

# **OPERATION MANUAL**

## **SM6028 Series Precision LCR Meter**

**User Manual**

**scientific**

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## Contents

Chapter 1	Overview .....	8
1.1	To Inspect the package .....	8
1.2	Power connection .....	8
1.3	Fuse .....	8
1.4	Environment .....	8
1.5	Use of Test Fixture .....	9
1.6	Warm-up .....	9
1.7	Other features .....	9
Chapter 2	Introduction .....	10
2.1	Introduction to front panel .....	10
2.2	Introduction to rear panel .....	12
2.3	Introduction to display zone .....	13
2.4	Main menu keys and corresponding displayed pages .....	14
2.4.1	[DISP] .....	14
2.4.2	[SETUP] .....	14
2.4.3	[SYSTEM] .....	14
2.5	Basic Operation .....	14
2.6	Start the instrument .....	15
Chapter 3	Introduction to [DISP] .....	16
3.1	<MEAS DISPLAY> .....	16
3.1.1	Test function .....	17
3.1.2	AC Test range .....	19
3.1.3	Test frequency .....	19
3.1.4	AC Test level .....	20
3.1.5	DC bias .....	21
3.1.6	Test speed .....	22
3.1.7	DC Source .....	23
3.1.8	Tools .....	23
3.2	<BIN NO. DISP> .....	24
3.2.1	Comparator function .....	25
3.3	<BIN COUNT DISP> .....	25
3.3.1	PARAM .....	26
3.3.2	NOM. .....	26
3.3.3	BIN .....	26
3.3.4	HIGH/LOW .....	27
3.3.5	COUNT .....	27
3.3.6	AUX .....	27
3.3.7	OUT .....	27
3.4	<LIST SWEEP DISP> .....	27
3.4.1	Sweep mode .....	28
3.4.2	FREQ (Hz) .....	29
3.4.3	R[:] X[: ] .....	29

---

3.4.4	CMP (Compare)	29
3.5	<TRACE SWEEP>	29
3.5.1	FORMAT	30
3.5.2	SCALE	30
3.5.3	READ	30
3.5.4	TRACE	31
3.5.5	POINTS	31
3.5.6	TRIGGER	31
3.5.7	SAVE CSV & SAVE AS	31
3.6	<MEAS SETUP>	32
3.6.1	Trigger mode	34
3.6.2	Auto level control function	34
3.6.3	Bias current isolation function	35
3.6.4	Average	35
3.6.5	DC Bias Level monitor function	36
3.6.6	Trigger Delay	36
3.6.7	Step Delay	36
3.6.8	DCI Range	37
3.6.9	DC Level	38
3.6.10	DC Range	38
3.6.11	Bias polarity	39
3.6.12	Deviation test function	40
3.7	<CORRECTION>	41
3.7.1	OPEN	42
3.7.2	SHORT	43
3.7.3	LOAD	45
3.7.4	Load correction test function	46
3.7.5	Single-point correction	46
3.7.6	Clear correction data	47
3.7.7	Cable length selection	47
3.8	<LIMIT TABLE>	47
3.8.1	Swap parameter	48
3.8.2	Limit modes of compare function	49
3.8.3	Set nominal value of tolerance mode	50
3.8.4	Comparator function ON/OFF	50
3.8.5	Auxiliary bin ON/OFF	50
3.8.6	HIGH/LOW	51
3.9	<LIST SWEEP SETUP>	52
3.9.1	MODE	53
3.9.2	Test parameter	53
3.9.3	Sweep parameter setup	53
3.10	TRACE SWEEP SETUP	54
3.10.1	Function	54
3.10.2	Level	55

---

3.10.3	DC Bias .....	55
3.10.4	Trace.....	55
3.10.5	Range .....	55
3.10.6	Scale .....	55
3.10.7	Frequency.....	55
3.10.8	Speed.....	55
3.10.9	Format .....	55
3.10.10	Trigger.....	56
3.10.11	Mode .....	56
3.10.12	Start delay.....	56
3.10.13	Point .....	56
3.10.14	Step delay .....	56
3.10.15	Maximum and minimum.....	56
3.10.16	START.....	56
3.10.17	END .....	56
3.10.18	Coordination range setting .....	57
Chapter 4	[SYSTEM] and <FILE MANAGE> .....	58
4.1	<SYSTEM SETUP> .....	58
4.1.1	MAIN FUNC .....	58
4.1.2	KEY SOUND .....	58
4.1.3	PASS BEEP.....	59
4.1.4	FAIL BEEP.....	59
4.1.5	LANGUAGE.....	59
4.1.6	PASS WORD .....	60
4.1.7	BUS MODE .....	60
4.1.8	GPIB ADDR.....	60
4.1.9	TALK ONLY .....	61
4.1.10	BIAS SRC .....	61
4.1.11	BAUD RATE .....	61
4.1.12	DATA/TIME.....	62
4.2	LCR <FILE MANAGE>.....	62
4.2.1	Setup file for single-group component (*.STA) .....	62
4.2.2	U-disk manage performance .....	63
4.2.3	Operation steps for file management.....	64
Chapter 5	Execute LCR operation and some examples .....	66
5.1	Correction operation.....	66
5.1.1	Sweep correction.....	66
5.1.2	Point-frequency correction .....	66
5.2	Correct connection of DUT.....	67
5.3	Eliminate the influence of stray impedance .....	68
5.4	Operation example for testing inductance with SM6028 .....	69
5.5	Operation example of testing capacitance by multi-frequency list sweep .....	70
5.6	Setup example of comparator.....	72
5.6.1	Capacitor sorting .....	72

---

5.7	Operation example of load correction .....	73
Chapter 6	Performance and Test .....	75
6.1	Test function.....	75
6.1.1	Parameter and symbol .....	75
6.1.2	Equivalent mode.....	75
6.1.3	Range .....	75
6.1.4	Trigger.....	75
6.1.5	Delay time .....	75
6.1.6	Connection modes of test terminals .....	76
6.1.7	Test speed (Frequency $\geq$ 10kHz).....	76
6.1.8	Average .....	76
6.1.9	Display digit.....	76
6.2	Test signal.....	76
6.2.1	Test signal frequency.....	76
6.2.2	Signal mode.....	76
6.2.3	Test signal level.....	77
6.2.4	Output impedance .....	77
6.2.5	Monitor for test signal level .....	77
6.2.6	Maximum measurement display range.....	77
6.2.7	DC bias voltage source.....	77
6.3	Measurement accuracy .....	78
6.3.1	Z ,  Y , L, C, R, X, G, B accuracies .....	78
6.3.2	D accuracy.....	78
6.3.3	Q accuracy.....	78
6.3.4	$\Theta$ accuracy.....	79
6.3.5	G accuracy.....	79
6.3.6	R <sub>p</sub> accuracy.....	79
6.3.7	R <sub>s</sub> accuracy .....	80
6.3.8	Accuracy factor .....	81
6.3.9	DCR accuracy .....	85
6.3.10	Test time .....	85
6.4	Safety requirement .....	85
6.4.1	Insulation resistance .....	85
6.4.2	Insulation intensity .....	85
6.4.3	Leakage current.....	85
6.5	Electromagnetic compatibility .....	85
6.6	Performance test.....	86
6.6.1	Working condition.....	86
6.6.2	The used instruments and devices .....	86
6.6.3	Function check .....	87
6.6.4	Test signal level.....	87
6.6.5	Frequency.....	87
6.6.6	Measurement accuracy.....	87
6.6.7	Accuracy of C and D.....	87

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6.6.8	Accuracy of L.....	87
6.6.9	Accuracy of Z.....	88
6.6.10	Accuracy of DCR.....	88
Chapter 7	Command Reference.....	89
7.1	Subsystem commands for SM6028.....	89
7.1.1	DISPlay subsystem commands.....	89
7.1.2	FREQuency subsystem commands.....	91
7.1.3	VOLTage subsystem commands.....	92
7.1.4	CURRent subsystem commands.....	92
7.1.5	AMPLitude subsystem commands.....	93
7.1.6	OUTPut subsystem commands.....	93
7.1.7	BIAS subsystem commands.....	94
7.1.8	FUNcTION subsystem commands.....	95
7.1.9	LIST subsystem commands.....	101
7.1.10	APERture subsystem commands.....	104
7.1.11	TRIGger subsystem commands.....	104
7.1.12	FETCh? subsystem commands.....	106
7.1.13	CORRection subsystem commands.....	108
7.1.14	COMParator subsystem commands.....	113
7.1.15	Mass MEMory subsystem commands.....	118
7.1.16	TRAN subsystem commands.....	118
7.2	GPIB Common Commands.....	127
Chapter 8	Description for Handler.....	131
8.1	Technology description.....	131
8.2	Operation description.....	131
8.2.1	Introduction.....	131
8.2.2	The definition for the signal line.....	131
8.2.3	Electrical feature.....	138
8.2.4	Handler interface board circuit.....	139
8.2.5	Operation.....	141
Chapter 9	Service and Maintenance.....	142
Chapter 10	Warranty.....	143

# Chapter 1 Overview

When you receive the instrument, some inspections are necessary, and the condition must be understood and available before installing the instrument.

## 1.1 To Inspect the package

Inspect the shipping container for damage after unpacking it. It is not recommended to power on the instrument in the case of a damaged container.

If the contents in the container do not conform to the packing list, notify us or your dealer.

## 1.2 Power connection

- 1) Power-supplying voltage range: 100~120Vac or 198~242Vac. Being related with the power setup on the rear panel.
- 2) Power-supplying frequency range: 47~63Hz.
- 3) Power-supplying power range: less than 80VA.
- 4) Power supplying input phase line L, zero line N, ground lead E should be as same as the power plug of the instrument.
- 5) After careful design, the instrument can reduce the clutter jamming caused by AC power terminal input, however, it should be used under the environment with low-noise. Please install power filter if being unavoidable.

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**Warning: In order to prevent user and instrument from being hurt by leakage, it is necessary for user to guarantee the ground line of supply power being reliably grounded.**

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## 1.3 Fuse

The instrument has installed fuse, so operators should use the installed fuse of our company.

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**Warning: Be sure that the location of fuse is consistent with power-supplying voltage range before charging.**

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## 1.4 Environment

- 1) Please do not operate the instrument in the place that is vibrative, dusty, under direct sunlight



or where there is corrosive air.

- 2) The normal working temperature is  $0^{\circ}\text{C}\sim 40^{\circ}\text{C}$ , relative humidity  $\leq 75\%$ , so the instrument should be used under above condition to guarantee the accuracy.
- 3) There is heat abstractor on the rear panel to avoid the inner temperature rising. In order to keep good airiness, please don't obstruct the left and right airiness holes to make the instrument maintain the accuracy.
- 4) Although the instrument has been specially designed for reducing the noise caused by ac power, a place with low noise is still recommended. If this cannot be arranged, please make sure to use power filter for the instrument.
- 5) Please store the instrument in the place where temperature is between  $5^{\circ}\text{C}$  and  $40^{\circ}\text{C}$ , humidity is less than 85%RH. If the instrument will not be put in use for a time, please have it properly packed with its original box or a similar box for storing.
- 6) The instrument, especially the test cable should be far from strong electro-magnetic field, to avoid the jamming on measurement.

## 1.5 Use of Test Fixture

Please use the accessory test fixture or cable, **the test fixture made by user or from other company may cause the incorrect measurement result**. The test fixture or cable should be kept clean, as well as the pin of DUT, thus to guarantee the good connection between DUT and fixture.

Connect the fixture or cable to four test terminals Hcur, Hpot, Lcur, Lpot on the front panel. As for the DUT with shielding shell, connect shielding layer or ground “ $\perp$ ”.

Note: When test fixture or cable has not being installed, the instrument will display an unstable test result.

## 1.6 Warm-up

- 1) To guarantee the accurate measurement, the warm-up time is no less than 15min.
- 2) Please not turn on or off instrument frequently, in order to avoid the inner data fluster.

## 1.7 Other features

- 1) Power: consumption power  $\leq 80\text{VA}$ .
- 2) Dimension (W\*H\*D):  $400\text{mm}\ast 132\text{mm}\ast 385\text{mm}$
- 3) Weight: About 13kg.

## Chapter 2 Introduction

In this chapter, the basic operation features of SM6028 series are described. Please read the content carefully before using SM6028 series instruments, thus you can learn the operation of SM6028.

### 2.1 Introduction to front panel

Figure 2-1 shows the front panel of SM6028.

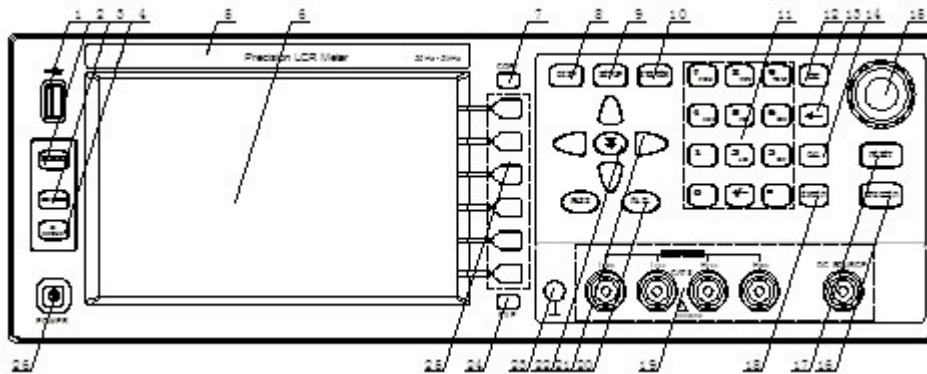


Figure 2-1 Front panel

- 1) USB HOST interface  
Connect U flash disk so as to save or use a specified file.
- 2) [KEYLOCK]  
Press [KEYLOCK], it will be lighted, which means the function of current panel is locked. Press it again, it will be off, which means discharging the lock status. If the password function is ON, it means correct password is necessary when discharging the key-lock, or the key cannot be unlocked.  
When the instrument is controlled by RS232, [KEYLOCK] will be lighted. Press it again, it will be off, which means discharging the lock status.
- 3) [DC BIAS]  
[DC BIAS] is used to permit or forbid the output of DC bias source. Press this key, it will be lighted which means DC bias output is permitted. Press this key once more, it will be off which means DC bias output is prohibited. The key is useless in some pages where the DC BIAS cannot be added.
- 4) [DC SOURCE]  
It is the function of DC voltage source (-10~+10V). It can extend the flexibility of DC control and biasing through independent output of DC source port. For example, it can be used for measurement of three-port devices.
- 5) Brand and model  
Brand and model
- 6) LCD  
800\*480 colorful TFT LCD display, showing the measurement results and conditions
- 7) [COPY]

- 
- Copy the currently displayed page to USB memory.
- 8) [DISP]  
Press this key to enter into the corresponding test display page.
  - 9) [SETUP]  
Press this key to enter into the corresponding test setup page.
  - 10) [SYSTEM]  
Press this key to enter into the system setup page.
  - 11) Numerical keys  
These keys are used to input data to the instrument. The key consists of numerical keys [0] to [9], decimal point [.] and [+/-] key.
  - 12) [ESC]  
ESCAPE key
  - 13) [←]  
BACKSPACE key is used to delete the last numeric of the input value.
  - 14) [CAL]  
Reserved function.
  - 15) Knob with confirmation function  
Move the cursor to select and set the parameters. The middle confirmation button is used to terminate the data input, confirm and save the data entered by the knob.
  - 16) [TRIGGER]  
When the trigger mode is set to MAN mode, press this key to trigger the instrument.
  - 17) [RESET]  
Press the [RESET] button to end the scan only during automatic scanning and any operation cannot be executed on other pages.
  - 18) [ENTER]  
This key is used to end the input of data, and confirm and save the data displayed on the inputting line (the bottom line on LCD).
  - 19) Test terminals (UNKNOWN)  
4-terminal test pair are used to connect 4-terminal test fixture or cable to measure DUT.  
The 4 terminals are respectively as follows: Hcur, Hpot, Lpot and Lcur.  
**DC power output end (DC SOURCE)**
  - 20) PASS / FAIL indicator  
LED indicator shows the test result has passed or failed.
  - 21) CURSOR  
Four cursor keys are used to move the cursor between the fields and fields of the LCD display page. When the cursor moves to a field, the field is highlighted on the LCD.
  - 22) Jump button  
It enables the cursor to jump quickly between different fields.
  - 23) Ground terminal  
The ground terminal is connected with the case of instrument, which can be used to protect or shield the ground connection.
  - 24) FILE  
This key is used to enter into FILE MANAGE interface.
  - 25) Soft keys

Six softkeys are available for selecting controls and parameters, and the left side of each softkey has a corresponding function definition. Softkey definitions vary depending on the display page.

- 26) POWER  
Power switch

## 2.2 Introduction to rear panel

Figure 2-2 shows the rear panel of SM6028.

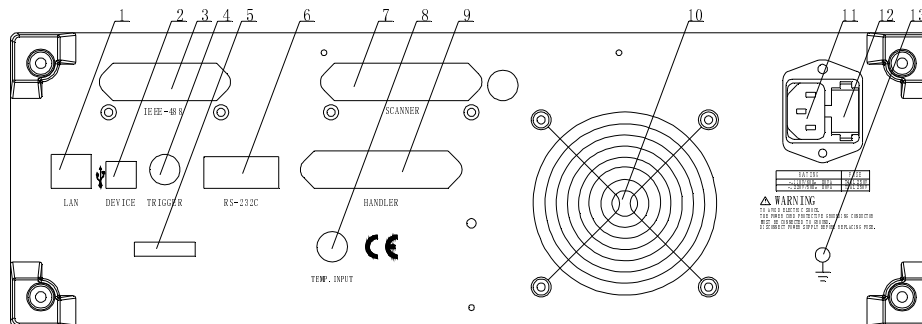


Figure 2-2 Rear panel

- 1) LAN interface  
LAN interface is used to realize the control and the communication of network system.
- 2) USB DEVICE interface  
The tester can communicate with PC through the USB DEVICE interface.
- 3) IEEE-488 interface  
The tester can communicate with PC through GPIB interface.
- 4) TRIGGER interface  
External trigger device such as foot control can be connected.
- 5) Nameplate  
Information about production date, instrument serial number and manufacturer etc..
- 6) RS232 interface  
Series communication interface can realize the communication with PC.
- 7) SCANNER interface  
SCANNER interface (reserved).
- 8) Temperature measurement interface  
Interface for temperature measurement (reserved).
- 9) HANDLER interface  
Handler interface is used to realize the sorting output of test results.
- 10) Fan window  
Heat elimination, maintaining the normal working temperature.
- 11) Power socket  
Input AC power.
- 12) Fuse base  
Being used to install power fuse, protect instrument, and switch 110V/220V by changing the

direction of core.

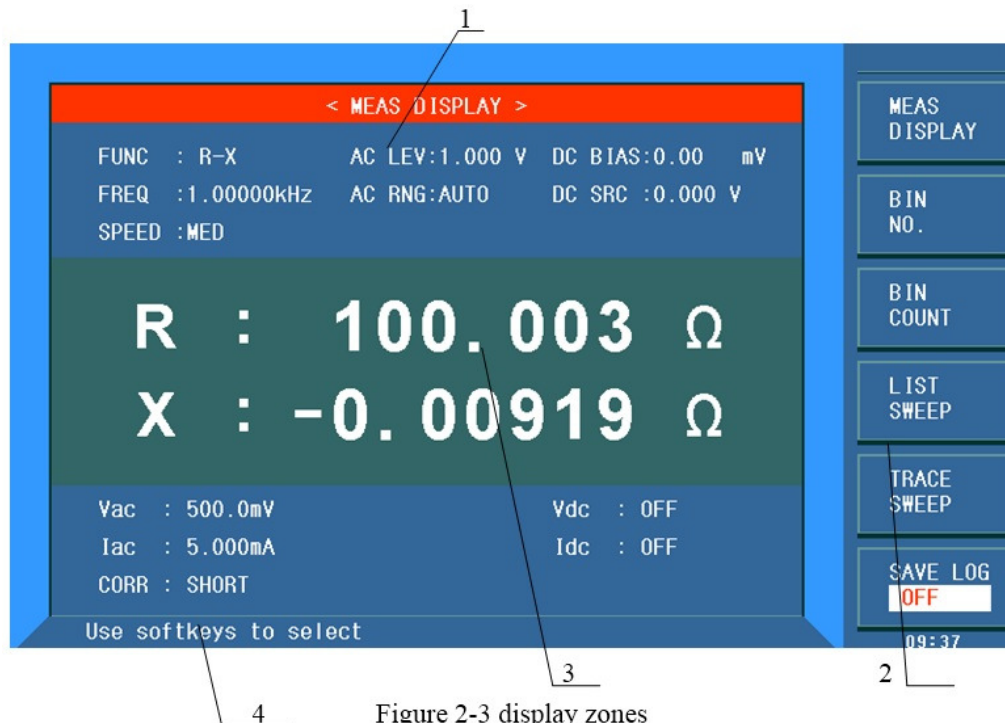
**Warning: Be sure that the direction of fuse is accordant with power-supply voltage range before charging.**

### 13) Ground terminal

The ground terminal is connected with instrument casing, being available for protecting or shielding ground connection.

## 2.3 Introduction to display zone

SM6028 applies a 65k, 7-inch TFT display. The display screen is divided into the following zones:



- 1) Display page name  
Indicate the name of the currently displayed page.
- 2) Soft keys  
The zone is used to display the function definition of soft key. The definition of soft key can be different as the difference of cursor's direction in the zone.
- 3) Test result/ condition display zone  
In this zone, test result information and current condition are displayed.
- 4) Help  
In this zone, information about system and user data input is displayed.

---

## 2.4 Main menu keys and corresponding displayed pages

### 2.4.1 [DISP]

When the LCR function is active, press this key-[DISP] to enter into the LCR measurement display page, the following soft keys will be displayed in the soft key zone.

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

### 2.4.2 [SETUP]

When the LCR function is active, press this key-[SETUP], the following soft keys will be displayed in the soft key zone on the LCR measurement setup page.

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

### 2.4.3 [SYSTEM]

This key-[SYSTEM] is used to enter into the system setup page. The following soft keys will be available:

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

## 2.5 Basic Operation

Basic operation of SM6028 is as follows:

- Use menu keys ([DISP], [SETUP], [SYSTEM]) and soft keys to select the desired page.
- Use cursor keys ([←] [→] [↑] [↓]) to move the cursor to the desired zone. When the cursor moves to a specified zone, this zone will be highlighted to change the background color

display. A zone is an area where values can be set or changed.

- When the knob is in the non-input state, clockwise and anticlockwise direction correspond respectively the function of the [←] and [→] key. The confirmation button in the middle of the knob can be used for input and non-input status at the position where the cursor can be changed. When in input state, the clockwise and counterclockwise directions of the knob can be used to switch the data of the cursor position.
- The soft key functions corresponding to the current zone of the cursor will be displayed in the soft key zone. Users can select and use the desired key. Numeric keys, [←] and [ENTER] are used to input data.

When a numeric key is pressed down, the usable unit soft key will be displayed in the soft key zone. You can choose a unit soft key or press [ENTER] to end data inputting. When [ENTER] is used to terminate data inputting, the unit of data will be set to a default unit, such as Hz, V or A. For example, the default unit for frequency is Hz.

## 2.6 Start the instrument

Plug in 3-line power plug.

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

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



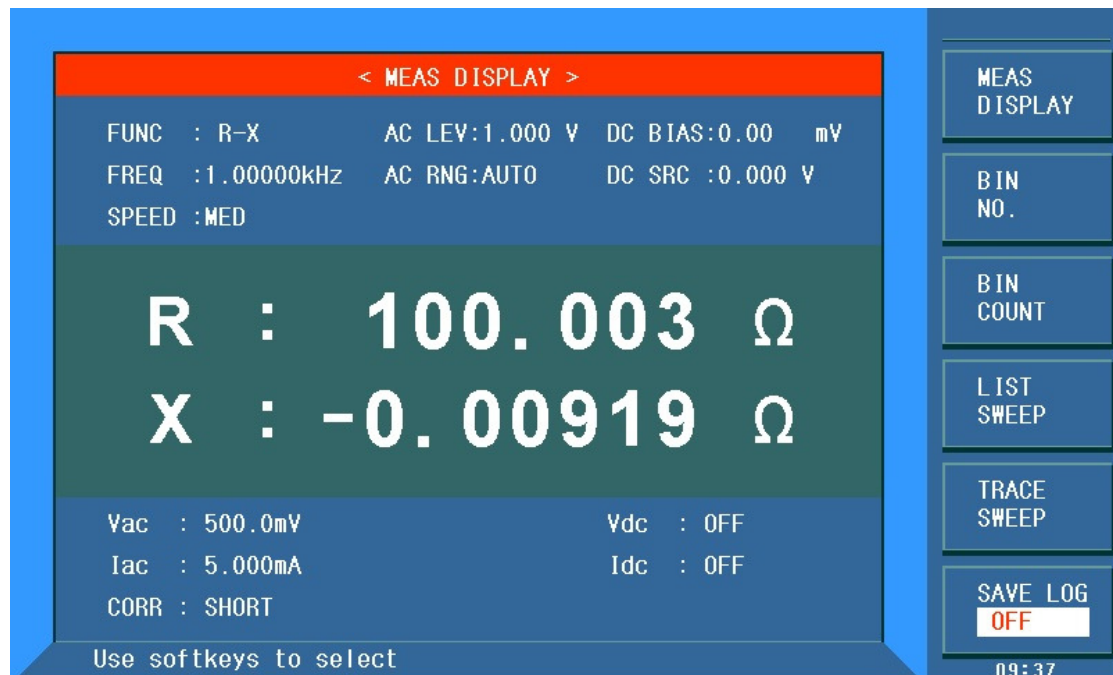
If the password protection function is on, users are required to input the password and then press [ENTER] to enter into the page of main menu.

Note: The instrument has a **default password-2838**. In your practical use, you can change it and set your own one. Please see <SYSTEM> section for more information.

## Chapter 3 Introduction to [DISP]

### 3.1 <MEAS DISPLAY>

Press [DISP], the <MEAS DISPLAY> page will be displayed on screen as shown in the following figure.



On this page, the test result is displayed in upper-case character. The measurement control parameters can be set in this page:

- Test function (FUNC)
- Test frequency (FREQ)
- Test level (AC LEV)/(DC LEV) (in DCR function)
- Test range (AC RNG)/(DC RNG)(in DCR function)
- Test speed (SPEED)
- DC bias (DC BIAS)
- DC power source (DC SRC)

There are 7 zones in this page: FUNC, FREQ, AC LEV/DC LEV, AC RNG/DC RNG, SPEED, DC BIAS, DC SRC. The details will be discussed later.

The test result/ condition display zone shows the information about test condition. These conditions can be set on <MEAS SETUP> page or <CORRECTION> page.

- Signal source voltage/ current monitoring (**Vac, Iac**)
- DC source voltage / current monitoring (**Vdc, Idc**)
- Open, short, load correction ON/OFF status (**CORR**)



### 3.1.1 Test function

In one measurement period, SM6028 can test two parameters for an impedance component: one primary parameter and one secondary parameter. Parameters that can be tested are as follows:

#### Primary parameters

- |Z| (Module of impedance)
- |Y| (Module of admittance)
- L (Inductance)
- C (Capacitance)
- R (Resistance)
- G (Conductance)
- DCR (DC resistance)

#### Secondary Parameters

- D (Dissipation factor)
- Q (Quality factor)
- Rs (Equivalent Series Resistance ESR)
- Rp (Equivalent Parallel Resistance)
- X (Reactance)
- B (Admittance)
- $\theta$  (Phase Angle)
- Rd (DC Resistance)

Test results of primary and secondary parameters are respectively displayed in two lines in the form of upper-case characters. The primary parameter displays in the upper line while the secondary parameter displays in the lower line.

#### Operation steps for setting test function:

- 1) Move the cursor to FUNCA zone, the following soft keys will be displayed on the screen.
  - Cp—...→
  - Cs—...→
  - Lp—...→
  - Ls—...→
  - Z—...→
  - ↓
- 2) Press the soft key corresponding to Cp—...→, the following parameters will be shown for your choice.
  - Cp-D
  - Cp-Q
  - Cp-G
  - Cp-Rp
  - ←

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

- 3) Press Cs—...→, the following parameters will be shown for your choice.
  - Cs-D
  - Cs-Q

- Cs-Rs
- ←

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

4) Press Lp—...→, the following parameters will be shown for your choice.

- Lp-D
- Lp-Q
- Lp-G
- Lp-Rp
- Lp-Rd
- ←

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

5) Press Ls—...→, the following parameters will be shown for your choice.

- Ls-D
- Ls-Q
- Ls-Rs
- Ls-Rd
- ←

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

6) Press Z—...→, the following parameters will be shown for your choice.

- Z-d
- Z-r
- ←

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

7) Press ↓, another group of soft keys will be shown.

- Y—...→
- R—...→
- G—B
- DCR
- ←

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

8) Press Y—...→, the following parameters will be shown for your choice.

- Y-d
- Y-r
- ←

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

9) Press R—...→, the following parameters will be shown for your choice.

- R-X
- Rp-Q

- Rs-Q
- ←

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

- 10) Press G-B soft key to select the desired parameter.
- 11) Press DCR soft key to select the desired parameter

### 3.1.2 AC Test range

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

The SM6028 has 15 test ranges: 0.1Ω, 1Ω, 10Ω, 20Ω, 50Ω, 100Ω, 200Ω, 500Ω, 1kΩ, 2kΩ, 5kΩ, 10kΩ, 20kΩ, 50kΩ, 100kΩ.

Note: SM6028H has a total of 15 ranges when the test voltage is higher than 2V. SM6028 and SM6028A have 14 ranges except 0.1Ω. Different frequency will have different range selection.

#### Operation steps for setting test range:

- 1) Move the cursor to the range zone, the following soft keys will be displayed:
  - AUTO The soft key is used to set the range mode to AUTO.
  - HOLD The soft key is used to switch the AUTO mode to the 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 zone.
  - ↑(+) The soft key is used to increase the range under HOLD mode.
  - ↓(-) The soft key is used to decrease the range under HOLD mode.
- 2) Use soft keys to set measurement range.

### 3.1.3 Test frequency

The measurement range of SM6028 ranges from 20Hz to 2MHz with minimum resolution of 0.001Hz.

The corresponding frequency of SM6028A, SM6028/SM6028H are respectively 20Hz~1MHz, 20Hz~2MHz. The last bit of the displayed test frequency represents the resolution.

#### Frequency range and test frequency point

Frequency range (F)	Test frequency points	Resolution
20Hz < F < 99.999Hz	20.00Hz, 20.001Hz .....99.999Hz	0.001Hz
100Hz < F < 999.99Hz	100.0Hz, 100.01Hz .....999.99Hz	0.01Hz
1kHz < F < 9.9999kHz	1.000kHz, 1.0001kHz .....9.9999kHz	0.1Hz
10kHz < F < 99.999kHz	10.00kHz, 10.001kHz.....99.999kHz	1Hz
100kHz < F < 999.99 kHz	100.0kHz, 100.01 kHz.....999.99 kHz	10Hz
1MHz < F < 2 MHz	1 MHz, 1 MHz.....2 MHz	100 Hz

#### Operation steps for setting test frequency:

SM6028 provides two methods to set measurement frequency. The first one is to use soft keys and the other one is to input data by using numeric keys.

- 1) Move the cursor to the **FREQ** zone, the following soft keys will be displayed.
- **↑(++)**  
This is a coarse adjustment soft key used to increase the frequency. Press this key, the frequency will change as the following sequence: 20 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz and 2MHz.
  - **↑(+)**  
This is a fine adjustment soft key used to increase the frequency. Press this key, the frequency will switch between the following ones (the maximum frequency of SM6028A is 1MHz, and the maximum frequency of SM6028 and SM6028H are 2MHz.):  

20 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1MHz
25 Hz	120 Hz	1.2 kHz	12 kHz	120 kHz	1.2MHz
30 Hz	150 Hz	1.5 kHz	15 kHz	150 kHz	1.5MHz
40 Hz	200 Hz	2 kHz	20 kHz	200 kHz	2MHz
50 Hz	250 Hz	2.5 kHz	25 kHz	250 kHz	
60 Hz	300 Hz	3 kHz	30 kHz	300 kHz	
80 Hz	400 Hz	4 kHz	40 kHz	400 kHz	
	500 Hz	5 kHz	50 kHz	500 kHz	
	600 Hz	6 kHz	60 kHz	600 kHz	
	800 Hz	8 kHz	80 kHz	800 kHz	
  - **↓(-)**  
This is a fine adjustment soft key used to decrease the frequency. The selectable frequencies are the same as that of **↑(+)**.
  - **↓(--)**  
This is a coarse adjustment soft key used to decrease the frequency. The selectable frequencies are the same as that of **↑(++)**.
- 2) Use soft keys or numeric keys to select or set frequency. When using numeric keys to input the required frequency value, the soft key displays the available frequency units (**Hz**, **kHz** and **MHz**). You can use unit soft key to input unit and data. When using [ENTER] to input frequency, the default unit is Hz.

### 3.1.4 AC Test level

The measurement level of SM6028 can be set according to the RMS value of sine wave signal. The frequency of sine wave signal is the test frequency which is generated by inner oscillator. You can set measurement voltage or current. The level range of SM6028/SM6028A are 5mV~2V and SM6028H is 5mV~20V. The corresponding current level mode value has a linear relationship with the internal resistance. (If the test function is DCR, the item is DC level. For the specific DC level test parameters, please refer to the description of the MEAS SETUP interface.)

#### Level voltage and resolution

Level voltage	Resolution
5mVrms ~ 100mVrms	100 $\mu$ Vrms
100 mVrms ~ 1Vrms	1mVrms
1Vrms ~ 20Vrms	10mVrms

**Note: The measurement current is the output one when the tested terminal is short, while the measurement voltage is the output one when the tested terminal is open.**

The auto level control function of SM6028 can realize the measurement of constant voltage or current. The auto level control function (ALC) can be set as ON in <MEAS SETUP> page. When the auto level control function is set to ON, “\*” will be displayed following the current level value. Refer to <MEAS SETUP> for more information.

**Operation steps for setting test level:**

SM6028 provides two methods to set the level of test signal source. The first one is to use soft keys, while the second one is to input data by numeric keys.

- 1) Move the cursor to LEVEL, the following soft keys will be displayed.
  - $\uparrow(+)$   
This soft key is used to increase the level of test signal source.
  - $\downarrow(-)$   
This soft key is used to decrease the level of test signal source.
- 2) Soft or numeric keys are used to select or set the test level. When numeric keys are used to input the desired level, the available units (mV, V,  $\mu$ A, mA and A) will be displayed in the soft key zone. Users can use these unit keys to input unit and data. When [ENTER] is used to terminate the input of level, the default level is V or A.

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

**3.1.5 DC bias**

SM6028 provides internal DC bias voltage from -40V to +40V.

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

Set value		Limit value
DC bias	AC test signal level	
Vdc (V)	Vosc (Vrms)	$V_{osc} \times \sqrt{2} \times 1.15 + V_{dc} \times 1.002 < 42V$
Vdc(V)	Iosc (Arms)	$I_{osc} \times \sqrt{2} \times 115 + V_{dc} \times 1.002 < 42V$
Idc(A)	Vosc(Vrms)	$V_{osc} \times \sqrt{2} \times 1.15 + I_{dc} \times 100.2 < 42V$
Idc(A)	Iosc (Arms)	$I_{osc} \times \sqrt{2} \times 115 + I_{dc} \times 100.2 < 42V$

**Operation steps for setting DC bias:**

SM6028 provides two methods to set the DC bias. The first one is to use soft keys, while the second one is to input data by numeric keys.

- 1) Move the cursor to DC BIAS, the following soft keys will be displayed.
  - $\uparrow(+)$   
This soft key is used to increase the output level of DC bias.

- **↓(-)**

This soft key is used to decrease the output level of 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,  $\mu$ A, mA and A) will be displayed in the soft key zone. Users can use these soft keys to input unit or data. When [ENTER] is used to terminate the input of bias value, the default unit is V or A.

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

Press the [DC BIAS] key on the front panel to allow the output of DC bias. When DC bias is permitted to output, the [DC BIAS] key will be lighted.

### 3.1.6 Test speed

The test speed of SM6028 is determined by the following factors:

- Integration time (A/D conversion)
- Average times (average times an individual test takes)
- Measurement delay (from startup to the start of measurement)
- Display time of test results

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

- Test function is not Ls\_Rdc, Lp\_Rdc
- Range is LOCK
- DC bias voltage level monitoring: OFF
- DC bias current level monitoring: OFF
- Trigger delay: 0s
- Step delay: 0s
- Calibration data:
- Automatic level control: OFF
- Average times: 1
- Calibration:OFF

Measuring time (ms) (DC bias is OFF)

	Measuring Speed	Test Frequency						
		20Hz	100Hz	1kHz	10kHz	100kHz	1MHz	2MHz
1	FAST	380	100	20	7.7	5.7	5.6	5.6
2	MED	380	180	110	92	89	88	88
3	SLOW	480	300	240	230	220	220	220

Generally, the test result is more stable and accurate in SLOW test mode. You can select test mode as FAST, MED or SLOW.

#### Operation steps for setting test speed:

- 1) Move the cursor to SPEED, the following soft keys will be displayed:
  - **FAST**

- MED
  - SLOW
- 2) Use above soft keys to set the test speed.

### 3.1.7 DC Source

The user can set the DC voltage output from the DC source from -10 V to 10 V. The minimum resolution is 1mV.

(**Note:** only SM6028H has this function).

#### Operation steps for setting DC source:

SM6028 provides two methods to set the DC source. The first one is to use soft keys, while the second one is to input data by numeric keys.

- 1) Move the cursor to DC SRC, the following soft keys will be displayed:

- ↑(++)  
Increase the DC source output level in steps of the resolution in the table below.
- ↑(+)  
Press this softkey to increase the DC source output level in steps of 1mV.
- ↓(-)  
Press this softkey to decrease the DC source output level in steps of 1mV.
- ↓(--)  
Decrease the DC source output level in steps of the resolution in the table below.

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

- 2) Soft or numeric keys can be used to select or set the test level. When numeric soft keys are used to input the desired level, the available units ((mV, V) will be displayed in the soft key zone. Users can use these soft keys to input unit or data. When [ENTER] is used to terminate the input of value, the default unit is V.

### 3.1.8 Tools

The test result of SM6028 is displayed as 6 floating-point digits. Decimal point lock function can make SM6028 output the test result in fixed way. Meanwhile this function can change the displayed digits of test result.

#### Operation steps for tools

Set the display mode of decimal point in fixed mode according to the following operation steps.

- 1) Move the cursor to MEAS RESULT DISP zone, the following soft keys will be displayed:
- DECIMAL AUTO

- **DECIMAL HOLD**
  - **DECIMAL LOCATION +**
  - **DECIMAL LOCATION \_**
  - **FONT**
- 2) Press **DECIMAL AUTO** to reset the decimal position of the primary or the secondary parameter test result to its default setting.
  - 3) Press **DECIMAL HOLD** to lock the decimal location of primary parameter TEST result.
  - 4) Press **DECIMAL LOCATION +** to increase the displayed digit by ten times.
  - 5) Press **DECIMAL LOCATION \_** to decrease the displayed digit by ten times.
  - 6) Press **FONT**, the displayed result can be selected to be shown in LARGE, TINY or OFF. When in OFF, the measurement data will not be displayed and only test status will be displayed with the test pointer before the principal parameter.

**NOTE: Under the following circumstance, the function of decimal lock will be cancelled automatically to recover to floating decimal point status.**

- **Test function is changed.**
- **In deviation test, the deviation test mode ( $\Delta$ ABS,  $\Delta$ %, OFF) is changed.**

## 3.2 <BIN NO. DISP>

Press [**DISP**] firstly and then the **BIN NO.** soft key to enter into <BIN NO. DISP> display page. On this page, bin NO. is displayed in upper-case character while the test result, in lower-case character.



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

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



There are 2 zones: **BIN NO. DISP, COMP**. Their detailed information will be introduced as below. The following test conditions are displayed in the measurement result/condition zone. These zones cannot be set on this page but can be set on **<MEAS SETUP>**, **<MEAS DISP>** or **<CORRECTION>**.

- Test function (FUNC)
- Test frequency (FREQ)
- Test level (AC LEV)/(DC LEV) (in DCR function)
- Test range (AC RNG)/(DC RNG)(in DCR function)
- Test speed (SPEED)
- DC Bias (DC BIAS)
- DC power source (DC SRC)
- Open, short and load correction ON/OFF status (CORR)

### 3.2.1 Comparator function

SM6028 has an inserted compare function which can divide DUT to up to 10 bins (from BIN1 to BIN9 and BIN OUT). Users can set 9 pairs of primary parameter limit and one pair of secondary bin limit. The BIN function and PASS/FAIL indication rules are as follows when COMP is ON. When SM6028 has installed an HANDLER interface, the compare result will be output into the automatic test system and further realizing auto-sorting test. These limits can only be set on the **<LIMIT TABLE SETUP>** page. Users can set the compare function to ON or OFF in the **COMP** zone.

COMP ON	AUX ON	AUX OFF
Primary parameter PASS	BIN1 ~BIN9	BIN1 ~BIN9
Secondary parameter PASS	PASS	PASS
Primary parameter FAIL	BIN AUTO	BIN1 ~BIN9
Secondary parameter PASS	FAIL	FAIL
Primary parameter PASS	BIN AUX	BIN OUT
Secondary parameter FAIL	PASS	FAIL
Primary parameter FAIL	BIN AUTO	BIN AUTO
Secondary parameter FAIL	PASS	FAIL

#### Operation steps for compare function

- 1) Move the cursor to **COMP**, the following soft keys will be displayed.
  - ON
  - OFF
- 2) Select one of above soft keys to set the compare function as ON or OFF.

### 3.3 <BIN COUNT DISP>

Press **[DISP]** and then select the soft key of **BIN COUNT** to enter into the **<BIN COUT>** page which shows the count of each bin.

< BIN COUNT DISP >			
PARAM: R-X		NOM. : 0.00000pΩ	COUNT:OFF
BIN	LOW [Ω]	HIGH[Ω]	COUNT
1	---	---	0
2	---	---	0
3	---	---	0
4	---	---	0
5	---	---	0
6	---	---	0
7	---	---	0
8	---	---	0
9	---	---	0
2nd	---	---	[Ω]
AUX :OFF		OUT : 0	

Use softkeys to select

MEAS DISPLAY  
BIN NO.  
BIN COUNT  
LIST SWEEP  
TRACE SWEEP  
SAVE LOG  
OFF

09:42

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

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

There are 2 zones are displayed in this page: **BIN COUNT DISP**, **COUNT**. The function of each zone will be introduced as below.

The following test result/ condition can be displayed in this page but cannot be set in this page. Users can set them on the <LIMIT TABLE SETUP> page.

- Test parameter (PARAM)
- Nominal value (NOM)
- Bin limit value (HIGH/ LOW)

### 3.3.1 PARAM

Parameter zone shows the “Function” parameter, if user selects primary and secondary parameter swap compare mode, the parameter will be displayed as swap parameter, such as: “Cp-D” is displayed as “D-Cp”, which means the current D is compared as primary parameter while Cp is compared as secondary parameter.

### 3.3.2 NOM.

Nominal parameter is the nominal value used to make bin compare.

### 3.3.3 BIN

This zone shows the bin number of the limit list. “2nd” means the secondary parameter limit.

### 3.3.4 HIGH/LOW

This zone shows the high and the low limits of the limit list.

### 3.3.5 COUNT

This zone shows the count value of the current bin.

### 3.3.6 AUX

This zone shows the count value of the auxiliary bin.

### 3.3.7 OUT

This zone shows the count value of the out bin.

#### Operation steps for bin count function

Execute the following operations to set the bin count function ON/OFF on <BIN COUNT DISP> page.

- 1) On <BIN COUNT DISP> page, move the cursor to **COUNT** zone, the following soft keys will be displayed.
  - **ON**
  - **OFF**
  - **RESET**
- 2) Press the soft key **ON** to turn on the count function.
- 3) Press the soft key **OFF** to turn off the count function.
- 4) Press the soft key **RESET**, “☺ : Reset count, Sure?” will be displayed in the help zone. Then the following soft keys will be displayed.
  - **YES**
  - **NO**
- 5) Press the soft key **YES** to reset all bin counts to 0.
- 6) Press the soft key **NO** to cancel the reset operation.

## 3.4 <LIST SWEEP DISP>

Up to 201 test frequencies, test levels or DC bias can be set on this page. Users can set the high and the low limits for each list-sweep test point. Auto sweep test will be made on these test points. And their test results will be compared with their limits.

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

< LIST SWEEP DISP >							
MODE : SEQ							
No.	FREQ	AC LEV	DC BIAS	FUNC	RESULT-A	CMP	
001	1.00000kHz	1.000 V	0.00 mV	R-X	140.965 Ω	PASS	
>002	1.00000kHz	1.000 V	0.00 mV	R-X	147.459 Ω	PASS	
003	1.00000kHz	1.000 V	0.00 mV	R-X	139.596 Ω	PASS	
004	1.00000kHz	1.000 V	0.00 mV	R-X	139.342 Ω	PASS	
005	1.00000kHz	1.000 V	0.00 mV	R-X	136.455 Ω	PASS	
006	1.00000kHz	1.000 V	0.00 mV	R-X	145.125 Ω	PASS	
007	1.00000kHz	1.000 V	0.00 mV	R-X	141.213 Ω	PASS	
008	1.00000kHz	1.000 V	0.00 mV	R-X	137.146 Ω	PASS	
009	1.00000kHz	1.000 V	0.00 mV	R-X	141.990 Ω	PASS	
010	1.00000kHz	1.000 V	0.00 mV	R-X	137.172 Ω	PASS	
Use softkeys to select							

MEAS DISPLAY

BIN NO.

BIN COUNT

LIST SWEEP

TRACE SWEEP

SAVE LOG  
OFF

10:26

Test points will be automatically tested in a scanning mode. Meanwhile, comparison will be made between test results and limit values. In the process of list sweep test, “▶” denotes the current sweep test point. The following control parameters can be set on <LIST SWEEP DISP>.

- Sweep mode (**MODE**)
- Sequence number (**NO.**)

There are 3 zones on this page: **LIST SWEEP DISP**, **MODE** and **NO.**. Move the cursor to **NO.**, press the **PAGE** soft key to activate the serial number page switching state. In the active state, the panel knob can switch the serial number page. List sweep points cannot be set on this page but can be set on <LIST SWEEP SETUP>.

### 3.4.1 Sweep mode

The list sweep function of SM6028 can make automatic sweep test for up to 201 points' test frequencies, test levels or DC bias. Two sweep modes are available on SM6028: SEQ and STEP. In SEQ mode, each press of [TRIGGER] will direct SM6028 to automatically test all list sweep test points. In STEP mode, each press of [TRIGGER] will direct SM6028 to test one list sweep point.

---

NOTE: When the trigger mode is set to INT, sweep test modes of SEQ and STEP will not be controlled by [TRIGGER]. When the trigger mode is set to MAN, [TRIGGER] can be used to trigger the list sweep test.

---

#### Operation steps for setting the list sweep mode:

Set the sweep mode on the <LIST SWEEP DISP> page as **SEQ** or **STEP**.

- 1) On the <LIST SWEEP DISP > page, move the cursor to the **MODE** zone, the following soft keys will be displayed:
  - **SEQ**

### ■ STEP

- 2) Press **SEQ** to set the sweep mode as sequential sweep test mode.
- 3) Press **STEP** to set the sweep mode as single step sweep test mode.

### 3.4.2 FREQ (Hz)

This zone shows the currently swept parameter mode and its unit. What are right below this item are parameters of the sweep list.

### 3.4.3 R[:] X[: ]

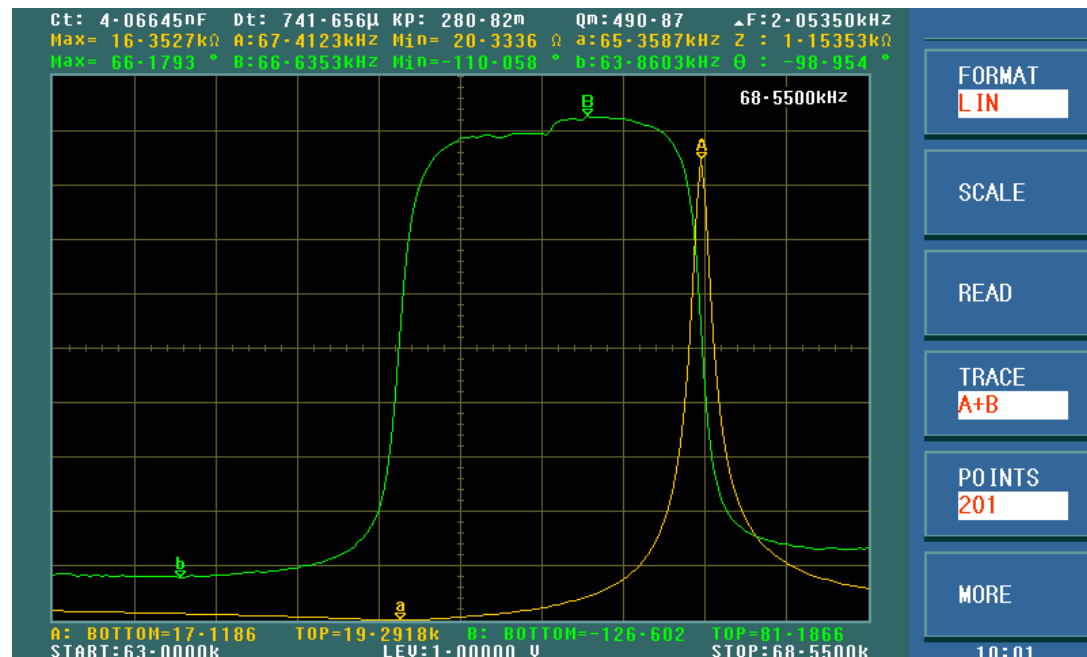
This zone is the currently swept Function parameter and its unit. What are right below this item are the sweep results.

### 3.4.4 CMP (Compare)

This zone indicates the compare results of the currently swept points. L means the result is lower than the standard and H is higher than the standard, while blank is medium.

## 3.5 <TRACE SWEEP>

Press **[DISP]** and Choose **TRACE SWEEP** to enter into the <TRACE SWEEP> page. As shown in figure below:



Within the user preset mode, automatic sweeping of the components and parts can be conducted in linearity or logarithm mode with the points of 51, 101, 201, 401 and 801. The LCD screen will

dynamically display how the primary and secondary parameters of the measured components change with the mode and condition. Any point of result within the sweep range can be read on the screen. Meanwhile, the MAX and MIN primary and secondary parameters of the measured components and its condition of corresponding mode within the sweep range will be displayed on the screen.

**NOTE:** when finishing setting the sweep condition, please press [**TRIGGER**] to start sweeping. Press [**RESET**] key to pause the testing and press it again to start sweeping again.

### 3.5.1 FORMAT

This zone is used to change the coordinate mode of sweeping.

**LIN** Choose this mode, now the sweep mode is increasing as linearity way, vertical coordinate is distributed as linearity way.

**LOG** Choose this mode, now the sweep mode is increasing as the long way with the base of 10, vertical coordinate is distributed as the long way with the base of 10.

### 3.5.2 SCALE

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

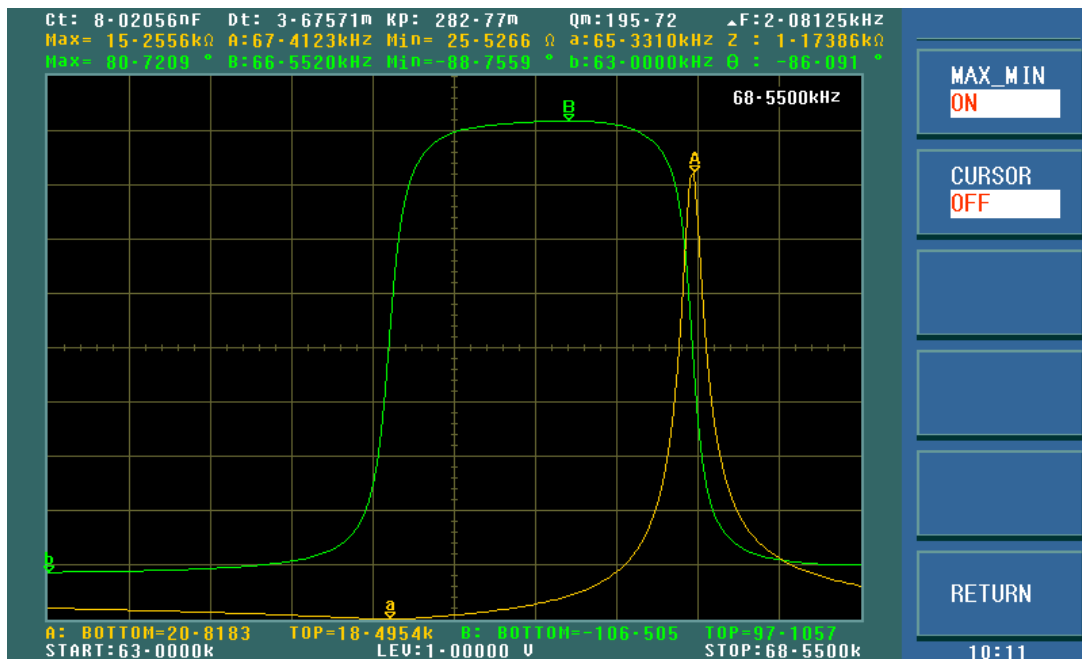
**AUTO** It can automatically adjust the display scale of the curve to fit the curve display area one time. After adjusting, the SCALE changes to HOLD state.

**HOLD** Now, it will hold the current display scale. Users should manually set the parameter of A MIN, A MAX, B MIN and B MAX in <TRACE SWEEP SETUP> page to adjust the display scale of the curve.

### 3.5.3 READ

Press this key to enter into the selection interface and select ON/OFF to decide whether to display the extreme value and the cursor.

Extreme value is the limit value of the primary and secondary parameters. The cursor is a red line. You can observe the value of the primary and secondary parameters in the same frequency by turning the rotary knob.



### 3.5.4 TRACE

Press this key to select TRACE A (display the primary parameters only), TRACE B (display the secondary parameters only), TRACE A+B (display the primary and secondary parameters simultaneously).

### 3.5.5 POINTS

This parameter controls the scan points. That is, the number of points stepped in the starting and ending conditions. The system sets the number of measurement points to 51, 101, 201, 401, 801. The more the number of points is selected, the more precise the image is drawn, but the scan time will be longer. The system defaults to 201.

### 3.5.6 TRIGGER

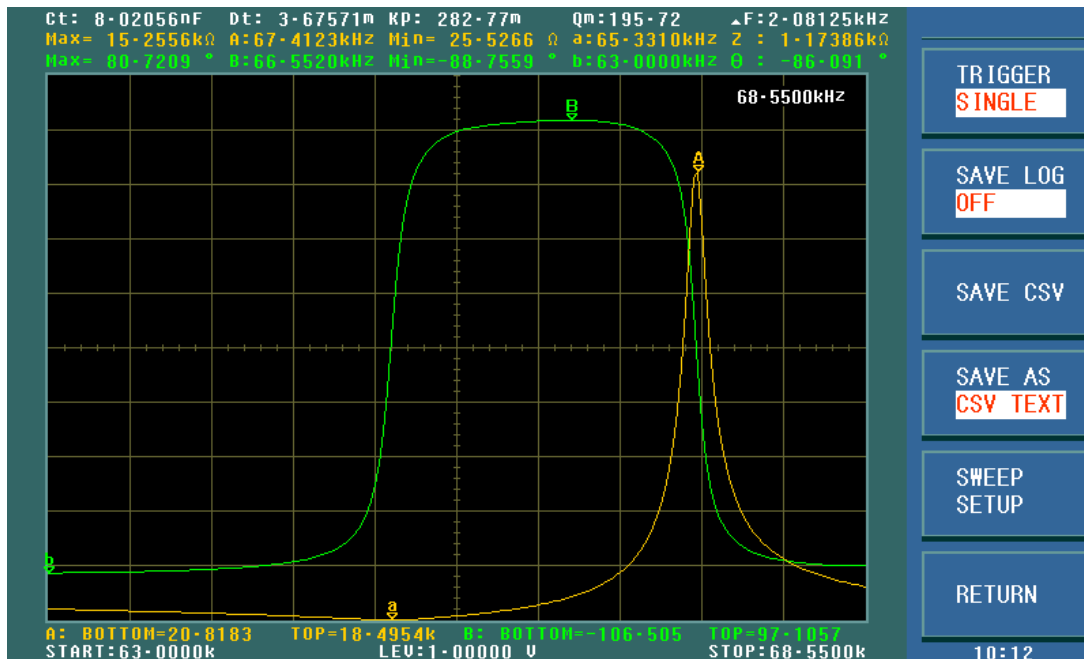
Press **MORE** on the TRACE interface, the option of TRIGGER will be displayed. SINGLE is single trigger, CONTINUE is continue trigger.

### 3.5.7 SAVE CSV & SAVE AS

Press **MORE** on the TRACE interface, the option of SAVE CSV & SAVE AS will be displayed. After selecting CSV TEXT or CSV DATA in SAVE AS, press SAVE CSV to execute.

**CSV TEXT:** save the test results to excel form in \*.CSV format.

**CSV DATA:** save the test results in scientific notation to excel form in \*.CSV format.



When the user selects the sweep parameter as frequency and impedance, the instrument will display the parameters of some ultrasound components, the detailed parameter is as below:

Static capacitance value when  $C_t$ : 1kHz.

Static capacitance value when  $D_t$ : 1kHz.

$Z_{min}$  and its corresponding frequency  $f_s$  (point a on the screen)

$Z_{max}$  and its corresponding frequency  $f_p$  (point A on the screen)

$$\Delta F = f_p - f_s$$

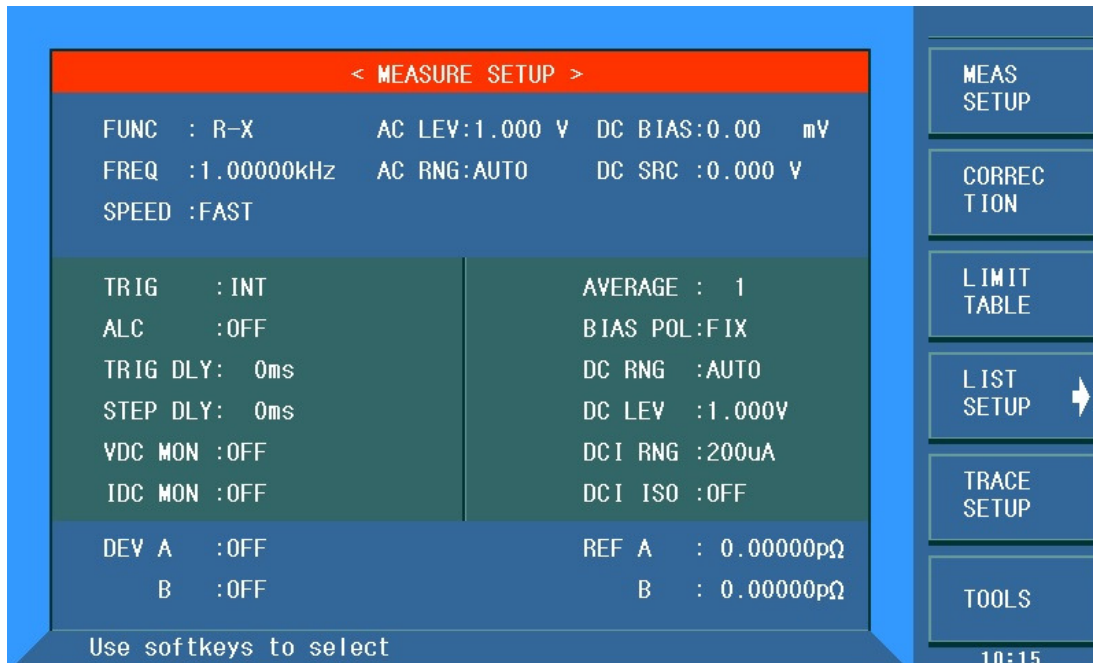
$$k_p \approx \sqrt{\frac{f_p - f_s}{f_s}} \times 2.51$$

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

### 3.6 <MEAS SETUP>

Press [SETUP] to enter into the <MEASURE SETUP> page shown as below:





In this page, the following control parameters can be set. (Items in parenthesis can be set)

- Test function (**FUNC**)
- Test frequency (**FREQ**)
- Test level (**AC LEV**)
- Test range (**AC RNG**)
- Test speed (**SPEED**)
- DC Bias (**DC BIAS**)
- DC Voltage Source (**DC SRC**)
- Trigger Mode (**TRIG**)
- Auto Level Control (**ALC**)
- Trigger delay time (**TRIG DLY**)
- Step Delay Time (**STEP DLY**)
- Average times (**AVERAGE**)
- Auto bias polarity (**BIAS POL**)
- DC resistance range (**DC RNG**)
- DC resistance voltage (**DC LEV**)
- DC bias range (**DCI RNG**)
- DC bias voltage level monitoring ON/OFF (**VDC MON**)
- DC bias voltage level monitoring ON/OFF (**IDC MON**)
- Bias Current Isolation ON/ OFF (**DCI ISO**)
- Deviation Test Mode A (**DEV A**)
- Deviation Test Mode B (**DEV B**)
- Deviation Test Reference Value A (**REF A**)
- Deviation Test Reference Value B (**REF B**)

Some zones listed below are as same as that on <MEAS DISP> page, so it is not necessary to introduce in this section, but others will be introduced briefly in the following sections.

- Test function (**FUNC**)
- Test frequency (**FREQ**)
- Test level (**AC LEV**)/(**DC LEV**) (in DCR function)
- Test range (**AC RNG**)/(**DC RNG**)(in DCR function)
- Test speed (**SPEED**)
- DC Bias (**DC BIAS**)
- DC Voltage Source (**DC SRC**)

### 3.6.1 Trigger mode

There are 4 trigger modes on SM6028: INT, MAN, EXT and BUS.

When the trigger mode is set as INT, SM6028 will make sequential and repeated tests.

When the trigger mode is set as MAN, press [TRIGGER] once, SM6028 will make one test.

When the trigger mode is set as EXT, once the HANDLER interface receives a positive impulse, SM6028 will execute one measurement.

When the trigger mode is set as BUS, once the IEEE 488 interface receives a TRIGGER command, SM6028 will execute a test. BUS trigger mode cannot be set on the instrument front panel.

---

Note: In the process of testing, when SM6028 receives a trigger signal, it will be ignored. So the trigger signal should be sent after the test is done.

When optional HANDLER interface triggers SM6028, the trigger mode is set as EXT.

---

#### Operation steps for the trigger mode setup

Execute the operation of other trigger modes except BUS trigger. If BUS trigger mode is necessary, then use IEEE488 interface to send **TRIGger:SOURce BUS** command.

- 1) Move the cursor to the **TRIGGER** zone, the following soft keys will be displayed:
  - **INT**
  - **MAN**
  - **EXT**
- 2) Use above soft keys to set the trigger mode.

### 3.6.2 Auto level control function

Auto level control function can adjust the real test level (voltage across or current through DUT) to the test level value. This function can guarantee the test voltage or current being constant.

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

The range of constant voltage: 5 mV<sub>rms</sub> to 1 V<sub>rms</sub> (SM6028H: 5 mV<sub>rms</sub> to 20 V<sub>rms</sub>)

The range of constant current: 5 μA<sub>rms</sub> to 10 mA<sub>rms</sub> (SM6028: 5 μA<sub>rms</sub> to 100 mA<sub>rms</sub>)

**NOTE:** When the constant level function is valid, if the level exceeds above ranges, this function will be automatically set as OFF. The level value currently set is generally deemed as non-constant level value.

### Operation steps for setting auto level control function

Execute the following steps and set the constant level function as ON or OFF.

- 1) Move the cursor to **ALC** zone, the following soft keys are displayed.
  - **ON**
  - **OFF**
- 2) Press **ON** to turn on the auto level control function.
- 3) Press **OFF** to turn off the auto level control function.

### 3.6.3 Bias current isolation function

Bias current isolation function can prevent the DC current from affecting the test input circuit. In **DCI ISO** zone, users can set the bias current isolation function as ON or OFF. When the bias current isolation function is set as ON, the bias current flowing through DUT can reach 100mA. When the bias current isolation function is set as OFF, the bias current value allowed to flow through DUT is shown as figure 3-1, if the bias current flowing through DUT is over the value in figure 3-1, then instrument cannot work normally.

Figure 3-1 Max. DC bias current

Test range	10 $\Omega$	30 $\Omega$	100 $\Omega$	300 $\Omega$	1 k $\Omega$	3 k $\Omega$	10 k $\Omega$	30 $\Omega$	100 k $\Omega$
Max. current	2 mA	2 mA	2 mA	2 mA	1 mA	300 $\mu$ A	100 $\mu$ A	30 $\mu$ A	10 $\mu$ A

Note: After bias current isolation function is turned on, the test accuracy will be influenced, so under the condition of low frequency and bias current, the bias current isolation function should be set as OFF.

#### Operation steps for setting the bias current isolation function:

Execute the following steps and set the bias current isolation function as ON or OFF.

- 1) Move the cursor to **DCI ISO** zone, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Press **ON** to turn on the bias current isolation function.
- 3) Press **OFF** to turn off the bias current isolation function.

### 3.6.4 Average

The AVERAGE function can calculate the average value of two or more test results. The average times can be set from 1 to 255 with an increase or decrease of 1.

Operation steps for setting test average times.

- 1) Move the cursor to the **AVERAGE** zone, the following soft keys are displayed.
  - **↑ (+)**

This key is used to increase the average times.

- **↓ (-)**

This key is used to decrease the average times.

- 2) Use above soft keys to set the average times or use numeric keys and [ENTER] input average times directly.

### 3.6.5 DC Bias Level monitor function

The DC bias level monitor function can monitor the real voltage across DUT or real current through DUT. The monitored voltage value is displayed in **Vdc** zone on <MEASURE DISP> page while the monitored current value is in **Idc** zone.

#### Operation steps for setting the level monitor function

Execute the following operation steps to set the level monitor function as ON or OFF.

- 1) Move the cursor to **VDC MON** zone, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Press **ON** to set the voltage monitor function as ON while press **OFF** to set the voltage monitor function as OFF.
- 3) Move the cursor to **IDC MON** zone, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 4) Press **ON** to set the current level monitor function as ON while press **OFF** to set the current level monitor function as OFF.

### 3.6.6 Trigger Delay

SM6028 trigger delay means the delay time from triggering to test-start. Delay function can set the trigger delay time. When the list sweep test function is used, all set delay time will be delayed at each sweep test point. The range of the trigger delay time can be set from 0s to 60s with 1ms as the resolution. The trigger delay function is great useful when the instrument is applied in an auto test system. When the instrument is triggered by HANDLER interface, the trigger delay time can ensure DUT and test terminal has a reliable contact.

#### Operation steps for setting the trigger delay function

Execute the following steps to set the measurement trigger delay time.

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

### 3.6.7 Step Delay

SM6028 step delay means the delay time from the output of the test signal to each measurement.

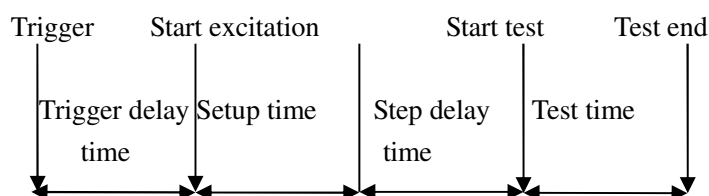
### Operation steps for setting the step delay function

Execute the following steps to set the measurement step delay time.

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

**NOTE:** There are two step delays in the DCR measurement. Because voltages in both the positive and negative directions should be added, there are two measurement cycles. Likewise, Ls-Rdc and Lp-Rdc measurements have three test steps, so it takes three times of the step delay time.

### Schematic diagram of trigger delay time and step delay time:



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

### 3.6.8 DCI Range

The user can set the range of the DCI. Make sure the DCI ISO is ON before setting the DCI range.

Type	Test range				
Standard configuration	20 $\mu$ A	2 00 $\mu$ A	2 mA	20mA	100 mA

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

### Operation steps for setting the DC bias current range:

1) Move the cursor to the **DCI RNG** zone, the following soft keys will be displayed:

- **AUTO** The soft key is used to set the range mode to **AUTO**.
- **HOLD** The soft key is used to switch the **AUTO** mode to the **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 zone.
- **↑(+)** The soft key is used to increase the range under **HOLD** mode.
- **↓(-)** The soft key is used to decrease the range under **HOLD** mode.

2) Use soft keys to set measurement range.

### 3.6.9 DC Level

Level setting for DC resistance measurement. The range is from 100mV to 2V.

Resolution for DC resistance level:

Voltage level	Resolution
100 mVrms ~ 1Vrms	100 $\mu$ Vrms
1Vrms ~ 2Vrms	1mVrms

#### Operation steps for setting DC resistance level:

SM6028 provides two methods to set the DC resistance level. The first one is to use soft keys, while the second one is to input data by numeric keys.

1) Move the cursor to DC LEV, the following soft keys will be displayed.

- $\uparrow(+)$   
This soft key is used to increase the DC resistance level.
- $\downarrow(-)$   
This soft key is used to decrease the DC resistance level.

2) Soft or numeric keys can be used to select or set the DC resistance level. When numeric soft keys are used to input the level, the available units ((mV, V) will be displayed in the soft key zone. Users can use these soft keys to input unit or data. When [ENTER] is used to terminate the input of value, the default unit is V.

### 3.6.10 DC Range

SM6028 has 13 test ranges: 10 $\Omega$ , 20 $\Omega$ , 50 $\Omega$ , 100 $\Omega$ , 200 $\Omega$ , 500 $\Omega$ , 1k $\Omega$ , 2k $\Omega$ , 5k $\Omega$ , 10k $\Omega$ , 20k $\Omega$ , 50k $\Omega$ , 100k $\Omega$ .

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

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

**Note:** If the DCR measurement is initiated while the DC bias is ON, the DC bias will be automatically cut off. If the measurement parameter is Lp-Rdc and Ls-Rdc, the DC bias can not be connected, otherwise an error message will appear.

#### Operation steps for setting the DC resistance range:

1) Move the cursor to the DC RNG zone, the following soft keys will be displayed:

- AUTO The soft key is used to set the range mode to AUTO.
- HOLD The soft key is used to switch the AUTO mode to the 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 zone.
- $\uparrow(+)$  The soft key is used to increase the range under HOLD mode.
- $\downarrow(-)$  The soft key is used to decrease the range under HOLD mode.

2) Use soft keys to set measurement range.

### 3.6.11 Bias polarity

The automatic bias polarity control function is suitable for testing varactors. SM6028 can identify the diode's connection state through the internally bias (approximately 1V) and internally controls the polarity of the DC bias to add a reverse bias to the diode. When the AUTO mode is selected, there is a "\*" prompt after the DC bias voltage.

For example, when the varactor diode is connected as shown in Figure 3-1, when SM6028 recognizes that the diode is properly connected, it begins to add the specified DC bias. Conversely, when the varactor is connected as shown in Figure 3-2, the SM6028 recognizes the reverse connection of the diode and adds a DC bias that is opposite to the specified polarity. This feature eliminates the need to check the polarity of the varactor diode before connecting it to the UNKNOWN terminal.

**Note:** When the DC bias function is set as OFF and the auto bias control function is set to AUTO, the auto bias polarity control function is disabled.

#### Variable capacitance diode (normal polarity)

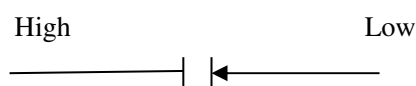


Figure 3-1

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

The result is as follows:

The set bias voltage	Practical used bias voltage
1V	1V
10V	10V

#### Variable capacitance diode (opposite polarity)

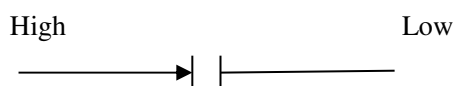


Figure 3-2

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

The result is as follows:

The set bias voltage	Practical used bias voltage
1V	-1V
10V	-10V

#### Operation steps for setting the auto bias polarity function

Execute the following steps to set the bias polarity function as AUTO or FIX.

1) Move the cursor to the **BIAS POL** zone, the following soft keys will be displayed:

- AUTO
  - FIX
- 2) Press soft key **AUTO** to set the auto bias polarity function to AUTO.
  - 3) Press soft key **FIX** to set the auto bias polarity function to FIX.

### 3.6.12 Deviation test function

The deviation test function can make the deviation value (instead of real test value) be directly displayed on the screen. The deviation value is equivalent to the real test value subtracting the pre-set reference value. This function brings great convenience to observe variations of component parameters with temperature, frequency, bias. Deviation test function can be used for primary or secondary parameter or primary and secondary parameters meanwhile. The instrument provides two deviation test modes as below:

- $\Delta$ ABS (Absolute Deviation mode)

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

$$\Delta\text{ABS}=\text{X}-\text{Y}$$

Where, X is the test value of DUT

Y is the preset reference value.

- $\Delta\%$  (Percentage deviation mode)

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

$$\Delta\%=(\text{X}-\text{Y})/\text{Y}*100[\%]$$

Where, X is the test value of DUT.

Y is the preset reference value.

#### Operation steps for setting deviation test function

- 1) Move the cursor to the **REF A** zone to input the reference value of the primary parameter, the following soft key will be displayed.
  - **MEAS**

When the reference component is connected with the test terminal, you should press **MEAS**. Then SM6028 will test the reference component and the test result will be automatically input as the value of **REF A**.
- 2) Use **MEAS** or numeric keys to input the reference value of primary parameter.
- 3) Move the cursor to the **REF B** to input the reference value of the secondary parameter, the following soft key will be displayed.
  - **MEAS**

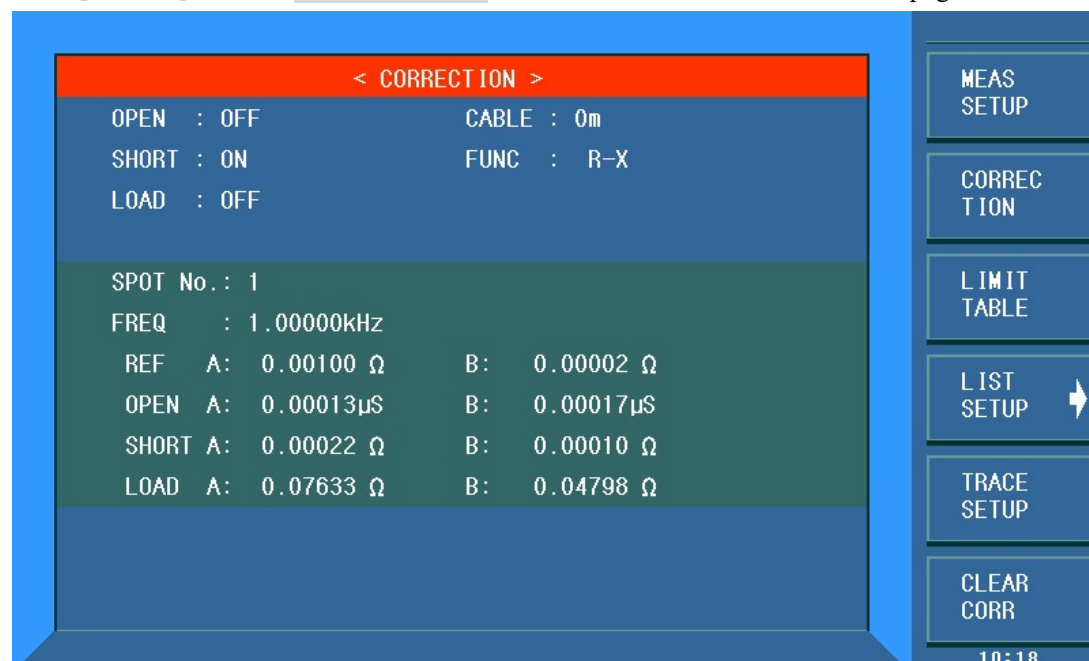
When the reference component is connected to the test terminal, you should press **MEAS**. Then SM6028 will test the reference component and the test result will be automatically input as the value of **REF B**.
- 4) Use **MEAS** or numeric keys to input the reference value of the secondary parameter. If the reference values of primary and secondary parameters have been set in steps 2), you can skip this step.
- 5) Move the cursor to the **DEV A** zone, the following soft keys will be displayed:



- **ΔABS**
  - **Δ%**
  - **OFF**
- 6) Use above soft keys to set the deviation mode of the primary parameter.
- 7) Move the cursor to the **DEV B** zone, the following soft keys will be displayed.
- **ΔABS**
  - **Δ%**
  - **OFF**
- 8) Use above soft keys to set the deviation mode of the secondary parameter.

### 3.7 <CORRECTION>

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



Open, short and load correction on the <CORRECTION> page can be used to eliminate the distribution capacitance, spurious impedance and other measurement errors. SM6028 provides two correction modes: the first one is executing open and short correction on all frequency points through interpolation method; the other one is executing open, short and load correction on the frequency point currently set. It provides dot frequency correction of 201 points. The following measurement control parameters can be set on the <CORRECTION> page.

- Open correction (**OPEN**)
- Short correction (**SHORT**)
- Load correction (**LOAD**)
- Cable length selection (**CABLE**)
- Load correction test function (**FUNC**)
- SPOT No. (**1-201**)
- Frequency of the current spot no. (**FREQ**)
- Reference values for the current spot no. of load correction ( **REF A**, **REF B** )

- Open value of the current spot no. (OPEN A, OPEN B)
- Short value of the current spot no. (SHORT A, SHORT B)
- Load value of the current spot no. (LOAD A, LOAD B)

There are 16 zones on this page: CORRECTION, OPEN, SHORT, LOAD, CABLE, FUNC, SPOT No., FREQ, REF A, REF B, OPEN A, OPEN B, SHORT A, SHORT B, LOAD A, LOAD B. Each control function zone will be introduced in the following paragraphs.

Besides above setting zones, the <CORRECTION> page will also display the following monitoring zones. The monitoring zones are similar with the setting zones, but the monitoring zones can only provide information and you cannot change state. The **LOAD** software can be selected for testing in the FREQ setting field.

- Actual test results for open correction. (OPEN A, OPEN B)
- Actual test result for short correction. (SHORT A, SHORT B)
- Actual test results for load correction. (LOAD A, LOAD B)

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

### 3.7.1 OPEN

The open correction function of SM6028 can eliminate the error caused by the stray admittance (G, B) parallel-connected with DUT, shown as figure 3-1.

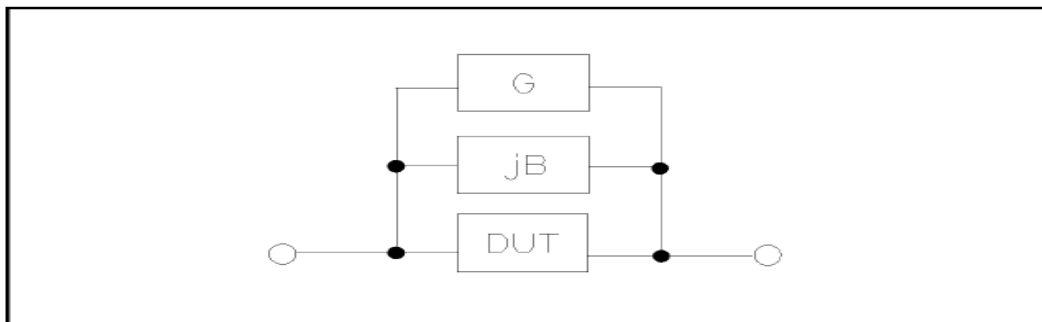


Figure 3-1 Stray Admittance

SM6028 adopts the following two kinds of open correction data:

- SM6028 will automatically make open correction test on 51 fixed frequency points no matter what the currently set frequency is. Based on the open correction data of the following 51 frequencies, the instrument can calculate all open correction data of different test ranges which corresponds to all test frequencies. Move the cursor to OPEN and then used MEAS OPEN to execute full frequency open correction. The highest test frequency of SM6028/6028H is 2MHz (51 points), the highest test frequency of SM6028A is 1MHz (48 points). The following is taking SM6028 as the example:

20 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1.2 MHz
25 Hz	120 Hz	1.2 kHz	12 kHz	120 kHz	1.5 MHz
30 Hz	150 Hz	1.5 kHz	15 kHz	150 kHz	2 MHz
40 Hz	200 Hz	2 kHz	20 kHz	200 kHz	

50 Hz	250 Hz	2.5 kHz	25 kHz	250 kHz
60 Hz	300 Hz	3 kHz	30 kHz	300 kHz
80 Hz	400 Hz	4 kHz	40 kHz	400 kHz
	500 Hz	5 kHz	50 kHz	500 kHz
	600 Hz	6 kHz	60 kHz	600 kHz
	800 Hz	8 kHz	80 kHz	800 kHz
				1 MHz

- The correction point can be set in **Spot No.** on <CORRECTION>. Move the cursor to **FREQ** to set the the open correction frequencies and then use the **MEAS OPEN** soft key to execute open correction on selected frequency.

#### Operation steps of open correction function

Open correction includes full frequency open correction which adopts imbedding algorithm and single frequency open correction on setting frequency. Execute the following operation steps to make open correction. The single frequency open correction can refer to “Load correction”

- 1) Move the cursor to **OPEN**, the following soft keys will be displayed:

- **ON**
- **OFF**
- **MEAS OPEN**
- **DCR OPEN**

- 2) Connect test fixture to test terminal. The fixture is open and not connecting to any DUT.
- 3) Press **MEAS OPEN**, SM6028 will test the open admittance (capacitance and inductance) under 51 frequencies. It will take about 30 seconds to finish the open full-frequency correction. In the process of correction , the following soft key will be displayed:

- **ABORT**

This soft key can be used to terminate the current open correction operation and reserve the formal open correction data.

- 4) Press **DCR OPEN**, SM6028 will test the open-circuit resistance under the DC resistance function.
- 5) Press **ON** to turn on the function of open-circuit correction, then SM6028 will perform open-circuit correction calculation in the later testing process. IF **FREQ** is set as OFF, the open-circuit correction data of the current frequency will be calculated by imbedding algorithm. When **FREQ** is set as ON, the value of the current test frequency will be that of the frequency set in **FREQ**, in this case, the open correction data of **FREQ** will be used to the calculation of open correction.
- 6) Press **OFF** to turn off the open correction function. In later measurement, no open correction calculation will be taken.

### 3.7.2 SHORT

The short correction function of SM6028 can eliminate the error caused by spurious inductance (R, X) in serial with DUT as shown in figure 3-2.

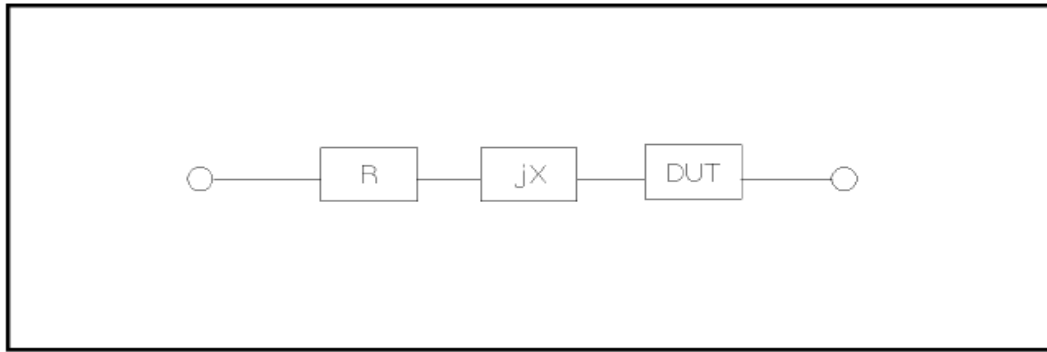


Figure 3-2 Spurious Inductance

SM6028 adopts two kinds of short correction data.

- No matter what the current frequency is, SM6028 will execute short correction test on the 51 fixed frequency points. Except the 51 frequencies, the instrument will adopt imbedding algorithm to calculate the short correction data of different test frequencies which correspond to different ranges. Move the cursor to the **SHORT** zone, and then use the **MEAS SHORT** soft key to execute full frequency short correction. The 51 fixed frequencies are the same as that in open correction. The highest test frequency of SM6028 is 2MHz (51 points), the highest test frequency of SM6028A is 1MHz (48 points).
- The correction point (total 201 points) can be set in **Spot No.** on <CORRECTION>. Move the cursor to **FREQ** to set the short correction frequencies and then use the **MEAS SHORT** soft key to execute short correction on selected frequency.

#### Operation steps of short correction function

Short correction includes full frequency short correction which adopts imbedding algorithm and single frequency short correction on set frequency. Execute the following operation steps to make short correction. The single frequency short correction can refer to “Load correction”.

- 1) Move the cursor to the **SHORT** zone, the following soft keys will be displayed:
  - **ON**
  - **OFF**
  - **MEAS SHORT**
  - **DCR SHORT**
- 2) Connect the test fixture to the test ports. Short the test fixture by using short plate.
- 3) Press the **MEAS SHORT** soft key, SM6028 will test the short spurious impedances (resistance and reactance) of 51 frequencies. Short full frequency correction takes about 30 seconds and in this process, the following soft keys will be displayed.
  - **ABORT**

This soft key can be used to cancel the current short correction operation and reserve the formal open correction data.
- 4) Press **DCR SHORT**, SM6028 will test the short resistance under DC resistance function.
- 5) Press **ON** to validate the short correction function. SM6028 will make short correction calculation in latter test. If **FREQ** is set as OFF, the short correction function will calculate the short correction data of the current frequency. If **FREQ** is set as ON and the current frequency will be that of the frequency set in **FREQ**, the short correction data of **FREQ** will be used in the calculation of the short correction.

- 6) Press **OFF** to turn off the short correction function. In latter test, no short correction calculation will be performed.

### 3.7.3 LOAD

By using transport coefficient between the real test value and the standard reference value at the preset frequency, the load correction of SM6028 can eliminate the test error. It is obvious that open, short, and load correction can be performed at preset frequencies. The frequency can be set in **FREQ** zone. The standard reference values can be set in the setup zones of **REF A** and **REF B**. The standard test function must be set in the **FUNC** zone before setting standard reference value. When the cursor moves to **FREQ**, the **MEAS LOAD** soft key will be displayed. Press **MEAS LOAD** to perform the load correction test.

#### Operation steps for setting load correction

According to the following steps, perform open/ short/ load correction test at preset frequencies.

- 1) Move the cursor to **FREQ**, the following soft keys will be displayed:
  - **ON**  
Press this soft key to make the open/short/load correction data be available.
  - **OFF**  
Press the soft key to make the open/short/load correction data be unavailable.
  - **MEAS OPEN**  
Press this soft key to execute open correction at the current frequency.
  - **MEAS SHORT**  
Press this soft key to execute short correction at the current frequency.
  - **MEAS LOAD**  
Press this soft key to execute the load correction at the current frequency.
- 2) Press the soft key **ON**, the original preset open/short/load correction frequency is displayed on the frequency setting zone.
- 3) Use numeric keys to input the correction frequency. After pressing any numeric key, the available unit keys (**Hz**, **kHz** and **MHz**) will be displayed on the soft key zone and these soft keys can replace the **[ENTER]** key to input correction frequency. When the **[ENTER]** key is used to input correction frequency, the default unit is Hz.
- 4) Connect the test fixture to the test terminal.
- 5) Make the test fixture be open.
- 6) Press **MEAS OPEN** to perform open correction at the current set frequency. The test result (G, B) of the open correction test will be displayed in the help line (the bottom line).
- 7) Move the cursor to **OPEN**.
- 8) Press **ON** to perform the open correction calculation at preset frequency in latter measurements.
- 9) Move the cursor to **FREQ** to set the required correction frequency.
- 10) Make the test fixture be short.
- 11) Press **MEAS SHORT** to perform short correction at preset frequency. The test result (R, X) of the short correction will be displayed in the help line (the bottom line).
- 12) Move the cursor to **SHORT**.

- 13) Press **ON** to perform the short correction calculation at preset frequency in latter measurements.
- 14) Prepare a standard test component.
- 15) Move the cursor to **FUNC**.
- 16) Set the function parameters required to be set.
- 17) Move the cursor to **REF A**.
- 18) Use numeric keys and unit keys to input the primary reference values of the standard component.
- 19) Move the cursor to **REF B**.
- 20) Use numeric keys and unit keys to input the secondary reference value of the standard component.
- 21) Move the cursor to the corresponding **FREQ**.
- 22) Connect the standard component to the test fixture.
- 23) Press **MEAS LOAD**, the instrument will execute a load correction. The real test results of the standard component will be displayed in **LOAD A** and **LOAD B**.
- 24) Move the cursor to **LOAD**.
- 25) Press **ON** to perform load correction calculation at preset frequencies in latter measurements.

### 3.7.4 Load correction test function

When performing load correction, the reference value of the standard component is required to be input in advance. The test parameters of reference value should conform with the preset load correction test function.

Load correction function adopts the transport coefficient between the real test value of preset frequency and the standard reference value to eliminate the test error. Load correction function is only available for calculating transport coefficient.

### 3.7.5 Single-point correction

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

#### Operation steps for setting single-point correction:

- 1) Move the cursor to **SPOT No.**, the following soft keys will be displayed:
  - **↑(++)** Press this softkey to increase the value of Spot No. in steps of 10.
  - **↑(+)** Press this softkey to increase the value of Spot No. in steps of 1.
  - **↓(-)** Press this softkey to decrease the value of Spot No. in steps of 1.
  - **↓(--)** Press this softkey to decrease the value of Spot No. in steps of 10.
- 2) Move the cursor to **FREQ**.
  - **ON**  
Press this soft key to make the open/short/load correction data be available.
  - **OFF**  
Press the soft key to make the open/short/load correction data be unavailable.
  - **MEAS OPEN**  
Press this soft key to execute open correction at the current frequency.

- **MEAS SHORT**

Press this soft key to execute short correction at the current frequency.

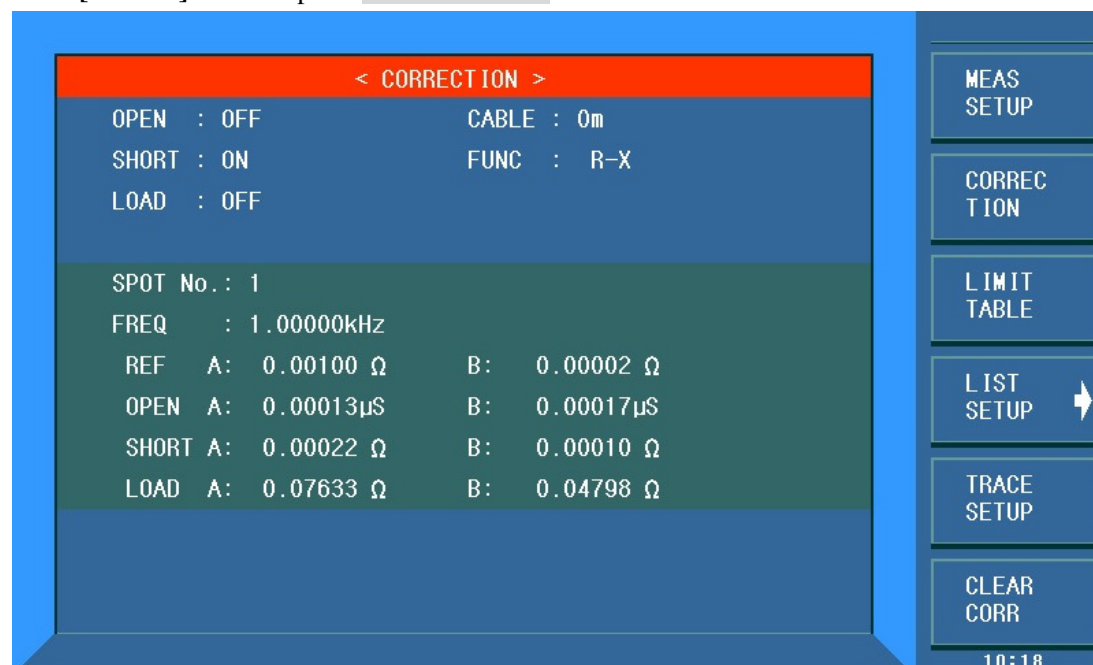
- **MEAS LOAD**

Press this soft key to execute the load correction at the current frequency.

Use numeric keys to input the correction frequency. After pressing any numeric key, the available unit keys (**Hz**, **kHz** and **MHz**) will be displayed on the soft key zone and these soft keys can replace the [ENTER] key to input correction frequency. When the [ENTER] key is used to input correction frequency, the default unit is Hz. In the OFF state, the frequency can also be input and the frequency of the point can be updated. After the ON state, the updated frequency value can be refreshed.

### 3.7.6 Clear correction data

Press [SETUP] and then press **CLEAR CORR** to enter into the clear correction data selection.



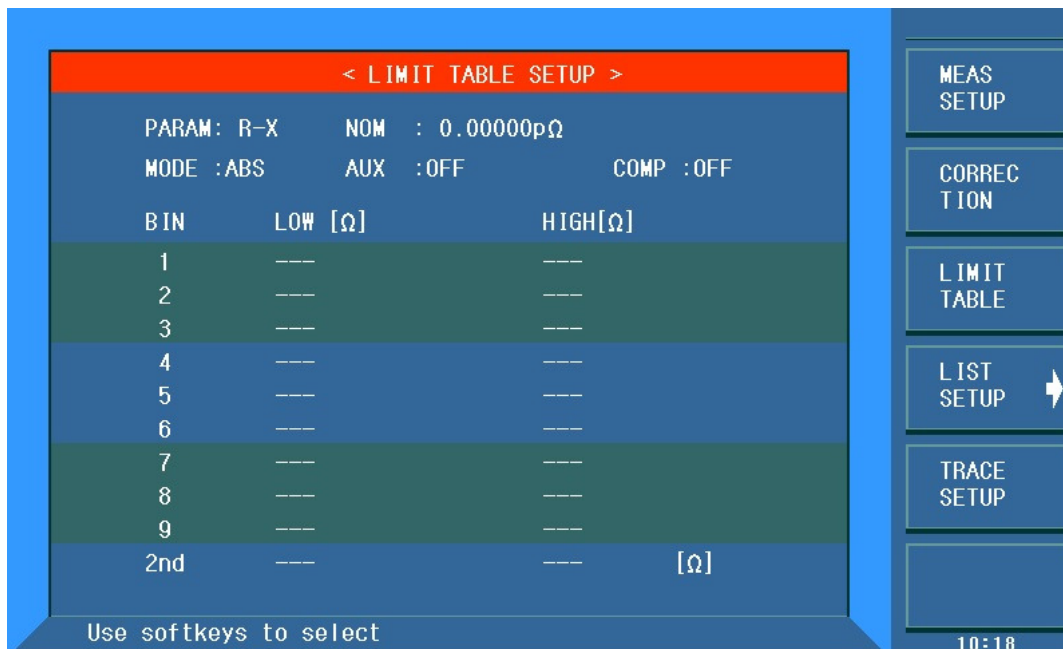
After entering the clear correction data selection, the softkey menu displays the choice of **YES** and **NO**. Select **YES** to start clearing all user correction data for 201 points. There are prompts in the information bar. Choose **ON** to return.

### 3.7.7 Cable length selection

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

## 3.8 <LIMIT TABLE>

Press [SETUP] and then **LIMIT TABLE** to enter into the <LIMIT TABLE SETUP> page as the following figure shown.



Compare function can be set on this page. SM6028 can set 9 bin limits of primary parameters and one of secondary parameters. The tested result can be divided into up to 10 bins (BIN 1 to BIN 9 and BIN OUT). If the primary parameter of DUT is within the limit range from BIN1 to BIN9, but the secondary parameter is out of the limit range, in this case the DUT will be sorted into aux bin. When SM6028 installs the HANDLER interface and it is used in automatic sorting system, the compare function will be especially useful. The following limit parameter of compare function only be set on <LIMIT TABLE SETUP> page.

- Test parameter (**PARAM**)
- Limit mode of compare function (**MODE**)
- Nominal value (**NOM**)
- Auxiliary bin ON/OFF (**AUX**)
- Compare function ON/OFF (**COMP**)
- Low limit of each bin (**LOW**)
- High limit of each bin (**HIGH**)

### 3.8.1 Swap parameter

The swap parameter function can swap the primary and the secondary parameter in **PARAM**. For example, when the test parameter is Cp-D, the swap parameter function can change the test parameter as D-Cp. Then user can set 9 pairs of compare limits for D, but only 1 pair of compare limit can be set for Cp.

#### Operation steps for the swap parameter function

Execute the following operations to swap the primary and the secondary parameters.

- 1) 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 swap the primary and the secondary parameter, which is to recover



the formal setup.

### 3.8.2 Limit modes of compare function

Compare functions has two limit setup modes for primary parameters as shown in figure 3-3.

#### ■ Tolerance mode

Under tolerance mode, set the deviation value of the nominal one (be set in the **NOM** zone) as the compare limit value. Deviation value has two modes: percentage deviation and absolute deviation.

#### ■ Sequential mode

Under sequential mode, the range of the test value is the compare limit value. The compare limit value should be set in the order from small to large.

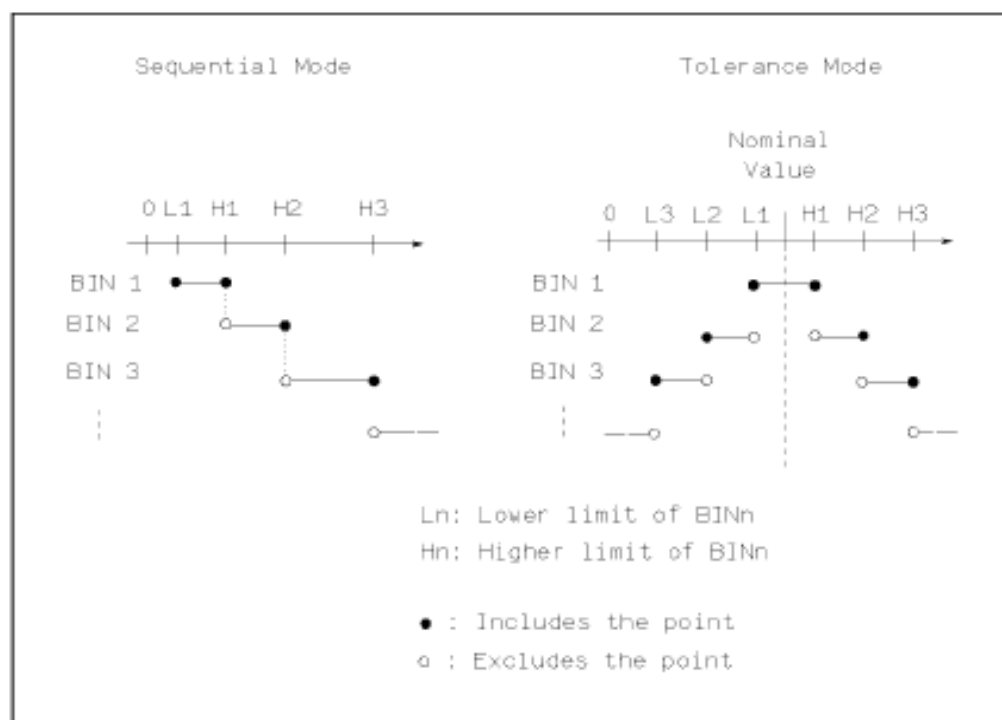


Figure 3-3 Tolerance mode and Sequential mode

**Note:** When setting limit values of tolerance mode, the error range should be set in the order from small to large. If the error range of BIN1 is the largest one, then all DUT will sort into BIN 1. Under tolerance mode, the low limit is not necessary to be smaller than the nominal value and the high limit is not necessary to be larger than the nominal value. The limit range of each bin can be discontinues or overlapped.

#### Operation steps for setting the limit mode of the compare function

1) Move the cursor to the **MODE** zone, the following soft keys will be displayed.

#### ■ %TOL

This soft key is used to set the limit mode as the tolerance mode of percentage deviation (%TOL).

- **ABS TOL**

This soft key is used to set the limit mode as the tolerance mode of absolute deviation (ABS TOL).

- **SEQ MODE**

This soft key is used to set the limit mode as sequential mode.

- 2) Use above soft keys to set the limit mode.

### 3.8.3 Set nominal value of tolerance mode

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

When the sequential mode is selected as the limit mode the primary parameter, the nominal value can be set, but it is not necessary to use it under this mode.

#### Operation steps for setting the nominal value

- 1) Move the cursor to **NOM**.
- 2) Use numeric keys to input nominal value. After inputting the data, the following soft keys (**p**, **n**, **μ**, **m**, **k**, **M**, **\*1**) can replace the [ENTER] key to input the nominal value. When using [ENTER] to input the nominal value, the default unit is the same as that input last time. Press **\*1** to input nominal value, the instrument will select F, H or Ω as the default unit of the nominal value according to primary parameter.

### 3.8.4 Comparator function ON/OFF

SM6028 can set 9 bin limits of primary parameters and 1 bin limit of secondary parameters. The tested results can be sorted into 10 bins (BIN 1 to BIN 9 and BIN OUT) at most. If the primary parameter of DUT is within the limit range from BIN 1 to BIN 9, but the secondary parameter is out of the limit range, in this case the DUT will be sorted into aux bin. When SM6028 installs the HANDLER interface and it is used in the automatic sorting system, the compare function will be especially useful.

#### Operation steps for setting the compare function ON/OFF

- 1) Move the cursor to **COMP**, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Use above soft keys to set the compare function as ON or OFF.

### 3.8.5 Auxiliary bin ON/OFF

When it is necessary to sort the secondary parameters, the limits of the secondary parameter can be set in **HIGH** and **LOW** of 2<sup>nd</sup>.

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

- On <LIMIT TABLE SETUP> page, no low / high limit of the secondary parameters has been set.
- On < LIMIT TABLE SETUP > page, the low/high limit of secondary parameters has been

set but **Aux** function is set as OFF.

In this case, only those components whose secondary parameters are qualified can perform primary parameter sorting according to sorting limits. If the secondary parameters are unqualified and the corresponding primary parameters are within limit ranges, those components will be sorted into BIN OUT.

- On <Limit list setup> page, the low/high limit of the secondary parameters has been set and the **Aux** function is set as ON.

If the primary parameter is out of the limit range, it is sorted into BIN OUT. If the primary parameter of DUT is within the limit range but its secondary parameter is out of the limit range, the DUT will be sorted into the **Aux** bin.

---

Note: When the secondary parameter only has low limit and the auxiliary bin is set as ON, if the primary parameter of DUT is within the limit range and the secondary parameter is smaller than or equal to its low limit, the DUT will be sorted into the auxiliary bin. When the secondary parameter only has high limit and the auxiliary bin is set as ON, if the primary parameter of DUT is within the limit range and the secondary parameter is larger than or equal to its high limit, the DUT will be sorted into the auxiliary bin.

---

#### Operation steps for setting the auxiliary bin function ON/OFF

- 1) Move the cursor to **AUX**, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Use above soft keys to set the auxiliary function as ON or OFF.

### 3.8.6 HIGH/LOW

SM6028 can set bin limits of 9 primary parameters and one secondary parameter. The test results can be sorted into 10 bins at most (BIN 1 to BIN 9 and BIN OUT). The high/low limits of primary parameters can be set in high limit and low limit of bins from BIN 1 to BIN 9. The limit of the secondary parameter can be set in **HIGH** and **LOW** of 2<sup>nd</sup>.

#### Operation steps for setting high/low limit

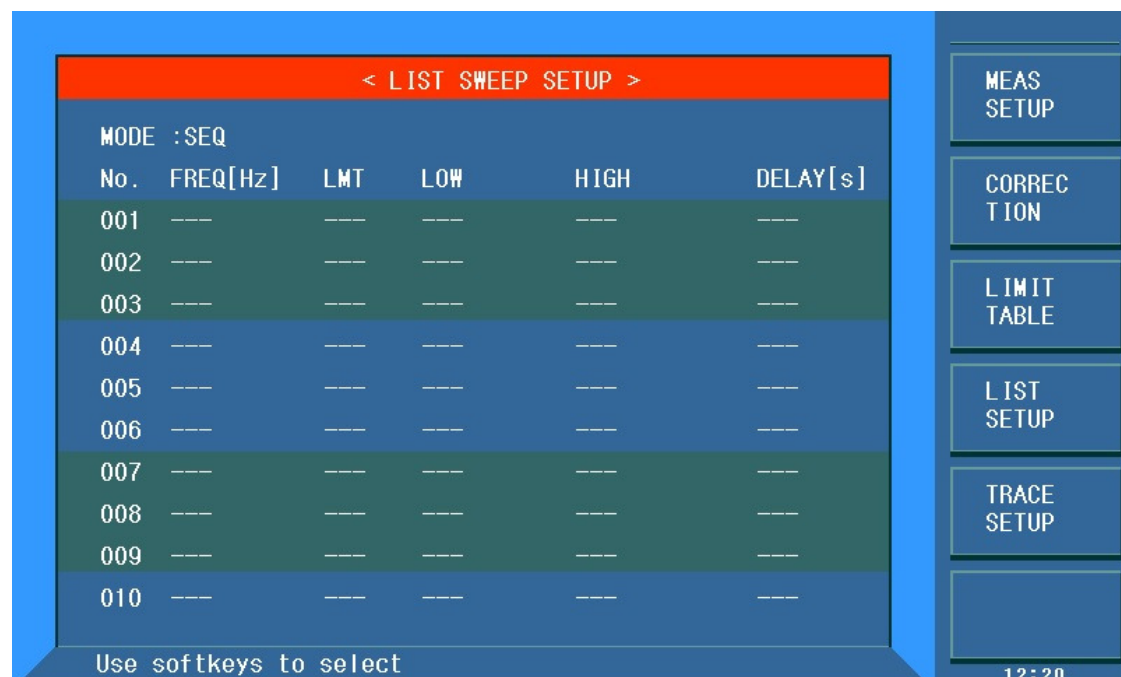
Execute the following steps to set sorting limits.

- 1) Set **PARAM** and **NOM** in the compare function menu and the limit **MODE** of the primary parameter.
- 2) Move the cursor to Low limit of BIN 1. If you select tolerance mode, the following operation steps should be from step 3 to step 6; if you select sequential mode, the following operation steps should be from step 7 to step 11.
- 3) User numeric keys to input low limit value in Low limit. After inputting the data, you can use (**p**, **n**, **μ**, **m**, **k**, **M**, **\*1**) to replace **[ENTER]** to input the limit value. When **[ENTER]** is used, the default unit is the same as that being input last time. When pressing **\*1**, the default unit will be F, H or Ω. After inputting limit value in **LOW** of BIN 1, the low limit of BIN 1 will be automatically set as – (absolute limit) and the high limit will be + (absolute limit).
- 4) The cursor will automatically move to **LOW** of BIN 2. Repeat step 4 until the limits of BIN 9

- are input. Then the cursor will automatically move **LOW** of 2<sup>nd</sup>.
- 5) After inputting the low limit of the secondary parameter, the cursor will automatically move to **HIGH** of 2<sup>nd</sup>.
  - 6) Input the high limit of the secondary parameter.
  - 7) In Low limit of BIN 1, use numeric keys to input the low limit. After inputting the data, you can use (**p, n,  $\mu$ , m, k, M, \*1**) to replace **[ENTER]** to input the limit value. When **[ENTER]** is used to input the limit value, the default unit is the same as that being input last time. When pressing **\*1**, the default unit will be F, H or  $\Omega$ .
  - 8) After inputting the low limit of BIN 1, the cursor will automatically move to **HIGH** of BIN 1. Input the high limit of BIN 1.
  - 9) The cursor will automatically move **HIGH** of BIN 2. For the limit mode is sequential mode, the low limit of BIN 2 will be the high limit of BIN 1. Input the high limit of BIN 2.
  - 10) Repeat step 9 until the high limit of BIN 9 is input. Then the cursor will automatically move to **LOW** of 2<sup>nd</sup>. Input the low limit of the secondary parameter.
  - 11) The cursor will automatically move to **HIGH** of 2<sup>nd</sup>. Input the high limit of the secondary parameter.
  - 12) When the cursor is at **HIGH** and **LOW** position and in non-data input status, the software provides the function of clearing lines and clearing the table. Clearing the line clears the upper and lower limit data of the line where the cursor is currently located, and clearing the table function is to clear all the data in the entire limit setting list, including BIN 1~9 and 2<sup>nd</sup> data.

### 3.9 <LIST SWEEP SETUP>

Press **[SETUP]** and then **LIST SWEEP** to enter into the **<LIST SWEEP SETUP>** page as shown below.



The list sweep function of SM6028 can perform auto sweep test for the test frequency, test level or bias voltage of 201 points. On <LIST SWEEP SETUP> page, the following list sweep parameters can be set.

- Sweep mode (**MODE**)
- Sweep parameter setup (frequency [**Hz**], level [**V**], level [**I**], bias [**V**], bias [**I**])
- Sweep test point setup (sweep point)
- Selection of limit parameter (**LMT**)
- High/low limit (**HIGH**, **LOW**)
- Single point delay (**DELAY[s]**)

### 3.9.1 MODE

Mode menu is the same as the mode on <List sweep display> page.

### 3.9.2 Test parameter

Sweep parameters can be: frequency [Hz], level [V], level [I], bias [V], bias [I].

#### Operation steps for setting test parameter

- 1) 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 one of above soft keys to select the list sweep parameter.

### 3.9.3 Sweep parameter setup

Move the cursor to the table to perform the setup of each sweep parameter: **FREQ (HZ)**, **LMT**, **HIGH**, **LOW** and **DELAY[s]**. Use numeric keys on the front panel to input the data of test frequency/level/bias and high/low limit used to compare, as well as the selected primary/secondary use to compare. After setting, if some inputs are unnecessary, you can execute the function of “Delete line” in the soft key zone to delete the corresponding value.

In the bottom of the **LMT** zone, parameter A indicates that the primary parameters of the measurement result are use to compare with the high and low limits of the table. Parameter B indicates that the secondary parameters of the measurement result are used to compare with the high and low limits of the table. “---“ means no compare. The soft key zone has corresponding items. Press the soft key **LMT A**, “A” will be displayed in the **LMT** zone. When press the soft key **LMT B**, “B” will be displayed in the **LMT** zone. While press the soft key **OFF**, data in LMT zone and the corresponding high and low limits will be cleared and be displayed as “---”.

Where, **DELAY** parameter indicates the delay time from the last measurement of each sweep step to the next sweep measurement. When the external bias current source (such as, SM6027A) is

connected, the delay time of the external bias current source can be used.

(NOTE: the delay time will be accumulated with the delay time in measurement display).

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

### 3.10 TRACE SWEEP SETUP

Press **[SETUP]** and then **TRACE SETUP** to enter into the **<TRACE SETUP>** page as the following figure shown.



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

#### 3.10.1 Function

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

### 3.10.2 Level

**LEVEL** here is to set the sweep level. When the **MODE** is not set as LEVEL[V] or LEVEL[A], using this level when in trace sweep measurement. The specific operation, please see details in Chapter 3.1.4 LEVEL.

### 3.10.3 DC Bias

**DC BIAS** here is to set the sweep DC bias. When the **MODE** is not set as DC BIAS[V] or DC BIAS[A], the DC bias will be superimposed when in trace sweep measurement. The specific operation, please see details in Chapter 3.1.5 DC BIAS.

### 3.10.4 Trace

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

### 3.10.5 Range

**RANGE** here is to set the sweep test range. Please see details in Chapter 3.1.2 Test range.

### 3.10.6 Scale

**SCALE** here is to set the display scale of sweep curve. Please see details in Chapter 3.5.2 SCALE.

### 3.10.7 Frequency

**FREQ** here is to set the sweep frequency. When the **MODE** is not set as FREQ [Hz], using this frequency when in trace sweep measurement. The specific operation, please see details in Chapter 3.1.3 FREQ.

### 3.10.8 Speed

**SPEED** here is to set the sweep speed. Please see details in Chapter 3.1.6 Test speed.

### 3.10.9 Format

**FORMAT** here is to set the sweep format mode, LIN and LOG. Please see details in Chapter 3.5.1 Format.

### 3.10.10 Trigger

TRIG here is to set the sweep trigger mode. Single is the single trigger, while continue is the continuous trigger.

### 3.10.11 Mode

MODE here is to set the sweep mode, including FREQ[Hz], LEVEL[V], LEVEL[A],BIAS[V], BIAS[A].

### 3.10.12 Start delay

**START DEL** here is to set the test delay when the bias source is SM6027A and the sweep mode is BIAS[A]. When the sweep starts or the slave machine of the bias source starts to superimpose the current, the test delay is enabled.

### 3.10.13 Point

POINT here is to set the sweep points, including 51, 101, 201, 401, 801.

### 3.10.14 Step delay

STEP DEL here is to set the delay time added in each sweep point.

### 3.10.15 Maximum and minimum

MAX\_MIN here can set whether to display the maximum and minimum value of the primary and secondary parameter.

### 3.10.16 START

**START** here is to set the start condition of the trace sweep.

Select the number you need on keyboard (0~9/+, -/.) and press enter key or select a corresponding unit.

NOTE: when the cursor moves to “START”, “STOP”, “A MIN, A MAX, B MIN, B MAX”, “TRACE SWEEP” will be displayed in the soft key zone; press the corresponding softkey to enter into the <TRACE SWEEP DISP> page).

### 3.10.17 END

**END** here is to set the end condition of the trace sweep.



Select the number you need on keyboard (0~9/+, -/.) and press enter key or select a corresponding unit.

NOTE: the END condition should be greater than the START condition, or error message will be displayed on the screen. Also, it should be less than the upper frequency limit. (The upper limit of 6028A is 1MHz, the upper limit of 6028/6028H is 2MHz).

### **3.10.18 Coordination range setting**

The coordination range includes A Min, A Max, B Min, B Max, which is the coordination range of primary and secondary parameter, which is used to formulate the frequency response curve drawing range.

Move cursor to zone, input operation: Select the number you need on keyboard (0~9/+, -/.) and press enter key or select a corresponding unit.

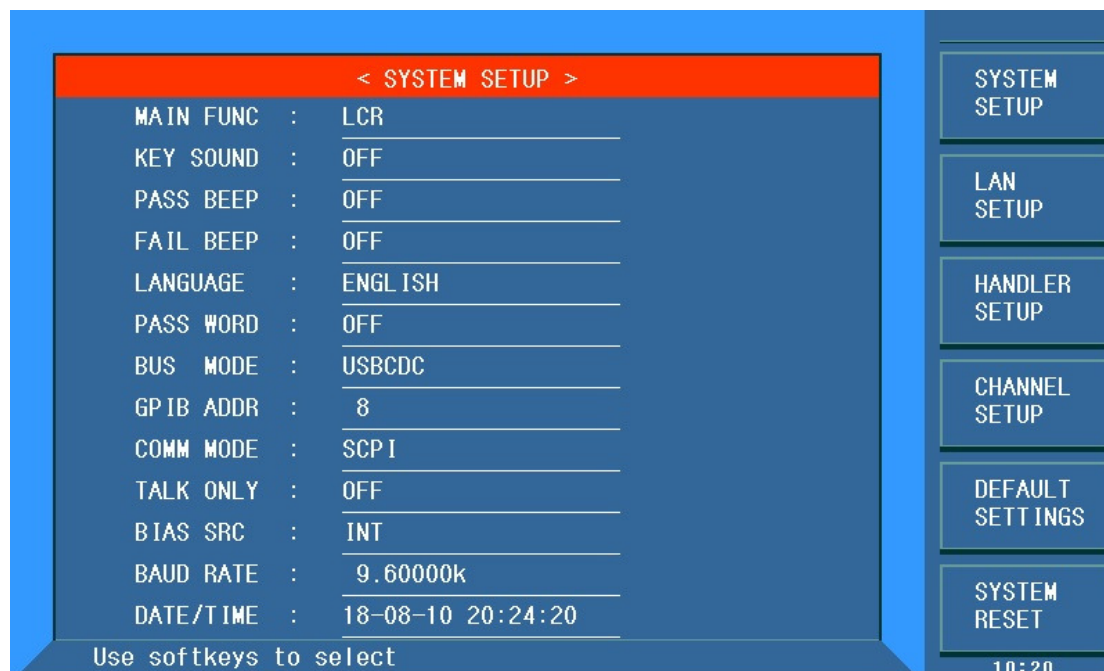
The instrument default is automatic coordinate. When the user lock the coordinate, manual setting is needed. As the same, the MAX should be greater than the MIN, or error message will be displayed on the screen.

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

## Chapter 4 [SYSTEM] and <FILE MANAGE>

### 4.1 <SYSTEM SETUP>

Press [System] and then **SYSTEM SETUP** to enter into the <SYSTEM SETUP> page shown as below.



On this page, most system setup items are displayed, such as instrument main function, key sound, PASS beeper, FAIL beeper, language, PASS word, bus mode, GPIB address, TALK only, Bias SRC, baud rate, data/time. After the parameter in system setting page is set, it is automatically saved. After the next power-on, it is the last data set before the last shutdown.

#### 4.1.1 MAIN FUNC

The function of this zone is to control and display available instrument functions.

**Only LCR function is displayed.**

#### 4.1.2 KEY SOUND

This zone is used to control the key sound.

**Operation steps for selecting key sound:**

- 1) Move the cursor to **KEY SOUND**, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Select ON to turn on the key sound and select OFF to turn off the key sound.

### 4.1.3 PASS BEEP

This zone is used to control and display the beep mode when the test result is qualified.

#### Operation steps for setting PASS BEEP

- 1) Move the cursor to PASS BEEP, the following soft keys will be displayed.
  - **HIGH LONG**  
This soft key is used to select high and long beep.
  - **HIGH SHORT**  
This soft key is used to select high and short beep.
  - **LOW LONG**  
This soft key is used to select 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 set the pass beep function OFF.

### 4.1.4 FAIL BEEP

This zone is used to control and display the beep mode as **FAIL BEEP** when the test result is unqualified.

#### Operation steps for setting FAIL BEEP

- 1) Move the cursor to FAIL beep, the following soft keys will be displayed.
  - **HIGH LONG**  
This soft key is used to select high and long beep.
  - **HIGH SHORT**  
This soft key is used to select high and short beep.
  - **LOW LONG**  
This soft key is used to select 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 set the fail beep mode OFF.

### 4.1.5 LANGUAGE

This zone is used to control and display the current language mode of the operating instrument.

#### Operation steps for setting language

- 1) Move the cursor to Language, the following soft keys will be displayed.
  - **English**  
This soft key is used to select English as the operation language.

#### 4.1.6 PASS WORD

This zone is used to display the password-protection mode.

##### Operation steps for setting the password

- 1) Move the cursor to Password, the following soft keys will be displayed.

- **OFF**

This soft key is used to turn off the password protection mode.

- **Hold SYSTEM**

This soft key is used to turn on the password protection function including file protection and starting up password.

- **Hold FILE**

This soft key is used to protect user's file.

- **MODIFY**

This soft key is used to modify the password. The operation steps are as follows:

Press **MODIFY** to input a new password. After inputting, a prompt information will appear on the screen to prompt you to confirm the new password. Input the new password again till the modification finishes.

- **Hold SETUP**

This soft key is used to restrict the modification operation of the setup files.

---

Note: The default password is 2838.

---

#### 4.1.7 BUS MODE

This mode is used to select RS232C, GPIB, LAN, USBTMC or USBCDC.

##### Operation steps for setting bus mode

- 1) Move the cursor to **Bus**, the following soft keys will be displayed.

- **RS232C**

- **GPIB**

- **LAN**

- **USBTMC**

- **USBCDC**

- 2) Use above soft keys to select the required interface bus.

---

**Note:** GPIB option must be installed before GPIB mode is available.

---

#### 4.1.8 GPIB ADDR

This zone is used to control and display the current GPIB address.

---

Operation steps for setting GPIB address:

- 1) Move the cursor to **GPIB ADDR**, the following soft keys will be displayed.
  - **↑ (+)**  
This soft key is used to increase the GPIB address.
  - **↓ (-)**  
This soft key is used to decrease the GPIB address.

#### 4.1.9 TALK ONLY

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

##### Operation steps for setting the talk only function

- 1) Move the cursor to **TALK ONLY**, the following soft keys will be displayed.
  - **ON**
  - **OFF**
- 2) Press **ON** to turn on the talk only function or **OFF** to turn off this function.

#### 4.1.10 BIAS SRC

Bias source is used to select the DC bias power.

- INT mode

The standard DC bias voltage source is from -40V to +40V and the DC bias current source is from -100mA to 100mA.

- SM6027A mode

When the instrument adopts the external bias source to perform on-line test, SM6027A mode should be selected.

---

NOTE: SM6027A must be connected, then this mode can be supported.

---

#### 4.1.11 BAUD RATE

Baud rate is used select the baud rate of the RS232C interface. The available baud rate of this instrument is from 9.600k to 115.200k.

##### Operation steps for setting the baud rate

- 1) Move the cursor to **BAUD RATE**, the following soft keys will be displayed.
  - **↑ (+)**  
This soft key is used to increase the baud rate.
  - **↓ (-)**  
This soft key is used to decrease the baud rate.

### 4.1.12 DATE/TIME

When moving to the time zone, user should input the password to enter.

## 4.2 LCR <FILE MANAGE>

SM6028 series instrument can save the user-set parameter to the nonvolatile memory in the form of file, so when use the same setting next time user can load a corresponding file to obtain the parameter set and used last time. By doing so, it can save the time of setting parameter and improve the production efficiency. The file manage function of the transformer scanning will be described in the part of transformer test setting.

Press [FILE MANAGE] to enter into the file manage page, shown as below.



### 4.2.1 Setup file for single-group component (\*.STA)

40 groups of different single groups of component set file (\*.STA file) can be saved in the instrument and more than 500 can be saved in external U-disc (note: U-disc is an optional accessory).

Use **FILE MANAGE** function on the following File menus, the following data will be saved or loaded in the form of file, which are called \*.STA file.

- Control and setting parameter on <MEASURE SETUP> page
  - FUNC
  - FREQ
  - AC LEL
  - AC RNG
  - SPEED
  - DC BIAS

- 
- BIAS SRC
  - TRIG
  - ALC
  - TRIG DLY
  - STEP DLY
  - AVERAGE
  - BIAS POL
  - DC RNG
  - DC LEV
  - DCI ISO
  - VDC MON
  - IDC MON
  - DEV A
  - DEV B
  - REF A
  - REF B
  - Control and set parameters on <BIN COUNT DISP> page
    - BIN COUNT (ON/OFF)
  - Control and set parameter on <LIMIT TABLE SETUP> page
    - PARAM (swap parameter)
    - NOM
    - MODE (%-TOL/ABS-TOL/SEQ-MODE)
    - AUX (ON/OFF)
    - COM (ON/OFF)
    - High and low limits of each bin
  - Control and set parameters on <List Sweep Setup> 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 U-disk manage performance

As described above, SM6028 has a standard configuration of USB HOST interface, so the external U-disk can be used as the memory media. In this condition, it breaks the memory limit of 40 groups of \*.LCR files. Meanwhile those files can be copied to IBM PC or compatible desk-top computer, laptop with USB interface to reach the infinite extension.

SM6028 supports the USB memory devices as below:

- Meet the USB 1.0/1.1 standard
- Capacity: 32MB/256MB/2GB/4GB
- File format: FAT16, FAT32 (Format the USB memory on Microsoft Windows operation system)

### 4.2.3 Operation steps for file management

#### A. Search an existed file

- 1) Roll the knob 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 name and then press the [ENTER] to search the target file.
- 4) Input the number and press [ENTER] to jump directly to the page.

#### B. Save the following control and setting parameters to a file by the following steps

- 1) Select and set all control and setting parameters on the desired page.
- 2) Move the cursor to **FILE MANAGE**, the following soft keys will be displayed.
  - **LOAD**
  - **SAVE**
  - **DEL**
  - **COPY TO E:**
  - **FIND**
  - **EXT**
- 3) In the file list, move the cursor to the file-saved position or input the file number directly.
- 4) Press **SAVE**, 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 “Ⓢ : Input LCR file name: ” will displayed
- 7) Use numeric keys to input the current file name and press [ENTER]. Then SM6028 will save the control and setting parameters as a file in this name.

#### C. Load the control and setting parameters from a file by the following steps

- 1) Press File Manage, the file list and the following soft keys will be displayed.
  - **LOAD**
  - **SAVE**
  - **DEL**
  - **COPY to E:**
  - **FIND**
  - **EXT**
- 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 step 1.
- 5) Press **Yes** to load the currently selected file. Then SM6028 will return the current display page.

#### D. Copy a file to an U disk by the following steps

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



- 2) Press **FILE MANAGE**, the file list and the following soft keys will be displayed.
  - **LOAD**
  - **SAVE**
  - **DEL**
  - **COPY to E:**
  - **FIND**
  - **EXT**
- 3) Move the cursor the file to be copied and press [ENTER] to confirm.
- 4) Press **COPY to E:** to copy the file the instrument.
- 5) When copying the files, the progress bar will prompt the replication schedule. When the progress bar disappears, the copy operation is finished.



---

NOTE: Please make sure that your U-disk meets the standard that described in this chapter and no write-read protection.

---

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# Chapter 5 Execute LCR operation and some examples

## 5.1 Correction operation

To execute correction operation (in order to prevent the stray impedance from affecting the test accuracy, it is necessary to make open/short correction), users can select one of the two correction modes.

### 5.1.1 Sweep correction

- a) Press the menu key [SETUP] and then the soft key **CORRECTION**, the instrument will enter into the <CORRECTION> page.
- b) Move the cursor to the **OPEN** zone. **ON**, **OFF** and **MEAS OPEN** will be displayed in the soft key zone.
- c) Keep the test fixture be in the open status, then press **MEAS OPEN** to execute open correction till the prompt information zone displays that open correction is finished.
- d) Press **ON** to turn on the open correction function.
- e) Insert the short plate (TH26010) to the test fixture.
- f) Move the cursor to the **SHORT** zone. **ON**, **OFF** and **MEAS SHORT** will be displayed in the soft key zone.
- g) Press **MEAS SHORT** to execute the short correction till the prompt information zone displays that the short correction is finished.
- h) Press **ON** to turn the short correction function.
- i) Move the cursor to the **LOAD** zone. **ON**, **OFF** will be displayed in the soft key zone.
- j) Press **OFF** to turn off the load correction function.
- k) Move the cursor to the **FREQ** zone, **ON**, **OFF**, **MEAS OPEN**, **MEAS SHORT** and **MEAS LOAD** will be displayed in the soft key zone.
- l) Press **OFF** to turn off the point-frequency correction function of **FREQ**.

### 5.1.2 Point-frequency correction

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

If the test frequency is 5.5kHz,

- a) Press the menu key [SETUP] and then **CORRECTION**, then instrument will display the <CORRECTION> function.
- b) Move the cursor to the **Open** zone, **ON**, **OFF** and **MEAS OPEN** will be displayed in the soft key zone.
- c) Press **ON** to turn on the open correction function.
- d) Move the cursor to the **SHORT** zone, **ON**, **OFF** and **MEAS SHORT** will be displayed in the

- soft key zone.
- e) Press **ON** to turn on the short correction function.
  - f) Move the cursor to the **LOAD** zone, **ON**, **OFF** will be displayed in the soft key zone.
  - g) Press **OFF** to turn on the load correction function.
  - h) Move the cursor to the **SPOT No.** zone to select the calibration point.
  - i) Move the cursor to the **FREQ** zone, **ON**, **OFF**, **MEAS OPEN**, **MEAS SHORT** and **MEAS LOAD** will be displayed in the soft key zone.
  - j) Press **ON** to turn on the point-frequency correction function of **FREQ**.
  - k) Press [5] [.] [5], +5.5 will be displayed in the prompt information zone at the bottom of the screen meanwhile the available units (**Hz**, **kHz** and **MHz**) will be displayed in the soft key zone. Press **kHz**, the **FREQ** zone will be changed as 5.5000kHz (be the same as that of test frequency).
  - l) Keep the test fixture be in open status and press **MEAS OPEN** to execute open correction.
  - m) Insert the short plate (TH26010) to the test fixture.
  - n) Press **MEAS SHORT** to execute short correction.

## 5.2 Correct connection of DUT

There are 4 pairs of test terminal: Hcur, Hpot, Lpot and corresponding shielding terminal of each terminal.

Each terminal contains shielding layer whose function is to reduce the influence of the ground stray capacitance and the interference of the electromagnetic field. In the process of testing, Hcur, Hpot and Lpot, Lcur should be connected with DUT lead to form a complete 4-terminal measurement, thus reducing the effect of the lead and the connection points on the test results (especially the dissipation measurement). When testing low-ohm components, Hpot, Lpot should be connected to the lead terminal so as to avoid the impedance being added to the lead impedance and the connection principle is that the Hpot and Lpot test should be the actual existed voltage on DUT.

In other words, before connecting to DUT, it is not recommended to connect Hcur, Hpot with Lpot, Lcur, for doing this will increase test error.

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

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

So, the use of the test fixture should be used as possible in high frequency. If the test fixture is unavailable or cannot be used, the status of test leads should be the same in the processes of correction and test.

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

1. Distribution impedance must be reduced to the Min. especially when testing high impedance

components.

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

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

**Warning:** Before testing, please discharge the tested polarity component so as to avoid the damage to the instrument.

### 5.3 Eliminate the influence of stray impedance

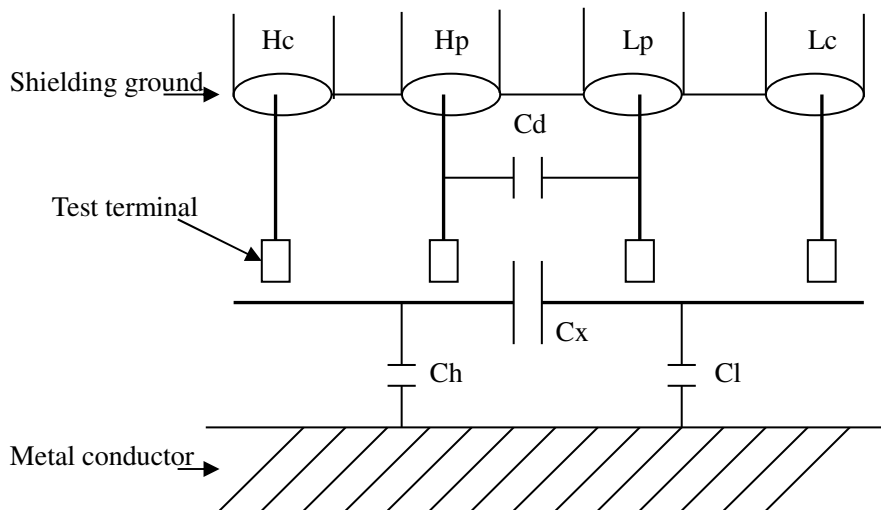


Figure 5-1 Influence of stray capacitance

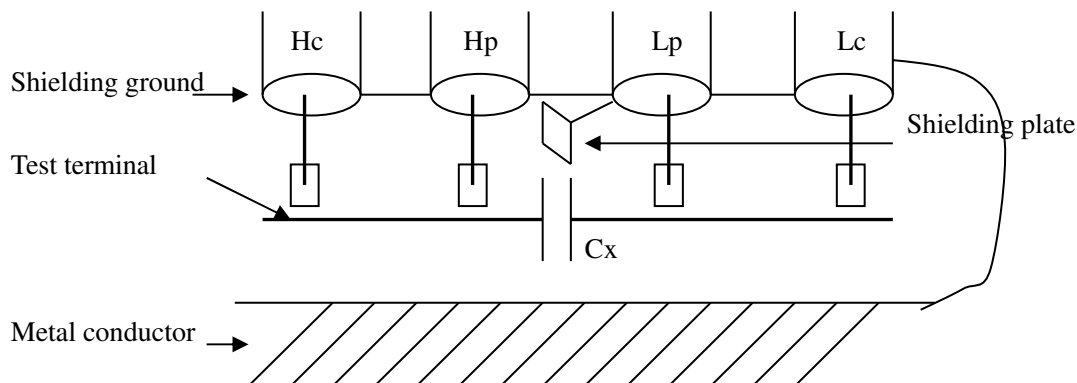


Figure 5-2 Eliminate the influence of stray capacitance

When the DUT has high impedance (such as small capacitance), the influence of stray capacitance cannot be ignored. Figure 5-1 is an example of the use of 4 terminal pair measurement. In this

figure,  $C_d$  is connected with  $C_x$  in a parallel way and when a conductance plate is positioned under DUT, capacitance  $C_h$  will connect with  $C_x$  in parallel after connecting with  $C_l$  in series and by this way the measurement result will have errors. If a ground conductor is installed between high and low terminals,  $C_d$  can be reduced to Min. Meanwhile if the ground terminal is connected to the conductance plate, the influence of  $C_h$  and  $C_l$  will be eliminated.

When the DUT is low impedance (such as small inductance, large capacitance), a large current will flow through test leads  $H_c$  and  $L_c$ . In this case, **electromagnetic coupling between test leads becomes the main source of test errors** except the influence of the contact resistance on test terminals. If this coupling cannot be eliminated, it will bring unexpected influence on test results. Generally, contact resistance affects the resistance of impedance and electromagnetic affects the reactance of impedance. Test terminals can adopt 4TP connection method. For 4 terminal-pair (4TP) connection, the currents flow through  $H_c$  and  $L_c$  are equal in value and opposite in direction with those flowing through each shielding terminals (the current reflow from  $H_c$  to shielding layer). By this way, the magnetic fields produced by these currents can be mutually offset and further eliminate the influence of mutual inductance coupling on test results.

## 5.4 Operation example for testing inductance with SM6028

### Test Condition

Function: Ls-Q

Frequency: 5.5kHz

Level: 1.5Vrms

Internal impedance: 100Ω

### Operation steps

- 1) Turn on the instrument.
- 2) Set basic parameters
  - a) Press [DISP] to enter into the <MEAS DISP> page.
  - b) Use the knob to move the cursor to FUNC, the current item is displayed as Cp-D. Meanwhile Cp—...→, Cs—...→, Lp—...→, Ls—...→, Z—...→, ↓ will be displayed in the soft key zone.
  - c) Press the soft key Ls—...→, Ls-D, Ls-Q and Ls-Rs will be displayed.
  - d) Press Ls-Q to select the Ls-Q function.
  - e) Move the cursor to **FREQ** the current frequency is 1.0000kHz.
  - f) Press [5][.][5], +5.5 will be displayed in the prompt information zone at the bottom of the screen. The available units Hz, kHz and MHz will be displayed in the soft key zone. Press kHz, the frequency will be changed as 5.5000kHz.
  - g) Move the cursor to **LEVEL**, the current displayed level will be 1.000V.
  - h) Press [1][.][5], +1.5 will be displayed in the prompt information zone at the bottom of the screen. The available units mV, V, μA, mA and A will be displayed in the soft key zone. Press [ENTER], the level will be changed as 1.5V.
  - i) Press [SETUP] to enter into the <MEAS SETUP> page.
- 3) Connect the test fixture (TH26005) to the test terminals of SM6028.
- 4) Execute correction (To avoid the influence of stray impedance on measurement accuracy,

Open/ Short correction must be operated) (refer to 5.1.2 “Point-frequency correction”)

- 5) Mount the tested inductance to the test fixture.
- 6) Execute test operation.

Press [DISP] to enter into the <MEAS DISP> page. The instrument can test continuously and the test result will be displayed in upper case character in the center of the page.

- 7) If the test result is obviously incorrect, please check the following items.
  - a) Check the tested inductance is in good connection with the test fixture or not.
  - b) Check the test fixture is in good connection with the test terminals of the instrument or not.
  - c) Redo the open/short correction.

**\*NOTE:** When the sweep open/short correction is used, the point-frequency correction function should be set as OFF. Refer to Correction operation in this chapter.

## 5.5 Operation example of testing capacitance by multi-frequency list sweep

### Test condition

Function: Cp-D

Level: 1Vrms

Other parameters

Frequency	Compare parameter	Low limit	High limit
1kHz	Cp(capacitance)	325.0nF	333.0nF
10kHz	D (Dissipation)	0.0001	0.0003
100kHz	D (Dissipation)	0.0060	0.0100

Beep: HIGH LONG

Alarm mode: OUT (trigger the beeper: HIGH or LOW)

### Operation steps

- 1) Turn on the instrument.
- 2) Set basic parameters.
  - a) Press [DISP] to enter into the <MEAS DISP> page.
  - b) The **FUNC** zone is currently displayed as **Cp-D** and the Level zone is **1.000V**.
  - c) Press [SETUP] to enter into the <MEAS SETUP> page, meanwhile the following soft keys will be displayed in the soft key zone: **MEAS SETUP**, **CORRECTION**, **LIMIT SETUP**, **SWEEP SETUP** and **FILE MANAGE**.
  - d) Press **SWEEP SETUP** to enter into the <SWEEP SETUP> page.
  - e) Move the cursor to the **SWEEP PARAM** zone. Then this zone will be displayed as **FREQ[Hz]**.
  - f) Use the knob to move the cursor to the parameter zone of sweep point 1, then this zone will displayed as **---**.
  - g) Press [1], **+1** will be displayed in the prompt information zone and the soft key zone will display available units: **Hz**, **kHz** and **MHz**. Press **kHz**, this zone will be changed as **1.0000k**.
  - h) Press [**→**] to move the cursor to the **LMT** zone of sweep point 1, then this zone will be displayed as **---**. The soft key zone will display: **LIMIT DATA A**, **LIMIT DATA B** and

OFF.

- i) Press **LIMIT DATA A** to select the compare primary parameter Cp function. This zone will be display **A** and the cursor will automatically move the low limit zone of sweep point 1.
  - j) Press [3][2][5], +325 will be displayed in the prompt information zone and the following available units will be displayed in the soft key zone: **p, n,  $\mu$ , m**. Press **n**, this zone will be changed as 325.000n. Then the cursor will automatically move the high limit zone of the sweep point 1.
  - k) Press [3] [3] [3], +333 will be displayed in the prompt information zone and the following units will be displayed in the soft key zone: **p, n,  $\mu$ , m**. Press **n**, this zone will be changed as 333.000n and the cursor will automatically move to the parameter zone of sweep point 2.
  - l) Press [10], +10 will be displayed in the prompt information zone and the soft key zone will display the following available units: **Hz, kHz and MHz**. Press **kHz**, this zone will be displayed as 10.0000k.
  - m) Press [ $\rightarrow$ ] to move the cursor to the LMT zone of sweep point 2, this zone will be displayed as---. the following soft key will be displayed in the soft key zone: **LIMIT DATA A, LIMIT DATA B** and **OFF**.
  - n) Press **LIMIT DATA B** to select the compare secondary parameter D function. This zone will be displayed as **B** and the cursor will be automatically moved to the low limit zone of the sweep point 2.
  - o) Press [0][.][0][0][0][1], +0.0001 will be displayed in the prompt information zone and the soft key zone will display the following available units: **p, n,  $\mu$ , m**. Press **ENTER**, this zone will be changed as 100.000 $\mu$  and the cursor will automatically move to the high limit zone of sweep point 2.
  - p) Press [0][.][0][0][0][3], +0.0003 will be displayed in the prompt information zone and the soft key zone will display the following available units: **p, n,  $\mu$ , m**. Press **ENTER**, this zone will be changed as 300.000 $\mu$  and the cursor will automatically move to the parameter zone of sweep point 3.
  - q) Based on 1-p steps, input 100kHz, B, 0.0060 and 0.0100 for the 3rd sweep point.
- 3) Alarm setup
    - a) Press **[SYSTEM]** to enter into the <System Setup> page.
    - b) Move the cursor to the **FAIL BEEP** zone to select **HIGH LONG**.
  - 4) Mount the test fixture (TH26005) to the test terminals of SM6028.
  - 5) Execute correction function (To avoid the influence of the stray impedance on the measurement accuracy, it is necessary to execute open/short correction (refer to chapter 5.1.1 Sweep Correction)).
  - 6) Insert the tested capacitor to the test fixture.
  - 7) Execute test operations.  
Press **[DISP]** and then List Sweep to enter into the <List Sweep Display> page. The instrument will test continuously and then display the test and the compare results on page. If the compare result is H (higher than the high limit) or L (lower than the low limit), there is a beep alarm.
  - 8) If the test result is obviously incorrect, please check the following items.
    - a) Check the tested inductance is in good connection with the test fixture or not.

- b) Check the test fixture is in good connection with the test terminals of the instrument or not.
- c) Redo the open/short correction.

**\*NOTE:** When the sweep open/short correction is used, the point-frequency correction function should be set as OFF. Refer to Correction operation in this chapter.

## 5.6 Setup example of comparator

SM6028 provides complete comparator function. It is convenient for component measurement and judgment, incoming and outgoing quality inspection in production line. Standard configuration of HANDLER interface makes it realize automatic sorting measurement system.

The concept and specific operation of the comparator has been described in the preceding chapter. Here are two setup examples.

### 5.6.1 Capacitor sorting

**Capacitor type:** 0805CG271

**Basic requirements:** the capacitance is divided into two bins: BIN J and BIN K. When the capacitance passes and the loss fails, it will be sorted additionally.

**Measurement parameters:** frequency of 100kHz, level of 1Vrms, SLOW, FAIL alarm and external trigger.

**Sorting parameters:** J bin -4.6% ~ +4.8%, K bin -9% ~ +10%, loss  $\text{tg}\delta < 0.15\%$ .

The parameters needed to be set in this example are listed below:

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)



**Instruction:**

1. For small capacitance, equivalent parallel mode should be selected.
2. When any bin of the capacitance passes but loss fails, it will be archived additionally. Now, auxiliary bin should be set as ON and it will be sorted into AUX BIN. If the AUX BIN is set as OFF, it will be judged as FAIL when loss fails.
3. Because the given upper and lower limit is based on the percentage tolerance of nominal value 270pF, the primary parameter should select %TOL percentage mode.

**Specific setup:**

- 1) In MEAS DISP page, select Cp-D and set the frequency, level and speed.
- 2) Press **SETUP** key to enter into the MEAS SETUP page and change the TRIGGER MODE as EXT (external trigger).
- 3) Press **SETUP**--**LIMIT** to enter into the LIMIT TABLE SETUP page and set the nominal value, primary parameter tolerance mode, upper/lower limit parameter, comparator switch and auxiliary bin switch.
- 4) Press **SYSTEM** key to enter into the SYSTEM SETUP page (System Config), find FAIL BEEP item and set it as HIGH LONG.

Return to the MEAS DISP page after setup.

## 5.7 Operation example of load correction

### 1) Operation steps

#### Test condition

Frequency: 100kHz

Cp: 11nF

D: 0.0005

- a) Press [SETUP], the following soft keys will be displayed in the soft key zone: **MEAS SETUP**, **CORRECTION**, **LIMIT SETUP**, **LIST SETUP**, **FILE MANAGE** and **TOOLS**.
- b) Press **CORRECTION** to enter into the <CORRECTION> page.
- c) Move the cursor to **OPEN**, the following soft keys will be displayed in the soft key zone: **ON**, **OFF** and **MEAS OPEN**.
- d) Press **ON** to turn on the open correction function.
- e) Move the cursor to **SHORT**, the following soft keys will be displayed in the soft key zone: **ON**, **OFF** and **MEAS SHORT**.
- f) Press **ON** to turn on the short correction function.
- g) Move the cursor to **LOAD**, the following soft keys will be displayed in the soft key zone: **ON** and **OFF**.
- h) Press **ON** to turn on the load correction function.
- i) Move the cursor to **FUNC**, this zone will display Cp-D. Meanwhile **Cp—...→**, **Cs—...→**, **Lp—...→**, **Ls—...→**, **Z—...→**, **↓** will be displayed in the soft key zone.
- j) Press **Cp-D** to select the Cp-D function.
- k) Move the cursor to **FREQ** zone, the following soft keys will be displayed in the soft key zone: **ON**, **OFF**, **MEAS OPEN**, **MEAS SHORT** and **LOAD**.
- l) Press **ON** to turn on the point-frequency correction function of the **FREQ**.
- m) Press [1][0][0], +100 will be displayed in the prompt information zone and the soft key zone

---

will display the following available units: Hz, kHz and MHz. Press kHz, the **FREQ** zone will be changed as 100.000kHz (the same with the test frequency).

- n) Move the cursor to the **REF A:** zone of the frequency 1. Press [1][1], +11 will be displayed in the prompt information zone and the following available units will be displayed in the soft key zone: p, n,  $\mu$ , m and k. Press n, this zone will be changed as 11.0000nF.
- o) Move the cursor the **REF B:** zone of the frequency 1. Press [0][.][0][0][0][5], +0.0005 will be displayed in the prompt information zone and the following available units will be displayed in the soft key zone: p, n,  $\mu$ , m and k. Press [ENTER], this zone will be changed as 0.00050.
- p) Move the cursor to **SPOT No.** to select the calibration point.
- q) Move the cursor to **FREQ**. The following soft keys will be displayed: ON, OFF, MEAS OPEN, MEAS SHORT and LOAD.
- r) Hold the test fixture be in open status and keep user's hands or other interference source be far away from the test fixture. Press the soft key MEAS OPEN to execute open correction.
- s) Insert the short plate (SMA26010) into the test fixture. Please ensure that the short plate and the reeds of the test fixture have good contact.
- t) Press the soft key MEAS SHORT to execute short correction.
- u) Insert a standard capacitance into the test fixture. Please ensure that the pins of the standard capacitance have good connection with the reeds of the test fixture.
- v) Press the soft key LOAD to execute load correction.

## 2) Note

- a) Because of the different software editions, the soft keys and status information may be different from this book, but it may not affect users' understanding.
- b) The load correction is only valid for the components with the same specification. If the specification is changed, it is required to redo load correction.

# Chapter 6 Performance and Test

## 6.1 Test function

### 6.1.1 Parameter and symbol

C: capacitance                      L: Inductance  
 R: resistance                      Z: impedance                      Y: Admittance  
 X: reactance                      B: susceptance                      G: Conductance  
 D: dissipation                       $\theta$ : phase angle                      Q: Quality factor  
 DCR: DC resistance

#### Test combination

Parameters described above are combined in the following modes:

Primary parameter	Z, Y	L, C	R	G
Secondary parameter	$\theta$ (deg phase), $\theta$ (rad radian)	D, Q, R <sub>s</sub> , R <sub>p</sub> , G, R <sub>dc</sub>	X	B

There is no combination for DCR.

#### Mathematical operation

Operation between the measurement value and the programmable nominal value: absolute deviation  $\Delta$ ABS and percent deviation  $\Delta$ %.

### 6.1.2 Equivalent mode

Series and parallel

### 6.1.3 Range

Auto, Manual (Hold, increase and decrease)

### 6.1.4 Trigger

Internal, external and manual

Internal: Test DUT constantly and display the result

Manual: Press TRIGGER to test once then the result will be displayed.

External: After HANDLER receiving “start” signal, perform a measurement and output test result.

### 6.1.5 Delay time

Delay time: time from trigger to start. 0 to 60s are programmable with a resolution of 1ms.

### **6.1.6 Connection modes of test terminals**

SM6028 adopts 4-terminal test method.

HD(Hcur): current sample high terminal

LD(Lcur): Current sample low terminal

HS(Hpot): voltage sample high terminal

LS(Lpot): Voltage sample low terminal

### **6.1.7 Test speed (Frequency $\geq$ 10kHz)**

Fast: about 130 times/s (7.7ms/time)

Medium: about 11 times/s (92ms/time)

Slow: about 4 times/s (230ms/time)

The fast and middle speed will be slow down when frequency  $<10\text{kHz}$ .

### **6.1.8 Average**

Be programmable from 1 to 255.

### **6.1.9 Display digit**

6 digits, max. displayed digit: 999999

## **6.2 Test signal**

### **6.2.1 Test signal frequency**

Test signal is sine wave, accuracy: 0.01%

Frequency range:

20Hz $\sim$ 1MHz (SM6028A)

20Hz $\sim$ 2MHz (SM6028/6028H)

Min. resolution: 0.01Hz

### **6.2.2 Signal mode**

Normal: When testing, on measurement display page, voltage across test terminals may be smaller than preset voltage.

Constant level: The auto adjustment of internal level makes the voltage of DUT accordant with preset voltage.

### 6.2.3 Test signal level

	Mode	Range	Accuracy	Resolution
Voltage	Normal constant level	$5\text{mV}_{\text{RMS}}—2\text{V}_{\text{RMS}}$	$\pm (10\% \times \text{preset value} + 2\text{mV})$	100 $\mu\text{V}$
		$10\text{mV}_{\text{RMS}}—1\text{V}_{\text{RMS}}$	$\pm (6\% \times \text{preset value} + 2\text{mV})$	
Current	Normal constant current	$50\mu\text{A}_{\text{RMS}}—20\text{mA}_{\text{RMS}}$	$\pm (10\% \times \text{preset value} + 10\mu\text{A}_{\text{RMS}})$	1 $\mu\text{A}$
		$100\mu\text{A}_{\text{RMS}}—10\text{mA}_{\text{RMS}}$	$\pm (6\% \times \text{preset value} + 10\mu\text{A}_{\text{RMS}})$	

### 6.2.4 Output impedance

100 $\Omega \pm 2\%$

### 6.2.5 Monitor for test signal level

Mode	Range	Frequency	Accuracy
Voltage	$5\text{mV}_{\text{RMS}}—2\text{V}_{\text{RMS}}$	$\leq 1\text{MHz}$	$\pm (3\% \times \text{reading} + 0.5\text{V}_{\text{rms}})$
		$> 1\text{MHz}$	$\pm (6\% \times \text{reading} + 0.1\text{mV})$
Voltage	$50\mu\text{A}_{\text{RMS}}—20\text{mA}_{\text{RMS}}$	$\leq 1\text{MHz}$	$\pm (3\% \times \text{reading} + 5\mu\text{A})$
		$> 1\text{MHz}$	$\pm (6\% \times \text{reading} + 1\mu\text{A})$

### 6.2.6 Maximum measurement display range

Parameter	Measurement display range
L, Lk	0.00001 $\mu\text{H}$ ~ 99.9999kH
C	0.00001pF ~ 9.99999F
Z, R, X, DCR	0.00001 $\Omega$ ~ 99.9999M $\Omega$
Y, B, G	0.00001 $\mu\text{S}$ ~ 99.9999S
D	0.00001 — 9.99999
Q	0.00001 — 99999.9
$\theta$	Deg -179.999 $^{\circ}$ ~ 179.999 $^{\circ}$
	Rad -3.14159 ~ 3.14159

### 6.2.7 DC bias voltage source

0V— $\pm 40\text{V}$  Minimum resolution: 0.5mV, Accuracy: 1% x preset voltage+5mV  
 0mA— $\pm 100\text{mA}$  Minimum resolution: 5 $\mu\text{A}$ , Accuracy: 5% x preset voltage+50 $\mu\text{A}$

## 6.3 Measurement accuracy

Test accuracy includes stability、 temperature coefficient、 linear degree、 test repeatability and calibration inter-error.

Check the accuracy of instrument should be under the following circumstances:

- a. warm-up time:  $\geq 30$  min
- b. cable: 0m, 1m, 2m, 4m
- c. correct open and short correction after warming up
- d. DC bias is in the position of “OFF”
- e. The range works in “AUTO” to select correct test range

### 6.3.1 $|Z|$ , $|Y|$ , L, C, R, X, G, B accuracies

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

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

$K_a$ : impedance rate factor (table A)

$K_{aa}$ : cable length factor (table B)

$K_b$ : impedance rate factor (table A)

$K_{bb}$ : cable length factor (table C)

$K_c$ : calibrated interpolating factor (table D)

$K_d$ : cable length factor (table F)

$K_e$ : temperature factor (table G)

Using condition of L, C, X, B accuracy  $A_e$ :  $D_x$  (test value of D)  $\leq 0.1$

Using condition of R, G accuracy  $A_e$ :  $Q_x$  (test value of Q)  $\leq 0.1$

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

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

Accuracy of G can only be used when in G-B measurement combination.

### 6.3.2 D accuracy

The accuracy of D is given by the formula below:

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

The formula is only available when  $D_x \leq 0.1$ .

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

### 6.3.3 Q accuracy

The accuracy of Q is given by the formula below:

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

Where,  $Q_x$  is the value of the tested  $Q$ .

$D_e$  is the accuracy of  $D$

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

### 6.3.4 $\theta$ accuracy

The accuracy of  $\theta$  is given by the formula below:

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

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

### 6.3.5 $G$ accuracy

When  $D_x$  (tested value of  $D$ )  $\leq 0.1$

The accuracy of  $G$  is given by the formula below:

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

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

Where,  $B_x$  is the value of tested  $B$  with the unit [S].

$C_x$  is the value of tested  $C$  with the unit [F].

$L_x$  is the value of tested  $L$  with the unit [H].

$D_e$  is the accuracy of  $D$ .

$f$  is test frequency.

The above  $G$  accuracy is only used in the Cp-G and Lp-G measurement combinations.

### 6.3.6 $R_p$ accuracy

when  $D_x$  (value of tested  $D$ )  $\leq 0.1$

The accuracy of  $R_p$  is given by the formula below:

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

Where,  $R_{px}$  is the value of tested  $R_p$  with the unit [S].

$D_x$  is the value of test  $D$  with the unit [F].

$D_e$  is the accuracy of  $D$ .

### 6.3.7 Rs accuracy

when  $D_x$  (value of tested D)  $\leq 0.1$

The accuracy of  $R_s$  is given by the formula below:

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

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

Where,  $X_x$  is the value of test X with the unit [S].

$C_x$  is the value of test C with the unit [F].

$L_x$  is the value of test L with the unit [H].

$D_e$  is the accuracy of D.

F is test frequency.



6.3.8 Accuracy factor

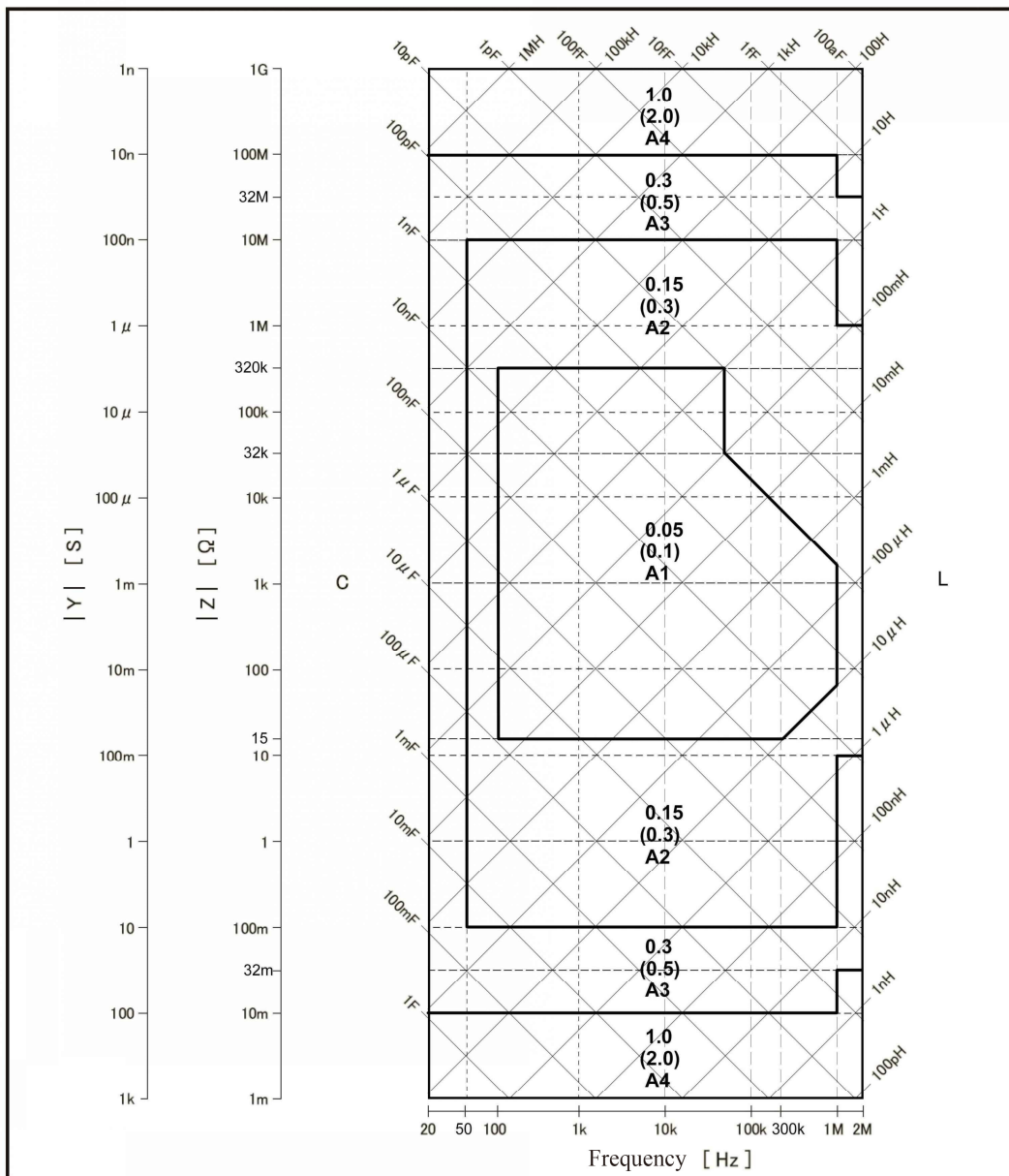


Figure 6-3 Basic accuracy A (one of two)

In figure 6-3, select a smaller value on boundary line.

In this figure, the basic accuracy value A can be obtained by the following methods:

0.05---When  $0.3V_{rms} \leq V_s \leq 1V_{rms}$ , the test speed is the value A of medium, slow.

0.1---When  $0.3V_{rms} \leq V_s \leq 1V_{rms}$ , the test speed is the value A of fast.

A1----When  $V_s < 0.3V_{rms}$  or  $V_s > 1V_{rms}$ , use the corresponding value A1, A2, A3 and A4 in figure 6-4.

Here,  $V_s$  is the test signal voltage.

The following table lists the value A for different test voltages at fast, medium and slow speeds.

Use Figure 6-4 to find the value of Alt when Alt is not specified.

**Test Signal Voltage**

	5m	15m	0.1	0.15	1.5	2	5	20[Vrms]	
Medium /Slow	A1=Alt A2=Alt* A3=Alt A4=Alt	A1=Alt A2=Alt* A3=0.3 A4=Alt	A1=Alt A2=0.15* A3=0.3 A4=Alt	A1=Alt A2=0.15 A3=0.3 A4=1.0	A1=Alt A2=0.15 A3=0.3 A4=Alt	A1=Alt A2=Alt A3=0.3 A4=Alt	A1=Alt A2=Alt** A3=0.3 A4=Alt		
Fast	A1=Alt A2=Alt A3=Alt A4=Alt	A1=Alt A2=Alt A3=0.5 A4=Alt	A1=Alt A2=0.3 A3=0.5 A4=Alt		A1=Alt A2=0.3 A3=0.5 A4=2.0		A1=Alt A2=Alt A3=0.5 A4=Alt	A1=Alt A2=Alt** A3=Alt A4=Alt	
	5m	33m	0.1	0.15		2	5	20[Vrms]	

Note \*: When  $100\text{Hz} \leq f_m < 300\text{Hz}$ , the value of A is equal to the value in the above table multiplied by 2.

When  $f_m < 100\text{Hz}$ , the value of A is equal to the value in the above table multiplied by 2.5.

\*\* : A value is added to 0.15 when all the following measurement conditions are met.

Test frequency:  $100\text{Hz} < f_m \leq 2\text{MHz}$

Test signal voltage:  $5\text{Vrms} < V_s \leq 20\text{Vrms}$

DUT: Inductor,  $|Z_m| < 200\Omega$  ( $|Z_m|$  : DUT Impedance)

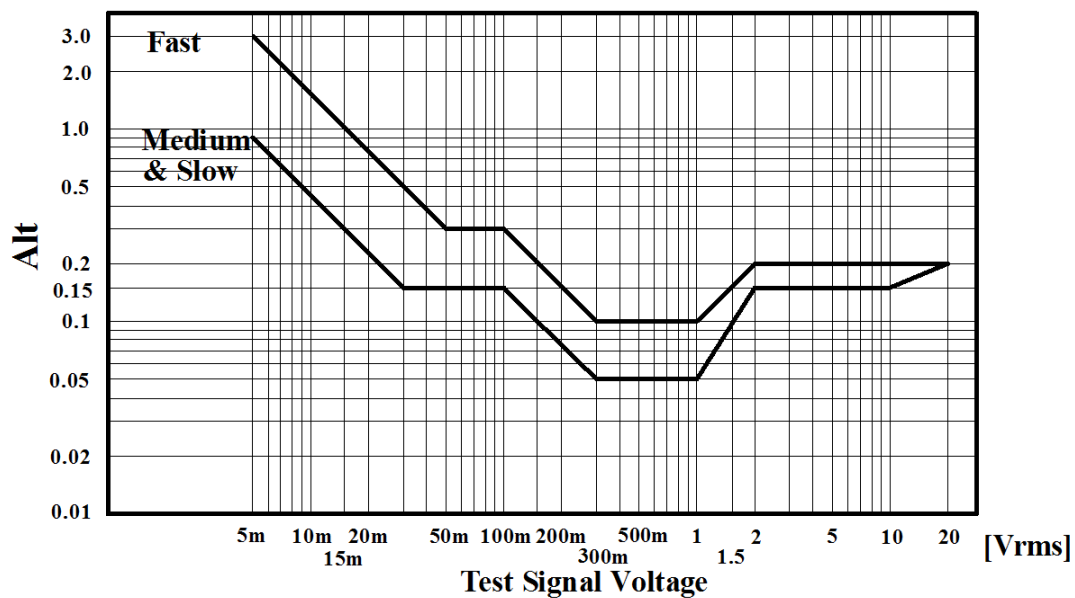


Figure 6-4 Basic accuracy of A (two of two)

$K_a$  and  $K_b$  are respectively low impedance and high impedance increase factors. When the impedance is greater than  $500\Omega$ ,  $K_a$  can be ignored; when the impedance is less than  $500\Omega$ ,  $K_b$  can be ignored.

Table A Impedance rate factors:  $K_a$ ,  $K_b$

Speed	Frequency	$K_a$	$K_b$
Medium Slow	$f_m < 100\text{Hz}$	$(\frac{1 \times 10^{-3}}{ Z_m })(1 + \frac{200}{V_s})(1 + \sqrt{\frac{100}{f_m}})$	$ Z_m (1 \times 10^{-9})(1 + \frac{70}{V_s})(1 + \sqrt{\frac{100}{f_m}})$
	$100\text{Hz} \leq f_m \leq 100\text{kHz}$	$(\frac{1 \times 10^{-3}}{ Z_m })(1 + \frac{200}{V_s})$	$ Z_m (1 \times 10^{-9})(1 + \frac{70}{V_s})$
	$100\text{kHz} < f_m \leq 300\text{kHz}$	$(\frac{1 \times 10^{-3}}{ Z_m })(2 + \frac{200}{V_s})$	$ Z_m (3 \times 10^{-9})(1 + \frac{70}{V_s})$
	$300\text{kHz} < f_m \leq 2\text{MHz}$	$(\frac{1 \times 10^{-3}}{ Z_m })(3 + \frac{200}{V_s} + \frac{V_s^2}{10^8})$	$ Z_m (10 \times 10^{-9})(1 + \frac{70}{V_s})$
Fast	$f_m < 100\text{Hz}$	$(\frac{2.5 \times 10^{-3}}{ Z_m })(1 + \frac{400}{V_s})(1 + \sqrt{\frac{100}{f_m}})$	$ Z_m (2 \times 10^{-9})(1 + \frac{100}{V_s})(1 + \sqrt{\frac{100}{f_m}})$
	$100\text{Hz} \leq f_m \leq 100\text{kHz}$	$(\frac{2.5 \times 10^{-3}}{ Z_m })(1 + \frac{400}{V_s})$	$ Z_m (2 \times 10^{-9})(1 + \frac{100}{V_s})$
	$100\text{kHz} < f_m \leq 300\text{kHz}$	$(\frac{2.5 \times 10^{-3}}{ Z_m })(2 + \frac{400}{V_s})$	$ Z_m (6 \times 10^{-9})(1 + \frac{100}{V_s})$
	$300\text{kHz} < f_m \leq 2\text{MHz}$	$(\frac{2.5 \times 10^{-3}}{ Z_m })(3 + \frac{400}{V_s} + \frac{V_s^2}{10^8})$	$ Z_m (20 \times 10^{-9})(1 + \frac{100}{V_s})$
$f_m$ : test frequency [Hz] $ Z_m $ : impedance of DUT [ $\Omega$ ] $V_s$ : test signal voltage [mV <sub>rms</sub> ]			

When the impedance is larger than 500 $\Omega$ ,  $K_{aa}$  can be ignored.

Table B Cable length factor  $K_{aa}$

Test signal voltage	Cable length			
	0m	1m	2m	4m
$\leq 2V_{rms}$	0	0	$\frac{Ka}{2}$	$Ka$
$> 2V_{rms}$	0	$\frac{2 \times 10^{-3} \times f_m^2}{ Z_m }$	$\frac{(1 + 5 \times f_m^2) \times 10^{-3}}{ Z_m }$	$\frac{(2 + 10 \times f_m^2) \times 10^{-3}}{ Z_m }$
$f_m$ : test frequency [Hz] $ Z_m $ : impedance of DUT [ $\Omega$ ] $K_a$ : Impedance rate factor				

Table C Cable length factor  $K_{bb}$

Test signal voltage	Cable length			
	0m	1m	2m	4m
$f_m \leq 100\text{kHz}$	1	$1+5 \times f_m$	$1+10 \times f_m$	$1+20 \times f_m$
$100\text{kHz} < f_m \leq 300\text{kHz}$	1	$1+2 \times f_m$	$1+4 \times f_m$	$1+8 \times f_m$
$300\text{kHz} < f_m \leq 2\text{MHz}$	1	$1+0.5 \times f_m$	$1+1 \times f_m$	$1+2 \times f_m$
$f_m$ : test frequency [MHz]				

Table D Calibrated interpolating factor  $K_c$

Test frequency	$K_c$
Direct calibrated frequency (listed in Table E)	0
Other frequency	0.0003

Table E Direct Calibrated frequency

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

There are 51 frequencies in Table E. The highest frequency of SM6028A is 1MHz (total 48 frequencies), the highest frequency of SM6028/6028H is 2MHz(total 51 frequencies).

Table F Cable length factor  $K_d$

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

Table G Temperature factor  $K_e$

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

### 6.3.9 DCR accuracy

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

When the instrument is in Middle and slow speed,  $A=0.25$

In Fast speed,  $A=0.5$

Where,  $R_x$  is the tested resistance.

### 6.3.10 Test time

Test time (ms) (DC BIAS is OFF)

	Test speed	Test frequency						
		20Hz	100Hz	1kHz	10kHz	100kHz	1MHz	2MHz
1	Fast	380	100	20	7.7	5.7	5.6	5.6
2	Medium	380	180	110	92	89	88	88
3	Slow	480	300	240	230	220	220	220

## 6.4 Safety requirement

The instrument is the I class safety instrument.

### 6.4.1 Insulation resistance

Under reference working condition, the insulation resistance between power terminal and instrument jacket should not be smaller than  $50M\Omega$ .

Under humidity condition, the insulation resistance between voltage terminal and instrument jacket should not be smaller than  $2M\Omega$ .

### 6.4.2 Insulation intensity

Under reference working condition, the insulation between the power terminal and the instrument jacket should bear an AC voltage (50Hz frequency and 1.5kV rated voltage) for 1 minute and there is no breakdown and flashover.

### 6.4.3 Leakage current

The leakage current should not be larger than 3.5mA (AC effective value).

## 6.5 Electromagnetic compatibility

- Transient sensitivity, based on the requirement of GB6833.4.

- Conductive sensibility, based on the requirement of GB6833.6.
- Radiated interference, based on the requirement of GB6833.10.

## 6.6 Performance test

### 6.6.1 Working condition

All tests should be performed under the working condition listed in Chapter 1. In this part, only the main indexes are listed. Users can make test under the specified condition mentioned in this manual. Performance test can be worked in the warm up conditions discussed in Chapter 1.

### 6.6.2 The used instruments and devices

No.	Instrument and Device	Specification	
1	Standard capacitor	100pF	0.02 % D is known
		1000pF	
		10000pF	
		10nF	
		0.1uF	
		1uF	
2	AC standard resistor	10Ω	0.02 %
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
3	DC standard resistor	0.1Ω	0.02 %
		1Ω	
		10Ω	
		100Ω	
		1kΩ	
		10kΩ	
		100kΩ	
4	Standard inductor	100μH	0.02 %
		1mH	
		10mH	
		100mH	
5	Frequency counter	(0~1000) MHz	
6	Digital Multimeter	0.5 %	
7	Insulation resistance meter	500V 10 levels	
8	Hipot Tester	0.25kW (0~500) V	

### 6.6.3 Function check

Ensure function keys, display and terminal etc. can work normally.

### 6.6.4 Test signal level

Adjust multimeter in AC voltage range, where one test cable is connected to  $H_{CUR}$  and the other is connected to ground terminal. Change level as: 10mV, 20mV, 100mV, 200mV, 1V, 2V, the reading should meet the demand of test signal level in this chapter.

### 6.6.5 Frequency

Connect frequency meter to ground terminal. The test terminal of the frequency meter is connected with  $H_{CUR}$ . Change the frequency as: 20Hz, 100Hz, 1kHz, 10kHz, 100kHz, 200kHz, 300kHz, 1MHz and 2MHz. The reading of frequency meter should meet the demand of the test signal frequency in this chapter.

### 6.6.6 Measurement accuracy

Basic parameters are R, L, C and D, so measurement accuracy is mainly about R, L, C and D.

### 6.6.7 Accuracy of C and D

Function	$C_p$ -D				
Test frequency	100Hz	1kHz	10kHz	100kHz	Test respectively
Level	1V				
Range	AUTO				
Bias	0V				
Speed	Slow				

Open and short correction should be made before testing. Connect standard capacitors: 100pF, 1000pF, 10nF, 0.1uF, 1uF and change the frequency. The error capacitance C between reading and nominal value should be in the range ruled in this chapter, dissipation D should be in the range ruled in this chapter.

### 6.6.8 Accuracy of L

Test condition:

Function	$L_s$ -Q		
Test frequency	100Hz	1kHz	Test respectively
Level	1V		
Range	AUTO		
Bias	0V		

Speed Slow

Open and short correction should be made before testing. Connect standard inductors: 100 $\mu$ H, 1mH, 10mH, 100mH and change the frequency. The error between reading and nominal value should be in the range ruled in this chapter.

### 6.6.9 Accuracy of Z

Test condition:

Function	Z- $\theta$				
Test frequency	100Hz	1kHz	10kHz	100kHz	Test respectively
Level	1V				
Range	AUTO				
Bias	0V				
Speed	Slow				

Open and short correction should be made before testing. Connect standard AC resistors: 10 $\Omega$ , 100 $\Omega$ , 1k $\Omega$ , 10k $\Omega$ , 100k $\Omega$  and change the frequency. The error between reading and nominal value should be in the range ruled in this chapter.

### 6.6.10 Accuracy of DCR

Test condition

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

Short correction should be made before testing. Connect standard DC resistors: 0.1 $\Omega$ , 1 $\Omega$ , 10 $\Omega$ , 100 $\Omega$ , 1k $\Omega$ , 10k $\Omega$ , 100k $\Omega$ . The error between reading and nominal value should be in the range ruled in this chapter.



# Chapter 7 Command Reference

The signs in this manual are as follows:

NR1: integer, e.g.:123

NR2: fix-point number, e.g.: 12.3

NR3: floating-point number, e.g.: 12.3E+5

NL: carriage return character, integer 10

^END: EOI signal in IEEE-488

## 7.1 Subsystem commands for SM6028

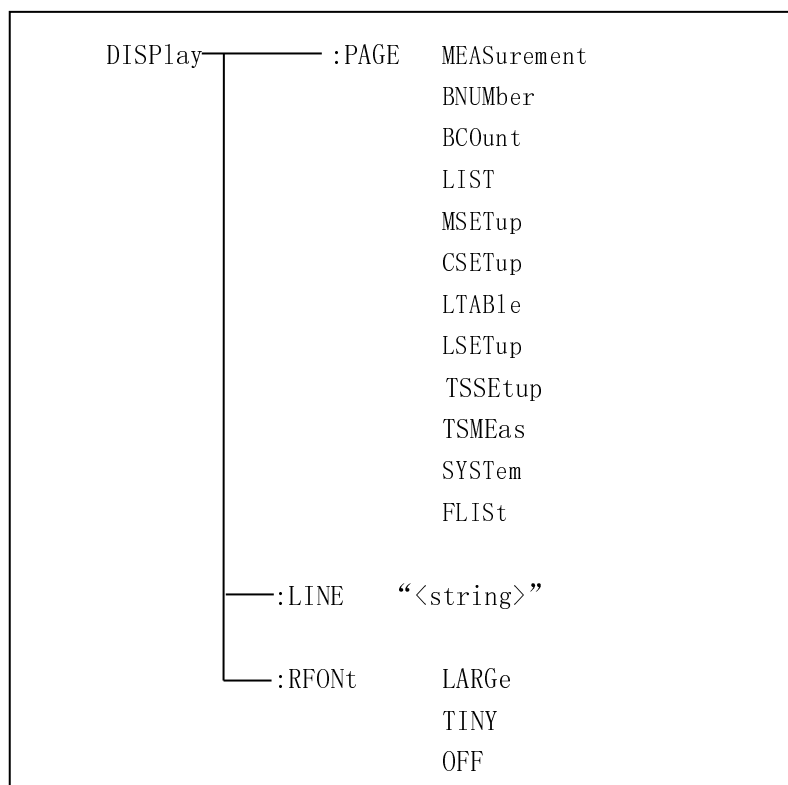
- DISPlay
- ORESister
- TRIGger
- CORRection
- FREQuency
- BIAS
- INITiate
- COMParator
- VOLTage
- FUNCTion
- FETCh?
- Mass MEMory
- CURRent
- LIST
- ABORT

### 7.1.1 DISPlay subsystem commands

DISPlay subsystem commands are mainly used to set the display page for the instrument.

The :DISPlay? Query returns the current page.

Command tree:



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 set as the following items:

MEASurement	Set the display page as the LCR measurement display.
BNUMBER	Set the display page as the bin number display.
BCOunt	Set the display page as the bin count display.
LIST	Set the display page as the list sweep display.
MSETup	Set the display page as the measurement display.
CSETup	Set the display page as the correction setup.
LTABle	Set the display page as the limit table setup.
LSETup	Set the display page as the list sweep setup.
TSSEtup	Set the display page as the trace sweep setup.
TSMEas	Set the display page as the trace sweep display.
SYSTem	Set the display page as the system setup page.
FLISt	Set the display page as the file list page.

For example: WrtCmd("DISP:PAGE MEAS"), Set the display page as the LCR measurement display page.

Query syntax: DISPlay:PAGE?

Return format: <page name><NL^END>

<page name> can be set as the following items:

<LCR MEAS DISP>	The current page is the LCR measurement display page.
<BIN No. DISP>	The current page is the bin number display page.
<BIN COUNT DISP>	The current page is the bin count display page.
<LIST SWEEP DISP>	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.
<TRACE SWEEP SETUP>	The current page is the trace sweep setup page.
<TRACE SWEEP>	The current page is the trace sweep display 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 item which can be a substring with up to 16 characters. The :LINE? query returns the current measurement item. The character string of the measurement item can be used as the file name when saving a file.

Command syntax: DISPlay:LINE"<string>"

Where,

<string> can be an ASCII character string (maximum number is 16).

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

Query syntax: DISPlay:LINE?

Return format: <string><NL^END>

The :ResultFONt command is used to set the current font of the measurement result. The :ResultFONt? Query returns the current font of the measurement result.

Command syntax: DISPlay:RFONt <font>

<font> can be the following information:

LARGE: Use large character to display the measurement result, 12ms/meas.

TINY: Use tiny character to display the measurement result, 5ms/meas.

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

Query syntax: DISPlay:FRONt?

Return format: <font><NL^END>

<font> can be the following information:

LARGE

TINY

OFF

### 7.1.2 FREQUency subsystem commands

The FREQUency subsystem commands are mainly used to set the measurement frequency of the instrument. The :FREQUency query returns the current measurement frequency.

Command syntax:

$$\text{FREQuency} \left\{ \begin{array}{l} \langle \text{value} \rangle \\ \text{MIN} \\ \text{MAX} \end{array} \right.$$

Where,

$\langle \text{value} \rangle$  NR1, NR2 or NR3 data format followed by Hz, kHz, MHz.

MIN Set the measurement frequency as 20Hz.

MAX Set the measurement frequency as 2MHz (The maximum frequency of SM6028/6028H is 2MHz, the maximum frequency of SM6028A is 1MHz)

For example: WrtCmd("FREQ 1KHZ") Set the frequency as 1000Hz.

Query syntax: FREQuency?

Return format:  $\langle \text{NR3} \rangle \langle \text{NL}^{\wedge} \text{END} \rangle$

### 7.1.3 VOLTage subsystem commands

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

Command syntax:

$$\text{VOLTage} \left\{ \begin{array}{l} \langle \text{value} \rangle \\ \text{MIN} \\ \text{MAX} \end{array} \right.$$

Where,

$\langle \text{value} \rangle$  NR1, NR2 or NR3 data format followed by V.

MIN Set the measurement voltage as 5mV.

MAX Set the measurement voltage as 2V (SM6028H is 20V).

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

Query syntax: VOLTage?

Return format:  $\langle \text{NR3} \rangle \langle \text{NL}^{\wedge} \text{END} \rangle$

### 7.1.4 CURRent subsystem commands

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

Command syntax:

$$\text{CURRent} \left\{ \begin{array}{l} \langle \text{value} \rangle \\ \text{MIN} \\ \text{MAX} \end{array} \right.$$

Where,

$\langle \text{value} \rangle$  NR1, NR2 or NR3 data format followed by mA.

MIN Set the measurement current as 50 $\mu$ A.

MAX Set the measurement current as 20mA (SM6028H is 100mA).

For example: WrtCmd (“CURR 10MA”) Set the measurement current as 10mA.

Query syntax: CURRent?

Return format: <NR3><NL^END>

### 7.1.5 AMPLitude subsystem commands

The :AMPLitude subsystem commands are mainly used to set the auto level control (ALC) function as ON or OFF. The :AMPLitude:ALC? query returns the current status of the ALC function.

Command syntax:

AMPLitude:ALC  $\left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“AMPL:ALC 0”) Set the ALC function as OFF.

Query syntax: AMPLitude:ALC?

Return format: <NR1><NL^END>

### 7.1.6 OUTPut subsystem commands

The OUTPut subsystem commands are mainly used to set the instrument DC isolation function switch.

The OUTPut:DC:ISOLation command is used to set the DC isolation function of the 500mA/5V DC bias source as ON or OFF. The OUTPut:DC:ISOLation? query returns the current status of the DC isolation function.

Command syntax:

OUTPut:DC:ISOLation  $\left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

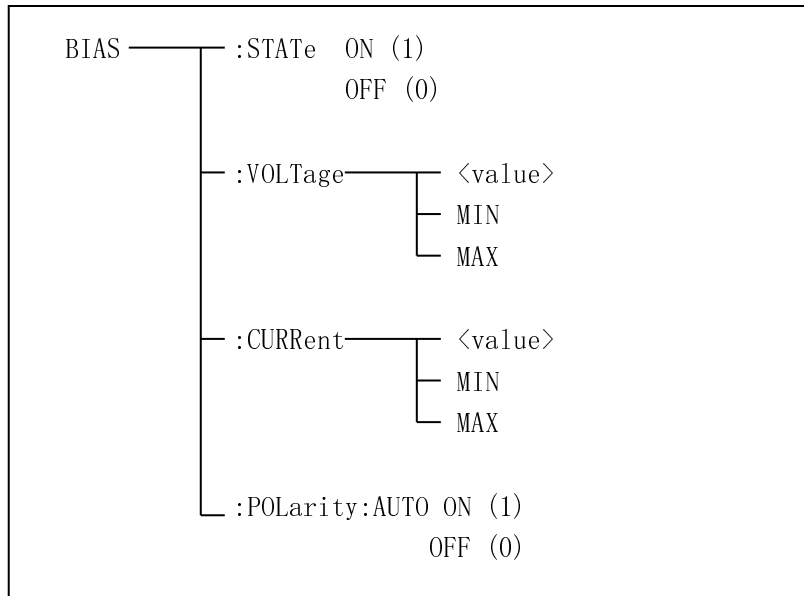
Query syntax: OUTPut:DC:ISOLation?

Return format: <NR1><NL^END>

### 7.1.7 BIAS subsystem commands

The :BIAS subsystem commands are mainly used to set the internal bias voltage and the bias status.

Command tree:



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

Command syntax:

$$\text{BIAS:STATe} \left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right.$$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“BIAS:STATe 0”)      Set the DC bias function as OFF.

Query syntax: BIAS:STATe?

Return format: <NR1><NL^END>

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

Command syntax:

$$\text{BIAS:VOLTage} \left\{ \begin{array}{l} \text{<value>} \\ \text{MIN} \\ \text{MAX} \end{array} \right.$$

Where,

<value>      NR1, NR2 or NR3 data format.

MIN            Set the bias voltage as -10V.

MAX            Set the bias voltage as 10V (SM6028H is 40V).  
 For example: WrtCmd (“BIAS:VOLT MIN”)    Set the DC bias voltage as 0V.

Query syntax: BIAS:VOLTage?  
 Return format: <NR1><NL^END>

The BIAS:CURREnt command is used to set the external bias current. The BIAS:CURREnt? query returns the bias current.

Command syntax:

BIAS:CURREnt { <value>  
                   MIN  
                   MAX

Where,

<value>      NR1, NR2 or NR3 data format

MIN            Set the bias current as -100mA.

MAX            Set the bias current as 100mA.

For example: WrtCmd (“BIAS:CURR MIN”)    Set the DC bias current as 0A.

Query syntax: BIAS:CURREnt?  
 Return format: <NR3><NL^END>

The BIAS:POLarity command is used to set the signal polarity of bias current.

Command syntax:

BIAS:POLarity:AUTO { ON  
                           OFF  
                           1  
                           0

Where,

Character 1 (49) is equal to ON (correspond to AUTO).

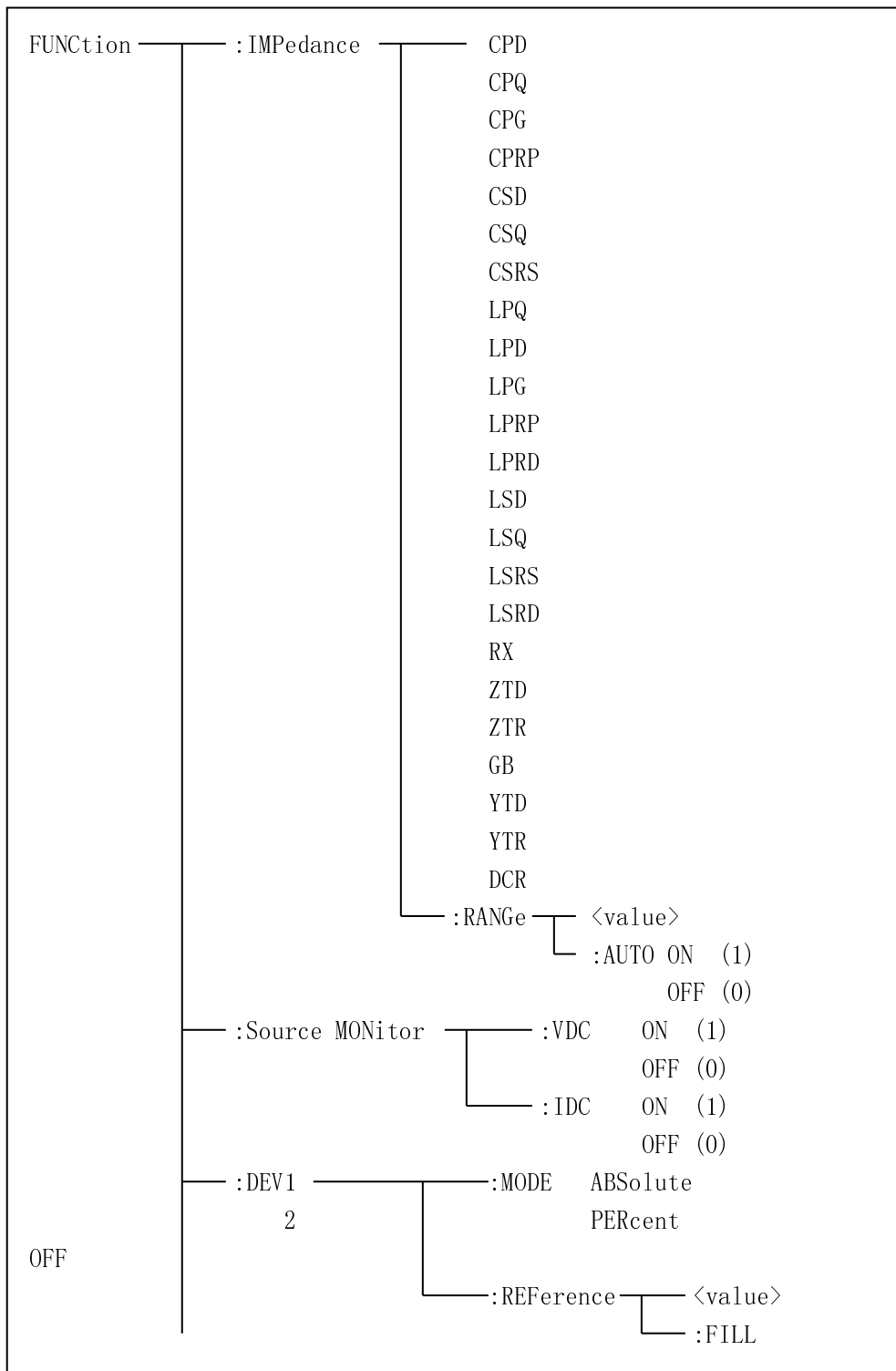
Character 0 (48) is equal to OFF (correspond to FIX).

For example: WrtCmd (“BIAS:POL:AUTO 1”)    Set the DC bias polarity as AUTO.

### 7.1.8    FUNCtion subsystem commands

The FUNCtion subsystem commands are mainly used to set measurement functions, range, current/voltage monitor ON/OFF, deviation display mode, nominal setting.

Command tree:



— :StepDELay <value>  
 MIN  
 MAX

— :DCResistance <value>  
 : AUTO ON (1)  
 OFF (0)



The FUNCtion:IMPedance command is used to set instrument functions. The FUNCtion:IMPedance? query returns the current function parameters.

Command syntax: FUNCtion:IMPedance <function>

<function> can be one of the following items.

CPD	Set the function as Cp-D	LPRP	Set the function as Lp-Rp
CPQ	Set the function as Cp-Q	LSD	Set the function as Ls-D
CPG	Set the function as Cp-G	LSQ	Set the function as Ls-Q
CPRP	Set the function as Cp-Rp	LSRS	Set the function as Ls-Rs
CSD	Set the function as Cs-D	RX	Set the function as R-X
CSQ	Set the function as Cs-Q	ZTD	Set the function as Z- $\theta^\circ$
CSRS	Set the function as Cs-Rs	ZTR	Set the function as Z- $\theta_r$
LPQ	Set the function as Lp-Q	GB	Set the function as G-B
LPD	Set the function as Lp-D	YTD	Set the function as Y- $\theta^\circ$
LPG	Set the function as Lp-G	YTR	Set the function as Y- $\theta_r$
LPRD	Set the function as Lp-Rd	RPQ	Set the function as Rp-Q
LSRD	Set the function as Lp-Rd	RSQ	Set the function as Rs-Q
DCR	Set the function as DXR		

For example: WrtCmd (“FUNC:IMP RX”) Set the function as R-X.

Query syntax: FUNCtion:IMPedance?

Return format: <function><NL^END>

The FUNCtion:IMPedance:RANGe command is used to set the range. The FUNCtion:IMPedance:RANGe? query returns the current range.

Command syntax: FUNCtion:IMPedance:RANGe <value>

Where, <value> can be the impedance of the DUT or NR1, NR2 or NR3 data format followed by OHM or KOHM.

For example: WrtCmd (“FUNC:IMP:RANG 1KOHM”) Set the range as 1kOHM.

Query syntax: FUNCtion:IMPedance:RANGe?

Return format: <value><NL^END>

Where, <value> can be

0.1	1	10	20	50	100
200	500	1000	2000	5000	
10000	20000	50000	100000		

Note: SM6028H has a total of 15 ranges when the test voltage is higher than 2V. SM6028 and SM6028A have the other 14 ranges that do not include 0.1. Different frequency will have different range selection.

The FUNCtion:IMPedance:RANGe:AUTO command is used to set the automatic range selection status. The FUNCtion:IMPedance:RANGe:AUTO? query returns the current range status.

Command syntax:

FUNCtion:IMPedance:RANGe:AUTO  $\left\{ \begin{array}{l} \text{ON (1)} \\ \text{OFF (0)} \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“FUNC:IMP:RANG:AUTO ON”) Set the automatic range as ON.

Query syntax: FUNCtion:IMPedance:RANGe:AUTO?

Return format: <NR1><NL^END>

The FUNCtion:DCResistance:RANGe command is used to set the range of the instrument. The FUNCtion: DCResistance:RANGe? query returns the current range parameter.

Command syntax: FUNCtion:DCResistance:RANGe <value>

Where, <value> can be the impedance of the DUT or NR1, NR2 or NR3 data format followed by OHM or KOHM.

For example: WrtCmd (“FUNC:DCR:RANG 1KOHM”) Set the DCR range as 1kOHM.

Query syntax: FUNCtion:DCR:RANGe?

Return format: <value><NL^END>

Where, <value> can be

10	20	50	100		
200	500	1000	2000	5000	
10000	20000	50000	100000		

The FUNCtion:DCResistance:RANGe:AUTO command is used to set the automatic range selection status. The FUNCtion: DCResistance:RANGe:AUTO? query returns the current range status.

Command syntax:

FUNCtion:DCResistance:RANGe:AUTO  $\left\{ \begin{array}{l} \text{ON (1)} \\ \text{OFF (0)} \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“FUNC:DCR:RANG:AUTO ON”) Set the automatic DCR range as ON.

Query syntax: FUNCtion:DCRe:RANGe:AUTO?

Return format: <NR1><NL^END>

The FUNCTION:Source MONitor:VAC command is used to set the voltage monitor ON or OFF. The FUNCTION:Source MONitor:VAC? query returns the current voltage monitor status.

FUNCTION:SMONitor:VAC  $\left\{ \begin{array}{l} \text{ON (1)} \\ \text{OFF (0)} \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“FUNC:SMON:VAC ON”) Set the voltage monitor as ON.

Query syntax: FUNCTION:SMONitor:VAC?

Return format: <NR1><NL^END>

The FUNCTION:SMONitor:IAC command is used to set the current monitor as ON or OFF. The FUNCTION:SMONitor:IAC? query returns the current monitor status.

Command syntax:

FUNCTION:SMONitor:IAC  $\left\{ \begin{array}{l} \text{ON (1)} \\ \text{OFF (0)} \end{array} \right.$

Where,

Character 1 (49) is equal to ON.

Character 0 (48) is equal to OFF.

For example: WrtCmd (“FUNC:SMON:IAC ON”) Set the current monitor as ON.

Query syntax: FUNCTION:SMONitor:IAC?

Return format: <NR1><NL^END>

The FUNCTION:DEV<n>:MODE command is used to set the deviation measurement mode. The FUNCTION:DEV<n>:MODE? query returns the current deviation measurement mode.

Command syntax:

FUNCTION:DEV<n>:MODE  $\left\{ \begin{array}{l} \text{ABSolute} \\ \text{PERCent} \\ \text{OFF} \end{array} \right.$

Where,

ABSolute Absolute value deviation display

PERCent Percent deviation display

OFF Real value display

Where, <n> is

Character 1 (49) is equal to the nominal value of primary parameter.

Or character 2 (50) is equal to the nominal value of the secondary parameter.

For example: WrtCmd (“FUNC:DEV1:MODE ABS”)

Query syntax: FUNCtion:DEV<n>:MODE?

Return format:

ABX  
PERC } <NL^END>  
OFF }

The FUNCtion:DEV<n>:REFerence<value> command is used to set the nominal value of the deviation. The FUNCtion:DEV<n>:REFerence<value>? query returns the current nominal value of the deviation.

Command syntax: FUNCtion:DEV<n>:REFerence<value>

Where,

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

<n> is

Character 1 (49) is equal to the nominal value of primary parameter.

Or character 2 (50) is equal to the nominal value of the secondary parameter.

For example: WrtCmd (“FUNC:DEV1:REF 10”)

Query syntax: FUNCtion:DEV<n>:REFerence?

Return format: <NR1><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 make a test and then copies the results of the primary and the secondary parameters as the nominal values of the deviation.

Command syntax: FUNCtion:DEV<n>:REFerence:FILL

Where,

Character 1 (49) or haracter 2 (50)is equal to the nominal values of the primary and secondary parameters.

For example: WrtCmd (“FUNC:DEV1:REF:FILL”)

The FUNCtion:StepDELay command is used to set the step delay time of the instrument, The FUNCtion:StepDELay? query returns the current step delay time parameter.

Command syntax:

StepDELay { <value>  
MIN  
MAX

Where,

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

MIN Set the step delay parameter as 0s.

MAX Set the step delay parameter as 60s.

For example: WrtCmd(“FUNC:SDEL 5S”) Set the step delay parameter as 5s.

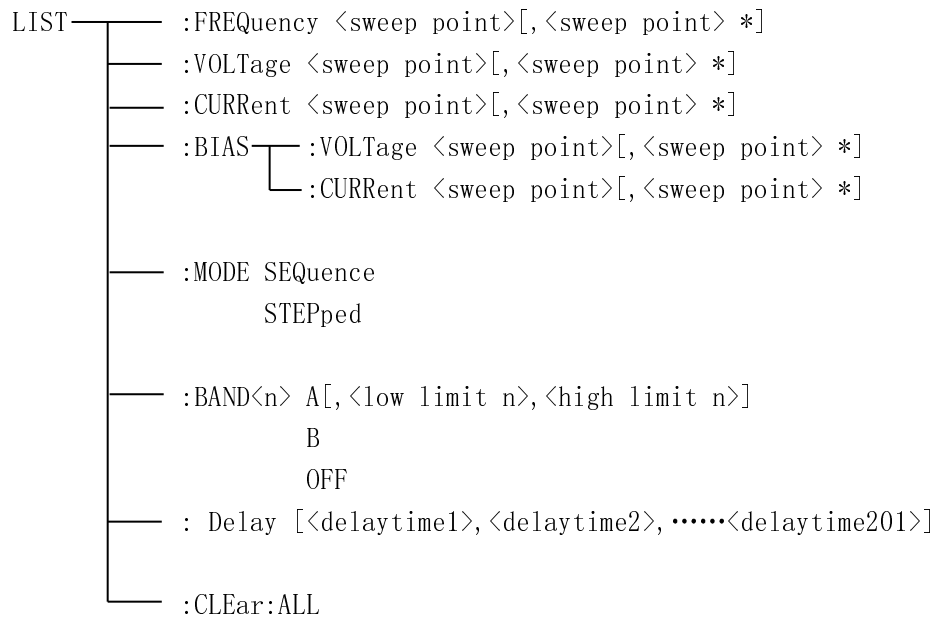
Query syntax: FUNC:SDEL?

Return format: <NR3><NL^END>

### 7.1.9 LIST subsystem commands

The LIST subsystem commands are mainly used to set the list sweep function, sweep points, sweep mode, sweep limits.

Command tree:



The LIST:FREQuency command is used to clear the original sweep points and set the frequencies of the sweep points. The LIST:FREQuency? query returns the current frequency of each sweep point.

Command syntax: LIST:FREQuency<value>[, <value>\*]

**NOTE: \* part means 201 sweep points at most can be set.**

Where,

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

<value> should be set from

**20HZ-1MHZ(SM6028A),**

**20HZ-2MHZ(SM6028/6028H),**

**or return format will report errors.**

For example: WrtCmd("LIST:FREQ 1E3, 2E3, 3E3, 4E3")

Set the frequency of the sweep point 1 as 1KHZ;

Set the frequency of the sweep point 2 as 2KHZ;

Set the frequency of the sweep point 3 as 3KHZ;

Set the frequency of the sweep point 4 as 4KHZ;

NOTE: HZ(hertz) is the suffix unit, MAHZ and MHZ is MHz (2E6 Hz).

Query syntax: LIST:FREQuency?

Return format: <NR3>, [,<NR3>\*]<NL^END>

The LIST:VOLTage command is used to clear the original voltage of the each sweep point and reset the voltage. The LIST:VOLTage? query returns the current voltage of each sweep point.

Command syntax: LIST:VOLTage<value>[,<value>\*]

**NOTE: \* part means 201 sweep points at most can be set.**

Where,

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

For example: WrtCmd (“LIST:VOLT 1.5”) Set the frequency of the sweep point 1 as 1.5V.

WrtCmd (“LIST:VOLT 1E-2, 2E-2, 3E-2, 4E-2”) Set the frequencies of sweep point 1, 2, 3 and 4 respectively as 10mV, 20mV, 30mV and 40mV.

**NOTE: This command can be followed by suffix unit V.**

Query syntax: LIST:VOLTage?

Return format:<NR3>[,<NR3>\*]<NL^END>

**<value> should be set from 5mV to 2V, or return format will report errors.**

The LIST:CURREnt command is used to clear the measurement current of each sweep point and reset the current. The LIST:CURREnt? query returns the current of each sweep point.

Command syntax: LIST:CURREnt<value>[,<value>\*]

**NOTE: \* part means 201 sweep points at most can be set.**

Where,

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

For example: WrtCmd (“LIST:CURR 100MA”) Set the measurement current of the sweep point 1 as 100mA.

WrtCmd (“LIST:CURR 1E-2, 2E-2, 3E-3, 4E-3”) Set the currents of sweep points 1, 2, 3 and 4 respectively as 10mA, 20mA, 3mA and 4mA.

**NOTE: This command can be followed by a suffix unit A (ampere).**

Query syntax: LIST:CURREnt?

Return format: <NR3>[,<NR3>\*]<NL^END>

**NOTE: The current of each sweep point should be set from 50µA to 100mA, or 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 LIST:BIAS:VOLTage? query returns the current DC bias voltage of each sweep point.

Command syntax: LIST:BIAS:VOLTage<value>[,<value>\*]

**NOTE: \* part means 201 sweep points at most can be set.**

Where,

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

For example: WrtCmd (“LIST:BIAS:VOLT 1.5V”) Set the DC bias voltage of sweep point 1 as 1.5V.

Set the DC bias voltage of sweep point 1 as 1.5V.

Query syntax: LIST:BIAS: VOLTage?

Return format: <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 the DC bias current of each sweep point.

Command syntax: LIST:BIAS:CURRENT<value>[,<value>\*]

**NOTE: \* part means 201 sweep points at most can be set.**

Where,

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

For example: WrtCmd (“LIST:BIAS:CURR 100MA”) Set the DC bias current of the sweep point 1 as 100mA.

WrtCmd (“LIST:BIAS:CURR 1E-2, 2E-2, 3E-2,4E-2”) Set the DC bias currents of sweep points 1, 2, 3 and 4 respectively as 10mA, 20mA, 30mA and 40mA.

Query syntax: LIST:BIAS:CURRENT?

Return format: <NR3>[,<NR3>\*]<NL^END>

**NOTE: SM6028 instrument has installed a 40V/100mA internal DC bias current source. If 1A DC source is required, please install an external source. The instrument can be used with SM6027A DC Bias Source (providing DC current from 0 to 20A, supporting 120A at most and you can purchase from our company).**

The LIST:MODE command is used to set the list sweep mode. The LIST:MODE? query returns the current list sweep mode.

Command syntax:

LIST:MODE { SEQUENCE }  
                  { STEPped }

Where,

SEQUENCE means sequential mode.

STEPped means single step mode.

For example: WrtCmd (“LIST:MODE SEQ”)

Query syntax: LIST:MODE?

Return format:

{ SEQ } <NL^END>  
  { STEP }

The LIST:BAND<n> command is used to set the limits of list sweep table. The LIST:BAND<n>? query returns the current limits.

Command syntax: LIST:BAND<n><parameter>[,<low limit n>,<high limit n>]

Where,

<n> 1 to 201 (NR1 format): sweep points on the n<sup>th</sup> 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  $n^{\text{th}}$  line.  
 <high limit n> NR1, NR2 or NR3 data format, high limit of the sweep point on the  $n^{\text{th}}$  line.

For example: WrtCmd ("LIST:BAND1 A, 10, 20")  
 WrtCmd ("LIST:BAND3 OFF")

Query syntax: LIST:BAND<n>?

Return Format: <parameter>,<low limit n>,<high limit n>

The LIST:CLear:ALL command is used to clear the setup data of all the sweeping points.

Query syntax: LIST:CLear:ALL

### 7.1.10 APERture subsystem commands

The APERture subsystem commands are mainly used to set the measurement speed, average times used in measurement. The APERture? query returns the current measurement speed, average times.

Command syntax:

APERture  $\left\{ \begin{array}{l} \text{FAST} \\ \text{MEDium} \\ \text{SLOW} \end{array} \right\} [,<\text{value}>]$

Where,

FAST: 130 times/sec

MEDium: 11 times/sec

SLOW: 4 times/sec

<value> 1 to 255 in NR1

For example: WrtCmd ("APER MED, 55")

Query syntax: APERture?

Return format:

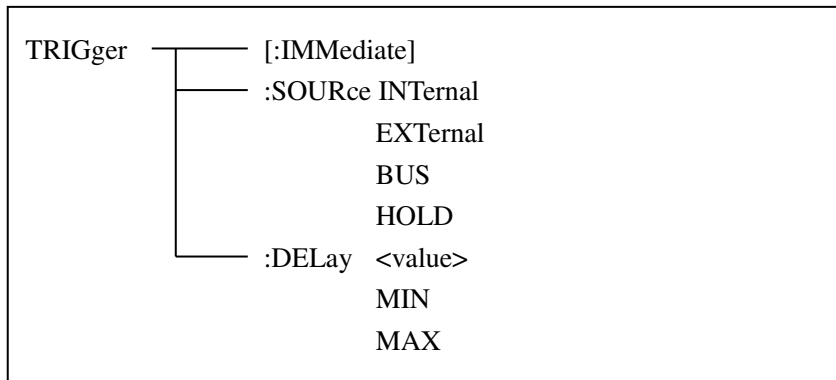
$\left\{ \begin{array}{l} \text{FAST} \\ \text{MED} \\ \text{SLOW} \end{array} \right\} , <\text{NR1}><\text{NL}^{\wedge}\text{END}>$

### 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 trigger a test.

Command syntax: TRIGGER[:IMMEDIATE]

For example: WrtCmd("TRIG")

The TRIGGER:SOURCE command is used to set the trigger source mode. The TRIGGER:SOURCE? query returns the current trigger source mode.

Command syntax:

TRIGGER:SOURCE { INTERNAL  
EXTernal  
BUS  
HOLD

Where,

INTERNAL The default trigger mode.

EXTernal Triggered by HANDLER interface.

BUS Triggered by RS232C interface or GPIB interface

HOLD Triggered by pressing **TRIGGER**.

For example: WrtCmd ("TRIG:SOUR BUS")

Query syntax: TRIGGER:SOURCE?

Return format:

{ INT  
EXT  
BUS  
HOLD } <NL^END>

The TRIGGER:DELAY command is used to set the delay time after triggering. The TRIGGER:DELAY? query returns the current delay time.

Command syntax:

TRIGGER:DELAY { <value>  
MIN  
MAX

Where,

<value> In NR1, NR2 or NR3 data format, from 0 to 60s with 1ms as the resolution.

MIN Set the delay time as 0s.

MAX Set the delay time as 60s.

For example: WrtCmd (“TRIG:DEL 5s”) Set the delay time as 5s.

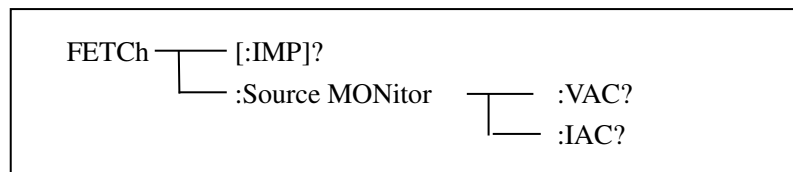
Query syntax: TRIGger:DELay?

Return format: <NR3><NL^END>

### 7.1.12 FETCh? subsystem commands

The FETCh? subsystem commands are mainly used to direct SM6028 to input a measurement result.

Command tree:



The FETCh[:IMP]? query directs SM6028 to input the last measurement result to the output buffer zone.

Query syntax: FETCh[:IMP]?

For example: WrtCmd (“TRIG:SOUR BUS”)

WrtCmd (“TRIG”)

WrtCmd (“FETC?”)

SM6028 applies ASCII to delivery result, details are follows.

**On measurement display page, bin NO. display page, bin count display page, ASCII data output format are described as 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-digits ASCII format are as below:

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-digits ASCII: SN (S: +/-, N: from 0 to 4)

**NOTE: When <status> is -1, +1 or +2, the measurement data is 9.9E37. When <status> is 0, +3 or +4, the real measurement data is beyond the limits.**

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 as ON, <bin No.> data can be displayed.

The output format of <bin No.> data applies 2 to 3 digits ASCII: 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.**

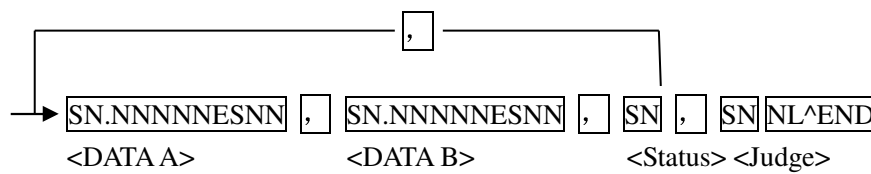


Figure 6 ASCII format 2 (list sweep)

Where,

Descriptions for <DATA A>, <DATA B>, <Status> are the same described before. <Judge> format is as below:

<Input/Output> format: The data displays the compare result of the list sweep..

Data	Result
-1	low
0	pass
+1	high

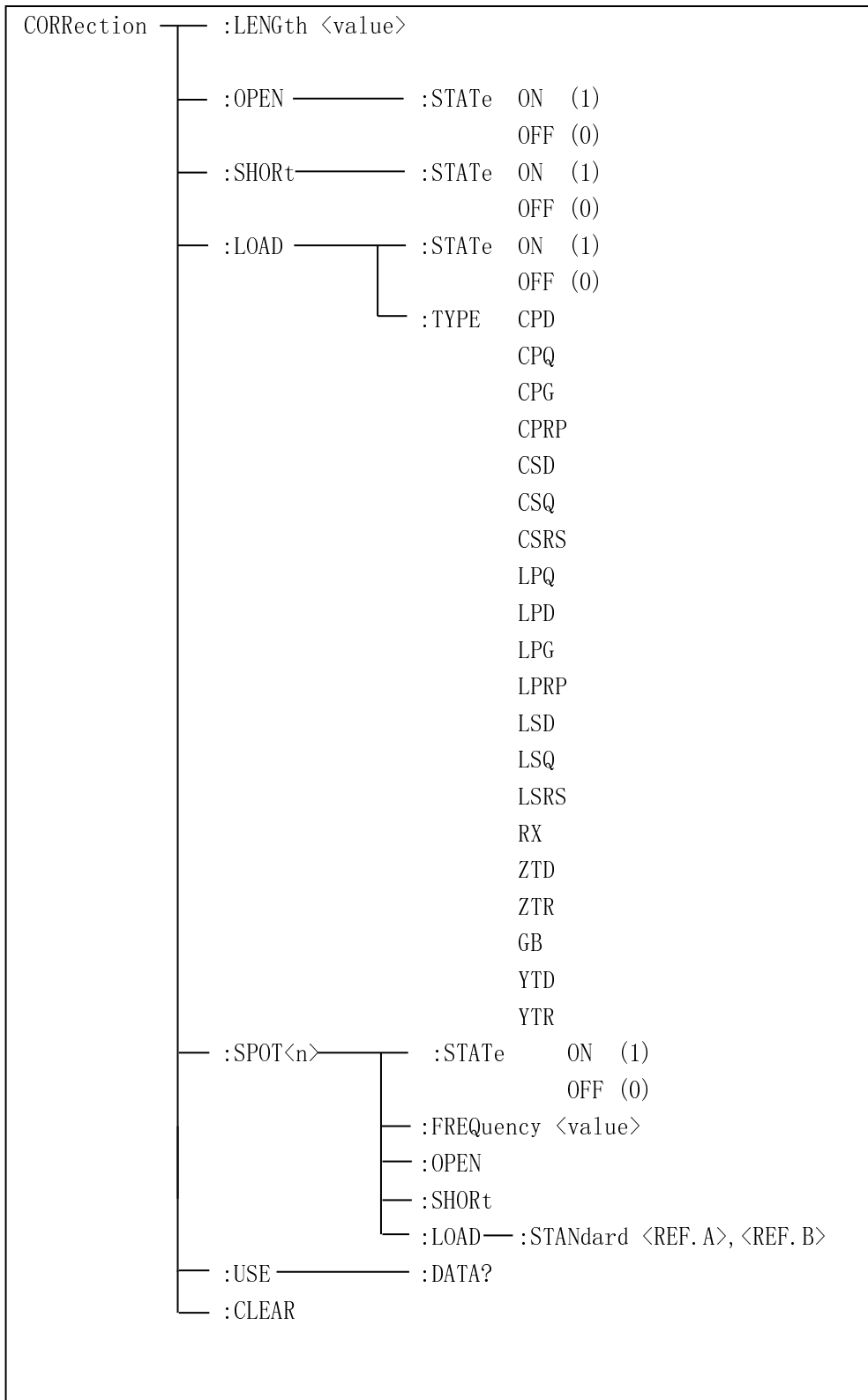
When the compare function of the list sweep measurement is turned off, the output result of <Input/Output> is 0.

<Input/Output> data output format applies 2-digits ASCII format: SN (S: +/-, N: from 0 to 1)

### 7.1.13 CORRection subsystem commands

The CORRection subsystem commands are mainly used to set the correction function, OPEN, SHORT, LOAD.

Command tree:



The CORRection:LENGth command is used to set the correction cable length. The CORRection:LENGth? query returns the current set cable length.

Command syntax: CORRection:LENGth<value>

Where,

<value> is 0, 1, 2 or 4 followed by M.

For example: WrtCmd (“CORR:LENG 1M”) Set the cable length as 1 meter.

Query syntax: CORRection:LENGth?

Return format: <NR1><NL^END>

The CORRection:OPEN command is used to execute open correction for 51 preset test points (SM6028 has 51 preset test points).

Command syntax: CORRection:OPEN

For example: WrtCmd (“CORR:OPEN”)

The CORRection:OPEN:STATe command is used to set the open correction ON or OFF. The CORRection: OPEN:STATe? query returns the current open correction status.

Command syntax:

CORRection:OPEN:STATe  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“CORR:OPEN: STAT ON”)

Query syntax: CORRection:OPEN:STATe?

Return format: <NR1><NL^END>

The CORRection:SHORT command is used to execute short correction for 51 preset test points (SM6028 has 51 preset test points).

Command syntax: CORRection:SHORT

For example: WrtCmd (“CORR:SHOR”)

The CORRection:SHORT:STATe command is used to set the short correction status. The CORRection:SHORT:STATe? query returns the current short correction status.

Command syntax:

CORRection:SHORT:STATe  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“CORR:SHOR:STAT ON”)

Query syntax: CORRection:SHORt:STATe?

Return format: <NR1><NL^END>

The CORRection:LOAD:STATe command is used to set load correction. The CORRection:LOAD:STATe? query returns the current load correction status.

Command syntax:

CORRection:LOAD:STATe  $\left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“CORR:LOAD:STAT ON”)

Query syntax: CORRection:LOAD:STATe?

Return format: <NR1><NL^END>

The CORRection:LOAD:TYPE command is used to set the tested parameter type. The CORRection:LOAD:TYPE query returns the current parameter type.

Details of function are as follows:

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

For example: WrtCmd (“CORR:LOAD:TYPE CPD”)

Query syntax: CORRection:LOAD:TYPE?

Return format: <function><NL^END>

The CORRection:SPOT<n>:STATe command is used to set the state of some specific frequency spots. The CORRection:SPOT<n>:STATe query returns the state of current calibration point.

Command syntax:

CORRection:SPOT<n>:STATe  $\left. \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

<n>:

Frequency spot 1~201.

For example: WrtCmd (“CORR:SPOT1:STAT ON”)

Query syntax: CORRection:SPOT<n>:STATe?

Return format: <NR1><NL^END>

The CORRection:SPOT<n>:FREQuency command is used to set the frequencies of frequency spots 1, 2...201. The CORRection:SPOT<n> query returns the current frequency of specific frequency spot.

Command syntax: CORRection:SPOT<n>:FREQuency<value>

Where,

<value> can be NR1, NR2 or NR3 data format followed by HZ, kHz and MHz.

<n>:

Frequency spot 1~201

For example: WrtCmd (“CORR:SPOT1:FREQ 2KHZ”) Set the frequency of frequency spot 1 as 2kHz.

**NOTE: <value> should be ranged from 20HZ to 2MHZ (SM6028), or return format will report errors.**

Query syntax: CORRection:SPOT<n>:FREQuency?

Return format: <NR3><NL^END>

The CORRection:SPOT<n>:OPEN command is used to execute open correction for specific frequency spots.

Command syntax: CORRection:SPOT<n>:OPEN

Where,

<n>:

Frequency spot 1~201

For example: WrtCmd (“CORR:SPOT1:OPEN”) Execute open correction for frequency spot 1.

The CORRection:SPOT<n>:SHORT command is used to execute short correction for specific frequency spots.

Command syntax: CORRection:SPOT<n>:SHORT

Where,

<n>:



Frequency spot 1~201

For example: WrtCmd (“CORR:SPOT1:SHOR”) Execute short correction for frequency spot 1.

The CORRection:SPOT<n>:LOAD:STANdard command is used to set the standard reference of specific frequency spots. The CORRection:SPOT<n>:LOAD:STANdard query returns the current standard reference of specific frequency spot.

Command syntax: CORRection:SPOT<n>:LOAD:STANdard <REF. A><REF. B>

Where,

<n>:

Frequency spot 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: CORRection:SPOT<n>:LOAD:STANdard?

Return format: <NR3><NL^END>

The CORRection:USE:DTAT? query returns the OPEN/SHORT/LOAD correction measurement data of specific frequency spot 1, 2 ... 201.

Command syntax: CORRection:USE:DATA?

Return format:

<open1 A>,<open1 B>,<short1 A>,<short1 B>,<load1 A>,<load1 B>,

<open2 A>,<open2 B>,<short2 A>,<short2 B>,<load2 A>,<load2 B>,

<open3 A>,<open3 B>,<short3 A>,<short3 B>,<load3 A>,<load3 B>,

.....

Where,

<open n A> is NR3 data format and the primary open correction data at frequency spot n.

<open n B> is NR3 data format and the secondary open correction data at frequency spot n.

<short n A> is NR3 data format and the primary short correction data at frequency spot n.

<short n B> is NR3 data format and the secondary short correction data at frequency spot n.

<load n A> is NR3 data format and the primary load correction data at frequency spot n.

<load n B> is NR3 data format and the secondary load correction data at frequency spot n.

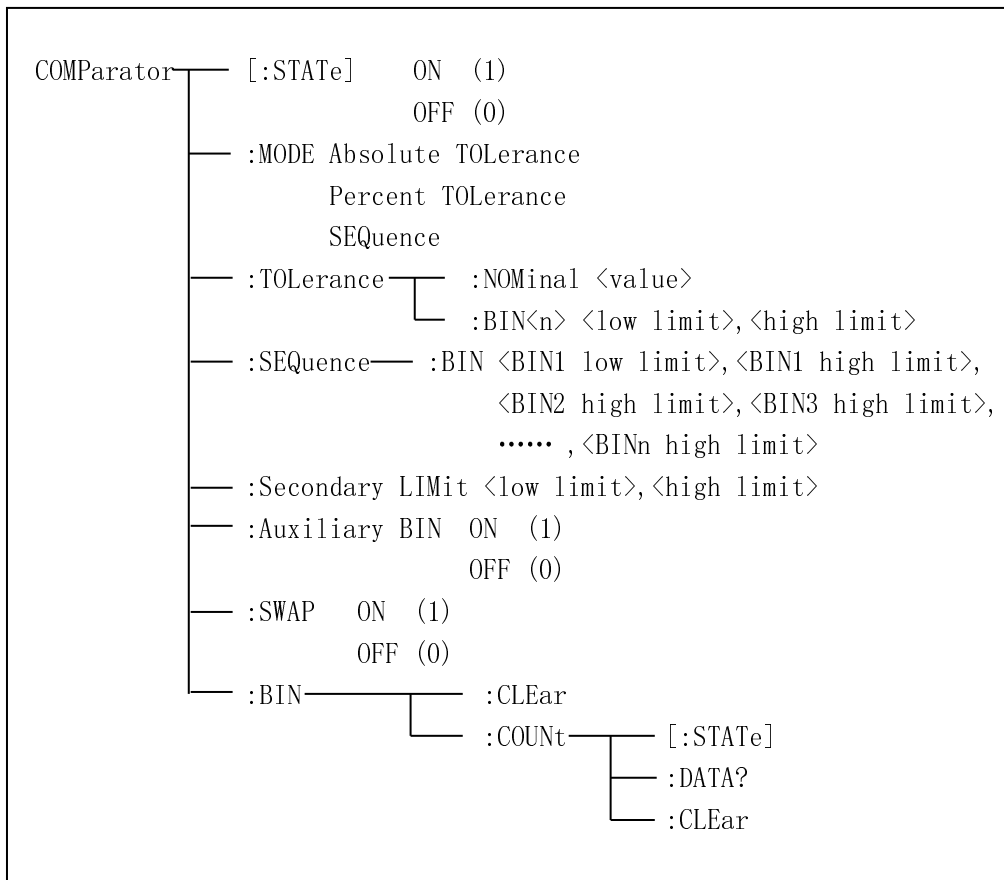
The CORRection:CLEAr command is used to clear the correction data of all the correction points.

Command syntax: CORRection:CLEAr

### 7.1.14 COMParator subsystem commands

The COMParator subsystem commands are used to set the bin comparator function including ON/OFF setting, Limit table setting.

Command tree:



The COMPArator[STATe] command is used to set the comparator function as ON or OFF. The COMPArator[STATe]? query returns the current comparator state.

Command syntax:

$$\text{COMPArator[:STATe]} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“COMP ON”)

Query syntax: COMPArator[:STATe]?

Return format: <NR1><NL^END>.

The COMPArator:MODE command is used to set the comparator mode. The COMPArator:MODE? query returns the current mode.

Command syntax:

COMParator:MODE  $\left\{ \begin{array}{l} \text{ATOLerance} \\ \text{PTOLerance} \\ \text{SEQuence} \end{array} \right\}$

Where,

ATOLerance means absolute tolerance mode.

PTOLerance means proportional tolerance mode.

SEQuence means sequential tolerance mode.

For example: WrtCmd (“COM:MODE ATOL”)

Query syntax: COMParator:MODE?

Return format:  $\left\{ \begin{array}{l} \text{ATOL} \\ \text{PTOL} \\ \text{SEQ} \end{array} \right\} \langle \text{NL}^{\wedge} \text{END} \rangle$

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 COMParator:TOLerance:NOMinal? query 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: COMParator:TOLerance:NOMinal?

Return format: <NR3><NL^END>

The COMParator:TOLerance:BIN<n> command is used to set the high and the low limits of each bin (this function is valid only when the limit mode is set as deviation mode). The COMParator:TOLerance:BIN<n>? query returns the current high and the low limits of each bin.

Command syntax: COMParator: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.

**NOTE: 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: COMParator:TOLerance:BIN<n>?

Return format: <low limit><high limit><NL^END>

The COMParator:SEQuence:BIN command is used to set the high and the low limits of sequential mode (this function is valid only when the limit mode is set as the sequential mode.). The COMParator:SEQuence:BIN? query 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.

**NOTE: 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: COMPArator:SEQuence:BIN?

Return format: <BIN1 low limit>, <BIN1 high limit>, <BIN2 high limit>, ..., <BINn high limit><NL^END>

The COMPArator:Secondary LIMit command is used to set the high and the low limits of the secondary parameter. The COMPArator:Secondary LIMit query returns the current high and the low limits of the secondary parameter.

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.

**NOTE: 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: COMPArator:SLIMit?

Return format: <NR3><NL^END>

The COMPArator:Auxiliary BIN command is used to set the auxiliary bin as ON or OFF. The COMPArator:Auxiliary BIN? query returns the current auxiliary bin state.

Command syntax:

COMPArator:Auxiliary BIN  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“COMP:ABIN ON”)

Query syntax: COMPArator:Auxiliary BIN?

Return format: <NR1><NL^END>

The COMPArator:SWAP command is used to set the swap mode ON or OFF. For example: the original function parameter is Cp-D, after the SWAP mode is set as ON, the function parameter will be changed as D-Cp. In this case, the limits from BIN1 to BIN9 become the high and the low limits of D, the original secondary limits become that of Cp. That is to say, this function is to make swap comparison between the primary and the secondary parameters. On the contrary, If OFF is selected, the comparison will be made according to the original sequence. The COMPArator:SWAP? query returns the current state of the swap function.

Command syntax:

COMPArator:SWAP  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“COMP:SWAP ON”)

Query syntax: COMPArator:SWAP?

Return format: <NR1><NL^END>

The COMPArator:BIN:CLEAr command is used to clear all limits on limit table setup page.

Command syntax: COMPArator:BIN:CLEAr

For example: WrtCmd (“COMP:BIN:CLE”)

The COMPArator:BIN:COUNT[:STATe] command is used to set the bin count function as ON or OFF. The COMPArator:BIN:COUNT[:STATe]? query returns the current state of the bin count function.

Command syntax:

COMPArator:BIN:COUNT[:STATe]  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“COMP:BIN:COUN ON”)

Query syntax: COMPArator:BIN:COUNT[STATe]?

Return format: <NR1><NL^END>

The COMPArator:BIN:COUNT:DATA? query returns the current comparison result of the bin count.

Query syntax: COMPArator:BIN:COUNT:DATA?

Return format: <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.

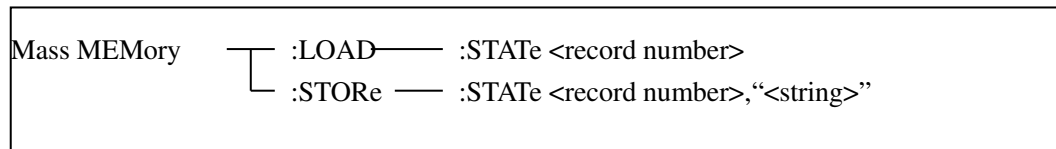
Command syntax: COMPArator:BIN:COUNT:CLEAr

For example: WrtCmd (“COMP:BIN:COUN:CLE”)

### 7.1.15 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 the existed 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:STOR:STATe command is used to storing the current setting to a file.

Command syntax: MMEMory:STOR:STATe<value>,”<string>”

Where,

<value> is the file number ranging from 0 to 39 (NR1).

<string> can be ASCII character string (maximum length is 16).

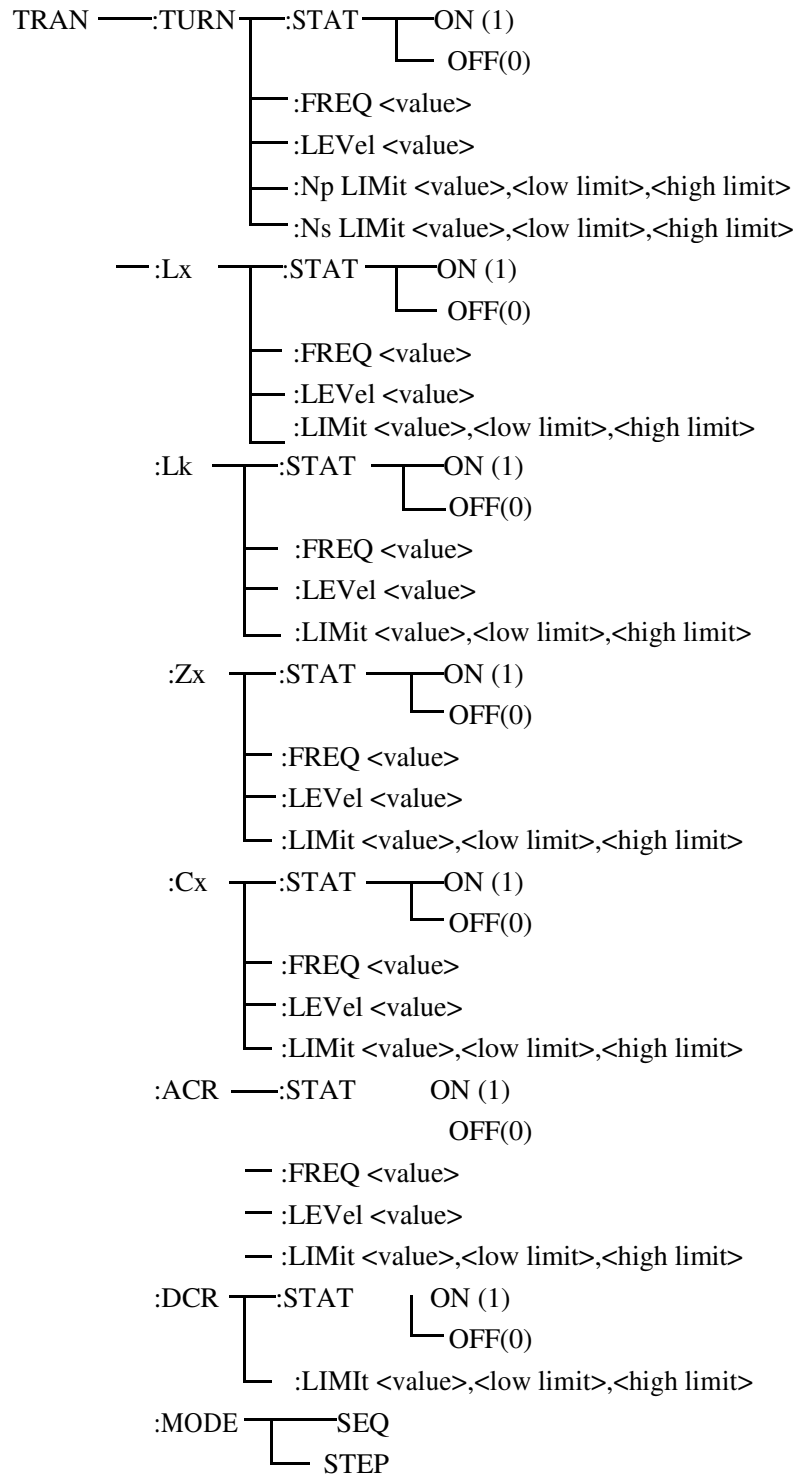
For example: WrtCmd (“MMEM:STOR:STAT 1, “Resistor meas””)

or WrtCmd (“MMEM:STOR:STAT 1”), IF “;”<string>”” has not been input, the default file name will be stored.

### 7.1.16 TRAN subsystem commands

The TRAN subsystem commands are mainly used to transformer parameters, such as turn-ratio, primary inductance, leakage inductance, stray capacitance, impedance, AC impedance, DC resistance, working mode and limits of each parameter.

Command tree:



The TRAN:TURN:STAT command is used to set the turn-ration ON or OFF. The TRAN:TURN:STAT? query returns the current state of the turn-ratio. Command syntax:

TRAN:TURN:STAT  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:TURN:STAT:ON”) All test parameter setting of turn-ratio is valid.

Query syntax: TRAN:TURN:STAT?

Return format: <NR1><NL^END>

The TRAN:TURN:FREQ command is used to set the test frequency of turn-ratio. The TRAN:TURN:FREQ? query returns the current test frequency of turn-ratio. Command syntax: TRAN:TURN:FREQ <value>

Where,

<value> can be NR1, NR2 or NR3 data format followed by HZ, KHZ, and MHZ.

For example: WrtCmd (“TRAN:TURN:FREQ 1KHZ”) Set the test frequency of turn-ratio as 1KHZ.

Query syntax: TRAN:TURN:FREQ?

Return format: <NR3><NL^END>

The TRAN:TURN:LEVEl command is used to set the test level of the turn-ratio. The TRAN:TURN:LEVEl query returns the current test level of the turn-ratio. Command syntax: TRAN:TURN:LEVEl<value>

Where,

<value> can be NR1, NR2 or NR3 data format followed by mV or V.

NOTE: <value> ranges from 5mV to 10V. Beyond this range, error information will be reported.

For example: WrtCmd (“TRAN:TURN:LEVEl 1V”)

Query syntax: TRAN:TURN:LEVEl?

Return format: <NR3><NL^END>

The TRAN:TURN: LImit command is used to set the primary nominal value, secondary nominal value, high and low limits of secondary turn. The TRAN:TURN:LImit query returns the current primary nominal value, secondary nominal value, high and low limits of secondary turn.

Command syntax: TRAN:TURN:LImit <Np value>,<Ns value>,<Ns low limit>,<Ns high limit> Where,

<Np value> is the primary nominal value in NR1, NR2 or NR3 data format.

<Ns value> is the secondary nominal value in NR1, NR2 or NR3 data format.

<Ns low limit> is the secondary low limit in NR1, NR2 or NR3 data format.



<Ns high limit> is the secondary high limit in NR1, NR2 or NR3 data format.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:TURN:LIMit 10, 100, -0.01, 0.01”)

Query syntax: TRAN:TURN:LIMit?

Return format: <NR3>, <NR3>, <NR3>, <NR3><NL^END>

The TRAN:Lk:STAT command is used to set the leakage inductance test parameter ON or OFF. The TRAN:Lk:STAT? query returns the current leakage inductance state. Command syntax:

$$\text{TRAN:Lk:STAT} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:Lk:STAT:ON”) Set all leakage inductance test parameters to be valid.

Query syntax: TRAN:Lk:STAT?

Return format: <NR1><NL^END>

The TRAN:Lk:FREQ command is used to set the test frequency of the leakage inductance.

The TRAN:Lk:FREQ query returns the current test frequency of the leakage inductance.

Command syntax: TRAN:Lk:FREQ<value>

Where,

<value> is NR1, NR2 or NR3 data format followed by HZ, KHZ and MHZ.

For example: WrtCmd (“TRAN:Lk:FREQ 1KHZ”) Set the test frequency of the leakage inductance is 1KHZ.

Query syntax: TRAN:Lk:FREQ?

Return format: <NR3><NL^END>

The TRAN:Lk:LEVel command is used to set the test level of the leakage inductance. The

TRAN:Lk:LEVel query returns the current test level of the leakage inductance. Command

syntax: TRAN:Lk:LEVel<value>

Where,

<value> is NR1, NR2 or NR3 data format followed by mV or V.

**Note: <value> ranges from 5mV to 2V. Beyond this range, error information will be reported.**

For example: WrtCmd (“TRAN:Lk:LEVel 1V”)

Query syntax: TRAN:Lk:LEVel?

Return format: <NR3><NL^END>

The TRAN:Lk:LIMit command is used to set the Lk nominal value, high and low limits. The TRAN:Lk:LIMit? query returns the current Lk nominal value, high and low limits.

Command syntax: TRAN:Lk:LIMit <value>, <low limit>, <high limit> Where,

<value> is the Lk nominal value in NR1, NR2 or NR3 data format followed by H.

<low limit> is the Lk low limit in NR1, NR2 or NR3 data format.

<high limit> is the Lk high limit in NR1, NR2 or NR3 data format.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:Lk:LIMit 0.01H, -0.01H, 0.01”)

Query syntax: TRAN:Lk:LIMit?

Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:Lx:STAT command is used to set the primary Lx ON or OFF. The TRAN:Lx:STAT?

query returns the current state of the primary Lx.

Command syntax:

$$\text{TRAN:Lx:STAT} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:Lx:STAT:ON”) Set all Lx parameters to be valid.

Query syntax: TRAN:Lx:STAT?

Return format: <NR1><NL^END>

The TRAN:Lx:FREQ command is used to set the Lx test frequency. The TRAN:Lx:FREQ query returns the current Lx test frequency.

Command syntax: TRAN:Lx:FREQ <value>

Where,

<value> is NR1, NR2 or NR3 data format followed by HZ, KHZ and MHZ.

For example: WrtCmd (“TRAN:Lx:FREQ 1KHZ”) Set the Lx test frequency as 1KHZ.

Query syntax: TRAN:Lx:FREQ?

Return format: <NR3><NL^END>

The TRAN:Lx:LEVel command is used to set the Lx test level. The TRAN:Lx:LEVel query returns the current Lx test level.

Command syntax: TRAN:Lx:LEVel<value>

Where,

<value> can be NR1, NR2 or NR3 data format followed by mV or V.

NOTE: <value> ranges from 5mV to 2V. Beyond this range, error information will be reported.

For example: WrtCmd (“TRAN:Lx:LEVel 1V”)

Query syntax: TRAN:Lx:LEVel?

Return format: <NR3><NL^END>

The TRAN:Lx:LIMit command is used to set the Lx nominal value, high and low limits. The TRAN:Lx:LIMit query returns the current nominal value, high and low limits.

Command syntax: TRAN:Lx:LIMit <value>, <low limit>, <high limit>

Where,

<value> is the Lx nominal value in NR1, NR2 or NR3 data format followed by H.

<low limit> is the Lx low limit in NR1, NR2 or NR3 data format.

<high limit> is the Lx high limit in NR1, NR2 or NR3 data format.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:Lx:LIMit 0.01H, -0.01, 0.01”)

Query syntax: TRAN:Lx:LIMit?

Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:Zx:STAT command is used to set the Zx test parameter as ON or OFF. The

TRAN:Zx:STAT? query returns the current state of the Zx test parameter. Command syntax:

$$\text{TRAN:Zx:STAT} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:Zx:STAT:ON”) Set all Zx test parameters to be valid.

Query syntax: TRAN:Zx:STAT?

Return format: <NR1><NL^END>

The TRAN:Zx:FREQ command is used to set the Zx test frequency. The TRAN:Zx:FREQ query returns the current Zx test frequency.

Command syntax: TRAN:Zx:FREQ<value>

Where,

<value> is NR1, NR2 or NR3 data format followed by HZ, KHZ or MHZ.

For example: WrtCmd (“TRAN:Zx:FREQ 1KHZ”) Set the Zx frequency as 1KHZ.

Query syntax: TRAN:Zx:FREQ?

Return format: <NR3><NL^END>

The TRAN:Zx:LIMit command is used to set the Zx nominal value, high and low limits. The TRAN:Zx:LIMit? query returns the current Zx nominal value, high and low limits.

Command syntax: TRAN:Zx:LIMit <value>, <low limit>, <high limit>

Where,

<value> is the Zx nominal value in NR1, NR2 or NR3 data format followed by H.

<low limit> is the Zx low limit in NR1, NR2 or NR3 data format.

<high limit> is the Zx high limit in NR1, NR2 or NR3 data format.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:Zx:LIMit 0.01H, -0.01, 0.01”)

Query syntax: TRAN:Zx:LIMit?

Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:ACR:STAT command is used to set the ACR test parameter to be ON or OFF. The TRAN:ACR:STAT query returns the current state of the ACR test parameter. Command syntax:

$$\text{TRAN:ACR:STAT} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:ACR:STAT:ON”) Set the ACR test parameter to be valid.

The TRAN:ACR:FREQ command is used to set the ACR test frequency.

The TRAN:ACR:FREQ?

query returns the current ACR test frequency.

Command syntax: TRAN:ACR:FREQ<value>

Where,

<value> is NR1, NR2 or NR3 data format followed by HZ, KHZ, or MHZ.

For example: WrtCmd (“TRAN:ACR:FREQ 1KHZ”) Set the ACR test frequency as 1KHZ.

Query syntax: TRAN:ACR:FREQ?

Return format: <NR3><NL^END>

The TRAN:ACR:LEVel command is used to set the ACR test level. The TRAN:ACR:LEVel query returns the current ACR level.

Command syntax: TRAN:ACR:LEVel<value>

Query syntax: TRAN:ACR:LEVel?

Return format: <NR3><NL^END>

The TRAN:ACR:LIMit command is used to set the ACR nominal value, high and low limits. The TRAN:ACR:LIMit query returns the current ACR nominal value, high and low limits.

Command syntax: TRAN:ACR:LIMit<value>,<low limit>,<high limit> Where,

<value> is the ACR nominal value in NR1, NR2 or NR3 data format followed by H.

<low limit> is the ACR low limit in NR1, NR2 or NR3 data format.

<high limit> is the ACR high limit in NR1, NR2 or NR3 data format.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:ACR:LIMit 0.01H, -0.01, 0.01”)

Query syntax: TRAN:ACR:LIMit?

Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:Cx:STAT command is used to set the Cx test parameter to be ON or OFF. The TRAN:Cx:STAT query returns the current state of the Cx test parameter. Command syntax:

$$\text{TRAN:Cx:STAT} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) is equal to ON.

0 (decimal 48) is equal to OFF.

For example: WrtCmd (“TRAN:Cx:STAT:ON”) Set the Cx test parameter to be valid.

Query syntax: TRAN:Cx:STAT?

Return format: <NR1><NL^END>

The TRAN:Cx:FREQ command is used to set the Cx test frequency. The TRAN:Cx:FREQ query returns the current Cx test frequency.

Command syntax: TRAN:Cx:FREQ <value>

Where,

<value> is NR1, NR2 or NR3 data format followed by HZ, KHZ and MHZ.

For example: WrtCmd (“TRAN:Cx:FREQ 1KHZ”) Set the Cx test frequency as 1KHZ.

Query syntax: TRAN:Cx:FREQ?

Return format: <NR3><NL^END>

The TRAN:Cx:LEVel command is used to set the Cx test level. The TRAN:Cx:LEVel? query returns the current Cx test level.

Command syntax: TRAN:Cx:LEVel <value>

Where,

<value> is NR1, NR2 or NR3 data format followed by mV or V.

**NOTE: <value> ranges from 5mV to 2V. Beyond this range, error information will be reported.**

For example: WrtCmd (“TRAN:Cx:LEVel 1V”)

Query syntax: TRAN:Cx:LEVel?

Return format: <NR3><NL^END>

The TRAN:Lx:LIMit command is used to set the Cx nominal value, high and low limits. The TRAN:Lx:LIMit? query returns the current Cx nominal value, high and low limits. Command syntax: TRAN:Cx:LIMit <value>,<low limit>,<high limit>

Where,

<value> is the Cx nominal value in NR1, NR2 or NR3 data format followed by H.

<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.

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd (“TRAN:Cx:LIMit 0.01H, -0.01, 0.01”)

Query syntax: TRAN:Cx:LIMit?

Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:DCR:STAT command is used to set the DCR test parameter to be ON or OFF. The TRAN:DCR:STAT? query returns the current state of the DCR test parameter. Command syntax:

TRAN:DCR:STAT  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49) is equal to ON.  
 0 (decimal 48) is equal to OFF.  
 For example: WrtCmd (“TRAN:DCR:STAT:ON”)

Query syntax: TRAN:DCR:STAT?  
 Return format: <NR1><NL^END>

The TRAN:DCR:LIMit command is used to set the DCR nominal value, high and low limit.  
 The TRAN:DCR:LIMit? query returns the current DCR nominal value, high and low limits.  
 Command syntax: TRAN:DCR:LIMit <value>,<low limit>,<high limit>

Where,

<value> is the DCR nominal value in NR1, NR2 or NR3 data format followed by  $\Omega$ .

<low limit> is the DCR low limit in NR1, NR2 or NR3 data format.

<high limit> is the DCR high limit in NR1, NR2 or NR3 data format

**NOTE: The low limit should be smaller than the high limit, or error information will be reported.**

For example: WrtCmd(“TRAN:DCR:LIMIT 50  $\Omega$ , -0.01, 0.01”)

Query syntax: TRAN:DCR:LIMI?  
 Return format: <NR3>,<NR3><NR3><NL^END>

The TRAN:MODE is used to set the transformer working mode. The TRAN:MODE? query returns the current working mode of the transformer.

Command syntax:

$$\text{TRAN:MODE} \left\{ \begin{array}{l} \text{SEQuence} \\ \text{STEPped} \end{array} \right\}$$

Where,

SEQuence refers to sequential mode.

STEPped refers to single step mode.

For example: WrtCmd (“TRAN:MODE SEQ”)

Query syntax: TRAN:MODE?  
 Return format:  $\left\{ \begin{array}{l} \text{SEQ} \\ \text{<NL^END>} \\ \text{STEP} \end{array} \right\}$

## 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 triggers the measurement and then sends the result to the output buffer.  
For example: WrtCmd (“\*TRG”)
- The \*CLS command clears the standard event status register and the service request status register.  
Command syntax: \*CLS  
For example: WrtCmd (“\*CLS”)
- The \*IDN? query returns SM6028 ID.  
Query syntax: \*IDN?  
Return format: <manufacturer>,<model>,<firmware>,<HW\_version>,<NL^END>  
Where,  

<manufacturer>	Name of Manufacturer
<model>	Instrument Model (SM6028)
<firmware>	Firmware Version (VER1.0.0)
<HW_version>	Hardware version (Hardware Ver A5.0)
<date>	Date of the software version (2016-01-11)

For example: WrtCmd (“\*IDN?”);
- The \*TST? query executes an internal self test and returns the test result as the sum of all existing errors codes. If there are no error SM6028 returns 0.  
Query syntax: \*TST?  
Return format: 0<NL^END>  
Where,  
0        0 (NR1 format)  
For example: WrtCmd (“\*TST?”);
- The \*ESE (standard Event Status Enable command) command sets each open bit of the standard event status register. This command returns setups of each open bit for the standard event status permission register.  
Command syntax: \*ESE<value>  
Where,  
<value>    NR1 format: 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: \*ESE?  
Return format: <value><NL^END>



For example: WrtCmd (“\*ESE?”)

- The \*SRE (Service Request Enable command) command sets each open bit of the service status byte register. This command returns the current setups for each open bit of the status byte permission register.

Command syntax: \*SRE<value>

Where,

<value> NR1 format: 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: \*SRE?

Return format: <value><NL^END>

For example: WrtCmd (“\*SRE?”);

- The \*ESR? query returns the contents of the standard event status register.

Query syntax: \*ESR?

Return format: <value><NL^END>

Where,

<value> NR1 format: decimal expression for contents of the standard event status register.

Descriptions for each bit of the standard event status register

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

Query syntax: \*STB?

Return format: <value><NL^END>

Where,

<value> NR1 format: decimal expression for contents of the standard status byte register.

Descriptions for each bit of the standard status byte register

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 equals to set the OPC bit of the standard event status register when SM6028 finishes all parameter measurements. Ever since all pending operations have been completed, this command will inform the instrument to add a ASCII number “1” (decimal number: 49) into the output buffer.

Command syntax: \*OPC

For example: OUTPUT 717;“\*OPC”! Set the OPC bit of the instrument when the last command is done.

Query syntax: \*OPC?

Return format: 1 <NL^END>

Where,

1           ASCII number 1 (decimal number: 49)

For example: WrtCmd (“\*OPC?”)

## Chapter 8 Description for Handler

SM6028 provides the Handler interface for you. The interface is mainly used for the output of the sorted result. The interface offers the communication signal and the signal for the output of the sorted result. The separator result is corresponding to the output of BIN 10. The design for the Handler interface is very smart with the status of the output signal can be defined according to your application target.

### 8.1 Technology description

Table 1 shows the description for SM6028 HANDLER.

Table 1 the HANDLER description

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: ADC 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 $\geq 1\mu\text{S}$

### 8.2 Operation description

#### 8.2.1 Introduction

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

#### 8.2.2 The definition for the signal line

The Handler interface has 3 signal: comparison output, control output and control input. The signal line's definition for the BIN comparison and 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 figure 1.

- 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 table 2 and figure 2.

Table 2 The signal distribution for the pins

pin	signal name	description
1	/BIN1	BIN sorted result /BIN(BIN number) output are all open collector output.
2	/BIN2	
3	/BIN3	
4	/BIN4	
5	/BIN5	
6	/BIN6	
7	/BIN7	
8	/BIN8	
9	/BIN9	
10	/OUT	
11	/AUX	
12	/EXT.TRIG	External trigger: when the trigger mode is EXT.TRIG, SM6028 will be triggered by the positive-edge in this pin.
13		
14	EXT.DCV2	External DC voltage 2: The DC provider pin for the optoelectronic coupling signal(/EXT_TRIG, /KeyLock, /ALARM, /INDEX, /EOM)
15		
16	+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.
17		
18		
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	NC	No connection.

23	NC	
24	NC	
25	/KEY LOCK	When this signal 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.

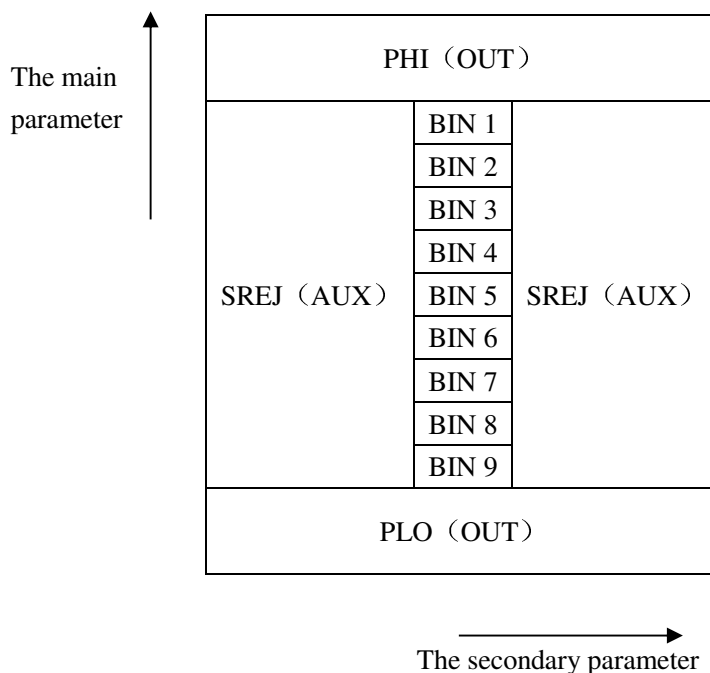
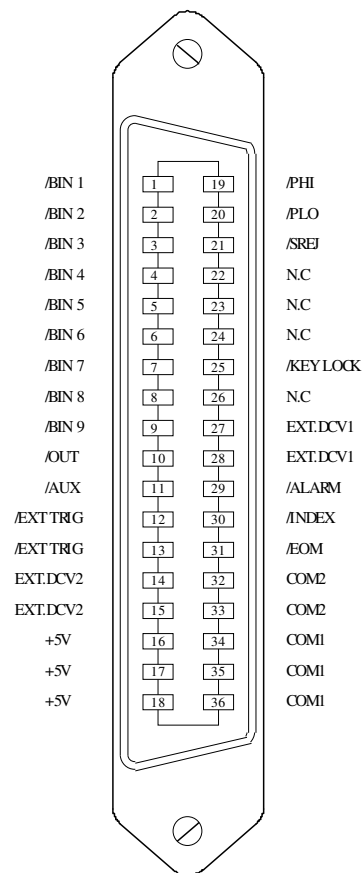


Figure 1 the /PHI, /PLO, /SREJ signal distribution for BIN comparison



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.

Figure 2 the pin definition for HANDLER

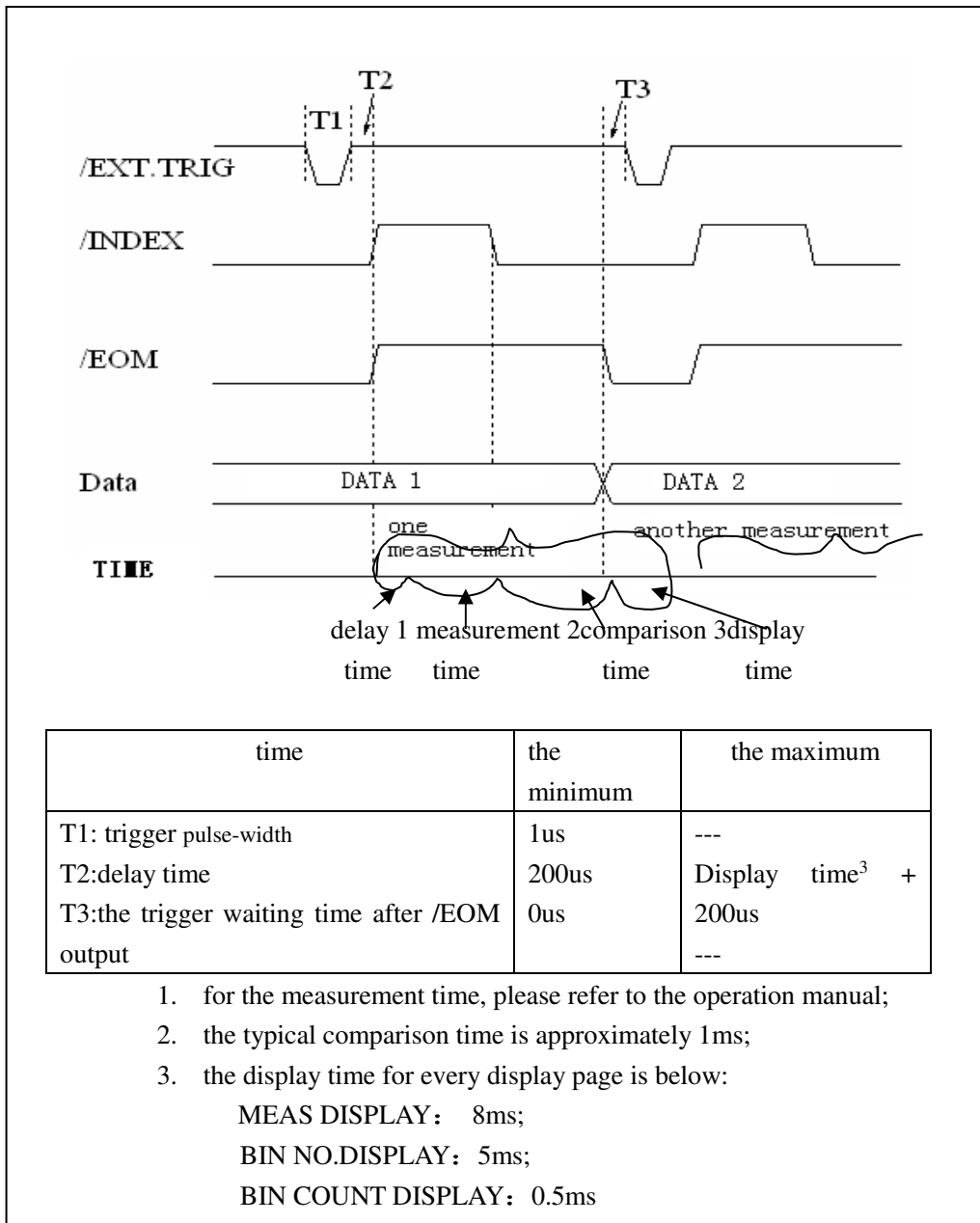


Figure 3 the timing chart

**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 (figure 4).  
 /AUX shows PASS/FAIL judgement.  
 When a sweep test is finished, these signal will be the output signal.
- Control  
 /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 to that for the BIN comparison). The timing chart is shown in figure 5.

Table 3 the pin distribute for the list sweep comparison

pin	signal	description
1	/BIN1	out of the limit of sweep point1
2	/BIN2	out of the limit of sweep point2
3	/BIN3	out of the limit of sweep point3
4	/BIN4	out of the limit of sweep point4
5	/BIN5	out of the limit of sweep point5
6	/BIN6	out of the limit of sweep point6
7	/BIN7	out of the limit of sweep point7
8	/BIN8	out of the limit of sweep point8
9	/BIN9	out of the limit of sweep point9
10	/OUT	out of the limit of sweep point10
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 of the last 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 to that of the comparison.



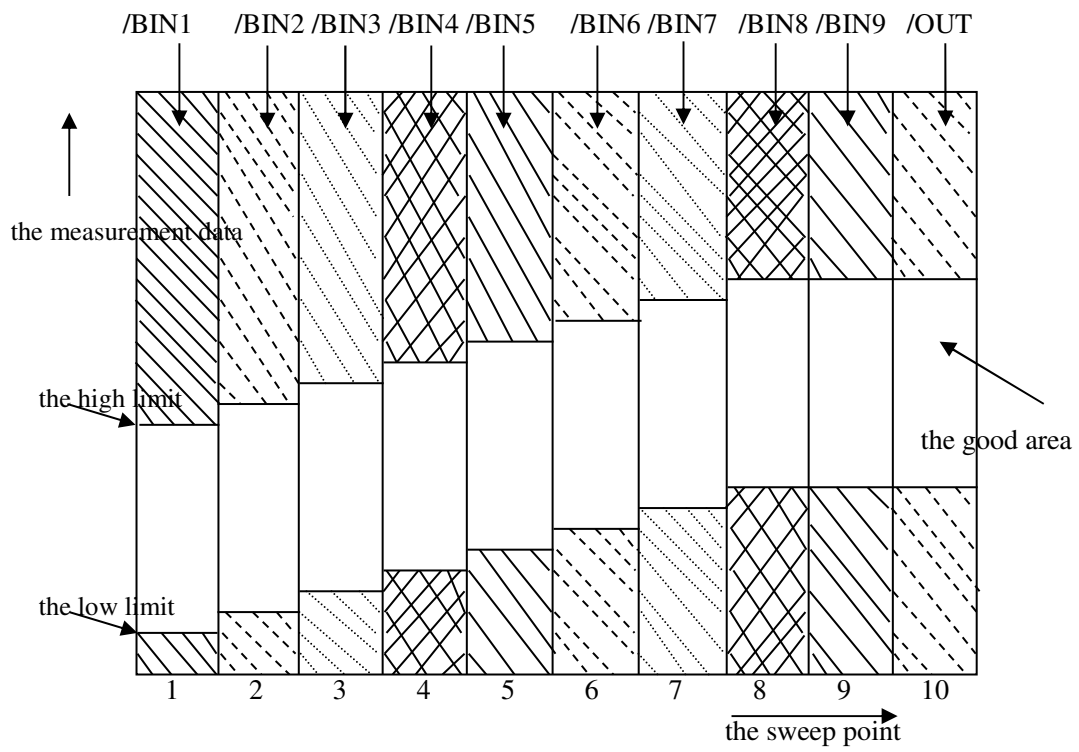


Figure 4 the signal area of the list sweep comparison

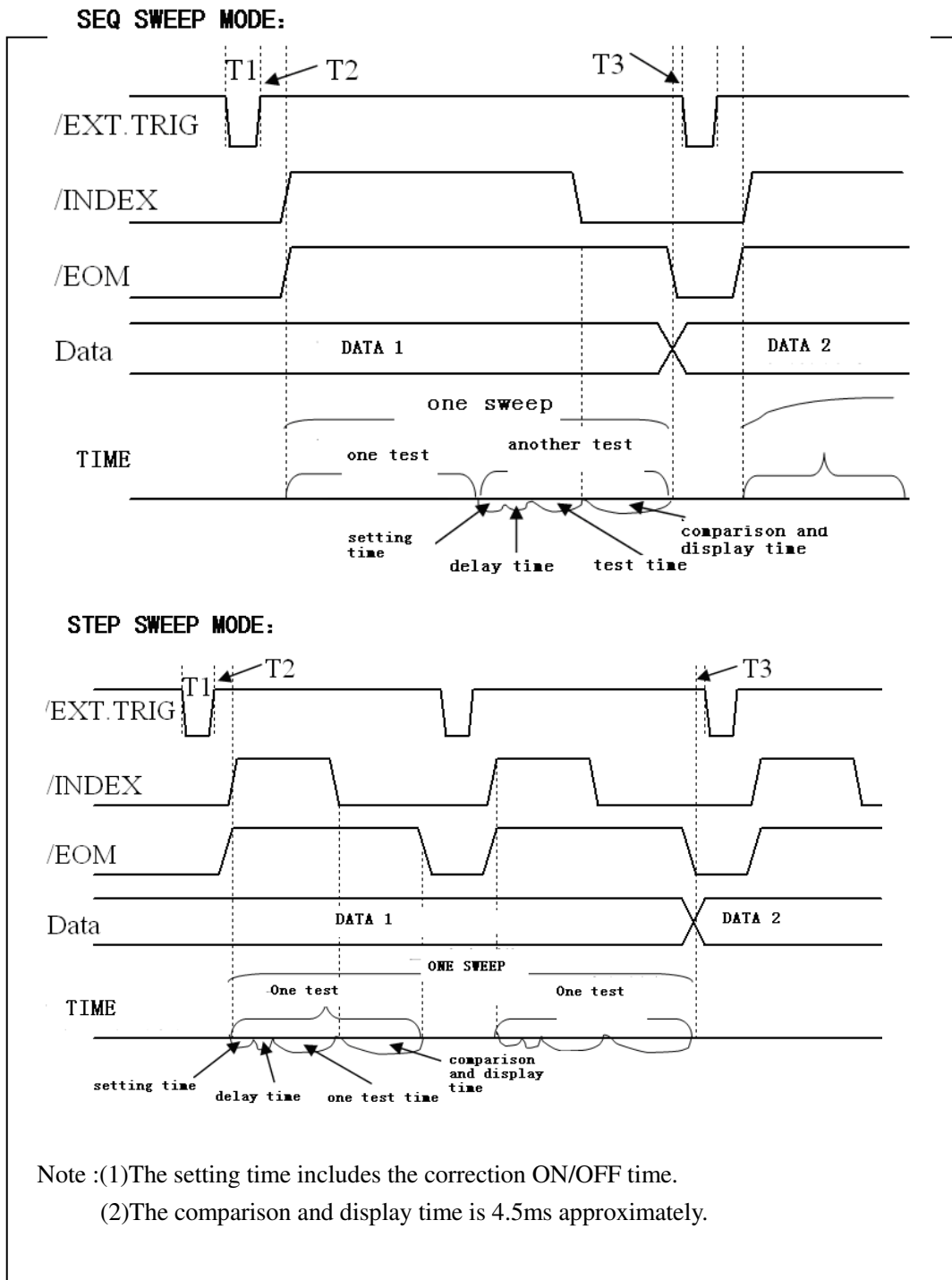


Figure 5 the time counting

### 8.2.3 Electrical feature

As it is shown above, the signal definition for the comparison and the list sweep comparison are different. But the electrical feature is same. So the description can be applied to BIN comparison and list sweep comparison.

DC isolation output: the DC isolation output (pin1 to pin16) generates the isolation by the optoelectronic coupler with the collector open. The output voltage on every line is set by the

pull-up resistance on the HANDLER interface board. The pull-up resistance 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 shown in Table 4.

Table 4 the electrical feature of the DC isolation output

the output signal	the output rated voltage		the maximum current	the reference ground for the circuit
	LOW	HIGH		
compared signal /BIN1 - /BIN9 /AUX /OUT /PHI /PLO	≤0.5V	+5V--+24V	6mA	Internal pull-up voltage: SM6028 GND  EXTV1: COM1
control signal /INDEX /EOM /ALARM	≤0.5V	+5V--+24V	5mA	Internal pull-up voltage : SM6028 GND  EXTV2: COM2

### 8.2.4 Handler interface board circuit

The circuit of interface card is shown as below.

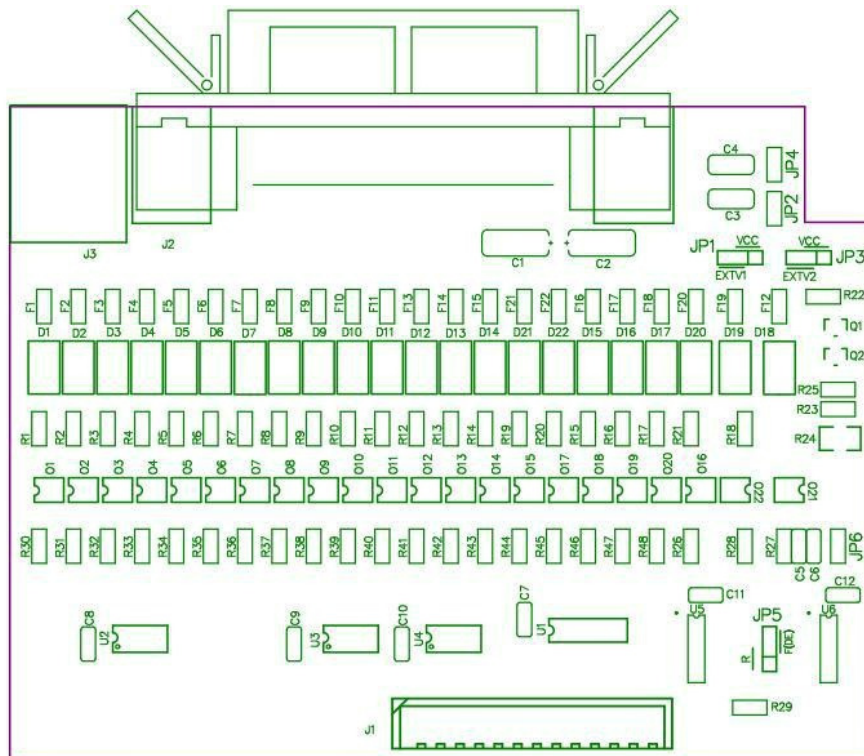


Figure 6 the output circuit for control signaloutput circuit

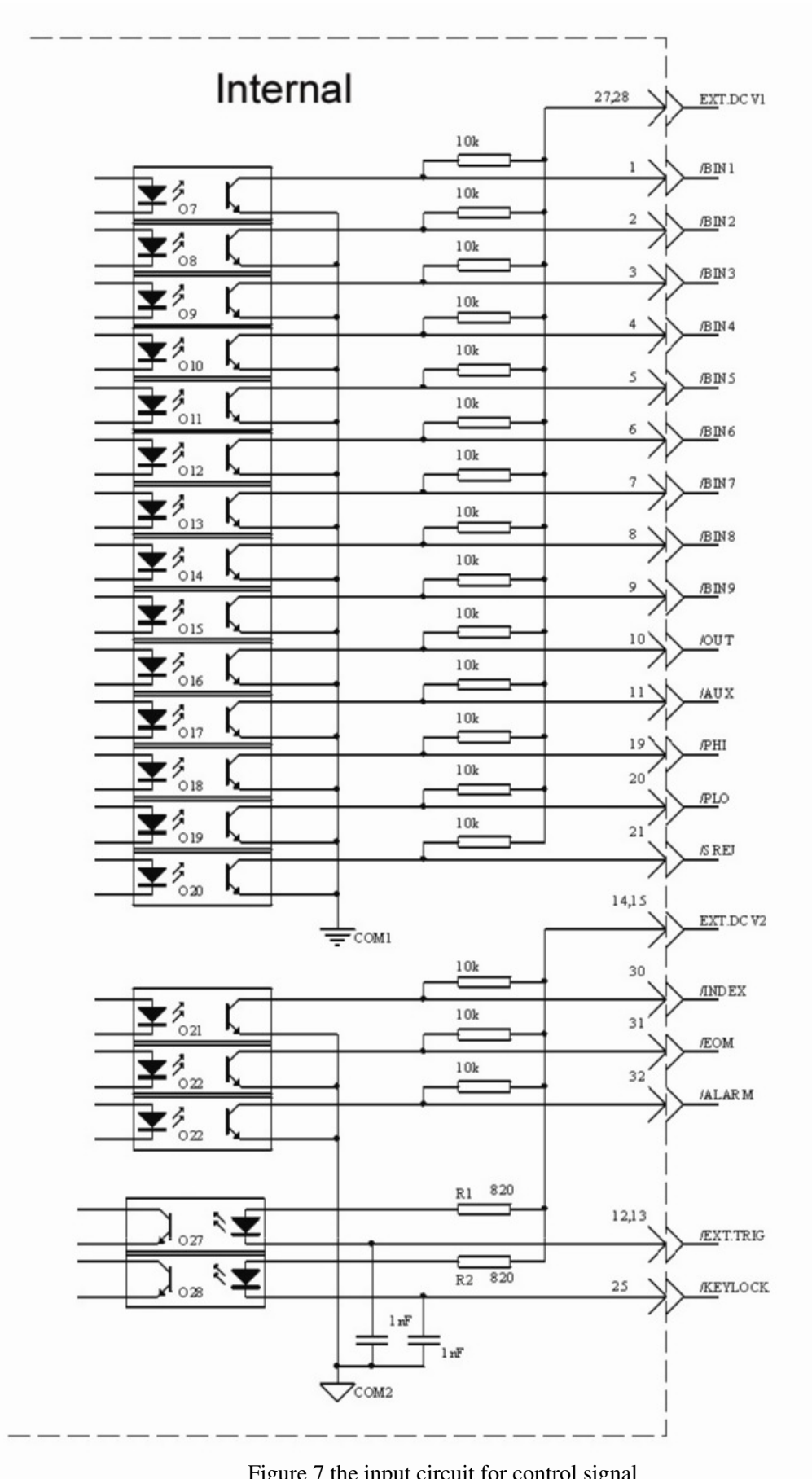


Figure 7 the input circuit for control signal

**NOTE:** as the HANDLER interface card of this instrument, the internal voltage adopts +5V. The actual using value of Internal Power Supply Voltage described in this manual is +5V and it is non-adjustable. When using Internal Power Supply Voltage, the jumping line of Handler interface board must be in short circuit.

Considering the anti-interference ability of SM6028, we suggest you to provide and use external +5V power supply as pull-up power supply of optocoupler. Now, the jumping line should be open (factory settings).

**Possible jumping line:**

1. Use internal power supply, set JP1 and JP3 as VCC, JP2 and JP4 in short circuit.
2. Use the same external power supply(EXTV1, EXTV2: same), set JP1 and JP3 as external power supply, JP2 and JP4 in short circuit.
3. Use two sets of external power supply (EXTV1, EXTV2: not same), set JP1 and JP3 as external power supply, disconnect JP2 and JP4.

## 8.2.5 Operation

Before you use the HANDLER function, you should ensure that your instrument has install the HANDLER interface board.The following procedure will show you how to use the interface comparison and the list sweep comparison.

**The procedure for comparison setting :**

- (1) Press the softkey [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.  
Refer to the [DISP] key description to see more details.
- (3) Move the cursor to COMP zone. The softkey area will be displayed:
  - ON
  - OFF
- (4) Press the softkey ON to enable the comparison function.
- (5) Press [DISP], and then press the softkey 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.

**The procedure for 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 [DISP] key description to see more details.
- (3) Press [DISP] and then press the softkey LIST SWEEP, LIST SWEEP DISP page will be displayed. Refer to the DISP 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.

## Chapter 9 Service & Maintenance

### Maintenance

There are no user serviceable parts inside the unit. Your Precision LCR Meter is thoughtfully engineered for ease of use, accuracy and reliability. The instrument is carefully tested and calibrated using standards traceable to National Laboratories. Take care of your instrument by cleaning the exterior of the instrument regularly with a dusting brush. Dirt which is difficult to remove on the casing & plastic parts, can be removed with a moist cloth ( 99% water, 1% mild detergent) spirit or washing benzene(petroleum ether) can be used to remove greasy dirt. The display may be cleaned with water or washing benzene (but not with spirit- alcohol solvents), it must then be wiped with a dry clean lint-free cloth. Under no circumstances the cleaning fluid should get into the instrument. The use of cleaning agents can attack the plastic & paint surfaces.

### Dispatch Procedure for Service

No user serviceable parts are inside the instrument, should it become necessary to send back the instrument to factory for service, please observe the following procedure:

1. Before dispatching the instrument please write to us giving full details of the model number, serial number, fault noticed and contact details of concerned person.
2. After receipt of your communication, our service department will advise you whether it is necessary to send the instrument back to us for repairs or the adjustment is possible in your premises.
3. Dispatch the instrument (only on the receipt of our advice) securely packed in original packing duly insured and freight paid along with accessories and a copy of the faults details noticed at our Service Center listed on last page of this manual, nearest to you.

## Chapter 10 Warranty

Scientific warrants all its Instruments to be free from defects in material and workmanship when used under normal operating conditions in accordance with the instructions given in the manual for a period of 12 (Twelve) months from date of purchase from Scientific or its authorized dealers.

The service during the warranty period will be rendered on return to factory / service center basis.

1. Its obligation under this warranty is limited to repairing or replacing at its own discretion. This warranty shall not apply to any defect, failure or damage caused by accident, negligence, mis-application, alteration or attempt to repair, service or modify in any way.
2. This warranty does not include display, fuses, batteries or accessories. This warranty is only valid with the original purchaser who must have properly registered the product within 15days from date of purchase. No other warranty is expressed or implied.
3. When it becomes necessary to return the instrument to our Factory facility, kindly pack it carefully in the original carton or equivalent and ship it duly insured, transportation charges prepaid.
4. Your Scientific instrument is a complex electronic device and deserves the best service available by technicians thoroughly familiar with its service and calibration procedures.