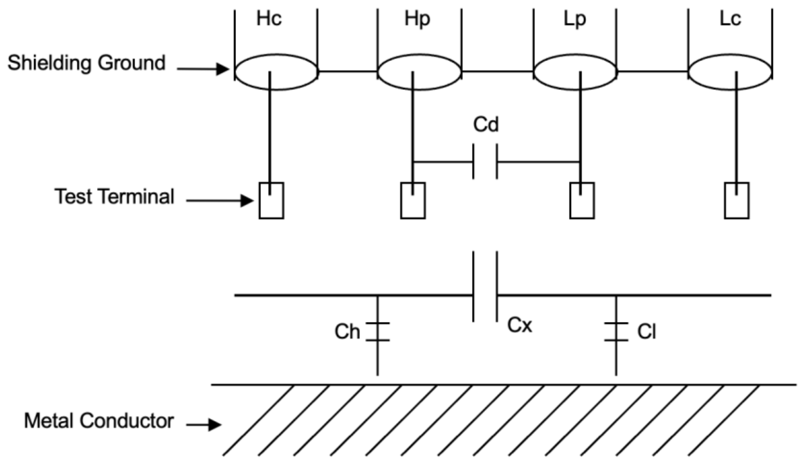


Figure 6-1 Influence of Stray Capacitance (Problem)

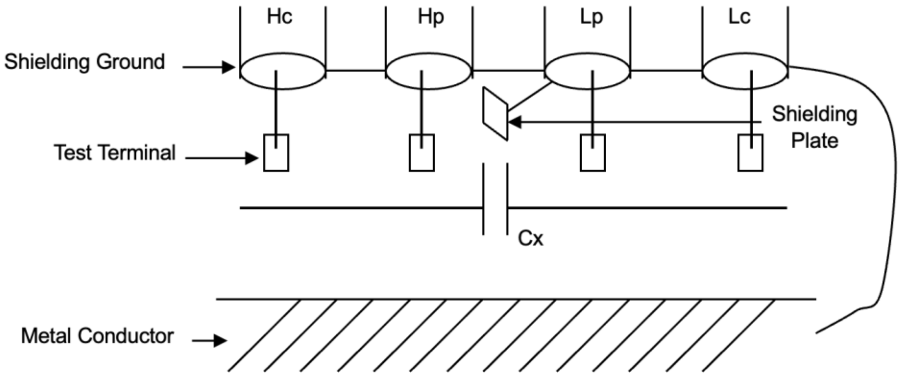


Figure 6-2 Influence of Stray Capacitance (Solution)

When the DUT has high impedance (such as small capacitance), the influence of stray capacitance cannot be ignored.

Figure 6-1 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 the 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 a minimum. Meanwhile if the ground terminal is connected to the conductance plate, the influence of Ch and Cl will be eliminated.

When the DUT has 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 measurement errors**, except for the influence of the contact resistance on the 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 flowing though Hc and Lc are equal in value and opposite in direction compared to those flowing through each of the shielding terminals (the current reflows from Hc to the 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.

6.4 Example: Testing Inductance

6.4.1 Measurement Settings

Function: Ls–Q

Frequency: 5.5kHz

Level: 1.5V_{rms}

Internal Impedance: 100Ω

6.4.2 Operation Steps

1) Turn on the instrument.
2) Configure the basic measurement parameters:
   a) Press [DISP] to access the <MEAS DISP> page.
   b) Use the knob to move the cursor to the FUNC area, which currently displays Cp–D. The following soft keys will be displayed:
      - **Cp–…→**
      - **Cs–…→**

- **Lp–…→**
- **Ls–…→**
- **Z–…→**
- ↓

c) Press the soft key **Ls–…→**. The following soft keys will be displayed:

- **Ls–D**
- **Ls–Q**
- **Ls–Rs**

d) Press **Ls–Q** to select the Ls–Q function.

e) Move the cursor to the FREQ area, which currently displays 1.0000 kHz.

f) Press [5] [.] [5]. "+5.5" will be displayed in the prompt information area at the bottom of the screen, and the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. Press **kHz**. The frequency now changes to 5.5000 kHz.

g) Move the cursor to the LEVEL area, which currently displays 1.000 V.

h) Press [1] [.] [5]. "+1.5" will be displayed in the prompt information area at the bottom of the screen, and the available units (**mV**, **V**, **μA**, **mA** and **A**) will be displayed in the soft key area. Press [ENTER]. The level now changes to 1.5 V.

3) Press [SETUP] to access the <MEAS SETUP> page.

4) Connect the test fixture (ST26005) to the test terminals of the ST2839.

5) Perform a correction (to avoid the influence of stray impedance on measurement accuracy, an open-circuit/short-circuit correction is needed). For details, please see Chapter 6.1 Corrections.

6) Mount the inductor under test to the test fixture and start the measurement.

7) Press [DISP] to return to the <MEAS DISP> page. The instrument will continuously measure and display the measurement result in the center of the page in uppercase characters.

8) If the measurement result appears obviously incorrect, please check the following items:

a) Ensure that the inductor under test is in good connection with the test fixture.

b) Ensure that the test fixture is in good connection with the test terminals of the instrument.

c) Re-do the open-circuit/short-circuit correction.

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

6.5 Example: Testing Capacitance by Multi-Frequency List Sweep

6.5.1 Measurement Settings

Function: Cp–D

Level: 1 V_{rms}

Other Parameters:

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

Sound: High Long

Alarm Mode: OUT

6.5.2 Operation Steps

1) Turn on the instrument.
2) Configure basic parameters:
   a) Press [DISP] to access the <MEAS DISP> page. The FUNC area currently displays Cp–D, and the LEVEL area displays 1.000V.
   b) Press [SETUP] to access the <MEAS SETUP> page. The following soft keys will be displayed:
      - **MEAS SETUP**
      - **CORRECTION**
      - **LIMIT TABLE**
      - **SWEEP SETUP**
      - **FILE MANAGE**
   c) Press the **SWEEP SETUP** soft key to access the <LIST SWEEP SETUP> page.
   d) Move the cursor to the SWEEP PARAM area. This area currently displays FREQ [Hz].
   e) Use the knob to move the cursor to the PARAMETER area of sweep point 1. This area currently displays no information ("---").
   f) Press [1]. "+1" will be displayed in the prompt information area, and the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. If you press **kHz**, the display changes to 1.0000k.
   g) Press [→] to move the cursor to the LMT area of sweep point 1. This area will display no information ("---"). The following soft keys will be displayed:
      - **LIMIT DATA A**
      - **LIMIT DATA B**
      - **OFF**
   h) Press the **LIMIT DATA A** soft key to select the primary parameter Cp function. This area will display "A", and the cursor will automatically move to the LOW limit area of sweep point 1.
   i) Press [3] [2] [5]. "+325" will be displayed in the prompt information area and the available units (**p**, **n**, **μ** and **m**) will be displayed in the soft key area. If you press **n**, the display changes to 325.000n, and the cursor automatically moves to the HIGH limit area of sweep point 1.
   j) Press [3] [3] [3]. "+333" will be displayed in the prompt information area and the available units (**p**, **n**, **μ** and **m**) will be displayed in the soft key area. If you press **n**, the display changes to 333.000n, and the cursor automatically moves to the PARAMETER area of sweep point 2.
   k) Press [1] [0]. "+10" will be displayed in the prompt information area, and the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. If you press **kHz**, the display will change to 10.0000k.
   l) Press [→] to move the cursor to the LMT area of sweep point 2. This area will display no information ("---"). The following soft keys will be displayed:
      - **LIMIT DATA A**
      - **LIMIT DATA B**
      - **OFF**

m) Press the **LIMIT DATA B** soft key to select the secondary parameter D function. This area will display "B", and the cursor will automatically move to the LOW limit area of sweep point 2.

n) Press [0] [.] [0] [0] [0] [1]. "+0.0001" will be displayed in the prompt information area and the available units (**p**, **n**, **μ** and **m**) will be displayed in the soft key area. If you press [ENTER], the display will change to 100.000μ, and the cursor automatically moves to the HIGH limit area of sweep point 2.

o) Press [0] [.] [0] [0] [0] [3]. "+0.0003" will be displayed in the prompt information area, and the available units (**p**, **n**, **μ** and **m**) will be displayed in the soft key area. If you press [ENTER], the display will change to 300.000μ, and the cursor automatically moves to the PARAMETER zone of sweep point 3.

p) Based on the previous steps, input a frequency of 100kHz, and lower and upper B limit values of 0.0060 and 0.0100 for the 3rd sweep point.

3) Configure the alarm settings:

a) Press [SYSTEM] to access the <SYSTEM SETUP> page.

b) Move the cursor to the FAIL BEEP area to select **High Long**.

4) Mount the test fixture (ST26005) to the test terminals of the ST2839.

5) Perform a correction (to avoid the influence of stray impedance on measurement accuracy, an open-circuit/short-circuit correction is needed). For details, please see Chapter 6.1 Corrections.

6) Insert the capacitor under test into the test fixture and start the measurement.

7) Press [DISP], then the **LIST SWEEP** soft key to access the <LIST SWEEP DISP> page. The instrument will continuously measure and display the measurement and comparison results on the page. If the comparison result is H (higher than the upper limit) or L (lower than the lower limit), the instrument will play the configured alarm sound.

8) If the measurement result appears obviously incorrect, please check the following items:

a) Ensure that the capacitor under test is in good connection with the test fixture.

b) Ensure that the test fixture is in good connection with the test terminals of the instrument.

c) Re-do the open-circuit/short-circuit correction.

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

6.6 Setup Example of Comparator

ST2839 offers a complete comparator function. This can be convenient for component measurement and judgment, as well as incoming and outgoing quality inspection in a production line. The standard configuration of the Handler interface makes it realize an automatic sorting measurement system.

The concept and specific operation of the comparator has been described in the preceding chapter. Below, two specific setup examples will be laid out.

6.6.1 Capacitor Sorting

Capacitor Type: 0805CG271

Basic Requirements: The capacitance is divided into two BINs: BIN J and BIN K. When the capacitance passes and the loss fails, it will be sorted additionally.

Measurement Parameters:

Primary Parameter (FUN1): Cp

Secondary Parameter (FUN2): D

Frequency (FREQ):	100kHz
Level (LEV):	1V_{rms}
Speed (SPEED):	SLOW
Auxiliary BIN (AUX):	ON
Tolerance Mode of Primary Parameter (MODE):	$\%_{TOL}$ (Percentage Tolerance Mode)
Nominal Value (NOMINAL):	270pF
Lower Limit of BIN1 (BIN1 LOW):	-4.6%
Upper Limit of BIN1 (BIN1 HIGH):	4.8%
Lower Limit of BIN2 (BIN2 LOW):	-9%
Upper Limit of BIN2 (BIN2 HIGH)	10%
Lower Limit of Secondary Parameter (2nd LOW):	0.0000
Upper Limit of Secondary Parameter (2nd HIGH):	0.0015
Trigger Mode (TRIG):	EXT (External)
Alarm Mode (CMP ALARM):	FAIL ALARM (HIGH LONG)

Sorting Parameters:

J BIN:	-4.6% ~ +4.8%
K BIN:	-9% ~ +10%
Loss tgδ	< 0.15%

Additional Instructions:

- For a small capacitance, the equivalent parallel mode should be selected.
- When any BIN of the capacitance passes but the loss fails, it will be sorted additionally. If the AUX BIN is enabled, it will be sorted into the AUX BIN. If the AUX BIN is disabled, it will be judged as FAIL when the loss fails.
- Because the given upper and lower limits are based on the percentage tolerance of the nominal value 270pF, $\%_{TOL}$ tolerance mode should be selected for the primary parameter.

Operating Steps for the Setup:

1) While on the <MEAS DISP> page, select **Cp–D** and set the frequency, level and speed.
2) Press [SETUP] to access the <MEAS SETUP> page and change the TRIGGER MODE to **EXT** (external trigger).
3) Press [SETUP], then the **LIMIT TABLE** soft key to access the <LIMIT TABLE SETUP> page and set the nominal value, primary parameter tolerance mode, upper/lower limits, and enable the comparator function and the AUX BIN.
4) Press [SYSTEM] to access the <SYSTEM SETUP> page, find the FAIL BEEP item and set it to **HIGH LONG**.
5) Return to the <MEAS DISP> page after setup.

6.7 Example: Load Correction

6.7.1 Measurement Settings

Frequency: 100kHz

Cp: 11nF

D: 0.0005

6.7.2 Operation Steps

1) Press the menu key [SETUP], then the soft key **CORRECTION**. The instrument will display the <CORRECTION> page.
2) Move the cursor to the OPEN area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS OPEN**
3) Press **ON** to turn on the open-circuit correction function.
4) Move the cursor to the SHORT area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS SHORT**
5) Press **ON** to turn on the short-circuit correction function.
6) Move the cursor to the LOAD area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
   - **MEAS LOAD**
7) Press **ON** to turn on the load correction function.
8) Move the cursor to the FUNC area. The following soft keys will be displayed:
   - **Cp–…→**
   - **Cs–…→**
   - **Lp–…→**
   - **Ls–…→**
   - **Z–…→**
   - ↓
9) Press **Cp–…→**, then **Cp–D** to select the Cp-D function.
10) Move the cursor to the FREQ area. The following soft keys will be displayed:
    - **ON**
    - **OFF**
    - **MEAS OPEN**
    - **MEAS SHORT**
    - **MEAS LOAD**
11) Press **ON** to turn on the point-frequency correction function of the corresponding frequency.
12) Press [1] [0] [0]. "+100" will be displayed in the prompt information area, and the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key area. If you press **kHz**, the display changes to 100.000kHz (the same as the measurement frequency).
13) Move the cursor to the REF A area of frequency 1. Press [1] [1]. "+11" will be displayed in the prompt information area, and the available units (**p**, **n**, **μ**, **m** and **k**) will be displayed in the soft key area. If you press **n**, the display changes to 11.0000nF.

14) Move the cursor the REF B area of frequency 1. Press [0] [.] [0] [0] [0] [5]. "+0.0005" will be displayed in the prompt information area, and the available units (**p**, **n**, **μ**, **m** and **k**) will be displayed in the soft key area. If you press [ENTER], the display changes to 0.00050.
15) Move the cursor to the SPOT NO. area and select the calibration point.
16) Move the cursor back to the FREQ area. The following soft keys will be displayed:
    - **ON**
    - **OFF**
    - **MEAS OPEN**
    - **MEAS SHORT**
    - **MEAS LOAD**
17) Keep the test fixture open and ensure that your hands or other possible sources of interference are kept far away from the test fixture.
18) Press the soft key **MEAS OPEN** to execute an open-circuit correction.
19) 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.
20) Press the soft key **MEAS SHORT** to execute a short-circuit correction.
21) 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.
22) Press the soft key **MEAS LOAD** to execute a load correction.

Note: Due to different software versions, the soft keys and status information may differ slightly from the way they are referenced in this manual, but this should not affect your general understanding of the processes.

The load correction is only valid for the components with the same specification. If the specification is changed, the load correction must be redone.

7 Performance and Measurement

7.1 Measurement Function

7.1.1 Parameters and Abbreviations

C:	Capacitance	L:	Inductance	Y:	Admittance
R:	Resistance	Z:	Impedance	G:	Conductance
X:	Reactance	B:	Susceptance	Q:	Quality Factor
D:	Dissipation	θ:	Phase Angle	DCR:	DC Resistance

The parameters described above can be combined in the following modes:

Primary Parameter	Secondary Parameter
Z, Y	θ (deg phase), θ (rad radian)
L, C	D, Q, Rs, Rp, G, Rdc
R	X
G	B

Note: There is no combination for DCR.

7.1.2 Mathematical Operation

Operation between the measurement value and the programmable nominal value:

- Absolute Deviation Δ_{ABS}
- Percent Deviation $\Delta_{\%}$

7.1.3 Equivalence Mode

- Series
- Parallel

7.1.4 Range

- Auto
- Manual (Hold, increase and decrease)

7.1.5 Trigger Mode

- **Manual:** Press [TRIGGER] to execute one measurement and display the result.
- **Internal:** Measure the DUT continuously and display the result.
- **External:** After the Handler interface receives a "start" signal, execute a measurement and output the result, then return to the waiting state.

7.1.6 Delay Time

Trigger Delay: The time between the trigger and the beginning of the measurement. Programmable; 0 ~ 60 s; 1 ms resolution.

7.1.7 Connection Modes of Test Terminals

ST2839 series instruments adopt a 4-terminal measurement method:

- **HD (Hcur):** Current sample high terminal
- **LD (Lcur):** Current sample low terminal
- **HS (Hpot):** Voltage sample high terminal
- **LS (Lpot):** Voltage sample low terminal

7.1.8 Measurement Speed (Frequency ≥ 10 kHz)

- **Fast:** about 130 measurements per second (7.7 ms per measurement)
- **Medium:** about 11 measurements per second (92 ms per measurement)
- **Slow:** about 4 measurements per second (230 ms per measurement)

The fast and medium speed will slow down when the frequency is below 10 kHz.

7.1.9 Average

Programmable; 1 ~ 255.

7.1.10 Digits Displayed

6 digits; with a max. display of 999999.

7.2 Measurement Signal

7.2.1 Measurement Signal Frequency

The measurement signal is a sine wave.

Accuracy: 0.01 %

Frequency Range:

- 20 Hz ~ 5 MHz (ST2839A)
- 20 Hz ~ 10 MHz (ST2839)

Min. Resolution: 0.01 Hz

7.2.2 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 the preset voltage.

7.2.3 Measurement Signal Level

	Mode	Range	Accuracy	Resolution
Voltage	Normal	5mV$_{rms}$ ~ 2V$_{rms}$	± (10% × preset value + 2mV$_{rms}$)	100μV
	Constant Voltage	10mV$_{rms}$ ~ 1V$_{rms}$	± (6% × preset value + 2mV$_{rms}$)	
Current	Normal	50μA$_{rms}$ ~ 20mA$_{rms}$	± (10% × preset value + 10μA$_{rms}$)	1μA
	Constant Current	100μA$_{rms}$ ~ 10mA$_{rms}$	± (6% × preset value + 10μA$_{rms}$)	

7.2.4 Output Impedance

100Ω ± 2%.

7.2.5 Monitor for Measurement Signal Level

Mode	Frequency	Range	Accuracy
Voltage	≤ 1MHz	5mV$_{rms}$ ~ 2V$_{rms}$	± (5% × reading + 0.5mV$_{rms}$)
	> 1MHz	5mV$_{rms}$ ~ 1V$_{rms}$	± (10% × reading + 0.5mV$_{rms}$)
Current	≤ 1MHz	50μA$_{rms}$ ~ 20mA$_{rms}$	± (5% × reading + 5μA$_{rms}$)
	> 1MHz	50μA$_{rms}$ ~ 10mA$_{rms}$	± (10% × reading + 5μA$_{rms}$)

7.2.6 Maximum Measurement Display Range

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

7.2.7 DC Bias Source

Range	Minimum Resolution	Accuracy
0V ~ ±40V	0.5mV	1% × set value + 5mV
0mA ~ ±100mA	5μA	5% × set value + 50μA

7.3 Measurement Accuracy

Measurement accuracy includes:

- Stability
- Temperature Coefficient
- Linear Degree
- Measurement Repeatability
- Calibration Inter-Error

Any examination of the instrument's accuracy should be under the following circumstances:

- **Warm-Up Time:** ≥ 30 min
- **Cable Length:** 0 m, 1 m, 2 m, 4 m
- Open-circuit and short-circuit correction after warming up
- DC bias turned OFF
- The range is set to AUTO to select the correct measurement range.

7.3.1 Accuracy of │Z│,│Y│, L, C, R, X, G and B

The accuracy A_e of │Z│,│Y│, L, C, R, X, G and B is expressed as:

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

- K_a: Impedance Rate Factor (Table 7-1)
- K_{aa}: Cable Length Factor (Table 7-2)
- K_b: Impedance Rate Factor (Table 7-1)
- K_{bb}: Cable Length Factor (**Fehler! Verweisquelle konnte nicht gefunden werden.**)
- K_c: Calibration Interpolation Factor (Table 7-4)
- K_d: Cable Length Factor (Table 7-6)
- K_e: Temperature Factor (Table 7-7)

L, C, X, B Accuracy A_e Conditions of Use: D_x (measured value of D) ≤ 0.1.

R, G Accuracy A_e Conditions of Use: Q_x (measured value of Q) ≤ 0.1.

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

The accuracy of G can only be used when in G–B measurement combination.

7.3.2 Accuracy of D

The accuracy of D is defined as:

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

The formula is only available when $D_x \leq 0.1$. When $D_x > 0.1$, D_e should be multiplied by $(1 + D_x)$.

7.3.3 Accuracy of Q

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 measured value of Q.
- D_e is the accuracy of D.

The formula above should be used when $Q_x \times D_e < 1$.

7.3.4 Accuracy of Θ

The accuracy of θ is defined as:

$$\theta_e = \frac{180}{\pi} \times \frac{A_e}{100} [\mathrm{deg}]$$

$$\theta_e = \frac{A_e}{100} [\mathrm{rad}]$$

7.3.5 Accuracy of G

When D_x (measured value of D) ≤ 0.1, the accuracy of G is defined as:

$$G_e = B_x \times D_e [S]$$

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

Where…

- B_x is the measured value of B with the unit [S].
- C_x is the measured value of C with the unit [F].
- L_x is the measured value of L with the unit [H].
- D_e is the accuracy of D.
- f is the measurement frequency.

The formula for the accuracy of G that is shown above is only used in the Cp–G and Lp–G measurement combinations.

7.3.6 Accuracy of Rp

When D_x (measured value of D) ≤ 0.1, the accuracy of Rp is defined as:

$$Rp_e = \pm \frac{Rp_x \times D_e}{D_x \mp D_e} [\Omega]$$

Where…

- Rp_x is the measured value of Rp with the unit [S].
- D_x is the measured value of D with the unit [F].
- D_e is the accuracy of D.

7.3.7 Accuracy of Rs

When D_x (measured value of D) ≤ 0.1, the accuracy of Rs is defined as:

$$Rs_e = X_x \times D_e[\Omega]$$

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

Where…

- X_x is the measured value of X with the unit [S].
- C_x is the measured value of C with the unit [F].
- L_x is the measured value of L with the unit [H].
- D_e is the accuracy of D.
- f is the measurement frequency.

7.3.8 Accuracy of DCR

$$DCR_e = A\left(1 + \frac{R_x}{5M\Omega} + \frac{16m\Omega}{R_x}\right)[\%] \pm 0.2m\Omega$$

Where…

- at medium/slow measurement speed, A = 0.25.
- at fast measurement speed, A = 0.5.
- R_x is the measured resistance.

7.3.9 Accuracy Factor

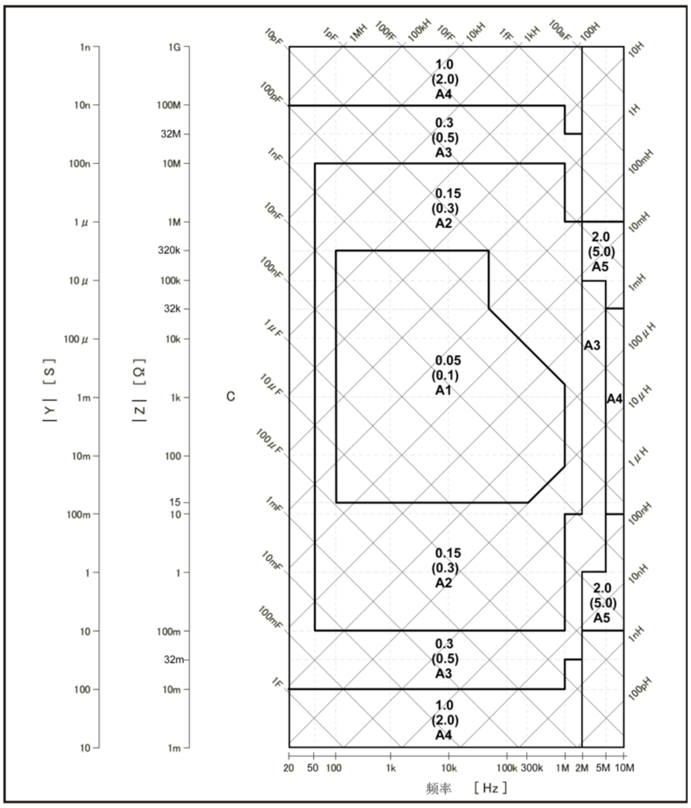


Figure 7-1 Basic Accuracy A (Part 1)

In Figure 7-1, on the boundary line, the smaller value is selected. An example of how to select the basic accuracy value A is shown below:

0.05: When $0.3V_{rms} \le V_s \le 1V_{rms}$, the measurement speed is the value A of medium, slow.

0.1: When $0.3V_{rms} \le V_s \le 1V_{rms}$, the measurement speed is the value A of fast.

A_1: When $V_s < 0.3V_{rms}$ or $V_s > 1V_{rms}$, use the corresponding value A_1, A_2, A_3 and A_4 in Figure 7-2.

Here, V_s is the measurement signal voltage.

The following figure lists the value A for different measurement voltages at fast, medium and slow speeds. Use Figure 7-3 to find the value of Alt when Alt is not specified.

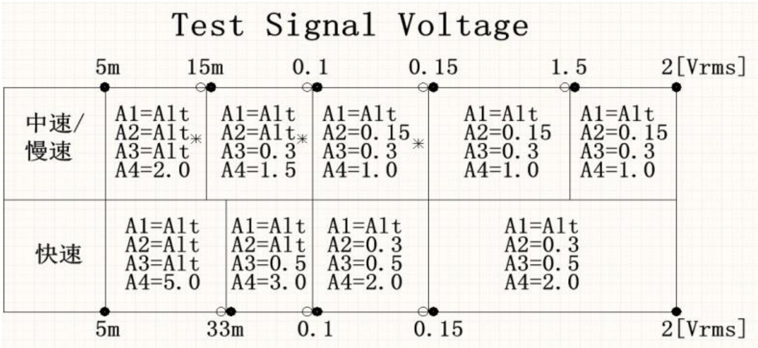


Figure 7-2 Measurement Signal Voltage

*** Note:**

- When $100Hz \le f_m < 300Hz$, the value of A is equal to the value in the above figure multiplied by 2.
- When $f_m < 100Hz$, the value of A is equal to the value in the above figure multiplied by 2.5.

**** Note:** If all of the following measurement conditions are met, the value of A is increased by 0.15:

- **Measurement Frequency:** $100Hz < f_m \le 10MHz$
- **Measurement Signal Voltage:** $5mV_{rms} < V_s \le 2V_{rms}$
- **DUT:** Inductor, $|Z_m| < 200\Omega$ ($|Z_m|$: DUT Impedance)

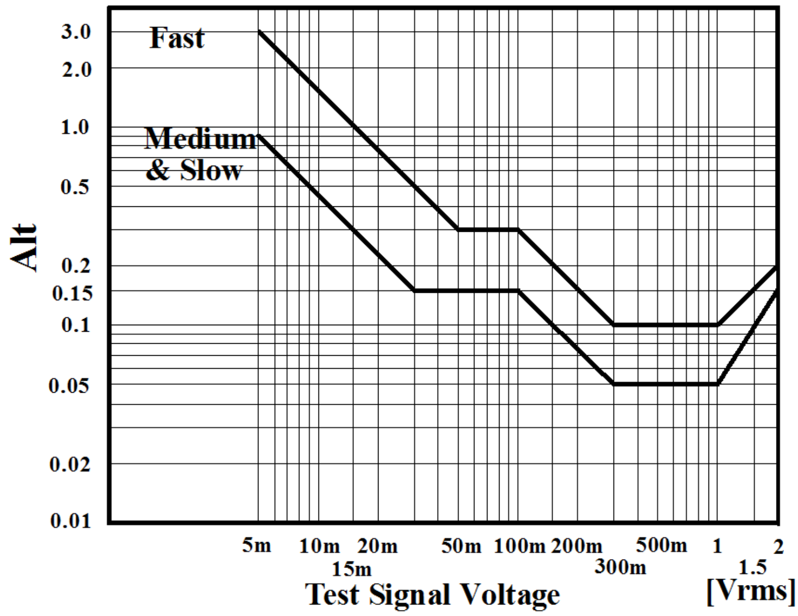


Figure 7-3 Basic Accuracy A (Part 2)

Table 7-1 Impedance Rate Factors K_a and K_b

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

Where…

- f_m is the measurement frequency with the unit **[Hz]**;
- $|Z_m|$ is the impedance of the DUT with the unit **[Ω]**;
- V_s is the measurement signal voltage with the unit **[mV_{rms}]**.

K_a and K_b are the low impedance and high impedance increase factors, respectively. K_a is negligible when the impedance is greater than 500 Ω, and K_b is negligible when the impedance is less than 500 Ω.

Table 7-2 Cable Length Factor K_{aa}

Measurement Signal Voltage	**Cable Length**			
	0m	**1m**	**2m**	**4m**
≤ 2V_{rms}	0	0	$\frac{K_a}{2}$	K_a

Where…

- f_m is the measurement frequency with the unit **[Hz]**;
- $|Z_m|$ is the impedance of the DUT with the unit **[Ω]**;
- K_a is the impedance rate factor.

For impedances above 500 Ω, K_{aa} is negligible.

Table 7-3 Cable Length Factor K_{bb}

Measurement Signal Frequency	Cable Length			
	0m	**1m**	**2m**	**4m**
$f_m \le 100kHz$	1	$1 + 5 \times f_m$	$1 + 10 \times f_m$	$1 + 20 \times f_m$
$100kHz < f_m \le 300kHz$	1	$1 + 2 \times f_m$	$1 + 4 \times f_m$	$1 + 8 \times f_m$
$300kHz < f_m \le 10MHz$	1	$1 + 0.5 \times f_m$	$1 + 1 \times f_m$	$1 + 2 \times f_m$

Where f_m is the measurement frequency with the unit **[MHz]**.

Table 7-4 Calibrated Interpolating Factor K_c

Measurement Frequency	K_c
Direct Calibrated Frequency (listed in Table 7-5)	0
Other Frequency	0.0003

Table 7-5 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	800	**[kHz]**
1	1.2	1.5	2	2.5	3	3.5	4	4.5	5	**[MHz]**
5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	**[MHz]**

Note: There are 67 frequencies listed in Table 7-5. The highest frequency of ST2839A is up to 5MHz (57 frequencies total), and the highest frequency of ST2839 is up to 10MHz (67 frequencies total).

Table 7-6 Cable Length Factor K_d

Measurement Signal Voltage	Cable Length		
	1m	**2m**	**4m**
$\le 2V_{rms}$	$2.5 \times 10^{-4}(1 + 50 \times f_m)$	$5 \times 10^{-4}(1 + 50 \times f_m)$	$1 \times 10^{-3}(1 + 50 \times f_m)$

Where f_m is the measurement frequency with the unit **[MHz]**.

Table 7-7 Temperature Factor K_e

Temperature	K_e
< 5°C	6
5 ~ 8°C	4
8 ~ 18°C	2
18 ~ 28°C	1
28 ~ 38°C	2
> 38°C	4

7.3.10 Measurement Time

Note: The DC bias function is turned OFF.

Measurement Speed	Measurement Frequency						
	20Hz	**100Hz**	**1kHz**	**10kHz**	**100kHz**	**1MHz**	**10MHz**
Fast	380ms	100ms	20ms	7.7ms	5.7ms	5.6ms	5.6ms
Medium	380ms	180ms	110ms	92ms	89ms	88ms	88ms
Slow	480ms	300ms	240ms	230ms	220ms	220ms	220ms

7.4 Safety Requirement

The instruments in this series correspond to protection class I.

7.4.1 Insulation Resistance

Under normal operating conditions, the insulation resistance between the power terminals and the device housing must **not be less than 50MΩ**.

In case of increased heat or humidity during transportation, the insulation resistance between the voltage terminals and the device housing must **not be less than 2MΩ**.

7.4.2 Insulation Intensity

Under normal operating conditions, the device can withstand a voltage of 1.5kV AC 50Hz between the power terminals and the device housing for at least 1 minute without voltage drop or flashover.

7.4.3 Leakage Current

The leakage current should not exceed 3.5mA (AC effective value).

7.5 Electromagnetic Compatibility

- Transient sensitivity, based on the requirement of GB6833.4.
- Conductive sensitivity, based on the requirement of GB6833.6.
- Radiation interference, based on the requirement of GB6833.10.

7.6 Performance Test

7.6.1 Operating Conditions

All measurements should take place under the specific operating conditions listed in this manual, including an appropriate warm-up time (see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**). Only primary indexes are listed in this section.

7.6.2 Used Instruments and Devices

No.	Instrument and Device		Specification
1	Standard Capacitor	100pF	0.02% D is known
		1000pF	
		10000pF	
		10nF	
		0.1μF	
		1μF	
2	AC Standard Resistor	10Ω	0.02%
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	DC Standard Resistor	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	Hipot Tester		0.25kW (0 ~ 500)V

7.6.3 Basic Functionality Check

Ensure that the function keys, display, terminals etc. are operating normally.

7.6.4 Check the Signal Level

Connect a multimeter in the AC voltage range between Hcur and the ground. Set the measurement level to 10mV, 20mV, 100mV, 200mV, 1V and 2V, and check that the reading is within the limits given in this chapter.

7.6.5 Check the Frequency

Connect a frequency meter between the ground terminal and Hcur. Set the frequency to 20Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz, 300kHz, 1MHz and 2MHz, and check that the reading is within the limits given in this chapter.

7.6.6 Check the Measurement Accuracy

R, L, C and D are the basic parameters; therefore the measurement accuracy is mainly defined by them.

7.6.6.1 Accuracy of C and D

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
Cp–D	• 100 Hz • 1 kHz • 10 kHz • 100 kHz	1 V	AUTO	0 V	Slow

Open-circuit and short-circuit correction should be performed before measurement. Connect your standard capacitors of 100 pF, 1000 pF, 10 nF, 0.1 μF and 1 μF, and measure them at the different frequencies. Check that the differences between the readings and the standard values of C and D is within the limits given in this chapter.

7.6.6.2 Accuracy of L

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
Ls–Q	• 100 Hz • 1 kHz	1 V	AUTO	0 V	Slow

Open-circuit and short-circuit correction should be performed before measurement. Connect your standard inductors of 100μH, 1 mH, 10 mH and 100 mH, and measure them at the different frequencies. Check that the difference between the reading and the standard value of L is within the limits given in this chapter.

7.6.6.3 Accuracy of Z

Function	Measurement Frequency (test each respectively)	Level	Range	Bias	Speed
Z–θ	• 100 Hz • 1 kHz • 10 kHz • 100 kHz	1 V	AUTO	0 V	Slow

Open-circuit and short-circuit correction should be performed before measurement. Connect your AC standard resistors of 10 Ω, 100 Ω, 1 kΩ, 10 kΩ and 100 kΩ, and measure them at the different frequencies. Check that the difference between the reading and the standard value of Z is within the limits given in this chapter.

7.6.6.4 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 0.1 Ω, 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ and 100 kΩ. Check that the difference between the reading and the standard value of DCR is within the limits given in this chapter.

8 Command Reference

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 return character, integer: 10
- **^END:** 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

8.1 DISPlay Subsystem Commands

8.1.1 DISPlay:PAGE

Set or query the currently displayed page.

Syntax:

Command Format:	DISP:PAGE <page name>
Query Format:	DISP:PAGE?
Return Format:	<page name><NL^END>

Parameter:

page name — Indicates the name of the current displayed page; the possible values are as follows:

Page Name	Meaning
MEASurement	Enter the LCR measurement display page.
BNUMber	Enter the BIN number display page.

BCOunt	Enter the BIN count display page.
LIST	Enter the list sweep display page.
MSETup	Enter the measurement setup display page.
CSETup	Enter the correction setup page.
LTABle	Enter the limit table setup page.
LSETup	Enter the list sweep setup page.
TSSEtup	Enter the trace sweep setup page.
TSMEas	Enter the trace sweep display page.
SYSTem	Enter the system setup page.
FLISt	Enter the file list page.

Example:

DISP:PAGE MEAS Enter the LCR measurement display page.

8.1.2 DISPlay:LINE

Set or query the current measurement item, which can be a substring with up to 16 characters. The character string of the measurement item can be used as the file name when saving a file.

Syntax:

Command Format: DISP:LINE "<string>"

Query Format: DISP:LINE?

Return Format: <string><NL^END>

Parameter:

string Can be an ASCII character string (maximum number is 16).

Example:

DISP:LINE "Resistor meas" Set the instrument's current measurement item to resistor measurement.

8.1.3 DISPlay:ResultFONt

Set or query the display font of the measurement result.

Syntax:

Command Format: DISP:RFON <LARG | TINY | OFF>

Query Format: DISP:RFON?

Return Format: <LARG | TINY | OFF><NL^END>

Parameter:

LARGe Use large characters to display the measurement result for about 12ms at a time.

TINY Use tiny characters to display the measurement result for about 5ms at a time.

OFF	Measurement result will not be displayed but can be read from the bus.

Example:

DISP:RFON LARG	Set the display font to LARGE.

8.2 FREQuency Subsystem Commands

8.2.1 FREQuency

Set or query the measurement frequency of the instrument.

Syntax:

Command Format:	FREQ <value | MIN | MAX>
Query Format:	FREQ?
Return Format:	<NR3><NL^END>

Parameter:

value	NR1, NR2 or NR3 data format followed by Hz, kHz, MHz.
MIN	Set the measurement frequency to 20Hz.
MAX	Set the measurement frequency to 5MHz / 10MHz (The maximum frequency of ST2839 is 10MHz, the maximum frequency of ST2839A is 5MHz).

Example:

FREQ 1KHZ	Set the frequency to 1000Hz.

8.3 VOLTage Subsystem Commands

8.3.1 VOLTage

Set or query the measurement voltage.

Syntax:

Command Format:	VOLT <value | MIN | MAX>
Query Format:	VOLT?
Return Format:	<NR3><NL^END>

Parameter:

value	NR1, NR2 or NR3 data format followed by V.
MIN	Set the measurement voltage to 5mV.
MAX	Set the measurement voltage to 2V.

Example:

VOLT 1V	Set the measurement voltage to 1V.

8.4 CURRent Subsystem Commands

8.4.1 CURRent

Set or query the measurement level current of the instrument.

Syntax:

Command Format:	CURR <value | MIN | MAX>
Query Format:	CURR?
Return Format:	<NR3><NL^END>

Parameter:

value	NR1, NR2 or NR3 data format followed by mA.
MIN	Set the measurement current to 50 µA.
MAX	Set the measurement current to 20 mA.

Example:

CURR 10MA	Set the measurement level to 10 mA.

8.5 AMPLitude Subsystem Commands

8.5.1 AMPLitude:ALC

Set or query the auto level control (ALC) function ON/OFF status.

Syntax:

Command Format:	AMPL:ALC <0 | 1 | OFF | ON>
Query Format:	AMPL:ALC?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the ALC function.
1 | ON	Enable the ALC function.

Example:

AMPL:ALC 0	Turn the ALC function OFF.

8.6 OUTPut Subsystem Commands

8.6.1 OUTPut:DC:ISOLation

Set or query the DC isolation function ON/OFF status of the 500 mA / 5V DC bias source.

Syntax:

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

Query Format: OUTP:DC:ISOL?

Return Format: <NR1><NL^END>

Parameter:

0 | OFF Disable DC isolation.

1 | ON Enable DC isolation.

Example:

OUTP:DC:ISOL 0 Turn the DC isolation OFF.

8.7 BIAS Subsystem Commands

8.7.1 BIAS:STATe

Set or query the DC bias ON/OFF status.

Command Syntax:

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

Query Format: BIAS:STAT?

Return Format: <NR1><NL^END>

Parameter:

0 | OFF Disable the DC bias.

1 | ON Enable the DC bias.

Example:

BIAS:STAT 0 Turn the DC bias OFF.

8.7.2 BIAS:VOLTage

Set or query the internal bias voltage of the instrument.

Syntax:

Command Format: BIAS:VOLT <value | MIN | MAX>

Query Format: BIAS:VOLT?

Return Format: <NR3><NL^END>

Parameter:

value NR1, NR2 or NR3 data format.

MIN Set the bias voltage to -40V.

MAX Set the bias voltage to 40V.

Example:

BIAS:VOLT MIN Set the DC bias voltage to -40V.

8.7.3 BIAS:CURRent

Set or query the external bias current of the instrument.

Syntax:

Command Format:	BIAS:CURR <value | MIN | MAX>
Query Format:	BIAS:CURR?
Return Format:	<NR3><NL^END>

Parameter:

value	NR1, NR2 or NR3 data format.
MIN	Set the bias current to -100mA.
MAX	Set the bias current to 100mA.

Example:

BIAS:CURR MAX	Set the bias current to 100mA.

8.7.4 BIAS:POLarity

Set the bias polarity of the instrument.

Syntax:

Command Format:	BIAS:POL:AUTO <0 | 1 | OFF | ON>

Parameter:

0 | OFF	Disable the bias polarity AUTO mode (set it to FIX mode).
1 | ON	Enable the bias polarity AUTO mode.

Example:

BIAS:POL:AUTO 1	Set the bias polarity to AUTO mode.

8.8 FUNCtion Subsystem Commands

8.8.1 FUNCtion:IMPedance

Set or query the "function" parameters of the instrument.

Syntax:

Command Format:	FUNC:IMP <function>
Query Format:	FUNC:IMP?
Return Format:	<function><NL^END>

Parameter:

function	Indicates the optional function parameter name; the possible values are as follows:

Parameter Name	Parameter Meaning	Parameter Name	Parameter Meaning
CPD	Set the function to Cp–D	LPRP	Set the function to Lp–Rp
CPQ	Set the function to Cp–Q	LSD	Set the function to Ls–D
CPG	Set the function to Cp–G	LSQ	Set the function to Ls–Q
CPRP	Set the function to Cp–Rp	LSRS	Set the function to Ls–Rs
CSD	Set the function to Cs–D	RX	Set the function to R–X
CSQ	Set the function to Cs–Q	ZTD	Set the function to Z–θ°
CSRS	Set the function to Cs–Rs	ZTR	Set the function to Z–θr
LPQ	Set the function to Lp–Q	GB	Set the function to G–B
LPD	Set the function to Lp–D	YTD	Set the function to Y–θ°
LPG	Set the function to Lp–G	YTR	Set the function to Y–θr
LPRD	Set the function to Lp–Rd	RPQ	Set the function to Rp–Q
LSRD	Set the function to Lp–Rd	RSQ	Set the function to Rs–Q
DCR	Set the function to DCR		

Example:

FUNC:IMP RX Set the function to R–X.

8.8.2 FUNCtion:IMPedance:RANGe

Set or query the range of the instrument.

Syntax:

Command Format: FUNC:IMP:RANG <value>

Query Format: FUNC:IMP:RANG?

Return Format: <return value><NL^END>

Parameter:

value The impedance of the DUT in NR1, NR2 or NR3 data format followed by OHM or KOHM.

return value Can be any of the following: 1, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000.

Note: Different frequency settings will have different range selection.

Example:

FUNC:IMP:RANG 1KOHM Set the range to 1kΩ.

8.8.3 FUNCtion:IMPedance:RANGe:AUTO

Set or query the range AUTO mode ON/OFF status of the instrument.

Syntax:

Command Format:	FUNC:IMP:RANG:AUTO <0 | 1 | OFF | ON>
Query Format:	FUNC:IMP:RANG:AUTO?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the range AUTO mode (set it to FIX mode).
1 | ON	Enable the range AUTO mode.

Example:

FUNC:IMP:RANG:AUTO 1	Turn the range AUTO mode ON.

8.8.4 FUNCtion:DCResistance:RANGe

Set or query the DC range of the instrument.

Syntax:

Command Format:	FUNC:DCR:RANG <value>
Query Format:	FUNC:DCR:RANG?
Return Format:	<return value><NL^END>

Parameter:

value	The impedance of the DUT in NR1, NR2 or NR3 data format followed by OHM or KOHM.
return value	Can be any of the following: 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000.

Example:

FUNC:DCR:RANG 1KOHM	Set the DCR range to 1kΩ.

8.8.5 FUNCtion:DCResistance:RANGe:AUTO

Set or query the DCR range AUTO mode ON/OFF status of the instrument.

Syntax:

Command Format:	FUNC:DCR:RANG:AUTO <0 | 1 | OFF | ON>
Query Format:	FUNC:DCR:RANG:AUTO?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the DCR range AUTO mode (set it to FIX mode).
1 | ON	Enable the DCR range AUTO mode.

Example:

FUNC:DCR:RANG:AUTO 1	Turn the DCR range AUTO mode ON.

8.8.6 FUNCtion:SourceMONitor:VDC

Set or query the voltage monitoring ON/OFF status of the instrument.

Syntax:

Command Format:	FUNC:SMON:VDC <0 | 1 | OFF | ON>
Query Format:	FUNC:SMON:VDC?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable voltage monitoring.
1 | ON	Enable voltage monitoring.

Example:

FUNC:SMON:VDC ON	Turn the voltage monitoring function ON.

8.8.7 FUNCtion:SMONitor:IAC

Set or query the current monitoring ON/OFF status of the instrument.

Syntax:

Command Format:	FUNC:SMON:IAC <0 | 1 | OFF | ON>
Query Format:	FUNC:SMON:IAC?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable current monitoring.
1 | ON	Enable current monitoring.

Example:

FUNC:SMON:IAC ON	Turn the current monitoring function ON.

8.8.8 FUNCtion:DEViation<n>:MODE

Set or query the deviation measurement mode of the instrument.

Syntax:

Command Format:	FUNC:DEV <n>:MODE <ABS | PERC | OFF>
Query Format:	FUNC:DEV <n>:MODE?
Return Format:	<ABS | PERC | OFF><NL^END>

Parameter:

n	1 for primary parameter; 2 for secondary parameter.
ABS	Δ Absolute deviation mode.
PERC	Δ% Percent deviation mode.
OFF	Disable the deviation measurement.

Example:

FUNC:DEV 1:MODE ABS	Set parameter 1 to absolute deviation.
FUNC:DEV 2:MODE PER	Set parameter 2 to percentage deviation.

8.8.9 FUNCtion:DEViation<n>:REFerence

Set or query the reference value of the deviation.

Syntax:

Command Format:	FUNC:DEV <n>:REF <value>
Query Format:	FUNC:DEV <n>:REF?
Return Format:	<NR1><NL^END>

Parameter:

n	1 for primary parameter; 2 for secondary parameter.
value	NR1, NR2 or NR3 data format.

Example:

FUNC:DEV 1:REF 10	Set the deviation reference of parameter 1 to 10.

8.8.10 FUNCtion:DEViation<n>:REFerence:FILL

Set the nominal value of the deviation. This command directs the instrument to take a measurement and then copies the results of the primary and the secondary parameters as the nominal values of the deviation.

Syntax:

Command Format:	FUNC:DEV <n>:REF:FILL

Parameter:

n	1 for primary parameter; 2 for secondary parameter.

Example:

FUNC:DEV 2:REF:FILL	Measure once; the result of parameter 2 is used as the deviation reference value.

8.8.11 FUNCtion:StepDELay

Set or query the step delay time of the instrument.

Syntax:

Command Format:	FUNC:SDEL<value | MIN | MAX>
Query Format:	FUNC:SDEL?
Return Format:	<NR3><NL^END>

Parameter:

value	NR1, NR2 or NR3 data format.
MIN	Set the step delay parameter to 0s.
MAX	Set the step delay parameter to 60s.

Example:

FUNC:SDEL 5S	Set the step delay to 5s.

8.9 LIST Subsystem Commands

8.9.1 LIST:FREQuency

Clear and set or query the frequency of each sweep point.

Syntax:

Command Format:	LIST:FREQ <value$_1$>[,<value$_2$>…, <value$_{201}$>]
Query Format:	LIST:FREQ?
Return Format:	<NR3$_1$>[,<NR3$_2$>, …, <NR3$_{201}$>]<NL^END>

Parameter:

value	NR1, NR2 or NR3 data format. <value> must be set to 20Hz ~ 5MHz (for ST2839A) or 20Hz ~ 10MHz (for ST2839); otherwise an error will be returned! Up to 201 sweep point frequencies can be set.

Example:

LIST:FREQ 1E3, 2E3, 3E3, 4E3 — Set the frequency of…

- Sweep point 1 to 1kHz
- Sweep point 2 to 2kHz
- Sweep point 3 to 3kHz
- Sweep point 4 to 4kHz.

Note: HZ (Hertz) is the suffix unit, MAHZ and MHZ is MHz (2E6Hz).

8.9.2 LIST:VOLTage

Clear and set or query the measurement voltage of each sweep point.

Syntax:

Command Format:	LIST:VOLT <value$_1$>[,<value$_2$>…, <value$_{201}$>]
Query Format:	LIST:VOLT?
Return Format:	<NR3$_1$>[,<NR3$_2$>, …, <NR3$_{201}$>]<NL^END>

Parameter:

<value>	NR1, NR2 or NR3 data format. <value> must be set to 5mV ~ 2V; otherwise an error will be returned! Up to 201 sweep point voltage values can be set.

Example:

LIST:VOLT 1E-2, 2E-2, 3E-2, 4E-2 Set the voltage of…

- Sweep point 1 to 10mV
- Sweep point 2 to 20mV
- Sweep point 3 to 30mV
- Sweep point 4 to 40mV.

Note: This command can be followed by suffix unit V.

8.9.3 LIST:CURRent

Clear and set or query the measurement current of each sweep point.

Syntax:

Command Format:	LIST:CURR <value$_1$>[,<value$_2$>…, <value$_{201}$>]
Query Format:	LIST:CURR?
Return Format:	<NR3$_1$>[,<NR3$_2$>, …, <NR3$_{201}$>]<NL^END>

Parameter:

value	NR1, NR2 or NR3 data format. <value> must be set to 50μA ~ 100mA; otherwise an error will be returned! Up to 201 sweep point current values can be set.

Example:

LIST:CURR 1E-2, 2E-2, 3E-2, 4E-2 Set the current of…

- Sweep point 1 to 10mA
- Sweep point 2 to 20mA
- Sweep point 3 to 30mA
- Sweep point 4 to 40mA.

Note: This command can be followed by suffix unit A.

8.9.4 LIST:BIAS:VOLTage

Clear and set or query the DC bias voltage of each sweep point.

Syntax:

Command Format:	LIST:BIAS:VOLT <value$_1$>[,<value$_2$>…, <value$_{201}$>]
Query Format:	LIST:BIAS:VOLT?
Return Format:	<NR3$_1$>[,<NR3$_2$>, …, <NR3$_{201}$>]<NL^END>

Parameter:

value	NR1, NR2 or NR3 data format. Up to 201 sweep point DC bias voltage values can be set.

Example:

LIST:BIAS:VOLT 1.5V	Set the bias voltage of sweep point 1 to 1.5V.

8.9.5 LIST:BIAS:CURRent

Clear and set or query the DC bias current of each sweep point.

Syntax:

Command Format:	LIST:BIAS:CURR <value$_1$>[,<value$_2$>…, <value$_{201}$>]
Query Format:	LIST:BIAS:CURR?
Return Format:	<NR3$_1$>[,<NR3$_2$>, …, <NR3$_{201}$>]<NL^END>

Parameter:

value	NR1, NR2 or NR3 data format. Up to 201 sweep point current values can be set.

Example:

LIST:CURR 100MA	Set the DC bias current of sweep point 1 to 100mA.

Note: ST2839 series instruments have a 40V / 100mA internal DC bias current source installed. If a 1A DC bias source is required, please install an external one. These instruments can be used with the ST1778 DC Bias Source (providing DC current from 0A ~ 20A, supporting 120A at most).

8.9.6 LIST:MODE

Set or query the list sweep mode of the instrument.

Syntax:

Command Format:	LIST:MODE <SEQ | STEP>
Query Format:	LIST:MODE?
Return Format:	<SEQ | STEP><NL^END>

Parameter:

SEQ	Sequential Mode
STEP	Single-Step Mode

Example:

LIST:MODE SEQ	Set to sequential mode.

8.9.7 LIST:BAND<n>

Set or query the limit data at the specified point in the list sweep setting table.

Syntax:

Command Format:	LIST:BAND<n><A | B | OFF>[,<lower limit n>,<upper limit n>]
Query Format:	LIST:BAND<n>?
Return Format:	<A | B | OFF>,<lower limit n>,<upper limit n>

Parameter:

n	1 ~ 201 (NR1 format); sweep points on the n^{th} line.
A | B | OFF	A = Compare the primary parameter of the measurement results with the limit values. B = Compare the secondary parameter of the measurement results with the limit values. OFF = No comparison.
lower limit n	NR1, NR2 or NR3 format; lower limit of the parameter corresponding to the n^{th} point.
upper limit n	NR1, NR2 or NR3 format; upper limit of the parameter corresponding to the n^{th} point.

Example:

LIST:BAND1 OFF	Turn OFF the comparison function for both parameters at point 1.
LIST:BAND2 A, 10, 20	Set the lower limit at point 2 of the 2^{nd} parameter to 10 and the upper limit to 20.

8.9.8 LIST:DELay

Set or query the measurement delay time of each sweep point.

Syntax:

Command Format:	LIST:DEL<$value_1$>[,<$value_2$>…, <$value_{201}$>]
Query Format:	LIST:DEL?
Return Format:	<$NR3_1$>[,<$NR3_2$>, …, <$NR3_{201}$>]<NL^END>

Parameter:

value	NR1, NR2 or NR3 data format. Up to 201 sweep point delay times can be set. Unit can me ms or s; defaults to s when not specified.

Example:

LIST:DEL 1, 1	Set the step delay time of sweep points 1 and 2 to 1s.

8.9.9 LIST:CLEar:ALL

Clear the setting data of all sweep points.

Syntax:

Command Format:	LIST:CLE:ALL

8.10 APERture Subsystem Commands

8.10.1 APERture

Set and query the measurement speed and average number of measurements.

Syntax:

Command Format:	APER<FAST | MED | SLOW>[,<value>]
Query Format:	APER?
Return Format:	<FAST | MED | SLOW>,<NR1><NL^END>

Parameter:

FAST	130 measurements per second
MED	11 measurements per second
SLOW	4 measurements per second
value	1 ~ 255 (NR1 format)

Example:

APER MED, 55	Set the measurement speed to medium and the average number of measurements used to 55.

8.11 TRIGger Subsystem Commands

8.11.1 TRIGger[:IMMediate]

Trigger a measurement.

Syntax:

Command Format:	TRIG[:IMM]

Example:

TRIG	Trigger the instrument to measure once.

8.11.2 TRIGger:SOURce

Set or query the trigger source mode of the instrument.

Syntax:

Command Format:	TRIG:SOUR <INT | EXT | BUS | HOLD>

Query Format:	TRIG:SOUR?
Return Format:	<INT | EXT | BUS | HOLD><NL^END>

Parameter:

INT	Default trigger mode; internal.
EXT	Triggered by HANDLER interface; external.
BUS	Triggered by RS232C interface or GPIB interface.
HOLD	Triggered by pressing [TRIGGER] on the instrument.

Example:

TRIG:SOUR BUS	Set the instrument trigger mode to respond to the RS232C or GPIB interface.

8.11.3 TRIGger:DELay

Set or query the trigger delay time of the instrument.

Syntax:

Command Format:	TRIG:DEL <value | MIN | MAX>
Query Format:	TRIG:DEL?
Return Format:	<NR3><NL^END>

Parameter:

value	In NR1, NR2 or NR3 data format. Ranges from 0s ~ 60s with a resolution of 1ms.
MIN	Set the delay time to 0s.
MAX	Set the delay time to 60s.

Example:

TRIG:DEL 5s	Set the trigger delay time to 5s.

8.12 FETCh? Subsystem Commands

8.12.1 FETCh[:IMP]?

Query the result of the most recent measurement in the currently selected measurement mode. Directs the instrument to input the result to the output buffer zone.

Syntax:

Query Format:	FETC[:IMP]?

On the measurement display page, BIN no. display page and BIN count display page, the ASCII data output is formatted as follows:

SN.NNNNNESNN	,	SN.NNNNNESNN	,	SN	,	SN or SNN	NL^END
<data A>		<data B>		<status>		<BIN no.>	

Parameter:

data A	Primary measurement data; 12-digit ASCII format (S = +/-; N = 0 ~ 9; E = Exponent)
data B	Secondary measurement data; 12-digit ASCII format (S = +/-; N = 0 ~ 9; E = Exponent)
status	Measurement status (S = +/-; N = 0 ~ 4); can be any of the following: -1 = (In data buffer memory) No data 0 = General measurement data +1 = Analog LCR imbalance +2 = A/D converter not working +3 = Signal source overload +4 = Constant voltage cannot be adjusted **Note:** When <status> is -1, +1 or +2, the measurement data is 9.9E37. When <status> is 0, +3 or +4, the real measurement data is beyond the limits.
BIN no.	Sorting results of the displayed BIN. <BIN no.> data can only be displayed when the instrument comparator function is set to ON. The output format of <BIN no.> data applies 2 to 3 digits ASCII: SN or SNN (S = +/-; N = 0 ~ 9) 0 = Out of Tolerance +1 = BIN 1 +2 = BIN 2 … +9 = BIN 9 +10 = Auxiliary BIN

On the list sweep display page, the ASCII data output is formatted as follows (i.e. the return-circuit replaces the sweep point number):

SN.NNNNNESNN	,	SN.NNNNNESNN	,	SN	,	SN	NL^END
<data A>		<data B>		<status>		<judgement>	

Parameter:

data A	See above.
data B	See above.
status	See above.
judgement	Comparison results of the list sweep (S = +/-; N = 0 ~ 1). When the comparator function for the list sweep measurement is turned OFF, <judgement> is 0. -1 = Low 0 = Pass +1 = High

8.13 CORRection Subsystem Commands

8.13.1 CORRection:LENGth

Set or query the correction cable length of the instrument.

Syntax:

Command Format:	CORR:LENG <value>
Query Format:	CORR:LENG?
Return Format:	<NR1><NL^END>

Parameter:

value	0, 1, 2 or 4, followed by M for meter.

Example:

CORR:LENG 1M	Set the cable length to 1 m.

8.13.2 CORRection:OPEN

Execute the open-circuit correction for 67 preset measurement points (ST2839A has 57 preset points).

Syntax:

Command Format:	CORR:OPEN

Example:

CORR:OPEN	Perform the open-circuit correction on the preset measurement points.

8.13.3 CORRection:OPEN:STATe

Set or query the open-circuit correction function ON/OFF status.

Syntax:

Command Format:	CORR:OPEN:STAT <0 | 1 | OFF | ON>
Query Format:	CORR:OPEN:STAT?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable open-circuit correction.
1 | ON	Enable open-circuit correction.

Example:

CORR:OPEN:STAT ON	Turn ON the open-circuit correction function.

8.13.4 CORRection:SHORt

Execute the short-circuit correction for 67 preset measurement points (ST2839A has 57 preset points).

Syntax:

Command Format: CORR:SHOR

Example:

CORR:SHOR Perform the short-circuit correction on the preset measurement points.

8.13.5 CORRection:SHORt:STATe

Set or query the short-circuit correction function ON/OFF status.

Syntax:

Command Format: CORR:SHOR:STAT <0 | 1 | OFF | ON>

Query Format: CORR:SHOR:STAT?

Return Format: <NR1><NL^END>

Parameter:

0 | OFF Disable short-circuit correction.

1 | ON Enable short-circuit correction.

Example:

CORR:SHOR:STAT OFF Turn OFF the short-circuit correction function.

8.13.6 CORRection:LOAD:STATe

Set or query the load correction function ON/OFF status.

Syntax:

Command Format: CORR:LOAD:STAT <0 | 1 | OFF | ON>

Query Format: CORR:LOAD:STAT?

Return Format: <NR1><NL^END>

Parameter:

0 | OFF Disable load correction.

1 | ON Enable load correction.

Example:

CORR:LOAD:STAT 1 Turn ON the load correction function.

8.13.7 CORRection:LOAD:TYPE

Set or query the measured parameter combination for the load correction.

Syntax:

Command Format: CORR:LOAD:TYPE <function>

Query Format: CORR:LOAD:TYPE?

Return Format: <function><NL^END>

Parameter:

<function> Indicates the optional function parameter name; the possible values are as follows:

Parameter Name	Parameter Meaning	Parameter Name	Parameter Meaning
CPD	Set the function to Cp–D	LPRP	Set the function to Lp–Rp
CPQ	Set the function to Cp–Q	LSD	Set the function to Ls–D
CPG	Set the function to Cp–G	LSQ	Set the function to Ls–Q
CPRP	Set the function to Cp–Rp	LSRS	Set the function to Ls–Rs
CSD	Set the function to Cs–D	RX	Set the function to R–X
CSQ	Set the function to Cs–Q	ZTD	Set the function to Z–θ°
CSRS	Set the function to Cs–Rs	ZTR	Set the function to Z–θr
LPQ	Set the function to Lp–Q	GB	Set the function to G–B
LPD	Set the function to Lp–D	YTD	Set the function to Y–θ°
LPG	Set the function to Lp–G	YTR	Set the function to Y–θr

Example:

CORR:LOAD:TYPE CPD Set the load type to CP–D.

8.13.8 CORRection:SPOT<n>:STATe

Set or query the specified frequency point ON/OFF status.

Syntax:

Command Format: CORR:SPOT<n>:STAT<0 | 1 | OFF | ON>

Query Format: CORR:SPOT<n>:STAT?

Return Format: <NR1><NL^END>

Parameter:

n Frequency spot index, value 1 ~ 201.

0 | OFF Disable the specified frequency point.

1 | ON Enable the specified frequency point.

Example:

CORR:SPOT1:STAT ON Turn ON frequency point 1.

8.13.9 CORRection:SPOT<n>:FREQuency

Set or query the measurement frequency of the specified frequency point.

Syntax:

Command Format:	CORR:SPOT<n>:FREQ <value>
Query Format:	CORR:SPOT<n>:FREQ?
Return Format:	<NR3><NL^END>

Parameter:

n	Frequency spot index, value 1 ~ 201.
value	NR1, NR2 or NR3 data format followed by Hz, kHz or MHz. <value> must be set within the range of 20Hz ~ 10MHz (ST2839) or 20Hz ~ 5MHz (ST2839A); otherwise an error will be returned!

Example:

CORR:SPOT1:FREQ 2KHZ	Set the measurement frequency of frequency point 1 to 2kHz.

8.13.10 CORRection:SPOT<n>:OPEN

Execute an open-circuit correction at a specific frequency point.

Syntax:

Command Format:	CORR:SPOT<n>:OPEN

Parameter:

n	Frequency spot index, value 1 ~ 201.

Example:

CORR:SPOT1:OPEN	Execute an open-circuit correction at frequency point 1.

8.13.11 CORRection:SPOT<n>:SHORt

Execute a short-circuit correction at a specific frequency point.

Syntax:

Command Format:	CORR:SPOT<n>:SHOR

Parameter:

n	Frequency spot index, value 1 ~ 201.

Example:

CORR:SPOT2:SHOR	Execute a short-circuit correction at frequency point 2.

8.13.12 CORRection:SPOT<n>:LOAD:STANdard

Set or query the standard load correction reference values for specific frequency points.

Syntax:

Command Format:	CORR:SPOT<n>:LOAD:STAN <ref A, ref B>
Query Format:	CORR:SPOT<n>:LOAD:STAN?
Return Format:	<NR3><NL^END>

Parameter:

n	Frequency spot index, value 1 ~ 201.
ref A	NR1, NR2 or NR3 data format; standard reference of the primary parameter.
ref B	NR1, NR2 or NR3 data format; standard reference of the secondary parameter.

Example:

CORR:SPOT1:LOAD:STAN 1.1, 1.2	Set the standard reference value of the primary parameter to 1.1 and that of the secondary parameter to 1.2 at frequency point 1.

8.13.13 CORRection:USE:DATA?

Query the open-circuit/short-circuit/load correction measurement data of all frequency points.

Syntax:

Query Format:	CORR:USE:DATA?
Return Format:	<open$_1$ A>, <open$_1$ B>, <short$_1$ A>, <short$_1$ B>, <load$_1$ A>, <load$_1$ B>, <open$_2$ A>, <open$_2$ B>, <short$_2$ A>, <short$_2$ B>, <load$_2$ A>, <load$_2$ B>, …

Parameter:

open$_n$ A	NR3 data format; the primary open-circuit correction data at frequency spot n.
open$_n$ B	NR3 data format; the secondary open-circuit correction data at frequency spot n.
short$_n$ A	NR3 data format; the primary short-circuit correction data at frequency spot n.
short$_n$ B	NR3 data format; the secondary short-circuit correction data at frequency spot n.
load$_n$ A	NR3 data format; the primary load correction data at frequency spot n.
load$_n$ B	NR3 data format; the secondary load correction data at frequency spot n.

Example:

CORR:USE:DATA?	Return the primary and secondary open-circuit, short-circuit and load correction values of all set frequency points.

8.13.14 CORRection:CLEar

Clear the correction measurement data of all frequency points.

Syntax:

Command Format:	CORR:CLE

8.14 COMParator Subsystem Commands

8.14.1 COMParator[:STATe]

Set or query the comparator function ON/OFF status.

Syntax:

Command Format:	COMP[:STAT]<0 | 1 | OFF | ON>
Query Format:	COMP[:STAT]?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the comparator function.
1 | ON	Enable the comparator function.

Example:

COMP ON	Turn the comparator function ON.

8.14.2 COMParator:MODE

Set or query the comparator function's limit mode.

Syntax:

Command Format:	COMP:MODE<ATOL | PTOL | SEQ>
Query Format:	COMP:MODE?
Return Format:	<ATOL | PTOL | SEQ><NL^END>

Parameter:

ATOL	Absolute Tolerance Mode
PTOL	Proportional Tolerance Mode
SEQ	Sequential Mode

Example:

COMP:MODE ATOL	Set the comparator limit mode to absolute tolerance mode.

8.14.3 COMParator:TOLerance:NOMinal

Set or query the nominal value (this function is only accessible when the limit mode is set to tolerance mode).

Syntax:

Command Format:	COMP:TOL:NOM<value>
Query Format:	COMP:TOL:NOM?
Return Format:	<NR3><NL^END>

Parameter:

value	Nominal value in NR1, NR2 or NR3 data format.

Example:

COMP:TOL:NOM 100E-12	Set the nominal value (primary parameter) of the comparator function in tolerance mode to 100pF (unit is added based on selected function, e.g. function Cp–Rp).

8.14.4 COMParator:TOLerance:BIN<n>

Set or query the upper and lower limit values of each BIN in the tolerance mode of the comparison function (this function is only accessible when the limit mode is set to tolerance mode).

Syntax:

Command Format:	COMP:TOL:BIN<n><lower limit>,<upper limit>
Query Format:	COMP:TOL:BIN<n>?
Return Format:	<lower limit>,<upper limit><NL^END>

Parameter:

n	BIN number index, ranges from 1 ~ 9.
lower limit	Lower limit value in NR1, NR2 or NR3 data format.
upper limit	Upper limit value in NR1, NR2 or NR3 data format.

Note: The lower limit should be smaller than the upper limit; otherwise an error will be returned.

Example:

COMP:TOL:BIN2 -10, 10	Set the lower limit of BIN2 to -10 and the upper limit to 10.

8.14.5 COMParator:SEQuence:BIN

Set or query the upper and lower limit data of the sequential mode of the comparison function (this function is only accessible when the limit mode is set to sequential mode).

Syntax:

Command Format:	COMP:SEQ:BIN<BIN1 lower limit>,<BIN1 upper limit>,<BIN2 upper limit>… <BINn upper limit>
Query Format:	COMP:SEQ:BIN?
Return Format:	<BIN1 lower limit>,<BIN1 upper limit>,<BIN2 upper limit>…<BINn upper limit><NL^END>

Parameter:

BIN1 lower limit	Lower limit value of BIN1 in NR1, NR2 or NR3 data format.
BIN1 upper limit	Upper limit value of BIN1 in NR1, NR2 or NR3 data format.
BINn upper limit	Upper limit value of BINn (up to 9) in NR1, NR2 or NR3 data format.

Note: Each limit value should be smaller than the next corresponding upper limit; otherwise an error will be returned.

Example:

COMP:SEQ:BIN 10, 20, 30, 40, 50	Set the lower limit of BIN1 to 10, the upper limit of BIN1 to 20, the upper limit of BIN2 to 30, the upper limit of BIN3 to 40 and the upper limit of BIN4 to 50.

8.14.6 COMParator:SecondaryLIMit

Set or query the upper and lower limit data of the secondary parameter.

Syntax:

Command Format:	COMP:SLIM<lower limit>,<upper limit>
Query Format:	COMP:SLIM?
Return Format:	<lower limit>,<upper limit><NL^END>

Parameter:

lower limit	Lower limit value in NR1, NR2 or NR3 data format.
upper limit	Upper limit value in NR1, NR2 or NR3 data format.

Note: The lower limit should be smaller than the upper limit; otherwise an error will be returned.

Example:

COMP:SLIM 0.001, 0.002	Set the lower limit of the secondary parameter to 0.001 and the upper limit to 0.002.

8.14.7 COMParator:AuxiliaryBIN

Set or query the auxiliary BIN ON/OFF status.

Syntax:

Command Format:	COMP:ABIN<0 | 1 | OFF | ON>
Query Format:	COMP:ABIN?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the auxiliary BIN.
1 | ON	Enable the auxiliary BIN.

Example:

COMP:ABIN ON	Turn the auxiliary BIN function ON.

8.14.8 COMParator:SWAP

Set or query the swap mode function ON/OFF status. For example: The original function parameter is Cp–D – if the swap mode is now enabled, the function parameter will be changed to D-Cp. In this case, the set limits of BIN1 to BIN9 become the upper and the lower limits of D, and the original secondary limits become those of Cp. That is to say, this function is to swap the primary and the secondary parameters for the comparison. Thus, if this function is disabled, the comparison will be made according to the original sequence.

Syntax:

Command Format:	COMP:SWAP<0 | 1 | OFF | ON>
Query Format:	COMP:SWAP?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the parameter swap function.
1 | ON	Enable the parameter swap function.

Example:

COMP:SWAP ON	Swap the primary and secondary parameter.

8.14.9 COMParator:BIN:CLEar

Clear all the limit setting data on the limit table setup page.

Syntax:

Command Format:	COMP:BIN:CLE

Example:

COMP:BIN:CLE	Clear the limit data in the table.

8.14.10 COMParator:BIN:COUNt[:STATe]

Set or query the BIN count function ON/OFF status.

Syntax:

Command Format:	COMP:BIN:COUNt[:STATe]<0 | 1 | OFF | ON>
Query Format:	COMP:BIN:COUNt[:STATe]?
Return Format:	<NR1><NL^END>

Parameter:

0 | OFF	Disable the BIN count function.
1 | ON	Enable the BIN count function.

Example:

COMP:BIN:COUN 1	Turn the BIN count function ON.

8.14.11 COMParator:COUNt:DATA?

Query the current comparison result of the BIN count.

Syntax:

Query Format:	COMP:COUN:DATA?
Return Format:	<BIN1 count>,<BIN2 count>…<BIN9 count>,<OUT BIN count>,<AUX BIN count><NL^END>

Parameter:

BIN1 ~ 9 count	The count result of BIN1 ~ BIN9 in NR1 data format.
OUT BIN count	The count result of the OUT BIN in NR1 data format.
AUX BIN count	The count result of the auxiliary BIN in NR1 data format.

Example:

COMP:COUN:DATA?	Return the count result of each BIN.

8.14.12 COMParator:COUNt:CLEar

Clear all BIN count results.

Syntax:

Command Format:	COMP:COUN:CLE

Example:

COMP:COUN:CLE	Clear all BIN count results.

8.15 Mass MEMory Subsystem Commands

8.15.1 MassMEMory:LOAD:STATe

Load existing files.

Syntax:

Command Format:	MMEM:LOAD:STAT<file number>
Query Format:	MMEM:LOAD:STAT?

Parameter:

file number	File number ranging from 0 ~ 39 (NR1 data format).

Example:

MMEM:LOAD 1	Load the file with the index number 1.

8.15.2 MassMEMory:STORe:STATe

Save the current settings to a file.

Syntax:

Command Format:	MMEM:STOR:STAT<file number>"<string>"

Parameter:

file number	File number ranging from 0 ~ 39 (NR1 data format).
string	ASCII character string (max. length 16).

Example:

MMEM:STOR:STAT 5, "Resistor meas"   Save the current instrument settings to a file named "Resistor meas".

Note: If "<string>" is not input, the file will be saved under the default file name.

8.16 GBIP Common Commands

8.16.1 *RST

Reset the instrument.

Syntax:

Command Format: *RST

8.16.2 *TRG

Trigger a measurement and then send the results to the output buffer.

Syntax:

Command Format: *TRG

8.16.3 *CLS

Clear the standard event status register and the service request status register.

Syntax:

Command Format: *CLS

8.16.4 *IDN?

Query product information (manufacturer, model number, product serial number, etc.).

Syntax:

Query Format: *IDN?

Return Format: <manufacturer>,<model>,<firmware>,<HW_version><NL^END>

Parameter:

manufacturer	Name of manufacturer (Sourcetronic).
model	Instrument model (ST2839).
firmware	Firmware version.
HW_version	Hardware version.

8.16.5 *TST?

Execute an internal self test and query the test result. If there are no errors, the device returns 0.

Syntax:

Query Format:	*TST?
Return Format:	0<NL^END>

8.16.6 *ESE

Set or query each open bit of the standard event status register.

Syntax:

Command Format:	*ESE<value>
Query Format:	*ESE?
Return Format:	<value><NL^END>

Parameter:

value

Decimal expression for each bit of the operation status register in NR1 data format.
Descriptions for each byte are as follows:
7 = Power On (PON) Bit
6 = User Request (URQ) Bit
5 = Command Error (EME) Bit
4 = Execution Error (EXE) Bit
3 = Device Dependent Error (DDE) Bit
2 = Query Error (QYE) Bit
1 = Request Control (RQC) Bit
0 = Operation Complete (OPC) Bit

8.16.7 *SRE

Set or query each open bit of the service status byte register.

Syntax:

Command Format:	*SRE<value>
Query Format:	*SRE?
Return Format:	<value><NL^END>

Parameter:

value

Decimal expression for each permission bit of the status byte register in NR1 data format.
Descriptions for each byte are as follows:
7 = Operation Status Register Summary Bit
6 = Request Service (RQS) Bit
5 = Standard Event Status Register Summary Bit
4 = Message Available (MAV) Bit
3 ~ 0 = Always Zero

8.16.8 *ESR?

Query the contents of the standard event status register.

Syntax:

Query Format:	*ESR?
Return Format:	<value><NL^END>

Parameter:

value	Decimal expression for each bit of the operation status register in NR1 data format. Descriptions for each byte are the same as for the *ESE command.

8.16.9 *STB?

Query the contents of the service status byte register. The execution of this command will not affect contents of the standard status byte register.

Syntax:

Query Format:	*STB?
Return Format:	<value><NL^END>

Parameter:

value	Decimal expression contents of the service status byte register in NR1 data format. Descriptions for each byte are the same as for the *SRE command.

8.16.10 *OPC

Set or query the OPC bit of the standard event status register when the ST2839 series instrument has completed measurement of all parameters to be measured. After measurement completion, this command will instruct the instrument to add an ASCII number “1” (decimal number: 49) into the output buffer.

Syntax:

Command Format:	*OPC
Query Format:	*OPC?
Return Format:	1<NL^END>

Example:

OUTPUT 717; "*OPC"!	Set the OPC bit of the instrument when the last command is done.

9 Description for Handler

ST2839 series instruments provide users with a Handler interface, which is mainly used for the output of sorting results. This interface provides the communication signal with the system, as well as the sorting result output signal.

The separator result corresponds to the output of BIN 10.

The Handler Interface design is flexible; the output signal states can be defined according to the specific requirements.

9.1 Technology Description

Output Signal: Active low, open collector output, optoelectronic isolation.

Output Signal Judgment:

BIN Comparator: Good, over the standard, not good.

List Sweep Comparator: IN/OUT for every sweep point and PASS/FAIL for all the compared result.

INDEX: ADC ended.

EOC: End of one test and comparison.

Alarm: Alarm for circuit interruption.

Input Signal: Optoelectronic isolation.

Keylock: Lock the keys on the front panel.

External Trigger: Pulsewidth ≥ 1 μs.

9.2 Operation Description

9.2.1 Introduction

The information provided in this chapter includes the necessary descriptions of using the Handler interface signal lines and electrical features.

9.2.2 Signal Line Definition

The Handler interface has 3 signals: Comparison output, control output and control input. The signal line’s definition for the BIN comparison and list sweep comparison are below:

9.2.2.1 BIN Comparison

Comparison Output Signal:

- /BIN1 ~ /BIN9
- /AUX
- /OUT
- /PHI (primary parameter too high)
- /PLO (primary parameter too low)
- /SREJ (secondary parameter too high/low)

Control Output Signal:

- /INDEX (analog test finished signal)
- /EOM (test ended and the compared data effective)
- /ALARM (circuit interruption)

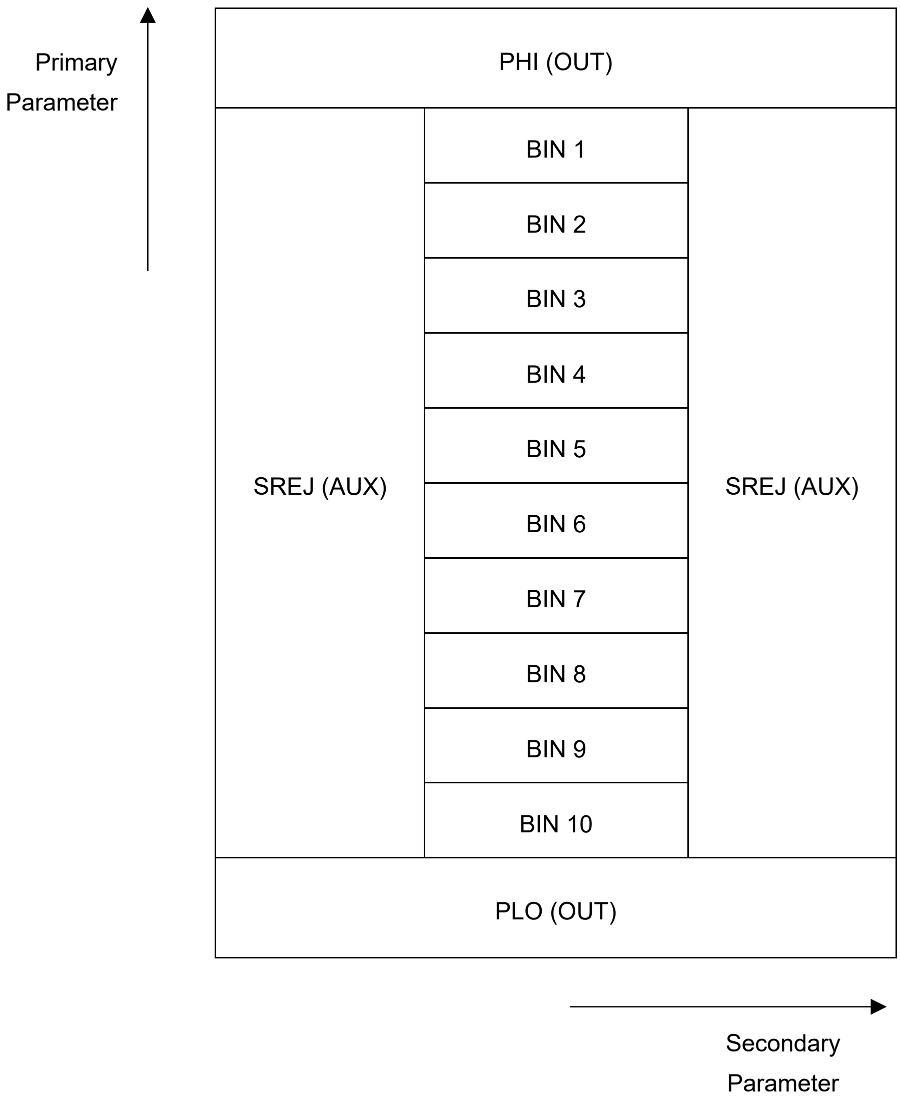
Control Input Signal:

- /EXT.TRIG (external trigger signal)
- /Keylock

Table 9-1 Pin Signal Distribution for the BIN Comparison

Pin	Signal Name	Description
1 2 3 4 5 6 7 8 9 10 11	/BIN1 /BIN2 /BIN3 /BIN4 /BIN5 /BIN6 /BIN7 /BIN8 /BIN9 /OUT /AUX	BIN sorting result. All BIN outputs are open collector outputs.
12 13	/EXT.TRIG	**External Trigger:** When the trigger mode is EXT.TRIG, ST2839 will be triggered by the positive-edge in this pin.
14 15	EXT.DCV2	**External DC Voltage 2:** The DC provider pin for the optoelectronic coupling signal (/EXT_TRIG, /KeyLock, /ALARM, /INDEX, /EOM)
16 17 18	+5V	**Internal +5V Power Supply:** Generally, it is not recommended to use the internal power supply of the instrument. If you do use it, please ensure that the current is lower than 0.3A and keep the signal line far away from interference sources.
19	/PHI	**Primary Parameter Too High:** The measurement result exceeds the upper limit in BIN1 ~ BIN9.
20	/PLO	**Primary Parameter Too Low:** The measurement result is below the lower limit in BIN1 ~ BIN9.
21	/SREJ	**Secondary Parameter Too High/Low:** The measurement result is outside the range of the upper and lower limit.
22 23 24	NC	No connection.
25	/KEY LOCK	When this signal is active, the keys in the front panel are locked.
27 28	EXT.DCV1	**External DC Voltage 1:** The pull-up DC power provider pin for the optoelectronic coupling signal (/BIN1 ~ /BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ).
29	/ALARM	Warning that the circuit has been interrupted.
30	/INDEX	When the analog measurement is complete and the UNKNOWN terminal can be connected to another DUT, /INDEX is output. But the comparison signal is not output until the /EOM signal.

31	/EOM	**End of Measurement:** Once the measurement data and the comparison results are output, this signal is also output.
32 33	COM2	Reference ground used for external power supply EXTV2.
34 35 36	COM1	Reference ground used for external power supply EXTV1.



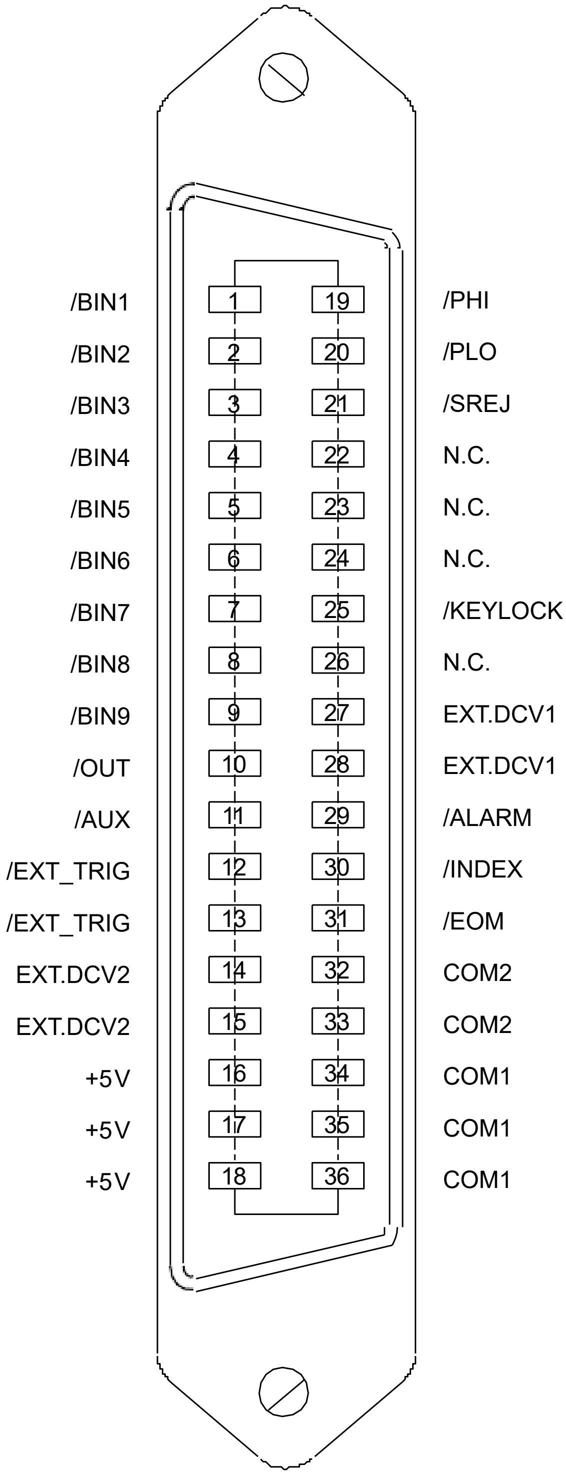
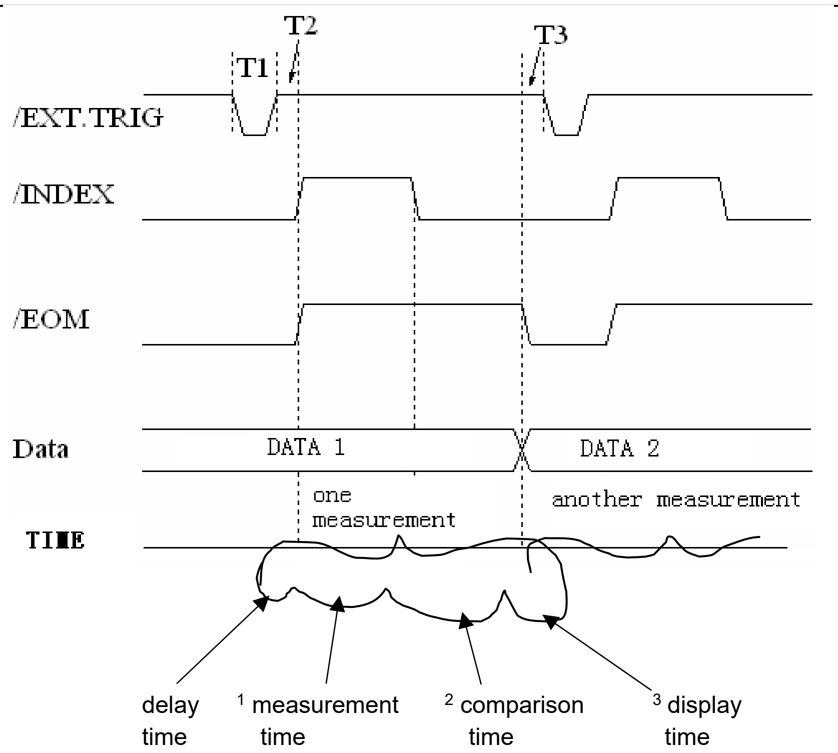


Figure 9-1 Pin Definition for Handler



Time	Minimum	Maximum
T1: Trigger Pulse-Width	1μs	—
T2: Delay Time	200μs	[3] Display Time +200μs
T3: Trigger Delay Time after /EOM Output	0μs	—

[1] For the measurement time, please refer to the operation manual.

[2] The typical comparison time is approx. 1ms.

[3] The display time for every display page is as follows:

- MEAS DISPLAY: 8ms
- BIN NO. DISPLAY: 5ms
- BIN COUNT DISPLAY: 0.5ms

Figure 9-2 Timing Chart

9.2.2.2 List Sweep Comparison

The signal definition for the list sweep comparison is different from that for the BIN comparison.

Comparison Output Signal:

- /BIN1 ~ /BIN9 and /OUT indicate IN/OUT (good or over the standard) judgements.
- /AUX signals indicate a PASS/FAIL judgement (one or more failures in the list during a scan).

When a sweep test is finished, these signals will be the output signal.

Control Output Signal:

- /INDEX (analog test finished)
- /EOM (end of measurement)

The timing is below for when /INDEX and /EOM are active:

SEQ Sweep Mode:

- /INDEX is active when the last sweep point of the analog measurement is finished.
- /EOM is active when all the measurement results are output, after every list sweep task is finished.

STEP Sweep Mode:

- /INDEX is active when the analog measurement of each sweep point is finished.
- /EOM is active when the measurement and the comparison of each sweep point are finished.

The pin distribution for the list sweep is shown in the following table and figure (the pin definition for the list sweep comparison is the same as that for the BIN comparison):

Table 9-2 Pin Signal Distribution for the List Sweep Comparison

Pin	Signal	Description
1 2 3 4 5 6 7 8 9 10	/BIN1 /BIN2 /BIN3 /BIN4 /BIN5 /BIN6 /BIN7 /BIN8 /BIN9 /OUT	Sweep point 1 outside limit values. Sweep point 2 outside limit values. Sweep point 3 outside limit values. Sweep point 4 outside limit values. Sweep point 5 outside limit values. Sweep point 6 outside limit values. Sweep point 7 outside limit values. Sweep point 8 outside limit values. Sweep point 9 outside limit values. Sweep point 10 outside limit values.
11	/AUX	Active when at least one point in the measurement result fails.
30	/INDEX	**SEQ:** The /INDEX signal is active after the analog measurement of the last sweep point is completed, and the UNKNOWN test terminal of the instrument can be connected to the next DUT. The comparison result signal is not output until the /EOM signal. **STEP:** The /INDEX signal is active after the analog measurement of each sweep point is completed. The comparison result signal is not output until the /EOM signal.
31	/EOM	**SEQ:** The /EOM signal registers after the entire list sweep measurement is completed and all comparisons are done. **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.
Other	—	The definition is the same as that of the BIN comparison.

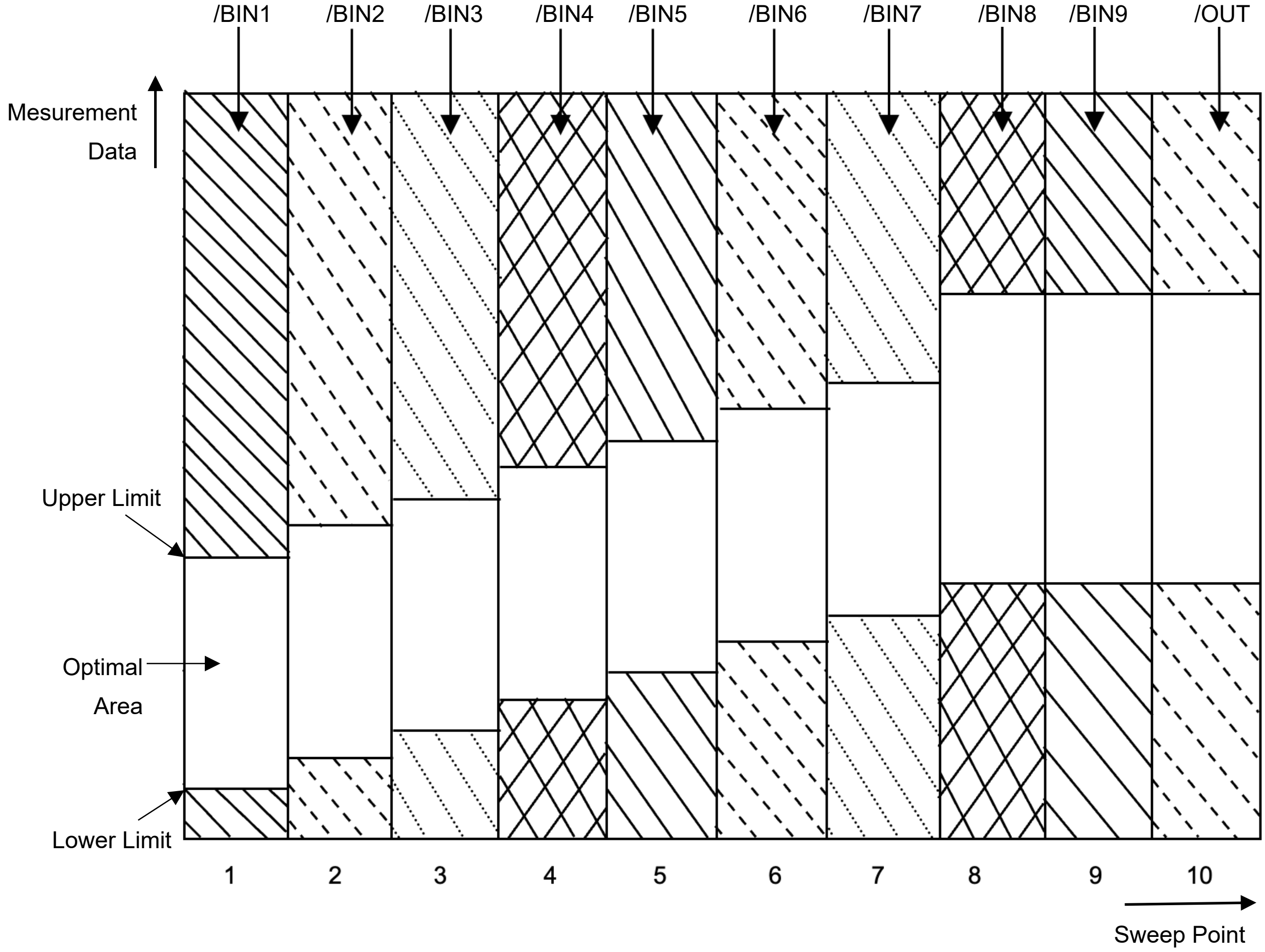


Figure 9-3 Signal Area of the List Sweep Comparison

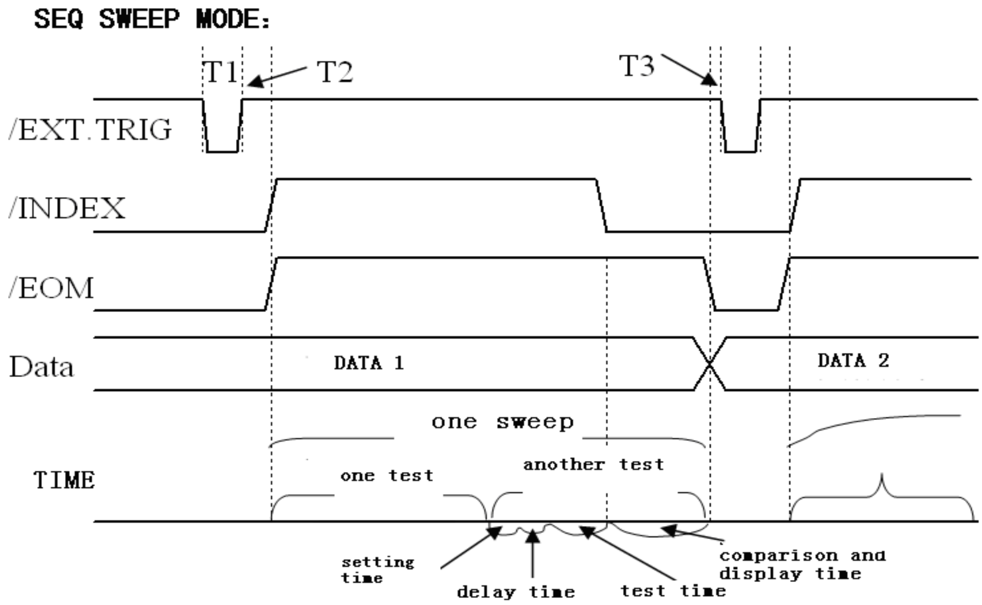


Figure 9-4 Timing Chart (Sequential Mode)

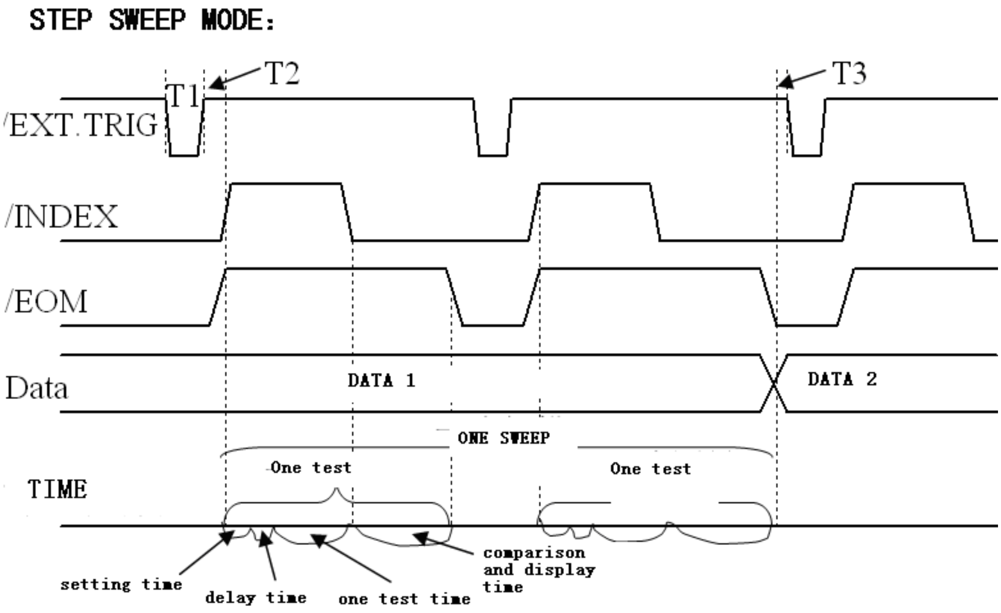


Figure 9-5 Timing Chart (Single-Step Mode)

Note:

- The setting time includes the correction ON/OFF time.
- The comparison and display time is approx. 4.5ms.

9.2.3 Electrical Features

As mentioned earlier, some of the signals in the BIN comparator function and the list sweep function have different meanings. However, the electrical characteristics of these signals are the same in both operations, and thus the following description is equally appropriate for both.

DC Isolation Output: Each DC isolation output (pin 1 to 16) 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).

The electrical characteristics of the DC isolation output are divided into two types, as shown in the following table.

<table>
<tr><th rowspan="2">Output Signal</th><th colspan="2">Output Rated Voltage</th><th rowspan="2">Maximum Current</th><th rowspan="2">Reference Ground for the Circuit</th></tr>
<tr><th>LOW</th><th>HIGH</th></tr>
<tr><td>Comparison Signal:
• /BIN1 ~ /BIN9
• /AUX
• /OUT
• /PHI
• /PLO</td><td rowspan="2">≤ 0.5V</td><td rowspan="2">+5V ~ +24V</td><td>6mA</td><td>Internal Pull-Up Voltage: ST2839 GND
EXTV1: COM1</td></tr>
<tr><td>Control Signal:
• /INDEX
• /EOM
• /ALARM</td><td>5mA</td><td>Internal Pull-Up Voltage: ST2839 GND
EXTV2: COM2</td></tr>
</table>

9.2.4 Handler Interface Board Circuit

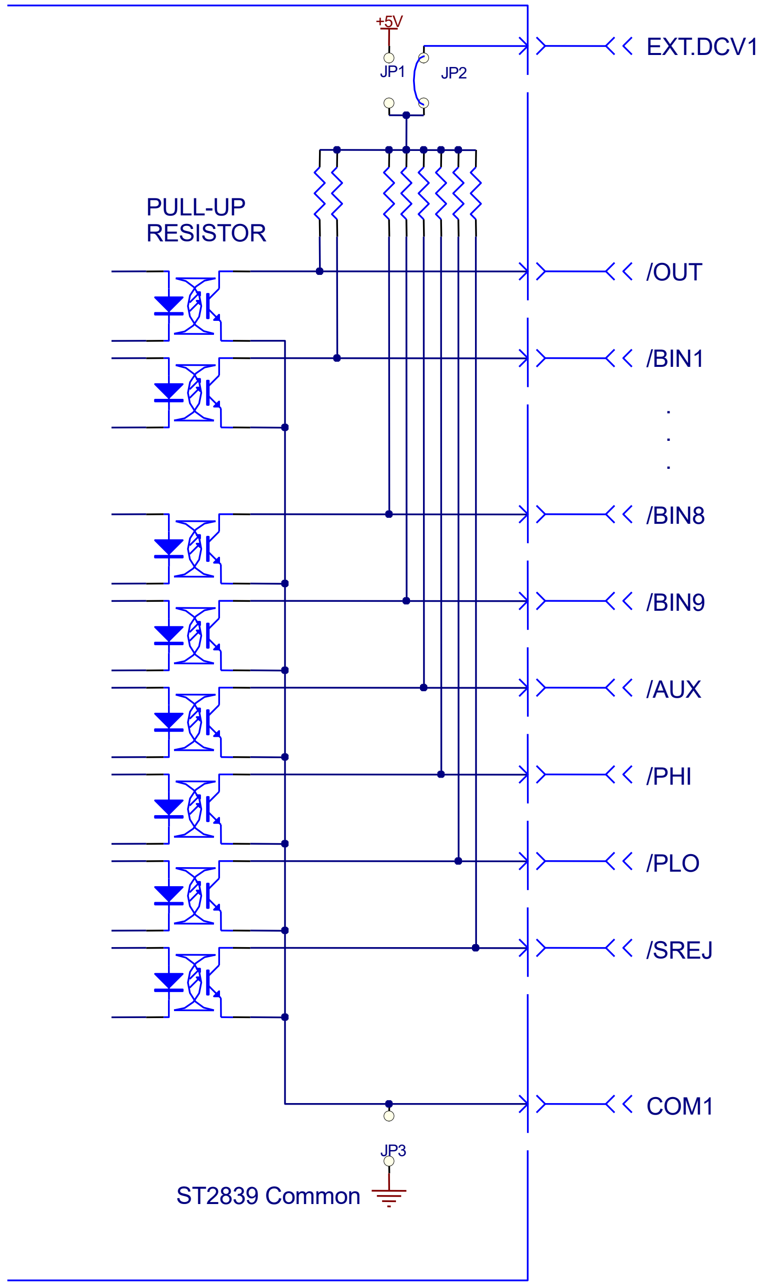


Figure 9-6 Comparison Result Signal Output Circuit

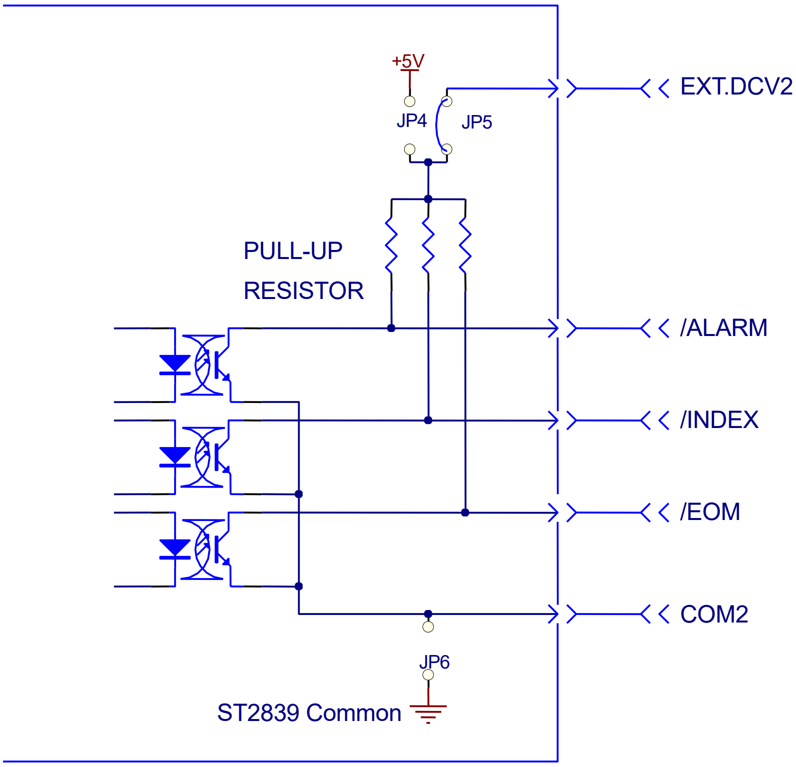


Figure 9-7 Control Signal Output Circuit

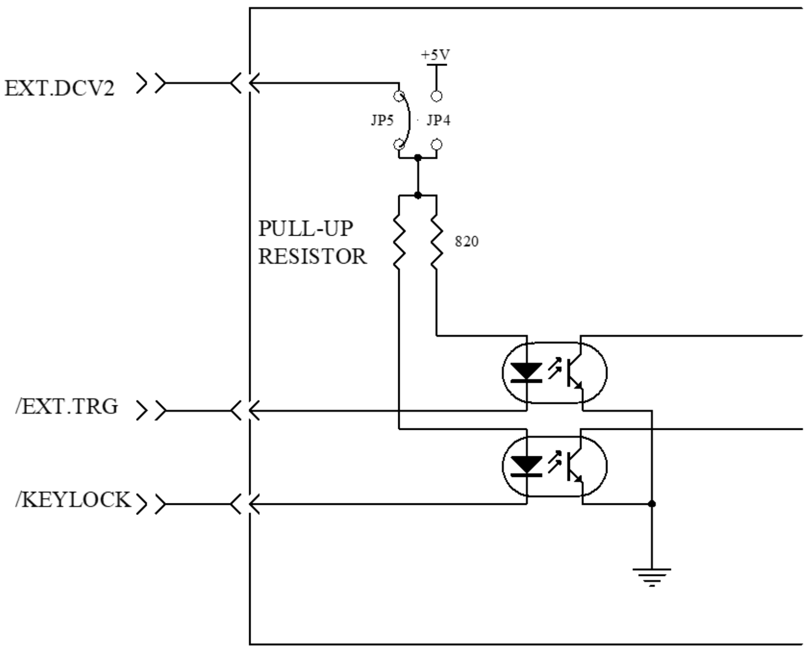


Figure 9-8 Control Signal Input Circuit

9.2.5 Operation

Before you use the Handler function, you should ensure that your instrument has installed the Handler interface board. The following operating steps will break down how to use the interface comparison and the list sweep comparison.

9.2.5.1 Comparator Function Setup

1) Press the soft key **LIMIT TABLE** to access the <LIMIT TABLE SETUP> page.
2) Set the standard value and the upper and lower limit value on the <LIMIT TABLE SETUP> page. Refer to the [DISP] key description for more details.
3) Move the cursor to COMP area. The following soft keys will be displayed:
   - **ON**
   - **OFF**
4) Press the soft key **ON** to enable the comparator function.
5) Press [DISP], then press the soft key **BIN NO.** or **BIN COUNT**. The DUT will now be measured, and at the same time, you can set the counter for the DUT and the auxiliary.

Note: COMP ON/OFF can also be configured on the <BIN COUNT> page.

9.2.5.2 List Sweep Comparison Setup

1) Press the soft key **LIST SETUP** to access the <LIST SWEEP SETUP> page.
2) Set the sweep mode, sweep frequency point, reference value, as well as the upper and lower limit values. Refer to the [DISP] key description for more details.
3) Press [DISP], then press the soft key **LIST SWEEP** to access the <LIST SWEEP DISP> page. Refer to the [DISP] key description for more details.

Note: The following methods can be used to improve speed:

- Set the range to the maximum that the capacitance may be and lock this range.
- Set Vm and Im both to OFF on the <MEAS SETUP> page.
- Measure the DUT on the <BIN COUNT> page.

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