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Manual

ST2830 Series LCR Meter

OPERATION MANUAL

ST2830 Series

LCR Meter

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Contents

Note

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

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1   Out of Box Audit

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

1.1 Inspect the Package

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

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

1.2 Power Connection

1)   Power-supplying voltage range: 198~242Vac.

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

3)   Power-supplying power range: no less than 80VA.

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

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

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

1.3 Fuse

The device is equipped with a 5x20mm fine-wire fuse. For operation at 100-120V a fuse with trip 4A slow-blow is required, for operation at 198-242V 2A slow-blow. The mains voltage used is selected by the position of the gray insert in the fuse holder. The factory setting is 220V. To change the voltage range, remove the gray insert from the fuse holder and reinsert it rotated 180° so that the desired voltage range is visible in the small window.

WARNING!

⚡	Make sure the displayed voltage range matches that of your power supply! When inserting the fuse holder, take care not to bend the contact springs.

1.4 Environment

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

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

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

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

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

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

1.5 Use of Test Fixture

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

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

NOTE
If neither text fixture nor cables have been connected, the instrument will display an unstable test 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 not switch the instrument on and off unnecessarily; this may affect measurement accuracy.

1.7 Other Features

1)   Power consumption: ≤ 80VA.

2)   Dimension (W*H*D): 235mm*105mm*360mm

3)   Weight: About 3.6 kg.

2   Introduction

This chapter details the basic operation features of ST2830 Series Precision LCR meters. Please read this chapter carefully before using your device.

2.1 Front Panel

Figure 2-1 shows the front panel of ST2830.
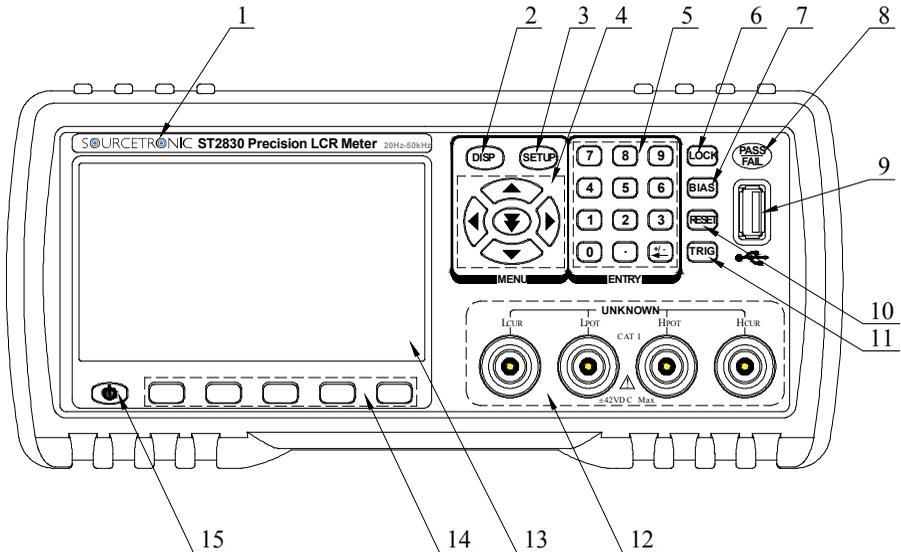
Figure 2-1 Front Panel

1)   Brand and Model

2)   [DISP]

Press this key to enter into the measurement display page.

3)   [SETUP]

Press this key to enter into the measurement setup page.

4)   Cursor Controls

These keys are used to move the cursor on the LCD display. When the cursor moves to an field, the active field lights up.

5)   Numerical Keys

These keys are used to input data to the instrument. They consist of the numerical keys [0] to [9], a decimal point [.] and a [+/-←] key, which – when pressed first – changes the sign, or otherwise deletes the last character entered.

NOTE
Long-pressing the [.] key saves a screenshot to the currently connected USB device (see no. 9).

6)   [KEYLOCK]

Pressing [KEYLOCK] locks the control panel; pressing it again unlocks it. In the locked state, the key lights up. If the password function is ON, the correct password is required for unlocking.

If the device is controlled via RS232, [KEYLOCK] is also active and lit up. In this case, too, you can release the lock by pressing [KEYLOCK] and entering the password if necessary.

If the device is switched off while [KEYLOCK] is active, the last loaded configuration file is automatically reloaded the next time the device is switched on.

7)   [BIAS]

[BIAS] is used to the 0-50mA/5V DC bias current source on or off. When you press this key, it lights up, which means the DC bias output is active. When you press this key again, it will turn off, which means the DC bias output is now deactivated. On pages where no DC bias function is provided, such as DCR, Lp-Rd and Ls-Rd, the key is disabled.

NOTE
This function is only present in ST2832, not in ST2830 or ST2831!

8)   PASS/FAIL Indicator

The green PASS LED indicator shows the test has passed.

The red FAIL LED indicator shows the test has failed.

9)   USB HOST Interface

Connect a USB flash drive to save, load or copy files, or to create screenshots.

10)   [RESET]

Press this key to cancel the automatic test sequence. On other pages, this key has no function.

11)   [TRIGGER]

If the trigger mode is set to MAN (manual) mode, press this key to start a measurement cycle.

12)   Test Terminals (UNKNOWN)

Four terminals for connecting the DUT via four-wire test adapter/box or four-wire Kelvin test terminals.

The four terminals are as follows:

- Hcur
- Hpot
- Lpot
- Lcur

13)   LCD

480*272 color TFT LCD displays the measurement results and settings.

14)   Soft Keys

The five soft keys are used to select parameters and functions. The current function of each key is displayed directly above it (at the bottom of the LCD). The available functions depend on the currently open page.

15)   POWER

Power switch.

2.2 Rear Panel

Figure 2-2 shows the rear panel of the ST2830 device.
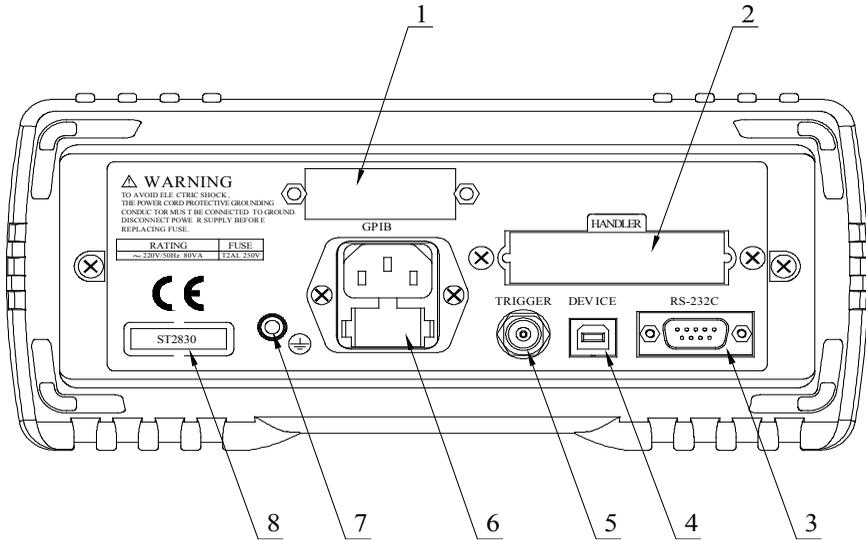
Figure 2-2 Rear Panel

1)   IEEE-488 (GPIB) Interface

The device can optionally be connected to the PC via GBIP.

2)   HANDLER Interface

The handler interface is used to realize the sorting of DUTs.

3)   RS232C Interface

Serial interface for communication with the PC.

4)   USB DEVICE Interface

The device can be connected to the PC via USB.

5)   TRIGGER Interface

A foot switch or other external trigger source can be connected here.

6) **Power socket**

Socket for a cold appliance plug. Always use three-pole connection cables with protective conductor and a corresponding socket.

7) **Ground Terminal**

This terminal is connected to the casing of the device and the protective conductor.

8) **Nameplate**

Information regarding production date, instrument number and manufacturer, etc.

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

2.3 Display

ST2830 series LCR meters use a 65k, 4.3-inch TFT display. The display screen is divided into the following fields:
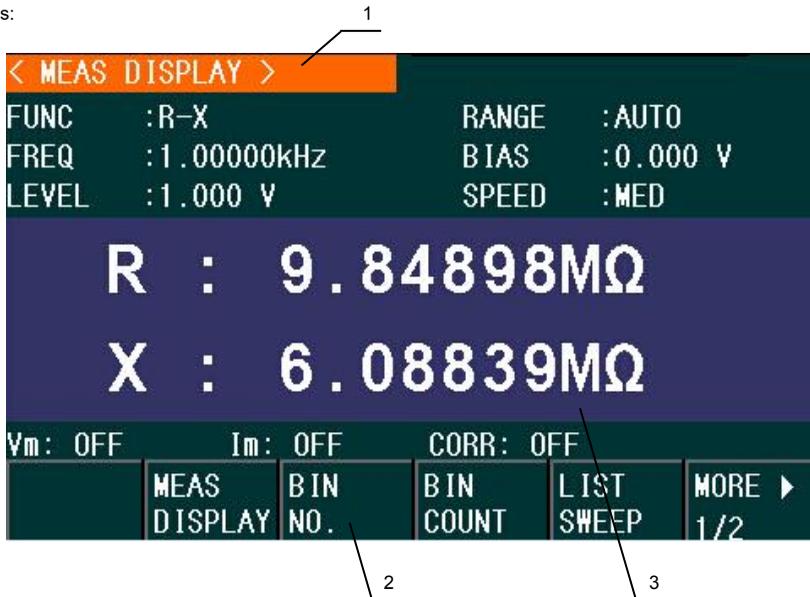
Figure 2-3 Display Fields

1)   **Display Page Name**

Indicates the name of the currently displayed page.

2)   **Soft Keys**

The current function of the soft keys below is displayed here. Their function differs depending on the

screen page and the cursor position.

3)   **Test Result/Settings Display Field**

In this field, test results and related settings are displayed.

2.4 Main Menu Keys and Corresponding Displayed Pages

2.4.1 [DISP]

When the LCR function is active, press the [DISP] key to enter into the **<LCR MEASUREMENT DISPLAY>**

page, the following soft keys will be displayed for accessing sub-pages:

- MEAS DISPLAY

- BIN NO.

- BIN COUNT

- LIST SWEEP

- MORE ▶

  1/2

- FILE MANAGE

- SAVE LOG

- MORE ▶

  2/2

NOTE
The SAVE LOG key is valid on the **<MEAS DISPLAY>** and **<LIST SWEEP>** pages. If you connect a USB stick and then press SAVE LOG, the status changes to ON and the measurement data is saved in .CSV format in the CSV directory. If you press SAVE LOG again, the status changes to OFF and saving is terminated.

The instrument will automatically record test data after inserting a USB disk in the MEAS interface.

2.4.2 [SETUP]

When the LCR function is active, press the [SETUP] key to access the **<LCR MEASUREMENT SETUP>** page with the following soft keys available:

- MEAS SETUP
- CORRECTION
- LIMIT TABLE
- LIST SETUP
- MORE ▶

  1/2
- FILE MANAGE
- SYSTEM SETUP
- TOOLS
- MORE ▶

  2/2

2.4.3 SYSTEM SETUP

The SYSTEM SETUP key is used to enter into the **<SYSTEM SETUP>** page with the following soft keys:

- SYSTEM SETUP
- MEAS SETUP
- DEFAULT SETTING
- SYSTEM RESET

2.5 Basic Operation

The basic operating procedure of ST2830 is as follows:

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

- Use the cursor keys ([←][→] [↑] [↓]) to move the cursor to the desired field. The field under the current cursor position will be displayed inverted.

- The soft keys belonging to the current cursor position are shown at the bottom of the display. Press the desired key. Use soft keys, numeric keys, [+/-] and [←] to input data.

- If a numeric key is pressed, soft keys are displayed with the units of measurement that match the field, including the prefix. You can complete the entry with one such soft key. If you want to enter a negative

value, first press the [+/-←] key. If a numeric key has already been pressed, the [+/-←] key deletes the

last character entered.

2.6 Start the Instrument

Plug in the power plug.

Caution!
⚠️	Make sure that the power supply voltage and frequency correspond to the specifications. Use a power cord with a protective earth conductor and protective contact plug. The power input phase line L, zero line N and ground line E should be the same as that of the instrument.

Press the power switch in the lower left corner of the front panel. A boot screen appears showing our company

logo, the device model (ST2830) and the software version (Ver1.00).

3   Introduction to [DISP]

3.1 <MEAS DISPLAY>

Upon pressing the [DISP] key, the following **<MEAS DISPLAY>** page will be displayed on screen:
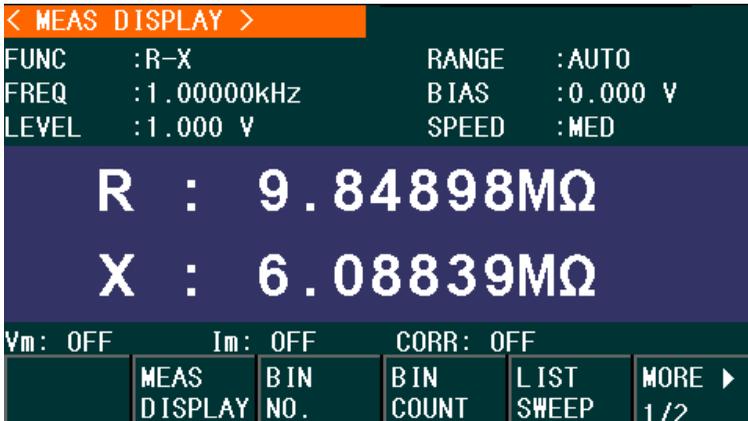
Figure 3-1 MEAS DISPLAY Page

On this page, the test result is displayed in capital characters. The following measurement control parameters can be set on this page:

- Test function (**FUNC**)

- Test frequency (**FREQ**)

- Test level (**LEVEL**)

- Test range (**RANGE**)

- DC bias (**BIAS**)

- Test speed (**SPEED**)

There are six fields in this page (**FUNC**, **FREQ**, **LEVEL**, **RANGE**, **BIAS** and **SPEED**), which will be discussed in further detail in this chapter.

The measurement result/condition display area in the lower part of the page shows information about the measurement conditions. These conditions can be set on the **<MEAS SETUP>** page or the **<CORRECTION>** page.

- Signal source voltage/current monitor (**Vm, Im**)

- Open/short/load correction ON/OFF status (**CORR**)

3.1.1 Measurement Function

In one measuring cycle, the ST2830 can measure two parameters of an impedance, a primary and a secondary parameter. The following parameters can be measured:

Primary parameters

- |Z| (Absolute value of impedance)

- |Y| (Absolute value of admittance)

- L   (Inductance)

- C   (Capacitance)

- R   (Resistance)

- G   (Conductance)

- DCR   (DC resistance)

Secondary Parameters

- D   (Dissipation factor)

- Q   (Quality factor)

- R_s (Equivalent Series Resistance ESR)

- R_p (Equivalent Parallel Resistance)

- Rd   (DC resistance)

- X   (Reactance)

- B   (Susceptance)

- θ   (Phase Angle)

The measurement results of the primary and secondary parameters are displayed in capital letters in one of two lines each, the primary parameter in the upper line and the secondary parameter in the lower line.

How to set the measurement function:

1)   When you move the cursor to **FUNC** field, the following soft keys will be displayed on the screen:

- C_p—…→

- C_s—…→

- L_p—…→

- L_s—…→

- MORE→

  1/3

2) When you press C_p—…→, the following parameters will be available to choose from:

- C_p-D

- C_p-Q

- C_p-G

- C_p-R_p

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

3) When you press Cs—…→, the following parameters will be available to choose from:

- Cs-D

- Cs-Q

- Cs-Rs

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

4) When you press L_p—…→, the following parameters will be available to choose from:

- L_p-Q

- L_p-R_p

- L_p-R_d

- MORE→

    1/2

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

5) When you press MORE→, the following parameters will be available to choose from:

- L_p-D

- L_p-G

- MORE→

    2/2

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

6) When you press Ls—…→, the following parameters will be available to choose from:

- Ls-D

- Ls-Q

- Ls-Rs

- Ls-Rd

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

7) When you press MORE→, the following parameters will be available to choose from:

- Z—…→

- Y—…→

- R—…→

- G-B

- MORE→

2/3

8) When you press Z—…→, the following parameters will be available to choose from:

- Z-d

- Z-r

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

9) When you press Y—…→, the following parameters will be available to choose from:

- Y-d

- Y-r

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to the upper soft key menu.

10) When you press R—…→, the following parameters will be available to choose from:

- R-X

- Rp-Q

- R_s-Q

- RETURN←

Press the soft key corresponding to your desired parameter. Then press RETURN← to return to upper soft key menu.

11) When you press MORE→, the following parameters will be available to choose from:

- DCR

- MORE→

   3/3

Press DCR and choose the desired parameter. Then press MORE→ to return to the first page of the soft key menu.

3.1.2 Measurement Range

The measurement range should be selected depending on the expected impedance of the tested LCR component.

ST2830 has 10 AC measurement ranges: 3Ω, 10Ω, 30Ω, 100Ω, 300Ω, 1kΩ, 3kΩ, 10kΩ, 30kΩ, 100kΩ.

ST2830 has 11 DCR measurement ranges: 1Ω, 3Ω, 10Ω, 30Ω, 100Ω, 300Ω, 1kΩ, 3kΩ, 10kΩ, 30kΩ, 100kΩ.

How to set the measurement range:

1) When you move the cursor to the **RANGE** field, the following soft keys will be displayed:

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

- HOLD: This soft key is used to 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 field.

- DECR-: This soft key is used to decrease the range in HOLD mode.

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

2) Use the soft keys to set the measurement range.

3.1.3 Measurement Frequency

The frequency range of the ST2832 is from 20Hz to 200kHz in steps of 0.01Hz. If the measuring function DCR is active, the **FREQ** field will display "**---**".

Device Model	Frequency Range	Points
ST2830	50Hz–100kHz	34
ST2831	50Hz–200kHz	37
ST2832	20Hz–200kHz	15025

How to set the test frequency:

The instruments of the ST2830 series support two methods for setting the measuring frequency. The first one is the input via soft keys, the other one is the direct input via the numeric keys.

1) When you move the cursor to the **FREQ** field, the following soft keys will be displayed:

- INCR(++): This soft key is used for coarse adjustment of the frequency. When the key is pressed, the frequency increases to the next higher value in this sequence:

Model	Frequency Point
ST2830	50Hz, 100Hz, 1kHz, 5kHz, 100kHz, 100kHz
ST2831	50Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz
ST2832	20Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz

- INCR(+): This soft key is used to fine tune the frequency. When the key is pressed, the frequency increases to the next higher value in this sequence:

  (20Hz   25Hz   30Hz   40Hz – ST2832 only)   50Hz   60Hz   75Hz

  100Hz   120Hz   150Hz   200Hz   250Hz   300Hz   400Hz   500Hz   600Hz   750Hz   1 kHz
  1.2kHz   1.5kHz   2kHz   2.5kHz   3kHz   4kHz   5kHz   6kHz   7.5kHz 10kHz   12kHz
  15kHz   20kHz   25kHz   30kHz   40kHz   50kHz   60kHz   75kHz   100kHz   120kHz
  150kHz   200kHz

  Note that ST2830 and ST2831 do not support all of these frequencies!

- DECR(-): This soft key is used to fine tune the frequency. When the key is pressed, the frequency increases to the next lower value in the sequence detailed under INCR(+).

- DECR(--): This soft key is used for coarse adjustment of the frequency. When the key is pressed, the frequency increases to the next lower value in the sequence detailed under INCR(++).

2) Use soft keys or numeric keys to select or set frequency.

    If you are using numeric keys to input the required frequency, the soft keys will display the available frequency units (Hz, kHz and MHz). Complete the entry with the soft keys to set frequency and prefix.

NOTE
If the entered frequency is not available, it is automatically rounded up to the next higher frequency point.

3.1.4 Measurement Level

The measurement signal level of the ST2830 series instruments can be set using the RMS value of the sine signal. The frequency of this sinusoidal signal generated by the internal oscillator was set in the previous section. You can set a current or a voltage. The output impedance of the ST2830's measurement signal source can be set to 30Ω or 100Ω. The measurement level range is 10mV-2V. If the value is entered as a current, the maximum current is calculated to maximum voltage level divided by output impedance.

NOTE
The measuring current is the short-circuit current with short-circuited test contacts, the measuring voltage is the open-circuit voltage with open contacts.

The automatic level control function (ALC) of ST2830 allows the measurement of constant voltage or current. The ALC can be switched on in the **<MEAS SETUP>** page. While the function is active, "*****" is displayed after the actual measured level value. Regardless of whether the function is enabled, in each case the actual measurement level values from the control measurement are used to calculate the actual display value. For more information, see section 3.5.

How to set the measurement level:

The ST2830 supports two methods for setting the measurement level. The first is input using soft keys, the other is direct input using the numeric keys.

1) When you move the cursor to **LEVEL**, the following soft keys will be displayed:

- INCR(+): This soft key is used to increase the level of measuring signal source.

- DECR(-): This soft key is used to decrease the level of measuring signal source.

2) Use the soft keys or numeric keys to select or set the measurement level.

    When 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 field. Complete the entry with the soft keys to set unit and prefix.

NOTE
To switch between current and voltage, the value must be entered using the numeric keys and completed with the corresponding unit soft key.

3.1.5 DC Bias

The ST2832 has an internal DC bias source which can supply -5V to +5V (100Ω) or -1.5V to +1.5V (30Ω) or -50mA to +50mA depending on the set output impedance. In DCR (direct current resistance) measurement mode, this is inactive and the **BIAS** field shows "---". ST2830 and 2831 do not have an internal BIAS source.

How to set the DC bias:

The ST2832 supports two methods for setting the DC bias. The first is input using soft keys, the other is direct input using the numeric keys.

1) When you move the cursor to **BIAS**, the following soft keys will be displayed:

- INCR(+): This soft key is used to increase the output level of the DC bias.

- DECR(-): This soft key is used to decrease the output level of the DC bias.

2) Soft or numeric keys can be used to select or set the DC bias source.

When numeric soft 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 field. Complete the entry with the soft keys to set unit and prefix.

NOTE
To switch between current and voltage, the value must be entered using the numeric keys and completed with the corresponding unit soft key.

Press the [DC BIAS] key on the left side of the screen to turn on the DC bias source. When the DC bias source is on, the [DC BIAS] key lights up.

3.1.6 Measurement Speed

The measurement speed of ST2830 is determined by the following factors:

- Integration time (A/D conversion)

- Average times (average test times per each test)

- Measurement delay (from startup to the beginning of the measurement)

- Display time of test results

You can select from FAST, MED (medium) and SLOW test modes. Generally, the measurement results are more stable and accurate in the SLOW mode.

How to set the measuring speed:

1) When you move the cursor to **SPEED**, the following soft keys will be displayed:

- FAST

- MED

- SLOW

2) Use the soft keys listed above to set the measuring speed.

3.1.7 Presentation of the Measurement Results

The measurement results are displayed by the ST2830 as a six-digit floating point number. This function can be used to switch the display of the measured values selected under **FUNC** to fixed point. This can change the currently displayed measured value until the next update.

How to set the decimal place and character size:

1) When you move the cursor to one of up to two **MEAS RESULT DISP** fields, the following soft keys will be displayed:

- D.P. AUTO

- D.P. FIX

- D.P.POS INCR +

- D.P.POS DECRL-

2) Press D.P. AUTO to reset the decimal position of the primary or the secondary parameter test result to its default setting (floating point).

3) Press D.P. FIX to fix the current comma position of the displayed measured value.

4) Press D.P.POS INCR + to to move the comma position one place to the left.

5) Press D.P.POS DECL - to to move the comma position one place to the right.

NOTE
Under the following circumstances, the display is automatically reset to floating point: • The measurement function is changed to another parameter. • The display mode (ΔABS, Δ%, OFF) is changed in the deviation measurement.

3.2 <BIN NO. DISP>

First, press [DISP], then press the BIN NO. soft key to access the **<BIN NO. DISP>** display page. On this page, **BIN NO.** is displayed in upper-case characters, while the test result is displayed in lower-case characters.

Figure 3-2 BIN NO. DISP Page

The following control parameters can be set on **<BIN NO. DISP>**:

- Compare function ON/OFF (**COMP**)

There are two fields: **BIN NO. DISP** and **COMP**. The latter will be explained in the following section.

The measurement conditions listed below are displayed in the settings area on this page, but can only be changed on the **<MEAS SETUP>**, **<MEAS DISP>** or **<CORRECTION>** pages:

- Test function (**FUNC**)

- Test frequency (**FREQ**)

- Test level (**LEVEL**)

- Test range (**RANGE**)

- **BIAS**

- Test speed (**SPEED**)

- ON/OFF set state of OPEN, SHORT, LOAD (**CORR**)

3.2.1 Comparator Function

The ST2830 has a built-in comparison function that allows the DUT to be assigned to one of up to ten sorting bins (BIN1 to BIN9 and BIN OUT). Nine pairs of limits of the primary parameter and one pair of the secondary parameter can be set by the user. If the primary parameter of the DUT is within the limits of any compartment, but the secondary one is not, the DUT will be assigned to the BIN AUX compartment if it is enabled, otherwise to BIN OUT. If the primary parameter is already outside the limits, the DUT is sorted into BIN OUT. If the HANDLER interface is installed, the comparison result is output via this, so that a connected sorting unit can automatically file the DUTs. The limit values can only be configured on the **<LIMIT TABLE SETUP>** page. The comparator function can be set in the **COMP** field using the soft keys.

AUX 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

How to use the comparison function

1) When you move the cursor to **COMP**, the following soft keys will be displayed:

- ON

- OFF

2) Select one of above soft keys to switch the comparison function on or off.

3.3 <BIN COUNT DISP>

Press [DISP] and then select the BIN COUNT soft key to access the <u>**<BIN COUNT>**</u> page where the count

values for each bin are displayed.

Figure 3-3 BIN COUNT Page

The following control parameters can be set on the <u>**<BIN COUNT>**</u> page:

- Count function ON/OFF (**COUNT**)

There are two fields in this page, each with their own soft key assignments: **BIN COUNT DISP** and **COUNT**.

The function of each field will be introduced below.

The measurement conditions listed below are displayed in the settings area on this page, but can only be

changed on the <u>**<LIMIT TABLE SETUP>**</u> page:

- Test parameter (**PARAM**)

- Nominal value (**NOM**)

- Bin limit value (**HIGH/LOW**)

3.3.1 PARAM

The Parameter field shows the active measuring functions. If the swapping of primary and secondary

parameter is activated, the parameters are also displayed swapped, e.g. "**Cp-D**" as "**D-Cp**", which means that

the current **D** is compared as primary and **Cp** as secondary parameter.

3.3.2 NOM.

The nominal parameter is the reference nominal value used for the bin comparison.

3.3.3 BIN

This column shows the sorting compartment number of the limit value list. "2nd" stands for the limit values of the secondary parameter.

3.3.4 HIGH/LOW

The respective upper and lower limit values are displayed in these columns.

3.3.5 COUNT

This field shows the count value of the current bin.

3.3.6 AUX

This field shows the count value of the auxiliary bin.

3.3.7 OUT

This field shows the count value of the out bin.

How to use the counting function:

1) On the **<u><BIN COUNT DISP></u>** page, when you move the cursor to the **COUNT** field, the following soft keys will be displayed:

- ON

- OFF

- RESET COUNT

2) Press ON to turn on the count function.

3) Press OFF to turn off the count function.

4) When you press RESET COUNT, the message "☺ : Reset count, Sure?" will be displayed in the help field. The following soft keys will be available:

- YES

- NO

5) Press YES to reset all bin counts to 0.

6) Press NO to cancel the reset.

3.4 <LIST SWEEP DISP>

Up to ten measuring frequencies, measuring levels or DC bias levels can be run through on one page. Upper

and lower limit values can be set for each point in the list. An automatic list scroll takes place over these points

and the measurement results are compared with the set limit values. Press down the menu key [MEAS

DISPLAY] and then the soft key LIST SWEEP to enter into the **<LIST SWEEP DISP>** page, as shown below.

Figure 3-4 LIST SWEEP DISP Page

The list of measuring points is scrolled through automatically. The measurement results and the set limit

values are compared. During the list run, a "►" indicates the current list point.

The following control parameters can be set on **<LIST SWEEP DISP>**:

- Sweep mode (**MODE**)

There are two fields on this page: **LIST SWEEP DISP** and **MODE**. List sweep points cannot be set on this

page but can be set on **<LIST SWEEP SETUP>**.

3.4.1 Sweep Mode

The list function of ST2830 can perform an automatic list sweep measurement for up to 201 points'

frequencies, measurement levels or DC bias levels. Two sweep modes are available in the ST2830: SEQ and

STEP. In SEQ mode, each press of the [TRIGGER] key will direct ST2830 to automatically sweep through all

of the measurement points in the list. In STEP mode, [TRIGGER] must be pressed separately for each

measuring point on the list.

NOTE
For this purpose, the trigger mode of the device must be set to MAN. If the trigger mode is set to INT, the list tests are not triggered by the [TRIGGER] key.

How to set the the list scroll function:

1)   On the **<LIST SWEEP DISP>** page, when you move the cursor to the **MODE** field, the following soft keys will be displayed:

- SEQ

- STEP

2)   Press SEQ to select the sequential list scrolling mode.

3)   Press STEP to select the single-step mode.

3.4.2 FREQ (Hz)

This column header shows the variable parameter and its unit. The column contains the individual list entries.

3.4.3 R[:] X[:]

The primary and secondary parameters are displayed here together with the unit, and the respective measured values are displayed below them.

3.4.4 CMP (Compare)

This column contains the comparison results. For each list entry it can be selected whether the primary or the secondary parameter is to be compared, and an upper and lower limit value can be configured. L in this column means that the respective measurement result is below the set lower limit, H correspondingly above, otherwise the field remains empty.

3.5 <MEASURE SETUP>

Press [SETUP] to access the **<MEASURE SETUP>** page as shown below:

Figure 3-5 MEASURE SETUP Page

The following parameters can be set here (the display name in brackets):

- Measurement Function (**FUNC**)

- Measurement Frequency (**FREQ**)

- Measurement Level (**LEVEL**)

- Measurement Range **(RANGE**)

- DC Bias (**BIAS**)

- Measurement Speed (**SPEED**)

- Trigger Mode (**TRIG**)

- Auto Level Control (**ALC**)

- Output Resistance (R_{sou})

- Average Times (**AVG**)

- Voltage/Current Level Monitor ON/ OFF (**Vm/Im**)

- DCR Polarity (**DCR POL**)

- Trigger Delay **(TRIG DLY)**

- Step Delay **(STEP DLY)**

- DC Range (**DC RNG**)

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- DC Level (**DC LEV**)

- 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 fields listed below are identical to those on the **<MEAS DISPLAY>** page, so they do not need to be explained here, but others will be introduced briefly in the following sections.

- Measurement Function (**FUNC**)

- Measurement Frequency (**FREQ**)

- Measurement Level (**LEVEL**)

- Measurement Range **(RANGE**)

- DC Bias (**BIAS**)

- Measurement Speed (**SPEED**)

3.5.1 Trigger Mode

The ST2830 supports four trigger modes: INT, MAN, EXT and BUS.

When the trigger mode is set to INT, the ST2830 performs continuous, repeated measurements.

When the trigger mode is set to MAN, the [TRIGGER] key will trigger a single measurement cycle.

When the trigger mode is set to EXT, the ST2830 performs a measurement cycle when it receives an active pulse on the corresponding pin at the trigger input or at the (optional) HANDLER interface.

When the trigger mode is set to BUS, the ST2830 executes a measuring cycle when it receives a TRIGGER command via the IEEE488 interface.

NOTE
If the ST2830 receives a trigger signal while a measurement is underway, this will be ignored. The trigger signal will only become active again after the end of the measurement.   When the optional HANDLER interface triggers ST2830, the trigger mode is set to EXT.

How to set the trigger mode:

All trigger modes except BUS can be set here. If the BUS mode is required, the command **TRIGger:SOURce BUS** must be sent via the IEEE488 interface.

1)   When you move the cursor to the **TRIGGER** field, the following soft keys will be displayed:

- INT

- MAN

- EXT

2)   Use the soft keys listed above to set the trigger mode.

3.5.2 Auto Level Control Function (ALC; ST2832 Only)

The automatic level control adjusts the actual measuring level (voltage across or current through the device under test) to the preset value. This function ensures that the level of measuring voltage or measuring current remains constant.

If the function is inactive, the level applied to the DUT may deviate from the preset value due to the internal resistance of the source and parasitic resistances. However, due to the four-wire measurement, the actual applied values are always used for the internal calculations.

When the function is activated, the levels can be set within the following limits:

Constant voltage level: 20 mVrms to 1 Vrms

Constant current level: 200 µArms to 10 mArms

NOTE
If the set level exceeds the range given above, the function is automatically disabled. Generally, the level is considered to be non-constant.

How to use the auto level control function:

1)   When you move the cursor to **ALC** field, the following soft keys will be displayed:

- ON

- OFF

2)   Press the corresponding soft key to switch ALC on or off.

3.5.3 Output Impedance

The ST2830 supports two selectable output resistances: 100 Ω and 30 Ω. When testing inductances, it is advisable to select a uniform output resistance for all measuring instruments to ensure comparability.

NOTE
When an optional bias board is selected, only 100Ω is available.

How to set the output impedance:

1)   When you move the cursor to the **R_{sou}** field, the following soft keys will be displayed:

- 100 Ω

- 30 Ω

2)   Press the corresponding soft key to set the output resistance.

3.5.4 Average

This function calculates the display value as the average of two or more individual measurements. This increases the accuracy of the display value, at the cost of an increase in the measurement duration. The number of single measurements can be set from 1 (=disabled) to 255.

How to set the measurement average times:

1)   When you move the cursor to the **AVG** field, the following soft keys will be displayed:

- INCR (+): This key is used to increase the average times.

- DECR (-): This key is used to decrease the average times.

2)   Use the above soft keys or enter the number directly using the numeric keypad and conclude with the *1 soft key.

3.5.5 Voltage/Current Level Monitor Function

The level monitor function monitors the actual voltage applied to the DUT or the current flowing through it. The value of the monitored voltage is displayed on the <u>**<MEASURE DISP>**</u> page in the **Vm** field, the current in the **Im** field. This is a purely informative function; if the instrument is to readjust the measured level to the set value, the level tracking function (→ **Error! Reference source not found.**) must be used.

NOTE
The level control function can be affected by the correction function so that the displayed values change when the correction data is changed or switched between OPEN, SHORT and LOAD.

How to set the level monitor function:

1)   When you move the cursor to the **Vm/Im** field, the following soft keys will be displayed:

- ON

- OFF

2)   Press the corresponding soft key to switch the level monitor function on or off.

3.5.6 DCR Polarity

The ST2830 shall support two test modes for DC resistance: ALT and FIX. However, currently only the ALT mode is available. In ALT mode the polarity of the DC measurement voltage alternates, in FIX mode it is always positive. The ALT mode ensures that inductors do not build up magnetization, which makes the measurement more accurate.

How to set the DCR polarity:

1)   When you move the cursor to the **DCR POL** field, the following soft keys will be displayed:

- FIX

- ALT

2)   Press the ALT soft key to select the alternating mode. The FIX soft key currently has no function.

3.5.7 Trigger Delay

The trigger delay refers to the delay time from the activation of the trigger to the start of the measurement. If the list scroll function is used, the delay is active for each individual measuring point. The setting range is 0s to 60s with a resolution of 1ms. This function is useful when the instrument is used in an automatic test system, since a waiting time after triggering via the HANDLER interface can ensure that mechanical oscillations have decayed and that the contact between the measuring instrument and the DUT is reliable.

How to use the the trigger delay function:

1)   Move the cursor to the **DELAY** field.

2)   Use the numeric keys to input a delay time. After pressing a numeric key, the following unit soft keys will be displayed:

- msec

- sec

3)   Complete the entry with the soft keys to set the unit and prefix.

3.5.8 Step Delay

The step delay refers to the delay time from the activation of the measuring voltage to the actual start of the measurement. The setting range is 0s to 60s with a resolution of 1ms. When measuring DCR or Rd on inductors, e.g. as Lp-Rd, the measurement delay can improve the accuracy of the measurement by skipping the settling time after switching the measurement signal from AC to DC.

How to use the step delay function:

1)   Move the cursor to the **STEP DLY** field.

2)   Use the numeric keys to input a delay time. After pressing a numeric key, the following unit soft keys will be displayed:

- msec

- sec

3)   Complete the entry with the soft keys to set the unit and prefix.

3.5.9 DC Resistance Range

With the ST2830, the measuring range of the DC resistance measurement can be set separately. The ST2830 offers 11 DCR measuring ranges: 1Ω, 3Ω, 10Ω, 30Ω, 100Ω, 300Ω, 1kΩ, 3kΩ, 10kΩ, 30kΩ, 100kΩ. The setting is the same as for the LCR measuring range (→ 3.1.2).

3.5.10 DC Level

The DC measurement level of the ST2830 and ST2831 models is fixed at 1V. On the ST2832, the DC measurement level can be set from 50mV-2V with a resolution of 1mV.

How to set the DC measurement level:

1)   Move the cursor to the **DC LEV** field.

2) Use the numeric keys to enter the level. After pressing a numeric key, the following unit soft keys will be displayed:

- mV

- V

3) Complete the entry with the soft keys to set the unit and prefix.

3.5.11 Deviation Measurement Function

The ST2830 can display the deviation from a reference value instead of the measured results. The value of the deviation is formed by subtracting the reference value from the measured value. This function is very useful to display deviations of parameters over different measurement conditions (frequency, measurement voltage, bias, temperature). It can be activated for the primary, secondary or both parameters. The deviation can be displayed in two ways:

- ΔABS (Absolute Deviation)

The displayed value is the difference between the measured value and the preset reference value. The formula for calculating ΔABS is as follows:

ΔABS=X-Y

Where   X is the DUT's measurement value,

         Y is the preset reference value.

- Δ% (Percentage deviation mode)

The percentage value displayed is the difference between the measured value and the reference value divided by the reference value. The formula for calculating Δ% is as follows:

Δ% = (X-Y)/Y*100[%]

Where   X is the DUT's measurement value,

         Y is the preset reference value.

How to use the deviation measurement function:

1) When you move the cursor to the **REF A** field to enter the reference value of the primary parameter, the following soft key will be displayed:

- MEASURE: With this key the reference value can be measured directly from a reference component. After pressing the key, the measured value is automatically transferred to the **REF A** field.

2) Use MEASURE or the numeric keys to enter the reference value of the primary parameter.

3) When you move the cursor to the **REF B** field to enter the reference value of the secondary parameter, the following soft key will be displayed:

- MEASURE: With this key the reference value can be measured directly from a reference component. After pressing the key, the measured value is automatically transferred to the **REF B** field

4) Use MEASURE or the numeric keys to enter the reference value of the secondary parameter, if this was not already done in step 2.

5) When you move the cursor to the **DEV A** field, the following soft keys will be displayed:

- ΔABS

- Δ%

- OFF

6) Use the corresponding soft key to set the display mode of the primary parameter.

7) When you move the cursor to the **DEV B** field, the following soft keys will be displayed:

- ΔABS

- Δ%

- OFF

8) Use the corresponding soft key to set the display mode of the secondary parameter.

3.6 <CORRECTION>

Press [SETUP] to select CORRECTION to get to the **<CORRECTION>** page.

```
< CORRECTION >
OPEN  : OFF              CABLE : 0m
SHORT : OFF              MODE  : Single
LOAD  : OFF              FUNC  : Cp-D
SPOT No. : 1
FREQ      : OFF
 REF   A: -------        B: -------
 OPEN  A: -------        B: -------
 SHORT A: -------        B: -------
 LOAD  A: -------        B: -------
         MEAS    CORREC  LIMIT   LIST    MORE ▶
         SETUP   TION    TABLE   SETUP   1/2
```
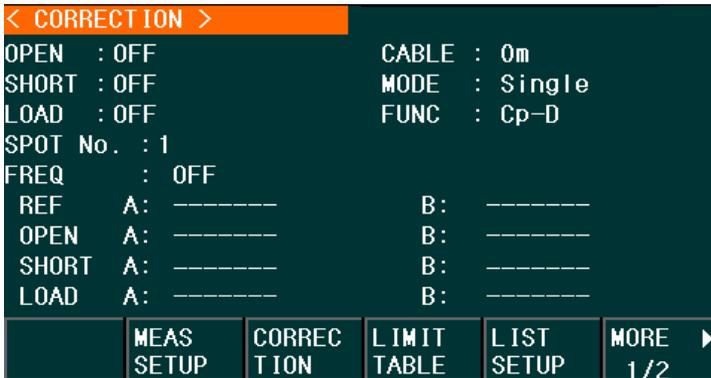
Figure 3-6 CORRECTION Page

On this page, open-circuit, short-circuit and reference load correction can be performed, which can minimize the influences of capacitance loading of the measuring arrangement, stray capacitance, parasitic impedance and other disturbances. ST2830 series instruments support two correction modes: On the one hand, open-circuit and short-circuit calibration at 41 (for the ST2832) fixed frequencies with interpolation of the correction values for the intermediate frequencies, on the other hand, open-circuit, short-circuit and reference load calibration at one of up to 201 predefined frequency points. The frequency point calibration has priority if the measuring frequency corresponds to one of the calibrated frequencies.

The following settings can be made on the **<CORRECTION>** page:

- Open correction (**OPEN**)

- Short correction (**SHORT**)

- Load correction (**LOAD**)

- Cable length selection (**CABLE**)

- Single/ multiple correction mode selection (**MODE**)

- Load correction test function (**FUNC**)

- Calibration spot numbers (**SPOT NO.**)

- Frequency points of OPEN, SHOR and LOAD (**FREQ**)

- Reference values for frequency points (**REF A**, **REF B**)

- Open values for frequency points (**OPEN A**, **OPEN B**)

- Short values for frequency points (**SHORT A**, **SHORT B**)

- Load values for frequency points (**LOAD A**, **LOAD B**)

There are sixteen fields on this page: **OPEN**, **SHORT**, **LOAD**, **CABLE**, **MODE**, **FUNCTION**, **SPOT NO.**, **FREQ**, **REF A**, **REF B**, **OPEN A**, **OPEN B**, **SHORT A**, **SHORT B**, **LOAD A** and **LOAD B**. Each control function field will be briefly introduced in the following paragraphs.

Besides the setting fields listed above, the **<CORRECTION>** page will also display the following monitoring fields. The monitoring fields are similar to the setting fields, but the monitoring fields can only provide reference information; you cannot change the state or parameters of these fields.

- Uncorrected measurement results of the open-circuit correction (**OPEN A**, **OPEN B**)

- Uncorrected measurement results of the short-circuit correction (**SHORT A**, **SHORT B**)

- Uncorrected measurement results of the load correction (**LOAD A**, **LOAD B**)

The uncorrected measurement results of the frequency point corrections can be re-recorded using the soft keys displayed in the **FREQ** field.

NOTE
The rule of user calibration is that if the open or short-circuit is ON and the measurement frequency corresponding to the point frequency clearing is ON, the data of the point frequency correction will be used first.

3.6.1 OPEN

The open circuit correction of the ST2830 can minimize disturbances caused by the stray admittance (G, B) parallel to the DUT as shown in Figure 3-7.
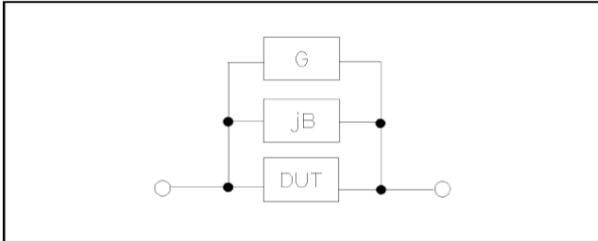
Figure 3-7 Stray Admittance

ST2830 uses the following two kinds of open correction data:

- The ST2830 automatically performs an idle measurement over 34 fixed frequency points between 50Hz and 100kHz, regardless of the currently set frequency. Move the cursor to the **OPEN** field and press the MEAS OPEN soft key to perform the open-circuit correction over the entire frequency range.

NOTE
The ST2831 measures over 37 fixed frequency points between 50Hz and 200kHz; the ST2832 measures over 41 frequency points between 20Hz and 200kHz. Based on the data obtained in this way, the instrument can interpolate the open-circuit correction data from these values for all other measuring ranges and frequencies.

- Up to 201 open-circuit correction frequency points can be set in the **FREQ** and **SPOT NO.** fields. Move the cursor to the **FREQ** field, use the numeric keys to enter a frequency and use the ON soft key to activate the selected frequency.

How to use the open-circuit correction function:

The following steps are used to perform the open-circuit correction over the entire frequency range. The single frequency point correction is described in the LOAD section (3.6.3).

1) When you move the cursor to **OPEN**, the following soft keys will be displayed:

- ON

- OFF

- MEAS OPEN

- DCR OPEN

2) Connect the measuring adapter to the terminals of the ST2830. Establish the measurement setup to be used as far as possible, but do not connect a DUT to the measurement adapter.

3) If you press the MEAS OPEN soft key, the ST2830 measures the open-circuit admittance (capacitance and inductance) for 34 frequencies. This process takes about 50 seconds. While performing the open-circuit correction, the following soft key is displayed:

- ABORT: This soft key can be used to cancel the current open-circuit correction. The previous correction data are retained in this case.

4) If you press the DCR OPEN soft key, the ST2830 performs an open-circuit correction of the DC resistance measurement.

5) Press the ON soft key to make the ST2830 take the correction data into account during the measurement process. If **FREQ** is OFF, the correction data for the currently used measuring frequency is interpolated from the data of the 34 to 41 measuring points. If **FREQ** is ON, and one of the frequencies entered there is the currently used measuring frequency, the correction data for this frequency is used to calculate the correction.

6) Press the OFF soft key to switch off the function. No correction will then take place during the course of the measurement.

3.6.2 SHORT

The short-circuit correction function of the ST2830 can minimize noise caused by the unwanted impedance components (R, X) in series with the DUT as shown in Figure 3-8.
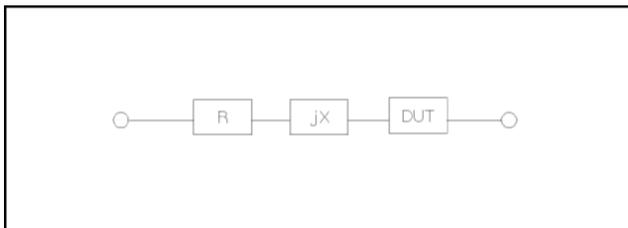
Figure 3-8 Spurious Inductance

The ST2830 supports the following two types of short-circuit correction:

- The ST2830 automatically performs a measurement over 34 fixed frequency points between 50Hz and 100kHz, regardless of the currently set frequency. Move the cursor to the **SHORT** field and press the MEAS SHORT soft key to perform the short-circuit correction over the entire frequency range.

NOTE
The ST2831 measures over 37 fixed frequency points between 50Hz and 200kHz; the ST2832 measures over 41 frequency points between 20Hz and 200kHz. Based on the data obtained in this way, the instrument can interpolate the short-circuit correction data from these values for all other measuring ranges and frequencies.

- Up to 201 short-circuit correction frequency points can be set in the **FREQ** and **SPOT NO.** fields. Move the cursor to the **FREQ** field, use the numeric keys to enter a frequency and use the ON soft key to activate the selected frequency.

How to use the short-circuit correction function:

The following steps are used to perform the short-circuit correction over the entire frequency range. The single frequency point correction is described in the LOAD section (3.6.3).

1) When you move the cursor to the **SHORT** field, the following soft keys will be displayed:

- ON

- OFF

- MEAS SHORT

- DCR SHORT

2) Connect the measuring adapter to the terminals of the ST2830 and insert the shorting plate.

3) If you press the MEAS SHORT soft key, the ST2830 will measure the unwanted short circuit impedance components (resistance and reactance) for 34, 37, and 41 frequencies, respectively. This process takes approximately 50 seconds. While performing the short circuit correction, the following soft key is displayed:

- ABORT: This soft key can be used to cancel the current short-circuit correction. The previous correction data are retained in this case.

4)   If you press the DCR SHORT soft key, the ST2830 performs a short-circuit correction of the DC resistance measurement.

5)   Press the ON soft key to make the ST2830 take the correction data into account during the measurement process. If **FREQ** is OFF, the correction data for the currently used measuring frequency is interpolated from the data of the 34 to 41 measuring points. If **FREQ** is ON, and one of the frequencies entered there is the currently used measuring frequency, the correction data for this frequency is used to calculate the short-circuit correction.

6)   Press OFF to turn off the short correction function. In later testing, there will be no short correction calculation.

3.6.3 LOAD

By including transfer coefficients between the reference element setpoint and the actual reference element measured value at the preset frequency (**FREQ**), the load correction of the ST2830 can minimize measurement errors when processing the measured values of the DUT. Up to 201 frequency points can be selected via the **SPOT NO.** field. The corresponding frequencies are entered in the **FREQ** field. Before entering the reference values, the measurement function must be set in the **FUNC** field. The reference component values are then entered in the **REF A** and **REF B** input fields. If the cursor is in the **FREQ** field, the MEAS LOAD soft key is displayed, which is used to activate the load correction after the reference values have been entered.

How to use the load correction function:

1)   When you move the cursor to **FREQ**, the following soft keys will be displayed:

- ON: Press this soft key to to switch on the correction of the measurement data at the selected frequency point.

- OFF: Press the soft key to to switch off the correction of the measurement data at the selected frequency point.

- MEAS OPEN: Press this soft key to perform an open-circuit correction at **FREQ**.

- MEAS SHORT: Press this soft key to perform a short-circuit correction at **FREQ**.

- MEAS LOAD: Press this soft key to perform a load correction at **FREQ**.

2)   When you press ON, the last set correction frequency is displayed in the frequency display area.

3)   If necessary, enter the new correction frequency using numeric keys. After pressing a numeric key, the available units with prefix (Hz, kHz and MHz) are displayed as soft keys. These are used to apply the new value together with the prefix.

4)   Connect the measuring adapter to the terminals of the ST2830. Establish the measurement setup to be used as far as possible, but do not connect a DUT to the measurement adapter.

5)   Press the MEAS OPEN soft key to perform the open-circuit correction at the selected frequency point. The measurement results (G, B) of the open-circuit measurement are displayed in the **OPEN A** and **B** fields.

6)   Move the cursor to **OPEN**.

7)   Press the ON soft key to make the ST2830 take the correction data into account during the measurement process.

8)   Move the cursor to **FREQ** to set the required correction frequency.

9)   Insert the shorting plate into the measuring adapter.

10)   Press the MEAS SHORT soft key to perform the short-circuit correction at the selected frequency point. The measurement results (R, X) of the short-circuit measurement are displayed in the **SHORT A** and **B** fields.

11)   Move the cursor to **SHORT**.

12)   Press the ON soft key to make the ST2830 take the correction data into account during the measurement process.

13)   Prepare a reference component for use.

14)   Move the cursor to **FUNC**.

15)   Select the measurement function for which the correction is to be performed.

16)   Move the cursor to **REF A**.

17)   Use the numeric and soft keys to enter the value of the primary parameter of the reference component.

18)   Move the cursor to **REF B**.

19)   Use the numeric and soft keys to enter the value of the secondary parameter of the reference component.

20)　Move the cursor back to **FREQ**.

21)　Insert the reference component into the measuring adapter. If necessary, remove the shorting plate beforehand.

22)　Press the MEAS LOAD soft key to perform the reference load correction. The actual results of the measurement on the reference component are displayed in the **MEAS A** and **MEAS B** fields.

23)　Move the cursor to **LOAD**.

24)　Press the ON soft key so that the ST2830 takes the correction data into account during the measurement process at the measured frequency points.

3.6.4 Load Correction Measurement Function

Before performing the reference load correction, the reference value of the reference component must be entered. The measurement parameters of this reference value should match the set measurement function.

The reference load correction function adjusts the transfer coefficients between the actual measured value and the reference element setpoint to minimize the measurement error. The calculation of the transfer coefficients is its only purpose.

Steps for setting the measuring function for the reference load correction: The setting is made in the FUNC field in the same way as in section 3.1.1.

3.6.5 Frequency Point Correction Function

The ST2830 series instruments support direct calibration at up to 201 frequency points. The steps for setting are included in sections 3.6.1 to 3.6.3. Note that the correction data of the frequency point correction has priority over the correction data of the automatic calibration over the entire frequency range if the measurement frequency used corresponds to one of these 201 frequency points and this is activated.

Note especially that only one frequency point can be displayed at a time and therefore existing but outdated correction data can easily be overlooked. To avoid this problem, the CLEAR CORR function on the **<TOOLS>** page can be used to clear all frequency point correction data at once.

3.6.6 Cable Length Selection

Currently, only a cable length of 0m can be selected.

3.7 <LIMIT TABLE>

Press [SETUP] and then LIMIT TABLE to access the **<LIMIT TABLE SETUP>** page as shown in the following

figure:

Figure 3-9 Limit Table Setup

On this page, the comparison function can be configured. The ST2830 supports nine sorting compartments

for limit value pairs of the primary parameters and one for secondary parameters. The measurement result

can be sorted into up to eleven bins (BIN 1 to BIN 9, BIN AUX and BIN OUT). If the primary parameter of the

DUT is within the limits of BIN1 to BIN9, but the secondary parameter is outside the limits, the DUT is sorted

into the AUX compartment. The sorting function is particularly useful when the HANDLER interface is

configured in the ST2830 and connected to an automatic sorting unit. The following settings of the sorting

function can be made on the **<LIMIT TABLE SETUP>** page:

- Measurement parameters (**PARAM**)

- Limit value mode of the comparison function (**MODE**)

- Nominal value (setpoint) (**NOM**)

- Auxiliary bin ON/OFF (**AUX**)

- Compare function ON/OFF (**COMP**)

- Lower limit value for the respective compartment (**LOW**)

- Higher limit value for the respective compartment (**HIGH**)

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3.7.1 Parameter Swap

The parameter swap function in **PARAM** can swap the primary and secondary measurement parameters. For example, if the measurement parameters are Cp-D, this function can make it D-Cp. Then up to nine pairs of limits can be set for D, but only one pair for Cp.

How to use the swap parameter function:

1)   When you move the cursor to **PARAM**, the following soft key will be displayed:

- SWAP PARAM

2)   Press SWAP PARAM to swap the primary and the secondary parameters.

3)   Press SWAP PARAM to change the parameters back to the default setting.

3.7.2 Limit Modes of Compare Function

The comparison function has two modes of operation for handling the limits of the primary parameter as shown in Figure 3-10.

- Tolerance Mode: In the tolerance mode, the deviation from the nominal value (to be set in the **NOM** field) is entered as a limit value. There are two possibilities: percentage and absolute deviation.

- Sequential Mode: In sequential mode, the absolute limit values are entered directly. The limits should be set in the order from small to large.
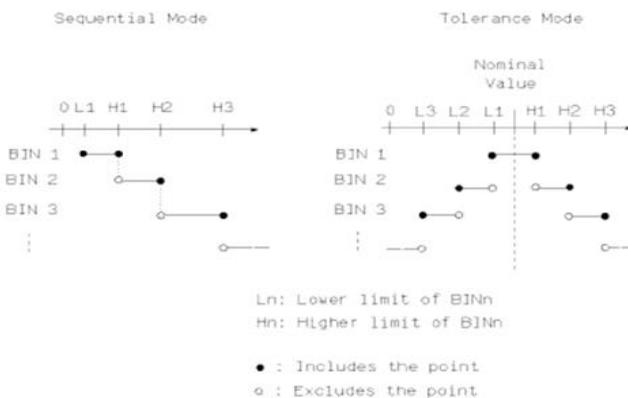
Figure 3-10 Tolerance Mode and Sequential Mode

NOTE
When setting the limits in tolerance mode, the ranges must be configured in the sequence from small to large deviation, since the compartments are processed in ascending order and the first positive comparison result applies; thus, in the case that the largest deviation is entered in BIN 1, all DUTs would be assigned to this compartment.

In tolerance mode, the lower limit value does not necessarily have to be smaller and the upper limit value does not necessarily have to be larger than the nominal value. The limit value ranges can be discontinuous or even overlap, in the latter case the matching compartment with the lowest number is selected.

In both modes, the limit values of the secondary parameter are entered directly. It is not mandatory to set both limit values.

How to set the the operating mode of the comparison function:

1)   When you move the cursor to the **MODE** field, the following soft keys will be displayed:

- %TOL: This soft key is used to set the tolerance mode with percentage deviation (% TOL).
- ABS TOL: This soft key is used to set the tolerance mode with absolute deviation (ABS TOL).
- SEQ MODE: This soft key is used to set the sequential mode.
- TWO ABS

2)   Use the soft keys listed above to set the operation mode.

3.7.3 Set Nominal Value of Tolerance Mode

In tolerance mode, it is necessary to enter the nominal value of the primary parameter as the basis for calculating the deviation. The entire possible display range of the selected parameter is available as the value range.

In sequential mode, a nominal value *can be* entered, but it is not used.

How to set the the nominal value:

1)   Move the cursor to **NOM**.

2)   Use the numeric keys to enter the nominal value. After entering the digits, you can press one of the soft keys (p, n, μ, m, k, M, *1) to complete the entry with the selected unit prefix. Here *1 stands for the basic unit F, H or Ω without prefix.

3.7.4 Comparator Function ON/OFF

The ST2830 supports nine sorting compartments for limit pairs of primary parameters and one for secondary parameters. The measurement result can be sorted into up to eleven compartments (BIN 1 to BIN 9, BIN AUX and BIN OUT). If the primary parameter of the DUT is within the limits of BIN1 to BIN9, but the secondary parameter is outside the limits, the DUT is sorted into the AUX compartment. The sorting function is particularly useful if the HANDLER interface is configured in the ST2830 and connected to an automatic sorting unit.

How to switch the compare function on or off:

1)   When you move the cursor to **COMP**, the following soft keys will be displayed:

   •   ON
   •   OFF

2)   Use the soft keys listed above to turn the comparator function on or off.

3.7.5 Auxiliary Bin ON/OFF

The limit values for the secondary parameter are entered in the **HIGH** and **LOW** columns of line **2nd**.

Three cases can occur in connection with the secondary parameter:

1)   No limits have been set for the secondary parameter on the **<LIMIT TABLE SETUP>** page. The function is therefore inactive.

3)   Limits are entered on the **<LIMIT TABLE SETUP>** page and the AUX function is turned on.

   •   If the primary parameter is outside the configured limits, the DUT is always sorted into compartment OUT. If the primary parameter is within at least one of the limit pairs, but the secondary parameter is not, the DUT is sorted into compartment AUX.

4)   Limits are entered on the **<LIMIT TABLE SETUP>** page, but the AUX function is turned off.

5)   As above, but if the secondary parameter is outside the configured limits, the DUT is sorted into compartment OUT (instead of AUX); compartment AUX is disabled.

NOTE
If the AUX compartment is switched on and only a lower limit value is set for the secondary parameter, the DUT is sorted into AUX if the measured value of the secondary parameter is less than or equal to this limit value and the primary parameter is within one of the limit value ranges entered for it. The same applies if only an upper limit value is entered and the secondary parameter value is greater than or equal to this limit value.

How to turn the auxiliary bin function on or off:

1)   When you move the cursor to **AUX**, the following soft keys will be displayed:

- ON
- OFF

2)   Use the soft keys listed above to switch the AUX function on or off.

3.7.6 HIGH/LOW

The ST2830 supports nine sorting compartments for limit pairs of primary parameters and one for secondary parameters. The measurement result can be divided into up to eleven compartments (BIN 1 to BIN 9, BIN AUX and BIN OUT). The limit values for the primary parameter are entered in the **HIGH** and **LOW** columns of the lines BIN 1 to BIN 9. The limit values for the secondary parameter are entered in the **HIGH** and **LOW** columns of line **2nd**.

How to set the upper/lower limit:

1)   First define the setting for the **PARAM** and **NOM** fields and select one of the limit value variants in **MODE**.

2)   Move the cursor to the **LOW** field of **BIN 1**. In tolerance mode, continue with steps 3 to 6, in sequential mode with steps 7 to 11.

3)   Use the numeric keys to enter the lower limit value. After entering the digits, you can press one of the soft keys (p, n, μ, m, k, M, *1) to complete the entry with the selected unit prefix. Here *1 stands for the basic unit F, H or Ω without prefix. After entering the limit value in the **LOW** field of **BIN 1**, the lower limit value of BIN 1 is automatically entered as - (absolute limit value) and the upper limit value as + (absolute limit value).

4)   The cursor automatically moves on to the **LOW** field of **BIN 2**. Repeat step 3 until BIN 9 is entered, after which the cursor automatically moves to the **LOW** field of **2nd**.

5)   After entering the lower limit value of the secondary parameter, the cursor automatically jumps to the **HIGH** field of **2nd**.

6)   Enter the upper limit value of the secondary parameter.

7)   Use the numeric keys to enter the lower limit value. After entering the digits, you can press one of the soft keys (p, n, μ, m, k, M, *1) to complete the entry with the selected unit prefix. Here *1 stands for the basic unit F, H or Ω without prefix.

8)   After entering the lower limit value of **BIN 1**, the cursor automatically jumps to the **HIGH** field of **BIN 1**. Enter the upper limit value of **BIN 1**.

9)   The cursor automatically jumps to the **HIGH** field of **BIN 2**, because in sequential mode the lower limit value of BIN 2 is equal to the upper limit value of BIN 1. Enter the upper limit value of BIN 2.

10) Repeat step 9 until the limit value for BIN 9 is entered. Then the cursor automatically jumps to the **LOW** field of **2nd**. Enter the lower limit value of the secondary parameter.

11) The cursor automatically jumps to the **HIGH** field of **2nd**. Enter the upper limit value of the secondary parameter.

3.8 <LIST SWEEP SETUP>

Press [SETUP] and then LIST SETUP to access the **<LIST SWEEP SETUP>** page as shown below:

Figure 3-11 LIST SWEEP SETUP Page

The list sweep function of the ST2830 can automatically sweep up to 201 measurement frequencies, measurement levels, or DC bias levels. On the **<LIST SWEEP SETUP>** page, the following list sweep parameters can be configured:

- Sweep mode (**MODE**)

- Sweep parameter setup (frequency **[Hz]**, level **[V]**, level **[I]**, bias **[V]**, bias **[I]**)

- Sweep measurement point setup (sweep point)

- Selection of limit parameter (**LMT**)

- High/low limit (**HIGH**, **LOW**)

3.8.1 MODE

The **MODE** field (sweep mode) corresponds to the field of the same name on the **<LIST SWEEP DISPLAY>** page. Select the desired function via soft key.

3.8.2 Parameters to Be Passed Through

Two independent parameters to be passed can be selected from: Frequency **[Hz]**, Measuring voltage **[V]**, Measuring current **[I]**, Bias voltage **[V]** and Bias current [**I**].

How to set the measuring parameters:

1)   When you move the cursor the line following **MODE**, the following soft keys will be displayed:

- FREQ [Hz]

- LEVEL [V]

- LEVEL [A]

- BIAS [V]

- BIAS [A]

2)   Press the corresponding soft key to set the desired parameter .

3.8.3 Sweep Parameter Setup

Move the cursor into the table to set the individual entries of the pass list: **FREQ (HZ)**, **LEVEL (V)**, **LMT**, **LOW**, **HIGH** and **DELY[s]**. Use the numeric keys to enter the values for measurement frequency/level, bias current/voltage, and low and high limits, and select the primary or secondary parameter for comparison. You can empty superfluous lines with the DELETE LINE soft key. You can use the PREV PAGE and NEXT PAGE

soft keys to call up more of the up to 201 lines. The **LMT** column shows whether the limit values entered in this line refer to the primary or secondary parameter. If you press the LMT A soft key, "A" is displayed in the **LMT** column. If you press the LMT B soft key, "B" is displayed. Pressing the OFF soft key resets the entry as well as the entries in the columns for the limit values to "---".

3.9 TOOLS

Press [SETUP] and use the TOOLS soft key to access the **<TOOLS>** page as shown in the figure below:

Figure 3-12 TOOLS Page

The TOOLS interface of ST2830 provides several specific functions and some custom design functions.

- CORR DATA
- NULL FIXTURE
- HOLD NOM RNG
- AUTO FETCH
- HDL VALID TIME

3.9.1 CORR DATA

Move the cursor to **CLEAR CORR**, press the soft key provided to clear the correction data of all up to 201 frequency points. A prompt box will be displayed.

3.9.2 NULL FIXTURE

This function helps check for poor contact or short-circuit conditions at the test fixture. If this function is enabled, the instrument automatically assumes NOM as the nominal value in the **LIMIT TABLE** interface, takes the value after the nominal value multiplied by 0.05 as the lower limit, and multiplies the nominal value by 100 as the upper limit. Values exceeding this upper and lower limit range are considered as either open- or short-circuit of the fixture. The instrument will stop outputting the HANDLER sorting result signal to prevent the output of an inaccurate measurement result.

3.9.3 HOLD NOM RNG

This function's purpose is to lock the range for quick measurement. If this function is enabled, the instrument will lock the corresponding range according to the nominal value in the **LIMIT TABLE** interface. If the range in the measurement setting interface is set to AUTO, the instrument will measure in locked range.

3.9.4 AUTO FETCH

This function works for data communication and transmits data through the RS-232C or USB interface. The general data transmission mode is to send the **FETCH?** command to the instrument, upon which the instrument sends the measurement data back through the communication port. Once AUTO FETCH is enabled, each measurement result is automatically sent through the communication port without the individual **FETCH?** command.

NOTE
When using this function, please ensure that the host computer is ready to accept the data continuously sent by the instrument.

3.9.5 HDL VALID TIME

This function is used to set the level hold time for the output signal of the HANDLER interface. The HOLD state indicates that the output signal of the interface is maintained until changes are made. Use the numeric keys to enter the hold time between 0–2s. Zero here corresponds to the HOLD state.

4   <SYSTEM SETUP> and <FILE MANAGE>

4.1 <SYSTEM SETUP>

Press [SETUP] and then SYSTEM SETUP to access the **<SYSTEM SETUP>** page as shown below:

Figure 4-1 SYSTEM SETUP Page

The following system settings are configured on this page:

- Operating Mode

- Signal Tones

- Language

- Password

- BUS Mode

- GPIB Address

- Unidirectional Communication

- Bias Source Internal/External

- Baud Rate

- Menu Display

- Date and Time.

NOTE
The system settings become active immediately after setting.

4.1.1 MAIN FUNC

This field displays the operating mode of the device. Currently, there is only the LCR setting.

4.1.2 PASS BEEP

This field is used to select the type of signaling for a passed component parameter check.

How to select the PASS BEEP tone:

1)   When you move the cursor to **PASS BEEP**, the following soft keys will be displayed:

- HIGH LONG: This soft key is used to select a high and long beep.

- HIGH SHORT: This soft key is used to select a high and short beep.

- LOW LONG: This soft key is used to select a low and long beep.

- TWO SHORT: This soft key is used to select two low and short beeps.

- OFF: This soft key is used to switch the signal tone off.

2)   Press the corresponding soft key to select the desired tone.

4.1.3 FAIL BEEP

This field is used to select the type of signaling for a failed component parameter check.

How to select the FAIL BEEP tone:

1)   When you move the cursor to **FAIL BEEP**, the following soft keys will be displayed:

- HIGH LONG: This soft key is used to select a high and long beep.

- HIGH SHORT: This soft key is used to select a high and short beep.

- LOW LONG: This soft key is used to select a low and short beep.

- TWO SHORT: This soft key is used to select two low and short beeps.

- OFF: This soft key is used to switch the signal tone off.

2)   Press the corresponding soft key to select the desired tone.

4.1.4 LANGUAGE

This field is used to select the display language of the device.

How to select the language:

1)   When you move the cursor to **LANGUAGE**, the following soft keys will be displayed:

- ENGLISH: This soft key is used to select English as the display language.

- CHINESE: This soft key is used to select Chinese as the display language.

2)   Press the corresponding soft key to select the desired language.

4.1.5 PASSWORD

This field is used to configure the password protection. Before each change, the current password is requested.

How to set the the password:

1)   When you move the cursor to **PASS WORD**, the following soft keys will be displayed:

- OFF: This disables the password protection.

- LOCK SYSTEM: In this setting, the password is required for changing the configuration and for file access.

- LOCK FILE: In this setting, the user files are access-protected.

- MODIFY: Here the password can be changed.

2)   Press the soft key MODIFY to enter a new password. For security reasons, the old password must be entered first and then the new password (twice); the new password is not saved until it has been entered without error.

NOTE
The default password is 0147852.

4.1.6 BUS MODE

The communication interface is selected in this field.

How to select the communication mode:

1)   When you move the cursor to **BUS**, the following soft keys will be displayed:

- RS232C

- GPIB

- **USBTMC**: Activates the USB mode "Test and Measurement Device", compatible with USBTMC-USB488; required for LabView connection

- **USBCDC**: Switches to USB "virtual serial port" mode.

2) Press the corresponding soft key to set the desired mode.

NOTE
The (optional) GPIB interface can only be selected if it is installed.

4.1.7 GPIB ADDR (Reserved Function)

The GPIB address is set in this field.

How to select the GPIB address:

1) When you move the cursor to **GPIB ADDR**, the following soft keys will be displayed:

- ↑ (+): This increases the GPIB address by 1.

- ↓ (-): This decreases the GPIB address by 1.

4.1.8 TALK ONLY

This function switches the selected communication interface to unidirectional mode. The measurement results are automatically output via RS232C, GPIB, USBTMC or USBCDC, but incoming control commands are ignored.

How to set the the talk only function:

1) When you move the cursor to **TALK ONLY**, the following soft keys will be displayed:

- ON

- OFF

2) Use the soft keys listed above to turn the function on or off.

4.1.9 BIAS SRC

This field is used to select the DC bias source. The device supports two types of bias sources:

- INT mode (ST2832 only): The DC bias voltage or current supported by the ST2832's internal bias source depends on the output resistance setting.

- • 30Ω Output Resistance: between -1.5V and +1.5V, or -50mA and +50mA.

  - • 100Ω Output Resistance: between -5V and +5V or -50mA and 50mA.

- • ST1778: Up to six external bias current sources of the ST1778 series with 0-20A each (i.e. up to 120A total) can be connected to the ST2830.

NOTE
At least one ST1778 must be connected for this function to be selected. When an external bias source is selected, only an output resistance of 100Ω can be used.

Steps to set the bias source:

1) Move the cursor to the **BIAS SRC** field. The following soft keys are displayed at the bottom of the screen:

   - • INT

   - • ST1778

2) Press INT to select the internal bias source (ST2832 only), or press ST1778 to select the external bias source ST1778.

4.1.10 BAUD RATE

The baud rate of the RS232C interface is set in this field. Transmission rates from 9.600 to 115.200 bit/s can be set. The other parameters (8/N/1) cannot be changed

How to set the the baud rate:

1) When you move the cursor to **BAUD RATE**, the following soft keys will be displayed:

   - • ↑ (+): This soft key increases the baud rate.

   - • ↓ (-): This soft key decreases the baud rate.

4.1.11 MENU DISP

The soft key area of the ST2830 can be displayed permanently or only for a certain time. If **MENU DISP** is set to HOLD, the soft key area is displayed permanently. If a time is set in **MENU DISP**, the soft key area is automatically hidden after this time has elapsed without any key being pressed. Each keystroke resets the timer and displays the soft key area again.

How to set the the menu display

1) When you move the cursor to **MENU DISP**, the following soft keys will be displayed:

- ↑ (+): This soft key increases the display time.

- ↓ (-): This soft key decreases the display time.

4.1.12 DATA/TIME

This line displays the date and time.

To reset them, use the arrow keys to select the desired field, then either enter the new value using the numeric keys and complete the entry with the *1 soft key, or use the INCR+ as well as DECR- soft keys to set the new value. The fields are assigned as follows: **Year** (two digits)-**Month**-**Day Hour**:**Minute**:**Second**.

4.2 LCR <FILE MANAGE>

The instruments of the ST2830 series are able to save user-set parameters in the form of files in non-volatile memory so that they can be read in again at a later time. This allows fast and efficient switching between different measurement environments.

Press [FILE MANAGE] to access the file management page, shown as below:

Figure 4-2 LCR FILES LIST Page

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

Up to 40 single component measurement settings files (*.STA files) can be stored in the instrument, and another 500 files each on (optional) USB data carriers.

Press the FILE MANAGE soft key to access the file management functions. The following data is saved to or restored from *.STA settings files:

Settings on the <u><MEASURE SETUP></u> page:

- FUNCA

- FREQ

- LEVEL

- RANGE

- SPEED

- Voltage BIAS

- Current BIAS

- TRIG

- ALC

- TRIG DLY

- STEP DLY

- DCR POL

- DC RNG

- DC LEV

- Rsou

- AVG

- Vm

- Im

- DEV A

- DEV B

- REF A

- REF B

Settings on the <u>\<BIN COUNT DISP></u> page:

- BIN COUNT (ON/OFF)

Settings on the <u>\<LIMIT TABLE SETUP></u> page:

- PARAM (swap parameter)

- NOM (reference value)

- MODE (%-TOL/ABS-TOL/SEQ-MODE)

- AUX (ON/OFF)

- COM (ON/OFF)

- HIGH and LOW limits of each bin

Settings on the <u>\<LIST SWEEP SETUP></u> page:

- List Sweep Mode (SEQ/STEP)

- List Sweep Parameter (Frequency/Level/Bias)

- Test points of all sweep parameters

- High and low limits of all test points, including limit parameters (LIMIT-DATA A/LIMIT-DATA B)

- Page format currently displayed

4.2.2 USB Storage Media

As already described, the ST2830 is equipped with a USB HOST interface, to which USB sticks can be connected as storage media. This also removes the limitation of 40 memory locations. With the possibility of storing the files saved in this way on a computer with USB connection, a virtually unlimited number of settings files can be managed.

The ST2830 supports USB storage devices with the following features:

- USB 1.0/1.1 or higher

- Capacity: 32MB/256MB/2GB/4GB; the larger the longer it takes to read the disk information after connecting to the ST2830.

- File format: FAT16, FAT32 (formatting on a Windows PC is recommended)

4.2.3 File Management

How to find an existing file:

1) Use the [↑] and [↓] to view one by one.

2) Use the [←] and [→] to view one page by one page.

3) Press the soft key FIND. Input the file character and then press [ENTER] to search the target file.

4) Input the page number and press the [ENTER] to search the file.

How to save the settings to a file:

1) Select and set all control and setting parameters on the desired page.

2) When you move the cursor to **FILE MANAGE**, the following soft keys will be displayed:

- LOAD

- STORE

- DEL

- FIND

- ⇩

- COPY TO E:

- EXT. FILE

- ⇧

3) In the file list, move the cursor to the file-saved position or input the file number directly.

4) Press STORE, the following soft keys will be displayed:

- Yes

- No

5) Press No to cancel the current save operation and return step 2.

6)   Press Yes, and LCR file name input operation interface will be displayed.
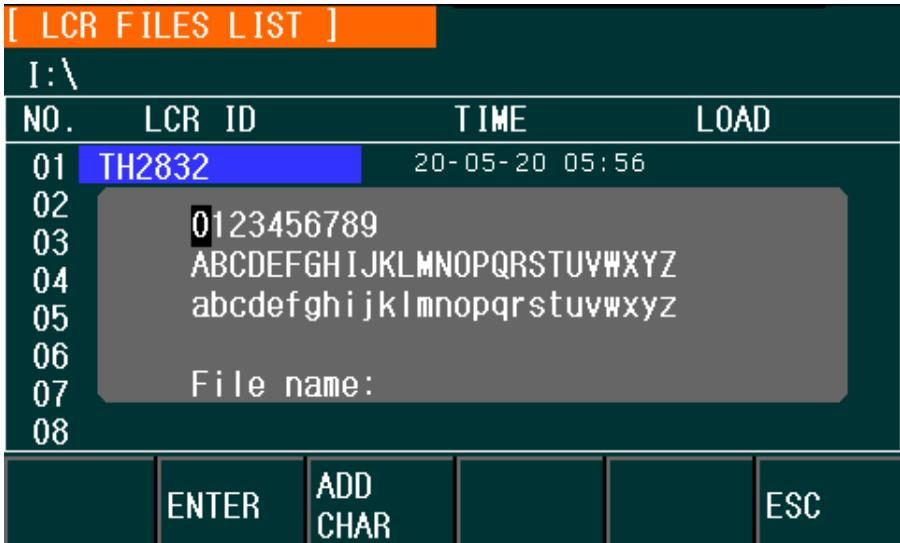
Figure 4-3 File Name Interface

7)   Move the cursor to select the character and press ADD CHAR to input the character. Press ENTER to save the current file name. Press ESC to quit the file name input interface.

How to load settings from a file:

1)   When you move the cursor to **FILE MANAGE**, the following soft keys will be displayed:

- LOAD

- STORE

- DEL

- FIND

- ⇩

- COPY TO E:

- EXT. FILE

- ⇧

2)   In the file list, move the cursor to the file-saved position or input the file number directly.

3)   Press LOAD, the following soft keys will be displayed:

- Yes

- No

4)   Press No to cancel the current load operation and return to step 1.

5)   Press Yes to load the currently selected file. Then ST2830 will return to the current display page.

How to copy a file to a USB memory stick:

1)   Assuming that it is necessary to copy internal files 2 to external U-disk.

2)   When you move the cursor to **FILE MANAGE**, the following soft keys will be displayed:

- LOAD

- STORE

- DEL

- FIND

- ⇩

- COPY TO E:

- EXT. FILE

- ⇧

3)   Move the cursor the file to be copied and press ENTER to confirm (multiple files can be selected).

4)   Press COPY to E: to copy the file the instrument.

5)   While copying the file, the progress bar will present the progress of the file copy. When the progress bar disappears, the operation of the file copy is finished.

NOTE
Please make sure that the USB memory stick has the properties listed in section 4.2.2 and is not set to read-only. After plugging in a USB stick, it can take a long time, especially with large sticks, until its data carrier information has been read by the device. During this time, the ST2830 does not respond to inputs and could possibly give the impression of having crashed. For the fastest possible workflow, use the smallest possible stick (64MB is usually quite sufficient) with the FAT16 file system.

5   Use of the LCR Function with Application Examples

5.1 Self-Calibration

In order to avoid the measuring accuracy being affected by capacitance coatings of the measuring arrangement, stray admittances, parasitic impedances and other disturbing influences, it is necessary to carry out the automatic calibration (short-circuit, open-circuit, as well as reference load if necessary; see also chapter 3.6). The ST2830 supports two different correction modes.

5.1.1 Multi-Frequency Calibration

1)   Press the [SETUP] key and then select the CORRECTION soft key to enter the **<CORRECTION>** page.

2)   Move the cursor to the **OPEN** field. The soft keys ON, OFF, MEAS OPEN and DCR OPEN are displayed at the bottom of the screen.

3)   Connect the test adapter to the ST2830. Do not connect a DUT; the test adapter must be empty. Then press the MEAS OPEN soft key to perform the open-circuit calibration. Wait for the completion message in the status line.

4)   Press the ON soft key to activate the corrections.

5)   Insert the shorting plate (ST26010) into the measuring adapter.

6)   Move the cursor to the **SHORT** field. The soft keys ON, OFF, MEAS SHORT and DCR SHORT are displayed at the bottom of the screen.

7)   Press the MEAS SHORT soft key to perform the short-circuit calibration. Wait for the completion message in the status line.

8)   Press the ON soft key to activate the corrections.

9)   Move the cursor to the **LOAD** field. The soft keys ON and OFF are displayed at the bottom of the screen.

10)   Press the OFF soft key to switch off the load compensation.

11) Move the cursor to the **FREQ** field. The soft keys ON, OFF, MEAS OPEN, MEAS SHORT and MEAS LOAD are displayed.

12) Press the OFF soft key to switch off the correction at the **FREQ** frequency point.

13) Move the cursor to the **SPOT NO.** field. The soft keys INCR++, INCR+, DECR-, and DECR-- are displayed.

14) Select the next frequency point with the soft keys or the numeric keys and repeat steps 11–14 until the corrections are switched off at all frequency points.

5.1.2 Frequency Point Calibration

This function provides better results when measuring with a directly entered frequency.

If the measuring frequency is e.g. 5.5kHz…

1) Press the [SETUP] key and then select the CORRECTION soft key to enter the **<CORRECTION>** page.

2) Move the cursor to the **OPEN** field. The soft keys ON, OFF, MEAS OPEN and DCR OPEN are displayed at the bottom of the screen.

3) Press the ON soft key to activate the function.

4) Move the cursor to the **SHORT** field. The soft keys ON, OFF, MEAS SHORT and DCR SHORT are displayed at the bottom of the screen.

5) Press the ON soft key to activate the function.

6) Move the cursor to the **LOAD** field. The soft keys ON and OFF are displayed at the bottom of the screen.

7) If a reference component is available, press the ON soft key to activate the function, otherwise press the OFF soft key.

8) If necessary, move the cursor to the **SPOT NO.** field to select one of 201 frequency points using soft keys or the numeric keypad.

9)   Move the cursor to the **FREQ** field. The soft keys ON, OFF, MEAS OPEN, MEAS SHORT and MEAS LOAD are displayed.

10)   Press the ON soft key to switch on the correction at **FREQ**.

11)   Enter [5] [.] [5] on the numeric keypad. The soft keys change to the available unit-prefix combinations (Hz, kHz and MHz). Press the kHz soft key and the **FREQ** field will change to the desired measurement frequency 5.5kHz.

12)   Connect the test adapter to the ST2830. Do not insert a DUT, the test adapter must be empty. Then press the MEAS OPEN soft key to perform the open-circuit calibration.

13)   Insert the shorting plate (ST26010) into the measuring adapter.

14)   Press MEAS SHORT to perform the short-circuit calibration.

15)   If a reference component is available, move the cursor to the **REF A** field and use the numeric and soft keys to enter the value of the primary parameter of the reference component.

16)   Move the cursor to the **REF B** field and use the numeric and soft keys to enter the value of the secondary parameter of the reference component.

17)   Move the cursor back to the **FREQ** field. Insert the reference component into the measuring adapter (if necessary, remove the short- circuit plate beforehand).

18)   Press the MEAS LOAD soft key to perform the reference load correction. The actual results of the measurement on the reference component are displayed in the **LOAD A** and **LOAD B** fields.

19)   If you need more measuring frequencies, move the cursor to the **SPOT NO.** field, select another frequency point number and repeat points 9–18 until all frequencies are entered.

5.2 Correct Connection of the DUT

The instrument has four measuring terminals: Hcur, Hpot, Lpot and Lcur; these are each provided with a shield intended to minimize the influence of stray capacitances against earth and electromagnetic fields. During the measurement process, Hcur, Hpot and Lpot, Lcur should be connected to the DUT in order to

perform a four-wire measurement and thus minimize the influence of the leads and the contact transitions in the current branch on the measurement (especially that of the dissipation factor).

Especially when measuring low impedance components, Hpot and Lpot should be connected directly and separately from Hcur and Lcur to the contacts of the DUT in order to measure the actual voltage applied to the DUT. In other words, the connections Hcur and Hpot as well as Lcur and Lpot should not be connected to each other already before the DUT is contacted, because then the measuring current between Hcur and Lcur also flows via the contacts between Hpot and DUT as well as DUT and Lpot and the voltage drop via the contact transfer resistance falsifies the measuring results.

It can make sense to connect Hcur and Hpot as well as Lpot and Lcur in advance (two-wire measurement) *only* if the impedance to be tested is much higher than the resistance of the test leads and contacts together (e.g. R_{lead} <Zx /1000 to stay below 0.1% error).

For measurements with high accuracy requirements, the measurement with the Kelvin measuring adapter ST26048A (supplied) gives better results than that with the Kelvin measuring cables ST26011C (also supplied). Below 10kHz measuring frequency the differences are negligible, but above 10kHz the arrangement of the measuring cables has an increasing effect on the stray capacitance and inductance; the influence on the measuring results is unavoidable because the position of the flexible cables cannot be fixed. Therefore, the measuring adapter should always be used at higher frequencies.

If it is not possible to use the measuring adapter, the position of the measuring cables should be changed as little as possible between self-calibration and measurement.

Regardless of whether the Kelvin measurement box, Kelvin clips or a user-made measurement setup is used, the following requirements should be met:

1)   The impedance of the measurement setup on the current flow paths as well as parasitic conductances between the measurement lines must be minimized, especially if components with high impedance are to be measured.

2)   Contact transition resistances must be minimized as they can be a source of noise.

3)   No-load and short-circuit calibration should be performed. With these the influence of the parasitic impedances on the measuring result can be reduced. For the open circuit calibration the distance between the measuring contacts should be the same as for the connection to the DUT, for the short circuit calibration the short circuit plate should be contacted in the same position as the DUT. For lower frequencies it is sufficient to connect Hcur and Lcur as well as Hpot and Lpot and then both together.

NOTE
If the device under test is a polarized component, its positive terminal should be connected to the terminal of the measuring instrument or measuring adapter marked "+", "Hcur", "Hpot" or "High", and the negative terminal should be connected to the terminal marked "-", "Lcur", "Lpot" or "Low".

WARNING!	
⚡	DUTs should be discharged before connecting to the meter to avoid damage to the instrument!

5.3 Minimize Influence of Stray Impedance
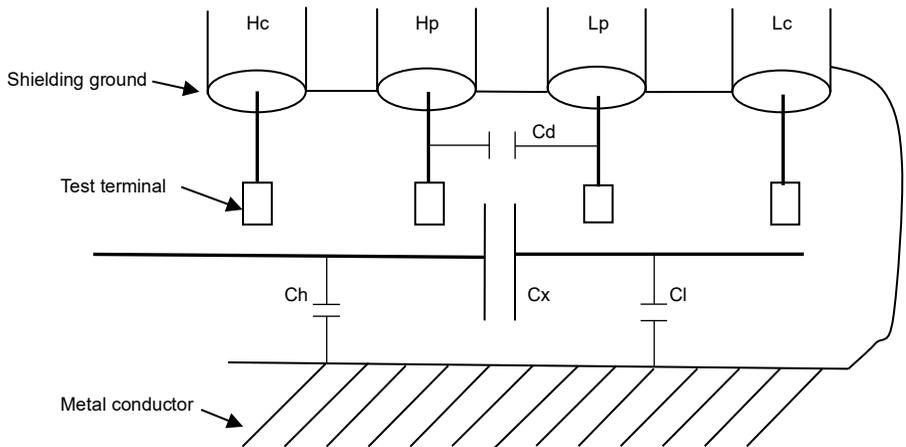
Figure 5-1 Influence of Stray Capacitance
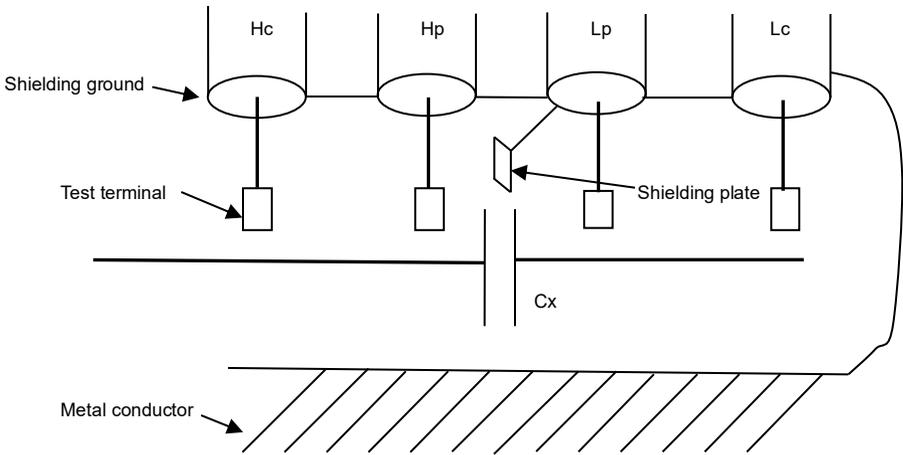
Figure 5-2 Influence of Stray Capacitance: Solution

If the DUT has a high impedance (e.g. a small capacitor), the influence of the stray capacitance cannot be neglected. Figure 5-1 is an example of the use of four-wire measurement. In this figure, the parasitic capacitance Cd is in parallel with the DUT Cx, and if there is a conductive plate under the DUT, the series connection of capacitances Ch and Cl will also be in parallel with the DUT, resulting in measurement errors. The capacitance Cd can be minimized by installing a grounded shielding plate between the contacts of the high side and those of the low side (Figure 5-2. The influence of the capacitances Ch and Cl can be eliminated by grounding the conductive plate as well.

In the case of a low impedance device under test (e.g. a small inductor or a large capacitor), a high current flows through the measuring cables between Hcur and Lcur. In this case, **the electromagnetic coupling between the measurement cables becomes the main source of measurement errors** apart from the influence of the contact transition resistance at the measurement terminals. If this coupling cannot be eliminated, it will have an unexpected influence on the measurement results. Generally speaking, the contact resistance affects the resistance part of the impedance and the electromagnetic coupling affects the reactance part of the impedance. As a countermeasure, the measurement cables can be designed in 4-terminal pair configuration. In this case, the shields of the measuring cables are not completely grounded and are used as

return conductors for the measuring current. In this way, the fields generated by the equal but oppositely directed currents through the conductors Hcur and Lcur and their shields cancel each other out, thus minimizing the influence of the coupling on the measurement results.

5.4 Application Example Based on an Inductance Measurement

Measurement Conditions:

- Function: Ls-Q

- Frequency: 5kHz

- Level: 1.5Vrms

- Internal impedance: 100Ω

Operating Steps:

1) Switch on the device.

2) Set the basic parameters:

   a) Press the [DISP] key to enter the **<MEAS DISPLAY>** page.

   b) Move the cursor to the **FUNC** field. This contains the current setting, e.g. Cp-D. The soft keys Cp-…→, Cs-…→, Lp-...→, Ls-...→, Z-...→ and ↓ are displayed at the bottom of the screen.

   c) Press the Ls-...→ soft key, which causes the display to change to Ls-D, Ls-Q and Ls-Rs.

   d) Press the soft key to select the Ls-Q measuring function.

   e) Move the cursor to the **FREQ** field, which contains the current setting, e.g. 1.0000kHz.

   f) Press the [5] key so that 5 is displayed in this field. The available units Hz, kHz and MHz are displayed at the bottom of the screen. Press the kHz softkey and the frequency will be set to 5.0000kHz.

   g) Move the cursor to the **LEVEL** field. This contains the current setting of the measuring level, e.g. 1.000V.

   h) Press the [1], [.] and [5] keys so that 1.5 is displayed in this field. The available units mV, V, μA, mA and A are displayed at the bottom of the screen. Press the V soft key and the measurement level will be set to 1.5V.

   i) Press the [SETUP] key to enter the **<MEASURE SETUP>** page.

j) Move the cursor to the **R_{sou}** field. The 100Ω, and 30Ω softkeys are displayed at the bottom of the screen.

k) Press the 100Ω softkey to select the 100Ω source impedance.

3) Connect the measuring adapter (ST26048A) to the ST2830.

4) Perform the correction measurements. (In order to minimize the influence of e.g. stray impedances on the measuring accuracy, the open/short correction must be performed). To do this, proceed as described under section 5.1.2.

5) Insert the DUT into the measuring adapter.

6) Execute test operation.

7) Perform the measurement: Press the [DISP] key to enter the **<MEAS DISPLAY>** page. The instrument measures continuously; the measurement results are displayed in large letters in the center of the screen.

8) If the measurement results are obviously incorrect:

a) Make sure that the DUT has good contact to all four contact springs of the measuring adapter.

b) Check that the measuring adapter is correctly connected to the terminals of the measuring instrument.

c) Perform the open/short correction again.

NOTE
If the multi-frequency calibration is used, the frequency point calibration should be switched off, otherwise the latter has priority. To do this, proceed as described in 5.1.1 Multi-Frequency Calibration.

5.5 Application Example of Testing Capacitance by Multi-Frequency List Sweep

Measurement Conditions:

• Function: Cp-D

• Level: 1Vrms

• Other parameters

Frequency	Comparison Parameters	Lower Limit	Upper Limit
1kHz	Cp (Capacitance)	325.0nF	333.0nF
10kHz	D (Dissipation)	0.0001	0.0003
100kHz	D (Dissipation)	0.0060	0.0100

Signal Tone: HIGH LONG

Signal sounds for: OUT (i.e. when the test item is sorted out).

Operating Steps:

1)   Switch on the device.

2)   Set the basic parameters:

     a)   Press the [DISP] key to enter the **<MEAS DISPLAY>** page.

     b)   The **FUNC** field already contains Cp-D and the **LEVEL** field 1.000V.

     c)   Press the [SETUP] key to access the **<MEASURE SETUP>** page. The MEAS SETUP, CORRECTION, LIMIT SETUP, LIST SETUP, FILE MANAGE and TOOLS soft keys are displayed on the right side of the screen.

     d)   Press the LIST SETUP softkey to go to the **<LIST SWEEP SETUP>** page.

     e)   Move the cursor to the field with the pass parameter; this contains **FREQ[Hz]**.

     f)   Move the cursor to the field directly below, this is the pass parameter area of list item 1 and contains "---"

     g)   Press the [1] key so that 1 is displayed in this field. The available units Hz, kHz and MHz are displayed at the right edge of the screen. Press the kHz soft key to set the first list item to 1.0000kHz.

     h)   Press the [→] key to move the cursor to the **LMT** column of list item 1. This contains "---". The LIMIT DATA A, LIMIT DATA B and OFF soft keys are displayed at the right edge of the screen.

i)   Press the LIMIT DATA A soft key to select the function for comparing the primary parameter Cp. The display in this field changes to A and the cursor automatically jumps to the column for the lower limit value of list item 1.

j)   Press keys [3], [2] and [5] so that 325 is displayed in this field. The available prefixes p, n, μ, m and k are displayed on the right side of the screen. Press the soft key n and this field will be set to 325,000nF. The cursor then automatically jumps to the column for the upper limit value of list item 1.

k)   Press the [3] key three times so that 333 is displayed in this field. The available prefixes p, n, μ, m and k are displayed at the right edge of the screen. Press the soft key n, and this field will be set to 333.000nF. The cursor then automatically jumps to the column for the pass parameter of list item 2.

l)   Press the [1] and [0] keys so that 10 is displayed in this field The available units Hz, kHz and MHz are displayed at the right edge of the screen. Press the kHz soft key so that this field is set to 10.0000kHz.

m)   Press the [→] key to move the cursor to the **LMT** column of list item 1. This contains "---". The LIMIT DATA A, LIMIT DATA B and OFF soft keys are displayed at the right edge of the screen.

n)   Press the LIMIT DATA B soft key to select the function for comparing the secondary parameter D. The display in this field changes to B and the cursor automatically jumps to the column for the lower limit value of list item 2.

o)   Press the [0] [.] [0] [0] [0] [1] keys so that 0.0001 is displayed in this field. The available prefixes p, n, μ, m and k are displayed at the right edge of the screen. Press the *1 key and the display in this field will change to 100.000μ and the cursor will automatically jump to the upper limit column of list item 2.

p)   Press the [0] [.] [0] [0] [0] [3] keys so that 0.0003 is displayed in this field. The available prefixes p, n, μ, m and k are displayed at the right edge of the screen. Press the *1 key and the display in this field will change to 300.000μ and the cursor will automatically jump to the pass parameter column of list item 3.

q)   Repeat steps l–p for the third list item with values 100kHz, B, 0.0060 and 0.0100.

3) Set the signal:

       a)   Press the [SYSTEM] key to enter the **<SYSTEM SETUP>** page.

       b)   Move the cursor to the **FAIL BEEP** field and press the HIGH LONG soft key.

4) Connect the measuring adapter (ST26048A) to the ST2830.

5) Carry out the correction measurements. (To minimize the influence of e.g. stray impedances on the measuring accuracy, the open/short correction must be performed). Proceed as described under 5.1.2 Frequency Point Calibration.

6) Insert the discharged DUT into the measuring adapter.

7) Perform the measurement: Press the [DISP] key and then the LIST SWEEP soft key to enter the **<LIST SWEEP DISP>** page. The instrument measures continuously and then displays the measurement and comparison results on the page. When the comparison result is H (higher than the upper limit) or L (lower than the lower limit), a beep sounds.

8) If the measurement results are obviously incorrect:

       a)   Make sure that the DUT has good contact to all four contact springs of the measuring adapter.

       b)   Check that the measuring adapter is correctly connected to the terminals of the measuring instrument.

       c)   Perform another open-/short-circuit correction.

NOTE
If the multi-frequency calibration is used, the frequency point calibration should be switched off, otherwise the latter has priority. To do this, proceed as described in 5.1.1 Multi-Frequency Calibration.

5.6 Application Example of the Comparator

The ST2830 includes a comparator function. This is useful when measuring, sorting and classifying components, for incoming and outgoing inspection. With the HANDLER interface it is possible to set up an automatic sorting test system. Function and setup of the comparator have been described in the previous chapter. Two application examples follow.

5.6.1 Capacitor Sorting

Capacitor Type: 0805CG271

Basic Requirements: The capacity should be sorted into two bins depending on the deviation: BIN J and BIN K (and, if the range is exceeded, BIN OUT). If the capacity falls within the range J or K, but the loss factor D exceeds a limit, it should be sorted into another bin (BIN AUX).

Measurement Parameters: Frequency of 100kHz, level of 1Vrms, SLOW, FAIL alarm and external trigger.

Sorting Parameters: Tray J -4.6% ~ +4.8%, Tray K -9% ~ +10%, loss tanδ < 0.15%.

The following parameters must be set:

Parameter	Setting
Primary parameter （FUN1）	Cp
Secondary parameter （FUN2）	D
Frequency （FRQ）	100kHz
Level （LEV）	1V
Speed （SPEED）	SLOW
Switch of 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

Lower limit of secondary parameter（2nd LOW）	0.0015
Trigger mode（TRIG）	EXT（external）
Alarm mode（CMP ALARM）	POOR ALARM（HIGH LONG）

NOTE
1)   For small capacitances (effective impedance above 1kΩ) the parallel equivalent circuit should be used (Cp instead of Cs).   2)   If one of the capacity comparisons is successful, but the losses exceed the limit, the component is sorted separately. The additional compartment must be switched on so that the component can be sorted into compartment AUX. If it is not switched on, the component ends up in the FAIL compartment.   3)   Since upper and lower limits are based on the percentage deviation from the nominal value, it makes sense to select the %TOL mode, since there this deviation can be specified directly without conversion.

Detailed Setup:

1)   On the **<MEAS DISP>** page, select Cp-D as the measurement function pair and set the frequency, level and measurement speed.

2)   Press the [SETUP] button to go to the **<MEAS SETUP>** page and set the **TRIGGER MODE** to EXT (external trigger).

3)   Press [SETUP]--LIMIT to access the **<LIMIT TABLE SETUP>** page where you activate the nominal value, mode, upper and lower limits, the AUX compartment and the entire comparator.

4)   Press the SYSTEM key to go to the **<SYSTEM SETUP>** page and set **FAIL BEEP** to HIGH LONG.

5)   Return to the **<MEAS DISP>** page.

5.7 Application Example for Reference Load Correction

Measurement Conditions:

- Frequency: 100kHz

- Cp: 11nF

- D: 0.0005

Operating Steps:

1) Press [SETUP], the MEAS SETUP, CORRECTION, LIMIT TABLE, LIST SETUP, FILE MANAGE and TOOLS soft keys are displayed at the bottom of the page.

2) Press CORRECTION to enter the **<CORRECTION>** page.

3) When you move the cursor to **OPEN**, the ON, OFF and MEAS OPEN And DCR OPEN soft keys are displayed at the right edge of the screen.

4) Press ON to switch on the open-circuit correction.

5) When you move the cursor to **SHORT**, the ON, OFF and MEAS SHORT And DCR SHORT soft keys are displayed at the bottom of the page.

6) Press ON to switch on the short-circuit correction.

7) When you move the cursor to **LOAD**, the ON and OFF soft keys are displayed at the bottom of the page.

8) Press ON to switch on the reference load correction.

9) When you move the cursor to **FUNC**, this field will display Cp-D. Meanwhile the Cp—…→, Cs—…→, Lp—…→, Ls—…→, Z—…→ and ↓ soft keys will be displayed at the right edge of the screen.

10) Press the Cp-…→ soft key an then the Cp-D soft key to select the Cp-D function.

11) When you move the cursor to **FREQ**, the ON, OFF, MEAS OPEN, MEAS SHORT and MEAS LOAD soft keys are displayed at the right edge of the screen.

12) Press ON to switch on the correction at the **FREQ** frequency point.

13) Press [1] [0] [0] so that 100 is displayed in this field. The available units Hz, kHz and MHz are displayed at the right edge of the screen. Press the soft key kHz so that this field is set to the measuring frequency 100.000kHz.

14) Move the cursor to the **REF A** field. Press [1] [1] so that 11 is displayed in this field. The available units p, n, μ, m and k are displayed at the right edge of the screen. Press the soft key n so that this field will be set to 11.0000nF.

15) Move the cursor to the **REF B** field. Press [0] [.] [0] [0] [0] [5] so that 0.0005 is displayed in this field. The available units p, n, μ, m and k are displayed at the right edge of the screen. Press → so that this field will be set to 0.00050.

16) When you move the cursor to **FREQ 1**, the ON, OFF, MEAS OPEN, MEAS SHORT and MEAS LOAD soft keys are displayed at the right edge of the screen.

17) Leave the connected measuring adapter empty and remove your hands and other possible sources of interference as far as possible from the measuring adapter. Press the MEAS OPEN soft key to perform the open-circuit correction.

18) Insert the shorting plate (ST26010) into the measuring adapter. Make sure that the shorting plate and the contact springs of the measuring adapter have stable contact.

19) Press the MEAS SHORT soft key to perform the short-circuit correction.

20) Insert a calibration capacitor with the values entered in step 14 and 15 into the measuring adapter. Make sure that the connecting legs of the capacitor have secure contact with the springs of the measuring adapter.

21) Press the MEAS LOAD soft key to perform the reference load correction.

NOTE

1)   Depending on the firmware version of the device, the soft key and field names and status information may differ from those mentioned here. However, the operation is the same, with one exception: with older firmware versions, three frequencies **FREQ 1** to **FREQ 3** are displayed on the **<CORRECTION>** page with the corresponding reference values; with newer ones, only the values for one frequency each are displayed, but a total of 201 memory locations are available here, which can be selected via the **SPOT NO.** field. These can be reset all at once with the CLEAR CORR function on the **<TOOLS>** page.

2)   If the reference components are not adjusted but calibrated, the actual values determined in the calibration must be entered instead of the reference values. It must be ensured that only frequencies are used for which the reference component is calibrated. Deviations which occur due to disregard of these requirements lead to systematic measuring errors.

6   Performance Data and Verification

6.1 Measurement Functions

6.1.1 Parameters and Symbols

C: Capacitance   L: Inductance

R: Resistance   Z: Impedance   Y: Admittance

X: Reactance   B: Susceptance   G: Conductance

D: Dissipation θ: Phase Angle   Q: Quality Factor

DCR: DC Resistance

Measuring Combinations:

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

Primary Parameter	Z, Y	L, C	R	G
Secondary Parameter	θ (deg phase), θ (rad radian)	D, Q, RS, RP, G, Rd	X	B

There is no combination option for the primary parameter DCR, but it can be used as a secondary parameter under the designation R_D.

Mathematical Operations:

Possible operations between measured value and configurable nominal value are: absolute deviation ΔABS and relative deviation Δ%.

6.1.2 Equivalent Mode

Serial and Parallel.

6.1.3 Range

Auto, Manual (Hold, Increase and Decrease).

6.1.4 Trigger

Internal, External and Manual

- Internal: Continuous measurement and continuously updated display of measurement results.

- Manual: Start of a single measurement by pressing the [TRIGGER] key, then display of the measurement results.

- External: Start of a single measurement via HANDLER input, then output of measurement results.

6.1.5 Delay Time

Delay time from trigger time to start of actual measurement, programmable from 0 to 60s with a resolution of 1ms.

6.1.6 Connection Modes of Test Terminals

The ST2830 supports four-wire measurement.

- HD(Hcur):   Measuring signal current injection, high potential
- LD(Lcur):   Measuring signal current injection, low potential
- HS(Hpot):   Voltage measurement, high potential
- LS(Lpot):   Voltage measurement, low potential

6.1.7 Test Speed (Frequency>=10kHz)

- Fast: approx. 75 measurements/s (13ms/measurement)
- Medium: approx. 12 measurements/s (83ms/measurement)
- Slow: approx. 6 measurements/s (167ms/measurement)

Fast and medium speed levels slow down when the frequency is below 10kHz.

6.1.8 Average

Programmable from 1 to 255 individual measurements.

6.1.9 Display digit

6 digits; max. display value: 999999

6.2 Measurement Signal

6.2.1 Measurement Signal Frequency

The measuring signal is a sine wave with an accuracy of 0.01%.

Frequency Range:

- 50Hz~100kHz (ST2830)

    50Hz~100kHz (ST2831)

- 20Hz~200kHz (ST2832)

Minimum Resolution: 0.01Hz

6.2.2 Measurement Signal Mode

- Normal: During the measurement, the signal source is programmed to the preset value. The voltage across the contacts of the DUT may be lower due to voltage drops on the leads.
- Constant level ALC (ST2832 only): The signal source is automatically tracked within its capabilities so that the value measured by four-wire measurement directly at the DUT adjusts as if the source were connected directly above the DUT.

6.2.3 Test Signal Level

Mode	Range (100Ω)	Accuracy	Resolution
Voltage	$10mV_{RMS}$—$2V_{RMS}$ $10mV_{RMS}$—$1V_{RMS}$	± (10%×preset value+2mV) ± (6%×preset value+2mV)	10mV
Current	$100\mu A_{RMS}$ —$20mA_{RMS}$ $100\mu A_{RMS}$ —$10mA_{RMS}$	± (10%×preset value+$10\mu A_{RMS}$) ± (6%×preset value+$10\mu A_{RMS}$)	100μA

Constant level and constant current are only possible with the ST2832.

6.2.4 Output Impedance

30Ω and 100Ω±1% are selectable.

6.2.5 Monitor for Test Signal Level

Mode	Range	Accuracy
Voltage	$5mV_{RMS}$—$2V_{RMS}$ $0.01mV_{RMS}$—$5mV_{RMS}$	± (3%×reading+0.5mV) ± (12%×reading +0.1mV)
Current	$50\mu A_{RMS}$—$20mA_{RMS}$ $0.001\mu A_{RMS}$—$10\mu A_{RMS}$	± (3%×reading +5μA) ± (12%×reading +1μA)

6.2.6 Maximum Measurement Display Range

Parameter	Measurement Display Range
L, Lk	0.00001µH ～ 99.999kH
C	0.00001pF ～ 9.99999F
Z, R, X, DCR	0.00001Ω～ 99.9999MΩ
Y, B, G	0.00001µs ～ 99.9999S
D	0.00001 — 9.99999
Q	0.00001 — 99999.9
θ	Deg -179.999°～179.999° Rad -3.14159 ～ 3.14159

6.2.7 DC Bias Voltage Source

100Ω	0V—±5V	Minimum Resolution: 1mV, Accuracy: 1% x preset voltage+5mV
	0mA—±50mA	Minimum Resolution: 10µA
30Ω	0V—±1.5V	Minimum Resolution: 1mV, Accuracy: 1% x preset voltage+5mV
	0mA—±50mA	Minimum Resolution: 10µA

6.3 Measurement Accuracy

Measurement accuracy includes stability, temperature coefficient, linearity, recoverability, and interpolation deviations between calibration points.

Checks for accuracy should be made under the following conditions:

1)   Warm-up time: ≥ 30 min

2)   Cable: 0m, 1m

3)   Open-circuit and short-circuit correction after warming up

4)   DC bias disabled

5)   Measuring range selection "AUTO", so that the measuring range is optimal.

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

The respective accuracies A_e of |Z|, |Y|, L, C, R, X, G and B are expressed as:

$$A_e = \pm[A + (K_a + K_b + K_c) \times 100 + K_d + K_f] \times K_e \ [\%]$$

A: Basic Measurement Accuracy (Figure 6-1)

K_a: Impedance Rate Factor ()

K_b: Impedance Rate Factor ()

K_c: Interpolation Deviations Between Calibration Points (Table 6-2)

K_d: Measuring Cable Length Factor (Table 6-4)

K_e: Temperature Factor (Table 6-5)

Kf: Scan Box Mark-Up Factor (without scan box: Kf = 0, add：Kf = 0.2)

L, C, X, B accuracy using condition: D_x (D Test value) ≤0.1

R, G accuracy using condition: Q_x (Q test value) ≤0.1

If D_x ≥ 0.1, for L, C, X, B the accuracy factor A_e is to be multiplied by $\sqrt{1 + D_x^2}$

If Q_x ≥ 0.1, for R, G, the accuracy factor A_e is to be multiplied by $\sqrt{1 + Q_x^2}$

This accuracy specification for G is only valid in the combination G-B.

6.3.2 Accuracy of D

The accuracy of D is given as D_e:

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

The formula is valid only as long as $D_x \leq 0.1$.

If $D_x > 0.1$, multiply D_e by $(1+D_x)$.

6.3.3 Accuracy of Q

The accuracy of Q is given as Q_e:

$$Q_e = \ \pm \frac{Q_x \times D_e}{1 \mp Q_x \times D_e}$$

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

The above formula is valid only as long as $Q_x \times D_e < 1$.

6.3.4 Accuracy of θ

The accuracy of θ is given as θ_e:

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

6.3.5 Accuracy of G

When Dx (measured value of D ≤ 0.1, the accuracy of G is calculated by the following formulas:

$$G_e = B_x \times D_e \qquad [\text{S}]$$

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

Here…

- B_x is the measured value of B with the unit [S],

- C_x the measured value of C with the unit [F],

- L_x the measured value of L with the unit [H],

- D_e the accuracy of D, and

- f is the measuring frequency.

This accuracy specification for G only applies in the combinations Cp-G and Lp-G.

6.3.6 Accuracy of R_p

When D_x (measured value of D) $\leq$ 0.1, the accuracy of R_p is calculated by the following formula:

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

Here…

- R_{px} is the measured value of Rp with the unit [Ω],

- D_x the measured value of D, and

- D_e is the accuracy of D.

6.3.7 Accuracy of Rs

When D_x (measured value of D) $\leq$ 0.1, the accuracy of R_s is calculated by the following formulas:

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

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

Here…

- X_x is the measured value of X with the unit [Ω],

- 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, and

- f is the measuring frequency.

6.3.8 Accuracy Factor
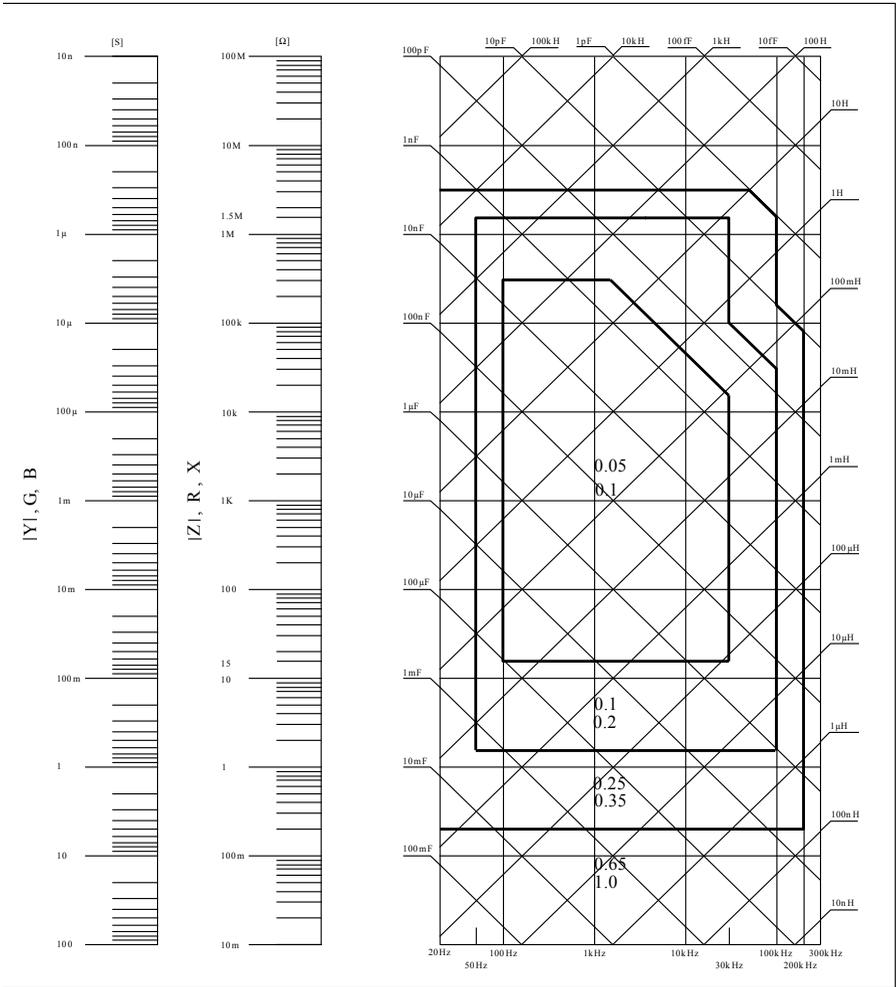
Figure 6-1 Basic Test Accuracy A

The basic accuracy A can be read from the diagram as follows:

Determine the intersection point of the straight line corresponding to the expected measured value with the measuring frequency. Two numbers are assigned to the outlined subarea in which this crossing point is located.

If $0.4V_{rms} \leq V_s \leq 1.2V_{rms}$, then at slow and medium measurement speeds the upper and at fast measurement

speeds the lower of the two numbers is the value of A we are looking for.

If the measurement voltage V_s <0.4V$_{rms}$ or V_s >1.2V$_{rms}$, A is calculated as follows**:**

1)   Determine A as indicated above.

2)   Read the accuracy modification coefficient Ar from Figure B and multiply it by the value from step 1.
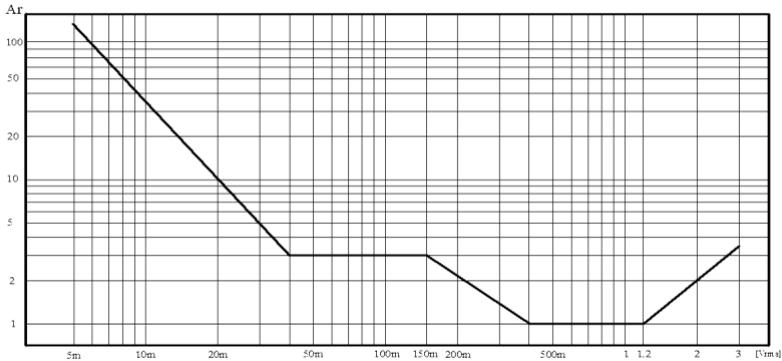
Table 6-1 Impedance Rate Factors

Figure 6-2 Basic Accuracy Modification Curve (where V_s is the test signal voltage)

Speed	Frequency	K_a	K_b
Medium Slow	f_m < 100Hz	$(\dfrac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\dfrac{200}{V_s})(1+\sqrt{\dfrac{100}{f_m}})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\dfrac{70}{V_s})(1+\sqrt{\dfrac{100}{f_m}})$
	100Hz $\leq f_m \leq$ 100kHz	$(\dfrac{1\times10^{-3}}{\lvert Z_m\rvert})(1+\dfrac{200}{V_s})$	$\lvert Z_m\rvert(1\times10^{-9})(1+\dfrac{70}{V_s})$
	100kHz $< f_m \leq$ 200kHz	$(\dfrac{1\times10^{-3}}{\lvert Z_m\rvert})(2+\dfrac{200}{V_s})$	$\lvert Z_m\rvert(3\times10^{-9})(1+\dfrac{70}{V_s})$
Fast	f_m < 100Hz	$(\dfrac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\dfrac{400}{V_s})(1+\sqrt{\dfrac{100}{f_m}})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\dfrac{100}{V_s})(1+\sqrt{\dfrac{100}{f_m}})$
	100Hz $\leq f_m \leq$ 100kHz	$(\dfrac{2.5\times10^{-3}}{\lvert Z_m\rvert})(1+\dfrac{400}{V_s})$	$\lvert Z_m\rvert(2\times10^{-9})(1+\dfrac{100}{V_s})$

100kHz < f_m ≤ 200kHz	$(\dfrac{2.5\times10^{-3}}{|Z_m|})(2+\dfrac{400}{V_s})$	$|Z_m|(6\times10^{-9})(1+\dfrac{100}{V_s})$

Here…

- f_m is the measuring frequency with the unit [Hz],

- Z_m the measured impedance with the unit [Ω],

- V_s the measuring voltage with the unit [mV_rms].

For impedances above 500Ω, K_a is negligible, and only K_b is used; for impedances below 500Ω, K_b is negligible, and only K_a is used.

The calibration correction data are linearly interpolated between the measured frequency points (Table 6-2). The interpolation correction factor K_c indicates the deviation between the interpolated data and the real measurement deviation between the calibration points.

Table 6-2 Calibrated Interpolating Factor K_c

Test Frequency	K_c
Direct calibrated frequency	0
Other frequency	0.0003

Table 6-3 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							[kHz]

Table 6-4 Cable Length Factor K_d

Test Signal Level	Cable Length		
	0m	**1m**	**2m**
≤1.5V$_{rms}$	0	$2.5×10^{-4}$ （$1+50×f_m$)	$5×10^{-4}$ （$1+50×f_m$)
>1.5V$_{rms}$	0	$2.5×10^{-3}$ （$1+16×f_m$)	$5×10^{-3}$ （$1+50×f_m$)
f_m: Test frequency [MHz]			

When using a scan box, use the value for 2m.

Table 6-5 Temperature Factor K_e

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

6.3.9 Accuracy of DCR

$R_{xe} = A×(1+R_x /5MΩ+16mΩ/R_x)[\%]±0.2mΩ$

At medium and slow measuring speed A=0.1.

At fast measuring speed A=0.25.

R_x is the resistance measured value.

6.4 Safety Requirements

The devices of the ST2830 series correspond to protection class I. Therefore, the correct function of the protective earth conductor must always be ensured.

6.4.1 Insulation Resistance

Under normal operating conditions, the insulation resistance between the mains connection and the device housing should not be less than 50MΩ.

In case of increased humidity, the insulation resistance between the mains connection and the device housing must not be less than 2MΩ.

6.4.2 Insulation Capability and Dielectric Strength

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

6.4.3 Leakage Current

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

6.5 Electromagnetic Compatibility

The series has been tested according to EMC Directive 2014/30/EC for compliance with:

- EN 61326-1:2013,

- EN 61000-3-2:2006+A1:2009+A2:2009 and

- EN 61000-3-3:2008

(CISPR 11:2009+A1:2010, IEC 61000-4-2:2008, IEC 61000-4-3:2006+A1:2007+A2:2010, IEC 61000-4-4:2012, IEC 61000-4-5:2005, IEC 61000-4-6:2008, IEC 61000-4-11:2004).

The test report number is MTE/TAC/B17040610.

6.6 Performance Data Review

6.6.1 Operating Conditions

All measurements should take place under the operating conditions listed in chapter 1.4 after a warm-up time of at least 15 minutes. Only primary parameters are checked in this section.

6.6.2 Used Instruments and Devices

No.	Instrument/Device		Specification
1	Calibration Capacitor	100pF	0.02% D is known
		1000pF	
		10000pF	
		10nF	

		0.1uF	
		1uF	
2	Resistance Standard AC	10Ω	0.02%
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	Resistance Standard DC	0.1Ω	0.02%
		1Ω	
		10Ω	
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
4	Inductance Standard	100μH	0.02%
		1mH	
		10mH	
		100mH	
5	Frequency Counter		（0～1000）MHz
6	Digital Multimeter		0.5%
7	Insulation Resistance Meter		500V 10 levels
8	High Voltage Tester		0.25kW （0～500）V

6.6.3 Function Test

Determine if function keys, display, interfaces, etc. are operating normally.

6.6.4 Measuring Signal Level

Connect a multimeter in the AC voltage setting between Hcur and the ground terminal (next to Lcur, or the shielding of the BNC terminals). Set the measurement level to 10mV, 20mV, 100mV, 200mV, 1V and 2V and check that the reading is within the limits given in section 6.2.

6.6.5 Frequency

Connect a frequency counter between ground terminal and Hcur. Set the frequency to 20Hz (ST2832) or 50Hz (ST2830/31), 100Hz, 1kHz, 10kHz, 100kHz (maximum for ST2830) and 200kHz and check that the reading is within the limits given in section 6.2.

6.6.6 Measurement Accuracy

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

6.6.7 Accuracy of C and D

Function	Test Frequency (test respectively)	Level	Range	Bias	Speed
C_p-D	100Hz 1kHz 10kHz 100kHz	1V	AUTO	0V	Slow

Open- and short-circuit correction should be performed before measurement. Connect your capacitance standards of 100pF, 1000pF, 10nF, 0.1µF and 1µF and measure them at the different frequencies. Check that the deviation between the reading and the nominal value of C and D is within the limits given in section 6.2, taking into account the accuracy of the standards.

6.6.8 Accuracy of L

Function	Test Frequency (test respectively)	Level	Range	Bias	Speed
L_s-Q	100Hz 1kHz	1V	AUTO	0V	Slow

Open- and short-circuit correction should be performed before measurement. Connect your inductance standards with 100μH, 1mH, 10mH and 100mH and measure them at the different frequencies. Check that the deviation between the reading and nominal value is within the limits from section 6.2, taking into account the accuracy of the standards.

6.6.9 Accuracy of Z

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

Open- and short-circuit correction should be performed before measurement. Connect your 10Ω, 100Ω, 1kΩ, 10kΩ and 100kΩ resistance standards and measure them at the different frequencies. Check that the deviation between the reading and nominal value is within the limits from section 6.2, taking into account the accuracy of the standards.

6.6.10 Accuracy of DCR

Function	Test Frequency	Level	Range	Bias	Speed
DCR	---	---	AUTO	---	Slow

Open- and short-circuit correction should be performed before measurement. Connect your 0.1Ω, 1Ω, 10Ω, 100Ω, 1kΩ, 10kΩ and 100kΩ resistance standards and measure them at the different frequencies. Via check if the deviation between reading and nominal value is within the limits from section 6.2, taking into account the accuracy of the standards.

7　Command Reference

The abbreviations and shorthands used in this manual are as follows:

NR1	NR2	NR3	NL	^END
Integer (e.g. 123)	Fix-point number (e.g. 12.3)	Floating-point number (e.g. 12.3E+5)	Carriage key, ASCII code: 10	EOI signal in IEEE-488

7.1 Subsystem Commands for ST2830

7.1.1 DISPlay Subsystem Commands

The **DISPlay** subsystem commands are primarily used to set the display page for the device. The **:DISPlay?** query returns the current page.

Command Tree

```
DISPlay        :PAGE         MEASurement

                             BNUMber

                             BCOunt

                             LIST

                             MSETup

                             CSETup

                             LTABle

                             LSETup

                             SYSTem

                             FLISt



               :LINE         "<string>"

               :RFONt        LARGe

                             TINY

                             OFF
```
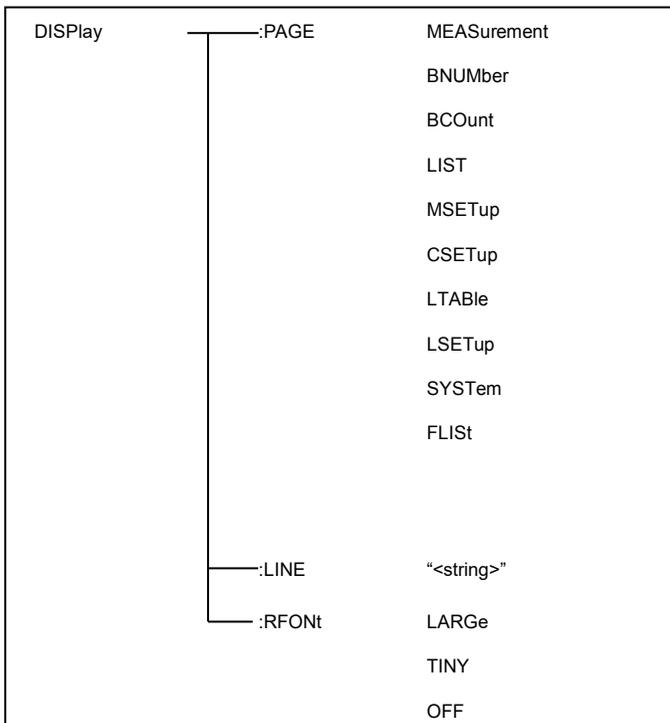
The **:PAGE** command sets the display page.

The **:DISPlay:PAGE?** query returns the current page.

Command Syntax
DISPlay:PAGE<page name>

<Page name> can be defined as any of the following:

- **MEASurement**   Open the LCR measurement display page.
- **BNUMber**   Open the bin number display page.
- **BCOunt**   Open the bin count display page.
- **LIST**   Open the list sweep display page.
- **MSETup**   Open the measurement display page.
- **CSETup**   Open the correction setup page.
- **LTABle**   Open the limit table setup page.
- **LSETup**   Open the list sweep setup page.
- **SYSTem**   Open the system setup page.
- **FLISt**   Open the file list page.

For example: **WrtCmd("DISP:PAGE MEAS")** opens the LCR measurement display page.

Query Syntax	Return Format
DISPlay:PAGE?	<page name><NL^END>

<Page name> can be returned as any of the following:

- **LCR MEAS MEAS**   The current page is the LCR measurement display page.
- **BIN No. MEAS**   The current page is the bin number display page.
- **BIN COUNT MEAS**   The current page is the bin count display page.
- **LIST SWEEP MEAS**   The current page is the list sweep display page.
- **MEAS SETUP**   The current page is the measurement setup page.
- **CORRECTION**   The current page is the correction page.
- **LIMIT TABLE SETUP**   The current page is the limit table setup page.
- **LIST SWEEP SETUP**   The current page is the list sweep setup page.
- **SYSTEM SETUP**   The current page is the system setup page.
- **FILE LIST**   The current page is the file list page.

The **:LINE** command is used to set the current measurement point, which can be a substring of up to 16 characters. The query **:LINE?** returns the current setting. The measurement point string can be used as a file name when saving.

Command Syntax
DISPlay:LINE"<string>"

Where **<string>** can be an ASCII character string (maximum number of characters is 16).

For example: **WrtCmd("DISP:LINE" Resistor meas"")**

Query Syntax	Return Format
DISPlay:LINE?	<string><NL^END>

The **:ResultFONt** command is used to set the font in which to display the measurement result. The query **ResultFONt?** returns the current setting.

Command Syntax
DISPlay:RFONt <font>

<font> can be defined as any of the following:

- **LARGe**   Use large digits to display the measurement result, 12ms/meas.
- **TINY**   Use tiny digits to display the measurement result, 5ms/meas.
- **OFF**   Measurement result will not be displayed but can be read from the bus.

Query Syntax	Return Format
DISPlay:RFONt?	<font><NL^END>

<font> can be returned as any of the following:

- **LARGE**
- **TINY**
- **OFF**

7.1.2 FREQuency Subsystem Commands

The **FREQuency** subsystem commands are used to set the measurement frequency of the instrument. The query **FREQuency?** returns the current setting.

Command Syntax
FREQuency { <value> / MIN / MAX }

Where…

- **<value>** is in NR1, NR2 or NR3 data format – followed by the unit Hz, kHz, or MHz.

- **MIN** sets the measurement frequency to 50Hz (the minimum frequency of ST2830 and ST2831   is 50Hz; the minimum of ST2832 is 20Hz)

- **MAX** sets the measurement frequency as 100kHz (the maximum frequency of ST2830 is   100kHz; the maximum of ST2831 and 2832 is 200kHz)

For example: **WrtCmd("FREQ 1KHZ")** sets the frequency to 1000Hz.

Query Syntax	Return Format
FREQuency?	<NR3><NL^END>

7.1.3 VOLTage Subsystem Commands

The **VOLTage** subsystem commands are used to set the measurement voltage. The query **VOLTage?** returns the current setting.

Command Syntax
VOLTage { <value> / MIN / MAX }

Where…

- **<value>** NR1, NR2 or NR3 data format followed by V.

- **MIN** sets the measurement voltage to 5mV.

- **MAX** sets the measurement voltage to 2V.

For example: **WrtCmd("VOLT 1V")** sets the measurement voltage as 1V.

Query Syntax	Return Format
VOLTage?	<NR3><NL^END>

7.1.4 CURRent Subsystem Commands

The **CURRent** subsystem commands are used to set the measurement current. The query **CURRent?** returns the current setting.

Command Syntax
CURRent { <value> / MIN / MAX }

Where…

- **<value>** is in NR1, NR2 or NR3 data format followed by MA.

- **MIN** sets the measurement current to 50μA.

- **MAX** sets the measurement current to 20mA.

For example: **WrtCmd ("CURR 10MA")** sets the measurement current to 10mA.

Query Syntax	Return Format
CURRent?	<NR3><NL^END>

7.1.5 AMPLitude Subsystem Commands

The **AMPLitude** subsystem commands are used to switch the auto level control (ALC) function on or off. The

query **:AMPLiture?** returns the current setting.

Command Syntax
AMPLitude:ALC { ON / OFF / 1 / 0 }
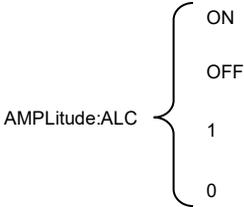
Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("AMPL:ALC 0")** turns the ALC function off.

Query Syntax	Return Format
AMPLitude:ALC?	<NR1><NL^END>

NOTE
This command is only valid for the ST2832; both ST2830 and ST2831 cannot make use of it.

7.1.6 Output RESister Subsystem Commands

The **Output RESister** subsystem commands are used to set the output internal resistor mode. The query

Output RESister? returns the current setting.

Command Syntax
ORESister { 30 / 100 }

For example: **WrtCmd ("ORES 30")** sets the output internal resistance to 30 OHM.

Query Syntax	Return Format
ORESister?	<NR1><NL^END>

7.1.7 BIAS Subsystem Commands

The :BIAS subsystem commands are used to set the internal bias voltage and the bias status (and therefore are only valid for the ST2832).

Command Tree:
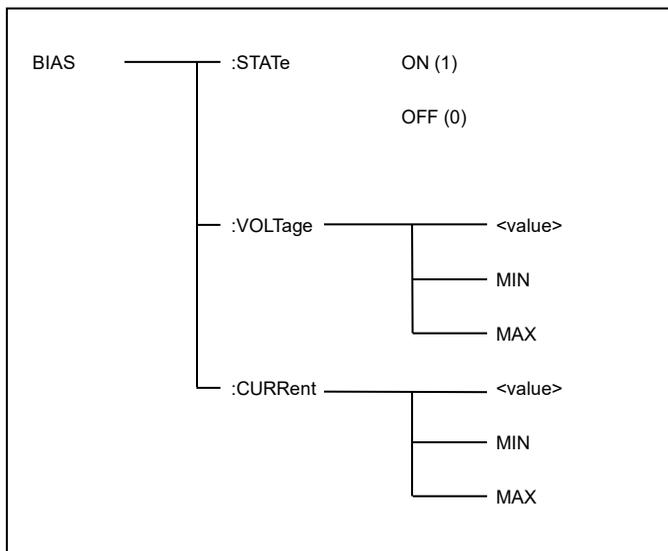
The **BIAS:STATe** command is used to set the bias status. The query **:STATe?** returns the current setting.

Command Syntax
BIAS:STATe $\begin{cases} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{cases}$

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("BIAS:STATe 0")** turns the DC bias function off.

Query Syntax	Return Format
BIAS:STATe?	<NR1><NL^END>

The **BIAS:VOLTage** command is used to set the internal bias voltage. The query **BIAS:VOLTage?** returns the current setting.

Command Syntax
BIAS:VOLTage $\begin{cases} \text{<value>} \\ \text{MIN} \\ \text{MAX} \end{cases}$

Where…

- **<value>** is in NR1, NR2 or NR3 data format.

- **MIN** sets the bias voltage to 0V.

- **MAX** sets the bias voltage to 5V.

For example: **WrtCmd ("BIAS:VOLT MIN")** sets the DC bias voltage to 0V.

Query Syntax	Return Format
BIAS:VOLTage?	<NR3><NL^END>

The **BIAS:CURRent** command is used to set the external bias current. The query **BIAS:CURRent?** returns the current setting. Note that the external bias current is controlled by the serial interface of the instrument; therefore only GPIB interface can support this command.

Command Syntax
BIAS:CURRent { <value> MIN MAX

Where...

- **<value>** is in NR1, NR2 or NR3 data format.

- **MIN** sets the bias voltage to 0A.

- **MAX** sets the bias voltage to 50mA.

For example: **WrtCmd ("BIAS:CURR MIN")** sets the DC bias current as 0A.

Query Syntax	Return Format
BIAS:CURRent?	<NR3><NL^END>
NOTE	
When the internal resistance is 30Ω, the range of bias voltage is ±1.5V and the range of bias current is ±100mA.	
When the internal resistance is 100Ω, the range of bias voltage is ±5V and the range of bias current is ±50mA.	

7.1.8 FUNCtion Subsystem Commands

The **FUNCtion** subsystem commands are used to set measurement functions, range, current/voltage monitor

ON/OFF, deviation display mode, and nominal setting.

Command tree:

```
FUNCtion ───────── :IMPedance ─────────── CPD
                                           CPQ
                                           CPG
                                           CPRP
                                           CSD
                                           CSQ
                                           CSRS
                                           LPQ
                                           LPD
                                           LPG
                                           LPRP
                                           LPRD
                                           LSD
                                           LSQ
                                           LSRS
                                           LSRD
                                           RX
                                           RPQ
                                           RSQ
                                           ZTD
                                           ZTR
                                           GB
                                           YTD
                                           YTR
                                           DCR
                                   :RANGe ───────── <value>
                                         └───── :AUTO      ON  (1)
                                                           OFF (0)
           :Source MONitor ─────────────── :VAC      ON  (1)
                                                     OFF (0)
                                          └── :IAC   ON  (1)
                                                     OFF (0)
           :DEV 1 ───────────────── :MODE ABSolute
                2                          PERcent
                                           OFF
                                    └── :REFerence ───────── <value>
                                                     └──── :FILL
           :StepDELay     <value>
                          MIN
                          MAX
```
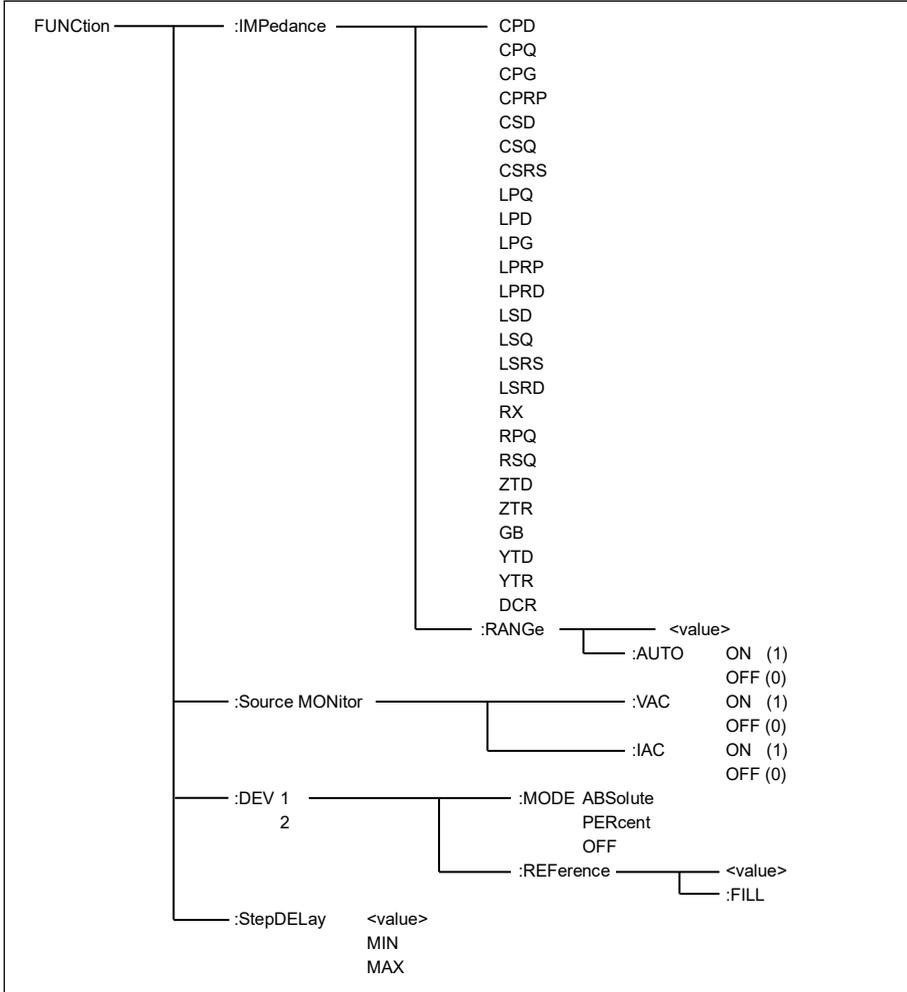
The **FUNCtion:IMPedance** command is used to set instrument functions. The query **FUNCtion:IMPedance?**

returns the current function parameters.

Command Syntax
FUNCtion:IMPedance <function>

<function> can be defined as any of the following:

- **CPD**   Set the function as Cp-D
- **CPQ**   Set the function as Cp-Q
- **CPG**   Set the function as Cp-G
- **CPRP** Set the function as Cp-Rp
- **CSD**   Set the function as Cs-D
- **CSQ**   Set the function as Cs-Q
- **CSRS** Set the function as Cs-Rs
- **LPQ**   Set the function as Lp-Q
- **LPD**   Set the funxtion as Lp-D
- **LPG**   Set the function as Lp-G
- **LPRD** Set the function as Lp-Rd
- **LSRD** Set the function as Ls-Rd
- **DCR**   Set the function as DCR

- **LPRP** Set the function as Lp-Rp
- **LSD**   Set the function as Ls-D
- **LSQ**   Set the function as Ls-Q
- **LSRS** Set the function as Ls-Rs
- **RX**   Set the function as R-X
- **ZTD**   Set the function as Z-$\theta°$
- **ZTR**   Set the function as Z-θr
- **GB**   Set the function as G-B
- **YTD**   Set the function as Y-$\theta°$
- **YTR**   Set the function as Y-θr
- **RPQ**   Set the function as Rp-Q
- **RSQ**   Set the function as Rs-Q

For example: **WrtCmd ("FUNC:IMP RX")** defines the function as R-X.

Query Syntax	Return Format
FUNCtion:IMPedance?	<function><NL^END>

The **FUNCtion:IMPedance:RANGe** command is used to set the range. The query **FUNCtion:IMPedance:**

RANGe? returns the current setting.

Command Syntax
FUNCtion:IMPedance:RANGe <value>

Where **<value>** can be the impedance of the DUT or NR1, NR2 or NR3 data format followed by the unit OHM or kOHM.

For example: **WrtCmd ("FUNC:IMP:RANG 1KOHM")** defines the range as 1kOHM.

Query Syntax	Return Format
FUNCtion:IMPedance:RANGe?	<value><NL^END>

Where **<value>** can be…

1	3	10	30
100	300	1000	3000
10000	30000	100000	

The **FUNCtion:IMPedance:RANGe:AUTO** command is used to set the automatic range selection status. The query   **FUNCtion:IMPedance:RANGe:AUTO?** returns the current setting.

Command Syntax
FUNCtion:IMPedance:RANGe:AUTO $\left\{\begin{array}{l} \text{ON (1)} \\ \\ \text{OFF (0)} \end{array}\right.$

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("FUNC:IMP:RANG:AUTO ON")** turns the automatic range on.

Query Syntax	Return Format
FUNCtion:IMPedance:RANGe:AUTO?	<NR1><NL^END>

The **FUNCtion:Source MONitor:VIAC** command is used to turn the voltage monitor ON or OFF. The query

FUNCTtion:Source MONitor:VIAC? returns the current setting.

Command Syntax
FUNCtion:SMONitor:VIAC { ON (1) / OFF (0) }

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("FUNC:SMON:VIAC ON")** turns the voltage monitor on.

Query Syntax	Return Format
FUNCtion:SMONitor:VIAC?	<NR1><NL^END>

The **FUNCtion:DEV<n>:MODE** command is used to set the deviation measurement mode. The query

FUNCtion:DEV<n>:MODE? returns the current setting.

Command Syntax
FUNCtion:DEV<n>:MODE { ABSolute / PERCent / OFF }

Where…

- **ABSolute**   Absolute value deviation display
- **PERCent**   Percent deviation display
- **OFF**   Real value display

Where **<n>** is…

- **Character 1 (49)** corresponds to the nominal value of the primary parameter.

- **Character 2 (50)** corresponds to the nominal value of the secondary parameter.

For example: **WrtCmd ("FUNC:DEV1:MODE ABS")**

Query Syntax	Return Format
FUNCtion:DEV<n>:MODE?	ABX PERC } <NL^END> OFF

The **FUNCtion:DEV<n>:REFerence<value>** command is used to set the nominal value of the deviation. The query **FUNCtion:DEV<n>:REFernece<value>?** returns the current setting.

Command Syntax
FUNCtion:DEV<n>:REFerence<value>

Where…

- **<value>** is in NR1, NR2 or NR3 data format.

- **<n>** is…

  - **Character 1 (49)** corresponds to the nominal value of primary parameter, OR

  - **Character 2 (50)** corresponds to the nominal value of the secondary parameter.

For example: **WrtCmd ("FUNC:DEV1:REF 10")**

Query Syntax	Return Format
FUNCtion:DEV<n>:REFerence?	<NR3><NL^END>

The **FUNCtion:DEV<n>:REFerence:FILL** command is used to set the nominal value of the deviation. This command directs the instrument to perform a measurement and subsequently copies the results of the primary and the secondary parameters as the nominal values of the deviation.

Command Syntax
FUNCtion:DEV<n>:RERerence:FILL

Where…

- **Character 1 (49)** corresponds to the nominal value of primary parameter, OR

- **Character 2 (50)** corresponds to the nominal value of the secondary parameter.

For example: **WrtCmd ("FUNC:DEV1:REF:FILL")**

The **FUNCtion:StepDELay** command is used to set the step delay time. The query **:StepDELay?** returns the current setting.

Command Syntax
StepDELay $\begin{cases} \text{<value>} \\ \text{MIN} \\ \text{MAX} \end{cases}$

Where…

- **<value>** is in NR1, NR2 or NR3 data format, 0-60s with the resolution of 1mS.

- **MIN** sets the delay time as 0s.

- **MAX** sets the delay time as 60s.

For example: **WrtCmd("FUNC:SDEL 5S")** sets the delay time to 5s.

Query Syntax	Return Format
FUNC:SDEL?	<NR3><NL^END>

7.1.9 LIST Subsystem Commands

The **LIST** subsystem commands are used to set the list sweep function and its sweep points, sweep mode and limits.

Command tree:

```
        LIST ──────┬────── :FREQuency <sweep point>[,<sweep point> *]

                   ├────── :VOLTage <sweep point>[,<sweep point> *]

                   ├────── :CURRent <sweep point>[,<sweep point> *]

                   ├────── :BIAS ──────┬────── :VOLTage <sweep point>[,<sweep point> *]

                   │                   └────── :CURRent <sweep point>[,<sweep point> *]


                   ├────── :MODE   SEQuence

                   │               STEPped


                   ├────── :BAND<n>   A[,<low limit n>,<high limit n>]

                   │                  B

                   │                  OFF

                   └────── CLEar
```
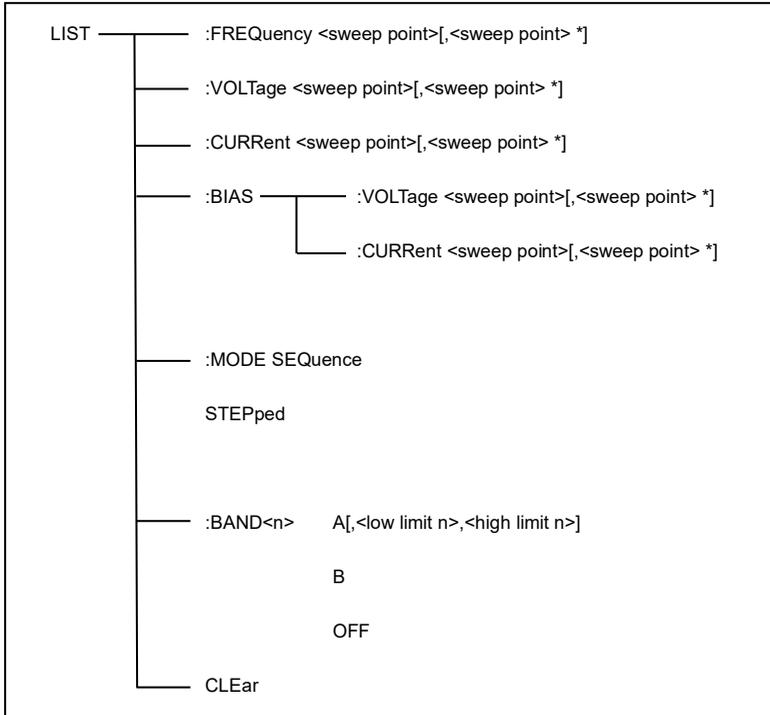
The **LIST:FREQuency** command is used to clear the original sweep points and set the frequencies of the sweep points. The query **LIST:FREQuency?** returns the current setting.

Command Syntax
LIST:FREQuency<value>[,<value>*]
NOTE
*A maximum of 201 sweep points can be set.

Where **<value>** is in NR1, NR2 or NR3 data format.

For example: **WrtCmd("LIST:FREQ 1E3, 2E3, 3E3, 4E3")**…

•   sets the frequency of sweep point 1 to 1KHZ;

- sets the frequency of sweep point 2 to 2KHZ;

- sets the frequency of sweep point 3 to 3KHZ;

- sets the frequency of sweep point 4 to 4KHZ;

NOTE
HZ is the suffix unit, MAHZ and MHZ is MHz (1E6 Hz).

Query Syntax	Return Format
LIST:FREQuency?	<NR3>, [,<NR3>*]<NL^END>

Mind that **<value>** should be set from 20HZ to 200KHZ, or the return format will report errors.

The **LIST:VOLTage** command is used to clear the original voltage of the each sweep point and reset the voltage. The query **LIST:VOLTage?** query returns the current setting.

Command Syntax
LIST:VOLTage<value>[,<value>*]
NOTE
*A maximum of 201 sweep points can be defined.

Where…

- **<value>** is in NR1, NR2 or NR3 data format.

- **<value>** should be defined between 10mV and 2V, or the return format will report errors.

For example:

- **WrtCmd ("LIST:VOLT 1.5")** sets the frequency of sweep point 1 to 1.5V.

- **WrtCmd ("LIST:VOLT 1E-2, 2E-2, 3E-2, 4E-2")** sets the frequencies of sweep points 1, 2, 3 and 4 to 10mV, 20mV, 30mV and 40mV, respectively.

NOTE
This command can be followed by suffix unit V.

Query Syntax	Return Format
LIST:VOLTage?	<NR3>[,<NR3>*]<NL^END>

The **LIST:CURRent** command is used to clear the measurement current of each sweep point and reset the current. The query **LIST:CURRent?** returns the current setting.

Command Syntax
LIST:CURRent<value>[,<value>*]
NOTE
*A maximum of 201 sweep points can be defined.

Where **<value>** is in NR1, NR2 or NR3 data format.

For example:

- **WrtCmd ("LIST:CURR 10MA")** sets the measurement current of the sweep point 1 to 10mA.
- **WrtCmd ("LIST:CURR 1E-2, 2E-2, 3E-2, 4E-2")** sets the currents of sweep points 1, 2,3 and 4 to 10mA, 20mA, 3mA and 4mA, respectively.

NOTE
This command can be followed by suffix unit A (ampere).

Query Syntax	Return Format
LIST:CURRent?	<NR3>[,<NR3>*]<NL^END>

Mind that the current of each sweep point should be set from 100μA to 20mA when the internal resistance is 100Ω, 333μA to 66.7mA when the internal resistance is 30Ω; otherwise, the return format will report errors.

The **LIST:BIAS:VOLTage** command is used to clear the original DC bias voltage of each sweep point and reset the voltage. The query **LIST:BIAS:VOLTage?** returns the current setting.

Command Syntax
LIST:BIAS:VOLTage<value>[,<value>*]
NOTE
*A maximum of 201 sweep points can be defined.

Where **<value>** is in NR1, NR2 or NR3 data format.

For example: **WrtCmd ("LIST:BIAS:VOLT 1.5V")** sets the DC bias voltage of sweep point 1 to 1.5V.

Query Syntax	Return Format
LIST:BIAS:VOLTage?	<NR3>[,<NR3>*]<NL^END>

The **LIST:BIAS:CURRent** command is used to clear the original DC bias current of each sweep point and reset them. The **LIST:BIAS:CURRent?** query returns the current setting.

Command Syntax
LIST:BIAS:CURRent<value>[,<value>*]
NOTE
*A maximum of 201 sweep points can be defined.

Where **<value>** is in NR1, NR2 or NR3 data format.

For example:

- **WrtCmd ("LIST:BIAS:CURR 100MA")** sets the DC bias current of the sweep point 1 to 100mA.

- **WrtCmd ("LIST:BIAS:CURR 1E-2, 2E-2, 3E-2,4E-2")** sets the DC bias currents of sweep points 1, 2, 3 and 4 to 10mA, 20mA, 30mA and 40mA, respectively.

Query Syntax	Return Format
LIST:BIAS:CURRent?	<NR3>[,<NR3>*]<NL^END>

NOTE
Only the ST2832 has an internal DC bias current source installed. The ST2830 and ST2831 do not, thus an external DC bias current source is needed for them instead.

The **LIST:MODE** command is used to set the list sweep mode. The query **LIST:MODE?** returns the current setting.

Command Syntax
LIST:MODE $\Big\{$ SEQuence STEPped

Where…

- **SEQuence** means sequential mode.
- **STEPped** means single step mode.

For example: WrtCmd **("LIST:MODE SEQ")**

Query Syntax	Return Format
LIST:MODE?	SEQ $\Big\}$ <NL^END> STEP

The **LIST:BAND<n>** command is used to set the limits of list sweep table. The query **LIST:BAND<n>?** returns

the current setting.

Command Syntax
LIST:BAND<n><parameter>[,<low limit n>,<high limit n>]

Where…

- **<n>**   1 to 201 (NR1 format): sweep points on the n_{th} line
- **<parameter>**

    - **A:**   Compare the primary parameter of the test results with the high and the low limits.

    - **B:**   Compare the secondary parameter of the test results with the high and the low limits.

- **OFF**   No comparison
- **<low limit n>**   NR1, NR2 or NR3 data format, low limit of the sweep point on the n_{th} line.
- **<high limit n>**   NR1, NR2 or NR3 data format, high limit of the sweep point on the n_{th} line.

For example:

- **WrtCmd ("LIST:BAND1 A, 10, 20")**
- **WrtCmd ("LIST:BAND3 OFF")**

Query Syntax	Return Format
LIST:BAND<n>?	<parameter>, <low limit n>, <high limit n>

The **LIST:CLEar** command is used to clear all the data in list sweep mode.

Command Syntax
LIST:CLEar

For example: **WrtCmd("LIST:CLEAR")**

7.1.10 APERture Subsystem Commands

The **APERture** subsystem commands are used to set the measurement speed and average times used in measurement. The query **APERture?** returns the current settings.

Command Syntax
APERture { FAST / MEDium / SLOW } [,<value>]

Where…

- **FAST**   75 times/sec
- **MEDium**   11 times/sec
- **SLOW**   2.7 times/sec
- **<value>**   1 to 255 in NR1

For example: **WrtCmd ("APER MED, 55")**

Query Syntax	Return Format
APERture?	{ FAST / MED / SLOW } , <NR1><NL^END>

7.1.11 TRIGger Subsystem Commands

The **TRIGger** subsystem commands are mainly used to set the instrument trigger source, trigger delay and trigger measurement.

Command tree:
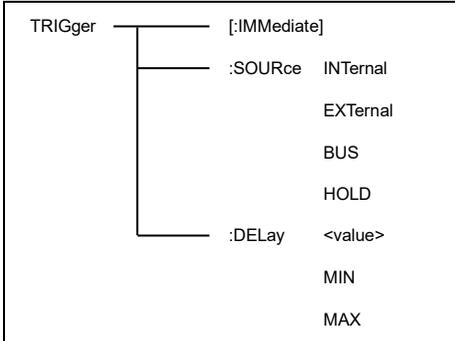
The **TRIGger[:IMMediate]** command is used to start a measurement.

Command Syntax
TRIGger[:IMMediate]

For example: **WrtCmd("TRIG")**

The **TRIGger:SOURce** command is used to set the trigger source mode. The query **TRIGger:SOURce?** returns the current setting.

Command Syntax

Where…

- **INTernal**   The default trigger mode.

- **EXTernal**   Measurements are initiated via the HANDLER interface.

- **BUS**   Measurements are initiated via the RS232C interface or GPIB interface

- **HOLD**   Measurements are initiated by pressing [TRIGGER].

For example: **WrtCmd ("TRIG:SOUR BUS")**

Query Syntax	Return Format
TRIGger:SOURce?	FAST MED SLOW HOLD } <NL^END>

The **TRIGger:DELay** command is used to set the delay time between the command to perform a measurement and the start of the actual measurement. The query **TRIGger:DELay?** returns the current setting.

Command Syntax
TRIGger:DELay { <value> MIN MAX

Where…

- **<value>** is in NR1, NR2 or NR3 data format, from 0 to 60s with 1ms as the resolution.

- **MIN** sets the delay time to 0s.

- **MAX** sets the delay time to 60s.

For example: **WrtCmd ("TRIG:DEL 5s")** sets the delay time as 5s.

Query Syntax	Return Format
TRIGger:DELay?	<NR3><NL^END>

7.1.12 FETCh? Subsystem Commands

The **FETCh?** subsystem commands are used to direct the ST2830 to output a measurement result.

Command tree:

```
FETCh ──────── [:IMP]?
        │
        ├──── :Source MONitor ──────── :VAC?
        │                          └── :IAC?
        │
        └──── :fres ──────────────── :acur?
                                  └── :bcur?
```
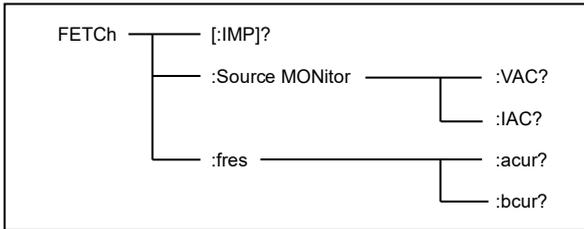
The query **FETCh[:IMP]?** directs ST2830 to display the last measurement result in the output buffer field.

Query Syntax
FETCh[:IMP]?

For example:

- **WrtCmd ("TRIG:SOUR BUS")**

- **WrtCmd ("TRIG")**

- **WrtCmd ("FETC?")**

ST2830 applies ASCII to deliver the result; details follow.

On the pages **<MEAS DISP>**, **<BIN NO. DISP>** and **<BIN COUNT DISP>**, the format of ASCII data output is as specified below:

SN.NNNNNESNN	SN.NNNNNESNN	SN , SN or SNN	NL^END
<DATA A>	<DATA B>	<Status>	<BIN number>

Where…

- **<DATA A>, <DATA B> format:**

  - **<DATA A>**   Primary measurement data

  - **<DATA B>**   Secondary measurement data

12-digit ASCII format is as follows:

SN.NNNNNESNN

- **S:** +/-

- **N:** From 0 to 9

- **E:** Exponent Sign

Status	Description
-1	(In data buffer memory) no data
0	Common measurement data
+1	Analog LCR unbalance
+2	A/D converter is not working.
+3	Signal source is over loading.
+4	Constant voltage cannot be adjusted.

- **<status> format:**   When above measurement data is used, <status> data will display measurement status.

The output format of the <status> display data uses 2-digit ASCII: SN

- **S:** +/-

- **N:** 0 to 4

NOTE
When <status> is -1, 1 or 2, the measurement data is 9.99999E37. When <status> is 0, 3 or 4, the real measurement data is beyond the limits.

Data	Sort Result
0	Out of tolerance
+1	Bin 1
+2	Bin 2
+3	Bin 3
+4	Bin 4
+5	Bin 5
+6	Bin 6
+7	Bin 7
+8	Bin 8
+9	Bin 9
+10	Auxiliary Bin

- **<Bin No.> format:** The data displays the sorting results of the displayed bin, shown as above.

Only when the instrument compare function is set to ON, <bin No.> data can be displayed.

<Bin No.> data output uses a 2–3 digit ASCII format: SN or SNN

- **S:** +/-
- **N:** from 0 to 9

On list sweep display page, the ASCII data output format is shown as below, that is, the return-circuit replaces sweep point number.

SN.NNNNNESN ,   SN.NNNNNESNN ,   SN , SN   NL^END

<DATA A>   <DATA B>   <Status>   <Judge>
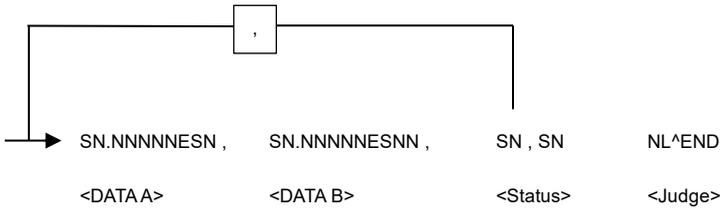
Figure 7-1 ASCII Format 2 (List Sweep)

Where…

- Descriptions for **<DATA A>**, **<DATA B>**, **<Status>** are the same as those listed before.
- **<Judge> format** is as described below.
- **<Input/Output> format:** The ST2830 displays the comparison result of the list sweep.

Data	Result
-1	Low
0	Pass
+1	High

Mind that when the comparison function of the list sweep measurement is turned off, the output result of **<Input/Output>** is 0.

<Input/Output> data output uses a 2-digit ASCII format: SN

- **S:** +/-
- **N:** from 0 to 1

7.1.13 CORRection Subsystem Commands

The **CORRection** subsystem commands are used to configure the correction function (OPEN, SHORT and LOAD).

Command tree:

```
CORRection ─────────────── :LENGth <value>
                  ┌─────── :METHod          SINGle
                  │                          MULTiple
                  ├─────── :OPEN ─────────── :STATe    ON   (1)
                  │                                    OFF  (0)
                  ├─────── :SHORt ────────── :STATe    ON   (1)
                  │                                    OFF  (0)
                  ├─────── :LOAD ─────────── :STATe    ON   (1)
                  │                     │              OFF  (0)
                  │                     └──── :TYPE    CPD
                  │                                    CPQ
                  │                                    CPG
                  │                                    CPRP
                  │                                    CSD
                  │                                    CSQ
                  │                                    CSRS
                  │                                    LPQ
                  │                                    LPD
                  │                                    LPG
                  │                                    LPRP
                  │                                    LPRD
                  │                                    LSD
                  │                                    LSQ
                  │                                    LSRS
                  │                                    LSRD
                  │                                    RX
                  │                                    RPQ
                  │                                    RSQ
                  │                                    ZTD
                  │                                    ZTR
                  │                                    GB
                  │                                    YTD
                  │                                    YTR
                  ├─────── :SPOT <1-201> ─── :STATe    ON   (1)
                  │                     │              OFF  (0)
                  │                     └──── :FREQuency <value>
                  │
                  │                     ┌──── :OPEN
                  │                     ├──── :SHORt
                  │                     ├──── :LOAD ──────── :STANdard <REF.A>,<REF.B>
                  ├─────── :USE ───────── <channel number>
                  │                     └──── :DATA? <channel number>
                  └─────── :CLEAR
```
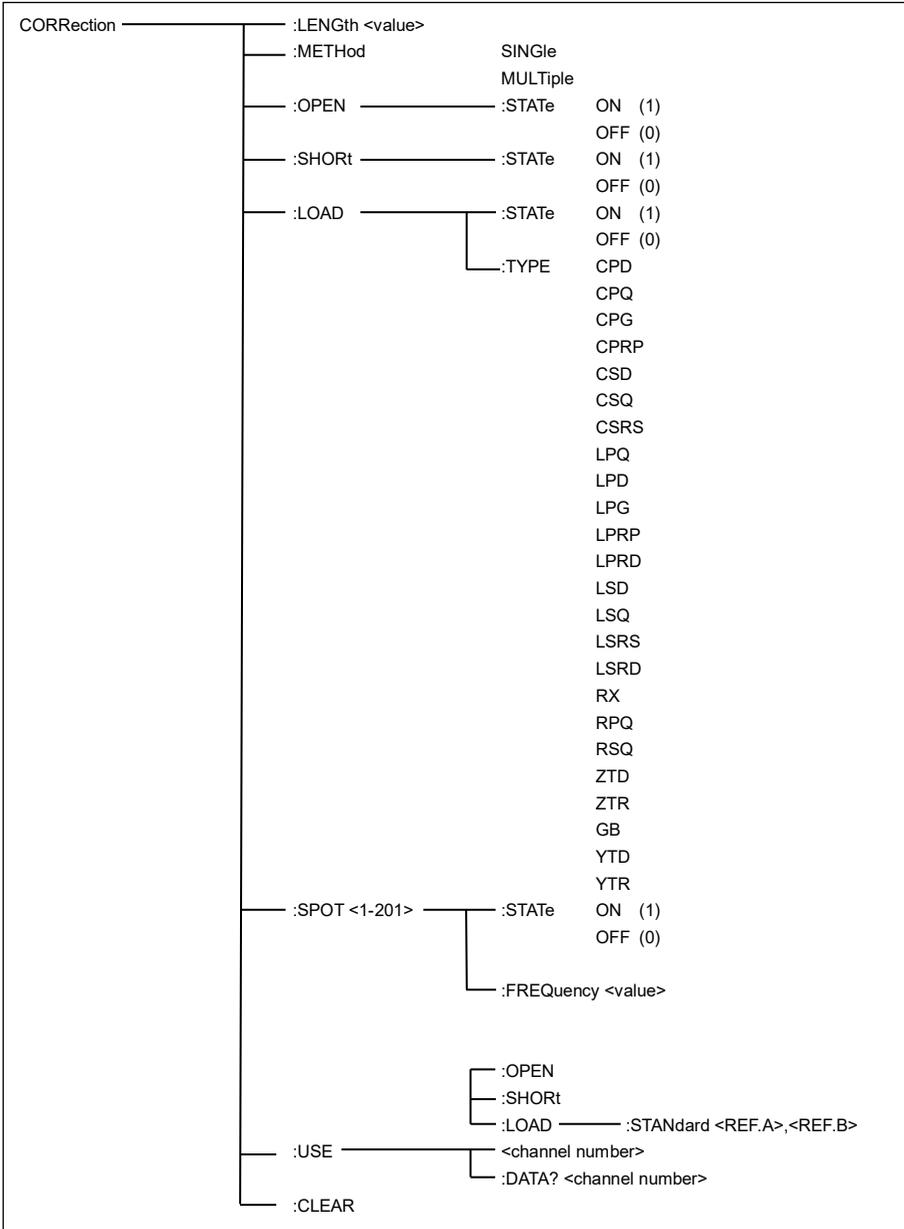
The **CORRection:LENGth** command is used to set the correction cable length. The query

CORRection:LENGth? returns the current setting.

Command Syntax
CORRection:LENGth<value>

Where **<value>** is 0, 1, 2 or 4, followed by the unit M.

For example: **WrtCmd ("CORR:LENG 1M")** defines the cable length as 1 meter.

NOTE
At present, only 0M data is available!

Query Syntax	Return Format
CORRection:LENGth?	<NR1><NL^END>

The **CORReciton:METHod** command is used to set the correction mode. The query **CORRection:METHod?**

returns the current setting.

Command Syntax

CORRection:METHod

SINGle

MULTi

Where…

- **SINGle:** Set or return single channel mode.
- **MULTi:** Set or return multi channel mode.

For example: **WrtCmd ("CORR:METH MULT")** sets the instrument to multi channel mode.

Query Syntax	Return Format
CORRection:METHod?	SINGle ⎫ ⎬ <NL^END> MULTi ⎭

The **CORReciton:OPEN** command is used to perform an open-circuit correction for 41 preset test points (ST2832 has 41 preset test points).

Command Syntax
CORRection:OPEN

For example: **WrtCmd ("CORR:OPEN")**

The **CORRection:OPEN:STATe** command is used to switch the open-circuit correction on or off. The query **CORRection:OPEN:STATe?** returns the current setting.

Command Syntax

CORRection:OPEN:STATe ⎧ ON
                            ⎪ OFF
                            ⎨ 1
                            ⎩ 0

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("CORR:OPEN: STAT ON")**

Query Syntax	Return Format
CORRection:OPEN:STATe?	<NR1><NL^END>

The **CORRection:SHORt** command is used to perform a short-circuit correction for 41 preset test points (ST2832 has 41 preset test points).

Command Syntax
CORRection:SHORt

For example: **WrtCmd ("CORR:SHOR")**

The **CORRection:SHORt:STATe** command is used to switch the short-circuit correction on or off. The query **CORRection:SHORt:STATe?** returns the current setting.

Command Syntax
ON
OFF
CORRection:SHORt:STATe 1
0

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("CORR:SHOR:STAT ON")**

Query Syntax	Return Format
CORRection:SHORt:STATe?	<NR1><NL^END>

The **CORRection:LOAD:STATe** command is used to switch the reference load correction on or off. The query

CORRection:LOAD:STATe? returns the current reference load correction status.

Command Syntax
CORRection:LOAD:STATe $\left\{\begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array}\right.$

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("CORR:LOAD:STAT ON")**

Query Syntax	Return Format
CORRection:LOAD:STATe?	<NR1><NL^END>

The **CORRection:LOAD:TYPE** command is used to define the tested parameter type. The query

CORRection:LOAD:TYPE? query returns the current setting.

Details of function are as follows:

- **CPD**   Set the function as Cp-D
- **CPQ**   Set the function as Cp-Q
- **CPG**   Set the function as Cp-G
- **CPRP** Set the function as Cp-Rp
- **CSD**   Set the function as Cs-D
- **CSQ**   Set the function as Cs-Q
- **CSRS** Set the function as Cs-Rs
- **LPQ**   Set the function as Lp-Q
- **LPD**   Set the funxtion as Lp-D

- **LPRP** Set the function as Lp-Rp
- **LSD**   Set the function as Ls-D
- **LSQ**   Set the function as Ls-Q
- **LSRS** Set the function as Ls-Rs
- **RX**   Set the function as R-X
- **ZTD**   Set the function as Z-θ°
- **ZTR**   Set the function as Z-θr
- **GB**   Set the function as G-B
- **YTD**   Set the function as Y-θ°

- **LPG**   Set the function as Lp-G
- **LPRD**   Set the function as Lp-Rd
- **LSRD**   Set the function as Ls-Rd

- **YTR**   Set the function as Y-θr
- **RPQ**   Set the function as Rp-Q
- **RSQ**   Set the function as Rs-Q

For example: **WrtCmd ("CORR:LOAD:TYPE CPD")**

Query Syntax	Return Format
CORRection:LOAD:TYPE?	<function><NL^END>

The **CORRection:SPOT<n>:STATe** command is used to define the specific frequency spots. The query

CORRection:SPOT<n>:STATe? returns the current setting of each frequency spot (FREQ 1, FREQ 2).

Command Syntax
CORRection:SPOT<n>:STATE { ON / OFF / 1 / 0 }

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

<n> is…

- **1** (refers to frequency spot 1).
- **2** (refers to frequency spot 2).

For example: **WrtCmd ("CORR:SPOT1:STAT ON")**

Query Syntax	Return Format
CORRection:SPTO<n>:STATe?	<NR1><NL^END>

The **CORRection:SPOT<n>:FREQuency** command is used to define the specific correction point frequency.

The query **CORRection:SPOT<n>:FREQuency?** returns the current setting.

Command Syntax
CORRection:SPOT<n>:FREQeuency<value>

Where…

- **<value>** is in NR1, NR2 or NR3 data format followed by HZ, KHZ and MHZ.

- **<value>** should be defined between 20HZ and 200KHZ (ST2832), otherwise the return format will report errors.

For example: **WrtCmd ("CORR:SPOT1:FREQ 2KHZ")** sets the frequency of frequency spot 1 as 2KHZ.

Query Syntax	Return Format
CORRection:SPOT<n>:FREQuency?	<NR3><NL^END>

The **CORRection:SPOT<n>:OPEN** command is used to perform an open-circuit correction at a specific correction point.

Command Syntax
CORRection:SPOT<n>:OPEN

Where **<n>** is between 1-201.

For example: **WrtCmd ("CORR:SPOT1:OPEN")** performs an open-circuit correction at defined correction point 1.

The **CORRection:SPOT<n>:SHORt** command is used to perform a short-circuit correction at a specific correction point.

Command Syntax
CORRection:SPOT<n>:SHORt

Where **<n>** is between 1-201.

For example: **WrtCmd ("CORR:SPOT1:SHOR")** performs a short-circuit correction at defined correction point 1.

The **CORRection:SPOT<n>:LOAD:STANdard** command is used to set the default reference of a particular correction point at which to perform a load correction. The query **CORRection:SPOT<n>:LOAD:STANdard?** returns the current setting.

Command Syntax
CORRection:SPOT<n>:LOAD:STANdard <REF. A><REF. B>

Where…

- **<n>** is between 1-201.
- **<REF. A>** can be NR1, NR2 or NR3 data format and taken as the standard reference of the primary parameter.
- **<REF. B>** can be NR1, NR2 or NR3 data format and taken as the standard reference of the secondary parameter.

For example: **WrtCmd ("CORR:SPOT1:LOAD:STAN 100.7, 0.0002")**

Query Syntax	Return Format
CORRection:SPOT<n>:LOAD:STANdard?	<NR3><NL^END>

The query **CORRection:USE:DATA?** returns the OPEN/SHORT/LOAD correction measurement data of all defined correction points.

Query Syntax	Return Format
CORRection:USE:DATA?	<open (n) A>,<open(n) B>,<short (n) A>,<short (n) B>,<load (n) A>,<load (n) B>

Where…

- **<open (n) A>** is in NR3 data format and represents the primary open-circuit correction data at this frequency point.

- **<open (n) B>** is in NR3 data format and represents the secondary open-circuit correction data at this frequency point.

- **<short (n) A>** is in NR3 data format and represents the primary short-circuit correction data at this frequency point.

- **<short (N) B>** is in NR3 data format and represents the secondary short-circuit correction data at this frequency point.

- **<load (n) A>** is in NR3 data format and represents the primary reference load correction data at this frequency point.

- **<load (n) B>** is in NR3 data format and represents the secondary reference load correction data at this frequency point.
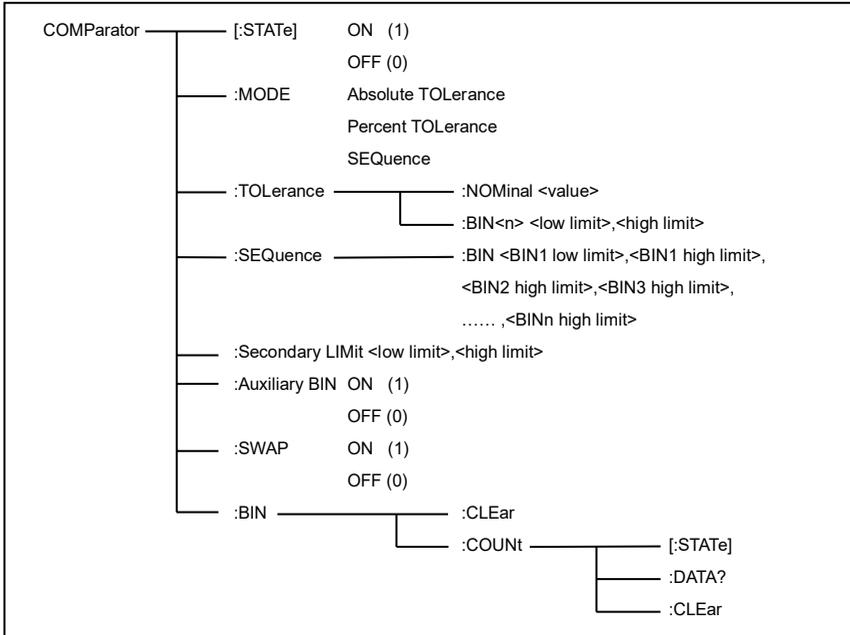
The **CORRection:CLEAR** command is used to clear all correction data.

Command Syntax
CORRection:CLEAR

7.1.14 COMParator Subsystem Commands

The COMParataor subsystem commands are used to set the bin comparator function including ON/OFF setting, Limit table setting.

Command tree:

```
COMParator ───────── [:STATe]      ON  (1)
                                   OFF (0)
                   ─── :MODE       Absolute TOLerance
                                   Percent TOLerance
                                   SEQuence
                   ─── :TOLerance ──────── :NOMinal <value>
                                      └──── :BIN<n> <low limit>,<high limit>
                   ─── :SEQuence ───────── :BIN <BIN1 low limit>,<BIN1 high limit>,
                                              <BIN2 high limit>,<BIN3 high limit>,
                                              …… ,<BINn high limit>
                   ─── :Secondary LIMit <low limit>,<high limit>
                   ─── :Auxiliary BIN  ON  (1)
                                       OFF (0)
                   ─── :SWAP       ON  (1)
                                   OFF (0)
                   ─── :BIN ───────────────── :CLEar
                                              :COUNt ─────── [:STATe]
                                                        ├─── :DATA?
                                                        └─── :CLEar
```

The **COMParator[STATe]** command is used to turn the comparator function on or off. The query **COMParator[STATe]?** returns the current setting.

Command Syntax
COMParator[:STATe]   ON / OFF / 1 / 0

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("COMP ON")**

Query Syntax	Return Format
COMParator[:STATe]?	<NR1><NL^END>

The **COMParator:MODE** command is used to set the comparator mode. The query **COMParator:MODE?**

returns the current setting.

Command Syntax
COMParator:MODE   ATOLerance   PTOLerance   SEQuence

Where…

- **ATOLerance** means absolute tolerance mode.

- **PTOLerance** means proportional tolerance mode.

- **SEQuence** means sequential tolerance mode.

For example: **WrtCmd ("COM:MODE ATOL")**

Query Syntax	Return Format
COMParator:MODE?	ATOL PTOL <NL^END> SEQ

The **COMParator:TOLerance:NOMinal** command is used to set the nominal value (this function is valid only when the limit mode is set as deviation mode). The query **COMParator:TOLerance:NOMinal?** returns the current nominal value.

Command Syntax
COMParator:TOLerance:NOMinal<value>

Where…

- **<value>** is a nominal value in NR1, NR2 or NR3 data format.

For example: **WrtCmd ("COMP:TOL:NOM 100E-12")**

Query Syntax	Return Format
COMParator:TOLerance:NOMinal?	<NR3><NL^END>

The **COMParator:TOLerance:BIN<n>** command is used to define the high and the low limits of each bin (this function is valid only when the limit mode is set to deviation mode). The query **COMParator:TOLeance: BIN<n>?** returns the current settings.

Command Syntax
COMParatro:TOLerance:BIN<n><low limit><high limit>

Where…

- **<n>** is the bin number from 1 to 9.
- **<low limit>** is the low limit in NR1, NR2 or NR3 data format.
- **<high limit>** is the high limit in NR1, NR2 or NR3 data format.
- The **low** limit should be smaller than the **high limit**, or error information will be reported.

For example:

- **WrtCmd ("COMP:TOL:BIN1 -5,5")**
- **WrtCmd ("COMP:TOL:BIN2 -10,10")**

Query Syntax	Return Format
COMParator:TOLerance:BIN\<n\>?	\<low limit\>\<high limit\>\<NL^END\>

The **COMParator:SEQuence:BIN** command is used to define the high and the low limits of sequential mode (this function is valid only when the limit mode is set to sequential mode). The query **COMParator:SEQuence: BIN?** returns the current high and the low limits of each bin.

Command Syntax
COMParator:SEQuence:BIN \<BIN1 low limit\>, \<BIN 1 high limit\>, \<BIN2 high limit\>, …, \<BINn high limit\>

Where…

- **\<BIN1 low limit\>** is the low limit of BIN 1 in NR1, NR2 or NR3 data format.

- **\<BIN1 high limit\>** is the high limit of BIN1 in NR1, NR2 or NR3 data format.

- **\<BINn high limit\>** is the high limit of BINn (the maximum of n is 9) in NR1, NR2 or NR3 data format.

- The **low limit** should be smaller than the **high limit**, or error information will be reported.

For example: **WrtCmd ("COMP:SEQ:BIN 10, 20, 30, 40, 50")**

Query Syntax	Return Format
COMParator:SEQuence:BIN?	\<BIN1 low limit\>, \<BIN1 high limit\>, \<BIN2 high limit\>, …, \<BINn high limit\>\<NL^END\>

The **COMParator:Secondary LIMit** command is used to define the high and the low limits of the secondary parameter. The query **COMParator:Secondary LIMit?** returns the current settings.

Command Syntax
COMParator:SLIMit\<low limit\>\<high limit\>

Where…

- **<low limit>** is the low limit in NR1, NR2 or NR3 data format.

- **<high limit>** is the high limit in NR1, NR2 or NR3 data format.

- The **low limit** should be smaller than the **high limit**, or error information will be reported.

For example: **WrtCmd ("COMP:SLIM 0.001, 0.002")**

Query Syntax	Return Format
COMParator:SLIMit?	<NR3>, <NR3> <NL^END>

The **COMParator:Auxiliary BIN** command is used to turn the auxiliary bin function on or off. The query **COMParator:Auxiliary BIN?** returns the current setting.

Command Syntax
COMParator:Auxiliary BIN { ON / OFF / 1 / 0 }

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("COMP:ABIN ON")**

Query Syntax	Return Format
COMParator:Auxiliary BIN?	<NR1><NL^END>

The **COMParator:SWAP** command is used to turn the swap mode on or off.

Example: The original function parameter is Cp-D; after SWAP mode is switched on, the function parameter is changed to D-Cp. In this case, the limit values from BIN1 to BIN9 become the upper and lower limit values of D, and the original secondary limit values become those of Cp. On the other hand, if the function is turned off, the comparison is performed in the original order. The query **COMParator:SWAP?** returns the current setting.

Command Syntax
COMParator:SWAP   ON   OFF   1   0

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("COMP:SWAP ON")**

Query Syntax	Return Format
COMParator:SWAP?	<NR1><NL^END>

The **COMParator:BIN:CLEar** command is used to clear all limits on the <u>**<LIMIT TABLE SETUP>**</u> page.

Command Syntax
COMParator:BIN:CLEar

The **COMParator:BIN:COUNt[:STATe]** command is used to turn the bin count function on or off. The

COMParator:BIN:COUNt[:STATe]? query returns the current state of the bin count function.

Command Syntax
COMParator:BIN:COUNt[:STATe] { ON / OFF / 1 / 0 }

Where…

- **Character 1 (49)** corresponds to ON

- **Character 0 (48)** corresponds to OFF

For example: WrtCmd **("COMP:BIN:COUN ON")**

Query Syntax	Return Format
COMParator:BIN:COUNt[STATe]?	<NR1><NL^END>

The query **COMParator:BIN:COUNt:DATA?** returns the current comparison result of the bin count.

Query Syntax	Return Format
COMParator:BIN:COUNt:DATA?	<BIN1 count>, <BIN2 count>, …, <BIN9 count>, <OUT OF BIN count>, <AUX BIN count> <NL^END>

Where…

- **<BIN1-9 count>** is the count result of BIN1-9, in NR1 data format.

- **<OUT OF BIN count>** is the count result of the OUT OF BIN, in NR1 data format.

- **<AUX BIN count>** is the count result of the auxiliary bin, in NR1 data format.
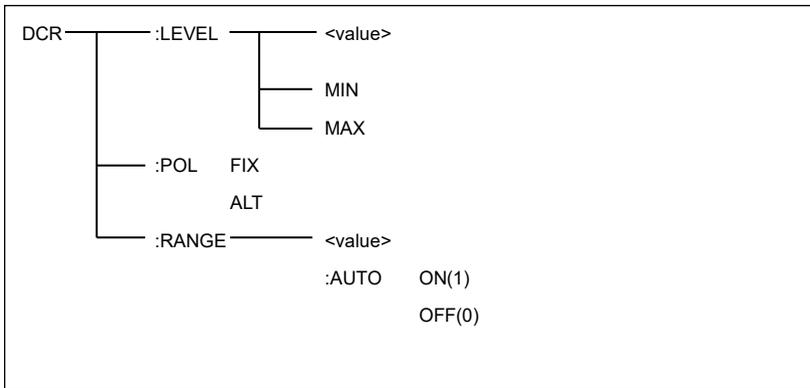
The **COMParator:BIN:COUNt:CLEar** command is used to clear all bin count results.

Command Syntax
COMParator:BIN:COUNt:CLEar

7.1.15 DCR Subsystem Commands

The **DCR** subsystem commands are used to configure and view the current settings for the measuring range,

polarity and level parameters.

Command tree:

```
DCR ──────── :LEVEL ──────── <value>

                                MIN

                                MAX

             :POL    FIX

                     ALT

             :RANGE ──────── <value>

                     :AUTO    ON(1)

                              OFF(0)
```

The **DCR:LEVEL** command is used to set the DCR level. The command **DCR:LEVEL?** query returns the

current setting.

Command Syntax
DCR:LEVEL { <value> / MIN / MAX }
NOTE
Only ST2832 can set different DCR level values, ST2830 and ST2831 are fixed at 1V.)

Where…

• **<value>** is in NR1, NR2 or NR3 data format.

• **<MIN>** sets the DCR test level to 50mV.

• **<MAX>** sets the DCR test level to 2V.

For example: **WrtCmd("DCR:LEVEL MIN")** sets the DCR test level to 50mV.

Query Syntax	Return Format
DCR:LEVEL?	<NR3><NL^END>

The **DCR:POL** command is used to set the DCR measurement mode. The query **DCR:POL?** returns the current setting.

Command Syntax
DCR:POL { FIX / ALT }

Where…

• **<FIX>** is the positive level measurement mode
• **<ALT>** is the alternating (positive and negative levels) measurement mode

For example: **WrtCmd("DCR:LEVEL ALT")** sets the DCR measurement mode to alternate between positive and negative levels.

Query Syntax	Return Format
DCL:POL?	{ FIX / ALT } <NL^END>

The **DCR:RANGe** command is used to set the DCR range. The query **DCR:RANGe?** returns the current setting.

Command Syntax
DCR:RANGe<value>

Where **<value>** is the impedance value of DUT – it can be NR1, NR2 or NR3 data format, with OHM, KOHM as the unit suffix.

For example: **WrtCmd("DCR:RANG 1KOHM")** sets the DCR test range to 1KOHM.

Query Syntax	Return Format
DCR:RANGe?	<value><NL^END>

Where **<value>** can be…

1	3	10	30
100	300	1000	3000
10000	30000	100000	

The **DCR:RANGe:AUTO** command is used to set the range status. The query **DCR:RANGe:AUTO?** returns the current setting.

Command Syntax
DCR:RANG:AUTO { ON (1) / OFF (0) }

Where…

- **Character 1 (49)** corresponds to ON
- **Character 0 (48)** corresponds to OFF

For example: **WrtCmd ("DCR:RANG:AUTO ON")** turns the automatic range on.

Query Syntax	Return Format
DCR:RANG:AUTO?	<NR1><NL^END>

7.1.16 Mass MEMory Subsystem Commands

The Mass MEMory subsystem commands are used for file storing and load.

Command tree:
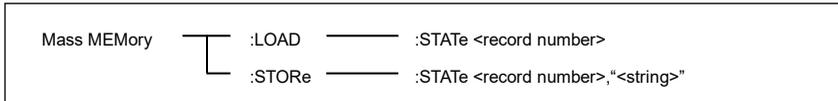
The **MMEMory:LOAD:STATe** command is used to load an existing file.

Command Syntax
MMEMory:LOAD:STATe<value>

Where **<value>** is the file number ranging from 0 to 39 (NR1).

For example: **WrtCmd ("MMEM:LOAD:STAT 1")**

The **MMEMory:STORe:STATe** command is used to save the current settings to a new file.

Command Syntax
MMEMory:STOR:STATe<value>, "<string>"

Where…

- **<value>** is the file number ranging from 0 to 39 (NR1).

- **"<string>"** represents an ASCII character string (maximum length is 16).

For example:

- **WrtCmd ("MMEM:STOR:STAT 1, "Resistor meas"")**

- **WrtCmd ("MMEM:STOR:STAT 1")**

  - if ", "<string>"" has not been input, the new file will be saved under the default name.

7.2 GPIB Common Commands

- *RST
- *TRG
- *IDN
- *TST

- *ESE
- *SRE
- *ESR
- *STB

- *OPC
- *CLS

The ***RST** command resets the instrument.

- For example: **WrtCmd ("*RST")**

The ***TRG** command starts the measurement and then sends the result to the output buffer.

- For example: **WrtCmd ("*TRG")**

The ***CLS** command clears the standard event status register, as well as the service request status register.

Command Syntax
*CLS

For example: **WrtCmd ("*CLS")**

The query ***IDN?** returns the product ID and other relevant information.

Query Syntax	Return Format
*IDN?	<manufacturer>,<model>,<firmware><NL^END>

Where…

- **<manufacturer>**   Name of Manufacturer (Sourcetronic)
- **<model>**   Instrument Model   (ST2830/ST2831/ST2832)
- **<firmware>**   Firmware Version (VER1.0.0)
- **<HW_version>**   Hardware Version (Hardware Ver A5.0)

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

The query ***TST?** performs a self-scan and returns the result as the sum of all currently existing error codes.

If there are no errors present, ST2830 returns 0.

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

The numeric output is in NR1 format.

For example: **WrtCmd("*TST?")**

The ***ESE** (Standard Event Status Enable) command configures each open bit of the standard event status register. This command returns the current settings of each open bit.

Command Syntax
*ESE<value>

Where **<value>** NR1 format is the decimal expression for each bit of operation status register.

Descriptions for each byte of the standard event status register are shown as follows:

Bit Number	Description
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

Query Syntax	Return Format
*ESE?	\<value\>\<NL^END\>

For example: **WrtCmd ("*ESE?")**

The ***SRE** (Service Request Enable) command configures each open bit of the service status byte register.

The query ***SRE?** returns the current settings for each open bit.

Command Syntax
*SRE\<value\>

Where **\<value\>** NR1 format is the decimal expression for each permission bit of the status byte register.

Descriptions for each byte of the status byte register are shown as follows:

Bit Number	Description
7	Operation Status Register Summary Bit
6	RQS(Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV(Message Available) Bit
3–0	Always 0 (zero)

Query Syntax	Return Format
*SRE?	\<value\>\<NL^END\>

For example: **WrtCmd("*SRE?")**

The ***ESR?** query returns the contents of the standard event status register.

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

Where **<value>** NR1 format is the decimal expression for contents of the standard event status register.

Descriptions for each bit of the standard event status register are shown as follows:

Bit Number	Description
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

For example: **WrtCmd ("*ESR?")**

The ***STB?** query returns the contents of the standard service status byte register. The execution of this command will not affect these contents.

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

Where **<value>** NR1 format is the decimal expression for contents of the standard status byte register.

Descriptions for each bit of the standard status byte register are shown as follows:

Bit Number	Description
7	Operation Status Register Summary Bit
6	RQS(Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV(Message Available) Bit
3–0	Always 0 (zero)

For example: **WrtCmd ("*STB?")**

The ***OPC** command sets the OPC bit of the standard event status register when the ST2830 has completed all parameter measurements. As all pending operations are completed, this command informs the device to insert an ASCII number "1" (decimal number: 49) into the output buffer.

Command Syntax
*OPC

For example: **OUTPUT 717; "*OPC"!** configures the OPC bit of the instrument when the last command is completed.

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

Where **ASCII number 1** corresponds to the decimal number 49.

For example: **WrtCmd("*OPC?")**

8   HANDLER Description (Optional)

The ST2830 provides the HANDLER interface for you. The interface is primarily used for the output of the sorted result and offers the communication signal and the signal for the output of the sorted result. The separator result corresponds to the output of BIN 10. The HANDLER interface is intelligent, meaning that the status of the output signal can be defined depending on the target of your application.

8.1 Technical Description

The following list shows the description for ST2830 HANDLER.

The output signal: low effective, 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: AD Conversion ended
- EOC: end of one test and comparison
- Alarm: alarm for circuit interruption

The input signal: optoelectronic isolation

- Keylock: lock the keys on the front panel
- External Trigger: pulsewidth≥1μS

8.2 The Operation Description

8.2.1 Signal Line Definition

The HANDLER interface has three signal lines: comparison output, control output and control input. The signal line's definition for the BIN comparison or list sweep comparison is below:

Comparison signal lines:

- Comparison output signal
    - /BIN1 - /BIN9, /AUX, /OUT, /PHI (the main parameter is higher)
    - /PLO (the main parameter is lower)
    - /SREJ (the secondary parameter is not good).

The signal line distribution for comparison out is shown in the list above.

- Control output signal

    - /INDEX (analog test finished signal)

    - /EOM (test ended and the compared data effective)

    - /ALARM (the circuit interruption)

- Control input signal

    - /EXT.TRIG (external trigger signal)

    - /Keylock (the key lock).

The signal distribution for the pins is described in the table below.

Table 8-1 Signal Distribution for the Pins

Pin	Signal Name	Description
1	/BIN1	
2	/BIN2	
3	/BIN3	
4	/BIN4	
5	/BIN5	
6	/BIN6	
7	/BIN7	BIN sorted result
8	/BIN8	/BIN (BIN number) output are all open collector output.
9	/BIN9	
10	/OUT	
11	/AUX	
12 13	/EXT.TRIG	External trigger: when the trigger mode is EXT.TRIG, ST2830 will be triggered by the positive-edge pulse signal in this pin.
14	EXT.DCV2	External DC voltage 2:

15		The DC provider pin for the optoelectronic coupling signal (/EXT_TRIG, /KeyLock, /ALARM, /INDEX, /EOM)
16 17 18	+5V	The internal power +5V: to use the internal power is not recommended. If you use the internal power, please ensure that the current is lower than 0.3A and the signal line is far from the disturbance source.
19	/PHI	The main parameter is higher: the test result is greater than the high limit in BIN1 to BIN9.
20	/PLO	The main parameter is lower: the test result is less than the low limit in BIN1 to BIN9.
21	/SREJ	The secondary parameter is not good: the test result is not in the range of the high limit and the low limit.
22 23 24	NC NC NC	Not connected.
25	/KEY LOCK	When this line is effective, the keys in the front panel are locked.
27 28	EXT.DCV1	The external DC voltage　1 : the pull-up DC power provider pin for optoelectronic coupling signal (/BIN-/BIN9, /AUX, /OUT, /PHI, /PLO, /SREJ).
29	/ALARM	When circuit is interrupted, /ALARM is effective.
30	/INDEX	When the analog test is finished and the UNKNOWN terminal can be connected to another DUT, /INDEX is effective. But the comparison signal is effective until /EOM is effective.

31	/EOM	End Of Measurement: when the test data and the compared result are effective, this signal is effective.
32,33	COM2	The reference ground for external power EXTV2.
34,35,36	COM1	The reference ground for external power EXTV1.

```
                    ┌──────────────────────────┐
         ↑          │        PHI (OUT)         │
The main │          ├──────────┬──────┬────────┤
         │          │          │ BIN 1│        │
parameter│          │          ├──────┤        │
         │          │          │ BIN 2│        │
                    │          ├──────┤        │
                    │          │ BIN 3│        │
                    │          ├──────┤        │
                    │          │ BIN 4│        │
                    │  SREJ    ├──────┤ SREJ   │
                    │  (AUX)   │ BIN 5│ (AUX)  │
                    │          ├──────┤        │
                    │          │ BIN 6│        │
                    │          ├──────┤        │
                    │          │ BIN 7│        │
                    │          ├──────┤        │
                    │          │ BIN 8│        │
                    │          ├──────┤        │
                    │          │ BIN 9│        │
                    ├──────────┴──────┴────────┤
                    │        PLO (OUT)         │
                    └──────────────────────────┘
                                        ───────────→
                                   The secondary parameter
```
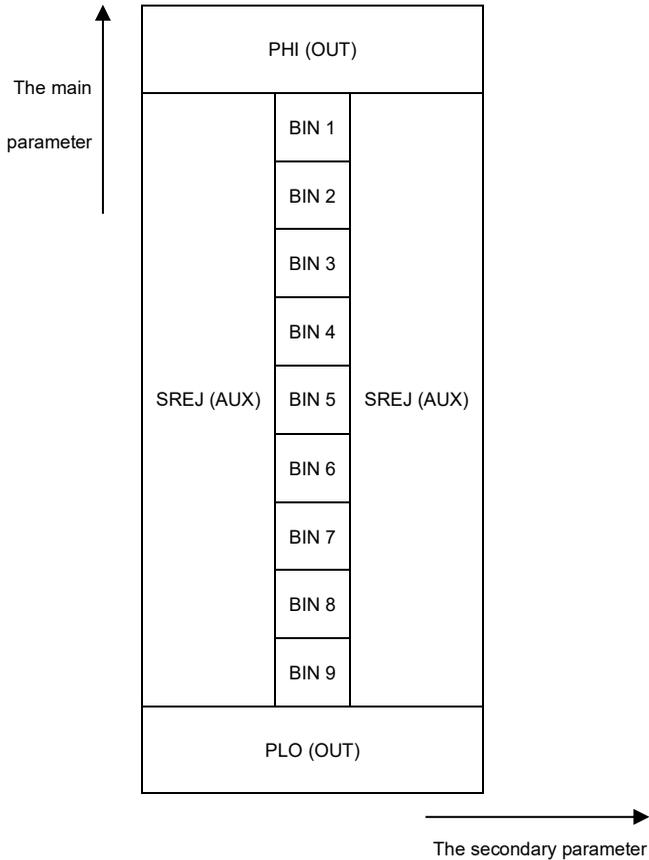
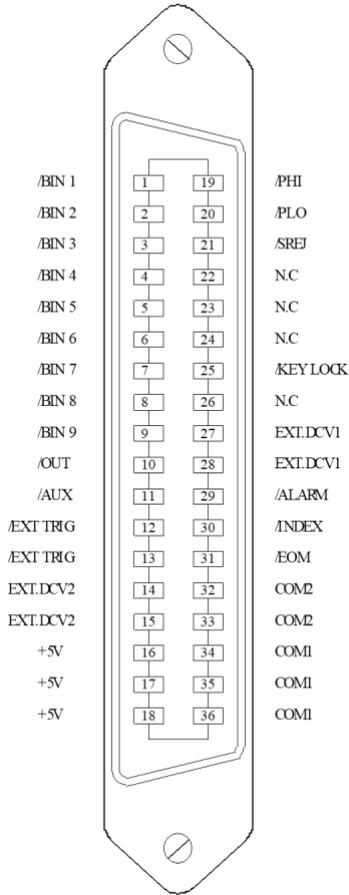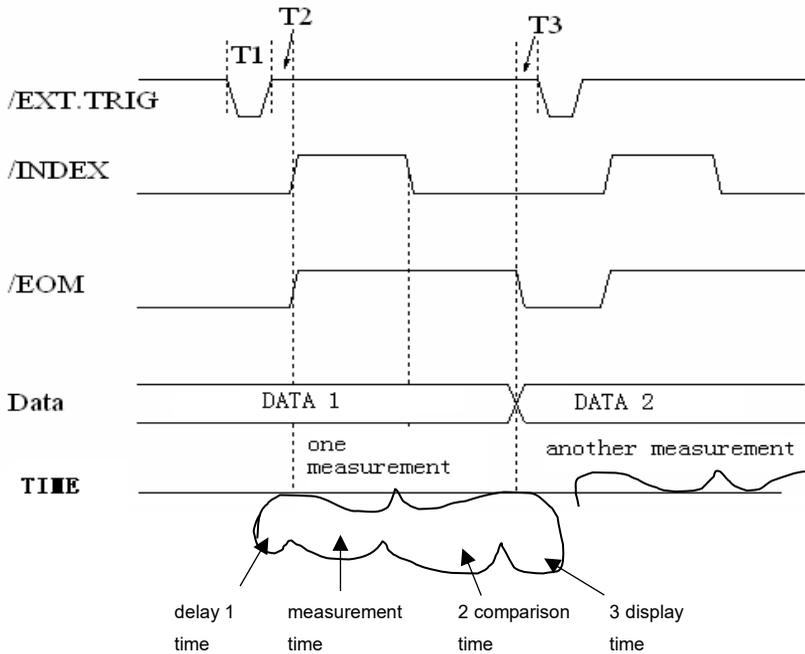Figure 8-1 The /PHI, /PLO, /SREJ Signal Distribution for BIN Comparison

Figure 8-2 The HANDLER Pin Definition

NOTE
The signal to /BIN1 - /BIN9, /OUT, /AUX, /PHI, /PLO and /SREJ in the list sweep comparison is different from that in the BIN comparison.

Time	Minimum	Maximum
T1: trigger pulse-width	1us	---
T2:delay time	200us	Display time3 + 200us
T3:the trigger waiting time after /EOM output	0us	---

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

2. The typical comparison time is approximately 1ms;

3. The display time for every display page is below:

MEAS DISPLAY: 8ms;

BIN NO.DISPLAY: 5ms;

BIN COUNT DISPLAY: 0.5ms

Figure 8-3 Timing Chart

List sweep comparison signal line:

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

- Comparison output signal
  - /BIN-/BIN9 and /OUT show the IN/OUT (good or over the standard) judgment.
  - /AUX shows PASS/FAIL judgement.

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

- Control output signal
  - /INDEX (analog test finished)
  - /EOM (the test ended).

The timing is below when /INDEX and /EOM are effective:

- SEQ sweep mode:
  - /INDEX is defined as the effective signal when the last sweep point of the analog test is finished.
  - /EOM is defined as the effective signal when all the test results are effective after every list sweep task is finished.
- STEP sweep mode：
  - /INDEX is defined as the effective signal when the analog test of every sweep point is finished.
  - /EOM is defined as the effective signal when the test and the comparison of every step are finished.

The pin distribution for list sweep is shown in table 3 and figure 2. (The pin definition for the list sweep comparison is the same as that for the BIN comparison). The timing chart is shown in figure 5.

<div align="center">Table 8-2 Pin Distribution for the List Sweep Comparison</div>

Pin	Signal	Description
1	/BIN1	Out of the limit of sweep point 1
2	/BIN2	Out of the limit of sweep point 2
3	/BIN3	Out of the limit of sweep point 3
4	/BIN4	Out of the limit of sweep point 4
5	/BIN5	Out of the limit of sweep point 5

| 6	/BIN6	Out of the limit of sweep point 6
7	/BIN7	Out of the limit of sweep point 7
8	/BIN8	Out of the limit of sweep point 8
9	/BIN9	Out of the limit of sweep point 9
10	/OUT	Out of the limit of sweep point 10
11	/AUX	/AUX is defined as the effective signal when at least one is not good in the list.
30	/INDEX	SEQ: When the analog test of the last sweep point is finished and the UNKNOWN terminal can be connected to another DUT, /INDEX is effective. But the comparison signal is effective until /EOM is effective. STEP: When the analog test at each sweep point is finished, /INDEX is effective. But the comparison signal is effective until /EOM is effective.
31	/EOM	Test ended: SEQ: When the test is finished and the compared results are effective, this signal is effective. STEP: When the test of every sweep point is finished, /EOM is finished. the comparison result signal is effective until /EOM is effecive.
Others		The definition is the same as that of the comparison.
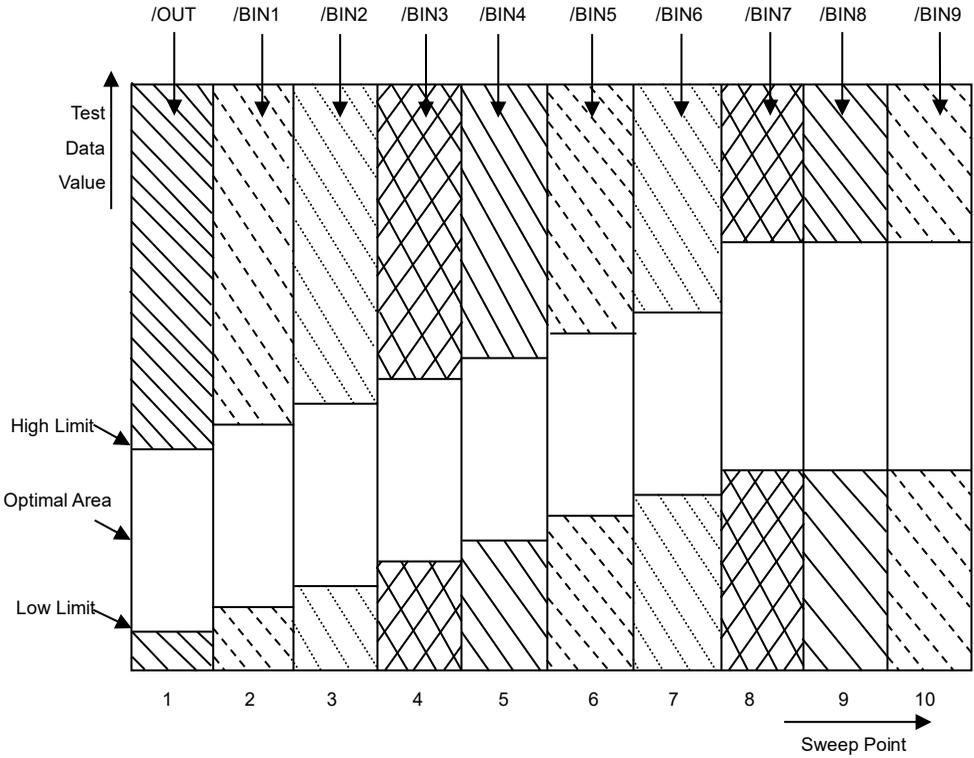
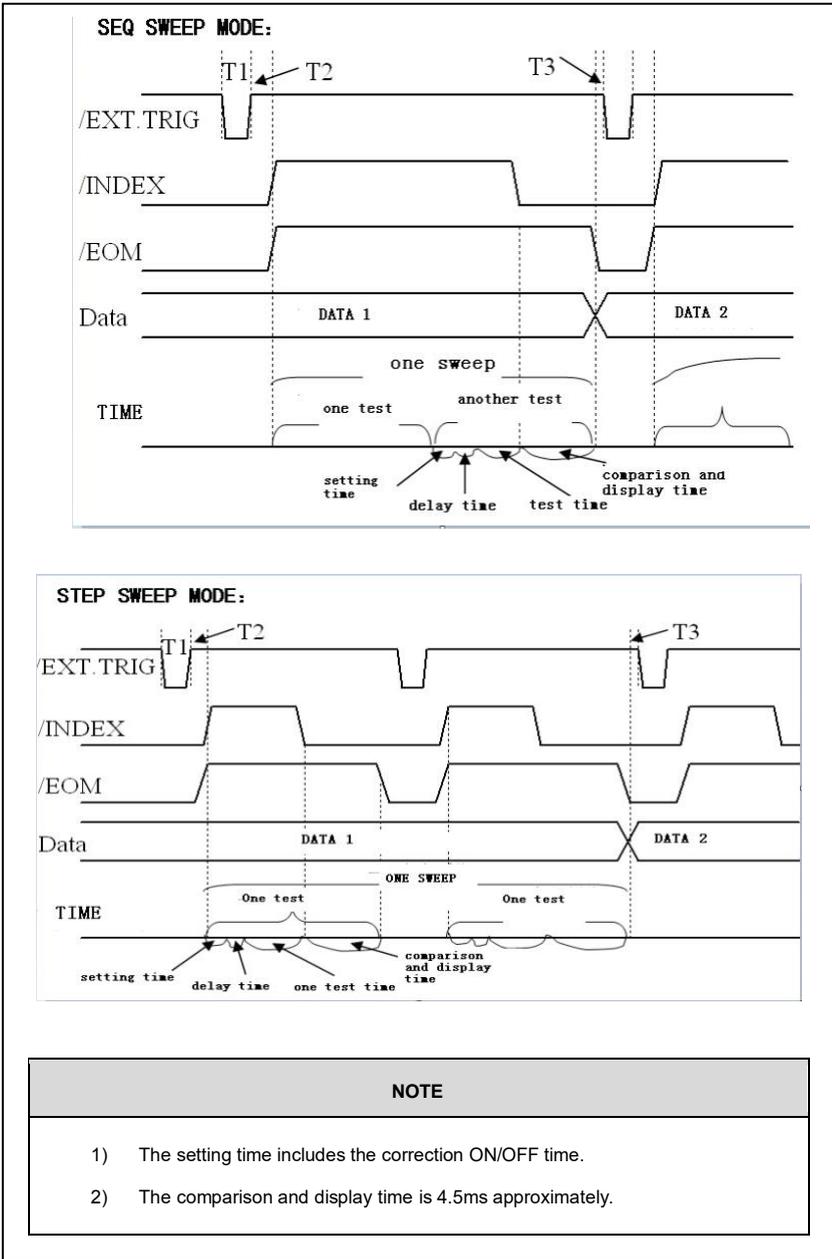Figure 8-4 Signal Field of the List Sweep Comparison

Figure 8-5 Time Counting

8.2.2 Electrical Feature

As shown above, the signal definition for the comparison and the list sweep comparison differ. But the electrical properties are the same. Therefore, the description can be applied to the BIN comparison and the Listensweep comparison.

DC Isolation Output:

The DC isolation output (Pin1 to Pin16) generates the isolation by the open collector optoelectronic coupler. The output voltage on each line is set by the pull-up resistor on the HANDLER interface board. The pull-up resistor is connected to the internal voltage (+5v) or the external voltage (EXTV:+5v).The electrical feature of the DC isolation output can be divided into 2 types, as shown shown in Table 8-3.

Table 8-3 Electrical Feature of the DC Isolation Output

Output Signal	Output Rated Voltage		Maximum Current	Reference Ground for the Circuit
	LOW	HIGH		
Compared Signal /BIN1 - /BIN9 /AUX /OUT /PHI /PLO	≤0.5V	+5V – +24V	6mA	Internal pull-up voltage: ST2830 GND EXTV1: COM1
Control Signal /INDEX /EOM /ALARM	≤0.5V	+5V – +24V	5mA	Internal pull-up voltage: ST2830 GND EXTV2: COM2

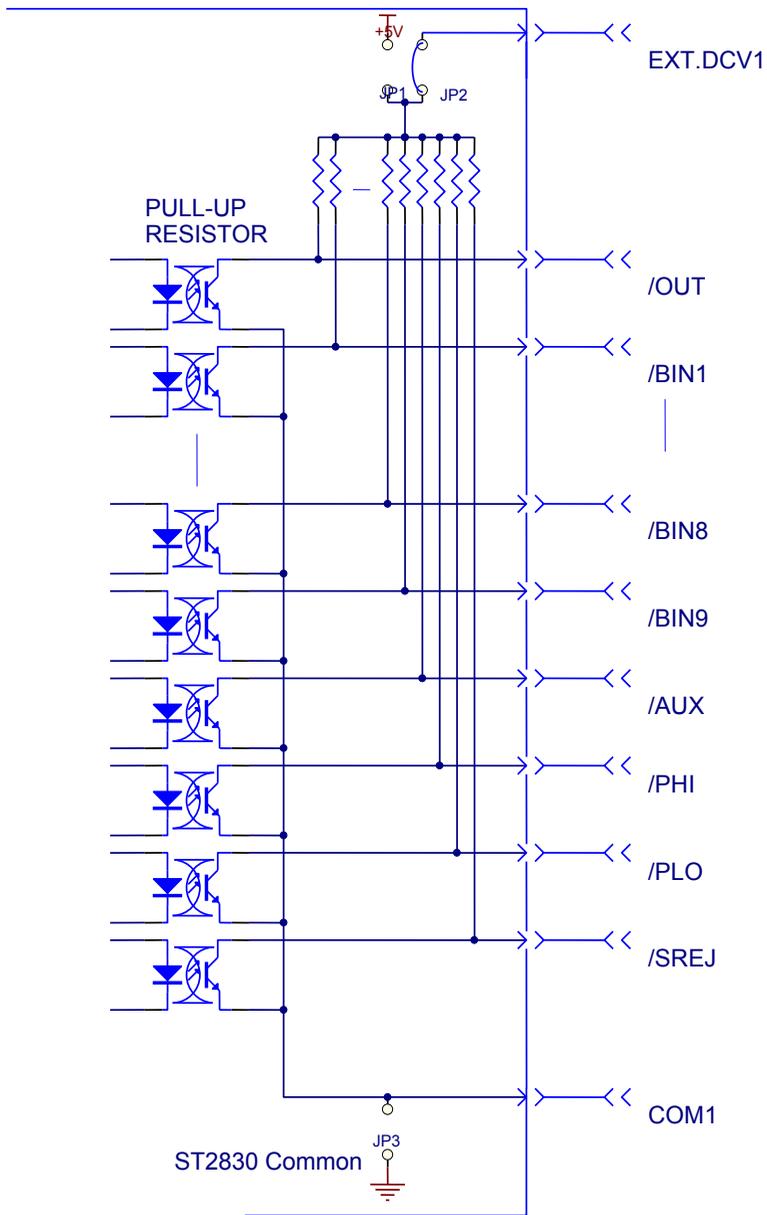**8.2.3 HANDLER Interface Board Circuit**

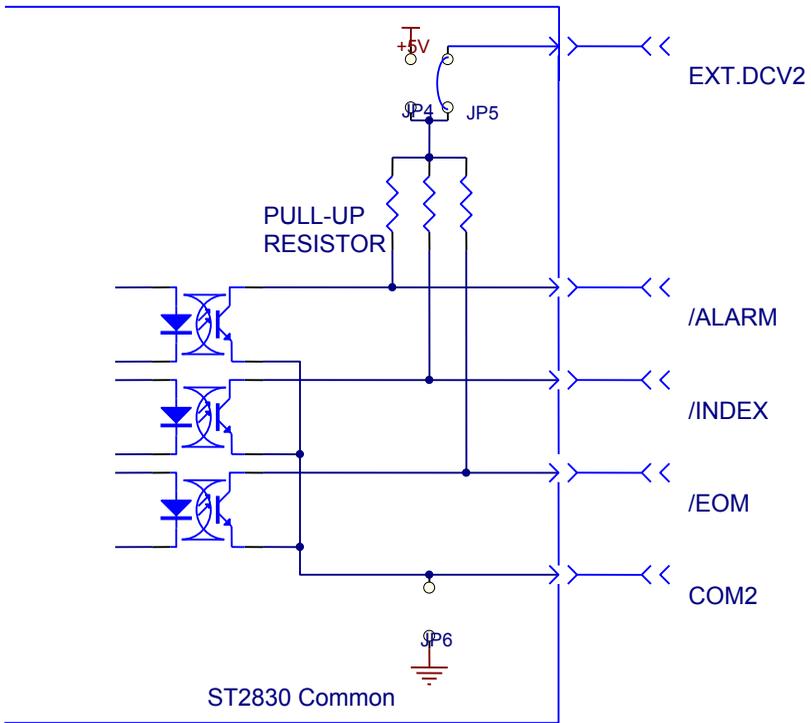Figure 8-6 Output Circuit for the Comparison Result

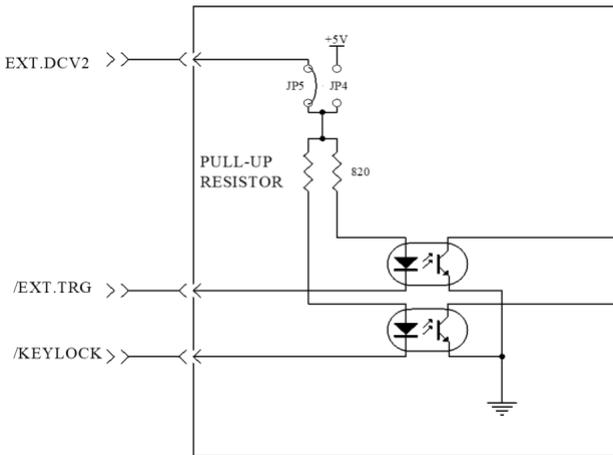Figure 8-7 Output Circuit for Control Signal

Figure 8-8 Input Circuit for Control Signal

8.2.4 Operation

Before you use the HANDLER function, you should ensure that the HANDLER interface board is installed on your instrument. The following procedure will show you how to use the interface comparison and the list sweep comparison.

How to configure the comparison settings:

1)   Press the soft key [LIMIT TABLE]. **<LIMIT TABLE SETUP>** page will be displayed.

2)   Set the standard value and the high limit and the low limit in **<LIMIT TABLE SETUP>**.

3)   Refer to the LCR menu key description to see more details.

4)   When you move the cursor to **COMP** field, the soft key field will display:

- ON

- OFF

5)   Press the soft key ON to enable the comparison function.

6)   Press [DISP], and then press the sotfkey BIN NO. or BIN COUNT, the DUT will be tested; at the same time, you can set the counter for the DUT and the auxiliary.

Note: **COMP** ON/OFF can be set in **<BIN COUNT>** page.

How to configure the list sweep comparison:

1)   Press LIST SETUP, **<LIST SWEEP SETUP>** page will be displayed.

2)   Set the sweep mode, sweep frequency point, reference value, the high limit and the low limit. Refer to the LCR menu key description to see more details.

3)   Press [LCRZ] and then press the soft key LIST SWEEP, **<LIST SWEEP DISP>** page will be displayed. Refer to the LCR menu key description to see more details.

NOTE
The following methods can be used to improve the speed: 1)   Set the range to the maximum that the capacitance may be, and lock this range. 2)   Set Vm: OFF and Im: OFF in the MEAS SETUP page. 3)   Test the DUT in the BIN COUNT page.