

User's Manual

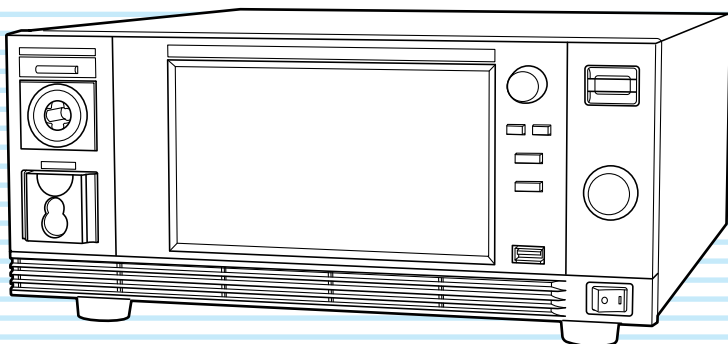
Electrical Safety Tester

TOS54 Series

TOS5401

TOS5402

TOS5403



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.

Contents **3**

General Description **7**

Component Names **11**

Safety Precautions for Testing **15**

Preparation **21**

Basic Operation **31**

Withstanding Voltage Test **37**

Insulation Resistance Test **62**

Measurement Function **79**

Auto Test **83**

External Control **101**

Memory Function **115**

System Settings **124**

Maintenance **154**

Specifications **159**

Appendix **173**

Testing is not possible upon opening the package

When you first turn on the series 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. 106](#)).

When you actually perform tests, design a system that uses the interlock for safety ([p. 107](#)).

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 Start Guide close to the TOS54 series product so that the operators can read it 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 receive an electric shock if 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.

Contents

General Description

About Manuals	7
Disposal.....	7
Open Source Software	7
Accessories	8
Product Overview	8
Notations Used in This Manual.....	9
Safety Precautions	9
Notes on Usage.....	10

Component Names

Front Panel.....	11
Rear Panel	12
Status Display Icons	13

Safety Precautions for Testing

Lighting of the DANGER LED.....	15
Checking Connector Covers.....	15
Test Precautions	16
Pre-test precautions	16
Testing precautions	16
Precautions when setting test conditions	17
Precautions after Output Has Been Turned Off.....	17
Estimated discharge time	17
Remote Control Precautions	17
Malfunction Precautions	18
Dangerous malfunctions.....	18
Emergency measures.....	18
Protection Functions.....	19

Preparation

Connecting the Power Cord	21
Checking Whether the Power Is On or Off	22

Checking the interlock operation	22
Turning the power on	23
Turning the power off	24
Setting the Date/Time and Calibration Date.....	25
Setting date	25
Setting the calibration date.....	26
Setting the calibration period.....	27
Connecting to the EUT	28
Connecting the test leads.....	28

Basic Operation

Operating Touch Panel Display	31
Touch operation	31
Mouse operation.....	31
Return to the Previous Page	32
Function and Home Screens.....	32
Entry Operation	33
Entering numbers.....	33
Entering characters	34
Entering date.....	34
Selecting the Test Mode	35
Selecting the test mode.....	35
Test Start Operation	36
Using the START switch	36
Using the SIGNAL I/O connector	36
Using optional products.....	36

Withstanding Voltage Test

Setting Test Conditions	37
Displaying the Setup Screen	37
Description of test conditions	38
Test voltage.....	39
Limit voltage	39
Start voltage	40
Frequency	41
Phase shift.....	42
Upper limit (Upper).....	43
Lower limit (Lower).....	44

Judgment delay (Judge Delay)	45
Test time	46
Test cycle	47
Voltage rise time (Rise Time)	48
Voltage fall time (Fall Time)	49
Discharge time	50
Discharge when interlock is activated (Dis- charge Interlock)	51
Voltage measure	52
Current measurement mode (Current Measure)	53
Discharge detection	54
Test time unit (Time Unit)	55
Starting a Test	56
Output time limit	56
Starting a test	57
Operation after a test starts	58
Changing the test voltage during a test	59
Finishing the Test and Viewing the Judgment.	60
Stopping tests	60
Conditions that cause a test to end	60
Judgment types and operation	61
Clearing the judgment result	61

Insulation Resistance Test

Setting Test Conditions	62
Displaying the setting screen	62
Description of test conditions	63
Test voltage	64
Limit voltage	64
Upper limit (Upper)	65
Lower limit (Lower)	66
Judgment delay (Judge Delay)	67
Test time	68
Voltage rise time (Rise Time)	69
Voltage fall time (Fall Time)	70
Discharge time	71
Discharge when interlock is activated (Dis- charge Interlock)	72
Using the low-pass filter	73
Starting a Test	74
Starting a test	74
Operation after a test starts	75
Changing the test voltage during a test	76
Finishing the Test and Viewing the Judgment.	77

Stopping tests	77
Conditions that cause a test to end	77
Judgment types and operation	78
Clearing the judgment result	78

Measurement Function

Setting Measurement Conditions	79
Setting triggers	79
Setting sampling	80
Setting the measurement data size	82
Measurement	82

Auto Test

Auto Test Overview	83
Programs and steps	83
Main functions	83
Creating/Deleting Program	84
Displaying the program list screen	84
Creating program as a new program	85
Changing a program name	86
Deleting a program	87
Editing Programs and Steps	88
Displaying the program/step editing screen	88
Outline of program/step configuration	89
Operation for FAIL judgment	90
Step start condition (Trigger Source)	91
Step interval	92
Editing step settings	92
Starting an Auto Test	94
Starting an auto test	94
Operation after a test starts	96
Finishing the Test and Viewing the Judgment.	97
Stopping tests	97
Conditions that cause a test to end	97
Judgment types and operation	98
Clearing the judgment result	98
Exporting and Importing Programs	99
Exporting programs to a USB memory device	99
Importing programs from a USB memory device	100

External Control

Main Functions	101
SIGNAL I/O Connector	102
Pin arrangement (TOS54 mode)	102
Pin arrangement (TOS53 compatibility mode) ...	103
I/O signal circuit	104
Input signal usage example	104
Output signal usage example	105
Connecting to the SIGNAL I/O connector	105
Activating and Releasing Interlock	106
Interlock activation conditions	106
Interlock release conditions	106
Examples of how to use interlock	107
Setting the SIGNAL I/O Compatible Mode	108
Recalling from Memory	109
Recall memory with TOS54 mode	109
Recall memory in TOS53 compatible mode	110
Selecting the Test Mode	111
Starting and Stopping Tests	112
Starting a test	112
Stopping a test	112
Monitoring the Test Status	113
Monitoring the test and voltage generation status	113
Monitoring the test status	113
Monitoring judgment results	113
Monitoring the activation status of protection functions	113
Using Option Products	114
Signal output from the STATUS OUT connector	114
Signal I/O of the REMOTE connector	114

Memory Function

Saving and Recalling Test Conditions	115
Saving to the setup memory	115
Recalling the setup memory	118
Displaying/Saving a List of Test Results	119
Displaying a list of test results	119
Saving test results to a USB memory device	120
Deleting a list of test results	121
Displaying/Saving the Measurement Data	122

Displaying measurement values of the most recent test	122
Saving measurement data to a USB memory device	123
Deleting measurement data	123

System Settings

Displaying and Changing CONFIG Settings ..	124
Displays the CONFIG setup screen.	124
Configuration setting summary	125
Panel settings at startup	126
Operation when there is no SCPI communication	127
Calibration period	128
Holding PASS judgment result	129
Key control lock	130
Screen brightness	133
Fail mode	134
Test start settings	135
Beep sound	136
STATUS OUT output	137
SIGNAL I/O compatible mode	137
Displaying/Changing the Interface Settings ...	138
Display the interface setup screen.	138
Description of the interface settings	138
RS232C	139
LAN	140
DNS server	141
Host name	142
Auto clock adjustment	143
Displaying SCPI Errors	144
Setting the Date/Time	145
Setting the Calibration Date	147
Initializing the Settings	148
Restoring the factory default settings	148
Resetting test conditions to factory default settings	149
Returning only the interface settings to the fac- tory default values	150
Returns LAN settings to their factory default setting	151
Update	152
Displaying the Device Information	153

Maintenance

Pre-Test Inspection	154
Cleaning	155
Enclosure	155
Dust filter	155
Replacing Components	155
Backup battery replacement	155
Replacing the high voltage relay	155
Periodic Calibration	156
Disposal	157
Removing the battery at the time of disposal	157

Specifications

Withstanding Voltage Test Section.....	160
Output function.....	160
Measurement function.....	162
Judgment function.....	163
Timer function	164
Insulation Resistance Test Section	165
Output function.....	165
Measurement function.....	166
Judgment function.....	167
Timer function	167
Auto Test	168
Interface.....	169
Other Functions	170
General Specifications.....	171
External Dimensions.....	172

Appendix

List of Factory Default Settings.....	173
Withstanding voltage (ACW/DCW) test condition.....	173
Insulation resistance (IR) test condition	174
Measurement conditions	174
Auto test (AUTO) settings	174
Memory function.....	175
CONFIG settings.....	175
Management settings.....	176
Interface settings.....	176

Stray Capacitance of AC Withstanding Voltage Tests.....	176
Timing Chart.....	177
ACW test (PASS judgment).....	177
ACW test (FAIL judgment).....	178
ACW test (Interlock).....	179
ACW test (Cycle test, PASS judgment)	180
ACW test (Cycle test, FAIL judgment)	181
ACW test (Cycle test, Interlock)	182
ACW test (Minimum setting)	183
Options.....	184
Remote control box.....	184
DIN adapter cable	184
High voltage test probe	185
Warning light unit	185
Brackets	186
Troubleshooting.....	187
Index.....	189

General Description

About Manuals

This manual provides an overview of the TOS54 series and notes on usage. It also explains how to configure it, operate it, perform maintenance on it, and so on. Read this manual thoroughly before use, and use the product properly.

Intended readers

This manual is intended for users of the TOS54 series 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.

Getting Started Guide



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

Safety Information



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

Manual updates

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



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

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Disposal

Dispose of the TOS54 series in accordance with your local regulations.

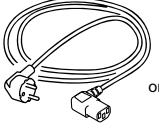
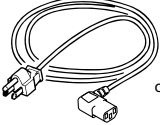
Open Source Software

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/>

Accessories

The attached power cord varies depending on the shipment destination.

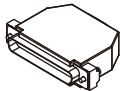
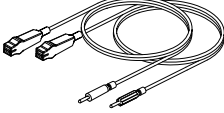


Plug: NEMA5-15,
Rating: 125 Vac/10 A

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

Plug: GB1002,
Rating: 250 Vac/10 A

☐ Power cord (1 pc., length: 2.5 m)



☐ High-voltage test lead
(TL31-TOS) (1 set)

☐ High-voltage warning
sticker (1 pc.)

☐ China RoHS sheet

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

☐ Cable tie for attaching USB
cables (1 pc.)

☐ Getting Started Guide

☐ Safety Information

Product Overview

The TOS54 Series Electrical Safety Testers perform with-standing voltage and insulation resistance tests, which are two of the four tests that are required for ensuring the safety of electrical products.

This product can perform withstanding voltage and insulation resistance tests on electrical products and electrical components in accordance with the requirements of safety and electrical standards and ordinances such as IEC, EN, BS, VDE, UL, CSA, GB and JIS.

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

TOS54 Series Lineup

Model	Supported tests ¹
TOS5401	ACW, DCW
TOS5402	ACW, IR
TOS5403	DCW, IR

1. ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: Insulation resistance

Features

Equipped with touch panel display

You can operate the product intuitively by touching the 7-inch display. The display provides noticeability and easy controls by showing various test settings as well as descriptions and drawings.

LAN, USB, and RS232C

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

Supporting high-speed takt time

The product can shorten takt times of withstanding voltage and insulation resistance tests in comparison with Kikusui's previous products.

Notations Used in This Manual

In-Text notations

- Electrical Safety Testers TOS5401, TOS5402, and TOS5403 are also referred to as the TOS54 Series.
- “PC” in this manual is a generic term for personal computers and workstations.
- The term “EUT” is used to refer generally to an equipment under test.
- “>” Indicates menu settings that you select. The menu item to the left of “>” is a higher-level menu.
- Test names may be abbreviated as follows:
AC withstanding voltage testing: ACW, DC withstanding voltage testing: DCW, Insulation resistance testing: IR
- The following icons indicate the TOS54 series model names.

- Screen examples used in this manual for ACW testing are captured from TOS5401 while those for IR testing are captured from TOS5402 unless otherwise noted.
- The screen captures and illustrations used in this manual may differ from the actual items.

Safety information

DANGER

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

WARNING

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

CAUTION

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

NOTE

Indicates information that you should know.

Safety Precautions

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

When using in general

DANGER

The TOS54 series generates high voltage, which may cause electric shock. Improper operation can lead to fatal accidents.

- To prevent accidents, be sure to thoroughly read the section “Safety Precautions for Testing” (p.15) in this manual.
- Please keep this Start Guide close to the TOS54 series product so that the operators can read it at any time.
- Do not touch an output terminal while output is being generated.
- Do not touch a test lead that is connected to an output terminal while output is being generated.
- Do not touch the EUT while output is being generated.
- Do not touch a location that is electrically connected to an output terminal while output is being generated.
- Do not touch a location that is electrically connected to an output terminal immediately after output is turned off after a DC withstanding voltage test or insulation resistance test has been performed.

WARNING

Risk of electric shock or fire.

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

Risk of electric shock.

- Do not operate without grounding the product.
- Wear rubber gloves for electrical work.
- In tests that use test leads, do not touch the tip of test leads.
- If you want to turn the POWER switch on again after turning it off, wait at least 10 seconds.

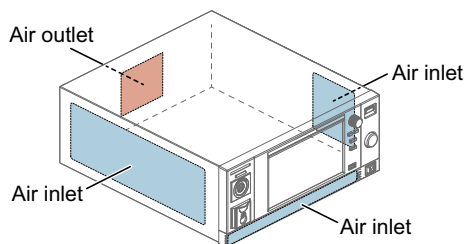
It is dangerous to do otherwise, because the protective functions of the product may not work effectively. This may cause the product to malfunction or reduce the life of the POWER switch and internal parts such as the fuses.

Risk of fire.

- Do not use the product where ventilation is poor.
The TOS54 series uses forced air cooling. The product sucks air through the inlet holes on its front, right, and left panels and discharges air through its rear panel.
- Secure adequate space around the product's air inlet and outlet so that they are not blocked.
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 especially when rack mounting the product.

- Do not place objects that are affected by heat near the air outlet.

Hot air (approximately 20 °C , hotter than the ambient temperature) is expelled from the outlet holes.



There is a risk of hearing loss.

- The beep sound of this product may exceed a noise sound pressure level of 80 dB depending on the volume setting and surrounding environment. Wear noise-protection earplugs when working near this product.

⚠ CAUTION

Risk of electric shock.

- Install the connector cover or terminal cover when not using the USB port, LAN port, RS232C port. (p.15)

Noise generated by the TOS54 series may affect other devices.

- Do not use the unit near highly sensitive measuring instruments or transceivers.

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.

Installation

⚠ WARNING

Risk of electric shock.

- Be sure to ground the product to prevent an electric shock.

TOS54 series is IEC Safety Class I equipment (equipment with a protective conductor terminal).

- Connect the protective conductor terminal to earth ground.

The TOS54 series is grounded through the power cord ground wire.

⚠ CAUTION

- Do not install the product in residential environment.

TOS54 series is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

General precautions during test

⚠ WARNING

Risk of electric shock.

- To prevent accidents, strictly follow the precautions and always pay the utmost attention to safety concerns when you operate the product.

This product generates a voltage up to 5 kVac during an ACW test and up to 6 kVdc during a DCW test. Handling this product improperly may lead to a fatal accident.

- Do not touch the EUT, test leads, test probes, the HIGH VOLTAGE terminal, or other peripheral components while the DANGER LED is lit.

- Stay away from the alligator clips of the supplied test leads that are connected to the product while the DANGER LED is lit.

The vinyl insulation of an alligator clip does not have dielectric strength. In addition, some energized parts protrude from the vinyl insulation during wiring.

- 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 and before this discharge completes, do not disconnect the tester from the EUT.

After the output has been turned off, the internal discharge circuit goes into operation and discharges the output voltage.

- Except in an emergency, do not turn the power off while output is being generated.

- Connect the test leads securely.

If connections are incomplete, the entire EUT may be charged to a high voltage.

- Connect the low-voltage test lead (black) first.

When using external control

⚠ WARNING

Risk of electric shock.

- When controlling the TOS54 series from external device using SIGNAL I/O, ensure that the operator does not approach high-voltage application areas.

Be sure to construct a system that uses the interlock for safety. (p.107)

In case of failure

⚠ WARNING

Risk of electric shock.

- Until you get the product fixed, make sure that nobody can use it.

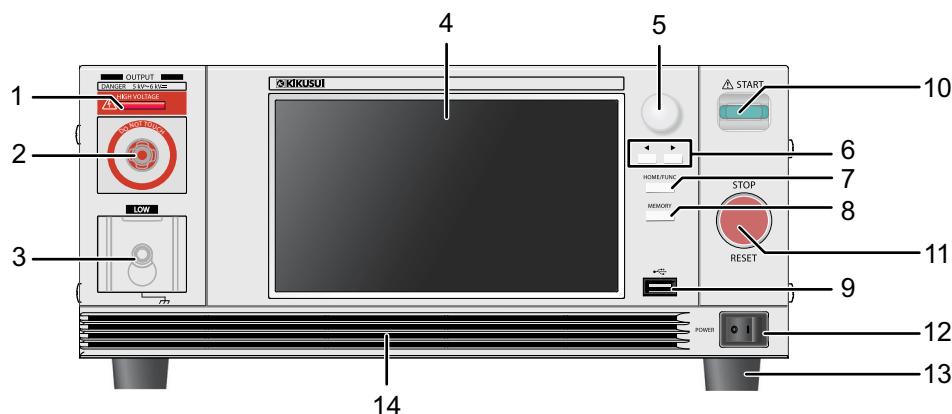
- For repairs, contact your Kikusui agent or distributor.

Notes on Usage

- When using or storing the series, be sure to observe the temperature and humidity ranges. For environmental conditions, see General Specifications (p.171).
- To protect the EUT, set the Protection Functions (p.19) appropriately.

Component Names

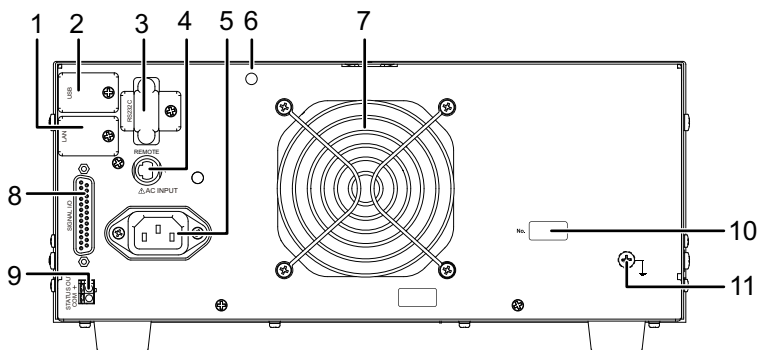
Front Panel



No.	Name	Function
1	DANGER LED	Lights red when the power is turned on ¹ , when a test is in progress, when a high voltage is being output, or when there is residual voltage at the output terminals.
2	HIGH VOLTAGE terminal	Outputs the test voltage of the high voltage side. (p.28)
3	LOW terminal	Outputs the test voltage of the low voltage side (with cable lock). (p.28)
4	Touch panel display	Displays the settings, measured values, and other information. Use the touch panel to operate. (p.31)
5	Rotary knob	Select items. Input numbers and characters. (p.33)
6	◀ and ▶ keys	Move the cursor left and right. (p.33)
7	HOME/FUNC key	Switches between the test selection screen (Function Menu) and the test setup screen (Home Menu). (p.32)
8	MEMORY	Displays the memory function screen. (p.115)
9	USB port (host)	Used for connect a mouse (p.31) , saving setup memory and test results (p.115) , exporting and importing AUTO test programs (p.99) , and updating (p.152) .
10	START switch	Press and hold the switch for approximately 1 second or more to start the test. The test start method can be changed. (p.135)
11	STOP/RESET switch	Stops testing or clears status. Returns to the Home menu screen.
12	POWER switch	Turns the power on (I) and off (O). (p.23)
13	Foot	Four locations on the bottom side. Remove them when installing in a rack. (p.186)
14	Air inlet	Air inlet for cooling.

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

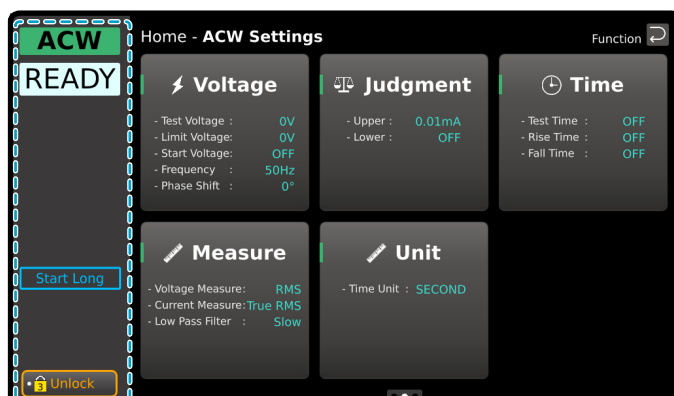
Rear Panel



No.	Name	Function
1	LAN port	Used for connecting remote control. When the product is shipped from the factory, covers are attached. (p.15)
2	USB port	
3	RS232C port	
4	REMOTE connector	Connect the optional remote control box (p.184) or high-voltage test probe (p.185) .
5	AC INPUT inlet	Used for connecting a power cord for supplying power to the TOS54 series. (p.21)
6	Cable tie attachment hole	Attach the included cable tie (for USB cables)
7	Air outlet	Air outlet for cooling
8	SIGNAL I/O Connector	An I/O signal connector for controlling the TOS54 series with an external device. (p.102)
9	STATUS OUT connector	You can use this with the optional warning light unit (p.185) .
10	Serial No	n/a
11	Functional ground terminal	n/a

Status Display Icons

The left side of the touch panel display shows the status of the TOS54 series.



Item	Icon	Description
Test mode	ACW	A selected test mode (p.35) is displayed.
	DCW	
	IR	
Auto Test	AUTO	Auto Test (p.83) is selected.
Test state	READY	A test is ready to start.
	TEST	A test is being conducted.
	↗RISE	A voltage is rising.
	↘FALL	A voltage is dropping.
Judgment result	PASS	A Pass judgment has been made.
	Upper-Fail	An Upper-FAIL judgment has been made.
	Lower-Fail	An Lower-FAIL judgment has been made.
Protection function is activated	Protection	The protection function has been activated. (p.19)
Locking state	• Unlock	Key lock (p.130) is released. Touch and hold the icon to activate key lock.
	• 1 Lock	Key lock is activated. The key lock level is indicated with a number. Touch and hold the icon to release key lock.
	• 2 Lock	
	• 3 Lock	
	• R Lock	Key lock is activated for remote control. Touch and hold the icon to release both remote control and key lock.
	• R Lock Out	Key lock is activated for remote control. The lock can be unlocked with remote control. For details, see the Communication Interface Manual.
Remote control mode	⇄ Remote	Remote control in progress
External control in progress	Signal I/O	The START switch on the front panel is disabled because the Enable signal (p.112) of SIGNAL I/O is turned on.
Remote device connected	Controller	The START switch on the front panel is disabled because a device (p.114) is connected to the REMOTE connector.
Fail Mode	FailMode	Fail Mode is enabled. (p.134)
Start long	Start Long	Start Long is enabled. (p.135)

Item	Icon	Description
Momentary		Momentary is enabled. (p. 135)
Double Action		Double Action is enabled. (p. 135)
SCPI error		There is an SCPI error. The number of error incidents (up to 16) is displayed numerically. (p. 144)
Discharging		Residual voltage is being discharged. (p. 50) (p. 71)
Auto test state		The product is on standby for an auto test. (p. 94)
		An auto test is being executed. (p. 94)

Safety Precautions for Testing

Lighting of the DANGER LED

The DANGER LED lights when the TOS54 series 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

Check whether the DANGER LED lights at power on. If it does not, stop using the TOS54 series, and contact your Kikusui agent or distributor.

Checking Connector Covers

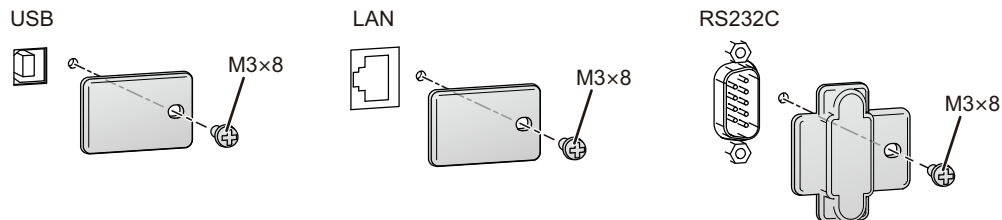
CAUTION

Risk of electric shock.

- **Install the connector cover or terminal cover when not using the USB port, LAN port, RS232C port.**

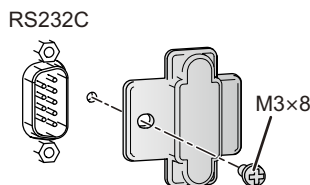
When the product is shipped from the factory, covers are attached to the USB, LAN, and RS232C ports on the rear panel.

If they are damaged or lost, contact your Kikusui agent or distributor.



■ Storing connector covers

You can store the removed RS232C connector cover by attaching it on the rear panel as shown in the figure below.



Store the USB or LAN port cover separately.

Test Precautions

Pre-test precautions

WARNING

Risk of electric shock.

- To prevent accidents, strictly follow the precautions and always pay the utmost attention to safety concerns when you operate the product.
This product generates a voltage up to 5 kVac during an ACW test and up to 6 kVdc during a DCW test. Handling this product improperly may lead to a fatal accident.
- Do not touch the EUT, test leads, test probes, the HIGH VOLTAGE terminal, or other peripheral components while the DANGER LED is lit.

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

- The power cord is connected to a properly grounded outlet.
- There is no damage such as tears or breaks in the test lead insulation.
- When the POWER switch is turned on, the DANGER LED lights.
- When the DANGER LED is lit, do not turn the POWER switch off except in an emergency.
- Ensure that the test lead connected to the HIGH VOLTAGE or LOW terminal of the TOS54 series is not connected to the energized main power circuit.

Testing precautions

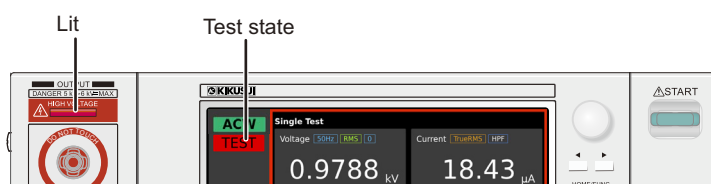
WARNING

Risk of electric shock.

- Do not touch the EUT, test leads, test probes, the HIGH VOLTAGE terminal, or other peripheral components while the DANGER LED is lit.
- The vinyl insulation of an alligator clip does not have dielectric strength. In addition, some energized parts protrude from the vinyl insulation during wiring.
The vinyl insulation of an alligator clip does not have dielectric strength. In addition, some energized parts protrude from the vinyl insulation during wiring.
- 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/RESET and check that the DANGER LED is turned off to ensure safety.

Precautions after Output Has Been Turned Off

WARNING

Risk of electric shock.

- **Do not touch the EUT, test leads, test probes, the HIGH VOLTAGE terminal, or other peripheral components while the DANGER LED is lit.**
- **During testing and before this discharge completes, do not disconnect the tester from the EUT.**

After the output has been turned off, the internal discharge circuit goes into operation and discharges the output voltage.

The EUT, test leads, 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 required to discharge the voltage between the TOS54 series output terminals from the maximum rated output to 30 V is as follows:

- When an EUT is not connected: approx. 16 ms for a DCW test, approx. 1.5 ms for an IR test
- When an EUT with a input capacitance of 0.05 μF is connected: approx. 45 ms for a DCW test, approx. 6 ms for an IR test

Remote Control Precautions

If you are performing remote control at a location away from the TOS54 series, to prevent accidents, follow the safety measures given below.

- **Make sure that high voltages are not generated unintentionally.**
- **Make it impossible to touch the EUT, test leads, 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/RESET switch, the DANGER LED remains lit.**
- **Even though a voltage is indicated on the voltmeter, the DANGER LED does not light.**

If the tester is not operating properly, it may be generating a high voltage irrespective of the settings made by the operator. Immediately turn the POWER switch off, and disconnect the power cord of the TOS54 series from the outlet. Stop using the product immediately, and contact your Kikusui agent or distributor.

Emergency measures

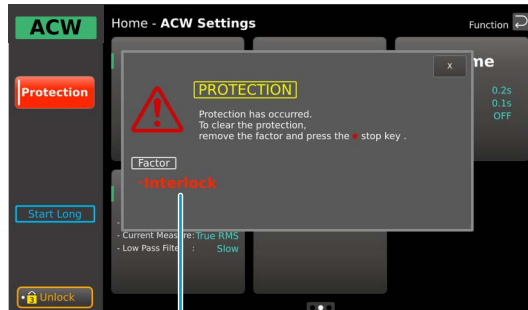
There are two actions that you must carry out if, due to a malfunction in the TOS54 series or the EUT, there is a possibility of an emergency occurring such as electric shock or damage to the EUT.

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

Protection Functions

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

If the protection function is activated, the PROTECTION screen appears on the display. The PROTECTION screen shows how to clear the function and the type of protection. If a PROTECTION mode occurs during a test, the output is shut off and the test is stopped immediately.



Type of protection

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

The text inside the parentheses in the “Type of protection” column is displayed in the list of test results (p. 119).

Type of protection	Activation condition	Remedy
Interlock (ILOCK)	Interlock is activated.	Release the interlock (p. 106).
Power Supply (PS)	There is an error in the power supply section.	Pressing STOP/RESET releases the PROTECTION mode, but the product needs to be repaired. Contact your Kikusui agent or distributor.
Output Error (OUTERR)	An output outside of the following range is detected. ACW/DCW: ± 350 V or more IR: $\pm (10\% \text{ of setting} + 10 \text{ V})$ or more This error may also occur when the output changes suddenly.	Eliminate the cause of the error, and press STOP/RESET.
Over Load (OL)	An output outside of the following specified range is detected. ACW: 550 VA, DCW: 110 W or 50 mA, IR: 2 mA	Eliminate the cause of the error, and press STOP/RESET.
Over Heat (OH)	The internal temperature of the TOS54 series is abnormally high.	- Leave the POWER switch on for 10 minutes. - Check that the air inlet/outlet is not blocked. After checking the above, press the STOP/RESET switch to release the mode. If release fails, the internal temperature remains high.
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. 56).	Press STOP/RESET, and wait the necessary rest time.
Calibration (CAL)	The preset calibration period is exceeded.	The PROTECTION mode can be released by setting Protection Keep under Calibration (p. 128) to Disable and pressing the STOP/RESET switch, but the product needs to be calibrated. To have your product calibrated, contact your Kikusui agent or distributor.
Remote (RMT)	The REMOTE connector is connected or disconnected.	Check the REMOTE connector, and then press STOP/RESET.

Type of protection	Activation condition	Remedy
Signal I/O (SIO)	There is a change in the SIGNAL I/O connector's ENABLE signal.	Press STOP/RESET.
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. 127) was enabled.	Check the SCPI communication status.

■ Tests supported by each model

	TOS5401	TOS5402	TOS5403
ACW	✓	✓	n/a
DCW	✓	n/a	✓
IR	n/a	✓	✓

Preparation

This chapter describes how to prepare TOS54 series for use.

- For information about installing and moving TOS54 series, see “Precautions Concerning Installation Location” and “Precautions to Be Taken When Moving the Product” in the Safety Information Manual.
- When using or storing TOS54 series, be sure to observe the temperature and humidity ranges. For environmental conditions, see “General Specifications” ([p.171](#))
- If you want to mount the product on a rack, see “Brackets” ([p.186](#)).

Connecting the Power Cord

WARNING

Risk of electric shock.

- **Be sure to ground the product to prevent an electric shock.**
TOS54 series is IEC Safety Class I equipment (equipment with a protective conductor terminal).
- **Connect the protective conductor terminal to earth ground.**
The TOS54 series is grounded through the power cord ground wire.

NOTE

- Use the supplied power cord to connect to the AC power line.
If the supplied power cord cannot be used because the rated voltage or the plug shape is incompatible, have a qualified engineer replace it with an appropriate power cord that is 3 m or less in length. If obtaining a power cord is difficult, contact your Kikusui agent or distributor.
- Do not use the supplied power cord with other instruments.
- The power cord with a plug can be used to disconnect the TOS54 series from the AC power line in an emergency.
- Secure adequate space around the power plug. Do not insert the power plug to an outlet where accessibility to the plug is poor. And, do not place objects near the outlet that would result in poor accessibility to the plug.

The TOS54 series is IEC standard overvoltage category II equipment (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 input rating of the TOS54 series.**
An acceptable input voltage is a nominal supply voltage in the range of 100 Vac to 240 Vac. A frequency range is 47 Hz to 63 Hz.
- 3 Connect the power cord to the AC INPUT inlet on the rear panel.**
- 4 Connect the power cord plug to an outlet with a ground terminal.**
This completes the connections.

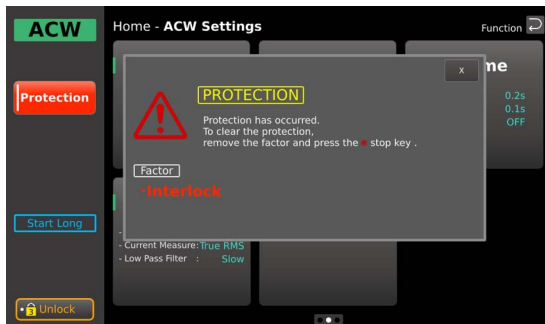
Checking Whether the Power Is On or Off

Checking the interlock operation

When you turn on the product for the first time after purchase, it starts in the PROTECTION mode in which testing is disabled by the interlock function ([p.106](#)). 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/RESET on the front panel. When you actually perform tests, design a system that uses the interlock for safety ([p.107](#)).

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.106](#)).
- When you actually perform tests, design a system that uses the interlock for safety ([p.107](#)).

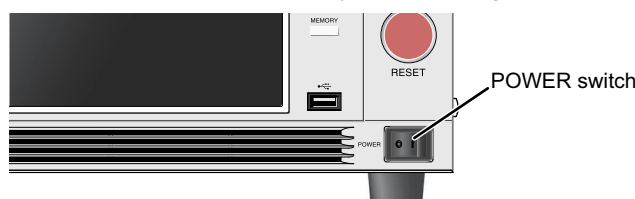
By factory default, the panel settings immediately before the POWER switch is turned off are saved. When you turn the power on, the product starts in the same state as it was in the last time it was turned off. (However, the output is off.)

The panel setting state at startup can be changed ([p.126](#)).

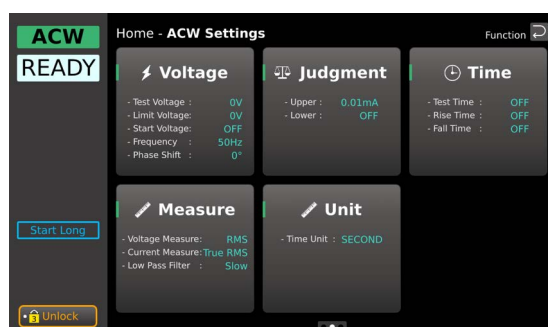
1 Check that the power cord is connected properly.

2 Turn the POWER switch on (I).

The DANGER LED is turned on and off soon, but no voltage is generated. If it does not, stop using the TOS54 series, and contact your Kikusui agent or distributor.



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



The power is now on.

Turning the power off

WARNING

Risk of electric shock.

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

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

Setting the Date/Time and Calibration Date

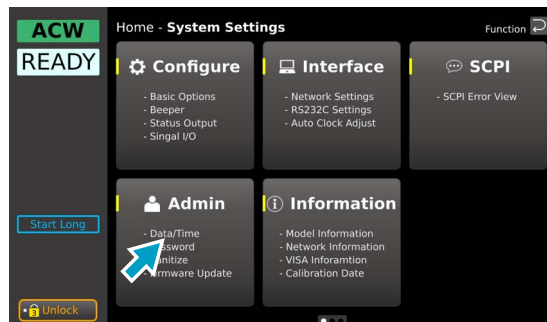
Set the date/time, calibration date, and calibration period.

Setting date

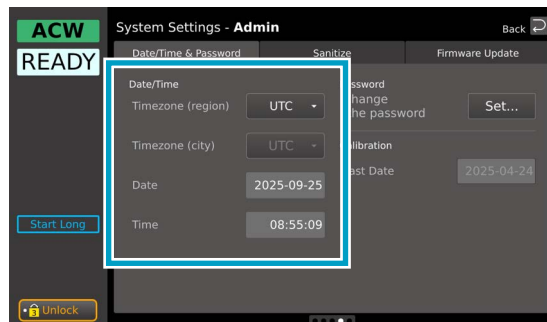
Set the time zone, date, and time. The following settings will be used as an example to explain how to change the date in Japan's time zone.

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



The date/time setup screen appears.



3 Tap the entry field of Timezone (region), and tap and select Japan.

4 Tap the input field of the Date and enter the year, month and day.

5 Tap the input field of the Time and enter the time.

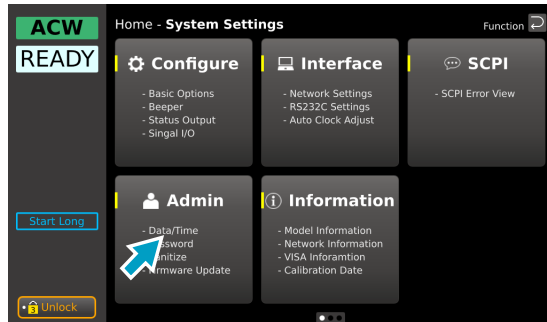
This completes the setting.

Setting the calibration date

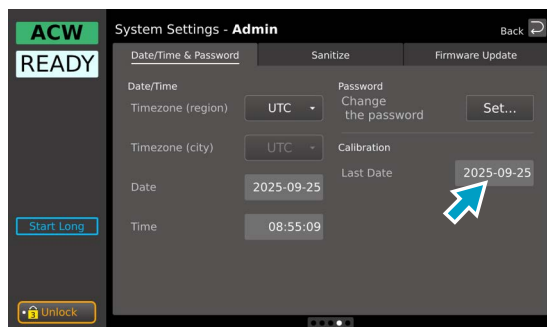
Set the date on which calibration was carried out.

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



3 Tap the input field of Last Date for a long time.



You will now be able to enter the calibration date.

4 Tap the input field of Last Date and enter the calibration date.
This completes the setting.

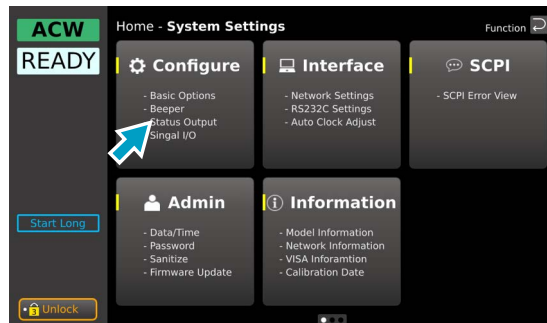
Setting the calibration period

Set the calibration period and the operation performed when the calibration period elapses.

Item	Set value	Description
Calibration Protection Keep	ON	When the calibration period elapses, the protection function is activated, and the product switches to PROTECTION mode (CAL). To release the PROTECTION mode, set Protection Keep to Disable, and press STOP/RESET.
	OFF	When the calibration period passes, a warning appears on the display when the power is turned on. To clear the warning, press STOP/RESET.
Calibration DUE	1 to 36 (month)	Sets a period of months until the next calibration from the last calibration date (p.26).
	Infinity	Calibration period is not monitored.

1 Flick left and right on the Home screen to display the System Settings screen.

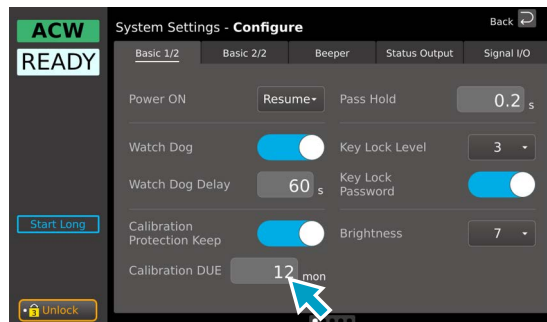
2 Tap Configure.



3 Tap the toggle button of Calibration Protection Keep to set ON/OFF.



4 If you set it to ON, tap the entry field of Calibration DUE to enter the calibration period.



This completes the setting.

Connecting to the EUT

WARNING

Risk of electric shock.

- Do not touch the EUT, test leads, test probes, the HIGH VOLTAGE terminal, or other peripheral components while the DANGER LED is lit.

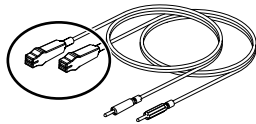
Connecting the test leads

WARNING

Risk of electric shock.

- Stay away from the alligator clips of the supplied test leads that are connected to the product while the DANGER LED is lit.

The vinyl insulation of an alligator clip does not have dielectric strength. In addition, some energized parts protrude from the vinyl insulation during wiring.

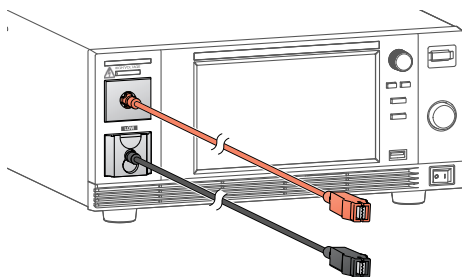


- Connect the test leads securely.
If connections are incomplete, the entire EUT may be charged to a high voltage.
- Connect the low-voltage test lead (black) first.

Connect the supplied high-voltage test lead to the front panel.

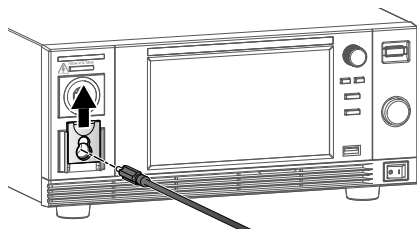
Before starting work, check that the covering of the test leads are not torn and that the wires are not broken ([p.154](#)).

The following figure shows the state where the test leads are connected.

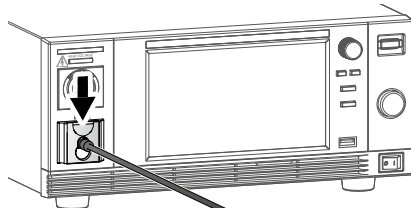


- 1 Check that the POWER switch is off and that the DANGER LED is off.

- 2** Raise the LOW terminal's cable lock, and then connect the low-voltage test lead (black).



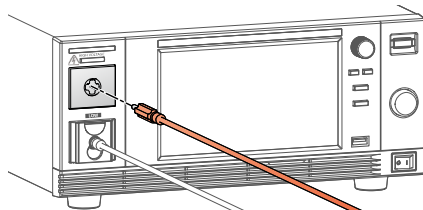
- 3** Lower the cable lock.
Check that the connection is secure.



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

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

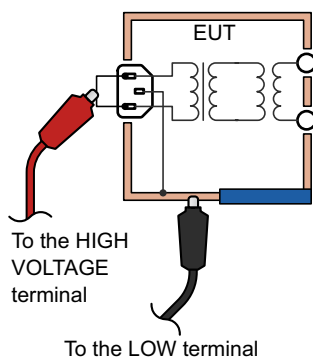
- 6** Connect the high-voltage test lead (red) to the HIGH VOLTAGE terminal.



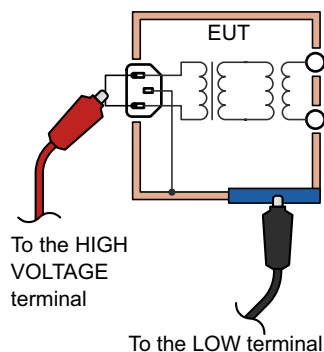
This completes the connections.

Examples of how to connect test leads to the EUT

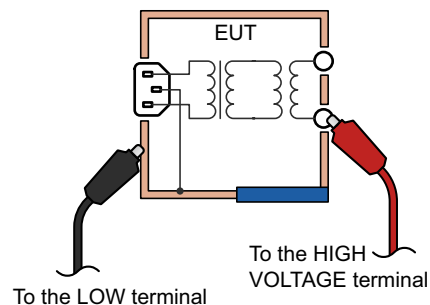
Ex: Between the power supply (primary) and grounded enclosure



Ex: Between the power supply (primary) and ungrounded enclosure



Ex: Between the insulation connection area and enclosure



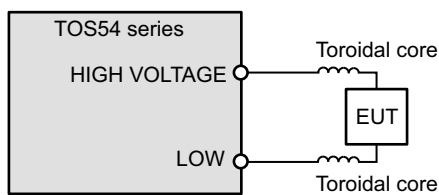
Reducing the effect of noise

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 TOS54 series' 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

Using the optional high voltage test probe

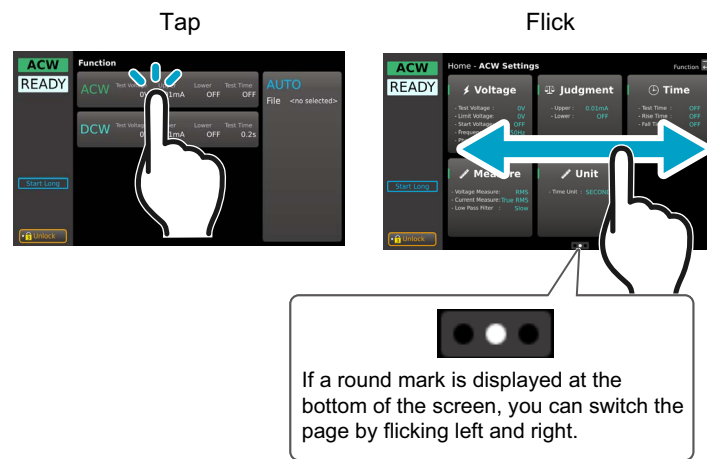
In a withstanding voltage test, if you use the optional high-voltage test probe ([p.185](#)) instead of the supplied test leads, you can start the test in hands-on control. For details, see the operation manual of the high-voltage test probe.

Basic Operation

Operating Touch Panel Display

Touch operation

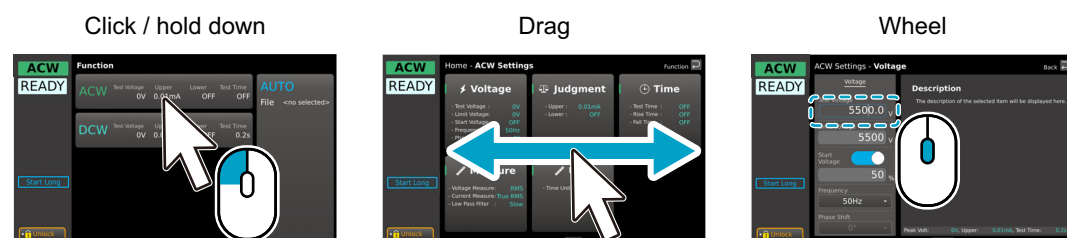
You can change settings or operate the screen by tapping or swiping the touch panel display (hereinafter referred to as the “display”). If you are wearing rubber gloves, we recommend using the stylus pen for operation.



Mouse operation

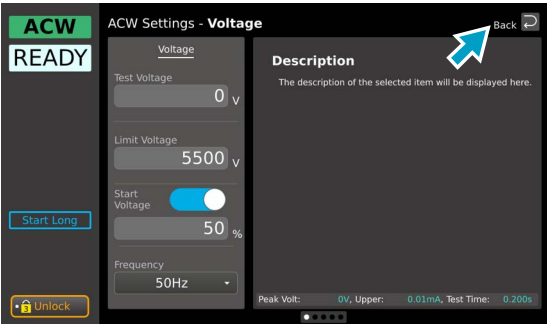
By connecting a mouse to the USB connector on the front panel, a mouse cursor appears on the display. With a left mouse click, you can select an item displayed on the screen or set a number.

When dragging with the mouse, you can perform an action equivalent to a swipe by touch. Press and hold the left mouse button for 1 second or more for a long press. You can use the mouse wheel to scroll up and down, performing the same action as a rotary knob.



Return to the Previous Page

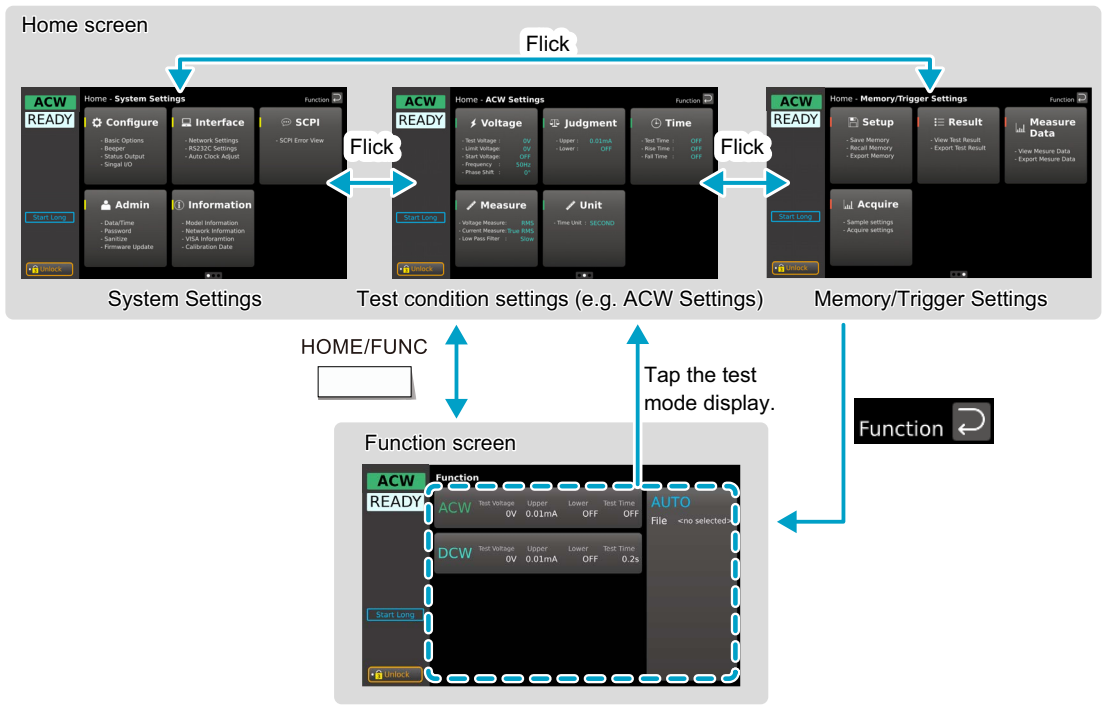
If the Back icon appears on the upper right of the display, tap the icon to return to the previous screen (a one-level superior in the hierarchy).



Function and Home Screens

On the Home screen appearing upon startup, press the HOME/FUNC key or tap Function on the upper right of the display to move to the Function screen.

On the Function screen, press the HOME/FUNC key or tap the test mode display to move to the Home screen.



Screen name		Description
Home	System Settings	System Setting screen (p.124)
	ACW Settings (p.37)	Setting screens of test conditions according to the selected test mode. The available test modes vary depending on models.
	DCW Settings (p.37)	
	IR Settings (p.62)	
	AUTO Settings (p.83)	
	Memory/Trigger Settings	Screens of the memory function (p.115) and the trigger function of measurement (p.79)
Function	Displays major test conditions and information on the selected auto test and switches test modes	

Entry Operation

This section describes how to enter values, characters, and dates.

Entering numbers

Tap or touch and hold the entry field of a numerical setting to enter a value.

■ Tap

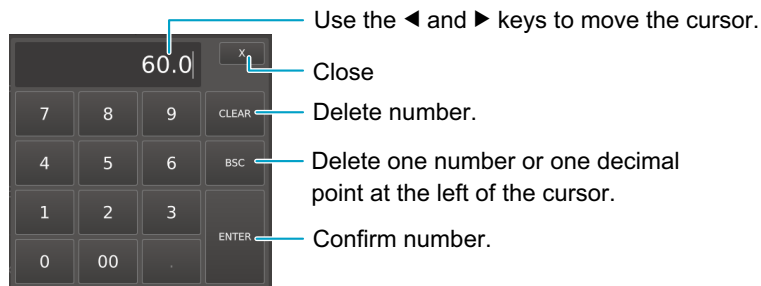
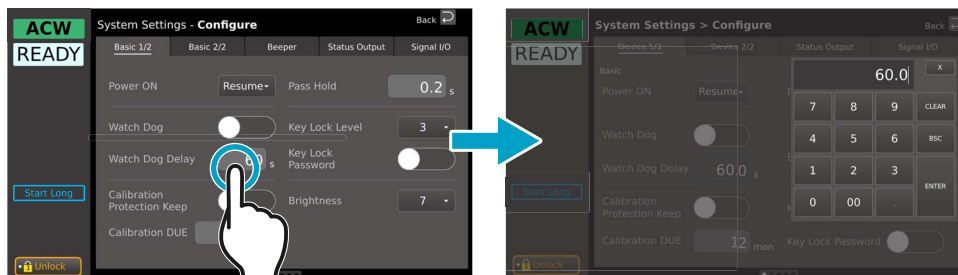
You can enter a value with the rotary knob.



Turn the rotary knob clockwise to increase the value while turn it counterclockwise to decrease the value. The setting is confirmed immediately after entry. You can move to either of the next digits with the ◀/▶ key.

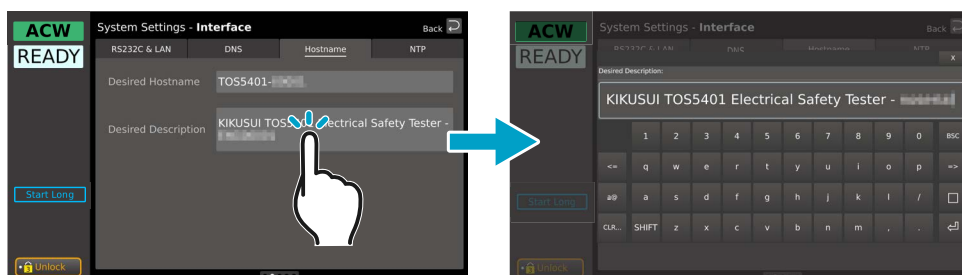
■ Touch and hold

You can enter a value with the numeric keypad.

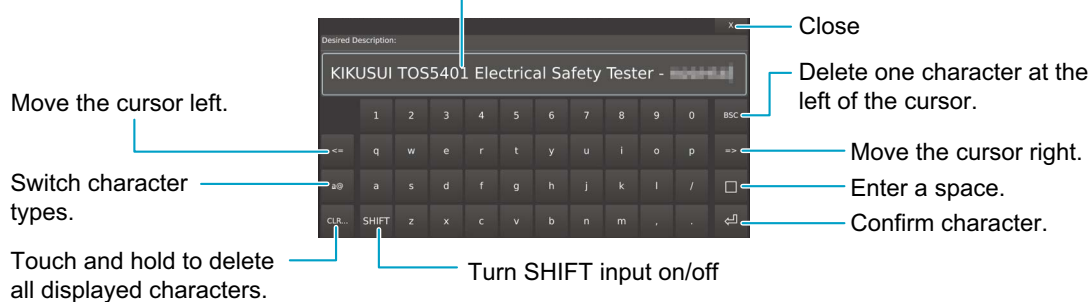


Entering characters

Tap the entry field of a character setting to enter characters.

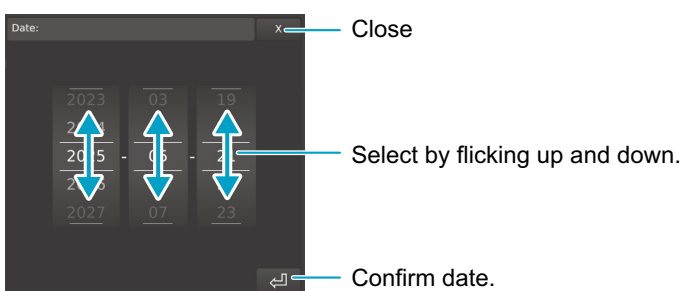
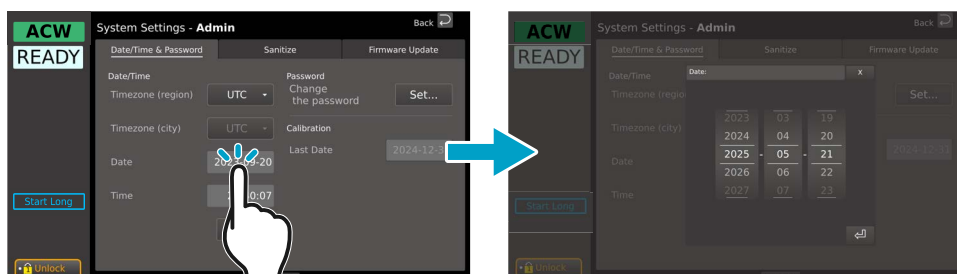


Move the cursor by touching a desired position or pressing the ◀ or ▶ key.



Entering date

Tap the entry field of a date setting to enter a date.



Selecting the Test Mode

The TOS54 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.

■ Tests supported by each model

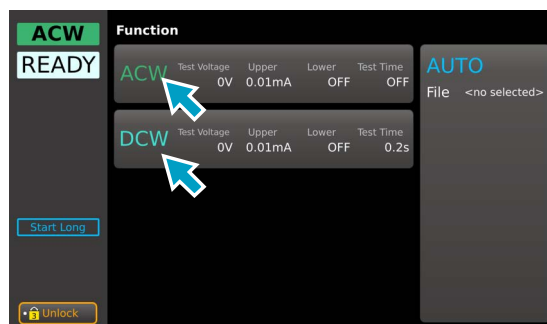
	TOS5401	TOS5402	TOS5403
ACW	✓	✓	n/a
DCW	✓	n/a	✓
IR	n/a	✓	✓

Selecting the test mode

You can select a test mode on the Function screen.

1 Tap a displayed test mode on the Function screen.

The available tests vary depending on models. The figure below shows a case of setting test conditions of TOS5401.



The test mode is changed.

The current test mode appears on the upper left of the display.

The setting screen of test conditions appears, so set the conditions if necessary.

- Withstanding Voltage Test ([p.37](#))
- Insulation Resistance Test ([p.62](#))

Test Start Operation

This section explains how to perform a test start operation using the START switch, SIGNAL I/O, and optional products. In all cases, the test start method can be changed ([p.135](#)).

Using the START switch

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

Using the SIGNAL I/O connector

Sending a START signal to the SIGNAL I/O connector starts the test under the configured test conditions. ([p.112](#))

Using optional products

By factory default, connecting the optional remote control box ([p.184](#)) and pressing the START switch for approximately 1 second or more starts the test under the configured test conditions.

Withstanding Voltage Test

Applicable models for AC withstanding voltage (ACW): **5401**, **5402**

Applicable models for DC withstanding voltage (DCW): **5401**, **5403**

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

- Setting Test Conditions ([p.37](#))
- Starting a Test ([p.56](#))
- Finishing the Test and Viewing the Judgment ([p.60](#))

Setting Test Conditions

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

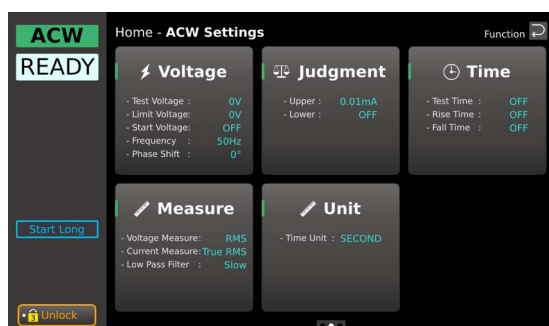
Displaying the Setup Screen

1 Tap ACW or DCW on the Function screen.

The figure below shows a case of setting the test conditions of ACW. The available tests vary depending on models.



The setting screen of test conditions appears.



Set the required conditions by referring to the description of test conditions ([p.38](#)).

Description of test conditions

The test conditions you can set vary for ACW and DCW.

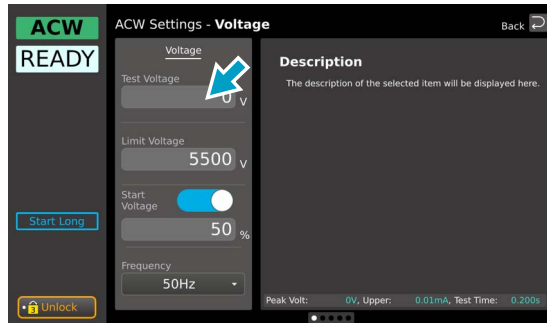
The following test conditions marked with “✓” are applicable to either/both of the tests.

ACW	DCW	Test condition	Overview
✓	✓	Test voltage	Voltage to apply to the EUT. (p.39)
✓	✓	Limit voltage	Upper limit of voltage to apply to the EUT. (p.39)
✓	✓	Start voltage	Voltage value 0.1 seconds after the test start operation. (p.40)
✓	n/a	Frequency	Test voltage frequency. (p.41)
✓	n/a	Phase Shift	The starting phase of a test voltage. (p.42)
✓	✓	Upper limit (Upper)	Reference current for the limit judgment. (p.43)
✓	✓	Lower limit (Lower)	Reference current for lower limit judgment. (p.44)
n/a	✓	Judgment delay (Judge Delay)	Time from the test start operation to the start of upper judgment. (p.45)
✓	✓	Test time	Time from when the voltage rise time has passed to the end of the test. (p.46)
✓	n/a	Test cycle	Sets a test time in AC cycles. (p.47)
✓	✓	Voltage rise time (Rise Time)	The time from the test start operation or the start voltage until the test voltage is reached. (p.48)
✓	✓	Voltage fall time (Fall Time)	The time from a pass judgment until the voltage falls. (p.49)
✓	n/a	Test time unit (Time Unit)	Selects the unit of a test time from seconds or cycles. (p.55)
n/a	✓	Discharge time	The time for discharging the voltage residing in the high voltage charge area. (p.50)
n/a	✓	Discharge when interlock is activated (Discharge Interlock)	Discharges the voltage when the interlock is activated. (p.51)
✓	n/a	Voltage measure	Select whether to measure voltage in true rms values or peak values. (p.52)
✓	n/a	Current measurement mode (Current Measure)	Select whether to measure current in true rms values or measure by converting the mean-value responses to rms values. (p.53)
✓	✓	Discharge detection	Response speed for detecting current (sensitivity). (p.54)

Test voltage

Set the voltage to apply to the EUT. You cannot specify a voltage that exceeds the limit voltage (p.39). If the Phase Shift (p.42) is set to 0°, the test voltage is limited to 1500 V or less.

- 1 Tap **Voltage** on the setting screen of test conditions (p.37).
- 2 Tap the entry field of **Test Voltage** to enter a voltage.
The following figure shows a screen example during an ACW test.



ACW setting range: 0 V to 5500 V

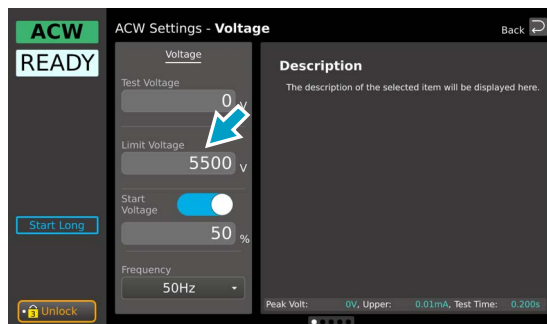
DCW setting range: 0 V to 6200 V

This completes the setting.

Limit voltage

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

- 1 Tap **Voltage** on the setting screen of test conditions (p.37).
- 2 Tap the entry field of **Limit Voltage** to enter a voltage.
The following figure shows a screen example during an ACW test.



ACW setting range: 0 V to 5500 V

DCW setting range: 0 V to 6200 V

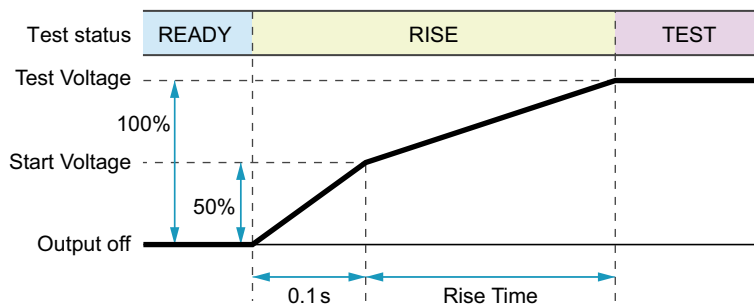
This completes the setting.

Start voltage

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

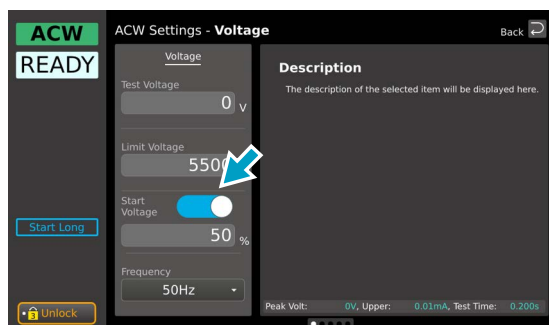
If the Time Unit (p.55) is set to CYCLE for ACW testing, it is fixed to OFF.

■ When the start voltage is 50%

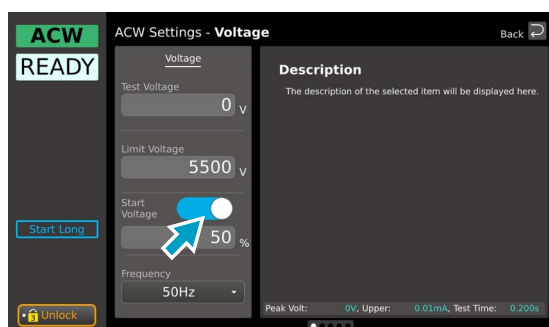


1 Tap Voltage on the setting screen of test conditions (p.37).

2 Tap the toggle button of Start Voltage to set ON/OFF.
The following figure shows a screen example during an ACW test.



3 If it is set to ON, tap the entry field to enter a percentage.



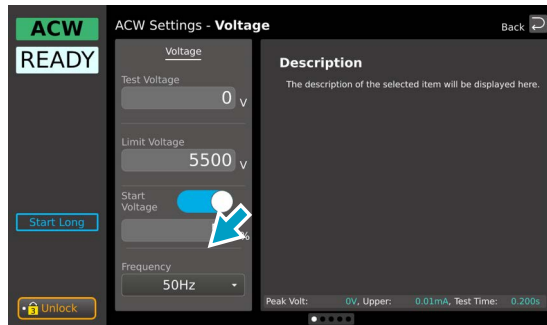
Setting range: 1 % to 99 %

This completes the setting.

Frequency

This can be set for AC withstanding voltage (ACW) tests.
Set the test voltage frequency to 50 Hz or 60 Hz.

- 1 Tap **Voltage** on the setting screen of test conditions (p.37).
- 2 Tap the entry field of **Frequency** to set a frequency.



This completes the setting.

Phase shift

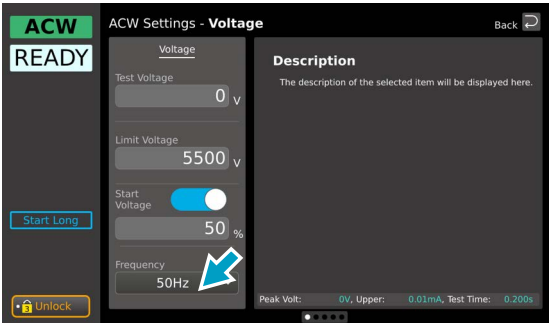
You can set a Phase Shift if the Time Unit (p.55) is set to CYCLE for ACW testing.

Set value	Description
0	Set the starting phase of the test voltage to 0°. It can be set when the test voltage (p.39) is 1500 V or less.
90	Set the starting phase of the test voltage to 90° (approx. 90° phase shifted). The first quarter-wave, treated as the voltage rise time, is not included in the test duration. Set when prioritizing takt time in tests of 1500 V or higher.

NOTE

If the Phase Shift is set to 0°, the test voltage is limited to 1500 V or less.

- 1 Tap Voltage on the setting screen of test conditions (p.37).
- 2 Tap the entry field of Phase Shift to set a phase.



This completes the setting.

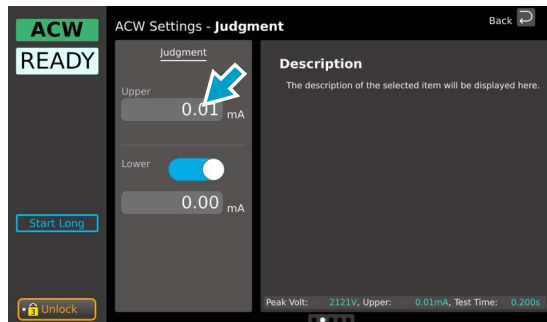
Upper limit (Upper)

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

If a value smaller than Lower (p.44) is set, the Lower setting will change according to the Upper setting.

1 Tap Judgment on the setting screen of test conditions (p.37).

2 Tap the entry field of Upper to enter a current.
The following figure shows a screen example during an ACW test.



ACW setting range: 0.01 mA to 110.00 mA

DCW setting range: 0.01 mA to 11.00 mA

This completes the setting.

Lower limit (Lower)

Set the reference current for the 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.

If a value larger than Upper (p.43) is set, the Lower setting will change according to the Upper setting.

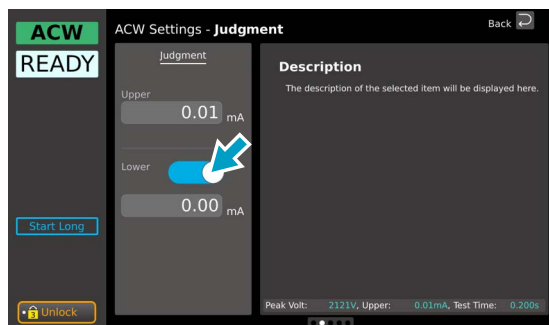
NOTE

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 EUT errors, breaks in the test leads, and poor connections, enabling you to perform highly reliable testing.

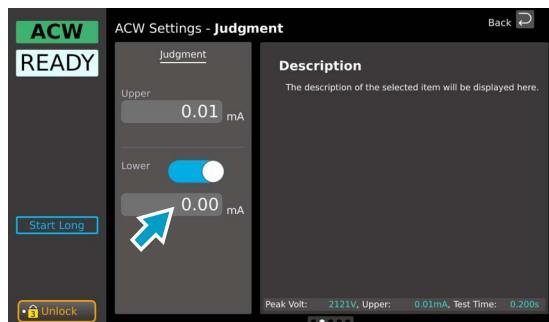
1 Tap Judgment on the setting screen of test conditions (p.37).

2 Tap the toggle button of Lower to set ON/OFF.

The following figure shows a screen example during an ACW test.



3 If it is set to ON, tap the entry field to enter a current.



ACW setting range: 0.01 mA to 109.99 mA

DCW setting range: 0.01 mA to 10.99 mA

This completes the setting.

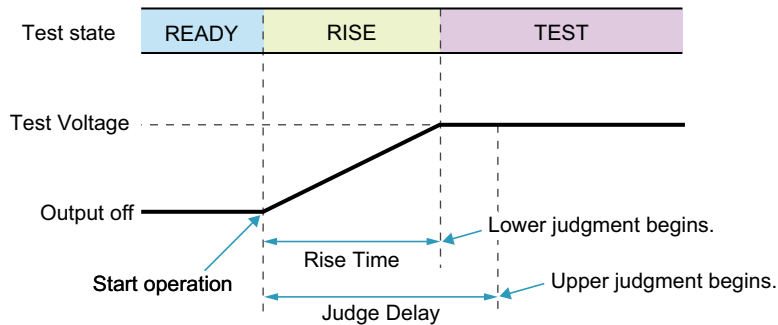
Judgment delay (Judge Delay)

Judge Delay can be set for DC withstanding (DCW) voltage testing.

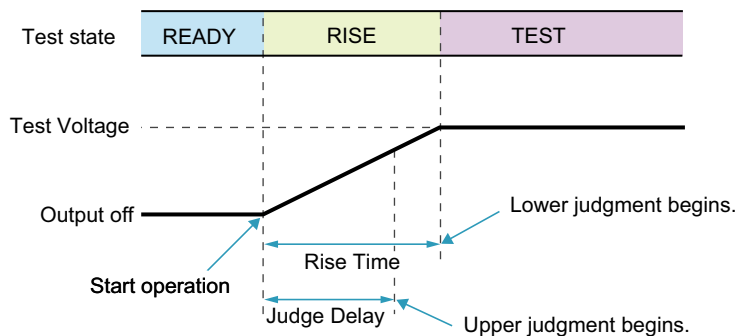
When the test voltage is applied to an EUT with a capacitive component, a large charge current may flow until charging is completed. Judgment errors due to the effects of charge current can be prevented by setting the time from when the test start operation is performed to the start of an upper limit judgment.

Referring to the figure below, set a time shorter than the total of the Voltage rise time (Rise Time) (p.48) and the Test time (p.46).

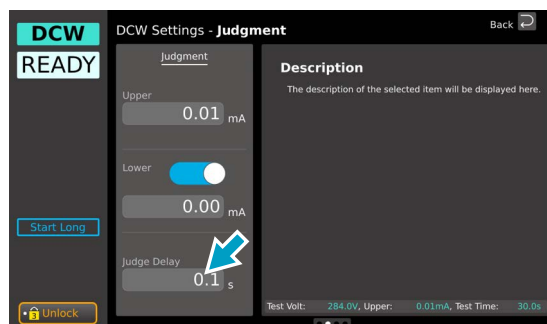
■ When Judge Delay is longer than Rise Time



■ When Judge Delay is shorter than Rise Time



- 1 Tap Judgment on the setting screen of test conditions (p.37).
- 2 Tap the entry field of Judge Delay to enter a time.



Setting range: 0.1 s to 100.0 s

This completes the setting.

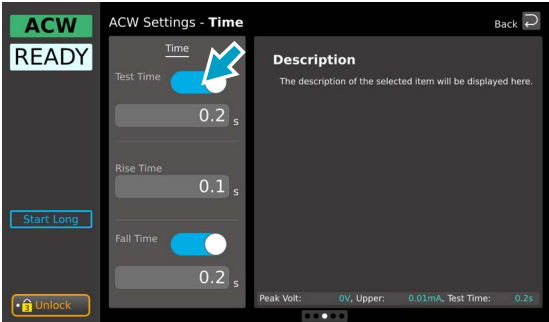
Test time

Set value	Description
ON	Voltage rise time (Rise Time) (p.48) has passed until 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/RESET switch is pressed. Pass judgments are not made.

If the sum of the times set for Test Time and Rise Time is shorter than the time set for Judge Delay, the set value of Judge Delay will change according to the sum of Test Time and Rise Time.

If the Time Unit (p.55) is set to CYCLE, the test time is fixed to ON and an AC cycle is set in Test Cycle (p.47).

- 1 Tap Time on the setting screen of test conditions (p.37).
- 2 Tap the toggle button of Test Time to set ON/OFF.
The following figure shows a screen example during an ACW test.



- 3 If it is set to ON, tap the entry field to enter a time.



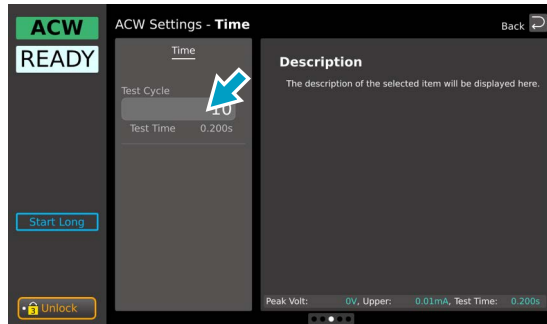
Setting range: 0.1 s to 1000.0 s
This completes the setting.

Test cycle

You can set a Test Cycle if the Time Unit ([p.55](#)) is set to CYCLE for AC withstanding (ACW) voltage testing.

Set a test time in AC cycles.

- 1 Tap Time on the setting screen of test conditions ([p.37](#)).
- 2 Tap the entry field of Test Cycle and enter a setting.



Test Time shows a converted test time value.

The range of the setting depends on the frequency setting ([p.41](#)).

Frequency setting	Setting range	Setting resolution
50 Hz	2 to 50000	1
60 Hz	2 to 60000	1

This completes the setting.

Voltage rise time (Rise Time)

Set the time from the test start operation until the test voltage (p.39) is reached, or from the start voltage (p.40) until the test voltage is reached.

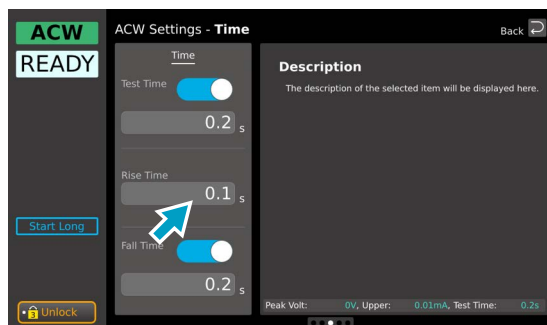
If the sum of the times set for Test Time and Rise Time is shorter than the time set for Judge Delay, the set value of Judge Delay will change according to the sum of Test Time and Rise Time.

In ACW tests, it is fixed to OFF if Time Unit (p.55) is set to CYCLE and Phase Shift (p.42) is 0°.

In ACW tests, it is fixed to 1/4 Cycle if Time Unit is CYCLE and Phase Shift is 90°.

1 Tap Time on the setting screen of test conditions (p.37).

2 Tap the entry field of Rise Time and enter a time.



Setting range: 0.1 s to 100.0 s

This completes the setting.

Voltage fall time (Fall Time)

You can set the time after the Test Time (p.46) has passed until a voltage decreases from the test voltage to approximately 0 V.

If the Time Unit (p.55) is set to CYCLE for ACW testing, it is fixed to OFF.

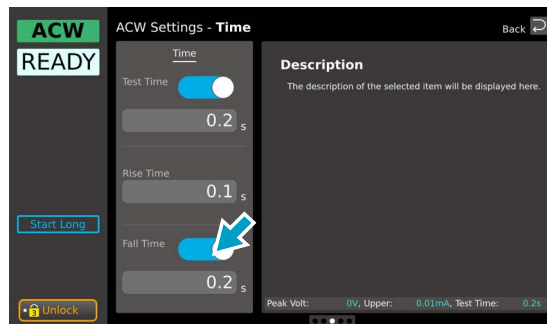
In DCW tests, note the following.

- After Fall Time ends, it will move to Discharge time (p.50). If Fall Time is set to off and a fail judgment occurs or the STOP/RESET switch is pressed during the test, discharge starts immediately without transitioning to Fall Time.
- Since the TOS54 series cannot absorb current during output, the voltage may not drop to around 0 V during the Fall Time period depending on the Fall Time setting and the connected load.

1 Tap Time on the setting screen of test conditions (p.37).

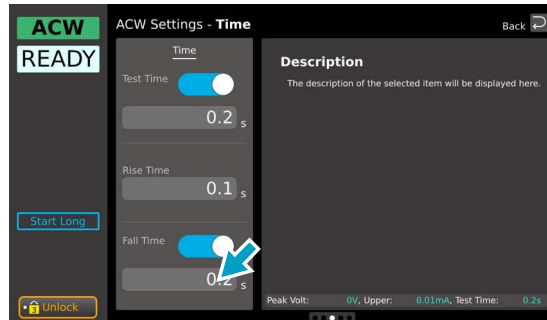
2 Tap the toggle button of Fall Time to set ON/OFF.

The following figure shows a screen example during an ACW test.



If Test Time is set to OFF, Fall Time cannot be set, and the toggle button is grayed out.

3 If it is set to ON, tap the entry field to enter a time.



Setting range: 0.1 s to 100.0 s

This completes the setting.

Discharge time

Judge Delay can be set for DC withstanding (DCW) voltage testing.

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 testing, Voltage fall time (Fall Time) (p.49) has passed. If Fall Time is set to off and a fail judgment occurs or the STOP/RESET 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 required to discharge the voltage between the TOS54 series output terminals from 6000 V to 30 V is as follows:

- When the EUT is not connected: approx. 16 ms
- When the EUT with an input capacitance of 0.05 μF is connected: approx. 45 ms

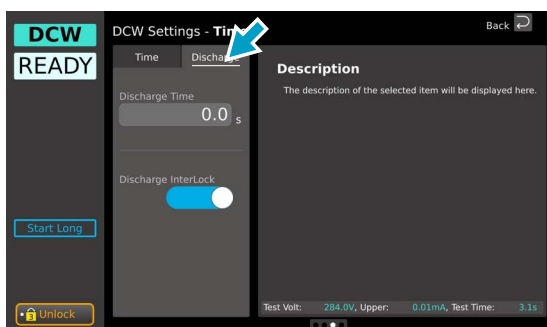
When the EUT capacitance is C, the estimated discharge time t_d from voltage V_e to 30 V is given by the following formula.

$$t_d = -\{125000 * (0.02e-6 + C)\} * \ln(30 / V_e)$$

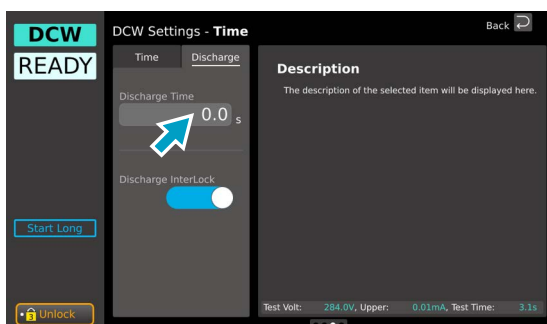
Setup procedure

1 Tap Time on the setting screen of test conditions (p.37).

2 Tap Discharge.



3 Tap the entry field of Discharge Time to enter a time.



Setting range: 0.0 s to 100.0 s

This completes the setting.

Discharge when interlock is activated (Discharge Interlock)

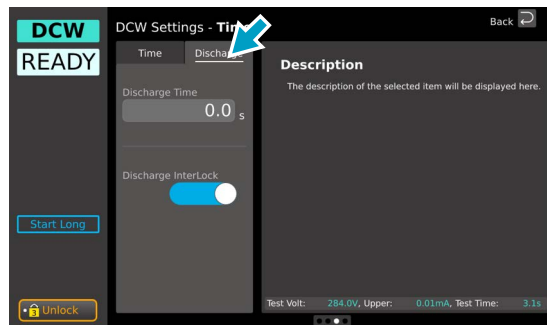
Judge Delay can be set for DC withstanding (DCW) voltage testing.

During a test, the EUT, test leads, test probes, output terminals, and other peripheral components are charged to a high voltage. You can set whether to discharge the voltage remaining in the high voltage charge area if the interlock (p.106) is activated during a test.

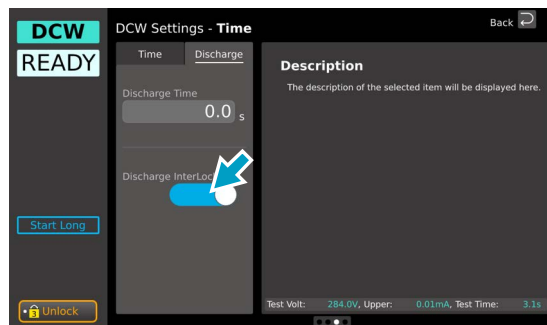
Set value	Description
ON	The voltage remaining in the high voltage charge area is discharged if the interlock is activated during a test. Use this when you do not want the voltage to remain if the interlock is activated, such as when a capacitive EUT is connected.
OFF	The output's high voltage relay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

1 Tap Time on the setting screen of test conditions (p.37).

2 Tap Discharge.



3 Tap the toggle button of Discharge InterLock to set ON/OFF.



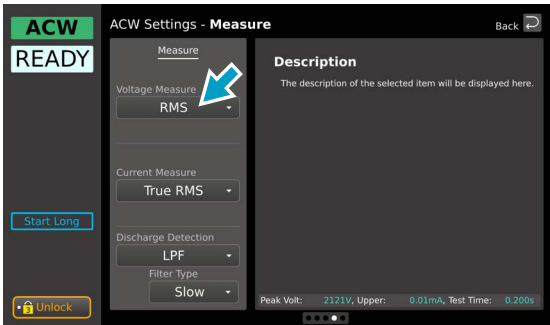
This completes the setting.

Voltage measure

This can be set for AC withstanding voltage (ACW) tests.
Sets the voltage measurement mode.

Set value	Description
RMS	Measures in true rms values.
Average	Measures by converting the mean-value responses to rms values.

- 1 Tap Measure on the setting screen of test conditions (p.37).
- 2 Tap the entry field of Voltage Measure to set a measurement mode.



This completes the setting.

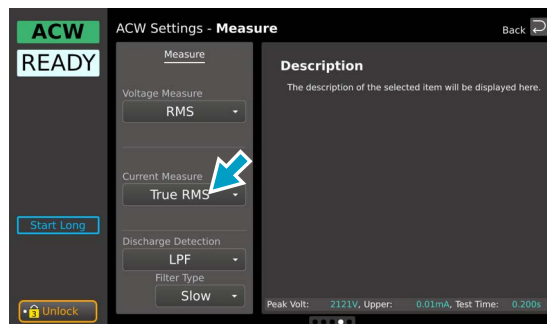
Current measurement mode (Current Measure)

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

Sets the current measurement mode.

Set value	Description
True RMS	Measures in true rms values.
Average	Measures by converting the mean-value responses to rms values.

- 1 Tap Measure on the setting screen of test conditions (p.37).
- 2 Tap the entry field of Current Measure to set a measurement mode.



This completes the setting.

Discharge detection

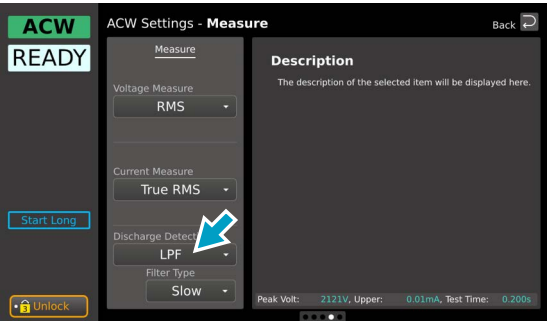
Set the response speed (sensitivity) for detecting the current when making upper limit judgments.

Discharge Detection	Filter Type	Description
LPF (Low Pass Filter)	Slow	Mean-value response type current detector. This is equivalent to the current detection response of Kikusui's general-purpose AC withstanding voltage testers. This setting is suitable for detecting dielectric breakdown defined in safety standards. It is used for performing withstanding voltage tests on general electronic devices and electronic components. This setting makes it difficult to detect corona discharge and the like, which are not considered to be dielectric breakdown in typical safety standards.
	Medium	With a mean-value response type current detector closer to peak detection, the response is faster than the Slow setting. Because the upper limit judgment detection speed is fast, this setting is suitable for performing withstanding voltage tests on compact electronic components and other EUT's prone to dielectric breakdown. But, because current may be detected for corona discharges and other instantaneous discharges and discharges with high frequency components, this setting may not be suitable for reproducible withstanding voltage tests.
	Fast	
HPF (High Pass Filter)	Low	The discharge current waveform after passing through the high-pass filter is compared with the reference value.
	Medium	Detection sensitivity increases in the order of Low, Medium, and High.
	High	Extremely small discharges such as corona discharges will be detected but reproducibility will be low.

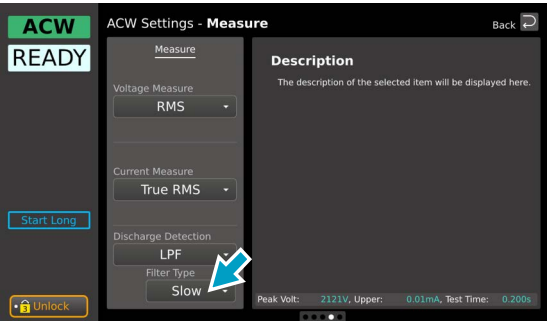
1 Tap Measure on the setting screen of test conditions (p.37).

2 Tap the entry field of Discharge Detection to set a filter.

The following figure shows a screen example during an ACW test.



3 Tap the entry field of Filter Type to set a response speed.



This completes the setting.

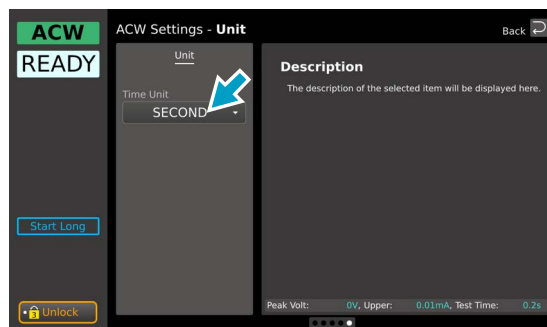
Test time unit (Time Unit)

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

You can select the unit of a test time from seconds or AC cycles.

Set value	Description
SECOND	Sets the unit of a test time to seconds.
CYCLE	Sets the unit of a test time to AC cycles. Test Time is fixed to ON. Start Voltage and Fall Time are fixed to OFF. Rise Time is fixed to OFF if Phase Shift is 0°, and to 1/4 Cycle if Phase Shift is 90°.

- 1 Tap Unit on the setting screen of test conditions (p.37).
- 2 Tap the entry field of Time Unit to set the unit.



This completes the setting.

Starting a Test

We recommend that you perform a pre-test inspection before executing a test ([p.154](#)).

Output time limit

The heat radiation capacity of the voltage generation part for withstanding voltage testing is 50 % of the rated output. When withstanding voltage tests are conducted consecutively, thus, the output time limit and a 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 left of the display when you press the STOP/RESET 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)
	$5 \text{ mA} < i \leq 11 \text{ mA}$	1 min. max.	At least the length of time the voltage was output

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

Starting a test

WARNING

Risk of electric shock.

- Do not touch the EUT, HIGH VOLTAGE terminals, test leads, test probes, output terminals, or other peripheral components 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.

- 1 Check that the TOS54 series is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then perform the start operation. [\(p.36\)](#)

The following figure shows a screen example during an ACW test. The available tests vary depending on models.

READY icon



The DANGER LED lights, and the test starts.

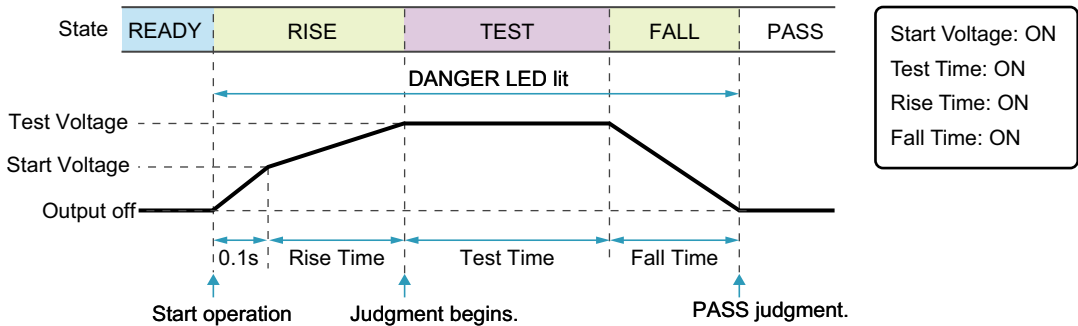
If the test does not start, see “Unable to start a test” [\(p.187\)](#).

If you want to start another test after the test finishes, set a rest time [\(p.56\)](#) between tests as necessary.

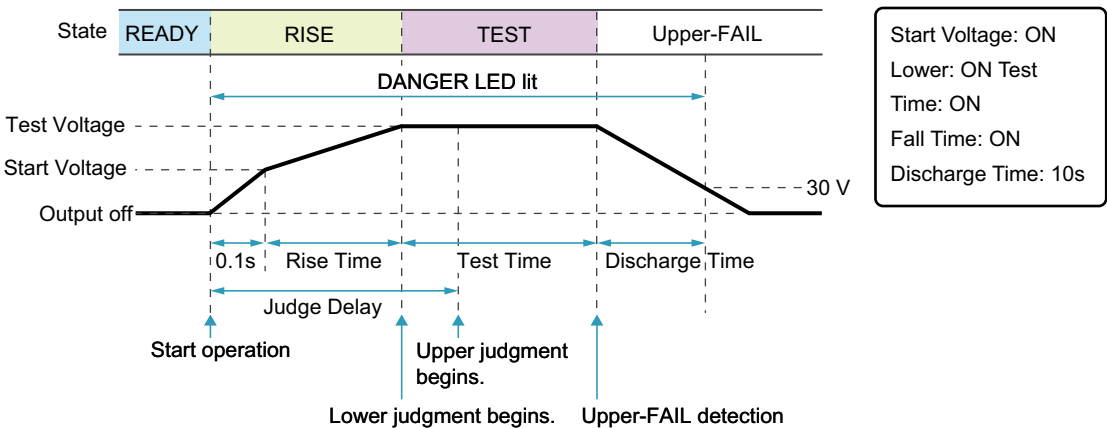
Operation after a test starts

Shown below are examples of operation after a test starts.

■ Example of an ACW test (PASS judgment)

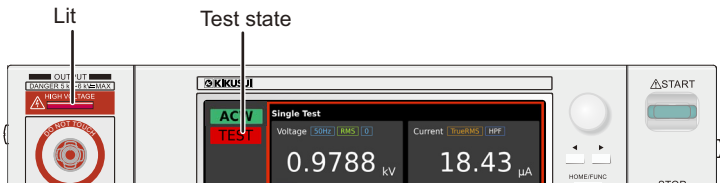


■ Example of a DCW test (FAIL judgment)



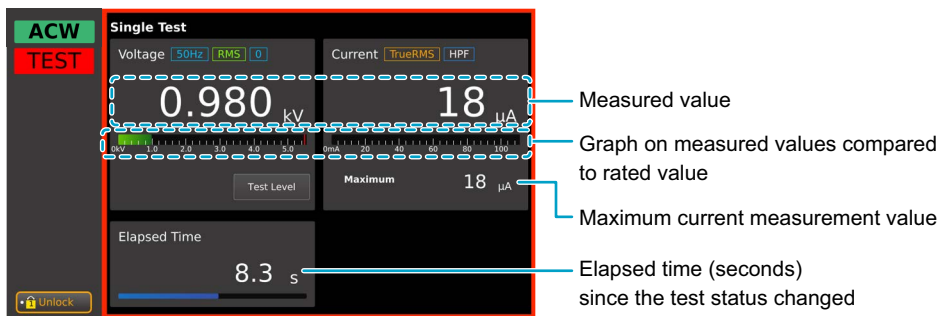
■ DANGER LED and test status display

During testing, the DANGER LED is lit and the current test state appears on the upper left of the display. The DANGER LED lights if voltage remains at the output terminals regardless of the test status.



Test state.	Description
TEST	Testing
↗RISE	Voltage rising
↘FALL	Voltage falling

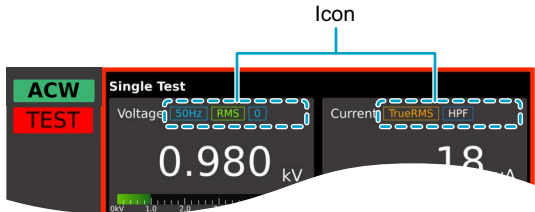
■ Measurement display



Up to 3600000.0 seconds are displayed. After 3600000.0 seconds, +Over is displayed.

■ Test condition display

Icons indicating the test conditions appear during testing.



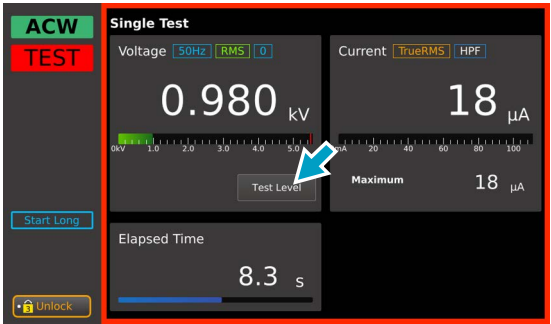
Icon	Description
50Hz / 60Hz	Frequency setting (50 Hz / 60 Hz)
0 / 90	Phase shift setting (0° / 90°)
RMS / Average	Volt Measure setting (RMS/Average)
TrueRMS / Average	Volt Measure setting (True RMS / Average)
LPF / HPF	Discharge Detection setting (LPF/HPF)

Changing the test voltage during a test

You can change the test voltage by tapping Test Level during a test.

The changed voltage is immediately applied to the test, but the voltage value on the display shows the measured value. The voltage setting is kept changed after the test is finished.

Drastic change in output may issue an Output Error.



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/RESET.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

- a. When FAIL judgment is not made.
- b. When the test time passes if the Test Time is set to ON.
- c. When you press STOP/RESET

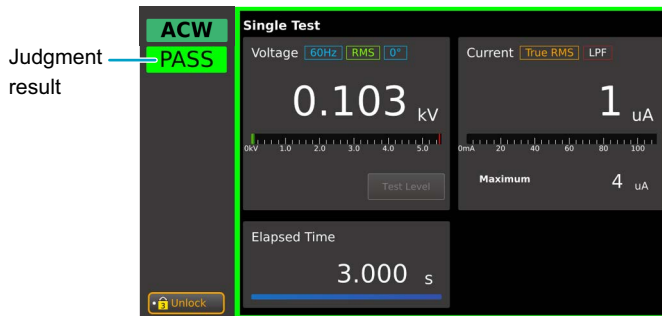
In the above cases, the "TEST" indication on the display disappears when the test ends. When the voltage residing at the output terminals is discharged, the DANGER LED turns off.

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

If a test finishes under above condition "b," the judgment result will appear on the display when the Fall Time is set to OFF. If the Fall Time is set to ON, the judgment result will appear after the Fall Time has passed.

Judgment types and operation

The judgment result is displayed when a test is completed.



	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.	A FAIL judgment was not made during the test.
Display	"Upper-Fail" appears until the judgment result is cleared.	"Lower-Fail" appears until the judgment result is cleared.	"PASS" appears until the time specified for Pass Hold passes. Then the judgment result is cleared.
Beep sound	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 0.2 seconds (regardless of the time specified by Pass Hold).
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.	The PASS signal is output until the judgment result is cleared.

Clearing the judgment result

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

Insulation Resistance Test

Applicable models: **5402**, **5403**

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

- Setting Test Conditions ([p.62](#))
- Starting a Test ([p.74](#))
- Finishing the Test and Viewing the Judgment ([p.77](#))

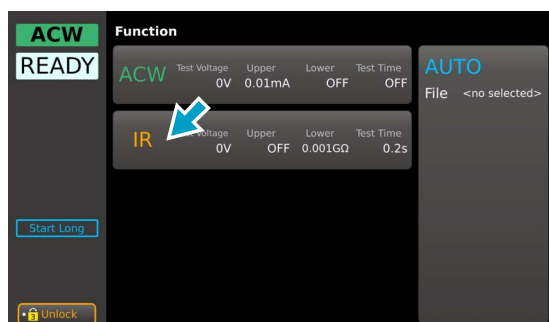
Setting Test Conditions

This section describes the outline of insulation resistance (IR) test conditions and how to configure settings.

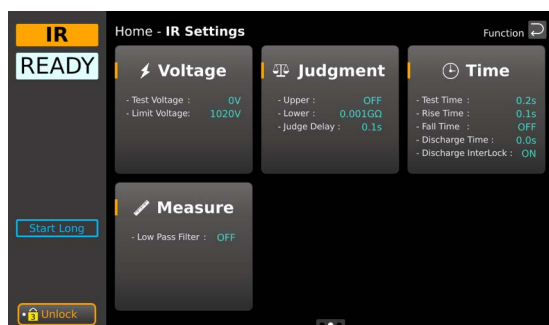
Displaying the setting screen

1 Tap IR on the Function screen.

The available tests vary depending on models.



The setting screen of test conditions appears.



Set the required conditions by referring to the description of test conditions ([p.63](#)).

Description of test conditions

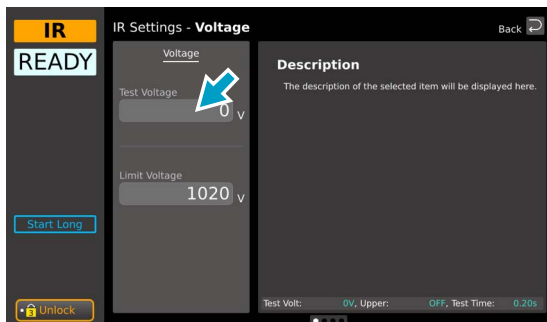
The following table shows the test conditions that you can set for insulation resistance (IR) testing.

Test condition	Overview
Test voltage	Voltage to apply to the EUT. (p.64)
Limit voltage	Upper limit of voltage to apply to the EUT. (p.64)
Upper limit (Upper)	Resistance used as a reference for upper limit judgment. (p.65)
Lower limit (Lower)	Resistance used as a reference for lower limit judgment. (p.66)
Judgment delay (Judge Delay)	Time from the test start operation to the start of upper judgment. (p.67)
Test time	Time from when the voltage rise time has passed to the end of the test. (p.68)
Voltage rise time (Rise Time)	Time from the test start operation until the test voltage is reached. (p.69)
Voltage fall time (Fall Time)	The time from a pass judgment until the voltage falls. (p.70)
Discharge time	The time for discharging the voltage residing in the high voltage charge area. (p.71)
Discharge when interlock is activated (Discharge Interlock)	Discharges the voltage when the interlock is activated. (p.72)
Using the low-pass filter	Stabilize measurements when measuring at high sensitivity or when the measurements are unstable and hard to read. (p.73)

Test voltage

Set the voltage to apply to the EUT. You cannot specify a voltage that exceeds the limit voltage (p.64).

- 1 Tap Voltage on the setting screen of test conditions (p.62).
- 2 Tap the entry field of Test Voltage to enter a voltage.



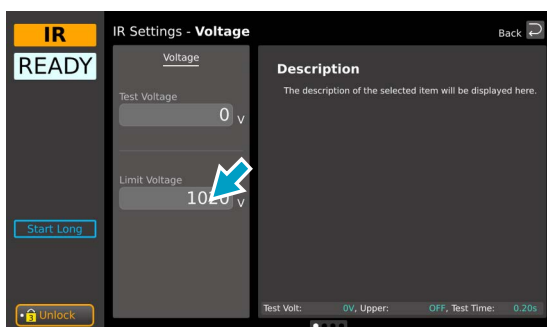
Setting range: 0 V to 1020 V

This completes the setting.

Limit voltage

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

- 1 Tap Voltage on the setting screen of test conditions (p.62).
- 2 Tap the entry field of Limit Voltage to enter a voltage.



Setting range: 0 V to 1020 V

This completes the setting.

Upper limit (Upper)

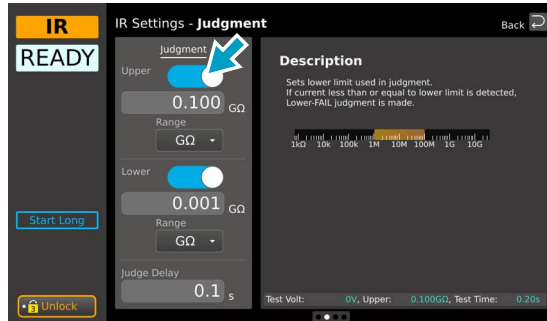
Set the reference resistance for upper limit judgment. If a value greater than or equal to Upper is measured, upper limit judgment (U-FAIL) results. To disable upper limit judgment, set Upper to off.

If a value smaller than Lower (p.66) is set, the Lower setting will change according to the Upper setting.

NOTE

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

- 1 Tap Judgment on the setting screen of test conditions (p.62).
- 2 Tap the toggle button of Upper to set ON/OFF.



- 3 If it is set to ON, tap the entry field to enter a resistance value.
Tap Range to select the unit of a resistance value from GΩ and MΩ.
The setting range depends on the setting of Range.

Range	Setting range
GΩ	0.001 GΩ to 10.000 GΩ
MΩ	0.001 MΩ to 999.999 MΩ

This completes the setting.

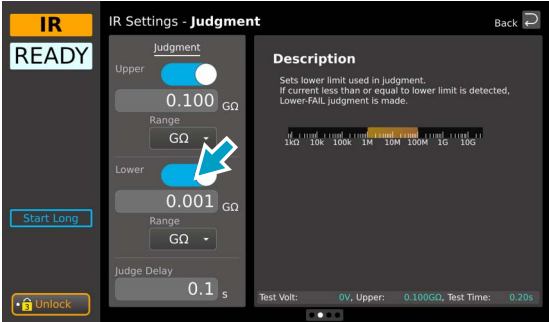
Lower limit (Lower)

Set the reference resistance for the lower limit judgment. If a resistance less than or equal to Lower is measured, lower limit judgment (Lower-FAIL) results. To disable lower limit judgment, set Lower to off.
If a value larger than Upper (p.65) is set, the Upper setting will change according to the Lower setting.

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 EUT errors, breaks in the test leads, and poor connections, enabling you to perform highly reliable testing.

- 1 Tap Judgment on the setting screen of test conditions (p.62).
- 2 Tap the toggle button of Lower to set ON/OFF.



- 3 If it is set to ON, tap the entry field to enter a resistance value.
Tap Range to select the unit of a resistance value from GΩ and MΩ.
The setting range depends on the setting of Range.

Range	Setting range
GΩ	0.001 GΩ to 9.999 GΩ
MΩ	0.000 MΩ to 999.999 MΩ

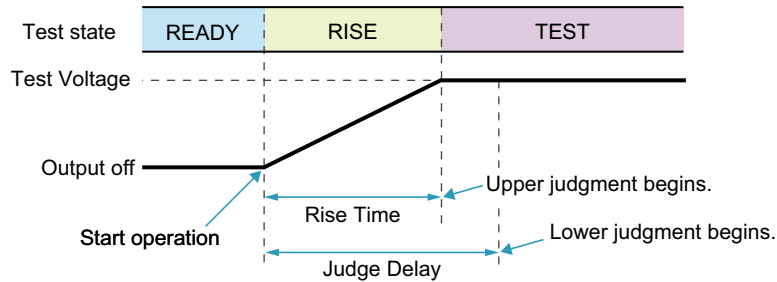
This completes the setting.

Judgment delay (Judge Delay)

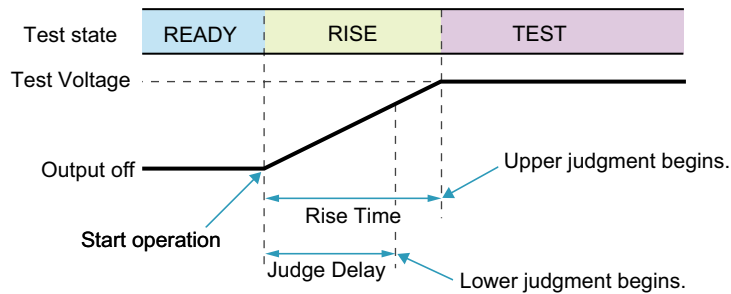
When the test voltage is applied to an EUT with a capacitive component, a large charge current may flow until charging is completed. Judgment errors due to the effects of charge current can be prevented by setting the time from when the test start operation is performed to the start of a limit judgment.

Referring to the figure below, set a time shorter than the total of the Voltage rise time (Rise Time) (p.69) and the Test time (p.68).

■ When Judge Delay is longer than Rise Time

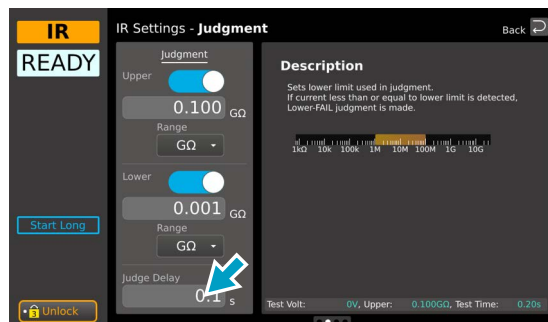


■ When Judge Delay is shorter than Rise Time



1 Tap Judgment on the setting screen of test conditions (p.62).

2 Tap the entry field of Judge Delay to enter a time.



Setting range: 0.1 s to 100.0 s

Resolution: 0.1 s

This completes the setting.

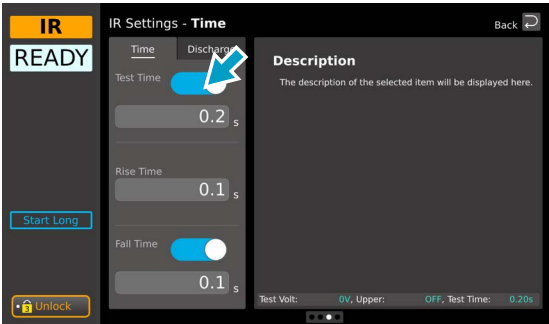
Test time

You can set ON/OFF of the test time.

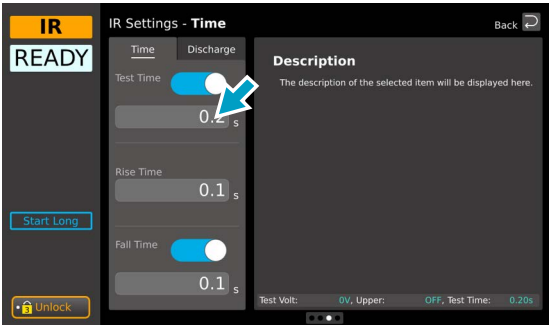
Set value	Description
ON	Voltage rise time (Rise Time) (p.69) has passed until the end of the test. If upper limit judgment (Upper-FAIL) or lower limit judgment (Lower-FAIL) does not occur during a test, the test will result in PASS. For a judgment of 1 μ A or less, a test time of at least 1.0 second is necessary.
OFF	The test continues until the STOP/RESET switch is pressed. Pass judgments are not made.

If the sum of the times set for Test Time and Rise Time is shorter than the time set for Judge Delay, the set value of Judge Delay will change according to the sum of Test Time and Rise Time.

- 1 Tap Time on the setting screen of test conditions (p.62).
- 2 Tap the toggle button of Test Time to set ON/OFF.



- 3 If it is set to ON, tap the entry field to enter a time.



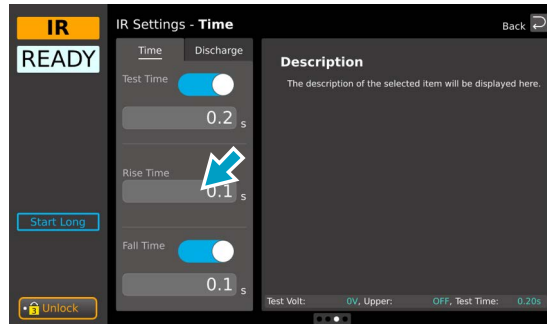
Setting range: 0.1 s to 1000.0 s
Resolution: 0.1 s
This completes the setting.

Voltage rise time (Rise Time)

Set the time from the test start operation until the test voltage is reached ([p.64](#)).

If the sum of the times set for Test Time and Rise Time is shorter than the time set for Judge Delay, the set value of Judge Delay will change according to the sum of Test Time and Rise Time.

- 1 Tap Time on the setting screen of test conditions ([p.62](#)).
- 2 Tap the entry field to enter a time.



Setting range: 0.1 s to 100.0 s

Resolution: 0.1 s

This completes the setting.

Voltage fall time (Fall Time)

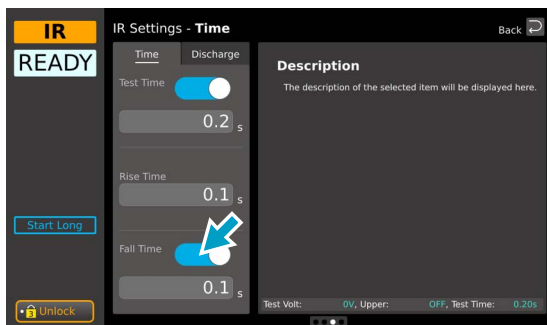
You can set the time after the Test Time (p.68) has passed until a voltage decreases from the test voltage to approximately 0 V.

Note the following.

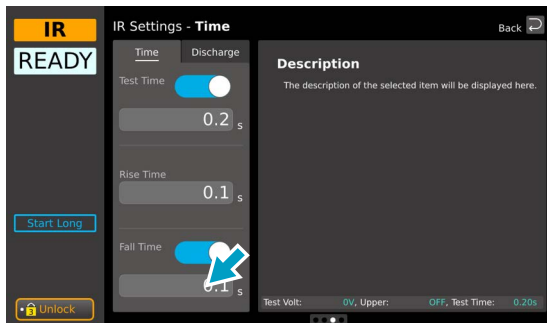
- After Fall Time ends, it will move to Discharge time (p.71).
- An electrical discharge immediately starts without shifting to the Fall Time in the following cases.
 - When the Fall Time is OFF
 - When a FAIL judgment is made
 - When the STOP/RESET switch is pressed during testing
- Since the TOS54 series cannot absorb current during output, the voltage may not drop to around 0 V during the Fall Time period depending on the Fall Time setting and the connected load.

1 Tap Time on the setting screen of test conditions (p.62).

2 Tap the toggle button of Fall Time to set ON/OFF.



3 If it is set to ON, tap the entry field to enter a time.



Setting range: 0.1 s to 100.0 s

Resolution: 0.1 s

This completes the setting.

Discharge time

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.

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 required to discharge the voltage between the TOS54 series output terminals from 1000 V to 30 V is as follows:

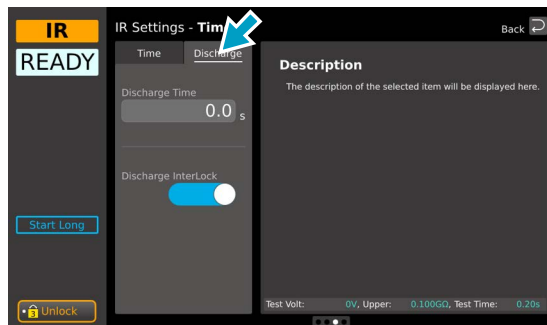
- When the EUT is not connected: approx. 1.5 ms
- When the EUT with an input capacitance of 0.05 μF is connected: approx. 6 ms

When the EUT capacitance is C, the estimated discharge time t_d from voltage V_e to 30 V is given by the following formula.

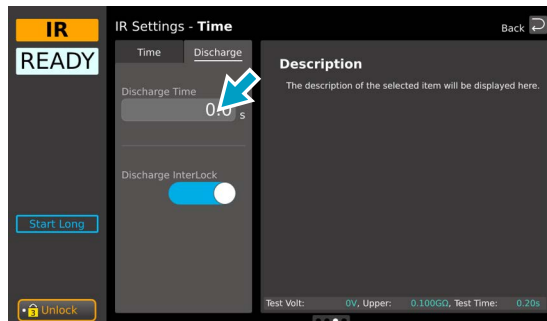
$$t_d = -(20000 * (0.01e-6 + C)) * \ln(30 / V_e)$$

Setup procedure

- 1 Tap Time on the setting screen of test conditions (p.62).
- 2 Tap Discharge.



- 3 Tap the entry field of Discharge Time to enter a time.



Setting range: 0.0 s to 100.0 s

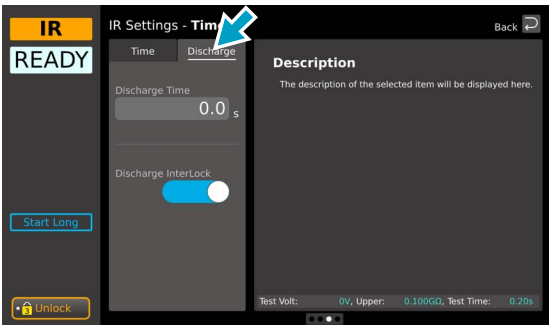
This completes the setting.

Discharge when interlock is activated (Discharge Interlock)

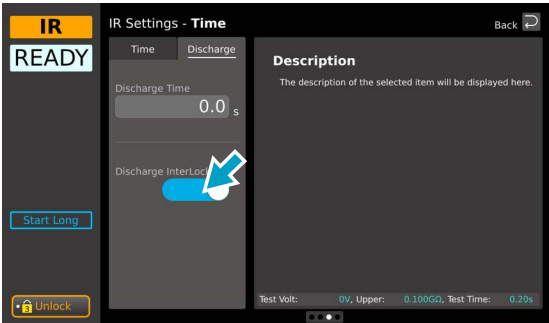
During a test, the EUT, test leads, test probes, output terminals, and other peripheral components are charged to a high voltage. You can set whether to discharge the voltage remaining in the high voltage charge area if the interlock (p.106) is activated during a test.

Set 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 Tap Time on the setting screen of test conditions (p.62).
- 2 Tap Discharge.



- 3 Tap the toggle button of Discharge InterLock to set ON/OFF.



This completes the setting.

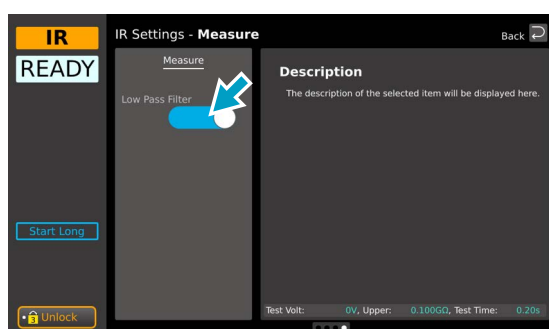
Using the low-pass filter

Turning the low-pass filter on stabilizes measurements when measuring at high sensitivity or when the measurements are unstable and hard to read.

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 Tap Measure on the setting screen of test conditions (p.62).
- 2 Tap the toggle button of Lower Pass Filter to set ON/OFF.



This completes the setting.

Starting a Test

We recommend that you perform a pre-test inspection before executing a test [\(p.154\)](#).

Starting a test

 WARNING

Risk of electric shock.

- Do not touch the EUT, HIGH VOLTAGE terminals, test leads, test probes, output terminals, or other peripheral components 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.

- 1 Check that the TOS54 series is correctly connected to the EUT.
- 2 Check that “READY” is shown on the display, and then perform the start operation [\(p.36\)](#)

READY icon

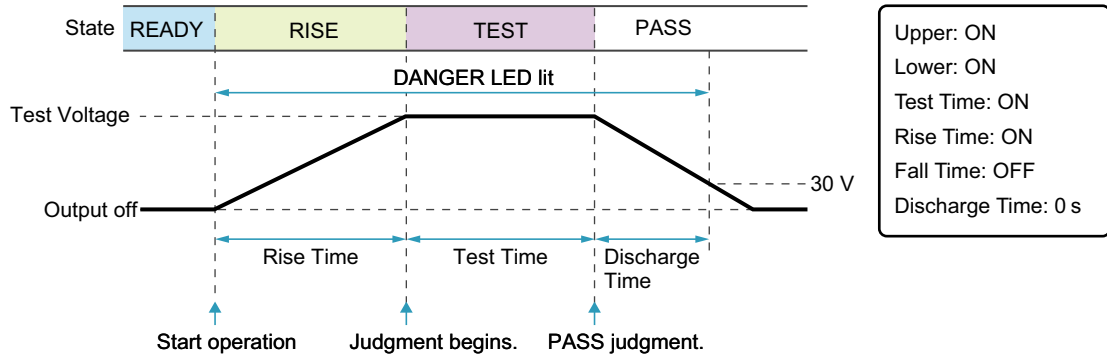


The DANGER LED lights, and the test starts.
If the test does not start, see “Unable to start a test” [\(p.187\)](#).

Operation after a test starts

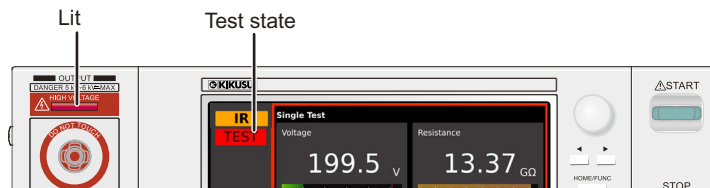
Shown below are examples of operation after a test starts.

■ Example of a PASS judgment



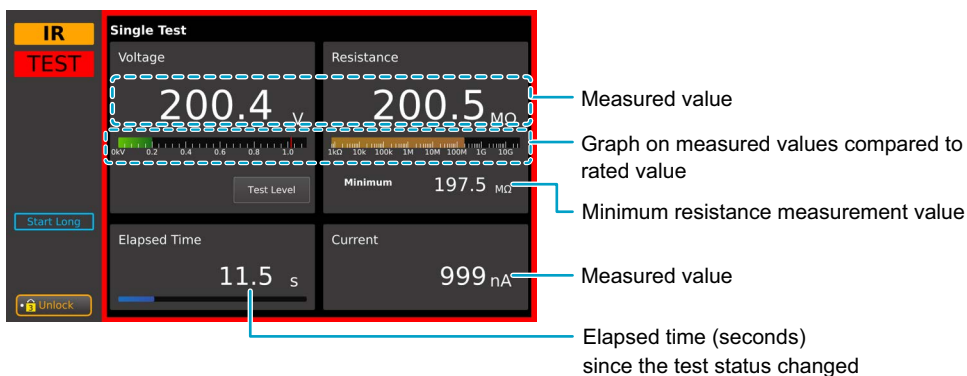
■ DANGER LED and test status display

During testing, the DANGER LED is lit and the current test state appears on the upper left of the display. The DANGER LED lights if voltage remains at the output terminals regardless of the test status.



Test state.	Description
TEST	Testing
RISE	Voltage rising
FALL	Voltage falling

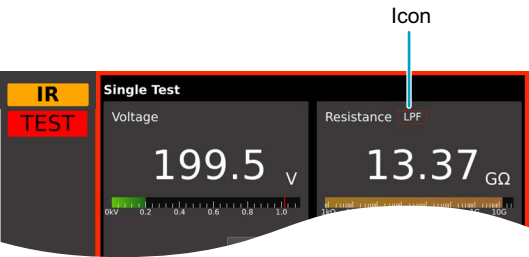
■ Measurement display



Up to 3600000.0 seconds are displayed. After 3600000.0 seconds, +Over is displayed.

■ Test condition display

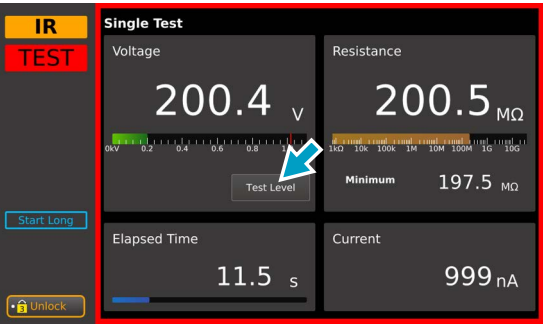
Icons indicating the test conditions appear during testing.



Icon	Description
LPF	Low Pass Filter is set to ON.

Changing the test voltage during a test

You can change the test voltage by tapping Test Level during a test.
The changed voltage is immediately applied to the test, but the voltage value on the display shows the measured value. The voltage setting is kept changed after the test is finished.
Drastic change in output may issue an Output Error.



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/RESET.



Conditions that cause a test to end

Conditions that cause a test to end are as follows:

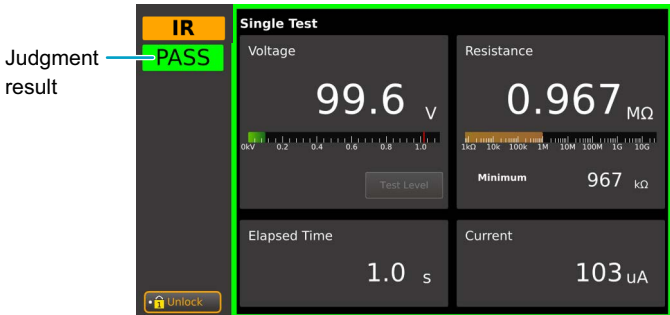
- a. When FAIL judgment is not made.
- b. When the test time passes if the Test Time is set to ON.
- c. When you press STOP/RESET

In the above cases, 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 the condition mentioned in a or b above, the judgment result ([p.78](#)) will appear on the display.

Judgment types and operation

The judgment result is displayed when a test is completed.



	Upper-FAIL	Lower-FAIL	PASS
Condition	A resistance greater than or equal to the upper limit was measured.	A resistance less than or equal to the lower limit was measured.	A FAIL judgment was not made during the test.
Display	“Upper-FAIL” appears until the judgment result is cleared.	“Lower-FAIL” appears until the judgment result is cleared.	“PASS” appears until the time specified for Pass Hold passes. Then the judgment result is cleared.
Beep sound	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 0.2 seconds (regardless of the time specified by Pass Hold).
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.	The PASS signal is output until the judgment result is cleared.

Clearing the judgment result

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

Measurement Function

This chapter describes settings for measurement and how to view/save measurement data.

Setting Measurement Conditions

You can set triggers, sampling, and the data size.

Setting triggers

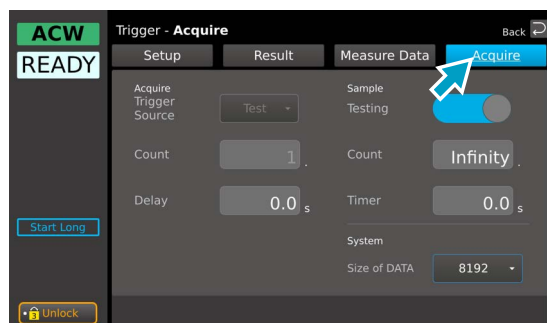
Set the timing for starting measurement.

Item	Set value	Description
Trigger Source ¹	Test (fixed)	The trigger is applied upon the test start operation.
	Immediate	The trigger is applied once the INIT or INIT:ACQ command is received in remote control.
	BUS	The trigger is applied after the INIT or INIT:ACQ command is received or once the *TRG or TRIG:ACQ command is received in remote control.
Count ¹	1 to 100 or Infinity (fixed to 1)	Set the number of times the trigger can be applied. If it is set to Infinity, the trigger wait state continues indefinitely.
Delay	0.0 s to 100.0 s (Resolution: 0.1 s)	Set the delay time until the measurement is started after the trigger is applied.

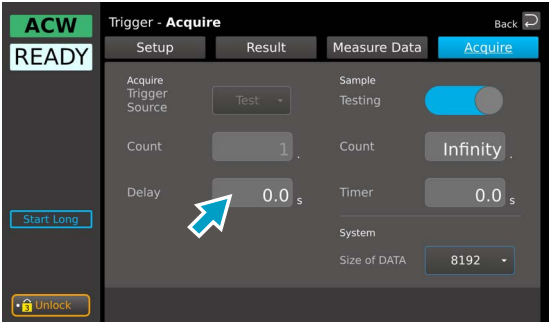
1. You can change the setting when using remote control. For details, see the Communication Interface Manual.

1 Press the MEMORY key.

2 Tap Acquire.



3 Tap the entry field of Delay to enter a delay time.



This completes the setting.

Setting sampling

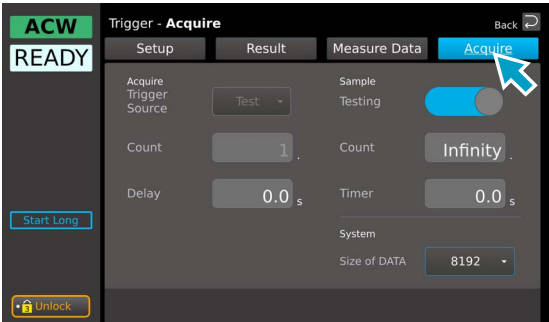
You can set the times of sampling at a time of measurement.

Item	Set value	Description
Testing ¹	ON (fixed)	Limits sampling to the period of a test. If a test finishes during recording, the rest of the times of sampling set for Count is ignored.
	OFF	Conducts sampling until the times of it reach those set for Count even though a test finishes.
Count	1 to 8192 or Infinity	Sets the times of sampling. If it is set to Infinity, the times of sampling are not limited.
Timer	0.0 s to 10.0 s	Sets a sampling interval.
	(Resolution: 0.1 s)	If it is set to 0.0 seconds, sampling will occur at the following intervals. • In ACW test at a frequency of 50 Hz (p.41): 10 ms • In ACW test at a frequency of 60 Hz (p.41): 8.33 ms • In DCW and IR tests: 100 ms

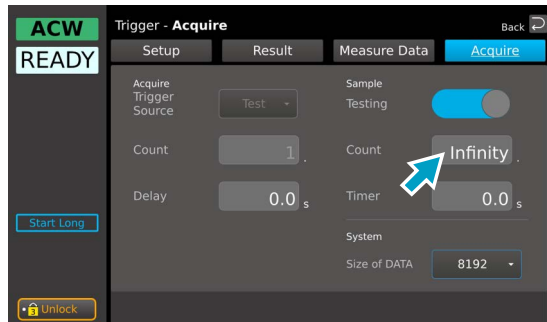
1. You can change the setting when using remote control. For details, see the Communication Interface Manual.

1 Press the MEMORY key.

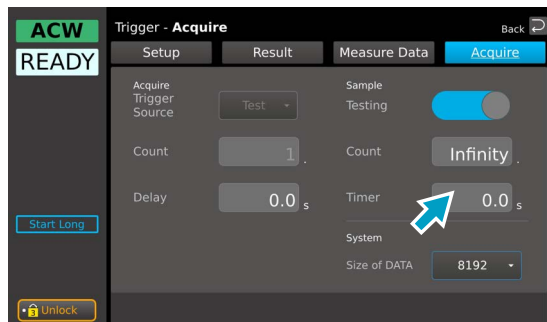
2 Tap Acquire.



- 3 Tap the entry field of Count to enter the times of sampling.**
If you keep turning the rotary knob counterclockwise during entry, you can select Infinity.



- 4 Tap the entry field of Timer to enter a time.**



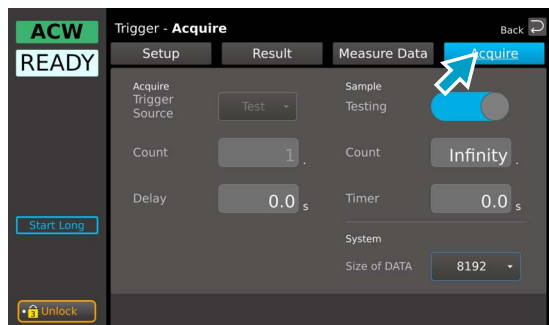
This completes the setting.

Setting the measurement data size

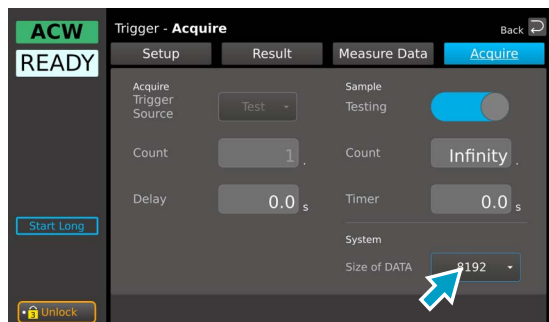
Select the maximum number of measurement data recordings from 8192, 16384, or 32768. If the maximum number of measurement data recordings is exceeded, the oldest measurement data will be discarded. When you change the data size, recorded measurement data will be deleted.

1 Press the **MEMORY** key.

2 Tap **Acquire**.



3 Tap the entry field of **Size of DATA** to select a data size.



This completes the setting.

Measurement

After pressing the **START** key, measurement starts after the time set in **Delay** ([p.79](#)) has passed. For checking and saving measured data, "Displaying/Saving the Measurement Data" ([p.122](#)).

Auto Test

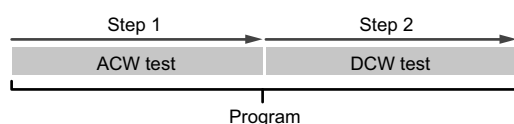
Auto test is a function that executes a sequence of test combinations set in advance. This section provides an overview of the auto test function and how to configure the test, execute the test, and import and export programs.

Auto Test Overview

This section describes the concept of programs and steps and the main functions of auto test.

Programs and steps

An auto test consists of programs and 2 steps. A single test can be configured for each step, and steps are executed in order from Step 1 to Step 2. When step 2 is complete, the program is complete. The following schematic diagram shows an exemplary program of TOS5401.



Main functions

The following types of programs are available. Programs are saved in the memory of the TOS54 series.

Type	Maximum number of programs	Number of steps	Executed under external control ¹	Changing the program name	Notes
Program	50	2 (fixed)	n/a	✓	—
Program memory	10	2 (fixed)	✓	n/a	Can be registered in memory numbers 51 to 60

1. "Recalling from Memory" ([p.109](#)) and "Starting and Stopping Tests" ([p.112](#)).

Configurable items

There are functions that can be set for each program, and those that can be set for each step.

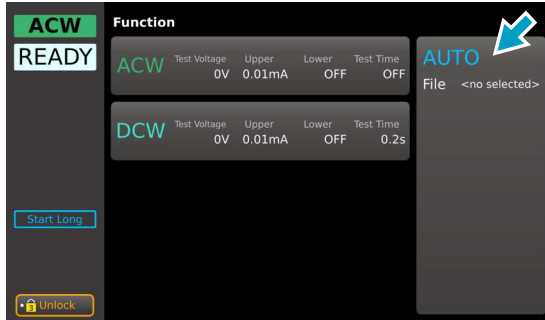
Setting range	Setting parameter	Description
For each program	Fail judgment operation	Set whether to stop the auto test or run all steps when a fail judgment occurs.
	Step start condition	Set the conditions for starting the test.
	Step interval	Set the step interval time.
By step	Test conditions of each test	You can set test conditions that are similar to those that are used when running tests individually, with a few exceptions.

Creating/Deleting Program

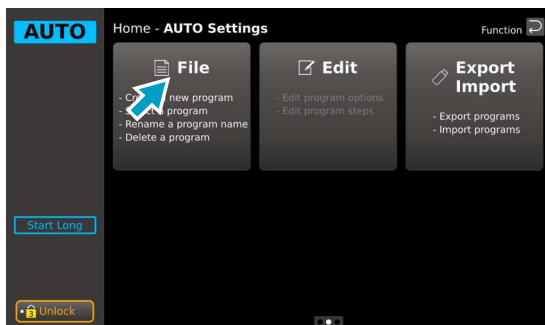
This section explains how to create programs, change program names, and delete programs.

Displaying the program list screen

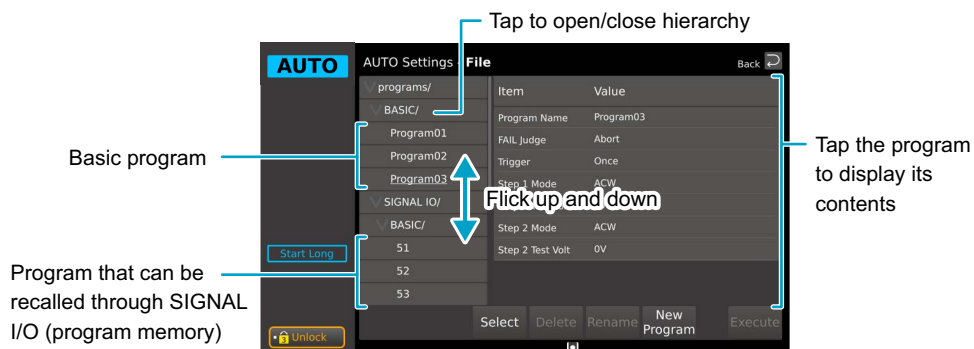
1 Tap AUTO on the Function screen.



2 Tap File.



The program list screen is displayed.



- Creating program as a new program ([p.85](#))
- Changing a program name ([p.86](#))
- Deleting a program ([p.87](#))

Creating program as a new program

The created program is automatically saved and is not deleted even if the POWER switch is turned off.

1 Tap New Program on the program list screen (p.84).

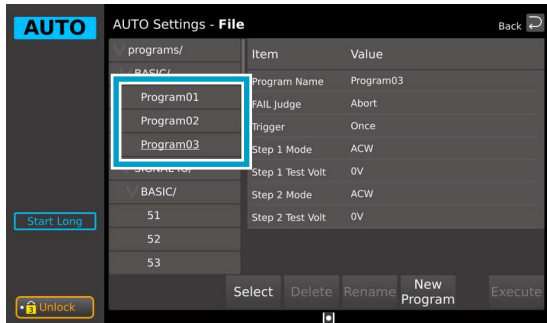


A program is newly created under “programs/BASIC/”.

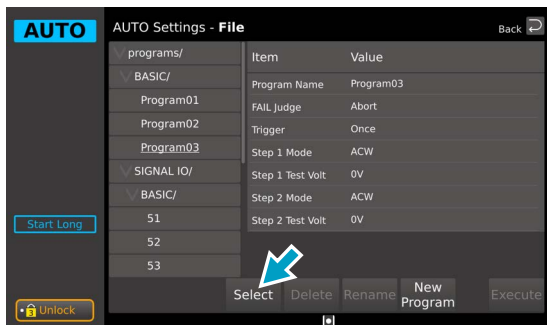
Changing a program name

You can change the name of a program saved under “programs/BASIC/”.

- 1 Tap any program on the program list screen (p.84).



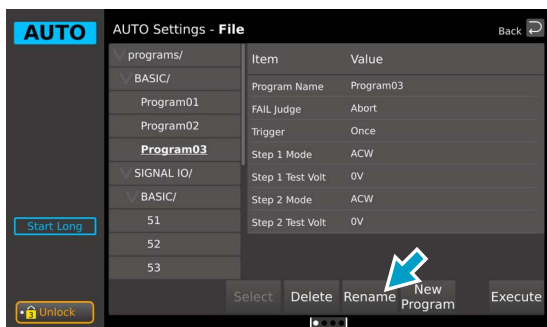
- 2 Tap Select



The program is selected.

- 3 Tap Rename to enter the new name of the program.

You can enter up to 55 characters.

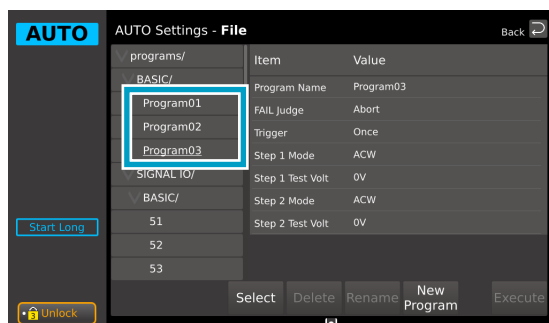


The program name is changed.

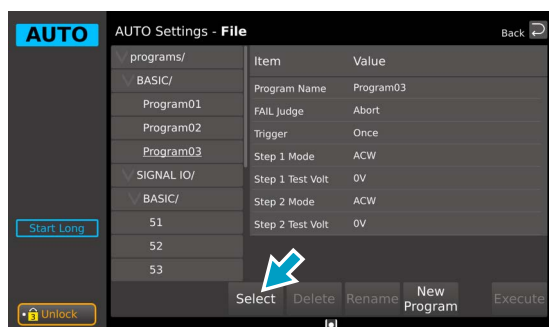
Deleting a program

You can delete a program saved under “programs/BASIC/”.

1 Tap any program on the program list screen (p.84).

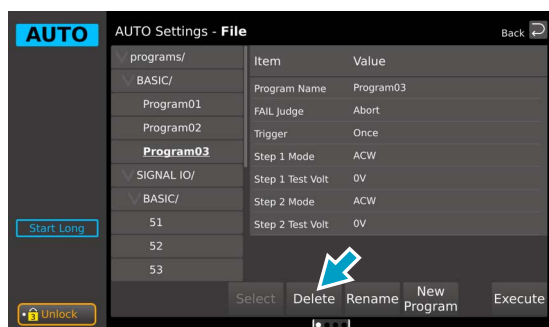


2 Tap Select



The program is selected.

3 Tap Delete.



The program is deleted.

Editing Programs and Steps

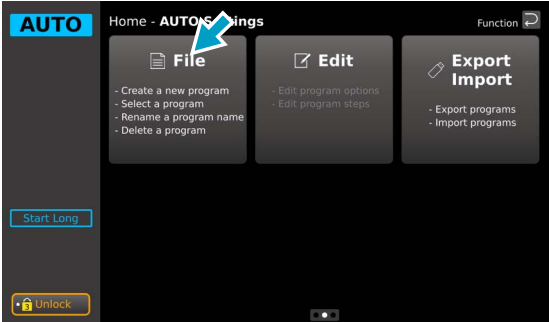
You can edit a program and steps to configure the operation of the program when it is executed.

Displaying the program/step editing screen

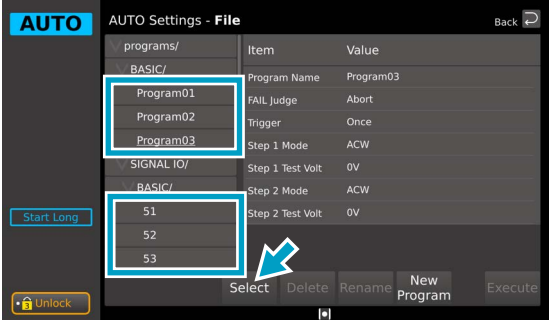
1 Tap AUTO on the Function screen.



2 Tap File.



3 Tap any program and then tap Select.

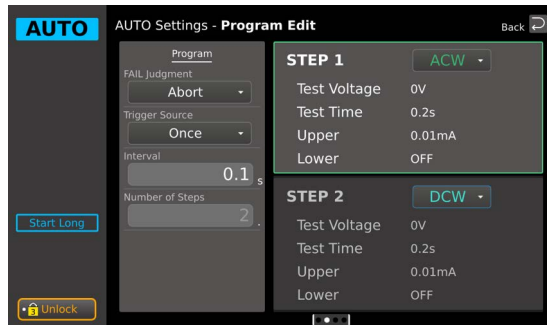


The program is selected.

4

Flick leftward.

The program/step editing screen appears.



If a program is already selected, the same screen will be shown by tapping Edit in Step 2.

Outline of program/step configuration ([p.89](#)) to proceed with configuration.

Outline of program/step configuration

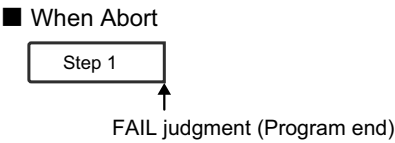
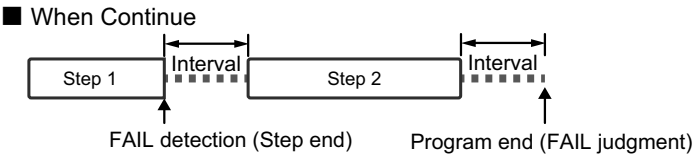
The table below shows the configurable items for programs and steps.

Setup	Overview
Configuration per program	Operation for FAIL judgment: Set whether to stop the auto test or run all steps when a fail judgment occurs. (p.90) Step start condition (Trigger Source): Selects the trigger for starting a step. (p.91) Step interval: Sets the step interval time. (p.92)
Configuration per step	You can set test conditions that are similar to those that are used when running tests individually, with a few exceptions. (p.92)

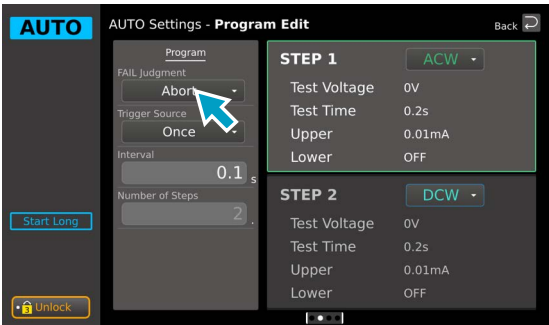
Operation for FAIL judgment

Set whether to stop the auto test or run all steps when a fail judgment occurs.

Set value	Overview
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	Finishes the program when a FAIL occurs, and a FAIL judgment is made.



1 Tap the entry field of FAIL Judgment on the program/step editing screen (p.88).



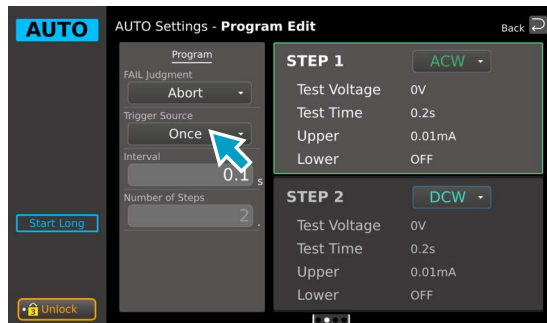
2 Tap and select a setting.
This completes the setting.

Step start condition (Trigger Source)

You can select the trigger for starting a step.

Set value	Overview
Immediate	When the INIT or INIT:TEST command is received via remote control, all steps will be executed consecutively.
BUS	When the *TRG or TRIG:TEST command is received via remote control, Step 1 starts. After Interval of Step 1, the program enters a trigger wait state. When the *TRG or TRIG:TEST command is received again, Step 2 starts.
External	Step 1 starts when you perform a start operation (p.36). After Interval of Step 1, the program enters a trigger wait state. Step 2 starts when you perform a start operation again.
Once	When you perform a start operation (p.36), all the steps are executed consecutively.

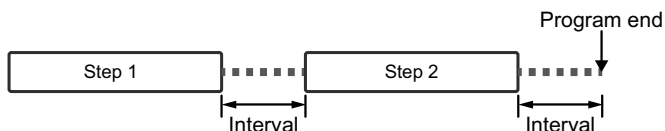
- 1 Tap the entry field of Trigger Source on the program/step editing screen (p.88).



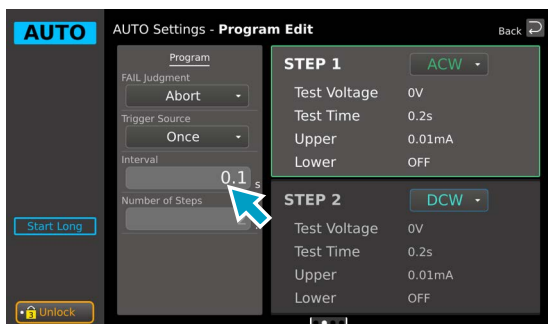
- 2 Tap and select a setting.
This completes the setting.

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 Tap the entry field of Interval on the program/step editing screen (p.88).



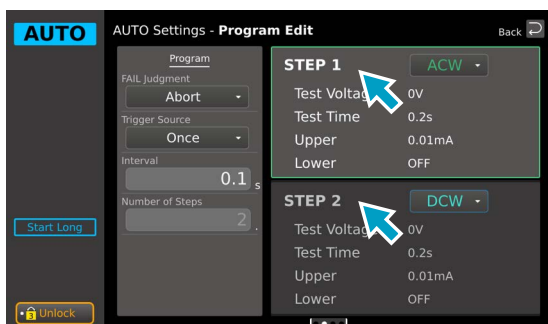
- 2 Enter the time.
Setting range: 0.1 s to 100.0 s
This completes the setting.

Editing step settings

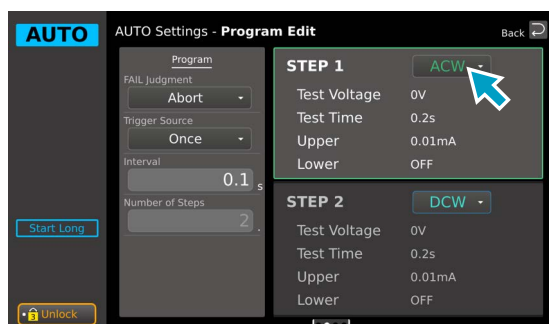
You can set test conditions that are similar to those that are used when running tests individually, with a few exceptions. The test conditions that cannot be configured for auto testing are as follows.

- Limit Voltage is fixed to the maximum rated value per test mode.
- Test Time is fixed to ON.
- Lower is fixed to ON for IR testing.

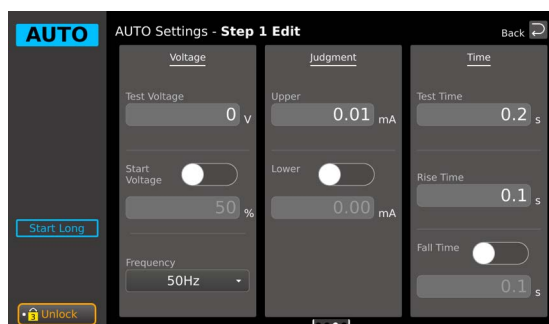
- 1 Tap and select any step on the program/step editing screen (p.88).



- 2** Tap the entry field of test modes to select one of the modes.



- 3** Flick leftward.
The step editing screen appears.

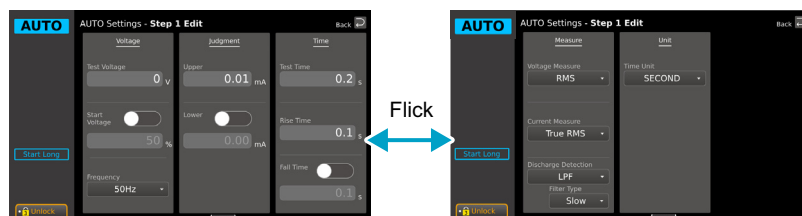


- 4** Set the test conditions.

Flick to switch test conditions.

For the details of the items, see “Withstanding voltage testing” (p.37) and “Insulation resistance testing” (p.62).

The available test conditions depend on selected test modes. The figure below shows a case where ACW is selected as the test mode.



This completes the setting.

Starting an Auto Test

When you finish setting the program and steps, run the auto test.

Starting an auto test

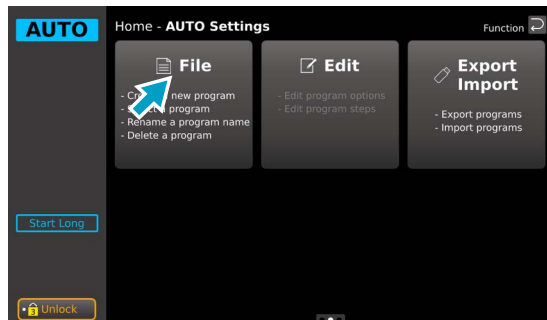
The test start operation varies depending on the trigger source ([p.91](#)) setting.

If a USB memory device is inserted into the USB connector on the front panel at the start of an Auto Test, it may take time for the test results to be displayed. Remove the USB memory device before starting the test.

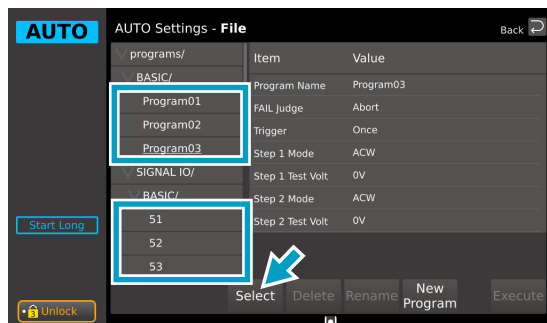
1 Tap AUTO on the Function screen.



2 Tap File.



3 Tap any program and then tap Select.



The program is selected.

4 Tap Execute.



Auto appears on the left of the display, and the product is in the trigger wait state for an auto test.

5 Operate the product according to the trigger selected for Trigger Source (p.91).

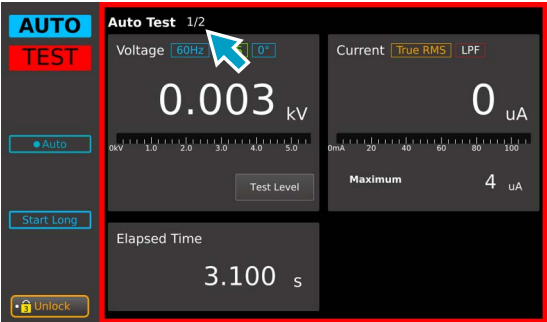
Trigger	Description
Immediate	When the INIT or INIT:TEST command is received via remote control, all steps will be executed consecutively.
BUS	When the *TRG or TRIG:TEST command is received via remote control, Step 1 starts. After Interval of Step 1, the program enters a trigger wait state. When the *TRG or TRIG:TEST command is received again, Step 2 starts.
External	Step 1 starts when you perform a start operation (p.36). After Interval of Step 1, the program enters a trigger wait state. Step 2 starts when you perform a start operation again.
Once	When you perform a start operation (p.36), all the steps are executed consecutively.

While an auto test is being executed, **Auto** appears on the left of the display. To cancel the trigger wait state, tap Edit.

Operation after a test starts

Step in progress

The display shows what step is being executed during the test.



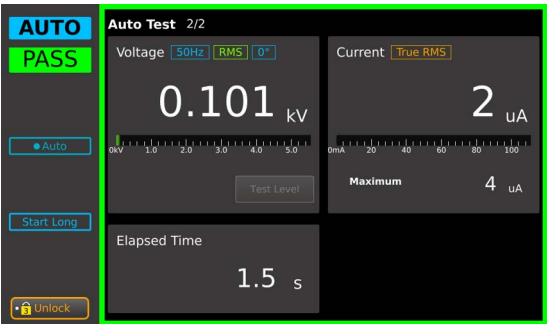
Other operations are the same as those when a single test is executed.

- Operation after the start of a withstanding voltage test (p.58)
- Operation after the start of an insulation resistance test (p.75)

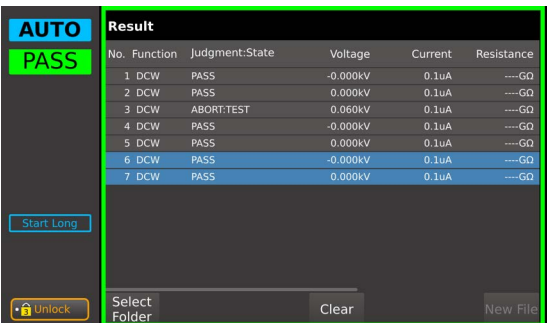
After step completion

The step judgment result is displayed during the Interval (p.92).

■ Example of Step 1 judgment result screen



■ Example of Step 2 judgment result screen



Finishing the Test and Viewing the Judgment

Stopping tests

Press STOP/RESET to stop testing.



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 a FAIL judgment is made if the FAIL Judgment is set to Abort
- c. When you press STOP/RESET

In the above cases, 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 a test finishes under above condition "a." or "b.," the judgment result (p.98) will appear on the display.

Judgment types and operation

Once the test is completed, the judgment result of the entire program is displayed on the screen. The Result list displays the judgment result for each step in blue. When the FAIL Judgment (p.90) is set to Continue, the judgment result of a program is FAIL if one or more steps are judged FAIL.



	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.	A FAIL judgment was not made during the test.
Display	"Upper-FAIL" appears until the judgment result is cleared.	"Lower-FAIL" appears until the judgment result is cleared.	"PASS" appears until the time specified for Pass Hold passes. After that, the Result screen is displayed.
Beep sound	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 0.2 seconds (regardless of the time specified by Pass Hold).
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.	The PASS signal is output until the judgment result is cleared.

Clearing the judgment result

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

Exporting and Importing Programs

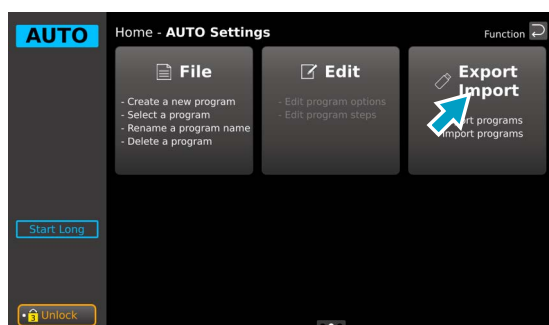
Programs saved in the internal memory can be exported to a USB memory device. Programs exported to a USB memory device can also be imported into the internal memory.

Exporting programs to a USB memory device

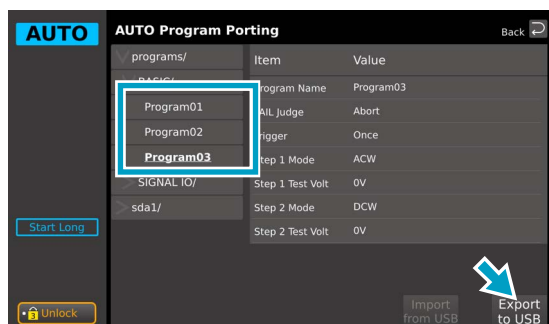
- 1 Insert a USB memory device into the USB connector on the front panel.
- 2 Tap AUTO on the Function screen.



- 3 Tap Export Import.



- 4 Tap and select a program under "programs/BASIC/" and tap Export to USB.



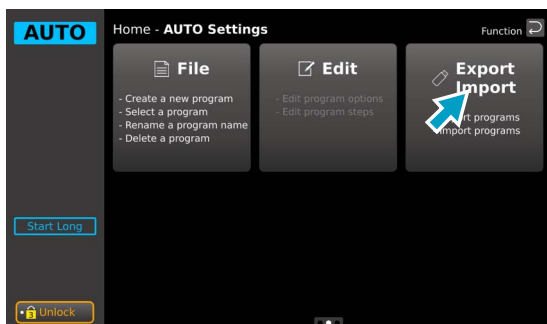
A file named "*program name*.prog" is saved to a USB memory device. If there is a file with the same name in the USB device, it will be overwritten.

Importing programs from a USB memory device

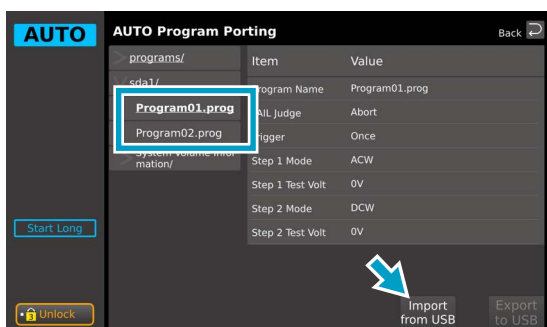
- 1 Insert a USB memory device into the USB connector on the front panel.
- 2 Tap AUTO on the Function screen.



- 3 Tap Export Import.



- 4 Tap and select a program under “sdxx/” (xx depends on USB memory devices) and tap Import from USB.



A file named “*program name.prog*” is saved under “programs/BASIC/”. If there is a file with the same name in the USB device, it will be overwritten.

External Control

Main Functions

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

For details on the SIGNAL I/O connector, see "SIGNAL I/O Connector" (p. 102).

You can also switch the SIGNAL I/O to the compatible mode with our TOS5300, TOS5301, and TOS5302 (hereinafter referred to as TOS53) (p. 108).

Functions that can be controlled/monitored	IN/OUT	Connector used
Activating and Releasing Interlock (p. 106)	IN	SIGNAL I/O
Recalling Setup Memory Entries (p. 109)	IN	SIGNAL I/O
Selecting a test mode (p. 111) (only available for the TOS53-compatible mode)	IN	SIGNAL I/O
Starting and Stopping Tests (p. 112)	IN	SIGNAL I/O
Monitoring the test and voltage generation status (p. 113)	OUT	SIGNAL I/O
Monitoring the test status (p. 113)	OUT	SIGNAL I/O
Monitoring judgment results (p. 113)	OUT	SIGNAL I/O
Monitoring the activation status of protection functions (p. 113)	OUT	SIGNAL I/O
Monitor the status of a device using optional products (p. 114)	OUT	STATUS OUT
Control and monitor the starting and stopping of tests using optional products (p. 114)	OUT/IN	REMOTE

■ 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, only the one with the highest precedence can be used.

- Highest: SIGNAL I/O connector (when the ENABLE signal is set to ON)
- Medium: REMOTE connector (when a production option is connected)
- Low: Front panel

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

SIGNAL I/O Connector

⚠ WARNING

Risk of electric shock.

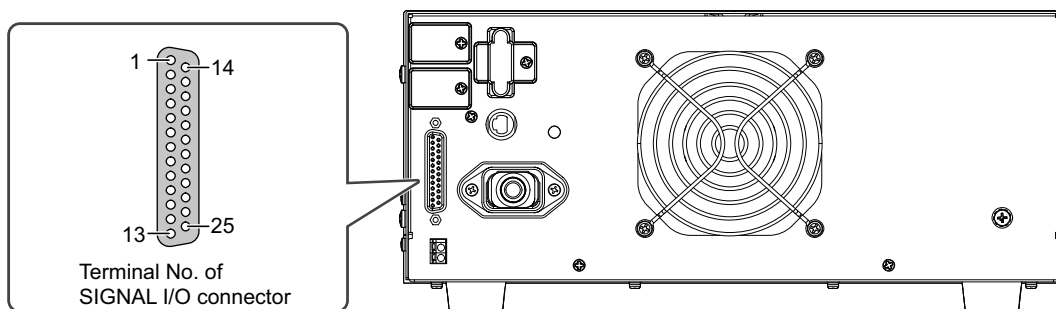
- When controlling the TOS54 series from external device using SIGNAL I/O, ensure that the operator does not approach high-voltage application areas.

Be sure to construct a system that uses the interlock for safety. (p.107)

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.

The pin arrangement of the SIGNAL I/O connector changes according to the settings of the compatibility mode (p.108)

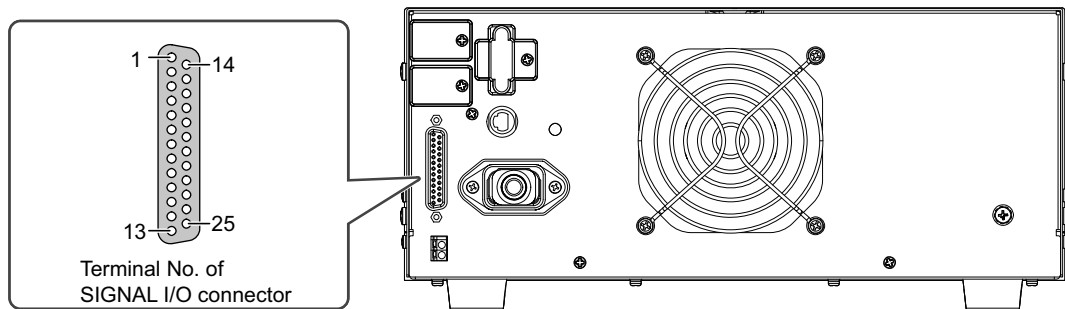
Pin arrangement (TOS54 mode)



Terminal No.	Signal name	IN/OUT	Description
1	INTERLOCK+	IN	Activating and Releasing Interlock. (p.106)
2	PM0	IN	Select setup memory or program memory. (p.109)
3	PM1	IN	
4	PM2	IN	
5	PM3	IN	
6	Reserved	n/a	Not used.
7	Reserved	n/a	
8	Reserved	n/a	
9	STB	IN	Recall the setup memory selected with the PM0 to PM5 signals. (p.109)
10	PM4	IN	Select setup memory or program memory. (p.109)
11	PM5	IN	
12	COM	n/a	I/O circuit common (chassis potential).
13	INTERLOCK-	IN	Activating and Releasing Interlock. (p.106)
14	H.V ON	OUT	Set to on in any of the following conditions. Testing. Auto testing. Voltage remaining across the output terminals.
15	TEST	OUT	Set to on during test time. (p.113)
16	PASS	OUT	Set to on for the duration of time specified by Pass Hold when a PASS judgment is made. (p.113)
17	U FAIL	OUT	Set to ON continuously when an Upper-FAIL judgment is made. (p.113)
18	L FAIL	OUT	Set to ON continuously when an Lower-FAIL judgment is made. (p.113)
19	READY	OUT	Set to on when the product is ready to start a test. (p.113)
20	PROTECTION	OUT	Set to on when a protection function is activated. (p.19)
21	START	IN	Starting a Test. (p.112)

Terminal No.	Signal name	IN/OUT	Description
22	STOP	IN	Finishing a Test. (p.112)
23	ENABLE	IN	Enable the START signal. (p.112)
24	+24V	n/a	+24 V internal power supply output terminal. Maximum output current 100 mA.
25	COM	n/a	Common of input/output circuit.

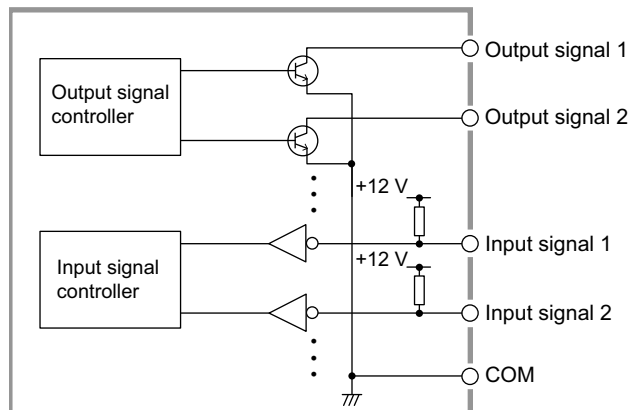
Pin arrangement (TOS53 compatibility mode)



Terminal No.	Signal name	IN/OUT	Description
1	INTERLOCK+	IN	Activating and Releasing Interlock. (p.106)
2	PM0	IN	Selecting Setup Memory Entries. (p.110)
3	PM1	IN	
4	Reserved	n/a	Not used.
5	Reserved	n/a	
6	Reserved	n/a	
7	Reserved	n/a	
8	Reserved	n/a	
9	STB	IN	Recall the setup memory selected with the PM0 to PM1 signals. (p.110) Recall the test mode selected by the TEST SEL or AUTO SEL signal. (p.111)
10	TEST SEL	IN	Selecting the Test Mode. (p.111)
11	AUTO SEL	IN	
12	COM	n/a	I/O circuit common (chassis potential).
13	INTERLOCK-	IN	Activating and Releasing Interlock. (p.106)
14	H.V ON	OUT	Turns ON when voltage is remains across the output terminals during the test. (p.106)
15	TEST	OUT	Set to on during test time. (p.113)
16	PASS	OUT	Set to on for the duration of time specified by Pass Hold when a PASS judgment is made. (p.113)
17	U FAIL	OUT	Set to ON continuously when an Upper-FAIL judgment is made. (p.113)
18	L FAIL	OUT	Set to ON continuously when an Lower-FAIL judgment is made. (p.113)
19	READY	OUT	Set to on when the product is ready to start a test. (p.113)
20	PROTECTION	OUT	Set to on when a protection function is activated. (p.19)
21	START	IN	Starting a Test. (p.112)
22	STOP	IN	Finishing a Test. (p.112)
23	ENABLE	IN	Enable the START signal. (p.112)
24	+24V	n/a	+24 V internal power supply output terminal; maximum output current 100 mA.
25	COM	n/a	Common of input/output circuit.

I/O signal circuit

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

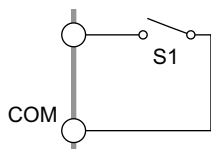


Input signal	Output signal
Opening the input terminals is equivalent to high-level input.	• Open collector output (4.5 Vdc to 24 Vdc)
• Low-active control	• Output withstanding voltage: 24.5 Vdc
• The input terminal is pulled up to +12 V by a resistor.	• Output saturation voltage: Approx. 1.1 V (25 °C)
• High-level input voltage: 11 V to 15 V	• Maximum current: Each terminal 10 mA
• Low-level input voltage: 0 V to 4 V	
• Low-level input current: 5 mA max	
• Input time width: 5 ms min.	

Input signal usage example

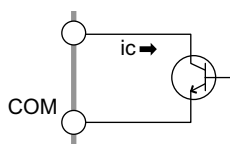
Using a make contact to control input

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

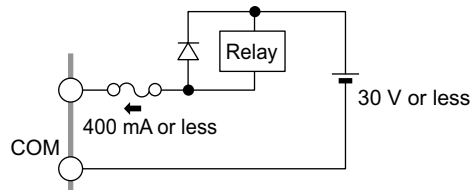
Use a logic element, such as a transistor, in place of the make contact. Design the circuit so that a transistor collector current i_c of 5 mA or greater flows.



Output signal usage example

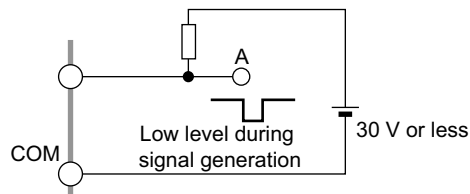
Driving a relay

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-sub25 pin plug by referring to the following information.

SIGNAL I/O connector specifications	D-sub 25-pin female connector (socket), #4-40 UNC inch screws
Compatible plug	D-sub 25-pin male (with #4-40 UNC fixing screws) To prevent malfunction caused by noise, use a shielded plug.
Required cable	Single wire: $\varnothing$ 0.32 (AWG28) to $\varnothing$ 0.65 (AWG22) 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 tool	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 TOS54 series switches to PROTECTION mode, which prevents tests from being started with the START switch on the front panel or an external control START signal. Moreover, you cannot release PROTECTION mode with the STOP/RESET switch or the external control STOP signal.

Interlock activation conditions

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

- When the resistance across terminal 1 and terminal 13 is 1.2 k Ω or greater.
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 13 is no more than 5 mA.

Interlock release conditions

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

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

- Resistance across terminal 1 and terminal 13 is 1 k Ω or less.
- If you are using transistors or an optical device, the current flowing across pin 1 and pin 13 is at least 6 mA.

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 lock temporarily, connect the included SIGNAL I/O plug to the SIGNAL I/O connector, and then press the STOP/RESET switch on the front panel. The included SIGNAL I/O plug is shorted across terminal 1 and 13, so the interlock will be released.

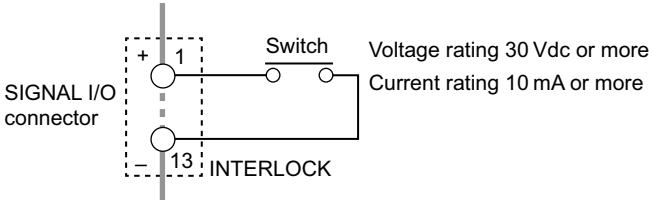
NOTE

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

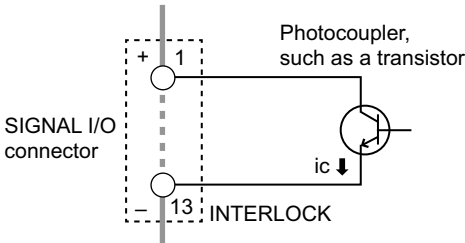
Using an open/close switch

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.

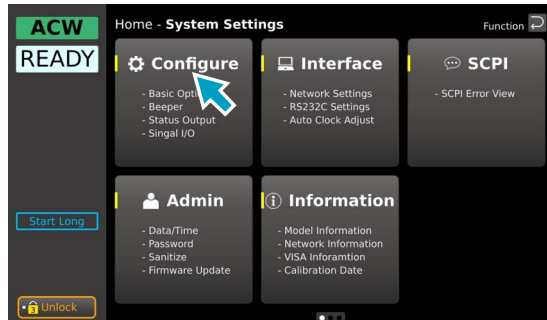


Setting the SIGNAL I/O Compatible Mode

You can determine whether the SIGNAL I/O is used in the TOS54 mode or in the TOS53-compatible mode (the compatible mode with our TOS5300, TOS5301, and TOS5302).

1 Flick left and right on the Home screen to display the System Settings screen.

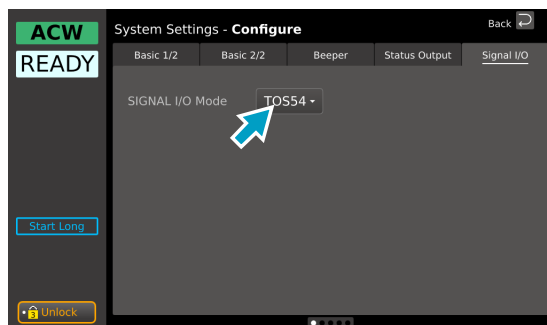
2 Tap Configure.



3 Tap Signal I/O.



4 Tap the input field of the SIGNAL I/O Mode. Tap and select the value.



This completes the setting.

Recalling from Memory

Recall the setup memory or program memory. The methods for recalling memory differ between TOS54 mode and TOS53 compatible mode ([p.108](#)).

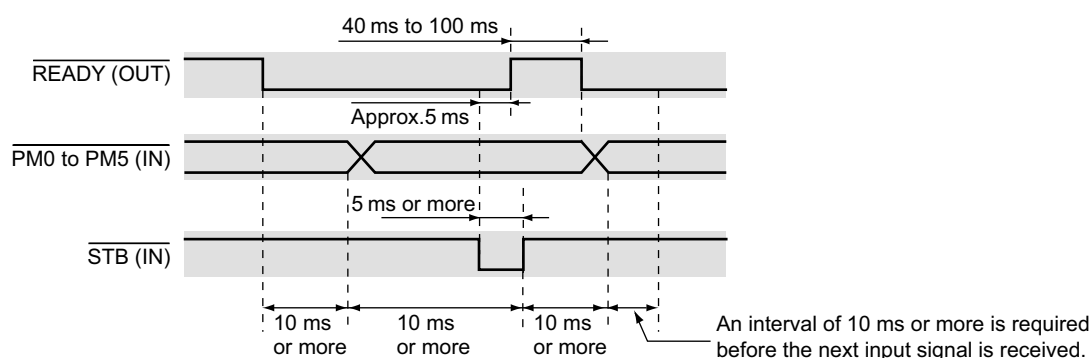
Recall memory with TOS54 mode

You can recall the setup memory or the program memory by applying signals to PM0 (pin 2) to PM3 (pin 5), PM4 (pin 10), PM5 (pin 11), and STB (pin 9) of the SIGNAL I/O.

Convert the number (0 to 50) of the setup memory or that (51 to 60) of the program memory you want to recall into 8-bit binary notation, and apply high-level (0) or low-level (1) signals to PM5 to PM0 except for the two most significant bits.

For example, to recall memory number 52, convert the 52 in decimal notation into 8-bit binary notation, which is 00110100. So apply L,L,H,L,H,H to PM5 to PM0.

Setup memory number	PM5	PM4	PM3	PM2	PM1	PM0
0	H	H	H	H	H	H
1	H	H	H	H	H	L
⋮	⋮	⋮	⋮	⋮	⋮	⋮
49	L	L	H	H	H	L
50	L	L	H	H	L	H
Program memory number	PM5	PM4	PM3	PM2	PM1	PM0
51	L	L	H	H	L	L
52	L	L	H	L	H	H
⋮	⋮	⋮	⋮	⋮	⋮	⋮
59	L	L	L	H	L	L
60	L	L	L	L	H	H



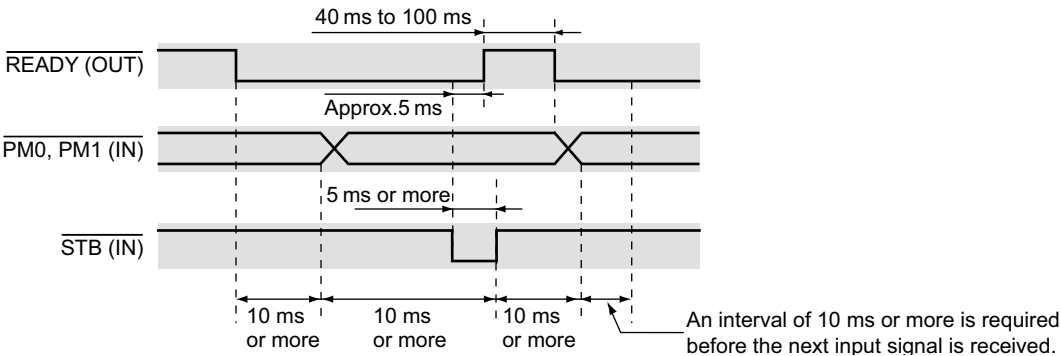
- 1 With “READY” shown in the upper left of the display, apply high-level or low-level signals to PM0 (terminal 2) to PM3 (terminal 5), PM4 (terminal 10), and PM5 (terminal 11) of the SIGNAL I/O connector.
- 2 Set STB (pin 9) to low-level for at least 5 ms.
The setup memory or program corresponding to the number specified with the PM5 to PM0 signals is recalled.

Recall memory in TOS53 compatible mode

You can recall the setup memories by applying signals to PM0 (pin 2) to PM1 (pin 3), and STB (pin 9) of the SIGNAL I/O.

Convert the number (0 to 2) of the memory you want to recall into 2-bit binary notation, and apply high-level (0) or low-level (1) signals to PM1 and PM0.

Setup memory number	PM1	PM0
0	H	H
1	H	L
2	L	H



- 1 With “READY” shown on the upper left of the display, apply high-level or low-level signals to PM0 (pin 2) and PM1 (pin 3) of the SIGNAL I/O.
- 2 Set STB (pin 9) to low-level for at least 5 ms.
The setup memory corresponding to the number specified with the PM0, PM1 signals is recalled.

Selecting the Test Mode

If the SIGNAL I/O is set to the TOS53-compatible mode (p.108), you can select a test mode.

Select a test mode by applying low-level signals to PM0 (pin 2) and PM1 (pin 3) of the SIGNAL I/O and using TEST SEL (pin 10) and AUTO SEL (pin 11).

Depending on the model, the test modes that you can select differ.

■ TOS5401

Test type	AUTO SEL	TEST SEL	PM1	PM0
ACW	L	L	L	L
DCW	H	L	L	L

■ TOS5402

Test type	AUTO SEL	TEST SEL	PM1	PM0
ACW	L	L	L	L
IR	H	L	L	L
Continuous test ¹ (ACW → IR)	L	H	L	L
Continuous test ¹ (IR → ACW)	H	H	L	L

1. The test conditions set for the single tests of ACW and IR are applied.

■ TOS5403

Test type	AUTO SEL	TEST SEL	PM1	PM0
DCW	L	L	L	L
IR	H	L	L	L
Continuous test ¹ (DCW → IR)	L	H	L	L
Continuous test ¹ (IR → DCW)	H	H	L	L

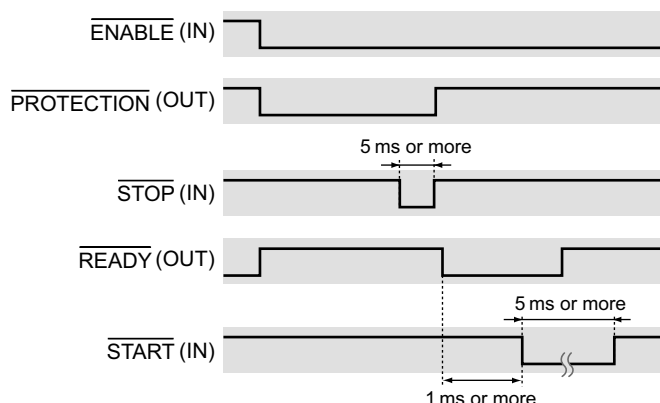
1. The test conditions set for the single tests of DCW and IR are applied.

- 1** While “READY” is displayed at the top left of the display, set PM0 (pin 2) and PM1 (pin 3) of SIGNAL I/O to low level and input high or low level signals to TEST SEL (pin 10) and AUTO SEL (pin 11).
- 2** Set STB (pin 9) to low-level for at least 5 ms.
This recalls the test mode corresponding to the signal combination input to TEST SEL and AUTO SEL.

Starting and Stopping Tests

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

Starting a test



- 1** Set **ENABLE** (pin 23) of the **SIGNAL I/O** connector to low level.
The product switches to **PROTECTION** mode.
- 2** Set **STOP** (pin 22) to low-level for at least 5 ms to release **PROTECTION** mode.
The test status switches to **READY**.
- 3** When at least 1 ms elapses after the test status becomes “**READY**,” set **START** (pin 21) to low level for at least 5 ms or more.
The test starts.
The duration for which the **START** signal is set to a low level is unaffected by the Start Long setting (p. 135).

NOTE

- While **ENABLE** signal 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** signal 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/RESET** switch or **SIGNAL I/O STOP** signal to release **PROTECTION** mode.

Stopping a test

- 1** While a test is in progress, set **STOP** (pin 22) to low-level for at least 5 ms.

Monitoring the Test Status

Monitoring the test and voltage generation status

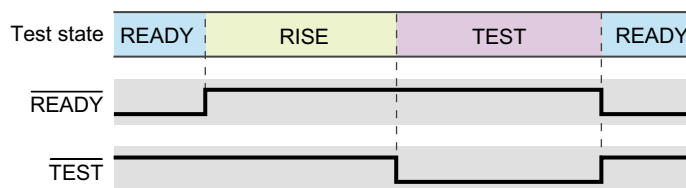
H.V ON (pin 14) of the SIGNAL I/O connector is set to low level in the following cases:

- During test, during auto test.
- Voltage remaining across the output terminals.

Monitoring the test status

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

SIGNAL I/O READY (pin 19) 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 16) is set to low level:

- Until the time set by Pass Hold (p.129) is elapsed or the judgment result is cleared.
- Until the STOP/RESET switch is pressed or a STOP signal is received if Pass Hold is set to Infinity.

UPPER FAIL judgment

If the judgment is Upper-FAIL, SIGNAL I/O U FAIL (pin 17) shall become low level until the judgment result is cleared.

LOWER FAIL judgment

If the judgment is Lower-FAIL, SIGNAL I/O L FAIL (pin 18) shall become low level until the judgment result is cleared.

Monitoring the activation status of protection functions

PROTECTION (pin 20) of the SIGNAL I/O is set to the low level when the protection function (p.19) is activated.

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 A-TOS) ([p. 185](#)). Use Status Output ([p. 137](#))

For details on the warning light unit, see the "Warning Light PL02 A-TOS Operation Manual."

Signal I/O of the REMOTE connector

You can control the TOS54 series from the following option products using the REMOTE connector on the rear panel. For details, see the operation manual for each option.

- Remote control box (RC01-TOS/RC02-TOS) ([p. 184](#))
- High voltage test probe (HP01A-TOS/HP02A-TOS) ([p. 185](#))

Memory Function

You can save and recall test conditions and view and save test results.

Saving and Recalling Test Conditions

The test conditions that can be saved in the TOS54 series memory (internal memory) are as follows.

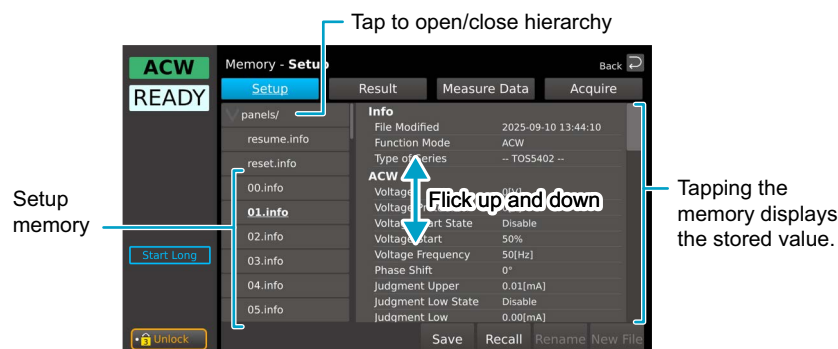
Memory name	Description
resume.info	The test conditions that were in use immediately before the power was turned off are saved. Other test conditions cannot be saved.
reset.info	The test conditions in the factory default setting are stored. Other test conditions cannot be saved.
00.info to 50.info	You can save up to 51 test modes and test conditions (setup memory) of your choice. The setup memory saved in 00.info to 10.info can be recalled via SIGNAL I/O (p.109).

The setup memory can also be saved in USB memory devices.

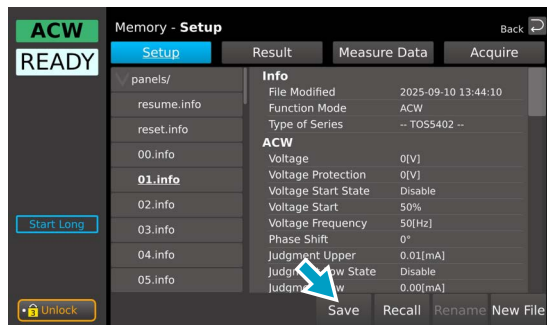
Saving to the setup memory

Saving over previous settings (internal memory and USB memory)

- 1 Set the test conditions.
- 2 When using a USB memory device, insert the USB memory device into the USB port on the front panel.
- 3 Press the MEMORY key.
- 4 Tap the memory of your choice and select.
“Panels/” shows the test conditions saved in the internal memory, and “sdxx/” (xx depends on USB memory devices) shows those saved in a USB memory device.
The value stored in the selected memory is displayed on the right side of the display.
resume.info and reset.info cannot be saved.



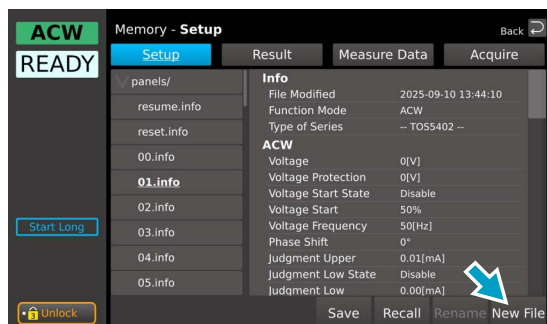
5 Press Save.



The test conditions are overwritten in the setup memory.

Saving to a new file (USB memory device only)

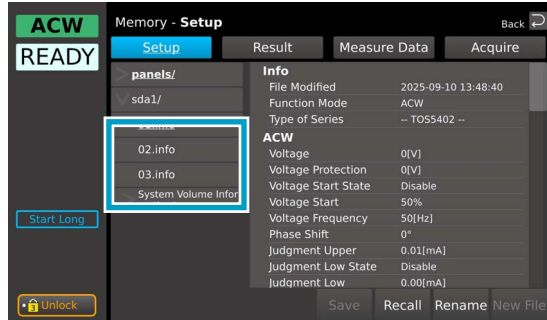
- 1 Set the test conditions.
- 2 Insert a USB memory device into the front panel.
- 3 Press the MEMORY key.
- 4 Press New File.



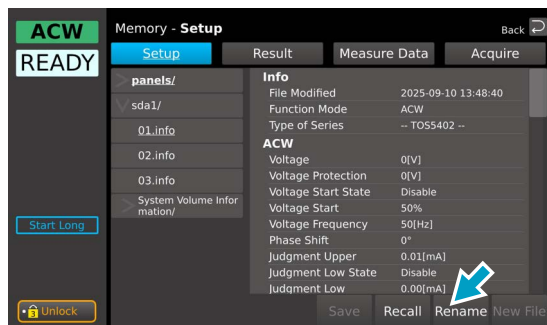
The setup memory is saved to the USB memory device.

Changing the memory name (USB memory device only)

- 1 Insert a USB memory device into the front panel.
- 2 Press the MEMORY key.
- 3 Tap and select the memory below “sdxx/” (xx changes according to the USB memory device).



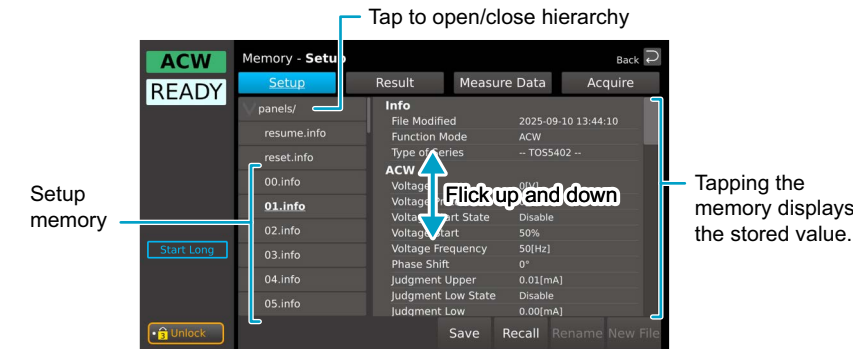
- 4 Tap Rename and enter a file name of your choice.



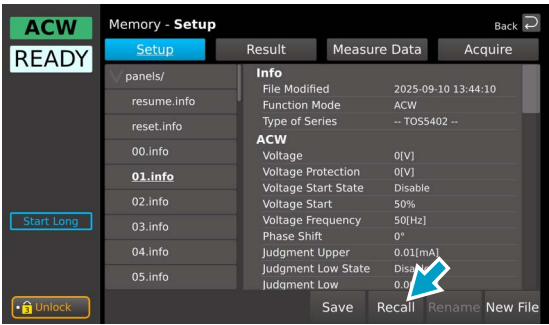
The memory name is saved.

Recalling the setup memory

- 1 Press the MEMORY key.
- 2 Tap the memory of your choice and select.
The value stored in the selected memory is displayed on the right side of the display.



- 3 Tap Recall.



The test conditions of each test are overwritten with the content saved in the memory.

Displaying/Saving a List of Test Results

Test results are temporarily saved to the TOS54 series memory automatically. The 1000 latest test results are saved regardless of the test mode. They are deleted 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 test, DCW: DC withstanding voltage test, IR: Insulation resistance test
Judgment:State	Judgment PASS: A fail judgment was not made. U-FAIL: A value greater than or equal to the upper limit was measured. L-FAIL: A value less than or equal to the lower limit was measured. PROT (XXX): A protection function was activated. The type of protection is displayed in "XXX" (p.19). ABORT: The test was aborted.
	State Test state at the time of judgment RISE: Voltage rising TEST: Testing FALL: Voltage falling
Elapsed Time	Elapsed time (seconds) since a test condition (Rise time, Test time, or Fall time) changed
Voltage	Measured voltage
Current	Current measurement
Resistance	Resistance measurement
Peak	Peak value
Executed Datetime	Starting a Test [day] [month] [year] [hour]:[minute]:[second] [time zone] Example: 4 Apr 2025 17:00:00 +0900

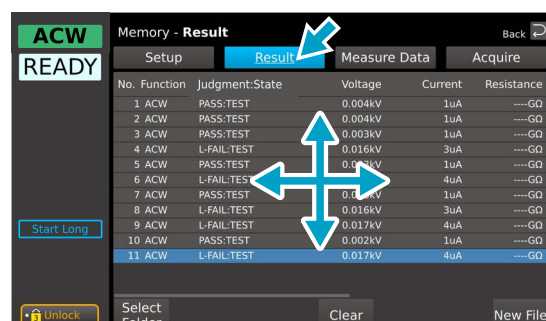
Displaying a list of test results

1 Press the **MEMORY** key.

2 Tap **Result**.

A list of test results is displayed.

You can switch between displayed items by flicking.

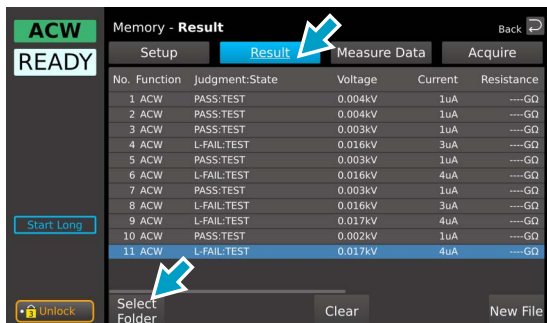


The display is complete.

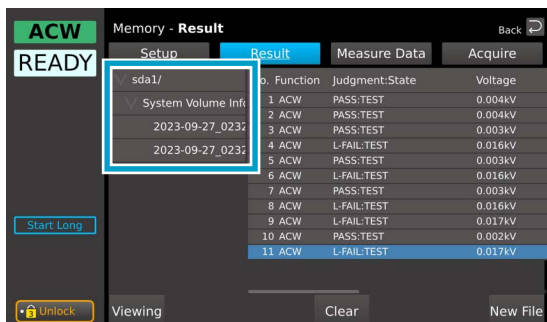
Saving test results to a USB memory device

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

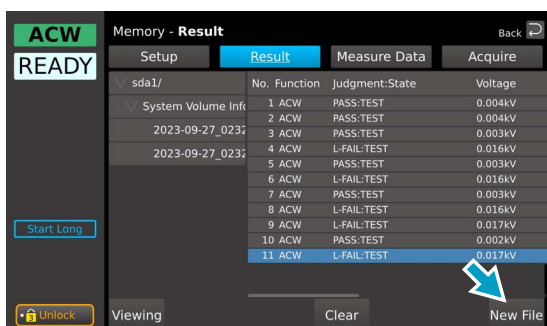
- 1 Insert a USB memory device into the USB connector on the front panel.
- 2 Press the MEMORY key.
- 3 Tap Result. Then, tap Select Folder.



USB memory device folder “sdxx/” appears (xx changes according to the USB memory device).
If there is a folder under “sdxx/,” tap the folder to change a path where the result is to be saved.



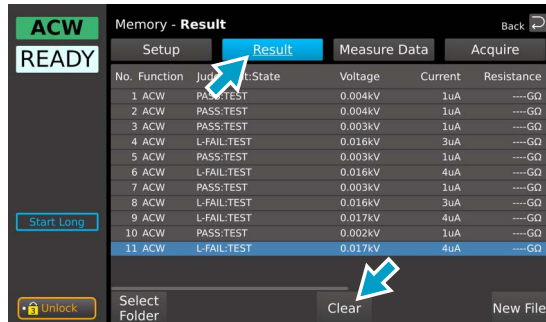
- 4 Tap New File and enter a file name of your choice.



Test results are saved to the USB memory device.

Deleting a list of test results

- 1 Press the MEMORY key.
- 2 Tap Result. Then, tap Clear.



The test results are cleared.

Displaying/Saving the Measurement Data

Measurement data is temporarily saved to the TOS54 series memory automatically. The maximum number of measurement data recordings can be changed (p.82). They are deleted when the power is turned off.

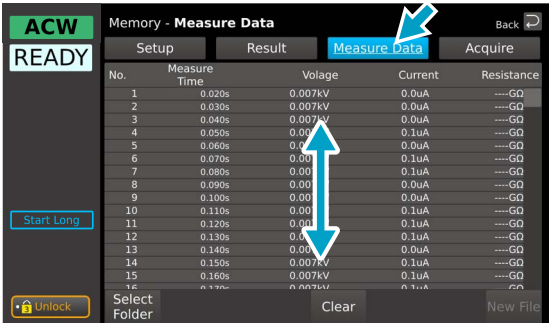
Measurement data can also be stored in CSV format to a USB memory device.

■ Saved contents

Item	Description
Current	Current
Voltage	Voltage
Resistance	Resistance
Measure Time	The amount of time that has elapsed since the test started.

Displaying measurement values of the most recent test

- 1 Press the MEMORY key.
- 2 Tap Measure Data.

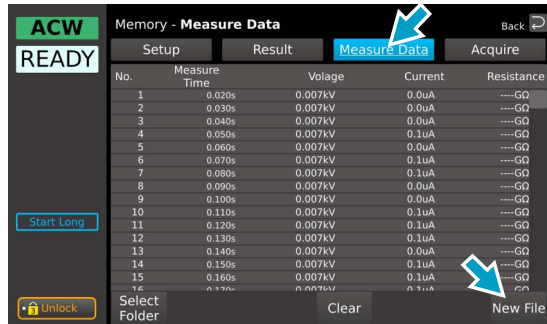


A list of measured values is displayed.
You can switch between displayed items by flicking up and down.

Saving measurement data to a USB memory device

You can save the latest measurement data results in CSV format to a USB memory device.

- 1 Insert a USB memory device into the USB connector on the front panel.
- 2 Press the MEMORY key.
- 3 Tap Measure Data. Then, tap New File.

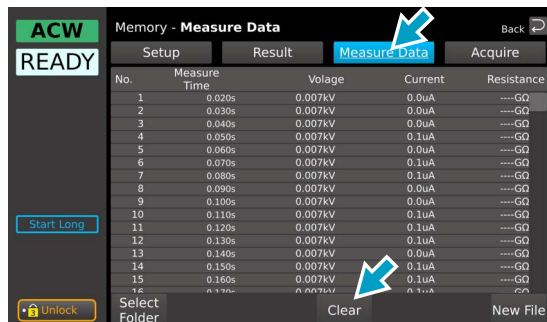


- 4 Enter the file name.
The measurement data is saved.

Deleting measurement data

Though measurement data are deleted by turning off the power, you can also delete them manually.

- 1 Press the MEMORY key.
- 2 Tap Measure Data. Then, tap Clear.



The measurement data will be deleted.

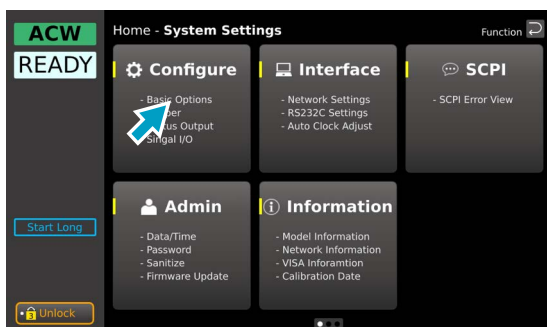
System Settings

CONFIG settings, interface settings, view SCPI errors, set the clock, initialize and update the instrument, and the instrument information can be displayed.

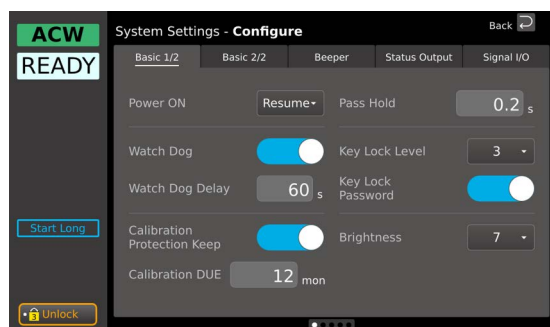
Displaying and Changing CONFIG Settings

Displays the CONFIG setup screen.

- 1 Flick left and right on the Home screen to display the System Settings screen.
- 2 Tap Configure.



The CONFIG setup screen appears.



Set the required conditions by referring to the description of Configuration setting summary ([p.125](#)).

Configuration setting summary

You can display and change the following settings.

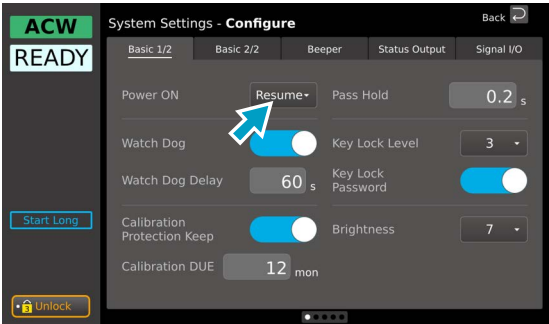
Item	Description
Basic	Basic Configuration.
Power On	Panel settings at startup. (p. 126)
Watch Dog	Turns the TOS54 series off automatically when no SCPI communication takes place for a given period. (p. 127)
Watch Dog Delay	The duration of time until the product decides that there is no SCPI communication when watchdog is ON.
Calibration Protection Keep	Sets the operation that is performed when calibration period elapses. (p. 128)
Calibration DUE	Sets the next calibration period. (p. 128)
Pass Hold	PASS judgment result hold time. (p. 129)
Key Lock Level	Sets the range of the key lock of when the key lock is enabled. (p. 130)
Key Lock Password	Sets a password to unlock key operations. (p. 131)
Brightness	Sets the display brightness. (p. 133)
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. (p. 134)
Double Action	Tests can only be started by pressing and releasing STOP/RESET and then pressing START within 0.5 seconds of releasing the STOP/RESET switch. (p. 135)
Start Long	A test starts only when the START switch is held down for at least 1 second. (p. 135)
Momentary	Tests are only executed while the START switch is held down. (p. 135)
Beeper	Setting the Beep Sound. (p. 136)
Pass Volume	Beep volume for pass judgment results.
Fail Volume	Beep volume for fail judgment results.
Key	ON/OFF of beep sound for invalid operation.
Protection	ON/OFF of beep sound for alarm occurrence.
SCPI Error	ON/OFF of beep sound for SCPI error.
Status Output	Conditions for outputting signals from the STATUS OUT connector. (p. 137)
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.
SIGNAL I/O Mode	Set the SIGNAL I/O to TOS54 mode or TOS53 compatibility mode. (p. 108)

Panel settings at startup

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

Item	Description
Resume	Start with some settings, such as the test conditions (p.173), in the previous power-off state.
RST	Start with some settings, such as the test conditions (p.173), in the factory default conditions.
RCL0	Start in setup memory (p.115) number 0 (00 info) condition.

1 Tap the Power ON on the CONFIG setup screen (p.124).



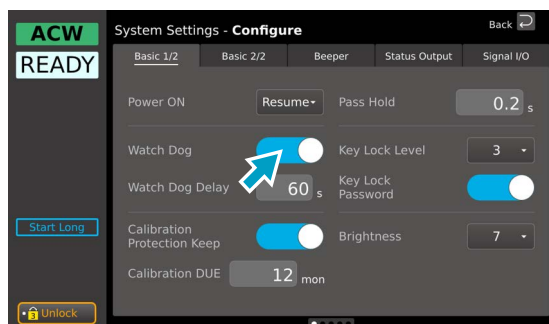
2 Tap and select the value.
This completes the setting.

Operation when there is no SCPI communication

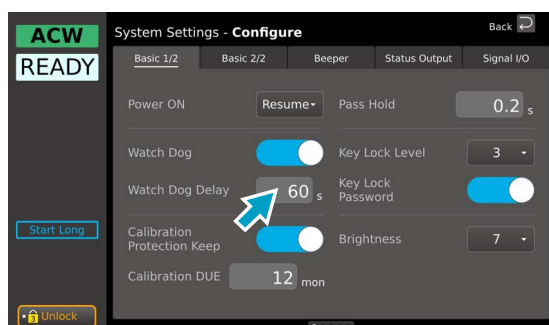
The product switches to PROTECTION (p.19) mode when there is no SCPI communication over a given period of time.

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

- 1 Tap the toggle button of Watch Dog on the CONFIG setup screen (p.124) to set ON/OFF.



- 2 If it is set to ON, tap the entry field of Watch Dog Delay to enter a time when communications are judged to be ceased.



Setting range: 1 s to 3600 s

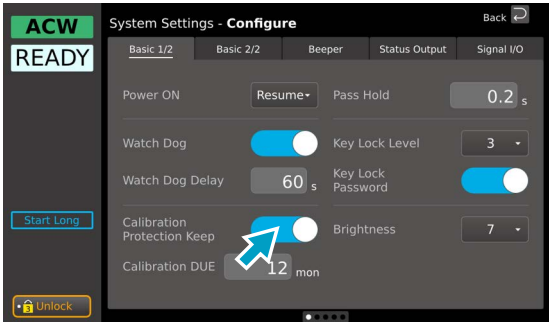
This completes the setting.

Calibration period

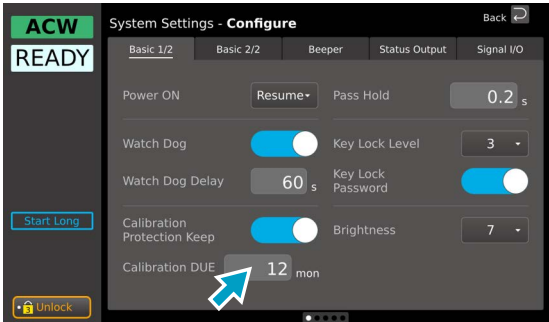
Set the calibration period and the operation performed when the calibration period elapses.

Item	Set value	Description
Calibration Protection Keep	ON	When the calibration period elapses, the protection function is activated, and the product switches to PROTECTION mode (CAL). To release the PROTECTION mode, set Calibration Protection Keep to OFF and press the STOP/RESET switch.
	OFF	When the calibration period passes, a warning appears on the display when the power is turned on. To clear the warning, press STOP/RESET.
Calibration DUE	1 to 36 (month)	Sets a period of months until the next calibration from the last calibration date (p.147).
	Infinity	Calibration period is not monitored.

- 1 Tap the toggle button of Calibration Protection Keep on the CONFIG setup screen (p.124) to set ON/OFF.



- 2 If it is set to ON, tap the entry field of Calibration DUE to enter a calibration period.



This completes the setting.

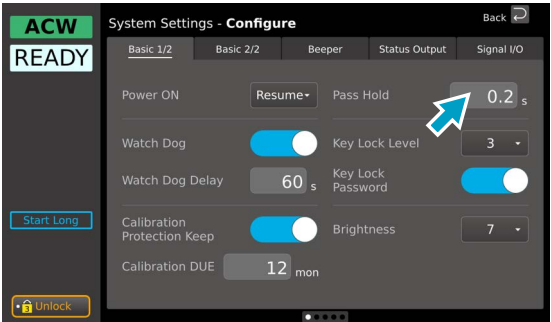
Holding PASS judgment result

Sets the length of time or condition that a PASS judgment result display will be held.

Item	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/RESET.

When a FAIL judgment occurs, the FAIL judgment results remain displayed until you press STOP/RESET, regardless of the value of the Pass Hold setting.

- 1 Tap the entry field of Pass Hold on the CONFIG setup screen (p.124).



- 2 Enter the time.
If you turn the rotary knob counterclockwise during the input, you can select infinity.
This completes the setting.

Key control lock

You can lock the operation of the keys to prevent changing the settings or overwriting memory or programs by mistake. You can also set a password to unlock the key lock.

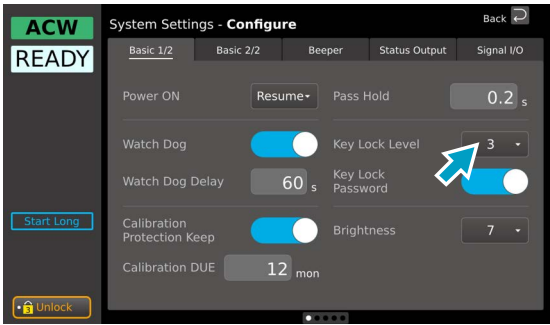
Setting lock level

The range of key operations that are permitted when locking is divided into the following three lock levels. While the keys are locked, an icon indicating the lock level is shown in the lower left of the display.

Item	Allowed operations	Icon
3	- Release key lock - STOP/RESET switch¹	
2	- Release key lock - START and STOP/RESET switches	
1	- Release key lock - START and STOP/RESET switches - Used to recall setup memory.	

1. Only the START switch on the front panel is locked. The START switch on an option product connected to the TOS54 series is not locked.

1 Tap the Key Lock Level on the CONFIG setup screen (p.124).



2 Tap and select the value. This completes the setting.

Lock during remote control

An icon is displayed in the lower left corner of the display according to the setting value of the SYST:COMM:RLST command for remote control. For details, refer to the Communication Interface Manual.

Set value	Allowed operations	Icon
REMOte	- Release key lock - START and STOP/RESET switches	
RWLock	START and STOP/RESET switches	

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

Set whether to require password entry when unlocking the key lock from the display operation.

For password settings, refer to “Changing the key lock password” (p.132)

- 1 Tap the toggle button of Key Lock Password on the CONFIG setup screen (p.124) to set ON/OFF.

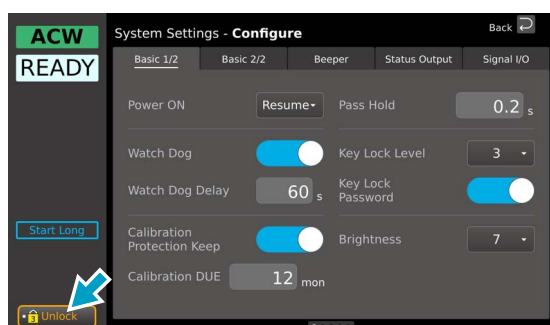
If it is set to ON, password entry will be required to unlock the key lock.



This completes the setting.

Locking and releasing key operations

- 1 Touch and hold the key lock icon on the lower left of the display.



- If you touch Unlock for a long time, the key operation becomes locked.
- If you touch Lock for a long time, it is unlocked. If you have set the Key Lock Password to ON, enter the password to unlock.
- To release Lock Out, set LOCAL using the remote control command SYST:COMM:RLST. For details, refer to the Communication Interface Manual.

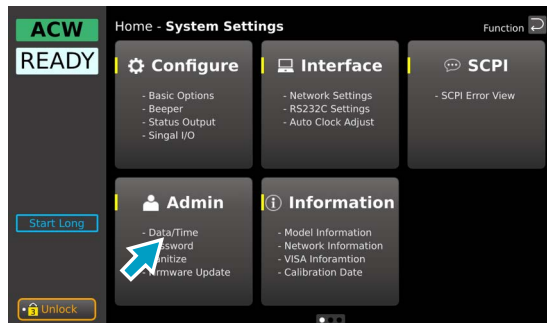
Changing the key lock password

The factory default password is set to "0000".

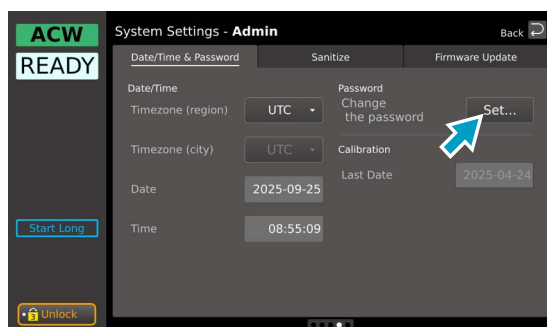
For enabling or disabling the necessity for password entry, refer to "Enabling or disabling the requirement to enter a password when unlocking the keys" (p.131).

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



3 Tap Set... of Change the password.



4 Enter the current password and tap ENTER.

5 Enter the new password and tap ENTER.

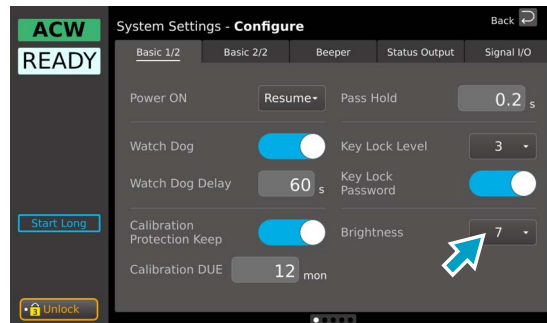
The password must be 4 to 15 characters long.

The password is now changed.

Screen brightness

Sets the display brightness from 1 to 7. The higher the setting, the brighter the display.

- 1 Tap the entry field of Brightness on the CONFIG setup screen (p.124).



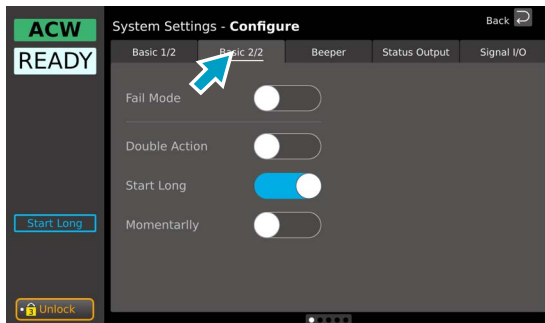
- 2 Tap and select the value.
This completes the setting.

Fail mode

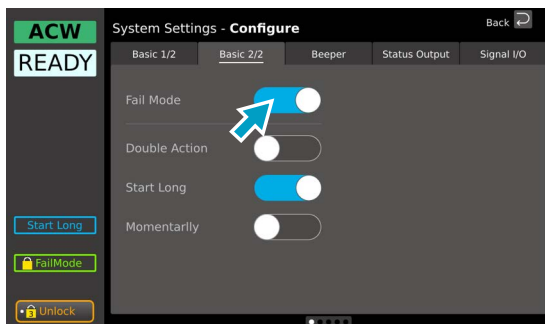
Set the instrument so that fail judgment results and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector or REMOTE connector. When Fail Mode is ON, it appears on  the left side of the display.

If you are using the optional high voltage test probe ([p.185](#)), turn the Fail Mode ON. When a test ends with a fail judgment, or when the product is in PROTECTION mode, the fail judgment / PROTECTION mode is not released even if you let go of the probe.

1 Tap Basic 2/2 on the CONFIG setup screen ([p.124](#)).



2 Tap the toggle button of Fail Mode to set ON/OFF.



This completes the setting.

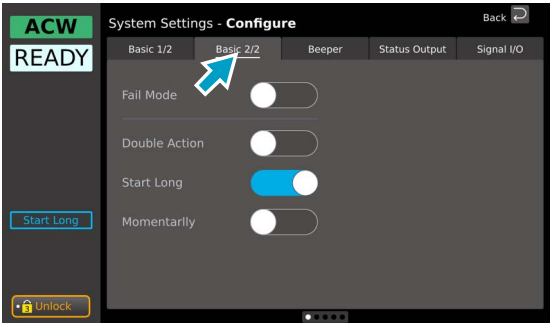
Test start settings

The following functions can be used to start tests safely. Either Double Action or Start Long can be enabled, not both. When the setting is ON, it appears on the left side of the display.

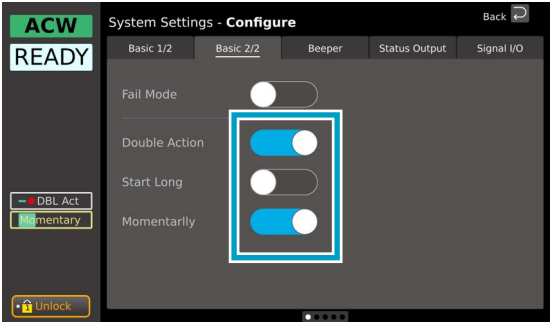
If both Double Action and Start Long are set to OFF, Start Long will be changed to ON upon power reapplication for safety.

Item	Description	Icon
Double Action	When you press and release STOP/RESET, "READY" is shown in the upper left 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. The START signals of the REMOTE and SIGNAL I/O connectors are also affected.	
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 START signal from the REMOTE connector is also affected. The START signal from SIGNAL I/O connector is unaffected.	
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/RESET 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. 184), which requires you to press the START switch with both hands. The START signals of the REMOTE and SIGNAL I/O connectors are also affected.	

1 Tap Basic 2/2 on the screen (p. 124).



2 Tap the toggle buttons of Double Action, Start Long, and Momentary to set ON/OFF.



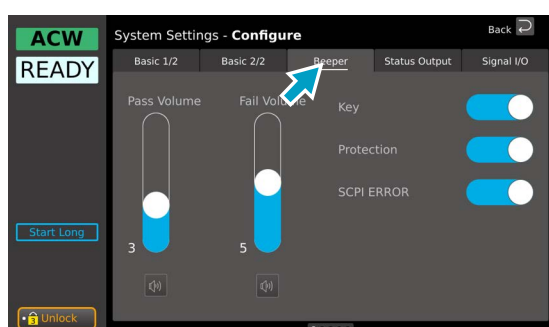
This completes the setting.

Beep sound

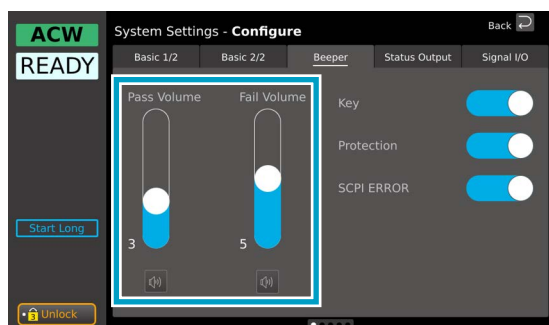
You can turn ON/OFF beep sounds that are emitted in the case of invalid operation, alarm occurrence, or SCPI error and the beep volume for pass and fail judgments.

Item	Set value	Description
Pass Volume	0 to 10	Beep volume for pass judgments
Fail Volume	0 to 10	Beep volume for fail judgments
Key	ON/OFF	Beep sound for invalid operation
Protection	ON/OFF	Beep sound for alarm occurrence
SCPI Error	ON/OFF	Beep sound for SCPI errors

1 Tap Beeper on the screen (p.124).

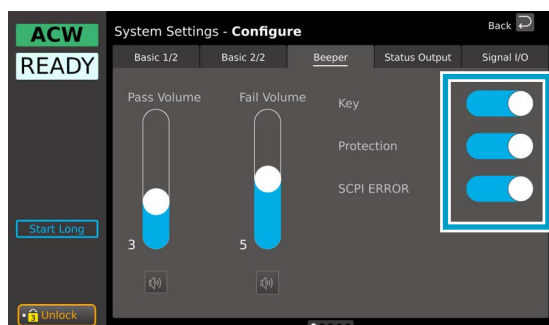


2 Swipe the entry fields of Pass Volume and Fail Volume to enter volume.



If you tap the speaker icon under the input field, you can check the actual volume.

3 Tap the toggle buttons of Key, Protection, and SCPI ERROR to set ON/OFF.



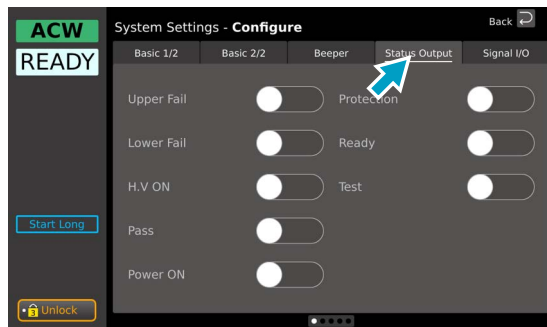
This completes the setting.

STATUS OUT output

Set the conditions for outputting 24 Vdc from the STATUS OUT connector. You can use this with the optional warning light unit ([p.185](#)).

Item	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.

1 Tap Status Output on the CONFIG setup screen ([p.124](#)).



2 Tap the toggle button of any item to set ON/OFF.

This completes the setting.

SIGNAL I/O compatible mode

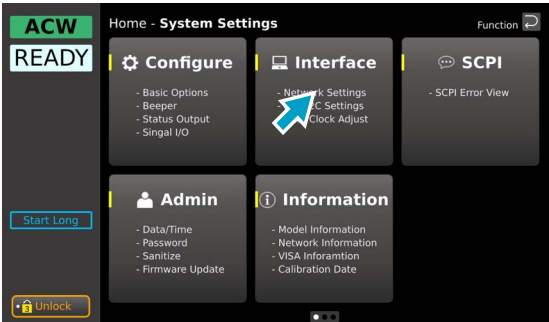
You can determine whether the SIGNAL I/O is used in the TOS54 mode or in the compatible mode with our TOS5300, TOS5301, and TOS5303 (the TOS53-compatible mode).

For details, see "Setting the SIGNAL I/O Compatible Mode" ([p.108](#)).

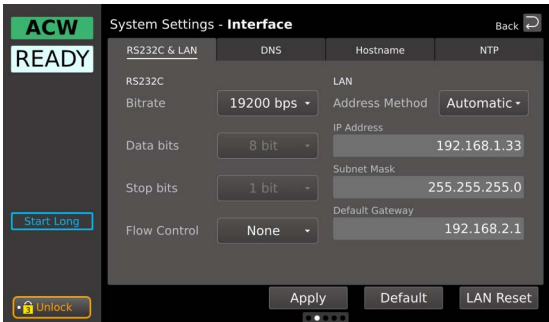
Displaying/Changing the Interface Settings

Display the interface setup screen.

- 1 Flick left and right on the Home screen to display the System Settings screen.
- 2 Tap Interface.



The interface setup screen appears.



Set the required conditions by referring to the Description of the interface settings [\(p.138\)](#).

Description of the interface settings

You can display and change the following settings.

Item	Description
RS232C	Data rate, data length, stop bits, flow control. (p.139)
LAN	How to address the IP address, IP address, subnet mask, default getaway. (p.140)
DNS server	Primary/secondary DNS server address. (p.141)
Services	multicast DNS, dynamic DNS. (p.141)
Hostname	Host name, mDNS service name. (p.142)
Auto Clock Adjust	Auto clock adjustment, NTP server address. (p.143)

Related settings

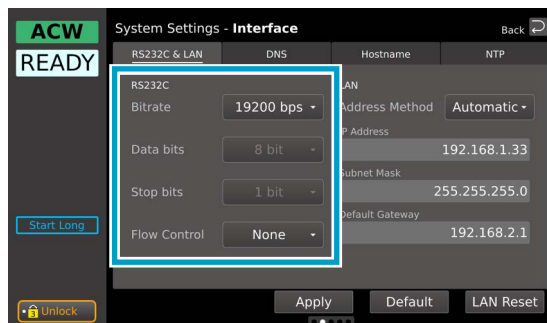
- Returning only the interface settings to the factory default values [\(p.150\)](#)
- Returns LAN settings to their factory default setting [\(p.151\)](#)

RS232C

You can display and change the following settings.

Item	Set value	Description
Bitrate	9600/19200/38400/57600/115200	Baud rate [bps]
Data bits	8 bit (fixed)	Data length
Stop bits	1 bit (fixed)	Stop bits
Flow Control	None/RTS-CTS	Flow control

- 1 Tap the input field under RS232C of the interface setup screen (p.138) and select the value.



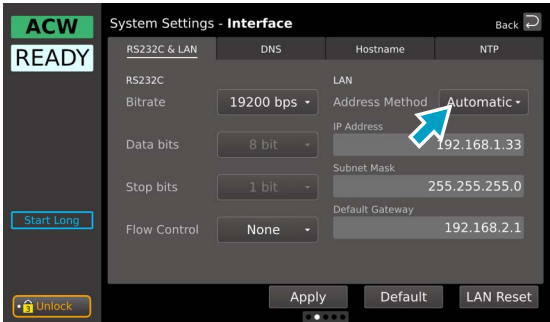
- 2 Tap Apply.
This completes the setting.

LAN

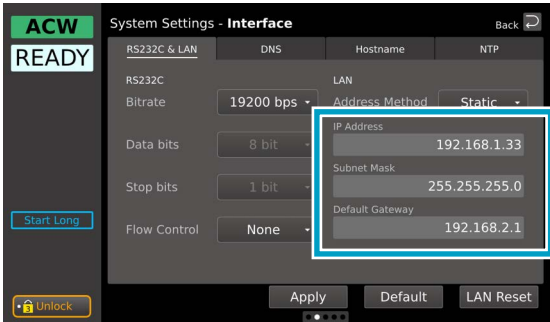
You can display and change the following settings.

Item	Set value	Description
Address Method	Automatic/Static	IP address assignment method
IP address	Arbitrary	IP address
subnet mask	Arbitrary	Subnet mask
default gateway	Arbitrary	Default gateway

- 1 Tap the input field of the Address Method of the interface setup screen (p.138) and select the value.



- 2 If Address Method is set to Static, tap the IP Address, Subnet Mask, and Default Gateway input fields and enter the values.

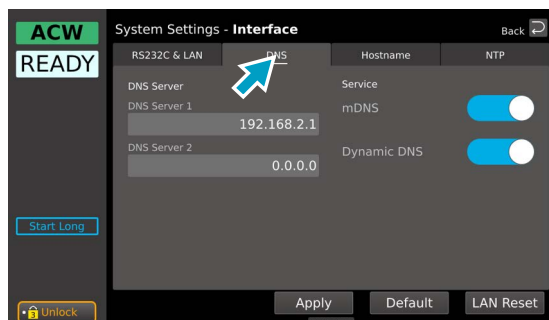


- 3 Tap Apply.
This completes the setting.

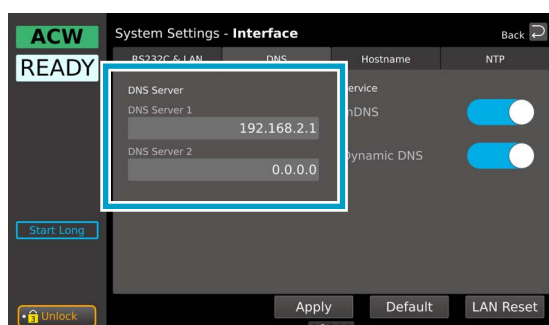
DNS server

Item		Set value	Description
DNS server	DNS Server 1	Arbitrary	Primary DNS server address
	DNS Server 2	Arbitrary	Secondary DNS server address
Service	mDNS	ON/OFF	Setting of multicast DNS
	Dynamic DNS	ON/OFF	Setting of dynamic DNS

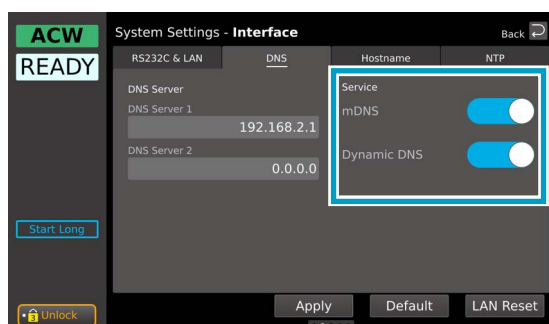
- 1 Tap DNS on the interface setup screen (p.138).



- 2 Tap the input field of the DNS Server and enter the address.



- 3 Tap the toggle buttons of Service to set ON/OFF.

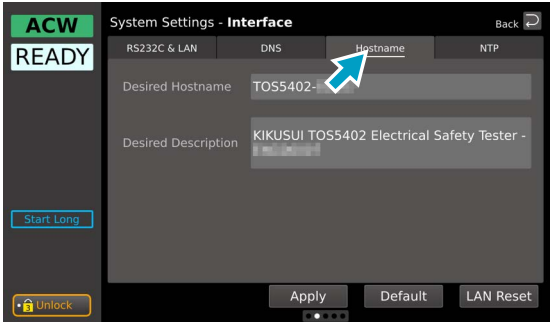


- 4 Tap Apply.
This completes the setting.

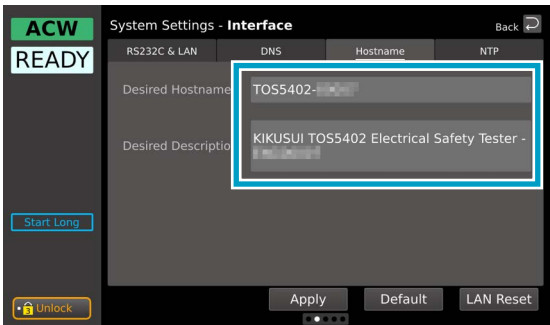
Host name

Item	Set value	Description
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

1 Tap Hostname on the interface setup screen (p.138).



2 Tap the input field of Desired Hostname and Desired Description, and enter the name.

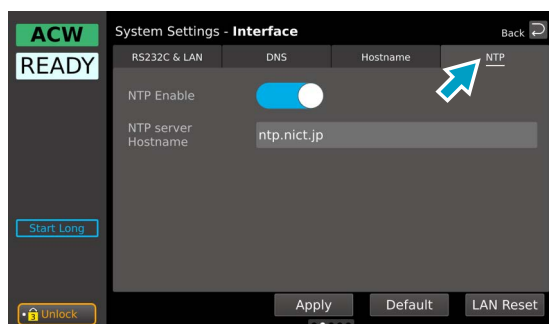


3 Tap Apply.
This completes the setting.

Auto clock adjustment

Item	Set value	Description
NTP Enable	ON/OFF	Setting of auto clock adjustment
NTP Server Hostname	Arbitrary (15 characters)	NTP server address

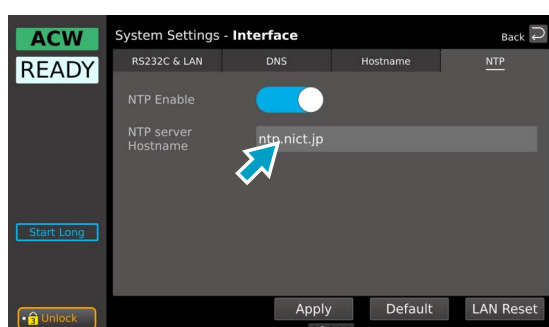
- 1 Tap NTP on the interface setup screen (p.138).



- 2 Tap the toggle button of NTP Enable to set ON/OFF.



- 3 If you set the NTP Enable to ON, tap the input field of the NTP Server Hostname and enter the address.

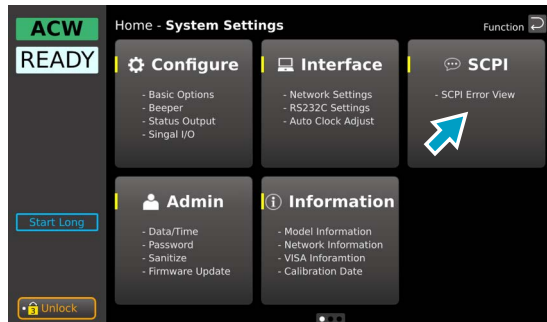


- 4 Tap Apply.
This completes the setting.

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 Flick left and right on the Home screen to display the System Settings screen.
- 2 Tap SCPI.



The SCPI error is displayed.



For details on the error content, see the communication interface manual. Tapping Clear or restarting the TOS54 series 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.

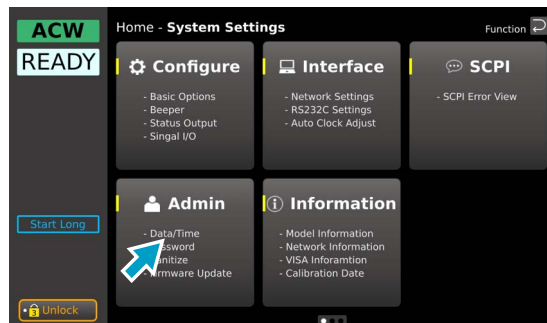
If you change the time zone, the year, month, and day change accordingly.

If the product can access the Internet through a LAN, the year, month, and day are automatically updated according to the time zone by setting NTP Enable ([p.143](#)) of the interface settings to ON.

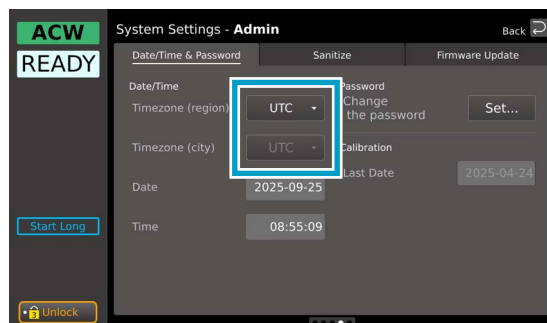
Item	Description
Timezone (region)	Time zone (region name)
Timezone (city)	Time zone (city name)
Date	Year/Month/Day
Time	Time

1 Flick left and right on the Home screen to display the System Settings screen.

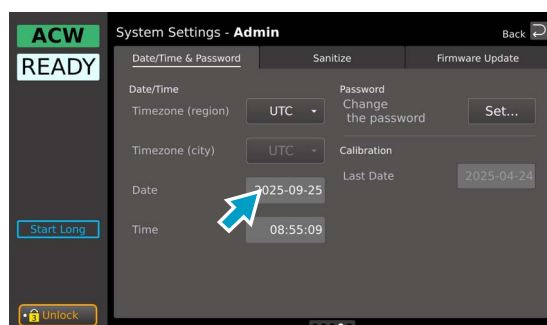
2 Tap Admin.



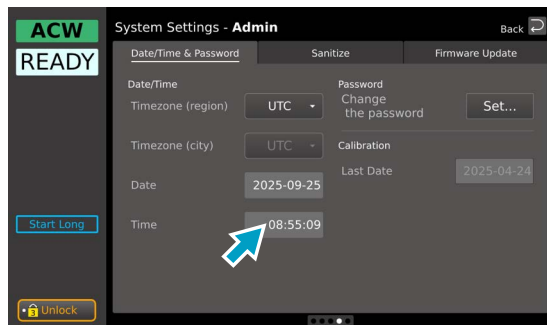
3 Tap the input field of the Timezone (region) and Timezone (city), and tap to select the value.



4 Tap the input field of the Date and enter the year, month and day.



5 Tap the input field of the Time and enter the time.



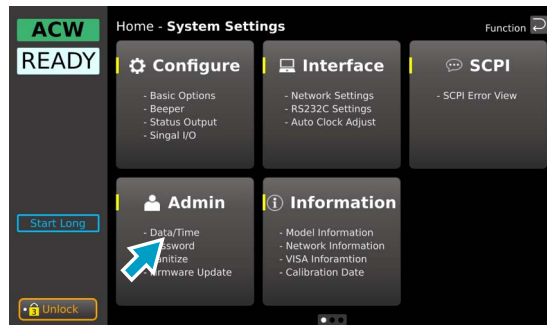
This completes the setting.

Setting the Calibration Date

Set the date on which calibration was carried out. Calibration period (p.128) can also be set on another setup screen.

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



3 Tap the input field of Last Date for a long time.



You will now be able to enter the calibration date.

4 Tap the input field of Last Date and enter the calibration date.

This completes the setting.

Initializing the Settings

This section explains how to reset the settings to their factory default conditions or a portion of the settings to their factory default conditions.

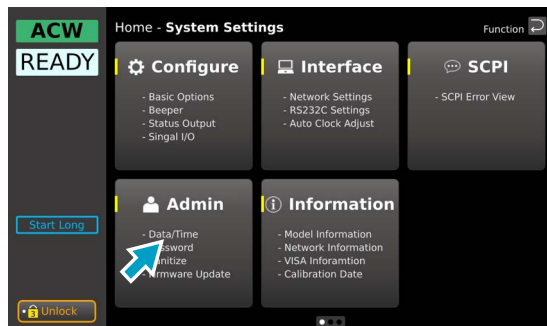
Restoring the factory default settings

Resetting your settings to the factory default settings will erase all user data except for the date and time settings and calibration date.

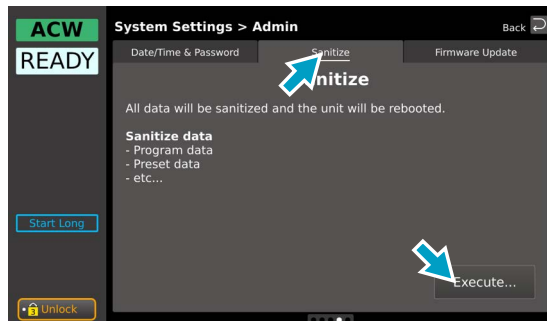
For details on the factory default settings, refer to “List of Factory Default Settings” ([p.173](#)).

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



3 Tap Sanitize, then tap Execute.



A confirmation screen appears.

4 Tap OK.

The TOS54 series restarts, and the factory default settings are restored.

Once started, the error messages of “-314 Save/recall memory lost” and “-315 Configuration memory lost” appear, but they are not abnormal.

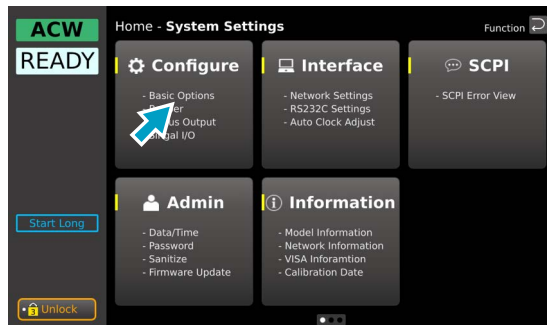
To remove the error messages, press CLR on the SCPI error screen ([p.144](#)) or turn the power off and then back on.

Resetting test conditions to factory default settings

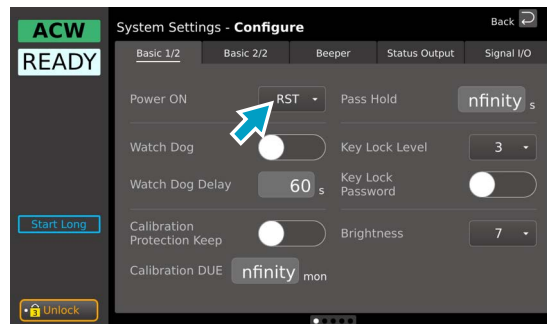
When the power is turned on, some settings (p. 173), such as test conditions, are reset to the factory default settings.

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Configure.



3 Tap the input field of Power ON and set to RST.



4 Turn the TOS54 series off and then back on.

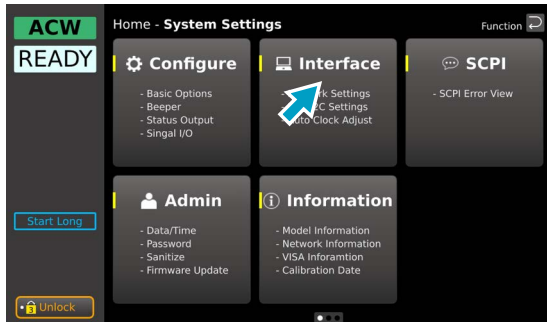
The device starts with some settings, such as the test conditions, in the factory default conditions.

Returning only the interface settings to the factory default values

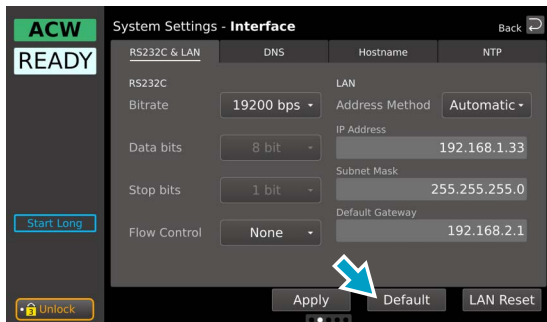
The items of the interface settings (p.176) in the factory default setting list will be reset to the factory default settings.

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Interface.



3 Tap Default.

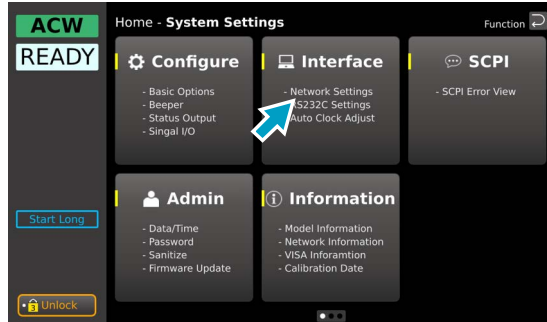


The interface settings are returned to the factory default values.

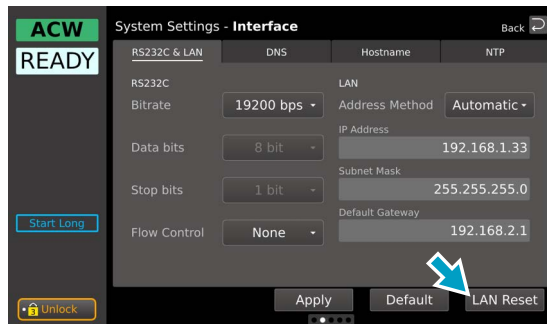
Returns LAN settings to their factory default setting

You can return the LAN settings to their factory default settings ([p.176](#)).

- 1 Flick left and right on the Home screen to display the System Settings screen.
- 2 Tap Interface.



- 3 Tap LAN Reset.



A confirmation screen appears.

- 4 Tap OK.
The LAN settings return to the factory default settings.

Update

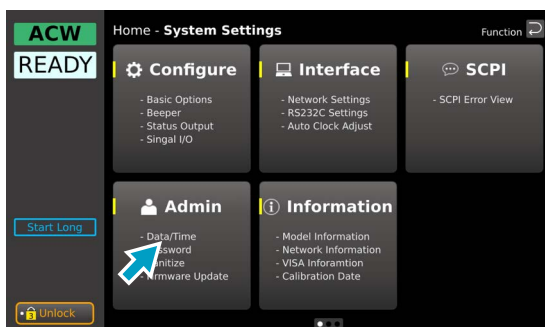
You can update the firmware of the TOS54 series by using a USB memory device.
 You can download the updated file from the Kikusui Electronics Corporation website.
<https://global.kikusui.co.jp/downloads/>

NOTE

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

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Admin.



3 Tap Firmware Update.



4 Insert the USB memory device on which the update files have been saved into the USB port on the front panel, and then tap Execute.

An update screen appears.

5 Tap OK.

6 Tap Enter.

The update process begins. Do not turn off the TOS54 series while updating is in progress. Do not remove the USB memory device.

7 If “Cycle the unit power...” is displayed, remove the USB memory device, and turn the TOS54 series off and then back on.

Update is complete.

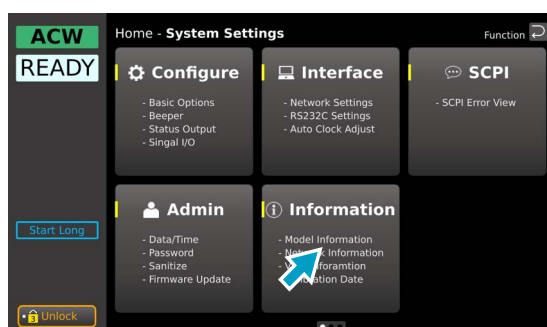
Displaying the Device Information

You can display the model name, serial number, firmware version, IP address, last calibration date and other instrument information.

Item	Displayed device information
Basic	Model, Serial Number, Firmware Version, IFC Version, IOC Version, IP Address, LAN Status, IP Address Source, mDNS Hostname, mDNS Description
Network	Subnet Mask, Default Gateway, DNS Server 1, DNS Server 2, DNS Hostname, Domain, MAC Address
VISA & Calibration	VXI-11, HiSLIP, SCPI-RAW, USBTMC, Calibration date, Installed Options

1 Flick left and right on the Home screen to display the System Settings screen.

2 Tap Information.



Instrument information is displayed in each tabs of Basic, Network, VISA & Calibration.

Pre-Test Inspection

Applicable models for AC withstanding voltage (ACW): **5401**, **5402**

Applicable models for DC withstanding voltage (DCW): **5401**, **5403**

Applicable models for insulation resistance (IR): **5402**, **5403**

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

Risk of electric shock or fire.

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

- 1** Connect the low-voltage test lead (black) and high-voltage test lead (red) to the TOS54 series (p.28).
- 2** Short the low-voltage test lead (black) and high-voltage test lead (red).
- 3** Set the test conditions.
For a withstanding voltage test, set the Upper limit (Upper) (p.43). For an insulation resistance test, be sure to set the Lower limit (Lower) (p.66)
- 4** Perform the start operation (p.36).
The test starts.
- 5** Check the test results.

Test type	Result	Inspection result
Withstanding voltage (ACW, DCW) test	Upper-FAIL or PROTECTION (Output Error or Over Load)	Normal.
	Other than above	The test leads may be broken. If there are no breaks in the test leads, the TOS54 series needs to be repaired.
Insulation resistance (IR) test	lower-FAIL or PROTECTION (Output Error or Over Load)	Normal.
	Other than above	The test leads may be broken. If there are no breaks in the test leads, the TOS54 series needs to be repaired.

This completes the inspection.

If the TOS54 series needs to be repaired, contact your Kikusui agent or distributor.

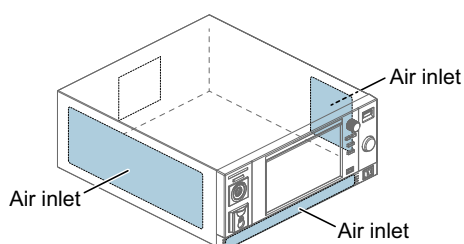
Cleaning

Enclosure

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

Dust filter

The air inlet on the front panel and sides have built-in dust filters. Clogging of the filter reduces the cooling efficiency inside the device, which may cause malfunctions or shorten its service life. Make sure to clean it regularly with a vacuum cleaner.



Replacing Components

Before requesting part replacement, we recommend either noting your settings or saving them to a USB memory device as described below.

- “Exporting programs to a USB memory device” (p.99)
- “Saving to the setup memory” (p.115)

Backup battery replacement

TOS54 series 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.

Replacing the high voltage relay

The high voltage relay inside the TOS54 series is a consumable item. Though its life depends on usage conditions, we recommend you replace it once in every one million test cycles, along with internal inspection and cleaning. For information about replacing the high voltage relay, contact your Kikusui agent or distributor.

Periodic Calibration

The TOS54 series is calibrated before shipment. To maintain long-term performance, we recommend the product be calibrated once a year.

Calibration can be managed by Setting the Calibration Date [\(p.147\)](#) and the Calibration period [\(p.128\)](#).

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

Before requesting calibration of the device, we recommend either noting your settings or saving them to a USB memory device as described below.

- "Exporting programs to a USB memory device" [\(p.99\)](#)
- "Saving to the setup memory" [\(p.115\)](#)

Disposal

Dispose of TOS54 series in accordance with your local regulations.

Removing the battery at the time of disposal

This product contains a CR2032 coin-type manganese dioxide lithium battery.

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

CR coin Lithium Battery contains Perchlorate Material - special handling may apply.

See www.dtsc.ca.gov/hazardouswaste/perchlorate.

WARNING

Risk of electric shock.

- To remove the power cord from the switchboard, turn the switch of the switchboard off.

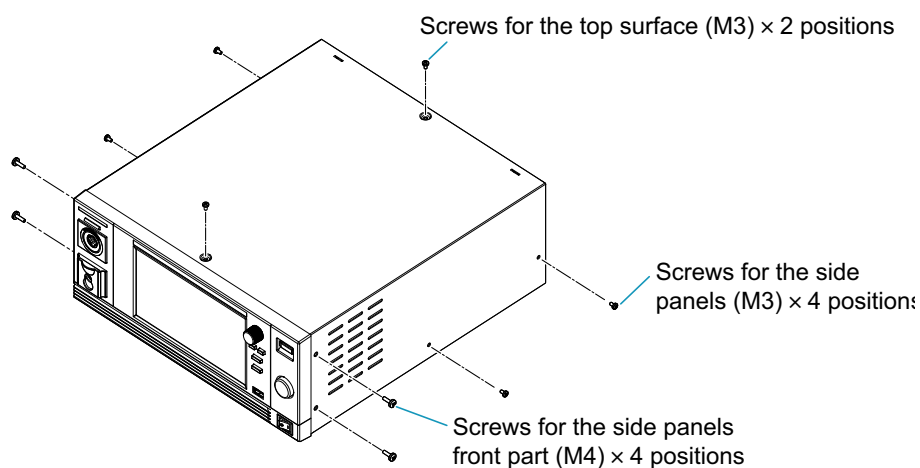
Risk of rupture or ignition.

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

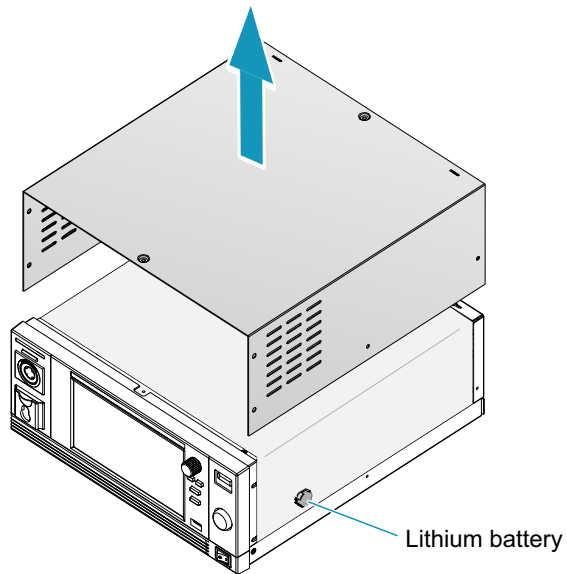
NOTE

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

1 Remove the screws holding the top cover.



2 Remove the cover.



3 Remove the lithium battery.

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

4 Close the cover and fasten the screws.

This completes the removal of the battery.

Specifications

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

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

The used terminology is as follows:

- TYP: These are typical values that are representative of situations where the product operates in an environment with an ambient temperature of 23 °C (73.4 °F). 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.
- digit: Indicates the number of digits.
- The various tests are abbreviated as follows:
ACW: AC withstanding voltage test, DCW: DC withstanding voltage test, IR: Insulation resistance test
- The following table shows which tests are supported by each model.

	ACW	DCW	IR
TOS5401	✓	✓	n/a
TOS5402	✓	n/a	✓
TOS5403	n/a	✓	✓

<i>Withstanding Voltage Test Section</i>	160
<i>Insulation Resistance Test Section</i>	165
<i>Interface</i>	169
<i>Other Functions.....</i>	170
<i>General Specifications</i>	171
<i>External Dimensions</i>	172

Withstanding Voltage Test Section

Applicable models for ACW: **5401**, **5402**

Applicable models for DCW: **5401**, **5403**

Output function

AC output section (ACW only)

Item		TOS5401, TOS5402
Output range		0.05 kV to 5.00 kV
Output setting accuracy		$\pm(2\% \text{ of setting} + 20 \text{ V})$ (at no load)
Output setting range		0.000 kV to 5.500 kV 0.000 kV to 1.500 kV (When Time Unit is set to Cycle and Phase Shift is set to 0°)
Output resolution		1 V
Maximum rated output ¹		500 VA (5 kV/100 mA)
Max. rated voltage		5 kV
Max. rated current		100 mA (when the output voltage is 0.5 kV or higher)
Transformer rating		500 VA
Output voltage waveform ²	Waveform	Sine.
	Phase shift	The output voltage waveform can start with a phase shifted approx. 90° from the zero-crossing point.
	Distortion rate	3 % or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)
Frequency		50 Hz/60 Hz
Frequency accuracy		$\pm 0.5\%$ (excluding during voltage rise time)
Voltage regulation		$\pm 10\%$ or less (when changing from maximum rated load to no load)
Input line regulation		$\pm 0.3\%$ (5 kV at no load; power supply voltage: 90 V to 250 V)
Short-circuit current		200 mA or more (output voltage 1.0 kV or higher)
Output method		PWM switching

- When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting ([p.56](#)).
- 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 1000 pF or less can be ignored. Because the high-voltage power supply of the TOS54 series 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.

DC output section (DCW only)

Item	TOS5401, TOS5403	
Output range	0.05 kV to 6.00 kV	
Output setting accuracy	$\pm(2\% \text{ of setting} + 20 \text{ V})$ (at no load)	
Output setting range	0.000 kV to 6.200 kV	
Output resolution	1 V	
Maximum rated output ¹	50 W (5 kV/10 mA)	
Max. rated voltage	6 kV	
Max. rated current	10 mA	
Ripple (TYP)	5 kV no load	50 Vp-p
	Max. rated load	100 Vp-p
Voltage regulation	3 % or less (when changing from maximum rated load to no load)	
Short-circuit current (TYP)	40 mA (when generating 6 kV output)	
Discharge function	Forced discharge after test completion (discharge resistance: $125 \text{ k}\Omega$) ² Maximum capacitance: $1 \mu\text{F}$ ³ Discharge time: 0.0 to 100.0 seconds Discharge function during interlock activation: ON/OFF	

1. When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting (p.56).
2. In the following conditions, charging current may activate a FAIL judgment or trigger the protection function.
EUT capacitance: $1 \mu\text{F}$; Rise Time: 1.0 second or less; Judge Delay: 1.2 seconds or less.
3. Maximum capacitance that can be discharged within 2 seconds in a DC withstanding voltage test. Tests can still be conducted beyond the maximum capacitance, but the discharge time will increase.

Common

Item	TOS5401	TOS5402	TOS5403
Start voltage function	The initial voltage at test start can be set to 1 % to 99 % of the test voltage. Resolution: 1 %		
	Disabled if the Time Unit is set to Cycle.		n/a
Limit voltage function	The upper limit of the test voltage can be set. ACW: 0.000 kV to 5.500 kV, DCW: 0.000 kV to 6.200 kV		
	ACW: 0.000 kV to 1.500 kV (When Time Unit is set to Cycle and Phase Shift is set to 0°)		n/a
Output voltage monitor function	If the output voltage deviates more than ±(350 V) from the set value, the output is turned off, and the protection function is activated.		

Measurement function

Digital voltmeter

Item	TOS5401	TOS5402	TOS5403
Measuring range	AC/DC: 0.000 kV to 6.500 kV	AC: 0.000 kV to 6.500 kV	DC: 0.000 kV to 6.500 kV
Display	□.□□□ kV		
Accuracy	$V < 500 \text{ V}$: $\pm(1.5 \% \text{ of reading} + 10 \text{ V})$ $V \geq 500 \text{ V}$: $\pm 1.5 \% \text{ of reading}$		
Response ¹	ACW: True rms/ Mean-value response rms display can be switched. DCW and IR: Mean-value		Mean-value
Hold function	Holds the measured voltage value at the end of the test while the PASS/FAIL judgment result is displayed.		

1. The true rms value and the average response rms value, require a response time of at least 50 ms in order to meet the measurement accuracy.

Digital ammeter

Item	TOS5401	TOS5402	TOS5403
Measuring range	AC: 0.00 mA to 110 mA DC: 0.00 mA to 11 mA	AC: 0.00 mA to 110 mA	DC: 0.00 mA to 11 mA
Display (i = measured current)	$i < 10 \text{ uA}$	□ . □ uA	
	$10 \text{ uA} \leq i < 100 \text{ uA}$	□□ . □ uA	
	$100 \text{ uA} \leq i < 1 \text{ mA}$	□□□ . □ uA	
	$1 \text{ mA} \leq i < 10 \text{ mA}$	□ . □□□ mA	
	$10 \text{ mA} \leq i < 100 \text{ mA}$	□□ . □□ mA	
	$100 \text{ mA} \leq i$	□□□ . □ mA	
Accuracy ¹ (i = measured current)	$1.00 \text{ mA} \leq i$	$\pm(1.5 \% \text{ of reading})$	
	$i < 1.00 \text{ mA}$	$\pm(1.5 \% \text{ of reading} + 20 \text{ uA})$	
Response ²	ACW: True rms/ Mean-value response rms display can be switched. DCW: Mean-value		Mean-value
Hold function	The current measurement after a test is finished is held while the pass judgment is displayed.		

1. When the humidity is 70 % or higher, add 50 μA . 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. 176).
2. The true rms value and the average response rms value, require a response time of at least 50 ms in order to meet the measurement accuracy.

Judgment function

Item			TOS5401	TOS5402	TOS5403
Current judgment ¹	Function		The output is shut off when a judgment is made. Beep volume level can be set for PASS and FAIL separately.		
	UPPER FAIL	Judgment method	Upper limit (Upper) is detected.		
		Display	Shown on the display.		
		Beep sound	On		
		SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.		
	LOWER FAIL	Judgment method	Lower limit (Lower) is detected. Voltage rise time (Rise Time)Voltage fall time (Fall Time)		
		Display	Shown on the display		
		Beep sound	On		
		SIGNAL I/O	The L-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	Shown on the display		
		Beep sound	ON (fixed at 0.2 s regardless of Pass Hold setting)		
		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 limit setting range			AC: 0.01 mA to 110.00 mA DC: 0.01 mA to 11.00 mA		DC: 0.01 mA to 11.00 mA
Lower limit setting range			AC: 0.00 mA to 109.99 mA, or OFF DC: 0.00 mA to 10.99 mA, or OFF		DC: 0.00 mA to 10.99 mA, or OFF
Judgment accuracy ²	1.00 mA ≤ i		±(1.5 % of setting)		
	i < 1.00 mA		±(1.5 % of setting + 20 μA)		
Current detection method			Calculates the current's true rms value or mean-value and compares this value with the reference value		
Calibration			Calibrated with the rms of a sine wave using a pure resistive load		
Discharge detection function		Function	Separately from the Upper judgment, it is possible to choose between low-pass filter (LPF) and high-pass filter (HPF) to detect a discharge at the EUT.		
		LPF	The judgment criterion is set to a value greater than the set Upper value. It can be switched between three levels: Fast, Medium, Slow. It is generally for normal withstanding voltage test.		
		HPF	The judgment criterion is set to a fixed value independently of the set Upper value. It can be switched between three levels: High, Medium, Low. It is mainly for detecting small discharges.		

1. In the following conditions, charging current may activate a FAIL judgment or trigger the protection function.
EUT capacitance: 1 μF ; Rise Time: 1 second or less; Judge Delay: 1.2 seconds or less.
2. When the humidity is 70 % or higher, add 50 μA . 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.176).

Timer function

Item		TOS5401	TOS5402	TOS5403
Voltage rise time (Rise Time)	Setting range	0.1 s to 100 s, or OFF. If Time Unit is set to CYCLE in ACW tests: ¹ • If Phase Shift is set to 0°: Fixed to OFF. • If Phase Shift is set to 90°: Fixed to 1/4 Cycle.		n/a
	Setting resolution	0.1 s		
Voltage fall time (Fall Time)	Setting range	0.1 s to 100 s, only enabled when a PASS judgment occurs. Disabled if the Time Unit is set to CYCLE.		
		If Time Unit is set to CYCLE in ACW tests, it is fixed to OFF.		n/a
	Setting resolution	0.1 s		
Test time	Setting range	0.1 to 1000 seconds, or OFF. If Time Unit is set to CYCLE in ACW tests:: • At 50 Hz: 2 to 50000 cycles • At 60 Hz: 2 to 60000 cycles		n/a
	Setting resolution	0.1 s or 1 Cycle		
Judgment delay (Judge Delay)	Setting range	0.1 s to 100 s	n/a	0.1 s to 100 s
	Setting resolution	0.1 s	n/a	0.1 s
Accuracy		±(100 ppm + 20 ms) excluding Fall Time		

1. If Phase Shift is set to 90°, the time for quarter-wave length is fixed as Rise Time; therefore, the voltage is output for Test Time + 1/4 cycles. For example, If Test Time is set to 2, Time Unit to Cycle, Phase Shift to 90°, and Frequency to 50 Hz, voltage is output for approx. 45 ms (20 ms × (2 + 1/4 cycles)).

Insulation Resistance Test Section

Applicable models: **5402**, **5403**

Output function

Item		TOS5402, TOS5403
Output voltage		25 Vdc to 1000 Vdc, negative polarity
Output setting accuracy		$\pm(1.0\% \text{ of setting} + 2 \text{ V})$
Output setting range		0.00 kV to 1.02 kV
Output setting regulation		1 V
Max. rated load		1 W (-1000 Vdc/1 mA)
Max. rated current		1 mA
Ripple	1000 V no load	2 Vp-p or less
	Max. rated load	10 Vp-p or less
Voltage regulation		1 % or less (when changing from maximum rated load to no load)
Short-circuit current		12 mA or less
Discharge function		Forced discharge after test completion (discharge resistance: approx. 25 k Ω) ¹ Maximum capacitance: 2 μF ² Discharge time: 0.0 to 100.0 seconds Discharge function during interlock activation: ON/OFF
Output voltage monitor function		If the output voltage exceeds $\pm(10\% \text{ of setting} + 10 \text{ V})$, the output is turned off, and the protection function is activated.

1. In the following conditions, charging current may activate a FAIL judgment or the protection function:
EUT capacitance: 2 μF ; Rise Time: seconds or less; Judge Delay: 2.0 seconds or less; Low Pass Filter: OFF
2. Maximum capacitance that can be discharged within 2 seconds in a insulation resistance test. Tests can still be conducted beyond the maximum capacitance, but the discharge time will increase.

Measurement function

Digital voltmeter

Item		TOS5402, TOS5403
Measuring range		0 V to -1200 V
Display (v = measured voltage)	$v < 10 \text{ V}$	□.□ V
	$10 \text{ V} \leq v < 100 \text{ V}$	□□.□ V
	$100 \text{ V} \leq v < 1000 \text{ V}$	□□□.□ V
	$1000 \text{ V} \leq v$	□□□□.□ V
Accuracy		$\pm(1 \% \text{ of reading} + 1 \text{ V})$

Resistance meter

Item		TOS5402, TOS5403	
Measurement range / accuracy ¹ (i: Measurement current) (R = measured insulation resistance)	$40 \text{ nA} \leq i \leq 100 \text{ nA}$	$200.00 \text{ M}\Omega \leq R \leq 10.000 \text{ G}\Omega$:	$\pm(20 \% \text{ of reading})$
	$100 \text{ nA} < i \leq 200 \text{ nA}$	$100.00 \text{ M}\Omega \leq R < 5.000 \text{ G}\Omega$:	$\pm(10 \% \text{ of reading})$
	$200 \text{ nA} < i \leq 1000 \text{ nA}$	$5.000 \text{ G}\Omega \leq R \leq 10.000 \text{ G}\Omega$:	$\pm(20 \% \text{ of reading})$
	$1 \mu\text{A} < i \leq 2 \text{ mA}$	$10.000 \text{ M}\Omega \leq R < 5.000 \text{ G}\Omega$:	$\pm(5 \% \text{ of reading})$
Display (R = measured insulation resistance)	$25 \text{ k}\Omega \leq R < 1.000 \text{ M}\Omega$	□□□ k Ω	
	$1.000 \text{ M}\Omega \leq R < 20.0 \text{ G}\Omega$	□.□□□ M Ω □□.□□ M Ω □□□.□ M Ω □.□□□ G Ω □□.□□ G Ω	
	$20.0 \text{ G}\Omega \leq R$	OVER	
Hold function		The resistance measurement after a test is finished is held while the pass judgment is displayed.	
Response		Average response (averaged time: Fixed at 100 ms)	

- Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems. For measurements of 200 nA or less, the humidity 50 %Rh or less.

Judgment function

Item			TOS5402, TOS5403
Judgment method and judgment operation ¹	Function		The output is shut off when a judgment is made. Beep volume level can be set for PASS and FAIL separately.
	UPPER FAIL	Judgment method	Upper limit (Upper) is detected. Voltage rise time (Rise Time)
		Display	Shown on the display
		Beep sound	On
		SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
	LOWER FAIL	Judgment method	Lower limit (Lower) is detected or when there is an abnormality during the voltage rise.
		Display	Shown on the display
		Beep sound	On
		SIGNAL I/O	The L-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	Shown on the display
		Beep sound	ON (fixed at 0.2 s regardless of Pass Hold setting)
		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 limit setting range			0.001 MΩ to 10.000 GΩ
Lower limit setting range			0.000 MΩ to 9.999 GΩ
Judgment accuracy (common between Upper and Lower) ^{2 3 4}			Measurement accuracy + 2 digits

1. In the following conditions, charging current may activate a FAIL judgment or the protection function:
EUT capacitance: 2 μF; Rise Time: 1.5 seconds or less; Judge Delay: 2.0 seconds or less; Low Pass Filter: OFF
2. Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
3. For judgments of 5 μA or less, a test time of at least 1.0 seconds is necessary.
4. When the low pass filter is set to medium, a test time of at least 0.3 seconds is required. When the low pass filter is set to slow, a test time of at least 0.5 seconds is required.

Timer function

Item		TOS5402, TOS5403	
Voltage rise time (Rise Time)	Setting range	0.1 s to 100 s or OFF	
	Setting resolution	0.1 s	
Voltage fall time (Fall Time)		0.1 s to 100 s or OFF (only enabled when a PASS judgment occurs)	
Judgment delay (Judge Delay)	Setting range	0.1 s to 100 s	
	Setting resolution	0.1 s	
Accuracy		±(100 ppm + 20 ms) excluding Fall Time	

Auto Test

Item	Specifications
Number of programs	61
Number of steps	2
Test mode	The same settings as for single test settings are possible, except for the following. The same test can be selected consecutively. • Limit Voltage is fixed to the maximum rated value per test mode. • Test Time is fixed to ON. • In IR test, Lower is fixed to ON (only for models that support IR testing).
Fail judgment operation	The following operations are selectable: • Continue: All steps are executed even for a FAIL judgment. • Abort: Automatic test ends for a FAIL judgment.
Interval time between steps	0.1 s to 100 s
Step start condition	The following operations are selectable: • Immediate: When the INIT or INIT:TEST command is received via remote control, starts all steps consecutively. • BUS: Step 1 can be started using the software trigger from remote control. After it is completed, the operation pauses. When the command is then received again, Step 2 starts. • External: Step 1 starts upon performing the start operation (p.36). After a step is completed, the operation is paused. When you perform another start operation, step 2 starts. • Once: When you perform a start operation (p.36), all steps are executed consecutively.

Interface

Item		Specifications
Display		7-inch LCD.
Remote Control	Function	Functions except turning on and off the power can be remotely controlled. The icon is displayed during the SCPI command operation.
	RS232C	D-sub 9-pin connector (EIA-232D) Baud rate: 9600, 19200, 38400, 57600, 115200 bps
	USB (device)	USB Specification 2.0, USBTMC-USB488 device class 480 Mbps maximum (high speed) B type socket
	LAN	Hardware IEEE 802.3 1000Base-T/100Base-TX/10Base-T Ethernet Complies with LXI Class C, Specification 1.5, IPv4 and RJ-45 connector Communication protocol HiSLIP, SCPI-RAW
USB (host)		USB Specification 2.0, 480 Mbps (High Speed), A type socket
REMOTE		MINI DIN 9-pin connector. Connect the following option products to enable the remote control of the starting and stopping of tests.
SIGNAL I/O	Function	D-sub 25-pin connector. It is possible to switch between TOS54 mode and TOS53 compatibility mode. For details on pin arrangement, see SIGNAL I/O Connector (p. 102). Enabling/disabling interlock, recalling the setup memory, starting/stopping testing, selecting test modes (only available for the TOS53-compatible mode), monitoring testing/voltage generation status, monitoring test status, monitoring judgment results, monitoring the activation status of protection functions.
	Output specifications	Output method Open collector output (4.5 Vdc to 24 Vdc)
		Withstand voltage 24.5 Vdc
		Saturation voltage Approx. 1.1 V at 25 °C (77 °F)
		Maximum current Each terminal 10 mA
	Input specifications	Control The input signals are all low-active control. The input terminal is pulled up to +12 V by a resistor. Leaving the input terminal open is equivalent to applying a high level signal.
		High-level voltage 11 V to 15 V
		Low-level voltage 0 V to 4 V
		Low-level current 5 mA max. Input time width 5 ms min.
STATUS OUT	Function	Output terminal for the warning light unit (optional product). 100 mA max
	+ Terminal	Outputs + 24 V during the setup period.
	COM	+24 V circuit common terminal

Other Functions

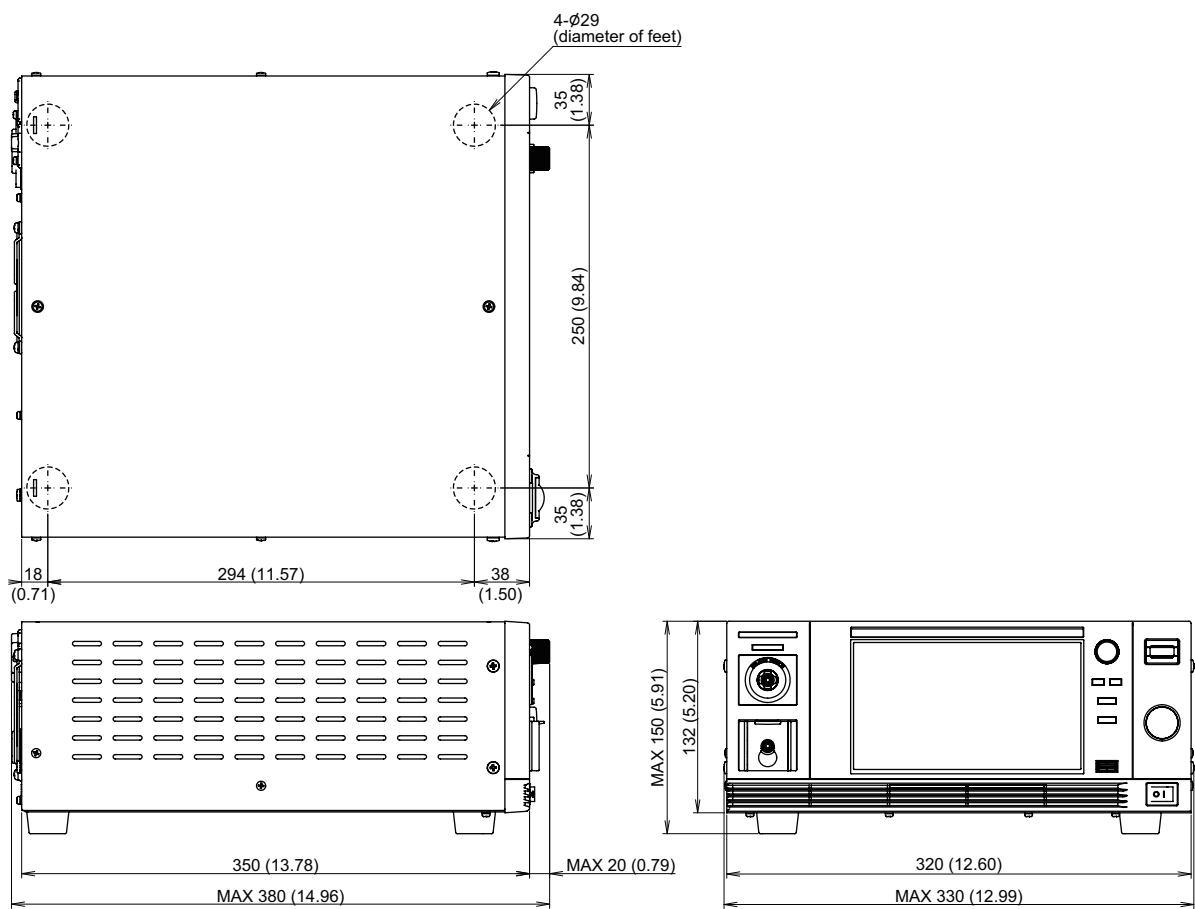
Item		Specifications
Settings at startup		The following settings are selectable: • Resume: Start with some settings, such as the test conditions, in the previous power-off state. • RST: Start with some settings, such as the test conditions, in the factory default conditions. • RCL0: Start in setup memory 0 condition
Key lock		Allows you to select whether or not to use a password to unlock the key lock. Key lock setting is shown with an icon. The following settings are selectable: • 3: Unlocks the key lock and permits only STOP/RESET switch operation. • 2: Unlocks the key lock and permits only START and STOP/RESET switch operation. • 1: Unlocks the key lock, and permits only START and STOP/RESET switch operation and setup memory recall.
Display of remote mode		Displays during SCPI command operation via RS232C, USB, or LAN.
Watch dog	Function	If there is no SCPI communication for the set period of time, the protection function will be activated.
	Setting range	1 s to 3600 s
Test start method		The following settings are selectable: • Double Action: Tests can only be started by pressing and releasing STOP/RESET and then pressing START within 0.5 seconds of releasing the STOP/RESET switch. • Momentary: Tests are only executed while the START switch is held down • Start Long: A test starts only when the START switch is held down for at least 1 second.
Example of PASS judgment display time (Pass Hold)		Set the time to hold the pass judgment result display (0.02 s to 10 s) or hold it until the STOP/RESET switch is pressed (Infinity).
Deactivation of the STOP signal (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.
Protection Functions	Common actions	If the protection function is activated, the test can not be done. If a protection function is activated during a test, the output is shut off and the test is stopped immediately. While the protection function is activated, the contents of protection is shown on the display. Conditions that cause a protection function to be activated are as follows.
	Interlock	Interlock is activated.
	Power Supply	There is an error in the power supply section.
	Output Error	An output outside of the following range is detected. ACW, DCW: ± 350 V IR: $\pm(10\% \text{ of setting} + 10 \text{ V})$
	Over Load	An output outside of the following range is detected. ACW: 550 VA, DCW: 55 VA, IR: 2 mA
	Over Heat	The internal temperature of the TOS54 series 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.56).
	Calibration	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. Alternatively, the watchdog was activated.
Memory		Can store 52 test conditions, including one autosave memory, of which 51 can be recalled via SIGNAL I/O. In the TOS53-compatible mode, only the three superior sets can be recalled by the SIGNAL I/O.
Test result log		You can view up to 1000 of the most recent test results. Deleted when the power is turned off. Test results can be saved in CSV format to a USB memory device.
Measurement data log		You can view a set number of the most recent measured values. The number of data pieces can be set to 8192 (default), 16384, or 32768. Deleted when the power is turned off. Test results can be saved in CSV format to a USB memory device.
Saving the calibration date		year/month/day/time. Changeable.
Calibration period setting		1 to 36 months, or no expiration. You can select whether the warning can be cleared when the calibration period has expired.
Backup battery life		3 years (at 25 °C, 77 °F)

General Specifications

Item			Specifications
Environment	Installation location		Indoors, 2000 m or less, Pollution Degree 2 ¹
	Spec guaranteed range	Temperature	5 °C to 35 °C (41 °F to 95 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Operating range	Temperature	0 °C to 40 °C (32 °F to 104 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Storage range	Temperature	-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)		100 Vac to 240 Vac (90 Vac to 250 Vac)
	Power consumption	No load (READY state)	100 VA or less
		Rated load	800 VA max. Maximum 200 VA for TOS5403 only.
	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)			1400 Vac for 2 seconds
Earth continuity			25 Aac/0.1 Ω or less
External dimensions			See External Dimensions (p. 172).
Weight			TOS5401: Approx. 16 kg (35.27 lb), TOS5402: Approx. 15 kg (33.07 lb), TOS5403: Approx. 9 kg (19.84 lb)
Accessories			Accessories (p. 8).
Electromagnetic compatibility (EMC) ^{2 3}			Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1 (Class A ⁴) EN 61000-3-2 EN 61000-3-3 EN 55011 (Class A ⁴ , Group 1 ⁵) Applicable under the following conditions: The maximum length of all cabling and wiring connected to the TOS54 series must be less than 2.5 m. Use the included high voltage test leads. Electrical discharges are applied only to the EUT. Shielded cables are being used when using the SIGNAL I/O.
Safety ²			Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU ³ EN 61010-1, EN61010-2-034 (Class I ⁶ , Pollution Degree 2 ¹)

1. Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.
2. Does not apply to specially ordered or modified products.
3. Only for models with CE marking / UKCA marking on their body.
4. 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.
5. This product belongs to Group 1 products. This product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.
6. The TOS54 series is a Class I device. Be sure to ground the protective conductor terminal of the TOS54 series. The safety of this product is guaranteed only when the product is properly grounded.

External Dimensions



Unit: mm (inches)

Appendix

List of Factory Default Settings

Factory default settings are indicated in the following tables.

Items marked with a check mark (✓) in the “Power On” column are affected by the Power On settings (p. 126).

Withstanding voltage (ACW/DCW) test condition

Applicable models for AC withstanding voltage (ACW): 5401, 5402

Applicable models for DC withstanding voltage (DCW): 5401, 5403

ACW	DCW	Item	Factory default	Power On
✓	✓	Test voltage	0 V	✓
✓	✓	Limit voltage	ACW: 5500 V DCW: 6200 V	✓
✓	✓	Start voltage	OFF	✓
✓	n/a	Frequency	50 Hz	✓
✓	n/a	Phase shift	0°	✓
✓	✓	Upper limit (Upper)	0.01 mA	✓
✓	✓	Lower limit (Lower)	OFF	✓
n/a	✓	Judgment delay (Judge Delay)	0.1 s	✓
✓	✓	Test time	ON, 0.2 s	✓
✓	n/a	Test cycle	10	✓
✓	✓	Voltage rise time (Rise Time)	0.1 s	✓
✓	✓	Voltage fall time (Fall Time)	OFF	✓
✓	n/a	Test time unit (Time Unit)	SECOND	✓
n/a	✓	Discharge time	0.0 s	✓
n/a	✓	Discharge when interlock is activated (Discharge Interlock)	ON	✓
✓	n/a	Voltage measure	RMS	✓
✓	n/a	Current measurement mode (Current Measure)	True RMS	✓
✓	✓	Discharge detection	LPF, Slow	✓

Insulation resistance (IR) test condition

Applicable models: **5402**, **5403**

Item	Factory default	Power On
Test voltage	0 V	✓
Limit voltage	1020 V	✓
Upper limit (Upper)	OFF	✓
Lower limit (Lower)	ON, 0.001 GΩ	✓
Judgment delay (Judge Delay)	0.1 s	✓
Test time	ON, 0.2 s	✓
Voltage rise time (Rise Time)	0.1 s	✓
Voltage fall time (Fall Time)	OFF	✓
Discharge time	0.0 s	✓
Discharge when interlock is activated (Discharge Interlock)	ON	✓
Using the low-pass filter	OFF	✓

Measurement conditions

Item	Factory default	Power On
Measurement trigger	Trigger Source	Test
	Count	1
	Delay	0.0 s
Sample settings	Testing	ON
	Count	Infinity
	Timer	0.0 s
Measurement data size (Size of DATA)	8192	✓

Auto test (AUTO) settings

Item	Factory default	Power On
Registered programs	None	n/a
Program selection	No selection	✓
Operation for FAIL judgment	Abort	n/a
Step start condition (Trigger Source)	Once	n/a
Step interval	0.1 s	n/a

Memory function

Item	Factory default	Power On
Setup memory	Empty memory	n/a
Test result	None	✓

CONFIG settings

Item		Factory default	Power On
Basic	Power On	Resume	n/a
	Watch Dog	OFF	n/a
	Watch Dog Delay	60 s	n/a
	Calibration Protection Keep	OFF	n/a
	Calibration DUE	12 months	n/a
	Pass Hold	0.20 s	n/a
	Key Lock Level	3	n/a
	Key Lock Password	OFF	n/a
	Brightness	7	n/a
	Fail Mode	OFF	n/a
	Double Action	OFF	n/a ¹
	Start Long	ON	n/a ¹
	Momentary	OFF	n/a
Beeper	Pass Volume	2	n/a
	Fail Volume	3	n/a
	Key	ON	n/a
	Protection	ON	n/a
	SCPI Error	ON	n/a
Status Output	Upper Fail	OFF	n/a
	Lower Fail	OFF	n/a
	H.V ON	OFF	n/a
	Pass	OFF	n/a
	Power ON	OFF	n/a
	Protection	OFF	n/a
	Ready	OFF	n/a
	Test	OFF	n/a
Signal I/O	SIGNAL I/O Mode	TOS54	n/a

1. If both Double Action and Start Long are set to OFF, Start Long will be changed to ON upon power reapplication for safety.

Management settings

Item	Factory default	Power On
Timezone ¹	UTC	n/a
Date/Time	n/a	n/a
Password for unlocking the key lock	0000	n/a
Calibration date	Last calibration date	n/a

1. The current settings are retained even after performing Sanitize (p.148).

Interface settings

Item	Factory default	Power On
RS232C	Bitrate	19200
	Data Bits	8
	Stop Bits	1
	Flow Control	None
LAN	Address Method	Automatic
	IP address	n/a
	subnet mask	n/a
	default gateway	n/a
DNS server	DNS Server 1	0.0.0.0
	DNS Server 2	0.0.0.0
Services	mDNS	ON
	Dynamic DNS	ON
Hostname	Desired Hostname	Model name and serial number
	Desired Description	KIKUSUI XXXX Electrical Safety Tester (XXXX is the model name) and serial number
NTP	NTP Enable	ON
	NTP Server Hostname	ntp.nict.jp

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.

For high-sensitivity and high-accuracy measurement, in particular, the upper and lower limits are required to be set in consideration of current running through the stray capacitance.

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 included high voltage test lead wire is used (typical value)	16 μ A	32 μ A	48 μ A	64 μ A	80 μ A

Timing Chart

Typical examples of timing charts are provided below.

ACW test (PASS judgment)

■ Setting conditions

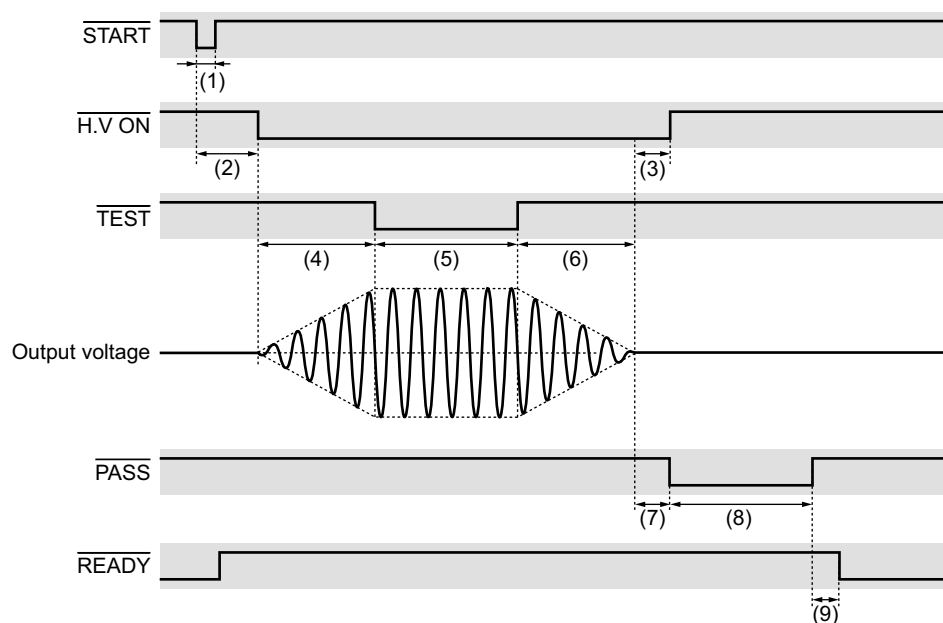
Rise Time: ON

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.



- | | |
|--------------------------------|---------------------------------|
| (1) 5 ms min. | (6) Fall Time |
| (2) Approx. 15 ms ¹ | (7) Approx. 4 ms ¹ |
| (3) Approx. 4 ms ¹ | (8) Pass Hold |
| (4) Rise Time | (9) Approx. 0.3 ms ¹ |
| (5) Test Time | |

1. TYP (typical value)

ACW test (FAIL judgment)

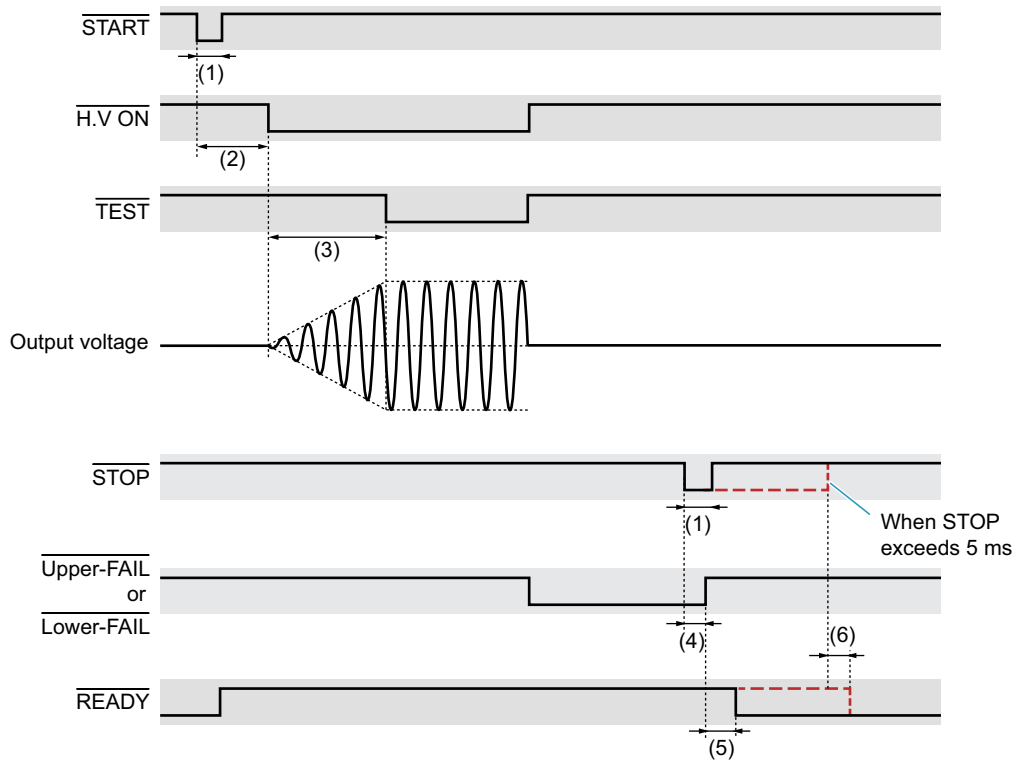
■ Setting conditions

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.



(1) 5 ms min.

(4) Approx. 3 ms¹

(2) Approx. 15 ms¹

(5) Approx. 5 ms¹

(3) Rise Time

(6) Approx. 3 ms¹

1. TYP (typical value)

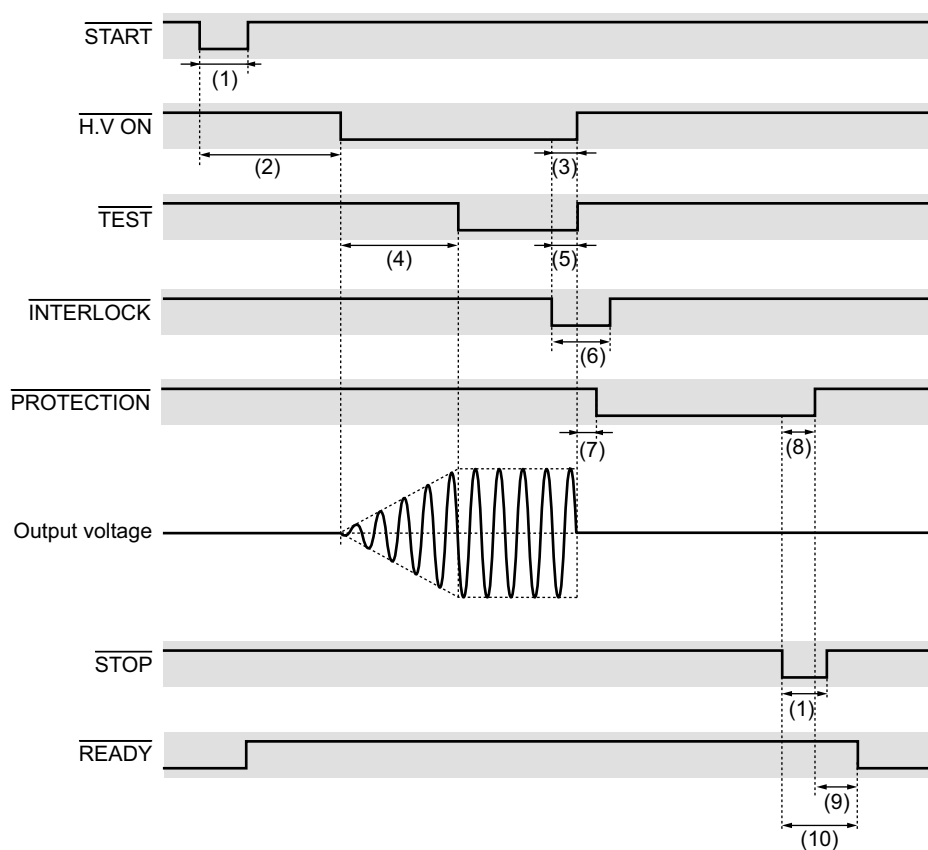
ACW test (Interlock)

■ Setting conditions

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.



- | | |
|--------------------------------|---------------------------------|
| (1) 5 ms min. | (6) 5 ms min. |
| (2) Approx. 15 ms ¹ | (7) Approx. 0.2 ms ¹ |
| (3) Approx. 3 ms ¹ | (8) Approx. 3 ms ¹ |
| (4) Rise Time | (9) Approx. 5 ms ¹ |
| (5) Approx. 3 ms ¹ | (10) Approx. 8 ms ¹ |

1. TYP (typical value)

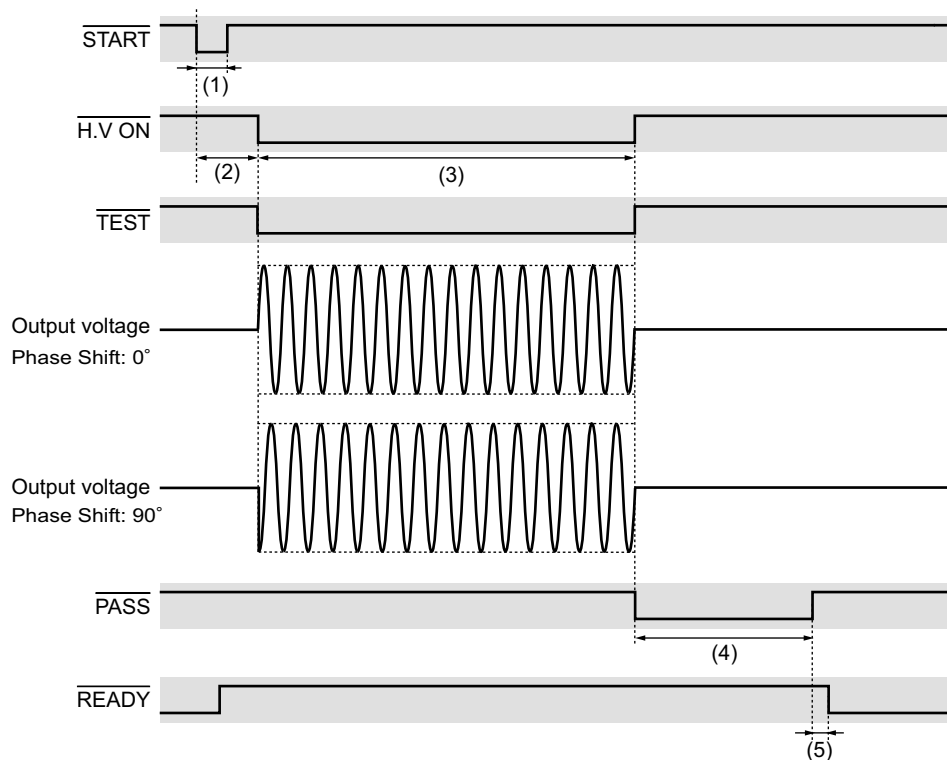
ACW test (Cycle test, PASS judgment)

■ Setting conditions

Test Unit: CYCLE

Phase Shift: 0° or 90°

No load, start the test with the SIGNAL I/O.



(1) 5 ms min.

(4) Pass Hold

(2) Approx. 12 ms¹

(5) Approx. 0.3 ms¹

(3) Test Cycle

1. TYP (typical value)

When the Time Unit is set to CYCLE and the Phase Shift to 0°, the Rise Time and Fall Time fixed at OFF (0 seconds)

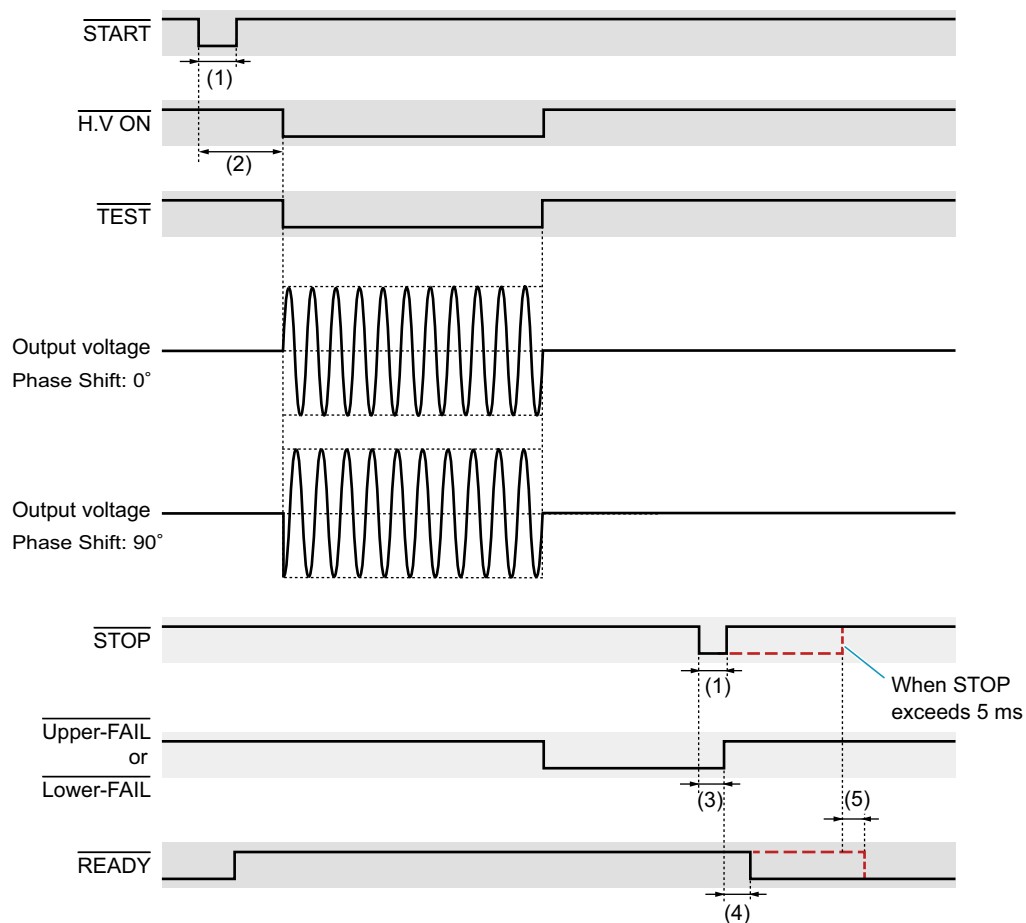
ACW test (Cycle test, FAIL judgment)

■ Setting conditions

Time Unit: CYCLE

Phase Shift: 0° or 90°

No load, start the test with the SIGNAL I/O.



(1) 5 ms min.

(4) Approx. 5 ms¹

(2) Approx. 12 ms¹

(5) Approx. 3 ms¹

(3) Approx. 3 ms¹

1. TYP (typical value)

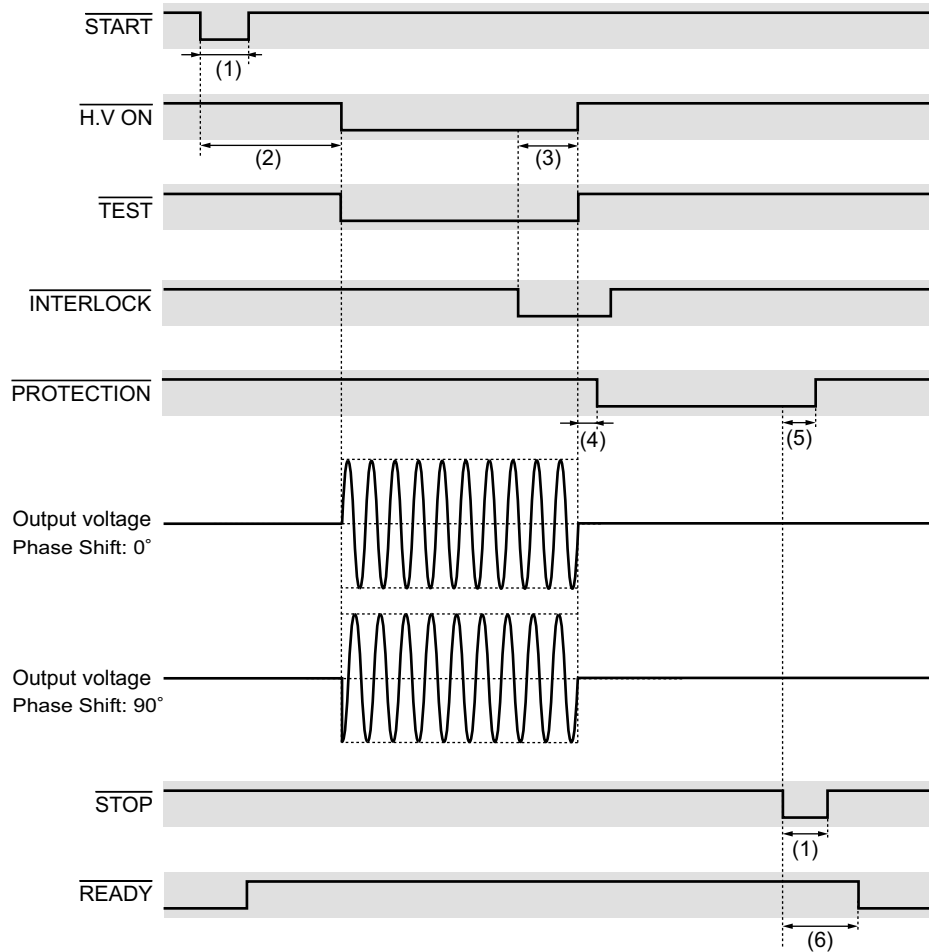
ACW test (Cycle test, Interlock)

■ Setting conditions

Time Unit: CYCLE

Phase Shift: 0° or 90°

No load, start the test with the SIGNAL I/O. Abort test with an interlock operation.



(1) 5 ms min.

(4) Approx. 0.2 ms¹

(2) Approx. 12 ms¹

(5) Approx. 3 ms¹

(3) Approx. 8 ms¹

(6) 8 ms min.¹

1. TYP (typical value)

ACW test (Minimum setting)

■ Setting conditions

Test Unit: CYCLE

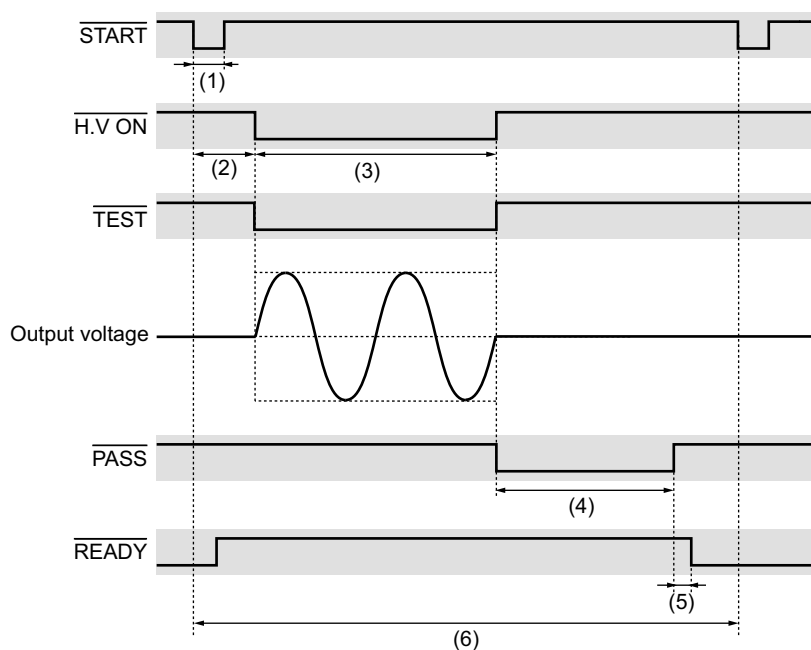
Test Cycle: 2

Phase Shift: 0°

Pass Hold: 20 ms

Frequency: 50 Hz

No load, start the test with the SIGNAL I/O.



(1) 5 ms min.

(4) Pass Hold

(2) Approx. 12 ms¹

(5) Approx. 0.3 ms¹

(3) Test Cycle

(6) 100 ms (Minimum takt time)

1. TYP (typical value)

If Phase Shift is set to 0°, the test voltage is limited to 1500 V or less. If the test voltage exceeds 1500 V, set Phase Shift to 90°.

Options

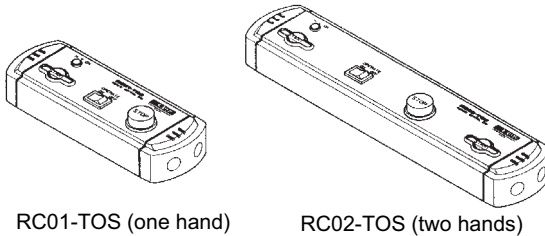
This product has the following options.

For information about options, contact your Kikusui agent or distributor.

- Remote control box (RC01-TOS/RC02-TOS)
- DIN adapter cable (DD-5P/9P)
- High voltage test probe (HP01A-TOS/HP02A-TOS)
- Warning light unit (PL02A-TOS)
- Brackets (KRA4-TOS/KRA200-TOS)

Remote control box

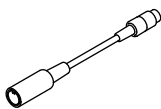
The RC01-TOS/RC02-TOS remote control box can be used to remotely control the starting and stopping of ACW, DCW, or IR tests. One model is for use with one hand, and the other model is for use with two hands. A DIN adapter cable ([p. 184](#)).



DIN adapter cable

DIN adapter cable DD-5P/9P (5 pin to 9 pin) is for connecting the following option products to the TOS54 series.

- Remote control box (RC01-TOS/RC02-TOS)
- High voltage test probe (HP01A-TOS/HP02A-TOS)



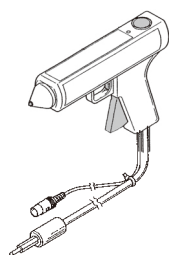
High voltage test probe

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. DIN adapter cable ([p.184](#)) is required to connect to the TOS54 series.

WARNING

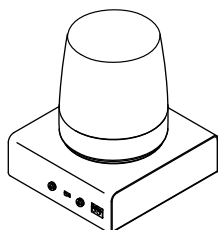
Risk of electric shock.

- The maximum rated voltages of the HP01A-TOS/HP02A-TOS are 4 kVac and 5 kVdc. For safety reasons, set the limit voltage of the TOS54 series ([p.39](#)) to limit the applied voltage.



Warning light unit

The PL02A-TOS warning light unit indicates that a test is in progress or other statuses. You can view the status from a distance. The conditions for the signals for output to the warning light unit can be set on the Status Output tab on the CONFIG setup screen ([p.137](#)).



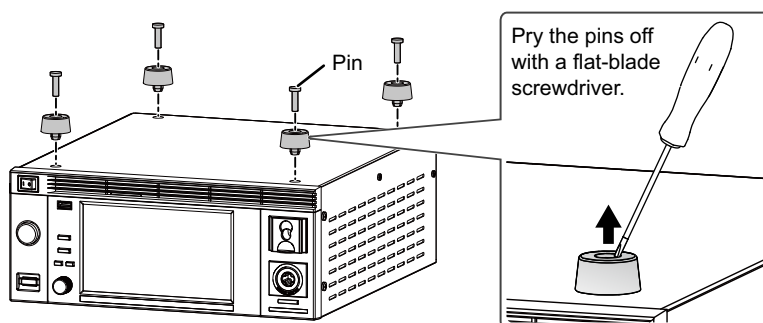
Brackets

Brackets are rack mounting options. There are two types of brackets: EIA standard and JIS standard.

- KRA4-TOS: EIA inch rack standard
- KRA200-TOS: JIS millimeter rack standard

Removing the feet

We recommend that you keep all pieces that you remove from the TOS54 series. 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.

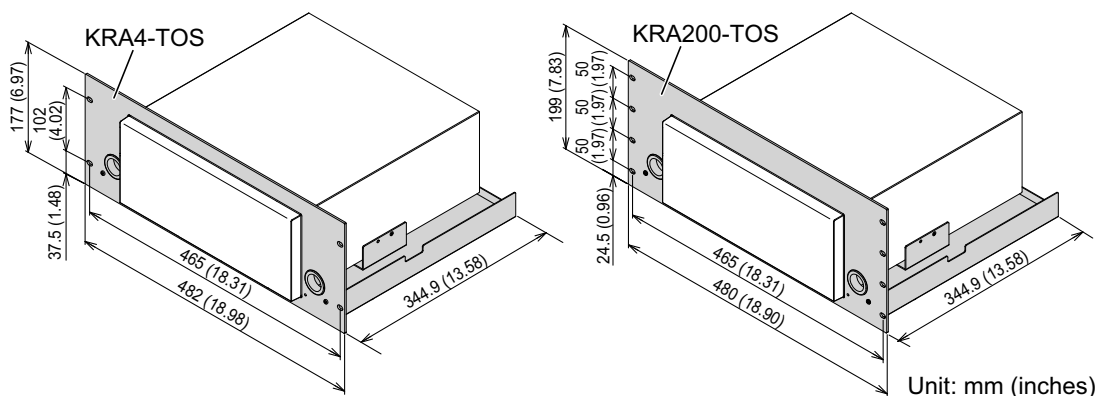
Attaching the rack adapter or bracket.

NOTE

When mounting the product on a rack, be sure to use support angles (auxiliary brackets) to safely support the TOS54 series.

For information on rack mounting, see the operation manual of the relevant bracket.

■ Outline drawing



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 resetting the product to its factory default settings (p. 148). If following the remedy does not solve your problem, contact your Kikusui agent or distributor.

■ The power does not turn on.

Symptom	Possible cause	Remedy
The product does not operate when the POWER switch is turned on.	The power cord is disconnected.	Check the power cord connection (p. 21)

■ Unable to control from the panel.

Symptom	Possible cause	Remedy
Front panel key operations are not accepted.	When the key lock icons  are shown in the lower left corner of the display, the key lock is enabled.	Press and hold the key lock icon to release the key lock. (p. 130)
	The password for the key lock is forgotten.	Enter "9941104" to cancel the password. If the product is returned to factory default settings, the password will be reset to "0000" and the password setting will be invalid. (p. 148)
	Interlock is activated.	Release the interlock. (p. 106)

■ Unable to start a test

Symptom	Possible cause	Remedy
"PASS," "Upper-FAIL," or "Lower-FAIL" is displayed.	A judgment result is displayed.	Press STOP/RESET to clear the judgment result.
"PROTECTION" is displayed.	A protection function is activated.	Clear the protection mode. (p. 19)
Testing does not begin when the START switch is pressed.	 appearing on the left of the display indicates that an optional product is connected to the REMOTE connector.	Disconnect it, or press the START switch on the option product.
	 appearing on the left of the display indicates that the ENABLE signal of the SIGNAL I/O is set to low level.	Set the ENABLE signal to high level. (p. 112)
	If  or  appears in the left of the display, Double Action or Start Long is set to on in the CONFIG settings.	Start the test properly, or set Double Action and Start Long to off (p. 135)

■ Unable to measure

Symptom	Possible cause	Remedy
The measured values are abnormal.	The test leads are connected to the wrong terminals.	Connect the test leads properly.
PASS judgment is not recognizable.	The pass judgment result display is cleared immediately.	Set the Pass Hold time to an appropriate value. (p. 129)
The judgment does not start.	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/RESET switch is pressed. Turn on the test timer, and set an appropriate timer value.

Index

A

accessories	8
ACW	37
AUTO	83
auto test	83

B

battery replacement	155
Beep sound	136

C

calibration	27, 128, 156
Calibration date	26, 153
component names	11
configuration	124
Configure	124

D

DANGER LED	15
date and time setting	
time setting	145
DCW	37
Default settings	148
default settings	173
device information	153
discharge time	17, 50, 71

E

external dimensions	172
---------------------------	-----

F

Factory default settings	148
factory default settings	173
firmware version	153

I

Initialize	148
insulation resistance test	62
Interface settings	138
Interlock	106
IP address	153
IR	62

K

Key lock	130
----------------	-----

L

lock	130
------------	-----

M

malfunction	18
Memory	115

O

Options	184
output limit	56

P

panel settings at startup	126
power cord	21
power on/off	22
POWER switch	23
Program	83, 84
PROTECTION	19
protection function	19

R

Rack mount	186
Reset	148

S

Sanitize	148
Saving test conditions	115
Saving test results	119
SCPI error	144
sequence	83
Serial number	153
SIGNAL I/O	102
Specifications	159
Step	83
Stray capacitance	176
SYSTEM	124
System settings	124

T

test mode	35
Troubleshooting	187

U

Update	152
USB	99, 120, 152

V

version	153
---------------	-----

W

withstanding voltage test	37
---------------------------------	----

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.

KIKUSUI ELECTRONICS CORP.

1-1-3 Higashiyamata, Tsuzuki-ku, Yokohama,
224-0023, Japan

Phone: +81-45-482-6353

Facsimile: +81-45-482-6261

<https://global.kikusui.co.jp/>

