
OPERATION MANUAL

TH2515 DC Resistance Meter

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Declaration

The descriptions contained in this manual may not cover all information about this instrument. Introductions to the improvements of the instrument in performance, function, internal structure, outer appearance, accessories, packing material, etc. are subject to change without notice. If you find any inconformity of this manual with our instruments, please contact us for further consultation by the address listed on the cover.

1) Introduction to Instrument, Unpacking and Installing

Thank you for your purchase and use of our products! This chapter will introduce the basic instrument performance, which is followed by notes of unpacking and installing.

1.1 Introduction to Instrument

TH2515 is a DC Resistance Meter with color LCD display and touch function. Its accuracy of 0.01% is able to meet general resistance test requirements. Better measurement result is obtained for temperature-sensitive resistors by the adoption of temperature compensation function. Statistic function has the capacity to make statistic analysis of massive test data.

TH2515 is a powerful test tool for all kinds of resistor design, detection, quality control and production. Its high test speed is applicable to the spot-check machines on production lines. With multiple output data and comparison mode, TH2515 can meet different test requirements of different resistor manufacturers. The prominent performance makes the test results come up to IEC and MIL standard.

1.2 Unpacking

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

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

1.3 Power Connection

- 1) Power supply: 90V to 240V (dependable on the voltage setup on the rear panel).
- 2) Power supply frequencies: 50Hz and 60Hz
- 3) Power supply power range: $\leq 30\text{VA}$
- 4) L (line wire), N (neutral wire) and E (earth ground wire) of the power supply input socket should correspond to the power plug of the instrument.
- 5) The instrument has been specially designed for decreasing noise jamming caused by the input in AC power terminal, but it is also recommended to use it in the environment of low noise. If noises cannot be avoided, install a power source filter please.

WARNING: To avoid injury to personnel and damage to the instrument resulting from electric shock, do sure that the earth ground wire is safely grounded.

1.4 Fuse

The fuse is a standard configuration, so use the included custom fuse please.

1.5 Environment

- 1) Do not store or use the instrument where it could be exposed to many dusts, great vibration, direct sunshine and corrosive gas.
- 2) Working condition:
Temperature: 0°C to 40°C Relative humidity: ≤ 80% No condensation
Storage condition:
Temperature: -10°C to 50°C Relative humidity: ≤ 90% No condensation
- 3) For high accuracy, do not block the left air vent so as to ensure good ventilation.
- 4) The instrument has been specially designed for decreasing noise jamming caused by the AC power input, but it is also recommended to use it in the environment of low noise. If noise cannot be avoided, install a power filter please.
- 5) Test leads on the instrument that are connected to DUTs should be kept away from strong electromagnetic fields to avoid interference.

1.6 Use of Test Fixture

Only use the test fixture or cable made by our company, because the use of other test fixtures or cables may result in incorrect measurement results. In addition, for good contact of DUT and fixture, keep the test fixture or cable and pins of DUT clean.

Connect the test fixture or cable to HI and LO terminals on the instrument front panel. Ensure the color and arrow conformity of the test fixture with that of sockets on panels, thus to avoid abnormal measurement.

1.7 Warm-up

- 1) For accurate measurement, the warm-up time should not be less than 30 minutes.
- 2) Do not turn on or off the instrument frequently. This may cause internal data confusion.

1.8 Other Features

- 1) Consumption: ≤10VA
- 2) Dimensions (W*H*D): 235mm*104mm*360mm; this dimension is the final packaging size.
- 3) Weight: Approx. 3.6kg

2) Introduction to Front and Rear Panels

This chapter will describe the basic operation of TH2515. Before using the instrument, please read this chapter carefully.

2.1 Introduction to Front Panel

Figure 2-1 shows the front panel of TH2515.

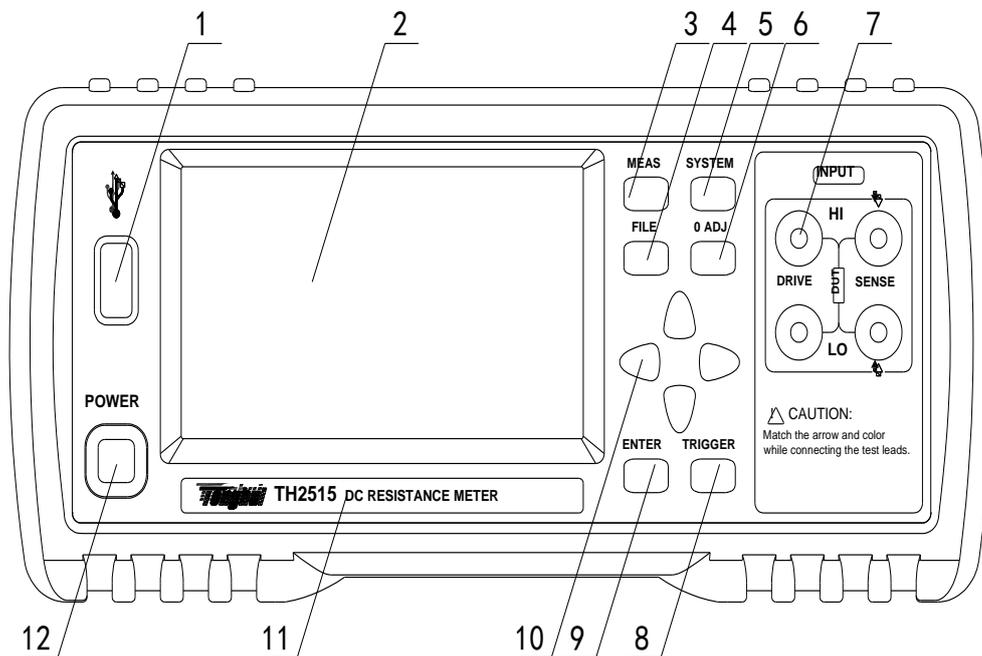


Figure 2-1 Front Panel

- 1) **USB interface**
HOST interface of USB
- 2) **LCD and touch screen**
480*272 dot-matrix, 24-bit, 4.3-inch TFT and touch LCD is used for measurement setup and result display.
- 3) **[MEAS]**
Press [MEAS] to enter into the MEAS DISP page.
- 4) **[FILE]**
Press [FILE] to enter into the page of internal and external File Manage.
- 5) **[SYSTEM]**
Press [SYSTEM] to enter into the SYSTEM SETUP page.
- 6) **[0 ADJ]**
Press [0 ADJ] to execute correction function.
- 7) **Test terminals (INPUT)**
4-terminal test terminal is used to measure DUT by a 4-terminal test cable.

The color and arrow of the test cable should correspond to that of socket on panel, thus to avoid abnormal measurement.

8) [TRIGGER]

When the trigger mode is set as MANU (manual), pressing this key can trigger the instrument manually.

9) [ENTER]

Press this key to terminate and store input data.

10) Universal Arrow Keys

There are four arrow keys: up, down, left and right arrow keys.

11) Trademark and Model

Show instrument trademark and model.

12) POWER

It is the power switch.

2.2 Introduction to Rear Panel

Figure 2-2 shows the rear panel of TH2515.

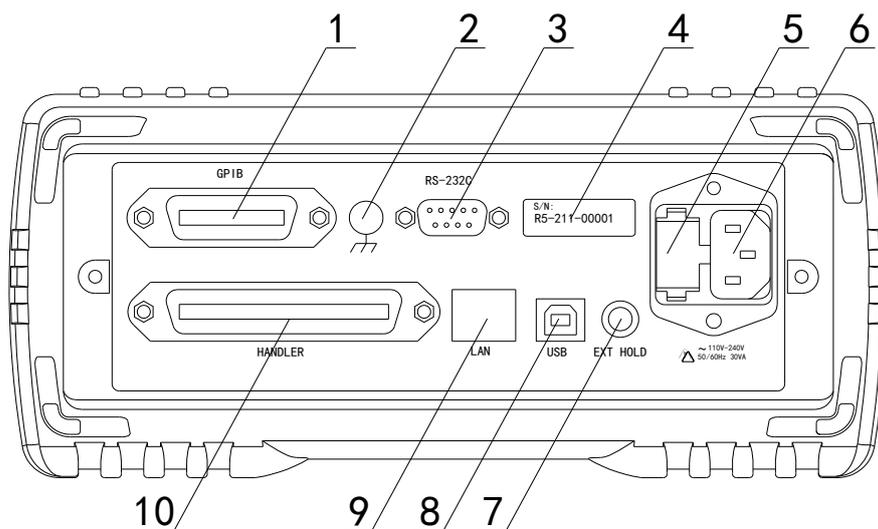


Figure 2-2 Rear Panel

1) GPIB Interface (Option)

The GPIB interface is used to communicate with PC and further construct a GPIB test system.

2) Ground Terminal

This terminal connects the instrument chassis thus to protect or shield ground connection.

3) RS232C Serial Interface

It realizes serial communication of the instrument with PC.

4) Nameplate

It shows the instrument model.

5) Fuse socket

Fuse will be placed in this socket to protect the instrument.

6) Power Socket

It is used to input AC power.

7) TEMP.INPUT

It is used to insert the temperature sensor or serve as the input interface of analog temperature.

8) USB Interface

PC can remotely control TH2515 through USB DEVICE.

9) LAN Interface

This instrument can communicate with PC by this interface.

10) HANDLER Interface

Through HANDLER interface, an automatic test system can be conveniently constructed to realize auto test. TH2515 will output bin comparator result signals, measuring result and some simple signal control. Please refer to the introduction of HANDLER in Chapter 8 for specific information.

2.3 Display Zone

TH2515 adopts 24-bit 4.3-inch LCD touch screen with a resolution of 480*272. The display screen is divided into the following zones, as shown in figure 2-3.

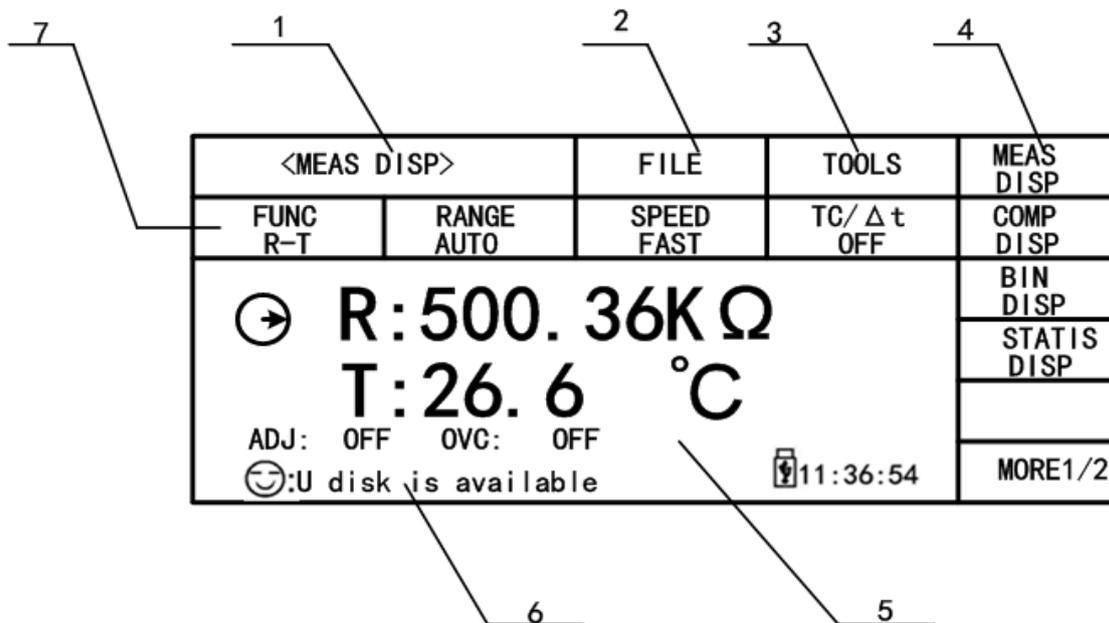


Figure 2-3 Display zone

1. Page name

This zone shows the current page name.

2. FILE

In this zone, file manage can be executed such as File Manage, Screen Copy.

3. TOOLS

Some short-cut functions can be set: DISP ON/OFF, 0 ADJ ON/OFF, 0 ADJ, OVC ON/OFF, SelfCalib AUTO/MANU, Save Data.

4. Soft keys

This zone displays the function menu corresponding to the cursor-located zone.

5. Result display

This zone displays the measurement result such as resistance and temperature.

6. Prompt information

This zone displays all prompt information.

7. Function zone

This zone is used to change the measurement parameters.

2.4 Introduction to Buttons on Front Panel

2.4.1 [MEAS DISP]

Press <MEAS DISP> to enter into display homepage. Selectable functions in this page are shown as follows:

<MEAS DISP>

<COMP DISP>

<BIN DISP>

<STATIS DISP>

< >

<MORE 1/2>

<MEAS SETUP>

<TC/ Δ t SETUP>

<BIN SETUP>

<SYSTEM SETUP>

< >

<MORE 2/2>

2.4.2 [SYSTEM SETUP]

Press the [SYSTEM] button to enter into the <SYSTEM SETUP> page; the following soft keys will be displayed:

<SYSTEM SETUP>

<LAN SETUP>

<MEAS DISP>

2.5 Simple Operation

Simple operation steps for TH2515:

- Use [MEAS], [SYSTEM] or [FILE] or soft keys to enter into the page required to enter. (Refer to figure 2-5)
- Use arrow buttons ([←] [↑] [→] [↓]) to move the cursor to desired zone.
- When the cursor is moved to a soft key zone, press ENTER to confirm the selection. If it is required to input a number or a file name, use the keyboard to input and press ENTER to finish entry. You can use arrow buttons to select a number or a letter.

NOTE: DO NOT use acute units or nails to touch the screen. Doing so will cause damage to the screen, our company shall not be liable to this case.

2.6 Starting Up

Ensure the power earth (ground) wire is grounded, plug into a 3-wire power socket. Press down the power switch on the bottom left corner of the front panel, the instrument will be started up and a boot screen will be displayed.

Figure 2-4 shows the boot screen of TH2515, indicating product information such as instrument trademark, model and version.



Figure 2-4 TH2515 Boot Screen

If the password protection is enabled, you will be asked to input your password. After inputting your password, press [ENTER] to enter into the main menu page.

NOTE: This series of products have enabled password protection and the default password is 2515. You can reset the password by yourself. Refer to the password function on <SYSTEM SETUP> page for more details.

3) Basic Operation

3.1 <MEAS DISP>

Touch the screen or press down [MEAS], the <MEAS DISP> page will be displayed in the screen shown as figure 3-1.

<MEAS DISP>		FILE	TOOLS	MEAS DISP
FUNC R-T	RANGE AUTO	SPEED FAST	TC/Δt OFF	COMP DISP
				BIN DISP
				STATIS DISP
				MORE1/2

Figure 3-1 Measure Display

The following measurement parameters can be set on this page.

- Measurement function (**FUNC R-T**)
- Resistance range (**RANGE AUTO**)
- Measurement speed (**FAST SLOW2**)
- Measurement temperature (**TC/Δt T.SENS**)
- File manage (**FILE**)
- Other tools (**TOOLS**)
- Soft keys (used to enter into operation pages)

3.1.1 Measurement Functions

Measurable parameters on TH2515 are as follows:

- R (Resistance)
- R-T (Resistance and temperature)
- T (Temperature)
- LPR (Resistance tested at low voltage)
- LPR-T (Temperature and resistance tested at low voltage)

Note: Settings and modifications of all functions can be taken by the following steps:

1. Touch the corresponding function zone and then select the desired soft keys.
2. Use arrow buttons and [ENTER] button to set and modify the corresponding function.

Setting steps for measurement function:

You use buttons or touch the screen to select **FUNC**, available soft keys will be displayed in the right soft key zone.

- R
- R-T
- T
- LPR
- LPR-T

3.1.2 Measurement Range

There are two resistance modes: resistance measurement mode and resistance measurement mode at low voltage.

Measure and display two types of parameters: resistance parameters and temperature parameters. Parameters of resistance range, current, resolution, etc. have been displayed in diagram 3-1-2.

TH2515 has 11 DC resistance ranges: 20mΩ, 200mΩ, 2Ω, 20Ω, 200Ω, 2kΩ, 20kΩ, 100kΩ, 1MΩ, 10MΩ, 100MΩ.

TH2515 has 4 DC low voltage resistance ranges: 2Ω, 20Ω, 200Ω, 2KΩ.

The testing range of temperature of TH2515: -10°C to 99.9°C.

Resistance Range	Current	Resolution	Accuracy Rd% + Fs%
20mΩ	1A	0.1uΩ	0.10+0.025
200mΩ		1uΩ	0.05+0.030
2Ω	100mA	10 uΩ	0.03+0.010
20Ω	10mA	100 uΩ	0.02+0.008
200Ω		1mΩ	0.01+0.002
2kΩ	1mA	10 mΩ	0.01+0.002
20kΩ	100uA	100 mΩ	0.01+0.002
100kΩ		1Ω	0.01+0.005
1M	10uA	10Ω	0.02+0.005
10MΩ	1uA	100Ω	0.05+0.010
100MΩ	100nA	1kΩ	0.40+0.040

Diagram 3-1-2

NOTE:

Error= (measured value*Rd% + range*Fs%)/measured value

Operation steps for setting measurement ranges:

1) Touch the range zone, the following soft keys will be displayed.

- **AUTO** Set the range mode as AUTO.
- **HOLD** Switch the range mode from AUTO to HOLD. When the range mode is set as HOLD, the range will be locked at the current measurement range which is displayed in the **RANG**

- zone.
- **↑ (+)** Increase the range.
 - **↓ (-)** Decrease the range.
- 2) Touch the corresponding soft key to select the required range.

3.1.3 Measurement Speed

The measurement speed of TH2515 is decided by the following factors:

- Integral sampling period (approx. 5ms)
- Average times (measurement times)
- Measurement delay time (a time starting from the measurement start-up to the measurement beginning)
- Time showing measurement result

Three measurement speeds are available on TH2515: FAST (fast, approx. 50meas/sec), MED (medium, approx. 6meas/sec) and SLOW (including SLOW1 and SLOW 2, approx. 2meas/sec).

Operation steps for setting measurement speed:

TH2515 displays the measurement result as a 6-digit number in the decimal point floating mode. In FAST mode, the result is shown as a 5-digit number while in MED and SLOW, as a 6-digit number and temperature as 4-digit.

- 1) Touch the speed zone, the following soft keys will be displayed.
- **FAST**
 - **MED**
 - **SLOW1**
 - **SLOW2**
- 2) Use above soft keys to modify the speed.

3.1.4 File Manage

- 1) Touch **FILE**, the following soft keys will be displayed.
- File Manage: Touch this key to enter into the file operation page.
 - Screen Copy: Touch this key to capture the current screen and save it to a U disk in image format. Before a U disk is inserted, the save function will be disabled.
- 2) As for File Manage, please refer to 4.2 for details.

3.1.5 Tools

Operation steps for setting tools:

Touch **TOOLS**, the following soft keys will be displayed in the soft key zone.

- Display (ON/OFF): Display the measurement result or not. ON is to display, OFF is not to display.
- 0 ADJ (ON/OFF): OFF means the base number at the short correction will not be subtracted while ON is to subtract the base number.

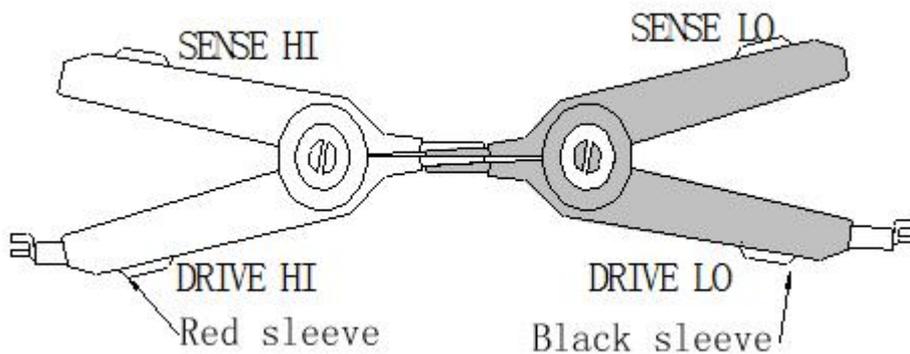
- 0 ADJ: Execute short correction. In this process, please ensure the test terminals have been correctly shorted. Only by doing this, unexpected measurement errors could be avoided.
- OVC (ON/OFF): ON is to take over voltage compensation for measurement results. OFF is not to.
- Correction: Auto and Manual
- Save data: Touch the screen or press the corresponding button to save the current measurement results to a U disk. If no external U disk is founded, this function will be invalid. Once a U disk is found and this function is selected, the corresponding soft key will be displayed as STOP SAVE and you can press this soft key to terminate this operation.

NOTE:

SPEED: In SLOW2, SLOW1 or MED mode, the measurement result is a 6-digit number while FAST is a 5-digit one.

SAVE: Once START SAVE is selected, you must press STOP SAVE to terminate or the saved data will be lost.

SHORT: When this key is used to take short correction, the test fixture should be correctly connected. If not, the deducted data will be wrong, and further it will cause result errors. The correct connection is shown as the following figure.



3.2<COMP DISP>

Touch <MEAS DISP> or press [MEAS] to select the **COMP DISP** soft key to enter into the <COMP DISP> page shown as figure 3-2.

<COMP DISP>		FILE	TOOLS	MEAS DISP
COMP OFF	COMP MODE ABS	HIGH 225.00	LOW 63.00	COMP DISP
 R: 499.76 				BIN DISP
COMP: NC				STATIS DISP
TOT:0000000		IN:0000000		
HI:0000000		LO:0000000		 11:36:54
				MORE1/2

Figure 3-2

The following parameters can be set on this page:

- FILE
- TOOLS
- COMP ON/OFF
- COMP MODE
- HIGH (nominal value)
- LOW (%)

3.2.1 File Manage

- 1) Touch **FILE**, the following soft keys will be displayed:
 - File manage: Touch this soft key to enter into the file manage page.
 - Screen copy: Touch this key to save the current screen page to a U disk. If no U disk is found, this function will be disabled.
- 2) Refer to 4.2 for more details about **FILE MANAGE**.

3.2.2 Tools

Touch <TOOLS>, the following soft keys will be displayed.

- **DISP (ON/OFF)**: ON is to display the measurement result and OFF is not to display.
- **BEEP (NG/GD/OFF)**: NG: The beeper will sound when the measurement result is not consistent with the setting value. GD: The beep will sound when the measurement result conforms to the setting value. OFF: Turn off the beeper.
- **COUNT (ON/OFF)**: ON: Start count; OFF: Stop count.
- **COUNT CLEAR**: Clear the count numbers of TOT, IN, HI and LO and start count from zero.
- **DATA STORAGE**: Save all data.

3.2.3 COMP (ON/OFF)

COMP (ON/OFF): ON indicates the compare function has been turned on. Only when the

compare function is in ON mode, count function can be enabled.

OFF is to turn off this function.

3.2.4 Compare Mode and SETTINGS of ABS & Percent Error

You can set the compare mode and concerned values by touching the screen or pressing keyboard. There are two compare modes: ABS and %.

Compare modes:

1) ABS (high and low limits)

In this mode, you can set low and high limits. The instrument will take comparison between the tested values and the set ones so as to judge the DUT is HI or LO or IN.

2) % (percent error)

In this mode, you can set the nominal value and the percent error. If you set the nominal value as 100 and percent as 10, the set value should be 100±10%. The instrument will take comparison between the tested values and the set ones so as to judge the DUT is HI or LO or IN.

3.3<BIN DISP>

Touch <MEAS DISP> or press [MEAS]. Then select the soft key **BIN DISP** to enter into <BIN DISP> shown as figure 3-3.

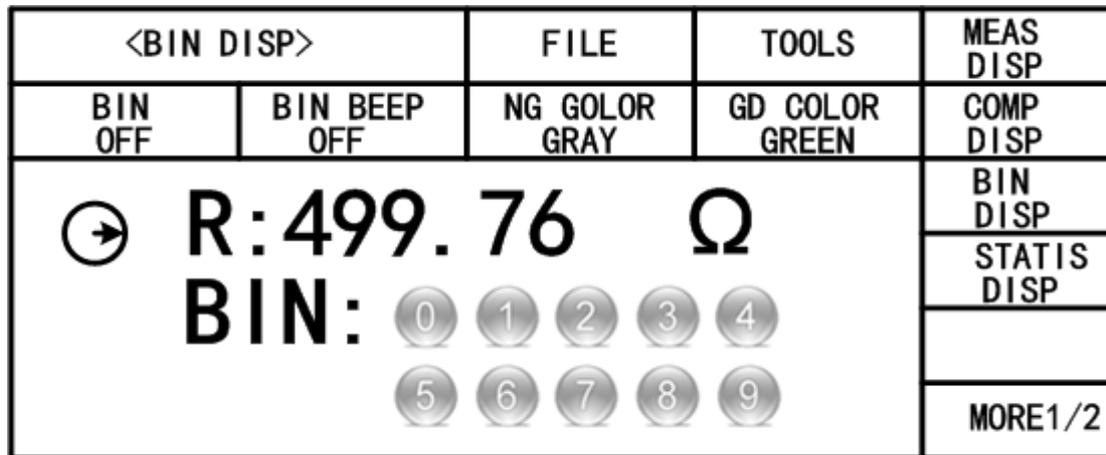


Figure 3-3 Bin display

The following parameters can be set on <BIN DISP>.

■ **FILE**

- 1) File Manage: Touch this key to enter into the file manage page.
- 2) Screen Copy: Touch this key to save the current screen page to an external U disk. If no U disk is found, this function will be disabled.

■ **TOOLS**

- 1) DISP (ON/OFF): ON is to display the result while OFF is not to.
- 2) SAVE DATA: Touch this key to save the result. Touch again to stop saving.

■ **BIN**

BIN ON/OFF: ON is to turn on bin compare display while OFF is to turn off.

■ **BIN BEEP ON/OFF**

OFF is to turn off the bin beep function.

NG: Bin beep function is ON. When the result is not consistent with the bin setting, the beep will sound.

GD: Bin beep function is ON. When the result is consistent with bin setting, the beep will sound.

■ **NG Color**

OFF: When the measurement result is different from the bin setting, there is no display. **GREY**: When the measurement result is different from the bin setting, the corresponding bin will be displayed in grey; **RED**: When the measurement result is different from the bin setting, the corresponding bin will be displayed in red; **GREEN**: When the measurement result is different from the bin setting, the corresponding bin will be displayed in green.

■ **GD Color**

OFF: When the measurement result conforms to the bin setting, there is no display. **GREY**: When the measurement result conforms to the bin setting, the corresponding bin will be displayed in grey; **RED**: When the measurement result conforms to the bin setting, the corresponding bin will be displayed in red; **GREEN**: When the measurement result conforms to the bin setting, the corresponding bin will be displayed in green.

NOTE: NG is the abbreviation of not good while GD is the abbreviation of good.

3.4 STATIS DISP

Touch the main menu or press [MEAS]. And then touch the soft key **STATIS DISP** to enter into the STATIS DISP page shown as figure 3-4.

STATIS DISP		FILE	TOOLS	MEAS DISP
EdgeMode %	NOM 500.360	% 20.0000	Status ON	COMP DISP
\bar{X} 499.75	σ 176.78m	s 176.78m	Cp 99.990	BIN DISP
Cpk 99.990	Hi (num) 0	Lo (num) 0	In (num) 3	STATIS DISP
Max 449.76	MaxIndex 5	Min 449.70	MinIndex 4	
R:4997.76 Ω num: 3 valn: 3  Statis is started. Trig!				 11:36:54 MORE1/2

Figure 3-4 Statistic display

The function of this page is to count measurement data. It is workable to analyze the average value of results for multiple measurements, the PASS/FAIL rate and some engineering coefficients. Details are as below.

3.4.1 Edge Mode and Settings of Its Relevant Values

Touch this key, two modes is available: ABS (high and low limits) and % (percent error mode). When ABS is selected, the adjacent two items on the same line will be high and low limits. Touch them to set the values. When % is selected, the adjacent two items on the same line will be nominal value and percent. Touch them to set the values.

3.4.2 Status ON/OFF

Status ON/OFF:

- (1) When ON is selected, except the **trigger** button, no other keys and buttons could be enabled. The instrument makes a statistic at every trigger.
- (2) When OFF is selected, the statistic function will be turned off and other keys and buttons is available.

3.4.3 Parameters of Statistic Analysis

- 1) \bar{x} : Average value. Corresponding formula: $\bar{x} = \frac{\sum x}{n}$
- 2) σ : Population Standard Deviation. Corresponding formula: $\sigma = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n}}$ ($=\sigma_n$)
- 3) s : Sample Standard Deviation. Corresponding formula: $s = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n-1}}$ ($=\sigma_{n-1}$)
- 4) C_p : Process Capability Index (Dispersion). Corresponding formula: $C_p = \frac{|Hi - Lo|}{6s}$
- 5) C_{pK} : Process Capability Index (Deviation). Corresponding formula: $C_{pK} = \frac{|Hi - Lo| - |Hi + Lo - 2\bar{x}|}{6s}$

NOTE: Explanations for variables in formulas from 1) to 5)

n : The total measurement times that a sample is used to make statistic analysis, which corresponds to the value of TIMES.

x : Measurement results of each sample measurement. The data are saved in the instrument buffer memory.

Hi : Upper limit value, used to be compared, corresponds to the value of UPPER limit.

Lo : Lower limit value, used to be compared, corresponds to the value of LOWER limit.

When $C_p, C_{pK} > 1.33$, the working capacity is ideal.

When $1.33 \geq C_p$, $C_p K > 1.00$, the working capacity is qualified.

When $1.00 \geq C_p$, $C_p K$, the working capacity is insufficient.

-
- 6) Hi (num): Be used to add up times that the measurement result exceeds the upper limit value.
 - 7) Lo (num): Be used to add up times that the measurement result is less than the lower limit value.
 - 8) In (num): Be used to add up times that the measurement result passes.
 - 9) Max: Be used to display the maximum measurement result among all measurement results.
 - 10) MaxIndex: Be used to display the test serial corresponding to the maximum measurement result.
 - 11) Min: Be used to display the minimum measurement result among all measurement results.
 - 12) MinIndex: Be used to display the test serial corresponding to the minimum measurement result.

3.4.4 TOOLS

- CLEAR: Clear all parameters obtained from last statistic.
- TRIGGER: Trigger the instrument to execute a measurement.
- SAVE DATA: Touch this key to save the current measurement result (not all statistic results) to an external U disk. If no U disk is found, this function will be disabled. Touch this key again to stop saving.

3.4.5 FILE

- 1) File Manage: Touch this key to enter into the file manage page.
- 2) Screen copy: Touch this key to save the current screen page to an external U disk. If no U disk is found, this function will be disabled.

3.5<MEAS SETUP>

Touch the main menu. And then touch the soft key **MEAS SETUP** to enter into the MEAS SETUP page shown as figure 3-5.

MEAS SETUP		FILE		MEAS SETUP
FUNC R-T	RANGE AUTO		TRIG INT	TC/ Δ t SETUP
TRIG DELAY AUTO	AVERAGE 236.0		200mΩ 1A	BIN SETUP
DETECT AUTO	Meas Mode FAST		SPEED MED	SYSTEM SETUP
0 ADJ ON	OVC OFF		Adjust AUTO	
 11:36:54				MORE1/2

Figure 3-5 Measurement Setup

On this page, the following parameter can set:

- **mR+b (ON/OFF):** Press this touch key to turn on/off the function of this option. This function indicates that the measured resistance value is linearly converted. The measured physical quantity of the resistance value can be converted into other user-defined physical meanings. The formula is $R_s = mR + b$, where m , b are parameters, R is the measured resistance value, and R_s is the value after conversion.
- **FUNC R-T:** Touch this key to select the required parameter.
- **RANGE AUTO:** Touch this key, the following soft keys will be displayed: AUTO (automatically set the resistance range), HOLD (lock the resistance range), ↑ (increase the range), ↓ (decrease the range). Touch the corresponding soft key to set the range mode.
- **TRIG INT:** Touch this key, the following soft keys will be displayed in the soft key zone: INT (auto measurement mode), MAN (manual measurement mode), EXT (external trigger mode), BUS (BUS trigger mode).
- **TRIG DELAY:** Touch this key, the following soft keys will be displayed: **AUTO**, **MANUAL**, **INPUT**. (NOTE: The setting time manually input should not be less than the DETECT time, or the instrument will prompt a message “Input number is over ranging.”)

Auto Trigger Delay (the unit is ms.)

		Range[Ω]	20m	200m	2	20	200	2K	20K	100K	1M	10M	100M
Resistance Delay [ms] Measurement	OVC OFF		30	30	3	3	3	3	3	10	50	100	1000
	OVC ON		100	100	100	100	100	100	100	—	—	—	—
Low-Power Resistance Delay [ms] Measurement	OVC OFF		—	—	3	3	3	15	—	—	—	—	—
	OVC ON		—	—	100	100	100	100	—	—	—	—	—

The setting of manual measurement delay time is determined by inputting. Range: 0ms—9.99ms

NOTE: If the delay time is set as 0ms, the detection for wrong measurement cannot be

executed. Therefore, it is recommended to set the delay time being more than 1ms.

- **AVERAGE 1:** Touch this key, a numeric keyboard will pop up. Input the average number ranging from 1 to 255. The larger the average number is set, the better the accuracy will be obtained but the longer time it will cost to display the result.
- **200mΩ 1A:** At the range of 200mΩ, two current sources are available of which 100mA is commonly used for remote control or for the case of voltage rising. Note: Once the range is set as 200mΩ, the open voltage is 5V_{max} at the current of 1A while 2.6V_{max} at the current of 100mA.
- **DETECT:** Detection time for wrong measurement. Touch this key, the following soft keys will be displayed in the soft key zone: **AUTO**, **MANUAL** and **INPUT**. The detection time should be less than the trigger delay time.
- **MEAS Mode:** This mode is usually applied in 4-terminal measurement. Touch this key, **SLOW** and **FAST** will be selectable.

1) SLOW

In circuit, the purpose of using a 10nF(C) capacitance across test terminals is to improve the stability of testing large resistance and inductive load. However, by doing this, the response time (T) of measuring large resistance will be greatly reduced and it is 95% of that time measuring resistance.

$$T = 3 \times R \times C = 3 \times R \times 10 \times 10^{-9}F$$

Sometimes, even a 10nF capacitance is applied, it also cannot ensure the measurement stability of all inductive loads. So if the inductance of an inductive load is larger than 10H, please add a 0.1μF or larger capacitor across fixture terminals or adopt other solutions.

In order to make better response time in testing large resistors, please select **FAST** (no 10nF capacitor is used). In this case, the test for inductive loads will be quite unstable.

2) FAST

If fast measurement is required, please select the **FAST** mode.

- **0 ADJ (ON/OFF):** Touch this key to select **ON** or **OFF**. **ON** is to turn on the short correction function while **OFF** is to turn off.
 - **OVC:** Touch this key to select **ON** or **OFF**. **ON** is to turn on the compensation voltage while **OFF** is to turn off.
 - **Adjust:** Touch this key to select the correction as **MANUAL** or **AUTO**. If you select **AUTO**, the instrument will make corrections in every 30 minutes and it will cost 55ms. If you select **MANUAL**, the instrument will make correction according to **HANDLER** command.
-

NOTE: When two different materials contact, a thermoelectromotive force will be generated on the contact surface of them. It will vary with the environment temperature. The higher the environment temperature is, the larger the thermoelectromotive force will be. The principle of

OVC is to apply an inverse current through tested terminals and the formula is $R = \frac{Rp - Rn}{2}$, where *R_p* is a positive value, *R_n* is a negative value.

3.6 <TC/Δt SETUP>

Touch the main menu. And then touch the soft key **TC/Δt SETUP** to enter into the TC/Δt setup page shown as figure 3-6.

TC/ Δ t SETUP		FILE		MEAS SETUP
T₀ (°C) 99.0	α t0 (ppm) 56	R1 (Ω) 0.00000n		TC/ Δ t SETUP
t1 (°C) 25.0	K (Ω) 236.0	V1 (V) 0.00		BIN SETUP
T1 (°C) 0.0	V2 (V) 1.00	T2 (°C) 500.0		SYSTEM SETUP
TC/ Δ t OFF	T. SENS Pt			
🔋 11:36:54				MORE 1/2

Figure 3-6 TC/Δt setup

3.6.1 Temperature Correction

Temperature correction function: By this function, the resistance tested under the current environment temperature will be converted to a resistance value under the user-set environment temperature. For instance, a resistor is tested as 100Ω under 20°C. If user sets the temperature as 10°C, after correction, the value will be displayed as 96.22Ω.

Formula: $R_t = R_{t0} * \{1 + \alpha_{t0} * (t - t0)\}$

R_t Resistance measured under the current environment temperature

R_{t0} Resistance after correction

t0 Preset temperature

t Current environment temperature

α_{t0} Temperature coefficient of the material

For example: A resistor is measured as 100Ω under 20°C (Suppose the temperature coefficient as 3930ppm), the resistance under 10°C will be 96.22Ω.

$$R_{t0} = \frac{R_t}{1 + \alpha_{t0} * (t - t0)} = \frac{100}{1 + (3930 \times 10^{-6}) \times (20 - 10)} = 96.22\Omega$$

NOTE:

Before measurement, it is necessary to warm up the instrument and the probe for about half an hour. The temperature sensor should be placed to the DUT as close as possible but cannot contact it. After the displayed result comes to be stable, you can read or record the result.

3.6.2 Temperature Conversion

Temperature conversion (Δt): Basically, resistors have heat effect. Temperature conversion represents the temperature difference between the resistor and the environment.

$$\Delta t = \frac{R2}{R1} (k + t1) - (k + ta)$$

Δt is the temperature increment.

$t1$ is the temperature at the start of resistance measurement.

ta is the environment temperature.

$R1$ is the resistance at the start of contact.

$R2$ is the resistance after the display is stable.

k is the variance ration of the environment temperature coefficient when the conductor is at 0°C.

For example

When $R1$ is 100m Ω , $t1$ is 20°C, $R2$ is 105m Ω , ta is 25°C and k is 235.

$$\Delta t = \frac{R2}{R1} (k + t1) - (k + ta) = \frac{105 \times 10^{-3}}{100 \times 10^{-3}} (235 + 20) - (235 + 25) = 7.75^\circ\text{C}$$

The temperature after the resistance is stable is calculated as the following formula:

$$t_R = ta + \Delta t = 25 + 7.75 = 32.75^\circ\text{C}$$

Where, $k = \frac{1}{\alpha t_0} - t_0$, if $\alpha_{t_0} = 3930\text{ppm}$, k is 234.5 (where if α_{t_0} is 3930ppm, t_0 is 20°C)

Conductivity and temperature coefficient of metal and alloy

Metallic material	Metal [%]	Material density ($\times 10^3$) [kg/m ³]	Conductivity	Temperature coefficient (20°C) [ppm]
Annealed copper	Copper >99.9	8.89	1.00 to 1.02	3810 to 3970
Hard-drawn copper	Copper >99.9	8.89	0.96 to 0.98	3370 to 3850
Cadmium copper	Cadmium: 0.7 to 1.2	8.94	0.85 to 0.88	3340 to 3460
Silver copper	Silver: 0.03 to 0.1	8.89	0.96 to 0.98	3930
Chromium copper	Chromium: 0.4 to	8.89	0.40 to 0.50	20

	0.8		0.80 to 0.85	30
Anti-corrosion alloy	Nickel: 2.5 to 4.0 Silicon: 0.5 to 1.0	---	0.25 to 0.45	980 to 1770
Soft aluminum	Aluminum>99.5	2.7	0.63 to 0.64	42
Hard-drawn aluminum	Aluminum>99.5	2.7	0.60 to 0.62	40
Aluminum alloy	Silicon: 0.4 to 0.6 Magnesium: 0.4 to 0.5 Aluminum: 99.2 to 98.9	---	0.50 to 0.55	36

Calculating the conductivity and the temperature coefficient of the copper wire:

Diameter [mm]	Annealed copper (Conductivity)	Tinning and annealed copper (conductivity)	Hard-drawn copper (Conductivity)
0.01 to 0.26	0.98	0.93	---
0.26 to 0.50	0.993	0.94	0.96
0.50 to 2.00	1.00	0.96	0.96
2.00 to 8.00	1.00	0.97	0.97

Temperature coefficient (α_t) varies with environment temperature and material conductivity. It is supposed that the temperature coefficient of a material at 20°C is α_{20} , its temperature coefficient (α_{ct}) at t°C will be as the following expression:

$$\alpha_{ct} = \frac{1}{\frac{1}{\alpha_{20} \times c} + (t-20)}$$

3.6.3 Types of Temperature Sensor

There are two temperature input types: PT500 and Analog Input.

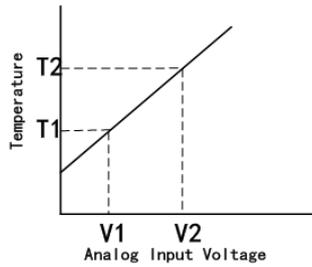
■ PT500

Press the touch key **T.SENS** to select the type of temperature input and select PT. The input type of the temperature is the platinum resistance temperature sensor. At this time, "PT500 temperature sensor" as standard in the instrument should be inserted into the temperature measurement input terminal.

■ Analog Input

Touch the **T.SENS** soft key to select the temperature input type. AnLG_In is analog input (the range of the input voltage is 0-2V) and the corresponding formula is:

$$\frac{T2-T1}{V2-V1} * (InputVoltage) + \frac{T1V2-T2V1}{V2-V1}$$



NOTE: V1 and V2 range from 00.00V to 02.00V while T1 and T2 range from -99.9°C to 999.9°C.

3.6.4 Parameter Setting

- **t0**: Touch this key, the numeric keyboard will pop up and you can input the reference temperature.
- **α_{t0}** : Touch this key, the numeric keyboard will pop up and you can input the reference temperature.
- **R1**: Touch this key, the numeric keyboard will pop up and you should record and manually input the resistance value gained at the start of the test.
- **t1**: Touch this key, the numeric keyboard will pop up and you should record and manually input the resistance temperature gained at the start of the test.
- **k**: Touch this key, a numeric keyboard will pop up and you can input the value.
- **V1**: Touch this key, a numeric keyboard will pop up and you can input the value.
- **V2**: Touch this key, a numeric keyboard will pop up and you can input the value.
- **T1**: Touch this key, a numeric keyboard will pop up and you can input the value.
- **T2**: Touch this key, a numeric keyboard will pop up and you can input the value.
- **TC/ Δ t**: Touch this key, **OFF**, **TC** and **Δ t** will be displayed in the soft key zone. Touch the corresponding key to choose.
- **T.SENS**: Touch this key, **Pt** and **AnaLG_In** will be displayed in the soft key zone. Touch the corresponding key to choose.

3.6.5 File

- 1) File manage: Touch this key to enter into the file manage page.
- 2) Screen copy: Touch this key to save the screen page to an external U disk. If no U disk is found, the function will be disabled.

3.7<BIN SETUP>

Touch the main menu. And then touch MORE 1/2 to select **BIN SETUP**, and the corresponding Bin Setup page will be displayed as figure 3-7:

BIN SETUP		FILE	TOOLS	MEAS SETUP
BIN NO.	STATE	NOM	%	TC/ Δt SETUP
0	ON	500.000	10.0000	BIN SETUP
1	ON	490.000	20.0000	SYSTEM SETUP
2	ON	510.000	15.0000	
11:36:54				MORE1/2

Figure 3-7 Bin Setup

On this page you can set all parameters concerned with the bin comparator. There are 10 groups of parameters (high and low limits, nominal value, %) at most can be set.

The following parameters can be set on this page:

- **BIN:** Touch this key, **Previous Page** and **Next Page** will be displayed in the soft key zone. Touch a soft key to enter into the desired page.
- **STATE:** Display the bin state as ON or OFF. When ON is set, the corresponding bin in the display zone will be shown as lighted circle. When OFF is set, the corresponding bin is shown as a horizontal line.
- **HIGH:** Touch this key, a numeric key board will pop up and you can input the high limit.
- **LOW:** Touch this key, a numeric keyboard will pop up and you can input the low limit.
- **NOM:** Touch this key, a numeric keyboard will pop up and you can input the nominal value.
- **%:** Touch this key, a numeric keyboard will pop up and you can input the percent value.
- **Num. 0:** Bin number. Touch this key, a **Delete** soft key will be displayed which can be used to clear the setting values.

3.7.1 File

- **File Manage:** Touch this key to enter into the file manage page.
- **Screen copy:** Touch this key to save the current screen copy to an external U disk. If no U disk is found, this function will be disabled.

3.7.2 Tools

Touch **TOOLS**, the following soft keys will be displayed:

- **MODE:** **ABS** (Absolute value error mode) and **%** (percentage error).
- **BEEP:** There are three bin beep modes: **OFF**, **GD** and **NG**. Touch this key to select the

required mode.

- **CLEAR:** Clear all setting parameters of all bins.
- **BIN OUTPUT:** Two formats-BCD (binary output) and BIN (bin compare result output) are output through the HANDLER interface.

4) System Setup and File Manage

4.1 System Setup

Entering the system setup page, you can press **[SYSTEM]** or touch **MORE2/2** on any display page to select system setup function as shown in figure 4-1.

SYSTEM SETUP	FILE	TOOLS	SYSTEM SETUP
TouchTone OFF	Language Chinese	Password OFF	LAN SETUP
Bus Mode USBVCOM	Baud Rate 9600	Bus Addr 29	MEAS DISP
EOC (ms) HOLD	ERR. OUT SYNG	AC Freq 50Hz	
Time : 11-01-08 09:21:19			

Figure 4-1 System Setup

On this page, the following functions can be set: TouchTone, Language, Password, Bus Mode, Baud Rate, Bus Addr, EOC (ms), Err.OUT and AC Freq.

4.1.1 TouchTone

The function is used to control the touch tone.

Steps for setting the touch tone

Touch **TouchTone**, the following soft keys will be displayed:

- **ON**

Touch this key to turn on the touch tone.

- **OFF**

Touch this key to turn off the touch tone.

You can touch soft keys to set corresponding functions.

4.1.2 Language

The function is used to set the language.

Steps for setting the language

Touch **Language**, the following soft keys will be displayed:

- **English**

Touch this soft key to set the language as English.

- **Chinese**

Touch this soft key to set the language as Chinese.

You can touch soft keys to set corresponding functions.

4.1.3 Password

The function is used to set the password.

Steps for setting the password

Touch **Password**, the following soft keys will be displayed:

- **OFF**

Touch this key to turn off the password protection function. This function would be disabled only when the preset password is correctly input.

- **LOCK SYSTEM**

Touch this key to enable the password function. Please input the password which will be required to be input when opening a file or starting up the instrument.

- **LOCK FILE**

It is necessary to input the password if this function is enabled.

- **MODIFY**

Touch this key to modify the password.

Steps for modify the password:

Touch **MODIFY**, a numeric keyboard will pop up then you should input the original password and press [ENTER] to confirm. Input the new password when the numeric keyboard is shown once again and press [ENTER] to confirm. Then the numeric keyboard will be displayed for the third time, please input the new password. Press [ENTER] to finish the password modification.

NOTE: The default password is 2515.

4.1.4 Bus Mode

Touch this zone to select the communication interface.

Steps for setting the bus mode

1) Touch **Bus Mode**, the following soft keys will be displayed:

- **RS232C**

- **GPIB**

- **LAN**

- **USBTMC**

- **USBVCOM**

2) Touch **RS232C** to select the RS232C interface.

- 3) Touch **GPIB** to select the GPIB interface.

NOTE: This mode is available only when the optional GPIB interface is bought and installed.

- 4) Touch **LAN** to select the LAN interface.
- 5) Touch **USBTMC** to select the USBTMC interface. The instrument communicates with PC through the USB interface on the rear panel.
- 6) Touch **USBVCOM** to select the USBVCOM interface. The instrument communicates with PC through the USB interface on the rear panel.

4.1.5 Baud Rate

Touch this key, the following six baud rates is selectable:

- 9600
- 19200
- 28800
- 38400
- 96000
- 115200

4.1.6 Bus Addr

Touch this key to control and display the current GPIB interface bus address.

Operation Procedures:

Touch **Bus Addr**, the following items will be displayed in the soft key zone.

- **↑↑ (+ +)**

Touch this key, the instrument increases the number of bus address by 5.

- **↑ (+)**

Touch this key, the instrument increases the number of bus address by 1.

- **↓ (-)**

Touch this key, the instrument decreases the number of bus address by 1.

- **↓↓ (- -)**

Touch this key, this instrument decreases the number of bus address by 5.

The bus address number ranges from 0 to 31.

4.1.7 EOC Signal

EOC (End-of-Measurement): Signal of measurement end with two setting modes for signal level: HOLD and Impulse Input. The time of EOC level conversion varies with measurement time and trigger mode.

Timing diagram of external trigger:

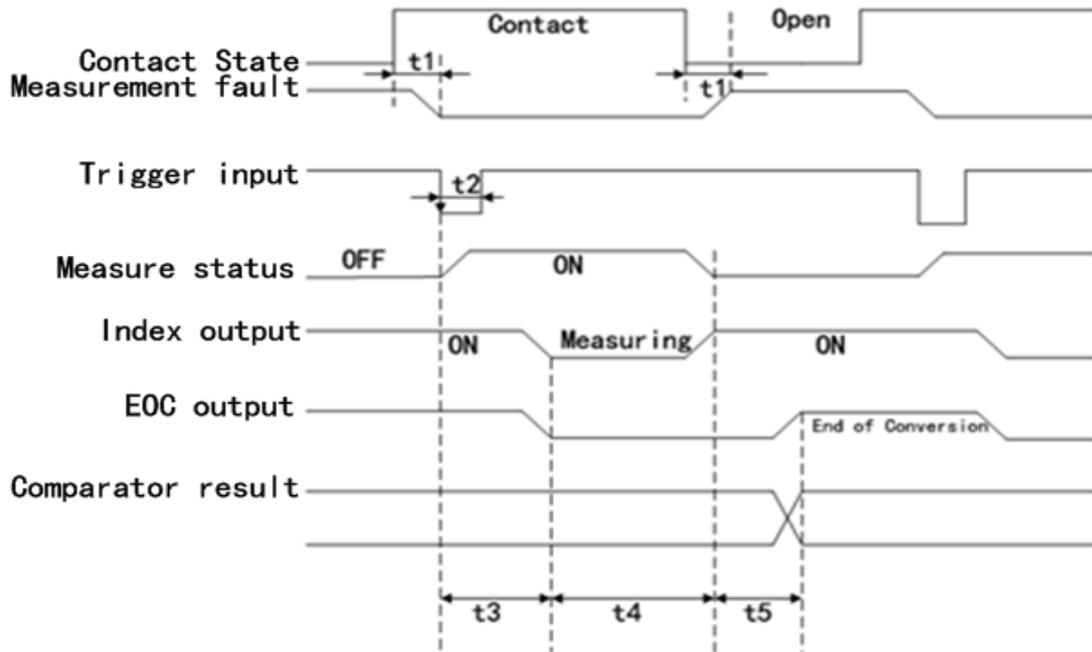


Diagram 4-1-7-1

Timing diagram of internal trigger:

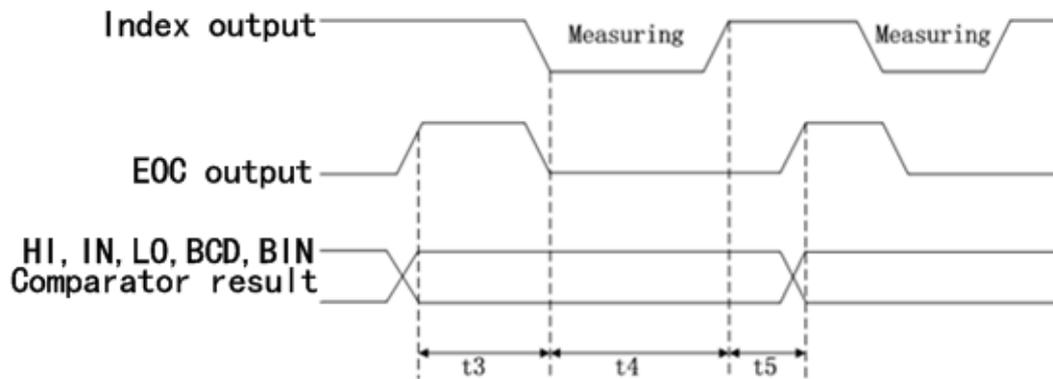


Diagram 4-1-7-2

4.1.8 Err.OUT signal

Diagram of measurement time:

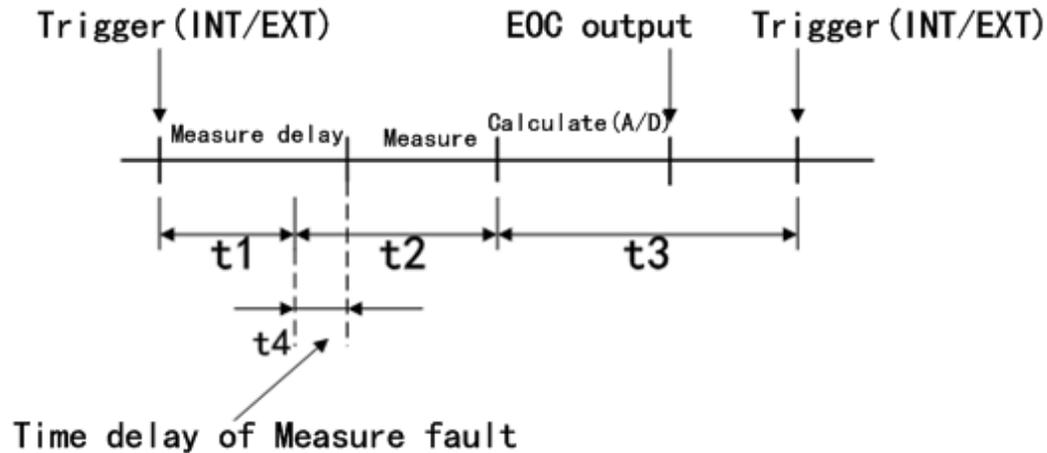


Figure 4-1-8

- Synchronization: If the measurement error is detected during t_2 , the instrument will output a measurement error signal. In other time range, no error detection will be taken.
- Asynchronization: If the measurement error is detected during t_2 , the instrument will output a measurement error signal. If the measurement error is detected during t_3 and lasts for over 5ms, the instrument will output a measurement error signal (If the measurement error disappears in 5ms, no measurement error signal will be output.).

4.1.9 Power Supply Frequency

TH2515 supplies two power supply frequencies: **50Hz** and **60Hz**. Please select the correct frequency so as to eliminate the influence of the power noise on the instrument.

4.1.10 Setting Time and Date

Set the time.

For example: 9 o'clock 13 minute and 25 second a.m. on November 12, 2010 will be shown as 10-11-12 09:13:25.

Operations are as follows: Touch the time zone to be modified, the following items will be displayed.

- **↑↑ (++)**

Touch this key, the time will increase rapidly by 5.

- **↑ (+)**

Touch this key, the time will increase by 1.

- **↓ (-)**

Touch this key, the instrument will decrease by 1.

- **↓↓ (--)**

Touch this key, the instrument will decrease rapidly by 5.

- **<<**

Touch this key, the cursor under the time will move left.

- **>>**

Touch this key, the cursor under the time will move right.

4.2<File Manage>

TH2515 series can save parameters that are set by user to the internal non-volatile memory in the file format. User can load the file to use these parameters instead of resetting.

This section will introduce the information about the function of Save/Recall.

Notation Explanation:

E: Abbreviation of External, representing external memory, like U disk.

I: Abbreviation of Internal, representing internal memory, like internal Flash of TH2515.

4.2.1 Introduction to Save/Recall

By the function of save/recall, user can save measurement results and configuration information to TH2515 internal Flash or external U disk; meanwhile user can recall data from TH2515 internal Flash or external U disk.

Introduction to Methods and Applications of Save

The table below shows the applicable save methods and applications:

Table 4-1 Methods and Applications of Save

save method		recall	application
type	file format		
configuration save (internal Flash)	*.STA	Yes	Save the current configuration to internal Flash.
configuration save (external U disk)	*.STA	Yes	Save the current configuration to a U disk.
data save (external U disk)	*.CSV	No	Save measurement results to a U disk.
screen save (external U disk)	*.gif	No	Save the screen information to a U disk.

4.2.2 Structure of File Folder/File in a U Disk

Before saving data to a U disk, you are recommended to save it into a file and folder that have existed in the memory as shown in table 4-2. If you want to save the configuration file into a file folder in PC, you should enter into the folder on the instrument and then take relative file operations.

Table 4-2 Folder in U disk

Folder	Maximum Amount of File	Description
CSV	40	Including measurement result, like *.CSV file.
STA	40	Including configuration data, like *.STA file.
IMAGE	40	Including screen information, like *.gif file.

NOTE: CSV and STA folders might be automatically generated when a U disk is connected.

Structure of Folder/File in a U disk is shown in figure 4-2.

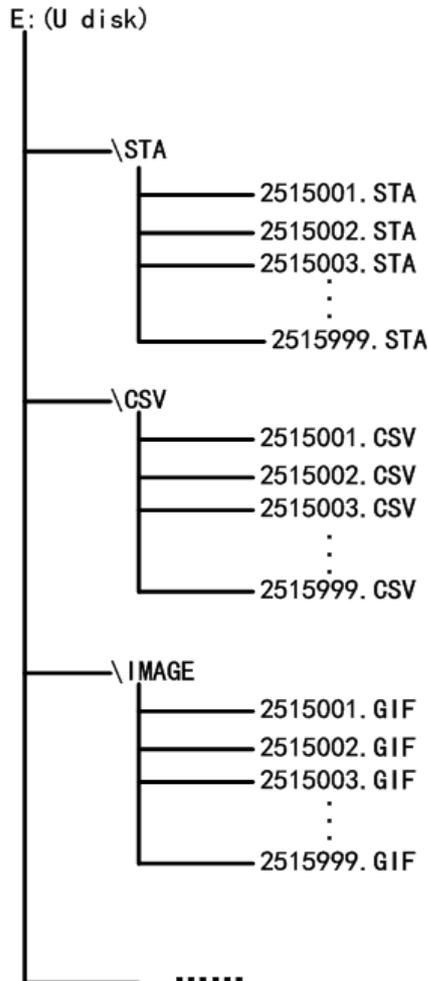


Figure 4-2 file structure in a U disk

When using a U disk on TH2515, you should pay special attention to the following points:

1. Use a U disk with the USB2.0 interface.
2. The U disk file system should be FAT16 or FAT32. FAT16 or FAT32 standard should be used to format the U disk. If the U disk memory exceeds 512M, it is recommended to use FAT32 standard to format the disk.
3. Before a U disk is connected to TH2515, you are recommended to save the data on it and Tonghui will not be liable for the data loss.
4. In order to rapidly save the instrument data to a U disk, it is not recommended to store too many files or folders.

Operation Procedures

Touch **FILE** in any page and select **File Manage** to enter into the internal file page (or directly press the FILE button on the front panel) as shown in below figure.

Touch [Inter File] and [External File] to respectively display files stored in the internal FLASH and

be displayed in the soft key zone. When [YES] is selected, the instrument will load the setup data in the file; when [NO] is selected, the current operation will be cancelled.

- **Save**
Touch this key, [YES] and [NO] will be displayed in the soft key zone. When [NO] is selected, the current operation of save file will be cancelled; when [YES] is selected, the numerical keyboard will pop up and then you can input the file name and press [ENTER] to finish inputting. Thus the current settings in all pages will be saved to the file. (NOTE: When storing a file, if the inputting file number has already existed, the save operation will overwrite the original file.)
- **Delete**
Touch "Delete", if "YES" is selected, the instrument will delete the file that the cursor locates.
- **Copy to E:**
Touch "Copy to E". The instrument will copy the file the cursor locates or the selected file to a U disk.
- **Select**
Touch "Select", the file the cursor locates will be selected. TH2515 can simultaneously copy several files to a U disk.
Touch "Select" once again, the selected file will be cancelled from selection.

Save Measurement Results

In the "MEAS DISP" page, touch "FILE" and select "Start Save" to save measurement results to a U disk. Touch "Stop Save", the instrument will stop saving measurement results.

Save Screen Information:

Touch "FILE" and select "Screen Save" to store the current screen information to a U disk.

Operations of External File and Folder

Operations of external file are similar to that of internal file.

Operations of external file folder are as below:

- (1) Touch the name of the desired file folder to enter into the corresponding folder;
- (2) Touch "Upper Page" in the right soft key zone to return to the upper page shown as below.

EXTERNAL FILE	E:\	Internal File
 CSV	2011/06/18 17:06	External File
 STA	2011/06/18 17:06	
		Exit
Page 1		
		 10:19:55

<LAN SETUP>

Touch "SYSTEM" to enter into the system setup page. Choose "LAN SETUP" to enter into the <LAN SETUP> page.

LAN SETUP	FILE				SYSTEM SETUP
DHCP ON					LAN SETUP
IP ADDR	192	168	1	100	MEAS DISP
SUBNET MASK	255	255	255	1	
GATEWAY	192	168	1	251	
DNS SERVER1	192	168	1	1	
DNS SERVER2	221	228	255	1	
					 10:18:23

This page shows most LAN setups including DHCP, IP ADDR, SUBNET MASK, GATEWAY, DNS SERVER1 and DNS SERVER2.

4.2.3 DHCP

DHCP is the short form of Dynamic Host Configuration Protocol.

DHCP is divided into two parts: server and client. DHCP server controls all IP network configuration protocols and deals with DHCP requests sent by client; Client will use the IP address configured by server. Therefore, when you use this function, please ensure that a DHCP exists in

your network.

Operation Procedures:

Move the cursor to **DHCP**, the following items will be displayed:

- **ON**

Enable the DHCP function.

NOTE: For the sake that TH2515 will acquire correct network parameters, please ensure a DHCP server exists in the current network.

- **OFF**

Disable the DHCP function.

4.2.4 IP ADDR

IP address, a 32-bit binary number, is used to label address for each PC that uses TCP/IP protocol for communication. Dot-mode decimal system is commonly used to represent an IP address, like 192.168.1.6.

Touch the IP address zone to be modified, the numerical keyboard will pop up. You can input the desired address and press [ENTER] to finish the modification.

NOTE: Set the IP addresses on the instrument and PC to be in the same segment but be different.

4.2.5 SUBNET MASK

In TCP/IP protocol, SUBNET MASKS is used to judge whether all host computers are in the same network segment.

NOTE: Set the subnet masks on the instrument and PC to be the same.

4.2.6 GATEWAY

A gateway is a network address that acts as an entrance to another network.

NOTE: Set the gateways on the instrument and PC to be the same.

4.2.7 DNS SERVER1, DNS SERVER2

DNS (Domain Name Server) is used to realize the mutual transition of domain name and IP address.

NOTE: Set the DNSs on the instrument and PC to be the same.

5) Performance Index

5.1 Measurement Function

5.1.1 Measurement Parameters and Notations

R: Resistance T: Temperature
LPR: Resistance tested at low voltage

5.1.2 Measurement Groups

Five measurement groups are available: R, R-T, T, LPR, LPR-T

5.1.3 Equivalent Mode

The equivalent mode of TH2515 is series.

5.1.4 Range

Resistance Mode: AUTO, MANU (HOLD, UP, DOWN)

5.1.5 Trigger

Internal, manual, external, bus

Internal: Continuously test a DUT and then output and display the result.

Manual: Press the "TRIGGER" button on the panel, the instrument will test a DUT once and display the result. This mode keeps in waiting mode when it is not used.

External: Test a DUT once and display the result when the instrument receives an external "start up" signal from the footswitch of HANDLER interface on the rear panel.

BUS: The measurement of the instrument will be triggered through the communication interface.

5.1.6 Mode of Test Terminal

4-terminal measurement mode

DRIVE HI: Current-drive high terminal DRIVE LO: Current-drive low terminal

SENSE HI: Voltage-sense high terminal SENSE LO: Voltage-sense low terminal

5.1.7 Time Expenditure of Measurement

Instruction		Time	
		Offset voltage compensation (OVC) OFF	Offset voltage compensation (OVC) ON
Error test signal output response		100us	100us
Trigger pulse width		100us	100us
Measuring delay		Auto, manual setup	Auto, manual setup
Measuring time	FAST	5ms	10ms+measuring delay
	MED	20ms(50Hz) 16.7ms(60Hz)	40ms+ measuring delay (50Hz) 33.3ms+measuring delay (60Hz)
	SLOW1	100ms	200ms+ measuring delay
	SLOW2	400ms	800ms+7* measuring delay
Computing time	FAST	1ms	1ms
	MED	1ms	1ms
	SLOW1,2	1ms	1ms
Loading time		70ms min,190ms max	70ms min, 190ms max

5.1.8 Average

Range from 1 to 255, programmable: this value reflects the measurement times from measuring resistance to measuring display. The setup of average is shown in the average settings of <Measurement Setup> interface.

5.1.9 Display Digits

	SLOW2、SLOW1、MED	FAST
Resistance range	6digits, maximum display: 110M	5 digits, maximum display: 110M
Temperature range	3 digits, maximum display number: 999.9℃	3 digits, maximum display number: 999.9℃

5.2 Test Signal

5.2.1 Current range

Current range: 100nA -- 1A

5.2.2 Output Voltage of Open Circuit

Output voltage of open circuit: 5V , 2.6V , 13V , 60mV

5.2.3 Maximum Display Range

Parameter	Measurement Display Range
R	0.1 $\mu\Omega$ -- 110M Ω
LPR	2 Ω --2K Ω
T	-99.9 $^{\circ}\text{C}$ -- 999.9 $^{\circ}\text{C}$

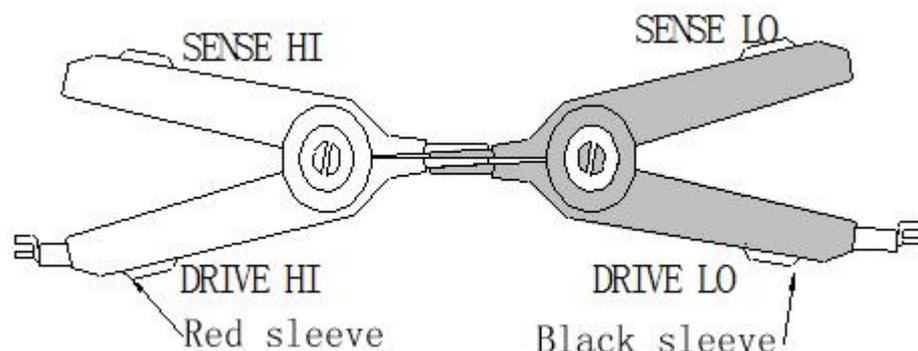
5.3 Measurement Accuracy

Measurement accuracy includes the basic measurement accuracy under environmental conditions of basic temperature and humidity and temperature correction factor beyond the environmental conditions of basic temperature and humidity.

Checking the measurement accuracy should be taken under the following circumstances:

- Warm-up time should be more than 30 minutes.
- Correctly short the test cables, turn 0 ADJ to ON and perform short calibration by pressing the touch key or 0 ADJ panel.

The correct short of the test cable is as follows:



- Guarantee the following basic temperature and humidity environmental conditions for basic

measurement accuracy.

Temperature range: 23°C± 5°C

Relative humidity: ≤80%RH

5.3.1 Basic Accuracy for Resistance Measurement

Basic Measurement Accuracy in one year of TH2515 (23±5°C, ≤80%RH)

Range	Maximum display value	OVC	± (ppm of Rd + ppm of Fs)				Current range	Open circuit voltage
			SLOW2	SLOW1	MED	FAST		
20m Ω	20.0000 ±	OFF	2500+150	2500+170	2500+200	2500+250	1A ± 5%	5Vmax
	0.2000 m Ω	ON	2500+10	2500+10	2500+10	2500+40		
200 m Ω	200.000 ±	OFF	2500+60	2500+80	2500+120	2500+300	1A ± 5%	5Vmax
	02.000 m Ω	ON	2500+10	2500+10	2500+10	2500+20		
200 m Ω	200.000 ±	OFF	3500+100	3500+120	3500+150	3500+300	100mA ±5%	2.6Vmax
	02.000 m Ω	ON	3500+10	3500+10	3500+20	3500+80		
2 Ω	2000.00 ±	OFF	350+40	350+60	350+80	350+80	100mA ±5%	2.6Vmax
	020.00 m Ω	ON	350+10	350+10	350+10	350+40		
20 Ω	20.0000 ±	OFF	250+40	250+50	250+70	250+80	10mA ±5%	2.6Vmax
	0.2000 Ω	ON	250+10	250+10	250+10	250+40		
200 Ω	200.000 ±	OFF	100+20	100+20	100+30	100+40	10mA ±5%	2.6Vmax
	02.000 Ω	ON	100+10	100+10	100+10	100+40		
2k Ω	2000.00 ±	OFF	100+15	100+20	100+40	100+50	1mA ± 5%	2.6Vmax
	020.00 Ω	ON	100+10	100+10	100+10	100+40		
20k Ω	20.0000 ±	OFF	100+20	100+20	100+20	100+20	100uA ±5%	2.6Vmax
	0.2000K Ω	ON	100+5	100+5	100+5	100+5		
100k Ω	110.000 ± 02.000 K Ω	----	100+30	100+30	100+40	100+50	100uA ±5%	13Vmax
1M Ω	1100.00 ± 020.00 K Ω	----	200+10	200+30	200+40	200+50	10uA ± 5%	13Vmax
10M Ω	11.000 ± 0.2000M Ω	----	1000+60	1000+90	1000+100	3000+120	1uA ± 5%	13Vmax

100M Ω	110.00 ± 02.000 M Ω	----	8000+600	8000+600	8000+800	15000 + 800	100nA ±5%	13Vmax
-----------	---------------------------	------	----------	----------	----------	----------------	--------------	--------

Accuracy for Resistance Tested at Low Voltage Measurement

Basic Measurement Accuracy in one year (23±5°C, ≤80%RH)

Range	Maximum display value	OVC	± (ppm of Rd + ppm of Fs)				Current range	Open circuit voltage
			SLOW2	SLOW1	MED	FAST		
2 Ω	2000.00 ± 020.00m Ω	OFF	500+100	500+120	500+150	500+200	10mA ±5%	60mVmax
		ON	500+10	500+10	500+20	500+80		
20 Ω	20.0000 ± 0.2000 Ω	OFF	500+100	500+120	500+150	500+200	1mA ± 5%	60mVmax
		ON	500+10	500+10	500+20	500+80		
200 Ω	200.000 ± 02.000 Ω	OFF	500+100	500+120	500+150	500+200	100uA ±5%	60mVmax
		ON	500+10	500+10	500+20	500+80		
2k Ω	2000.00 ± 020.00 Ω	OFF	500+100	500+120	500+150	500+200	10uA ± 5%	60mVmax
		ON	500+10	500+10	500+20	500+80		

5.3.2 Accuracy for Temperature Measurement (Pt500)

Temperature range	-10.0 to 39.9°C	40.0 to 99.9°C
Resolution	0.1°C	0.1°C
Accuracy in six months	±0.30%Rd ±0.5°C *1	±0.30%Rd ±1.0°C
Accuracy in one year	±0.45%Rd ±0.8°C	±0.45%Rd ±1.5°C

*1: accuracy=0.3%*measured value ±0.5°C

5.3.3 Accuracy for Temperature Measurement (Analog Input)

One year

Input voltage range	0 to 2V
Temperature range display	-99.9°C to 999.9°C
Resolution	1mV
Accuracy	±1%Rd ± 3mV

$$\text{Accuracy} = 1\% * (T_R - T_{0V}) + 0.3\% * (T_1 - T_{0V})$$

T_{1V}: The temperature measured under input voltage of 1V.

T_{0V}: The temperature measured under input voltage of 0V.

T_R: The current measured temperature.

5.3.4 Temperature correction factor

When the instrument is used under the following environmental conditions:

0°C~18°C, ≤80%RH; 28°C~40°C, ≤80%RH

Measurement Accuracy: Multiply the basic measurement accuracy value listed in chapter 5.3.1

-5.3.4 by the temperature correction factor K in the following table.

Temperature(°C)	0 - 5	5 - 18	18 - 28	28 - 35	35 - 40
Temperature correction factor K	4	2	1	2	4

Note: Rd is the digit reading of measuring instrument; Fs is the full range.

6) Remote Control

6.1 RS232C Connection

RS-232 standard, also called as asynchronous serial communication standard, has already been widely used for data communication between computers, computer and external equipment. RS is the English abbreviation of Recommended Standard; 232, the standard number. This standard is issued by EIA in 1969, which rules to send one bit in a data line every time.

As most serial interfaces, the serial interface of TH2515 is also not strictly based on RS-232 standard but only uses the smallest subset of this standard. The signals are listed in the following table.

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

Table 6-1 RS-232 Signal and Pin Connector

The reason is that the use of three lines is much more inexpensive and much simpler than that of five lines or six lines, which is the biggest advantage of using serial interface for communication.

The connection of the instrument with PC is shown in figure 6-1.

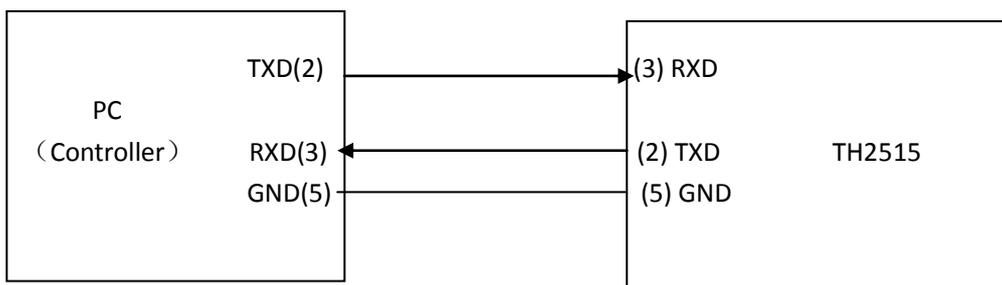


Figure 6-1 Connection of the instrument with PC

Figure 6-1 shows that the serial interface pin definition of this instrument is different from that of 9 pin connector used in the computer. User can purchase the serial interface cable from our company.

RS232 interface characterizes with a baud rate ranging from 9600 to 115200, no parity, 8-bit data bit, 1-bit stop bit.

The instrument commands comply with the SCPI standard. When a command string is

transmitted to the instrument, it is required to send LF (hexadecimal: 0AH) as the terminating character. Each time the maximum receivable number of SPCI command string is 2kB.

For result data formats transmitted to a PC from the instrument, see Commands Reference.

6.2 GPIB Bus (option)

IEEE488 (GPIB) is an international bus interface standard used on intelligent instruments. IEEE is the English abbreviation of Institute of Electrical and Electronics Engineers, and 488 is the standard number. Through this interface, TH2515 can communicate with PC or others intelligent equipments and meanwhile can make up automatic test system with the other test equipments. Up to 15 equipments can be connected on a same bus. TH2515 applies IEEE488.2 and the interface plate can be inserted in any one of the three expansion slots Control command system is open so that user can use the PC operation interface provided by TH2515 or take measurements by the control command system. The control command system supports most functions of the instrument, that is to say, user can execute almost all operations on PC. Thus remote control to the instrument is realized.

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

1. 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.
2. A maximum of 15 devices can be connected on one bus system.
3. 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.

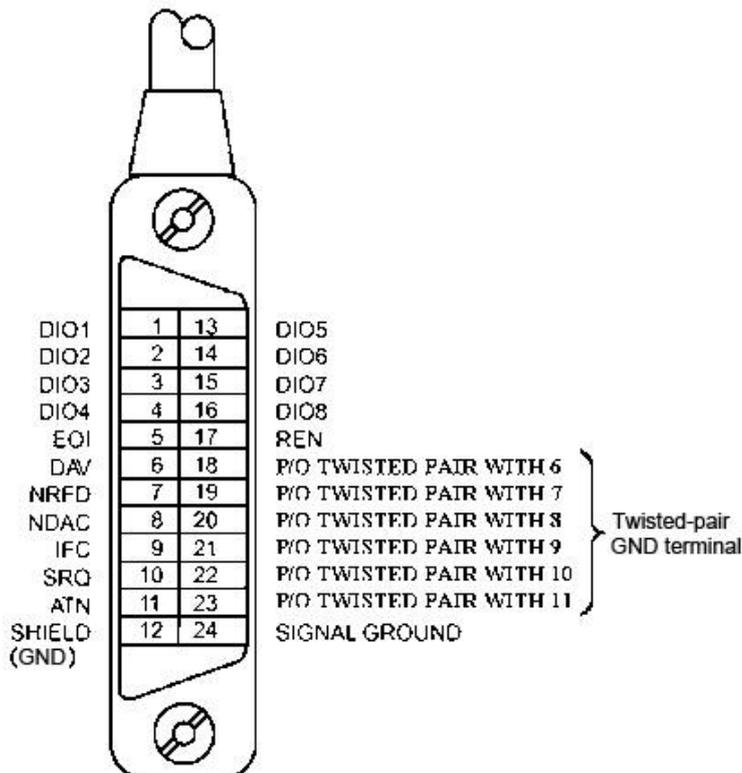


Figure 6-2 GPIB Connector/Pin Structure

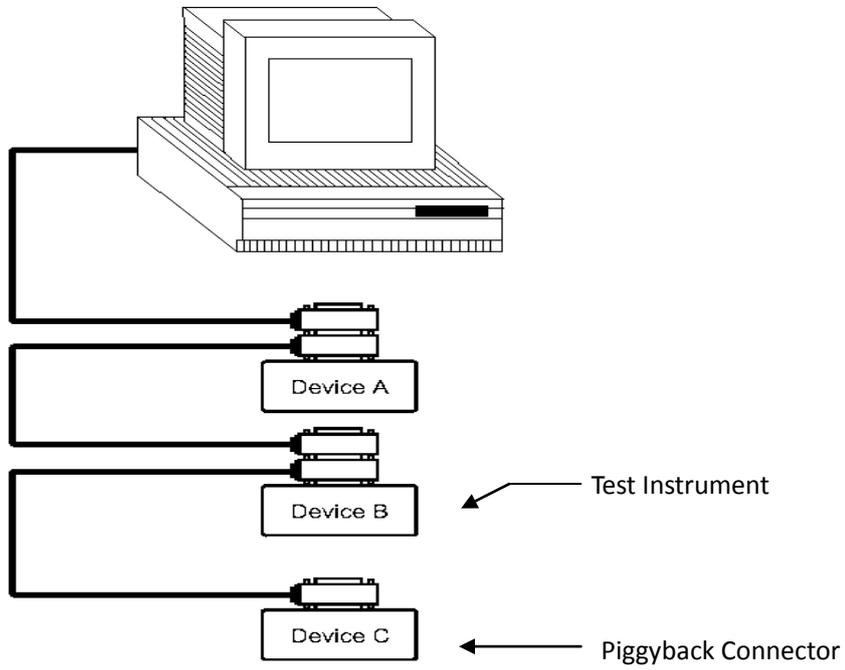


Figure 6-3 Typical GPIB System Interconnection for Double-piggyback Connector

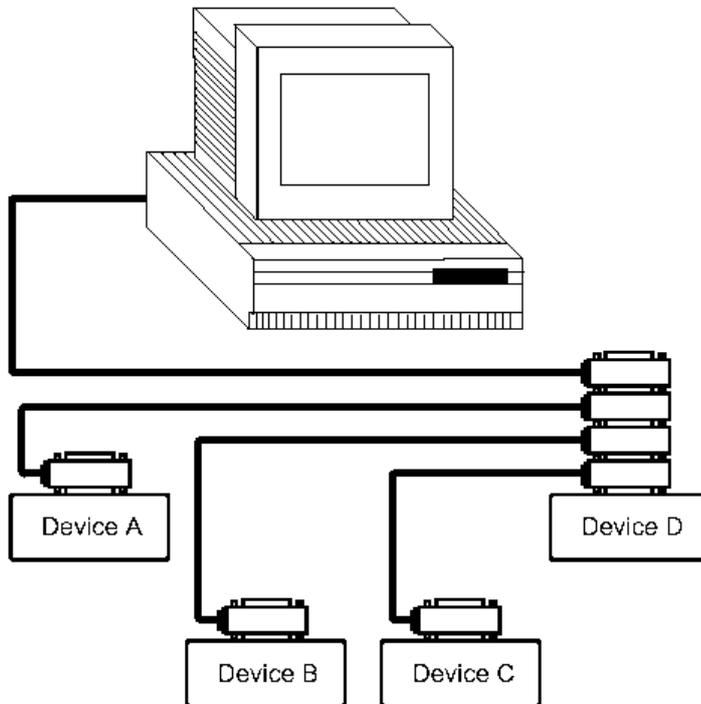


Figure 6-4 Typical GPIB System Interconnection for 4-piggyback Connector

6.2.1 GPIB Interface Function

The following table shows the TH2515 GPIB interface functions:

Code	Capability	Function
SH1	Data Source Handshake	Three-wire Shake
AH1	Acceptor Handshake	Three-wire Shake
T5	Basic Talker	Transmit instrument data.
L4	Basic Listener	Receive instrument data.
SR1	Service Request	Request service.
RL1	Remote/Local Conversion	Remote/Local Conversion
DC1	Device Reset	Transmit clear signal.
Code	Capability	Function
DT1	Device Trigger	Transmit trigger signal.
C0	Control	Transmit control data.

Table 6-2 GPIB Interface Capabilities and Functions.

6.2.2 GPIB Addressing

User can set the bus mode address of the GPIB parallel communication interface to a value from 1 to 31. For more details about address setup, please refer to the page of <SYSTEM SETUP> under the [SYSTEM] menu.

6.2.3 GPIB Bus Commands

TH2515 will respond to the following bus commands:

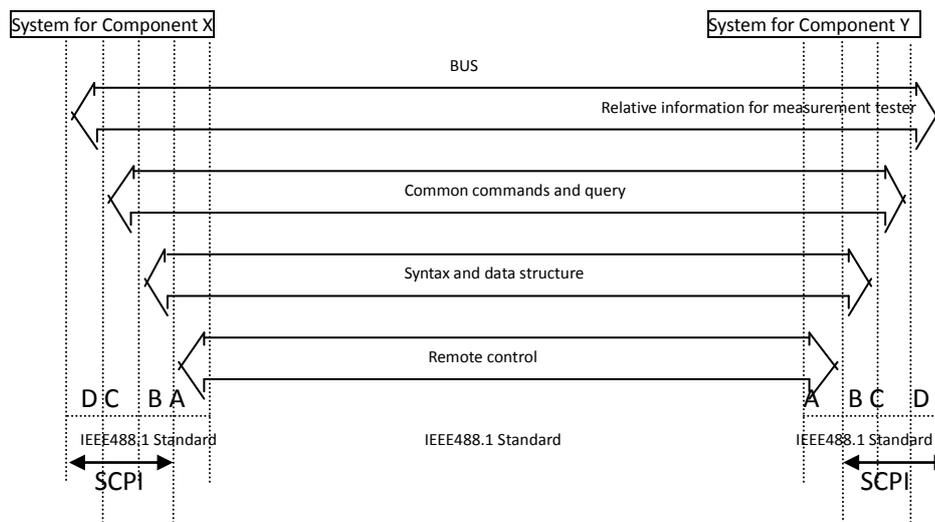
- **ABORT I/O (IFC)**
When this command is received, all bus activities will abort and the instrument will no longer receive data and reset the interface to the idle mode.
- **CLEAR LOCKOUT/SET LOCAL**
This command provides conditions for the instrument to operate remotely.
- **DEVICE CLEAR (SDC or DCL)**
As soon as this command is received, the selected device or all devices connecting with this interface will be cleared.
- **LOCAL (GTL)**
LOCAL returns to local control and buttons on the front panel will be valid.
- **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 TH2515 from the front panel including the soft key LOCAL. Execute the LOCAL command to undo LOCAL LOCKOUT.

- REMOTE
Set the control mode as remote control.
- SPOLL
The SPOLL (serial poll) command is set the bus address status byte. 8 bytes are used to shield, read and judge the instrument operating status.
- SERVICE REQUEST
When TH2515 requires the controller to execute a task, it will send out a SRQ service request control signal. SRQ, deemed as an interruption, will inform the controller to prepare the transmitted data or that errors exist on the instrument. As soon as TH2515 sends a SRQ service request signal, it will set the status byte to 6. 6 bytes are RQS request service bytes and sometimes connects with serial poll to act as the status byte. When TH2515 enables the SPOLL command, it will clear the RQS request service bit and the SRQ string. Each bit in a status byte will enables a SRQ service request. User can shield the status byte to judge which bit causes TH2515 to set SRQ. For details, see "Status Byte".
- TRIGGER (GET)
Trigger bus command. This command can be sent to a selected device or all listener devices. It is necessary to assign TH2515 as a listener device firstly and then set the trigger mode as bus trigger mode. Finally send trigger data.

6.2.4 SCPI (Standard Commands for Programmable Instruments)

SCPI is a new general command based on the IEEE488.2-1987 standard. (SCPI is the same as TMSL, a system language for measurement testers adopted by HP.)



Where: Level D shows the instrument functions

Level C shows the common system functions
Level B shows the information communication functions
Level A shows the interface functions (IF)

Figure 6-5 SCPI functions levels

6.3 LAN Remote Control System

LAN (Local Area Network) can access TH2515 by two ways:

- (1) Access TH2515 by a browser.
- (2) Access TH2515 by software of upper computer.

System Configuration

TH2515 is connected to a PC by a crossover network cable. If TH2515 is connected to a router, peer to peer network cable should be used.

Parameter Settings

Touch <SYSTEM SETUP> on the <SYSTEM SETUP> page. Choose **LAN SETUP** in the right soft key zone to enter into the page of network parameter setup.

Now you can set the following parameters: DHCP, IP, SUB MASK and DNS. Refer to the PC (connecting with TH2515) network parameter setup for TH2515 LAN parameter setup.

For example: PC (connecting with TH2515) network parameter setup

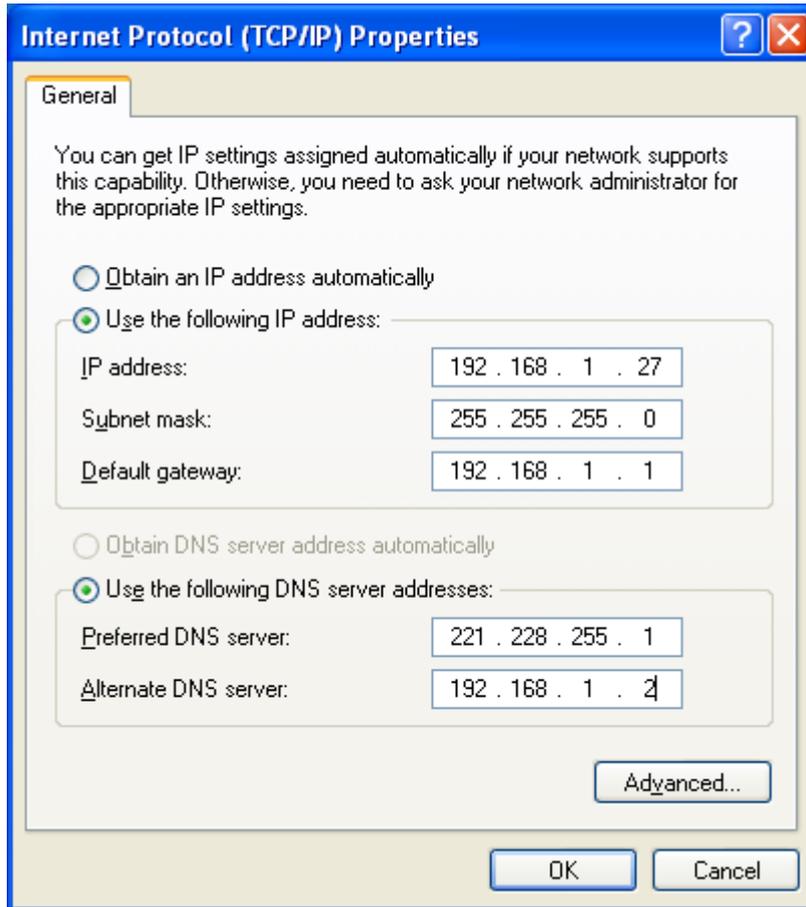


Figure 6-6 Network Parameters of Host computer

TH2515 LAN setup:

LAN SETUP		FILE			SYSTEM SETUP
DHCP ON					LAN SETUP
IP ADDR	192	168	1	100	MEAS DISP
SUBNET MASK	255	255	255	1	
GATEWAY	192	168	1	251	
DNS SERVER1	192	168	1	1	
DNS SERVER2	221	228	255	1	
🕒 10:18:23					

Figure 6-7 TH2515 LAN Setup

6.3.1 Access TH2515 through a Browser

When TH2515 is accessed through a browser, it acts as a WEB server. User can access TH2515 by Internet Explorer (IE6.0 or upgraded version).

Procedures of the access to TH2515 through a browser (assume that the instrument IP is 192.168.1.28.)

- (1) Start up Internet Explorer.
- (2) Input <http://192.168.1.28/> in the address zone and then press ENTER to finish inputting.
- (3) The startup screen of Web server is shown as figure 6-8.

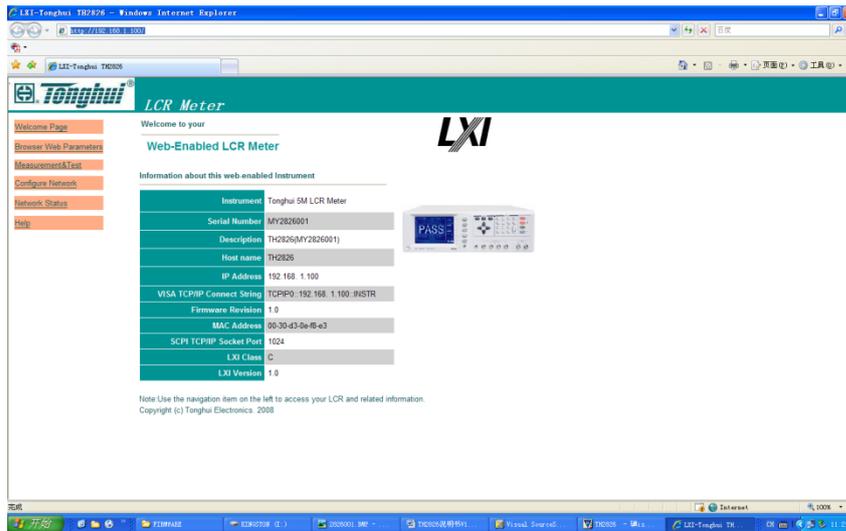


Figure 6-8 Access to TH2515 through a Browser

- (4) Click the item link on the left side of the web page to enter into the corresponding web page.

6.3.2 Access TH2515 through the Software of a Upper Computer

User can program and access TH2515 by development tools like labview as shown below:

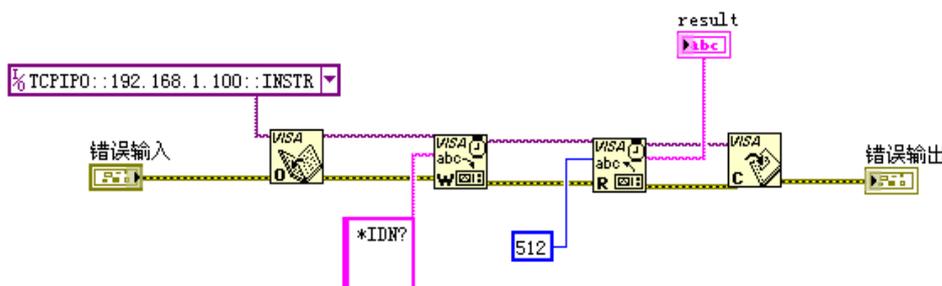


Figure 6-9 Access to TH2515 through Labview

6.4 USBTMC Remote Control System

USB (Universal Serial Bus) remote control system controls the instrument through the USB interface. This connection conforms to USBTMC-USB488 and USB2.0 protocols.

6.4.1 System Configuration

Connect USB interfaces on PC and TH2515 through a USB cable.

6.4.2 Install the Driver

When TH2515 is first connected to a PC through a USB cable, the prompt information –Found New Hardware will show on the right bottom of the computer desktop, as is shown below:

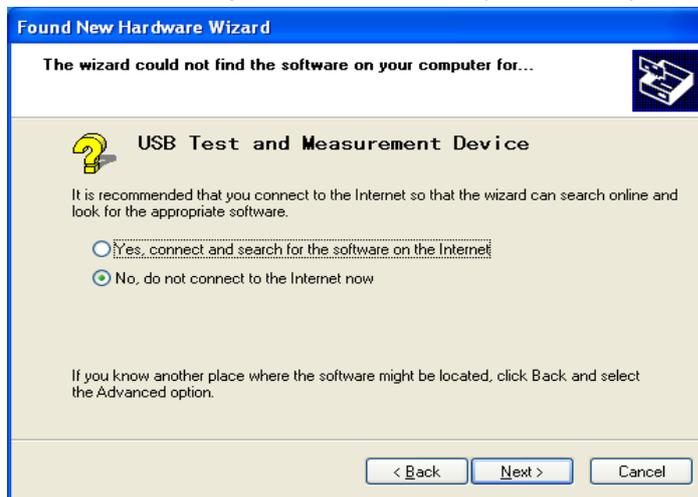


Figure 6-10 Procedure 1 of Installing USB Driver

Click “NEXT”, dialogue 6-11 will pop up. Choose “Install the software automatically (recommended)”.



Figure 6-11 Procedure 2 of Installing USB Driver

When the installation of driver is finished, user can see “usb test and measurement device” in the device manager of PC, as is shown in the following figure.

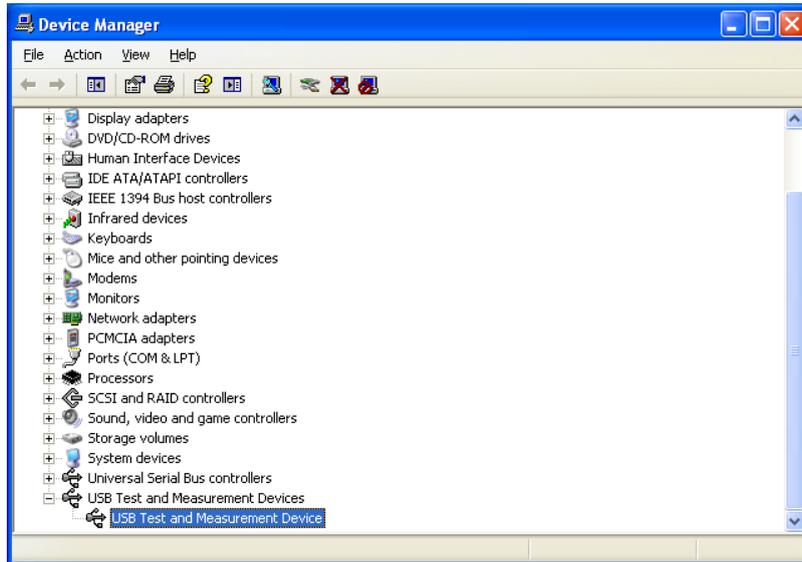


Figure 6-12 USBTMC Display of PC Device Manager

When user is using USBTMC interface, labview software can be used to access the instrument.

6.5 USBVCOM Virtual Serial Port

When “USBVCOM” is selected, the USB interface can be configured as a virtual serial port (VCom).

6.5.1 System Configuration

Connect PC and TH2515 to the USB interface through a USB cable.

6.5.2 Installing Driver

Methods of installing USBVCOM driver are the same with that of installing USBTMC driver. When the installation of driver is finished, user can see “usb VCom port” in the PC device manager, as is shown in figure 6-13.

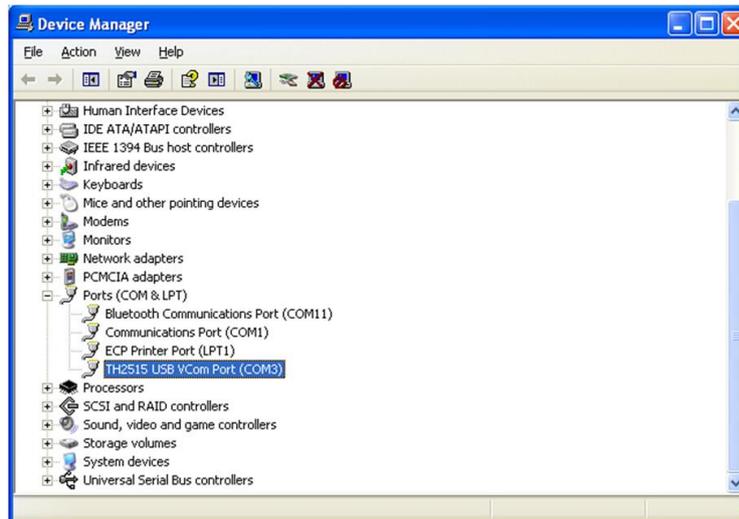


Figure 6-13 VCom Display of PC Device Manager

Now, usb VCom port acts as a serial port. When PC has no serial port, the communication software based on this serial port can be used as USB virtual serial port.

7) SCIP Command Reference

1. Data Conventions of This Manual

NR1 : integer, for example:123

NR2 : fixed number, for example: 12.3

NR3 : floating number, for example: 12.3E+5

NL : CR character, integer: 10

^END: EOI (end) signal of IEEE-488 bus.

7.1TH2515 Subsystem Commands

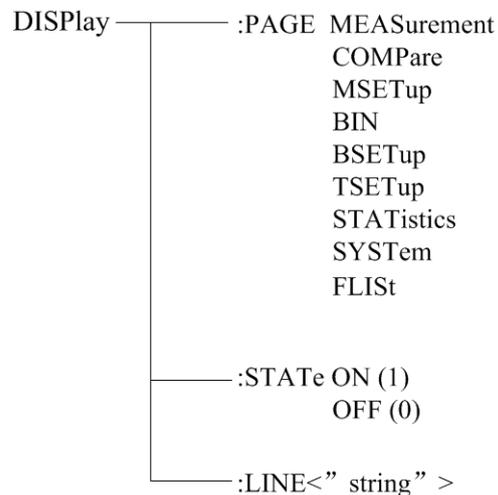
- DISPlay ●TRIGger ●COMParator ●IO
- FUNctIon ●FETCh? ●BIN ●MEMory
- APERture ●TEMPerature ●STATistical ●SYSTem

7.1.1 DISPlay Subsystem Commands

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

The :DISPlay? query returns to the current page.

Command Tree:



The :PAGE command sets the display page.

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

Command Syntax: DISPlay:PAGE <page name>

Functions of <page name> are as follows:

- MEASurement Set the display page to the basic measurement.
- COMPare Set the display page to compare.
- BIN Set the display page to bin.
- MSETup Set the display page to measurement setup.

BSEtup	Set the display page to bin setup.
TSEtup	Set the display page to temperature setup.
STATistics	Set the display page to statistics.
SYSTem	Set the display page to system setup.
FLISt	Set the display page to (internal) file list.

For example: WrtCmd("DISP:PAGE MEAS"); Set the display page to basic measurement.

Query syntax: DISPlay:PAGE?

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

Functions of <page name> are as follows:

MEAS	Set the display page to the basic measurement.
COMP	Set the display page to compare.
BIN	Set the display page to bin.
MSET	Set the display page to measurement setup.
BSET	Set the display page to bin setup.
TSET	Set the display page to temperature setup.
STAT	Set the display page to statistics.
SYST	Set the display page to system setup.
FLISt	Set the display page to (internal) file list.

The :STATe command is used to set whether the measurement display page has refreshed the display results.

Command syntax:

DISPlay:STATe { ON (0)
OFF (1)

Query syntax: DISPlay:STATe?

Return format: <NR1><NL^END>

<NR1> are as follows:

- 1
- 2

The :LINE command sets the current measurement topic as a substring with up to 20 characters. The DISPlay:LINE? query returns the current measurement topic. The character string of the measurement topic can be shown in the file list page and be saved as the file name.

Command Syntax: DISPlay:LINE"<string>"

Where:

<string> can be a ASCII character string (up to 20 characters).

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

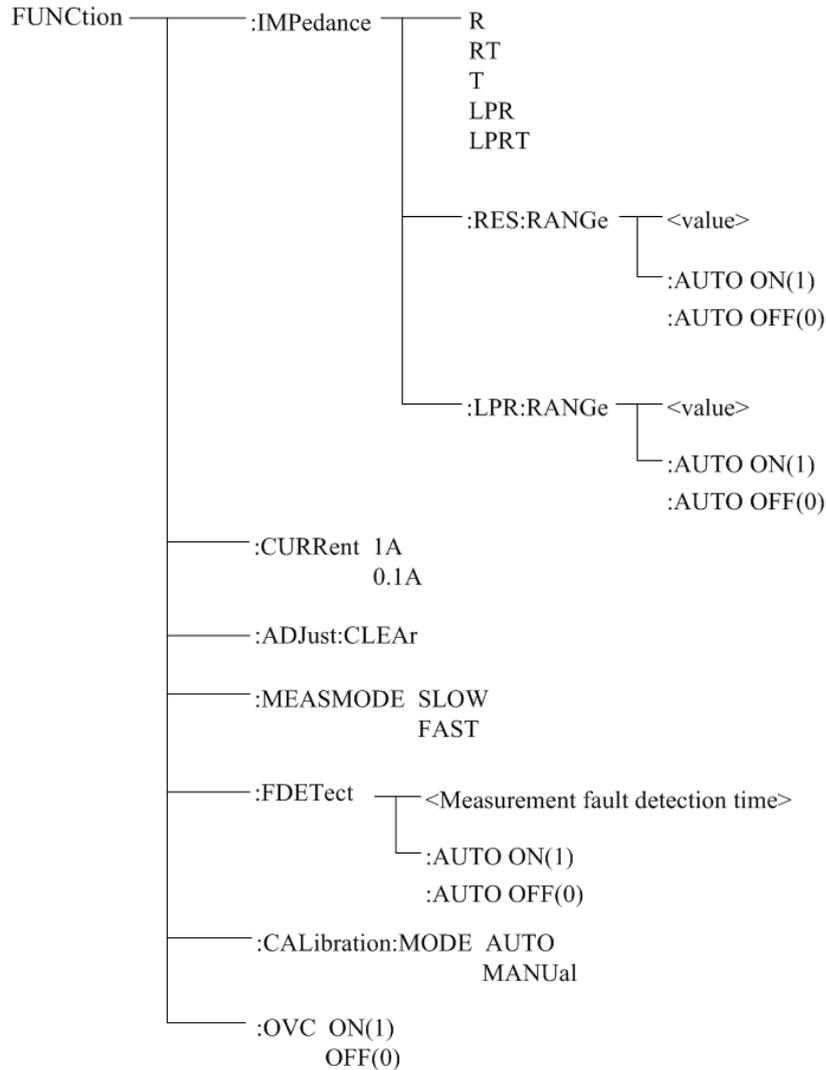
Query syntax: DISPlay:LINE?

Return format: <string><NL^END>

7.1.2 FUNcTion Subsystem Commands

FUNcTion subsystem commands are mainly used to set “function”, “range”, “measurement pattern”, “self-calibration mode”, etc.. The DISPlay:PAGE? query returns to the current page.

Command Tree:



The :IMPedance command sets the “function” parameters.

The FUNcTion:IMPedance? query returns to the current “function” parameters.

Command Syntax: FUNcTion:IMPedance <function>

Details are as follows:

R Set “function” as R.

RT Set “function” as R-T.

T Set “function” as T.

LPR Set “function” as LPR.

LPRT Set “function” as LPR-T.

For example: WrtCmd(“FUNC:IMP RT”); Set “function” as R-T .

Query syntax: FUNCTION:IMPedance?

Return Format: <function><NL^END>

If the current "function" is R-T, it will returns to RT.

The :IMPedance:RES:RANGe command sets the instrument range in common resistance measurement pattern.

The FUNCTION:IMPedance:RES:RANGe? query returns to the current range parameters in common resistance measurement pattern.

Command Syntax: FUNCTION:IMPedance:RANGe <value>

Where, <value> can be the impedance of the tested LCR component or the specific range values. Its data format is NR1, NR2, NR3, <value> = 0 to 110E+6.

For example: WrtCmd("FUNC:IMP:RES:RANG 123"); Set the instrument range in common resistance measurement pattern as 200Ω.

Query syntax: FUNCTION:IMPedance: RES:RANGe?

Return format: <value><NL^END>

Where, <value> can be:

20.0000E-3, 200.000E-3, 2000.00E-3, 20.0000E+0, 200.000E+0,
2000.00E+0, 20.0000E+3, 110.000E+3, 1100.00E+3, 11.0000E+6,
110.000E+6

The :IMPedance:RES:RANGe:AUTO command sets the range auto selection mode in common resistance measurement pattern.

The FUNCTION:IMPedance:RANGe:AUTO? query returns to the current range mode.

Command syntax:

:IMPedance:RES:RANGe:AUTO { ON (1)
OFF (0)

Where,

Character 1 (integer:49) means ON.

Character 0 (integer: 48) means OFF.

For example: WrtCmd("FUNC:IMP:RES:RANG:AUTO ON"); Set the range mode in common resistance measurement pattern as AUTO.

Query syntax: FUNCTION:IMPedance:RES:RANGe:AUTO?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

The:IMPedance:LPR:RANGe command sets the instrument range in resistance tested at low voltage measurement pattern.

The FUNCTION :IMPedance:LPR:RANGe? query returns to the current range parameter in resistance tested at low voltage measurement pattern.

Command syntax: FUNCTION:IMPedance:LPR:RANGe <value>

Where, <value>can be the impedance of the tested LCR component or the specific

range values. Its data format is NR1, NR2, NR3, <value> = 0 to 2000.

For example: WrtCmd("FUNC: IMP:LPR:RANG 15"); Set the instrument range in resistance tested at low voltage measurement pattern as 20Ω.

Query syntax: FUNCtion:IMPedance:LPR:RANGe?

Return format: <value><NL^END>

Where, <value> can be:

2000.00E-3, 20.0000E+0, 200.000E+0, 2000.00E+0

The :IMPedance:LPR:RANGe:AUTO command sets the auto selection mode of range in resistance tested at low voltage measurement pattern.

The FUNCtion :IMPedance:LPR:RANGe:AUTO? query returns to the current range mode.

Command syntax:

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

Where:

Character 1 (integer:49) means ON.

Character 0 (integer: 48) means OFF.

For example: WrtCmd("FUNC:IMP:LPR:RANG:AUTO ON"); Set the range in resistance tested at low voltage measurement pattern as AUTO.

Query syntax: FUNCtion:IMPedance:LPR:RANGe:AUTO?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

The :CURRent command sets the instrument current range of 200mΩ.

The :CURRent command? query returns to the current range of 200mΩ.

Command syntax:

FUNCtion:CURRent $\left\{ \begin{array}{l} 1A \\ 0.1A \end{array} \right.$

For example: WrtCmd("FUNC:CURR 1A"); Set the instrument current range of 200mΩ as 1A.

Query syntax: FUNCtion: CURRent?

Return format: <1A/0.1A><NL^END>

The :ADJust command is used to execute or clear 0 ADJ.

Clear 0 ADJ data

Command syntax: :ADJust:CLEAr

Execute 0 ADJ operation

Command syntax: ADJust

Returned value: <0 or 1><NL^END>

0: it indicates that the 0 ADJ has completed successfully and open 0 ADJ after the completion.

1: it indicates that the measured value of resistance exceeds 1,000 dgt, namely operation failed.

The :MEASMODE command sets the measurement mode of the instrument.

The :MEASMODE? query returns to the current measurement mode.

Command syntax:

$$\text{:MEASMODE} \left\{ \begin{array}{l} \text{SLOW} \\ \text{FAST} \end{array} \right.$$

For example: WrtCmd("FUNC: MEASMODE SLOW"); Set the measurement mode of the instrument as SLOW.

Query syntax: FUNCtion: MEASMODE?

Return format: <SLOW or FAST><NL^END>

The :FDETECT command sets the instrument measurement fault detection time setup.

The :FDETECT? query returns to the current measurement fault detection time time.

Command syntax: FUNCtion:FDETECT <Measurement fault detection time>

Where, < Measurement fault detection time > = 0 to 9.998(NR2)

For example: WrtCmd("FUNC:FDETECT 0.020"); Set the instrument measurement fault detection time as 0.020 seconds.

The measurement fault detection time should not be set greater than or equal to the measurement delay time!

Query syntax: FUNCtion:FDETECT?

Return format: <value><NL^END> value(NR2) in second(s)

The :FDETECT:AUTO command sets the instrument auto selection mode of the measurement fault detection time setup.

The :FDETECT:AUTO? query returns to the current setstate.

Command syntax:

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

Where,

Character 1 (integer:49) means ON.

Character 0 (integer: 48) means OFF.

For example: WrtCmd("FUNC:FDETECT:AUTO ON"); Set the instrument measurement fault detection time setup as AUTO.

Query syntax: FUNCtion:FDETECT:AUTO?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the measurement fault detection time setup "AUTO" ON

0: the measurement fault detection time setup "AUTO" OFF

The :CALibration:MODE command sets the instrument self-calibration mode selection.

The :CALibration:MODE? query returns to the current self-calibration mode.

Command syntax:

$$\text{:CALibration:MODE} \left\{ \begin{array}{l} \text{AUTO} \\ \text{MANUal} \end{array} \right.$$

For example: WrtCmd("FUNC:CALibration:MODE AUTO"); Set the instrument self-calibration mode as AUTO.

Query syntax: FUNCtion: :CALibration:MODE?

Return format: <AUTO or MANU><NL^END>

The :OVC command sets the instrument offset voltage compensation state.

The :OVC? Query returns to the current setstate.

Command syntax:

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

Where,

Character 1 (integer:49) means ON.

Character 0 (integer: 48) means OFF.

For example: WrtCmd("FUNCtion:OVC ON"); Set the instrument offset voltage compensation state as "ON".

Query syntax: FUNCtion: FUNCtion:OVC?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the offset voltage compensation state is "ON".

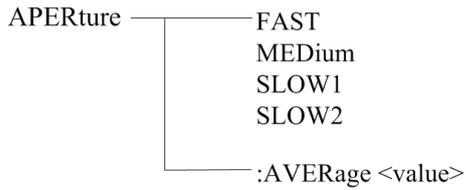
0: the offset voltage compensation state is "OFF".

7.1.3 APERture Subsystem Commands

The APERture subsystem commands are mainly used to set the measurement speed and the average times used in measurement.

The APERture? query returns to the current measurement speed and average times used in measurement.

Command Tree:



The :APERTure command sets the instrument measurement speed.

The :APERTure? query returns to the current measurement speed.

Command syntax:

Command syntax: APER <FAST, MEDium, SLOW1 or SLOW2>

For example: WrtCmd("APERture SLOW1"); Set the instrument self-calibration mode as SLOW.

Query syntax: APERTure?

Return format: <FAST, MEDium, SLOW1 or SLOW2> <NL^END>

The :APERTure:AVERage command sets the instrument average times used in measurement.

The :APERTure:AVERage? query returns to the current average times.

Command syntax:

Command syntax: APER:AVERage <value>

Where, <value> = 1 to 255

For example: WrtCmd("APERture:AVER 10"); Set nstrument average times used in measurement as 10.

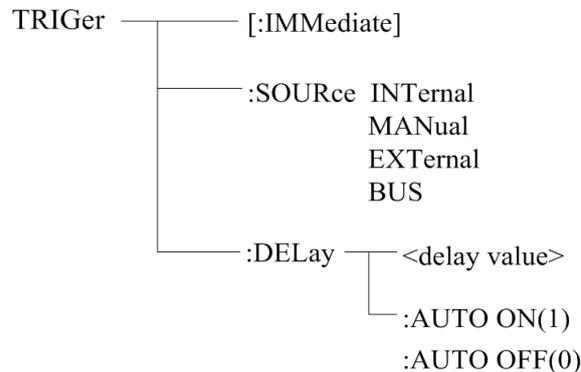
Query syntax: APERTure:AVERture?

Return format: < NR1> <NL^END>

7.1.4 TRIGger Subsystem Commands

The TRIGger subsystem commands set the instrument trigger source and the delay time after triggering, and triggers instrument measurement.

Command Tree:



The :IMMEDIATE command triggers a measurement.

Command syntax: TRIGger[:IMMEDIATE]

For example: WrtCmd("TRIG");

The :SOURce command sets the mode of trigger source.

The :SOURce? query returns to the current mode of trigger source.

Command syntax:

```
TRIGger:SOURce <INTernal, MANual, EXTernal 或 BUS>
```

Where,

INTernal	Be automatically triggered by the instrument and be the default setting of the instrument.
MANual	Be triggered by pressing the TRIGGER button on the panel.
EXTernal	Be triggered by the HANDLER interface.
BUS	Be triggered by the RS232 interface or the GPIB interface.

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

Query syntax: TRIGger:SOURce?

Return format: <INTernal, MANual, EXTernal or BUS> <NL^END>

The :DELay command sets the insreument measurement delay time after triggering.

The TRIGger:DELay? query returns to the current delay time.

Command syntax:

```
TRIGger:DELay <delay value>
```

Where, <delay value> = 0 to 9.999 [in seconds]

For example: WrtCmd("TRIG:DEL 0.5"); Set the delay time as 0.5S.

Query syntax: TRIGger:DELay?

Return format: <NR2><NL^END>

The :DELay:AUTO command sets the instrument measurement delay mode after triggering.

The :DELay:AUTO? query returns to the current delay mode status.

Command syntax:

```
TRIGger:DELay:AUTO ON(1)
OFF(0)
```

Where, ON Set the measurement delay mode as automatic "ON"

OFF Set the measurement delay mode as automatic "OFF"

For example: WrtCmd("TRIG:DEL:AUTO ON"); Set the delay mode as automatic "ON".

Query syntax: TRIG:DEL:AUTO?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the measurement delay mode is automatic "ON".

0: the measurement delay mode is automatic "OFF".

7.1.5 FETCH? Subsystem Commands

The FETCH? Subsystem commands are used to get the last measurement result and the setup of the mode.

Command Tree:

```

FETCh ———— [:IMP]?
          |
          +—— :AUTO ON(1)
              OFF(0)

```

The [:IMP]? query returns TH2515's last measurement result to its output buffer.

Query syntax: FETCh[:IMP]?

The data got from the commands can be divided into three types according to different functions and display page.

1. On the measurement display page, compare display interface, bin display page and statistical interface and the measurement function is one-parameter mode (functions are R, T, LPR):

Data format: <primary parameter>, <system status>;

<primary parameter>= the measured value of the current parameter and the format is NR3 (when the temperature conversion function is enabled and on the measurement display interface, the primary parameter is the temperature increment ΔT), when existing outrange or measurement error, the returned value is "+9.90000E+37".

System status: -1 No data in the buffer zone.
 0 Ordinary measurement data.
 +1 Measurement status error.

2. On the measurement display page, compare display interface, bin display page and statistical interface and the measurement function is two-parameter mode (functions are R-T, LPR-T):

Data format: <primary parameter>, <secondary parameter>, <system status>;

<primary parameter>= the measurement of the current primary parameter and the format is NR3 (when the temperature conversion function is enabled and on the measurement display interface, the primary parameter is the temperature increment ΔT), when existing outrange or measurement error, the returned value is "+9.90000E+37".

<secondary parameter>= the measurement of the current secondary parameter and the format is NR3, when existing outrange or measurement error, the returned value is "+9.90000E+37".

The system status is the same as above.

3. There is no return value for other display page.

The FETCh:AUTO command sets the automatic mode switch to send each measurement result to its output buffer.

Command syntax: FETCh:AUTO ON(1)
 OFF(0)

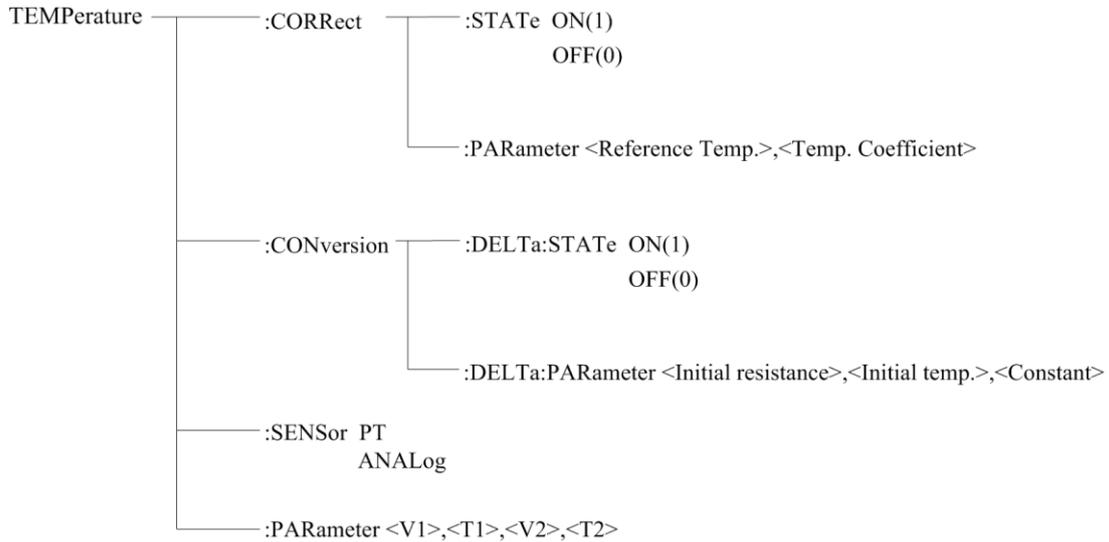
For example: WrtCmd("FETC:AUTO ON"); namely opening the automatic sending mode of each

measurement result.

7.1.6 TEMPerature Subsystem Commands

TEMPerature subsystem commands set the instrument trigger source and the delay time after triggering, and triggers instrument measurement.

Command Tree:



The :TEMPerature:CORRect:STATe command sets “ON” and “OFF” of the instrument temperature correction function.

The :TEMPerature:CORRect:STATe? query returns to the current state of the temperature correction function.

Command syntax:

```
:TEMPerature:CORRect:STATe <ON(1) or OFF(0)>
```

For example: WrtCmd(“:TEMPerature:CORRect:STATe ON”); Set the instrument temperature correction function as “ON”.

NOTE: Turning the temperature correction function on will stop the temperature conversion function!

Query Syntax: :TEMPerature:CORRect:STATe?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the instrument temperature correction function is “ON”.

0: the instrument temperature correction function is “OFF”.

The :TEMPerature:CORRect:PARAmeter command sets the “reference temperature” and “temperature coefficient” of the instrument temperature correction function.

The :TEMPerature:CORRect:PARAmeter? query returns to the current “reference temperature” and “temperature coefficient”.

Command syntax:

```
:TEMPerature:CORRect:PARAmeter<Reference Temp.>,<Temp. Coefficient>
```

Where, <Reference Temp.> = -10.0 to 99.9(NR2) means “reference temperature”, unit: °C

<Temp. Coefficient> = -99999 to 99999(NR1) means "temperature coefficient", unit: ppm/°C

For example: WrtCmd(":TEMP:CORR:PAR 25,3390"); Set the instrument "reference temperature" and "temperature coefficient" as 25°C and 3390 ppm/°C respectively.

Query Syntax: :TEMPerature:CORRect:PARAmeter?

Return format: <Reference Temp.>,<Temp. Coefficient><NL^END>

Where, the format and unit of <Reference Temp.>,<Temp. Coefficient> are the same as above.

The :TEMPerature:CONVersion:DELTA:STATe command sets "ON" and "OFF" of the instrument temperature conversion function.

The :TEMPerature:CONVersion:STATe? query returns to the current state of the temperature conversion function.

Command syntax:

:TEMPerature: CONVersion:STATe <ON(1) or OFF(0)>

For example: WrtCmd(":TEMPerature:Conversion: :DELTA:STATe ON"); Set the instrument temperature conversion function as "ON".

NOTE: Turning the temperature conversion function on will stop the temperature correction function!

Query Syntax: :TEMPerature:CONVersion:DELTA:STATe?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the temperature conversion function of the instrument is "ON".

0: the temperature conversion function of the instrument is "OFF".

The :TEMPerature:CONVersion:DELTA:PARAmeter command sets the "initial resistance", "initial temperature" and "constant k" of the instrument temperature conversion function.

The :TEMPerature:CONVersion:DELTA:PARAmeter? query returns to the current "initial resistance", "initial temperature" and "constant k".

Command syntax:

:TEMPerature:CONVersion:DELTA:PARAmeter<Initial resistance>,<Initial temperature>,<Constant>

Where, < Initial resistance> = 0 to 110.000E+6(NR3) means "initial resistance", unit: Ω

< Initial temperature> = -10.0 to 99.9(NR2) means "initial temperature", unit: °C

< Constant > = -999.9 to 999.9(NR2) means "constant k", unit: °C

For example: WrtCmd(":TEMP:CON:DELTA:PAR 100,20,235"); Set the instrument "initial resistance", "initial temperature" and "constant k" as 100Ω, 20°C and 235°C respectively.

Query Syntax: :TEMPerature:CORRect:STATe:PARAmeter?

Return format: <Initial resistance>,<Initial temperature>,<Constant><NL^END>

Where, the format and unit of <Initial resistance>,<Initial temperature>,<Constant> are the same

as above.

The :TEMPerature:SENSor command sets the input mode selection of the instrument temperature sensor.

The :TEMPerature:SENSor? query returns to the current input mode of the temperature sensor.

Command syntax:

:TEMPerature:SENSor <PT or ANALog>

Where, PT : Using PT500 as the input signal of the temperature sensor

ANALog: Using analog voltage signal as the input signal of the temperature sensor

Query Syntax: :TEMPerature:SENSor?

Return format: < PT or ANAL ><NL^END>

The :TEMPerature:PARAmeter command sets the parameter setting when using analog voltage signal as the input signal of the temperature sensor.

The :TEMPerature:PARAmeter? query returns to the current parameter setting.

Query Syntax:

:TEMPerature:PARAmeter <V1>,<T1>,<V2>,<T2>

Where, <V1> = 0 to 2.00 (NR2) means "reference voltage1", unit: V

<T1> = -99.9 to 999.9 (NR2) means "reference temperature1", unit: °C

<V2> = 0 to 2.00 (NR2) means "reference voltage2", unit: V

<T2> = -99.9 to 999.9 (NR2) means "reference temperature2", unit: °C

For example: WrtCmd(":TEMP: PAR 0,0,1,500"); Set the "reference voltage1", "reference temperature1", "reference voltage2" and "reference temperature2" of the instrument as 0V, 0°C, 1V and 500°C respectively.

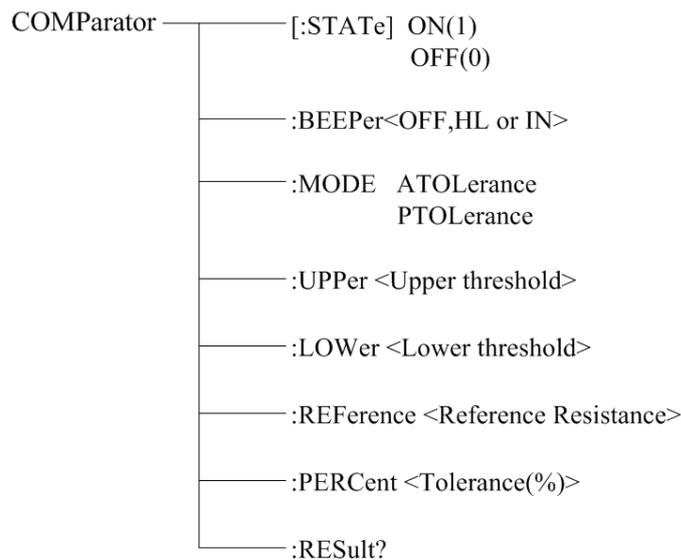
Query Syntax: :TEMPerature:PARAmeter?

Return format: the format and unit of <V1>,<T1>,<V2>,<T2><NL^END> are the same as above.

7.1.7 COMParator Subsystem Commands

COMParator subsystem commands are used to set the compare function of the instrument, including the setup of comparator switch, beeper mode, limit mode and other compare parameters.

Command Tree:



The :COMParator[:STATe] command sets the status of instrument comparator function.

The :COMParator[:STATe]? query returns to the current comparator state.

Command syntax:

```
:COMParator[:STATe] <ON(1) or OFF(0)>
```

For example, WrtCmd(":COMP:STAT ON"); Set the comparator function of the instrument as "ON".

Query Syntax: :COMParator:STATe?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the current comparator function of the instrument is "ON"

0: the current comparator function of the instrument is "OFF"

The :COMParator:BEEPer command sets the comparator beeper mode of the instrument.

The :COMParator:BEEPer? query returns to the current beeper mode.

Command syntax:

```
:COMParator:BEEPer <OFF, HL or IN>
```

Where, OFF: the comparator beeper function is "OFF"

HL : it beeps when the comparative result is not qualified

IN : it beeps when the comparative result is qualified

For example, WrtCmd(":COMP:BEEP IN"); Set the comparator beeper mode as IN.

Query Syntax: :COMParator:BEEPer?

Return format: <OFF, HL or IN><NL^END>

The :COMParator:MODE command sets the comparator limit mode of the instrument.

The :COMParator:MODE? query returns to the current limit mode.

Command syntax:

COMParator:MODE < ATOLerance or PTOLerance >

Where, ATOLerance: set the limit mode of the instrument as absolute tolerance mode

PTOLerance: set the limit mode of the instrument as proportional tolerance mode

For example, WrtCmd("COMP:MODE ATOL"); Set the limit mode of the instrument as absolute tolerance mode.

Query Syntax: COMParator:MODE?

Return format: <ATOL or PTOL><NL^END>

The :COMParator:UPPer command sets the upper threshold of the instrument comparator function.

The :COMParator:UPPer? query returns to the current upper threshold.

Command syntax:

COMParator:UPPer < Upper threshold >

Where,

< Upper threshold > = 0 to 110E+6 (NR3) the upper threshold of the comparator function unit: "Ω"

For example, WrtCmd("COMP:UPP 2000"); Set the the upper threshold of the instrument comparator function as 2000Ω.

NOTE: The upper threshold must be greater than or equal to the lower threshold.

Query Syntax: COMParator:UPPer?

Return format: the format and unit of < Upper threshold ><NL^END> are the same as above.

The :COMParator:LOWer command sets the lower threshold of the instrument comparator function.

The :COMParator:LOWer? query returns to the current lower threshold.

Command syntax:

COMParator:LOWer< Lower threshold >

Where,

< Lower threshold > = 0 to 110E+6 (NR3) the lower threshold of the comparator function unit: "Ω"

For example: WrtCmd("COMP:LOW 1800"); Set the the lower threshold of the instrument comparator function as 1800Ω.

NOTE: The lower threshold must be less than or equal to the upper threshold.

Query Syntax: COMParator:LOWer?

Return format: the format and unit of < Lower threshold ><NL^END> are the same as above.

The :COMParator:REFerence command sets the reference resistance of the instrument comparator function.

The :COMParator:REFerence? query returns to the current reference resistance.

Command syntax:

COMParator:REFerence<Reference Resistance>

Where,

< Reference Resistance > = 0 to 110E+6 (NR3) the reference resistance of the comparator function unit: "Ω"

For example: WrtCmd("COMP:REF 20E+3"); Set the reference resistance of the instrument comparator function as 20kΩ.

Query Syntax: COMPArator: REFerence?

Return format: the format and unit of < Reference Resistance ><NL^END> are the same as above.

The :COMPArator:PERCent command sets the tolerance of the instrument comparator function.

The :COMPArator:PERCent? query returns to the current tolerance.

Command syntax:

COMPArator:PERCent<Tolerance(%)>

Where, < Tolerance(%)> = 0 to 99.999 (NR2) the tolerance of the comparator function unit: "%"

For example: WrtCmd("COMP:PERC 10"); Set the tolerance of the instrument comparator function as 10%.

Query Syntax: COMPArator: PERCent?

Return format: the format and unit of < Tolerance(%)><NL^END> are the same as above.

The :COMPArator:RESult command queries the last comparator result of the instrument.

Query Syntax: COMPArator: RESult?

Return format: < HI, IN, LO, OFF or ERR> <NL^END>

Where,

HI: it indicates that the measurement result is greater than the upper boundary of the comparator

IN: it indicates that the measurement result is between the upper and lower boundary of the comparator

LO: it indicates that the measurement result is less than the lower boundary of the instrument

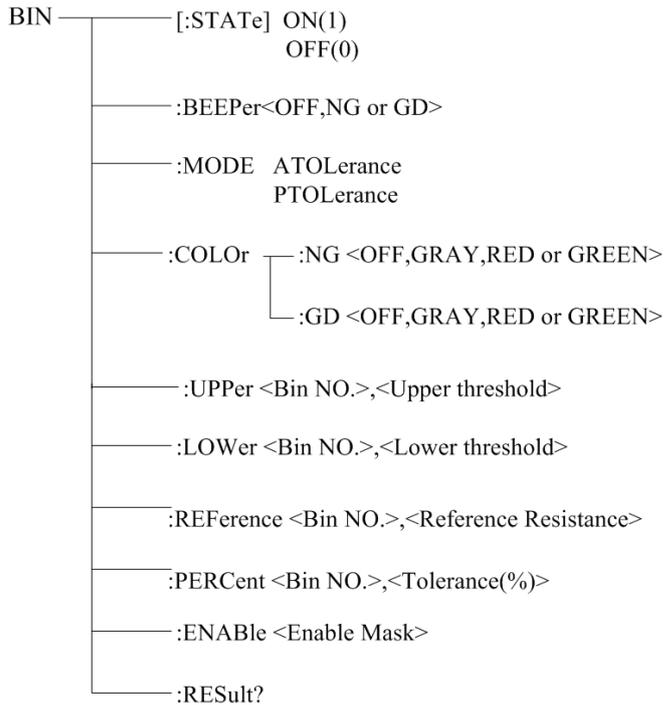
OFF: it indicates that the comparator function is "OFF"

ERR: it indicates that the comparator function is "ON", but there exists the measurement error.

7.1.8 BIN Subsystem Commands

BIN subsystem commands sets the bin comparator function of the instrument, including bin status switch, beeper mode, limit mode, enable mask and other bin parameters.

Command Tree:



The `:BIN[:STATe]` command sets the state of the instrument comparator.

The `:BIN[:STATe]?` query returns to the current state of the bin comparator.

Command syntax:

`:BIN[:STATe] <ON(1) or OFF(0)>`

For example: `WrtCmd(":BIN:STAT ON");` Set the bin comparator function as "ON".

Query Syntax: `:BIN:STATe?`

Return format: `<NR1><NL^END>`

`<NR1> = 1 or 0`

1: the current bin comparator function of the instrument is "ON"

0: the current bin comparator function of the instrument is "OFF"

The `:BIN:BEEPer` command sets the beeper mode of the instrument bin comparator.

The `:BIN:BEEPer?` query returns to the current bin beeper mode.

Command syntax:

`:BIN:BEEPer <OFF, NG or GD>`

Where, OFF: the bin beeper is "OFF"

NG : it beeps when one or more bin comparator results are not qualified

GD : it beeps when all the bin comparator results are qualified

For example: `WrtCmd(":BIN:BEEP GD");` Set the comparator beeper mode as GD.

Query Syntax: `BIN:BEEPer?`

Return format: `<OFF, NG or GD><NL^END>`

The `:BIN:MODE` command sets the limit mode of the instrument bin comparator function.

The `:BIN:MODE>?` query returns to the current limit mode.

Command syntax:

BIN:MODE < ATOLerance or PTOLerance >

Where, ATOLerance: set the bin limit mode as absolute tolerance mode

PTOLerance: set the bin limit mode as proportional tolerance mode

For example: WrtCmd("BIN:MODE ATOL"); Set the bin limit mode as absolute tolerance mode.

Query Syntax: BIN:MODE?

Return format: <ATOL or PTOL><NL^END>

The :BIN:COLOr:NG command sets the color of the display mark when the bin comparator result is "NG".

The :BIN:COLOr:NG? query returns to the color of the display mark when the bin comparator result is "NG".

Command syntax:

BIN:COLOr:NG <OFF, GRAY, RED or GREEN>

Where,

OFF: when the bin comparator result is "NG", no result mark will be displayed

GRAY: when the bin comparator result is "NG", set the color of the result mark as GRAY

RED: when the bin comparator result is "NG", set the color of the result mark as RED

GREEN: when the bin comparator result is "NG", set the color of the result mark as GREEN

For example: WrtCmd("BIN:COLOr:NG GRAY"); Set the color of the result mark as GRAY when the bin comparator result is "NG".

Query Syntax: BIN:COLOr:NG?

Return format: <OFF, GRAY, RED or GREEN><NL^END>

The :BIN:COLOr:GD command sets the color of the display mark when the bin comparator result is "GD".

The :BIN:COLOr:GD? query returns to the color of the display mark when the bin comparator result is "GD".

Command syntax:

BIN:COLOr:GD <OFF, GRAY, RED or GREEN>

Where,

OFF: when the bin comparator result is "GD", no result mark will be displayed

GRAY: when the bin comparator result is "GD", set the color of the result mark as GRAY

RED: when the bin comparator result is "GD", set the color of the result mark as RED

GREEN: when the bin comparator result is "GD", set the color of the result mark as GREEN

For example: WrtCmd("BIN:COLOr:GD RED"); Set the color of the result mark as RED when the

bin comparator result is "GD".

Query Syntax: BIN:COLOr:GD?

Return format: <OFF, GRAY, RED or GREEN><NL^END>

The :BIN:UPPer command sets the upper threshold of the instrument specific bin.

The :BIN:UPPer? query returns to the upper threshold of the specific bin.

Command syntax:

BIN:UPPer <Bin NO.>,< Upper threshold >

Where, <Bin NO.> = 0 to 9(NR1) specified bin no., namely specific bin

< Upper threshold > = 0 to 110E+6 (NR3) the upper threshold of the specific bin
unit: "Ω"

For example: WrtCmd("BIN:UPP 1,2000"); Set the upper threshold of bin 1 as 2000Ω.

NOTE: The upper threshold of the same bin should be greater than or equal to the lower threshold!

Query Syntax: BIN:UPPer?<Bin NO.>

Return format: the format and unit of < Upper threshold ><NL^END> are the same as above.

Note: If the upper threshold does not exist, the returned value is "+9.90000E+37"

The : BIN:LOWer command sets the lower threshold of the instrument specific bin.

The : BIN:LOWer? query returns to the lower threshold of the specific bin.

Command syntax:

BIN: LOWer <Bin NO.>,< Lower threshold >

Where, <Bin NO.> = 0 to 9(NR1) specified bin no., namely specific bin

< Lower threshold > = 0 to 110E+6 (NR3) the lower threshold of the specific bin
unit: "Ω"

For example: WrtCmd("BIN:LOW 1,1800"); Set the lower threshold of bin 1 as 1800Ω.

NOTE: The lower threshold of the same bin should be less than or equal to the upper threshold!

Query Syntax: BIN:LOWer?<Bin NO.>

Return format: the format and unit of < Lower threshold ><NL^END> are the same as above.

Note: If the lower threshold does not exist, the returned value is "+9.90000E+37"

The : BIN:REFErrence command sets the reference resistance of the instrument specific bin.

The : BIN:REFErrence? query returns to the current reference resistance of the specific bin.

Command syntax:

BIN: REFErrence <Bin NO.>,<Reference Resistance>

Where,

<Bin NO.> = 0 to 9(NR1) specified bin no., namely specific bin

< Reference Resistance > = 0 to 110E+6 (NR3) the reference resistance of the
specific bin unit: "Ω"

For example: WrtCmd("BIN:REF 1,20E+3"); Set the reference resistance of bin 1 as 20kΩ.

Query Syntax: BIN: REFerence?<Bin NO.>

Return format: the format and unit of < Reference Resistance ><NL^END> are the same as above.

Note: If the reference resistance does not exist, the returned value is "+9.90000E+37"

The : BIN:PERCent command sets the tolerance of the instrument specific bin.

The : BIN:PERCent? query returns to the current tolerance of the specific bin.

Command syntax:

BIN:PERCent <Bin NO.>,<Tolerance(%)>

Where,

<Bin NO.> = 0 to 9(NR1) specified bin no., namely specific bin

< Tolerance(%)> = 0 to 99.999 (NR2) the tolerance of the specific bin
unit: "%"

For example: WrtCmd("BIN:PERC 1,10"); Set the tolerance of bin 1 as 10%.

Query Syntax: BIN: PERCent?<Bin NO.>

Return format: the format and unit of < Tolerance(%)> <NL^END> are the same as above.

Note: If the tolerance does not exist, the returned value is "+9.90000E+37"

The : BIN:ENABle command sets the enable mask of the bin function.

The : BIN:ENABle? query returns to the current enable number of the bin function.

Command syntax:

BIN: ENABle <Enable Mask>

Where,

<Enable Mask> = 0 to 1023(NR1) enable mask (decimal system)

Transfer some bit to 1, namely hold the corresponding bin enable

Bit No.	9	8	7	6	5	4	3	2	1	0
BIN NO.	BIN9	BIN8	BIN7	BIN6	BIN5	BIN4	BIN3	BIN2	BIN1	BIN0

For example: WrtCmd("BIN:ENAB 15"); Set the enable mask from BIN0 to BIN3.

Query Syntax: BIN:ENABle?

Return format: the format and unit of < Enable Mask ><NL^END> are the same as above.

The :BIN:RESult command queries the last bin comparator result of the instrument.

Query Syntax: BIN:RESult?

Return format: < NR1> <NL^END>

Where,

< NR1> = 0 to 1023

When the judging result of some bin is "GD", transfer the corresponding bit to 1

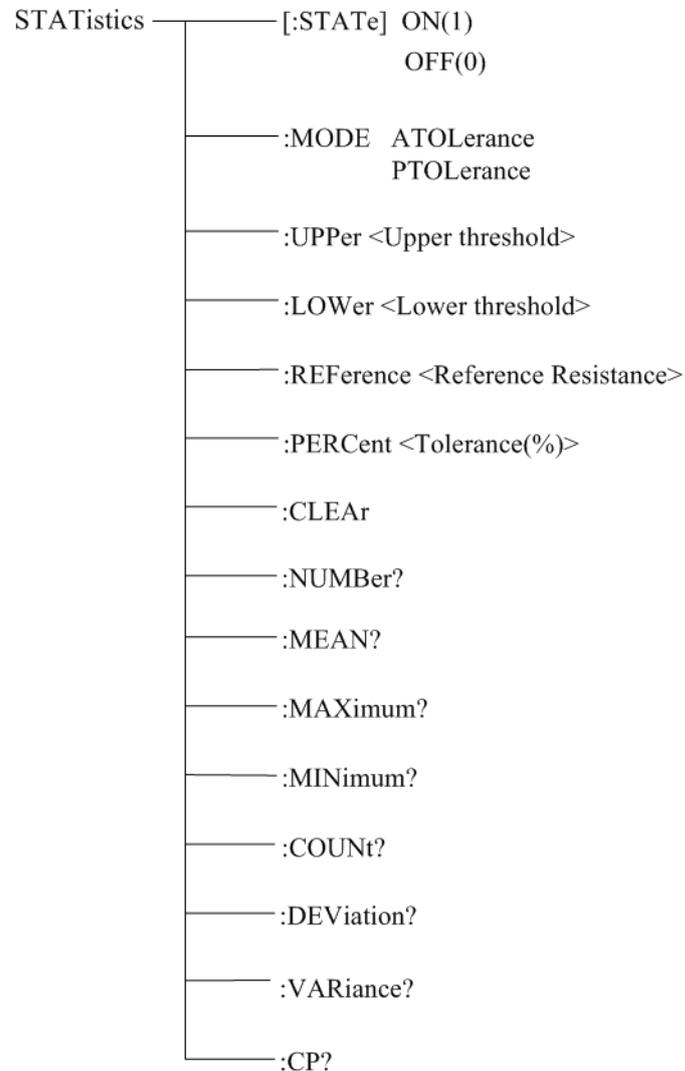
Bin Number	9	8	7	6	5	4	3	2	1	0
BIN NO.	BIN9	BIN8	BIN7	BIN6	BIN5	BIN4	BIN3	BIN2	BIN1	BIN0

For example: when < NR1> = 128, only the judging result of BIN7 is "GD'.

7.1.9 STATistics Subsystem Commands

Statistics subsystem commands are used to set the statistics function of the instrument, including statistics state switch, statistics limit, limit mode and statistics data clear.

Command Tree:



The `:STATistic [:STATe]` command sets the statistics state of the instrument.

The `:STATistic [:STATe]?` query returns to the current statistics state.

Command syntax:

```
: STATistics [:STATe] <ON(1) or OFF(0)>
```

For example: `WrtCmd(":STAT:STAT ON");` Set the statistics function as "ON".

Query Syntax: `: STATistics[:STATe]?`

Return format: `<NR1><NL^END>`

`<NR1> = 1 or 0`

1: the current statistics function of the instrument is "ON"

0: the current statistics function of the instrument is "OFF"

The `:STATistics:MODE` command sets the limit mode of the instrument statistics function.

The :STATistics:MODE? query returns to the current limit mode.

Command syntax:

STATistics:MODE < ATOLerance or PTOLerance >

Where, ATOLerance: set the limit mode of the instrument statistics function as absolute tolerance mode

PTOLerance: set the limit mode of the instrument statistics function as proportional tolerance mode

For example: WrtCmd("STAT:MODE ATOL"); Set the limit mode of the instrument as absolute tolerance mode.

NOTE: If the statistics function of the instrument is "ON", ignore this command!

Query Syntax: STATistics:MODE?

Return format: <ATOL or PTOL><NL^END>

The :STATistics:UPPer command sets the upper threshold of the instrument statistics function.

The :STATistics:UPPer? query returns to the current upper threshold.

Command syntax:

STATistics:UPPer < Upper threshold >

Where,

< Upper threshold > = 0 to 110E+6 (NR3) the upper threshold of the statistics function unit: "Ω"

For example: WrtCmd("COMP:UPP 200"); Set the upper threshold of the statistics function as 200Ω.

**NOTE: The upper threshold should be greater than or equal to the lower threshold!
If the statistics function of the instrument is "ON", ignore this command!**

Query Syntax: STATistics:UPPer?

Return format: the format and unit of < Upper threshold ><NL^END> are the same as above.

The :STATistics:LOWer command sets the lower threshold of the instrument statistics function.

The :STATistics:LOWer? query returns to the current lower threshold.

Command syntax:

STATistics: LOWer< Lower threshold >

Where,

< Lower threshold > = 0 to 110E+6 (NR3) the lower threshold of the statistics function unit: "Ω"

For example: WrtCmd("STAT:LOW 180"); Set the lower threshold of the statistics function as 180Ω.

**NOTE: The lower threshold should be less than or equal to the upper threshold!
If the statistics function of the instrument is "ON", ignore this command!**

Query Syntax: STATistics:LOWer?

Return format: the format and unit of < Lower threshold ><NL^END> are the same as above.

The :STATistics:REference command sets the reference resistance of the instrument statistics

function.

The :STATistics:REference? query returns to the current reference resistance.

Command syntax:

STATistics: REference<Reference Resistance>

Where,

< Reference Resistance > = 0 to 110E+6 (NR3) the reference resistance of the statistics function unit: "Ω"

For example: WrtCmd("STAT:REF 20E+3"); Set the reference resistance of the instrument statistics function as 20kΩ.

NOTE: If the statistics function of the instrument is "ON", ignore this command!

Query Syntax: STATistics: REference?

Return format: the format and unit of < Reference Resistance ><NL^END> are the same as above.

The :STATistics:PERCent command sets the tolerance of the instrument statistics function.

The :STATistics:PERCent? query returns to the tolerance.

Command syntax:

STATistics:PERCent<Tolerance(%)>

Where,

< Tolerance(%) > = 0 to 99.999 (NR2) the tolerance of the statistics function unit: "%"

For example: WrtCmd("STAT:PERC 10"); Set the tolerance of the instrument statistics function as 10%.

NOTE: If the statistics function of the instrument is "ON", ignore this command!

Query Syntax: STATistics:PERCent?

Return format: the format and unit of < Tolerance(%) ><NL^END> are the same as above.

The :STATistics:CLEAR command is used to clear the statistics results (all kinds of statistics).

NOTE: If the statistics function of the instrument is "ON", ignore this command!

The :STATistics:NUMBER command is used to query the statistics numbers of statistics results.

Query Syntax: :STATistics:NUMBER?

Return format: <Total statistics numbers (NR1), valid statistics numbers (NR1)>

For example: WrtCmd(":STAT:NUMB?")

Returned value: 1256, 1243

The : STATistics:MEAN command is used to query the mean of the statistics results.

Query Syntax: :STATistics:MEAN?

Return format: <Mean (NR3) >

NOTE: When the valid statistics numbers >= 1, it will returns to the valid value or "+9.90000E+37".

For example: WrtCmd(":STAT:MEAN?")

Returned value: 1.240E+01

The :STATistics:MAXimum command is used to query the maximum of the statistics results.

Query Syntax: :STATistics:MAXimum?

Return format: <Maximum (NR3), the corresponding data serial number of the maximum data (NR1)>

NOTE: When the valid statistics numbers ≥ 1 , it will returns to the valid value or "+9.90000E+37, 0".

For example: WrtCmd(":STAT:MAX?")

Returned value: 1.2450E+01, 5

The :STATistics:MINimum command is used to query the minimum of the statistics results.

Query Syntax: :STATistics:MINimum?

Return format: <Minimum (NR3), the corresponding data serial number of the minimum data (NR1)>

NOTE: When the valid statistics numbers ≥ 1 , it will returns to the valid value or "+9.90000E+37, 0".

For example: WrtCmd(":STAT:MIN?")

Returned value: 1.2350E+01, 8

The :STATistics:COUNT command is used to query the statistics compare results.

Query Syntax: :STATistics:COUNT?

Return format: <HI count (NR1)>, <IN count (NR1)>, < LO count (NR1)>, <measurement error count (NR1)>

For example: WrtCmd(":STAT:COUNT?")

Returned value: 12, 246, 78, 5

The :STATistics:DEVIation command is used to query the statistics standard deviation.

Query Syntax: :STATistics:DEVIation?

Return format: < σ (NR3)>

For example: WrtCmd(":STAT:DEV?")

Returned value: 0.0159E-3

The :STATistics:VARiance command is used to query the statistics sample variance.

Query Syntax: :STATistics:VARiance?

Return format: <sn (NR3)>

For example: WrtCmd(":STAT:VAR?")

Returned value: 0.0159E-3

The :STATistics:CP command is used to query the Process Capability Index (CP).

Query Syntax: :STATistics:CP?

Return format: <Cp (NR2)>, <Cpk (NR2)>

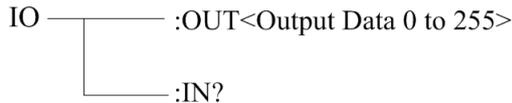
For example: WrtCmd(":STAT:CP?")

Returned value: 0.86, 0.14

7.1.10 IO Subsystem Commands

IO subsystem commands are used to output 8-bit binary data and input 2-bit binary data by handler port.

Command Tree:



The :IO:OUT command is used to output 8-bit binary data by Handler EXT I/O port.

Command syntax: :IO:OUT <output data>

Where, <output data> = 0 to 255

Data bit number	7	6	5	4	3	2	1	0
Output bit number	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0
Handler pin number	50	25	49	24	48	23	47	22

NOTE: This command is valid when the bin output is set as "BIN" mode, otherwise ignore this command!

For example: WrtCmd(":IO:OUT 15")

The :IO:IN command is used to read 2-bit binary data input by Handler EXT I/O port.

Bit number 0: RTIG pin of EXT I/O

Bit number 1: PRINT pin of EXT I/O

The data bit will transfer to 1 while the falling edge turns up on its corresponding pin and it will be cleared after having been read by this command.

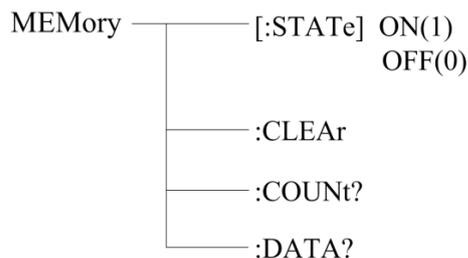
Command syntax: :IO:OUT?

Returned value: 0 to 3 (NR1)

7.1.11 MEMory Subsystem Commands

MEMory subsystem commands are used to save and load 20 measurement results.

Command tree:



The :MEMory[:STATe] command sets the save state of the instrument resistance measurement

results.

The :MEMory[:STATe]? query returns to the current save state.

Command syntax:

: MEMory [:STATe] <ON(1) or OFF(0)>

For example: WrtCmd(":MEM:STAT ON"); Set the save state of the instrument as "ON".

Query Syntax: : MEMory[:STATe]?

Return format: <NR1><NL^END>

<NR1> = 1 or 0

1: the current instrument save state is "ON"

0: the current instrument save state is "OFF"

The :MEMory:CLEAr command is used to clear the current resistance measurement results saved.

Command syntax:

: MEMory:CLEAr

For example: WrtCmd(":MEM:CLEAr"); namely clear the current measurement results saved.

The : MEMory:COUNT command is used to query the current count of resistance measurement results saved.

Query Syntax: :MEMory:COUNT?

Return format: <Memory data count>

<Memory data count> = 0 to 20(NR2)

NOTE: The new measurement result will not be saved once the count of measurement results saved has reached 20, only when the clear command ": MEMory:CLEAr" is executed!

The : MEMory:DATA command is used to query the current count of resistance measurement results saved.

Query Syntax: :MEMory:DATA?

Return format: <Memory no (NR1)>, <Measurement value (NR3)>

<Memory no (NR1)>, <Measurement value (NR3)>

<Memory no (NR1)>, <Measurement value (NR3)>

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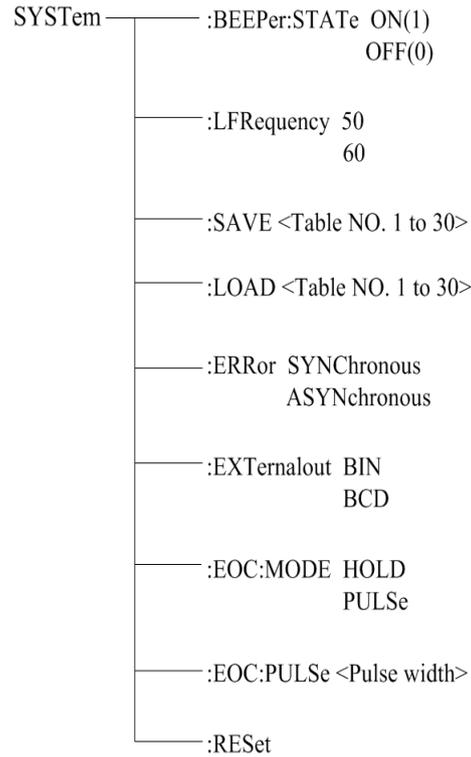
END

NOTE: This command has no returned value if there is no measurement result saved, it will only returns to "END"!

7.1.12 SYSTEM Subsystem Commands

SYSTEM subsystem commands are used to set the system function of the instrument, including the beeper switch, parameters save, output mode of measurement state error, parameter setting reset and so on.

Command tree:



The `:SYSTEM:BEEPer:STATe` command sets the beeper switch state of the instrument.

The `:SYSTEM:BEEPer:STATe?` query returns to the current beeper state.

Command syntax:

```
:SYSTEM:BEEPer:STATe <ON(1) or OFF(0)>
```

For example: `WrtCmd(":SYST:BEEP:STAT ON");` Set the save state of the instrument as "ON".

Query Syntax: `:SYST:BEEP:STAT?`

Return format: `<NR1><NL^END>`

`<NR1> = 1 or 0`

1: the current beeper state of the instrument is "ON"

0: the current beeper state of the instrument is "OFF"

The `:SYSTEM:LFRequency` command sets the line frequency of the instrument.

The `:SYSTEM:LFRequency?` query returns to the current line frequency.

Command syntax:

```
:SYSTEM:LFRequency <50 or 60>
```

For example: `WrtCmd(":SYST:LFR 50");` Set the line frequency of the instrument as 50 Hz.

Query Syntax: `:SYST:LFRequency?`

Return format: `<NR1><NL^END>`

`<NR1> = 50 or 60`

50: the current line frequency of the instrument is "50Hz"

60: the current line frequency of the instrument is "60Hz"

The `:SYSTEM:SAVE` command is used to save the current parameter setting.

Command syntax:

:SYSTem:SAVE <Table NO.1 to 30>, <File name>

Where,

<Table NO.1 to 30> = 1 to 30 (NR1), the serial number of file to be saved

<File name> the filename to be saved (no need with suffix.STA, the length of the file name should be no more than 15 characters)

For example: WrtCmd(":SYST:SAVE 9 filename"); Save the current parameter setting of the instrument to No.9 file and set the name of the file as "filename".

The :SYSTem:LOAD command is used to load the parameter setting file saved.

Command syntax:

:SYSTem:LOAD <Table NO.1 to 30>

Where,

<Table NO.1 to 30> = 1 to 30 (NR1) the serial number of file saved

For example: WrtCmd(":SYST:LOAD 9"); load No.9 file of parameter setting file saved.

NOTE: The file to be loaded must have been saved, otherwise ignore this command!

The :SYSTem:ERRor command sets the output mode of the instrument measurement state error.

The :SYSTem:ERRor? query returns to the current output mode of the measurement state error.

Command syntax:

:SYSTem:ERRor SYNChronous
ASYNchronous

Where, SYNChronous: set the output mode of the measurement state error as "synchronous"

ASYNchronous: set the output mode of the measurement state error as "asynchronous"

For example: WrtCmd(":SYST:ERR SYNC"); Set the output mode of the measurement state error as "synchronous".

Query Syntax: :SYSTem:ERRor?

Return format: <SYNC or ASYN ><NL^END>

SYNC: the current output mode of the measurement state error is "synchronous"

ASYN: the current output mode of the measurement state error is "asynchronous"

The :SYSTem:EXTernalout command sets the bin output mode of the instrument.

The :SYSTem:EXTernalout? query returns to the current bin output mode.

Command syntax:

:SYSTem:EXTernalout BIN
BCD

Where,

BIN: set the output of EXT I/O as "bin comparator results"

BCD: set the output of EXT I/O as "BCD code of the measurement results"

For example: WrtCmd(":SYST:EXT BIN"); Set the output of EXT I/O as "bin comparator results".

Query Syntax: :SYSTem:EXTernalout?

Return format: < BIN or BCD ><NL^END>

BIN: the current output of EXT I/O is “bin comparator results”

BCD: the current output of EXT I/O is “BCD code of the measurement results”

The :SYSTem:EOC:MODE command sets the EOC output mode of the instrument.

The :SYSTem:EOC:MODE? query returns to the current EOC output mode.

Command syntax:

```
:SYSTem:EOC:MODE HOLD
PULSe
```

Where,

HOLD: set the EOC output mode as “HOLD”

PULSe: set the EOC output mode as “PULSe”

For example: WrtCmd(“:SYST:EOC:MODE HOLD”); Set the EOC output mode as “HOLD”.

Query Syntax: :SYSTem:EOC:MODE?

Return format: < HOLD 或 PULS ><NL^END>

HOLD: the current EOC output mode is “HOLD”

PULS: the current EOC output mode is “PLUSe”

The :SYSTem:EOC:PULSe command sets the pulse width when the EOC output mode is “PULSe”.

The :SYSTem:EOC:PULSe? query returns to the current pulse width.

Command syntax:

```
:SYSTem:EOC:PULSe <Pulse width>
```

Where,

<Pulse width> = 0.001 to 0.100(NR2) unit: second(s)

For example: WrtCmd(“:SYSTem:EOC:PULS 0.02”); Set the pulse width as 0.02 seconds.

Query Syntax: :SYSTem:EOC:PULSe?

Return format: the format and unit of < Pulse width ><NL^END> are the same as above.

The :SYSTem:RESet command is used to reset the parameter setting to factory default.

Command syntax:

```
:SYSTem:RESet
```

For example: WrtCmd(“:SYSTem:RES”); namely finish the parameter reset of the instrument.

7.1.13 GPIB Common Commands

- *RST ● *TRG ● *IDN ● *TST
- *ESE ● *SRE ● *ESR ● *STB
- *OPC ● *CLS

- The *RST command resets the instrument.

Command syntax: *RST

For example: WrtCmd(“*RST”);

- The *TRG command triggers the measurement and then sends the result to the output buffer.

Command syntax: *TRG

For example: WrtCmd(“*TRG”);

NOTE: “*trg” will be valid when :INIT:CONT ON and trig:sour bus commands are enabled.

- The *CLS command clears the standard event status register and the service request status register.

Command syntax: *CLS

For example: WrtCmd(“*CLS”);

- The *IDN? query returns TH2515’s identification string.

Query syntax: *IDN?

Return format: <manufacturer>,<model>,<firmware><NL^END>

Where,

<manufacturer> Name of Manufacturer (Tonghui)

<model> Instrument Model (TH2515)

<firmware> Firmware Version (VER2.3.7)

For example: WrtCmd(“*IDN?”);

- The *TST? query executes an internal self test and returns the test result as the sum of all existing errors codes. If there are no error TH2515 returns 0.

Query syntax: *TST?

Return format: 0<NL^END>

Where,

0 0 (NR1 format)

For example: WrtCmd(“*TST?”);

- The *ESE (standard Event Status Enable command) command sets each open bit of the standard event status register. This command returns setups of each open bit for the standard event status permission register.

Command syntax: *ESE<value>

Where,

<value> NR1 format: decimal expression for each bit of operation status register.

Descriptions for each byte of the standard event status register are shown as follows:

Bit number	Description
7	Power On(PON) Bit
6	User Request(URQ) Bit
5	Command Error(EME) Bit
4	Execution Error(EXE) Bit
3	Device Dependent Error(DDE) Bit
2	Query Error(QYE) Bit
1	Request Control(RQC) Bit
0	Operation Complete(OPC) Bit

Query syntax: *ESE?

Return format: <value><NL^END>

For example: WrtCmd(“*ESE?”);

- The *SRE (Service Request Enable command) command sets each open bit of the service status byte register. This command returns the current setups for each open bit of the status byte permission register.

Command syntax: *SRE<value>

Where,

<value> NR1 format: decimal expression for each permission bit of the status byte register.

Descriptions for each byte of the status byte register are shown as follows:

Bit number	Description
7	Operation Status Register Summary Bit
6	RQS(Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV(Message Available) Bit
3-0	Always 0(zero):

Query syntax: *SRE?

Return format: <value><NL^END>

For example: WrtCmd(“*SRE?”);

- The *ESR? query returns the contents of the standard event status register.

Query syntax: *ESR?

Return format: <value><NL^END>

Where,

<value> NR1 format: decimal expression for contents of the standard event status register.

Descriptions for each bit of the standard event status register are shown as follows:

Bit number	Description
7	Power On(PON) Bit
6	User Request(URQ) Bit
5	Command Error(EME) Bit
4	Execution Error(EXE) Bit
3	Device Dependent Error(DDE) Bit
2	Query Error(QYE) Bit
1	Request Control(RQC) Bit
0	Operation Complete(OPC) Bit

For example: WrtCmd(“*ESR?”);

- The *STB? query returns contents of the standard service status byte register. The execution of this command will not affect contents of the standard status byte register.

Query syntax: *STB?

Return format: <value><NL^END>

Where,

<value> NR1 format: decimal expression for contents of the standard status byte register.

Descriptions for each bit of the standard status byte register are shown as follows:

Bit number	Description
7	Operation Status Register Summary Bit
6	RQS(Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV(Message Available) Bit
3-0	Always 0(zero)

For example: `WrtCmd("**STB?");`

- The *OPC command equals to set the OPC bit of the standard event status register when TH2515 finishes all parameter measurements. Ever since all pending operations have been completed, this command will inform the instrument to add a ASCII number "1" (decimal number: 49) into the output buffer.

Command syntax: *OPC

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

Query syntax: *OPC?

Return format: 1 <NL^END>

Where,

0 ASCII number 1 (decimal number: 49)

For example: `WrtCmd("**OPC?")`

8) Handler Interface

TH2515 DC Resistance Meter equips with a Handler interface which is mainly used to output the sorting result. When the instrument is applied to an automatic component sorting test system, this interface will output the handshake signal and the sorting result output signal. The sorting result output corresponds to the comparison result output of the current comparator bin.

Terminals and Their Descriptions:

Pin	I/O	Signal name	Pin	I/O	Signal name
1	IN	$\overline{\text{LOAD0}}$	26	IN	$\overline{\text{LOAD1}}$
2	IN	$\overline{\text{LOAD2}}$	27	IN	$\overline{\text{LOAD3}}$
3	IN	$\overline{\text{LOAD4}}$	28	IN	$\overline{\text{OAJ}}$
4	IN	$\overline{\text{TRIG(IN0)}}$	29	IN	$\overline{\text{CAL}}$
5	----	Unused	30		COM
6		COM	31		COM
7		INT.GND	32		INT.GND
8		INT.VCC	33		INT.VCC
9		INT.VCC	34		EXTV
10		EXTV	35		EXTV
11	OUT	ERR	36	OUT	INDEX
12	OUT	EOC	37	OUT	Hi
13	OUT	IN	38	OUT	Lo
14	OUT	BIN0(BCD1-0)	39	OUT	BIN1(BCD1-1)
15	OUT	BIN2(BCD1-2)	40	OUT	BIN3(BCD1-3)
16	OUT	BIN4(BCD2-0)	41	OUT	BIN5(BCD2-1)
17	OUT	BIN6(BCD2-2)	42	OUT	BIN7(BCD2-3)
18	OUT	BIN8(BCD3-0)	43	OUT	BIN9(BCD3-1)
19	OUT	OB (BCD3-2)	44	OUT	(BCD3-3)
20	OUT	(BCD4-0)	45	OUT	(BCD4-1)
21	OUT	(BCD4-2)	46	OUT	(BCD4-3)
22	OUT	OUT0(BCD5-0)	47	OUT	OUT1(BCD5-1)
23	OUT	OUT2(BCD5-2)	48	OUT	OUT3(BCD5-3)
24	OUT	OUT4(BCD6-0)	49	OUT	OUT5(BCD6-1)
25	OUT	OUT6(BCD6-2)	50	OUT	OUT7(BCD6-3)

Here, OB is short for Out of BINS (this value of DUT is not among the range of the bin setup)

Input Signal

$\overline{\text{LOAD0}}$ to $\overline{\text{LOAD4}}$ is used to load the internal files. It can load 30 kinds of files in all and the saved file is parameter file. $\overline{\text{LOAD0}}$ is low-order, while $\overline{\text{LOAD4}}$ is high-order.

$\overline{\text{LOAD4}}$	$\overline{\text{LOAD3}}$	$\overline{\text{LOAD2}}$	$\overline{\text{LOAD1}}$	$\overline{\text{LOAD0}}$	File Number
0	0	0	0	0	*
0	0	0	0	1	30
0	0	0	1	0	29
0	0	0	1	1	28
0	0	1	0	0	27
0	0	1	0	1	26
0	0	1	1	0	25
0	0	1	1	1	24
0	1	0	0	0	23
0	1	0	0	1	22
0	1	0	1	0	21
0	1	0	1	1	20
0	1	1	0	0	19
0	1	1	0	1	18
0	1	1	1	0	17
0	1	1	1	1	16
1	0	0	0	0	15
1	0	0	0	1	14
1	0	0	1	0	13
1	0	0	1	1	12
1	0	1	0	0	11
1	0	1	0	1	10
1	0	1	1	0	9
1	0	1	1	1	8
1	1	0	0	0	7
1	1	0	0	1	6
1	1	0	1	0	5
1	1	0	1	1	4
1	1	1	0	0	3
1	1	1	0	1	2
1	1	1	1	0	1
1	1	1	1	1	*

NOTE: The file load could not be controlled through RS232 or GPIB

$\overline{\text{TRIG}}$: When the trigger of the measurement is external trigger, it will take one measurement

while this signal transferred from high to low.

- (1) This signal will be ignored if the trigger of the measurement is internal trigger.
- (2) This signal will be ignored when it is not measurement interface.
- (3) This signal will be ignored while loading the file.

0ADJ: It will executes one 0 calibration when the signal transferred from high to low.

CAL : It will execute one self-calibration when the signal transferred from high to low.

Output Signal

ERR: error signal output is divided into synchronous measurement error signal output and asynchronous measurement error signal output. The measurement error signal is outputted together with EOC as synchronous error signal output, not asynchronous error signal output.

INDEX: when this signal transferred from low to high, it indicates that the measurement of the instrument has been finished and it will calculate the resistance of the DUT.

EOC: the end signal of measurement conversion.

Hi, IN, Lo: the comparator results

BIN0 to BIN9,

OB (out of bins): if the value of the DUT conforms to the bin value required as set, the corresponding bin no. will be outputted. If not satisfied, the signal of OB will be outputted.

OUT0 to OUT7: this signal is controlled by :IO:OUT command. For example: IO: OUT 3, OUT0:OUT1=11(two digits is high level). This control signal can be used to control the movement of some relays or switches.

BCD1-0 to BCD6-3: it means the value of the DUT. For example, if the tested resistance is 498.992, where, BCDx-0 is low-order, while BCDx-3 is high-order. If x is 4, BCD4-0 : BCD4-3 indicates value 8. Here, using binary system to represent decimalism, so binary system needs four digits.

Power supply and Ground

COM: external power supply EXT.V reference ground

EXT.V: external power supply(+5 ~ +24V)

INT.GND: internal ground

INT.VCC: internal voltage

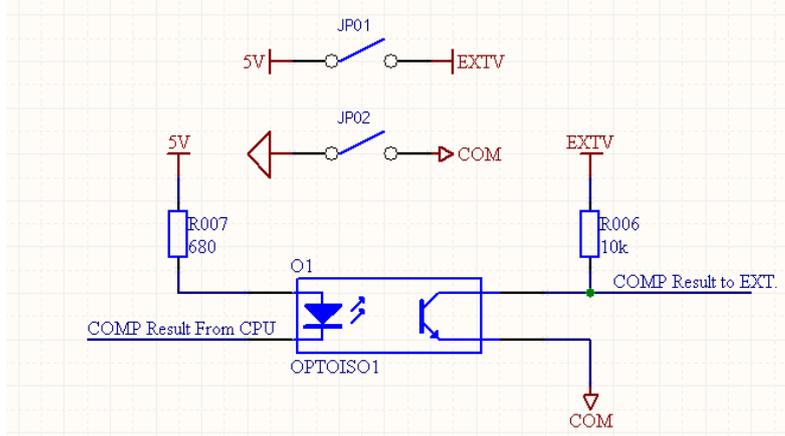
NOTE: when using **internal** power supply, COM and INT.GND short connection, EXT.V and INT.VCC short connection. When using external power supply, short connection is forbidden.

Electrical Characteristics

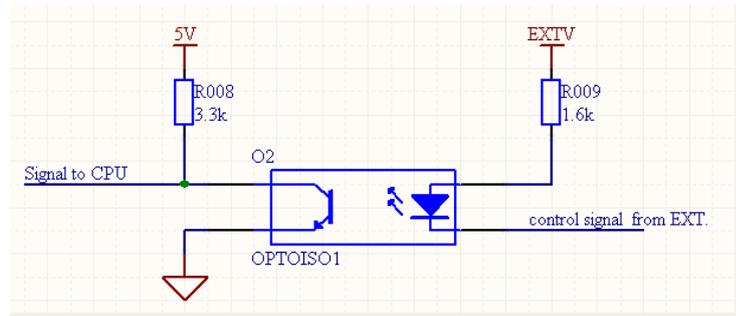
DC isolated output

Each output signal is output and isolated by a photoelectric coupler. The output voltage of each line is determined by the connection between a pull-up resistor and an externally applied voltage (EXTV).

Comparator result output circuit is shown as follows:



External control signal input circuit is shown as follows:



Program upgrading method:

- (1) Plug in the U disk and turn on the machine. Press the FILE key on the front panel to enter the file management interface.
- (2) After entering the file management interface, there will be Internal File, External File, Update File items.
- (3) Select the Update File to enter into the update file interface, you will see the appropriate update file names (the update file name of TH2515 is 2515_001), press "Ok" to confirm the upgrade.
- (4) After updating, the machine will automatically restart, which means the success of the update.

9) Package Contents and Warranty

9.1 Package Contents

Following items should be contained in the package.

Serial Number	Name	Quantity
1	TH2515 DC Resistance Meter	1
2	TH26050 4-terminal test cable	1
3	PT500	1
4	Three-Wire power line	1
5	Operation Manual	1
6	Manufacturer Certificate	1
7	Fuse of 2A	2
8	Test Report	1
9	Warranty Card	1

Verify that you have received all above items and any optional accessories you may have ordered. If anyone is missing, please contact our company or operating division without delay.

NOTE: IEEE-488 interface is optional component and it is sold separately.

9.2 Marks

The following marks can be seen on each instrument panel and nameplate:

- a. Manufacturer name and trademark
- b. Product name and model
- c. Product number and date
- d. the License for Manufacturing Measurement Instruments and its number
- e. Marks for test terminal

9.3 Package

The instrument, generally wrapped in a plastic bag, should be packed in a strong packing box that could resist dust, vibration and moisture. Accessories, spare parts, operation manual and

manufacturer certificates, etc. should also be included in it.

9.4 Shipping

In the shipment, the instrument should be handled with care and some precautions must be taken to resist moisture and water.

9.5 Storage

The instrument should be stored in an airy room where the environment temperature ranges from 5°C to 40°C, relative humidity is not greater than 85% and the air contains no detrimental impurities that might corrode the instrument.

9.6 Warranty

This Tonghui instrument product is warranted against defects in material and workmanship for a period of two years from the date of shipment. You should supply us with the warranty card before you enjoy the free maintenance service. This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. Tonghui will, without charge, repair or replace, at its option, defective product or component parts.

The maintenance for this instrument should be performed by professional maintenance personnel. Do not substitute the internal components unauthorized when maintaining. In order to ensure the measurement accuracy, the instrument must be measured and corrected after maintenance. You should bear the maintenance expense for damages caused by unauthorized repairing or substituting components.