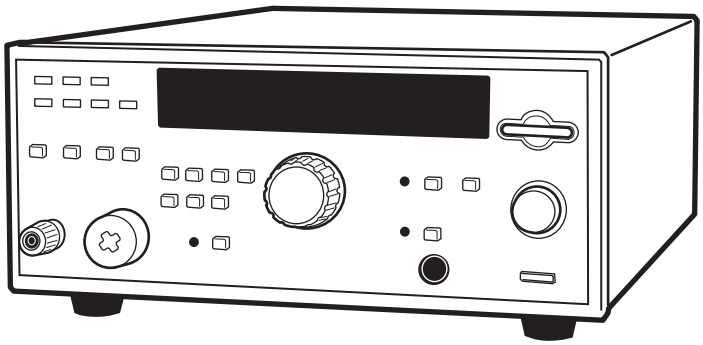
Part No. Z1-AB0-032, IB007935
Oct. 2005

OPERATION MANUAL

AC Withstanding Voltage/
Insulation Resistance Tester

TOS8830



DANGER

This instrument generates high voltage.

- Any incorrect handling may cause death.
- Read “Precautions for Safe Testing” in this manual to prevent accident.
- Keep this manual near the instrument for easy access of the operator.

KIKUSUI

Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

If you find any incorrectly arranged or missing pages in this manual, 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 Kikusui distributor/agent, and provide the "Kikusui Part No." given on the cover.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Manual Changes

TOS8830 Operation Manual
Part No. Z1-AB0-032, IB007933/IB007934/IB007935

Please make the following changes to the text in this manual.

■ Page 19, Table and CAUTION

Previous

SETTING SUPPLY	LINE VOLTAGE	FREQUENCY	VA MAX
STANDARD	220V	50/60Hz	650
	100V		

If this field is blank, the supply voltage is 220 V.

⚠CAUTION • The tester can operate correctly in the range of 200 V to 240 V. Use beyond this range may result in malfunction or failure in addition to improper operation. Operate the tester with the supply voltage within the voltage range required. The waveform of the power source should be a sine wave having a peak value within 130% to 150% of the rms value.

New

SETTING SUPPLY	LINE VOLTAGE	FREQUENCY	VA MAX
STANDARD	220V	50/60Hz	650
	120V		
	100V		

If this field is marked, the supply voltage is 120 V.

⚠CAUTION • For the nominal input rating, the input voltage range for the tester to be able to operate correctly is required. Use beyond the input voltage range may result in malfunction or failure in addition to improper operation. Operate the tester with the supply voltage within the voltage range required. The waveform of the power source should be a sine wave having a peak value within 130% to 150% of the rms value. For information on the input voltage range to the nominal input rating, see “General Specifications” (page 66).

■ Page 62, Specifications–Maximum rated load and Voltage regulation

Previous

Output section		
	Maximum rated load (*1)	400 VA (4 kV/100 mA) (at an input voltage of 220 V)
	Voltage regulation	10 % or less (during transition from the maximum rated load to no-load)

New

Output section		
	Maximum rated load (*1)	400 VA (4 kV/100 mA) (at a nominal input rating)
	Voltage regulation	10 % or less (during transition from the maximum rated load to no-load, models for a nominal input rating of 220 V) 15 % or less (during transition from the maximum rated load to no-load, models for a nominal input rating of 120 V or 100 V)

■ Page 66, Specifications–Nominal input rating, Input voltage range and Weight

Previous

AC input		
	Nominal input rating	220 V, 50 Hz or 60 Hz
	Input voltage range	200 V to 240 V
Weight		Approx. 18 kg

New

AC input		
	Nominal input rating (Input voltage range)	220 V (200 V to 240 V), 120 V (110 V to 130 V), or 100 V (90 V to 110 V), 50 Hz or 60 Hz
Weight		Approx. 18 kg (models for a nominal input rating of 220 V) Approx. 21 kg (models for a nominal input rating of 120 V or 100 V)

Testing Cannot be Performed at Unpacking

If the TOS8830's power is turned on in the condition in which the tester has been simply unpacked upon receipt, the interlock function will be activated, preventing performance of testing as-is.
See "6.2 Using the INTERLOCK Terminal" (page 53) to operate the tester, taking advantage of the interlock function.

■ About this manual

This documentation is the Operation Manual for the TOS8830 AC Withstanding Voltage / Insulation Resistance Tester.

Firmware version of the product to be used:

This Operation Manual applies to products incorporating firmware of:

Version 1.0x

The firmware version is indicated on the resistance meter when the POWER switch is turned on. For more information, see "5.1 Turning the POWER Switch On" (page 33).

When inquiring about the product, please provide this version number and the serial number indicated on the rear of the product.

To the Supervisor in Charge of Operation

- **If the operator does not read the language used in this manual, translate the manual into the appropriate language.**
- **Help the operator in understanding this manual before operation.**
- **Keep this manual near the instrument for easy access by the operator.**

Hazardous Operations

Any of the following operations will result in electric shock, which may lead to serious injury or death.

- **Touching the output terminal while output is being generated.**
- **Touching a test lead connected to the output terminal while output is being generated.**
- **Touching the DUT while output is being generated.**
- **Touching a part electrically connected to the output terminal while output is being generated.**
- **During an insulation resistance test, touching any part electrically connected to the output terminal immediately after the output has been shut off.**

Any of the following actions may result in electric shock leading to serious injury or death.

- **Operating the tester without connecting the grounding wire to ground.**
- **Operating the tester without wearing rubber gloves intended for electrical work.**
- **Approaching a section electrically connected to the output terminal while output is being generated.**
- **During an insulation resistance test, approaching any part electrically connected to the output terminal immediately after the output has been shut off.**

⚠ Safety Symbols

For the safe use and safe maintenance of this product, the following symbols are used throughout this manual and on the product. Understand the meanings of the symbols and observe the instructions they indicate (the choice of symbols used depends on the products).

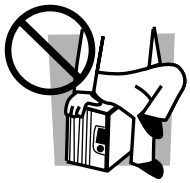
	**Indicates that a high voltage (over 1000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.**
DANGER	**Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.**
	**Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.**
	**Indicates a potentially hazardous situation which, if ignored, may result in damage to the product and other property.**
	**Shows that the act indicated is prohibited.**
	**Is placed before the sign "DANGER," "WARNING," or "CAUTION" to emphasize these. When this symbol is marked on the product, see the relevant sections in this manual.**
	**Protective conductor terminal.**
	**Chassis (frame) terminal.**
	On (supply)
	**Off (supply)**
	**In position of a bi-stable push control**
	**Out position of a bi-stable push control**

⚠ Safety Precautions

The following safety precautions are intended to avoid fire hazard, electrical shock, and other accidents or failures. Use of the product in a method not specified in this manual may impair the effectiveness of built-in protective functions.

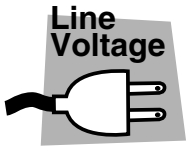
Users

- This product must be used only by qualified personnel who understand the contents of this Operation Manual.
- If this product is handled by unqualified personnel, personal injury may result. Ensure that the product is handled under the supervision of qualified personnel (i.e., those experienced in electrical applications).



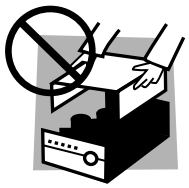
Purposes of use

- Do not use the product for any purpose other than those specified.
- This product is not designed or manufactured for home use or for general consumers.



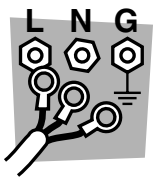
Input power

- Always connect the product to a power supply in line with the product's input rating.
- Use the provided power cord to supply input power.
- This product is designed as equipment falling under Overvoltage Category II of the IEC Standards (energy-consuming equipment to be supplied from fixed installation).



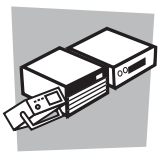
Cover

- Components inside the instrument may present physical hazards. Do not remove the external cover.



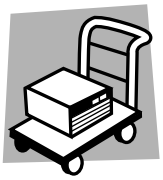
Grounding

- The product is equipment falling under Safety Class I of the IEC Standards (equipment with a protective conductor terminal). Always ground the product's protective conductor terminal to prevent electric shock.



Installation

- This product is designed for indoor use. Only use it indoors.
- When installing products be sure to observe "2.2 Precautions for Installation" described in this manual.



Relocation

- Turn off the POWER switch and disconnect all cables before relocating the product.
- Be sure the operation manual be included when the product is relocated.

Operation

- Before using the tester, check that there are no abnormalities on the surface of the power cord. (Before doing this, always disconnect the power cord from the electrical outlet.)
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the power cord. Be careful not to allow the product to be used before it is completely repaired.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

- To avoid electrical shock, be absolutely sure to unplug the power cord before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

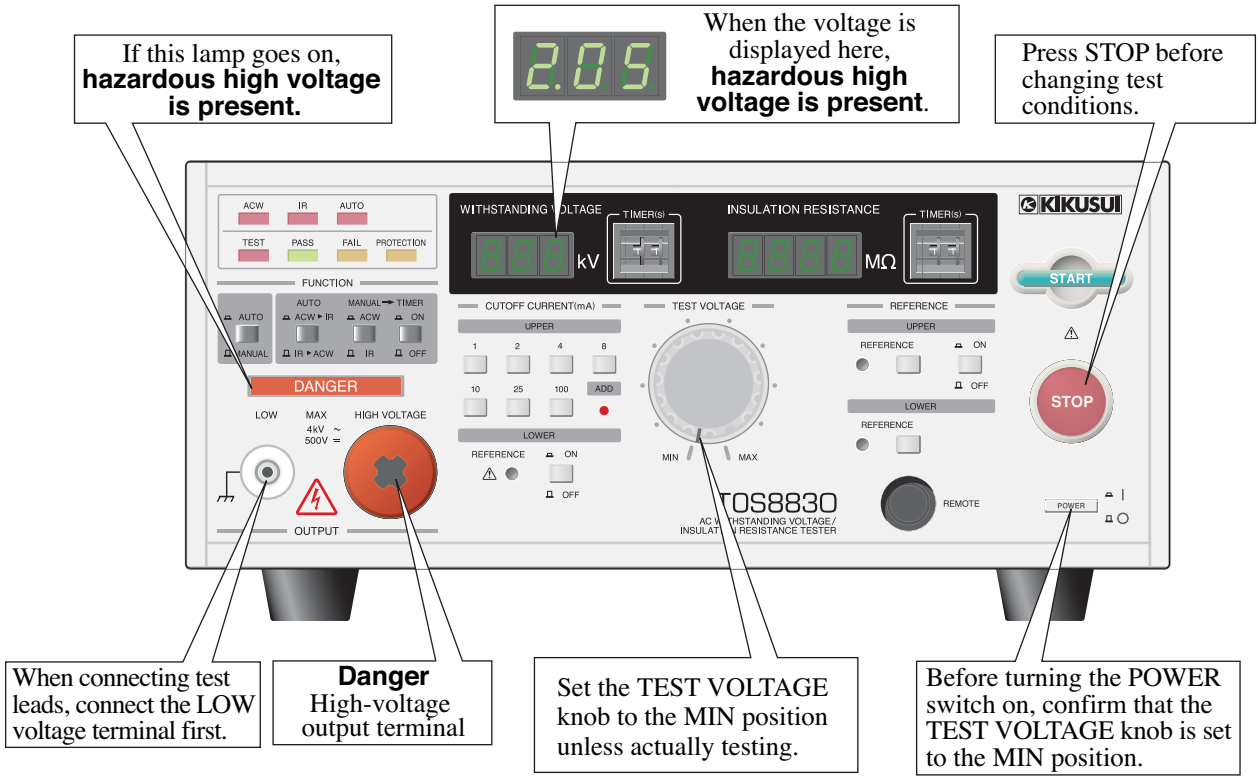
- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

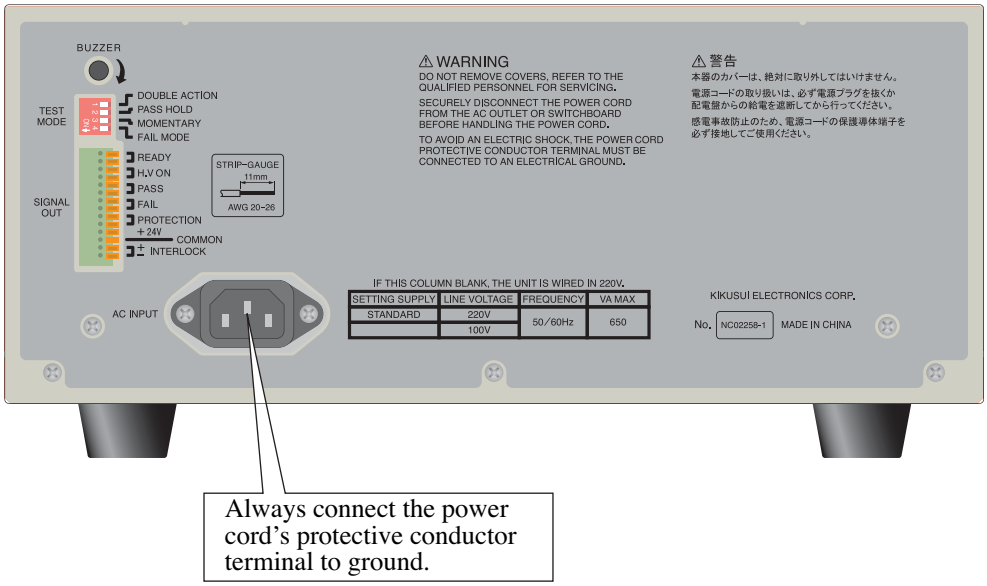
Label

- The product carries a label providing important safety information. If this label is damaged or the information provided becomes illegible, replace it with a new label. To obtain a new label, please contact your Kikusui distributor or agent.

Front and rear panels

- Before using the tester, make sure you read and understand Chapter 3, “Precautions for Safe Testing.”





Organization of the Operation Manual

The information in this manual is organized into the following chapters:

Chapter 1 General

Provides a product overview and describes features and options.

Chapter 2 Installation and Preparations for Use

Describes how to unpack the tester for preparation before use.

Chapter 3 Precautions for Safe Testing

Gives the precautions to be observed at all times to ensure safe testing.

Chapter 4 Part Names and Functions

Gives the names of switches, terminals, and other controls of the TOS8830.

Chapter 5 Panel Operations

Describes procedures for individual and automatic testing.

Chapter 6 Remote Control

Gives the procedure for operating the tester from a remote location using the REMOTE connector and the INTERLOCK terminal.

Chapter 7 Status Signal Output

Describes the status signal outputs (SIGNAL OUT).

Chapter 8 Special Test Modes

Explains the special test modes.

Chapter 9 Maintenance and Calibration

Describes the maintenance and calibration of the tester. The tester must be periodically inspected, maintained, and calibrated to maintain performance.

Chapter 10 Specifications

Provides the electrical and mechanical specifications for the TOS8830.

Appendix

Provides guidelines for discharge time, current detection lower reference limit, and zero-start switch.

Contents

Chapter 10 Specifications

Appendix

Chapter 1 General

Provides a product overview and describes features and options.

1.1 Product Overview

This instrument is an automatic tester with two functions: a withstanding voltage tester and an insulation resistance tester. The tester is capable of performing continuous withstanding voltage and insulation resistance tests as an integrated process.

With a maximum output of 4 kV/100 mA, the withstanding voltage tester function is capable of performing withstanding voltage (dielectric strength) tests for any electronic device or component according with JIS, UL, CSA, BS, or other various standards.

The insulation resistance test function has a measuring capacity of 500 V/999.9 MΩ.

⚠WARNING • Note to the supervisor in charge of operation, and operator
The utmost care has been devoted to making this tester as safe as possible. However, accidental contact with the device under testing (DUT), test lead, test probe, or the periphery of the output terminals may result in electric shock, since high voltage is applied to the DUT during tester operations. Thus, use of the tester requires thorough safety measures, including provision of fences at the peripheries of the tester and DUT to prevent personnel from approaching without good reason and to maintain safety.

1.2 Features

■ AC withstanding voltage tests of up to 4 kV/100 mA

The TOS8830 has a 500 VA high-voltage transformer in the high-voltage power supply section for tests involving a maximum output of 4 kV/100 mA (for 10 minutes maximum). For test voltages of 1 kV or higher, the tester can perform tests that meet the requirements (short-circuit current of 200 mA or more *) of the IEC standards.

* Continuous output is not available, since the output shuts off when an overcurrent is detected.

■ Insulation resistance tests of 500 V/0.50 MΩ to 999.9 MΩ

Tests can be performed in the resistance measurement range of 0.50 MΩ to 999.9 MΩ at a test voltage of 500 V (negative polarity).

■ Equipped with a discharge function

Since general DUTs contain capacitive components, the DUT may be charged on the completion of insulation resistance testing, posing a risk of electric shock. The tester provides a function that discharges such electrical charge carried by the DUT after insulation resistance testing.

■ PASS — FAIL judgment using the window comparator

The test results are determined using the window comparator. The window comparator indicates a PASS judgment if the measured value is between the upper and lower reference limit values and indicates FAIL in any other case.

In withstanding voltage testing, the tester is capable of issuing a FAIL judgment not only when it detects leakage currents above the preset upper reference limit, but also if a leakage current below the lower reference limit (which can be adjusted continuously up to 1/2 the upper reference limit). This allows the tester to provide PASS—FAIL judgments of test results even in cases involving broken wires in the test leads or contact failure. (This function does have limits and will not work past certain values.)

In insulation resistance tests, setting the upper reference limit lets you control insulation resistance values, even in cases involving broken wires in the test leads or contact failure.

■ Displaying the cause of activation of the protective function as a code number

If the protective function is activated, the cause is given as a code number via the voltmeter. A code number is also indicated if there are discrepancies in setting test conditions, allowing you to promptly correct the setting based on the code number displayed.

■ Remote control

The optional remote control box or test probe allows testing to be started or stopped remotely.

■ Status signal output

The tester has output terminals for READY, H.V ON, PASS, FAIL, and PROTECTION signals to enable external monitoring of tester status.

Use this function with the remote control function to automate functions or to reduce actual hands-on testing requirements.

■ Sequence circuit with noise reduction features

For reliability, the sequence circuit incorporates thorough noise reduction features to prevent noise-induced malfunctions.

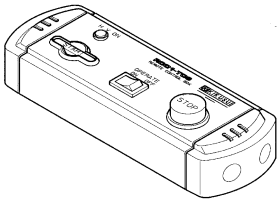
1.3 Options

Remote Control Boxes

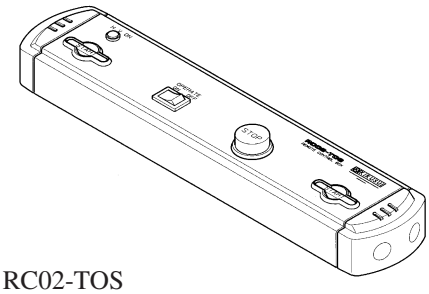
Connecting a remote control box to the REMOTE connector of our Withstanding Voltage Testers, Insulation Resistance Testers, or Withstanding Voltage Insulation Resistance Testers, enables remote starting or stopping of testing.

The RC01-TOS has one START switch; the RC02-TOS has two START switches. With the RC02-TOS remote control box, testing can be started only when both START switches are pressed simultaneously.

Description of RC01-TOS/RC02-TOS	
OPERATE switch	The START switch is enabled only when this switch is ON. Turning this OFF halts testing.
START switch	When the OPERATE switch is ON and the tester is in a READY state, press this switch to begin testing.
STOP switch	This switch shuts off the output voltage or cancels a status (such as FAIL). It has the same function as the STOP switch on the tester.



RC01-TOS
200(W) x 70(H) x 39(D) mm



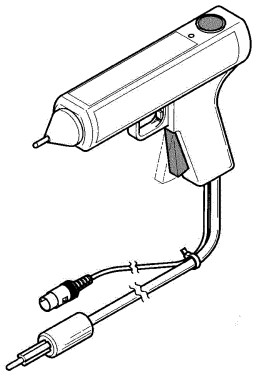
RC02-TOS
330(W) x 70(H) x 39(D) mm

High-voltage test probes

The HP01A-TOS and HP02A-TOS are test voltage output probes designed to be connected to our withstanding voltage tester.

The test probes are constructed so that a test voltage is output only when the slide lever at the grip of a test probe is held and the trigger is activated with one hand, and a switch on the upper part of the probe is pressed with the other; that is, operation requires two hands. Releasing either hand outputs a STOP signal, shutting off the tester's test voltage.

This features are intended to prevent inadvertent output of test voltages when using these probes.



HP01A-TOS

Model number	Maximum usage voltage	Cable length
HP01A-TOS	4 kVac (rms) 50 Hz/60 Hz 5 kVdc	Approx. 1.8 m
HP02A-TOS		Approx. 3.5 m

⚠WARNING • When using a test probe, do not connect it to the DUT while a test voltage is being output from the probe. Also, do not disconnect the probe from the DUT while a test voltage is being output from the probe.

Disconnecting the probe from the DUT while high voltage is being output from the probe may result in damage to the DUT. Additionally, disconnecting the probe from the DUT in the middle of testing may result in a residual electrical charge in the DUT, posing a significant hazard.

For these reasons, the probe must be connected to the DUT before testing begins. When ending the test, confirm that the LED on the probe is not lit, then disconnect the probe from the DUT.

NOTE • To use a test probe, activate the FAIL MODE special test mode.

With FAIL MODE activated, even releasing your hand from the probe when the test has ended in a FAIL judgment will not clear the FAIL state, thus allowing for secure identification of FAIL judgments. For more information, see "8.1.4 FAIL MODE" (page 59).

High-voltage test leads

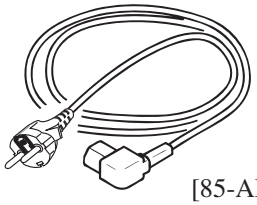
Model number	Maximum usage voltage	Cable length	Remarks
TL01-TOS	5 kVac (rms) 50 Hz/60 Hz 5 kVdc	Approx. 1.5 m	Equivalent of TOS8830 accessory
TL02-TOS		Approx. 3.0 m	

Chapter 2 Installation and Preparations for Use

Describes how to unpack the tester for preparation before use.

2.1 Unpacking Inspection

Check the TOS8830 tester upon receipt for any damage that may have occurred during transit and to confirm that all accessories have been provided.
If the product is damaged or if any accessories are missing, notify your Kikusui distributor or agent.



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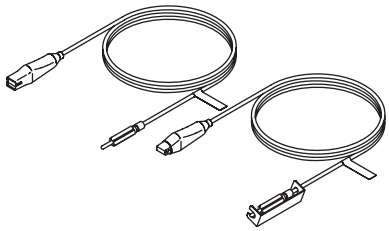
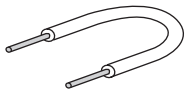
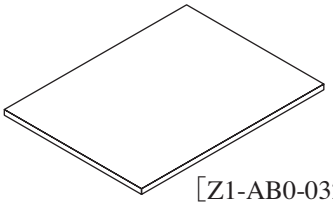
☐ Power cord, 1



☐ High-voltage test leads, 1 set
TL01C-TOS, 1.5 m



☐ INTERLOCK terminal jumper, 1



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☐ Operation Manual, 1 copy

Fig.2-1 Accessories

NOTE

- We recommend retaining all packing materials in case the product needs to be transported at a later date.

2.2 Precautions for Installation

Always observe the following precautions and conditions when installing the tester indoors:

■ Do not use the tester in a flammable atmosphere.

To prevent explosions or fires, never use the tester near combustible materials such as alcohol or thinner or in an atmosphere containing such vapors.

■ Avoid locations subject to high temperatures or exposed to direct sunlight.

Do not locate the tester near a heater or in areas subject to drastic temperature fluctuations.

Operating temperature range: 0°C to +40°C
Storage temperature range: -40°C to +70°C

■ Avoid humid locations.

Do not install the tester in high-humidity locations, including near boilers, humidifiers, or water supply.

Operating relative humidity range: 20% to 80% (with no dew condensation)
Storage relative humidity range: 90% or less (with no dew condensation)

Condensation may occur even within the operating relative humidity range. If so, do not use the tester until it is completely dry.

■ Do not install the tester in a corrosive atmosphere.

Do not install the tester in a corrosive atmosphere or in an atmosphere containing sulfuric acid mist or the like. Doing so may result in corrosion of conductors or improper connector contacts in the tester, resulting in malfunctions or failures and leading to potential fires.

■ Do not install the tester in locations with excessive dust.

Excessive dirt and dust may result in electric shock or fire.

■ Do not use the tester in areas with poor ventilation.

The tester uses an unforced air cooling system. Provide adequate space around the tester.

■ Do not place any objects on the tester.

In particular, heavy objects placed on the tester may lead to malfunctions.

■ Do not install the tester on tilted surfaces or in locations subject to vibration.

The tester may fall, resulting in damage or injury.

■ Do not use the tester in locations subject to strong magnetic or electric fields.

Using the tester in such locations may result in malfunctions, leading to electric shock or fire.

■ **Do not use the tester in locations where sensitive measuring instruments or receivers are also being used.**

Use of the tester may affect the reliability or accuracy of such instruments or devices.

At a test voltage of more than 3 kV, corona discharges may occur that result in significant wide-range RF emissions between the clips of the test leads. To minimize these effects, keep the alligator clips as far apart as possible. Never allow an alligator clip or test lead to contact or approach the conductor surface (especially sharp metal ends).

■ **Provide sufficient space around the power plug.**

Do not use excessive force to insert the power plug into an electrical outlet that resists insertion/extraction. Do not install objects near the plug that make plug insertion/extraction difficult.

2.3 Moving Precautions

When moving or transporting the tester to another installation site, observe the following precautions:

■ **Turn the POWER switch off.**

Moving the tester with the power turned on may result in electric shock or damage.

■ **Disconnect all wiring.**

Moving the tester with cables connected may result in breaks in the cables or may cause the tester to fall, which could result in injury.

■ **When transporting the tester, always use the dedicated packing materials.**

Failure to use the dedicated packing materials may result in damage to the tester in the event of a fall or due to vibrations during transport.

2.4 Connecting the Power Cord

This product is designed to meet the standards for Overvoltage Category II (energy-consuming equipment to be supplied from fixed installation) of the IEC standards.

Checking the supply voltage

Before connecting the power cord, check the tester's supply voltage.

The tester's nominal input rating is indicated on the rear panel. The tester's standard specifications specify a supply voltage of 220 V.

SETTING SUPPLY	LINE VOLTAGE	FREQUENCY	VA MAX
STANDARD	220V	50/60Hz	650
	100V		

If this field is blank, the supply voltage is 220 V.

⚠ CAUTION • The tester can operate correctly in the range of 200 V to 240 V. Use beyond this range may result in malfunction or failure in addition to improper operation. Operate the tester with the supply voltage within the voltage range required. The waveform of the power source should be a sine wave having a peak value within 130% to 150% of the rms value.

NOTE • The tester's maximum rated output (4 kV at 100 mA) is specified at the nominal supply voltage. When the input voltage is less than the nominal input rating, the maximum rated output is not assured.

The tester is equipped with a high voltage output transformer of 500 VA. In the following two instances, large currents (several tens of amperes) may flow in the AC power line to which the tester is connected.

- A period of several tens of milliseconds during which the tester detects a FAIL judgment if the DUT is judged FAIL.
- The instant at which testing is conducted

In such cases, take into account the capacity of the AC power line and the power consumption of other electronic devices connected to that power line.

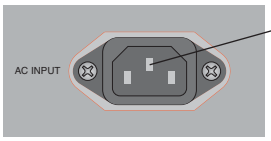
Connecting the power cord

NOTE
- The power cord is a disconnecting device that disconnects the tester from the AC power line. Connect it to an easily accessible electrical outlet.
- Do not use the power cord provided with the product as a power cord for other equipment.

1. Check that the power supply meets the nominal input rating for the tester.
2. Turn the POWER switch off.
3. Connect the power cord to the AC INPUT connector on the tester's rear panel.
4. Insert the power cord plug into an electrical outlet.

2.5 Grounding

Ground the tester by connecting the power cord to a properly grounded three-prong electrical outlet.



Protective conductor terminal
Grounding is established when the power cord is connected to a three-prong electrical outlet.

Fig. 2-2 Protective Conductor Terminal

⚠WARNING • This product is Safety Class I equipment (equipment with a protective conductor terminal) under IEC Standards. To prevent electric shock, always connect the product's protective conductor terminal to an electrical ground (safety ground).

■ Grounding is essential.

If the tester is used without grounding and output is inadvertently short-circuited to peripheral equipment such as a conveyor connected to ground or a nearby AC power line*, the tester's enclosure may be charged to hazardous voltages.

However, when the tester is properly grounded, it will not malfunction, and its enclosure will not be charged to high voltages even if the output is short-circuited to the ground via a peripheral, as noted above, or if the tester's LOW terminal and HIGH VOLTAGE terminal are short-circuited.

For these reasons, grounding the tester is essential to ensure safety.

Description * An AC power line is generally a power line connected to an electrical outlet to which the tester's power cord is connected. Here, it also refers to an AC line connected to a privately-owned electrical power generation device.

Chapter 3 Precautions for Safe Testing

Gives the precautions to be observed at all times to ensure safe testing.

⚠WARNING • This tester supplies voltages as high as 4 kVAC or more or 500 VDC or more to an external device during testing. Misuse may result in injury or death. To prevent such accidents, always observe the precautions given in this chapter. Use the tester with the utmost care and regard for safety.

3.1 Startup Inspection

Check the following items before testing:

Item	Description of inspection	Refer to:
Grounding	Confirm that the power cord has been connected to a properly grounded three-prong electrical outlet.	"2.5, Grounding" (page 20)
High-voltage test leads	Check for breaks, cracks, or other defects in the covering and for broken wires.	"3.3.1, Connecting the Test Leads" (page 22)
Displays and indicators	Confirm that all the displays and indicators light.	"5.1, Turning the POWER Switch On" (page 33)

3.2 Preparations Before Testing

3.2.1 Checking the Test Leads

Check for breaks, cracks, or other defects in the covering of the LOW-side test lead (black) and HIGH VOLTAGE-side test lead (red).

Use a tester to confirm that there are no broken wires in the test leads.

3.2.2 Wearing Rubber Gloves

⚠WARNING • When using the tester, always wear rubber gloves intended for electrical work to prevent electric shock.

If you have difficulty obtaining proper rubber gloves, consult your Kikusui distributor or agent.

3.3 Operating Precautions

3.3.1 Connecting the Test Leads

When connecting the test leads, observe the procedure given below to ensure secure connections.

1. Check the indications at the two locations shown in Fig. 3-1.

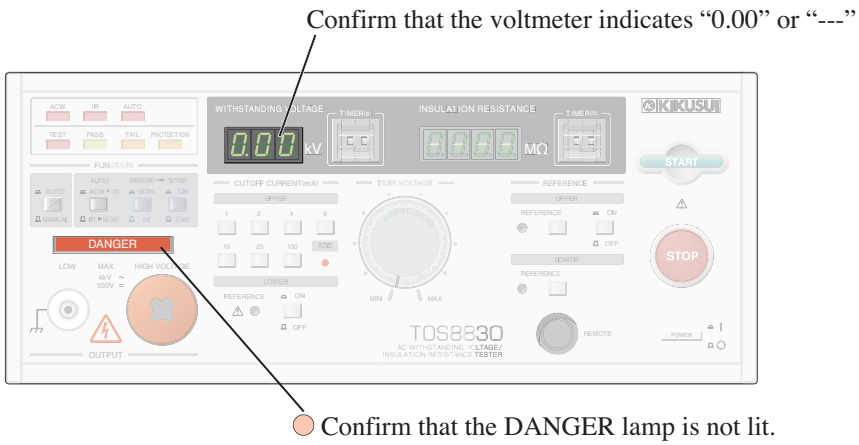


Fig.3-1 Checking that No High Voltage is Being Output

2. Insert the black test lead into the LOW terminal and attach an extraction prevention guard to the terminal, as shown in Fig. 3-2.

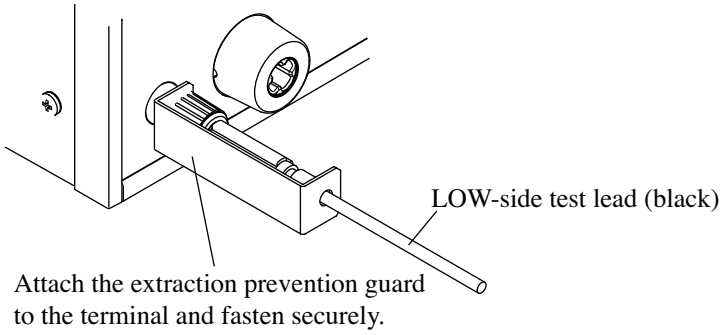


Fig. 3-2 Connecting the LOW-side Test Lead

3. Connect the black test lead to the DUT.

   Note that improper test-lead connections may cause the entire DUT to be charged to dangerously high voltages.

4. Connect the red test lead to the DUT.

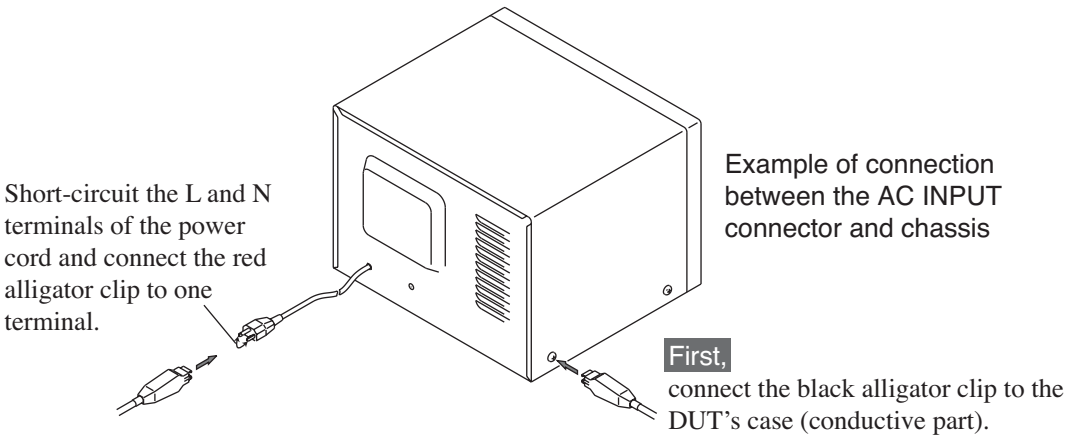


Fig. 3-3 Example of Connection to the DUT

5. Insert the red test lead into the HIGH VOLTAGE terminal.

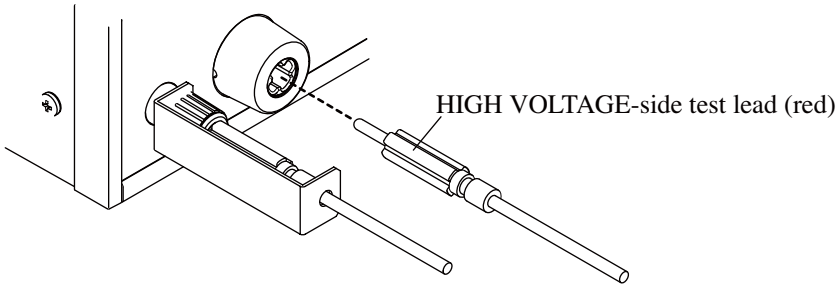


Fig. 3-4 Connecting the HIGH VOLTAGE-side test lead

■ To disconnect the test leads from the DUT

Disconnect the red test lead from the HIGH VOLTAGE terminal. You do not need to disconnect the black test lead from the LOW terminal.

3.3.2 For High Voltage Output

The TEST lamp goes on during testing. In this case, the DANGER lamp also lights up, alerting the operator that high voltages are being output.

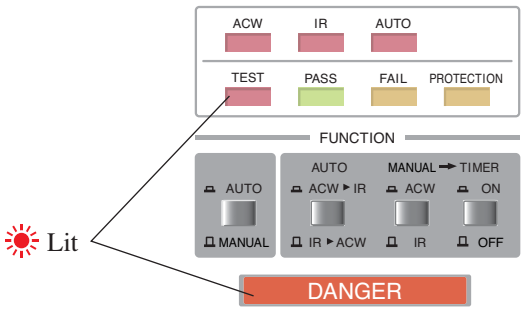


Fig. 3-5 Indicators Lit during Testing

When the DANGER lamp is lit

⚠ WARNING **■ Do not touch the DUT, test lead, test probe, or any high-voltage-charged sections at the periphery of the output terminals.**

Contact with any of these areas may result in electric shock.

Never attempt to touch the PVC covering of the alligator clip of a test lead. (The dielectric strength is inadequate to prevent shock.)

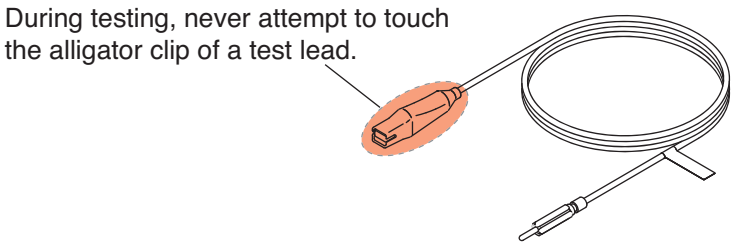


Fig. 3-6 Test Lead

■ Do not leave the tester while it is operating.

A person who operates the tester must remain with it until the test is complete. If he/she must leave the tester, always turn the POWER switch off.

■ Do not turn the POWER switch off.

Except in emergencies, do not turn the POWER switch off while output is being generated.

■ Do not change the test conditions.

Changing the test type with the FUNCTION switches during testing activates the protective function and shuts off output. For safety purposes, operate the FUNCTION switches only when the TEST lamp is not lit.

3.3.3 Checking Safety after Shutting off the Output

■ Checking indications at two locations

If you must touch the DUT, test lead, test probe, and/or a high-voltage-charged section such as the periphery of the output terminals for re-installing wiring, etc., check the indications at the two locations shown in Fig. 3-7 to ensure safety.

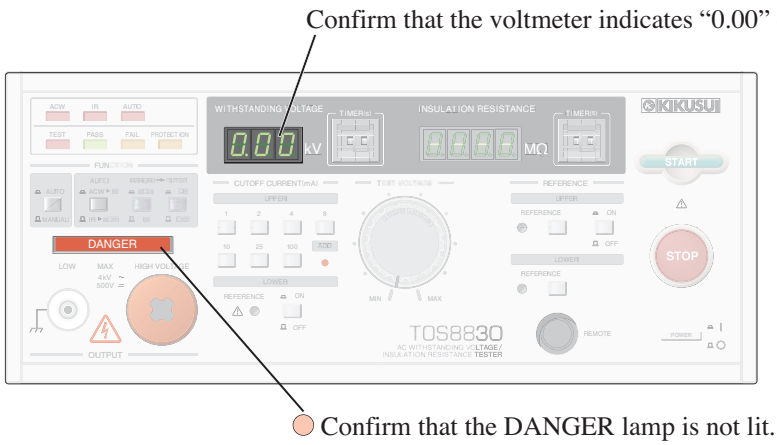


Fig. 3-7 Checking for the Absence of High Voltage

■ When disconnecting the test leads from the DUT

Disconnect the red test lead from the HIGH VOLTAGE terminal. You do not need to disconnect the black test lead from the LOW terminal.

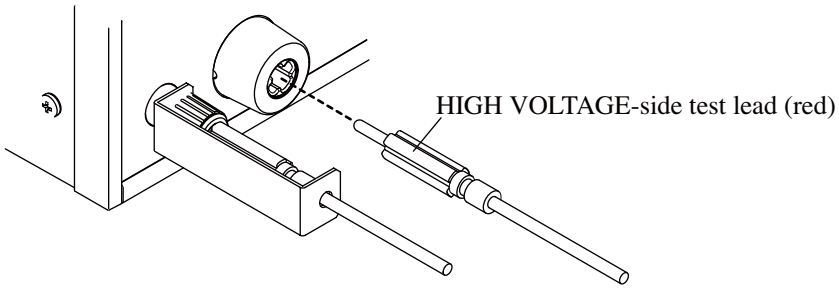


Fig. 3-8 Disconnecting the HIGH VOLTAGE-side Test Lead

3.3.4 Precautions for Charge during Insulation Resistance Testing

⚠WARNING • To avoid electric shock, always avoid contact with the DUT, test leads, test probe, and any high-voltage-charged sections such as the periphery of the output terminals for a period after output has been shut off.

In insulation resistance testing, the tester charges the test leads, test probe, and DUT to high voltages. Although the tester is equipped with a discharge circuit, discharge still takes some time even after output has been shut off.

■ Do not break the connection to the DUT

The tester's discharge circuit discharges voltage after output is shut off. Do not break the connection between the tester and the DUT during testing or before the discharge is complete.

If the connection between them is broken, you must wait for the voltages to discharge naturally. For information on the time required for discharge, see "A.1, Guidelines for Discharge Time" (page 68).

3.4 When Interrupting Operations

If the tester will not be used for certain periods or if the operator is to leave the tester, turn the TEST VOLTAGE knob all the way counterclockwise (to the MIN position), then turn the POWER switch off.

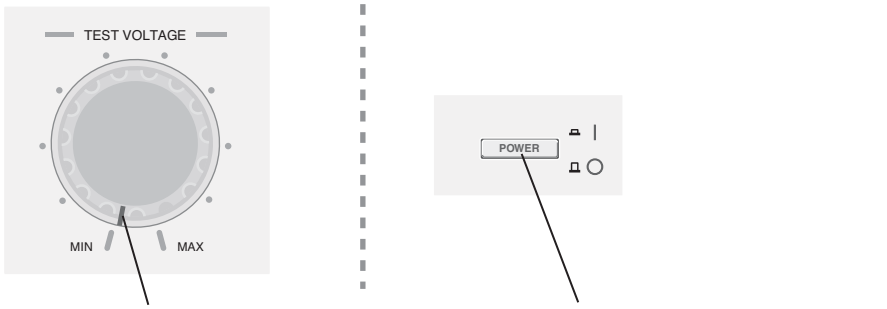


Fig. 3-9 When Interrupting Operations

3.5 Response to Emergencies

If electric shock occurs or the DUT is burned due to abnormalities in the tester, DUT, or other components, take the following two steps. Both must be performed, although either may be performed first.

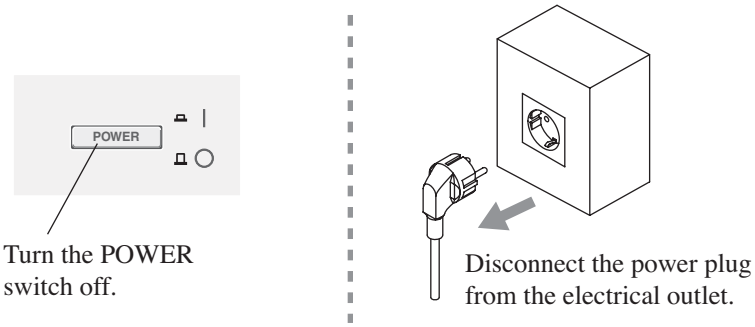


Fig. 3-10 Response to Emergencies

3.6 Stop Using the Tester in the Event of a Malfunction

Any of the following tester conditions may result in serious and hazardous malfunctions in which the tester's output cannot be shut off while high voltage is output. In such cases, immediately stop using the tester, turn the POWER switch off, and disconnect the power plug from the outlet.

1 The DANGER lamp remains lit even when the STOP switch is pressed.

2 The DANGER lamp does not light, but the voltage is displayed on the voltmeter.

The cause of condition 2 may simply be a defective DANGER lamp. Nevertheless, immediately stop using the tester to guard against the possibility of malfunctions resulting electric shock.

Additionally, if the tester fails to operate normally, suspend use immediately. In certain cases, high voltages may be output regardless of operator intention.

⚠ WARNING
- Implement safeguards so that no one will attempt to use the tester before it has been sent for repair.
- Always contact your Kikusui distributor or agent to request repairs. To ensure safety, never attempt to repair the product yourself.

Chapter 4 Part Names and Functions

Gives the names of switches, terminals, and other controls of the TOS8830.

4.1 Front Panel

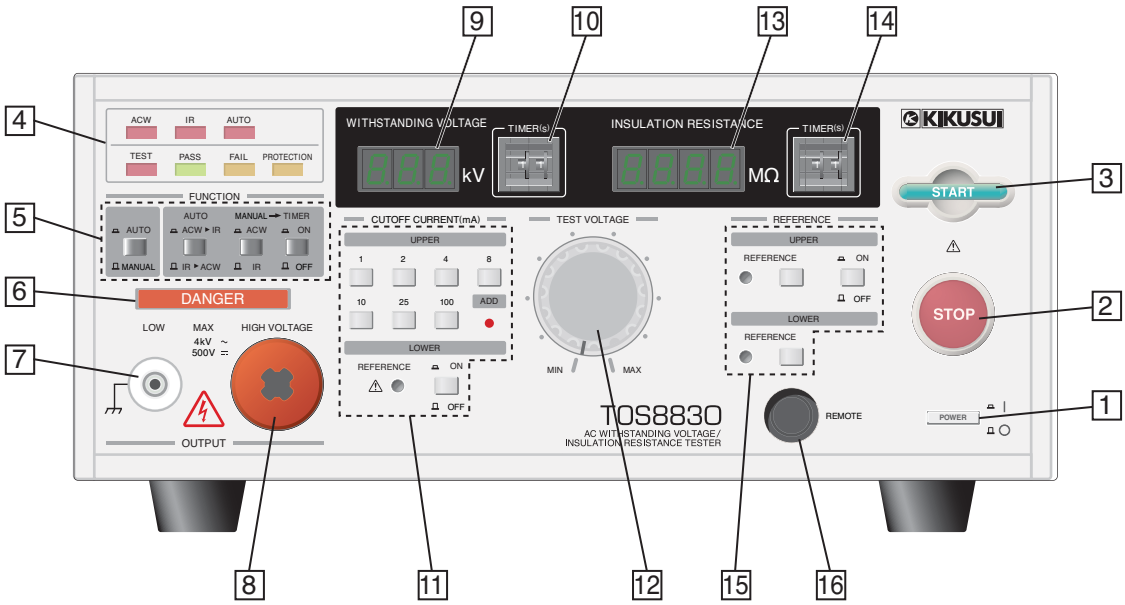


Fig.4-1 TOS8830 Front Panel

[1] POWER switch

Turns the tester power on/off. Depressing the switch turns power on (|).
Before turning the POWER switch on, see "5.1 Turning the POWER Switch On" (page 33).

[2] STOP switch

This switch interrupts the test in progress.

Pressing this switch transitions the tester from PASS, FAIL, or PROTECTION to the READY state. Tester states are defined in "5.3.1 Five States" (page 35).

[3] START switch

Press this switch when the tester is in the READY state to perform testing under the current test conditions.

This switch is disabled for remote control operations.

[4] Indicators

Indicators indicate the selected test type and tester status. For more information, see “5.3 Tester States and Indications” (page 34).

ACW	Lights up when individual withstanding voltage testing is selected.
IR	Lights up when individual insulation resistance testing is selected.
AUTO	Lights up when automatic testing is selected.
TEST	Lights up when testing is in progress.
PASS	Lights up for approx. 200 ms* if the test result is determined to be PASS. * for standard setting
FAIL	Lights up when the test result is determined to be FAIL.
PROTECTION	Lights up when the protective function is activated.

[5] FUNCTION switches

Used to set the test type.

AUTO/MANUAL	Allows selection of automatic or individual testing.
AUTO ACW>IR / IR>ACW	Sets the sequence of withstanding voltage testing and insulation resistance testing in automatic testing. Selecting automatic testing enables this switch.
MANUAL ACW/IR	Selects either withstanding voltage testing or insulation resistance testing. Selecting individual testing enables this switch.
TIMER ON/OFF	Enables or disables the timer for individual testing. Selecting individual testing enables this switch. The timer is always enabled for automatic testing, regardless of the position of this switch.

[6] DANGER lamp

Lights up when high voltages are being output.

This lamp remains lit not just during actual testing, but for the period after interruption or completion of testing during which the output terminals retain a high voltage.

⚠WARNING • To prevent electric shock, always avoid contact with the DUT, test lead, test probe, and high-voltage-charged sections such as the periphery of the output terminals when the DANGER lamp is lit.

[7] LOW terminal

A low voltage terminal for outputting test voltages. Since it is connected directly to the chassis, grounding the protective conductor terminal of the power cord also grounds this terminal.

For more information, see “2.5 Grounding” (page 20).

[8] HIGH VOLTAGE terminal

A high voltage terminal for outputting test voltages

[9] Voltmeter

This voltmeter displays the output voltage of a withstanding voltage test, indicating the voltage at the HIGH VOLTAGE terminal.

If the tester enters the PROTECTION state, the voltmeter displays the reason for protective function activation by a code ranging from P01 to P12.

Selecting insulation resistance testing results in a display of “---”.

[10] TIMER

Sets the test time for a withstanding voltage test.

For more information, see item “Test time” (page 39).

[11] CUTOFF CURRENT (mA)

Used to set leakage current detection reference values for a withstanding voltage test.

UPPER	Used to set the upper reference limit. Allows selection of a limit value from 7 ranges of 1/2/4/8/10/25/100 mA. Pressing two or more switches sets a value equal to the algebraic sum of the selected ranges; the ADD lamp will light to indicate that the set value is an algebraic sum. For more information, see item “Current detection upper reference limit” (page 38).
LOWER	This area provides a switch for selecting whether to make a lower limit judgment and a variable resistor (VR) for setting the lower reference limit. The range of settings for the lower reference limit is from “0” to 1/2 of the upper reference limit set. When the VR is turned fully clockwise, the lower reference limit becomes 1/2 of the upper reference limit currently set. For more information, see item “Current detection lower reference limit” (page 38).

[12] TEST VOLTAGE knob

Regulates the test voltage of a withstanding voltage test.

Turning the knob clockwise from the MIN position increases output voltage. Unless testing is being performed, always turn the knob to the counterclockwise limit position (to the MIN position).

For more information, see item “Test voltage” (page 40).

[13] Resistance meter

Displays the resistance value measured in insulation resistance testing.

If a resistance detection upper reference limit or lower reference limit value is set, the value set is displayed here.

When a withstanding voltage test is selected, this indication will display "----".

[14] TIMER

Used to set the duration of testing for an insulation resistance test.

For more information, see item "Test time" (page 45).

[15] REFERENCE

Used to set the reference values for insulation resistance testing.

UPPER	This area provides a switch for selecting whether to make an upper limit judgment and a variable resistor (VR) for setting the upper reference limit. If insulation resistance testing is selected, pressing the switch to the right of the VR displays the resistance value currently set for the resistor. Turn the VR to set the desired upper reference resistance limit. For more information, see item "Resistance detection upper reference limit" (page 44).
LOWER	This area provides a variable resistor (VR) for setting the lower reference limit. If insulation resistance testing is selected, pressing the switch to the right of the VR displays the resistance value currently set for the resistor. Turn the VR to set the desired lower reference resistance limit. For more information, see item "Resistance detection lower reference limit" (page 44).

[16] REMOTE connector

Used to start or stop testing from a remote location.

For more information, see "6.1 Using the REMOTE Connector" (page 49).

4.2 Rear Panel

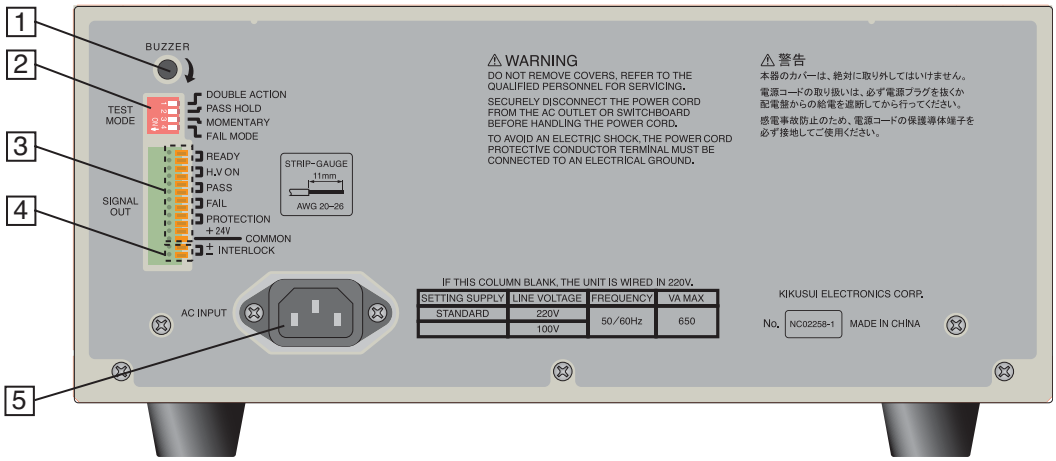


Fig. 4-2 TOS8830 Rear Panel

[1] BUZZER knob

Adjusts the volume of the buzzer that indicates a FAIL or PASS judgment.

Turning the knob clockwise makes the buzzer louder. The buzzer cannot be turned off.

[2] TEST MODE switches

Used to select four special test modes (DOUBLE ACTION, PASS HOLD, MOMENTARY, and FAIL MODE).

For more information, see “Chapter 8 Special Test Modes” (page 57).

[3] SIGNAL OUT terminal

Used to monitor the tester status externally.

There are five status terminals: READY, H.V ON, PASS, FAIL, and PROTECTION. A +24 V terminal is also provided to drive lamps or other devices during signal output.

For more information, see “Chapter 7 Status Signal Output” (page 54).

[4] INTERLOCK terminal

An interlock signal terminal.

Opening this interlock signal terminal causes the tester to enter the PROTECTION state (P01), disabling testing.

For more information, see “6.2 Using the INTERLOCK Terminal” (page 53).

[5] AC INPUT

An AC power input connector.

Connect the provided power cord to this connector.

For more information, see “2.4 Connecting the Power Cord” (page 18).

Chapter 5 Panel Operations

Describes procedures for individual and automatic testing.

5.1 Turning the POWER Switch On

1. Turn the TEST VOLTAGE knob all the way counterclockwise (to the MIN position), then turn the POWER switch on.

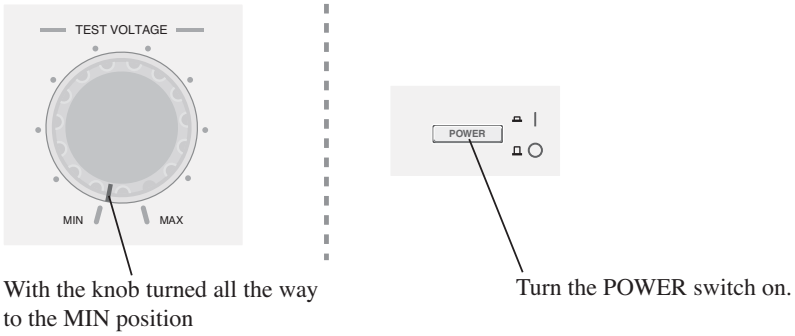


Fig.5-1 Check when Turning the POWER Switch On

2. Check that all display units and indications light appropriately.

   If for any reason you fail to check their status, turn the POWER switch off, wait several seconds, then turn on once again.

   After all the display units and indications light, the firmware version is displayed in the resistance meter display. The tester then changes to display the test conditions currently set.

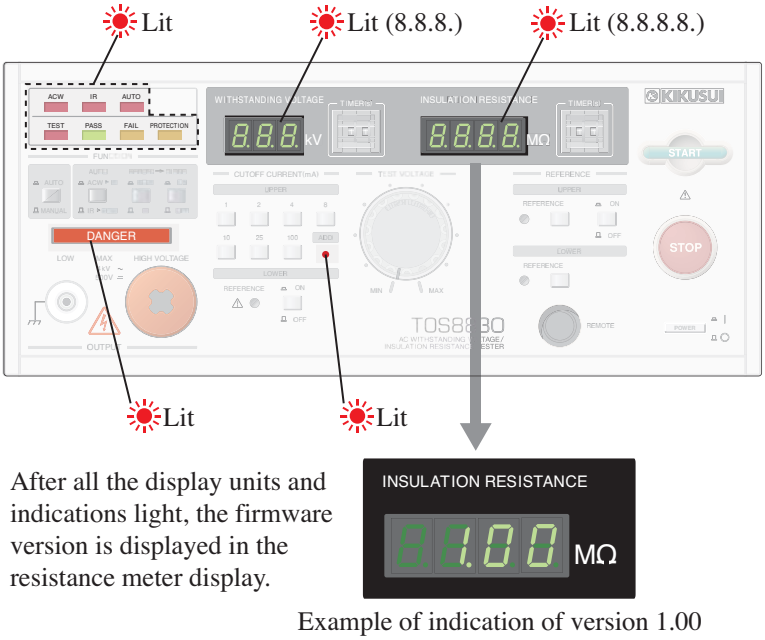


Fig. 5-2 Indications Displayed After POWER Switch is Turned On

■ Do not turn the POWER switch on/off in quick succession.

After turning the POWER switch off, wait several seconds before turning it on again.

Never perform a rapid on/off cycle of the POWER switch. The tester's protection function may be unable to protect the tester under these conditions, resulting in electric shock or other problems.

Except during an emergency, never turn the POWER switch off while voltage is being output.

5.2 Types of Testing

The TOS8830 is capable of performing two types of testing: withstanding voltage and insulation resistance tests. These two test types may be performed singly or automatically in succession.

The operator can select one of the following four testing sequences:

- Individual withstanding voltage test
- Individual insulation resistance test
- Withstanding voltage test followed by insulation resistance test
- Insulation resistance test followed by withstanding voltage test

5.3 Tester States and Indications

The front panel's indicators indicate the selected test type and tester state.

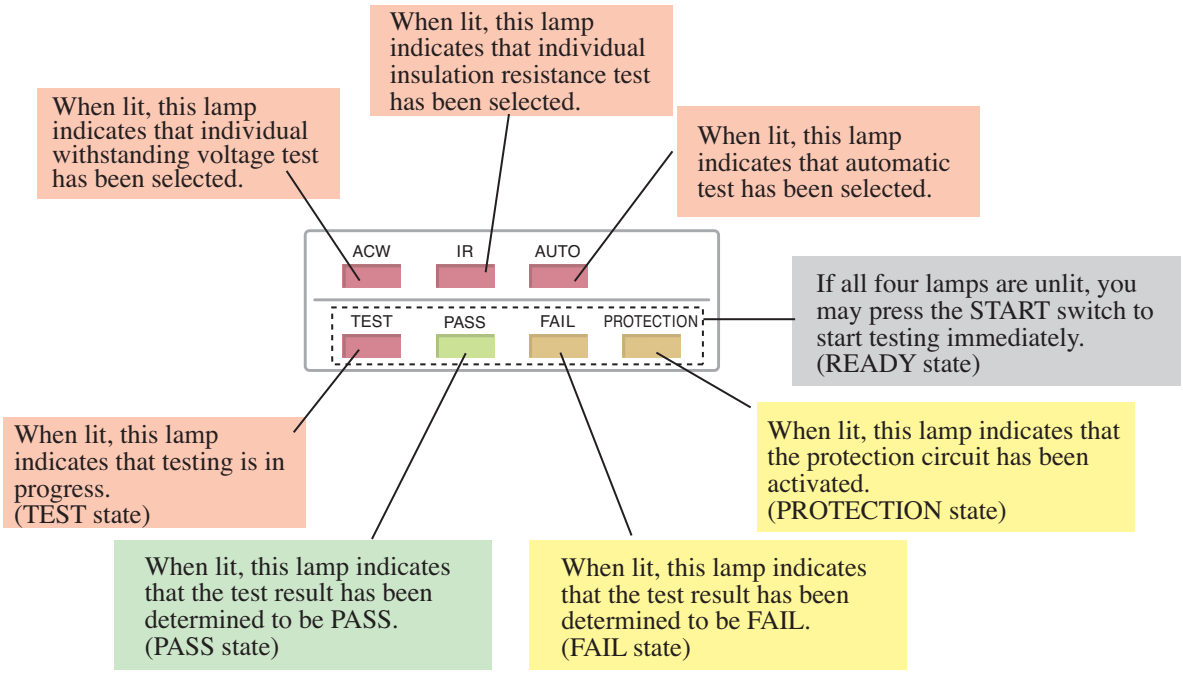


Fig. 5-3 Indicators on the Front Panel

5.3.1 Five States

This tester recognizes five tester states: TEST, PASS, FAIL, PROTECTION, and READY, which are defined below:

■ TEST state

State from start of to suspension or completion of testing

The TEST and DANGER lamps remain lit to indicate that a test voltage is being output. An H.V ON signal is generated.

■ PASS state

Indicates a state in which testing has ended and the result has been determined to be PASS.

The PASS lamp lights, a buzzer sounds, and a PASS signal is generated to indicate a PASS judgment. Note that this state is indicated only briefly (approx. 200 ms*) in the standard mode, after which the tester transitions to a READY state.

* If the PASS HOLD special test mode is activated, the PASS state is held until the STOP switch is pressed. For more information, see “8.1.2 PASS HOLD” (page 58).

■ FAIL state

Indicates a state in which testing has ended and the result has been determined to be FAIL.

The FAIL lamp lights, a buzzer sounds, and a FAIL signal is generated to indicate a FAIL judgment. The FAIL state can be canceled by pressing the STOP switch, after which the tester transitions to a READY state.

■ PROTECTION state

Indicates a state in which the protection function is activated.

The PROTECTION lamp lights, and a PROTECTION signal is generated to indicate that the tester is in the PROTECTION state. A code representing the cause of protection function activation is also displayed on the voltmeter in this state. For more information, see “5.3.2 Events or Conditions That Can Activate the Protection Function” (page 36).

The PROTECTION state can be canceled by pressing the STOP switch (or by inputting a STOP signal*), after which the tester transitions to a READY state.

* If the FAIL MODE special test mode is activated, the PROTECTION state cannot be cancelled by remote input of a STOP signal.

■ READY state

A READY signal is generated in this state.* All four lamps (TEST, PASS, FAIL, and PROTECTION) remain unlit.

Press the START switch in this state to start testing.

* If the DOUBLE ACTION special test mode is activated, a READY signal is generated for only approx. 0.5 second after the operator operates the STOP switch.

5.3.2 Events or Conditions That Can Activate the Protection Function

The following 12 events or conditions can activate the protection function. Each is assigned a unique code, which is displayed on the voltmeter.

If the protection function is activated, check the indicated code number and take appropriate measures in accordance with Table 5-1.
To clear the PROTECTION state, press the STOP switch.

⚠ WARNING • If the PROTECTION lamp remains lit even after the event or condition activating the PROTECTION state has been removed and the STOP switch pressed, the tester may be defective. To ensure safety, immediately stop using the tester.

Table5-1 Events or Conditions Activating the Protection Function, and Remedies

Code Number	Possible Cause	Remedy
P01	The INTERLOCK terminal is open.	Take appropriate measures to close (short-circuit) the INTERLOCK terminal for the duration of the test.
P02	The test time has been set to “0 s” for an individual withstanding voltage test involving the timer.	Set the test time to a value ranging from 1 s to 99 s.
P03	The test time has been set to “0 s” for an individual insulation resistance test involving the timer.	Set the test time to a value ranging from 1 s to 99 s.
P04	The test time has been set to “0 s” for withstanding voltage testing, for insulation resistance testing, or for both in an automatic test.	Set the test time to a value ranging from 1 s to 99 s.
P05	A FUNCTION switch was operated.	Check the settings of the FUNCTION switches.
P06	The value set for the upper reference limit has exceeded 105 mA in a withstanding voltage test.	Set the upper reference limit to a value ranging from 1 mA to 105 mA.
P07	The value set for the upper reference limit is 0 mA in a withstanding voltage test.	Set the upper reference limit to a value ranging from 1 mA to 105 mA.
P08	The value set for the lower reference limit has exceeded the upper reference limit in an insulation resistance test for which upper limit judgment was enabled.	Set the lower reference limit to a value below the upper reference limit.
P09	A voltage of -550 V or higher was output during an insulation resistance test.	The tester is defective. Immediately stop using the tester.
P10	The REMOTE connector was inserted or extracted.	Turn the POWER switch off before connecting or disconnecting the plug to or from the REMOTE connector.
P11	The tester’s internal temperature is too high.	Halt testing for a period equal to or longer than the test duration. For more information, see “Footnote *1” in “10.1 Withstanding Voltage Tester” (page 62).
P12	A voltage of 4.3 kV or higher was output during a withstanding voltage test.	Adjust the output voltage to 4.0 kV or less using the TEST VOLTAGE knob.

To cancel the PROTECTION state, press the STOP switch.

Fig. 5-4 Example of Display of Code “P05”

5.4 Procedure for Individual Withstanding Voltage Test

5.4.1 Selecting Withstanding Voltage Test

Set the FUNCTION switches as shown in Fig. 5-5. The ACW lamp will light to indicate the selection of withstanding voltage testing.

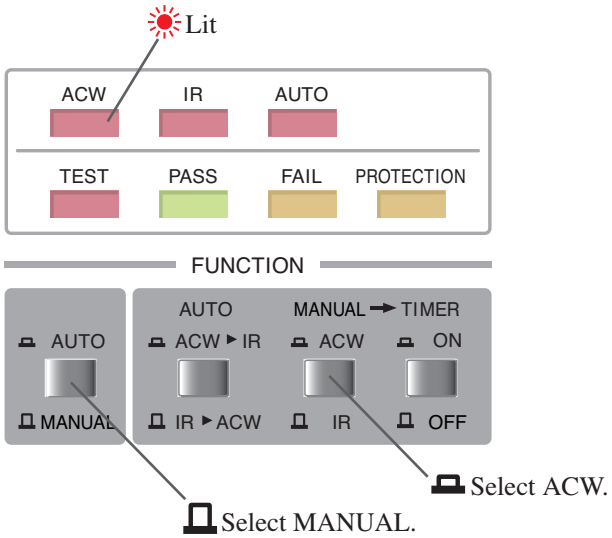


Fig. 5-5 Setting up an Individual Withstanding Voltage Test

5.4.2 Withstanding Voltage Test Parameters

In a withstanding voltage test, the following parameters must be set.

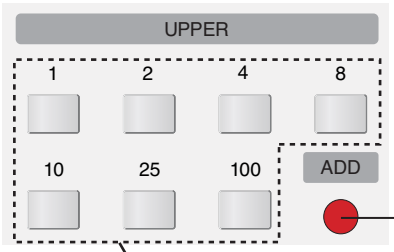
Set these values according to the standards of the withstanding voltage test to be performed.

Parameter	Range
Current detection upper reference limit	1 mA to 105 mA
Current detection lower reference limit	OFF, 0 mA to 1/2 of the upper reference limit value set
Test time	TIMER OFF, 1 s to 99 s
Test voltage	0.05 kV to 4.00 kV

5.4.2 Withstanding Voltage Test Parameters (Continued)

Current detection upper reference limit

If the measured leakage current exceeds the value set here, a FAIL determination is returned (upper limit judgment). Valid current values range from 1 mA to 105 mA. The current value can be set in 1 mA steps from 1 mA to 50 mA. Setting 0 mA (a condition in which no switch is pressed) or 106 mA or higher will cause the tester to enter a PROTECTION state (P07 or P06).



Valid current values: 1 mA to 105 mA

This indicator lights when
two or more switches are pressed.

Press the appropriate switch(es) to set the reference current value (mA).
Press multiple switches to set the value equal to the sum of the algebraic values corresponding to the switches pressed.
Example: Press the "1" and "100" switches to set a value of 101 mA.

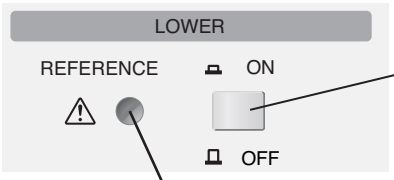
Fig. 5-6 Setting a Current Detection Upper Reference Limit

NOTE

- If the operator sets a current value exceeding 50 mA, testing is subject to output time limitations. For more information, see "Footnote *1" in "10.1 Withstanding Voltage Tester" (page 62).

Current detection lower reference limit

If the leakage current measured is less than the value set here, a FAIL determination is returned (lower limit judgment). Valid current values range from 0 mA to 1/2 of the upper reference limit value set. (The lower reference limit varies proportionally with the upper reference limit value.)



Enables lower limit judgment.

If no lower limit judgment is to be made, move the switch to the OFF position.

To set the lower reference limit, adjust the variable resistor (VR) using an adjustment screwdriver.

Valid current values: from 0 to 1/2 of the upper reference limit value set
Turning the VR all the way clockwise sets a current value equal to 1/2 of the upper reference limit value currently set.

Fig. 5-7 Setting a Current Detection Lower Reference Limit

NOTE

- If the lower reference limit is to be 1/2 of the upper reference limit value set, turn the VR all the way clockwise. To set the lower reference limit to other values, see “A.2 Setting the Current Detection Lower Reference Limit” (page 69).

■ Advantages of lower limit judgment

If the variation in leakage current values of the DUT is small and is more than the current value that can be recognized by the tester, test with the lower reference limit set to a value below the lower limit of variations. This allows identification of DUTs with exceptionally small leakage current or detection of contact failure or broken wires in the test leads for higher quality withstanding voltage testing.

Test time

When the time set here from the start of testing has elapsed, the test result is determined to be PASS, and the test is deemed complete. If the measured leakage current value exceeds the upper reference limit or falls below the lower reference limit, the test result is determined to be FAIL, even if the set test time has not yet expired, ending testing.

Valid test times range from 1 s to 99 s. Setting a test time of 0 s will invoke the PROTECTION state (P02).

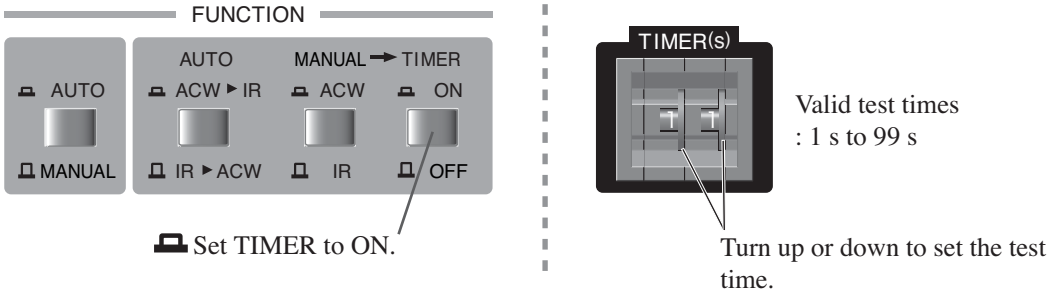


Fig. 5-8 Setting the Test Time

For testing in which the test time will exceed 99 s or in which no test time will be set, move the FUNCTION switch TIMER to the OFF position.

If the timer is not used, no PASS judgment will be made.

5.4.2 Withstanding Voltage Test Parameters (Continued)

Test voltage

The voltage set here is applied to the DUT during the test.

⚠WARNING

- The test voltage must be set by actually outputting the voltage and reading the value on the voltmeter. For safety reasons, disconnect the test leads if they are connected to the output terminals.

NOTE

- The maximum output voltage of the tester at no-load rises above 4 kV. This value rises higher in proportion to power supply fluctuations, but it should always be set to a value ranging from 0.05 kV to 4.00 kV.

1. Bring the tester to the state shown in Fig. 5-9.
   If the PROTECTION lamp is lit, press the STOP switch to cancel PROTECTION.

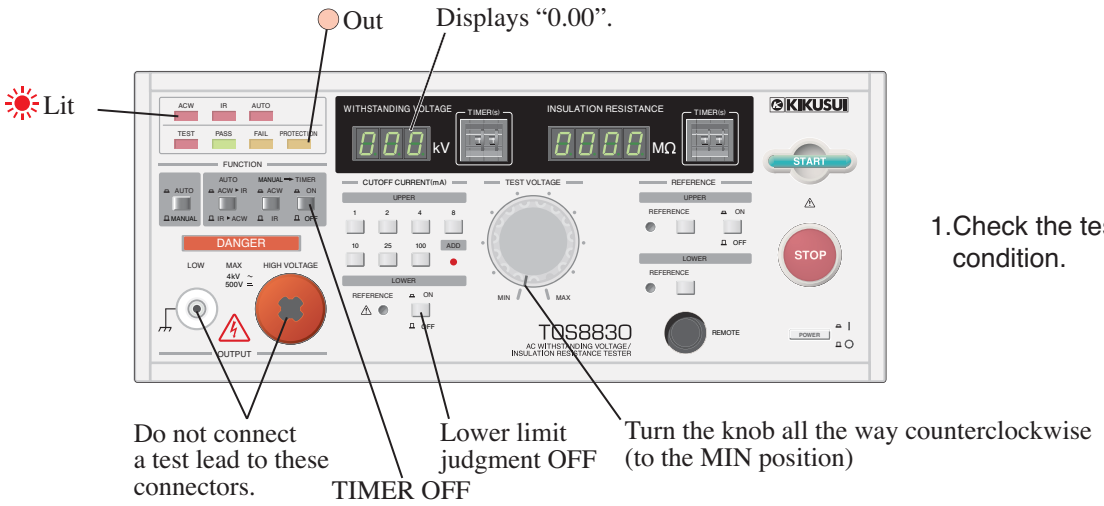


Fig. 5-9 Preparing for Test Voltage Setup

2. Press the START switch.

3. Monitoring the indication on the voltmeter, gradually turn the TEST VOLTAGE knob clockwise to set the test voltage.

4. Press the STOP switch to shut off the output.

If timer and/or lower limit judgment settings were changed in step 1 to set the test voltage, return the settings to their original values.

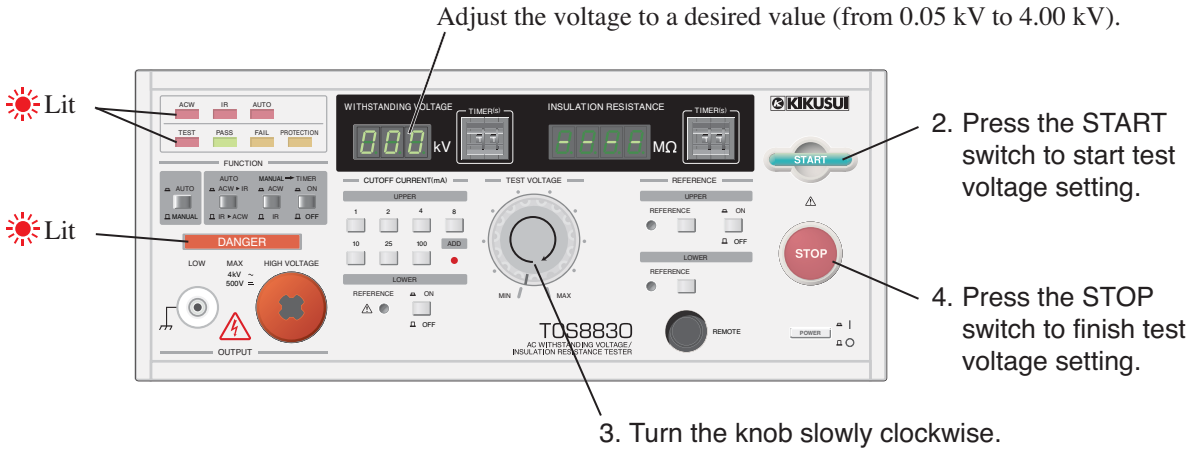


Fig. 5-10 Setting the Test Voltage

5.4.3 Connection to the DUT

Follow the procedure described in "3.3.1 Connecting the Test Leads" (page 22).

5.4.4 Starting the Test and Making Judgments

To start the test:

Press the START switch when the tester is in the READY state.

When a PASS judgment is made

When the time set by the timer has elapsed, the test voltage is shut off, causing a PASS determination to be returned. The PASS judgment is indicated in three ways: the PASS lamp lights, the buzzer sounds, and a PASS signal is generated.

In the standard test mode, the PASS state is indicated only briefly (approx. 200 ms), after which the tester immediately enters the READY state. To hold the PASS state until the STOP switch is pressed, activate the PASS HOLD special test mode. For more information, see “8.1.2 PASS HOLD” (page 58).

If a FAIL judgment is returned

If a leakage current exceeding the upper reference limit (or falling below the lower reference limit) flows through the DUT during testing, the test voltage is shut off, causing a FAIL determination to be returned. The FAIL judgment is indicated in three ways: the FAIL lamp lights, the buzzer sounds, and a FAIL signal is generated.

The FAIL state is held until the STOP switch is pressed.

To stop the test:

To stop testing (shut off the output) for any reason after testing begins, press the STOP switch.

The following test types are also possible.

It is possible to conduct testing in which the test voltage is gradually increased from 0 V without using the timer. Note that, when setting test voltages of more than 50 mA, testing is subject to output time limitations. For more information, see “Footnote *1” in “10.1 Withstanding Voltage Tester” (page 62).

Re-application of test voltage (re-testing)

As long as the tester is in a READY state, testing can be repeated under the current test conditions simply by pressing the START switch.

■ Before disconnecting the test leads from the DUT

Confirm that high voltage is not being output, referring to “3.3.3 Checking Safety after Shutting off the Output” (page 25).

5.5 Procedure for an Individual Insulation Resistance Test

5.5.1 Selecting Insulation Resistance Test

Set the FUNCTION switches as shown in Fig. 5-11. The IR lamp will light to indicate selection of insulation resistance testing.

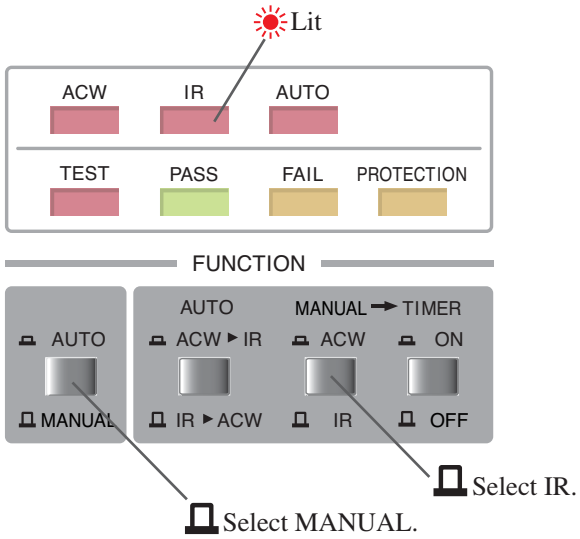


Fig. 5-11 Selecting Individual Insulation Resistance Test

5.5.2 Insulation Resistance Test Parameters

In insulation resistance testing, the following parameters must be set.

Set these values according to the standards of the insulation resistance test to be performed.

Parameter	Range
Resistance detection upper reference limit	OFF, 0.5 MΩ to 999.9 MΩ
Resistance detection lower reference limit	0.5 MΩ to 999.9 MΩ
Test time	TIMER OFF, 1 s to 99 s

5.5.2 Insulation Resistance Test Parameters (Continued)

Resistance detection upper reference limit

If the insulation resistance measured exceeds the value set here, a FAIL determination is returned (upper limit judgment). A valid resistance value is any of the following 33 values, in a value ranging from 0.50 MΩ to 999.9 MΩ.

0.50/0.60/0.70/0.80/0.90/
1.00/2.00/3.00/4.00/5.00/6.00/7.00/8.00/9.00/
10.0/20.0/30.0/40.0/50.0/60.0/70.0/80.0/90.0/
100.0/200.0/300.0/400.0/500.0/600.0/700.0/800.0/900.0/999.9 MΩ

If the upper reference limit is set to a value below the lower reference value, the PROTECTION state (P08) is invoked.

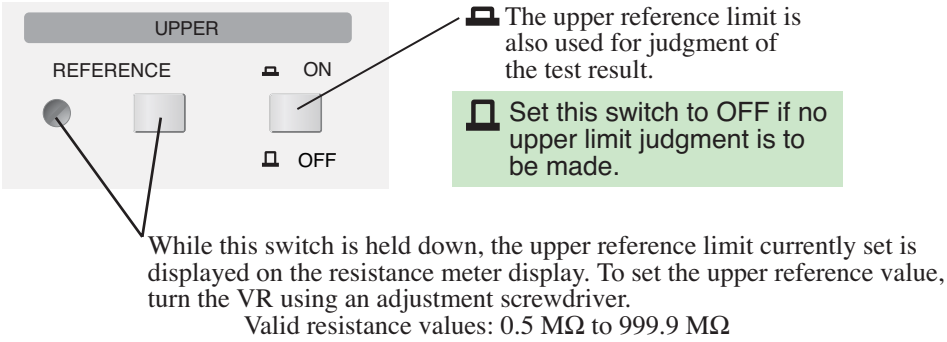


Fig. 5-12 Setting a Resistance Detection Upper Reference Limit

■ Advantages of upper limit judgment

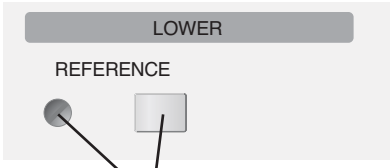
If variations in the insulation resistance of the DUT are known in advance and their upper limit is within the tester's measurement range, test with the tester's upper reference limit set to a value above the upper limit of the variations. This allows identification of DUTs with exceptionally large insulation resistances or detection of contact failure or broken wires in test leads for higher quality insulation resistance testing.

Resistance detection lower reference limit

If the insulation resistance measured is less than the value set here, a FAIL determination is returned (lower limit judgment). A valid resistance value is any of the following 33 values, in a value ranging from 0.50 MΩ to 999.9 MΩ.

0.50/0.60/0.70/0.80/0.90/
1.00/2.00/3.00/4.00/5.00/6.00/7.00/8.00/9.00/
10.0/20.0/30.0/40.0/50.0/60.0/70.0/80.0/90.0/
100.0/200.0/300.0/400.0/500.0/600.0/700.0/800.0/900.0/999.9 MΩ

If the lower reference limit is set to a value greater than the upper reference value, the PROTECTION state (P08) is invoked.



Enter settings so that
the upper reference value
> the lower reference value.

The lower reference limit currently set is displayed on the resistance meter display while the switch is held down; to set the lower reference limit, turn the VR using an adjustment screwdriver.
Valid resistance values: 0.5 MΩ to 999.9 MΩ

Fig. 5-13 Setting a Resistance Detection Lower Reference Limit

Test time

If the time set here elapses from the start of testing, the test result is determined to be PASS, and the test is deemed complete. If the measured insulation resistance value exceeds the upper reference limit or falls below the lower reference limit, the test result is determined to be FAIL, even if the test time set has not yet expired, ending testing.

Valid test times range from 1 s to 99 s. Setting a test time of 0 s will invoke the PROTECTION state (P03).

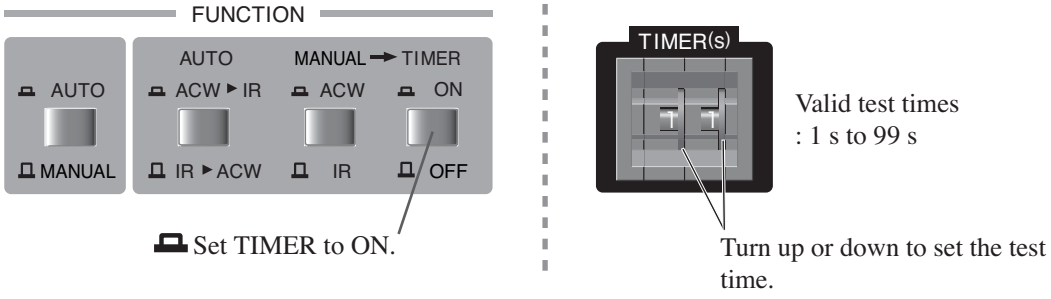


Fig. 5-14 Setting the Test Time

To perform testing in which the test time exceeds 99 s or testing in which no test time is set, move the FUNCTION switch TIMER to the OFF position.
If the timer is not used, no PASS judgment will be made.

5.5.3 Connection to the DUT

Follow the procedure described in "3.3.1 Connecting the Test Leads" (page 22).

5.5.4 Starting the Test and Making Judgments

To start the test:

Press the START switch when the tester is in a READY state.

When a PASS judgment is returned

When the time set in the timer has elapsed, the test voltage is shut off, causing a PASS determination to be returned. The PASS judgment is indicated in three ways: the PASS lamp lights, the buzzer sounds, and a PASS signal is generated.

In the standard test mode, the PASS state is indicated only briefly (approx. 200 ms), after which the tester immediately enters the READY state. To hold the PASS state until the STOP switch is pressed, activate the PASS HOLD special test mode. For more information, see "8.1.2 PASS HOLD" (page 58).

If a FAIL judgment is returned

If an insulation resistance falling below the lower reference limit (or exceeding the upper reference limit) is measured during testing, the test voltage is shut off, causing a FAIL determination to be returned. The FAIL judgment is indicated in three ways: the FAIL lamp lights, the buzzer sounds, and a FAIL signal is generated.

The FAIL state is held until the STOP switch is pressed.

To stop the test:

To stop testing (shut off the output) for any reason after testing begins, press the STOP switch.

Re-application of test voltage (re-testing)

As long as the tester is in a READY state, testing can be repeated under the current test conditions simply by pressing the START switch.

■ If the TEST lamp flashes

If the TEST lamp flashes after the test begins, press the STOP switch to stop the test. Disconnect the test leads from the output terminals and press the START switch with no test leads connected to the output terminals. If the TEST lamp still flashes, the tester may be defective. Immediately stop using the tester.

■ Before disconnecting a test lead from the DUT

Confirm that high voltage is not being output, referring to "3.3.3 Checking Safety after Shutting off the Output" (page 25).

⚠WARNING • During an insulation resistance test, the DUT is charged. To prevent electric shock, be sure to check that the DUT has been discharged. For more information, see "3.3.4 Precautions for Charge during Insulation Resistance Testing" (page 26).

5.6 Automatic Test Procedure

5.6.1 Selecting an Automatic Test

Select AUTO using the FUNCTION switch, as shown below. The AUTO lamp lights, indicating selection of automatic testing.

Then select the sequence in which withstanding voltage testing and insulation resistance testing are to be carried out.

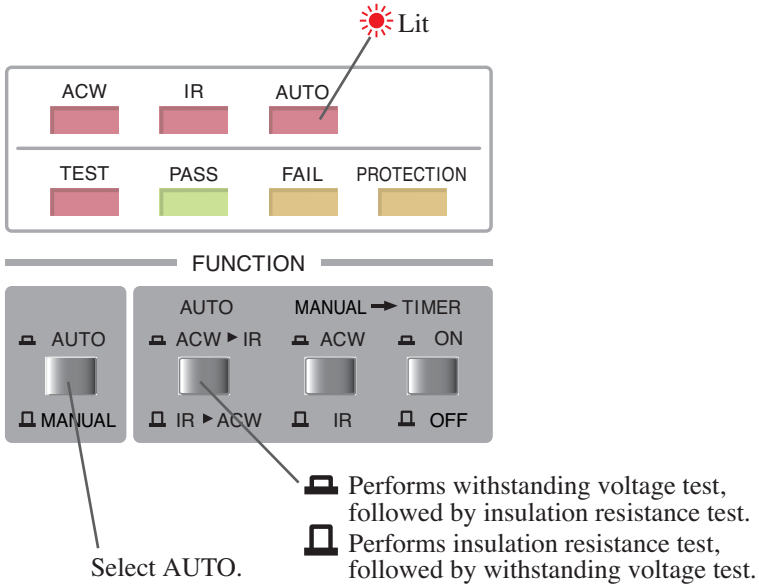


Fig. 5-15 Setting up an Automatic Test

5.6.2 Automatic Test Parameters

In automatic testing, withstanding voltage testing and insulation resistance testing are performed in succession in the specified order. The automatic test parameters are the same as those for each individual test.

Set the test conditions in accordance with "5.4.2 Withstanding Voltage Test Parameters" (page 37) and "5.5.2 Insulation Resistance Test Parameters" (page 43).

NOTE

- Automatic testing always requires the timer. Note that the test time currently set in the timer is enabled in automatic testing, although the timer has been set to OFF for individual testing.

5.6.3 Connection to the DUT

Follow the procedure described in "3.3.1 Connecting the Test Leads" (page 22).

5.6.4 Starting the Test and Making Judgments

To start the test:

Press the START switch when the tester is in a READY state.

When a PASS judgment is returned

When the time set in each timer for withstanding voltage testing and insulation resistance testing has elapsed, the test voltage is shut off, causing a PASS determination to be returned. The PASS judgment is indicated in three ways: the PASS lamp lights, the buzzer sounds, and a PASS signal is generated.

In the standard test mode, the PASS state is indicated only briefly (approx. 200 ms), after which the tester immediately enters the READY state. To hold the PASS state until the STOP switch is pressed, activate the PASS HOLD special test mode. For more information, see "8.1.2 PASS HOLD" (page 58).

If a FAIL judgment is returned

If a leakage current exceeding the upper reference limit (or falling below the lower reference limit) flows through the DUT during withstanding voltage testing, the test voltage is shut off, causing a FAIL determination to be returned.

Also, if an insulation resistance falling below the lower reference limit (or exceeding the upper reference limit) is measured during insulation resistance testing; the test voltage is shut off, causing a FAIL determination to be returned.

The results of a FAIL judgment are indicated in three ways: the FAIL lamp lights, the buzzer sounds, and a FAIL signal is generated.

The FAIL state is held until the STOP switch is pressed.

To stop the test:

To stop testing (shut off the output) for any reason after testing begins, press the STOP switch.

Re-application of test voltage (re-testing)

As long as the tester is in a READY state, testing can be repeated under the current test conditions simply by pressing the START switch.

■ If the TEST lamp flashes

If the TEST lamp flashes after the test begins, press the STOP switch to stop the test. Disconnect all test leads from the output terminals and press the START switch with no test leads connected to the output terminals. If the TEST lamp still flashes, the tester may be defective. Immediately stop using the tester.

■ Before disconnecting the test leads from the DUT

Confirm that high voltage is not being output, referring to "3.3.3 Checking Safety after Shutting off the Output" (page 25).

⚠WARNING • In insulation resistance testing, the DUT is charged. For automatic testing in which the insulation resistance test has been stopped or suspended, be sure to confirm that the DUT has discharged to prevent electric shock. For more information, see "3.3.4 Precautions for Charge during Insulation Resistance Testing" (page 26).

Chapter 6 Remote Control

Gives the procedure for operating the tester from a remote location using the REMOTE connector and the INTERLOCK terminal.

6.1 Using the REMOTE Connector

Always turn the tester POWER switch off before connecting or disconnecting an optional remote control box or other device to or from the REMOTE connector on the front panel.

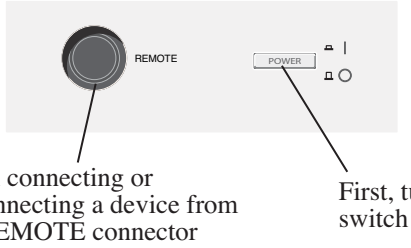


Fig. 6-1 REMOTE Connector and POWER Switch

NOTE

- If the FAIL MODE special test mode is activated during remote control, FAIL and PROTECTION cannot be cancelled with the STOP switch on the remote control box or by a STOP signal from the control device. For more information, see "8.1.4 FAIL MODE" (page 59).

6.1.1 Remote Control with the Optional Remote Control Box

The TOS8830 can be controlled from a remote location using an optional remote control box to start or stop testing.

Connecting the remote control box to the REMOTE connector on the front panel switches the tester from front panel control to remote control. Remote-controlled testing can be started or stopped as shown below:

	Front panel operation	Operations using the remote control box
Start testing	Disabled	START switch
Stop testing	STOP switch	STOP switch

For information on the optional remote control boxes, see "1.3 Options" (page 14).

6.1.2 Remote Control Using a Control Device

The tester can also be operated by remote control using a control device other than one of the listed optional remote control boxes.

⚠WARNING • Remote control operations involve outputting/shutting down high voltages by external signals. In certain cases, this may entail significant hazards. When high voltages are generated, thorough safety measures are required to prevent inadvertent generation of high voltages and human contact with the DUT, test lead, test probe, or the periphery of the output terminals. Do not operate the tester by remote control unless such measures can be assured.

Connecting a control device to the front panel's REMOTE connector switches the tester from front panel control to remote control. Remote-controlled testing using a control device is started or stopped as shown below:

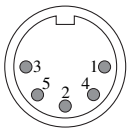
	Front panel operation	Operations using a control device
Start testing	Disabled	START signal
Stop testing	STOP switch	STOP signal

For remote control via a control device, the descriptions given for START and STOP switch operations in other chapters (including chapter 5 "Panel Operations") are modified as follows:

Front panel operation	Remote control operations from a control device
Press the START switch.	Input a START signal.
Press the STOP switch.	Input a STOP signal, or press the STOP switch on the front panel.

Connecting a control device to the REMOTE connector requires a 5-pin, DIN Standard-based connector. Contact your Kikusui distributor or agent if you have difficulty obtaining a 5-pin DIN connector.

REMOTE connector pin configuration



Viewed from the panel face

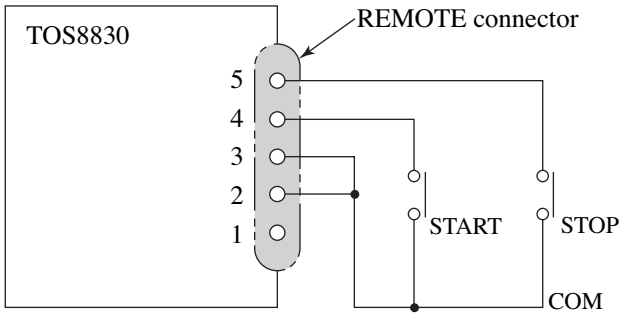
Pin number	Signal name	Description
1	NC	Leave this pin unconnected.
2	COM	Common terminal
3	ENABLE	Enables remote control at level L.
4	START	Testing begins at level L.
5	STOP	Stops testing at level L.

- The configuration of the REMOTE connector pin numbers are based on DIN Standards. Please note that the pins are not arranged by pin number.

NOTE

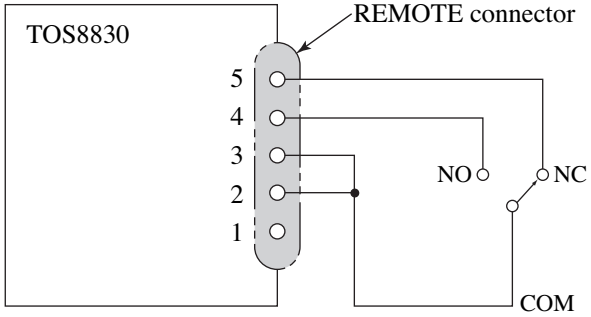
- If the REMOTE connector pin 3 is at level L, the tester switches from front panel control to remote control.
  Configure the control circuits so that pins 2 and 3 connect externally.

Control circuit example



In this example, controlling the START and STOP contacts lets you operate the tester in the same way as from the front panel.

Fig.6-1 Example: Circuit 1



In this example, setting the contact to the NO position invokes a TEST state; returning it to the NC position stops testing.

Fig. 6-2 Example: Circuit 2

Logic elements, transistors, photocouplers, or other elements may take the place of contacts in Fig. 6-1. Fig. 6-3 shows one example.

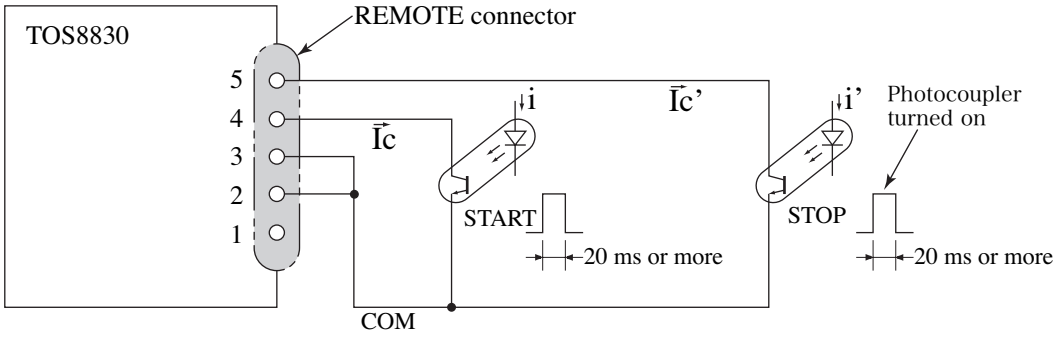


Fig. 6-3 Example: Circuit 3

REMOTE Connector Input Conditions	
H-level input voltage	11 V to 15 V
L-level input voltage	0 V to 4 V
L-level output-enable current	5 mA or less
Input time width	20 ms minimum

- Each gate is pulled up to +12 V. Opening the input terminals renders a state equivalent to H-level input.
- Consider i and i' so that 5 mA or greater flows through Ic and Ic'.
- To cancel a FAIL state, transmit a STOP signal of at least 20 ms in duration no sooner than 100 ms after the generation of a FAIL signal, as indicated in Fig. 6-4.

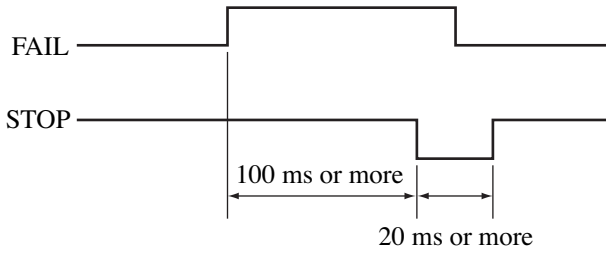


Fig. 6-4 Timing of a STOP Signal

Countermeasures against noise

For elements connected to the tester, using photocouplers as shown in Fig. 6-3 or relays as shown in Fig. 6-2 appears to be advantageous, in that they are capable of reducing the incidence of noise-induced system malfunctions.

The TOS8830 tester has been designed to minimize susceptibility to noise-induced malfunctions, whether originating from the tester itself or from a peripheral device. Nevertheless, to prevent malfunctions in connected devices, the user is advised to implement thorough measures to minimize noise.

6.2 Using the INTERLOCK Terminal

⚠WARNING • Short-circuiting the INTERLOCK terminals with the provided jumper is a convenient way to cancel the PROTECTION function, but this jumper should only be used when the tester is being temporarily operated for inspection. For safety, always enable the interlock function when performing actual testing.

To ensure user safety, the TOS8830 interlock function interlocks with external equipment to shut down output. When this function is activated, a PROTECTION state is invoked and output is shut off, preventing further testing. When this function is activated, the PROTECTION state cannot be cancelled simply by pressing the STOP switch on the front panel or by issuing a STOP signal from the remote control.

For improved safety, the interlock function allows testing to be controlled from an external device.

When using the tester, take advantage of the interlock function to improve operational safety. Consider the following examples:

- A cover covering the DUT is provided as an electric shock-prevention device; the status of the interlock function is linked to the opening and closing of the cover.
- Fences are installed around locations where testing is performed; the status of the interlock function is linked to the opening and closing of the fence.

Using the interlock function

Opening the INTERLOCK terminals on the rear panel activates the interlock function. This invokes the PROTECTION state.

To cancel the PROTECTION state invoked by the interlock function, short-circuit the terminals. Press the front panel STOP switch or send a STOP signal from the remote control.

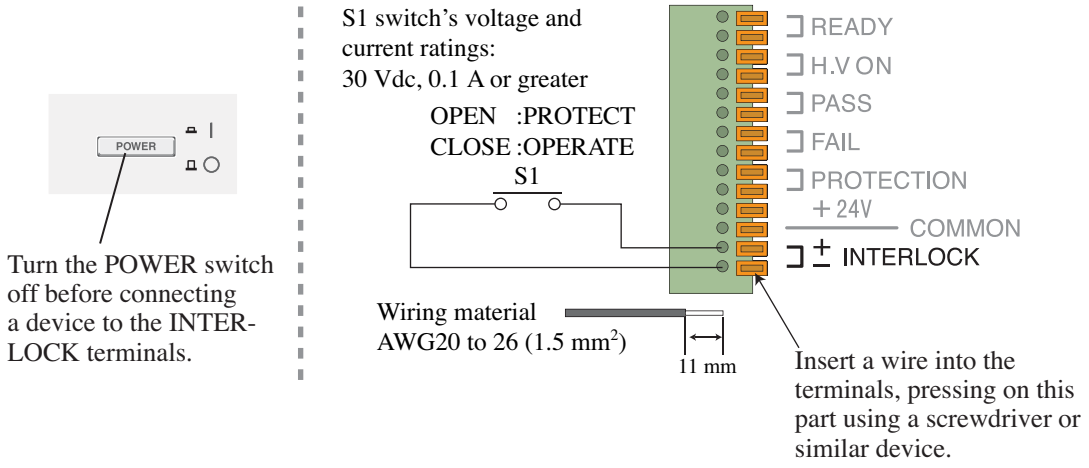


Fig. 6-5 Connecting a Device to the INTERLOCK Terminals

Chapter 7 Status Signal Output

Describes the status signal outputs (SIGNAL OUT).

7.1 Five Signal Outputs

The following status signals are output from the SIGNAL OUT terminals on the rear panel. These signals are output in sync with the states defined in “5.3.1 Five States.” For more information on each state, see “5.3.1 Five States” (page 35).

READY signal

This signal is output when the tester is in a READY state.*

* In the DOUBLE ACTION special test mode, a READY signal is generated for approx. 0.5 second after the operator presses the STOP switch. For more information, see “8.1.1 DOUBLE ACTION” (page 57).

H.V ON signal

This signal is output during testing or when high voltage remains in the output terminals (the DANGER lamp remains lit).

PASS signal

This signal is output when the test result is determined to be PASS.

In standard mode, a PASS signal is output for approx. 200 ms*, after which the tester shifts to a READY state, outputting a READY signal.

* In the PASS HOLD special test mode, a PASS signal is output until the operator presses the STOP switch. For more information, see “8.1.2 PASS HOLD” (page 58).

FAIL signal

This signal is output when the test result is determined to be FAIL. A FAIL signal is output continuously until the tester enters a READY state or PROTECTION state.

PROTECTION signal

This signal is output when the tester is in a PROTECTION state.*

* Connecting or disconnecting the REMOTE connector with the FAIL MODE special test mode set to off and the tester in a STOP state will result in no PROTECTION signal being output.

7.2 Using the SIGNAL OUT Terminals

7.2.1 Description of the Terminals

The SIGNAL OUT terminals are circuits in which a contact is closed when a signal is output (make contact signal), and there is no power supply in the internal circuits of SIGNAL OUT terminals. The terminals cannot drive a load without a power supply. See the internal circuit for each pair of terminals shown in Fig. 7-1.

The +24 V terminal can be used as a power supply for a lamp or similar device.

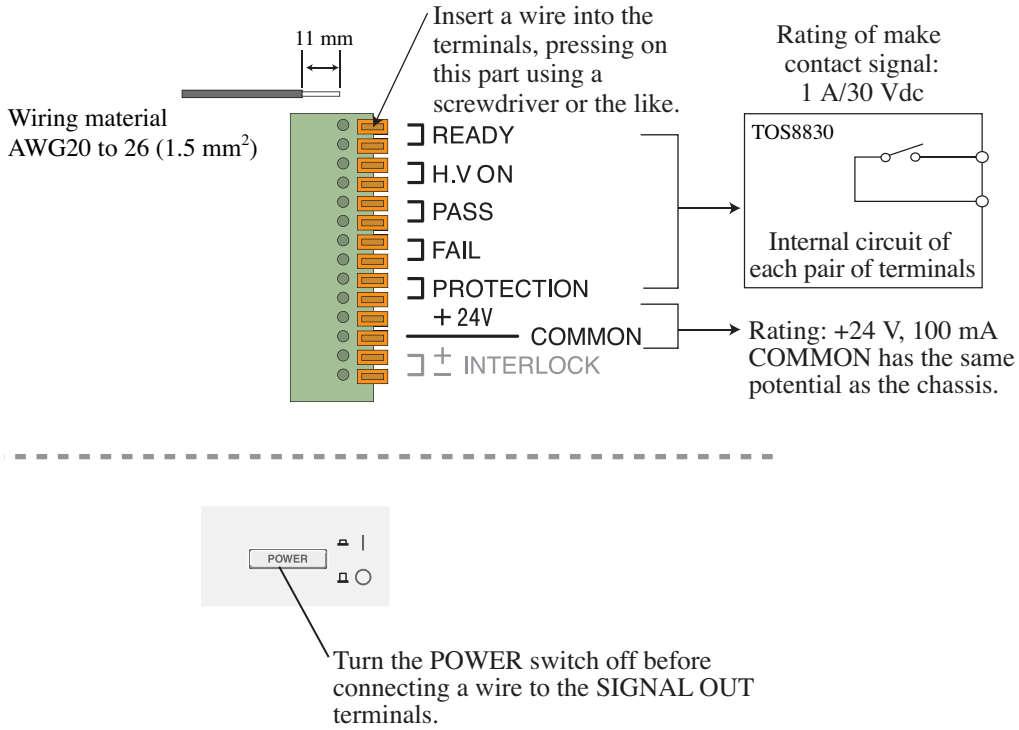


Fig. 7-1 Connecting a Wire to the SIGNAL OUT Terminals

7.2.2 Example: Use of Signals

■ Driving a DC buzzer using a FAIL signal

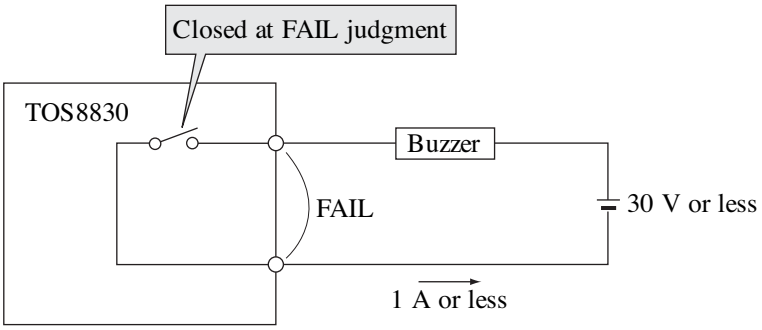


Fig. 7-2 Example: Use of FAIL Signal

■ Driving a lamp using an H.V ON signal

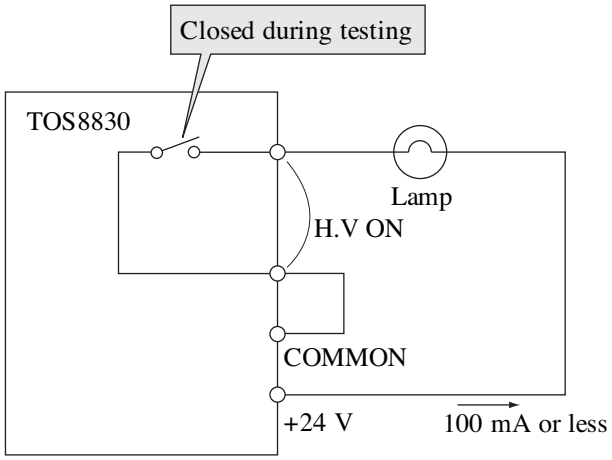


Fig. 7-3 Example: Use of an H.V ON Signal

■ Obtaining an L-level digital signal at signal output

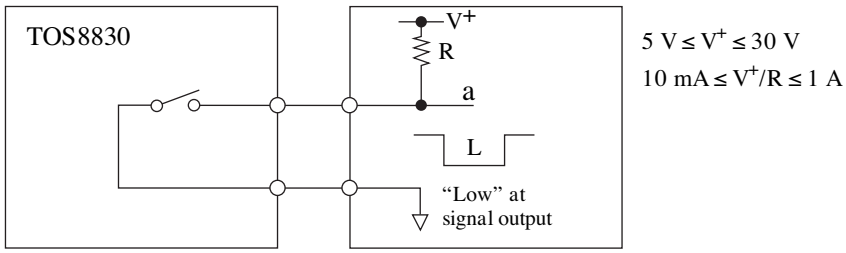


Fig. 7-4 Conversion into a Logical Signal

In Fig. 7-4, "L"-level output is obtained at point "a" at signal output. However, because a signal at point "a" contains contact chatter, measures for preventing contact chatter are required, which measures are compatible with the subsequent circuit to be connected. Moreover, the minimum applicable load for the contact is 5 V, 10 mA or greater. Thus, set V^+ and R values so that a load has this rating or above. Other cases may require additional measures against noise.

Chapter 8 Special Test Modes

Explains the special test modes.

8.1 Four Test Modes

Four special TOS8830 tester test modes can be set using TEST MODE switches. Fig. 8-1 shows the standard switch configuration (default factory settings).

Moving switches 1 to 4 from the standard position to the ON position permits selection of the following four modes. These modes can be used in any combination.

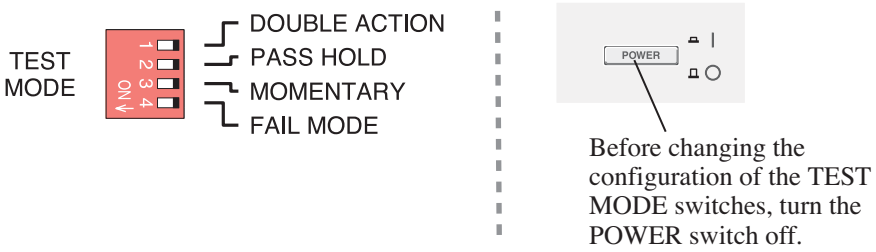


Fig. 8-1 Standard Settings of TEST MODE Switches

8.1.1 DOUBLE ACTION

Shown below are the differences in operation between the standard setting and this test mode:

Standard setting	DOUBLE ACTION
Start testing by pressing the START switch when the tester is in a READY state.	Simply pressing the START switch when the tester is in a READY state will not start testing. Testing starts only if the START switch is pressed within approx. 0.5 second after the STOP switch is pressed.

While operations are more complex in this mode, safety is improved. (This function works in the same way with remote control.)

NOTE

- If this test mode is set, a READY signal is generated for only approx. 0.5 second after the operator presses the STOP switch.

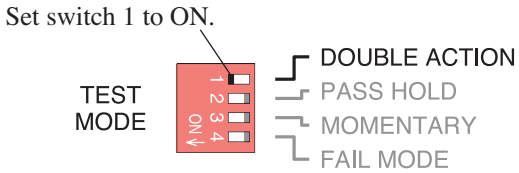


Fig. 8-2 Setting DOUBLE ACTION Test Mode

8.1.2 PASS HOLD

Shown below are the differences in operation between the standard setting and this test mode:

Standard setting	PASS HOLD
A PASS state is held for approx. 200 ms if the test result is determined to be PASS.	After the result is judged PASS, a PASS state is held until the operator presses the STOP switch.

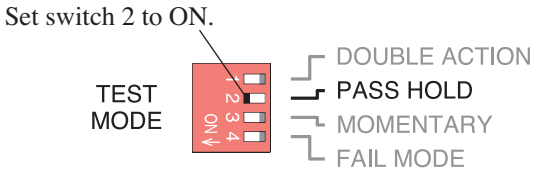


Fig. 8-3 Setting the PASS HOLD Test Mode

8.1.3 MOMENTARY

Shown below are the differences in operation between the standard setting and this test mode:

Standard setting	MOMENTARY
Once the START switch is pressed, a TEST state is held until the test time set with the timer elapses, or until the operator presses the STOP switch. The TEST state holds even if the START switch is released.	Testing can be performed only while the START switch is held down. Releasing the switch halts testing.

This operation ensures safety by requiring the operator to keep his/her hand on the START switch on the front panel during testing.

Use this function with the optional RC02-TOS (remote control box requiring two-hand operations) for even higher safety.

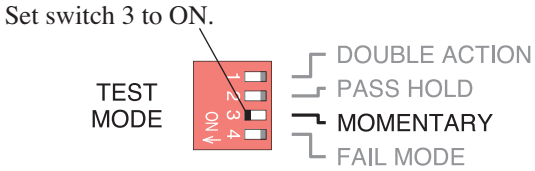


Fig. 8-4 Setting the MOMENTARY Test Mode

8.1.4 FAIL MODE

Shown below are the differences in operation between the standard setting and this test mode:

Standard setting	FAIL MODE
A STOP signal issued from the remote control can shut off output during testing or cancel a FAIL, PROTECTION, or PASS state just like the front panel STOP switch.	A STOP signal issued from the remote control can shut off the output during testing or cancel a PASS state, but cannot clear a FAIL or PROTECTION state. The FAIL or PROTECTION state must be cancelled by pressing the front panel STOP switch.

This function is useful for confirming a FAIL state when using the optional high-voltage probe HP01A-TOS or HP02A-TOS.

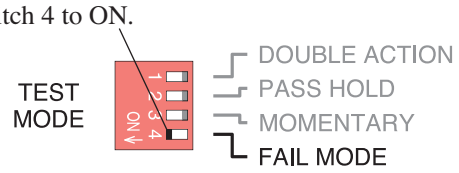


Fig. 8-5 Setting FAIL MODE Test Mode

Chapter 9 Maintenance and Calibration

Describes the maintenance and calibration of the tester. The tester must be periodically inspected, maintained, and calibrated to maintain performance.

9.1 Cleaning the Tester

⚠ CAUTION
- Always turn the POWER switch off before cleaning.
- Do not use volatile solvents such as thinners or benzine. They may discolor the tester surface coating, dissolve printed characters, or cause other problems.

If the panel becomes dirty, moisten a piece of soft cloth with a diluted mild detergent and gently wipe the panel.

9.2 Inspection

Power cord

Check that the cover is free of breaks and cracks and that the plug is free of cracks and looseness.

High-voltage test leads

Check that the covering is free of breaks and cracks. Check for broken wires in the test leads using a tester or other device.

⚠ WARNING
- A broken wire or breaks or cracking in the wire covering poses the risk of electric shock. If any such defect is observed, immediately stop using the power cord and/or test leads.

Please contact your Kikusui distributor or agent to purchase accessories.

9.3 Maintenance

High voltage relays

The high voltage relays in the tester are considered consumable parts.

They should be replaced after approx. 200,000 tests, although the appropriate replacement interval will vary with actual usage conditions. We also recommend performing an internal inspection and cleaning when the relays are replaced.

⚠WARNING • The tester generates voltages as high as 4 kV. Since replacement of internal parts is extremely hazardous, all such work should be performed by Kikusui service personnel.

9.4 Calibration

The TOS8830 tester is calibrated appropriately on shipment from the factory. However, the tester should be calibrated after long-term usage.

⚠WARNING • The tester generates voltages as high as 4 kV. Because tester calibration is extremely hazardous, all such work should be performed by Kikusui service personnel.

Chapter 10 Specifications

Provides the electrical and mechanical specifications for the TOS8830.

The specifications are based on the following conditions and settings, unless otherwise specified.

- Warm-up time: 30 minutes
- Temperature: 5°C to 35°C
- Relative humidity: 20% to 80% (with no dew condensation)
- "xx% of reading" represents xx% of voltmeter (or resistance meter) reading.

10.1 Withstanding Voltage Tester

Output section		
	Output voltage range	0.05 kV to 4.00 kV/single range
	Maximum rated load (*1)	400 VA (4 kV/100 mA) (at an input voltage of 220 V)
	Transformer capacity	500 VA
	Output voltage waveform (*2)	AC line waveform
	Voltage regulation	10% or less (during transition from the maximum rated load to no-load)
	Short-circuit current	200 mA or more (at output voltage of 1.0 kV or more)
	Switching	A zero-start switch is used.
Voltmeter		
	Display	Digital three-digit indication
	Measurement range	0.00 kV to 5.00 kV/two ranges
	Display resolution	10 V
	Accuracy	± 1.5% full scale or Vm ≥ 1.00 kV: ± (2% of reading +10 V), Vm < 1.00 kV: ± (2% of reading +20 V) – whichever is smaller. where Vm: measured voltage value
	Response	Mean value response/rms value indication

*1 Time limitations on the output

The heat radiation capacity of the output voltage generator section of the tester is designed to be 1/2 of the rated output, in consideration of the instrument dimensions, weight, costs, and other factors. The tester, therefore, must be used under the following time constraints (interval time and output time). If used beyond these limits, the output section may overheat, activating the internal protection circuit. In such cases, always halt testing for a duration equal to or greater than the test duration.

Ambient temperature (t)	Upper reference limit (i)	Interval time	Output time
t ≤ 40°C	50 mA < i ≤ 105 mA	Equal to or greater than output time	10 minutes max.
	i ≤ 50 mA	Not necessary	Continuous output is possible.

*2 Test voltage waveform

If AC voltage is applied to a capacitive load, the output voltage in certain cases may rise above the value at no-load, depending on the value of the capacitive element of the load. Moreover, for samples whose capacitance values show voltage dependency (as with ceramic capacitors), waveform distortions may result. However, for a test voltage of 1.5 kV, the effects of a capacitance of 1000 pF or less may be ignored.

Judgment function		
	Judgment method	Compares the reference values and measured leakage current using a window comparator. The result is returned as a PASS or FAIL.
	Judgment action	FAIL judgment • If a current exceeding the upper reference limit or falling below the lower reference limit is detected: • The FAIL lamp is lit, • A FAIL signal is output from the SIGNAL OUT terminal (*3), and • The buzzer sounds. (*4)
		PASS judgment • When there are no abnormalities even after the set time has elapsed: • The PASS lamp is lit. • A PASS signal is output from the SIGNAL OUT terminal (*5), and • The buzzer sounds. (*4)
	Upper reference limit	1/2/4/8/10/25/100 mA, 7 ranges May be set from 1 mA to 50 mA in 1 mA steps by a combination.
	Lower reference limit	Continuously variable from 0 to 1/2 of the upper reference limit
	Judgment accuracy (*6)	± (5% + 20 μA) with respect to the upper reference limit ± 20% with respect to the lower reference limit (*7)
	Current detection method	Integrates the absolute current value to compare it to the reference value.
	Calibration	Use a pure resistive load to make calibrations based on sine-wave rms values.
	Output voltage at no-load that is required for detection (*8)	Approx. 300 V when set to 100 mA
Time		
	Test time	1 s to 99 s (the TIMER off function provided)
	Resolution	1 s
	Accuracy	-0 ms, +50 ms

*3 A FAIL signal is continuously output until STOP is input.

*4 The volume of a buzzer can be adjusted. However, it cannot be individually adjusted with respect to FAIL and PASS judgments.

*5 If PASS HOLD has been set, a PASS signal will be continuously output until STOP is input.

*6 In an AC withstanding voltage test, a current also flows in stray capacities such as measurement leads and devices. The approximate current values flowing in these stray capacities are as shown in the table below.

Output voltage	1 kV	2 kV	3 kV	4 kV
Main unit only (without measurement leads)	4 μA	8 μA	12 μA	16 μA
When a lead wire with a length of 350 mm is suspended in air (typical values)	6 μA	12 μA	18 μA	24 μA
When the provided TL01C-TOS or TL01-TOS lead wires are used (typical values)	20 μA	40 μA	60 μA	80 μA

*7 When the lower reference value is 1/2 of the upper reference limit (i.e., the variable resistor is turned fully clockwise). No calibration is made for other values.

*8 Voltage required to make FAIL judgment with the output terminals short-circuited (due to internal resistance in the output circuit).

10.2 Insulation Resistance Tester

Output section		
	Rated output voltage	-500 Vdc
	Accuracy	$-\left(500 \begin{smallmatrix}+20\\-0\end{smallmatrix}\right)$ Vdc
	Maximum rated load	0.5 W (-500 V / 1 mA)
	Maximum rated current	1 mA
	Ripple	2 Vp-p or less (at 500 V and no-load) 10 Vp-p or less (at the maximum rated load)
	Voltage regulation	1% or less (during transition from the maximum rated load to no-load)
	Short-circuit current	12 mA or less
	Discharge function	Forced discharge at the end of testing (discharge resistance of 25 kΩ)
	Output voltage-monitoring function	If the output becomes -10% or below, the output is shut off for safety reasons.
Resistance meter		
	Display	Rm < 10.0 MΩ: □ . □□ MΩ 10.0 MΩ ≤ Rm < 100.0 MΩ: □□ . □ MΩ 100.0 MΩ ≤ Rm < 1000 MΩ: □□□ . □ MΩ Rm: measured insulation resistance value
	Effective measurement range	0.50 MΩ - 999.9 MΩ
	Accuracy (*1)	Rm < 20 MΩ: ± (5 % of reading) Rm ≥ 20 MΩ: ± (10 % of reading) Rm: measured insulation resistance value
	Hold function	A measured resistance value applied at the end of testing is held during a PASS period.
Judgment function		
	Judgment method	Compares the reference values and measured resistance using a window comparator. The result is returned as a PASS or FAIL. A reference value can be independently set for the upper and lower limits.
	Judgment action (*5)	FAIL judgment • If a resistance value falling below the lower reference limit or exceeding the upper resistance limit is detected: • The FAIL lamp is lit, • A FAIL signal is output from the SIGNAL OUT terminal (*2), and • The buzzer sounds. (*3)
		PASS judgment • When there are no abnormalities even after the set time has elapsed: • The PASS lamp is lit, • A PASS signal is output from the SIGNAL OUT terminal (*4), and • The buzzer sounds. (*3)

Judgment function (continued)		
	The value set for the upper reference limit	Any of the following 33 values is valid, to a value ranging from 0.50 MΩ to 999.9 MΩ. 0.50/0.60/0.70/0.80/0.90/ 1.00/2.00/3.00/4.00/5.00/6.00/7.00/8.00/9.00/ 10.0/20.0/30.0/40.0/50.0/60.0/70.0/80.0/90.0/ 100.0/200.0/300.0/400.0/500.0/600.0/700.0/800.0/900.0/999.9 MΩ
	The value set for the lower reference limit	
	Judgment accuracy (*1)	Rm < 20 MΩ: ± (5 % of reading + 3 digit) Rm ≥ 20 MΩ: ± (10 % of reading + 10 digit) Rm: measured insulation resistance value
	Judgment wait time	0.3 s fixed (*5)
Time		
	Test time	1 s to 99 s (the TIMER off function provided)
	Resolution	1 s
	Accuracy	-0 ms, +50 ms

*1 There must be no disturbances such as swinging of the test lead at relative humidities of 20% to 70% (with no dew condensation).
*2 A FAIL signal is continuously output until STOP is input.
*3 The volume of the buzzer can be adjusted, but not individually for FAIL and PASS judgments.
*4 If PASS HOLD has been set, a PASS signal will be continuously output until STOP is input.
*5 Judgment begins following the elapse of the judgment wait time from the start of testing.

10.3 Common Items

Other Functions

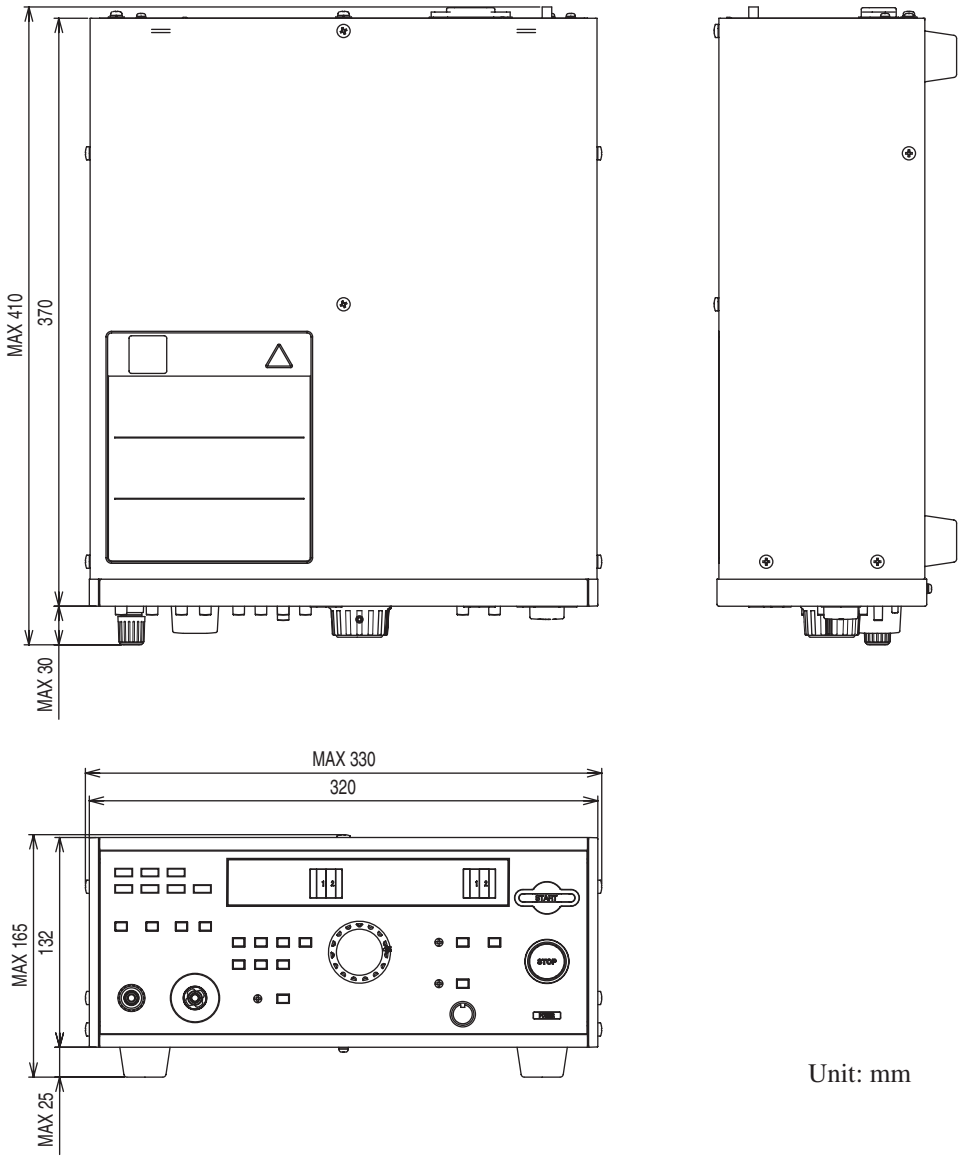
Test function		
	ACW → IR	Conducts tests in the sequence of withstanding voltage testing and insulation resistance testing.
	IR → ACW	Conducts tests in the sequence of insulation resistance testing and withstanding voltage testing.
	ACW	Conducts withstanding voltage test singly.
	IR	Conducts insulation resistance test singly.
Remote control		
	Connector	5-pin DIN connector on the front panel
	Control available	Start/stop of testing
	Optional devices connectable	Remote control boxes: RC01-TOS and RC02-TOS High-voltage test probes: HP01A-TOS and HP02A-TOS

Signal I/O		
	Connector	14-pin screw-less terminal on the rear panel
	Status signal output	Output of a READY signal / H.V ON signal / PASS signal / FAIL signal / PROTECTION signal Make-contact signal (contact rating: 1 A/30 Vdc)
	Power output terminal	Output of internal power (24 V at 100 mA) The COMMON terminal has a potential equal to the chassis potential.
	INTERLOCK input terminal	A PROTECTION state is invoked when the terminals are open.
Special test modes		
	DOUBLE ACTION	Starts testing only when the START switch is pressed within approx. 0.5 second. after the STOP switch has been released.
	PASS HOLD	Holds PASS judgment.
	MOMENTARY	Performs testing only while the START switch is pressed.
	FAIL MODE	Disables cancellation of the FAIL or PROTECTION state caused by a remote STOP signal.

General Specifications

Environment			
	Operation environment		Indoor use, Overvoltage Category II
	Specifications-assured range	Temperature	5°C to 35°C
		Relative humidity	20% to 80% (with no dew condensation)
	Operating range	Temperature	0°C to 40°C
		Relative humidity	20% to 80% (with no dew condensation)
	Storage range	Temperature	-40°C to 70°C
		Relative humidity	90% or less (with no dew condensation)
	Altitude		Up to 2000 m
AC input			
	Nominal input rating		220 V, 50 Hz or 60 Hz
	Input voltage range		200 V to 240 V
	Power consumption	At no-load (in READY state)	50 VA or less
		At rated load	650 VA maximum
Insulation resistance		AC INPUT to chassis	30 MΩ or more (at 500 Vdc)
Withstand voltage		AC INPUT to chassis	20 mA or less when 1390 Vac is applied for 2 seconds
Earth continuity			25 Aac/0.1 Ω or less
Dimensions (largest section)			320 (330) W x 132 (165) H x 370 (410) D mm
Weight			Approx. 18 kg
Accessories			• High-voltage test leads TL01C-TOS (approx. 1.5 m): 1 set • Power cord: 1 • INTERLOCK jumper: 1 • Operation Manual: 1 copy

10.4 Dimensions



Unit: mm

Appendix

Provides guidelines for discharge time, current detection lower reference limit, and zero-start switch.

A.1 Guidelines for Discharge Time

In insulation resistance testing, the device under test (DUT) is charged. The time required to discharge an electrical charge depends on the properties of the DUT and the test voltage.

The discharge circuit built into the tester activates immediately after insulation resistance testing ends. The discharge resistance is approx. 25 kΩ. Without the DUT, the time required by the internal capacitor to attenuate the voltage of the tester alone to 30 V is approx. 0.4 ms.

Assuming that the DUT is a capacitor with a capacitance of 0.05 μF, the time required to discharge to 30 V is approx. 4 ms.

■ If the connection to the DUT is interrupted during testing

If the connection to the DUT is interrupted during testing or before discharge is complete, the time required to discharge the DUT voltage to 30 V will be approx. 2.8 seconds, assuming that the DUT has a capacitance of 0.01 μF and parallel resistance of 100 MΩ.

If the DUT's approximate time constant is known, the time required by the DUT's voltage to discharge to 30 V after the output has been shut off is obtained by multiplying the noted attenuation time by the DUT's time constant.

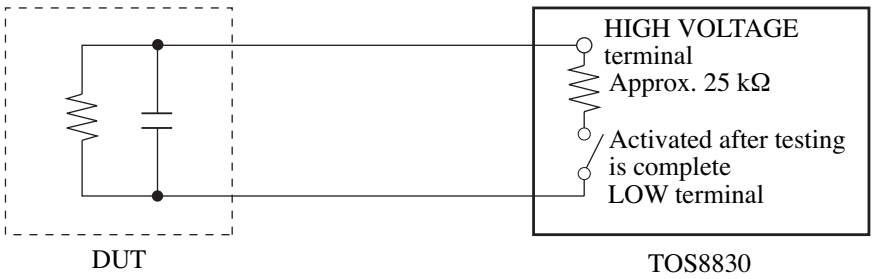


Fig. A-1 Example of Equivalent Circuit for Discharge

A.2 Setting the Current Detection Lower Reference Limit

This section describes precautions for making lower limit judgments in withstanding voltage testing. It also describes how to set the current detection lower reference limit.

■ Precautions for lower limit judgment

If lower limit judgment is enabled in the following cases, the test result will be judged inappropriately as FAIL.

- Test voltage is set under no-load conditions.
- Virtually no current flows through the DUT.

Judgment error caused by stray capacity

In certain cases of high sensitivity and high voltage AC testing, a current flowing through stray capacities such as the test leads will exceed the lower reference limit, disabling lower limit judgment. Since no current flows through the DUT when the connection to the DUT is interrupted, the current flowing through the DUT should be less than the lower reference limit, which should result in a FAIL judgment. However, if a current exceeding the lower reference limit flows through stray capacities, the tester's current detection circuit detects that current, and the tester issues a PASS judgment. For information on stray capacities, see "Footnote *6" in "10.1 Withstanding Voltage Tester" (page 62).

Be alert for comprehensive judgment errors. Check whether the tester issues a FAIL judgment when the connection to the DUT is interrupted at the setting of test conditions.

Setting the current detection lower reference limit:

1. Set the current detection upper reference limit.
   See "Current detection upper reference limit" (page 38).
2. Adjust the front panel settings as shown in Fig. A-2.

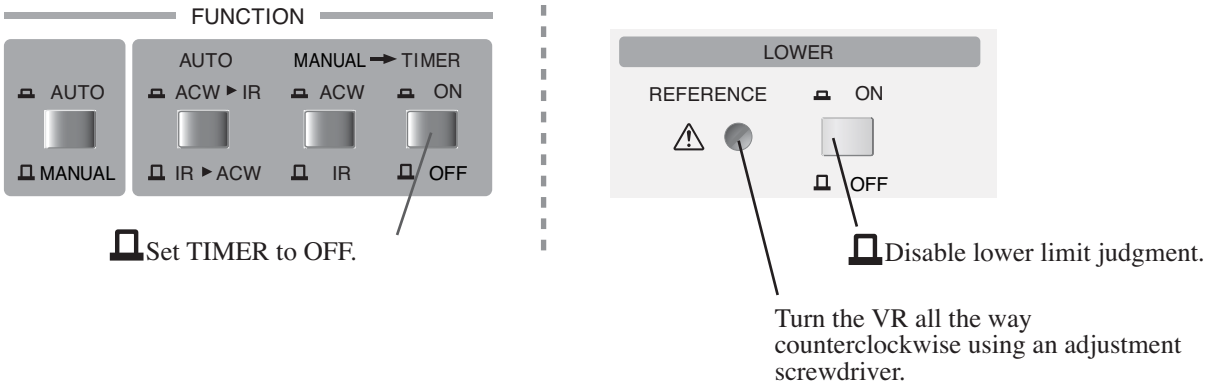
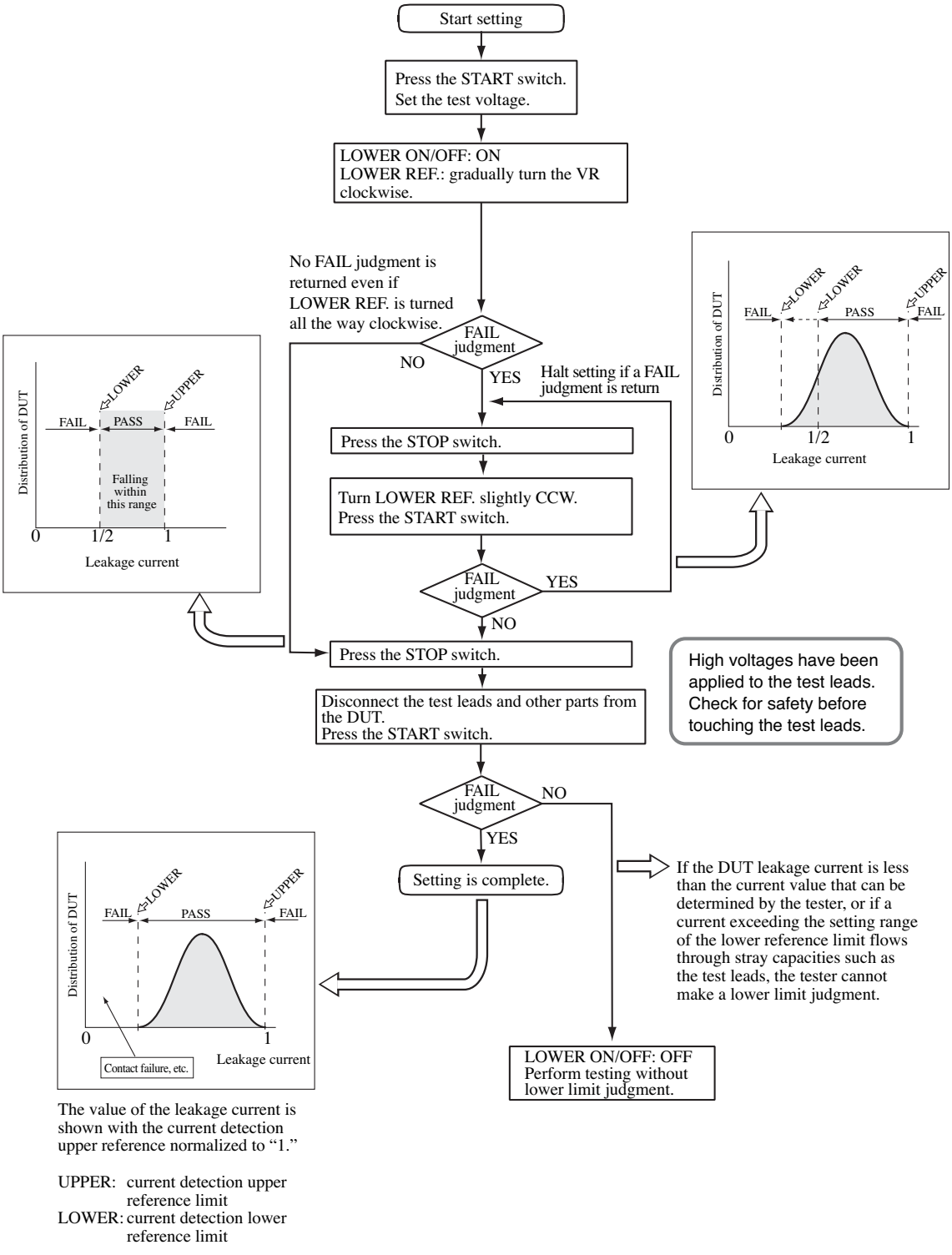


Fig. A-2 Preparing to Set the Current Detection Lower Reference Limit

3. Connect the DUT to the tester as described in "3.3.1 Connecting the Test Leads" (page 22).
4. Set the lower reference limit as indicated in the flowchart in Fig. A-3.



The value of the leakage current is shown with the current detection upper reference normalized to "1."

UPPER: current detection upper reference limit
LOWER: current detection lower reference limit

Fig. A-3 Flowchart for Setting the Current Detection Lower Reference Limit

A.3 Improvements in Waveform Obtained Using a Zero-start Switch

In the withstanding voltage tester, opening and closing the primary side of the high voltage transformer with a contact switch opens and closes the primary winding, distorting the output waveform. This results in the application of unnecessarily high voltage to the DUT, potentially damaging the DUT or resulting in a FAIL assessment for a good DUT.

To reduce distortion of test voltage waveforms, the TOS8830 tester uses a zero-start switch semiconductor to open or close a circuit when the supply voltage is near 0 V.

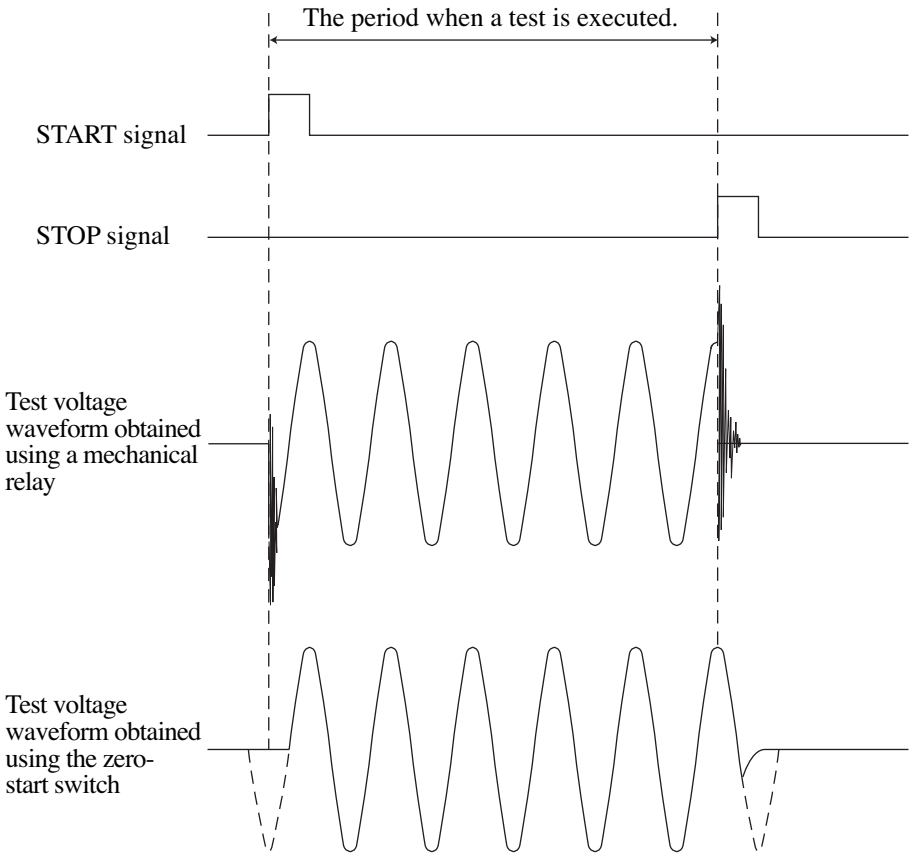


Fig. A-4 Improvements in Waveform Obtained Using the Zero-start Switch

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