

# **OPERATION MANUAL**

## **TH2816B**

**Precision LCR Meter**

**TONGHUI (CHANGZHOU) Electronic Co., Ltd.**

**Version 1.0**

**[www.tonghui.com.cn](http://www.tonghui.com.cn)**

## Contents

Chapter 1	Overview .....	5
1.1	Product introduction.....	5
1.2	Operation conditions .....	6
1.2.1	Power requirements.....	6
1.2.2	Operation environment.....	6
1.2.3	Warm-up time.....	6
1.2.4	Notes for usage.....	6
1.3	Dimension and weight.....	7
1.4	Safety Summary .....	7
1.5	Electromagnetic compatibility .....	7
Chapter 2	Basic Specifications .....	8
2.1	Measurement Functions .....	8
2.1.1	Measurement Parameters .....	8
2.1.2	Combinations of Measurement Parameters.....	8
2.1.3	Equivalent Circuit .....	8
2.1.4	Ranging .....	9
2.1.5	Trigger.....	9
2.1.6	Delay Time .....	10
2.1.7	Measurement Terminals .....	10
2.1.8	Measurement Speed .....	10
2.1.9	Averaging .....	10
2.1.10	Basic Accuracy .....	10
2.2	Test Signal.....	10
2.2.1	Test Signal Frequency .....	10
2.2.2	Test signal level.....	10
2.2.3	Output impedance .....	11
2.2.4	Test Signal Level Monitor.....	11
2.2.5	Display Range .....	11
2.3	Functions.....	11
2.3.1	Correction Functions.....	11
2.3.2	Comparator function .....	11
2.3.3	Measurement results display .....	12
2.3.4	File Function .....	12
2.3.5	Other Function .....	12
2.3.6.1	Ranging mode .....	12
2.3.6.2	Contrast adjustment.....	12
2.3.6.3	Beep .....	12
2.3.6.4	Comparator alarm.....	12
2.3.6.5	Key lock function.....	12
2.3.6.6	Password .....	13
2.3.7	Interface Function .....	13
2.3.7.1	IEEE488 interface .....	13
2.3.7.2	RS232C interface .....	13
2.3.7.3	HANDLER interface.....	13
Chapter 3	Panel and Display Introduction .....	14
3.1	A Tour of the Front Panel .....	14
3.2	A Tour of the Rear Panel .....	15
3.3	Display Area Definition .....	16
3.4	MENU keys and Display Page.....	16
3.5	Summary of Pages.....	17
Chapter 4	Operation.....	19
4.1	Basic operation.....	19
4.2	Welcome Page.....	20
4.3	Detailed Operation .....	21
4.3.1	MeasDisplay Page.....	21
4.3.1.1	Measurement Function.....	22

4.3.1.2	Test Frequency .....	23
4.3.1.3	Oscillator Level .....	24
4.3.1.4	Measurement Range .....	25
4.3.1.5	Measurement Speed .....	26
4.3.1.6	Short Correction .....	26
4.3.1.7	Open Correction .....	27
4.3.1.8	File Management .....	27
4.3.1.9	Useful Tools .....	29
4.3.2	Bin Number Display Page .....	30
4.3.2.1	Comparator Function ON/OFF .....	31
4.3.2.2	Auxiliary Bin ON/OFF .....	31
4.3.2.3	File Management .....	32
4.3.2.4	Useful Tools .....	32
4.3.3	Meas Setup Page .....	33
4.3.3.1	Trigger Mode .....	35
4.3.3.2	Output Signal impedance .....	36
4.3.3.3	Delay Time (DELAY ) .....	36
4.3.3.4	Averaging Rate (AVG) .....	36
4.3.3.5	Signal Level Monitor ON/OFF .....	36
4.3.3.6	Deviation Measurement Function .....	37
4.3.3.7	File Management .....	38
4.3.3.8	Useful Tools .....	38
4.3.4	Limit Table .....	38
4.3.4.1	Nominal Value for tolerance mode .....	39
4.3.4.2	Swap Parameter Function .....	40
4.3.4.3	Comparator Function's Limit Mode .....	40
4.3.4.4	Comparator Function ON/OFF .....	40
4.3.4.5	Auxiliary bin ON/OFF .....	40
4.3.4.6	Low/High Limit Value .....	40
4.3.4.7	File Management (File) .....	41
4.3.4.8	Useful Tools .....	41
4.3.5	System Configuration Page .....	41
4.3.5.1	LCD Contrast Function .....	42
4.3.5.2	Information Beeper Function ON/OFF .....	43
4.3.5.3	Comparator Alarm Function ON/OFF .....	43
4.3.5.4	Password Function .....	43
4.3.5.5	Bus Mode Function .....	44
4.3.5.6	GPIB address .....	44
4.3.5.7	AutoFetch mode ON/OFF .....	44
Chapter 5	Remote Control .....	45
5.1	RS232C Interface Introduction .....	45
5.1.1	RS232C Connection .....	45
5.1.2	Communication with a Computer .....	46
5.1.3	Communication with a DC Bias Current Source .....	49
5.2	GPIB Interface Introduction .....	50
5.2.1	GPIB Connection .....	50
5.2.2	GPIB Interface Capabilities Functions .....	53
5.2.3	GPIB Addressing .....	53
5.2.4	GPIB Bus Function .....	53
5.3	Data Format .....	53
5.3.1	Format 1 .....	54
5.3.2	Format 2 .....	55
Chapter 6	Command Reference .....	56
6.1	Notation Conventions and Definitions .....	56
6.2	Command Structure .....	56
6.3	Command Abbreviations .....	58
6.4	Suffix Units and suffix Multipliers .....	58

6.5	Command Reference .....	59
6.5.1	DISPlay Subsystem .....	60
6.5.2	FREQuency Subsystem .....	61
6.5.3	VOLTage Subsystem .....	62
6.5.4	FUNCTion Subsystem .....	63
6.5.5	APERture Subsystem .....	66
6.5.6	TRIGger Subsystem .....	67
6.5.7	FETCh? Subsystem .....	68
6.5.8	ABORt Subsystem .....	69
6.5.9	CORRection Subsystem .....	69
6.5.10	COMParator Subsystem .....	71
6.5.11	Mass MEMory Subsystem .....	76
6.5.12	Common Commands .....	77
6.5.13	Error and Warning Messages .....	78
Chapter 7	Handler Interface .....	79
7.1	Basic Information .....	79
7.2	Handler Interface Operation .....	79
7.2.1	Signal line definition .....	79
7.2.1.1	Signal Line Used for Comparator Function .....	79
7.2.1.2	Signal Line Used for List Sweep Comparator Function .....	83
7.3	Electrical Characteristics .....	87
7.3.1	DC Isolated Outputs .....	87
7.3.2	DC Isolated Input .....	89
7.4	Setting Up the Handler Interface Board .....	89
7.5	Operation .....	91
7.5.1	Setting Procedure For Comparator Function .....	91
7.5.2	Setting Procedure For List Sweep Comparator function .....	91

# Chapter 1 Overview

Thank you for choosing our product. The contents of the shipment should be as listed in the packing list. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the power-on self tests, please notify our company.

## 1.1 Product introduction

TH2816B is a precision LCR meter with high accuracy, good stability, and wide measurement range. Controlled by a 16 bits MPU, TH2816B can be used for evaluating LCR components, materials and semiconductor devices over a wide range of frequencies (50 Hz to 200 kHz) and test signal levels (0.01 V to 2.00 V, with 0.01 V resolution ). With its powerful function, excellent performance, perspicuous LCD display and easy menu operation, TH2816B is suitable for high speed measurement need on product line and high accuracy and stability measurement need in laboratory. By using the Handler interface, IEEE488 interface (optional), and RS232C interface, TH2816B can easily be used for automatic test system and computer remote control.

The instrument provides variable test conditions, typical conditions are as follows:

- Test signal frequency  
37 typical frequency points available from 50 Hz to 200 kHz.
- Test signal level  
Programmable signal level from 0.01 V to 2.00 V in 0.01 V resolution.
- Measurement speed  
Fast, Medium and Slow measurement speed can be selected. Using the averaging rate (from 1 to 255 programmable) function, you can get more stable measurement results.
- Constant signal source output impedance  
30  $\Omega$  or 100 $\Omega$  selectable
- Bias current  
TH2816B can control the external bias current source (for example TH1773) for bias current list sweep measurement.
- Correction function  
The OPEN, SHORT correction for correcting the stray admittance, the residual impedance, and the other errors can be performed. The correction function has two kinds of correction methods. In one method the open and short correction can be performed at all of the frequency points, and in the other method the open, short correction can be performed at the frequency points you specify.
- Test signal level monitor  
The actual signal level may be different with the setup signal level. The level monitor function allows you to monitor the actual voltage level across the device under test or the actual current level through the device under test.

TH2816B provides 3 types of display results and 2 kinds of comparison methods

- Direct readout: The actual measurement results are displayed.
- Absolute deviation ( $\Delta$ ABS): The difference between the measured value of the DUT and a previously stored reference value are displayed.
- Percent deviation ( $\Delta$ %): The difference between the measured value of the DUT and a previously stored reference value are displayed as a percentage of the reference value.

- Absolute deviation or percent deviation can be set as comparison limits. TH2816B can output comparison results for sorting components into a maximum of 10 bins. (BIN1 to BIN 9 and OUT). Also, devices whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits, can be sorted into an AUXiliary BIN.

TH2816B provides several communication interfaces which make it easy to output the measurement results to other equipments (for example computers), or build an automatic test system.

- RS232C interface: RS232C interface make it easy to communicate with other equipments. You can set the measurement functions and input the parameters through the RS232C interface instead of front panel keyboard. The RS232C interface can also be used as the control interface for the external bias current source.
- IEEE488 interface (optional): The IEEE488 interface is an optional interface on the TH2816B and can be used to build an automatic test system to completely characterize new components and materials, and to fully automate production line testing.
- HANDLER interface(optional): By using the handler interface, the TH2816B can easily be combined with a component handler, and a system controller to fully automate component testing, sorting, and quality control data processing.

TH2816B's file function can save the setup parameters, limit parameters and list sweep parameters as a file in the internal nonvolatile memory, and the No. 0 file will be automatically reloaded when TH2816B is powered on.

## 1.2 Operation conditions

### 1.2.1 Power requirements

TH2816B requires the following power source:

Voltage: 198 to 242 Vac

Frequency: 47 to 66 Hz

Power: 50 VA maximum

### 1.2.2 Operation environment

TH2816B must be operated under within the following environment conditions.

Temperature: 0°C to 40°C

Humidity: less then 90% RH

### 1.2.3 Warm-up time

Allow TH2816B to warm up a minimum of 20 minutes before starting tests.

### 1.2.4 Notes for usage

- Please do not operate the instrument in the places where is vibrative, dusty, under direct sunlight, or where there is corrosive air.
- 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.
- Please store the instrument in the place where temperature is between 5°C and 40°C, humidity is less then 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.
- TH2816B has the cooling fan on the rear panel and cooling holes on both sides. High temperature inside will decrease the measurement accuracy, so sufficient space must be kept around the TH2816B to avoid obstructing the air flow of the

- cooling fans.
- Don't frequently turn on and off the instrument, doing so will lead to the loss of the calibrated data and the data saved by users.

### **1.3 Dimension and weight**

Dimensions: 350(W) by 110(H) by 340(D) (mm)

Weight: Approximately 4 kg

### **1.4 Safety Summary**

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument.

#### **Ground the Instrument**

To avoid electric shock hazard, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

#### **DO NOT Operate In an Explosive Atmosphere**

Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

#### **Keep Away From Live Circuits**

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

#### **DO NOT Service or Adjust Alone**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

#### **DO NOT Substitute Parts or Modify Instrument**

Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to our Sales and Service Office for service and repair to ensure that safety features are maintained.

### **1.5 Electromagnetic compatibility**

This product has been designed and tested to the requirements of the Electromagnetic Compatibility (EMC) Directive. To use a properly shielded cable or shielded coaxial cable to connect each of the ports to their respective controllers, peripherals, equipments or devices may ensure to meet the requirements.

# Chapter 2 Basic Specifications

## 2.1 Measurement Functions

### 2.1.1 Measurement Parameters

L:	Inductance
C:	Capacitance
R:	Resistance
Z :	Absolute value of impedance
X:	Reactance
B:	Susceptance
G:	Conductance
D:	Dissipation factor
$\theta$ :	Phase angle
Q:	Quality factor

### 2.1.2 Combinations of Measurement Parameters

Main parameters	Z	L	C	R	G
Secondary parameters	$\theta(\text{deg}), \theta(\text{rad})$	Q, $R_s, R_p$	D, $R_s, R_p$	X	B

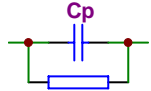
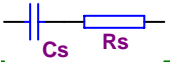
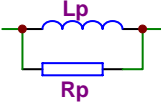
Suffix "s" means series; suffix "p" means parallel.

### 2.1.3 Equivalent Circuit

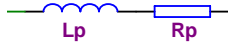
The actual capacitor, resistor and inductor are not the ideal capacitor, resistor and inductor. Normally, a component has the characteristics of the resistor and the reactor at the same time. The actual component is composed of an ideal resistor and reactor (ideal inductor or capacitor) in series or parallel equivalent circuits.

The values in the two different equivalent circuits can be converted to each other using the following formulas in Table 2-1. The values are different due to the quality factor Q (or the dissipation factor D).

**Table 2-1 Parallel and Series Circuit Mode**

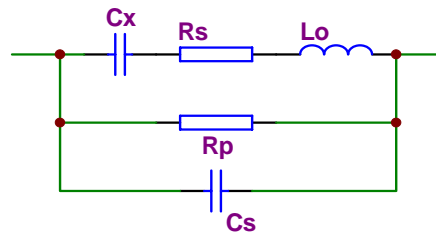
Circuit Mode	Dissipation Factor	Conversion
C	 $D = \frac{1}{2\pi f C_p R_p} = \frac{1}{Q}$	$C_s = (1 + D^2) C_p$ $R_s = R_p D^2 / (1 + D^2)$
	 $D = 2\pi f R_s C_s = \frac{1}{Q}$	$C_p = 1 / (1 + D^2) C_s$ $R_p = R_s (1 + D^2) / D^2$
L	 $D = \frac{2\pi f L_p}{R_p} = \frac{1}{Q}$	$L_s = 1 / (1 + D^2) L_p$ $R_s = R_p D^2 / (1 + D^2)$



		$D = \frac{R_s}{2\pi f L_s} = \frac{1}{Q}$	$L_p = (1 + D^2)L_s$ $R_p = R_s(1 + D^2)/D^2$
	<i>L: Inductor</i> <i>R: Resistor</i> <i>Suffix s: Series</i>	<i>C: Capacitor</i> <i>D: Dissipation factor</i> <i>Suffix p: Parallel</i>	<i>f: Frequency</i> <i>Q: Quality factor</i>

The following description gives some practical guidelines for selecting the capacitance measurement circuit mode.

- a) We can select the circuit mode according to the variation of D at two different frequencies. If the dissipation factor of a capacitor increases with the increase of the test frequency, series circuit mode should be selected. If the dissipation factor decreases with the increase of the test frequency, parallel circuit should be used. For inductor, the situation is just in the opposite side. In fact, D is impossible in direct ratio with the test frequency. From Figure 2-1, we can find that Rp and Rs exist at the same time. If Rs is more significant than Rp, series mode is selected; If Rp is more significant than Rs, parallel mode is more suitable.



**Figure 2-1. Equivalent circuit of an actual capacitor**

Where,

Cx: ideal capacitor

Rx: resistance of the leads

Lo: inductance of the leads

Rp: insulation resistance across the capacitor

Co: stray capacitor across the capacitor.

For a given frequency F, Cs and Cp can be calculated.

- b) When there is no proper information available, please make decision according to following rules:
- For low impedance component ( such as large capacitor or small inductor ) , the series equivalent circuit mode should be used.
  - For high impedance component ( such as small capacitor or large inductor ) , the parallel equivalent circuit mode is the appropriate choice.
  - If a capacitor is used as a filter capacitor, series circuit mode is the best choice.
  - If a capacitor is used in a LC oscillator then parallel circuit mode can be selected.

#### 2.1.4 Ranging

Auto and Manual (Hold/Up/Down), total 9 ranges.

#### 2.1.5 Trigger

TH2816B has four trigger modes: INTernal, EXTernal, MANual, and BUS. Except for BUS trigger mode these trigger modes can be set on the front panel. The BUS trigger mode is used when TH2816B is controlled via GPIB.

Internal: When the trigger mode is set to INTernal trigger mode, TH2816B continuously repeats measurements.

External: When the trigger mode is set to EXTERNAL, TH2816B performs a single measurement every time a low-to-high transition TTL level signal is applied to the Handler interface on the rear panel.

BUS: When the trigger mode is set to BUS trigger mode, TH2816B performs a single measurement every time the \*TRG common command is sent to TH2816B via GPIB. The BUS trigger mode cannot be set on the front panel. Send the TRIGGER:SOURCE BUS command via GPIB or RS232C to set the trigger mode to the BUS trigger mode.

Manual: When the trigger mode is set to MANUAL trigger mode, TH2816B performs a single measurement every time when TRIGGER key on the front panel is pressed.

### 2.1.6 Delay Time

Programmable delay from the trigger command to the start of the measurement, 0 to 60.000 s in 1 ms steps.

### 2.1.7 Measurement Terminals

Four terminals:

HD ( $H_{CUR}$ ): High current

HS ( $H_{POT}$ ): High potential

LS ( $L_{POT}$ ): Low potential

LD ( $L_{CUR}$ ): Low current

### 2.1.8 Measurement Speed

TH2816B's measurement speed is determined by Integration time, measurement result display time, averaging rate and delay time.

FAST: about 25 meas/sec, maximum 30 meas/sec.

MED: about 10 meas/sec.

SLOW: about 1.5 meas/sec.

### 2.1.9 Averaging

1 to 255, programmable

### 2.1.10 Basic Accuracy

0.05%

## 2.2 Test Signal

### 2.2.1 Test Signal Frequency

Total 37 typical frequency points available from 50Hz to 200kHz:

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

Frequency Accuracy: 0.02%

### 2.2.2 Test signal level

0.01 V to 2.00 V, 0.01 V resolution

Level accuracy:  $\pm(10\% \times \text{setup value} + 2 \text{ mV})$

### 2.2.3 Output impedance

30Ω±5% (default), 100Ω±5%

### 2.2.4 Test Signal Level Monitor

Mode	Range	Monitor Accuracy
Voltage	10 mV <sub>rms</sub> – 2.00 V <sub>rms</sub>	±(3% of reading+0.5mV)
	0.01 mV <sub>rms</sub> – 10 mV <sub>rms</sub>	±(12% of reading+0.1mV)
Current	100μA <sub>rms</sub> – 66mA <sub>rms</sub>	±(3% of reading+5μA)
	0.001μA <sub>rms</sub> – 100 μA <sub>rms</sub>	±(12% of reading+1μA)

### 2.2.5 Display Range

Parameter	Range
L	0.01 nH to 9999.99 H
C	0.00001 pF to 999.999 mF
R, X, Z	0.01 mΩ to 99.9999 MΩ
B, G	0.01 nS to 999.999 S
D	0.00001 to 9.99999
Q	0.01 to 99999.9
θ	Deg -179.999° to 179.999°
	Rad -3.14159 to 3.14159
%	-99.999% to 999.999%

## 2.3 Functions

### 2.3.1 Correction Functions

- Open correction  
Eliminates measurement errors due to parasitic stray admittance (C, G) of the test fixture. Three frequency points or sweep frequency Open correction is available.
- Short correction  
Eliminates measurement errors due to parasitic residual impedances (L, R) of the test fixture. Three frequency points or sweep frequency Short correction is available.
- Load correction  
Improves the measurement accuracy by using a device which value is accurately known (a working standard) as a reference. Three frequency points load correction is available.

### 2.3.2 Comparator function

10-bin sorting for the primary measurement parameter, and IN/ OUT decision output for the secondary measurement parameter.

BIN1 to BIN9: Both primary and secondary measurement parameters are within limits.

OUT BIN: Primary parameter is not within limits. Or primary parameter is within limits, secondary parameter is not within limits, and AUX bin is off.

AUX BIN: Primary parameter is within limits, but whose secondary parameter measurement result is not within limits.

If the secondary parameter limits are not set, TH2816B will not compare the secondary parameter.

- Sorting Modes  
Absolute deviation mode: absolute deviations are compared with bin limits.  
Percent deviation mode: percent deviations are compared with bin limits.
- Bin Count  
Each bin has a bin counter, counts from 0 to 999999.

- Display pages  
**BinNo. Disp** page and **Bin Count** page

More detail information is outputted through the Handler interface:

PHI: Primary measurement parameter is high.  
PLO: Primary measurement parameter is low.  
SREJ: Secondary measurement parameter is rejected.

### 2.3.3 Measurement results display

- Measurement results can be displayed in large characters or normal characters.
- Measurement results display mode
  - 1) Direct readout: The actual measurement values are displayed.
  - 2)  $\Delta$ ABS: The difference between the measured value of the DUT and a previously stored reference value are displayed
  - 3)  $\Delta$  %: The difference between the measured value of the DUT and a previously stored reference value are displayed as a percentage of the reference value.
- Primary and secondary parameters are displayed with 6 digits resolution.
- Fixed decimal point function is used to display the measurement data using a fixed point display format. This function can also be used to change the number of digits displayed.

### 2.3.4 File Function

Control settings, comparator high and low limits etc. can be stored and retrieved as a file in the non-volatile memory. Users don't have to set the parameters for the instrument every time. A maximum of 12 sets of instrument control settings can be stored in the internal non-volatile memory.

TH2816B will reload the No. 0 file every time when the instrument is turned on. So users can save the control settings in file No. 0 for convenience.

### 2.3.5 Other Function

#### 2.3.6.1 Ranging mode

When the measurement range is set to AUTO, TH2816B automatically selects the appropriate range according to the DUT's impedance, test frequency, and oscillator level.

When the measurement range is set to the HOLD mode, the impedance range is fixed at the current range setting, and the impedance range name is displayed in the **RANGE** field.

#### 2.3.6.2 Contrast adjustment

Contrast function allows you to adjust the LCD's contrast value from 1 to 31.

#### 2.3.6.3 Beep

You can turn on or turn off the internal beep.

#### 2.3.6.4 Comparator alarm

You can select a comparator alarm status from IN, OUT, AUX and OFF.

#### 2.3.6.5 Key lock function

TH2816B has keyboard lock-out capability that disables all front panel operation except for softkey **KEY**. This is useful when you don't want the control settings changed.

#### **2.3.6.6 Password**

If the password function is set to ON, you are required to input the correct password in order to turn on the TH2816B, or unlock the keyboard.

Password is composed of the digits 0 to 9.

Factory default password: **2816**

#### **2.3.7 Interface Function**

##### **2.3.7.1 IEEE488 interface**

IEEE488 interface is also called as GPIB interface, and equal to IEC625 interface (only with different connector). The programming language is SCPI. All commands and data are transmitted using ASCII codes over the bus.

Interface Functions: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, C0, E1

Compatible with IEEE-488.1 and 488.2

##### **2.3.7.2 RS232C interface**

Baud rate: fixed 9600 bps

Signal logical level:  $\pm 8V$

Maximum transmission distance: 15 m

The programming language is SCPI. All commands and data are transmitted using ASCII codes over the bus.

##### **2.3.7.3 HANDLER interface**

TH2816B can receive the Trigger signal and output the comparison results and list sweep comparison results through the HANDLER interface.

Synchronous signal IDX and EOM can be outputted.

The output signals are logical low active and opto-isolated.

TH2816B's outputs have pull-up resistors on the handler interface board. External source is used as the default power supply.

# Chapter 3 Panel and Display Introduction

This chapter provides information including a tour of the front panel and display area definition, which will help you to quickly learn how to operate the TH2816B. For more information, please refer to chapter 4.

## 3.1 A Tour of the Front Panel

Figure 3-1 shows the brief description of key on the TH2816B's front panel.

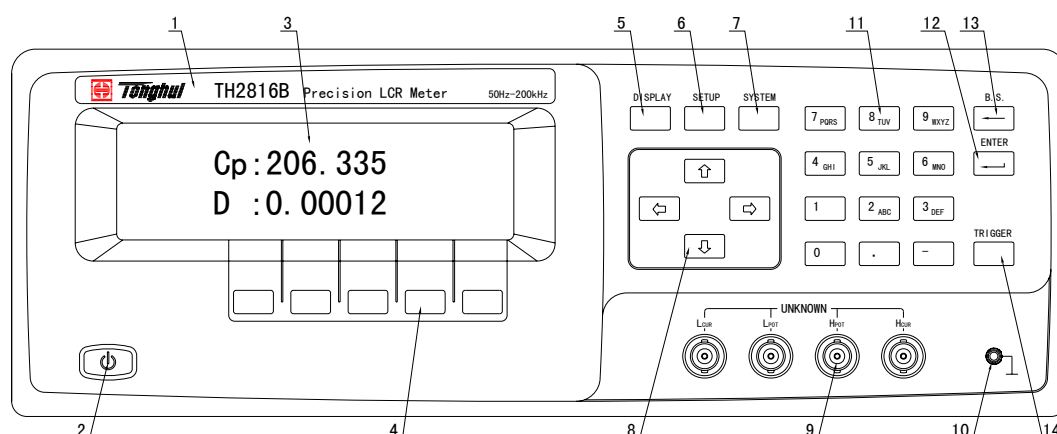


Figure 3-1. Front panel overview

- 1) Brand and Model  
The registered brand of our company and model of the instrument are printed.
- 2) Power on/off  
Power on/off switch. In the "ON" position all operating voltages are applied to the instrument. In the "OFF" position NO operating voltages are applied to the instrument.
- 3) LCD  
240×64 dot-matrix Liquid Crystal Display (LCD) displays measurement results, test conditions, etc.
- 4) SOFTKEYs  
The five keys' functions are not fixed, they have different functions in different menus. Five softkeys are used to select control and parameter functions. Current function of each softkey is displayed in the softkey area at the bottom of LCD.
- 5) **HOME** menu key  
Press **HOME** menu key to enter the **Meas Display** page.
- 6) **PREV** menu key  
Press **PREV** menu key to enter the **Previous** page.
- 7) **NEXT** menu key  
Press **NEXT** menu key to enter the **Next** page.
- 8) Cursor keys  
The CURSOR arrow keys are used to move the field select cursor from field to field on the LCD display page. When the cursor is moved to a field the field changes to an inverse video image of the original field.
- 9) Unknown terminals  
These are the UNKNOWN Terminals used to connect a four-terminal pair test

fixture or test leads for measuring the device under test.

HD( $H_{CUR}$ ): High current drive

HS( $H_{POT}$ ): High potential sense

LS( $L_{POT}$ ): Low potential sense

LD( $L_{CUR}$ ): Low current drive

10) Frame terminal

This is the FRAME Terminal which is tied to the instrument's chassis and which can be used for measurements that require guarding.

11) Number keys

The NUMBER keys are composed of the digits 0 to 9, a period ., a minus sign -, number keys are used to enter numeric data into the TH2816B.

12) ENTER key

ENTER terminates numeric input data and enters the displayed value in the input window.

13) B.S. key

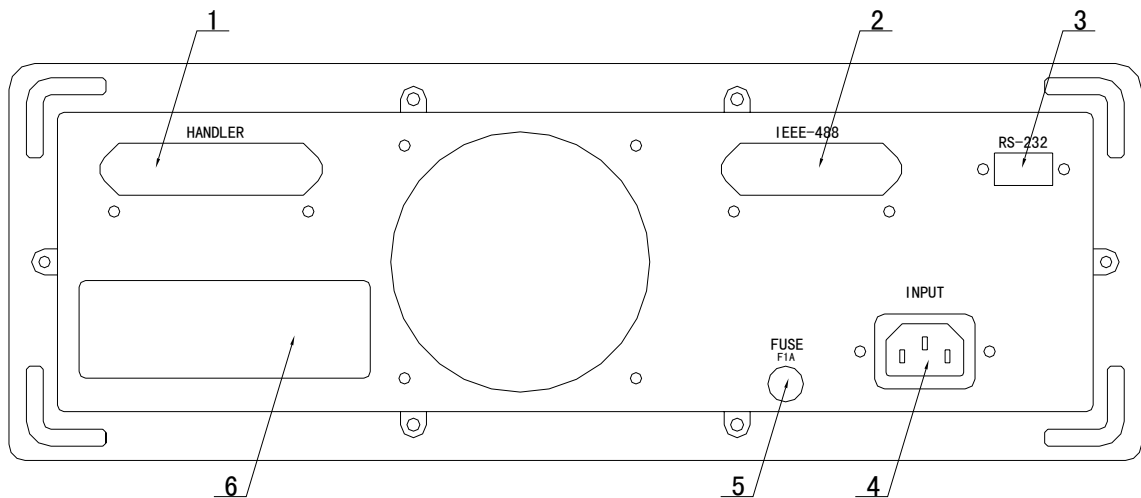
BACKSPACE key deletes one last character of the input value.

14) TRIGGER key

This is the TRIGGER key used to manually trigger the TH2816B when it is set to the Manual Trigger mode.

## 3.2 A Tour of the Rear Panel

Figure 3-2 gives a brief description of the TH2816B's rear panel.



**Figure 3-2. Rear panel overview**

1) HANDLER Interface Connector(Optional)

This is the HANDLER interface connector used when operation with a component handler to fully automate component testing, sorting, and quality control data processing.

2) IEEE488 Interface Connector (Optional)

This is the IEEE488 interface connector used when operating on the General Purpose Interface Bus.

3) RS232C Interface Connector

This is the RS232C interface connector used when operating on the serial interface.

4) LINE Input Receptacle

- 5) AC power cord receptacle.
- 5) Fuse Holder  
Fuse holder for TH2816B line fuse, 220Vac, 1A.
- 6) Name Plate  
Name Plate is used to provide the information of date, model, lot number and manufacturer etc.

### 3.3 Display Area Definition

The display area on the LCD is divided into the areas show in Figure 3-3.

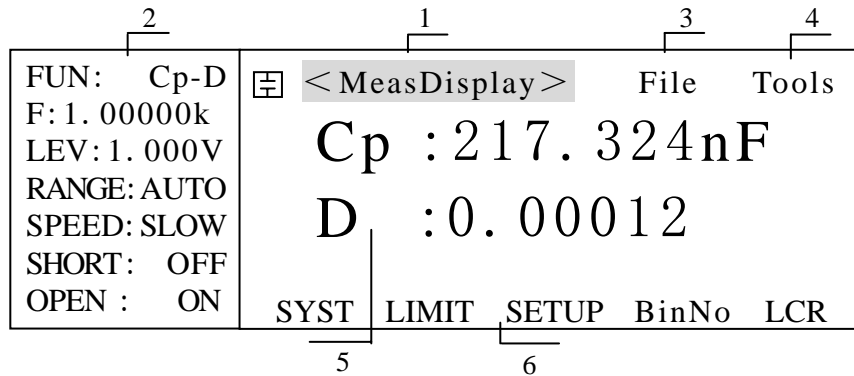


Figure 3-3. Display Area Definition

- 1) Display Page Area  
This is the display page area. This area identifies the current display page.
- 2) Measurement Conditions area  
This area is where measurement conditions are displayed.
- 3) File Menu Field  
When the cursor is set on the **File** field, common file functions which are not displayed on the display pages (for example, LOAD/Save function) are made available.
- 4) Tools Menu Field  
Some special controls which cannot be set on a display page's fields are made available.
- 5) Measurement Date Area  
This area is where measurement results are displayed.
- 6) Softkey Area  
The bottom line is reserved for softkey labels. The softkeys displayed correspond to the field at the cursor's position on the LCD.

### 3.4 MENU keys and Display Page

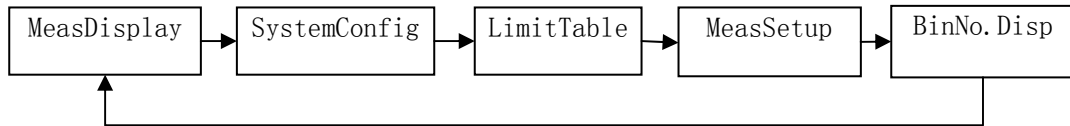
TH2816B has total file display pages:

- **MeasDisplay**
- **BinNo. Disp**
- **MeasSetup**
- **LimitSetup**
- **SystemConfig**

TH2816B has three MENU keys which are used to switch the LCD display page.

- 1) **HOME** MENU key  
This MENU key always switch to MeasDisplay page.
- 2) **PREV** MENU key  
This MENU key can switch to the previous page sequentially.





### 3) **NEXT** MENU key

This MENU key can switch to the next page sequentially.



## 3.5 Summary of Pages

### **MeasDisplay**

This display page provides the measurement result information, and some control settings are entered from this page. TH2816B measures the DUT from this page, and displays the measurement results in large or normal size characters. This display page is the default display page when TH2816B is turned on.

FUN: Cp-D F: 1.00000k LEV:1.000V RANGE: AUTO SPEED: LOW SHORT: OFF OPEN : ON	<div>&lt; MeasDisplay&gt; File Tools</div> <div>Cp :217.324nF</div> <div>D :0.00012</div> <div>SYST LIMIT SETUP BinNo LCR</div>
--	---


### **BinNo. Disp**

This display page provides the bin sorting result information, the measurement results, and comparator function on/off settings. The TH2816B measures the DUT from this page. The bin number is displayed in large characters, and the measurement results are displayed in normal size characters.

FUN: Cp-D F: 1.00000k LEV:1.000V RANGE:AUTO SPEED:LOW SHORT: OFF OPEN : ON	<div>☐ &lt; BinNo. Disp&gt; File Tools</div> <div>COMP: ON AUX: ON</div> <div>BIN : AUX</div> <div>Cp : 217.324nF D : 0.00012</div> <div>SYST LIMIT SETUP BinNo LCR</div>
--	---


### **Meas Setup**

This display page provides all of the measurement control settings. TH2816B can not perform a measurement from this page, and the measurement result can not be displayed on this page. When you want to measure the DUT using the control settings on this page, use one of the display pages from **DISPLAY** menu key.

FUN: Cp-D	 < Meas Setup > File Tools
F: 1.00000k	TRIG : INT DEV_A:OFF
LEV:1.000V	INT_R : 30Ω REF_A:0.00000pF
RANGE:AUTO	DELAY: 0ms DEV_B:OFF
SPEED: LOW	Vm/Im : OFF REF_B:0.00000
CABLE: 0m	SYST LIMIT SETUP BinNo LCR


### Limit Table

This display page provides the limit table settings for bin sorting. TH2816B doesn't perform measurement from this page. To see the comparison results, either the **BinNo. Disp** page or the **Bin Count** page should be used.

NOMINAL:	 < Meas Setup > File Tools
0. 00000pF	[BIN] [ LOW ] [ HIGH ]
FUNC: Cp-D	1
MODE: ±TOL	2
COMP: OFF	3
AUX : OFF	2nd
IN ALARM	SYST LIMIT SETUP BinNo LCR

### System Config

This display page provides the system information and control settings, such as LCD contrast adjustment, PASSWORD, and GPIB ADDRESS etc.

CONTRAST	 < System Config >
INFO BEEP	
CMP ALARM	
PASSWORD	Set Item From
BUS MODE	Left Column◀
GPIB ADDR	
AUTO FETCH	SYST LIMIT SETUP BinNo LCR

# Chapter 4 Operation

## 4.1 Basic operation

TH2816B's basic operation is described in the following paragraphs.

- Display the desired display page using the MENU keys and the softkeys. (Refer to Figure 3-1.)
- Move the CURSOR to the field to be used using the CURSOR keys. The cursor will be an inverse video marker, and the field is an area at which you can set the CURSOR. (Refer to Figure 4-1.)

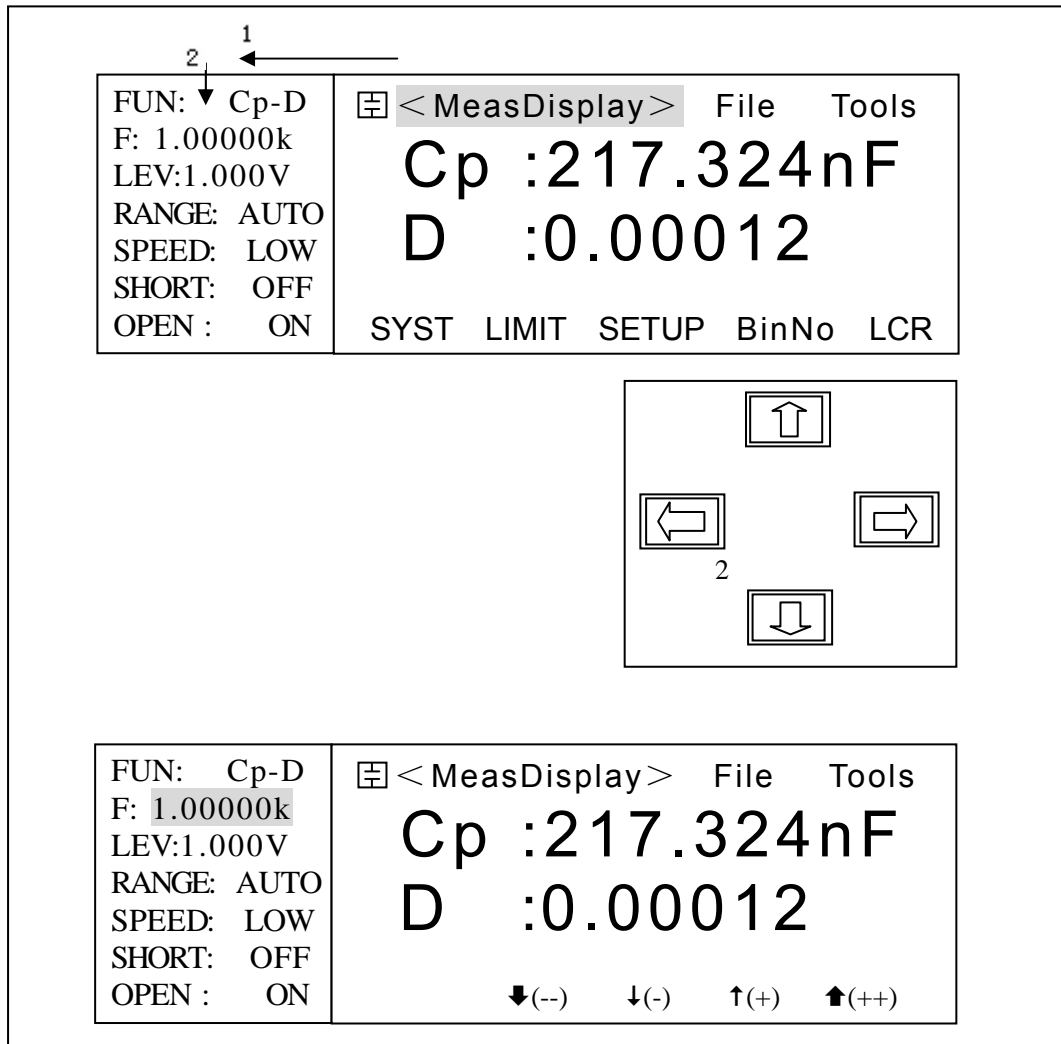
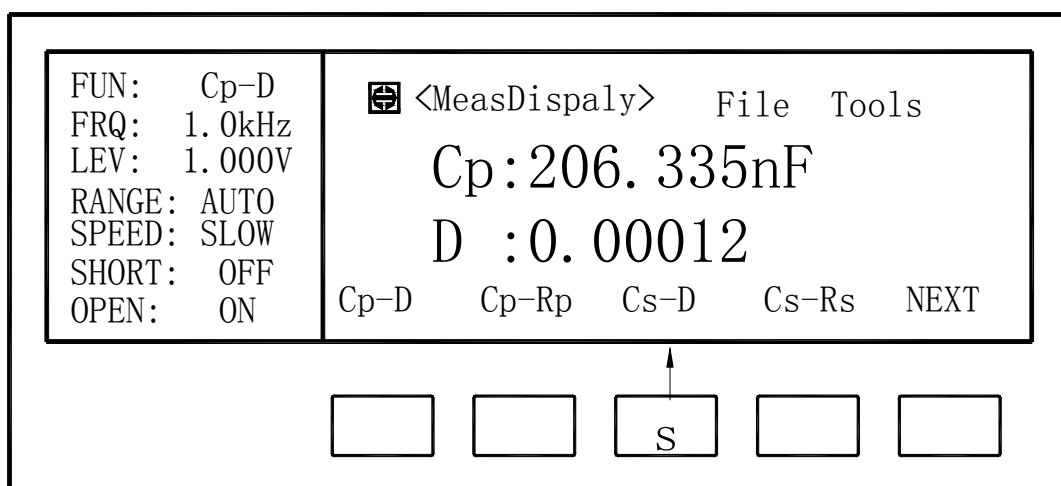


Figure 4-1. CURSOR Keys and Field Operation Example

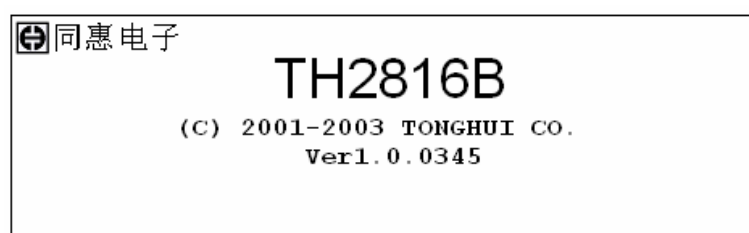
- The softkeys corresponding to the field pointed to by the CURSOR will be displayed. Select and press a softkey. The numeric entry keys and **ENTER** are used to enter numeric data. (Refer to Figure 4-2.)  
When one of the numeric entry keys is pressed, the softkeys will change to the available unit softkeys. You can use these unit softkeys instead of **ENTER**. When **ENTER** is used, the numeric data is entered with Hz, V, or A as the default unit depending on the cursor field selected, for example, the test frequency's unit will be Hz, etc.



**Figure 4-2. Softkey Selection Example**

## 4.2 Welcome Page

Press the power switch to turn on TH2816B, the welcome page will display as shown in Figure 4-3. The name of the instrument with its version will also be displayed. If password function is ON, you must input the correct password to start the instrument. If you input a wrong password for three times, the instrument will be locked. You must turn off the power and then turn on the power again in order to try another password. (Refer to Figure 4-4)



**Figure 4-3. Welcome Page**



**Figure 4-4. Input the Password**

Note: TH2816B's factory default password is "2816".

## 4.3 Detailed Operation

This Chapter provides information about the function of each page.

- **MeasDisplay**
- **BinNo. Disp**
- **MeasSetup**
- **LimitSetup**
- **SystemConfig**

This Chapter describes the functions on each page in the order of the preceding list.

### 4.3.1 MeasDisplay Page

When you press **HOME**, the **MeasDisplay** page will be displayed. On this page, the measurement results are displayed in large characters, and the following measurement controls can be set from this page. (The field in parenthesis is used to set the control function.)

- Measurement Function (**FUN**)
- Test Frequency (**FRQ**)
- Oscillator Level (**LEV**)
- Measurement Range (**RANGE**)
- Measurement Speed (**SPEED**)
- Short Correction (**SHORT**)
- Open Correction (**OPEN**)
- File Management (**File**)
- Useful Tools (**Tools**)

There are ten fields on this page: **<MeasDisplay>**, **FUN**, **FRE**, **LEV**, **RANGE**, **SPEED**, **SHORT**, **OPEN**, **File** and **Tools**. Each control function is described in the following paragraphs.

This page also provides the oscillator level voltage/current monitor value information in monitor areas on the displayed page. These conditions can be set from the **Meas Setup** page.

The available fields and the softkeys which correspond to the fields on this page are shown in Figure 4-5 and Figure 4-6 respectively.

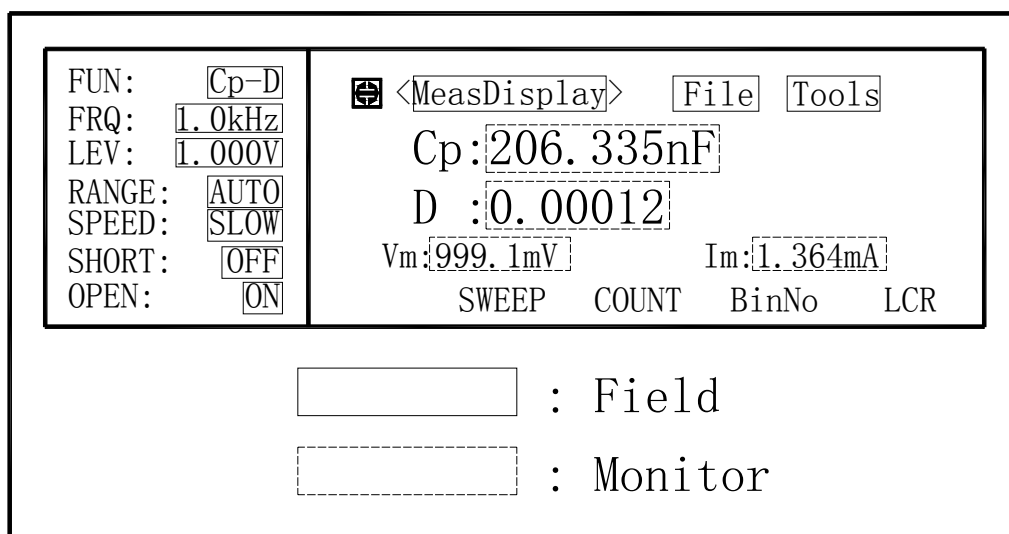


Figure 4-5. Available Fields on the MeasDisplay Page

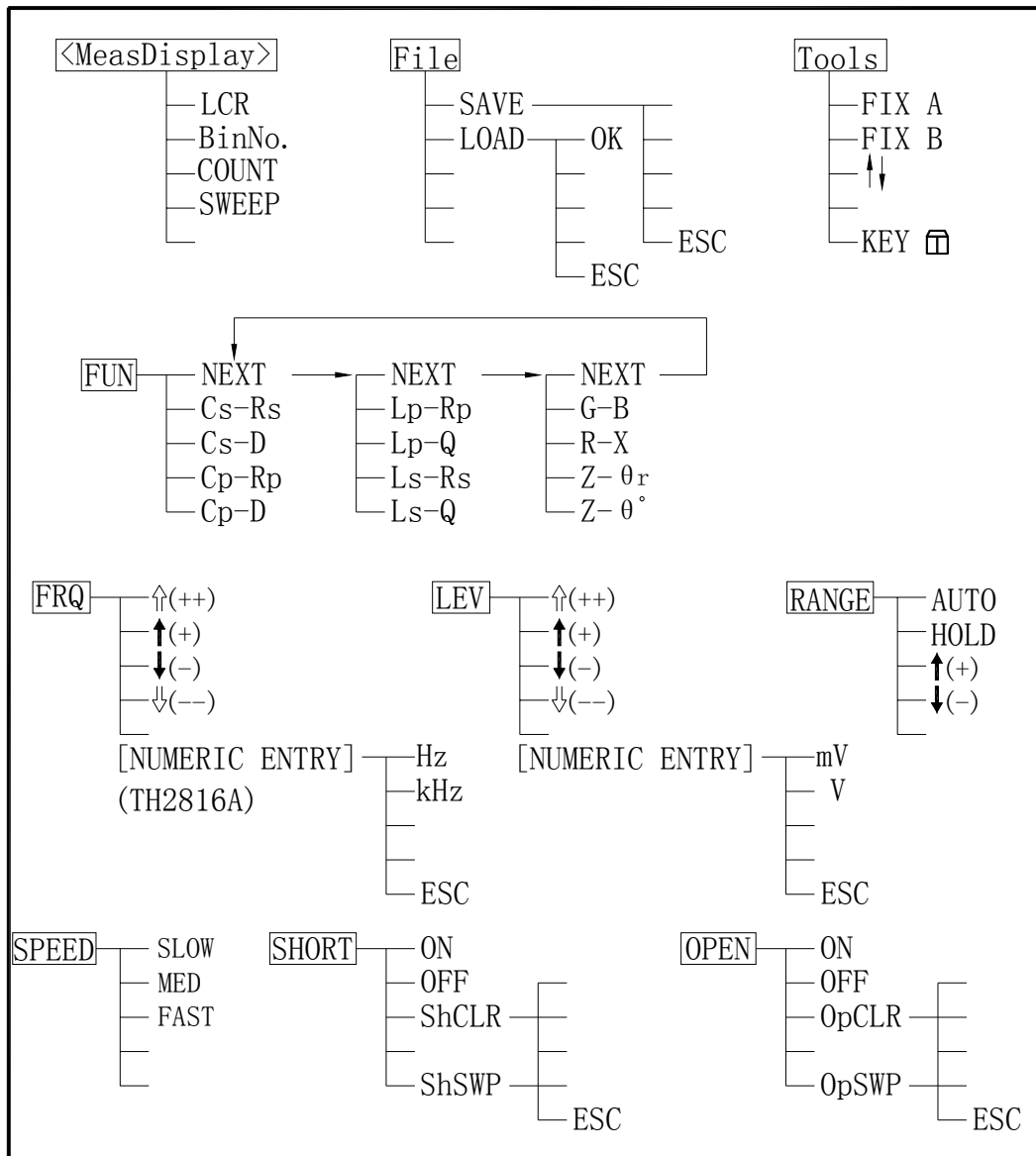


Figure 4-6. Available Softkeys on the MeasDisplay Page

#### 4.3.1.1 Measurement Function

TH2816B measures two components of the complex impedance (parameters) at the same time in a measurement cycle. The measurement parameters are listed as follows.

- Primary Parameters
  - |Z| (absolute value of impedance)
  - L (inductance)
  - C (capacitance)
  - R (resistance)
- Secondary Parameters
  - D (dissipation factor)
  - Q (quality factor)
  - Rs (equivalent series resistance)

- R<sub>p</sub> (equivalent parallel resistance)
- X (reactance)
- Θ (phase angle)

The primary parameter measurement result is located on the upper line as two large character lines on this page, and the secondary parameter measurement result is located on the lower line as two large character lines on this page.

The combinations of primary and secondary parameters, including the equivalent parallel and serial combinations, are listed in Table 4-1.

**Table 4-1. Measurement Function**

Primary Parameter	Serial Mode	Parallel Mode
Z	Z-Θ <sub>r</sub> Z-Θ°	
C	Cs-D Cs-Rs	Cp-D Cp-Rp
L	Ls-Q Ls-Rs	Lp-Q Lp-Rp
R	R-X	

#### Front Panel Operation for Setting the Measurement Function

Perform the following steps to set the measurement function.

- 1) Use the CURSOR arrow keys to move the cursor to the **FUN** field. The following softkeys will be displayed.
  - Cp-D
  - Cp-Rp
  - Cs-D
  - Cs-Rs
  - NEXT
- 2) Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press **NEXT** to display the following set of softkeys.
  - Ls-Q
  - Ls-Rs
  - Lp-Q
  - Lp-Rp
  - NEXT
- 3) Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press **NEXT** to display the following set of softkeys.
  - Z-Θ°
  - Z-Θ<sub>r</sub>
  - R-X
  - 
  - NEXT
- 4) Select and press a softkey to set the measurement function. When **NEXT** is pressed, the softkeys shown in step 1 will be displayed. Retry steps 1 through 4 if you missed the function you were looking for.

#### 4.3.1.2 Test Frequency

TH2816B operates from 50 Hz to 200 kHz with 37 typical frequency points which can be selected through softkeys, or set through numeric entry keys.

#### Front Panel Operation for Setting the Test Frequency

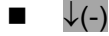
Perform the following steps to set the test frequency.

- 1) Move the CURSOR to the **FRQ** field. The following softkeys will be displayed.



This softkey is the coarse frequency decrement softkey which is used to decrease the test frequency to the next sequentially lower tenth value after 50 Hz. The frequency points set using this softkey are as follows.

50 Hz    100 Hz    1.0 kHz    10 kHz    100 kHz    200 kHz



This softkey is the fine frequency decrement softkey used to decrease the test frequency to the next sequentially lower frequency point. The sequential frequency points which can be set using this softkey are as follows.

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

If the input frequency is not the one supported by TH2816B, the TH2816B will automatically modify to the frequency point which is the nearest higher point.



This softkey is the fine frequency increment softkey used to increase the current test frequency to the next sequentially higher frequency point. The frequency points set using this softkey are the same values as set using .



This softkey is the coarse frequency increment softkey used to increment the test frequency to the next sequentially higher tenfold value after 50 Hz. The frequency points set using this softkey are the same as the frequency points set using .

#### 4.3.1.3 Oscillator Level

TH2816B's oscillator level can be set as the effective value (RMS value) of a sine wave of the test frequency from TH2816B's internal oscillator. The oscillator level can be set from 0 V<sub>rms</sub> to 2.00 V<sub>rms</sub> with a 0.01 V<sub>rms</sub> resolution. The output impedance can be selected either 30Ω or 100Ω.

Note: The set value of the oscillator voltage level is the value set when the measurement contacts (UNKNOWN Terminals) are opened.

#### Front Panel Operation for Setting the Oscillator Level

There are two ways to set the oscillator level. One is to use the softkeys, and the other is to use the numeric entry keys.

Perform the following steps to set the oscillator level.

- 1) Move the cursor to the **LEV** field. The following softkeys will be displayed.



This softkey is the coarse level decrement softkey which is used to decrease the test signal level by a 0.1 V<sub>rms</sub> step.



This softkey is the fine level decrement softkey which is used to decrease the test signal level by a 0.01 V<sub>rms</sub> step.



This softkey is the fine level increment softkey which is used to increase the test signal level by a 0.01 V<sub>rms</sub> step.





This softkey is the coarse level increment softkey which is used to increase the test signal level by a 0.01 V<sub>rms</sub> step.

- 2) Select and set the oscillator level using either the softkeys or the numeric entry keys. When the oscillator level is entered using the numeric entry keys, the softkey labels are changed to the available units labels (mV, V), and you can use these softkeys to enter the units and enter the data instead of **ENTER**. When **ENTER** is used, the numeric data is entered with V as the default unit.

#### 4.3.1.4 Measurement Range

TH2816B has nine measurement ranges: 10  $\Omega$ , 30  $\Omega$ , 100  $\Omega$ , 300  $\Omega$ , 1 k $\Omega$ , 3 k $\Omega$ , 10 k $\Omega$ , 30 k $\Omega$ , and 100 k $\Omega$ . The measurement range is selected according to the DUT's impedance even if measurement parameter is capacitance or inductance. Table 4-2 shows the effective measuring range for each measurement range while in the impedance mode (|Z|, R, X).

**Table 4-2. Measurement Range for Each Range**

RANGE	MEASUREMENT RANGE
10 $\Omega$	0 $\Omega$ to 10 $\Omega$
30 $\Omega$	10 $\Omega$ to 100 $\Omega$
100 $\Omega$	100 $\Omega$ to 316 $\Omega$
300 $\Omega$	316 $\Omega$ to 1 k $\Omega$
1 k $\Omega$	1 k $\Omega$ to 3.16 k $\Omega$
3 k $\Omega$	3.16 k $\Omega$ to 10 k $\Omega$
10 k $\Omega$	10 k $\Omega$ to 31.6 k $\Omega$
30 k $\Omega$	31.6 k $\Omega$ to 100 k $\Omega$
100 k $\Omega$	More than 100 k $\Omega$

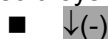
When the measurement range is set manually, the optimum measurement range should be selected by matching the DUT's impedance to the measurement range shown in Table 4-2. When the measurement range is set to AUTO, the optimum measurement range is automatically selected according to the impedance of each DUT.

**Note:** The measurement range is limited by the test frequency setting, when the oscillator level is equal to 2 V or less than 2 V. When the measurement range and the test frequency are set under the above conditions, the test frequency must be set first, and then the measurement range. If you set the measurement range first and then frequency, the resulting measurement range may not be the one you wanted to set.

#### Front Panel Operation for Setting the Measurement Range

Perform the following procedure to set the measurement range.

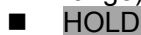
- 1) Move the cursor to the **RANGE** field using the CURSOR keys. The following softkeys will be displayed.



This softkey is used to decrease the measurement range in the HOLD (fixed range) mode.



This softkey is used to increase the measurement range in the HOLD (fixed range) mode.



This softkey is used to change the measurement range from the AUTO mode to the HOLD mode. When the measurement range is set to the HOLD mode, the impedance range is fixed at the current range setting, and the

- impedance range is displayed in the **RANGE** field.
  - **AUTO**  
This softkey is used to set the measurement range to AUTO.
- 2) Use the softkeys to set the measurement range.

#### 4.3.1.5 Measurement Speed

TH2816B's measurement speed is determined by the following conditions.

- Integration Time (A/D conversion)
- Averaging Rate (number of measurement averaged)
- Delay Time (time delay between the trigger and the start of the measurement)
- Measurement result's display time.

Generally, a slow measurement speed will result in more stable and accurate measurement results. SLOW, MED, and FAST measurement speed can be set.

##### Front Panel Operation for Setting the Measurement Speed

Perform the following steps to set the measurement speed.

- 1) Move the cursor to the **SPEED** field. The following softkeys will be displayed.
  - **FAST**
  - **MED**
  - **SLOW**
- 2) Use the preceding softkeys to select and set the measurement speed.

#### 4.3.1.6 Short Correction

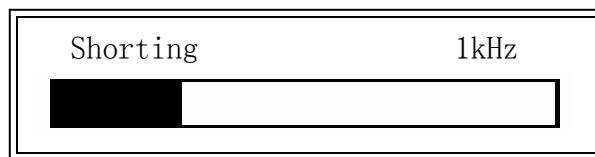
TH2816B's SHORT correction capability corrects for the residual impedance (R, X) in serial with the device under test.

##### Front Panel Operation for the Short Correction

There are two procedures: SHORT correction at all frequency points, and SHORT correction at the current test frequency point.

Perform the following steps to execute SHORT correction.

- 1) Move the cursor to the **SHORT** field. The following softkeys will be displayed.
  - **ShSWP**
  - **ShCLR**
  - **OFF**
  - **ON**
- 2) Connect the test fixture to the UNKNOWN Terminals, and short the measurement contacts together.
- 3) Press **ShSWP**. TH2816B will measure the short impedance (inductance and resistance) at all frequency points. Figure 4-7 shows the short correction information.



**Figure 4-7. Short Correction Information**

During the SHORT correction measurement cycle, the following softkey is available.

- **ESC**

This softkey is used to stop the short correction data measurement. The previous SHORT correction data is still stored.

- 4) Press **ON** to perform SHORT correction calculations on subsequent measurements.
- 5) Press **OFF** to halt SHORT correction calculations on subsequent measurements.

#### 4.3.1.7 Open Correction

TH2816B's OPEN correction capability corrects errors due to the stray admittance (G, B) in parallel with the device under test.

##### Front Panel Operation for the Open Correction

There are two procedures: OPEN correction at all frequency points, and OPEN correction at the current test frequency point.

Perform the following steps to execute OPEN correction.

- 1) Move the cursor to the **OPEN** field. The following softkeys will be displayed.
  - OpSWP
  - OpCLR
  - OFF
  - ON
- 2) Connect the test fixture to the UNKNOWN Terminals without connecting the device under test.
- 3) Press OpSWP. TH2816B will measure the open admittance (capacitance, and inductance) at all frequency points. Figure 4-8 shows the open correction information.

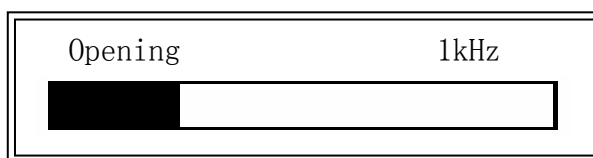


Figure 4-8. Open Correction Information

During the OPEN correction measurement cycle, the following softkey is available.

- ESC
- This softkey is used to stop the OPEN correction data measurement. The previous OPEN correction data is still stored.
- 4) Press ON to perform OPEN correction calculations on subsequent measurements.
  - 5) Press OFF to halt OPEN correction calculations on subsequent measurements.

#### 4.3.1.8 File Management

TH2816B uses the internal non-volatile memory for storing and retrieving a maximum of 12 sets of instrument control settings. The following data will be stored in non-volatile memory as one file.

- Control settings on the **Meas Setup** page.
  - ✧ Measurement Function
  - ✧ Test Frequency
  - ✧ Oscillator Level
  - ✧ Measurement Range
  - ✧ Measurement Speed
  - ✧ Trigger Mode
  - ✧ Output Impedance
  - ✧ Delay Time
  - ✧ Averaging Rate
  - ✧ Deviation Measurement A/B( $\Delta$ ABS/ $\Delta$ %/off)
  - ✧ Deviation Measurement AB Reference Value
- Control settings on the **Limit Table** page.
  - ✧ Nominal Value
  - ✧ Measurement Function (Swap Parameter)
  - ✧ Limit Mode for the Primary Parameter
  - ✧ Comparator Function on/off

- ✧ Auxiliary Bin on/off
- ✧ Alarm on/off
- ✧ Low/High Limits for Each Bin
- Display page format

When TH2816B is turned on, TH2816B's auto load function will load the control settings stored in file number 0. If there are no control settings stored in file number 0, the power-on default settings will be used.

The following items are stored in internal nonvolatile memory without using the LOAD/SAVE function.

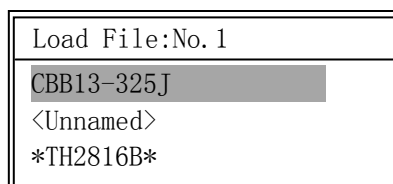
- Control settings on the **User Correction** page.
  - ✧ OPEN, SHORT, LOAD correction on/ff
  - ✧ OPEN, SHORT correction data for all test frequencies.
  - ✧ OPEN, SHORT, LOAD correction data at FREQ1, FREQ2, and FREQ3. (OPEN correction data at each frequency, SHORT correction data at each frequency, and LOAD correction reference data and actual data at each frequency.)
- Control settings on the **System Config** page.
  - ✧ Contrast of LCD
  - ✧ Information Beeper on/off
  - ✧ Comparator Alarm on/off
  - ✧ Password
  - ✧ Bus Mode
  - ✧ GPIB address
  - ✧ AutoFetch on/off

Perform the following steps to save the control settings to the internal non-volatile memory.

- 1) Select and set all control settings on the **MeasDisplay** page.
- 2) Move the cursor to the **File** field.
- 3) Press **SAVE**. The message "Enter save number" will be displayed in the message window.
- 4) Press **ESC** to cancel the number input operation.
- 5) Enter a save number from 0 to 11 using the numeric entry keys and press **ENTER**. The message "Enter File Name" will be displayed in the message window.
- 6) Press **ESC** to cancel the file name input operation.
- 7) Enter a file name using the numeric entry keys and **ENTER** to save the current control settings. Numeric digits and characters can be inputted as a file name.

Perform the following steps to load the control settings from the internal non-volatile memory.

- 1) Move the cursor to the **File** field.
- 2) Press **LOAD**. The message of available file(s) will be listed in the message window as shown in Figure 4-9.



**Figure 4-9. Available Files Message Window**

- 3) Use the up and down cursor keys to select a file and press **OK** to load the file.

- 4) Press **ESC** to cancel the load file operation.

#### 4.3.1.9 Useful Tools

TH2816B displays the measurement data using a six digit floating point display format. The fixed decimal point function is used to display the measurement data using a fixed point display format. This function can also be used to change the number of digits displayed.

Perform the following steps to use the xed decimal point function.

- 1) Move the cursor to the **Tools** field.
- 2) Press **FIX A** to fix the decimal point for the main parameter's data. The “\_” mark will be displayed at the decimal fixed point. Each time **FIX A** is pressed, the last digit is dropped, the value is rounded off.
- 3) Press **FIX B** to fix the decimal point for the sub parameter's data. The “\_” mark will be displayed at the decimal fixed point. Each time **FIX B** is pressed, the value is rounded off giving one less digit.
- 4) Press **↕** to switch the measurement result display characters between large character and normal character.
- 5) Press **KEY** to lock the keyboard and “KeyLocked !” message will be displayed in the message window.
- 6) Press **KEY** to unlock the keyboard and “KeyUnlock !” message will be displayed in the message window.

Note: When the measurement function is changed, the fixed decimal point function is automatically disabled.

### 4.3.2 Bin Number Display Page

When you press **PREV** or **NEXT**, or **BinNo** softkey, the **BinNo. Disp** page will be displayed. The bin sorting results are displayed in large characters and the measurement results are displayed in normal characters on the **BinNo. Disp** page, and the following measurement controls can be set from the **BinNo. Disp** page. (The field in parenthesis is used when this control is set.)

- Comparator Function ON/OFF (**COMP**)
- Auxiliary Bin ON/OFF (**AUX**)
- File Management (**File**)
- Useful Tools (**Tools**)

There are five fields on this page: **<BinNo. Disp>**, **COMP**, **AUX**, **File**, and **Tools** fields.

Each control is described in the following paragraphs.

This page also provides the following information in the monitor areas (each monitor area looks like a field, but is not). These conditions can be set from the **Meas Setup** page, and most conditions can be set from the **MeasDisplay** page.

- Measurement Function (**FUN**)
- Test Frequency (**FRQ**)
- Oscillator Level (**LEV**)
- Measurement Range (**RANGE**)
- Measurement Speed (**SPEED**)
- Open Correction (**OPEN**)
- Short Correction (**SHORT**)

The available fields and the softkeys which correspond to each field on this page are shown in Figure 4-10 and Figure 4-11.

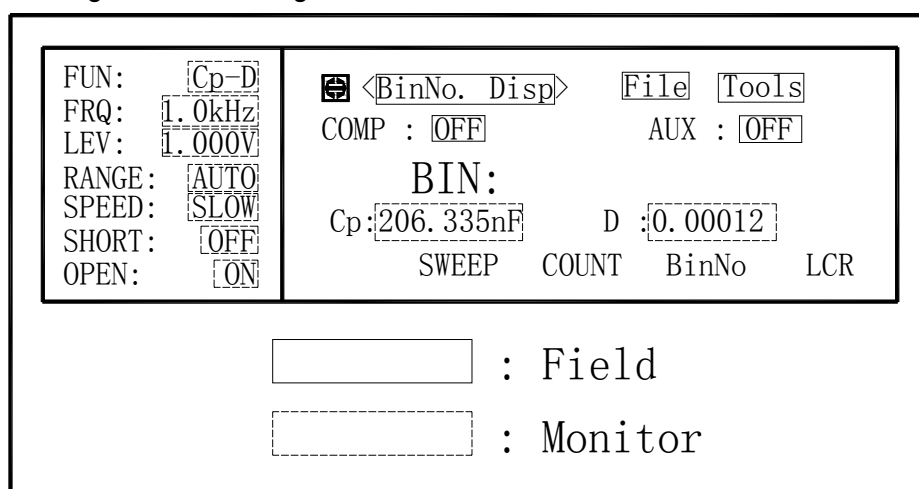


Figure 4-10 Available Fields on the BinNo. Disp Page

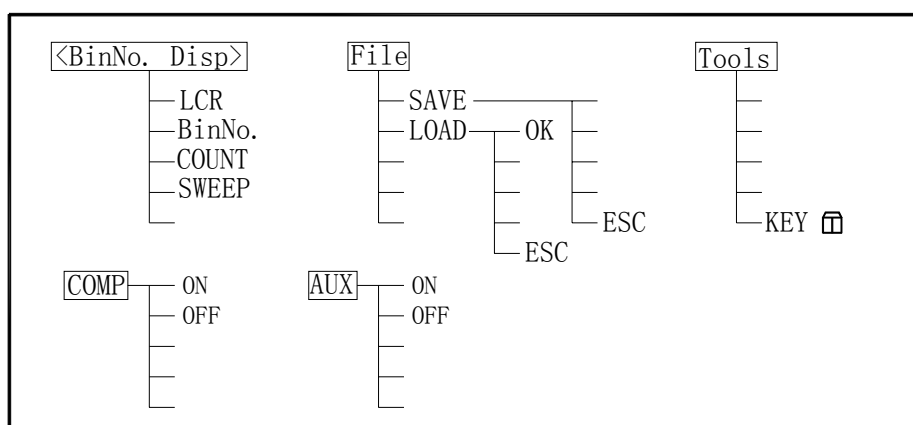


Figure 4-11 Available Softkeys on the BinNo. Disp Page

#### 4.3.2.1 Comparator Function ON/OFF

TH2816B's built-in comparator can sort devices into a maximum of 10 bins (BIN 1 to BIN 9 and the OUT bin) using a maximum of 3 pairs of primary limits and one pair of secondary parameter limits. Also, a device whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits can be sorted into an AUXiliary BIN. The comparator function is especially useful when using TH2816B with a component handler. These limit settings for bin sorting are only set on the **Limit Table** page under **SETUP** menu. So this **COMP** field allows you to only set the comparator function to ON or OFF.

##### Front Panel Operation for Setting the Comparator Function to ON or OFF

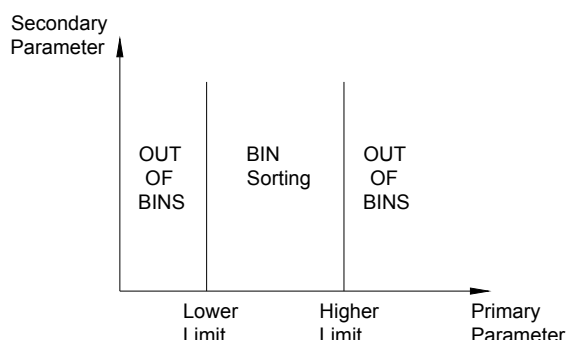
Perform the following steps to set the comparator function to ON or OFF.

- 1) Move the cursor to the **COMP** field. The following softkeys will be displayed.
  - **ON**
  - **OFF**
- 2) Use the softkeys to set the comparator function to ON or OFF.

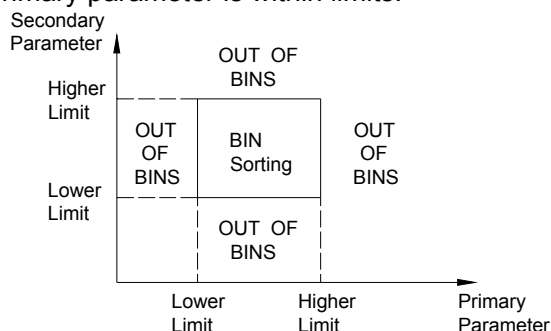
#### 4.3.2.2 Auxiliary Bin ON/OFF

When the secondary parameters affect the sorting results, the limits for the secondary parameter can be set in 2nd **LOW/HIGH** fields. So there are four patterns for the sorting area of the secondary parameter.

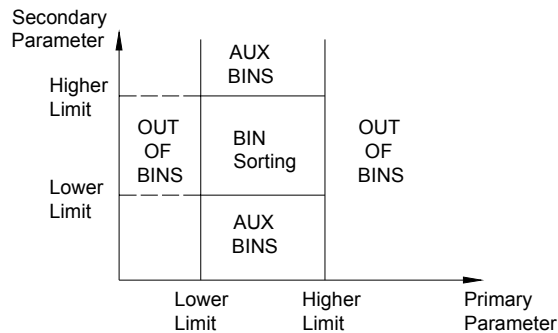
- When the secondary parameter limits are not specified on the **Limit Table** page. Devices will be sorted according to primary parameter comparison results.



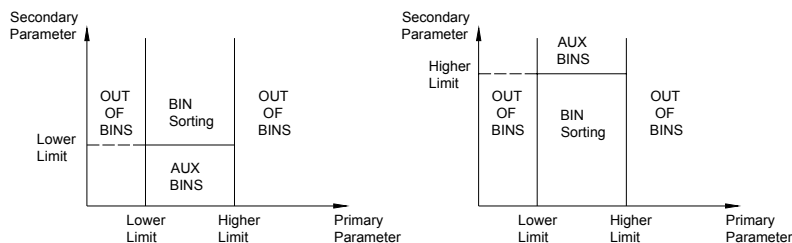
- When the secondary parameter limits are set and AUX BIN are set to OFF. Only devices with secondary limits are sorted by the primary parameter result. Devices not within the secondary parameter limits are sorted OUT OF BINS even if the device's primary parameter is within limits.



- When the secondary parameter limits are set and AUX BIN are set to ON. Devices whose primary parameter is not within limits are sorted OUT OF BINS. Devices whose primary parameter is within limits, but whose secondary parameter is out of limits are sorted into the AUX BIN.



- When only the lower limit of the secondary parameter is set and the AUX BIN are set to ON, the devices whose primary parameter is within limits, but whose secondary parameter is equal to or below the lower limit are sorted into the AUX BIN. Also when only the higher limit of the secondary parameter is set and the AUX BIN are set to ON, the devices whose primary parameter is within limits, but whose secondary parameter is equal to or above the higher limit are sorted into the AUX BIN. (See below.)



The **AUX** field allows you to set the AUX BIN to ON or OFF.

#### Front Panel Operation for Setting the AUX BIN to ON or OFF

Perform the following steps to set the AUX BIN to ON or OFF.

- 1) Move the cursor to the **AUX** field. The following softkeys will be displayed.
  - **ON**
  - **OFF**
- 2) Select and press a softkey to set AUX BIN to ON or OFF.

#### 4.3.2.3 File Management

This function is the same as the function on the **MeasDisplay** page (Refer to 4.3.1.8 File Management.)

#### 4.3.2.4 Useful Tools

The key lock function is used to disable all front panel operation.

Perform the following steps from the **BinNo. Disp** page to disable or enable all front panel operation.

- 1) Move the cursor to the **Tools** field.
- 2) Press **KEY** to lock the keyboard and "KeyLocked !" message will be displayed in the message window.
- 3) Press **KEY** to unlock the keyboard and "KeyUnlock !" message will be displayed in the message window.



### 4.3.3 Meas Setup Page

When you press **PREV** or **NEXT**, or **SETUP** softkey, the **Meas Setup** page can be displayed. On this **Meas Setup** page, all of the following measurement control functions can be set. (Each field in parenthesis is used when each control is set.)

- Measurement Function (**FUN**)
- Test Frequency (**FRQ**)
- Oscillator Level (**LEV**)
- Measurement Range (**RANGE**)
- Measurement Speed (**SPEED**)
- Short Correction (**SHORT**)
- Open Correction (**OPEN**)
- Trigger Mode (**TRIG**)
- Output Signal impedance (**INT\_R**)
- Delay Time (**DELAY**)
- Averaging Rate (**AVG**)
- Signal Level Monitor ON/OFF (**Vm/Im**)
- Deviation Measurement A Mode (**DEV\_A**)
- Deviation Measurement B Mode (**DEV\_B**)
- Reference Value for the Deviation Measurement A (**REF\_A**)
- Reference Value for the Deviation Measurement B (**REF\_B**)
- File Management (**File**)
- Useful Tools (**Tools**)

Following fields on the **Meas Setup** page are the same as the fields on the **MeasDisplay** page as follows. So, these fields are not described in this Chapter, and the other functions on the **Meas Setup** page are described in the following paragraphs.

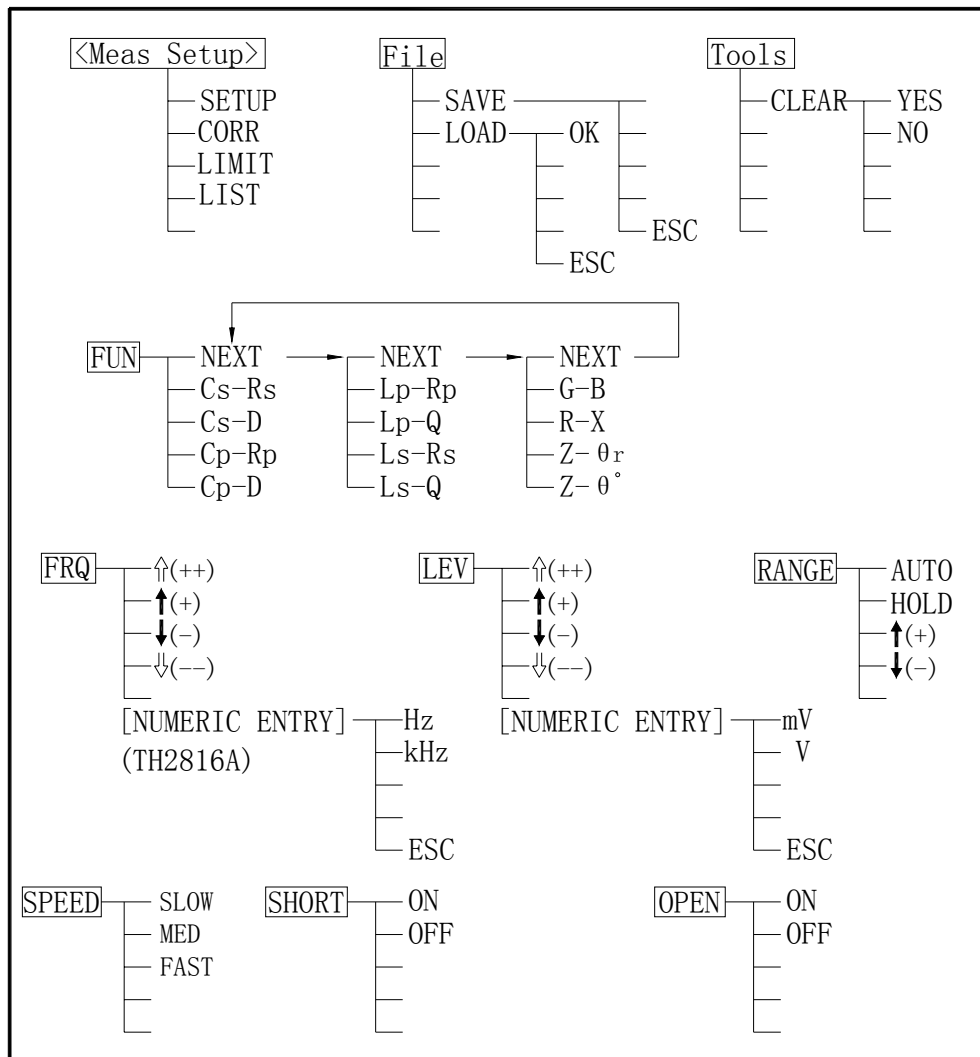
- Measurement Function (**FUN**)
- Test Frequency (**FRQ**)
- Oscillator Level (**LEV**)
- Measurement Range (**RANGE**)
- Measurement Speed (**SPEED**)
- Short Correction (**SHORT**)
- Open Correction (**OPEN**)

The available fields and the softkeys which corresponded to each field on this page are shown in Figure 4-12 and Figure 4-13.

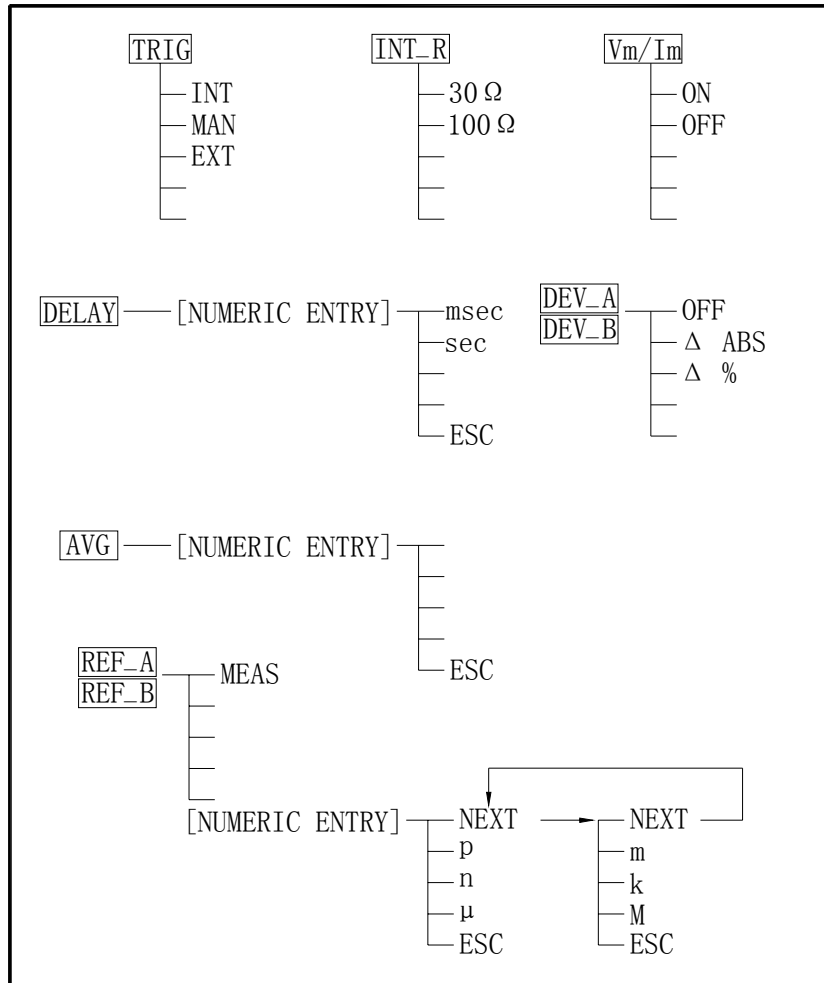
FUN: <input type="text" value="Cp-D"/> FRQ: <input type="text" value="1.0kHz"/> LEV: <input type="text" value="1.000V"/> RANGE: <input type="text" value="AUTO"/> SPEED: <input type="text" value="SLOW"/> SHORT: <input type="text" value="OFF"/> OPEN: <input type="text" value="ON"/>	<div style="display: flex; justify-content: space-between; align-items: center;"> <span><input type="checkbox"/> &lt;Meas Setup&gt;</span> <span><input type="text" value="File"/></span> <span><input type="text" value="Tools"/></span> </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;">           TRIG : <input type="text" value="INT"/>            INT R : <input type="text" value="30 Ω"/>            DELAY : <input type="text" value="0ms"/>            AVG : <input type="text" value="1"/>            Vm/Im: <input type="text" value="OFF"/> </div> <div style="width: 30%;">           DEV _ A: <input type="text" value="OFF"/>            REF _ A: <input type="text" value="0.00000pF"/>            DEV _ B: <input type="text" value="OFF"/>            REF _ B: <input type="text" value="0.00000"/> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <span>LIST</span> <span>LIMIT</span> <span>CORR</span> <span>SETUP</span> </div>
--	--

: Field

Figure 4-12. Available Fields on the MEAS SETUP Page



**Figure 4-13. Available Softkeys on the MEAS SETUP Page (1/2)**



**Figure 4-13. Available Softkeys on the MEAS SETUP Page (2/2)**

#### 4.3.3.1 Trigger Mode

TH2816B has four trigger modes: INTERNAL, EXTERNAL, MANUAL, and BUS.

When the trigger mode is set to INT trigger mode, TH2816B continuously repeats measurements on any display page under **DISPLAY**.

When the trigger mode is set to MAN trigger mode, TH2816B performs a single measurement on any display page under **DISPLAY** every time **TRIGGER** on the front panel is pressed.

When the trigger mode is set to EXT trigger mode, TH2816B performs a single measurement on any display page under **DISPLAY** every time a rising edge of a pulse is applied to the EXT Trigger pin in the Handler Interface.

When the trigger mode is set to BUS trigger mode, TH2816B performs a single measurement every time the TRIGGER command is sent to TH2816B via GPIB or RS232C. Then the BUS trigger mode cannot be set on the front panel.

##### Front Panel Operation for Setting the Trigger Mode

Perform the following steps to set the trigger mode except for in the BUS TRIG mode.

- 1) Move the cursor to the **TRIG** field. The following softkeys will be displayed.

- **EXT**
- **MAN**
- **INT**

- 2) Set the trigger mode using the softkeys.

#### 4.3.3.2 Output Signal impedance

TH2816B provides two different signal output impedance 30Ω and 100Ω in order to be compatible with other well-known instruments in the world.

##### Front Panel Operation for Setting the Trigger Mode

Perform the following steps to select the signal output impedance.

- 1) Move the cursor to the **INT\_R** field. The following softkeys will be displayed.
  - 30Ω
  - 100Ω
- 2) Set the signal output impedance using the softkeys.

#### 4.3.3.3 Delay Time (DELAY )

TH2816B's delay time function allows you to set a trigger delay, so TH2816B will delay the start of the measurement after it is triggered. (When the list sweep measurement is performed, TH2816B will delay the start of the measurement at each sweep point using the trigger delay time.) The trigger delay time can be set from 0 s to 60 s in 1 ms steps. This function is useful if a component handler triggers TH2816B before stable contact is made with the device under test (dut).

##### Front Panel Operation for Setting the Delay Time

Perform the following steps to set the delay time.

- 1) Move the cursor to the **DELAY** field.
- 2) Enter the delay time using the numeric entry keys. When one of the numeric entry keys is pressed, the following unit softkeys will be displayed, these can be used instead of **ENTER**.
  - sec
  - msec
  - ESC
- 3) Press **ESC** to cancel the date input.

#### 4.3.3.4 Averaging Rate (AVG)

TH2816B's averaging rate function arithmetically averages the results of two or more A/D conversions. The number of conversions averaged can be set from 1 to 255, in steps of 1.

##### Front Panel Operation for Setting the Averaging Rate

Perform the following steps to set the averaging rate.

- 1) Move the cursor to the **AVG** field.
- 2) Enter the averaging rate using the numeric entry keys. When one of the numeric entry keys is pressed, data input message window will be displayed, and the **ESC** softkey will be displayed, **ESC** can be used to cancel the data input operation.

#### 4.3.3.5 Signal Level Monitor ON/OFF

The level monitor function allows you to monitor the actual voltage level across the device under test or the actual current level though the device under test. The voltage monitor value is only displayed on the **MeasDisplay** page at Vm monitor area. The current monitor value is only displayed on the **MeasDisplay** page at Im monitor area.

##### Front Panel Operation for Setting the Level Monitor Function

Perform the following steps to set the level monitor function to ON or OFF.

- 1) Move the cursor to the **Vm/Im** field. The following softkeys will be displayed.
  - ON
  - OFF

- 2) Press **ON** to set the level monitor function to ON. Press **OFF** to set the level monitor function to off.

#### 4.3.3.6 Deviation Measurement Function

The deviation measurement function allows you to display the deviation value instead of the actual measurement value. The deviation value is the value calculated by taking the difference between the actual measurement value and a previously stored reference value. This function is useful when the change of a component's value versus changes in temperature, frequency, bias, etc. are being observed. Deviation measurements can be made for either or both primary parameter and/or secondary parameter measurements. There are two types of deviation measurements.

- **ΔABS (Delta ABSolute) deviation measurement**  
The difference between the measured value of the DUT and a previously stored reference value are displayed. The formula used to calculate the deviation is as follows.  
$$\Delta\text{ABS} = X - Y$$
  
Where, X: The measured value of DUT.  
Y: The stored reference value.
- **Δ% (Delta percent) deviation measurement**  
The difference between the measured value of the DUT and a previously stored reference value are displayed as a percentage of the reference value. The formula used to calculate the percent deviation is as follows.  
$$\Delta\% = (X - Y) / Y \times 100\%$$
  
Where, X: The measured value of DUT.  
Y: The stored reference value.

Perform the following steps to execute the deviation measurement function.

- 1) Move the cursor to the **REF\_A** field to enter the reference value for the primary parameter. The following softkey will be displayed.
  - **MEAS**  
When the device which has a reference value is connected, pressing this MEAS softkey, TH2816B measures the device, and the primary measurement result is entered as a reference value for **REF\_A**.
- 2) Enter the reference value for the primary parameter using MEAS or the numeric entry keys.
- 3) Move the cursor to the **REF\_B** field to enter the reference value for the secondary parameter. The following softkey will be displayed.
  - **MEAS**  
When the device is to be used as the reference value is connected, **MEAS** is pressed, TH2816B measures the device, and the secondary measurement result is entered as a reference value for **REF\_B** values.
- 4) Enter the reference value for the secondary parameter using MEAS or the numeric entry keys.
- 5) Move the cursor to the **DEV\_A** field. The following softkeys will be displayed.
  - **Δ%**
  - **ΔABS**
  - **OFF**
- 6) Select and press a softkey to select the deviation mode for the primary parameter.
- 7) Move the cursor to the **DEV\_B** field. The following softkeys will be displayed.
  - **Δ%**
  - **ΔABS**
  - **OFF**
- 8) Select and press a softkey to select the deviation mode for the secondary parameter.

#### 4.3.3.7 File Management

This function is the same as the function on the **MeasDisplay** page. (Refer to 4.3.1.8 File Management.)

#### 4.3.3.8 Useful Tools

The **Tools** field on this page allows you to reset all the control settings to the default settings.

Perform the following steps from the **Meas Setup** page to reset all control settings.

- 1) Move the cursor to the **Tools** field. The following softkey will be displayed.  
■ **CLEAR**
- 2) Press **CLEAR**, "Confirm: Clear All?" will be displayed in the message window. The following softkeys will be displayed.  
■ **NO**  
■ **YES**
- 3) Press **NO** to cancel the CLEAR operation.
- 4) Press **YES** to reset all control settings to the default settings.

#### 4.3.4 Limit Table

When you press **PREV** or **NEXT**, or **LIMIT** softkey, the **Limit Table** page will be displayed. The **Limit Table** page allows you to set TH2816B's comparator. TH2816B's built-in comparator can sort devices into a maximum of 10 bins (BIN1 to BIN 9 and one OUT OF BINS) using a maximum of 3 pairs of primary limits and one pair of secondary parameter limits. Also, devices whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits, can be sorted into an AUXiliary BIN. The comparator function is especially useful when using TH2816B with a component handler. These limit settings for bin sorting are only set on this **Limit Table** page.

- Nominal Value for tolerance mode (**NOMINAL**)
- Measurement Function (**FUNC**)
- Comparator Function's Limit Mode (**MODE**)
- Comparator Function ON/OFF (**COMP**)
- Auxiliary bin ON/OFF (**AUX**)
- Low Limit Value of each bin (**LOW**)
- High Limit Value of each bin (**HIGH**)
- File Management (**File**)
- Useful Tools (**Tools**)

Each function is described in the following paragraphs.

The available fields and the softkeys which correspond to the fields on this page are shown in Figure 4-14 and Figure 4-15.



#### 4.3.4.2 Swap Parameter Function

The swap parameter function is used to swap the primary parameter for the secondary parameter in the **FUNC** field. For example, when the measurement function is Cp-D, the swap parameter function sets the measurement function to D-Cp. Then the comparison limits for D are a maximum of 3 pairs of comparison limits, and the comparison limits for Cp are now one pair.

##### Front Panel Operation for Swapping Parameter Function.

Perform the following steps to swap the primary parameter for the secondary parameter.

- 1) Move the cursor to the **FUNC** field. The following softkey will be displayed.  
■ **SWAP**
- 2) Press **SWAP** to swap the primary parameter for the secondary parameter.
- 3) Press **SWAP** again to return the measurement function to the previous combination.

#### 4.3.4.3 Comparator Function's Limit Mode

There are two methods used to specify the tolerance mode limits, the ratio in percent and by parameter value.

##### Front Panel Operation for Setting the Limit Mode for the Comparator.

Perform the following steps to set the limit mode for the comparator.

- 1) Move the cursor to the **MODE** field. Then the following softkeys will be displayed.  
■ **% TOL**  
This softkey is used to set the limit mode to the tolerance mode (the ratio in percent).  
■ **±TOL**  
This softkey is used to set the limit mode to the tolerance mode (parameter value).
- 2) Select and set the limit mode using the softkeys.

#### 4.3.4.4 Comparator Function ON/OFF

This function is the same as the function on the **BinNo. Disp** Page (Refer to 4.3.2.1 Comparator Function.)

#### 4.3.4.5 Auxiliary bin ON/OFF

This function is the same as the function on the **BinNo. Disp** Page. (Refer to 4.3.2.2 Measurement Function.)

#### 4.3.4.6 Low/High Limit Value

TH2816B's built-in comparator can sort devices into a maximum of 4 bins (BIN 1 to BIN 3, and OUT OF BINS) using a maximum of 3 pairs of primary parameter limits and one pair of secondary parameter limits. These primary parameter low/high limits can be set in the BIN 1 to BIN 3 **LOW/HIGH** fields, and the secondary parameter low/high limits can be set in the 2nd **LOW/HIGH** fields.

Note: Do NOT enter a value which is lower than the LOW limit into the HIGH limit. If you do, the warning message "Warning: Low>High" will be displayed (this isn't an error), and TH2816B will not sort a DUT into the warning BINs you specify.

##### Front Panel Operation for Setting the Low/High Limits

Perform the following steps to set the bin sorting limits.

- 1) Set the measurement function for the comparator function, the nominal value,



- and the limit mode for the primary parameter.
- 2) Move the cursor to the **Tools** field, and perform the clear table function.
  - 3) Move the cursor to the BIN 1 **LOW** field.
  - 4) Enter the limit value of the BIN 1 at BIN 1 **LOW** field using the numeric entry keys. When one of the numeric entry keys is pressed, the unit softkeys (**p**, **n**, **u**, **m**, **k**, and **M**) are available, and so you can use these softkeys to enter the unit and terminate the entry without hitting **ENTER**. When the limit value of BIN 1 is entered in the BIN 1 **LOW** field, the BIN 1 low limit becomes – (absolute input value), and the BIN 1 high limit becomes + (absolute input value).
  - 5) The cursor will be automatically moved to the BIN 2 **LOW** field. Repeat step 4 until the limits of the BIN 3 is entered. After that, the cursor will be moved to the 2nd **LOW** field.
  - 6) Enter the low limit value of the secondary parameter. After that, the cursor will be automatically moved to the 2nd **HIGH** field.
  - 7) Enter the high limit value of the secondary parameter.
  - 8) If you want to change one of the high or low limit value. Move the cursor to the **HIGH** or **LOW** limit field, and input the new value using the numeric entry keys.
  - 9) If you want to change both high and low limit values. Move the cursor to the **HIGH** or **LOW** limit field, press **DEL—** softkey to clear both high and low limit values. Then repeat step 4 to input the limits again.

#### 4.3.4.7 File Management (File)

This function is the same as the function on the **MeasDisplay** page. (Refer to 4.3.1.8 File Management.)

#### 4.3.4.8 Useful Tools

The **Tools** field on this page allows you to clear all of the limit values. Perform the following steps from the **Limit Table** page to clear all of the limit values.

- 1) Move the cursor to the **Tools** field. The following softkey will be displayed.  
■ **CLEAR**
- 2) Press **CLEAR**, “Confirm: Clear Table?” will be displayed in the message window. The following softkeys will be displayed.  
■ **NO**  
■ **YES**
- 3) Press **NO** to cancel the CLEAR operation.
- 4) Press **YES** to clear all of the limit values.

#### 4.3.5 System Configuration Page

When you press **PREV** or **NEXT**, or **SYST** softkey, the **System Config** page will be displayed. On this **System Config** page, the following control functions can be set. (The field in parenthesis is used to set the control function.)

- LCD Contrast Function (**CONTRAST**)
- Information Beeper Function ON/OFF (**INFO BEEP**)
- Comparator Alarm Function ON/OFF (**CMP ALARM**)
- Password Function (**PASSWORD**)
- Bus Mode Function (**BUS MODE**)
- GPIB address (**GPIB ADDR**)
- AutoFetch mode ON/OFF (**AUTO FETCH**)

So there are eight fields on this page: **<System Config>**, **CONTRAST**, **INFO BEEP**, **CMP ALARM**, **PASSWORD**, **BUS MODE**, **GPIB ADDR**, and **AUTO FETCH** fields.

Each control function is described in the following paragraphs.

The available fields and the softkeys which correspond to each field on this page are shown in Figure 4-16 and Figure 4-17.

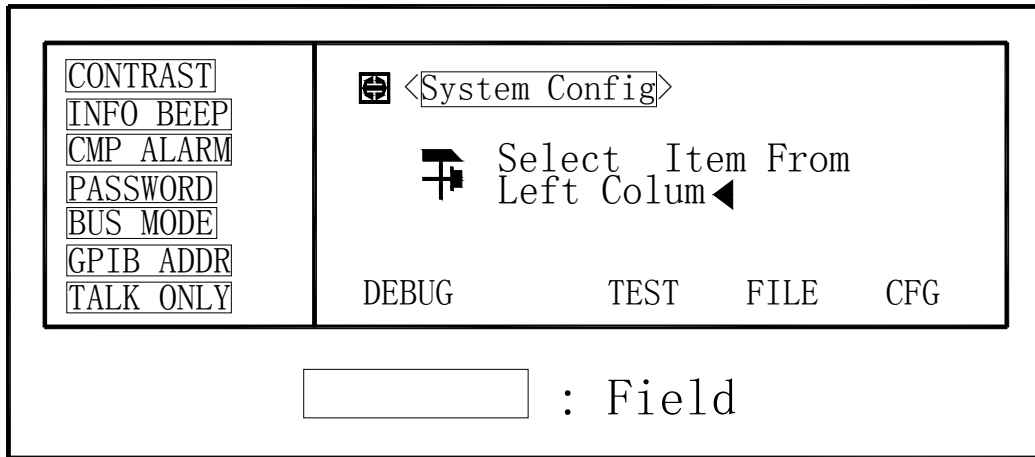


Figure 4-16. Available Fields on the SYSTEM CONFIG Page

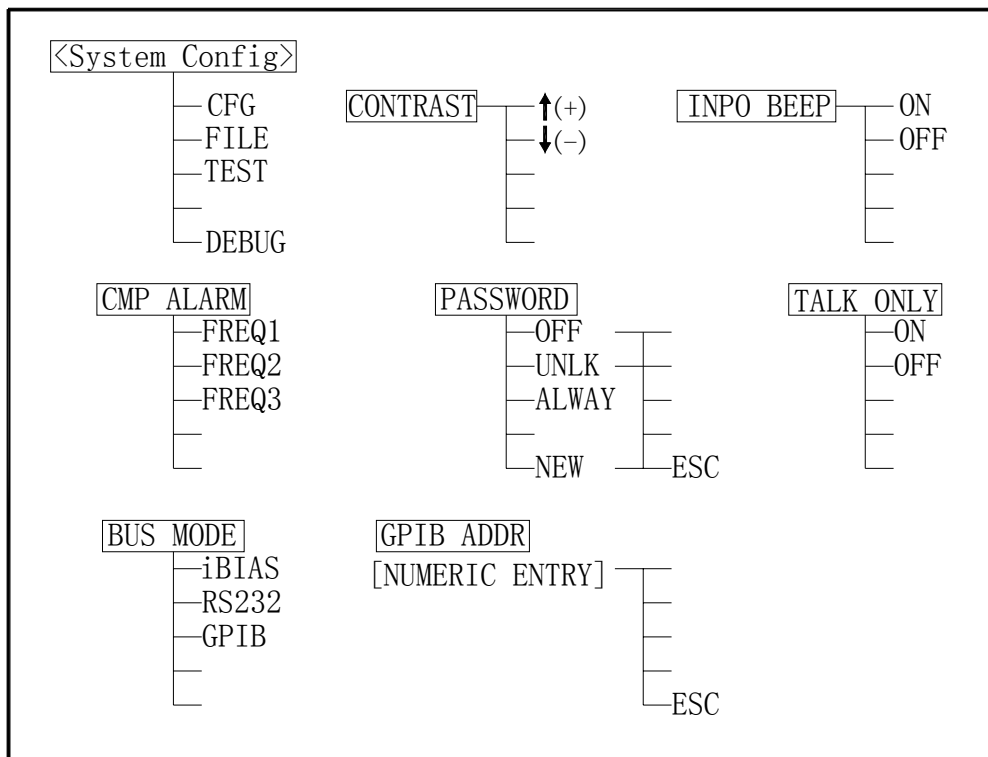


Figure 4-17. Available Softkeys on the SYSTEM CONFIG Page

#### 4.3.5.1 LCD Contrast Function

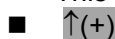
TH2816B's Contrast Function allows you to adjust the LCD contrast in order to get a clear display. You can adjust the LCD contrast from 0 to 31.

Perform the following steps to adjust the LCD contrast.

- 1) Move the cursor to the **CONTRAST** field, the following softkeys will be displayed.



This softkey is used to decrease LCD contrast in 1 step.



This softkey is used to increase LCD contrast in 1 step.

- 2) Use the softkeys to adjust the LCD Contrast as required.

#### 4.3.5.2 Information Beeper Function ON/OFF

TH2816B beeps when a warning message is displayed or an error has occurred.

Perform the following steps to set beeper function to ON or OFF.

- 1) Move the cursor to the **INFO BEEP** field, the following softkeys will be displayed.
  - **ON**
  - **OFF**
- 2) Use the softkeys to set the information beeper function to ON and OFF.

#### 4.3.5.3 Comparator Alarm Function ON/OFF

TH2816B alarms when the comparator result is the same as the preset alarm status. Perform the following steps to set the alarm status to be alarmed.

- 1) Move the cursor to the **CMP ALARM** field, the following softkeys will be displayed.
  - **AUX**
  - **OUT**
  - **IN**
  - **OFF**
- 2) Use the softkeys to set the alarm status you want.

#### 4.3.5.4 Password Function

TH2816B's password function can be used to prevent unauthorized person to turn on the instrument, or to prevent unauthorized person to operate from the front panel keyboard.

Perform the following steps to set the password function or change the password.

- 1) Move the cursor to the **PASSWORD** field, the following softkeys will be displayed.
  - **NEW**
  - **ALWAY**
  - **UNLK**
  - **OFF**
- 2) Press softkey **NEW**. Message "Old Password:" is displayed in the message window. The old password is required to input correctly. Press the **ESC** softkey, if you want to cancel the change password operation.
- 3) When the old password is inputted correctly, message "New Password:" is displayed in the message window. Use the numeric entry keys to input the new password. Press the **ESC** softkey, if you want to cancel the change password operation.
- 4) When the new password is inputted, the message "Confirm Password:" is displayed in the message window. Press the **ESC** softkey, if you want to cancel the change password operation. The new password must be inputted correctly again, before the new password is valid.
- 5) Press **AWAY**. The password is required both to turn on the TH2816B and to unlock the key operation on front panel. "ALWAYS" will be displayed on the LCD.
- 6) Press **UNLK**. Message "Enter Password:" will be displayed, when you change the password status from "ALWAYS" to "UNLOCK". When the password status is "UNLOCK" status, the password is required only to unlock the key operation on front panel.
- 7) Press **OFF**. Message "Enter Password:" will be displayed, when you change the password status from "ALWAYS"/"UNLOCK" to OFF. When the password status is "OFF" status, no password is required both to turn on the instrument and to unlock the key operation on front panel.

Note: The default password for TH2816B is 2816.

#### 4.3.5.5 Bus Mode Function

TH2816B provides three Bus modes: GPIB, RS232 and iBIAS. Only one of the three bus modes can be selected at the same time.

Perform the following steps to select the bus mode of TH2816B.

- 1) Move the cursor to the **BUS MODE** field, the following softkeys will be displayed.
  - GPIB
  - RS232
  - iBIAS
- 2) Press **iBIAS**. The RS232 interface is used to control the programmable DC bias current source. (Such as TH1773 )
- 3) Press **RS232**. The RS232 interface is used to communicate with a computer as a standard serial interface.
- 4) Press **GPIB**. The GPIB interface is used to communicate with computers and other instruments as a parallel interface. (When the optional GPIB board is equipped.)

#### 4.3.5.6 GPIB address

TH2816B with GPIB interface can be controlled via the GPIB bus.

The GPIB address can be set on this page

Perform the following steps to set the GPIB address.

- 1) Move the cursor to the **GPIB ADDR** field, the current address will be displayed on the LCD. The default address is 8.
- 2) Input the new address from 0 to 30 using the numeric keys.

#### 4.3.5.7 AutoFetch mode ON/OFF

When TH2816B is set to the auto fetch mode, TH2816B outputs the measurement result after each measurement automatically.

Perform the following steps to set the Talk only mode.

- 1) Move the cursor to the **Auto Fetch** field, the current setting will be displayed on the LCD. The following softkeys will also be displayed.
  - ON
  - OFF
- 2) Use the softkeys to set the Auto Fetch mode to ON (Auto fetch) or to OFF (query mode).

# Chapter 5 Remote Control

TH2816B has the RS232C serial interface and the parallel GPIB (optional) interface. Both interfaces can be used to remotely control TH2816B, but they can not be used at the same time. The two interfaces share the same program commands, but they have different hardware configurations and different communication protocols. This chapter provides the information about the two interfaces and how to use the interfaces. For the available commands, refer to Chapter 6 Command reference.

## 5.1 RS232C Interface Introduction

The RS232C interface can be used to remotely control the TH2816B, and it also can be used to control the DC current bias sources manufactured by our company such as TH1773/TH1775 DC current bias source. All operations from the front panel can be performed by a computer via the serial interface.

### 5.1.1 RS232C Connection

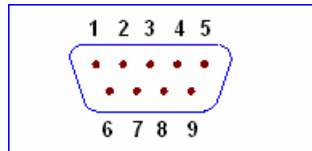
RS232C Standard now is widely used as the serial communication standard. RS232 stands for Recommend Standard number 232 and C is the latest revision of the standard. The serial ports on most instruments use a subset of the RS-232C standard. The full RS-232C standard specifies a 25-pin "D" connector of which 22 pins are used. Most of these pins are not needed for normal serial communications, and the common RS232 signals are listed as follows.

Function	Code	25 Pin Connector Pin Number	9 Pin Connector Pin Number
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmitted Data	TXD	3	3
Received Data	RXD	2	2
Signal Ground Common	GND	7	5

TH2816B only uses the smallest subset of the RS232C standard, the signal are listed as follows.

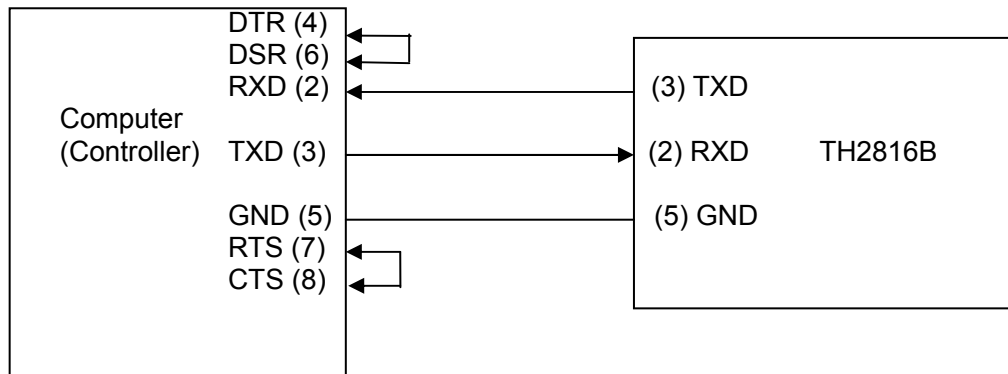
Function	Code	9 Pin Connector Pin Number
Transmitted Data	TXD	3
Received Data	RXD	2
Signal Ground Common	GND	5

TH2816B's RS232 interface may be different with the standard RS232C. The pin configuration is shown as follows.



### 5.1.2 Communication with a Computer

- Diagram of connection to a controller.



There may be some difference between TH2816B RS232C interface and a standard RS232C interface. You can make the connection cable by yourself according to the diagram or order one from our company.

Note: Pin 4 and 6, pin 7 and 8 are shorted respectively at the end of controller.

- When the RS232C interface is used to communicate with a controller, RS232C bus mode should be selected as follows.
  - 1) Press **NEXT** menu key, until the **System Config** page be displayed.
  - 2) Move the cursor to the **BusMode** field.
  - 3) Press **RS232** to select the bus mode to RS232 bus mode.

- Serial Interface Specifications

Baud Rate	9600 bps
Date Bits	8 Bits
Stop Bits	1 Bit
Parity Bit	None
End of Sequence	NL (ASCII Code 10)
Connector	DB9

- Software Protocol

- 1) For command configuration and format, refer to chapter 6 Command Reference.
- 2) The controller sends the command using the ASCII code with NL as the end character. TH2816B executes the command after the end character NL is received.
- 3) The character received by TH2816B will be sent back to the controller again. The controller will not send the next character until the last return character is received correctively from TH2816B. If the controller cannot receive the character sent back by TH2816B, the reasons may be as follows.
  - A. The serial interface is not connected correctly.
  - B. Check if the RS232 function is turned on and TALK ONLY function is turned off.
  - C. When TH2816B is executing a bus command, TH2816B will not accept any character through the serial interface at the same time and the

character sent by controller will be ignored. In order to make sure the whole command is sent and received correctly, the character without a return character should be sent again by the controller.

- 4) TH2816B sends information under following two conditions. The first is when a character is received normally; TH2816B will send the character back as response. The second is when a query command is received; TH2816B will send the query response information.
- 5) Once a query command is received, TH2816B will send the query response information immediately even if the whole command has not been executed. So if the command includes two queries, the controller should read the query responses twice. One query is recommended to be included in a single command.
- 6) A query response is sent out in ASCII codes with NL as the terminal character.
- 7) Several query responses will be sent continuously with 1ms interval. The controller should be ready to receive the responses; otherwise the response information will be lost.
- 8) The controller should receive the query response terminal character NL. Otherwise you will confuse a terminal character NL with a returned character. At the same time the controller should receive the last returned character before receiving a query response.
- 9) For some commands that will take a long time to execute, for example Correction command, the controller should keep waiting to avoid the next command being lost when TH2816B is executing the former command.

#### ■ Sample Program for Serial Interface

The following is a C language sample program under DOS environment. The main function may be expanded by users, and the other sub functions teach you how to input or output a character string via the RS232 interface.

```
#define PORT 0
#include "dos.h"
#include "stdio.h"
#include "stdlib.h"
#include "ctype.h"
#include "conio.h"

void port_init( int port,unsigned char code );
int check_stat( int port );      /* read serial port state(16bit) */
void send_port( int port,char c ); /* send a character to serial port */
char read_port( int port );      /* recive a character form serial port */

void string_wr( char *ps );      /* write a string to serial port */
void string_rd( char *ps );      /* read a string from serial port */
char input[256];                /* quarry recieve bufer */

main()
{ port_init( PORT,0xe3 );/* initilize serial port:baud = 9600,no verify,1 bit stop,8 bit
data */

string_wr( "trig:sour bus;*trg" );
string_rd( input );
printf( "\n%s",input );

string_wr( "freq 10khz" );
string_wr( "func:imp:type rx::func:smon on" );
string_wr( "voltage:level 500mv" );
```

```
}
```

```
/* write string to serial port */
```

```
void string_wr( char *ps )
```

```
{ char c;
```

```
  int m,n;
```

```
  while( check_stat(PORT) & 256 ) read_port( PORT );/* read data until null */
```

```
  for( ;*ps; )
```

```
  { c = 0;
```

```
    for( m = 100;m;m-- )
```

```
    { send_port( PORT,*ps );
```

```
      for( n = 1000;n;n-- )
```

```
      { delay( 2 ); /* wait about 2ms, use dos.h library funtion */
```

```
        if( kbhit() && ( getch() == 27 ) ) /* if escape key keypress */
```

```
        { printf( "\nE20:Write Canceled!" );
```

```
          exit(1);
```

```
        }
```

```
        if( check_stat(PORT) & 256 )
```

```
        { c = read_port( PORT );
```

```
          break;
```

```
        }
```

```
    }
```

```
    if( n ) break;
```

```
  }
```

```
  if( c == *ps ) ps++;
```

```
  else
```

```
  { printf( "\nE10:Write Echo Error!" );
```

```
    exit(1);
```

```
  }
```

```
}
```

```
send_port( PORT,'\n' );/* send command end symbol */
```

```
delay( 2 );
```

```
while( !(check_stat(PORT) & 256) );
```

```
read_port( PORT );
```

```
}
```

```
/* read string from serial port */
```

```
void string_rd( char *ps )
```

```
{ unsigned char c,i;
```

```
  for( i = 0;i < 255;i++ ) /* max read 256 characters */
```

```
  { while( ! (check_stat(PORT) & 256) ) /* wait serial recieve ready */
```

```
    if( kbhit() && ( getch() == 27 ) ) /* if escape key keypress */
```

```
    { printf( "\nE21:Read Canceled!" );
```

```
      exit(1);
```

```
    }
```

```
  }
```

```
  c = read_port( PORT );
```

```
  if( c == '\n' ) break;
```

```
  *ps = c;
```

```
  ps++;
```

```
}
```

```
*ps = 0;
```

```
}
```

```
/* send a character to serial port */
```

```
void send_port( int port,char c )
```



```

{
    union REGS r;
    r.x.dx = port;          /* serial port */
    r.h.ah = 1;             /* int14 function1:send character */
    r.h.al = c;             /* character to be sent */
    int86( 0x14,&r,&r );
    if( r.h.ah & 128 )      /* check ah.7,if set by int86( 0x14,&r,&r ),mean trans error */
    { printf( "\nE00:Serial port send error!" );
      exit(1);
    }
}

/* read a character from serial port */
char read_port( int port )
{ union REGS r;
  r.x.dx = port;          /* serial port */
  r.h.ah = 2;             /* int14 function2:read character */
  int86( 0x14,&r,&r );
  if( r.h.ah & 128 )      /* if ah.7 be set,mean trans error */
  { printf( "\nE01:Serial port read error!" );
    exit(1);
  }
  return r.h.al;
}

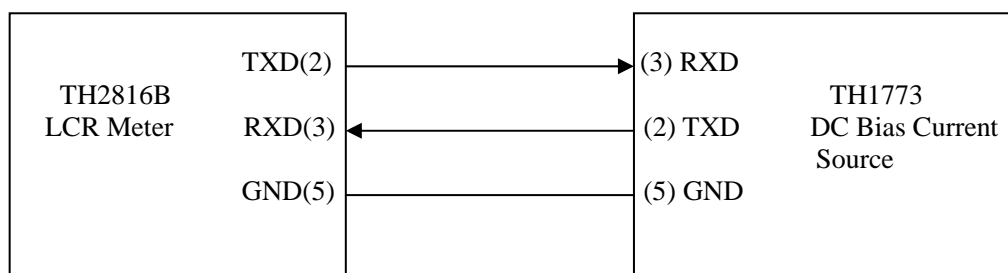
/* check the status of serial port */
int check_stat( int port )
{ union REGS r;
  r.x.dx = port;          /* serial port */
  r.h.ah = 3;             /* int14 function3:read status */
  int86( 0x14,&r,&r );
  return r.x.ax;          /* ax.7 show serial operation, ax.8 show serial recive ready */
}

/* initialize the serial port */
void port_init( int port,unsigned char code )
{ union REGS r;
  r.x.dx = port;          /* serial port */
  r.h.ah = 0;             /* int14 function0:initial serial port */
  r.h.al = code;          /* initialization code */
  int86( 0x14,&r,&r );
}

```

### 5.1.3 Communication with a DC Bias Current Source

When you want to perform a DC bias current list sweep measurement, the RS232C can be used to control a DC Bias Current Source. The following diagram shows how TH2816B and TH1773 are connected via the RS232C interface.



Perform the following steps to realize the DC bias current list sweep measurement.

- 1) Only on the **List Sweep** page, TH2816B has the capacity to control the DC Bias Current Source via the RS232C interface.
- 2) Connect TH2816B and TH1773 according the above diagram.
- 3) Set TH2816B's bus mode to iBIAS mode. Press **SYSTEM** menu key, the **System Config** page will be displayed. Move the cursor to the **BusMode** field, and use the softkey **iBIAS** to set the bus mode to iBIAS mode.
- 4) Set TH1773's serial function to ByLCR mode (Refer to TH1773 user manual.).
- 5) Set a list sweep measurement limit table on the **List Setup** page, and perform the measurements on the **List Sweep** page.

When perform the DC bias current list sweep measurement, delay time should be set in order to get stable measurement results.  
SEQ or STEP sweep mode can be selected.

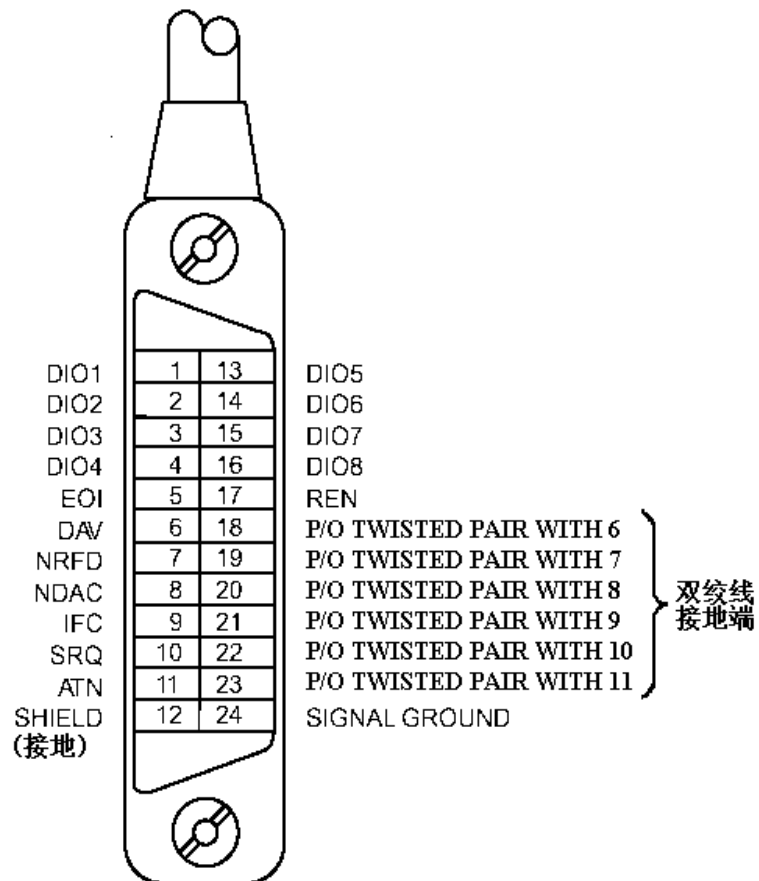
## 5.2 GPIB Interface Introduction

### 5.2.1 GPIB Connection

When configuring a GPIB system, the following restrictions must be adhered to.

- The total length of cable in one bus system must be less than or equal to two meters times the number of devices connected on the bus (the GPIB controller counts as one device) and the total length of cable must not exceed 20 meters.
- A maximum of 15 devices can be connected on one bus system.
- There are no restrictions on how the cables are connected together. However, it is recommended that no more than four piggyback connectors be stacked together on any one device. The resulting structure could exert enough force on the connector mounting to damage it.

Figure 5-1 shows a GPIB interface connector.



**Figure 5-1. GPIB Connector Signal/Pin Configuration**

Typical GPIB system interconnection is shown in Figure 5-2 and Figure 5-3. The GPIB connector is firmly fastened using two bolts to keep it from working loose during use.

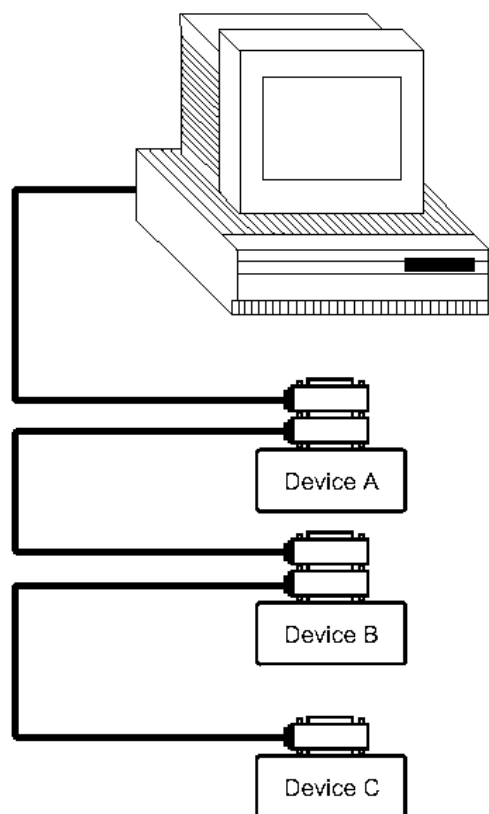


Figure 5-2. Typical GPIB System Interconnection-1

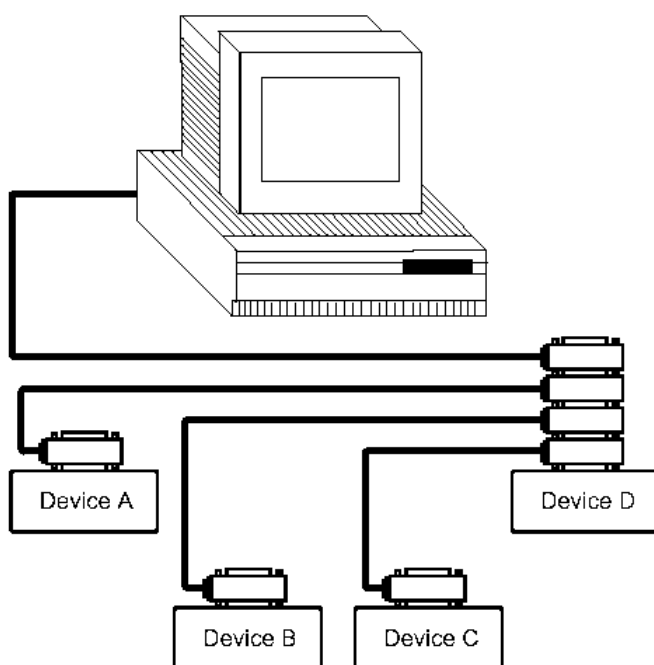


Figure 5-3. Typical GPIB System Interconnection-2

### 5.2.2 GPIB Interface Capabilities Functions

Table 7-1 lists TH2816B's GPIB capabilities and functions. These functions provide the means for an instrument to receive, process, and transmit commands, data, and status over the GPIB bus.

Table 7-2. GPIB Interface Capability

Code	Function
SH1	Complete Source Handshake capability
AH1	Complete Acceptor Handshake capability
T5	Basic Talker; Talk-Only; unaddressed if MLA; no serial poll
L4	Basic Listener; unaddressed if MTA; no Listen Only
SR0	No Service Request capability
RL1	Remote/Local capability
DC1	Device Clear capability
DT1	Device Trigger capability
C0	No Controller capability
E1	Drivers are open-collector

### 5.2.3 GPIB Addressing

TH2816B's GPIB address is stored in non-volatile memory and can be set to any address from 0 to 30 by front panel key entry in the **System Config** page. When TH2816B is shipped from the factory the default GPIB address is 8. For more information, refer to "4.4.1.6 GPIB Address" in Chapter 4.

### 5.2.4 GPIB Bus Function

TH2816B will respond to the following bus commands.

- **ABORT I/O (IFC)**  
ABORT I/O (IFC control line TRUE) halts all bus activity and deselects TH2816B.
- **DEVICE CLEAR (SDC or DCL)**  
This command can be used with an address to clear a particular device (SDC : selected device clear) or used without an address (DCL : clears all devices). The Input buffer is cleared, output data buffer is cleared and bit 4 (MAV bit) of the status byte is set to "0", when TH2816B receives this command.
- **LOCAL (GTL)**  
LOCAL returns control of a listening device to front panel control.
- **LOCAL LOCKOUT (LLO)**  
LOCAL LOCKOUT disables the LOCAL operation of all devices on the bus. After this command is sent you will be unable to operate TH2816B from the front panel include the softkey **LOCAL**. Execute the LOCAL command to undo LOCAL LOCKOUT.
- **REMOTE**  
REMOTE sets TH2816B to the remote mode. When this command is sent, front panel with the exception of **LOCAL** softkey will be disabled.
- **TRIGGER (GET)**  
Enables TH2816B to the TRIGGER bus command. This command may be sent to a selected device or to all devices addressed as listeners on the GPIB bus. TH2816B must first be addressed as a listener, second the trigger mode is set to the BUS trigger mode before the trigger message is sent. This command is equal to the SCPI command TRIG+FETCh? or the common command \*TRG.

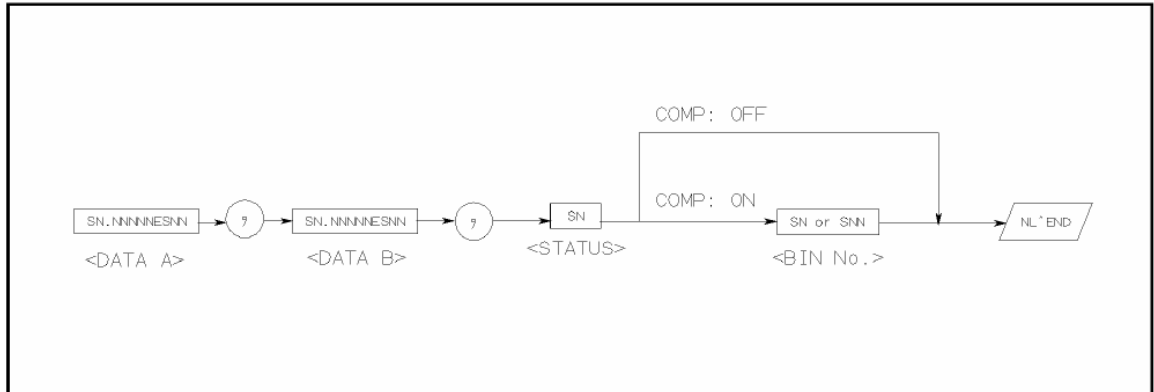
## 5.3 Data Format

Th2817 outputs the measurement results using the ASCII via the GPIB bus. The Format 1 is used by **MeasDisplay** page, **BinNo. Disp** page and **Bin Count** page,

while Format 2 is used by **List Sweep** page. The two formats are described respectively as follows.

### 5.3.1 Format 1

The ASCII data output format on the **MeasDisplay** page, **BinNo. Disp** page, or **Bin Count** page is described in Figure 5-4.



**Figure 5-4 ASCII Data Format 1**

The <DATA A>, <DATA B>, and <BIN> formats are as follows.

■ <DATA A> and <DATA B> format:

The data output formats for <DATA A> (primary parameter's measurement data), and <DATA B> (secondary parameter's measurement data) uses the 12 ASCII character fixed length format as follows.

SN.NNNNNESNN

(S: +/-, N: 0 to 9, E: Exponent Sign)

■ <BIN> Format:

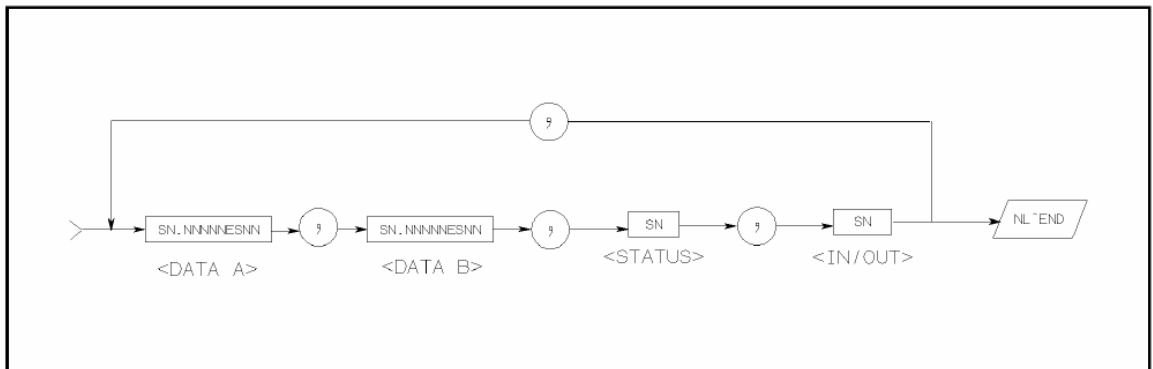
The <BIN No.> data shows the bin sorting results as follows.

Data	Sorting Results
1	BIN 1
2	BIN 2
3	BIN 3
4	AUX BIN
5	OUT_OF_BINS

The <BIN No.> data is output with the measurement data only when the comparator function is set to ON.

### 5.3.2 Format 2

The ASCII data output format on the **List Sweep** page is described in Figure 5-5.



**Figure 5-5 ASCII Data Format 2**

The data loop is repeated for the number of the sweep points.

The <DATA A>, <DATA B>, <STATUS> formats are the same as the formats on the **MeasDisplay**, **Bin No. Disp**, or **Bin Count** page. So the only the <IN/OUT> format will be described.

■ <IN/OUT> format:

Data	Result
-1	OUT
0	IN
+1	HIGH

The <IN/OUT> data shows the result of the list sweep's comparator function.

When the comparator function for the list sweep measurement isn't used, the <IN/OUT> use the 2 ASCII character fixed length format as follows.

SN (S:+/-, N: 0 to 1)

# Chapter 6 Command Reference

This chapter provides descriptions of all TH2816B's available GPIB commands which correspond to Standard Commands for Programmable Instruments (SCPI) command sets, listed in functional subsystem order. Use this chapter as a reference.

## 6.1 Notation Conventions and Definitions

The following characters are used in the command syntax.

- : A colon is used to separate the higher level commands and the lower level commands.
- ; The semicolon can be used as a separator to execute multiple commands on a single line.
- \* Asterisk is used to indicate that the command followed is a common command.
- ? A question mark is used to generate a query for the command in front of it.
- , Comma is used to separate the multi-parameters in the command.
- White space is used to separate the command and the parameter.
- "" Double quotation marks indicate that the enclosed text is string data.

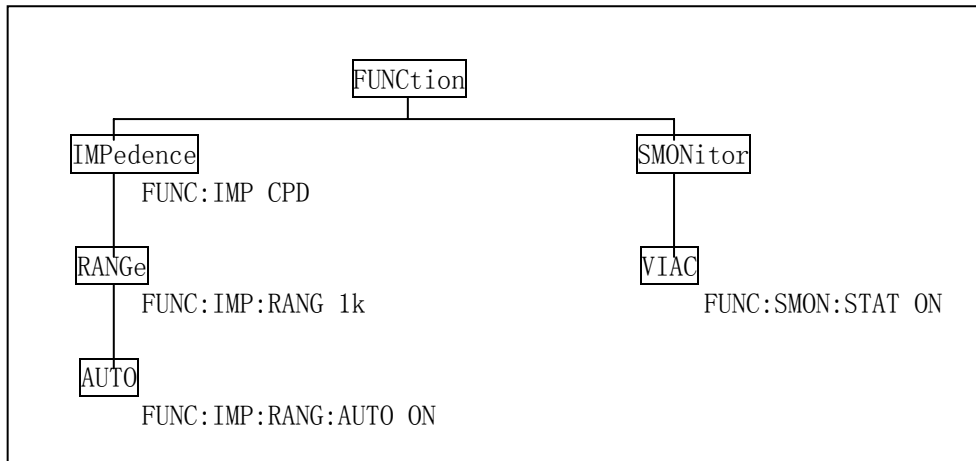
The following characters will be used in this chapter to describe GPIB commands.

- NR1 Integer numeric data
- NR2 fixed point numeric data
- NR3 floating point numeric data
- NL New Line character (decimal 10) is the end of the input/output string.
- ^END EOI terminator signal
- < > Angular brackets enclose words or characters that are used to symbolize a program code parameter or a GPIB command.
- [ ] Square brackets indicate that the enclosed items are optional. The square brackets with the asterisk (for example, [*<value>\** ]) means the enclosed item (*<value>*) repeats until the maximum counted number.
- { } When several items are enclosed by braces, one and only one of these elements may be selected.

## 6.2 Command Structure

TH2816B commands are divided into two types: GPIB common commands and SCPI commands. The GPIB common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. The SCPI commands are used to control all of the TH2816B's functions. The SCPI commands are tree structured three levels deep. (The highest level commands are called the subsystem commands in this manual.) So the lower level commands are legal only when the subsystem commands have been selected. A colon (:) is used to separate the higher level commands and the lower level commands. See Figure 6-1 for a sample.





**Figure 6-1. Command Tree Example**

The basic rules of the command tree are as follows.

- Letter case (upper and lower) is ignored.  
For example,  
FUNC:IMP CPD = func:imp cpd = Func:Imp CpD
- Spaces (␣ is used to indicate a space) must not be placed before and/or after the colon (:).  
For example,  
(wrong) FUNC␣:␣IMP CPD  
(right) FUNC:IMP CPD
- The command can be completely spelled out or in abbreviated type.  
(The rules for command abbreviation are described later in this section)  
For example,  
FUNCTION:IMPEDANCE CPD = FUNC:IMP CPD
- The command header should be followed by a question mark (?) to generate a query for that command.  
For example,  
FUNC:IMP?

The semicolon (;) can be used as a separator to execute multiple commands on a single line. The multiple command rules are as follows.

- Commands at the same level and in the same subsystem command group can be separated by a semicolon (;) on a multiple command line.  
For example,  
CORR:SPOT1:STAT ON;FREQ 1KHZ
- To restart commands from the highest level, a semicolon (;) must be used as the separator, and then a leading colon (:), which shows that the restarted command is a command at the top of the command tree, must follow.  
For example,  
FUNC:IMP CPD;;FUNC:SMON:STAT ON
- The GPIB common commands can restart only after a semicolon on a multiple command line.  
For example,  
FUNC:IMP CPD;\*trg;SMON ON
- The GPIB common commands keeps the previous commands level in a multiple command line.  
For example,  
FUNC:IMP CPD;\*SRE 32;SMON:VAC ON;IAC ON

## 6.3 Command Abbreviations

Every command and character parameter has at least two forms, a short form and a long form. In some cases they will be the same. The short form is obtained using the following rules.

- If the long form has four characters or less, the long form and short form are the same.
- If the long form has more than 4 characters, and if the 4th character is a vowel, the short form is the first 3 characters of the long form. If the 4th character is not a vowel, the short form is the first 4 characters.

For example:

MODE abbreviates to MODE.

TRIGger abbreviates to TRIG.

LEVel abbreviates to LEV.

FREQuency abbreviates to FREQ.

- If the long form mnemonic is defined as a phrase rather than a single word, then the long form mnemonic is the first character of the first word(s) followed by the entire last word. The above rules, when the long form mnemonic is a single word, are then applied to the resulting long form mnemonic to obtain the short form.

For example:

Percent TOLerance abbreviates to PTOL. (The long form is PTOLerance.)

Note: TH2816B accepts the three forms of the same SCPI commands: all upper case, all lower case, and mixed upper and lower case.

## 6.4 Suffix Units and suffix Multipliers

When numeric data is used as a parameter, the suffix multiplier mnemonics and suffix units (The suffix multiplier must be used with the suffix unit.) can be used for some commands as follows.

**Table 6-1. Multiplier Mnemonics**

Denition	Mnemonic	Used by TH2816B
1E18 (EXA)	EX	NO
1E15 (PETA)	PE	NO
1E12 (TERA)	T	NO
1E9 (GIGA)	G	NO
1E6 (MEGA)	MA	YES
1E3 (KILO)	K	YES
1E-3 (MILI)	M	YES
1E-6 (MICRO)	U	YES
1E-9 (NANO)	N	YES
1E-12 (PICO)	P	YES
1E-15 (FEMTO)	F	NO
1E-18 (ATTO)	A	NO
M or MA is available only when the suffix unit is HZ.		

**Table 6-2. Suffix Multipliers without Suffix Units**

Type of Command	Available Command	Example
Deviation reference value	FUNC:DEV1:REF FUNC:DEV2:REF	:REF 100p If the measurement function is Cp-D, then deviation reference value for primary parameter is 100pF
Standard value for load correction	CORR:SPOTn:LOAD:STAN	:STAN 0.1k,-12 If the measurement function for load correction is R-X, then standard value for load correction is 100 $\Omega$ and -12 $\Omega$ .
Limit value for list sweep	LIST:BANDn	:BAND1 A,100u,110u If the measurement function for list sweep measurement is L-Q, then the low limit for primary parameter is 100uH, and the high limit for primary parameter is 110uH.
Limit value for comparator	COMP:TOL:NOM COMP:TOL:BINn COMP:TOL:SLIM	:NOM 100m If the swapped measurement function for comparator is Cs-Rs, then the nominal value for Rs is 100m $\Omega$ .

**Table 6-3. Suffix Units and Available Commands**

Suffix Unit	Available Command
HZ	FREQ LIST:FREQ CORR:SPOTn:FREQ
V, mV	VOLT VOLT:LEV LIST:VOLT
A, mA, uA	LIST:BIAS
s,ms	TRIG:DEL
For TH2816B, only the fixed frequency value and unit configurations can be used. Refer to the FREQ subsystem commands.	

## 6.5 Command Reference

All commands in this reference are fully explained and listed in the following functional command order.

### TH2816B Subsystem Commands

- ◇ DISPlay      ◇ FREQuency      ◇ VOLTage      ◇ FUNCtion
- ◇ APERture      ◇ TRIGger      ◇ FETCh?
- ◇ ABORt      ◇ CORRection      ◇ COMParator      ◇ Mass MEMory

### GPIO Common Commands

- ◇ \*RST      ◇ \*TRG      ◇ \*IDN

The explanation of each subsystem command is patterned as follows.

- 1) Subsystem command name
- 2) Command Tree (Subsystem command only)
- 3) Compound Command Name
- 4) Command Description
- 5) Command Syntax
- 6) Example Using The Above Command Syntax
- 7) Query Syntax
- 8) Query Response
- 9) Example Using The Above Query Syntax

### 6.5.1 DISPlay Subsystem

The DISPlay subsystem command group sets the display page. Figure 6-2 shows the command tree of the DISPlay subsystem command group.

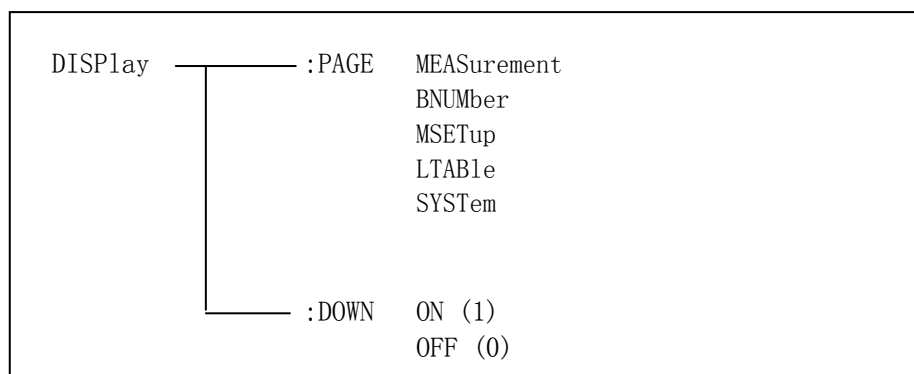


Figure 6-2. Display Subsystem Command Tree

#### :PAGE

The :PAGE command sets the display page. The :PAGE? Query returns the abbreviated page name currently displayed on the LCD screen.

##### Command Syntax

DISPlay:PAGE <page name>

Where, <page name> is:

MEASurement	Sets display page to MeasDisplay
BNUMber	Sets display page to BinNo. Disp
MSETup	Sets display page to Meas Setup
LTABLE	Sets display page to Limit Table
SYSTem	Sets display page to System Config

##### Example

WrtCmd("DISP:PAGE MEAS") Set display page to the *MeasDisplay* page.

##### Query Syntax

DISPlay:PAGE?

##### Query Response

Returned data format is :

<page name><NL^END>

Where,

<page name> Return the abbreviated name of the current display page as shown in the preceding list.

#### :DOWN

The :PAGE command sets the display character size of the measurement results. The :PAGE? Query returns the status of the display character size of the measurement results.

##### Command Syntax

DISPlay:DOWN  $\left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49)	When the function is ON, normal character size is displayed.
0 (decimal 48)	When the function is OFF, large character size is displayed.

**Example**

WrtCmd("DISP:DOWN 1") Set display character to normal size.

**Query Syntax**

DISPlay:DOWN?

**Query Response**

Returned data format is :

<NR1><NL^END>

**6.5.2 FREQuency Subsystem**

The FREQuency command sets the oscillator frequency. The FREQuency? query returns the current test frequency setting.

**Command Syntax**

FREQuency  $\left\{ \begin{array}{c} \text{<value>} \\ \text{MIN} \\ \text{MAX} \end{array} \right\}$

Where,

<value> The available values are listed as follows

50, 60,  
100, 120, 200, 400, 500,  
1000, 2000, 4000, 5000,  
10000, 20000, 40000, 50000  
100000,

50hz, 60hz,  
100hz, 120hz, 200hz, 400hz, 500hz,  
1khz, 2khz, 4khz, 5khz,  
10khz, 20khz, 40khz, 50khz,  
100khz

MIN Sets to the minimum value (50 Hz)

MAX Sets to the maximum value (100 kHz)

**Example**

WrtCmd ("FREQ 1KHZ") Set test frequency to 1000 Hz

Note: When frequency list sweep measurement is sweeping, you cannot use this command to set the frequency. If you do so, "Cannot Executed" will be displayed in the message window.

**Query Syntax**

FREQuency?

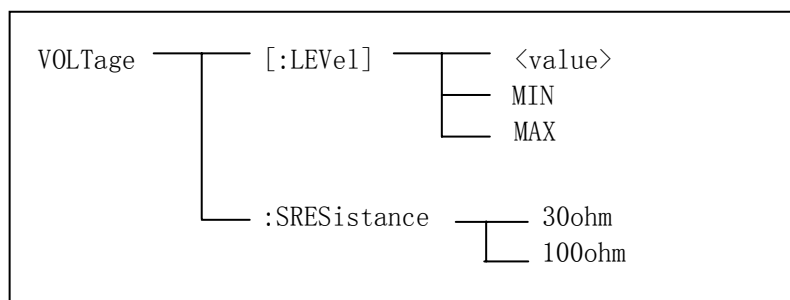
**Query Response**

Returned Format is :

<NR1><NL^END>

### 6.5.3 VOLTage Subsystem

The VOLTage command sets the oscillator's output voltage level and output impedance. The VOLTage? query returns the current oscillator voltage level. Figure 6-3 shows the VOLTage Subsystem Command Tree.



**Figure 6-3 VOLTage Subsystem Command Tree**

#### Command Syntax

$$\text{VOLTage[:LEVel]} \left\{ \begin{array}{l} \text{<value>} \\ \text{MIN} \\ \text{MAX} \end{array} \right\}$$

Where,

<value> is the NR1, NR2, or NR3 format followed by V or mV, the value must be from 10 mV to 2 V.

MIN Sets or returns to the minimum oscillator voltage level (10 mV)

MAX Sets or returns to the maximum oscillator voltage level (2 V)

#### Example

WrtCmd("VOLT 1V) Set oscillator voltage level to 1 V.

Note: When oscillator voltage level list sweep measurement is sweeping, you cannot use this command to set the oscillator voltage level. If you do so, "Cannot Executed" will be displayed in the message window.

#### Query Syntax

VOLTage? or VOLTage:LEVel?

#### Query Response

Returned format is :

<NR3><NL^END>

#### :SRESistance

:SRESistance is used to set the signal source output resistance.

#### Command Syntax

$$\text{VOLTage:SRESistance} \left\{ \begin{array}{l} 30 \text{ ohm} \\ 100 \text{ ohm} \end{array} \right\}$$

#### Example

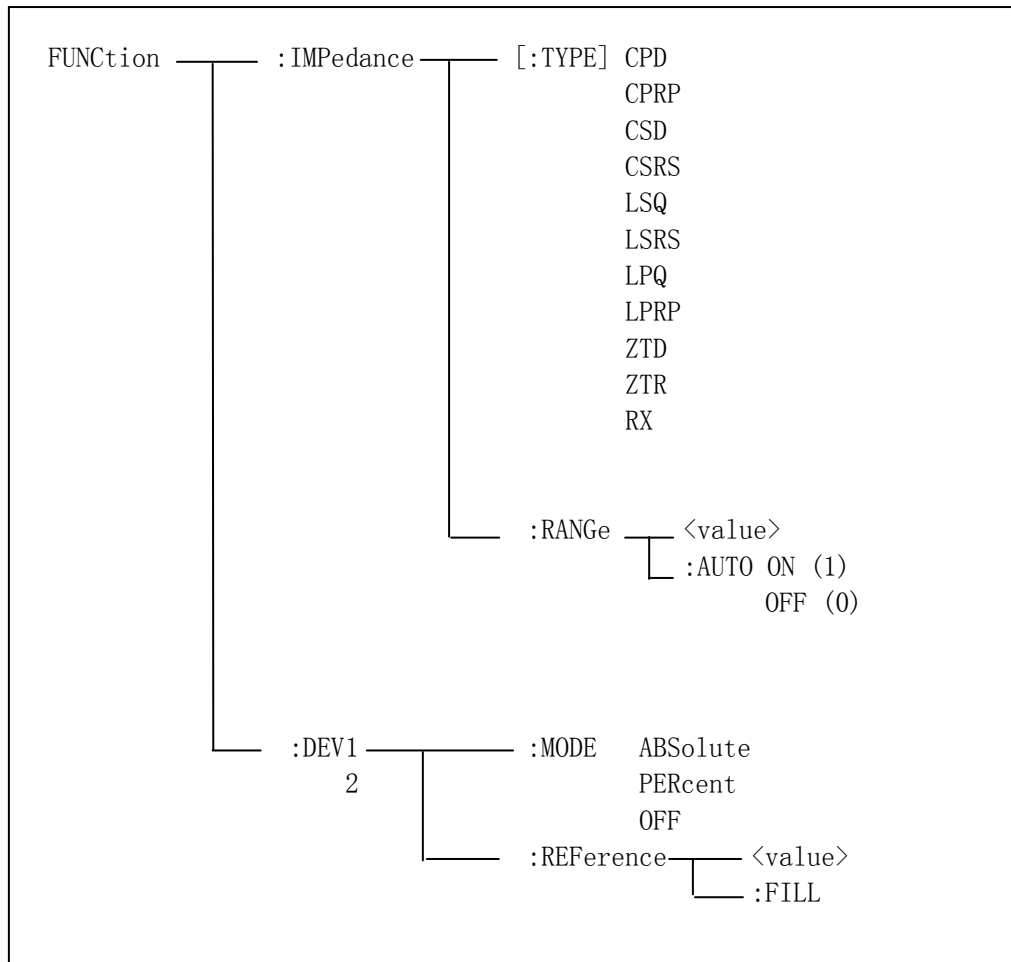
WrtCmd("VOLT:SRES 30 ohm") Set signal source output resistance to 30 ohm.

#### Query Syntax

There is no query command for signal source output resistance function.

### 6.5.4 FUNCTION Subsystem

The FUNCTION subsystem command group sets the measurement function, the measurement range, monitor ON/OFF control, and the deviation measurement control. Figure 6-4 shows the command tree of the FUNCTION subsystem command group.



**Figure 6-4. FUNCTION Subsystem Command Tree**

#### :IMPedance

The :IMPedance command sets the measurement function. The :IMPedance? query returns the current measurement function.

#### Command Syntax

FUNCTION:IMPedance <function>

Where, <function> is:

CPD	Sets function to Cp-D	LPQ	Sets function to Lp-Q
CPRP	Sets function to Cp-Rp	LPRP	Sets function to Lp-Rp
CSD	Sets function to Cs-D	ZTD	Sets function to Z-θ (deg)
CSRS	Sets function to Cs-Rs	RX	Sets function to R-X
LSQ	Sets function to Ls-Q	ZTR	Sets function to Z-θ (rad)
LSRS	Sets function to Ls-Rs		

#### Example

WrtCmd("FUNC:IMP RX)      Set the measurement function to R-X.

#### Query Syntax

FUNCtion:IMPedance?

#### Query Response

Returned format is:

<function><NL^END>

#### :IMPedance:RANGe

The :IMPedance:RANGe command sets the measurement range. The :IMPedance:RANGe? query returns the current measurement range even if the measurement range is set to AUTO.

#### Command Syntax

FUNCtion:IMPedance:RANGe <value>

Where, <value> is in the NR1 format with a suffix multiplier and a suffix unit. OHM, and KOHM can be used with this command. The values can be used with this command are listed as follows.

10, 30, 100, 300, 1000, 3000, 10000, 30000, 100000

or 10ohm, 30ohm, 100ohm, 300ohm, 1kohm, 3kohm, 10kohm, 30kohm, 100kohm

If values other than preceding values are used, "Error Parameter" will be displayed in the message window.

#### Example

WrtCmd("FUNC:IMP:RANG 1KOHM")      Set the measurement range to 1Kohm.

If this command is received while auto range is ON, the auto range function is automatically set to OFF and the range will be held at the range dictated by the received command.

#### Query Syntax

FUNCtion:IMPedance:RANGe?

#### Query Response

Returned format is:

<value><NL^END>

Where, <value> is 10, 30, 100, 300, 1000, 3000, 10000, 30000, 100000

#### :IMPedance:RANGe:AUTO

The :IMPedance:RANGe:AUTO command sets the auto range to ON or OFF. The :IMPedance:RANGe:AUTO? query returns the current auto range ON/OFF condition.

#### Command Syntax

FUNCtion:IMPedance:RANGe:AUTO  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

1 (decimal 49)      When the function is ON

0 (decimal 48)      When the function is OFF



**Example**

WrtCmd("FUNC:IMP:RANG:AUTO ON ")      Set the measurement range to AUTO.

**Query Syntax**

FUNCtion:IMPedance:RANGe:AUTO?

**Query Response**

Returned format is :

<NR1><NL^END>

**:DEV<n>:MODE**

The :DEV<n>:MODE command sets the deviation measurement mode. The :DEV<n>:MODE? query returns the current setting of the deviation measurement mode.

**Command Syntax**

FUNCtion:DEC<n>:MODE  $\left\{ \begin{array}{c} \text{ABSolute} \\ \text{PERCent} \\ \text{OFF} \end{array} \right\}$

Where,

ABSolute       $\Delta$ ABSolute deviation mode

PERCent       $\Delta\%$  deviation mode

OFF            Turn the deviation measurement mode OFF

<n> is:

1 (decimal 49)      Deviation mode setting for primary parameter

2 (decimal 50)      Deviation mode setting for secondary parameter

**Example**

WrtCmd("FUNC:DEV1:MODE ABS")

Set  $\Delta$ ABSolute deviation mode for the primary parameter.

**Query Syntax**

FUNCtion:DEV<n>:MODE?

**Query Response**

Returned format is :

$\left\{ \begin{array}{c} \text{ABS} \\ \text{PER} \\ \text{OFF} \end{array} \right\} <\text{NL}^{\wedge}\text{END}>$

**:DEV<n>:REFeRence**

The :DEV<n>:REFeRence command sets the reference value for deviation measurement. The :DEV<n>:REFeRence? query returns the current reference values.

**Command Syntax**

FUNCtion:DEV<n>:REFeRence<value>

Where,

<value>      is the NR1, NR2, or NR3 format with a suffix multiplier ma, k, m, u, n, p.

<n> is:

1 (decimal 49)      Reference value setting for primary parameter

2 (decimal 50)      Reference value setting for secondary parameter

**Example**

WrtCmd("FUNC:DEV1:REF 10")

The <value> may be used without a suffix unit; the unit has been defined by the current measurement function.

#### Query Syntax

FUNCtion:DEV<n>:REFerence?

#### Query Response

Returned format is :

<NR3><NL^END>

#### :REFerence:FILL

The :DEV<n>:REFerence:FILL command executes a single measurement and enters two measured values (the primary and secondary parameters) into each of the reference values for the deviation measurement.

#### Command Syntax

FUNCtion:DEV<n>:REFerence:FILL

Where, <n> is

1 or 2 (Both reference values are measured simultaneously.)

#### Example

WrtCmd("FUNC:DEV1:REF:FILL")

The instrument executes a single measurement and enters the measured primary parameter as the primary parameter reference value.

### 6.5.5 APERture Subsystem

The APERture command sets the measurement speed and the averaging rate. The APERture? query returns the current measurement speed and the averaging rate settings.

#### Command Syntax

APERture { SHORT/FAST  
          MEDium  
          LONG/SLOW } [, <value>]

Where,

SHORT/FAST Fast measurement speed, Short integration time.

MEDium Medium measurement speed, Medium integration time.

LONG/SLOW Slow measurement speed, Long integration time.

<value> 1 to 256 (NR1): Averaging rate.

#### Example

WrtCmd("APER MED,5")

#### Query Syntax

APERture?

#### Query Response

Returned format is:

{ FAST  
  MED  
  SLOW } , <NR1> <NL^END>

### 6.5.6 TRIGger Subsystem

The TRIGger subsystem command group is used to enable a measurement or a sweep measurement, and to set the trigger mode and the trigger delay time. Figure 6-5 shows the command tree of the TRIGger subsystem command group.

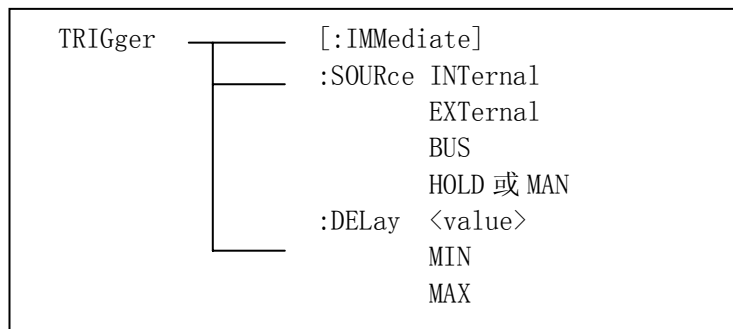


Figure 6-5. TRIGger Subsystem Command Tree

#### :IMMediate

The :IMMediate command causes the trigger to execute a measurement or a sweep measurement, regardless of the trigger state.

##### Command Syntax

TRIGger[:IMMediate]

##### Example

WrtCmd("TRIG")

Note: This command is valid only on **MeasDisplay**, **BinNo. Disp**, **Bin Count** and **List Sweep** page. On other pages this command will be ignored.

#### :SOURce

The :SOURce command sets the trigger mode. The :SOURce? Query returns the current trigger mode.

##### Command Syntax

TRIGger:SOURce {  
    INTernal  
    EXTernal  
    BUS  
    HOLD/MAN  
}

Where,

INTernal      Internal trigger mode  
EXTernal      External trigger mode  
BUS           Bus trigger mode  
HOLD/MAN     Trigger hold (Manual trigger mode)

##### Example

WrtCmd("TRIG:SOUR BUS")    Set bus trigger mode.

##### Query Syntax

TRIGger:SOURce?

##### Query Response

Returned format is:

$$\left\{ \begin{array}{c} \text{INT} \\ \text{EXT} \\ \text{BUS} \\ \text{HOLD} \end{array} \right\} \langle \text{NL}^{\wedge} \text{END} \rangle$$

### **:DElay**

The :DElay command sets the trigger delay time. The :DElay? query returns the current delay time.

#### **Command Syntax**

$$\text{TRIGger:DElay} \left\{ \begin{array}{c} \langle \text{value} \rangle \\ \text{MIN} \\ \text{MAX} \end{array} \right\}$$

Where,

$\langle \text{value} \rangle$  is the NR1, NR2, or NR3 format with suffix unit m,ms; 0 to 60 [s] in 1 ms resolution

MIN Sets the minimum delay value (0 s)

MAX Sets the maximum delay value (60 s)

#### **Example**

WrtCmd("TRIG:DEL 5S") Set trigger delay time to 5 s

WrtCmd("TRIG:DEL MIN") Set trigger delay time to minimum 0s.

#### **Query Syntax**

TRIGger:DElay?

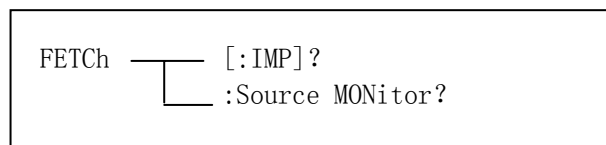
#### **Query Response**

Returned Format is:

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

### **6.5.7 FETCh? Subsystem**

The FETCh? subsystem command group is a sensor-only command which retrieves the measurement data taken by measurement(s) initiated by a trigger, and places the data into the TH2816B's output buffer. Figure 6-6 shows the command tree of the FETCh? subsystem command group.



**Figure 6-6. FETCh? Subsystem Command Tree**

### **[:IMP]?**

The [:IMP]? query sets the latest measurement data of the primary and secondary parameters into the TH2816B's output buffer.

#### **Query Syntax**

FETCh[:IMP]?

#### **Example**

WrtCmd("TRIG:SOUR BUS")

WrtCmd("TRIG")

WrtCmd("FETC?")

If the latest measurement data has been sent out, the new measurement is not begun or the new measurement is not over, then the FETC? command will be valid after the new measurement is over.

FETC? Command can only be used on **MeasDisplay**, **BinNo. Disp**, **Bin Count** and **List Sweep** page. The query response returned will be “9.9E37,9.9E37” on other pages.

On **List Sweep** page, if the list sweep mode is “STEP” mode, the measurement results for one sweep point will be returned. If the list sweep mode is “SEQ”, the measurement results for all sweep points will be returned. If one list sweep parameter point is not set, the query response will be “9.9E37,9.9E37”.

#### :Source MONitor?

The :Source MONitor? query sets the latest measured voltage and current monitor data into the TH2816B's output buffer.

##### Query Syntax

FETCH:SMONitor?

##### Query Response

Returned format is :

<NR3,NR3><NL^END>.

The latest measured monitor data will always be set in TH2816B's output buffer, even if the monitor data has been read out before.

The command can only be used on the four display pages under **DISPLAY** menu, and the level monitor must be set to ON, otherwise returned data is “9.9E37,9.9E37”.

### 6.5.8 ABORt Subsystem

TH2816B will halt the current measurement, once ABORt command is received.

##### Command Syntax

ABORt

##### Example

WrtCmd(“ABOR”)

### 6.5.9 CORRection Subsystem

The CORRection subsystem command group sets the correction function, including the the OPEN/SHORT/LOAD correction settings. Figure 6-7 shows the command tree of the CORRection subsystem command group.

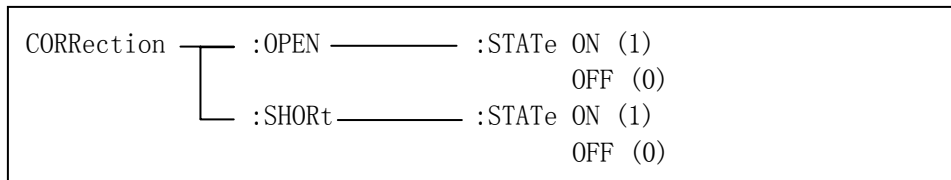


Figure 6-7. CORRection Subsystem Command Tree

#### :OPEN

The :OPEN command executes 16 presetted OPEN correction data measurement points.

##### Command Syntax

CORRection:OPEN

**Example**

WrtCmd("CORR:OPEN")

When a command needs a long time to execute for example the OPEN/SHORT command. The controller should not send the next command before the former command is finished. On GPIB bus, RFD can be used to dominate the BUS before the command is finished. While on RS232C bus, the first character of the command will be ignored by the instrument, if the controller sends the command before the former command is finished.

**:OPEN:STATe**

The :OPEN:STATe command sets the OPEN correction function to ON or OFF. The :OPEN:STATe? query returns the current ON/OFF condition of the OPEN correction.

**Command Syntax**

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

Where,

1 (decimal 49)      When the function is ON  
0 (decimal 48)      When the function is OFF

**Example**

WrtCmd("CORR:OPEN:STAT ON")

**Query Syntax**

CORRection:OPEN:STATe?

**Query Response**

Returned format is :  
<NR1><NL^END>

**:SHORT**

The :SHORT command executes 16 presetted SHORT correction data measurement points.

**Command Syntax**

CORRection:SHORT

**Example**

WrtCmd("CORR:SHOR")

**:SHORT: STATe**

The :SHORT:STATe command sets the SHORT correction function to ON or OFF. The :SHORT:STATe? query responds the current ON/OFF condition of the SHORT correction.

**Command Syntax**

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

Where,  
 1 (decimal 49)    When the function is ON  
 0 (decimal 48)    When the function is OFF

#### Example

WrtCmd("CORR:SHOR:STAT ON")

#### Query Syntax

CORRection:SHORT:STATe?

#### Query Response

Returned format is :  
 <NR1><NL^END>

### 6.5.10 COMParator Subsystem

The COMParator subsystem command group sets the comparator function, including its ON/OFF setting, limit mode, and limit values. Figure 6-8 shows the command tree of the COMParator subsystem command group.

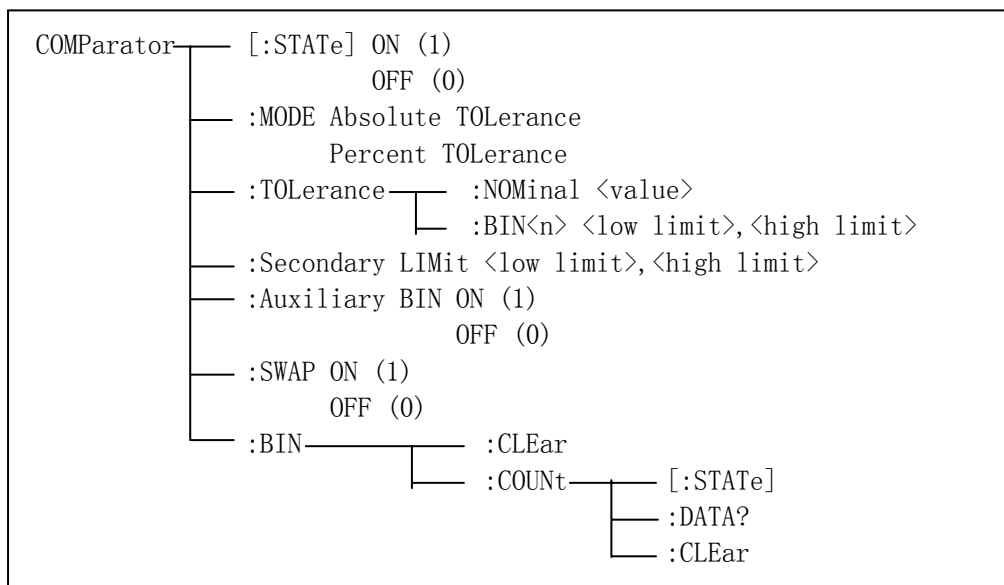


Figure 6-8. COMParator Subsystem Command Tree

#### [:STATe]

The [:STATe] command sets the comparator function to ON or OFF. The [:STATe]? query responds the current ON/OFF condition of comparator function.

#### Command Syntax

$$\text{COMParator[:STATe]} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,  
 1 (decimal 49)    When the function is ON  
 0 (decimal 48)    When the function is OFF

#### Example

WrtCmd("COMP ON")

**Query Syntax**

COMParator[:STATe]?

**Query Response**

Returned format is :

<NR1><NL^END>

**:MODE**

The :MODE command sets the limit mode of the comparator function. The :MODE? query returns the current settings of the limit mode.

**Command Syntax**

$$\text{COMParator:MODE} \left\{ \begin{array}{l} \text{ATOLerance} \\ \text{PTOLerance} \end{array} \right\}$$

Where,

ATOLerance      Set the absolute tolerance mode (parameter value)

PTOLerance      Set the percent tolerance mode (the ratio in percent)

**Example**

WrtCmd("COMP:MODE ATOL")

**Query Syntax**

COMParator:MODE?

**Query Response**

Returned format is:

$$\left\{ \begin{array}{l} \text{ATOL} \\ \text{PTOL} \end{array} \right\} <\text{NL}^{\wedge}\text{END}>$$
**:TOLerance:NOMinal**

The :TOLerance:NOMinal command sets the nominal value for the tolerance mode of the comparator function. This can be set only when the limit mode is set to the tolerance mode. The :TOLerance:NOMinal? query returns the current settings of the nominal value for the tolerance mode.

**Command Syntax**

COMParator:TOLerance:NOMinal <value>

Where,

<value>      is the NR1, NR2, or NR3 format with suffix ma, k, m, u, m, p.

**Example**

WrtCmd("COMP:TOL:NOM 100E-12")

**Query Syntax**

COMParator:TOLerance:NOMinal?

**Query Response**

Returned Format is:

<NR3><NL^END>



**:TOLerance:BIN<n>**

The :TOLerance:BIN<n> command sets the low/high limit values of each BIN for the comparator function tolerance mode. These limits can be set only when the limit mode is set to the tolerance mode. The :TOLerance:BIN<n>? query returns the current settings of the low/high limit values of each of the BINs.

**Command Syntax**

COMParator:TOLerance:BIN<n> <low limit>,<high limit>

Where,

<n>            1 to 4 (NR1) : BIN number  
 <low limit>   NR1, NR2, or NR3 format with suffix ma, k, m, u, n, p.  
 <high limit>   NR1, NR2, or NR3 format with suffix ma, k, m, u, n, p.

**Note**    The low limit value should be lower than the high limit value. If the low limit value is set higher than the high limit, a warning message is displayed when this command is received (an error does not occur).

**Example**

WrtCmd("COMP:TOL:BIN1 -5,5")  
 WrtCmd("COMP:TOL:BIN2 -10,10")

**Query Syntax**

COMParator:TOLerance:BIN<n>?

**Query Resopnse**

Returned Format is:

<low limit>,<high limit><NL^END>

Low limit and high limit are NR3 format. If the current limits are not set, "9.9E37, 9.9E37" will be returned.

**:Secondary LIMit**

The :Secondary LIMit command sets the low/high limit values for the comparator function secondary parameter. The :Secondary LIMit? query returns the current settings of the secondary parameter low/high limit values.

**Command Syntax**

COMParator:SLIMit <low limit>,<high limit>

Where,

<low limit>    is the NR1, NR2, or NR3 format with suffix ma, k, m, u, n, p.  
 <high limit>   is the NR1, NR2, or NR3 format with suffix ma, k, m, u, n, p.

**Note:**    The low limit value should be lower than the high limit value. If the low limit value is set higher than the high limit, a warning message is displayed when this command is received (an error does not occur).

**Example**

WrtCmd("COMP:SLIM 0.001,0.002")

**Query Syntax**

COMParator:SLIMit?

**Query Response**

Returned Format is:

<NR3>,<NR3><NL^END>

If the current secondary limits are not set, “9.9E37” will be returned.

### **:Auxiliary BIN**

The :Auxiliary BIN command sets the auxiliary BIN of the comparator to ON or OFF. The :Auxiliary BIN? query responds the current ON/OFF condition of the auxiliary BIN.

#### **Command Syntax**

COMParator:Auxiliary BIN  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

0 (decimal 48)      When the function is OFF  
1 (decimal 49)      When the function is ON

#### **Example**

WrtCmd(“COMP:ABIN ON”)

#### **Query Syntax**

COMParator:Auxiliary BIN?

#### **Query Response**

Returned Format is:

<NR1><NL^END>

### **:SWAP**

The :SWAP command sets the swap parameter function to ON (3 BIN settings for secondary parameter) or OFF (3 BIN settings for primary parameter). The :SWAP? query responds the current ON/OFF condition of the swap parameter function.

#### **Command Syntax**

COMParator:SWAP  $\left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$

Where,

0 (decimal 48)      When the function is OFF  
1 (decimal 49)      When the function is ON

#### **Example**

WrtCmd(“COMP:SWAP ON”)

#### **Query Syntax**

COMParator:SWAP?

#### **Query Response**

Returned Format is:

<NR1><NL^END>

### **:BIN:CLEAr**

The :BIN:CLEar command clears all of the limit value settings.

#### Command Syntax

COMParator:BIN:CLEar

#### Example

WrtCmd("COMP:BIN:CLE")

#### :BIN:COUNT[:STATe]

The :BIN:COUNT[:STATe] command sets the BIN count function to ON or OFF.  
The :BIN:COUNT[:STATe]? query responds with the current ON/OFF condition of the BIN count function.

#### Command Syntax

$$\text{COMParator:BIN:COUNT[:STATe]} \left\{ \begin{array}{c} \text{ON} \\ \text{OFF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

0 (decimal 48)	When the function is OFF
1 (decimal 49)	When the function is ON

#### Example

WrtCmd("COMP:BIN:COUN ON")

#### Query Syntax

COMParator:BIN:COUNT[:STATe]?

#### Query Response

Returned Format is:

<NR1><NL^END>

#### :BIN:COUNT:DATA?

The :BIN:COUNT:DATA? query returns the comparator BIN count results.

#### Query Syntax

COMParator:BIN:COUNT:DATA?

#### Query Response

Returned Format is:

<BIN1 count>,<BIN2 count>, <BIN3 count>,<OUT OF  
BIN count>, <AUX BIN count><NL^END>

Where,

<BIN1-3 count>	NR1 format : count result of BIN1-9
<OUT OF BINS count>	NR1 format : count result of OUT OF BINS
<AUX BIN count>	NR1 format : count result of AUX BIN

#### :BIN:COUNT:CLEar

The :BIN:COUNT:CLEar command clears all BIN counts.

#### Command Syntax

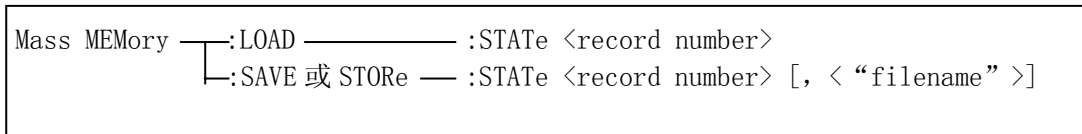
COMParator:BIN:COUNT:CLEar

### Example

WrtCmd("COMP:BIN:COUN:CLE")

## 6.5.11 Mass MEMory Subsystem

The Mass MEMory subsystem command group loads or stores setting data from/to the internal EEPROM. Figure 6-9 shows the command tree of the Mass MEMory subsystem command group.



**Figure 6-9. Mass MEMory Subsystem Command Tree**

### :LOAD:STATE

The :LOAD:STATE command loads the setting data from the internal EEPROM.

#### Command Syntax

MMEMory:LOAD:STATE <value>

Where,

<value> 0 to 11 (NR1) : file number for internal EEPROM

### Example

WrtCmd("MMEM:LOAD:STAT 1)

If the file number is not available, the message "Record Not Exist" will be displayed in the message window.

The file contains the page information. When a file is loaded, the instrument will display the saved page.

### :STORE:STATE/ :SAVE:STATE

The :STORE:STATE or :SAVE:STATE command stores the setting data to the internal EEPROM.

#### Command Syntax

MMEMory:STORE:STATE <value>[,<"filename">]

Where,

<value> 0 to 11 (NR1) : record number for EEPROM

<"filename"> The file name consists of not more than 18 characters.

<Unnamed> will be the default name, if you don't input a file name.

### Example

WrtCmd("MMEM:STOR:STAT 1,"#TH2816B\*")

### 6.5.12 Common Commands

A common command consists of an asterisk (\*) and a header. TH2816B acceptable GPIB common commands are described as follows.

#### **\*RST**

The \*RST command (reset command) sets the TH2816B to its initial settings.

#### **Command Syntax**

\*RST

#### **Example**

WrtCmd("\*RST")

#### **\*TRG**

The \*TRG command (trigger command) triggers a measurement. This command also moves the primary and secondary parameter measurement data into the TH2816B's output buffer.

#### **Command Syntax**

\*TRG

This command will be ignored on no measurement pages, and "9.9E37,9.9E37" will be returned

.

#### **Example**

WrtCmd("\*TRG")

#### **\*IDN?**

The \*IDN? query returns the TH2816B ID.

#### **Query Syntax**

\*IDN?

#### **Query Response**

Returned format is:

<product>,<version>,<NL^END>

Where,

<product> TH2816B Precision LCR Meter

<version> software revision number

### 6.5.13 Error and Warning Messages

The bus commands maybe contain error commands, command syntax errors or error parameters. TH2816B executes a command after the command is checked. If one of these errors occurs, TH2816B halts the command analysis, and the rest commands are ignored.

The error messages listed as follows are displayed in the message window.

Error Message	Description
Unknow Message!	Unrecognized command is received.
Syntax Error!	Unrecognized command or data type is received. The message unit separator (for example , “;” ,” ,” ) is improper.
Data Error!	Improper data type used. Data value was too large. Data value is not allowed.
Error Parameter.	Unrecognized parameter used.
Error Suffix.	Units are unrecognized, or the units are not appropriate. A suffix is not allowed for this operation.
Data Too Long!	Program Data is too long.
Cannot Executed!	Improper command. For example, frequency set command is sent when frequency list sweep measurement is performed.
Record Not Exist!	Load a file that is not exist.

The note messages listed as follows are displayed in the message window when some commands are executing.

Note message	Description
Open Progress..	Open correction is in progress.
Short Progress..	Short correction is in progress.
Save Progress..	Save control settings is in progress
Query Updated!	A new query received when the output buffer is not empty.
Data Print Fail!	Data output operation is over time in talk only mode.
Data Corrupt	“Data Corrupt” is sent to the bus as a query response, and the message is not displayed on the LCD.

# Chapter 7 Handler Interface

## 7.1 Basic Information

The handler interface outputs signals to indicate measurement completed, bin sorting judgments of the comparator function, and Go/No-Go judgments of the list sweep comparator function. The handler interface also has an input for an external trigger signal. Using these signals, TH2816B can easily be combined with a component handler and a system controller to fully automate component testing, sorting, and quality control data processing to increase production efficiency. Table 7-1 lists the handler interface specifications.

**Table 7-1 Specifications of Handler Interface.**

<b>Output signal</b> (Negative true, open collector, opto-isolated)	Decision output for comparator function	Bin number, out of bins, and rejection status
	Decision output for list sweep comparator function	IN/OUT at each sweep point and pass/fail for the result of sequential comparisons
	IDX	Analog measurement complete
	EOM	Full measurement complete. Display time is not included on the <b>BinNo Disp</b> page. Display time is included on the <b>List Sweep</b> page.
<b>Input Signal</b> (Opto-isolated)	TRIG	External Trigger, Pulse width $\geq 1\mu s$

## 7.2 Handler Interface Operation

This paragraph provides information, including a description of the interface signal lines and their electrical characteristics, necessary to use the Handler Interface.

### 7.2.1 Signal line definition

The handler interface uses three types of signals, comparison output, control input and control output. The signal lines for the Comparator Function and the List Sweep Comparator Function are defined differently for comparison output and control output signals. The following defines the signals when the handler interface Comparator Function and the List Sweep Comparator Function are used.

#### 7.2.1.1 Signal Line Used for Comparator Function

The signal definitions used for the Comparator Function are as follows.

- Comparison Output Signals:
  - /BIN1 - /BIN3
  - /AUX
  - /OUT
  - /PHI     primary parameter high reject signal
  - /PLO     primary parameter low reject signal
  - /SREJ    secondary parameter reject signal
- Control Output Signals:
  - /IDX     analog measurement completed signal
  - /EOM     end of measurement and comparison data valid signal

- Control Input Signal:  
/TRIG external trigger signal

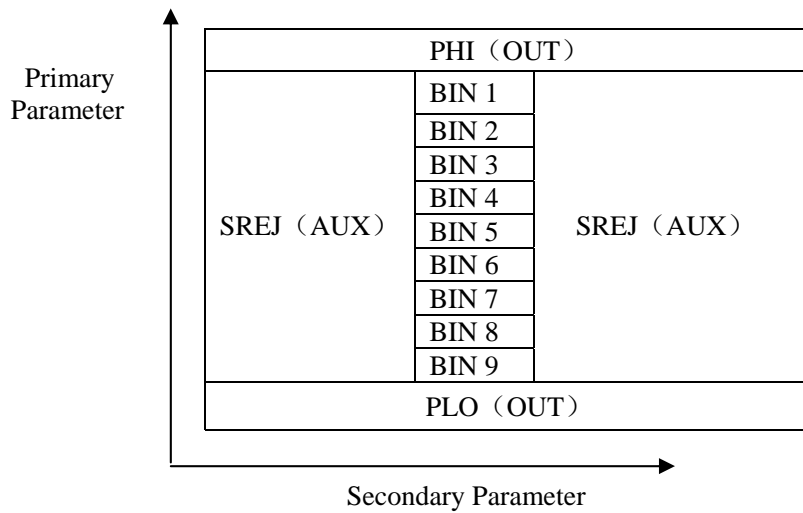
The contact assignments and a brief description of each signal used for the comparator function are given in Table 7-2 and Figure 7-2. The timing diagram is shown in Figure 7-3.

The /(back slash) in the signal name means that the signal is asserted when low.

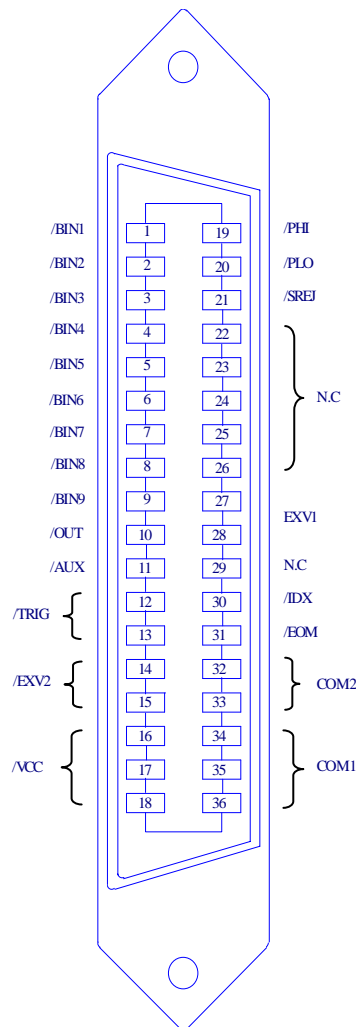


**Table 7-2. Pin Assignments For Comparator Function**

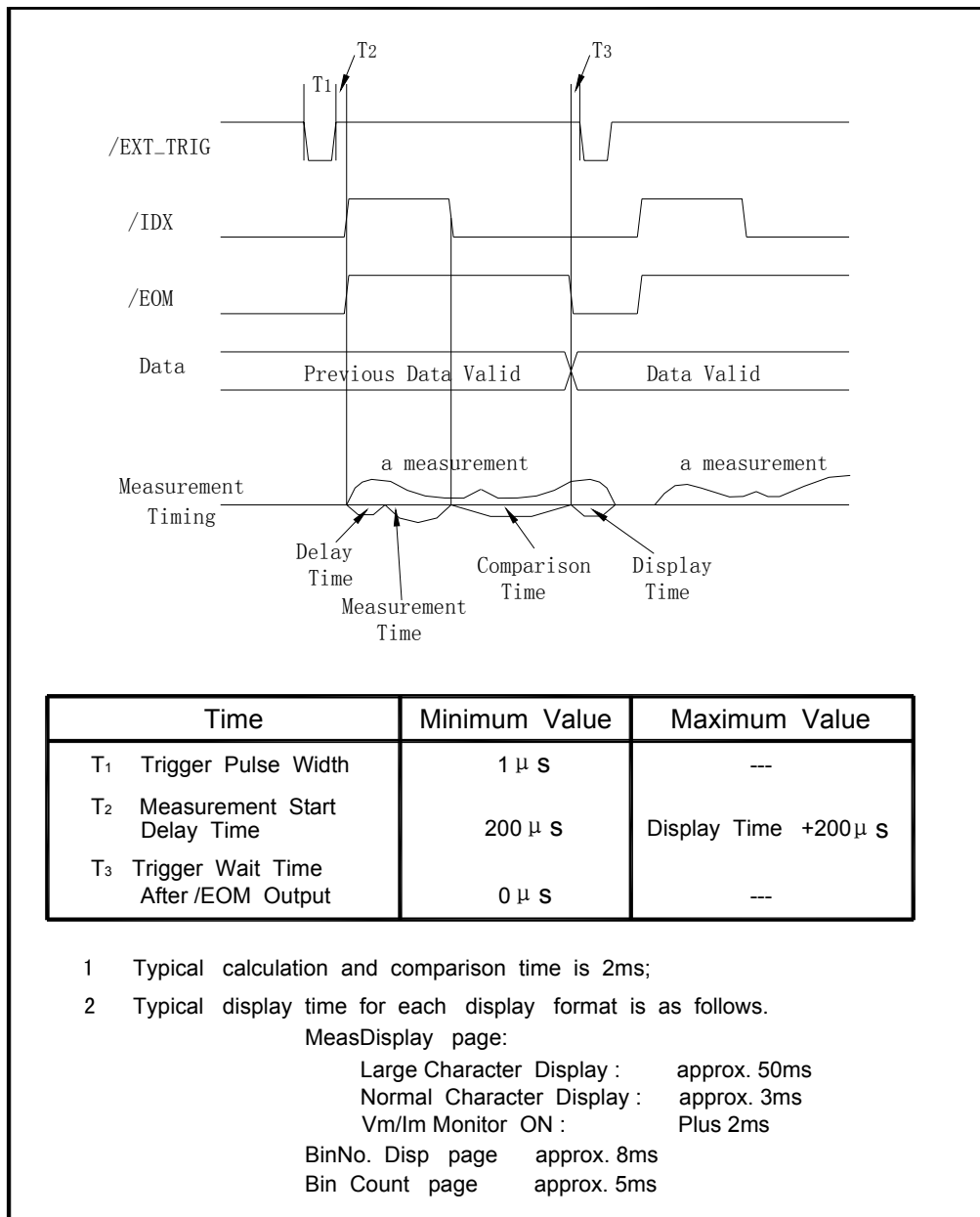
Pin No.	Signal Name	Description
1 2 3 4 5 6 7 8 9	/BIN1 /BIN2 /BIN3 /BIN4 /BIN5 /BIN6 /BIN7 /BIN8 /BIN9	Bin sorting judgments. All bin sorting signal outputs are opto-isolated open collector.
10 11	/OUT /AUX	Bin sorting judgments. All bin sorting signal outputs are opto-isolated open collector.
12 13	/TRIG /TRIG	External Trigger: TH2816B is triggered on the rising edge of a pulse applied to this pin when the trigger mode is set to EXT mode.
14 15	EXV2 EXV2	External DC voltage 2: DC voltage supply pins for DC isolated control signals (/TRIG, /IDX, /EOM). Setting of internal jumpers must be changed when using an internal voltage supply.
16 17 18	VCC	Internal voltage supply (maximum 100 mA) Setting of internal jumpers must be changed when using an internal voltage supply.
19	/PHI	Primary Parameter High Reject: The measurement value is greater than the high limit value of BIN1–BIN3. (See Figure 7-1)
20	/PLO	Primary Parameter Low Reject: The measurement value is less than the low limit value of BIN1-BIN3. (See Figure 7-1)
21	/SREJ	Secondary Parameter Reject: The measurement value is not within the range of the secondary parameter limit. (See Figure 7-1)
22 23 24 25 26	NC NC NC NC NC	No Connection No Connection No Connection No Connection No Connection
27 28	EXTV1 EXTV1	External DC voltage 1: DC voltage supply pins for DC isolated open collector outputs, /BIN1-/BIN3, /AUX, /OUT, /PHI, /PLO, /SREJ. The setting of internal jumpers must be changed when using the internal voltage supply.
29	NC	No Connection
30	/IDX	/IDX signal is asserted when an analog measurement is completed and TH2816B is ready for the next DUT to be connected to the UNKNOWN terminals. The measurement data, however, is not valid until /EOM is asserted. (See Figure 7-3)
31	/EOM	End of Measurement: This signal is asserted when the measurement data and comparison results are valid. (See Figure 7-3)
32 33	COM2 COM2	Common for EXTV2
34 35 36	COM1 COM1 COM1	Common for EXTV1



**Figure 7-1. /PHI, /PLO, /SREJ Signal's Area Example**



**Figure 7-2 Pin Assignment For Handler Interface Connector**



**Figure 7-3 Timing Diagram**

### 7.2.1.2 Signal Line Used for List Sweep Comparator Function

Signal definition used for the list sweep comparator function is different from that used for the comparator function. Signal definition used for the list sweep comparator function is as follows.

- Comparison Output Signals:  
 /BIN1-BIN3 and /OUT indicate IN/OUT judgments for each sweep point (refer to Figure 7-4). /AUX indicates pass/fail judgment (one or more failed judgments of steps 1 to 4 occurred during a single sweep).  
 These signals are output when the sweep measurement is completed.
- Control Output Signals:  
 /IDX (analog measurement completed signal) and /EOM (end of measurement signal). The timing when /IDX and /EOM are asserted is as follows: (different from that used for the comparator function).

In the SEQ sweep mode:

/IDX is asserted when the last step of an analog measurement of a sweep

measurement is completed. /EOM is asserted when all of the comparison results are valid after a sweep measurement.

In the STEP sweep mode:

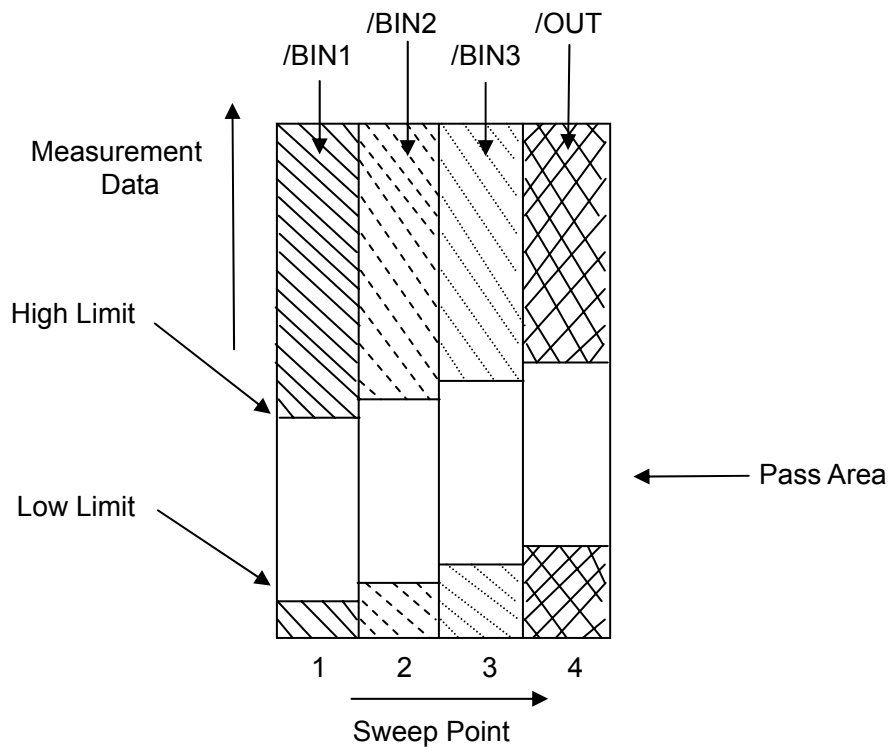
/IDX is asserted after each step of analog measurement in a seep measurement is completed. /EOM is asserted after each step measurement, inclding comparison time, is completed.

The contact assignments and a brief description of signals used for the list sweep function are given in Table 7-3 and Figure 7-2 (pin assignments for the list sweep comparator function are the same as for the comparator function). The timing diagram is shown in Figure 7-5.

The /(back slash) in the signal name means that the signal is asserted when LOW.

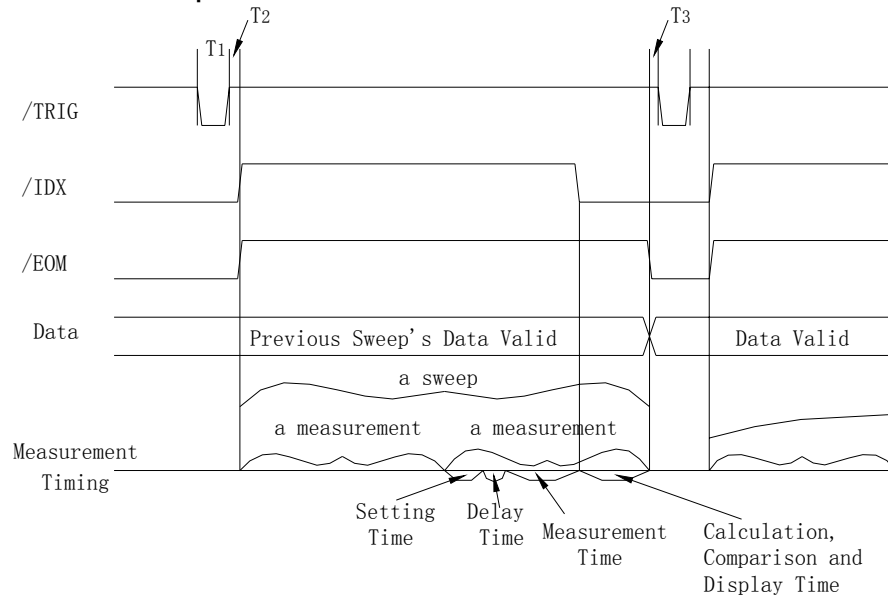
**Table 7-3 Contact Assignments for List Sweep Comparator Function**

Pin No.	Signal Name	Description
1	/BIN1	Failed (out of limit ) at sweep Point 1
2	/BIN2	Failed (out of limit ) at sweep Point 2
3	/BIN3	Failed (out of limit ) at sweep Point 3
4	/BIN4	Not Used
5	/BIN5	Not Used
6	/BIN6	Not Used
7	/BIN7	Not Used
8	/BIN8	Not Used
9	/BIN9	Not Used
10	/OUT	Failed (out of limit ) at sweep Point 4
11	/AUX	/AUX is asserted when one or more file judgments of Steps 1 to 10 occur in a single sweep.
12-18		Same as the assignments for the comparator function (Refer to Table 7-2).
19-21	N.U	Not Used (Off state, HIGH level)
22-29		Same as the assignments for the comparator function (Refer to Table 7-2).
30	/IDX	In the SEQ sweep mode: /IDX is asserted when an analog measurement of the last sweep step is completed, and TH2816B is ready for the next DUT to be connected to the UNKNOWN terminals. The measurement data, however, is not valid until/EOM is asserted. (See Figure 7-5) In the STEP sweep mode: /IDX is asserted when each analog measurement is complete and TH2816B is ready for the next sweep step. The measurement data, however, is not valid until /EOM is asserted (See Figure 7-5).
31	/EOM	End of Measurement In the SET sweep mode : /EOM is asserted when the measurement data and comparison results are valid after the last step measurement is completed. (See Figure 7-5.) In the STEP sweep mode: /EOM is asserted when each step measurement, including the comparison times, is completed and the measurement data is valid. The comparison results are valid after the /EOM signal of the last sweep point is asserted. (See figure 7-5)
32-36		Same as the assignments for the comparator function (Refer to Table 7-2).

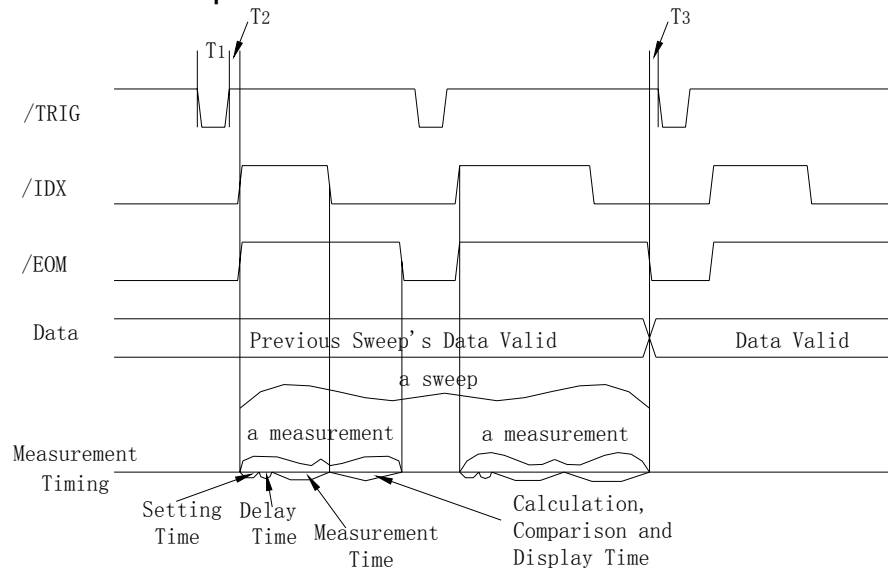


**Figure 7-4 Signal Area Example**  
(For The List Sweep Comparator Function)

### SEQ Sweep Mode:



### STEP Sweep Mode:



#### NOTE

1. Setting Time includes Correction Data Switching Time.
2. Calculation, Comparison and Display Time is approx. 5ms.  
Refer to Figure 7-3 for information of T1, T2, T3.

**Figure 7-5 Timing Diagram for List Sweep Comparator Function**

## 7.3 Electrical Characteristics

As mentioned in the previous paragraph, the meaning of some of the signals is different for the comparator function and the list sweep comparator function. However, the electrical characteristics of these signals are identical for the two operations. The following descriptions apply to both the comparator function and the list sweep comparator function.

### 7.3.1 DC Isolated Outputs

Each DC output (pins 1 through 11, pins 19 through 21, pins 30 through 31) is isolated using an open collector output opto-coupler. The output voltage of each line is set by a pull-up resistor on the handler interface board. The pull-up resistors can be connected to the internally supplied voltage (+5V), or to an externally applied voltage (EXTV: +5V to +24V) by setting jumpers.

The electrical characteristics of the DC isolated outputs are divided into two types. (See Table 7-4)

Since the power source for the Comparison Output and Control Output signals are different, two circuit commons (COM1, COM2) are made available.

**Table 7-4 DC Isolated Output Electrical Characteristics**

Output Signals	Voltage Output Rating		Maximum Current	Circuit Common
	Low	High		
Comparison Signals /BIN1 - /BIN3 /OUT /AUX /PHI /PLO /SREJ	≤0.5V	+5V to +24V	6mA	Internal pull-up voltage: TH2816B circuit common (GND)  External voltage (EXTV1): COM1
Control Signals /IDX /EOM	≤0.5V	+5V to +24V	6mA	Internal pull-up voltage: TH2816B circuit common (GND)  External voltage (EXTV2): COM2

A simplified diagram of the output signals is shown in Figure 7-6 (Comparison Signals) and Figure 7-7 (Control Signals).

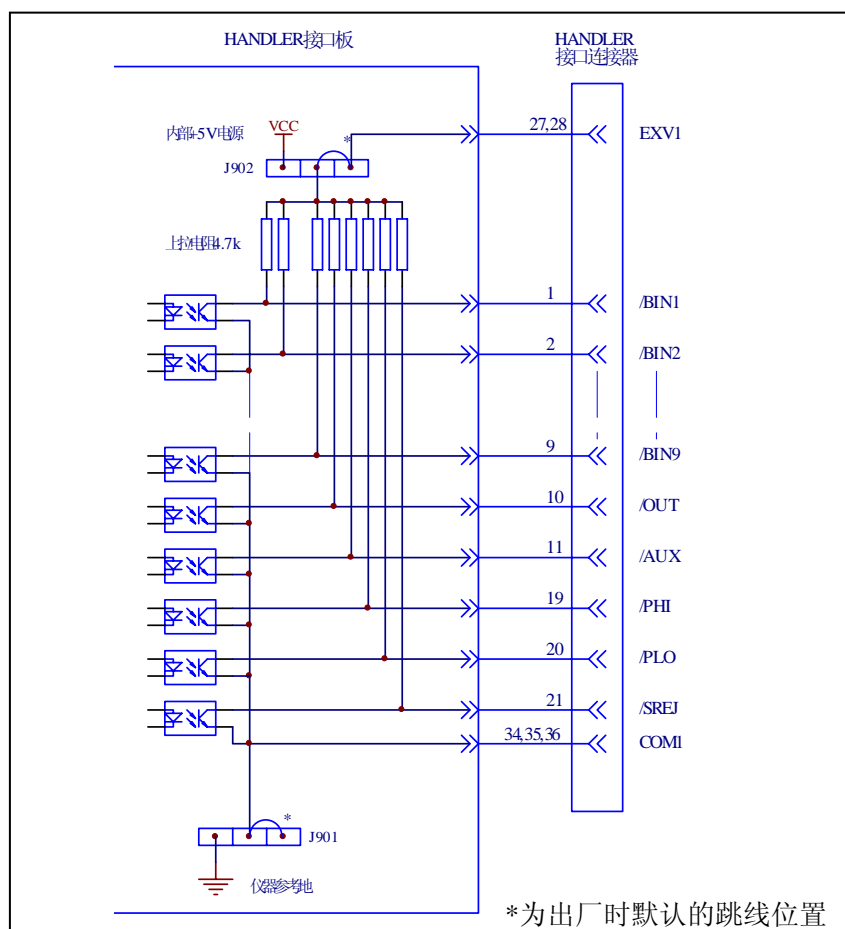


Figure 7-6 Simplified Diagram of The Comparison Output Signals

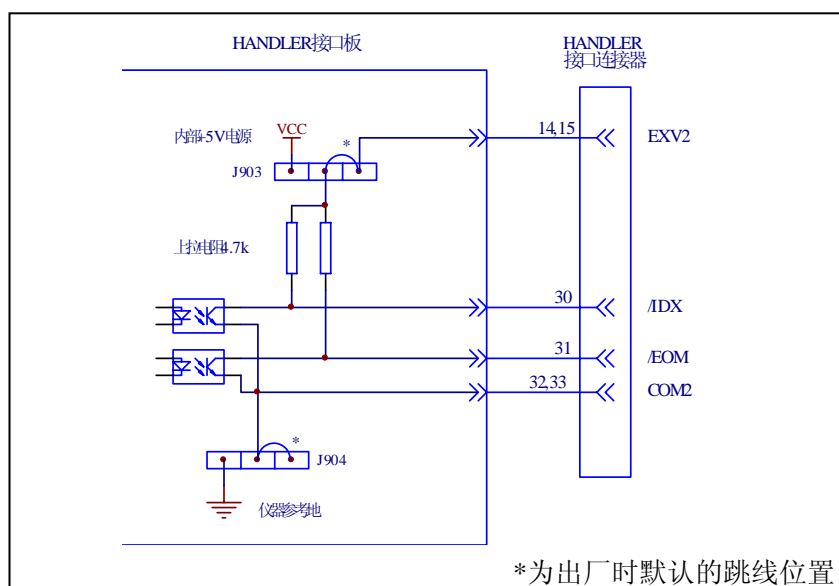
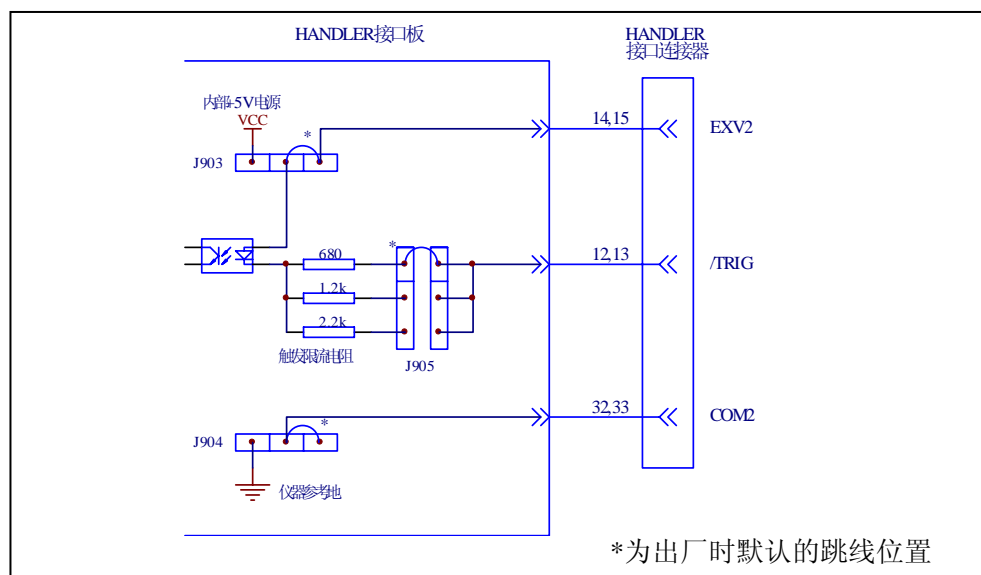


Figure 7-7 Simplified Diagram of The Control Output Signals



### 7.3.2 DC Isolated Input

The /TRIG signal (pin 12 and 13) is connected to the cathode of the LED in an opto-coupler. TH2816B is triggered on the rising edge of the /TRIG pulse. The anode of the LED can be powered from the internal 5 V, or by an external voltage source EXTV2.



**Figure 7-8 Handler Interface Input Signal Diagram**

To limit the trigger current, jumper J905 must be selected considering the optocoupler anode voltage being used.

## 7.4 Setting Up the Handler Interface Board

Jumpers on the Handler Interface board must be set to select the signal outputs (Open collector, internal voltage outputs, or External voltage outputs). A description of each jumper is given in Table 7-5, and their locations are shown in Figure 7-9.

When shipped from the factory, each jumper is set to the (N) position (marked “N” on the handler interface board).

Jumper J901 and J902 are used to select the internal voltage or external voltage for the output signals.

Jumper J903 and J904 are used to select the internal voltage or external voltage for the control signals.

Jumper J905 is used to select the current limiting resistor under different voltage range.

Jumper		Description	Signals
No.	Position		
J901	Left	DC isolated outputs are not isolated. COM1 is connected to TH2816B circuit common.	/BIN1-/BIN3 /AUX /OUT /PHI /PLO /SREJ
	Right(N)	DC isolated outputs are isolated.	
J902	Left	The open collector outputs are pulled up to the internal VCC (+5 V).	
	Right(N)	The open collector outputs are pulled up to the external EXV1(+5V to +24V)。	
J903	Left	The open collector outputs are pulled up to the internal VCC (+5V).	/IDX /EOM /TRIG
	Right(N)	The open collector outputs are pulled up to the external EXV2 (+5V to +24V).	
J904	Left	DC isolated outputs are not isolated. COM2 is connected to TH2816B circuit common.	
	Right(N)	DC isolated outputs are isolated.	
J905	Left (N)	Trigger current limiting resistor is 680Ω. This position should be set when EXV2 is between 5V to 8V or when internal VCC is used for control signals (J903 and J904 are set to the left position).	/TRIG
	Center	Trigger current limiting resistor is 1.2kΩ. This position should be set when EXV2 is between 8V to 15V.	
	Right	Trigger current limiting resistor is 2.2kΩ. This position should be set when EXV2 is between 15V to 24V.	

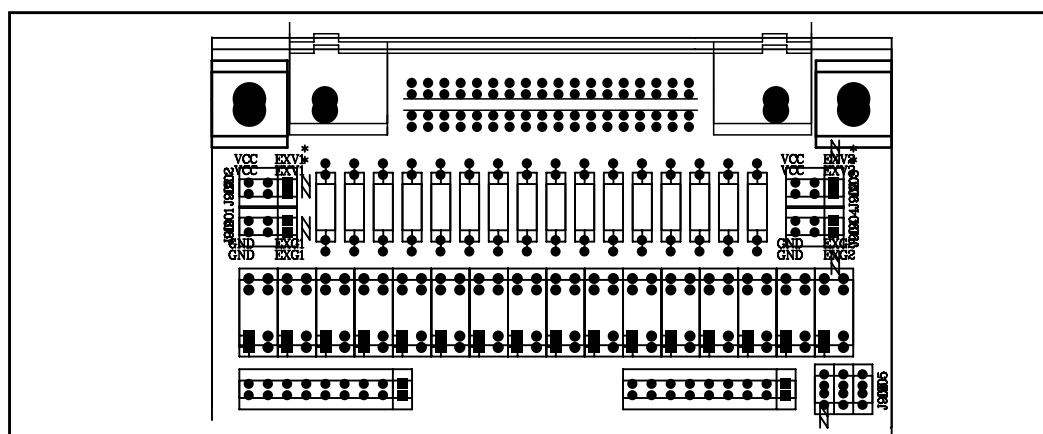


Figure 7-9. Handler Interface Input Signal Diagram

## 7.5 Operation

To use the handler interface, after setting up the handler interface board, setup the limit table for using the comparator function or the list sweep setup table for using the list sweep comparator function. Then set the handler interface to be enabled to output/input the signals. The following procedures are for using the handler interface with the comparator function or the list sweep comparator function.

### 7.5.1 Setting Procedure For Comparator Function

The following operation procedures are for using the handler interface with the comparator function.

- 1) Set the measurement function, test frequency, oscillator signal level, and measurement speed on the **Meas Setup** page.
- 2) Press the **SETUP** menu key, and the **LIMIT** softkey. The Limit Table will be displayed.
- 3) Move the cursor to the **FUNC** field, and set if the parameter swap function is used.
- 4) Move the cursor to the **MODE** field, and set the comparator limit mode: %TOL or  $\pm$ TOL.
- 5) Move the cursor to the **COMP** field, and press softkey **ON** to enable the comparator function.
- 6) Move the cursor to the **AUX** field. Press softkey **ON** to enable the AUX BIN, then a device whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits will be sorted into an AUX BIN.
- 7) The EXT trigger mode is always be used, when a handler interface is used. Press **SETUP** menu key, move the cursor to the **TRIG** field and set the trigger mode to EXT. Check if the deviation display mode DEV\_A/DEV\_B is set to OFF.
- 8) Press **DISPLAY** menu key. To perform a measurement, select the **LCR**, **BinNo**, **COUNT** softkey.
- 9) Comparator function are always used for sorting large amount of components with the same nominal value, so range hold function may be used to increase the measurement efficiency.
- 10) Move the cursor to the **File** field, use the **SAVE** softkey to save the current control settings and limit table to a file.

### 7.5.2 Setting Procedure For List Sweep Comparator function

The following operation procedures are for using the handler interface with the list sweep comparator function.

- 1) Set the measurement function, test frequency, oscillator signal level, and measurement speed on the **Meas Setup** page.
- 2) The EXT trigger mode is always be used, when a handler interface is used. Press **SETUP** menu key, move the cursor to the **TRIG** field and set the trigger mode to EXT. Set deviation display mode DEV\_A/DEV\_B to ON if you want.
- 3) Press the **SETUP** menu key, and the **LIST** softkey. The **List Setup** page will be displayed.
- 4) Setup a list table including sweep parameter points, parameter compared, and high/low limits for the list sweep measurement.
- 5) Move the cursor to the **MODE** field, and set the sweep mode: SEQ or STEP.
- 6) Auto ranging always be selected, considering the delay time and source output impedance.
- 7) Press **DISPLAY** menu key. To perform list sweep measurement, select the **SWEEP** softkey.
- 8) Move the cursor to the **File** field, use the **SAVE** softkey to save the current control settings and list table to a file.