KIKUSUI

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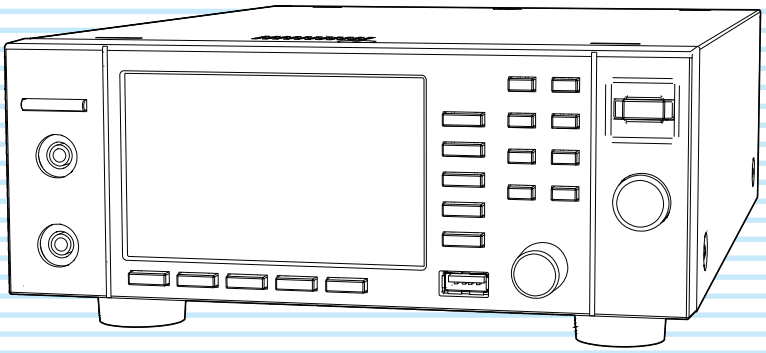
TELONIC
TEST INSTRUMENTS & POWER SUPPLIES
ISO 9001 QUALITY MANAGEMENT
UKAS MANAGEMENT SYSTEMS 0015
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User's Manual

Insulation Resistance and Battery Insulation Resistance Tester

TOS73 Series

TOS7300
TOS7300 WITH LAN
TOS7301
TOS7301 WITH LAN



DANGER

This product generates high voltage!
Improper operation can lead to serious accidents.

To prevent accidents, be sure to read the section "Safety Precautions for Testing" in this manual.
Keep the manuals close to the product so that the operators can read the manual at any time.

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Notes to the supervisor

- If the operators cannot understand the language used in this manual, translate the manuals into the appropriate language.
- Make sure that the operators understand the information in this manual before they operate this product.
- Keep the manuals close to the TOS73 series so that the operators can read the manual at any time.



DANGER

You will receive a potentially fatal electric shock if:

- You touch an output terminal while output is being generated.
- You touch a test lead that is connected to an output terminal while output is being generated.
- You touch the EUT while output is being generated.
- You touch a location that is electrically connected to an output terminal while output is being generated.
- You touch a location that is electrically connected to an output terminal immediately after output is turned off.

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General Description

About Manuals

This manual provides an overview of the TOS73 series and notes on usage. It also explains how to configure it, operate it, perform maintenance on it, and so on. Read this manual thoroughly before use, and use the product properly.

Intended readers

This manual is intended for users of the TOS73 series and their instructors. The manuals assume that the reader has knowledge about electric safety testing.

Manual construction

User's manual (this manual) PDF </> HTML

This document is intended for first-time users of this product. It provides an overview of the product, notes on usage, and specifications. It also explains how to connect the product, configure the product, operate the product, perform maintenance on the product, and so on.

Communication Interface Manual PDF </> HTML

This document contains details about remote control. It is written for readers with sufficient basic knowledge of how to control testers and measuring instruments using SCPI commands.

Getting Started Guide Paper

This document is intended for first-time users of the product. It provides an overview of the product, safety information, and main specifications. It also explains how to connect the product. Please read this manual before you operating the TOS73 series.

Safety Information PDF Paper

This document contains general safety precautions. Keep them in mind and make sure to observe them.

Manual updates

This manual is subject to be revised due to product improvement and/or specification change. The latest manual (PDF and HTML) is available on our website.

https://global.kikusui.co.jp/kikusui-manuals/

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Disposal

Dispose of the TOS73 series in accordance with your local regulations.

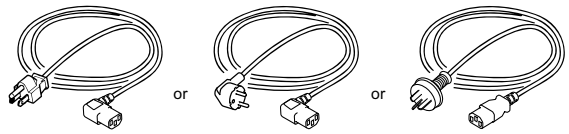
Open Source Software

The TOS73 series contains open source software under the licensing terms of GNU General Public License (GPL), GNU LESSER General Public License (LGPL), and other licenses. For details, see the following URL.

https://rddocuments.kikusui.co.jp/oss/

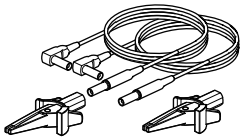
Accessories

The attached power cord varies depending on the shipment destination.



Plug: NEMA5-15, Rating: 125 Vac/10 A | or | Plug: CEE7/7, Rating: 250 Vac/10 A | or | Plug: GB1002, Rating: 250 Vac/10 A

☐ Power cord (1 pc., length: 2.5 m)



☐ High-voltage test lead TL35-TOS (1 set)

☐ Getting Started Guide
☐ Safety Information
☐ China RoHS sheet

Product Overview

The TOS73 series insulation resistance/battery insulation resistance testers perform insulation resistance tests and battery insulation resistance tests. They are suitable for research and development facilities, quality assurance testing and standard certification agency testing facilities, production line facilities, and more.

TOS73 Series Lineup

TOS7301 and TOS7301 WITH LAN are battery insulation resistance testers. These not only allow the use of dV judgment to protect the EUT from damage during testing, but also support the selection of shorter Aperture Times and the display of measurement data graphs during testing.

Model	Supported tests	Supported judgment functions
TOS7300	Insulation resistance test	Upper limit judgment, lower limit judgment, short-circuit detection, contact check
TOS7300 WITH LAN		
TOS7301	Battery insulation resistance test	Upper limit judgment, lower limit judgment, short-circuit detection, contact check, dV judgment
TOS7301 WITH LAN		

Model	Aperture time *(p. 47)*	Measurement data display
TOS7300	16.66 ms, 20 ms, or 100 ms	Numerical value display only
TOS7300 WITH LAN		
TOS7301	10 ms, 16.66 ms, 20 ms, or 100 ms	Selected from numerical value or graph display
TOS7301 WITH LAN		

TOS7300 WITH LAN and TOS7301 WITH LAN come standard with a LAN interface.

Model	Supported interfaces
TOS7300	RS232C, USB
TOS7301	
TOS7300 WITH LAN	RS232C, USB, LAN
TOS7301 WITH LAN	

Features

Graphing of test result data (TOS7301 and TOS7301 WITH LAN only)

As data are graphed through seamless range switching, defects can be identified at a glance. This allows safe testing even in the next process.

Remote control interface equipped as standard

All models come standard with USB 2.0, USB-TMC compliant USB, and RS232C interfaces.

In addition, WITH LAN models allow the use of a LAN interface.

Color liquid crystal display

Intuitive display and controls are provided through the 4.3-inch display that shows various test settings, descriptions, and drawings.

Notations Used in This Manual

In-Text notations

- In this manual, Insulation Resistance/Battery Insulation Resistance Testers TOS7300, TOS7300 WITH LAN, TOS7301 and TOS7301 WITH LAN are also referred to as the TOS73 Series.
- In this manual, among the TOS73 series, specifically the TOS7300 WITH LAN and TOS7301 WITH LAN are also referred to as WITH LAN models.
- The term “PC” is used to refer generally to both personal computers and workstations.
- The term “EUT” is used to refer generally to an equipment under test.
- “>” indicates the hierarchy of items you need to select. The item to the left of this symbol indicates a higher level item.
- Test name of the insulation resistance tests may be abbreviated as “IR”.
- Screen examples used in this manual are captured from TOS7301 WITH LAN unless otherwise noted.
- The screen captures and illustrations used in this manual may differ from the actual items.

Safety information

⚠DANGER

Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.

⚠WARNING

Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which, if ignored, may result in slight injury or damage to the product and other property.

NOTE

Indicates information that you should know.

Safety Precautions

When using the TOS73 series, be sure to observe the precautions in the Safety Information Manual. Items specific to the TOS73 series are given below.

When using in general

⚠DANGER

The TOS73 series generates high voltage, which may cause electric shock. Improper operation can lead to fatal accidents.

- **To prevent accidents, be sure to thoroughly read the section "Safety Precautions for Testing" *(p. 14)* in this manual.**
- **Keep getting the Getting Started Guide close to the TOS73 series product so that the operators can read the manual at any time.**
- **Do not touch an output terminal while output is being generated.**
- **Do not touch a test lead that is connected to an output terminal while output is being generated.**
- **Do not touch the EUT while output is being generated.**
- **Do not touch a location that is electrically connected to an output terminal while output is being generated.**
- **Do not touch a location that is electrically connected to an output terminal immediately after output is turned off.**

⚠WARNING

Risk of electric shock or fire.

- **If any breaks or tears are found in the test lead, stop using it immediately.**

Risk of electric shock.

- **Do not operate without grounding the product.**
- **Wear rubber gloves for electrical work.**
- **In tests that use test leads, do not touch the tip of test leads.**
- **If you want to turn the POWER switch on again after turning it off, wait at least 10 seconds.**
  It is dangerous to do otherwise, because the protective functions of the product may not work effectively. This may cause the product to malfunction or reduce the life of the POWER switch and internal parts such as the fuses.

Installation

⚠WARNING

Risk of electric shock.

- **Be sure to ground the product to prevent an electric shock.**
  The TOS73 series is IEC standard overvoltage category II equipment (energy-consuming equipment supplied from a fixed installation).
- **Connect the protective conductor terminal to earth ground.**
  The TOS73 series is grounded through the power cord ground wire.

⚠CAUTION

- **Do not install the product in residential environment.**
  TOS73 series is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

General precautions during test

⚠WARNING

Risk of electric shock.

- **To prevent accidents, strictly follow the precautions and always pay the utmost attention to safety concerns when you operate the product.**
  This product generates a voltage up to 1.0 kVdc. Handling this product improperly may lead to a fatal accident.
- **Do not apply an external voltage to the OUTPUT LOW terminal.**
  This causes a voltage exceeding the rated voltage at the OUTPUT HIGH terminal.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**
- **During testing and before this discharge completes, do not disconnect the tester from the EUT.**
  After the output has been turned off, the internal discharge circuit goes into operation and discharges the output voltage.
- **Except in an emergency, do not turn the power off while output is being generated.**
- **Use the high-voltage test leads (TL35-TOS) for the leads.**
- **Be sure to connect the low-voltage test lead (black) first.**
- **Connect the test leads securely.**
  If connections are incomplete, the entire EUT may be charged to a high voltage.

When using external control

⚠WARNING

Risk of electric shock.

- **When controlling the TOS73 series from external device using SIGNAL I/O, ensure that the operator does not approach high-voltage application areas.**

  Be sure to construct a system that uses the interlock for safety. *(p. 67)*

In case of failure

⚠WARNING

Risk of electric shock.

- **Until you get the product fixed, make sure that nobody can use it.**
- **For repairs, contact your Kikusui agent or distributor.**

Disposal

⚠WARNING

Risk of electric shock.

- **Be sure to turn off the POWER switch, and disconnect the power cord from the switchboard.**
- **Do not remove the top cover until residual voltage has been discharged.**

  Residual voltage may remain on the circuit board for up to 3 minutes after disconnecting the power cord.

Risk of rupture or ignition.

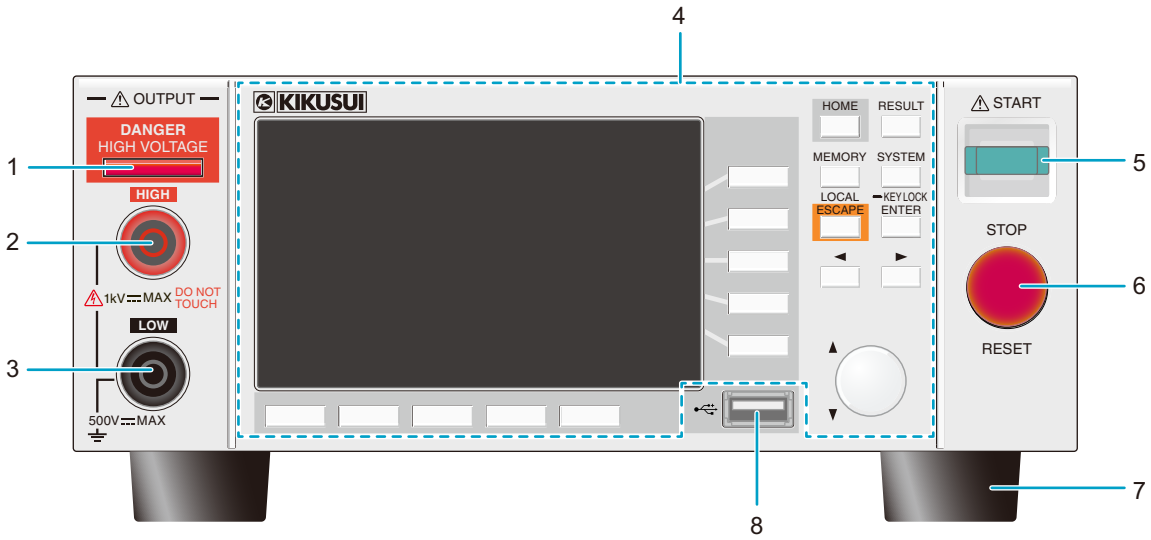
- **Do not short-circuit, charge, disassemble, deform, throw into fire, or overheat the built-in battery.**

Notes on Usage

- When using or storing the TOS73 series, be sure to observe the temperature and humidity ranges. For environmental conditions, see General Specifications *(p. 117)*.
- To protect the EUT, set the Protection Functions *(p. 18)* appropriately.

Component Names

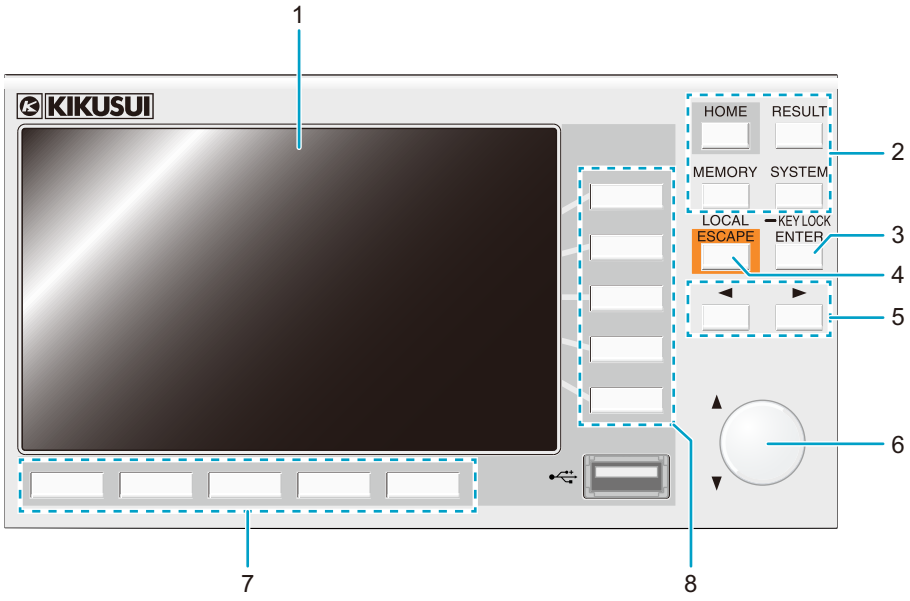
Front panel



No.	Name	Function
1	DANGER LED	Lights red when the power is turned on [1], when a test is in progress, when a high voltage is being output, or when there is residual voltage at the output terminals.
2	OUTPUT HIGH terminal	Outputs the test voltage of the high voltage side. *(p. 24)*
3	OUTPUT LOW terminal	Outputs the test voltage of the low voltage side. *(p. 24)*
4	Controls	See “Controls” *(p. 11)*.
5	START switch	Press and hold the switch for approximately 1 second or more to start the test. The test start method can be changed. *(p. 94)*
6	STOP/RESET switch	• The test will be aborted. • Releases the PROTECTION mode andjudgment results. • Returns to the Home Menu screen.
7	Feet	Four locations on the bottom side.
8	USB port (host)	• Connects an external keyboard or mouse. *(p. 31)* • Saves setup memory, test results, and measurement data to the connected USB memory device. *(p. 71)* • Used for updates the firmware. *(p. 105)*

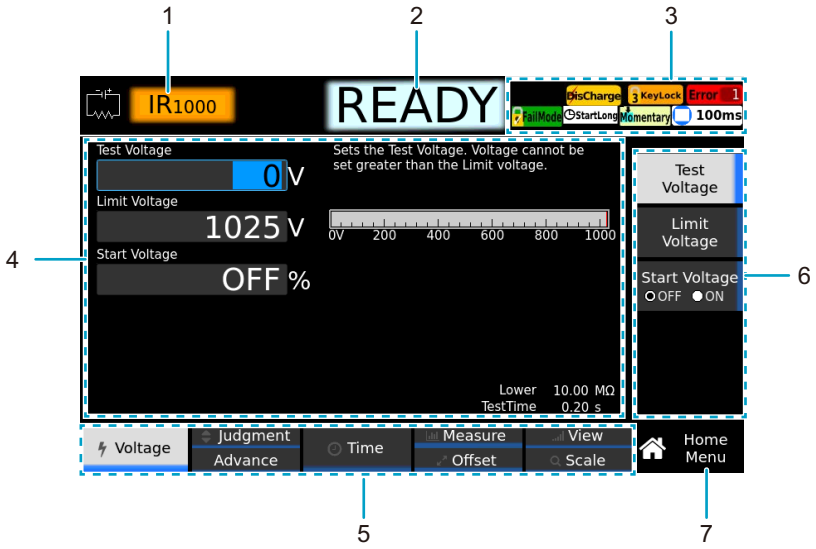
1. The indicator lights up for a few seconds for inspection, whether or not residual voltage is present.

Controls



No.	Name	Function
1	Display	Displays the settings, measured values, and other information. *(p. 12)*
2	Menu keys	Switch the display. *(p. 28)*
	HOME key	Displays the test conditions setup screen (Home Menu). *(p. 28)*
	RESULT key	Displays the list screen (Result Menu) of test results or measurement data. *(p. 76)* *(p. 80)*
	MEMORY key	Displays the memory function screen (Memory Menu). *(p. 71)*
	SYSTEM key	Displays the system setting screen (System Menu). *(p. 84)*
3	ENTER key	Fixes the entered or selected value. *(p. 31)*
	KEY LOCK key	Engages or unlocks the key lock when held down. *(p. 90)*
4	ESCAPE key	Cancels numeric/character input. *(p. 31)* Closes popup windows such as confirmation dialog boxes.
	LOCAL key	Returns remote control to panel control (local mode). *(p. 90)*
5	Arrow (◀/▶) keys	Move the cursor left and right. Select the left or right item. *(p. 31)*
6	Rotary knob	Enters numbers and characters. *(p. 31)* Selects an item.
7	Function keys	Executes the item that is displayed above each key (function area). *(p. 29)*
8	Sub-function keys	Executes the item that is displayed to the left of each key (sub-function area). *(p. 29)*

Display

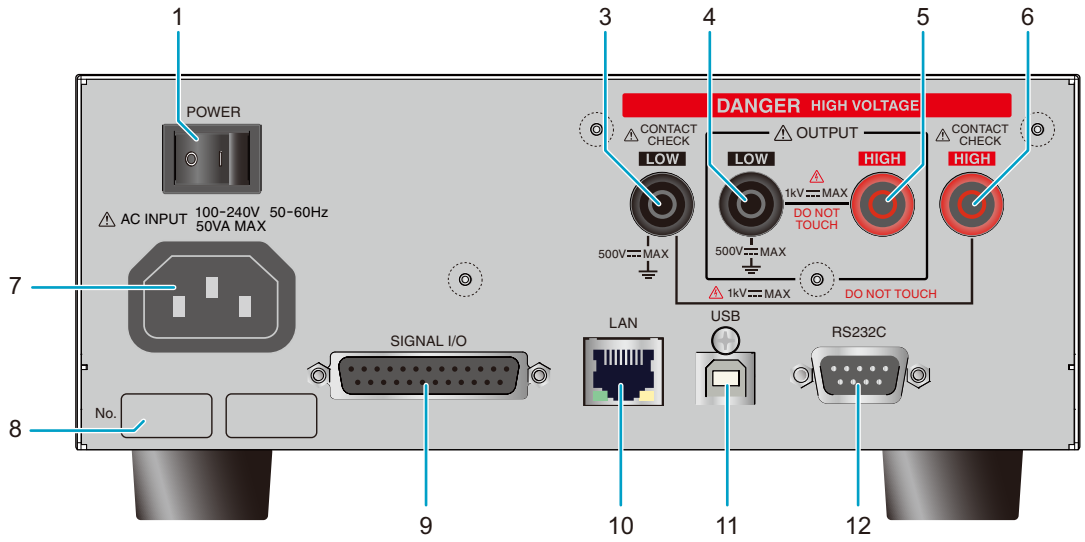


No.	Name	Function
1	Test mode	Displays the test type. (Fixed at IR 1000)
2	Test state	Displays the test status until the test ends. *(p. 56)*
	READY	A test is ready to start.
	RISE	A voltage is rising.
	TEST	A test is being conducted.
	CHECK	Contact check in progress or short-circuit detection in progress.
	Judgment result	Displays the judgment result when a test is completed. *(p. 61)*
	PASS	A PASS judgment has been made.
	Upper-FAIL	An Upper-FAIL judgment has been made.
	Upper-FAIL(dV)	A dV judgment has been made.
	Lower-FAIL	A Lower-FAIL judgment has been made.
	Lower-FAIL(SCD)	A short circuit was detected.
	Contact-FAIL	A Contact-FAIL judgment has been made.
3	Status display icon area	Displays the TOS73 series status using icons [1].
	Discharge	Residual voltage is being discharged.
	3 KeyLock	Key lock is activated. The key lock level is indicated with a number. *(p. 88)* Hold down KEY LOCK to unlock the key lock and hide the icon.
	Remote	Key lock is activated since remote control in progress (remote mode). Press LOCAL to unlock the key lock and hide the icon. [2]
	Error 1	There is an SCPI error. The number of error incidents (up to 16) is displayed numerically. *(p. 99)*
	FailMode	Fail Mode is enabled. *(p. 93)*
	DBL Act	Double Action is enabled. *(p. 94)*
	StartLong	Start Long is enabled. *(p. 94)*
	Momentary	Momentary is enabled. *(p. 94)*
	100ms	Displays the current set value of Aperture Time. *(p. 47)*
4	Settings area	Displays settings and descriptions. Displays measured values *(p. 57)* during testing.
5	Function area	Indicates that execution is possible with the keys (function keys) at the bottom of the display. *(p. 29)*
6	Sub-function area	Indicates that execution is possible with the keys (sub-function keys) in the right side of the display. *(p. 29)*
7	Menu name	Displays the name of the currently displayed menu screen. *(p. 28)*

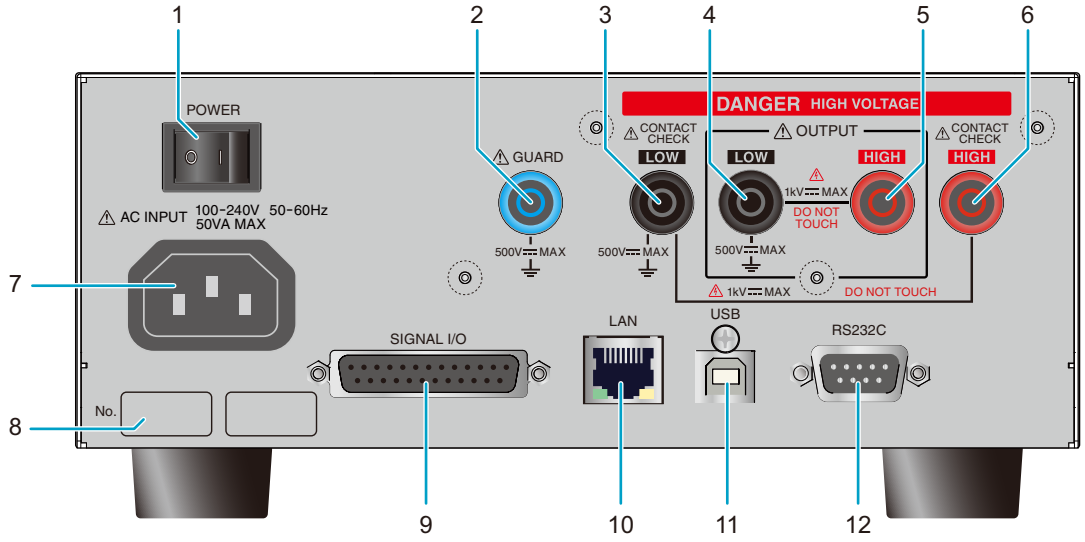
1. For icons displayed during test, see “Test condition display” *(p. 57)*.
2. If the key lock is not unlocked even when you press LOCAL, see “Unable to control from the panel” *(p. 125)*.

Rear panel

■ TOS7300



■ TOS7301



No.	Name	Function
1	POWER switch	Turns the power on (I) and off (O). *(p. 20)*
2	GUARD terminal [1]	Connects the chassis connection wire of the shield box when a shield box is used. *(p. 27)*
3	CONTACT CHECK LOW terminal	Connects a lead before using the Contact Check function. *(p. 22)*
4	OUTPUT LOW terminal	Outputs the test voltage of the low voltage side. *(p. 22)*
5	OUTPUT HIGH terminal	Outputs the test voltage of the high voltage side. *(p. 22)*
6	CONTACT CHECK HIGH terminal	Connects a lead before using the Contact Check function. *(p. 22)*
7	AC INPUT inlet	Used for connecting a power cord for supplying power to the TOS73 series. *(p. 19)*
8	Serial No.	Serial number.
9	SIGNAL I/O connector	An I/O signal connector for controlling the TOS73 series with an external device. *(p. 63)*
10	LAN port [2]	Used for connecting remote control. For details, see the TOS73 Series Communication Interface Manual.
11	USB port	
12	RS232C port	

1. TOS7301 and TOS7301 WITH LAN only.
2. WITH LAN model only.

Safety Precautions for Testing

Lighting of the DANGER LED

The DANGER LED lights when the TOS73 series is in any of the following conditions.

- At power on
- When a test is running
- When high voltage is being output
- A voltage equal to or more than the Danger Voltage *(p. 96)* setting remains at the output terminal

Check whether the DANGER LED lights at power on. If it does not, stop using the TOS73 series, and contact your Kikusui agent or distributor.

Test Precautions

Pre-test precautions

⚠WARNING

Risk of electric shock.

- **To prevent accidents, strictly follow the precautions and always pay the utmost attention to safety concerns when you operate the product.**
  This product generates a voltage up to 1.0 kVdc. Handling this product improperly may lead to a fatal accident.
- **Do not apply an external voltage to the OUTPUT LOW terminal.**
  This causes a voltage exceeding the rated voltage at the OUTPUT HIGH terminal.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

Check the following items before you start testing, and always follow the precautions.

- **The power cord is connected to a properly grounded outlet.**
- **There is no damage such as tears or breaks in the test lead insulation.**
- **When the POWER switch is turned on, the DANGER LED lights.**
- **When the DANGER LED is lit, do not turn the POWER switch off except in an emergency.**
- **Ensure that the test lead connected to the OUTPUT terminals or CONTACT CHECK terminals of the TOS73 series is not connected to the energized main power circuit.**

Testing precautions

⚠WARNING

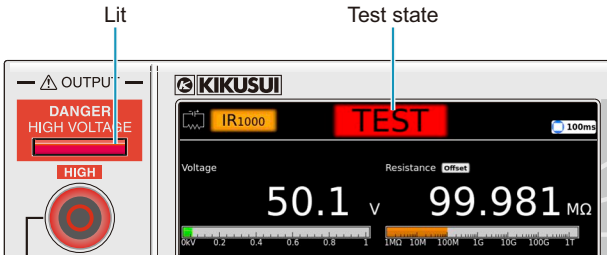
Risk of electric shock.

- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

During testing, the DANGER LED lights, and the display shows “TEST”.

Be careful because high voltage may be being output when the DANGER LED is lit.

The voltage threshold at which the DANGER LED turns on/off can be set in Danger Voltage *(p. 96)*.



Precautions when setting test conditions

Before changing test conditions, press STOP/RESET switch and check that the DANGER LED is turned off to ensure safety.

Precautions after Output Has Been Turned Off

⚠WARNING

Risk of electric shock.

- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**
- **During testing and before this discharge completes, do not disconnect the tester from the EUT.**
  After the output has been turned off, the internal discharge circuit goes into operation and discharges the output voltage.

The EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminal, and other peripheral components are charged to a high voltage. After the output has been turned off, be sure to check the following before you touch the items that have been charged to a high voltage.

- **The DANGER LED is off.**
- **"RISE," or "TEST," is not shown on the display.**

If you will not use the product for some time or if the operator will be away from the product, be sure to turn the POWER switch off.

Estimated discharge time

The time required to discharge the built-up electrical charge varies according to the test voltage and the properties of the EUT.

The time that the TOS73 series requires to discharge the voltage from its internal capacitors from 1000 V to 30 V is as follows:

- When an EUT is not connected: 1 ms
- When an EUT with a input capacitance of 0.05 μF is connected: 5 ms

Remote Control Precautions

If you are performing remote control at a location away from the TOS73 series, to prevent accidents, follow the safety measures given below.

- **Make sure that high voltages are not generated unintentionally.**
- **Make it impossible to touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminal, and the areas near the output terminals when high voltages are being generated.**

Malfunction Precautions

⚠WARNING

Risk of electric shock.

- **Until you get the product fixed, make sure that nobody can use it.**
- **For repairs, contact your Kikusui agent or distributor.**

Dangerous malfunctions

If the product is in one of the states explained below, it may be malfunctioning in a very dangerous manner—it may not be possible to turn off the high voltage that is being generated.

- **Even when you press the STOP/RESET switch, the DANGER LED remains lit.**
- **Even though a voltage is indicated on the voltmeter, the DANGER LED does not light.**

If the tester is not operating properly, it may be generating a high voltage irrespective of the settings made by the operator. Immediately turn the POWER switch off, and disconnect the power cord of the TOS73 series from the outlet. Stop using the product immediately, and contact your Kikusui agent or distributor.

Emergency measures

There are two actions that you must carry out if, due to a malfunction in the TOS73 series or the EUT, there is a possibility of an emergency occurring such as electric shock or damage to the EUT.

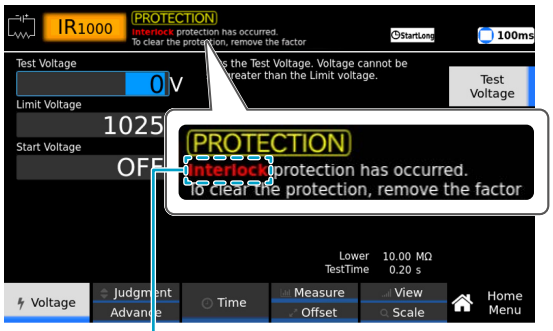
- **Turn the POWER switch off.**
- **Remove the power cord plug from the outlet.**

Protection Functions

When one or more protection function activation conditions are met, the protection function will be activated, and you will no longer able to perform test in this state (PROTECTION mode).

When the protection function is activated, the word “PROTECTION” appears on the display, along with the type of protection and the remedy.

If a PROTECTION mode occurs during a test, the output is shut off and the test is stopped immediately.



Type of protection

Use the following table to check the type of protection function, activation condition, and remedy, and release PROTECTION mode.

The text inside the parentheses in the “Type of protection” column is displayed in the list of test results *(p. 76)*.

Type of protection	Activation condition	Remedy
Interlock (ILOCK)	Interlock is activated.	Unlock the interlock. *(p. 66)*
Output Error (OUTERR)	An output voltage exceeding the range of ±(10% of setting + 5 V) of the set Test Voltage *(p. 35)* was detected.	Eliminate the cause of the error, and press STOP/RESET switch.
	The output changed suddenly.	
Communication (COMM)	An internal communication error is occurring.	Press STOP/RESET switch. [1]
	No SCPI communication took place for or more than the specified time when the watchdog *(p. 86)* was enabled.	Check the SCPI communication state and press STOP/RESET switch.
Signal I/O (SIO)	There is a change in the SIGNAL I/O connector’s ENABLE signal.	Press STOP/RESET switch.
Calibration (CAL)	The preset calibration period is exceeded.	The PROTECTION mode can be canceled by setting Protection Keep under Calibration *(p. 91)* to Disable and pressing the STOP/RESET switch, but the TOS73 series needs to be calibrated. To have your product calibrated, contact your Kikusui agent or distributor.

1. If pressing the STOP/RESET switch does not improve the situation, please contact your Kikusui agent or distributor.

Preparation

This chapter describes how to prepare the TOS73 series for use.

- For information about installing and moving the TOS73 series, see “Precautions Concerning Installation Location” and “Precautions to Be Taken When Moving the Product” in the Safety Information Manual.
- When using or storing the TOS73 series, be sure to observe the temperature and humidity ranges. For environmental conditions, see “General Specifications” *(p. 117)*.

Connecting the Power Cord

⚠WARNING

Risk of electric shock.

- **Be sure to ground the product to prevent an electric shock.**
  The TOS73 series is IEC standard overvoltage category II equipment (energy-consuming equipment supplied from a fixed installation).
- **Connect the protective conductor terminal to earth ground.**
  The TOS73 series is grounded through the power cord ground wire.

NOTE

- Use the supplied power cord to connect to the AC power line.
  If the supplied power cord cannot be used because the rated voltage or the plug shape is incompatible, have a qualified engineer replace it with an appropriate power cord that is 3 m or less in length. If obtaining a power cord is difficult, contact your Kikusui agent or distributor.
- Do not use the supplied power cord with other instruments.
- The power cord with a plug can be used to disconnect the TOS73 series from the AC power line in an emergency.
- Secure adequate space around the power plug. Do not insert the power plug to an outlet where accessibility to the plug is poor. And, do not place objects near the outlet that would result in poor accessibility to the plug.

The TOS73 series is designed as an equipment of IEC Overvoltage Category II (energy-consuming equipment supplied from a fixed installation).

1. **Turn off (○) the POWER switch on the rear panel.**
2. **Check that the AC power line meets the input rating of the TOS73 series.**
   An acceptable input voltage is a nominal supply voltage in the range of 100 Vac to 240 Vac. A frequency range is 47 Hz to 63 Hz.
3. **Connect the power cord to the AC INPUT inlet on the rear panel.**
4. **Connect the power cord plug to an outlet with a ground terminal.**
   This completes the connections.

Checking Whether the Power Is On or Off

Turning the power on

NOTE

When you actually perform tests, design a system that uses the interlock for safety *(p. 67)*.

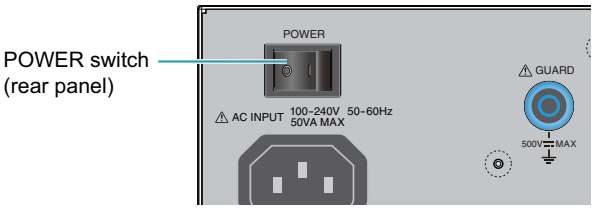
By factory default, the panel settings immediately before the POWER switch is turned off are saved. When you turn the power on, the product starts in the same state as it was in the last time it was turned off (however, the output is off).

The panel setting state at startup can be changed. *(p. 85)*

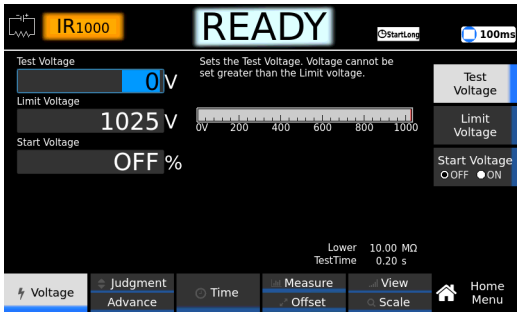
1 **Check that the power cord is connected properly.**

2 **Turn the POWER switch on (|).**

When startup, the DANGER LED is turned on and then off soon, but no voltage is generated. If it does not, stop using the TOS73 series, and contact your Kikusui agent or distributor.



After the startup screen appears on the display, the Home Menu screen appears.



The power is now on.

Turning the power off

⚠WARNING

Risk of electric shock.

- **If you want to turn the POWER switch on again after turning it off, wait at least 10 seconds.**
  It is dangerous to do otherwise, because the protective functions of the product may not work effectively. This may cause the product to malfunction or reduce the life of the POWER switch and internal parts such as the fuses.
- **Except in an emergency, do not turn the power off while output is being generated.**

1 **Turn the POWER switch off (○).**
The power is turned off.

Setting the Date/Time

Set the date and time on the RTC (real-time clock).

For details, see “Setting the Date/Time” *(p. 100)*.

Also set the calibration date *(p. 101)* and calibration period *(p. 91)* separately.

Connecting to the EUT

Connecting the test leads

Connects the OUTPUT terminals of the TOS73 series to the EUT with a test lead. Contact Check *(p. 45)* function can be used to detect connection failure with the EUT.

When the contact check function is used

When using the contact check function, which detects poor connection with the EUT or broken test leads, connect the EUT to the CONTACT CHECK terminals and OUTPUT terminals.

Two sets (four leads total) of high-voltage test leads (TL35-TOS) are required for connection, so additional high-voltage test leads are needed beyond the included accessories.

For how to obtain additional high-voltage test leads, contact your Kikusui agent or distributor.

⚠WARNING

Risk of electric shock.

- **Use the high-voltage test leads (TL35-TOS) for the leads.**
- **Be sure to connect the low-voltage test lead (black) first.**
- **Connect the test leads securely.**
  If connections are incomplete, the entire EUT may be charged to a high voltage.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

NOTE

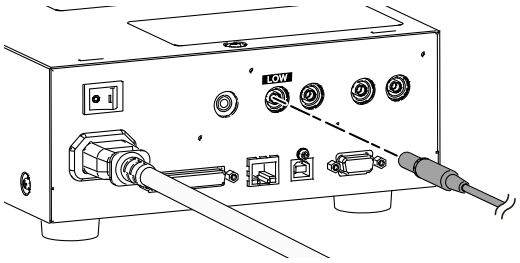
When conducting tests in accordance with JIS C 1302, ground the positive input terminal. Since the voltage between the negative input terminal and ground is 500 V, set the Test Voltage *(p. 35)* to within 500 V.

Connect one set of high-voltage test leads (TL35-TOS) to the CONTACT CHECK terminals and another set to the OUTPUT terminals on the rear panel.

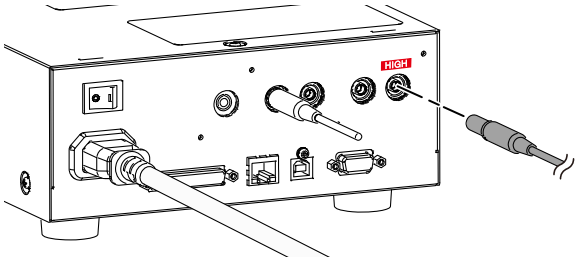
- Do not use the OUTPUT terminals on the front panel and rear panel simultaneously.
- Before starting work, check that the covering of the test leads are not torn and that the wires are not broken *(p. 107)*.

1 Check that the POWER switch is off (○) and that the DANGER LED is off.

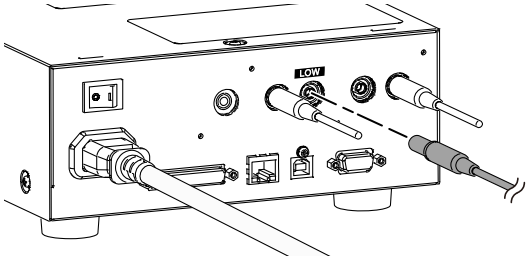
2 Connect the first low-voltage test lead (black) to the CONTACT CHECK LOW terminal and the EUT.



3 **Connect the first high-voltage test lead (red) to the CONTACT CHECK HIGH terminal and the EUT.**



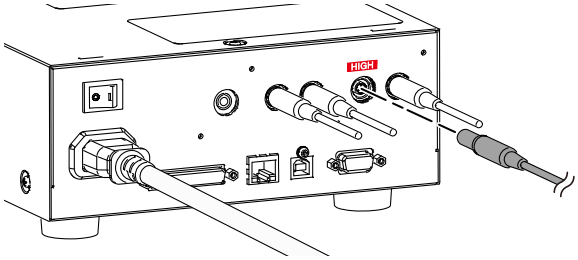
4 **Connect the second low-voltage test lead (black) to the OUTPUT LOW terminal.**



5 **Connect the second low-voltage test lead (black) to the EUT.**

6 **Connect the second high-voltage test lead (red) to the EUT.**

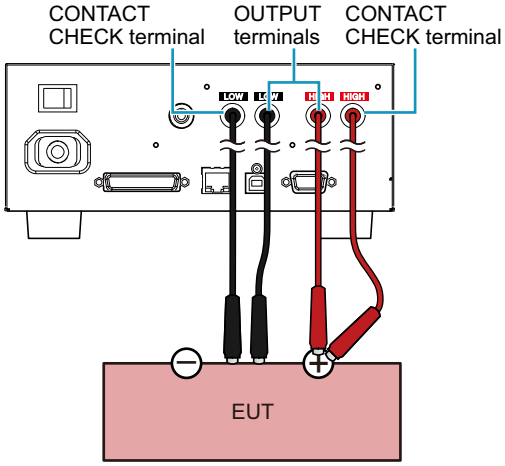
7 **Connect the second high-voltage test lead (red) to the OUTPUT HIGH terminal.**



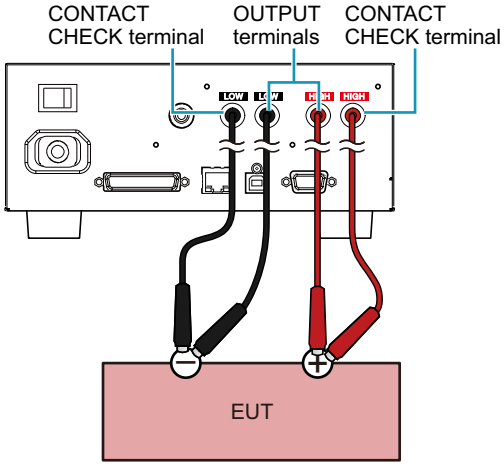
This completes the connections. See “Contact Check” *(p. 45)* for contact check settings.

■ Examples of how to connect test leads to the EUT

Ex: Between the positive polarity of a battery and exterior packaging



Ex: Between the positive polarity and the negative polarity of a battery (Separator test before electrolyte injection)



When the contact check function is not used

Connect the EUT to the OUTPUT terminals on the front panel or rear panel.

■ When using the OUTPUT terminals on the front panel

⚠WARNING

Risk of electric shock.

- **Use the high-voltage test leads (TL35-TOS) for the leads.**
- **Be sure to connect the low-voltage test lead (black) first.**
- **Connect the test leads securely.**
  If connections are incomplete, the entire EUT may be charged to a high voltage.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

NOTE

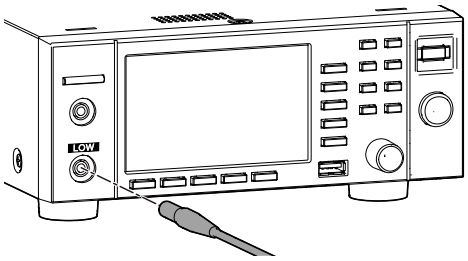
When conducting tests in accordance with JIS C 1302, ground the positive input terminal. Since the voltage between the negative input terminal and ground is 500 V, set the Test Voltage *(p. 35)* to within 500 V.

Connect the high-voltage test lead (TL35-TOS) to the OUTPUT terminals on the front panel.

- Do not use the OUTPUT terminals on the front panel and rear panel simultaneously.
- Before starting work, check that the covering of the test leads are not torn and that the wires are not broken *(p. 107)*.

1 **Check that the POWER switch is off (○) and that the DANGER LED is off.**

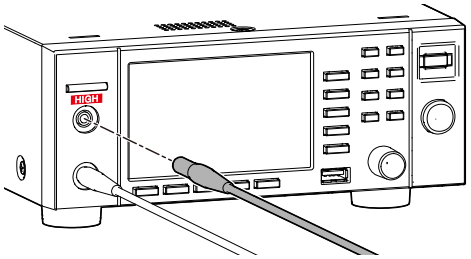
2 **Connect the low-voltage test lead (black) to the OUTPUT LOW terminal.**



3 **Connect the low-voltage test lead (black) to the EUT.**

4 **Connect the high-voltage test lead (red) to the EUT.**

5 **Connect the high-voltage test lead (red) to the OUTPUT HIGH terminal.**



This completes the connections.

■ When using the OUTPUT terminals on the rear panel

⚠WARNING

Risk of electric shock.

- **Use the high-voltage test leads (TL35-TOS) for the leads.**
- **Be sure to connect the low-voltage test lead (black) first.**
- **Connect the test leads securely.**
  If connections are incomplete, the entire EUT may be charged to a high voltage.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

NOTE

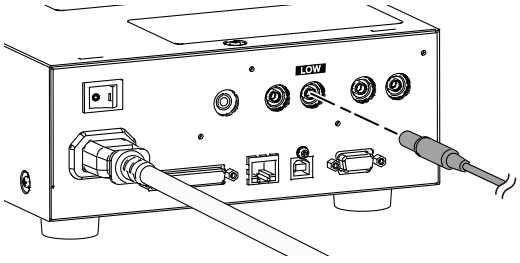
When conducting tests in accordance with JIS C 1302, ground the positive input terminal. Since the voltage between the negative input terminal and ground is 500 V, set the Test Voltage *(p. 35)* to within 500 V.

Connect the high-voltage test lead (TL35-TOS) to the OUTPUT terminals on the rear panel.

- Do not use the OUTPUT terminals on the front panel and rear panel simultaneously.
- Before starting work, check that the covering of the test leads are not torn and that the wires are not broken *(p. 107)*.

1 **Check that the POWER switch is off (○) and that the DANGER LED is off.**

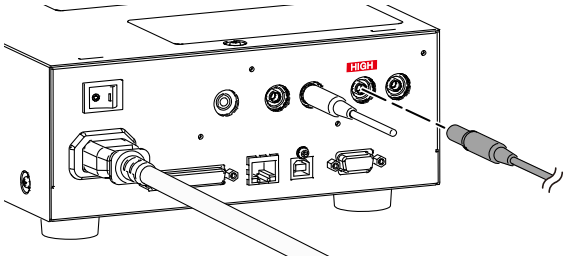
2 **Connect the low-voltage test lead (black) to the OUTPUT LOW terminal.**



3 **Connect the low-voltage test lead (black) to the EUT.**

4 **Connect the high-voltage test lead (red) to the EUT.**

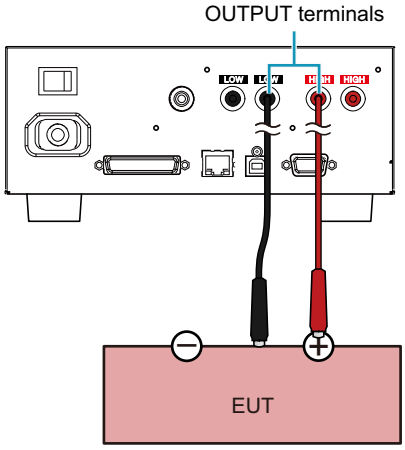
5 **Connect the high-voltage test lead (red) to the OUTPUT HIGH terminal.**



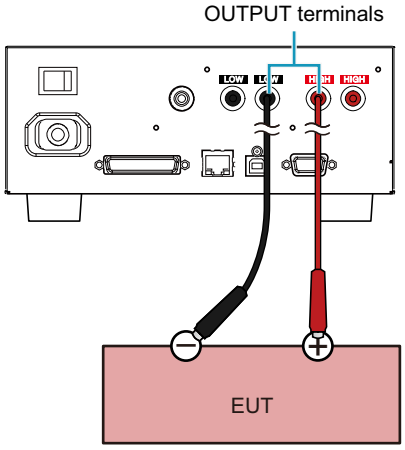
This completes the connections.

■ Examples of how to connect test leads to the EUT

Ex: Between the positive polarity of a battery and exterior packaging



Ex: Between the positive polarity and the negative polarity of a battery (Separator test before electrolyte injection)

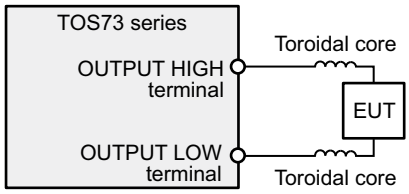


Reducing the effect of noise

Electronic devices in the surrounding area may malfunction due to the effect of noise produced by short circuits across outputs or a dielectric breakdown of the EUT. To reduce the effect of noise, connect a toroidal core or a resistor of approximately 470 Ω between the tips of the high- and low-voltage test leads and the EUT. Connect the toroidal core or resistor as close to the EUT as possible.

These methods are extremely useful in reducing the effect of noise.

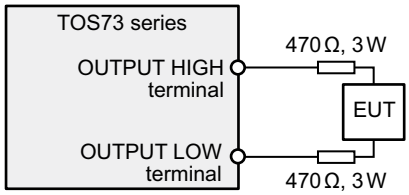
- If you are connecting a toroidal core, it is effective to wrap the test leads two to three times around a type of core that can be snapped on and that is often used with power cords. This type of core is usually approximately 20 mm in diameter.



When connecting toroidal cores

- If you are connecting a resistor, pay close attention to the power rating of the resistor. Connect a resistor of approximately 470 Ω (3 W, 2 kV impulse withstanding voltage).

  Because connecting the resistor causes the voltage to fall, the voltage that is actually applied to the EUT is slightly lower than the voltage that is generated from output terminals of the TOS73 series (when a 1 mA current flows, the voltage falls approximately 1 V).



When connecting resistors

About the GUARD terminal (TOS7301 and TOS7301 WITH LAN only)

If measurements are unstable due to the effect of noise, such as when making highly sensitive measurements, using a shield box can stabilize the measurements.

Three high-voltage test leads (TL35-TOS) are required for connection, so additional high-voltage test leads are needed beyond the included accessories.

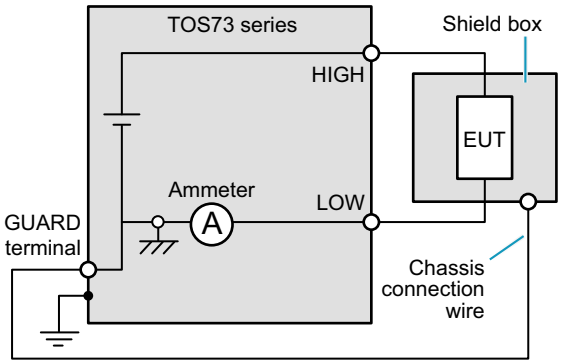
For how to obtain additional high-voltage test leads, contact your Kikusui agent or distributor.

⚠WARNING

Risk of electric shock.

- **Use the high-voltage test leads (TL35-TOS) for the leads.**
- **Be sure to connect the low-voltage test lead (black) first.**
- **Connect the test leads securely.**
  If connections are incomplete, the entire EUT may be charged to a high voltage.
- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

- Referring to the figure below, connect the GUARD terminal *(p. 13)* on the rear panel to the shield box's chassis connection wire using the high-voltage test lead (TL35-TOS).



- The voltage at the GUARD terminal may change up to around the test voltage, so do not use cables other than high-voltage test leads (TL35-TOS).

Removing the test leads

Check that the test is completed and the DANGER LED is turned off before removing the test leads.

You can remove the test leads in any order.

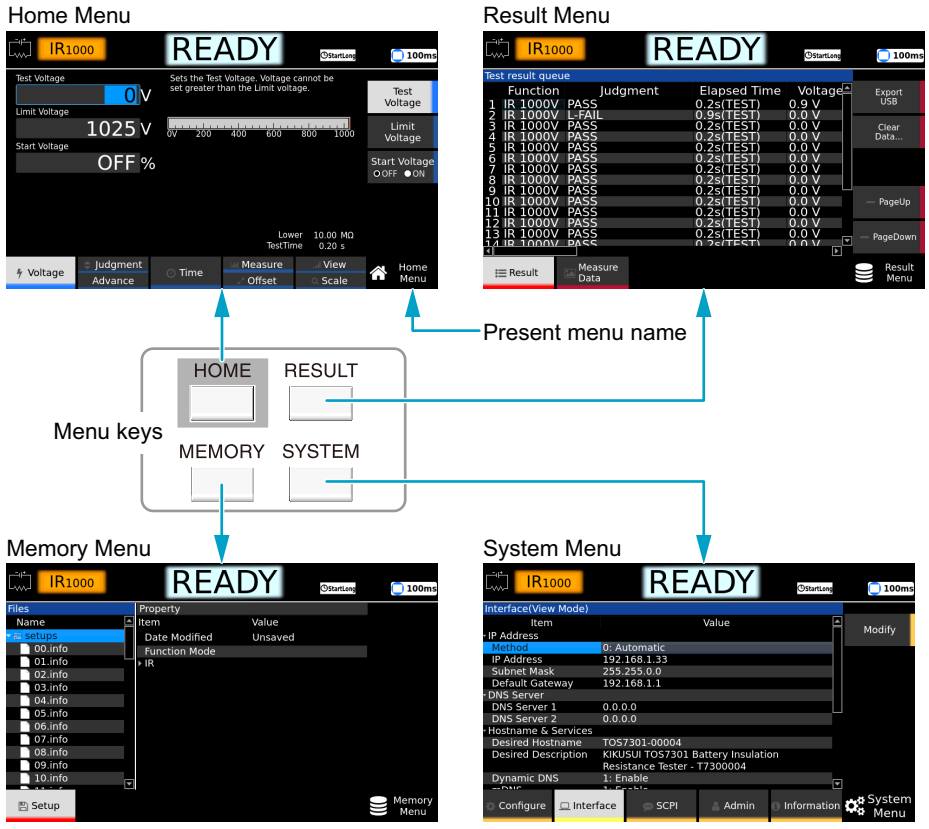
Basic Operation

Basic Panel Operations

Switching menus

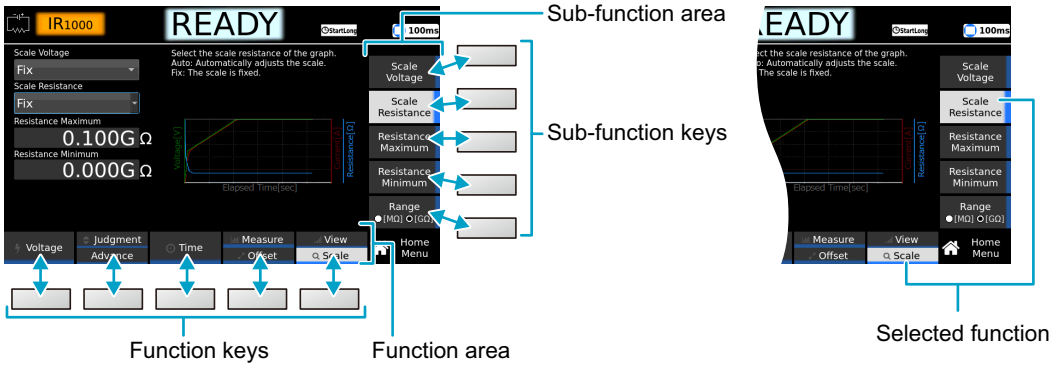
The following menus are available. To switch between menus, press the Menu key.

- Home Menu: Set the test conditions of each test. Execute tests.
- Result Menu: Check test results and measurement data.
- Memory Menu: Use the memory function.
- System Menu: Display and change system settings.

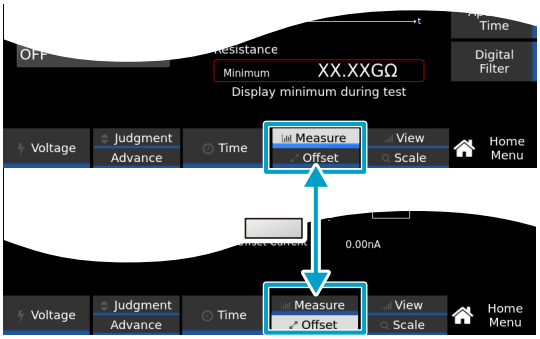


Using the function keys

On the display, the available functions are shown in the function area and sub-function area. You can execute or select the functions by pressing the corresponding function key or sub-function key. The selected function is shown with a light gray background.



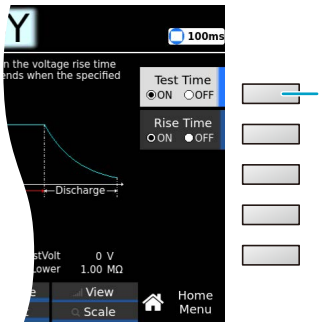
If several functions are displayed for a single key, the function switches each time you press the key.



Turning a function ON and OFF

If the function can be turned ON and OFF, the sub-function area may show the function name and settings such as ON and OFF. The function turns ON and OFF each time you press the corresponding sub-function key.

Ex:

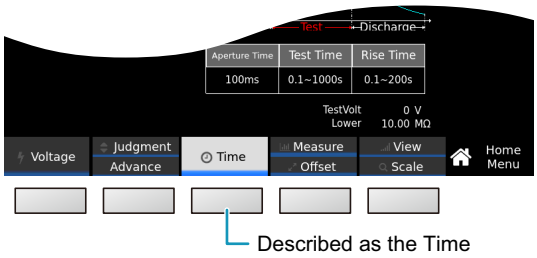


Start Voltage switches between on and off each time you press the corresponding key

Key names

Individual function keys and sub-function keys are distinguished by indicating the function names shown in the function area or sub-function area as the key names.

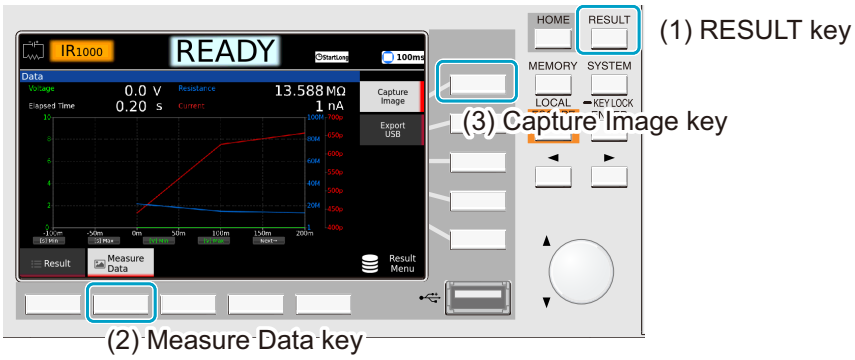
Ex:



Operation example: Checking the captured image of test results

1 **Press RESULT > Measure Data > Capture Image.**

In the above step example, press the buttons in the following order.



Mouse operation

By connecting a mouse to the USB port on the front panel, a mouse cursor appears on the display.

- With a left mouse click, you can select an item displayed on the screen or set a number.
- You can use the mouse wheel to scroll up and down, performing the same action as a rotary knob.

Entering numbers and characters

You can enter numbers and characters in input areas from the front panel or external keyboard. Number input and character input switch automatically according to the input area.

If numbers or characters are selected in an input area, they can be changed. If only a cursor is shown in an input area, you can enter characters or numbers at the cursor position.



Entering from the front panel

Purpose	Operation	Description
Cursor movement	Arrow (◀/▶) keys	Moves one digit to the right/left or between entry fields.
Numeric input	Rotary knob	Turn clockwise to increase the value and counterclockwise to decrease. The set value is confirmed immediately after entry.
Character input	Rotary knob	Turn clockwise to enter characters in the following order: space, uppercase letters, lowercase letters, numbers, and symbols. Turn counterclockwise to enter character in reverse order. To enter the next character, press the arrow (◀/▶) keys to move the cursor.
Delete	BackSpace key	If the BackSpace key is displayed in the sub-function area of the display, pressing the BackSpace key deletes the value/character on the left of the cursor or in the selected range.
Cancel	ESCAPE key	Cancels numeric/character input.

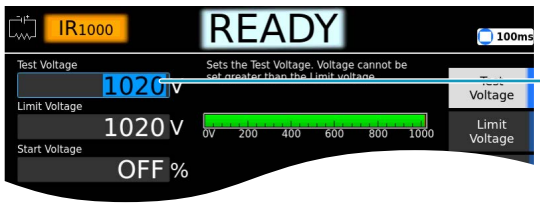
Entering from an external keyboard

If you connect a keyboard to the USB port on the front panel, you will be able to control the TOS73 series from the keyboard.

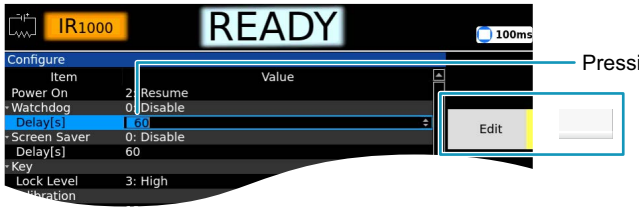
Controllable function	Keyboard operation
Number and character input	Keys corresponding to the numbers and characters. (US keyboards are supported.)
Cursor movement	Arrow keys
Number and character deletion	[Backspace], [Delete]
Input canceling	[Escape]
Confirmation	[Enter]
Input item movement	[Tab]
Function keys	(from the left) [F6], [F7], [F8], [F9], [F10]
Sub-function keys	(from the top) [F1], [F2], [F3], [F4], [F5]
START switch	[Alt] + [Ctrl] + [s] (press simultaneously)
STOP/RESET switch	[Alt] + [t]
Home Menu display	[Alt] + [h]
Result Menu display	[Alt] + [r]
Memory Menu display	[Alt] + [m]
System Menu display	[Alt] + [y]

Changing set values

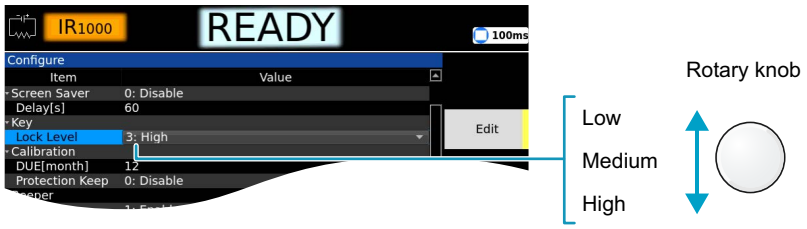
To change the test voltage or other values, use the rotary knob.



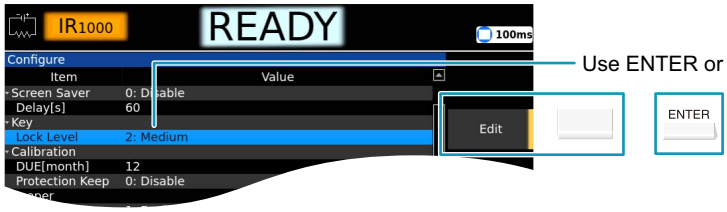
On screens in which “Edit” is shown in the sub-function area, use the rotary knob to select the item you want to change, and then press the Edit key to start changing the set value.



When changing a setting, if there are multiple items you can choose from, select the item using the rotary knob.



To confirm a set value you entered, press the ENTER key or Edit key. Procedures using the ENTER key are provided in this document.



Test Start Operation

This section explains how to perform a test start operation using the START switch and SIGNAL I/O connector.

In all cases, the test start method can be changed. *(p. 94)*

Using the START switch

By factory default, pressing and holding the START switch on the front panel for approximately 1 second or more starts the test with the configured test conditions.

Using the SIGNAL I/O connector

Sending a START signal to the SIGNAL I/O connector starts the test under the configured test conditions. *(p. 69)*

Insulation Resistance Tests

This chapter describes how to set test conditions, start tests, and view the results.

- Setting Test Conditions *(p. 34)*
- Starting a Test *(p. 55)*
- Finishing the Test and Viewing the Judgment *(p. 60)*

Setting Test Conditions

This section provides an overview of test conditions and how to configure them.

Description of test conditions

The following table shows the test conditions that you can set for testing.

Test conditions	Overview
Test Voltage	Voltage to apply to the EUT. *(p. 35)*
Limit Voltage	Upper limit of voltage to apply to the EUT. *(p. 35)*
Start Voltage	Voltage value 0.1 seconds after the test start operation. *(p. 36)*
Upper limit (Upper)	Reference resistance for upper limit judgment. *(p. 37)*
Lower limit (Lower)	Reference resistance for lower limit judgment. *(p. 38)*
Judgment delay (Judge Delay)	Time from the test start operation to the start of judgment. *(p. 39)*
Short-Circuit Detection	Detects a short-circuit between the HIGH and LOW terminals at the start of the test. *(p. 40)*
Delta Voltage [1]	Voltage difference that serves as the criterion for dV judgment. *(p. 41)*
Number of consecutive detections (Continuous Count) [1]	Specify how many consecutive times a voltage difference equal to or more than the delta voltage must be detected as a dV judgment criterion. *(p. 42)*
Test Time	Time from when the voltage rise time has passed to the end of the test. *(p. 43)*
Voltage rise time (Rise Time)	The time from the test start operation or the start voltage until the test voltage is reached. *(p. 44)*
Contact Check	Check the continuity between the test leads connected to the TOS73 series and the EUT. *(p. 45)*
Peak value display (Display Peakhold)	Selects whether to display the minimum value of resistance, during the test and in the judgment result. *(p. 46)*
Aperture Time	Sets the aperture time. *(p. 47)*
Digital Filter	Stabilize measurements when measuring at high sensitivity or when the measurements are unstable and hard to read. *(p. 48)*
Offset	Applies an offset to the resistance of test leads, tools, etc. *(p. 49)*
Measurement screen display during the test (Display View)	Selects the display format for the measurement screen displayed during the test from numerical values or graphs. *(p. 50)*
Graph axis setting (Graph Format) [1]	Sets the value types to be displayed on the Y-axis in the graph. *(p. 51)*
Scale of the voltage-axis (Scale Voltage) [1]	Select whether to fix the voltage-axis scale or to apply Auto-scale. *(p. 52)*
Scale of the resistance-axis (Scale Resistance) [1]	Select whether to fix the resistance-axis scale or to apply Auto-scale. *(p. 53)*

1. This can only be set on TOS7301 and TOS7301 WITH LAN.

Test Voltage

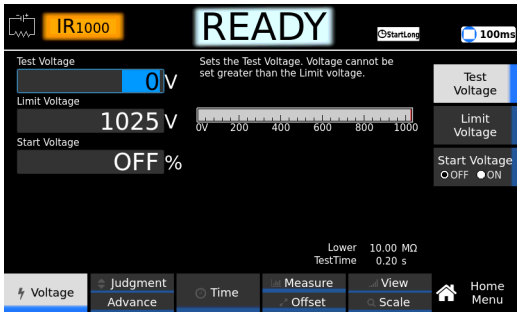
Set the voltage to apply to the EUT.
You cannot specify a test voltage that exceeds the Limit Voltage *(p. 35)*.

NOTE

When conducting tests in accordance with JIS C 1302, ground the positive input terminal. Since the voltage between the negative input terminal and ground is 500 V, set the test voltage to within 500 V.

1 **On the Home Menu screen, press Voltage > Test Voltage.**

2 **Use the rotary knob to enter the voltage value.**



Setting range	Resolution
0 V to 1025 V	1 V

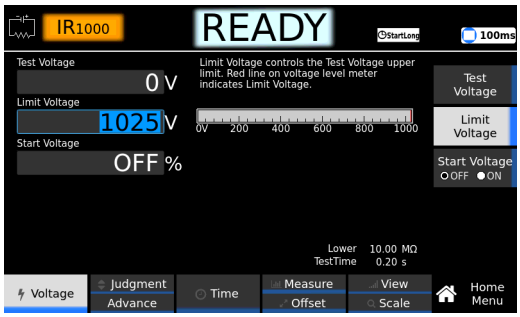
This completes the setting.

Limit Voltage

Set the upper limit of the voltage applied to EUT.
This prevents unnecessarily high voltage from being applied to the EUT by mistake.
You cannot specify a limit voltage below the Test Voltage *(p. 35)*.

1 **On the Home Menu screen, press Voltage > Limit Voltage.**

2 **Use the rotary knob to enter the voltage value.**



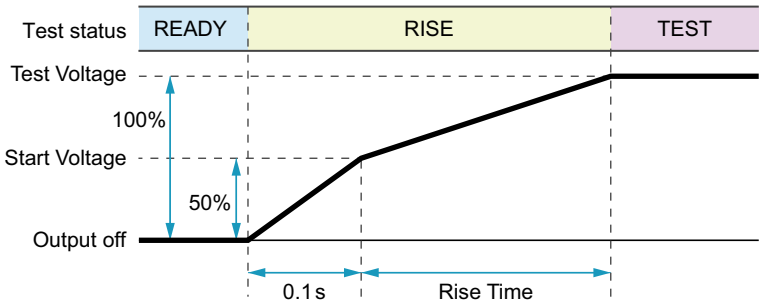
Setting range	Resolution
0 V to 1025 V	1 V

This completes the setting.

Start Voltage

Set the voltage 0.1 seconds after the test start operation *(p. 33)* as a percentage of Test Voltage *(p. 35)*.
If you do not want to set the start voltage, set Start Voltage to OFF.

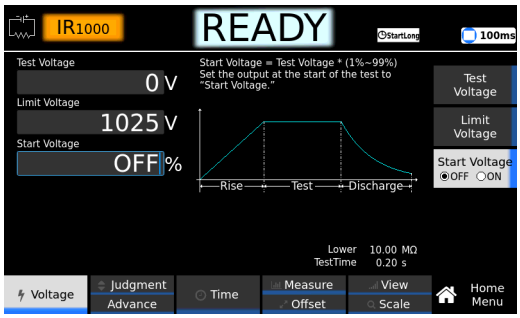
■ When the start voltage is 50%



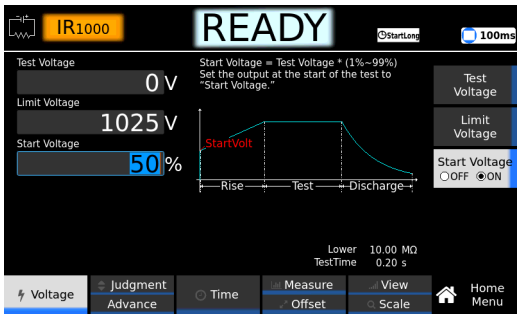
1 **On the Home Menu screen, press Voltage > Start Voltage.**

2 **Press Start Voltage to switch between ON and OFF.**

Each time you press the key, the Start Voltage setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter a percentage value.**



Setting range	Resolution
1 % to 99 %	1 %

This completes the setting.

Upper limit (Upper)

Set the reference resistance for the upper limit judgment.

If resistance greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results.

- If disable upper limit judgment, set Upper to OFF.
- If you set a resistance value for Upper that is below the Lower limit (Lower) *(p. 38)*, Lower will be changed to a resistance value smaller than Upper.

NOTE

Normally, even a good EUT will have a certain degree of leakage current. Setting Upper slightly greater than the resistance of the EUT is useful in detecting EUT errors, breaks in the test leads, and poor connections, enabling you to perform highly reliable testing.

1 **On the Home Menu screen, press Judgment repeatedly until Judgment is selected.**

Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Upper to switch between ON and OFF.**

Each time you press the key, the Upper setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter a resistance value.**

Press Range to select the unit of resistance value from MΩ or GΩ.



The setting range that can be specified changes according to the selected unit of resistance value as shown in the table below.

Unit of resistance value	Setting range	Resolution
MΩ	0.02 MΩ to 999.99 MΩ	0.01 MΩ
GΩ	0.02 GΩ to 10.00 GΩ	0.01 GΩ

This completes the setting.

Lower limit (Lower)

Set the reference resistance for the lower limit judgment.

If resistance less than or equal to Lower is measured after the voltage reaches the Test Voltage *(p. 35)*, lower limit judgment (Lower-FAIL) results.

- If disable lower limit judgment, set Lower to OFF.
- If you set a resistance value for Lower that exceeds the Upper limit (Upper) *(p. 37)*, Upper will be changed to a resistance value greater than Lower.
- The time from performing the test start operation *(p. 33)* to starting the lower limit judgment is set in the Judgment delay (Judge Delay) *(p. 39)*.

1 **On the Home Menu screen, press Judgment repeatedly until Judgment is selected.**

Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Lower to switch between ON and OFF.**

Each time you press the key, the Lower setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter a resistance value.**

Press Range to select the unit of resistance value from MΩ or GΩ.



The setting range that can be specified changes according to the selected unit of resistance value as shown in the table below.

Unit of resistance value	Setting range	Resolution
MΩ	0.01 MΩ to 999.99 MΩ	0.01 MΩ
GΩ	0.01 GΩ to 9.99 GΩ	0.01 GΩ

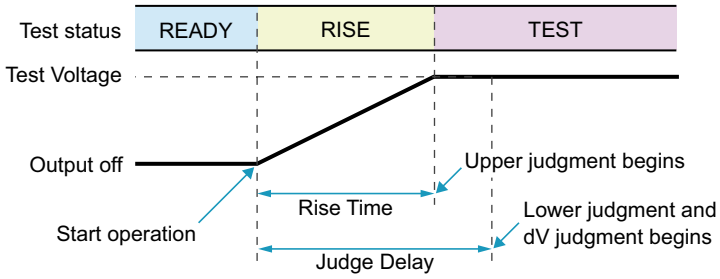
This completes the setting.

Judgment delay (Judge Delay)

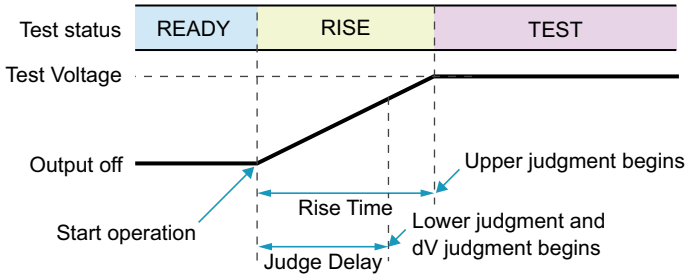
Set the judgment delay time from performing the test start operation *(p. 33)* to starting the lower limit judgment *(p. 38)* and dV judgment *(p. 41)*.

When the test voltage *(p. 35)* is applied to an EUT with a capacitive component, a large charge current may flow until charging is completed. Setting the judgment delay prevents judgment errors due to the effects of the charge current. Referring to the figure below, set a time shorter than the total of the Voltage rise time (Rise Time) *(p. 44)* and the Test Time *(p. 43)* to the judgment delay.

■ When Judge Delay is longer than Rise Time



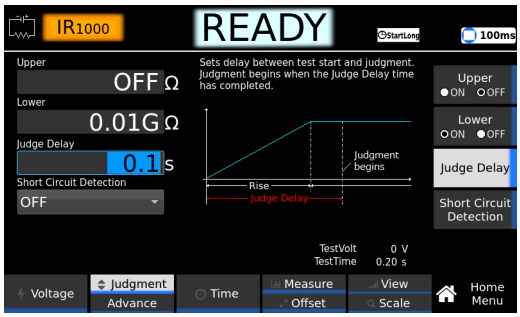
■ When Judge Delay is shorter than Rise Time



1 **On the Home Menu screen, press Judgment repeatedly until Judgment is selected.**

Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Judge Delay, and then use the rotary knob to enter the delay time.**



The setting range that can be specified changes according to the set value of Aperture Time *(p. 47)* as shown in the table below.

Set value of Aperture Time	Setting range [1]	Resolution
10 ms [2] [3]	0.04 s to 15.00 s	0.01 s
16.66 ms [3]	0.05 s to 15.00 s	0.05 s
20 ms	0.04 s to 100.00 s	0.02 s
100 ms	0.2 s to 100.0 s	0.1 s

1. The judgment delay time cannot be changed to a value greater than the sum of the Voltage rise time (Rise Time) and the Test Time.
2. This can only be set on TOS7301 and TOS7301 WITH LAN.
3. Only when the Test Time *(p. 43)* is set to ON.

This completes the setting.

Short-Circuit Detection

Detects a short-circuit between the HIGH and LOW terminals at the start of the test.

Detects the EUT in short-circuit state before high voltage is applied to prevent damage to the EUT.

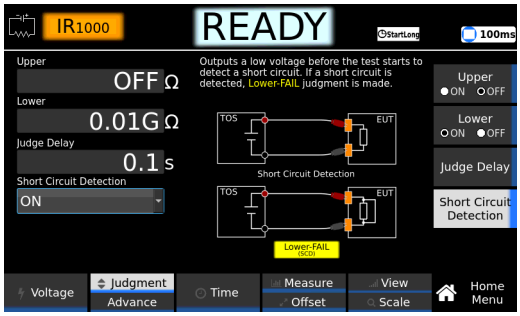
When Short Circuit Detection is turned ON, if the HIGH and LOW terminals are short-circuited at the start of the test, Lower-FAIL(SCD) judgment is made and the test shall be terminated.

If disable short-circuit detection, set Short Circuit Detection to OFF.

1 **On the Home Menu screen, press Judgment repeatedly until Judgment is selected.**

Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Short Circuit Detection, and then use the rotary knob to select ON or OFF.**



This completes the setting.

Delta Voltage

This can only be set on TOS7301 and TOS7301 WITH LAN.

Set the voltage difference (the difference between two consecutive voltage measured values) that serves as the criterion for dV judgment in percentage (%) of the Test Voltage *(p. 35)*.

If a voltage difference exceeding the delta voltage is detected consecutively for the times specified in Continuous Count *(p. 42)*, it is judged as an Upper-FAIL(dV), and the test ends.

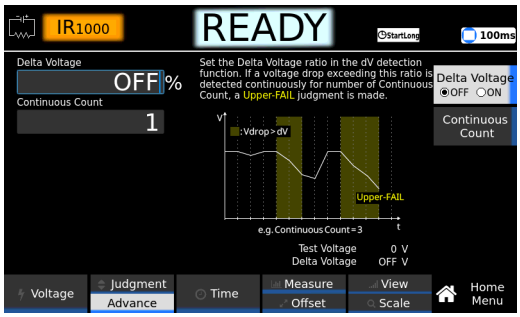
- To disable dV judgment set Delta Voltage to OFF.
- Voltage measured values are sampled at intervals based on the set value of Aperture Time *(p. 47)*.
- The time from performing the test start operation *(p. 33)* to starting the dV judgment is set in the Judgment delay (Judge Delay) *(p. 39)*.

1 **On the Home Menu screen, press Advance repeatedly until Advance is selected.**

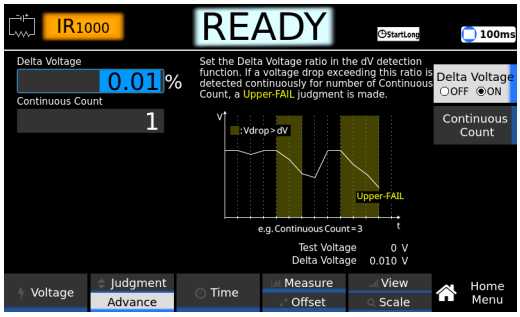
Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Delta Voltage to switch between ON and OFF.**

Each time you press the key, the Delta Voltage setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter a percentage value.**



Setting range	Resolution
0.01 % to 10.00 %	0.01 %

This completes the setting.

Number of consecutive detections (Continuous Count)

This can only be set on TOS7301 and TOS7301 WITH LAN.

Set the number of consecutive detections of a voltage difference (the difference between two consecutive voltage measured values) exceeding the Delta Voltage *(p. 41)* as the dV judgment criterion.

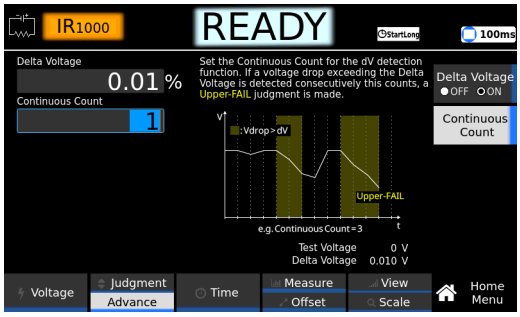
If a voltage difference exceeding the delta voltage is detected consecutively for the times specified in Continuous Count, it is judged as an Upper-FAIL(dV), and the test ends.

- To disable dV judgment set Delta Voltage to OFF.
- Voltage measured values are sampled at intervals based on the set value of Aperture Time *(p. 47)*.
- The time from performing the test start operation *(p. 33)* to starting the dV judgment is set in the Judgment delay (Judge Delay) *(p. 39)*.

1 **On the Home Menu screen, press Advance repeatedly until Advance is selected.**

Each time you press the key, the screen changes between Judgment and Advance.

2 **Press Continuous Count, and then use the rotary knob to enter the set value.**



Setting range	Resolution
1 to 100	1

This completes the setting.

Test Time

Set the test time to ON or OFF.

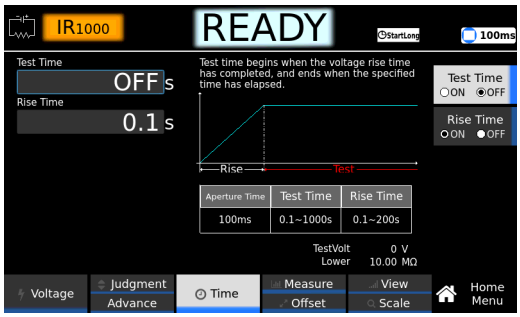
Set value	Description
ON	Set the time from when the Voltage rise time (Rise Time) *(p. 44)* has passed to the end of the test. If FAIL judgments does not occur during a test, the test will result in PASS judgment.
OFF	The test continues until the STOP/RESET switch is pressed. PASS judgments are not made. The selectable set values for Aperture Time *(p. 47)* are limited to 20 ms and 100 ms. If a set value below 20 ms is selected, it will be changed to 20 ms.

If the total time of the Test Time and Rise Time *(p. 44)* is shorter than the set value of Judgment delay (Judge Delay) *(p. 39)*, the set value of Judge Delay will be changed to a time shorter than the total of Test Time and Rise Time.

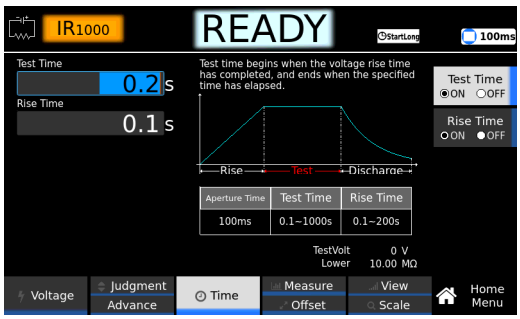
1 **On the Home Menu screen, press Time > Test Time.**

2 **Press Test Time to switch between ON and OFF.**

Each time you press the key, the Test Time setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter the time.**



The setting range that can be specified changes according to the set value of Aperture Time *(p. 47)* as shown in the table below.

Set value of Aperture Time	Setting range	Resolution
10 ms [1] [2]	0.04 s to 10.00 s	0.01 s
16.66 ms [2]	0.05 s to 10.00 s	0.05 s
20 ms	0.04 s to 1000.00 s	0.02 s
100 ms	0.2 s to 1000.0 s	0.1 s

1. This can only be set on TOS7301 and TOS7301 WITH LAN.
2. Only when the Test Time *(p. 43)* is set to ON.

This completes the setting.

Voltage rise time (Rise Time)

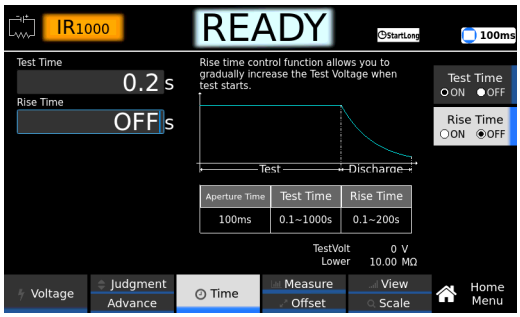
Set the time from the test start operation *(p. 33)* or from the Start Voltage *(p. 36)* until the Test Voltage *(p. 35)* is reached.

If the total time of the Test Time *(p. 43)* and Rise Time is shorter than the set value of Judgment delay (Judge Delay) *(p. 39)*, the set value of Judge Delay will be changed to a time shorter than the total of Test Time and Rise Time.

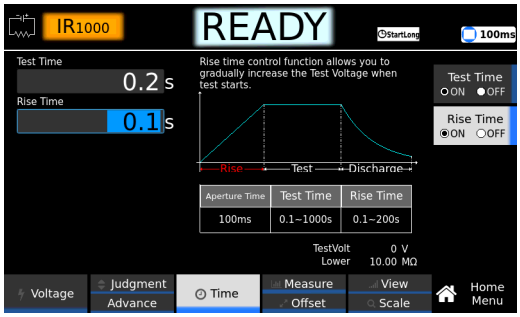
1 **On the Home Menu screen, press Time > Rise Time.**

2 **Press Rise Time to switch between ON and OFF.**

Each time you press the key, the Rise Time setting switches between ON and OFF.



3 **If you select ON, use the rotary knob to enter the time.**



The setting range that can be specified changes according to the set value of Aperture Time *(p. 47)* as shown in the table below.

Set value of Aperture Time	Setting range	Resolution
10 ms [1] [2]	0.01 s to 5.00 s	0.01 s
16.66 ms [2]	0.05 s to 5.00 s	0.05 s
20 ms	0.02 s to 200.00 s	0.02 s
100 ms	0.1 s to 200.0 s	0.1 s

1. This can only be set on TOS7301 and TOS7301 WITH LAN.
2. Only when the Test Time *(p. 43)* is set to ON.

This completes the setting.

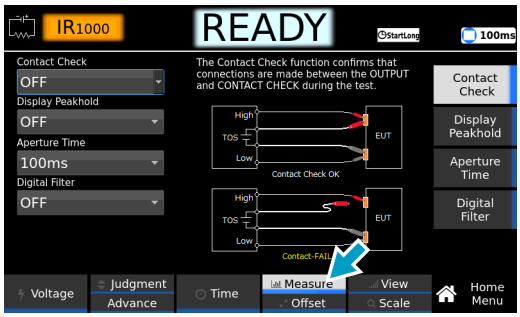
Contact Check

Detects poor connection with the EUT or broken test leads from performing the test start operation *(p. 33)* to the end of the test.

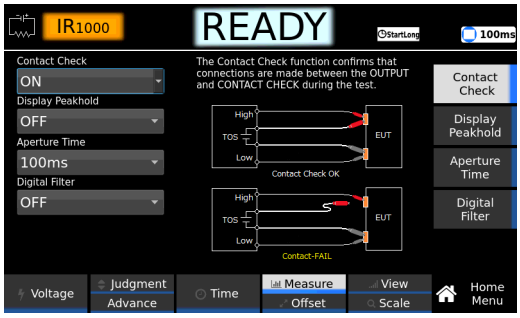
- If disable contact check function, set Contact Check to OFF.
- When using contact check function, connect one set of high-voltage test leads (TL35-TOS) to the CONTACT CHECK terminals and another set to the OUTPUT terminals on the rear panel. *(p. 22)*

1 **On the Home Menu screen, press Measure repeatedly until Measure is selected.**

Each time you press the key, the screen changes between Measure and Offset.



2 **Press Contact Check, and then use the rotary knob to select ON or OFF.**



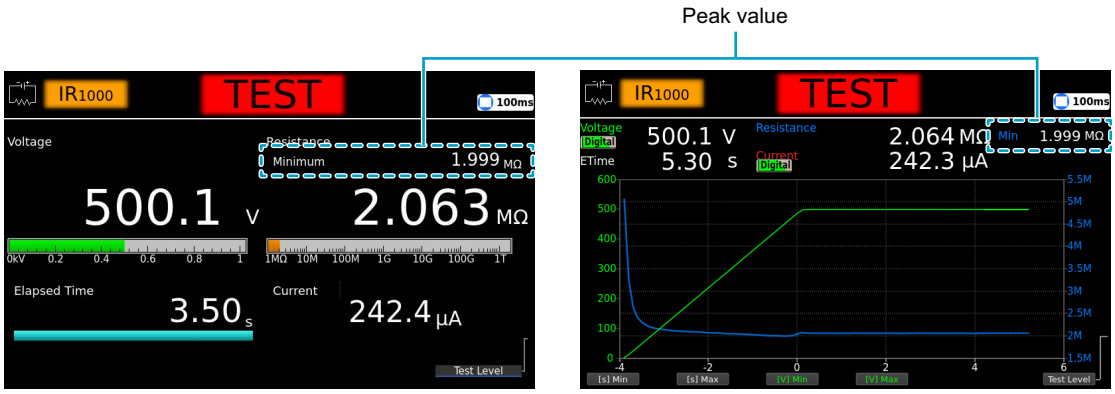
This completes the setting.

■ If continuity cannot be confirmed

The test is completed, and the “Contact-FAIL” judgment result shall be displayed. The U FAIL and L FAIL signals of the SIGNAL I/O Connector *(p. 63)* will be set to on simultaneously until the judgment result is cleared. Check that the test leads are connected properly.

Peak value display (Display Peakhold)

When Display Peakhold is set to ON, the minimum value of measured resistance is displayed during the test and in the judgment result.

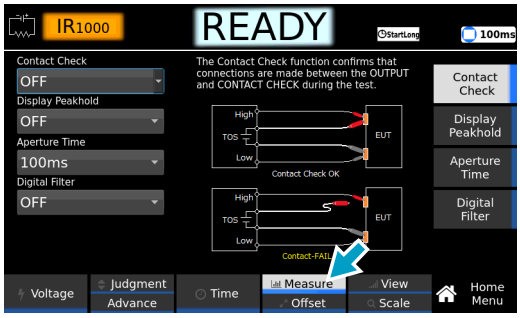


When Display View is set to Numeric

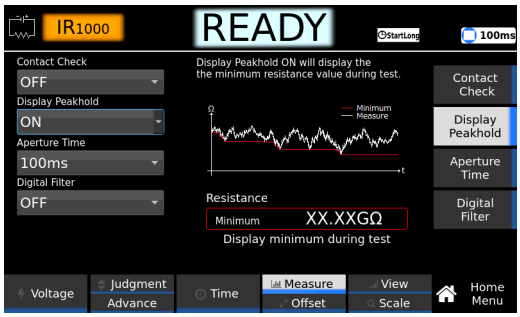
When Display View is set to Graph
(TOS7301 and TOS7301 WITH LAN only)

1 **On the Home Menu screen, press Measure repeatedly until Measure is selected.**

Each time you press the key, the screen changes between Measure and Offset.



2 **Press Display Peakhold, and then use the rotary knob to select ON or OFF.**



This completes the setting.

Aperture Time

Sets the aperture time.

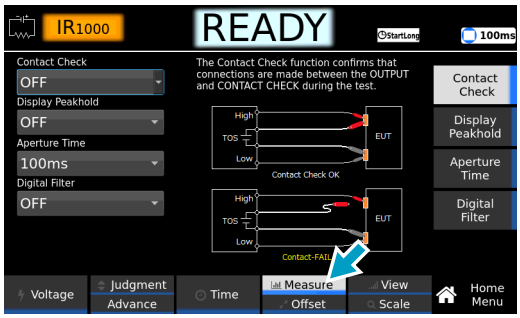
The average value obtained during the aperture time shall be the measured value.

The set aperture time is displayed as an icon ([10ms] / [16.6ms] / [20ms] / [100ms]) in the upper-right corner of the display.

- Longer aperture time increases the judgment interval but provides more stable measurement values.
- Fluctuations in measured values due to power line noise can be reduced by selecting 20 ms when the power line frequency is 50 Hz, or 16.66 ms when it is 60 Hz.

1 On the Home Menu screen, press Measure repeatedly until Measure is selected.

Each time you press the key, the screen changes between Measure and Offset.



2 Press Aperture Time, and then use the rotary knob to select the set value.



Depending on the selected set value, the setting range that can be specified for other test conditions will change as shown in the table below.

Set value of aperture time	Judgment delay (Judge Delay) *(p. 39)*		Test Time *(p. 43)*		Voltage rise time (Rise Time) *(p. 44)*	
	Setting range [1]	Resolution	Setting range	Resolution	Setting range	Resolution
10 ms [2] [3]	0.04 s to 15.00 s	0.01 s	0.04 s to 10.00 s	0.01 s	0.01 s to 5.00 s	0.01 s
16.66 ms [3]	0.05 s to 15.00 s	0.05 s	0.05 s to 10.00 s	0.05 s	0.05 s to 5.00 s	0.05 s
20 ms	0.04 s to 100.00 s	0.02 s	0.04 s to 1000.00 s	0.02 s	0.02 s to 200.00 s	0.02 s
100 ms	0.2 s to 100.0 s	0.1 s	0.2 s to 1000.0 s	0.1 s	0.1 s to 200.0 s	0.1 s

1. The judgment delay time cannot be changed to a value greater than the sum of the Voltage rise time (Rise Time) and the Test Time.
2. This can only be set on TOS7301 and TOS7301 WITH LAN.
3. Only when the Test Time *(p. 43)* is set to ON.

This completes the setting.

Digital Filter

Stabilize measurements when measuring at high sensitivity or when the measurements are unstable and hard to read.

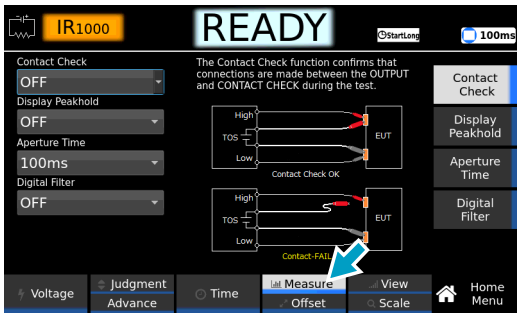
If the Digital Filter is set to ON, Digital icon appears on the screen when testing.

NOTE

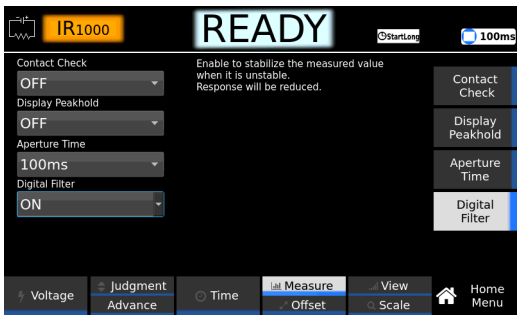
Because the response will be slow if the Digital Filter is set to ON, making judgments will require at least 1 second after the Voltage rise time (Rise Time) *(p. 44)* has elapsed. Judgments may not be accurate if the time until a judgment is made is short.

1 **On the Home Menu screen, press Measure repeatedly until Measure is selected.**

Each time you press the key, the screen changes between Measure and Offset.



2 **Press Digital Filter, and then use the rotary knob to select ON or OFF.**



This completes the setting.

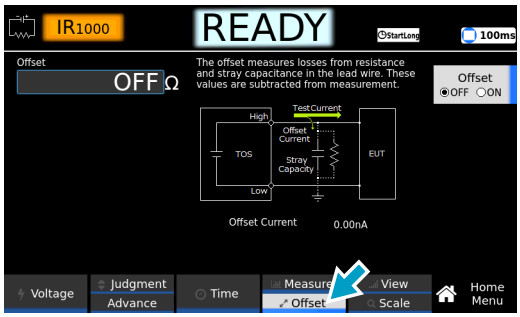
Offset

An offset can be applied to the current or resistance of test leads, tools, etc.

If the Offset is set to ON, **Offset** icon appears on screen when testing.

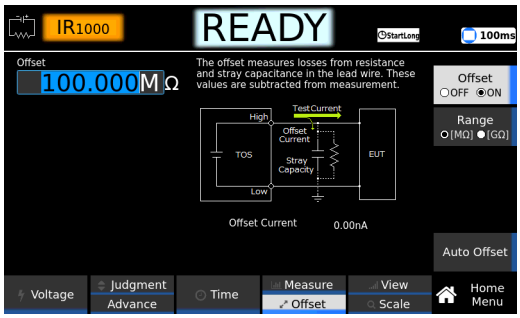
1 On the Home Menu screen, press Offset repeatedly until Offset is selected.

Each time you press the key, the screen changes between Measure and Offset.



2 Press Offset to switch between ON and OFF.

Each time you press the key, the Offset setting switches between ON and OFF.



3 If you select ON, set the Offset value according to the following procedure.

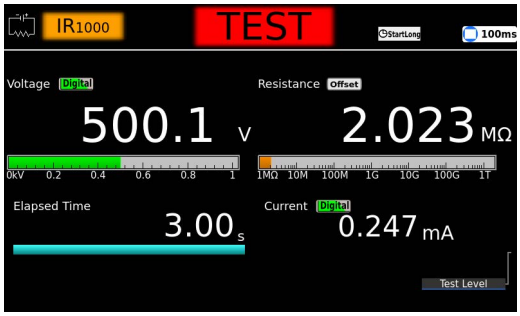
Purpose	Operation
Measure the Offset value to set it automatically	1 Press Auto Offset.
	2 Use the rotary knob to enter the test voltage.
	3 Connect test leads to the TOS73 series, and open the test leads.
	4 Perform the test start operation *(p. 33)*.
	5 When the measurement stabilizes, press STOP/RESET switch.
	The Offset value is set automatically.
Set the Offset value manually	Use the rotary knob to enter the set value. • Press Range to select the unit of resistance value from MΩ or GΩ. The setting range that can be specified changes according to the selected unit of resistance value as follows. MΩ: 0.001 MΩ to 999.999 MΩ (Resolution: 0.001 MΩ) GΩ: 0.001 GΩ to 2000.000 GΩ (Resolution: 0.001 GΩ) • The minimum value of the setting range varies according to the test voltage because the value converted to the current of 2 mA or more cannot be offset.

This completes the setting.

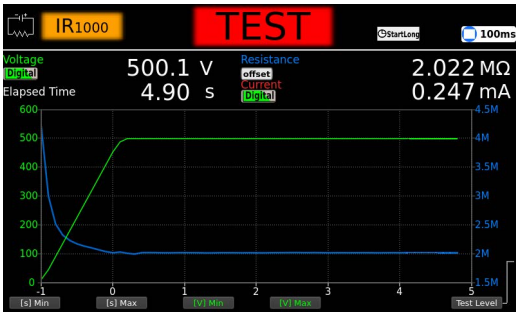
Measurement screen display during the test (Display View)

This can only be set on TOS7301 and TOS7301 WITH LAN.

Select the measurement screen to be displayed during the test from the numerical values and graphs.



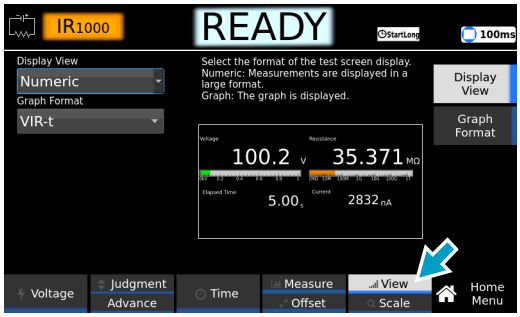
Set value: Numeric



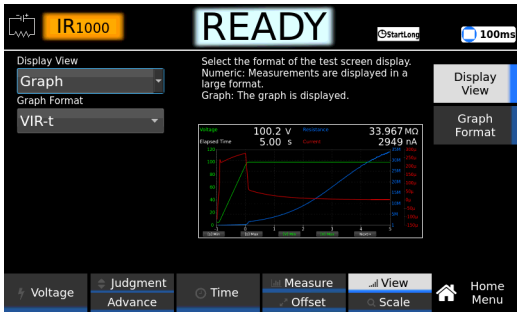
Set value: Graph

1 **On the Home Menu screen, press View repeatedly until View is selected.**

Each time you press the key, the screen changes between View and Scale.



2 **Press Display View, and then use the rotary knob to enter the set value.**



This completes the setting.

Graph axis setting (Graph Format)

This can only be set on TOS7301 and TOS7301 WITH LAN.
Sets the value to be displayed on the Y-axis of the graph when Display View *(p. 50)* is set to Graph.
Always displays time (seconds) on the X-axis.

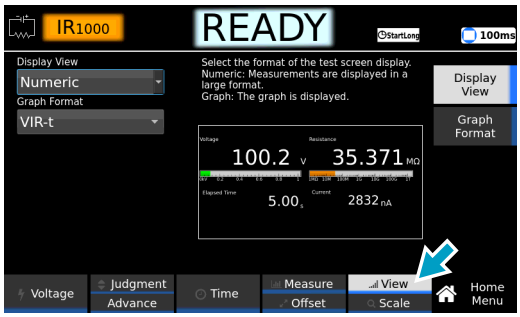
Set value	Description
VR-t	Displays voltage on the left side of the Y-axis, while resistance on the right side.
IR-t	Displays current and resistance on the right side of the Y-axis.
VIR-t	Displays voltage on the left side of the Y-axis, while current and resistance on the right side.

The following scales are respectively applied to the axis.

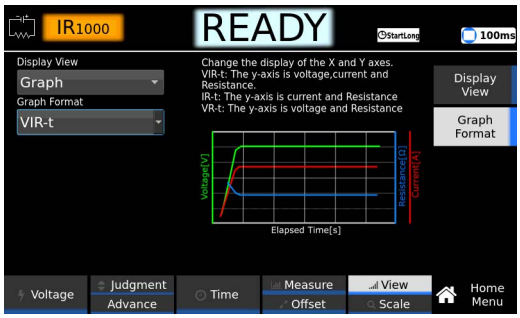
Axis	Minimum value	Maximum value
Time-axis	0 s	When Test Time *(p. 43)* is ON: Sum of the Test Time and Voltage rise time (Rise Time) *(p. 44)* set values
		When Test Time is OFF: Auto-scale
Current-axis	Auto-scale	Auto-scale
Voltage-axis	Depends on the settings instructed in Scale Voltage *(p. 52)*	
Resistance-axis	Depends on the settings instructed in Scale Resistance *(p. 53)*	

1 **On the Home Menu screen, press View repeatedly until View is selected.**

Each time you press the key, the screen changes between View and Scale.



2 **Press Graph Format, and then use the rotary knob to enter the set value.**



This completes the setting.

Scale of the voltage-axis (Scale Voltage)

This can only be set on TOS7301 and TOS7301 WITH LAN.

If Display View *(p. 50)* is set to Graph and Graph Format *(p. 51)* is set to VR-t or VIR-t, select whether the voltage-axis scale should be Fixed or Auto.

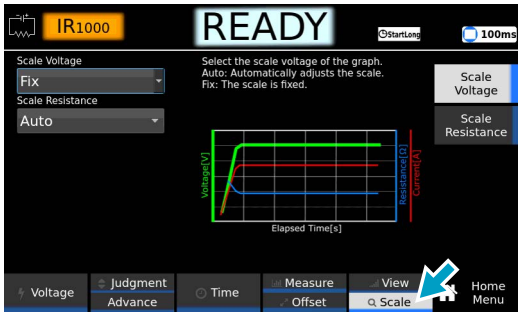
Set value	Description
Fixed	The minimum value shall be fixed at 0 V, while the maximum value shall be fixed at the Test Voltage x 1.2.
Auto	The minimum value shall be set at 0 V, while the maximum value shall be set at Auto-scale.

NOTE

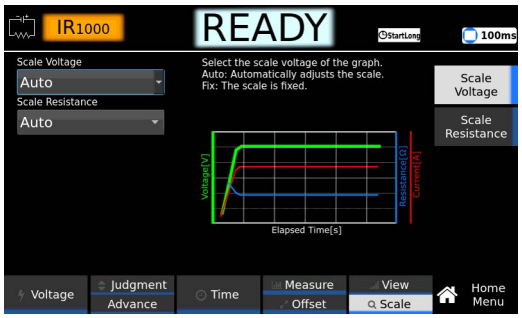
If the scale of axis is changed by Auto-scale, the maximum data points of the graph drawing shall be limited to 10000. The old measurement data shall not be drawn when exceeding the limit.

1 **On the Home Menu screen, press Scale repeatedly until Scale is selected.**

Each time you press the key, the screen changes between View and Scale.



2 **Press Scale Voltage, and then use the rotary knob to enter the set value.**



This completes the setting.

Scale of the resistance-axis (Scale Resistance)

This can only be set on TOS7301 and TOS7301 WITH LAN.

If Display View *(p. 50)* is set to Graph, select whether the resistance-axis scale should be Fixed or Auto.

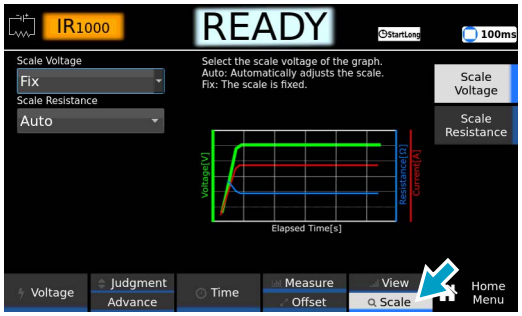
Set value	Description
Fixed	The minimum and maximum values shall be fixed at arbitrary values.
Auto	Both minimum value and maximum value shall be set at Auto-scale.

NOTE

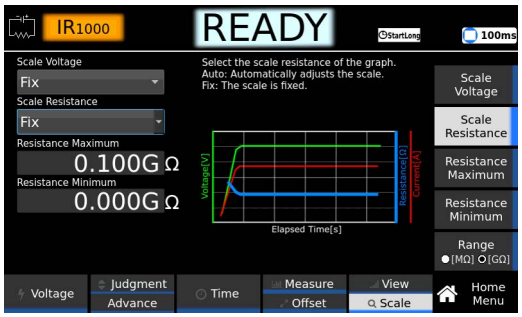
If the scale of axis is changed by Auto-scale, the maximum data points of the graph drawing shall be limited to 10000. The old measurement data shall not be drawn when exceeding the limit.

1 **On the Home Menu screen, press Scale repeatedly until Scale is selected.**

Each time you press the key, the screen changes between View and Scale.

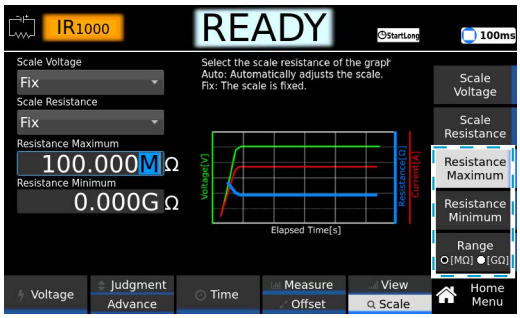


2 **Press Scale Resistance, and then use the rotary knob to enter the set value.**



3 If Scale Resistance is set to Fix, press Resistance Maximum key or Resistance Minimum, and then use the rotary knob to enter the maximum or minimum value of the resistance-axis.

Press Range to select the unit of resistance value from MΩ or GΩ.



The setting range that can be specified changes according to the selected unit of resistance value as shown in the table below.

Unit of resistance value	Setting range of the Resistance Maximum	Setting range of the Resistance Minimum	Resolution (common)
MΩ	0.001 MΩ to 999.999 MΩ	0.000 MΩ to 999.999 MΩ	0.001 MΩ
GΩ	0.001 GΩ to 20.000 GΩ	0.000 GΩ to 19.999 GΩ	0.001 GΩ

This completes the setting.

Starting a Test

We recommend that you perform a pre-test inspection *(p. 107)* before executing a test.

Starting a test

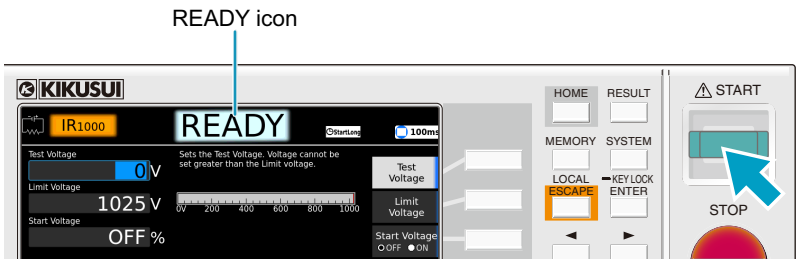
⚠WARNING

Risk of electric shock.

- **Do not touch the EUT, test leads, OUTPUT terminals, CONTACT CHECK terminals, GUARD terminals, or their surrounding areas while the DANGER lamp is lit, and for a short time after the output is turned off.**

1 **Check that the TOS73 series is correctly connected to the EUT.**

2 **Check that "READY" is shown on the display, and then perform the test start operation *(p. 33)*.**



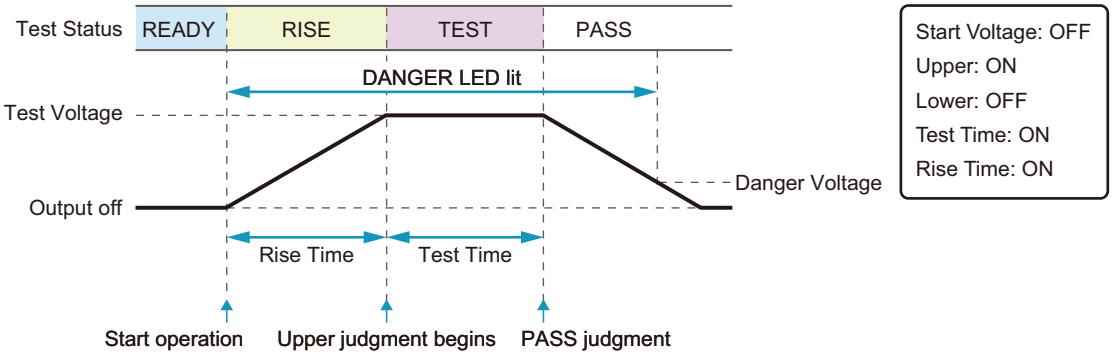
The DANGER LED lights, and the test starts.

If the test does not start, see "Unable to start a test" *(p. 125)*.

Operation after a test starts

Shown below are examples of operation after a test starts.

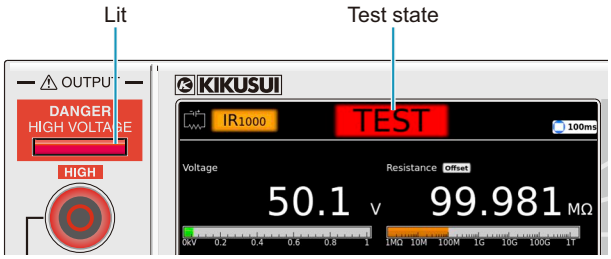
■ Example of a PASS judgment



■ DANGER LED and test state display

During testing, the DANGER LED is lit and the current test state appears on the upper of the display.

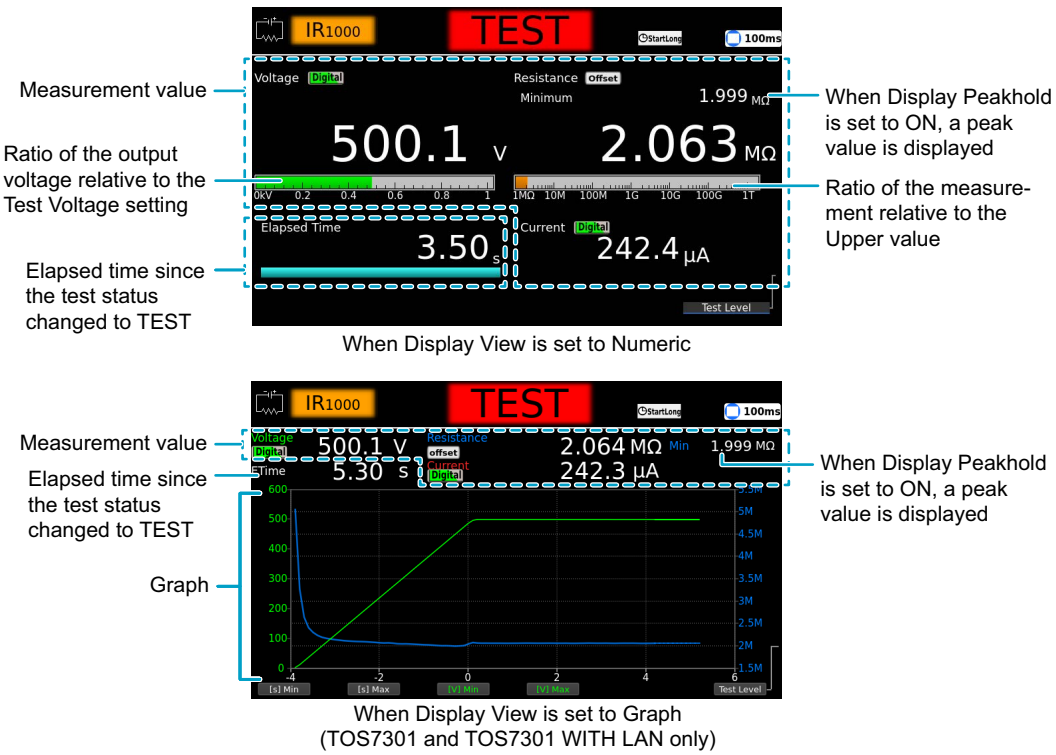
If a voltage equal to or more than the Danger Voltage *(p. 96)* setting remains at the output terminal, the DANGER LED turns on even when a test is not in progress.



Test state	Description
TEST	During test
↗RISE	Voltage rising
CHECK	Performing short-circuit detection *(p. 40)* or/and contact check *(p. 45)*

■ Measurement value display

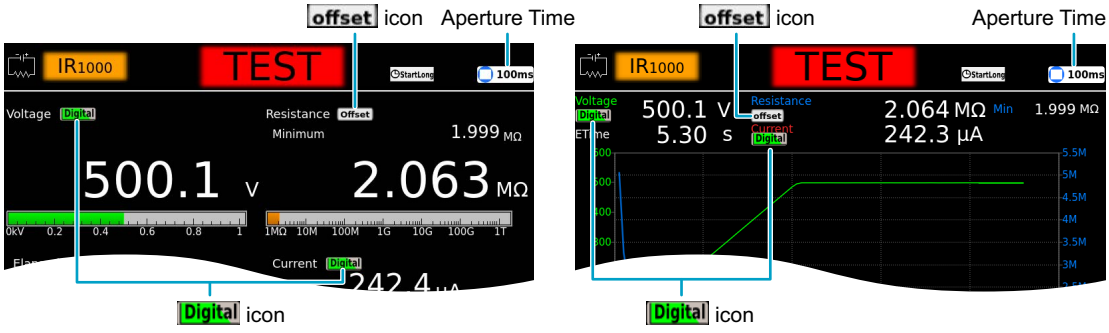
The display varies according to the setting of Display View *(p. 50)*.



For the elapsed time since it changed to TEST, see ““Elapsed Time (or ETime) display” *(p. 58)*.

■ Test condition display

Icons indicating the test conditions appear during testing.

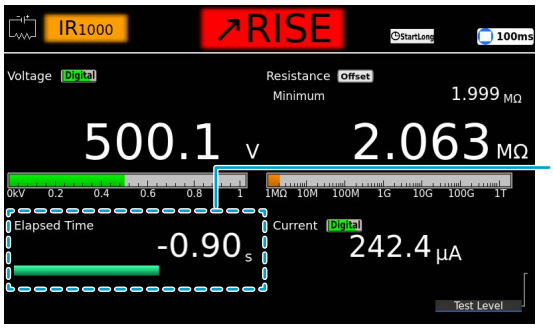


Icon	Description
10ms / 16.6ms / 20ms / 100ms	Aperture Time *(p. 47)* setting (10 ms/16.66 ms/20 ms/100 ms)
Digital	Digital Filter *(p. 48)* is set to ON
Offset	Offset *(p. 49)* is set to ON

■ Elapsed Time (or ETime) display

Voltage rise time (Rise Time):

During the voltage rise, the test state on the display changes to “RISE”, and at the same time, the remaining voltage rise time is displayed as a negative number in the Elapsed Time (ETime) field on the test screen.

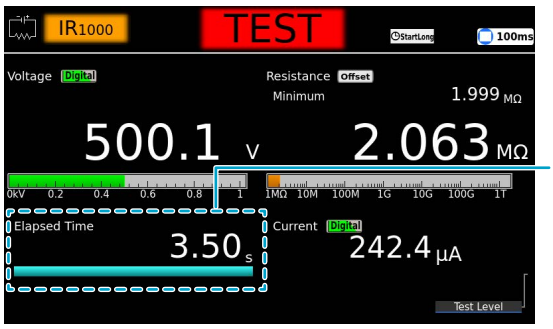


Voltage rise time (Rise Time):
- The remaining voltage rise time shall be displayed with a minus sign
- The progress of the voltage rise time shall be displayed as a bar graph

- When the time specified by Voltage rise time (Rise Time) *(p. 44)* elapses, “TEST” is shown, and the test starts.
- If Display View *(p. 50)* is set to Numeric, the remaining voltage rise time shall be displayed as a bar graph.

Test Time:

During the test time, the test state on the display changes to “TEST”, and at the same time, the elapsed time since the status changed from “RISE” to “TEST” is displayed in Elapsed Time (ETime) field on the test screen.



Test Time:
If Test Time is set to on, the remaining test time is displayed with a bar graph

- If Test Time *(p. 43)* is set to OFF, the elapsed time is displayed up to 3600000.0 seconds.

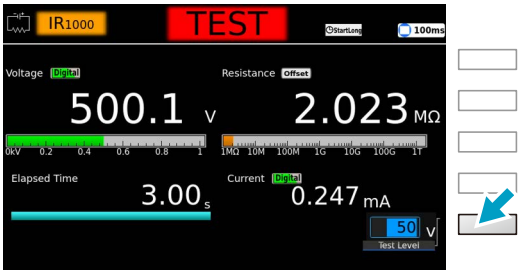
  After 3600000.0 seconds, +Over is displayed.
- If Display View *(p. 50)* is set to Numeric, the remaining test time shall be displayed as a bar graph when the Test Time is on.

Changing the test voltage during a test

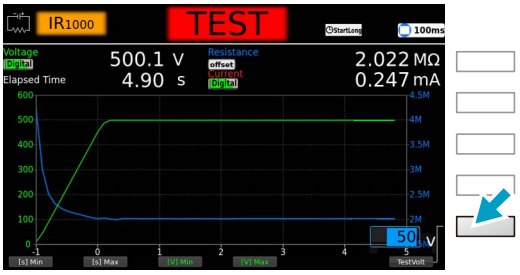
During a test, pressing Test Level allows you to change the Test Voltage *(p. 35)* using the rotary knob.

The changed test voltage is immediately applied to the test, but the Voltage on the test screen shows the measured voltage value instead of the changed Test Voltage. The Test Voltage changed during the test will continue to be applied to the Test Voltage after the test ends.

The Output Error may occur wh en the output changes suddenly.



When Display View is set to Numeric

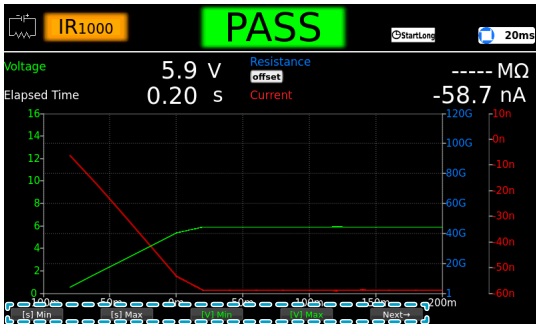


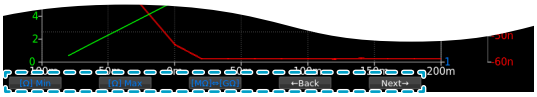
When Display View is set to Graph
(TOS7301 and TOS7301 WITH LAN only)

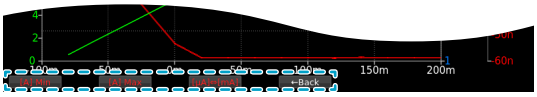
Changing the graph scale

This can only be set on TOS7301 and TOS7301 WITH LAN.

If Display View *(p. 50)* is set to Graph, the scale of the graph can be changed with the function key and rotary knob during or after the test.







Item	Description
[s] Min	When Test Time *(p. 43)* is ON, the minimum value of the time-axis can be changed.
[s] Max	When Test Time *(p. 43)* is ON, the maximum value of the time-axis can be changed.
[V] Min	When the scale of the voltage-axis (Scale Voltage) *(p. 52)* is Fixed, the minimum value of the voltage-axis can be changed.
[V] Max	When the scale of the voltage-axis (Scale Voltage) *(p. 52)* is Fixed, the maximum value of the voltage-axis can be changed.
[Ω] Min	Changes the minimum value of the resistance-axis.
[Ω] Max	Changes the maximum value of the resistance-axis.
[MΩ] ↔ [GΩ]	Changes the unit of the resistance while the minimum value/maximum value of the resistance-axis is being changed.
[A] Min	Changes the minimum value of the current-axis.
[A] Max	Changes the maximum value of the current-axis.
[μA] ↔ [mA]	Changes the unit of the current value while the minimum value/maximum value of the current-axis is being changed.
Next→	Switches the functions that can be performed with the function key.
←Back	Switches the functions that can be performed with the function key.

Finishing the Test and Viewing the Judgment

Stopping tests

If you want to abort a test before the set Test Time *(p. 43)* elapses, or if you want to end a test when test time is OFF, press STOP/RESET switch.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

a. When a resistance greater than or equal to Upper limit (Upper) *(p. 37)* or less than equal to Lower limit (Lower) *(p. 38)* is measured.
b. When a voltage difference equal to or more than the Delta Voltage *(p. 41)* is detected consecutively for the times specified in Continuous Count *(p. 41)*.
c. When poor contact is detected if Contact Check *(p. 45)* is set to ON.
d. When the test time elapses if Test Time *(p. 43)* is set to ON.
e. When you press STOP/RESET switch.

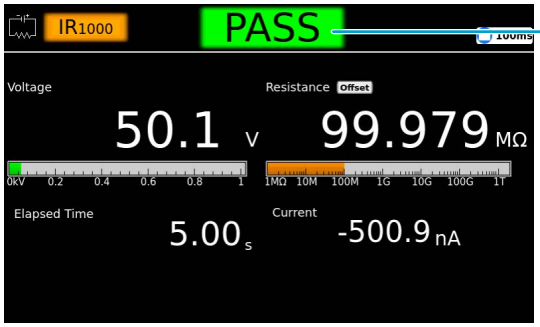
In either case, when the test ends, the test state (TEST) on the display will change to another icon.

When the residual voltage in the output terminal is discharged to a value lower than the DANGER LED lighting conditions (Danger Voltage) *(p. 96)*, the DANGER LED turns off.

If the test finishes under condition a to d given above, the judgment result *(p. 61)* will appear on the display.

Judgment types and operation

The judgment result is displayed when a test is completed.



Judgment result on the display	Judgment	Conditions for judgment	Beep sound	SIGNAL I/O connector
Upper-FAIL [1]	upper limit judgment	During a test where upper limit judgment *(p. 37)* was set to ON, a resistance value greater than or equal to the Upper limit (Upper) was measured.	Sounds when Beeper > Fail *(p. 92)* is enabled. [1]	U FAIL signal is output until the judgment result is cleared.
Upper-FAIL(dV) [1]	dV judgment	During a test where dV judgment *(p. 41)* was set to ON, a voltage difference greater than or equal to the Delta Voltage was detected consecutively for the times specified in number of consecutive detections (Continuous Count) *(p. 42)*.		
Lower-FAIL [1]	lower limit judgment	During a test where lower limit judgment *(p. 38)* was set to ON, a resistance value less than or equal to the Lower limit (Lower) was measured.	Sounds when Beeper > Fail *(p. 92)* is enabled. [1]	L FAIL signal is output until the judgment result is cleared.
Lower-FAIL(SCD) [1]	Short-circuit detection	During a test where Short-Circuit Detection *(p. 40)* was set to ON, a short-circuit between HIGH and LOW terminals was detected.		
Contact-FAIL (HIGH&LOW) [1]	Open-circuit detection	During a test where Contact Check *(p. 45)* was set to ON, a connection failure of the EUT to the OUTPUT HIGH terminal and OUTPUT LOW terminal was detected.	Sounds when Beeper > Fail *(p. 92)* is enabled. [1]	Both the U FAIL and L FAIL signals are output simultaneously until the judgment result is cleared.
Contact-FAIL (HIGH) [1]		During a test where Contact Check was set to ON, a connection failure of the EUT to the OUTPUT HIGH terminal was detected.		
Contact-FAIL (LOW) [1]		During a test where Contact Check was set to ON, a connection failure of the EUT to the OUTPUT LOW terminal was detected.		
PASS [2]	Passed	During a test with Test Time *(p. 43)* was set to ON, the specified test time elapsed without any of the following FAIL judgments occurring: upper limit judgment, lower limit judgment, dV judgment, short-circuit detection, or open-circuit detection.	Sounds when Beeper > Pass *(p. 92)* is enabled. [3]	PASS signal is output until the time set in Pass Hold *(p. 95)* elapses or the judgment result is cleared.

1. In the case of a FAIL judgment, the display of the judgment result and the beep sound will be held for the time set in Fail Hold *(p. 96)*.
   If Fail Hold is set to the default (Infinity), the display of the judgment result and the beep sound will be held until the judgment result is cleared.
2. In the case of a PASS judgment, the display of the judgment result will be held for the time set in Pass Hold *(p. 95)*.
   If Pass Hold is set to the default (0.2 s), the display of the judgment result will be canceled 0.2 s after the test ends.
3. In the case of a PASS judgment, the beep sound will be canceled 50 ms after the test ends, regardless of the Pass Hold setting.

Clearing the judgment result

Press STOP/RESET switch to clear the judgment result. The product is ready to start another test.

External Control

Main Functions

The following functions can be controlled and monitored from an external device using the SIGNAL I/O connector.

For details on the SIGNAL I/O connector, see “SIGNAL I/O Connector” *(p. 63)*.

Functions that can be controlled/monitored	IN/OUT
Activating/Unlocking Interlock *(p. 66)*	IN
Recalling setup memories *(p. 68)*	IN
Starting and stopping tests *(p. 69)*	IN
Monitoring of the test and voltage generation status *(p. 70)*	OUT
Monitoring of test state *(p. 70)*	OUT
Monitoring of judgment results *(p. 70)*	OUT
Monitoring of the activation status of protection functions *(p. 70)*	OUT

■ Precedence between external control and front panel operation

The following precedence applies to the SIGNAL I/O connector and START operation from the front panel. If these are used simultaneously, only the one with the highest precedence can be used.

- Highest: SIGNAL I/O connector (when the ENABLE signal is set to ON)
- Lowest: Front panel (including the keyboard connected to the USB port)

Example: If the ENABLE signal is set to ON for the SIGNAL I/O connector, the front panel can not be used.

SIGNAL I/O Connector

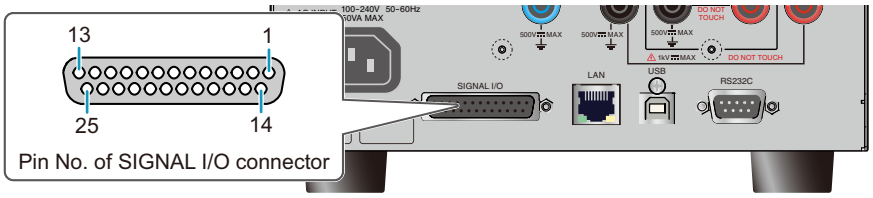
⚠WARNING

Risk of electric shock.

- **When controlling the TOS73 series from external device using SIGNAL I/O, ensure that the operator does not approach high-voltage application areas.**
  Be sure to construct a system that uses the interlock for safety. *(p. 67)*

Before using the SIGNAL I/O connector for external control, check the connector specifications, and connect the external device to the SIGNAL I/O connector.

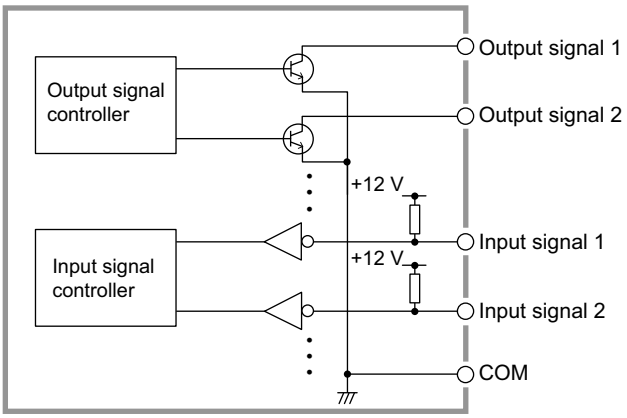
Pin arrangement



Pin no.	Signal name	IN/OUT	Description
1	INTERLOCK+	IN	Activating and unlocking Interlock *(p. 66)*
2	PM0	IN	Select the setup memory *(p. 68)*
3	PM1	IN	
4	PM2	IN	
5	PM3	IN	
6	Reserved	n/a	Not used
7	Reserved	n/a	
8	Reserved	n/a	
9	STB	IN	Recall the setup memory selected with the PM0 to PM3 signals *(p. 68)*
10	Reserved	n/a	Not used
11	Reserved	n/a	
12	COM	n/a	Common of I/O circuit (chassis potential)
13	INTERLOCK-	IN	Activating and unlocking Interlock *(p. 66)*
14	H.V ON	OUT	Set to on during testing or when voltage remains across the output terminals
15	TEST	OUT	Set to on during test time *(p. 70)*
16	PASS	OUT	Set to on for the duration of time specified by Pass Hold when a PASS judgment is made *(p. 70)*
17	U FAIL	OUT	Set to on continuously when an Upper-FAIL judgment is made
			Set to on continuously along with the L FAIL signal when a Contact-FAIL judgment is made *(p. 70)*
18	L FAIL	OUT	Set to on continuously when a Lower-FAIL judgment is made
			Set to on continuously along with the U FAIL signal when a Contact-FAIL judgment is made *(p. 70)*
19	READY	OUT	Set to on when the product is ready to start a test *(p. 70)*
20	PROTECTION	OUT	Set to on when a protection function is activated (PROTECTION mode) *(p. 18)*
21	START	IN	Starting a test *(p. 69)*
22	STOP	IN	Finishing a test *(p. 69)*
23	ENABLE	IN	Enable the START signal *(p. 69)*
24	+12V	OUT	+12 V internal power supply output terminal. Maximum output current 100 mA
25	COM	IN	Common of I/O circuit (chassis potential)

I/O signal circuit

The input signal circuit and the output signal circuit share the same common. The input terminal is pulled up to +12 V by a resistor. The following figure shows the internal construction of the SIGNAL I/O.

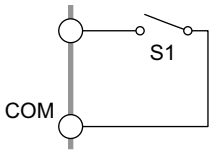


Input signal	Output signal
Opening the input terminals is equivalent to high-level input. • Low-active control • The input terminal is pulled up to +12 V by a resistor • High-level input voltage: 11 V to 15 V • Low-level input voltage: 0 V to 4 V • Low-level input current: 5 mA max. • Input time width: 5 ms min.	• Open collector output (4.5 Vdc to 30 Vdc) • Output withstanding voltage: 30 Vdc • Output saturation voltage: Approx. 1.1 V (25 °C) • Maximum output current 400 mA (TOTAL)

Input signal usage example

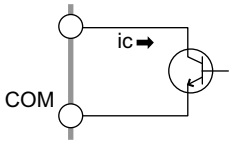
Using a make contact to control input

Use a make contact, such as a relay or switch, to set the input terminal to low level.



Using a logic element to control input

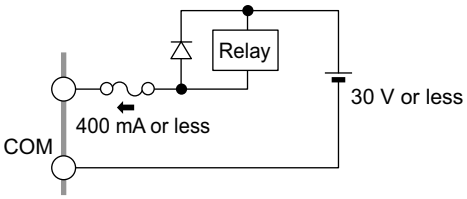
Use a logic element, such as a transistor, in place of the make contact. Design the circuit so that a transistor collector current ic of 5 mA or greater flows.



Output signal usage example

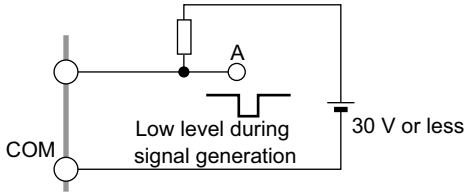
Driving a relay

Use the output signal to drive a relay. To improve the safety of the circuit, we recommend that you insert a protection fuse or connect a diode.



Obtaining a low-level digital signal

Use the output signal to obtain a low-level digital signal.



Connecting to the SIGNAL I/O connector

To connect the signal cable to the SIGNAL I/O connector, create a D-sub25 pin plug by referring to the following information.

SIGNAL I/O connector specifications	D-sub 25-pin female connector (socket), M2.6 x 0.45 screws
Compatible plug	D-sub 25-pin male (with M2.6×0.45 fixing screws)
Required cable	Single wire: 0.32 mm (AWG28) to 0.65 mm (AWG22) in diameter Twisted wire: 0.32 mm^2 (AWG22) to 0.08 mm^2 (AWG28)
Required tool	Wire stripper for the above cable

Activating/Unlocking Interlock

Links the product to an external device to stop output appropriately. This ensures the safety of the operator.

When the interlock is activated, the TOS73 series switches to PROTECTION mode, which prevents tests from being started with the START switch on the front panel or an external control START signal. Moreover, you cannot release PROTECTION mode with the STOP/RESET switch or the external control STOP signal.

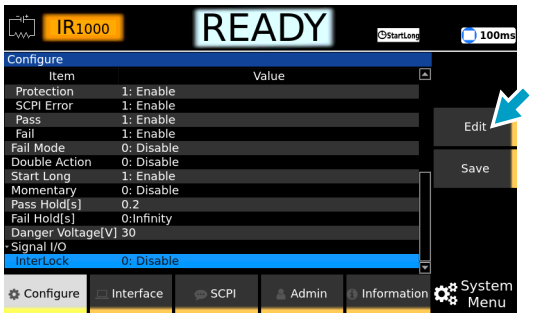
Enabling or disabling the interlock

To use the interlock, you need to enable the interlock function.

1 **Press SYSTEM > Configure.**

The Configure setup screen appears.

2 **Use the rotary knob to select InterLock under Signal I/O, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

This completes the setting.

Interlock activation conditions

Open across the INTERLOCK+ (1) pin and INTERLOCK- (13) pin of the SIGNAL I/O connector. For the pins to be considered open, any of the following conditions must be met.

- When the resistance across terminal 1 and terminal 13 is 1.2 kΩ or greater
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 13 is 5 mA or less

Interlock unlock conditions

Short the INTERLOCK+ (1) pin and INTERLOCK- (13) pin of the SIGNAL I/O connector, and then press the STOP/RESET switch on the front panel or apply an external control STOP signal.

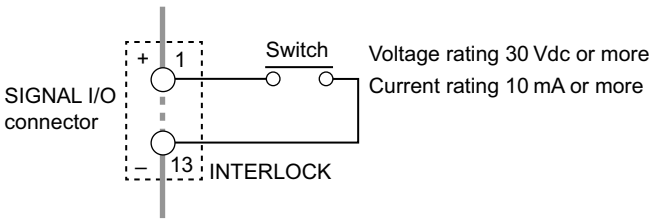
For the pins to be considered shorted, any of the following conditions must be met.

- The resistance between pin 1 and pin 13 is 1 kΩ or less
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 13 is at least 6 mA

Examples of how to use interlock

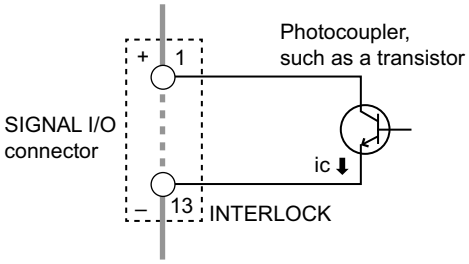
Using an open/close switch

Place a cover over the EUT or install a fence around the EUT, and use a switch to shut off the output when the cover or fence is opened.



Using a transistor or optical device

You can use a transistor or optical device in place of a switch.



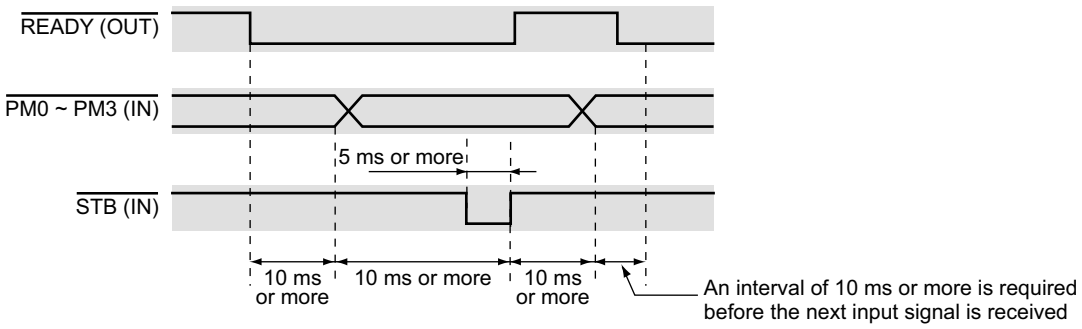
Recalling Setup Memories

You can recall the setup memory from memory number 0 to 15 by applying signals to PM0 (pin 2) to PM3 (pin 5), and STB (pin 9) of the SIGNAL I/O connector.

Convert the number (0 to 15) of the setup memory you want to recall into 4-bit binary notation, and apply high-level (0) or low-level (1) signals to PM3 to PM0.

For example, to recall setup memory number 2, convert the 2 in decimal notation into 8-bit binary notation, which is 0010. So apply H, H, L, H to PM3 to PM0.

Setup memory number	PM3	PM2	PM1	PM0
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
• • •	• • •	• • •	• • •	• • •
13	L	L	H	L
14	L	L	L	H
15	L	L	L	L



1 **With “READY” shown on the test state of the display, apply high-level or low-level signals to PM0 (pin 2) to PM3 (pin 5) of the SIGNAL I/O connector.**

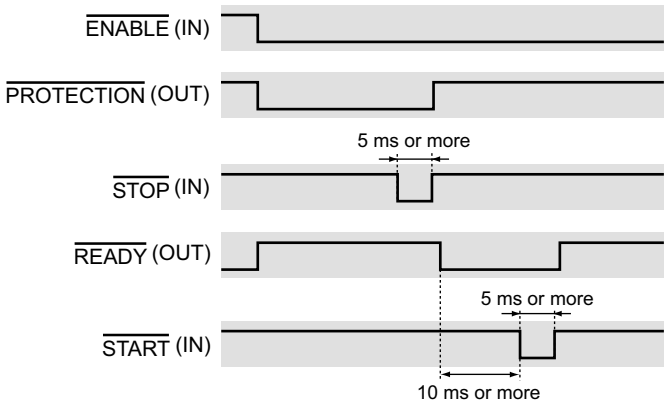
2 **Set STB (pin 9) to low-level for 5 ms or more.**

The setup memory corresponding to the number specified with the PM0 to PM3 signals is recalled.

Starting and Stopping Tests

You can start and stop tests using the SIGNAL I/O connector.

Starting a test



1 **Set ENABLE (pin 23) of the SIGNAL I/O connector to low level.**
The product switches to PROTECTION mode.

2 **Set STOP (pin 22) to low-level for at least 5 ms to release PROTECTION mode.**
The test state switches “READY”.

3 **When at least 10 ms elapses after the test state becomes “READY,” set START (pin 21) to low level for 5 ms or more.**
The test starts.
The duration for which the START signal is set to a low level is unaffected by the Start Long *(p. 94)* setting.

NOTE

- While ENABLE signal is at low level, the START switch on the front panel is ignored.
- If you change the ENABLE signal level, the product switches to PROTECTION mode.
  If set to low level, use the SIGNAL I/O connector STOP signal to release PROTECTION mode.
  If set to high level, use the STOP/RESET switch or SIGNAL I/O connector STOP signal to release PROTECTION mode.

Stopping a test

1 **Set STOP (pin 22) to low-level for at least 5 ms, while a test is in progress.**
The test ends.

Monitoring the Test Status

Monitoring of the test and voltage generation status

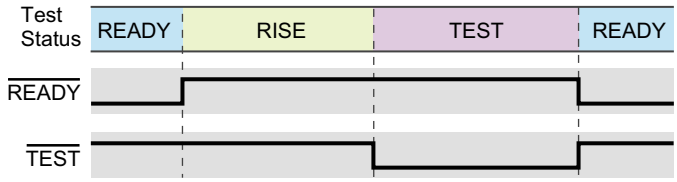
H.V ON (pin 14) of the SIGNAL I/O connector is set to low level in the following cases:

- Testing
- A voltage of Danger Voltage *(p. 96)* or more is applied to the OUTPUT terminals

Monitoring of test state

SIGNAL I/O connector TEST (pin 15) is set to low level when a test is in progress.

SIGNAL I/O connector READY (pin 19) is set to low level when the product is ready to start a test.



Monitoring of judgment results

PASS judgment

When the PASS judgment, the SIGNAL I/O connector PASS (pin 16) is set to low level under the following conditions:

- Until the time set by Pass Hold *(p. 95)* is elapsed or the judgment result is cleared.
- Until the STOP/RESET switch is pressed or a STOP signal is received if Pass Hold is set to Infinity.

Upper-FAIL judgment

When the Upper-FAIL judgment, the SIGNAL I/O connector U FAIL (pin 17) is set to low level until the judgment result is cleared.

Lower-FAIL judgment

When the Lower-FAIL judgment, the SIGNAL I/O connector L FAIL (pin 18) is set to low level until the judgment result is cleared.

Contact-FAIL judgment

When the Contact-FAIL judgment, both the SIGNAL I/O connector U FAIL (pin 17) and L FAIL (pin 18) are set to low level simultaneously until the judgment result is cleared.

Monitoring of the activation status of protection functions

SIGNAL I/O connector PROTECTION (pin 20) is set to low level when a protection function *(p. 18)* is activated.

Memory Function

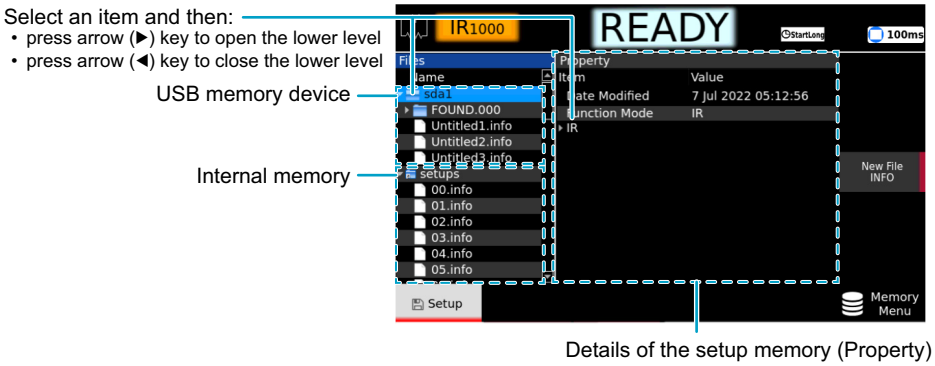
You can save and recall test conditions, view and save test results, and view and save the measurement data of the latest tests or an image captured at the end of the latest test.

Saving and Recalling Test Conditions

Test conditions can be saved as setup memories. (System settings *(p. 84)* cannot be saved)
The setup memory can also be saved in USB memory devices. *(p. 72)*

How to view the setup memory screen

Press MEMORY to display the setup memory screen (Memory Menu).
The saved setup memories are displayed in the folder tree on the left side of the screen.



- The setup memories (internal memories) of the TOS73 series main unit are displayed in the “setups” folder.
- There are the following types of the internal memory.

Memory name	Description
resume.info	The test conditions that were in use immediately before the power was turned off are saved. Other test conditions cannot be saved.
reset.info	The test conditions in the factory default setting are stored. Other test conditions cannot be saved.
00.info to 50.info	Up to 51 optionally set test conditions can be saved. • Each setup memory in its initial state stores the default test conditions. • The setup memory saved in 00.info to 15.info can be recalled via SIGNAL I/O connector *(p. 68)*.

- Connecting a USB memory device to the USB port on the front panel displays an “sdxx” folder (the “xx” changes depending on the USB memory device).
  You can save test conditions to a file name of your choice to the USB memory device and recall them later.

Saving to the setup memory

Saving over previous settings (internal memory and USB memory)

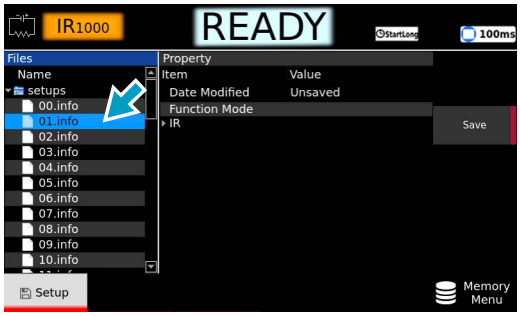
When saving to a USB memory device, insert the USB memory device into the USB port on the front panel.

1 **Set the test conditions.**

2 **Press MEMORY.**

The setup memory screen appears.

3 **Use the rotary knob to select a setup memory in the save destination.**



Select an .info file from the folder tree on the left side of the screen.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

The folder tree displays the following folders for each save destination, and lists the setup memories within each folder.

setups:

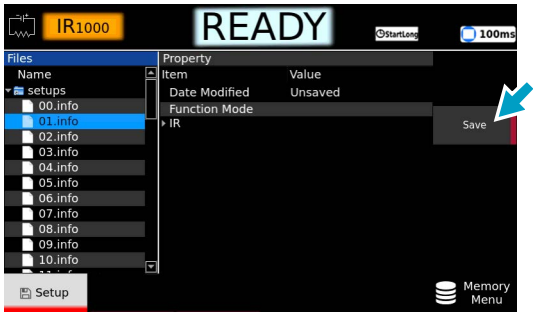
The setup memories saved in the internal memory are displayed.

Test conditions cannot be saved in resume.info and reset.info.

sdxx/ (the "xx" changes depending on the USB memory device):

The setup memories saved on the USB memory device are displayed if it is inserted.

4 **Press Save.**



The test conditions will be overwritten into the selected setup memory.

Operation completed.

Saving to a new file (USB memory device only)

1 **Set the test conditions.**

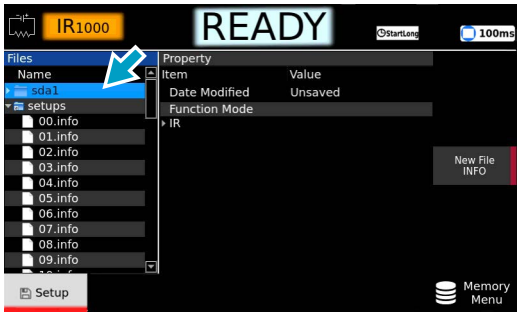
2 **Insert a USB memory device into the USB port on the front panel.**

3 **Press MEMORY.**

The setup memory screen appears.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree on the left side of the screen.

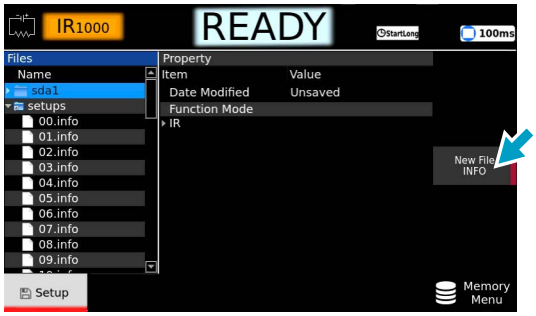
4 **Use the rotary knob to select any save destination in the USB memory device.**



Select an sdxx folder, or a subfolder or .info file in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

5 **Press New File INFO.**



A setup memory (Untitled#.info, where “#” is a sequential number) will be newly saved in the selected save destination.

Operation completed.

For how to change the file name of a setup memory saved to the USB memory device, see “Changing the memory name (USB memory device only)” *(p. 74)*.

Changing the memory name (USB memory device only)

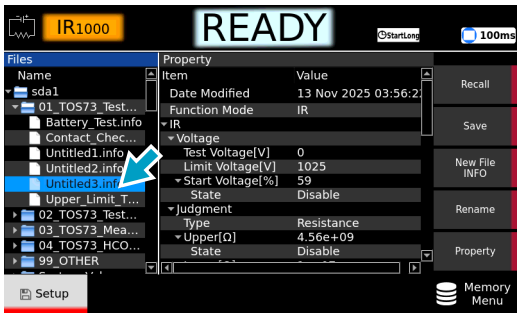
1 **Insert a USB memory device into the USB port on the front panel.**

2 **Press MEMORY.**

The setup memory screen appears.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree on the left side of the screen.

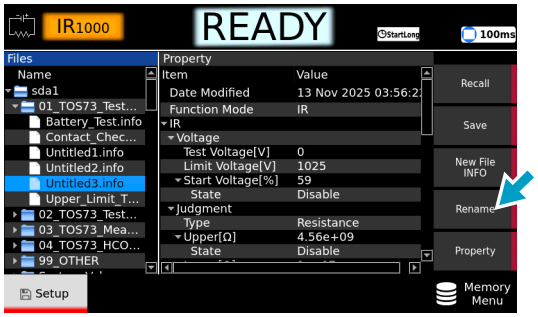
3 **Use the rotary knob to select any setup memory in the USB memory device.**



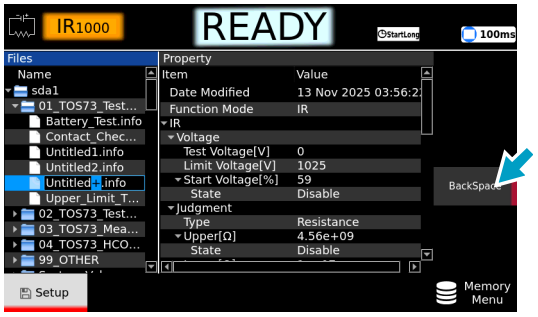
Select an .info file in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

4 **Press Rename.**



5 **Use the rotary knob, arrow (◀/▶) keys, and BackSpace key to enter the desired file name.**



For input instructions, see “Entering numbers and characters” *(p. 31)*.

6 **Press ENTER.**

The file name change will be saved.

Operation completed.

Checking the setup memory details

When using a setup memory saved on a USB memory device, insert the USB memory device into the USB port on the front panel.

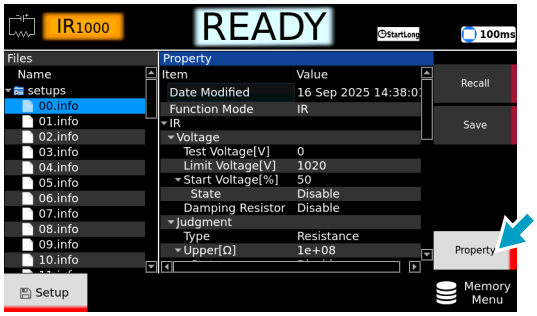
1 **Press MEMORY.**

The setup memory screen appears.

2 **Use the rotary knob to select any setup memory.**

3 **Press Property.**

The detailed information of the setup memory appears on the right side of the display.



The detailed information can be scrolled by using the rotary knob.

Press Property again to return to setup memory selection.

Recalling the setup memory

When using a setup memory saved on a USB memory device, insert the USB memory device into the USB port on the front panel.

1 **Press MEMORY.**

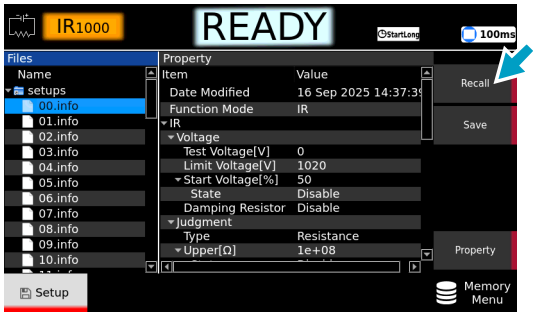
The setup memory screen appears.

2 **Use the rotary knob to select any setup memory.**

Press Property to view the settings of the setup memory on the right side of the display.

Press Property again to return to setup memory selection.

3 **Press Recall.**



The contents saved in the setup memory are applied to the test conditions of the TOS73 series.

Operation completed.

Viewing/Saving the Test Results

Test results are automatically saved temporarily in the memory of the TOS73 series. Up to 1000 of the latest test results are stored and are cleared when the power is turned off.

Test results can also be stored in CSV format to a USB memory device.

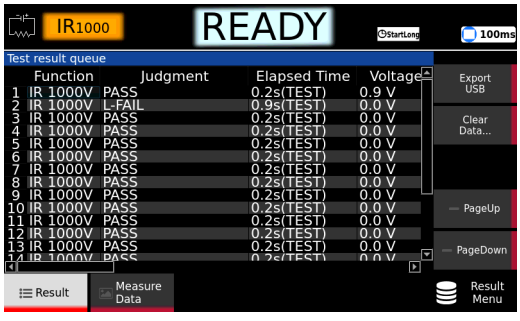
■ Saved contents (test results)

Item	Description	
Function	IR 1000V (fixed)	
Judgment	PASS	During a test with Test Time *(p. 43)* was set to ON, the specified test time elapsed without any of the following judgments occurring: upper limit judgment, lower limit judgment, dV judgment, short-circuit detection, or open-circuit detection.
	U-FAIL	During a test where upper limit judgment *(p. 37)* was set to ON, a resistance value greater than or equal to the Upper limit (Upper) was measured.
	U-FAIL(dV)	During a test where dV judgment *(p. 41)* was set to ON, a voltage difference greater than or equal to the Delta Voltage was detected consecutively for the times specified in number of consecutive detections (Continuous Count) *(p. 42)*.
	L-FAIL	During a test where lower limit judgment *(p. 38)* was set to ON, a resistance value less than or equal to the Lower limit (Lower) was measured.
		During a test where Short-Circuit Detection *(p. 40)* was set to ON, a short-circuit between HIGH and LOW terminals was detected.
	C-FAIL (HIGH&LOW)	During a test where Contact Check *(p. 45)* was set to ON, a connection failure of the EUT to the OUTPUT HIGH terminal and OUTPUT LOW terminal was detected.
	C-FAIL (HIGH)	During a test where Contact Check was set to ON, a connection failure of the EUT to the OUTPUT HIGH terminal was detected.
	C-FAIL (LOW)	During a test where Contact Check was set to ON, a connection failure of the EUT to the OUTPUT LOW terminal was detected.
	PROT(XXX)	A protection function was activated. The type of protection is displayed in “XXX” *(p. 18)*.
	ABORT	The test was aborted.
Elapsed Time	Remaining voltage rise time (seconds, negative number) during Rise Time, elapsed time (seconds) from the start of the test during Test Time, or test state at the point of judgment after the end of the test	
Voltage	Voltage value at the time of judgment	
Current	Current value at the time of judgment	
Resistance	Resistance value at the time of judgment	
Peak resistance	Minimum resistance value during a test	
Executed Datetime	Test start time [day] [month] [year] [hour]:[minute]:[second] [time zone] Ex: 4 Sep 2022 17:00:00 +0900	

Viewing the list of test results

1 **Press RESULT > Result.**

A list of test results is displayed.



You can move the display ranges by using the rotary knob and arrow (◀/▶) keys, PageUp, and PageDown keys.

Saving test results to a USB memory device

You can save test results in CSV format to a USB memory device.

Saving to a new file (USB memory device only)

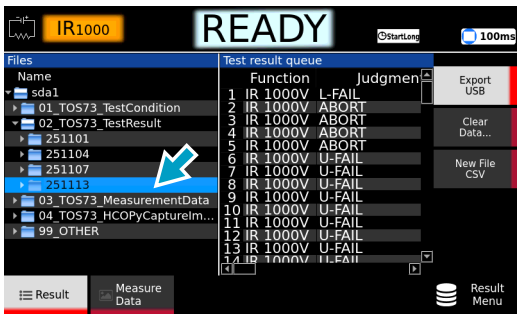
1 **Insert a USB memory device into the USB port on the front panel.**

2 **Press RESULT > Result > Export USB.**

A folder tree appears on the left side, and a list of test results appears on the right side of the screen.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree.

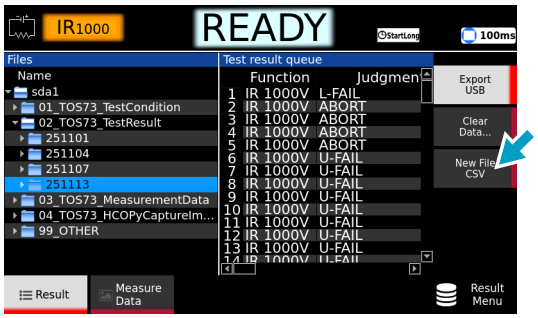
3 **Use the rotary knob to select any save destination in the USB memory device.**



Select an sdxx folder or a subfolder in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

4 **Press New File CSV.**



The test results (Untitled#.csv, where “#” is a sequential number) will be newly saved in the selected save destination.

Operation completed.

- To hide the folder tree, press Export USB.
- For how to change the file name of a test results file saved to the USB memory device, see “Changing the test results file name (USB memory device only)” *(p. 78)*.

Changing the test results file name (USB memory device only)

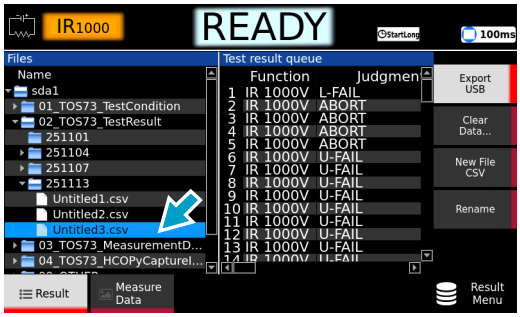
1 **Insert a USB memory device into the USB port on the front panel.**

2 **Press RESULT > Result > Export USB.**

A folder tree appears on the left side, and a list of test results appears on the right side of the screen.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree.

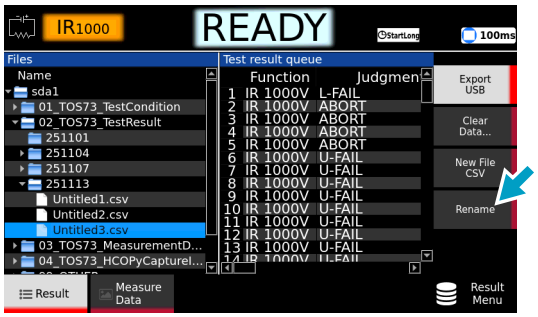
3 **Use the rotary knob to select any test result in the USB memory device.**



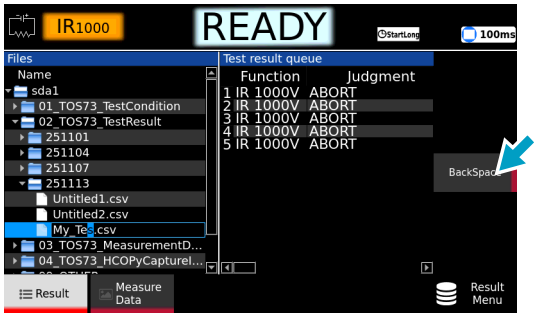
Select a .csv file in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

4 **Press Rename.**



5 **Use the rotary knob, arrow (◀/▶) keys, and BackSpace key to enter the desired file name.**



For input instructions, see “Entering numbers and characters” *(p. 31)*.

6 **Press ENTER.**

The file name change will be saved.

Operation completed.

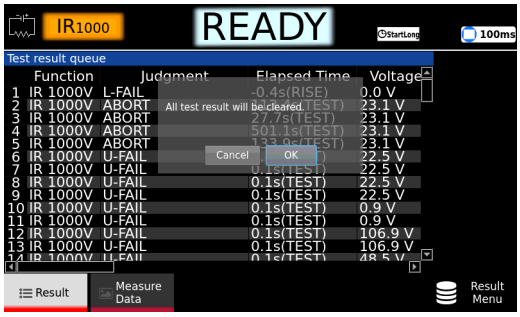
To hide the folder tree, press Export USB.

Clearing the list of test results

All test results are cleared from the internal memory by this operation.

1 **Press RESULT > Result > Clear Data.**

A confirmation dialog box appears.



To cancel this operation, press ESCAPE.

2 **Press arrow (▶) key to select OK, and then press ENTER.**

The test results are cleared.

Operation completed.

Viewing/Saving the Measurement Data

Measurement data are automatically saved temporarily in the memory of the TOS73 series. Up to 8192 of the latest measurement data and one image of test result captured at the end of the latest test are stored and cleared when the power is turned off.

You can store the measurement data in CSV format and the image captured at the end of the test in PNG format to the USB memory device.

■ Saved contents (measurement data)

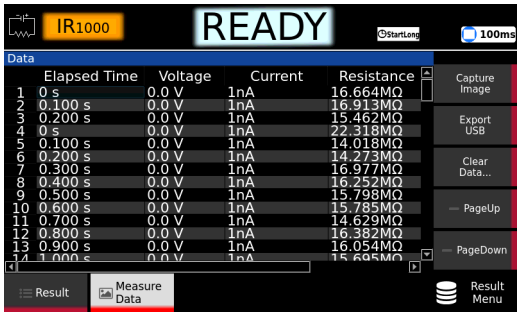
Item	Description
Elapsed Time	Remaining voltage rise time (seconds, negative number) during Rise Time, elapsed time (seconds) from the start of the test during Test Time, or test state at the point of judgment after the end of the test
Voltage	Measured voltage value
Current	Measured current value
Resistance	Measured resistance value

For information displayed in the captured image, see “Viewing the list of test results” *(p. 76)*.

Viewing the list of measurement data

1 **Press RESULT > Measure Data.**

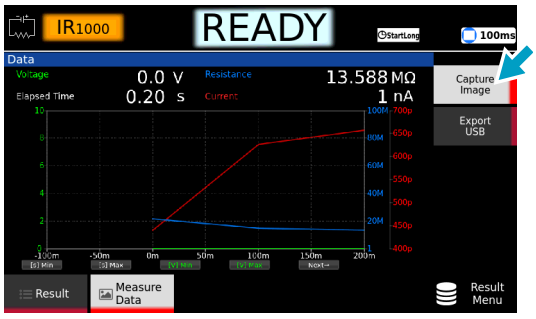
A list of the latest measurement data taken at the end of the tests, or a captured image, is displayed.



For the list of measurement data, you can move the display ranges by using the rotary knob and arrow (◀/▶) keys, PageUp, and PageDown keys.

2 **Press Capture Image.**

The screen switches between the list of measurement data and the captured image each time you press Capture Image.



Operation completed.

Saving measurement data to a USB memory device

You can save the latest measurement data (CSV format) or the image of test result captured at the end of the latest test (PNG format) to the USB memory device.

Saving to a new file (USB memory device only)

1 **Insert a USB memory device into the USB port on the front panel.**

2 **Press RESULT > Measure Data > Export USB.**

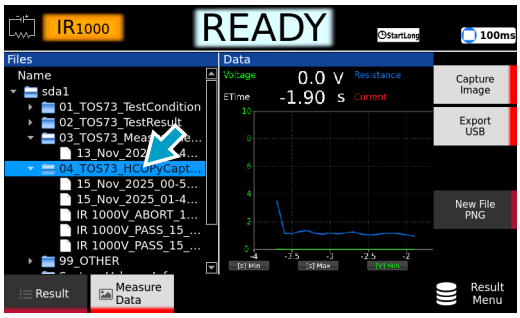
A folder tree is displayed on the left side, and a list of measurement data or the captured image is displayed on the right side of the screen.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree.

3 **Press Capture Image and select the data to be saved.**

The right side of the screen switches between the list of measurement data and the captured image each time you press Capture Image.

4 **Use the rotary knob to select any save destination in the USB memory device.**

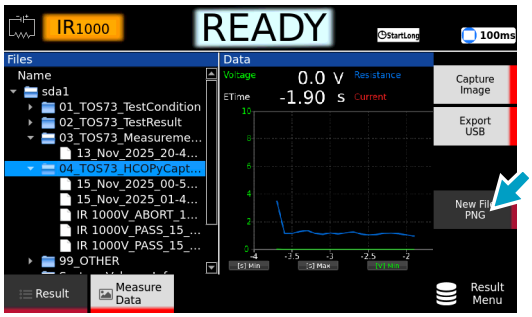


Select an sdxx folder or a subfolder in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

5 **Press New File CSV or New File PNG.**

The names of the function keys operated in this procedure change depending on the display on the right side of the screen.



The measurement data (CSV format) or captured image (PNG format) will be newly saved in the selected save destination.

Operation completed.

- To hide the folder tree, press Export USB.
- For how to change the file name of a file saved to the USB memory device, see “Changing the test results file name (USB memory device only)” *(p. 78)*.

Changing the measurement data/captured image file name (USB memory device only)

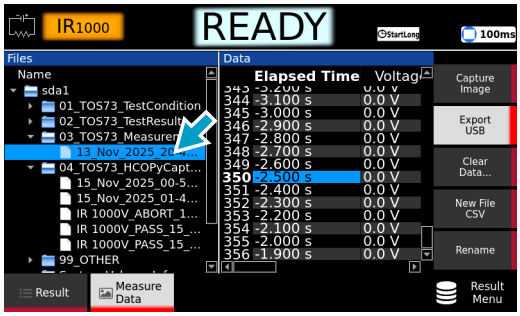
1 **Insert a USB memory device into the USB port on the front panel.**

2 **Press RESULT > Measure Data > Export USB.**

A folder tree is displayed on the left side, and a list of measurement data or the captured image is displayed on the right side of the screen.

If a USB memory device is inserted, “sdxx” folders (“xx” changes depending on the USB memory device) will be appeared in the folder tree.

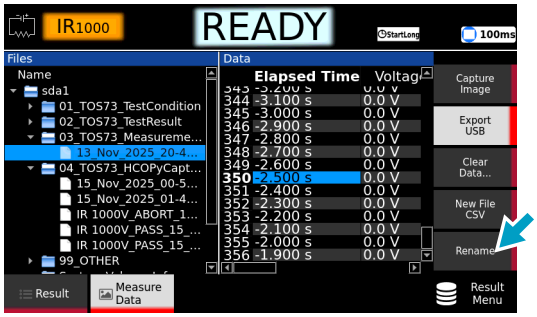
3 **Use the rotary knob to select any file in the USB memory device.**



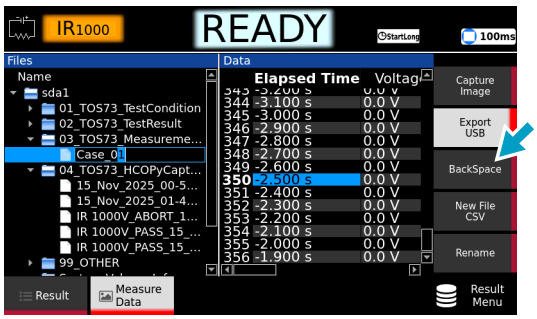
Select a .csv file or a .png file in an sdxx folder.

If there are subfolders, you can press arrow (◀/▶) keys to explode or collapse folders.

4 **Press Rename.**



5 **Use the rotary knob, arrow (◀/▶) keys, and BackSpace key to enter the desired file name.**



For input instructions, see “Entering numbers and characters” *(p. 31)*.

6 **Press ENTER.**

The file name change will be saved.

Operation completed.

To hide the folder tree, press Export USB.

Clearing the measurement data

All measurement data are cleared from the internal memory by this operation. The captured image is not cleared.

1 **Press RESULT > Measure Data.**

A list of the latest measurement data taken at the end of the tests, or a captured image, is displayed.
If Clear Data is displayed in the sub-function area, proceed to Step 4.

2 **If the folder tree is displayed on the left side of the screen, press Export USB.**

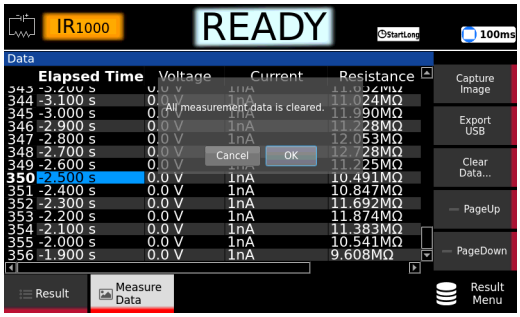
The folder tree will be hidden.
If Clear Data is displayed in the sub-function area, proceed to Step 4.

3 **If the captured image is displayed on the screen, press Capture Image.**

Only the list of measurement data will be displayed.

4 **Press Clear Data.**

A confirmation dialog box appears.



To cancel this operation, press ESCAPE.

5 **Press arrow (▶) key to select OK, and then press ENTER.**

The measurement data are cleared.
Operation completed.

System Settings

On the System Menu screen that appears when you press SYSTEM, you can change the CONFIG settings and interface settings, view SCPI errors, set the clock, initialize and update the instrument, and view the instrument information.

Displaying and Changing CONFIG Settings

Configuration setting summary

You can display and change the following settings.

Pressing SYSTEM > Configure > Save stores the CONFIG settings in the TOS73 series, allowing it to start up with the same CONFIG settings the next time power is turned on *(p. 97)*.

Item	Description
Power On	Panel settings at startup *(p. 85)*
Watchdog	Turns the TOS73 series off automatically when no SCPI communication takes place for a given period *(p. 86)*
Delay	The duration of time until the product decides that there is no SCPI communication when watchdog is enabled
Screen Saver	Screen saver starts *(p. 87)*
Delay	Time until the screen saver starts
Key	Settings for locking key operations *(p. 88)*
Lock Level	Range of key operations to lock *(p. 88)*
Password	Sets a password to unlock key operations *(p. 89)*
Calibration	Calibration settings *(p. 91)*
DUE	Sets the next calibration period
Protection Keep	Sets the operation that is performed when calibration period elapses
Beeper	Enables or disables the beep sound *(p. 92)*
Key	Beep sound for invalid operation
Protection	Beep sound for alarm occurrence
SCPI Error	Beep sound for SCPI errors
Pass	Beep sound for PASS judgments
Fail	Beep sound for FAIL judgments
Fail Mode	Sets the product so that the FAIL judgments and PROTECTION mode cannot be released from devices connected to the SIGNAL I/O connector *(p. 93)*
Double Action	Tests can only be started by pressing START switch within 0.5 seconds of pressing and releasing the STOP/RESET switch *(p. 94)*
Momentary	Tests are only executed while the START switch is held down *(p. 94)*
Start Long	Starts a test only when the START switch is held down for at least 1 second *(p. 94)*
Pass Hold	The duration for which the judgment result is displayed when PASS judgment *(p. 95)*
Fail Hold	Sets whether to keep displaying the judgment result when a FAIL judgment is made *(p. 96)*
Danger Voltage	The threshold at which the DANGER LED turns on/off *(p. 96)*
Signal I/O	Signal I/O settings
InterLock	Enables/disables the InterLock *(p. 66)*

Panel settings at startup (Power On)

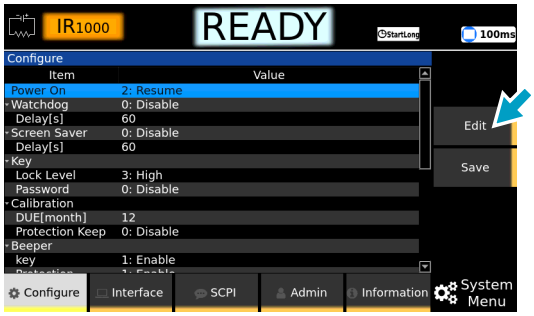
The panel setting state at power-on can be selected from the following.

Set value	Description
RST	Start with the reset settings *(p. 119)*.
RCL0	Start in setup memory *(p. 71)* number 0 (00.info) condition.
Resume	Start in setup memory *(p. 71)* resume.info condition.

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Power On, and then press Edit.**



3 **Use the rotary knob to select the items, and then press ENTER.**

This completes the setting.

Operation when there is no SCPI communication (Watchdog)

The product switches to PROTECTION mode *(p. 18)* when there is no SCPI communication over a given time period.

Set the duration of time until the product decides that there is no SCPI communication when watchdog is enabled. You can also disable watchdog.

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Watchdog, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

Watchdog is set to enable or disable.

4 **If set to Enable, use the rotary knob to select Delay under Watchdog, and then press Edit.**



5 **Use the rotary knob to enter the duration of time until SCPI communication is determined to be absent, and then press the ENTER.**

Setting range: 1 s to 3600 s

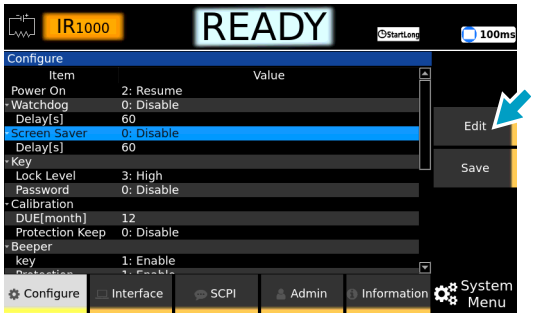
This completes the setting.

Screen saver

The display dims when there is no panel activity for a specified length of time.
If screen saver is enabled, set the time until the screen saver starts. You can also disable the screen saver.

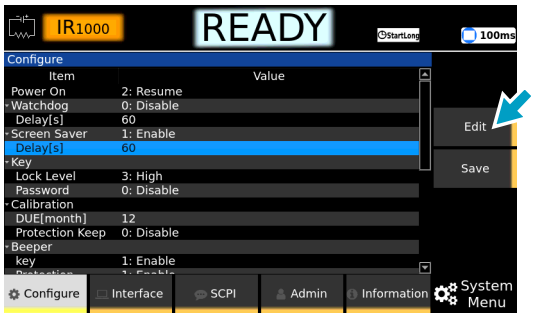
1 **Press SYSTEM > Configure.**
The configure setup screen appears.

2 **Use the rotary knob to select Screen Saver, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**
Screen saver is set to enable or disable.

4 **If set to Enable, use the rotary knob to select Delay under Screen Saver, and then press Edit.**



5 **Use the rotary knob to set the time until the screen saver is activated, and press ENTER.**
Setting range: 60 s to 59940 s
Setting resolution: 60 s (If the set value contains a fractional part below the resolution, it is rounded up or down to the nearest minute.)
This completes the setting.

Key lock (Key)

You can lock the key operation on the front panel to prevent changing set value or overwriting memory by mistake.

You can also set a password to unlock the key lock.

Setting of Lock Level

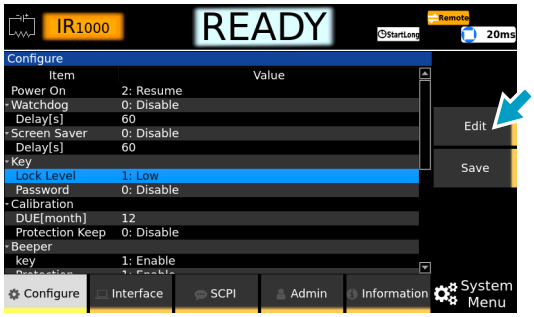
The range of key operations that are locked is divided into the following three lock levels. While the keys are locked, an icon indicating the lock level is shown in the upper right of the display.

Set value	Allowed operations	Icon
Low	Unlock key lock, STOP/RESET switch, START switch, HOME key, and recall setup memory	1 KeyLock
Medium	Unlock key lock, STOP/RESET switch and START switch	2 KeyLock
High	Unlock key lock, STOP/RESET switch	3 KeyLock

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Lock Level under Key, and then press Edit.**



3 **Use the rotary knob to select the level.**

4 **Press ENTER.**

This completes the setting.

Locking and unlocking key operations

1 **Hold down KEY LOCK.**

Operation completed.

Depending on the password setting for unlocking the key lock *(p. 89)*, one of the following will occur.

If password entry is disabled:

Each time KEY LOCK is held down, key operations are locked or unlocked.

If password entry is enabled:

- When key operations are unlocked: Key operations are locked.
- When key operations are locked: A dialog box for entering a password will appear. Key operations will be unlocked only if the correct password is entered.

Setting the requirement to enter a password when unlocking the key lock

Set whether password entry is required when LOCAL is held down to unlock the key lock.

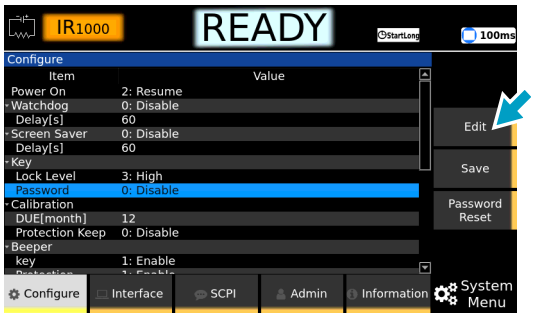
The factory default password is set to “0000”. If you cannot remember your password, you can reset it to “0000” by restoring the factory default settings *(p. 102)*.

■ Enabling or disabling the requirement to enter a password when unlocking the keys

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Password under Key, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

If enabled, password entry will be required to unlock the key lock.

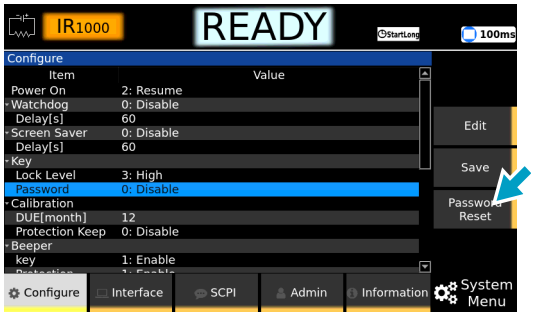
This completes the setting.

■ Changing the key lock unlocking password

1 **Press SYSTEM > Configure.**

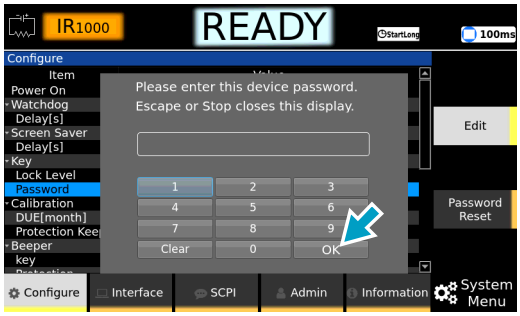
The configure setup screen appears.

2 **Use the rotary knob to select Password under Key, and then press Password Reset.**



A settings dialog box appears.

3 **Enter the current password, select OK, and then press ENTER.**



Use the rotary knob, arrow (◀/▶) keys, and ENTER to enter the password.

If the password is not correct, “Password is incorrect” is displayed in the dialog box.

4 **Enter the new password, select OK, and then press ENTER.**



Use the rotary knob, arrow (◀/▶) keys, and ENTER to enter the password.

The password must be 4 to 15 characters long.

The password is now changed.

Lock during remote control

An icon is displayed in the upper right of the display according to the set value of the SYST:COMM:RLST command for remote control. For details, see the TOS73 Series Communication Interface Manual.

Command set value	Allowed operations	Icon
REMote	STOP/RESET switch, LOCAL (hold down)	Remote
RWLock	STOP/RESET switch	

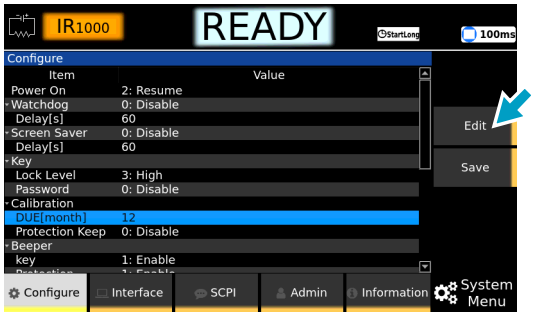
Calibration period (Calibration)

Configures settings related to calibration.

Item	Set value	Description
DUE	1 to 24 (month)	Sets a calibration period of months until the next calibration from the last calibration date.
	Infinity	Calibration period is not monitored.
Protection Keep	Enable	When the calibration period elapses, the protection function is activated, and the product switches to PROTECTION mode (CAL). To release the PROTECTION mode, set Protection Keep to Disable, and press STOP/RESET switch.
	Disable	When the calibration period elapses, a warning appears on the display when the power is turned on. To clear the warning, press STOP/RESET switch.

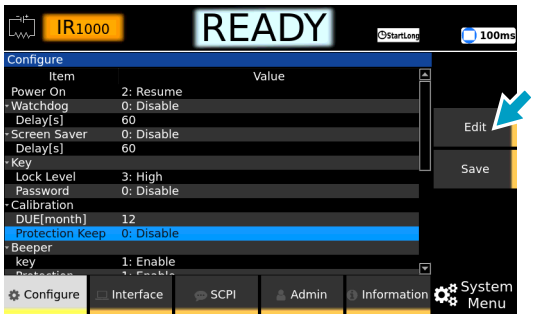
1 **Press SYSTEM > Configure.**
The configure setup screen appears.

2 **Use the rotary knob to select DUE under Calibration, and then press Edit.**



3 **Use the rotary knob to enter the calibration period, and then press ENTER.**
The calibration period is set.

4 **Use the rotary knob to select Protection Keep under Calibration, and then press Edit.**



5 **Use the rotary knob to select Enable or Disable, and then press ENTER.**
This completes the setting.

Beep sound (Beeper)

You can enable or disable beep sounds that are emitted in case of invalid operation, alarm occurrence, SCPI error, PASS judgments, or FAIL judgments.

Item	Set value	Description
Key	Enable/Disable	Beep sound for invalid operation
Protection	Enable/Disable	Beep sound for alarm occurrence
SCPI Error	Enable/Disable	Beep sound for SCPI errors
Pass	Enable/Disable	Beep sound for PASS judgments
Fail	Enable/Disable	Beep sound for FAIL judgments

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select any item (Key, Protection, SCPI Error, Pass, or Fail) under Beeper, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

This completes the setting.

Fail mode

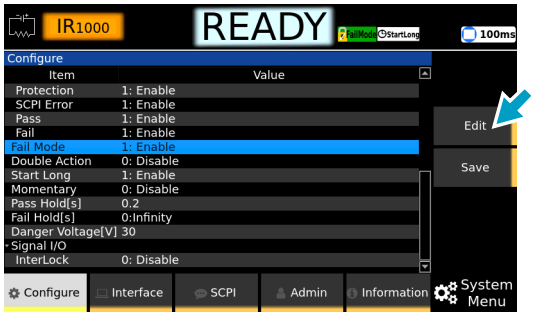
Sets the instrument so that FAIL judgment (displaying judgment results) and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector *(p. 63)*.

When Fail Mode is enabled, FailMode appears in the upper right of the display.

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Fail Mode, and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

If enabled, FailMode will be displayed in the upper right of the display.

This completes the setting.

Test start settings

The following functions can be used to start tests safely.

- Either Double Action or Start Long can be enabled, not both. When the setting is Enable, it appears on the upper right of the display.
- If both Double Action and Start Long are set to Disable, Start Long will be changed to Enable upon power reapplication for safety.

Item	Description	Icon
Double Action	When you press and release STOP/RESET switch, “READY” is shown in the upper right of the display for 0.5 seconds. A test starts only when you press START switch within this period. This prevents a test from being started by pressing START switch by mistake. The START signals of the SIGNAL I/O connector is also affected.	DBL Act
Start Long	A test starts only when the START switch is held down for at least 1 second. This prevents a test from being started by pressing START switch by mistake. The START signals of the SIGNAL I/O connector is not affected.	StartLong
Momentary	A test is executed only while the START switch is held down. If you release START switch in the middle of a test, the test stops in the same manner as when STOP/RESET switch is pressed. Tests can be performed safely because your hand is fixed on the START switch while the test is in progress. The START signals of the SIGNAL I/O connector is also affected.	Momentary

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select any item (Double Action, Momentary, or Start Long), and then press Edit.**



3 **Use the rotary knob to select Enable or Disable, and then press ENTER.**

When Double Action is enabled, the screen switches to the test condition setup screen.

This completes the setting.

PASS judgment result hold time (Pass Hold)

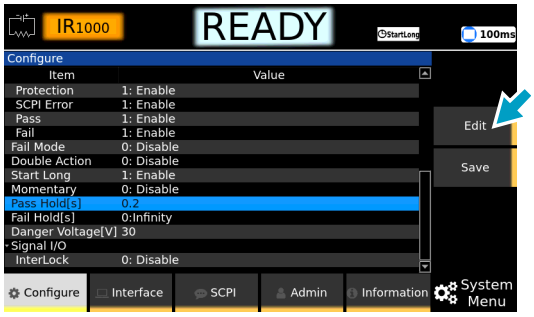
Sets the duration or conditions for retain displaying the judgment result display when PASS judgment is made.

Set value	Description
0.05 s to 10.00 s	Set the duration in seconds, for which the PASS judgment result remains displayed. When a PASS judgment is made, the judgment result will remain displayed until the set time has elapsed or the STOP/RESET switch is pressed.
Infinity	When a PASS judgment is made, the judgment result will remain displayed until the STOP/RESET switch is pressed.

1 **Press SYSTEM > Configure.**

The configure setup screen appears.

2 **Use the rotary knob to select Pass Hold, and then press Edit.**



3 **Use the rotary knob to select a set value, and then press ENTER.**

Continuing to turn the rotary knob counterclockwise, you can select Infinity.

This completes the setting.

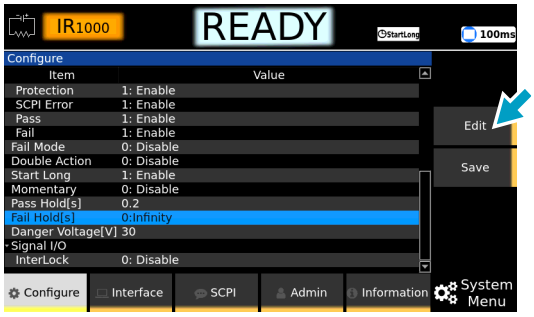
FAIL judgment result hold time (Fail Hold)

Sets whether to keep displaying the judgment result when a FAIL judgment is made.

Set value	Description
200 ms	When a FAIL judgment is made, the judgment result shall be displayed for 200 ms.
Infinity	When a FAIL judgment is made, the judgment result will remain displayed until the STOP/RESET switch is pressed.

1 **Press SYSTEM > Configure.**
The configure setup screen appears.

2 **Use the rotary knob to select Fail Hold, and then press Edit.**



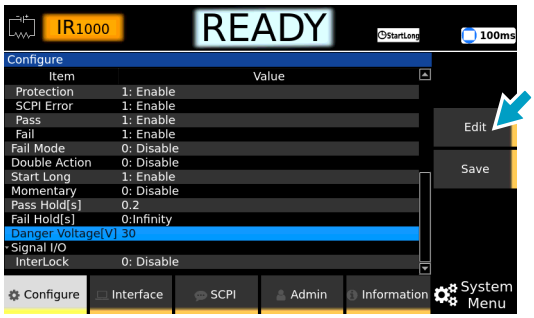
3 **Use the rotary knob to select a set value, and then press ENTER.**
This completes the setting.

DANGER LED lighting conditions (Danger Voltage)

Sets the threshold voltage at which the DANGER LED turns on/off in the range of 1 V to 30 V.

1 **Press SYSTEM > Configure.**
The configure setup screen appears.

2 **Use the rotary knob to select Danger Voltage, and then press Edit.**



3 **Use the rotary knob to select a set value, and then press ENTER.**
This completes the setting.

Interlock

Interlock links the product to an external device to stop output appropriately. This ensures the safety of the operator. For details, see “Interlock activation conditions” *(p. 66)*.

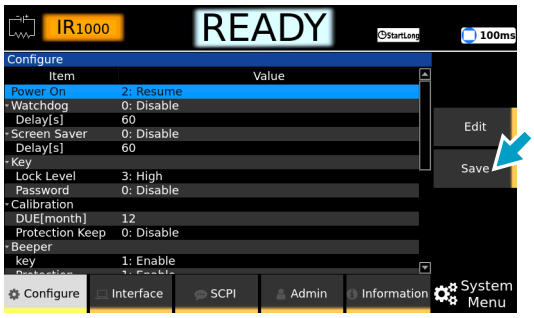
Save CONFIG settings

You can store the CONFIG settings in the TOS73 series so it starts up with the same CONFIG settings the next time power is turned on.

1 **Press SYSTEM > Configure.**

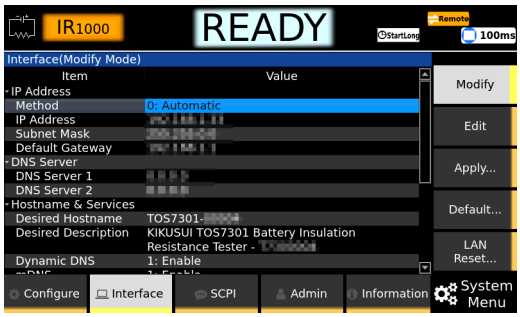
The configure setup screen appears.

2 **Press Save.**



CONFIG settings shall be saved.

Displaying/Changing the Interface Settings



You can display and change the following settings.

Item	Set value	Description
IP Address [1]	n/a	IP address
Method	Automatic/Static	IP address assignment method
IP Address	n/a	IP address
Subnet Mask	n/a	Subnet mask
Default Gateway	n/a	Default gateway
DNS Server [1]	n/a	DNS server address
DNS Server 1	n/a	Primary DNS server address
DNS Server 2	n/a	Secondary DNS server address
Hostname & Services [1]	n/a	Host name and service
Desired Hostname	Enter the host name (up to 15 characters)	Host name setting
Desired Description	Enter the service name (up to 63 characters)	mDNS service name setting
Dynamic DNS	Disable/Enable	Setting of dynamic DNS
mDNS	Disable/Enable	Setting of multicast DNS
Auto Clock Adjustment [1]	n/a	Auto clock
NTP Server Hostname	ntp.nict.jp	NTP server address
Auto Adjustment	Disable/Enable	Setting of auto clock adjustment
RS232C Settings	n/a	Setting of RS232C
Bitrate	9600/19200/38400/57600/115200	Baud rate [bps]
Data Bits	8 bit (fixed)	Data length
Stop Bits	1 bit/2 bit	Stop bits
Flow Control	None/CTS-RTS	Flow control

1. WITH LAN model only.

For the interface setting procedure and details, see the TOS73 Series Communication Interface Manual.

Related settings:

- Returning only the interface settings to the factory default values *(p. 104)*
- Returning only LAN settings to their factory default settings *(p. 104)*

Displaying SCPI Errors

You can check the histories of SCPI errors and SCPI command reception.

Displays SCPI errors

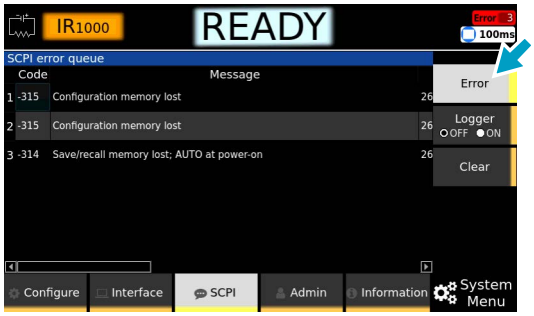
You can check the content of the SCPI error when an SCPI error occurs during remote control.

Up to 16 errors are displayed. If the 17th error occurs, the 16th error changes to “-350 Queue overflow,” and subsequent errors are not displayed.

For details on errors, see the TOS73 Series Communication Interface Manual.

1 **Press SYSTEM > SCPI > Error.**

The SCPI error is displayed.



Pressing Clear or restarting the TOS73 series will clear the error.

Operation completed.

Check the SCPI command history

Up to 100 SCPI command and response histories received through remote control can be viewed.

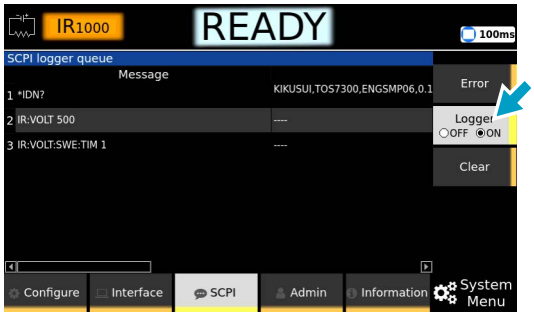
For details on remote control, see the TOS73 Series Communication Interface Manual.

1 **Press SYSTEM > SCPI > Logger.**

2 **Press Logger to switch between ON and OFF.**

Logger switches between ON and OFF each time you press the key.

If set to ON, the history list will be displayed.



To delete the history list, press the Clear key or restart the TOS73 series.

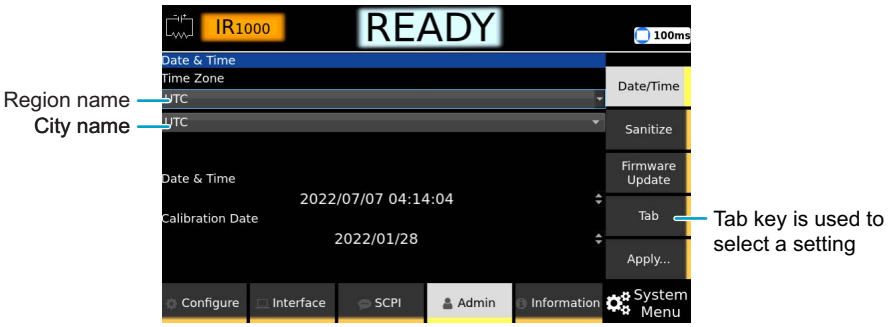
Operation completed.

Setting the Date/Time

Set the time zone, date, and time.
The date and time are used when saving setup memory.
If you change the time zone, the year, month, and day change accordingly.

1 **Press SYSTEM > Admin > Date/Time.**
The date/time setup screen appears.

2 **Set the time zone or the date and time.**
Each time you press the Tab key, the item that you can set changes.



Purpose	Operation
Set the time zone (region name)	Press Tab to select the item in the top row of Time Zone, and then use the rotary knob to select the region name.
Set the time zone (city name)	Press Tab to select the item in the bottom row of Time Zone, and then use the rotary knob to select the city name.
Set the year, month, day, and time	Press Tab to select the year, month, day, or time of Date & Time, and use rotary knob to enter the set value.

3 **Press Apply.**
A confirmation dialog box appears.

4 **Press arrow (▶) key to select OK, and then press ENTER.**
This completes the setting.

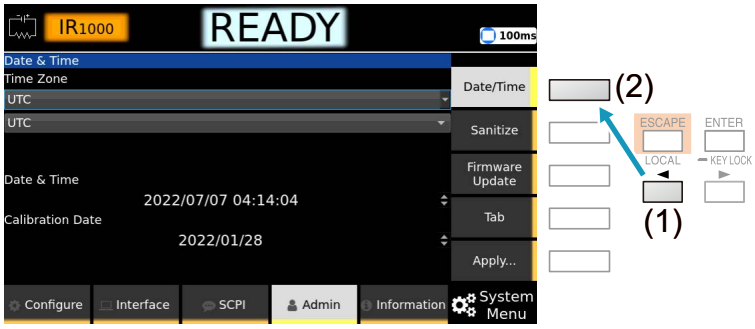
Setting Calibration Date

Sets the date on which calibration was carried out. Calibration period (Calibration) *(p. 91)* can also be set on another setup screen.

1 **Press SYSTEM > Admin > Date/Time.**

The currently set calibration date appears in Calibration Date.

2 **Press arrow (◀) key, and then press Date/Time.**



A confirmation dialog box appears.

3 **Press arrow (▶) key to select OK, and then press ENTER.**

4 **Use the rotary knob to enter the data on which calibration was carried out.**

Press Tab to move between entry fields.

5 **Press Apply.**

A confirmation dialog box appears.

6 **Press arrow (▶) key to select OK, and then press ENTER.**

This completes the setting.

Initializing the Settings

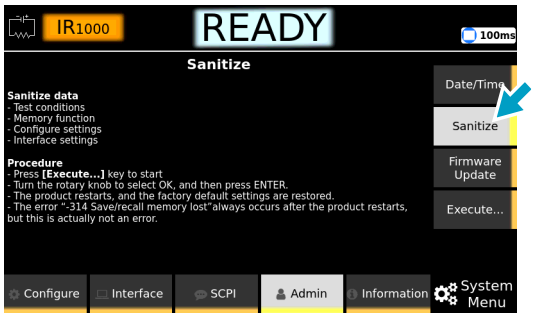
The TOS73 series has two sets of default settings: factory default settings and reset settings.
Returning the product to the “factory default settings” will delete all user data.
Returning the product to the “reset settings” will set some the settings back to the factory default settings.
You can also return only the interface settings to factory default settings or reset settings.

Restoring the factory default settings

Restoring the factory default settings deletes all the user data*.
For details about the factory default setting, see “Default Settings and Reset Settings” *(p. 119)*.
You can also return only the interface settings to their factory default values.

*: The user data is deleted in accordance with the NISPOM (National Industrial Security Program Operating Manual) standard.

1 **Press SYSTEM > Admin > Sanitize.**



2 **Press Execute.**

A confirmation dialog box appears.
To cancel the initialization of settings, press ESCAPE.

3 **Press rotary knob to select OK, and then press ENTER.**

The TOS73 series restarts, and the factory default settings are restored.
The errors “-314 Save/recall memory lost” and “-315 Configuration memory lost” occurs, but this is actually not an error. Turn off the power supply to the TOS73 series and turn it on again to clear the errors.
This completes the setting.

Restoring the reset settings

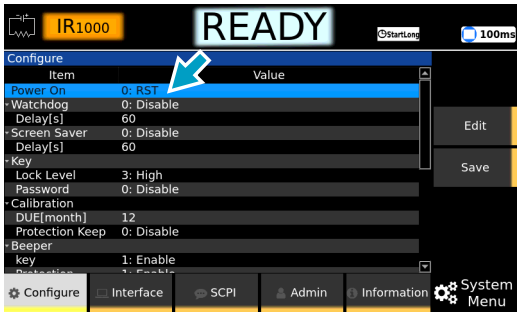
You can reset some of the settings to their factory defaults at power-on.

- For the items that are reset, see “Default Settings and Reset Settings” *(p. 119)*.
- You can also return only the interface settings to the “reset settings”. *(p. 104)*

1 **Press SYSTEM > Configure.**

2 **Use the rotary knob to select Power On, and then press Edit.**

3 **Use the rotary knob to select RST, and then press ENTER.**



4 **Turn the TOS73 series off and then back on.**

The product restarts with some of the settings reset to their factory defaults.
This completes the setting.

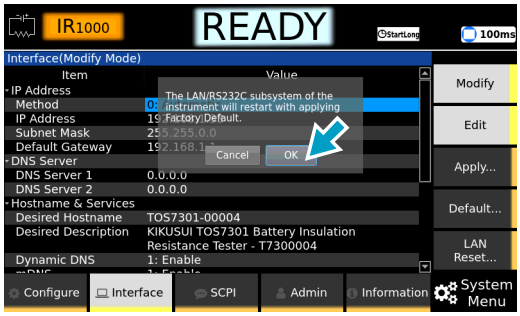
Returning only the interface settings to the factory default values

This operation returns the LAN and RS232C interface settings to the factory default settings.

1 **Press SYSTEM > Interface > Modify.**
The interface setup screen (Modify Mode) appears.

2 **Press Default.**
A confirmation dialog box appears.
To cancel the initialization of settings, press ESCAPE.

3 **Press arrow (◀/▶) keys to select OK, and then press ENTER.**



The interface settings are returned to the factory default settings.
This completes the setting.

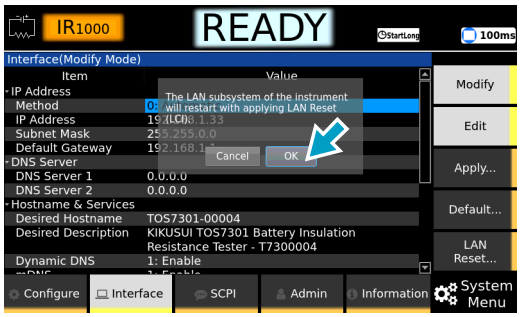
Returning only LAN settings to their factory default settings

This operation returns only the LAN interface settings to the factory default settings.

1 **Press SYSTEM > Interface > Modify.**
The interface setup screen (Modify Mode) appears.

2 **Press LAN Reset.**
A confirmation dialog box appears.
To cancel the initialization of settings, press ESCAPE.

3 **Press arrow (◀/▶) keys to select OK, and then press ENTER.**



The LAN interface settings are returned to the factory default settings.
This completes the setting.

Updating

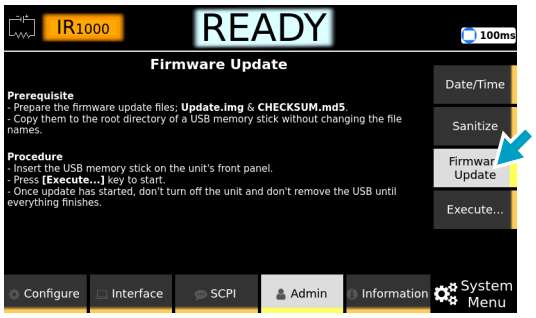
You can update the TOS73 series's firmware by using a USB memory device.
If there is an update, you can obtain it from the download service on the Kikusui website.
https://global.kikusui.co.jp/downloads/

NOTE

Save the update files (Update.img, CHECKSUM.md5) in the root directory of the USB memory device. Do not change the names of the update files.

1 **Insert the USB memory device on which the update files have been saved into the USB port on the front panel.**

2 **Press SYSTEM > Admin > Firmware Update.**



3 **Press Execute.**

An update screen appears.

4 **Press ENTER.**

The update process begins.

Do not turn off the TOS73 series while updating is in progress. Do not remove the USB memory device.

5 **If "Cycle the unit power..." is displayed, remove the USB memory device, and turn the TOS73 series off and then back on.**

Updating is complete.

Displaying the Device Information

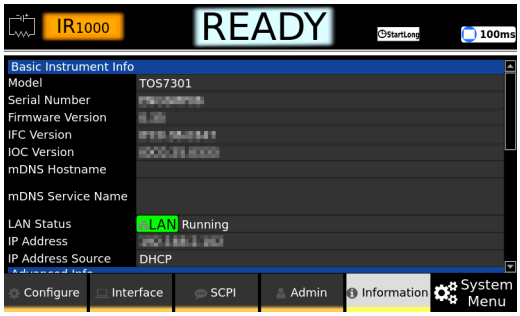
You can display the model name, serial number, firmware version, IP address, last calibration date and other instrument information. Some instrument information is only displayed on WITH LAN models.

Item	Displayed device information
Basic Instrument Info	Model, Serial Number, Firmware Version, IFC Version, IOC Version, mDNS Hostname, mDNS Service Name, LAN Status, IP Address, IP Address Source
Advanced Info [1]	Subnet Mask, Default Gateway, DNS Server 1, DNS Server 2, DNS Hostname, Domain, MAC Address
VISA Address Strings	HiSLIP, SCPI-RAW, USBTMC
System Status	Calibration Date, Installed Options

1. Only displayed on WITH LAN models.

1 **Press SYSTEM > Information.**

The device information is displayed.



You can scroll the screen by turning the rotary knob.

Maintenance

Pre-Test Inspection

Perform test by shorting the test leads, and determine the inspection results from those results. The test leads are consumable parts. Check them periodically for tears and breaks in the insulation.

⚠WARNING

Risk of electric shock or fire.

- **If any breaks or tears are found in the test lead, stop using it immediately.**

1 **Connect the low-voltage test lead (black) and high-voltage test lead (red) to the TOS73 series *(p. 22)*.**

2 **Short the low-voltage test lead (black) and high-voltage test lead (red).**

3 **Set the test conditions.**

Be sure to set the Lower limit (Lower) *(p. 38)*.

4 **Perform the start operation *(p. 33)*.**

The test starts.

5 **Check the result.**

Result	Inspection result
Lower-FAIL judgment	Normal.
PROTECTION (Output Error)	
Other than the above	The test leads may be broken. If there are no breaks in the test leads, the TOS73 series needs to be repaired.

This completes the inspection.

If the TOS73 series needs to be repaired, contact your Kikusui agent or distributor.

Cleaning

If the enclosure needs cleaning, gently wipe it using a soft cloth with water-diluted neutral detergent. Do not use volatile chemicals such as benzene or thinner.

RTC Battery Replacement

The TOS73 series uses a lithium battery for the RTC (real-time clock). When the battery is exhausted, the time becomes inaccurate.

Battery life varies depending on the operating environment. As a guideline, we recommend that the battery be replaced once every three years. For information about replacing the battery, contact your Kikusui agent or distributor.

Periodic Calibration

The TOS73 series is calibrated before shipment. To maintain long-term performance, we recommend the product be calibrated once a year.

Calibration can be managed by Setting the Calibration Date *(p. 101)* and the Calibration period *(p. 91)*.

To have your product calibrated, contact your Kikusui agent or distributor.

Disposal

Dispose of the TOS73 series in accordance with your local regulations.

Removing the battery at the time of disposal

The TOS73 series contains a CR2032 coin-type manganese dioxide lithium battery.

Dispose of the product in accordance with your local regulations after removing the battery referring to the followings.

⚠WARNING

Risk of electric shock.

- **Be sure to turn off the POWER switch, and disconnect the power cord from the switchboard.**
- **Do not remove the top cover until residual voltage has been discharged.**
  Residual voltage may remain on the circuit board for up to 3 minutes after disconnecting the power cord.

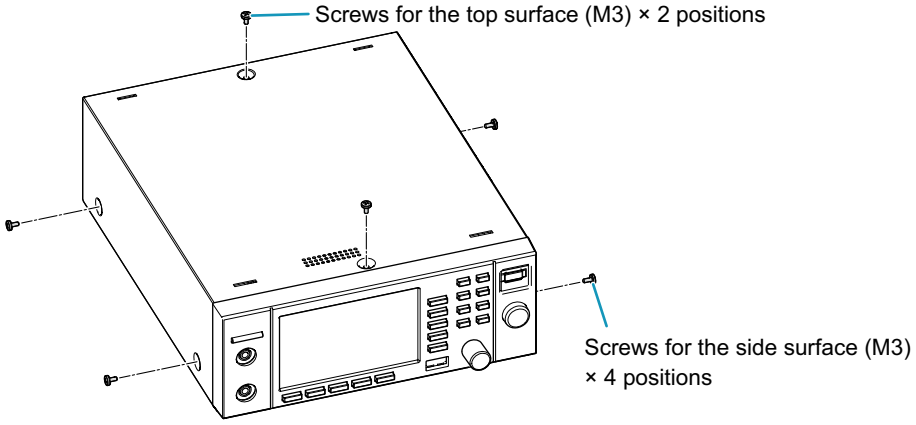
Risk of rupture or ignition.

- **Do not short-circuit, charge, disassemble, deform, throw into fire, or overheat the built-in battery.**

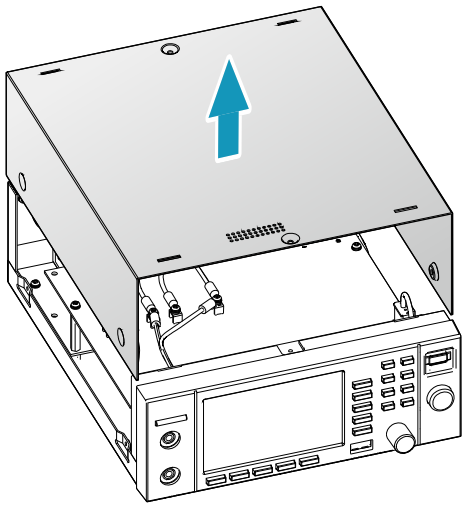
NOTE

The warranty does not apply if the top cover is opened.

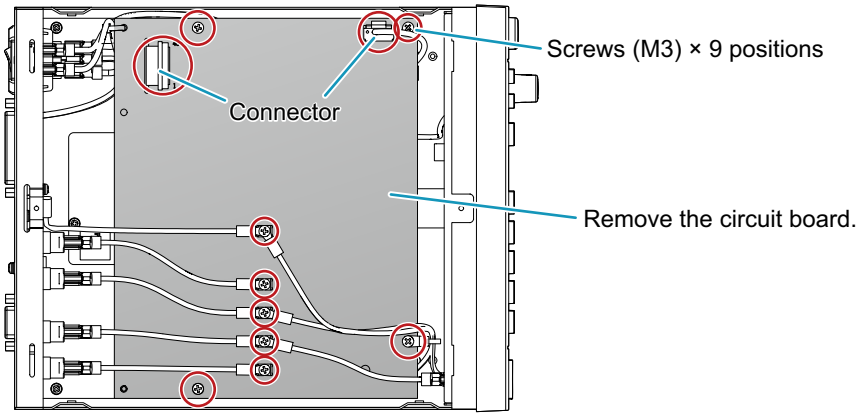
1 Remove the screws holding the top cover.



2 **Remove the cover.**

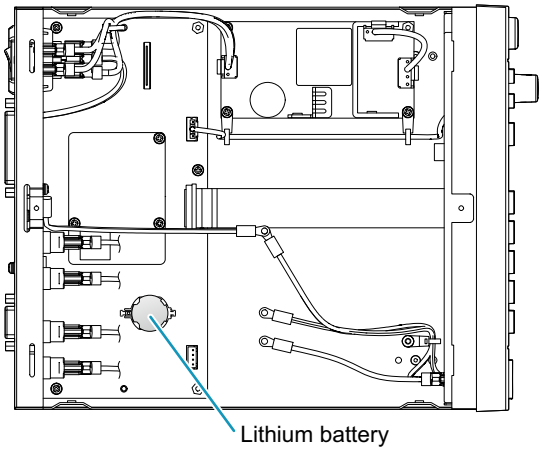


3 **Remove the screws and connectors circled in the figure below, and remove the circuit board.**



4 **Remove the lithium battery.**

After removing the battery, completely cover their electrode parts with insulation tape.



5 **Close the cover and fasten the screws.**

This completes the removal of the battery.

Specifications

Unless specified otherwise, the specifications are for the following settings and conditions.

- The product is warmed up for at least 30 minutes.

The used terminology is as follows:

- TYP: These are typical values that are representative of situations where the product operates in an environment with an ambient temperature of 23 °C. These values do not guarantee the performance of this product.
- setting: Indicates a setting.
- reading: Indicates a readout value.

Insulation Resistance Test Section

Output section

Item		Specifications
Output voltage		25 Vdc to 1000 Vdc
Output setting accuracy		±(1.0 % of setting + 2 V)
Output setting range		0 V to 1025 V
Output setting resolution		1 V
Max. rated load		1 W (1000 V/1 mA)
Max. rated current		1 mA
OUTPUT terminal	Output form	Floating
	Isolation voltage	±500 Vdc (including the output of the TOS73 series)
Ripple	1 kV no load	5 Vp-p or less
	Max. rated load	10 Vp-p or less
Voltage regulation		1 % or less (when changing from maximum rated load to no load)
Constant current charge function		Charge current 2 mA
Short-circuit current		10 mA or less
Discharge function		At the end of the test, constant current discharge, discharge current 10 mA (TYP), Maximum capacitance: 2 μF [1]
Output voltage rise time		1 ms or less (when Voltage rise time (Rise Time) *(p. 44)* is OFF)
Output voltage monitor function		If the output voltage exceeds ±(10 % of setting + 5 V), the output is turned off, and the protection function is activated *(p. 18)*

1. Maximum capacitance that can be discharged within 0.2 seconds in a insulation resistance test. Tests can still be conducted beyond the maximum capacitance, but the discharge time will increase.

Voltmeter

Item	Specifications
Measurement range	0 Vdc to 1200 Vdc
Resolution	0.1 V
Accuracy	±(1 % of reading + 1 V)

Resistance meter

Item		Specifications
Measurement range		0.001 MΩ to 10.00 GΩ (in the range of maximum rated current of 1 mA to 40 nA)
Accuracy[1] (i: measured current) (R: measurement resistance)	40 nA ≤ i ≤ 100 nA	200.00 MΩ ≤ R < 10.000 GΩ: ±(20 % of reading)
	100 nA < i ≤ 200 nA	100.00 MΩ ≤ R < 5.000 GΩ: ±(10 % of reading) 5.000 GΩ ≤ R < 10.000 GΩ: ±(20 % of reading)
	200 nA < i ≤ 1000 nA	10.000 MΩ ≤ R < 5.000 GΩ: ±(5 % of reading)
	1 µA < i ≤ 2 mA	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of reading + 5 digit) 10.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of reading)
Display (R: measurement resistance)	10.000 GΩ < R	Over
Hold function		The resistance measurement after a test is finished is held while the PASS judgment is displayed. *(p. 46)*
Offset cancel function		Cancels up to 2000 GΩ of the unnecessary insulation resistance across output cables and the like. OFF function available. *(p. 49)*

1. Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.

Judgment function

Item			Specifications
Behavior based on judgment	Common functions		The output is shut off when a judgment is made, and a beep sounds. The beep sound can be enabled and disabled.
	UPPER FAIL	Judgment method	Upper-FAIL results when a resistance greater than or equal to the Upper limit (Upper) is detected. Judgment is not made during or Voltage rise time (Rise Time).
		Display	“Upper-FAIL” is displayed.
		Beep sound	On
		SIGNAL I/O connector	The U FAIL signal is generated continuously until a STOP signal is received.
	LOWER FAIL	Judgment method	Lower-FAIL results when a resistance less than or equal to the Lower limit (Lower) is detected. Judgment is not made during the Judgment delay (Judge Delay).
		Display	“Lower-FAIL” is displayed.
		Beep sound	On
		SIGNAL I/O connector	The L FAIL signal is generated continuously until a STOP signal is received.
	dV FAIL	Judgment method	When a voltage difference exceeding the Delta Voltage is measured consecutively for a number of times exceeding the Number of consecutive detections (Continuous Count), it is judged as Upper-FAIL (dV). Judgment is not made during the Judgment delay (Judge Delay).
		Display	“Upper-FAIL(dV)” is displayed.
		Beep sound	On
		SIGNAL I/O connector	The U FAIL signal is generated continuously until a STOP signal is received.
	PASS	Judgment method	If the Test Time elapses without a FAIL judgment, a PASS judgment is made.
		Display	“PASS” is displayed.
		Beep sound	On (fixed to 50 ms)
		SIGNAL I/O connector	The PASS signal is generated for the length of time specified by the Pass Hold setting. If Pass Hold is set to Infinity, the PASS signal is generated continuously until a STOP signal is received.
Upper limit (Upper) setting range			0.02 MΩ to 10.00 GΩ (in the range up to the maximum rated current), OFF
Lower limit (Lower) setting range			0.01 MΩ to 9.99 GΩ (in the range up to the maximum rated current), OFF
Judgment accuracy[1] (i: measured current) (R: measurement resistance)		40 nA ≤ i ≤ 100 nA [2]	200.00 MΩ ≤ R < 1.000 GΩ: ±(20 % of setting + 0.01 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(20 % of setting + 0.01 GΩ)
		100 nA < i ≤ 200 nA [2]	100.00 MΩ ≤ R < 1.000 GΩ: ±(10 % of setting + 0.01 MΩ) 1.000 GΩ ≤ R < 5.000 GΩ: ±(10 % of setting + 0.01 GΩ) 5.000 GΩ ≤ R < 10.000 GΩ: ±(20 % of setting + 0.01 GΩ)
		200 nA < i ≤ 1000 nA	10.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of setting + 0.01 MΩ) 1.000 GΩ ≤ R < 5.000 GΩ: ±(5 % of setting + 0.01 GΩ)
		1 µA < i ≤ 2 mA	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of setting + 5 digit+ 0.01 MΩ) 10.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of setting + 0.01 MΩ)

1. Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
2. A Judgment delay (Judge Delay) *(p. 39)* of 3.0 seconds or more and a Test Time *(p. 43)* of 3.0 seconds or more are required for judgment of 200 nA or less.

Time

Item	TOS7300, TOS7300 WITH LAN	TOS7301, TOS7301 WITH LAN
Aperture Time settings range	16.66 ms (60 Hz) [1], 20 ms (50 Hz), 100 ms	10 ms [1], 16.66 ms (60 Hz) [1], 20 ms (50 Hz), 100 ms
Voltage rise time (Rise Time) settings range [2]	[16.66 ms] [1] 0.05 s to 5.00 s [20 ms] 0.02 s to 200.00 s [100 ms] 0.1 s to 200.0 s (OFF function available)	[10 ms] [1] 0.01 s to 5.00 s [16.66 ms] [1] 0.05 s to 5.00 s [20 ms] 0.02 s to 200.00 s [100 ms] 0.1 s to 200.0 s (OFF function available)
Test Time settings range [2]	[16.66 ms] [1] 0.05 s to 10.00 s [20 ms] 0.04 s to 1000.00 s [100 ms] 0.2 s to 1000.0 s (OFF function available)	[10 ms] [1] 0.04 s to 10.00 s [16.66 ms] [1] 0.05 s to 10.00 s [20 ms] 0.04 s to 1000.00 s [100 ms] 0.2 s to 1000.0 s (OFF function available)
Judgment delay (Judge Delay) settings range [2]	[16.66 ms] [1] 0.05 s to 15.00 s [20 ms] 0.04 s to 100.00 s [100 ms] 0.2 s to 100.0 s (Rise Time + Test Time ≥ Judge Delay Time)	[10 ms] [1] 0.04 s to 15.00 s [16.66 ms] [1] 0.05 s to 15.00 s [20 ms] 0.04 s to 100.00 s [100 ms] 0.2 s to 100.0 s (Rise Time + Test Time ≥ Judge Delay Time)
Accuracy	±(100 ppm of setting + 2 ms) (Settings range < 10 s) ±(100 ppm of setting + 20 ms) (Settings range ≥ 10 s)	

1. If the Test Time is set to OFF, the Aperture Time is changed to 20 ms.
2. The setting range changes according to the set value of the Aperture Time (values in []).

Interface

Item			TOS7300, TOS7301	TOS7300 WITH LAN, TOS7301 WITH LAN
SIGNAL I/O	Function		D-sub 25-pin connector. For the pin arrangement, see “SIGNAL I/O Connector” *(p. 63)*. Enable/disable interlock, recall setup memories, start/stop testing, monitor the test and voltage generation status, monitor the test state, monitor judgment results, monitor the activation status of protection functions.	
	Input specifications	Control	The input signals are all low-active control. The input terminal is pulled up to +12 V by a resistor. Leaving the input terminal open is equivalent to applying a high level signal.	
		High-level input voltage	11 V to 15 V	
		Low-level input voltage	0 V to 4 V	
		Low-level input current	5 mA max.	
		Input time width	5 ms min.	
	Output specifications	Output method	Open collector output (4.5 Vdc to 30 Vdc)	
		Output withstanding voltage	30 Vdc	
		Output saturation voltage	Approx. 1.1 V (25 °C)	
		Maximum output current	400 mA (TOTAL)	
Remote control	RS232C	Function	All functions except turning on and off the power can be remotely controlled.	
		Hardware	D-sub 9-pin connector (EIA-232D compliant)	
		Baud rate	9600, 19200, 38400, 57600, 115200 bps selectable.	
		Flow control	None/CTS-RTS	
		Message terminator	During reception: LF During transmission: LF	
	USB (device)	Function	All functions except turning on and off the power can be remotely controlled.	
		Hardware	Standard Type B socket, complies with the USB 2.0 specifications Data rate: 480 Mbps (high speed)	
		Message terminator	During reception: LF or EOM During transmission: LF+EOM	
		Device class	Complies with the USBTMC-USB488 device class specifications	
	LAN	Hardware	n/a	1000BASE-T/100BASE-TX Ethernet, Auto-MDIX compliant, IPv4, RJ-45 connector
		Compliant standards	n/a	LXI 1.5 Core Specification 2016
		Communication protocol	n/a	HiSLIP, SCPI-RAW
		Message terminator	n/a	• HiSLIP: During reception: LF or END During transmission: LF+END • SCPI-RAW: During reception: LF During transmission: LF
USB (host)			Standard type A socket, FAT32 (32 GB or less), exFAT Complies with the USB 2.0 specifications; data rate: 480 Mbps (high speed)	
Display			4.3-inch LCD: Displays set values, measured values, judgment results, etc.	

Other Functions

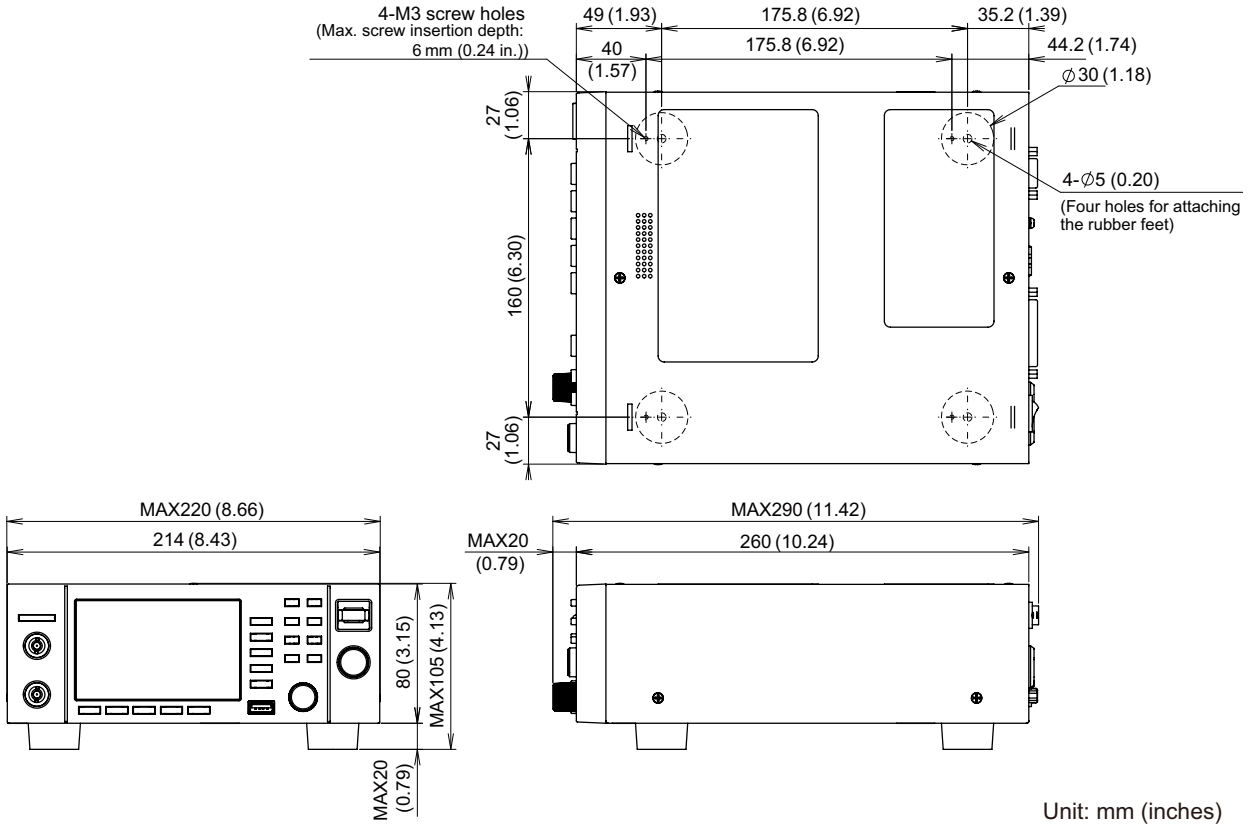
Item		Specifications
Contact check function		Checks the contact of the OUTPUT HIGH terminal and OUTPUT LOW terminal to the EUT. Contact-FAIL shall be generated when a resistance of approximately 10 kΩ or more is detected.
Digital filter function		A low-pass filter can be inserted into the measurement circuit.
Short-circuit detection function		Judge the existence of a short circuit between the OUTPUT HIGH terminal and OUTPUT LOW terminal immediately after the test. If there is a short circuit, an L_FAIL signal shall be generated.
Test condition memory function (Setup memory)		Up to 51 test condition patterns can be saved in the setup memory. 16 out of these patterns can be recalled from SIGNAL I/O.
Test result memory function		Records up to 1000 latest test result. These are cleared when the power is turned off. They can be saved in CSV format to a USB memory device.
System clock		For recording the calibration time and test times. Recording is possible until December 31, 2099.
Calibration period setting		Enable to set the calibration period. Displays a warning at power-on when the period passes.
RTC battery life		3 years (at 25 °C, 77 °F)
Peak value display (Display Peakhold)		The minimum value of the resistance measurement is displayed during the test period.
Test start method	Double Action	Tests can be started only when the START switch is pressed within 0.5 seconds after releasing the pressed STOP/RESET switch.
	Momentary	Tests are only executed while the START switch is held down.
	Start Long	A test starts only when the START switch is held down for at least 1 second.
	Fail mode	It is possible to set the instrument so that FAIL judgment and PROTECTION mode cannot be released from a STOP signal of external control *(p. 62)*.
	Pass Hold	Set the time to hold the PASS judgment result display (0.05 s to 10.00 s) or hold it until STOP/RESET switch is pressed (Infinity). However, the beep sound at the time of PASS judgment is fixed at 50 ms.
	Fail Hold	Automatically clears FAIL judgment at INF/200 ms.
Key lock (Key)		Transitions to a state where no key operations other than the START switch and STOP/RESET switch are accepted to prevent changing the set value or overwriting memory by mistake.
Protection functions	Common actions	If the protection function is activated, the test can not be done. If a protection function is activated during a test, the output is shut off and the test is stopped immediately. While the protection function is activated, the contents of protection is shown on the display. Conditions that cause a protection function to be activated are as follows.
	Interlock (ILOCK)	Interlock is activated.
	Output Error (OUTERR)	An output voltage exceeding the range of ±(10 % of setting + 5 V) of the set Test Voltage was detected.
		The output changed suddenly.
	Communication (COMM)	An internal communication error is occurring.
		No SCPI communication took place for or more than the specified time when the watchdog was enabled.
	Signal I/O (SIO)	There is a change in the SIGNAL I/O connector's ENABLE signal.
	Calibration (CAL)	The preset calibration period is exceeded.

General Specifications

Item			Specifications
Environment	Installation location		Indoors, 2000 m or less. Pollution Degree 2 [1]
	Spec guaranteed range	Temperature	18 °C to 28 °C (64.4 °F to 82.4 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Operating range	Temperature	0 °C to 40 °C (32 °F to 104 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Storage range	Temperature	-25 °C to 70 °C (-13 °F to 158 °F)
		Humidity	90 %rh or less (no condensation)
Power supply	Nominal voltage range (allowable voltage range)		100 Vac to 240 V (90 Vac to 250 V)
	Power consumption	No load (READY state)	10 VA or less
		Rated load	50 VA max.
	Allowable frequency range		47 Hz to 63 Hz
Insulation resistance (between AC LINE and chassis)			30 MΩ or more (500 Vdc)
Withstanding voltage	Between AC LINE and chassis		1500 Vac, 1 minute, 10 mA or less
	Between output terminal and chassis		800 Vac, 1 minute, 10 mA or less
Earth continuity			25 Aac, 0.1 Ω or less
Dimensions			See “External Dimensions” *(p. 118)*
Weight			Approx. 2.5 kg (5.5 lb.)
Accessories			See “Accessories” *(p. 6)*
Electromagnetic compatibility [2] [3]			Complies with the requirements of the following directive and standards EMC Directive 2014/30/EU EN 61326-1 (Class A [4]) EN 61000-3-2 EN 61000-3-3 EN 55011 (Class A [4], Group 1 [5]) Applicable under the following conditions: The maximum length of all cabling and wiring connected to the TOS73 series must be less than 2.5 m Use the included high voltage test leads Electrical discharges are applied only to the EUT Shielded cables are being used when using the SIGNAL I/O
Safety [2] [3]			Complies with the requirements of the following directive and standards Low Voltage Directive 2014/35/EU [3] EN 61010-1, EN 61010-2-034 (Class I [6], Pollution Degree 2 [1])

1. Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.
2. Does not apply to specially ordered or modified products.
3. Only for models with CE mark/UKCA mark on their body.
4. This product is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
5. This product is a Group 1 instrument. This product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.
6. This product is a Class I instrument. Be sure to ground this product's protective conductor terminal. The safety of this product is guaranteed only when the product is properly grounded.

External Dimensions



Unit: mm (inches)

Appendix

Default Settings and Reset Settings

Factory default settings are indicated in the following tables. All items that have the check (✓) in the “Reset” column are returned to their factory default values upon reset.

Test conditions

Item	Factory default	Reset
Test Voltage	0 V	✓
Limit Voltage	1025 V	✓
Start Voltage	OFF	✓
Upper limit (Upper)	OFF	✓
Lower limit (Lower)	ON, 0.01 GΩ	✓
Judgment delay (Judge Delay)	0.2 s	✓
Short-Circuit Detection	OFF	✓
Delta Voltage [1]	OFF	✓
Number of consecutive detections (Continuous Count) [1]	1	✓
Test Time	ON, 0.2 s	✓
Voltage rise time (Rise Time)	ON, 0.1 s	✓
Contact Check	OFF	✓
Peak value display (Display Peakhold)	OFF	✓
Aperture Time	100 ms	✓
Digital Filter	OFF	✓
Offset	OFF	✓
Measurement screen display during the test (Display View) [1]	Numeric	✓
Graph axis setting (Graph Format) [1]	VR-t	✓
Scale of the voltage-axis (Scale Voltage) [1]	Fix	✓
Scale of the resistance-axis (Scale Resistance) [1]	Auto	✓

1. This can only be set on TOS7301 and TOS7301 WITH LAN.

Memory function

Item		Factory default	Reset
Setup memory	00.info to 50.info	Empty memory	n/a
	reset.info	Factory default test conditions	n/a
Test result		None	✓

CONFIG settings

Item	Factory default	Reset
Power On	Resume	n/a
Watch Dog	Disable	n/a
Delay	60 s	n/a
Screen Saver	Disable	n/a
Delay	60 s	n/a
Key	n/a	n/a
Lock Level	High	n/a
Password	Disable [1]	n/a
Calibration	n/a	n/a
DUE	12	n/a
Protection Keep	Disable	n/a
Beeper	n/a	n/a
Key	Enable	n/a
Protection	Enable	n/a
SCPI Error	Enable	n/a
Pass	Enable	n/a
Fail	Enable	n/a
Fail Mode	Disable	n/a
Double Action	Disable [2]	n/a
Start Long	Enable [2]	n/a
Momentary	Disable	n/a
Pass Hold	0.2 s	n/a
Fail Hold	Infinity	n/a
Danger Voltage	30 V	n/a
SIGNAL I/O	n/a	n/a
InterLock	Disable	n/a

1. When enabled, the password is set to the factory default “0000”.
2. If Double Action and Start Long were both disabled the last time the power was turned off, the next time the power is turned on, the system starts with Start Long enabled regardless of the Power On setting.

Interface settings

Item	Factory default	Reset
IP Address [1]	n/a	n/a
Method	0: Automatic	n/a
IP Address	n/a	n/a
Subnet Mask	n/a	n/a
Default Gateway	n/a	n/a
DNS Server [1]	n/a	n/a
DNS Server 1	0.0.0.0	n/a
DNS Server 2	0.0.0.0	n/a
Hostname & Services [1]	n/a	n/a
Desired Hostname	Model name and serial number	n/a
Desired Description	• TOS7300 WITH LAN: KIKUSUI TOS7300 Insulation Resistance Tester and serial number • TOS7301 WITH LAN: KIKUSUI TOS7301 Battery Insulation Resistance Tester and serial number	n/a
Dynamic DNS	1: Enable	n/a
mDNS	1: Enable	n/a
Auto Clock Adjustment [1]	n/a	n/a
NTP Server Hostname	ntp.nict.jp	n/a
Auto Adjustment	1: Enable	n/a
RS232C Settings	n/a	n/a
Bitrate	3: 19200 bps	n/a
Data Bits	0: 8 bit	n/a
Stop Bits	0: 1 bit	n/a
Flow Control	0: None	n/a
Password for the Web browser interface [1]	Not set	n/a

1. WITH LAN model only.

Admin settings

Item	Factory default	Reset
Time Zone (Zone, City)	UTC	n/a
Calibration Date	The calibration date shall be displayed. Not initialized.	n/a

Timing Charts

Typical examples of timing charts are provided below.

Test (PASS judgment)

■ Setting conditions

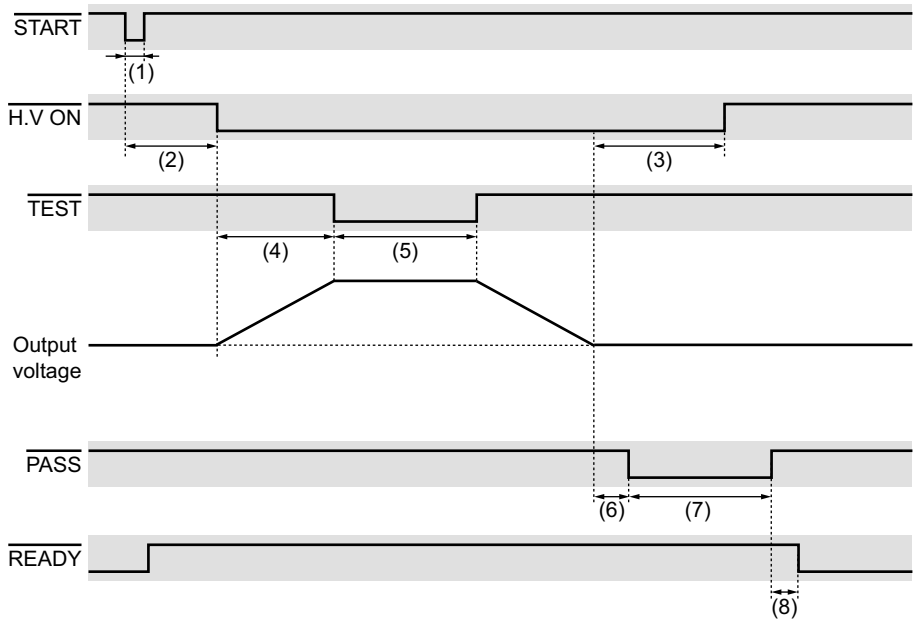
Rise Time (p. 44): ON

Test Time (p. 43): ON

Pass Hold (p. 95): 50 ms

Aperture Time (p. 47): 20 ms

No load (waveform monitoring with a high voltage probe), start the test with the SIGNAL I/O.



(1) 5 ms min.

(2) Approx. 20 ms [1]

(3) Approx. 100 ms [1]

(4) Rise Time

(5) Test Time

(6) Approx. 5 ms [1]

(7) Pass Hold

(8) Approx. 2 ms [1]

1. TYP (typical value)

Test (FAIL judgment)

■ Setting conditions

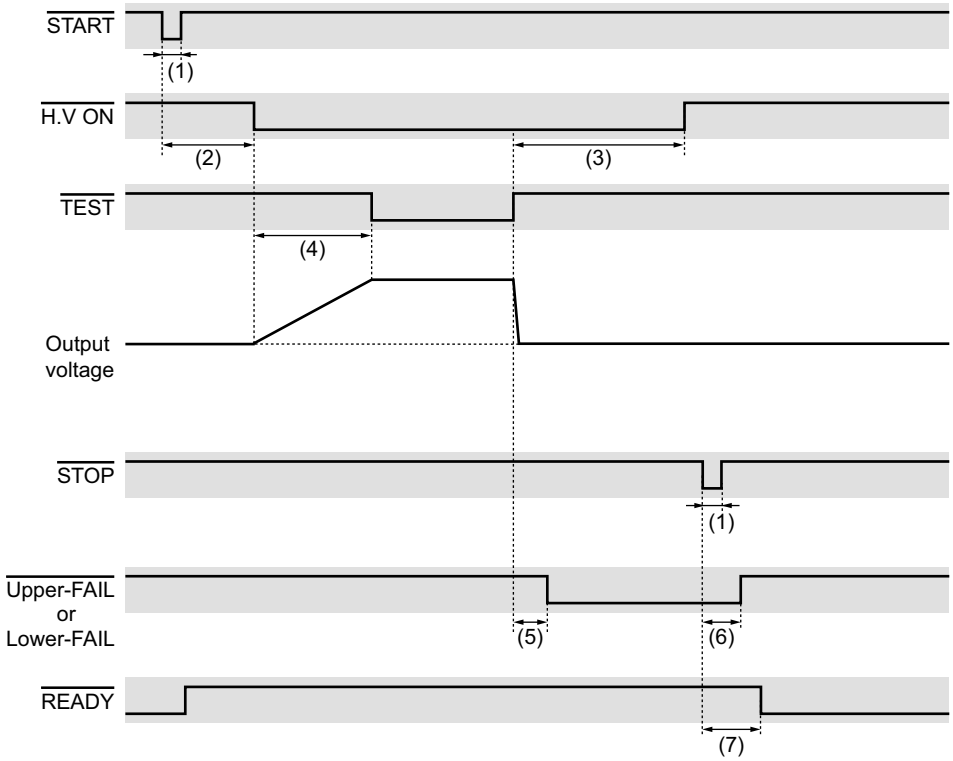
Rise Time (p. 44): ON

Test Time (p. 43): OFF

Pass Hold (p. 95): 50 ms

Aperture Time (p. 47): 20 ms

No load (waveform monitoring with a high voltage probe), start the test with the SIGNAL I/O.



(1) 5 ms min.

(2) Approx. 20 ms [1]

(3) Approx. 100 ms [1]

(4) Rise Time

(5) Approx. 5 ms [1]

(6) Approx. 5 ms [1]

(7) Approx. 6 ms [1]

1. TYP (typical value)

Test (interlock)

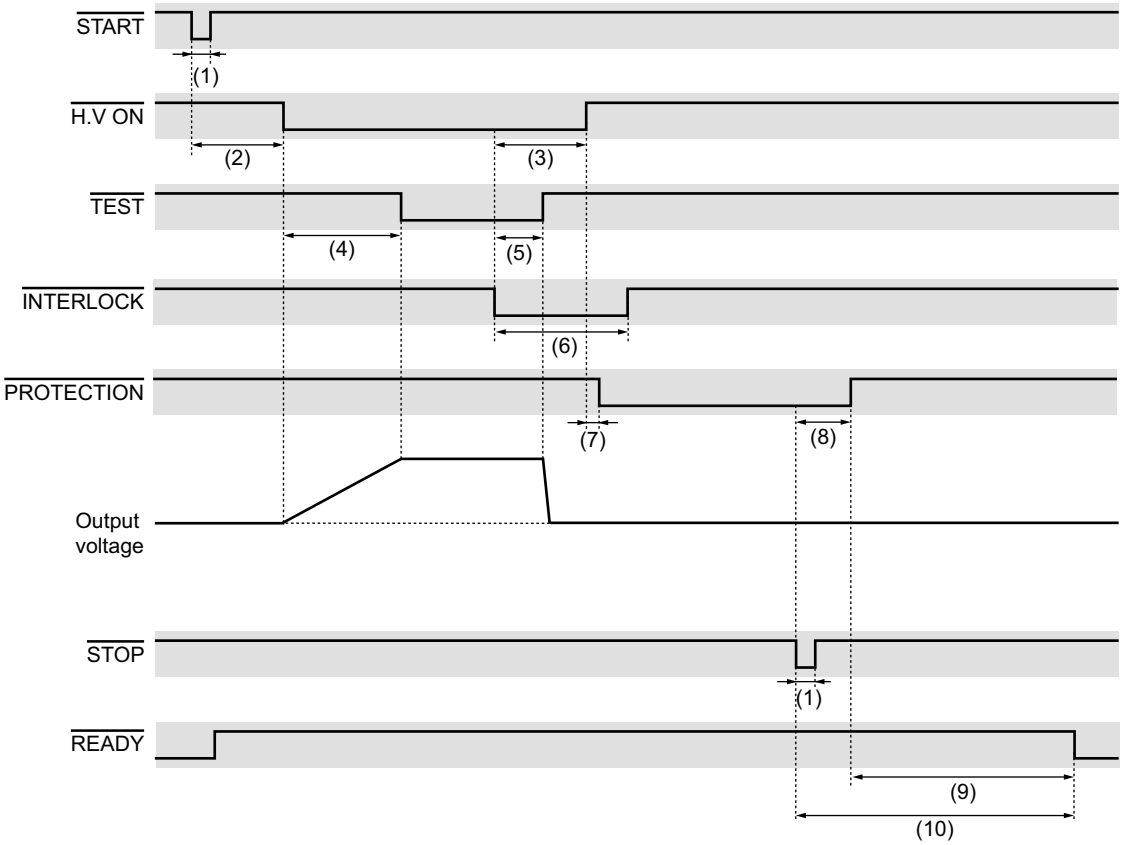
■ Setting conditions

Rise Time (p. 44): ON

Test Time (p. 43): OFF

Aperture Time (p. 47): 20 ms

No load (waveform monitoring with a high voltage probe), start the test with the SIGNAL I/O. Abort test with an interlock operation.



(1) 5 ms min.

(2) Approx. 20 ms [1]

(3) Approx. 110 ms [1]

(4) Rise Time

(5) Approx. 10 ms [1]

(6) 5 ms min.

(7) Approx. 0.5 ms [1]

(8) Approx. 10 ms [1]

(9) Approx. 90 ms [1]

(10) Approx. 100 ms [1]

1. TYP (typical value)

Troubleshooting

This section introduces troubleshooting measures. Typical symptoms are listed. Check whether any of the items listed below apply to your case. In some cases, the problem can be solved quite easily.

If none of the items apply to your case, we recommend that you initialize the product to its factory default settings (p. 102). If following the remedy does not solve your problem, contact your Kikusui agent or distributor.

■ The power does not turn on

Symptom	Possible cause	Remedy
The product does not operate when the POWER switch is turned on.	The power cord is disconnected.	Check the power cord connection. (p. 19)
	Interlock is activated.	Unlock the interlock. (p. 66)

■ Unable to control from the panel

Symptom	Possible cause	Remedy
1 KeyLock / 2 KeyLock / 3 KeyLock is displayed in the upper right of the display.	The key lock is engaged.	Hold down KEY LOCK to unlock the key lock. (p. 88)
Remote is displayed in the upper right of the display.	The TOS73 series has received some command from the controller (PC) and is in REM (remote mode).	Press LOCAL. If the problem persists, try sending the following command:
	The TOS73 series has received a SYST:COMM:RLST REM command from the controller (PC) and is in RWL (remote mode with local lockout).	Send a SYST:COMM:RLST LOC command to the TOS73 series. For instructions on using the commands, see the TOS73 Series Communication Interface Manual.

■ Unable to start a test

Symptom	Possible cause	Remedy
“PASS”, “Upper-FAIL”, or “Lower-FAIL” is displayed.	A judgment result is displayed.	Press STOP/RESET switch to clear the judgment result.
“PROTECTION” is displayed.	A protection function is activated (PROTECTION mode).	Release the PROTECTION mode. (p. 18)
“Contact-FAIL” is displayed.	During a test where Contact Check (p. 45) was set to ON, a connection failure of the EUT to the OUTPUT HIGH terminal and/or OUTPUT LOW terminal was detected.	Connect the test leads properly. (p. 22)
Testing does not begin when the START switch is pressed.	If StartLong or DBL Act appears in the upper right of the display, Double Action or Start Long in set to on in the CONFIG settings.	Perform a test start operation properly (p. 33), or set Double Action and Start Long to OFF. (p. 94)
	A STOP signal is applied to SIGNAL I/O connector.	Turn off the STOP signal. (p. 69)
	The SIGNAL I/O connector ENABLE signal is set to low level.	Set the ENABLE signal to high level. (p. 69)
OUTPUT error	The OUTPUT HIGH terminal and CONTACT CHECK LOW terminal are short-circuited.	Connect the test leads properly. (p. 22)
	The OUTPUT LOW terminal and CONTACT CHECK HIGH terminal are short-circuited.	

■ Unable to measure

Symptom	Possible cause	Remedy
The measured values are abnormal.	The test leads are connected to the wrong terminals.	Connect the test leads properly.
	Digital Filter (p. 48) is set to ON.	Because the response will be slow if the Digital Filter is set to ON, making judgments will require at least 1 second after the Voltage rise time (Rise Time) (p. 44) has elapsed. Set the Test Time (p. 43) to 1 second or longer, or set the Digital Filter to OFF.
PASS judgment is not recognizable.	When a PASS judgment, the display of the judgment result is immediately cleared.	Set the Pass Hold time to an appropriate value. (p. 95)
FAIL judgment is not recognizable.	When a FAIL judgment, the display of the judgment result is immediately cleared.	Set the Fail Hold to Infinity. (p. 96)
Judgments do not begin.	Judgment delay (Judge Delay) (p. 39) is set.	Judgment begins after the Judge Delay elapses. Set Judge Delay to an appropriate value.
Testing does not finish.	The Test Time (p. 43) is set to OFF.	The test continues until the STOP/RESET switch is pressed. Set the Test Time to ON, and set an appropriate test time value.

■ USB memory device is not recognized

Symptom	Possible cause	Remedy
A USB memory device is not recognized when saving/recalling the test conditions or saving the test results.	USB memory device not applicable to TOS73 series is used.	Use the following USB memory devices. • Capacity: 32 GB or less • File system: FAT32

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Version 106

Warranty Period

Before delivery, our products have undergone strict testing and inspections and have been found to comply with the specifications. We offer different warranty periods for different product models. If the product should become defective within the specific warranty period applied to the product model after the date of purchase, we will repair the product or replace it with a new one for free. In a case in which the customer concluded a separate agreement with us regarding the warranty period, the conditions of the warranty period are applied based on such agreement.

Scope of Warranty

If the product should become defective within the warranty period, we will repair the product or replace it with a new one. However, the warranty does not cover:

- Failure or damage caused by use that is not in accordance with the Operation Manual, misuse, or neglect.
- Failure or damage during transportation after delivery.
- Failure or damage caused by improper modification, adjustment, or repair.
- Failure or damage caused by an Act of God, fire, or other events beyond our control.
- Failure or damage caused by use in a corrosive atmosphere, a dusty environment, or an environment where salt damage occurs or contamination by liquid or foreign matters is likely to occur.
- Failure or damage due to causes that are not attributable to us.

Disclaimer

Regardless of the warranty period, in no event shall we be liable for loss of opportunity or profit caused by the failure of our product, or initial or secondary damages, accident compensation, damages to products other than our products, or compensation for other operations caused by unavoidable circumstances that we may or may not have foreseen.

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If you find any misplaced or missing pages in the manuals, they will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact your Kikusui agent or distributor. At that time, inform your agent or distributor of the “Part No.” written on the front cover of this manual.

Every effort has been made to ensure the accuracy of this manual. However, if you have any questions or find any errors or omissions, please contact your Kikusui agent or distributor.

After you have finished reading this manual, store it so that you can use it for reference at any time.

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