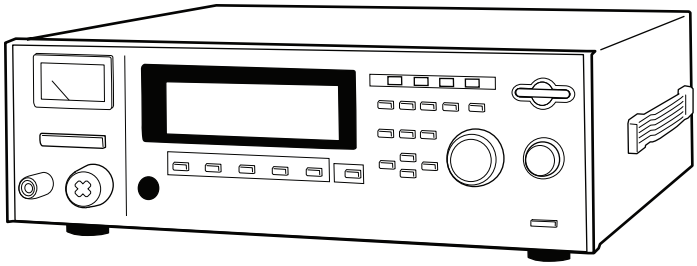
Part No. Z1-002-412, IB002876
May. 2008

OPERATION MANUAL

WITHSTANDING VOLTAGE/
INSULATION RESISTANCE TESTER
TOS9200 Series

TOS9200
TOS9201



⚠ DANGER

This Tester generates high voltage.

- ○ Any incorrect handling may cause death.
- ○ Read Chapter 2 “PRECAUTIONS ON HANDLING” 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.

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.

Interlock Function

The first time the tester is turned on following delivery, the interlock function activates and testing is disabled.
Before starting a test, read "4.3 INTERLOCK Connector" for the procedure for starting up the tester using the interlock function.

About this manual

This operation manual describes the withstanding voltage tester TOS9200/TOS9201.

■ This manual is applicable to the Tester whose ROM version number is:

Ver. 1.1X for TOS9200
Ver. 1.1X for TOS9201

You can check the version number on the opening screen at turning on the power or by using the *IDN? message.
For the *IDN? message, see the separate volume "GPIB, RS-232C interface" operation manual.
When you contact us for any information about the Tester, please indicate the ROM version number and serial number of the Tester. The serial number is shown on the rear panel of the Tester.

The opening screen (Example of ROM version is 1.01)

TOS9200
AC WITHSTANDING VOLTAGE /
INSULATION RESISTANCE TESTER
Ver. 1.01
KIKUSUI ELECTRONICS CORP.

TOS9201
AC/DC WITHSTANDING VOLTAGE /
INSULATION RESISTANCE TESTER
Ver. 1.01
KIKUSUI ELECTRONICS CORP.

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 (to avoid electrification)

While the tester is delivering its test voltage, never touch the following areas, or else, you will be electrified, and run the risk of death by electric shock.

- the output terminal
- the test leadwires 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 when in the DC mode of 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 when in the DC mode of 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.

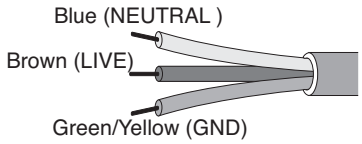
☐ AC power cord

The product is provided with AC power cords described below. If the cord has no power plug, attach a power plug or crimp-style terminals to the cord in accordance with the wire colors specified in the drawing.

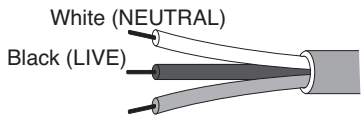
⚠WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

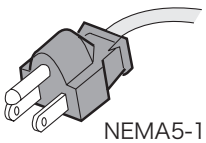
☐ Without a plug



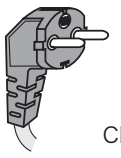
☐ Without a plug



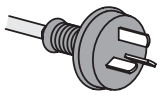
☐ Plug for USA



☐ Plug for Europe



☐ Plug for China



☐ Provided by Kikusui distributor/agent

Kikusui agents can provide you with suitable power cord.
For further information, contact Kikusui distributor/agent.

⚠ Safety Symbols

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

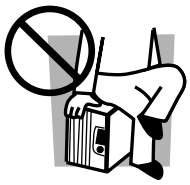
	Indicates that a high voltage (over 1000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.
DANGER	Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.
⚠ 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.

⚠ 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.

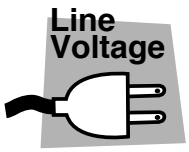
Users

- 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.

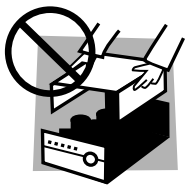


Input power

- 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.

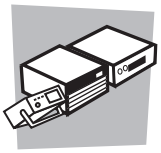
Fuse

- 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

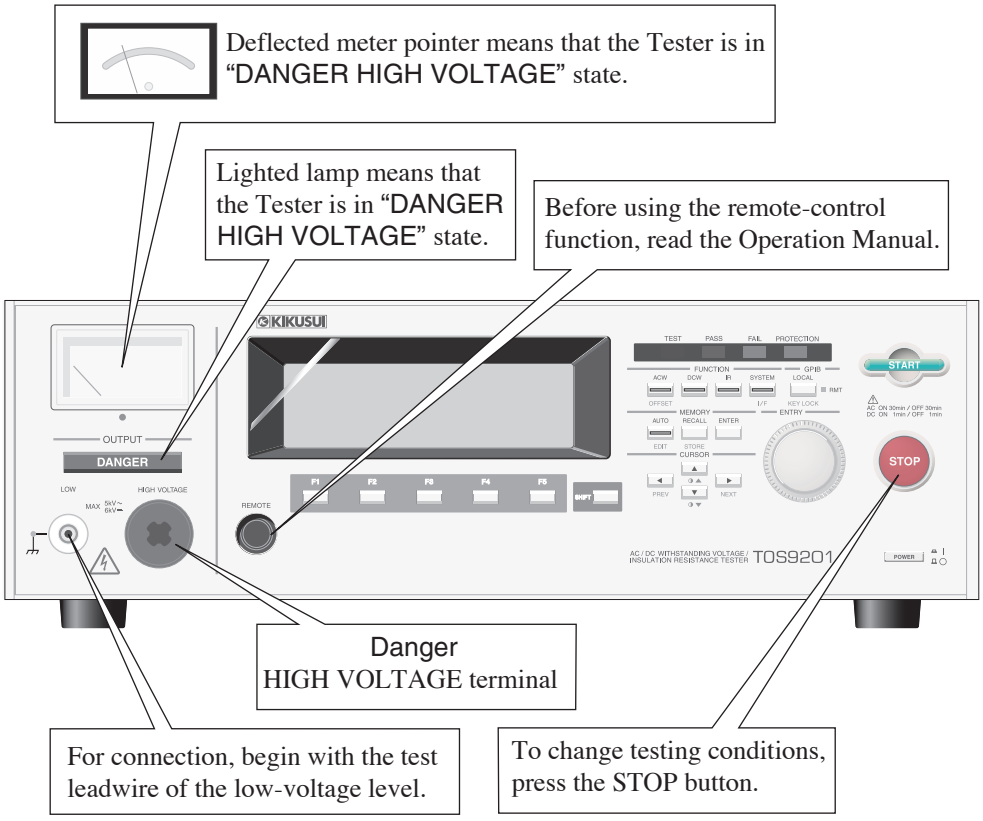
- To avoid electrical shock, be absolutely sure to unplug the AC power cord before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking,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

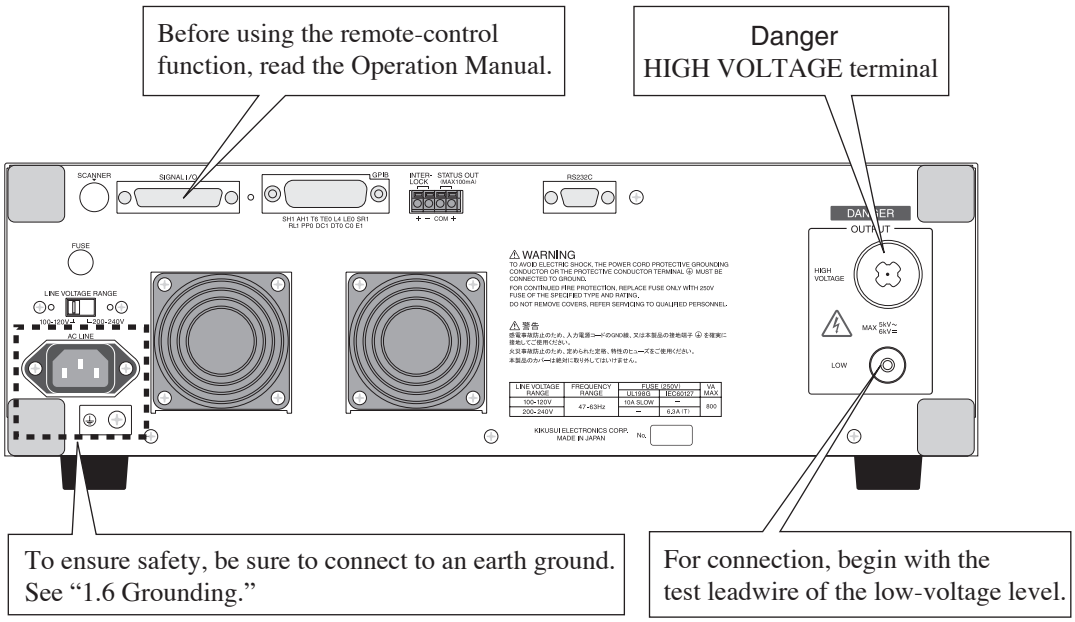
Service

- 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

- Before using the tester, be sure to read Chapter2 "Precautions on Handling"





Description of Contents

This manual is composed of the following chapters:

Preface

This section provides an outline of the tester and explains its features and options.

Chapter 1 Setup

This chapter describes the procedures from unpacking to installation to operation checking.

Chapter 2 Precautions on Handling

This chapter describes the precautions to be followed in the handling of this tester. When using the tester, take utmost care to ensure safety.

Chapter 3 Basic Operations

This chapter describes the procedures for conducting withstanding voltage and insulation resistance tests.

Chapter 4 Using Terminals and Connectors

This chapter describes the procedures for use of the connectors on the front and rear panels.

Chapter 5 Controlling the TOS6200

This chapter describes the procedure for using the TOS9200/TOS9201 to control Kikusui's earth continuity tester TOS6200 via the RS-232C interface.

Chapter 6 Part names and Functions

This chapter describes the names and functions of components such as switches, displays, and connectors on the front and rear panels.

Chapter 7 Maintenance

This chapter describes the maintenance, inspection, and calibration of the tester.

Chapter 8 Specifications

This chapter describes the electrical and mechanical specifications for the tester.

Appendix

Contents

Chapter 4 Using Terminals and Connectors

Chapter 5 Controlling the TOS6200

Chapter 6 Part names and Functions

Chapter 7 Maintenance

Chapter 8 Specifications

Appendix

Preface

Outline

The TOS9200 and TOS9201 are withstanding voltage/insulation resistance testers. The TOS9200 can perform AC withstanding voltage testing and insulation resistance testing. The TOS9201 can perform DC withstanding voltage testing, in addition to AC withstanding voltage testing and insulation resistance testing. Both can operate at up to 5 kVAC/100 mA (for up to 30 minutes) in AC withstanding voltage testing, and up to 6 kVDC (at a maximum output of 50 W for up to 1 minute) in DC withstanding voltage testing. These models are capable of performing withstanding voltage testing on electronic equipment and components in accordance with safety standards, including IEC, EN, VDE, BS, UL, CSA, JIS, and the Electrical Appliance and Material Safety Law (in Japan.)

The high-voltage block features a high-efficiency switching power supply and a PWM-based switching amplifier. This ensures high and stable output extremely resistant to power-supply and load fluctuations. The TOS9200 and TOS9201 are almost 30% smaller and lighter than Kikusui's previous models.

For insulation resistance testing, these testers are compatible with 25 V to 1000 V (at a resolution of 1 V) and 0.01 MΩ to 9.99 GΩ (at a maximum rated current of 1 mA to 50 nA).

Once connected to a DUT, the TOS9200 and TOS9201 can not only perform AC withstanding voltage tests, DC withstanding voltage tests, and insulation resistance tests separately, but can also conduct these tests consecutively using the program function. When combined with the high-voltage scanner TOS9221/TOS9220, each tester can operate using four channels. The tester can be connected to four scanners, thus permitting the connection of a total of 16 channels. Further, when used together with the earth continuity tester TOS6200, the TOS9200 and TOS9201 can also be applied to safety tests such as earth continuity tests.

The TOS9200 and TOS9201 are equipped with GPIB and RS-232C as standard features, making them highly applicable to a variety of automatic testing systems that require greater safety and reliability.

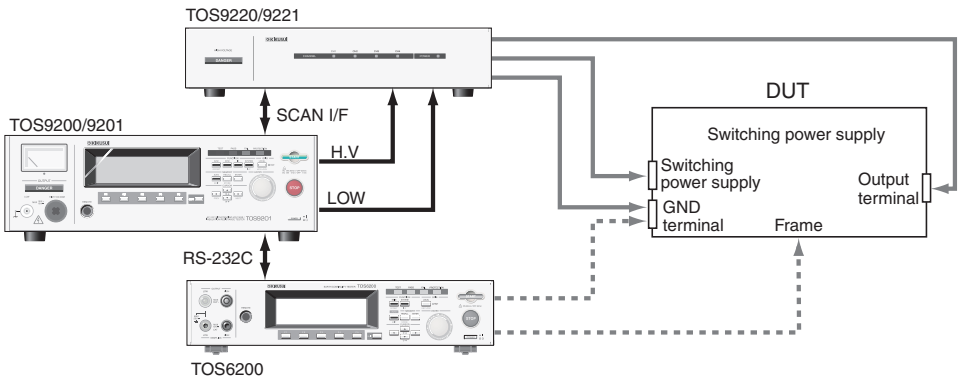


Fig.P-1 Example of system application 1

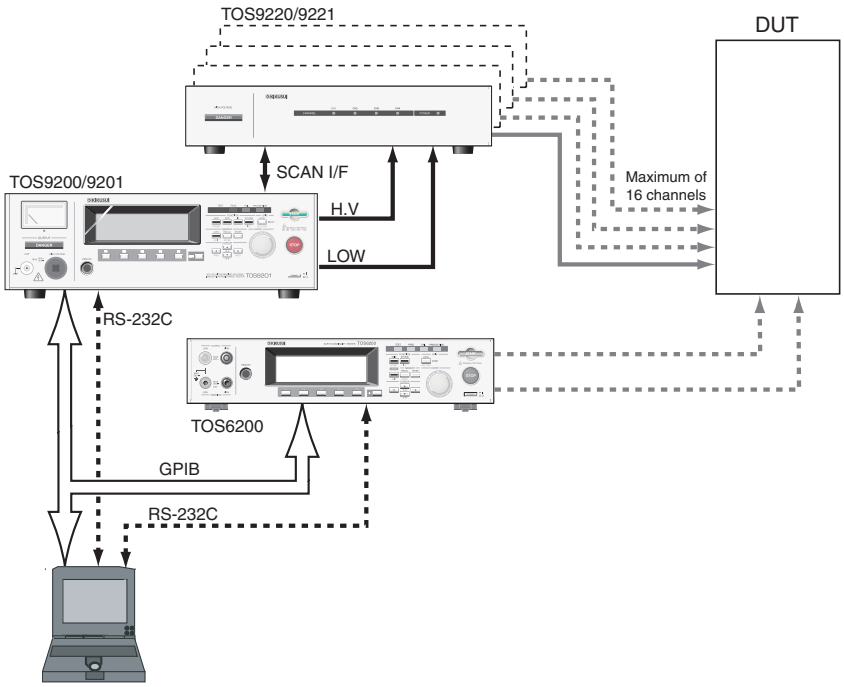


Fig.P-2 Example of system application 2

Features

■ Three testing functions – AC withstanding voltage, DC withstanding voltage, and insulation resistance tests

The TOS9200 performs AC withstanding voltage testing and insulation resistance testing. The TOS9201 conducts AC withstanding voltage testing, DC withstanding voltage testing, and insulation resistance testing.

When connected to a DUT, the tester can perform these three different tests consecutively.

■ AC withstanding voltage test at 5 kV/100 mA

The high-voltage power block is equipped with a high-efficiency switching power supply, a PWM-based switching amplifier, and a high-voltage 500 VA transformer, realizing a maximum output of 5 kV/100 mA (up to 30 minutes), 2.5 times that of Kikusui's former counterparts. For an upper limit of 100 mA or more at a test voltage of at least 500 V, the TOS9200 and TOS9201 conform, though only for an instant, to IEC requirements for short-circuit current of 200 mA or more. (The testers do not allow continuous output, as the output is cut off when an overcurrent is detected.) In addition, these testers generate a consistent test voltage of 50 Hz/60 Hz, independently of the power voltage, and contain the voltage regulation to less than ±3 %. This makes it unnecessary to readjust the output voltage when a test voltage has been preset.

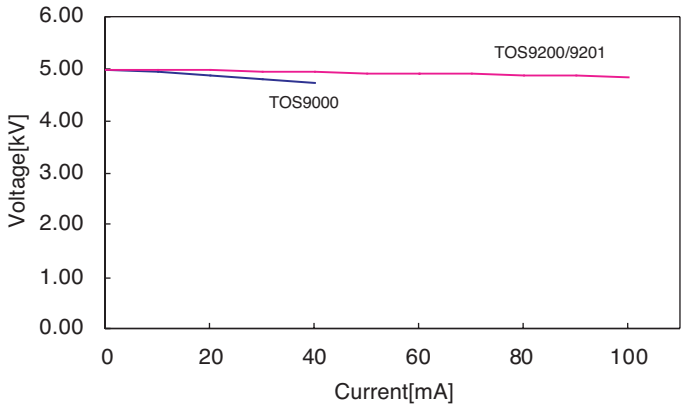


Fig.P-3 ACW Load Regulation

■ DC withstanding voltage test at 6 kV (maximum output of 50 W)

The TOS9201 can perform DC withstanding voltage tests for a wide voltage range of up to 6 kV (maximum output of 50 W and maximum duration of 1 minute). The tester is equipped with a stable, low-ripple DC/DC converter with a voltage regulation of 1 % or less.

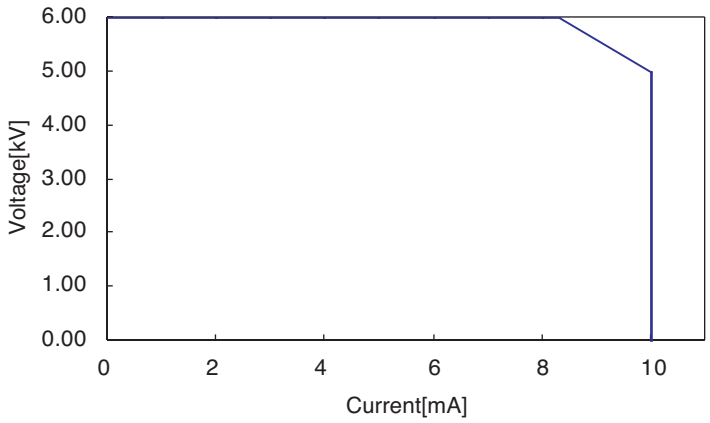


Fig.P-4 DCW Output Voltage Range

■ Insulation resistance test at 25 V to 1000 V (resolution of 1 V)/ 0.01 MΩ to 9.99 GΩ (in a range from a maximum rated current of 1 mA to 50 nA)

The test voltage ranges from 25 V to 1000 V at a resolution of 1 V, with a wide resistance measuring range of 0.01 MΩ to 9.99 GΩ.

Test voltage	Resistance measuring range
25 V	0.03 MΩ - 500 MΩ
50 V	0.05 MΩ - 1.00 GΩ
100 V	0.10 MΩ - 2.00 GΩ
125 V	0.13 MΩ - 2.50 GΩ
250 V	0.25 MΩ - 5.00 GΩ
500 V	0.50 MΩ - 9.99 GΩ
1 000 V	1.00 MΩ - 9.99 G

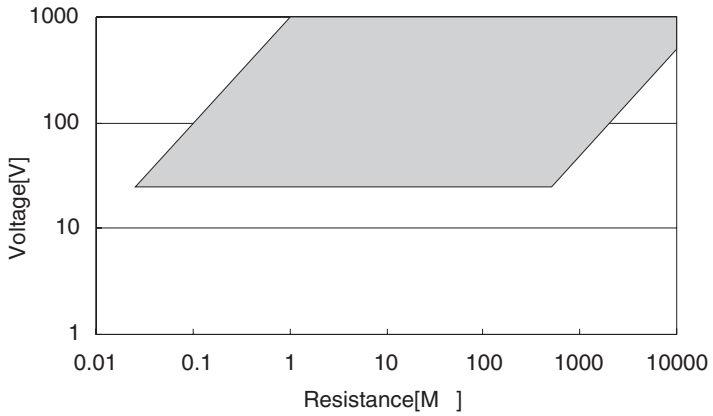


Fig.P-5 IR Measurement Range

■ Fully programmable GPIB and RS-232C interfaces as a standard feature

All functions except for the POWER switch, KEYLOCK, and program execute (AUTO) functions, are remote-controllable. Test conditions such as the test voltage, judgement value, and test time can be controlled remotely in AC and DC withstanding voltage and insulation resistance tests. Measured values and measurement results can also be read back by remote control. The GPIB and RS-232C interfaces provided as a standard feature smoothly interface the tester with a PC, sequencer, and other devices.

■ Flexible control function realized by a high-voltage scanner

When combined with the optional high-voltage scanner TOS9220 (5 kVAC/6 kVDC), the TOS9200/9201 can test multiple points in withstanding voltage and insulation resistance tests. Using the TOS9200/TOS9201 panel, each channel can be set to a HI/LO/OPEN voltage. One scanner can operate up to four channels. Up to four scanners can be connected to the TOS9200/9201, enabling the simultaneous operation of a total of 16 channels. The TOS9221 is equipped with a function for detecting connections between the high-voltage test leadwire and the DUT, thus ensuring highly reliable testing.

■ Rise-time control function

In AC withstanding voltage testing, DC withstanding voltage testing, and insulation resistance testing, a voltage can be slowly increased until it reaches a required test value, instead of applying the required test voltage to the DUT immediately after the start of a test. The voltage rise time can be set to 0.1 s through 99.9 s at a resolution of 0.1 s, and to 100 s through 200 s at a resolution of 1 s. The start voltage, which is applied at the start of a test, can be set to 0 % to 99 % of the test voltage at a resolution of 1 %. Thus, the TOS9200/TOS9201 conforms to the requirement for the type certification test under the UL standard and the withstanding voltage test under the IEC standard that less than half of the test voltage be applied initially and slowly increased for a specified period of time before the test voltage is reached.

■ Fall-time control function

For PASS judgement in AC withstanding voltage testing, the test voltage can be decreased in increments. The voltage fall time can be set to 0.0 s through 99.9 s at a resolution of 0.1 s and to 100 s through 200 s at a resolution of 0.1 s.

■ Discharge function

Generally, DUTs contain capacitive elements. Therefore, DUTs remain charged immediately after a DC withstanding voltage test or insulation resistance test has been conducted, resulting in the danger of electric shock. The TOS9200/TOS9201 has a function for forcibly discharging the DUT upon completion of DC withstanding voltage test or insulation resistance test.

■ Enhanced safety

To enhance safety, the TOS9200/TOS9201 is equipped with a number of devices and safety functions, including safe output terminals, a discharge function, and an analog voltmeter that constantly monitor the output-terminal voltages. Such safety measures also include a danger lamp that constantly monitors output-terminal voltages even when no test is under way and lights up when a voltage is detected, in addition to an interlock function that cuts off output in coordination with an external device.

■ Improved measurement accuracy

The TOS9200/TOS9201 is equipped with a digital voltmeter for withstanding voltage testing with an accuracy of ±(1 % of the reading +30 V), and another for insulation resistance testing with an accuracy of ±(1 % of the reading +1 V). The two voltmeters display measured values not only during a test but also during execution of a program.

The testers are equipped with an ammeter for withstanding voltage testing that features accuracy of ±(1 % of the reading +20 μA). Kikusui's previous testers had a measurement resolution of approximately 1 mA and an accuracy of approximately ±5 % of the upper current that was set to 100 mA. By comparison, the TOS9200/TOS9201 can operate with an accuracy of ±(3 % of the reading +20 μA) at an upper current of 100 mA. The two ammeters display measured values not only during a test but also during execution of a program.

■ Offset cancel function

In an AC withstanding voltage test that requires high sensitivity and high voltage, current flowing into the stray capacity of test leadwires and jigs tends to cause measurement errors. The TOS9200/TOS9201 features an offset cancel function that cancels offset currents such as stray currents.

■ Voltage hold function

During judgement, this function allows the tester to retain measured voltages recorded upon completion of a test, while it is still outputting the judgement results. Combined with the rise-time control function, the voltage hold function enables detection of the dielectric breakdown voltage.

■ Output voltage monitoring function

When the output voltage deviates from ± (10 % of the setting +50 V), the monitoring function activates to suspend the test, ensuring highly reliable testing.

■ High operability

The TOS9200/TOS9201 is easy to operate, allowing the operator to start using it without difficulty. Featuring the TOS5000's high operability, the tester displays the primary test conditions on the first page of the menu, with the secondary test conditions shown on the following pages. To set test conditions, simply use the cursor key to choose from among the items displayed on the LCD, and then turn the rotary knob. The function keys allow you to jump to items to be set. During a test, the output voltage can be changed using the rotary knob.

■ Saving 100 test conditions for each test

One hundred test conditions, such as the test voltage, judgement value, and test time, can be set and named for each test of the AC withstanding voltage, DC withstanding voltage, and insulation resistance. For example, the name of the applicable safety standard and the shipment destination of the DUT can be saved. Even when a change is made to the destination of a product or the name of the applicable safety standard, there is no need to change the preset test conditions. To recall these test conditions, simply set the memory number. If such test conditions have their own name, they can be confirmed using that name. Test conditions can even be recalled from outside.

■ Programmed test conditions

By configuring the test conditions saved for each test, 100 test steps can be performed consecutively.

When used together with the earth continuity tester TOS6200, the TOS9200/TOS9201 integrates the test conditions saved in the earth continuity tester to perform continuous tests. Tests can be performed easily, such as on the AC withstanding voltage, insulation resistance, DC withstanding voltage, and earth continuity, in that order.

Up to 500 steps can be configured, with 100 programs storable, permitting recalls even from outside.

■ Remote-control function and signal output function

Used exclusively for options, the DIN connector on the front panel enables the remote control of start/stop operations, like its conventional counterpart. Using the SIGNAL I/O connector on the rear panel, start/stop operations can be conducted and the panel memory or program memory can be recalled.

Seven signals are output by the open collector through the SIGNAL I/O connector – HV ON, TEST, PASS, UPPER FAIL, LOWER FAIL, READY, and PROTECTION. These signals can be used together with the remote-control function to automate testing and save labor.

■ High-voltage output terminal on the rear panel

The rear panel includes a high-voltage output terminal to be used for an optional high-voltage scanner. This terminal also facilitates wiring when you mount the tester on a rack.

■ Small and lightweight

For AC withstanding voltage testing, the TOS9200/TOS9201 is provided with an output power supply 2.5 times that of Kikusui's conventional testers, in addition to DC withstanding voltage and insulation resistance testing mechanisms. Nevertheless, its body is 30 % smaller in both size and weight than that of Kikusui's conventional models.

⚠WARNING • This tester handles a high voltage of 5 kVAC/6 kVDC. Therefore, do not touch the DUT or cables, as electric shock may result.

Around the DUT, provide full safety measures such as an enclosure to keep workers away. In addition, to ensure safety, exercise extreme care to prevent the output of a high voltage due to improper connections and operations.

Options

The following options are available for this tester:

■ RC01-TOS/RC02-TOS remote-control box

This remote-control box is used for remote control of the start/stop operations of this tester. It is connected to the REMOTE terminal on the front panel.

The RC01-TOS has one START switch. The RC02-TOS has two START switches, and starts operation only when both are pressed simultaneously.

Function

OPERATE switch

The TEST-switch operation is effective only when the OPERATE switch is on. Operation is forcibly stopped when the switch is turned off.

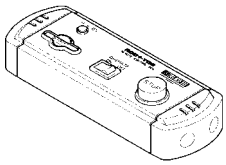
START switch

This switch starts a test only when the OPERATE switch is on and in the ready status.

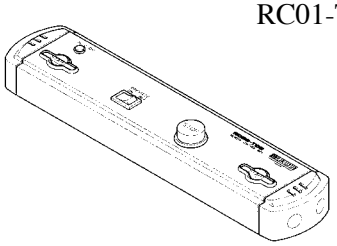
STOP switch

This switch is used to cut off the output voltage and cancel the FAIL status.

It performs the same function as the STOP switch on the front panel.



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



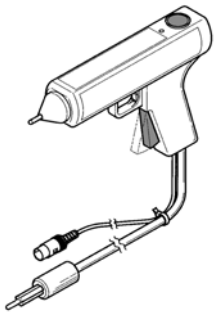
RC02-TOS: 330mm (W) x 70mm (H) x 39mm (D)

■ High-voltage test probe HP01A-TOS/HP02A-TOS

This test probe is connected to Kikusui's withstanding voltage tester to output a test voltage. It is designed to prevent the unintended output of a test voltage.

To output a test voltage, hold the slide lever on the test-probe grip and pull the trigger with one hand, then press the switch on top of the probe using the other hand.

When you release either hand, the STOP signal is output and the test voltage is cut off.



Maximum working voltage

AC 4 kV (rms) 50 Hz/60 Hz

DC 5 kV

Cable length

HP01A-TOS: Approximately 1.8 m

HP02A-TOS: Approximately 3.5 m

Fig.P-6 High-voltage test probe

⚠WARNING

- This probe is designed for a maximum working voltage of 4 kVAC/5 kVDC. It is dangerous to apply a voltage exceeding this level. Be sure to use this probe at a test voltage below the maximum working voltage.
- Do not connect this probe to the DUT when a test voltage is being output from the probe. In addition, do not cut off the connection to the DUT when a test voltage is being output from the probe.

  If the connection between the probe and the DUT is cut off while a high voltage is being output from the probe, the DUT may be damaged. In addition, the DUT remains charged, making it extremely dangerous.

  Therefore, connect the probe to a DUT before staring a test, be sure to confirm that the LED on the probe is off before ending a test, and then disconnect the DUT from the probe.

⚠CAUTION • To conduct a test under the UL standard using this probe, turn on the FAIL MODE function on the tester. When this function is on, the tester performs the next action to allow the FAIL status to be checked.

When the test ends in the FAIL status, the status is not cancelled even when you release your hand from the probe. To cancel the FAIL status, press the STOP switch on the tester. For settings, see “FAIL MODE” in "3.10 System Settings".

■ High-voltage scanner

The high-voltage scanner TOS9220/TOS9221 has a function to distribute a test voltage supplied by the tester among multiple test points.

- A single high-voltage scanner distributes an output to four channels. Each channel can be set to a different electric-potential level – HIGH, LOW, or OPEN. AC/DC testing and insulation resistance testing can be conducted at any of four test points.
- Up to four scanners can be connected to one tester, enabling expansion to a maximum of 16 channels.
- The contact between the output on each channel and a test point can be checked (the contact check function is provided for the TOS9221 scanner only).

These features ensure highly reliable, labor-saving withstanding voltage and insulation resistance tests on electric and electronic devices and components having multiple test points.

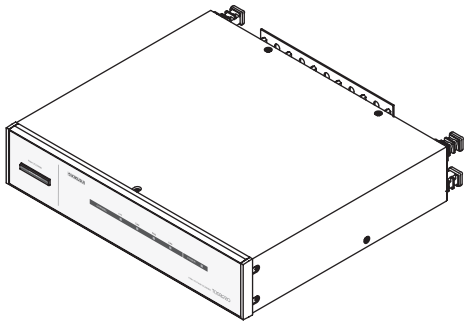


Fig.P-7 High-voltage scanner TOS9220/TOS9221

Chapter 1 Setup

This chapter describes the procedures from unpacking to installation to operation checking.

1.1 Unpacking

Upon receiving the product, confirm that the necessary accessories are included and have not been damaged in transit. Should any damage or shortage be found, please contact Kikusui distributor/agent.

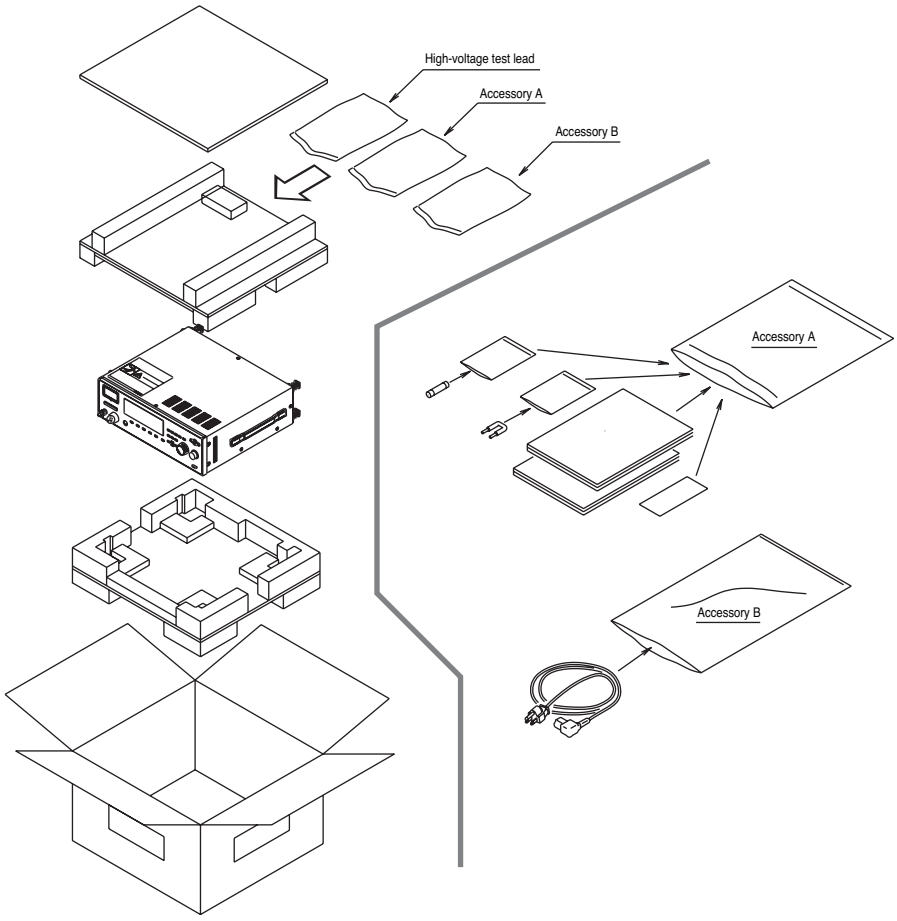
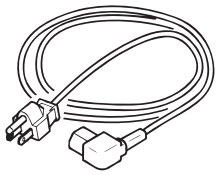
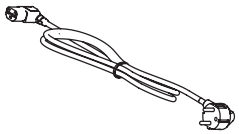


Fig.1-1 Packing/unpacking

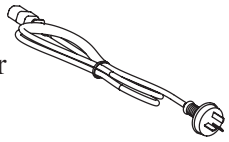
NOTE • Retain the packing material for future transport.



or



or



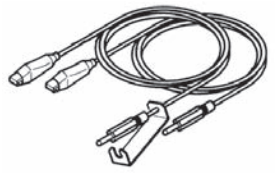
The power cord that is provided varies depending on the destination for the product at the factory-shipment.

PLUG: NEMA5-15
[85-AA-0003]

PLUG: CEE7/7
[85-AA-0005]

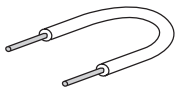
PLUG: CB1002
[85-10-0790]

☐ AC Power cord (1 pc.)



☐ TL01-TOS High-voltage test leadwires (1 set)
1.5 m
[82970]

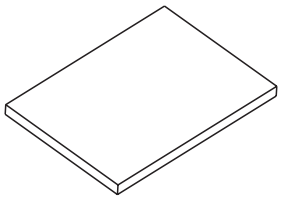
☐ "DANGER HIGH VOLTAGE" sticker (1 sheet)
[A8-210-202]



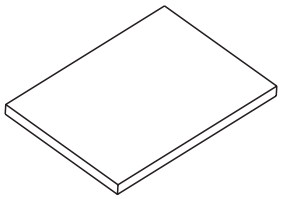
☐ Interlock jumper (1 pc.)
[91-82-1510]

The fuse that is provided varies depending on the destination for the product at the factory-shipment.

☐ Spare fuse (1 pc.)
10 A, 250 V [99-02-0031]
or 6.3 A, 250 V [99-02-0019]



☐ Tester
Operation Manual (1 copy)
[Z1-002-412]



☐ GPIB, RS-232C
Operation Manual (1 copy)
[Z1-002-422]

Fig.1-2 List of accessories

NOTE

- Place the "DANGER HIGH VOLTAGE" sticker in a visible location near the tester or installation site.

The product does not include a SIGNAL I/O cable, GPIB interface cable, or RS-232C interface cable. Users are requested to procure them on their own.

1.2 Precautions for Installation

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

■ Do not use the tester in a flammable atmosphere.

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

■ Avoid locations where the tester is exposed to high temperatures or direct sunlight.

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

Operating temperature range: 5 °C to +35 °C

Storage temperature range: -20 °C to +70 °C

■ Avoid humid environments.

Do not locate the tester in a high-humidity environment—near a boiler, humidifier, or water supply.

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

Condensation may occur even within the operating humidity range. In that case, do not start using the tester until the location is completely dry.

■ Do not place the tester in a corrosive atmosphere.

Do not install the tester in a corrosive atmosphere or one containing sulfuric acid mist or the like. This may cause corrosion of various conductors and imperfect contact with connectors, leading to malfunction and failure, or in the worst case, a fire.

■ Do not locate the tester in a dusty environment.

Dirt and dust in the tester may cause electrical shock or fire.

■ Do not use the tester where ventilation is poor.

This tester features a forced-air cooling system. Provide sufficient space for the air inlet on the lateral side and the air outlet on the rear side to allow air to flow.

■ Do not place the tester on a tilted surface or in a location subject to vibrations.

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

■ Do not use the tester in locations affected by strong magnetic or electric fields.

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

■ Do not use the tester in locations near a sensitive measuring instrument or receiver.

Operation in a location subject, may cause such equipment may be affected by noise generated by the tester. At a test voltage exceeding 3 kV, corona discharge may be generated to produce substantial amounts of RF broadband emissions between grips on the test leadwire. To minimize this effect, secure a sufficient distance between alligator clips.

In addition, keep the alligator clips and test leadwire away from the surfaces of conductors (particularly sharp metal ends).

■ 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 moving the tester to the installation site or otherwise transporting it, take the following precautions:

■ Before moving the tester, turn off the power switch.

Transporting the tester with its POWER switch on can lead to electric shock and damage.

■ When moving the tester, Disconnect all wires from it.

Moving the tester without disconnecting the cables may result in breakage of the wire or injury due to the tester tipping over.

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

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

1.4 Checking the Line voltage and Fuse

1.4.1 Switching source voltages

⚠WARNING
- This instrument is designed to operate from the overvoltage category II. Do not operate it from the overvoltage category III or IV.
- Before turning on the power, make sure of the fuse and the source voltage agree with the LINE-VOLTAGE RANGE switch on the rear panel.

  Nominal voltage range (allowable voltage range):

  100 V to 120 V AC (85 V to 132 V AC)

  200 V to 240 V AC (170 V to 250 V AC)

  Allowable frequency range: 47 Hz to 63 Hz

⚠CAUTION
- To prevent malfunctions, be sure to operate within the line-voltage range.

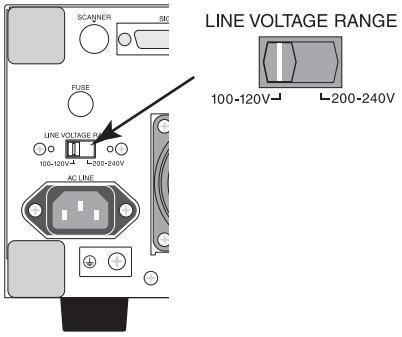


Fig.1-3 LINE-VOLTAGE RANGE switch

1.4.2 Checking and replacing fuses

⚠WARNING
- To prevent electric shock, before checking or replacing the fuse, be sure to turn off the POWER switch and unplug the AC power cord.
- Make sure that the fuse used conforms to the instrument specifications, including shape, rating, and characteristics. Using a fuse with different rating or short-circuiting, the fuse holder will damage the instrument.

1. Turn off the POWER switch, and unplug the AC power cord.
2. On the rear panel, remove the fuse holder, as shown in Fig. 1-4, by pushing it inward and unscrewing it counterclockwise using a screwdriver.

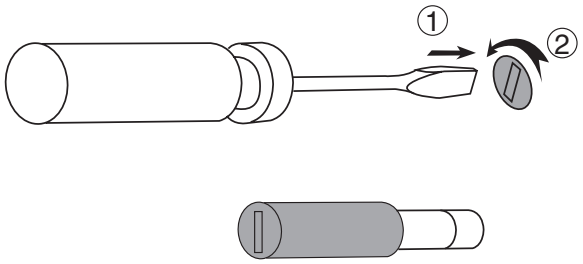


Fig.1-4 Removing the fuse holder

3. In accordance with the fuse rating specified below, check the fuse type and replace the fuse.
4. Following the above steps in the reverse order, reinstall the fuse holder.

■ Fuse rating

LINE VOLTAGE RANGE	FREQUENCY RANGE	FUSE (250V)		VA MAX
		UL198G	IEC60127	
100-120V	47-63Hz	10A SLOW	—	800
200-240V		—	6.3A (T)	

NOTE
- The pre-arcing time-current characteristic of fuses are named differently in the UL and IEC standards. Use fuses conforming to both or either of the standards.

1.5 Connecting the AC Power Cord

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

⚠WARNING

- The AC power cord for 100 V system shown in Fig. 1-5 has a rated voltage of 125 VAC. If this AC power cord is used at the line voltage of a 200 V system, replace the AC power cord with that satisfying that line voltage.
  An appropriate AC power cord must be selected by qualified personnel. If it is difficult to obtain the AC power cord, consult your Kikusui distributor/agent.

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

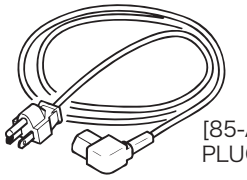
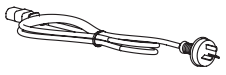
 [85-AA-0003] PLUG:NEMA5-15	Power cord for 100 V system Rated voltage: 125 VAC Rated current: 10 A
 [85-AA-0005] PLUG:CEE7/7  [85-10-0790] PLUG:GB1002	Power cord for 200 V system Rated voltage: 250 VAC Rated current: 10 A

Fig.1-5 AC power cord

Connection procedure

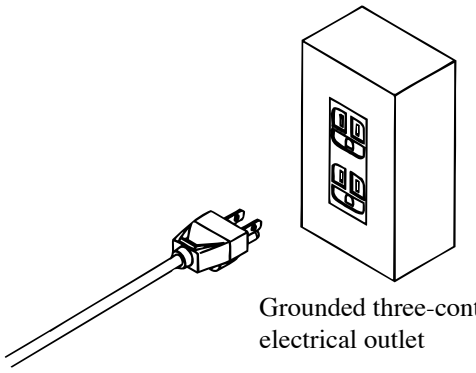
1. Confirm that the supply voltage is within the line voltage range of the tester.
2. Confirm that the POWER switch on the tester is off.
3. Connect the AC power cord to the AC LINE connector on the rear panel.
   Use the provided power code or power code that is selected by qualified personnel.
4. Plug in the AC power cord.

1.6 Grounding

⚠WARNING
- Be sure to connect the tester to an electrical ground (safety ground).
  If the output to a conveyor or peripheral device that is connected to an earth ground or a nearby commercial power line is short-circuited without grounding, the tester chassis is charged to an excessively high voltage, resulting in extreme danger.
- This tester is designed as a Class I equipment (equipment protected against electric shock with protective grounding in addition to basic insulation). Therefore, electric shock may occur without proper grounding.

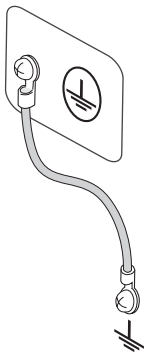
To ensure safety, be sure to ground the tester.
Choose either of the following two available methods of doing so:

1. Connect the AC power cord to a three-contact grounded electrical outlet.



Grounded three-contact ☐ electrical outlet

2. Connect the protective conductor terminal on the rear panel to the earth ground.
   Have specialized engineers select, manufacture, and install cables.
   To ensure secure connection, use proper tools.



Electrical ground (safety ground)

1.7 Checking Operations

This tester does not generate output until the protection status is cancelled by the interlock function. To quickly check operations, connect the interlock jumper (provided with this product) to the INTERLOCK connector.

⚠ WARNING

- Use the interlock jumper only to quickly cancel the protection status.

  When using this tester, use the interlock function as much as possible to ensure a safe operating environment. To use jigs in withstanding voltage or insulation resistance testing, provide a cover or other means for the DUT to prevent electric shock by cutting off the output when the cover is opened. It is also recommended that an enclosure be provided around the operating area and that output be cut off every time the door is opened.

  For details, see "4.3 INTERLOCK Connector".
- Before turning on the power, confirm that the allowable voltage range indicated on the power supply is the same as that indicated on the rear panel of the tester. For details, see "1.4 Checking the Line voltage and Fuse"
- When the power is turned on, the tester lights all LEDs on the front panel and self-diagnosis is started.

  Before starting up the tester, confirm that all LEDs are on to ensure safety. It is particularly dangerous to start a test when the DANGER lamp is broken. Note that, in self-diagnosis, even when the DANGER lamp is lighting, no output or voltage is being generated.

⚠ CAUTION

- After turning off the POWER switch, wait several seconds before turning it on. Turning the POWER switch on/off repeatedly with insufficient intervals may damage the tester.

Checking procedure

1. Confirm that the allowable voltage range indicated on the power supply is the same as that indicated on the rear panel.
2. Confirm that the AC power cord is properly connected to the AC LINE connector on the rear panel.
3. Plug in the AC power cord.
4. Turn on the POWER switch. Confirm that all LEDs on the front panel are lit.
5. Following the opening screen, display the ACW screen and confirm that the tester is kept in the PROTECTION status by the interlock function (“INTERLOCK” flickers on the LCD).
6. Turn off the POWER switch.
7. As shown in Fig. 1-7, connect the interlock jumper (provided with the product) to the INTERLOCK connector on the rear panel.
8. Turn on the POWER switch again.

9. Following the opening screen, display the ACW screen and confirm that the tester is kept in the READY status.

The above steps complete the checking procedure.

Connecting the interlock jumper

1. Insert a screwdriver into A to open B.
2. Insert the interlock jumper into B. Confirm that the cable shield is not caught in the jumper.
3. By lightly pulling on the jumper, confirm that it is connected securely.
4. Take the same steps for the positive (+) and negative (-), then short-circuit both sides.

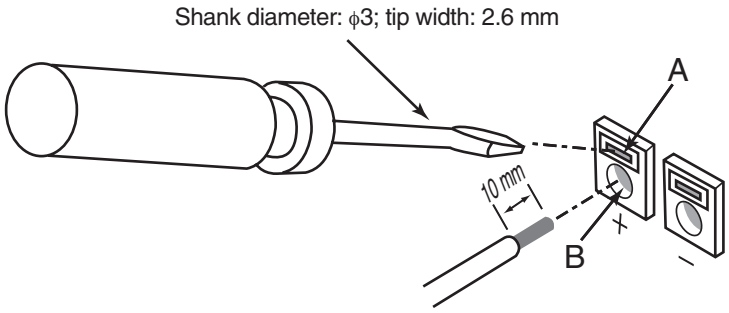


Fig.1-6Connecting the jumper

Chapter 2 Precautions on Handling

This chapter describes the precautions to be followed in the handling of this tester. When using the tester, take utmost care to ensure safety.

⚠WARNING • The tester derivers a 5 kVAC/6 kVDC test voltage which can cause human injury or death. When operating the tester, be extremely careful and observe the cautions, warnings, and other instructions given in this chapter.

2.1 Prohibited Operations

■ Do not turn on/off the power repeatedly

After turning OFF the power switch, be sure to allow several seconds or more before turning it ON again. Do not repeat turning ON/OFF the power switch rapidly –if you do this, the protectors of the tester may not be able to render their protective functions properly. Do not turn OFF the power switch when the tester is delivering its test voltage–you may do this only in case of emergency.

■ Do not short the output to the earth ground

Pay attention so that the high test voltage line is not shorted to a nearby AC line or nearby devices (such as conveyors) which are connected to an earth ground. If it is shorted, the tester chassis can be charged up to the hazardous high voltage.

Be sure to connect the protective grounding terminal of the tester to an earth line. If this has been securely done, even when the HIGH VOLTAGE terminal is shorted to the LOW terminal, the tester will not be damaged and its chassis will not be charged up to the high voltage.

Be sure to use a dedicated tool when grounding the protective grounding terminal. See "1.6 Grounding".

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

■ Do not apply an External Voltage

Do not apply a voltage from any external device to the output terminals of the tester. The analog voltmeter on the front panel cannot be used as stand-alone voltmeter. They may be damaged if their output terminals are subject to an external voltage.

2.2 Action When in Emergency

In case of an emergency (such as electric shock hazard or burning of DUT), take the following actions. You may do either (a) or (b) first. But be sure to do both.

(a) Turn OFF the power switch of the tester.

(b) Disconnect the AC power cord of the tester from the AC line receptacle.

2.3 Precautions on Testing

■ 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 Kikusui distributor/agent for them.

■ Precautions for Pausing Tests

When changing test conditions, press the STOP switch once to take precautions. If you are not going to resume the test soon or if you are leaving the Test area, be sure to turn-OFF the POWER switch.

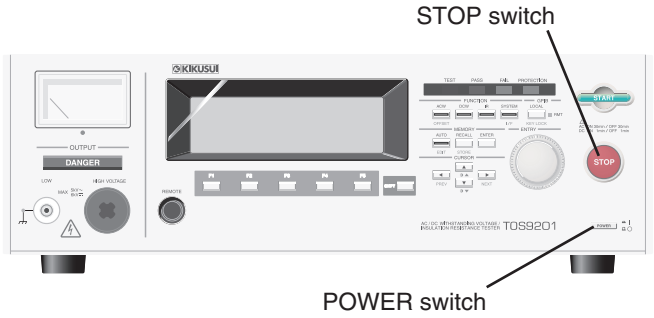
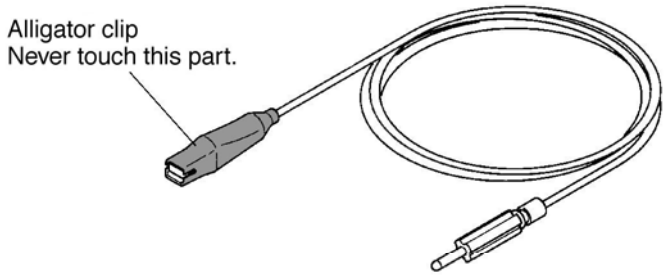


Fig.2-1 Suspending testing and operation

■ Items Charged Up to Dangerous High Voltages

When in test, the DUT, test leadwires, probes, and output terminals and their vicinities can be charged up to dangerous high voltages. Never touch them when in test.

⚠WARNING • The vinyl sheaths of the alligator clips of the test leadwires which are supplied accompanying the tester have no sufficient insulation for the high test voltages. Never touch them when in test.



■ Matters to be Sure of After Turning-OFF Power

If you have to touch the DUT, test leadwires, probes, and/or output terminals and their vicinities for re-connections or other reasons, be sure of the following two matters.

(a) The analog voltmeter indicates "zero."

(b) The DANGER lamp has gone out.

■ Warnings for Remote Control

Be extremely careful when operating the tester in the remote control mode in which the dangerous high test voltage is ON/OFF-controlled remotely. Provide protective means as follows:

- **Provide means to assure that the test setup does not become the test voltage is being delivered by inadvertent operation.**
- **Provide means to assure that none can touch the DUT, test leadwires, probes, output terminals and their vicinities when the test voltage is being delivered.**

2.4 Warning for Residual High Voltages

⚠WARNING
- In DC withstanding voltage testing and insulation resistance testing, the test leadwire, test probe, and DUT are charged to a high voltage. The tester is equipped with a discharge circuit, but some time is nonetheless required to discharge them after the output is cut off. There is a danger of electric shock during discharge. To avoid electric shock, take the utmost care to ensure that the DUT, test leadwire, probe, and highly charged parts around the output terminal are not touched. If it is necessary to touch them, be sure to confirm both (a) and (b):

  (a) The analog voltmeter indicates “zero.”
  (b) The DANGER lamp has gone out.

- As soon as the output is cut off, the tester’s discharge circuit starts forced discharging. Do not disconnect the DUT during a test or prior to completion of discharging.

Discharge time

The length of the discharge time varies according to the properties of the DUT and the test voltage.

Discharge is conducted at a resistance of approximately 125 kΩ in DC withstanding voltage testing, and at 25 kΩ in insulation resistance testing.

When no DUT is connected, the tester itself requires the following lengths of time to reduce the internal capacitor voltage to 30 V.

- Insulation resistance testing at 1000 V: Approximately 0.5 ms
- DC withstanding voltage testing at 6 kV: Approximately 5 ms

Assuming that a 0.05 μF capacitor is tested, the following lengths of time are required to reduce the charge to 30 V.

- Insulation resistance testing at 1000 V: Approximately 5 ms
- DC withstanding voltage testing at 6 kV: Approximately 40 ms

If the DUT is disconnected during a test or before the completion of discharging, assuming that the DUT has a capacity of 0.01 μF and a parallel resistance of 100 MΩ, approximately 5.3 seconds at 6 kV and approximately 3.5 seconds at 1 kV are required for the DUT to discharge to 30 V.

When the approximate time constant of the DUT is known, the time required for discharging to 30 V after the output is cut off is calculated as the time constant times the value given above.

2.5 Dangerous States of Failed Tester

Typical possible dangerous states of the tester are as shown below and in which cases the most dangerous situation that **"the high test voltage remains delivered and won't be turned off!"** may occur. When this situation has occurred, immediately turn OFF the power switch and disconnect the AC power cable from the AC line receptacle.

- **The DANGER lamp does not go out despite you have pressed the STOP switch.**
- **The DANGER lamp does not light up despite the pointer of the analog voltmeter is deflected indicating that the output voltage is being delivered.**

Also when the tester is in other malfunctioning states than the above, there is a possibility that the output voltage is delivered irrespective of your proper operating procedure. Never use the tester when it has failed.

⚠ WARNING
- Keep the tester away of other people until you call our service engineer for help.
- Immediately call Kikusui distributor/agent. It is hazardous for an unqualified person to attempt to troubleshoot any tester problem.

2.6 To Ensure Long-Term Use Without Failures

The withstanding voltage-generating block of the tester is designed to release half the rated amount of heat, in consideration of the size, weight, cost, and other factors of the tester. The tester must therefore be used within the ranges specified below. If you deviate from these ranges, the output block may be heated to excess, activating the internal protection circuit. Should this happen, wait until the temperature returns to the normal level.

Output requirements for withstanding voltage testing

Ambient temperature	Upper current		Pause	Output time
t ≤ 40 ˚C	AC	50< i ≤ 110 mA	At least as long as the output time	Maximum of 30 minutes
		i ≤ 50 mA	Not necessary	Continuous output possible
	DC	5< i ≤ 11 mA	At least as long as the output time	Maximum of 1 minute
		i ≤ 5 mA	At least as long as the judgement wait time (WAIT TIME)	Continuous output possible

(Output time = voltage rise time + test time + voltage fall time)

2.7 Daily Checking

To avoid accidents, confirm at least the following before starting operation:

- The tester is connected to an earth ground.
- The coating of the high-voltage test leadwire is free from cracks, fissures, and breakage.
- The high-voltage test leadwire is not broken.
- The tester generats FAIL signal when the ends of the low-voltage test leadwire and high-voltage test leadwire are short-circuited.

Chapter 3 Basic Operations

This chapter describes the procedures for conducting withstanding voltage and insulation resistance tests.

3.1 Turning on the Power

⚠ WARNING

- This tester does not generate output until the protection status is cancelled by the interlock function. The tester can be activated temporarily using the interlock jumper (provided with the product). Before starting a test, read "4.3 INTERLOCK Connector" for the procedure for starting up the tester using the interlock function.
- Before turning on the power, be sure to confirm that the allowable voltage range shown on the power supply is the same as that indicated on the tester's rear panel. For details, see "1.4 Checking the Line voltage and Fuse".
- To prevent electric shock, be sure to turn off the POWER switch before connecting/disconnecting the SIGNAL I/O, GPIB, and RS-232C cables.
- As soon as the power is turned on, all LEDs of the tester light up, and self-diagnosis is started.

  To ensure safety, confirm before starting up the tester that all LEDs are lit. It is particularly dangerous to start a test when the DANGER lamp is broken. Even when the DANGER lamp is lit, no output or voltage is being generated.

⚠ CAUTION

- When the POWER switch has been turned off, wait several seconds before turning it on again. Turning the POWER switch on/off repeatedly at insufficient intervals may damage the tester.

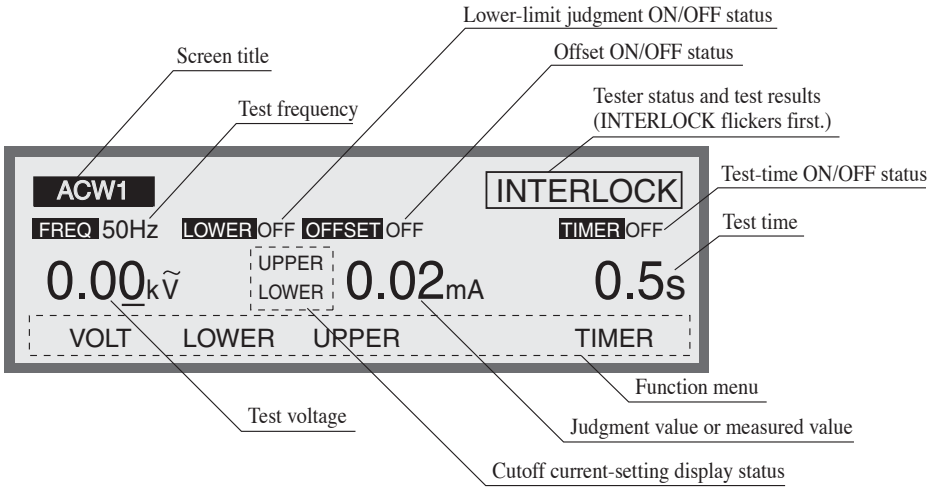
NOTE

- Even after the power is turned on, the tester does not start a test if the settings are invalid or the tester is in the protection status. For details on the invalid settings and protection status, see "3.15 Invalid Settings" and "3.16 Protection".

Turning on the power

1. Confirm that the allowable voltage range shown on the power supply is the same as that indicated on the tester's rear panel.
2. Confirm that the AC power cord is properly connected to the AC LINE connector on the rear panel.
3. Plug in the AC power cord.
4. Turn on the tester's POWER switch.

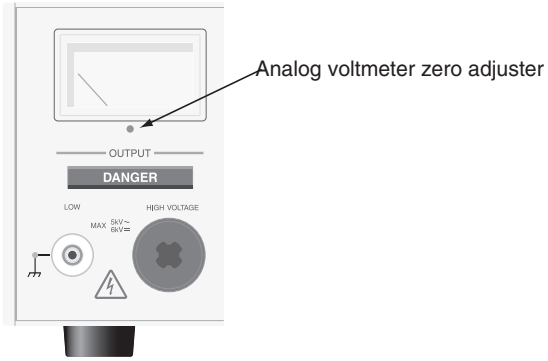
   Following the opening screen that displays the ROM version and other information, the LCD displays the last screen displayed when the POWER switch was turned off in the previous test. The first time the POWER switch is turned on following the delivery of the product, the tester is placed in the PROTECTION status by the interlock function.



3.2 Pre-Test Zero Adjustment

Before starting a test, perform zero adjustment on the analog voltmeter. Perform the following procedure:

1. Turn off the POWER switch.
2. Confirm that the analog voltmeter indicates "0." Otherwise, adjust the analog-voltage zero adjuster until the voltmeter indicates "0."



3.3 Structure of LCD Screen

The tester's LCD screens are composed of setting screens and execution screens, as shown in Fig. 3-1. On the setting screens, settings can be made for the tester and test conditions or automatic testing can be programmed. The execution screens indicate the test status.

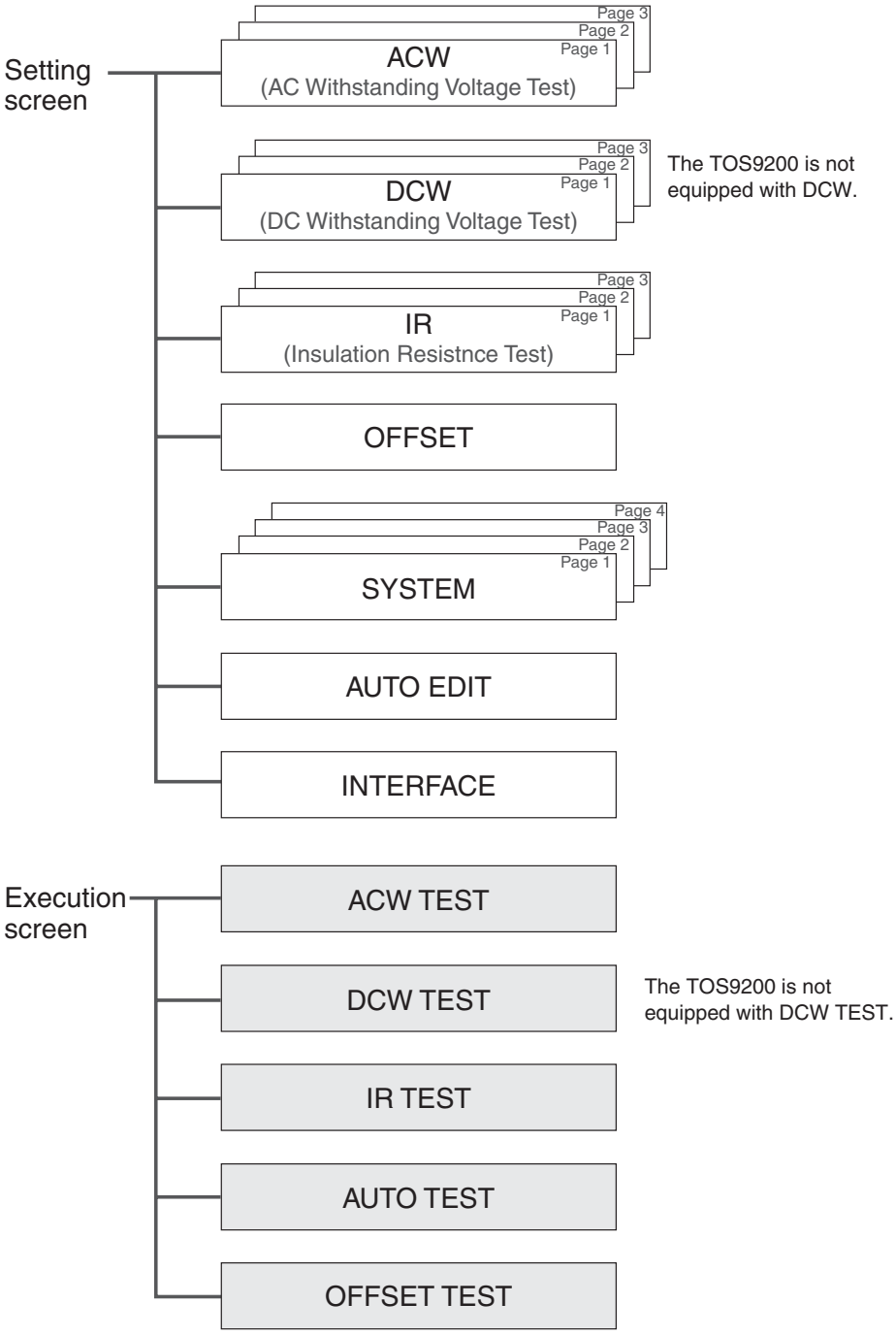


Fig.3-1 Structure of the LCD screen

3.4 Settings for AC Withstanding Voltage Testing

To make settings for an AC withstanding voltage test, use the AC withstanding voltage test screen (ACW). To jump to this screen (ACW1), press the ACW key. The LED on the ACW lights up.

The AC withstanding voltage test screen has three pages from ACW1 to ACW3. To move between these pages, press the SHIFT key + ◀ ▶ keys. To return to ACW1 from ACW2 or ACW3, press the ACW key.

NOTE

- No setting is permitted in the KEYLOCK status.

The three ACW pages allow the following settings to be made:

ACW1

- Test voltage
- Test frequency
- Lower current (LOWER) and ON/OFF of the lower judgement function
- Upper current (UPPER)
- ON/OFF of the offset function
- Test time (TEST TIME) and ON/OFF of the timer function

ACW2

- Start voltage
- Voltage rise time (RISE TIME)
- Voltage fall time (FALL TIME)
- Output-voltage range
- SLOW/MID/FAST settings for the current detection response (RESPONSE)
- LOW/GUARD settings for the GND

ACW3

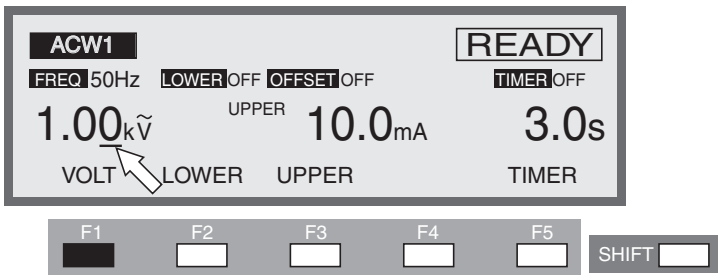
- Channel settings for the high-voltage scanner
- ON/OFF of the contact check function

To move the cursor between items, use the ▲ ▼ ◀ ▶ keys.

When a function is shown on keys F1 to F5, they can be used to jump to the target item. To make settings for the items to be displayed on these keys, press the SHIFT key + F1 to F5 keys.

3.4.1 Settings on the ACW1 Screen

Settings for AC withstanding voltage testing



The test voltage to be applied to a DUT can be set between AC 0.00 kV and 5.20 kV (at a resolution of 0.01 kV).

To make a setting, use the rotary knob with the cursor at the test voltage.

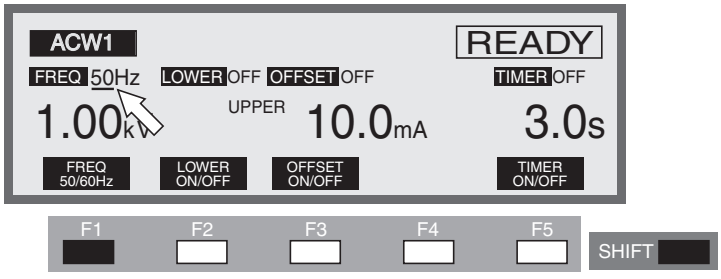
1. If the cursor is not at the test voltage, press the F1 (VOLT) key to bring the cursor to the test voltage (the ▲ ▼ ◀ ▶ keys can also be used).
2. Move the cursor to the target digit using the ◀ ▶ keys.
3. Set a test voltage using the rotary knob.

NOTE

- When settings are being made, if the test voltage multiplied by the upper current exceeds 550 VA, "READY" disappears and "OVER 550VA" flickers at the top right of the LCD to indicate that testing cannot be performed.

  In such a case, reduce the test voltage or the upper current.
- If the output voltage range is at AUTO and the test voltage is 2.6 kV or less, the 2.5 kV range is selected automatically. It is therefore impossible to change the voltage to more than 2.6 kV during the test.

Setting the frequency



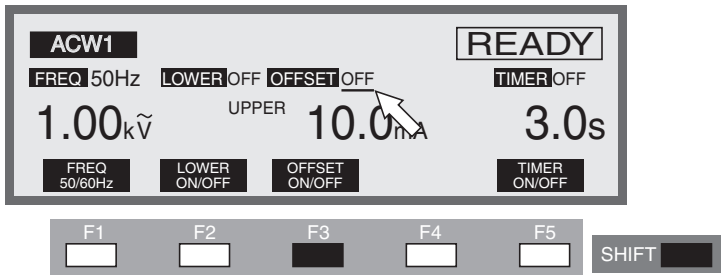
The frequency of the test voltage can be set to either 50 Hz or 60 Hz. The test frequency can be set using the SHIFT + F1 keys (press the F1 key while pressing the SHIFT key), regardless of where the cursor is positioned. Every time the SHIFT + F1 keys are pressed, the setting alternates between 50 Hz and 60 Hz.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to the test frequency. When the cursor is at the test frequency, the rotary knob can be used to make settings.

Turn the rotary knob clockwise: 60 Hz

Turn the rotary knob counterclockwise: 50 Hz

Turning the lower judgement function ON/OFF



The lower judgement function can be turned on/off.

When the lower judgement function is on, the test result is judged to be FAIL if the measured current drops below the lower current, and the test is ended.

The lower current is explained in the following section. The lower judgement function can be set to ON/OFF using the SHIFT + F2 keys, regardless of where the cursor is positioned.

Every time the SHIFT + F2 keys are pressed, the setting alternates between ON and OFF. The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the lower judgement function. If the cursor is at the ON/OFF of the lower judgement function, the rotary knob can be used to make settings.

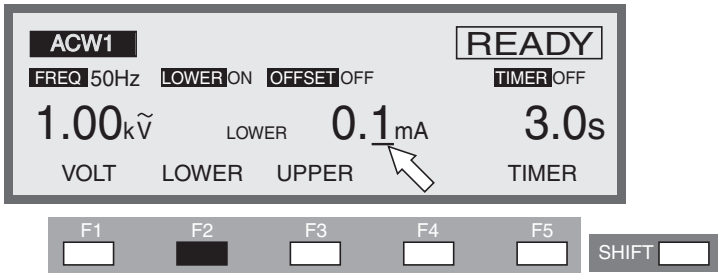
Turn the rotary knob clockwise: ON

Turn the rotary knob counterclockwise: OFF

NOTE

- In AC withstanding voltage testing, the maximum rated current of 100 mA is not attained at a test voltage of 200 V or less. If outputs are short-circuited during the test at a test voltage of 200 V or less and an upper judgement of 100 mA or more is made, the test result may not be judged as FAIL, thus activating the output-voltage monitor function.

Setting the lower current (LOWER)



The lower current can be set between 0.01 mA and 110 mA (at a resolution of 0.01 mA for 0.01 mA to 9.99 mA, 0.1 mA for 10.0 mA to 99.9 mA, and 1 mA for 100 mA to 110 mA).

When the cursor is at the lower current, the rotary knob can be used to make settings. When the lower judgement function is set to ON and the measured current is at or below the lower current, the test ends with a FAIL judgement.

When the fluctuations of the leakage current of the DUT are limited and exceed the current by a sufficient amount to permit the tester to make a judgement, set the lower current below the smallest fluctuation. By making such a setting, it is possible to identify a DUT that generates a small leakage current and even detect disconnection and failed contact in the test leadwire, ensuring an accurate withstanding voltage test. If the lower judgement function is not to be used, turn it off.

1. To display the lower current, press the F2 key (LOWER). While the lower current is displayed, the cursor can be moved using the ▲ ▼ ◀ ▶ keys.
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the lower current.

NOTE

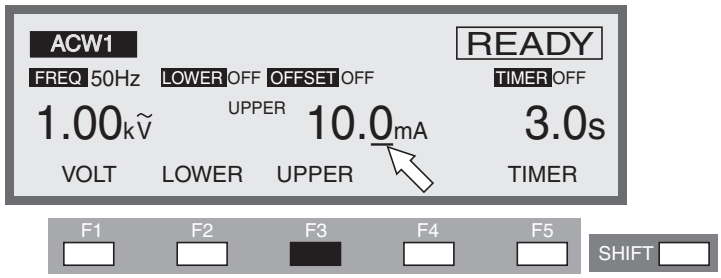
- If the lower current is set at or above the upper current while the lower judgement function is on, “READY” disappears and “UP<=LOW” flickers at the top right of the LCD to indicate that testing cannot be performed (the lower current is factory-set to 0.10 mA).

  Lower the lower current or raise the upper current.

  The invalid settings shown above have the priority specified in "3.15 Invalid Settings". When there are two or more invalid settings, messages with higher priority may be displayed first.
- As described in "Chapter 8 Specifications", in a high-sensitivity and high-voltage test using an alternating current, a current larger than the lower current may flow into the stray capacity of the test leadwire and other components, making it impossible to conduct lower judgement. No current flows into a DUT if it is not connected to the tester. Thus, the current flowing into the DUT is smaller than the lower current. The test may then be judged as FAIL. Nonetheless, if a current larger than the lower current flows into the stray capacity, the current detection circuit detects the current and makes a PASS judgement. Carefully check combined judgement errors. In addition, disconnect the DUT under preset test conditions and confirm that a FAIL judgement is possible.
- No lower judgement is made while the voltage is rising or falling.

Setting the upper current (UPPER)

⚠ CAUTION • If the upper current is set above 50 mA, the protective circuit may be activated. To avoid this, set the output time to 30 minutes or less and provide a pause longer than the output time.



The upper current can be set between 0.01 mA and 110 mA (at a resolution of 0.01 mA for the 0.01 mA to 9.99 mA range, 0.1 mA for the 10.0 mA to 99.9 mA range, and 1 mA for the 100 mA to 110 mA range).

When a current exceeding the upper current is detected, the test ends with a FAIL judgement.

When the cursor is at the upper current, the rotary knob can be used to make settings.

1. To display the upper current, press the F3 key (UPPER). (When the upper current is displayed, the cursor can be moved using the ▲▼◀▶ keys.)
2. Using the ◀ ▶keys, move the cursor to the target digit.
3. Using the rotary knob, set the upper current.

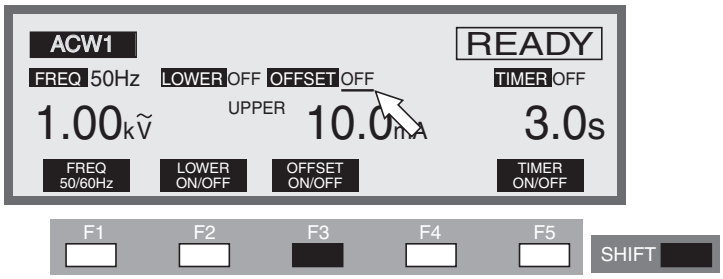
NOTE • If the upper current is set at or below the lower current while the lower judgement function is on, “READY” disappears and “UP<=LOW” flashes at the top right of the LCD to indicate that testing cannot be performed. (The upper current is factory-set to 0.20 mA.)

Lower the lower current, raise the upper current, or turn off the lower judgement function.

• When settings are being made, if the test voltage multiplied by the upper current exceeds 550 VA, “READY” disappears and “OVER 550 VA” flashes at the top right of the LCD to indicate that testing cannot be performed.

In such a case, reduce the test voltage or the upper current.

Turning the offset cancel function ON/OFF



The offset cancel function can be turned on/off. When it is on, this function displays the difference calculated by subtracting from the measured value the offset value recorded by the function ("3.9 Offset Cancel Function").

NOTE

- To use the recorded offset value, make the same settings for the frequency, LOW/GUARD of the GND, and the scanner as were made for the offset value.

  Each time the test voltage is changed, the recorded offset value is converted to reflect the change.

  For details, see "3.9 Offset Cancel Function".

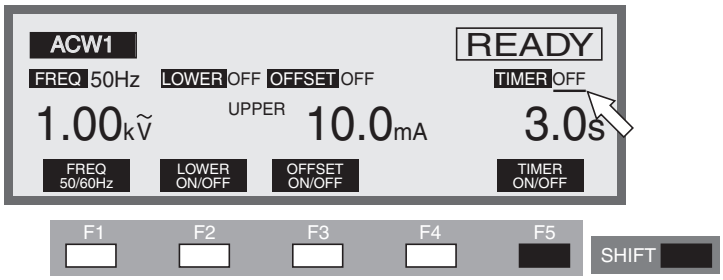
The offset cancel function can be set to ON/OFF using the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the offset cancel function. If the cursor is at ON/OFF of the offset cancel function, the rotary knob can be used to make settings.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Turning the timer ON/OFF



Make ON/OFF settings for the timer function.

When the timer function is turned on, the test time can be controlled as shown in "Setting the test time" in the next section. When the preset test time has elapsed with a recorded leakage current between the lower and upper currents, the test ends

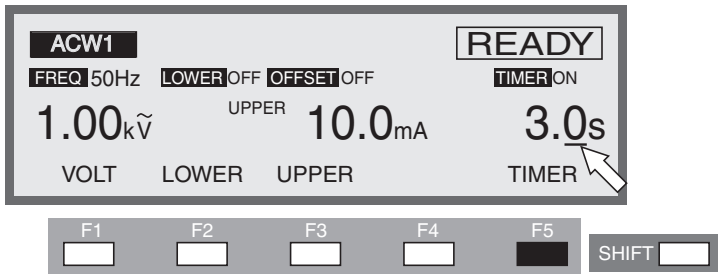
with a PASS judgement. The timer function can be set to ON/OFF using the SHIFT + F5 keys, regardless of the location of the cursor. Each time the SHIFT + F5 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the timer function. When the cursor is at ON/OFF of the timer function, the rotary knob can be used to make settings.

Turn the rotary knob clockwise : ON
Turn the rotary knob counterclockwise : OFF

Setting the test time (TEST TIME)

⚠ CAUTION • If the upper current is set above 50 mA, the protective circuit may be activated. To avoid this, set the output time to 30 minutes or less and provide a pause longer than the output time.



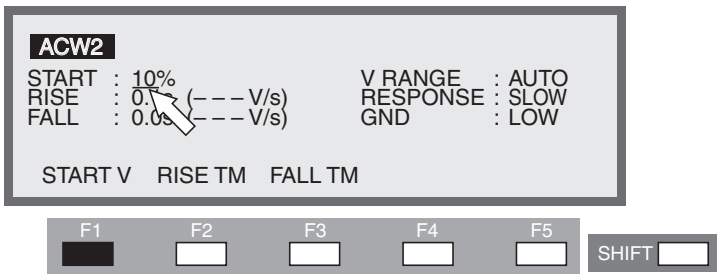
The time for which a preset voltage is applied to the DUT can be set to 0.3 s through 999 s (at a resolution of 0.1 s for the 0.3 s to 99.9 s range and 1 s for the 100 s to 999 s range).

When the cursor is at the test time, the rotary knob can be used to make settings.

1. To move the cursor to the timer, press the F5 key (TIMER). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the test time.

3.4.2 Settings on the ACW2 screen

Setting the start voltage



For an AC withstanding voltage test, set the start voltage as a percentage of the test voltage, to 0% through 99% (at a resolution of 1%). When the cursor is located to the right of START, settings can be made using the rotary knob.

1. To move the cursor to the right of START, press the F1 key (START V). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the rotary knob, set the start voltage.

NOTE

- When the start voltage is set to 1% or more, approximately 100 ms is required for the tester to reach the start voltage from 0 V.

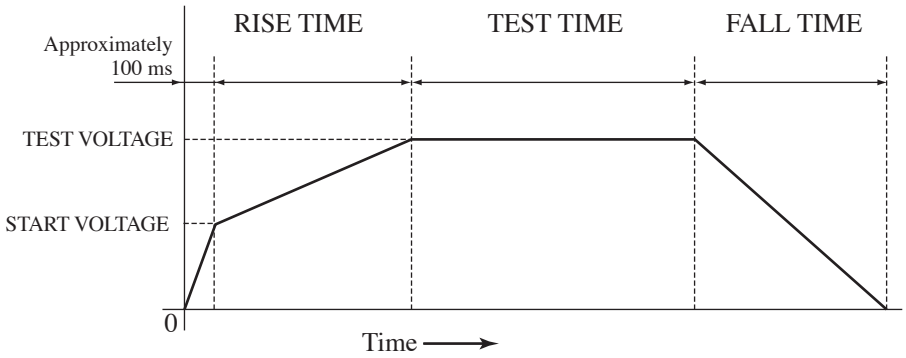
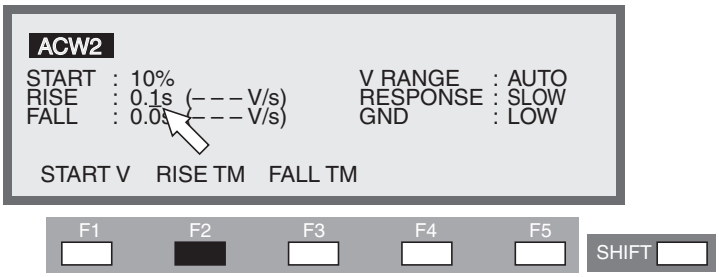


Fig.3-2 Start voltage (ACW)

Setting the voltage rise time (RISE TIME)



The rise time between the start voltage and the test voltage can be set to 0.1 s through 200 s (at a resolution of 0.1 s for the 0.1 s to 99.9s range and 1 s for the 100 s to 200s range).

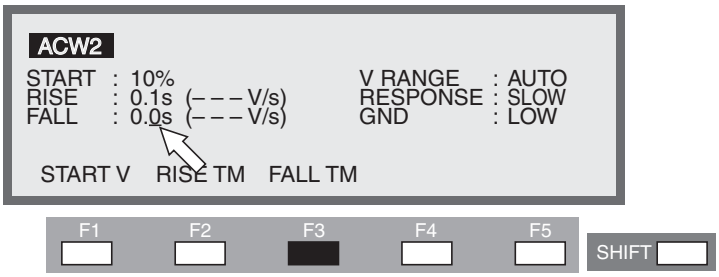
When the cursor is to the right of RISE, settings can be made using the rotary knob.

1. To move the cursor to the right of RISE, press the F2 key (RISE TM). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the rise time.

The figure (V/s) in parentheses represents the voltage increase per second calculated for reference using the preset value.

If the value cannot be displayed in three digits, "---"is displayed instead.

Setting the voltage fall time (FALL TIME)



When the test ends with a PASS judgement, the voltage falls to 0 V during the preset voltage fall time. This voltage fall time can be set to 0.0 s through 200 s (at a resolution of 0.1 s for the 0.1 s to 99.9s range and 1 s for the 100 s to 200s range).

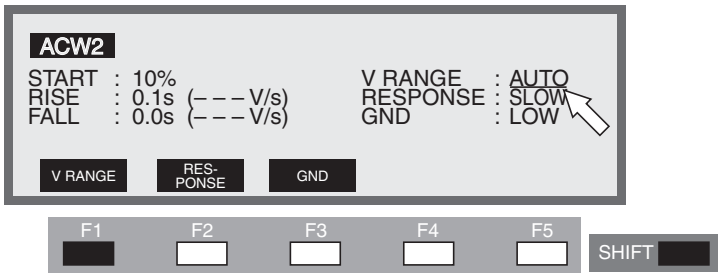
When the cursor is to the right of FALL, settings can be made using the rotary knob.

1. To move the cursor to the right of FALL, press the F3 key (FALL TM). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the fall time.

The figure (V/s) in parentheses represents the voltage fall per second calculated for reference using the set value.

If the value cannot be displayed in three digits, "---" is displayed instead.

Setting the output-voltage ranges (V RANGE)



Switch the output-voltage ranges.

For the output-voltage range, select between AUTO and 5 kV.

The 5-kV range can be changed at any time up to 5.20 kV.

The AUTO range automatically selects either the 2.5 kV range or the 5 kV range, as it is selected in the pre-test settings. If the pre-test setting exceeds 2.6 kV, the 5 kV range is selected. Otherwise, the 2.5 kV range is selected. Once the 2.5 kV range has been selected, the voltage cannot be reset above 2.6 kV during the test.

To run a test at or below 2.6 kV, it is recommended that the AUTO range be selected to prevent the application of an unnecessarily large voltage.

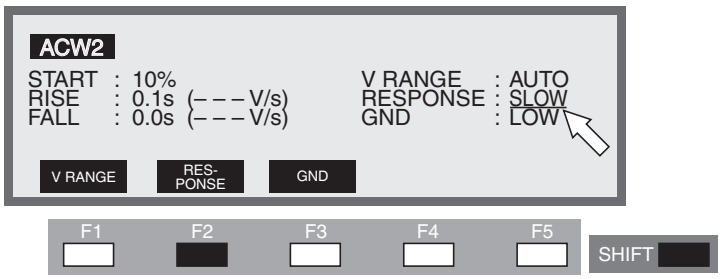
The output-voltage ranges can be switched using the SHIFT + F1 keys (V RANGE), regardless of the location of the cursor. Each time the SHIFT + F1 keys are pressed, AUTO and 5 kV alternate.

Using the ▲ ▼ ◀ ▶ keys, move the cursor to the right of the output-voltage range (V RANGE), and make settings using the rotary knob.

Turn the rotary knob clockwise : 5 kV

Turn the rotary knob counterclockwise : AUTO

Setting the current detection response (RESPONSE)



By changing the integrated time constant of the current detection circuit, switch the current detection response for UPPER FAIL judgement.

Integrated time constant

- SLOW : Approximately 40 ms
- MID : Approximately 4 ms
- FAST : Approximately 0.4 ms

The current detection response can be set using the SHIFT + F2 keys (RESPONSE), regardless of the location of the cursor. Each time the SHIFT + F2 keys are pressed, the selection is switched among SLOW, MID, and FAST, in order.

Using the ▲ ▼ ◀ ▶ keys, move the cursor to the right of the current detection response (RESPONSE), and make settings using the rotary knob.

Turn the rotary knob clockwise : SLOW → MID → FAST

Turn the rotary knob counterclockwise : FAST → MID → SLOW

■ SLOW

In the SLOW mode, a current is detected at an integrated time constant of approximately 40 ms in response to the mean value. This is equivalent to the current-detection response of Kikusui's general-purpose AC withstanding voltage tester. This setting complies with the dielectric breakdown detection defined in the safety standards, and can be used to conduct withstanding voltage testing of ordinary electric devices and electronic components.

NOTE

- According to the safety standard (IEC60950 1999), "dielectric breakdown is regarded to have occurred when, as a result of the application of a test voltage, the flowing current sharply increases beyond control, that is, it becomes impossible to maintain the flowing current below a certain level. Coronal discharge or instantaneous flashover is not regarded as dielectric breakdown." In accordance with this standard, Kikusui's general-purpose AC withstanding voltage tester makes a FAIL judgement for a test if the tester, having a mean-value-responsive current-detection circuit, detects a current above the upper current (UPPER) flowing into a DUT.

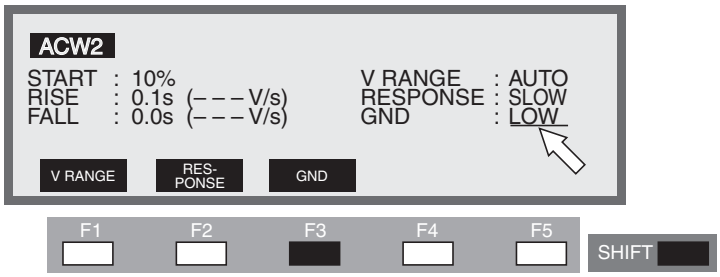
■ MID, FAST

MID and FAST, with integrated time constants of approximately 4 ms and 0.4 ms, respectively, detect currents in response to the mean value, similarly to peak detection. These two modes respond more quickly than the SLOW mode, making them suitable for the detection of an instantaneous discharge, as well as a discharge containing high-frequency elements. Due to their excellent ability to detect the upper current, they are effective in withstanding voltage tests on DUTs that are prone to dielectric breakdown, such as small electronic devices. However, the two modes are not always useful in repeatable withstanding voltage tests, as they detect even a minimal discharge.

⚠ CAUTION

- Even in the FAST mode, minimal discharges are sometimes not detected. This tester is designed for conducting withstanding voltage tests on electric devices and electronic components under a safety standard. It has a transformer capacity of 500 VA with a short-circuit current of 200 mA. Therefore, the tester may destroy some types of electronic components such as small relays and semiconductors, even if the tester is capable of detecting dielectric breakdowns by monitoring an overcurrent.

Setting LOW/GUARD for the GND



You can select either of the following two measurement modes;

the LOW mode that the GND is connected to the tester's LOW terminal,

the GUARD mode that the GND is used as guard.

In both modes, the tester detects the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT. In the LOW mode, the LOW terminal is connected to the chassis. This leads to the problem that the stray capacity and insulation resistance existing between the test leadwire or jigs and the earth are included in the measurement. Nonetheless, the GND mode ensures safe testing, as it does not short-circuit the ammeter.

In the GUARD mode, on the other hand, only the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT is measured, and the influence of the stray capacity and insulation resistance existing between the test leadwire or jigs and the earth is eliminated. For this reason, the GUARD mode is effective in measurements that require high sensitivity and high accuracy. At the same time, however, the ammeter can be short-circuited, posing a grave danger if the LOW terminal and the chassis are short-circuited when part of the DUT is connected to an earth ground. If it is possible that the DUTs and jigs are grounded, select the LOW mode.

To switch between the two modes, use the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, LOW and GUARD alternate.

Using the ▲ ▼ ◀ ▶ keys, move the cursor to the right of GND; settings can then be made using the rotary knob.

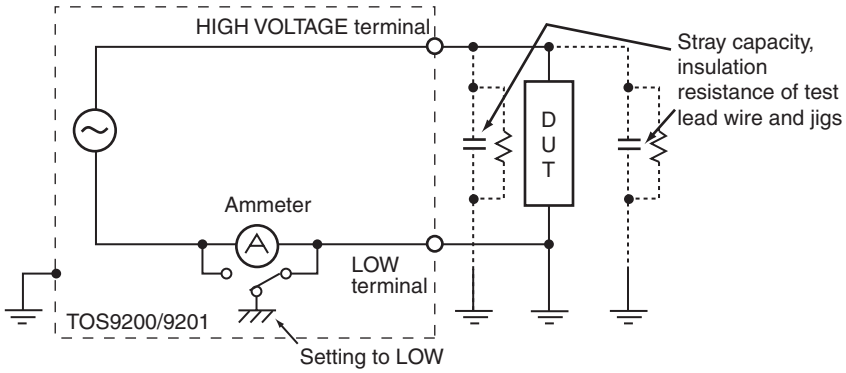
Turn the rotary knob clockwise : GUARD

Turn the rotary knob counterclockwise : LOW

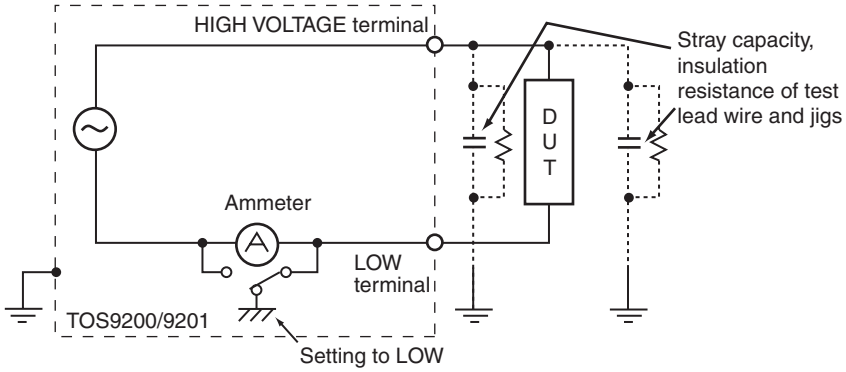
When LOW is selected, the LED to the left of the LOW terminal lights up.

■ LOW

In the LOW mode, the current which flows through the LOW terminal by stray capacity and insulation resistance of the test leadwire and jigs is included in measurements, as shown in Fig. 3-3 (A) and (B). However, the ammeter is protected from short-circuiting, thereby ensuring safe testing regardless of whether the DUT is grounded. For this reason, it is recommended that LOW be set in ordinary tests.



(A) DUT grounded



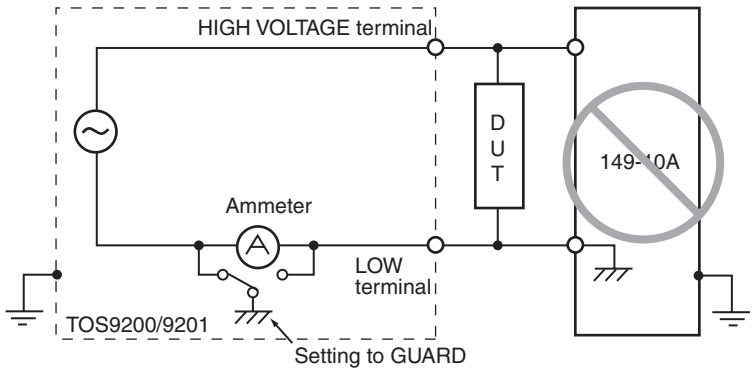
(B) DUT not grounded

Fig.3-3 Selecting LOW

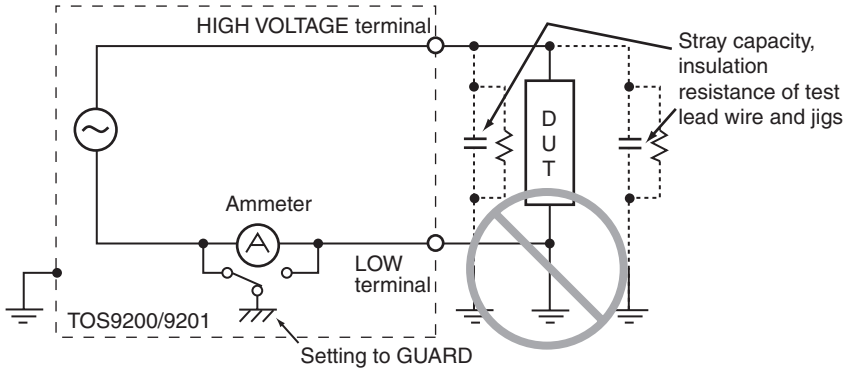
■ GUARD

⚠WARNING

- If it is not known whether the DUT or jig is grounded, never select GUARD. If GUARD is selected while the DUT is grounded, the ammeter will be short-circuited, thereby disabling measurement and posing a grave danger. See Fig. 3-4 (B).
- If GUARD is selected, do not connect this tester to any measuring instruments or other devices that involve single-side grounding, such as Kikusui's high-voltage digital voltmeter 149-10A or current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-4 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-4 Dangerous connection

⚠CAUTION • If the LOW terminal of this tester is connected to the HIGH or LOW terminal of the earth continuity tester TOS6200, the ammeter will be subject to measurement errors if GUARD is selected, as the resistor inside the TOS6200 is connected in parallel to the tester's ammeter. Therefore, to use the TOS6200, avoid connecting these terminals or select LOW.

Select GUARD only when DUTs such as small electronic components and jigs are completely "floating" electrically.

The GUARD mode enables high-sensitivity, high accuracy measurements to be made, as it excludes the current by stray capacity and insulation resistance of the test leadwire and jigs.

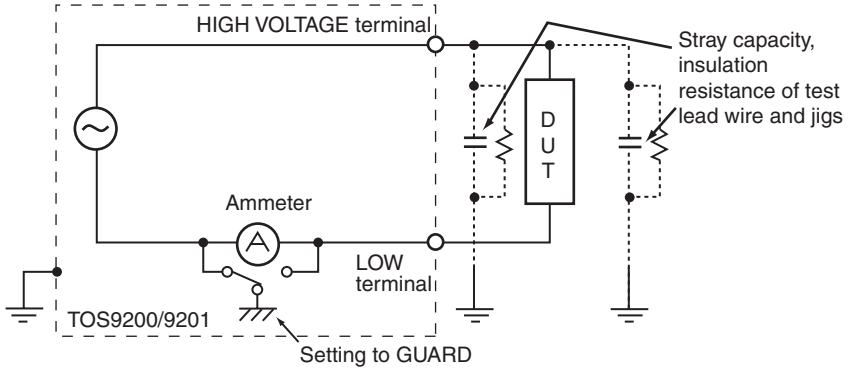
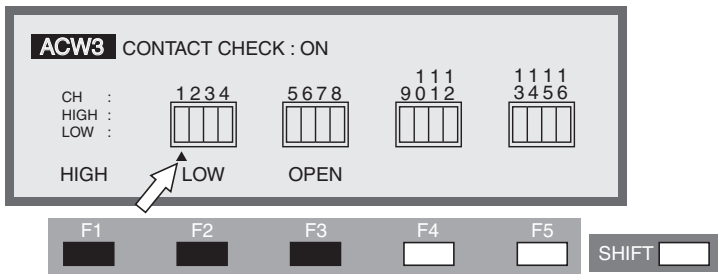


Fig.3-5 Selecting GUARD

3.4.3 Settings on the ACW3 screen

Channel settings for the high-voltage scanner



Make settings with the optional scanner connected.

Each channel can be set to HIGH, LOW, or OPEN.

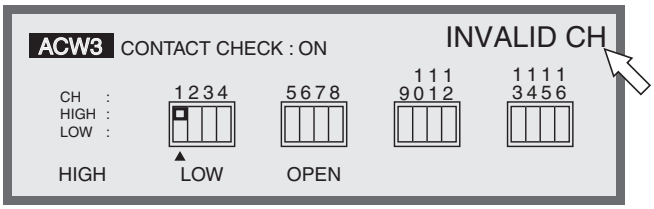
Use the ◀ ▶ keys to move the cursor (▲) to a channel, and then use the F1, F2, and F3 keys to make settings.

If the channel has already been specified, settings can be made using the rotary knob.

All channels can be opened using the SHIFT + F1 keys, regardless of the location of the cursor.

NOTE

- If an unconnected channel is selected, "INVALID CH" flashes on the LCD.



⚠ WARNING

- If the test leadwire is not connected to the DUT, do not leave the test leadwire connected to the scanner's output terminal.

  The TOS9220 scanner does not have a contact check function to check connections to the DUT. If the tester is set to the high-voltage (HIGH) level, a test can be started using a channel with the test leadwire not connected to the DUT.

NOTE

- To clearly indicate the relationships between the connected test leadwire and the channel, affix the Channel Display Seal (provided for the scanner) to the test leadwire.

Turning the contact check ON/OFF

When the optional high-voltage scanner TOS9221 (with a contact check function) is connected to the tester, the continuity between the test leadwire and the DUT can be checked using the HIGH or LOW terminal prior to the application of a test voltage. To do so, turn on the contact check function.

With the high-voltage scanner TOS9220, a check of the continuity is conducted up to the inside of the scanner only.

To turn the contact check function on/off, use the SHIFT + F5 keys.

Each time the SHIFT + F5 keys are pressed, ON and OFF alternate, regardless of the location of the cursor. The cursor moves to CONTACT CHECK.

Using the ▲ key, move the cursor to the right of CONTACT CHECK. Settings can also be made using the rotary knob.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Press the ACW key to return to the ACW1 screen, and then press the START switch.

READY will then disappear from the LCD, and a contact check will start for each channel.

The test starts as soon as the continuity is confirmed, and continues until the test time preset on the timer has elapsed or the STOP switch is pressed.

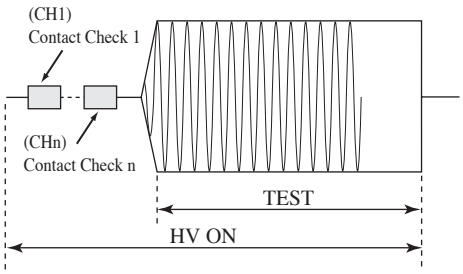
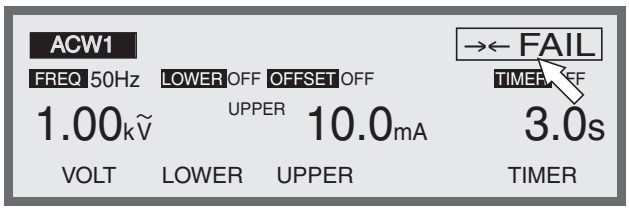


Fig.3-6 Contact check

The contact check time is calculated using the following formula:

Contact check time = 260 ms + 60 ms x (number of channels set to HIGH or LOW)

When a continuity error is detected in a contact check, " →← FAIL" appears at the top right of the LCD. On the high-voltage scanner, the LED of the failed channel lights up in orange.



3.5 Settings for DC Withstanding Voltage Testing (TOS9201 only)

To make settings for a DC withstanding voltage test, use the DC Withstanding Voltage-Test Setting screen (DCW).

To jump to this screen (DCW1), press the DCW key. The LED on the DCW key lights up.

The DC Withstanding Voltage-Test Setting screen has three pages, from DCW1 to DCW3. To move between these pages, press the SHIFT key + ◀ ▶ keys. To return to DCW1 from DCW2 or DCW3, press the DCW key.

NOTE

- No setting can be made in the KEYLOCK status.

The three DCW pages allow the following settings to be made:

DCW1

- Test voltage
- Lower current (LOWER) and ON/OFF of the lower judgement function
- Upper current (UPPER)
- Test time (TEST TIME) and ON/OFF of the timer function

DCW2

- Start voltage
- Voltage rise time (RISE TIME)
- Judgement wait time (WAIT TIME)
- LOW/GUARD settings for the GND

DCW3

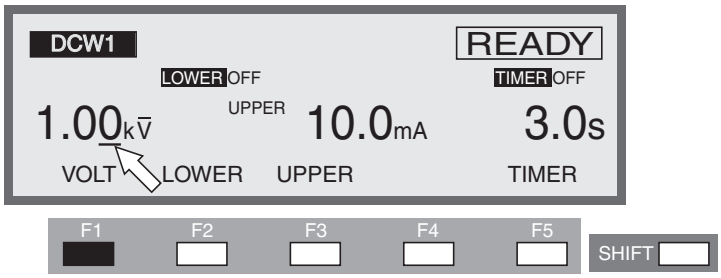
- Channel settings for the high-voltage scanner
- ON/OFF of the contact check function

To move the cursor between items, use the ▲ ▼ ◀ ▶ keys.

When a function is shown on the F1 to F5 keys, they can be used to jump to the target item. To make settings for items displayed on these keys, press the SHIFT key + F1 to F5 keys.

3.5.1 Settings on the DCW1 screen

Setting the test voltage for DC withstanding voltage testing



The test voltage to be applied to a DUT can be set to DC 0.00 kV through 6.10 kV (at a resolution of 0.01 kV).

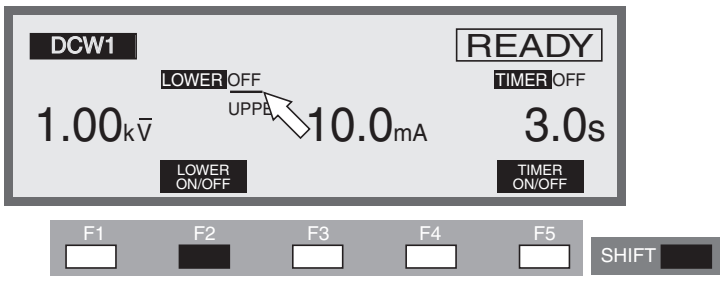
To make settings, use the rotary knob with the cursor at the test voltage.

1. To bring the cursor to the test voltage, press the F1 (VOLT) key (the ▲ ▼ ◀ ▶ keys can also be used).
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set a test voltage.

NOTE

- When settings are being made, if the test voltage multiplied by the upper current exceeds 55 W, "READY" disappears and "OVER 55 W" flashes at the top right of the LCD to indicate that testing cannot be performed. In such a case, reduce the test voltage or the upper current.

Turning the lower judgement function ON/OFF



The lower judgement function can be turned on/off.

When the lower judgement function is on, the test ends with a FAIL judgement if the measured current drops below the lower current. The lower current is explained in the following section.

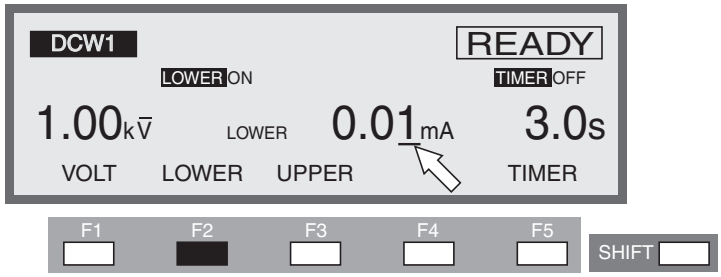
The lower judgement function can be set to ON/OFF using the SHIFT + F2 keys, regardless of the location of the cursor. Each time the SHIFT + F2 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the lower judgement function. If the cursor is at ON/OFF of the lower judgement function, the rotary knob can be used to make settings.

Turn the rotary knob clockwise: ON

Turn the rotary knob counterclockwise: OFF

Setting the lower current (LOWER)



The lower current can be set between 0.01 mA and 11.0 mA (at a resolution of 0.01 mA for the 0.01 mA to 9.99 mA range, and 0.1 mA for the 10.0 mA to 11.0 mA range).

When the lower judgement function is set to ON and the measured current is at or below the lower current, the test ends with a FAIL judgement.

If the fluctuation of the leakage current of the DUT is limited and the leakage current is sufficiently high to enable the tester to make a judgement, set the lower current below the smallest fluctuation. Making this setting makes it possible to identify a DUT that contains an exceptionally small leakage current, and even to detect a disconnection and failed contact in the test leadwire, thus ensuring a high-quality withstanding voltage test. If the lower judgement function is not to be used, turn it off.

If the cursor is at the lower current, the rotary knob can be used to make settings.

1. If the lower current is not displayed, press the F2 key (LOWER) to display it. (When the lower current is displayed, the cursor can be moved using the ▲ ▼ ◀ ▶ keys.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the lower current.

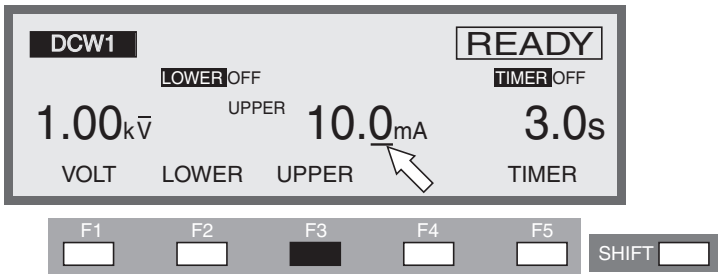
NOTE

- If the lower current is set at or above the upper current while the lower judgement function is on, "READY" disappears and "UP<=LOW" flashes at the top right of the LCD to indicate that testing cannot be performed (the lower current is factory-set to 0.10 mA).

  Lower the lower current or raise the upper current.
- No lower judgement is made while the voltage is rising or before the WAIT TIME has elapsed.

Setting the upper current (UPPER)

⚠CAUTION • If the upper current is set to above 5 mA, the protective circuit may be activated. To avoid this, set the output time to 1 minute or less and provide a pause longer than the test time.



The upper current can be set to 0.01 mA through 11.0 mA (at a resolution of 0.01 mA for the 0.01 mA to 9.99 mA range, and 0.1 mA for the 10.0 mA to 11.0 mA range).

Once a current exceeding the upper current is detected, the test ends with a FAIL judgement.

If the cursor is at the upper current, the rotary knob can be used to make settings.

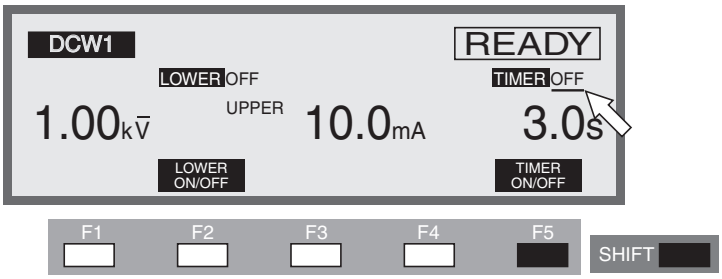
1. If the upper current is not displayed, press the F3 key (UPPER) to display it (while the upper current is displayed, the cursor can be moved using the ▲ ▼ ◀ ▶ keys).
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the upper current.

NOTE

- With the lower judgement function on, if the upper current is set at or below the lower current, "READY" disappears and "UP<=LOW" flashes at the top right of the LCD to indicate that testing cannot be performed (the lower current is factory-set to 0.20 mA).

  Lower the lower current, raise the upper current, or turn off the lower judgement function.
- When settings are being made, if the test voltage multiplied by the upper current exceeds 55 W, "READY" disappears and "OVER 55 W" flashes at the top right of the LCD to indicate that testing cannot be performed. In such a case, lower the test voltage or the upper current.

Turning the timer ON/OFF



Make ON/OFF settings for the timer function.

When the timer function is turned on, the test time can be controlled, as shown in "Setting the test time" in the next section. When the preset test time has elapsed with a leakage current recorded between the lower and upper currents, the test ends with a PASS judgement.

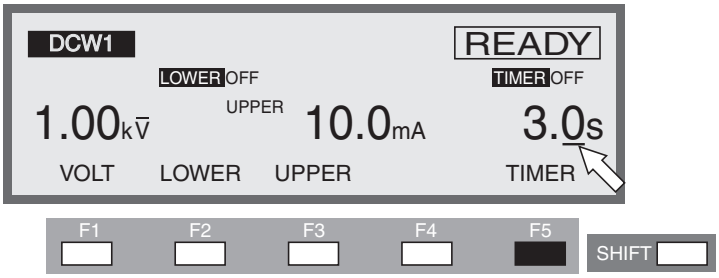
The timer function can be set to ON/OFF using the SHIFT + F5 keys, regardless of the location of the cursor. Each time the SHIFT + F5 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the timer function. If the cursor is at ON/OFF of the timer function, the rotary knob can be used to make settings.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Setting the test time (TEST TIME)



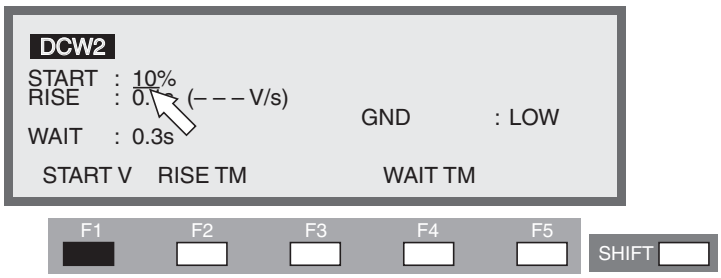
The time during which a preset voltage is applied to the DUT can be set to 0.3 s through 999 s (at a resolution of 0.1 s for the 0.3 s to 99.9s range and 1 s for the 100 s to 999s range).

When the cursor is at the timer, the rotary knob can be used to make settings.

1. To move the cursor to the timer, press the F5 key (TIMER). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the test time.

3.5.2 Settings on the DCW2 screen

Setting the start voltage



For a DC withstanding voltage test, set the start voltage as a percentage of the test voltage, to 0% through 99% (at a resolution of 1%). When the cursor is located to the right of START, settings can be made using the rotary knob.

1. To move the cursor to the right of START, press the F1 (START V) key (the ▲ ▼ ◀ ▶ keys can also be used).
2. Using the rotary knob, set the start voltage.

NOTE

- When the start voltage is set to 1% or more, approximately 100 ms is required for the tester to reach the start voltage from 0 V.

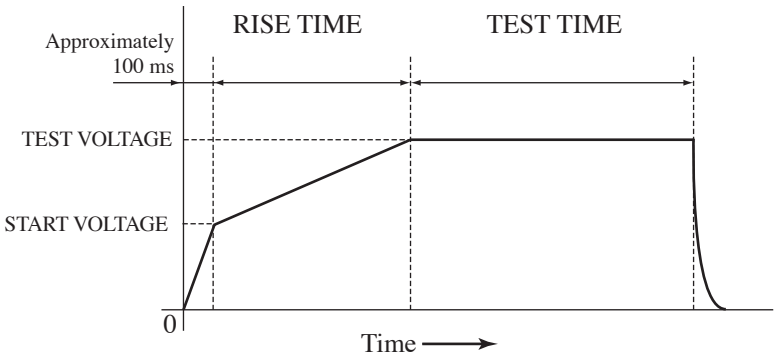
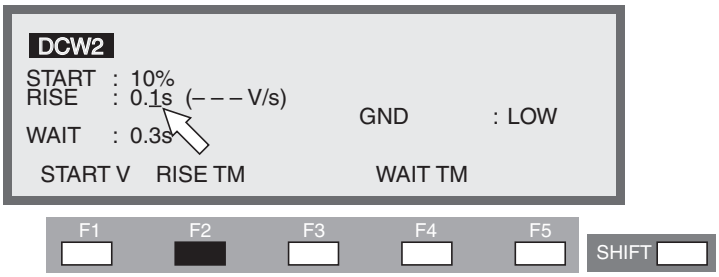


Fig.3-7 Start voltage (DCW)

Setting the voltage rise time (RISE TIME)



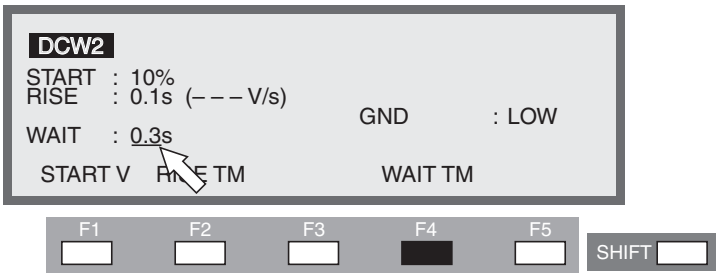
The rise time between the start voltage and the test voltage can be set to 0.1 s through 200 s (at a resolution of 0.1 s for the 0.1 s to 99.9s range and 1 s for the 100 s to 200s range).

When the cursor is to the right of RISE, settings can be made using the rotary knob.

1. To move the cursor to the right of RISE, press the F2 key (RISE TM). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the rise time.

The figure (V/s) in parentheses represents the voltage increase per second calculated for reference using the set value. If the value cannot be displayed in three digits, "---" is displayed instead.

Setting the WAIT TIME



In DC withstanding voltage testing, if a test voltage is applied to a DUT that contains capacitive elements, a large charge current may flow until charging is completed. To avoid upper fail judgement by the charge current, a wait time must be provided from the starts of START VOLTAGE, and upper fail judgement will be ignored during wait time.

Set the wait time to 0.3 s through 10.0 s (at a resolution of 0.1 s).

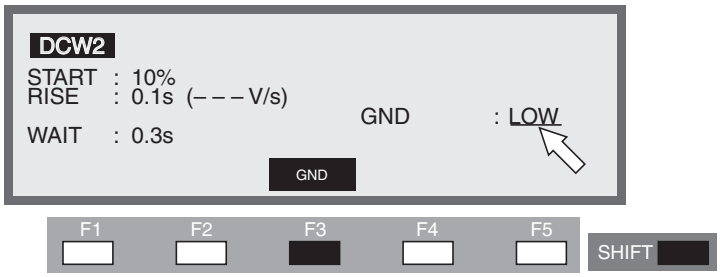
When the cursor is located to the right of WAIT, the rotary knob can be used to make settings.

1. To move the cursor to the right of WAIT, press the F4 key (WAIT TM). (The ▲ ▼ ◀ ▶ keys also can be used.)
2. Using the rotary knob, set the wait time.

NOTE

- With the timer ON, if the wait time thus set exceeds the sum of the voltage rise time and the test time, “OVER WAIT” flashes on the LCD to indicate that testing cannot be performed.

Setting LOW/GUARD for the GND



You can select either of the following two measurement modes;

the LOW mode that the GND is connected to the tester’s LOW terminal,

the GUARD mode that the GND is used as guard.

In both modes, the tester detects the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT. In the LOW mode, the LOW terminal is connected to the chassis. This leads to the problem of the insulation resistance between the test leadwire and jigs and the earth being included in the measurement. Nonetheless, the GND mode ensures safe testing, as it does not short-circuit the ammeter.

In the GUARD mode, on the other hand, only the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT is measured, while the influence of the insulation resistance between the earth and the test leadwire and jigs is eliminated. For this reason, the GUARD mode is effective in measurements that require high sensitivity and high accuracy. At the same time, however, the ammeter can be short-circuited, posing a grave danger if the LOW terminal and the chassis are short-circuited when part of the DUT is connected to an earth ground.

If it is not known whether the DUTs and jigs are grounded, select the LOW mode. To switch between the two modes, use the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, LOW and GUARD alternate.

Using the ▲ ▼ ◀ ▶ keys, move the cursor to the right of GND; settings can then be made using the rotary knob.

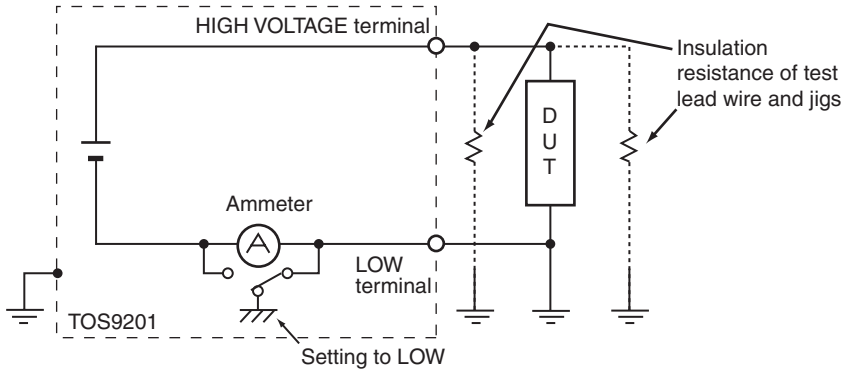
Turn the rotary knob clockwise: GUARD

Turn the rotary knob counterclockwise: LOW

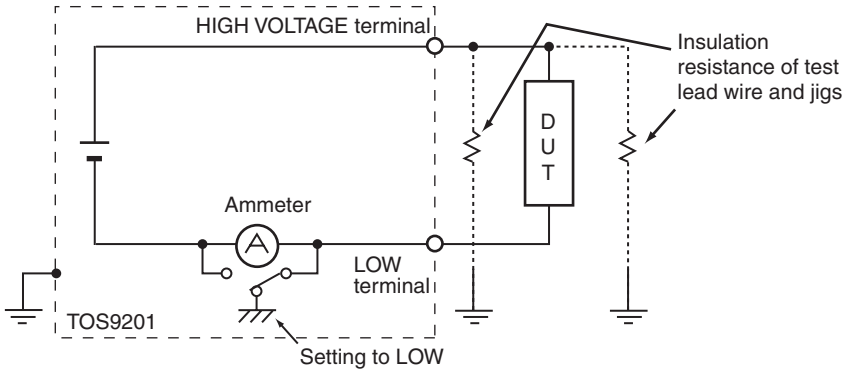
When LOW is selected, the LED to the left of the LOW terminal lights up.

■ LOW

In the LOW mode, the current which flows through the LOW terminal by insulation resistance of the test leadwire and jigs is included in the measurements, as shown in Fig. 3-8 (A) and (B). However, the ammeter is protected from short-circuiting, thereby ensuring safe testing regardless of whether the DUT is grounded. For this reason, it is recommended that LOW be set in ordinary tests.



(A) DUT grounded



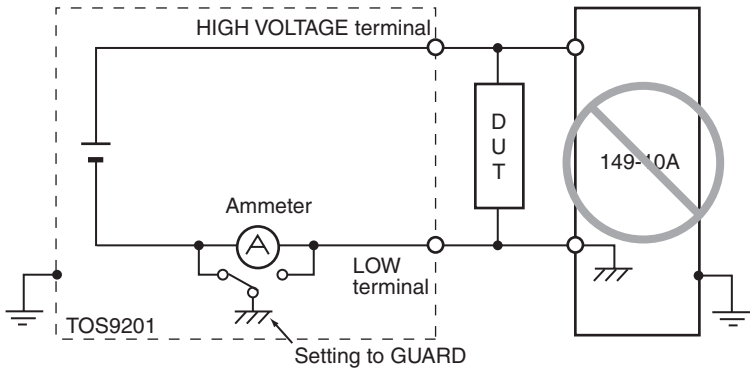
(B) DUT not grounded

Fig.3-8 Selecting LOW

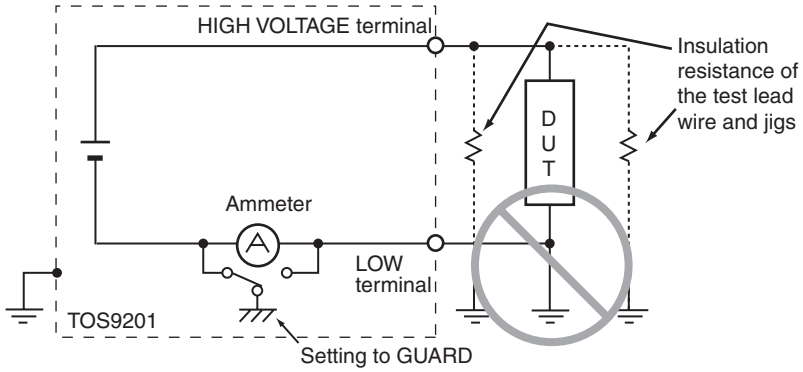
■ GUARD

⚠WARNING

- If it is not known whether the DUT or jig is grounded, never select GUARD.
  If GUARD is selected while the DUT is grounded, the ammeter will be short-circuited, thereby disabling measurement and posing a grave danger. See Fig. 3-9 (B).
- If GUARD is selected, do not connect this tester to any measuring instruments or other devices that involve single-side grounding, such as Kikusui's high-voltage digital voltmeter 149-10A and current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-9 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-9 Dangerous connection

⚠CAUTION • If the LOW terminal of this tester is connected to the HIGH or LOW terminal of the earth continuity tester TOS6200, the ammeter will make measurement errors if GUARD is selected, as the resistor inside the TOS6200 is connected in parallel to the tester's ammeter. Therefore, to use the TOS6200, avoid connecting these terminals, or select LOW.

Select GUARD only when DUTs, such as small electronic components and jigs, are completely "floating" electrically.

As shown in Fig. 3-10, the GUARD mode enables high-sensitivity, high accuracy measurement, as it excludes the current by insulation resistance of the test leadwire and jigs.

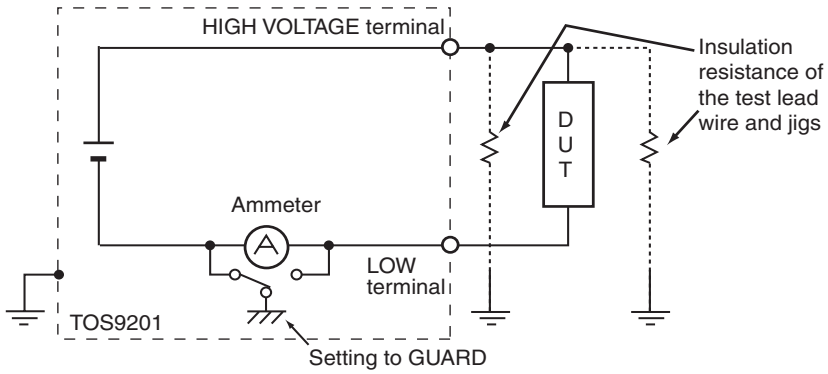
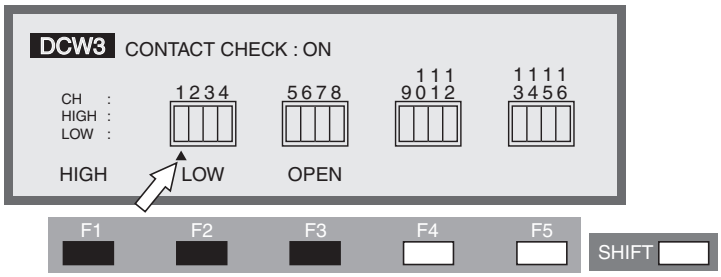


Fig.3-10 Selecting GUARD

3.5.3 Settings on the DCW3 screen

Channel settings for the high-voltage scanner



Make settings with the optional scanner connected.

Each channel can be set to HIGH, LOW, or OPEN.

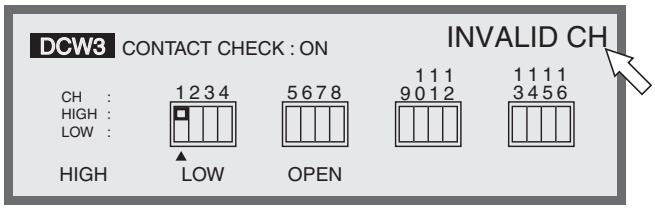
Use the ◀ ▶ keys to move the cursor (▲) to a channel, and use the F1, F2, and F3 keys to make settings.

If the channel has already been specified, settings can be made using the rotary knob.

The SHIFT + F1 keys can be used to open all channels, regardless of the location of the cursor.

NOTE

- If an unconnected channel is selected, "INVALID CH" flashes on the LCD.



⚠WARNING

- If the test leadwire is not connected to the DUT, do not leave the wire connected to the output terminal on the scanner.

  The TOS9220 scanner does not have a contact check function to detect connection to the DUT. If the tester is set to the high-voltage (HIGH) level, a test can be started using a channel with the test leadwire not connected to the DUT.

NOTE

- To clearly indicate the relationships between the connected test leadwire and the channel, affix the Channel Display Seal (provided for the scanner) to the test leadwire.

Turning the contact check ON/OFF

When the optional high-voltage scanner TOS9221 (with the contact check function) is connected to the tester, the continuity between the test leadwire and the DUT can be tested using the HIGH or LOW terminal prior to application of a test voltage. To do so, turn on the contact check function.

With the high-voltage scanner TOS9220, a check is conducted on the continuity through to inside of the scanner only.

To turn the contact check function on/off, use the SHIFT + F5 keys.

Each time the SHIFT + F5 keys are pressed, ON and OFF alternate, regardless of the location of the cursor. The cursor moves to CONTACT CHECK.

Using the ▲ key, move the cursor to the right of CONTACT CHECK. Settings can also be made using the rotary knob.

Turn the rotary knob clockwise: ON

Turn the rotary knob counterclockwise: OFF

Press the DCW key to return to the DCW1 screen, and then press the START switch. READY will then disappear from the LCD, and a contact check will start for each channel.

The test starts as soon as the continuity is confirmed.

The test continues until the test time preset on the timer has elapsed or the STOP switch is pressed.

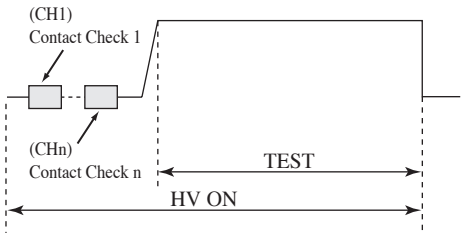
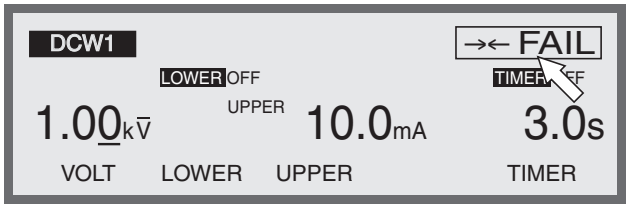


Fig.3-11 Contact check

The contact check time is calculated using the following formula:

Contact check time = 260 ms + 60 ms x (number of channels set to HIGH or LOW)

When a continuity error is detected in a contact check, " →← FAIL" appears at the top right of the LCD. On the high-voltage scanner, the LED of the failed channel lights up in orange.



3.6 Settings for Insulation Resistance Testing

To make settings for an insulation resistance test, use the Insulation Resistance-Test Setting screen (IR).

To jump to this screen, press the IR key. The LED on the IR key will then light up. The Insulation Resistance-Test Setting screen has three pages from IR1 to IR3.

To move between these pages, press the SHIFT key + ◀ ▶ keys. To return to IR1 from IR2 or IR3, press the IR key.

NOTE

- No setting can be made in the KEYLOCK status.

The three IR pages allow the following settings to be made:

IR1

- Test voltage
- Lower resistance (LOWER) and ON/OFF of the lower judgement function
- Upper resistance (UPPER) and ON/OFF of the upper judgement function
- Test time (TEST TIME) and ON/OFF of the timer function

IR2

- Voltage rise time (RISE TIME)
- Judgement wait time (WAIT TIME)
- LOW/GUARD settings for the GND

IR3

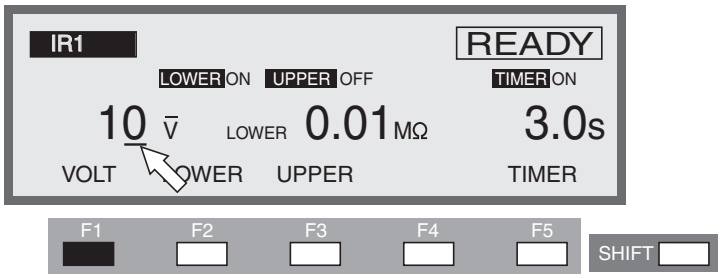
- Channel settings for the high-voltage scanner
- ON/OFF of the contact check function

To move the cursor between items, use the ▲ ▼ ◀ ▶ keys.

When a function is shown on the F1 to F5 keys, they can be used to jump to the target item. To conduct the operations displayed on these keys, press the SHIFT key + the F1 to F5 keys.

3.6.1 Settings on the IR1 screen

Setting the insulation resistance test voltage



The test voltage to be applied to a DUT can be set to DC –10 V through –1020 V (at a resolution of 1 V). (The negative (-) mark is not displayed.)

To make setting, use the rotary knob with the cursor at the test voltage.

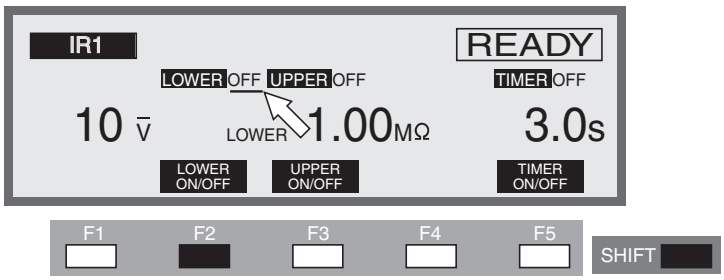
1. To move the cursor to the test voltage, press the F1 key (VOLT). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the test voltage.

NOTE

- With the lower judgement function on, if the test voltage divided by the lower resistance exceeds 1.1 mA, "READY" disappears and "OVER 1.1 mA" flashes at the top right of the LCD to indicate that testing cannot be performed.

  In such a case, lower the test voltage or raise the lower resistance.

Turning the lower judgement function ON/OFF



The lower judgement function can be turned on/off.

When the lower judgement function is on, the test ends with a FAIL judgement if the measured insulation resistance drops below the lower resistance.

The lower resistance is explained in the following section.

If the lower judgement function is off, the test ends without a FAIL judgement.

The lower judgement function can be set to ON/OFF using the SHIFT + F2 keys, regardless of the location of the cursor. Each time the SHIFT + F2 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can be used to move the cursor to ON/OFF of the lower judgement function. When the cursor is located at ON/OFF of the lower judgement function, the rotary knob can be used to make settings.

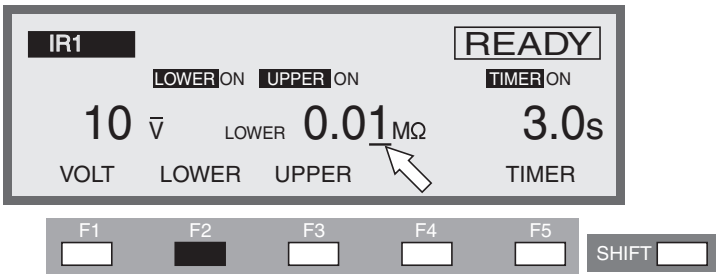
Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

⚠CAUTION

- If the lower and upper judgement function is off, no FAIL judgement is made for that function. Note that a PASS judgement is made when the timer is turned on.

Setting the lower current (LOWER)



The lower resistance can be set to 0.01 MΩ through 9.99 GΩ (at a resolution of 0.01 MΩ for the 0.01-9.99 MΩ range, 0.1 MΩ for the 10.0 MΩ to 99.9 MΩ range, 1 MΩ for the 100 MΩ to 999 MΩ range, and 0.01 GΩ for the 1.00 GΩ to 9.99 GΩ range), but below the maximum rated current.

When a resistance value at or below the lower resistance is detected following a wait time, the test ends with a FAIL judgement.

When the cursor is at the lower resistance, the rotary knob can be used to make settings.

1. To display the lower resistance, press the F2 key (LOWER). (When the lower resistance is displayed, the cursor can be moved using the ▲ ▼ ◀ ▶ keys.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the lower resistance.

NOTE

- With both the upper and lower judgement functions on, if the lower resistance is set at or above the upper resistance, “READY” disappears and “UP<=LOW” flashes at the top right of the LCD to indicate that testing cannot be performed. (The lower resistance is factory-set to 1.00 MΩ.)

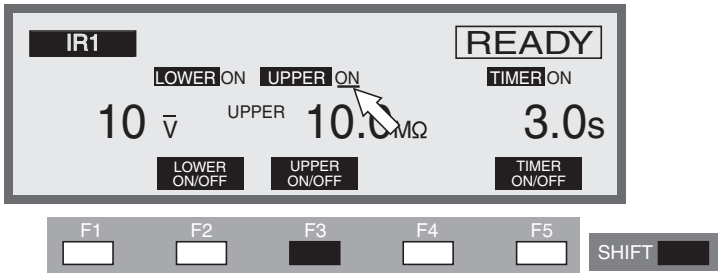
  Reduce the lower resistance or raise the upper resistance.
- With the lower judgement function on, if settings are made so that the test voltage divided by the lower resistance exceeds 1.1 mA, “READY” disappears and

"OVER 1.1 mA" flashes at the top right of the LCD to indicate that testing cannot be performed.

In such a case, lower the test voltage or raise the lower resistance.

- To measure the resistance even when it results in a decrease in the test voltage, turn off the low judgement. In such a case, if the output voltage deviated from the range of the output-voltage monitor function by ±(10% of the setting + 50 V), the measured voltage flashes on the LCD voltmeter to warn of a decrease in the test voltage. The test can still be conducted, however.
- No lower judgement is made during the voltage rise time or until the WAIT TIME has elapsed.

Turning the upper judgement function ON/OFF



The upper judgement function can be turned on/off.

When the upper judgement function is on, the test ends with a FAIL judgement if the measured resistance exceeds the upper resistance.

The upper resistance is explained in the following section. The upper judgement function can be set to ON/OFF using the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can be used to move the cursor to ON/OFF of the upper judgement function. If the cursor is at ON/OFF of the upper judgement function, the rotary knob can be used to make settings.

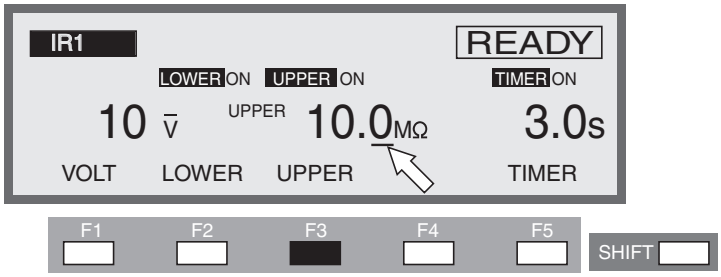
Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

NOTE

- If the lower and upper judgement functions are off, no FAIL judgement is made. Note that, when the timer is turned on with both functions off, a PASS judgement is made.

Setting the upper current (UPPER)



The upper resistance can be set to 0.01 MΩ through 9.99 GΩ (at a resolution of 0.01 MΩ for the 0.01-9.99 MΩ range, 0.1 MΩ for the 10.0 MΩ to 99.9 MΩ range, 1 MΩ for the 100 MΩ to 999 MΩ range, and 0.01 GΩ for the 1.00 GΩ to 9.99 GΩ range), but below the maximum rated current.

When the cursor is at the upper resistance, the rotary knob can be used to make settings.

1. To display the upper resistance, press the F3 key (UPPER). (When the upper resistance is displayed, the cursor can be moved using the ▲ ▼ ◀ ▶ keys.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the upper resistance.

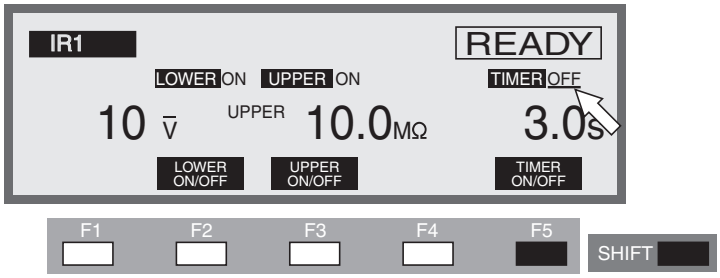
NOTE

- With both the upper and lower judgement functions on, if the upper resistance is set at or below the lower resistance, "READY" disappears and "UP<=LOW" flashes at the top right of the LCD to indicate that testing cannot be performed. (The upper resistance is factory-set to 100 MΩ.)

  Raise the upper resistance, reduce the lower resistance, or turn off the lower judgement function.
- With the upper judgement function on, if settings are made so that the test voltage divided by the upper resistance exceeds 1.1 mA, "READY" disappears and "OVER 1.1 mA" flashes at the top right of the LCD to indicate that testing cannot be performed.

  In such a case, lower the test voltage or raise the upper resistance.

Turning the timer ON/OFF



Make ON/OFF settings for the timer function.

When the timer function is turned on, the test time can be controlled as specified in "Setting the test time" in the next section. When the preset test time has elapsed with the resistance recorded between the lower and upper resistances, the test ends with a PASS judgement.

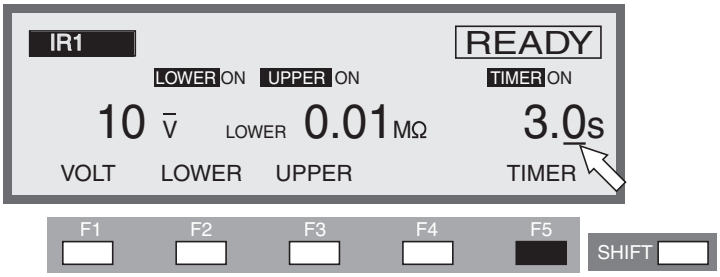
The timer function can be set to ON/OFF using the SHIFT + F5 keys, regardless of the location of the cursor. Each time the SHIFT + F5 keys are pressed, ON and OFF alternate.

The ▲ ▼ ◀ ▶ keys can also be used to move the cursor to ON/OFF of the timer function. If the cursor is at ON/OFF of the timer function, the rotary knob can be used to make settings.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Setting the test time (TEST TIME)



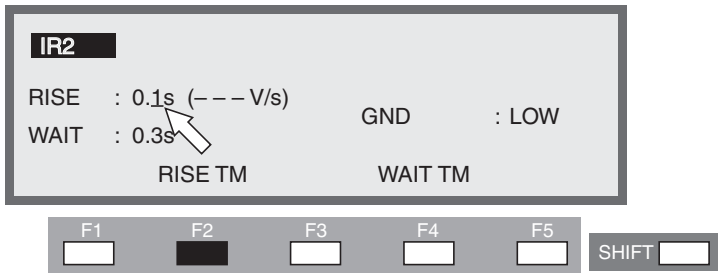
The time during which a preset voltage is applied to the DUT can be set to between 0.5 s and 999 s (at a resolution of 0.1 s for the 0.5 s to 99.9 s range and 1 s for the 100 s to 999 s range).

When the cursor is at TIMER, the rotary knob can be used to make settings.

1. To move the cursor to TIMER, press the F5 key (TIMER). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the test time.

3.6.2 Settings on the IR2 screen

Setting the voltage rise time (RISE TIME)



The rise time between the start voltage and the test voltage can be set to 0.1 s through 200 s (at a resolution of 0.1 s for the 0.1 s to 99.9 s range and 1 s for the 100 s to 200 s range).

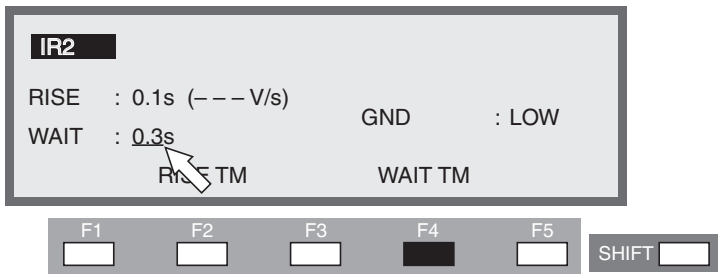
When the cursor is to the right of RISE, settings can be made using the rotary knob.

1. To move the cursor to RISE, press the F2 key (RISE TM). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the ◀ ▶ keys, move the cursor to the target digit.
3. Using the rotary knob, set the rise time.

The figure (V/s) in parentheses represents the voltage increase per second calculated for reference using the set value.

If the value cannot be displayed in three digits, "---" is displayed instead.

Setting the WAIT TIME



In DC insulation resistance testing, if a test voltage is applied to a DUT that contains capacitive elements, the measured insulation resistance will be below the optimal value due to a charge current, until charging is completed. To avoid upper fail judgement by the charge current, a wait time must be provided from the starts of START VOLTAGE, and upper fail judgement will be ignored during wait time.

Set the wait time to 0.3 s through 10 s (at a resolution of 0.1 s).

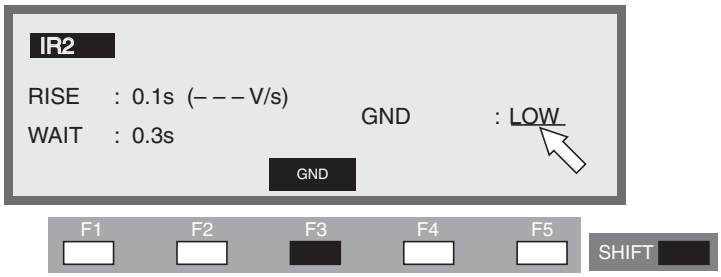
When the cursor is located to the right of WAIT, the rotary knob can be used to make settings.

1. To move the cursor to the right of WAIT, press the F4 key (WAIT TM). (The ▲ ▼ ◀ ▶ keys can also be used.)
2. Using the rotary knob, set the wait time.

NOTE

- With the timer ON, if the wait time thus set exceeds the sum of the voltage rise time and the test time, “OVER WAIT” flashes on the LCD to indicate that testing cannot be performed.

Setting LOW/GUARD for the GND



You can select either of the following two measurement modes;

the LOW mode that the GND is connected to the tester’s LOW terminal,

the GUARD mode that the GND is used as guard.

In both modes, the tester detects the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT. In the LOW mode, the LOW terminal is connected to the chassis. This leads to the problem of the insulation resistance between the test leadwire and jigs and the earth being included in the measurement. Nonetheless, the GND mode ensures safe testing, as it does not short-circuit the ammeter.

In the GUARD mode, on the other hand, only the current flowing into the LOW terminal from the HIGH VOLTAGE terminal via the DUT is measured, while the influence of the insulation resistance between the test leadwire and jigs and the earth is eliminated. For this reason, the GUARD mode is effective in measurements that require high sensitivity and high accuracy. At the same time, however, the ammeter can be short-circuited, posing a grave danger if the LOW terminal and the chassis are short-circuited when part of the DUT is connected to the earth ground. If it is not known whether the DUTs and jigs are grounded, select the LOW mode.

To switch between the two modes, use the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, LOW and GUARD alternate.

Using the ▲ ▼ ◀ ▶ keys, move the cursor to the right of GND; settings can then be made using the rotary knob.

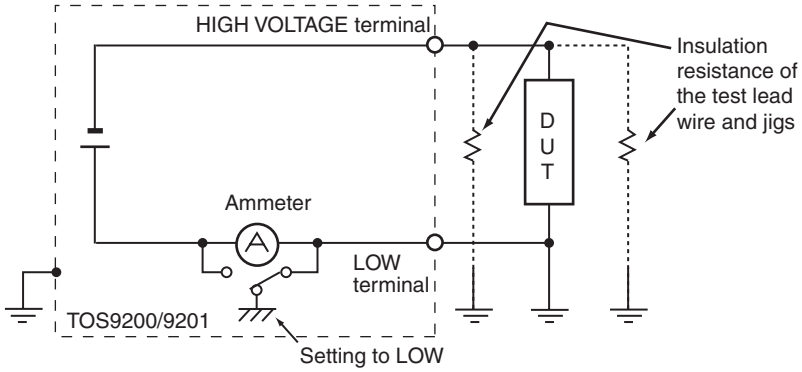
Turn the rotary knob clockwise : GUARD

Turn the rotary knob counterclockwise : LOW

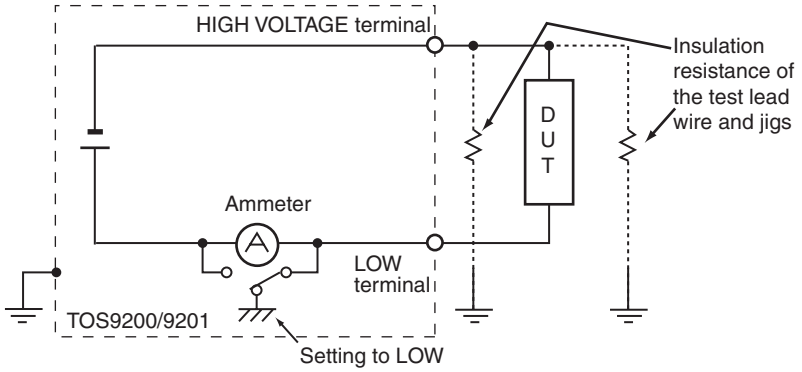
When LOW is selected, the LED to the left of the LOW terminal lights up.

■ LOW

In the LOW mode, the insulation resistance of the test leadwire and jigs is included in measurements, as shown in Fig. 3-12 (A) and (B). However, the ammeter is protected from short-circuiting, ensuring safe testing regardless of whether the DUT is grounded. For this reason, it is recommended that LOW be set in ordinary tests.



(A) DUT grounded



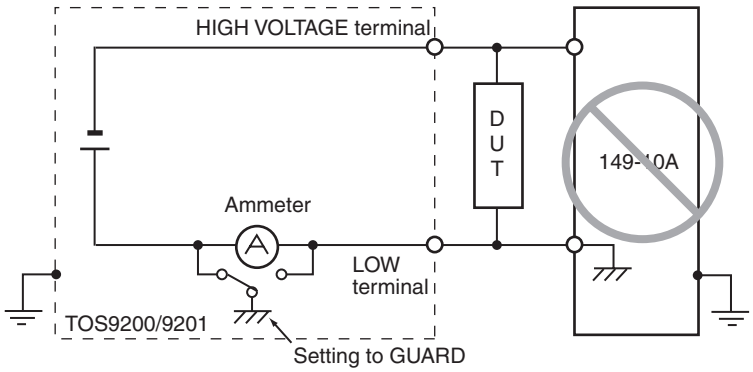
(B) DUT not grounded

Fig.3-12 Selecting LOW

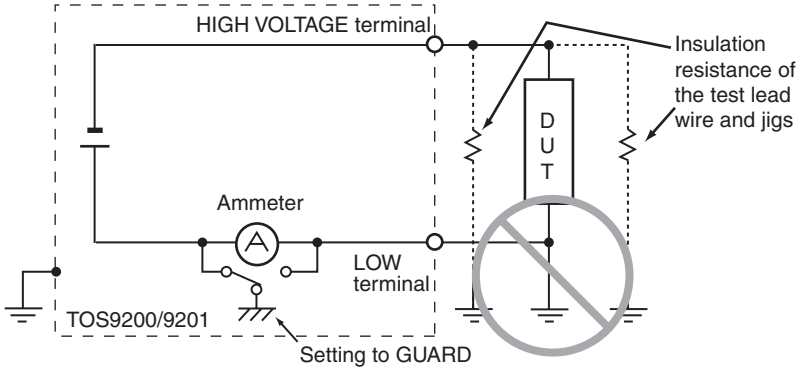
■ GUARD

⚠WARNING

- If it is not known whether the DUT or jig is grounded, never select GUARD.
  If GUARD is selected while the DUT is grounded, the ammeter will be short-circuited, disabling measurement and posing a grave danger. See Fig. 3-13 (B).
- If GUARD is selected, do not connect this tester to any measuring instruments or other devices that involve single-side grounding, such as Kikusui's high-voltage digital voltmeter 149-10A or current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-13 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-13 Dangerous connection

⚠CAUTION • If the LOW terminal of this tester is connected to the HIGH or LOW terminal of the earth continuity tester TOS6200, the ammeter will make measurement errors if GUARD is selected, as the resistor inside the TOS6200 is connected in parallel to the tester's ammeter. Therefore, to use the TOS6200, avoid connecting these terminals, or select LOW.

Select GUARD only when DUTs, such as small electronic components and jigs, are completely "floating" electrically.

As shown in Fig. 3-14, the GUARD mode enables high-sensitivity, high accuracy measurement, as it excludes the insulation resistance of the test leadwire and jigs.

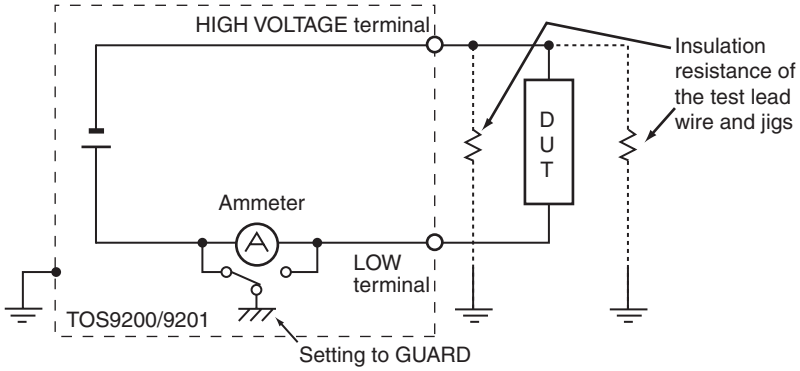
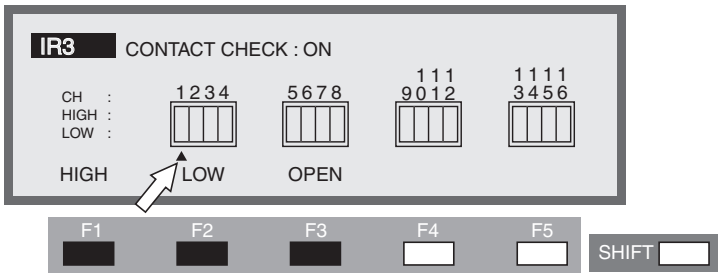


Fig.3-14 Selecting GUARD

3.6.3 Settings on the IR3 screen

Channel settings for the high-voltage scanner



Make settings when the optional scanner is connected.

Each channel can be set to HIGH, LOW, or OPEN.

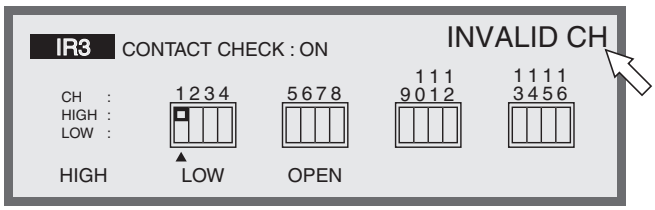
Use the ◀ ▶ keys to move the cursor (▲) to a channel, and use the F1, F2 and F3 keys to make settings.

If the channel has already been specified, settings can be made using the rotary knob.

Using the SHIFT + F1 keys, all channels can be opened regardless of the location of the cursor.

NOTE

- If an unconnected channel is selected, "INVALID CH" flashes on the LCD.



⚠WARNING

- If the test leadwire is not connected to the DUT, do not leave the wire connected to the output terminal on the scanner.

  The TOS9220 scanner does not have a contact check function to detect connection to the DUT. If the tester is set to the high-voltage (HIGH) level, a test can be started using a channel with the test leadwire not connected to the DUT.

NOTE

- To clearly indicate the relationships between the connected test leadwire and the channel, affix the Channel Display Seal (provided for the scanner) to the test leadwire.

Turning the contact check ON/OFF

When the optional high-voltage scanner TOS9221 (with the contact check function) is connected to the tester, the continuity between the test leadwire and the DUT with the HIGH or LOW terminal can be checked prior to the application of a test voltage. To do so, turn on the contact check function.

With the high-voltage scanner TOS9220, a check is conducted on the continuity through to inside of the scanner only.

Use the SHIFT + F5 keys to turn the contact check function on/off.

Each time the SHIFT + F5 keys are pressed, ON and OFF alternate, regardless of the location of the cursor. The cursor moves to CONTACT CHECK.

Using the ▲ key, move the cursor to the right of CONTACT CHECK. Settings can also be made using the rotary knob.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Press the IR key to return to the IR1 screen, and then press the START switch.

READY then disappears on the LCD, and a contact check starts for each channel.

The test starts as soon as the continuity is confirmed, and continues until the test time preset on the timer has elapsed or the STOP switch is pressed.

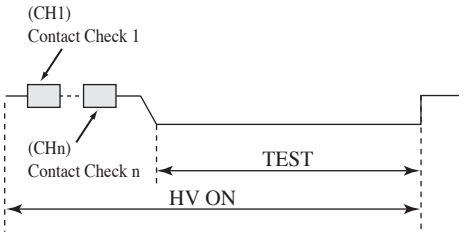
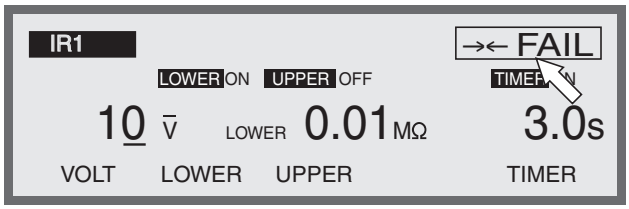


Fig.3-15 Contact check

The contact check time is calculated using the following formula:

Contact check time = 260 ms + 60 ms x (number of channels set to HIGH or LOW)

When a continuity error is detected in a contact check, " →← FAIL" appears at the top right of the LCD. On the high-voltage scanner, the LED of the failed channel lights up in orange.



3.7 Connecting the Test Leadwire

⚠WARNING • It is extremely dangerous to connect the test leadwire incorrectly, as the DUT may be charged to an excessively high voltage. Be sure to make connections securely.

3.7.1 Connecting the test leadwire to the tester

■ Connecting the low-voltage test leadwire

1. Check for a disconnection in the test leadwire.
2. Connect the low-voltage test leadwire to the tester's LOW terminal.

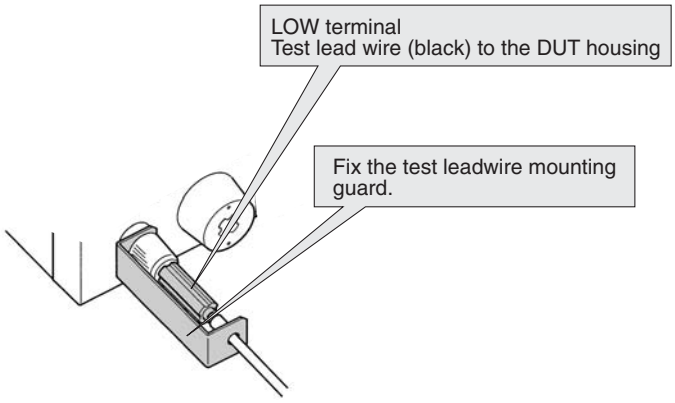


Fig.3-16 Connecting the low-voltage test leadwire

■ Connecting the high-voltage test leadwire

After connecting the low-voltage test leadwire, follow the procedure specified below.

Connection procedure

1. Press the STOP switch.
2. Confirm that the analog voltmeter indicates "0."
3. Confirm that the DANGER lamp is off.
4. Connect the high-voltage test leadwire to the HIGH VOLTAGE terminal.
5. Short-circuit the low-voltage and high-voltage test leadwires, and confirm that no high voltage is output.

3.7.2 Connecting a DUT

After connecting the low-voltage and high-voltage test leadwires, connect a DUT by following the procedure specified below.

Connection procedure

1. Press the STOP switch.
2. Confirm that the analog voltmeter indicates “0.”
3. Confirm that the DANGER lamp is off.
4. Short-circuit the low-voltage and high-voltage test leadwires, and confirm that no high voltage is applied.
5. Connect the low-voltage test leadwire to the DUT.
6. Connect the high-voltage test leadwire to the DUT.

⚠ WARNING • During the test (the TEST lamp or DANGER lamp is lit), never touch the HIGH VOLTAGE terminal, test leadwire, or DUT.

■ Reducing the effects of noise

If a short circuit or breakdown occur, noise generated can lead to the malfunctioning of peripheral electronic components. To reduce the effects of noise, install a toroidal core or a resistor of approximately 470 Ω between the DUT and the end of the high-voltage test leadwire from the tester, and between the DUT and the end of the low-voltage test leadwire, as close as possible to the DUT. See Fig. 3-17.

Using a toroidal core, it is recommended that a divisible core be used for power cable with a diameter of approximately 20 mm, and that it be wound two or three times around the core.

When connecting a resistor, check its power rating. For an upper current of 10 mA or less, use a resistor of approximately 470 Ω (3 W, impulse withstanding voltage of 30 kV). When such a resistor is connected, the voltage actually applied to the DUT is slightly smaller than the output-terminal voltage (approximately 10 V less at 10 mA) due to a voltage drop caused by the resistor. This type of resistor is highly useful in reducing the effects of noise.

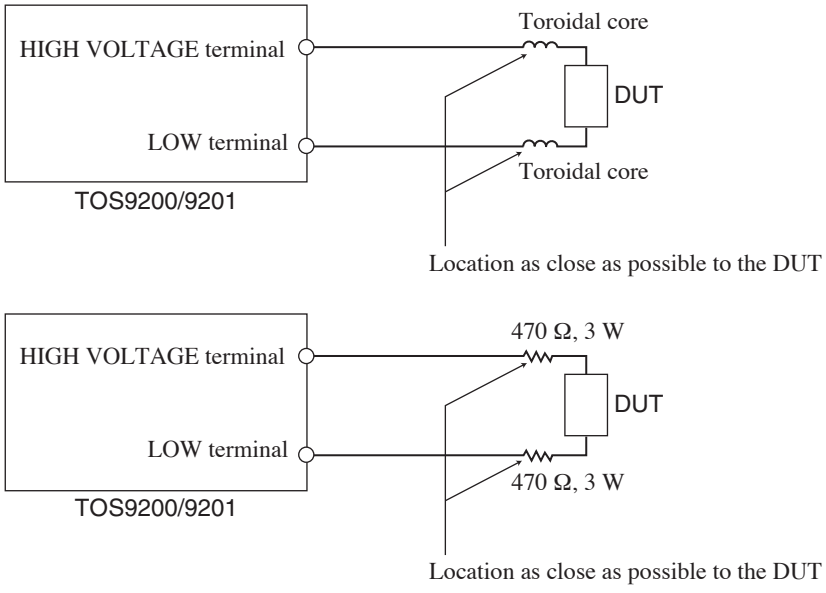


Fig.3-17 Reducing the effects of noise

3.8 Starting and Ending a Test

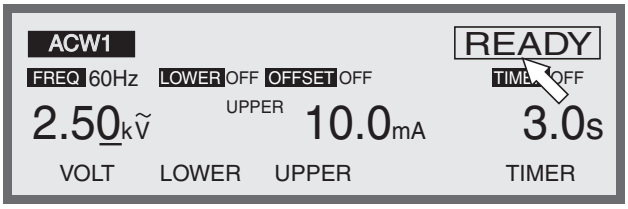
NOTE

- The test cannot be started with invalid settings or in the protection status. For information on invalid settings and the protection status, see "3.15 Invalid Settings" and "3.16 Protection".
- The test cannot be started while the STOP switch is pressed. (The test also cannot be started when the STOP signal of remote control is active.)
- If the DOUBLE ACTION is on, press the START switch within approximately 0.5 seconds after pressing the STOP switch, as the test will not start otherwise. For details on DOUBLE ACTION, see "3.10 System Settings".
- If the MOMENTARY function is ON, the test runs only while the START switch is pressed. For details on MOMENTARY, see "3.10 System Settings".

3.8.1 Starting a test

To start a test, press the START switch when the tester is in the READY status on the Test-Condition Settings screen. When the tester is in the READY status, "READY" lights up at the top right of the LCD.

Example of an AC withstanding voltage test (READY)



As soon as the test starts, the LCD displays the following:

During the test, "TEST" is displayed at the top right of the LCD, and the TEST LED and DANGER lamp light up on the indicator. (During a voltage rise, "TEST" flashes at the top right of the LCD.)

Example of an AC withstanding voltage test (TEST)

The time is displayed differently depending on whether the timer function is on or off.

The timer is ON : The remaining test time is displayed.

The timer is OFF : The elapsed test time is displayed.
(When 999 seconds have elapsed, "999" flashes.)

If the key is not locked, the test voltage can be changed during the test using the rotary knob.

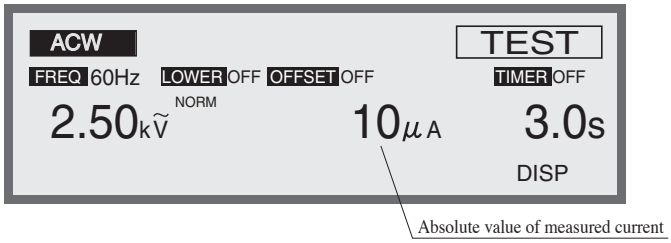
The cursor moves to the 2nd decimal place in ACW and IR, and to the 1st decimal place in DCW.

NOTE

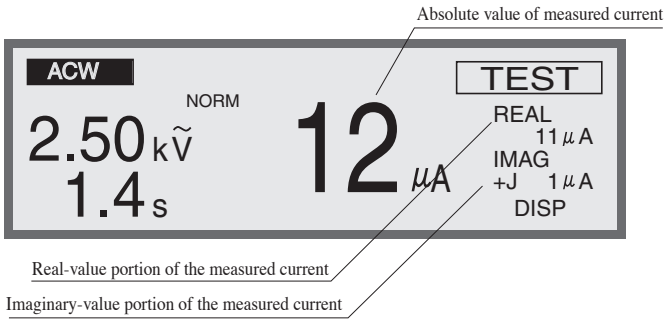
- In an AC withstanding voltage test with the output voltage range set to AUTO, if the test starts with the test voltage set to 2.60 kV or less, the voltage cannot be reset to 2.60 kV or more during the test.
- If the test voltage is changed when the measured current is close to the upper current, the test may end with a FAIL judgement.

Screens can be switched during the test using the F5 key (DISP). To suspend the test, press the STOP switch.

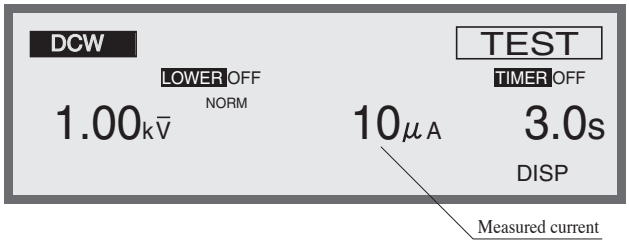
Example of an AC withstanding voltage test (DISP1)



Example of an AC withstanding voltage test (DISP2)



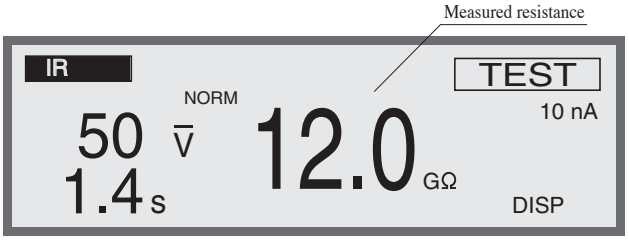
Example of a DC withstanding voltage test (DISP1)



Example of a DC withstanding voltage test (DISP2)

Example of an insulation resistance test (DISP1)

Example of an insulation resistance test (DISP2)



NOTE

- In insulation resistance testing, when the resistance value to exceed 99.9 GΩ is detected, "99.9" flashes on the LCD.
- In insulation resistance testing with the lower judgment function off, even if settings are made so that the test voltage divided by the lower resistance exceeds 1.1 mA, testing can be performed. However, when the voltage value which is out of the range of ±(10 % of setting +50 V) is detected during the test, the measurement voltage value flashes on the LCD.

3.8.2 Ending the test

PASS judgement

Example of an AC withstanding voltage test (PASS)

When the timer is ON:

When the test time has elapsed without the occurrence of the FAIL status, the test ends with a PASS judgement.

When a PASS judgement is made, “PASS” appears at the top right of the LCD, the PASS LED lights on the indicator, and a buzzer sounds. The PASS judgement is displayed for approximately 0.2 seconds (by default). The display time for the PASS judgement can be set to 0.2 s through 10.0 s or to HOLD. The buzzer action synchronizes with the PASS display time. For the setting procedure, see "3.10 System Settings".

The measurement results are displayed while “PASS” is displayed.

When “PASS HOLD” is not set to “HOLD,” the tester automatically returns to the READY status after a PASS judgement is made.

When the timer is OFF:

The test continues until the FAIL conditions are met.

Press the STOP switch to suspend the test. The test does not make a judgement and “PASS” is not displayed.

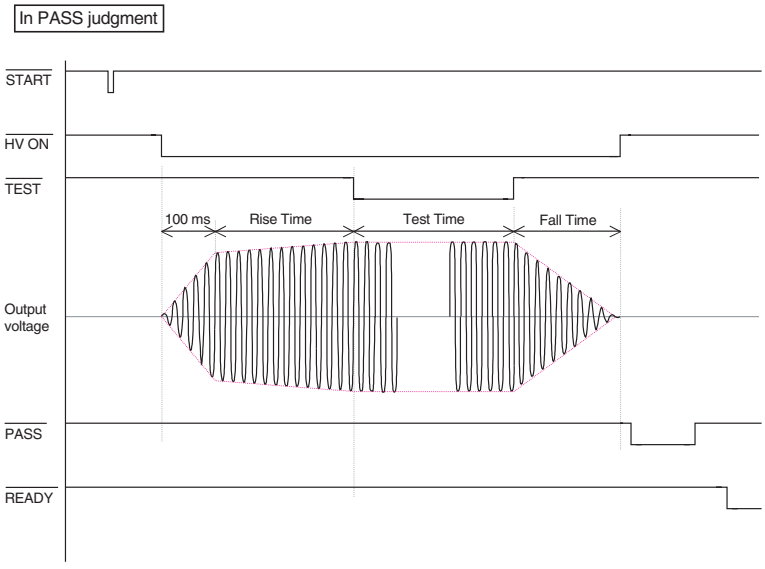


Fig.3-18 Timing chart for PASS judgement
(The start voltage is set on the ACW.)

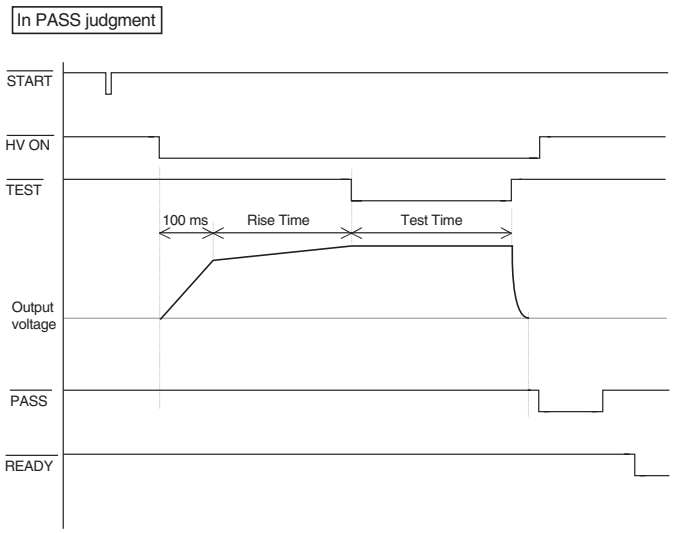


Fig.3-19 Timing chart for PASS judgement
(The start voltage is set on the DCW.)

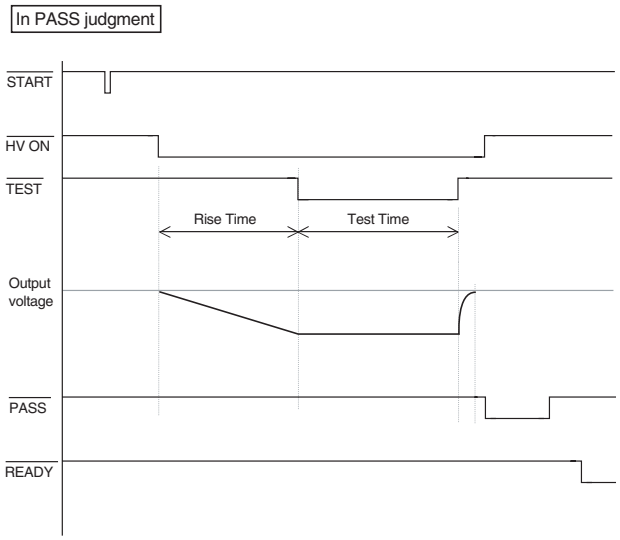


Fig.3-20 Timing chart for PASS judgement (IR)

FAIL judgement

Example of an AC withstanding voltage test (FAIL)

■ AC/DC withstanding voltage testing

If the lower judgement function is off, the test ends with a FAIL judgement when a current larger than the upper current is detected. The power is then cut off.

If the lower judgement function is on, the test ends with a FAIL judgement when the tester detects a current larger than the upper current or a current smaller than the lower current. The power is then cut off.

When lower and upper judgements are made, " ↓ FAIL" and " ↑ FAIL" appear, respectively, at the top right of the LCD.

At the same time, the FAIL LED lights on the indicator and a buzzer sounds. To cancel the FAIL judgement, press the STOP switch (the FAIL judgement is output until the STOP switch is pressed).

The measurement results are displayed until the STOP switch is pressed.

The FAIL judgement other than that described above is a CONTACT FAIL (" →← FAIL") judgement that is made when the contact failure is detected while a scanner is used.

NOTE

- In AC withstanding voltage testing, a lower judgement is not made during a voltage rise time (RISE TIME) or a voltage fall time (FALL TIME).
- In DC withstanding voltage testing, no lower judgement is made during a voltage rise time (RISE TIME).
- In DC withstanding voltage testing, an upper judgement is not made until the WAIT TIME has elapsed to eliminate the effects of a charge current in capacitive DUTs.

■ Insulation resistance testing

If the upper judgement function is on, the test ends with a FAIL judgement when a resistance larger than the upper resistance is detected. The power is then cut off.

If the lower judgement function is on, the test ends with a FAIL judgement when the tester detects a resistance smaller than the lower resistance. The power is then cut off.

Using a lower and upper judgement, " ↓ FAIL" and " ↑ FAIL" appear, respectively, at the top right of the LCD. At the same time, the FAIL LED lights up on the indicator and a buzzer sounds.

To cancel the FAIL judgement, press the STOP switch (the FAIL judgement is output until the STOP switch is pressed).

The measurement results are displayed until the STOP switch is pressed.

The FAIL judgement other than that described above is a CONTACT FAIL (" →← FAIL") judgement that is made when the contact failure is detected while a scanner is used.

NOTE

- In insulation resistance testing, an upper judgement is not made during a voltage rise time (RISE TIME).
- In insulation resistance testing, a lower judgement is not made until the WAIT TIME has elapsed to eliminate the effects of a charge current in capacitive DUTs.

Interruption by a FAIL judgment

ACW

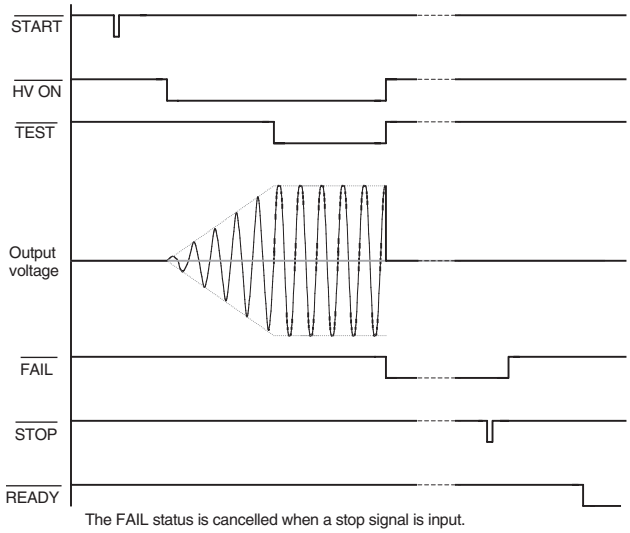


Fig.3-21 Timing chart for the FAIL judgement (ACW)

Interruption by a FAIL judgment

DCW

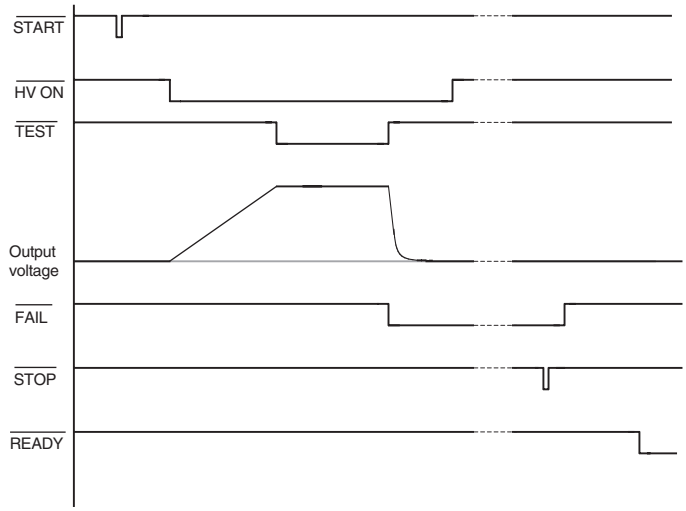


Fig.3-22 Timing chart for the FAIL judgement (DCW)

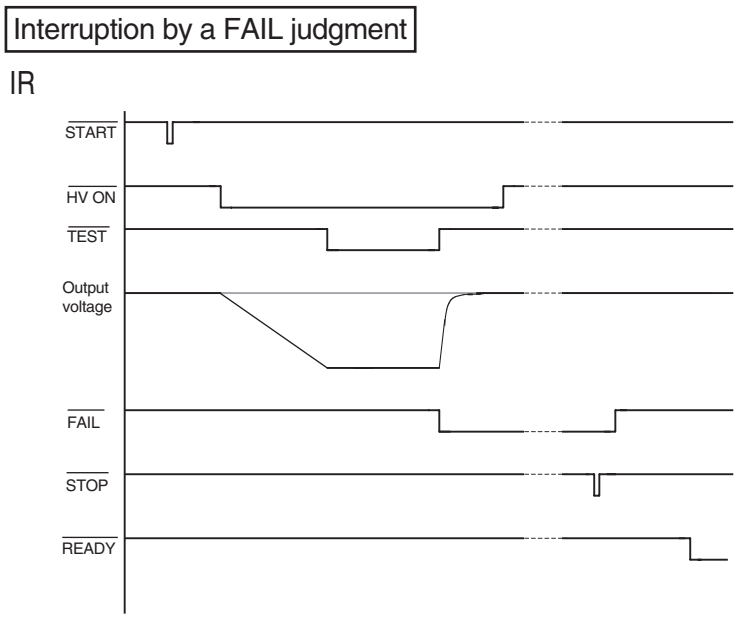


Fig.3-23 Timing chart for the FAIL judgement (IR)

3.9 Offset Cancel Function

The offset cancel function is used to measure the current flowing as insulation resistance, stray capacity in the test leadwire, and jigs in AC withstanding voltage testing. The results are subtracted such current from the measurement results of the testing.

To activate the offset cancel function, open the end of the test leadwire. From the measured current, separate the real-number portion (REAL) and the imaginary-number portion (IMAG.) Save these numbers as offset values.

Measure offset values under actual test conditions. If conditions are modified in an actual test, irrelevant offset values would be used for subtraction. Particularly when the frequency, the scanner, or the LOW/GUARD settings for the GND, which affect the capacitive element, are changed, the offset cancel operation must be repeated.

When the test voltage is changed, however, it is not necessary to repeat the offset cancel operation, as the offset value for deduction is converted to suitable value according to test voltage.

An offset cancel operation reflects the test voltage, test frequency, test time, ON/OFF settings for the timer, LOW/GUARD settings for the GND, and settings for the high-voltage scanner in AC withstanding voltage testing.

NOTE

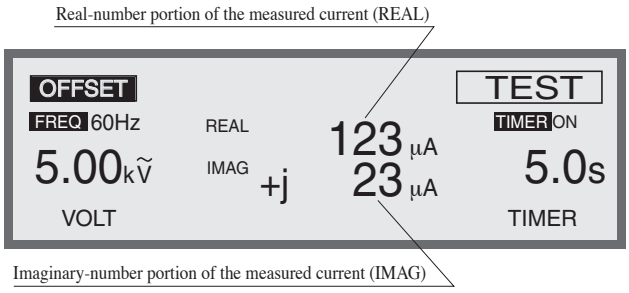
- To ensure high-sensitivity measurement, avoid moving the test leadwire. The stray capacity depends on the status of the test leadwire. To obtain actual offset values, it is recommended that measurements be conducted under actual test conditions.
- Once the real-number portion and imaginary-number portion of the measured current exceed 500 μA at 5 kV and 100 μA/kV, the tester flashes the measured current to indicate that it is impossible to cancel the offset function. When a current exceeding 550 μA is detected, the test ends with a FAIL judgement.

When the measured current flashes, recheck the cable connections in order to reduce the stray capacity, and then reactivate the offset cancel function.

Offset cancel procedure

1. Connect cables exactly as they are connected in an actual AC withstanding voltage test, but remove the DUT.
2. On the ACW1 screen, set the lower judgement function to OFF.
3. Using the SHIFT + ACW/OFFSET keys, shift to the offset measurement screen (OFFSET). The screen displays the test voltage, test frequency, test time, and the on/off settings for TIMER exactly as they were on the previous screen.

4. When necessary, set the test voltage, test frequency, and test time. For the setting procedures, see "3.4 Settings for AC Withstanding Voltage Testing".
5. When “READY” (READY status) is displayed on the offset measurement screen (OFFSET), press the START switch; offset measurement then starts.



The tester saves the offset value that is valid when the STOP-switch is pressed or the preset timer time has elapsed. Upon completion of the offset measurement, the tester returns to the READY status.

On the ACW1 screen, if OFFSET is set to ON, the test result is the value obtained by subtracting the offset value measured above from the measured current.

To check the offset value, press the SHIFT + ACW/OFFSET keys in order to return to the offset measurement screen (OFFSET).

3.10 System Settings

To display the system setting screen (SYSTEM), press the SYSTEM key. The LED on the SYSTEM key lights up.

The system settings screen (SYSTEM) is composed of four pages – SYSTEM1 to SYSTEM4. To switch among these pages, press the SHIFT key + ◀ ▶ keys.

Settings can be made for the following items:

SYSTEM1

- Measurement-mode (MEAS MODE) settings
- Pass hold-time (PASS HOLD) settings
- Turning ON/OFF the momentary function (MOMENTARY)
- Turning ON/OFF the FAIL mode (FAIL MODE)
- Turning ON/OFF the double-action function (DOUBLE ACTION)

SYSTEM2

- Buzzer-volume (BUZZER) settings
- Contrast (CONTRAST) settings

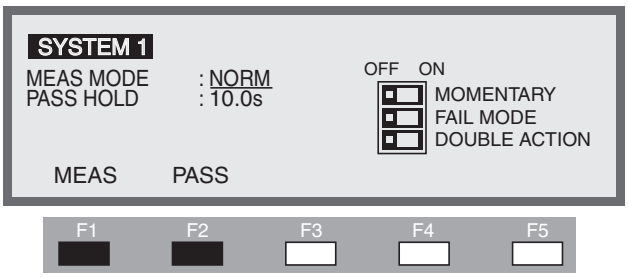
SYSTEM3

- STATUS-SIGNAL OUTPUT settings

SYSTEM4

- Inputting a comment (COMMENT)

3.10.1 SYSTEM 1



Setting the measurement mode (MEAS MODE)

A leakage-current measurement mode can be selected.

NORM : Ordinary measurement mode

MIN/MAX : The measurement mode for holding the maximum current in withstanding voltage testing and the minimum resistance recorded after the WAIT TIME has elapsed in insulation resistance testing

1. Using the F1 key (MEAS) or the ▲ ▼ ◀ ▶ keys, move the cursor to MEAS MODE.
2. Using the rotary knob, select NORM or MIN/MAX.

Setting the pass hold time (PASS HOLD)

The hold time can be set to 0.2 s through 10.0 s (at a resolution of 0.1 s) for a PASS judgement.

When HOLD is set, a PASS judgement is held until the STOP switch is pressed.

1. Using the F2 key (PASS) or the ▲ ▼ ◀ ▶ keys, move the cursor to PASS HOLD.
2. Using the rotary knob, set the pass hold time.

Turning the momentary function ON/OFF (MOMENTARY)

NOTE

- Releasing the START switch with MOMENTARY on is equivalent to pressing the STOP switch. As a result, in a programmed automatic test, the test is unable to proceed to the next step if the step interval time is set to HOLD.

When MOMENTARY is on, the test continues as long as the START switch is held down.

When MOMENTARY is set to ON, the tester performs a test only for as long as the START switch remains pressed. Since this operation keeps the operator's hands confined to the front panel of the tester or the optional START switch during a test,

it increases the safety of operations. Use of this function together with the optional RC02-TOS (a remote-control box operated using both hands) further increases safety.

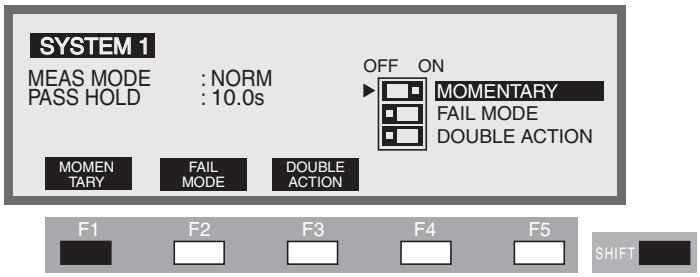
The momentary function can be set using the SHIFT + F1 keys, regardless of the location of the cursor. Each time the SHIFT + F1 keys are pressed, ON and OFF alternate. The ▶ mark on the screen is to the left of MOMENTARY.

When the ▶ mark is to the left of MOMENTARY, settings can be made using the rotary knob.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

When ON is set, items are highlighted.



Turning the FAIL mode ON/OFF (FAIL MODE)

When the FAIL mode is on, it is impossible to cancel a FAIL judgement or the protection status using the STOP signal by remote control.

To use the optional high-voltage test probe (HP01-TOS, HP02-TOS), turn on the FAIL mode. When the test ends with a FAIL judgement, the tester's FAIL status is not cancelled even if you release your hand from the probe. To cancel the FAIL status, press the STOP switch on the front panel.

The FAIL mode can be set using the SHIFT + F2 keys, regardless of the location of the cursor. Each time the SHIFT + F2 keys are pressed, ON and OFF alternate. The ▶ mark on the screen is to the left of FAIL MODE.

When the ▶ mark is to the left of MOMENTARY, settings can be made using the rotary knob.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Turning the double-action function ON/OFF (DOUBLE ACTION)

When the double-action function is set to ON, a test cannot be started unless the START switch is pressed within approximately 0.5 s after the STOP switch is pressed ("READY" disappears approximately 0.5 s after the STOP switch is pressed).

To start a test, not only the START switch but also the STOP switch must be pressed. This bothersome operation is intended to enhance safety.

To control the tester using the GPIB or RS-232C, turn off this function.

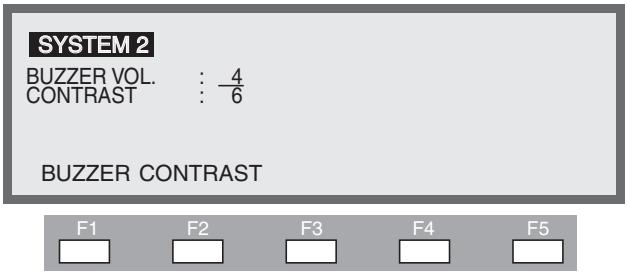
The double-action function can be set using the SHIFT + F3 keys, regardless of the location of the cursor. Each time the SHIFT + F3 keys are pressed, ON and OFF alternate. The ▶ mark on the screen appears to the left of DOUBLE ACTION.

When the ▶ mark is to the left of DOUBLE ACTION, settings can be made using the rotary knob.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

3.10.2 SYSTEM2



Setting the buzzer volume (BUZZER)

The buzzer volume can be set to 0 through 10 (at a resolution of 1) for FAIL judgement. The buzzer volume for PASS judgement is half that for FAIL judgement.

1. To display the BUZZER VOL., press the SHIFT + ◀ ▶ keys to display the SYSTEM2 screen.
2. Using the F1 key (BUZZER) or the ▲ ▼ keys, move the cursor to BUZZER VOL. To hear the preset sound, press the F1 key (BUZZER).
3. Using the rotary knob, adjust the buzzer volume.

Setting the contrast (CONTRAST)

The LCD screen contrast level can be set to 1 through 10 (at a resolution of 1).

1. To display the CONTRAST, press the SHIFT + ◀ ▶ keys to display the SYSTEM2 screen.

2. Using the F2 key (CONTRAST) or the ▲ ▼ keys, move the cursor to CONTRAST.

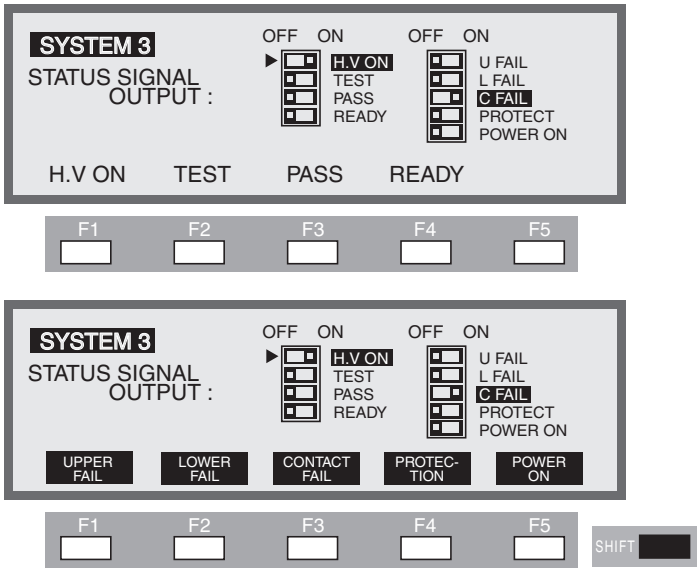
3. Using the rotary knob, adjust the contrast level.

The contrast level can be set using the SHIFT + ▲ ▼ keys, regardless of the screen displayed.

3.10.3 SYSTEM3

Setting the STATUS SIGNAL OUTPUT

Make settings to specify the timing of the output of a DC voltage of 24 V from the STATUS OUT connector on the rear panel.



To make settings for the STATUS SIGNAL OUTPUT terminal, use the function keys or the rotary knob.

Each time a function key or the SHIFT + function keys are pressed, the item shown on the key is turned on/off.

The ▶ mark appears to the left of the selected item. Using the rotary knob, the items shown with the ▶ mark on the left can be set.

Turn the rotary knob clockwise : ON

Turn the rotary knob counterclockwise : OFF

Items set to ON are highlighted.

H.V ON

When H.V ON is set to ON, DC 24 V is output during the test, while a voltage remains between the output terminals, or during automatic testing.

TEST

When TEST is set to ON, DC 24 V is output during the test after the test voltage reaches the preset value. That is, no voltage is output during the RISE time or FALL time.

PASS

When PASS is set to ON, DC 24 V is output during a PASS judgement.

READY

When READY is set to ON, DC 24 V is output while READY is displayed on the LCD.

U FAIL

When U FAIL is set to ON, DC 24 V is output while FAIL is output in an upper judgement.

L FAIL

When L FAIL is set to ON, DC 24 V is output while FAIL is output in a lower judgement.

C FAIL

When C FAIL is set to ON, DC 24 V is output while FAIL is output in a contact check.

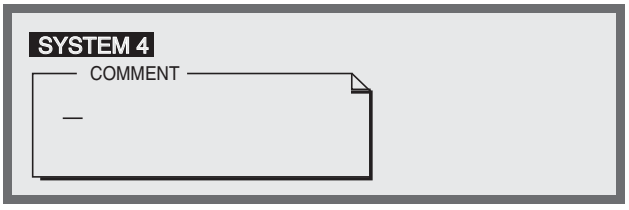
PROTECT

When PROTECT is set to ON, DC 24 V is output while the tester is in the PROTECTION status. However, DC 24 V is not output if the tester is in the PROTECTION status due to errors in DC 24 V of STATUS OUT or DC 24 V of SIGNAL I/O.

POWER ON

When POWER ON is set to ON, DC 24 V is output while the POWER switch is on.

3.10.4 SYSTEM4



Inputting a comment (COMMENT)

A comment can be added using up to 3 lines with 20 characters per line (ASCII 20H to 7EH, Appendix 2).

1. Display the SYSTEM4 screen.
2. Using the ▲ ▼ ◀ ▶ keys, move the cursor to where the comment is to be input.
3. Using the rotary knob, select characters.

3.11 Interface Settings

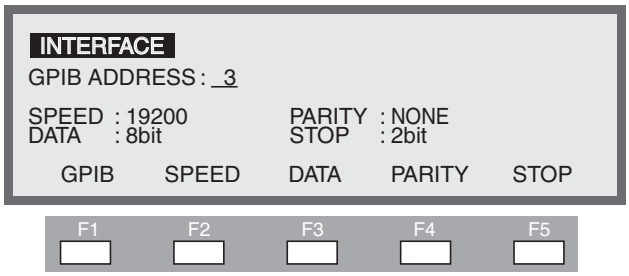
To display the interface setting screen (INTERFACE), press the SHIFT + SYSTEM/I/F keys. The SYSTEM/I/F key lights up.

NOTE

- When interfaces have been changed, turn the power off and on again to confirm the new settings.

The interface setting screen permits the following settings to be made:

1. GPIB address
2. Baud rate of the RS-232C interface
3. Data length of the RS-232C interface
4. Parity of the RS-232C interface
5. Stop bit of the RS-232C interface



Setting the GPIB address

Set the GPIB address to 0 through 30.

1. Using the F1 key (GPIB) or the ▲ ▼ ◀ ▶ keys, move the cursor to GPIB ADDRESS.
2. Using the rotary knob, set the GPIB address.

Setting the baud rate of the RS-232C interface

For the baud rate of the RS-232C interface, select one of the following three speeds:
38400 bps
19200 bps
9600 bps

1. Using the F2 key (SPEED) or the ▲ ▼ ◀ ▶ keys, move the cursor to SPEED.
2. Using the rotary knob, select 38,400, 19,200, or 9,600.

Setting the data length of the RS-232C interface

For the data length of the RS-232C interface, select either of the following:
7 bits
8 bits

1. Using the F3 key (DATA) or the ▲ ▼ ◀ ▶ keys, move the cursor to DATA.
2. Using the rotary knob, select 7 or 8.

Setting the parity of the RS-232C interface

For the parity of the RS-232C interface, select one of the following three parities:
NONE
ODD
EVEN

1. Using the F4 key (PARITY) or the ▲ ▼ ◀ ▶ keys, move the cursor to PARITY.
2. Using the rotary knob, select NONE, ODD, or EVEN.

Setting the stop bit of the RS-232C interface

For the stop bit of the RS-232C interface, select either of the following:
1 bit
2 bits

1. Using the F5 key (STOP) or the ▲ ▼ ◀ ▶ keys, move the cursor to STOP.
2. Using the rotary knob, select 1 or 2.

3.12 Panel Memory

The tester is capable of storing up to 100 preset patterns of test conditions in its internal memory for each AC/DC withstanding voltage test and insulation resistance test.

Storable test conditions

■ AC withstanding voltage testing

- Test voltage
- Test frequency
- Lower current (LOWER) and ON/OFF of the lower judgement function
- Upper current (UPPER)
- ON/OFF of the offset function
- Test time (TEST TIME) and ON/OFF of the timer function

- Start voltage
- Voltage rise time (RISE TIME)
- Voltage fall time (FALL TIME)
- Test-voltage range
- SLOW/MID/FAST settings for the response filter
- LOW/GUARD settings for the GND
- HIGH/LOW/OPEN settings for the scan channel
- ON/OFF of the contact check function

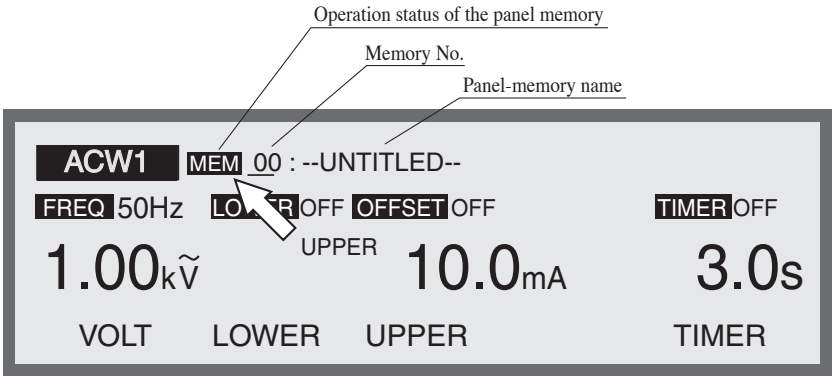
■ DC withstanding voltage testing

- Test voltage
- Lower current (LOWER) and ON/OFF of the lower judgement function
- Upper current (UPPER)
- Test time (TEST TIME) and ON/OFF of the timer function
- Start voltage
- Voltage rise time (RISE TIME)
- Judgement wait time (WAIT TIME)
- LOW/GUARD settings for the GND
- HIGH/LOW/OPEN settings for the scan channel
- ON/OFF of the contact check function

■ Insulation resistance testing

- Test voltage
- Lower resistance (LOWER) and ON/OFF of the lower judgement function
- Upper resistance (UPPER) and ON/OFF of the upper judgement function
- Test time (TEST TIME) and ON/OFF of the timer function
- Voltage rise time (RISE TIME)
- Judgement wait time (WAIT TIME)
- LOW/GUARD settings for the GND
- HIGH/LOW/OPEN settings for the scan channel
- ON/OFF of the contact check function

Example of an AC withstanding voltage test (display of panel memory)



3.12.1 Storage in the panel memory

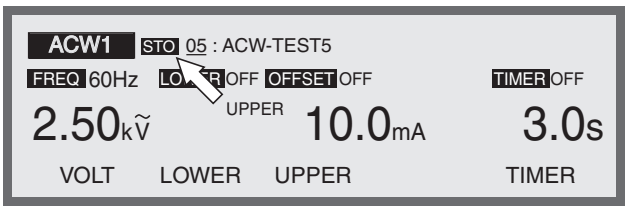
NOTE

- To store data, first specify a memory number, followed by a memory name. To return to the previous name, move the cursor to the memory number after setting the memory name.

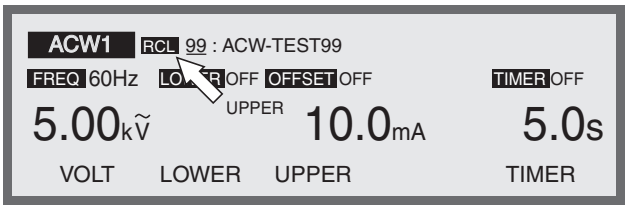
Storing the results of an AC withstanding voltage test in panel memory (example)

1. Press the ACW key to display the AC withstanding voltage test screen (ACW1), and set the test conditions.
2. Press the SHIFT + RECALL/STORE keys to display "STO 00:--UNTITLTED--" to the right of the title.
3. Using the rotary knob, set a memory number (00 to 99).
4. Using the ▶ key, move the cursor to "--UNTITLTED--."
5. Using the rotary knob, enter a memory name (using up to 12 characters). Use ASCII-code characters from 20H through 7EH (see the Appendix).
6. Press the ENTER key to store the test conditions under the set memory number.
   Upon completion of the storage procedure, "STO" changes to "MEM."

To cancel the storage operation, move the cursor to any location on the display before pressing the ENTER key.



3.12.2 Recalling panel memory



1. Press the RECALL key to display "RCL Memory No.: Memory Name" to the right of the title.
2. Using the rotary knob, specify the memory number to be recalled (00 to 99).

3. Press the ENTER key to recall the test conditions under the memory number. “RCL” changes to “MEM” to the right of the title.

To cancel the recall operation, move the cursor to any location on the display before pressing the ENTER key. Once the recalled test conditions have been changed, the memory number disappears. The memory number does not reappear even if the previous test conditions are restored.

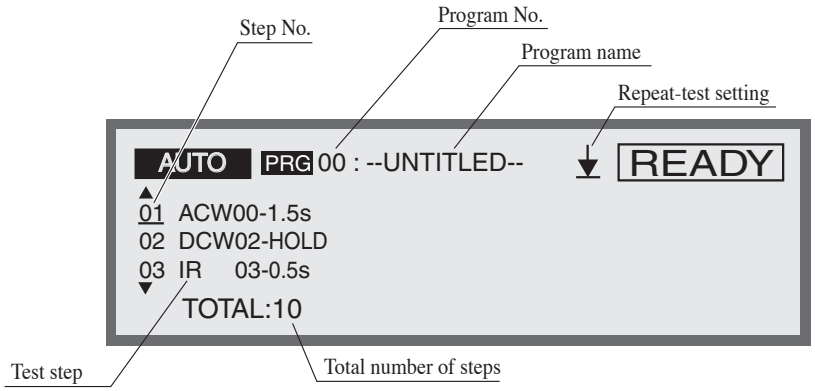
3.13 Program

By combining test conditions stored in internal memory, up to 100 programs composed of a total of 500 steps can be created.

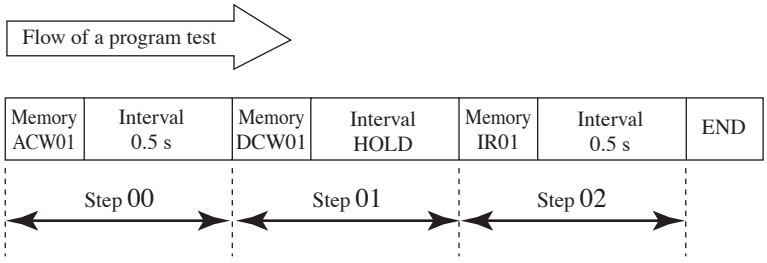
Each program can accommodate 100 steps.

For details on memory, see "3.12 Panel Memory".

Press the AUTO key. The LED lights up and the program screen (AUTO) is displayed.



Example of a program



To create the above program, make the following settings:

00: ACW01-0.5s

01: DCW01-HOLD

02: IR01-0.5s

END

(Explanation of the program example)

At Step 00, Memory ACW01 (AC withstanding voltage test) is conducted. Then, 0.5 second later, at Step 01, DCW01 (DC withstanding voltage test: available with the TOS9201 only) is conducted. The Step-01 interval time is set to HOLD. Thus, Step 02 does not start until the START switch is pressed. When START is pressed, IR01 (insulation resistance test) ends at Step 02 and, 0.5 seconds later, the tester enters the READY status.

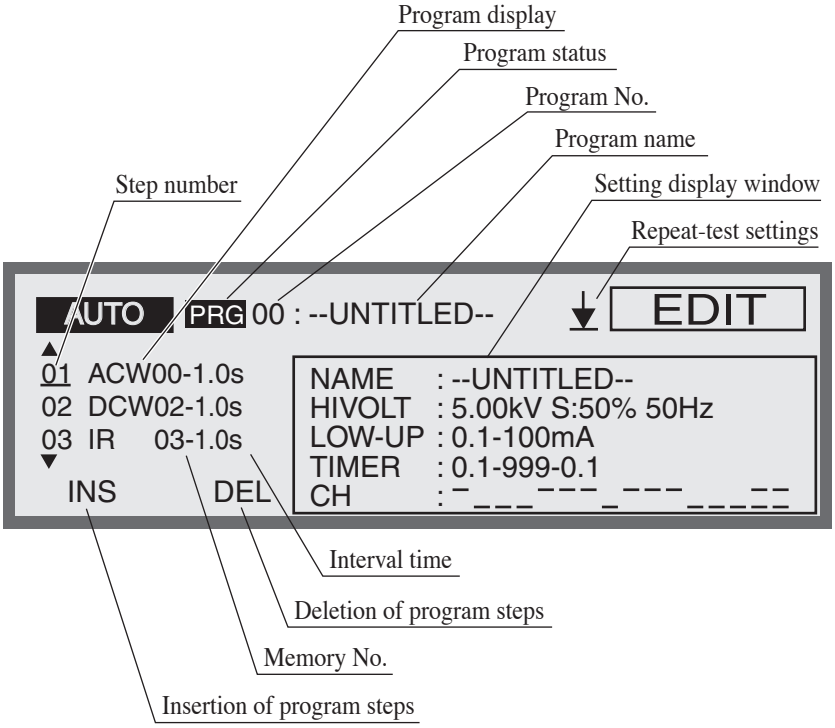
When END is set to RET, the test restarts at Step 00.

3.13.1 Creating and editing a program

On the program screen (AUTO), recall the number of the program to be created or edited. Press the SHIFT + AUTO/EDIT keys. The program edit screen will then appear, with "EDIT" displayed at the top right. The program is stored as it is created or edited.

If a program is to be created or edited, the following settings must be made:

- Program name
- Memory number (step settings)
- Interval time
- Repeat-test settings



Setting the program name

Enter the name of the program to be created (using up to 12 characters).

1. Press the SHIFT + F1 keys to move the cursor to the program name.
2. Using the ◀ ▶ keys, move the cursor to the target character.
3. Using the rotary knob, select characters. Use ASCII characters from 20H (space) to 7EH (~) (see the Appendix 2).
4. Upon completion of editing, press the SHIFT + F1 keys to move the cursor to the step number.

Setting the test conditions (Memory No.) and interval time

NOTE

- If a test condition under the preset memory number is set to TIMER OFF, a program test ends once the STOP switch is pressed, preventing the next test from being performed.

For each step, set the memory number of the test conditions to be used and the interval between steps. The program executes the test in order of step number.

When the cursor is positioned at the step number, the screen can be scrolled using the rotary knob. The ▲ ▼ keys can be used to perform scrolling, regardless of the location of the cursor.

Upon completion of each step, “END” or “RET” is displayed.

1. To move the cursor to the step number, press the SHIFT + F1 keys.
2. Move the cursor to the step below the step to be inserted. To add a step to the previous step, move the cursor to END or RET.
3. Press the F1 key (INS). A step (ACW00-0.2s) will be inserted at the cursor.
4. Using the ▶ key, move the cursor to ACW to the right of the step number.
5. Using the rotary knob, set the target test (ACW, DCW, IR, EC). (To control the earth continuity tester TOS6200, select EC. See "Chapter 5 Controlling the TOS6200").
6. Using the ▶ key, move the cursor to the memory number.
7. Using the rotary knob, set a memory number.
8. Using the ▶ key, move the cursor to the interval time to the right of the memory number.
9. Using the rotary knob, set an interval time (from 0.2 s to 9.9 s, HOLD).

   If the interval time is set to HOLD, the next step starts when the START switch is pressed with the specified step in the HOLD status.

To delete a step, move the cursor to the corresponding step number and press the F2 key (DEL).

To change the interval time or the memory number of a step, move the cursor to the target and make changes using the rotary knob.

Setting the repeat test

To make settings necessary to repeat a test, use the SHIFT + F2 keys, regardless of the location of the cursor.

Each time the SHIFT + F2 keys are pressed, END and RET alternate.

END: The program ends, the tester returns to the first step and enters the READY status and.

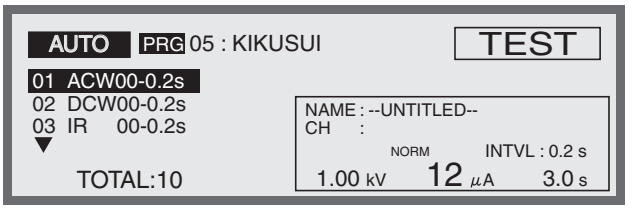
RET: The program returns to the first step and starts a new test.

3.13.2 Executing a program

NOTE

- Releasing the START switch when START MOMENTARY is on is equivalent to pressing the STOP switch. As a result, in a programmed automatic test, the test is unable to proceed to the next step if the step interval is set to HOLD.
- If the test executes a step with the timer function set to OFF, it is unable to proceed to the next step.

To run a program, display the program screen (AUTO).



1. Press the AUTO key to display the program screen (AUTO).
2. Using the rotary knob, specify the number of the program to be recalled. The name of the selected program is displayed to the right of the program number.
   To check the memory contents, press the SHIFT + F1 keys. The cursor will move to the step number. Using the rotary knob, select a step number. The test conditions for the selected step are displayed.
3. To run the program, press the START switch.

During the test, "TEST" is displayed and the TEST LED lights up on the indicator.

The step being run is displayed in reverse image.

3.13.3 Suspending the program

To suspend the test while running a program, press the STOP switch.

To start the program from the beginning, press the START switch.

3.13.4 Judgement on the program

■ PASS judgement

When the interval time for each step is set to other than HOLD, the program makes a PASS judgement if a PASS judgement is made for every step (only if the programmed repeat test is set to END).

A PASS judgement is made after the interval time for the previous step has elapsed. The tester then returns to the READY status.

If the interval time for any step is set to HOLD, the test does not proceed to the next step unless the START switch is pressed.

■ FAIL judgement

Once a FAIL judgement is made while the program is being run, the test stops at that step.

Check the failed step and press the STOP switch.

If the START switch is pressed again, the program starts from the beginning.

3.13.5 Exiting the program

To exit the PROGRAM mode in order to return to the normal mode, press the ACW key (or the DCW or IR key).

The LED on the AUTO key goes off, and the test-condition setting screen appears.

3.14 Key Lock

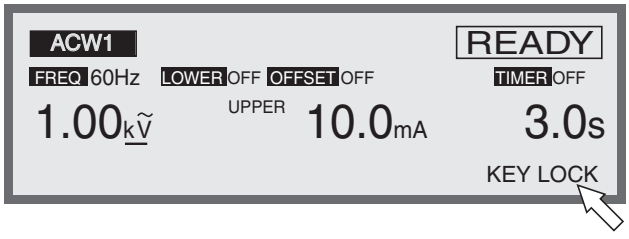
The key lock function is used to prevent the unintentional alteration of test conditions.

To lock the panel settings, press the SHIFT + LOCAL/KEY LOCK keys.

On the panel, only the START and STOP switches are operable.

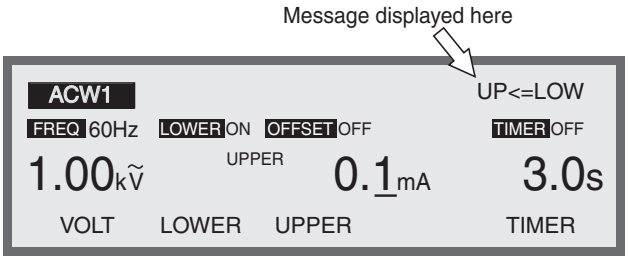
While the key lock function is on, “KEY LOCK” is displayed on the LCD.

To cancel the key lock function, press the SHIFT + LOCAL/KEY LOCK keys.



3.15 Invalid Settings

When an invalid setting is made, the messages shown below flash on the tester. Testing cannot be performed when a message is displayed. The messages below are arranged in order of priority.



INVALID CH

"INVALID CH" appears in the scanner channel settings when a channel that is not connected to the tester is specified.

OVER WAIT

"OVER WAIT" is displayed when, with the timer on, the preset wait time exceeds the sum of the rise time and the test time.

OVER 550 VA

"OVER 550 VA" is displayed when, during settings for an AC withstanding voltage test, the test voltage multiplied by the upper current exceeds 550 VA.

OVER 55 W

"OVER 55 W" is displayed when, in settings for a DC withstanding voltage test, the test voltage multiplied by the upper current exceeds 55 VA.

OVER 1.1 mA

"OVER 1.1 mA" is displayed when, during settings for an insulation resistance test, the test voltage divided by the lower resistance exceeds 1.1 mA.

UP<=LOW

"UP<=LOW" is displayed when, with the lower or upper judgement function on, the upper value is set at or below the lower value.

3.16 Protection

The tester enters the PROTECTION status in the cases specified below, as the internal protective circuit activates.

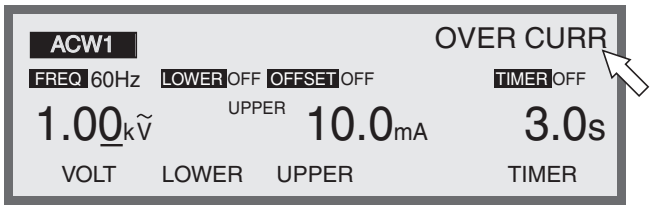
In the PROTECTION status, the PROTECTION LED lights on the indicator, the output is cut off, and the test stops.

The following events are arranged in order of priority in protection:

■ Internal power fault

When the main power supply in the tester is overloaded, “OVER CURR” flashes on the LCD.

Press the POWER-switch again. If “OVER CURR” is still displayed, an internal circuit may be broken. Contact Kikusui distributor/agent.

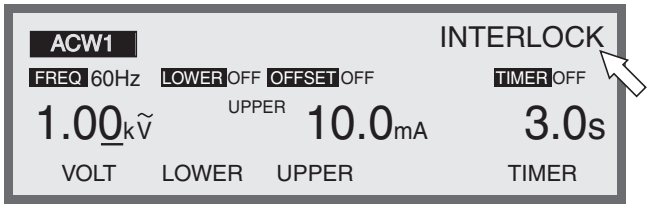


■ INTERLOCK signal

When the interlock connector is opened, the tester enters the INTERLOCK status. “INTERLOCK” flashes on the LCD.

To cancel the INTERLOCK status, short-circuit the INTERLOCK signal and press the STOP switch.

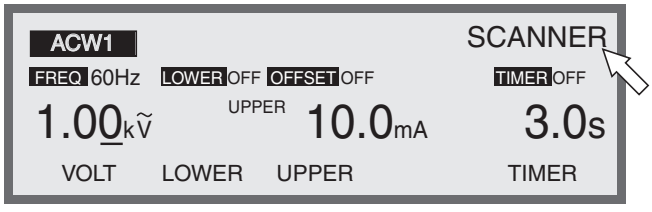
For details, see "4.3 INTERLOCK Connector".



■ Insertion/extraction of the scanner connector

When a connector is inserted or extracted with the optional scanner in use, the protection function activates and “SCANNER” flashes on the LCD.

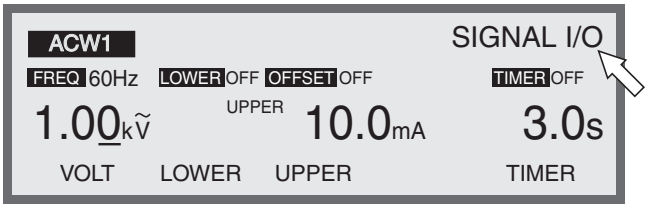
To cancel the protection function, press the STOP switch.



■ SIGNAL I/O signal

When there is a change in the ENABLE-signal level of pin 23 on the SIGNAL I/O connector, the protection function activates and “SIGNAL I/O” flashes on the LCD.

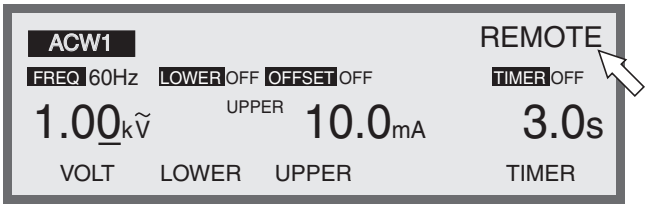
To cancel the protection function, press the STOP switch.



■ REMOTE

When the remote-control connector on the front panel is inserted or extracted, the protection function activates and “REMOTE” flashes on the LCD.

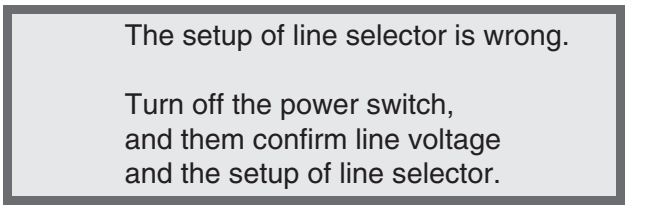
To cancel the protection function, press the STOP switch.



■ Monitoring of AC power

When INPUT-VOLTAGE RANGE on the rear panel differs from the actual input-voltage range, the protection function activates and the following message is displayed on the LCD.

To cancel the protection function, turn off the POWER switch, and check the AC power and the settings on the tester.



■ Output-voltage monitoring function

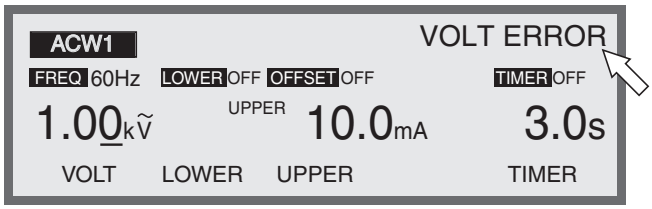
When the output voltage deviates from ±(10 % of the setting +50 V), the protection function activates. “VOLT ERROR” flashes on the LCD, and the test stops.

To cancel the protection function, press the STOP switch.

In insulation resistance testing, however, the test continues if LOWER is set to OFF. In this case, the measured voltage flashes on the LCD voltmeter to indicate the decrease in the test voltage if the output voltage deviates the monitor range.

NOTE

- In AC withstanding voltage testing, a maximum rated current of 100 mA is not achieved at a test voltage of 200 V or less. If the upper current is set to 100 mA or more at a test voltage of 200 V or less, no FAIL judgement may be made even if the output is short-circuited during the test, thus activating the output-voltage monitoring function.

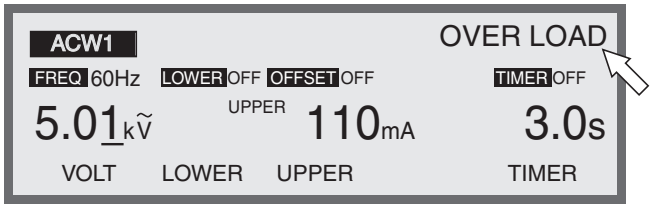


■ Output-power limiting function

This is a protection function intended to limit the output power during a test. If the output voltage multiplied by the measured current (including the offset value) exceeds 550 VA and 55 VA in AC and DC withstanding voltage tests, respectively, the protection function activates. “OVERLOAD” flashes on the LCD, and the test stops.

At an output voltage of 5.01 kV, for instance, when the measured current (including the current in the DUT and test probe) exceeds 110 mA, the output power exceeds 550 VA and the test stops due to an overload.

To cancel this function, press the STOP switch.

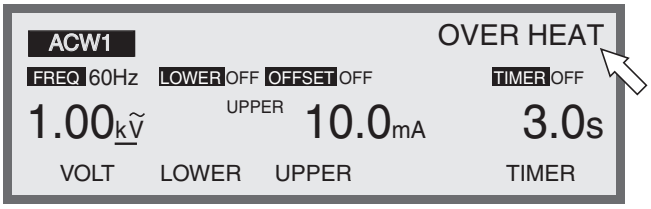


■ Overheat protection

When the internal temperature of the tester rises to an abnormal level, the protection function activates. “OVERHEAT” flashes on the LCD, and the test stops. Abnormal temperatures are caused by a reduction in the air flow of the air inlet or outlet, malfunctioning of the fan or other components, and operations at high temperatures.

Usually, the internal temperature falls to a normal level in approximately 10 minutes if there is no malfunctioning of the fan. Once the temperature returns to the normal level, press the STOP switch to cancel the protection function.

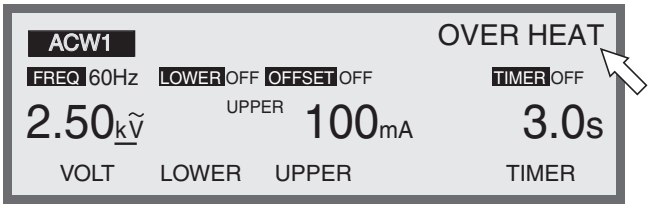
Abnormal temperatures may be caused by the malfunctioning of the fan if the protection function activates frequently.



■ Time restriction by the output current

The tester is designed to release heat that is half the rated output in consideration of the tester’s size, weight, cost, and other factors. Therefore, to conduct an AC withstanding voltage test with an upper current of 50 mA, it is necessary to provide a pause longer than the output time. Note that the maximum output time is 30 minutes (at an ambient temperature of 40 ˚C or below). During a test, if a current of 50 mA or greater is detected for 30 minutes or more, the protection function activates. “OVERHEAT” flickers on the LCD, and the test stops. There is no time restriction when the tester is operated below 50 mA.

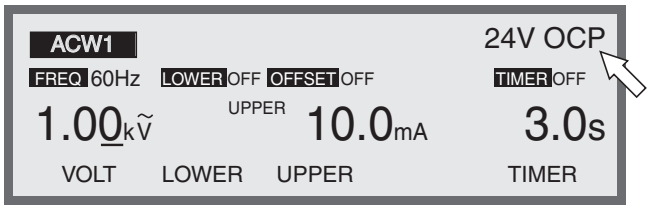
To cancel the protection function, turn off the POWER switch.



■ Abnormal 24-V output

When the DC 24-V output of the STATUS connector or SIGNAL I/O connector suffers an overload or other abnormality, the protection function activates, “24V OCP” flashes on the LCD.

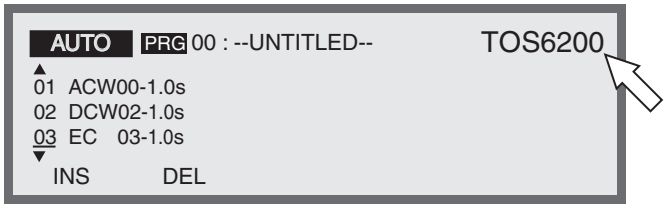
To cancel the protection function, eliminate the cause of the problem and then press the STOP switch.



■ TOS6200 protection

When the TOS6200, while controlled by the tester, enters the PROTECTION status, the tester itself also enters the PROTECTION status. “TOS6200” flashes on the LCD.

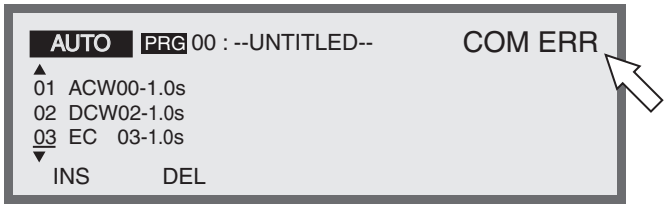
To cancel the status, eliminate the cause of the problem with the TOS6200 and then press the STOP switch.



■ Communication error during TOS6200 control

When an error occurs in interface settings or communication cables while the tester is controlling the TOS6200, “COM ERR” flashes on the LCD.

To cancel the protection function, eliminate the cause of the communication error and then press the STOP switch.



3.17 Initialization

NOTE

- When the tester is initialized, the contents of panel memory and all programs are cleared. Before initializing the tester, make sure these contents will not be needed.

To initialize the tester, press the SHIFT key + the POWER switch to start it up. Initialization will start. All contents of memory are deleted, and the tester returns to the factory settings. (Hold the SHIFT key down until "KIKUSUI ELECTRONICS CORP." disappears.)

■ Factory settings

- **Test-Condition Settings screen (ACW)**

Test voltage (VOLTAGE)	: 0.00 kV
Frequency (FREQ)	: 50 Hz
Lower judgement (LOWER)	: OFF
Lower current (LOWER)	: 0.10 mA
Upper current (UPPER)	: 0.20 mA
Offset (OFFSET)	: OFF
Timer (TIMER)	: ON
Timer set value (TIMER)	: 0.5 s
Start voltage (START)	: 0 %
Voltage rise time (RISE TIME)	: 0.1 s
Voltage fall time (FALL TIME)	: 0.0 s
Voltage range (V RANGE)	: AUTO
Response filter (RESPONSE)	: SLOW
LOW/GUARD of the GND (GND)	: GND
Scanner channel	: ALL OPEN
CONTACT CHECK	: OFF

- **Test-Condition Settings screen (DCW)**

Test voltage (VOLTAGE)	: 0.00 kV
Lower judgement (LOWER)	: OFF
Lower current (LOWER)	: 0.10 mA
Upper current (UPPER)	: 0.20 mA
Timer (TIMER)	: ON
Timer set value (TIMER)	: 0.5 s
Start voltage (START)	: 0 %
Voltage rise time (RISE TIME)	: 0.1 s
Judgement wait time (WAIT TIME)	: 0.3 s
LOW/GUARD of the GND (GND)	: GND
Scanner channel	: ALL OPEN
CONTACT CHECK	: OFF

- **Test-Condition Settings screen (IR)**

Test voltage (VOLTAGE)	: 10 V
Lower judgement (LOWER)	: ON
Lower resistance (LOWER)	: 1.00 MΩ
Upper judgement (UPPER)	: OFF
Upper resistance (UPPER)	: 100 MΩ
Timer (TIMER)	: ON
Timer set value (TIMER)	: 0.5 s
Voltage rise time (RISE TIME)	: 0.1 s
Judgement wait time (WAIT TIME)	: 0.3 s
LOW/GUARD of the GND (GND)	: GND
Scanner channel	: ALL OPEN
CONTACT CHECK	: OFF

- **Offset screen (OFFSET)**

Offset value

REAL (OFFSET)	: 0 μA
IMAG (OFFSET)	: 0 μA

- **System screen (SYSTEM)**

MEAS MODE	: NORM
PASS HOLD	: 0.2 s
MOMENTARY	: OFF
FAIL MODE	: OFF
DOUBLE ACTION	: OFF
BUZZER VOL	: 4
CONTRAST	: 6
STATUS-SIGNAL OUTPUT	: All OFF
COMMENT	: Clear

- **Interface screen (INTERFACE)**

GPIB ADDRESS	: 4
SPEED	: 19200
DATA	: 8 bits
PARITY	: NONE
STOP	: 2 bits

Chapter 4 Using Terminals and Connectors

This chapter describes the procedures for use of the connectors on the front and rear panels.

⚠WARNING

- In remote control, the tester turns an extremely high voltage on/off using an external signal. This poses grave potential danger. Provide full safety measures to prevent the unintentional generation of a high voltage. While a high voltage is being generated, the DUT, high-voltage test leadwire, probe, and output terminals never touched. Never conduct remote control unless sufficient safety measures have been provided.

NOTE

- When the START signal of the SIGNAL I/O connector is valid, the START signal of the SIGNAL I/O has priority over that of the REMOTE terminal.

  The STOP signals of the SIGNAL I/O connector and the REMOTE terminal are accepted equally.

REMOTE terminal on the front panel

The optional remote-control box RC01-TOS/RC02-TOS or high-voltage test probe HP01A-TOS/HP02A-TOS can be used to start and stop a test.

SIGNAL I/O connector on the rear panel

By inputting a signal to this connector, a test can be started and stopped, and the panel memory and program memory can be recalled. In addition, using the output signal from the SIGNAL I/O connector, the status of the tester can be checked.

INTERLOCK connector

Using a signal from an external safety device, the tester can be placed in the INTERLOCK status.

STATUS OUT connector

This connector is used to connect to a warning light and certain other devices. A voltage of +24 V is output under the conditions (of the tester) selected on the System screen.

4.1 REMOTE Terminal

The REMOTE terminal is the 5-pin DIN connector on the front panel.

This connector is used exclusively to connect the optional remote-control box RC01-TOS/RC02-TOS and high-voltage test probe HP01A-TOS/HP02A-TOS.

When this optional device is connected, the START switch on the front panel becomes invalid.

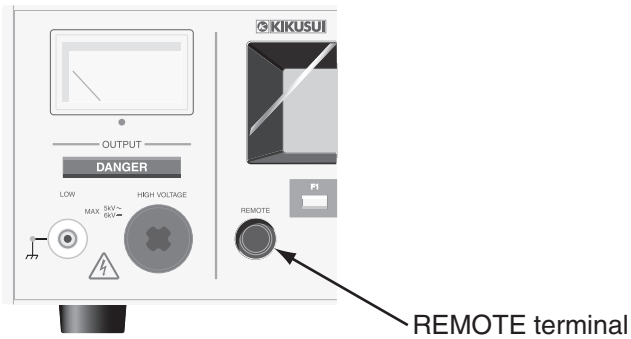


Fig.4-1 REMOTE terminal

⚠WARNING • Use the optional high-voltage test probe HP01A-TOS/HP02A-TOS at AC 4 kV or DC 5 kV or less.

⚠CAUTION • Keep the signal line at least 500 mm from the high-voltage test leadwire and the DUT. Do not short-circuit the test voltage to the signal line. Otherwise, all internal circuits may be destroyed.

Control procedure

1. Turn off the POWER switch.
2. Using the exclusive connection cable (5-pin DIN cable), connect the optional device to the REMOTE connector on the front panel.
3. Turn on the POWER switch.

   A test can be started on the optional device. In such a case, the START switch on the panel becomes invalid. To stop the test, either press the STOP switch on the panel or input the STOP signal on the optional device. For details, see the operation manual for the optional device.
4. To return to the panel for control, first turn off the POWER switch on the tester.
5. On the front panel, remove the exclusive connection cable (5-pin DIN cable) from the REMOTE connector.
6. Turn on the POWER switch.
   The START switch on the panel becomes valid.

NOTE

- When the START signal of the SIGNAL I/O connector is valid, the signal has priority over the START signal of the REMOTE terminal.

  The STOP signals of the SIGNAL I/O connector and the REMOTE terminal are accepted equally.
- If the REMOTE connector is inserted/extracted with the POWER switch on, “REMOTE” flashes on the LCD. The tester enters the PROTECTION status (“PROTECTION” lights up) and cuts off the high-voltage output.
- In making system settings, when FAIL MODE is set to ON, the FAIL or PROTECTION status cannot be cancelled even if the STOP signal is input from the REMOTE terminal. To cancel the statuses, press the STOP switch on the panel. For the system settings, see "3.10 System Settings".

4.2 SIGNAL I/O Connector

⚠WARNING • To prevent electric shock, turn off the device before connecting/disconnecting a cable.

⚠CAUTION • Keep the signal line at least 500 mm from the high-voltage test leadwire and the DUT. Do not short-circuit the test voltage to the signal line. Otherwise, all internal circuits may be destroyed.

The SIGNAL I/O connector is the 25-pin D-SUB connector on the rear panel.

By inputting a signal to the SIGNAL I/O connector, a test can be started/stopped and the panel memory and program memory can be recalled. In addition, the status of the tester can be checked using the output signal from the SIGNAL I/O connector.

Connector on the tester side

Omron's XM2B-2502 25-pin D-SUB female connector or the equivalent

Connection cable

25-pin D-SUB male – 25-pin D-SUB male straight cable

Connector for the cable

Omron's XM2D-2501 25-pin D-SUB female connector or the equivalent

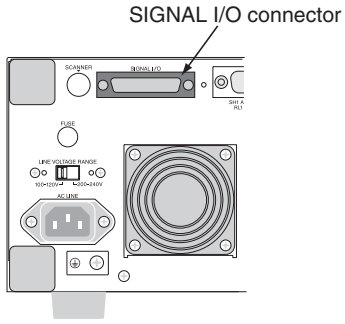


Fig.4-2 SIGNAL I/O

NOTE

- For 25-pin D-SUB connectors and cables, use a shielded type with a length of 3 m or less to prevent malfunction due to noise.
- The internal control circuit of the tester is designed to prevent malfunction caused by noise generated by the tester or peripheral devices. However, connected devices may malfunction if unshielded cables are connected to SIGNAL I/O terminals, because such cables would virtually make a sort of "antenna" to pick up external noise. To avoid this problem, use metal connectors, shielded cables, and external circuits housed in a shielded case. Connect them to the tester's housing (do not connect the COM line to a shield or an earth ground). These measures insulate SIGNAL I/O-related circuits from the external environment, thus reducing malfunction due to noise.

4.2.1 Specifications for the SIGNAL I/O connector

■ Input signal

Low active control input

High-level input voltage:
11 V to 15 V

Low-level input voltage:
0 V to 4 V

Low-level AC current:
Maximum –5 mA

Input interval:
Minimum 5 ms

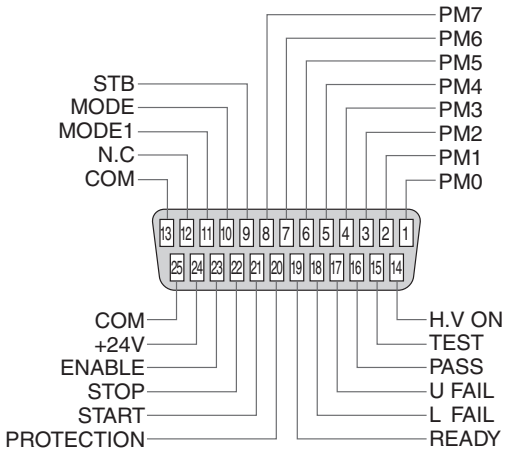


Fig.4-3 SIGNAL I/O pin assignment

■ Output signal

Open collector output

Output withstanding voltage: DC 30 V

Output saturation voltage : Approximately 1.1 V (25 ˚C)

Maximum output current : 400 mA (TOTAL)

■ Pin assignment

No.	Signal name	I/O	Details of signal		
1	PM0	I	LSB		2-digit BCD low active input
2	PM1	I		LSD	Signal input terminal for selection between the panel memory for ACW, DCW, and IR, and the program memory for AUTO
3	PM2	I			
4	PM3	I			
5	PM4	I			Memory recall by latching this selection signal at the rise of the strobe signal
6	PM5	I		MSD	
7	PM6	I			
8	PM7	I	MSB		
9	STB	I	Input terminal for the strobe signal of the panel memory and program memory		
10	MODE0	I	Selects a test mode 2-bit low active input		
11	MODE1	I			
12	NC				
13	COM		Circuit common (chassis potential)		
14	H.V ON	O	ON during a test and an automatic test (AUTO) or while a voltage remains between the output terminals		
15	TEST	O	ON during a test (except for voltage rise and voltage fall)		
16	PASS	O	ON during the time preset in the PASS HOLD settings when a PASS judgement is made		
17	U FAUL	O	Continuously ON in an UPPER FAIL judgement. Continuously ON in a CONTACT FAIL judgement with the scanner connected.		
18	L FAUL	O	Continuously ON in an LOWER FAIL judgement. Continuously ON in a CONTACT FAIL judgement with the scanner connected.		
19	READY	O	ON during the READY status		
20	PROTECTION	O	ON when the PROTECTION function is activated		
21	START	I	Input terminal for the START signal		
22	STOP	I	Input terminal for the STOP signal		
23	ENABLE	I	Input terminal for the ENABLE signal for the START signal		
24	+24V		Output terminal for +24 V internal power, with a maximum output current of 100 mA		
25	COM		Circuit common (chassis potential)		

MODE0	H	L	H	L
MODE1	H	H	L	L
Test mode	ACW	DCW	IR	AUTO

Table4-1 SIGNAL I/O assignment

NOTE
- If U FAIL and L FAIL are turned on simultaneously, CONTACT FAIL is meant.
- It is impossible to directly control the input signal using a logic IC such as HC.

■ Internal configuration

The same common line is used for the input signal circuit and the output signal circuit.

The input signal circuit is pulled up to +12 V. Therefore, opening the input terminal is equivalent to inputting a high-level signal.

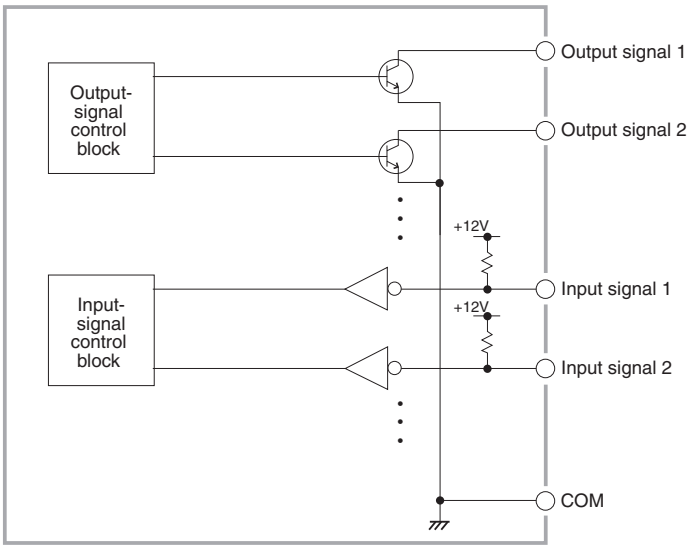


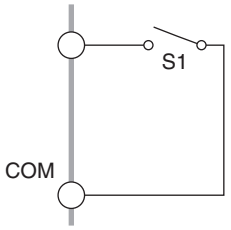
Fig.4-4 Internal configuration of the SIGNAL I/O block

4.2.2 Example

■ Input signal

Control at a make-contact

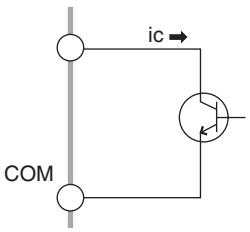
Using the make-contact of a relay or switch, set the input level to LOW.



Control using a logic elements

Instead of the switch described above, use a logic element such as a transistor.

For the transistor's collector current ic, allow at least 5 mA.



■ Output signal

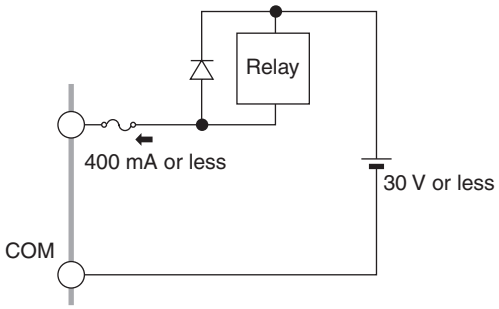
NOTE

- The open collector output can lead to burning of the output device and the printed circuit board if the load is short-circuited. Use a protection fuse for output.
- To drive an inductive load such as a relay, be sure to connect a diode in parallel with the coil.

■ Output signal

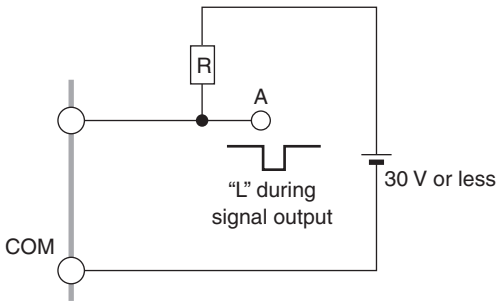
Driving a relay (example)

The relay can be driven using the output signal.



Achieving the L-level for the digital signal (example)

Using the output signal, the L-level for the digital signal can be achieved.



⚠ CAUTION

- Keep the signal line at least 500 mm from the high-voltage test leadwire and the DUT. Do not short-circuit the test voltage to the signal line. Otherwise, all internal circuits may be destroyed.
- Do not extract a current exceeding the maximum rated current of 100 mA from the +24 V internal power supply. Once a current exceeds the maximum rated current, the overcurrent protection function activates and "24V OCP" flashes on the LCD. The tester enters the PROTECTION status.

  If the overcurrent protection function activates, turn off the POWER switch to prevent an overcurrent.

  If an overcurrent flows continually for hours, the internal circuit may malfunction.

NOTE

- The internal control circuit of the tester is designed to prevent malfunction caused by noise generated by the tester or peripheral devices. However, connected devices may malfunction, if unshielded cables are connected to SIGNAL I/O terminals, because cables would virtually make a sort of "antenna" to pick up external noise. To avoid this problem, use metal connectors, shielded cables, and

external circuits housed in a shielded case. Connect them to the tester's housing (do not connect the COM line to a shield or an earth ground). These measures insulate SIGNAL I/O-related circuits from the external environment, thus reducing malfunction due to noise.

4.2.3 Starting a test

To start a test by using the SIGNAL I/O connector, set the ENABLE signal to a low level first. After a lapse of 10 ms or more from the READY signal has turned to a low level, set the START signal to a low level for 5 ms or more. The READY signal turns to a high level after the effective START signal has been detected.

When the ENABLE signal is the low level, the START signal for the SIGNAL I/O connector is enabled. At the same time, the START input for the REMOTE terminal and the START switch on the panel are disabled.

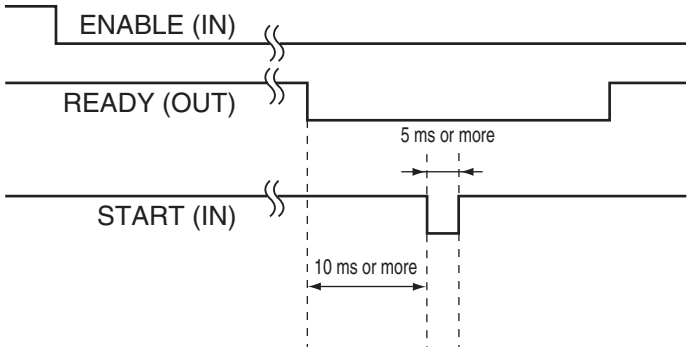


Fig.4-5 START signal

Control procedure

1. Short-circuit ENABLE of the START signal on pin 23 using pin 13 or pin 25 (COM) to shift to the low level. The START switch on the panel and the START input of REMOTE will then become invalid. A stop operation is workable with the STOP switch on the panel, or by inputting STOP from the REMOTE terminal or the STOP signal from SIGNAL I/O.
2. While the READY signal on pin 19 is ON, short-circuit the START signal on pin 21 using pin 13 or pin 25 (COM) to shift to the low level. The test will then start.
3. Short-circuit the STOP signal on pin 22 using pin 13 or pin 25 (COM) to shift to the low level. The test will then stop.
4. To cancel the remote-control function, set ENABLE of the START signal to the high level. The START switch on the panel will then become valid, while the START signal for SIGNAL I/O will become invalid.

NOTE

- When the ENABLE level of the START signal is changed, “REMOTE” flashes on the LCD. The tester enters the PROTECTION status (“PROTECTION” lights up). To cancel the PROTECTION status, use the STOP switch on the panel or the STOP signal.
- If FAIL MODE is set to ON in the system settings, neither the FAIL status nor the PROTECTION status can be cancelled using the STOP signal from the remote control. To cancel these statuses, use the STOP switch on the panel.

  For the system settings, see "3.10 System Settings".
- The input terminal is pulled up to +12 V by resistance. Opening the input terminal is equivalent to inputting a high level.

4.2.4 Recalling the panel memory and programs

The MODE signal, PM signal, and STB signal are handled with the timing specified below (confirm that the READY signal is at the low level).

Fig. 4-2 shows how the MODE1 to MODE0 signals and the PM0 to PM7 signals relate to the panel memory number and the program number.

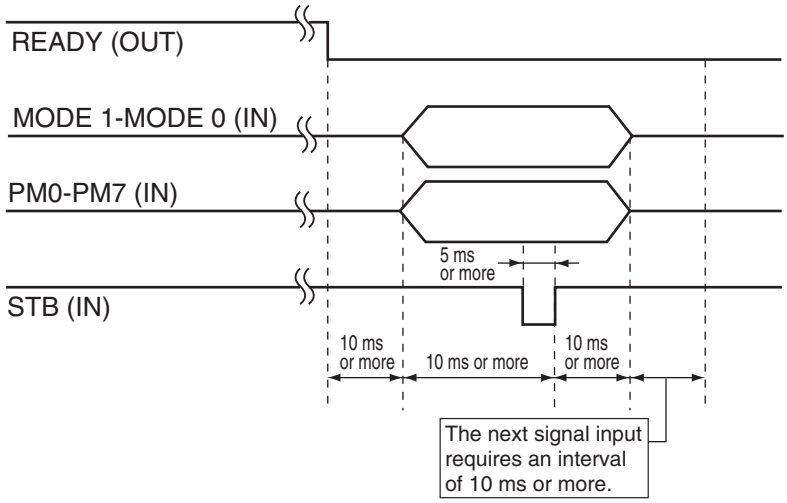


Fig.4-6 Strobe signal

NOTE

- The input terminal is pulled up to +12 V by resistance. Opening the input terminal is equivalent to inputting a high level.

MODE 1	MODE 0	MSD				LSD				MAIN
		PM7	PM6	PM5	PM4	PM3	PM2	PM1	PM0	
H	H	H	H	H	H	H	H	H	H	Recalls ACW panel memory 0.
		H	H	H	H	H	H	H	L	Recalls ACW panel memory 1.
		H	H	H	H	H	H	L	H	Recalls ACW panel memory 2.
		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
		L	H	H	L	L	H	H	H	Recalls ACW panel memory 98.
		L	H	H	L	L	H	H	L	Recalls ACW panel memory 99.
H	L	H	H	H	H	H	H	H	H	Recalls DCW panel memory 0.
		H	H	H	H	H	H	H	L	Recalls DCW panel memory 1.
		H	H	H	H	H	H	L	H	Recalls DCW panel memory 2.
		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
		L	H	H	L	L	H	H	H	Recalls DCW panel memory 98.
		L	H	H	L	L	H	H	L	Recalls DCW panel memory 99
L	H	H	H	H	H	H	H	H	H	Recalls IR panel memory 0.
		H	H	H	H	H	H	H	L	Recalls IR panel memory 1.
		H	H	H	H	H	H	L	H	Recalls IR panel memory 2.
		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
		L	H	H	L	L	H	H	H	Recalls IR panel memory 98.
		L	H	H	L	L	H	H	L	Recalls IR panel memory 99.
L	L	H	H	H	H	H	H	H	H	Recalls AUTO program 0.
		H	H	H	H	H	H	H	L	Recalls AUTO program 1.
		H	H	H	H	H	H	L	H	Recalls AUTO program 2.
		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
		L	H	H	L	L	H	H	H	Recalls AUTO program 98.
		L	H	H	L	L	H	H	L	Recalls AUTO program 99.

Table4-2 PM signals and recall numbers

NOTE

- For TOS9200, which lacks a DC withstanding voltage function, the DCW items specified above are invalid.

4.3 INTERLOCK Connector

As a means of ensuring the safety of the operator, the tester is equipped with an interlock function to cut off output in coordination with external devices.

Once the interlock input terminals are opened, the interlock function activates to shift the tester to the PROTECTION status ("PROTECTION" lights up). The output is cut off to disable testing. In this status, it is impossible to start a test using the START switch (*1) or cancel the PROTECTION status using the STOP switch (*2).

The interlock function restricts the tester's output from outside to ensure the safety of the operator.

If the interlock function shifts the tester to the PROTECTION status, short-circuit the interlock input terminals to disable the INTERLOCK signal. Then, cancel the status using the STOP switch.

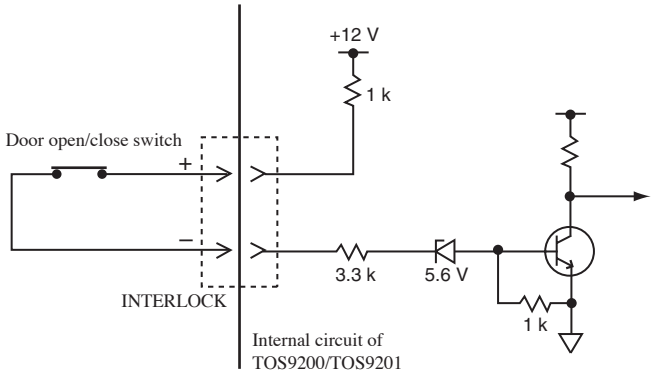
*1: Includes the REMOTE terminal, START signal for SIGNAL I/O, and START command for GPIB and RS-232C

*2: Includes the REMOTE terminal, STOP signal for SIGNAL I/O, and STOP command for GPIB and RS-232C

⚠WARNING • The first time the tester is turned on following delivery, the interlock function activates and testing is disabled. An interlock jumper is provided with the product to be used for performance checks. Use this jumper only to temporarily cancel the protection function.

When installing the tester, use the interlock function as much as possible to ensure safety. When using jigs and devices in withstanding voltage and insulation resistance testing, provide a safety cover that encloses the DUT and cuts off output while the cover is open. Alternatively, to prevent electric shock, set up a safety fence around the testing area that cuts off output in coordination with door movements.

Circuit of the interlock input block



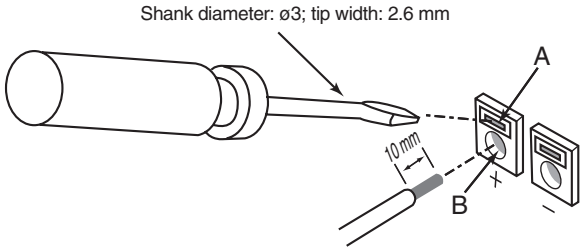
INTERLOCK-signal input requirements

Open: Terminal-to-terminal current of 0.5 mA or less

Short-circuited: Terminal-to-terminal current of 1 mA or more

Connecting the interlock jumper

1. Insert a screwdriver into A, and open B.
2. Insert the interlock jumper into B. Take care to prevent the jumper coating from becoming caught in B.
3. Lightly pull on the jumper to confirm that it is securely connected.
4. Take the same steps for the positive (+) and negative (-) terminals. Then, short-circuit (+) and (-).



To connect a safety device, use the following cable and switch types:

Compatible cables:

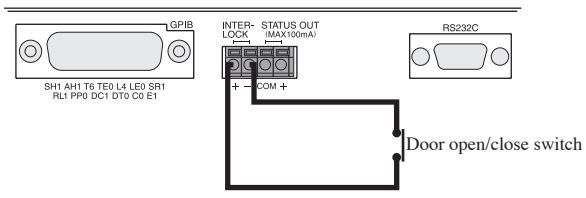
- Solid wire: ø0.65 (AWG22)
- Stranded wire: 0.32 mm^2 (AWG22); element-wire diameter: ø0.18 or more
- Removed coating: 10 mm

Rated switch voltage and current:

- DC 30 V, 0.1 A or more

Circuit for reference

When the door is opened, its contacts open, thus setting the INTERLOCK signal high. This activates the interlock function.



Connection to the door open/close switch

4.4 STATUS OUT Connector

The STATUS OUT connector is an output connector to be connected to the warning light.

Choose warning statuses on the System screen, from among H.V ON, TEST, PASS, READY, U FAIL, L FAIL, CONTACT FAIL, PROTECTION, and POWER ON. If two or more statuses are chosen at a time, the logical sum of them, is outputted. For settings on the System screen, see "3.10 System Settings".

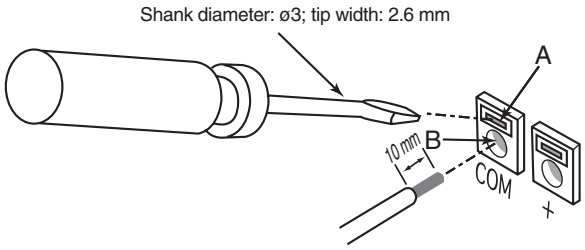
Maximum output voltage: DC 24 V; maximum output current: 100 mA

Compatible cables:

- Solid wire, ø0.65 (AWG22)
- Stranded wire, 0.32 mm^2 (AWG22); element wire diameter: ø0.18 or more

Connecting to the connector

1. Remove approximately 10 mm of coating from the tip of the signal cable.
2. Insert a screwdriver into A, and open B.
3. Insert the cable into B. Take care to prevent the coating from becoming caught in B.
4. Gently pull on the cable to confirm that it is securely connected.



⚠CAUTION

- Do not extract a current exceeding the maximum rated current of 100 mA from the +24 V internal power supply. Once a current exceeds the maximum rated current, the overcurrent protection function activates and “24V OCP” flashes on the LCD.

  The tester enters the PROTECTION status. If the overcurrent protection function activates, turn off the POWER switch to prevent an overcurrent.

  If an overcurrent flows for an extended period, the internal circuit may malfunction.

Chapter 5 Controlling the TOS6200

This chapter describes the procedure for using the TOS9200/TOS9201 to control Kikusui's earth continuity tester TOS6200 via the RS-232C interface.

This control function is used to recall and execute the test conditions stored in the TOS6200's memory by executing the TOS9200/TOS9201 program.

For details on the RS-232C interface, see the Operation Manual for the GPIB and RS-232C Interfaces separately available.

NOTE

- The GPIB interface cannot be used to control the TOS6200 with the TOS9200/TOS9201.

  During control of the TOS6200, the TOS9200/TOS9201 cannot be controlled using the GPIB interface.

5.1 Pre-Control Preparation

5.1.1 Connection and startup procedure

1. Turn off the POWER switch on the TOS9200/TOS9201 and the TOS6200.
2. Using an RS-232C cable, connect the RS-232C connectors on the rear panel of the TOS9200/TOS9201 and the TOS6200 (use a cross cable of the 9-pin D-SUB female-female AT type as the RS-232C cable).
3. Turn on the POWER switch on the TOS9200/TOS9201 and the TOS6200.

5.1.2 Settings on the TOS6200

Interface settings

On the TOS6200, press the SHIFT + SYSTEM /I/F keys. The LED on the SYSTEM /I/F key will then light up, and the Interface Settings screen (INTERFACE) will appear.

On this screen, make the settings specified below.

SPEED (baud rate)	: 19200 bps
DATA (data length)	: 8 bits
PARITY	: NONE
STOP (stop bit)	: 2 bits

Upon completion of the above settings, turn the POWER switch off and then on again.

For details on the setting procedure, see the Operation Manual for the TOS6200.

Setting the PASS hold time

On the TOS6200, press the SYSTEM key. The LED lights up on the SYSTEM key, and the System Settings screen (SYSTEM 1) appears.

The PASS hold time must be set to HOLD so that the TOS9200/TOS9201 can catch PASS signals from the TOS6200 without failure.

When the TOS9200/TOS9201 recognizes the PASS signal from the TOS6200, the tester enters the INTERVAL mode, regardless of the pass hold time settings.

For details on the setting procedure, see the Operation Manual for the TOS6200.

Setting test conditions

It is necessary to preset test conditions for the TOS6200 in panel memory.

In the TOS6200, memories 1 through 18 contain factory settings that conform to the relevant safety standards. To add new test conditions, use memories 19 through 99.

5.1.3 Settings on the TOS9200

Interface settings

On the TOS9200/9201, press the SHIFT + SYSTEM /I/F keys. The LED then lights up on the SYSTEM /I/F key, and the Interface Settings screen (INTERFACE) appears.

On this screen, make the settings specified below.

SPEED (baud rate)	: 19200 bps
DATA (data length)	: 8 bits
PARITY	: NONE
STOP (stop bit)	: 2 bits

Upon completion of the above settings, turn the POWER switch off and then on again.

For details on the setting procedure, see "3.11 Interface Settings".

Setting LOW/GUARD for the GND

To conduct an earth continuity test together with other tests, set GND to LOW on the ACW2, DCW2, and IR2 screens.

If GND is set to GUARD, the internal resistor of the TOS6200 is connected in parallel with the tester's ammeter, leading to measurement errors in the ammeter. To use the TOS6200, do not connect the TOS6200's HIGH or LOW terminal to the tester's terminal. Otherwise, set GND to LOW.

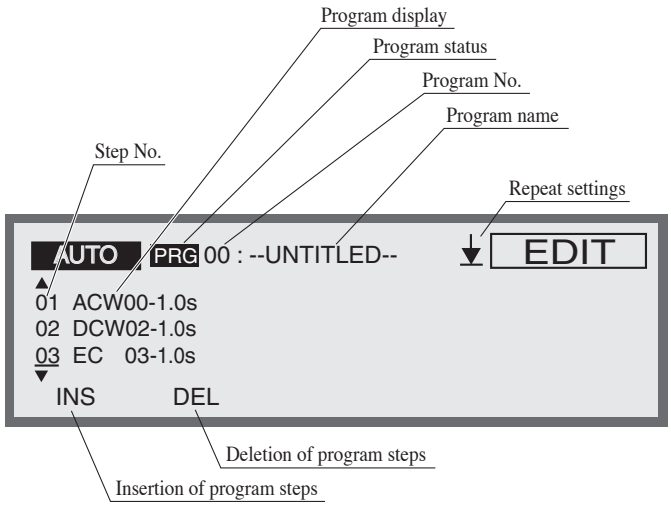
Making settings for a test program

On the TOS9200/TOS9201's Program Settings screen (AUTO), set the TOS6200's memory number for the step in which an earth continuity test is to be conducted.

For details on program settings, see "3.13 Program"

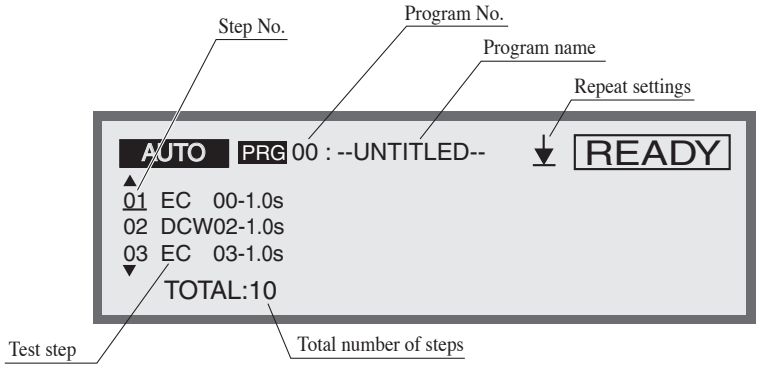
Setting procedure

1. Press the AUTO key to display the Program screen (AUTO).
2. Using the rotary knob, select the number of the program to be created or edited.
3. With the target number selected, press the SHIFT + AUTO/EDIT keys to display the Program Edit screen ("EDIT" appears at the top right of the screen).



4. To enter or change program names, press the SHIFT + F1 keys to move the cursor to the program name.
   Using the ◀ ▶ keys, move the cursor to the target character.
   Using the rotary knob, select a character.
   Use characters from 20H to 7EH of the ASCII code (see Appendix 2).
   If program names are not to be changed, move on to Step 5.
5. If the cursor is at the program name, press the SHIFT + F1 keys to move the cursor to the program step.
6. Using the rotary knob or the ▼ ▲ keys, select the step number for the earth continuity test.
   Position the cursor at the step to be inserted.
   Press the F1 key (INS) to insert a step (ACW00-0.2s) at the cursor position.
7. Using the ▶ key, move the cursor to "ACW" to the right of the step number.
8. Using the rotary knob, select EC.
9. Using the ▶ key, move the cursor to the memory number.

10. Using the rotary knob, set the TOS6200's memory number to be used.
11. Using the ▶ key, move the cursor to the interval time to the right of the memory number.
12. Using the rotary knob, set the interval time (0.2 s to 9.9 s, HOLD). With the interval time set to HOLD, when the START switch is pressed, the next step starts if the specified step is in the HOLD status.
13. In accordance with the above procedure, make settings for an earth continuity test in the program step. Upon completion of settings, press the AUTO key to return to the Program screen.
    The Program screen displays the total number of steps thus set. The tester enters the READY status.



5.2 Starting a Test

Screen settings

■ TOS6200

On the TOS6200, display the Test Condition Settings screen (MAIN).

The TOS9200/TOS9201 forcibly shifts the TOS6200 to the Test Condition Settings screen (MAIN).

■ TOS9200/9201

On the TOS9200/TOS9201, display the Program screen (AUTO).

(To display the Program screen (AUTO), press the AUTO key.)

Checking the TOS6200 status

Confirm that the TOS6200 is in the READY status. In the READY status, the TOS6200 displays "READY" at the top right of the screen.

Unless the TOS6200 is in the READY status, the TOS9200/9201 is unable to control the TOS6200.

Key-locking the TOS6200

If the LOCAL key is pressed on the TOS6200 while it is running a program, the tester enters the LOCAL mode and the test is suspended.

To prevent such an occurrence, it is recommended that the tester be key-locked. To lock the panel settings, press the SHIFT + LOCAL/KEY LOCK keys.

On the panel, only the START switch and the STOP switch are valid. During key-lock, “KEY LOCK” appears on the LCD.

To cancel the key-lock function, press the SHIFT + LOCAL/KEY LOCK keys.

Starting/suspending a test

To start a test, use the START switch on the TOS9200/9201.

To suspend a test, use the STOP switch on the TOS9200/9201.

If the STOP switch on the TOS9200/9201 fails to stop the TOS6200 due to a communication error between the TOS9200/9201 and the TOS6200, also press the STOP switch on the TOS6200 to suspend the test.

5.3 Test Judgement

The TOS9200/9201 reads the test results of the TOS6200 and displays a judgement on-screen.

FAIL judgement by the TOS6200

When the TOS9200/9201 or TOS6200 makes a FAIL judgement at any step of the execution of a program, the program stops at that step regardless of whether the repeat settings of the TOS9200/9201 program are made to RETURN or END, and regardless of the preset interval time.

To cancel the FAIL status of a FAIL judgement in an earth continuity test, use the STOP switch on the TOS9200/TOS9201.

PASS judgement by the TOS6200

With the interval time for each step set to any value other than HOLD, if a PASS judgement is made for all steps, a PASS judgement is made for the program as a whole. (This applies only to the repeat settings made to END.)

A PASS judgement is made after the interval time has elapsed for the last step. The tester then returns to the READY status.

If the interval time is set to HOLD in any step, it is not possible to proceed to the next step unless the START switch on the TOS9200/TOS9201 is pressed.

To suspend the test, press the STOP switch on the TOS9200/TOS9201. The tester returns to the READY status.

NOTE

- During the execution of a program, no buzzer may sound even if the TOS6200 makes a PASS judgement. This does not indicate any abnormality.

Displaying a communication error

In the following cases, “COM ERR” flashes and the PROTECTION LED lights up to indicate a communication error:

- The POWER switch on the TOS6200 is turned off.
- The interface settings for the TOS6200 are not made as instructed in "5.1.2 Settings on the TOS6200"
- The RS-232C cable is disconnected or broken.
- At the start of a test, the TOS6200 is not in the READY status.

To cancel a communication error, press the STOP switch. Eliminate the cause of the communication error, and restart the test.

PROTECTION

During the execution of the TOS9200/9201 program, if the PROTECTION function activates on the TOS6200, “TOS6200” flashes at the top right of the screen on the TOS9200/TOS9201, and the PROTECTION LED lights up.

To cancel the PROTECTION function on both the TOS9200/9201 and the TOS6200, press the STOP switch on the TOS9200/TOS9201.

A test using the TOS6200 may not start, depending on the cause of PROTECTION. To restart the test, eliminate the cause of PROTECTION and confirm that the tester is in the READY status.

5.4 Canceling the TOS6200 Control Mode

The TOS9200/9201 is ready to control the TOS6200 via the RS-232C interface, so the POWER switch must first be turned off. To cancel the control mode, take the following steps:

1. On the TOS9200/9201 and the TOS6200, turn off the POWER switch.
2. On the rear panel of the TOS9200/9201 and the TOS6200, disconnect the RS-232C cable from the RS-232C connector.

To use either the TOS9200/9201 or the TOS6200 alone, turn on the POWER switch.

Chapter 6 Part names and Functions

This chapter describes the names and functions of components such as switches, displays, and connectors on the front and rear panels.

6.1 Front Panel

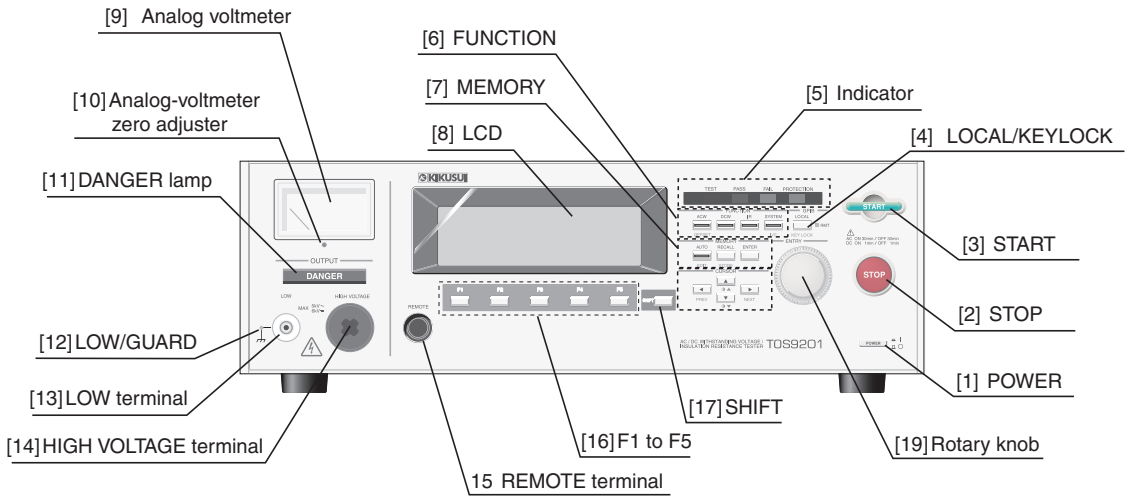


Fig.6-1 Front panel

[1] POWER

Used to turn the power on/off. When the power is turned ON (|), the tester starts under the same test conditions as when the power was turned off (○) at the end of the preceding test. To start using the factory settings, press the SHIFT key + the POWER switch to initialize the settings. For details, see "3.17 Initialization".

NOTE

- With initialization, all contents of the panel memory and stored programs are cleared. Before starting initialization, confirm that no necessary data remains in the memory.

[2] STOP

Used to suspend a test.

Also used to cancel the PASS, FAIL, and PROTECTION statuses.

After this switch is pressed, the tester enters the READY status.

[3] START

Used to start a test.

The test starts when this switch is pressed while “READY” is displayed on the LCD.

Once the test starts, the LCD displays “TEST” and the TEST LED flashes on the indicator during a voltage rise.

When the tester reaches the test voltage, the TEST LED remains lit.

[4] LOCAL/KEYLOCK

Used to return to the LOCAL mode during remote control with the GPIB or RS-232C interface. In remote control, the LED lights up to the right of the key.

To activate the key-lock function during local control, press this key together with the SHIFT key. In the key-lock mode, the LCD displays “KEYLOCK.”

[5] Indicator

- TEST

  LED indicating that a test is under way.

  The LED flashes during contact checks, voltage rise, and voltage fall. It lights up while the test voltage is being output.

- PASS

  LED indicating the test results.

  This LED lights up when a PASS judgement is made.

  No PASS judgement is made when the timer function is off.

- FAIL

  LED indicating the test results.

  This LED lights up when a FAIL judgement is made.

- PROTECTION

  LED indicating that the protection function has been activated. The activated protection function is shown at the top right of the LCD. For the protection function, see "3.16 Protection".

[6] FUNCTION

Used to select the test-mode settings, system settings, or interface settings.

- ACW/OFFSET

  When this key is pressed, the LED lights up. The LCD displays the AC withstanding voltage testing screen (ACW).

  To display the offset screen (OFFSET), press this key together with the SHIFT key.

- DCW (TOS9201 only)

  When this key is pressed, the LED lights up. The LCD displays the DC withstanding voltage testing screen (DCW).

- IR

  When this LED is pressed, the LED lights up. The LCD displays the insulation resistance testing screen (IR).

- SYSTEM /I/F

  When this key is pressed, the LED lights up. The LCD displays the system settings screen (SYSTEM).

  To display the interface settings screen (INTERFACE), press this key together with the SHIFT key.

[7] MEMORY

- AUTO/EDIT

  When this key is pressed, the LED lights up. The LCD displays the program execution screen (AUTO READY).

  To display the program edit screen (AUTO EDIT), press this key together with the SHIFT key.

- RECALL/STORE

  Used to recall the panel memory.

  To change the memory number, first press the rotary knob, then press the ENTER key next to the rotary knob to recall the contents.

  To store data in memory, press this key together with the SHIFT key.

[8] LCD

Displays settings and measurements.

[9] Analog voltmeter

Voltmeter used to display the output voltage. Directly reads the voltage between the HIGH VOLTAGE terminal and the LOW terminal.

⚠ WARNING • While the pointer of the analog voltmeter is moving, never touch the HIGH VOLTAGE terminal, test leadwire, or DUT.

⚠ CAUTION • This voltmeter cannot be used as an independent voltmeter. It may malfunction if a voltage is applied to the output terminal from outside.

---

[10] Analog-voltmeter zero adjuster

Adjuster used to adjust the analog voltmeter to the zero point.

⚠ CAUTION • Prior to zero adjustment, be sure to turn off the POWER switch.

---

[11] DANGER lamp

Red lamp indicating that a high voltage is being output.

This lamp lights up during testing and automatic testing, or while an output voltage remains in the output terminal.

⚠WARNING • While this lamp is lit, never touch the HIGH VOLTAGE terminal, test lead-wire, or DUT.

[12] LOW/GUARD

Lights when the LOW/GUARD for the GND is set to LOW for each test.

⚠WARNING • When this lamp is off, check the grounding of the DUT, jigs and peripheral devices. Read the relevant sections of "Chapter 3 Basic Operations", and strictly follow the instructions given.

[13] LOW terminal

Low-voltage terminal for outputting the test voltage.

[14] HIGH VOLTAGE terminal

High-voltage terminal for outputting the test voltage. The test voltage is output between this terminal and the LOW terminal.

⚠WARNING • During a test, never touch the HIGH VOLTAGE terminal.

⚠CAUTION • Internal circuit may malfunction if a voltage is applied to it from outside.

[15] REMOTE terminal

Terminal used to connect the optional remote-control box or the exclusive probe.

[16] F1 to F5

Functions corresponding to the F1 to F5 keys on the LCD.

[17] SHIFT

Used to switch the function menus and expand key functions.

When the POWER switch is turned on while this key is pressed, the tester settings are initialized (returns to the default settings). For details, see "3.17 Initialization".

NOTE

- With initialization, all contents of panel memory and stored programs are cleared. Before starting initialization, confirm that no necessary data remains in the memory.

[18] CURSOR

Used to move the cursor to set test conditions.

When pressed together with the SHIFT key, it enables screen contrast adjustment and the switching of setting screens.

[19] Rotary knob

READY status : Used to set test conditions on the LCD

Test in Progress : Used to change the test voltage

6.2 Rear Panel

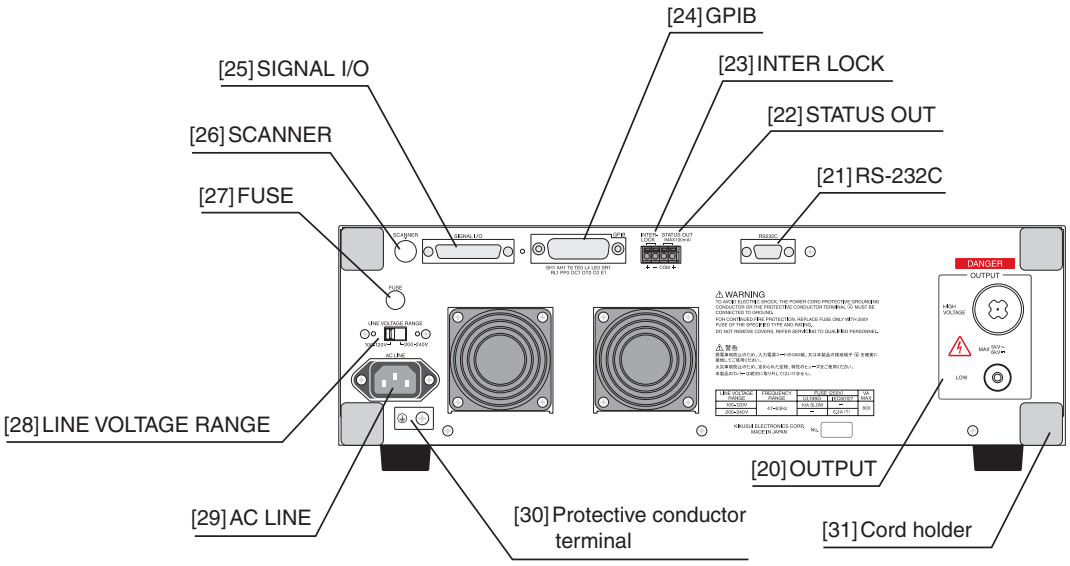


Fig.6-2 Rear panel

[20] OUTPUT

- LOW terminal
  Low-voltage terminal for outputting the test voltage.
  This terminal is connected to the LOW terminal on the front panel.
- HIGH VOLTAGE terminal
  High-voltage terminal for outputting the test voltage.
  This terminal is connected to the HIGH VOLTAGE terminal on the front panel.

⚠WARNING • During a test, never touch the HIGH VOLTAGE terminal.

⚠CAUTION • Internal circuit may malfunction if a voltage is applied to it from outside.

---

[21] RS-232C

Connector used to connect an RS-232C cable in order to remotely control the tester via a PC using the RS-232C interface.

[22] STATUS OUT

Connector for connecting a warning light.

Maximum output voltage of DC 24 V and maximum output current of 100 mA.

[23] INTERLOCK

If the line between these terminals is opened, the tester enters the PROTECTION status and disables the execution of a test. “INTER LOCK” flashes on the LCD.

[24] GPIB

Connector used to connect a GPIB cable in order to remotely control the tester via a PC using the GPIB interface.

[25] SIGNAL I/O

25-pin D-SUB connector.

Used to start and end a test by remote control, and to check the status of the tester using a signal.

For details, see "4.2 SIGNAL I/O Connector".

[26] SCANNER

Connector used to connect the optional high-voltage scanner.

[27] FUSE

Fuse holder. Contains a fuse for AC input.

⚠ WARNING • Improper handling of the fuse holder may lead to electric shock. Be sure to follow the instructions given in "1.4 Checking the Line voltage and Fuse".

---

[28] LINE VOLTAGE RANGE

Switch for selecting an input-voltage range.

⚠ WARNING • Before turning on the POWER switch, be sure to confirm that the voltage to be used is consistent with the voltage range selected using the LINE VOLTAGE RANGE switch. For details, see "1.4 Checking the Line voltage and Fuse".

---

[29] AC LINE

Power-cord connector used to supply power to the tester. Use the power cord provided with the product.

⚠ WARNING • Improper handling of this connector may lead to electric shock. Be sure to follow the instructions given in "1.5 Connecting the AC Power Cord".

---

[30] Protective conductor terminal

Terminal used to ground the tester.

⚠WARNING • Be sure to ground the tester. For details, see "1.6 Grounding".

[31] Cord holder

Holder for the power cord.

⚠CAUTION • Do not place the tester on sides other than the bottom surface. Leaving the cord holder beneath the tester makes it extremely unstable, and is extremely dangerous.

Chapter 7 Maintenance

This chapter describes the maintenance, inspection, and calibration of the tester.

Regular maintenance and inspection are necessary to maintain the initial performance of the product.

7.1 Cleaning

To clean the surface of the tester, including the panel, wipe it with a soft cloth moistened with water-diluted neutral detergent.

⚠ WARNING • Before starting cleaning, be sure to turn off the POWER switch and unplug the power cord.

⚠ CAUTION • Do not use volatile materials such as thinner and benzene. These materials may change surface colors, erase prints, or blur the display.

7.2 Inspection

⚠ WARNING • Tearing and breakage of the cable coating may lead to electric shock and fire. In such a case, immediately discontinue use of the tester.

To purchase accessories, contact Kikusui distributor/agent.

■ AC Power cord

Check for tears in the cable coating, looseness and fracture of the plug, and breakage of the cable.

■ High-voltage test leadwire

Check the cable coating for tears, fissures, and breakage.

7.3 Maintenance

⚠WARNING • To replace components, the tester cover must be opened, but only by our service representative. Contact your Kikusui agent/distributor if it is necessary to perform replacement work.

■ High-voltage relay

The high-voltage relays inside the tester are consumable. Although service life depends on the usage environment, we recommend that the high-voltage relays be replaced every one million tests. We also recommend regular internal inspections and cleaning at the same intervals.

■ Cooling fan

The service life of the cooling fan is approximately 60,000 hours.

The revolutions per minute of the cooling fan are controlled based on the internal temperature, and its service life depends partly on the conditions under which it is used. Replace the cooling fan after approximately 60,000 hours. In addition, conduct internal inspection and cleaning of the tester at the same time.

■ Backup battery

The tester uses a lithium battery for memory backup.

When the battery's power supply runs out, such data as test conditions cannot be stored in memory. Depending on the conditions under which it is used, replace the backup battery every three years. In addition, conduct internal inspection and cleaning of the tester at the same time.

7.4 Calibration

To maintain the accuracy of measuring instruments for an extended period, calibration should be performed regularly.

⚠WARNING • The tester generates voltages as high as AC 5 kV and DC 6 kV. Calibration is extremely dangerous; contact your Kikusui agent if calibration services are required.

7.5 Troubleshooting

Not all problems involve mechanical failures. Before requesting repair service, recheck your problem.

Find your problem in the list below, and correct it as instructed. If it still persists or if you cannot find it in the list, contact Kikusui distributor/agent

Problem	Checkpoint	Items for reference	Page
The tester does not start when the POWER is turned on.	• Is the power cord disconnected?	"1.5 Connecting the AC Power Cord"	1-7
	• Is the fuse broken?	"1.4 Checking the Line voltage and Fuse"	1-5
The LCD screen does not appear when the POWER is turned on.	• Is the contrast level too low?	"3.10 System Settings"	3-55
	• Is the ambient temperature too low?	“General Items of Specifications”	
A panel key does not work.	• Is the Key Lock function working?	"3.14 Key Lock"	3-69
	• Is the panel key remotely controlled from the REMOTE terminal or SIGNAL I/O?	"4.1 REMOTE Terminal" "4.2 SIGNAL I/O Connector"	4-2 4-4
	• Is the panel key remotely controlled from outside via the GPIB or RS-232C?	LOCAL/KEYLOCK	6-2
The START switch does not work.	• Is the STOP signal input?	"Chapter 4 Using Terminals and Connectors"	4-1
	• Is the tester in the PROTECTION, PASS, or FAIL status?	"3.16 Protection"	3-71
	• Are you currently making settings for the system and interface or editing a program?	"3.10 System Settings" "3.11 Interface Settings" "3.13 Program"	3-55 3-61 3-65
	• Are you currently storing data in or recalling it from the panel memory?		
	• Is the double-action function valid?	Turning the double-action function ON/OFF (DOUBLE ACTION)	3-58
	• Is “READY” displayed?	"3.15 Invalid Settings"	3-70
	• Is the ENABLE signal for SIGNAL I/O at the low level?	"4.2 SIGNAL I/O Connector"	4-4
The output voltage does not reach 2.6 kV.	• Is the output voltage range set to AUTO?	Setting the output-voltage ranges (V RANGE)	3-13
The output voltage does not reach the preset level.	• Is RISE TIME set to too large a value?	RISE TIME settings for each test	
The fan does not work.	• The revolutions per minute are controlled based on the internal temperature. The fan stops revolving if the temperature is too low. If “OVERHEAT” appears without the fan revolving, a fault has occurred.		
The high-voltage scanner does not work.	• Is the interface cable connected?		
The TOS6200 does not start up.	• Is a cross cable being used as the interface cable? • Are the RS-232C settings correct? If they are incorrect, correct them. Then, reset the POWER switch.	"Chapter 5 Controlling the TOS6200"	5-1

Chapter 8 Specifications

This chapter describes the electrical and mechanical specifications for the tester.

Withstanding Voltage test mode

Item				Specifications	
				TOS9200	TOS9201
Output section					
	AC	Output-voltage range		0.05 kV to 5.00 kV	
			Resolution	10 V	
			Accuracy	±(1.5% of setting + 20 V) [with no load]	
		Maximum rated load (*1)		500 VA (5 kV/100 mA)	
		Maximum rated current		100 mA [output voltage of 0.2 kV or more]	
		Transformer capacity		500 VA	
		Output-voltage waveform(*2)		Sine wave	
			Distortion	2% or less [with no load or pure resistive load at output voltage of 0.5 kV or more applied]	
		Frequency		50 Hz/60 Hz	
			Accuracy	±0.1%	
		Voltage regulation		±3% or less [maximum rated load → no load]	
		Short-circuit current		200 mA or more, 350 mA or less [at output voltage of 0.5 kV or more]	
		Type of output		PWM switching	
	DC	Output-voltage range		————	0.05 kV to 6.00 kV DC
			Resolution	————	10 V
			Accuracy	————	±(1.5 % of setting + 20 V)
		Maximum rated load (*1)		————	50 W (5 kV/10 mA)
		Maximum rated current		————	10 mA
		Ripple	No load at 5 kV	————	50 Vp-p Typ.
			Maximum rated load	————	150 Vp-p Typ.
		Voltage regulation		————	1 % or less [maximum rated load → no load]
		Short-circuit current		————	40 mA Typ.
		Discharge function		————	Forced discharge at the end of test (discharge resistance: 125 kΩ)
	Start voltage			The voltage at the start of the test can be set as the start voltage.	
			Setting range	0% to 99% of the test voltage (resolution of 1%)	
	Output-voltage monitoring function			If the output voltage exceeds ±(10% of setting + 50 V), output is cut off and the protection function activates.	

Item			Specifications	
			TOS9200	TOS9201
Voltmeter				
	Analog	Scale	6 kV AC/DC F.S	
		Accuracy	±5% F.S	
		Indicator	Mean-value responsive/root-mean-square value scale	
	Digital	Measurement range	0.0 kV to 6.00 kV AC/DC	
		Resolution	10 V	
		Accuracy	±(1.0% of reading + 30 V)	
		Response	Mean-value responsive/root-mean-square value display (response time of 200 ms)	
		HOLD function	The voltage measured at the end of test is held during the PASS and FAIL period.	

*1 Limitation on output

The tester's withstanding voltage generator is designed to radiate half as much heat as the rated output, in consideration of the size, weight, cost, and other factors of the tester. It is therefore necessary to use the tester within the ranges specified below. Operations deviating from these ranges may heat the output section excessively, thereby activating the protective circuit. In such a case, suspend the test and wait until the temperature falls to the normal level.

Output limitation in withstanding voltage testing

Ambient temperature	Upper current		Pause	Output time
t ≤ 40 ˚C	AC	50< i ≤ 110 mA	At least as long as the output time	Maximum of 30 minutes
		i ≤ 50 mA	Not necessary	Continuous output possible
	DC	5< i ≤ 11 mA	At least as long as the output time	Maximum of 1 minute
		i ≤ 5 mA	At least as long as the judgement wait time (WAIT TIME)	Continuous output possible

(Output time = voltage rise time + test time + voltage fall time)

*2 Test-voltage waveform

When an AC test voltage is applied to a capacitive load, it is possible that the voltage becomes higher even than that when in the no load state. Furthermore, waveform distortion also may occur if the capacitance of the load is voltage-dependent (such as of ceramics capacitors). When the test voltage is not higher than 1.5 kV and the capacitance is not larger than 1000 pF, such test voltage changes are only of negligible levels. As the output type of the high-voltage generator block of the tester is PWM switching, switching noise and spike noise that the test voltage includes increase when the test voltage is 500 V or less. The lower the test voltage is, the more the waveform distortion increases.

<table>
<tr><th colspan="3" rowspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><th>TOS9200</th><th>TOS9201</th></tr>
<tr><td colspan="5">Ammeter *3</td></tr>
<tr><td></td><td colspan="2">Measurement range</td><td>0.00 mA to 110 mA AC</td><td>0.00 mA to 110 mA AC
/0.00 mA to 11 mA DC</td></tr>
<tr><td></td><td colspan="2">Display</td><td colspan="2">i = measured current<table><tr><td>i < 1 mA</td><td>1 mA≤ i < 10 mA</td><td>10 mA ≤ i < 100 mA</td><td>100 mA ≤ i</td></tr><tr><td>□□□ μA</td><td>□. □□ mA</td><td>□□. □ mA</td><td>□□□ mA</td></tr></table></td></tr>
<tr><td></td><td colspan="2">Accuracy</td><td colspan="2">±(3% of the reading + 20 μA)
[after the offset cancel function is activated, if the scanner is mounted]</td></tr>
<tr><td></td><td colspan="2">Response</td><td colspan="2">Mean-value responsive / root-mean-square value display (response time of 200 ms)</td></tr>
<tr><td></td><td colspan="2">Hold function</td><td colspan="2">The measured current at the end of the test is held during the PASS period.</td></tr>
<tr><td></td><td colspan="2">Offset cancel function</td><td colspan="2">The current flowing to the insulation resistor between the output cables and the stray capacity is cancelled up to 100 μA/kV (in AC withstanding voltage testing only).</td></tr>
<tr><td></td><td colspan="2">Calibration</td><td colspan="2">Performs calibration using the root-mean-square value of a sine wave with a pure resistive load</td></tr>
<tr><td></td><td colspan="2">Selection of LOW/GUARD for the GND (*4)</td><td colspan="2">Selection permitted for current measurement between the mode for the GND point connected to the LOW terminal, and the mode using guard.</td></tr>
<tr><td></td><td></td><td>LOW</td><td colspan="2">Connects the GND point to the LOW terminal. Measures the current flowing to the LOW terminal (chassis) (for normal operation).</td></tr>
<tr><td></td><td></td><td>GUARD</td><td colspan="2">Sets the GND point as guard. Measures the current flowing to the LOW terminal, but does not measure the current flowing to the chassis (for high-sensitivity, high-accuracy measurements).</td></tr>
</table>

<table>
<tr><th colspan="2" rowspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><th>TOS9200</th><th>TOS9201</th></tr>
<tr><td colspan="4">Judgement function</td></tr>
<tr><td></td><td>Judgement method/action</td><td colspan="2">
<table>
<tr><th>Judge-ment</th><th>Judgement method</th><th>Display</th><th>Buzzer</th><th>SIGNAL I/O</th></tr>
<tr><td>UPPER FAIL</td><td>When the tester detects a current exceeding the upper current, it cuts off the output and makes an UPPER FAIL judgement. In DC withstanding voltage testing, however, no judgement is made until the judgement wait time (WAIT TIME) has elapsed.</td><td>The FAIL LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the U FAIL signal</td></tr>
<tr><td>LOWER FAIL</td><td>When the tester detects a current below the lower current, it cuts off the output and makes a LOWER FAIL judgement. However, no judgement is made during the voltage rise time (RISE TIME) or voltage fall time (FALL TIME) in AC withstanding voltage testing.</td><td>The FAIL LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the L FAIL signal</td></tr>
<tr><td>PASS</td><td>When the preset time has elapsed without any abnormalities, the tester cuts off the output and makes a PASS judgement.</td><td>The PASS LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the PASS signal</td></tr>
</table>
• The PASS signal is output at the timing preset on PASS HOLD. If HOLD is set, the PASS signal is output continuously until the STOP signal is input.
• The UPPER FAIL signal and the LOWER FAIL signal are output continuously until the STOP signal is input.
• The FAIL and PASS buzzer volumes are adjustable. However, they cannot be adjusted individually, as they are set in common.
</td></tr>
<tr><td></td><td>Setting range for the upper current (UPPER)</td><td>0.01 mA to 110 mA AC</td><td>0.01 mA to 110 mA AC /
0.01 mA to 11 mA DC</td></tr>
<tr><td></td><td>Setting range for the lower current (LOWER)</td><td>0.01 mA to 110 mA AC
(With the LOWER OFF function)</td><td>0.01 mA to 110 mA AC /0.01 mA to 11 mA DC (With the LOWER OFF function)</td></tr>
<tr><td></td><td>Judgement accuracy (*3)</td><td colspan="2">±(3% of setting + 20 μA)
[After the offset cancel function is activated, if the scanner is mounted]</td></tr>
<tr><td></td><td>Current detection method</td><td colspan="2">The absolute current values are integrated and compared with the reference value.</td></tr>
<tr><td></td><td>Response switching function</td><td colspan="2">The current detection response for UPPER FAIL judgement can be set to FAST/MID/SLOW (for AC withstanding voltage testing only).</td></tr>
<tr><td colspan="4">Time</td></tr>
<tr><td></td><td>Setting range for the voltage rise time (RISE TIME)</td><td colspan="2">0.1 s to 200 s</td></tr>
<tr><td></td><td>Setting range for the voltage fall time (FALL TIME)</td><td>0 s to 200 s (Valid only with PASS judgement)</td><td>0 s to 200 s (Valid only with PASS judgement in AC withstanding voltage testing)</td></tr>
<tr><td></td><td>Setting range for the test time (TEST TIME)</td><td colspan="2">0.3 s to 999 s With the TIMER OFF function</td></tr>
<tr><td></td><td>Setting range for the judgement wait time (WAIT TIME)</td><td>_____</td><td>0.3 s to 10 s
(Only for DC withstanding voltage testing)
[(RISE TIME + TEST TIME) > WAIT TIME]</td></tr>
<tr><td></td><td>Accuracy</td><td colspan="2">± (100 ppm + 20 ms)</td></tr>
</table>

*3
In AC withstanding voltage testing, a current flows into the stray capacity of measurement leadwire and fixtures. When the optional high-voltage scanner TOS9220/9221 is used, a current of approximately 22 μA/kV flows into the stray capacity of each scanner. The table below shows the approximate currents flowing into such stray capacity.

When the GND is set to LOW, a current flowing into the stray capacity is added for measurement purposes to the current flowing into the DUT. In particular, for high-sensitivity, high-accuracy judgement, it is necessary to add the current flowing into the stray capacity to the lower/upper current.
When the GND is set to GUARD, the effect of the current flowing into the stray capacity is negligible. If the offset cancel function is used, the current flowing into the stray capacity can be eliminated from the measurement.

Output voltage	1 kV	2 kV	3 kV	4 kV	5 kV
Hanging a 350 mm test leadwire (Typ. value)	2 μA	4 μA	6 μA	8 μA	10 μA
Using the accessory leadwire TL01-TOS (Typ. value)	16 μA	32 μA	48 μA	64 μA	80 μA
High-voltage scanner (Typ. value, not including the test leadwire)	22 μA	44 μA	66 μA	88 μA	110 μA

*4
With the GND set to GUARD, current measurement is disabled if the part of the DUT connected to the LOW terminal is grounded, which poses extreme danger. Never ground the DUT. In ordinary operation, set the GND to LOW.

Insulation Resistance Testing Mode

<table>
<tr><th colspan="3">Item</th><th>Specifications (TOS9200/TOS9201)</th></tr>
<tr><td colspan="4">Output section</td></tr>
<tr><td></td><td colspan="2">Output-voltage range</td><td>-25 V to -1 000 V</td></tr>
<tr><td></td><td rowspan="2"></td><td>Resolution</td><td>1 V</td></tr>
<tr><td></td><td>Accuracy</td><td>± (1.5 % of Setting + 2 V)</td></tr>
<tr><td></td><td colspan="2">Maximum rated load</td><td>1 W (-1000 V DC/1 mA)</td></tr>
<tr><td></td><td colspan="2">Maximum rated current</td><td>1 mA</td></tr>
<tr><td></td><td rowspan="2">Ripple</td><td>1 kV no-load</td><td>2 Vp-p or less</td></tr>
<tr><td></td><td>Maximum rated load</td><td>10 Vp-p or less</td></tr>
<tr><td></td><td colspan="2">Voltage regulation</td><td>1% or less [Maximum rated load → no load]</td></tr>
<tr><td></td><td colspan="2">Short-circuit current</td><td>12 mA or less</td></tr>
<tr><td></td><td colspan="2">Discharge function</td><td>Forced discharge at the end of test (discharge resistance: 25 kΩ)</td></tr>
<tr><td></td><td colspan="2">Output-voltage monitoring function</td><td>If the output voltage exceeds ±(10% of the setting + 50 V),
output is cut off and the protection function activates.</td></tr>
<tr><td colspan="4">Voltmeter</td></tr>
<tr><td></td><td rowspan="3">Analog</td><td>Scale</td><td>6 kV AC/DC F.S</td></tr>
<tr><td></td><td>Accuracy</td><td>±5% F.S</td></tr>
<tr><td></td><td>Indicator</td><td>Mean-value responsive / root-mean-square value scale</td></tr>
<tr><td></td><td rowspan="3">Digital</td><td>Measurement range</td><td>0 V to -1200 V</td></tr>
<tr><td></td><td>Resolution</td><td>1 V</td></tr>
<tr><td></td><td>Accuracy</td><td>± (1 % of reading + 1 V)</td></tr>
<tr><td colspan="4">Resistance meter</td></tr>
<tr><td></td><td colspan="2">Measurement range</td><td>0.01 MΩ - 9.99 GΩ (Within the maximum rated current range of 1 mA to 50 nA)</td></tr>
<tr><td></td><td colspan="2">Display</td><td>
<table>
<tr><td>R < 10.0 MΩ</td><td>10.0MΩ ≤ R < 100.0MΩ</td><td>100.0MΩ ≤ R < 1.00GΩ</td><td>1.00GΩ ≤ R ≤ 9.99GΩ</td></tr>
<tr><td>□. □□ MΩ</td><td>□□. □ MΩ</td><td>□□□ MΩ</td><td>□. □□ GΩ</td></tr>
</table>
R = measured insulation resistance</td></tr>
<tr><td></td><td colspan="2">Accuracy</td><td>
<table>
<tr><td>50 nA ≤ i ≤ 100 nA</td><td>100 nA < i ≤ 200 nA</td><td>200 nA < i ≤ 1 μA</td><td>1 μA < i ≤ 1 mA</td></tr>
<tr><td>± (20 % of reading)</td><td>± (10 % of reading)</td><td>± (5 % of reading)</td><td>± (2 % of reading)</td></tr>
</table>
[In the humidity range of 20 % to 70 % R.H (no condensation), with no disturbance such as swinging of the test leadwire]
i = measured current</td></tr>
<tr><td></td><td colspan="2">Hold function</td><td>The measured current at the end of the test is held during the PASS period.</td></tr>
<tr><td></td><td colspan="2">Selection of LOW/GUARD for the GND (*4)</td><td>Selection permitted for current measurement between the mode for the GND point connected to the LOW terminal, and the mode using guard.</td></tr>
<tr><td></td><td></td><td>LOW</td><td>Connects the GND point to the LOW terminal. Measures the current flowing to the LOW terminal (chassis) (for normal operation).</td></tr>
<tr><td></td><td></td><td>GUARD</td><td>Sets the GND point as guard. Measures the current flowing to the LOW terminal, but does not measure the current flowing to the chassis (for high-sensitivity, high-accuracy measurements).</td></tr>
</table>

<table>
<tr><th>Item</th><th>Specifications (TOS9200/TOS9201)</th></tr>
<tr><td colspan="2">Judgement function</td></tr>
<tr><td>Judgement method/action</td><td>
<table>
<tr><th>Judge-ment</th><th>Judgement method</th><th>Display</th><th>Buzzer</th><th>SIGNAL I/O</th></tr>
<tr><td>UPPER FAIL</td><td>When the tester detects a resistance exceeding the upper resistance, it cuts off the output and makes an UPPER FAIL judgement. However, no judgement is made during a voltage rise time (RISE TIME).</td><td>The FAIL LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the U FAIL signal</td></tr>
<tr><td>LOWER FAIL</td><td>When the tester detects a resistance below the lower resistance, it cuts off the output and makes a LOWER FAIL judgement. However, no judgement is made until the judgement wait time (WAIT TIME) has elapsed.</td><td>The FAIL LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the L FAIL signal</td></tr>
<tr><td>PASS</td><td>When the preset time has elapsed without any abnormalities, the tester cuts off the output and makes a PASS judgement.</td><td>The PASS LED lights up. Displayed on the LCD</td><td>ON</td><td>Outputs the PASS signal</td></tr>
</table>
• The PASS signal is output at the timing preset on PASS HOLD. If HOLD is set, the PASS signal is output continuously until the STOP signal is input.
• The UPPER FAIL signal and the LOWER FAIL signal are output continuously until the STOP signal is input.
• The FAIL and PASS buzzer volumes are adjustable. However, they cannot be adjusted individually, as they are set in common.
</td></tr>
<tr><td>Setting range for the upper resistance (UPPER)</td><td>0.01 MΩ to 9.99 GΩ
[Below the maximum rated current]</td></tr>
<tr><td>Setting range for the lower resistance (LOWER)</td><td>0.01 MΩ to 9.99 GΩ
[Below the maximum rated current]</td></tr>
<tr><td>Judgement accuracy
For both UPPER and LOWER</td><td>
<table>
<tr><th colspan="2">Judgement current</th><th>50 nA ≤ i ≤ 100 nA</th><th>100 nA < i ≤ 200 nA</th><th>200nA < i ≤ 1 µA</th><th>1 µA < i ≤ 1 mA</th></tr>
<tr><td rowspan="10">UPPER, LOWER</td><td>0.01 MΩ ≤ R < 10.0 MΩ</td><td rowspan="4">—</td><td rowspan="2">—</td><td>—</td><td rowspan="5">± (2 % of setting + 3digit)</td></tr>
<tr><td>10.0 MΩ ≤ R < 50.0 MΩ</td><td rowspan="6">± (5 % of setting + 5digit)</td></tr>
<tr><td>50.0 MΩ ≤ R < 100 MΩ</td><td rowspan="4">± (10 % of setting + 5digit)</td></tr>
<tr><td>100 MΩ ≤ R < 200 MΩ</td></tr>
<tr><td>200 MΩ ≤ R < 500 MΩ</td><td rowspan="2">± (20 % of setting + 5digit)</td></tr>
<tr><td>500 MΩ ≤ R < 1.00 GΩ</td><td rowspan="5">—</td></tr>
<tr><td>1.00 GΩ ≤ R < 2.00 GΩ</td><td>± (20 % of setting + 10digit)</td></tr>
<tr><td>2.00 GΩ ≤ R < 5.00 GΩ</td><td rowspan="2">± (20 % of setting + 20digit)</td><td rowspan="2">± (10 % of setting + 10digit)</td></tr>
<tr><td>5.00 GΩ ≤ R < 10.0 GΩ</td><td>—</td></tr>
</table>
Judgement current = test voltage/(UPPER,LOWER)
[In the humidity range of 20 % to 70 % R.H (no condensation), with no disturbance such as swinging of the test leadwire]
[In LOWER judgement, at least 0.5 s is necessary for testing after the WAIT TIME has elapsed. In LOWER judgement for 200 nA or lower, a wait time of at least 1.0 s is necessary.]
</td></tr>
</table>

Item		Specifications (TOS9200/TOS9201)
Time		
	Setting range for the voltage rise time (RISE TIME)	0.1 s to 200 s
	Setting range for the test time (TEST TIME)	0.5 s to 999 s With the TIMER OFF function
	Setting range for the judgement wait time (WAIT TIME)	0.3 s to 10 s [(RISE TIME + TEST TIME) > WAIT TIME]
	Accuracy	± (100 ppm + 20 ms)

*4

When the GND is set to GUARD, current measurement is disabled if the part of the DUT connected to the LOW terminal is grounded, which poses extreme danger. Never ground the DUT. In ordinary operation, set the GND to LOW.

Interface and Other Functions (TOS9200/TOS9201)

<table>
<tr><th colspan="4">Item</th><th colspan="4">Specifications</th></tr>
<tr><td colspan="4">REMOTE</td><td colspan="4">5-pin DIN connector on front panel
Remote control of start/stop operation using an option
• Remote control box RC01-TOS, RC02-TOS
• High-voltage test probe HP01A-TOS, HP02A-TOS (at a test voltage of AC 4 kV/DC 5 kV or less)</td></tr>
<tr><td colspan="4">SIGNAL I/O</td><td colspan="4">25-pin D-SUB connector on rear panel</td></tr>
<tr><td></td><td>No.</td><td>Signal name</td><td>I/O</td><td colspan="3">Description of signals</td></tr>
<tr><td></td><td>1</td><td>PM0</td><td>I</td><td>LSB</td><td rowspan="4">LSD</td><td rowspan="8">2-digit BCD low active input
Signal input terminal for selection between the panel memory for ACW, DCW, and IR, and the program memory for AUTO
Memory recall by latching this selection signal at the rise of the strobe signal</td></tr>
<tr><td></td><td>2</td><td>PM1</td><td>I</td><td></td></tr>
<tr><td></td><td>3</td><td>PM2</td><td>I</td><td></td></tr>
<tr><td></td><td>4</td><td>PM3</td><td>I</td><td></td></tr>
<tr><td></td><td>5</td><td>PM4</td><td>I</td><td></td><td rowspan="4">MSD</td></tr>
<tr><td></td><td>6</td><td>PM5</td><td>I</td><td></td></tr>
<tr><td></td><td>7</td><td>PM6</td><td>I</td><td></td></tr>
<tr><td></td><td>8</td><td>PM7</td><td>I</td><td>MSB</td></tr>
<tr><td></td><td>9</td><td>STB</td><td>I</td><td colspan="3">Input terminal for the strobe signal of the panel memory or the program memory</td></tr>
<tr><td></td><td>10</td><td>MODE0</td><td>I</td><td colspan="3" rowspan="2">Selection of a test mode
2-bit low active input
<table><tr><td>MODE0</td><td>H</td><td>L</td><td>H</td><td>L</td></tr><tr><td>MODE1</td><td>H</td><td>H</td><td>L</td><td>L</td></tr><tr><td>Test mode</td><td>ACW</td><td>DCW</td><td>IR</td><td>AUTO</td></tr></table></td></tr>
<tr><td></td><td>11</td><td>MODE1</td><td>I</td></tr>
<tr><td></td><td>12</td><td>NC</td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>13</td><td>COM</td><td></td><td colspan="3">Circuit common (chassis potential)</td></tr>
<tr><td></td><td>14</td><td>H.V ON</td><td>O</td><td colspan="3">ON during a test and an automatic test (AUTO) or while a voltage remains between the output terminals</td></tr>
<tr><td></td><td>15</td><td>TEST</td><td>O</td><td colspan="3">ON during a test (except for voltage rise and voltage fall)</td></tr>
<tr><td></td><td>16</td><td>PASS</td><td>O</td><td colspan="3">ON during the time preset in the PASS HOLD settings when a PASS judgement is made</td></tr>
<tr><td></td><td>17</td><td>U FAIL</td><td>O</td><td colspan="3">Continuously ON in an UPPER FAIL judgement. Continuously ON in a CONTACT FAIL judgement with the scanner connected.</td></tr>
<tr><td></td><td>18</td><td>L FAIL</td><td>O</td><td colspan="3">Continuously ON in an LOWER FAIL judgement. Continuously ON in a CONTACT FAIL judgement with the scanner connected.</td></tr>
<tr><td></td><td>19</td><td>READY</td><td>O</td><td colspan="3">ON during the READY status</td></tr>
<tr><td></td><td>20</td><td>PROTECTION</td><td>O</td><td colspan="3">ON when the PROTECTION function is activated</td></tr>
<tr><td></td><td>21</td><td>START</td><td>I</td><td colspan="3">Input terminal for the START signal</td></tr>
<tr><td></td><td>22</td><td>STOP</td><td>I</td><td colspan="3">Input terminal for the STOP signal</td></tr>
<tr><td></td><td>23</td><td>ENABLE</td><td>I</td><td colspan="3">Input terminal for the ENABLE signal for the START signal</td></tr>
<tr><td></td><td>24</td><td>+24 V</td><td></td><td colspan="3">Output terminal for +24 V internal power, with a maximum output current of 100 mA</td></tr>
<tr><td></td><td>25</td><td>COM</td><td></td><td colspan="3">Circuit common (chassis potential)</td></tr>
</table>

<table>
<tr><th colspan="3">Item</th><th colspan="2">Specifications</th></tr>
<tr><td rowspan="6">SIG-
NAL I/
O</td><td colspan="4">Input specifications</td></tr>
<tr><td rowspan="4"></td><td>High-level input voltage</td><td>11 V to 15 V</td><td rowspan="4">Low active control of all input signals
The input terminal is pulled up by the resistance to +12 V.
Opening the input terminal is equivalent to inputting a high-level voltage.</td></tr>
<tr><td>Low-level input voltage</td><td>0 V to 4 V</td></tr>
<tr><td>Low-level input current</td><td>Maximum of –5 mA</td></tr>
<tr><td>Input period</td><td>Minimum of 5 ms</td></tr>
<tr><td colspan="4">Output specifications</td></tr>
<tr><td></td><td>Output method</td><td colspan="2">Open collector output (4.5 V to 30 V DC)</td></tr>
<tr><td></td><td>Output withstanding voltage</td><td colspan="2">30 V DC</td></tr>
<tr><td></td><td>Output saturation voltage</td><td colspan="2">Approximately 1.1 V (25 ˚C)</td></tr>
<tr><td></td><td>Maximum output current</td><td colspan="2">400 mA (TOTAL)</td></tr>
<tr><td colspan="2">STATUS OUT</td><td colspan="2">Output terminal for the warning light</td></tr>
<tr><td></td><td>+ terminal (red)</td><td colspan="2">Outputs +24 V during the preset period with a maximum output current of 100 mA</td></tr>
<tr><td></td><td>- terminal (black)</td><td colspan="2">+24 V circuit common line</td></tr>
<tr><td colspan="2">INTERLOCK input</td><td colspan="2">Cuts off output when the + and – terminals are opened, and enters the PROTECTION status to disable testing</td></tr>
<tr><td></td><td>+ terminal (yellow)</td><td>Interlock input + terminal</td><td rowspan="2">Open: When the current between terminals is 0.5 mA or less
Short-circuited: When the current between terminals is 1 mA or more</td></tr>
<tr><td></td><td>- terminal (yellow)</td><td>Interlock input – terminal</td></tr>
<tr><td colspan="2">SCANNER</td><td colspan="2">8-pin MINI DIN connector on rear panel
Interface terminal for optional high-voltage scanner TOS9220/9221</td></tr>
<tr><td colspan="2">RS-232C</td><td colspan="2">9-pin D-SUB connector on rear panel (conforming to EIA-232-D)
Remote control possible for all functions other than POWER switch, KEY-LOCK, and AUTO</td></tr>
<tr><td></td><td>Baud rates</td><td colspan="2">9600 bps/19200 bps/38400 bps</td></tr>
<tr><td></td><td>TOS6200 interface
(only in AUTO mode)</td><td colspan="2">START/STOP control, test-condition settings
Reads TOS6200 measurements and measurement results</td></tr>
<tr><td colspan="2">GPIB</td><td colspan="2">Conforms to IEEE Std.488-1978
Remote control possible for all functions other than POWER switch, KEY-LOCK, and AUTO
<table>
<tr><th>Function</th><th>Subset</th><th>Description</th></tr>
<tr><td>Source handshaking</td><td>SH1</td><td>All functions provided</td></tr>
<tr><td>Acceptor handshaking</td><td>AH1</td><td>All functions provided</td></tr>
<tr><td>Talker</td><td>T6</td><td>All functions provided except for the talk-only function</td></tr>
<tr><td>Expansion talker</td><td>TE0</td><td>No function</td></tr>
<tr><td>Listener</td><td>L4</td><td>All functions provided except for the listen-only function</td></tr>
<tr><td>Expansion listener</td><td>LE0</td><td>No function</td></tr>
<tr><td>Service request</td><td>SR1</td><td>All functions provided</td></tr>
<tr><td>Remote local</td><td>RL1</td><td>All functions provided</td></tr>
<tr><td>Parallel port</td><td>PP0</td><td>No function</td></tr>
<tr><td>Device clear</td><td>DC1</td><td>All functions provided</td></tr>
<tr><td>Device trigger</td><td>DT0</td><td>No function</td></tr>
<tr><td>Controller</td><td>C0</td><td>No function</td></tr>
<tr><td>Electrical interface</td><td>E1</td><td>Open collector</td></tr>
</table></td></tr>
</table>

Item		Specifications
Indicator		240x64-dot LCD. Displays settings, measurements and judgement results.
Testing function	ACW	Executes AC withstanding voltage test
	DCW (*5)	Executes DC withstanding voltage test
	IR	Executes insulation resistance test
	AUTO (*5)	Automatically executes AC withstanding voltage test (ACW), DC withstanding voltage test (DCW), insulation resistance test (IR), and earth continuity test (EC). The TOS6200 (Earth Continuity Tester) is necessary for earth continuity testing.
Memory function	ACW	Maximum of 100
	DCW (*5)	Maximum of 100
	IR	Maximum of 100
	AUTO	Maximum of 100 test patterns, with each having up to 100 steps (total of 500 steps)
Backup battery life		At least 3 years (at 25 ˚C)
MEASURE MODE		Displaying the measured current in withstanding voltage testing and the measured insulation resistance in insulation resistance testing can be selected as shown below
	NORM	Displays, during the test, the measured current in withstanding voltage testing and the measured insulation resistance in insulation resistance testing
	MAX/MIN	Displays, during the test, the maximum measured current in withstanding voltage testing and the minimum measured insulation resistance in insulation resistance testing during one test
PASS HOLD TIME		The time during which a PASS judgement is held can be set from 0.2 s to 10.0 s at a resolution of 0.1 s, or to HOLD.
TEST TIME	MOMENARY	Executes a test only while the START switch is pressed
	FAIL MODE	Cancels to reset the FAIL or PROTECTION status produced by the STOP signal with remote control
	DOUBLE ACTION	Starts a test only when the START switch is pressed within approximately 0.5 s after the STOP switch is pressed
KEYLOCK		Shifts to the status in which no keys other than the START and STOP switches are accepted

*5
The DCW (DC withstanding voltage testing) function is provided only for TOS9201.

General Specifications (TOS9200/TOS9201)

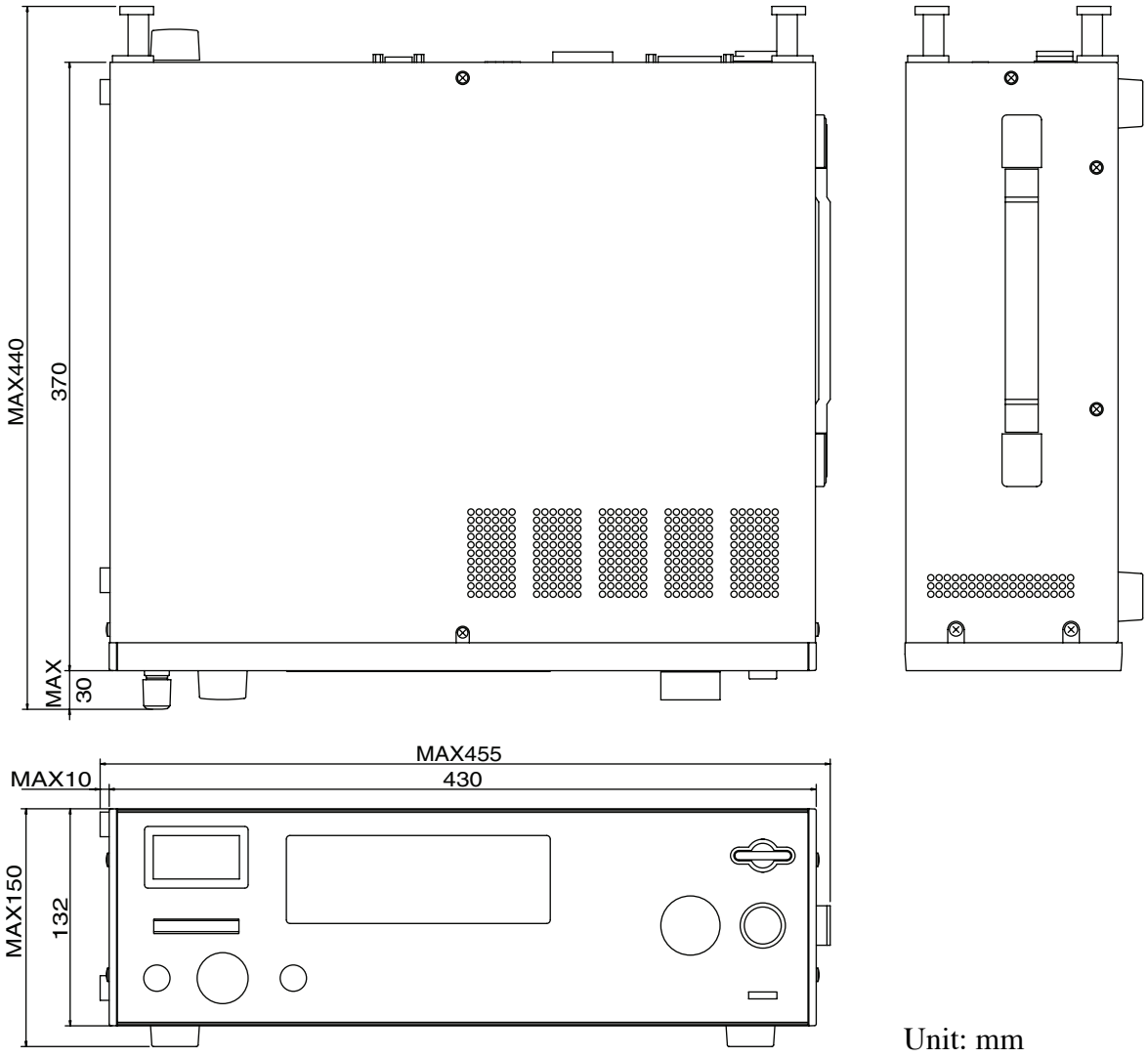
Item			Specifications
Environment			
	Installation location		Indoors at an altitude of up to 2000 m
	Warranty range	Temperature	5 ˚C to 35 ˚C
		Humidity	20 % to 80 % RH (No condensation)
	Operating range	Temperature	0 ˚C to 40 ˚C
		Humidity	20 % to 80 % RH (No condensation)
	Storage range	Temperature	-20 ˚C to 70 ˚C
		Humidity	90 % RH or less (No condensation)
Power requirements			
	Nominal voltage range (Allowable voltage range)		100 V to 120 V AC / 200 V to 240 V AC (85 V to 130 V AC / 170 V to 250 V AC) Selectable
	Power consumption	Using no load (READY)	100 VA or less
		Using the rated load	Maximum of 800 VA
	Allowable frequency range		47 Hz to 63 Hz
Insulation resistance			30 MΩ or more (500 V DC) [between the AC LINE and chassis]
Withstanding voltage			1390 V AC, 2 seconds, 20 mA or less [between the AC LINE and chassis]
Earth continuity			25 A AC/0.1 Ω or less
Safety*6, *7			Conforms to the requirements of the following directive and standard. Low Voltage Directive 73/23/EEC EN61010-1 Class I Pollution degree 2
Electromagnetic compatibility (EMC)*6			Conforms to the requirements of the following directive and standard. EMC Directive 89/336/EEC EN61326 EN61000-3-2 EN61000-3-3 Under following conditions 1. Used test leadwire TL01-TOS which is supplied. 2. No discharge occurs at outside of the tester. 3. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.

*6
Only on models that have CE marking on the panel.
Not applicable to custom order models.

*7
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.

Item		Specifications
Dimensions		See Fig. 8-1 Dimensions.
Weight		Approximately 19 kg
Accessory		
	AC Power cord	1 pc.
	High-voltage test leadwire TL01-TOS (1.5 m)	1 set
	Interlock jumper	1 pc.
	High-Voltage Danger sticker	1 sheet
	Fuse	1pc.
	Operation Manual	Operation Manual for Tester: 1 copy, Operation for GPIB/RS-232C Interface: 1 copy

Dimensions



Unit: mm

Fig.8-1 Dimensions

Appendix

1. Operating Principle

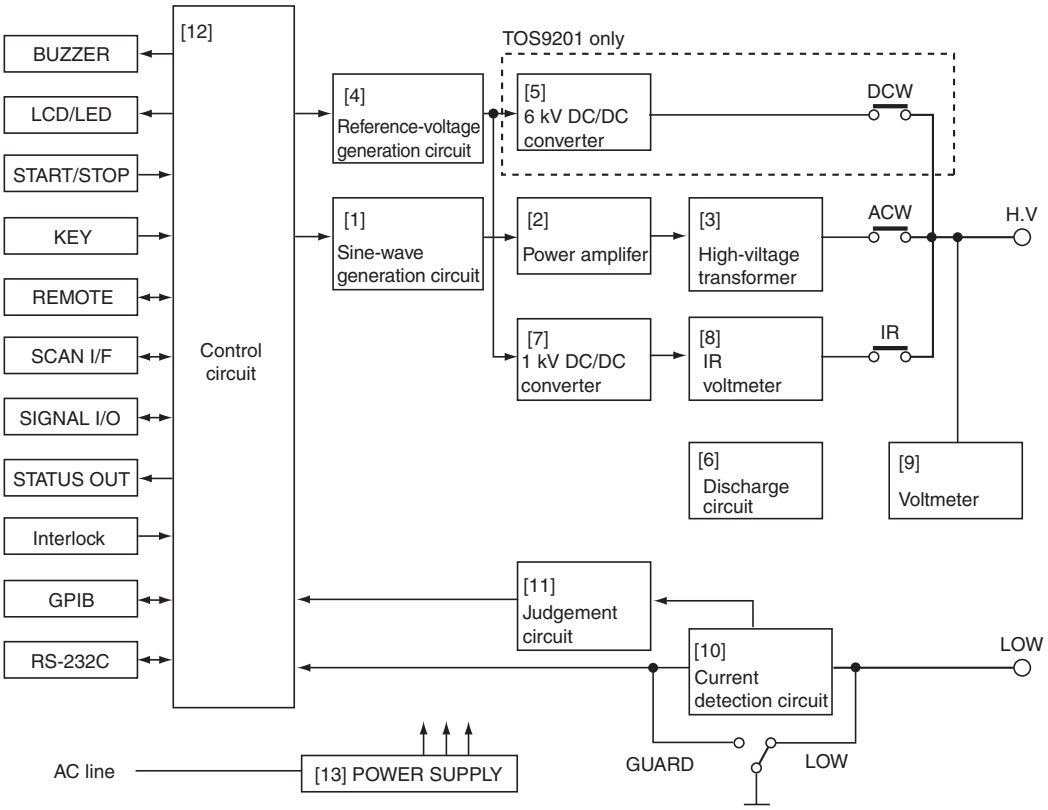


Fig.A-1 TOS9200/9201 block diagram

[1] Sine-wave generation circuit

In AC withstanding voltage testing, this circuit generates a slightly distorted 50 Hz or 60 Hz sine wave corresponding to the test voltage. During the preset voltage rise time (RISE TIME), the tester rises from zero to the preset test voltage while applying no transient voltage stress to the DUT. When the test ends with a PASS judgement, the tester falls from the test voltage to zero during the preset voltage fall time (FALL TIME).

[2] Power amplifier

The large-capacity (500 VA), high-efficiency PWM switching amplifier amplifies the output from the sine-wave generation circuit up to a consistent maximum of 100 V.

Although it is subject to time limitations, the tester's high-voltage generation block, including a high-voltage transformer, can generate a rated maximum of 500 VA (5 kV/100 mA), or 2.5 times that of Kikusui's conventional counterparts. The amplifier generates a consistent test voltage of 50 Hz/60 Hz independent of the supply voltage, with a voltage regulation within ±3 %. Further, at a test voltage of 500 V or more, it is capable of supplying a momentary current of at least 200 mA.

[3] High-voltage transformer

Increases the output voltage for the power amplification circuit to a maximum of 5 kV at a ratio of 1 to 50. Has a transformer capacity as large as 500 VA.

[4] Reference-voltage generation circuit

Generates a reference voltage corresponding to the test voltage in DC withstanding voltage testing and insulation resistance testing. During the preset voltage rise time (RISE TIME), the reference voltage increases from zero to the preset test voltage, exerting little transient voltage stress on the DUT.

[5] 6 kV DC/DC converter (TOS9201 only)

The high-voltage generation circuit for DC withstanding voltage testing. At an output of 6 kV, the converter enhances the output from the reference-voltage generation circuit by approximately 300 times to obtain 1.25 kV. Further, it achieves 6 kVDC in the 4-time Cockcroft and Wolton circuit. The converter realizes a low-ripple stable test voltage of up to 6 kV (maximum rated power of 50 W) with a voltage regulation of 1 % or less.

[6] Discharge circuit

Equipped with a function for forcibly releasing a charge in the DUT contained at the end of a DC withstanding voltage test or an insulation resistance test, thus preventing electric shock.

[7] 1 kV DC/DC converter

High-voltage generation circuit for insulation resistance testing. At an output of 1000 V, the converter enhances the output from the reference-voltage generation circuit by approximately 200 times to obtain 1000 V. At -25 V to -1000 V (a maximum rated current of 1 mA), the converter realizes a low-ripple stable test voltage with a voltage regulation of 1 % or less.

[8] IR voltmeter

Digital voltmeter for insulation resistance testing with an accuracy of ±(1 % of reading + 1 V). The output voltage is divided using a high-precision, high-voltage resistor. These voltages are input to the A/D converter and displayed on the LCD during the test. The insulation resistance is obtained by dividing voltage by current which detected on the current detection circuit in the insulation resistance meter.

[9] Voltmeter

Equipped with a high-precision digital voltmeter with an accuracy of ±(1 % of reading + 30 V) and an analog voltmeter with an accuracy of ±5% f.s.

(a) Digital voltmeter

The digital voltmeter divides the output voltage using a high-precision high-voltage resistor, and converts divided voltages into DC voltages in the AC/DC conversion circuit. These voltages are collected by the A/D converter and displayed on the LCD

during the test. The voltmeter constantly monitors the voltage on the output terminal, even when no test is under way. When a voltage is detected, the voltmeter turns on the DANGER lamp.

(b) Analog voltmeter

Rectifies currents flowing into divider resistors, and drives the DC voltmeter. Conducts voltage measurement in AC/DC withstanding voltage testing, as well as insulation resistance testing.

[10] Current detection circuit

(a) Current detection circuit for withstanding voltage testing

Converts the current flowing into the output terminal into a voltage using the reference resistance, and further transforms it into a DC voltage in the AC/DC conversion circuit. This voltage is input to the A/D converter and displayed on the LCD. Compared with Kikusui's conventional counterparts, which have a measurement resolution of 1 mA and accuracy of ±5% of the upper current when the upper current is set to 100 mA, this tester enables measurement with an accuracy of ±(3 % of reading + 20 μA) to be conducted even at an upper current of 100 mA.

(b) Current detection circuit for insulation resistance testing

Converts the current flowing into the output terminal into a voltage in the current-voltage conversion circuit, and collects it in the A/D converter. The insulation resistance value is determined by dividing the voltage measured on the voltmeter for insulation resistance testing by the current obtained in this current detection circuit. The insulation resistance value is then displayed on the LCD.

[11] Judgement circuit

In withstanding voltage testing, this circuit compares the DC current measured in the current detection circuit with the reference voltage, which corresponds to the preset upper or lower current. If a current exceeding the upper current is detected, the circuit determines that a withstanding voltage error has occurred and cuts off the test voltage. In addition, if detected currents are below the lower current, the circuit determines that the high-voltage test leadwire is disconnected or in poor contact, and thus cuts off the test voltage.

[12] Control circuit

Controls the test voltage. This circuit also manages voltage measurement, current measurement, judgement, and test time, in addition to conducting sequence control on the CPU.

[13] POWER SUPPLY

Converts AC voltages from an AC line into DC voltages in order to supply them to circuits

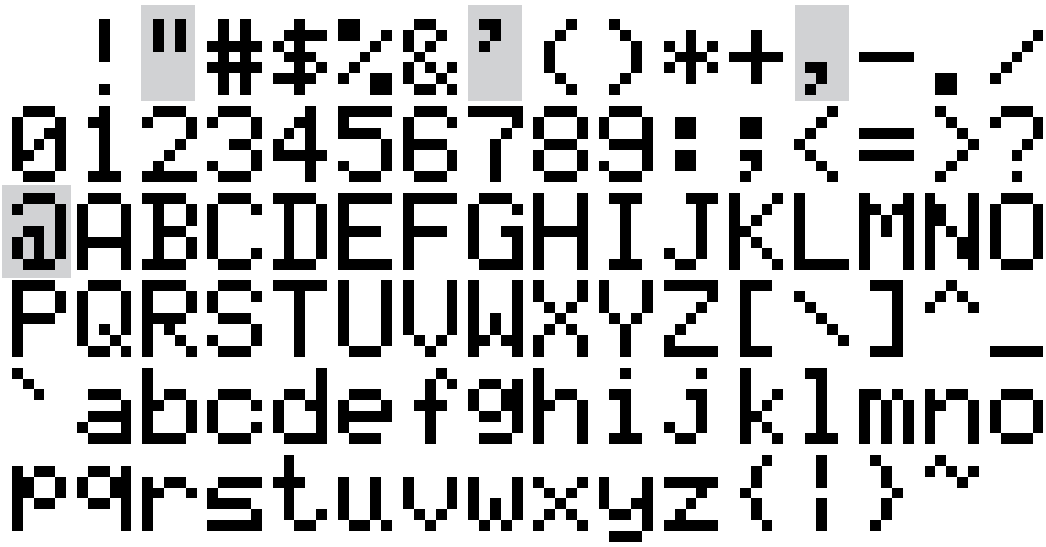
2. ASCII Code 20H to 7EH

These characters can be used for the title names in panel memory and program memory and comments.

Turn the rotary knob counterclockwise to enter ASCII code [ ] (20H). Turn the rotary knob clockwise to enter ASCII code [~] (7E).

NOTE

- The tester does not accept [“] (22H), [‘] 27H, [,] (2CH), or [@] (40H).



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V

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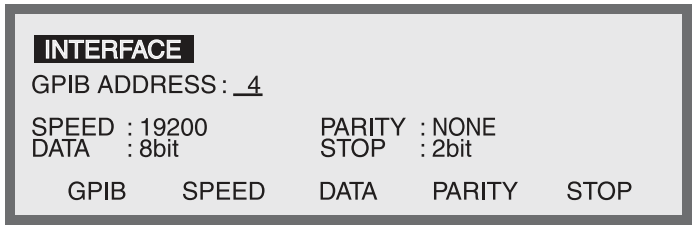
Part No. Z1-002-422, IB002894
Apr. 2004

OPERATION MANUAL

WITHSTANDING VOLTAGE/
INSULATION RESISTANCE TESTER
TOS9200 Series

TOS9200
TOS9201

GPIB/RS-232C INTERFACE



⚠ DANGER

This Tester generates high voltage.

- ○ Any incorrect handling may cause death.
- ○ Read Chapter 2 “PRECAUTIONS ON HANDLING” in TOS9200/9201 manual to prevent accident.
- ○ Keep this manual together with the manual for TOS9200/9201, near the tester for easy accsse 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.

Printed in Japan.

⚠ Safety Symbols

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

	Indicates that a high voltage (over 1000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.
DANGER	Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.
⚠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.

Description of Contents

This manual is composed of the following chapters.

Chapter 1 TOS9200 GPIB/RS-232CSetup

This chapter describes the preparations to be made for remote control using the GPIB/RS-232C interface.

Chapter 2 GPIB and RS-232C

This chapter describes the GPIB/RS-232C interface and device messages.

Chapter 3 Messages and Registers

This chapter describes the device messages and registers.

Appendix

This section provides some examples of programs to be created and used with the GPIB/RS-232C interface.

Contents

Appendix

Chapter 1 TOS9200 GPIB/RS-232CSetup

This is the operation manual designed to remotely control the TOS9200 Series withstanding voltage/insulation resistance tester using the GPIB or RS-232C interface. Attention is focused on the device message used in remote control.

Before starting remote control, prepare the Operation Manual for the TOS9200 Series and gain a full understanding of the instructions given in the manual.

⚠WARNING • In remote control, an external signal is used to turn a high voltage on/off, resulting in serious potential danger. To avoid the accidental generation of a high voltage and prevent workers from touching the device under testing (hereinafter referred to as a "DUT"), the high-voltage test leadwire, the high-voltage probe, and the output terminals when a high voltage is being output, provide full safety measures. Never conduct remote control without taking proper safety measures.

NOTE • When an abnormal voltage occurs on the power line while a remote control operation using GPIB or RS-232C interface, the tester returns PROTECTION (line voltage monitoring) message. However, when the power of the tester is turned on while an abnormal voltage occurs already on the power line, the tester cannot return a message.

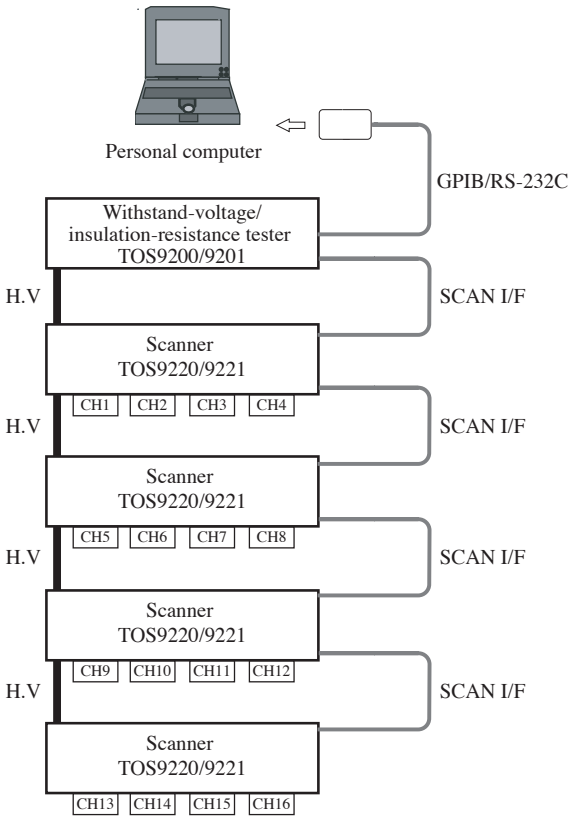


Fig.1-1 System configuration (example)

1.1 Preparing for GPIB Control

NOTE

- If settings are made so that the tester controls the earth continuity tester TOS6200, the GPIB interface cannot be used for remote control. For details, see "Controlling the TOS6200" in the Operation Manual for the Tester.

1.1.1 Connecting the GPIB cable

Turn off all POWER switches on the TOS9200 and other devices that are part of the GPIB system.

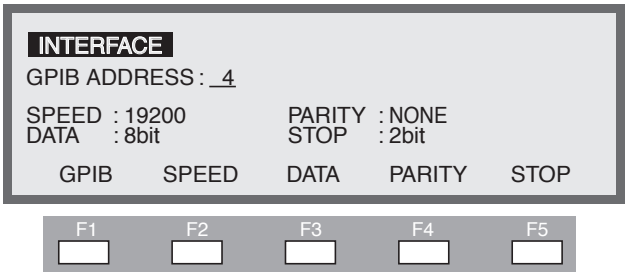
Connect the GPIB cable to the GPIB connector on the rear panel of the TOS9200/ TOS9201.

1.1.2 Setting the GPIB address

To conduct remote control using the GPIB interface, a GPIB address must be set on the TOS9200/TOS9201. Do not use an address already set in the system.

To set a GPIB address, use the Interface Settings screen.

To display the Interface Settings screen (INTERFACE), press the SHIFT + SYSTEM(I/F) keys. The SYSTEM(I/F) key then lights up.



Set the GPIB address on the TOS9200/TOS9201 to 0 through 30.

NOTE

- The set GPIB address becomes valid after the TOS9200/9201 is restarted.

1. Using the F1 key (GPIB) or the ▲ ▼ ◀ ▶ keys, move the cursor to the GPIB ADDRESS.
2. Using the rotary knob, set a GPIB address.
3. On the TOS9200/TOS9201, turn off the POWER switch and then turn it on again.

1.2 Preparing for RS-232C Control

1.2.1 Connecting the RS-232C cable

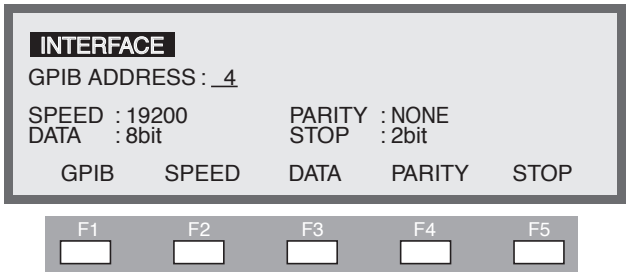
Turn off all POWER switches on the TOS9200 and other devices that are part of the RS-232C system.

Connect the RS-232C cable to the RS-232C connector on the rear panel of the TOS9200/TOS9201.

1.2.2 RS-232C settings

To make settings, use the Interface Settings screen.

To display the Interface Settings screen (INTERFACE), press the SHIFT + SYSTEM(I/F) keys. The SYSTEM(I/F) key will then light up.



NOTE

- When the interface settings are changed, they become valid after the TOS9200/9201 is restarted.

Setting the communication speed of the RS-232C interface

Three communication speeds are available for the RS-232C interface:

38,400 bps
19,200 bps
9,600 bps

1. Using the F2 key (SPEED) or the ▲ ▼ ◀ ▶ keys, move the cursor to SPEED.
2. Using the rotary knob, select 38,400, 19,200, or 9,600 bps.

Setting the data length of the RS-232C interface

The following two data lengths are available for the RS-232C interface:

7 bits
8 bits

1. Using the F3 key (DATA) or the ▲ ▼ ◀ ▶ keys, move the cursor to DATA.
2. Using the rotary knob, select 7 or 8.

Setting the parity of the RS-232C interface

The following three parities are available for the RS-232C interface:

NONE
ODD
EVEN

1. Using the F4 key (PARITY) or the ▲ ▼ ◀ ▶ keys, move the cursor to PARITY.
2. Using the rotary knob, select NONE, ODD, or EVEN.

Setting the stop bit of the RS-232C interface

The following two stop bits are available for the RS-232C interface:

1 bit
2 bits

1. Using the F5 key (STOP) or the ▲ ▼ ◀ ▶ keys, move the cursor to STOP.
2. Using the rotary knob, select 1 or 2.

Chapter 2 GPIB and RS-232C

This chapter describes the GPIB/RS-232C interface and device messages.

2.1 Interface

The tester is provided with a GPIB and RS-232C interface. Either can be selected.

2.1.1 GPIB interface

List of GPIB functions

Function	Subset	Description
Source handshaking	SH1	All functions provided
Acceptor handshaking	AH1	All functions provided
Talker	T6	All functions provided except for the talk-only function
Expansion talker	TE0	No function
Listener	L4	All functions provided except for the listen-only function
Expansion listener	LE0	No function
Service request	SR1	All functions provided
Remote local	RL1	All functions provided
Parallel polling	PP0	No function
Device clear	DC1	All functions provided
Device trigger	DT0	No function
Controller	C0	No function
Electrical interface	E1	Open collector

GPIB cables are available from Kikusui. Contact the supplier or your Kikusui agent.

GPIB cable: 1 m (Product No. 92080)

GPIB cable: 2 m (Product No. 92070)

GPIB cable: 4 m (Product No. 92090)

2.1.2 RS-232C interface

To use an RS-232C interface, the settings specified below must be made. For the setting procedure, see "1.2.2 RS-232C settings".

- RS-232C interface communication speed
- RS-232C interface data
- RS-232C interface parity
- RS-232C interface stop bit

Communication with the RS-232C must be regulated by flow control or using an acknowledge message. One-way transmission may make proper communication difficult. For details on acknowledge messages, see "2.2.1 Messages".

As the RS-232C cable, use an AT-type 9-pin D-SUB female-female cross cable.

RS-232C pin assignment

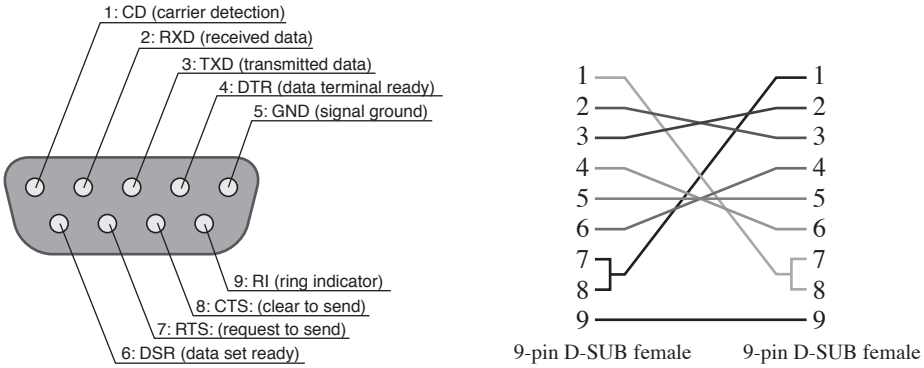


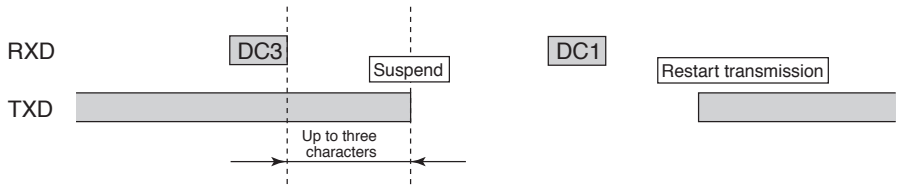
Fig.2-1 AT-type 9-pin connector

RS-232C flow control

Communication among tester controllers can be controlled by executing Xon and Xoff. These control codes are controlled by DC (Device Control) codes.

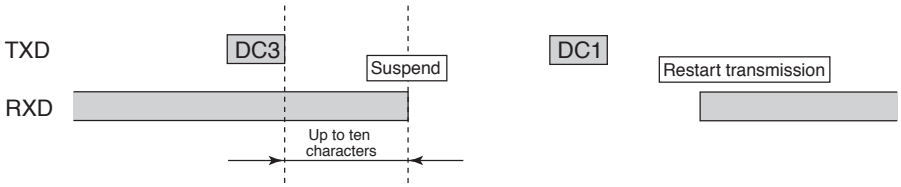
	Function	ASCII code
DC1	Send request	11h
DC3	Send Stop request	13h

Controlling transmission from the RS-232C terminal to the tester



The tester suspends transmission within three characters following the receipt of DC3.

Controlling transmission from the tester to the RS-232C terminal



Have the RS-232C terminal suspend transmission within 10 characters following the receipt of DC3.

Fig.2-2 Controlling transmission between the RS-232C terminal and the tester

2.2 Messages and Terminators

This section explains the terms used for communication between the computer (controller) and the tester (device). See Fig. 2-3.

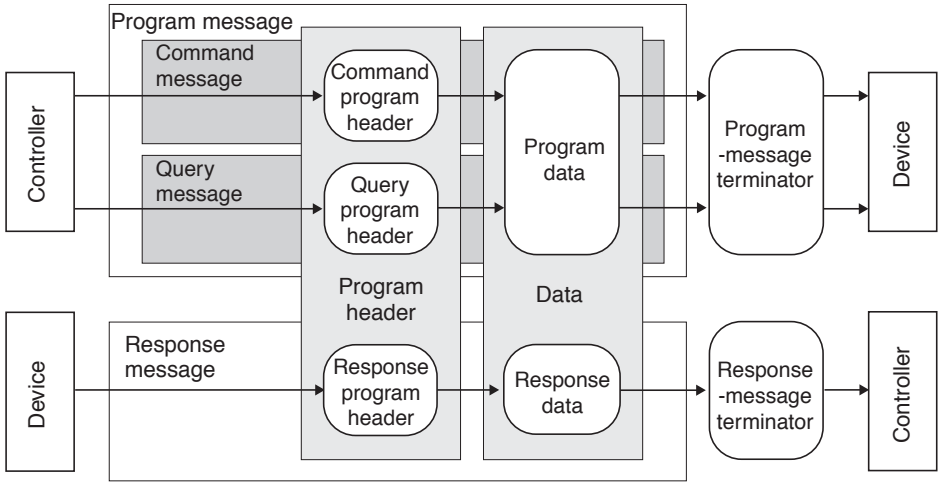


Fig.2-3 Messages and terminators

2.2.1 Messages

Commands sent from the computer to the tester are referred to as “program messages.” Responses sent from the tester to the computer are referred to as “response messages.”

Each message is composed of a program-header block and a data block.

Program messages

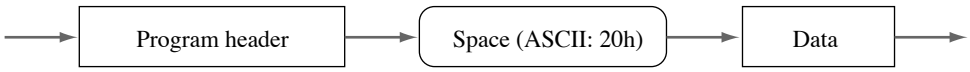
Program messages are either “command messages” or “query messages.”

Command messages are used to execute specific functions of the tester and to change settings.

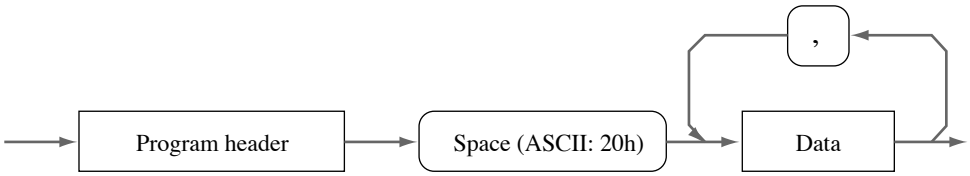
Query messages are used to inquire about the settings and status of the tester.

Describing a program message

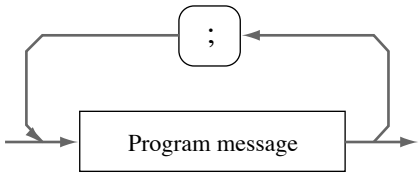
- A space (ASCII: 20h) must be inserted between the program header and the data.



- If there are two or more pieces of data, connect them using " , " (ASCII: 2Ch).



- To connect program messages, use " ; " (ASCII: 3Bh).

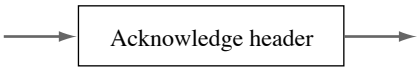


NOTE

- To describe data using hexadecimals, add "#H."
  (Example) The decimal 10 is expressed as "#H0A" in hexadecimal.
- With the GPIB interface, add "@" to the end of a program message to maintain the HOLD OFF status until the message has been executed. However, in the event of a command message terminator with only EOI, use "@@".

Acknowledge message (RS-232C)

Acknowledge messages are used only with the RS-232C interface. They are sent from the tester to the controller, and are used to confirm that the handling of a program message has been completed.



Acknowledge messages contain only a header composed of character strings in ASCII codes. The following two acknowledge messages are used:

- OK : Normal termination
- ERROR : Abnormality such as a syntax error

Using the SILENT command message, settings can be made to specify whether to return an acknowledge message.

2.2.2 Terminators

A program-message terminator is used to end a program message. A response-message terminator is used to end a response message.

- Program-message terminators

  Any of the following can be used as a program-message terminator. No settings necessary:

  CR+LF+EOI, LF, LF+EOI, CR+EOI

- Response-message terminators

  By default, CR+LF+EOI is used. It can be changed to one of the following in accordance with the TRM command message. EOI is used only for GPIB.

  CR+LF+EOI, LF+EOI, EOI, CR+EOI

NOTE

- EOI is exclusively used for GPIB as a program-message terminator and a response-message terminator.

Chapter 3 Messages and Registers

Program messages and response messages supported by the tester are referred to as “device messages.”

The following describes each device message supported by the tester.

The symbol in parentheses following the device-message name is the abbreviation of the message name.

Special symbols and characters

The symbols and characters used to describe program messages and response messages are given below, along with their definitions.

Symbols and character	Description
< >	The parentheses indicate program data. In actual programming, do not use these parentheses.
{ }	Choose one from among the characters and numerals enclosed in parentheses and separated by “ : ”. In actual programming, do not use these parentheses.
_	Represents a space

3.1 Register-Related Messages and General Purpose Messages

Below, general purpose device messages and messages common to all modes are explained. general purpose device messages are used to set and reset each register, make inquiries, and specify a terminator.

*CLS

Resets the status byte register, event status register, device status register, protection register 1, protection register 2, fail register, invalid-setting register, and error register.

For each register, see "3.9 Registers".

Program message

- Syntax

  Command message: `*CLS`

*ESR

The event status register is reset when it is read by the *ESR? Message.
For details on the event status register, see "3.9 Registers".

Program message

- Syntax
  Query message: `*ESR?`

Response message

To reset, the contents of the event status register are returned to *ESR?.
(Example) When Bit 5 of the event status register is set, `32` is returned.

*IDN

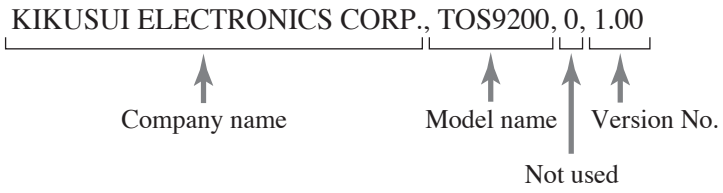
Inquires about the model name and ROM version of the tester

Program message

- Syntax
  Query message: `*IDN?`

Response message

The model name of the tester is returned to *IDN?, as follows:



*RST

Initializes the tester (to original factory-set settings). Note the settings made in the INTERFACE screen will not be initialized.
For details on initialization, see the relevant section of the operation manual for the tester.

Program message

- Syntax
  Command message: `*RST`

*SRE

Sets or resets each bit of the service-request enable register, or inquires about the contents of the register.

For details on the service-request enable register, see "3.9 Registers".

Program message

- Syntax

  Command message: `*SRE_<value>`

  Query message: `*SRE?`

- Program data

  Data format: Hexadecimal or decimal

  Set value: 00H to FFH (0 to 255)

  Resolution: 1H (1)

(Example) To set the service-request enable register to #50H,

```
*SRE #H50
```

Response message

To *SRE?, the contents of the service-request enable register are returned.

(Example) When Bit 5 and Bit 6 of the service-request enable register are set, `96` is returned.

*STB

Used to inquires about the contents of the status byte register.

For details on the status byte register, see "3.9 Registers".

Program message

- Syntax

  Query message: `*STB?`

Response message

To *STB?, the contents of the status byte register are returned.

(Example) When Bit 5 and Bit 6 of the status byte register are set, `96` is returned.

CLR

Resets all registers exclusive of enable register and sets the STOP flag.

The same procedure is performed as when the GPIB bus line message DCL or SDC has been received.

Also used to perform the same processing as is performed by a DCL message from the RS-232C.

Program message

- Syntax

  Command message: `CLR`

DSE

Sets or resets each bit of the device-status enable register, or inquires about the contents of the register.

For details on the device-status enable register, see "3.9 Registers".

Program message

- Syntax

  Command message: `DSE_<value>`

  Query message: `DSE?`

- Program data

  Data format: Hexadecimal or decimal

  Set value: 00H to FFH (0 to 255)

  Resolution: 1H (1)

(Example) To set the device-status enable register to 01H,

```
DSE #H01
```

Response message

To DSE?, the contents of the device-status enable register are returned.

(Example) When Bit 5 of the device-status enable register is set, `32` is returned.

DSR

Used to inquires about the contents of the device status register.

For details on the device status register, see "3.9 Registers".

Program message

- Syntax

  Query message: `DSR?`

Response message

To DSR?, the contents of the device status register are returned.

(Example) When Bit 5 of the device-status enable register is set, `32` is returned.

ERR

The error register is reset when read by the ERR? Message.

For details on the error register, see "3.9 Registers".

Program message

- Syntax

  Query message: `ERR?`

Response message

To ERR?, the contents of the error register are returned.

(Example) When Bit 3 of the error register is set, `8` is returned.

FAIL

Inquires about the contents of the fail register.

For details on the fail register, see "3.9 Registers".

Program message

- Syntax

  Query message: `FAIL?`

Response message

To FAIL?, the contents of the fail register are returned.

(Example) When Bit 4 of the fail register is set, `16` is returned.

FUNCTION (FUN)

Shifts the LCD to each mode (setting screen) and Inquires about the current mode (displayed screen).

Program message

- Syntax

  Command message: `FUNCTION_<`*`value`*`>`
  `FUN_<`*`value`*`>`

  Query message: `FUNCTION?`
  `FUN?`

- Program data

  Data format: Integer

  Set value: 0: ACW; 1: DCW; 2: IR; 3: AUTO TEST; 4: AUTO EDIT; 5: SYSTEM; 6: OFFSET ADJ; 7: INTERFACE

(Example) To change the contents of the program (to shift to AUTO EDIT)

```
FUN 4
```

Response message

To FUN?, the current mode is returned.

(Example) If the current mode is the AC withstanding voltage test, `0` is returned.

INVALID (INV)

Used to inquires about the contents of the invalid-setting register.

For details on the invalid-setting register, see "3.9 Registers".

Program message

- Syntax

  Query message: `INVALID?`
  `INV?`

Response message

To INV?, the contents of the invalid-setting register are returned.

(Example) When Bit 3 of the invalid-setting register is set, `8` is returned.

LOCAL (LOC)

Return to the LOCAL from the REMOTE state.

Program message

- Syntax

  Query message: `LOCAL`
  `LOC`

PROTECTION (PROT)

Inquires about the contents of protection registers 1 and 2.

For details on the protection registers, see "3.9 Registers".

Program message

- Syntax

  Query message: `PROTECTION?`
  `PROT?`

Response message

To PROT?, the contents of protection registers 1 and 2 are returned.

(Example) When Bit 3 and Bit 5 are set in protection registers 1 and 2, 8 and 32 are returned, respectively.

SILENT (SIL)

Used in control via RS-232C to specify whether to return an acknowledgment message to a message divided by the response message terminator. The SILENT? message is used to inquire about the set value that specifies whether to return an acknowledgment message.

As an acknowledgment message, either “OK” or “ERROR.” is returned.

If an acknowledgment message is to be received, the RS-232C must be set at full duplex communication.

Full duplex communication: The transmission of data in two directions simultaneously. For full duplex settings, see the manual for your PC.

Program message

- Syntax

  Command message: `SILENT_<{0|1}>`
  `SIL_<{0|1}>`
  Query message: `SILENT?`
  `SIL?`

- Program data

  Data format: Integer
  Set value: 0: Return an acknowledge message.
  1: Do not return an acknowledge message.

(Example) To set “Do not return an acknowledge message,”

```
SIL 1
```

Response message

To SIL?, the set value for an acknowledge message is returned.

(Example) If the current settings are made to “Do not return an acknowledge message,” 1 is returned.

START

Starts testing.

While a test program is running, it shifts the program from the step suspended due to a HOLD setting in the interval to the next step.

This command message is valid only in the test conditions set up (ACW, DCW, IR), offset measurement (OFFSET), or program (AUTO) screens. Switch screens using the FUNCTION message.

Program message

- Syntax

  Command message: `START`

STOP

Stops a test. Also cancels FAIL, PASS (HOLD), and PROTECTION.

Program message

- Syntax

  Command message: `STOP`

TRM

Used to set the response-message terminator, then inquire about the set value it. Note that the GPIB uni-line message "EOI" is effective only in GPIB communication.

Program message

- Syntax

  Command message: `TRM_<{0|1|2|3}>`

  Query message: `TRM?`

- Program data

  Data format: Integer

  Set value: 0: CR/LF+EOI; 1: LF+EOI; 2: EOI; 3: CR+EOI

(Example) To set the response-message terminator to LF+EOI,

```
TRM 1
```

Response message

To TRM?, the preset response-message terminator is returned.

(Example) If the response-message terminator is set to LF+EOI, 1 is returned.

3.2 Messages Exclusively Used for AC Withstanding Voltage Testing

This section explains the messages used to check the test conditions and settings for AC withstanding voltage testing.

ACW:TESTV (A:TES)

Sets the test voltage for an AC withstanding voltage test, or inquires about the set or setting test voltage

NOTE

- This message is valid even during a test. However, make only fine voltage adjustment instead of making a large change to the voltage. A substantial change may activate the protective circuit to shift the tester to the protection status.

Program message

- Syntax

  Command message: `ACW:TESTV_<voltage>`
  `A:TES_<voltage>`

  Query message: `ACW:TESTV?`
  `A:TES?`

- Program data

  Data format: Real number
  Set value: 0.00 to 5.20 E3 (or 0 to 5200)
  Resolution: 0.01
  Unit: V

(Example) To set the test voltage to 5.00 kV,

```
A:TES 5.00E3
```

Response message

To A:TES?, the currently set test voltage is returned.

(Example) If the currently set test voltage is 2.50 kV, `2.50E3` is returned.

ACW:FREQUENCY (A:FREQ)

Sets the test frequency for an AC withstanding voltage test, or inquires about the set or setting test frequency.

Program message

- Syntax

  Command message: `ACW:FREQUENCY_<{50|60}>`
  `A:FREQ_<{50|60}>`

  Query message: `ACW:FREQUENCY?`
  `A:FREQ?`

- Program data

  Data format: Character

  Set value: 50, 60

  Unit: Hz

(Example) To set the test frequency to 50 Hz,

```
A:FREQ 50
```

Response message

To A:FREQ?, the currently set test frequency is returned.

(Example) If the current test frequency is 60 Hz,
`60` is returned.

ACW:LOWER (A:LOW)

Sets the lower current (LOWER) and ON/OFF of the lower judgment function for an AC withstanding voltage test. Also inquires about the lower current and the ON/OFF status of the lower judgment function.

Program message

- Syntax

  Command message: `ACW:LOWER_<`*`lower current`*`, {ON|OFF}>`
  `A:LOW_<`*`lower current`*`, {ON|OFF}>`

  Query message: `ACW:LOWER?`
  `A:LOW?`

- Program data <*lower current*>

  Data format: Real number

  Set value: 0.01 E-3 to 110 E-3

  Resolution: 0.01 E-3 (0.01 E-3 to 9.99 E-3)
  0.1 E-3 (10.0 E-3 to 99.9 E-3)
  1 E-3 (100 E-3 to 110 E-3)

  Unit: A

- Program data <{ON|OFF}>

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the lower current (LOWER) to 10.0 mA,

```
A: LOW 10.0E-3,ON
```

Response message

To A:LOW?, the currently set lower current and the ON/OFF status of the lower judgment function are returned as "lower current, 1/0."

(Example) If the present lower current is 5.00 mA and the lower judgment function is OFF, `5.00E-3,0` is returned.

ACW:UPPER (A:UPP)

Sets the upper current (UPPER) for an AC withstanding voltage test. Also inquires about the present upper current.

⚠CAUTION • If the upper current is set above 50 mA, the protective circuit may be activated. To prevent this, set the output time below 30 minutes and the pause to longer than the output time.

Program message

- Syntax

  Command message: `ACW:UPPER_<upper current>`
  `A:UPP_<upper current>`

  Query message: `ACW:UPPER?`
  `A:UPP?`

- Program data

  Data format: Real number

  Set value: 0.01 E-3 to 110 E-3

  Resolution: 0.01 E-3 (0.01 E-3 to 9.99 E-3)
  0.1 E-3 (10.0 E-3 to 99.9 E-3)
  1 E-3 (100 E-3 to 110 E-3)

  Unit: A

(Example) To set the upper current to 50.0 mA,

```
A:UPP 50.0E-3
```

Response message

To A:UPP?, the present upper current is returned.

(Example) If the present upper current is 80.0 mA,
`80.0E-3` is returned.

ACW:TIMER (A:TIM)

Sets the test time (TEST TIME) and ON/OFF of the timer function for an AC withstanding voltage test. Also inquires about the current test time and the ON/OFF status of the timer function.

⚠ CAUTION • If the upper current is set above 50 mA, the protective circuit may be activated. To prevent this, set the output time below 30 minutes and the pause to longer than the output time.

Program message

- Syntax

  Command message: `ACW:TIMER_<test time, {ON|OFF}>`
  `A:TIM_<test time, {ON|OFF}>`

  Query message: `ACW:TIMER?`
  `A:TIM?`

- Program data *<test time>*

  Data format: Real number
  Set value: 0.3 to 999
  Resolution: 0.1 for 0.3 to 99.9, 1 for 100 to 999
  Unit: s

- Program data `<{ON|OFF}>`

  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set the test time to 5 s,

```
A:TIM 5,ON
```

Response message

To A:TIM?, the current test time and the ON/OFF status of the timer function are returned as "test time, ON/OFF."

(Example) If the current test time is 2.0 s and the timer function is set to OFF,
`2.0,0` is returned.

ACW:OFFSET (A:OFF)

Sets ON/OFF of the offset function for an AC withstanding voltage test. Also inquires about the ON/OFF status of the offset function.

Program message

- Syntax

  Command message: `ACW:OFFSET_<{ON|OFF}>`
  `A:OFF_<{ON|OFF}>`

  Query message: `ACW:OFFSET?`
  `A:OFF?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the offset function to ON,

```
A:OFF 1
```

Response message

To A:OFF?, the ON/OFF status of the offset function is returned.

(Example) If the offset function is currently set to OFF,
`0` is returned.

ACW:STARTV (A:STAR)

Sets the start voltage for an AC withstanding voltage test. Also inquires about the set or setting start voltage.

Program message

- Syntax

  Command message: `ACW:STARTV_<`*`start voltage`*`>`
  `A:STAR_<`*`start voltage`*`>`

  Query message: `ACW:STARTV?`
  `A:STAR?`

- Program data

  Data format: Integer

  Set value: 0 to 99

  Resolution: 1

  Unit: %

(Example) To set the start voltage to 10% of the test voltage,

```
A:STAR 10
```

Response message

To A:STAR?, the current start voltage is returned.

(Example) If the start voltage is currently set to 0%,
`0` is returned.

ACW:RISETIME (A:RTIM)

Sets the voltage rise time (RISE TIME) for an AC withstanding voltage test. Also inquires about the set or setting voltage rise time.

Program message

- Syntax

  Command message: `ACW:RISETIME_<voltage rise time>`
  `A:RTIM_<voltage rise time>`

  Query message: `ACW:RISETIME?`
  `A:RTIM?`

- Program data

  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s

(Example) To set the voltage rise time to 1 s,

```
A:RTIM 1
```

Response message

To A:RTIM?, the current voltage rise time is returned.

(Example) If the voltage rise time is currently set to 2.0 s,
`2.0` is returned.

ACW:FALLTIME (A:FTIM)

Sets the voltage fall time (FALL TIME) for an AC withstanding voltage test. Also inquires about the set or setting voltage fall time.

Program message

- Syntax

  Command message: `ACW:FALLTIME_<voltage fall time>`
  `A:FTIM_<voltage fall time>`

  Query message: `ACW:FALLTIME?`
  `A:FTIM?`

- Program data

  Data format: Real number
  Set value: 0.0 to 200
  Resolution: 0.1 for 0.0 to 99.9, 1 for 100 to 200
  Unit: s

(Example) To set the voltage fall time to 1 s,

```
A:FTIM 1
```

Response message

To A:FTIM?, the current voltage fall time is returned.

(Example) If the voltage fall time is currently set to 2.0 s,
`2.0` is returned.

ACW:VRANGE (A:VRAN)

Sets the output-voltage range for an AC withstanding voltage test. Also inquires about the set or setting output range.

Program message

- Syntax

  Command message: `ACW:VRANGE_<{0|1}>`
  `A:VRAN_<{0|1}>`

  Query message: `ACW:VRANGE?`
  `A:VRAN?`

- Program data

  Data format: Integer

  Set value: 0: AUTO; 1: 5 kV

(Example) To set the output range to AUTO,

```
A:VRAN 0
```

Response message

To A:VRAN?, the output-voltage range is returned.

(Example) If the current output-voltage range is 5 kV,
`1` is returned.

ACW:RESPONSE (A:RES)

Sets the current detection response speed (RESPONSE) for an AC withstanding voltage test.

Also inquires about the set or setting current detection response speed.

Program message

- Syntax

  Command message: `ACW:RESPONSE_<{0|1|2}>`
  `A:RES_<{0|1|2}>`

  Query message: `ACW:RESPONSE?`
  `A:RES?`

- Program data

  Data format: Integer

  Set value: 0: SLOW; 1: MID; 2: FAST

(Example) To set the current detection response speed to FAST,

```
A:RES 2
```

Response message

To A:RES?, the preset current detection response speed is returned.

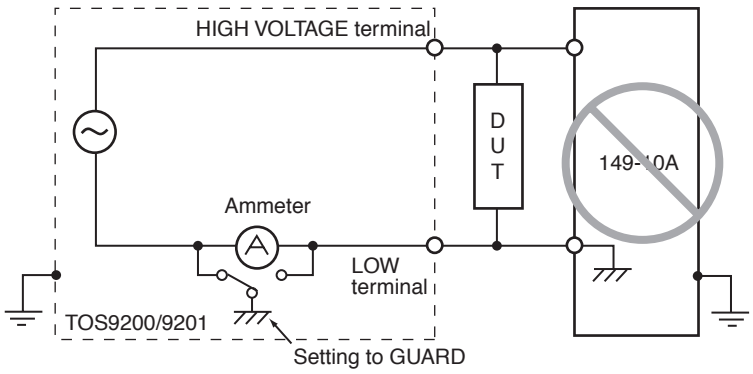
(Example) If the detection response speed is currently set to MID,
1 is returned.

ACW:GND (A:GND)

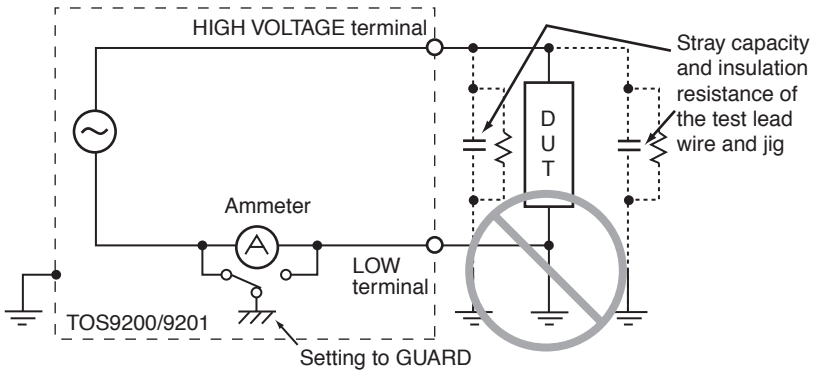
Sets LOW/GUARD of the GND for an AC withstanding voltage test. Also inquires about the set or setting value of the GND.

⚠WARNING

- If it is not known whether a DUT or jig is grounded, never select GUARD.
  If GUARD is selected with a DUT grounded, the ammeter will be short-circuited, disabling measurement and posing grave danger. See Fig. 3-1 (B).
- When GUARD is selected, do not connect the tester to devices grounded on a single side, such as Kikusui's high-voltage digital voltmeter 149-10A and the current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-1 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-1 Dangerous connections

⚠CAUTION • When the tester's LOW terminal is connected to the HIGH or LOW terminal on the earth continuity tester TOS6200, the ammeter will make measurement errors if GUARD is selected. This is due to the fact that the resistor in the TOS6200 is connected in parallel with the tester's ammeter. To use the TOS6200, do not connect one terminal to another, or set the LOW terminal to LOW.

Program message

- Syntax

  Command message: `ACW:GND_<{GUARD|LOW}>`
  `A:GND_<{GUARD|LOW}>`

  Query message: `ACW:GND?`
  `A:GND?`

- Program data

  Data format: Character

  Set value: LOW (0), GUARD (1)

(Example) To set the GND to GUARD,

```
A:GND 1
```

Response message

To A:GND?, the current GND setting is returned.

(Example) If the GND is currently set to LOW,
`0` is returned.

ACW:SCAN (A:SCAN)

Sets HIGH/LOW/OPEN for the scanner channel for an AC withstanding voltage test.

Also inquires about the set or setting value of the high-voltage scanner channel.

Program message

- Syntax

  Command message: `ACW:SCAN_<`*`channel`*`, {H|L|O}>`
  `A:SCAN_<`*`channel`*`, {H|L|O}>`

  Query message: `ACW:SCAN?_<`*`channel`*`>`
  `A:SCAN?_<`*`channel`*`>`

- Program data <*channel*>

  Data format: Integer

  Set value: 1 to 16

  Resolution: 1

- Program data <{H|L|O}>

  Data format: Character

Set value: O (0): OPEN; L (1): LOW; H (2): HIGH

(Example) To set scanner channel 1 to HIGH,

```
A:SCAN 1,H
```

Response message

To A:SCAN?2, the preset value for scanner channel 2 is returned.

(Example) If scanner channel 2 is currently set to OPEN,
`0` is returned.

ACW:SCANW (A:SCANW)

Sets HIGH/LOW/OPEN for 16 scanner channels at a time using 16 bits for an AC withstanding voltage test. Also inquires about the current settings for all 16 channels.

Program message

- Syntax

  Command message: **ACW:SCANW_**<*setting 1, setting 2*>
  A:SCANW_<*setting 1, setting 2*>

  Query message: **ACW:SCANW?**
  A:SCANW?

- Program data <*setting 1*>

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  LOW is represented by 0 and HIGH by 1.

- Program data <*setting 2*>

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  OPEN is represented by 1 and NOT OPEN by 0.

(Example) To set scanner channels 1 through 4 to LOW, scanner channels 5 through 8 to HIGH, and the other channels to OPEN,

```
A:SCANW #H00F0,#HFF00
```

OPEN in setting 2 has priority over setting 1.

Response message

To A:SCANW?, the settings for all 16 channels are returned as “setting 1” and “setting 2” using 16 bits.

(Example) If scanner channels 1 through 5 are currently set to HIGH, channels 6 through 10 to OPEN, and the other channels to LOW,
`31,992` is returned.

ACW:CONTACTCHECK (A:CCH)

Sets ON/OFF of the contact check function for an AC withstanding voltage test. Also inquires about the status of the function.

Program message

- Syntax

  Command message: `ACW:CONTACTCHECK_<{ON|OFF}>`
  `A:CCH_<{ON|OFF}>`

  Query message: `ACW:CONTACTCHECK?`
  `A:CCH?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the contact check to ON,

```
A:CCH ON
```

Response message

To A:CCH?, the current setting for the contact check is returned.

(Example) If the contact check is currently set to ON,
`1` is returned.

3.3 Messages Used Exclusively for DC Withstanding Voltage Testing

This section explains the messages used to check the test conditions and settings for DC withstanding voltage testing.

These messages are exclusively designed for the TOS9201 equipped with a DC withstanding voltage testing function.

With the TOS9200, these messages are invalid. However, they do not cause an error.

DCW:TESTV (D:TES)

Sets the test voltage for a DC withstanding voltage test. Also inquires about the set or setting test voltage

NOTE

- This message is valid even during a test. However, make only fine voltage adjustments rather than large changes to the voltage. A substantial change may activate the protective circuit to shift the tester to the protection status.

Program message

- Syntax

  Command message: `DCW:TESTV_<voltage>`
  `D:TES_<voltage>`

  Query message: `DCW:TESTV?`
  `D:TES?`

- Program data

  Data format: Real number
  Set value: 0.00 E3to 6.10 E3 (or 0 to 6100)
  Resolution: 0.01 E3
  Unit: V

(Example) To set the test voltage to 5.00 kV,

```
D:TES 5.00E3
```

Response message

To D:TES?, the currently set test voltage is returned.

(Example) If the test voltage is currently set to 2.50 kV,
`2.50E3` is returned.

DCW:LOWER (D:LOW)

Sets the lower current (LOWER) and ON/OFF of the lower judgment function for a DC withstanding voltage test. Also inquires about the lower current and the ON/OFF status of the lower judgment function.

Program message

- Syntax

  Command message: `DCW:LOWER_<`*`lower current`*`, {ON|OFF}>`
  `D:LOW_<`*`lower current`*`, {ON|OFF}>`

  Query message: `DCW:LOWER?`
  `D:LOW?`

- Program data <*lower current*>

  Data format: Real number

  Set value: 0.01 E-3 to 11.0 E-3

  Resolution: 0.01 for 0.01 E-3 to 9.99 E-3, 0.1 for 10.0 E-3 to 11.0 E-3

  Unit: A

- Program data `<{ON|OFF}>`

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the lower current to 1 mA,

```
D:LOW 1E-3,ON
```

Response message

To D:LOW?, the currently set lower current and the ON/OFF status of the lower judgment function are returned as "lower current, ON/OFF."

(Example) If the lower current is currently set to 2.0 mA and the lower judgment function to OFF,
"`2.00E-3,0`" is returned.

DCW:UPPER (D:UPP)

Sets the upper current (UPPER) for a DC withstanding voltage test. Also inquires about the set or setting upper current.

⚠CAUTION • If the upper current is set above 5 mA, the protective circuit may be activated. To prevent this, set the output time below 1 minute and the pause to longer than the output time.

Program message

- Syntax

  Command message: `DCW:UPPER_<upper current>`
  `D:UPP_<upper current>`

  Query message: `DCW:UPPER?`
  `D:UPP?`

- Program data

  Data format: Real number

  Set value: 0.01 E-3 to 11.0 E-3

  Resolution: 0.01 for 0.01 E-3 to 9.99 E-3, 0.1 for 10.0 E-3 to 11.0 E-3

  Unit: A

(Example) To set the upper current to 5 mA,

```
A:UPP 5E-3
```

Response message

To D:UPP?, the preset upper current is returned.

(Example) If the upper current is currently set to 2.00 mA,
`2.00E-3` is returned.

DCW:TIMER (D:TIM)

Sets the test time (TEST TIME) and ON/OFF of the timer function for an DC withstanding voltage test. Also inquires about the current test time and the ON/OFF status of the timer function.

Program message

- Syntax

  Command message: `DCW:TIMER_<test time, {ON|OFF}>`
  `D:TIM_<test time, {ON|OFF}>`

  Query message: `DCW:TIMER?`
  `D:TIM?`

- Program data *<test time>*

  Data format: Real number

Set value: 0.3 to 999
Resolution: 0.1 for 0.3 to 99.9, 1 for 100 to 999
Unit: s

- Program data <{ON|OFF}>
  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set the test time to 5 s,

```
D:TIM 5,ON
```

Response message

To D:TIM?, the current test time and the ON/OFF status of the timer function are returned as "test time, 1/0."

(Example) If the test time is currently set to 2.0 s and the timer function to OFF,
`2.0,0` is returned.

DCW:STARTV (D:STAR)

Sets the start voltage for a DC withstanding voltage test. Also inquires about the set or setting start voltage.

Program message

- Syntax
  Command message: `DCW:STARTV_<start voltage>`
  `D:STAR_<start voltage>`
  Query message: `DCW:STARTV?`
  `D:STAR?`
- Program data
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1
  Unit: %

(Example) To set the start voltage to 10% of the test voltage,

```
D:STAR 10
```

Response message

To D:STAR?, the current start voltage is returned.

(Example) If the start voltage is currently set to 0%,
`0` is returned.

DCW:RISETIME (D:RTIM)

Sets the voltage rise time (RISE TIME) for a DC withstanding voltage test. Also inquires about the set or setting voltage rise time.

Program message

- Syntax

  Command message: `DCW:RISETIME_<voltage rise time>`
  `D:RTIM_<voltage rise time>`

  Query message: `DCW:RISETIME?`
  `D:RTIM?`

- Program data

  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s

(Example) To set the voltage rise time to 1 s,

```
D:RTIM 1
```

Response message

To D:RTIM?, the current voltage rise time is returned.

(Example) If the voltage rise time is currently set to 2.0 s,
`2.0` is returned.

DCW:WAITTIME (D:WTIM)

Sets the WAIT TIME for a DC withstanding voltage test. Also inquires about the set or setting WAIT TIME.

Program message

- Syntax

  Command message: `DCW:WAITTIME_<WAIT TIME>`
  `D:WTIM_<WAIT TIME>`

  Query message: `DCW:WAITTIME?`
  `D:WTIM?`

- Program data

  Data format: Real number
  Set value: 0.3 to 10.0
  Resolution: 0.1
  Unit: s

(Example) To set the WAIT TIME to 1 s,

```
D:WTIM 1
```

Response message

To D:WTIM?, the currently set WAIT TIME is returned.

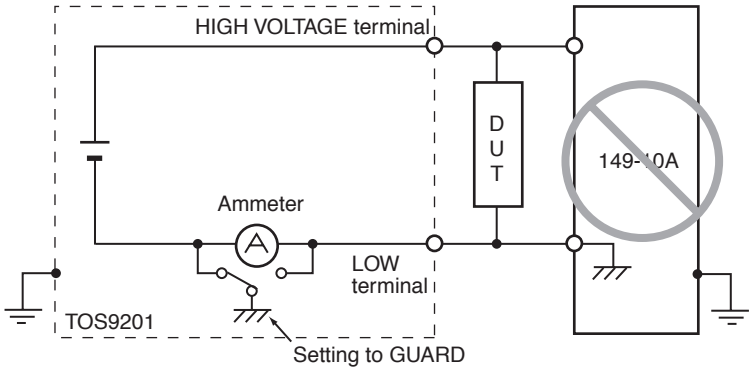
(Example) If the WAIT TIME is currently set to 2.0 s,
`2.0` is returned.

DCW:GND (D:GND)

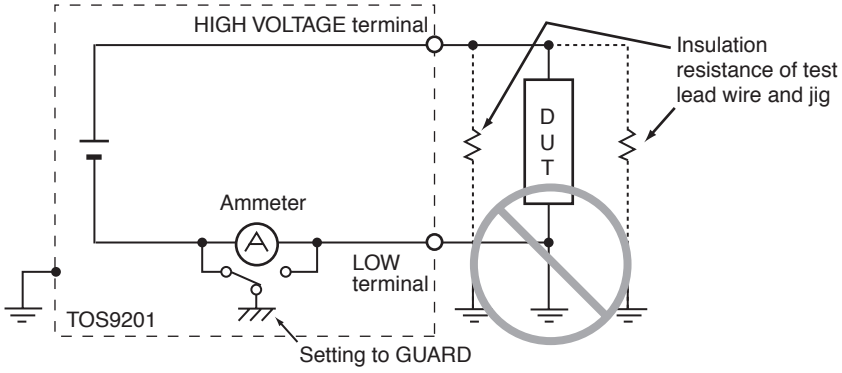
Sets LOW/GUARD of the GND for a DC withstanding voltage test. Also inquires about the set or setting value of the GND.

⚠WARNING

- If it is not known whether a DUT or jig is grounded, never select GUARD.
  If GUARD is selected with a DUT grounded, the ammeter will be short-circuited, disabling measurement and posing a grave danger. See Fig. 3-2 (B).
- When GUARD is selected, do not connect the tester to devices grounded on a single side, such as Kikusui's high-voltage digital voltmeter 149-10A or current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-2 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-2 Dangerous connections

⚠CAUTION • When the tester's LOW terminal is connected to the HIGH or LOW terminal of the earth continuity tester TOS6200, the ammeter will suffer measurement errors if GUARD is selected, as the resistor in the TOS6200 is connected in parallel with the tester's ammeter. To use the TOS6200, either do not connect one terminal to another, or set the LOW terminal to LOW.

Program message

- Syntax

  Command message: `DCW:GND_<{GUARD|LOW}>`
  `D:GND_<{GUARD|LOW}>`

  Query message: `DCW:GND?`
  `D:GND?`

- Program data

  Data format: Character

  Set value: LOW (0), GUARD (1)

(Example) To set the GND to GUARD,

```
D:GND 1
```

Response message

To D:GND?, the current GND setting is returned.

(Example) If the GND is currently set to LOW,
0 is returned.

DCW:SCAN (D:SCAN)

Sets HIGH/LOW/OPEN for the scanner channel in a DC withstanding voltage test. Also inquires about the current setting for the scanner channel.

Program message

- Syntax

  Command message: `DCW:SCAN_<channel, {H|L|O}>`
  `D:SCAN_<channel, {H|L|O}>`

  Query message: `DCW:SCAN?_<channel>`
  `D:SCAN?_<channel>`

- Program data `<channel>`

  Data format: Integer

  Set value: 1 to 16

  Resolution: 1

- Program data `<{H|L|O}>`

  Data format: Character

  Set value: O (0): OPEN; L (1): LOW; H (2): HIGH

(Example) To set scanner channel 1 to HIGH,

```
D:SCAN 1,H
```

Response message

To D:SCAN?2, the preset value for scanner channel 2 is returned.

(Example) If scanner channel 2 is currently set to OPEN,
0 is returned.

DCW:SCANW (D:SCANW)

Sets HIGH/LOW/OPEN for 16 channels at a time using 16 bits in a DC withstanding voltage test. Also inquires about the current settings for all 16 channels.

Program message

- Syntax

  Command message: `DCW:SCANW_<setting 1, setting 2>`
  `D:SCANW_<setting 1, setting 2>`

  Query message: `DCW:SCANW?`
  `D: SCANW?`

- Program data *<setting 1>*

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  LOW is represented by 0 and HIGH by 1.

- Program data *<setting 2>*

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  OPEN is represented by 1 and NOT OPEN by 0.

(Example) To set scanner channels 1 through 4 to LOW, scanner channels 5 through 8 to HIGH, and the other channels to OPEN,

```
D:SCANW #H00F0,#HFF00
```

OPEN in setting 2 has priority over setting 1.

Response message

To D:SCANW?, the settings for all 16 channels are returned as “setting 1” and “setting 2” using 16 bits.

(Example) If scanner channels 1 through 5 are currently set to HIGH, channels 6 through 10 to OPEN, and the other channels to LOW,
“31,992” is returned.

DCW:CONTACTCHECK (D:CCH)

Sets ON/OFF of the contact check function for a DC withstanding voltage test. Also inquires about the status of the function.

Program message

- Syntax

  Command message: `DCW:CONTACTCHECK_<{ON|OFF}>`
  `D:CCH_<{ON|OFF}>`

  Query message: `DCW:CONTACTCHECK?`
  `D:CCH?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the contact check to ON,

```
D:CCH ON
```

Response message

To D:CCH?, the current setting for the contact check is returned.

(Example) If the contact check is currently set to ON,
1 is returned.

3.4 Messages Used Exclusively for Insulation Resistance Testing

This section explains the messages used to check the test conditions and settings for insulation resistance testing.

IR:TESTV (I:TES)

Sets the test voltage for an insulation resistance test. Also inquires about the preset test voltage.

NOTE

- This message is valid even during a test. However, make only fine voltage adjustments rather than a large change to the voltage. A substantial change may activate the protective circuit to shift the tester to the protection status.

Program message

- Syntax

  Command message: `IR:TESTV_<voltage>`
  `I:TES_<voltage>`

  Query message: `IR:TESTV?`
  `I:TES?`

- Program data

  Data format: Integer
  Set value: 10 to 1020
  Resolution: 1
  Unit: V

(Example) To set the test voltage to 500 V,

```
I:TES 500
```

Response message

To I:TES?, the currently set test voltage is returned.

(Example) If the test voltage is currently set to 250 V,
`250` is returned.

IR:LOWER (I:LOW)

Sets the lower resistance (LOWER) and ON/OFF of the lower judgment function for an insulation resistance test. Also inquires about the lower resistance and the ON/OFF status of the lower judgment function.

⚠ CAUTION • If the lower or upper judgment function is OFF, no FAIL judgment is made for that function. With this setting, note that, a PASS judgment is made when the timer is turned on.

Program message

- Syntax

  Command message: `IR:LOWER_<`*`lower resistance`*`, {ON|OFF}>`
  `I:LOW_<`*`lower resistance`*`, {ON|OFF}>`

  Query message: `IR:LOWER?`
  `I:LOW?`

- Program data

  Data format: Real number

  Set value: 0.01 E6 to 9.99 E9

  Resolution: 0.01 E6 (0.01 E6 to 9.99 E6)
  0.1 E6 (10.0 E6 to 99.9 E6)
  1 E6 (100 E6 to 999 E6)
  0.01 E9 (1.00 E9 to 9.99 E9)

  Unit: Ω

(Example) To set the lower resistance to 99.9 MΩ,

```
I:LOW 99.9E6,1
```

Response message

To I:LOW?, the currently set lower resistance and the ON/OFF status of the lower judgment function are returned as "lower resistance, 1/0."

(Example) If the lower resistance is currently set to 1.00 GΩ and the lower judgment function to OFF,
"`1.00E9,0`" is returned.

IR:UPPER (I:UPP)

Sets the upper resistance (UPPER) and ON/OFF of the upper judgment function for an insulation resistance test. Also inquires about the set or setting upper resistance and the ON/OFF status of the upper judgment function.

Program message

- Syntax

  Command message: `IR:UPPER_<`*`upper resistance`*`, {ON|OFF}>`
  `I:UPP_<`*`upper resistance`*`, {ON|OFF}>`

  Query message: `IR:UPPER?`
  `I:UPP?`

- Program data

  Data format: Real number

  Set value: 0.01 E6 to 9.99 E9

  Resolution: 0.01 E6 (0.01 E6 to 9.99 E6)
  0.1 E6 (10.0 E6 to 99.9 E6)
  1 E6 (100 E6 to 999 E6)
  0.01 E9 (1.00 E9 to 9.99 E9)

  Unit: Ω

- Program data `<{ON|OFF}>`

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the upper resistance to 1.00 GΩ,

```
I: UPP 1.00E9,1
```

Response message

To I:UPP?, the preset upper resistance and the ON/OFF status of the upper judgment function are returned as "upper resistance, 1/0."

(Example) If the upper resistance is currently set to 5.00 GΩ and the upper judgment function to OFF,
"`5.00E9,0`" is returned.

IR:TIMER (I:TIM)

Sets the test time (TEST TIME) and ON/OFF of the timer function for an insulation resistance test. Also inquires about the current test time and the ON/OFF status of the timer function.

Program message

- Syntax

  Command message: `IR:TIMER_<`*`test time`*`, {ON|OFF}>`
  `I:TIM_<`*`test time`*`, {ON|OFF}>`

Query message: `IR:TIMER?`
`I:TIM?`

- Program data *<test time>*
  Data format: Real number
  Set value: 0.5 to 999
  Resolution: 0.1 for 0.5 to 99.9, 1 for 100 to 999
  Unit: s
- Program data <{ON|OFF}>
  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set the test time to 5 s,
`I:TIM 5,ON`

Response message

To I:TIM?, the current test time and the ON/OFF status of the timer function are returned.

(Example) If the test time is currently set to 2 s and the timer function to OFF,
"`2.0,0`" is returned.

IR:RISETIME (I:RTIM)

Sets the voltage rise time (RISE TIME) for an insulation resistance test. Also inquires about the set or setting voltage rise time.

Program message

- Syntax
  Command message: `IR:RISETIME_<voltage rise time>`
  `I:RTIM_<voltage rise time>`
  Query message: `IR:RISETIME?`
  `I:RTIM?`
- Program data
  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s

(Example) To set the voltage rise time to 1 s,
`I:RTIM 1`

Response message

To I:RTIM?, the current voltage rise time is returned.

(Example) If the voltage rise time is currently set to 2.0 s,
`2.0` is returned.

IR:WAITTIME (I:WTIM)

Sets the WAIT TIME for an insulation resistance test. Also inquires about the set or setting WAIT TIME.

Program message

- Syntax

  Command message: `IR:WAITTIME_<WAIT TIME>`
  `I:WTIM_<WAIT TIME>`

  Query message: `IR:WAITTIME?`
  `I:WTIM?`

- Program data

  Data format: Real number
  Set value: 0.3 to 10.0
  Resolution: 0.1
  Unit: s

(Example) To set the WAIT TIME to 1 s,
`I:WTIM 1`

Response message

To I:WTIM?, the currently set WAIT TIME is returned.

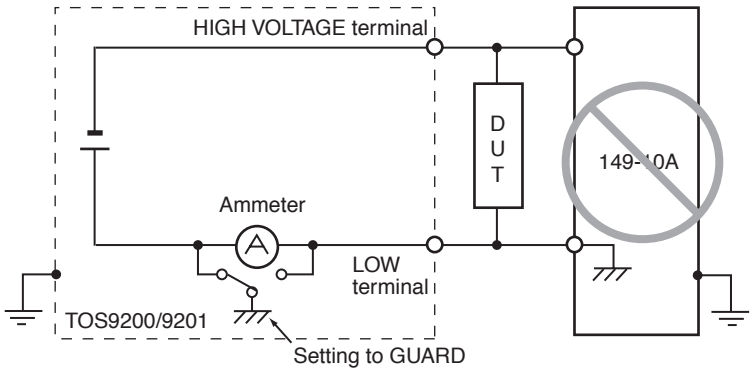
(Example) If the WAIT TIME is currently set to 2.0 s,
`2.0` is returned.

IR:GND (I:GND)

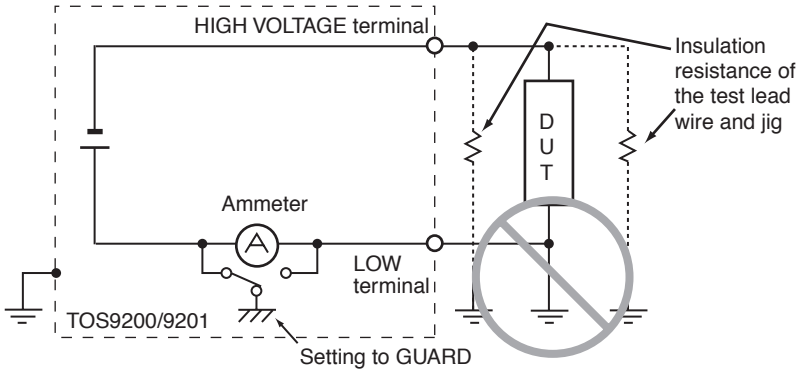
Sets LOW/GUARD of the GND for an insulation resistance test. Also inquires about the set or setting value of the GND.

⚠ WARNING

- If it is not known whether a DUT or jig is grounded, never select GUARD. If GUARD is selected with a DUT grounded, the ammeter is short-circuited, disabling measurement and posing grave danger. See Fig. 3-3 (B).
- When GUARD is selected, do not connect the tester to devices grounded on a single side, such as Kikusui's high-voltage digital voltmeter 149-10A or current calibrator TOS1200. Otherwise, the ammeter will be short-circuited. See Fig. 3-3 (A).



(A) Connecting the 149-10A



(B) Selecting GUARD when the DUT is grounded

Fig.3-3 Dangerous connections

⚠CAUTION • When the tester's LOW terminal is connected to the HIGH or LOW terminal on the earth continuity tester TOS6200, the ammeter will suffer measurement errors if GUARD is selected, as the resistor in the TOS6200 is connected in parallel with the tester's ammeter. To use the TOS6200, either do not connect one terminal to another, or set the LOW terminal to LOW.

Program message

- Syntax

  Command message: `IR:GND_<{GUARD|LOW}>`
  `I:GND_<{GUARD|LOW}>`

  Query message: `IR:GND?`
  `I:GND?`

- Program data

  Data format: Character

  Set value: LOW (0), GUARD (1)

(Example) To set the GND to GUARD,

```
I:GND 1
```

Response message

To I:GND?, the current GND setting is returned.

(Example) If the GND is currently set to LOW,
0 is returned.

IR:SCAN (I:SCAN)

Sets HIGH/LOW/OPEN for the scanner channel in an insulation resistance test. Also inquires about the current setting of the high-voltage scanner channel.

Program message

- Syntax

  Command message: `IR:SCAN_<channel, {H|L|O}>`
  `I:SCAN_<channel, {H|L|O}>`

  Query message: `IR:SCAN?_<channel>`
  `I:SCAN?_<channel>`

- Program data *<channel>*

  Data format: Integer

  Set value: 1 to 16

  Resolution: 1

- Program data `<{H|L|O}>`

  Data format: Character

  Set value: O (0): OPEN; L (1): LOW; H (2): HIGH

(Example) To set scanner channel 1 to HIGH,

```
I:SCAN 1,H
```

Response message

To I:SCAN? 2, the scanner channel 2 setting is returned.

(Example) If the scanner channel is currently set to OPEN,
0 is returned.

IR:SCANW (I:SCANW)

Sets HIGH/LOW/OPEN for 16 scanner channels at a time using 16 bits for an insulation resistance test. Also inquires about the settings for all 16 channels.

Program message

- Syntax

  Command message: `IR:SCANW_<setting 1, setting 2>`
  `I:SCANW_<setting 1, setting 2>`

  Query message: `IR:SCANW?`
  `I:SCANW?`

- Program data *<setting 1>*

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  LOW is represented by 0 and HIGH by 1.

- Program data *<setting 2>*

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  OPEN is represented by 1 and NOT OPEN by 0.

(Example) To set scanner channels 1 through 4 to LOW, scanner channels 5 through 8 to HIGH, and the other channels to OPEN,

`I:SCANW #H00F0,#HFF00`

OPEN in setting 2 has priority over setting 1.

Response message

To I:SCANW?, the settings for all 16 channels of the high-voltage scanner are returned as "setting 1" and "setting 2" using 16 bits.

(Example) If scanner channels 1 through 5 are currently set to HIGH, channels 6 through 10 to OPEN, and the other channels to LOW,
`31,992` is returned.

IR:CONTACTCHECK (I:CCH)

Sets ON/OFF of the contact check function for an insulation resistance test. Also inquires about the status of the function.

Program message

- Syntax

  Command message: `IR:CONTACTCHECK_<{ON|OFF}>`
  `I:CCH_<{ON|OFF}>`

  Query message: `IR:CONTACTCHECK?`
  `I:CCH?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the contact check to ON,

```
I:CCH ON
```

Response message

To I:CCH?, the current setting for the contact check is returned.

(Example) If the contact check is currently set to ON,
`1` is returned.

3.5 Messages Common to All Tests

This section explains the messages commonly used in all tests.

VDATA (VDAT)

Inquires about the monitor voltage for each test. During the test, the real-time voltage is returned. After the test, the previous test voltage is returned.

Program message

- Syntax

  Query message: `VDATA?`
  `VDAT?`

Response message

To VDAT?, the monitor voltage is returned for ACW in an AC withstanding voltage test, for DCW in a DC withstanding voltage test, and for IR in an insulation resistance test.

(Example) If the current monitor voltage in an AC withstanding voltage test is 1.5 kV,
`1.50E3` is returned.

NOTE

- In insulation resistance testing with the lower judgment function off, even if settings are made so that the test voltage divided by the lower resistance exceeds 1.1 mA, testing can be performed. However, when the voltage value which is out of the range of ±(10 % of setting +50 V) is detected during the test, the measurement voltage value flashes on the LCD.

  In this case, -1 is returned.

IDATA (IDAT)

Inquires about the monitor current.

During the test, the measured normal value or the maximum value is returned, depending on the MEAS MODE setting in the system settings. After the test, the previous test current is returned.

Program message

- Syntax

  Query message: `IDATA?`
  `IDAT?`

Response message

To IDAT?, the monitor current is returned for ACW in an AC withstanding voltage test and for DCW in a DC withstanding voltage test.

(Example) If the present monitor current in an AC withstanding voltage test is 10.0 mA,
`10.0E-3` is returned.

RDATA (RDAT)

Inquires about the monitor resistance

During the test, the measured normal value or the maximum value is returned, depending on the MEAS MODE setting in the system settings. After the test, the previous monitor resistance is returned.

Program message

- Syntax

  Query message: `RDATA?`
  `RDAT?`

Response message

To RDAT?, the monitor resistance is returned for IR in an insulation resistance test.

(Example) If the current monitor resistance is 10.0 MΩ,
`10.0E6` is returned.

NOTE

- In insulation resistance testing, when the resistance value to exceed 99.9 GΩ is detected, "99.9" flashes on the LCD.

  In this case, -1 is returned.

REALDATA (REAL)

Inquires about the real current.

During the test, the real-time real current is returned. After the test, the previous real current is returned.

Program message

- Syntax

  Query message: `REALDATA?`
  `REAL?`

Response message

To REAL?, the present real current is returned.

(Example) If the present real current is 1 mA,
`1E-3` is returned.

IMAGDATA (IMAG)

Inquires about the imaginary current. During the test, the real-time imaginary current is returned. After the test, the previous imaginary current is returned.

Program message

- Syntax

  Query message: `IMAGDATA?`
  `IMAG?`

Response message

To IMAG?, the present imaginary current is returned.

(Example) If the present imaginary current is 20 μA,
`20E-6` is returned.

TIME

Inquires about the test time elapsed (the remaining time when the timer function is on) and the test status

Program message

- Syntax

  Query message: `TIME?`

Response message

To TIME?, the time elapsed (the remaining time when the timer function is on) and the test status are returned as "time, status."

Rising (Rise): 0; Testing (Test): 1; Falling (Fall): 2; Ending (End): 3

(Example) If the time elapsed (or the remaining time) is 7.0 s and the test is under way,
`7.0,1` is returned.

MON

Inquires about each monitor value

Program message

- Syntax

  Query message: `MON?`

Response message

To MON?, the current monitor value is returned.

When no test is under way, the previous test results are returned.

Returning in AC withstanding voltage testing

Test type (0: ACW), monitor voltage, monitor current NORM, monitor current MAX, real current, imaginary current, elapsed (remaining) time, test status (0: Rise/ 1: Test/2: Fall/3: End)

Returning in DC withstanding voltage testing

Test type (1: DCW), monitor voltage, monitor current NORM, monitor current MAX, monitor resistance MIN, elapsed (remaining) time, test status (0: Rise/1: Test/3: End)

Returning in insulation resistance testing

Test type (2: IR), monitor voltage, monitor resistance NORM, monitor resistance MIN, monitor current , 0, elapsed (remaining) time, test status (0: Rise/1: Test/3: End)

(Example) If an AC withstanding voltage test is under way at a monitor voltage of 2.50 kV, monitor current NORM of 5.2 mA, monitor current MAX of 12 mA, real current of 5 mA, imaginary current of 10 μA, and remaining time of 2.6 s,
"`0,2.5E3,5.2E-3,12E-3,5E-3,10E-6,2.6,1`" is returned.

NOTE

- In insulation resistance testing with the lower judgment function off, even if settings are made so that the test voltage divided by the lower resistance exceeds 1.1 mA, testing can be performed. However, when the voltage value which is out of the range of ±(10 % of setting +50 V) is detected during the test, the measurement voltage value flashes on the LCD.

  In this case, -1 is returned.
- In insulation resistance testing, when the resistance value to exceed 99.9 GΩ is detected, "99.9" flashes on the LCD.

  In this case, -1 is returned.

SCANTYPE (STYP)

Inquires about the number of valid connected channels and the model name of the scanner

Program message

- Syntax

  Query message: `SCANTYPE?`
  `STYP?`

Response message

To STYP?, the number of valid channels and the model name of the scanner are returned as follows:

Number of valid channels, scanner 1, scanner 2, scanner 3, scanner 4

0: None; 1: TOS9220; 2: TOS9221

(Example) If there are 12 valid channels and scanners TOS9220, TOS9220, and TOS9221 (in that order, from the nearest to the tester) are connected without a fourth scanner connected,
"`12,1,1,2,0`" is returned.

CFAILCH (CFCH)

Inquires about the channel in the C FAIL status

Program message

- Syntax

  Query message: `CFAILCH?`
  `CFCH?`

Response message

To CFCH?, the channel in the CONTACT FAIL status is returned.

(Example) If channel 12 is currently in the CONTACT FAIL status,
`12` is returned.

3.6 System-Related Messages

This section describes the messages to be set on the system screen.

MEASMODE (MMOD)

Sets the display mode (MEAS MODE) of the measured current (or measured resistance). Also inquires about the display mode of the measured current (or measured resistance).

Program message

- Syntax

  Command message: `MEASMODE_<{NORM|MAX}>`
  `MMOD_<{NORM|MAX}>`
  Query message: `MEASMODE?`
  `MMOD?`

- Program data

  Data format: Character
  Set value: NORM: Real Time; MAX: Max Hold (Min Hold)

(Example) To set the display mode of the measured current (or resistance) to Max Hold (Min Hold for resistance),

```
MMOD MAX
```

Response message

To MMOD?, the present display mode of the measured current (or resistance) is returned as 0 for NORM and 1 for MAX.

(Example) If the display mode of the present measured current is set to Real Time,
`0` is returned.

PASSHOLD (PHOL)

Sets the PASS hold time in a PASS judgment. Also inquires about the current PASS hold time.

Program message

- Syntax

  Command message: `PASSHOLD_<set value>`
  `PHOL_<set value>`

  Query message: `PASSHOLD?`
  `PHOL?`

- Program data

  Data format: Real number, character

  Set value: 0.2 to 10.0, HOLD

  Unit: s

(Example) To set the PASS hold time to HOLD,

```
PHOL HOLD
```

Response message

To PHOL?, the current PASS hold time is returned.

(Example) If the current PASS hold time is 0.5 s,
`0.5` is returned.

BUZZERVOL (BVOL)

Set the buzzer volume. Also inquires about the current buzzer volume.

Program message

- Syntax

  Command message: `BUZZERVOL_<set value>`
  `BVOL_<set value>`

  Query message: `BUZZERVOL?`
  `BVOL?`

- Program data

  Data format: Integer

  Set value: 0 to 10

  Resolution: 1

(Example) To set the buzzer volume to 5,

```
BVOL 5
```

Response message

To BVOL?, the current volume is returned.

(Example) If the current buzzer volume is 3,
3 is returned.

CONTRAST (CON)

Sets the LCD contrast. Also inquires about the current LCD contrast.

Program message

- Syntax

  Command message: `CONTRAST_<set value>`
  `CON_<set value>`

  Query message: `CONTRAST?`
  `CON?`

- Program data

  Data format: Integer

  Set value: 0 to 10

  Resolution: 1

(Example) To set the LCD contrast to 5,

```
CON 5
```

Response message

To CON?, the current LCD contrast is returned.

(Example) If the current LCD contrast is 6,
`6` is returned.

MOMENTARY (MOM)

Sets the start momentary function (MOMENTARY). Also inquires about the current start momentary setting.

Program message

- Syntax

  Command message: `MOMENTARY_<{ON|OFF}>`
  `MOM_<{ON|OFF}>`

  Query message: `MOMENTARY?`
  `MOM?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the start momentary function to OFF,

```
MOM OFF
```

Response message

To MOM?, the current start momentary setting is returned.

(Example) If the start momentary function is currently ON,
1 is returned.

FAILMODE (FMOD)

Sets the FAIL mode (FAIL MODE). Also inquires about the current FAIL mode setting.

Program message

- Syntax

  Command message: `FAILMODE_<{ON|OFF}>`
  `FMOD_<{ON|OFF}>`

  Query message: `FAILMODE?`
  `FMOD?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the FAIL mode to OFF,

```
FMOD OFF
```

Response message

To FMOD?, the current FAIL mode setting is returned.

(Example) If the FAIL mode function is currently ON,
1 is returned.

DOUBLE ACTION (DAC)

Sets the double-action mode (DOUBLE ACTION). Also inquires about the current double-action mode setting.

Program message

- Syntax

  Command message: `DOUBLEACTION_<{ON|OFF}>`
  `DAC_<{ON|OFF}>`

  Query message: `DOUBLEACTION?`
  `DAC?`

- Program data

  Data format: Character

Set value: OFF (0), ON (1)

(Example) To set the double-action mode to OFF,

```
DAC OFF
```

Response message

To DAC?, the current double-action mode setting is returned.

(Example) If the double-action mode is currently ON,
1 is returned.

SIGHVON (SHV)

Sets H.V ON of Status Signal Output. Also inquires about the H.V ON setting.

Program message

- Syntax

  Command message: `SIGHVON_<{ON|OFF}>`
  `SHV_<{ON|OFF}>`

  Query message: `SIGHVON?`
  `SHV?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set H.V ON of Status Signal Output to OFF,

```
SHV OFF
```

Response message

To SHV?, the current H.V ON setting for Status Signal Output is returned.

(Example) If H.V ON for Status Signal Output is currently set to ON,
1 is returned.

SIGTEST (STES)

Sets TEST for Status Signal Output. Also inquires about the current TEST setting.

Program message

- Syntax

  Command message: `SIGTEST_<{ON|OFF}>`
  `STES_<{ON|OFF}>`

  Query message: `SIGTEST?`
  `STES?`

- Program data

  Data format: Character

Set value: OFF (0), ON (1)

(Example) To set TEST for Status Signal Output to OFF,

```
STES OFF
```

Response message

To STES?, the current TEST setting for Status Signal Output is returned.

(Example) If the TEST status of Status Signal Output is currently set to ON, 1 is returned.

SIGPASS (SPAS)

Sets PASS for Status Signal Output. Also inquires about the current PASS setting.

Program message

- Syntax

  Command message: `SIGPASS_<{ON|OFF}>`
  `SPAS_<{ON|OFF}>`

  Query message: `SIGPASS?`
  `SPAS?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the PASS status of Status Signal Output to OFF,

```
SPAS OFF
```

Response message

To SPAS?, the current PASS setting for Status Signal Output is returned.

(Example) If the PASS status of Status Signal Output is currently set to ON, 1 is returned.

SIGUFAIL (SUF)

Sets U FAIL for Status Signal Output. Also inquires about the current U FAIL setting.

Program message

- Syntax

  Command message: `SIGUFAIL_<{ON|OFF}>`
  `SUF_<{ON|OFF}>`

  Query message: `SIGUFAIL?`
  `SUF?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the U FAIL status of Status Signal Output to OFF,

```
SUF OFF
```

Response message

To SUF?, the current U FAIL setting for Status Signal Output is returned.

(Example) If the U FAIL status of Status Signal Output is currently set to ON, 1 is returned.

SIGLFAIL (SLF)

Sets L FAIL for Status Signal Output. Also inquires about the current LOW FAIL setting.

Program message

- Syntax

  Command message: `SIGLFAIL_<{ON|OFF}>`
  `SLF_<{ON|OFF}>`

  Query message: `SIGLFAIL?`
  `SLF?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the L FAIL status of Status Signal Output to OFF,

```
SLF OFF
```

Response message

To SLF?, the current L FAIL setting for Status Signal Output is returned.

(Example) If the L FAIL status of Status Signal Output is currently set to ON, 1 is returned.

SIGREADY (SREA)

Sets READY for Status Signal Output. Also inquires about the current READY setting.

Program message

- Syntax

  Command message: `SIGREADY_<{ON|OFF}>`
  `SREA_<{ON|OFF}>`

Query message: `SIGREADY?`
`SREA?`

- Program data
  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set the READY status of Status Signal Output to OFF,
`SREA OFF`

Response message

To SREA?, the current READY setting for Status Signal Output is returned.

(Example) If the READY status of Status Signal Output is currently set to ON,
`1` is returned.

SIGPROTECTION (SPR)

Sets PROTECT for Status Signal Output. Also inquires about the current PROTECT setting.

Program message

- Syntax
  Command message: `SIGPROTECTION_<{ON|OFF}>`
  `SPR_<{ON|OFF}>`
  Query message: `SIGPROTECTION?`
  `SPR?`
- Program data
  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set the PROTECT status of Status Signal Output to OFF,
`SPR OFF`

Response message

To SPR?, the current PROTECT setting for Status Signal Output is returned.

(Example) If the PROTECT status of Status Signal Output is currently set to ON,
`1` is returned.

SIGPOWERON (SPOW)

Sets POWER ON for Status Signal Output. Also inquires about the current POWER ON setting.

Program message

- Syntax

  Command message: `SIGPOWERON_<{ON|OFF}>`
  `SPOW_<{ON|OFF}>`

  Query message: `SIGPOWERON?`
  `SPOW?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the POWER ON status of Status Signal Output to OFF,

```
SPOW OFF
```

Response message

To SPOW?, the current POWER ON setting for Status Signal Output is returned.

(Example) If the POWER ON status of Status Signal Output is currently set to ON, 1 is returned.

SIGCFAIL (SCF)

Sets C FAIL for Status Signal Output. Also inquires about the current C FAIL setting.

Program message

- Syntax

  Command message: `SIGCFAIL_<{ON|OFF}>`
  `SCF_<{ON|OFF}>`

  Query message: `SIGCFAIL?`
  `SCF?`

- Program data

  Data format: Character

  Set value: OFF (0), ON (1)

(Example) To set the C FAIL status of Status Signal Output to OFF,

```
SCF OFF
```

Response message

To SCF?, the current C FAIL setting for Status Signal Output is returned.

(Example) If the CONTACT FAIL status of Status Signal Output is currently set to ON,
1 is returned.

COMMENT (COM)

Inputs a comment (memo). Also inquires about the current comment. Up to three lines can be entered, with a maximum of 12 characters per line.

Program message

- Syntax

  Command message: `COMMENT_<"1st line","2nd line","3rd line">`
  `COM_<"1st line","2nd line","3rd line">`

  Query message: `COMMENT?`
  `COM?`

- Program data

  Data format: Character

  Set value: ASCII Code 20H to 7EH
  (Except 22H (“), 27H (‘), 2CH (,), and 40H (@))

(Example) To enter “KIKUSUI” in the 1st line, a blank in the 2nd line, and “TOS9201” in the 3rd line,

```
COM “KIKUSUI”,“␣”,“TOS9201”
```

Response message

To COM?, the current comment is returned.

(Example) If “KIKUSUI” is entered in the 1st line and “123456789ABCDEFGHIJK” in the 3rd line, with no entry in the 2nd line, the following comment is returned (␣ = space):

```
KIKUSUI␣␣␣␣␣␣␣␣␣␣,␣␣␣␣␣␣␣␣␣␣␣␣␣␣␣␣,
123456789ABCDEFGHIJK
```

3.7 Memory-Related Messages

This section explains the messages used in connection with memory.

ACW:RECALL (A:REC)

Recalls the contents of memory stored in an AC withstanding voltage test

Program message

- Syntax
  Command message: `ACW:RECALL_<memory number>`
  `A:REC_<memory number>`
- Program data
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To recall memory 10 for AC withstanding voltage testing,

```
A:REC 10
```

DCW:RECALL (D:REC)

Recalls the contents of memory stored in a DC withstanding voltage test

Program message

- Syntax
  Command message: `DCW:RECALL_<memory number>`
  `D:REC_<memory number>`
- Program data
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To recall memory 10 for DC withstanding voltage testing,

```
D:REC 10
```

IR:RECALL (I:REC)

Recalls the contents of memory stored in an insulation resistance test

Program message

- Syntax

  Command message: `IR:RECALL_<memory number>`
  `I:REC_<memory number>`

- Program data

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To recall memory 10 for insulation resistance testing,

```
I:REC 10
```

ACW:STORE (A:STOR)

Stores the current settings for an AC withstanding voltage test. Note that the memory name is not stored (the existing memory name is not replaced).

Program message

- Syntax

  Command message: `ACW:STORE_<memory number>`
  `A:STOR_<memory number>`

- Program data

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To store the current settings for an AC withstanding voltage test to memory 10,

```
A:STOR 10
```

DCW:STORE (D:STOR)

Stores the current settings for a DC withstanding voltage test. Note that the memory name is not stored (the existing memory name is not replaced).

Program message

- Syntax

  Command message: `DCW:STORE_<memory number>`
  `D:STOR_<memory number>`

- Program data

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To store the current settings for a DC withstanding voltage test to memory 10,

```
D:STOR 10
```

IR:STORE (I:STOR)

Stores the current settings for an insulation resistance test. Note that the memory name is not stored (the existing memory name is not replaced).

Program message

- Syntax

  Command message: `IR:STORE_<memory number>`
  `I:STOR_<memory number>`

- Program data

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To store the current settings for an insulation resistance test to memory 10,

```
I:STOR 10
```

ACW:MEMORY (A:MEM)

Stores the test conditions for an AC withstanding voltage test to a specified memory number. Also inquires about the contents of the memory with the specified number.

Program message

- Syntax

  Command message: `ACW:MEMORY_<`*`memory number, memory name, test voltage, lower current, upper current, test time, frequency`*`{50|60}, `*`lower judgment`*`{ON|OFF}, `*`offset`*`{ON|OFF}, `*`timer`*`{ON|OFF}, `*`start voltage, voltage rise time, voltage fall time, voltage range`*`{0|1}, `*`current-detection response speed`*`{0|1|2}, `*`GND`*`{GUARD|LOW}, `*`contact check`*`{ON|OFF}, `*`scanner Hi/Low, scanner Open`*`>`

  Query message: `ACW:MEMORY?`
  `A:MEM?`

- Program data <*memory number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*memory name*>

  Data format: Character
  Set value: ASCII Code 20H to 7EH (up to 12 characters)
  (Except 22H (“), 27H (‘), 2CH (,), and 40H (@))

- Program data <test voltage>

  Data format: Real number
  Set value: 0.00 to 5.20 E3
  Resolution: 0.01 E3
  Unit: V

- Program data <*lower current*>

  Data format: Real number
  Set value: 0.01 E-3 to 110 E-3
  Resolution: 0.01 E-3 (0.01 E3 to 9.99 E-3)
  0.1 E-3 (10.0 E-3 to 999 E-3)
  1 E-3 (100 E-3 to 110 E-3)
  Unit: A

- Program data <*upper current*>

  Data format: Real number
  Set value: 0.01 E-3 to 110 E-3
  Resolution: 0.01 E-3 (0.01 E3 to 9.99 E-3)
  0.1 E-3 (10.0 E-3 to 999 E-3)
  1 E-3 (100 E-3 to 110 E-3)

Unit: A

- Program data <*test time*>
  Data format: Real number
  Set value: 0.3 to 999
  Resolution: 0.1 for 0.3 to 99.9, 1 for 100 to 999
  Unit: s
- Program data <*frequency*>
  Data format: Character
  Set value: 50, 60
  Unit: Hz
- Program data <*lower judgment*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*offset*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*timer*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*start voltage*>
  Data format: Integer
  Set value: 1 to 99
  Resolution: 1
  Unit: %
- Program data <*voltage rise time*>
  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s
- Program data <*voltage fall time*>
  Data format: Real number
  Set value: 0.0 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s
- Program data <*test-voltage range*{0|1}>
  Data format: Integer
  Set value: 0: AUTO; 1: 5 kV
- Program data <*current-detection response speed*{0|1|2}>
  Data format: Integer
  Set value: 0: SLOW; 1: MID; 2: FAST

- Program data <*GND*{GUARD|LOW}>
  Data format: Character
  Set value: LOW (0), GUARD (1)
- Program data <*contact check*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*scanner Hi/Low*>
  Data format: Integer
  Set value: 0 to 65535 (#HFFFF)
  Resolution: 1
  LOW is represented by 0 and HIGH by 1.
- Program data <*scanner Open*>
  Data format: Integer
  Set value: 0 to 65535 (#HFFFF)
  Resolution: 1
  OPEN is represented by 1 and NOT OPEN by 0.
  OPEN has priority over HIGH/LOW.

Response message

To A:MEM? _<*memory number*>, the contents of memory specified by memory number are returned.

The memory contents are returned in the same order as with program messages.

(Example) If memory 10, at inquiry, contains the memory name ACW10, test voltage of 5.00 kV, lower current of 5.00 mA, upper current of 80.0 mA, test time of 2.0 s, frequency of 50 Hz, lower judgment set to ON, offset set to OFF, timer set to ON, start voltage of 15%, voltage rise time of 0.2 s, voltage fall time of 0.4 s, voltage range of AUTO, current-detection response speed of SLOW, GND set to LOW, contact check set to ON, scanners 1 through 5 set to Low, scanners 6 through 10 set to High, and the other scanners set to Open, then,

"ACW10,5.00E3,5.00E-3,80.0E-3,2.0,50,1,0,1,15,
0.2,0.4,0,0,0,1,31,992" is returned.

DCW:MEMORY (D:MEM)

Stores the test conditions for a DC withstanding voltage test to a specified memory number. Also inquires about the contents of the memory with the specified number.

Program message

- Syntax

  Command message: `DCW:MEMORY (D: MEM)_<memory number, memory name, test voltage, lower current, upper current, test time, lower judgment{ON|OFF}, timer{ON|OFF}, start voltage, voltage rise time, WAIT TIME, GND{GUARD|LOW}, contact check{ON|OFF}, scanner Hi/Low, scanner Open>`

  Query message: `DCW:MEMORY?`
  `D:MEM?`

- Program data <*memory number*>
  - Data format: Integer
  - Set value: 0 to 99
  - Resolution: 1
- Program data <*memory name*>
  - Data format: Character
  - Set value: ASCII Code 20H to 7EH (up to 12 characters)
    (Except 22H (“), 27H (‘), 2CH (,), and 40H (@))
- Program data <*test voltage*>
  - Data format: Real number
  - Set value: 0.00 to 6.00 E3
  - Resolution: 0.01 E3
  - Unit: V
- Program data <*lower current*>
  - Data format: Real number
  - Set value: 0.01 E-3 to 11.0 E-3
  - Resolution: 0.01 for 0.01 E3 to 9.99 E-3, 0.1 for 10.0 E-3 to 11.0 E-3
  - Unit: A
- Program data <*upper current*>
  - Data format: Real number
  - Set value: 0.01 E-3 to 11.0 E-3
  - Resolution: 0.01 for 0.01 E3 to 9.99 E-3, 0.1 for 10.0 E-3 to 11.0 E-3
  - Unit: A
- Program data <*test time*>
  - Data format: Real number
  - Set value: 0.3 to 999
  - Resolution: 0.1 for 0.3 to 99.9, 1 for 100 to 999
  - Unit: s

- Program data <*lower judgment*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*timer*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*start voltage*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1
  Unit: %
- Program data <*voltage rise time*>
  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s
- Program data <*WAIT TIME*>
  Data format: Real number
  Set value: 0.3 to 10.0
  Resolution: 0.1
  Unit: s
- Program data <*GND*{GUARD|LOW}>
  Data format: Character
  Set value: LOW (0), GUARD (1)
- Program data <*contact check*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*scanner Hi/Low*>
  Data format: Integer
  Set value: 0 to 65535 (#HFFFF)
  Resolution: 1
  LOW is represented by 0 and HIGH by 1.
- Program data <*scanner Open*>
  Data format: Integer
  Set value: 0 to 65535 (#HFFFF)
  Resolution: 1
  OPEN is represented by 1 and NOT OPEN by 0.
  OPEN has priority over HIGH/LOW.

Response message

To D:MEM? _<*memory number*>, the contents of the memory specified by memory number are returned. The memory contents are returned in the same order as with program messages.

(Example) If memory 12, at inquiry, contains the memory name DCW12, test voltage of 5.50 kV, lower current of 5.00 mA, upper current of 10.0 mA, test time of 2.0 s., lower judgment set to ON, timer set to ON, start voltage of 20%, voltage rise time of 0.2 s, WAIT TIME of 0.5 s, GND set to LOW, contact check set to ON, scanners 1 through 5 set to Low, scanners 6 through 10 set to High, and the other scanners set to Open, then, "`DCW12,5.50E3,5.00E-3,10.0E-3,2.0,1,1,20,0.2, 0.5,0,1,31,992`" is returned.

IR:MEMORY (I:MEM)

Stores the test conditions for an insulation resistance test to a specified memory number. Also inquires about the contents of the memory with the specified number.

Program message

- Syntax

  Command message: `IR:MEMORY (I: MEM)_<`*`memory number, memory name, test voltage, lower resistance, upper resistance, test time, lower judgment`*`{ON|OFF}, `*`upper judgment`*`{ON|OFF}, `*`timer`*`{ON|OFF}, `*`voltage rise time, WAIT TIME, GND`*`{GUARD|LOW}, `*`contact check`*`{ON|OFF}, `*`scanner Hi/Low, scanner Open`*`>`

  Query message: `IR:MEMORY?`
  `I:MEM?`

- Program data <*memory number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*memory name*>

  Data format: Character
  Set value: ASCII Code 20H to 7EH (up to 12 characters)
  (Except 22H (“), 27H (‘), 2CH (,), and 40H (@))

- Program data <*test voltage*>

  Data format: Real number
  Set value: 10 to 1020
  Resolution: 1
  Unit: V

- Program data <*lower resistance*>
  Data format: Real number
  Set value: 0.01 E6 to 9.99 E9
  Resolution: 0.01 E6 (0.01 E6 to 9.99 E6)
  0.1 E6 (10.0 E6 to 99.9 E6)
  1 E6 (100 E6 to 999 E6)
  0.01 E9 (1.00 E9 to 9.99 E9)
  Unit: Ω
- Program data <*upper resistance*>
  Data format: Real number
  Set value: 0.01 E6 to 9.99 E9
  Resolution: 0.01 E6 (0.01 E6 to 9.99 E6)
  0.1 E6 (10.0 E6 to 99.9 E6)
  1 E6 (100 E6 to 999 E6)
  0.01 E9 (1.00 E9 to 9.99 E9)
  Unit: Ω
- Program data <test time>
  Data format: Real number
  Set value: 0.5 to 999
  Resolution: 0.1 for 0.5 to 99.9, 1 for 100 to 999
  Unit: s
- Program data <*lower judgment*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*upper judgment*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*timer*{ON|OFF}>
  Data format: Character
  Set value: OFF, ON (0, 1)
- Program data <*voltage rise time*>
  Data format: Real number
  Set value: 0.1 to 200
  Resolution: 0.1 for 0.1 to 99.9, 1 for 100 to 200
  Unit: s
- Program data <*WAIT TIME*>
  Data format: Real number
  Set value: 0.3 to 10.0
  Resolution: 0.1
  Unit: s

- Program data <*GND*{GUARD|LOW}>

  Data format: Character

  Set value: LOW (0), GUARD (1)

- Program data <*contact check*{ON|OFF}>

  Data format: Character

  Set value: OFF, ON (0, 1)

- Program data <*scanner Hi/Low*>

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  LOW is represented by 0 and HIGH by 1.

- Program data <scanner Open>

  Data format: Integer

  Set value: 0 to 65535 (#HFFFF)

  Resolution: 1

  OPEN is represented by 1 and NOT OPEN by 0.

  OPEN has priority over HIGH/LOW.

Response message

To I:MEM? _<*memory number*>, the contents of the memory specified by memory number are returned.

The memory contents are returned in the same order as with program messages.

(Example) If memory 15, at inquiry, contains the memory number IR15, test voltage of 50 V, lower resistance of 0.05 MΩ, upper resistance of 10.0 MΩ, test time of 2.0 s., lower judgment set to ON, upper judgment set to OFF, timer set to ON, voltage rise time of 0.2 s, WAIT TIME of 0.5 s, LOW terminal set to GND, contact check set to ON, scanners 1 through 5 set to Low, scanners 6 through 10 set to High, and the other scanners set to Open, then
"IR15,50,0.05E6,10.0E6,2.1,0,1,0.2,0.5,0,1,31,992" is returned.

3.8 Program-Related Messages

This section describes the messages used in connection with the program (AUTO).

PRGNAME (PNAM)

Specifies a program number and names the program. Also inquires about the program name.

Program message

- Syntax

  Command message: `PRGNAME_<program number,program name>`
  `PNAM_<program number,program name>`

  Query message: `PRGNAME?_<program number>`
  `PNAM?_<program number>`

- Program data <*program number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*program name*>

  Data format: Character
  Set value: ASCII Code 20H to 7EH (up to 12 characters)
  (Except 22H (“), 27H (‘), 2CH (,), and 40H (@))

(Example) To name program 10 “TEST 10,”

```
PNAM 10,“TEST 10”
```

Response message

To PNAM?_<*program number*>, the name of the program with the specified number is returned.

(Example) If the name of program 10 is TEST10, “`TEST10`” is returned.

PRGTEST (PTES)

Sets the specified program.

Program message

- Syntax

  Command message: `PRGTEST_<program number>`
  `PTES_<program number>`

- Program data

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To set program 10,

```
PTES 10
```

PRGEDIT (PED)

Creates a program using stored memory. Also inquires about the contents of the program corresponding to a program number and step number.

Following execution of this message, the program edit screen automatically appears.

Program message

- Syntax

  Command message: `PRGEDIT_<program number, step number, mode selection {0|1|2}>, memory number, interval time>`
  `PED_<program number, step number, mode selection {0|1|2}, memory number, interval time>`

  Query message: `PRGEDIT? (PED?)_<program number, step number>`
  `PED?_<program number, step number>`

- Program data <*program number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*step number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*mode selection* {0|1|2}>
  Data format: Integer
  Set value: 0: ACW; 1: DCW; 2: IR
- Program data <*memory number*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1
- Program data <*interval time*>
  Data format: Real number, character
  Set value: 0.2 to 9.9, HOLD
  Resolution: 0.1
  Unit: s

NOTE

- All parameters must be entered, even if the value isn't changed.
- Do not skip a step number. Overwrite the existing step, or add a new step after the last step.
- Up to 500 steps can be used in a set of programs.
  For example, if 100 steps are set for each of programs 0 to 4, no step is available for program 5.

(Example) At step 15 of program 10, to program memory 3 for AC withstanding voltage testing at an interval time of 2 s,

```
PED 10,15,0,3,2.0
```

Response message

To PED?_<*program number, step number*>, the contents of the specified step of a specified program are returned.

(Example) If, at step 15 of program 10, memory 3 for AC withstanding voltage testing is programmed at an interval time of 2 s,
"`0,3,2`" is returned.

PRGRETURN (PRET)

Makes the RETURN/END settings for a specified program.
Also inquires about the RETURN/END setting for a specified program.

Program message

- Syntax
  Command message: `PRGRETURN_<program number,{ON|OFF}>`
  `PRET_<program number,{ON|OFF}>`
  Query message: `PRGRETURN?_<program number>`
  `PRET?_<program number>`
- Program data <*program number*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1
- Program data <*program name*>
  Data format: Character
  Set value: OFF (0), ON (1)

(Example) To set program 10 to RETURN,

```
PRET 10,ON
```

Response message

To PRET?_<*program number*>, the RETURN setting for the specified program is returned.

(Example) If program 10 is set to the END mode,
`0` is returned.

PRGNEW (PNEW)

Deletes a specified program.

Program message

- Syntax
  Command message: `PRGNEW_<program number>`
  `PNEW_<program number>`
- Program data
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To delete program 10,

```
PNEW 10
```

PRGTOTAL (PTOT)

Inquires about the total number of steps in a specified program

Program message

- Syntax

  Query message: `PRGTORAL?_<program number>`
  `PTOT?_<program number>`

- Program data <*program number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

Response message

To PRET?_<*program number*>, the total number of steps in a specified program is returned.

(Example) If the total number of step in program 10 is 55,
`55` is returned.

PRGINS (PIN)

Inserts a memory number into the specified step of a specified program. Following the execution of this message, the tester automatically displays the program edit screen.

Program message

- Syntax

  Command message: `PRGINS_<program number, step number, mode selection{0|1|2}, memory number>`
  `PIN_<program number, step number, mode selection{0|1|2}, memory number>`

- Program data <*program number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*step number*>

  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

- Program data <*mode selection* {0|1|2}>
  Data format: Integer
  Set value: 0: ACW; 1: DCW; 2: IR
- Program data <*memory number*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

NOTE

- Do not skip a step number. Overwrite the existing step or add a new step after the last step.
- Up to 500 steps can be used in a set of programs. For example, if 100 steps are set for each of programs 0 to 4, no step is available for program 5.

(Example) To insert memory 3 for AC withstanding voltage testing into step 15 of program 10,

```
PIN 10,15,0,3
```

PRGDEL (PDEL)

Deletes the specified step of a specified program

Program message

- Syntax
  Command message: PRGDEL_<*program number, step number*>
  PDEL_<*program number, step number*>
- Program data <*program number*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1
- Program data <*step number*>
  Data format: Integer
  Set value: 0 to 99
  Resolution: 1

(Example) To delete step 15 from program 10,

```
PDEL 10,15
```

AUTORUNNING (ARUN)

Inquires which step the program is currently executing

Program message

- Syntax

  Query message: `AUTORUNNING?`
  `ARUN?`

Response message

To ARUN?, the step currently being executed by the program is returned.

(Example) If step 55 of the program is being executed,
`55` is returned.

3.9 Registers

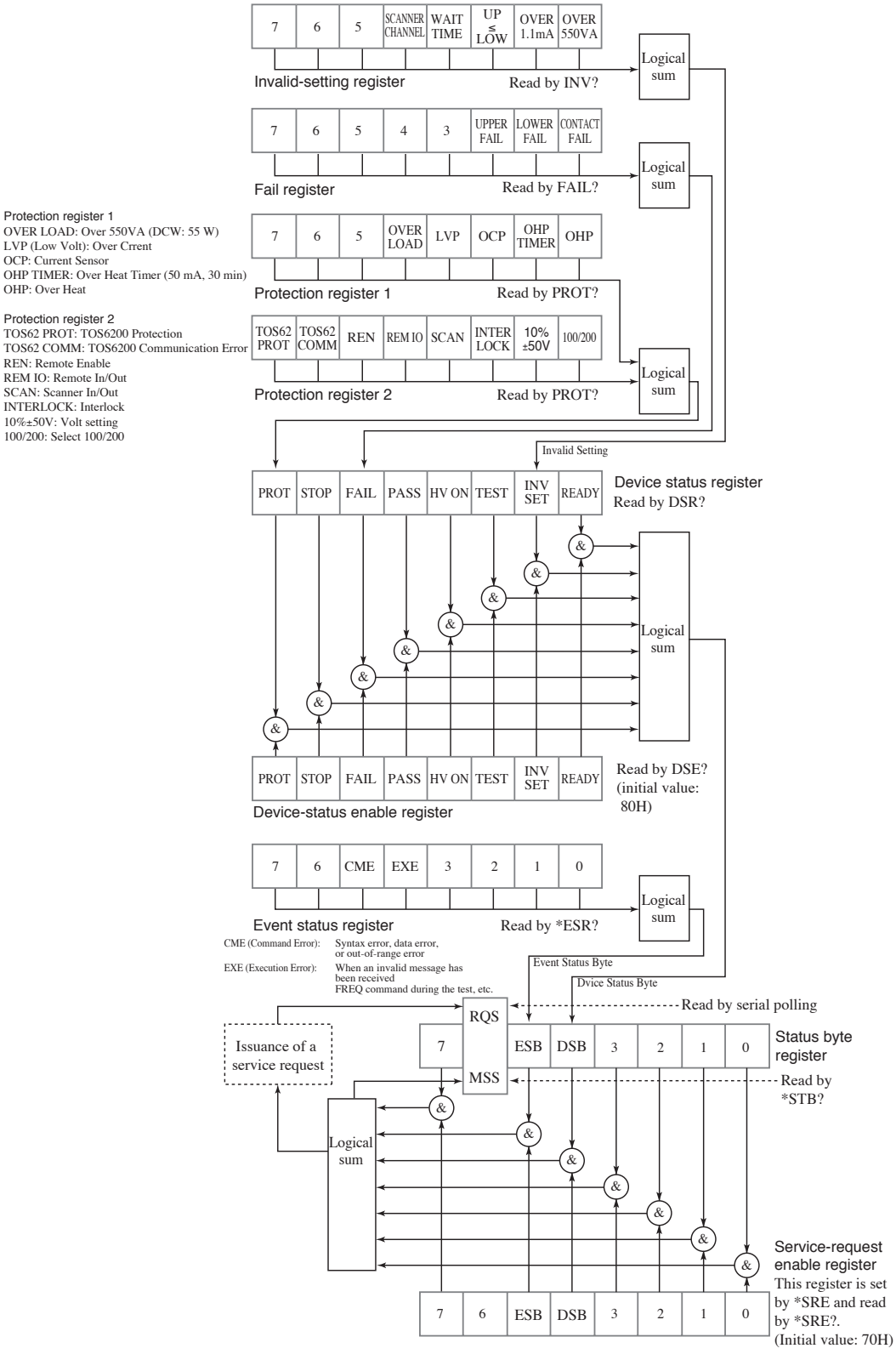


Fig.3-4 Structure of status data

NOTE
- In a command message in each register, hexadecimal data can be used by adding “#H”.
- In a query message in each register, all response data is composed of decimals.
- For each bit of each register, 1 represents “set” and 0 represents “reset.”
- The contents of the enable register are not backed up.

Status Byte register, Service-Request Enable register

Bit		Description
7		Not used with this tester
6	"RQS (Request)	Confirms that a service request has been issued. Reset by being read by series polling.
	"MSS (Master Summary Status)"	Logical sum of the status byte register and the service-request enable register. Read by *STB?
5	"ESB (Standard Event Status Bit)"	Indicates that a bit of the event status register has been set
4	"DSB (Device Status Bit)"	Indicates that a bit of the device status register has been set
3		Not used with this tester
2		Not used with this tester
1		Not used with this tester
0		Not used with this tester

Table 3-1 Status Byte register and Service-Request Enable register

Event Status register

Bit		Description
7		Not used with this tester
6		Not used with this tester
5	CME (Command Error)	Indicates a syntax error, data error, or our-of-range error
4	EXE (Execution Error)	Indicates that an invalid message has been received during the test or in the protection status
3		Not used with this tester
2		Not used with this tester
1		Not used with this tester
0		Not used with this tester

Table 3-2 Event Status register

Device Status register, Device-Status Enable register

Bit		Description
7	PROT (Protection)	Protection status
6	STOP	Suspension of the test
5	FAIL	FAIL judgment
4	PASS	PASS judgment
3	HV ON	Waiting for a contact check and outputting a voltage
2	TEST	Outputting a test voltage
1	INV SET (Invalid setting)	LCD displaying an invalid message such as “UP≤LOW” or “OVER 550 VA” (“OVER 55 W” in DC)
0	READY	READY status

Table 3-3 Device Status register and Device-Status Enable register

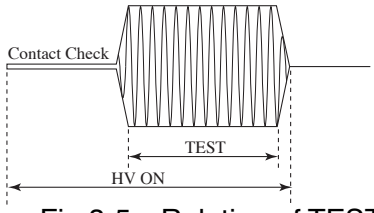


Fig.3-5 Relation of TEST (Bit 2) to HV ON (Bit 3).

Protection register 1

Bit		Description
7		Not used with this tester
6		Not used with this tester
5		Not used with this tester
4	OVER LOAD	When 550 VA is exceeded in ACW (55 W in DCW)
3	LVP (Low Voltage Protection)	When 1.1 mA is exceeded in IR
2	OCP (24 V)	When a 24 V overcurrent has been detected in the SIGNAL I/O connector or INTERLOCK connector
1	OHP TIMER (Over Heat Timer)	When a current exceeding 50 mA has been detected for over 30 minutes during the test
0	OHP (Over Heat Protection)	When the internal temperature has increased abnormally

Table 3-4 Protection register

Protection register 2

Bit		Description
7	TOS6200 PROT (Protection)	When the TOS6200 is in the protection status
6	TOS6200 COMM (Communication Error)	When an error has occurred in communication with the TOS6200
5	REN (Remote Enable)	Change in the Enable signal for SIGNAL I/O
4	REM IO (Remote In/Out)	When the remote-control connector has been connected/disconnected
3	SCAN (Scanner In/Out)	When the scanner connector has been connected/disconnected, or when a channel specified at a step during the AUTO test is disconnected.
2	INTERLOCK	In the INTERLOCK status
1	10 %±50 V (Setting 10 %±50 V)	When the test voltage has deviated from 10% ±50 V
0	100/200 (Select 100/200)	When a source voltage outside the preset range has been applied

Table 3-5 Protection register

Fail register

Bit		Description
7		Not used with this tester
6		Not used with this tester
5		Not used with this tester
4		Not used with this tester
3		Not used with this tester
2	UPPER FAIL	Indicates FAIL for the upper cutoff value
1	LOWER FAIL	Indicates FAIL for the lower cutoff value
0	CONTACT FAIL	Indicates FAIL in a contact check

Table 3-6 Fail register

Invalid-Setting register

Bit		Description
7		Not used with this tester
6		Not used with this tester
5		Not used with this tester
4	SCANNER CHANNEL	When an unconnected channel has been specified
3	WAIT TIME	At rise time + test time ≤ wait time
2	UP≤LOW	When the lower cutoff value exceeds the upper cutoff value
1	OVER 1.1mA	In IR, when the test voltage divided by the lower resistance has exceeded 1.1 mA
0	OVER 550VA	In ACW, when the test voltage multiplied by the upper current has exceeded 550 VA (55 W in DCW)

Table 3-7 Invalid-Setting register

Error register

Bit		Description
7		Not used with this tester
6		Not used with this tester
5		Not used with this tester
4		Not used with this tester
3	Invalid message	Indicates an invalid message
2	Out-of-range error	Indicates an out-of-range error
1	Data Error	Indicates a data error
0	Syntax Error	Indicates a header error

Table 3-8 Error register

3.10 Message List

The symbols in parentheses in the Header column represent abbreviated messages. R/W represents a query message (R) or command message (W).

Note 1: The commands that are valid during a rise time, test time, fall time, pass judgment, fail judgment, or interval time are marked with "①", and invalid commands are indicated by "②". The commands valid only in the ready status or interval hold status are marked with "③".

Note 2: The commands valid in the protection status are marked with "①", and the invalid commands are marked with "②".

3.10.1 Register-related messages and general messages

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
1	*RST	W				--	Initializes devices. (Resets to factory settings, except for the INTERFACE screen settings)	①	①
2	*IDN?	R				--	Returns "KIKUSUI ELECTRONICS CORP., TOS9200, 0, x.xx" (TOS9200).	①	①
3	ERR?	R				--	Returns an error value and clears it.	①	①
4	TRM	W	0	3		--	Sets the terminator. 0: CR LF+EOI; 1: LF+EOI; 2: EOI; 3: CR+EOI	②	②
5	TRM?	R				--	Returns the preset terminator value.	①	①
6	*CLS	W				--	Clears the status byte register, event status register, device status register, protection register 1, protection register 2, fail register, invalid-setting register, and error register.	①	①
7	*STB?	R				--	Returns the status-byte-register value.	①	①
8	*SRE	W	0	255		--	Sets the service-request enable register.	②	②
9	*SRE?	R				--	Returns the service-request-enable-register value.	①	①
10	*ESR?	R				--	Returns the event-status-register value and clears it.	①	①
11	DSE	W	0	255		--	Sets the device-status enable register.	②	②
12	DSE?	R				--	Returns the device-status-enable-register value.	①	①
13	DSR?	R				--	Returns the device-status-register value.	①	①
14	PROTECTION? (PROT?)	R				--	Returns the values of protection registers 1 and 2.	①	①
15	FAIL?	R				--	Returns the fail-register value.	①	①
16	INVALID? (INV?)	R				--	Returns the invalid-setting-register value.	①	①
17	CLR	W				--	Clears all registers and sets a Stop flag (same as DCL and SDC).	①	①
18	SILENT (SIL)	W	0	1	0/1	--	Acknowledge message (RS-232C)	②	②
19	SILENT? (SIL?)	R				--	Returns the acknowledge-message (RS-232C) value.	①	①
20	START (STAR)	W				--	Starts a test. (valid in the ready status and the interval hold status)	③	②
21	STOP	W				--	Suspends the test and cancels the protection status.	①	①
22	FUNCTION (FUN)	W	0	4	1	--	Shifts between modes. 0: ACW; 1: DCW; 2: IR; 3: AUTO TEST; 4: AUTO EDIT; 5: SYSTEM; 6: OFFSET ADJ	②	②
23	FUNCTION? (FUN?)	R				--	Returns the current mode. 0: ACW; 1: DCW; 2: IR; 3: AUTO TEST; 4: AUTO EDIT; 5: SYSTEM; 6: OFFSET ADJ; 7: INTERFACE	①	①
24	LOCAL (LOC)	W					Return to the LOCAL from the REMOTE state.	②	①

3.10.2 Messages for AC withstanding voltage testing

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
25	ACW:TESTV (A:TES)	W	0.00	5.20 E3	0.01 E3	V	Sets the test voltage.	①	②
26	ACW:TESTV? (A:TES?)	R	0.00 E3	5.20 E3		V	Returns the test-voltage setting.	①	①
27	ACW:FREQUENCY (A:FREQ)	W	50	60	50/60	Hz	Sets the output frequency.	②	②
28	ACW:FREQUENCY? (A:FREQ?)	R				Hz	Returns the output-frequency setting.	①	①
29	ACW:LOWER (A:LOW)	W	0.01 E-3	110 E-3	0.01, 0.1, 1	A	Lower current (0.01 to 9.99/10.0 to 99.9/100 to 110)	②	②
			OFF	ON	OFF/ON	--	Turns ON/OFF the low judgment function.		
30	ACW:LOWER? (A:LOW?)	R				A, --	Returns the lower current and the ON/OFF status of the judgment function. Returns ON/OFF as 1 or 0.	①	①
31	ACW:UPPER (A:UPP)	W	0.01 E-3	110 E-3	0.01, 0.1, 1	A	Upper current (0.01 to 9.99/10.0 to 99.9/100 to 110)	②	②
32	ACW:UPPER? (A:UPP?)	R				A	Returns the upper current.	①	①
33	ACW:TIMER (A:TIM)	W	0.3	999	0.1, 1	s	Timer set value (0.3 to 99.9/100 to 999)	②	②
			OFF	ON	0/1	--	Timer function		
34	ACW:TIMER? (A:TIM?)	R				s, --	Returns the timer ON/OFF setting. Returns ON/OFF as 1 or 0.	①	①
35	ACW:OFFSET (A:OFF)	W	OFF	ON	0/1	--	Offset function.	②	②
36	ACW:OFFSET? (A:OFF?)	R				--	Returns the ON/OFF status of the offset function Returns ON/OFF as 1 or 0.	①	①
37	ACW:STARTV (A:STAR)	W	0	99	1	%	Sets the start voltage.	②	②
38	ACW:STARTV? (A:STAR?)	R				%	Returns the start-voltage setting.	①	①
39	ACW:RISETIME (A:RTIM)	W	0.1	200	0.1, 1	s	Sets the voltage rise time (0.1 to 99.9/100 to 200).	②	②
40	ACW:RISETIME? (A:RTIM?)	R				s	Returns the voltage-rise-time setting.	①	①
41	ACW:FALLTIME (A:FTIM)	W	0	200	0.1, 1	s	Sets the voltage fall time (0.1 to 99.9/100 to 200).	②	②
42	ACW:FALLTIME? (A:FTIM?)	R				s	Returns the voltage-fall-time setting.	①	①
43	ACW:VRANGE (A:VRAN)	W	AUTO	5kV	0/1	--	Sets VRANGE (0: AUTO; 1: 5 kV).	②	②
44	ACW:VRANGE? (A:VRAN?)	R	0	1	0/1	--	Returns the VRANGE setting (0: AUTO; 1: 5 kV).	①	①
45	ACW:RESPONSE (A:RES)	W	SLOW	FAST	0/1/2	--	Sets the response filter (0: SLOW; 1: MID; 2: FAST).	②	②
46	ACW:RESPONSE? (A:RES?)	R				--	Returns the response-filter setting. (0: SLOW; 1: MID; 2: FAST)	①	①
47	ACW:GND (A:GND)	W	LOW	GUARD	0/1	--	1 to set GND to GUARD, and 0 to set to LOW.	②	②
48	ACW:GND? (A:GND?)	R				--	Returns the GUARD/LOW setting for GND as 1 or 0.	①	①
49	ACW:SCAN (A:SCAN)	W	1	16	1	--	Sets channels 1 through 16 to Hi/Low/Open (0: Open; 1: Low; 2: High).	②	②
			H	L	H/L/O	--			
50	ACW:SCAN? (A:SCAN?)	R	1	16	1	--	Returns the Hi/Low/Open setting for channels 1 through 16 (0: Open; 1: Low; 2: High).	①	①
51	ACW:SCANW (A:SCANW)	W	0	65535 #HFFFF	1	--	The 1st data represents channels 1 through 16 with 0: Low and 1: Hi, using 16 bits. The 2nd data represents Open and Not Open, with 1 for Open. The Open setting for the 2nd data has priority over the 1st data.	②	②
			0	65535 #HFFFF	1	--			

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
52	ACW:SCANW? (A:SCANW?)	R				--	Returns a WORD-type value for Hi/Low and Open/Not Open.	①	①
53	ACW:CONTACT CHECK (A:CCH)	W	OFF	ON	0/1	--	Sets ON/OFF for the scanner contact check function.	②	②
54	ACW:CONTACT CHECK?(A:CCH?)	R	0	1	0/1	--	Returns the ON/OFF status of the scanner contact check function.	①	①

3.10.3 Messages for DC withstanding voltage testing

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
55	DCW:TESTV (D:TES)	W	0.00	6.00 E3	0.01 E3	V	Sets the test voltage.	①	②
56	DCW:TESTV? (D:TES?)	R	0.00 E3	6.00 E3		V	Returns the test-voltage setting.	①	①
57	DCW:LOWER (D:LOW)	W	0.01 E-3	11.0 E-3	0.01,0.1	A	Lower current (0.01 to 9.99/10.0 to 11.0)	②	②
			OFF	ON	OFF/ON	--	Turns the low judgment function ON/OFF.		
58	DCW:LOWER? (D:LOW?)	R				A, --	Returns the lower current and the ON/OFF status of the judgment function. Returns ON/OFF as 1 or 0.	①	①
59	DCW:UPPER (D:UPP)	W	0.01 E-3	11.0 E-3	0.01,0.1	A	Upper current (0.01 to 9.99/10.0 to 11.0)	②	②
60	DCW:UPPER? (D:UPP?)	R				A	Returns the upper current.	①	①
61	DCW:TIMER (D:TIM)	W	0.1	999	0.1, 1	s	Timer set value (0.3 to 99.9/100 to 999)	②	②
			OFF	ON	0/1	--	Timer function		
62	DCW:TIMER? (D:TIM?)	R				s, --	Returns the timer ON/OFF setting. Returns ON/OFF as 1 or 0.	①	①
63	DCW:STARTV (D:STAR)	W	0	99	1	%	Sets the start voltage.	②	②
64	DCW:STARTV? (D:STAR?)	R				%	Returns the start-voltage setting.	①	①
65	DCW:RISETIME (D:RTIM)	W	0.1	200	0.1, 1	s	Sets the voltage rise time (0.1 to 99.9/100 to 200)	②	②
66	DCW:RISETIME? (D:RTIM?)	R				s	Returns the voltage-rise-time setting.	①	①
67	DCW:WAITTIME (D:WTIM)	W	0.3	10	0.1	s	Sets the WAIT TIME (0.3 to 10.0)	②	②
68	DCW:WAITTIME? (D:WTIM?)	R				s	Returns the judgment-wait-time setting.	①	①
69	DCW:GND(D:GND)	W	LOW	GUARD	0/1	--	1 to set GND to GUARD, and 0 to set to LOW	②	②
70	DCW:GND? (D:GND?)	R				--	Returns the GUARD/LOW setting for GND as 1 or 0.	①	①
71	DCW:SCAN (D:SCAN)	W	1	16	1	--	Sets channels 1 through 16 to Hi/Low/Open (0: Open; 1: Low; 2: High).	②	②
			H	L	H/L/O	--			
72	DCW:SCAN? (D:SCAN?)	R	1	16	1	--	Returns the Hi/Low/Open setting for channels 1 through 16 (0: Open; 1: Low; 2: High).	①	①
73	DCW:SCANW (D:SCANW)	W	0	65535 #HFFFF	1	--	The 1st data represents channels 1 through 16 with 0: Low and 1: Hi, using 16 bits. The 2nd data represents Open and Not Open, with 1 for Open. The Open setting for the 2nd data has priority over the 1st data.	②	②
			0	65535 #HFFFF	1	--			
74	DCW:SCANW? (D:SCANW?)	R				--	Returns a WORD-type value for Hi/Low and Open/Not Open.	①	①

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
75	DCW:CONTACT CHECK (D:CCH)	W	OFF	ON	0/1	--	Sets ON/OFF of the scanner contact check function.	②	②
76	DCW:CONTACT CHECK? (D:CCH?)	R	0	1	0/1	--	Returns the ON/OFF status of the scanner contact check function.	①	①

3.10.4 Messages for insulation resistance testing

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
77	IR:TESTV (I:TES)	W	10	1020	1	V	Sets the test voltage.	①	②
78	IR:TESTV? (I:TES?)	R				V	Returns the test-voltage setting.	①	①
79	IR:LOWER (I:LOW)	W	0.01 E6	9.99 E9	0.01	Ω	Lower resistance (0.01 M to 9.99 M, 10.0 M to 99.9 M, 100 M to 999 M, 1.00 G to 9.99 G)	②	②
			OFF	ON	OFF/ON				
80	IR:LOWER? (I:LOW?)	R				Ω	Returns the lower resistance. Uses MΩ as the unit. Returns the ON/OFF status of the judgment function. Returns ON/OFF as 1 or 0.	①	①
81	IR:UPPER (I:UPP)	W	0.01 E6	9.99 E9	0.01	Ω	Upper resistance (0.01 M to 9.99 M, 10.0 M to 99.9 M, 100 M to 999 M, 1.00 G to 9.99 G)	②	②
			OFF	ON	OFF/ON	--	Turns the upper judgment function ON/OFF.		
82	IR:UPPER? (I:UPP?)	R				Ω --	Returns the upper resistance (in MΩ) and the ON/OFF status of the upper judgment function. Returns ON/OFF as 1 or 0.	①	①
83	IR:TIMER (I:TIM)	W	0.5	999	0.1, 1	s	Timer set value (0.5 to 99.9/100 to 999)	②	②
			OFF	ON	0/1	--	Timer function		
84	IR:TIMER? (I:TIM?)	R				s, --	Returns the timer value and the ON/OFF status of the timer. Returns ON/OFF as 1 or 0.	①	①
85	IR:RISETIME (I:RTIM)	W	0.1	200	0.1, 1	s	Sets the voltage rise time (0.1 to 99.9/100 to 200).	②	②
86	IR:RISETIME? (I:RTIM?)	R				s	Returns the voltage-rise-time setting.	①	①
87	IR:WAITTIME (I:WTIM)	W	0.3	10	0.1	s	Sets the WAIT TIME (0.3 to 10.0).	②	②
88	IR:WAITTIME? (I:WTIM?)	R				s	Returns the judgment-wait-time setting.	①	①
89	IR:GND (I:GND)	W	LOW	GUARD	0/1	--	1 to set GND to GUARD, and 0 to set it to LOW	②	②
90	IR:GND? (I:GND?)	R				--	Returns the GUARD/LOW setting for GND as 1 or 0.	①	①
91	IR:SCAN (I:SCAN)	W	1	16	1	--	Sets channels 1 through 16 to Hi/Low/Open.	②	②
			H	L	H/L/O	--			
92	IR:SCAN? (I:SCAN?)	R	1	16	1	--	Returns the Hi/Low/Open settings for channels 1 through 16.	①	①
93	IR:SCANW (I:SCANW)	W	0	65535 #HFFFF	1	--	The 1st data represents channels 1 through 16 with 0: Low and 1: Hi, using 16 bits. The 2nd data represents Open and Not Open, with 1 for Open. The Open setting for the 2nd data has priority over the 1st data.	②	②
			0	65535 #HFFFF	1	--			
94	IR:SCANW? (I:SCANW?)	R				--	Returns a WORD-type value for Hi/Low and Open/Not Open.	①	①
95	IR:CONTACT CHECK (I:CCH)	W	OFF	ON	0/1	--	Sets ON/OFF for the scanner contact check function.	②	②
96	IR:CONTACT CHECK?(I:CCH?)	R	0	1	0/1	--	Returns the ON/OFF status of the scanner contact check function.	①	①

3.10.5 Messages common to all tests

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
97	VDATA? (VDAT?)	R				V	Monitor voltage (ACW: 0 E3 to 9.99 E3) (DCW: 0 E3 to 99.9 E3) (IR: 0 to 9999)	①	①
98	IDATA? (IDAT?)	R				A	Monitor current (0 to 999 E–6, 1.00 E–3 to 9.99 E–3, 10.0 E–3 to 99.9 E–3, 100 E–3 to 999 E–3)	①	①
99	RDATA? (RDAT?)	R				Ω	Monitor resistance (0.01 E6 to 9.99 E6, 10.0 E6 to 99.9 E6, 100 E6 to 999 E6, 1.00 E9 to 9.99 E9)	①	①
100	REALDATA? (REAL?)	R				A	Real current (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3)	①	①
101	IMAGDATA? (IMAG?)	R				A	Imaginary current (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3)	①	①
102	TIME?	R				s, --	Returns the elapsed (remaining) time (0 s to 99.9 s, 100 s to 999 s) and Rise/Test/Fall/End (0/1/2/3). Returns the elapsed time when the timer is off. Returns the remaining time when the timer is on.	①	①
103	MON?	R					Test type (0: ACW; 1: DCW; 2: IR) Monitor voltage (W: 0 E3 to 99.9 E3; IR: 0 to 9999) Monitor current Norm (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3) Monitor current MAX (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3) Monitor resistance Norm (0.01 E6 to 9.99 E6, 10.0 E6 to 99.9 E6, 100 E6 to 999 E6, 1.00 E9 to 9.99 E9) Monitor resistance Min (0.01 E6 to 9.99 E6, 10.0 E6 to 99.9 E6, 100 E6 to 999 E6, 1.00 E9 to 9.99 E9) Real current (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3) Imaginary current (0 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3) Monitor current IR (0 to 999 E-9, 1.00 E–6 to 9.99 E–6, 100 E–6 to 999 E–6, 1.00 E-3 to 9.99 E-3, 10.0 E-3 to 99.9 E-3, 100 E-3 to 999 E-3) Monitor resistance DCW (0.01 E6 to 9.99 E6, 10.0 E6 to 99.9 E6, 100 E6 to 999 E6, 1.00 E9 to 9.99 E9, 10.0 E9 to 99.9 E9, 100 E9 to 999 E9) Elapsed (remaining) time (0 s to 99.9 s, 100 s to 999 s) Separates Rise/Test/Fall/End (0/1/2/3) using “,” in this order and then returns it. The results of the previous test are returned except during the test. Returns the monitor current in ACW and DCW, and the monitor resistance in IR.	①	①
104	SCANTYPE? (STYP?)	R				--	Returns the number of valid channels and the scanner type (Units 1 through 4). (0: none; 1: TOS9220; 2: TOS9221)	①	①
105	CFAILCH? (CFCH?)	R				--	Returns the channel number (1 through 16) in the CONTACT FAIL status.	①	①

3.10.6 System-related messages

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
106	MEASMODE (MMOD)	W	NORM	MAX		--	Sets the measured-current (resistance) display mode. NORM: Real Time; MAX: Max Hold	②	②
107	MEASMODE? (MMOD?)	R	0	1	0/1	--	Sets the measured-current (resistance) display mode. NORM: Real Time; MAX: Max Hold	①	①
108	PASSHOLD (PHOL)	W	0.2	10 HOLD	0.1	s	Pass hold time	②	②
109	PASSHOLD? (PHOL?)	R				s	Returns the pass hold time. 0.2 to 10.0 or HOLD	①	①
110	BUZZERVOL (BVOL)	W	0	10	1	--	Sets the buzzer volume.	①	①
111	BUZZERVOL? (BVOL?)	R				--	Returns the buzzer-volume setting.	①	①
112	CONTRAST (CON)	W	0	10	1	--	Sets the contrast level.	①	①
113	CONTRAST? (CON?)	R				--	Returns the contrast setting.	①	①
114	MOMENTARY (MOM)	W	OFF	ON	OFF/ON	--	Start momentary	②	②
115	MOMENTARY? (MOM?)	R				--	Returns the start-momentary setting. ON/OFF is returned as 1 or 0.	①	①
116	FAILMODE (FMOD)	W	OFF	ON	OFF/ON	--	Fail mode (The STOP key used to cancel the Fail and Protection statuses.)	②	②
117	FAILMODE? (FMOD?)	R				--	Returns the Fail-mode value. ON/OFF is returned as 1 or 0.	①	①
118	DOUBLEACTION (DAC)	W	OFF	ON	OFF/ON	--	Start double action	②	②
119	DOUBLEACTION? (DAC?)	R				--	Returns the start-double-action value. ON/OFF is returned as 1 or 0.	①	①
120	SIGHVON (SHV)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: HVON.	①	①
121	SIGHVON? (SHV?)	R				--	ON/OFF is returned as 1 or 0.	①	①
122	SIGTEST (STES)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: TEST.	①	①
123	SIGTEST? (STES?)	R				--	ON/OFF is returned as 1 or 0.	①	①
124	SIGPASS (SPAS)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: PASS.	①	①
125	SIGPASS? (SPAS)	R				--	ON/OFF is returned as 1 or 0.	①	①
126	SIGUFAIL (SUF)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: U FAIL.	①	①
127	SIGUFAIL? (SUF?)	R				--	ON/OFF is returned as 1 or 0.	①	①
128	SIGLFAIL (SLF)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: L FAIL.	①	①
129	SIGLFAIL? (SLF)	R				--	ON/OFF is returned as 1 or 0.	①	①
130	SIGREADY (SREA)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: READY.	①	①
131	SIGREADY? (SREA?)	R				--	ON/OFF is returned as 1 or 0.	①	①
132	SIGPROTECTION (SPR)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: PROTECTION.	①	①
133	SIGPROTECTION? (SPR?)	R				--	ON/OFF is returned as 1 or 0.	①	①
134	SIGCFAIL (SCF)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: CONTACT FAIL.	①	①

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
135	SIGCFAIL? (SCF?)	R				--	ON/OFF is returned as 1 or 0.	①	①
136	SIGPOWERON (SPOW)	W	OFF	ON	OFF/ON	--	Sets the value of Status Signal Output: POWER ON.	①	①
137	SIGPOWERON? (SPOW?)	R				--	ON/OFF is returned as 1 or 0.	①	①
138	COMMENT (COM)	W	20H	7EH		--	Comment (memo) 20 characters in the 1st line *1	②	②
			20H	7EH		--	Comment (memo) 20 characters in the 2nd line *1		
			20H	7EH		--	Comment (memo) 20 characters in the 3rd line *1		
			(“*1: 20H to 7EH are ASCII code. Except (“), (‘), (,), and (@))						
139	COMMENT? (COM?)	R				--,--, --	Returns a comment (memo). 1st line, 2nd line, 3rd line	①	①

3.10.7 Memory-related messages

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
140	ACW:RECALL (A:REC)	W	0	99	1	--	Recalls ACW memory.	②	②
141	DCW:RECALL (D:REC)	W	0	99	1	--	Recalls DCW memory.	②	②
142	IR:RECALL (I:REC)	W	0	99	1	--	Recalls IR memory.	②	②
143	ACW:STORE (A:STOR)	W	0	99	1	--	Stores the current settings in ACW memory (except for the memory name).	②	②
144	DCW:STORE (D:STOR)	W	0	99	1	--	Stores the current settings in DCW memory (except for the memory name).	②	②
145	IR:STORE (I:STOR)	W	0	99	1	--	Stores the current settings in IR memory (except for the memory name).	②	②
146	ACW:MEMORY (A:MEM)	W	0	99	1	--	Stores the next contents in the memory corresponding to an ACW memory number.	②	②
			20H	7EH		--	Memory name: 12 characters (20H to 7EH are ASCII code. Except (“), (‘), (,), and (@))		
			0	5.2 E3	0.01	V	Test voltage		
			0.01 E-3	110 E-3	0.01, 0.1, 1	A	Lower current		
			0.01 E-3	110 E-3		A	Upper current		
			0.3	999	0.1, 1	s	Test time		
			50	60	50/60	Hz	Frequency		
			OFF	ON	OFF/ON	--	Lower ON/OFF		
			OFF	ON	OFF/ON	--	Offset ON/OFF		
			OFF	ON	OFF/ON	--	Timer ON/OFF		
			0	99	1	%	Start-voltage/test-voltage ratio		
			0.1	200	0.1, 1	s	Voltage rise time		
			0	200	0.1, 1	s	Voltage fall time		
			0	1	0/1	--	V RANGE (0: AUTO; 1: 5 kV)		
			0	2	0/1/2	--	Response settings (0: SLOW; 1: MID; 2: FAST)		
			0	1	0/1	--	GND (0: LOW; 1: GUARD)		
			0	1	0/1	--	Contact Check		
			0	65535	1	--	Scanner Hi/Low (0 to 0xFFFF:16Bit, 0:Low, 1:Hi)		
			0	65535	1	--	Scanner Open (0 to 0xFFFF:16Bit, 0:Hi or Low, 1:Open)		

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
147	ACW:MEMORY? (A:MEM?)	R	0	99	1	--	Returns the contents of memory corresponding to the ACW memory number (memory name, test voltage, lower current, upper current, test time, frequency, lower ON/OFF, offset ON/OFF, timer ON/OFF, start-voltage/test-voltage ratio, voltage rise time, voltage fall time, V RANGE (0/1), response filter setting (0/1/2), GND, contact check, scanner Hi/Low, scanner Open). ON/OFF is returned as 1 or 0. Scanner Hi/Low and scanner Open are returned in decimal form using 16 bits.	①	①
148	DCW:MEMORY (D:MEM)	W	0	99	1	--	Stores the next contents in the memory corresponding to a DCW memory number.	②	②
			20H	7EH		--	Memory name: 12 characters (20H to 7EH are ASCII code. Except (“), (‘), (,), and (@))		
			0	6 E3	0.01	V	Test voltage		
			0.01 E-3	11 E-3	0.01,0.1	A	Lower current		
			0.01 E-3	11 E-3	0.01,0.1	A	Upper current		
			0.3	999	0.1, 1	s	Test time		
			OFF	ON	OFF/ON	--	Lower ON/OFF		
			OFF	ON	OFF/ON	--	Timer ON/OFF		
			0	99	1	%	Start-voltage/test-voltage ratio		
			0.1	200	0.1, 1	s	Voltage rise time		
			0.3	10	0.1	s	WAIT TIME		
			0	1	0/1	--	GND (0: LOW; 1: GUARD)		
			0	1	0/1	--	Contact Check		
			0	65535	1	--	Scanner Hi/Low (0 to 0xFFFF:16Bit, 0:Low, 1:Hi)		
			0	65535	1	--	"Scanner Open (0 to 0xFFFF:16Bit, 0:Hi or Low, 1:Open)"		
149	DCW:MEMORY? (D:MEM?)	R	0	99	1	--	Returns the contents of memory corresponding to the DCW memory number (memory name, test voltage, lower current, upper current, test time, lower ON/OFF, timer ON/OFF, start-voltage/test-voltage ratio, voltage rise time, WAIT TIME, response filter setting (0/1/2), GND, contact check, scanner Hi/Low, scanner Open). ON/OFF is returned as 1 or 0. Scanner Hi/Low and scanner Open are returned in decimal form using 16 bits.	①	①
150	IR:MEMORY (I:MEM)	W	0	99	1	--	Stores the next contents in the memory corresponding to an IR memory number.	②	②
			20H	7EH		--	Memory name: 12 characters (20H to 7EH are ASCII code. Except (“), (‘), (,), and (@))		
			10	1020	1	V	Test voltage		
			0.01 E6	9.99G E9	0.01, 0.1, 1	Ω, Ω	Lower current		
			0.01 E6	9.99 E9			Upper current		
			0.5	999	0.1, 1	s	Test time		
			OFF	ON	OFF/ON	--	Lower ON/OFF		
			OFF	ON	OFF/ON	--	Timer ON/OFF		
			OFF	ON	OFF/ON	--	Start-voltage/test-voltage ratio		
			0.1	200	0.1, 1	s	Voltage rise time		
			0.3	10	0.1	s	WAIT TIME		
			0	1	0/1	--	GND (0: LOW; 1: GUARD)		
			0	1	0/1	--	Contact Check		
			0	65535	1	--	Scanner Hi/Low (0 to 0xFFFF:16Bit, 0:Low, 1:Hi)		
			0	65535	1	--	"Scanner Open (0 to 0xFFFF:16Bit, 0:Hi or Low, 1:Open)"		

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
151	IR:MEMORY? (I:MEM?)	R	0	99	1	--	Returns the contents of the memory corresponding to an IR memory number (memory name, test voltage, lower resistance, upper resistance, test time, upper ON/OFF, timer ON/OFF, voltage rise time, WAIT TIME, GND, contact check, scanner Hi/Low, scanner Open). ON/OFF is returned as 1 or 0. Scanner Hi/Low and scanner Open are returned in decimal form using 16 bits.	①	①

3.10.8 Program-related messages

	Header	Data					Function and response data	A	B
		R/W	Min.	Max.	Resolution	Unit		Note 1	Note 2
152	PRGNAME (PNAM)	W	0	99	1	--	Program number	②	②
			20H	7EH		--	Program name: 12 characters (20H to 7EH are ASCII code. Except (“), (‘), (,), and (@))		
153	PRGNAME? (PNAM?)	R	0	99	1		Returns the program name corresponding to a program number	①	①
154	PRGTEST (PTES)	W	0	99	1	--	Sets the program corresponding to a program number.	②	②
155	PRGEDIT (PED) Note 3	W	0	99	1	--	Program number	②	②
			0	99	1	--	Program step number		
			0	2	0/1/2	--	0: ACW, 1: DCW, 2: IR		
			0	99	1	--	Memory number		
			0.2	9.9, HOLD	0.1	s	Interval time Proceeds to the next step by pressing the START key when in the HOLD status.		
156	PRGEDIT? (PED?)	R	0	99	1	--	Returns the contents of a program corresponding to a program number and step number.	①	①
			0	99	1	--			
157	PRGRETURN (PRET)	W	0	99	1	--	Program number	②	②
			OFF	ON	OFF/ON	--	OFF: END (Ends the program) ON: RET (Returns to the first step)		
158	PRGRETURN? (PRET?)	R	0	99	1	--	Returns ON/OFF of the RETURN setting for the program corresponding to a program number.	①	①
159	PRGNEW (PNEW)	W	0	99	1	--	Clears the program corresponding to a program number.	②	②
160	PRGTOTAL? (PTOT?)	R	0	99	1	--	Returns the total number of steps in the program corresponding to a program number.	①	①
161	PRGINS (PIN) Note3	W	0	99	1	--	Program number	②	②
			0	99	1	--	Program step number		
			0	2	0/1/2	--	0: ACW, 1: DCW, 2: IR		
			0	99	1	--	Memory number		
162	PRGDEL (PDEL)	W	0	99	1	--	Program number	②	②
			0	99	1	--	Program step number		
163	AUTORUNNING? (ARUN?)	R					Returns the step currently being executed by a program.	①	①

Note 3: When PRGEDIT (PED) or PRGINS (PIN) is executed, the program EDIT screen automatically appears.

Appendix

Sample Program

The following provides some examples of remote programming using the GPIB or RS-232C interface.

These sample programs are created with Microsoft Visual Basic running on Windows 95/98/NT/2000, and use as a GPIB board a National Instruments NI-488.2M-compatible board or an Agilent Technologies HP-IB board. To run the program, the VISA (Virtual Instrument Software Architecture) library is required.

To use the VISA library on Visual Basic, follow the procedure specified below.

1. Obtain the VISA library.

   The VISA library may be included as a standard or optional feature with a GPIB/HP-IB board. It is also available on certain CD-ROMs such as LabVIEW. In addition, it can be downloaded at http://www.ni.com.

2. Install the VISA library.

3. Add VISA32.BAS and VPPTYPE.BAS to the Visual Basic project.

   These files can be found in c:\vxipnp\winnt\include folder (“winnt” may be changed in accordance with the OS).

The sample programs specified in this Appendix use GPIB. To create a program using the COM1 or COM2 port, convert the character strings that are passed to viOpen functions into “ASRL1” or “ASRL2.”

Sample Program 1

This sample program runs a test after setting TOS9200 test conditions using GPIB and displays the test results in the message box. When the RS-232C is used, comments are used for commands.

```
Private Sub Command1_Click()
   'Writing style is based on VISA 1.20 or 2.01
   '-----------------------------------------
   Dim vi As Long, tos As Long
   Dim vs As Long

   'Initialize VISA library                              'Initialize the VISA library.
   vs = viOpenDefaultRM(vi)
   'Open GPIB or COM1 port for tos                       'Open the port.
   vs = viOpen(vi, "GPIB::4", vbNull, 10, tos)          'Open address 4 of the GPIB port.
   'vs = viOpen(vi, "ASRL1", vbNull, 10, tos)           'To use the open RS-232C  of the
                                                        'COM1 port, delete the existing
                                                        'comment and use the GPIB lines as a
                                                        ' comment instead.
   'Sets attributes if RS232                            'For the RS-232C, make communication settings.
   Dim lIntfType As Long
   vs = viGetAttribute(tos, VI_ATTR_INTF_TYPE, lIntfType)
   If lIntfType = VI_INTF_ASRL Then
      vs = viSetAttribute(tos, VI_ATTR_ASRL_BAUD, 9600)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_PARITY, VI_ASRL_PAR_NONE)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_DATA_BITS, 8)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_STOP_BITS, VI_ASRL_STOP_TWO)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_FLOW_CNTRL, VI_ASRL_FLOW_XON_XOFF)
   End If

   Const DSR_READY = 1: Const DSR_INVSET = 2: Const DSR_TEST = 4: Const DSR_TESTON =8
                                                        'Define the device status register.
   Const DSR_PASS = 16: Const DSR_FAIL = 32: Const DSR_STOP = 64: Const DSR_PROTECTION = 128
   Const LOWER_FAIL = 2: Const UPPER_FAIL = 4           'Define the fail register.
   Const OHP = 1: Const OHPT = 2: Const LVP = 16: Const OVLD = 32
                                                        'Define protection register 1.
   Const LCK = 4: Const REN = 32                        'Define protection register 2.

   Dim r As Long, c As Long
   Dim strCommand As String, strRdBack As String, DSR As Integer, Result As String
   Dim PROT1 As Integer, PROT2 As Integer
   strRdBack = Space(255)

   'Device Clear
   vs = viClear&(tos)                                   'Clear the device used with GPIB.
   'strCommand = "SILENT 1" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'RS-232C command

   'FREQUENCY 50Hz,VOLT 0.05kV,UPPER 0.35mA,LOWER 0.01 ON,OFFSET OFF,TIMER 10sec ON
   '-------------------------------------------------------------------------
   strCommand = "FUNCTION 0" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'Make settings on the ACW screen.
   strCommand = "A:FREQ 50" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'Test frequency: 50Hz
   strCommand = "A:TES 0.05E+3" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'Test voltage: 0.05kV
   strCommand = "A:UPP 0.35E-3" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'Upper current: 0.35mA
```

```
strCommand = "A:LOW 0.01E-3,OFF" + vbCrLf: vs = viWrite(tos, strCommand,
Len(strCommand), r)                                    'Lower current: 0.01mA, ON
strCommand = "A:OFF OFF" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Offset function OFF
strCommand = "A:TIM 10,ON" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Timer function: 10s, ON
strCommand = "PASSHOLD HOLD" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Pass hold function: HOLD
strCommand = "DSE #HFF" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Set the device-status enable
                                                       'register to FFH.

Do              'Check the device status register, wait until the READY status is ON.
   strCommand = "DSR?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   If Val(strRdBack) = DSR_READY Then Exit Do          'Exit the loop when the test is
Loop                                                   'ready.

strCommand = "START" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Start the program because the READY
                                                       'status is ON.

Do            'Read the DSR value using the DSR? command. Read the measured value and other
              'data using the MON? command.
   strRdBack = Space(255)
   strCommand = "DSR?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   DSR = Val(strRdBack)                                'Retrieve the DSR value.
   strRdBack = Space(255)
   strCommand = "MON?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   Result = strRdBack                                  'Retrieve the measured value.
   If DSR = DSR_READY Or DSR = DSR_PASS Or DSR = DSR_FAIL Or DSR = DSR_STOP
   Or DSR = DSR_PROTECTION Then Exit Do                'Upon completion of the test, exit
Loop                                                   'the loop.

Select Case DSR                                        'Display the test results.
   Case DSR_STOP
      MsgBox ("USER CANCEL! " + Result)
                                                       'The STOP switch has been pressed
   Case DSR_READY                                      'during the test.
      MsgBox ("USER CANCEL! " + Result)
                                                       'The STOP switch has been pressed
   Case DSR_PASS                                       'during the test.
      MsgBox ("PASS! " + Result)
                                                       'Display the PASS test results.
   Case DSR_FAIL
      strRdBack = Space(255)
      strCommand = "FAIL?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                       'Read the contents of the fail
      vs = viRead(tos, strRdBack, 255, c)              'register, and determine whether the
                                                       'LOWER FAIL or UPPER FAIL test has
                                                       'been failed.
      If Val(strRdBack) = LOWER_FAIL Then MsgBox ("LOWER FAIL! " + Result)
                                                       'Display the LOWER FAIL test results.
      If Val(strRdBack) = UPPER_FAIL Then MsgBox ("UPPER FAIL! " + Result)
                                                       'Display the UPPER FAIL test results.
   Case DSR_PROTECTION
      strRdBack = Space(255)
```

```
        strCommand = "PROT?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Read the protection register, check
        vs = viRead(tos, strRdBack, 255, c)         'the cause of the protection status.
        PROT1 = Val(Left$(strRdBack, InStr(1, strRdBack, ",") - 1))
        PROT2 = Val(Mid$(strRdBack, InStr(1, strRdBack, ",") + 1))
        If PROT1 = OHP Then MsgBox ("OVER HEAT PROTECTION! " + Result)
                                                    'The overheat protection function has
                                                    'activated.
        If PROT1 = OHPT Then MsgBox ("OVER HEAT TIMER PROTECTION! " + Result)
                                                    'A current of 50 mA or more has been
                                                    'detected for 30 minutes.
        If PROT1 = LVP Then MsgBox ("OVER CURRENT PROTECTION! " + Result)
                                                    'The voltage of the main power supply
                                                    'has dropped.
        If PROT1 = OVLD Then MsgBox ("OVER LOAD PROTECTION! " + Result)
                                                    'The overload (500 VA) protection
                                                    'function has activated.
        If PROT2 = LCK Then MsgBox ("INTER LOCK PROTECTION! " + Result)
                                                    'There has been a change in the
                                                    'signal for SIGNAL I/O.
        If PROT2 = REN Then MsgBox ("SIGNAL I/O PROTECTION! " + Result)
                                                    'There has been a change in ENABLE
                                                    'for SIGNAL I/O.
      Case Else
        MsgBox ("ERROR!!")
    End Select
    strCommand = "STOP" & vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Check the test results, and press
                                                    'the STOP switch.
    'Closes the port
    vs = viClose(tos)                               'Close the port.
    'Finalize VISA library
    vs = viClose(vi)                                'Close the VISA library.

End Sub
```

Sample Program 2

This program sets test conditions in three memories of the TOS9200 using GPIB, then sets a memory number for the program memory and prepares for execution of an AUTO test.

```
Private Sub Command1_Click()
   'Writing style is based on VISA 1.20 or 2.01
   '-----------------------------------------
   Dim vi As Long, tos As Long
   Dim vs As Long

   'Initialize VISA library                                    'Initialize the VISA library.
   vs = viOpenDefaultRM(vi)

   'Open GPIB or COM1 port for tos                             'Open the port.
   vs = viOpen(vi, "GPIB::4", vbNull, 10, tos)                'Open address 4 of the GPIB port.

   'vs = viOpen(vi, "ASRL1", vbNull, 10, tos)                  'To use the open RS-232C of the COM1
                                                              'port, delete the existing comment
                                                              'and instead use the GPIB lines as a
                                                              'comment.

   'Sets attributes if RS232                                  'For RS-232C, make communication
   Dim lIntfType As Long                                      'settings.
   vs = viGetAttribute(tos, VI_ATTR_INTF_TYPE, lIntfType)
   If lIntfType = VI_INTF_ASRL Then
      vs = viSetAttribute(tos, VI_ATTR_ASRL_BAUD, 9600)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_PARITY, VI_ASRL_PAR_NONE)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_DATA_BITS, 8)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_STOP_BITS, VI_ASRL_STOP_TWO)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_FLOW_CNTRL, VI_ASRL_FLOW_XON_XOFF)
   End If

   Dim r As Long, c As Long
   Dim strCommand As String

   'Device Clear
   vs = viClear&(tos)                                         'Clear the device used with the GPIB.
   'strCommand = "SILENT 1" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                              'RS-232C command

   strCommand = "FUNCTION 0" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                              'Make settings on the ACW screen.

   strCommand = "A:MEM 20," + Chr$(34) + "TEST1" + Chr$(34) + ",1.05E3,0.1E-3,0.2E-3,10,50,
   0,0,1,0,0.1,0.0,0,0,0,0,0,65535" + vbCrLf                  'A: Set test conditions in MEM20.
   vs = viWrite(tos, strCommand, Len(strCommand), r)
   strCommand = "A:MEM 21," + Chr$(34) + "TEST2" + Chr$(34) + ",1.15E3,0.1E-3,0.2E-3,10,50,
   0,0,1,0,0.1,0.0,0,0,0,0,0,65535" + vbCrLf                  'A: Set test conditions in MEM21.
   vs = viWrite(tos, strCommand, Len(strCommand), r)
   strCommand = "A:MEM 22," + Chr$(34) + "TEST3" + Chr$(34) + ",1.25E3,0.1E-3,0.2E-3,10,50,
   0,0,1,0,0.1,0.0,0,0,0,0,0,65535" + vbCrLf                  'A: Set test conditions in MEM22.
   vs = viWrite(tos, strCommand, Len(strCommand), r)

   strCommand = "FUNCTION 4" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                              'Make settings on the AUTO EDIT
                                                              'screen.
```

```
   strCommand = "PRGNEW 10" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Clear program 10.

   strCommand = "PRGNAME 10," + Chr$(34) + "TEST_SAMPLE" + Chr$(34) + vbCrLf
                                                    'Name program 10.
   vs = viWrite(tos, strCommand, Len(strCommand), r)

   strCommand = "PRGEDIT 10,0,0,20,0.5" + vbCrLf: vs = viWrite(tos, strCommand,
   Len(strCommand), r)                              'Set MEM20, MEM21, and MEM22 in
                                                    'program 10.
   strCommand = "PRGEDIT 10,1,0,21,1.5" + vbCrLf: vs = viWrite(tos, strCommand,
   Len(strCommand), r)
   strCommand = "PRGEDIT 10,2,0,22,2.5" + vbCrLf: vs = viWrite(tos, strCommand,
   Len(strCommand), r)

   strCommand = "FUNCTION 3" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Make settings on the AUTO TEST
                                                    'screen.
   'Closes the port
   vs = viClose(tos)                                'Close the port.
   'Finalize VISA library
   vs = viClose(vi)                                 'Close the VISA library.

   MsgBox ("END")

End Sub
```

Sample Program 3

This sample program automatically runs Program 10 that is programmed on Sample Program 2 and displays the test results in the message box.

```
Private Sub Command1_Click()
   'Writing style is based on VISA 1.20 or 2.01
   '-----------------------------------------
   Dim vi As Long, tos As Long
   Dim vs As Long

   'Initialize VISA library                              'Initialize the VISA library.
   vs = viOpenDefaultRM(vi)

   'Open GPIB or COM1 port for tos                       'Open the port.
   vs = viOpen(vi, "GPIB::4", vbNull, 10, tos)          'Open address 4 of the GPIB port

   'vs = viOpen(vi, "ASRL1", vbNull, 10, tos)           'To use the open RS-232C of the COM1
                                                        'port, delete the existing comment
                                                        'and instead use GPIB lines as a
                                                        'comment.

   'Sets attributes if RS232                            'For RS-232C, make communication
                                                        'settings.
   Dim lIntfType As Long
   vs = viGetAttribute(tos, VI_ATTR_INTF_TYPE, lIntfType)
   If lIntfType = VI_INTF_ASRL Then
      vs = viSetAttribute(tos, VI_ATTR_ASRL_BAUD, 9600)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_PARITY, VI_ASRL_PAR_NONE)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_DATA_BITS, 8)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_STOP_BITS, VI_ASRL_STOP_TWO)
      vs = viSetAttribute(tos, VI_ATTR_ASRL_FLOW_CNTRL, VI_ASRL_FLOW_XON_XOFF)
   End If

   Const DSR_READY = 1: Const DSR_INVSET = 2: Const DSR_TEST = 4: Const DSR_TESTON = 8
                                                        'Define the device status register.
   Const DSR_PASS = 16: Const DSR_FAIL = 32: Const DSR_STOP = 64: Const DSR_PROTECTION = 128
                                                        'Define the fail register.
   Const OHP = 1: Const OHPT = 2: Const LVP = 16: Const OVLD = 32
                                                        'Define protection register 1.
   Const LCK = 4: Const REN = 32                        'Define protection register 2.

   Dim r As Long, c As Long
   Dim strCommand As String, strRdBack As String, DSR As Integer, Result As String
   Dim PROT1 As Integer, PROT2 As Integer
   strRdBack = Space(255)

   'Device Clear
   vs = viClear&(tos)                                   'Clear the device used with GPIB.
   'strCommand = "SILENT 1" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'RS-232C command

   strCommand = "FUNCTION 3" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                        'Make settings on the AUTO TEST
                                                        'screen.
     strCommand = "PRGTEST 10" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                         'Recall No. 10.
```

```
  strCommand = "PASSHOLD HOLD" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Set the pass hold function to HOLD.
  strCommand = "DSE #HFF" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Set the device-status enable
                                                    'register to FFH.
strCommand = "PRGTOTAL? 10" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Check the total number of steps in No.10.
vs = viRead(tos, strRdBack, 255, c)
If Val(strRdBack) = 0 Then                          'If the total number of steps is 0,
   MsgBox ("Not program! ")                         'end the program.
   GoTo Err
End If

Do              'Check the device status register and wait until the READY status is on.
   strCommand = "DSR?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   If Val(strRdBack) = DSR_READY Then Exit Do       'Exit the loop when the READY status
Loop                                                'is on.

   strCommand = "START" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Start the program because the READY
                                                    'status is on.

Do              'Read the DSR value using the DSR? command. Read the measured value and other
                'data using the MON? command.
   strRdBack = Space(255)
   strCommand = "DSR?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   DSR = Val(strRdBack)                             'Retrieve the DSR value.
   strRdBack = Space(255)
   strCommand = "MON?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
   vs = viRead(tos, strRdBack, 255, c)
   Result = strRdBack                               'Retrieve the measured value.
   If DSR = DSR_READY Or DSR = DSR_PASS Or DSR = DSR_FAIL Or DSR = DSR_STOP
   Or DSR = DSR_PROTECTION Then Exit Do             'Upon completion of the test, exit
Loop                                                'the loop.

Select Case DSR                                     'Display the test results.
   Case DSR_STOP
      MsgBox ("USER CANCEL! " + Result)             'The STOP switch has been pressed
                                                    'during the test.
   Case DSR_READY
      MsgBox ("USER CANCEL! " + Result)             'The STOP switch has been pressed
                                                    'during the test.
   Case DSR_PASS
      MsgBox ("PASS! " + Result)                    'Display the PASS test results.
   Case DSR_FAIL
      strRdBack = Space(255)
      strCommand = "FAIL?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Read the contents of the fail
      vs = viRead(tos, strRdBack, 255, c)           'register and determine whether the
                                                    'LOWER FAIL or UPPER FAIL test has
                                                    'been failed.
      If Val(strRdBack) = LOWER_FAIL Then MsgBox ("LOWER FAIL! " + Result)
                                                    'Display the LOWER FAIL test results.
      If Val(strRdBack) = UPPER_FAIL Then MsgBox ("UPPER FAIL! " + Result)
                                                    'Display the UPPER FAIL test results.
   Case DSR_PROTECTION
      strRdBack = Space(255)
```

```
        strCommand = "PROT?" + vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Read the protection register and
        vs = viRead(tos, strRdBack, 255, c)         'check the cause of the protection status.
        PROT1 = Val(Left$(strRdBack, InStr(1, strRdBack, ",") - 1))
        PROT2 = Val(Mid$(strRdBack, InStr(1, strRdBack, ",") + 1))
        If PROT1 = OHP Then MsgBox ("OVER HEAT PROTECTION! " + Result)
                                                    'The overheat protection function has
                                                    'activated.
        If PROT1 = OHPT Then MsgBox ("OVER HEAT TIMER PROTECTION! " + Result)
                                                    'A current of 50 mA or more has been
                                                    'detected for 30 minutes.
        If PROT1 = LVP Then MsgBox ("OVER CURRENT PROTECTION! " + Result)
                                                    'The voltage of the main power supply
                                                    'has dropped.
        If PROT1 = OVLD Then MsgBox ("OVER LOAD PROTECTION! " + Result)
                                                    'The overload (500 VA) protection
                                                    'function has activated.
        If PROT2 = LCK Then MsgBox ("INTER LOCK PROTECTION! " + Result)
                                                    'There has been a change in the
                                                    'signal for SIGNAL I/O.
        If PROT2 = REN Then MsgBox ("SIGNAL I/O PROTECTION! " + Result)
                                                    'There has been a change in ENABLE
                                                    'for SIGNAL I/O.
     Case Else
       MsgBox ("ERROR!!")
     End Select
     strCommand = "STOP" & vbCrLf: vs = viWrite(tos, strCommand, Len(strCommand), r)
                                                    'Check the test results, and press
                                                    'the STOP switch.
Err:
     'Closes the port
     vs = viClose(tos)                              'Close the port.
     'Finalize VISA library
     vs = viClose(vi)                               'Close the VISA library.

End Sub
```

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