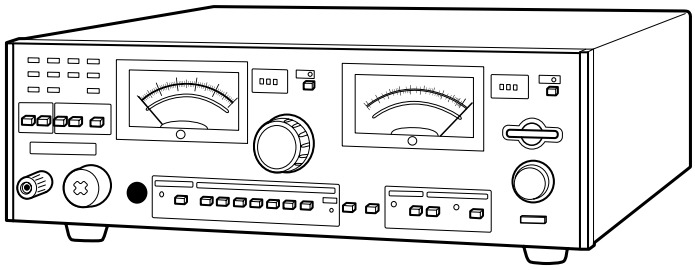
Part No. Z1-002-472, IB003177
Dec. 2009

OPERATION MANUAL

WITHSTANDING VOLTAGE/ INSULATION RESISTANCE TESTER

TOS8870A



⚠ DANGER

This Tester generates high voltage!

- ○ Any incorrect handling may cause death.
- ○ Read Chapter 2 “WARNINGS AND CAUTIONS FOR OPERATING THE TESTER” in this manual to prevent accident.
- ○ Keep this manual near the tester 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 it 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.

Waste Electrical and Electronic Equipment (WEEE)

Disposing of used Kikusui products in the EU

Under a law adopted by member nations of the European Union (EU), used electric and electronic products carrying the symbol below must be disposed of separately from general household waste.

This includes the power cords and other accessories bundled with the products. When disposing of a product subject to these regulations, please follow the guidance of your local authority, or inquire with your Kikusui distributor/agent where you purchased the product.

The symbol applies only to EU member nations.

Disposal outside the EU

When disposing of an electric or electronic product in a country that is not an EU member, please contact your local authority and ask for the correct method of disposal.

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

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To supervisor in charge of operation

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

For your own safety (How to avoid electrification)

While the Tester is generating the output, do not touch the following areas, or else, you will be electrified, and run the risk of death by electric shock.

- the output terminal
- the test lead-wire connected to the output terminal
- the Device Under Test (DUT)
- any part of the Tester, which is electrically connected to the output terminal, and
- the same part as above immediately after the output has been cut off. (in case of insulation resistance test)

Also, electric shock or accident may arise in the following cases:

- the Tester being operated without grounding.
- if the gloves for electrical job are not used.
- approach to any part connected to the output terminal while the power of the Tester is turned on.
- the same action as above immediately after the power of Tester has been turned off. (in case of insulation resistance test)

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.

(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____ A, _____ VAC, and _____ .

⚠ WARNING

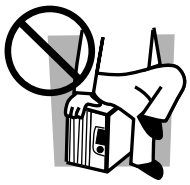
- To avoid electrical shock, always disconnect the AC power cord or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

⚠ Safety Precautions

The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly.

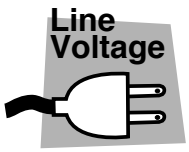
Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)
- This product is not designed or manufactured for general home or consumer use.



Purposes of use

- Do not use the product for purposes other than those described in the operation manual.

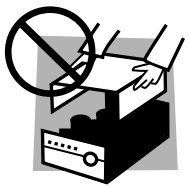


Input power

- Use the product with the specified input power voltage.
- For applying power, use the AC power cord provided. Note that the provided power cord is not use with some products that can switch among different input power voltages or use 100 V and 200 V without switching between them. In such a case, use an appropriate power cord.

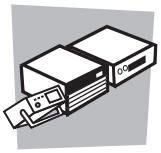
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.



Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.



Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When installing products with casters, be sure to lock the casters.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

Operation

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cord. Be sure to unplug the AC power cord.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the AC 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

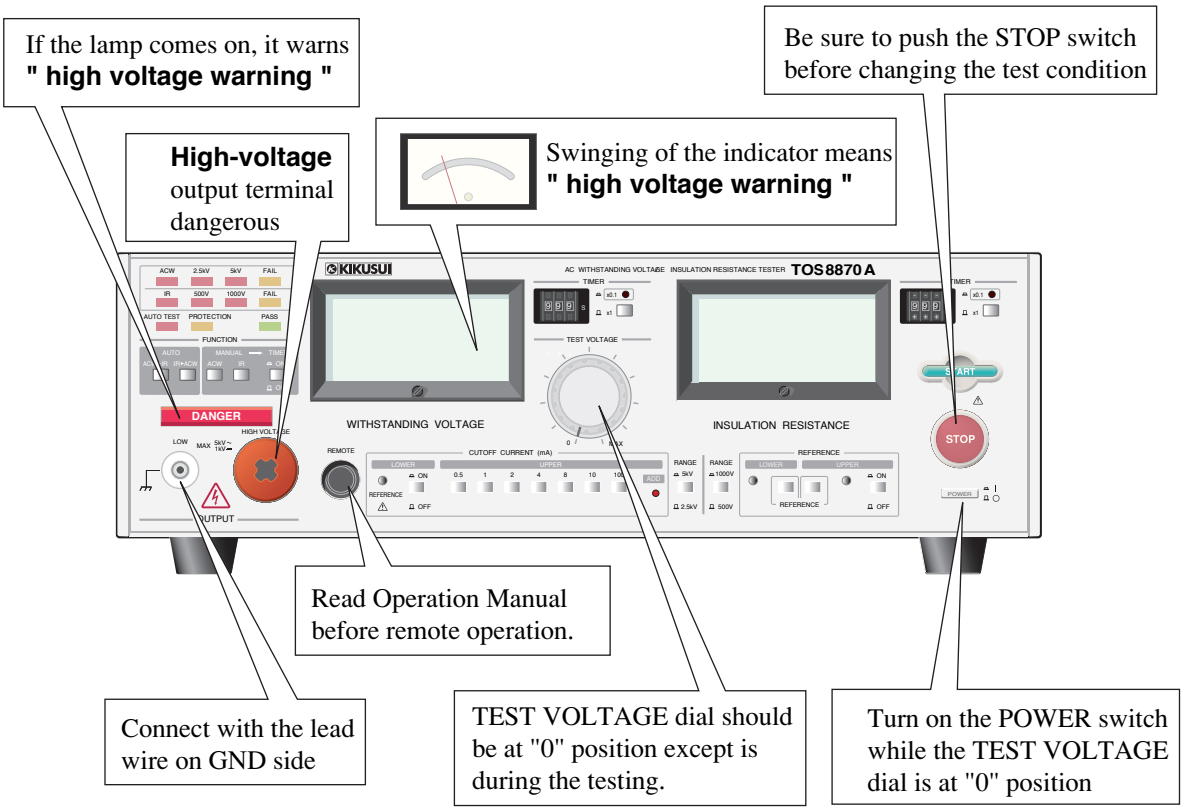
- To avoid electrical shock, be absolutely sure to unplug the AC power cord before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking,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

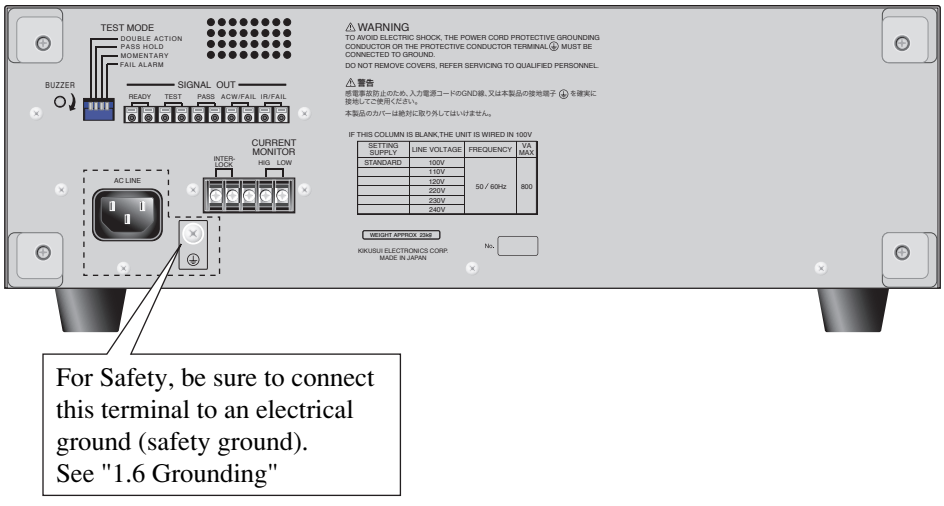
Service

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

Front panel and Rear panel

- Be sure to read Chapter 2 "WARNINGS AND CAUTIONS FOR OPERATING THE TESTER"





⚠ 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 1,000 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.
⚠ WARNING	Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if ignored, may result in 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.
	Indicates a protective conductor terminal.
	Indicates a chassis(frame) terminal.

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INTRODUCTION

General

Model TOS8870A is a combination of an withstanding voltage tester and an insulation resistance tester, and it is capable of performing withstanding voltage test and insulation resistance test in one continuous process.

As for the withstanding voltage tester, the Tester can provide a maximum output voltage of 5 kV and an output capacity of 500 VA, and can be used for withstanding voltage test in compliance with JIS, UL, CSA, BS and other major electrical standards and ordinances. As for the insulation resistance tester, the Tester has two ranges of 500 V/ 1 000 MΩ and 1 000 V/ 2 000 MΩ.

The Tester can perform a PASS-FAIL judgement function when in either the withstanding voltage or insulation resistance test mode. A PASS-FAIL judgement is with a window comparator type. When in withstanding voltage test, the Tester is capable of generating a FAIL judgement not only when the detected leakage current is greater than the high limit reference value preset on the front panel of the Tester but also when it is less than the low limit reference value (which is continuously adjustable down to one-half of the high limit reference value), thereby contributing to make PASS-FAIL judgement including test of open circuiting of leadwires and imperfect contacting of connections.

The Tester is incorporated with a function to deliver signals representing the result of PASS-FAIL-judgement and the state of the Tester, and a remote control function. The signals namely are TEST ON, PASS, READY, and FAIL alarm (contact signals). The Tester is incorporated also with a remote control function for test set/reset. These features can be utilized for automatic test with labor economization.

Its sequence circuit is designed with full attention to noise to prevent erroneous operation which could be caused by noise.

⚠ WARNING • Although many safety features are incorporated in the Tester, a deadly accident may occur when the operator touches the device under test (DUT) or the probe.Safety guards around DUT should be considered for safe operation.Also, other precaution, which deemed necessary for the tester and the devices, shall be maintained under positive control.

Chapter 1 SETUP

This chapter describes unpacking and general preliminary notes and precautions.

1.1 Checking for Shipping Damages and Accessories

■ Unpacking

The Tester should be checking upon receipt for damage that might have occurred during transportation. Also check that all accessories have been provided.

Should the Tester be damaged or accessory missing, notify your Kikusui agent/distributor.

Accessories				
	Item	Parts No.	Q'ty	Check
	Power cord*1	85-AA-0003	1	
	TL01-TOS High Voltage Test Leadwires (Approx.1.5m)	KA-0607-02	1	
	"DANGER High-Voltage" sticker	A8-210-202	1	
	Operation Manual	Z1-002-472	1	

*1. The power cord that is provided varies depending on the destination for the product at the factory-shipment.

■ Packing

⚠ CAUTION
- When transporting the Tester, be sure to use the original packing materials. If they are missing, contact your Kikusui agent/distributor.
- When packing the Tester, remove the power cord and all other connection cables.

1.2 Precautions for Installation

Be sure to observe the following precautions when installing the unit.

■ Do not use the unit in a flammable atmosphere.

To prevent explosion or fire, do not use the unit near alcohol or thinner, or in an atmosphere containing such vapors.

■ Avoid locations where the unit is exposed to high temperature or direct sunshine.

Do not locate the unit near a heater or in areas subject to drastic temperature changes.

Operation temperature range: 0 ˚C to 40 ˚C (32 ˚F to 104 ˚F)

Storage temperature range: -20 ˚C to 70 ˚C (-4 ˚F to 158 ˚F)

■ Avoid locations of high humidity.

Do not locate the unit in high-humidity locations, i.e., near a boiler, humidifier, water supply, etc.

Operation humidity range: 20 % to 80 % RH (without condensation)

Storage humidity range: 80 % RH or less (without condensation)

Dew condensation may take place even in the operation humidity range. In such a case, do not use the unit until the dew dries up completely.

■ Do not place the unit in a corrosive atmosphere.

Do not install the unit in a corrosive atmosphere or one containing sulfuric acid mist, etc. This may cause corrosion of various conductors and imperfect contact with connectors, malfunction, failure, or a fire.

■ Do not locate the unit in a dusty location.

Presence of dirt or dust may cause electric shock or fire.

■ Do not use the unit where ventilation is poor.

Since the unit must cool naturally, leave sufficient space around it.

■ Do not place any object on the unit.

The unit employs a naturally air cooling.

■ Do not install the unit along a tilted section of floor or in a location subject to vibrations.

If placed on a non-level surface or in a location subject to vibration, the unit may fall, resulting in damage and injury.

■ Do not use the unit in locations affected by strong magnetic and/or electric fields.

Operation in a location subject to magnetic or electric fields may cause the power supply to malfunction, resulting in electrical shock or fire.

■ Do not use the unit in locations where highly sensitive measuring instruments or receivers are nearby.

Such instruments may be affected by the noise generated by the unit.

■ Secure adequate space around the power plug.

Do not insert the power plug to an outlet where accessibility to the plug is poor. And, do not place objects near the outlet that would result in poor accessibility to the plug.

1.3 Precautions for moving

When relocating the unit to an installation site or transporting it, observe the following:

■ Turn the power switch off.

Moving the unit with the power on may result in electrical shock or damage.

■ Remove all wirings connected.

Moving the unit with cables connected may break the cables or cause the unit to fall, resulting in injury..

■ For transportation, use the special packing material for the unit.

Transport the unit in its original package to prevent vibration and falls, which may damage the unit. If you require packing material, contact your Kikusui agent/distributor.

■ Do not move the unit by yourself.

Use two or more persons when moving the unit, which weighs more than 20 kg. Use particular caution where there are slopes or steps.

1.4 AC Line Requirements

The AC line requirements of the Tester are as follows:

Nominal voltage	Voltage tolerance	Nominal frequency
100 V	±10 % of nominal voltage	50/60 Hz

The standard nominal AC line voltage of the Tester is 100 V. The Tester normally operates on an AC line voltage within ±10 % of the nominal voltage. If the line voltage is outside of this range, the Tester may not operate normally or may be damaged. If your AC line voltage is outside of this range, be sure to convert it into within this range by using an autotransformer or other appropriate means. The waveform of the power supply must be a sine wave with a peak value 1.3 to 1.5 times the rms value.

Testers to operate on other AC line voltages as shown below also are available as below.

Optional AC line voltage	110 V	120 V	220 V	230 V	240 V

A sheet that indicates the AC line setting of the Tester as shown below is posted near the AC line power input terminal of the Tester. If no particular indication is made on this indicator sheet, the AC line setting of the Tester is for the standard nominal voltage (100 VAC). As an option, modification to one of the other nominal voltages is made at the factory before the Tester is shipped from the factory. When this has been done, the modified nominal AC line voltage is indicated by a marking on the indicator sheet. Before turning ON the AC input power of the Tester, be sure that your AC line voltage conforms with the nominal voltage indicated on the indicator sheet.

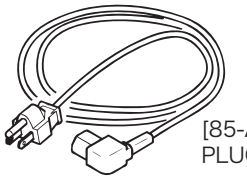
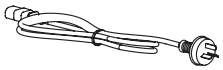
SETTING SUPPLY	
STANDARD	100 V
	110 V
	120 V
	220 V
	230 V
	240 V

⚠WARNING • Do not attempt to convert your Tester for AC line voltage change for yourself. Order your Kikusui agent/distributor for conversion of your Tester.

1.5 Connecting the AC Power Cord

⚠WARNING • The tester is designed to operate from the overvoltage category II. Do not operate it from the overvoltage category III or IV.

- *Do not use the AC power cord provided with the product as a AC power cord for other instruments.*

 [85-AA-0003] PLUG:NEMA5-15	Power cord for 100 V system Rated voltage: 125 VAC Rated current: 10 A
[85-AA-0005] PLUG:CEE7/7  [85-10-0790] PLUG:GB1002	Power cord for 200 V system Rated voltage: 250 VAC Rated current: 10 A

1. Check that the supply voltage is within the line voltage range of the tester.
2. Turn OFF the POWER switch.
3. Connect the AC power cord to the AC LINE connector on the rear panel.
4. Plug in the AC power cord.

1.6 Grounding

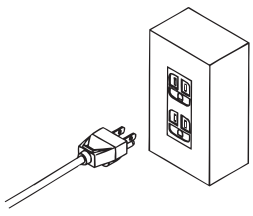
⚠WARNING • Electric shock may occur, if proper grounding is not furnished.
• Connect the ground terminal to an electrical ground (safety ground).

⚠CAUTION • If you do not ground the unit, malfunction may occur due to external noise, or the noise generated by the unit may become large.

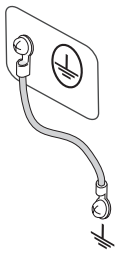
Make sure to ground the unit for your safety.

To make a secure grounding connection, use one of the following two methods:

1. Plug the power cord into a three-pronged outlet with grounding installation.



2. Connect the protective conductor terminal on the rear panel to a dedicated ground (GND) terminal securely using a tool.



Chapter 2 WARNINGS AND CAUTIONS FOR OPERATING THE TESTER

This Chapter gives warnings and cautions when operating the Tester. When operating the Tester, be extremely careful and observe the cautions, warnings, and other instructions given in this chapter.

⚠WARNING • The Tester delivers maximum 5 kVAC or 1 kVDC or higher test voltage, which can cause a fatal accident if it is not handled properly. When operating the Tester, be extremely careful and observe the cautions, warnings and other instructions given in this chapter.

2.1 Preparative Procedures

2.1.1 Wearing Insulation Gloves

When handling the Tester, be sure to wear insulation gloves in order to protect yourself against high voltages. If no insulation gloves are available on your market, please order your Kikusui agent/distributor for them.

2.1.2 Grounding the Tester

Be sure to ground the Tester. Unless the Tester is securely grounded, when the Tester output is shorted to an earth line or to a conveyor or other device which is connected to an earth line or when it is shorted to the AC line, the Tester chassis can be charged up to the high voltage that can cause electric shock hazard.

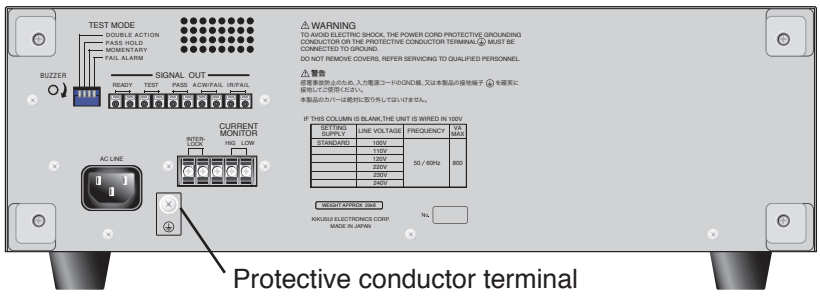


Fig.2-1 Protective conductor terminal

DESCRIPTION • The term "AC line" here means the line on which the Tester is operating. That is the line to whose outlet the AC power cord of the Tester is connected. It may be of a commercial AC power line or of a private-generator AC power line.

2.2 Warnings and Cautions when Operating the Tester

2.2.1 Connecting of test lead-wire on LOW side

Fig.2-2 shows the connection of the test lead-wire on LOW side. Every time the Tester is used, check if the lead wire is not damaged or disconnected. The lead-wire connection to the DUT shall be made from LOW side. If the connection is incomplete, it is hazardous that the entire DUT may be changed with high voltage.

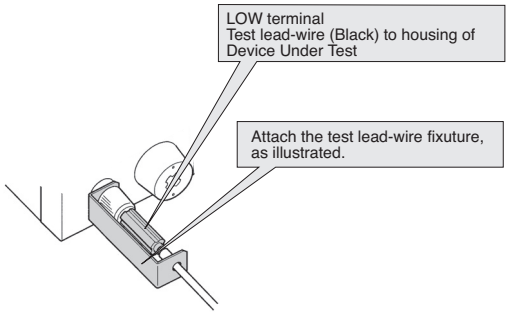


Fig.2-2 Connecting of test lead-wire on LOW side

2.2.2 Connection of test lead-wire on high-voltage output side

After connecting the lead-wire on LOW side, take the following procedure.

1. Push the STOP switch.
2. Confirm if the indicator of the output voltmeter is at "0".
3. Confirm if the DANGER lamp has been off.
4. Connect the high-voltage test lead-wire with the HIGH VOLTAGE terminal.
5. Short the high-voltage test lead-wire with the LOW test lead-wire once, and confirm that no high voltage is output.
6. Lastly, connect the LOW test lead-wire and then the high-voltage output test lead-wire to the DUT.

2.2.3 Power switch

The power switch shall be turned on after confirming that the TEST VOLTAGE dial has been turned to the extreme left ("0" position).

2.2.4 Change of test condition

Change-over of the switches on the panel shall be made after confirming that the STOP switch has been pushed in and that the TEST VOLTAGE dial has been turned to the extreme left ("0" position).

2.2.5 Suspension of testing

Except under testing, the TEST VOLTAGE dial shall be turned to the extreme left ("0" position). Also, push the STOP switch (H.V OFF) to ensure safety.

The Power switch shall be turned off (○) if the Tester is not used for some time or the operator is to leave from the Tester.

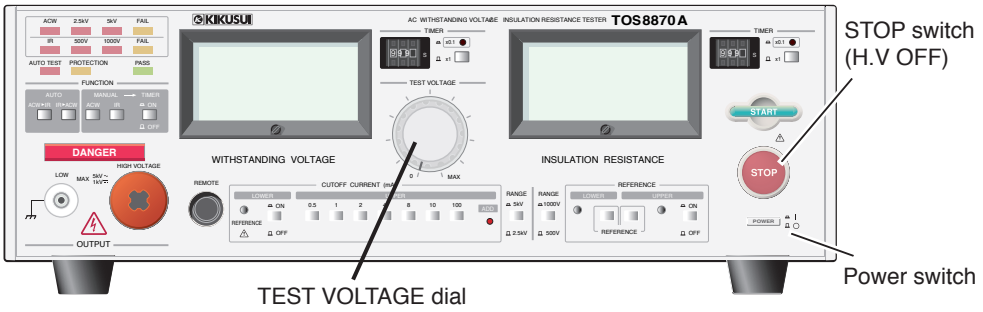


Fig.2-3

2.2.6 Critical areas of the Tester under operation

It is dangerous to touch such high voltage areas as the DUT, and the test lead-wire, probe and output terminal while the Tester is under operation.

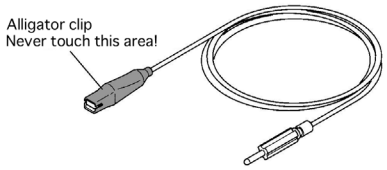


Fig.2-4

⚠WARNING • NEVER touch the alligator clip of the test lead-wire and the vinyl-cover of the clip because they are NOT insulation proof.

2.3 Warning after the output has been cut off

2.3.1 Confirmation on completion of testing

You may touch the DUT and the high-voltage areas (test lead-wire, probe or output terminal) for correction of the wiring or any other purpose provided that the following confirmation has been made;

- the indication of output voltage is at "0", and
- the DANGER lamp has been turned off.

In the case of insulation resistance test, DUT is charged after testing.

Be sure to read "2.3.2 Cautions in electric charging in insulation resistance test".

2.3.2 Cautions in electric charging in insulation resistance test

1) Electric charging

⚠WARNING • Do not touch charged high-voltage areas such as the DUT, test lead-wire, probe and output terminal, etc. to prevent electric shock for a while after the power has been turned off.

In insulation resistance tests, the test lead-wire, test probe, and DUT are charged with high voltage. Although the Tester is provided with a discharge circuit, it takes some time to discharge after the power has been turned off. Do not touch the DUT, test lead-wire, test probe, output terminal, or other charged high-voltage areas for a while after turning off the power. Before touching any of them, be sure to check the following points:

Check the following two points before touching high-voltage areas:

1. The DANGER lamp is turned off.

Check point 1 above before checking point 2.

2. When the LOW terminal and HIGH VOLTAGE terminal are short-circuited using the LOW side test lead-wire, a high voltage is not output.

When the power is turned off, the discharge circuit inside the Tester is activated to discharge forcibly. Therefore, do not disconnect the DUT from the Tester during testing.

If it is disconnected, check the two points above before touching high-voltage areas.

2) Consideration of discharge time

The time required to discharge electric charge depends on the characteristic of the DUT and the test voltage.

The built-in discharge circuit operates for about 70 ms after an insulation resistance test is completed. Since the discharge resistance is about 150 kΩ, the charge voltage may remain if the time constant by the capacitance of the DUT exceeds 70 ms.

If the DUT is disconnected from the Tester during a test, use the following discharge time as a rough standard.

Suppose that the high-voltage area such as the DUT and the test lead-wire are an equivalent circuit and that it can be expressed as a capacity of 0.01 μF and a parallel resistance of 100 MΩ, then the time required to attenuate the voltage of the DUT down to 30 V will be about 3.5 seconds. at the test voltage of 1000 V, and about 2.8 seconds at 500 V. If the time constant of the DUT is known, the attenuation time down to 30 V, after the power has been cut off, of the DUT can be determined by multiplying the attenuation time given above with such a time constant.

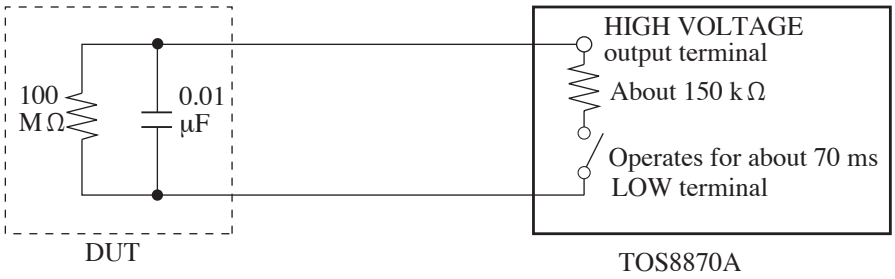


Fig.2-5 Example of discharge of equivalent circuit

2.4 Remote controls of the Tester

In the case of the Tester is to be remote controlled, the application of high voltage to the Tester will be controlled by an external signal.Take the following safety precautions to prevent accident. Also, shall be maintained the safety precaution under positive control.

- NOT to permit unexpected output of high voltage from the Tester (that is, to prevent the Tester from being put in TEST ON condition).
- NOT to permit operator and any other come into contact with DUT test lead-wire, probe, output terminal, etc. while the Tester is generating high test voltage.

2.5 Inhibitions

2.5.1 Inhibition of rapid ON/OFF repetitions

Once the Power switch of the Tester has been turned off, leave at least several seconds before it is turned on again. Do not repeat ON-OFF switching of the Power switch particularly when the Tester is generating the output voltage. In such a case, the safety protection of the Tester may not work properly, and the operator is endangered.

The power switch shall not be turned off while the Tester is generating the output voltage except in the case of emergency.

2.5.2 Inhibition of shorting to earth ground

Do not short-circuit the Tester output with the ground or a conveyer or any device connected to the ground, or with the commercial power-line around Tester location. Such a short-circuit may cause high-voltage charging on the Tester casing, which is very dangerous.

However, such a risky condition will not arise if only the casing has been grounded, in which case the casing will not be electrically charged nor will cause the damage on the Tester even when the LOW terminal has been short-circuited with the HIGH VOLTAGE terminal.

Make sure to ground the unit for your safety. Be sure to read "1.6 Grounding" on page 4.

2.6 Emergency handling

In the case of any accident such as an electric shock or burn-down of the DUT resulting from the failure of the Tester or DUT, take the following actions promptly. It does not make any difference whichever action of the above two is taken first, but be sure to take the two actions.

- Turn off (○) the POWER switch.
- Pull out the plug of AC power cord from the socket of the power source.

2.7 Troubleshooting

2.7.1 In case of trouble

In the following cases of trouble, it is very hazardous that the output voltage of the Tester may not be cut off while the Tester continues to generate high voltage: The immediate action to take, in the next page cases, is to turn off the power switch and pull out the plug of AC power cord from the socket of the power source, and suspend the operation of the Tester.

- DANGER lamp keeps on lighting even when the STOP switch has been pushed.
- DANGER lamp is turned off but the indicator of the output voltmeter continues swinging.

If the Tester shows any irregular performance, it is possible that a high voltage may be output irrespective of the operator's will. Suspend the operation of the Tester immediately.

⚠WARNING • Never attempt to repair the Tester for yourself. Please order your Kikusui agent/distributor for such service.

2.7.2 Fade out of DANGER lamp

In the case the DENGER lamp has been faded out, it may cause erroneous operation of the Tester, which in turn give rise to dangerous electrification. Please entrust us with the repair of such a defective Tester.

2.8 Attention for Trouble-Free Operation

1. The maximum output voltage of the Tester reaches higher than 5 kV under no-load condition, and even higher voltage in proportion to the line voltage fluctuation. But be sure to operate the Tester at a lower voltage than the specified 5 kV.
2. The heat dissipation capacity of the high-voltage transformer, embodied in the Tester, is designed to be a half of the rated output, taking into consideration of the size, weight and cost.

   Accordingly, if the test is to be conducted at the CUTOFF CURRENT of 100 mA, leave a suspension time longer than the test duration. Incidentally, the maximum allowable test duration is 30 minutes at ambient temperature of 40 ˚C or lower.

   The above timing is not applicable if the Tester is used at the CUTOFF CURRENT setting of 25.5 mA or lower.

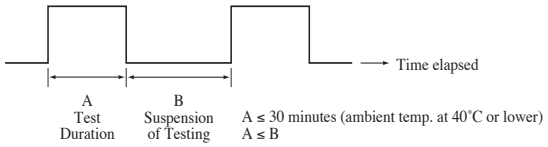


Fig.2-6 Test Duration and Suspension of Testing

3. The Tester can be properly used with the input voltage range of nominal input voltage ±10 %, but its operation becomes incomplete outside of this range and leads to possible failures.

   It is thus important to adjust the voltage within the range of nominal input voltage ±10 % by any proper means.
4. The operation and storage of the Tester under exposure to the direct sunshine, high temperature and humidity or dusty environment should be avoided.
5. The Tester is incorporated with a transformer of high output voltage up to 500 VA.

   A considerably large current (in scores of amperes) may flow through the commercial power line, which is connected with the Tester in the following two cases:
   - In the duration of scores of milli-second, in which the Tester detects that a DUT has failed the testing.
   - At an instant when the test is executed.

   Also it is important to determine the capacities of the power line and of any electronic device connected to the same line, taking into consideration of such a large current.

Chapter 3 OPERATION PROCEDURE

This Chapter describes operation procedures such as single test and automatic test.

3.1 Procedure Before Test

1) Check that the indicator

⚠ CAUTION • Check that the indicator after being off (○) with power switch.

Before turning on (|) the POWER switch, check that the voltmeter is indicating the "0" scale position and the ohmmeter is indicating the "∞" scale position. If the meters are not indicating these positions, adjust them to these positions with their mechanical zero at their centers.

2) Confirmation of attention on the handling

Before turning on the POWER switch, thoroughly read and note the items of Chapter 2 "WARNINGS AND CAUTIONS FOR OPERATING THE TESTER"

3) Reset the Tester

When the PROTECTION indicator lamp is illuminating, test is disabled and cannot be started by pressing the START switch. The conditions for illuminating of the lamp are given on "5.1 Description of Front Panel Items" on page 30. Eliminate the conditions and then press the STOP switch to reset the Tester.

NOTE • When the POWER switch is turned on or off, the ohmmeter pointer may deflect irregularly. This is only transiential and is not an abnormal indication.

3.2 Single Withstanding Voltage Test

1) Selecting the withstanding voltage test mode

1. Select the MANUAL ACW test mode with the FUNCTION selector switches.
2. The ACW TEST indicator lamp will illuminate. Letter "ACW" stand for withstanding voltage test.

2) Selecting a test voltage range

1. Select the required test voltage range with the RANGE 2.5 kV/5 kV switches.
2. The corresponding indicator lamp will illuminate.

3) Setting the high limit reference value of leakage current

1. With the CUTOFF CURRENT switch, set the high limit reference value (upper reference value) of leakage current of the DUT as required of standards, and other.
   If you do not set the high limit reference value of leakage current or it is set to 108 mA or higher, PROTECTION results.

4) Setting the test time

1. With the timer, set the test time of the DUT as required of standards, and other.

Selecting the timer range

The timer of the tester can be set to 0.2 to 99.9 seconds (in a withstanding voltage test) and 1 to 999 seconds by operating the time setup switch and the range selector switch next to it.

When the range selector switch is protruding, the setting of the time setup switch equals the timer setting. When the range selector switch is pressed, the timer setting equals the setting of the time setup switch multiplied by 0.1.

The setting of the timer setup switch can be changed by pressing the switches above and below the numbers.

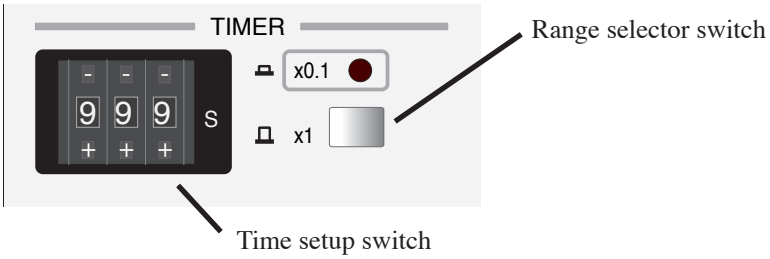


Fig.3-1

NOTE

- In a withstanding voltage test, be sure to set the timer to 0.2 seconds or longer period.
- In an insulation resistance test, be sure to set the timer to 0.5 seconds or longer period. Refer to " Waiting-time for Judgement in Insulation Resistance Test" on page 18.

5) Setting the test voltage

1. Set both TIMER ON/OFF switch and LOWER ON/OFF switch to the OFF state.
2. Check that the PROTECTION lamp is not illuminating.
   If the PROTECTION lamp is illuminating, press the STOP switch once and then perform the above procedure.
3. Check that the TEST VOLTAGE dial is at fully counterclockwise position
4. Press the START switch.
5. Adjust the test voltage by gradually turning clockwise the TEST VOLTAGE dial and reading the voltage on the voltmeter.
6. Cutoff the output by pressing the STOP switch.
7. Set the TIMER ON/OFF switch to the ON state.

6) Connecting the DUT

1. Make sure that the output voltmeter indication is zero.
2. Make sure that the DANGER lamp is not illuminating.
3. Connect the LOW test leadwire to the LOW terminal of the Tester.
4. Connect the high voltage test leadwire to the HIGH VOLTAGE terminal.
5. Short the high voltage test leadwire to the LOW test leadwire to make sure that no high voltage is being delivered to the output terminal.
6. Connect the LOW leadwire to the DUT.
7. Connect the high voltage test leadwire to the DUT.

7) Test procedure

1. To start test, press the START switch.
2. When the period set by the timer has elapsed, the test voltage is cutoff and PASS judgement is made and the PASS signal is generated in the forms of lamp and buzzer and make-contact signal for about 50 ms.
3. When a leakage current larger than the high limit reference value set by the CUTOFF CURRENT switches has flowed, the FAIL judgement is made and the output is instantaneously cutoff and the FAIL alarm with the lamp, buzzer and make-contact are generated. To reset from the FAIL state, press the STOP switch.
4. To abort the test being executed (to cutoff the output) for any reason, press the STOP switch.

8) Single test without using the timer

The timer built into the tester can be set to a maximum of 999 seconds. When a test time longer than this is needed, or do not need to set the test time, perform the test without using the timer. However, note that, when the CUTOFF CURRENT switches are set for 100 mA or more, the continuous operation time rating of the Tester is up to 30 minutes. When the current setting is 25.5 mA or less, the Tester may be operated for a longer period.

1. Set the TIMER ON/OFF switch to the OFF state.
2. Connect the DUT to the output terminals of the Tester as described in "6) Connecting the DUT".
3. Check that the TEST VOLTAGE dial is set at the fully counterclockwise position.
4. Press the START switch. The DANGER lamp will illuminate to indicate that the test voltage is ready to be applied to the DUT.
5. Gradually turn clockwise the TEST VOLTAGE dial until the necessary test voltage is obtained.
6. When the required test time has elapsed or when a condition calling for aborting the test has occurred, press the STOP switch to cutoff the output voltage. In this case the PASS signal is not generated.
7. If a current exceeding the current set by the CUTOFF CURRENT switches flows in the DUT during test, the tester issues a FAIL judgment to turn off the power immediately and then generates a FAIL alarm. This alarm consists of an indicator, buzzer, and make-contact signals. To cancel this alarm, press the STOP switch.

9) Reapplication of test voltage (retest)

If the Tester is in the RESET state, the test voltage as set by the TEST VOLTAGE dial can be delivered again to the output terminal simply by pressing the START switch.

If the Tester is generating a FAIL alarm or is in the PROTECTION state, press the STOP switch to reset the Tester. If a PASS judgement is made at the end of the test, the auto reset circuit operates and the Tester is automatically reset.

10) Setting the PASS-FAIL judgement reference values for withstanding voltage test

The PASS-FAIL judgement by the Tester is done in a window comparator system such that the PASS judgement is made only when the measured leakage current is between the high and low limit reference values. The FAIL judgement can be made not only when the measured value is larger than the high limit reference value but also when it is smaller than the low limit reference value (0 to one-half of the high limit reference value).

Detection small leakage currents

The window comparator system is especially advantageous when the leakage current values of DUT are not distributed widely and are larger than the minimum detectable current of the Tester. To test such DUT, the low limit reference (LOWER REFERENCE) value may be set at a value slightly smaller than the predicted lowest value, and the test may be done in the window comparator system. When this is done, DUT of exceptionally small leakage currents can be identified and open-circuiting of leadwires and imperfect contacting also can be detected, thereby substantially facilitating the withstanding voltage test.

Tests with low limit judgements for low leakage currents will be inconvenient when setting the test voltage in the no-load state or when the DUT draw almost no current. In such cases, set the LOWER ON/OFF switch to the OFF state to disable the low limit judgement function.

Judgment errors by stray capacitances

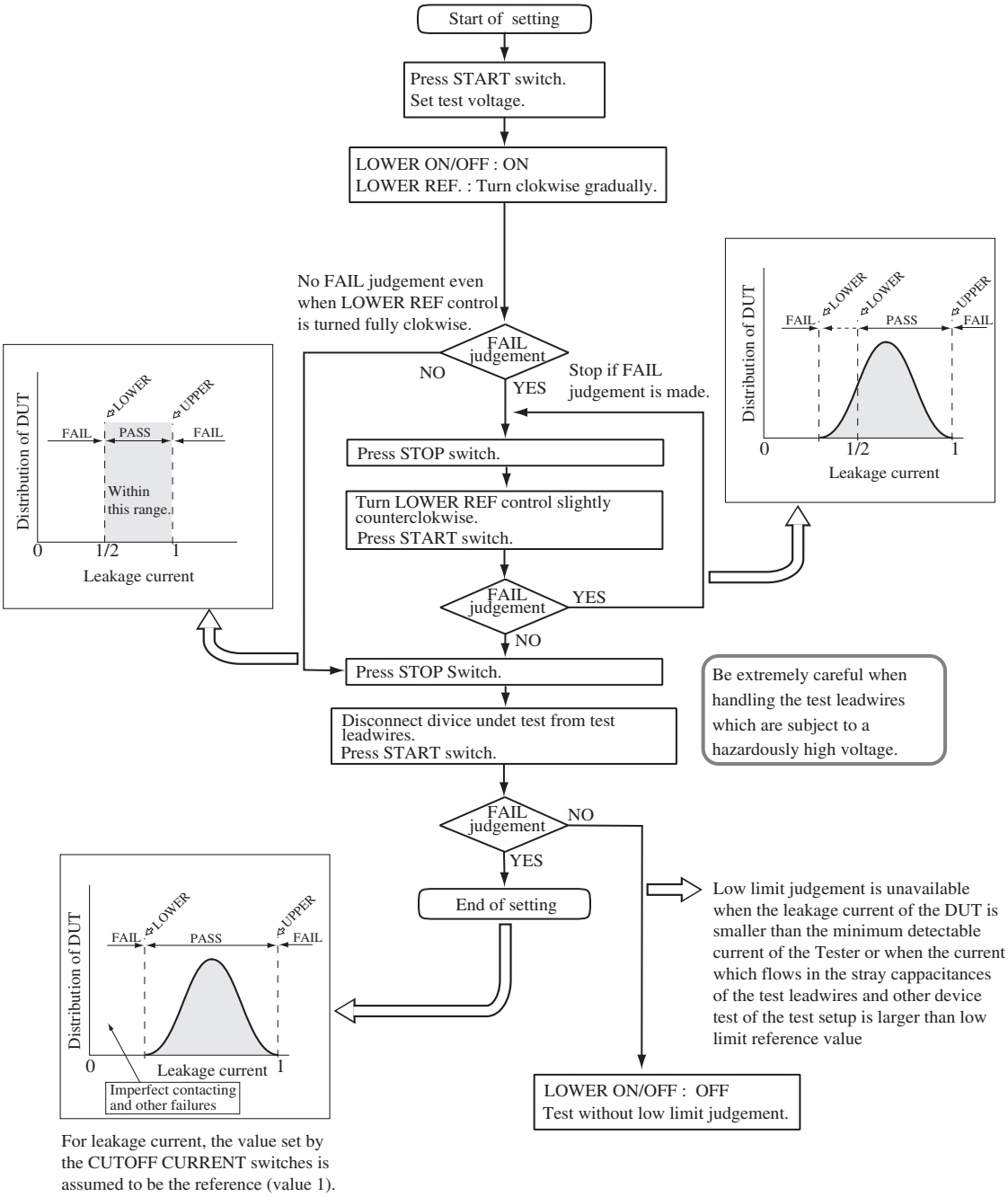
When test is made with a high sensitivity using a high AC voltage, it is possible that the current which flows through stray capacitances of the test leadwires and other DUT becomes larger than the low limit reference value and no low limit judgement for low leakage current can be correctly made. That is, when the DUT is disconnected from the test setup, a FAIL judgement should be made since the current drawn by the DUT is zero and is absolutely smaller than the low limit reference value. Actually, however, since the current which flows through the stray capacitances is larger than the low limit reference value, the Tester erroneously generates a PASS judgement signal. Refer to the *3 in Chapter 7 "SPECIFICATIONS" on page 36.

Pay attention to this type of judgement errors. Make it sure that the Tester correctly makes FAIL judgement when the DUT is disconnected from the test setup.

11) Setting the LOWER REFERENCE value

To set LOWER REFERENCE, use a trimming screw driver, etc.

1. Set the high limit reference value (CUTOFF CURRENT value).
2. Set the TIMER ON/OFF switch to the OFF state.
3. Set the LOWER ON/OFF switch in the OFF state.
4. Turn the LOWER REFERENCE value control to the counterclockwise position.
5. Connect the DUT as described in "6) Connecting the DUT".
6. Make settings as shown in the flowchart on the Fig.3-2.



For leakage current, the value set by the CUTOFF CURRENT switches is assumed to be the reference (value 1).

UPPER :High limit reference value of leakage current for withstanding voltage test.
LOWER :Low limit reference value of leakage current for withstanding voltage test.

Fig.3-2 Flowchart of set the LOWER REFERENCE value

3.3 Single Insulation Resistance Test

1) Selecting the insulation resistance test mode

1. Select the MANUAL IR test mode with the FUNCTION selector switches.
2. The IR TEST indicator lamp will illuminate. Letter "IR" stand insulation resistance test.

2) Check the Zero-ohm

1. Check that the TIMER ON/OFF switch is in the OFF state.
2. Short the high voltage test leadwire (hot line) to the LOW test leadwire to make sure that no high voltage is being delivered to the output terminal.
3. Press the STOP switch with a state of 2.
4. Press the START switch with a state of 2.
5. Check the ohmmeter will indicate approximately zero ohms.

3) Selecting a test voltage

With the RANGE 500V/1000V switch, select the test voltage of the DUT as required of standards, and other.

4) Setting the PASS-FAIL judgement reference values for Insulation resistance test

The PASS-FAIL judgement by the Tester is done in a window comparator system such that the PASS judgement is made only when the measured insulation resistance is between the high and low limit reference values. The FAIL judgement is made not only when the measured value is lower than the low limit reference value but also when it is higher than the high limit reference value.

Detection high insulation resistances

The window comparator system is especially advantageous when the distribution of the insulation resistances of DUT can be predicted and the predicted high limit value is in the range of the detectable resistance of the Tester. To test such DUT, the high limit reference value may be set at a value slightly higher than the predicted highest value of the DUT, and the test may be made in the window comparator system. When this is done, DUT of exceptionally high insulation resistances can be identified and open-circuiting of leadwires and imperfect contacting also can be detected, thereby attaining still better insulation resistance test.

With the REFERENCE SET switches set in the regular state ( ), the ohmmeter indicates the measured resistance when in the insulation resistance test. When not in the insulation resistance test, the ohmmeter indicates the ∞ position.

A selection and setting of judgment reference value

Press the LOWER REFERENCE SET switch, and the ohmmeter will indicate the low limit reference value. Next, press the UPPER REFERENCE SET switch, and the ohmmeter will indicate the high limit reference value. When the two switches are pressed at the same time, the LOWER REFERENCE SET switch has a priority.

The high and low limit reference values can be set with the potentiometers located at right and left of the switches. Set the values as required by the DUT. (To make a setting, press down the resistor with the trimming screw driver and then turn it.)

When the low limit judgement is not required, turn the low limit reference value setting potentiometer so that the ohmmeter pointer for the low limit reference value indicates a position lower than the zero ohm scale position.

For some types of tests, it may be undesirable to perform high limit judgement. In such cases, set the UPPER ON/OFF switch in the OFF state.

5) Setting the test time

To set the test time, set the TIMER ON/OFF switch to ON and then set the timer to 0.5 to 999 seconds according to the standard of the test to be performed for the DUT.

Selecting the timer range

The timer of the tester can be set to 0.5 to 99.9 seconds (in an insulation resistance test) and 1 to 999 seconds by operating the time setup switch and the range selector switch next to it.

When the range selector switch is protruding, the setting of the time setup switch equals the timer setting. When the range selector switch is pressed, the timer setting equals the setting of the time setup switch multiplied by 0.1.

The setting of the timer setup switch can be changed by pressing the switches above and below the numbers.

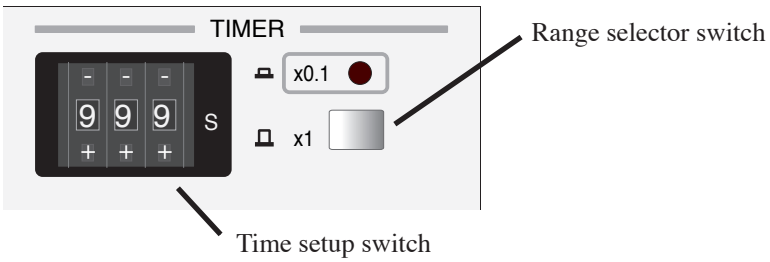


Fig.3-3

NOTE
- In a withstanding voltage test, be sure to set the timer to 0.2 seconds or longer period.
- In an insulation resistance test, be sure to set the timer to 0.5 seconds or longer period. Refer to " Waiting-time for Judgement in Insulation Resistance Test" on page 18.

6) Connecting the DUT

1. Make sure that the DANGER lamp is not illuminating.
2. Connect the LOW test leadwire to the LOW terminal of the Tester.
3. Connect the high voltage test leadwire to the HIGH VOLTAGE terminal.
4. Short the high voltage test leadwire to the LOW test leadwire to make sure that no high voltage is being delivered to the HIGH VOLTAGE terminal.
5. Connect the LOW leadwire to the DUT.
6. Connect the high voltage test leadwire to the DUT.

7) Test procedure

1. If the PROTECTION indicator lamp is illumination, press the STOP switch to reset the Tester. If the Tester is already in the RESET state, test can be immediately started simply by pressing the START switch.
2. If the DUT satisfies the conditions of PASS judgement set for PASS-FAIL judgement in "4) Setting the PASS-FAIL judgement reference values for Insulation resistance test", the ohmmeter will indicates the measured resistance value.
3. When the preset time has elapsed, the test voltage is cutoff, the DUT is judged to be pass.
4. When the PASS judgment, the Tester will generate PASS signals with the lamp, buzzer and make-contact for approximately 50 ms.

If the DUT does not meet the above-mentioned test conditions, the FAIL judgement is made and the output is instantaneously cutoff and the FAIL alarm is generated. The alarm is with the lamp and make-contact which are different from those for the withstanding voltage test and with the buzzer which is used in common for the withstanding voltage test.

To reset the alarm, press the STOP switch.

8) Test without using the timer

Set the TIMER ON/OFF switch to the OFF state. When this is done, insulation resistance test can be done irrespective of the timer as is the case for withstanding voltage test. If the Tester is in the RESET state, the test will start as you press the START switch. As you press the STOP switch, the output voltage is cutoff and the test ends.

9) Reapplication of test voltage (retest)

If the Tester is in the RESET state, the test voltage as set by the RANGE switch can be delivered again to the output terminal simply by pressing the START switch.

If the Tester is generating a FAIL alarm or is in the PROTECTION state, press the STOP switch to reset the Tester. If a PASS judgement is made at the end of the test, the auto reset circuit operates and the Tester is automatically reset.

10) Checking discharge from DUT

⚠WARNING • In case of this mode (Single Insulation Resistance Test), DUT is charged after testing. Be sure to check discharge from DUT. Refer to "2.3.2 Cautions in electric charging in insulation resistance test" on page 8.

Waiting-time for Judgement in Insulation Resistance Test

When a test voltage is applied to a DUT which has a larger capacitance, a larger charge current will flow at the initial short period and the resistance of the DUT may be indicated lower than the actual value. In order to eliminate such period from the PASS-FAIL judgement period, a time delay provision is incorporated. The delay time is set at approximately 0.3 seconds. If the timer is set at a period shorter than 0.3 seconds, the effect of the above provision will be lost and a PASS judgement may be made erroneously.

Be sure to set the timer for a period longer than 0.5 seconds.

3.4 Automatic Test

1) Selecting a test sequence

The Tester is capable of performing a withstanding voltage test and an insulation resistance test sequentially.

1. Sequence is selectable for "ACW→IR" or "IR→ACW" with the FUNCTION switches.
2. When the Tester is set for this mode, the AUTO lamp illuminates. (Letter "ACW" stands for withstanding voltage test and letter "IR" for insulation resistance tests.)

2) Setting the test conditions

Set the test voltages of withstanding voltage test or insulation resistance test, leakage current detection reference values, test time, and insulation resistance judgement reference values as in the case for the single-item tests.

3) Connecting the DUT

1. Make sure that the output voltmeter indication is zero.
2. Make sure that the DANGER lamp is not illuminating.
3. Connect the LOW test leadwire to the LOW terminal of the Tester.
4. Connect the high voltage test leadwire to the HIGH VOLTAGE terminal.
5. Short the high voltage test leadwire to the LOW test leadwire to make sure that no high voltage is being delivered to the HIGH VOLTAGE terminal.
6. Connect the LOW leadwire to the DUT.
7. Connect the high voltage test leadwire to the DUT.

4) Test procedure

1. Set the Tester in the RESET state.
2. Press the START switch.
3. The Tester will automatically perform the two types of tests.
4. When the test is over without the FAIL judgement, the PASS signals are generated at the end of the test. The signals are the same with those of the single test.

When the withstanding voltage test or insulation resistance test is over with FAIL judgement, the output voltage is instantaneously cutoff the FAIL alarm is generated, and the test is end.

The signals are the same with those of the single test.

5) To abort the test

To abort the test being performed, press the STOP switch. The output voltage will be instantaneously cutoff and the Tester will be RESET state.

6) Reapplication of test voltage (retest)

When the test is over with the PASS judgement, the Tester generates the PASS signals for approximately 50 ms and then resets itself. The next test can be started simply by pressing the START switch. When the Tester has generated the FAIL alarms, reset once the Tester and then press the START switch.

7) Checking discharge from DUT

⚠WARNING • In case of "ACW→IR" test mode, DUT is charged after testing. Be sure to check discharge from DUT. Refer to "2.3.2 Cautions in electric charging in insulation resistance test" on page 8.

3.5 Remote Control

1) Remote-control with the option

The START/STOP operation of the Tester can be remote-controlled with the remote control box (optional).

As the plug of the remote control cable is connected to the REMOTE control connector on the Tester front panel, the internal circuit is automatically switched to the remote operation mode. In this case, the START switch on the Tester front panel is disabled, although the stop operation can be done either at the Tester front panel or at the remote control box.

2) Remote-control by the other control system

The Tester can be remote-controlled by other control system equipment without using the remote control box.

A 5-pin connector as per the DIN standard is required for the following operation. If it is difficult to obtain a DIN connector, contact your Kikusui agent/distributor.

⚠WARNING • Be extremely careful when using this method because the high voltage is on/off - controlled with an external signal. Pay attention so that the high test voltage is not generated inadvertently. Also, provide full measures to ensure that nobody is contacted with the high voltage areas (DUT, test lead-wire, probe or output terminal etc.) when the test voltage is being delivered. When these measures are unavailable, do not use the following remote control method.

■ REMOTE control connector

To use the Tester in remote control mode, the pin No.2 and No.3 of connector must be externally connected.

By controlling the START and STOP contacts shown in Fig.3-4, test voltage can be on-off controlled in the same manner as done at the Tester front panel. However, when the FAIL ALARM of TEST MODE switch on the rear panel is OFF. For details, refer to "3.7 Special Test Modes" on page 25.

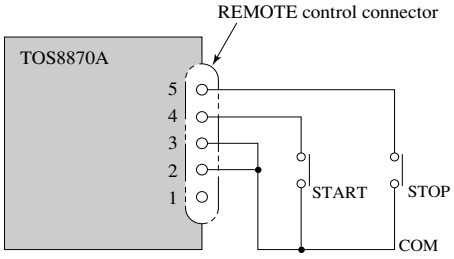


Fig.3-4

In the case of the setup shown in Fig.3-5, the test voltage is turned on when the switch is thrown to the NO position, and Tester is forcefully reset when the switch is returned to the NC position.

However, when the FAIL ALARM of TEST MODE switch on the rear panel is OFF. For details, refer to "3.7 Special Test Modes" on page 25.

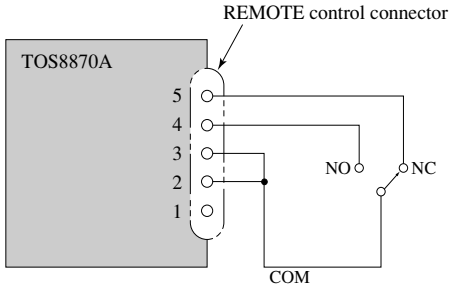


Fig.3-5

Logical elements, transistors or photocouplers may be used instead of the switches in Fig.3-4.

The example is shown in Fig.3-6. The input conditions of the Tester for such operation are as follows:

High level input voltage	: 11 V to 15 V
Low level input voltage	: 0 V to 4 V
Low level sweep out current	: ≤ 5 mA
Input pulse width	: 20 ms minimum

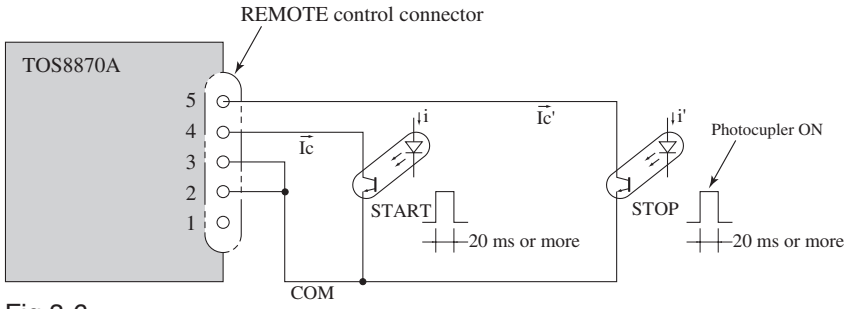


Fig.3-6

DESCRIPTION The gates are pulled up to +15 V. Opening of the input terminals is equivalent to a high level input.

- Currents i and i' must be sufficient to provide currents Ic and Ic' of 5 mA or more.
- When using the CURRENT MONITOR terminals, isolate the common line (line COM in Fig.3-6) of the control circuit from the power line and ground line of the Tester.
- A timing of STOP signal for clearing of FAIL alarm sends STOP signal more than 20 ms after doing 100 ms or more after FAIL signal generated as follows.

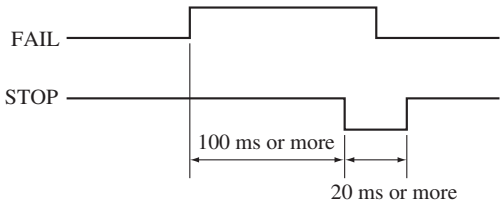


Fig.3-7

With a view to prevent erroneous operation which could be caused by noise, it is recommendable to use photocouplers as shown in Figure 3-6 or relays as shown in Fig.3-4.

The Tester is designed with full attention so that it does not erroneously operate by noise. Pay attention so that the devices connected to the Tester do not erroneously operate by noise.

Note that the layout of pins of the REMOTE control connector is as per the DIN standard and is not in the due order of number progression, as shown in Fig.3-8.

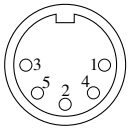


Fig.3-8 Layout of connector pins as viewed from panel surface

3) INTERLOCK terminal

To ensure the safety of operators, the tester is provided with an interlock function which cuts off the power in cooperation with an external device. When this function is activated, the protection mode is entered (PROTECTION lamp goes on) and the power is cut off, retaining the condition in which testing is disabled. While this function is active, it cannot be canceled by the STOP switch on the panel or the STOP signal for remote control.

This function allows testing to be protected from outside, ensuring safe operation.

Using the interlock function

The INTERLOCK terminal on the rear panel is the input terminal of the interlock signal. When the terminal is opened, it becomes high level and the interlock function is activated to activate the protection mode. Use a crimping terminal to connect the wire to the interlock terminal.

To cancel the protection mode by the interlock function, short-circuit the terminal to set it to the low level, then press the STOP switch on the front panel or input the STOP signal for remote control.

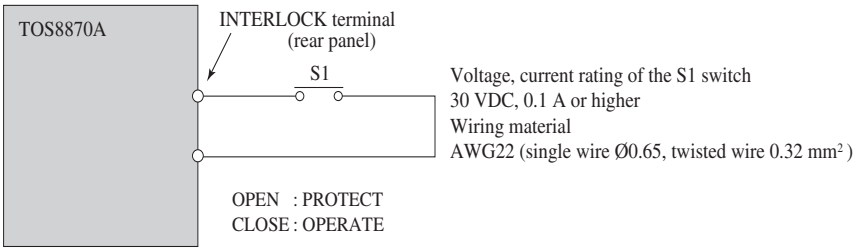


Fig.3-9

⚠CAUTION • With the tester in the loaded condition, the interlock terminal is short-circuited with a shorting piece to cancel the protection mode on a casual basis. To perform a withstanding voltage test, you must use the interlock function to operate the tester.

3.6 Output Signals

The Tester delivers the following signals from the SIGNAL OUTPUT terminal on the rear panel other than the lamp and buzzer signals.

	Signal	Condition for Delivery	Type and Rating	Compatible Cables
[1]	TEST ON	Entire period during test is on.	Make-contact signal Ratings: 125 VAC/1 A 30 VDC/1 A	Solid wire: ø1.0 (AWG18) Stranded wire: 0.75 mm^2; element-wire diameter: ø0.18 or more Removed coating: 10 mm
[2]	PASS	When test is over. About 50 ms		
[3]	ACW / FAIL	When FAIL judgement is made for withstanding voltage test. Continuous.		
[4]	IR / FAIL	When FAIL judgement is made for insulation resistance test. Continuous.		
[5]	READY	When in ready for test.		

[1] TEST ON signal

This signal is generated and remains on for the entire period of either the single test or the automatic test.

[2] PASS signal

This signal is generated when a PASS judgement is made at the end of a single test with the timer or at the end of the latter one of automatic tests. The signal lasts for approximately 50 ms.

[3] ACW/FAIL signal

This signal is generated when a FAIL judgment is made for the withstanding voltage test. This signal remains on till the following operation is done.

- The next STOP signal is applied.
- The STOP switch is pressed.
- The PROTECTION signal is applied.

[4] IR/FAIL signal

This signal is generated when a FAIL judgment is made for the insulation resistance test. This signal remains till the following operation is done.

- The next STOP signal is applied.
- The STOP switch is pressed.
- The PROTECTION signal is applied.

[5] READY

NOTE • When in the MOMENTARY of Special Test Mode, this signal is not generated.

This signal is continuously delivered when the Tester is in the READY state.

The READY state that the Tester is ready to be driven into the TEST ON state. That is, this signal is delivered when the test that all following five conditions are met.

- Power of the Tester is turned on.
- The STOP signal is not applied. (or the STOP switch is not pressed.)
- Not in the TEST ON state.
- Not generating the PASS signal.
- Not generating the FAIL alarm.
- Not in the PROTECTION state.

As the START signal is applied (or the START switch is pressed) when the READY signal is being delivered, the Tester starts the test operation.

■ Contact signals

The contact signals are only with contacts and without any power sources as Fig.3-10. Therefore, cannot drive any loads which have no power.

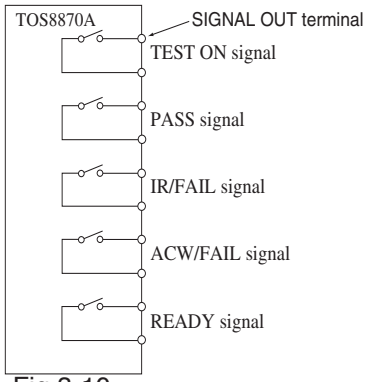


Fig.3-10

A contact which is closed when the signal is applied is called make contact, normally open contact, or form "a" contact. A contact which opens when the signal is applied is called break contact, normally closed contact, or form "b" contact. The contacts of the Tester are of the make-contact type and their rating is 125 VAC, 1 A or 30 VDC, 1 A. The withstanding voltage is 500 VAC 1 minute between the circuit and chassis.

■ Use examples of contact signal

To drive a DC buzzer with an ACW/FAIL or IR/FAIL alarms.

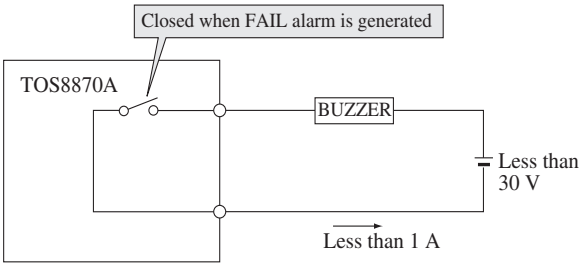


Fig.3-11

To drive a lamp with the TEST ON signal.

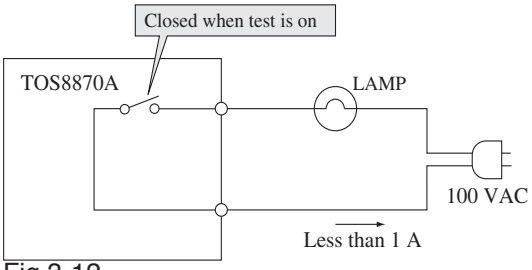


Fig.3-12

To obtain an "L" level digital signal with the contact signal.

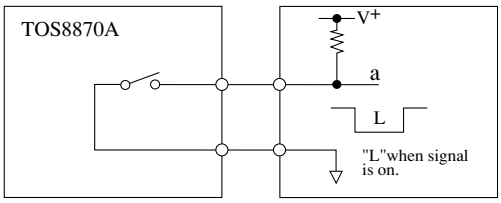


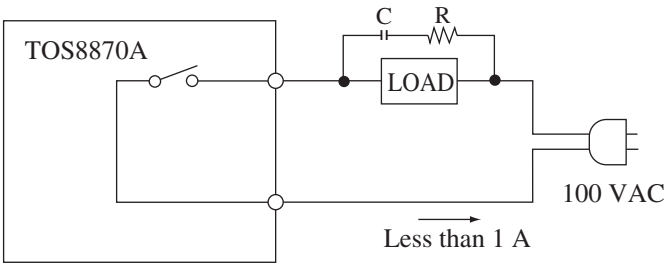
Fig.3-13

In the Fig.3-13 illustration, an "L" level signal is obtained at point "a" when the contact output signal is on. However, since the signal obtained at point "a" include chattering, an appropriate chattering suppression provision should be incorporated depending on the nature of the circuit to be driven by this signal. The minimum rating of the load applicable to the contact is 5 V, 10 mA or higher. Set V^+ and R so that a load with higher rating is applicable. Noise measures are also required in some cases.

■ Precaution on using the contact signal

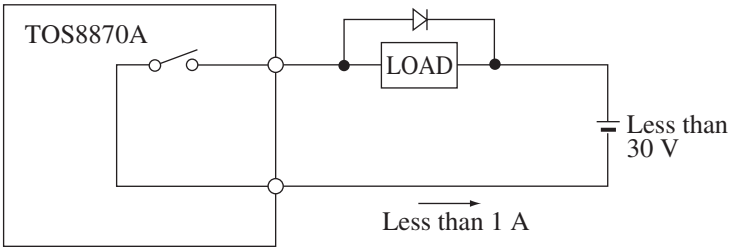
Before using this contact signal, provide a contact protection measure (to absorb surge) suitable to the using method. Failure can not only cause malfunction of the circuit being connected later but also break the contact of the tester.

The Fig.3-14 and Fig.3-15 are the examples of the contact protection method recommended.



R : Approx. 100 Ω, 2 W or over
C : Approx. 0.1 µF, 250 VAC or higher
(The R and C are reference values only. Select proper values in accordance with the actual conditions.)

Fig.3-14



Diode
Reverse voltage : 200 V or higher
Foward current : 1 A or more
(Tha diode ratings are reference value only. Select proper values in accodance with the actual conditions.)

Fig.3-15

3.7 Special Test Modes

Four types of special modes are selectable with the TEST MODE selector switches on the rear panel. The standard positions of the switches (the positions as the switches are set as the Tester is shipped) are the OFF positions as shown in Fig.3-16.

By throwing the switches to the ON positions, respective modes as described below can be selected. Since mode settings are mutually independent, any combinations of switch settings are possible.

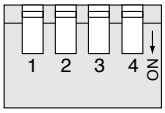


Fig.3-16 STANDARD POSITIONS

■ DOUBLE ACTION

For the DOUBLE ACTION mode, set the switches as shown in Fig.3-17.

When in the RESET state in the standard mode, as you press the START switch, the Tester is driven into the TEST ON state.

In this mode, testing cannot be performed simply by pressing the START switch. Testing will only start when the STOP switch is pressed followed by the START switch within about 0.5 seconds.

While the procedure is more complicated due to the double switch actions, a higher safety of test can be attained.

The function is the same as above also when in the remote control mode.

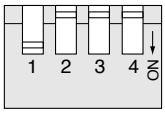


Fig.3-17 DOUBLE ACTION

PASS HOLD

For the PASS HOLD mode, set the switches as shown in Fig.3-18.

When a PASS judgement is made in the standard mode, the Tester generates a PASS signal only for approximately 50 ms. When in the PASS HOLD mode, the PASS signal is continuously held until the STOP signal is applied.

Fig.3-18 PASS HOLD mode

■ MOMENTARY

For the MOMENTARY mode, set the switches as shown in Fig.3-19.

When in the standard mode, once the START switch is pressed, the TEST ON state is maintained until the period set by the timer elapses or the STOP switch is pressed. When in the MOMENTARY mode, the TEST ON state is maintained only for the period the START switch is kept pressed.

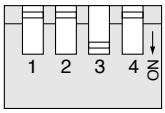


Fig.3-19 MOMENTARY mode

As you release the START switch, the test stops instantaneously. Thus, the MOMENTARY mode is advantageous from the viewpoint of operation safety.

Still higher operation safety can be attained by operating the Tester in the MOMENTARY mode and using RC02-TOS Remote Control Box (both-hand type, option) in conjunction.

When test is made with the timer, the Tester generates a PASS signal for approximately 50 ms after the test for the period preset by the timer has elapsed, and then the test ends.

NOTE • When in this mode, the READY signal is not generated.

■ FAIL ALARM

For the FAIL ALARM mode, set the switches as shown in Fig.3-20.

When the Tester is set in the standard mode, as a remote STOP signal is applied, the test voltage is cutoff and the FAIL alarm and PROTECTION state and PASS signal are reset as in the case that the STOP switch on the front panel is pressed. When in the FAIL ALARM mode, as a remote STOP signal is applied, although the output is cutoff and the PASS signal is reset, the FAIL alarm and the PROTECTION state are not reset. To reset the FAIL alarm and PROTECTIONS state, press the STOP switch on the front panel.

This mode provides an effective means for confirming the FAIL alarm when HP01A-TOS or HP02A-TOS High Voltage Probe (optional) is used.

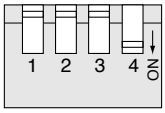


Fig.3-20 FAIL ALARM mode

Chapter 4 OPERATING PRINCIPLE

This Chapter describes operating principle of the tester, used the block diagram.

4.1 Block Diagram

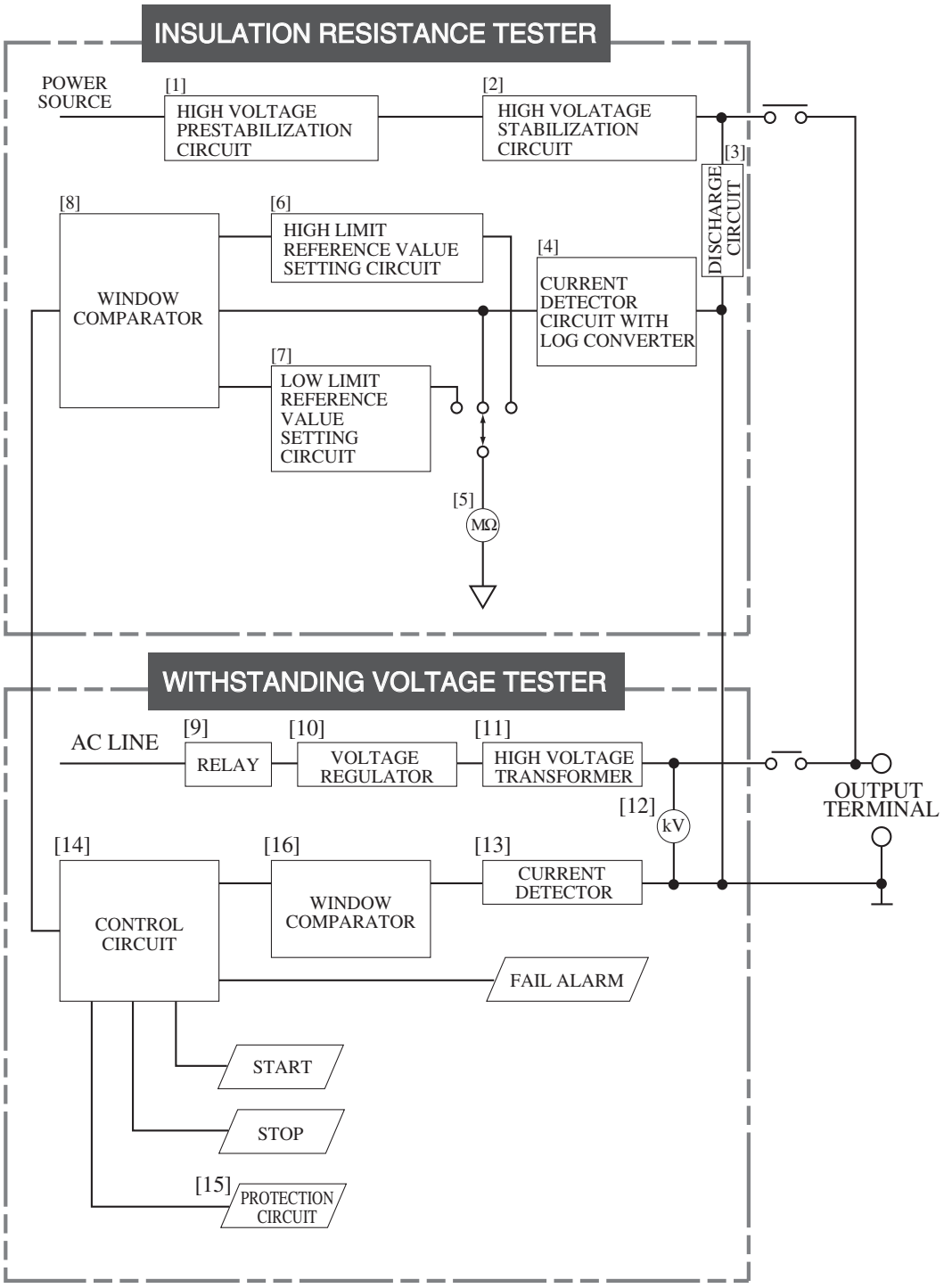


Fig.4-1 TOS8870A Block Diagram

4.2 Description of Individual Circuits

[1] High voltage prestabilization circuit

To obtain a high DC voltage required for an insulation resistance test, rough stabilization is carried out using a step-up converter to obtain about 1 150 V.

[2] High voltage stabilization circuit

Stabilizes the above DC voltage more finely, in order to be applied as an insulation resistance test voltage to the DUT.

The test voltage is a negative voltage of nominal 1 000 V or 500 V.

[3] Discharge circuit

This circuit forcibly discharges the DUT, which was charged once at the end of an insulation resistance test, for about 70 ms using a resistor of about 150 kΩ.

[4] Current detector circuit with log converter

The current which flows in the DUT varies ranging from less than 1 μA to approximately 1.2 mA when shorted.

To detect and indicate this wide dynamic range current on the single range scale of the ohmmeter, this circuit has a log converter which converts the detected signal into a logarithmic signal. A highly accurate log converter is used in order to satisfy the specification accuracy.

[5] Ohmmeter

This meter is driven by the above logarithmic signal to indicate the insulation resistance of the DUT.

[6] High limit reference value setting circuit

Sets the high limit reference value for PASS-FAIL judgement. The value is adjustable with its potentiometer on the front panel.

[7] Low limit reference value setting circuit

Sets the low limit reference value for PASS-FAIL judgement. The value is adjustable with its potentiometer on the front panel.

[8] Window comparator

Generates a PASS signal if the measured value is within the range between high and low limit reference values. If not, generates a FAIL signal.

[9] Relay

On-off controls the power applied to the voltage regulator for withstanding voltage test. A solid-state zero-start type relay circuit is employed to minimize transiential spike voltages caused when the high voltage output is turned on or off.

[10] Voltage regulator

A slide transformer is used to control the output voltage.

[11] High voltage transformer

Boosts the voltage regulator output with a ratio of 1:25 or 1:50 into a high output voltage of 0 to 2.5 kV or 0 to 5 kV. The rating is 5 kV, 100 mA (500 VA) when the AC line voltage is 100 V.

[12] Voltmeter

Indicates the output voltage for withstanding voltage test.

[13] Current detection circuit

Consists of a current detecting resistor, a reference voltage generator circuit, and a comparator.

[14] Control circuit

Controls overall operations of the Tester. Structured in high-reliability logic circuits with CMOS IC.

[15] Protective circuits

Various protective features are incorporated for the safety of tests. But be careful to operate.

[16] Window comparator

Generates a PASS signal only when the leakage current is within the range between the high limit reference value set with the CUTOFF CURRENT switches and the low limit reference value set with the LOWER REFERENCE value control. When the leakage current is not within the above range, the comparator generates a FAIL judgement.

4.3 Zero-Start Switch

If a regular mechanical contact type relay is used for on-off operation of the primary circuit of the high voltage transformer, transiential spike voltages could be produced, thereby applying an unjustifiedly high voltage to the device under test (DUT) and causing a possibility of re-jecting an acceptable DUT. The zero-start switch, which employ a solid-state switching circuit, turns on and off the power line at approximately 0 V level, thereby reducing transiential overshoots.

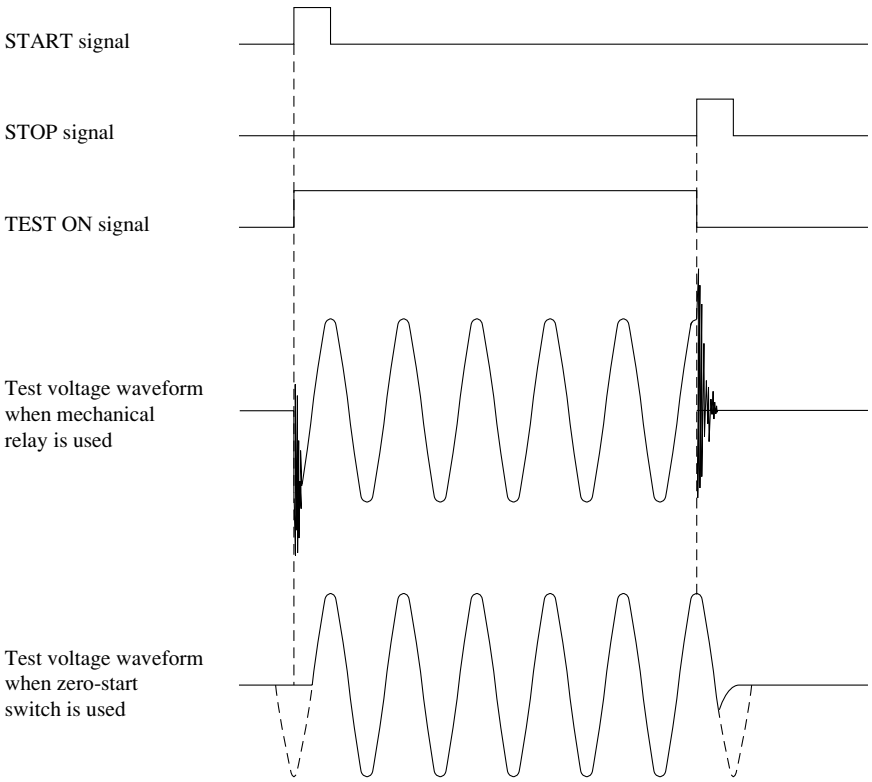


Fig.4-2

Chapter 5 DESCRIPTION OF FRONT AND REAR PANEL ITEMS

This Chapter gives descriptions and functions, connectors, switches, etc., for front and rear panels.

5.1 Description of Front Panel Items

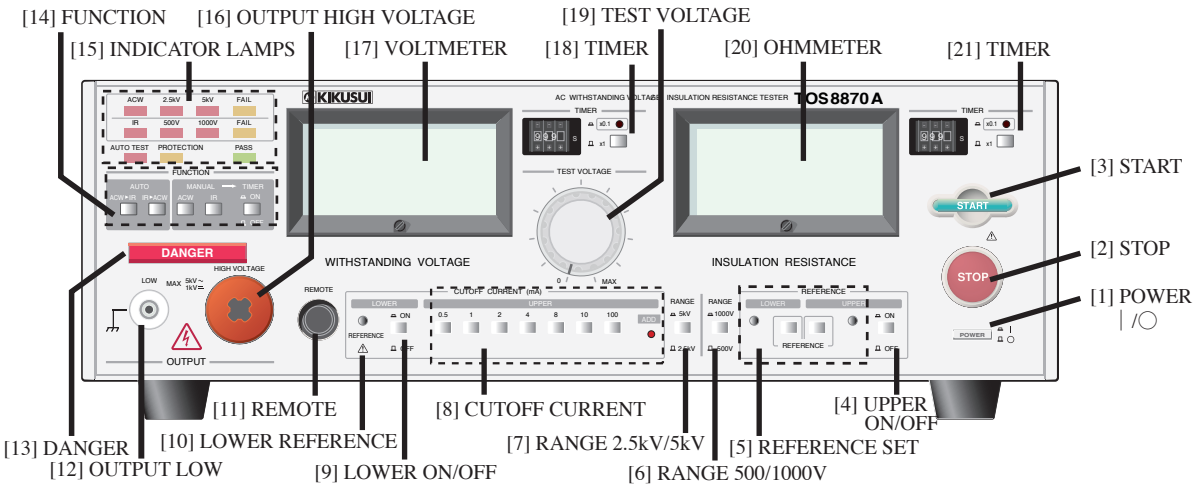


Fig.5-1

[1] POWER | / ◯

Main power switch of Tester. Before turning on the switch, be sure to read Chapter 2 "WARNINGS AND CAUTIONS FOR OPERATING THE TESTER" The state which this button was put is on (1).

[2] STOP

Push this switch in case of following three.

- To cutoff the H.V output when in test operation.
- Reset from the FAIL alarm state.
- Reset from the PROTECTION state.

[3] START

As you press the switch when the Tester is in the RESET state, the DANGER lamp illuminates and the test as selected by the FUNCTION selector switch is performed.

[4] UPPER ON/OFF

The switch selects whether the high-limit PASS-FAIL judgment in the insulation resistance test is to be done or not.

[5] REFERENCE SET

The switches are for setting a PASS-FAIL judgement reference value for insulation resistance test.

When neither the UPPER switch nor the LOWER switch is pressed, the ohmmeter indicates the value of measuring resistance.

When the LOWER switch is pressed, the ohmmeter indicates the low limit reference value for PASS-FAIL judgment; when UPPER switch is pressed, the ohmmeter indicates the high limit reference value. When both switches are pressed, the LOWER switch has a priority. The limit reference values are adjustable with the potentiometers located at right and left of the switches.

[6] RANGE 500V/1000V

The switches select a test voltage for insulation resistance test.

[7] RANGE 2.5kV/5kV

The switches select either the 2.5 kV or 5 kV range for withstanding voltage test. The switches are linked to the output voltmeter to change its ranges.

[8] CUTOFF CURRENT (mA)

The switches select a high limit reference value (UPPER REFERENCE value) of leakage current for withstanding voltage test. The switch values are 0.5, 1, 2, 4, 8, 10 and 100 mA.

By pressing one or more of these switches, values are selectable for a range of 0.5 mA to 25.5 mA in 0.5 mA steps. When two or more switches are pressed, the ADD lamp illuminates to indicate that the set current is the sum of those selected by two or more switches.

If the setting is 108 mA or higher, PROTECTION results.

At the instant the leakage current of the DUT has exceeded the set high limit reference value, a FAIL judgement is mode and the output is cutoff and a FAIL alarm is generated. Set the high limit reference value as you may require for the DUT.

[9] LOWER ON/OFF

The Tester is able to make a FAIL judgement also when the leakage current is less than the low limit reference value (LOWER REFERENCE value), as well as when the leakage current is more than the high limit reference value. The LOWER ON/OFF switch enables or disables this function.

[10] LOWER REFERENCE

The potentiometer is used to set the low limit reference value for withstanding voltage test (LOWER REFERENCE value). The adjustable range is from zero to one-half of the high limit reference value set by the CUTOFF CURRENT switches.

The fully clockwise position of the potentiometer is for one-half of the high limit reference value.

[11] REMOTE

When the TEST/RESET operation of the Tester is remote controlled, the connector is used to connect the control signal of the Remote Control Box (RC01-TOS or RC02-TOS) or other devices.

Be sure to read "3.5 Remote Control" on page 20 before remote-controlling the Tester.

[12] OUTPUT LOW

The ground line of the test voltage. Electrically, the line is connected to the Tester chassis.

[13] DANGER

The lamp (red) indicates that the test voltage is ready to be delivered to the output terminal or that it is being delivered.

[14] FUNCTION

When in the automatic test mode, the switches are used to set the order of withstanding voltage test and insulation resistance test. When in the single test mode, the switches are used to select either one of the two types of tests.

When in the automatic test mode, the test period is as preset by the timer. When in the single test mode, use or unuse of the timer is selectable by the TIMER ON/OFF switch located in the right hand side.

[15] INDICATOR LAMPS

• AUTO TEST

Identifies between automatic test and single test. The lamp illuminates when in the automatic test mode. When in the single test mode, either the ACW TEST lamp or the IR TEST lamp illuminates.

• ACW TEST

Illuminates when in the withstanding voltage test mode.

• 2.5kV/5kV

Indicate the output voltage range being used for withstanding voltage test.

• IR TEST

Illuminates when in the insulation resistance test mode.

• 500V/1000V

Indicate the test voltage being used for insulation resistance test.

• PASS/FAIL

Indicate the test result. If the result of PASS-FAIL judgement is PASS, the PASS lamp illuminates; if it is FAIL, the FAIL lamp illuminates. The FAIL lamp illuminates continuously; the PASS lamp illuminates only for about 50ms.

However, at the PASS HOLD of TEST MODE switch on the rear panel is OFF. For details, refer to "3.7 Special Test Modes" on page 25.

NOTE • When no timer is used in the single test mode, the PASS judgement is not done.

• PROTECTION

When in any of the following cases, the protective circuit trips, the output is cutoff and the lamp illuminates. (When this has occurred, remove the cause of the trip and then press the STOP switch to reset the Tester.)

1. When the RANGE 2.5kV/5kV switches of withstanding voltage tester are changed.
2. When the IR TEST VOLTAGE 500V/1000V switches are changed.
3. When the FUNCTION switches are changed. When two or more switches are in the pushed-in state (▬ ▬ ▬ ▬) or all switches are in the pushed-out state (▮ ▮ ▮ ▮).
4. When the REMOTE CONTROL connector is disconnected and then connected. (However, the lamp does not light when a connector which meets the requirements of reset condition is connected without the FAIL ALARM of the SPECIAL TEST MODE switch ON state).
5. When the interlock terminals are made open.
6. When the POWER switch is turned on again immediately after turning it off.
7. When all of the CUTOFF CURRENT switches are set in the pushed-out state or set at 108 mA or more.
8. When both withstanding voltage tester and insulation resistance tester are operated at the same time due to a failure of the Tester.

⚠WARNING • If the lamp does not go off even when you have eliminated the cause of the trip to the PROTECTION state and have pressed the STOP switch, the most probable cause is a failure of the Tester. Immediately stop using the Tester.

[16] OUTPUT HIGH VOLTAGE (HIGH VOLTAGE terminal)

The hot line of the test voltage.

[17] VOLTMETER

Indicates the output voltage for withstanding voltage test.

Directly measures the voltage of the high voltage HIGH VOLTAGE terminal.

The adjustor in the centre of the meter is used to adjust mechanical "0".

[18] TIMER

Presets the withstanding voltage test period. See " Selecting the timer range" on page 12.

[19] TEST VOLTAGE

The dial controls the output voltage for withstanding voltage test. The output voltage increases as you turn this dial clockwise. Be sure to set the dial at the fully counterclockwise position (zero position) whenever no test is being done.

[20] OHMMETER

Indicates the resistance measured in insulation resistance test.

The adjustor in the centre of the meter is used to adjust mechanical "0".

[21] TIMER

Presets the insulation resistance test period. See " Selecting the timer range" on page 17.

5.2 Description of Rear Panel Items

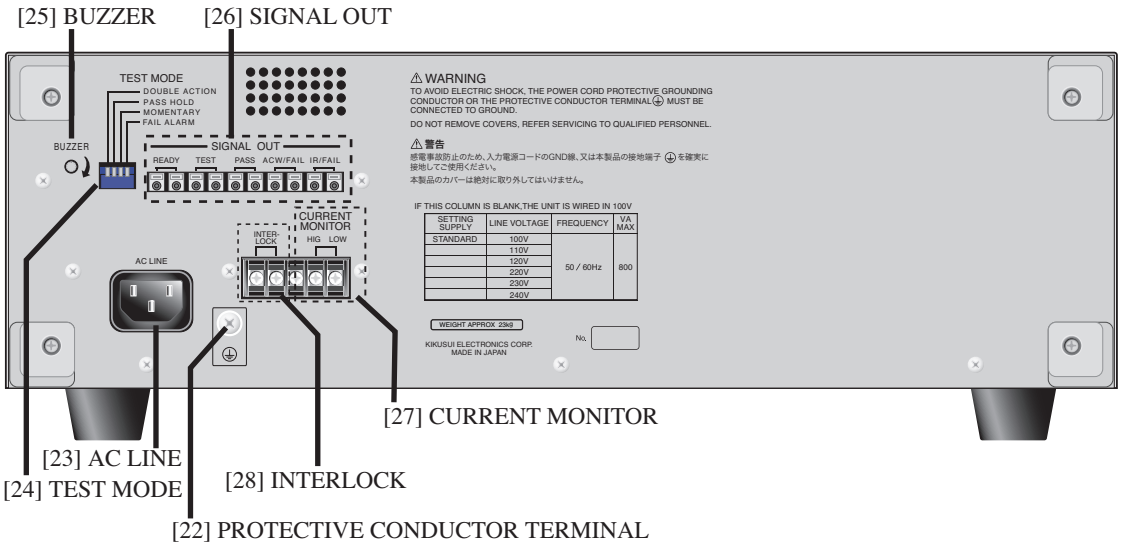


Fig.5-2

[22] PROTECTIVE CONDUCTOR TERMINAL

To ground the Tester to an electrical ground (safety ground).

See "1.6 Grounding" on page 4

[23] AC LINE

The AC line connector is for the AC input power. Use the input power cord which accompanies the Tester.

[24] TEST MODE

Select the DOUBLE ACTION, PASS HOLD, MOMENTARY, or FAIL ALARM mode. Be sure to turn off the POWER switch before setting the selector switches. For details, refer to "3.7 Special Test Modes" on page 25.

[25] BUZZER

Controls the loudness of buzzer of a FAIL or PASS judgement.

[26] SIGNAL OUT

For the READY, TEST ON, PASS, ACW/FAIL, and IR/FAIL output signals (contact signals). For details, refer to "3.6 Output Signals" on page 22.

[27] CURRENT MONITOR

The leakage current when in withstanding voltage test can be directly monitored by disconnecting the shorting bar from the terminals(M3) and connecting a milliammeter between them. The milliammeter should be capable of measuring the leakage current. Be sure to connect the shorting bar when the current is not monitored.

A current may flow also when in insulation resistance test and this is not an abnormal indication.

[28] INTERLOCK

For INTERLOCK input signal. The terminals(M3) are shorted with a shorting piece at the shipment. When the terminals are made open, the TEST ON state is inhibited for protection.

Chapter 6 MAINTENANCE AND CALIBRATION

This Chapter describes maintenance and calibration. Perform regular maintenance, inspection and calibration to maintain optimum performance for a long time.

6.1 Cleaning the Outer Surfaces

⚠CAUTION
- Be sure to turn OFF (○) the power of the Tester before start cleaning it.
- Do not use volatile solvents such as thinner and benzine. They may discolor the unit surface coating, erase printing characters.

When the panel of the Tester has become dirty, clean them by wiping them with a soft cloth moistened with neutral soapsuds.

6.2 Inspection

Checking the AC Power Cord

Check the AC power cord for broken sheath and for loose or cracked plug.

Checking the High Voltage Test Leadwires

Visually inspect the leadwires and be sure that they have no indications of broken sheaths or other signs of damage.

Electrically check that the leadwires are not open-circuited (by using a circuit tester or other instrument).

⚠WARNING
- If the test leadwire is damaged (its sheath is damaged or its core wire is open-circuit), it can be a cause of electric shock hazards. Never use imperfect test leadwires.

To purchase accessories, contact your Kikusui agent/distributor.

6.3 Maintenance

■ High Voltage Relay

The high voltage relay of the internal discharge circuit is a wearable component.

In this regard, it is recommended to order your Kikusui agent/distributor to overhaul the Tester at every approximately 200,000 repetitions of tests (although the service intervals may differ depending on the conditions of use).

⚠WARNING
- The Tester generates a hazardously high voltage of 5 kV. Never attempt to overhaul the Tester for yourself. For such service, contact your Kikusui agent/distributor.

6.4 Calibration

The Tester was properly calibrated at shipment. However, the Tester should be calibrated after long-term usage.

⚠WARNING
- The Tester generates a hazardously high voltage of 5 kV. Never attempt to calibrate the Tester for yourself. For such service, contact your Kikusui agent/distributor.

Chapter 7 SPECIFICATIONS

This Chapter provides electric and mechanical specifications and descriptions of options.

7.1 Withstanding Voltage Tester

Table 7-1

WITHSTANDING VOLTAGE TESTER			
Test Voltage	Applied AC Voltage	0 V to 2.5 kV/0 V to 5 kV (tow ranges)	
	Output Rating	500 VA (5 kV, 100 mA with 100 V line voltage). *1	
	Waveform	AC line waveform	
	Voltage regulation	Better than 20% (for maximum rated load to no load, with 100 V line voltage)	
	Switching	With zero-start type switch	
Output Voltmeter	Scales	2.5 kV f.s / 5 kV f.s, two ranges linear scales	
	Class of meter	JIS Class 1	
	Accuracy	5 °C to 15 °C : ±3 % f.s 15 °C to 35 °C : ±1.5 % f.s (with a sine wave *2)	
	Indication	Mean-value response, effective-value scale graduation	
Judgment of Test Result PASS-FAIL judgment. Output cutoff by leakage current detection	Judgment	Window comparator system	
		FAIL judgment when leakage current larger than high limit reference value is detected.	
		FAIL judgment also when leakage current smaller than low limit reference value is detected.	
		When FAIL judgment is made, output is cutoff and FAIL alarm is generated.	
		If no FAIL judgment is made after preset period has elapsed, PASS signal is generated.	
	High limit reference value (CUTOFF CURRENT)	0.5/1/2/4/8/10/100 mA (7 values)	
		By combinations of above values, a range of 0.5 mA to 25.5 mA can be covered in 0.5 mA steps.	
	Low limit reference value (LOWER REFERENCE)	0 to one-half of high limit reference values (continuously variable)	
	Accuracy of judgment *3	±5 % of high limit	
		±20 % of low limit reference value (one-half of high limit reference values at maximum counterclockwise). (Other are non-calibrated.)	
	Judging method	Absolute value of leakage current is integrated and compared with preset limit reference value	
	Calibration	Calibrated with rms value of sine wave, using a pure resistance load.	
	No-load output voltage need for detection *4	2.5 kV range	Approx. 450 V when set at 100 mA
		5 kV range	Approx. 550 V when set at 100 mA
Test time		Timer :0.2 s to 99.9 s (× 0.1 range) ±50 ms 1 s to 999 s (× 1 range) ±0.5 s	
Terminals		Terminals for monitoring of leakage current	

*1. The heat radiation of the output section of the tester is designed to be 1/2 of the rated output, taking the size, weight, cost, etc., into consideration. Therefore, use it within the limitations shown in Table7-2. If it is used in excess of these limitations, the temperature of the output section rises excessively and the internal protection circuit may be activated. In this case, cancel the test for a while and wait until the normal temperature is restored.

*2. Crest factor of 1.35 to 1.41, distortion of 3% or less

*3. The current which flows due to stray capacitances of the output circuit and leadwires causes an error. The overall accuracy of judgement is the above-mentioned accuracy of judgement plus a factor caused by this current. Typical values of this type of currents are shown in the Table7-3. Note that, when a test is made with a high voltage and high sensitivity, the current which flows through the stray capacitances may become larger than the preset low limit reference value and low limit judgement may become unavailable.

*4. When making an FAIL judgement test with the output terminals shorted, a certain level of no-load output voltage is needed due to the internal resistance of the output circuit. The voltages shown here are this type of output voltages.

Table 7-2

Ambient temperature	Test current I (mA)	Suspension time	Maximum test time
t ≤ 40 °C	25.5 < I ≤ 100	Test time or longer	30 minutes or less
	I ≤ 25.5	Not required	Continuous test possible

Table 7-3

Output voltage	1 kV	2 kV	3 kV	4 kV	5 kV
Test alone (without leadwires)	4 μA	8 μA	12 μA	16 μA	20 μA
When 350mm long leadwires are hung in air	6 μA	12 μA	18 μA	24 μA	30 μA
When the accessory leadwire (TL01-TOS) are used	20 μA	40 μA	60 μA	80 μA	100 μA

Test Voltage Waveform

When an AC output voltage is applied to a capacitive load, it is possible that the voltage becomes higher than that when in the no-load state due to the capacitance of the load. Moreover, when the capacitance of the load is voltage dependent (typical examples are ceramic capacitors), the voltage waveform may be distorted. When the test voltage is 1.5 kV, however, effects caused by a capacitance of 1000 pF or less are negligible.

7.2 Insulation resistance Tester

Table 7-4

INSULATION RESISTANCE TESTER		
Measuring Voltage		500 V or 1 000 V
		DC, negative polarity (two ranges)
Measuring terminal voltage		0 % to + 5 % of rated measuring voltage (At rated measuring current or less)
Output current	Rated measuring current	1.0 mA
	Short circuit current	12 mA or less
Effective Measuring Ranges	500 V range	1 MΩ to 1 000 MΩ
	1 000 V range	2 MΩ to 2 000 MΩ
Values center of scale	500 V range	20 MΩ
	1 000 V range	50 MΩ
Accuracy		1st effective measuring range : ±5 % of the indicated value 2nd effective measuring range : ±10 % of the indicated value*1
Judgment of Test Result PASS-FAIL judgment	Judgment	Window comparator system (mutually independent settings of high limit and low limit)
		FAIL judgment when measured resistance is smaller than low limit reference value.
		FAIL judgment when measured resistance is larger than high limit reference value.
		When FAIL judgment is made, output is cutoff and FAIL alarm is generated.
		If no FAIL judgment is made after preset period has elapsed, PASS signal is generated.
	Limit reference value setting range	Low and high limit reference values can be set at any points within the effective measuring range of the Tester.
	Accuracy of judgment	1st effective measuring range : ±10 % of set value 2nd effective measuring range : ±15 % of set value*1
	Waiting-time for judgment	Approx. 0.3 s
Test time		Timer :0.5 s to 99.9 s (× 0.1 range) ±50 ms 1 s to 999 s (× 1 range) ±0.5 s

*1. At 25 ˚C ± 10 ˚C
The 1st effective measuring range is from 1/1000 to 1/2 of the maximum effective scale value. The 2nd effective measuring range is from the above to the maximum effective scale value.

7.3 Common Specifications

Table 7-5

Common Specifications			
Types of test	1.AUTO ACW→IR	Withstanding voltage test first and insulation resistance test next	
	2.AUTO IR→ACW	Insulation resistance test first and withstanding voltage test next	
	3.MANUAL ACW	Withstanding voltage test alone	
	4.MANUAL IR	Insulation resistance test alone	
Remote Control	Test / Reset control	Low active control Input conditions *1 • High level input voltage 11 V to 15 V • Low level input voltage 0 V to 4 V • Low level sweep out current 5 mA or less • Input pulse width 20 ms minimum	
	Interlock	Protection is effected when INTERLOCK terminal is made open (test is disabled).	
Output signals *2	Signal Name	Conditions for Signal Generation	Type of Signals
	TEST ON signal	Delivered during entire test-on period.	Make-contact signal and lamp
	PASS signal	Delivered when PASS judgment is made, for approximately 50 ms.	Make-contact signal, lamp and buzzer
	ACW/FAIL alarm	Delivered continuously when FAIL judgment of withstanding voltage test is made.	Make-contact signal, lamp and buzzer
	IR/FAIL alarm	Delivered continuously when FAIL judgment of insulation resistance test is made.	Make-contact signal, lamp and buzzer
	READY signal	Delivered when in the READY state.	Make-contact signal
Special Test Mode Selectable with DIP switches at rear of Tester	1.DOUBLE ACTION	Test starts only when the START switch is pressed within approximately 0.5 s after pressing the STOP switch.	
	2.PASS HOLD	The PASS state is held.	
	3.MOMENTARY	Test is executed only during the period the START switch is kept pressed.	
	4.FAIL ALARM	FAIL alarm and PROTECTION state cannot be reset by the remote-control STOP signal.	
Ambient Temperature and Humidity		Specification range	5 ˚C to 35°C (41°F to 95°F) / 20 % to 80 % RH
		Operable range	0 ˚C to 40 °C (32°F to 104°F) / 20 % to 80 % RH
		Storage range	-20 ˚C to 70 °C (-4°F to 158°F) / 80 % RH or less

*1. The input terminal is pulled up to +15 V supply voltage by resistor. Opening of the input terminals is equivalent to a high level input.

*2. The rating of the signal contacts is 125 VAC, 1 A, or 30 VDC, 1 A.
Loudness of the buzzer is adjustable with a knob in common for the PASS signal and FAIL alarm.

Table 7-6

Safety *1, *2	Conforms to the requirements of the following directive and standard. Low Voltage Directive 2006/95/EC EN 61010-1 Pollution degree 2		
EMC *1	Conforms to the requirements of the following directive and standard. EMC Directive 2004/108/EC EN 61326-1 EN 61000-3-2 EN 61000-3-3 Under following conditions 1. Used HV test leadwire TL01-TOS. 2. No discharge in testing.		
Power Requirements	Line voltage	100 VAC ± 10 %, 50/60 Hz *3	
	Power consumption	When no load (RESET state) : 15 VA or less *4 When with rated load : Approx. 600 VA	
	Insulation resistance	30 MΩ or more, 500 VDC	
	Withstanding voltage	1390 VAC (2 seconds), between AC line and chassis	
Dimensions		See the outline drawing.	
Weight		Approx. 23 kg (51 lb)	
Accessories		TL01-TOS High Voltage Test Leadwires, approx. 1.5 m long.	1
		AC Power cord	1
		Operation Manual	1
Options	RC01-TOS Remote Control Box		
	RC02-TOS Remote Control Box		
	HP01A-TOS High Voltage Test Probe, approx. 1.5 m long		
	HP02A-TOS High Voltage Test Probe, approx. 3 m long		
	TL02-TOS High Voltage Test Readwires, approx. 3 m long		
	KRB150-TOS Rackmount Bracket (for JIS)		
	KRB3-TOS Rackmount Bracket (for EIA)		

*1. Only on models that have CE marking on the panel.
Not applicable to custom order models.

*2. This instrument is a Class I equipment. Be sure to ground the protective conductor terminal of the instrument. The safety of the instrument is not guaranteed unless the instrument is grounded properly.

*3. Can be factory-modified to nominal 110 V, 120 V, 220 V, 230 V and 240 V.

*4. Power consumption of the instrument modified to operate on an AC line voltage other than 100 V is as follows.
110 V / 120 V: 25 VA or less
220 V / 230 V / 240 V: 45 VA or less

7.4 Outline Drawing

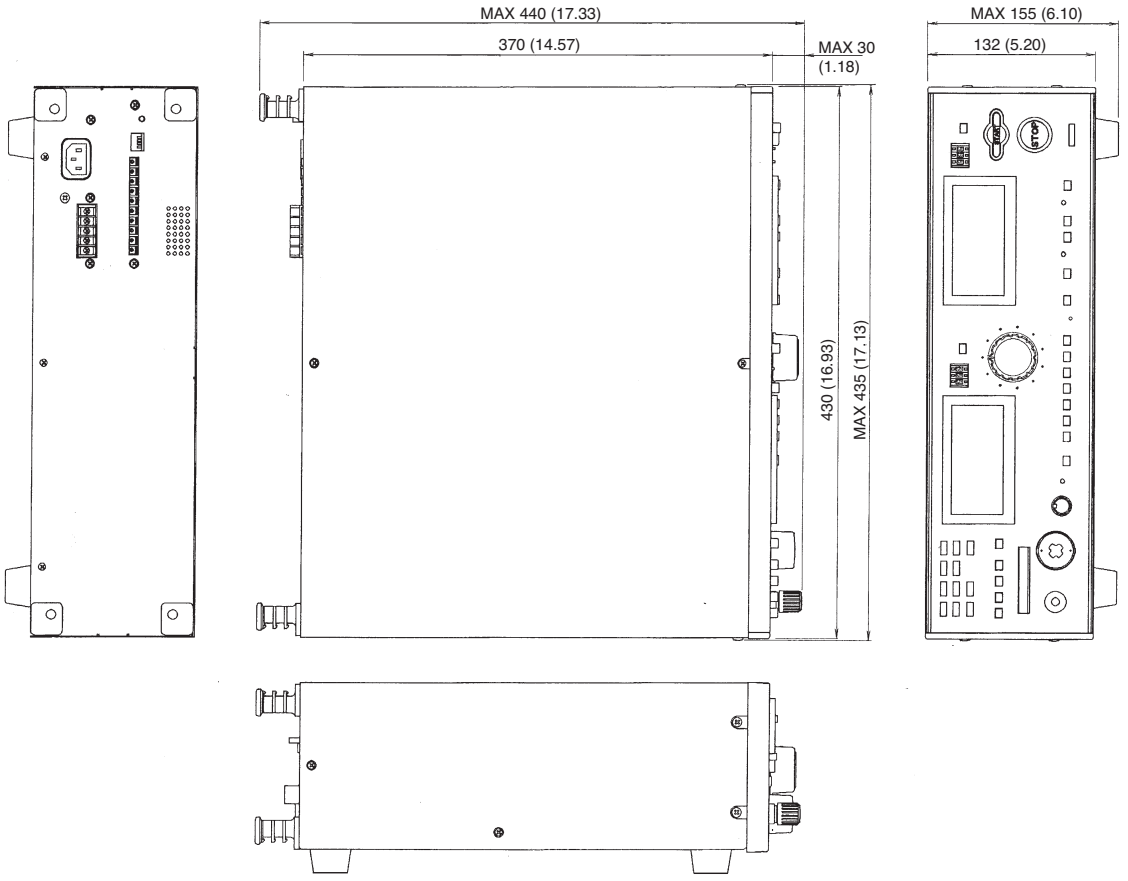


Fig.7-1

Unit : mm (inch)

7.5 Options

The following options are provided to the Tester.

1) Model RC01-TOS/RC02-TOS Remote Control Box

Model RC01-TOS or RC02-TOS Remote Control Box is for remote control of start/stop of test operation of the Tester.

For remote control, connect the Control Box to the REMOTE connector on the front panel of the Tester.

The RC01-TOS has one START switch; RC02-TOS has two START switches and the test starts as you press both switches at the same time with your both hands, thereby enhancing the operating safety.

■ Functions of switches

OPERATE switch

This switch enables (when ON) or disables (when OFF) the START switch or switches.

START switch

The test starts as you press this switch (or switches) when the OPERATE switch is ON and the Tester is in the READY status.

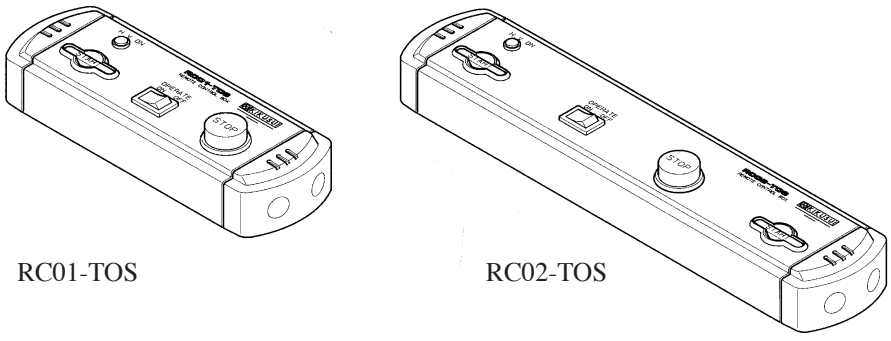
STOP switch

This switch terminates the test (cuts off the test voltage or resets the Tester from the FAIL or other particular status — its functions are the same with those of the STOP switch on the front panel of the Tester.)

■ Dimensions

RC01-TOS :200 W × 70 H × 39 D mm (7.9 W × 2.8 H × 1.5 D in.)

RC02-TOS :330 W × 70 H × 39 D mm (13 W × 2.8 H × 1.5 D in.)



RC01-TOS RC02-TOS

Fig.7-2

2) Model HP01A-TOS/HP02A-TOS High Voltage Test Probe

The High Voltage Test Probe renders a threefold operating safety, namely, the test voltage is not delivered unless you squeeze with one hand the slide lever of the grip of the probe and pull the trigger and you press with the other hand the switch on top of the probe, thereby occupying your both hands. As you release even a single one of these, the probe immediately and forcefully delivers the STOP signal to cut off the test voltage.

Voltage ratings

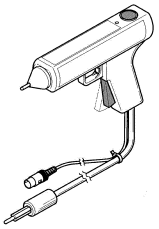
4 kVAC rms 50/60 Hz

5 kVDC

Length of cable

HP01A-TOS : Approx. 1.8 m

HP02A-TOS : Approx. 3.5 m



⚠ WARNING

- The maximum voltage ratings of the probe is 4 kVAC rms or 5 kVDC. Never let it subjected to voltages higher than these limits.
- Do not connect the probe to or disconnect it from the DUT while letting it deliver the test voltage—if you do this, the DUT may be damaged. If you disconnect the probe from the DUT while letting it deliver the test voltage, the items of the tested circuit may remain charged up to the high test voltage. Before connecting the probe to the DUT, be sure that the test voltage is OFF (the LED on top of the probe is OFF); before disconnecting the probe from the DUT, be sure that the test voltage is OFF (the LED is OFF).

⚠ CAUTION

- If you need a test in compliance to the UL Standard by using the probe, set the FAIL ALARM mode switch (DIP switch on the rear panel) of the Tester to ON. If you have set this switch to ON, the Tester is not reset from the FAIL alarm has gone out even when you have released your hand from the probe. To reset it, you have to press the STOP switch of the Tester. Thus, you will be securely informed of the FAIL alarm. For details, refer to Item "FAIL ALARM" on Chapter 3 "3.7 Special Test Modes" on page 25.

3) High Voltage Test Leadwires

Model	Voltage rating	Length
TL01-TOS	5 kVAC rms, 50/60 Hz	Approx. 1.5 m
TL02-TOS	5 kVDC	Approx. 3 m