TESSIO TECHNOLOGY LTD.

TR-2301 Series

DC Resistance Meter

Operation Manual

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Contents

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-2301 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 0.01% accuracy and minimum 0.1 μΩ 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-2301 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 10 sort results through HANDLER interface. With multiple output data display, comparison mode and bin comparator, TR-2301 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-240V.
2) Power supply frequencies: 50Hz and 60Hz
3) Power supply power range: ≤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℃～40℃，humidity:≤80%RH，no condensation
3) Storage Condition:

   temperature：-10℃～50℃，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 TR-2301. To use the instrument properly, please read this chapter carefully.

2.1 Front Panel

Figure 2-1 shows the front panel of TR-2301

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-2301。

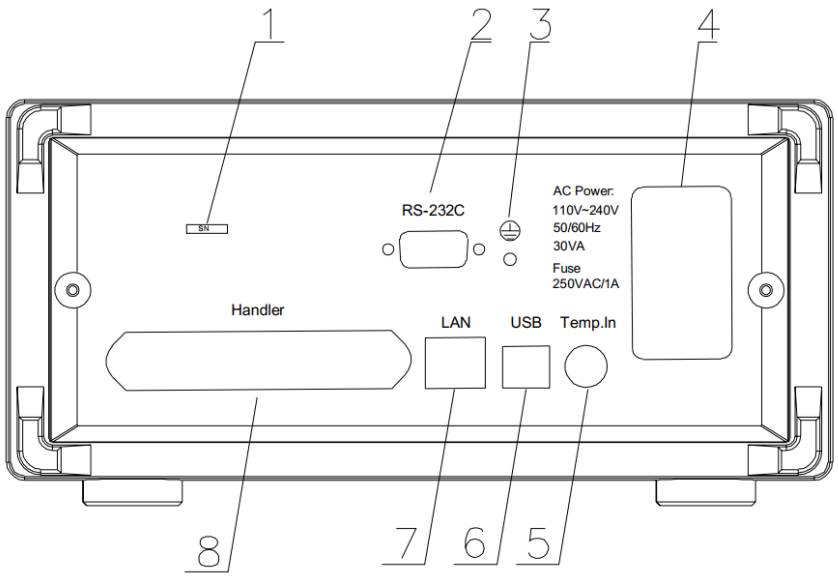


Figure 2-2 Rear Panel

1) S/N

Instrument's Serial No.

2) **RS232C Serial Interface**

It realizes serial communication of the instrument with PC.

3) Ground Terminal

4) **Fuse socket and Power Socket**

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

5) TEMP.INPUT

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

6) **USB Interface**

PC can remotely control TR-2301 series through USB DEVICE.

7) LAN Interface

PC can remotely control TR-2301 series through LAN interface

8) **HANDLER Interface**

Through HANDLER interface, an automatic test system can be conveniently constructed to realize auto test. TR-2301 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.

9) **SN**

2.3 Display Zone

TR-2301 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.

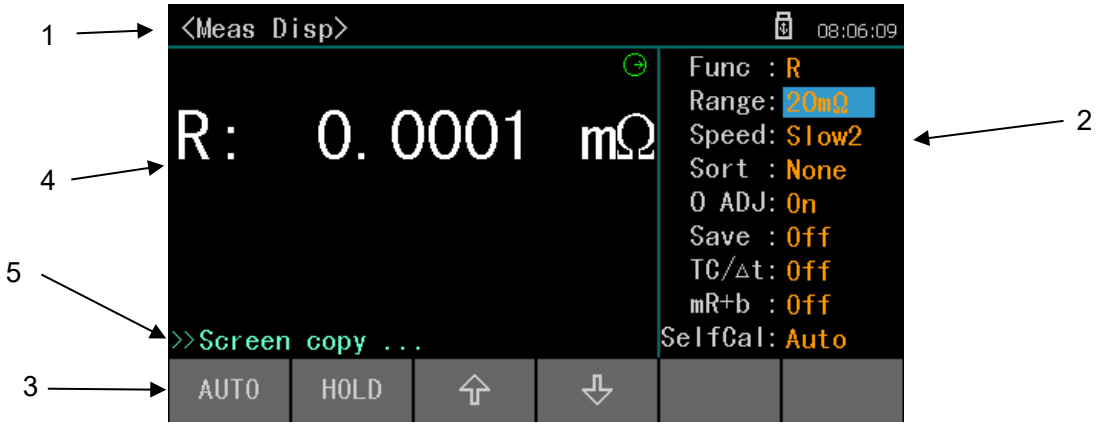


Fig.2-3 display zone definition

1) Page Title

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 DIisp>
<Meas Setup >
<Sort Setup >
<System Setup>
<Net 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>
<Net Setup>

3） Lock

Switch the lock status of buttons

4） O ADJ

Execute 0 ADJ

5） Trigger

Trigger one time measurement if Trigger Mode is Man

2.5 Basic operation

Simple operation steps for TR-2301:

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.

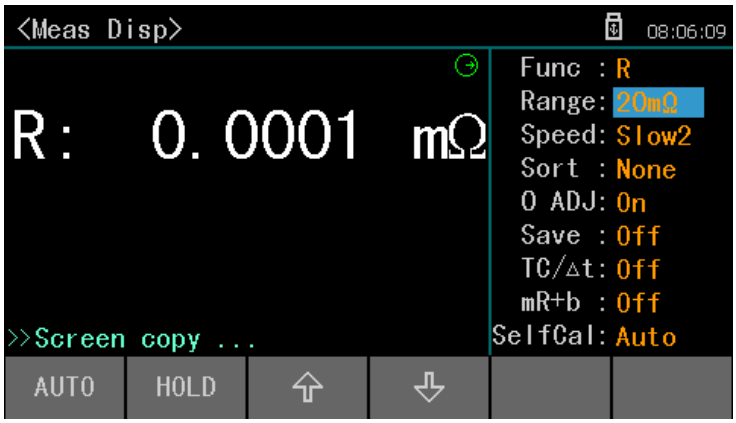


Figure 3-1 Measure Display

The following measurement parameters can be set on this page:

3.1.1 Measurement Functions

1) Measurable parameters on TR-2301 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
- T
- LPR
- LPR-T

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-2301 has 11 DC resistance ranges: **20mΩ，200mΩ，2Ω，20Ω，200Ω，2kΩ，20kΩ，100kΩ，1MΩ，10MΩ，100MΩ**
TR-2301 has 4 DC low voltage resistance ranges: **2Ω, 20Ω, 200Ω, 2KΩ**

TR-2301 The testing range of temperature (Pt500 and Pt100): **-10℃ to 99.9℃.**

Performance of Function R

Range	Current	resolution	accuracy Rd% + Fs%
20mΩ	1A	0.1uΩ	0.10+0.025
200mΩ		1uΩ	0.05+0.030
2Ω	100mA	10uΩ	0.03+0.010
20Ω	10mA	100uΩ	0.02+0.008
200Ω		1mΩ	0.01+0.002
2kΩ	1mA	10mΩ	0.01+0.002
20kΩ	100uA	100mΩ	0.01+0.002
100kΩ		1Ω	0.01+0.005
1M	10uA	10Ω	0.02+0.005
10MΩ	1uA	100Ω	0.10+0.010
100MΩ	100nA	1kΩ	1.00+0.100

note： $error = \frac{\text{Meas Value}*\text{Rd\%}+\text{Range}*\text{Fs\%}}{\text{Meas Value}}$

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 **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-2301 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, there are 10 bins in totals。

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/Δt

Move cursor to TC/Δt，the following menu will be displayed。See 3.6.3 for detail。

- Off

  Turn off temperature related function.

- TC

  Turn on temperature correction function.

- Δt

  Turn on temperature conversion function.

  Use above soft keys to modify function TC/Δt

3.1.8 mR+b

Switch linearity convert function, when this function is on, the displayed result will be converted data using this formula, R is measurement resistance and m and b are settings。

3.1.9 SelfCalib

Set self-calibration status。

- Auto

The instrument will execute self-calibration every 30 minutes.

- Manual

The instrument will execute self-calibration when every time CAL signal (Handler->29) from high goes to low

3.2 < Statics Disp >

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

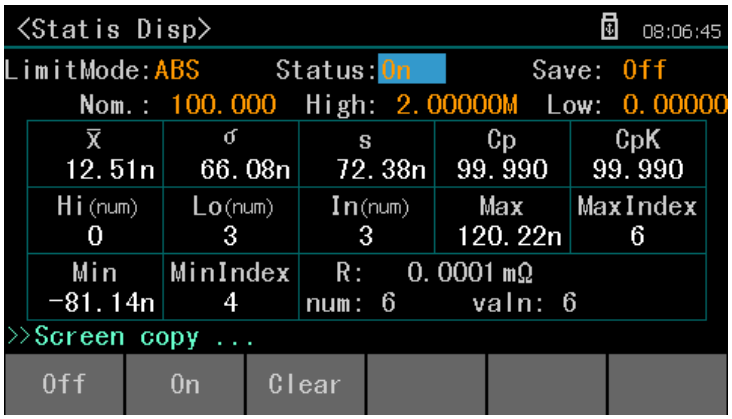


Figure 3-4 Statistic display

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) $\overline{X}$: 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.

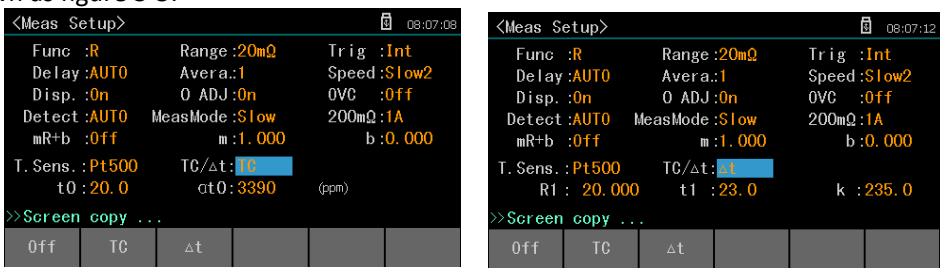


Figure 3-5 Measurement Setup page

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.

- Off

Turn off the offset voltage compensation

3.3.10 DETECT

Detect indicates the error measurement delay time. and its value **must not be greater than** the measurement delay time:

- Auto

Use default time to detect error.

- Manual

Specify the time to detect error

3.3.11 Meas Mode

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

- Slow

A **10nF capacitor** is added to the high and low ends of the test drive in the circuit to improve the stability of large resistance and inductive load measurement in the process of test, but it will also prolong the stability time of the test signal and the calculation formula of signal stability time

$T = 3 * R * C = 3 * R * 10 * 10^{-9} F.$

Even if this setting is set to slow, it cannot guarantee that all inductive loads can be measured stably. If the inductive reactance of an inductive load reaches 10H or more, **please add a 0.1uF capacitor or larger at both ends of the test fixture**, or use other solutions.

In order to test the reflection time of large resistance faster, please select fast mode (the test port in this circuit is not connected with 10nf capacitor), and it will become unstable when measuring inductive load.

- Fast

  No 10nF capacitor between high and low ends of the test drive.

3.3.12 200mOhm

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

- 1A

  Use 1A current for range 200mOhm.

- 100mA

  Use 100mA current for range 200mOhm

3.3.13 mR+b

Press this key to turn on / off the function of this option. This function indicates the corresponding adjustment of the measured resistance value

Linear conversion can convert the physical quantity of the measured resistance value into other physical meanings defined by the user. The replacement formula is Rs = mR + b, where m and b are parameters, R is the measured resistance value, and Rs is the value after conversion:

- On

  Turn on the offset voltage compensation.

- Off

  Turn off the offset voltage compensation

3.3.14 m

m of Conversion formula Rs = mR + b. range[-100000, 1000000].

3.3.15 b

b of Conversion formula Rs = mR + b. range[-100000, 1000000].

3.3.16 T.Sense

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

- 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

3.3.17 TC/Δt

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

Note:

◆ 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℃. If user sets the temperature as 10℃, after correction, the value will be displayed as 96.22Ω. This is realized by formulary conversion.

Formula: Rt=Rt0*{1+αt0*(t-t0)}

Rt Resistance measured under the current environment temperature
Rt0 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℃ (Suppose the temperature coefficient as 3930ppm), the resistance under 10℃ will be 96.22Ω.

$$R_{t0} = \frac{R_t}{1 + at0 * (t - t0)} = \frac{100}{1 + (3930 \times 10^{-6}) \times (20 - 10)} = 96.22\Omega$$

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.

◆ 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℃.
For example
When R1 is 200mΩ, t1 is 20℃, R2 is 210mΩ, ta is 25℃ and k is 235.

$$\Delta t = \frac{R2}{R1}(k+t1)-(k+ta) = \frac{210\times10^{-3}}{200\times10^{-3}}(235+20)-(235+25) = 7.75℃$$

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

t_R = ta +Δt = 25 +7.75 = 32.75℃

Where, $k = \frac{1}{at0} - t0 = \frac{1}{3930\times10^{-6}} - 20 = 234.5$

NOTE: Conductivity and temperature coefficient of metal and alloy

Metallic material	Metal [%]	Material density ($x10^3$) [kg/m^3]	Conductivity	Temperature coefficient (20℃) [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℃ is α_{20}, its temperature coefficient (α_{ct}) at t℃ 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:

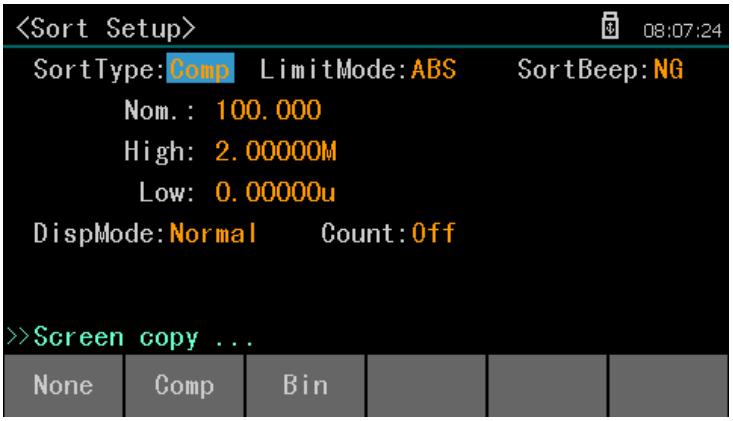


Figure 3-7 Comp setup page

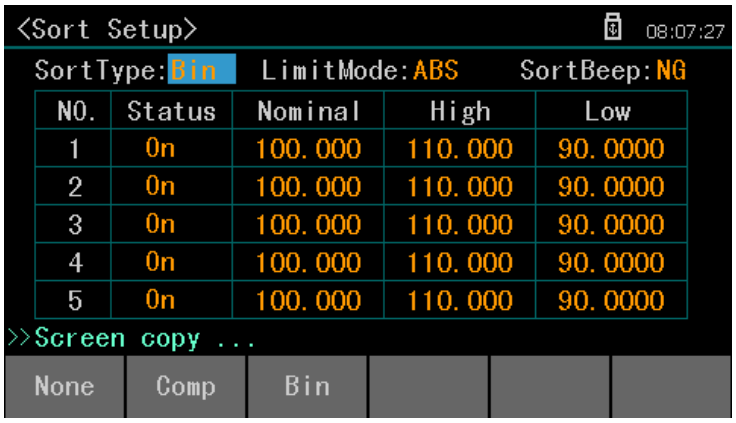


Figure 3-8 Bin setup page

3.4.1 Sort

Move cursor to zone Sort, the menu will be displayed as following:

- None

Turn off Comparator and Bin functions

- Comp

Press this softkey to turn on comparator, which compare measurement value with hi and low limit to get sort result

Limit mode: ABS->absolute limit mode, %->percentage limit mode

Comp beep: Off-> turn off beep

NG-> beep when comp result is Hi or Lo

GD-> beep when comp result is GD

Nominal: Nominal of limit when limit mode is percentage

Up: upper limit

Low: lower limit

Note: set the above parameter with digital button

Display mode： Normal-> display the measurement resistance result

Dev-> display the deviation related to **Nominal**

Count： off-> turn off count

On-> turn on count

Clear-> clear count data

- Bin

Press this softkey to turn on Bin, which compare measurement value with hi and low limit to get sort result

Limit mode: ABS->absolute limit mode, %->percentage limit mode

Bin beep: Off-> turn off beep

NG-> beep when comp result is Hi or Lo

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

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.

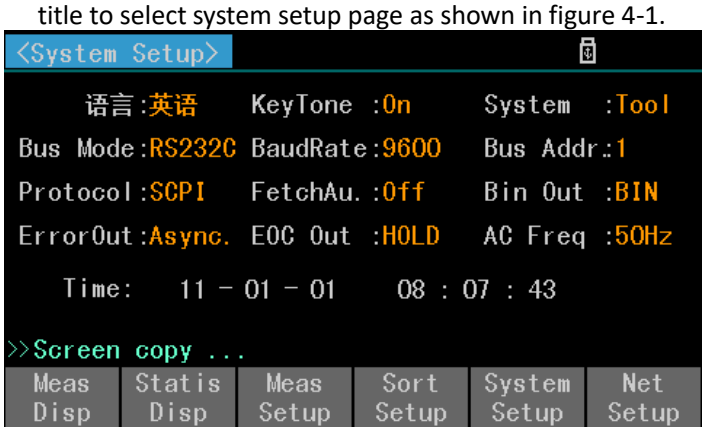


Fig. 4-1 System setup page

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

- LAN

  To select the LAN interface. The related parameter can be set in **Net Setup** Page

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：

- SCPI

To select protocol SCPI.

- Modbus

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:

- Off

To turn on Auto Fetch.

- On

To turn off Auto Fetch.

4.1.9 Bin output mode

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

- BIN

Output bin comparator result on handler interface.

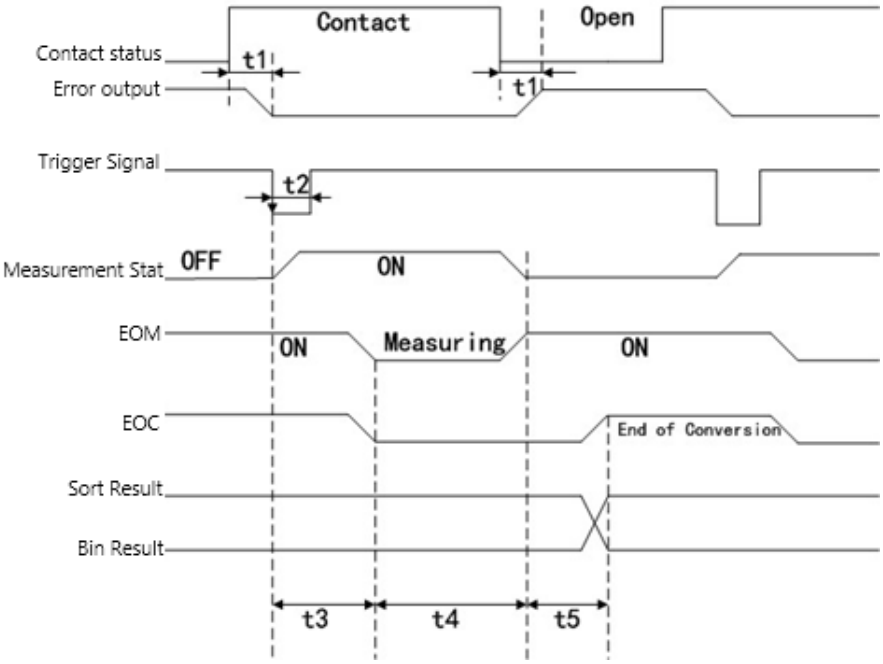
- BCD

Output BCD of measurement result on handler interface。

4.1.10 EOC

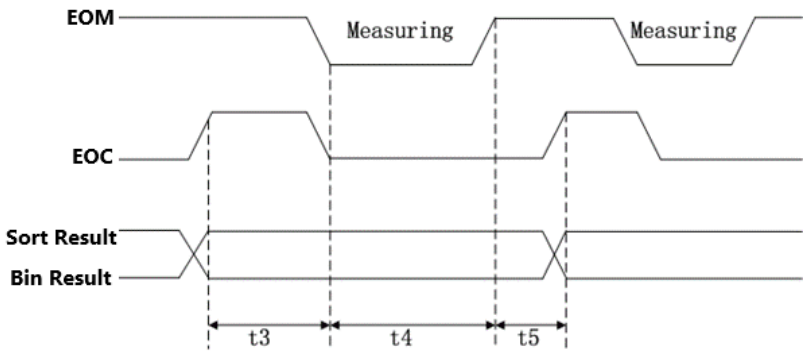
EOC(End-of-Measurement)： Measure the conversion end signal. There are two setting modes for this signal level. One is **Hold** and the other is **Pulse**. The time of EOC level conversion is also different according to the measurement time and trigger mode.

External trigger sequence diagram：



External trigger sequence diagram

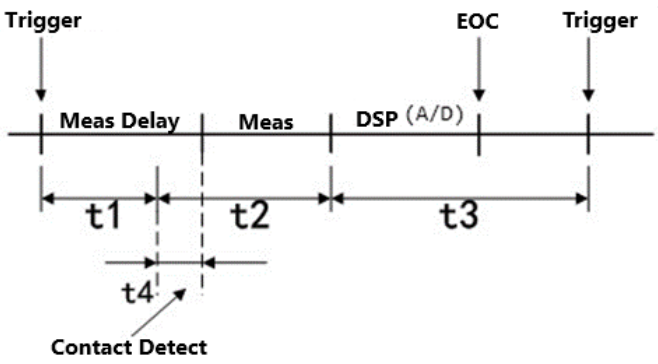
Internal trigger sequence diagram:



Internal trigger sequence diagram

4.1.11 Err.OUT

Measurement sequence diagram：



- Sync

If there is a measurement error within the time t2, the measurement error signal is output. Other time periods, no errors are detected.

- Async

If there is a measurement error within t2 time, the measurement error signal is output. In t3 time period, if the measurement error occurs and remains for at least 5ms, the measurement error signal will be output (if the measurement error returns to the normal state within 5ms, the measurement error signal will not be output).

4.1.12 AC Frequency

TR-2301 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

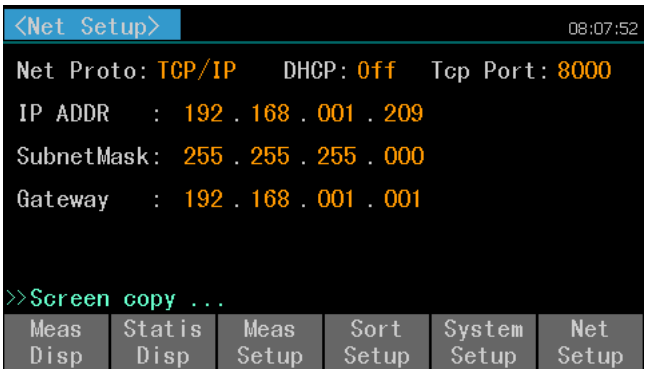
Select 60Hz as AC frequency.

4.1.13 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 <Net Setup>



4.2.1 Net Protocol

- **TCP/IP**

Select TCP/IP， The instrument network adopts TCP / IP IPv4 communication protocol.

- LXI

Select LXI, the instrument network adopts LXI protocol, and the upper computer needs LabVIEW software. LXI is a new instrument platform based on industrial standards such as Ethernet technology and composed of small and medium-sized bus modules.。

4.2.2 Port

Numeric values can be entered via the numeric keypad. Range: 0~65535。

TCP port number assignment can be divided into three Class:

- Well known port number (0 ~ 1023): managed by IANA and reserved for general TCP / IP applications.
- Registration port number（1024~49151）
- Dynamic or private port number（49152~65535）: These ports are not managed by IANA and can be used by any organization.

The complete port number allocation table is maintained by IANA and can be found at www.iana.com Org found.

4.2.3 IP

Set the IP address from 1 to 255 through the numeric keypad.

4.2.4 Subnet mask

Through the numeric keypad, set the subnet mask in the range of 1 ~ 255. The default setting is 255.255.255.000.

4.2.5 Gateway

Set the gateway through the numeric keypad. The setting range is 1 ~ 255.

4.3 <File Manage>

TR-2301 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 TR-2301.

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

4.3.1 Introduction to Save/Recall

By the function of save/recall, user can save measurement results and configuration information to TR-2301 internal Flash or external U disk; meanwhile user can recall data from TR-2301 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		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.

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

4.3.2 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:

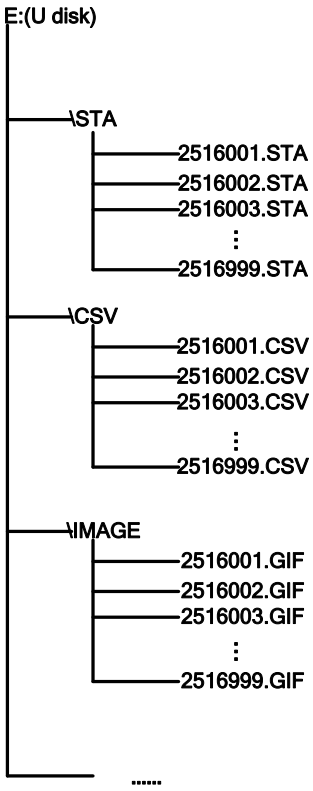


Figure 4-2 file structure in a U disk

When using a U disk on TR-2301, 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-2301, 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.

4.3.2.1 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

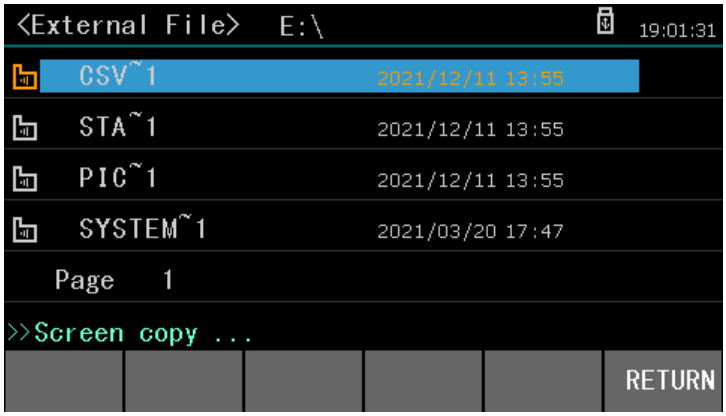


Figure 4-4 External file page

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.

4.3.2.2 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-2301 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-2301：R，R-T，T，LPR，LPR-T

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

Description	time	
	Offset Voltage Compensation(OVC) OFF	Offset Voltage Compensation (OVC) ON
Error Detect signal output response	100us	100us
Trigger Pulse	100us	100us

Delay		Auto	Manual
Meas Time	Fast	5ms	10ms+Delay
	Med	20ms(50Hz) 16.7ms(60Hz)	40ms Delay (50Hz) 33.3ms+ Delay (60Hz)
	Slow 1	100ms	200ms+ Delay
	Slow 2	400ms	800ms+7* Delay
DSP	Fast	1ms	1ms
	Med	1ms	1ms
	Slow 1 ,2	1ms	1ms
Load		min：70ms max：190ms	min：70ms max：190ms

For more detailed time parameters, please refer to Chapter 6 "instructions for handler interface"

5.1.7 Average

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

5.1.8 Display

	SLOW2、SLOW1、MED	FAST
Resistance	6 digits，Max 110MΩ	5 digits，Max 110MΩ
Temperature	3 digits，Max 999.9℃	3 digits，Max 999.9℃

5.2 Measurement Signal

5.2.1 Current range

100nA~1A

5.2.2 Output Voltage of Open Circuit

5V，2.6V，13V，60mV

5.2.3 Measurement Display Resolution

Function	Display Range
R	0.1uΩ~110MΩ
LPR	0.01mΩ~2KΩ
T	-99.9℃~299.9℃

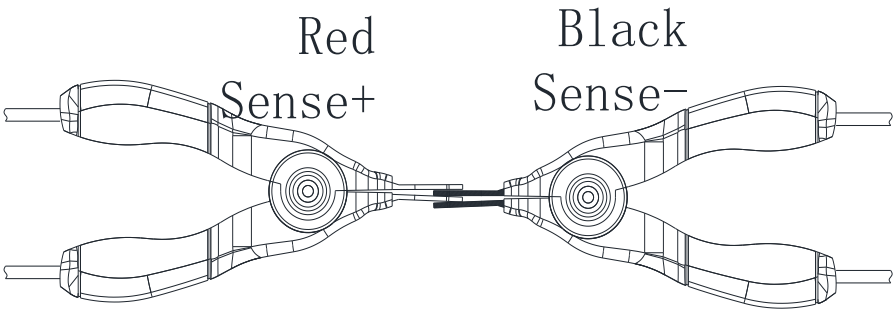
5.3 Measurement Accuracy

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℃±5℃

Relatively Humidity：≤80％RH

5.3.1 Basic Accuracy for Resistance Measurement

TR-2301 series(within one year 23±5℃，≤80%RH)

Range	Max Display	OVC	±(ppm of Rd + ppm of Fs)				Current	Open Voltage
			Slow2	Slow1	Med	Fast		
20mΩ	20.0000±0.2000mΩ	OFF	2500+150	2500+170	2500+200	2500+250	1A±5%	5Vmax
		ON	2500+10	2500+10	2500+10	2500+40		
200mΩ	200.000±02.000mΩ	OFF	2500+60	2500+80	2500+120	2500+300	1A±5%	5Vmax
		ON	2500+10	2500+10	2500+10	2500+20		
200mΩ	200.000±02.000mΩ	OFF	3500+100	3500+120	3500+150	3500+300	100mA±5%	2.6Vmax
		ON	3500+10	3500+10	3500+20	3500+80		
2Ω	2000.00±020.00mΩ	OFF	350+40	350+60	350+80	350+80	100mA±5%	2.6Vmax
		ON	350+10	350+10	350+10	350+40		
20Ω	20.0000±0.2000Ω	OFF	250+40	250+50	250+70	250+80	10mA±5%	2.6Vmax
		ON	250+10	250+10	250+10	250+40		
200Ω	200.000±02.000Ω	OFF	100+20	100+20	100+30	100+40	10mA±5%	2.6Vmax
		ON	100+10	100+10	100+10	100+40		
2kΩ	2000.00±020.00Ω	OFF	100+15	100+20	100+40	100+50	1mA±5%	2.6Vmax
		ON	100+10	100+10	100+10	100+40		
20kΩ		OFF	100+20	100+20	100+20	100+20	100uA±5%	2.6Vmax

	20.0000± 0.2000kΩ	ON	100+5	100+5	100+5	100+5		
100kΩ	110.000±02. 000KΩ	----	100+30	100+30	100+40	100+50	100uA±5%	13Vmax
1MΩ	1100.00±02 0.00KΩ	----	200+10	200+30	200+40	200+50	10uA±5%	13Vmax
10MΩ	11.000±0 .2000MΩ	----	1000+60	1000+90	1000+100	3000+120	1uA±5%	13Vmax
100M Ω	110.00±02.0 00MΩ	----	10000+ 1000	10000+ 1000	10000+ 1200	20000 +1000	100nA±5%	13Vmax

5.3.2 Accuracy for Resistance Tested at Low Current Mode

TR-2301 (within 1 year; 23±5℃，≤80%RH)

Range	Max Display	OVC	± (ppmof Rd + ppm of Fs)				Current	Open Voltage
			Slow2	Slow1	Med	Fast		
2Ω	2000.00± 020.00mΩ	OFF	500+100	500+120	500+150	500+200	10mA±5%	60mVmax
		ON	500+10	500+10	500+20	500+80		
20Ω	20.0000± 0.2000Ω	OFF	500+100	500+120	500+150	500+200	1mA ±5%	60mVmax
		ON	500+10	500+10	500+20	500+80		
200Ω	200.000± 02.000Ω	OFF	500+100	500+120	500+150	500+200	100uA±5 %	60mVmax
		ON	500+10	500+10	500+20	500+80		
2kΩ	2000.00± 020.00Ω	OFF	500+100	500+120	500+150	500+200	10uA±5%	60mVmax
		ON	500+10	500+10	500+20	500+80		

Accuracy[1]：Out of temperature range, should take Temperature coefficient into consideration

5.3.3 Accuracy for Temperature Measurement (PT100&PT500)

TR-2301 (within 1 year; 23±5℃，≤80%RH)

Temperature range	-99.9 to 39.9℃	40.0 to 250.0℃
Resolution	0.1℃	0.1℃
Accuracy in 1 years	±0.45%Rd±0.8℃	±0.45%Rd±1.5℃

Chapter 6 Handler Interface

TR-2301 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 Port Definition

Pin	I/O	Description		Pin	I/O	Description
1	IN	LOAD0		26	IN	LOAD1
2	IN	LOAD2		27	IN	LOAD3
3	IN	LOAD4		28	IN	0 ADJ
4	IN	TRIG		29	IN	CAL
5	IN	PRINT		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)

6.2 Input Signal

- **LOAD0~LOAD4：** It is used to load internal files. A total of 30 parameter files can be loaded. The saved files are parameter files, LOAD0 is low and LOAD4 is high. Trigger signal triggers loading corresponding file

LOAD4	LOAD3	LOAD2	LOAD1	LOAD0	File No
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	*

- **TRIG**
  When the trigger mode is Ext (external trigger), this signal will be measured from high to low.
  a. If it is an internal trigger, this signal will be ignored
  b. When it is not a measurement interface, this signal will be ignored
  c. This signal is ignored when loading a file
- **0 ADJ**
  One time 0 Adjustment is performed when the signal changes from high to low
- **CAL**

A self calibration is performed when the signal changes from high to low

6.3 Power and Ground

COM： External power supply EXTV reference ground
EXTV： External power supply（+5~+24V）
INT.GND： Instrument internal ground

INT.VCC： Internal power supply

Note: when using internal power supply, COM and int.gnd are short circuited, and extv and int.vcc are short circuited. When using the external power supply, it cannot be short circuited, because the external power supply may have high voltage and damage the instrument.

6.4 Output Signal

- **ERR**

  The error signal output is divided into **Sync**hronous measurement error signal output and **Asyn**chronous measurement error signal output. When the measurement error signal is output together with EOC, it is synchronous error signal output, and when it is not output together with EOC, it is asynchronous. See section 4.1.10 for specific signal sequence diagram。

- **INDEX**

  This signal from low to high indicates that the instrument measurement has ended

- **EOC**

  Measure the conversion end signal. See section 4.1.10 for specific signal sequence diagram.

- **HI，IN，LO**

  The signal is valid only if the following conditions are met at the same time.

  a. The sorting function is set to **Sort**

  b. On the measurement display interface

  Hi: indicates that the measurement result is greater than the upper boundary of the comparison

  In: indicates that the measurement result is between the upper and lower boundaries of the comparison

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

  Note: when using this signal, the output signals of **BIN0~BIN9**、**OUT0~OUT7**、**BCD1-0~BCD6-3** output signal is invalid

- **BIN0~BIN9**

  The signal is valid only if the following three conditions are met at the same time.

  a. The sorting function is set to **Bin**

  b. On the measurement display interface

  c. <System Setup>->Bin output“BIN”

  BIN0 to BIN9 Corresponding to the sorting results of BIN 0 to 9 respectively. When the sorting result is "NG", the signal output is high level; When the sorting result is "GD", the low level is output. Please set parameter under page <Sort Setup>.

- **OB**

  This signal is a overall sorting signal. When the sorting results are all "NG", the low level is output. As long as one sorting signal is "GD", high level is output

- **OUT0~OUT7**

  The signal is sent by the remote controller via command *IO:OUT <value>*

bits	7	6	5	4	3	2	1	0
Pin	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0

For example: IO: out 44, the binary corresponding to 44 is 01000100, which corresponds to the output low level of OUT6 and OUT2 in the above table, and the output high level of other signals. This signal can be used to control the action of some relay switches.

Note: when using the above signals, the output signals of HI、IN、LO、BCD3-3~BCD4-3 are invalid.

- **BCD1-0~BCD6-3**

  The signal is valid only if the following three conditions are met at the same time.

  a. On the measurement display interface

  c. < System Setup>->Bin output“BCD”

The measured resistance value has 6 digits in total.
BCD6-0~BCD6-3 BCD code corresponding to hundreds of digits,
BCD5-0~BCD5-3 BCD code corresponding to ten digits，
BCD4-0~BCD4-3 BCD code corresponding to single digit,
BCD3-0~BCD3-3 BCD codes corresponding to deciles,
BCD2-0~BCD2-3 BCD code corresponding to percentile,
BCD1-0~BCD1-3 BCD code corresponding to the thousandth digit.

For example, when the measured resistance value is：498.992，
BCD6-0~BCD6-3 Corresponding number 4，
BCD5-0~BCD5-3 Corresponding number 9，
BCD4-0~BCD4-3 Corresponding number 8，
BCD3-0~BCD3-3 Corresponding number 9，
BCD2-0~BCD2-3 Corresponding number 9，
BCD1-0~BCD1-3 Corresponding number 2。
note：When using this signal，**HI**、**IN**、**LO** output signal is invalid

6.5 Interface and Command

6.5.1 SCPI

6.5.1.1Non-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）。

6.5.1.2Semi-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）。

6.6 MODBUS

6.6.1.1Non-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）

6.6.1.2Semi-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-2301 series DC Resistance Meter	1
2	4-terminal test cable	1
3	Three-Wire power line	1
4	PT100（only for TR-2301）	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℃ to 40℃, 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-2301.sec to U disk，plug U disk to TR-2301(on front panel of TR-2301)
2) Power on TR-2301, 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 TR-2301_command set.pdf**	2021.04
V1.1	Modify description of handler interface	2021.08