UNI-T®

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User's Manual

UT3510+ Bench Top Micro Ohm Meter

V1.0

August 2024

Preface

Thank you for choosing Uni-T brand new product. To safely operate this equipment, please review this manual thoroughly, pay close attention to 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

Warranty Service

If the original purchaser sells or transfers the product to a third party within three year from the date of purchase of the product, the warranty period of three year shall be from the date of the original purchase from UNI-T or an authorized UNI-T distributor. Power cords, accessories and fuses, etc. are not included in this warranty.

If the product is proved to be defective within the warranty period, UNI-T reserves the rights to either repair the defective product without charging of parts and labor, or exchange the defected product to a working equivalent product (determined by UNI-T). Replacement parts, modules and products may be brand new, or perform at the same specifications as brand new products. All original parts, modules, or products which were defective become the property of UNI-T.

The "customer" refers to the individual or entity that is declared in the guarantee. In order to obtain the warranty service, "customer "must inform the defects within the applicable warranty period to UNI-T, and perform appropriate arrangements for the warranty service.

The customer shall be responsible for packing and shipping the defective products to the individual or entity that is declared in the guarantee. In order obtain the warranty service, customer must inform the defects within the applicable warranty period to UNI-T, and perform appropriate arrangements for the warranty service. The customer shall be responsible for packing and shipping the defective products to the designated maintenance center of UNI-T, pay the shipping cost, and provide a copy of the purchase receipt of the original purchaser. If the product is shipped to the location of the UNI-T service center, UNI-T shall pay the return shipping fee. If the product is sent to any other location, the customer shall be responsible for all shipping, duties, taxes, and any other expenses.

Limited Warranty and Liability

The warranty is inapplicable to any defects, failures or damages caused by accident, normal wear of components, use beyond specified scope or improper use of product, or improper or insufficient maintenance. UNI-T is not obliged to provide the services below as prescribed by the warranty:

a. Repair damage caused by installation, repair or maintenance of personnel other than service representatives of UNI-T;

b. Repair damage caused by improper use or connection to incompatible equipment;

c. Repair any damages or failures caused by using power source not provided by UNI-T;

d. Repair products that have been changed or integrated with other products (if such change or integration increases time or difficulty of repair).

The warranty is formulated by UNI-T for this product, replacing any other express or implied warranties. UNI-T and its distributors refuse to give any implied warranty for marketability or applicability for special purpose. For violation of the warranty, repair or replacement of defective products is the only and all remedial measure UNI-T provides for customers. No matter whether UNI-T and its distributors are informed of any possible indirect, special, occasional or inevitable damage in advance, they assume no responsibility for such damage.

Trademark

UNI-T is the registered trademark of UNI-T Technology (China) Co., Ltd.

Statement

- UNI-T products are protected by patents (including obtained and pending) in China and other countries and regions.
- UNI-T reserves the right to change specifications and prices.
- The information provided in this manual supersedes all previous publications.
- The information provided in this manual is subject to change without notice.
- UNI-T shall not be liable for any errors that may be contained in this manual. For any incidental or consequential damages arising out of the use or the information and deductive functions provided in this manual.
- No part of this manual shall be photocopied, reproduced or adapted without the prior written permission of UNI-T.

1. Introduction

This manual introduces the important safety precautions, installation information, and operation guide of UT3510+ series Benchtop Micro Ohm Meter.

2. Safety Requirements

This section contains information and warnings that must be followed to keep the instrument operating under safety conditions. In addition, user should also follow the common safety procedures.

Safety Precautions		
Warning	Please follow the following guidelines to avoid possible electric shock and risk to personal safety.	
	Users must follow the following conventional safety precautions in operation, service and maintenance of this device. UNI-T will not be liable for any personal safety and property loss caused by the user's failure to follow the following safety precautions. This device is designed for professional users and responsible organizations for measurement purposes. Do not use this device in any way not specified by the manufacturer. This device is only for indoor use unless otherwise specified in the product manual.	
Safety Statements		
Warning	"Warning" indicates the presence of a hazard. It reminds users to pay attention to a certain operation process, operation method or similar. Personal injury or death may occur if the rules in the "Warning" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Warning" statement.	
Caution	"Caution" indicates the presence of a hazard. It reminds users to pay attention to a certain operation process, operation method or similar. Product damage or loss of important data may occur if the rules in the "Caution" statement are not properly executed or observed. Do not proceed to the next step until you fully understand and meet the conditions stated in the "Caution" statement.	
Note	"Note" indicates important information. It reminds users to pay attention to procedures, methods and conditions, etc. The contents of the "Note" should be highlighted if necessary.	
Safety Sign		
	Danger	It indicates possible danger of electric shock, which may cause personal injury or death.

	Warning	It indicates that you should be careful to avoid personal injury or product damage.
	Caution	It indicates possible danger, which may cause damage to this device or other equipment if you fail to follow a certain procedure or condition. If the "Caution" sign is present, all conditions must be met before you proceed to operation.
	Note	It indicates potential problems, which may cause failure of this device if you fail to follow a certain procedure or condition. If the "Note" sign is present, all conditions must be met before this device will function properly.
	AC	Alternating current of device. Please check the region's voltage range.
	DC	Direct current device. Please check the region's voltage range.
	Grounding	Frame and chassis grounding terminal
	Grounding	Protective grounding terminal
	Grounding	Measurement grounding terminal
	OFF	Main power off
	ON	Main power on
	Power	Standby power supply: when the power switch is turned off, this device is not completely disconnected from the AC power supply.
CAT I	Secondary electrical circuit connected to wall sockets through transformers or similar equipment, such as electronic instruments and electronic equipment; electronic equipment with protective measures, and any high-voltage and low-voltage circuits, such as the copier in the office.	
CAT II	Primary electrical circuit of the electrical equipment connected to the indoor socket via the power cord, such as mobile tools, home appliances, etc. Household appliances, portable tools (e.g. electric drill), household sockets, sockets more than 10 meters away from CAT III circuit or sockets more than 20 meters away from CAT IV circuit.	
CAT III	Primary circuit of large equipment directly connected to the distribution board and circuit between the distribution board and the socket (three-phase distributor circuit includes a single commercial lighting circuit). Fixed equipment, such as multi-phase motor and multi-phase fuse box; lighting equipment and lines inside large buildings; machine tools and power distribution boards at industrial sites (workshops).	
CAT IV	Three-phase public power unit and outdoor power supply line equipment. Equipment designed to "initial connection", such as power distribution system of power station, power instrument, front-end overload protection, and any outdoor transmission line.	

CE	Certification	CE indicates a registered trade mark of EU.
UKCA	Certification	UKCA indicates a registered trade mark of UK.
ETL Intertek 4007682	Certification	ETL indicates a registered trade mark of Intertek.
	Waste	This product meets the requirements of Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC. It indicates that the product must not be discarded in the trash can.
40	EFUP	This environment-friendly use period (EFUP) mark indicates that dangerous or toxic substances will not leak or cause damage within this indicated time period. The environment-friendly use period of this product is 40 years, during which it can be used safely. Upon expiration of this period, it should enter the recycling system.

Safety Requirements

Warning	
Preparation before use	Please connect this device to AC power supply with the power cable provided; The AC input voltage of the line reaches the rated value of this device. See the product manual for specific rated value. The line voltage switch of this device matches the line voltage; The line voltage of the line fuse of this device is correct. It is not used to measure the main circuit.
Check all terminal rated values	Please check all rated values and marking instructions on the product to avoid fire and impact of excessive current. Please consult the product manual for detailed rated values before connection.
Use the power cord properly	You can only use the special power cord for the instrument approved by the local and state standards. Please check whether the insulation layer of the cord is damaged or the cord is exposed, and test whether the cord is conductive. If the cord is damaged, please replace it before using the instrument.
Instrument Grounding	To avoid electric shock, the grounding conductor must be connected to the ground. This product is grounded through the grounding conductor of the power supply. Please be sure to ground this product before it is powered on.
AC power supply	Please use the AC power supply specified for this device. Please use the power cord approved by your country and confirm that the insulation layer is not damaged.
Electrostatic prevention	This device may be damaged by static electricity, so it should be tested in the anti-static area if possible. Before the power cable is connected to this device, the internal and external conductors should be grounded briefly to release static electricity. The protection grade of this device is 4 kV for contact discharge and 8 kV for air discharge.
Measurement accessories	Measurement accessories are of lower class, which are definitely not applicable to main power supply measurement, CAT II, CAT III or CAT IV circuit measurement. Probe subassemblies and accessories within the range of IEC 61010-031 and current sensor within the range of IEC 61010-2-032 can meet its requirements.

Use the input / output port of this device properly	Please use the input / output ports provided by this device in a properly manner. Do not load any input signal at the output port of this device. Do not load any signal that does not reach the rated value at the input port of this device. The probe or other connection accessories should be effectively grounded to avoid product damage or abnormal function. Please refer to the product manual for the rated value of the input / output port of this device.
Power fuse	Please use power fuse of specified specification. If the fuse needs to be replaced, it must be replaced with another one that meets the specified specifications by the maintenance personnel authorized by UNI-T.
Disassembly and cleaning	There are no components available to operators inside. Do not remove the protective cover. Maintenance must be carried out by qualified personnel.
Service environment	This device should be used indoors in a clean and dry environment with ambient temperature from 0 ℃ -40 ℃。 Do not use this device in explosive, dusty or humid air.
Do not operate in humid environment	Do not use this device in a humid environment to avoid the risk of internal short circuit or electric shock.
Do not operate in flammable and explosive environment	Do not use this device in a flammable and explosive environment to avoid product damage or personal injury.
Caution	
Abnormality	If this device may be faulty, please contact the authorized maintenance personnel of UNI-T for testing. Any maintenance, adjustment or parts replacement must be done by the relevant personnel of UNI-T.
Cooling	Do not block the ventilation holes at the side and back of this device; Do not allow any external objects to enter this device via ventilation holes; Please ensure adequate ventilation, and leave a gap of at least 15 cm on both sides, front and back of this device.
Safe transportation	Please transport this device safely to prevent it from sliding, which may damage the buttons, knobs or interfaces on the instrument panel.
Proper ventilation	Poor ventilation will cause the device temperature to rise, thus causing damage to this device. Please keep proper ventilation during use, and regularly check the vents and fans.
Keep clean and dry	Please take actions to avoid dust or moisture in the air affecting the performance of this device. Please keep the product surface clean and dry.
Note	
Calibration	The recommended calibration period is one year. Calibration should only be carried out by qualified personnel.

3. Inspection and Installation

3.1 Packing List

Before using the instrument,

1. Check the appearance whether is damaged or scratched;

2. Check the packing list if has loss.

If the product is damaged or accessory is missing, please contact UNI-T sales department or distributor.

3.2 Power Requirements

- Supply Voltage: AC 100 V-240 V
- Supply Frequency: 47.5 Hz-63 Hz
- Power of Supply Power: ≤ 25 VA
- The phase wire L, zero wire N, and ground wire E should be connected to the instrument's power socket correspondingly.
- This instrument is specially designed for decreasing the stray interference cause by the AC power input terminal, but it should still be used in a low noise environment. If the noise cannot be avoided, consider installing a power filter.

Warning:

1. To prevent electric shock, please ensure that the power ground wire is correctly connected.
2. If the user changes the power cable, please ensure that the power ground wire is securely connect to the ground.

3.3 Operating Environment

UT3510+ series Benchtop Micro Ohm Meter is recommended for use under the following environmental conditions.

1. Do not use the instrument where it could be exposed to excessive dusts, strong vibrations, direct sunlight, or corrosive gas.
2. The instrument should be operated within the temperature of 0℃-40℃ and humidity of ≤ 75% RH.

to ensure measurement accuracy.

3. If the instrument will not be used for an extended period, store it in its original packing box or a similar container. Store at between 0°C and 50°C with humidity ≤ 85% RH in a well-ventilated area free from corrosive gases and direct sunlight.
4. Test leads of the instrument connected to DUTs should be kept away from strong electromagnetic fields to avoid interference.

3.4 Cleaning

1. To prevent electric shock, unplug the power line before cleaning.
2. Use a clean cloth slightly dampened with water to wipe the outer shell and panel, and keep it dry. Avoid letting water enter the instrument.
3. Do not clean the interior of the instrument.

⚠ **Caution:** Do not use solvents (such as alcohol or gasoline) to clean the instrument.

3.5 Handle

The handle is adjustable and can be set to four positions. Hold both sides of the handle to pull or rotate it as shown in the following figure.

Figure 3-1 Original Position

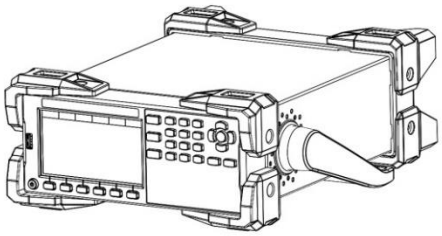


Figure 3-2 Test Position

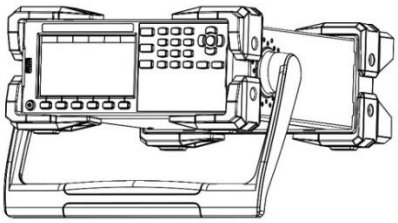


Figure 3-3 Remove Handle

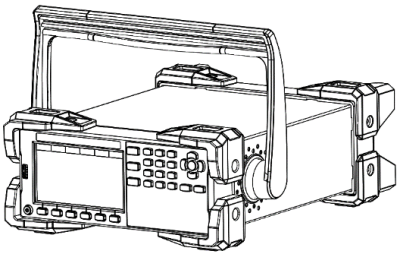
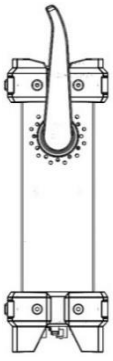


Figure 3-4 Lift Position



3.6 Routine Checking

To avoid accidents, please check the instrument before using.

1. Ensure the instrument's input power conforms to the specifications and the power configuration is correct.
2. The instrument should be securely connected to the ground.
3. The test line material should be intact, with no cracks, breaks, or damage.

3.7 Warm-up and Operating Duration

1. For accurate measurement, the warm-up time should be at least 30 minutes.
2. The operating duration should not exceed 16 hours.

3.8 Use of Test Fixture

1. Only use the test cable provided by UNI-T. Using user-made or other company's test cables may result in incorrect measurement results.
2. Keep the test cable and the pins of the DUT clean to ensure good contact between the DUT and the test cable.
3. Connect the test cable to the circulation connector on the instrument's front panel.
4. For DUTs with a shielded shell, connect the shield to the instrument ground "⊥".

4. Product Overview

UT3510+ series Benchtop Micro Ohm Meter includes two models: UT3513+ and UT3516+.

The product features 4.3-inch TFT LCD with high precision, high resolution, and high-speed measurement capabilities, boasting an accuracy of up to 0.05% and a high resolution of 1 μΩ.

Both UT3513+ and UT3516+ are equipped with RS-232C/RS485, LAN, and HANDLER communication interfaces, supporting SCPI and MODBUS RTU protocols. These interfaces enable communication with a PC, PLC, or WINCE device, facilitating efficient remote control and data acquisition functions.

4.1 Measurement Application

Components: Resistance, inductance, transformer, motor, relay, circuit solder joint, capacitor knuckle joint, cables, strand wire, connector, and various switches.

Materials: Thermal sensitive materials (fuses, heating regulator sensors), metal foil, and other conductive materials.

New energy: Connection bridge for electric vehicle battery pack, core connection resistance.

4.2 Accuracy and Specification

UT3513+ (Range 0-6), UT3516+ (Range 0-8)								
Range		Maximum Display	Resolution	Accuracy			Test Current	Open-circuit Voltage on Test End
				Fast	Medium	Slow		
0	20 mΩ	22.000 mΩ	1 μΩ	0.8 % ± 5	0.2 % ± 5	0.1 % ± 3	1A	< 1 V
1	200 mΩ	220.00 mΩ	10 μΩ	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	1A	< 1 V
2	2 Ω	2.2000 Ω	100 μΩ	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	100 mA	< 1 V
3	20 Ω	22.000 Ω	1 mΩ	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	10 mA	< 2.7 V
4	200 Ω	220.00 Ω	10 mΩ	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	1 mA	< 2.7 V
5	2 kΩ	2.2000 kΩ	100 mΩ	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	1 mA	< 2.7 V
6	20 kΩ	22.000 kΩ	1Ω	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	100 μA	< 2.7 V
7	200 kΩ	220.00 kΩ	10 Ω	0.5 % ± 5	0.1 % ± 3	0.05 % ± 2	10 μA	< 2.7 V
8	2 MΩ	2.2000 MΩ	100 Ω	0.8 % ± 5	0.2 % ± 5	0.1 % ± 5	1 μA	< 2.7 V
(LPR Mode) UT3513+ and UT3516+ are the same range								
Range			Resolution	Accuracy				

		Maximum Display		Fast	Medium	Slow	Test Current	Open-circuit Voltage on Test End
0	2Ω	2.2000 Ω	100 μΩ	0.8 % ± 5	0.5 % ± 5	0.2 % ± 5	10 mA	< 40 mv
1	20 Ω	22.000 Ω	1 mΩ	0.8 % ± 5	0.5 % ± 5	0.2 % ± 5	1 mA	< 40 mv
2	200 Ω	220.00 Ω	10 mΩ	0.8 % ± 5	0.5 % ± 5	0.2 % ± 5	100 uA	< 40 mv
3	2 kΩ	2.2000 kΩ	100 mΩ	0.8 % ± 5	0.5 % ± 5	0.2 % ± 5	10 μA	< 40 mv

Range Mode	Auto, manual, and nominal Value
Maximum Reading	22, 000
Calibration	Short-circuit full ranges
Beeper	OFF, Pass, and Fail
Sorting	Three outputs: High (higher than the upper limit), Low (lower than the upper limit), and Pass. Sorting result: BIN1--BIN6, and NG
Compare Mode	Absolute deviation, percentage deviation, and sequence mode
Trigger Mode	Internal trigger, external trigger
Test Speed	High speed: 10 ms/time， Fast speed: 17ms/ time， Medium speed: 56ms/ time， Slow speed: 334 ms/ time
Test Terminal	Four terminals
Interface	HANDLER, RS-232/RS485, LAN, and PT1000
Supply Voltage Frequency	AC100-240 V 50/60 Hz
Temperature/Humidity Index	Temperature: 18℃--28℃， Humidity: < 65% RH.
Operating Temperature	0℃--40℃
Storage Temperature	0℃--50℃
Operating Humidity	10--80% RH.
Storage Humidity	10--90% RH.
Operating Altitude	≤ 2000m
Standard Accessories	Kelvin test clips
	PT1000 temperature line (only for UT3516+)
	RS232 communication wire
Size	348.5 mm*215*88 mm
Weight	2.5 kg

Zero adjustment: Pre-test zero clearing

Warm-up time: >30 minutes

Temperature test accuracy: 0.2% ±0.1℃

4.3 Main Features

- 4.3-inch TFT LCD
- Accuracy of 0.05 %, with 22,000 reading
- High resolution of 1 μΩ, with 4 1/2 digit display
- UT3513+ measurement range: 1 μΩ--20 kΩ
- UT3516+ measurement range: 1 μΩ--2 MΩ
- Various test combinations: R, LPR, and T
- Low voltage (LRP) test mode for effective protection of the DUT (Device Under Test)
- Temperature correction (TC)
- Temperature conversion (Δt)
- USB Disk for saving data and screenshots
- Comparator with sorting and beeper function
- Supports data storage and browse
- Maximum test speed: 10 ms/time
- Built-in temperature correction interface

5. Front and Rear Panel

5.1 Front Panel

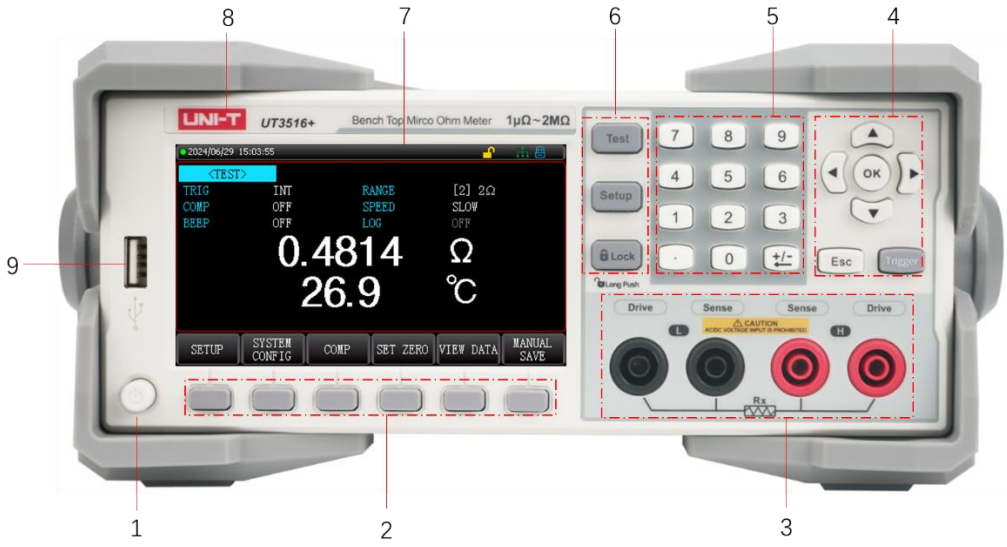


Figure 5-1 Front Panel

No.	Function	Description
1	Power Switch	Turn on/off the Ohm Meter
2	Functional keys (at the bottom of the screen)	The function key changes according to the menu displayed on the screen.
3	Test Terminals	4 test terminals: Source test terminals and Sense terminals
4	Arrow Keys	Move the cursor up, down, left, or right on the screen.
	OK Key	Used to confirm the input setting Long press to "Screenshot" when a USB Disk is inserted.
	Esc Key	Used to cancel or return
	Trigger Key	Trigger key: When the trigger source is external trigger, it generates a measurement.
5	Numeric Keypad	Used to input the numerical value; Addition, subtraction, and deletion keys are used to add, subtract or delete the input.
6	Test Key	Used to display the measured results.
	Setup Key	Used to set the measurement parameter configuration.
	Lock Key	Used to lock the key to disable it. Long press 1s to unlock the key.
7	Screen	4.3-inch TFT LCD
8	Nameplate	Logo and model information
9	USB Disk	Used for externally connecting a USB Disk to upgrade and save data.

5.2 Rear Panel

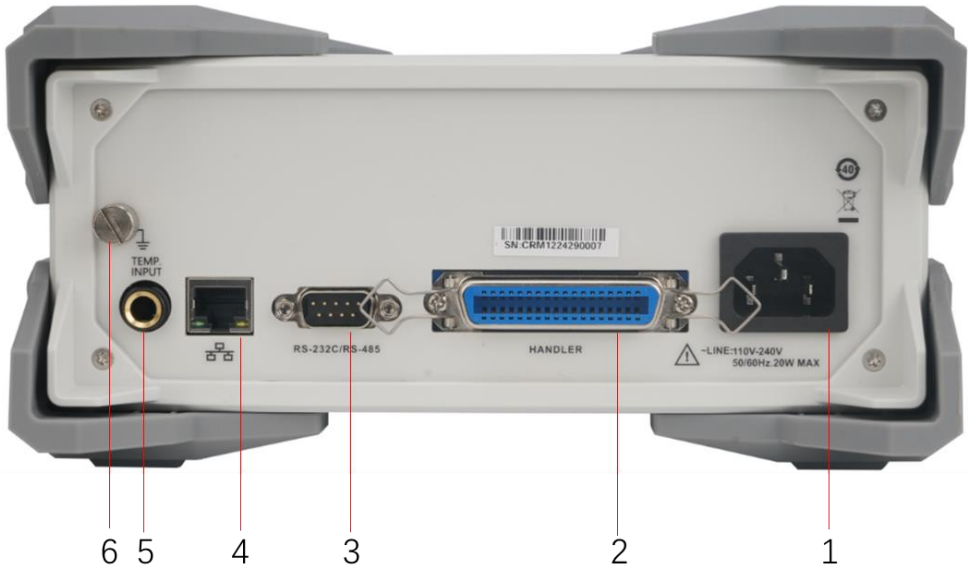


Figure 5-2 Rear Panel

No.	Function	Description
1	Power Socket	Used to connect AC power.
2	Handler Interface	The Handler interface simplifies the setup of a test system for automated testing. Through this interface, the instrument outputs the results of BIN comparison result and the contact signal, while also receiving the "start" signal.
3	RS232/485 Serial Interface	Serial communication interface
4	LAN Interface	TCP communication interface
5	PT1000 Temperature Interface	Used to connect temperature correction sensor
6	Grounding Wire	Used to connect the instrument to ground for protective or shielded ground connections.

5.3 Test Cable Connection

5.3.1 Kelvin Test Clip

Figure 5-3 Kelvin Test Clip

5.3.2 Connection Method

Connect the circular connector to the instrument's test terminal, where HD/LD represents current excitation high-end and current excitation low-end; HS/LS represents voltage sampling high-end and voltage sampling low-end. The connection is shown in the following figure.

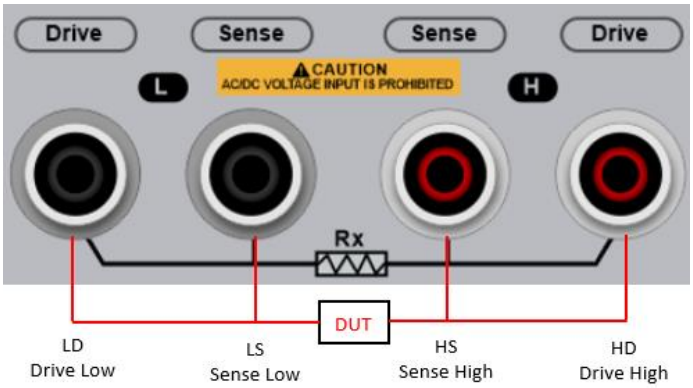


Figure 5-4 Cable Wiring for Testing Automated Device

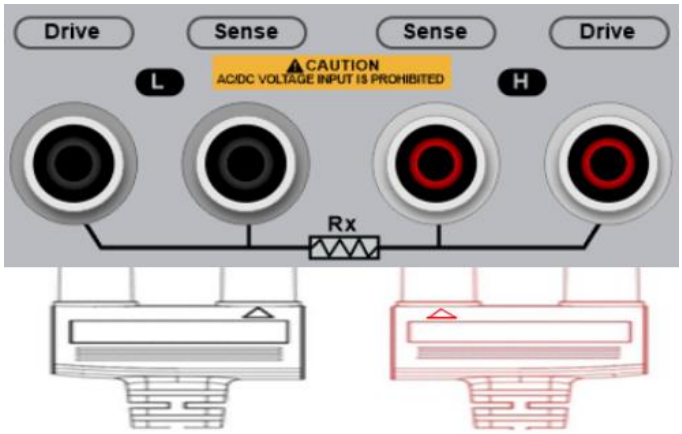


Figure 5-5 Connect Wiring for Test Cable and Test Terminal

Caution:

1. Do not apply voltage at test terminal; otherwise, the instrument will be damaged.
2. Do not directly connect the current source to the test terminal; otherwise, the instrument will be damaged.
3. The energy storage element can only be connected to the test terminal after it is discharged; otherwise, the instrument will be damaged.

Notes:

1. When connecting the test cable, ensure that the test end with ▲ symbol on the black test wire matches the black SENSE port on the front panel.
2. When connecting the test cable, ensure that the ▲ symbol on the red test wire matches the red SENSE port on the front panel.

5.4 Calibration

Before testing, perform a short-circuit calibration to eliminate the stray resistance caused by the test wires or external environment. If the test resistance is very small, such as 20 mΩ, the voltage signal will be very weak when the test current pass through the resistance, possibly only a few mV. The position, length, and the shape of the test wire can all affect the measurement. Please ensure that the test conditions remain the same after the test wire is short circuited.

5.4.1 Zero Clearing

Before zero clearing, short circuit the test clips using the following steps.

Correct Short-circuit for Kelvin Test Clips:

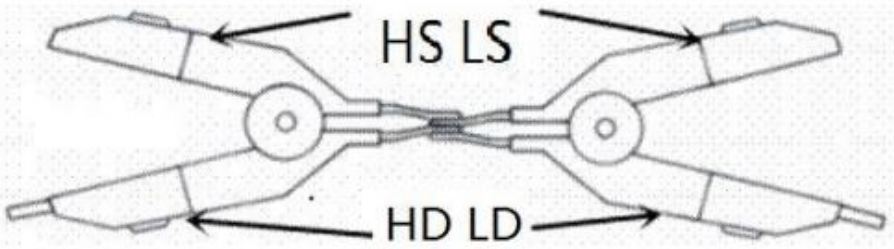
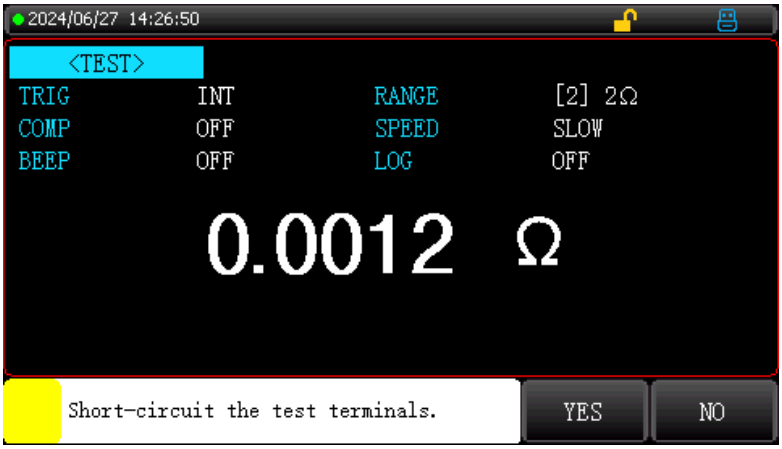


Figure 5-6 Short-circuit for Kelvin Test Clip

Step 1 Set the Kelvin test clip to be cross-connected as shown in the figure above.

Note: Connect the test clips so that ends with the ▲ symbol are together, and ends without the ▲ symbol are together. At this point, the base number displayed on LCD should be close to 0. If the test clips are connected in reverse, the data from the test wire significantly or display a high negative resistance value. The correct base number can be obtained after the test clips are correctly connected.

Step 2 Press the [Setup] key or the [Setup] displayed at the bottom of the screen to enter the <Setup> page, select **0 ADJ (zero clearing) function** to **ON,** and press the [Test] key or the [Setup] displayed at the bottom of the screen to return to the measurement page. Press the [Zero] key, a prompt saying "Short-circuit the test terminals" will appear, select "**YES**" to start zero clearing.



Step 3 After zero clearing, the beeper will sound, and a prompt saying "Zero setting successfully!" will be displayed at the center of the screen. If the base number is too large during zero clearing, a prompt saying "Zero setting failed!" will be displayed.

Notes

1. During zero clearing, the test end of the test clips with the ▲ symbol should be on the same side. If zero clear fails, a prompt saying "Zero setting failed!" will be displayed at the top of the screen. Please check whether the test clips are correctly short-circuited. Follow the steps above to reconnect short-circuit for the test clips, and then start to zero clearing again.
2. For automated testing, correct measurement requires removing the clips while ensuring the correct wiring. The limit value should be very small.
3. If the range is fixed, the zero clearing applies only for the current range. If the range is set to Auto, the zero clearing is used for all ranges.

6. <Test> Display Page

6.1 <Test> Page

Boot up the instrument or press the [Test] key to enter the [Test] page.

If the test page displays OL, it indicates that the test clips are disconnected or the measurement exceeds the test range.

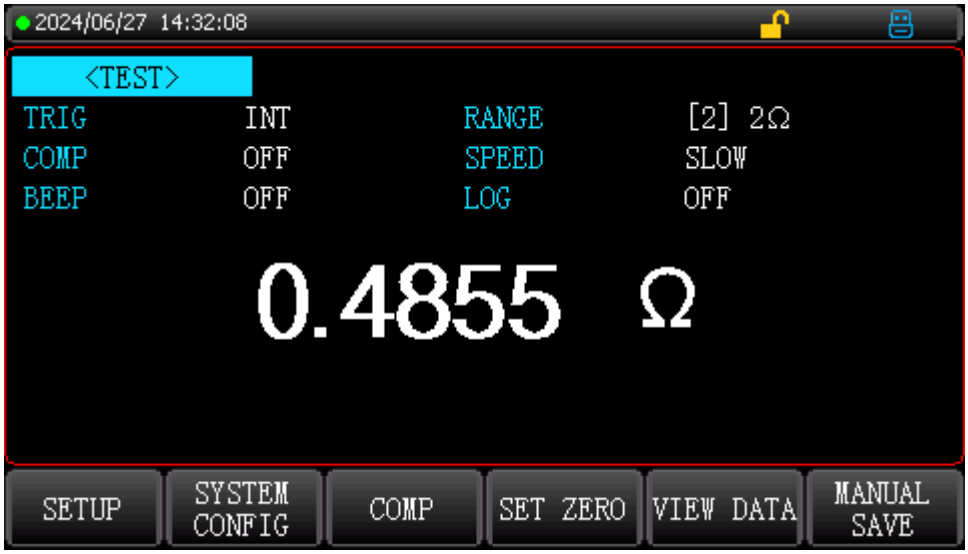


Figure 6-1 <Test> Page

TRIG	INT	This is also known as continuous test, where the instrument internally tests the trigger signal continuously according to an inherent cycle. This method is generally chosen for measurements.

	EXT	**Handler**: When the instrument receives a rising edge or falling edge pulse signal from the Handler on the rear panel, a measurement cycle will be performed. The instrument waits for another trigger signal in the meantime. Refer to the Handler Interface in section *4.2 Rear Panel*. The instrument is wait to trigger in other time. Refer to Handler Interface on the section *4.2 Rear Panel*. **Manual**: Each time press the **[Trigger]** key, the instrument will perform a measurement cycle. The instrument waits for another trigger signal in the meantime. **Remote**: The instrument measures once and returns the measured results when the command TRGGER is sent.
RANGE	AUTO	1. The instrument can automatically select the most suitable test range according to the resistance. The range number in the range field will be set automatically. 2. Automatic range selection requires pre-testing of the range, so the test speed will be slower compared to manual range selection. However, users do not need to set it manually.
	MANUAL	The instrument will continually perform tests using the user-defined range. This method offers the fastest test speed but requires the user to manually select the range.
	NOMINAL RANGE	1. Nominal range has two range modes: ● In SEQ mode, the instrument will automatically select the optimum range according to the highest upper limit value of all enabled BINs in the comparator. ● In Δ and Δ% mode, the instrument will automatically select the optimum range according to the nominal value. 2. The nominal range is the best mode for sorting test, offering the fastest test speed. This mode is exclusively for sorting tests.
	INC+; DEC-	Increase or decrease the manual range.
COMP	OFF; 1-BIN; 2-BIN; 3-BIN; 4-BIN; 5-BIN; 6-BIN	After the BIN is set on the <Comparator Setup Page>, the comparator BIN can be turned on or off.
SPEED	SOLW; MED; FAST; HIGH	Test speed: 10ms, 17ms, 56ms, 334ms
BEEP	OFF; PASS; FAIL	OFF: Disable the beeper function PASS: The beeper will sound when the sorting result is PASS. FAIL: The beeper will sound when the sorting result is FAIL.
LOG/STAT	START	Start recording data
	SAVE & STOP	Save the recorded data and stop recording
	SAVE TO USB DISK	Stop recording and clear the buffer area
	CLEAR BUFFER	Save the recorded data to a USB Disk

Setting steps:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Press the function key displayed at the bottom of the screen to select the desired parameter.

6.2 <Setup> Page

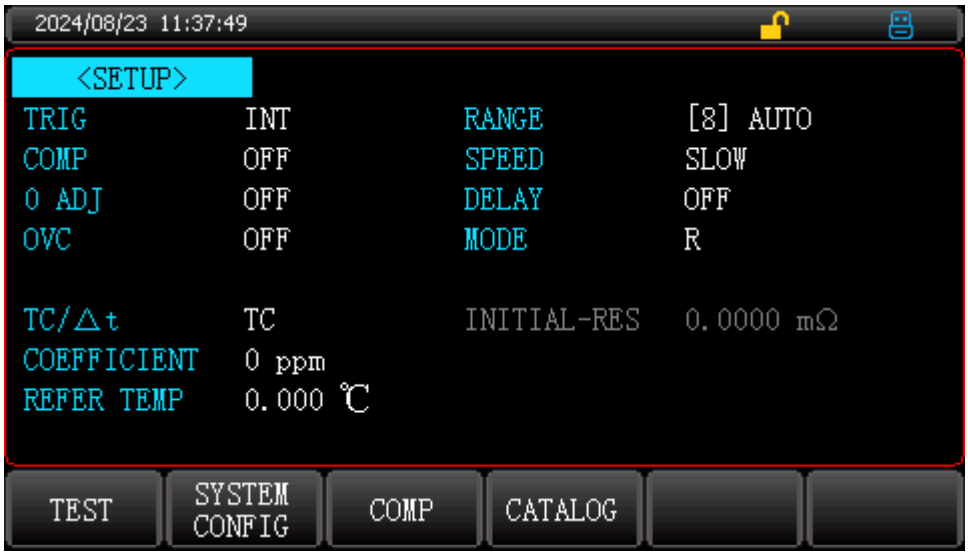


Figure 6-2 <Setup> Page

TRIG/RANGE/COMP/SPEED can be set on the <TEST> page, refer to <TEST> page for more details.

Item	Function	Description
0 ADJ	OFF: Disable the zero clearing function ON: Enable the zero clearing function	The zero clearing function can only be enabled when 0 ADJ (zero clearing) function is set to ON. When 0 ADJ (zero clearing) function is ON, the instrument will automatically load the last cleared data. The user can perform the zero clearing again.
DELAY	OFF: Disable the delay function Delay time: 0.1s-10s	In external trigger mode, to synchronize with external devices, it is sometimes necessary to set a trigger delay for reliable measurement. Trigger delay refers to the period between when the instrument receives a trigger signal to start measurement. The maximum trigger delay can be set to 10s.
OVC	OFF: Disable bias compensation function	UT3516+ can set the bias compensation function to compensate the measurement

	ON: Enable bias compensation function	errors caused by the thermo-electromotive force on the DUT. UT3513+ does not have the OVC function.
MODE	R: Resistance T: Temperature LRP: Low power R-T: Resistance-Temperature LPR-T: Low power-Temperature	LPR function supports low current and low voltage measurements to protect the DUT from damage.
TC/Δt	OFF: Disable the temperature function TC: Enable the temperature correction function Δt: Enable the temperature conversion function	Refer to *TC/Δt Setup* for more details.
INITIAL-RES	Resistance in the initial state	Only in *Δt* mode, refer to *TC/Δt Setup* for more details.
COEFFICIENT	Temperature coefficient of material	Refer to *TC/Δt Setup* for more details
REFER TEMP	Set temperature value	Refer to *TC/Δt Setup* for more details

Setting steps for 0 ADJ/OVC/MODE/ TC/Δt:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Press the function key displayed at the bottom of the screen to select the desired function.

Setting steps for DELAY/INITIAL-RES /COEFFICIENT/REFER TEMP:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Use the numeric keypad to input the number.
3. Press the function key displayed at the bottom of the screen to select the unit.

TC/Δt Setup

UT3510+ series supports the temperature correction and temperature conversion functions.

UT3516+ is equipped with a PT1000 temperature sensor. Before measuring, the instrument and probe should be warm up for at least 30 minutes. The temperature probe should be placed as close to the DUT as possible without making direct contact.

Figure 6-3 PT1000 Temperature Sensor

The instrument has a built-in temperature compensation circuit that compensates for measurement bias caused by the temperature variations. Connect the temperature compensation wire to the temperature compensation port on the instrument's rear panel.

TC (Temperature Correction) function: This function converts the resistance measured under the current ambient temperature to the resistance at a user-defined temperature.

Temperature Compensation Formula:

$$Rt = Rt0 * [1 + \alpha to * (T1 - T0)]$$

T1: Current ambient temperature

R_t: Resistance measured under the current ambient temperature

T0: Preset temperature, which can be set in the [REFER TEMP] option.

R_{t0}: Resistance at the preset temperature.

α_{t0}: Temperature coefficient of material, which can be set in the [COEFFICIENT] option.

For example, when the current ambient temperature is 30℃, a copper wire with a resistance of 100 Ω (resistance temperature coefficient is 3930 ppm at 20℃) can have its temperature correction calculated using the following formula:

$$R_{t0} = \frac{R_t}{1 + \alpha_{t0} * (t - t0)} = \frac{100}{1 + (3930 \times 10^{-6}) * (30 - 20)} = 96.22$$

Temperature Conversion (Δt): This function converts the change in resistance value into the difference between the internal temperature of the DUT and the ambient temperature, using the thermal effect of the resistor.

Temperature Conversion Formula:

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

Δt: The difference between the internal temperature of the DUT and the ambient temperature

R1: The initial resistance (in a cold state) when measured at t1, which can be set in the [INITIAL-RES] option.

t1: The temperature (in a cold state) of the DUT when the resistance is R1, which can be set in the [REFER TEMP] option.

R2: The current resistance of the DUT

ta: Current ambient temperature

k: The reciprocal of temperature coefficient of the DUT (baseline is 0℃), which can be set in the [COEFFICIENT] option.

For example, when the initial temperature of t1 is 20℃, R1 is a copper wire with a resistance of 200 mΩ, ta(the current ambient temperature) is 25℃, and R2 is 210 mΩ, the increasement of temperature can be calculated using the following formula:

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

$$= \frac{210\ x\ 10^{-3}\ \text{x}\ (235+20)}{200\ \text{x}\ 10^{-3}} - (235 + 25) = 7.75℃$$

Thus, the current temperature of the resistor is calculated as:

$$t_R = t2 + \Delta t = 25 + 7.75 = 32.75℃$$

Here, k can be calculated using the formula:

$$\text{k} = \frac{1}{\alpha_{t0}} - \text{t1}$$

For example, since the temperature coefficient of copper is 3930 ppm at 20℃, the constant **k** is calculated as:

$$\text{k} = \frac{1}{3930\ \text{x}\ 10^{-6}} - 20 = 235$$

Table 6-1 Temperature Coefficient of Metallic Material

Metallic Material	Metal Content (%)	Material Density ($x10^3$) [kg/m^3]	Conductivity	Temperature Coefficient (20℃) [ppm]
Annealed copper	Copper > 99.9	8.89	1.00 - 1.02	3810 - 3970
Hard-drawn copper	Copper > 99.9	8.89	0.96 - 0.98	3370 - 3850
Cadmium copper	Cadmium: 0.7 - 1.2	8.94	0.85 - 0.88	3340 - 3460
Silver copper	Silver: 0.03 - 0.1	8.89	0.96 - 0.98	3930
Chromium copper	Chromium: 0.4 - 0.8	8.89	0.40 - 0.50 0.80 - 0.85	20 30
Anti-corrosion	Nickel: 2.5 - 4.0		0.25 - 0.45	980 - 1770

alloy	Silicon: 0.5 - 1.0			
Soft aluminum	Aluminum > 99.5	2.7	0.63 - 0.64	42
Hard-drawn aluminum	Aluminum > 99.5	2.7	0.60 - 0.62	40
Aluminum alloy	Silicon: 0.4 - 0.6 Magnesium: 0.4 - 0.5 Aluminum: 99.2 - 98.9		0.50 - 0.55	36

Table 6-2 Conductivity and Temperature Coefficient of Copper Wire

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

Temperature coefficient α varies with ambient temperature and material conductivity.

For example, the temperature coefficient of a material is α_{20} at 20℃ and the material conductivity is c at t℃, its temperature coefficient at t℃ can be calculated using the following formula:

$$\alpha = \frac{1}{\frac{1}{\alpha_{20} \cdot c} + (t - 20)}$$

6.3 System Configuration

On the <Test> page, press the [Setup] key and then press the [System Config] key at the bottom of the screen to enter the system configuration page.

Figure 6-4 <System Configuration> Page

Item	Function	Description
LANGUAGE	Simplified Chinese, English	Set the system language
Key Beep	ON: Enable the key beep OFF: Disable the key beep	
DATE/TIME	xxxx-xx-xx xx:xx:xx	Set the data and time
REMOTE	RS232, LAN, RS485	Remote control interface for communication
BAUD	4800, 9600, 19200, 38400, 57600, 115200	Select the baud rate for communication
PROTOCOL	SCPI, MODBUS	Select the communication protocol
ADDRESS	0-255	For use with Modbus protocol
LOG/STAT	LOG: Switch to the recording function on the <Test> page STAT: Switch to the statistics function on the <Test> page	Select the recording or statistics function
BUFFER	10-10000	Set the group size for buffer area
STAT LOWER	Set the lower limit for statistics function	Statistic function: Calculate Hi and Lo in Cp and Cpk
STAT UPPER	Set the upper limit for statistics function	
DEFAULT SETTING	RESET	Reset the instrument to the factory settings
IP ADDR	Set the IP address	For use with LAN remote control
SOUND LEVER	HIGH, MEDIUN, LOW	Set the key sound

Setting steps for Language/Sound beep/Remote/Baud Rate/Protocol/Log/Statistics/Default setting/Sound Lever:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Press the function key displayed at the bottom of the screen to select the desired function.

Setting steps for Address/Buffer:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Use the numeric keypad to input the number.
3. Press the [OK] key displayed at the bottom to confirm the setting.

Setting steps for Statistics lower limit/ Statistics upper limit:

1. Use the arrow keys to move the cursor to the item to be edited.

2. Use the numeric keypad to input the number.
3. Press the function key displayed at the bottom of the screen to select the unit.

Setting steps for Time/Date:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Press the **function** key displayed at the bottom of the screen, and use the arrow keys to move the cursor to the item to be edited.
3. Use the numeric keypad to input the number.
4. Press the [OK] key displayed at the bottom to confirm the setting.

Setting steps for IP Address:

5. Use the arrow keys to move the cursor to the item to be edited.
6. Press the [INPUT] key displayed at the bottom of the screen, and use the arrow keys to move the cursor to the item to be edited.
7. Use the numeric keypad to input the number.
8. Press the [OK] key displayed at the bottom to confirm the setting.

6.4 Comparator Setting

Sorting is the process of using beeper and comparator settings to help the production line determine and improve product compliance with specifications. This is important for the implementation of assembly line test screening.

This chapter includes the comparator setting and judgment results. UT3510+ series has a built-in comparator BIN, allowing set the compare result for 6 BIN. The measured component can be divided into 7 BINs: BIN1, BIN2, BIN3, BIN4, BIN5, BIN6, and NG.

On the <Test> page, press the [COMP] to enter the <Comparator Setting> page.

Figure 6-5 <Setup> Page

Item	Function	Description
COMP	OFF; 1-BIN; 2-BIN; 3-BIN; 4-BIN; 5-BIN; 6-BIN;	OFF: Disable the comparator. 1-BIN, 2-BIN, -BIN, 4-BIN, 5-BIN, 6-BIN: Select the BIN, with a maximum of 6 BINs.
BEEP	OFF, PASS, FAIL	OFF: Disable the beep PASS: The beep will sound when the result is pass. FAIL: The beep will sound when the result is fail.
MODE	SEQ, ABS, PER	Refer to the compare mode as below.
NOMINAL	Set nominal value	Absolute deviation and percentage deviation modes require entering the nominal value. The nominal value is not involved in the operation of sequence mode. In sequence mode, the measured value is compared with the upper and lower limits.
LOWER	Set the lower limit of this BIN	UT3510+ series can set the upper and lower limits for 6 pairs. The upper limit of each BIN should greater than the lower limit; otherwise, the component will not be sorted into its BIN. ABS (Absolute deviation) and % (Percentage deviation) modes do not require selecting the unit multiplier, but the percentage value should be entered. ABS and SEQ mode should select the unit using the function key. In ABS and SEQ modes, select the unit using the function key.
UPPER	Set the upper limit of this BIN	

Setting steps for COMP/BEEP/MODE:

1. Use the arrow keys to move the cursor to the item to be edited.

2. Press the function key displayed at the bottom of the screen to select the desired parameter.

Setting steps for NORMINAL/LOWER/UPPER:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Use the numeric keypad to input the parameter.
3. Press the function key displayed at the bottom of the screen to select the unit.

UT3510+ series provides three compare modes: SEQ (Sequence mode), ABS (Absolute deviation), and % (Percentage deviation). The last of two are also called tolerance mode (TOL).

Sequence mode (SEQ): Set the measured value to be the comparison limits, and the limits should be ordered from smallest to largest.

Tolerance mode (TOL): Set the deviation value of the nominal value to be the compare limits. This includes ABS (Absolute deviation) and % (Percentage deviation).

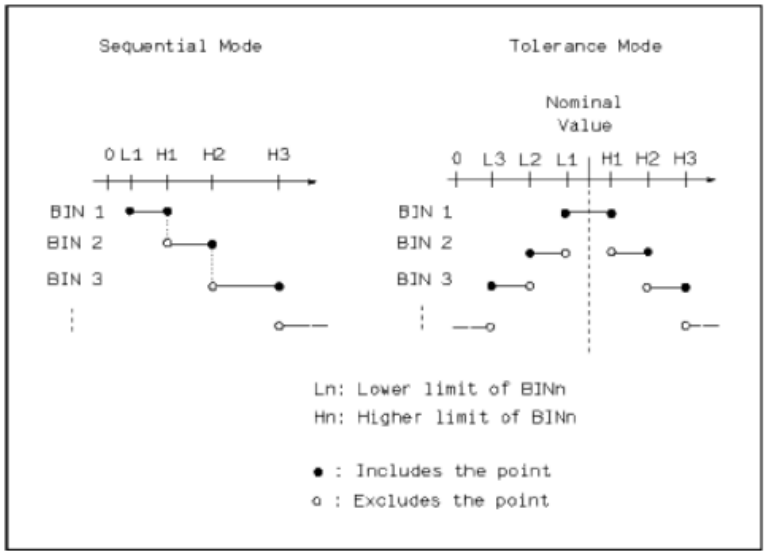


Figure 6-6 Tolerance and Sequence Mode

Notes

1. When setting the limits for tolerance mode, the error range should be ordered from smallest to largest. If the error range in BIN1 is the maximum, then all DUTs will be sorted to BIN1.
2. In zero tolerance mode, the lower limit does not have to be less than the nominal value, and the upper limit does not have to be greater than the nominal value. There can be discontinuities or overlapping ranges between the limits of each BIN.

■ ABS Absolute deviation):

ABS = X – Y

Here, X represents the measured value of the DUT, and Y represents the set nominal value.

■ % (Percentage deviation):

$$\% = (X - Y) / Y \times 100[\%]$$

Here, X represents the measured value of the DUT, and Y represents the set nominal value.

6.5 File Management

Press the [Setup] key to enter the <SETUP> page, then press the function key [CATALOG] key at the bottom of the screen to enter the <CATALOG> page.

The file management allows saving the settings into 10 file folders for later use or loading for when changing specifications.

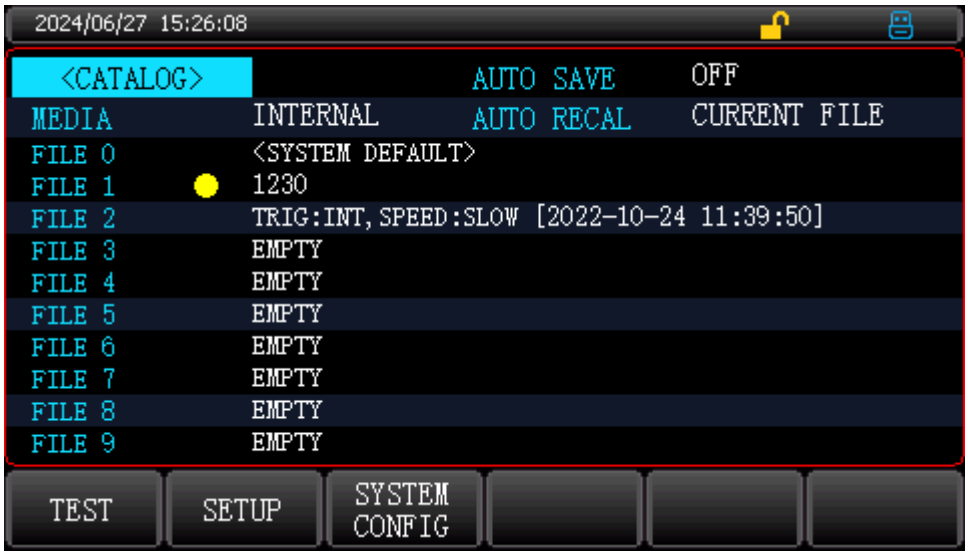


Figure 6-7 <File Management> Page

Item	Function	Description
MEDIA	INTERNAL: Save the file into internal storage USB-DISK: Save the file into a USB Disk	The files in file management can be saved to internal storage or a USB Disk for later use.
Auto Save	Forbid: The setting data will not be saved. Allow: Save the setting data for later use	Forbid: The user-defined parameters can only be manually saved to a file; otherwise, they cannot be loaded at the next boot-up. Allow: The user-defined parameters can automatically be saved to the current file.
Auto Recall	Current File: Load the setting values of the current file (highlighted with a yellow cursor) when booting up File 0: Load the setting values of File 0when booting up	To select the load file when booting up
TEST	Return to the <Test> page	/

SETUP	Return to the <Setup> page	/
SYSTEM CONFIG	Return to the <SYSTEM CONFIG> page	/
SAVE	Save all settings to the current file	Move the cursor to a specific file to perform "Save, Recall, Erase, or Rename" respective operations.
RECALL	Load the parameters form the current file to the system	
ERASE	Delete file data	
RENAME	Rename the file, which can be customized.	

Setting steps for file management operation:

1. Use the arrow keys to move the cursor to the item to be edited.
2. Press the function key displayed at the bottom of the screen to select the desired function
3. Use the arrow keys to move the cursor to the file to be edited, then select "Save, Recall, Erase, or Rename" operations to perform.

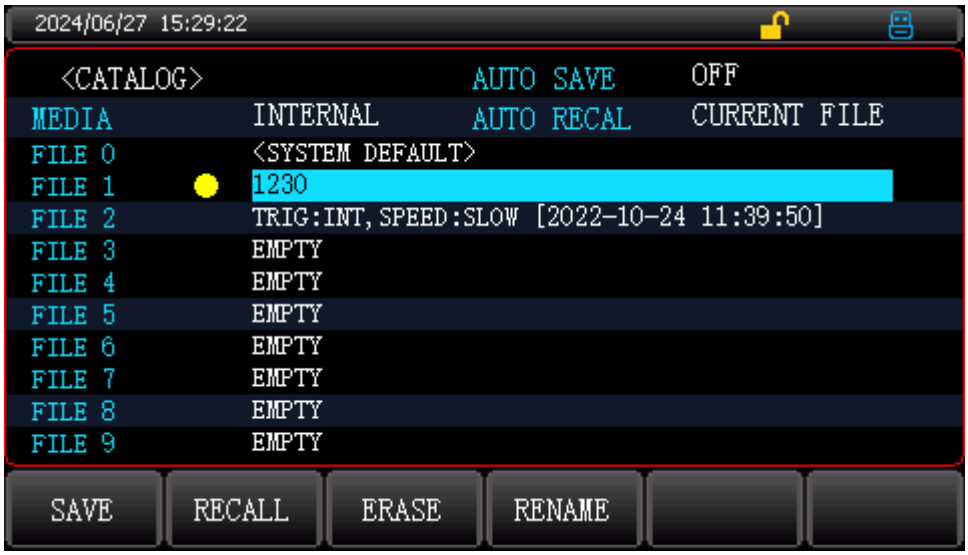


Figure 6-8 File Management Operation

Rename File:

1. Enter the rename file page as shown in Figure 6-10. Use the numeric keypad to enter the number.
2. Alternatively, use the arrow keys (or the function key at the bottom of the screen) to move the cursor to select letter or number.
3. Press the [OK] key to complete the setting, and then press the [Enter] key at the bottom of the screen to confirm the rename setting.

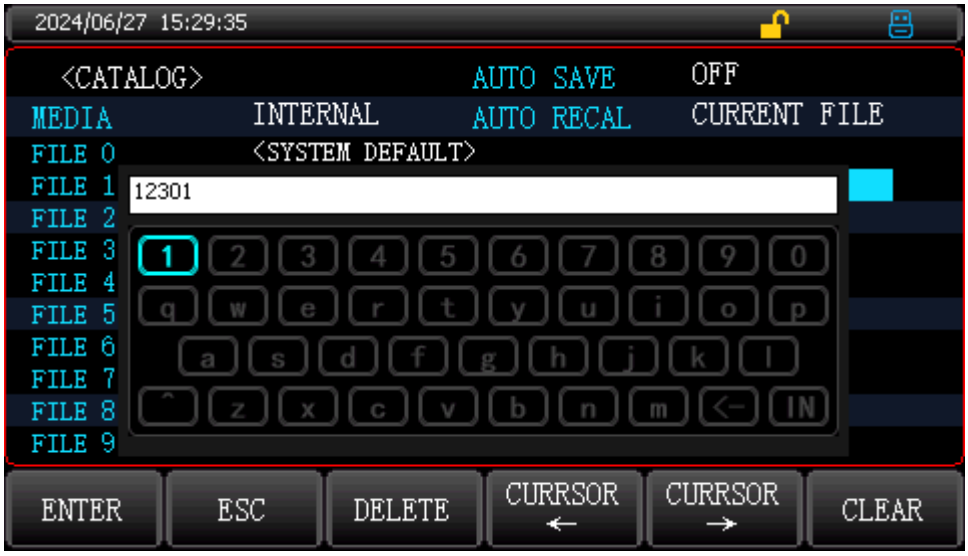


Figure 6-9 Rename File

6.6 View Data

The measurement display values can be manually saved (up to 500 sets of data can be stored) and quickly viewed on the instrument screen. Press the function key [Manual Save] at the bottom of the screen to manually save the data, press the key once to add a manual data saving, and click the function key [View Data] to browse the manually saved measurement data on the instrument screen. As shown in the picture below:

You can also press [Save to USB Disk] to save the file to the USB Disk. In the 'TEST DATA' folder of the USB Disk, the file name starts from Test0001.

Users can perform data management in the < VIEW DATA > page and choose their own resistance unit display mode.

Figure 6-10 View Data

Item	Function	Description
SAVE TO USB DISK	Save the test data to a USB Disk	/
PAGE UP	Browse data on the previous page	/
PAGE DOWN	Browse data on the next page	/
CLEAR	Clear data	/
JUMP TO	Jump to any page to browse data	Use the numeric keypad to enter the specified page, then press the [OK] key to jump to the selected page.
UNIT	AUTO, mΩ, Ω, kΩ, MΩ, SCI.NOTE. (unit:Ω)	Move the cursor to the unit, then use the function key at the bottom of the screen to select the unit.

6.7 Recording and Statistic

The instrument provides data [Recording] and [Statistic] functions. The default setting is recording function. The [Record] character appears on the <Test> page. This function allows recording up to 10,000 groups. The measured data can be saved to the instrument's buffer area in real time, and can be sent to a PC via communication port, or directly saved in CSV format to USB Disk.

Only R and LPR mode can use the recording and statistics function.

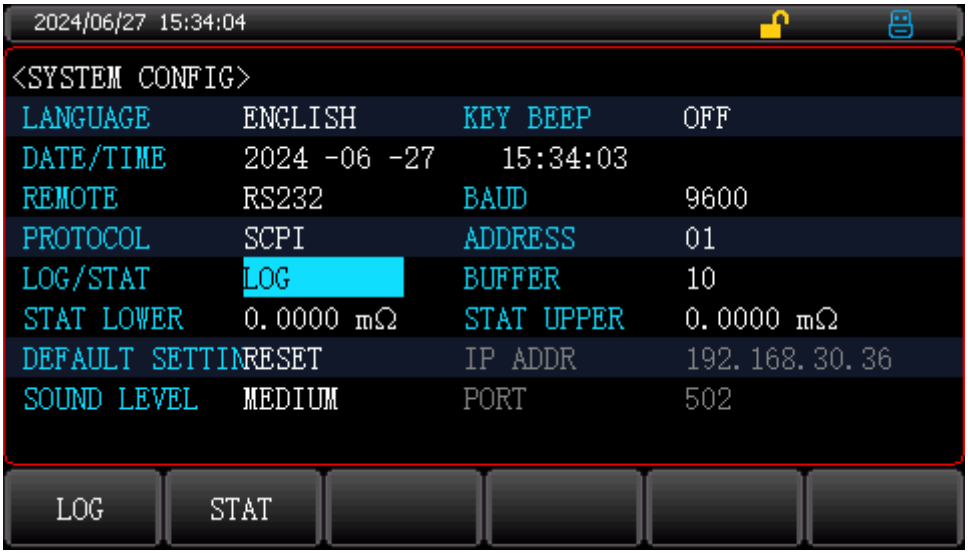


Figure 6-11 Recording and Statistic Function on <System Config> Page

Setting steps for Recording and Statistic Functions:

1. On the <System Config> page, use the arrow keys to move to Record or Statistic field.
2. Use the function key at the bottom of the screen to select the Record or Statistic function.
3. When select the Record or Statistic function, the data caching should be set.

4. When using the Statistic function, the upper limit and lower limits for the statistics should be set.
5. After the Record or Statistic function is selected, press the **[Test]** key to return to the <Test> page to use the Record or Statistic function.

Use of Recording Function:

1. When connected to the DUT, use the arrow keys to move to Record filed.
2. Press the [Start] key to start recording data.
3. The record will automatically stop when recorded value reaches the upper limit of data caching.
4. During the recording process or when the recording is completed, use the function key "Save, Stop, Clear" at the bottom of the screen to perform the respective operations.

Use of Statistic Function:

1. Use the arrow keys to move the cursor to Record filed, and press the function key **[Start]** at the bottom of the screen.
2. Connect a DUT and proceed next until the data caching reaches the upper limit.
3. During the recording process or when the recording is completed, use the function key "Save, Stop, Clear" at the bottom of the screen to perform the respective operations.

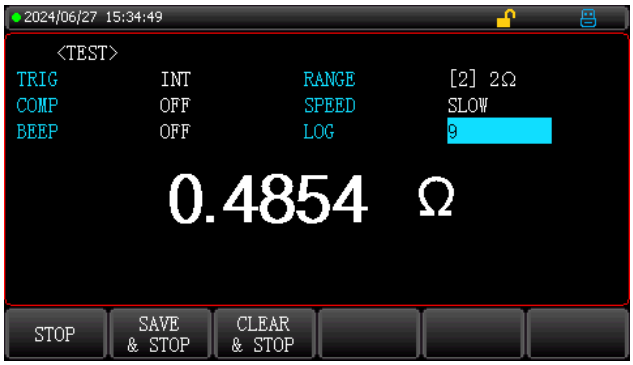


Figure 6-12 Recording Process

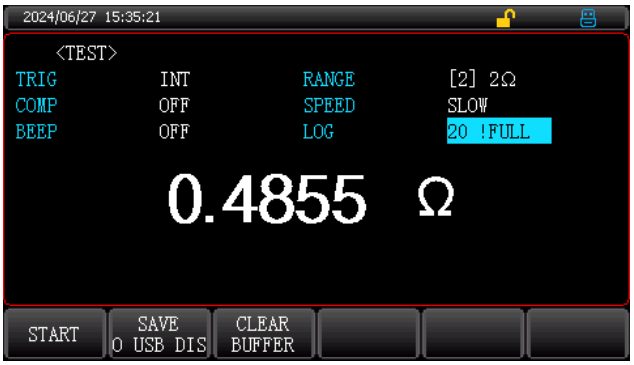


Figure 6-13 Recording Completed

Item	Function
START	Start recording data
SAVE TO U DISK	Save the cached data to a USB Disk
CLEAR BUFFER	Clear the cached data
STOP	Stop recording data
SAVE & STOP	Stop recording and save the cached data to a USB Disk
CLEAR & STOP	Stop recording and clear the cached data

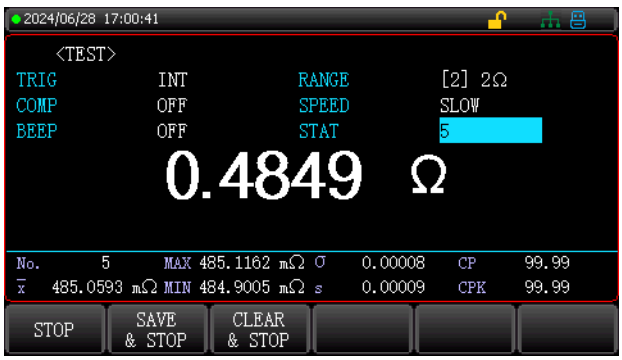


Figure 6-14 Statistic Process

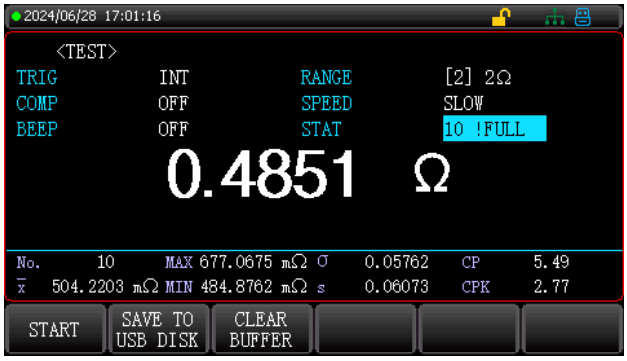


Figure 6-15 Statistic Completed

Item	Function
START	Start data statistics
SAVE TO USB DISK	Save the cached data to a USB Disk
CLEAR BUFFER	Clear the cached data
STOP	Stop data statistics
SAVE & STOP	Stop data statistics and save the cached data to a USB Disk
CLEAR & STOP	Stop data statistics and clear the cached data

Statistic Parameter	Function
$\bar{X}$	Average value
mAx	Maximum value
Min	Minimum value
	Population standard deviation
s	Sample standard deviation
Cp	Capability index of process (deviation)
Cpk	Capability index of process (bias)

Notes

1. Data statistics function can only be set when Statistic function is enabled on the <System Config> page.
2. When data statistics function is enabled, the instrument performs various complex parameter operations, which will decrease the test speed.
3. Once the recording data is enabled, the <Test> page will be locked and cannot switch to other pages.
4. In the external state, the recording data function also needs to be disabled before switching to another page. The recording data function will automatically enable if the <Test> page is accessed directly from other pages.

6.8 Save Data

The size of the data cache can be set in advance to facilitate the user's later organization of the data. When data recording is on, data can be saved to a USB Disk at any time. Measurement data is saved in the file folder 'TEST DATA' in CSV format.

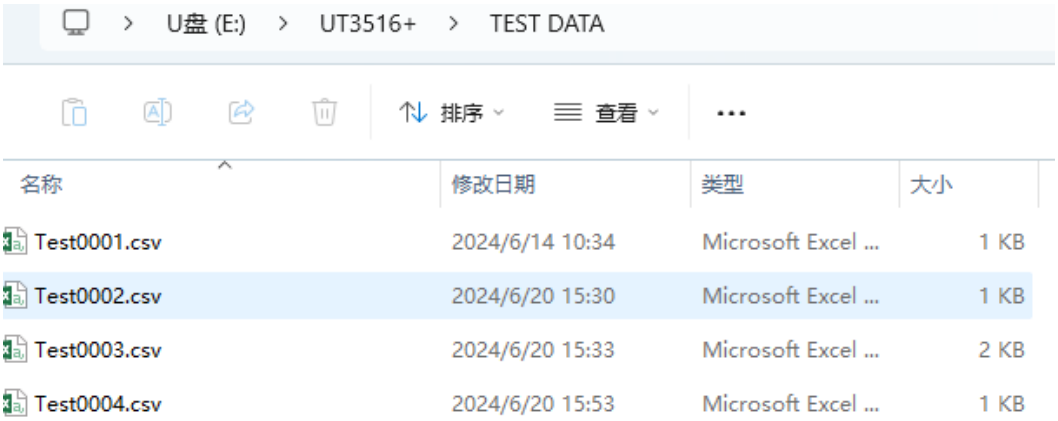


Figure 6-16 Save Data

In the Windows operating system, use Excel to open the file. Due to Excel's default format, the cell properties of the Time/Resistance field (highlighted in yellow in the following figure) need to be modified to display the data correctly. The following figure shows a comparison of the data before and after the modification.

MODEL	UT3516+	V3.28
TIME	2024/6/20 15:33	
NO.	R(Ω)	
1	2.51E-01	
2	2.51E-01	
3	2.51E-01	
4	2.51E-01	
5	2.51E-01	
6	2.51E-01	
7	2.50E-01	
8	2.50E-01	
9	2.50E-01	
10	2.50E-01	

MODEL	UT3516+	V3.28
TIME	2024/6/20 15:33	
NO.	R(Ω)	
1	2.5074E-01	
2	2.5070E-01	
3	2.5063E-01	
4	2.5062E-01	
5	2.5059E-01	
6	2.5052E-01	
7	2.5047E-01	
8	2.5038E-01	
9	2.5033E-01	
10	2.5037E-01	

Figure 6-17 Data Display

Setting steps for the cell format:

1. Select a data and right-click to choose "Format Cells"
2. Select "Custom" to change the display type to "yyyy/m/d".
3. Select "Scientific" notation and set the decimal places to 4.

6.9 Data Statistic - Capability Index of Process

On the <System Config> page, the Record/statistics function can be switched as needed.

Process capability refers to the ability of the process to meet quality requirements. It is also known as process capability. It measures the inherent consistency of the process, representing the smallest fluctuations in its most stable state. When the process is in a steady state, 99.73% of the product quality characteristics fall within the interval [μ-3σ, μ+3σ], where μ is the overall average and σ is the overall standard deviation of the product characteristics. This means almost all product characteristics fall within the range of 6σ. Therefore, process capability is usually expressed in terms of 6σ, with smaller values indicating better process capability.

Usually,

Cp, CpK > 1.33 indicates that the process capability is adequate.

1.00 < Cp, CpK ≤ 1.33 indicates that the process capability is acceptable.

Cp, CpK < 1.00 indicates that the process capability is insufficient.

Capability Index of Process and Formula

Capability Index of Process	Formula
Average (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)	$s = \sigma_{n-1} = \sqrt{\frac{\sum(x-\overline{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - n\overline{x}^2}{n-1}}$
Capability index of process (deviation) Cp	$Cp = \frac{\lvert Hi - Lo\rvert}{6\sigma_{n-1}}$
Capability index of process (bias) CpK	$CpK = \frac{\lvert Hi - Lo\rvert - \lvert Hi + Lo - 2\overline{x}\rvert}{6\sigma_{n-1}}$

Notes	1. n represents valid data: This refers to data that excludes overflow and open-circuit values, encompassing all digitally displayable values on the screen. 2. Hi and Lo variables in Cp and CpK formulas: These represent the actual upper and lower limit values of the comparator. In PER and ABS comparison methods, the actual value will be calculated by nominal values. This calculation is crucial regardless of whether the comparator is enabled. 3. When standard deviation σ(n-1)=0, Cp=99.99， CpK=99.99 4. When CpK < 0, Cp=0

6.10 Screenshot

The instrument features a screenshot function. Insert a USB storage device into the USB port on the instrument's front panel. Wait until the USB drive's indicator light changes from grey to blue. Long press the [OK] key to capture the current screen and save it in the "SCREENSHOT" file folder of the USB storage device for future reference.

Notes	1. It is recommended to use a branded USB storage device for saving data. The format and capacity can be FAT, FAT32, or EXFAT, with a maximum capacity of 128GB. 2. Taking a screenshot during data collection may result in failure. It should be executed after the instrument has finished collecting data points.

6.11 System Information

Press the [Test] or [Setup] key to enter the main page, and press the function key [System Config] key at the bottom of the screen to enter the <System Config> page. Press the [System Info] key to view the model's name, serial number, and version number of the instrument. This page does not need to be set.

7. Handler Interface

7.1 Handler Introduction

UT3510+ series provides a Handler interface to output the instrument's sorting results. When the instrument is used in an automatic component sorting test system, this interface provides the contact signals with the system and the output signals of sorting results.

As shown in Table 7-1, the contact signals include: /TRIG (Start signal), /EOM (End of all measurements); the sorting result outputs include: qualified (pass) BIN: /BIN1, /BIN2, /BIN3, /BIN4, /BIN5, and /BIN6, unqualified (fail) BIN: /NG.

Using these signals, the instrument can be easily combined with a system controller to form an automated test system for component testing, sorting and quality control, thus improving production efficiency.

Table 7-1 Handler Interface Description

Name	Signal	Circuit Characteristics
/BIN1	Qualified (Pass) signal	Collector output Active low Photoelectrical coupling isolation
/BIN2		
/BIN3		
/BIN4		
/BIN5		
/BIN6		
/NG	Unqualified (Fail) signal	
/EOM	End of all measurements	
/TRIG	Start signal	Pulse width ≥ 1μs, rising edge trigger, low level drive current approx. 5-10 mA.

7.2 Handler Operation

7.2.1 Signal Wire Definition

HANDLER interface provides three types of signals: compare signal output, control input signal, and control output signal.

■ Compare Signal Output:

/BIN1，/BIN2，/BIN3，/BIN4，/BIN5，/BIN6，and /NG. Refer to Figure 7-1 for the compare signal output

■ Control Output Signal:

/EOM (End of measurement and active compare data signal).

■ Control Input Signal:

/TRIG (External trigger signal)

Note: The slash "/" before signal name indicates that the signal is active at a low level.

Compare Function Setting Figure:

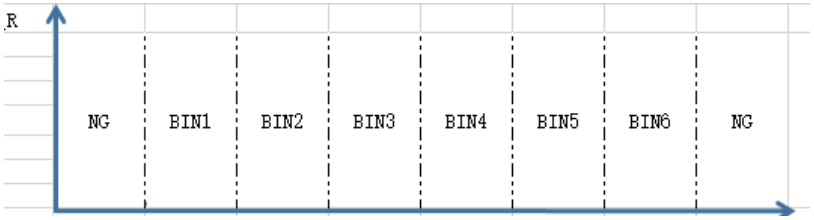


Figure 7-1 Opened Zone in Compare Function

7.2.2 Terminal and Signal

Figure 7-2 Handler Interface

The pin assignments and brief descriptions of the signals are shown in Table 7-2 and Figure 7-2, and the time sequence is detailed in Figure 7-3.

Table 7-2 Pin Definition of Handler Interface

Pin Number	Signal Name	Description
1	/BIN1	BIN sorting results output
2	/BIN2	
20	/BIN3	
3	/BIN4	
21	/BIN5	
4	/BIN6	
22	/NG	
5	/EOM	/EOM (End Of Measurement): The signal is active when the measurement data and compare results are active.
18	/TRIG	The instrument test will be generated by the falling edge of the signal. The internal circuit is configured with a 0.5 W, 1 k resistance limit.
19/23/36	COM	Reference ground for EXTV (external power).

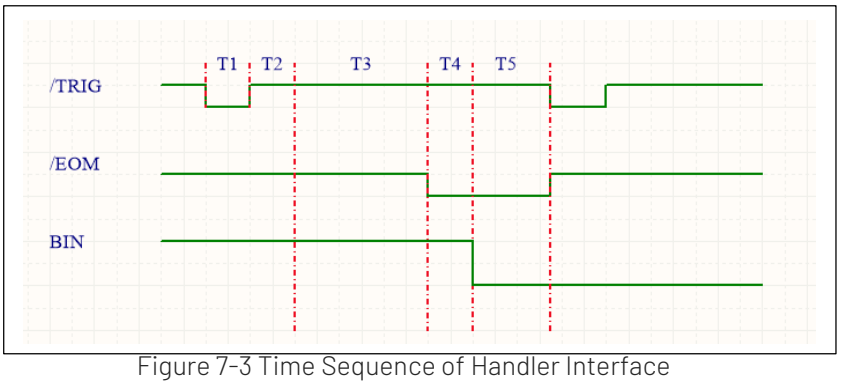


Figure 7-3 Time Sequence of Handler Interface

Table 7-3 DC isolated output electrical characteristics

Time	Minimum
T1: Trigger pulse Width	1 ms
T2: Trigger delay	10 μs
T3: Test time	Related to the test speed: high, fast, medium, and slow
T4: BIN output delay	200 μs
T5: Wait time after trigger	0s

During the high test, the sorting result will be sent 10 ms after the start signal.

During the fast test, the sorting result will be sent 17 ms after the start signal.

During the medium test, the sorting result will be sent 56 ms after the start signal.

During the slow test, the sorting result will be sent 334 ms after the start signal.

Notes	1. The /TRIG signal is the start signal, which can be triggered by either a rising edge or a falling edge, with a minimum pulse width of 1 ms. A level trigger signal can only be measured once; if it remains at a low level, it can only be measured once. 2. The /EOM signal is an activated end-of-measurement signal at a low level. Low level indicates that the sorting signal is active, but the results are not yet displayed. High level indicates that the device is still measuring. 3. The BIN X/NG is an activated sorting output signal at a low level. Low level indicates that the sorting signal is active. High level: the sorting signal is inactive.

7.2.3 Electrical Characteristic

Each DC output (pins 1-6) is isolated by an open-collector photoelectric coupler. The output voltage for each line is determined by the pull-up voltage of the Handler interface, which is supplied by an external voltage (EXTV: +5V to +24V).

Table 7-4 Electrical Characteristic for DC Isolation Output

Output Signal	Output Rated Voltage		Maximum Current	Circuit Reference Ground
	Low Level	High Level		
/BIN1- /BIN6 /NG /EOM	≤ 0.5V	+5V- +24V	50 mA	All signals are collector outputs, and external pull-up resistors are required. For example, 10 k, the power supply can be selected from +5V to +24V. Ground can be connected to output pins 19, 23, 36, or the COM terminal.

7.2.4 Schematic Diagram for Input Terminal

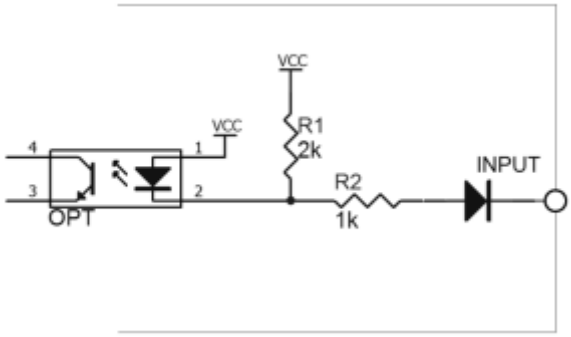


Figure 7-4 Schematic Diagram for Input Terminal (Trig)

7.2.5 Schematic Diagram for Output Terminal

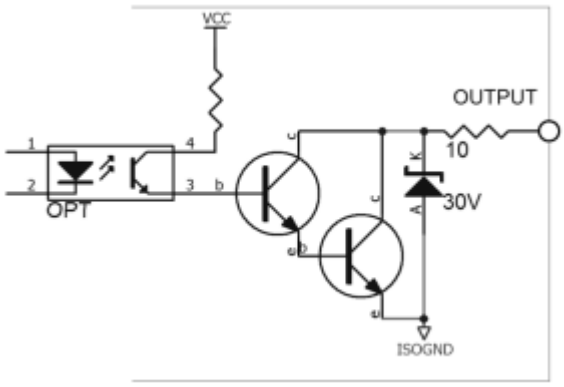


Figure 7-5 Schematic Diagram for Output Terminal

7.2.6 Circuit Connection for Input Circuit

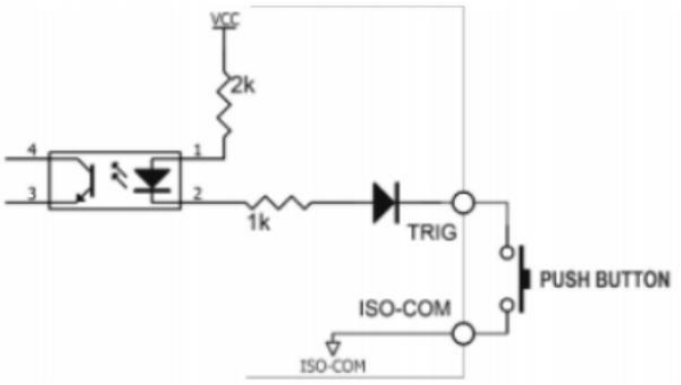


Figure 7-6 Circuit Connection for Connected with Switch

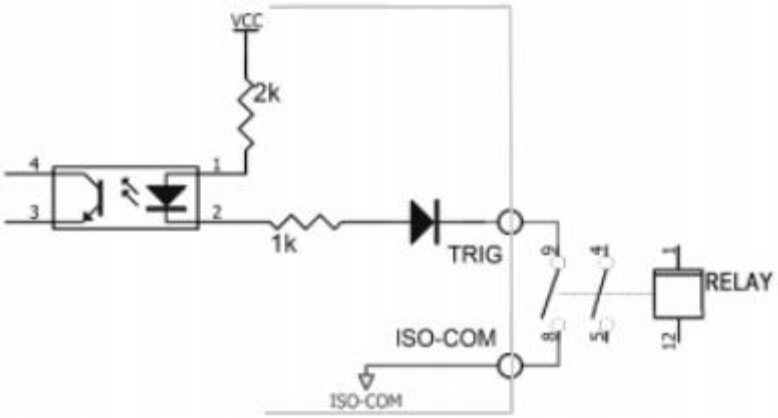


Figure 7-7 Circuit Connection of Relay Control

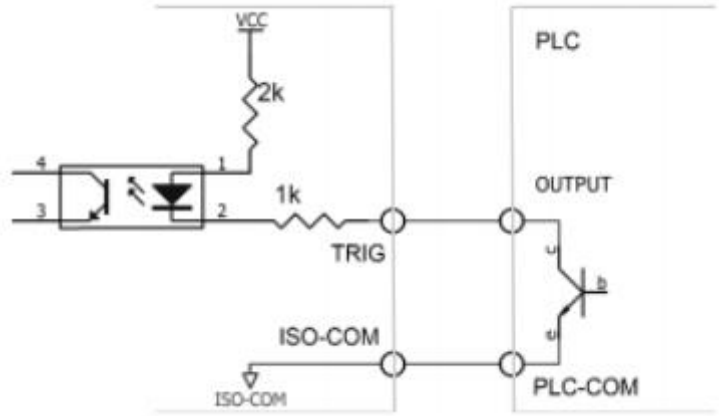


Figure 7-8 Circuit Connection for Negative Common Terminal of PLC Control

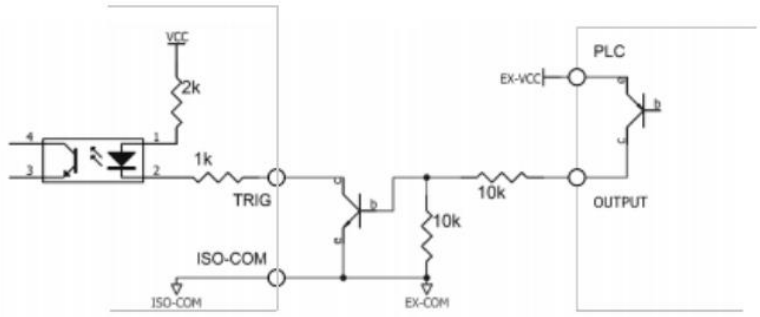


Figure 7-9 Circuit Connection for Positive Common Terminal of PLC Control

7.2.7 Circuit Connection for Output Circuit

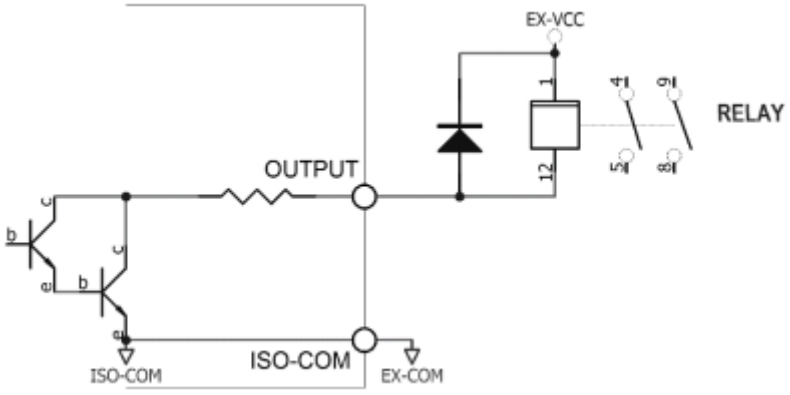


Figure 7-10 Circuit Connection for Control Relay

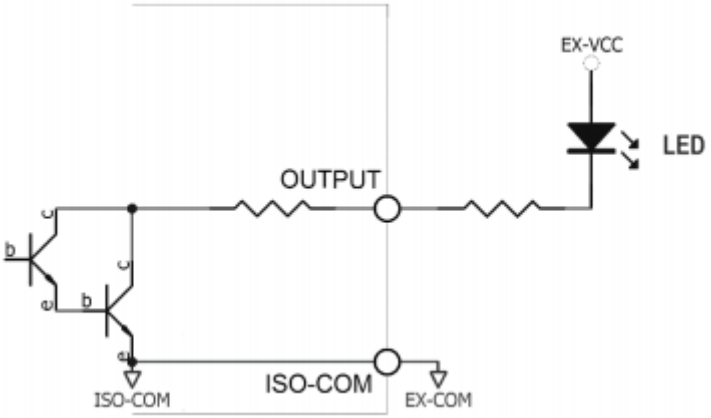


Figure 7-11 Circuit Connection for Control Diode or Photoelectric Coupler

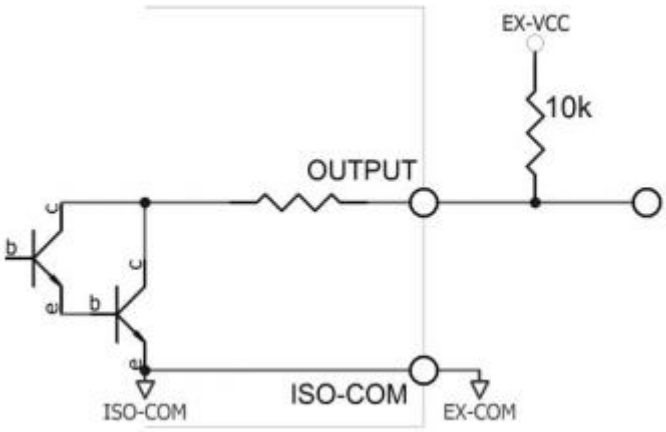


Figure 7-12 Circuit Connection for Negative Logic Output

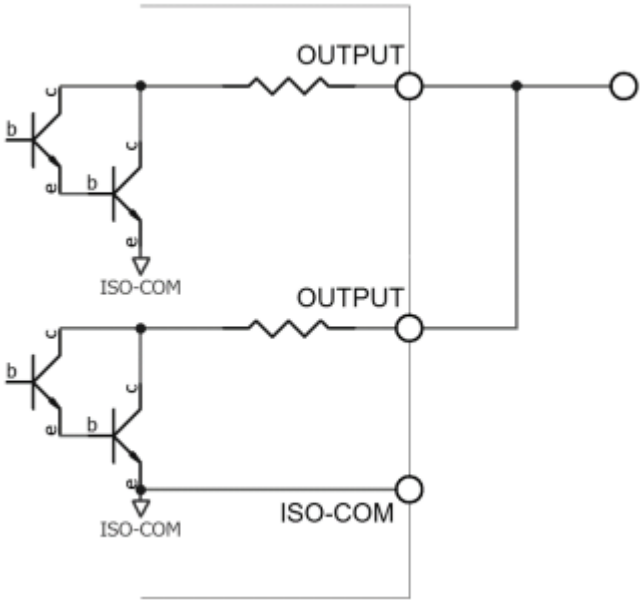


Figure 7-13 Circuit Connection for Two Output Combined Logic or Circuit

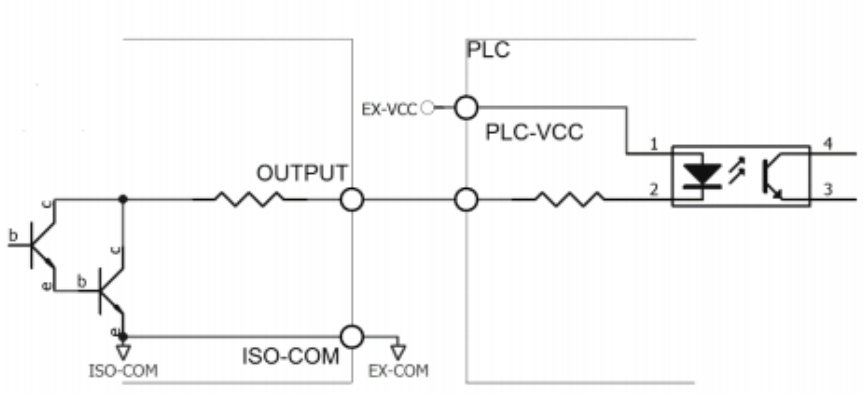


Figure 7-14 Circuit Connection for Output to Negative Common Terminal of PLC Control

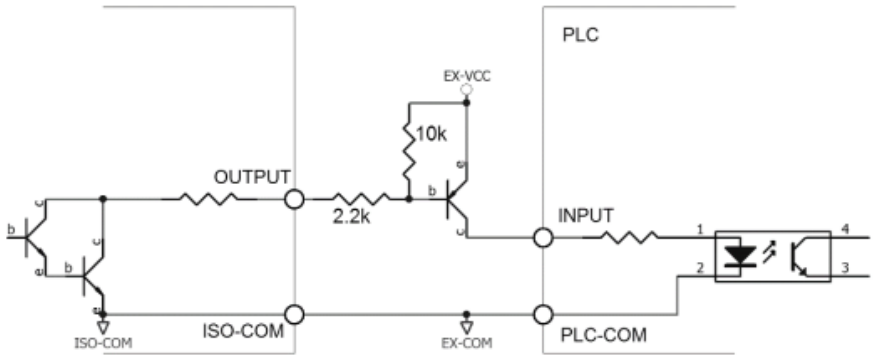


Figure 7-15 Circuit Connection for Output to Positive Common Terminal of PLC Control

8. Remote Communication

8.1 RS-232C Introduction

RS-232 is a widely used serial communication standard, also known as the asynchronous serial communication standard. It is used to facilitate data communication between computers and peripherals. RS stands for "Recommended Standard," and 232 is the standard number. This standard was officially published by the Electronic Industries Alliance (EIA) in 1969. It requires that each bit be transmitted via a data line.

However, the configuration of most serial ports is usually not strictly based on the RS-232 standard. Originally, each port used a 25-pin connector, but today's computers typically use a 9-pin connector. The common RS-232 signals are shown in Table 8-1 RS-232 common signal.

Table 8-1 RS-232 Common Signal

Signal	Symbol	Pin Number of 25-core Connector	Pin Number of 9-core Connector
Request to send	RTS	4	7
Clear to send	CTS	5	8
Data set ready	DSR	6	6
Data carrier detect	DCD	8	1
Data terminal ready	DTR	20	4
Transmit data	TXD	2	3
Receive data	RXD	3	2
Ground	GND	7	5

8.2 Serial Interface

8.2.1 RS232C Interface

UT3510+ series serial interface is not strictly based on the RS-232 standard described above. Instead, it provides a minimal, abbreviated set of signals, as shown in Table 8-2 RS232 serial pin interface.

Table 8-2 RS232 Serial Pin Interface

Signal	Symbol	Pin Number of 9-core Connector
Transmit data	TXD	3
Receive data	RXD	2
Ground	GND	5

The connector uses a 9-pin DB socket, with pin sequence as shown in Figure 8-1.

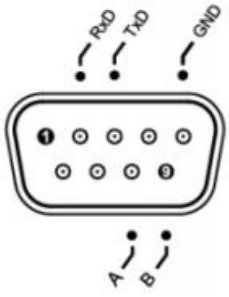


Figure 8-1 Rear View of RS232C/485

8.2.2 RS485 Interface

The instrument is equipped with an RS485 interface. RS485 and RS232 use the same DB 9 terminal. RS485 supports multi-machine communication and can be connected to various machines via a master machine.

Table 8-3 RS485 Serial Pin Interface

Symbol	Pin Number of 9-core Connector
A	8
B	9
GND	5

Caution:

1. To avoid electrical shock, switch off the instrument when plugging or unplugging connectors.
2. Do not short the output terminals or the chassis to avoid damaging the device.

8.3 Connecting PC

As shown in Figure 8-2, the pin definition of UT3510+ series differs from that of the 9-pin connector serial interface used by computers. Users can create their own 3-wire connecting cable (length should be less than 1.5m) using two-core shielded cable as depicted, or purchase the serial interface cable for connecting a computer to the UT3510+ series from Hoyi. When making your own cable, note that pins 4 and 6 should be shorted to pins 7 and 8 on the computer side.

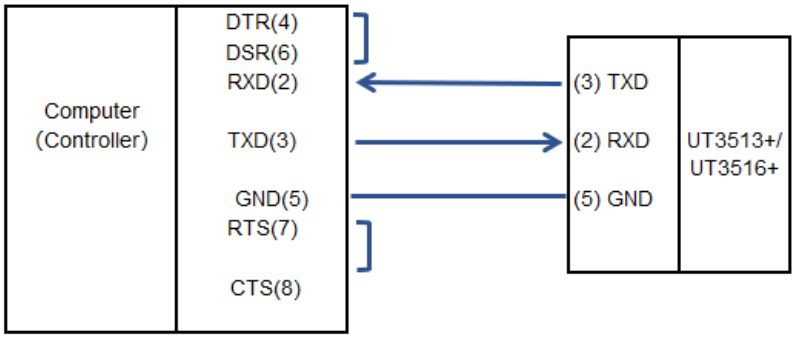


Figure 8-2 Instrument Connect to a PC

8.4 Serial Port Parameter

Table 8-4 Serial Port Parameter

Transmission Mode	Full-duplex Asynchronous Communication with Start and Stop bits
Baud rate	115200 bps
Data bit	8 BIT
Stop bit	1 BIT
Check parity bit	None
Terminator	NL (Newline character， ASCII code 10)
Connector	DB9

8.5 LAN Interface Setting

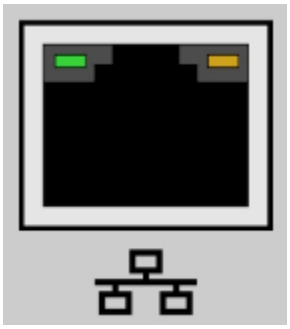


Figure 8-3 Rear View of LAN Connector

Connect the LAN cable into the instrument's LAN connector.

Green LED

ON: Indicates the connection is established.

Blinking: Indicates data is being communicated.

Orange LED

OFF: 10M BASE-T

ON: 100M BASE-TX

9. Appendix

9.1 Appendix A Maintenance and Cleaning

(1) General Maintenance

Keep the instrument away from the direct sunlight.

Caution: Keep sprays, liquids and solvents away from the instrument or probe to avoid damaging the instrument or probe.

(2) Cleaning

Check the instrument and probe frequently according to the operating condition. Follow these steps to clean the external surface of the instrument.

a. Use a soft cloth to wipe the dust from the outside of the instrument.

b. When cleaning the LCD screen, please pay attention to protect the transparent surface.

c. To clean the dust screen, use a screwdriver to remove the screws of the dust cover and then remove the dust screen. After cleaning, reinstall the dust screen in sequence.

d. Disconnect the power supply, then wipe the instrument with a damp (not dripping) soft cloth. Do not use any abrasive or chemical cleaning agents on the instrument or probes.

Warning: **Before reboot up the instrument, please ensure that the instrument is completely dry to avoid electrical short circuits or even personal injury caused by moisture.**

9.2 Appendix B Warranty Overview

UNI-T (UNI-TREND TECHNOLOGY (CHINA) CO., LTD.) ensures the production and sale of products, from authorized dealer's delivery date of three years, without any defects in materials and workmanship. If the product is proven to be defective within this period, UNI-T will repair or replace the product in accordance with the detailed provisions of the warranty.

To arrange for repair or acquire warranty form, please contact the nearest UNI-T sales and repair department.

Aside from the warranty provided by this summary or other applicable insurance guarantees, UNI-T does not offer any other explicit or implied warranties, including but not limited to implied warranties of merchantability and fitness for a particular purpose.

In any case, UNI-T does not bear any responsibility for indirect, special, or consequential loss.

9.3 Appendix C Contact Us

If you encounter any inconvenience due to the use of this product and are located in mainland China, you can contact UNI-T directly.

Service support hours: 8am to 5.30pm (UTC+8), Monday to Friday

Email: infosh@uni-trend.com.cn

For product support outside mainland China, please contact your local UNI-T distributor or sales center.

Many UNI-T products offer options for extending the warranty and calibration period. Please reach out to your local UNI-T dealer or sales center for more information.

To find the address list of our service centers, please visit our website at: UNI-T Website