



TR-2305 series

DC Resistance Meter

Operation Manual

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Chapter 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

TR-2305 adopts 32 bits CPU and high density SMD technology. 24 bits, 4.3-inch LCD screen brings ease for your eyes and convenience to your operation. The maximum 0.05% accuracy and minimum 1 $\mu\Omega$ resolution shore up its leading role in testing relay contact resistance, interconnecting resistance, conductor resistance, PCB resistance and welding-hole resistance. Temperature compensation functions make your tests be free from the effect of the environment temperature. The offset voltage compensation (OVC) has effectively eliminated the electromotive force of the DUT and its contact potential difference. For the contact influence of the thermoelectricity on DUT, its elimination is achieved; especially when the resistance changes with the temperature greatly, better measurement results will be achieved. With statistics analysis function, the instrument can make statistics analysis for large number of measurement data.

TR-2305 series is a powerful test tool for all kinds of resistor design, detection, quality control and production. Automation on production lines can be greatly improved by the realization of ultra-high measurement speed and the signal output of 3 sort results through HANDLER interface. With multiple output data display, comparison mode and bin comparator, TK2516 series can meet different test requirements of different resistor manufacturers. The excellent performance makes the test results meet IEC and IML 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

- 1) Power supply: 90V-125V, 190V-250V.
- 2) Power supply frequencies: 50Hz and 60Hz
- 3) Power supply power range: $\leq 30VA$.
- 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, directly sunshine and corrosive gas
- 2) Working Condition:
temperature: 0°C~40°C, humidity: ≤80%RH, no condensation
- 3) Storage Condition:
temperature: -10°C~50°C, humidity: ≤90%RH, no condensation。
- 4) For getting best performance, do not block the left air vent so to ensure good ventilation
- 5) 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.
- 6) Test leads on the instrument that are connected to DUTs should be kept away from strong electromagnetic fields to avoid interference.

1.6 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 performance, 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 corrupt

1.8 Other Features

- 1) Consumption: ≤30VA
- 2) Dimensions (W*H*D) : 235mm*105mm*360mm; this dimension is the final packaging size.
- 3) Weight: Approx. 3.5kg

Chapter 2 Front and Rear Panels Introduction

This chapter will introduce the basic operation of TK2516. To use the instrument properly, please read this chapter carefully.

2.1 Front Panel

Figure 2-1 shows the front panel of TK2516

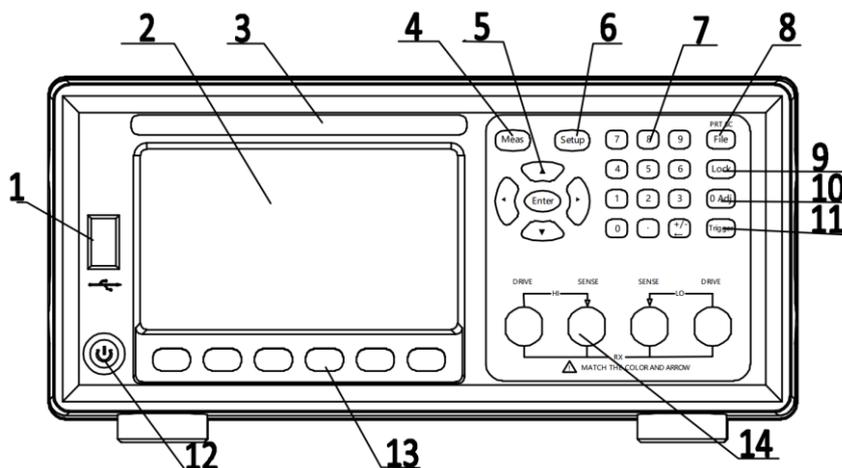


Figure 2-1 Front Panel

- 1) **USB interface**
HOST interface of USB
- 2) **LCD true color screen**
480*272 dot-matrix, 24-bit, 4.3-inch TFT LCD is used for measurement setup and result display
- 3) **Trademark and Model**
Show instrument trademark and model.
- 4) **Meas**
Press **Meas** key to enter into the Meas Disp page.
- 5) **Universal Arrow Keys and enter key**
There are four arrow keys: up, down, left and right arrow keys.
Press this key to terminate and store input data.
- 6) **Setup**
Press **Setup** key to enter into the Meas Setup page.
- 7) **Digital Keys**
Used to input Digit
- 8) **File**
Press **File** key to enter into the page of internal and external File Manage
Long press File key to do screen copy
- 9) **Lock**

Press **Lock** key to switch key lock status

10) **0 ADJ**

Press [0 ADJ] to execute correction function.

11) **Trigger**

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

12) **Power**

Power Switch.

13) **SoftKeys**

Softkeys used to set instrument based on page and cursor position

14) **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.

2.2 Rear Panel

Figure 2-2 shows the front panel of TR-2305.

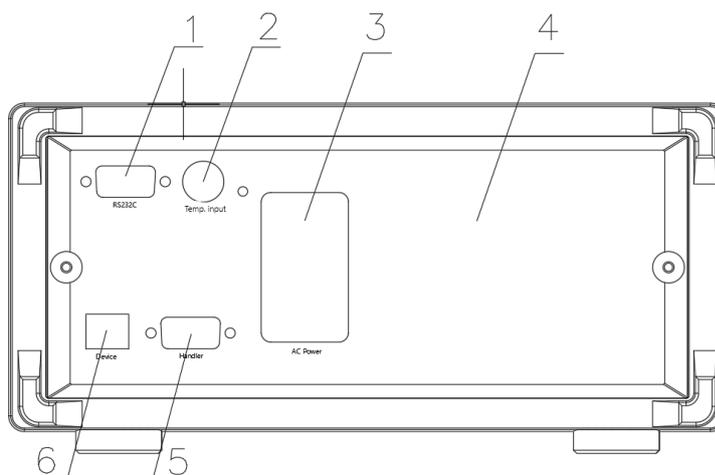


Figure 2-2 Rear Panel

1) **RS232C Serial Interface**

It realizes serial communication of the instrument with PC.

2) **TEMP.INPUT**

There are two kinds of temperature signal input: Pt500 and Pt100 Input.

3) **Fuse socket and Power Socket**

Fuse will be placed in this socket to protect the instrument; be used to input AC power.

4) **Pin Description**

Used to indicate pin definition of RS232 and Handler.

5) **USB Interface**

PC can remotely control TK2516 series through USB DEVICE.

6) **HANDLER Interface**

Through HANDLER interface, an automatic test system can be conveniently constructed to realize auto test. TR-2305 series will output bin comparator result signals and handshake signals by this interface, meanwhile, external trigger signal will also be sent to the instrument by it.

7) **SN**

2.3 Display Zone

TR-2305 series adopts 24-bit 4.3-inch LCD screen with a resolution of 480*272. The display screen is divided into the following zones, as shown in figure 2-3.

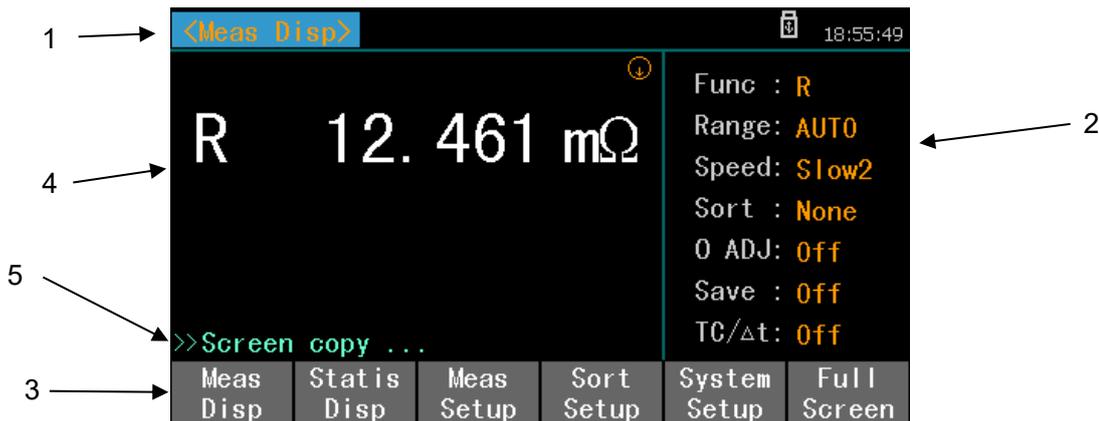


Fig.2-3 display zone definition

- 1) Page name
This zone shows the current page name.
- 2) Function zone
This zone is used to change the measurement mode and measurement parameters.
- 3) Soft keys
This zone displays the function menu corresponding to the cursor-located zone.
- 4) Result display
This zone displays the measurement result such as resistance and temperature.
- 5) Prompt zone
This zone displays all prompt information.

2.4 Introduction to Buttons on Front Panel

1) Meas

Press [MEAS] to enter into main measurement page. Selectable functions in this page are shown as follows:

- < Meas Disp>
- <Statics DDisp>
- <Meas Setup >
- <Sort Setup >
- <System Setup>

2) Setup

Press [Setup] to enter into measurement setup page. Selectable functions in this page are shown as follows:

< Meas Disp>
<Statics Dlisp>
<Meas Setup >
<Sort Setup >
<System Setup>

3) Lock

Switch the lock status of buttons

4) O ADJ

Execute O ADJ

5) Trigger

Trigger one time measurement if Trigger Mode is Man

2.5 Basic operation

Simple operation steps for TR-2305:

- 1) Use [Meas], [Setup] or [File] or soft keys to enter into the page required to enter.
(Refer to figure 3-1)
- 2) Use arrow buttons ([←] [↑] [→] [↓]) to move the cursor to desired zone.
- 3) 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.

2.6 Power Up

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

Chapter 3 Basic Operation

3.1 < MEAS DISP >

press down [Meas], the <Meas Disp> page will be displayed in the screen shown as figure 3-1.

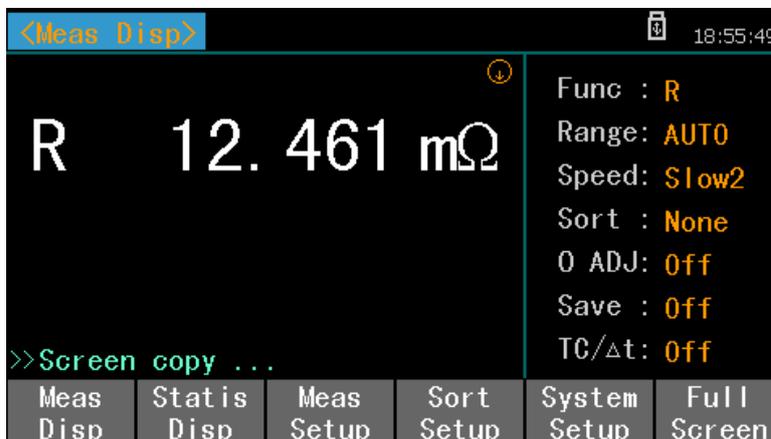


Figure 3-1 Measure Display

The following measurement parameters can be set on this page:

3.1.1 Measurement Functions

- 1) Measurable parameters on TK2516 are as follows:
 - R (Resistance)
 - R-T (Resistance and temperature)
 - T (Temperature)
 - LPR (resistance test at low current mode)
 - LPR-T (Temperature and resistance test at low current mode)

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 (only for TR-2305)
- ◆ T (only for TR-2305)
- ◆ LPR (only for TR-2305 and TR-2305A)
- ◆ LPR-T (only for TR-2305)

3.1.2 Measurement Range

There are two resistance modes: resistance measurement mode and resistance measurement at low voltage mode. Measure and display two types of parameters: resistance parameters and temperature parameters.

TR-2305 has 9 DC resistance ranges: **20mΩ, 200mΩ, 2Ω, 20Ω, 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ**

TR-2305A has 7 DC resistance ranges: **200mΩ, 2Ω, 20Ω, 200Ω, 2kΩ, 20kΩ, 200kΩ**

TR-2305B has 7 DC resistance ranges: **20mΩ, 200mΩ, 2Ω, 20Ω, 200Ω, 2kΩ, 20kΩ**

TR-2305, TR-2305A has 4 DC low voltage resistance ranges: **2Ω, 20Ω, 200Ω, 2kΩ**

TR-2305 The testing range of temperature (Pt500 and Pt100): **-10°C to 99.9°C**.

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

3.1.3 Measurement Speed

TR-2305 displays the measurement result as a 5-digit number in the decimal point floating mode. The measurement result of the speed is shown as a 4-digit number with one digit after the decimal point.

Touch the speed zone, the following soft keys will be displayed.

- ◆ **Fast**
- ◆ **Med**
- ◆ **Slow1**
- ◆ **Slow2**

Use above soft keys to modify the speed.

3.1.4 Sort

Move Cursor to Sort, Softkeys will be displayed as following:

- ◆ **None** turn off sort function
- ◆ **Comp** turn on comparator function with high and low threshold
 - Hi : measurement result above high threshold
 - Lo: measurement result below low threshold
 - In: measurement result follow in [Lo, Hi]
- ◆ **Bin** Indicator Bin Sort result.

Note: if the result of Bin 1 if IN, Bin 2 and Bin 3 will not be processed

Use above soft keys to modify Sort function

3.1.5 0 ADJ

Move cursor to 0 ADJ, Softkeys will be displayed as following:

- ◆ **On**

turn on the function of short correction.

◆ Off

turn off the function of short correction.

Use above soft keys to modify 0 ADJ function.

3.1.6 Data Save

Move cursor to Save (Save measurement data to U disk), Softkeys will be displayed as following: :

◆ Off

Turn off save status.

◆ On

Turn on save status

Once SAVE DATA OFF is selected, you must press SAVE DATA ON to terminate or the saved data will be lost.

3.1.7 TC/ Δ t

Move cursor to TC/ Δ t, the following menu will be displayed. See 3.6.3 for detail.

TR-2305A/B/C no this function.

◆ Off

Turn off temperature related function.

◆ TC

Turn on temperature correction function.

◆ Δ t

Turn on temperature conversion function.

Use above soft keys to modify function TC/ Δ t

3.2 < Statics Disp >

Press soft key Statics Disp to enter into the <Statics Disp> page shown as figure 3-4.

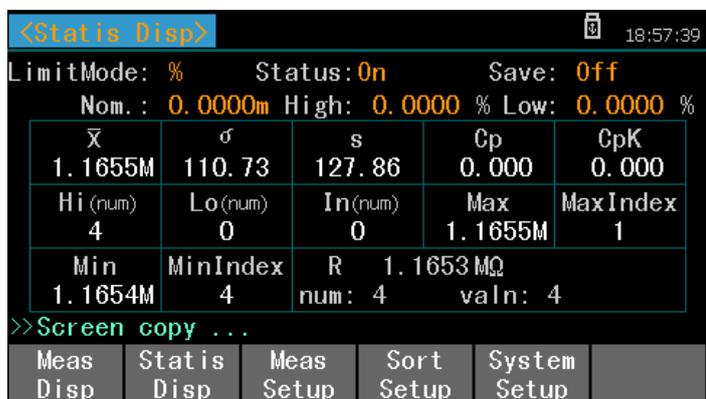


Figure 3-4 Statistic display

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.

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

When $1.00 \geq C_p, C_pK$, 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.

3.2.1 Edge Mode

two modes is available: ABS (high and low limits) and % (percent error mode).

◆ ABS

When ABS is selected, the adjacent two items on the same line will be high and low limits. Use digital buttons to set the values.

- ◆ %

the two items on the same line will be nominal value and percent. Use digital buttons to set the values.

3.2.2 Status ON/OFF

Status ON/OFF:

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

3.2.3 Data Save

Move cursor to Save (Save measurement data to U disk), Softkeys will be displayed as following: :

- ◆ Off

Turn off save status.

- ◆ On

Turn on save status

Once SAVE DATA OFF is selected, you must press SAVE DATA ON to terminate or the saved data will be lost.

3.3 < MEAS SETUP >

Press the [Setup] or the soft key Meas Setup to enter into the Meas Setup page shown as figure 3-5.

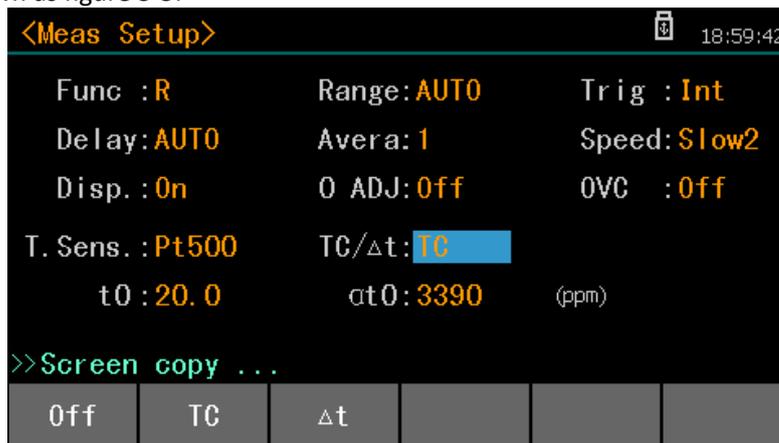


Figure 3-5 Measurement Setup page

3.3.1 Measurement Functions

See 3.1.1 for detail.

3.3.2 Measurement Range

See 3.1.2 for details.

3.3.3 Trigger Mode

When move cursor to this zone, the menu will be displayed as following:

- ◆ **Int**
Auto measurement mode
- ◆ **Man**
Manual measurement mode
- ◆ **Ext**
External trigger mode
- ◆ **Bus**
BUS trigger mode

3.3.4 Delay

When move cursor to this zone, the menu will be displayed as following:

- ◆ **Auto**
Use default delay value, i.e. 5ms
- ◆ **Manual**
Use digital key to input delay, range from 0ms to 9.999s.

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

3.3.5 Average

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. Use digital button to input

3.3.6 Speed

See 3.1.3 for detail

3.3.7 Display

When move cursor to this zone, the menu will be displayed as following:

- ◆ **On**
Display measurement result on main screen.
- ◆ **Off**
Do not display measurement result on main screen to speed up measurement.

3.3.8 0 ADJ

See 3.1.5 for detail.

3.3.9 OVC

When move cursor to this zone, the menu will be displayed as following:

- ◆ On
Turn on the offset voltage compensation. **TR-2305B has no this function**
- ◆ Off
Turn off the offset voltage compensation

3.3.10 T.Sense

Move cursor to zone T.Sense, the menu will be displayed as following:

(TR-2305A/B no this function)

- ◆ Pt 100
Set temperature sensor as Pt 100, in this case, please plug "Pt100 temperature sensor" into TEMP.INPUT interface, which reside on rear panel

Note: Attached accessories includes PT100
- ◆ Pt 500
Set temperature sensor as Pt 500, in this case, please plug "Pt500 temperature sensor" into TEMP.INPUT interface, which reside on rear panel

3.3.11 TC/Δt

Move cursor to zone TC/Δt, the menu will be displayed as following:

Note: **TR-2305A/B/C no this function**

- ◆ Off
Turn off TC and Δt.
- ◆ TC (Temperature Correction)
Temperature correction (TC): 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. This is realized by formulary conversion.
Formula: $R_t = R_{t0} * \{1 + \alpha_{t0} * (t - t_0)\}$
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.

$$R_{t0} = \frac{R_t}{1 + \alpha t_0 * (t - t_0)} = \frac{100}{1 + (3930 \times 10^{-6}) \times (20 - 10)} = 96.22 \Omega$$

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.

◆ **Δt (Temperature conversion)**

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

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

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 200mΩ, t1 is 20°C, R2 is 210mΩ, ta is 25°C and k is 235.

$$\Delta t = \frac{R2}{R1} (k + t1) - (k + ta) = \frac{210 \times 10^{-3}}{200 \times 10^{-3}} (235 + 20) - (235 + 25) = 7.75^\circ\text{C}$$

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, $k = \frac{1}{\alpha t_0} - t_0 = \frac{1}{3930 \times 10^{-6}} - 20 = 234.5$

NOTE: Conductivity and temperature coefficient of metal and alloy

Metallic material	Metal [%]	Material density (x10 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 0.8	8.89	0.40 to 0.50 0.80 to 0.85	20 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
----------------	--	-----	--------------	----

NOTE: 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:

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

3.4 <Sort Setup>

Move cursor to zone title, press softkey [Sort setup] to enter Sort Setup page. As shown in Figure 3-7、Figure 3-8:

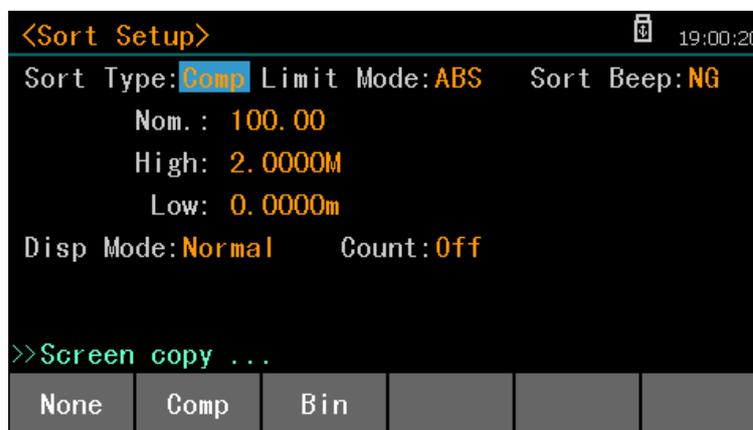


Figure 3-7 Comp setup page

GD-> beep when comp result is GD

Bin Status : On: turn on this Bin

Off: turn off this Bin

Nominal: Nominal of limit when limit mode is percentage

Up: upper limit

Low: lower limit

Note: set the above parameter with digital button

Note: if the result of Bin 1 is IN, Bin 2 and Bin 3 will not be processed

Chapter 4 System Setup and File Manage

4.1 System Setup

Entering the system setup page, you can press [**System Setup**] when cursor is on title to select system setup page as shown in figure 4-1.



Fig. 4-1 System setup page

4.1.1 Language

When move cursor to this zone, the menu will be displayed as following:

- ◆ English
Set the language as English.
- ◆ Chinese
Set the language as Chinese.

4.1.2 Key Tone

When move cursor to this zone, the menu will be displayed as following:

- ◆ On
To turn on the key tone.
- ◆ Off
To turn off the key tone.

4.1.3 Tool

When move cursor to this zone, the menu will be displayed as following:

- ◆ System Reset
To reboot the instrument.
- ◆ Default Settings

Reset all settings to default value.

◆ **System Info**

To display system information, such as type, version etc.

◆ **Update**

To update Firmware of instrument.

4.1.4 Bus Mode

Bus mode is used to set the communication interface.

When move cursor to this zone, the menu will be displayed as following:

◆ **RS232C**

To select the RS232C interface.

◆ **USBVCOM**

To select the USBVCOM interface. The instrument communicates with PC through the USB interface on the rear panel.

◆ **RS485**

To select the RS485 interface. When use this interface, RS232/RS485 converter is needed

4.1.5 Baud Rate

Use soft key to select Baud rate, the following six baud rates is selectable:

◆ 9600

◆ 19200

◆ 28800

◆ 38400

◆ 57600

◆ 115200

4.1.6 Bus Address

To set bus address when comm protocol is Modbus.

When move cursor to this zone, the menu will be displayed as following:

◆ **++**

Press this soft key, the address will increase rapidly by 5

◆ **+**

Press this soft key, the address will increase by 1.

◆ **-**

Press this soft key, the address will decrease by 1。



Press this soft key, the address will decrease rapidly by 5。

4.1.7 Comm protocol

When move cursor to this zone, the menu will be displayed as following:



To select protocol SCPI.



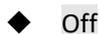
To select protocol Modbus

Note: the related command set see related file

4.1.8 Auto Fetch

(Measurement result will send out through communication interface automatically when this function is on)

When move cursor to this zone, the menu will be displayed as following:



To turn on Auto Fetch.



To turn off Auto Fetch.

4.1.9 PLC power

When move cursor to this zone, the menu will be displayed as following:



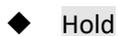
To set Handler Power as external power supply.



To set Handler Power as external power supply.

4.1.10 PLC Output

When move cursor to this zone, the menu will be displayed as following:



Keep current Sort result on Handler till next Sort result is available.



Keep current Sort result on Handler this period and then reset to default status.
Period range: 1ms~2000ms. Use digital key to input.

4.1.11 AC Frequency

TK2516 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.

When move cursor to this zone, the menu will be displayed as following:

- ◆ **50Hz**
Select 50Hz as AC frequency.
- ◆ **60Hz**
Select 60Hz as AC frequency.

4.1.12 Setting Time and Date

Set the time.

For example: 8 o'clock 21 minute and 20 second a.m. on February 8, 2021 will be shown as 21-02-08 08:21:20.

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>

TK2516 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 TK2516.

Note: The instrument will load setting which is saved by last power off.

4.2.1 Introduction to Save/Recall

By the function of save/recall, user can save measurement results and configuration information to TK2516 internal Flash or external U disk; meanwhile user can recall data from TK2516 internal Flash or external U disk.

Introduction to Methods and Applications of Save

The table below shows the applicable save methods and applications:

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

Table 4-1 Methods and Applications of Save
 Table 4-1 Methods and Applications of Save

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.

Folder	Maximum Amount of File	Description
CSV	999	Including measurement result, like *.CSV file.
STA	999	Including configuration data, like *.STA file.
IMAGE	999	Including screen information, like *.GIF file.

Table 4-2 Folder in U disk

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:

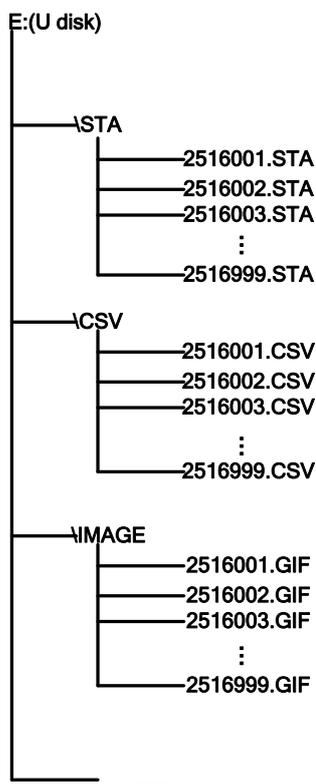


Figure 4-2 file structure in a U disk

When using U disk on TR-2305, you should pay special attention to the following points:

1. Use a U disk with the USB2.0/USB3.0 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 TR-2305, you are recommended to save the data on it and Tessio 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.

4.2.2.1 Operation Procedures

Press **FILE** button in any page and select **File Manage** to enter into the internal file page shown in below figure.

Touch [Inter File] and [External File] to respectively display files stored in the internal FLASH and the external U disk. Touch [Exit] to exit the file manage page.



Figure 4-3 Internal file page



Figure 4-4 External file page

Four files' information will be displayed in the internal file page or the external file page, including file names and time of being saved.

Operations of the internal file and the external file are similar. Take internal file operations as an example to describe the specific procedures of file operations.

4.2.2.2 Operations on file are as follows

Move cursor to the file name to be edited (If the file name does not exist in the current page, you can move cursor to [Page 1] and select [Previous Page] and [Next Page] to toggle between file pages, and then select the desired file.), the following items will be displayed.

- **Load**

Press this soft key, if the file name that the cursor locates is not empty, [Yes] and [No] will 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**

Press this soft 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**

Press soft key "Delete", if "Yes" is selected, the instrument will delete the file that the cursor locates.
- **Copy to E:**

Press soft key "Copy to E". The instrument will copy the file the cursor locates or the selected file to a U disk.
- **Select**

Press soft key "Select", the file the cursor locates will be selected. TR-2305 can simultaneously copy several files to a U disk.
Press soft key "Select" once again, the selected file will be cancelled from selection.
- **Save Measurement Results**

In the "Meas Disp" page, turn on "Save" to save measurement results to a U disk. Turn off "Save", the instrument will stop saving measurement results.
- **Save Screen Information:**

Long press button "File" 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.

Chapter 5 Performance Index

5.1 Performance Index

5.1.1 Measurement Parameters and Notations

R: Resistance
 T: Temperature
 LPR: Low current mode

5.1.2 Measurement Combination

Five Combinations:

TR-2305 : R, R-T, T, LPR, LPR-T

TR-2305A : R, LPR

TR-2305B : R

5.1.3 Range

Range Mode: Auto, Manu (Hold, Up, Down)

5.1.4 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 HANDLER interface on the rear panel.

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

5.1.5 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

5.1.6 Resistance Measurement Time

When OVC is Off:

50Hz	60Hz	
5ms+t1	5ms+t1	Fast
20ms+t1	16.6ms+t1	Med
110ms+t1	110ms+t1	Slow1
450ms+t1	450ms+t1	Slow2

When OVC is On:

50Hz	60Hz	
10ms+t+t1	10ms+t+t1	Fast
40ms+t+t1	33ms+t+t1	Med
220ms+9*t +t1	220ms+11*t +t1	Slow1
900ms+39*t +t1	900ms+47*t +t1	Slow2

NOTE: t is the measurement waiting time, t1 is the data processing time, approximately is 5ms.

More detailed information about time parameters, please refer to Chapter 6 "Handler Interface".

5.1.7 Average

Range from 1 to 255, programmable: this value reflects the measurement times from measuring resistance to measuring display.

5.2 Measurement Signal

5.2.1 Current range

5.2.1.1 R

range model	20mΩ	200 mΩ	2 Ω	20Ω	200Ω	2KΩ	20KΩ	200KΩ	2MΩ
TR-2305	1A	1A	100mA	10mA	1mA	100uA	100uA	10uA	1uA
TR-2305A	-								-
TR-2305B	1A								-

5.2.1.2 LPR

range model	2 Ω	20Ω	200Ω	2KΩ
TR-2305	10mA	1mA	100uA	10uA
TR-2305A				

5.2.2 Output Voltage of Open Circuit

5.2.2.1 R

range model	20mΩ	200 mΩ	2 Ω	20Ω	200Ω	2KΩ	20KΩ	200KΩ	2MΩ
TR-2305	0.7V	0.7V	0.7V	2.7V	2.7V	2.7V	2.7V	2.7V	2.7V
TR-2305A	-								-
TR-2305B	0.7V								-

5.2.2.2 LPR

Range model	2 Ω	20Ω	200Ω	2KΩ
TR-2305	36mV	36mV	36mV	36mV
TR-2305A				

5.2.3 Measurement Display Resolution

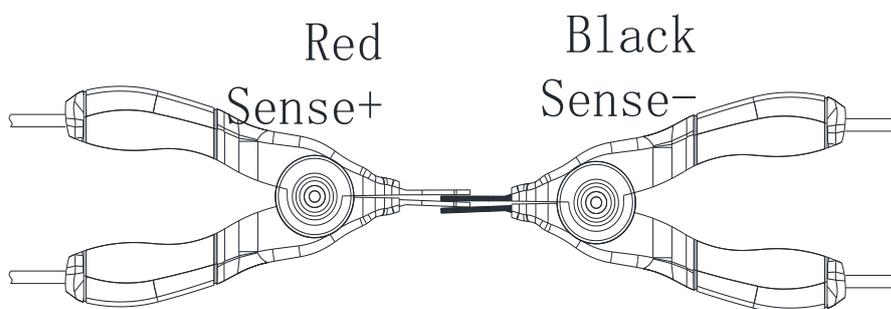
range model	20mΩ	200 mΩ	2 Ω	20Ω	200Ω	2KΩ	20KΩ	200KΩ	2MΩ
TR-2305	0.001 mΩ	0.01 mΩ	0.0001Ω	0.001Ω	0.01Ω	0.0001 KΩ	0.001 KΩ	0.01 KΩ	0.0001 MΩ
TR-2305A	-								-
TR-2305B	0.001 mΩ								-

5.3 Measurement Accuracy

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

- a. Warm-up time should be more than 30 minutes.
- b. 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:



■ Measurement Condition:

Temperature Range: 23°C±5°C

Relatively Humidity: ≤80%RH

5.3.1 Basic Accuracy for Resistance Measurement

TR-2305 (within one year 23±5°C, ≤80%RH)

Range	20mΩ	200mΩ	2Ω	20Ω	200Ω	2kΩ	20kΩ	200kΩ	2MΩ
Current	1A	1A	100mA	10mA	1mA	100μA	100μA	10μA	1μA
OCV	0.7V			3V					
Resolution	1μΩ	10μΩ	100μΩ	1mΩ	10mΩ	100mΩ	1Ω	10Ω	100Ω
Accuracy	0.1%+3	0.05%+2	0.05%+2						0.2%+2
Temperature coefficient	300ppm		100ppm						

TR-2305A/B (within 1 year; 23±5°C, ≤80%RH)

Range	200mΩ	2Ω	20Ω	200Ω	2kΩ	20kΩ	200kΩ
Current	1A	100mA	10mA	1mA	100μA	100μA	10μA

OCV	0.7V		3V				
Resolution	10 $\mu\Omega$	100 $\mu\Omega$	1m Ω	10m Ω	100m Ω	1 Ω	10 Ω
Accuracy	0.05%+2						
Temperature coefficient	300ppm	100ppm					

5.3.2 Accuracy for Resistance Tested at Low Current Mode

TR-2305、TR-2305A (within 1 year; 23 \pm 5 $^{\circ}$ C, \leq 80%RH)

Range	2 Ω	20 Ω	200 Ω	2k Ω
Current	10mA	1mA	100 μ A	10 μ A
OCV	40mV			
Resolution	100 $\mu\Omega$	1m Ω	10m Ω	100m Ω
Accuracy	0.2%+5			
Temperature coefficient	200ppm			

Accuracy¹: Out of temperature range, should take Temperature coefficient into consideration

5.3.3 Accuracy for Temperature Measurement (PT100&PT500)

TR-2305 (within 1 year; 23 \pm 5 $^{\circ}$ C, \leq 80%RH)

Temperature range	-99.9 to 39.9 $^{\circ}$ C	40.0 to 250.0 $^{\circ}$ C
Resolution	0.1 $^{\circ}$ C	0.1 $^{\circ}$ C
Accuracy in 1 years	\pm 0.45%Rd \pm 0.8 $^{\circ}$ C	\pm 0.45%Rd \pm 1.5 $^{\circ}$ C

Chapter 6 Handler Interface

TR-2305 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.

6.1 Bin output mode

Port	Name	Description
1	Start	Measurement trigger signal, falling edge is valid. When the instrument holds in the external trigger mode and this signal is valid, the instrument will trigger a measurement.
2	Pass2	The low bin 2 comparison result output signal will be valid.
3	Fail	The low bin comparison result output signal will be valid.
4	+5V	Internal +5V power output.
5	Ext_VCC	When the "Handler" power supply is set as "External", the terminal is external power source and the voltage ranges from +5V to +30V; when the "Handler" power supply is set as "Internal", the terminal is internal power source.
6	Pass1	The low bin 1 comparison result output signal will be valid.
7	Pass3	The low bin 3 comparison result output signal will be valid.
8	EOC	Measurement end signal. The low output signal will be valid.
9	Ext_GND	When the "Handler" power supply is set as "External", the terminal is external GND; when the "Handler" power supply is set as "Internal", the terminal is internal GND.

Note1: the above Handler only valid when sort function as Bin.

Note2: if the result of Bin 1 if IN, Bin 2 and Bin 3 will not be processed

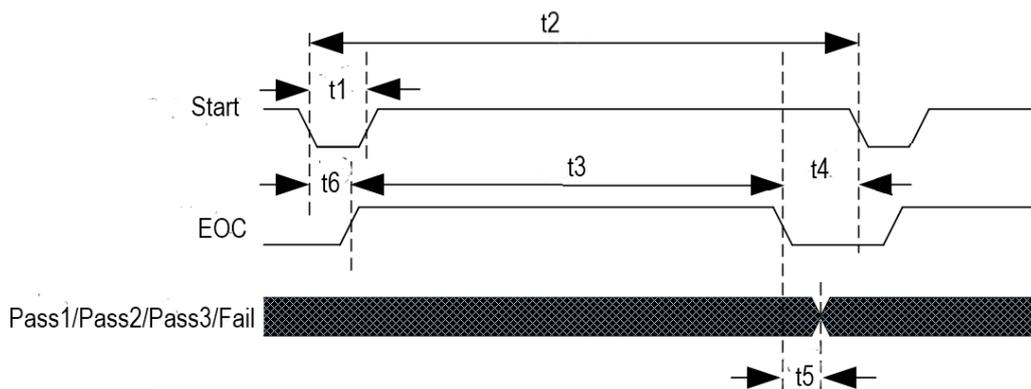
6.2 Comp output mode

Port	Name	Description
1	Start	Measurement trigger signal, falling edge is valid. When the instrument holds in the external trigger mode and this signal is valid, the instrument will trigger a measurement.
2	Fail_HI	Output low when the result of comparator is Hi, otherwise output high.
3	Fail	Output low when the result of comparator is Hi or Lo, otherwise output high.
4	+5V	Internal +5V power output.
5	Ext_VCC	When the "Handler" power supply is set as "External", the terminal is external power source and the voltage ranges from +5V to +30V; when the "Handler" power supply is set as "Internal", the terminal is internal power source.
6	Pass1	Output low when the result of comparator is GD, otherwise output high.
7	Fail_LO	Output low when the result of comparator is Lo, otherwise output high.
8	EOC	Measurement end signal. The low output signal will be valid.

9	Ext_GND	When the "Handler" power supply is set as "External", the terminal is external GND; when the "Handler" power supply is set as "Internal", the terminal is internal GND.
---	---------	---

Note1: the above Handler only valid when sort function as comp

6.3 Sequence timing



Time	Minimum value	Maximum value
t1: trigger pulse width	1ms	---
t2: measurement time at one time	t3+t4	---
t3: sampling time of one measurement	1 Sampling Time	---
t4: data processing and display time of one measurement	Display "ON": 22ms Display "OFF": 5ms	---
t5: end of sampling to control output time	2ms	---
t6: measurement delay time	See the setup for measurement delay	---

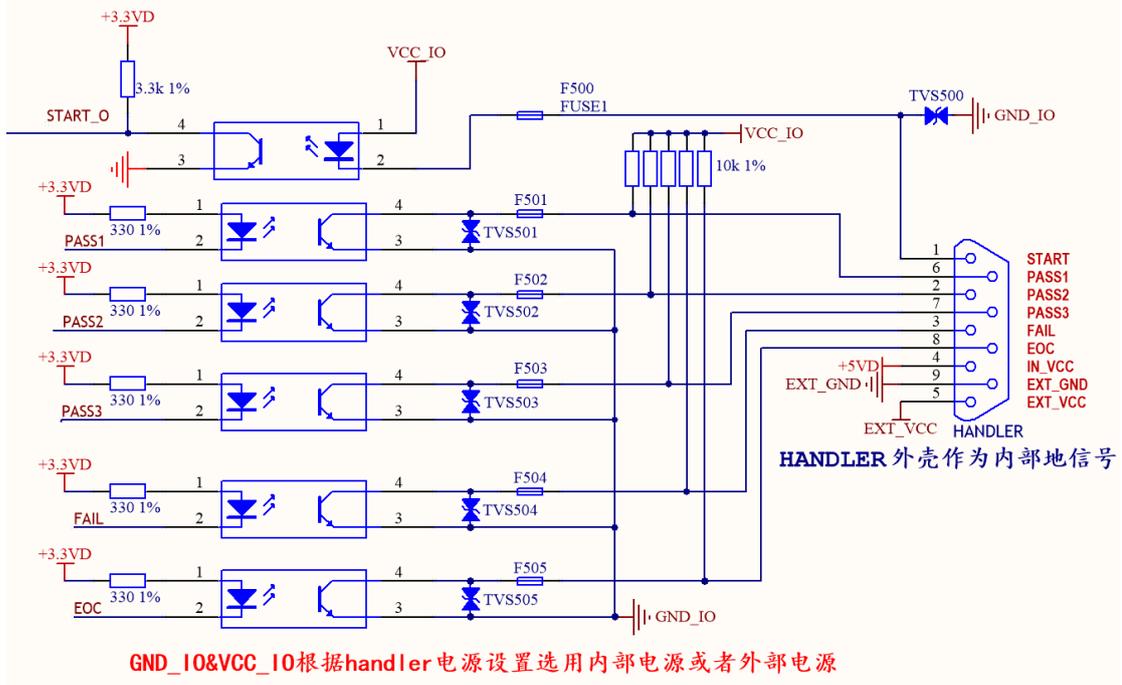
When OVC is off, Sampling Time shown as below table

50Hz	60Hz	
5ms	5ms	Fast
20ms	16.6ms	Med
110ms	110ms	Slow1
450ms	450ms	Slow2

When OVC is on, Sampling Time shown as below table

50Hz	60Hz	
10ms+t6	10ms+t6	Fast
40ms+t6	33ms+t6	Med
220ms+9*t6	220ms+11*t6	Slow1
900ms+39*t6	900ms+47*t6	Slow2

Internal Circuit:



Note1: the shell of interface is internal GND

Note2: GND_IO&VCC_IO can be set as internal or external power

6.4 Interface and Command

6.4.1 SCPI

6.4.1.1 Non-Automation

- 1) TRIG:SOUR EXT (set trigger mode as EXT)
- 2) Handler interface's Start generate falling edge.
- 3) Waiting Handler interface's EOC goes low
- 4) FETC?
- 5) Read measurement result and repeat 2)、3)、4)。

6.4.1.2 Semi-Automation (recommend)

- 1) TRIG:SOUR EXT (set trigger mode as EXT)
- 2) FETC:AUTO ON (set FetcAuto as ON)
- 3) Handler interface's Start generate falling edge.
- 4) Read measurement result and repeat 3)。

6.5 MODBUS

6.5.1.1 Non-Automation

- 1) TRIG:SOUR EXT (set trigger mode as EXT)
- 2) Handler interface's Start generate falling edge.
- 3) Send command address 0x13, read measurement result.

Send: 08 03 00 13 00 04 B5 55

Back: 08 03 08 41 C2 C9 3D 00 00 00 00 E1 27

- 4) Read measurement result and repeat2) 、 3)

6.5.1.2 Semi-Automation (recommend)

- 1) TRIG:SOUR EXT (set trigger mode as EXT)
- 2) FETC:AUTO ON (set FetcAuto as ON) .
- 3) Handler interface's Start generate falling edge.
- 4) Read measurement result and repeat3) .

Chapter 7 Package Contents and Warranty

7.1 Package Contents

Following items should be contained in the package:

No	Name	Quantity
1	TR-2305 series DC Resistance Meter	1
2	Tessio 4-terminal test cable	1
3	Three-Wire power line	1
4	PT100 (only for TK2516)	1
5	Fuse of 1A	2
6	Operation Manual	1
7	Manufacturer Certificate	1
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.

7.2 Marks

The following marks can be seen on each instrument panel and nameplate:

- 1) Manufacturer name and trademark
- 2) Product name and model
- 3) Product number and date
- 4) the License for Manufacturing Measurement Instruments and its number
- 5) Marks for test terminal

7.3 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.

7.4 Shipping

In the shipment, the instrument should be handled with care and precautions must be taken to resist moisture and water.

7.5 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.

7.6 Warranty

This instrument 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. We 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.

Chapter 8 Appendix

8.1 Update Firmware

Update procedures:

- 1) Copy file TR-2305.sec to U disk, plug U disk to TR-2305 (on front panel of TR-2305)
- 2) Power on TR-2305, on menu <System Setup> -> Tool, press update softkey, the updating will begin

If tips "Load *.SEC File failed!", please format U disk and make sure only update file in U.

U disk format requirement:

File system: FAT32(default)

Sector size: default

Format option: deselect fast format

8.2 Revision

version	description	time
V1.0	First release About communication and protocol, please refer <u>TR-2305 command set.pdf</u>	2021.04
V1.1	Modify internal schematic of handler interface	2021.11
V1.2	Add type TR-2305C and modify the feature of TR-2305B	