

CKT3544

PRECISION RESISTANCE METER

User's Manual

2016-3-15

Manual Edition V1.0

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Introduction

Thank you for purchasing our CKT3544 DC Resistance Meter. To obtain maximum performance from the product, please read this manual first, and keep it handy for future reference.

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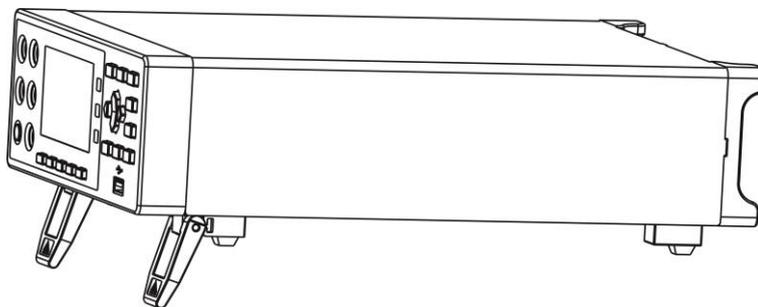
Checking Package Contents

When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your authorized distributor or reseller.

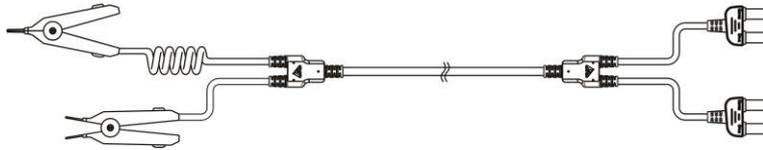
When transporting the instrument, use the same packaging materials used for the delivery to you.

Check the package contents as follows

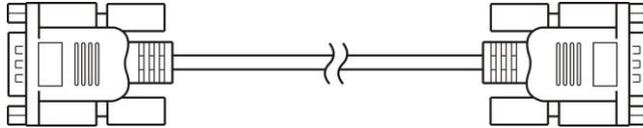
No.	Item	Quantity
1	3544 Resistance Meter	1
2	User's Manual	1
3	CD	1
4	RS23 Cable	1
5	Test Lead	1
6	Power Cord	1



3544 Resistance Meter



9363A Test Lead



9800 RS232 Cable

Safety Note

The instrument is designed to conform to IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, using the instrument in a way not described in this manual may negate the provided safety features.

Before using the instrument, be certain to carefully read the following safety notes.

Note

Mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use.

Notation

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using the instrument, be certain to carefully read the following safety notes.



Indicates very important message in this manual. When the symbol is printed on the instrument, refer to a corresponding topic in the Instruction Manual.



indicates DC (direct current)



indicates a fuse



indicates earth terminal

Accuracy

We define measurement tolerances in terms of f.s. (full scale), rdg. (reading) and dgt. (digit) values, with the following meanings:

f.s.	(Maximum display value)
	This is usually the maximum display value. In the instrument, this indicates the currently used range.
rdg.	(Reading or displayed value)
	The value currently being measured and indicated on the measuring instrument.
dgt.	(Resolution)
	The smallest displayable unit on a digital measuring instrument, i.e., the input value that causes the digital display to show a "1".

Usage Notes

Installation environment

- Operating temperature
0°C to 40°C 80%RH or less (no condensation) and humidity ranges
- Ideal working environment
23°C to 5°C 80%RH or less (no condensation) and humidity ranges

Installing the instrument in inappropriate locations may cause a malfunction of instrument or may give rise to an accident. Avoid the following locations.

- Exposed to direct sunlight or high temperature
- Exposed to corrosive or combustible gases
- Exposed to water, oil, chemicals, or solvents
- Exposed to high humidity or condensation
- Exposed to a strong electromagnetic field or electrostatic charge
- Exposed to high quantities of dust particles
- Near induction heating systems (such as high-frequency induction heating systems and IH cooking equipment)
- Susceptible to vibration

Checking before use

Before using the instrument the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your authorized distributor or reseller.

 WARNING	Before using the instrument, check that the coating of the test leads or cables are neither ripped nor torn and that no metal parts are exposed. Using the instrument under such
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	conditions could result in electrocution. Contact your authorized distributor or reseller in this case
--	--

Handling Precautions

 DANGER	<p>Do not modify, disassemble, or repair the instrument. This may result in fire, electric shock accident, or injury.</p>
 CAUTION	<p>Do not place the instrument on an unstable or slanted surface. It may drop or fall, causing injury or instrument failure.</p>
 NOTE	<p>To avoid corrosion and/or damage to the instrument due to battery leakage, remove the batteries from the instrument if it is to be kept in storage for an extended period.</p> <p>Be sure to turn the power off after using it.</p>

Measurement precautions

 DANGER	<p>To avoid electric shock accident and short circuit, please operate the instrument as following:</p> <p>Do not allow the instrument to get wet, and do not use it with wet hands. This may cause electric shock accident.</p> <p>Do not modify, disassemble, or repair the instrument. This may result in fire, electric shock accident, or injury.</p>
 CAUTION	<p>Do not place the instrument on an unstable or slanted surface. It may drop or fall, causing injury or instrument failure.</p> <p>To avoid any damage to the instrument, avoid any vibration or shock during transport or handling. Especially, be careful not to drop or fall the instrument which will cause shock.</p> <p>To avoid any damage to the instrument, do not input voltage or current to any measurement, TC terminals, or EXPORT terminals.</p>

Handling leads and cables

 DANGER	<p>To avoid electrical shock accident, do not short test leads where voltage is applied.</p>
 CAUTION	<p>Do not use any test lead or temperature sensor other than the ones specified by our company. It may result in inaccurate measurement due to poor contact or other reasons.</p> <p>To avoid damaging the cables, do not bend or pull the base of cables and the leads.</p> <p>The ends of pin type leads are sharp. Be careful to avoid injury.</p> <p>Be careful not to allow contact between the lead wire and the heat generating portion.</p>

Chapter 1 Overview

1.1 Overview and Features

The CKT3544 is capable of performing high-speed, high-precision measurement of the winding resistance of components such as motors and transformers, the contact resistance of relays and switches, the pattern resistance of printed circuit boards, and the DC resistance of fuses, resistors, and materials such as conductive rubber using four-terminal measurement.

The CKT3544 has a measuring range from $3\text{m}\Omega$ to $3\text{M}\Omega$ to test resistors from $0.1\mu\Omega$ to $3\text{M}\Omega$ with a maximum display of 32000. At a test speed of 15 times/second, 0.02% accuracy is still guaranteed, and the reading jitter can be controlled within 3 words. Its unique OVC test mode can be adapted to high-precision test requirements. Since the instrument incorporates a temperature correction function, it is particularly well suited to the measurement of targets whose resistance values vary with temperature.

The CKT3544 series instruments support scan test function. With the company's multi-channel scanning tester, it is possible to simultaneously scan and measure multiple resistors.

The instrument has sorting function, with 10 sets of panel storage and various sorting beeper setting, and can also be equipped with Handler interface, which is applied to the automatic sorting system to complete the automatic pipeline test. It is equipped with RS232C, RS485 and Ethernet interfaces for remote control and data acquisition and analysis.

The computer remote control command is compatible with SCPI (Standard Command for Programmable Instrument), which can efficiently perform remote control and data acquisition functions.

1.2 Features

□ Appearance

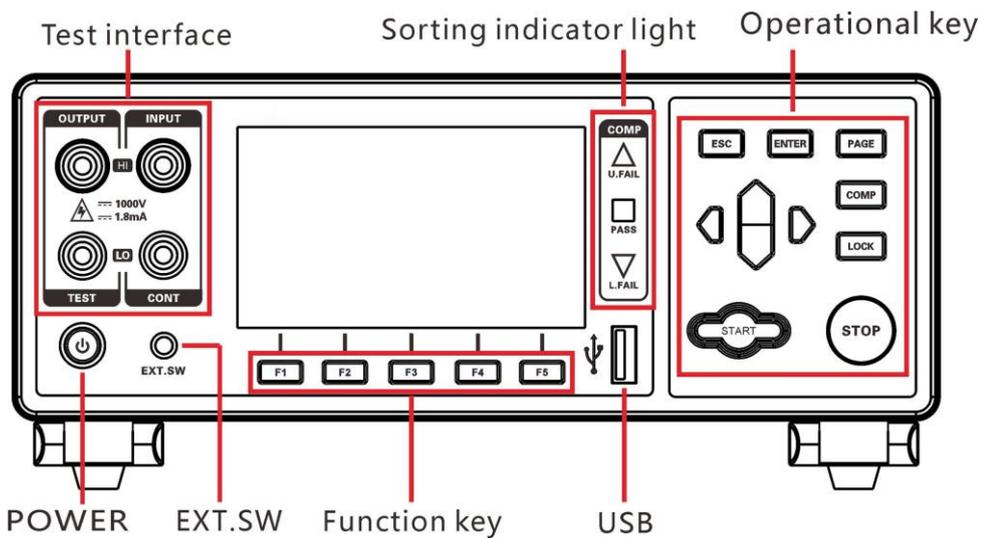
- Display with 3.5-inch high-resolution TFT screen display, easy to operate
- Compact design
- Reliable specifications even if the body is small and light weight
- High resolution of 32,000 dgt.
- $0.1\mu\Omega$ resolution at 1 A measuring current
- Quick test
- Minimum test cycle only 20ms

- Four-terminal test
- High precision measurement of low resistance

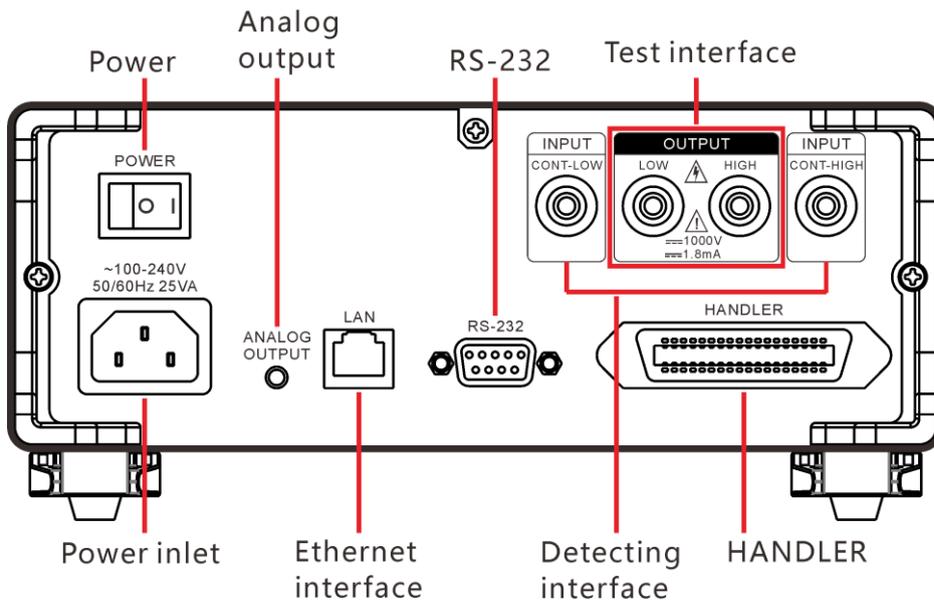
- Various interface configuration
- External I / O port
- RS-232C interface
- RS-485 interface
- Ethernet interface
- Temperature test interface
- U disk interface
- Power supply
- 100~256 V wide power supply
- Power frequency 50Hz/60Hz automatic identification
- Maximum power consumption 10W

1.3 Component Names and Operation Overview

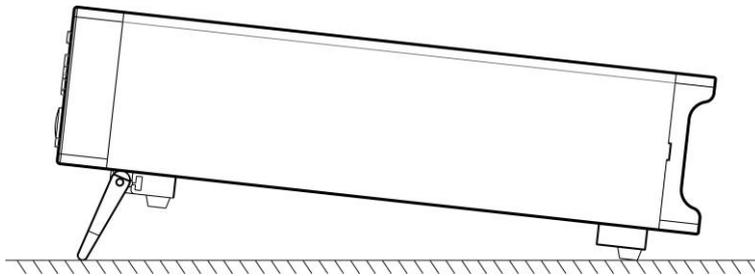
Front Panel



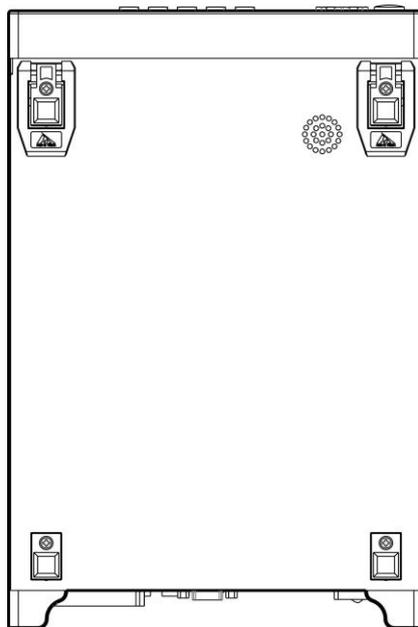
Rear Panel



Side view



Bottom



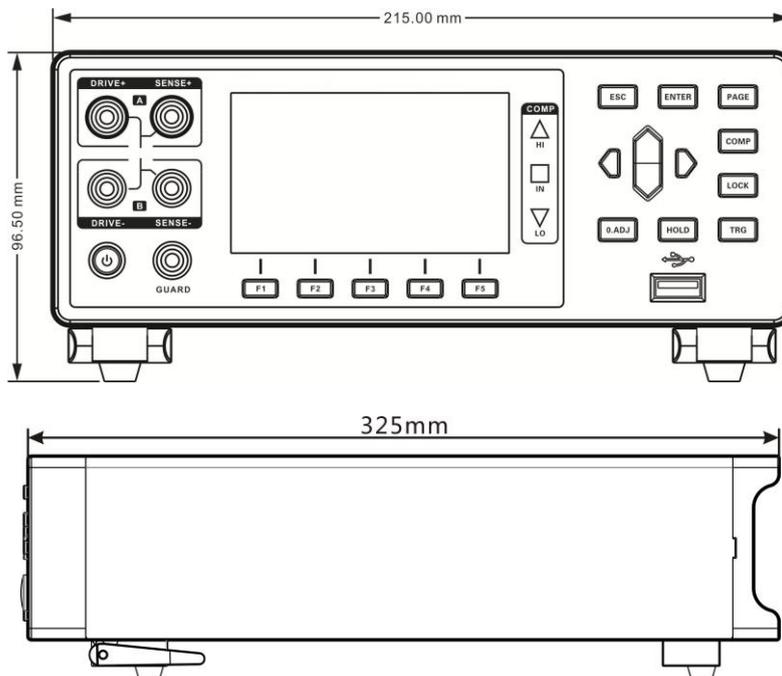
Keys

Keys	Description
------	-------------

	Function key F1
	Function key F2
	Function key F3
	Function key F4
	Function key F5
	Function key Escape Cancellation of operation
	Function key Enter Acceptance of settings and manual trigger input
	[Page Switch] switch to [Test Page] <-> [Setup Page] <-> [Panel Page] <-> [Communication Settings Page] <-> [Sort Settings Page] <-> [I/O Settings page]
	On/Off Comparator key
	Lock key Short press [LOCK] key to lock the current page and the other keys get invalid. Long press to unlock.
	[0.ADJ] key Short press to zero-adjustment function Long press to release the zero-adjustment function

	<p>[HOLD] key Hold the current measurement during the test</p>
	<p>[Trigger] key Single trigger test to the instrument in manual trigger mode</p>
	<p>[Direction] key, Select menu items or set values</p>

1.4 Size



1.5 Screen Composition

Measurement screen

INT					
Test	Set	Panel	Comm	Sort	I/O
Range	3mΩ	<div style="text-align: right;">25.0°C</div> <div style="font-size: 2em; text-align: center;">R: 1.0000mΩ</div>			
Speed	Fast				
Panel	Default				
Upper	OFF				
Lower	OFF				
Range ↑	Range ↓	Auto	Speed	Temp	

Settings screen

INT					
Test	Set	Panel	Comm	Sort	I/O
Trig Source	INT	Average	OFF		
Delay	OFF	Alarm	OFF		
OVC	OFF	key tome	OFF		
300mA	OFF				
Temp Set	OFF				
INT	EXT	MAN	A.HOLD		

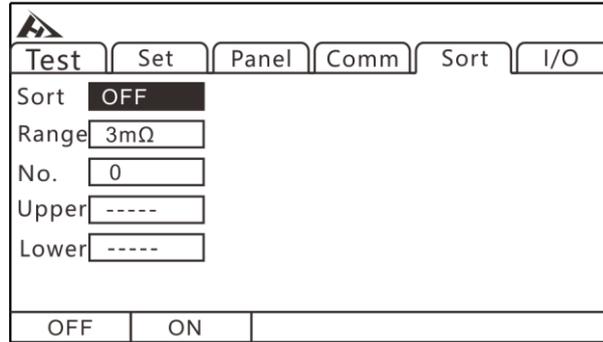
Settings save screen

INT					
Test	Set	Panel	Comm	Sort	I/O
No.	Name	Empty			
01	-----				
02	-----				
03	-----				
04	-----				
05	-----				
06	-----				
07	-----				
08	-----				
09	-----				
10	-----				
Save					

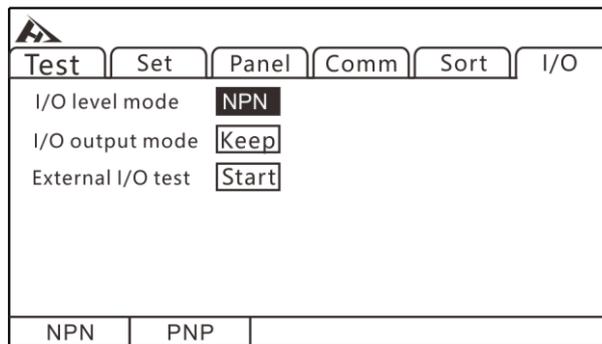
Communication interface screen

INT					
Test	Set	Panel	Comm	Sort	I/O
Interface	RS232				
Band Rate	9600				
RS232	RS485	TCP			

Sort screen



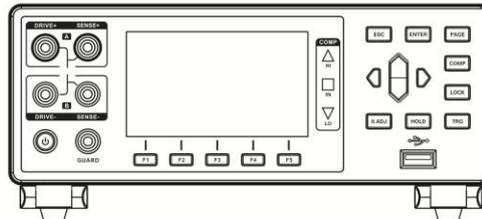
EXT I/O Settings screen



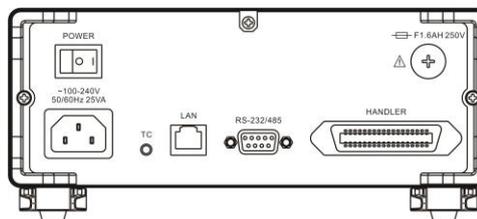
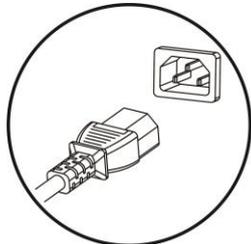
Chapter2 Preparing for Measurement

2.1 Measurement process overview

1. Turn off the power before disconnecting the power cord

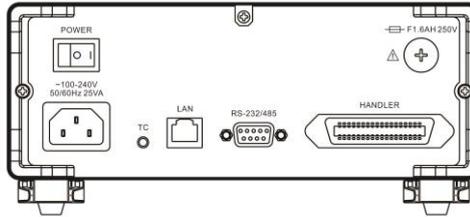
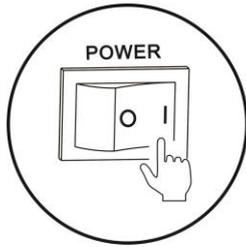


2. Plug the power cord into the mains outlet



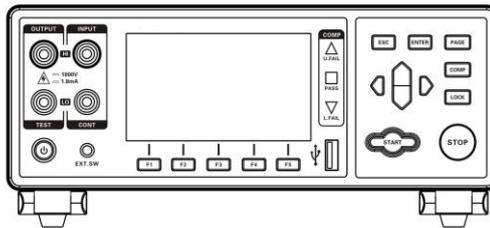
Ensure that the power cord is well grounded, which is conducive to the stability of the test.

3. Dial the power of the instrument to the "on" state



At this moment, the instrument inside has been turned on and it is in standby state.

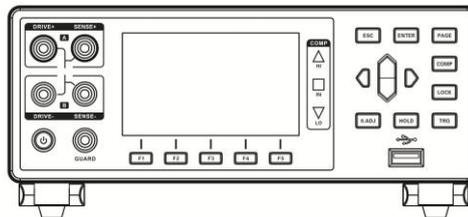
4. Press and hold the panel **POWER** button to turn on the power.



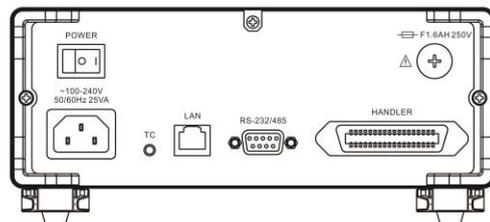
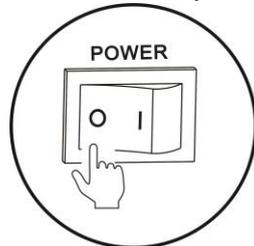
When in the standby state, the panel **POWER** button light is red, long press the panel **POWER** button, the power is turned on, the screen is lit, and the panel button light turns green.

5. Set test parameters (see section 2.2 for details)

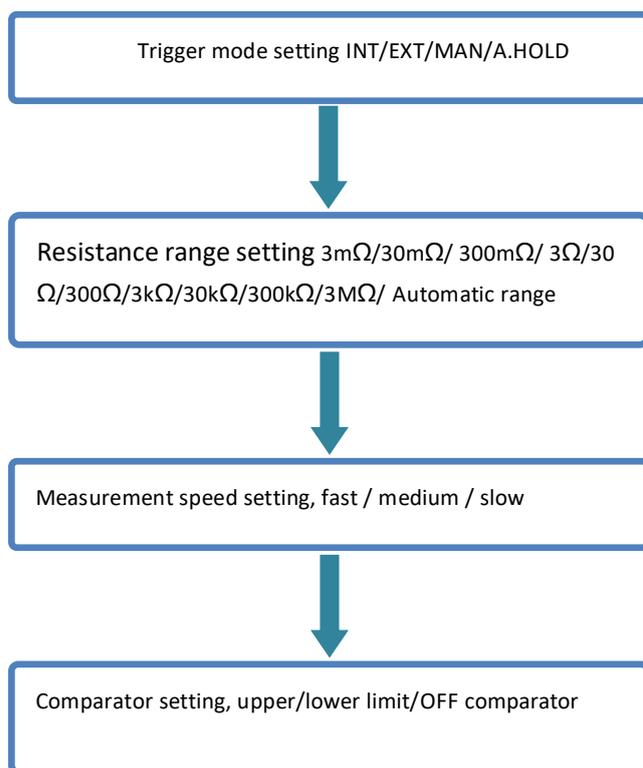
6. Start to test



7. End of test, turn off the power



2.2 Basic parameter setting process



2.3 Pre-measurement Inspection

Before using the instrument, inspect it to verify that no damage has occurred during storage or transportation and it operates normally. If you find any damage, contact your authorized distributor or reseller.

Instrument and peripheral checking

Inspection item	Action
Is there any damage or a crack in the instrument? Are the internal circuits exposed?	If any damage is found, do not use it. Return it for repair.
Is there any dust or contamination, such as pieces of metal, on any	If dust or contamination is adhered to a terminal, clean the terminal with a swab or the like.
Is the test lead coating broken or is the metal exposed ?	If the coating of a test lead is broken, the measured value may become unstable or have an error. Replace the damaged test lead.

Power-on checking

Inspection item	Action
-----------------	--------

After turn on the power on at the back of the instrument, check instrument POWER button lit or not?	Return the instrument for repair, if the POWER button is not lit.
When you turn the power on, does the entire display turn on and then the model name and a measurement screen appear on the screen?	If the screen does not behave like this, the instrument may be damaged internally. Return it for repair.

2.4 Confirming the measured object

It is necessary to appropriately change the measurement conditions according to the object to be measured in order to reliably measure the resistance. Please refer to the recommended example shown in the table below to start measuring after setting up the instrument.

Measured object	Recommended setting		
	Temperature compensation temperature conversion	OVC function	Measuring current at 300mΩ range
Coil products	TC	OFF	Lo
Contact products	*1	ON	Lo
Conductive coating, conductive rubber	--	OFF	Lo
Metal wire, profile	*1	ON	Lo
Car grounding resistance	*1	ON	Hi

Coil products:

Coil products has large inductance components such as inductors, coils, transformers, and motor speakers. Under normal circumstances, when testing such products, avoid using the OVC function, because its inductance component will suppress the OVC current pulse. If the delay is not enough, the measurement will fail. Temperature compensation is required in some cases.

Contact products:

Relays, contactors, switches, etc. These products have a thermoelectric potential effect at the contacts due to the presence of contacts. The OVC function is recommended to eliminate the thermoelectric potential effect.

Metal wire, profile:

Such as metal wire, metal profiles, metal welded parts. Especially for wire rods, since the resistance value is relatively temperature dependent, it is recommended to use a low power test while using temperature compensation.

*1 When the temperature dependence of the object to be measured is large, use temperature compensation.

*2 Measurement values can be saved at regular intervals by using the interval measurement function.

2.5 Connecting Measurement Leads



WARNING

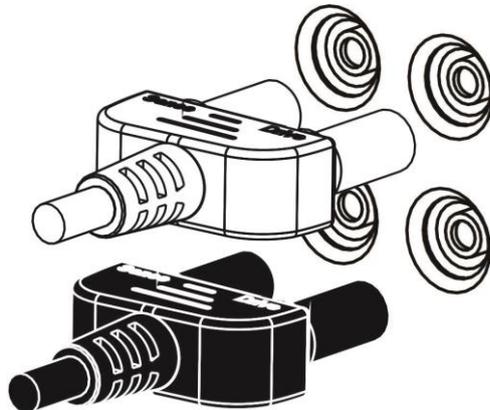
- To avoid electric shock accident, connect the test leads correctly.



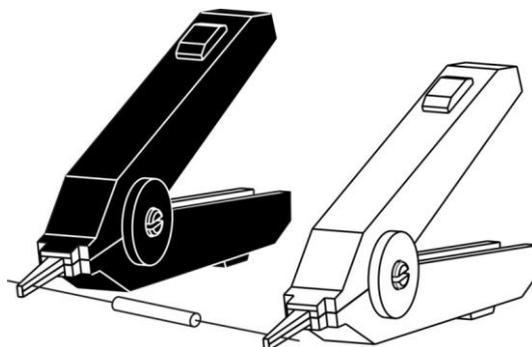
NOTE

- To be safe, do not use any test lead other than the ones specified by our company.
- The ends of leads are sharp. Be careful to avoid injury.

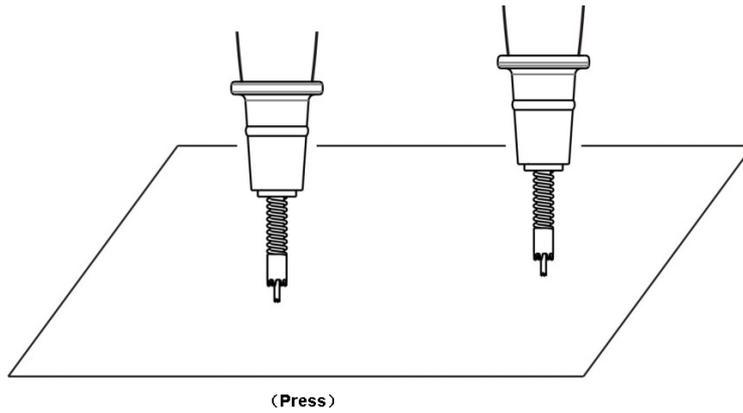
Front panel connection



Example 9363-A Test clip

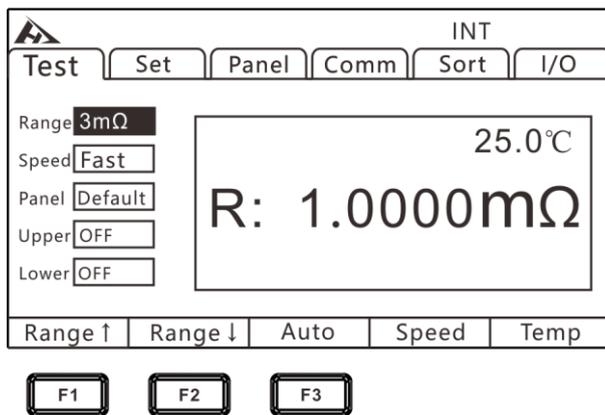


Example 9363-B Test Probe



Chapter 3 Basic Settings

3.1 Setting the test range



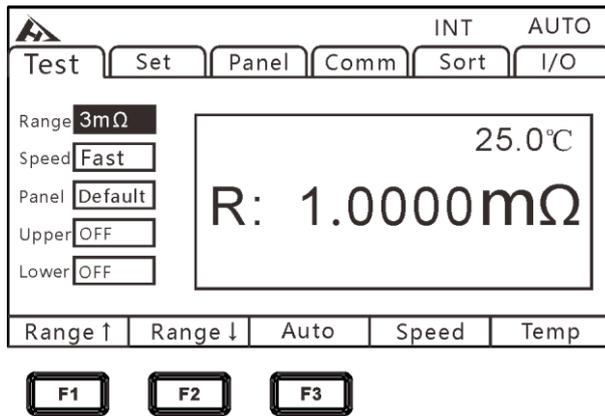
Manual Range Setting

Ranges

3mΩ ↔ 30mΩ ↔ 300mΩ ↔ 3Ω ↔ 30Ω ↔ 300Ω ↔
 3kΩ ↔ 30kΩ ↔ 300kΩ ↔ 3MΩ

Auto-Ranging

In the measurement interface, press [F3] to switch the auto range. When at auto range, the [AUTO] mark is lit, and when the auto range is turned off, the [AUTO] mark is not displayed.



Note:

If the range is changed while the auto range is ON, the auto range is automatically canceled and the manual range is set.

When the comparator function is turned ON, the range cannot be changed from fixed (it cannot be switched to auto-ranging). To change the range, turn OFF the comparator

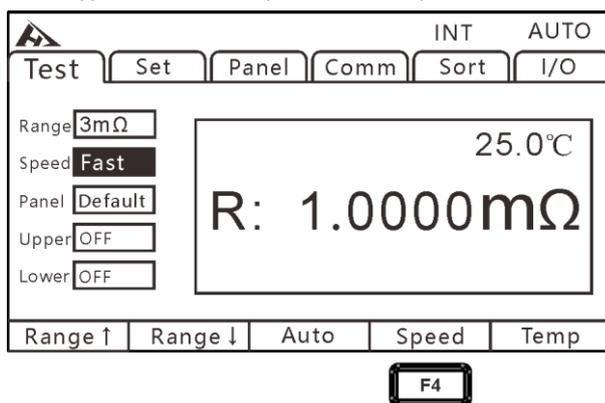
function or change the range from within the comparator settings.

When measuring certain motor, transformer or coil components, the auto range setting

may not stabilize. In such cases, use manual range selection(see chapter Resistance measurement accuracy)

3.2 Setting the Measurement Speed

The measurement speed can be set to FAST (50 mea/sec), MED (medium (20 mea/sec)), or SLOW (2 mea/sec)

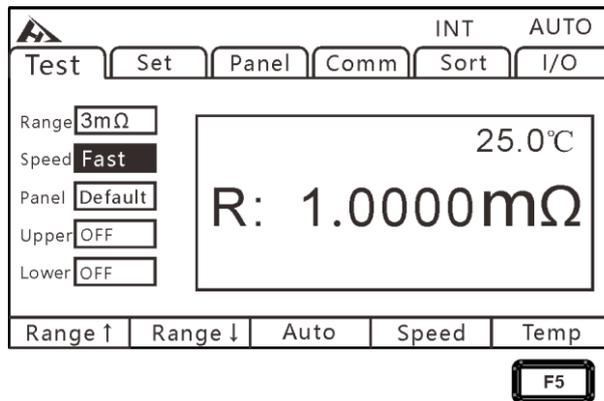


Note:

- When the measurement delay is set, the sampling period becomes slower.
- Test time includes ADC sampling, sorting output, and display time.
- In the test environment, when the electric field interference is relatively large, or when the test is difficult to stabilize, a slow test is recommended.

3.3 Temperature display settings

Press the [Temperature] key on the test page to switch whether the current temperature is displayed.



3.4 Setting the test trigger mode

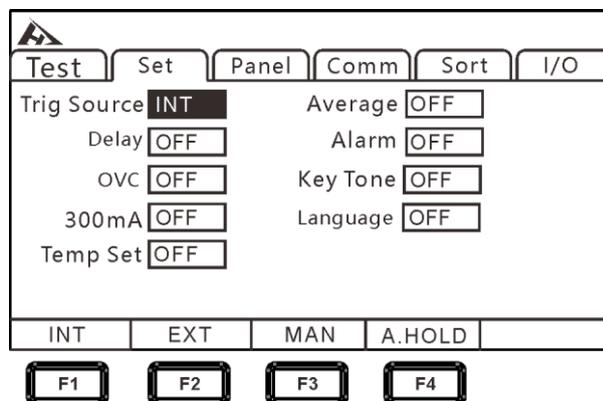
The user can select internal trigger/external trigger/manual trigger/auto hold.

1. Select the parameter setting screen



Press [PAGE] Button to parameter setting page

2. Select the relevant menu items



Menu item	Meaning
[INT]	Internal
[EXT]	External
[MAN]	Manual
[A.HOLD]	Auto hold

3.5 Measurement delay setting

Set the delay time after changing the measurement current under OVC and auto range to adjust the measurement stabilization time. By using this function, even if the reactance component of the object to be measured is large, measurement can be started after the internal circuit is stabilized. The preset settings vary depending on the range or offset voltage compensation function.

Preset set OVC delay value (internal fixed) (unit: ms)

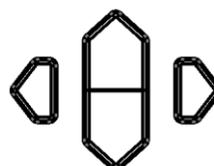
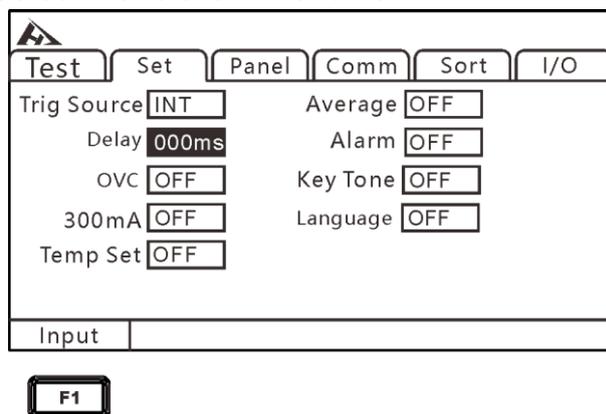
Measuring current	Range	Delay time (ms)
Lo	3mΩ ~ 30mΩ	200
	300mΩ ~ 3Ω	50
	30Ω ~ 300Ω	30
	300mΩ	200
Hi	300mΩ	200

1. Select the parameter setting page



Press [PAGE] Button to parameter setting page

2. Select the relevant menu item



Press up/down/left/right to choose the menu

Approximate calculation criteria for inductive load delay time

- When applying a measurement current to an inductive load, it takes a certain amount of time to stabilize. When it is not possible to make measurements in the initial state (preset), please adjust the delay. Set the delay time to approximately 10 times the following calculated value to ensure that the reactance components (inductors, capacitors) do not affect the measured value.

$$t = -\frac{L}{R} \ln\left(1 - \frac{IR}{V_o}\right)$$

L : inductance of the measured object

R : resistance of the object to be measured + wire resistance + contact resistance

I : Measuring current

VO: open circuit voltage

- Initially set the delay time to a longer time and then gradually reduce the delay time while observing the measured value.
- If the delay time is extended, the display of the measured value will be slower.

3.6 OVC (thermal electromotive force compensation) function setting

OVC function automatically compensates for the electromotive force or the bias voltage inside the instrument. (OVC: Offset Voltage Compensation)

1. Select the parameter setting page



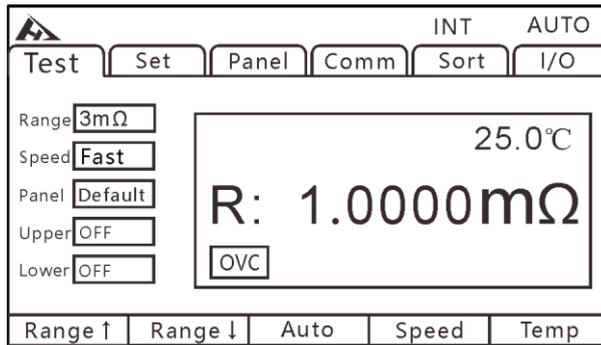
Press [PAGE] Button to parameter setting page

2. Select the relevant menu item

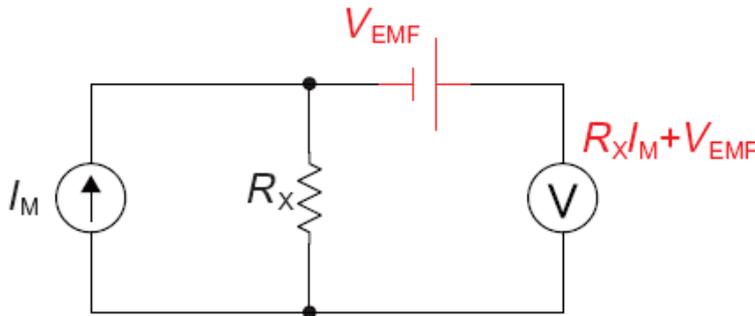
Menu item	Meaning
[OFF]	Turn on OVC function
[ON]	Turn off OVC function

2. OVC-on measurement page

When the OVC function is turned on, the OVC will be displayed on measurement page.



RP-RZ is displayed as the true resistance value based on the measured value RP when the measured current flows and the measured value RZ when the measured current does not flow.



V_{EMF} : It is a thermoelectric potential. When any metal is in contact, it will generate an electric potential. The magnitude of the electric potential is related to the temperature.

R_x : measured resistance

When the injection test current is I_M , $V_1 = V_{EMF} + R_x I_M$

When $I_M = 0$, $V_2 = V_{EMF}$

$V = V_1 - V_2 = R_x I_M$

The effect of the thermoelectric potential can be offset by a simple subtraction operation.

Note:

- When the offset voltage compensation function is ON (the OVC indicator is lit), the display of the measured value updates slowly.
- The OVC function cannot be used when the range is 3kΩ or more. It automatically changes to the OFF state.
- When the offset voltage compensation function has been changed, the zero adjustment function is released.
- When the inductance of the measured object is large, the delay time needs to be adjusted. (Initially set the delay time to a longer time and then gradually reduce it while observing the measured value.)
- When the measured heat capacity of the object is small, the effect of the offset voltage compensation function may not be seen.

3.7 Switching measurement current 300mA (300mΩ range)

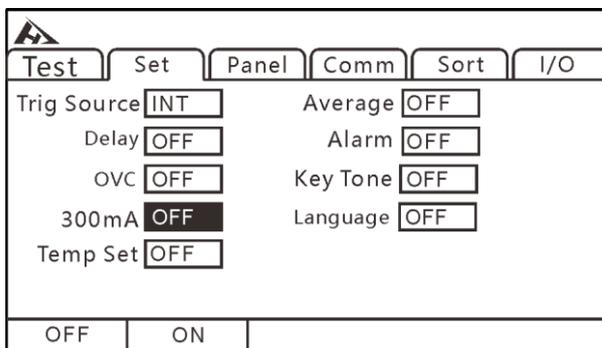
The instrument is able to change the measurement current of the 300mΩ range to 300 mA (100 mA at the factory). It is good to measure large current wiring under conditions close to the actual use state, it also helps to measure in an environment with large external noise.

1. Select the parameter setting interface



Press **[PAGE]** Button to parameter setting page

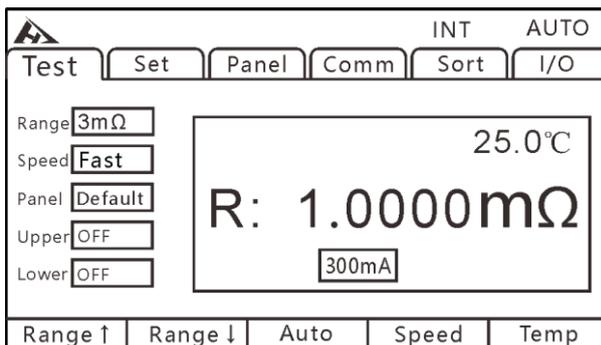
2. Select the relevant menu



item **[F1]** **[F2]**

Menu item	Meaning
[OFF]	300mΩ range test current 100mA
[ON]	300mΩ range test current 300mA

3. The measurement page when 300mA measurement current is turned on



Note:

- When the measurement current is set to 300 mA, the power consumption of the object to be measured increases.
- When high-precision measurement is required, please use the 100 mA measurement current.
- If the measurement current is changed, the zero adjustment will be cleared.

3.8 Temperature compensation setting

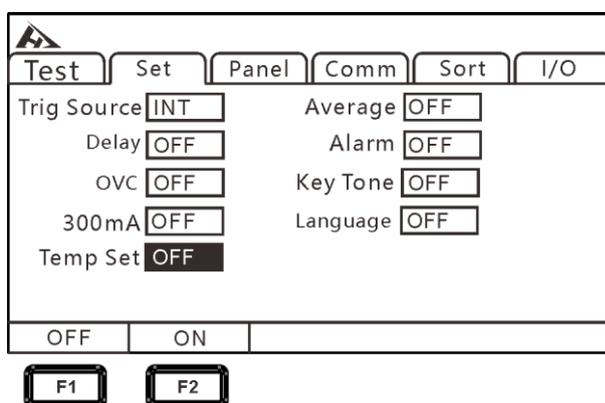
The resistance value is converted to the reference temperature for display. When performing temperature compensation, connect the temperature probe to the TC terminal on the rear panel of the instrument.

1. Select the parameter setting page

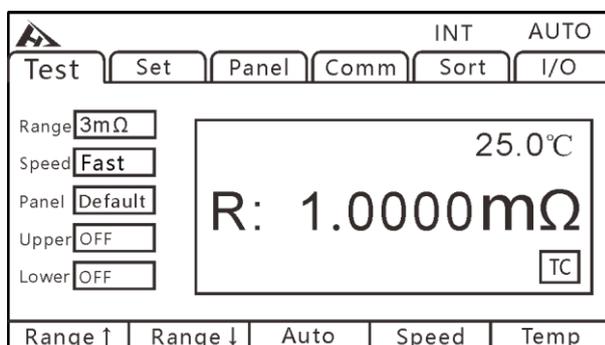


Press **[PAGE]** Button to parameter setting page

2. Select the relevant menu item

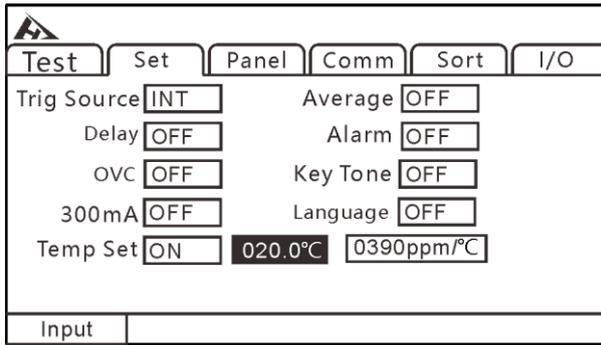


3. The measurement page when the temperature compensation is on.



After the temperature compensation is set to ON, the setting requires the reference temperature and temperature coefficient.

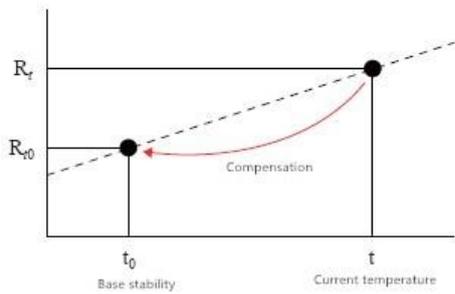
The default setting is 20°C and the temperature coefficient is 3930ppm/°C (the temperature coefficient of pure copper material at 20°C)



Press up/down/left/right to choose the menu



The compensation principle is as follows:



$$R_{t0} = \frac{R_t}{1 + \alpha_{t0}(t - t_0)}$$

R_t : measured resistance value

R_{t0}: compensation resistance value

t: current temperature

T₀: Base stability (Setting range -10°C to 99.9°C)

α_{t0}: temperature coefficient at t₀ of the material to be tested (setting range -9999ppm/°C to 9999ppm/°C)

Note:

When “t.error” is displayed, it indicates that the temperature probe is not connected or the temperature is displayed as ---. Please confirm the connection of the temperature probe.

3.9 Average function

The averaging function averages multiple measured values and displays the results. It can be used to reduce variation in measured values

Average times:

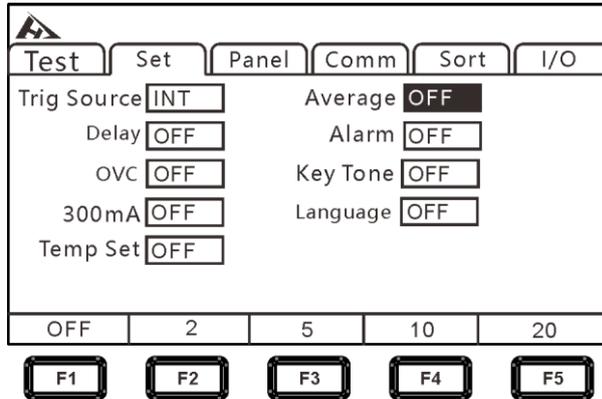
OFF ↔ 2 ↔ 5 ↔ 10 ↔ 20

1. Select the parameter setting page



Press [PAGE] Button to parameter setting page

2. Select the relevant menu item



Menu item	Meaning
[OFF]	Average function is OFF
[2]	Get average of 2 measurements to display
[5]	Get average of 5 measurements to display
[10]	Get average of 10 measurements to display
[20]	Get average of 20 measurements to display

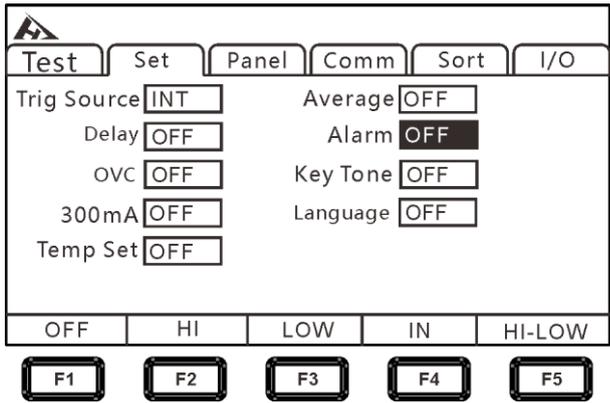
3.10 Setting Beep

After instrument comparator is turned on or test result of sorting opening output is judged, the instrument beep mode can be selected.



Press [PAGE] Button to parameter setting page

2. Select related menu items



Menu	Description
[OFF]	Beep is turned off
[HI]	Beep when exceed upper lim
[LOW]	Beep when less than lower lim
[IN]	Beep when PASS
[HI_LOW]	Beep when exceed upper lim Or less than lower limit

3.11 Button Sound Setting

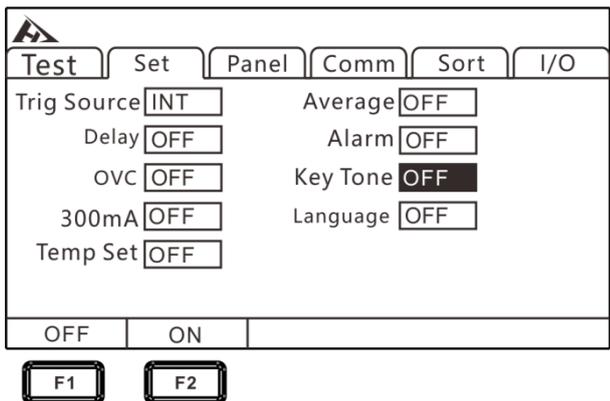
Users can choose whether to turn on the button sound when operating instrument keys.

1. Select parameter setting menu



Press [PAGE] Button to parameter setting page

2. Select related menu items



Menu	Description
[OFF]	Sound is turned off
[ON]	Sound is turned on

3.12 Comparator Function

3.12.1 Comparing result signal output method

When comparator function is turned on, instrument provides three alarm outputs:

1. LED light at front panel alarm



Measure value > Upper limit value

Upper limit value \geq Measure value \geq Lower limit value

Measure value < Lower limit value

2. Sound alarm

Please refer to chapter 3.10.

3. External IO interface, signal output

Please refer to chapter 6.1

3.12.2 Comparison Mode

There are 3 comparison modes: [\[upper limit comparing\]](#)/[\[lower limit comparing\]](#)/[\[upper and lower limit comparing\]](#)

Example:

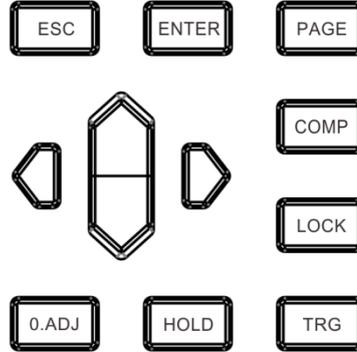
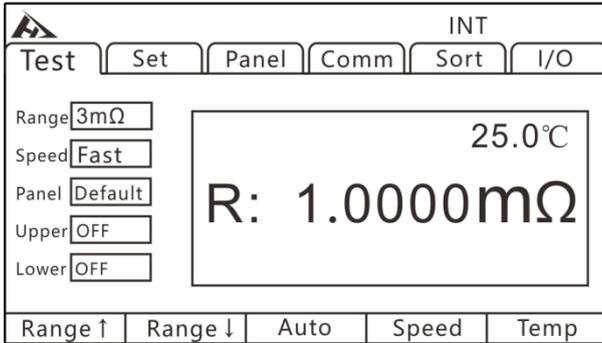
Sorting mode	Upper limit value	Lower limit value	Pass	Fail
upper limit comparison	100 Ω	----	Measuring value \leq 100 Ω	Measuring value > 100 Ω
lower limit comparison	----	10 Ω	Measuring value \geq 10 Ω	Measuring value < 10 Ω
upper and lower limit comparison	100 Ω	10 Ω	10 Ω \leq Measuring value \leq 100 Ω	Measuring value \geq 100 Ω
				Or Measuring value \leq 10 Ω

How to set:

Sorting mode	Setting up procedure
upper limit comparison	Upper limit ON input value is valid, lower limit turned off (----)
lower limit comparison	Lower limit ON input value is valid, upper limit turned off

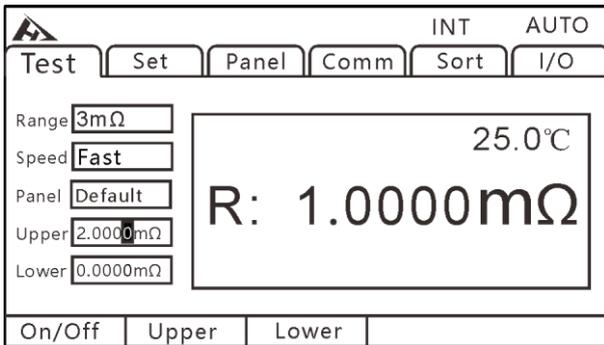
	(----)
upper and lower limit comparison	Both lower limit and lower limit input value are valid

1. Enter comparator to set up

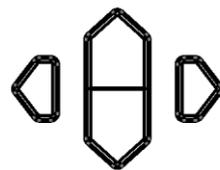
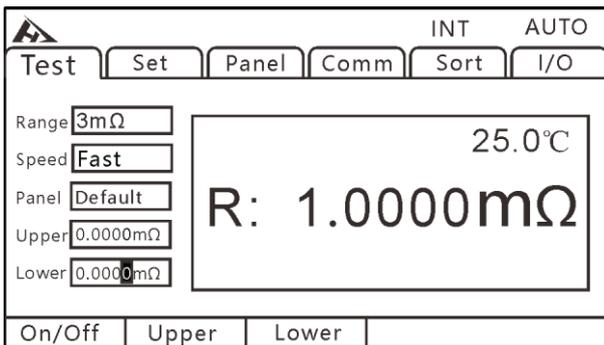


Press **[COMP]** key to enter comparator setting menu

2. Turn on upper limit value comparing



3. Turn on lower limit value comparing

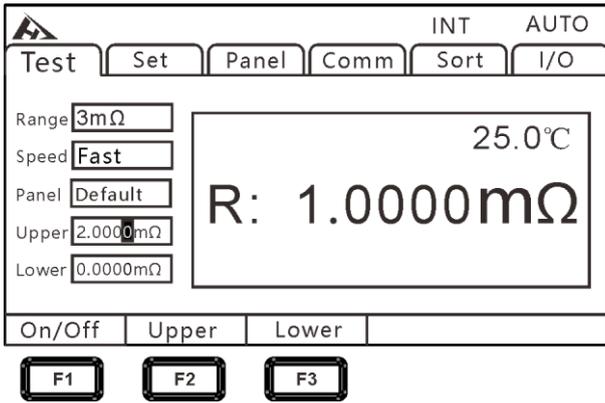


Press up/down/left/right to choose the menu

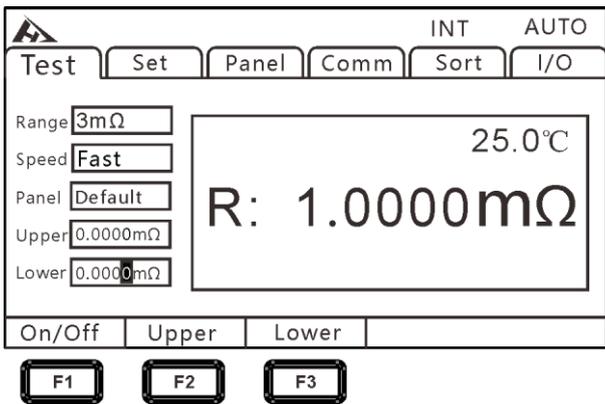
3.12.3 Setting upper and lower limits & compare mode

When upper limit comparing mode is turned on,

1. Upper limit value setting



2. Lower limit value setting



Press up/down/left/right to choose the menu

3.13 Sorting Function

The comparison between the upper and lower limits of one measurement and up to 10 groups (P0~P9) is performed by the classification measurement, and measurement result is displayed. All items not included in the BIN are judged as NG. The sorting result can also be output via EXT I/O terminal.

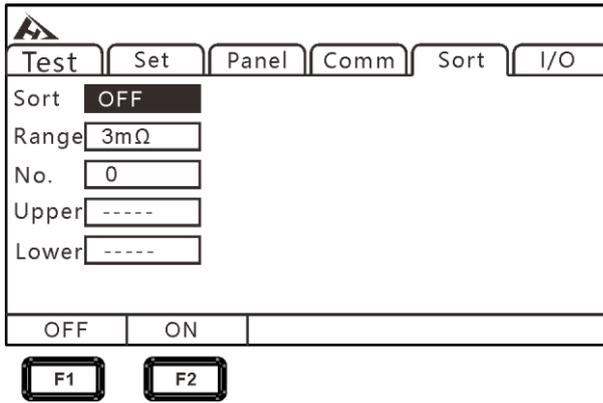
3.13.1 Sorting Function Opening Setting

1. Select parameter setting menu



Press [PAGE] Button to Sort page

2. Select related menu items



Tips:

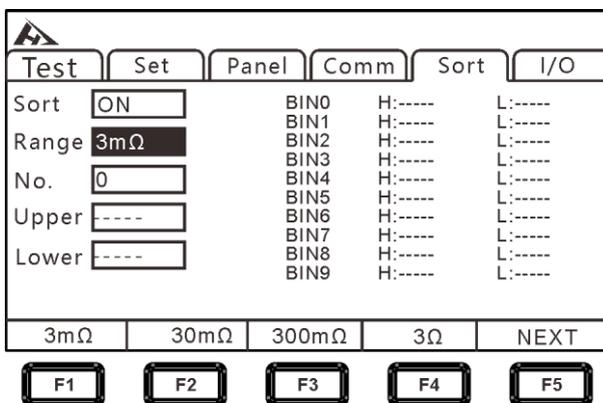
- If sort function is ON, the comparator cannot be set to ON.
- The range cannot be changed while sorting function is in use. To change the range, please make changes on the sorting settings page.

3.13.2 Sorting Function Range Setting

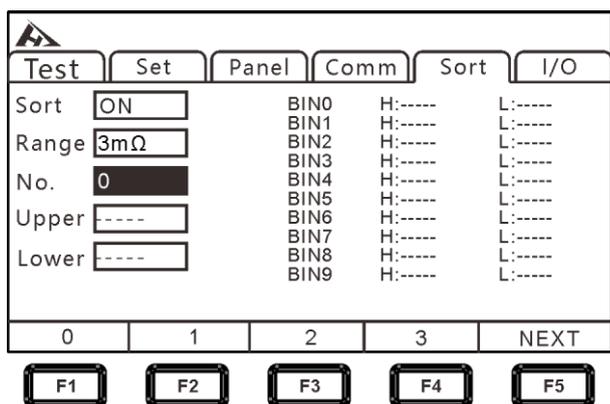
Range:

3mΩ ↔ 30mΩ ↔ 300mΩ ↔ 3Ω ↔ 30Ω ↔
 300Ω ↔ 3kΩ ↔ 30kΩ ↔ 300kΩ ↔ 3MΩ

After sorting function is turned on, range is turned off automatically.

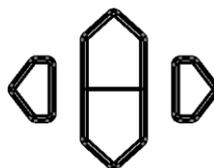
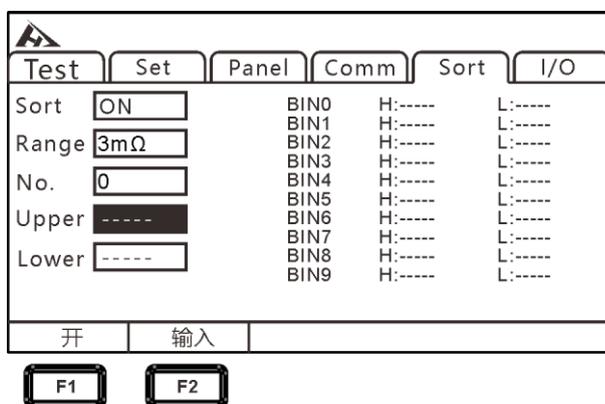


3.13.3 Sorting Function Group No. Setting



3.13.4 Sorting Function Upper Limit Setting

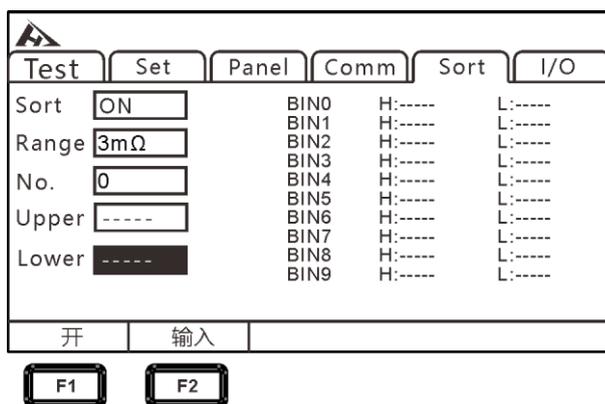
When range and group number settings are completed, corresponding upper limit value can be set. The upper limit unit is the same as that of range.



Press up/down/left/right to choose the menu

3.13.5 Sorting Function Lower Limit Setting

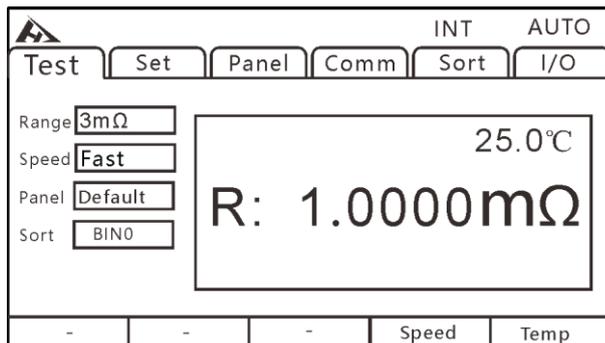
When range and group number settings are completed, corresponding lower limit value can be set. The lower limit unit is the same as that of range.



Press up/down/left/right to choose the menu

3.13.6 Return to Display Page

The display page after sorting function is turned on

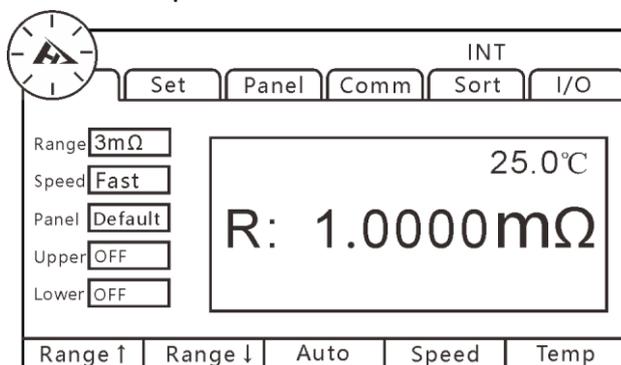


Chapter 4 Measuring

This chapter provides step-by-step descriptions of the functions used for proper measurement, including start-up settings, range scopes, and protection function startup.

4.1 Starting

1. Set relevant parameters
2. Connect test leads correctly
3. When test starts, the logo in the upper left corner of screen will flash according to the test speed.



Trigger Mode	Description
Internal Trigger	Automatic trigger test inside the instrument
External Trigger	Trigger test via external EXT IO terminal TRG signal
Manual Trigger	Manually press [TRG], RS232, LAN port command to trigger the test.
Auto Hold	Automatic test to be measured to maintain the current resistance value

Tips:

- Users cannot start another test when the test has not completed.
- When the EOC signal of the EX.I/O port is LOW, the test cannot be triggered.

4.2 Measuring Value Display

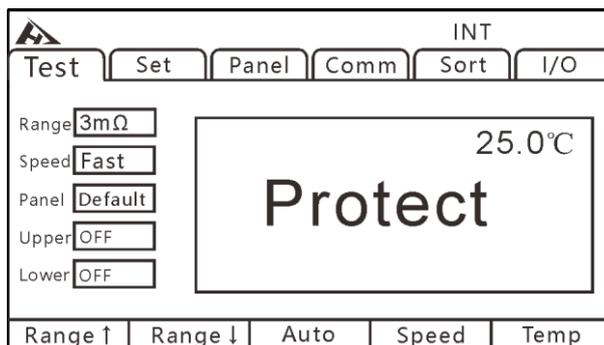
The following is the test range. Once the following range is exceeded, OF is displayed (over the range)

Test current and range:

Resistance Range	Test Current	Max Reading	Resolution (Ω)
3m Ω	1A	3.2000m Ω	0.1 $\mu\Omega$
30m Ω	1A	32.000m Ω	1 $\mu\Omega$
300m Ω	300mA	320.00m Ω	10 $\mu\Omega$
	100mA		
3 Ω	100mA	3.2000 Ω	100 $\mu\Omega$
30 Ω	10mA	32.000 Ω	1m Ω
300 Ω	1mA	320.00 Ω	10m Ω
3k Ω	1mA	3.2000k Ω	100m Ω
30k Ω	100uA	32.000k Ω	1 Ω
300k Ω	10uA	320.00k Ω	10 Ω
3M Ω	1uA	3.2000M Ω	100 Ω

4.3 Automatic Protection Function

If an overvoltage is input to the measurement terminals, internal circuit protection function of the instrument is activated. If users input an overvoltage incorrectly, please remove the test leads immediately from the object under test. Measurements cannot be made during the protection function action. To release the protection function, please touch the test cable DRIVE+ and DRIVE- or re-energize.

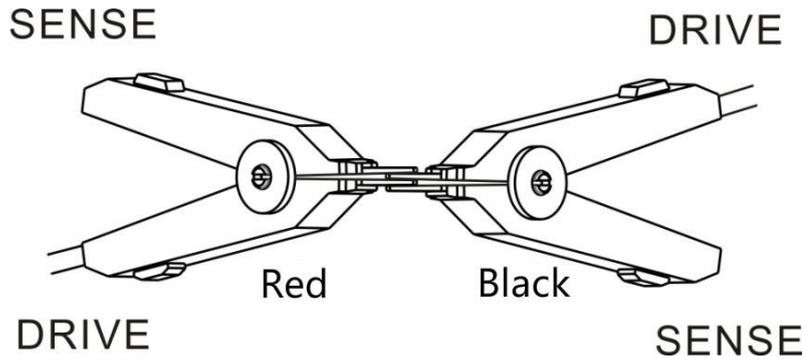


4.4 Perform Clear Zero

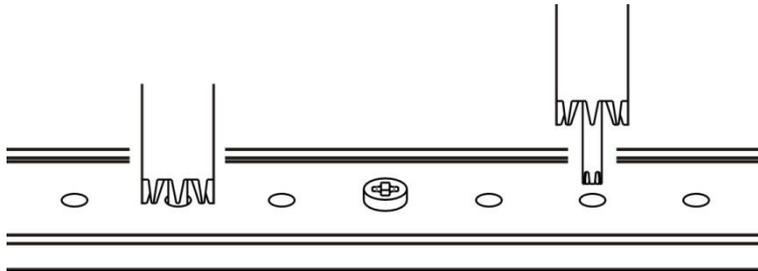
Please perform clear zero in the following cases. (Can cancel the resistance below $\pm 3\%$ f.s. for each range)

- When residual display content occurs due to effected by such as electromotive force

→ The display changes to zero.



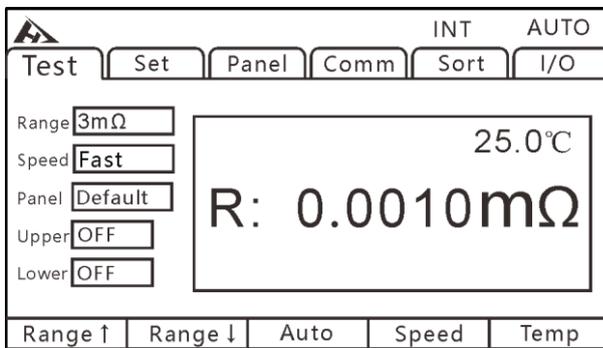
9363-B Probe type test leads



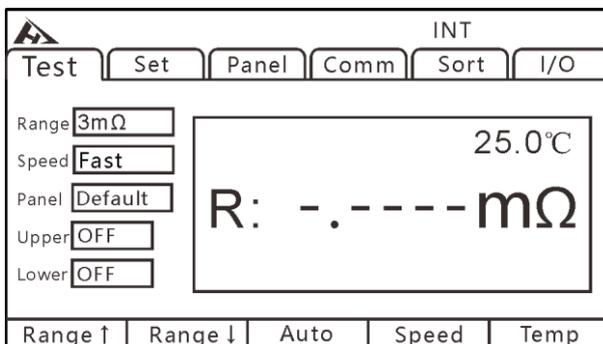
2. Confirm that the measured value is within $\pm 3\%$ s.

If measured value is not displayed, check that the test leads are connected correctly.

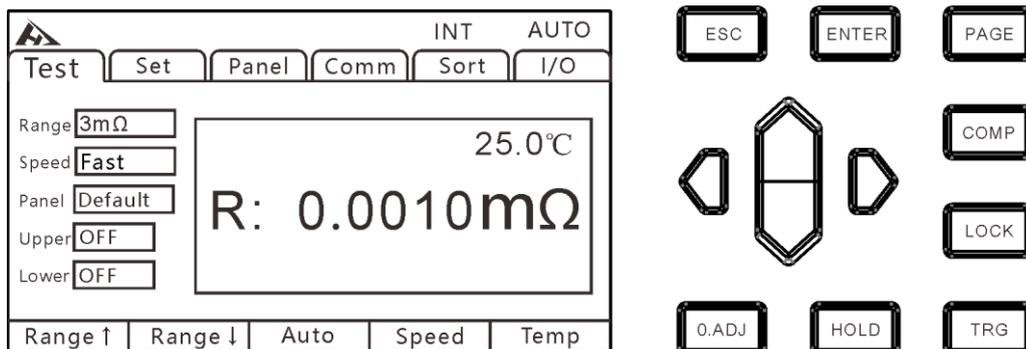
When the wiring is correct



When the wiring is Wrong



3. Clear Zero



Press the [O.ADJ] button to perform zero adjustment.

4. After zero adjustment

If clear zero is successful, the icon will be displayed in the lower right corner of the display measurement and then return to the measurement state. If zero adjustment failed, the icon is not displayed, the measurement state is returned.

Zero adjustment failed

When zero adjustment is not possible, it may be that the measured value before zero adjustment exceeds $\pm 3\%$ of the full scale of each range, or it is in a test abnormal state. Please make the correct wiring again and re-zero. Due to the resistance value of a self-made cable is high, it cannot be zeroed, please reduce the wiring resistance.

Tip:

When the zero adjustment fails, the zero adjustment of the current range will be released.

5. Contact zeroing

On the measurement page, press and hold the [O.ADJ] button to release the zero value of the current range.

Chapter 5 Measurement Panel Save

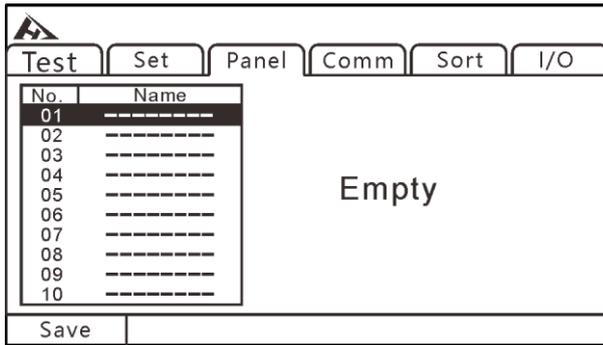
All measurement conditions can be saved, retrieved or deleted in the form of files. Press [PAGE] to enter measurement setting save page.



Press [PAGE] Button to Panel page

After entering this page, and pressing up and down keys, users can refer to the saved record, which can save, load, clear, rename, etc. the current record.

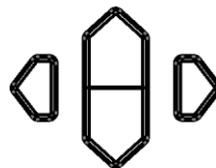
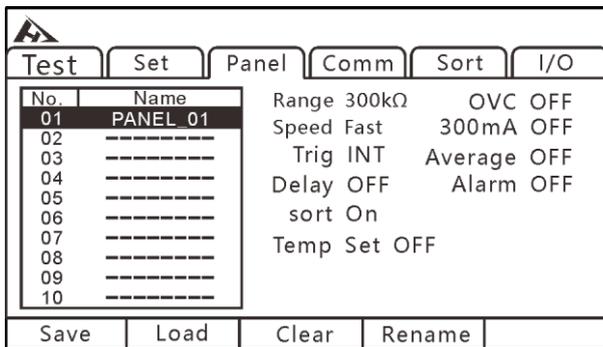
5.1 Save Panel Setting



Press up/down/left/right to choose the menu



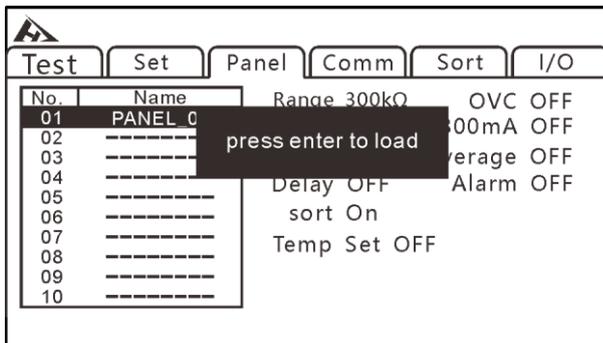
Use up and down keys to review current settings and press Save button to save current settings.



Press up/down/left/right to choose the menu



5.2 Retrieve Measuring Setting

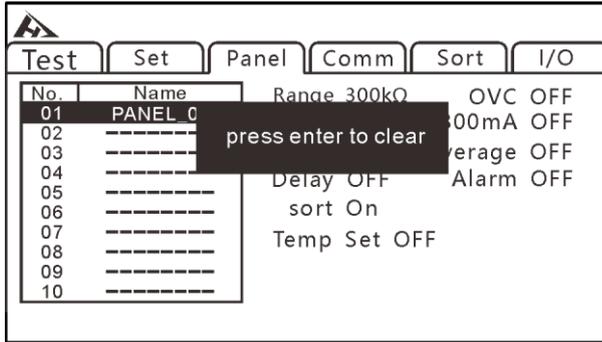


1 press  to choose load

2 press  to confirm load

Use up and down keys to review current settings and press Load button to retrieve current settings.

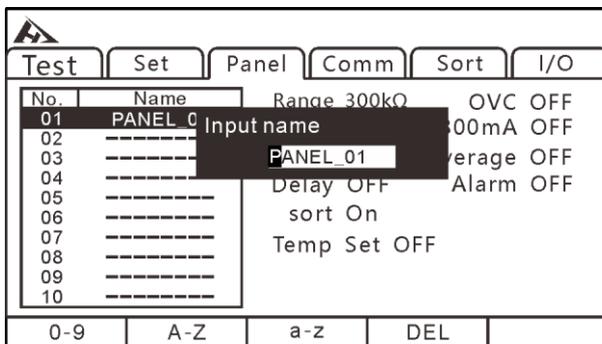
5.3 Delete Measuring Setting



1 press **F3** to choose clear
 2 press **ENTER** to confirm clear

Use up and down keys to review current settings and press Clear key to delete current settings.

5.4 Rename Measuring Setting



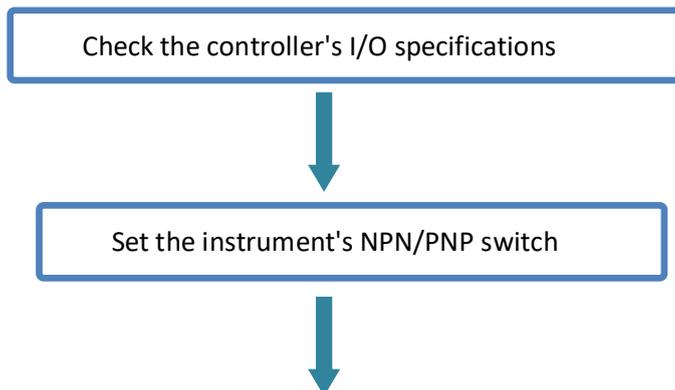
Press up/down/left/right to choose the menu



Use up and down keys to review the current settings and press Rename button to modify current file name.

Chapter 6 EXT I/O Port (Handler)

The EXT I/O connector on the rear of the instrument supports external control by providing output of the EOM and comparator judgment signals, and accepting input of TRIG and KEY_LOCK signals. All signals are isolated from the measurement circuit and ground (I/O common pins are shared). Input circuit can be switched to accommodate either current sink output (NPN) or current source output (PNP).



Connect the instrument's EXT I/O connector to the controller.



Make instrument settings

6.1 EXT I/O port and signal

In this chapter, you will learn about the connection and introduction of EXT I/O.

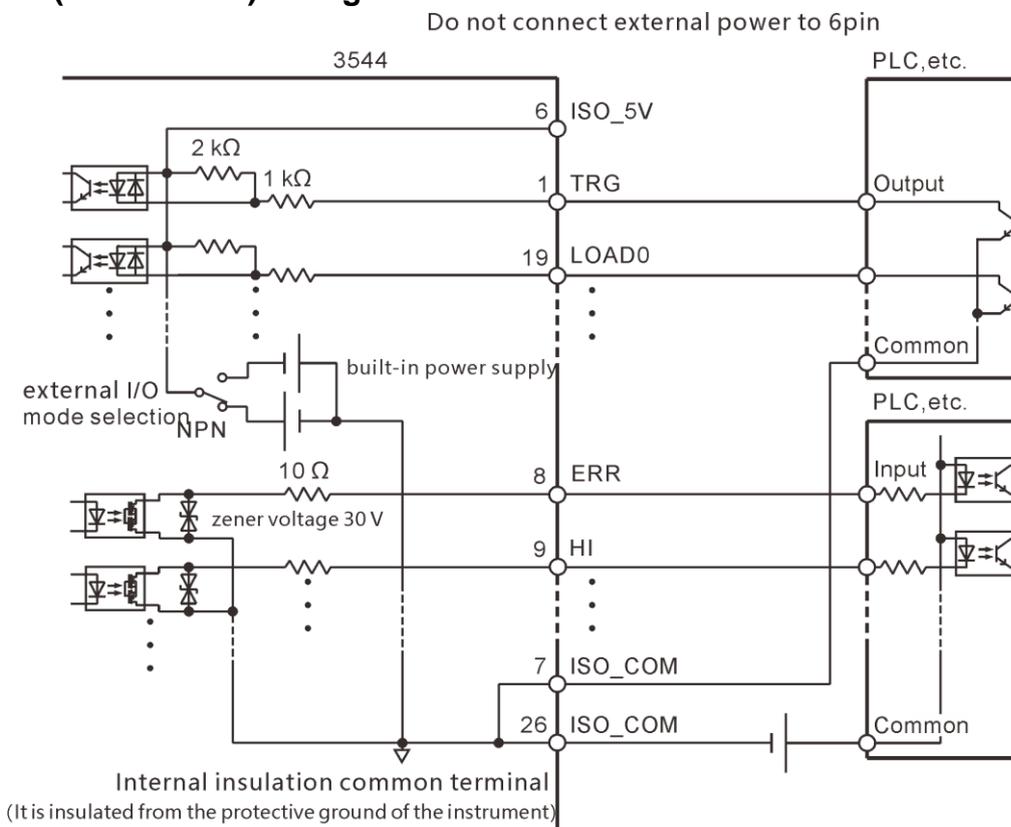


Do not plug or unplug EXT I/O ports during testing
Do not connect the IO port to the test end

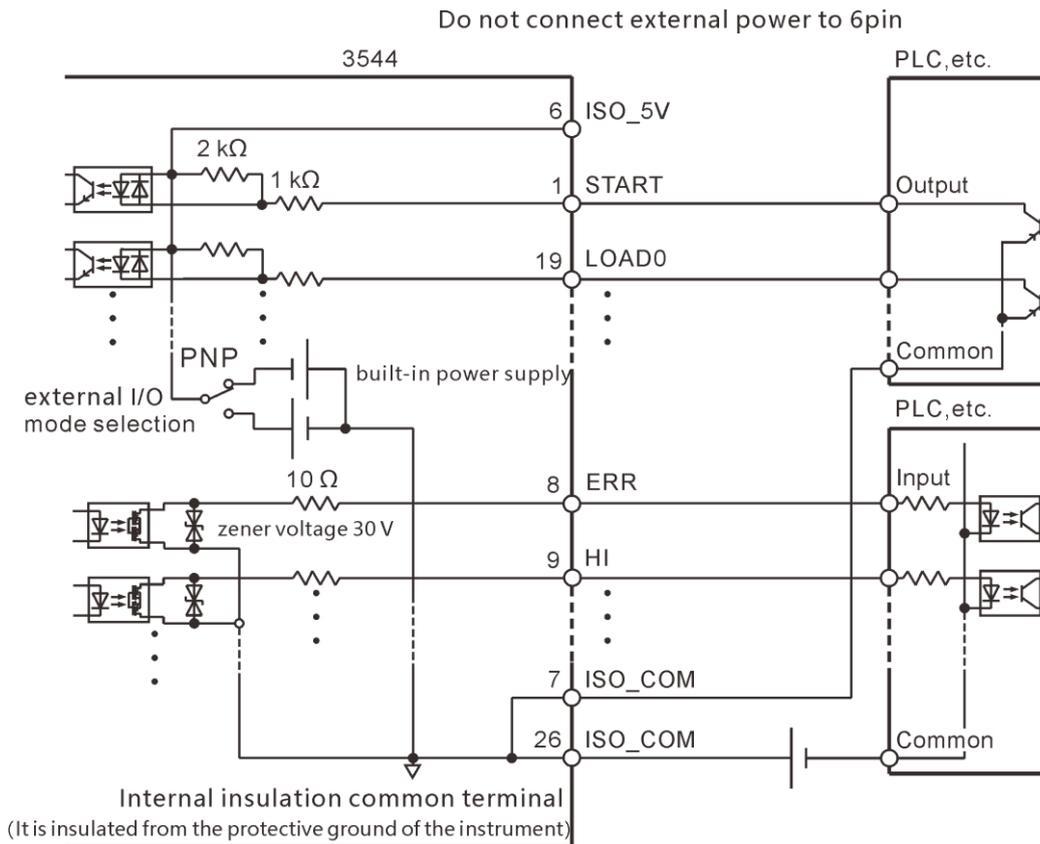
6.1.1 Level Mode Settings

Switching signal level mode NPN (current sink) and PNP (current source)

NPN (current sink) wiring



PNP (current source) wiring



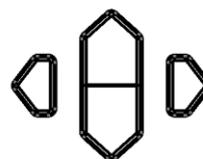
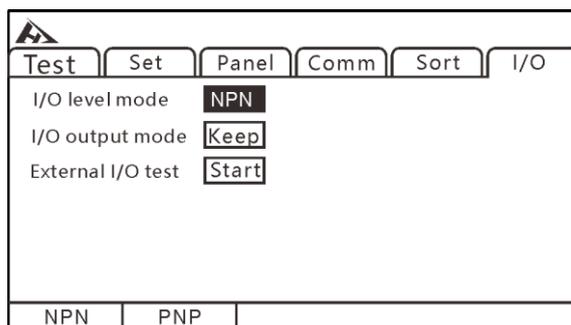
Level mode setting

- Select the I/O page



Press **[PAGE]** Button to I/O page

- Select I/O level mode



Press up/down/left/right to choose the menu



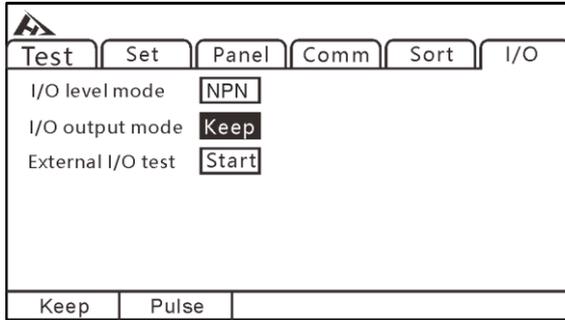
- Output mode setting

- Select the I/O page



Press [PAGE] Button to I/O page

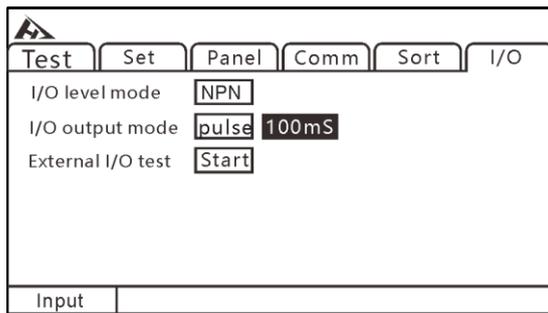
➤ Select I/O output mode



Press up/down/left/right to choose the menu



➤ Select pulse and set the output time



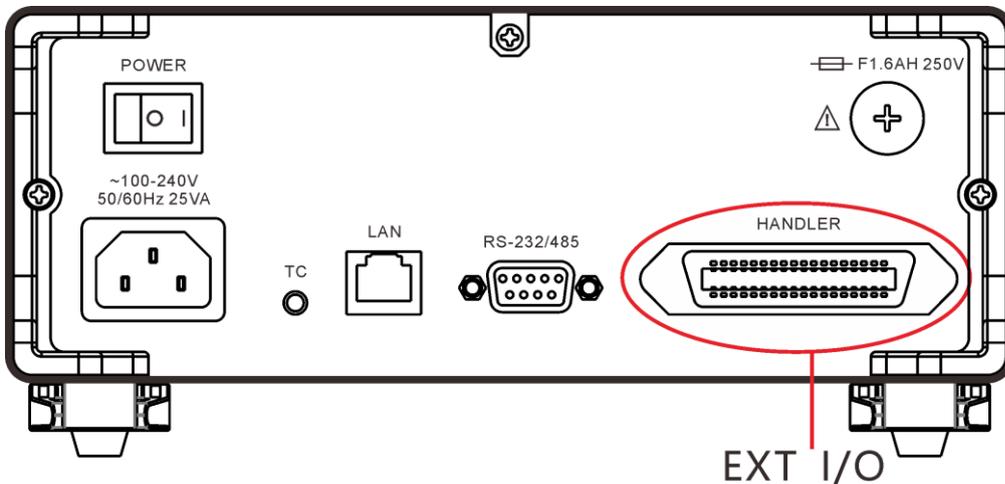
Press up/down/left/right to choose the menu



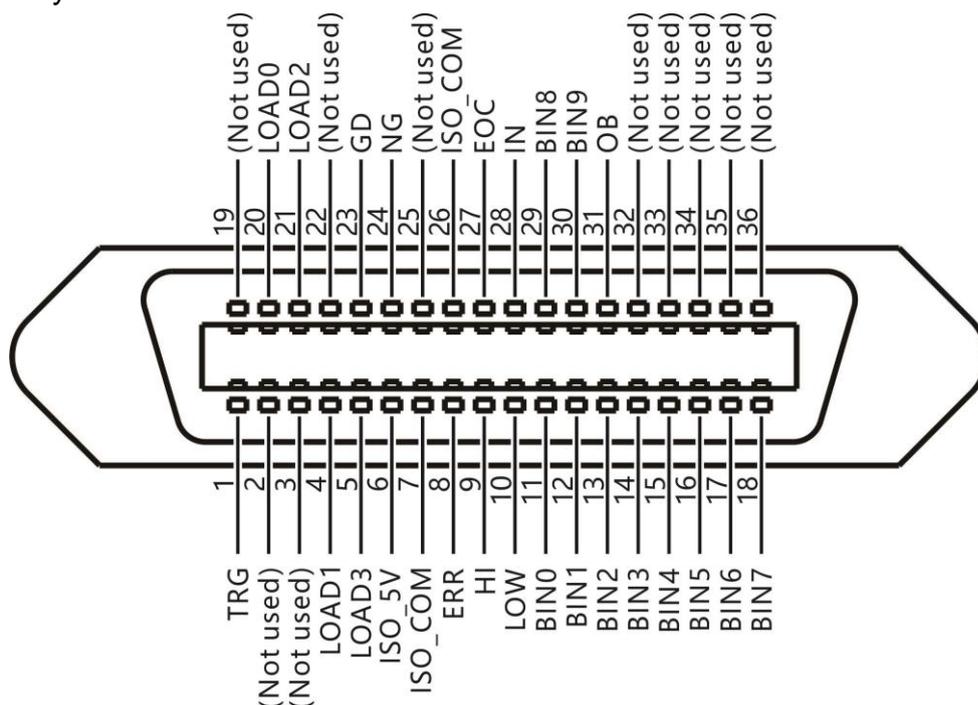
6.1.2 Port Signals description

The EXT I/O port connector uses the D-SUB female terminal of the 36-PIN pin.

Figure:



Port layout



(Instrument side)

PIN	signal	Functions	I/O	Logic
1	TRG	Trigger test	I	Edge trigger
2	--	--	-	--
3	--	--	-	--
4	LOAD1	Panel selection	I	Level
5	LOAD3	Panel selection	I	Level
6	ISO_5V	Isolated power supply 5V	O	--
7	ISO_COM	Isolated power ground	O	--
8	ERR	Automatic protection open	O	Level
9	HI	measurement value > upper limit value	O	Level
10	LOW	measurement value < lower limit value	O	Level
11	BIN0	Bin P0	O	Level
12	BIN1	Bin P1	O	Level
13	BIN2	Bin P2	O	Level
14	BIN3	Bin P3	O	Level
15	BIN4	Bin P4	O	Level

16	BIN5	Bin P5	O	Level
17	BIN6	Bin P6	O	Level
18	BIN7	Bin P7	O	Level
--	--	--	- -	--
20	LOAD0	Panel selection	I	Level
21	LOAD2	Panel selection	I	Level
22	--	--	- -	--
23	GD	Qualified output	O	Level
24	NG	Unqualified output	O	Level
25	--	--	- -	--
26	ISO_COM	Isolated common signal ground	O	--
27	EOC	End of Level measurement	O	Level
28	IN	IN Sort	O	Level
29	BIN8	Bin P8	O	Level
30	BIN9	Bin P9	O	Level
31	OB	Bin NG	O	Level
32	--	--	- -	--
33	--	--	- -	--
34	--	--	- -	--
35	--	--	- -	--
36	--	--	- -	--

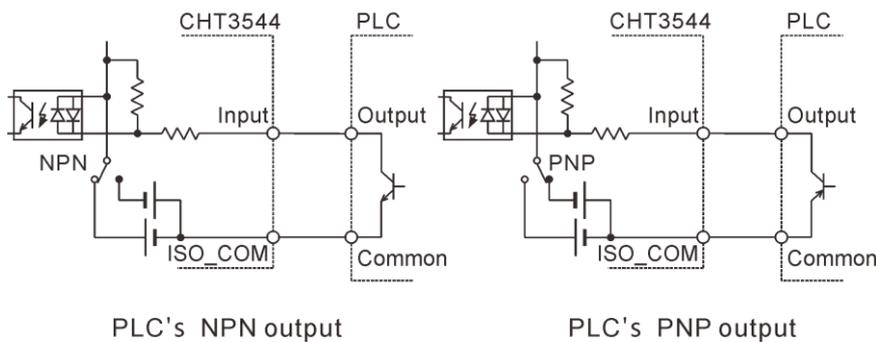
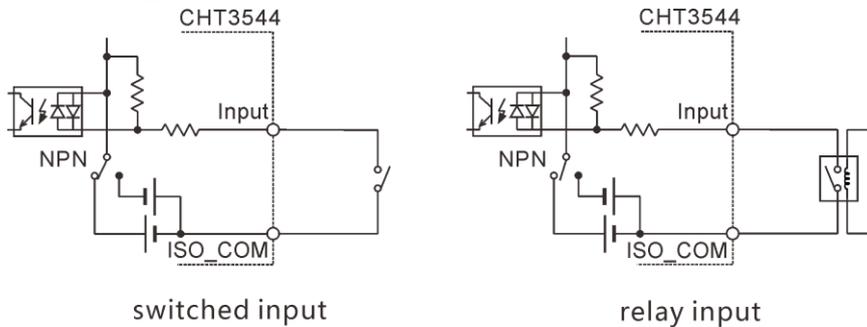
6.1.3 Port Signal Connection Method

Electrical performance parameter

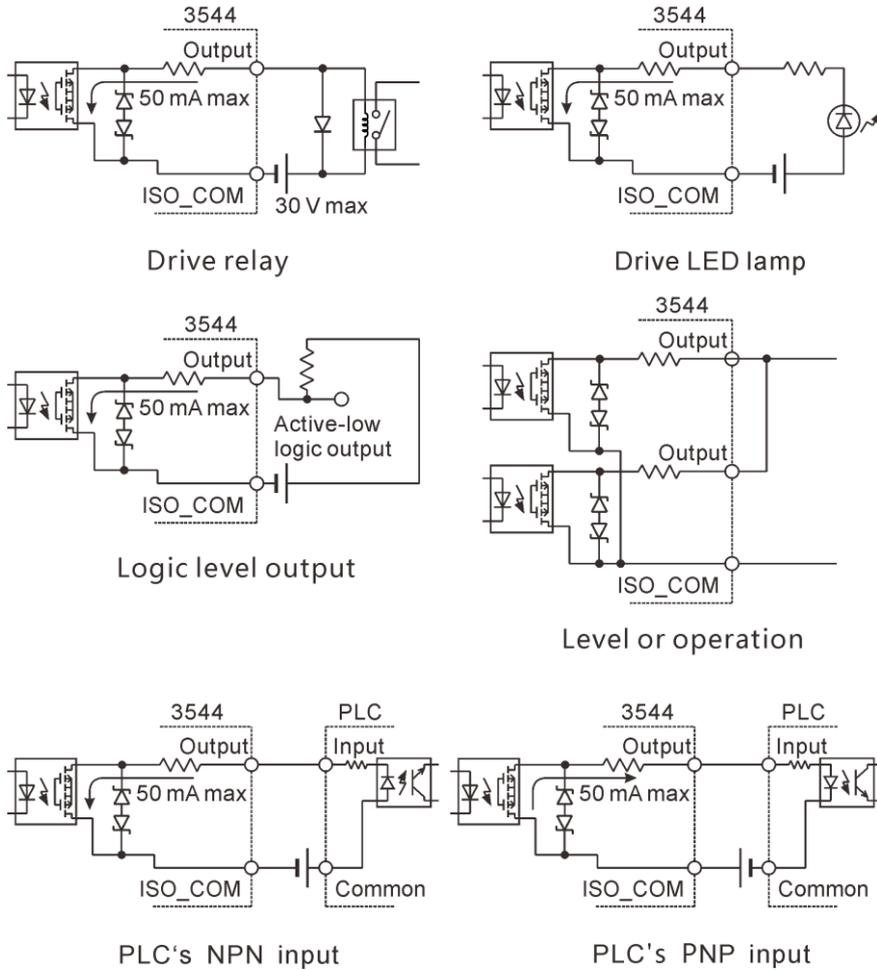
input signals	Type	Optocoupler input
	ON	Internal conduction current : 4mA or more the max voltage drop :1V
output	OFF	Input current less than 100μA
	Type	Optocoupler output, open drain output
	Maxim	30V DCMAX

signals	um load voltage	
	Maximum output circuit	50mA/channel
	Output voltage drop	1VMIN (at 50mA conditions)
Internal isolated current source	Rated voltage	+5V (NPN) , -5V (PNP)
	Rated current	100mA
	Isolation condition	Isolated from internal circuitry, floating

Input circuit wiring



Output circuit wiring

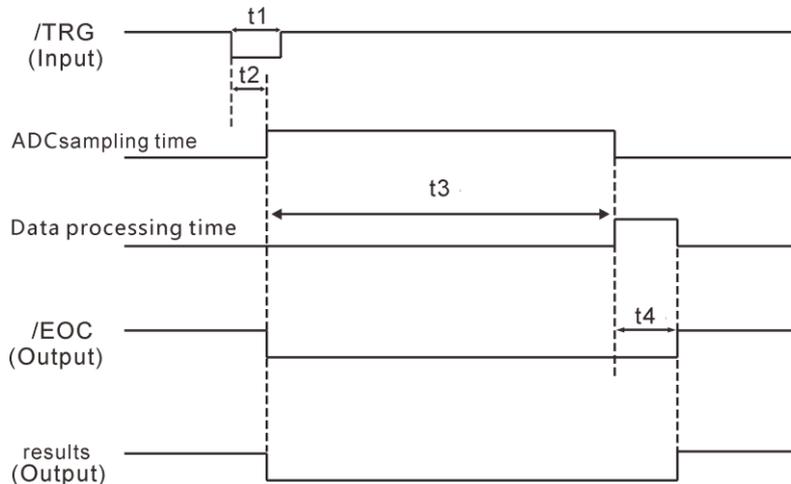


6.2 Timing Chart

Each signal level indicates the ON/OFF state of a contact. When using the current source (PNP) setting, the level is the same as the EXT I/O pin voltage level. When using the current sink (NPN) setting, the high and low voltage levels are reversed.

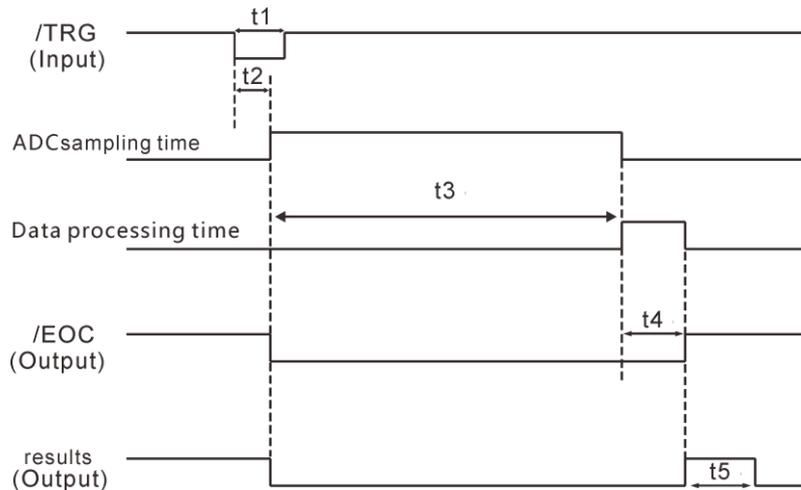
6.2.1 Timing chart for external triggering

External trigger [EXT] setting (EOC output hold)



	Item	Timing
1	TRG, Signal pulse width	5msMIN
2	delay	5msMAX
3	ADC sampling time	Fast 20ms Medium 50ms Slow 500ms
4	Data processing time	5msMAX

External trigger [EXT] setting (EOM output pulse)

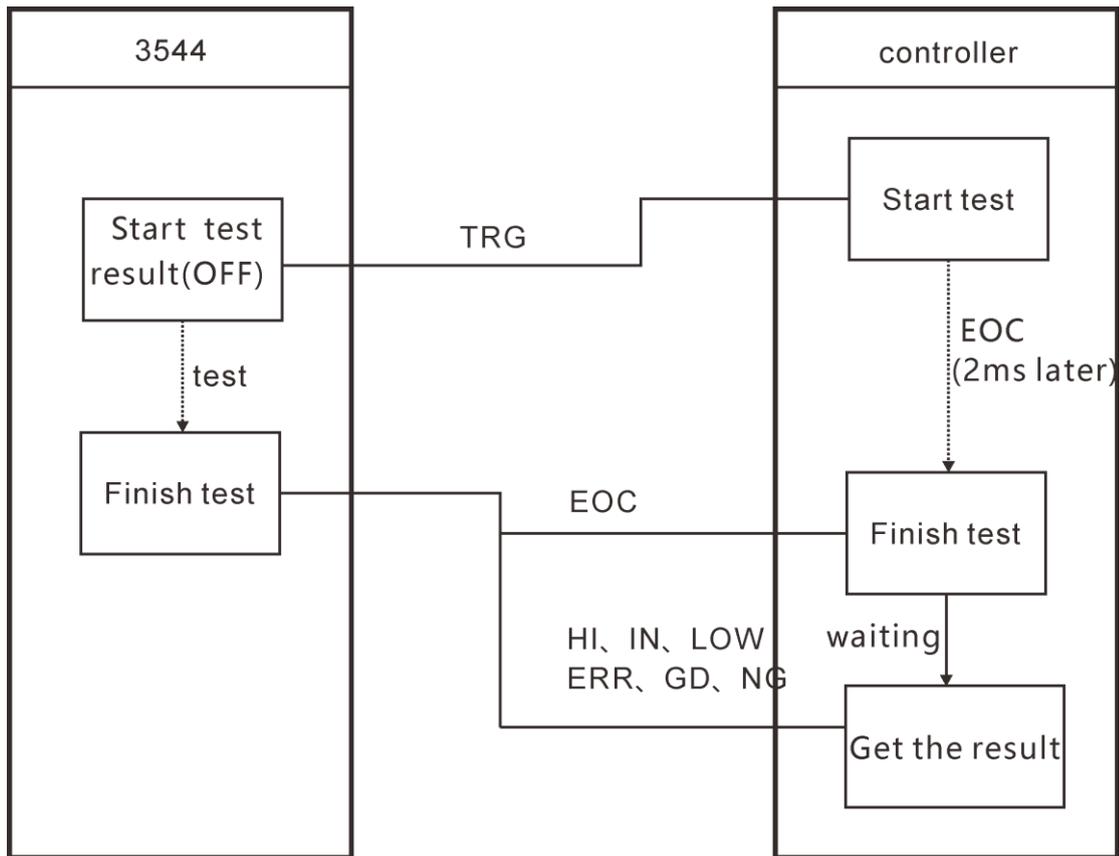


	Item	Timing
1	TRG, Signal pulse width	5msMIN
2	delay	5msMAX
3	ADC sampling time	Fast 20ms Medium 50ms Slow 500ms
4	Data processing time	5msMAX
5	Judgment result pulse time	available (1ms~999ms)

6.2.2 Reading process at external triggering

The following table shows from start of measurement to acquisition of judgment results

The EOC signal is output immediately after the instrument determines the judgment result (HI, IN, LOW, ER, GD, NG). If the controller's input circuit response is slow, it may be necessary to insert wait processing after EOM=ON is received until the judgment results are acquired



6.3 External Control Checking

In addition to switching output signals ON and OFF manually, you can view the input signal state on the screen.

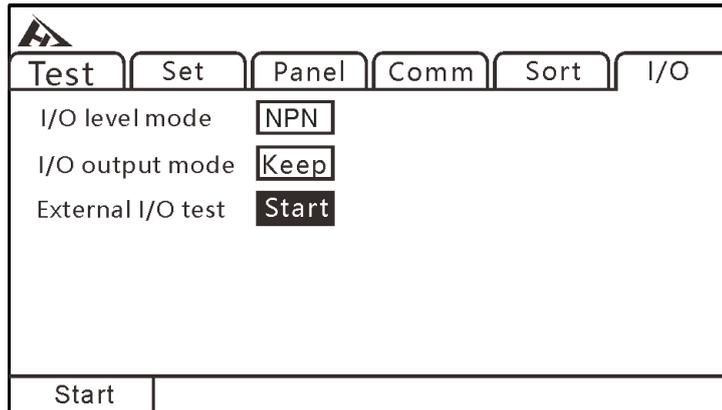
- Select the I/O



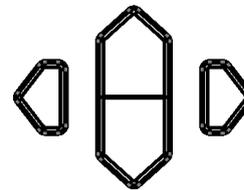
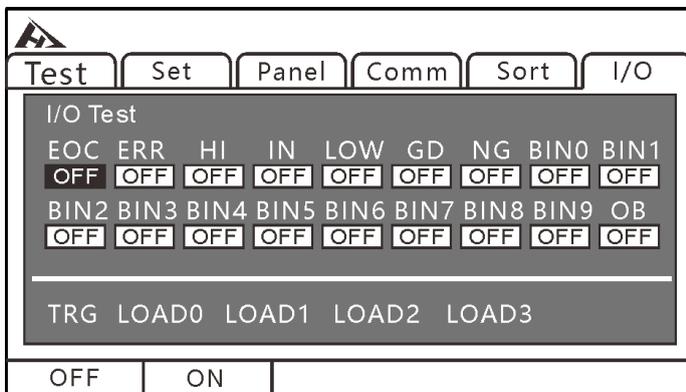
page

Press **[PAGE]** Button to I/O page

- Select the I/O settings page



- Select the manually I/O test page



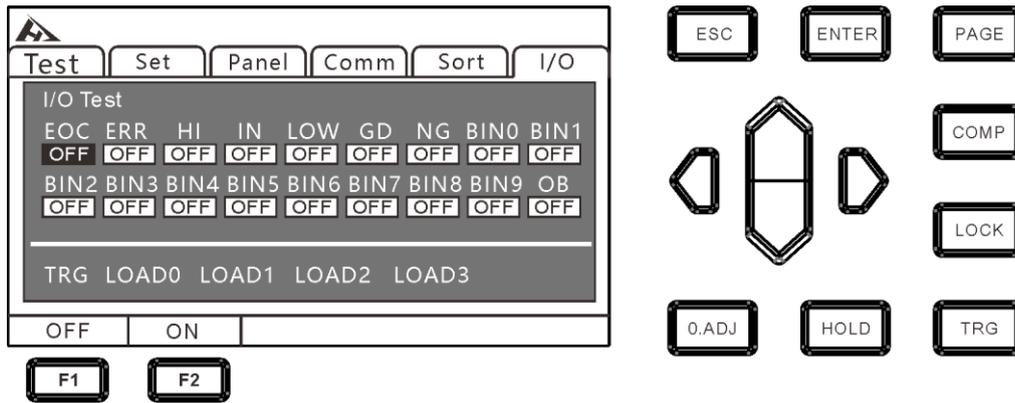
Press up/down/left/right to choose the menu



Output signal, operable signal (OFF: turn off the output ON: turn on the output)

Input signal, display the status of the signal (ON: reverse display OFF: normal display)

- Exit the I/O test page



 Back to I/O setting.

Chapter 7 Communication

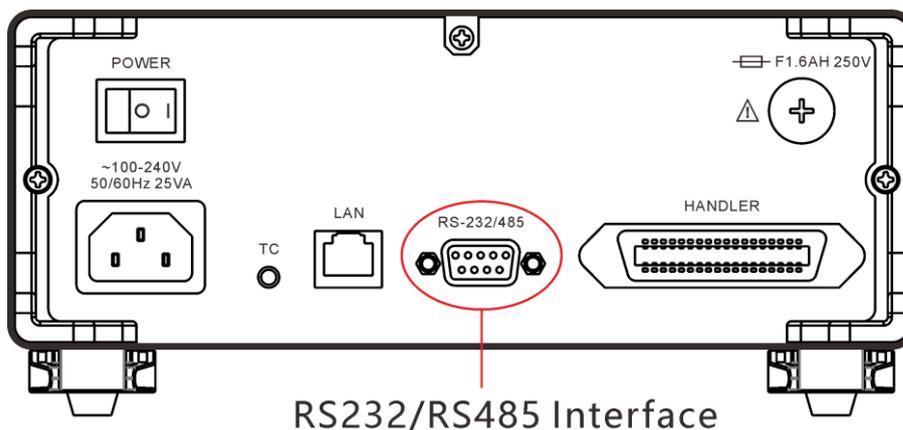
CKT3544 has two communication modes, one is RS232C communication, and the other is LAN (network protocol uses TCP protocol) communication mode. Both modes of the communication protocol use the SCPI protocol.

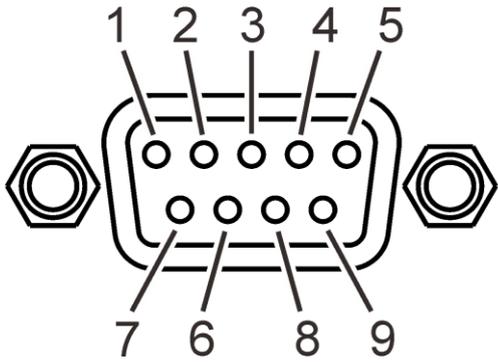


Do not connect the communication port to the measurement port, as this may damage the instrument.

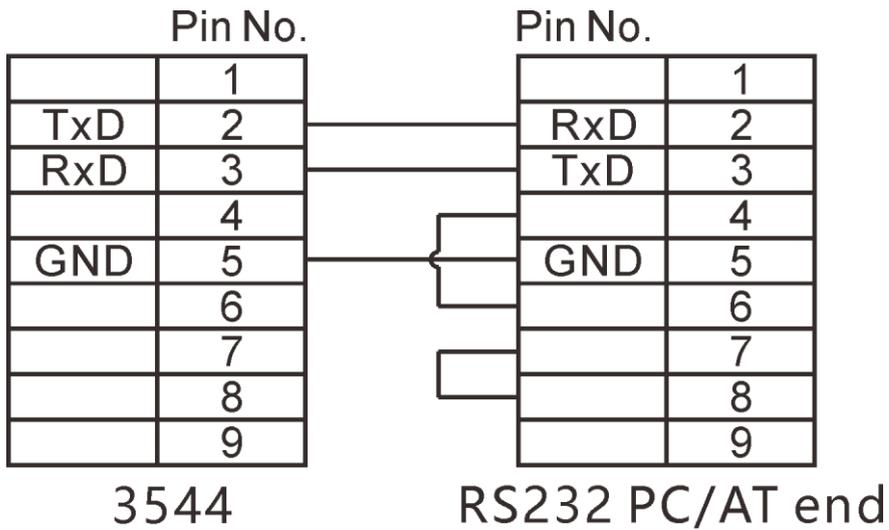
7.1 RS232C communication

The RS232C communication uses a 3-wire communication method. Interface and cable





9-pin D-sub Female port



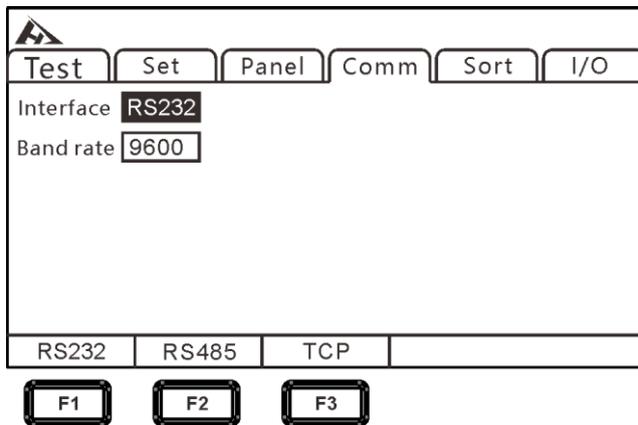
- Select the Comm



Press **[PAGE]** Button to Comm page

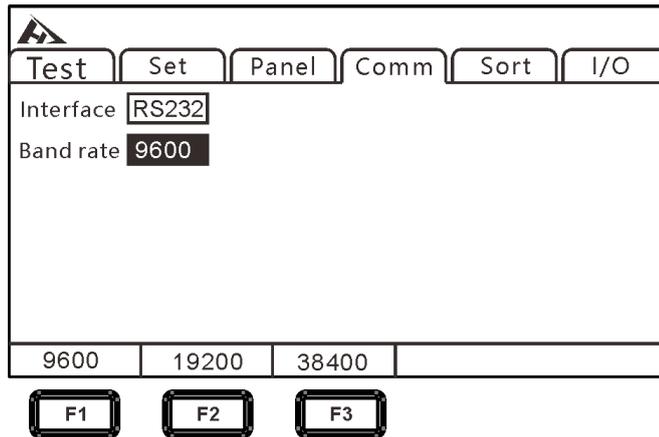
page

- Select RS232 communication mode



Press up/down/left/right to choose the menu

- Select the baud rate

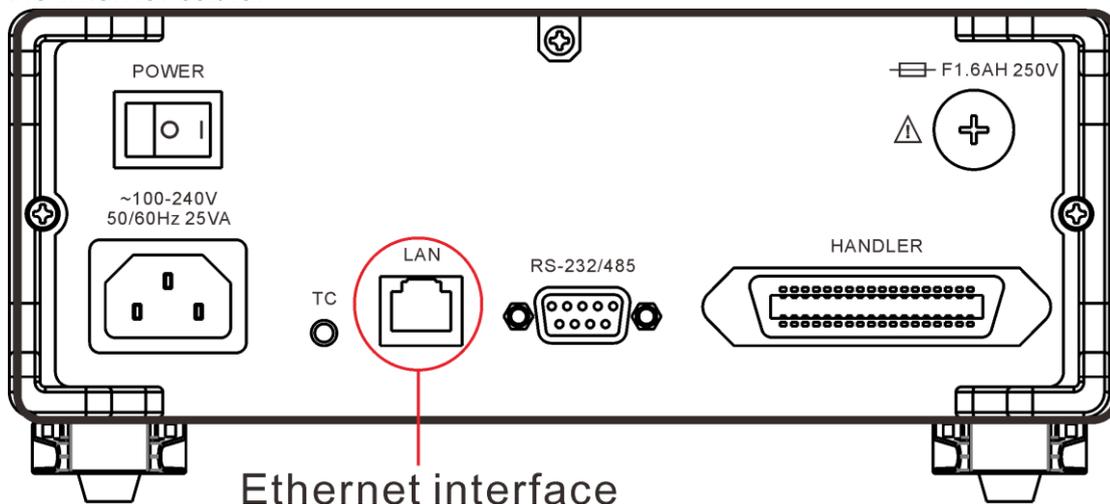


7.2 LAN communication

LAN port communication uses TCP protocol communication.

Interface and cable

The Ethernet uses the standard RJ45 port, and the cable uses Category 5 for the Internet cable.



Connection method

Instrument and computer connection

When the instrument is connected to a computer, the network cable uses a crossover cable.

Using T568B color code wiring standards to connect A side

Orange/White	Orange	Green/white	Blue	Blue/white	Green	Brown/white	Brown
--------------	--------	-------------	------	------------	-------	-------------	-------

Using T568A color code wiring standards to connect B side

Green /white	Green	Orange /White	Blue	Blue/white	Orange	Brown/white	Brown
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Instrument and computer connection

When the instrument is connected to the router, the network cable is directly connected.

Orange/ White	Orange	Green/ White	Blue	Blue/ White	Green	Green/ White	Brown
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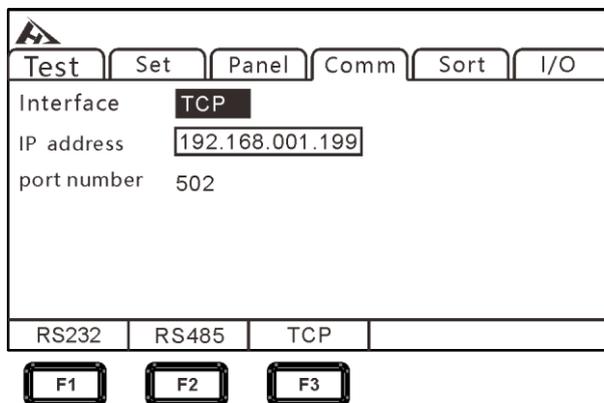
Setting

- Select the communication page



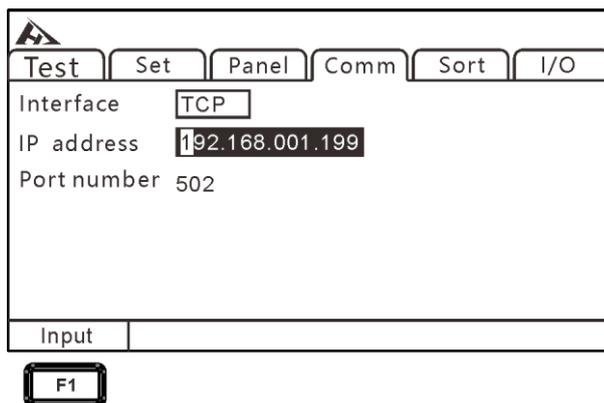
Press [PAGE] Button to Comm page

- Select TCP communication mode



Press up/down/left/right to choose the menu

- Set the communication page



Press up/down/left/right to choose the menu

Chapter 8 Specification

8.1 General Specification

General function

SPECIFICATIONS			
Model	CKT3544	CKT3544-12H	CKT3544-24H
Number of Channel	1	12	24
Parameters	DC resistance		
Measurement Range	0.1 $\mu\Omega$ ~ 3.3M Ω		
Min Resolution	0.1 $\mu\Omega$		
Signal Source	1A DC, Maximum DC 5.5 V		
Basic Accuracy	0.1% \pm 10 reading (3m Ω ,30m Ω ,3M Ω),0.05% \pm 4 reading (300k Ω), 0.02% \pm 2 reading (other ranges)		
Range	3m Ω /30m Ω /300m Ω /3 Ω /30 Ω /300 Ω /3k Ω /30k Ω /300k Ω /3M Ω		
Speed	Fast (50Hz: 21ms, 60Hz: 18ms), slow (200ms)		
Temperature Compensation	Range: -10 $^{\circ}$ C~60 $^{\circ}$ C, Accuracy: \pm 1 $^{\circ}$ C		
Display Max	32,000		
Adjustment	Short-circuit clear zero for all ranges		
Comparator	10 bins sorting, output HIGH/IN/LOW sorting signal		
Trigger	Internal trigger, External trigger, Manual trigger, BUS trigger		
Interface	External IO interface, LAN interface, RS232/485 interface		
Others	Temperature compensation function, comparator (ABS/REF%), lock button (OFF/menu lock/all lock), power frequency setting (AUTO/50Hz/60Hz), judgment tone setting, auto hold, average, panel save /read		
GENERAL FEATURES			
Power Supply	AC100 ~ 256V, Frequency: 50~60 Hz, rated power: 15 VA		
Size and Weight	325mm (L)x 215mm (W)x96mm (D); Weight: 4kg		
ORDER ING INFORMATION			
Accessories	KelvinTest leads; Temperature compensation probe; RS232 communication cable; AC power cord		

8.2 Accuracy

The following indicators test conditions:

Temperature: 20 \pm 3 $^{\circ}$ C

Humidity: <80% RH

Warm-up time is more than 15 minutes

Calibration time is less than 1 year

Resistance measurement accuracy:

range		Resolu tion	Fast speed	Medium speed, slow speed	Test current
1	3m Ω	0.1 $\mu\Omega$	0.1% \pm 2 count	0.1% \pm 2 count	1A
2	30m Ω	1 $\mu\Omega$	0.1% \pm 2 count	0.1% \pm 2 count	1A

3	300mΩ	10μΩ	0.1%±2 count	0.1%±2 count	300mA
			0.1%±2 count	0.02%±2 count	100mA
4	3Ω	100μΩ	0.1%±2 count	0.02%±2 count	100mA
5	30Ω	1mΩ	0.1%±2 count	0.02%±2 count	10mA
6	300Ω	10mΩ	0.1%±2 count	0.02%±2 count	1mA
7	3kΩ	100mΩ	0.1%±2 count	0.02%±2 count	1mA
8	30kΩ	1Ω	0.1%±2 count	0.02%±2 count	100uA
9	300kΩ	10Ω	0.1%±2 count	0.04%±2 count	10uA
10	3M	100Ω	0.3%±2 count	0.2%±2 count	1uA