UT3510 Series
Bench Top Micro Ohm Meters
User Manual

www.uni-trend.com

Preface

Thank you for purchasing this brand new product. In order to use this product safely and correctly, please read this manual thoroughly, especially the safety notes.

After reading this manual, it is recommended to keep the manual at an easily accessible place, preferably close to the device, for future reference.

Copyright Information

Limited Warranty and Liability

Uni-Trend guarantees that the product is free from any defect in material and workmanship within one year from the purchase date. This warranty does not apply to damage caused by accident, negligence, misuse, modification, contamination or mishandling. The dealer shall not be entitled to give any other warranty on behalf of Uni-Trend. If you need warranty service within the warranty period, please contact your seller directly.

Uni-Trend will not be responsible for any special, indirect, incidental or subsequent damage or loss caused by using this device.

Safety Information

 Warning  Danger: To avoid possible electric shock and personal injury, please follow the instructions below.

Disclaimer	Please read the following safety information carefully before using the instrument. Uni-Trend shall not be liable for any personal injury or property damage caused by failure to comply with the following terms.
Grounding	To prevent the risk of electric shock, please connect the earth wire of the power supply.
DO NOT	Do not use the instrument in a flammable, explosive, steamy, or dusty environment. Using any electronic device in such an environment is a risk to personal safety.
DO NOT	Non-professional personnel are not allowed to open the instrument case. Undischarged charge still exists for a period of time after the instrument is turned off, which may cause an electric shock hazard.
DO NOT	If the instrument does not work properly and its danger is unpredictable, please disconnect the power cord, do not use it again, and do not try to repair it by yourself.
DO NOT	Do not use the instrument in a manner not specified in this manual, or the protection provided by the instrument may be impaired.
	**Warning**: Do not input AC/DC voltages!
	The environment-friendly use period of the instrument is 40 years. After the specified time, it should enter the recovery system.
	Do not discard the instrument or its accessories in the trash. Please properly dispose of them in accordance with local regulations.

Table of Contents

1. Overview

1.1 Models

UT3510 series includes UT3513 and UT3516. The measuring resistance ranges are shown in the table below. For complete technical specifications, see the last chapter.

Model	Accuracy	Measuring range
UT3513	Slow: 0.1% Medium: 0.2%	Resistance: 1μΩ~20KΩ
UT3516	Slow: 0.05% Medium: 0.1% Fast: 0.5%	Resistance: 1μΩ~2MΩ

1.1.1 Features

- 4.3-inch large LCD display
- High-performance ARM microprocessor control and automatic real-time detection
- Highest accuracy: 0.05% (UT3516), minimum resolution: 1μΩ
- Up to 2MΩ measuring range (UT3516), 5-digit display of resistance values, 20000 counts
- Maximum test speed: 60 times/s (UT3516)
- Temperature compensation
- Self-calibration function
- Zero clearing function
- Manual/Auto save
- USB disk storage management function
- 10-scale comparator output and up to 6 PASS scales (UT3516). All comparator results can be output through the Handler interface.
- Handler interface to implement online operation
- RS-232 interface to communicate with computers, PLCs or WINCE devices by SCPI and Modbus RTU protocols
- USB interface to simplify the communication between computers and the instrument
- RS-485 interface to communicate with PLCs by Modbus RTU protocol
- PC software for remote operation and monitoring
- Non-volatile memory
- Keypad lock function
- Screenshot function
- Automatic upgrade of the operating software via USB HOST

1.1.2 Functions

Function	UT3513	UT3516
Measuring range	Resistance: 1μΩ~20KΩ, 7 ranges	1μΩ~2MΩ, 9 ranges
Range selection	Auto, manual, nominal	
Test speed	Slow: 3 times/s Medium: 18 times/s	Slow: 3 times/s Medium: 18 times/s Fast: 60 times/s
Accuracy	Slow: 0.1% Medium: 0.2%	Slow: 0.05% Medium: 0.1% Fast: 0.5%
Maximum reading	20000	
Calibration	Short circuit clearing for full range	
Temperature compensation	Yes	
Temperature compensation cable	Optional	Standard
Comparator sorting	**Sorting function**:  Resistance below lower limit  Resistance above upper limit  Resistance within sorting range. BIN2 in the figure means the resistance is in the range of scale 02.	
	Comparison mode: UT3516: 6-scale sorting, UT3513: a set of comparator Absolute tolerance (±TOL) sorting: The absolute deviation between the measured value and the nominal value is compared with the limits of each scale. Percentage tolerance (%TOL) sorting: The percentage deviation of the measured value and the nominal value is compared with the limits of each scale. Sequence comparison (Direct reading comparison) sorting: The measured value is directly compared with the upper and lower limits.	
	Buzzer: off, beeps for PASS, beeps for FAIL	
Interfaces	**RS-232 interface**: Supports baud rate up to 115200bps and is compatible with SCPI and Modbus RTU protocols.	

	USB interface: Creates a virtual serial port on the computer and is compatible with SCPI and Modbus RTU protocols. **RS-485 interface**: Supports baud rate up to 115200bps and uses the Modbus RTU protocol. **Handler interface**: input/output port with full optocoupler isolation and built-in pull-up resistor, which supports 5V internal and 24V external power supply. Input: trigger signal, output: PASS scales (BIN1~BIN6), HI/LO, OK/NG, measuring synchronization signal (EOC) **Temperature compensation interface**
Test terminal	4-terminal test
Trigger mode	Internal trigger, external trigger
Communication protocol	SCPI
Size	214mm W x 340mm L x 89mm H
Weight	3kg

1.2 Front Panel

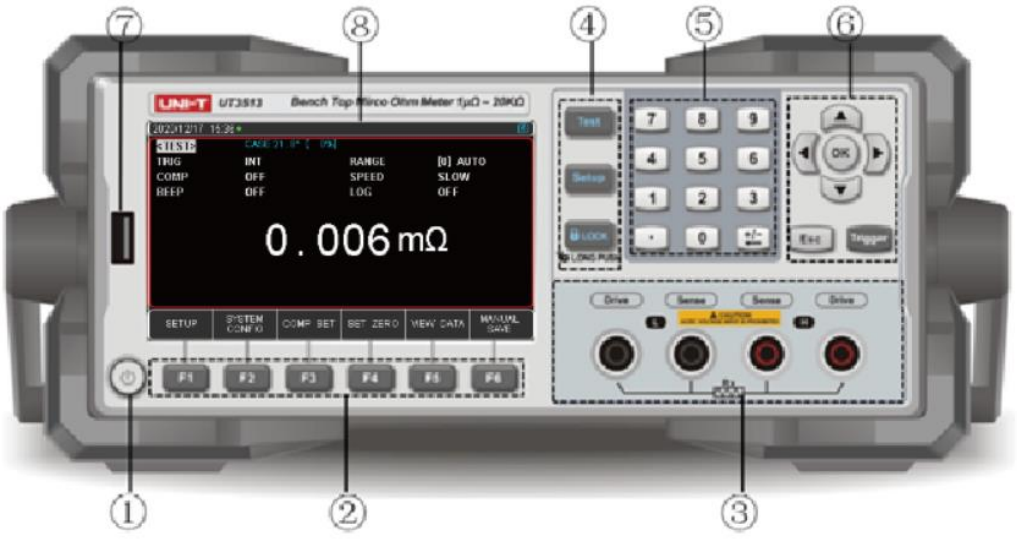


Figure 1-2-1 Front panel (Take UT3513 as an example)

Table 1-2-1 Function description

No.	Item	Description
1		Power switch (touch switch), yellow light for power ON and red light for power OFF
2		Function keys F1~F6. The function changes according to the menu displayed on the screen.
3		4 test terminals: Drive terminals and Sense terminals
4		Test key: Used to display test results
		Setup key: Used to set measurement parameters
		LOCK key: Disables other keys. Press for 1s to unlock.
5		Numeric keypad: Number keys are used to input numerical values; the  key is used for plus/minus sign input and deletion.
6		Arrow keys: Used to move the cursor up, down, left, and right
		OK key: ① Confirms the input value of the numeric keypad. ②Takes a screenshot and saves the picture after a USB disk is inserted.
		Esc Key: Used to cancel/return
		Trigger key: Triggers measurement when the trigger source is external.
7		USB interface
8		4.3-inch LCD display

Table 1-2-2 Display description

Symbol	Description
	A USB disk is inserted into the instrument and can be used to save data or screenshots.
	The buzzer is turned on.
	Total number of current comparator scales
	Keys are locked.
	The test clips are not properly connected to the object under test.
	Sorting scale. BIN2 means the resistance is in the range of scale 02.
	The measured value is above the upper limit of the comparator.

LO	The measured value is below the upper limit of the comparator.
	FAIL (NG) mark for comparison results
	PASS (OK) mark for comparison results

1.3 Rear Panel

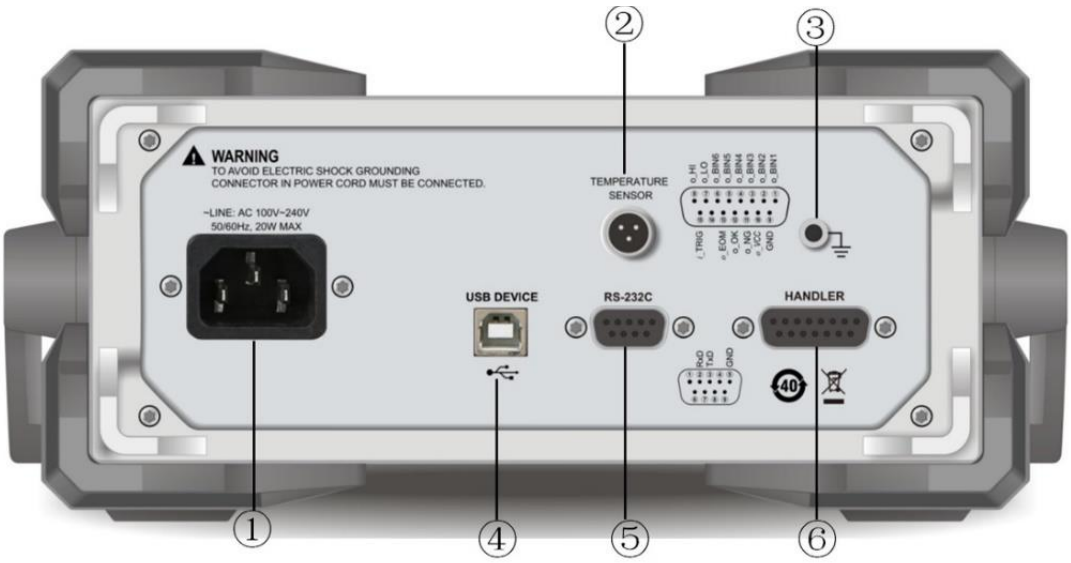


Figure 1-3-1 Rear panel (Take UT3516 as an example)

1. AC power socket (AC 100V~240V)
2. Temperature compensation interface
3. Grounding terminal
4. USB communication interface
5. RS-232C/RS-485 interface
6. Handler interface

2. Inspection and installation

2.1 Packing List

Before using the instrument, please first:

1. Check whether the instrument is damaged or scratched;
2. Check the accessories against the packing list.

If any item is damaged or missing, please contact your supplier immediately.

Item	Quantity	UT3513	UT3516
Micro ohm meter	1	√	√
Power cord	1	√	√
UT-L82 Kelvin test lead	1	√	√
Temperature compensation sensor	1		√
User Manual	1	Electronic file (Download from the official website)	

2.2 Power Requirements

UT3510 series can only be used under the following power conditions:
Voltage: AC 100~240V (1±10%)
Frequency: 50Hz/60Hz (1±10%)

Warning: To prevent the risk of electric shock, please connect the earth wire of the power supply.
If the power cord is replaced, make sure the earth wire of the power cord is reliably connected.

2.3 Environments

UT3510 series must comply with the following environmental conditions:
Index environment: 18°C~28°C (temperature), ≤65% RH (humidity)
Operating environment: 10°C~40°C (temperature), 10~80% RH (humidity)
Storage environment: 0°C~50°C (temperature), 10~90% RH (humidity)

To ensure accurate measurement of the instrument, the warm-up time should be no less than 30 minutes.

2.4 Cleaning

To prevent the risk of electric shock, please unplug the power cord before cleaning.
Please use a clean cloth dipped in a little water to clean the housing and panel.
Do not clean the inside of the instrument.

2.5 Carrying Handle

Caution: Do not use solvents (alcohol, gasoline, etc.) to clean the instrument.

To adjust the position, grasp the handle by the sides and pull outward. Then, rotate the handle to the desired position.

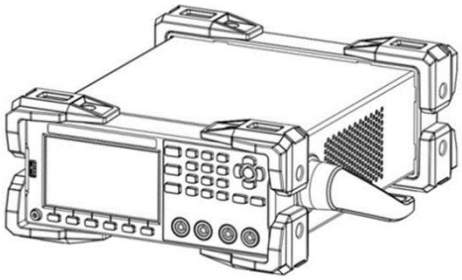


Figure 2-5-1 Original position

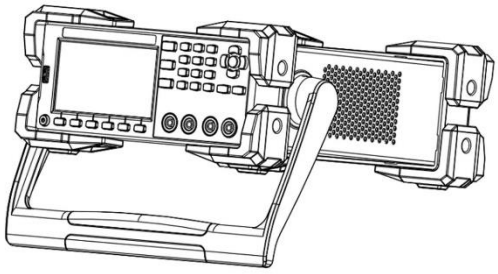


Figure 2-5-2 Test position

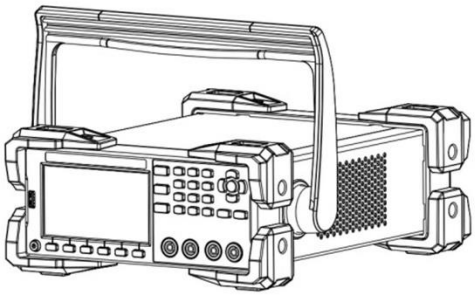


Figure 2-5-3 Removal position

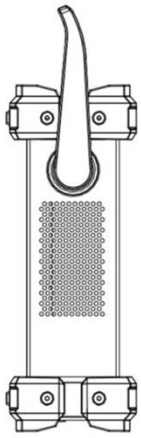


Figure 2-5-4 Carrying position

3. Preparation before Measurement

3.1 Power On/Off

Connect the power cord, if the instrument is normally powered, the power switch lights up in red. Press the power switch to turn on the instrument and the power switch turns yellow. Press the power switch again to turn off the instrument and the power switch turns back to red.

Warning: Make sure the supply voltage meets the power requirements, otherwise the instrument will be burnt out.
Before operating the instrument, make sure that it is well grounded.

3.2 Test Connection

3.2.1 Introduction to Test Lead

A UT-L82 Kelvin test lead specially used for DC resistance test is provided to facilitate more professional measurement.

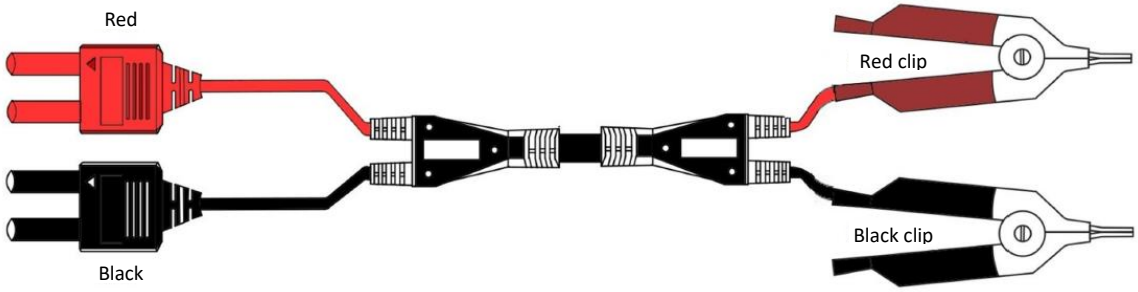


Figure 3-2-1 UT-L82 Kelvin test lead

3.2.2 Test Lead Connection

Before measurement, please follow the steps below to connect the test lead to the test terminals of the instrument.

1. Make sure the instrument is powered off.
2. Make sure no connection is made to the test lead.
3. Connect the test lead to the test terminals of the instrument as shown in Figure 3-2-2. The specific operation is as follows:

➢ Insert the black plug into the black terminals;

- Insert the red plug into the red terminals.
- The ▲ mark of the black plug must match the black Sense terminal of the instrument.
- The ▲ mark of the red plug must match the red Sense terminal of the instrument.

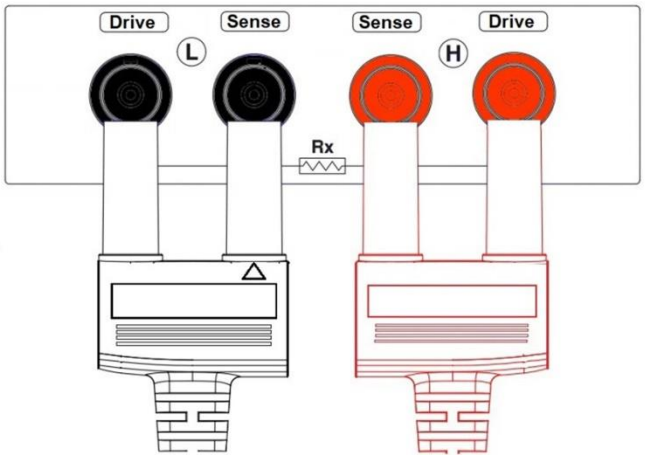


Figure 3-2-2 Connection diagram

Only one side of the red plug has the ▲ mark. When correctly connected, the ▲ mark should be right on the underside of the red plug. So it is not shown in the figure above.

Caution: To ensure the accuracy of the instrument, please use the attached test lead.
Warning: Do not connect AC current/voltage sources directly to the test terminals.

3.3 Zero Clearing

Before measurement, please perform short circuit clearing to remove the stray resistance caused by the test lead or external environmental factors.

If the measured resistance is very small (for example, in the range of 3mΩ or 30mΩ), when clearing, please try to keep the position, length, and shape of the test lead as same as those during subsequent measurement.

3.3.1 Shorting the Test Lead

Before clearing, please short the test clips of the test lead as follows.

Stack the tips of the test clips crosswise as shown in Figure 3-3-1. Make sure the short upper handle of the red clip is located above the holding direction of the hand, and the short upper handle of the black clip is located above the holding direction of the other hand.

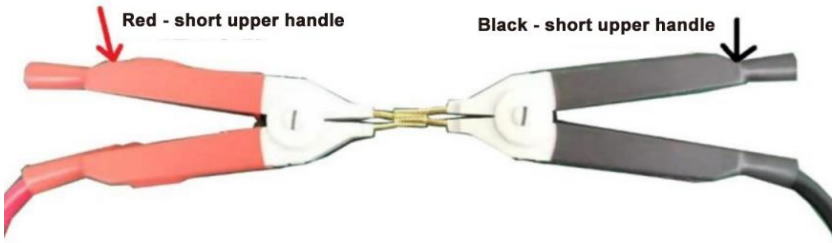


Figure 3-3-1 Shorting mode of the test lead

Caution: During clearing and measurement, the test lead must be kept away from any metal parts, live instruments, or other environments with magnetic fields to ensure measurement accuracy.
During clearing and measurement, please note that the handle directions of the red and black clips must be consistent, otherwise it may cause abnormal measurement.

3.3.2 Short Circuit Clearing

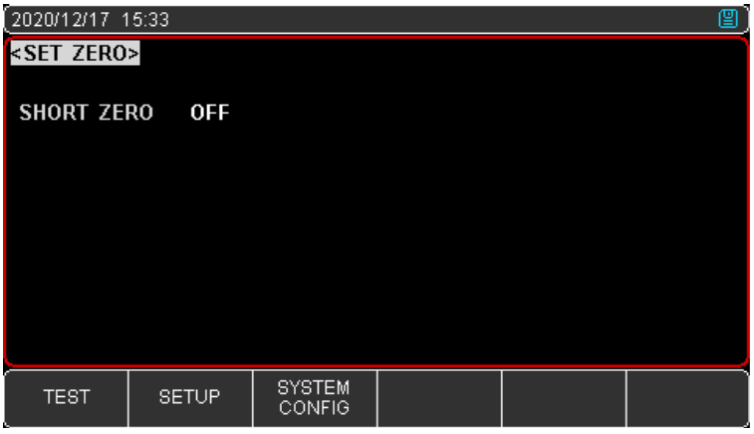


Figure 3-3-2 Short circuit clearing page

Operating steps:

1. Turn on the instrument and the instrument loads the <TEST> page. If the instrument is on but not on the <TEST> page, please press the [Test] key to enter the <TEST> page.
2. Press the function key corresponding to [SET ZERO] at the bottom of the <TEST> page to enter the short circuit clearing page.
3. Use the ▼ key to move the cursor from [SET ZERO] to the “ON” field.
4. Press the function key corresponding to [SHORT ZERO] and “Short-circuit the test terminals” will be displayed at the bottom of the screen. Short the test clips according to last section, execute the “OK” command, and the system executes the clearing procedure. After clearing, “Correction completed, data saved" flashes on the top of the screen, and then the screen returns to the <TEST> page.
5. Press the function key corresponding to [OFF] if clearing is not needed.
6. If clearing fails, “Correction fail” will be displayed at the top of the screen. Check whether the test clips are properly shorted, and repeat step 4.

4. <TEST> Page

4.1 <TEST> Page

<TEST> page is mainly used to display measurement and sorting results. The following 6 common functions can be set on this page.

- TRIG (Trigger) – trigger mode
- COMP (Comparator) – comparator scale
- BEEP – buzzer indication for test results
- RANGE – test range
- SPEED – test speed
- STAT – logging or statistics (Refer to Chapter 7)

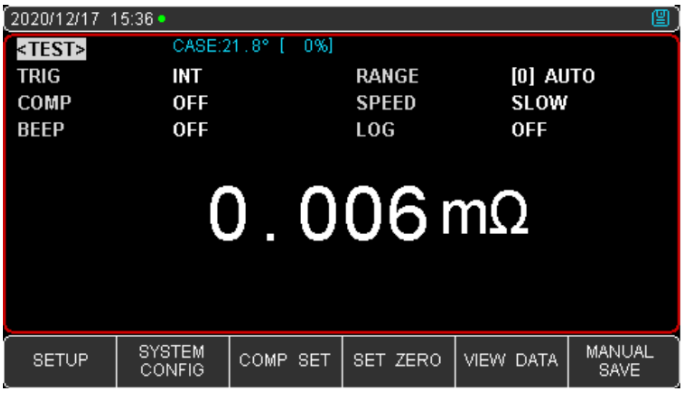


Figure 4-1 <TEST> page

4.1.1 [TRIG]

The instrument has 2 trigger modes: internal trigger and external trigger (manual/Handler/remote).

Function	Description
Internal trigger	Also called continuous test. The trigger signal is continuously tested within the instrument according to the natural period. This mode is generally chosen for measurement.
External trigger	Manual: Each time the [Trigger] key is pressed, the instrument executes a measurement period. At other times, the instrument is in the waiting state.
	Handler: Upon receiving a rising edge pulse from the Handler interface, the instrument executes a measurement period. At other times, the instrument is in the waiting state. Refer to the Handler interface.
	Remote: Send a command to trigger, the instrument measures once and returns the measured value.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [TRIG] field.
3. Use the function keys to select the desired trigger mode.

4.1.2 [COMP]

The comparator of the instrument has up to 6 scales (UT3513: 1 scale, UT3516: 6 scales). For specific setting of the comparator, please refer to Chapter 6.

Steps to turn on the comparator:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [COMP] field.
3. Use the function keys to select the desired comparator scale.

4.1.3 [BEEP]

The beep function is only available when the comparator is on.

- OFF – no sound output
- PASS – The buzzer beeps when the measurement result is within the setting range of the comparator.
- FAIL – The buzzer beeps when the measurement result is outside the setting range of the comparator.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [BEEP] field.
3. Use the function keys to select OFF, PASS, or FAIL as needed.

4.1.4 [RANGE]

The instrument has 3 range modes: auto, manual, and nominal.

Table 4-1-4 Range description

Range mode	Description	Advantages	Disadvantages
Auto	The instrument automatically selects the optimal range.	No user involvement is required.	In auto range mode, the range needs to be predicted and the test speed will be lower than in manual range mode.
Manual	The instrument always tests at the range specified by the user.	The test speed is the highest.	Users need to select the range manually.
Nominal	In nominal range mode, there are 2 ways to select the range: 1. During SEQ comparison, the instrument selects the optimal range based on the upper limits of all enabled scales of the comparator. 2. During Δ and Δ% comparison, the instrument automatically selects the optimal range based on the nominal value.	It is the best way for sorting tests and the speed is the highest.	Suitable for sorting tests only

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [RANGE] field.

3. Use the function keys to select the desired range mode and range. “INC +” means to increase the range number; “DEC -” means to decrease the range number.

In auto range mode, the instrument performs range prediction in each measurement period, so the test speed is slightly lower. Besides, frequent changes to the range slows down the response.
Usually, manual range mode is suitable for sorting tests instead of auto range mode.

4.1.5 [SPEED]

UT3516 supports 3 test speeds (slow, medium, fast), UT3513 supports two test speeds (slow, medium). The lower the speed, the more accurate and stable the test result is. The sampling time is as follows:

- Slow: 3 times/s
- Medium: 18 times/s
- Fast: 60 times/s

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [SPEED] field.
3. Use the function keys to select the desired test speed.

4.1.6 [STAT]

Refer to Chapter 7.

4.2 Saving and Viewing Data

The measured value can be manually saved (up to 500 sets of data can be stored) and quickly viewed on the instrument.

Press the function key corresponding to [MANUAL SAVE] to save the data manually. Each time the key is pressed, the data is saved once. Press the function key corresponding to [VIEW DATA] to view the saved measurement data, as shown in Figure 4-2-1.

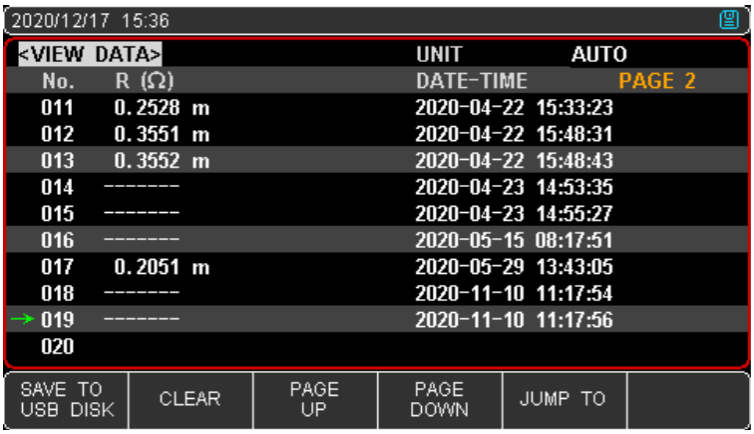


Figure 4-2-1 <VIEW DATA> page

On the <VIEW DATA> page, users can also use the function keys to do the following on the data:

- SAVE TO USB DISK: After a USB disk is inserted, the corresponding function key can be used to save the data in the "VIEW DATA" folder of the USB disk.
- CLEAR: The corresponding function key can be used to clear all data.
- PAGE UP/PAGE DOWN/JUMP TO: The corresponding function keys can be used to page up/page down/jump to a page.
- To delete a row of data, use the arrow keys to stop the cursor on the row, and press the function key corresponding to[DELETE] to delete it.

4.3 Screenshot Function

Insert a USB disk into the USB interface on the front panel and press the [OK] key to takes a screenshot and save it in the "Screen" folder of the USB disk for later reference.

It is recommended to use a branded USB disk. The format can be FAT, FAT32, or EXFAT, and the maximum capacity is 128G.
When data is being collected, the screenshot may fail, which can be executed after the collection is completed.

5. <SETUP> Page

5.1 Measurement Parameters

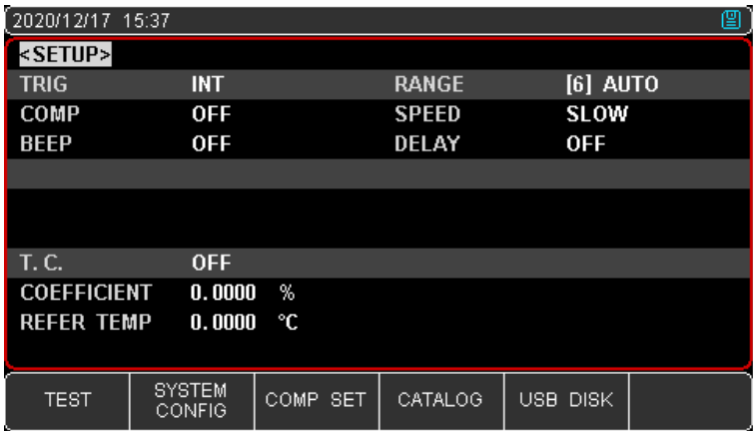


Figure 5-1 <SETUP> page

All settings related to measurement are operated on the <SETUP> page, among which [TRIG], [COMP], [BEEP], [RANGE], and [SPEED] can also be set on the <TEST> page. For these settings, please refer to Chapter 4.1.

The remaining settings include the following parameters:

- DELAY – delay before external trigger measurement
- COEFFICIENT – temperature coefficient
- REFER TEMP – reference temperature

5.1.1 [DELAY]

In external trigger mode, in order to synchronize with the external device, sometimes it is necessary to set a trigger delay to ensure reliable measurement.

The trigger delay refers to a time delay between the trigger and the start of the measurement.

The maximum trigger delay time can be set to 10s.

Setting steps:

1. Press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [DELAY] field.

3. Use the function key to turn on/off the delay function as needed.
4. If on, use the numeric keypad to input the time value to be delayed.

5.1.2 [T.C.] (Temperature Compensation)

UT3516 comes with a standard temperature compensation sensor (as shown in the figure below), and for UT3513, it is optional. If necessary, please contact your seller for purchase.

Figure 5-1-2 Temperature compensation sensor

The instrument has a built-in temperature compensation circuit, which can compensates for deviation of measured values caused by temperature. Please connect the temperature compensation sensor to the temperature compensation interface of the instrument.

The compensation formula is as follows:

$$F2 = \frac{100 + \alpha \times (T - T_0)}{100} \times F1$$

T_0 – Reference temperature
T – Current measured temperature
α – Temperature coefficient at reference temperature (%)
F1 – Uncompensated value
F2 – Value after temperature compensation

To turn on/off temperature compensation:

1. Press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [T.C.] field.
3. Use the function keys to select OFF or ON as needed.

Temperature coefficient (α) setting steps:

1. Press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [COEFFICIENT] field.
3. Use the numeric keypad to input the required temperature coefficient.
   For example, the temperature coefficient of copper is 0.393%. Just enter 0.393 here.

Reference temperature (T_0) setting steps:

1. Press the [Setup] key to enter the <SETUP> page.
2. Use the ▼ key to move the cursor to the [REFER TEMP] field.
3. Use the numeric keypad to input the required reference temperature value.

5.2 File Management

Press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [CATALOG] to enter the <CATALOG> page. Users can save settings to 10 files in the catalog for easy reading at power-on or in changing specifications.

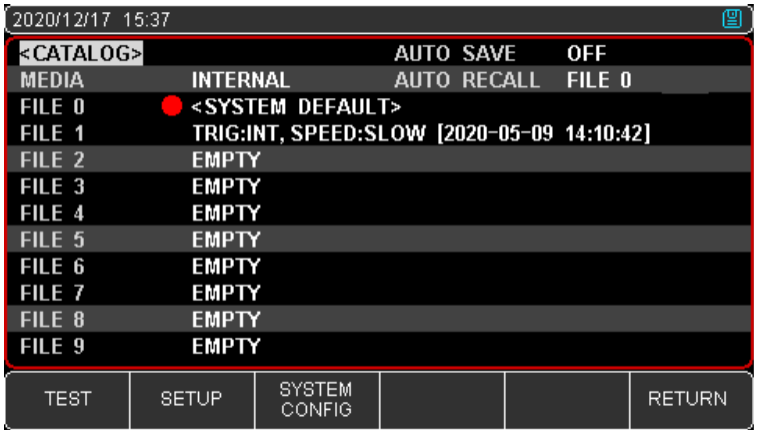


Figure 5-2 <CATALOG> page

5.2.1 [AUTO RECALL]

[AUTO RECALL] option specifies the file (FILE 0 or CURRENT FILE) to be recalled at power-on. If FILE 0 is selected, the setting value of FILE 0 will be loaded at power-on; if CURRENT FILE is selected, the setting value of the current file number will be loaded at power-on.

Setting steps:

1. Use the arrow keys to move the cursor to the [AUTO RECALL] field on the <CATALOG> page.

2. Use the function keys to select FILE 0 or CURRENT FILE.

5.2.2 [AUTO SAVE]

If [AUTO SAVE] is on, the parameters set by users will be automatically saved to the current file after shutdown; if [AUTO SAVE] is off, the parameters set by users can only be manually saved to the file, otherwise they will be lost at next power-on.

Setting steps:

1. Use the arrow keys to move the cursor to the [AUTO SAVE] field on the <CATALOG> page.
2. Use the function keys to select ON or OFF.

5.2.3 [FILE 0] ~ [FILE 9]

Users can specify a total of 10 files from 0 to 9 to save, recall and delete.

Function	Description
SAVE	Saves all settings to the current file
RECALL	Recalls the parameters of the file to the system
ERASE	Erases the file data
MODIFY DES	Modifies the file name (customizable)

Setting steps:

1. Use the arrow keys to select any field that needs to be set of [FILE 0] ~ [FILE 9] on the <CATALOG> page.
2. Use the function keys to select SAVE, RECALL, ERASE, or MODIFY DES as needed.

5.2.4 [MEDIA]

The files in the catalog can be saved inside the instrument or in a USB disk for recall.

Setting steps:

1. Use the arrow keys to move the cursor to the [MEDIA] field on the <CATALOG> page.
2. Use the function keys to select [INTERNAL] or [USB-DISK] for saving.

5.3 USB Disk Storage

If users have no special requirements, test data generated by the instrument during measurement will be automatically saved in the "TEST DATA" folder of the USB disk according to its own program settings, and the file name will be accumulated from TEST0001.

Users can also manage the storage of USB disk on the <USB DISK> page, create their own EXCEL file names, and select their own display mode of resistance unit. If “AUTO OPEN” is set to “ON”, the test data will be automatically saved under the file name specified by users. The files set by users are stored in the "DATA" folder of the USB disk.

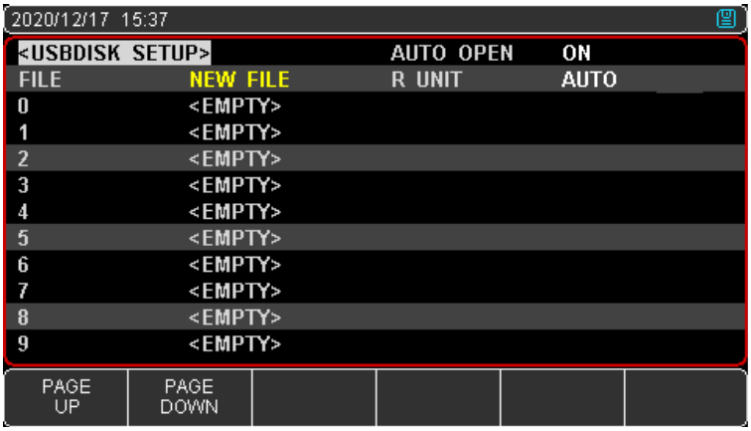


Figure 5-3 <USBDISK SETUP> page

Setting steps:

1. Press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [USB DISK] to enter the <USBDISK SETUP> page (If no USB disk is inserted at this time, “DISK NOT READY” will be displayed on the page to remind users to insert a USB disk into the interface on the front panel of the instrument).
2. Use the arrow keys to move the cursor to the [AUTO OPEN] field; if “ON” is selected, each time the USB disk is inserted, the instrument will detect whether there is a recently used file in it, and if there is, it will automatically open the file and use it for logging.
3. Use the arrow keys to move the cursor to the [R UNIT] field to select the desired unit of data storage. Due to the large span of measurement value units, in order to facilitate users to organize the data later, the stored data unit can be preset.

Function	Description
AUTO	The measurement data unit is consistent with the measurement result on the <TEST> page.
mΩ	The measurement data unit is fixed at mΩ.
Ω	The measurement data unit is fixed at Ω.
kΩ	The measurement data unit is fixed at kΩ.
MΩ	The measurement data unit is fixed at MΩ.
SCI. NOTE.	The measurement data format is scientific notation, of which the form is decimal + exponent. The unit is Ω.

4. Use the arrow keys to move the cursor to the [NEW FILE] field, and use the arrow keys and numeric keypad to create a new file in the USB disk. The file name can be customized.
5. The file format is fixed to CSV. The files set by users will be stored in the "DATA" folder of the USB disk.
6. The created folder can also be opened, closed and deleted through the function keys.

6. Comparator Sorting

6.1 Comparator Setting

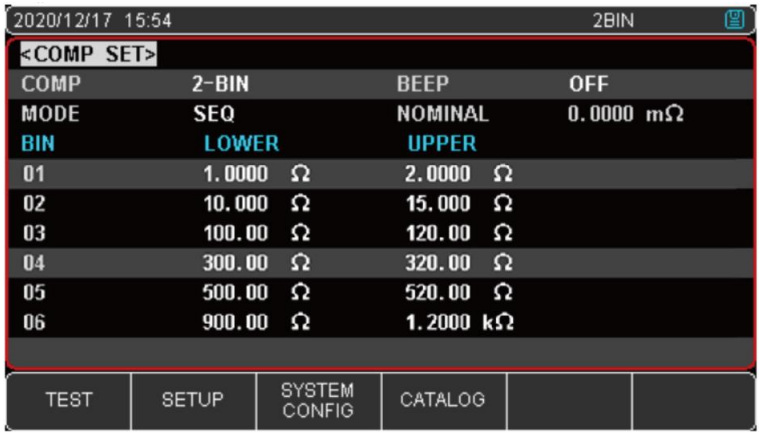


Figure 6-1 <COMP SET> page (Take UT3516 as an example)

6.1.1 [COMP SET]

The comparator of UT3516 has 6 scales and an “OFF” option. Users can select appropriate scales according to measurement needs.

The comparator of UT3513 only has 1 scale and an “OFF” option.

Setting steps:

1. Press the [Test] or [Setup] key, and press the function key corresponding to [COMP SET] to enter the <COMP SET> page.
2. Use the arrow keys to move the cursor to the [COMP] field.
3. Use the function keys to select an appropriate scale as needed.
4. After setting, press the [Test] key to enter the <TEST> page for measurement.

6.1.2 [BEEP] Setting

The beep function is only available when the comparator is on.

It can be set to OFF, PASS, and FAIL.

PASS: The buzzer beeps when the sorting result is PASS.

FAIL: The buzzer beeps when the sorting result is FAIL.

Setting steps:

1. Press the [Test] or [Setup] key, and press the function key corresponding to [COMP SET] to enter the <COMP SET> page.
2. Use the arrow keys to move the cursor to the [BEEP] field.
3. Use the function keys to select OFF, PASS, or FAIL as needed.

6.1.3 Comparison Mode Selection

There are three comparison modes for the built-in comparator:

a) ABS Δ (absolute value) ---------- ABS Δ = measured value - nominal value
b) PER Δ% (percentage or relative value) ---------- PER Δ% = (measured value - nominal value) / nominal value × 100%
c) SEQ (direct reading) ---------- The measured value is directly compared with the upper and lower limits.

Setting steps:

1. Press the [Test] or [Setup] key, and press the function key corresponding to [COMP SET] to enter the <COMP SET> page.
2. Use the arrow keys to move the cursor to the [MODE] field.
3. Use the function keys to select SEQ, ABS, or PER as needed.

For example:

In SEQ mode, the measured value is directly compared with the upper and lower limits, so the nominal value is not required to participate in the calculation. When the measured value is 0.128mΩ, 0.128mΩ is directly displayed on the measurement interface.

In ABS Δ mode, when the input nominal value is 0.1mΩ and the measured value is 0.125mΩ, the ABS Δ = measured value - nominal value = 0.125 - 0.1 = 0.025 mΩ. The measurement interface is displayed as below.

In PER Δ% mode, when the input nominal value is 0.1mΩ and the measured value is 0.127mΩ, the PER Δ% = (measured value - nominal value) / nominal value × 100% = 26.82%. The measurement interface is displayed as below.

6.1.4 [NOMINAL] Input

For ABS Δ and Δ% modes, a nominal value must be entered.

Setting steps:

1. Press the [Test] or [Setup] key, and press the function key corresponding to [COMP SET] to enter the <COMP SET> page.
2. Use the arrow keys to move the cursor to the [NOMINAL] field.
3. Use the numeric keypad to input data, and use the function keys to select the unit.

6.1.5 [LOWER] and [UPPER] Setting

Setting steps:

1. Press the [Test] or [Setup] key, and press the function key corresponding to [COMP SET] to enter the <COMP SET> page.
2. Move the cursor to the [LOWER] or [UPPER] field, use the numeric keypad to input data, and use the function keys to select the unit.
3. Note: For PER Δ% mode, please enter a percentage value; for ABS Δ and SEQ modes, please use the function keys to select the unit.

Caution:

1. When setting the upper and lower limits of the comparator, make sure the upper limit of scale n > the lower limit of scale n.
2. When setting the upper and lower limits of multiple scales, keep the upper and lower limits from scale 01 to scale n increasing and continuously set to avoid program misjudgment, that is, keep:
   Upper limit of scale n > lower limit of scale n
   Lower limit of scale n ≥ upper limit of scale n-1

6.2 Display and Discrimination

6.2.1 Comparator On

When the comparator is on, the scale is displayed, which means the comparator function has been turned on. At this time, it is normal for the screen to display the discrimination symbols  and  . "  " means the test clips are not properly connected to the object under test. At this time, please correct the connection.

In different modes, the comparator corresponds to different judgment procedures, which are as follows:

6.2.2 SEQ Mode

In SEQ mode, there are several discrimination situations as follows:

If the measured value is in the range of a certain scale of the comparator, the PASS mark will appear on the screen. Different scales correspond to different displays.  represents scale 01, indicating that the measured value is in the range of scale 01 of the comparator.  represents scale 02, and so on.

If the measured value is less than the lower limit of scale 01,  will be displayed.

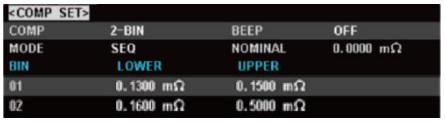
If the measured value is greater than the upper limit of the maximum set scale,  will be displayed.

If the measured value is not in the range of any scale and the scales are not set continuously,  will be displayed.

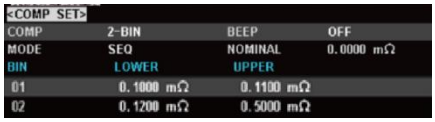
At this time, if the BEEP is set to PASS, the instrument will beep for pass situations; if the BEEP is set to FAIL, the instrument will beep for fail situations; if the BEEP is set to OFF, there will be no beep.

For example:

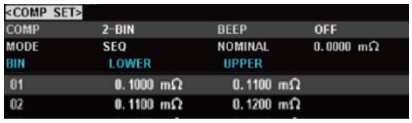
1. As shown in the figure below, in SEQ mode, the measured value (0.126mΩ) is less than the lower limit of scale 01 (0.1300mΩ) and  is displayed.



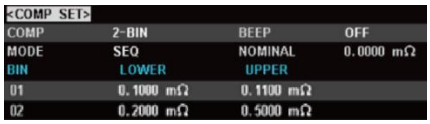
2. As shown in the figure below, in SEQ mode, the measured value (0.126mΩ) is in the range of scale 02 and  is displayed.



3. As shown in the figure below, in SEQ mode, the measured value (0.126mΩ) is greater than the upper limit of the maximum scale 02 and  is displayed.



4. As shown in the figure below, in SEQ mode, the measured value (0.126mΩ) is between the upper limit of scale 01 and the lower limit of scale 02, which is neither in the range of scale 01 nor scale 02, and  is displayed.



6.2.3 ABS Δ mode

In ABS Δ mode: ABS Δ = measured value - nominal value

If the ABS Δ is in the range of a certain scale of the comparator, the PASS mark will appear on the screen. Different scales correspond to different displays.  represents scale 01, indicating that the ABS Δ is in the range of scale 01 of the comparator.  represents scale 02, and so on.

If the ABS Δ is less than the lower limit of scale 01,  will be displayed.

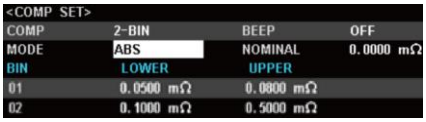
If the ABS Δ is greater than the upper limit of the maximum set scale,  will be displayed.

If the ABS Δ is not in the range of any scale and the scales are not set continuously,  will be displayed.

For example:

When the input nominal value is 0.1mΩ and the measured value is 0.127mΩ, the ABS Δ = measured value - nominal value = 0.127 - 0.1 = 0.027 mΩ. The measurement interface is displayed as below.

If the comparator is set as shown in the figure below at this time, scale 01 (0.0500, 0.0800) scale 02 (0.1000, 0.5000)



The ABS Δ (0.027mΩ) is less than the lower limit of scale 01 (0.0500mΩ) and  is displayed.

6.2.4 PER Δ% Mode

In PER Δ% mode: PER Δ% = (measured value - nominal value) / nominal value × 100%

If the PER Δ% is in the range of a certain scale of the comparator, the PASS mark will appear on the screen. Different scales correspond to different displays.  represents scale 01, indicating that the PER Δ% is in the range of scale 01 of the comparator.  represents scale 02, and so on.

If the PER Δ% is less than the lower limit of scale 01,  will be displayed.

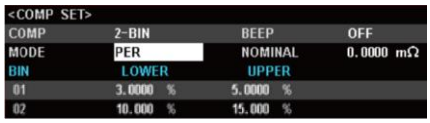
If the PER Δ% is greater than the upper limit of the maximum set scale,  will be displayed.

If the ⚠ PER Δ% is not in the range of any scale and the scales are not set continuously,  will be displayed.

For example:

When the input nominal value is 0.1mΩ and the measured value is 0.127mΩ, the PER Δ% = (measured value - nominal value) / nominal value × 100% = 26.82%. The measurement interface is displayed as below.

If the comparator is set as shown in the figure below at this time, scale 01 (3.0000, 5.0000)%, scale 02 (10.000, 15.000)%



The PER Δ% (26.82%) is greater than the upper limit of the maximum scale 02 (15%) and  is displayed.

Caution:

1. When setting the upper and lower limits of the comparator, make sure the upper limit of scale n > the lower limit of scale n.
2. When setting the upper and lower limits of multiple scales, keep the upper and lower limits from scale 01 to scale n increasing and continuously set to avoid program misjudgment, that is, keep:
   Upper limit of scale n > lower limit of scale n
   Lower limit of scale n ≥ upper limit of scale n-1
3. When the sorting result of scale 01 is PASS, other scales are no longer judged (Scales should be set continuously from low to high).

7. Logging and Statistics

7.1 Data Logging

7.1.1 Enabling Logging Function

The instrument has [LOG] and [STAT] functions. Through [LOG] function, 10000 sets of data can be logged, and the measurement data can be stored in the instrument buffer in real time. These data can be sent to a computer through the communication interface, or directly saved as CSV formatted text to a USB disk.

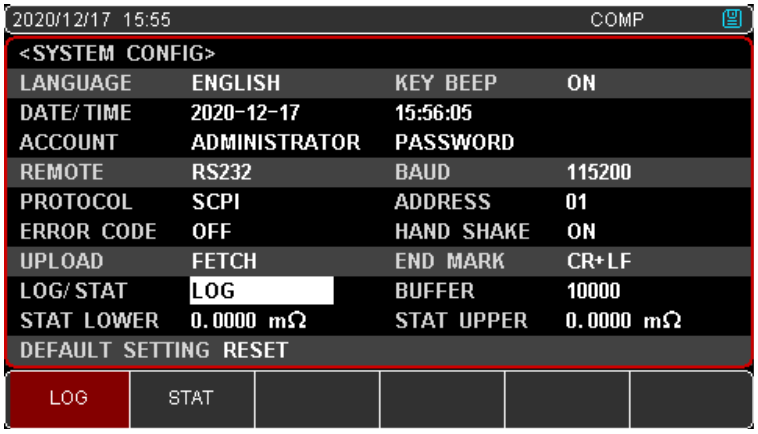


Figure 7-1-1-1 Enabling [LOG] on the <SYSTEM CONFIG> page

The instrument defaults to [LOG] function and 10000 sets of data buffer. The settings can be changed on the <SYSTEM CONFIG> page.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [LOG/STAT] field.
3. Press the function key corresponding to [LOG] to enable the logging function and set the data logging buffer to the maximum: 10000 sets. Users can also use the numeric keypad to input the required buffer size. For example, input 50 to set the buffer size to 50 sets.
4. After that, press the [Test] key and the [LOG] field will appear on the <TEST> page.
5. If logging is needed, move the cursor to the [LOG] field, and press the function key corresponding to [START] to start logging.

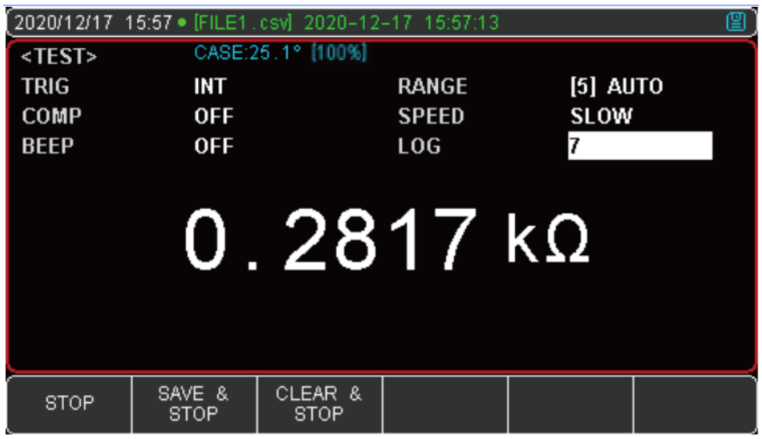


Figure 7-1-1-2 Logging page

6. After that, as shown in Figure 7-1-1-2, the instrument will automatically log the data. Users can use the function keys to stop logging, save the data to a USB disk, and stop and clear the cached data at any time.

Once data logging is started, the <TEST> page is locked and cannot be switched to other pages.
In the external trigger state, data logging must also be stopped before switching to other pages. After switching from other pages to the <TEST> page, the data logging will automatically start.

7.1.2 Saving Data

After data logging is started, users can save the data to a USB disk at any time. As shown in Figure 7-1-2, the test data is saved in the “TEST DATA” folder, and the file format is CSV.

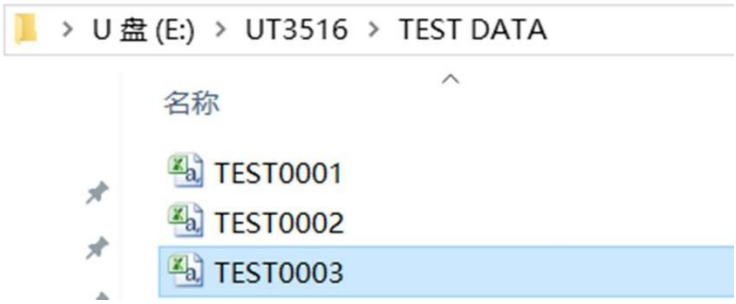


Figure 7-1-2 Data folder in USB disk

In Windows operating system, the files are opened with Excel. Due to the default format of Excel, the cell properties need to be correctly modified according to the following steps, and then the TIME/R (OHM) field (painted in yellow in the figure below) can display the data correctly.

Figure 7-1-3 shows the effect after opening data, and Figure 7-1-4 shows the effect after modifying cells.

MODEL	UT3516	REV B1.09
TIME	##############	
DCR:		
	HI	0.280 mOHM
	MEAN	0.291 mOHM
	MAX	3.799 mOHM
	MIN	0.033 mOHM
	POPULATION	0.0004
	SAMPLE	0.0004
	CP	0.015
	CPK	0
No.	R(OHM)	COMP
1	2.63E-04	
2	2.33E-04	
3	2.64E-04	
4	1.29E-04	

Figure 7-1-3 Before editing with Excel

MODEL	UT3516	REV B1.09
TIME	2020-6-4 12:01:22	
DCR:		
	HI	0.280 mOHM
	MEAN	0.291 mOHM
	MAX	3.799 mOHM
	MIN	0.033 mOHM
	POPULATION	0.0004
	SAMPLE	0.0004
	CP	0.015
	CPK	0
No.	R(OHM)	COMP
1	2.6340E-04	
2	2.3330E-04	
3	2.6430E-04	
4	1.2940E-04	

Figure 7-1-4 After editing with Excel

Specific steps of cell modification are as follows:

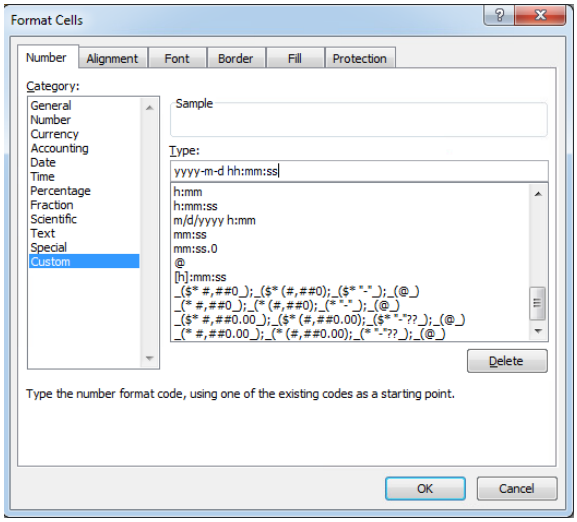


Figure 7-1-5 Customizing time format

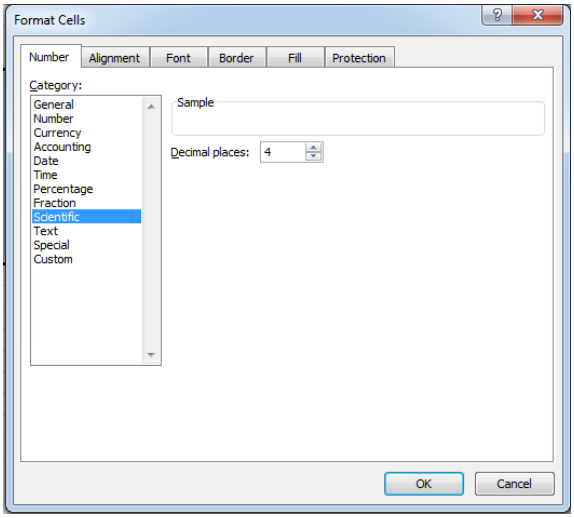


Figure 7-1-6 Scientific notation

1. To modify the format of TIME field, select the cell, right click the mouse, select “Format Cells”, select "Customize" on the left side of the open window, and enter: yyyy-m-d hh:mm:ss in the red box, as shown in Figure 7-1-5.
2. To modify the format of R (OHM) field, select the cells, and set the cell properties to: scientific notation, 4 decimal places, as shown in Figure 7-1-6.

7.2 Statistics

7.2.1 Process Capability Index

Process capability refers to the ability to meet the quality of processing in terms of process processing. It is a measure of the internal consistency of process processing and the minimum fluctuation in the most stable state. When the process is in a steady state, 99.73% of the product quality characteristic values are scattered in the interval [μ-3σ, μ+3σ], where μ is the overall mean value of the product characteristic values, and σ is the overall standard deviation of the product characteristic values. Almost all product characteristic values are within the range of 6σ. Therefore, 6σ is usually used to represent process capability, and the smaller the value, the better.

Usually,

Cp, CpK> 1.33	Sufficient process capability
1.00 < Cp, CpK ≤ 1.33	Appropriate process capability
Cp, CpK ≤ 1.00	Insufficient process capability

Process capability index and some related formulas:

Process capability index	Formula
Mean	$\overline{x} = \frac{\sum_{n=1}^{n} x}{n}$
Population standard deviation σn	$\sigma_n = \sqrt{\frac{\sum(x-\overline{x})^2}{n}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n}}$
Sample standard deviation s (=σn-1)	$s = \sigma_{n-1} = \sqrt{\frac{\sum(x-\overline{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n-1}}$
Process capability index (deviation) Cp	$Cp = \frac{\lvert Hi - Lo \rvert}{6\sigma_{n-1}}$
Process capability index (offset) CpK	$CpK = \frac{\lvert Hi - Lo \rvert - \lvert Hi + Lo - 2\overline{x} \rvert}{6\sigma_{n-1}}$

In the above formulas,

a) n represents valid data, that is, as long as the data that excludes overflow and open circuit values can display numbers on the screen is regarded as valid.
b) The Hi and Lo variables in the Cp and CpK formulas are the actual values of the upper and lower limits of the comparator. In ABS Δ and PER Δ% modes, actual values will be converted from nominal values. The values will participate in the calculation regardless of whether the comparator is on.
   c) When s = σn-1 = 0, Cp = 99.99, CpK = 99.99
   d) When CpK < 0, CpK = 0

7.2.2 Enabling Statistics Function

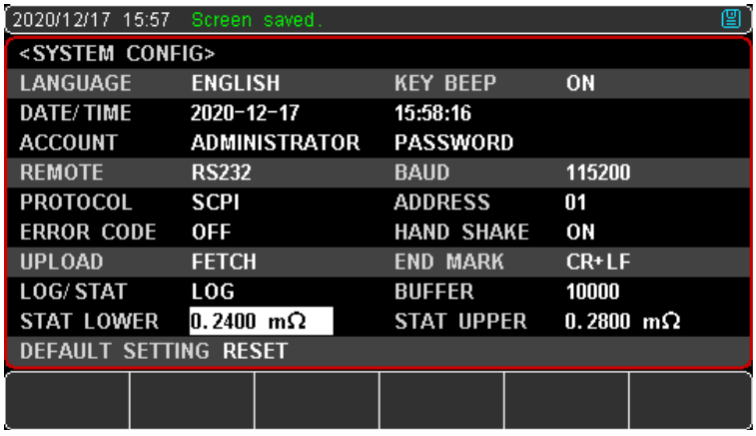


Figure 7-2-2-1 <SYSTEM CONFIG> page

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. As shown in Figure 7-2-2-1, use the arrow keys to move the cursor to the [LOG/STAT] field.
3. Press the function key corresponding to [STAT] to enable the statistics function and set the data logging buffer to the maximum: 10000 sets. Users can also use the numeric keypad to input the required buffer size. For example, input 50 to set the buffer size to 50 sets.
4. Move the cursor to the [STAT LOWER] and [STAT UPPER] fields, and use the numeric keypad to input the upper and lower limits. Make sure the upper limit > the lower limit.
5. After that, press the [Test] key and the [STAT] field will appear on the <TEST> page. At the same time, the following fields will be displayed at the bottom of the page.

Function	Description
MEAN($\overline{x}$)	Mean value
MAX	Maximum value
MIN	Minimum value
σ	Population standard deviation
s	Sample standard deviation
Cp	Process capability index (deviation)
CpK	Process capability index (offset)

6. Move the cursor to the [STAT] field, and press the function key corresponding to [START] to perform statistics. Note: To avoid many invalid repeated data, Note: To avoid a lot of invalid repetitive data, manual statistics is required by the instrument, and users can perform numerical statistics of test objects in batches.

Figure 7-2-2-2 Statistics page

7. After that, the instrument will automatically calculate $\overline{x}$, MAX, MIN and other values based on the test specimens. As shown in Figure 7-2-2-2, users can use the function keys to stop logging, save the data to a USB disk, and stop and clear the cached data at any time.

The statistics function can only be set after it is enabled on the <SYSTEM CONFIG> page.

After the statistics function is started, the instrument needs to perform complex calculations on multiple parameters and the measurement speed will slow down slightly.

Once data logging is started, the <TEST> page is locked and cannot be switched to other pages.

In the external trigger state, data logging must also be stopped before switching to other pages. After switching from other pages to the <TEST> page, the data logging will automatically start.

8. System Configuration

8.1 System Configuration Settings

The <SYSTEM CONFIG> page mainly includes system configuration such as language, date, time, key beep, remote control, and factory reset.

To enter the <SYSTEM CONFIG> page, press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and then press the function key corresponding to [SYSTEM CONFIG].

All settings on the system configuration page will be automatically saved in the system and automatically loaded when the instrument is turned on next time.

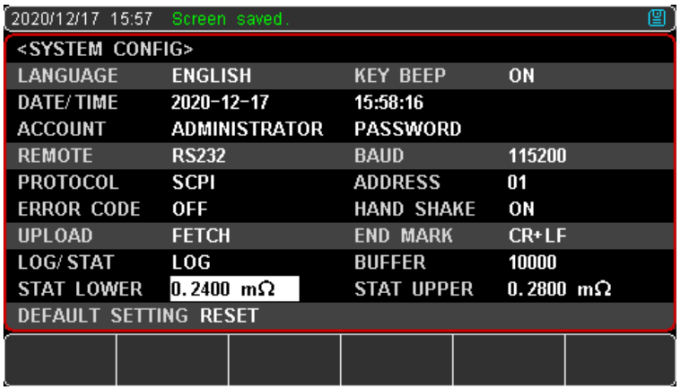


Figure 8-1 <SYSTEM CONFIG> page

8.1.1 [LANGUAGE] Setting

The instrument only supports Chinese and English.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [LANGUAGE] field.
3. Use the function keys to select CHN or ENGLISH as needed.

8.1.2 [KEY BEEP] Setting

The keys can be set with or without prompt tone.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [KEY BEEP] field.
3. Use the function keys to select ON or OFF as needed to turn on/off the key beep.

8.1.3 [DATE/TIME] Setting

The instrument uses a 24-hour clock and the date and time can be modified.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the date or time.
3. Use the function keys to set the date or time as needed. “+” means to increase the value by 1, and “-” means to decrease the value by 1. For example, YEAR INCR +, MONTH INCR +, DAY INCR +, HOUR INCR +, MINUTE INCR +, SECOND INCR + represents +1 year, +1 month, +1 day, +1 hour, +1 minute, and +1 second respectively.

8.1.4 [ACCOUNT] Setting

The instrument has two user modes:

ADMINISTRATOR – Except the [SYSTEM SERVICE] page, other functions are open to the administrator, and the parameters set by the administrator are saved in the system memory after a delay of 5 seconds, so that they can be loaded after next startup.

USER – Except the [SYSTEM SERVICES] and [FILE] pages, other functions are open to the user, and the data modified by the user will be restored to the value set by the administrator after next startup.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [ACCOUNT] field.
3. Use the function keys to select ADMIN or USER as needed.
4. The password can be deleted or changed. It can be set up to 9 digits and only includes numbers and symbols.

8.1.5 [REMOTE] Setting

[REMOTE] allows users to select the RS-232 interface or USB communication interface for remote control. If the RS232 interface is selected, please insert the communication cable into the RS-232C interface on the rear panel. If the USB interface is selected, please insert the communication cable into the USB interface on the rear panel.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [REMOTE] field.
3. Use the function keys to select RS232 or USB as needed.

8.1.6 [BAUD] Setting

After sensing signal conversion of the RS-232 or USB interface, the instrument will immediately communicate with the host computer at the set baud rate and the keypad will be locked at the same time. For correct communication, make sure the baud rate and stop bit are set correctly.

The configuration of RS-232 is as follows:

- Data bit: 8 bits
- Stop bit: 1 bit
- Parity check: none
- Baud rate: configurable

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [BAUD] field.
3. Press the function keys to select the desired baud rate (4800, 9600, 19200, 38400, 57600, or 115200).
4. 115200 is recommended to communicate with the host computer.

8.1.7 [PROTOCOL] Setting

The instrument supports SCPI and Modbus RTU protocols. The SCPI protocol is usually used to communicate with computers, and the Modbus RTU protocol is usually used to communicate with industrial control equipment such as PLCs.

Setting steps:

1. Press the [Test] key to enter the <TEST> page or press the [Setup] key to enter the <SETUP> page, and press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [PROTOCOL] field.
3. Press the function keys to select SCPI or MODBUS as needed.

8.1.8 Modbus [ADDRESS] Setting

Set the ADDRESS to use Modbus (RTU) protocol.

Setting steps：

1. Press [Test] or [Setup] key, press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [ADDRESS] field.
3. Press the function keys to select ADDRESS 01-15.

In order to operate same instruments at the same time, ADDRESS 00 broadcast communication is allowable. In ADDRESS 00, the instrument can only receive the command, but it can't return the response code.

8.1.9 SCPI [EOF], [Handshake], [Error Code]

The RS-232 instrument uses SCPI language to program. Please finish SCPI setting before using the SCPI protocol. For identifying commands, there must be EOF between the instrument and the host computer.

This instrument supports below EOF:

Stop bit	ASCII name	ASCII hexadecimal	Byte	Description
LF (0×0A)	Line separator	0×0A	One byte	Instrument default
CR (0×0D)	Carriage return	0×0D	One byte	
CR+LF	Carriage return + Line separator	First byte 0×0D Second byte 0×0A	Two bytes	
NUL (0×00)	Null character	0×00	Two bytes	

Setting steps:

1. Press [Test] or [Setup] key, press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [EOF] field.
3. Press the function keys to select EOF.

Handshake:

Handshake ON: Before returning the data, all commands to the instrument will return to the host computer.

Handshake OFF: The command to the instrument will be processed immediately. (If user don't need Handshake, please set Handshake into OFF state.)

Setting steps:

1. Press [Test] or [Setup] key, press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [Hand Shake] field.
3. Press the function keys to select Handshake ON or Handshake OFF.

Error Code:

Error Code ON: The instrument will return the error code after receiving the command. If it is a query command, only when the command is wrong will the instrument return the error code.

Error Code OFF: The host computer can query the previous error code by sending command ERR?

Setting steps:

1. Press [Test] or [Setup] key, press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [Error Code] field.
3. Press the function keys to select ON or OFF. ON represents that the instrument executes the error code after completing the uniline error. OFF represents that the error code will not auto return.

8.1.10 SCPI [UPLOAD] way

The host computer doesn't need to send TETCH? Command to the instrument, the data can be sent to the host computer automatically.

After finishing the test, the instrument will send the test result and comparator result to the host computer. Please refer to the Fetch? Subsystem for the format.

Setting steps:

1. Press [Test] or [Setup] key, press the function key corresponding to [SYSTEM CONFIG] to enter the <SYSTEM CONFIG> page.
2. Use the arrow keys to move the cursor to the [UPLOAD] field.
3. Press the function keys to select FETCH or auto. FETCH represents that all measurement data are obtained via the command FETCH. Auto represents that the data will be auto sent to the host computer after finishing the test.

8.1.11 Logging/Statistics, data cache, upper and lower bounds

Please refer to Chapter 7 <Logging and Statistics>.

8.1.12 [Restore Factory Setting]

After restoring factory setting, all setups of the instrument will restore preset parameters, including:

1. All setups on the <SYSTEM CONFIG> page will restore factory setting value.
2. The <Setup> page will restore factory setting value.
3. <File Management> page is preset to file 0: shutdown saving is set to disabled.

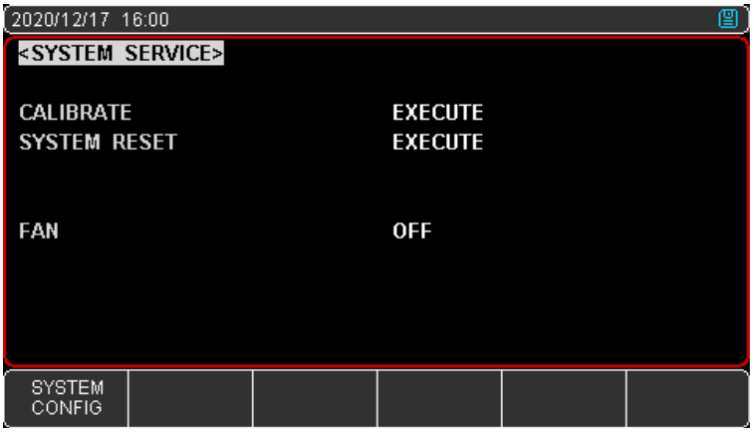
8.2 System Information

Press [Test] or [Setup] key to enter home page, press [SYSTEM CONFIG] on the taskbar, and then press the function key to select [System Information], system information includes mode, name, serial number and version.

User don't need to set up in this page.

8.3 System Service

Press [Test] or [Setup] key to enter home page, press [SYSTEM CONFIG] on the taskbar, and then press the function key to select [System Service]. Warning: User can't access to this page. Laymen are not allowed to access to this page which is used to calibrate data, otherwise the calibration data may lose and causes a deviated data.

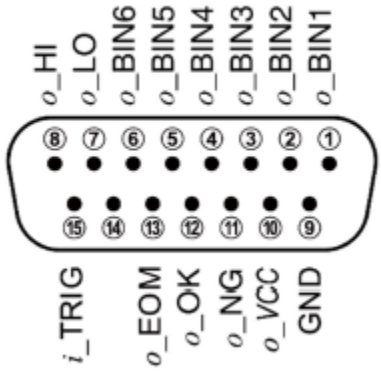


9. Handler

9.1 Terminal and Signal

Chart 9-1 Output terminal pin

Pin	Name	Description
1	o_BIN1	0: OK
2	o_BIN2	0: OK
3	o_BIN3	0: OK
4	o_BIN4	0: OK
5	o_BIN5	0: OK
6	o_BIN6	0: OK
7	o_LO	0: LOW
8	o_HI	0: HIGH
11	o_NG	0: NG
12	o_OK	0: OK
13	o_EOM	0: READY 1: MEAS



Output terminal (All signals are active low).

Chart 9-1 Connection terminal

Chart 10-2 Input terminal pin

Pin	Name	Description
15	Trigger input	Trigger input terminal, 0.25W, 499Ω current-limiting resistance is built in.

Chart 10-3 Power source pin

Pin	Name	Description
9	GND	Common ground terminal
10	Internal VCC	Positive terminal of internal VCC power source, internal isolated power: 5V, 0.5A, 2.5WMAX

9.2 Connecting Way

External power source (Recommended)

Connect bellow pins to the GND of the external power source:

GND: 9 pins

Internal power source 10: Not connected to the ground.

9.2.1 Internal power source

Internal power source: 5V, maximum 0.5 A.

Use internal power source, and connect to bellow pins:

VCC (5V): 12 pins

GND: 9 pins

⚠If the power is unknown or uncertain, internal power source is forbidden, otherwise the instrument can't operate normally. If small power is applied, internal power source is allowable, but the anti-interfering capability may become worse.

9.2.2 Electric Parameter

Output signal: Built-in a collector of pull-up resistor. Opto-isolator. Low electrical level enables.

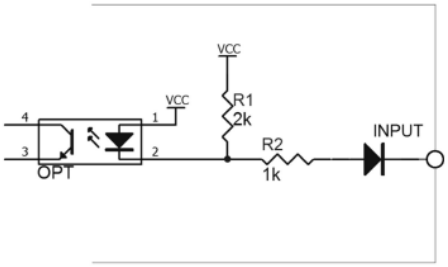
Maximum voltage: Voltage of external power source.

Input signal: Opto-isolator. Low electrical level enables.

Maximum current: 50mA

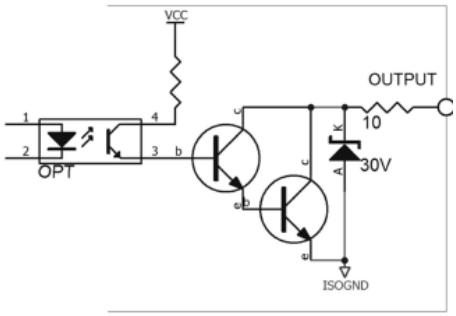
⚠Attention: To prevent the connecting end from being damaged, the voltage of power source must meet with power requirements, and, connect leads after turning off the instrument.

9.2.3 Input Schematic



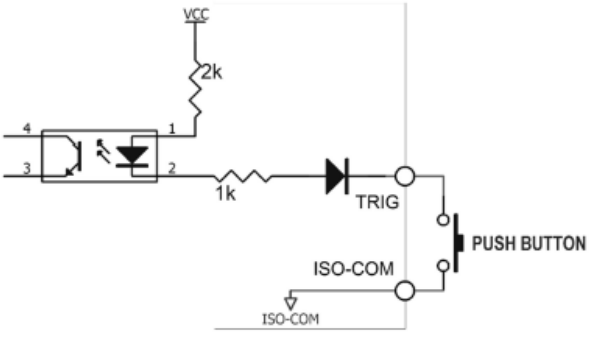
9-2-3 Input Schematic (Trig)

9.2.4 Output Schematic

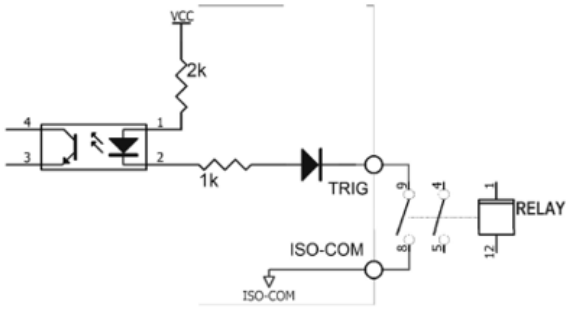


9.2-4 Output Schematic

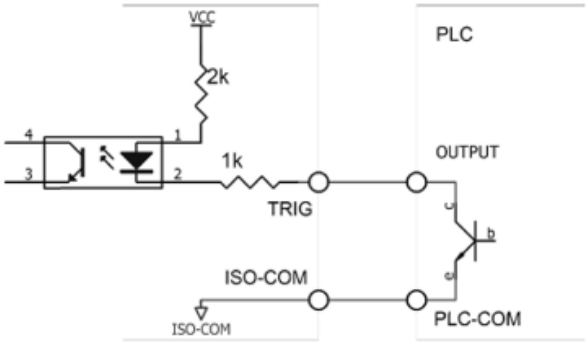
9.2.5 Input circuit connection



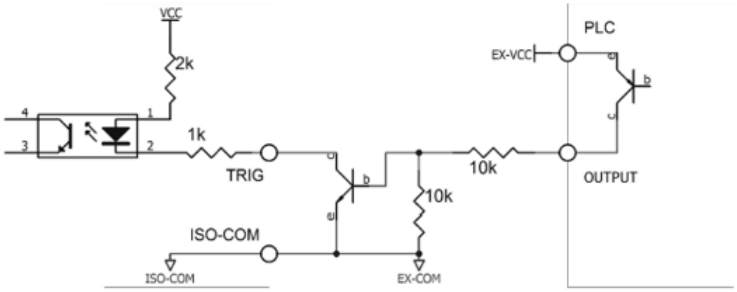
9-2-5-1 Connected to the switch



9-2-5-2 Relay Control

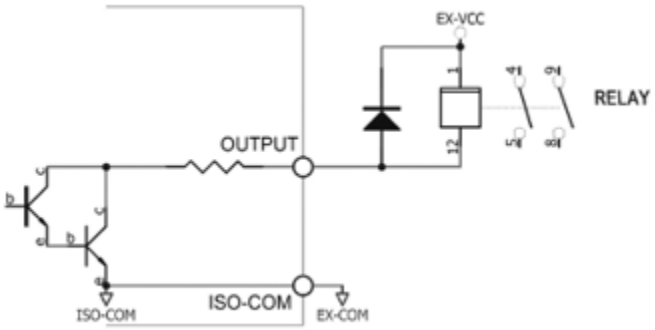


9-2-5-3 PLC Negative Public Terminal

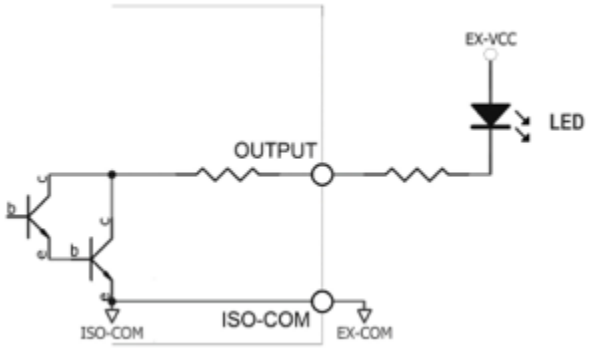


9-2-5-4 PLC Positive Public Terminal

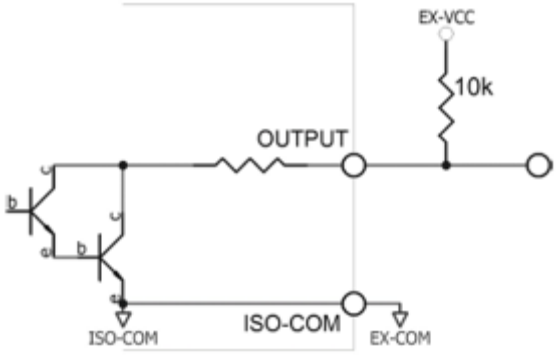
9.2.6 Output circuit connection



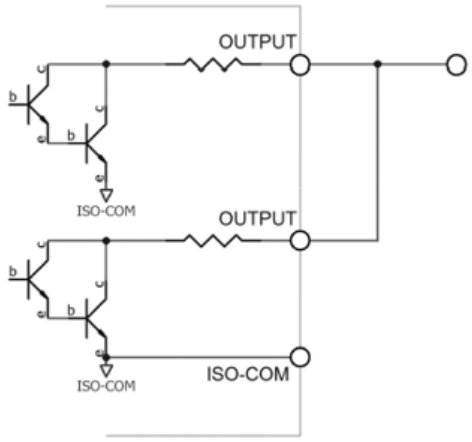
9-2-6-1 Relay Control



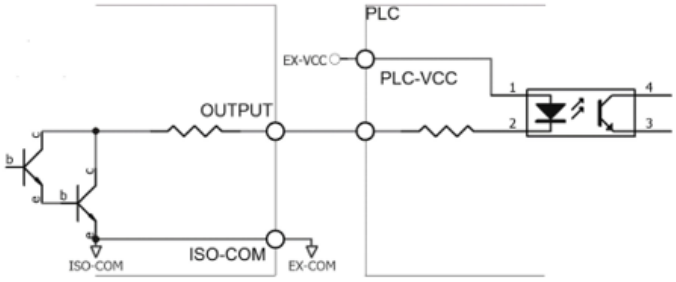
9-2-6-2 Emitting Diode and Optical Coupler



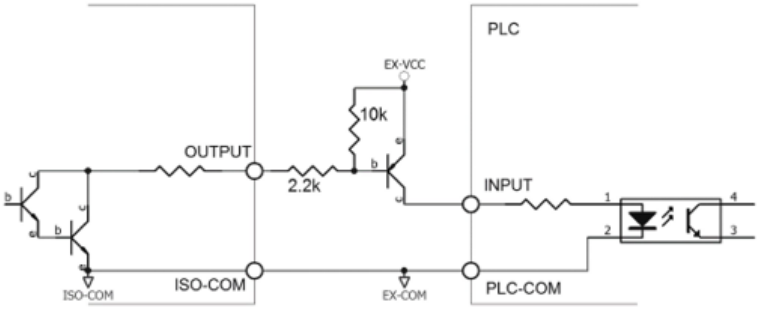
9-2-6-3 Negative Logic Output



9-2-6-4 Dual-Port Output Logic or Circuit

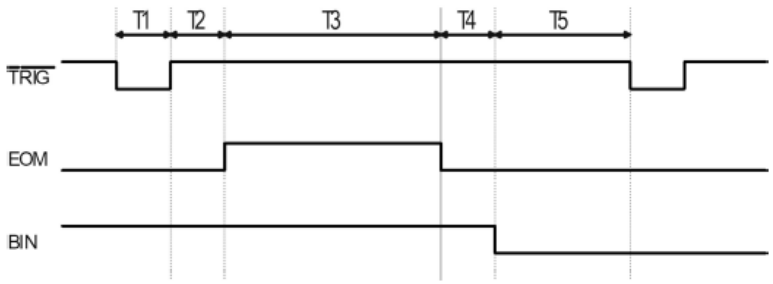


9-2-6-5 PLC negative public terminal



9-2-6-6 PLC positive public terminal

9.3 Periodic Chart



9-3-1 Periodic Chart

9-3-2 Time Chart

Description			Minimum Value
T1	Trigger pulse width		1ms
T2	Measurement Cycle	Trigger delay	<10 μs
T3		Measurement time	Related to the setting
T4		BIN output delay	200 μs
T5	Waiting time after trigging		0s

10. Telecommunication

The instrument communicates with the computer via RS-232 interface (standard configuration). User can compile different collecting system via standard SCPI command.

10.1 RS-232C

RS-232C is the widely-used serial communication standard currently, it is also called asynchronous serial communication standard, which is used to achieve the data communication of computers, and that of between computer and external devices. RS is abbreviated from “Recommended Standard”, 232 is a standard number. EIA officially issued this standard in 1969. The standard requires that the data is transmitted at one byte via data cable each time.

Generally, the configurations of most serial interfaces do not strictly follow the RS-232 standard: Each interface uses 25-cores connector (Most computers basically use 9-cores connector). The most frequently-used RS-232 signals are as follow:

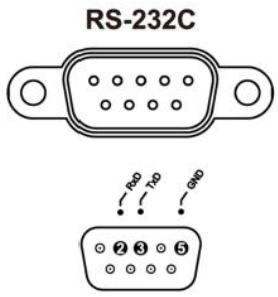
10-1-1 Frequently-used RS-232 signals

Signal	Symbol	25-cores connector pin number	9-cores connector pin number
Sending request	RTS	4	7
Clearing request	CTS	5	8
Data setting preparation	DSR	6	6
Data carrier detection	DCD	8	1
Data terminal preparation	DTR	20	4
Data sending	TXD	2	3
Data receiving	RSD	3	2
Grounding	GND	7	5
Sending request	RTS	4	7

10-1-2 Minimal Subset of RS-232 Standard

Signal	Symbol	9-cores connector pin number
Data sending	TXD	2
Data receiving	RXD	3
Grounding	GND	5

10.1.1 RS232C Interface

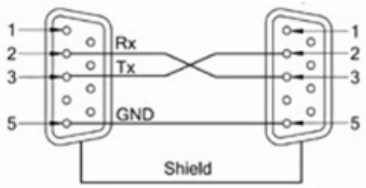


10-1-1 RS-232 interface (male connector) on the rear panel

⚠To avoid electric impact, please turn off the instrument when plugging/unplugging the connector.

Default communication setting:
Transmission way: Full-duplex asynchronous communication with start bit and stop bit.
Data bit: 8
Stop bit: 1
Check bit: 0

10.1.2 Connecting Way

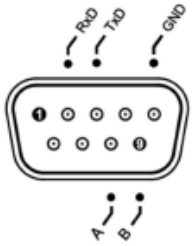


10-1-2 RS-232 interface (male connector) on the rear panel

RS-232 serial interface can connect with the controller serial interface via 2-3 crossover DB-9 cable.

10.2 RS485 interface

The instrument has a standard RS485 interface. RS485 interface and RS232 interface share the same D89 terminal: RS485 is a multi-computer communication interface, which can connect a host computer with sub-computers. For RS485 specifications, please refer to https://en.wikipedia.org/wiki/RS-485.



Pin	Function
8	A
9	B

10.3 USB interface

Some newly-launched computers and laptops don't have RS232 interface, so they need to achieve communication via USB interface. The USB-232 interface is built in the instrument, this virtual interface has same functionality with RS232.

Activate USB in the instrument:

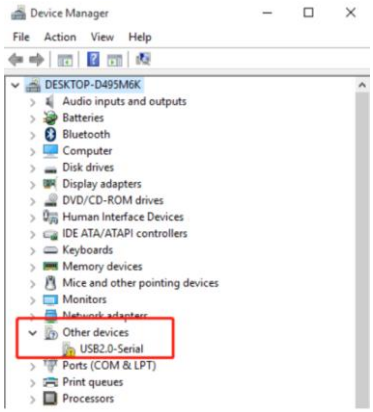
Before using USB interface communication, please select USB in <SYSTEM CONFIG> page, setting steps: Enter the <SYSTEM CONFIG> page, press arrow keys to select [REMOTE CONTROL] field, press function keys to select USB.

Install the driver in computer:

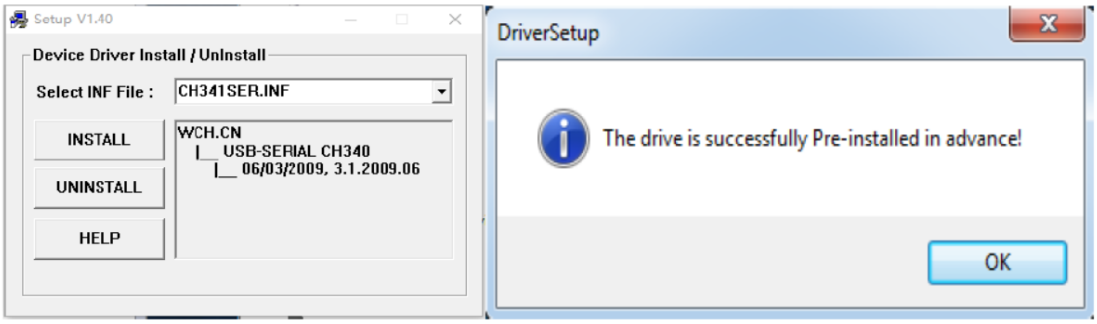
Only when the driver is installed in the computer can the USB interface operate normally, the installation steps for the USB driver is as bellow:

1) USB cable is plugged into the computer and instrument:

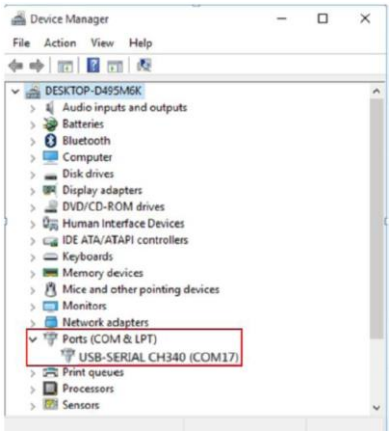
2) On the device manager of computer, it will display "other device", which means the driver needs to be installed.



3) Download the CH340 driver from the browser, the folder is CH341SER.EXE, click [Install], “Driver Installed Successfully” window displays after the installation is finished.



4) Open the device manager, if the installation is finished, the interface number COM17 will appear as marked in red box bellow. This number needs to be used in communication.



10.4 Communication protocol

The instrument supports two types of communication protocols: SCPI and Modbus (RTU).

SCPI protocol:

SCPI is abbreviated from “Standard Commands for Programmable Instruments”. SCPI defines a set of standard syntax and commands which are used to control programmable measurement instruments. SCPI command are transmitted by ASCII character string, the command is transmitted to the instrument by Physical transmission layer. The command consists of a series of keywords, some commands need parameters. In the protocol, the command is defined as CONFigure, in practical use, the form can be in full name, also can

be the abbreviations that only include capital letters. The instrument feedback to the inquiry command is also the ASCII code. Actually for simple applications (such as PLC), only need to translate the command into HEX bytes and then transmit based on these bytes.

Modbus (RTU) Protocol

Modbus protocol is a general language which is applied on electronic controller and field bus protocol, it is a communication standard of PLC, touchscreen.

11. Technical Index

11.1 Technical index

UT 3516:

Range		Low-speed, high-speed max. display value	Resolution	Fast speed	Middle speed	Low speed	Tested current	Open circuit of tested end
0	20mΩ	22.000mΩ	1μΩ	0.8%±5 byte	0.2%±5 byte	0.1%±3 byte	1A	<1V
1	200mΩ	220.00mΩ	10μΩ	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	1A	<1V
2	2Ω	2.2000Ω	100μΩ	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	100mA	<1V
3	20Ω	22.000Ω	1mΩ	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	10mA	<1V
4	200Ω	220.00Ω	10mΩ	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	1mA	<5V
5	2kΩ	2.200kΩ	100mΩ	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	1mA	<5V
6	20kΩ	22.000kΩ	1Ω	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	100μA	<5V
7	200kΩ	220.00kΩ	10Ω	0.5%±5 byte	0.1%±3 byte	0.05%±2 byte	10μA	<5V
8	2MΩ	2.2000MΩ	100Ω	0.8%±5 byte	0.5%±2 byte	0.1%±5 byte	1μA	<3V

UT3513:

Range		Low-speed, high-speed max. display value	Resolution	Middle speed	Low speed	Tested current	Open circuit of tested end
0	20mΩ	22.000mΩ	1μΩ	0.2%±5 byte	0.1%±3 byte	1A	<1V
1	200mΩ	220.00mΩ	10μΩ	0.1%±3 byte	0.1%±2 byte	1A	<1V
2	2Ω	2.2000Ω	100μΩ	0.1%±3 byte	0.1%±2 byte	100mA	<1V
3	20Ω	22.000Ω	1mΩ	0.1%±3 byte	0.1%±2 byte	10mA	<1V
4	200Ω	220.00Ω	10mΩ	0.1%±3 byte	0.1%±2 byte	1mA	<5V
5	2kΩ	2.200kΩ	100mΩ	0.1%±3 byte	0.1%±2 byte	1mA	<5V
6	20kΩ	22.000kΩ	1Ω	0.1%±3 byte	0.1%±2 byte	100μA	<5V

Measurement condition:
Temperature: 23℃±5℃, humidity: ≤65% RH
Short circuit zero clearing: Clearing before test
Warm up time: >60 minutes, calibration period: within 12 months, tested current accuracy: 10%

11.2 Product information

Power source: 100~240VAC
Fuse: 250V 2A slow blow fuse
Power: 20VA Maximum
Weight: About 3 kilos (net weight, accessories not included.)
Product standard: Q/YLD 17

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