

User's Manual

Electrical Safety Analyzer
TOS93 Series

TOS9300

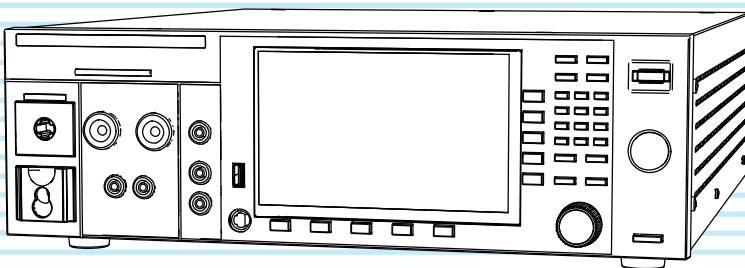
TOS9301

TOS9301PD

TOS9302

TOS9303

TOS9303LC



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 this manual close to the product so that the operators
can read the manual at any time.

Testing is not possible upon opening the package

When you first turn on this product after opening the package, the safety interlock will prevent you from performing tests. Connect the included SIGNAL I/O plug to the SIGNAL I/O connector to temporarily release the interlock (p. 239).

When you actually perform tests, design a system that uses the interlock for safety (p. 240).

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 this manual close to the product 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 after a DC withstanding voltage test or insulation resistance test has been performed.







About Manuals

This manual provides an overview of the product 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

These manuals are intended for users of this product and their instructors. The manuals assume that the reader has knowledge about electric safety testing.

Manual construction

- User's manual  (this manual)
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 
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.
- Setup Guide  
This document is intended for first-time users of the product. It gives an overview of the product, connecting procedures, safety precautions etc. Please read this manual before you operating the product.
- Safety Information  
This document contains general safety precautions. Keep them in mind and make sure to observe them.

PDF files are included in the accompanying CD-ROM.

The newest version of the operation manual can be downloaded from Download service of Kikusui website.

Firmware versions that this manual covers

This manual applies to products with firmware versions 2.0X.

For information on how to check the firmware version, see "Displaying the Device Information" (p.278).

When contacting us about the product, please provide us with:

- The model (marked in the top section of the front panel)
- Firmware version (p. 278)
- The serial number (marked on the rear panel)

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Both unit specifications and manual contents are subject to change without notice.

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Disposal

Dispose of the product in accordance with your local regulations.

Open Source Software

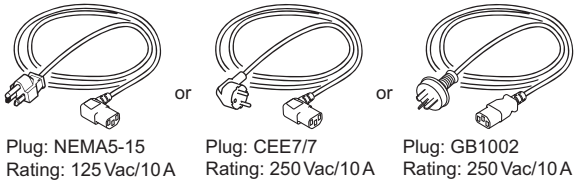
This product contains open source software under the licensing terms of GNU General Public License (GPL), GNU LESSER General Public License (LGPL), and other licenses.

For details, see the following URL.

<https://rddocuments.kikusui.co.jp/oss/tos93>

Accessories

The attached power cord varies depending on the shipment destination.

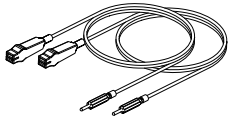


Plug: NEMA5-15
Rating: 125 Vac/10 A

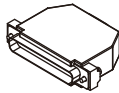
Plug: CEE7/7
Rating: 250 Vac/10 A

Plug: GB1002
Rating: 250 Vac/10 A

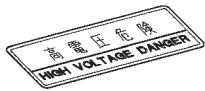
- Power cord (1 pc.,* length: 2.5 m)
- * Two pieces included for the TOS9303LC.



- High-voltage test lead TL31-TOS (1 pair)



- SIGNAL I/O plug (1 set)
Assembly type D-sub plug unit



- High-voltage warning sticker (1 pc.)

- Heavy object warning label (1 pc.)*
Affix this to the product as necessary.
* Not included with the TOS9300

- Setup Guide (1 copy)

- Cable tie (1 pc.)

- China RoHS sheet (1 sheet)

- CD-ROM (1 disc)

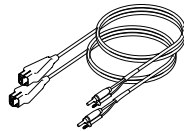
- Safety Information (1 copy)

TOS9303LC only

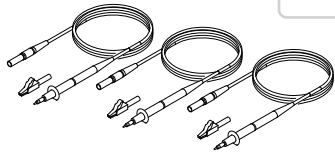


- Spare fuse (1 pc.)
15 A, 250 V
* Stored in the fuse holder

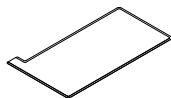
TOS9302, TOS9303,
TOS9303LC only



- Test leads for earth continuity test TL13-TOS (1 pair)



- Test leads for leakage current test TL22-TOS (2 red, 1 black)



- Flat probe FP01-TOS (1 sheet)

Product Overview

The TOS93 series is a electrical safety analyzer that can perform several types of safety tests on electronic devices and components. The available types of safety tests include withstanding voltage test, insulation resistance test, earth continuity test, partial discharge test, and leakage current test (touch current test, and protective conductor current test, patient leakage current test).

Different models are available according to the combination of tests you require, so a single unit is enough to cover your various safety test needs.

The product is suited to (1) research and development installations, (2) test facilities for quality assurance testing and standard certification, and (3) manufacturing lines.

TOS93 Series Lineup

Model	Supported tests ¹
TOS9300	ACW, IR
TOS9301	ACW, DCW, IR
TOS9301PD	ACW, DCW, IR, PD
TOS9302	ACW, EC
TOS9303	ACW, DCW, IR, EC
TOS9303LC	ACW, DCW, IR, EC, LC

- 1 ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: insulation resistance, EC: earth continuity, PD: partial discharge, LC: leakage current

Features

Diverse lineup of products

A diverse lineup of products is available for the various combinations of test required in production lines to accommodate a variety of needs. Tests can be performed in accordance with the requirements of safety and electrical standards and ordinances such as IEC, EN, BS, VDE, UL, CSA, GB, and JIS.

Dielectric breakdown detection sensitivity settings

Safety standards define that corona discharge and partial discharge are not dielectric breakdown. This product allows you to adjust the detection sensitivity of EUT's dielectric breakdown during withstanding voltage testing to support a wide range of settings from those that do not detect corona discharge or partial discharge to those that do. Failure analysis that were not possible with previous Kikusui withstanding voltage testers is now possible.

Support for AC/DC earth continuity test up to 40 A (TOS9302, TOS9303, TOS9303LC only)

The newly developed amplifier a broad range of tests from AC earth continuity test of general home electric appliances to DC earth continuity test of EV-PV systems.

A single unit for safety standard testing (TOS9303LC only)

A single TOS9303LC, which includes all functions necessary for AC/DC withstanding voltage testing, insulation resistance testing, AC/DC earth continuity testing, and leakage current testing, can perform the entire set of safety standard conformance tests.

Support for touch current, protective conductor current, and patient leakage current tests (TOS9303LC only)

Various leakage current tests for medical instruments are supported in addition to those for general electric appliances.

Partial discharge measurement function (TOS9301PD only)

Partial discharge, which could not be detected in withstanding voltage tests up to now, can be measured. This provides a step forward in insulation analysis, and device and material evaluation.

LAN, USB, and RS232C

The product is standard equipped with LXI compatible LAN, USB 2.0, USB-TMC compatible USB, and RS232C interface.

Color liquid crystal display

Intuitive display and controls are provided through the 7-inch display that shows various test settings, descriptions, and drawings.

Notations Used in This Manual

- In this manual, the TOS9300, TOS9301, TOS9301PD, TOS9302, TOS9303, and TOS9303LC electrical safety analyzer are also referred to as the TOS93 series.
- 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.
- Test names may be abbreviated as follows:
AC withstanding voltage: ACW, DC withstanding voltage: DCW, insulation resistance: IR, earth continuity: EC, partial discharge: PD, leakage current: LC, touch current: TC, protective conductor current: PCC, patient leakage current: Patient.
- The screen captures and illustrations used in this text may differ from the actual items.
- The following markings are used in this manual.

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 or other property.

NOTE

Indicates information that you should know.

>

Indicates the hierarchy of items you need to select. The item to the left of this symbol indicates a higher level item.

9300 , 9301 , 9301PD , 9302 , 9303 ,
9303LC

Indicate TOS93 series model names.

Safety Precautions

When using this product, be sure to observe the precautions in the Safety Information manual. Items specific to this product are given below.

DANGER

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

To prevent accidents, be sure to read “Safety Precautions for Testing” (p. 19) in this manual. Keep this manual close to the product so that the operators can read the manual at any time.

- **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 after a DC withstanding voltage test or insulation resistance test has been performed.

WARNING

- **You may receive a potentially fatal electric shock if:**

- You operate the tester without grounding it.
- You operate the tester without using rubber gloves for electrical work.
- You come close to a location that is electrically connected to an output terminal while output is being generated.
- You come close a location that is electrically connected to an output terminal immediately after output is turned off after a DC withstanding voltage test or insulation resistance test has been performed.

- **In tests that use test leads, do not touch the tip of test leads.**

Risk of electric shock.

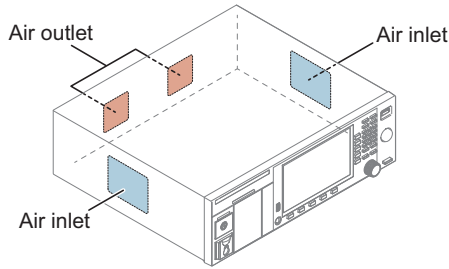
- **Do not use the product in a poorly ventilated location.**

The product uses forced air cooling. It sucks air through the inlet holes on its right and left panels and expels air through its rear panel. Secure adequate space around the product's inlet and outlet holes to prevent the possibility of fire caused by accumulation of heat.

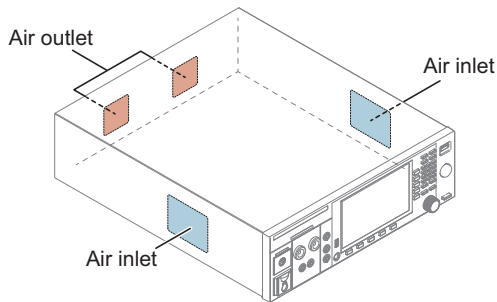
Allow at least 20 cm of space between the air inlet/outlet and the wall (or obstacles). Be careful not to block the air inlet and outlet when rack mounting the product.

Hot air (approximately 20 °C, 68 °F, hotter than the ambient temperature) is expelled from the outlet holes. Do not place objects that are affected by heat near the air outlet.

TOS9300, TOS9301, TOS9301PD



TOS9302, TOS9303, TOS9303LC



CAUTION

- **Do not use this product near highly sensitive measuring instruments or receivers.**
Noise generated by this product may affect other devices. At a test voltage of 3 kV or greater, the product may produce corona discharge between its test lead clips. This will generate a significant amount of broadband RF emission. To minimize this effect, keep the alligator clips away from each other. Also, keep the alligator clips and test leads away from conducting surfaces, especially sharp metal edges.
- **This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.**

Notes on Usage

- When installing this product, be sure to observe the temperature and humidity ranges indicated below.
Operating temperature range: 0 °C to 40 °C (32 °F to 104 °F)
Operating humidity range: 20 %rh to 80 %rh (no condensation)
- When storing this product, be sure to observe the temperature and humidity ranges indicated below.
Storage temperature range: -20 °C to 70 °C (-4 °F to 158 °F)
Storage humidity range: 90 %rh or less (no condensation)

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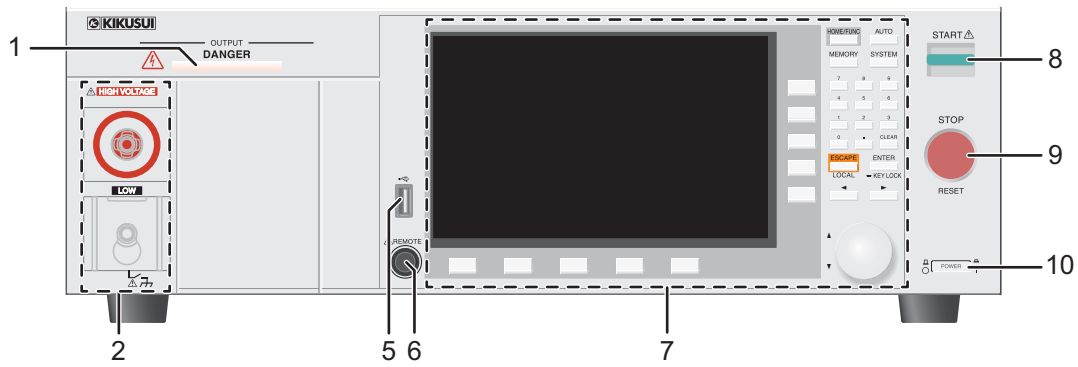
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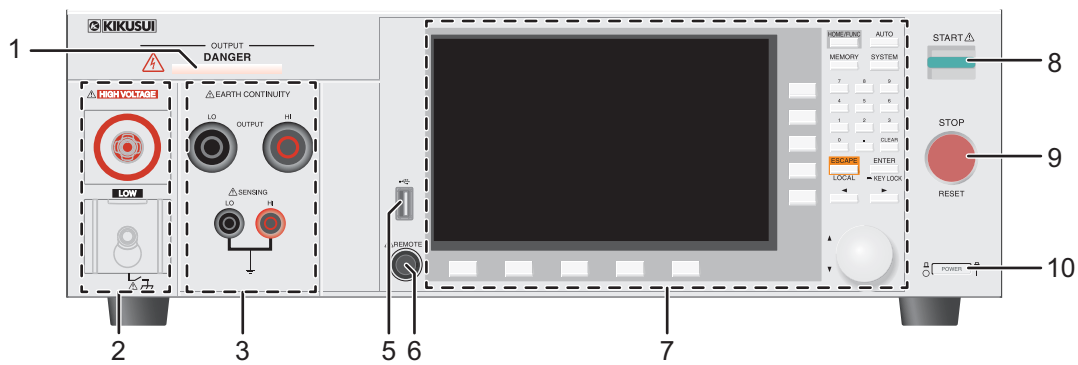
Component Names

Front panel

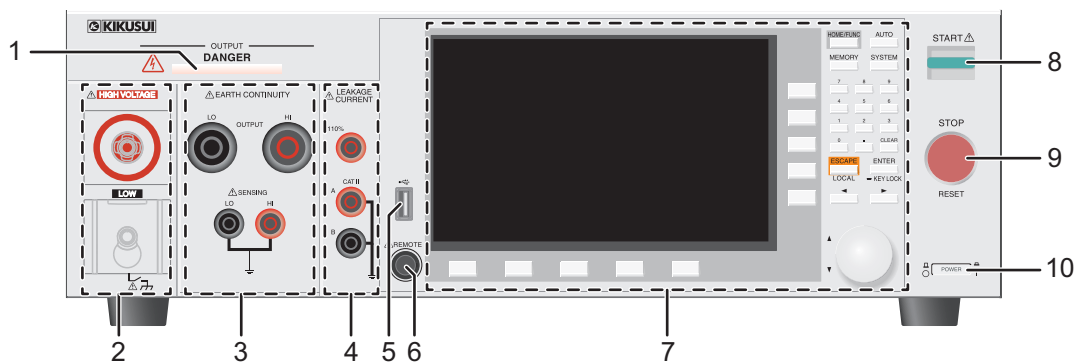
TOS9300, TOS9301, TOS9301PD



TOS9302, TOS9303



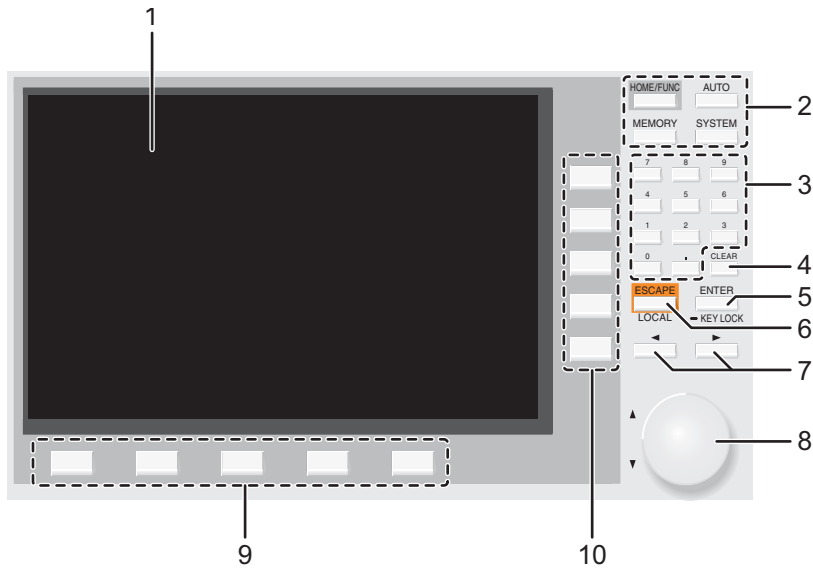
TOS9303LC



No.	Name	Function	See
1	DANGER LED	Lights red when the power is turned on, when a test is in progress, when a high voltage is being output, or when there is residual voltage at the output terminals. On the TOS9303LC, the LED also lights red when supply voltage is being supplied to the EUT.	–
2	Area for withstanding voltage, insulation resistance, and partial discharge tests ¹	–	p.29
	HIGH VOLTAGE terminal	Outputs the test voltage of the high voltage side.	–
	LOW terminal	Outputs the test voltage of the low voltage side (with cable lock).	–
3	Area for earth continuity test	–	p.34
	OUTPUT HI terminal	Outputs the test voltage of the high voltage side.	–
	OUTPUT LO terminal	Outputs the test voltage of the low voltage side.	–
	SENSING HI terminal	Detects the voltage at the sensing terminal (of the high voltage side) when four-terminal wiring is in use.	–
	SENSING LO terminal	Detects the voltage at the sensing terminal (of the low voltage side) when four-terminal wiring is in use.	–
4	Area for leakage current test	–	p.41
	110% terminal	Outputs the voltage applied to the AC LINE IN inlet on the rear panel.	–
	A and B terminals	Measurement terminals for connecting test leads and probes.	–
5	USB port (host)	For connecting an external keyboard. Saves setup memory and test results. Exporting and Importing Programs. Updates the firmware.	p.49 p.249 p.232 p.277
6	REMOTE connector	For connecting the optional remote control box or test probes.	p.330
7	Controls	–	p.14
8	START switch	Starts a test.	–
9	STOP switch	Stops testing and clears the current status. Returns to the HOME menu screen.	–
10	POWER switch	Turns the power on (I) and off(O).	p.27

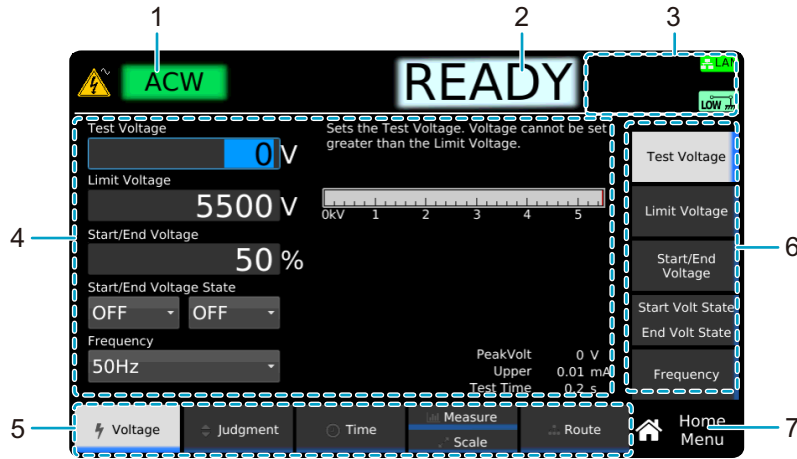
1 Partial discharge test is available only on the TOS9301PD.

Controls



No.	Name	Function	See
1	Display	Displays the settings, measured values, and other information.	p.15
2	Menu keys	Switch the display.	p.46
	HOME/FUNC key	Switches between the test setup screen (Home menu) and test selection screen (Function menu).	p.46
	AUTO key	Displays the auto test screen.	p.215
	MEMORY key	Displays the memory function screen.	p.249
	SYSTEM key	Displays the system setting screen (System Menu).	p.258
3	Numeric keypad	Enters values.	p.49
4	CLEAR key	Deletes numbers/characters.	p.49
5	ENTER key	Confirms numeric keypad input. Confirmation after selection of setting item.	p.49
	KEYLOCK key	Hold down to lock the keys. Hold down when key lock is enabled to unlock.	p.262
6	ESCAPE key	Cancels numeric/character input. Closes windows.	p.49
	LOCAL key	Returns remote control to panel operation.	p.335
7	◀▶ keys	Move the cursor left and right. Select the left or right item.	p.49
8	Rotary knob	Selects an item. Enters numbers and characters.	p.49
9	Function keys	Executes the item that is displayed above each key (function area).	p.47
10	Sub-function keys	Executes the item that is displayed to the left of each key (sub-function area).	p.47

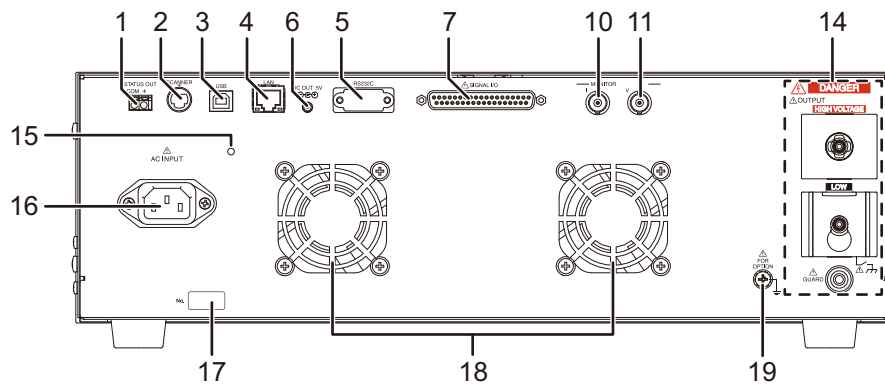
Display



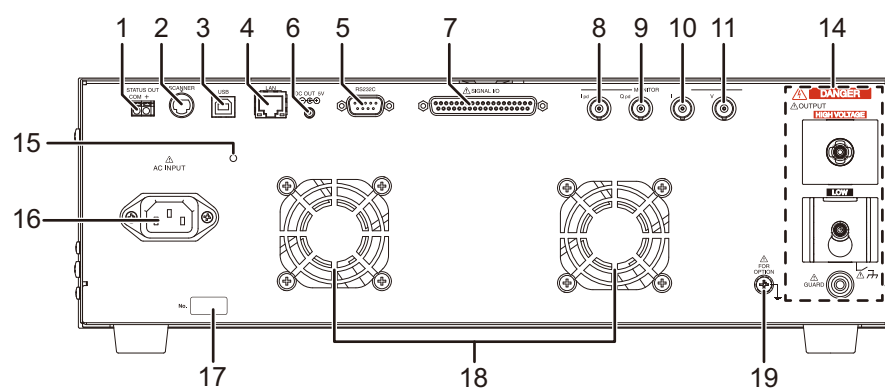
No.	Name	Function	See
1	Test mode	Selected test type.	-
2	Test status	-	-
	READY	Ready to start test.	-
	RISE	Voltage or current rising.	-
	FALL	Voltage or current falling.	-
	TEST	Testing.	-
	PASS	Test successful.	-
	Upper-FAIL	Test failed because a value greater than or equal to the upper limit was detected.	-
	Lower-FAIL	Test failed because a value less than or equal to the lower limit was detected.	-
	Upper-FAIL (dV/dt)	In a DCW test, the voltage rise rate (dV/dt) is less than approximately 1 V/s.	p.89
	Lower-FAIL (dV/dt)	In an IR test, the voltage rise rate (dV/dt) is less than approximately 1 V/s.	p.89
	Contact-FAIL	The continuity between the scanner and EUT cannot be verified. (TOS9303LC only) The test leads are grounded when the touch current test condition "Probe" is set to Enc-Liv or Enc-Neu.	p.79 p.153
	Calibration-FAIL	(TOS9301PD only) The test has started with no precalibration performed.	p.127
	CHECK	Contact check in progress.	p.98
3	Status display icon area	Displays a product status using icons.	p.18
4	Settings area	Displays settings and descriptions. Displays measured values during testing.	-
5	function area	Indicates that execution is possible with the keys (function keys) at the bottom of the display.	p.47
6	sub-function area	Indicates that execution is possible with the keys (sub-function keys) in the right side of the display.	p.47
7	Menu name	Name of the menu currently displayed.	p.46

Rear panel

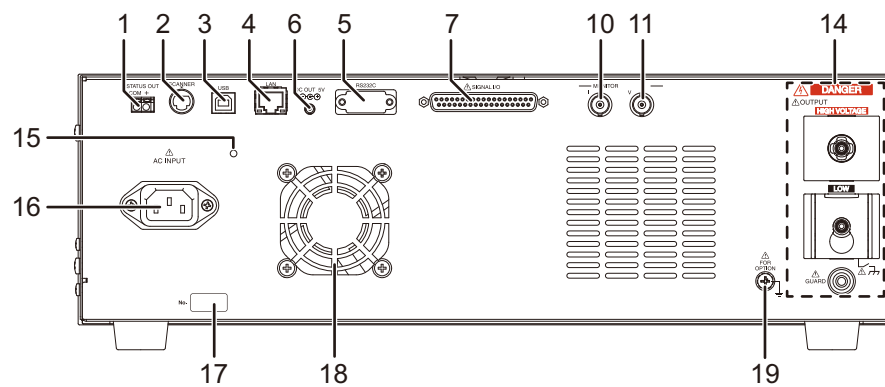
TOS9300, TOS9301



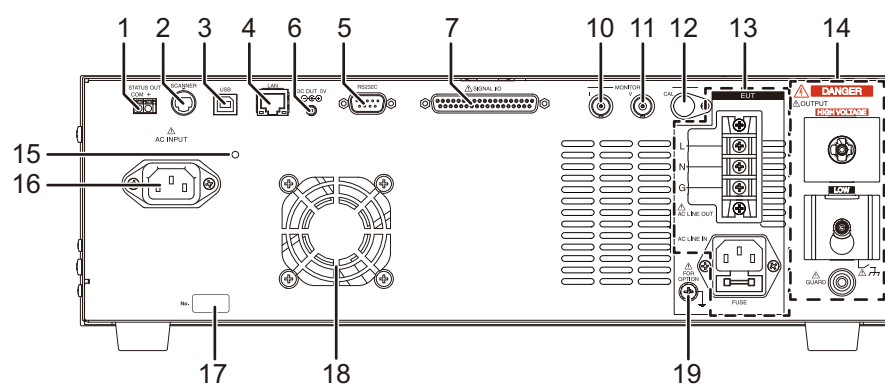
TOS9301PD



TOS9302, TOS9303



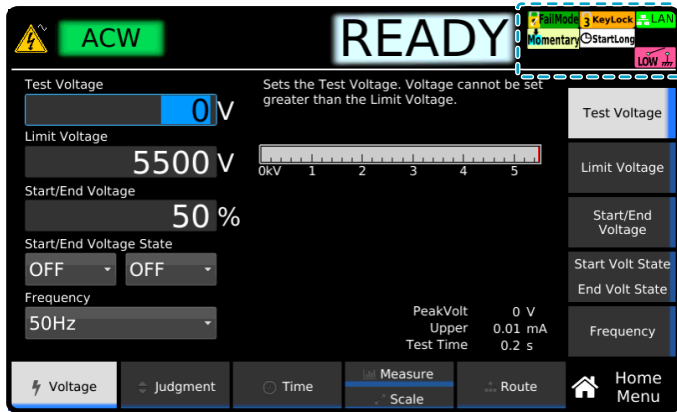
TOS9303LC



No.	Name	Function	See
1	STATUS OUT connector	Connect option products.	p.248
2	SCANNER connector	Connect to the high voltage scanner option.	p.330
3	USB port	USB port for remote control.	Interface Manual
4	LAN port	LAN port for remote control.	
5	RS232C port	RS232C port for remote control.	
6	DC OUT 5 V terminal	Connect option products.	–
7	SIGNAL I/O connector	A I/O signal connector for controlling this product from an external device.	p.234
8	Ipd terminal	Signal output terminal for monitoring the discharge waveforms of partial discharge.	p.247
9	Qpd terminal	Signal output terminal for monitoring the electric charge waveforms of partial discharge.	p.247
10	I terminal	Signal output terminal for monitoring the current waveforms of withstanding voltage tests.	p.246
11	V terminal	Signal output terminal for monitoring the voltage waveforms of withstanding voltage tests.	p.246
12	CAL terminal	Not used.	–
13	Area for leakage current test	–	p.41
	AC LINE OUT terminal block	Connect the EUT here. Power applied to the AC LINE IN inlet is supplied.	–
	AC LINE IN inlet	Connect a power cord for supplying power to the EUT.	–
	FUSE	Input fuse holder for the EUT power supply.	p.283
14	Area for withstanding voltage, insulation resistance, and partial discharge tests ¹	–	p.29
	HIGH VOLTAGE terminal	Outputs the test voltage of the high voltage side.	–
	LOW terminal	Outputs the test voltage of the low voltage side (with cable lock).	–
	GUARD terminal	Connect the chassis connection wire of the shield box when a shield box is used.	p.32
15	Cable tie attachment hole	Hole for attaching the included cable tie (for USB cables).	–
16	AC INPUT inlet	Connect a power cord for supplying power to this product.	p.25
17	Serial number	Serial number.	–
18	Air outlet	Vent for cooling this product.	–
19	FOR OPTION terminal	Connect the ground wire of option products.	–

1 Partial discharge test is available only on the TOS9301PD.

Status display icons



Icon	Description	See
	Indicates that key lock is on. The key lock level is displayed numerically.	p.262
	Under remote control.	Interface Manual
	LAN connection status. Green: Communication enabled, Orange: Preparing for communication, Red: Not connected.	–
	Fail Mode is enabled.	p.265
	Double Action is enabled.	p.266
	Start Long is enabled.	p.266
	Momentary is enabled.	p.266
	Auto testing/auto test standby.	p.215
	GND setting (Low, Guard).	p.71
	Applying voltage from the 110 % terminal.	p.210
	Supplying power to the EUT from the AC LINE OUT terminal block.	p.282
	While discharging.	p.68
	SCPI error. The number of error incidents (up to 16) is displayed numerically.	p.272

1 TOS9303LC only

2 TOS9302 not supported.

Safety Precautions for Testing

Lighting of the DANGER LED

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

- At power on
- When a test is running
- When high voltage is being output
- When voltage remains at the output terminals
- When supply voltage is being supplied to the EUT (TOS9303LC only)

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

Test Precautions

Pre-test precautions



WARNING Risk of electric shock.

- In a AC withstanding voltage test, the TOS93 series generates a maximum voltage of 5.0 kVac. In a DC withstanding voltage test, the TOS9301, TOS9301PD, TOS9303, and TOS9303LC generate a maximum voltage of 7.2 kVdc. Handling the product improperly may lead to a fatal accident. To prevent accidents, strictly follow the precautions and always pay the utmost attention to safety concerns when you operate the product.
- While the DANGER LED is lit, do not touch the EUT, test leads, test probes, output terminals, or other peripheral components.

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

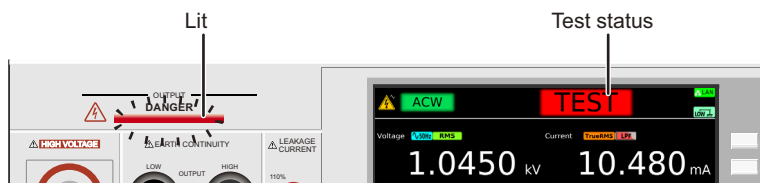
- **The power cord is connected to a properly grounded outlet.**
- **There is no damage such as tears or breaks in the test lead insulation.**
- **When the POWER switch is turned on, the DANGER LED lights.**
- **When the DANGER LED is lit, do not turn the POWER switch off except in an emergency.**
- **Test leads connected to the following output terminals of this product must not be connected to the main power supply circuit in the active state.**
 - HIGH VOLTAGE terminal or LOW terminal (all models)
 - OUTPUT HI terminal, OUTPUT LO terminal, SENSING HI terminal, or SENSING LO terminal (for TOS9302, TOS9303, TOS9303LC)

Testing precautions

⚠ WARNING Risk of electric shock.

- While the DANGER LED is lit, do not touch the EUT, test leads, test probes, output terminals, or other peripheral components.
- The alligator clip vinyl insulation of the supplied tests do not have dielectric strength. Never touch these while the DANGER LED is lit.
- When performing a withstanding voltage test, be sure to wear rubber gloves for electrical work. If obtaining these gloves is difficult, contact your Kikusui agent or distributor.

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.



Precautions when setting test conditions

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

Precautions after Output Has Been Turned Off

 **WARNING**

Risk of electric shock.

- **For a while after the output has been turned off, do not touch the EUT, test leads, test probes, output terminals, or other peripheral components.**
- **After the output has been turned off, the internal discharge circuit goes into operation and discharges the output voltage. During testing and before this discharge completes, do not disconnect the tester from the EUT.**

The EUT, test leads, test probes, output terminals, 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,” “TEST,” or “FALL” 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 this product requires to discharge the voltage from its internal capacitors down to 30 V is as follows:

- When an EUT is not connected: 16 ms for a DCW test, 1.5 ms for an IR test
- When an EUT with a input capacitance of 0.05 μF is connected: 50 ms for a DCW test, 6 ms for an IR test

Remote Control Precautions

If you are performing remote control at a location away from the product, 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, test probes, 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 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 from the outlet. Stop using the product immediately, and contact your Kikusui agent or distributor.

Emergency measures

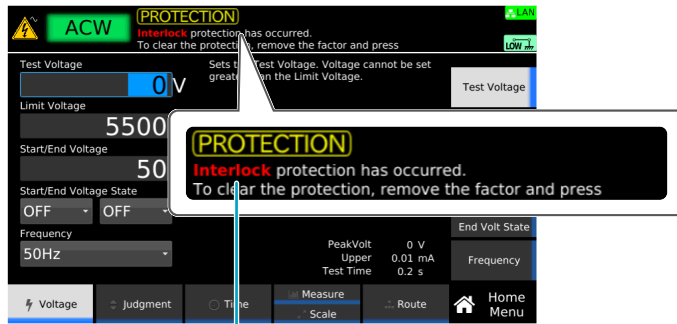
There are two actions that you must carry out if, due to a malfunction in the product or the EUT, there is a possibility of an emergency occurring such as electric shock or damage to the EUT.

- **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 be able to perform test in this state (PROTECTION mode).

When a protection function is activated, the word "PROTECTION" is indicated on the display along with the type of protection. If a PROTECTION mode occurs during a test, the output is shut off and the test is stopped immediately. If a leakage current (LC) test is in progress on the TOS9303LC, the power supply to the EUT is stopped, and the A and B terminals are opened.



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.253).

Type of protection	Activation condition	Remedy
Interlock (ILOCK)	Interlock is activated.	Release the interlock (p.239).
Power Supply (PS)	There is an error in the power supply section.	Pressing STOP releases the PROTECTION mode, but the product needs to be repaired. Contact your Kikusui agent or distributor.
Output Error (OUTERR)	An output voltage outside of the following range is detected. ACW, DCW, IR, PD test: $\pm(10\% \text{ of setting} + 50 \text{ V})$ EC test: $\pm(10\% \text{ of setting} + 2 \text{ A})$ This error may also occur when the output changes suddenly.	Eliminate the cause of the error, and press STOP.
Over Load (OL)	An output power or output current outside of the following range is detected. ACW: 550 VA, DCW: 110 W or 50 mA, IR (7200 V test): 110 W or 25 mA, IR (-1000 V test): 2 mA, EC: 240 VA, LC: AC LINE OUT current at approx. 15.7 A or power at 1600 VA	Eliminate the cause of the error, and press STOP. (TOS9303LC only) Disconnect the EUT from AC LINE OUT, and press STOP.
Over Heat (OH)	The internal temperature of the product is abnormally high.	Confirm that the internal temperature of the product has decreased, and then press STOP.
Over Rating (OR)	During a withstanding voltage test, an output current is generated for a length of time that exceeds the output time limit (p.82).	Press STOP, and wait the necessary rest time.
Calibration (CAL)	The preset calibration period is exceeded.	Setting Protection Keep under Calibration (p.263) to Disable and pressing STOP releases the PROTECTION mode, but the product needs to be calibrated. To have your product calibrated, contact your Kikusui agent or distributor.

Type of protection	Activation condition	Remedy
Remote (RMT)	The REMOTE connector is connected or disconnected.	Check the REMOTE connector, and then press STOP.
Signal I/O (SIO)	There is a change in the SIGNAL I/O connector's ENABLE signal.	Press STOP.
Communication (COMM)	An internal communication error is occurring.	Repair is necessary. Turn the power off, and contact your Kikusui agent or distributor.
	No SCPI communication took place for more than the specified time when the watchdog (p.260) was enabled.	Check the SCPI communication status.
Over Range (ORG)	A value exceeding the maximum value of the measurement range is detected.	Eliminate the cause of the error, and press STOP.
Measure (MEAS)	There is an error in the LC test measurement check (p.281).	Press STOP, and check whether the test leads are broken. If you perform another measurement check and "Measure" still appears, repairs are necessary. Contact your Kikusui agent or distributor.
Relay Short (RS)	A relay operation error is detected in an LC test.	Repair is necessary. Turn the power off, and contact your Kikusui agent or distributor.
Earth Fault (EF)	When the grounding mode (GND) is set to Guard, abnormal current flows from the high voltage output of this product to ground.	Set the grounding mode to Low.
Scan I/F (SIF)	While scanning, the interface cable is disconnected.	Connect the interface cable, and press STOP.
	The channel-assigned scanner is not detected.	Check the scanner connection, and then press STOP.

Installation

Connecting the Power Cord

⚠ WARNING

Risk of electric shock.

- This product is IEC Safety Class I equipment (equipment with a protective conductor terminal). To prevent electric shock, be sure to connect the protective conductor terminal of the product to electrical ground (safety ground).
- The product is grounded through the power cord ground wire. Connect the protective conductor terminal to earth ground.

NOTE

- Use the supplied power cord to connect to the AC 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 product 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.

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

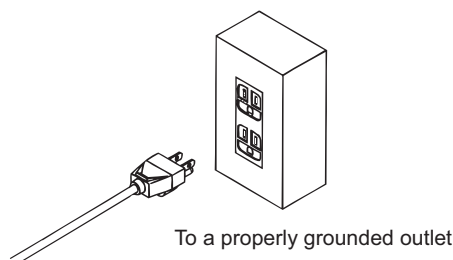
1 Turn off (○) the POWER switch on the front panel.

2 Check that the AC power line meets the nominal input rating of the product.

The product can receive a nominal power supply voltage in the range of 100 Vac to 120 Vac or 200 Vac to 240 Vac. The supported frequencies are 50 Hz and 60 Hz. (Frequency range: 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.

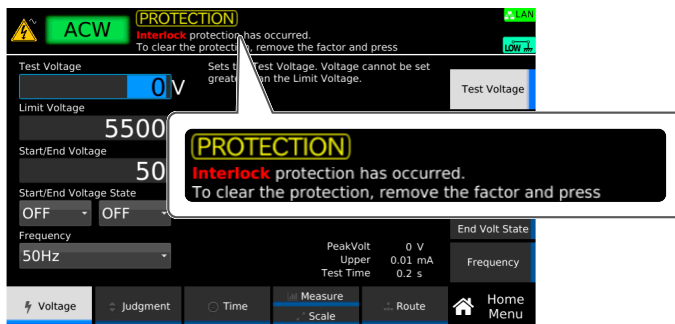
Checking Whether the Power Is On or Off

Checking the interlock operation

When this product is turned on for the first time after purchase, it starts in PROTECTION mode in which the interlock function (p.239) prevents tests from being executed. Check that the interlock is working properly.

- 1** Check that the power cord is connected properly.
- 2** Check that nothing is connected to the SIGNAL I/O connector on the rear panel.
- 3** Turn on (I) the POWER switch on the front panel.
- 4** Check that PROTECTION mode is activated.

After the startup screen, when the product enters PROTECTION mode, the following screen appears.



This completes the checking of the interlock operation.

To release the interlock temporarily, connect the included SIGNAL I/O plug to the SIGNAL I/O connector, and press STOP on the front panel. When you are actually performing tests, construct a system that uses the interlock to ensure safety (p.240).

Turning the power on

- NOTE**
- When the power is turned on for the first time after purchase, the interlock function sets the product in PROTECTION mode and prevents tests from being performed. Temporarily connect the included SIGNAL I/O plug to the SIGNAL I/O connector to release the PROTECTION mode (p.239).
 - When you actually perform tests, design a system that uses the interlock for safety (p.240).

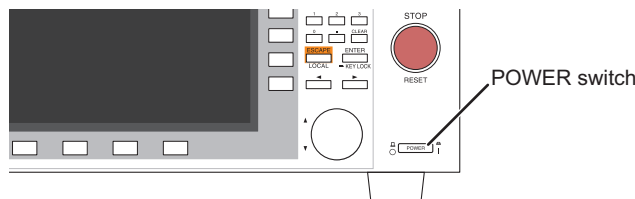
By factory default, the panel settings immediately before the POWER switch is turned off are saved. When you turn the power on, the product starts in the same state as it was in the last time it was turned off. (However, the output is off.)

The panel setting state at startup can be changed (p.259).

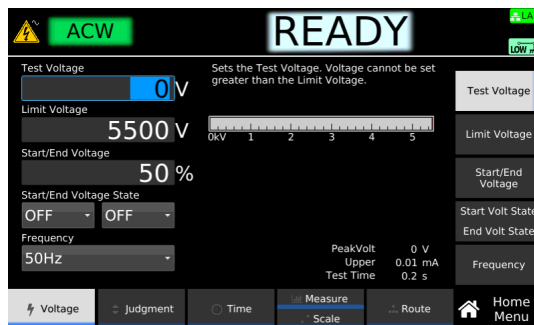
1 Check that the power cord is connected properly.

2 Turn the POWER switch (I) on.

The DANGER LED lights, but no voltage is generated. If it does not, stop using the product, and contact your Kikusui agent or distributor.



After the startup screen is displayed, the home screen of the test that was in use before the power was turned off the last time appears.



The power is now on.

Turning the power off

1 Turning the POWER switch off (O)

The power is turned off.

⚠ WARNING Risk of electric shock.

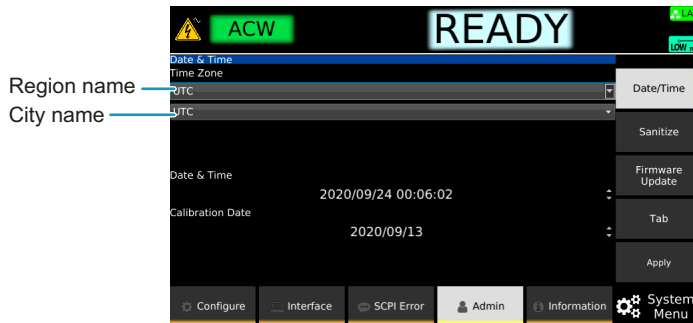
- If you want to turn the POWER switch back on, wait at least 10 seconds. It is dangerous to do otherwise, because the protective functions of the product may not work effectively. This may cause the product to malfunction or reduce the life of the POWER switch and internal parts such as the fuses.
-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

Setting date

Set the time zone, date, and time. The following settings will be used as an example to explain how to change the date in Japan's time zone.

1 Press SYSTEM > Admin > Date/Time.

The date/time setup screen appears.



2 Select Asia using the rotary knob.

3 Press Tab, and then turn the rotary knob to select Tokyo.

4 Press Tab, Use the numeric keypad or the rotary knob to set the time and date.

Press Tab to switch between items you can set.

5 Press Apply.

A confirmation screen appears.

6 Use the arrow (▶) key to select OK, and then press ENTER.

This completes the setting.

Connection for Withstanding Voltage and Insulation Resistance Tests

Applicable models for withstanding voltage test: All models

Applicable models for insulation resistance test: **9300**, **9301**, **9301PD**, **9303**, **9303LC**

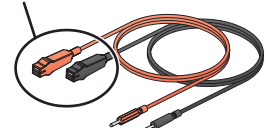
⚠ WARNING Risk of electric shock. While the DANGER LED is lit, never touch the HIGH VOLTAGE terminal, test leads, or EUT.

Connecting the test leads

⚠ WARNING Risk of electric shock.

- Parts of the included test leads near the alligator clips protrude from the vinyl insulation when the wires are connected. These parts are dangerous. Never come close to these parts while the DANGER LED is lit.
- If connections are incomplete, the entire EUT may be charged to a high voltage. This is dangerous, so be sure to connect the EUT correctly.
- Be sure to connect the low-voltage test lead (black) first.

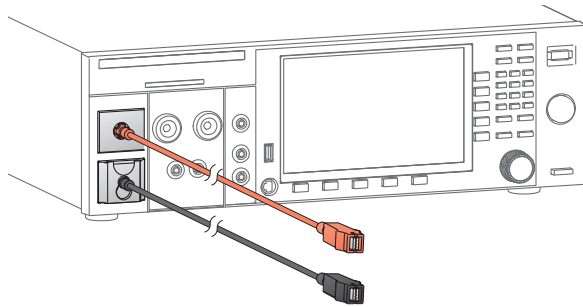
Never touch these while the DANGER LED is lit.



Connect the supplied high voltage test lead TL31-TOS to this product.

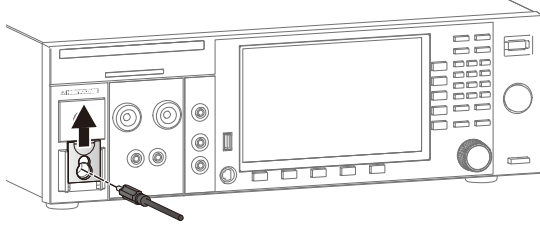
Before starting work, check that the covering of the test leads are not torn and that the wires are not broken (p.279).

The following procedure uses the TOS9303LC as an example.

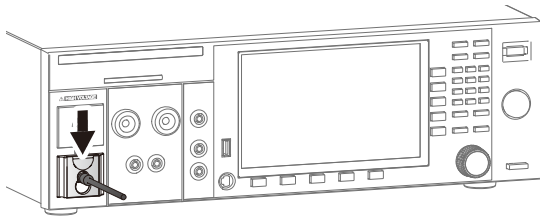


After the test leads are connected

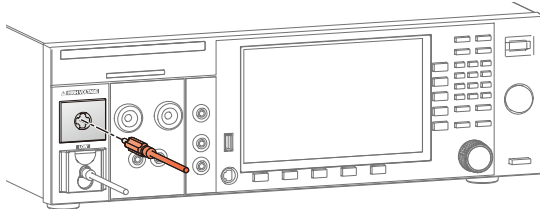
- 1** Check that the **POWER** switch is off and that the **DANGER LED** is off.
- 2** Raise the **LOW** terminal's cable lock, and then connect the low-voltage test lead (**black**).



- 3** Lower the cable lock.
Check that the connection is secure.

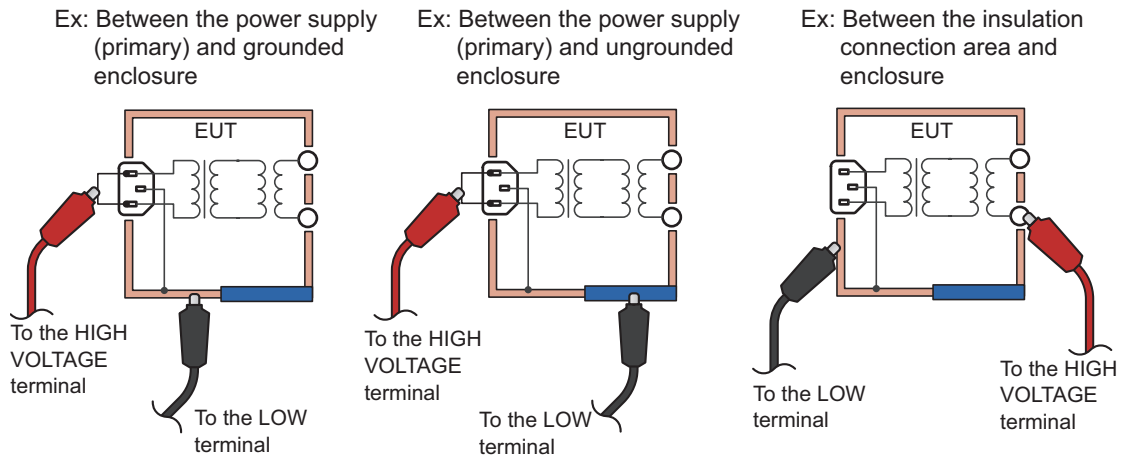


- 4** Connect the low-voltage test lead (**black**) to the EUT.
- 5** Connect the high-voltage test lead (**red**) to the EUT.
- 6** Connect the high-voltage test lead (**red**) to the **HIGH VOLTAGE** terminal.



This completes the connections.

Examples of how to connect test leads to the EUT



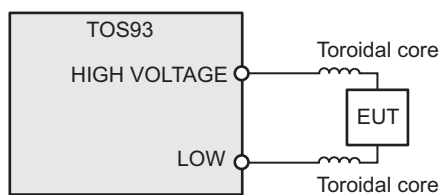
Reducing the effect of noise

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 $470\ \Omega$ 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.

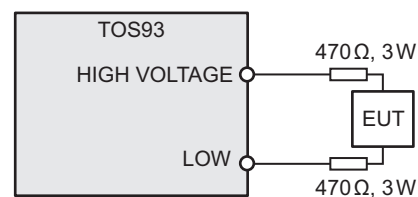
If you are connecting a toroidal core, it is effective to wrap the test leads two to three times around a type of core that can be snapped on and that is often used with power cords. This type of core is usually approximately 20 mm in diameter.

If you are connecting a resistor, pay close attention to the power rating of the resistor. When the upper limit is 10 mA or less, connect a resistor of approximately $470\ \Omega$ (3 W, 30 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 the product's output terminals (when a 10 mA current flows, the voltage falls approximately 10 V).

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



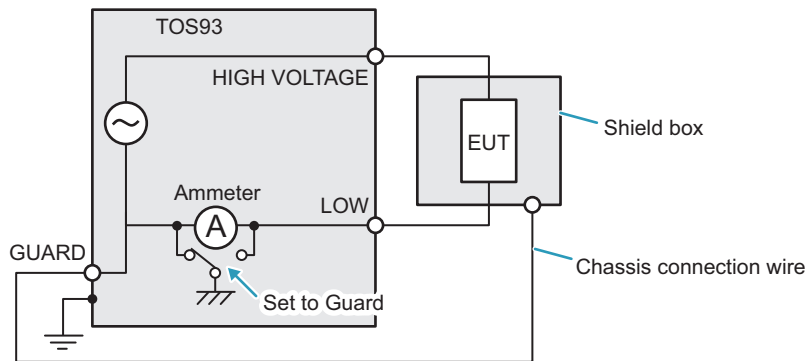
When connecting toroidal cores



When connecting resistors

Stabilizing measurements

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. When using a shield box, set Grounding mode (GND) (p.71) to Guard and connect the shield box's chassis connection wire to the GUARD terminal on the rear panel.



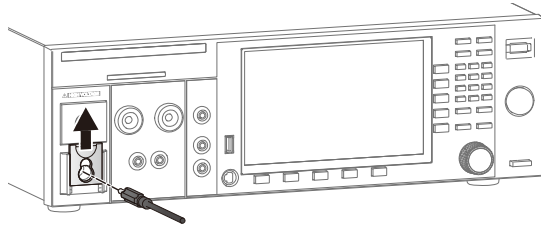
Using the optional high voltage test probe

In withstanding voltage tests, if you use the optional high voltage test probe (HP01A-TOS/HP02A-TOS) (p.332) instead of the supplied test leads, you can use hands-on control to start tests. For details, see the HP01A-TOS/HP02A-TOS Operation Manual.

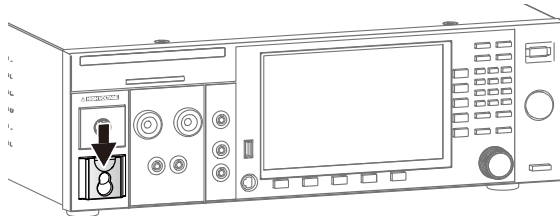
Removing the test leads

This section explains how to remove a test lead that is already connected to the EUT using the TOS9303LC as an example.

- 1** Check that the **DANGER LED** is turned off.
- 2** Disconnect the high-voltage test lead (red) from the front-panel **HIGH VOLTAGE** terminal.
- 3** Disconnect the high-voltage test lead (red) from the EUT.
- 4** Disconnect the low-voltage test lead (black) from the EUT.
You can disconnect the low-voltage test lead (black) first from either the product or the EUT.
- 5** Raise the **LOW** terminal's cable lock, and then remove the low-voltage test lead (black).



- 6** Lower the cable lock.



This completes the procedure.

Connection for Earth Continuity Tests

Applicable models: **9302**, **9303**, **9303LC**

- ⚠ WARNING**
- The TOS9302, TOS9303, and TOS9303LC produce large current up to 42 A. Connect the test leads securely. If the connection is loose, the OUTPUT terminals or the EUT may overheat and may cause burns or injury.
 - Do not connect the supplied test leads or the voltage measurement cable (the thinner cable) of the optional test probe to the OUTPUT terminals. Because the nominal cross-sectional area for running the current is insufficient, they may burn out.

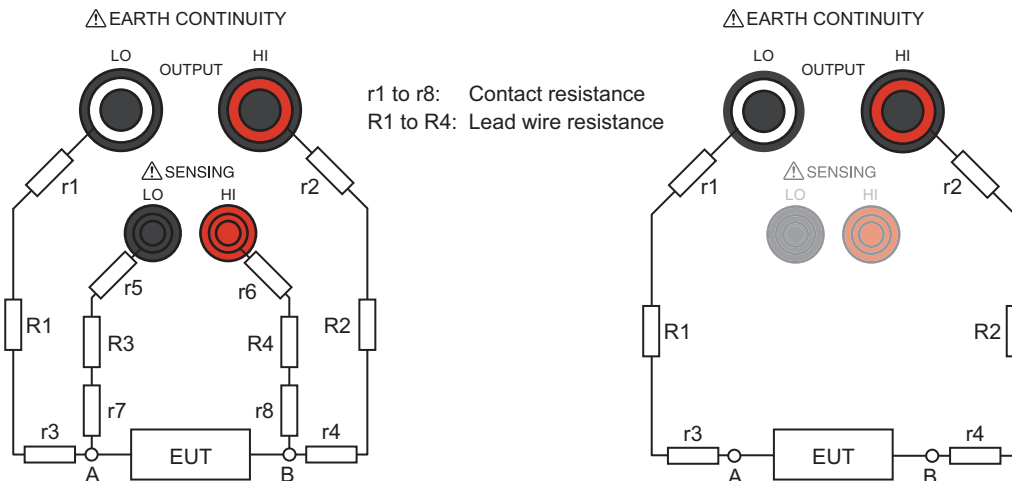
⚠ CAUTION Because the TOS9302, TOS9303, and TOS9303LC produce large current, a strong magnetic field is created. Do not bring objects that are easily affected by magnetic fields close to the test leads or the current output cable.

Four-terminal wiring and two-terminal wiring

There are two methods for wiring test leads to this product. They are the four-terminal wiring and two-terminal wiring. Each method requires the test leads to be connected to different locations.

If you use the supplied test leads for earth continuity testing (TL13-TOS), four-terminal wiring is used. When four-terminal wiring is not possible such as when using test leads other than those supplied with the product, two-terminal wiring is used. After making the connections, set the test conditions by referring to "Terminal wiring method (Terminals Wire)" (p.97).

If you use test leads other than those supplied with the product, the product specifications may not be met. Contact your Kikusui agent or distributor for details.



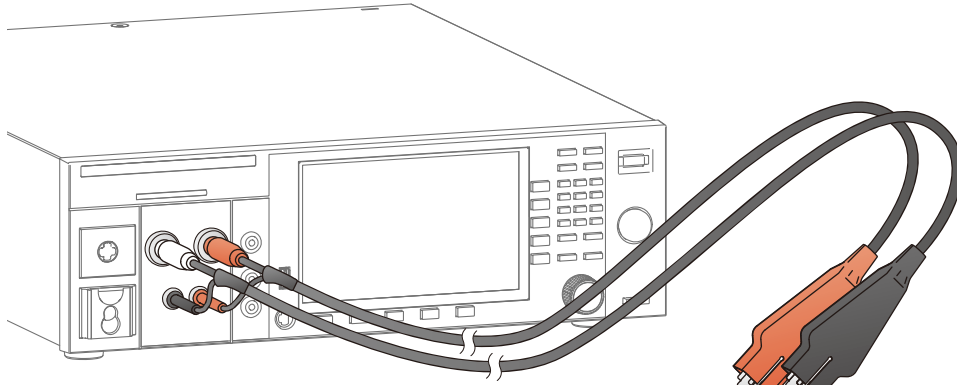
Four-terminal wiring
Connect test leads to the OUTPUT LO and HI terminals and the SENSING LO and HI terminals. The voltage across A and B can be sampled with the SENSING terminals. The measurement is not affected by contact resistance r1 to r8 or the lead wire resistance R1 to R4.

Two-terminal wiring
Connect test leads to the OUTPUT LO and HI terminals. The sum of contact resistance r1 to r4, lead wire resistance R1 and R2, and the resistance across A and B is measured.

Connecting the test leads

Connect the supplied test leads for earth continuity testing (TL13-TOS) to the product.

If you use test leads other than those supplied with the product, the product specifications may not be met. Contact your Kikusui agent or distributor for details.

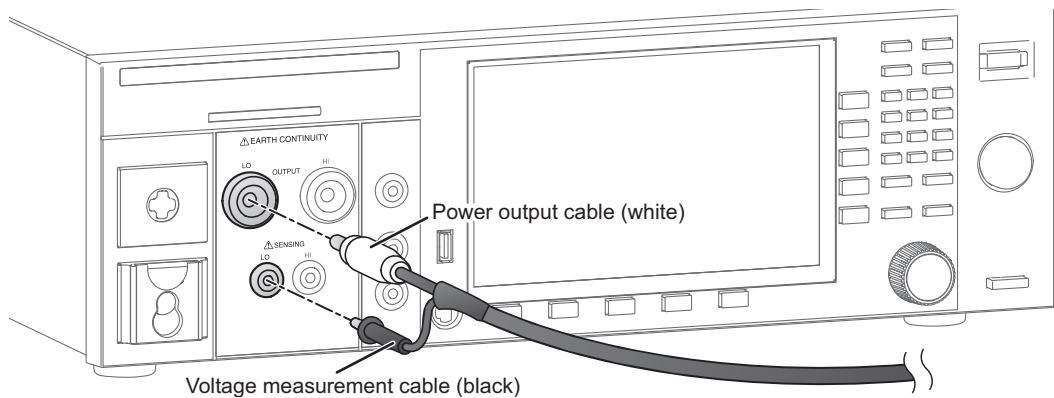


After the test leads are connected

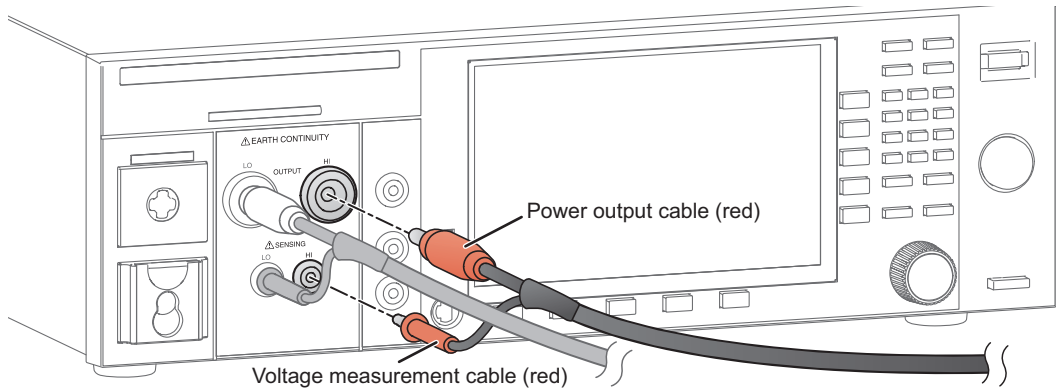
CAUTION

When using the included TL13-TOS test leads for earth continuity test, connect the voltage measurement cables (black and red) even when two-terminal wiring ([p.34](#)) is in use. Because the test voltage is applied also to the voltage measurement wiring terminals during testing, if the terminals make contact with other parts, it can cause slight injury or malfunction.

- 1 Connect the test lead's current output cable (white) to the **EARTH CONTINUITY OUTPUT LO** terminal and the voltage measurement cable (black) to the **SENSING LO** terminal.

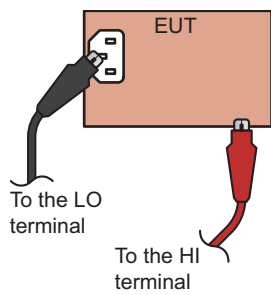


- 2** Connect the test lead's current output cable (red) to the **EARTH CONTINUITY OUTPUT HI** terminal and the voltage measurement cable (red) to the **SENSING HI** terminal.

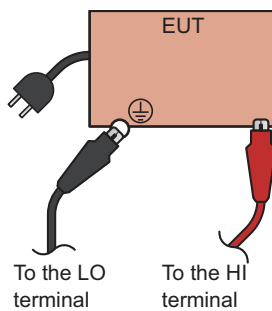


This completes the connections.

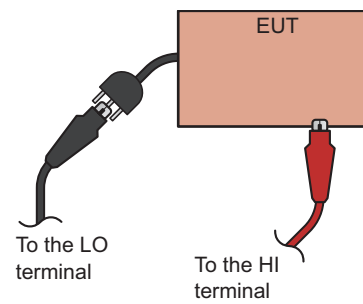
Examples of how to connect test leads to the EUT



Ex: Between the protective ground terminal and grounded enclosure



Ex: Between the protective conductor terminal and grounded enclosure

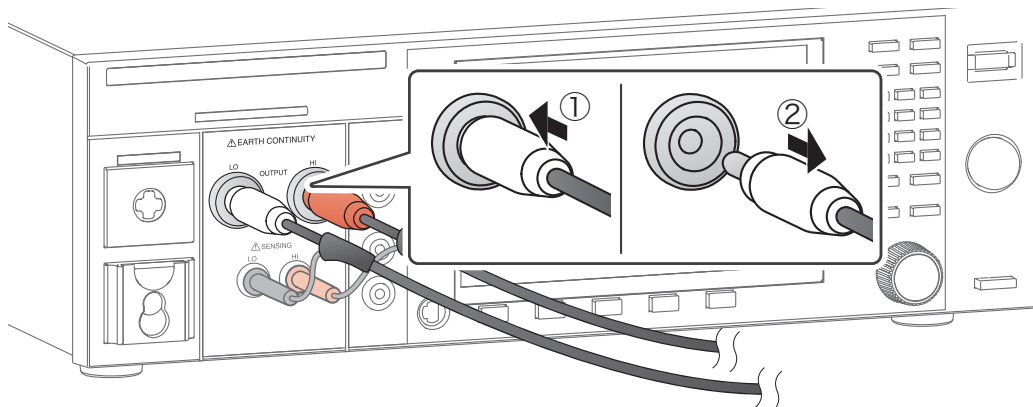


Ex: Between the grounding terminal of the power cord and grounded enclosure

Removing the test leads

You can remove the HI and LO test leads in any order. Check that the DANGER LED is turned off before removing the test leads.

To remove the test leads from the OUTPUT HI and LO terminals, push the plugs in once and then pull the terminals out.



Connection for Partial Discharge Tests

Applicable model: **9301PD**

⚠ WARNING

Risk of electric shock. While the DANGER LED is lit, never touch the HIGH VOLTAGE terminal, test leads, or EUT.

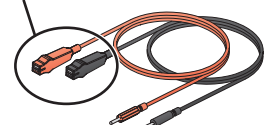
Connecting the test leads

⚠ WARNING

Risk of electric shock.

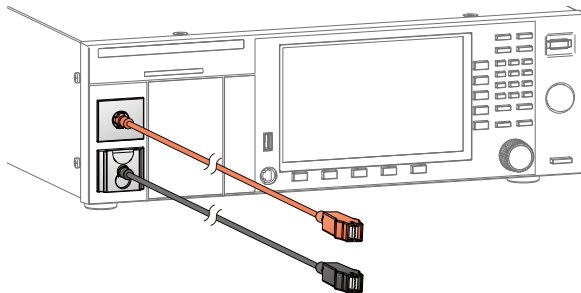
- Parts of the included test leads near the alligator clips protrude from the vinyl insulation when the wires are connected. These parts are dangerous. Never come close to these parts while the DANGER LED is lit.
- If connections are incomplete, the entire EUT may be charged to a high voltage. This is dangerous, so be sure to connect the EUT correctly.
- Be sure to connect the low-voltage test lead (black) first.

Never touch these while the DANGER LED is lit.



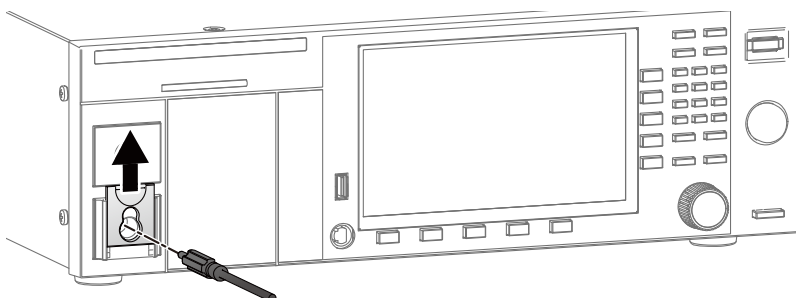
Connect the supplied high voltage test lead TL31-TOS to this product.

Before starting work, check that the covering of the test leads are not torn and that the wires are not broken (p.279).

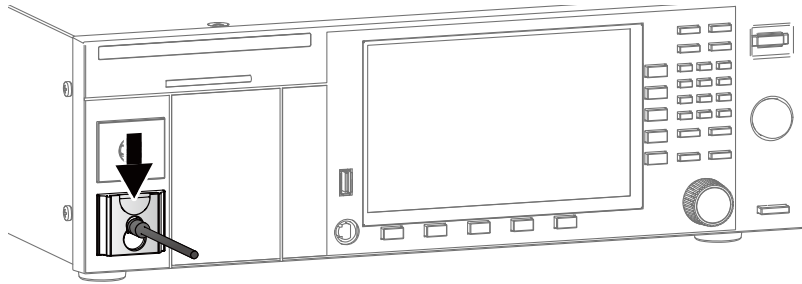


After the test leads are connected

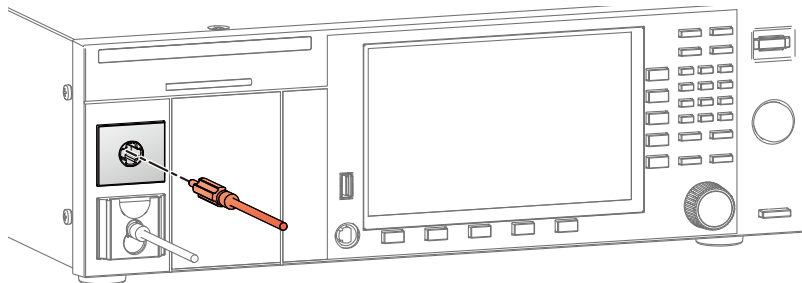
- 1 Check that the **POWER** switch is off and that the **DANGER LED** is off.
- 2 Raise the front-panel **LOW** terminal's cable lock, and then connect the low-voltage test lead (black).



- 3 Lower the cable lock.**
Check that the connection is secure.



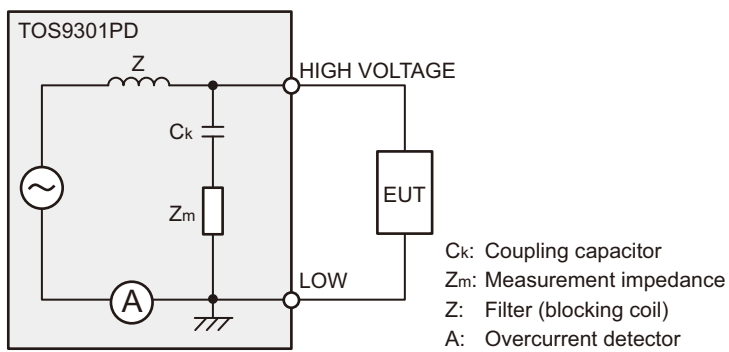
- 4 Connect the low-voltage test lead (black) to the EUT.**
5 Connect the high-voltage test lead (red) to the EUT.
6 Connect the high-voltage test lead (red) to the HIGH VOLTAGE terminal.



This completes the connections.

Connection diagram for PD tests

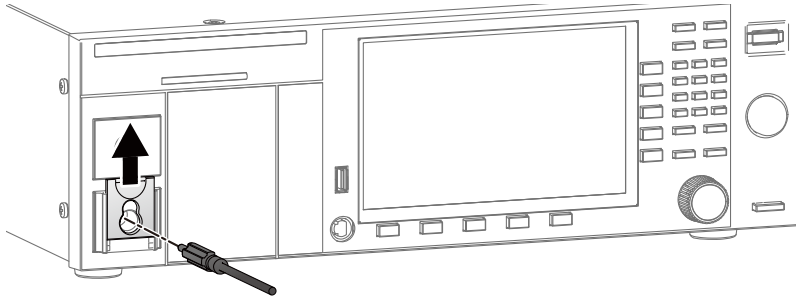
The connection diagram for PD tests is shown below.



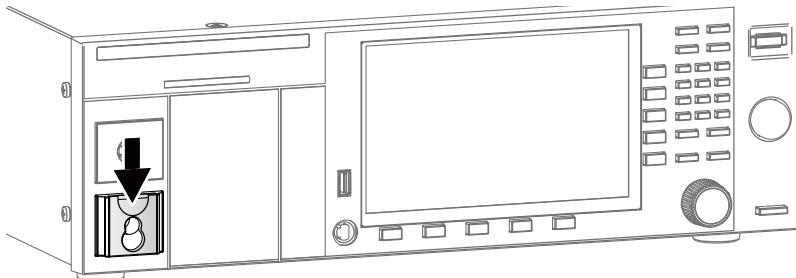
Removing the test leads

To remove the test leads connected to the EUT, follow the procedure below.

- 1** Check that the **DANGER LED** is turned off.
- 2** Disconnect the high-voltage test lead (red) from the front-panel **HIGH VOLTAGE** terminal.
- 3** Disconnect the high-voltage test lead (red) from the EUT.
- 4** Disconnect the low-voltage test lead (black) from the EUT.
You can disconnect the low-voltage test lead (black) first from either the product or the EUT.
- 5** Raise the front-panel **LOW** terminal's cable lock, and then remove the low-voltage test lead (black).



- 6** Lower the cable lock.



This completes the procedure.

Connection for Leakage Current Tests

Applicable model: **9303LC**

Using the insulation transformer

Some standards recommend an insulation transformer to be used in leakage current tests.

If unexpected current flows during a test due to an EUT malfunction or the like, other devices in the same facility may shut down as a result of the earth leakage circuit breaker tripping. This may cause serious accidents.

Inserting an insulation transformer in the power supply line for the EUT insulates the EUT from the earth leakage circuit breaker. This keeps the earth leakage circuit breaker from tripping even if unexpected current flows and prevents other devices from being affected.

Connecting the EUT to the power supply



WARNING

Risk of fire.

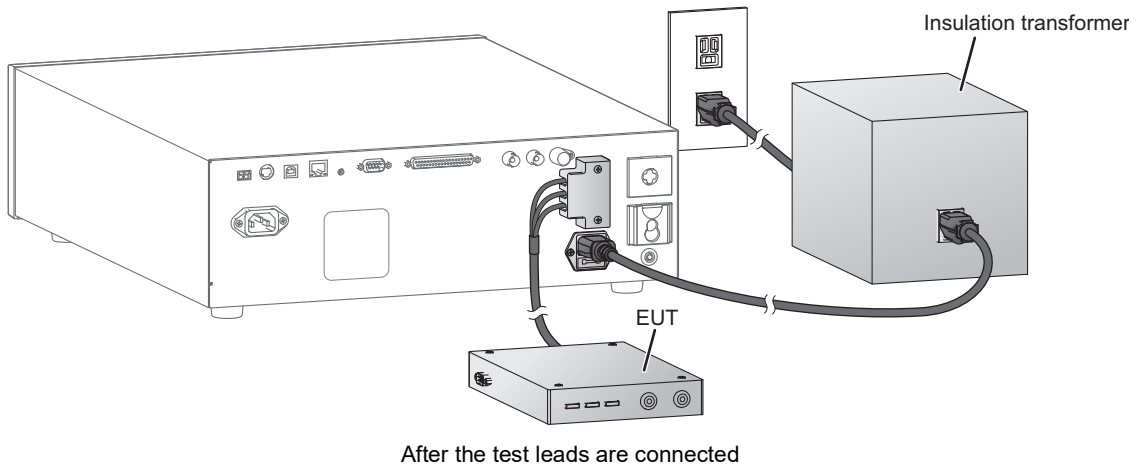
- The current rating of the supplied power cord is 10 A. To prevent fire, if the input current to the connected EUT exceeds 10 A, change the cord to an appropriate one.

Risk of electric shock.

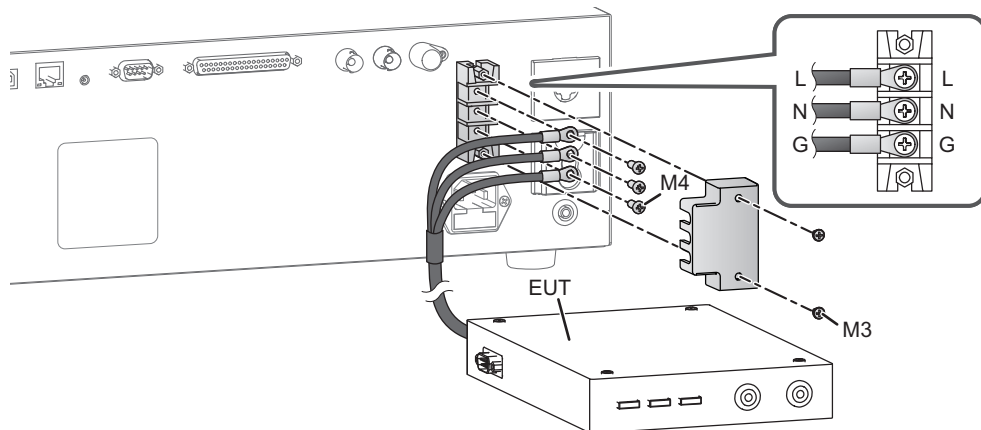
- Before connection, be sure to remove the power cord for the EUT from the AC LINE IN inlet, and then connect the EUT to the AC LINE OUT terminal block first.
- Before connecting, be sure to set Line OUT ([p.282](#)) to OFF.
- To keep the terminals of the AC LINE OUT terminal block from being exposed, be sure to attach the terminal cover. The voltage applied to the AC LINE IN inlet appears at the AC LINE OUT terminal block. When you measure the touch current when the EUT's protective ground wire is disconnected, dangerous voltage may be applied to the ground terminal of the AC LINE OUT terminal block.

Power is supplied to the EUT through this product. The EUT input rating needs to meet the following power supply input rating for the EUT.

- Input voltage range: 85 V to 250 V
- Frequency: 50 Hz or 60 Hz
- Maximum power: 1500 VA

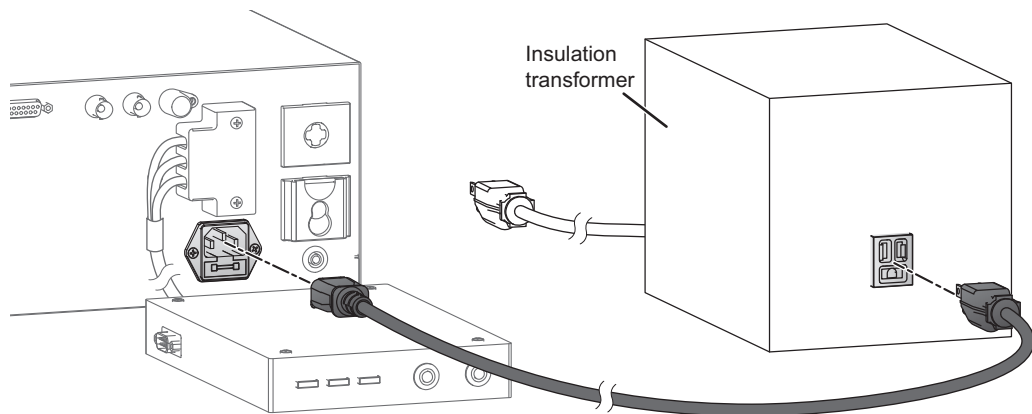


- 1** Check that Line OUT (p.282) is set to OFF.
- 2** Connect the EUT's power cord to the AC LINE OUT terminal block on the rear panel. Attach crimping terminals that match the terminal block screws (M4) to the EUT's power cord. Tightening torque: 1.2 N•m

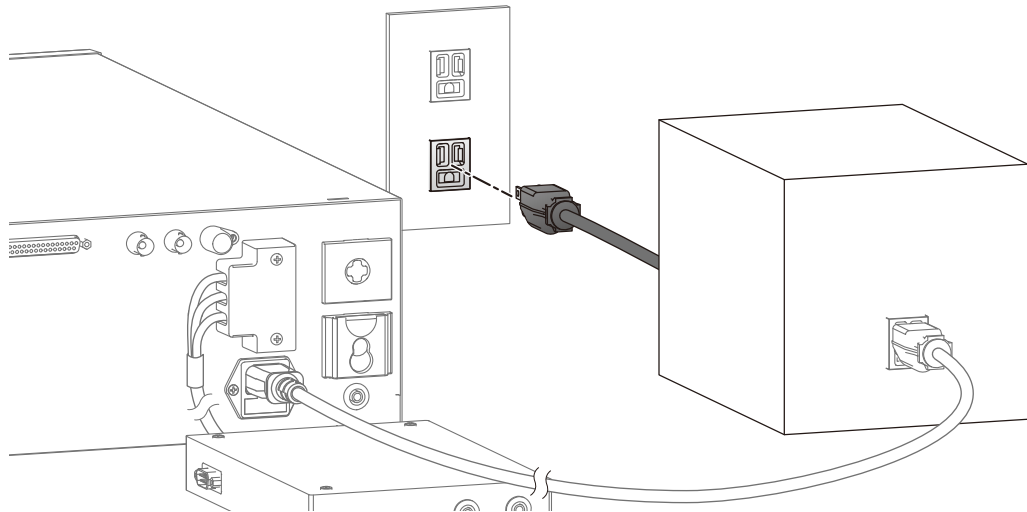


- 3** Connect the insulation transformer to the AC LINE IN inlet with the power cord for the EUT.

If you set the network (p.136) to B-U1 or B-U2, use an insulation transformer that can output voltage equivalent to 110 % of the EUT's rated voltage.



4 Connect the insulation transformer plug to the power supply that can output the EUT's rated voltage.



This completes the connections.

When not using the AC LINE OUT terminal block

Even when you are not using the terminal block, attach the terminal cover so that the terminals are not exposed.

Using the optional multi-outlet

If you connect the optional multi-outlet (OT01-TOS) ([p.333](#)) to the AC LINE OUT terminal block on the rear panel, you will be able to connect major plugs used around the world. For details, see the OT01-TOS Operation Manual.

Checking the EUT operation

The power supply line (AC LINE OUT) for the EUT normally outputs voltage only during testing. To check the operation of the EUT before testing, set Line OUT to on to temporarily run current from AC LINE OUT. For details, see "Checking the EUT operation" ([p.282](#)).

Testing three-phase input devices

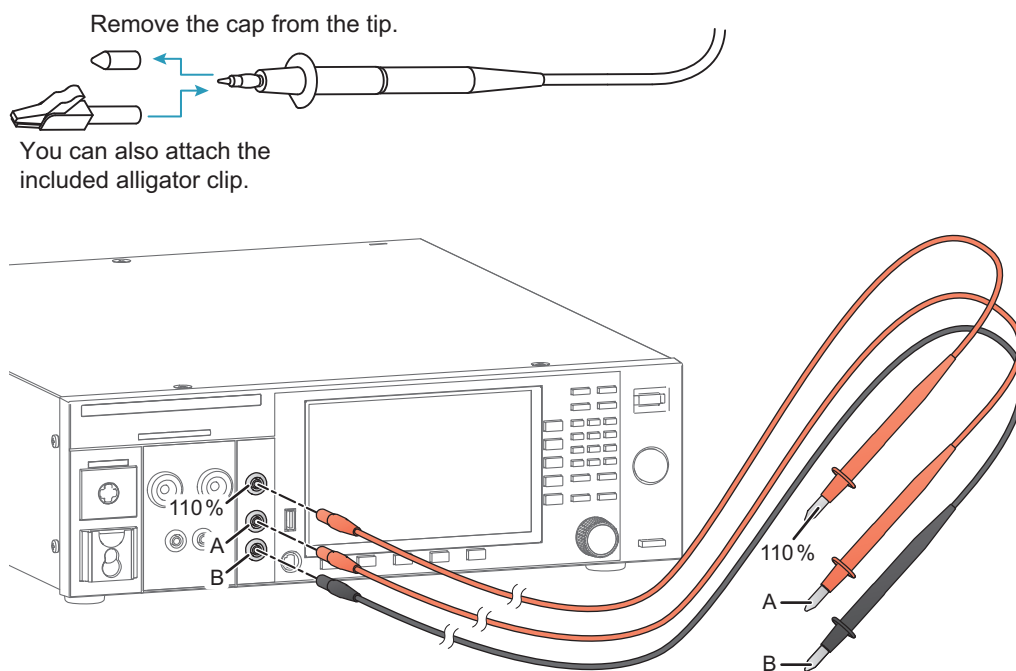
The power supply from this product to the EUT does not support three-phase devices. If the EUT is a three-phase input device, measurement in meter mode is only possible. To measure in meter mode, construct the necessary external circuit ([p.202](#)).

Connecting the test leads

⚠ WARNING Risk of electric shock. When using the test leads, do not touch the tip of the lead with your hand.

When performing a touch current (TC) test or patient leakage current (Patient) test, you will use the supplied test leads for leakage current testing (TL22-TOS).

Connect the red test lead to the LEAKAGE CURRENT A terminal and the black test lead to the LEAKAGE CURRENT B terminal. To use the 110 % output, connect the red test lead to the LEAKAGE CURRENT 110% terminal.

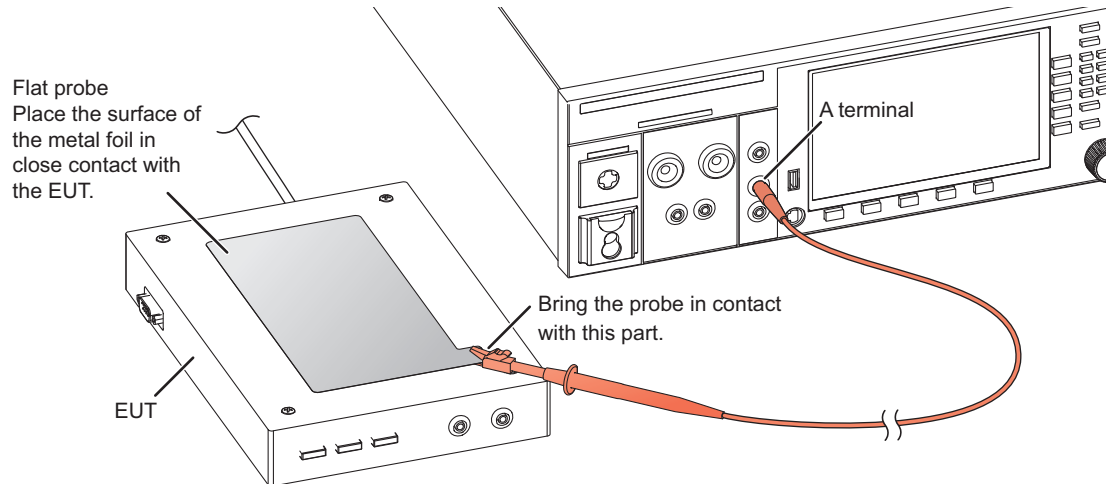


The locations on the EUT that test leads are connected to vary depending on the probe and condition settings of the test conditions and the appliance class of the EUT. For details on touch current testing, see “Connecting the test leads to the EUT” (p.152). For details on patient leakage current testing, see “Connecting the test leads to the EUT” (p.194).

Using the flat probe

In the touch current test, to measure the touch current when the enclosure of the EUT is touched with the palm of your hand, use the supplied flat probe (FP01-TOS). The size of the metal foil of the FP01-TOS (10 cm × 20 cm) complies with IEC 60990.

Connect the FP01-TOS as shown below.



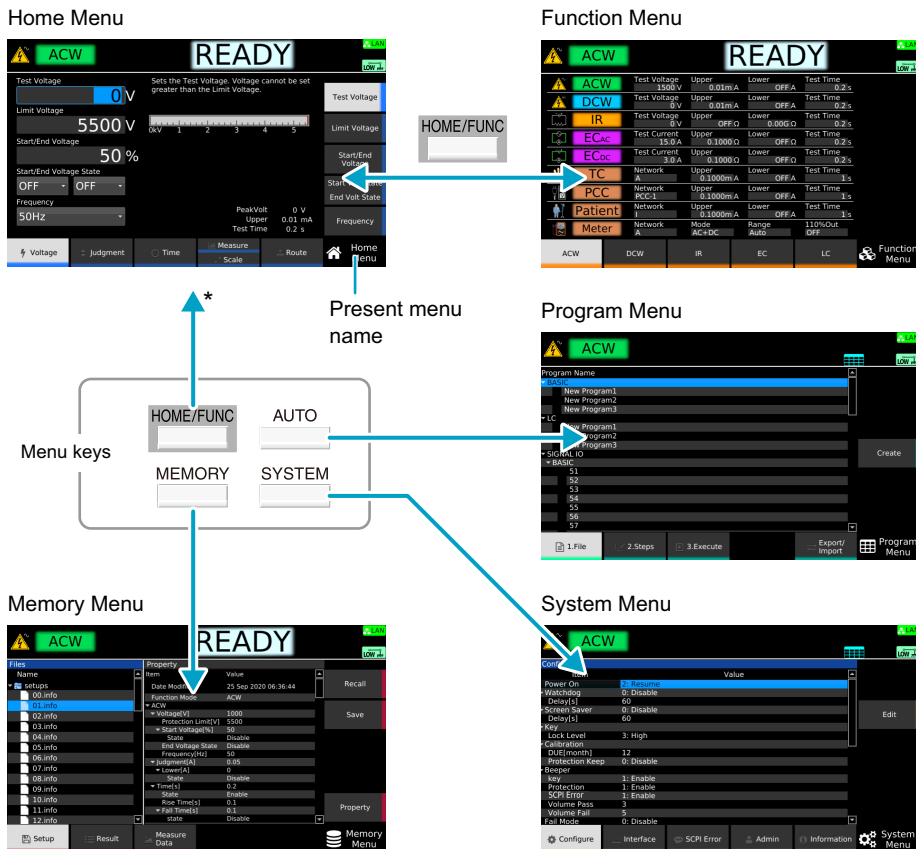
Basic Operation

Basic Panel Operations

Switching menus

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

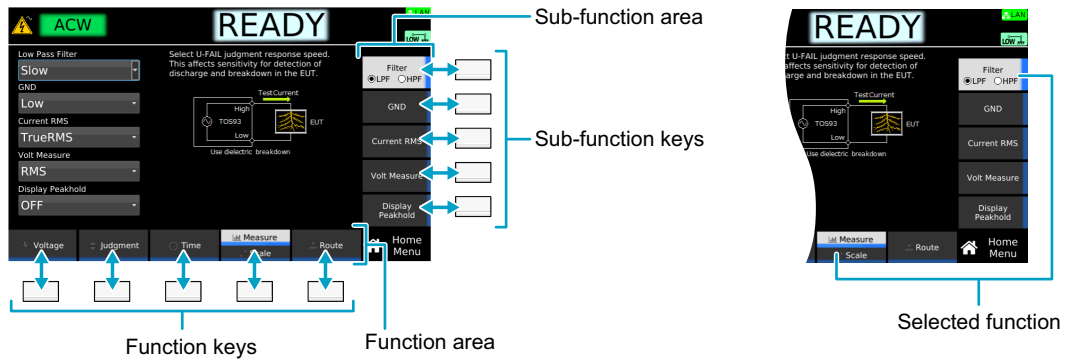
- Home Menu: Set the conditions of each test. Execute tests.
- Function Menu: Display a summary of settings of each test. Switch test modes.
- Memory Menu: Use the memory function.
- System Menu: Display and change system settings.
- Program Menu: Configure and execute auto tests.



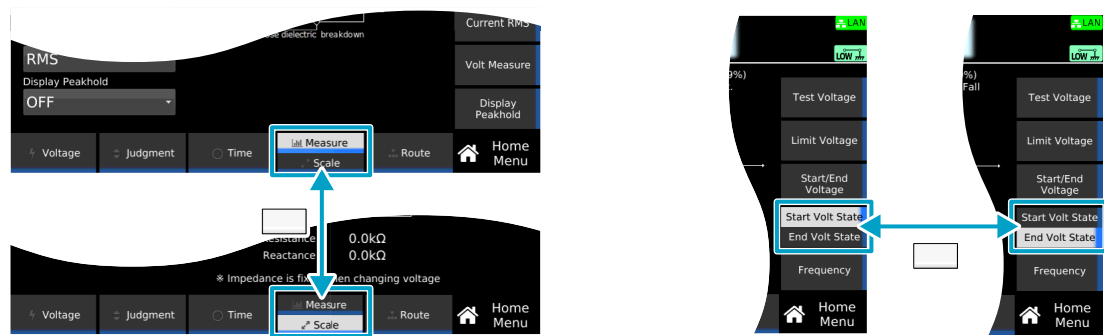
* If the Home menu is displayed, the screen switches to the Function menu. Otherwise, the screen switches to the Home menu.

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.

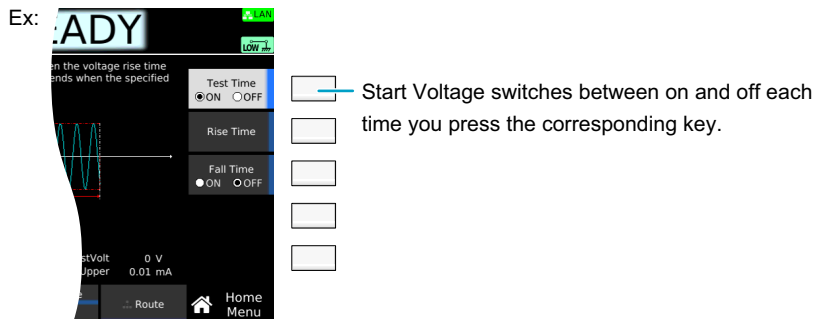


If several functions are displayed for a single key, the function switches each time you press the key.



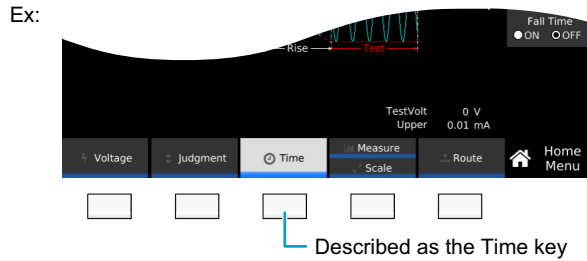
Turning a function on and off

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.



Key names

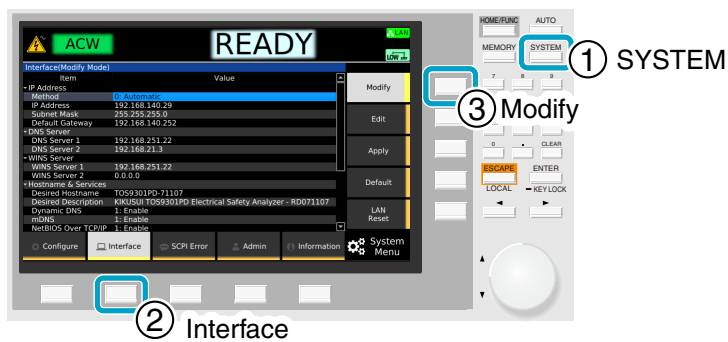
Individual function keys and sub-function keys are distinguished by indicating the function names shown in the function area or sub-function area as the key names.



Operation example (enabling the editing of the interface settings)

1 Press SYSTEM > Interface > Modify.

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



Inputting 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
Numeric input	Numeric keypad	You can enter numbers and a decimal point. To confirm a value after input, press the ENTER key.
	Rotary knob	You can enter numbers. Turn clockwise to increase the value and counterclockwise to decrease. The value is confirmed immediately upon input.
Character input	Numeric keypad	You can enter numbers and dots.
	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 (◀ or ▶) key to move the cursor.
Cursor movement	Arrow (◀▶) keys	Moves one digit to the right/left or between entry fields.
Delete	CLEAR key	Deletes the number or character on the left of the cursor or the selected range.
Cancel	ESCAPE key	Cancels numeric/character input.

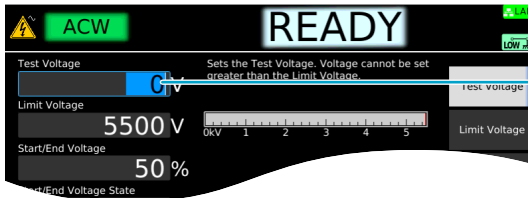
Entering from an external keyboard

If you connect a keyboard to the USB port on the front panel, you will be able to control the product 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 switch	[Alt] + [t]
Program Menu display	[Alt] + [p]
Home Menu display	[Alt] + [h]
System Menu display	[Alt] + [y]

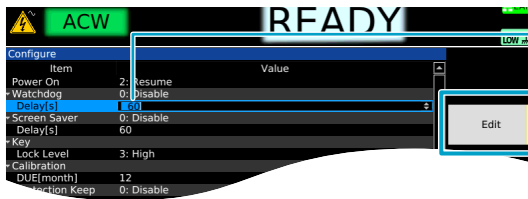
Changing values

To change the test voltage or other values, use the numeric keypad or the rotary knob. If you enter a value with the numeric keypad, following input, press the ENTER key to confirm the value.

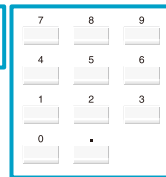


Use the numeric keypad or the rotary knob to change the value.

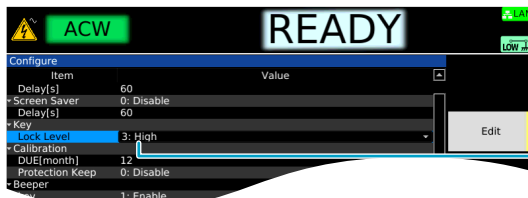
On screens in which “Edit” is shown in the sub-function area, use the rotary knob to select the item you want to change, and then press the Edit key or a numeric key to start changing the value. Procedures using the Edit key are provided in this document.



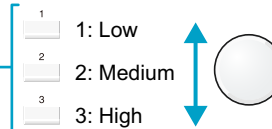
Pressing Edit or a numeric key makes it possible to edit the value.



When changing a setting, if there are multiple items you can choose from, select the item using the rotary knob. If there is a number before the item name, you can also select using the numeric keypad. Procedures using the rotary knob are provided in this document.



Numeric keypad Rotary knob



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



Use ENTER or Edit to confirm the value.



Selecting the Test Mode

The TOS93 series has the following test modes. The tests that can be selected varies depending on the model.

Test mode	Description
AC withstanding voltage (ACW)	This test evaluates whether the electrical insulation section of an electric product or component has enough dielectric strength for the voltage to be handled.
DC withstanding voltage (DCW)	This test evaluates whether the electrical insulation section of an electric product or component has enough dielectric strength for the voltage to be handled. This is used when the EUT's capacitive component is large and judging the dielectric breakdown is difficult using ACW.
Insulation resistance (IR)	This test evaluates whether the electrical insulation section of an electric product or component has enough resistance for the voltage to be handled. There is a 7200 V test and a -1000 V test (-1000 V test only on the TOS9300).
Earth continuity (EC)	This test evaluates the continuity of the protective connection of devices (Class I devices) that are designed to ensure safety with basic insulation and protective earth grounding. There is a DC test and an AC test.
Partial discharge (PD)	This test detects partial discharge before a dielectric breakdown is reached and evaluates latent defects and deviations in manufacturing of components.
Leakage current (LC)	This test measures leakage current of parts that can be touched on a device and evaluates the risk of electric shock. In leakage current test mode, measurements can be made using the following three tests and meter modes.
Touch current (TC)	This test measures the current that flows from the enclosure of devices not connected to protective ground through a simulated human body network to the ground. If the measurement does not exceed the value assumed to be harmful to human bodies as defined in safety standards or the like, the product meets the electric shock prevention requirements.
Protective conductor current (PCC)	This test measures the current that flows through the protective conductor of devices that are connected to protective ground. This test is also used to confirm the EUT's compatibility to power distribution systems.
Patient leakage current (Patient)	This test measures the current that flows from a wearable part of a medical instrument through a simulated human body network to the ground. If the measurement does not exceed the value assumed to be harmful to human bodies as defined in safety standards or the like, the product meets the electric shock prevention requirements.
Meter mode (Meter)	Like typical multimeters, the current and voltage across the LEAKAGE CURRENT A and B terminals on the front panel are measured and displayed. No judgment is made based on reference values.

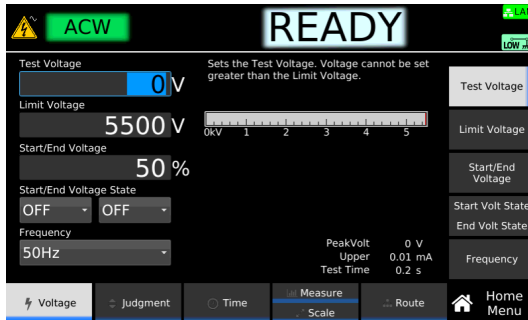
■ Tests supported by each model

	TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
ACW	✓	✓	✓	✓	✓	✓
DCW	—	✓	✓	—	✓	✓
IR	✓	✓	✓	—	✓	✓
EC	—	—	—	✓	✓	✓
PD	—	—	✓	—	—	—
LC	—	—	—	—	—	✓

Selecting the test mode

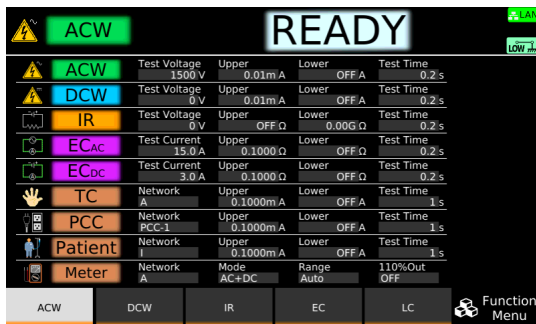
Select the test mode on the Function menu screen. The tests that can be selected varies depending on the model.

- 1 On the Home menu screen, press HOME/FUNC.



Example: Home menu screen of ACW

The Function menu screen appears.



Example: TOS9303LC Function Menu

- 2 On the Function menu screen, press a function key to select the test mode.
If you select IR, EC, or LC, press a sub-function key to select the sub test mode.
This completes the selection procedure.

Withstanding Voltage and Insulation Resistance Tests

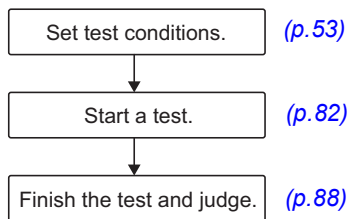
Applicable models for AC withstanding voltage (ACW): All models

Applicable models for DC withstanding voltage (DCW): **9301**, **9301PD**, **9303**, **9303LC**

Applicable models for insulation resistance (IR): **9300**, **9301**, **9301PD**, **9303**, **9303LC**

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

The following flowchart shows the configuration and test steps.



Setting Test Conditions

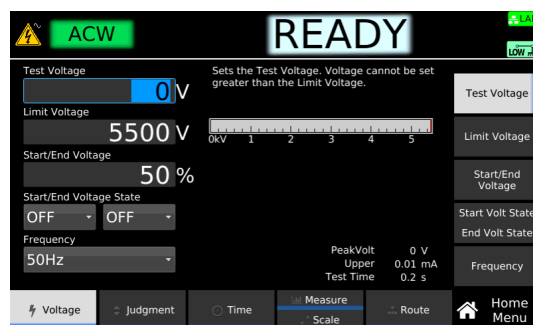
This section describes the test conditions of AC withstanding voltage (ACW), DC withstanding voltage (DCW), and insulation resistance (IR) tests and how to set the conditions.

Displaying the setup screen (Home menu)

- 1 On the Function menu screen (p.46), press **ACW**, **DCW**, or **IR**.

If you press IR, select the voltage range with the sub-function keys (7200 V or -1000 V) (excluding the TOS9300).

The setup screen (Home menu) for the ACW, DCW, or IR test conditions appears.



Example: Home menu screen of ACW

Set the required conditions by referring to the description of test conditions (p.54).

Description of test conditions

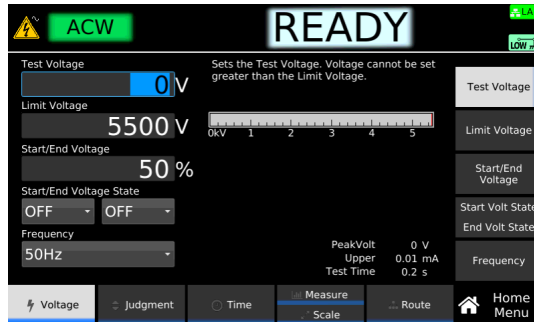
The test conditions you can set vary for ACW, DCW, and IR.
The following test conditions with a check mark can be used with the corresponding test.

ACW	DCW	IR	Test condition	Description	See
✓	✓	✓	Test voltage	Voltage to apply to the EUT.	p.55
✓	✓	✓	Limit voltage	Upper limit of voltage to apply to the EUT.	p.56
✓	✓	✓	Start voltage	Voltage 0.1 seconds after pressing the START switch	p.57
✓	✓	–	End Voltage	Voltage at the end of Fall Time.	p.58
✓	–	–	Frequency	Test voltage frequency.	p.59
✓	✓	✓	Upper limit	Current or resistance used as a reference for upper limit judgment	p.60
✓	✓	✓	Lower limit	Current or resistance used as a reference for lower limit judgment	p.61
–	–	✓	Unit of criteria (Judge Type)	The unit of upper and lower limits.	p.62
–	✓	✓	Auto setting of the judgment delay (Delay Auto)	Select the time (auto or manual) from when the START switch is pressed until the upper limit judgment starts.	p.63
✓	✓	✓	Test time	Time from when the voltage rise time has passed to the end of the test.	p.65
✓	✓	✓	Voltage rise time	The time from when the START switch is pressed or from the start voltage to when the test voltage is reached.	p.66
✓	✓	–	Voltage fall time	The time from a pass judgment until the voltage falls.	p.67
–	✓	✓	Discharge time	The time for discharging the voltage residing in the high voltage charge area.	p.68
–	✓	✓	Discharge when interlock is activated (Discharge Interlock)	Discharges the voltage when the interlock is activated.	p.69
✓	✓	–	Current detection response speed (Filter)	Response speed for detecting current (sensitivity).	p.70
✓	✓	✓	Grounding mode (GND)	Select whether to include the current running through the stray capacitance of test leads, tools, and the like in measurements.	p.71
✓	–	–	Current measurement mode (Current RMS)	Select whether to measure current in true rms values or measure by converting the mean-value responses to rms values.	p.73
✓	✓	–	Voltage measurement mode (Volt Measure)	Select whether to measure voltage in true rms values or peak values.	p.74
–	–	✓	Using the low-pass filter	Stabilize measurements when measuring at high sensitivity or when the measurements are unstable and hard to read.	p.75
✓	✓	✓	Peak value display (Display Peakhold)	Select whether to display the maximum value of current for the ACW test and DCW test, or the minimum value of resistance for the IR test, during the test and in the judgment result.	p.76
✓	–	–	Offset (Offset Real, Offset Imag)	Offset the real part and imaginary part of the current running through the stray capacitance of test leads, tools, and the like.	p.77
–	✓	✓	Offset	Applies an offset to the current or resistance of test leads, tools, etc.	p.78
✓	✓	✓	Checking the scanner contact (Contact Check)	Check the continuity between the test leads connected to the scanner and the EUT.	p.79
✓	✓	✓	Setting scanner channels (Edit)	Switches the connection (high, low, open) of each channel of the scanner.	p.80
✓	✓	✓	Opening the scanner (All Open)	Set all channels of the scanner to open.	p.81

Test voltage

Set the voltage to apply to the EUT. You cannot specify a voltage that exceeds the limit voltage (p.56).

1 On the Home menu screen, press Voltage > Test Voltage.



Example: Home menu screen of ACW

2 Use the numeric keypad or the rotary knob to enter the voltage.

ACW setting range: 0 V to 5500 V

DCW setting range: 0 V to 7500 V

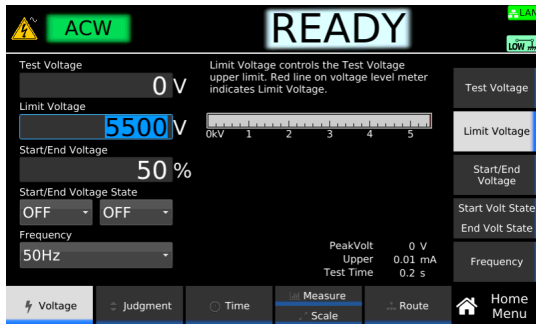
IR setting range: 0 V to 1020 V (-1000 V test), 0 V to 7500 V (7200 V test)

This completes the setting.

Limit voltage

Set the upper limit of the voltage to apply to the EUT. This prevents unnecessarily high voltage from being applied to the EUT by mistake.

1 On the Home menu screen, press Voltage > Limit Voltage.



Example: Home menu screen of ACW

2 Use the numeric keypad or the rotary knob to enter the voltage.

ACW setting range: 0 V to 5500 V

DCW setting range: 0 V to 7500 V

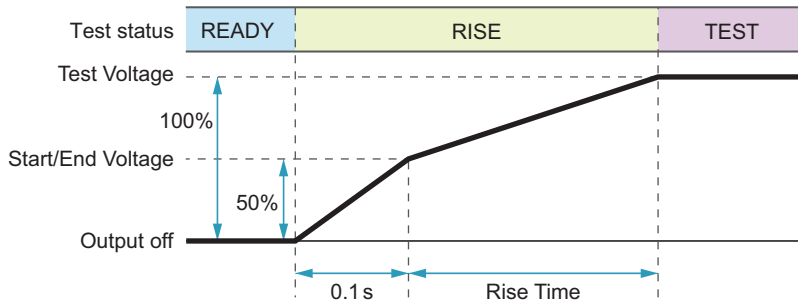
IR setting range: 0 V to 1020 V (-1000 V test), 0 V to 7500 V (7200 V test)

This completes the setting.

Start voltage

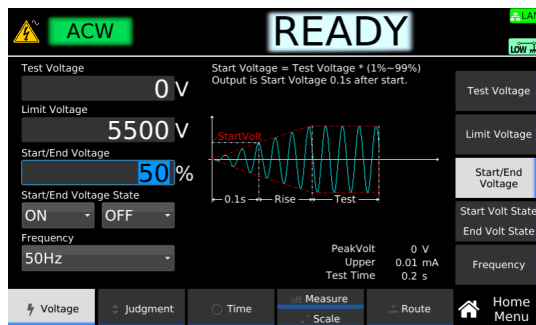
Set the voltage 0.1 seconds after the START switch is pressed as a percentage of the test voltage. If you do not want to set the start voltage, set Start Voltage to off.

- When the start voltage is 50%



1 On the Home menu screen, press Voltage > Start Voltage.

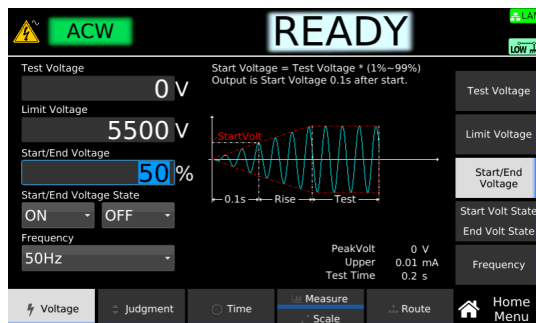
Each time you press the Start Volt State key, the setting changes between Start Volt State and End Volt State.



Example: Home menu screen of ACW

2 Turn the rotary knob to select ON or OFF.

3 If you select ON, press Start/End Voltage, and then use the numeric keypad or the rotary knob to enter a percentage value.



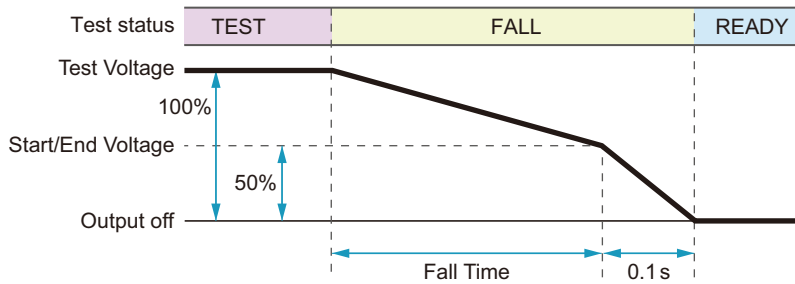
This completes the setting.

End Voltage

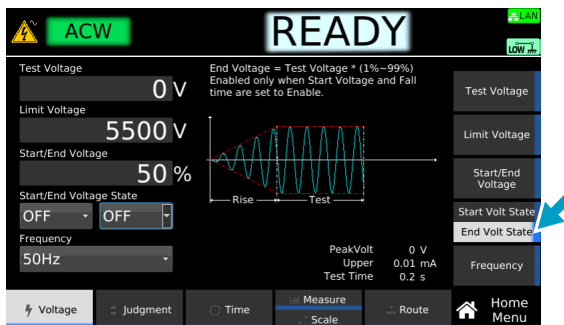
Set a voltage to finish Fall Time (p.67) in percentage to the Test voltage. Once the voltage has reached End Voltage, it will fall to around 0 V in 0.1 sec.

This command is valid when both Start Volt State (p.57) and Fall Time (p.67) are set to ON. If you do not want to set the end voltage, set End Volt State to off.

■ When Start/End Voltage is set to 50%

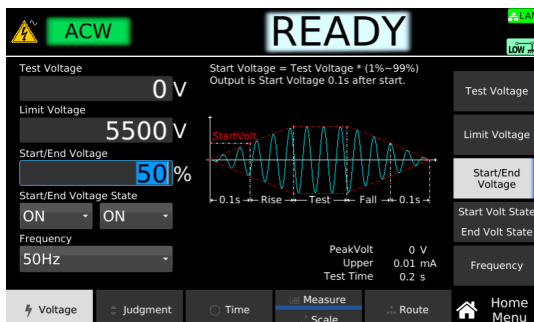


- 1 On the Home Menu screen, press Voltage.
- 2 Press End Volt State repeatedly until End Volt State is selected. Each press of the key switches between Start Volt State and End Volt State.



Example: Home Menu screen of ACW

- 3 Turn the rotary knob to select ON or OFF.
- 4 If you select ON, press Start/End Voltage, and then use the numeric keypad or the rotary knob to enter a percentage value.



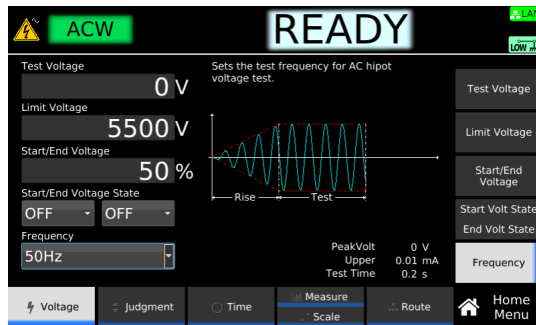
This completes the setting.

Frequency

This can be set only for AC withstanding voltage (ACW) tests.

Set the test voltage frequency to 50 Hz or 60 Hz. $\sqrt{\text{V}}50\text{Hz}$ / $\sqrt{\text{V}}60\text{Hz}$ appears during testing according to the setting.

- 1 On the Home menu screen, press Voltage > Frequency.



- 2 Turn the rotary knob to change the value.
This completes the setting.

Upper limit

Set the reference current or resistance for upper limit judgment. If current greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results. In insulation resistance (IR) tests, you can set Upper to off if upper limit judgment is not necessary.

In IR tests, the criteria can be set in terms of resistance or current (p.62).

NOTE Normally, even a good EUT will have a certain degree of leakage current. In IR tests, 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 > Upper.

In IR tests, Upper switches between on and off each time you press the Upper key.



Example: Home menu screen of ACW



Switch between on and off.

Example: Home menu screen of IR

2 Use the numeric keypad or the rotary knob to enter the current or resistance value.

ACW setting range: 0.01 mA to 110.00 mA

DCW setting range: 0.01 mA to 21.00 mA

IR setting range: 0.001 MΩ to 100.000 GΩ, 0.0001 mA to 1.0100 mA

This completes the setting.

Lower limit

Set the reference current or resistance for lower limit judgment. If current less than or equal to Lower is measured after the voltage reaches the test voltage, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.

In insulation resistance (IR) tests, the criteria can be set in terms of resistance or current ([p.62](#)).

NOTE Normally, even a good EUT will have a certain degree of leakage current. In ACW or DCW tests, setting the limit slightly less than the leakage current 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 > Lower.



Example: Home menu screen of ACW

2 Press Lower to switch between on and off.

Lower switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the current or resistance value.

ACW setting range: 0.00 mA to 109.99 mA

DCW setting range: 0.00 mA to 20.99 mA

IR setting range: 0.000 MΩ to 99.999 GΩ, 0.0000 mA to 1.0099 mA

This completes the setting.

Unit of criteria (Judge Type)

Set the unit of the upper limit (p.60) or lower limit (p.61) for insulation resistance (IR) tests to resistance or current.

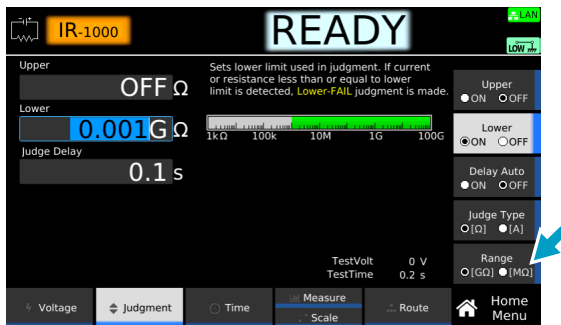
1 On the Home menu screen, press Judgment > Judge Type.

If the Judge Type key is not displayed, press Upper or Lower to display it. Each time you press Judge Type, the unit of Upper and Lower values switch between Ω and A.



2 If you select resistance ([Ω]), press Range to select the unit.

If the Range key is not displayed, set Upper or Lower to on to display it. Each time you press the key, the unit of Upper and Lower values switch between G Ω , and M Ω .



This completes the setting.

Auto setting of the judgment delay (Delay Auto)

This can be set only in DC withstanding voltage (DCW) and insulation resistance (IR) tests.

When the test voltage is applied to an EUT with a capacitive component, a large charge current may flow until charging is completed. Judgment errors due to the effects of the charge current can be prevented by setting a delay (Judge Delay) from when the START switch is pressed to when upper limit judgment is started.

Set Delay Auto to on or off to select auto or manual setting of the judgment delay.

Value	Description
ON	Upper limit judgment will start automatically when the voltage reaches the test voltage and judgment becomes possible. If the output voltage is 200 V or more and the voltage rise rate is less than approximately 1 V/s before the judgment starts, UPPER FAIL ¹ occurs, and the test ends. Problems can be discovered quickly such as when the EUT is shorted.
OFF	Set the judgment delay (Judge Delay) manually. Refer to the following, and set a delay shorter than the sum of Voltage rise time (p.66) and Test time (p.65).

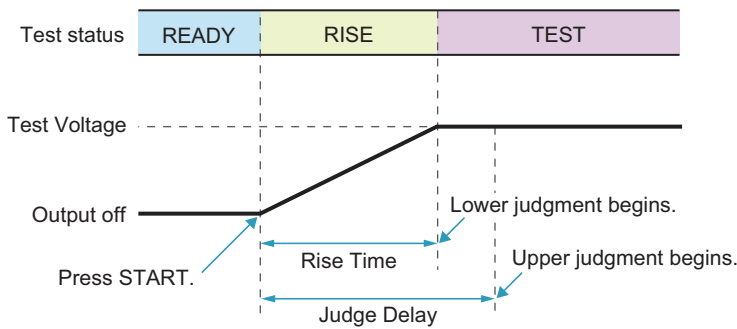
1 In an IR test, if Judge Type is set to Ω, LOWER FAIL will occur.

NOTE

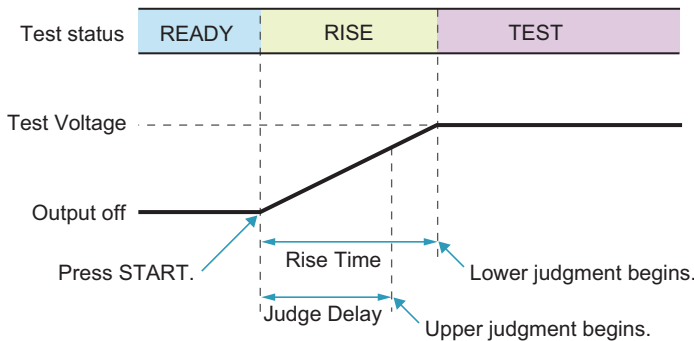
In a insulation resistance (IR) test, consider the following:

- Making judgments on 200 μA or less requires at least 3 seconds after the rise time ends.
- Making judgments when the low pass filter (p.75) is set to on requires at least 10 seconds after the rise time ends.

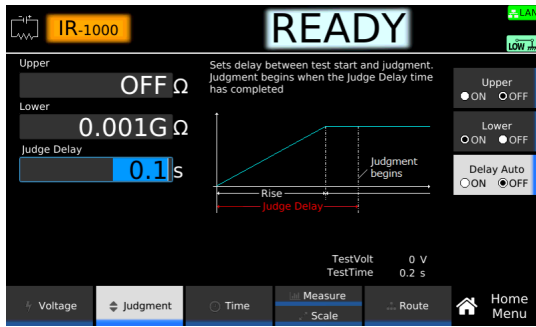
■ When Judge Delay is longer than Rise Time



■ When Judge Delay is shorter than Rise Time



1 On the Home menu screen, press Judgment > Delay Auto.



Example: Home menu screen of IR

2 Press Delay Auto to switch between ON and OFF.

Delay Auto switches between on and off each time you press the key.

3 If you select off, use the numeric keypad or the rotary knob to enter the time.

Setting range: 0.1 s to 100.0 s

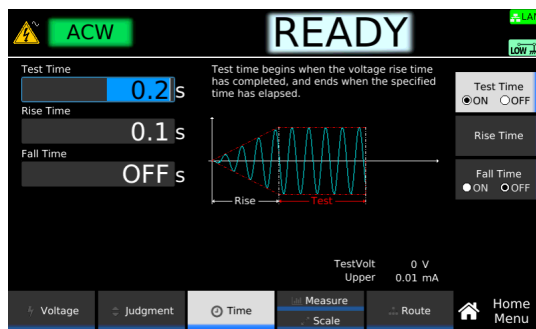
This completes the setting.

Test time

Set the test time to on or off.

Value	Description
ON	Set the time from when the Voltage rise time (p.66) has passed to the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS. For insulation resistance (IR) tests, making judgments at 1 μ A or less requires the test time to be at least 1.0 second.
OFF	The test continues until the STOP switch is pressed. Pass judgments are not made.

1 On the Home menu screen, press Time > Test Time.



Example: Home menu screen of ACW

2 Press Test Time to switch between on and off.

Test Time switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

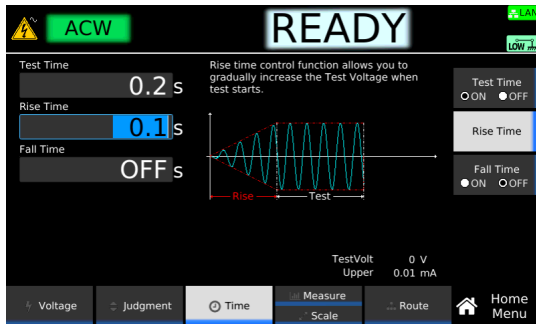
Setting range: 0.1 s to 1000.0 s

This completes the setting.

Voltage rise time

Set the time from when the START switch is pressed until the test voltage (p.55) is reached or the time for the voltage to change from the start voltage (p.57) to the test voltage.

- 1 On the Home menu screen, press Time > Rise Time.



Example: Home menu screen of ACW

- 2 Use the numeric keypad or the rotary knob to enter the time.
Setting range: 0.1 s to 200.0 s
This completes the setting.

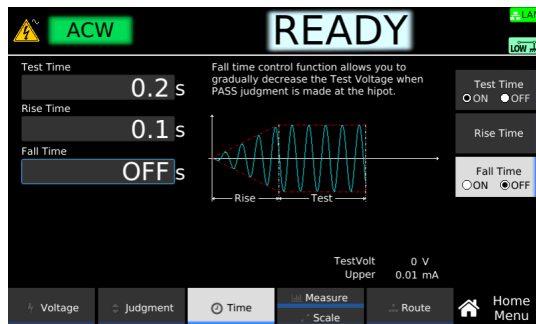
Voltage fall time

This can be set only for AC withstanding voltage (ACW) and DC withstanding voltage (DCW) tests.

Set the time for the voltage to fall from the test voltage to around 0 V or to Start/End Voltage (p.58) after PASS judgment.

In DCW tests, a transition is made to Discharge time (p.68) after the fall time ends. If Fall Time is set to off and a fail judgment occurs or the STOP switch is pressed during the test, discharge starts immediately without transitioning to Fall Time.

1 On the Home menu screen, press Time > Fall Time.



Example: Home menu screen of ACW

2 Press Fall Time to switch between on and off.

Fall Time switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 0.1 s to 200.0 s

This completes the setting.

Discharge time

This can be set only in DC withstanding voltage (DCW) and insulation resistance (IR) tests.

During a test, the EUT, test leads, test probes, output terminals, and other peripheral components are charged to a high voltage. Set the time for discharging the voltage remaining in the high voltage charge area after the test ends. If voltage remains even after the set discharge time elapses, discharge continues until the voltage reaches 30 V.

In DCW tests, discharge starts after Voltage fall time (p.67) is finished. If Fall Time is set to off and a fail judgment occurs or the STOP switch is pressed during the test, discharge starts immediately without transitioning to Fall Time.

■ Estimated discharge time

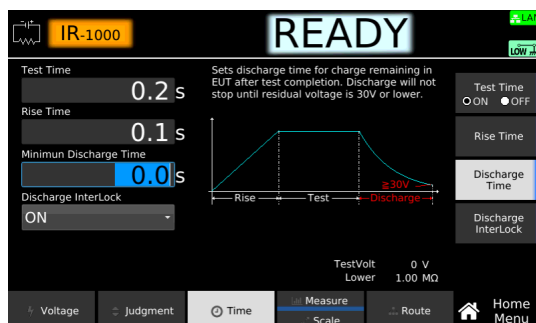
The time required to discharge the built-up electrical charge varies according to the test voltage and the properties of the EUT.

The time that this product requires to discharge the voltage from its internal capacitors down to 30 V is as follows:

- When an EUT is not connected: 16 ms for a DCW test, 1.5 ms for an IR test
- When an EUT with a input capacitance of 0.05 μF is connected: 50 ms for a DCW test, 6 ms for an IR test

■ Setup procedure

1 On the Home menu screen, press Time > Discharge Time.



Example: Home menu screen of IR

2 Use the numeric keypad or the rotary knob to enter the time.

Setting range: 0.0 s to 100.0 s

This completes the setting.

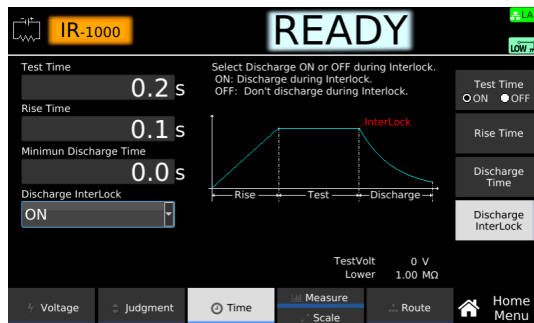
Discharge when interlock is activated (Discharge Interlock)

This can be set only in DC withstanding voltage (DCW) and insulation resistance (IR) tests.

During a test, the EUT, test leads, test probes, output terminals, and other peripheral components are charged to a high voltage. Set whether to discharge the voltage remaining in the high voltage charge area if the interlock is activated ([p. 239](#)) during a test.

Value	Description
ON	The voltage remaining in the high voltage charge area is discharged if the interlock is activated during a test. Use this when you do not want the voltage to remain if the interlock is activated, such as when a capacitive EUT is connected.
OFF	The output's high voltage relay is opened to shut off the output if the interlock is activated.

1 On the Home menu screen, press Time > Discharge Interlock.





Example: Home menu screen of IR

2 Turn the rotary knob to change the value. This completes the setting.

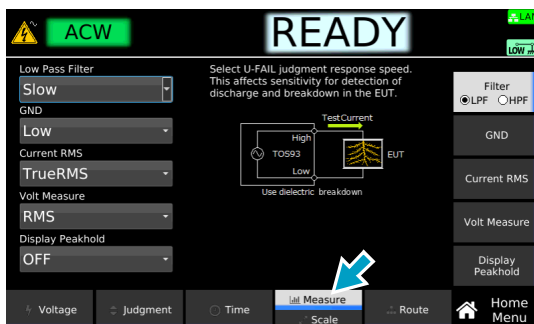
Current detection response speed (Filter)

This can be set only for AC withstanding voltage (ACW) and DC withstanding voltage (DCW) tests.

Set the response speed (sensitivity) for detecting the current when making upper limit judgments. An icon appears during testing according to the setting.

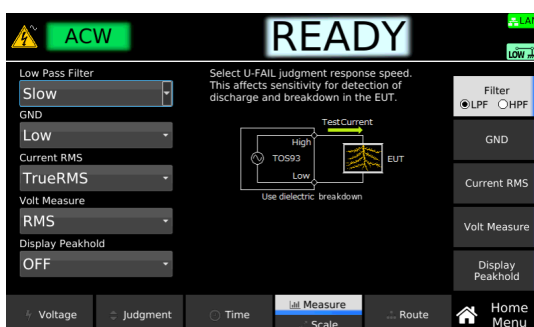
Value	Description	Icon
LPF (Low Pass Filter)	Slow	
	Medium	
	Fast	
HPF (High Pass Filter)	Slow	
	Fast	

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



Example: Home menu screen of ACW



- 2 Press Filter to switch between LPF and HPF. Each time you press the key, the setting changes between LPF and HPF.



- 3 Turn the rotary knob to change the value. This completes the setting.

Grounding mode (GND)

Select whether to include the current running through the stray capacitance (p.321) of test leads, tools, and the like in measurements. An icon is shown in the upper right of the display according to the setting.

Value	Description	Icon
Low	Measures by including the current running through the stray capacitance across test leads or tools and ground and the current running through the insulation resistance. Tests can be performed safely without the risk of shorting the ammeter.	
Guard	High-sensitivity high-precision measurement is possible because the current running through the stray capacitance across test leads or tools and ground and the current running through the insulation resistance are excluded from measurement. Use this mode only when the EUT and tools and the like are completely floating. If one end of the EUT is grounded to earth or if the LOW terminal and chassis are shorted, the ammeter will be shorted. This is extremely dangerous.	

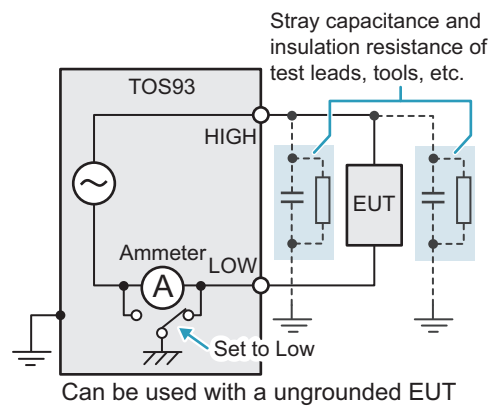
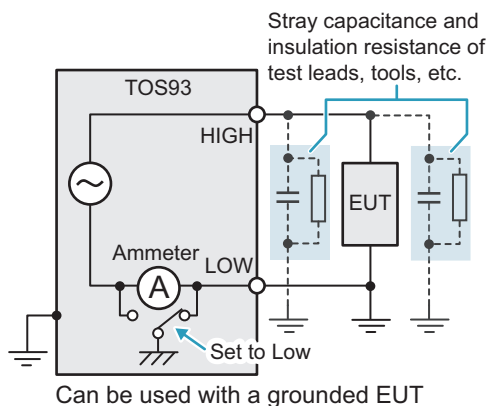
⚠ WARNING

- If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain about it, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current.
- If you set GND to Guard, do not connect measuring instruments that are grounded at one end (e.g., Kikusui 149-10A High Voltage Digital Voltmeter, TOS1200 Current Calibrator) to this product. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current.

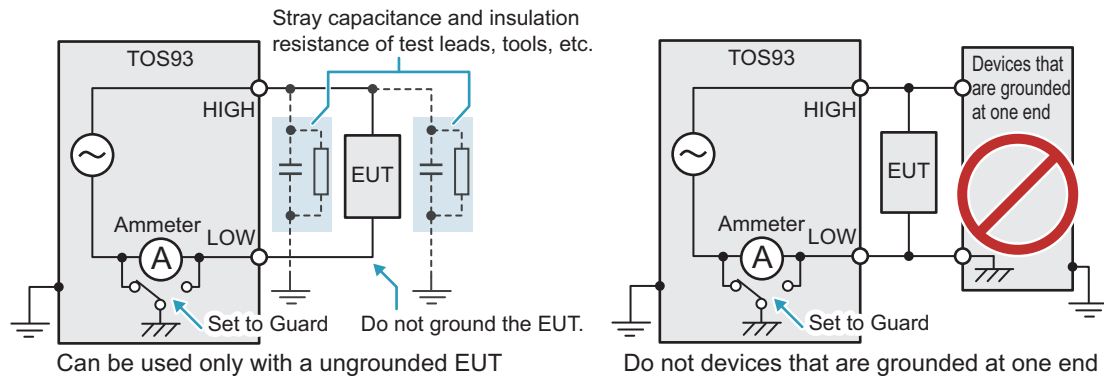
NOTE

Using the product in a high humidity environment when GND is set to low will adversely affect the measurement accuracy in insulation resistance tests. If the grounding mode (GND) is set to low in a high humidity environment, the current will leak to the ground from the high-voltage wiring sections inside the product and the high-voltage wiring sections between the product and the EUT. This leakage current ranges from several nA to several tens of μA depending on the usage and wiring conditions of the optional TOS9320 high voltage scanner. The effects of leakage current can be reduced by making measurements with the offset enabled.

■ When set to Low (example of ACW)

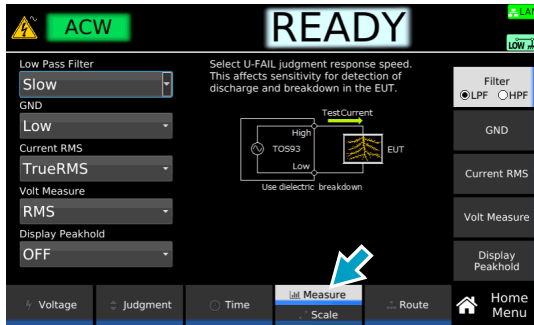


■ When set to Guard (example of ACW)



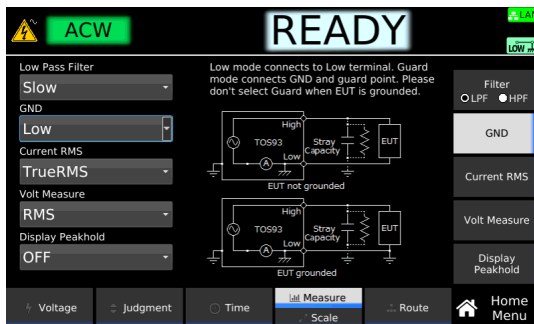
■ Setup procedure

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



Example: Home menu screen of ACW

- 2 Press GND, and then turn the rotary knob to change the value.



This completes the setting.

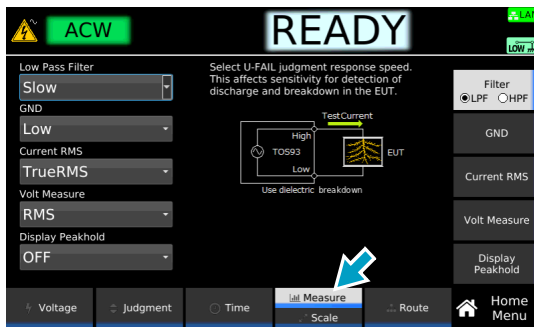
Current measurement mode (Current RMS)

This can be set only for AC withstanding voltage (ACW) tests.

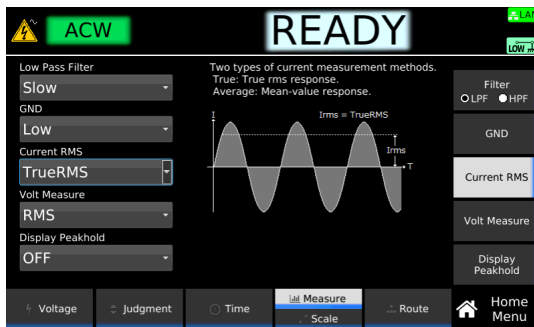
Sets the current measurement mode. An icon appears during testing according to the setting.

Value	Description	Icon
TrueRMS	Measures in true rms values.	TrueRMS
Average	Measures by converting the mean-value responses to rms values.	Average

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 **Press Current RMS, and then turn the rotary knob to change the value.**



This completes the setting.

Voltage measurement mode (Volt Measure)

This can be set only for AC withstanding voltage (ACW) and DC withstanding voltage (DCW) tests. Sets the voltage measurement mode. An icon appears during testing according to the setting.

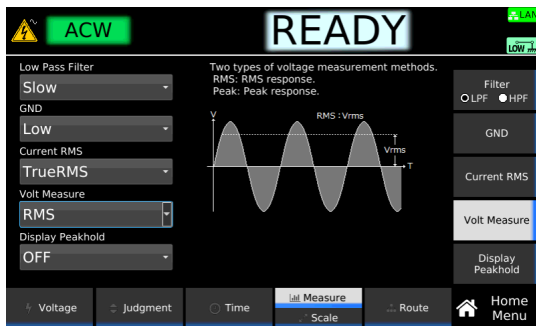
Value	Description	Icon
RMS (ACW only)	Measures in true rms values.	RMS
Average (DCW only)	Measures in average values.	Average
Peak	Measures in peak values.	Peak

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



Example: Home menu screen of ACW

- 2 **Press Volt Measure, and then turn the rotary knob to change the value.**



This completes the setting.

Using the low-pass filter

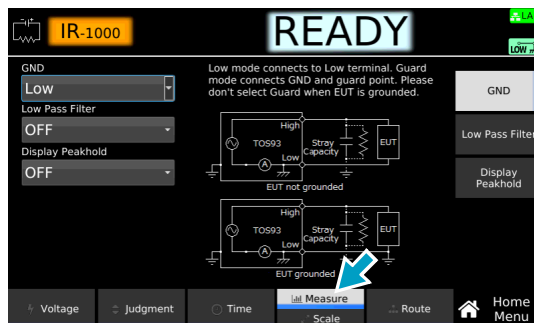
This can be set only in insulation resistance (IR) tests.

Turning the low-pass filter on stabilizes measurements when measuring at high sensitivity or when the measurements are unstable and hard to read. If the low pass filter is set to on, **LPF** appears during testing.

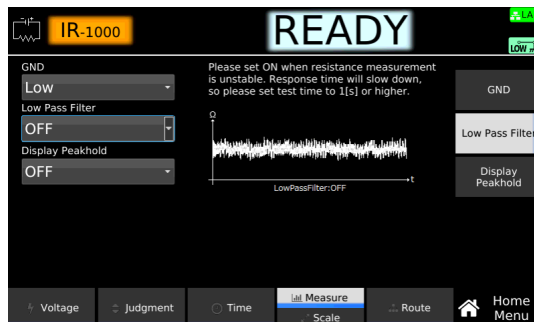
NOTE

Because the response will be slow if the low pass filter is set to on, making judgments will require at least 10 seconds after the rise time ends. 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 setting changes between Measure and Scale.



- 2 Press Low Pass Filter, and then turn the rotary knob to select ON or OFF.

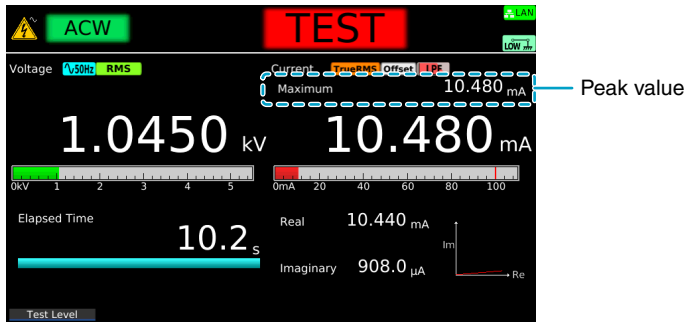


This completes the setting.

Peak value display (Display Peakhold)

When Display Peakhold is set to on, the maximum value of current is displayed during the test and in the judgment result for the ACW and DCW tests.

For the insulation resistance (IR) test, the minimum value of resistance is displayed during the test and in the judgment result.



- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



Example: Home menu screen of ACW

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



This completes the setting.

Offset (Offset Real, Offset Imag)

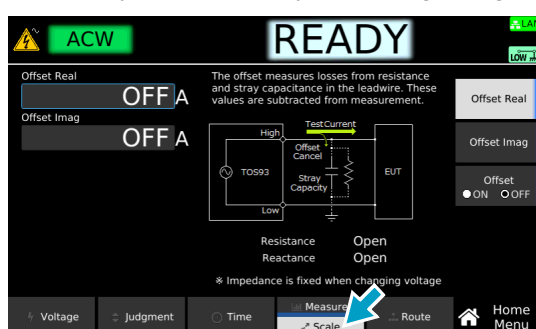
This can be set only for AC withstanding voltage (ACW) tests.

You can set the real part (Offset Real) and imaginary part (Offset Imag) of the offset for the current running through the stray capacitance of test leads, tools, and the like. If the offset is set to on, **Offset** appears during testing.

The offset current is recorded in terms of a resistance in the product. The actual offset current is calculated from the resistance and test voltage. Because the resistance resolution is 100 Ω , an error may occur in the measured value.

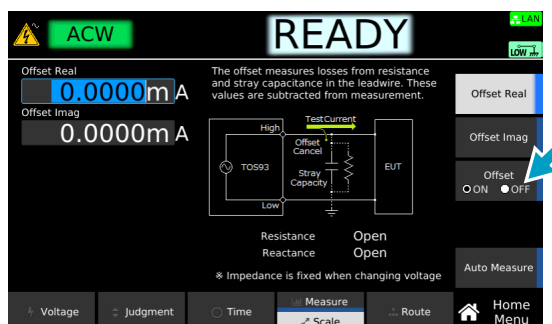
1 On the Home menu screen, press Scale repeatedly until Scale is selected.

Each time you press the key, the setting changes between Measure and Scale.



2 Press Offset to switch between on and off.

Offset switches between on and off each time you press the key.



3 If set to ON, set the Offset Real and Offset imag values according to the following procedure.

Purpose	Operation
Measure the Offset Real and Offset Imag values to set them automatically.	Press Auto Measure. Use the rotary knob or numeric keypad to enter the test voltage. Connect test leads to this product, and open the test leads. Press START. When the measurement stabilizes, press STOP. The Offset Real and Offset imag values are set automatically.
Set the Offset Real value manually.	Press Offset Real, and then use the numeric keypad or the rotary knob to enter the value. Setting range: 0.0000 mA to 10.0000 mA
Set the Offset imag value manually.	Press Offset imag, and then use the numeric keypad or the rotary knob to enter the value. Setting range: 0.0000 mA to 10.0000 mA

This completes the setting.

Offset

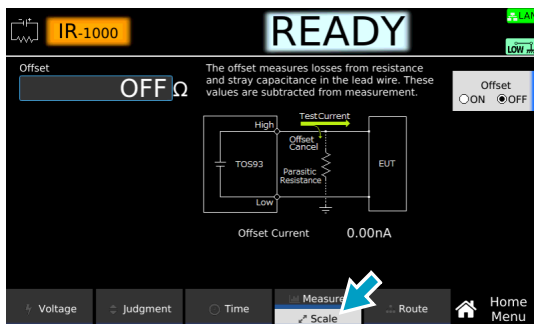
This can be set only in DC withstanding voltage (DCW) and insulation resistance (IR) tests.

An offset can be applied to the current or resistance of test leads, tools, etc. If the offset is set to on, **Offset** appears during testing.

The offset current is recorded in terms of a resistance in the product. The actual offset current is calculated from the resistance and test voltage. Because the resistance resolution is 100 Ω, an error may occur in the measured value.

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

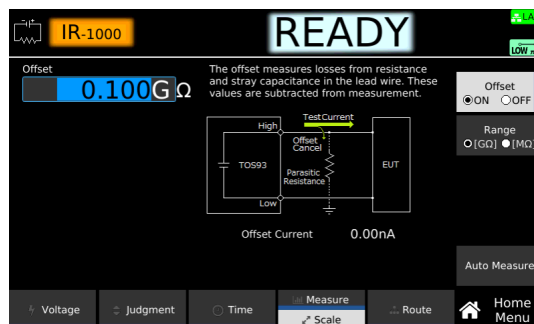
Each time you press the key, the setting changes between Measure and Scale.



Example: Home menu screen of IR

2 Press **Offset** to switch between on and off.

Offset switches between on and off each time you press the key.



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

Purpose	Operation
Measure the Offset value to set it automatically.	Press Auto Measure. Use the rotary knob or numeric keypad to enter the test voltage. Connect test leads to this product, and open the test leads. Press START. When the measurement stabilizes, press STOP. The Offset value is set automatically.
Set the Offset value manually.	Use the numeric keypad or the rotary knob to enter the value. For IR tests, the unit of resistance changes each time you press Range. DCW setting range: 0.0000 mA to 10.0000 mA IR setting range: 0.001 MΩ to 2000.0 GΩ

This completes the setting.

Checking the scanner contact (Contact Check)

Use this function when the TOS9320 high voltage scanner option (p.330) is connected.

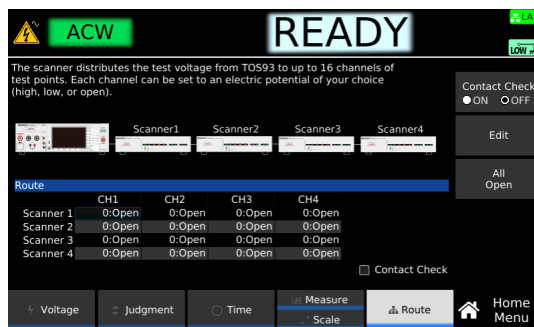
You can check the continuity between the test leads connected to the scanner channel set to High or Low and the EUT. When Contact Check is set to ON, "CHECK" will appear on the display, and continuity will be confirmed before the test voltage is applied after the START switch is pressed. When the continuity is confirmed, the test will begin.

The following equation can be used to calculate the execution time of a contact check.

Execution time = 50 ms + 30 ms × (number of channels set to High or Low)

For information on typical timing charts, see "Contact check operation" (p.322).

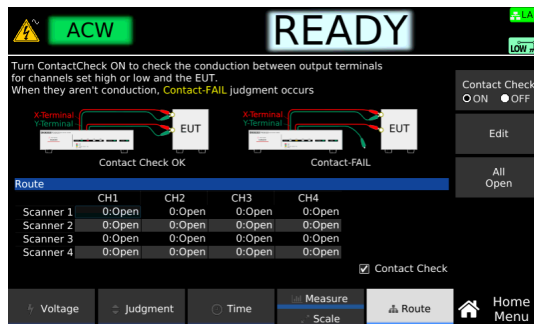
1 On the Home Menu screen, press Route.



Example: Home menu screen of ACW

2 Press Contact Check to switch between on and off.

Each time you press the key, Contact Check toggles between on and off.



This completes the setting.

If continuity cannot be confirmed

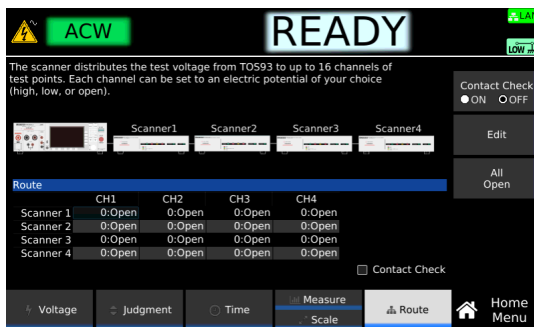
"Contact-FAIL" will appear in the top area of the display. The U FAIL and L FAIL signals of SIGNAL I/O Connector (p.235) will be set to on simultaneously. On the scanner side, the LED of the corresponding channel lights orange. Check that the test leads are connected properly.

Setting scanner channels (Edit)

Set the scanner channels when the TOS9320 high voltage scanner option (p.330) is connected.
Set each scanner channel connection to High, Low, or Open.

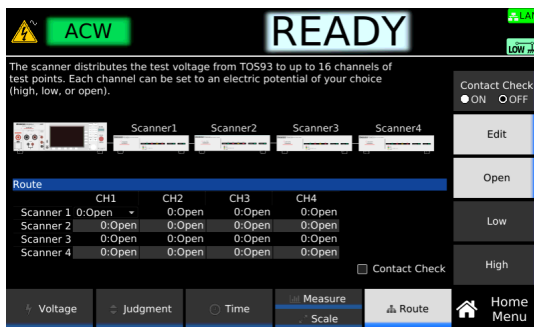
NOTE To make the association between the connected test lead and channels clear, affix the channel labels supplied with the scanner to the test leads.

1 On the Home menu screen, press Route.



Example: Home menu screen of ACW

2 Use the rotary knob and the arrow (◀▶) keys to select a channel, and then press Edit.



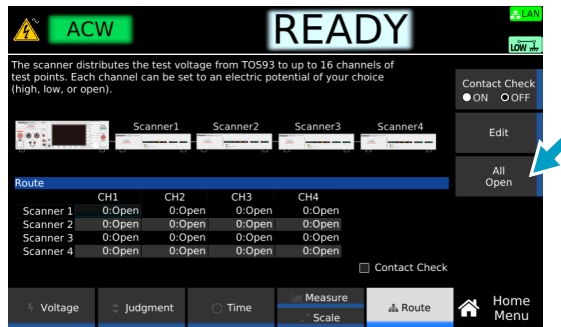
3 Use the sub-function keys to select Open, Low, or High and press ENTER.

4 To continue the settings, repeat step 2 and step 3 .
This completes the setting.

Opening the scanner (All Open)

Use this function when the TOS9320 high voltage scanner option (p.330) is connected.
You can set all channels of the scanner to open.

1 On the Home menu screen, press Route > All Open.



Example: Home menu screen of ACW

This completes the setting.

Starting a Test

We recommend that you perform a pre-test inspection ([p.279](#)) before executing a test.

Output time limit

When withstanding voltage tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit.

The following table shows the output time limit and rest time that are necessary when the ambient temperature is 40 °C or less. If you exceed the limit, the temperature of the output section may increase. This may cause the protection function to be activated and “OVER HEAT” to be indicated on the display. If this happens, stop testing and wait for the temperature to return to normal by referring to the rest time. If “READY” is displayed in the upper right of the display when you press the STOP switch, the temperature is back to normal.

Test mode	Upper limit (i)	Output time ¹ limit	Rest time
AC withstanding voltage (ACW)	$i \leq 50 \text{ mA}$	No limit	Not necessary
	$50 \text{ mA} < i \leq 110 \text{ mA}$	30 min. max.	At least the length of time the voltage was output
DC withstanding voltage (DCW)	$i \leq 5 \text{ mA}$	No limit	At least judgment delay (Judge Delay) ²
	$5 \text{ mA} < i \leq 20 \text{ mA}$	10 min. max.	At least the length of time the voltage was output

- 1 Includes the voltage rise time, test time, and voltage fall time.
- 2 If Delay Auto ([p.63](#)) is set to on, rest time is not necessary.

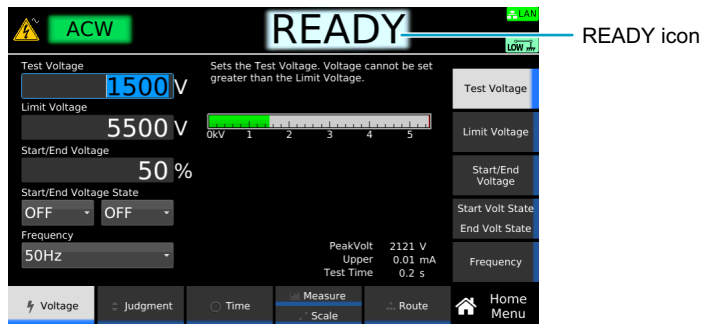
Starting a test

WARNING Risk of electric shock.

- While the **DANGER** LED is lit, do not touch the EUT, test leads, test probes, output terminals, or other peripheral components.
- When performing a test, be sure to wear rubber gloves for electrical work.

1 Check that the product is correctly connected to the EUT.

2 Check that “READY” is shown on the display, and then press **START**.



Example of ACW

The **DANGER** LED lights, and the test starts.

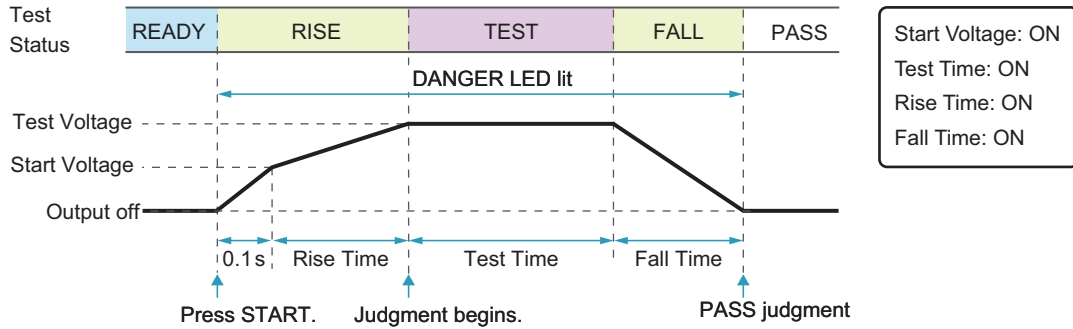
If the test does not start, see “Unable to start a test” (p.336).

If you want to start another test after the test finishes, set a rest time (p.82) between tests as necessary.

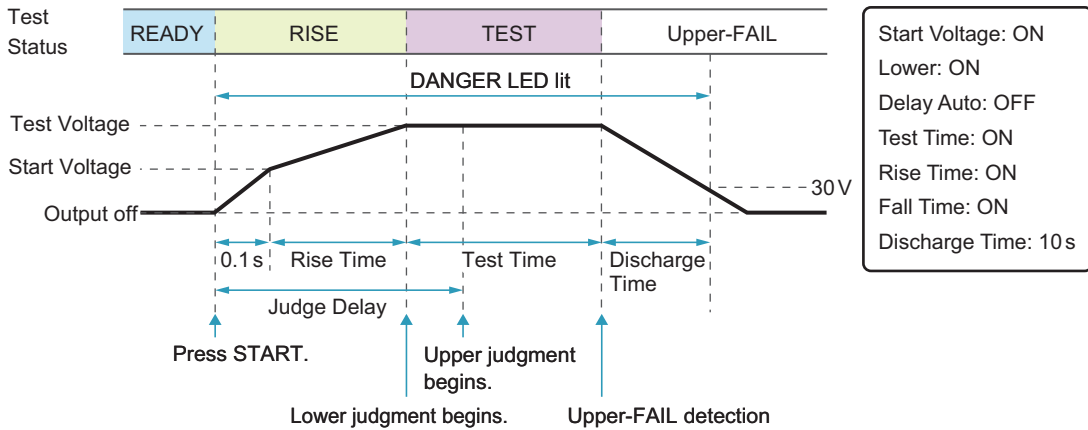
Operation after a test starts

Shown below are examples of operation after a test starts.

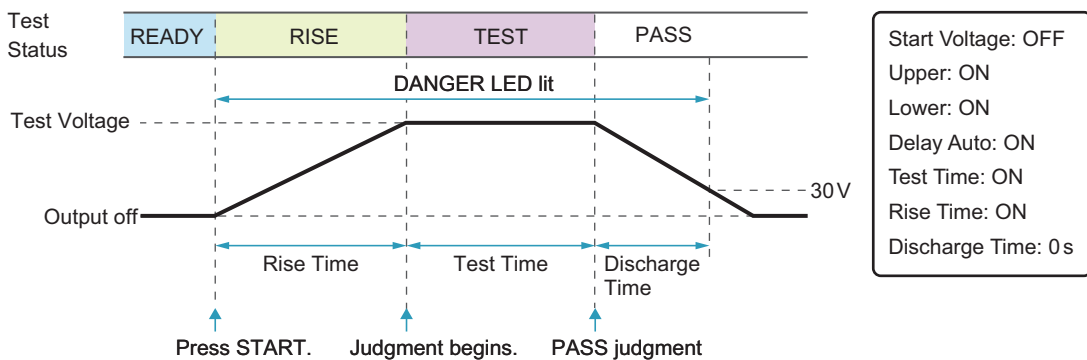
■ Example of an ACW test (PASS judgment)



■ Example of a DCW test (FAIL judgment)

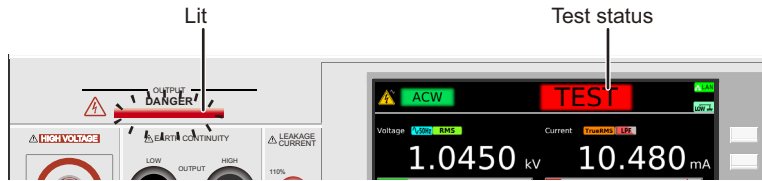


■ Example of an IR test (PASS judgment)



DANGER LED and test status display

During a test, the DANGER LED lights, and the test status is shown in the upper right of the display. The DANGER LED lights if voltage remains at the output terminals regardless of the test status.



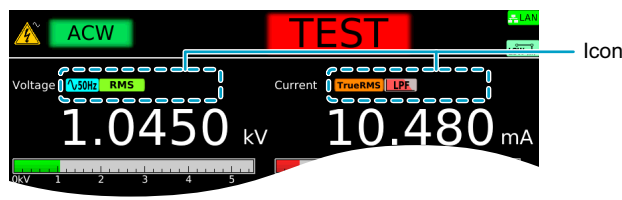
Test status	Description
TEST	Testing
↗RISE	Voltage rising
FALL↘	Voltage falling
CHECK	Performing Contact Check for scanner

Measurement display

During a test, measurements are shown on the display.

Test condition display

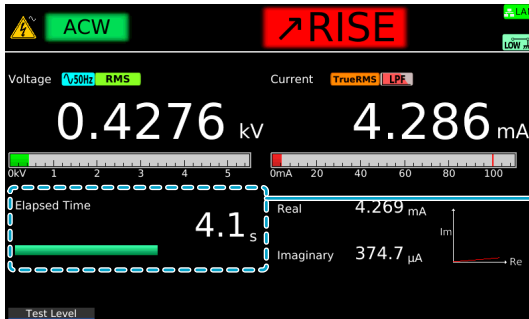
Icons indicating the test conditions appearing during testing.



Icon	Description
V50Hz/V60Hz	Frequency setting (50 Hz/60 Hz).
TrueRMS / Average	Current RMS setting (TrueRMS/Average).
RMS / Average / Peak	Volt Measure setting (RMS/Average/Peak).
Offset	Offsetting.
LPF / HPF	ACW or DCW test: Filter setting (LPF/HPF)
LPF	IR test: Low Pass Filter being set to ON.

■ Voltage rise time display

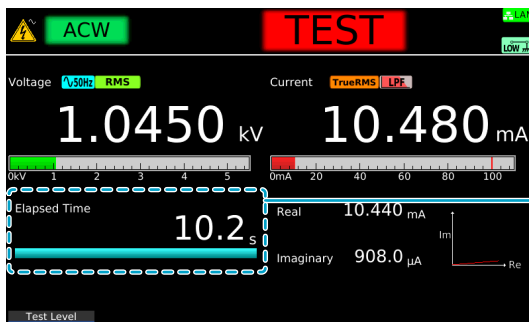
While the voltage is rising, “RISE” is displayed along with the elapsed time. The remaining rise time is displayed with a bar graph. When the time specified by Rise Time elapses, “TEST” is shown, and the test starts.



Elapsed time. The remaining rise time is displayed with a bar graph.

■ Test time display

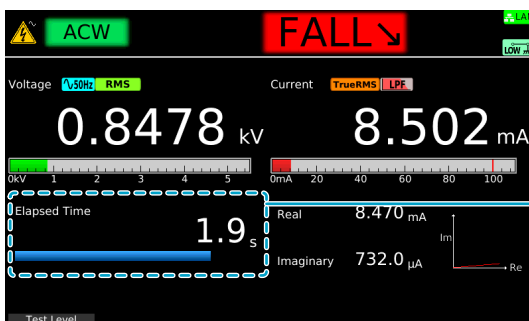
During the test time, “TEST” and the elapsed time are displayed. If Test Time is set to on, the remaining test time is displayed with a bar graph. If Test Time is set to off, the elapsed time is displayed up to 3600000.0 seconds. If the elapsed time is greater than 3600000.0, the display is fixed at 3600000.0.



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

■ Voltage fall time display

If Fall Time is set to on, “FALL” and the elapsed time are displayed while the voltage is falling. The remaining fall time is displayed with a bar graph.

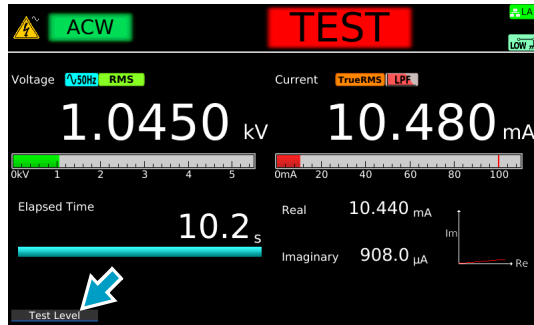


Elapsed time. The remaining fall time is displayed with a bar graph.

Changing the voltage setting during a test

During a test, press Test Level. Then, use the numeric keypad or the rotary knob to change the voltage. The changed voltage is immediately applied to the test, but the voltage value on the display shows the measured value. When “READY” appears in the upper right of the display after the test is finished, the new voltage setting will be displayed.

The Output Error may occur when the output changes suddenly.



Finishing the Test and Viewing the Judgment

Stopping tests

If you want to stop a test or finish a test when the test time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

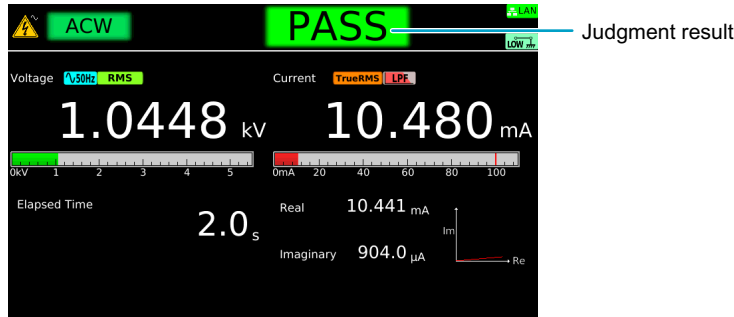
- a. When a current greater than or equal to Upper limit or less than equal to Lower limit is measured
- b. When the test time elapses if Test time is set to on
- c. When you press STOP

In any of the cases above, the "TEST" indication on the display disappears when the test ends. When the voltage residing at the output terminals is discharged, the DANGER LED turns off.

If the test finishes under condition a or b given above, the judgment result (p.89) will be shown on the display.

Judgment types and operation

When a test finishes, the judgment result is shown in the test status.



	Upper-FAIL	Lower-FAIL	Upper-FAIL (dV/dt)
Condition	A current greater than or equal to the upper limit was measured.	A current less than or equal to the lower limit was measured.	When Delay Auto is set to on in a DCW test and the output voltage is 200 V or more, the voltage rise rate (dV/dt) is less than approximately 1 V/s before starting a judgment.
Display	The test status shows “Upper-FAIL” until the judgment result is cleared.	The test status shows “Lower-FAIL” until the judgment result is cleared.	The test status shows “Upper-FAIL (dV/dt)” until the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.
SIGNAL I/O connector	U FAIL signal is output until the judgment result is cleared.	L FAIL signal is output until the judgment result is cleared.	U FAIL signal is output until the judgment result is cleared.

	Lower-FAIL (dV/dt)	Contact-FAIL	PASS
Condition	When Delay Auto is set to on in a IR test and the output voltage is 200 V or more, the voltage rise rate (dV/dt) is less than approximately 1 V/s before starting a judgment.	Continuity between the test lead and EUT could not be confirmed when the scanner is used with Contact Check enabled.	Upper-FAIL ,Lower-FAIL, or Contact-FAIL judgment did not occur during the test.
Display	The test status shows “Lower-FAIL (dV/dt)” until the judgment result is cleared.	The test status shows “Contact-FAIL” until the judgment result is cleared.	The test status shows “PASS” until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	L FAIL signal is output until the judgment result is cleared.	Both U FAIL and L FAIL signals are output simultaneously until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

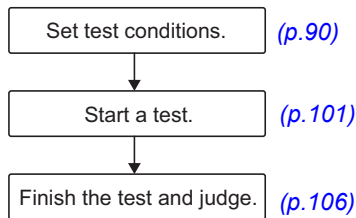
Press STOP to clear the judgment result. The product is ready to start another test.

Earth Continuity Test

Applicable models: **9302**, **9303**, **9303LC**

This chapter describes how to set test conditions, start tests, and view the results for earth continuity (EC) tests.

The following flowchart shows the configuration and test steps.

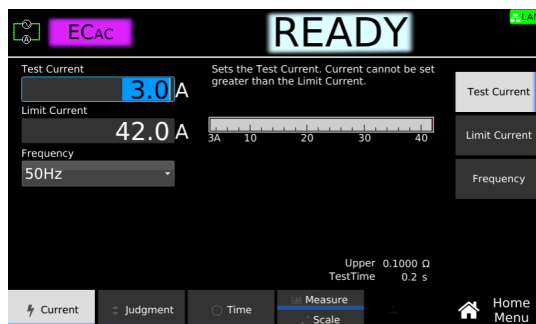


Setting Test Conditions

This section describes the test conditions of earth continuity (EC) tests and how to set the conditions.

Displaying the setup screen (Home menu)

- 1** On the Function menu screen (p.46), press EC.
- 2** Use the sub-function keys to select AC or DC.
The setup screen (Home menu) for the EC test conditions appears.



Set the required conditions by referring to the description of test conditions (p.91).

Description of test conditions

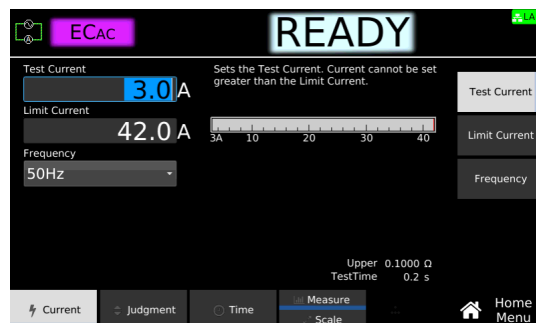
The following table shows the test conditions that you can set for earth continuity (EC) tests. The test conditions you can set are different for AC test and DC test. Test conditions with a check mark can be used with the corresponding test.

AC	DC	Test condition	Description	See
✓	✓	Test current	Current to run through the EUT.	p.91
✓	✓	Limit current	Upper limit of current to run through the EUT.	p.92
✓	–	Frequency	Test current frequency.	p.92
✓	✓	Upper limit	Reference resistance or voltage for upper limit judgment.	p.93
✓	✓	Lower limit	Reference resistance or voltage for lower limit judgment.	p.94
✓	✓	Test time	Time from when the current rise time has passed to the end of the test.	p.95
✓	✓	Current rise time	Time from when the START switch is pressed until the test current is reached.	p.96
✓	✓	Current fall time	The time from a pass judgment until the current falls.	p.96
✓	✓	Terminal wiring method (Terminals Wire)	Set the method of wiring test leads to four-terminal wiring or two-terminal wiring.	p.97
✓	✓	Contact check	Starts testing when the test leads touch the EUT and current starts flowing.	p.98
✓	✓	Peak value display (Display Peakhold)	Display the maximum resistance during the test.	p.99
✓	✓	Offset	Cancels the contact resistance of test leads, tools, and the like and the resulting voltage.	p.100

Test current

Set the current to run through the EUT. You cannot specify a voltage that exceeds the limit voltage Limit current ([p.92](#)).

- 1 On the Home menu screen, press **Current > Test Current**.



- 2 Use the numeric keypad or the rotary knob to enter the current.

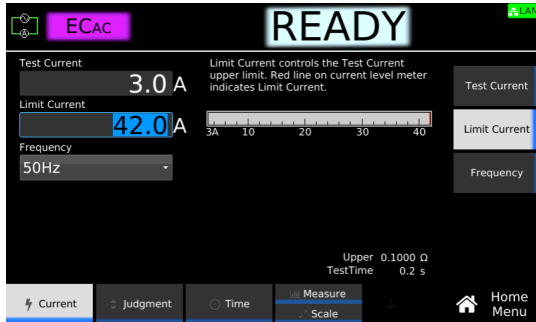
Setting range: 3.0 A to 42.0 A

This completes the setting.

Limit current

Set the upper limit of current to run through the EUT. This prevents unnecessarily high current from being run through the EUT by mistake.

- 1 On the Home menu screen, press Current > Limit Current.



- 2 Use the numeric keypad or the rotary knob to enter the current.

Setting range: 3.0 A to 42.0 A

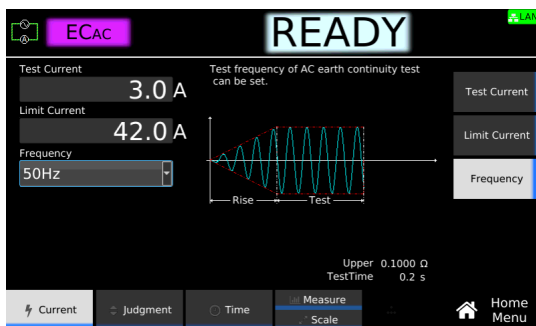
This completes the setting.

Frequency

This can be set only for AC tests.

Set the test current frequency to 50 Hz or 60 Hz. $\sqrt{50\text{Hz}}$ / $\sqrt{60\text{Hz}}$ appears during testing according to the setting.

- 1 On the Home menu screen, press Current > Frequency.



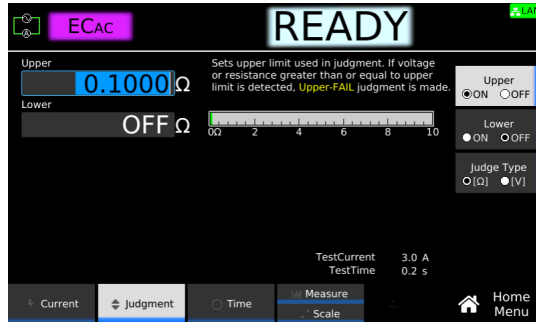
- 2 Turn the rotary knob to change the value.

This completes the setting.

Upper limit

Set the reference resistance or voltage for upper limit judgment. If a value greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results. To disable upper limit judgment, set Upper to off.

- 1 On the Home menu screen, press Judgment > Upper.



- 2 Press Upper to switch between on and off.

Upper switches between on and off each time you press the key.

- 3 If you select on, use the numeric keypad or the rotary knob to enter the resistance or voltage.

To change the unit of the value to resistance or voltage, press Judge Type. Each time you press the key, the unit of Upper and Lower values switch between Ω and V.

Setting range: 0.0001 Ω to 10.0000 Ω , 0.001 V to 5.000 V

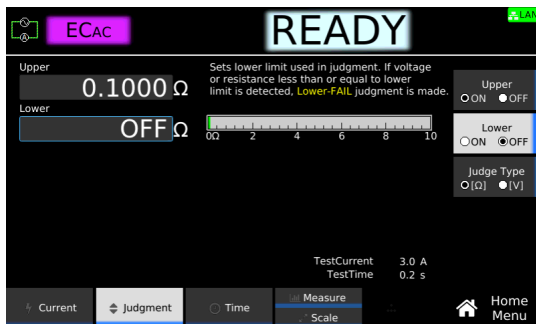
This completes the setting.

Lower limit

Set the reference resistance or voltage for lower limit judgment. If a value less than or equal to Lower is measured, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.

NOTE Normally, even a good EUT will have a certain degree of resistance. Setting the limit slightly less than the resistance of the EUT is useful in detecting problems with the EUT or cables or errors in the probe connection points, enabling you to perform highly reliable testing.

1 On the Home menu screen, press Judgment > Lower.



2 Press Lower to switch between on and off.

Lower switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the resistance or voltage.

To change the unit of the value to resistance or voltage, press Judge Type. Each time you press the key, the unit of Upper and Lower values switch between Ω and V.

Setting range: 0.0000 Ω to 9.9999 Ω , 0.000 V to 4.999 V

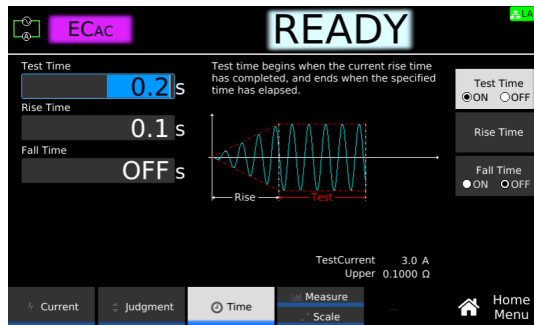
This completes the setting.

Test time

Set the test time to on or off.

Value	Description
ON	Set the time from when the Current rise time (p.96) has passed to the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS.
OFF	The test continues until the STOP switch is pressed. Pass judgments are not made.

1 On the Home menu screen, press Time > Test Time.



2 Press Test Time to switch between on and off.

Test Time switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

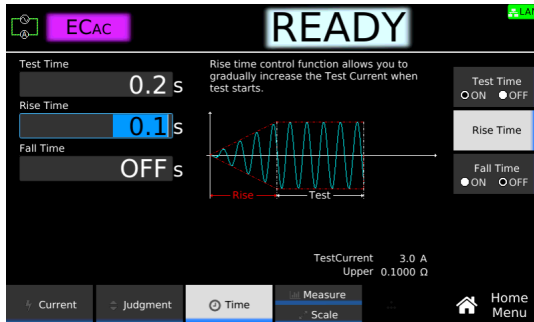
Setting range: 0.1 s to 1000.0 s

This completes the setting.

Current rise time

Set the time from when the START switch is pressed until the Test current (p.91) is reached.

- 1 On the Home menu screen, press Time > Rise Time.

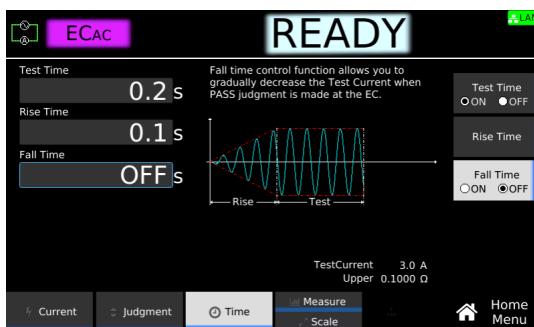


- 2 Use the numeric keypad or the rotary knob to enter the time.
Setting range: 0.1 s to 200.0 s
This completes the setting.

Current fall time

Set the time for the current to fall from the test current when a PASS judgment is made.



- 1 On the Home menu screen, press Time > Fall Time.



- 2 Press Fall Time to switch between on and off.
Fall Time switches between on and off each time you press the key.
- 3 If you select on, use the numeric keypad or the rotary knob to enter the time.
Setting range: 0.1 s to 200.0 s
This completes the setting.

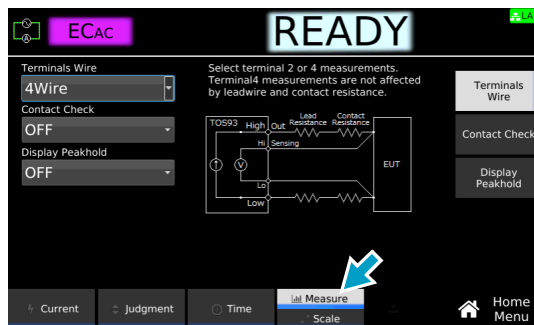
Terminal wiring method (Terminals Wire)

Set the method of wiring test leads to the product to four-terminal wiring (4 Wire) or two-terminal wiring (2 Wire). The locations to connect the test leads to the product are different between the two methods (p.34). Select the appropriate method depending on the type of test leads to be used and whether the minute resistance of lead wires or contact resistance of plugs will be included in the measurement. An icon appears during testing according to the setting.

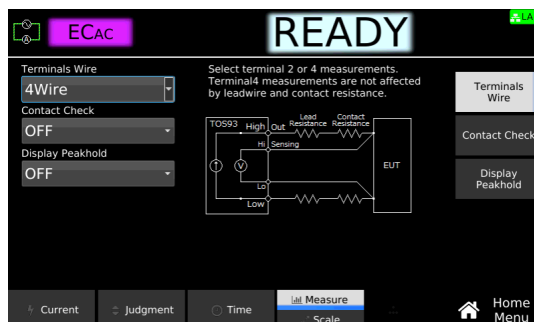
Value	Description	Icon
2 Wire	The resistance of lead wires and plugs is included in the measurement. Select this method when four-terminal wiring is not possible such as when using test leads other than those supplied with the product. The circuit between OUTPUT and SENSING is shorted inside the product.	
4 Wire	The resistance of lead wires and plugs is not included in the measurement. Select this method when four-terminal wiring can be used such as when you use the supplied test leads for earth continuity testing (TL13-TOS).	

NOTE If you use test leads other than those supplied with the product, the product specifications may not be met. Contact your Kikusui agent or distributor for details.

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Terminals Wire, and then turn the rotary knob to change the value.**



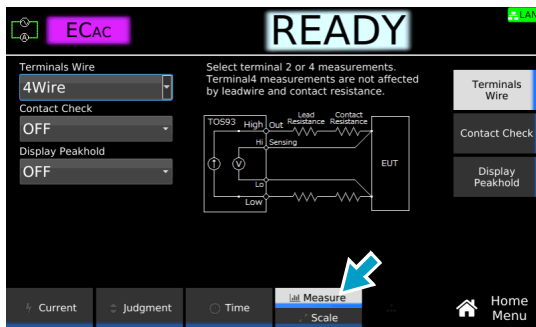
This completes the setting.

Contact check

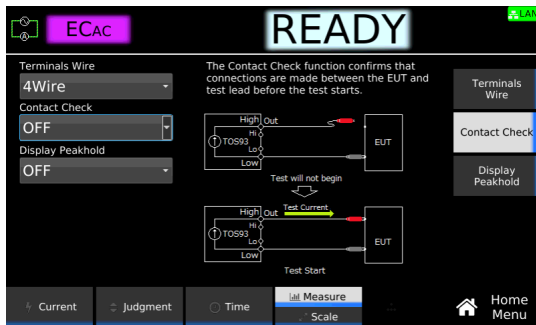
A contact check between the test lead and EUT is checked at the start of tests. If you do not want to check the contact, set Contact Check to off.

To start testing when Contact Check is set to on, press START with the test leads connected to the OUTPUT terminals open. Then, when the test leads make contact with the EUT and current starts flowing through the OUTPUT terminal, the test starts.

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



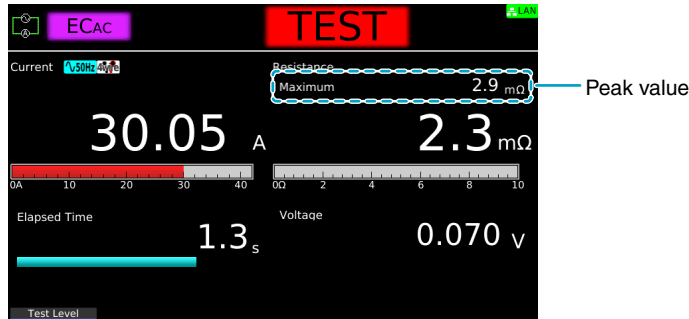
- 2 Press Contact Check, and then turn the rotary knob to select ON or OFF.**



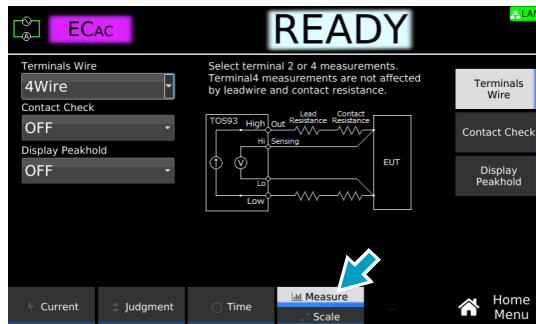
This completes the setting.

Peak value display (Display Peakhold)

When Display Peakhold is set to on, the peak resistance measured during testing is displayed. Judgment is also performed on the peak value.



- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



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

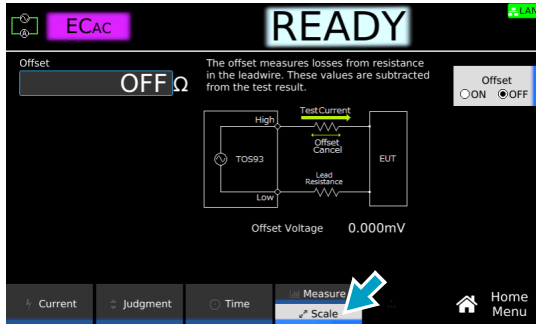


This completes the setting.

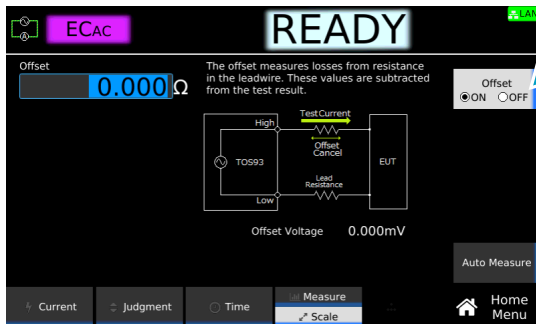
Offset

Contact resistance of test leads, tools, and the like and the resulting voltage drop can be canceled. If the offset is set to on, **Offset** appears during testing.

- 1 On the Home menu screen, press Scale repeatedly until Scale is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Offset to switch between on and off.**
Offset switches between on and off each time you press the key.



- 3 If set to ON, set the Offset value according to the following procedure.**

Purpose	Operation
Measure the Offset value to set it automatically.	Press Auto Measure. Use the rotary knob or numeric keypad to enter the test current. Connect test leads to this product, and short the test leads. Press START. When the measurement stabilizes, press STOP. The Offset value is set automatically.
Set the Offset value manually.	Use the numeric keypad or the rotary knob to enter the value. Setting range: 0.000 Ω to 10.000 Ω

This completes the setting.

Starting a Test

We recommend that you perform a pre-test inspection ([p.280](#)) before executing a test.

Output time limit

When earth continuity tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit.

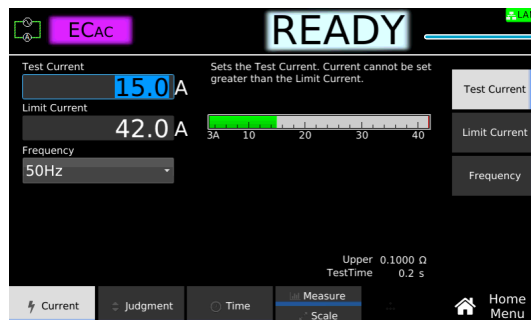
The following table shows the output time limit and rest time that are necessary when the ambient temperature is 40 °C or less. If you exceed the limit, the temperature of the output section may increase. This may cause the protection function to be activated and “OVER HEAT” to be indicated on the display. If this happens, stop testing and wait for the temperature to return to normal by referring to the rest time. If “READY” is displayed in the upper right of the display when you press the STOP switch, the temperature is back to normal.

Upper limit (i)	Output time ¹ limit	Rest time
$i \leq 20 \text{ A}$	No limit	Not necessary
$20 \text{ A} < i \leq 40 \text{ A}$	30 min. max.	At least the length of time the voltage was output

1 Includes the current rise time, test time, and current fall time.

Starting a test

- 1 Check that the product is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then press START.



READY icon

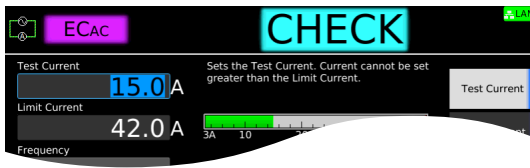


The DANGER LED lights, and the test starts.

If the test does not start, see “Unable to start a test” ([p.336](#)).

■ Contact check in progress display

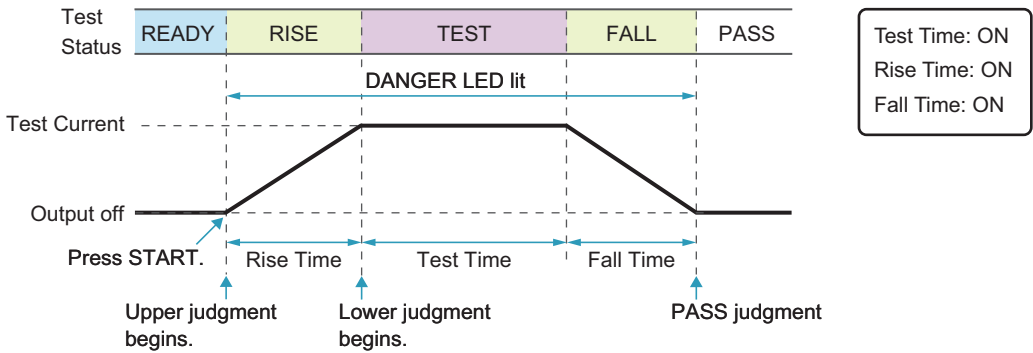
When Contact Check (p.98) is set to on, "CHECK" appears during the contact check.



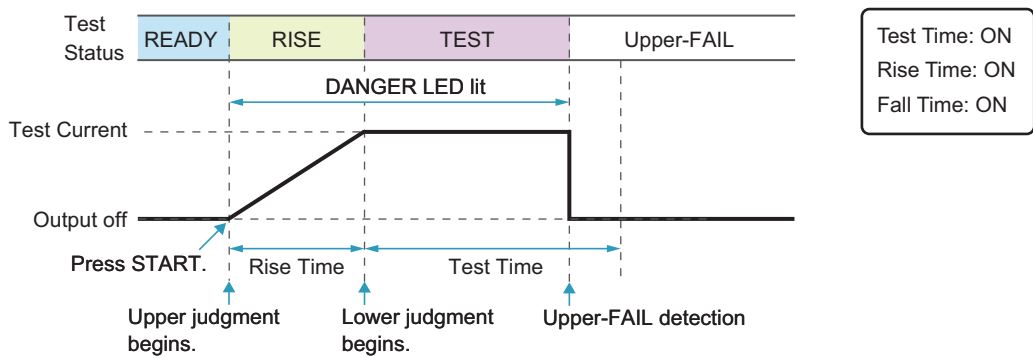
Operation after a test starts

Shown below are examples of operation after a test starts.

■ Example of a PASS judgment (applies to AC and DC tests)

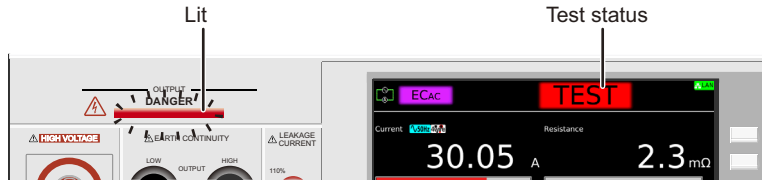


■ Example of a FAIL judgment (applies to AC and DC tests)



DANGER LED and test status display

During a test, the DANGER LED lights, and the test status is shown in the upper right of the display. The DANGER LED lights if voltage remains at the output terminals regardless of the test status.



Test status	Description
TEST	Testing
RISE	Voltage rising
FALL	Voltage falling

Measurement display

During a test, measurements are shown on the display.

Measurement value

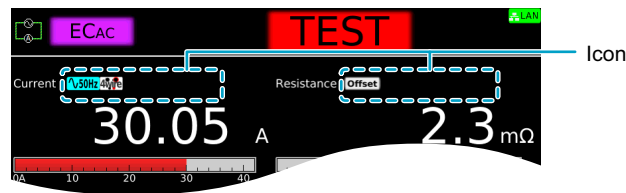
Displays the ratio of the output current relative to the Test Current setting

When Display Peakhold is set to ON, a peak value is displayed.

Displays the ratio of the measurement relative to the Upper value

Test condition display

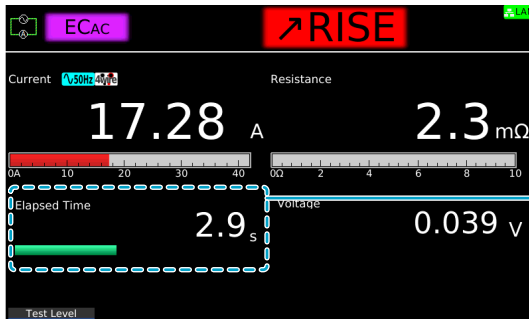
Icons indicating the test conditions appearing during testing.



Icon	Description
50Hz/60Hz	Frequency setting (50 Hz/60 Hz).
2Wire/4Wire	Terminal Wire setting (2Wire/4Wire)
Offset	Offsetting.

■ **Current rise time display**

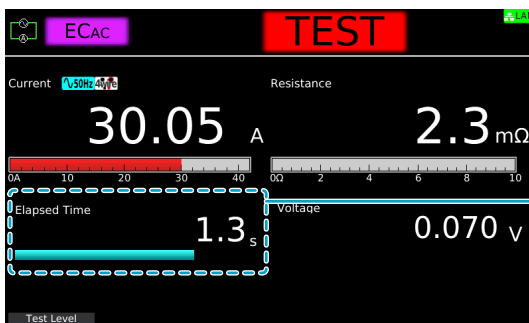
While the current is rising, “RISE” is displayed along with the elapsed time. The remaining rise time is displayed with a bar graph. When the time specified by Rise Time elapses, “TEST” is shown, and the test starts.



Elapsed time. The remaining rise time is displayed with a bar graph.

■ **Test time display**

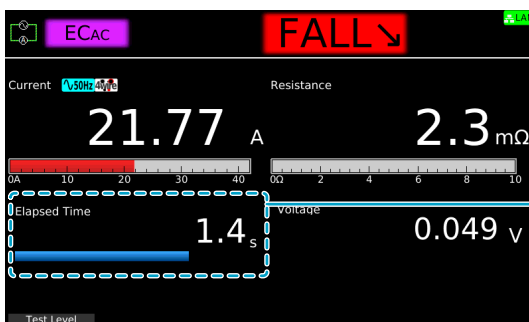
During the test time, “TEST” and the elapsed time are displayed. If Test Time is set to on, the remaining test time is displayed with a bar graph. If Test Time is set to off, the elapsed time is displayed up to 3600000.0 seconds. If the elapsed time is greater than 3600000.0, the display is fixed at 3600000.0.



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

■ **Current fall time display**

If Fall Time is set to on, “FALL” and the elapsed time are displayed while the current is falling. The remaining fall time is displayed with a bar graph.

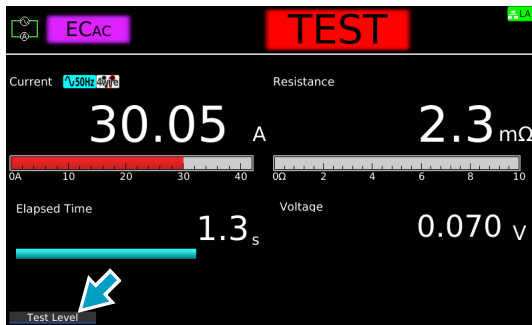


Elapsed time. The remaining fall time is displayed with a bar graph.

Changing the current setting during a test

During a test, press Test Level. Then, use the numeric keypad or the rotary knob to change the voltage. The changed voltage is immediately applied to the test, but the current value on the display shows the measured value. When "READY" appears in the upper right of the display after the test is finished, the new current setting will be displayed.

The Output Error may occur when the output changes suddenly.



Finishing the Test and Viewing the Judgment

Stopping tests

If you want to stop a test or finish a test when the test time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

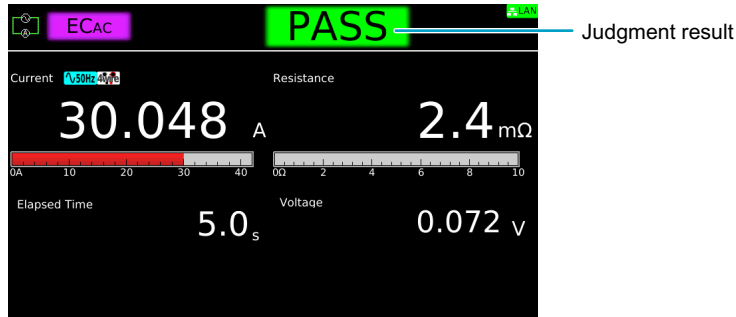
- a. When a resistance or voltage greater than or equal to Upper limit or less than equal to Lower limit is measured
- b. When the test time elapses if Test time is set to on
- c. When you press STOP

In any of the cases above, the "TEST" indication on the display disappears when the test ends. When the voltage residing at the output terminals is discharged, the DANGER LED turns off.

If the test finishes under condition a or b given above, the judgment result (p. 107) will be shown on the display.

Judgment types and operation

When a test finishes, the judgment result is shown in the test status.



	Upper-FAIL	Lower-FAIL	PASS
Condition	A resistance or voltage greater than or equal to the upper limit was measured.	A resistance or voltage less than or equal to the lower limit was measured.	Upper-FAIL or Lower-FAIL judgment did not occur during the test.
Display	The test status shows "Upper-FAIL" until the judgment result is cleared.	The test status shows "Lower-FAIL" until the judgment result is cleared.	The test status shows "PASS" until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	U FAIL signal is output until the judgment result is cleared.	L FAIL signal is output until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

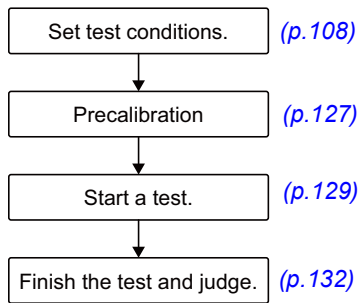
Press STOP to clear the judgment result. The product is ready to start another test.

Partial Discharge Test

Applicable models: **9301PD**

This chapter describes how to set test conditions, start a test, and view the results for partial discharge (PD) tests.

The following flowchart shows the configuration and test steps.



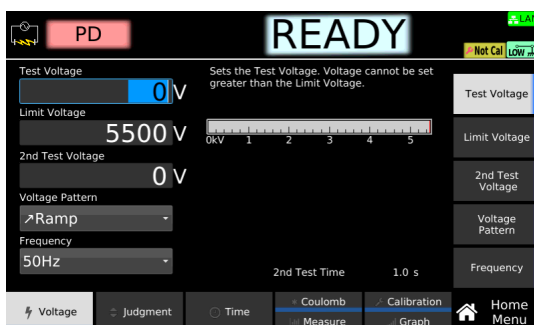
Set test conditions

This section describes the outline of the partial discharge (PD) test conditions and explains how to configure the settings.

Displaying the setup screen (HOME menu)

1 On the Function Menu screen (p.46), press PD.

The setup screen (HOME menu) for the PD test conditions appears.



Set the required conditions by referring to the description of test conditions (p.109).

Description of test conditions

The following table shows the test conditions that you can set for partial discharge (PD) test.

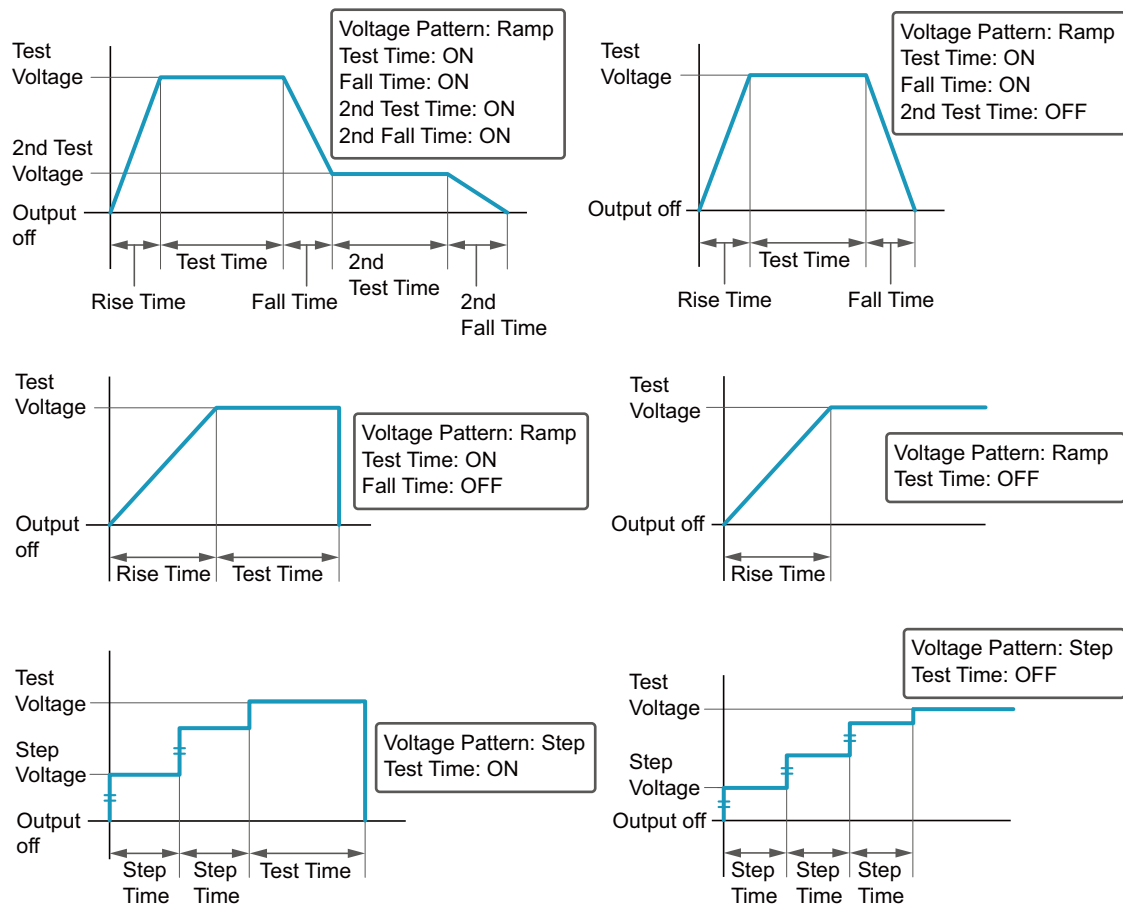
Test condition	Description	See
Test voltage (Test Voltage/2nd Test Voltage)	Voltage applied to EUT.	p. 110
Limit voltage	Upper limit of voltage applied to EUT.	p. 113
Step Voltage	Voltage applied to EUT at the first step.	p. 110
Voltage Pattern	Voltage pattern applied to EUT.	p. 110
Frequency	Test voltage frequency.	p. 113
Upper limit of electric charge (Upper Coulomb)	Reference electric discharge for upper limit judgment.	p. 114
Reference upper limit of discharge count (Upper Pulse Count)	Reference pulse count for upper limit judgment.	p. 115
Threshold for discharge (Pulse Count Threshold)	Threshold for electric charges to be counted as pulse count.	p. 116
Test time (Test Time/2nd Test Time)	The length of time that the test voltage is applied.	p. 110
Step time	Time per step until Test Voltage is reached.	p. 110
Voltage rise time (Rise Time)	Time from when the START switch is pressed until Test Voltage is reached.	p. 110
Voltage fall time (Fall Time/2nd Fall Time)	Time for the voltage to fall from the test voltage.	p. 110
Measurement range (Range)	Selects a measurement range.	p. 117
Electric charge for detecting discharge inception voltage (Inception Voltage)	Set the amount of electric charge that is the reference for discharge inception.	p. 118
Electric charge for detecting discharge extinction voltage (Extinction Voltage)	Set the amount of electric charge that is the reference for discharge extinction.	p. 119
Band Pass Filter	Selects a frequency band to be passed.	p. 120
Low-pass filter	Limits the noise that the AC power supply generates.	p. 121
Voltage Measure	Voltage measurement mode. Select whether to measure in true rms values or peak values.	p. 122
Electric charge peak value display (Display Peakhold)	Holds the maximum measured electric charge.	p. 123
Electric charge calibration (Precalibration)	Calibrates the electric discharge.	p. 127
Graph scale setting (Graph Scale)	The scale setting of a graph.	p. 124
Display of discharge inception voltage/discharge extinction voltage (Inc/Ext-Volt Marker)	Represents discharge inception voltage and discharge extinction voltage on the graph after a test.	p. 125
Graph axis setting (Graph Format)	Variables to be represented on the graph.	p. 126

Setting the voltage pattern, test voltages, and application times

The voltage pattern to apply to the EUT is determined by the combination of the following test conditions (voltage pattern, test voltages, application times).

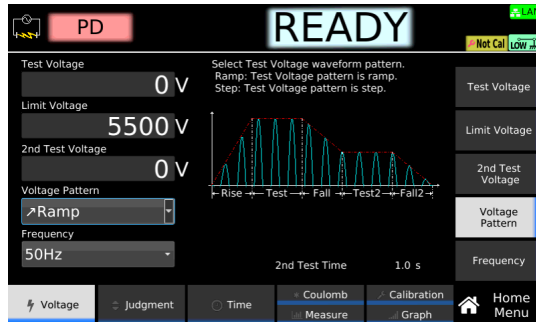
Value	Description	
Voltage Pattern	Ramp	You can define a test voltage pattern with increasing and decreasing ramps.
	Step	You can define a test voltage pattern that increase in steps. The number of steps is calculated automatically from the voltages set to Test Voltage and Step Voltage .
Test voltage (Test Voltage/ 2nd Test Voltage)	Set the test voltages to apply to EUT. You cannot specify a voltage that exceeds the limit voltage (p.113).	
Step Voltage	When Voltage Pattern is set to Step, set the voltage to apply to EUT in each step. You cannot specify the test voltage that exceeds the limit voltage (p.113).	
Step time	When Voltage Pattern is set to Step, set the time per step until Test Voltage is reached.	
Voltage rise time (Rise Time)	When Voltage Pattern is set to Ramp, set the time from when the START switch is pressed until Test Voltage is reached.	
Test time (Test Time/2nd Test Time)	Set the length of time that the test voltage is applied. To continue testing until the STOP switch is pressed without making Pass judgments, set Test Time to off.	
Voltage fall time (Fall Time/ 2nd Fall Time)	When Voltage Pattern is set to Ramp, set the time for the voltage to fall from the test voltage.	

■ Example of test conditions



Setting a voltage pattern

- 1 On the HOME Menu screen, press Voltage > Voltage Pattern.

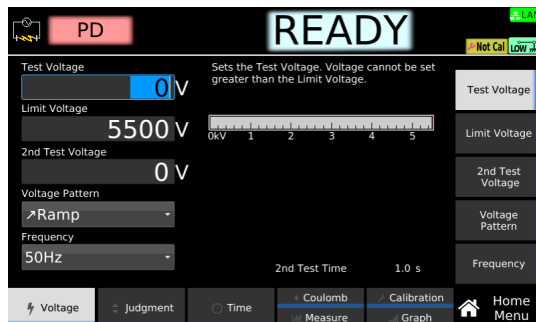


- 2 Turn the rotary knob to select Ramp or Step.
This completes the setting.

Setting test voltages

You cannot specify the test voltage that exceeds the Limit voltage (p.113).

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



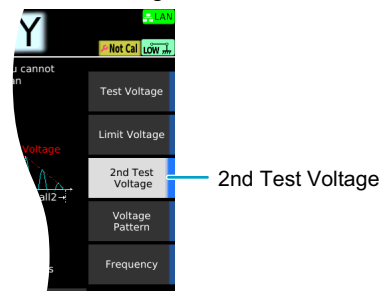
- 2 Use the numeric keypad or the rotary knob to enter the voltage value.

Setting range when Voltage Pattern is set to Ramp: 0 V to 5500 V

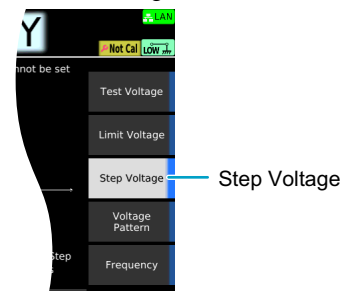
Setting range when Voltage Pattern is set to Step: 0 V to 1000 V

- 3 Press 2nd Test Voltage or Step Voltage.

■ When Voltage Pattern is set to Rump



■ When Voltage Pattern is set to Step

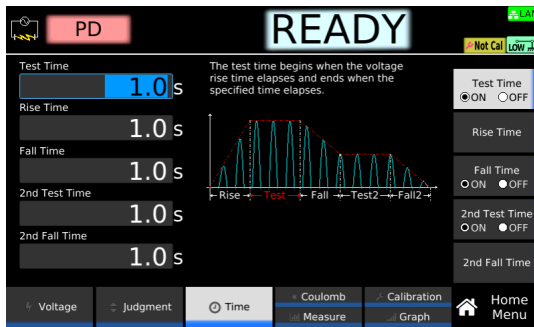


If you do not need 2nd Test Voltage, you do not have to set it. Set 2nd Test Time to OFF in the voltage application time setting.

- 4 Use the numeric keypad or the rotary knob to enter the voltage value.**
 Setting range: 0 V to 5500 V
 This completes the setting.

Setting the length of time that the test voltage is applied

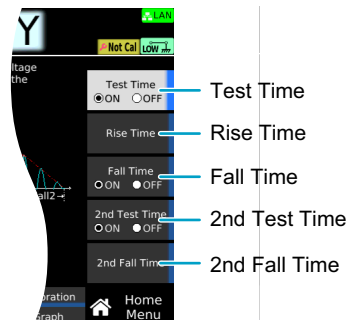
- 1 On the HOME Menu screen, press Time.**



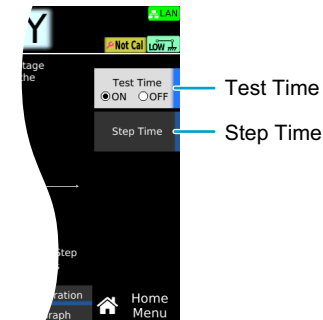
- 2 Press the key corresponding to the test condition you want to set.**

Set each test condition according to the voltage pattern you want to create by consulting. Refer to the graph shown on the display or the graphs on [p.110](#). For test conditions that have an ON or OFF setting, the setting switches between on and off each time you press the key.

■ When Voltage Pattern is set to Rump



■ When Voltage Pattern is set to Step

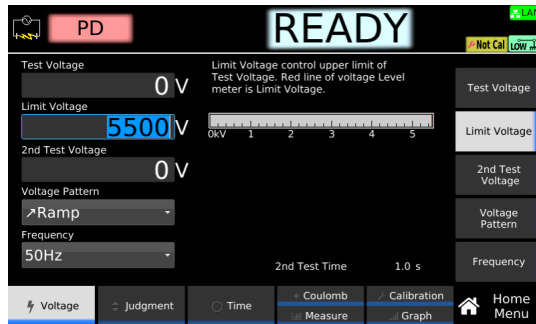


- 3 Use the numeric keypad or the rotary knob to enter the time.**
 Test Time/2nd Test Time setting range: 0.1 s to 1000.0 s
 Rise Time/Fall Time/2nd Fall Time/Step Time setting range: 0.1 s to 200.0 s
- 4 Repeat Step 2 and Step 3 to set an application time.**
 This completes the setting.

Limit voltage

Set the upper limit of the voltage applied to EUT. This prevents unnecessarily high voltage from being applied to EUT by mistake.

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

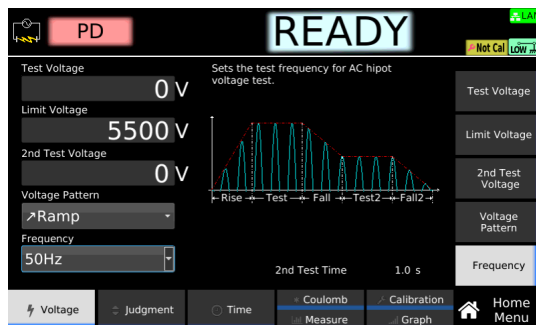


- 2 Use the numeric keypad or the rotary knob to enter the voltage value.
Setting range: 0 V to 5500 V
This completes the setting.

Frequency

Set the test voltage frequency to 50 Hz or 60 Hz.

- 1 On the Home Menu screen, press Voltage > Frequency.

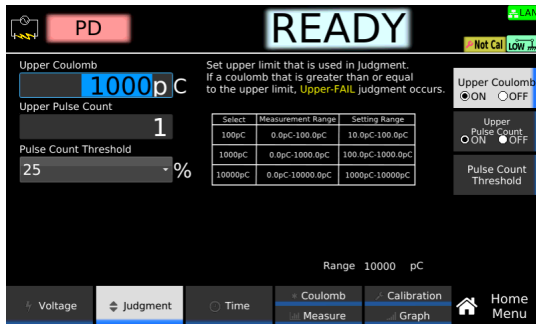


- 2 Use the rotary knob to select 50 Hz or 60 Hz.
This completes the setting.

Upper limit of electric charge (Upper Coulomb)

Set the reference electric charge of partial discharge for upper limit judgment. If an electric charge that is greater than or equal to the value specified by Upper Coulomb is measured, Upper-FAIL judgment results. To disable upper limit judgment, set Upper Coulomb to off.

- 1 On the HOME Menu screen, press Judgment > Upper Coulomb.



- 2 Press Upper Coulomb to switch between ON and OFF.

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

- 3 If you select ON, use the numeric keypad or the rotary knob to enter the electric charge.

The setting range varies according to the value set to Measurement range (Range) (p.117).

Setting range (100 pC range): 10.0 pC to 100.0 pC

Setting range (1000 pC range): 100.0 pC to 1000.0 pC

Setting range (10000 pC range): 1000 pC to 10000 pC

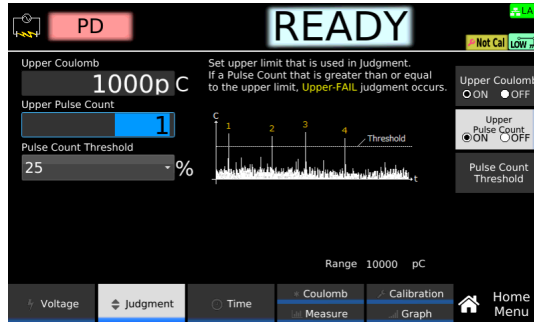
This completes the setting.

Reference upper limit of discharge count (Upper Pulse Count)

Set the reference pulse count for upper limit judgment. If a discharge count that is greater than or equal to the value specified by Upper Pulse Count is measured, upper limit (Upper-FAIL) judgment results. To disable upper limit judgment, set Upper Pulse Count to off.

Electric charges to be counted as discharge can be set by Pulse Count Threshold ([p. 116](#)).

1 On the HOME Menu screen, press Judgment > Upper Pulse Count.



2 Press Upper Pulse Count to switch between ON and OFF.

Upper Pulse Count switches between ON and OFF each time you press the key.

3 If you select ON, use the numeric keypad or the rotary knob to enter pulse count.

Setting range: 1 to 100000

This completes the setting.

Threshold for discharge (Pulse Count Threshold)

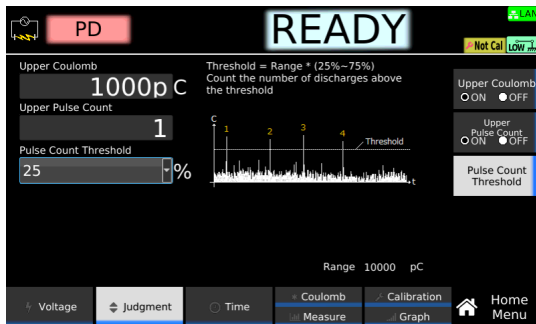
Set a threshold for the electric charges to be counted as discharge in a percentage to the measurement range (p. 117). The threshold can be selected from 25 %, 50 %, and 75 %.

When an electric charge that is greater or equal to the value set to Pulse Count Threshold is measured, the discharge count increments by one.

You can set a reference upper limit for the discharge count to Upper Pulse Count (p. 115).

NOTE The electric charge threshold is set based on the ratio specified by the Pulse Count Threshold and the reference value when nothing is connected to the HIGH VOLTAGE and LOW VOLTAGE terminals. When electric charge calibration (Precalibration) is carried out with EUT connected, the electric charge threshold becomes relatively high.

- 1 On the HOME Menu screen, press Judgment > Pulse Count Threshold.



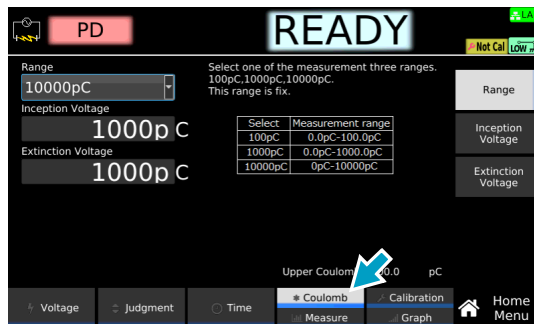
- 2 Turn the rotary knob to change the threshold value.
This completes the setting.

Measurement range (Range)

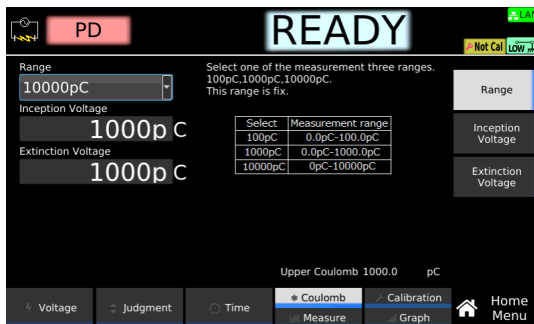
Set the measurement range.

Value	Description
100pC	Sets the measurement range from 0.0 pC to 100.0 pC.
1000pC	Sets the measurement range from 0.0 pC to 1000.0 pC.
10000pC	Sets the measurement range from 0 pC to 10000 pC.

- 1 On the HOME Menu screen, press **Coulomb** repeatedly until **Coulomb** is selected. Each press of the key switches between Coulomb and Measure.



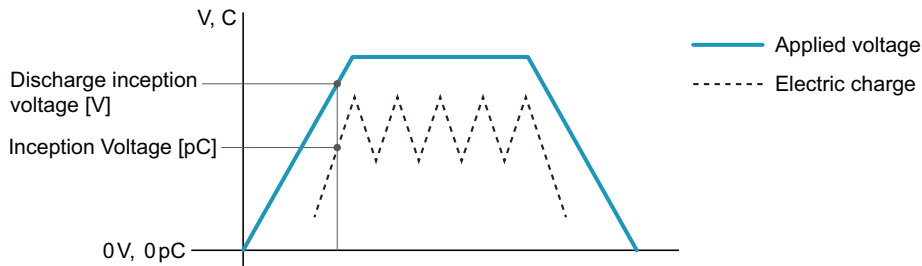
- 2 Press **Range**, and then turn the rotary knob to change the value.



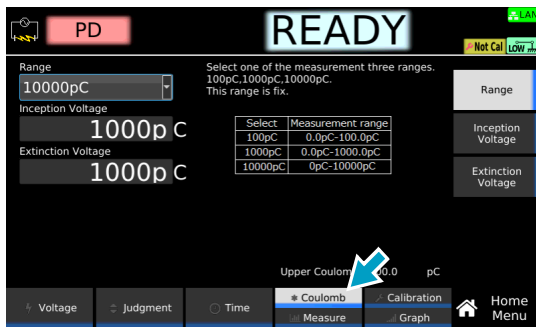
This completes the setting.

Electric charge for detecting discharge inception voltage (Inception Voltage)

This function detects the voltage when the specified electric charge is measured the first time after starting a test as discharge inception voltage.



- 1 On the HOME Menu screen, press Coulomb repeatedly until Coulomb is selected. Each press of the key switches between Coulomb and Measure.



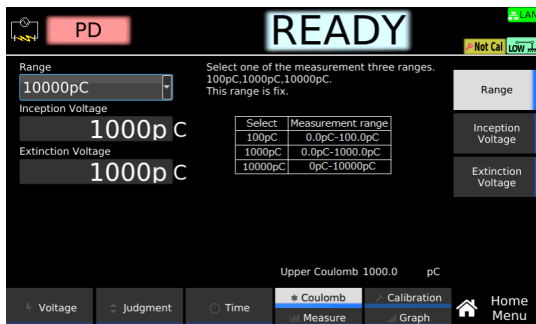
- 2 Press Inception Voltage, and use the numeric keypad or the rotary knob to enter a value.

The setting range varies according to the value set to Range (p.117).

Setting range (100 pC range): 10.0 pC to 100.0 pC

Setting range (1000 pC range): 100.0 pC to 1000.0 pC

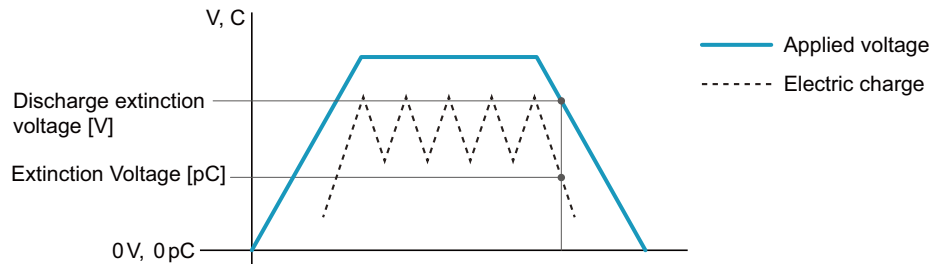
Setting range (10000 pC range): 1000 pC to 10000 pC



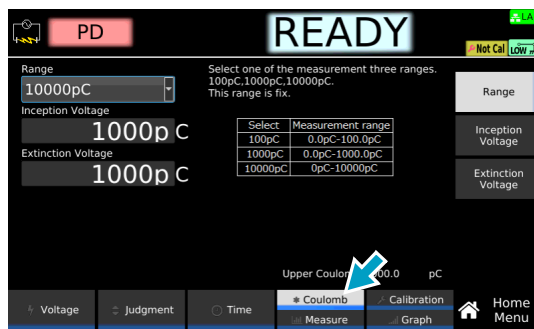
This completes the setting.

Electric charge for detecting discharge extinction voltage (Extinction Voltage)

This function detects the voltage when the specified electric charge is measured the first time after the discharge inception voltage as discharge extinction voltage.



- 1 On the HOME Menu screen, press **Coulomb** repeatedly until **Coulomb** is selected. Each press of the key switches between Coulomb and Measure.



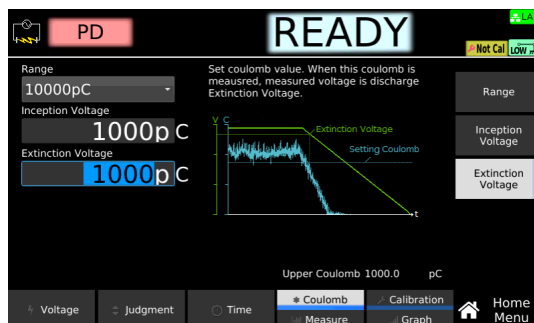
- 2 Press **Extinction Voltage**, and then use the numeric keypad or the rotary knob to enter a value.

The setting range varies according to the value set to Range ([p.117](#)).

Setting range (100 pC range): 10.0 pC to 100.0 pC

Setting range (1000 pC range): 100.0 pC to 1000.0 pC

Setting range (10000 pC range): 1000 pC to 10000 pC

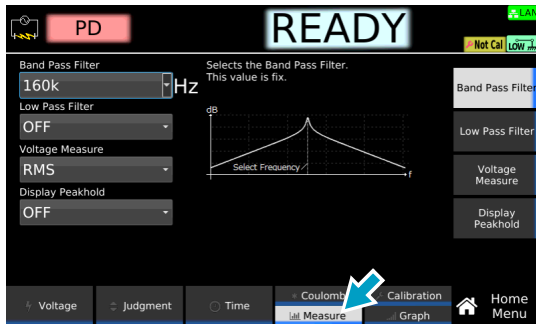


This completes the setting.

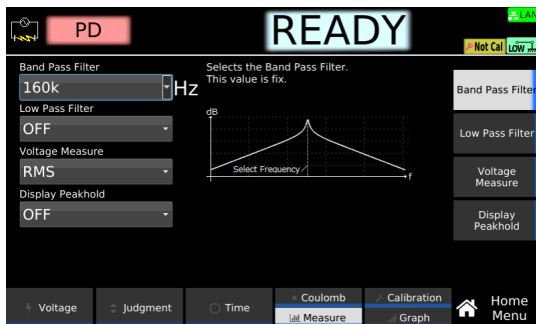
Band Pass Filter

This function provides a bandpass filter that allows only frequencies within a specific band to pass. You can select a center frequency from 100 kHz, 160 kHz, and 300 kHz. Select 160 kHz in normal tests.

- 1 **On the Home Menu screen, press Measure repeatedly until Measure is selected.**
Each press of the key switches between Coulomb and Measure.



- 2 **Press Band Pass Filter, and then turn the rotary knob to change the value.**

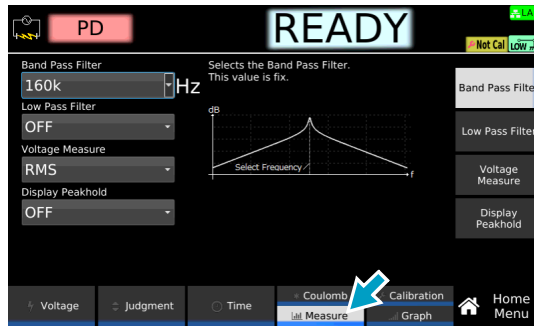


This completes the setting.

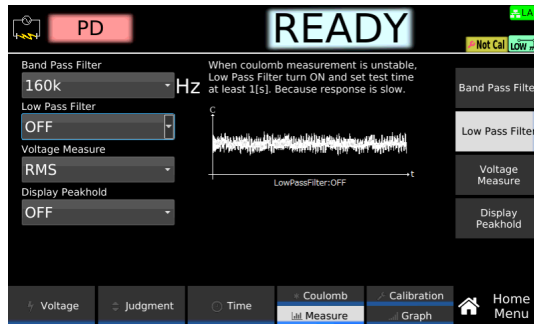
Low-pass filter

When Low Pass Filter is set to ON, the noise generated by the AC power supply can be suppressed.

- 1 On the Home Menu screen, press Measure repeatedly until Measure is selected. Each press of the key switches between Coulomb and Measure.



- 2 Press Low Pass Filter, and then turn the rotary knob to select ON or OFF.



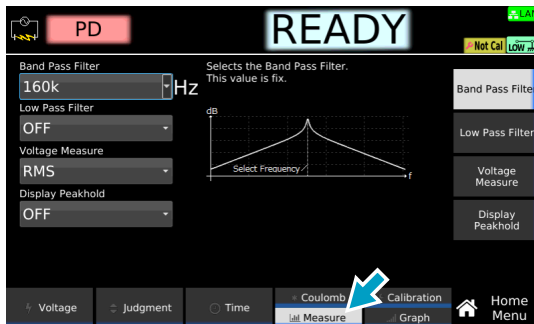
This completes the setting.

Voltage Measure

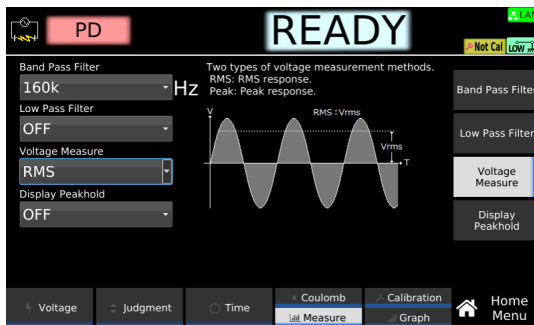
Sets the voltage measurement mode.

Value	Description
RMS	Measures in true rms values.
Peak	Measures in peak values.

- 1 On the Home Menu screen, press Measure repeatedly until Measure is selected. Each press of the key switches between Coulomb and Measure.



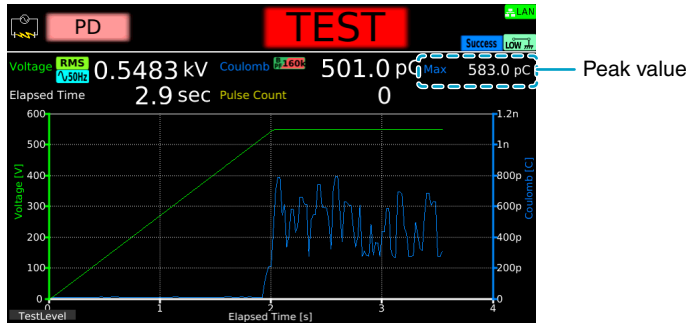
- 2 Press Voltage Measure, and then turn the rotary knob to change the value.



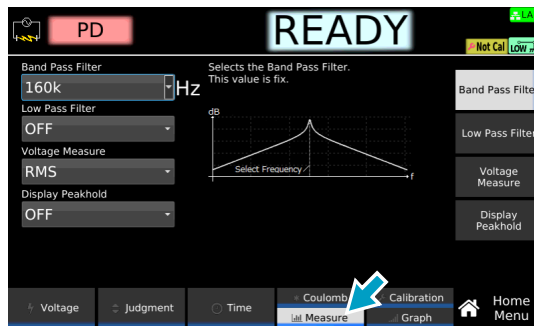
This completes the setting.

Electric charge peak value display (Display Peakhold)

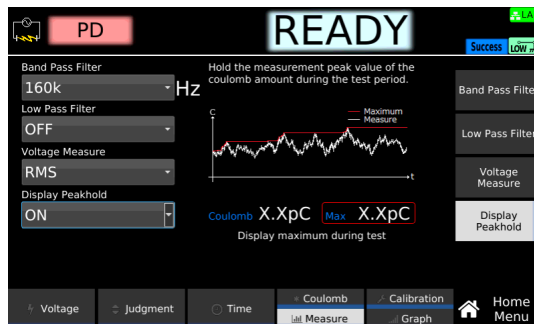
When Peak Hold is set to ON, the measured peak electric charge is displayed during a test and in the judgment result.



- 1 On the Home Menu screen, press Measure repeatedly until Measure is selected. Each press of the key switches between Coulomb and Measure.



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



This completes the setting.

Electric charge calibration (Precalibration)

For details, see "Precalibration" (p.127).

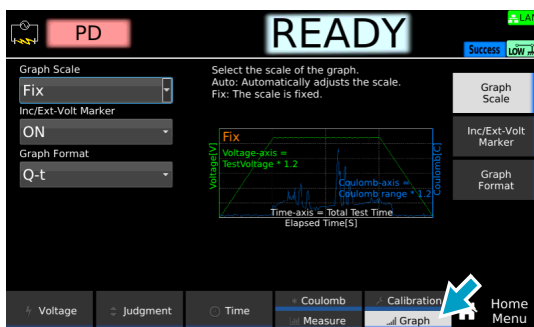
Graph scale setting (Graph Scale)

This function sets the scale of each axis in a graph to be displayed.

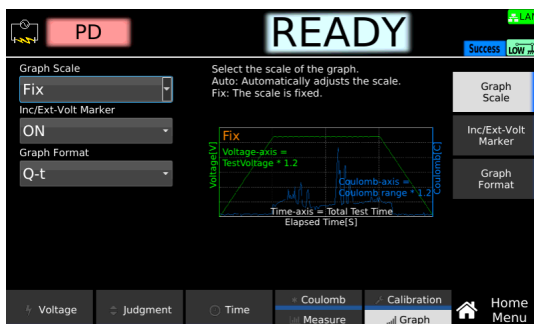
Value	Description
Fixed	<p>Fixes the graph scale. The scale of each axis in a graph is determined according to the set value listed below.</p> <ul style="list-style-type: none"> • Voltage axis: A set value of Test Voltage (p.111) • Electric charge axis: A set value of Range (p.117) • Time axis: The length of time the test voltage is applied (p.112)
Auto	<p>Adjusts the graph scale automatically according to the measured values. The range of time that can be represented on the time axis varies according to the value set to Frequency (p.113) as listed below. Outdated measured values that are outside of the range are not displayed.</p> <ul style="list-style-type: none"> • When Frequency is set to 50 Hz: 200 sec • When Frequency is set to 60 Hz: 166 sec

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

Each time you press the key, the setting item switches between Calibration and Graph.



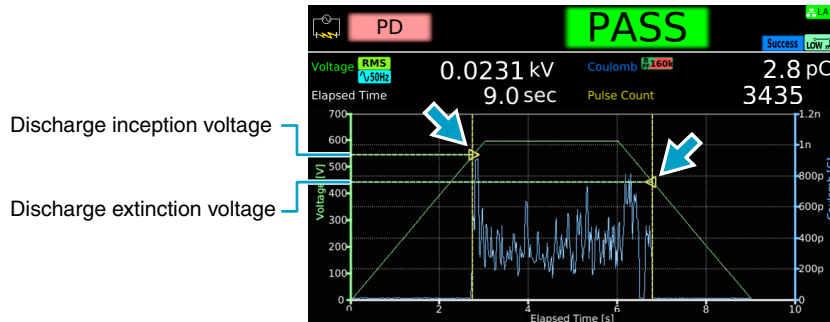
2 Press Graph Scale, and then turn the rotary knob to change the value.



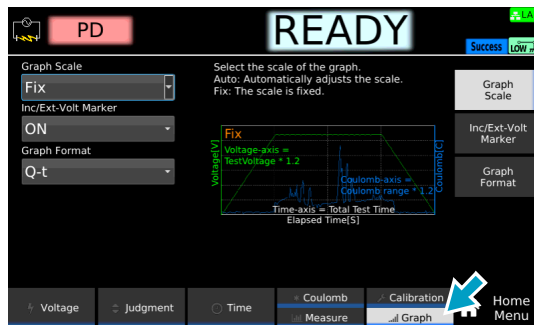
This completes the setting.

Display of discharge inception voltage/discharge extinction voltage (Inc/Ext-Volt Marker)

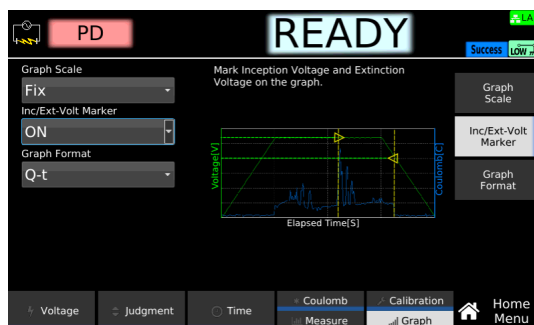
Select whether to display markers for discharge inception voltage and discharge extinction voltage on the graph after a test.



- 1 On the Home Menu screen, press Graph repeatedly until Graph is selected. Each time you press the key, the setting item switches between Calibration and Graph.



- 2 Press Inc/Ext-Volt Marker, and turn the rotary knob to select ON or OFF.



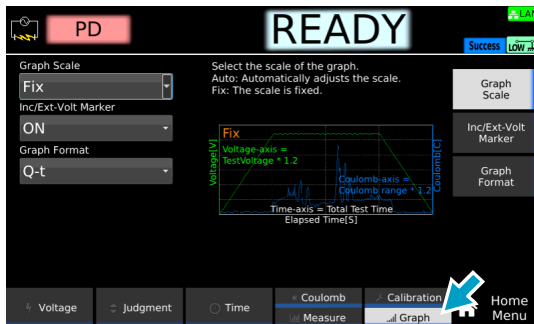
This completes the setting.

Graph axis setting (Graph Format)

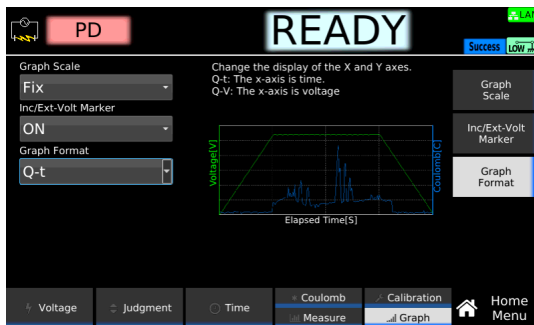
Set variables to be represented on the axes in the graph.

Value	Description
Q-V	Represents electric charge on the Y-axis, and voltage on the X-axis.
Q-t	Represents electric charge on the Y-axis and time (s) on the X-axis.

- 1 **On the Home Menu screen, press Graph repeatedly until Graph is selected.**
Each time you press the key, the setting item switches between Calibration and Graph.



- 2 **Press Graph Format, and then turn the rotary knob to change the value.**



This completes the setting.

Precalibration

If any of the following conditions applies, the electric discharge needs to be calibrated (Precalibration) before partial discharge testing.

You can select whether to calibrate the electric discharge automatically or manually.

- Before the first test of the day
- When the type of EUT or cable is changed
- When EUT is replaced because its electrostatic capacity deviates from others by 10% or more despite the type being the same as others.
- When you particularly want to measure with high accuracy
- When the ambient temperature changes by 5 °C or more since the previous precalibration

If you attempt to start a test without performing the electric charge calibration or completing it successfully, Calibration-FAIL will result.

The status of the electric calibration is displayed in the upper right of the display.

Not Cal : Not calibrated.

Execute : Calibrating.

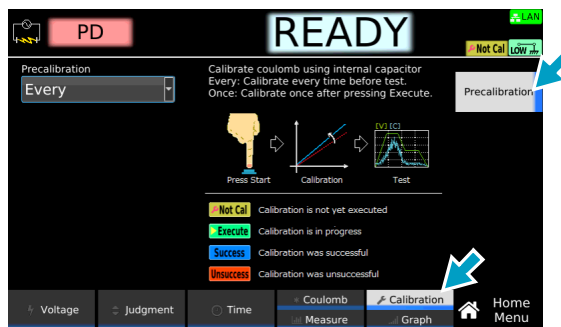
Success : Successfully Calibrated.

Unsuccess : Calibration failed.

Automatically perform precalibration before starting a test

Automatically perform precalibration each time before a test starts.

- 1 On the HOME Menu screen, press Calibration > Precalibration.

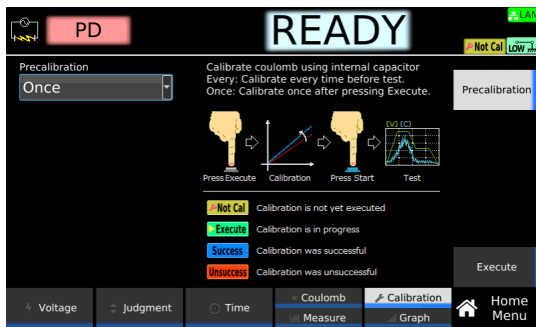


- 2 Using the rotary knob, select Every.
This completes the setting.

Manually perform precalibration

Manually perform precalibration before a test starts.

- 1 Turn on the product and let it warm up for more than 30 minutes.
- 2 Connect the test leads to the product (p.38).
- 3 Connect the test leads to the test location of the EUT.
- 4 On the HOME Menu screen, press Calibration > Precalibration.
- 5 Using the rotary knob, select Once.



- 6 Check that “READY” is shown on the display, and then press Execute.

When precalibration has been completed successfully, **Success** appears in the upper right of the display.

When precalibration fails, **Unsuccess** appears in the upper right of the display.

This completes precalibration.

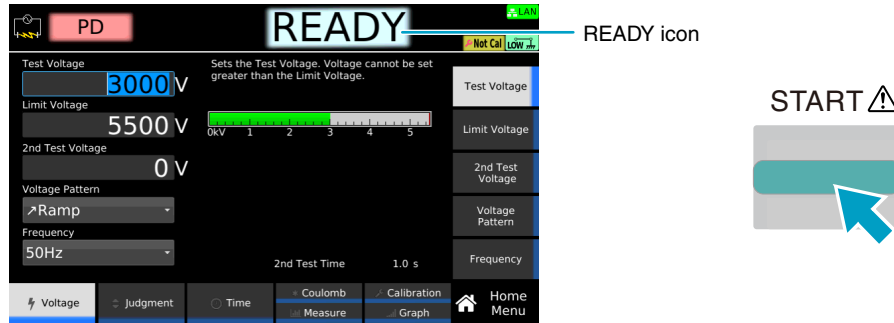
When precalibration fails

When precalibration fails (Unsuccess), check if the capacitance of the EUT does not exceed 10 nF. TOS9301PD supports EUT having an electrostatic capacity of up to 10 nF in performing partial discharge tests.

Starting a Test

Starting a test

- 1 Check that the product is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then press START.

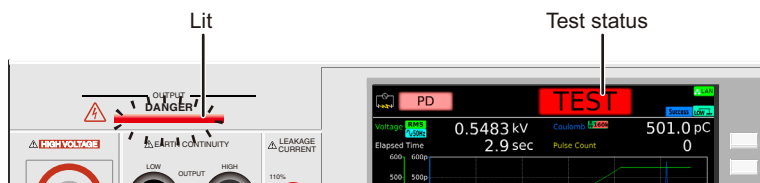


The DANGER LED lights, and the test starts.
 If the test does not start, see “Unable to start a test” (p.336).

Operation after a test starts

■ DANGER LED and test status display

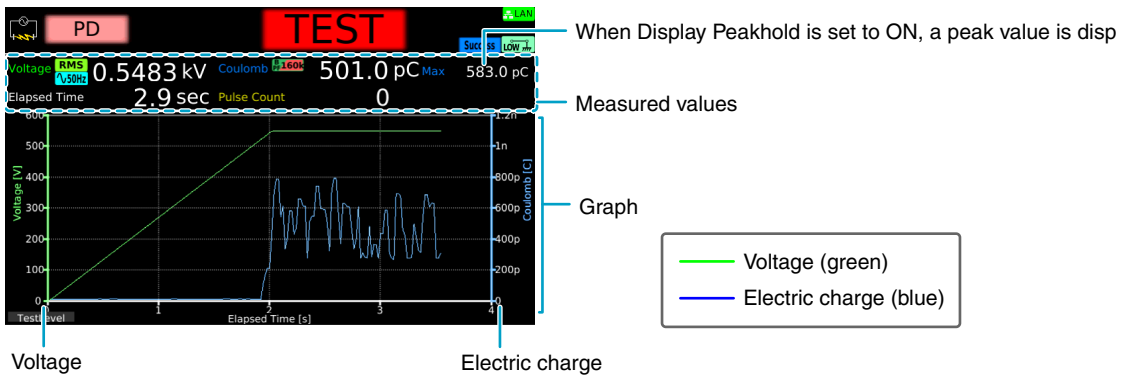
During a test, the DANGER LED lights, and the test status is shown in the upper right of the display. The DANGER LED lights if voltage is present at the output terminals regardless of the test status.



Test status	Description
TEST	Testing
↗RISE	Voltage rising
FALL↘	Voltage falling

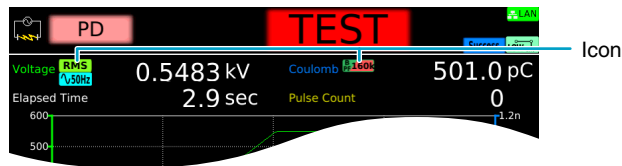
■ Displaying measured values and graph

During a test, measured values and a graph are shown on the display.



■ Test condition display

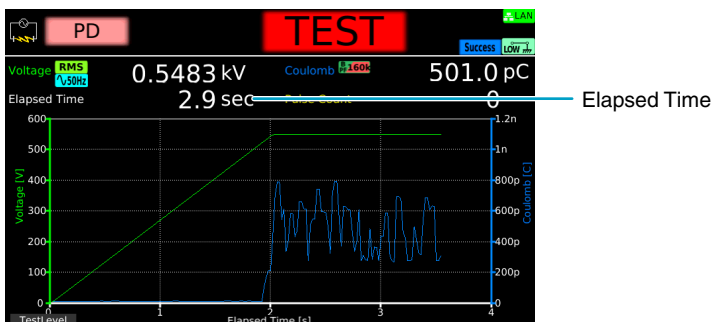
Icons indicating the test conditions appear during testing.



Icon	Description
	Frequency setting (50 Hz/60 Hz)
	Volt Measure setting (RMS/Peak)
	Band Pass Filter setting (100 kHz/160 kHz/300 kHz)
	Low Pass Filter is set to ON

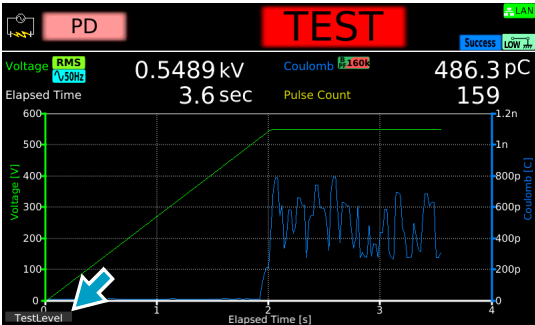
■ Displaying elapsed time

Displays elapsed time since the test started. Up to 3600000.0 seconds are displayed. If the elapsed time is greater than 3600000.0 seconds, the display is fixed at 3600000.0 seconds.



Changing the voltage setting during a test

If the voltage reaches the value set to Test Voltage during a test, press Test Level and then use the numeric keypad or the rotary knob to change the value. If Voltage Pattern is set to Step, the voltage value during the test cannot be changed.



The changed voltage is immediately applied to the test, but the voltage value on the display shows the measured value. When "READY" appears in the upper right of the display after the test is finished, the new voltage setting will be displayed.

Finish the Test and Judge

Stopping tests

If you want to stop a test or finish a test when the Test Time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

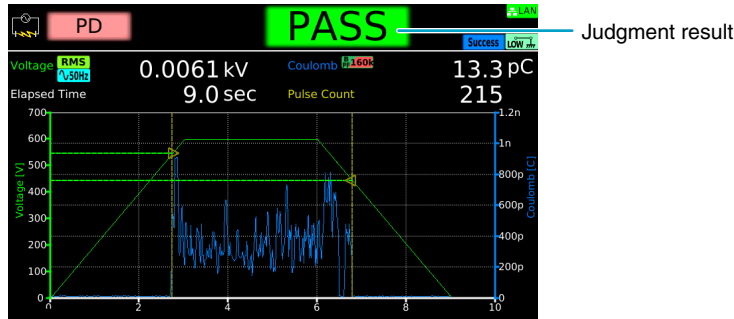
- a. When a value that is greater than or equal to the current upper limit (50 mA), the electric charge upper limit (Upper Coulomb), or the pulse count upper limit (Upper Pulse Count) is measured.
- b. When voltage application according to the specified voltage pattern completes.
- c. When STOP is pressed.

In the above cases, the "TEST" indication on the display disappears when the test ends. When the voltage residing in the unit is discharged, the DANGER LED turns off.

If the test finishes under the condition mentioned in a or b above, the judgment result ([p. 133](#)) will appear on the display.

Judgment types and operation

When a test finishes, the judgment result (Upper-FAIL, PASS) appears in the test status.



	Upper-FAIL (Current)	Upper-FAIL (Coulomb)	Upper-FAIL (Pulse)
Condition	A value greater than or equal to the current upper limit (50 mA) is measured.	A value greater than or equal to the electric charge upper limit (Upper Coulomb) is measured.	A value greater than or equal to the discharge count upper limit (Upper Pulse Count) is measured.
Display	The test status shows "Upper-FAIL (Current)" until the judgment result is cleared.	The test status shows "Upper-FAIL (Coulomb)" until the judgment result is cleared.	The test status shows "Upper-FAIL (Pulse)" until the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.
SIGNAL I/O Connector	The U FAIL signal is output until the judgment result is cleared.	The U FAIL signal is output until the judgment result is cleared.	The U FAIL signal is output until the judgment result is cleared.

	Calibration-FAIL	PASS
Condition	A test started despite the electric charge calibration that has been unperformed or failed.	Upper-FAIL judgment did not occur during the test.
Display	The test status shows "Calibration-FAIL" until the judgment result is cleared.	The test status shows "PASS" until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the time specified by Pass Hold).
SIGNAL I/O Connector	Both the U FAIL and L FAIL signals are output simultaneously until the judgment result is cleared.	The PASS signal is output until the judgment result is cleared.

Clearing the judgment result

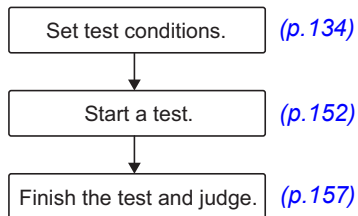
Press STOP. The product is ready to start another test.

Touch Current Test

Applicable model: **9303LC**

This chapter describes how to set test conditions, start tests, and view the results for touch current (TC) of leakage current (LC) tests.

The following flowchart shows the configuration and test steps.



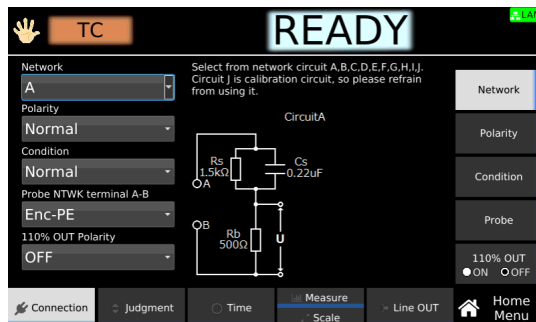
Setting Test Conditions

This section describes the test conditions of touch current (TC) tests and how to set the conditions.

Displaying the setup screen (Home menu)

1 On the Function menu screen (p.46), press LC >TC.

The setup screen (Home menu) for the TC test conditions appears.



Set the required conditions by referring to the description of test conditions (p.135).

Description of test conditions

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

Test condition	Description	See
Network	Select the measurement circuit network to use for the test.	p.136
Polarity of the power supply line	Polarity of the power supply line to supply to the EUT.	p.137
Single fault mode (Condition)	Select the single fault condition of the EUT.	p.138
Probe connection destination	Where on the EUT the test leads or probes are connected to.	p.139
Output from the 110% terminal (110% OUT)	Apply from the 110% terminal to the EUT the voltage applied to the AC LINE IN inlet.	p.140
Upper limit	Reference current for the limit judgment.	p.141
Lower limit	Reference current for lower limit judgment.	p.142
Judgment delay (Judge Delay)	Time to wait after the START switch is pressed before starting judgment.	p.143
Test time	Time from the start of the test to the end of the test.	p.144
Measurement range	Select the measurement range.	p.145
Measurement mode (Measure Mode)	Current measurement mode. Select peak measurement, rms measurement, or DC measurement.	p.147
Voltmeter band expansion (VoltMeter BandWidth)	Set the band of the internal voltmeter of the product to 0.1 Hz to 1 MHz as required by IEC 60601.	p.148
Peak value display (Display Peakhold)	Display the maximum current during the test.	p.149
Measurement check (Measure Check)	Run a weak current across the A and B terminals, and check the measurement circuit.	p.281
Offset	Cancel currents that lead to errors.	p.150
Voltage conversion (Conv Voltage)	Displays the current converted using a specified voltage based on the voltage supplied to the EUT and the measured current.	p.151
Checking the EUT operation (Line OUT)	Output a voltage temporarily from AC LINE OUT to check the EUT operation before a test.	p.282

Network

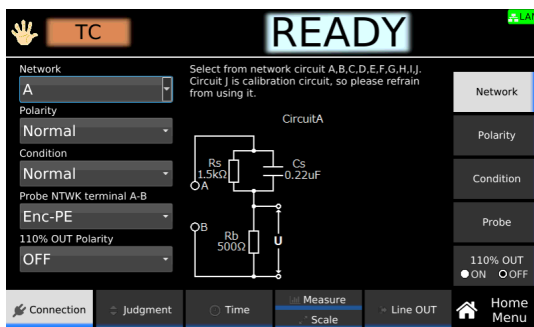
Set the measurement circuit network to use for the test.

If you set B-U1 or B-U2, use an insulation transformer that can output voltage equivalent to 110 % of the EUT's rated voltage.

Value	Application example
A	IEC 60990 Fig. 3 U1 measurement
B-U1	IEC 60990 Fig. 4 U2 measurement
B-U2	IEC 60990 Fig. 4 U1 measurement
C	IEC 60990 Fig. 5 U3 measurement
D	Electrical Appliances and Materials Safety Act single frequency
E	Electrical Appliances and Materials Safety Act multiple frequencies
F	IEC 61029, UL
G	IEC 60745
H	IEC 61010-1, IEC 61010-1 Wet condition
I	IEC 60601-1
J	For calibration. Do not use.

CAUTION If you set Network to J and apply 10 V or more between terminals A and B, the measurement circuit may break.

1 On the Home menu screen, press **Connection > Network**.



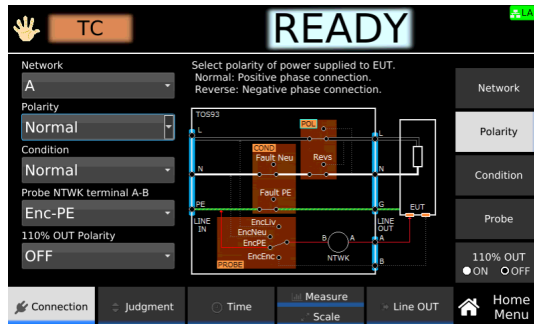
2 Turn the rotary knob to change the value.
This completes the setting.

Polarity of the power supply line

Set the polarity of the power supply line to supply to the EUT.

Value	Description
Normal	Power is supplied with positive polarity.
Reverse	Power is supplied with negative polarity.

- 1 On the Home menu screen, press **Connection > Polarity**.



- 2 Turn the rotary knob to change the value.
This completes the setting.

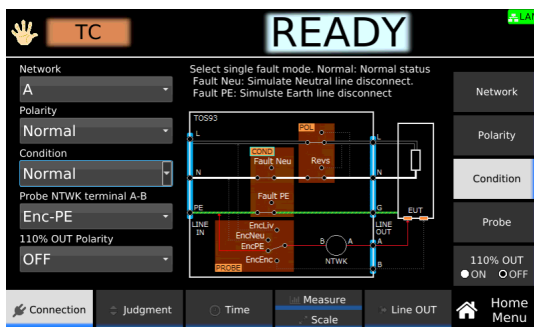
Single fault mode (Condition)

This is used to simulate a single fault condition of the EUT.

Value	Description
Normal	Normal condition.
Fault Neu	Disconnected power supply line (neutral) condition.
Fault PE	Disconnected protective ground wire condition.

If testing a Class II, selecting Fault PE will not have any effect.

- 1 On the Home menu screen, press **Connection > Condition**.



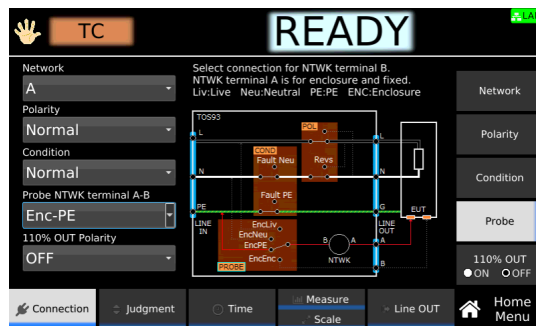
- 2 Turn the rotary knob to change the value.
This completes the setting.

Probe connection destination

Set where the test leads or probes are connected to.

Value	Description
Enc-Liv	Measures across the enclosure and power supply line (live). Connect the test lead or probe of the A terminal to the enclosure.
Enc-Neu	Measures across the enclosure and power supply line (neutral). Connect the test lead or probe of the A terminal to the enclosure.
Enc-PE	Measures across the enclosure and earth. Connect the test lead or probe of the A terminal to the enclosure.
Enc-Enc	Measures across two points on the enclosure. Connect the test leads or probes of the A and B terminals to two locations on the enclosure.

- 1 On the Home menu screen, press **Connection > Probe**.



- 2 Turn the rotary knob to change the value.
This completes the setting.

Output from the 110% terminal (110% OUT)

When you set 110% OUT to on and set the polarity, the voltage applied to the AC LINE IN inlet is output from the front-panel 110% terminal and applied to the EUT while a test is in progress.

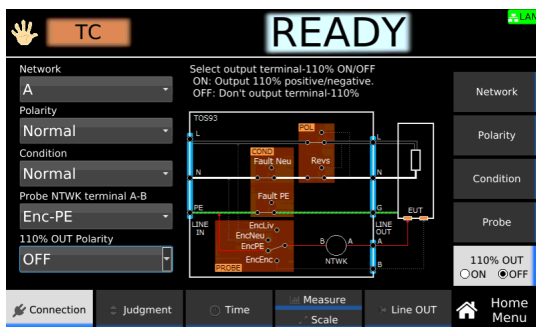
By applying a voltage at 110% of the EUT rating to the AC LINE IN inlet on the rear panel in advance, you can apply a voltage that takes into consideration the variation in the commercial power supply.

When 110% OUT is on, 110% is shown in the upper right of the display.

Value	Description
Normal	The voltage applied to the AC LINE IN inlet is output from the 110% terminal and applied to the EUT with positive polarity.
Reverse	The voltage applied to the AC LINE IN inlet is output from the 110% terminal and applied to the EUT with negative polarity.

⚠ WARNING Risk of electric shock. If you set 110% OUT to ON, do not touch the tip of the test lead connected to the 110% terminal with your hand while a test is in progress. A high voltage will be output from the 110% terminal while a test is in progress.

1 On the Home menu screen, press Connection > 110% OUT.



2 Press 110% OUT to switch between on and off.
110% OUT switches between on and off each time you press the key.

3 If you select on, turn the rotary knob to enter the polarity.
This completes the setting.

Upper limit

Set the reference current for upper limit judgment. If current greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results. To disable upper limit judgment, set Upper to off.

- 1 On the Home menu screen, press Judgment > Upper.



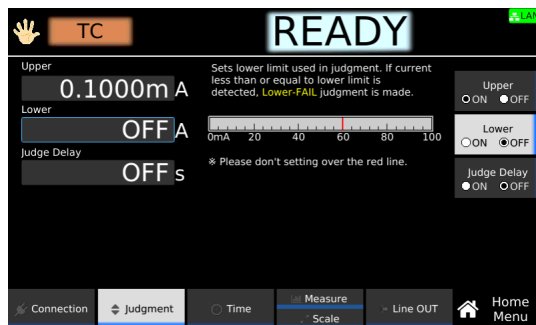
- 2 Press Upper to switch between on and off.
Upper switches between on and off each time you press the key.
- 3 If you select on, use the numeric keypad or the rotary knob to enter the current.
For the setting range, see the measurement range (p.301) in the specifications.
This completes the setting.

Lower limit

Set the reference current for the limit judgment. If a current less than or equal to Lower is measured, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.

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

1 On the Home menu screen, press Judgment > Lower.



2 Press Lower to switch between on and off.

Lower switches between on and off each time you press the key.

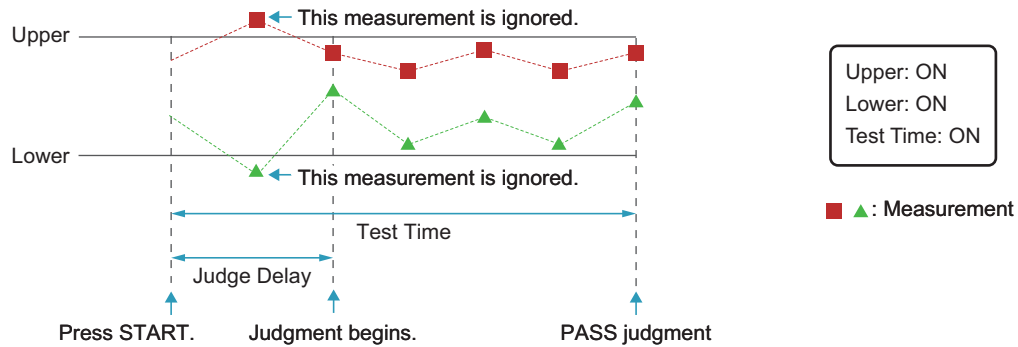
3 If you select on, use the numeric keypad or the rotary knob to enter the current.

For the setting range, see the measurement range ([p.301](#)) in the specifications.

This completes the setting.

Judgment delay (Judge Delay)

If you set the time from when the START switch is pressed to when judgment starts (judgment delay) longer than the startup time of the EUT, evaluation can be made on measurements in the steady-state condition of the EUT. Measurements made during Judge Delay are ignored and do not affect judgments. If you do not want to set the judgment delay, set Judge Delay to off.



- 1 On the Home menu screen, press Judgment > Judge Delay.



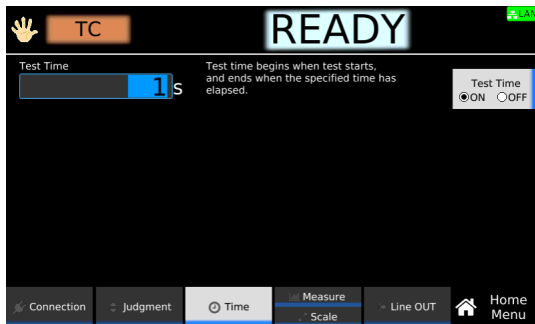
- 2 Press Judge Delay to switch between on and off.
Judge Delay switches between on and off each time you press the key.
- 3 If you select on, use the numeric keypad or the rotary knob to enter the time.
Setting range: 1 s to 1000 s
This completes the setting.

Test time

Set the test time to on or off.

Value	Description
ON	Set the time from when the START switch is pressed to the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS.
OFF	The test continues until the STOP switch is pressed. Pass judgments are not made.

- 1 On the Home menu screen, press Time > Test Time.



- 2 Press Test Time to switch between on and off.

Test Time switches between on and off each time you press the key.

- 3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 1 s to 1000 s

This completes the setting.

Measurement range

Set the measurement range.

Value	Description
Auto	Switches the range automatically according to the measured values.
Fix	The measurement range is fixed Range 1 to 4 according to the Network, Upper, and Measure Mode settings. See “Measurement range when Fix is selected” below.

■ Measurement range when Fix is selected

Network	Upper		Range setting ¹
	Measure Mode: Peak	Measure Mode: RMS (AC+DC), RMS (AC), DC	
A, B, C, H	0.1 μ A to 85 μ A	0.1 μ A to 60 μ A	Range 1
	86 μ A to 850 μ A	61 μ A to 600 μ A	Range 2
	851 μ A to 8.50 mA	601 μ A to 6.00 mA	Range 3
	8.51 mA to 85.0 mA	6.01 mA to 60.0 mA	Range 4
D, E, I	0.1 μ A to 42.4 μ A	0.1 μ A to 30 μ A	Range 1
	42.5 μ A to 424 μ A	31 μ A to 300 μ A	Range 2
	425 μ A to 4.50 mA	301 μ A to 3.00 mA	Range 3
	45.1 mA to 45.0 mA	3.01 mA to 30.0 mA	Range 4
F	0.1 μ A to 28.2 μ A	0.1 μ A to 20 μ A	Range 1
	28.3 μ A to 282 μ A	20.1 μ A to 200 μ A	Range 2
	283 μ A to 3.00 mA	201 μ A to 2.00 mA	Range 3
	3.01 mA to 30.0 mA	2.01 mA to 20.0 mA	Range 4
G	0.1 μ A to 21.2 μ A	0.1 μ A to 15 μ A	Range 1
	21.3 μ A to 212 μ A	15.1 μ A to 150 μ A	Range 2
	213 μ A to 2.12 mA	151 μ A to 1.50 mA	Range 3
	2.13 mA to 22.5 mA	1.51 mA to 15.0 mA	Range 4

¹ For the measurement range of each range setting, see the specifications (p.301).

■ Setup procedure

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Range and then turn the rotary knob to change the value. This completes the setting.

Measurement mode (Measure Mode)

Set the current measurement mode. An icon appears during testing according to the setting.

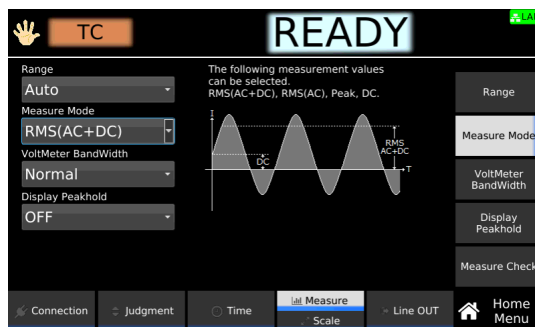
Value	Description	Icon
Peak	Measures the waveform peak value. ¹	Peak
RMS (AC+DC)	Measures the DC component and AC component with true rms values.	ACDC
RMS (AC)	Measures only the AC component with true rms values.	AC
DC	Measures only the DC component.	DC

- 1 When you set the measurement mode to Peak, noise generated by peripherals propagates through the communication control cables connected to the product and may affect the measurement. Particularly in low-level current measurement, we recommend attaching commercially available clip-type ferrite cores to the communication cables.

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.





- 2 **Press Measure Mode, and then turn the rotary knob to change the value.**



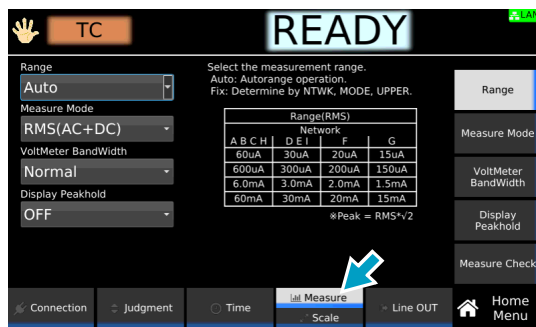
This completes the setting.

Voltmeter band expansion (VoltMeter BandWidth)

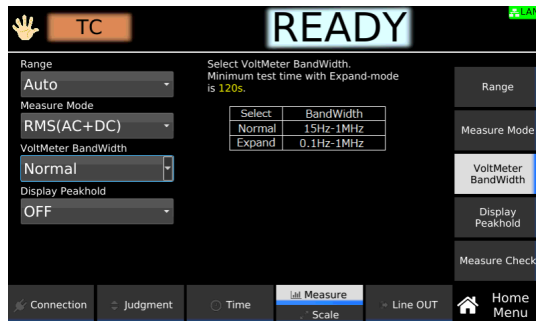
Sets whether to expand the band of the internal voltmeter of this product. An icon appears during testing according to the setting.

Value	Description	Icon
Normal	Uses the normal band (15 Hz to 1 MHz.)	
Expand	The expanded bandwidth (0.1 Hz to 1 MHz) is used as required by IEC 60601. To accurately measure low frequency components, set the test time to at least 120 seconds.	

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.



- 2 Press VoltMeter BandWidth, and then turn the rotary knob to change the value.

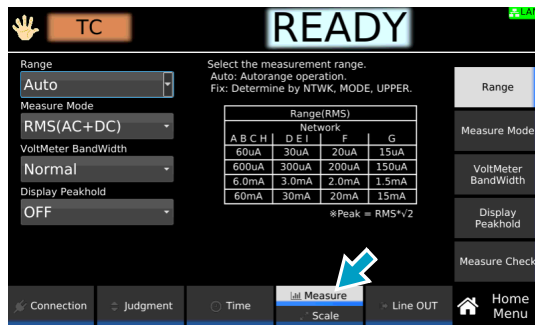


This completes the setting.

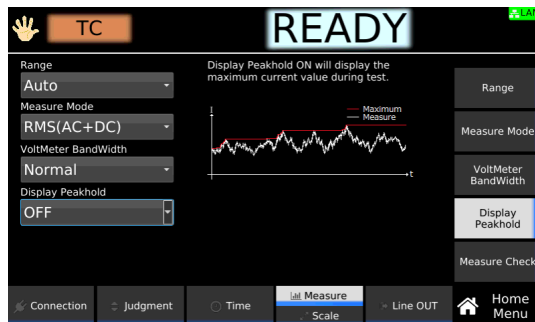
Peak value display (Display Peakhold)

When Display Peakhold is set to on, the peak current measured during testing is displayed. Judgment is also performed on the peak current.

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



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



This completes the setting.

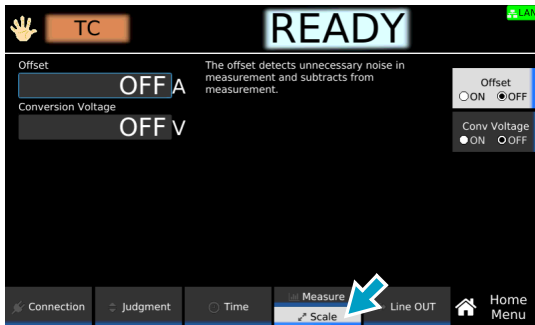
Measurement check (Measure Check)

You can run a weak current across the A and B terminals, and check the measurement circuit. For details, see "Measurement check" (p.281).

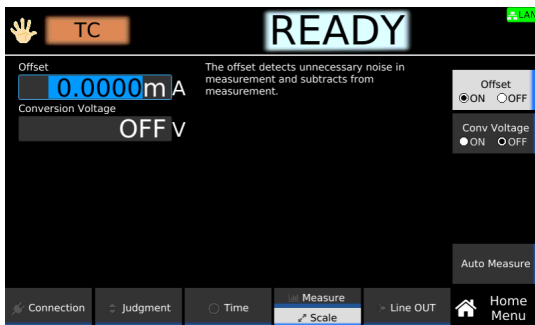
Offset

Even when the EUT is not running, a certain amount of current may be measured depending on the wiring environment or the like. If Offset is set to on, such currents, which lead to errors, can be canceled. If the offset is set to on, **Offset** appears during testing.

- 1 **On the Home menu screen, press Scale repeatedly until Scale is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 **Press Offset to switch between on and off.**
Offset switches between on and off each time you press the key.



- 3 **If set to ON, set the Offset value according to the following procedure.**

Purpose	Operation
Measure the Offset value to set it automatically.	Press Auto Measure. Connect test leads to this product, and open the test leads. Press START. When the measurement stabilizes, press STOP. The Offset value is set automatically.
Set the Offset value manually.	Use the numeric keypad or the rotary knob to enter the value. For the setting range, see the measurement range (p.301) in the specifications.

This completes the setting.

Voltage conversion (Conv Voltage)

If you set Conv Voltage to on, the current converted using a specified voltage is displayed based on the voltage supplied to the EUT and the measured current. Judgment is also performed on the converted current. If set to on, **CONV** appears during testing.

NOTE

If Conv Voltage is set to a value greater than or equal to five times the voltage applied from the AC LINE OUT terminal to the EUT, the measurement during testing is displayed as “+ Over.”

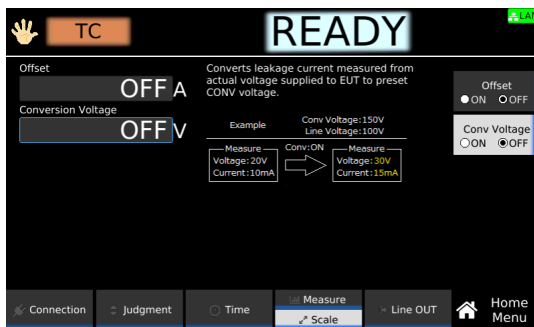
1 On the Home menu screen, press Scale repeatedly until Scale is selected.

Each time you press the key, the setting changes between Measure and Scale.



2 Press Conv Voltage to switch between on and off.

Conv Voltage switches between on and off each time you press the key.



3 If you select on, use the numeric keypad or the rotary knob to enter the voltage.

Setting range: 80.0 V to 300.0 V

This completes the setting.

Checking the EUT operation (Line OUT)

Check the EUT operation before testing. For details, see “Checking the EUT operation” (p.282).

Starting a Test

We recommend that you perform a pre-test inspection (p.281) before executing a test.

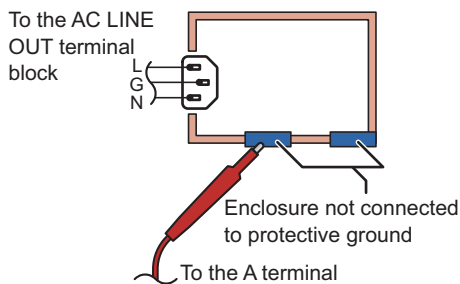
Connecting the test leads to the EUT

Connect the test leads to the test location of the EUT. For details on connecting the power supply line for the product and EUT and connecting test leads to the product, see “Connection for Leakage Current Tests” (p.41).

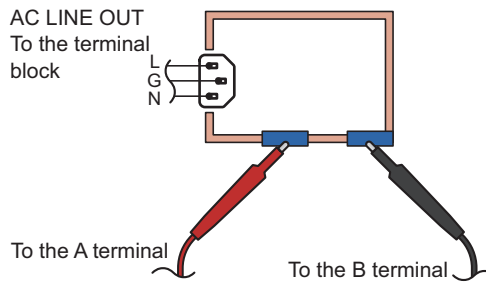
The test locations of the EUT in touch current tests vary depending on the test condition settings of “Probe connection destination” (p.139) and “Single fault mode (Condition)” (p.138) and the appliance class of the EUT. The following table shows where to connect the test lead connected to the A terminal (test lead A) and that connected to the B terminal (test lead B).

Test condition		Where to connect the test leads	
Probe	Condition	Class I instrument or Class 0I instrument	Class II instrument
Enc-Liv Enc-Neu	Normal	Test lead A to the enclosure not connected to protective ground (example 1).	Test lead A to the enclosure.
	Normal	Test lead A to the enclosure (example 3).	Test lead A to the enclosure.
Enc-PE	Fault Neu		
	Fault PE	Test lead A to the enclosure. If 110% OUT is turned on, connect test lead 110% to the signal I/O section not connected to protective ground.	–
Enc-Enc	Normal	Test lead A and B to two insulated locations on the enclosure not connected to protective ground (example 2).	Test lead A and B to two insulated locations on the enclosure. If 110% OUT is turned on, connect test lead 110% to the signal I/O section not connected to protective ground.
	Fault Neu	If 110% OUT is turned on, connect test lead 110% to the signal I/O section not connected to protective ground (example 4).	
	Fault PE	Test lead A and B to two insulated locations on the enclosure not connected to protective ground (example 2) or to the enclosure not connected to protective ground and enclosure connected to protective ground. If 110% OUT is turned on, connect test lead 110% to the signal I/O section not connected to protective ground (example 4).	–

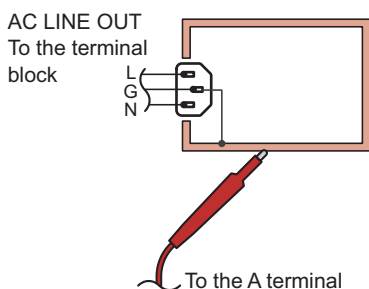
■ Connection example



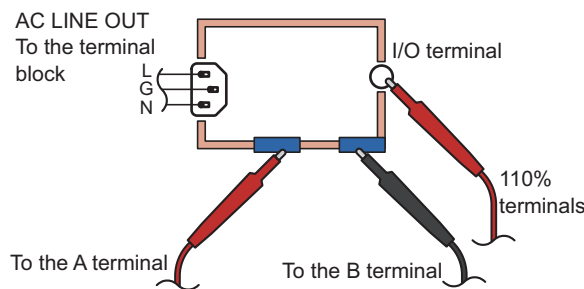
Example 1: Across the enclosure and power or across the enclosure and earth



Example 2: Across two points on the enclosure



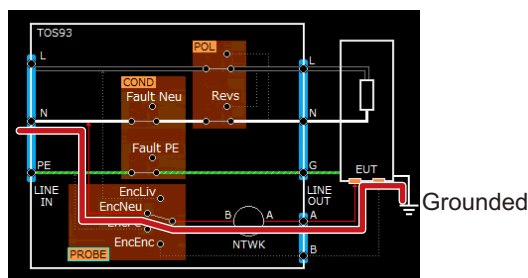
Example 3: Across the enclosure and earth



Example 4: Across two points on the enclosure (apply 110% voltage)

Ground check

If the test condition “Probe connection destination” ([p.139](#)) is set to “Enc-Liv” or “Enc-Neu”, test lead A is connected to the power supply line (L or N) through a network inside the product. Therefore, if test lead A is connected to a grounded EUT enclosure by mistake, the power line will be grounded through the network, and this is dangerous.



To perform tests safely, it is necessary to check in advance that the measurement point is not grounded. Ground check performs this check automatically. After you press START, a weak current is run between test lead A and the ground to check whether the measurement point is grounded before starting the test. If the measurement point is grounded, when you press START, “Contact-FAIL” is displayed in the top area of the display, and the test is aborted. Until Contact-FAIL is cleared, the U FAIL and L FAIL signals of the SIGNAL I/O connector are set to on simultaneously. To clear Contact-FAIL, press STOP.

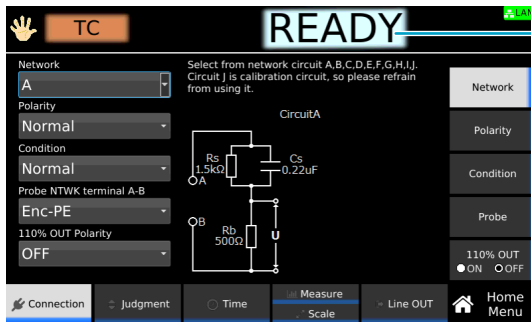
CAUTION

Be sure to connect the test leads to the measurement point, and then press START. If you connect the test leads to the measurement point after pressing START, the instrument will determine that the measurement point is not grounded, and the ground check will pass. Incorrect connections will not be detected.

Starting a test

⚠ WARNING Risk of electric shock. When using the test leads, do not touch the tip of the lead with your hand.

- 1 Check that the product is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then press START.



READY icon

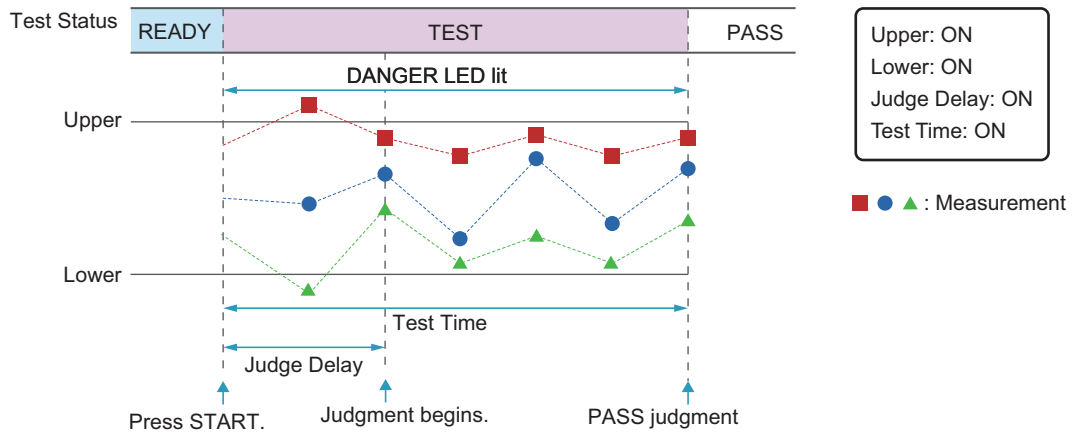


“TEST” is shown in the upper right of the display, and the test starts.
If the test does not start, see “Unable to start a test” (p.336).

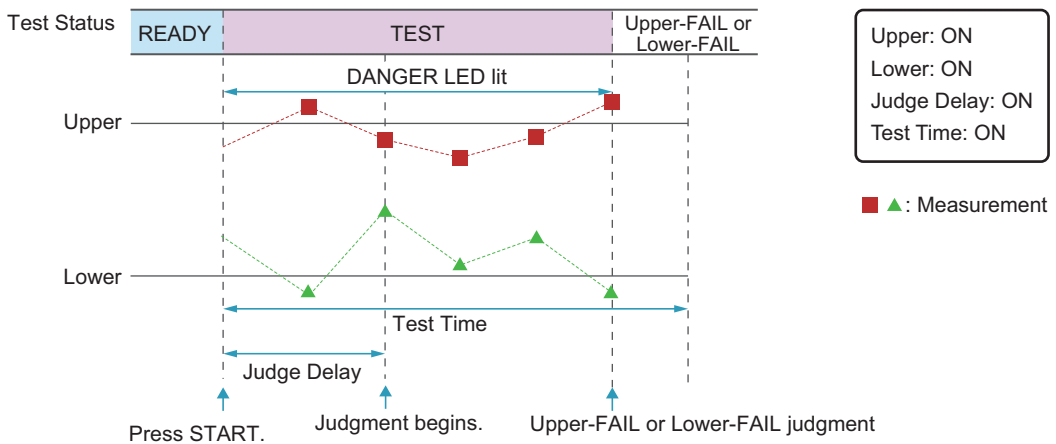
Operation after a test starts

Shown below are examples of operation after a test starts.

■ Example of a PASS judgment

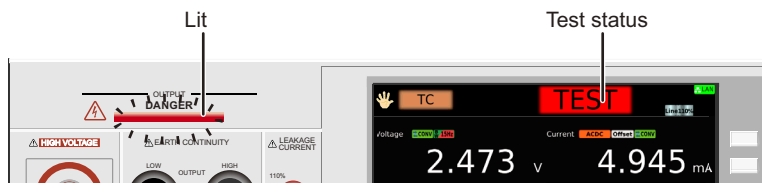


■ Example of a FAIL judgment



■ DANGER LED and test status display

During a test, the DANGER LED lights, and the test status is shown in the upper right of the display.



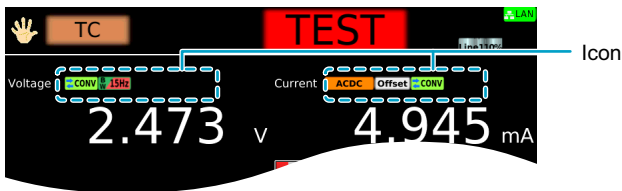
■ Measurement display

During a test, measurements are shown on the display.



■ Test condition display

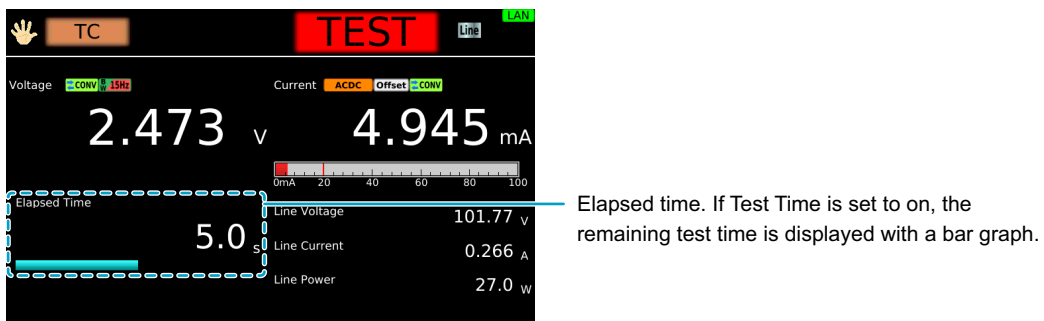
Icons indicating the test conditions appearing during testing.



Icon	Description
	VoltMeter BandWidth setting (Normal/Expand).
	Offsetting.
	Measure Mode setting (Peak/RMS (AC+DC)/RMS (AC)/DC).
	Conv Voltage being set to ON.

■ Test time display

During the test time, “TEST” and the elapsed time are displayed. If Test Time is set to on, the remaining test time is displayed with a bar graph. If Test Time is set to off, the elapsed time is displayed up to 3600000.0 seconds. If the elapsed time is greater than 3600000.0, the display is fixed at 3600000.0.



Finishing the Test and Viewing the Judgment

Stopping tests

If you want to stop a test or finish a test when the test time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

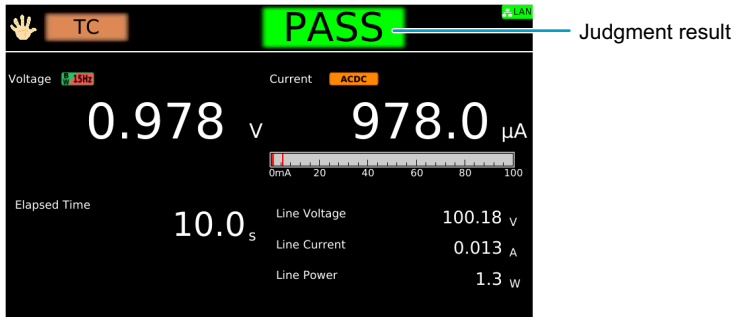
- a. When a current greater than or equal to Upper limit or less than equal to Lower limit is measured
- b. When the test time elapses if Test time is set to on
- c. When you press STOP

In any of the cases above, the "TEST" indication on the display disappears when the test ends.

If the test finishes under condition a or b given above, the judgment result ([p. 158](#)) will be shown on the display.

Judgment types and operation

When a test finishes, the judgment result is shown in the test status.



	Upper-FAIL	Lower-FAIL
Condition	A current greater than or equal to the upper limit was measured.	A current less than or equal to the lower limit was measured.
Display	The test status shows “Upper-FAIL” until the judgment result is cleared.	The test status shows “Lower-FAIL” until the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.
SIGNAL I/O connector	U FAIL signal is output until the judgment result is cleared.	L FAIL signal is output until the judgment result is cleared.

	Contact-FAIL	PASS
Condition	When each measurement point is grounded with Probe set to Enc-Liv or Enc-Neu.	Upper-FAIL, Lower-FAIL, or Contact-FAIL judgment did not occur during the test.
Display	The test status shows “Contact-FAIL” until the judgment result is cleared.	The test status shows “PASS” until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	Both the U FAIL and L FAIL signals are output simultaneously until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

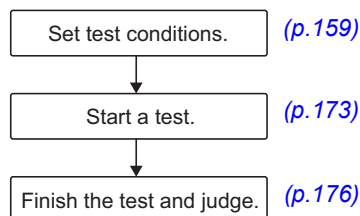
Press STOP to clear the judgment result. The product is ready to start another test.

Protective Conductor Current Test

Applicable model: **9303LC**

This chapter describes how to set test conditions, start tests, and view the results for protective conductor current (PCC) or leakage current (LC) tests.

The following flowchart shows the configuration and test steps.



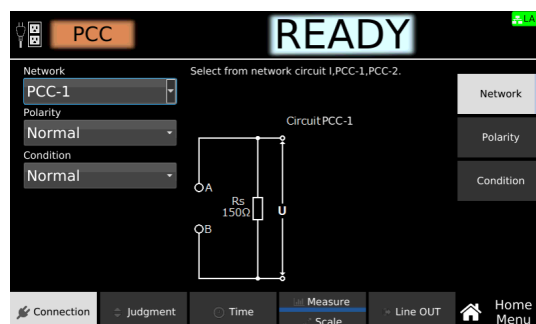
Setting Test Conditions

This section describes the test conditions of protective conductor current (PCC) tests and how to set the conditions.

Displaying the setup screen (Home menu)

- 1 On the Function menu screen (p.46), press **LC >PCC**.

The setup screen (Home menu) for the PCC test conditions appears.



Set the required conditions by referring to the description of test conditions (p.160).

Description of test conditions

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

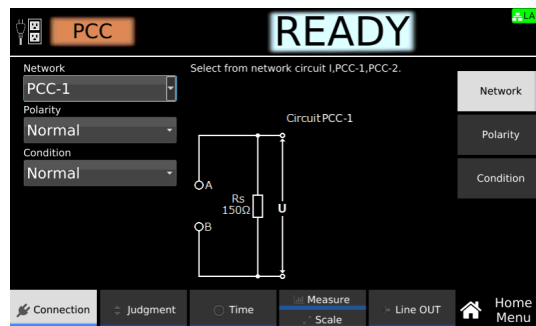
Test condition	Description	See
Network	Select the measurement circuit network to use for the test.	p. 161
Polarity of the power supply line	Polarity of the power supply line to supply to the EUT.	p. 162
Single fault mode (Condition)	Select the single fault condition of the EUT.	p. 162
Upper limit	Reference current for the limit judgment.	p. 163
Lower limit	Reference current for lower limit judgment.	p. 164
Judgment delay (Judge Delay)	Time to wait after the START switch is pressed before starting judgment.	p. 165
Test time	Time from the start of the test to the end of the test.	p. 166
Measurement range	Select the measurement range.	p. 167
Measurement mode (Measure Mode)	Current measurement mode. Select peak measurement, rms measurement, or DC measurement.	p. 168
Voltmeter band expansion (VoltMeter BandWidth)	Set the band of the internal voltmeter of the product to 0.1 Hz to 1 MHz as required by IEC 60601.	p. 169
Peak value display (Display Peakhold)	Display the maximum current during the test.	p. 170
Measurement check (Measure Check)	Run a weak current across the A and B terminals, and check the measurement circuit.	p. 281
Offset	Cancel currents that lead to errors.	p. 171
Voltage conversion (Conv Voltage)	Displays the current converted using a specified voltage based on the voltage supplied to the EUT and the measured current.	p. 172
Checking the EUT operation (Line OUT)	Output a voltage temporarily from AC LINE OUT to check the EUT operation before a test.	p. 282

Network

Set the measurement circuit network to use for the test.

Value	Application example
I	Ground leakage current measurement of medical instruments
PCC-1	Protective conductor current measurement
PCC-2	IEC 60598-1

- 1 On the Home menu screen, press **Connection > Network**.



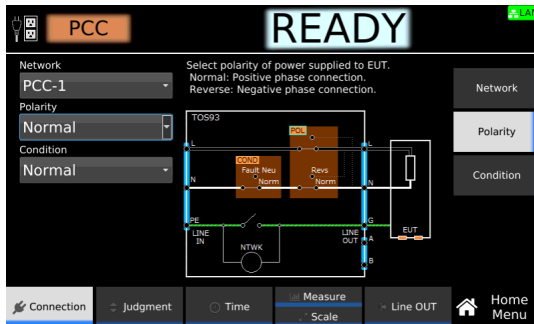
- 2 Turn the rotary knob to change the value.
This completes the setting.

Polarity of the power supply line

Set the polarity of the power supply line to supply to the EUT.

Value	Description
Normal	Power is supplied with positive polarity.
Reverse	Power is supplied with negative polarity.

1 On the Home menu screen, press Connection > Polarity.



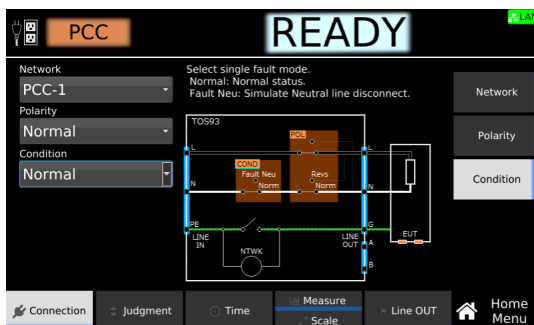
2 Turn the rotary knob to change the value.
This completes the setting.

Single fault mode (Condition)

This is used to simulate a single fault condition of the EUT.

Value	Description
Normal	Normal condition.
Fault Neu	Disconnected power supply line (neutral) condition.

1 On the Home menu screen, press Connection > Condition.

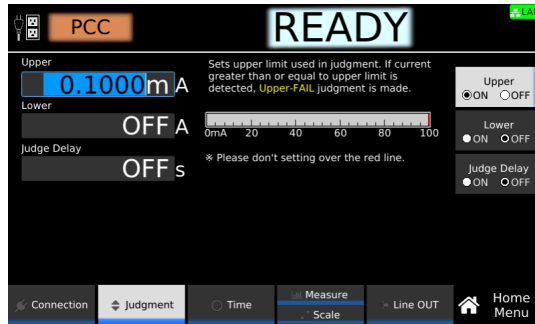


2 Turn the rotary knob to change the value.
This completes the setting.

Upper limit

Set the reference current for upper limit judgment. If current greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results. To disable upper limit judgment, set Upper to off.

- 1 On the Home menu screen, press Judgment > Upper.



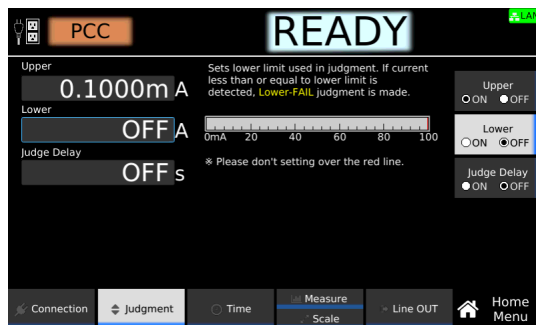
- 2 Press Upper to switch between on and off.
Upper switches between on and off each time you press the key.
- 3 If you select on, use the numeric keypad or the rotary knob to enter the current.
For the setting range, see the measurement range (p.301) in the specifications.
This completes the setting.

Lower limit

Set the reference current for the limit judgment. If a current less than or equal to Lower is measured, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.

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

1 On the Home menu screen, press Judgment > Lower.



2 Press Lower to switch between on and off.

Lower switches between on and off each time you press the key.

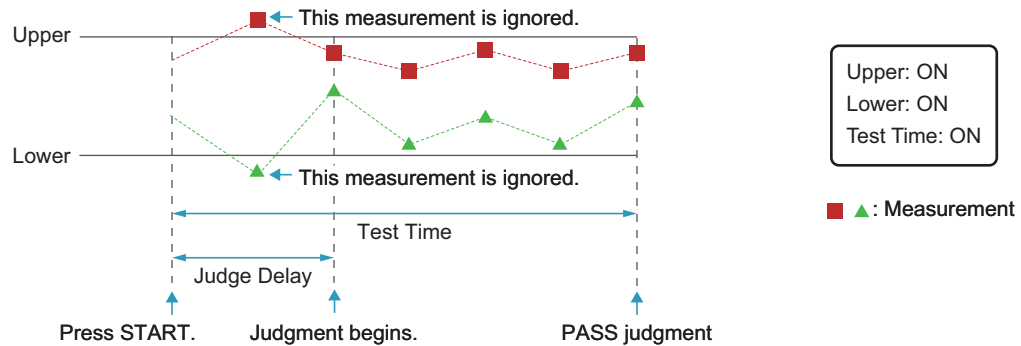
3 If you select on, use the numeric keypad or the rotary knob to enter the current.

For the setting range, see the measurement range (p.301) in the specifications.

This completes the setting.

Judgment delay (Judge Delay)

If you set the time from when the START switch is pressed to when judgment starts (judgment delay) longer than the startup time of the EUT, evaluation can be made on measurements in the steady-state condition of the EUT. Measurements made during Judge Delay are ignored and do not affect judgments. If you do not want to set the judgment delay, set Judge Delay to off.



1 On the Home menu screen, press Judgment > Judge Delay.



2 Press Judge Delay to switch between on and off.

Judge Delay switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 1 s to 1000 s

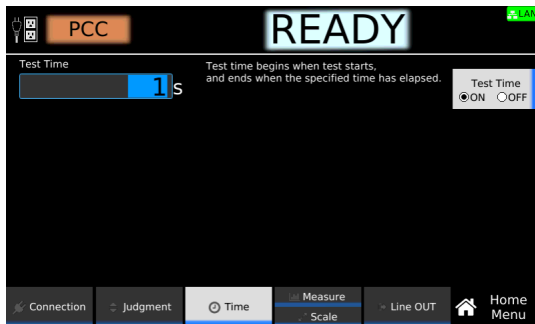
This completes the setting.

Test time

Set the test time to on or off.

Value	Description
ON	Set the time from when the START switch is pressed to the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS.
OFF	The test continues until the STOP switch is pressed. Pass judgments are not made.

1 On the Home menu screen, press Time > Test Time.



2 Press Test Time to switch between on and off.

Test Time switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 1 s to 1000 s

This completes the setting.

Measurement range

Set the measurement range.

Value	Description
Auto	Switches the range automatically according to the measured values.
Fix	The measurement range is fixed Range 1 to 4 according to the Network, Upper, and Measure Mode settings. See “Measurement range when Fix is selected” below.

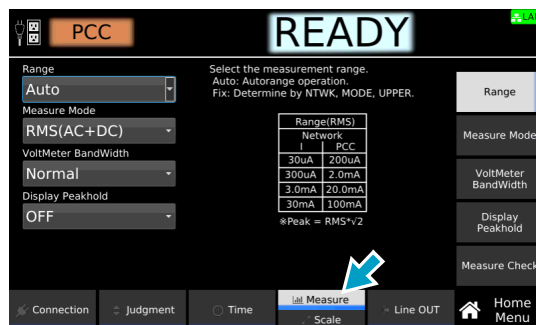
■ Measurement range when Fix is selected

Network	Upper		Range setting ¹
	Measure Mode: Peak	Measure Mode: RMS (AC+DC), RMS (AC), DC	
I	0.1 μ A to 42.4 μ A	0.1 μ A to 30 μ A	Range 1
	42.5 μ A to 424 μ A	31 μ A to 300 μ A	Range 2
	425 μ A to 4.50 mA	301 μ A to 3.00 mA	Range 3
	45.1 mA to 45.0 mA	3.01 mA to 30.0 mA	Range 4
PCC-1, PCC-2	0.1 μ A to 282 μ A	0.1 μ A to 200 μ A	Range 1
	283 μ A to 2.83 μ A	201 μ A to 2.00 mA	Range 2
	2.84 μ A to 28.3 mA	2.01 mA to 20.00 mA	Range 3
	28.4 mA to 100 mA	20.1 mA to 100 mA	Range 4

1 For the measurement range of each range setting, see the specifications (p.301).

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

Each time you press the key, the setting changes between Measure and Scale.







2 Press Range and then turn the rotary knob to change the value.

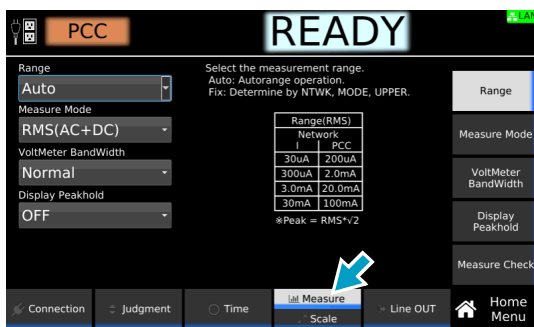
This completes the setting.

Measurement mode (Measure Mode)

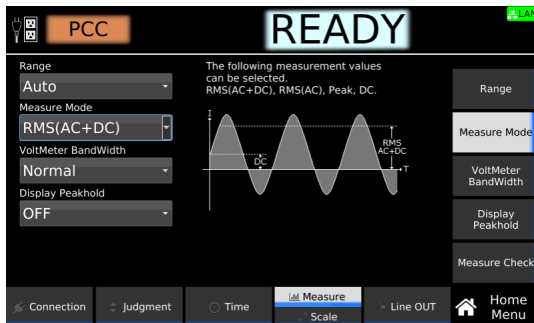
Set the current measurement mode. An icon appears during testing according to the setting.

Value	Description	Icon
Peak	Measures the waveform peak value.	
RMS (AC+DC)	Measures the DC component and AC component with true rms values.	
RMS (AC)	Measures only the AC component with true rms values.	
DC	Measures only the DC component.	

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected. Each time you press the key, the setting changes between Measure and Scale.





- 2 Press Measure Mode and then turn the rotary knob to change the value.



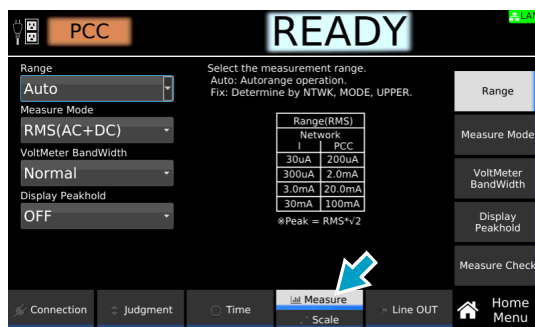
This completes the setting.

Voltmeter band expansion (VoltMeter BandWidth)

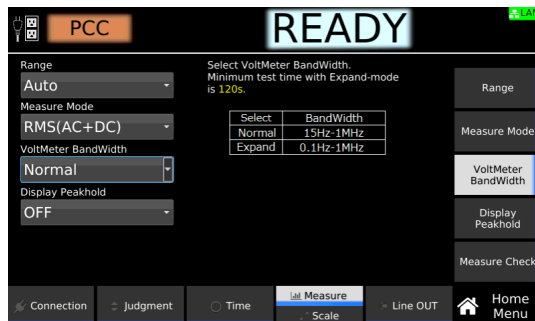
Sets whether to expand the band of the internal voltmeter of this product. An icon appears during testing according to the setting.

Value	Description	Icon
Normal	Uses the normal band (15 Hz to 1 MHz).	
Expand	The expanded bandwidth (0.1 Hz to 1 MHz) is used as required by IEC 60601. To accurately measure low frequency components, set the test time to at least 120 seconds.	

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 **Press VoltMeter BandWidth.**

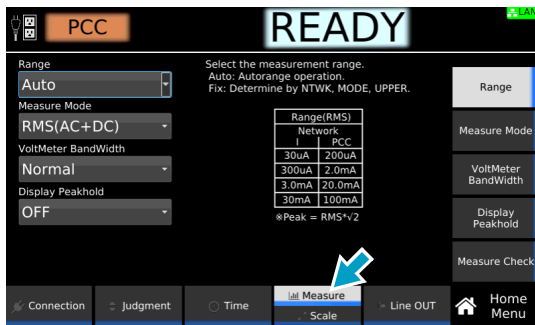


- 3 **Turn the rotary knob to change the value.**
This completes the setting.

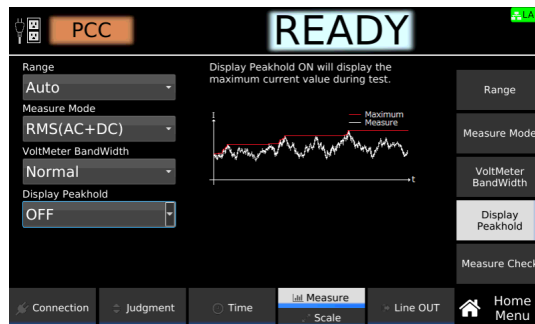
Peak value display (Display Peakhold)

When Display Peakhold is set to on, the peak current measured during testing is displayed. Judgment is also performed on the peak current.

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



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



This completes the setting.

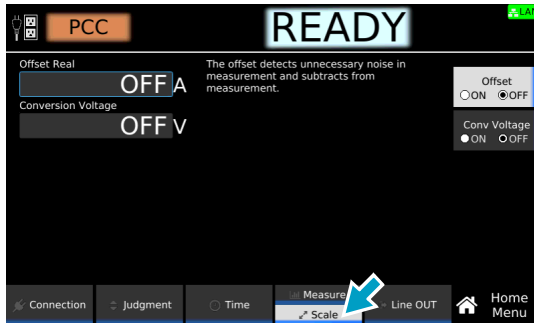
Measurement check (Measure Check)

You can run a weak current across the A and B terminals, and check the measurement circuit. For details, see "Measurement check" (p.281).

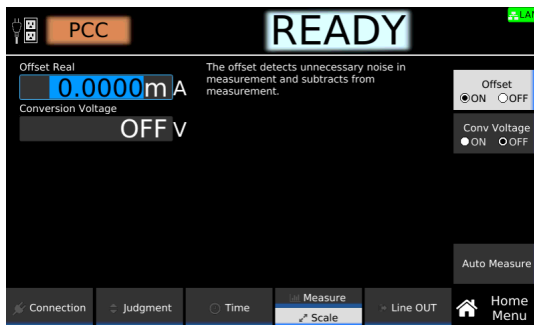
Offset

Even when the EUT is not running, a certain amount of current may be measured depending on the wiring environment or the like. If Offset is set to on, such currents, which lead to errors, can be canceled. If the offset is set to on, **Offset** appears during testing.

- 1 On the Home menu screen, press Scale repeatedly until Scale is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Offset to switch between on and off.**
Offset switches between on and off each time you press the key.



- 3 If set to ON, set the Offset value according to the following procedure.**

Purpose	Operation
Measure the Offset value to set it automatically.	Press Auto Measure. Connect test leads to this product, and open the test leads. Press START. When the measurement stabilizes, press STOP. The Offset value is set automatically.
Set the Offset value manually.	Use the numeric keypad or the rotary knob to enter the value. For the setting range, see the measurement range (p.301) in the specifications.

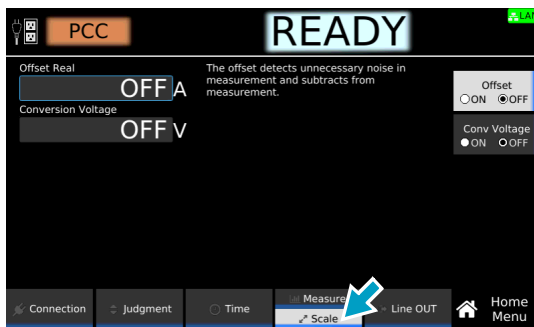
This completes the setting.

Voltage conversion (Conv Voltage)

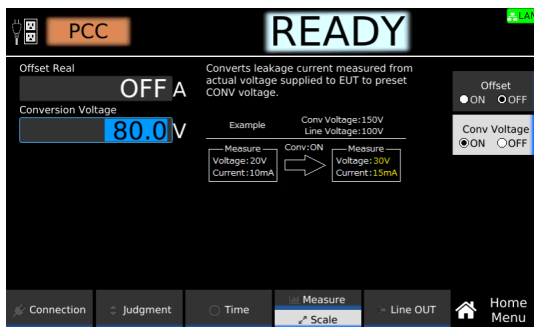
If you set Conv Voltage to on, the current converted using a specified voltage is displayed based on the voltage supplied to the EUT and the measured current. Judgment is also performed on the converted current. If set to on, **CONV** appears during testing.

NOTE If Conv Voltage is set to a value greater than or equal to five times the voltage applied from the AC LINE OUT terminal to the EUT, the measurement during testing is displayed as “+ Over.”

- 1 On the Home menu screen, press Scale repeatedly until Scale is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Conv Voltage to switch between on and off.**
Conv Voltage switches between on and off each time you press the key.



- 3 If you select on, use the numeric keypad or the rotary knob to enter the voltage.**
Setting range: 80.0 V to 300.0 V
This completes the setting.

Checking the EUT operation (Line OUT)

Check the EUT operation before testing. For details, see “Checking the EUT operation” (p.282).

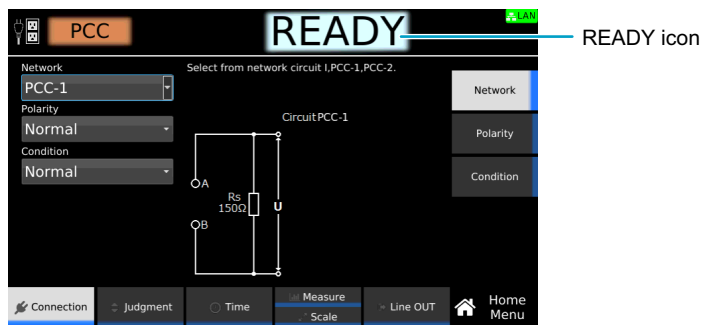
Starting a Test

We recommend that you perform a pre-test inspection ([p.281](#)) before executing a test. For details on connecting the power supply line for the product and EUT, see “Connecting the EUT to the power supply” ([p.41](#)).

Starting a test

⚠ WARNING Risk of electric shock. When using the test leads, do not touch the tip of the lead with your hand.

- 1 Check that the product is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then press START.

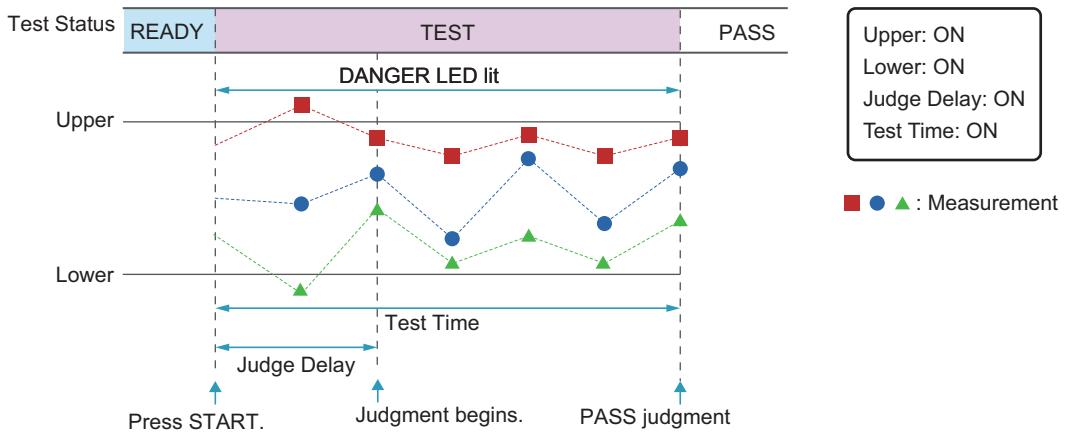


“TEST” is shown in the upper right of the display, and the test starts.
 If the test does not start, see “Unable to start a test” ([p.336](#)).

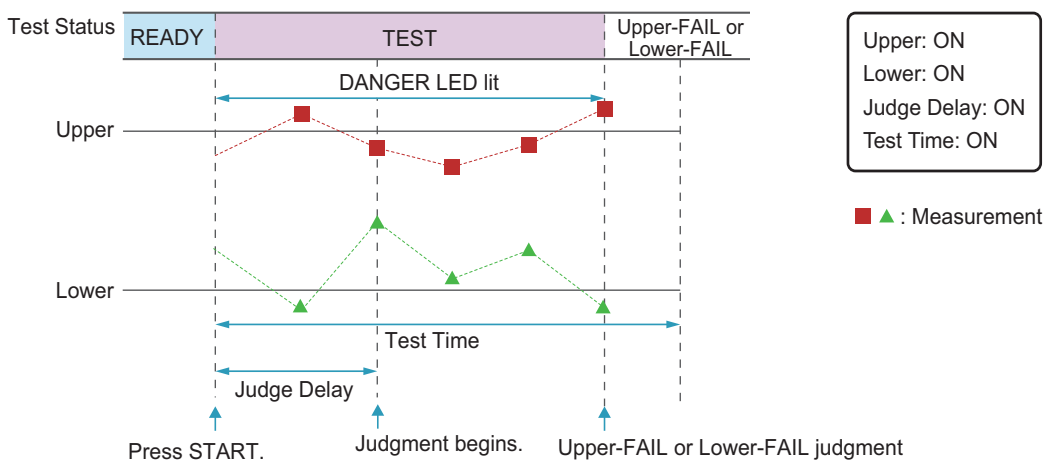
Operation after a test starts

Shown below are examples of operation after a test starts.

■ Example of a PASS judgment

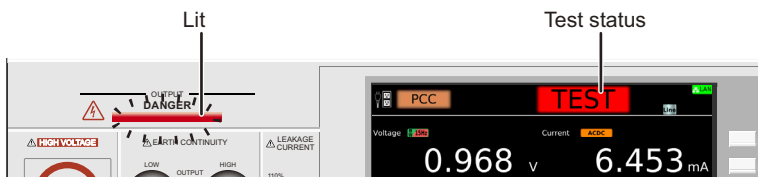


■ Example of a FAIL judgment



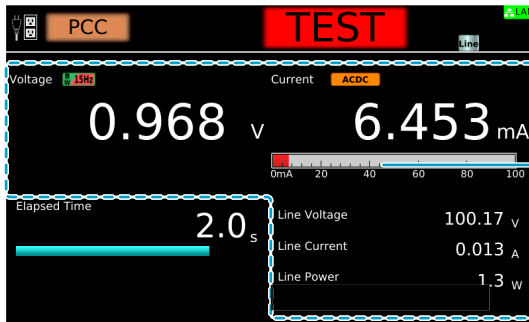
■ DANGER LED and test status display

During a test, the DANGER LED lights, and the test status is shown in the upper right of the display.



■ Measurement display

During a test, measurements are shown on the display.

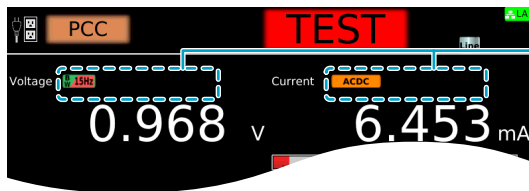


Measurement

Displays the ratio of the measurement relative to the Upper value

■ Test condition display

Icons indicating the test conditions appearing during testing.

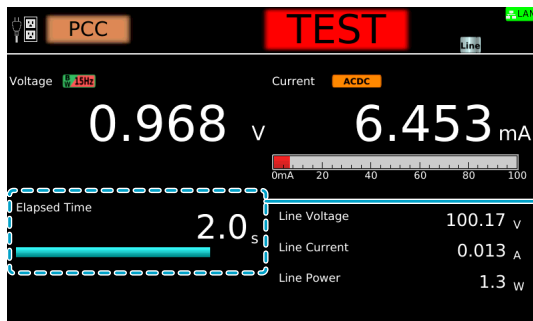


Icon

Icon	Description
	VoltMeter BandWidth setting (Normal/Expand).
	Offsetting.
	Measure Mode setting (Peak/RMS (AC+DC)/RMS (AC)/DC).
	Conv Voltage being set to ON.

■ Test time display

During the test time, "TEST" and the elapsed time are displayed. If Test Time is set to on, the remaining test time is displayed with a bar graph. If Test Time is set to off, the elapsed time is displayed up to 3600000.0 seconds. If the elapsed time is greater than 3600000.0, the display is fixed at 3600000.0.



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

Finishing the Test and Viewing the Judgment

Stopping tests

If you want to stop a test or finish a test when the test time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

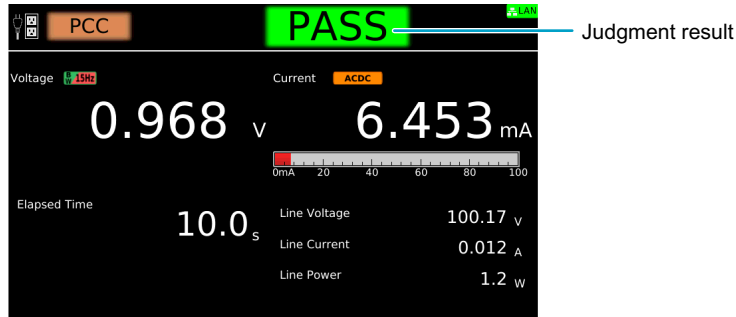
- a. When a current greater than or equal to Upper limit or less than equal to Lower limit is measured
- b. When the test time elapses if Test time is set to on
- c. When you press STOP

In any of the cases above, the "TEST" indication on the display disappears when the test ends.

If the test finishes under condition a or b given above, the judgment result (p. 177) will be shown on the display.

Judgment types and operation

When a test finishes, the judgment result is shown in the test status.



	Upper-FAIL	Lower-FAIL	PASS
Condition	A current greater than or equal to the upper limit was measured.	A current less than or equal to the lower limit was measured.	Upper-FAIL or Lower-FAIL judgment did not occur during the test.
Display	The test status shows "Upper-FAIL" until the judgment result is cleared.	The test status shows "Lower-FAIL" until the judgment result is cleared.	The test status shows "PASS" until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	Upper-FAIL signal is output until the judgment result is cleared.	Lower-FAIL signal is output until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

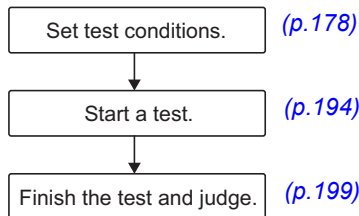
Press STOP to clear the judgment result. The product is ready to start another test.

Patient Leakage Current Test

Applicable models: **9303LC**

This chapter describes how to set test conditions, start tests, and view the results for patient leakage current (Patient) of leakage current (LC) tests.

The following flowchart shows the configuration and test steps.



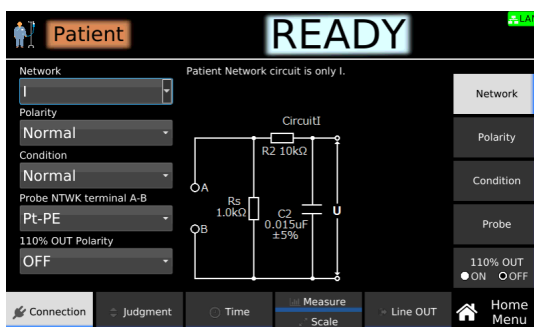
Setting Test Conditions

This section describes the test conditions of patient leakage current (Patient) tests and how to set the conditions.

Displaying the setup screen (Home menu)

- 1 On the Function menu screen (p.46), press **LC > Patient**.

The setup screen (Home menu) for the Patient test conditions appears.



Set the required conditions by referring to the description of test conditions (p.179).

Description of test conditions

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

Test condition	Description	See
Network	Measurement circuit network to use for the test (fixed to network I).	–
Polarity of the power supply line	Polarity of the power supply line to supply to the EUT.	p.180
Single fault mode (Condition)	Select the single fault condition of the EUT.	p.181
Probe connection destination	Where on the EUT the test leads or probes are connected to.	p.182
Output from the 110% terminal (110% OUT)	Apply from the 110% terminal to the EUT the voltage applied to the AC LINE IN inlet.	p.183
Upper limit	Reference current for the limit judgment.	p.184
Lower limit	Reference current for lower limit judgment.	p.185
Judgment delay (Judge Delay)	Time to wait after the START switch is pressed before starting judgment.	p.186
Test time	Time from the start of the test to the end of the test.	p.187
Measurement range	Select the measurement range.	p.188
Measurement mode (Measure Mode)	Current measurement mode. Select peak measurement, rms measurement, or DC measurement.	p.189
Voltmeter band expansion (VoltMeter BandWidth)	Set the band of the internal voltmeter of the product to 0.1 Hz to 1 MHz as required by IEC 60601.	p.190
Peak value display (Display Peakhold)	Display the maximum current during the test.	p.191
Measurement check (Measure Check)	Run a weak current across the A and B terminals, and check the measurement circuit.	p.281
Offset	Cancel currents that lead to errors.	p.192
Voltage conversion (Conv Voltage)	Displays the current converted using a specified voltage based on the voltage supplied to the EUT and the measured current.	p.193
Checking the EUT operation (Line OUT)	Output a voltage temporarily from AC LINE OUT to check the EUT operation before a test.	p.282

Network

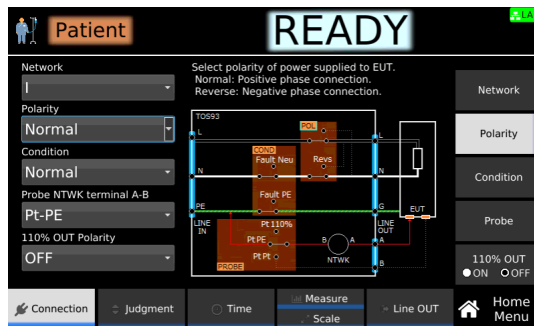
The only network that can be used for patient leakage current tests is I (for IEC 60601-1).

Polarity of the power supply line

Set the polarity of the power supply line to supply to the EUT.

Value	Description
Normal	Power is supplied with positive polarity.
Reverse	Power is supplied with negative polarity.

1 On the Home menu screen, press **Connection > Polarity**.



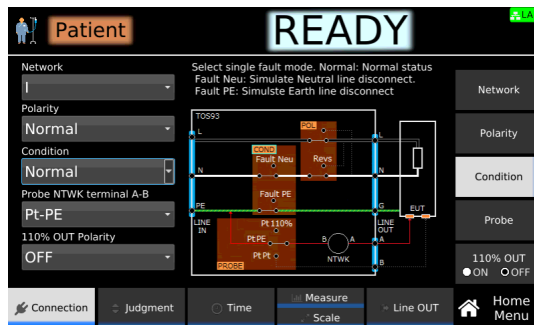
2 Turn the rotary knob to change the value.
This completes the setting.

Single fault mode (Condition)

This is used to simulate a single fault condition of the EUT.

Value	Description
Normal	Normal condition.
Fault Neu	Disconnected power supply line (neutral) condition.
Fault PE	Disconnected protective ground wire condition.

- 1 On the Home menu screen, press **Connection > Condition**.



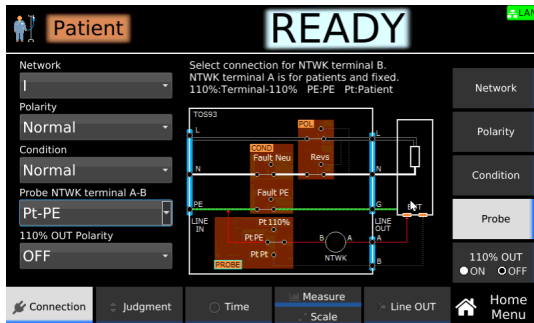
- 2 Turn the rotary knob to change the value.
This completes the setting.

Probe connection destination

Set where the test leads or probes are connected to.

Value	Description
Pt-110%	Measures the patient leakage current running across the F-type applied part and 110% terminal. Connect the test lead or probe of the A terminal to the F-type applied part.
Pt-PE	Measures the patient leakage current or the total patient leakage current across a part applied to the patient and earth. Connect the test lead or probe of the A terminal to the applied part.
Pt-Pt	Measures the patient measurement current across applied part. Connect the test leads or probes of the A and B terminals to each of the two applied parts.

- 1 On the Home menu screen, press **Connection > Probe**.



- 2 Turn the rotary knob to change the value. This completes the setting.

Output from the 110% terminal (110% OUT)

When you set 110% OUT to on and set the polarity, the voltage applied to the AC LINE IN inlet is output from the front-panel 110% terminal and applied to the EUT while a test is in progress.

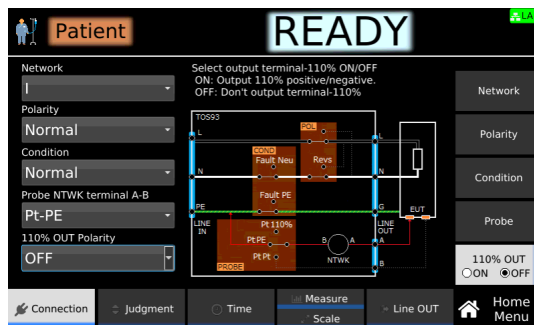
By applying a voltage at 110% of the EUT rating to the AC LINE IN inlet on the rear panel in advance, you can apply a voltage that takes into consideration the variation in the commercial power supply.

When 110% OUT is on, **110%** is shown in the upper right of the display.

Value	Description
Normal	The voltage applied to the AC LINE IN inlet is output from the 110% terminal and applied to the EUT with positive polarity.
Reverse	The voltage applied to the AC LINE IN inlet is output from the 110% terminal and applied to the EUT with negative polarity.

WARNING Risk of electric shock. If you set 110% OUT to ON, do not touch the tip of the test lead connected to the 110% terminal with your hand while a test is in progress. A high voltage will be output from the 110% terminal while a test is in progress.

- 1 On the Home menu screen, press Connection > 110% OUT.

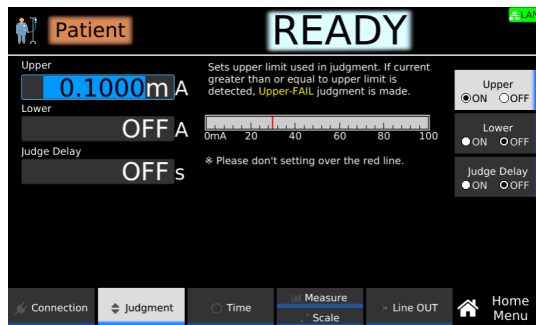


- 2 Press 110% OUT to switch between on and off.
110% OUT switches between on and off each time you press the key.
- 3 If you select on, turn the rotary knob to enter the polarity.
This completes the setting.

Upper limit

Set the reference current for upper limit judgment. If current greater than or equal to Upper is measured, upper limit judgment (Upper-FAIL) results. To disable upper limit judgment, set Upper to off.

- 1 On the Home menu screen, press Judgment > Upper.



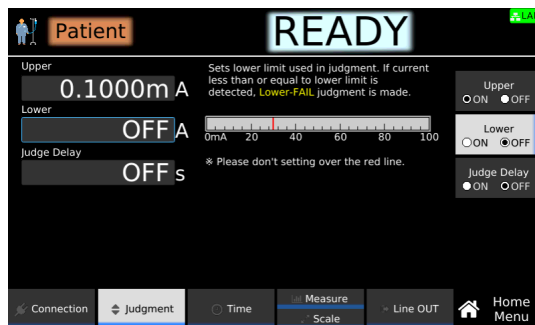
- 2 Press Upper to switch between on and off.
Upper switches between on and off each time you press the key.
- 3 If you select on, use the numeric keypad or the rotary knob to enter the current.
For the setting range, see the measurement range (p.301) in the specifications.
This completes the setting.

Lower limit

Set the reference current for the limit judgment. If a current less than or equal to Lower is measured, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.

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

1 On the Home menu screen, press Judgment > Lower.



2 Press Lower to switch between on and off.

Lower switches between on and off each time you press the key.

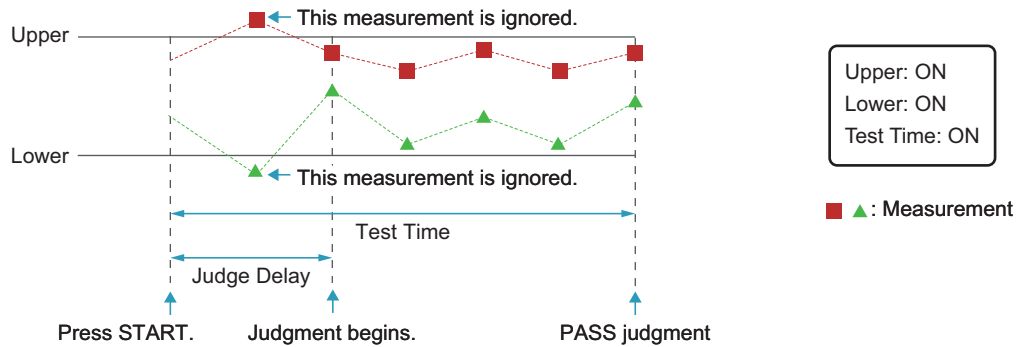
3 If you select on, use the numeric keypad or the rotary knob to enter the current.

For the setting range, see the measurement range ([p.301](#)) in the specifications.

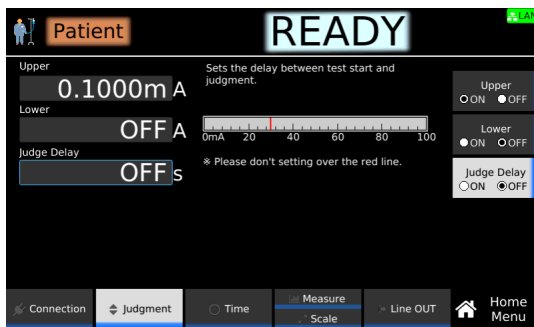
This completes the setting.

Judgment delay (Judge Delay)

If you set the time from when the START switch is pressed to when judgment starts (judgment delay) longer than the startup time of the EUT, evaluation can be made on measurements in the steady-state condition of the EUT. Measurements made during Judge Delay are ignored and do not affect judgments. If you do not want to set the judgment delay, set Judge Delay to off.



1 On the Home menu screen, press Judgment > Judge Delay.



2 Press Judge Delay to switch between on and off.

Judge Delay switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 1 s to 1000 s

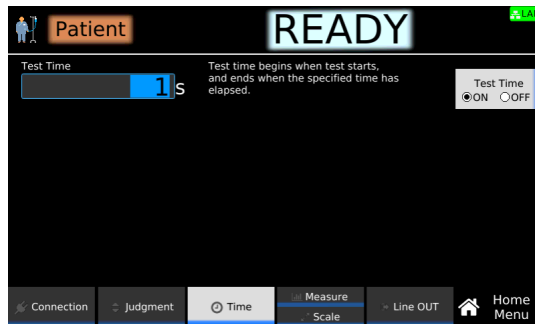
This completes the setting.

Test time

Set the test time to on or off.

Value	Description
ON	Set the time from when the START switch is pressed to the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS.
OFF	The test continues until the STOP switch is pressed. Pass judgments are not made.

1 On the Home menu screen, press Time > Test Time.



2 Press Test Time to switch between on and off.

Test Time switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the time.

Setting range: 1 s to 1000 s

This completes the setting.

Measurement range

Set the measurement range.

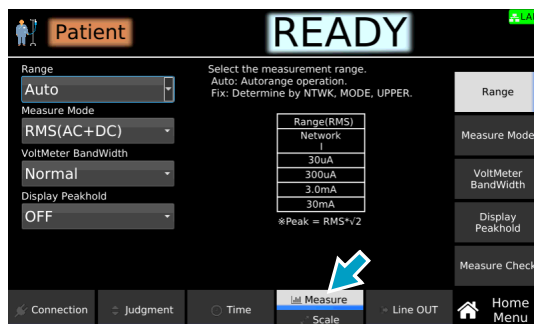
Value	Description
Auto	Switches the range automatically according to the measured values.
Fix	The measurement range is fixed Range 1 to 4 according to the Measure Mode, and Upper settings. See “Measurement range when Fix is selected” below.

■ Measurement range when Fix is selected

Measure Mode	Upper	Range setting ¹
Peak	0.1 μA to 42.4 μA	Range 1
	42.5 μA to 424 μA	Range 2
	425 μA to 4.50 mA	Range 3
	45.1 mA to 45.0 mA	Range 4
RMS (AC+DC), RMS (AC), DC	0.1 μA to 30 μA	Range 1
	31 μA to 300 μA	Range 2
	301 μA to 3.00 mA	Range 3
	3.01 mA to 30.0 mA	Range 4

1 For the measurement range of each range setting, see the specifications (p.301).





- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



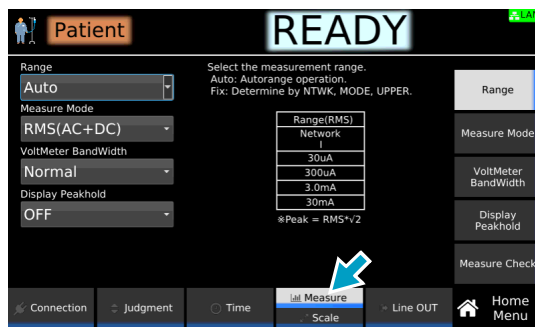
- 2 **Press Range and then turn the rotary knob to change the value.**
This completes the setting.

Measurement mode (Measure Mode)

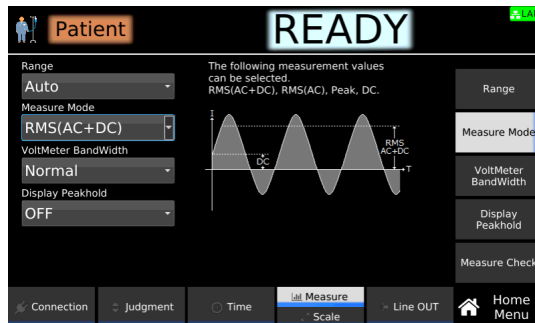
Set the current measurement mode. An icon appears during testing according to the setting.

Value	Description	Icon
Peak	Measures the waveform peak value.	
RMS (AC+DC)	Measures the DC component and AC component with true rms values.	
RMS (AC)	Measures only the AC component with true rms values.	
DC	Measures only the DC component.	

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.





- 2 **Press Measure Mode and then turn the rotary knob to change the value.**



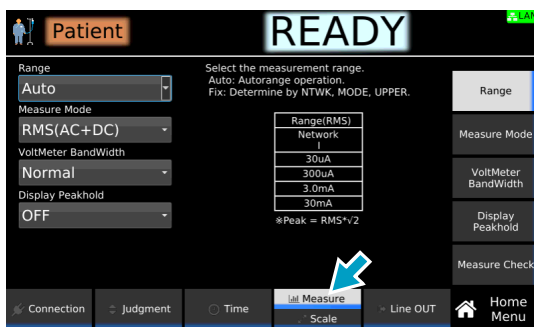
This completes the setting.

Voltmeter band expansion (VoltMeter BandWidth)

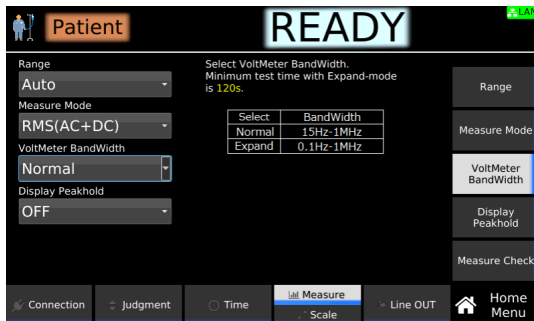
Sets whether to expand the band of the internal voltmeter of this product. An icon appears during testing according to the setting.

Value	Description	Icon
Normal	Uses the normal band (15 Hz to 1 MHz).	
Expand	The expanded bandwidth (0.1 Hz to 1 MHz) is used as required by IEC 60601. To accurately measure low frequency components, set the test time to at least 120 seconds.	

- 1 On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press VoltMeter BandWidth, and then turn the rotary knob to change the value.**

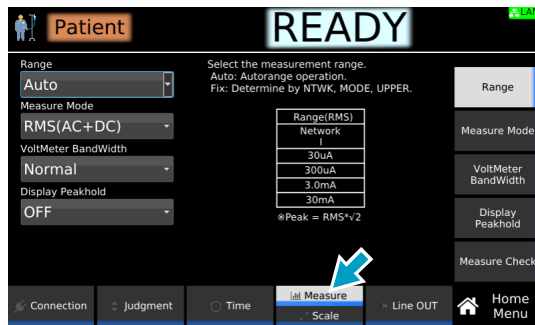


This completes the setting.

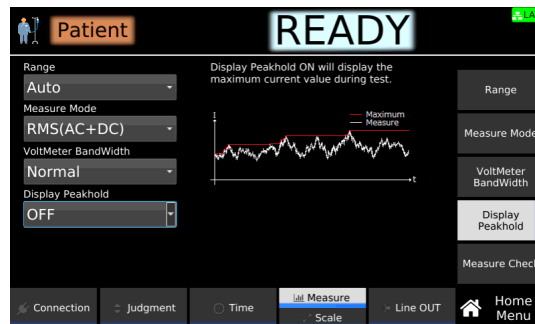
Peak value display (Display Peakhold)

When Display Peakhold is set to on, the peak current measured during testing is displayed. Judgment is also performed on the peak current.

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



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



This completes the setting.

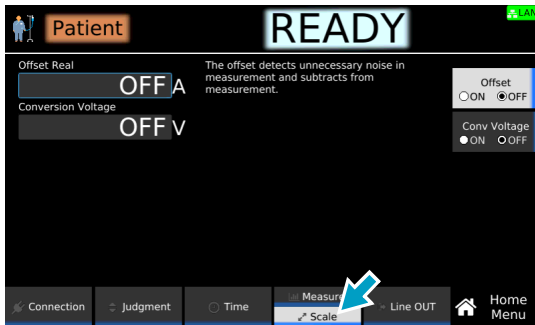
Measurement check (Measure Check)

You can run a weak current across the A and B terminals, and check the measurement circuit. For details, see "Measurement check" (p.281).

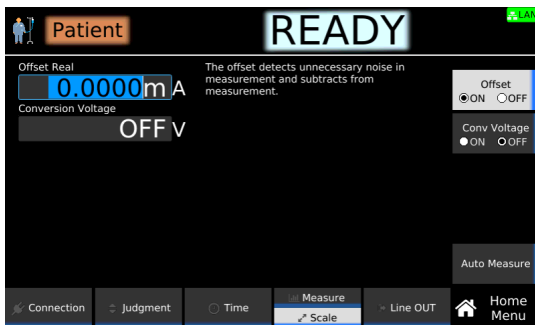
Offset

Even when the EUT is not running, a certain amount of current may be measured depending on the wiring environment or the like. If Offset is set to on, such currents, which lead to errors, can be canceled. If the offset is set to on, **Offset** appears during testing.

- 1 On the Home menu screen, press Scale repeatedly until Scale is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 Press Offset to switch between on and off.**
Offset switches between on and off each time you press the key.



- 3 If set to ON, set the Offset value according to the following procedure.**

Purpose	Operation
Measure the Offset value to set it automatically.	Press Auto Measure. Connect test leads to this product, and open the test leads. Press START. When the measurement stabilizes, press STOP. The Offset value is set automatically.
Set the Offset value manually.	Use the numeric keypad or the rotary knob to enter the value. For the setting range, see the measurement range (p.301) in the specifications.

This completes the setting.

Voltage conversion (Conv Voltage)

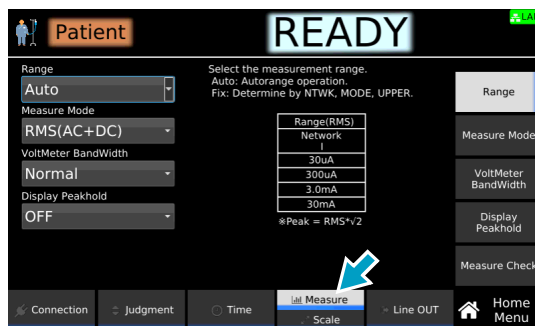
If you set Conv Voltage to on, the current converted using a specified voltage is displayed based on the voltage supplied to the EUT and the measured current. Judgment is also performed on the converted current. If set to on, **CONV** appears during testing.

NOTE

If Conv Voltage is set to a value greater than or equal to five times the voltage applied from the AC LINE OUT terminal to the EUT, the measurement during testing is displayed as “+ Over.”

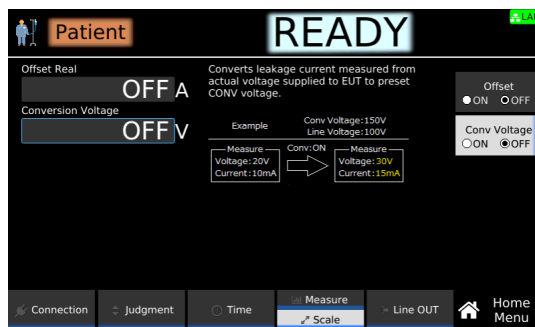
1 On the Home menu screen, press Scale repeatedly until Scale is selected.

Each time you press the key, the setting changes between Measure and Scale.



2 Press Conv Voltage to switch between on and off.

Conv Voltage switches between on and off each time you press the key.



3 If you select on, use the numeric keypad or the rotary knob to enter the voltage.

Setting range: 80.0 V to 300.0 V

This completes the setting.

Checking the EUT operation (Line OUT)

Check the EUT operation before testing. For details, see “Checking the EUT operation” (p.282).

Starting a Test

We recommend that you perform a pre-test inspection (p.281) before executing a test.

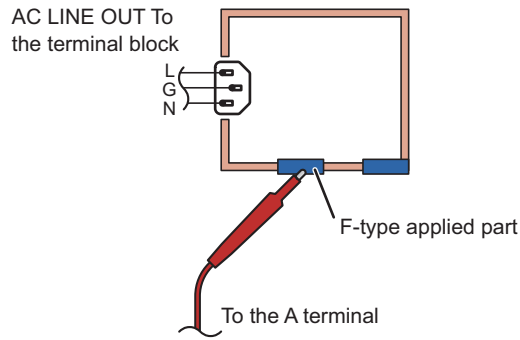
Connecting the test leads to the EUT

Connect the test leads to the test location of the EUT. For details on connecting the power supply line for the product and EUT and connecting test leads to the product, see “Connection for Leakage Current Tests” (p.41).

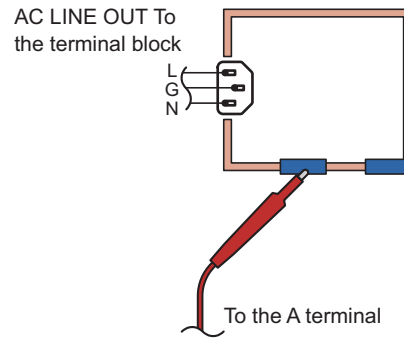
The test locations of the EUT in patient leakage current tests vary depending on the test condition settings of “Probe connection destination” (p.182) and “Single fault mode (Condition)” (p.181) and the appliance class of the EUT. The following table shows where to connect the test leads by referring to the test lead connected to the A terminal as *test lead A*, and the test lead connected to the B terminal as *test lead B*.

Test condition		Where to connect the test leads	
Probe	Condition	Class I instrument	Class II instrument
Pt-110%	Normal	Test lead A to the F-type applied part.	Test lead A to the F-type applied part.
	Fault Neu		
	Fault PE		–
Pt-PE	Normal	Test lead A to the applied part (example 2).	
	Fault Neu		
	Fault PE	Test lead A to the applied part (example 2).	–
Pt-Pt	Normal	Test lead A and Test lead B to different applied part (example 3).	Test lead A and Test lead B to different applied part.
	Fault Neu		
	Fault PE	Test lead A and Test lead B to different applied part (example 3).	–

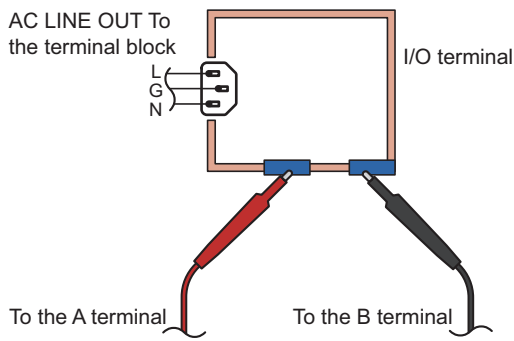
■ Connection example



Example 1: Across the patient connection area and F-type applied part



Example 2: Across the patient connection area and ground

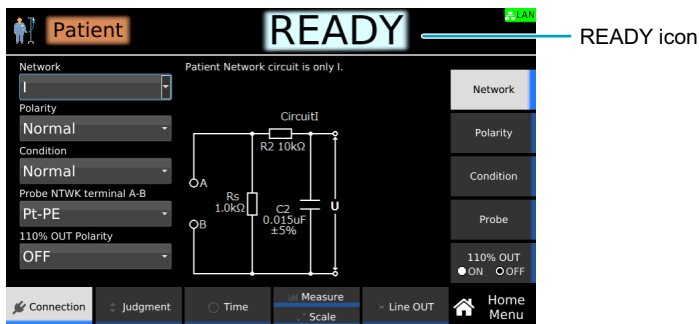


Example 3: Across two applied parts

Starting a test

⚠ WARNING Risk of electric shock. When using the test leads, do not touch the tip of the lead with your hand.

- 1 Check that the product is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then press START.

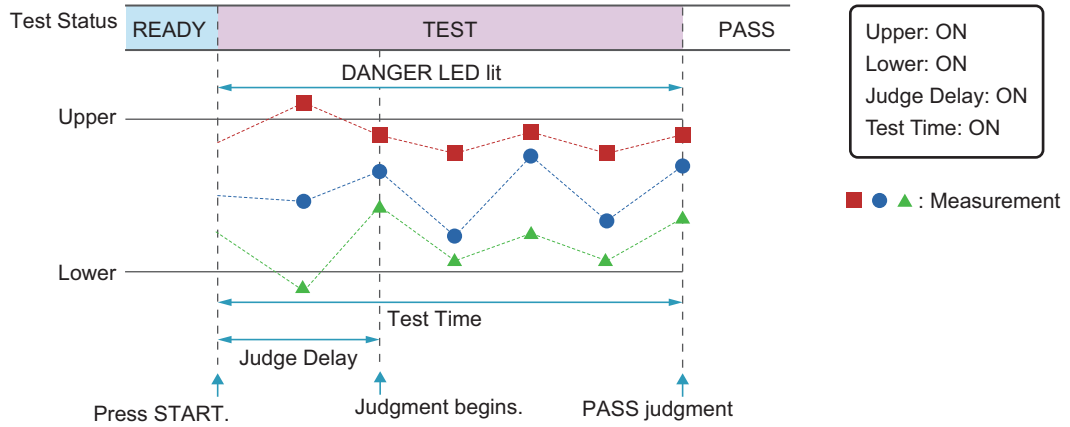


“TEST” is shown in the upper right of the display, and the test starts.
If the test does not start, see “Unable to start a test” (p.336).

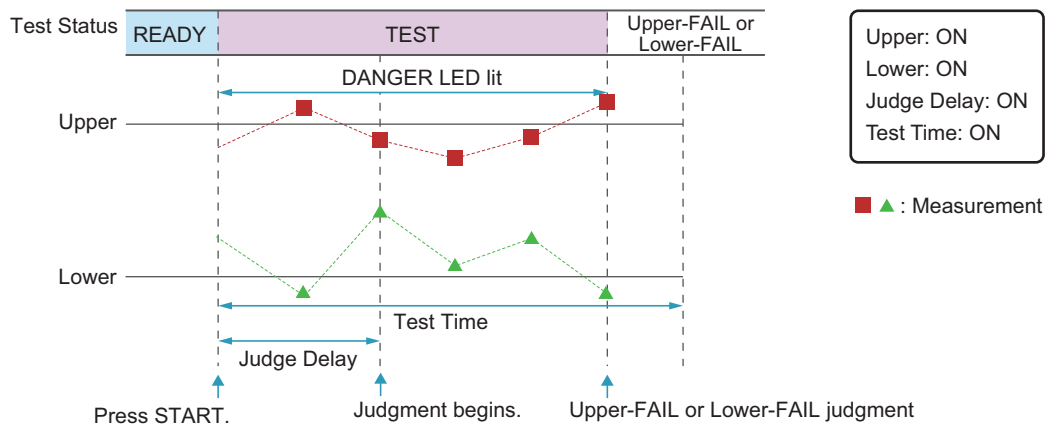
Operation after a test starts

Shown below are examples of operation after a test starts.

■ Example of a PASS judgment

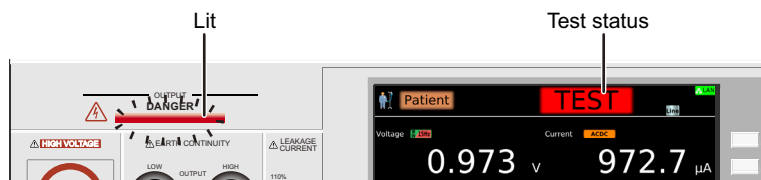


■ Example of a FAIL judgment



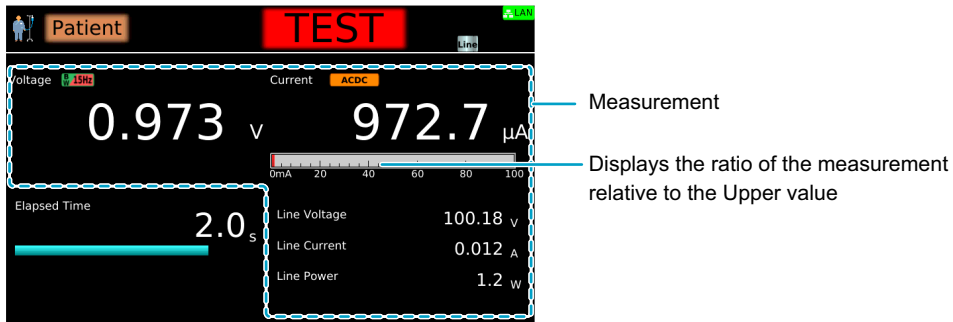
■ DANGER LED and test status display

During a test, the DANGER LED lights, and the test status is shown in the upper right of the display.



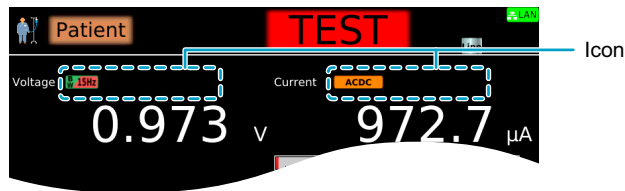
■ Measurement display

During a test, measurements are shown on the display.



■ Test condition display

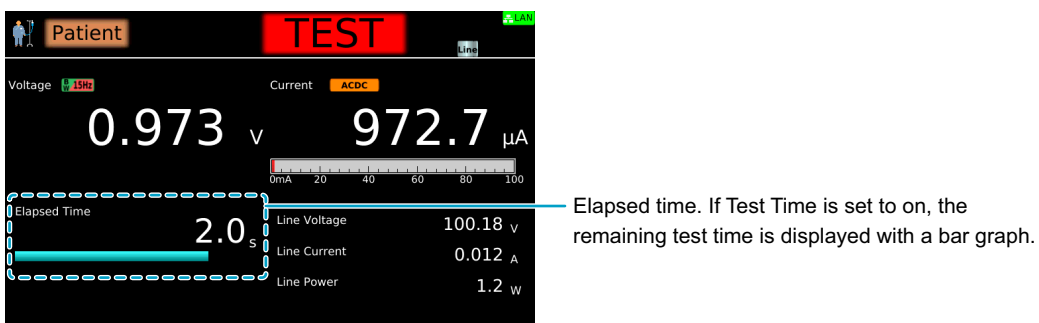
Icons indicating the test conditions appearing during testing.



Icon	Description
	VoltMeter BandWidth setting (Normal/Expand).
	Offsetting.
	Measure Mode setting (Peak/RMS (AC+DC)/RMS (AC)/DC).
	Conv Voltage being set to ON.

■ Test time display

During the test time, “TEST” and the elapsed time are displayed. If Test Time is set to on, the remaining test time is displayed with a bar graph. If Test Time is set to off, the elapsed time is displayed up to 3600000.0 seconds. If the elapsed time is greater than 3600000.0, the display is fixed at 3600000.0.



Finishing the Test and Viewing the Judgment

Stopping tests

If you want to stop a test or finish a test when the test time is off, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

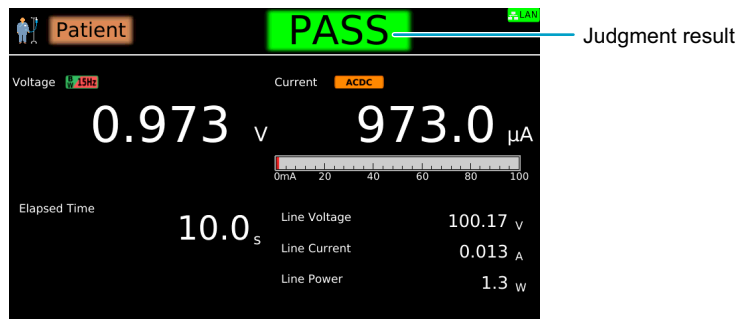
- a. When a current greater than or equal to Upper limit or less than equal to Lower limit is measured
- b. When the test time elapses if Test time is set to on
- c. When you press STOP

In any of the cases above, the "TEST" indication on the display disappears when the test ends.

If the test finishes under condition a or b given above, the judgment result ([p.200](#)) will be shown on the display.

Judgment types and operation

When a test finishes, the judgment result is shown in the test status.



	Upper-FAIL	Lower-FAIL	PASS
Condition	A current greater than or equal to the upper limit was measured.	A current less than or equal to the lower limit was measured.	Upper-FAIL or Lower-FAIL judgment did not occur during the test.
Display	The test status shows “Upper-FAIL” until the judgment result is cleared.	The test status shows “Lower-FAIL” until the judgment result is cleared.	The test status shows “PASS” until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	U FAIL signal is output until the judgment result is cleared.	L FAIL signal is output until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

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

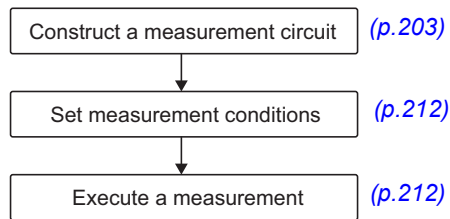
Meter Mode

Applicable models: **9303LC**

This section explains how to construct the measurement circuit, set measurement conditions, and execute the measurement for leakage current (LC) meter mode.

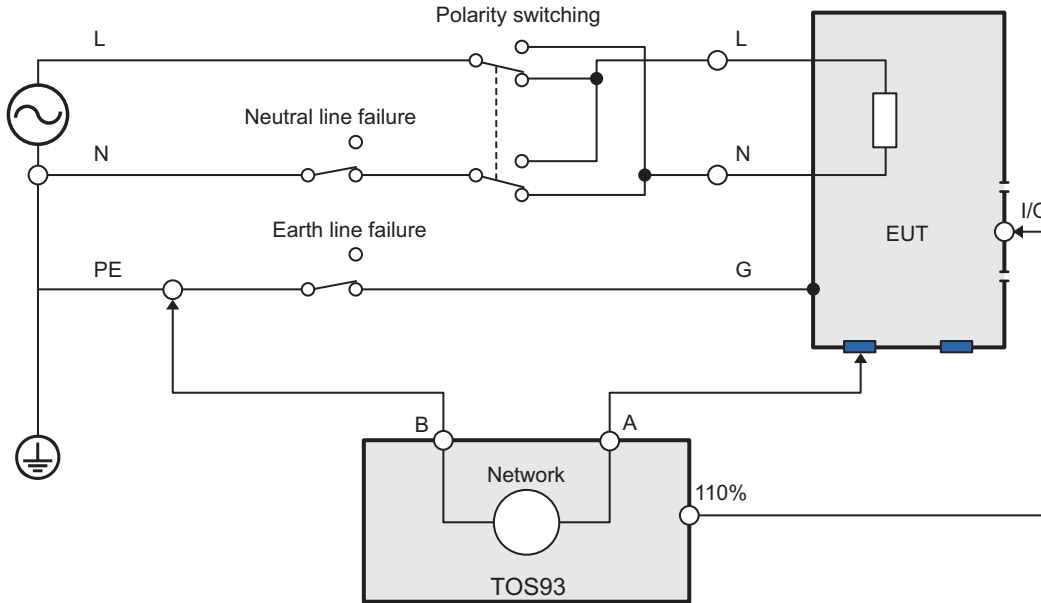
Like typical multimeters, meter mode is used to measure and display the current and voltage across terminals A and B. No judgment is made based on upper limit judgment or lower limit judgment reference values.

The following flowchart shows the configuration and measurement steps.

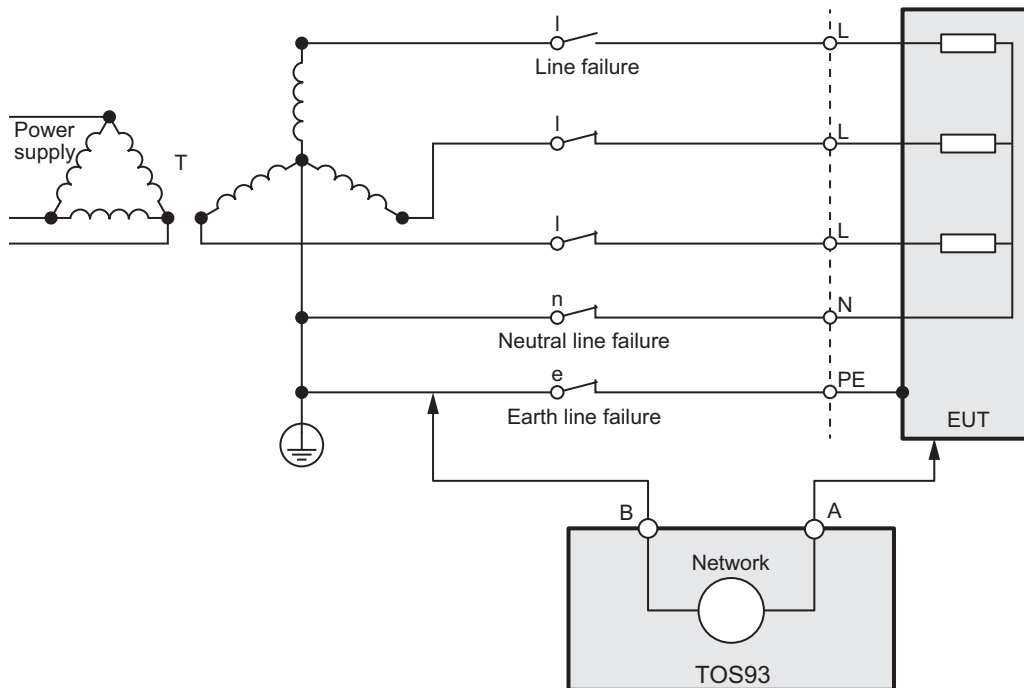


Constructing the Measurement Circuit

In meter mode, the current running across terminals A and B is measured. It is also possible to apply 110 % voltage to the EUT. Construct the following circuit external to the product.



Example: Measure the touch current (apply 110 % voltage to the signal I/O section of the medical instrument)



Example: Circuit for measuring the touch current of a three-phase device with a star configuration TN or TT system

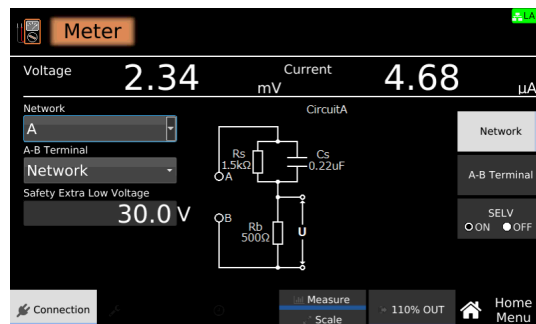
Setting Measurement Conditions

This section describes the test conditions of meter mode and how to set the conditions.

Displaying the setup screen (Home menu)

1 On the Function menu screen (p.46), press LC >Meter.

The setup screen (Home menu) for the meter measurement conditions appears.



Set the required conditions by referring to the description of measurement conditions (p.203).

Overview of measurement conditions

You can set the following measurement conditions in meter mode.

Test condition	Description	See
Network	Select the measurement circuit network to use for the measurement.	p.204
Measuring across terminals A and B (A-B Terminal)	Select whether to measure the touch voltage across terminals A and B or the touch current.	p.205
SELV setting	Set the SELV voltage. The DANGER LED lights when a value exceeding the specified voltage is measured.	p.206
Measurement range	Select the measurement range.	p.207
Measurement mode (Measure Mode)	Current measurement mode. Select DC measurement, rms measurement, or peak measurement.	p.208
Measurement check (Measure Check)	Run a weak current across the A and B terminals, and check the measurement circuit.	p.281
Offset	Cancel currents that lead to errors.	p.209
Output from the 110% terminal (110% OUT)	Apply from the 110% terminal to the EUT the voltage applied to the AC LINE IN inlet.	p.210
Polarity of the 110% output	Select the polarity of the voltage applied from the 110% terminal.	p.211

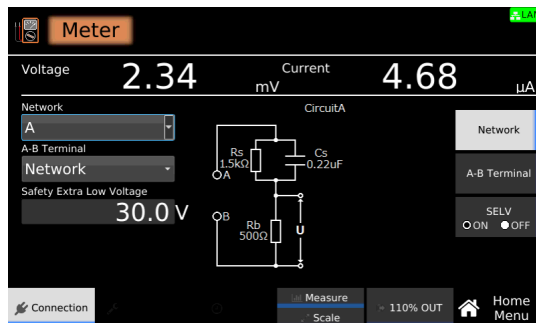
Network

Set the measurement circuit network to use for the measurement.

Value	Application example
A	IEC 60990 Fig. 3 U1 measurement
B-U1	IEC 60990 Fig. 4 U2 measurement
B-U2	IEC 60990 Fig. 4 U1 measurement
C	IEC 60990 Fig. 5 U3 measurement
D	Electrical Appliances and Materials Safety Act single frequency
E	Electrical Appliances and Materials Safety Act multiple frequencies
F	IEC 61029, UL
G	IEC 60745
H	IEC 61010-1, IEC 61010-1 Wet condition
I	IEC 60601-1
J	For calibration. Do not use.

CAUTION If you set Network to J and apply 10 V or more between terminals A and B, the measurement circuit may break.

1 On the Home menu screen, press Connection > Network.



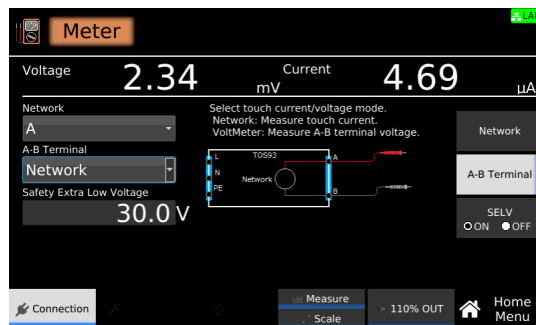
2 Turn the rotary knob to change the value.
This completes the setting.

Measuring across terminals A and B (A-B Terminal)

Select whether to measure the touch voltage across terminals A and B or the touch current.

Value	Description
Network	Measures the touch current across terminals A and B. The network set in Network (p.204) is used.
VoltMeter	Measures the touch voltage across terminals A and B. The DANGER LED lights when a voltage exceeding the SELV setting (p.206) is measured.

1 On the Home menu screen, press Connection > A-B Terminal.



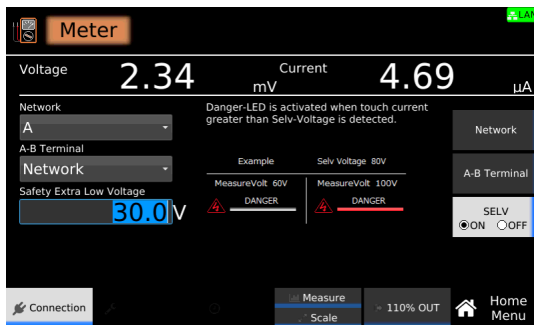
2 Turn the rotary knob to change the value. This completes the setting.

SELV setting

If SELV is set to on, the DANGER LED lights when a value exceeding the specified voltage is measured. This is valid when Measuring across terminals A and B (A-B Terminal) (p.205) is set to VoltMeter.

NOTE SELV stands for safety extra low voltage. It is assumed that when the voltage is less than or equal to SELV, there is no risk of electric shock. The definition and value of SELV vary depending on the standard.

1 On the Home menu screen, press Connection > SELV.



2 Press SELV to switch between on and off.

SELV switches between on and off each time you press the key.

3 If you select on, use the numeric keypad or the rotary knob to enter the voltage.

Setting range: 10.0 V to 99.9 V

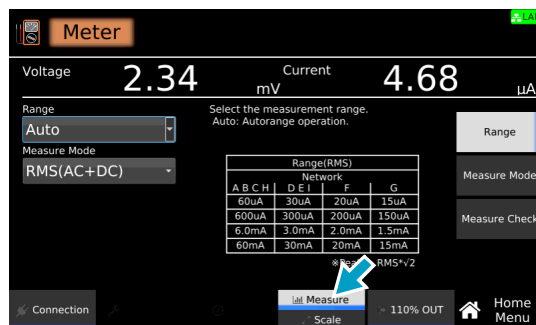
This completes the setting.

Measurement range

Set the measurement range.

Value	Description
Auto	Switches the range automatically according to the measured values.
60 μ A	Fixes the measurement range.
600 μ A	
6mA	
60mA	

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



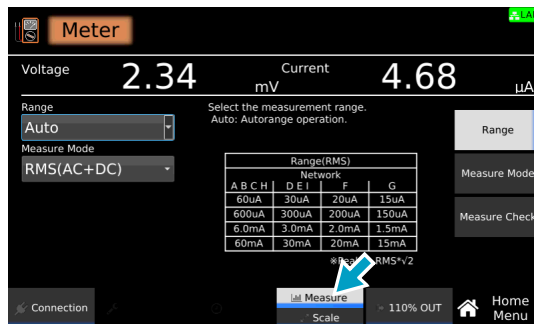
- 2 **Press Range, and then turn the rotary knob to change the value.**
This completes the setting.

Measurement mode (Measure Mode)

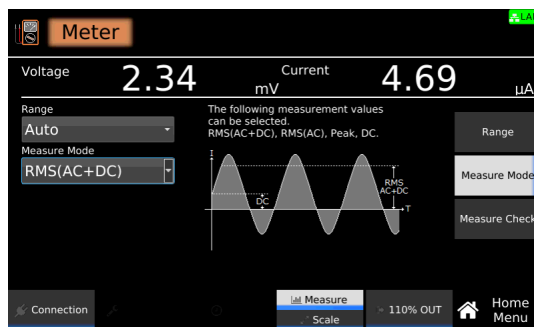
Sets the measurement mode. The value measured using the specified measurement mode is displayed. The judgment on whether the DANGER LED is to be lit when SELV setting (p.206) is set to ON is also performed for each measurement mode.

Value	Description
Peak	Measures the waveform peak value.
RMS (AC+DC)	Measures the DC component and AC component with true rms values.
RMS (AC)	Measures only the AC component with true rms values.
DC	Measures only the DC component.

- 1 **On the Home menu screen, press Measure repeatedly until Measure is selected.**
Each time you press the key, the setting changes between Measure and Scale.



- 2 **Press Measure Mode, and then turn the rotary knob to change the value.**



This completes the setting.

Measurement check (Measure Check)

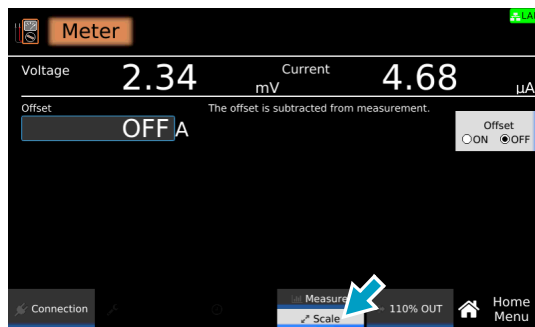
You can run a weak current across the A and B terminals, and check the measurement circuit. For details, see “Measurement check” (p.281).

Offset

Even when the EUT is not running, a certain amount of current may be measured depending on the wiring environment or the like. If Offset is set to on, such currents, which lead to errors, can be canceled.

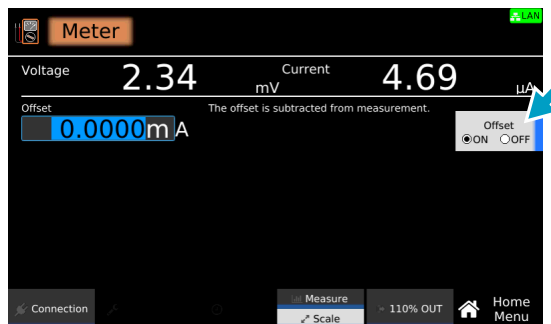
1 On the Home menu screen, press Scale repeatedly until Scale is selected.

Each time you press the key, the setting changes between Measure and Scale.



2 Press Offset to switch between on and off.

Offset switches between on and off each time you press the key.



3 If you select on, use the numeric keypad or the rotary knob to enter the current.

For the setting range, see the measurement range ([p.301](#)) in the specifications.

This completes the setting.

Output from the 110% terminal (110% OUT)

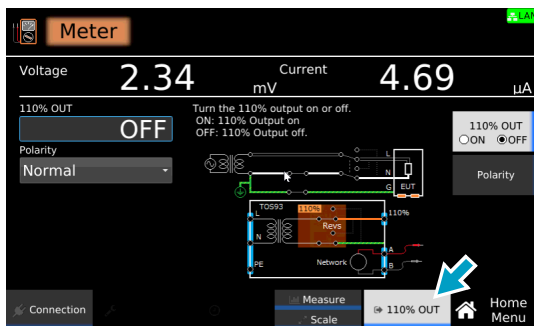
When you set 110% OUT to on, the voltage applied to the AC LINE IN inlet is output from the front-panel 110% terminal and applied to the EUT.

By applying a voltage at 110% of the EUT rating to the AC LINE IN inlet on the rear panel in advance, you can apply a voltage that takes into consideration the variation in the commercial power supply. You can set the polarity with the Polarity parameter (p.211).

If on is specified, you cannot use the menu keys. In addition, the DANGER LED lights, and 110% appears in the upper right of the display.

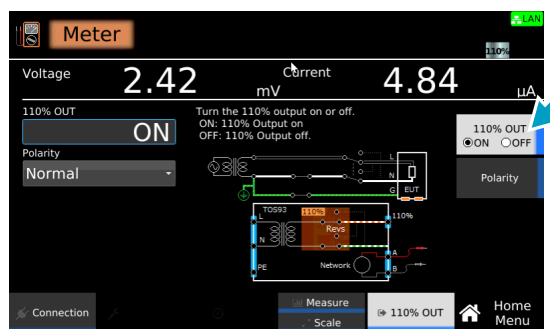
⚠ WARNING Risk of electric shock. If you set 110% OUT to ON, do not touch the tip of the test lead connected to the 110% terminal with your hand. A high voltage will be output from the 110% terminal.

1 On the Home menu screen, press 110% OUT.



2 Press 110% OUT to switch between ON and OFF.

110% OUT switches between on and off each time you press the key.



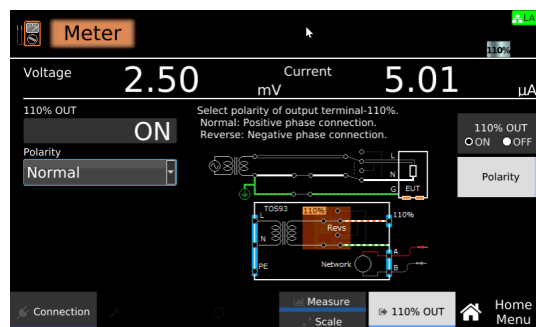
This completes the setting.

Polarity of the 110% output

If you set 110% OUT to on (p.210), set the polarity of the voltage applied from the 110% terminal.

Value	Description
Normal	The voltage applied from the 110 % terminal is set to positive polarity.
Reverse	The voltage applied from the 110 % terminal is set to negative polarity.

- 1 On the Home menu screen, press 110% OUT > Polarity.



- 2 Turn the rotary knob to change the value.
This completes the setting.

Executing a Measurement

We recommend that you perform a pre-test inspection ([p.281](#)) before executing a measurement.

Connecting the test leads


Connect the test leads to the test location of the EUT. For details on connecting test leads to the product, see “Connection for Leakage Current Tests” ([p.41](#)).

In meter mode, test leads from terminals A and B are connected to the measurement locations of the circuit constructed external to the product.

If you need to apply 110 % voltage, connect the test lead from the 110% terminal to the desired location.

Taking measurements

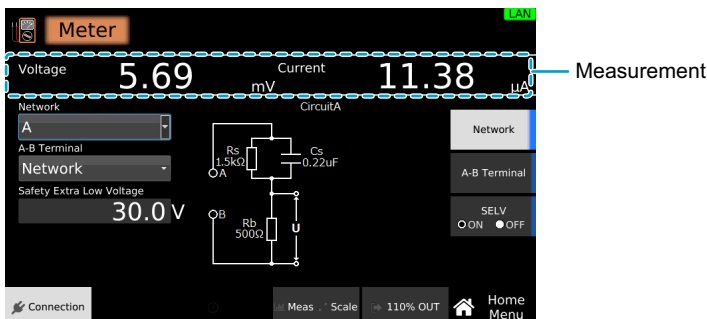
In meter mode, measurement will be running constantly.

 **WARNING** Risk of electric shock. When using the test leads, do not touch the tip of the lead with your hand.

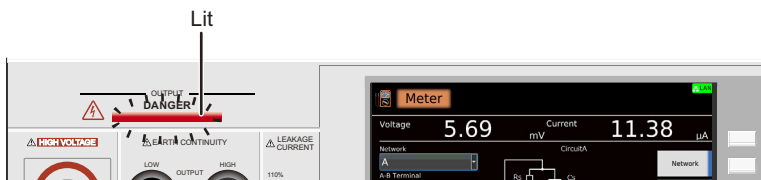
- 1 Connect the test leads to the measurement location.**
Measurements are shown on the display.

Measurement operation

Measurements are shown on the display.



If measuring across terminals A and B (A-B Terminal) is set to VoltMeter (p.205), the DANGER LED lights only when a voltage higher than or equal to the voltage specified by SELV setting (p.206) is present across the terminals A and B.



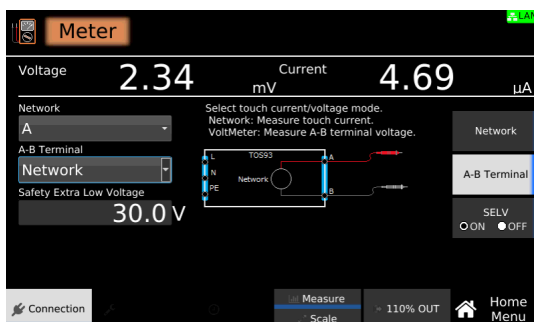
Measurement example (judgment of the parts that can be touched)

This section provides a measurement example of judging parts that can be touched as defined in IEC 61010-1 and the like. To judge whether a measurement location can be touched, any of the following conditions must be met.

- The measured voltage does not exceed the limit.
- If the measured voltage exceeds the limit, the touch current does not exceed the limit.

Follow the procedure below to configure and measure.

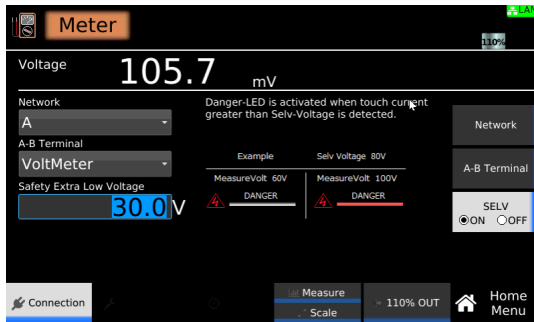
1 On the Home menu screen, press Connection > A-B Terminal.



2 Turn the rotary knob to select VoltMeter.
Measurement of the voltage across terminals A and B begins.

3 Press SELV to select ON.

The value switches between ON and OFF each time that you press the key.



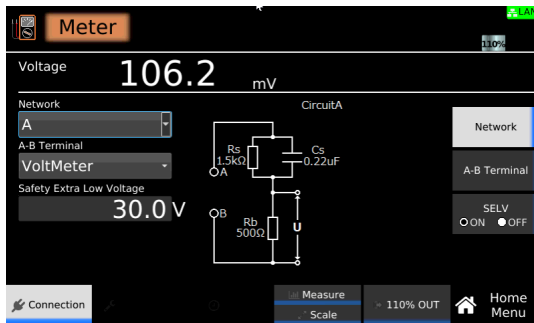
4 Use the numeric keypad or the rotary knob to enter the voltage limit.

If a voltage exceeding the voltage limit is measured, the DANGER LED will light.

5 Connect the test leads to the measurement location.

6 If the DANGER LED does not light, conclude that the part can be touched. If the DANGER LED lights, proceed to step 7.

7 Press Network, and use the rotary knob to select a network of your choice.



8 Press A-B Terminal, and then turn the rotary knob to select Network.

Measurement of the touch current across terminals A and B begins.

9 If the measured current does not exceed the limit, conclude that the part can be touched. If it exceeds the limit, conclude that the part cannot be touched.

This completes the inspection.

Auto Test

Auto test is a function that executes a sequence of test combinations set in advance. This section provides an overview of the auto test function and how to configure the test, execute the test, and import and export programs.

Auto Test Overview

This section explains the types of tests that auto test can run, overview of programs and steps, and the main functions of auto test.

Tests that auto test can run

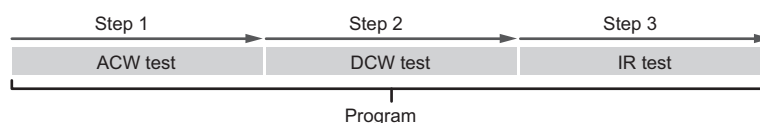
The tests that can be combined for auto tests varies depending on the model you are using.

Model	Tests that auto test can run ¹
TOS9300	ACW, IR
TOS9301	ACW, DCW, IR
TOS9301PD ²	ACW, DCW, IR
TOS9302	ACW, EC
TOS9303	ACW, DCW, IR, EC
TOS9303LC	ACW, DCW, IR, EC, or LC (TC, PCC, Patient) ³

- 1 ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: insulation resistance, EC: Earth continuity, LC: leakage current, TC: touch current, PCC: Protective conductor current, Patient: patient leakage current
- 2 Auto test is not possible for PD tests.
- 3 The LC test cannot be combined with other tests. Combination is possible among LC tests (TC, PCC, Patient).

Programs and steps

An auto test consists of programs and steps. A program is a collection of steps. For each step, a single test can be performed. Steps are executed in order from step 1. When the last step is complete, the program is complete.



Program schematic

Main functions

The following types of programs are available. Programs are saved in the product's memory.

Supported tests	Type	Maximum number of programs	Maximum number of steps ¹	Executed under external control ²	Changing the program name	Notes
Except LC tests	Program	100	100	–	✓	–
	Program memory	25	100	✓	–	Can be registered in memory numbers 51 to 75
LC tests only ³	Program	100	100	–	✓	–
	Program memory	24	100	✓	–	Can be registered in memory numbers 76 to 99

1 Per program

2 See "Recalling from memory" (p.241) and "Starting and Stopping Tests" (p.242).

3 TOS9303LC only

Settable items

There are functions that can be set for each step, and those that can be set for each program.

Scope	Setting	Description
By step	Test conditions of each test	You can set test conditions that are similar to those that are used when running tests individually, with a few exceptions.
For each program	Step start operation	Set the conditions for starting the test.
	Step interval	Set the step interval time.
	Fail judgment operation	Set whether to stop the auto test or run all steps when a fail judgment occurs.
	EUT power supply	Set whether to cut off the power supply to the EUT or continue the power supply to the EUT after the completion of each step.

Items that cannot be set

You cannot set the following functions.

- Set TestTime to OFF
- Auto Measure when setting the offset
- Set Judgment Lower to OFF when Judge Type is set to Ω (Resistance) in an IR test
- Set Judgment Upper to OFF when Judge Type is set to A (Current) in an IR test
- Set Judgment Upper to OFF when Judge Type is set to Ω (Resistance) in an EC test
- Set Judgment Upper to OFF when Judge Type is set to V (Voltage) in an EC test
- Set Judgment Upper to OFF in a LC test
- LineOUT in a LC test

Program Configuration

This section explains how to create programs, change program names, and delete programs.

Displaying the program editing screen

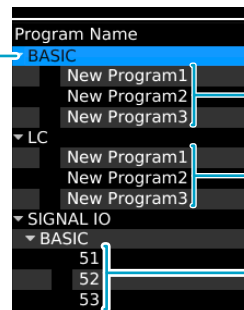
- 1 **Press AUTO > 1.File.**
The program editing screen appears.



Example: TOS9303LC

■ How to view the program editing screen

Use the rotary knob to select the item.
Press arrow (▶) key to open the lower level.
Press arrow (◀) key to close the lower level.



A program created with a name of your choice
 BASIC: Program other than LC
 LC: LC program (TOS9303LC only)
 Program that can be recalled through external control (program memory)

Creating a program

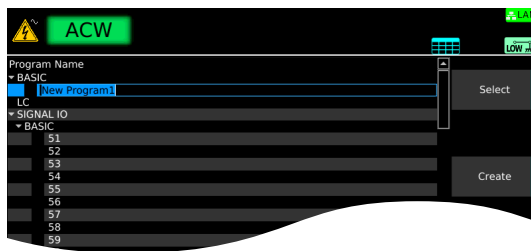
Create an empty program without any steps and assign a name of your choice.

The created program is automatically saved and is not deleted even if the POWER switch is turned off.

- 1 On the program editing screen, use the rotary knob to select the location to create the program in, and press Create.**

A program is created under the selected row.

If there is a check mark on another program, the Create key will not appear. If this happens, press Select to remove the check mark.



- 2 Use the numeric keypad or the rotary knob to enter the program name, and then press ENTER.**

You can enter up to 255 characters for the program name.

An empty program is created. For information about registering steps to a program, see "Setting Steps" (p.220).

Changing a program name

You can change the name of a program that you created with a name of your choice. Program names (memory numbers) under "SIGNAL I/O" cannot be changed.

- 1 On the program editing screen, use the rotary knob to select the program in, and press Select.**

A check mark appears to the left of the selected program name.



- 2 Press Rename.**
- 3 Use the numeric keypad or the rotary knob to enter the program name, and then press ENTER.**

The program name is changed.

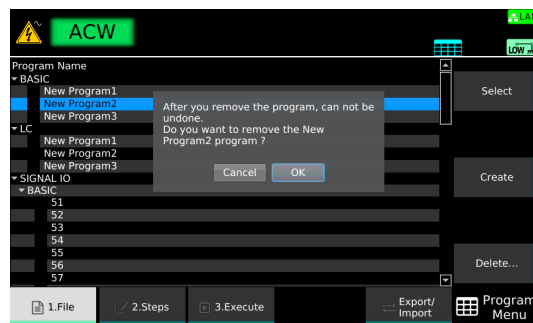
Deleting a program

You can delete a program that you created with a name of your choice. Programs under "SIGNAL I/O" cannot be deleted.

1 On the program editing screen, use the rotary knob to select the program in, and press Delete.

If there is a check mark on another program, the Delete key will not appear. In this situation, use the rotary knob to select the corresponding program, and then press Select to clear the check box.

A confirmation dialog appears. To cancel, press ESCAPE.



2 Press ENTER.

The program is deleted.

Setting Steps

This chapter explains how to edit steps.

Displaying the step editing screen

- 1 Press AUTO > 1.File.**
The program editing screen appears.
- 2 Use the rotary knob to select the program, and then press Select.**
A check mark appears to the left of the selected program name.

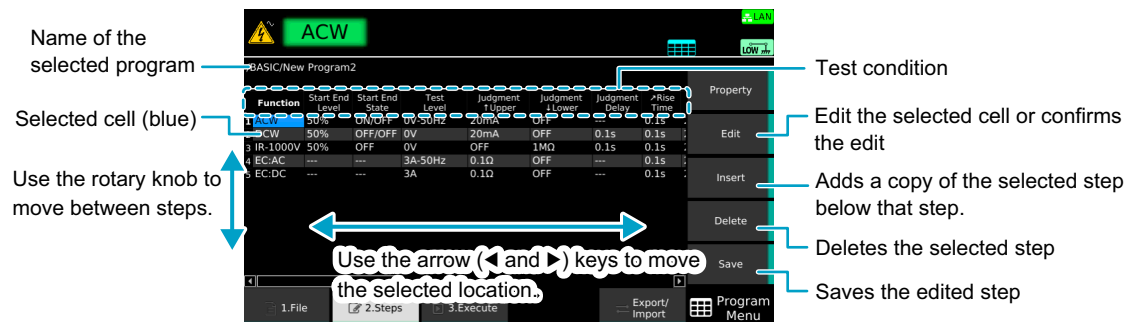


- 3 Press 2.Steps.**
The step editing screen appears.



Editing steps

On the step editing screen (p.220), you can edit, add, delete, and save steps. The basic operation on the step editing screen is provided below.


















- 1** On the step editing screen, add and delete steps.
- 2** Use the rotary knob and the arrow (◀▶) keys to select the Function column of a step of your choice, and then press Edit.
- 3** Use the sub-function keys to select the test mode, and press Edit.
The test mode is set for the selected step.
- 4** Use the arrow (◀▶) keys to select a test condition, and press Edit.
You can set test conditions similar to those you set when running tests individually, with a few exceptions (p.216). For test conditions that can be set to on or off or those that have options, items are displayed in a sub-function area.
- 5** Use the numeric keypad, rotary knob, or sub-function keys to set the test conditions of the step, and press ENTER.
The test conditions are set for the selected step.
- 6** Repeat Step 1 to Step 5 until all the steps have been registered.
- 7** Press Save.
The steps are registered to the program.









Icon list

The icons listed below are used to show some of the test condition settings.


■ Tests other than LC tests

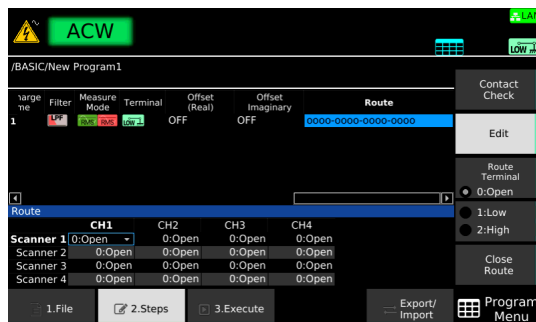
 : High Pass Filter (Fast)	 : Volt Measure (RMS)	 : GND (Low)
 : High Pass Filter (Slow)	 : Volt Measure (Peak)	 : GND (Guard)
 : Low Pass Filter (Fast/ON)	 : Current RMS (TrueRMS)	 : Terminals Wire (4Wire)
 : Low Pass Filter (Medium)	 : Current RMS (Average)	 : Terminals Wire (2Wire)
 : Low Pass Filter(Slow)	 : Root Contact Check (ON)	 : EC Contact Check (ON)

■ LC tests (TOS9303LC only)

 : Polarity (Normal)	 : VoltMeter BandWidth (Normal)
 : Polarity (Reverse)	 : VoltMeter BandWidth (Expand)
 : 100% OUT (Normal)	 : Range (Auto)
 : 100% OUT (Reverse)	 : Range (Fix)

Editing scanner settings

- 1** On the Step editing screen, select a cell the Route column and then press Edit.
- 2** Press Contact Check to switch between ON and OFF.
The value switches between ON and OFF each time you press the key. When Contact Check is set to ON,  appears in the cell being edited.
- 3** Use the rotary knob and the arrow (◀▶) keys to select a scanner and a channel, and then press Edit.



- 4** Use the sub-function keys to select a connection, and press ENTER.
The indication of a currently selected cell changes according to the settings.
For example, if you set High to CH1 of Scanner 2, Low to CH3 of Scanner 3, and Open to other channels, "oooo-Hooo-ooLo-oooo" appears.
- 5** To continue the settings, repeat Step 3 and Step 4 .
- 6** After you finish the scanner settings, press CloseRoute.
This completes the setting.

Program Operation Configuration

You can set the program execution operation for each program.

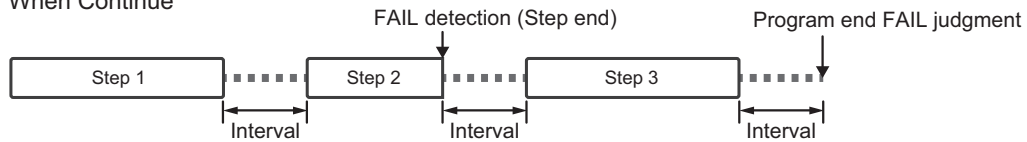
Setup	Description	See
Fail judgment operation (FAIL Judgment)	Set whether to stop the auto test or run all steps when a fail judgment occurs.	p.224
Step interval	Set the step interval time.	p.225
Step start operation (Trigger Source)	Set the conditions for starting the test.	p.226
EUT power supply (Line Output)	Set whether to cut off the power supply to the EUT or continue the power supply to the EUT after the completion of each step. (TOS9303LC only)	p.227

Fail judgment operation (FAIL Judgment)

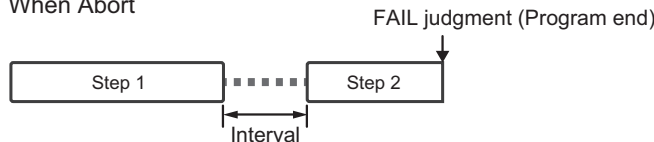
Set whether to stop the auto test or run all steps when a fail judgment occurs.

Value	Description
Continue	A transition is made to the next step when the step running when a failure occurs is completed and the time specified by Interval elapses. A fail judgment is indicated after the completion of all the steps.
Abort	Auto test ends when a failure occurs, and a fail judgment is indicated.

■ When Continue



■ When Abort



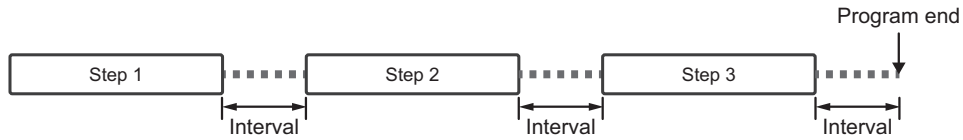
- 1 On the step editing screen (p.220), press Property.
- 2 Press FAIL Judgment to switch between Continue and Abort. Continue switches between Continue and Abort each time you press the key.



This completes the setting.

Step interval

Set the interval from the completion of a step to the next step. For the last step, this is the interval from the completion of the last step to the end of the program.



- 1** On the step editing screen (p.220), press Property.
- 2** Press Interval.



- 3** Use the numeric keypad or the rotary knob to enter the time.
Setting range: 0.1 s to 100.0 s
This completes the setting.

Step start operation (Trigger Source)

You can select the condition for starting the next step when a step is completed.

Value	Description
Immediate	When you press Initiate, all the steps are executed consecutively.
BUS	Pressing Initiate causes the product to enter the auto test trigger wait state. When in the trigger wait state, the step starts when you press START or send a *TRG command from the PC. After a step is completed, the operation is paused. When you press START or send another *TRG, the next step starts.
External	The step starts when you perform a start operation. ¹ After a step is completed, the operation is paused. When you perform another start operation, the next step starts.
Once	When you perform a start operation, ^{*1} all the steps are executed consecutively.

- 1 Any of the following operations: pressing START on the front panel, pressing the START switch on the device connected to the REMOTE connector, or sending a START signal to the SIGNAL I/O connector.

- 1 On the step editing screen (p.220), press Property.
- 2 Press Trigger Source.



- 3 Turn the rotary knob to select the value.
This completes the setting.

EUT power supply (Line Output)

Applicable models: **9303LC**

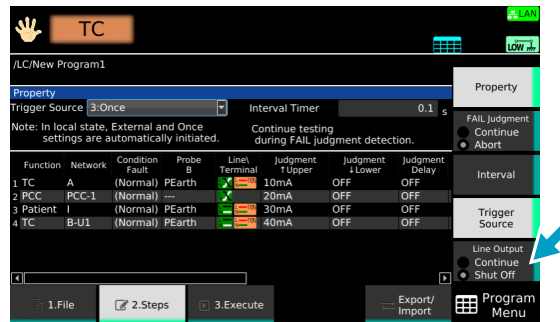
Set a method to supply power to the EUT after the completion of each step.

Value	Description
Continue	The power supply to the EUT continues even when a step is completed.
Shut Off	Under the following conditions, the power supply to the EUT is shut off after the completion of each step. <ul style="list-style-type: none"> • When the Condition setting between steps changes to Fault Natural from any setting other than Fault Natural. • When Line Polarity changes between steps.

1 On the step editing screen (p.220), press **Property**.

2 Press **Line Output** to switch between **Continue** and **Shut Off**.

Line Output switches between Continue and Shut Off each time you press the key.



This completes the setting.

Running Auto Tests

When you finish setting the program and steps, run the auto test.

Running an auto test

The test start operation varies depending on the trigger source ([p.226](#)) setting.

1 Press AUTO > 1.File.

The program editing screen appears.




2 Use the rotary knob to select the program, and then press Select.


A check mark appears to the left of the selected program name.

3 Press 3.Execute.




4 Perform the operation selected with Trigger Source.

 is shown in the upper right of the display, and the auto test starts.

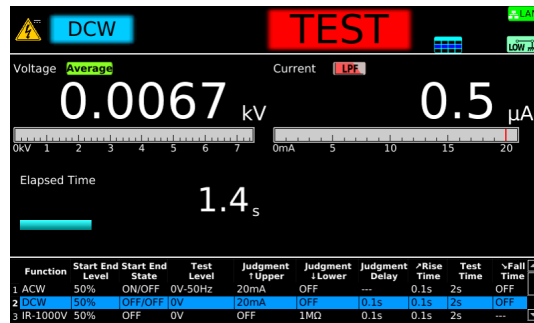
If the trigger source is set to BUS or External, pressing Initiate causes  to appear in the upper right of the display area (trigger wait state). To resume the test from the trigger wait state, send a trigger signal or press TriggerTEST. To cancel the trigger wait state, press Abort.

Behavior during the test

Steps are shown at the bottom of the display area with the step being executed highlighted in blue.

 is shown in the upper right of the display.

Other indications are the same as those when a single test is executed.



Finishing the Test and Viewing the Judgment

Stopping tests

To stop a test, press STOP.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

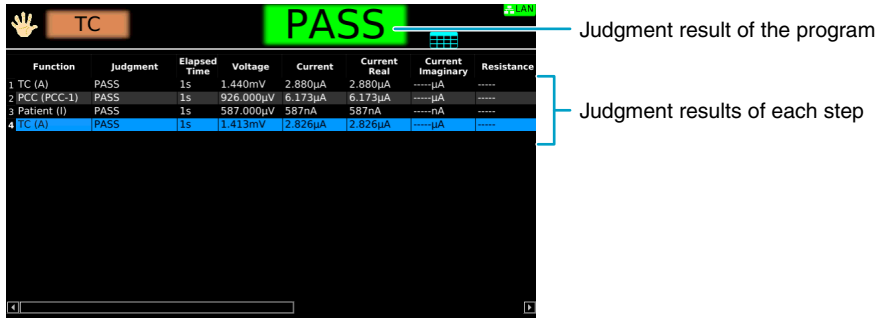
- a. When all steps are completed
- b. When Lower-FAIL or Upper-FAIL judgment occurs when FAIL Judgment is set to Abort
- c. When the STOP switch is pressed

In any of the cases above, the "TEST" indication on the display disappears when the test ends. When the voltage residing at the output terminals is discharged, the DANGER LED turns off.

If the test finishes under condition a or b given above, the judgment result ([p.231](#)) will be shown on the display.

Judgment types and operation

When a test finishes, the overall judgment result and each step's judgment results of the executed program appear in the test status. When FAIL Judgment (p.224) is set to Continue, a fail judgment results when a fail judgment occurs in any step.



	Upper-FAIL	Lower-FAIL	PASS
Condition	A value greater than or equal to the upper limit was measured.	A value less than or equal to the lower limit was measured.	Upper-FAIL or Lower-FAIL judgment did not occur during the test.
Display	The test status shows "Upper-FAIL" until the judgment result is cleared.	The test status shows "Lower-FAIL" until the judgment result is cleared.	The test status shows "PASS" until the time specified by Pass Hold elapses. Then the judgment result is cleared.
Buzzer	The buzzer continues to sound until the judgment result is cleared.	The buzzer continues to sound until the judgment result is cleared.	The buzzer sounds for 50 ms (regardless of the Pass Hold time).
SIGNAL I/O connector	U FAIL signal is output until the judgment result is cleared.	L FAIL signal is output until the judgment result is cleared.	PASS signal is output until the judgment result is cleared.

Clearing the judgment result

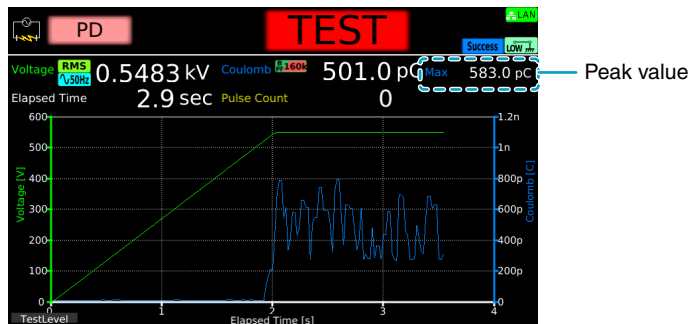
Press STOP to clear the judgment result. The product is ready to start another test.

Exporting and Importing Programs

Programs saved in the internal memory can be exported to a USB memory device. Programs exported to a USB memory device can also be imported into the internal memory.

- 1** Insert a USB memory device into the USB port on the front panel.
- 2** Press **AUTO > Export/Import**.
The Export/Import screen appears.

■ Basic operations on the Export/Import screen



Exporting programs to a USB memory device

- 1** On the Export/Import screen, press **USB ⇄ Internal**, and select “Internal Memory,” which is at the right side of the display area.
Each time you press **USB ⇄ Internal**, the selection toggles between USB Memory and Internal Memory.
- 2** Use the rotary knob to select the program to export, and then press **Copy**.
- 3** Press **USB ⇄ Internal**.
“USB Memory,” which is at the left side of the display area, is selected.
- 4** Use the rotary knob to select the export location, and press **Paste**.
To overwrite the selected file, press **Overwrite**.
A file named “program name”.prog is saved at the specified location.

Importing programs from a USB memory device

- 1 On the Export/Import screen (p.232), press USB↔Internal, and select “USB Memory,” which is at the left side of the display area.**

Each time you press USB↔Internal, the selection toggles between USB Memory and Internal Memory.

- 2 Use the rotary knob to select the program to import, and then press Copy.**

- 3 Press USB↔Internal.**

“Internal Memory,” which is at the right side of the display area, is selected.

- 4 Use the rotary knob to select the import location, and press Paste.**

To overwrite the selected memory area, press Overwrite.

The program is imported into the internal memory.

External Control

The following functions can be controlled and monitored from an external device using the external control connectors. For details on the SIGNAL I/O connector, see “SIGNAL I/O Connector” (p.235).

Functions that can be controlled/monitored	IN/OUT	Connector used	See
Activate/release interlock	IN	SIGNAL I/O	p.239
Recall setup memories and programs	IN	SIGNAL I/O	p.241
Start and stop tests	IN	SIGNAL I/O	p.242
Monitor the test mode being set	OUT	SIGNAL I/O	p.243
Monitor during testing/voltage generation status	OUT	SIGNAL I/O	p.243
Monitor the test status	OUT	SIGNAL I/O	p.243
Monitor the judgment result	OUT	SIGNAL I/O	p.244
Monitor the step execution status of auto tests	OUT	SIGNAL I/O	p.245
Monitor the activation status of protection functions	OUT	SIGNAL I/O	p.245
Monitor the current waveform	OUT	I	p.246
Monitor the voltage waveform	OUT	V	p.246
Monitor the discharge waveform of partial discharge (TOS9301PD only)	OUT	Ipd	p.247
Monitoring electric charge waveforms of partial discharge (TOS9301PD only)	OUT	Qpd	p.247
Monitor the status of a device using optional products	OUT	STATUS OUT	p.248
Control and monitor the starting and stopping of tests using optional products	OUT/IN	REMOTE	p.248

■ Precedence between external control and front panel operation

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

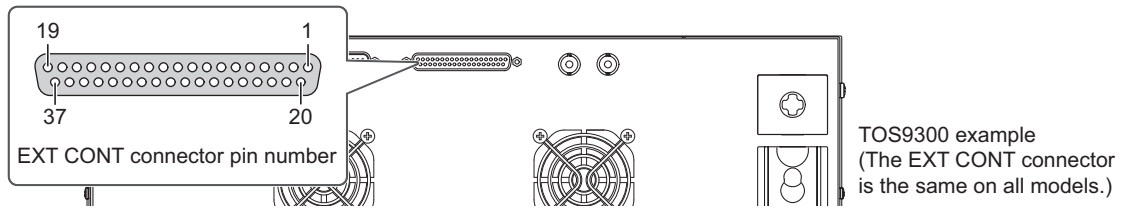
- Highest: SIGNAL I/O connector (when ENABLE is set to ON)
- Medium: REMOTE connector (when a production option is connected)
- Lowest: Front panel (including the keyboard connected to the USB port)

Example: If ENABLE is set to ON for the SIGNAL I/O connector, the REMOTE connector nor the front panel can be used.

SIGNAL I/O Connector

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

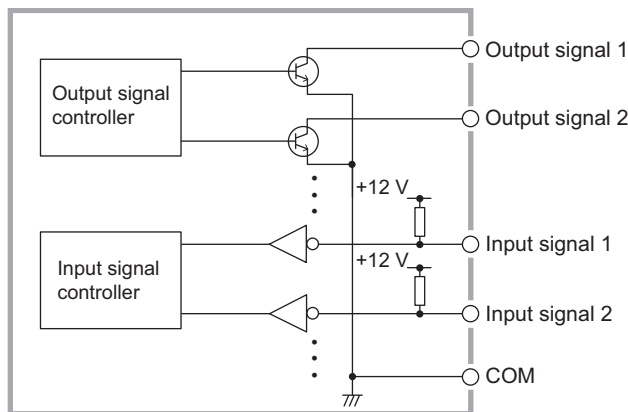


Pin no.	IN/OUT	Signal name	Description	See
1	IN	INTERLOCK+	Activate/release interlock.	p. 239
2	–	COM	Circuit common (chassis potential) shared by input and output.	–
3	IN	PM0	Select setup memories and auto test program memories.	p. 241
4	IN	PM1		
5	IN	PM2		
6	IN	PM3		
7	IN	PM4		
8	IN	PM5		
9	IN	PM6		
10	IN	PM7		
11	IN	STB	Recall setup memories and programs selected with the PM0 to PM7 signals.	p. 241
12	–	Reserved	Not used.	–
13	–	Reserved		
14	–	Reserved		
15	IN	START	Start a test.	p. 242
16	IN	STOP	Stop a test.	p. 242
17	IN	ENABLE	Enable the START signal.	p. 242
18	–	COM	I/O circuit common (chassis potential).	–
19	IN	INTERLOCK-	Activate/release interlock.	p. 239
20	–	COM	I/O circuit common (chassis potential).	–
21	–	+24V	+24 V internal power supply output terminal. Maximum output current 100 mA.	–
22	OUT	H.V ON/LINE ON	Set to on in any of the following conditions. Testing. Auto testing. Voltage remaining across the output terminals. Power being supplied to the EUT from the TOS9303LC through AC LINE OUT.	–
23	OUT	RISE	Set to on when the voltage is rising	p. 243
24	OUT	TEST	Set to on during test time	p. 243
25	OUT	PASS	Set to on for the duration of time specified by Pass Hold when a PASS judgment is made.	p. 244

Pin no.	IN/OUT	Signal name	Description	See
26	OUT	U FAIL	Set to on continuously when a Upper-FAIL judgment is made. Or set to on continuously along with the L FAIL signal when Contact-FAIL judgment is made.	p.244
27	OUT	L FAIL	Set to on continuously when an Lower-FAIL judgment is made. Or set to on continuously along with the U FAIL signal when Contact-FAIL judgment is made.	p.244
28	OUT	PD	Set to on when the test mode is set to partial discharge test.	p.243
29	OUT	READY	Set to on when the product is ready to start a test.	p.243
30	OUT	PROTECTION	Set to on when a protection function is activated.	p.23
31	OUT	STEP END	Set to on when each step ends during an auto test.	p.245
32	OUT	CYCLE END	Set to on when the last step ends during an auto test.	p.245
33	OUT	ACW	Set to on when the test mode is set to AC withstanding voltage test.	p.243
34	OUT	DCW	Set to on when the test mode is set to DC withstanding voltage test.	
35	OUT	IR	Set to on when the test mode is set to insulation resistance test.	
36	OUT	EC	Set to on when the test mode is set to earth continuity test.	
37	OUT	LC	Set to on when the test mode is set to leakage current test.	

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.



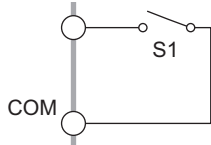
Internal construction of the

Input signal	Output signal
Opening the input terminals is equivalent to high-level input. <ul style="list-style-type: none"> • Low-active control • 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. 	<ul style="list-style-type: none"> • Open collector output • Output withstanding voltage: 30 Vdc • Output saturation voltage: Approx. 1.1 V (25°C) • Maximum output current 400 mA (TOTAL)

Input signal usage example

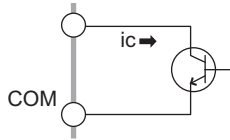
Using a make contact to control input

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

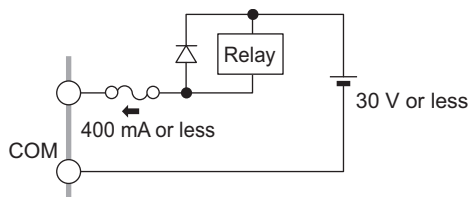
Use a logic element, such as a transistor, in place of the make contact. Design the circuit so that a transistor collector current (i_c) of 5 mA or greater flows.



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-sub37 pin plug by referring to the following information.

SIGNAL I/O connector specifications	D-sub 37-pin female connector (socket), #4-40 UNC inch screws
Compatible plug	D-sub 37-pin male (with #4-40 UNC fixing screws) To prevent malfunction caused by noise, use a shielded plug.
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) To prevent malfunction caused by noise, use a cable no longer than 2.5 m.
Required tools	Wire stripper for the above cable

Activating and Releasing Interlock

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 product 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 switch or the external control STOP signal.

Interlock activation conditions

Open the INTERLOCK+ (1) pin and INTERLOCK- (19) pin of the SIGNAL I/O connector. For the pins to be considered open, any of the following conditions must be met.

- The resistance between pin 1 and pin 19 is at least 1.2 k Ω .
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 19 is no more than 5 mA.

Interlock release conditions

Short the INTERLOCK+ (1) pin and INTERLOCK- (19) pin of the SIGNAL I/O connector, and then press the STOP 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 19 is no more than 1 k Ω .
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 19 is at least 6 mA.

Temporarily releasing interlock

Because nothing is connected to the SIGNAL I/O connector in the factory default conditions, interlock will be activated when you turn on the POWER switch. To release this temporarily, connect the included SIGNAL I/O plug to the SIGNAL I/O connector, and then press the STOP switch on the front panel. The included SIGNAL I/O plug has pins 1 and 19 shorted, so this will release the interlock.

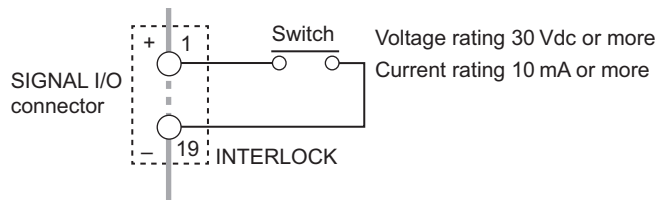
NOTE

When you actually perform tests, do not use this plug. In particular, if you use tools in a withstanding voltage test or insulation resistance test, we recommend that you place a cover over the EUT or install a fence around the EUT to prevent electric shock and devise a system that shuts off the output when the cover or fence is opened.

Examples of how to use interlock

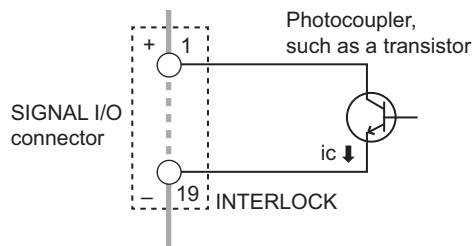
Using an open/close switch

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 from memory

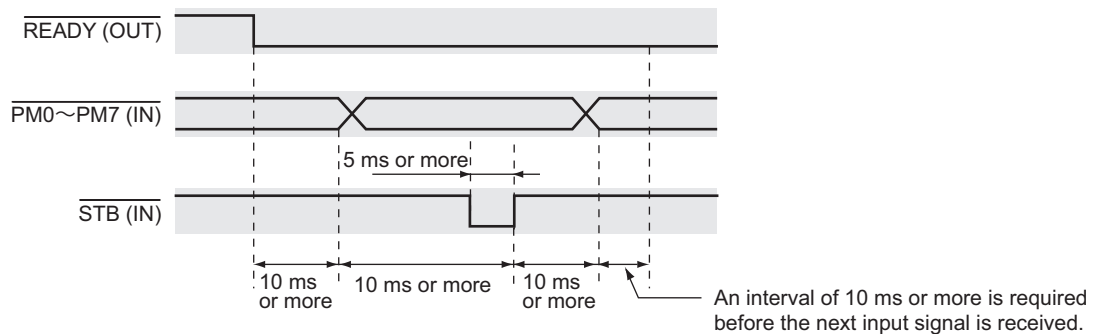
You can recall setup memories and program memories by applying signals to PM0 (pin 3) to PM7 (pin 10), and STB (pin 11) of the SIGNAL I/O connector.

Convert the number (0 to 99) of the memory you want to recall into 8-bit binary notation, and apply high-level (0) or low-level (1) signals to PM7 to PM0.

For example, to recall memory number 98, convert the 98 in decimal notation into 8-bit binary notation, which is 01100010. So apply H, L, L, H, H, H, L, H to PM7 to PM0.

Memory number ¹	MSD				LSD			
	PM7	PM6	PM5	PM4	PM3	PM2	PM1	PM0
0	H	H	H	H	H	H	H	H
1	H	H	H	H	H	H	H	L
2	H	H	H	H	H	H	L	H
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
97	H	L	L	H	H	H	H	L
98	H	L	L	H	H	H	L	H
99	H	L	L	H	H	H	L	L

1 0 to 50: setup memories, 51 to 75: program memories for tests other than LC, 76 to 99: program memories for LC tests (TOS9303LC only)

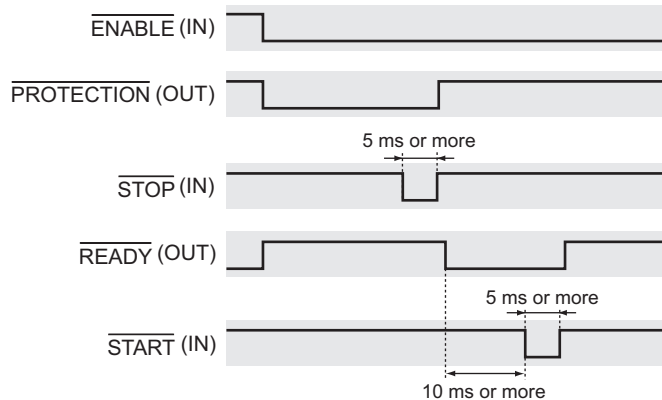


- 1** With “READY” shown in the upper right of the display, apply high-level or low-level signals to PM0 (pin 3) to PM7 (pin 10) of the SIGNAL I/O connector.
- 2** Set STB (pin 11) to low-level for at least 5 ms.
The setup memory or program corresponding to the number specified with the PM0 to PM7 signals 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 17) of the **SIGNAL I/O** connector to low level.
The product switches to **PROTECTION** mode.
- 2** Set **STOP** (pin 16) to low-level for at least 5 ms to release **PROTECTION** mode.
The test status shows "READY."
- 3** When at least 10 ms elapses after the test status becomes "READY," set **START** (pin 15) to low level for at least 5 ms.
The test starts.

NOTE

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

Stopping a test

- 1** While a test is in progress, set **STOP** (pin 16) to low-level for at least 5 ms.

Monitoring the Test Status

Monitoring the test mode

The SIGNAL I/O connector pins are set to low level depending on the set test mode. Monitoring is not possible for auto tests.

Test mode	Pins that are set to low level
AC withstanding voltage test	ACW (pin 33)
DC withstanding voltage test	DCW (pin 34)
Insulation resistance test	IR (pin 35)
Earth continuity test	EC (pin 36)
Partial Discharge Test	PD (pin 28)
Leakage current test	LC (pin 37)

Monitoring the test and voltage generation status

H.V ON/LINE ON (pin 22) of the SIGNAL I/O connector is set to low level in the following cases:

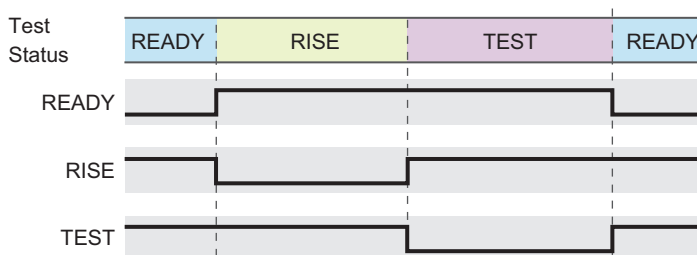
- A test or an auto test is in progress, or voltage is remaining across the output terminals.
- Power is being supplied to the EUT from the TOS9303LC through AC LINE OUT.

Monitoring the test status

SIGNAL I/O RISE (pin 23) is set to low level when the voltage is rising.

SIGNAL I/O TEST (pin 24) is set to low level when a test is in progress.

SIGNAL I/O READY (pin 29) is set to low level when the product is ready to start a test.



Monitoring judgment results

PASS judgment

When the judgment result is PASS, under the following conditions, SIGNAL I/O PASS (pin 25) is set to low level:

- Until the time set by Pass Hold (p.267) is elapsed or the judgment result is cleared.
- Until the STOP switch is pressed or a STOP signal is received if Pass Hold is set to Infinity.
- During the step interval when PASS judgment is made for a step if Step END Judgment (p.269) is enabled in an auto test.

UPPER FAIL judgment

When the judgment result is Upper-FAIL, under the following conditions, SIGNAL I/O U FAIL (pin 26) is set to low level:

- Until the judgment result is cleared.
- During the Interval time if a judgment result of a step is Upper-FAIL when Step END Judgment (p.269) is enabled in an auto test or FAIL Judgment (p.224) is set to Continue.

LOWER FAIL judgment

When the judgment result is Lower-FAIL, under the following conditions, SIGNAL I/O L FAIL (pin 27) is set to low level:

- Until the judgment result is cleared.
- During the Interval time if a judgment result of a step is FAIL when Step END Judgment (p.269) is enabled in an auto test or FAIL Judgment (p.224) is set to Continue.

CONTACT FAIL judgment

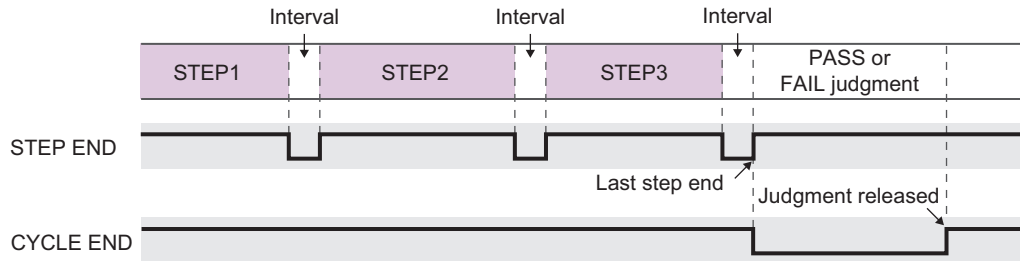
When the judgment result is Contact-FAIL, both U FAIL (pin 26) and L FAIL (pin 27) is set to low level simultaneously.

Monitoring the step execution status of auto tests

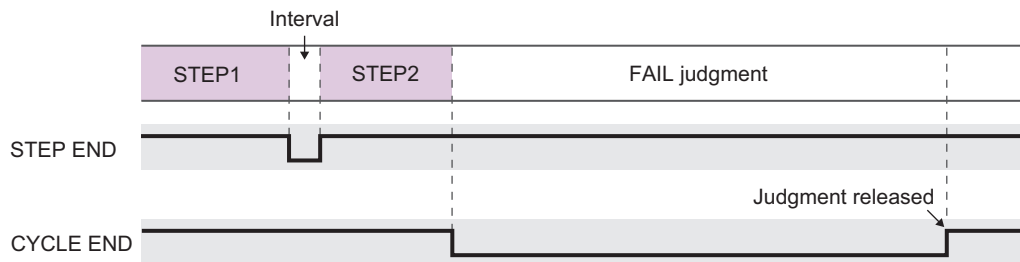
When a step of an auto test ends, SIGNAL I/O STEP END (pin 31) is set to low level.

CYCLE END (pin 32) of SIGNAL I/O is set to low level while a pass or fail judgment is being indicated after the last step is completed or from when a test is completed with a fail judgment until when the judgment is released.

- If a PASS or FAIL judgment is made after the last step ends



- If a FAIL judgment is made in the middle of a step and auto test stops



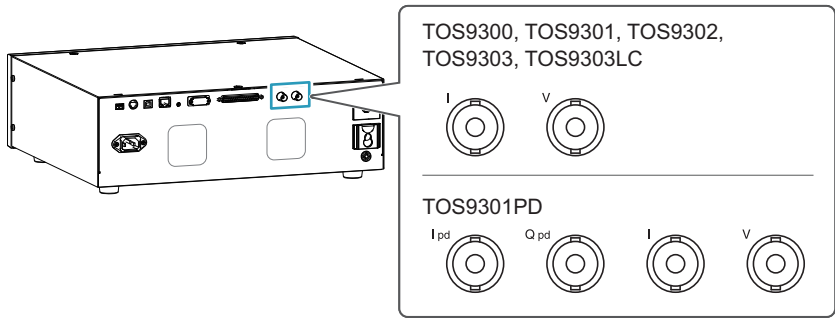
Monitoring the activation status of protection functions

SIGNAL I/O PROTECTION (pin 30) is set to low level when a protection function ([p.23](#)) is activated.

Monitoring Measurements

The current waveform and voltage waveform of the withstanding voltage test can be checked with the signals output from the monitor terminals on the rear panel.

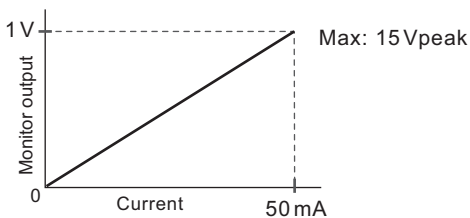
In the partial discharge test mode of TOS9301PD, the current waveform and electric charge waveform can be monitored.



NOTE Monitor signal output is isolated from the chassis (earth). If you connect an oscilloscope or an external device whose BNC shield is grounded for other than PD tests, be sure to set the grounding mode (GND) on the test conditions to Guard. This will not be an issue for PD tests (no GND setting).

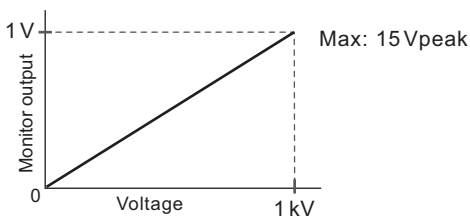
Monitoring current waveforms

Current waveforms of withstanding voltage tests can be monitored using the signal output from the I terminal on the rear panel. (Except for the partial discharge test mode of TOS9301PD)



Monitoring voltage waveforms

Voltage waveforms of withstanding voltage tests can be monitored using the signal output from the V terminal on the rear panel.



Monitor the discharge waveform of partial discharge

Applicable model: **9301PD**

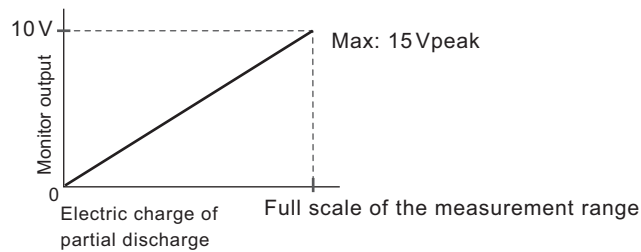
Discharge waveforms of partial discharge can be monitored using the signal output from the Ipd terminal on the rear panel.

NOTE Discharge waveforms obtained from the Ipd terminal are those that have passed through the filter (HPF) of the current detector inside the product. They may be different from the actual discharge waveforms.

Monitoring electric charge waveforms of partial discharge

Applicable model: **9301PD**

Electric charge waveforms of partial discharge can be monitored using the signal output from the Qpd terminal on the rear panel.



Using Option Products

Signal output from the STATUS OUT connector

The STATUS OUT connector on the rear panel outputs signals to the optional warning light unit (PL02-TOS). Use Status Output ([p.268](#)) of CONFIG settings to set the signal output conditions.

For details on the PL02-TOS, see the "Warning Light PL02-TOS Operation Manual."

Signal I/O of the REMOTE connector

You can control this product from the following option products using the REMOTE connector on the front panel. For details on option products, see the operation manual for the option.

- Remote control box (RC01-TOS/RC02-TOS)
- High voltage test probe (HP01A-TOS/HP02A-TOS)

Memory Function

You can save and recall test conditions, view and save test results, and view and save the values or captured image of the most recent test.

Saving and Recalling Test Conditions

You can save up to 51 test conditions that you specified as you like and the selected test mode type in the product memory (setup memory). Each memory location stores all test conditions of tests supported by the model you are using and the selected test mode type. Test conditions can also be saved in USB memory devices. System settings (p.258) are not saved.

How to view the setup memory screen

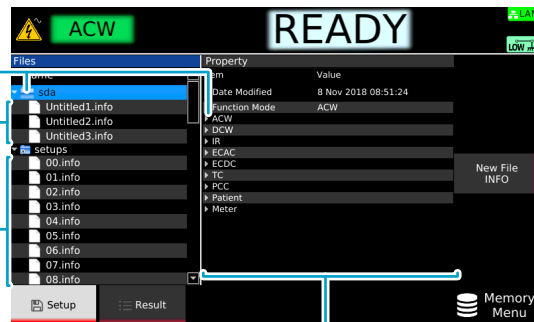
Press MEMORY > Setup to display the setup memory screen. The contents of the internal memory are shown in the setups folder. The internal memory contains setup memories with default values (00 to 50) and the test conditions that were in use when the power was turned off the last time (auto.info).

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 in the USB memory device and recall them later.

Select an item and
Press arrow (▶) key to open the lower level.
Press arrow (◀) key to close the lower level.

USB memory device

Internal memory

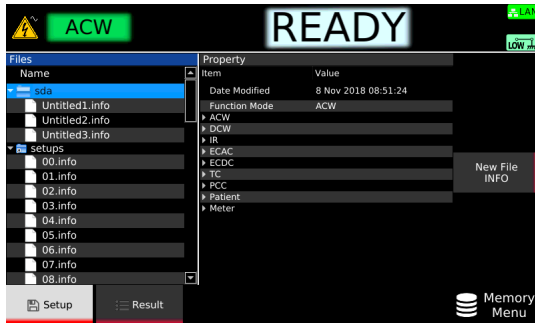


Details of the setup memory (Property)

Saving to the setup memory

Saving over previous settings (internal memory and USB memory)

- 1 Set the test conditions.
- 2 Press MEMORY > Setup.



- 3 Use the rotary knob to select the setup memory.
- 4 Press Save.
The test conditions are saved in the setup memory.

Saving to a new file (USB memory device only)

- 1 Set the test conditions.
- 2 Press MEMORY > Setup.
- 3 Insert a USB memory device into the USB port on the front panel.
An "sdxx" folder is displayed. The "xx" changes depending on the USB memory device.
- 4 Use the rotary knob to select the sdxx folder, and press New File.
A new setup memory is created.



- 5 Use the numeric keypad or the rotary knob to enter a file name of your choice, and then press ENTER.
The setup memory is saved to a new file.

Changing the memory name (USB memory device only)

- 1 Press MEMORY > Setup.
- 2 Insert a USB memory device into the USB port on the front panel.
An "sdxx" folder is displayed. The "xx" changes depending on the USB memory device.
- 3 Use the rotary knob to select the setup memory, and press Rename.

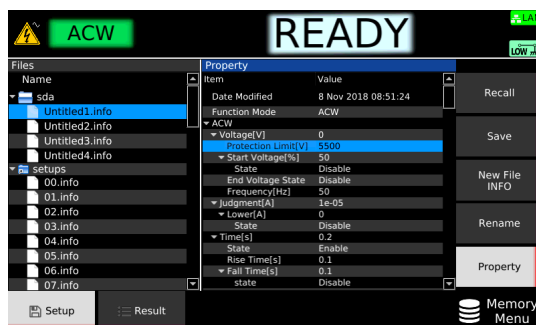


- 4 Use the numeric keypad or the rotary knob to enter a file name of your choice, and then press ENTER.
The memory name is saved.

Checking the setup memory details

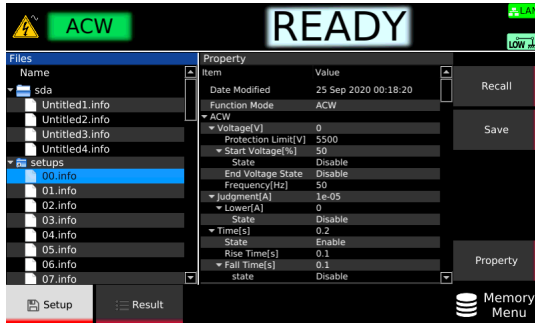
- 1 Press MEMORY > Setup.
- 2 Use the rotary knob to select the setup memory.
- 3 Press Property.

The detailed information of the setup memory is shown 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

- 1 Press MEMORY > Setup.
- 2 Use the rotary knob to select the 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 test conditions of each test are overwritten with the content saved in the setup memory.

Viewing and Saving Test Results

Test results are temporarily saved to the internal memory automatically. The 1000 latest test results are saved regardless of the test mode. These are cleared when the power is turned off.

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

■ Saved contents

Item	Description
Function	ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: insulation resistance, ECAC: AC earth continuity, ECDC: DC earth continuity, PD: partial discharge, TC (network): touch current (network parameters), PCC (network): protective conductor current (network parameters), Patient (I): patient leakage current
Judgment	PASS: A fail judgment was not made. Upper-FAIL: A value greater than or equal to the upper limit was measured. Lower-FAIL: A value less than or equal to the lower limit was measured. Upper-FAIL (dV/dt): In a DCW test, the voltage rise rate (dV/dt) is less than approximately 1 V/s. Lower-FAIL (dV/dt): In an IR test, the voltage rise rate (dV/dt) is less than approximately 1 V/s. PROT(XXX): A protection function was activated. The type of protection is displayed in "XXX" (p. 23). STOP: The test was aborted.
Elapsed Time	The amount of time that has elapsed since the test started (seconds).
Voltage	Measured voltage
Current	Current measurement
Current Real	Real part of the current
Current Imaginary	Imaginary part of the current
Resistance	Resistance measurement
Coulomb	Electric charge
Pulse Count	Pulse Count
Peak	Electric charge peak value
Inception Voltage	Discharge inception voltage
Extinction Voltage	Discharge extinction voltage
Test start time	[year] [month] [day] [hour]:[minute]:[second] [timezone] Ex: 4 Oct 2018 17:00:00 +0900

Displaying a list of test results

1 Press MEMORY > Result.

A list of test results is displayed.

Use the rotary knob and arrow (◀/▶) keys to move between the items you want to view.

Function	Judgment	Elapsed Time	Voltage	Current	Current Real	Current In	Export USB
1 ACW	ABORT	0.7s	0.0098kV	0.6μA	0.3μA	0.00	Export USB Clear Data
2 ACW	ABORT	0.1s	0.0098kV	0.6μA	0.2μA	0.00	
3 DCW	PASS	0.2s	0.2999kV	0.2μA	0.2μA	-----	
4 DCW	PASS	0.2s	0.2999kV	0.2μA	0.2μA	-----	
5 PD	PASS	6s	36.507 V	-----	-----	-----	
6 PD	PASS	6s	36.944 V	-----	-----	-----	
7 ACW	L-FAIL	0s	0.0104kV	0.6μA	0.3μA	0.00	

Saving test results to a USB memory device

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

1 Press MEMORY > Result.

A list of test results is displayed.

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

3 Press Export USB, and then turn the rotary knob to select the save destination folder.

The USB memory device folder ("sdx" folder) appears in the left side of the display area. The "xx" changes depending on the USB memory device. If there are sub folders, you can press arrow (◀/▶) keys to explode or collapse folders.

Name	Function	Judgment	Elapsed Time	Export USB
sda1	1 ACW	ABORT	0.7s	Export USB Clear Data New File CSV
	2 ACW	ABORT	0.1s	
	3 DCW	PASS	0.2s	
	4 DCW	PASS	0.2s	
	5 PD	PASS	6s	
	6 PD	PASS	6s	
	7 ACW	L-FAIL	0s	

4 Press New File CSV.

A new file is created.

5 Use the numeric keypad or the rotary knob to enter a file name of your choice, and then press ENTER.

The test results are saved. Press Rename to rename a file.

Clearing the list of test results



- 1 Press MEMORY > Result.**
- 2 Press Clear Data.**
A confirmation screen appears. To cancel, press ESCAPE.
- 3 Press ENTER.**
The test results are cleared.

Viewing and Saving Test Data

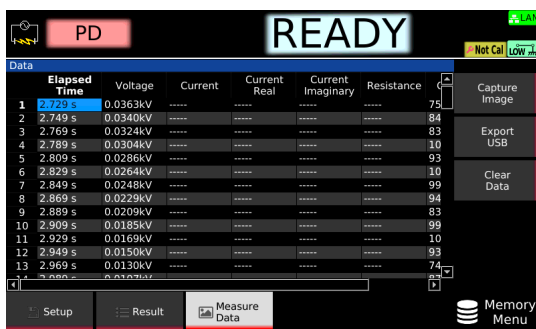
You can save and view the values and the captured image of the most recent test. They are deleted when the power is turned off.

Viewing test data

1 Press MEMORY > Measure Data.

Displays the values of the most recent test results.

Use the rotary knob and arrow (◀/▶) keys to move between the items you want to view.



2 Press Capture Image.

The captured image of the most recent test appears.

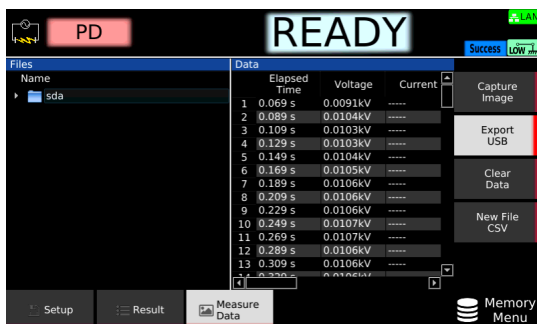
The screen switches between the list of test values and the captured image each time you press Capture Image.



Saving test data to a USB memory device

You can save the values and the captured image of the most recent test to a USB memory device. The values are saved in CVS format, and the image is saved in PNG format.

- 1 Press MEMORY > Measure Data.**
- 2 Insert a USB memory device into the USB connector on the front panel.**
- 3 Press Capture Image to display data you want to save.**
The screen switches between the list of test values and the captured image each time you press Capture Image.
- 4 Press Export USB, and then turn the rotary knob to select a save destination folder.**
The USB memory device folder ("sdxx" folder) appears in the left side of the display area. The "xx" changes depending on the USB memory device. If there are subfolders, you can press arrow (◀/▶) keys to open or close the folders.



- 5 Press New File CSV or New File PNG.**
A new file is created.
- 6 Use the numeric keypad or the rotary knob to enter a file name of your choice, and then press ENTER.**
The test data is saved. Press Rename to rename a file.

Deleting test data

- 1 Press MEMORY > Measure Data.**
- 2 Press Clear Data.**
A confirmation screen appears. To cancel, press ESCAPE.
- 3 Use the arrow (▶) key to select OK, and then press ENTER.**
The test data will be deleted.

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

You can display and change the following settings.

Item	Description	See
Power On	Panel settings at startup.	p.259
Watchdog	Turns the product off automatically when no SCPI communication takes place for a given period.	p.260
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.261
Delay	Time until the screen saver starts.	
Key	Key control lock.	p.262
Lock Level	Range of key operations to lock.	
Calibration	Calibration settings.	p.263
DUE	Sets the next calibration period.	
Protection Keep	Sets the operation that is performed when calibration period elapses.	
Beeper	Enables/disables the beep sound.	p.264
Key	Beep sound for invalid operation.	
Protection	Beep sound for alarm occurrence.	
SCPI Error	Beep sound for SCPI errors.	
Volume Pass	Beep volume for pass judgment results.	
Volume Fail	Beep volume for fail judgment results.	
Fail Mode	Sets the instrument so that fail judgment results and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector or REMOTE connector.	p.265
Double Action	Tests can only be started by pressing and releasing STOP and then pressing START within 0.5 seconds of releasing the STOP switch.	p.266
Momentary	Tests are only executed while the START switch is held down.	p.266
Start Long	Starts a test only when the START switch is held down for at least 1 second.	p.266
Pass Hold	PASS judgment result hold time.	p.267

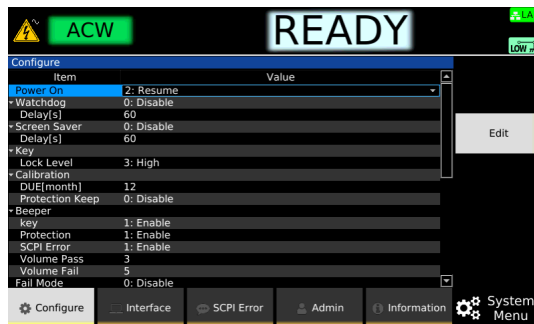
Item	Description	See
Status Output	Conditions for outputting signals from the STATUS OUT connector.	p.268
Upper Fail	While the test status is Upper-FAIL.	
Lower Fail	While the test status is Lower-FAIL.	
H.V ON	While there is a residual voltage and during testing.	
Pass	While the test status is PASS.	
Power ON	While the POWER switch is turned on.	
Protection	While in PROTECTION mode.	
Ready	While the test status is READY.	
Test	While the test voltage is at the specified value.	
Signal I/O	Signal I/O settings.	—
Step END Judgment	Output judgment results for each step from the SIGNAL I/O connector while an auto test is running.	p.269

Panel settings at startup (Power On)

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

Parameter	Description
RST	Start with the reset settings (p.315).
RCL0	Start in setup memory (p.249) number 0 (00.info) condition.
Resume	Start with the same settings as when the power was switched off the previous time.

- 1 Press SYSTEM > Configure.**
The CONFIG 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.23) 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 CONFIG setup screen appears.

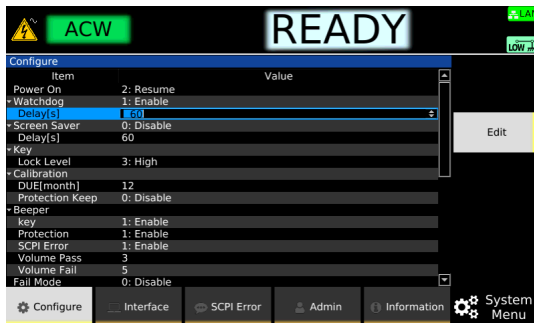
2 Use the rotary knob to select Watchdog, and then press Edit.



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 numeric keypad or the rotary knob to enter the duration of time until the product decides that there is no SCPI communication, and then press 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 CONFIG 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 numeric keypad or the rotary knob to set the time until the screen saver is activated, and press ENTER.**
60 s to 59940 s (after setting, rounded to nearest second unit)
This completes the setting.

Key lock

You can lock the operation of the keys to prevent changing the settings or overwriting memory or programs by mistake. 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.

Parameter	Description	Icon
Low	Locks all operations except the following. <ul style="list-style-type: none"> • Release key lock • START and STOP switches • Memory recall 	
Medium	Locks all operations except the following. <ul style="list-style-type: none"> • Release key lock • START and STOP switches 	
High	Locks all operations except the following. ¹ <ul style="list-style-type: none"> • Release key lock • STOP switch 	

1 Only the START switch on the front panel is locked. The START switch on an option product connected to this product is not locked.

Setting of lock level

- 1 Press SYSTEM > Configure.**
The CONFIG 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 releasing key operations

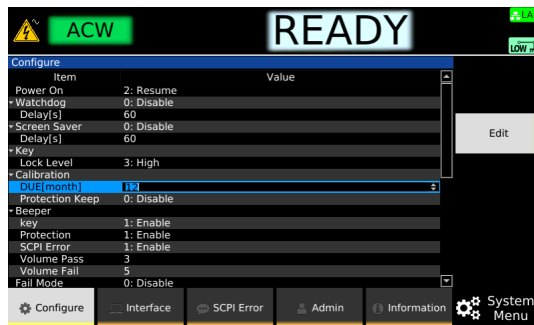
- 1 Hold down KEY LOCK.**
Each time the key is held down, key lock switches between lock and unlock. This completes the setting.

Calibration configuration

You can set the calibration period and the operation performed when the calibration period elapses.

Parameter	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.
	Disable	When the calibration period elapses, a warning appears on the display when the power is turned on. To clear the warning, press STOP.

- 1 Press SYSTEM > Configure.**
The CONFIG setup screen appears.
- 2 Use the rotary knob to select DUE under Calibration, and then press Edit.**



- 3 Use the rotary knob or numeric keys to enter the calibration period, and then press ENTER.**
The calibration period is set.
- 4 Use the rotary knob to select Protection Keep, and then press Edit.**



- 5 Use the rotary knob to select Enable or Disable, and then press ENTER.**
The operation that is performed when calibration period elapses is set.
This completes the setting.

Beep sound (Beeper)

You can enable or disable beep sounds that are emitted in case of invalid operation, alarm occurrence, or SCPI error and the beep volume for pass and fail judgments.

Parameter	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
Volume Pass	0 to 10	Beep volume for pass judgments
Volume Fail	0 to 10	Beep volume for fail judgments

1 Press **SYSTEM > Configure**.

The CONFIG setup screen appears.

2 Use the rotary knob to select **Key, Protection, or SCPI Error** under **Beeper**, and then press **Edit**.



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

4 Use the rotary knob to select **Volume Pass or Volume Fail**.

Press Beep Test to generate a beep at the present volume level.


5 Press **Edit**.

6 Use the rotary knob or numeric keys to enter the volume, and then press **ENTER**.

This completes the setting.

Fail mode

Set the instrument so that fail judgment results and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector or REMOTE connector. When Fail Mode is enabled,

 Fail Mode appears in the upper right of the display.

If you are using the optional high voltage test probe ([p. 332](#)), enable fail mode. When a test ends with a fail judgment, the fail judgment and PROTECTION mode is not released even if you let go of the probe.




- 1** Press **SYSTEM > Configure**.
The CONFIG 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**.
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.

Parameter	Description	Icon
Double Action	When you press and release STOP, “READY” is shown in the upper right of the display for 0.5 seconds. A test starts only when you press START within this period. This prevents a test from being started by pressing START by mistake.	
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 by mistake. The SIGNAL I/O START signal and START signals from the REMOTE connector are not accepted.	
Momentary	A test is executed only while the START switch is held down. If you release START in the middle of a test, the test stops in the same manner as when STOP is pressed. Tests can be performed safely because your hand is fixed on the START switch while the test is in progress. To perform tests more safely, use the remote control box (option) (p.331), which requires you to press the START switch with both hands.	

1 Press SYSTEM > Configure.
The CONFIG setup screen appears.

2 Use the rotary knob to select Double Action, Momentary, or Start Long, and then press Edit.



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

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

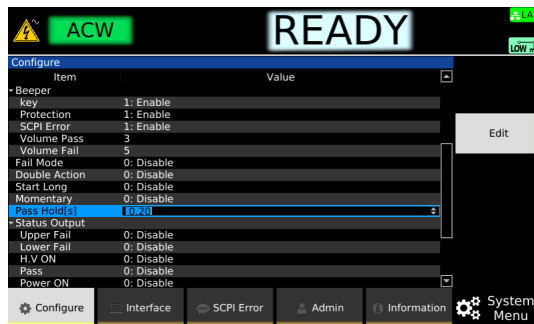
PASS judgment result hold time

Sets the length of time or condition that a PASS judgment result display will be held.

Parameter	Description
0.05 s to 10.00 s	Pass judgment results are displayed until the specified time elapses.
Infinity	Pass judgment results are displayed until you press STOP.

When a FAIL judgment occurs, the FAIL judgment results remain displayed until you press STOP, regardless of the value of the Pass Hold setting.

- 1 Press SYSTEM > Configure.**
The CONFIG setup screen appears.
- 2 Use the rotary knob to select Pass Hold, and then press Edit.**



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

STATUS OUT setting (Status Output)

Set the conditions for outputting 24 Vdc from the STATUS OUT connector. You can use this with the optional warning light unit (p.332).

- 1 Press SYSTEM > Configure.**
The CONFIG setup screen appears.
- 2 Use the rotary knob to select the following items under Status Output, and then press Edit.**



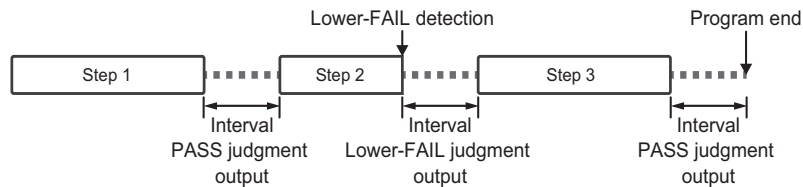
Parameter	Output condition
Upper Fail	While the test status is Upper-FAIL.
Lower Fail	While the test status is Lower-FAIL.
H.V ON	While there is a residual voltage and during testing.
Pass	While the test status is PASS.
Power ON	While the POWER switch is turned on.
Protection	While in PROTECTION mode.
Ready	While the test status is READY.
Test	While the test voltage is at the specified value.

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

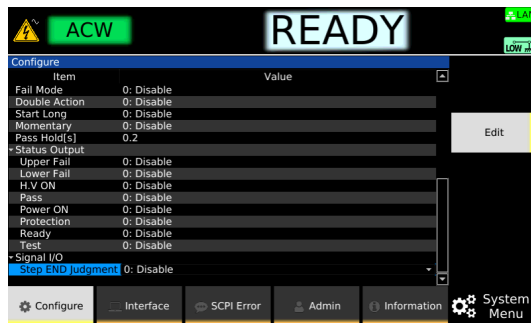
Outputting judgment for each step (Step END Judgment)

If you enable Step END Judgment, the judgment results of each step (PASS, Upper-FAIL, Lower-FAIL) is output from the SIGNAL I/O connector (pins 25 to 27) when an auto test is executed. The results are output at the end of each step over the Interval time (p.225) (the same time as the STEP END signal).

(When FAIL Judgment: Continue)



- 1** Press **SYSTEM > Configure**.
The CONFIG setup screen appears.
- 2** Use the rotary knob to select **Step END Judgment** 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.

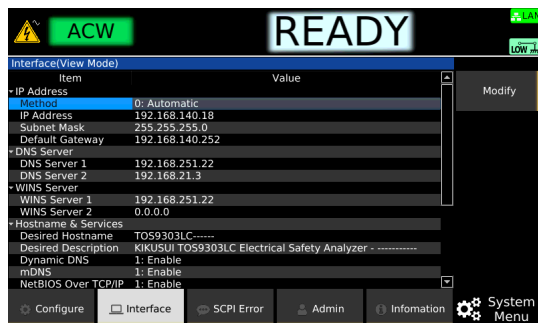
Displaying/Changing the Interface Settings

You can display and change the following settings.

Parameter	Value	Description
IP Address	–	IP address
Method	Automatic (auto)/Static (fixed)	IP address assignment method
IP Address	–	IP address
Subnet Mask	–	Subnet mask
Default Gateway	–	Default gateway
DNS Server	–	DNS server address
DNS Server 1	–	Primary DNS server address
DNS Server 2	–	Secondary DNS server address
WINS Server	–	WINS server address
WINS Server 1	–	Primary WINS server address
WINS Server 2	–	Secondary WINS server address
Host name & Services	–	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	Enable/Disable	Setting of dynamic DNS
mDNS	Enable/Disable	Setting of multicast DNS
NetBIOS Over TCP/IP	Enable/Disable	NetBIOS Over TCP/IP setting
Auto Clock Adjustment	–	Auto clock
NTP Server Hostname	ntp.nict.jp	NTP server address
Auto Adjustment	Enable/Disable	Setting of auto clock adjustment
RS232C Settings	–	Setting of RS232C
Bitrate	9600/19200/38400/57600/115200	Baud rate [bps]
Data Bits	8 bit	Data length
Stop Bits	1 bit	Stop bits
Flow Control	None/CTS-RTS	Flow control

1 Press SYSTEM > Interface.

The interface setup screen appears.

**2 Press Modify.**

You can now edit the interface settings.

3 Use the rotary knob to select a setting, and then press Edit.**4 Use the numeric keypad or the rotary knob to select or enter a value, and then press ENTER.**

Change the interface settings by repeating step 3 and step 4. The changes are not applied at this point.

5 Press Apply.

A confirmation screen appears. To cancel, press ESCAPE.

6 Press ENTER.

This completes the setting.

Displaying 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.

1 Press **SYSTEM > SCPI Error**.

The SCPI error is displayed. For details on errors, see the Communication Interface Manual on the included CD-ROM.

Pressing Clear or restarting the product will clear the error.

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.

If the product is connected to LAN and can access the Internet, setting Auto Adjustment under Auto Clock Adjustment in the Interface setup (p.270) to enable will cause the date to be updated automatically according to the time zone.

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 the numeric keypad or rotary knob to enter the value.

3 Press Apply.

A confirmation screen appears.

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

This completes the setting.

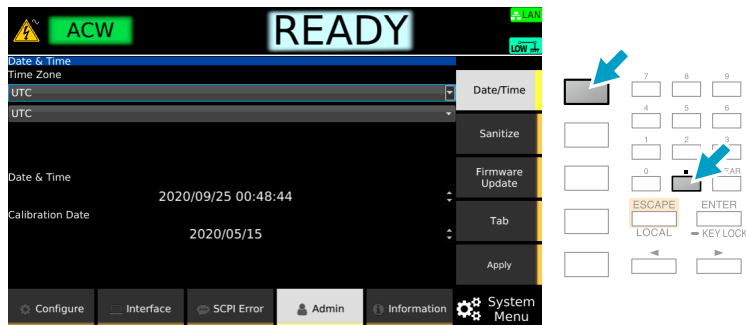
Changing calibration date

You can change the date on which calibration was carried out at your discretion.

1 Press SYSTEM > Admin > Date/Time.

The currently set calibration date appears in Calibration Date.

2 Press Date/Time and . simultaneously.



A confirmation screen appears.

3 Use the arrow (▶) key to select OK, and then press ENTER.

4 Use the numeric keypad or 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 screen appears.

6 Use the arrow (▶) key to select OK, and then press ENTER.

This completes the setting change.

Initializing the Settings

This product 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

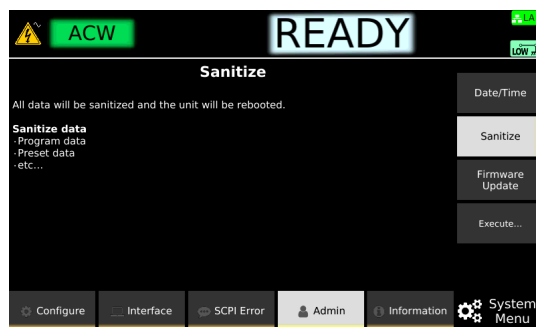
Restoring the factory default settings deletes all the user data*.

For details about the factory default setting, see “Default Settings and Reset Settings” (p.315).

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

You can also return only the interface settings to their factory default values.

1 Press SYSTEM > Admin > Sanitize.



2 Press Execute.

A confirmation screen appears. To cancel, press ESCAPE.

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

The error “-314 Save/recall memory lost” occurs, but this is actually not an error.

4 Turn the product off and then back on.

The product restarts, and the factory default settings are restored.

Returning only the interface settings to the factory default values

1 Press SYSTEM > Interface.

2 Press Modify > Default.

A confirmation screen appears. To cancel, press ESCAPE.

3 Press ENTER.

The interface settings are returned to the factory default values.

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.315).

You can also return only the interface settings to the “reset settings.”

- 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 product off and then back on.
The product restarts with some of the settings reset to their factory defaults.

Returning only the interface settings to the “reset settings”

Items that have a check mark in the reset column in Interface settings (p.320) of Default Settings and Reset Settings are returned to their factory default settings.

- 1 Press **SYSTEM** > **Interface**.
- 2 Press **Modify** > **LAN Reset**.
A confirmation screen appears. To cancel, press **ESCAPE**.
- 3 Press **ENTER**.
The interface setting is reset.

Updating

You can update the product'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 (<http://www.kikusui.co.jp/en/download/>).

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 Press SYSTEM > Admin > Firmware Update.



2 Insert the USB memory device on which the update files have been saved into the USB port on the front panel, and then press Execute.

An update screen appears.

3 Press ENTER.

The update process begins. Do not turn off this instrument while updating is in progress. Do not remove the USB memory device.

4 If "Cycle the unit power..." is displayed, remove the USB memory device, and turn the product off and then back on.

Updating is complete.

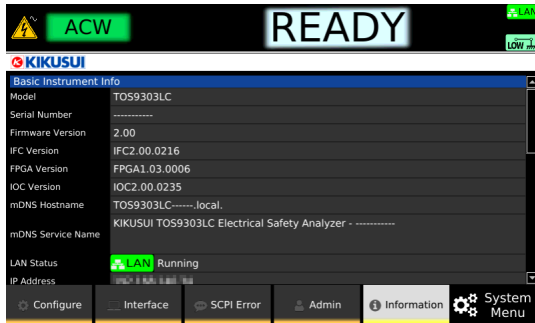
Displaying the Device Information

You can display the model name, serial number, firmware version, IP address, last calibration date, and other device information.

1 Press **SYSTEM > Information**.

The device information is displayed. You can scroll the screen by turning the rotary knob.

If a connection is established when IP Address > Method is set to Automatic in the interface settings (p.270) (the LAN connection status icon in the upper right of the display is green), the automatically assigned IP address is displayed next to IP Address.



Inspection

Pre-inspection for withstanding voltage test and insulation resistance test

Applicable models for AC withstanding voltage (ACW): All models

Applicable models for DC withstanding voltage (DCW): **9301**, **9301PD**, **9303**, **9303LC**

Applicable models for insulation resistance (IR): **9300**, **9301**, **9301PD**, **9303**, **9303LC**

Perform ACW, DCW, and IR tests 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 Breaks or tears in the test leads may cause electric shock or fire. If a break or tear is found, stop using the test leads immediately.

- 1** Connect the low-voltage test lead (black) and high-voltage test lead (red) to the product (p.29).
- 2** Short the low-voltage test lead (black) and high-voltage test lead (red).
- 3** Set the test conditions.
For a withstanding voltage test, be sure to set the Upper limit (p.60). For an insulation resistance test, be sure to set the Lower limit (p.61).
- 4** Press **START**.
The test starts.
- 5** Check the result.

Test type	Result	Inspection result
Withstanding voltage (ACW, DCW) test	Upper-FAIL or PROTECTION (Output Error or Over Load)	Normal.
	Other than the above	The test leads may be broken. If there are no breaks in the test leads, the product needs to be repaired.
Insulation resistance (IR) test	Lower-FAIL or PROTECTION (Output Error or Over Load)	Normal.
	Other than the above	The test leads may be broken. If there are no breaks in the test leads, the product needs to be repaired.

If the product needs to be repaired, contact your Kikusui agent or distributor.
This completes the inspection.

Pre-testing the earth continuity test

Applicable models: **9302**, **9303**, **9303LC**

Perform a test by shorting the test leads for earth continuity testing and a test by opening the test leads, and determine the inspection results from those results. If the product needs to be repaired, contact your Kikusui agent or distributor.

The test leads are consumable parts. Check them periodically for tears and breaks in the insulation.

1 Connect the low-voltage test lead (black) and high-voltage test lead (red) (p.35).

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

3 Set the upper limit (p.93) to on and lower limit (p.94) to off.

4 Press **START**.
The test starts.

5 Check the test result.

Judgment	Inspection result (when test leads are shorted)
PASS	Normal.
Upper-FAIL	The test leads may be broken. If there are no breaks in the test leads, the product needs to be repaired.

6 Press **STOP**.

7 Open the low-voltage test lead (black) and high-voltage test lead (red).

8 Press **START**.
The test starts.

9 Check the test result.

Judgment	Inspection result (when test leads are opened)
PASS	The product needs to be repaired.
Upper-FAIL	Normal.

This completes the pre-inspection.

Pre-testing the leakage current test

Applicable models: **9303LC**

Measurement check

Using the measurement check function, run a weak current across the A and B terminals, and check the measurement circuit. During this inspection, the two test leads are shorted, so you can check for breaks in the test leads at the same time.

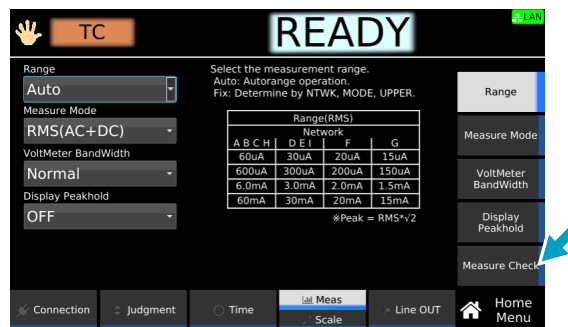
1 Attach alligator clips to the leakage current test leads and connect them to the A and B terminals.

2 Short the two test leads.

3 On the leakage current Home menu screen, press Measure repeatedly until Measure is selected.

Each time you press the key, the setting changes between Measure and Scale.

4 Press Measure Check.



Measure Check changes to Execute.

5 Press Execute.

A measurement check is executed.

This completes the check.

When the measurement check result is abnormal

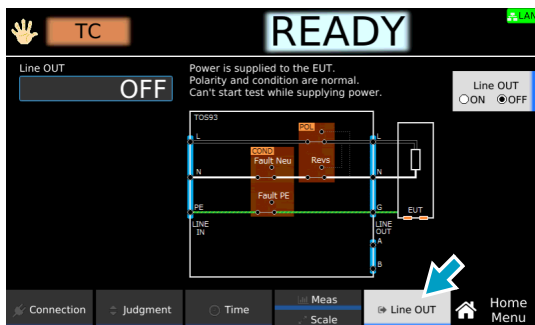
“Measure protection” is displayed. The protection function is activated, and the product switches to PROTECTION mode. Pressing STOP releases the PROTECTION mode. Check whether the test leads are broken. If you perform another measurement check but “Measure protection” is still displayed, the product needs to be repaired. Contact your Kikusui agent or distributor.

Checking the EUT operation

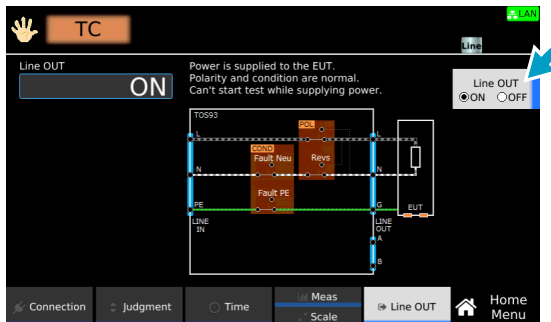
The power supply line (AC LINE OUT on the rear panel) for the EUT normally outputs current only during testing. To check the operation of the EUT before testing, set Line OUT to on to temporarily run current from AC LINE OUT.

While Line OUT is on, you cannot start a test. In addition, **Line** is shown in the upper right of the display.

- 1 Connecting the EUT (p.41).
- 2 On the Home menu screen, press Line OUT.



- 3 Press Line OUT to switch between on and off.
Line OUT switches between on and off each time you press the key.



This completes the setting.

Replacing Components

Replacing the backup battery

This product uses a lithium battery for memory backup. When the battery is low, the clock may become inaccurate or test conditions and the like may no longer be saved.

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.

This product comes with an installed CR Coin Lithium Battery which contains Perchlorate Material. Disposal of this battery may be regulated due to environmental considerations.

See www.dtsc.ca.gov/hazardouswaste/perchlorate

Replacing the fuse

Applicable models: **9303LC**

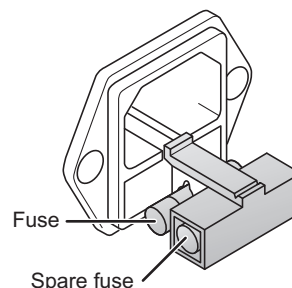
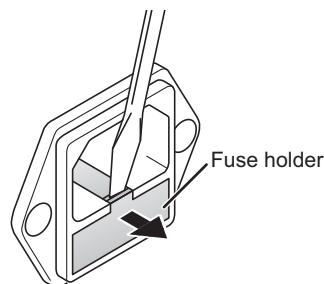
A fuse (rating: 250 V, 15 A (T)) is inserted in the EUT power supply line. When 1 600 VA or 15.7 A is exceeded, the protection function is activated, and the EUT power supply line is shut off. As such, normally, this fuse does not blow. However, should this fuse blow due to errors in wiring or aging, you can replace it.

⚠ WARNING Risk of electric shock.

- Before replacing the fuse, remove the power cord from the AC LINE IN inlet for the EUT power supply.
- Use a fuse compatible with the product in shape, rating, and characteristics. Using a fuse with a different rating or shorting the fuse holder is dangerous.

1 Remove the power cord from the AC LINE IN inlet on the rear panel.

2 Remove the fuse holder using a flat-blade screwdriver or the like.



3 Replace the blown fuse with an appropriate one.

4 Attach the fuse holder.

Periodic Calibration

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

You can set a calibration period by the calibration setting (Calibration) ([p.263](#)).

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

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.
- range: Indicates the rated value of each range.
- reading: Indicates a readout value.
- The various tests are abbreviated as follows:
ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: insulation resistance, EC: earth continuity, PD: partial discharge, LC: leakage current, TC: touch current, PCC: protective conductor current, Patient: patient leakage current, Meter: meter mode.
- The following table shows which tests are supported by each model.

	ACW	DCW	IR	EC	PD	LC
TOS9300	✓	–	✓	–	–	–
TOS9301	✓	✓	✓	–	–	–
TOS9301PD	✓	✓	✓	–	✓	–
TOS9302	✓	–	–	✓	–	–
TOS9303	✓	✓	✓	✓	–	–
TOS9303LC	✓	✓	✓	✓	–	✓

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Withstanding voltage test section

Applicable models for ACW: All models

Applicable models for DCW: **9301**, **9301PD**, **9303**, **9303LC**

Output function

Item		Specifications
AC output section (ACW only)	Output range	0.050 kV to 5.000 kV
	Resolution	1 V
	Setting accuracy	±(1.2 % of setting + 0.02 kV) (at no load)
	Max. rated load ¹	500 VA (5 kV/100 mA)
	Max. rated current	100 mA (when the output voltage is 0.2 kV or higher)
	Transformer rating	500 VA
	Output voltage waveform ²	Sine
	Distortion	2 % or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)
	Crest factor	$\sqrt{2} \pm 3 \%$ (800 V or more)
	Frequency	50 Hz/60 Hz
	Accuracy	±0.1 %
	Voltage regulation	±3 % or less (when changing from maximum rated load to no load)
	Short-circuit current	200 mA or more (output voltage 0.5 kV or higher)
Output method	PWM switching	
DC output section (DCW only)	Output voltage range	0.050 kV to 7.200 kV
	Resolution	1 V
	Setting accuracy	±(1.2 % of setting + 0.02 kV)
	Max. rated load ¹	100 W (5 kV/20 mA, 7.2 kV/13.9 mA)
	Max. rated current	20 mA
	Ripple	7.2 kV no load: 20 Vp-p (TYP) Max. rated load: 50 Vp-p (TYP)
	Voltage regulation	1 % or less (when changing from maximum rated load to no load)
	Short-circuit current	100 mA (TYP) (200 mA peak)
	Discharge function	Forced discharge after test completion (discharge resistance: 125 kΩ)
Start voltage	The voltage at the start of the test can be set.	
	Setting range	1 % to 99 % of the test voltage
	Resolution	1 %
Output voltage monitor function	If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.	

- 1 When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting (p. 82).
- 2 If an AC voltage is applied to a capacitive load, the output voltage may rise higher than at no load depending on the load capacitance. Further, waveform distortions may occur if an EUT whose capacitance is dependent on voltage (for example, an EUT that consists of ceramic capacitors) is connected as the load. However, if the test voltage is 1.5 kV, the effect of a capacitance of 1 000 pF or less can be ignored. Because the product's high-voltage power supply uses the PWM switching method, if the test voltage is 500 V or less, the switching and spike noise proportions are large. The lower the test voltage, the greater the waveform is distorted.

Measurement function

Item		Specifications
Voltmeter	Measurement range	0.00 kV to 7.50 kV AC/DC
	Resolution	0.1 V
	Accuracy	$\pm(1.2\% \text{ of reading} + 5 \text{ V})$
	Response	Can be switched between true rms and mean-value response rms conversion.
		Peak-value response in a separate system (the peak-value response is for measuring the dielectric breakdown voltage while rising)
Hold function	The voltage measurement after a test is finished is held while the pass/fail judgment is displayed.	
Ammeter ^{1 2}	Measurement range	AC: 0.00 mA to 110 mA, DC: 0.00 mA to 22 mA (Current including the active component and reactive component)
	Accuracy	$\pm(1\% \text{ of reading} + 2 \mu\text{A})$ (active component)
	Response	Can be switched between true rms and mean-value response rms conversion.
	Hold function	The current measurement after a test is finished is held while the pass judgment is displayed.
	Offset cancel function	Cancels up to 10 mA of the current flowing through the insulation resistance and stray capacitance components across output cables and the like (resistance component only for DC tests). OFF function available.
	Calibration	Active component: Calibrated with the rms of a sine wave using a pure resistive load. Reactive component: Not calibrated.

- 1 During AC voltage tests, current also flows in the stray capacitance of items such as the test leads and tools. For details on stray capacitance, see “Stray Capacitance of AC Withstanding Voltage Tests” (p.321).
- 2 When the temperature and humidity are high, erroneous current from the product’s internal and external high-voltage wiring sections to ground increases. When the humidity exceeds 70 %, an erroneous current of about 50 μA may be generated.

Judgment function

Item		Specifications
Current judgment operation		The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.
UPPER FAIL	Judgment method	UPPER FAIL results when a current greater than or equal to the Upper limit is detected. For DCW, judgment is not made during the judgment delay (Judge Delay).
	Display	“Upper-FAIL” is displayed.
	Buzzer	On
	SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
LOWER FAIL	Judgment method	LOWER FAIL results when a current less than or equal to the Lower limit is detected. Judgment is not made during Voltage rise time or Voltage fall time of an ACW test.
	Display	“Lower-FAIL” is displayed.
	Buzzer	On
	SIGNAL I/O	The Lower-FAIL signal is generated continuously until a STOP signal is received.
PASS	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.
	Display	“PASS” is displayed.
	Buzzer	On (fixed to 50 ms)
	SIGNAL I/O	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.

Item	Specifications	
Voltage rise rate judgment operation	Monitors the voltage rise rate during Voltage rise time. This is valid when Auto setting of the judgment delay (Delay Auto) is set to on and the output voltage is 200 V or more. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately.	
dV/dt FAIL	Judgment method	When the voltage rise rate (dV/dt) is less than approx. 1 V/s.
	Display	"Upper-FAIL (dV/dt)" is displayed.
	Buzzer	ON
	SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
Upper limit setting range	AC: 0.01 mA to 110.00 mA, DC: 0.01 mA to 21.00 mA	
Lower limit setting range	AC: 0.00 mA to 109.99 mA, DC: 0.00 mA to 20.99 mA, OFF. Setting 0.00 is equivalent to OFF.	
Judgment accuracy ^{1 2}	$\pm(1\% \text{ of setting} + 5 \mu\text{A})$	
Current detection method	Compares to the reference value using the following method. Calculate true rms values, convert mean-value responses to rms values	
Response speed (filter) switching	Switches the current detection response speed (sensitivity) used in UPPER FAIL judgment between five levels in ACW and DCW tests.	

- 1 During AC voltage tests, current also flows in the stray capacitance of items such as the test leads and tools. For details on stray capacitance, see "Stray Capacitance of AC Withstanding Voltage Tests" (p.321).
- 2 When the temperature and humidity are high, erroneous current from the product's internal and external high-voltage wiring sections to ground increases. When the humidity exceeds 70 %, an erroneous current of about 50 μA may be generated.

Timer function

Item	Specifications
Voltage rise time settings range	0.1 s to 200.0 s
Voltage fall time setting time ¹	0.1 s to 200.0 s, OFF
Test time setting range	0.1 s to 1000.0 s, OFF
Judgment delay (Judge Delay) setting range ²	0.1 s to 100.0 s, AUTO ³ (DCW only)
Accuracy	$\pm(100 \text{ ppm of setting} + 20 \text{ ms})$ (excluding the fall time)

- 1 This setting is used only when a PASS judgment occurs in ACW and DCW tests. During a DCW test, the voltage may not drop all the way within the set time because of the electrostatic capacity inside the product and the EUT.
- 2 Less than the sum of the rise time and fall time.
- 3 If Delay Auto is set to on, LOWER judgment is not made until the charge time ends.

Other specifications

Item	Specifications	
Analog monitor ¹	Outputs a voltage signal according to the current waveform or voltage waveform	
	I	Current waveform: Scale 50 mA/1 V
	V	Voltage waveform: Scale 1 kV/1 V
Grounding mode (GND)	Can be switched between Low and Guard.	
	Low	GND is connected to the low terminal. Measures the current flowing across the low terminal and chassis (normal applications).
	Guard ²	GND is connected to Guard. Measures only the current flowing through the low terminal (current flowing through the chassis is not measured) (high sensitivity, high accuracy measurement applications).

- 1 Monitor signal output is isolated from the chassis (earth). If you connect an oscilloscope or an external device whose BNC shield is grounded, be sure to set the grounding mode (GND) to Guard. The value is not calibrated.
- 2 If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current. For normal applications, set GND to Low.

Insulation resistance test section

Applicable models: **9300**, **9301**, **9301PD**, **9303**, **9303LC**

Output function

Item		Specifications	
Negative polarity	Output voltage range	-25 V to -1000 V	
		Resolution	1 V
		Setting accuracy	$\pm(1.2\% \text{ of setting} + 2 \text{ V})$
	Max. rated load		1 W (-1000 V/1 mA)
	Ripple	1 kV no load	2 Vp-p or less
		Max. rated load	10 Vp-p or less
Short-circuit current		12 mA or less	
Positive polarity ¹	Output voltage range	+50 V to +7200 V	
		Resolution	1 V
		Setting accuracy	$\pm(1.2\% \text{ of setting} + 0.02 \text{ kV})$
	Max. rated load		7.2 W(7200 V/1 mA)
	Ripple	1 kV no load	20 Vp-p or less
		Max. rated load	50 Vp-p or less
Short-circuit current		100 mA (TYP) (200 mA peak)	
Max. rated current		1 mA	
Voltage regulation		1 % or less (when changing from maximum rated load to no load)	
Discharge function		Forced discharge after test completion (discharge resistance: 20 k Ω)	
Output voltage monitor function		If the output voltage exceeds $\pm(10\% \text{ of setting} + 50 \text{ V})$, the output is turned off, and the protection function is activated.	

1 TOS9300 are not supported.

Measurement function

Item		Specifications	
Voltmeter	Measurement range	Negative polarity: 0 Vdc to -1200 Vdc, positive polarity: 0 Vdc to 7500 Vdc	
	Resolution	0.1 V	
	Accuracy	Negative polarity: $\pm(1\% \text{ of reading} + 1 \text{ V})$, positive polarity: $\pm(1.2\% \text{ of reading} + 1 \text{ V})$	
Resistance meter	Measurement range	0.001 M Ω to 100.0 G Ω (in the range of maximum rated current of 1 mA to 5 nA)	
	Accuracy ^{1 2} (when GND is set to Guard) (i: measured current) (R: measurement resistance)	$5 \text{ nA} \leq i \leq 50 \text{ nA}^3$	500.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(15\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(15\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R \leq 100.000 \text{ G}\Omega$: $\pm(20\% \text{ of reading} + 200 \text{ M}\Omega)$
		$50 \text{ nA} < i \leq 100 \text{ nA}^3$	200.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 50.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 50 \text{ M}\Omega)$ 50.000 G $\Omega \leq R \leq 100.000 \text{ G}\Omega$: $\pm(20\% \text{ of reading} + 200 \text{ M}\Omega)$
		$100 \text{ nA} < i \leq 200 \text{ nA}^4$	100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(7\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 2.000 \text{ G}\Omega$: $\pm(7\% \text{ of reading} + 5 \text{ M}\Omega)$ 2.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(7\% \text{ of reading} + 10 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 50.000 \text{ G}\Omega$: $\pm(7\% \text{ of reading} + 100 \text{ M}\Omega)$
		$200 \text{ nA} < i \leq 1 \mu\text{A}^4$	10.000 M $\Omega \leq R < 100.000 \text{ M}\Omega$: $\pm(5\% \text{ of reading} + 0.05 \text{ M}\Omega)$ 100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 25.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 50 \text{ M}\Omega)$
		$1 \mu\text{A} < i \leq 1 \text{ mA}^4$	0.001 M $\Omega \leq R < 10.000 \text{ M}\Omega$: $\pm(2\% \text{ of reading} + 0.003 \text{ M}\Omega)$ 10.000 M $\Omega \leq R < 100.000 \text{ M}\Omega$: $\pm(2\% \text{ of reading} + 0.03 \text{ M}\Omega)$ 100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(2\% \text{ of reading} + 0.3 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 5.000 \text{ G}\Omega$: $\pm(2\% \text{ of reading} + 3 \text{ M}\Omega)$
	Accuracy ⁵ (when GND is set to Low) (i: measured current) (R: measurement resistance)	$5 \text{ nA} \leq i \leq 50 \text{ nA}^3$	500.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(25\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(25\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R \leq 100.000 \text{ G}\Omega$: $\pm(30\% \text{ of reading} + 200 \text{ M}\Omega)$
		$50 \text{ nA} < i \leq 100 \text{ nA}^3$	200.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(20\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(20\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 50.000 \text{ G}\Omega$: $\pm(20\% \text{ of reading} + 50 \text{ M}\Omega)$ 50.000 G $\Omega \leq R \leq 100.000 \text{ G}\Omega$: $\pm(30\% \text{ of reading} + 200 \text{ M}\Omega)$
		$100 \text{ nA} < i \leq 200 \text{ nA}^4$	100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 2.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 5 \text{ M}\Omega)$ 2.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 10 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 50.000 \text{ G}\Omega$: $\pm(10\% \text{ of reading} + 100 \text{ M}\Omega)$
		$200 \text{ nA} < i \leq 1 \mu\text{A}^4$	10.000 M $\Omega \leq R < 100.000 \text{ M}\Omega$: $\pm(5\% \text{ of reading} + 0.05 \text{ M}\Omega)$ 100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 0.5 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 10.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 5 \text{ M}\Omega)$ 10.000 G $\Omega \leq R < 25.000 \text{ G}\Omega$: $\pm(5\% \text{ of reading} + 50 \text{ M}\Omega)$
		$1 \mu\text{A} < i \leq 1 \text{ mA}^4$	0.001 M $\Omega \leq R < 10.000 \text{ M}\Omega$: $\pm(2\% \text{ of reading} + 0.003 \text{ M}\Omega)$ 10.000 M $\Omega \leq R < 100.000 \text{ M}\Omega$: $\pm(2\% \text{ of reading} + 0.03 \text{ M}\Omega)$ 100.000 M $\Omega \leq R < 1.000 \text{ G}\Omega$: $\pm(2\% \text{ of reading} + 0.3 \text{ M}\Omega)$ 1.000 G $\Omega \leq R < 5.000 \text{ G}\Omega$: $\pm(2\% \text{ of reading} + 3 \text{ M}\Omega)$
	Hold function	The resistance measurement after a test is finished is held while the pass judgment is displayed.	
	Offset cancel function	Cancels up to 2000 G Ω of the unnecessary insulation resistance across output cables and the like. OFF function available.	

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

- 2 If the grounding mode (GND) is set to low in a highly humid environment, leakage current to ground will be generated from the high-voltage wiring sections inside the product and the high-voltage wiring sections between the product and the EUT. This leakage current ranges from several nA to several tens of nA depending on the usage and wiring conditions of the optional TOS9320 high voltage scanner and greatly affects measurement accuracy. The effects of leakage current can be reduced by making measurements with the offset enabled.
- 3 Add 10 % to the accuracy when measuring 100 V or less.
- 4 Add 5 % to the accuracy when measuring 100 V or less.
- 5 When the measured current is limited to 100 nA or more (no condensation) when the humidity is 50 %rh or less, no external disturbance is present such as swinging test leads, and the offset is enabled.

Judgment function

Item	Specifications	
Behavior based on judgment	The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.	
UPPER FAIL	Judgment method	UPPER FAIL results when a resistance greater than or equal to the Upper limit is detected. Judgment is not made during or Voltage rise time.
	Display	"Upper-FAIL" is displayed.
	Buzzer	On
	SIGNAL I/O	The Upper-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 is detected. Judgment is not made during the judgment delay (Judge Delay).
	Display	"Lower-FAIL" is displayed.
	Buzzer	On
	SIGNAL I/O	The Lower-FAIL signal is generated continuously until a STOP signal is received.
PASS	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.
	Display	"PASS" is displayed.
	Buzzer	On (fixed to 50 ms)
	SIGNAL I/O	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.
Voltage rise rate judgment operation	Monitors the voltage rise rate during Voltage rise time. This is valid when Auto setting of the judgment delay (Delay Auto) is set to on and the output voltage is 200 V or more. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately.	
dV/dt FAIL	Judgment method	When the voltage rise rate (dV/dt) is less than approx. 1 V/s.
	Display	"Lower-FAIL (dV/dt)" is displayed.
	Buzzer	ON
	SIGNAL I/O	The L FAIL signals are generated continuously until a STOP signal is received.
Upper limit setting range	0.001 MΩ to 100.000 GΩ (in the range up to the maximum rated current), OFF	
Lower limit setting range	0.000 MΩ to 99.999 GΩ (in the range up to the maximum rated current), OFF. Setting 0.000 is equivalent to OFF.	

Item		Specifications
Accuracy ^{1 2 3} (when GND is set to Guard) (i: measured current) (R: measurement resistance)	$5 \text{ nA} \leq i \leq 50 \text{ nA}^4$	500.000 MΩ ≤ R < 1.000 GΩ: ±(15 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(15 % of setting + 15 MΩ) 10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of setting + 210 MΩ)
	$50 \text{ nA} < i \leq 100 \text{ nA}^4$	200.000 MΩ ≤ R < 1.000 GΩ: ±(10 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(10 % of setting + 15 MΩ) 10.000 GΩ ≤ R < 50.000 GΩ: ±(10 % of setting + 60 MΩ) 50.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of setting + 210 MΩ)
	$100 \text{ nA} < i \leq 200 \text{ nA}^5$	100.000 MΩ ≤ R < 1.000 GΩ: ±(7 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 2.000 GΩ: ±(7 % of setting + 15 MΩ) 2.000 GΩ ≤ R < 10.000 GΩ: ±(7 % of setting + 20 MΩ) 10.000 GΩ ≤ R < 50.000 GΩ: ±(7 % of setting + 110 MΩ)
	$200 \text{ nA} < i \leq 1 \text{ } \mu\text{A}^5$	10.000 MΩ ≤ R < 100.000 MΩ: ±(5 % of setting + 0.06 MΩ) 100.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(5 % of setting + 15 MΩ) 10.000 GΩ ≤ R < 25.000 GΩ: ±(5 % of setting + 60 MΩ)
	$1 \text{ } \mu\text{A} < i \leq 1 \text{ mA}^5$	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of setting + 0.013 MΩ) 10.000 MΩ ≤ R < 100.000 MΩ: ±(2 % of setting + 0.04 MΩ) 100.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of setting + 0.31 MΩ) 1.000 GΩ ≤ R < 5.000 GΩ: ±(2 % of setting + 13 MΩ)
Accuracy ⁶ (when GND is set to Low) (i: measured current) (R: measurement resistance)	$5 \text{ nA} \leq i \leq 50 \text{ nA}^4$	500.000 MΩ ≤ R < 1.000 GΩ: ±(25 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(25 % of setting + 15 MΩ) 10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(30 % of setting + 210 MΩ)
	$50 \text{ nA} < i \leq 100 \text{ nA}^4$	200.000 MΩ ≤ R < 1.000 GΩ: ±(20 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(20 % of setting + 15 MΩ) 10.000 GΩ ≤ R < 50.000 GΩ: ±(20 % of setting + 60 MΩ) 50.000 GΩ ≤ R ≤ 100.000 GΩ: ±(30 % of setting + 210 MΩ)
	$100 \text{ nA} < i \leq 200 \text{ nA}^5$	100.000 MΩ ≤ R < 1.000 GΩ: ±(10 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 2.000 GΩ: ±(10 % of setting + 15 MΩ) 2.000 GΩ ≤ R < 10.000 GΩ: ±(10 % of setting + 20 MΩ) 10.000 GΩ ≤ R < 50.000 GΩ: ±(10 % of setting + 110 MΩ)
	$200 \text{ nA} < i \leq 1 \text{ } \mu\text{A}^5$	10.000 MΩ ≤ R < 100.000 MΩ: ±(5 % of setting + 0.06 MΩ) 100.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of setting + 0.51 MΩ) 1.000 GΩ ≤ R < 10.000 GΩ: ±(5 % of setting + 15 MΩ) 10.000 GΩ ≤ R < 25.000 GΩ: ±(5 % of setting + 60 MΩ)
	$1 \text{ } \mu\text{A} < i \leq 1 \text{ mA}^5$	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of setting + 0.013 MΩ) 10.000 MΩ ≤ R < 100.000 MΩ: ±(2 % of setting + 0.04 MΩ) 100.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of setting + 0.31 MΩ) 1.000 GΩ ≤ R < 5.000 GΩ: ±(2 % of setting + 13 MΩ)

- 1 Making judgments on 200 μA or less requires at least 3 seconds after the rise time ends. Making judgments when the low pass filter is set to on requires at least 10 seconds after the rise time ends.
- 2 Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
- 3 If the grounding mode (GND) is set to low in a highly humid environment, leakage current to ground will be generated from the high-voltage wiring sections inside the product and the high-voltage wiring sections between the product and the EUT. This leakage current ranges from several nA to several tens of nA depending on the usage and wiring conditions of the optional TOS9320 high voltage scanner and greatly affects measurement accuracy. The effects of leakage current can be reduced by making measurements with the offset enabled.
- 4 Add 10 % to the accuracy when measuring 100 V or less.
- 5 Add 5 % to the accuracy when measuring 100 V or less.
- 6 When the measured current is limited to 100 nA or more (no condensation) when the humidity is 50 %rh or less, no external disturbance is present such as swinging test leads, and the offset is enabled.

Timer function

Item	Specifications
Voltage rise time settings range	0.1 s to 200.0 s
Test time setting range	0.1 s to 1000.0 s, OFF
Judgment delay (Judge Delay) setting range ¹	0.1 s to 100.0 s, AUTO ²
Accuracy ³	±(100 ppm of setting + 20 ms)

- 1 Less than the sum of the rise time and fall time.
- 2 If Delay Auto is set to on, UPPER judgment is not made until the charge time ends.
- 3 This excludes fall time.

Other specifications

Item	Specifications	
Grounding mode (GND)	Can be switched between Low and Guard.	
	Low	GND is connected to the low terminal. Measures the current flowing across the low terminal and chassis (normal applications).
	Guard ¹	GND is connected to Guard. Measures only the current flowing through the low terminal (current flowing through the chassis is not measured) (high sensitivity, high accuracy measurement applications).
Filter function	A low-pass filter can be inserted into the ammeter measurement circuit. ²	

- 1 If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current. For normal applications, set GND to Low.
- 2 When the low pass filter is on, a judgment delay of at least 5 seconds and a test time are required.

Earth continuity test section

Applicable models: **9302**, **9303**, **9303LC**

Output function

Item		Specifications
Current setting range ¹		3.0 A to 42.0 A AC/DC
	Resolution	0.1 A
	Accuracy	±(1 % of setting + 0.4 A)
AC	Maximum rated output ²	220 VA (at the output terminal)
	Distortion	2% or less (20 A or more, using a 0.1 Ω pure resistive load)
	Frequency	Select 50 Hz or 60 Hz. Sine
	Accuracy	±200 ppm
	Open terminal voltage	6 Vrms or less
	Output method	PWM switching
DC	Maximum rated output	220 W (at the output terminal)
	Ripple	±0.4 Ap-p or less (TYP)
	Open terminal voltage	6.0 V or less

1 No greater than the maximum rated output and resistance no greater than the output terminal voltage 5.4 V.

2 When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting (p.101).

Measurement function

Item		Specifications
Output ammeter	Measurement range	0.0 A to 45.0 A AC/DC
	Resolution	0.01 A
	Accuracy	±(1 % of reading + 0.2 A)
	Response	AC: true rms value: DC: mean value
	Hold function	The current measurement after a test is finished is held while the pass or fail judgment is displayed.
Output voltmeter	Measurement range	AC: 0.00 V to 6.00 V, DC: 0.00 V to 8.50 V
	Resolution	0.001 V
	Offset cancel function	Cancels up to 5 V (AC/DC) of the unnecessary voltage from measurements. OFF function available.
	Accuracy	±(1 % of setting + 0.02 V)
	Response	AC: true rms value: DC: mean value
Resistance meter	Measurement range ¹	1 mΩ to 600 mΩ
	Resolution	1 mΩ
	Offset cancel function	Cancels up to 10 Ω of the unnecessary resistance from measurements. OFF function available.
	Accuracy	±(2 % of reading + 3 mΩ)
	Hold function	The resistance measurement after a test is finished is held while the pass judgment is displayed.

1 Calculated from the measured output voltage and measured output current.

Judgment function

Item	Specifications		
Behavior based on judgment	Judgment based on resistance or sensing voltage can be selected. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.		
	UPPER FAIL	Judgment method	UPPER FAIL results when a resistance greater than or equal to the Upper limit is detected or when a sensing voltage is detected. Judgment is not made during a contact check.
		Display	"Upper-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-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 or when a sensing voltage is detected.
		Display	"Lower-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Lower-FAIL signal is generated continuously until a STOP signal is received.
	PASS	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.
		Display	"PASS" is displayed.
		Buzzer	On (fixed to 50 ms)
		SIGNAL I/O	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.
Resistance judgment	Upper limit setting range	0.0001 Ω to 10.0000 Ω	
	Lower limit setting range	0.0000 Ω to 9.9999 Ω	
	Judgment accuracy	$\pm(2\%$ of setting + 3 m $\Omega)$	
Voltage judgment	Upper limit setting range	0.001 V to 5.000 V AC/DC	
	Lower limit setting range	0.000 V to 4.999 V AC/DC	
	Judgment accuracy	$\pm(2\%$ of setting + 0.05 V)	
Calibration	Calibrated using a pure resistive load (with the rms of a sine wave for AC)		
Contact check function	Checks that current flows through the test leads and then starts the test. (OFF setting available)		

Timer function

Item	Specifications
Current rise time settings range	0.1 s to 200.0 s
Current fall time setting time ¹	0.1 s to 200.0 s, OFF
Test time	0.1 s to 1000.0 s, OFF
Accuracy	$\pm(100\text{ ppm of setting} + 20\text{ ms})$ (excluding the fall time)

- ¹ This setting is used only when a PASS judgment occurs. During a DC test, the voltage may not drop all the way within the set time because of the electrostatic capacity inside the product and the EUT.

Partial discharge test section

Applicable models: **9301PD**

Output function

Item		Specifications
AC output section	Output range	0.050 kV to 5.000 kV
	Resolution	1 V
	Setting accuracy	±(1.2 % of setting + 0.02 kV) (at no load)
	Max. rated load	250 VA (5 kV/50 mA)
	Max. rated current	50 mA (when the output voltage is 0.2 kV or higher)
	Output voltage waveform ¹	Sine
	Distortion	2 % or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)
	Crest factor	$\sqrt{2} \pm 3 \%$ (800 V or higher)
	Frequency	50 Hz/60 Hz
	Accuracy	±0.1 %
	Voltage regulation	±3 % or less (when changing from maximum rated load to no load)
Output method	PWM switching	
Output voltage monitor function		If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.

- 1 If an AC voltage is applied to a capacitive load, the output voltage may rise higher than at no load depending on the load capacitance. Further, waveform distortions may occur if an EUT whose capacitance is dependent on voltage (for example, an EUT that consists of ceramic capacitors) is connected as the load. However, if the test voltage is 1.5 kV, the effect of a capacitance of 1 000 pF or less can be ignored. Because the product's high-voltage power supply uses the PWM switching method, if the test voltage is 500 V or less, the switching and spike noise proportions are large. The lower the test voltage, the greater the waveform is distorted.

Measurement function

Item	Specifications		
Voltmeter	Measurement range	0.00 kV to 7.50 kV AC/DC	
	Resolution	0.1 V	
	Accuracy	$\pm(1.2\% \text{ of reading} + 5 \text{ V})$	
	Response	Can be switched between true rms and peak-value response.	
	Hold function	The voltage measurement after a test is finished is held while the pass/fail judgment is displayed.	
Electric charge measurement	Electric charge measurement method	IEC60664-1 Edition 3.0 compliant	
	Measurement range	0 pC to 10000 pC	
	Measurement resolution	100 pC range	0.1 pC
		1000 pC range	0.1 pC
		10000 pC range	1 pC
	Accuracy ¹	100 pC range	$\pm(5\% \text{ of full scale} + 7 \text{ pC})$
		1000 pC range	$\pm(5\% \text{ of full scale})$
		10000 pC range	$\pm(5\% \text{ of full scale})$
	Measurement interval	Determined based on the measured values in each cycle of an applied voltage.	
	Hold function	The electric charge after a test is finished is held while the pass judgment is displayed.	
	Maximum electrostatic capacity of the EUT	10 nF	
	Peak hold function	Holds the maximum value during a measurement.	
	Filter function	A low-pass filter can be inserted into the electric charge measurement circuit.	
	Discharge inception voltage, discharge inception voltage measurement	Measures the voltage at which discharge exceeding a preset electric charge starts and the voltage at which discharge ceases (complies with IEC60664-1 third edition).	
	Calibration (Precalibration)	Calibrate using the built-in calibration capacitor (1000 pF).	
Pulse counting function		Counts the number of pulses that have passed through the high-pass filter and makes a FAIL judgment if the count exceeds the upper limit.	
	Upper limit setting range	1 to 100000	
BPF characteristics switching function		Can switch the characteristics of the band-pass filter in the electric charge measuring circuit	
	Center frequency	100 kHz / 160 kHz / 300 kHz	
Coupling capacitor		0.01 μF	

1 When Band Pass Filter is set to 160 kHz.

Judgment function

Item	Specifications	
Electric discharge judgment	The output is shut off when a judgment is made.	
Upper FAIL (Current)	Judgment method	A current higher than or equal to the upper limit is measured.
	Display	"Upper-FAIL (Current)" is displayed.
	Buzzer	On
	SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
Upper FAIL (Coulomb)	Judgment method	An electric charge greater than or equal to the upper limit is measured.
	Display	"Upper-FAIL (Coulomb)" is displayed.
	Buzzer	On
	SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
Upper FAIL (Pulse)	Judgment method	A discharge pulse count greater than or equal to the upper limit is measured.
	Display	"Upper-FAIL (Pulse)" is displayed.
	Buzzer	On
	SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
PASS	Judgment method	Upper-FAIL does not happen after the test time has elapsed.
	Display	"PASS" is displayed.
	Buzzer	On
	SIGNAL I/O	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 current limit	50 mA (with no calibration)	
Upper limit of electric charge (Upper Coulomb)	Setting range	1 pC to 10000 pC
	Accuracy	As per the accuracy of electric charge measurement
Pulse count judgment criteria (Upper Pulse Count) setting range	1 to 100000 (with no calibration)	

Timer function

Item	Specifications
Voltage rise time (Rise Time) setting range	0.1 s to 200.0 s
Voltage fall time (Fall Time) setting range ¹	0.1 s to 200.0 s, OFF
Test time setting range	0.1 s to 1000.0 s, OFF
Accuracy	±(100 ppm of setting + 20 ms) (excluding Fall Time)

1 This setting is used only when PASS judgment occurs.

Other specifications

Item	Specifications
Analog monitor ¹	Outputs a voltage signal according to the current waveform, voltage waveform, or electric discharge waveforms.
V	Voltage waveform: Scale 1 kV/1 V
Qpd	Electric discharge: Full scale of the scale measurement range/10 V
Ipd ²	Partial discharge current waveform

1 Monitor signal output is isolated from the chassis (earth).

2 The Ipd waveforms are the ones that can be obtained after the actual discharge waveforms have passed the TOS9301PD measurement filter. Therefore, the scale varies according to the frequency response of the discharge waveform.

Leakage current test section

Applicable model: **9303LC**

Measurement function

Item		Specifications	
Measurement Item	TC	Touch current measurement	
	Measurement mode	Uses a measurement circuit network representing the impedance of a human body and measures the voltage drop across a reference resistance to calculate the touch current.	
	Probe settings	Enc-Pe	A terminal: measurement terminal (for connecting to the enclosure of the EUT) B terminal: open
		Enc-Enc	A and B terminals: measurement terminal (for connecting to the enclosure of the EUT)
		Enc-Liv Enc-Neu	A terminal: measurement terminal (for connecting to the enclosure of the EUT) B terminal: open
	PCC	Protective conductor current measurement	
	Measurement method	Measures the voltage drop across a reference resistance inserted in the middle of the protective ground line to calculate the protective conductor current. The measurement impedance is 150 Ω .	
	Patient	Patient leakage current measurement	
	Measurement method	Uses a network conforming to IEC 60601 and measures the voltage drop across a reference resistance to calculate the patient leakage current.	
	Meter	Measures the current flowing or voltage applied across the A and B terminals (simultaneous measurement not possible).	
Measurement method	Current measurement	Uses a measurement circuit network representing the impedance of a human body and measures the voltage drop across a reference resistance to calculate the current flowing across the A and B terminals.	
	Voltage measurement	Measures the voltage applied across the A and B terminals.	
Current measurement mode	DC	Eliminates AC components and measures only the DC component.	
	RMS	Measures the true rms value (switch AC and AC+DC)	
	Peak ¹	Measures waveform peak values	

¹ Current measurements may not be stable due to the effects of the power supply line waveform or the wiring environment between the product and the EUT.

Measurement circuit network

Item		Specifications
Network	A (IEC 60990 compliant) ¹	(1.5 kΩ // 0.22 μF) + 500 Ω, reference measurement element: 500 Ω
	B (IEC 60990 compliant)	(1.5 kΩ // 0.22 μF) + 500 Ω // (10 kΩ + 22 nF), reference measurement element: 500 Ω, voltage measurement U1 and U3 switchable
	C (IEC 60990 compliant)	(1.5 kΩ // 0.22 μF) + 500 Ω // (10 kΩ + (20 kΩ + 6.2 nF) // 9.1 nF), reference measurement element: 500 Ω, voltage measurement U1 and U3 switchable
	D (Electrical Appliances and Materials Safety Act, etc.)	1 kΩ, reference measurement element: 1 kΩ
	E (Electrical Appliances and Materials Safety Act)	1 kΩ // (10 kΩ + 11.225 nF + 579 Ω), reference measurement element: 1 kΩ
	F (UL and the like)	1.5 kΩ // 0.15 μF, reference measurement element: 1.5 kΩ
	G	2 kΩ, reference measurement element: 2 kΩ
	H (IEC 61010-1, 60601-1wet)	375 Ω // 0.22 μF + 500 Ω, reference measurement element: 500 Ω
	I (Patient)	1 kΩ // 10 kΩ + 0.015 μF, reference measurement element: 1 kΩ
	J (through)	For voltmeter calibration
	PCC-1	150 Ω, reference measurement element: 150 Ω
	PCC-2 (IEC 60598-1)	150 Ω // 1.5 μF, reference measurement element: 150 Ω
Network constant tolerance		Resistance: ±0.1 %, capacitor 0.15 μF: ±2 %, others: ±1 %
Network accuracy	A, B, C, H	Input voltage vs. output voltage ratio: logical value ± 5 % (according to IEC 60990 Annex L and F)
	E	Input voltage vs. output voltage ratio: logical value ± 5 %
	D, G	Reference measurement element (resistance) ± 1 %
	I	Input voltage vs. output voltage ratio: logical value ± 5 %

¹ Current measurements may not be stable due to the effects of the power supply line waveform or the wiring environment between the product and the EUT.

Measurement section

Item		Specifications		
Measurement range ¹ , resolution	Range1	Network A, B, C, H	DC, RMS: 1.00 μ A to 60.00 μ A, Peak: 1.00 μ A to 85.00 μ A	
		Network D, E, I	DC, RMS: 1.00 μ A to 30.00 μ A, Peak: 1.00 μ A to 42.40 μ A	
		Network F	DC, RMS: 1.00 μ A to 20.00 μ A, Peak: 1.00 μ A to 28.20 μ A	
		Network G	DC, RMS: 1.00 μ A to 15.00 μ A, Peak: 1.00 μ A to 21.20 μ A	
		Network PCC-1, PCC-2	DC, RMS: 1.00 μ A to 200.00 μ A, Peak: 1.00 μ A to 282.00 μ A	
	Range2	Network A, B, C, H	DC, RMS: 50.0 μ A to 600.0 μ A, Peak: 70.0 μ A to 850.0 μ A	
		Network D, E, I	DC, RMS: 25.00 μ A to 300.00 μ A, Peak: 35.00 μ A to 424.00 μ A	
		Network F	DC, RMS: 16.60 μ A to 200.00 μ A, Peak: 23.30 μ A to 282.00 μ A	
		Network G	DC, RMS: 12.50 μ A to 150.00 μ A, Peak: 17.50 μ A to 212.00 μ A	
		Network PCC-1, PCC-2	DC, RMS: 166.0 μ A to 2000.0 μ A, Peak: 233.0 μ A to 2830.0 μ A	
	Range3	Network A, B, C, H	DC, RMS: 0.500 mA to 6.000 mA, Peak: 0.700 mA to 8.500 mA	
		Network D, E, I	DC, RMS: 250.0 μ A to 3000.0 μ A, Peak: 350.0 μ A to 4500.0 μ A	
		Network F	DC, RMS: 166.0 μ A to 2000.0 μ A, Peak: 233.0 μ A to 3000.0 μ A	
		Network G	DC, RMS: 125.0 μ A to 1500.0 μ A, Peak: 175.0 μ A to 2250.0 μ A	
		Network PCC-1, PCC-2	DC, RMS: 1.660 mA to 20.000 mA, Peak: 2.330 mA to 28.300 mA	
	Range4	Network A, B, C, H	DC, RMS: 5.00 mA to 60.00 mA, Peak: 7.00 mA to 85.00 mA	
		Network D, E, I	DC, RMS: 2.500 mA to 30.000 mA, Peak: 3.500 mA to 45.000 mA	
		Network F	DC, RMS: 1.660 mA to 20.000 mA, Peak: 2.330 mA to 30.000 mA	
		Network G	DC, RMS: 1.250 mA to 15.000 mA, Peak: 1.750 mA to 22.500 mA	
		Network PCC-1, PCC-2	DC, RMS: 16.60 mA to 100.00 mA, Peak: 23.30 mA to 100.00 mA	
	Range switching		Auto or Fix selectable. If a measurement falls outside the measurement range of each range, an error is displayed as a warning in the measurement value display area.	
			Auto	The range is set automatically according to the measurements.
			Fix	For TC, PCC and Patient measurements, the measurement range is selected automatically according to the UPPER value. For meter measurements, the range is fixed to the specified range.
	Bandwidth switching		Can be expanded to a bandwidth that allows measurements from 0.1 Hz, which is required in the measurement of medical instruments and the like.	
			Normal	Normal measurement bandwidth: 15 Hz to 1 MHz
			Expand	Expands the measurement range to 0.1 Hz to 1 MHz

Item		Specifications		
Voltmeter accuracy ²	Range1	DC	±(2.0 % of reading + 1 mV)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 1 mV)
			15 Hz ≤ f ≤ 100 kHz	±(2.0 % of reading + 1 mV)
			100 kHz < f ≤ 1 MHz	±(5.0 % of reading + 1 mV)
		Peak	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 1 mV)
			15 Hz ≤ f ≤ 1 kHz	±(5.0 % of reading + 1 mV)
			1 kHz < f ≤ 100 kHz	±(5.0 % of reading + 1 mV)
			100 kHz < f ≤ 1 MHz	±(15.0 % of reading + 1 mV)
	Range2	DC	±(2.0 % of reading + 5 mV)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 5 mV)
			15 Hz ≤ f ≤ 100 kHz	±(2.0 % of reading + 4 mV)
			100 kHz < f ≤ 1 MHz	±(5.0 % of reading + 5 mV)
		Peak	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 5 mV)
			15 Hz ≤ f ≤ 1 kHz	±(5.0 % of reading + 5 mV)
			1 kHz < f ≤ 100 kHz	±(5.0 % of reading + 5 mV)
			100 kHz < f ≤ 1 MHz	±(15.0 % of reading + 5 mV)
	Range3	DC	±(2.0 % of reading + 25 mV)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 10 mV)
			15 Hz ≤ f ≤ 100 kHz	±(2.0 % of reading + 10 mV)
			100 kHz < f ≤ 1 MHz	±(5.0 % of reading + 10 mV)
		Peak	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 25 mV)
			15 Hz ≤ f ≤ 1 kHz	±(2.0 % of reading + 25 mV)
			1 kHz < f ≤ 100 kHz	±(5.0 % of reading + 25 mV)
			100 kHz < f ≤ 1 MHz	±(15.0 % of reading + 25 mV)
	Range4	DC	±(2.0 % of reading + 0.25 V)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 0.1 V)
			15 Hz ≤ f ≤ 100 kHz	±(2.0 % of reading + 0.1 V)
			100 kHz < f ≤ 1 MHz	±(5.0 % of reading + 0.1 V)
Peak		0.1 Hz ≤ f < 15 Hz	±(5.0 % of reading + 0.25 V)	
		15 Hz ≤ f ≤ 1 kHz	±(2.0 % of reading + 0.25 V)	
		1 kHz < f ≤ 100 kHz	±(5.0 % of reading + 0.25 V)	
		100 kHz < f ≤ 1 MHz	±(15.0 % of reading + 0.25 V)	

Item			Specifications	
Total accuracy ³ (when network A, B, or C is used) ⁴	Range1	DC	±(5.0 % of reading + 2 µA)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 2 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 2 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 2 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 1 kHz	±(10.0 % of reading + 10 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 10 µA)
	100 kHz < f ≤ 1 MHz		±(20.0 % of reading + 10 µA)	
	Range2	DC	±(5.0 % of reading + 20 µA)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 8 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 10 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 1 kHz	±(10.0 % of reading + 10 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 10 µA)
	100 kHz < f ≤ 1 MHz		±(20.0 % of reading + 10 µA)	
	Range3	DC	±(5.0 % of reading + 50 µA)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 20 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 20 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 20 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 50 µA)
			15 Hz ≤ f ≤ 1 kHz	±(7.0 % of reading + 50 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 50 µA)
	100 kHz < f ≤ 1 MHz		±(20.0 % of reading + 50 µA)	
	Range4	DC	±(5.0 % of reading + 0.5 mA)	
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 0.2 mA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 0.2 mA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 0.2 mA)
Peak		0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 0.5 mA)	
		15 Hz ≤ f ≤ 1 kHz	±(7.0 % of reading + 0.5 mA)	
		1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 0.5 mA)	
	100 kHz < f ≤ 1 MHz	±(20.0 % of reading + 0.5 mA)		
Input resistance			1 MΩ ± 1 %	
Input capacitance			200 pF or less (internal voltmeter input capacitance: 100 pF or less)	
Common mode rejection ratio			10 kHz or less: 60 dB or more, 10 kHz to 1 MHz: 40 dB or more	
Offset cancel function			Cancels up to 10 mA of the unnecessary current from measurements. OFF function available.	

- 1 Voltmeter band expansion is possible when network I is selected.
- 2 When zero adjustment has been performed using the offset function. In current measurements, especially when the measurement mode is set to Peak or when network A is selected, current measurements may not be stable due to the effects of the power supply line waveform or the wiring environment between the product and the EUT.
- 3 0.1 Hz ≤ f < 15 Hz is for when voltmeter band expansion (VoltMeter BandWidth) is set to Expand. Requires at least 120 second of test time.
- 4 A value converted to current for measurements using Network A, B, C or H with voltmeter accuracy of this product as the reference. If a network other than A, B, C or H is used, calculate as follows:
For Network D, E, or I, the ■ part of ±(□ % of reading + ■ A) is half the value.
For F, the ■ part is one-third the value.
For G, the ■ part is one-fourth the value.
For PCC-1 or PCC-2, the ■ part is 3.3 times the value.

Judgment function

Item		Specifications	
Behavior based on judgment		Judgment starts after the judgment delay (Judge Delay). Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.	
Upper Setting range	UPPER FAIL	Judgment method	UPPER FAIL results when a current greater than or equal to the upper limit (Upper) is detected.
		Display	"Upper-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
	LOWER FAIL	Judgment method	LOWER FAIL results when a current less than or equal to the lower limit (Lower) is detected.
		Display	"Lower-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Lower-FAIL signal is generated continuously until a STOP signal is received.
	PASS	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.
		Display	"PASS" is displayed.
		Buzzer	On (fixed to 50 ms)
		SIGNAL I/O	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 Setting range	RANGE 1	Network A, B, C, H	DC, RMS: 0.1 μ A to 60 μ A, Peak: 0.1 μ A to 85 μ A
		Network D, E, I	DC, RMS: 0.1 μ A to 30 μ A, Peak: 0.1 μ A to 42.4 μ A
		Network F	DC, RMS: 0.1 μ A to 20 μ A, Peak: 0.1 μ A to 28.2 μ A
		Network G	DC, RMS: 0.1 μ A to 15 μ A, Peak: 0.1 μ A to 21.2 μ A
		Network PCC-1, PCC-2	DC, RMS: 0.1 μ A to 200 μ A, Peak: 0.1 μ A to 282 μ A
	RANGE 2	Network A, B, C, H	DC, RMS: 61 μ A to 600 μ A, Peak: 86 μ A to 850 μ A
		Network D, E, I	DC, RMS: 31 μ A to 300 μ A, Peak: 42.5 μ A to 424 μ A
		Network F	DC, RMS: 20.1 μ A to 200 μ A, Peak: 28.3 μ A to 282 μ A
		Network G	DC, RMS: 15.1 μ A to 150 μ A, Peak: 21.3 μ A to 212 μ A
		Network PCC-1, PCC-2	DC, RMS: 201 μ A to 2.00 mA, Peak: 283 μ A to 2.83 mA
	RANGE 3	Network A, B, C, H	DC, RMS: 601 μ A to 6.00 mA, Peak: 851 μ A to 8.50 mA
		Network D, E, I	DC, RMS: 301 μ A to 3.00 mA, Peak: 425 μ A to 4.50 mA
		Network F	DC, RMS: 201 μ A to 2.00 mA, Peak: 283 μ A to 3.00 mA
		Network G	DC, RMS: 151 μ A to 1.50 mA, Peak: 213 μ A to 2.12 mA
		Network PCC-1, PCC-2	DC, RMS: 2.01 mA to 20.00 mA, Peak: 2.84 mA to 28.3 mA
	RANGE 4	Network A, B, C, H	DC, RMS: 6.01 mA to 60.0 mA, Peak: 4.21 mA to 85.0 mA
		Network D, E, I	DC, RMS: 3.01 mA to 30.0 mA, Peak: 8.51 mA to 45.0 mA
		Network F	DC, RMS: 2.01 mA to 20.0 mA, Peak: 3.01 mA to 30.0 mA
		Network G	DC, RMS: 1.51 mA to 15.0 mA, Peak: 2.13 mA to 22.5 mA
		Network PCC-1, PCC-2	DC, RMS: 20.1 mA to 100 mA, Peak: 28.4 mA to 100 mA
Lower Setting range		A value that is -1 digit from the upper setting range.	
Judgment accuracy		Conforms to total accuracy (p.303). (Read "reading" as "setting" of total accuracy.)	

Timer function

Item		Specifications
Judgment delay (Judge Delay)	Setting range	1.0 s to 1000.0 s, OFF
	Accuracy	$\pm(100 \text{ ppm of setting} + 20 \text{ ms})$
Test time	Setting range	1.0 s to 1000.0 s, OFF
	Accuracy	$\pm(100 \text{ ppm of setting} + 20 \text{ ms})$

Other specifications

Item		Specifications	
Voltage conversion		Displays the estimated current converted with the preset supply voltage (Conv Voltage), based on the voltage supplied to the EUT and the measured current. (This is invalid in meter mode.)	
		Setting range	80.0 V to 300.0 V, OFF
		Resolution	0.1 V
Power supply line polarity selection		Set the polarity of the power supply line to supply to the EUT to positive or negative.	
Single fault mode (Condition) selection		Set the EUT single fault mode to normal, neutral line disconnection (Fault Neu), or protective ground wire disconnection (Fault PE).	
Ground check		In the touch current test between the enclosure and power supply line, if the EUT enclosure is grounded, Contact-FAIL occurs.	
Measurement check		Checks the measurement function by shorting across the A and B terminals. If an error is found, the protection function is activated.	
Supply voltage measurement AC LINE (EUT)	Measurement range	80.0 V to 250.0 V	
	Resolution	0.01 V	
	Accuracy	$\pm(3 \% \text{ of reading} + 1 \text{ V})$	
Supply current measurement AC LINE (EUT)	Measurement range	0.1 A to 15.00 A	
	Resolution	0.001 A	
	Accuracy	$\pm(5 \% \text{ of reading} + 30 \text{ mA})$	
Power measurement (active power)	Measurement range	10 W to 1500 W	
	Accuracy	$\pm(5 \% \text{ of reading} + 8 \text{ W})$ (with the supply voltage at 80 V or more, at a load power factor of 1)	
Voltage measurement across the A and B terminals	Measurement range	DC	10.00 V to 300.0 V
		RMS	10.00 V to 300.0 V
		Peak	15.00 V to 430.0 V
	Input impedance		Approx. 40 M Ω
	Accuracy ¹		$\pm(3 \% \text{ of reading} + 2 \text{ V})$ (measurement range fixed to AUTO)
	SELV detection		Set a voltage for detecting SELV. When the value is exceeded, the DANGER LED lights.
		Setting range	10.0 V to 99.9 V, OFF
	Resolution	0.1 V	

Item			Specifications
Measurement terminal	Rated voltage	Between the A and B terminals	250 V
		Between the terminals and chassis	250 V
	Rated current:		100 mA
	Measurement category		CAT-II
	Valid terminal display		Terminals valid for measurement are indicated on the display.
	110% terminal		A terminal for supplying the voltage applied to the AC LINE IN inlet.
Power supply for the EUT	Nominal voltage range		100 V to 240 V, 50 Hz/60 Hz
	Input voltage range (allowable voltage range)		85 Vac to 250 Vac
	Rated output capacity		1500 VA
	Maximum operating current		15 A (Overcurrent protection is activated at approximately 15.7 A.)
	Inrush current		70 Apeak max. (within 20 ms)

1 If voltage is measured with the A and B terminals open, measurements will be easily affected by induced voltage.

Interface

Item			Specifications
REMOTE			MINI DIN 9-pin connector. Connect the following option to remotely control the starting and stopping of tests. <ul style="list-style-type: none"> • Remote control box RC01-TOS, RC02-TOS • High voltage test probe HP01A-TOS, HP02A-TOS (when the test voltage is 4 kVac 5 kVdc or less)
SIGNAL I/O			D-sub 37-pin connector. For the pin arrangement, see p.235 .
Function	Function		Enable/disable interlock, recall setup memories, recall auto test programs, start/stop testing, monitor the test and voltage generation status, monitor the test status, monitor judgment results, monitor the step execution status of auto tests, monitor the activation status of protection functions
	Input specifications		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)	
STATUS OUT			Output terminal of an option product.
	Positive terminal (red)	Outputs +24 V. Use Status Out of CONFIG settings to set the output conditions.	
	Negative terminal (black)	+24 V circuit common.	

Item		Specifications
SCANNER		MINI DIN 8-pin connector. Terminal for the optional TOS9320 high voltage scanner. The maximum number of connections is 4 devices (16 channels).
USB (host)		Standard type A socket, FAT32, 32 GB or less Complies with the USB 2.0 specifications; data rate: 480 Mbps (high speed)
Remote control		All functions except turning on and off the power, key lock, and auto test can be remotely controlled.
RS232C	Hardware	D-sub 9-pin connector (EIA-232D compliant) Baudrate: 9600, 19200, 38400, 57600, 115200 bps Data length: 8 bits; stop bits: 1 bit; parity bit: none, flow control: none/CTS-RTS
	Message terminator	LF during reception, LF during transmission.
USB (device)	Hardware	Standard Type B connector Complies with the USB 2.0 specifications; data rate: 480 Mbps (high speed)
	Message terminator	LF or EOM during reception, LF + EOM during transmission.
	Device class	Complies with the USBTMC-USB488 device class specifications.
LAN	Hardware	IEEE 802,3 100Base-TX/10Base-T Ethernet Auto-MDIX compliant. IPv4, RJ-45 connector.
	Compliant standards	LXI 1.5 Core Specification 2011
	Communication protocol	VXI-11, HiSLIP, SCPI-RAW, SCPI-Telnet
	Message terminator	VXI-11, HiSLIP: LF or END during reception, LF + END during transmission. SCPI-RAW: LF during reception, LF during transmission.
Display		7-inch LCD

Other functions

Item	Specifications	
Auto test	Auto execution by combining ACW, DCW, IR, and EC. For LC, a combination is possible only using TC, PCC, and Patient.	
Test condition memory	Setup memory	Up to 51 test conditions (ACW, DCW, IR, EC, PD, LC) can be saved.
	Program (except LC tests)	Up to 100 program (ACW, DCW, IR, EC, PD) combinations, each containing 100 steps, can be saved.
	Program (LC tests only)	Up to 100 program (TC, PCC, Patient) combinations, each containing 100 steps, can be saved.
	Program memory (except LC tests)	Up to 25 program (ACW, DCW, IR, EC, PD) combinations, each containing 100 steps, can be saved.
	Program memory (LC tests only)	Up to 24 program (TC, PCC, Patient) combinations, each containing 100 steps, can be saved.
Test result memory	Records up to 1000 latest test result of independent tests and auto tests. These are cleared when the power is turned off. Test results can be saved in CSV format to a USB memory device.	
System clock		For recording the calibration time and test times
	Recordable time	Up to year 2038
	Calibration period setting	Displays a warning at power-on when the specified period passes. Select whether to activate a protection function or only display a warning in the display area when a warning occurs.
Measurement display		Maximum and minimum measurements can be displayed.
	Normal	Displays measurements during a test. Maximum and minimum values are not held.
	Maximum and minimum value display	Displays the maximum current measurement for withstanding voltage (ACW/DCW) tests, the minimum resistance measurement for insulation resistance (IR) tests, the resistance measurement or voltage measurement for earth continuity (EC) tests.
Test start method	Double Action	When you press STOP, "READY" is shown for 0.5 seconds. A test starts only when you press START within this period.
	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.
PASS judgment display time (Pass Hold)	Set the time to hold the pass judgment result display (0.05 s to 10.00 s) or hold it until STOP is pressed (Infinity).	
STOP signal disable (Fail Mode)	It is possible to set the instrument so that fail judgment results and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector or REMOTE connector.	
Key lock	Lock the operation of the keys to prevent changing the settings or overwriting memory or programs by mistake.	

Item	Specifications
Protection functions	<p>If a protection function is activated during a test, the output is shut off and the test is stopped immediately.</p> <p>In an LC test, the power supply to the EUT is stopped, and the A and B terminals are opened.</p> <p>Conditions that cause a protection function to be activated are as follows.</p>
Interlock	Interlock is activated.
Power Supply	There is an error in the power supply section.
Output Error	<p>An output voltage outside of the following range is detected.</p> <p>ACW, DCW, IR test, PD test: $\pm(10\%$ of setting + 50 V)</p> <p>EC test: $\pm(10\%$ of setting + 2 A)</p>
Over Load	<p>An output power or output current outside of the following range is detected.</p> <p>ACW: 550 VA, DCW: 110 W or 50 mA,</p> <p>IR (7200 V test): 110 W or 25 mA, IR (-1000 V test): 2 mA,</p> <p>EC: 240 VA, LC: AC LINE OUT current at approx. 15.7 A or power at 1600 VA.</p>
Over Heat	The internal temperature of the product is abnormally high.
Over Rating	During a withstanding voltage test, an output current is generated for a length of time that exceeds the output time limit (p. 82).
Cal	The preset calibration period is exceeded.
Remote	The REMOTE connector is connected or disconnected.
Signal I/O	There is a change in the SIGNAL I/O connector's ENABLE signal.
Communication	An internal communication error is occurring.
Over Range	A value exceeding the maximum value of the measurement range is detected.
Measure	An error is detected in the LC test measurement check.
Short	A relay operation error is detected in an LC test.
Earth Fault	When the grounding mode (GND) is set to Guard, abnormal current flows from the high voltage output of this product to ground.
Scan I/F	While scanning, the interface cable is disconnected. Or, the channel-assigned scanner is not detected.

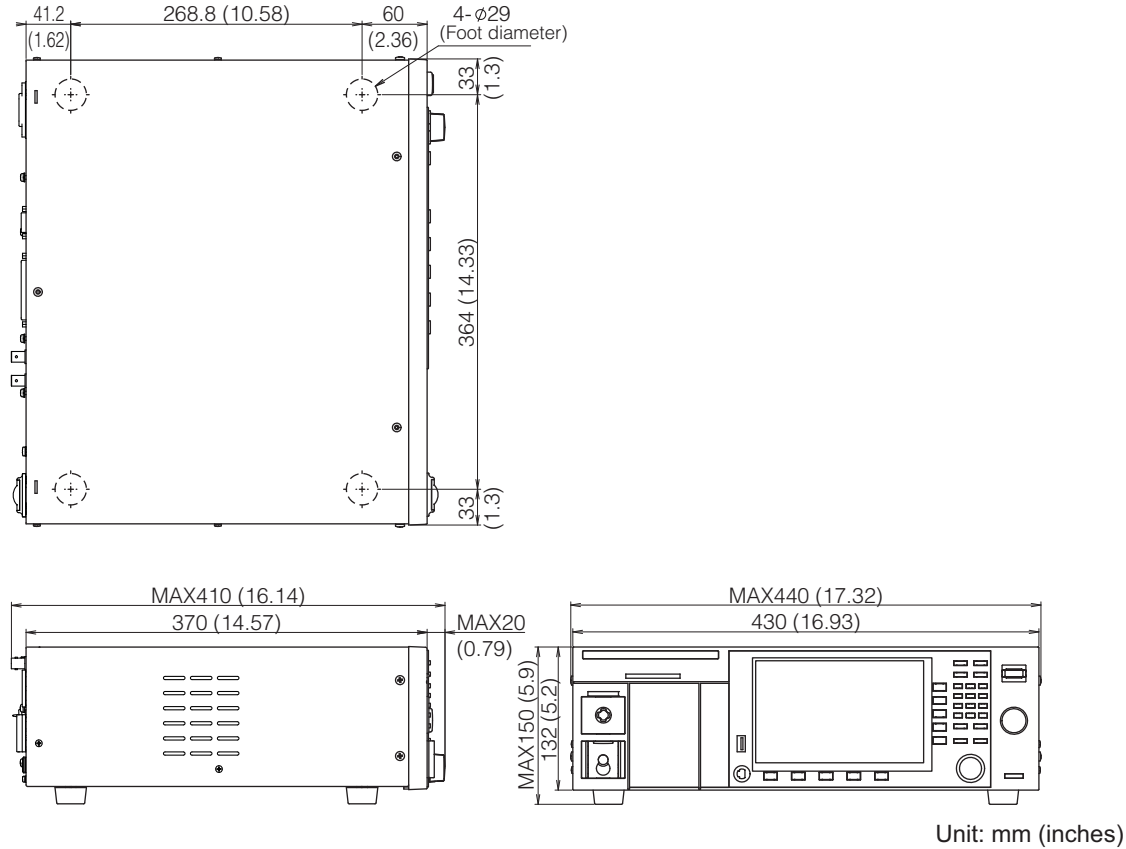
General specifications

Item	Specifications		
Backup battery life	3 years (at 25 °C)		
Environment	Installation location		
	Spec guaranteed range	Temperature	5 °C to 35 °C (41 °F to 95 °F) (18°C to 28°C for partial discharge tests)
		Humidity	20 %rh to 80 %rh (20%rh to 70%rh for partial discharge tests) (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	-20 °C to 70 °C (-4 °F to 158 °F)
Humidity		90 %rh or less (no condensation)	
Power supply	Nominal voltage range (allowable voltage range)		
	Power consumption	No load (READY state)	100 VA or less
		Rated load	800 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, 20 mA or less	
Earth continuity		25 Aac, 0.1 Ω or less	
Dimensions		See p.311 .	
Weight		TOS9300: Approx. 17 kg (37.5 lb.), TOS9301: Approx. 18 kg (39.7 lb.), TOS9301PD: 22 kg (48.5 lb.), TOS9302: Approx. 20 kg (44.1 lb.), TOS9303: Approx. 21 kg (46.3 lb.), TOS9303LC: Approx. 22 kg (48.5 lb.)	
Accessories		See p.4 .	
Electromagnetic compatibility ^{1 2}		Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1 (Class A ³) EN 55011 (Class A ³ , Group 1 ⁴) EN 61000-3-2 EN 61000-3-3 Applicable under the following conditions The maximum length of all cabling and wiring connected to the product must be less than 2.5 m. Shielded cables are being used when using the SIGNAL I/O. The high-voltage test lead TL31-TOS is in use. Electrical discharges are applied only to the EUT.	
Safety ^{*1}		Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU ^{*2} EN 61010-1 (Class I ⁵ , Pollution Degree 2 ⁶)	

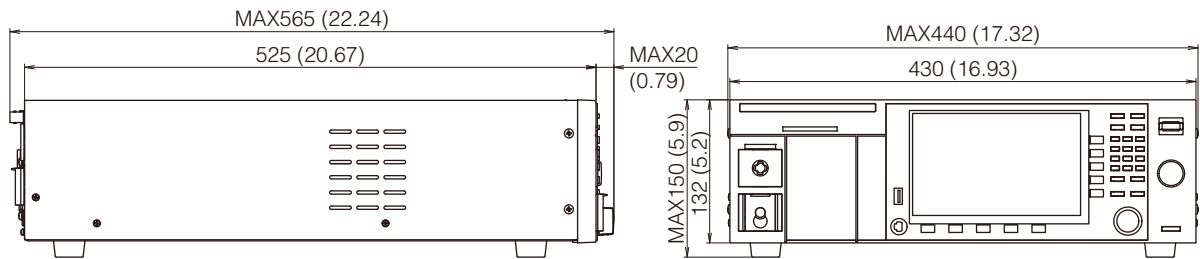
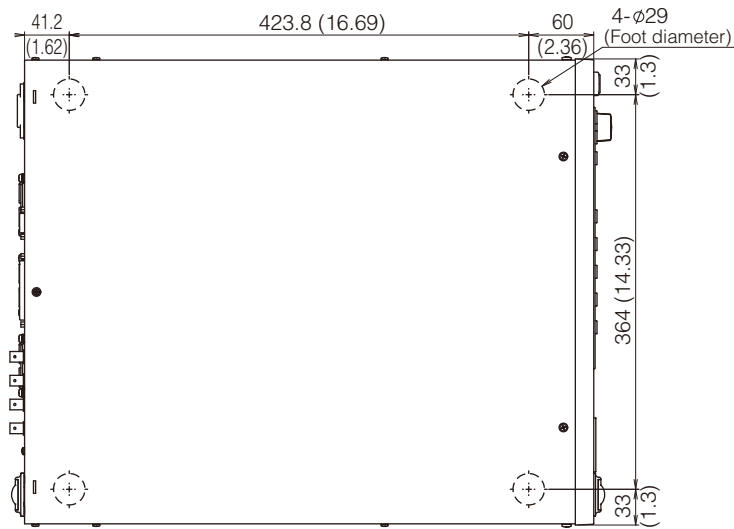
- 1 Does not apply to specially ordered or modified products.
- 2 Only on models that have CE/UKCA marking on the panel.
- 3 This is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
- 4 This 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.
- 5 This 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.
- 6 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.

External dimensions

TOS9300, TOS9301

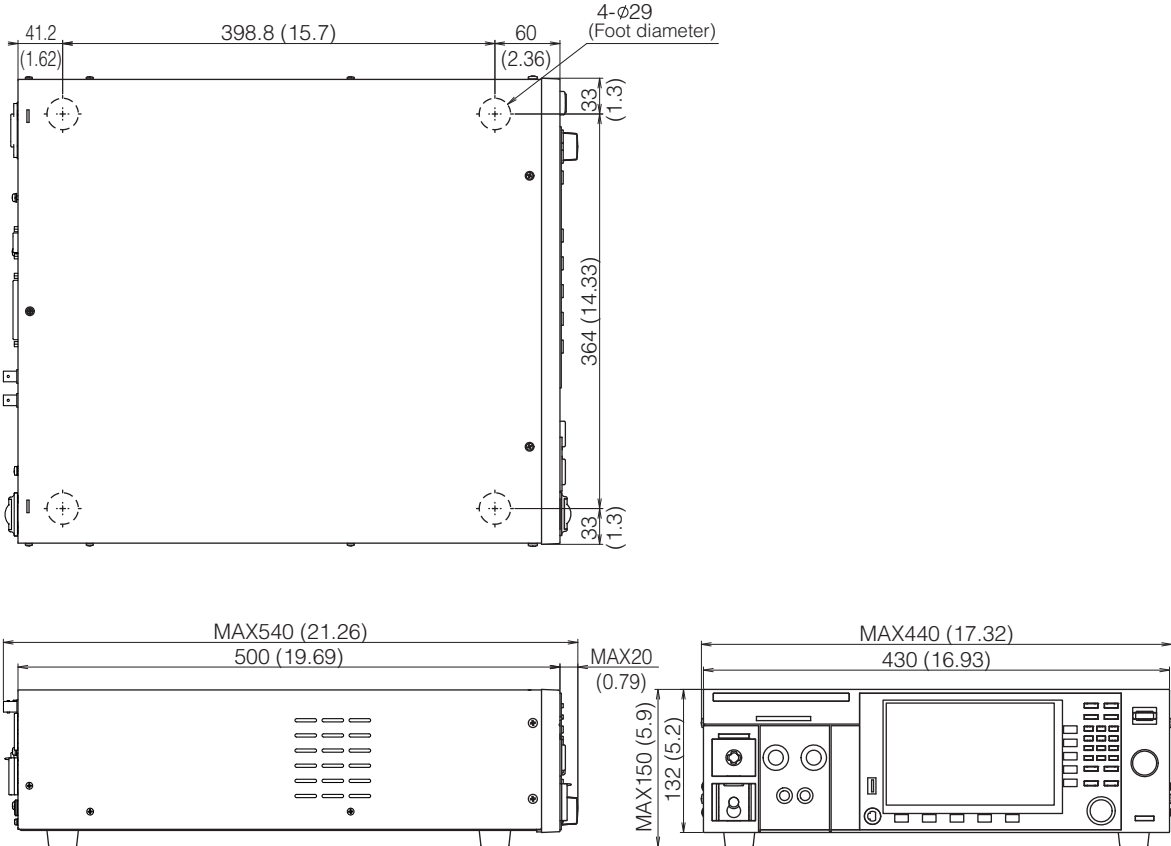


TOS9301PD



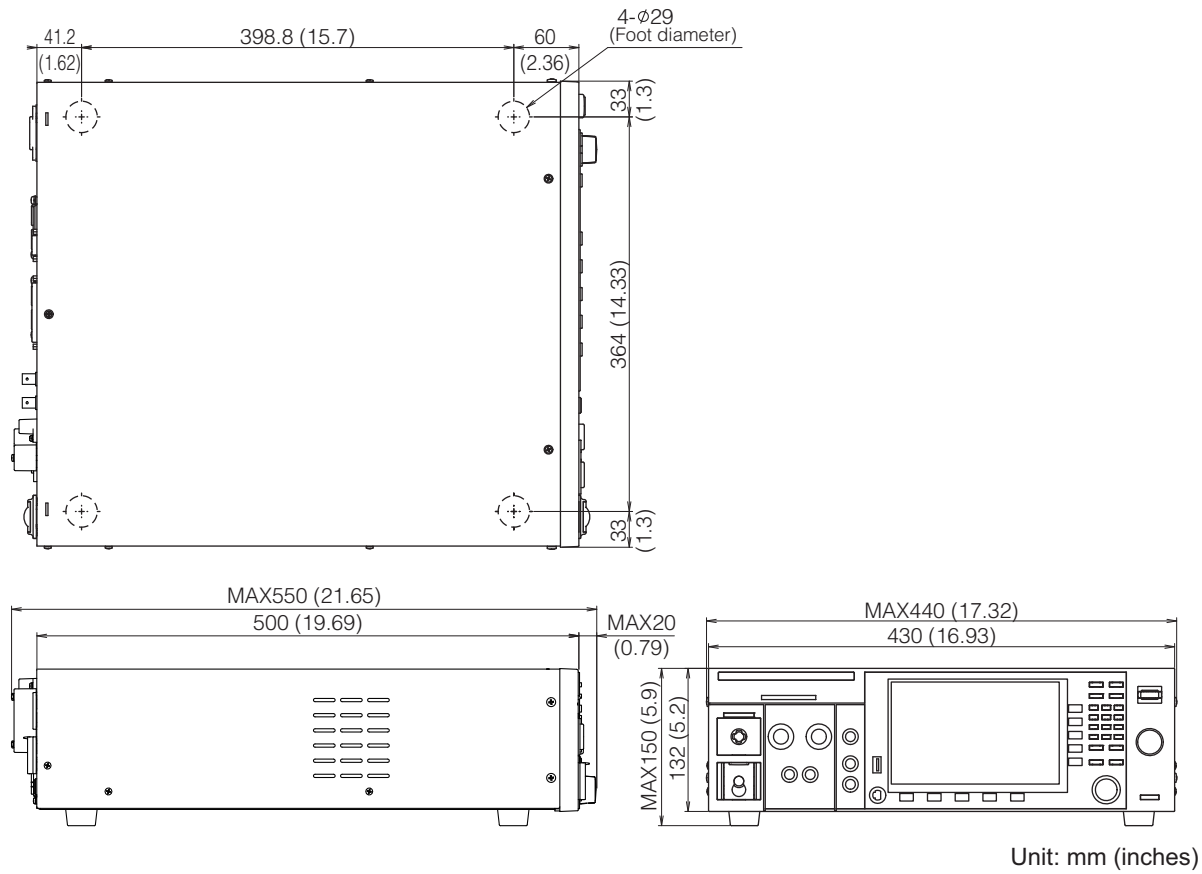
Unit: mm (inches)

TOS9302, TOS9303



Unit: mm (inches)

TOS9303LC



Appendix

Default Settings and Reset Settings

Factory default settings are indicated in the following tables. All items that have the check mark in the "Reset" column are returned to their factory default values upon reset.

Withstanding voltage (ACW/DCW), insulation resistance (IR) test conditions

Applicable models for AC withstanding voltage (ACW): All models

Applicable models for DC withstanding voltage (DCW): 9301, 9301PD, 9303, 9303LC

Applicable models for insulation resistance (IR): 9300, 9301, 9301PD, 9303, 9303LC

AC W	DC W	IR	Parameter	Factory default	Reset
✓	✓	✓	Test voltage	0 V	✓
✓	✓	✓	Limit voltage	ACW: 5500 V DCW: 7500 V IR: 1020 V	✓
✓	✓	–	Start/End Voltage	50 %	✓
✓	✓	–	Start Volt State	OFF	✓
✓	✓	–	End Volt State	OFF	✓
–	–	✓	Start voltage	OFF	✓
✓	–	–	Frequency	50 Hz	✓
✓	✓	✓	Upper limit	ACW/ DCW: 0.01 mA IR: OFF	✓
✓	✓	✓	Lower limit	ACW/ DCW: OFF IR: 0.001 GΩ	✓
–	✓	✓	Auto setting of the judgment delay (Delay Auto)	OFF (Judge Delay: 0.1 s)	✓
✓	✓	✓	Test time	0.2 s	✓
✓	✓	✓	Voltage rise time	0.1 s	✓
✓	✓	–	Voltage fall time	OFF	✓
–	✓	✓	Discharge time	0.0 s	✓
–	✓	✓	Discharge when interlock is activated (Discharge Interlock)	ON	✓
✓	✓	–	Current detection response speed (Filter)	LPF, Slow	✓
✓	✓	✓	Grounding mode (GND)	Low	✓
✓	–	–	Current measurement mode (Current RMS)	TrueRMS	✓
✓	✓	–	Voltage measurement mode (Volt Measure)	ACW: RMS DCW: Average	✓
✓	✓	✓	Peak value display (Display Peakhold)	OFF	✓
–	–	✓	Using the low-pass filter	OFF	✓
✓	–	–	Offset (Offset Real, Offset Imag)	OFF	✓
–	✓	✓	Offset	OFF	✓
✓	✓	✓	Scanner setting	All open	✓

Earth continuity (EC) test conditions

Applicable models: **9302**, **9303**, **9303LC**

AC	DC	Parameter	Factory default	Reset
✓	✓	Test current	3.0 A	✓
✓	✓	Limit current	42.0 A	✓
✓	–	Frequency	50 Hz	✓
✓	✓	Upper limit	0.1000 Ω	✓
✓	✓	Lower limit	OFF	✓
✓	✓	Test time	0.2 s	✓
✓	✓	Current rise time	0.1 s	✓
✓	✓	Current fall time	OFF	✓
✓	✓	Terminal wiring method (Terminals Wire)	4Wire	✓
✓	✓	Contact check	OFF	✓
✓	✓	Peak value display (Display Peakhold)	OFF	✓
✓	✓	Offset	OFF	✓

Partial discharge (PD) test conditions

Applicable models: **9301PD**

Parameter	Factory default	Reset
Test voltage (Test Voltage/2nd Test Voltage)	0 V	✓
Limit voltage	5500 V	✓
Step Voltage	0 V	✓
Voltage Pattern	Ramp	✓
Frequency	50 Hz	✓
Upper limit of electric charge (Upper Coulomb)	10000 pC	✓
Reference upper limit of discharge count (Upper Pulse Count)	1	✓
Threshold for discharge (Pulse Count Threshold)	25 %	✓
Test time (Test Time/2nd Test Time)	1.0 s	✓
Step time	1.0 s	✓
Voltage rise time (Rise Time)	1.0 s	✓
Voltage fall time (Fall Time/2nd Fall Time)	1.0 s	✓
Measurement range (Range)	10000 pC	✓
Electric charge for detecting discharge inception voltage (Inception Voltage)	1000 pC	✓
Electric charge for detecting discharge extinction voltage (Extinction Voltage)	1000 pC	✓
Band Pass Filter	160 kHz	✓
Low-pass filter	OFF	✓
Voltage Measure	RMS	✓
Electric charge peak value display (Display Peakhold)	OFF	✓
Electric charge calibration (Precalibration)	Every	✓
Graph scale setting (Graph Scale)	Fix	✓

Parameter	Factory default	Reset
Display of discharge inception voltage/discharge extinction voltage (Inc/Ext-Volt Marker)	ON	✓
Graph axis setting (Graph Format)	Q-t	✓

Leakage current (LC) test conditions

Applicable models: **9303LC**

Parameter	Factory default	Reset	
Touch current (TC)	Network	A	✓
	Polarity of the power supply line	Normal	✓
	Single fault mode (Condition)	Normal	✓
	Probe connection destination	Enc-PE	✓
	Output from the 110% terminal (110% OUT)	OFF	✓
	Upper limit	0.1000 mA	✓
	Lower limit	OFF	✓
	Judgment delay (Judge Delay)	OFF	✓
	Test time	1 s	✓
	Measurement range	Auto	✓
	Measurement mode (Measure Mode)	RMS(AC+DC)	✓
	Voltmeter band expansion (VoltMeter BandWidth)	Normal	✓
	Peak value display (Display Peakhold)	OFF	✓
	Offset	OFF	✓
	Voltage conversion (Conv Voltage)	OFF	✓
	Checking the EUT operation (Line OUT)	OFF	✓
Protective conductor current (PCC)	Network	PCC-1	✓
	Polarity of the power supply line	Normal	✓
	Single fault mode (Condition)	Normal	✓
	Upper limit	0.1000 mA	✓
	Lower limit	OFF	✓
	Judgment delay (Judge Delay)	OFF	✓
	Test time	1 s	✓
	Measurement range	Auto	✓
	Measurement mode (Measure Mode)	RMS(AC+DC)	✓
	Voltmeter band expansion (VoltMeter BandWidth)	Normal	✓
	Peak value display (Display Peakhold)	OFF	✓
	Offset	OFF	✓
	Voltage conversion (Conv Voltage)	OFF	✓
	Checking the EUT operation (Line OUT)	OFF	✓

Parameter		Factory default	Reset
Patient leakage current (Patient)	Network	I (fixed)	✓
	Polarity of the power supply line	Normal	✓
	Single fault mode (Condition)	Normal	✓
	Probe connection destination	Pt-PE	✓
	Output from the 110% terminal (110% OUT)	OFF	✓
	Upper limit	0.1000 mA	✓
	Lower limit	OFF	✓
	Judgment delay (Judge Delay)	OFF	✓
	Test time	1 s	✓
	Measurement range	Auto	✓
	Measurement mode (Measure Mode)	RMS(AC+DC)	✓
	Voltmeter band expansion (VoltMeter BandWidth)	Normal	✓
	Peak value display (Display Peakhold)	OFF	✓
	Offset	OFF	✓
	Voltage conversion (Conv Voltage)	OFF	✓
Checking the EUT operation (Line OUT)	OFF	✓	
Meter mode (Meter)	Network	A	✓
	Measuring across terminals A and B (A-B Terminal)	Network	✓
	SELV setting	30.0 V	✓
	Measurement range	Auto	✓
	Measurement mode (Measure Mode)	RMS(AC+DC)	✓
	Offset	OFF	✓
	Output from the 110% terminal (110% OUT)	OFF	✓
	Polarity of the 110% output	Normal	✓

Auto test (AUTO) settings

Parameter	Factory default	Reset
Registered programs	None	–
Program selection	No selection	✓

Memory function

Parameter	Factory default	Reset
Setup memory	Empty memory	–
Test result	None	✓

CONFIG settings

Parameter	Factory default	Reset
Power On	Resume	–
Watch Dog	Disable	–
Delay	60 s	–
Screen Saver	Disable	–
Delay	60 s	–
Key	–	–
Lock Level	High	–
Calibration	–	–
DUE	12 months	–
Protection Keep	Disable	–
Beeper	–	–
Key	Enable	–
Protection	Enable	–
SCPI Error	Enable	–
Volume Pass	3	–
Volume Fail	5	–
Fail Mode	Disable	–
Double Action	Disable	–
Start Long	Disable	–
Momentary	Disable	–
Pass Hold	0.2 s	–
Status Output	–	–
Upper Fail	Disable	–
Lower Fail	Disable	–
H.V ON	Disable	–
Pass	Disable	–
Power ON	Disable	–
Protection	Disable	–
Ready	Disable	–
Test	Disable	–
Signal I/O	–	–
Step END Judgment	Disable	–

Interface settings

Parameter	Factory default	Reset
IP Address	–	–
Method	Automatic	✓
IP Address	–	–
Subnet Mask	–	–
Default Gateway	–	–
DNS Server	–	–
DNS Server 1	0.0.0.0	–
DNS Server 2	0.0.0.0	–
WINS Server	–	–
WINS Server 1	0.0.0.0	–
WINS Server 2	0.0.0.0	–
Host name & Services	–	–
Desired Hostname	Model name and serial number	–
Desired Description	KIKUSUI XXXX Electrical Safety Analyzer (XXXX is the model name) and serial number	–
Dynamic DNS	Enable	✓
mDNS	Enable	✓
NetBIOS Over TCP/IP	Enable	✓
Auto Clock Adjustment	–	–
NTP Server Hostname	ntp.nict.jp	–
Auto Adjustment	Enable	–
RS232C Settings	–	–
Baudrate	19200	–
Data Bits	8	–
Stop Bits	1	–
Flow Control	None	–

Stray Capacitance of AC Withstanding Voltage Tests

During AC withstanding voltage tests, current also flows in the stray capacitance of items such as the test leads and tools. The following table shows a summary of the current running through the stray capacitance due to the output voltage.

Measurement environment	Output voltage				
	1 kV	2 kV	3 kV	4 kV	5 kV
When a lead wire 350 mm long is hung in air (typical value)	2 μ A	4 μ A	6 μ A	8 μ A	10 μ A
When the supplied lead wire TL31-TOS is used (typical value)	16 μ A	32 μ A	48 μ A	64 μ A	80 μ A
Per high voltage scanner (typical value, excluding the test lead)	22 μ A	44 μ A	66 μ A	88 μ A	110 μ A

Particularly when performing high-sensitivity, high-accuracy measurement or when using the optional high voltage scanner (p. 330), the effects of current running through the stray capacitance must be removed by referring to the following methods.

- If you set the grounding mode (GND) to low, add the current running through the stray capacitance to the upper and lower limits, or use the offset function.
- Set the grounding mode (GND) to Guard.

WARNING

- If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current.
- If you set GND to Guard, do not connect measuring instruments that are grounded at one end (e.g., Kikusui 149-10A High Voltage Digital Voltmeter, TOS1200 Current Calibrator) to this product. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current.

Timing Charts

Typical examples of timing charts are provided below.

Contact check operation

■ Setting conditions

Model: TOS9301 (connect a high voltage scanner)

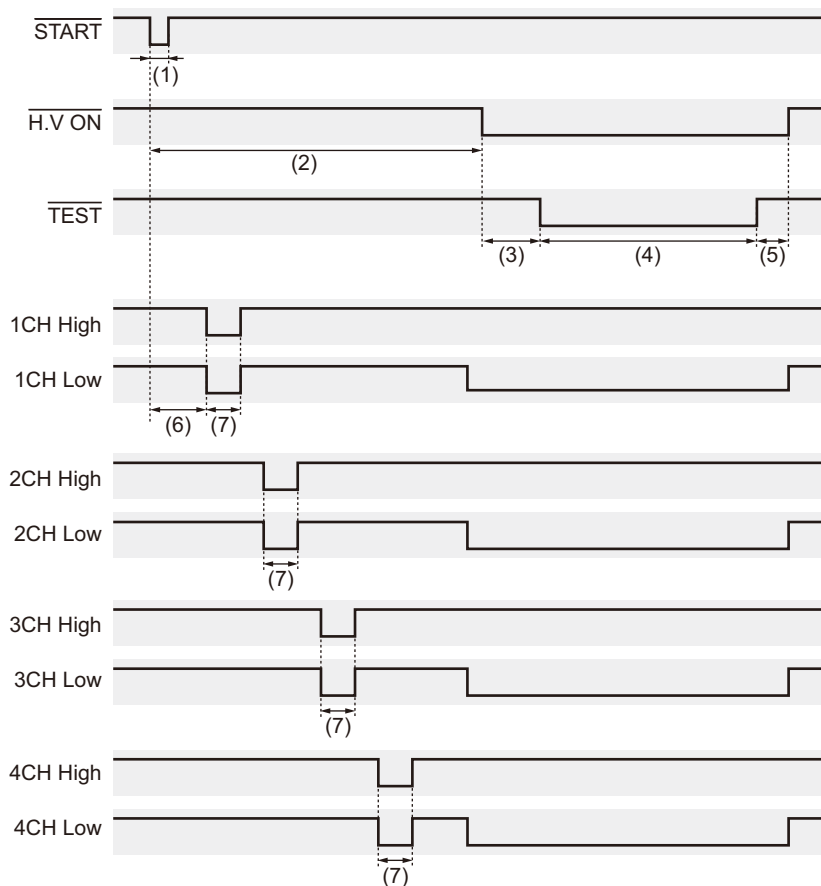
Contact Check: ON

CH1 to CH4 of the scanner: Low

Rise Time: ON

Test Time: ON

Start the test with the SIGNAL I/O



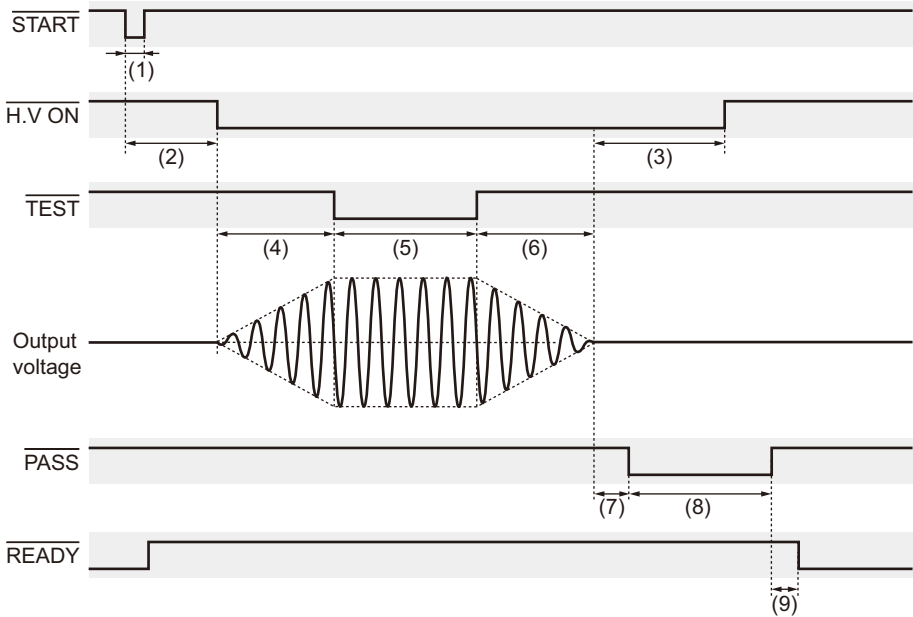
No.	Description
(1)	5 ms min.
(2)	Approx. 180 ms ¹
(3)	Rise Time
(4)	Test Time
1	TYP (typical value)

No.	Description
(5)	Varies depending on the EUT
(6)	Approx. 50 ms ^{*1}
(7)	Approx. 30 ms ^{*1}

ACW test (PASS judgment)

■ Setting conditions

Model: TOS9301
 Rise Time: ON
 Test Time: ON
 Fall Time: ON
 Pass Hold: 50 ms
 No load (waveform monitoring with a high voltage probe), start the test with the SIGNAL I/O.



No.	Description
(1)	5 ms min.
(2)	Approx. 20 ms ¹
(3)	Approx. 30 ms ^{*1}
(4)	Rise Time
(5)	Test Time

No.	Description
(6)	Fall Time
(7)	Approx. 5 ms ^{*1}
(8)	Pass Hold
(9)	Approx. 2 ms ^{*1}

1 TYP (typical value)

ACW test (FAIL judgment)

■ Setting conditions

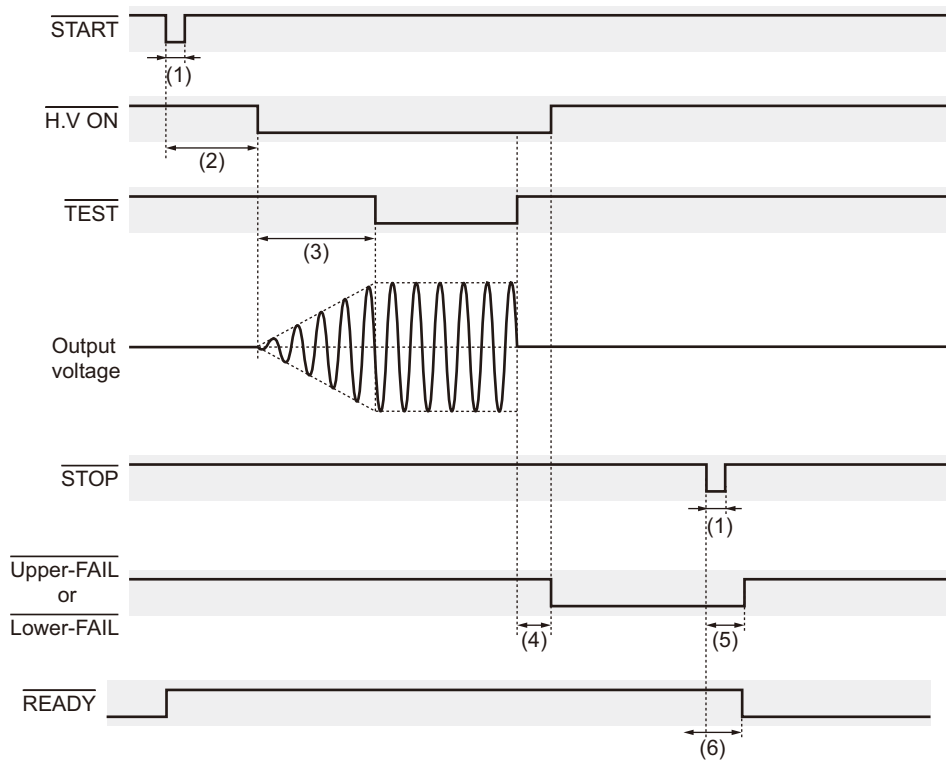
Model: TOS9301

Rise Time: ON

Test Time: OFF

Pass Hold: 50 ms

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



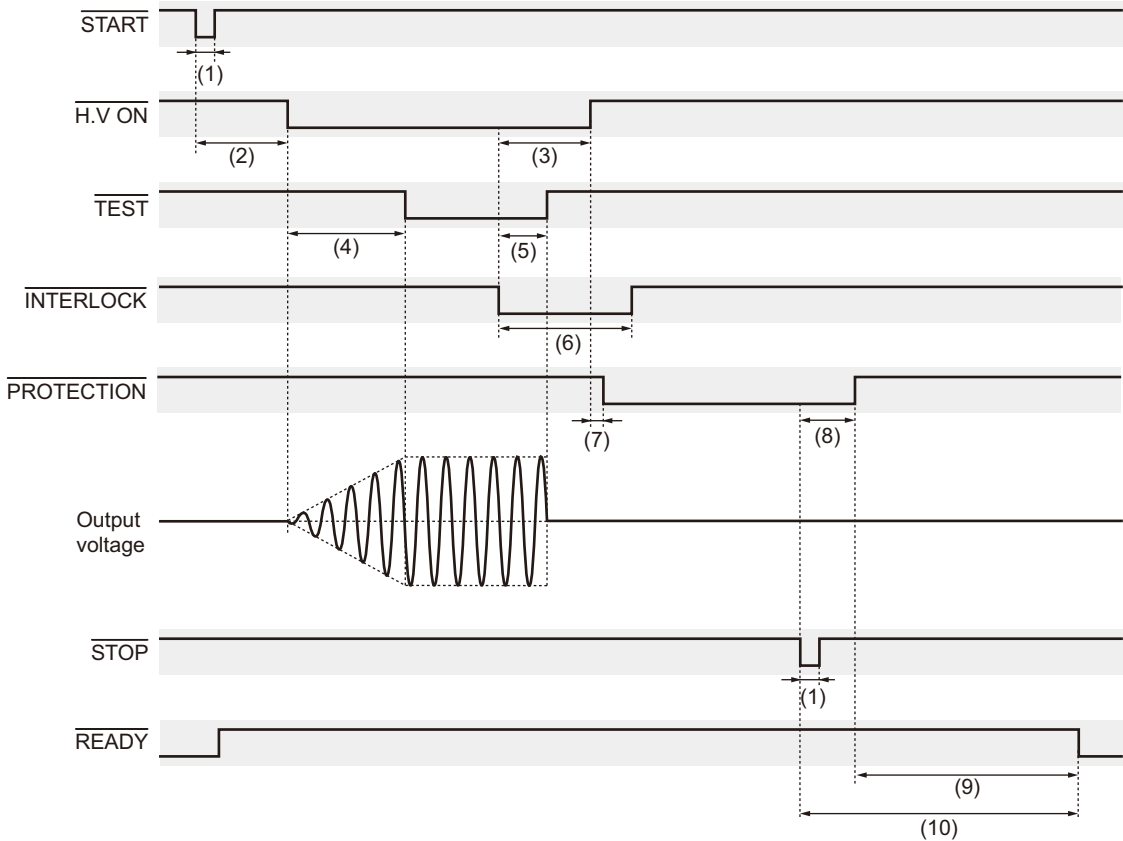
No.	Description
(1)	5 ms min.
(2)	Approx. 20 ms ¹
(3)	Rise Time
1	TYP (typical value)

No.	Description
(4)	Approx. 5 ms ^{*1}
(5)	Approx. 5 ms ^{*1}
(6)	Approx. 6 ms ^{*1}

ACW test (interlock)

■ Setting conditions

Model: TOS9301
 Rise Time: ON
 Test Time: OFF
 No load (waveform monitoring with a high voltage probe), start the test with the SIGNAL I/O. Abort test with an interlock operation.



No.	Description
(1)	5 ms min.
(2)	Approx. 20 ms ¹
(3)	Approx. 20 ms ¹
(4)	Rise Time
(5)	Approx. 10 ms ¹

No.	Description
(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)

Example of partial discharge test

Applicable model: **9301PD**

This section explains how to perform tests in conformity with EN50178.

Calculating the setting

Before the test, calculate the test voltage to apply to the EUT, the electric charge for detecting the discharge extinction voltage, and the limit voltage.

■ Rated voltage of the partial discharge test

When the EUT is in a steady-state condition, measure the maximum repeating peak voltage of the two isolated circuits using an oscilloscope or the like. The sum of the maximum repeating peak voltages is the rated voltage.

■ Discharge extinction voltage limit

Calculate as follows.

$$V_e = V_t \times 1.25 \div \sqrt{2} \approx V_t \times 0.884 \text{ Vrms}$$

V_e : Discharge extinction voltage limit

V_t : Rated voltage of the partial discharge test

■ Maximum application voltage

Calculate as follows.

$$V_{\max} = V_r \times 1.875 \div \sqrt{2} \approx V_r \times 1.326 \text{ Vrms}$$

V_{\max} : Maximum application voltage

V_r : Rated isolation voltage of the EUT

Performing a pre-test inspection

Partial discharge tests according to the EN50178 require the entire test environment to be inspected before testing.

NOTE

In EN50178, this inspection is described as “calibration,” but this document will refer to it as “inspection.” This is because this inspection can be confused with the periodic calibration of the instrument or the electric charge calibration performed before testing.

1

Check that the environment is not too far off from 23 °C and 50 % humidity.

EN50178 recommends that tests be performed in this environment.

2 Obtain a capacitor with the same level of impedance as the EUT and that does not produce partial discharge at the maximum test voltage.

If you cannot obtain this capacitor, use an EUT that does not produce partial discharge. If the appropriate EUT cannot be obtained, do not use any EUT.

3 Use the capacitor you obtained as the EUT, and perform an electric charge calibration .

If you are not using an EUT, leave the test leads open.

For details on electric charge calibration, see "Precalibration" (p.127).

4 After electric charge calibration, set the following test conditions.

For the procedure to set test conditions, see "Set test conditions" (p.108).

Test condition	Setting
Test Voltage	The voltage determined in "Maximum application voltage" (p.326).
Voltage Pattern	Ramp
Frequency	50 Hz
Upper Coulomb	50 pC (≤ 100.0 pC)
Upper Pulse Count	OFF
Test Time	2 s
Rise Time	10 s
Fall Time	10 s
2nd Test Time	OFF
Range	100 pC
Inception Voltage	10 pC (≤ 100.0 pC)
Extinction Voltage	10 pC (≤ 100.0 pC)

5 Press START.

The test starts.

6 As a result of the test, check that the maximum partial discharge electric charge is no more than 5 pC.

If a pass judgment is made, the inspection is complete.

NOTE If "PASS" is not displayed, check the following, and perform the test again.

- If there is dust or stain on the EUT, clean it.
- If the TOS9301PD is not grounded, connect it properly.
- If the temperature and humidity are off from 23 °C and 50 % by great amounts, regulate the environment using air conditioners and the like.
- If there are noise sources nearby, remove them.
- If there are noise sources in the same power supply line, take measures such as removing them or changing to another power supply line.
- After taking the measures above, repeat the test several times.

Performing tests

After pre-test inspection, perform the test by following the procedure below.

1 Set the following test conditions.

For the procedure to set test conditions, see "Set test conditions" (p.108).

Test condition	Setting
Test Voltage	0 V
Limit Voltage	The voltage determined in "Maximum application voltage" (p.326).
Voltage Pattern	RISE
Frequency	50 Hz
Upper Coulomb	OFF
Upper Pulse Count	OFF
Test Time	OFF
Rise Time	0.1 s
Fall Time	OFF
Range	100 pC
Inc/Ext-Volt Marker	ON
Inception Voltage	10 pC (≤ 100.0 pC)
Extinction Voltage	10 pC (≤ 100.0 pC)

2 Press START.

The test starts.

3 Press Test Level.

4 Use the rotary knob to gradually increase the voltage from 0 V.

5 When the partial discharge electric charge exceeds 10 pC while the voltage is being increased, stop increasing the voltage, and read the voltage on the display.

This voltage is the start voltage. If the voltage exceeds the maximum application voltage and a protection function is activated before the electric charge exceeds 10 pC, the test is successful.

6 Start increasing the voltage again. Increase the voltage to 10 % higher than the start voltage.

7 Then, gradually decrease the voltage down to 0 V.

8 After finishing the test, press MEMORY > Result to check the discharge extinction voltage.

The Extinction Voltage column in the test result list indicates discharge extinction voltage. If the extinction voltage is Discharge extinction voltage limit (p.326) or more, the test is successful.

Performing an alternative test

The test complying with EN50178 is inefficient because it must be performed manually. Here, we propose an alternative test method. This method makes the criteria for passing more stringent, but for EUTs with more than enough insulation performance, the test time can be reduced.

1 Estimate the start voltage by using a method described in “Performing tests” (p.328) or the like.

2 Set the following test conditions.

For the procedure to set test conditions, see “Set test conditions” (p.108).

Test condition	Setting
Test Voltage	Estimated start voltage × 1.15
Limit Voltage	The voltage determined in “Maximum application voltage” (p.326).
Voltage Pattern	Ramp
Frequency	50 Hz
Upper Coulomb	OFF
Upper Pulse Count	OFF
Test Time	2 s
Rise Time	10 s
Fall Time	10 s
Range	100 pC
Inception Voltage	10 pC (≤ 100.0 pC)
Extinction Voltage	10 pC (≤ 100.0 pC)

3 Press START.

The test starts.

4 After the test is complete, check that the discharge inception voltage is no more than 90 % of the voltage applied during the test.

If the discharge inception voltage exceeds 90 % of the applied voltage, increase Test Voltage in the test conditions by about 5 %, and perform the test again.

If step 4 is confirmed, and the judgment result is pass, the test is successful.

Options

This product has the following options.
For information about options, contact your Kikusui agent or distributor.

- High voltage scanner (TOS9320)
- Remote control box (RC01-TOS/RC02-TOS)
- DIN adapter cable (DD-5P/9P)
- High voltage test probe (HP01A-TOS/HP02A-TOS)
- Warning light unit (PL02-TOS)
- Multi-outlet (OT01-TOS)
- Brackets (KRB3-TOS/KRB150-TOS)

High voltage scanner

The TOS9320 high voltage scanner distributes the test voltage from this product to up to 16 channels of test points in a ACW, DCW, or IR test. This saves power when testing electric/electronic devices and components that have multiple test points and enables highly reliable tests.

- A single high voltage scanner expands an output to four channels. Each channel can be set to an electric potential of your choice (high, low, or open), and any of the four test points can be tested.
- Up to four high voltage scanners (16 channels) can be connected to a single TOS93.
- The output of each channel and the contact between each test point can be verified.

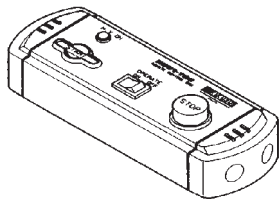
NOTE

High voltage scanners cannot be used in PD tests.

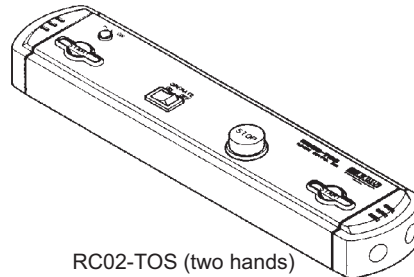


Remote control box

The RC01-TOS/RC02-TOS remote control box can be used to remotely control the starting and stopping of ACW, DCW, or IR tests. One model is for use with one hand, and the other model is for use with two hands. A DIN adapter cable (p.331) is required to connect to the TOS93.



RC01-TOS (one hand)

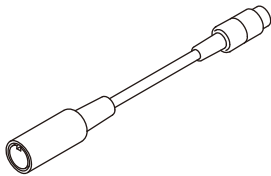


RC02-TOS (two hands)

DIN adapter cable

The DD-5P/9P DIN adapter cable (5 pin to 9 pin) is for connecting the following option products to the TOS93.

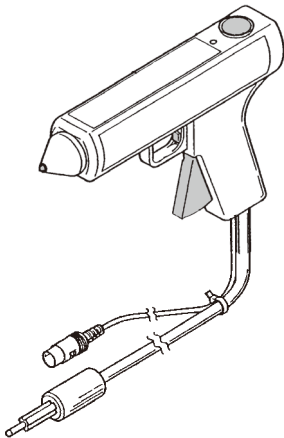
- Remote control box(RC01-TOS/RC02-TOS)
- High voltage test probe(HP01A-TOS/HP02A-TOS)



High voltage test probe

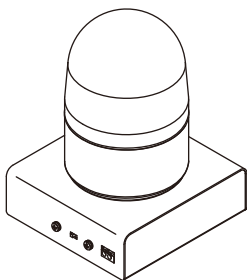
The HP01A-TOS/HP02A-TOS high voltage test probe is for outputting test voltages in ACW and DCW tests. The probe has to be operated with both hands to output the test voltage. This prevents the test voltage from being output inadvertently. A DIN adapter cable ([p.331](#)) is required to connect to the TOS93.

⚠ WARNING The maximum rated voltages of the HP01A-TOS/HP02A-TOS are 4 kVac and 5 kVdc. For safety reasons, set the product's limit voltage ([p.56](#)) to limit the applied voltage.



Warning light unit

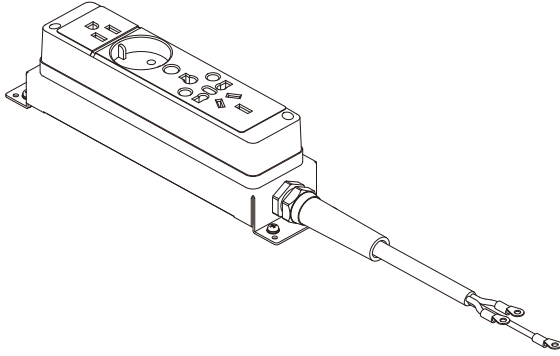
The PL02-TOS warning light unit indicates that a test is in progress or other statuses. You can view the status from a distance.



Multi-outlet

Applicable model: **9303LC**

The OT01-TOS multi-outlet when connected to the AC LINE OUT terminal block for the EUT power supply enables connection to major plugs used around the world.



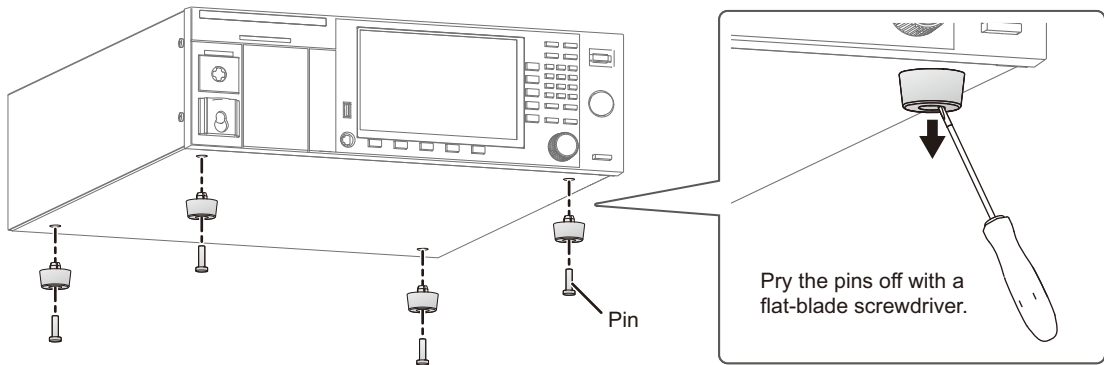
Brackets

Brackets are rack mounting options. There are two types of brackets: EIA standard and JIS standard.

- KRB3-TOS: EIA inch rack Standard
- KRB150-TOS: JIS millimeter rack standard

Removing the feet

We recommend that you keep all pieces that you remove from the product. You will need these pieces if you remove the product from the rack.

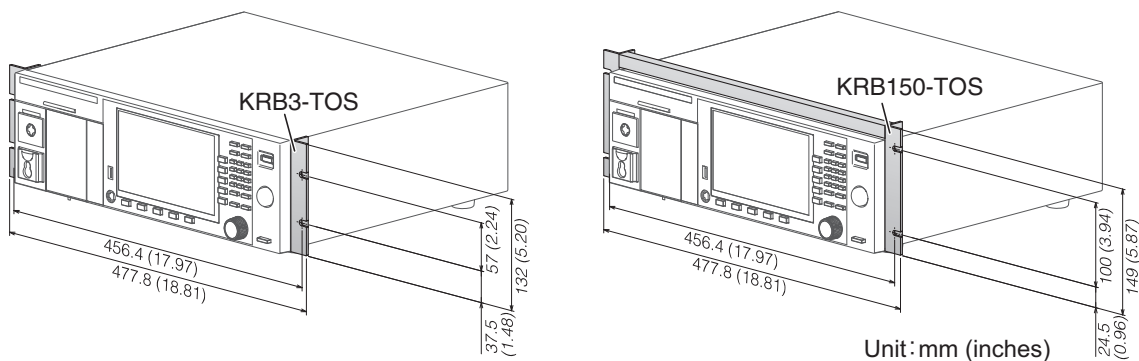


- 1** Pry off the pins holding the legs (four locations) with a flat-blade screwdriver.
- 2** Remove the legs (four locations).
This completes the removal.

Attaching the rack adapter or bracket.

NOTE When mounting the product on a rack, be sure to use support angles (auxiliary brackets) to safely support the product.

For information on rack mounting, see the operation manual of the relevant bracket.



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.275](#)). 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	See
The product does not operate when the POWER switch is turned on.	The power cord is disconnected.	Check the power cord connection.	p.25
	Interlock is activated.	Release the interlock.	p.239
	(TOS9303LC only) The power cord for the TOS9303LC is connected to the AC LINE IN inlet for supplying power to the EUT.	Connect the power cord to the AC INPUT inlet.	p.25
(TOS9303LC only) Power is not supplied to the EUT.	The power input fuse for the EUT is blown.	Replace the fuse.	p.283
	Power is not supplied to the AC LINE IN inlet for the EUT.	Connect the power cord for the EUT to the AC LINE IN inlet, and supply power.	p.41

■ Unable to control from the panel.

Symptom	Check	Remedy	See
Front panel key operations are not accepted.	 is displayed in the upper right of the display.	The keys are locked. Hold down KEY LOCK to release the key lock.	p.262
	"REMOTE" is shown in the display.	The product is being controlled remotely. Press LOCAL to control the product from the front panel.	–
The product does not switch to local mode even when I press the LOCAL key.	A local lockout (LLO) remote control command was sent.	Use a communication command to clear LLO command.	Interface Manual

■ Unable to start a test

Symptom	Possible cause	Remedy	See
"PASS," "Upper-FAIL," or "Lower-FAIL" is displayed.	A judgment result is displayed.	Press STOP to clear the judgment result.	–
"PROTECTION" is displayed.	A protection function is activated.	Clear the protection mode.	p.23
"Contact-FAIL" is displayed.	When a scanner was connected with Contact Check set to on, a bad test lead connection was detected.	Connect the test leads properly.	p.29
	(TOS9303LC only) The test leads are grounded when the touch current (TC) test condition Probe is set to Enc-Liv or Enc-Neu.	When Probe is set to Enc-Liv or Enc-Neu, connect the test leads to a location on the EUT that is not grounded.	p.139
"Calibration-FAIL" is displayed.	(TOS9301PD only) A partial discharge test started despite the precalibration that has been unperformed or failed.	Perform precalibration.	p.127
Testing does not begin when the START switch is pressed.	A test lead is connected to the REMOTE connector.	Remove the test lead, or press the START switch on the test lead.	–
	If  or  appears in the upper right of the display, Double Action or Start Long in set to on in the CONFIG settings.	Start the test properly, or set Double Action and Start Long to off.	p.266
	A STOP signal is applied to SIGNAL I/O.	Turn off the STOP signal.	p.242
	The SIGNAL I/O ENABLE signal is set to low level.	Set the ENABLE signal to high level.	p.242
	(TOS9303LC only) In an LC test, Line OUT is set to on.	Set Line OUT to off.	p.282

■ Unable to measure

Symptom	Possible cause	Remedy	See
The measured values are abnormal.	The test leads are connected to the wrong terminals.	Connect the test leads properly.	–
	(TOS9303LC only) A wrong measurement circuit network is being used.	Use the correct measurement circuit network as specified by the standard to make the measurement.	–
	(TOS9303LC only) Voltage conversion (Conv Voltage) is set to on.	Turn off Conv Voltage when measuring the voltage supplied to the EUT.	–
	(TOS9303LC only) Unstable data when the EUT is starting is being measured.	Set the judgment delay (Judge Delay) to an appropriate value.	–
Test data for pass judgments cannot be saved.	The pass judgment result display is cleared immediately.	Set the Pass Hold time to an appropriate value.	p.267
Judgments do not begin.	Judgment delay (Judge Delay) is set.	Judgment begins after the Judge Delay elapses. Set Judge Delay to an appropriate value.	–
Testing does not finish.	The test timer is set to off.	The test continues until the STOP switch is pressed. Turn the test timer on, and set an appropriate timer value.	–

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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.

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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