HIOKI

Instruction Manual

3156

LEAK CURRENT HiTESTER

HIOKI E. E. CORPORATION

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60002463A

Contents

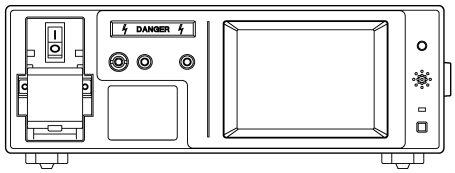
Introduction

Thank you for purchasing the HIOKI “3156 LEAK CURRENT HiTESTER”. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

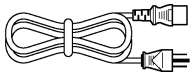
Standard Accessories

Checking the contents of the package

When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.



3156 LEAK CURRENT HiTESTER (1)



Power cord (2)

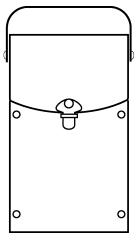
9170-10 TEST LEAD (2sets)
(2 red, 2 black, 1 spare included)

9195 ENCLOSURE PROBE (1)

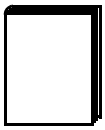
Alligator clips (3)
(2 red, 1 black)

Spare fuse for main instrument power supply 250V T0.1AL (1)

Spare fuse for measurement operation 250V T32mAL (1)



9399 CARRYING CASE (1)



Instruction manual (1)

Before using the 3156

- Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.
- Before using the instrument, make sure that the insulation on the test leads is undamaged and that no bare conductors are improperly exposed. Using the instrument under such conditions could result in electrocution. Replace the test leads with the specified Hioki Model 9170-10.

Shipping precautions

Use the original packing materials when reshipping the instrument, if possible.

Safety Notes

DANGER

This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument. However, using the instrument in a way not described in this manual may negate the provided safety features. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using the instrument, be sure to carefully read the following safety notes.

Safety Symbols

	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument.
	The ⚠ symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
	Indicates a fuse.
	Indicates a grounding terminal.
	Indicates AC (Alternating Current).
	Indicates the ON side of the power switch.
	Indicates the OFF side of the power switch.

The following symbols in this manual indicate the relative importance of cautions and warnings.

DANGER	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument.
NOTE	Advisory items related to performance or correct operation of the instrument.

Other Symbols

	Indicates the prohibited action.
❖	Indicates the reference.
GP-IB	Indicates descriptions relating to the GP-IB only.
RS-232C	Indicates descriptions relating to the RS-232C only.

Accuracy

We define measurement tolerances in terms of f.s. (full scale), rdg. (reading) and dgt. (digit) values, with the following meanings:

f.s. (maximum display value or scale length)
The maximum displayable value or the full length of the scale.
This is usually the maximum value of the currently selected range.

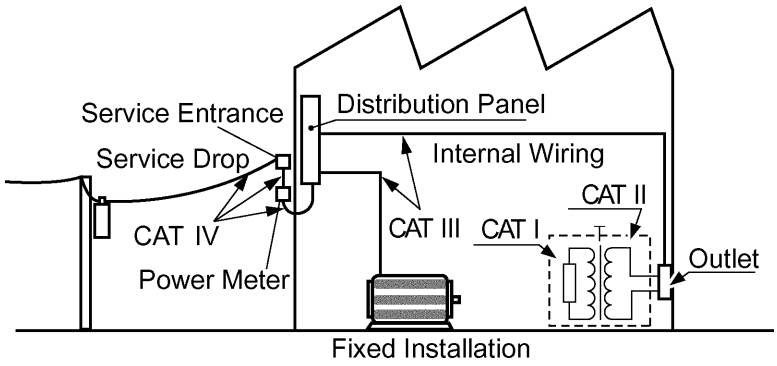
rdg. (reading or displayed value)
The value currently being measured and indicated on the measuring instrument.

dgt. (resolution)
The smallest displayable unit on a digital measuring instrument, i.e., the input value that causes the digital display to show a "1".

Measurement categories (Overvoltage categories)

This instrument complies with CAT II (300 V) safety requirements.
To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called measurement categories. These are defined as follows.

CAT I	Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.
CAT II	Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)
CAT III	Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.
CAT IV	The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



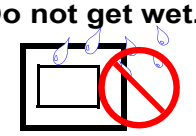
Higher-numbered categories correspond to electrical environments with greater momentary energy. So a measurement device designed for CAT III environments can endure greater momentary energy than a device designed for CAT II.
Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.
Never use a CAT I measuring instrumentin CAT II, III, or IV environments.
The measurement categories comply with the Overvoltage Categories of the IEC60664 Standards.

Usage Notes

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

WARNING

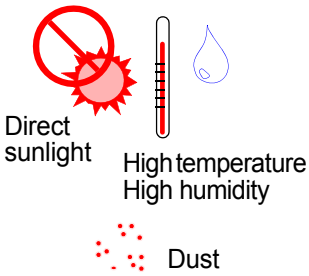
Do not get wet.



- **To avoid electric shock, do not allow the instrument to get wet, and do not use it when your hands are wet.**
- **Do not use the instrument where it may be exposed to corrosive or combustible gases. The instrument may be damaged or cause an explosion.**

Setting up the 3156

CAUTION



- This instrument should be installed and operated indoors only, between 0 and 40°C and 80% RH or less
- Do not store or use the instrument where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the instrument may be damaged and insulation may deteriorate so that it no longer meets specifications.
- This instrument is not designed to be entirely water- or dust-proof. To avoid damage, do not use it in a wet or dusty environment.
- Do not use the instrument near a device that generates a strong electromagnetic field or electrostatic charge, as these may cause erroneous measurements.
- To avoid damage to the instrument, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- If the protective functions of the instrument are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.

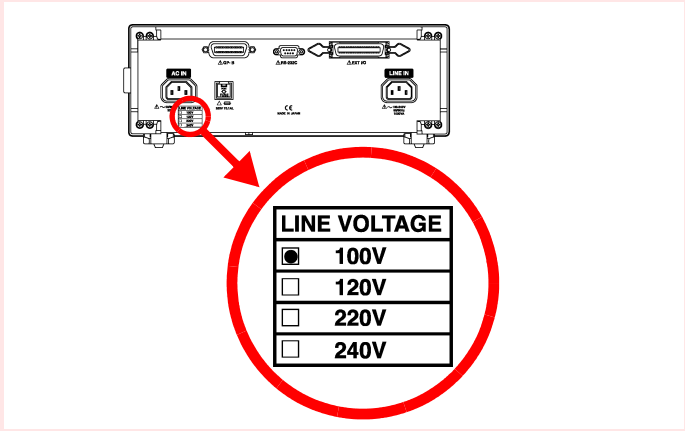
NOTE

If the instrument operates abnormally or displays an abnormal indication, turn off the power switch immediately, and contact your dealer or Hioki representative.

Precautions before measurement

WARNING

- **Before turning on the instrument, confirm that the voltage of the power source matches the voltage specification indicated on the instrument's power connector ([AC IN]). (The voltage specification (100, 120, 220 or 240 V) ordered by the customer is marked with a black dot ● in the line voltage column on the rear panel.)**
  Note that using the power supply with improper voltage may damage the instrument and result in electrical hazards.



- **To prevent electric shock and ensure safe instrument operation, connect the power cord provided to a grounded (3-contact) outlet.**

CAUTION

Do not use excessive force on the touch panel, and do not use sharp objects that could damage the touch screen.

Fuse

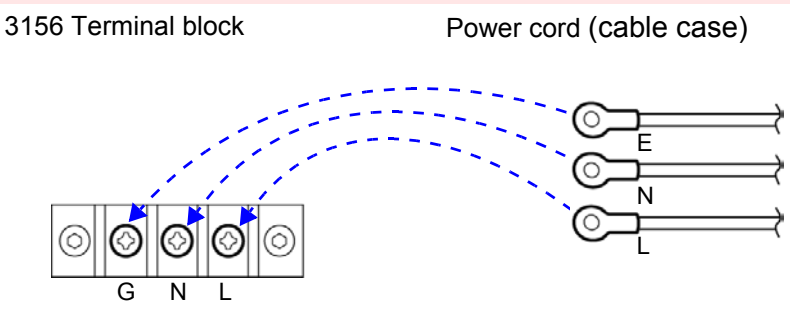
WARNING

- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Using a non-specified fuse or shorting the fuse holder may cause a life-threatening hazard.**
  Power supply section : F250V T0.1AL
  Measurement terminal section : F250V T32mAL
- **To avoid electric shock, turn off the power switch and disconnect the power cord and test leads before replacing the fuse.**

Connection

⚠CAUTION

- To avoid electrocution, turn off the power to all devices before plugging or unplugging any of the interface connectors.
- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging the cord from the power outlet.
- To avoid damaging the probes, do not bend or pull the probes.
- When the power is turned off, do not apply voltage or current to the measurement terminals. Doing so may damage the instrument.
- L (Line), N (Neutral) and G (Ground) are indicated on the terminal block of the instrument, and the contacts of the power cord of the device to be measured are denoted L, N and E (Earth). Connect the wires as shown below.
  Other wiring configurations may cause electric shock or damage.

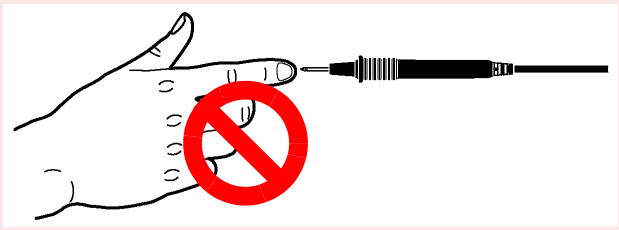


Note. If the power cord does not include an earth (E) line, connect only the L and N terminals.

Measurement

⚠WARNING

To avoid the risk of electric shock, do not touch the tips of test leads connected to terminals T1, T2, and T3.
In some measurement modes, high voltage is output from the terminals.



Chapter 1 Overview

1.1 Instrument Overview

To ensure the safe use of electrical products, it is necessary to conduct electrical safety tests such as insulation resistance, withstand voltage, ground resistance, and leakage current.
This instrument can be used to measure leakage current in all types of electrical products ranging from computers to medical equipment.
The instrument complies not only with medical electrical equipment standards but also standards and laws concerning other electrical products. This instrument consists of measurement networks that simulate the human body, and a high-frequency voltmeter, and can measure leakage current in compliance with various standards and laws. The instrument can also switch power supply polarities in equipment under test and measure leakage current under a simulated single-fault condition.
Because operation keys displayed on the touch panel are used to select and execute test items, it is easy to measure leakage current with the instrument.

Applicable lines of business and product applications

Manufacturers of medical electrical equipment	Type approval testing, shipment inspection
Dealers of medical electrical equipment	Maintenance, inspection
Service technicians for medical electrical equipment (authorized service technicians)	Maintenance, inspection
Clinical engineers, hospitals	Maintenance, inspection
Clinical engineering schools	For educational purposes
Authorized electricians for operating rooms, ICUs, and CCUs	Isolation transformer inspection
Public organizations	Type inspection
Manufacturers of general electrical equipment	Type inspection, shipment inspection
Users of general electrical equipment	Maintenance, inspection
General electrical equipment installers	Maintenance, inspection
Service technicians for general electrical equipment	Maintenance, inspection
Manufacturers of general electrical equipment parts	Type inspection, shipment inspection
Manufacturers of power supply equipment	Type inspection, shipment inspection

1.2 Features

Wide range of measurement networks in compliance with standards and laws

To test electrical equipment for leakage current, it is necessary to use a measurement network that simulates the human body in compliance with applicable standards or laws.
The instrument includes the six measurement networks below.
The use of these networks enables instrument compliance with other standards.

(1) Network A : For compliance with JIS Electrical Appliance and MaterialSafety Law
(2) Network B : For medical electrical equipment
(3) Network C : For IEC60990
(4) Network D : For UL
(5) Network E : For general-purpose 1
(6) Network F : For general-purpose 2

Leakage current measurement mode

Once a measurement network is set, the instrument displays a leakage current measurement mode corresponding to the applicable standard or law.

(1) Earth leakage current
(2) Leakage current between enclosure and earth
(3) Leakage current between enclosure and enclosure
(4) Leakage current between enclosure and line
(5) Patient auxiliary current
(6) Patient leakage current I
(7) Patient leakage current II
(8) Patient leakage current III

Ease of operation

Once a measurement network is set, the instrument displays a leakage current measurement mode corresponding to the applicable standard or law.
All operations are performed using the touch panel. The display shows operable keys and the interactive system guides you through measurement procedures.

Interfaces

The RS-232C, GP-IB, and EXT I/O interfaces are provided as standard equipment to enable the easy transfer of measurement data with a computer. The EXT I/O connector allows external control.

Printing (with optional printer)

Connect the optional 9442 PRINTER to print out measurement data and saved measurement data.

Monitor function

The instrument is equipped with a function to monitor the power supply voltage and current of equipment under test.

1.3 About Leakage Current Measurement

1.3.1 What is Leakage Current?

High voltage is generated in an electrical appliance that uses a commercial power supply as its main power source. Should an abnormality occur in such an appliance (due to faulty design or fault), electric current flows through the body of anyone who touches the appliance. This electric current is called "leakage current."
Leakage current can cause serious personal injury.
Severe electric shock can even result in death.
Some types of leakage current flow constantly, but leakage current, including under the single-fault condition*, are strictly regulated by safety standards. Equipment safety can be assured by measuring leakage current according to the applicable standard.

*: What is a single-fault condition?
This refers to when equipment has a fault in a safety protection measure, or a fault that may result in a hazardous condition.

1.3.2 Leakage Current Measurement Complying with Standards

Electrical safety standards and laws are enacted for electrical products according to fields of application. Each standard and law specifies a circuit network (hereafter called a measurement network) for simulating the human body, and prescribes network performance, as well as measuring locations, type (e.g., AC, DC) of current to be measured, allowable values, and other characteristics.
Listed below are various standards that require leakage current measurement.
The year in parenthesis following each standard shows the issued date. This product does not conform to the standards revised after the years in parenthesis.

Standards requiring leakage current measurement

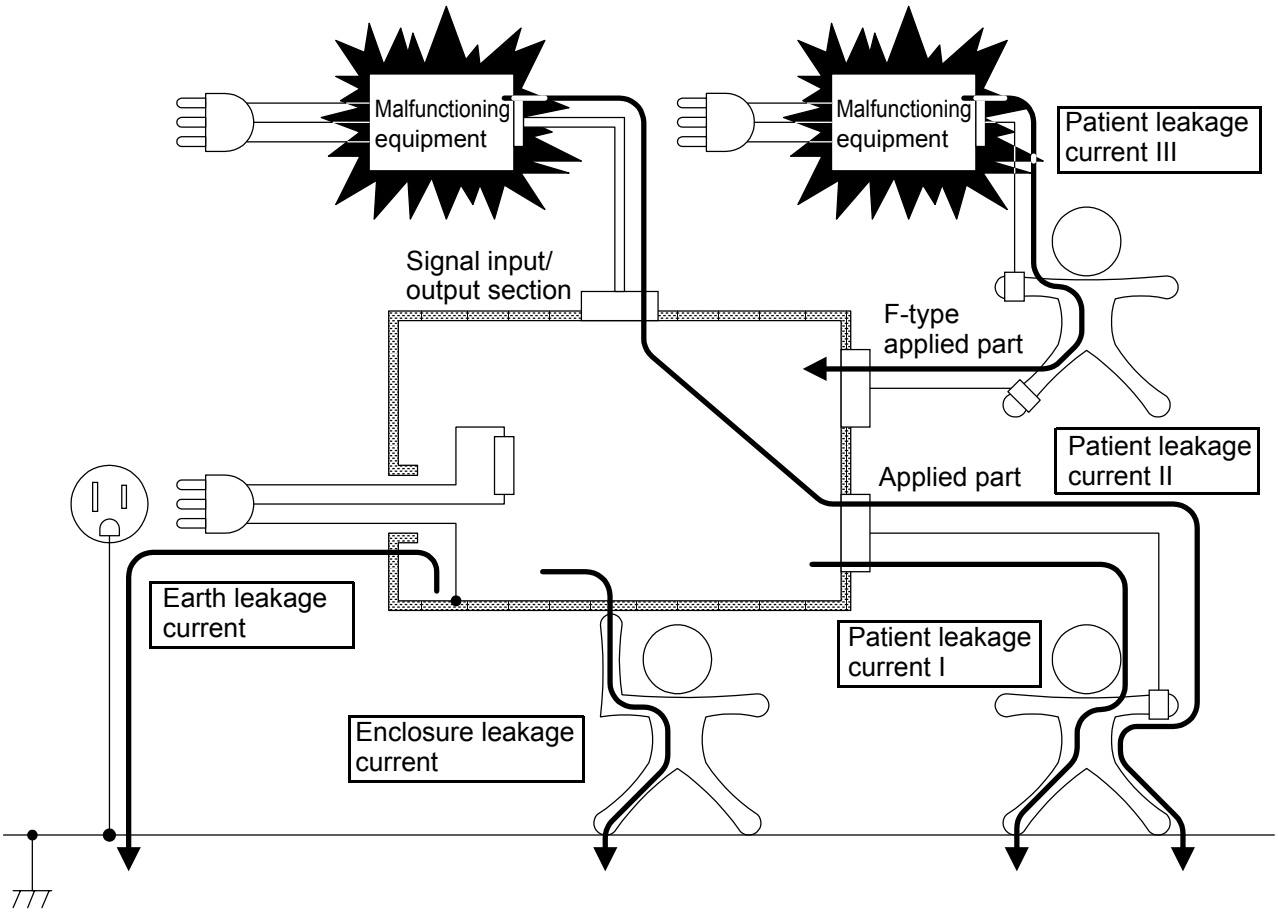
Electrical equipment			
General	International	IEC60065 ('98)	Audio, video, and similar electronic apparatus - Safety requirements
		IEC60335-1 ('01)	Safety of household and similar electrical appliances Part 1: General requirements
		IEC60950-1 ('01)	Information technology equipment - Safety - Part 1: General requirements
		IEC60990 ('99)	Methods of measuring touch current and protective conductor current
General	(Japanese)	JIS C6065 ('98)	Safety of home electronic equipment
		JIS C9335-1 ('98)	Safety of household and similar electric appliances - Part 1: General requirements
		JIS C6950 ('01)	Safety of information technology equipment
Individual	(Japanese)	Individual JIS standards	
Electric measuring instruments			
General	(Japanese)	JIS C1010-1 ('98)	Safety of equipment for measurement, control, and laboratory use - Part 1: General requirements
	International	IEC61010-1 ('90) + Amd.1 ('92) + Amd.2 ('95)	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
Medical electrical equipment			
General	(Japanese)	JIS T1001 ('92)	General safety regulations for medical electrical equipment
		JIS T1002 ('92)	General regulations for method of testing safety of medical electrical equipment
		JIS T0601-1 ('99)	Medical electrical equipment - Part 1: General requirements for safety
	International	IEC60601-1 ('88) + Amd.1 ('91) + Amd.2 ('95)	Medical electrical equipment - Part 1: General requirements for safety
Medical electrical facilities			
General	(Japanese)	JIS T1022 ('96)	Safety standard for electrical facilities for hospitals

Laws requiring leakage current measurement

Medical devices		
General	(Japanese)	Enforcement regulations of the Pharmaceutical Affairs Law, etc.
Electrical equipment		
General	(Japanese)	Ordinance Concerning Technical Requirements for Electrical Appliances and Materials (Electrical Appliance and Material Safety Law)

(As of October 3, 2002)

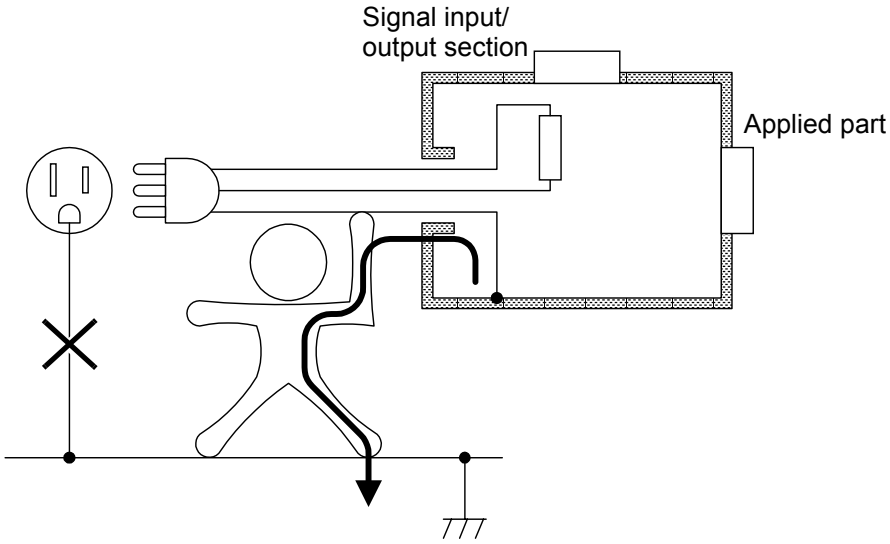
1.3.3 Types of Leakage Current Measurement



The following briefly describes each type of leakage current measurement.
Leakage currents can be roughly categorized into earth leakage current, enclosure leakage current, and patient leakage current. The following section describes the locations of leakage current measurement.

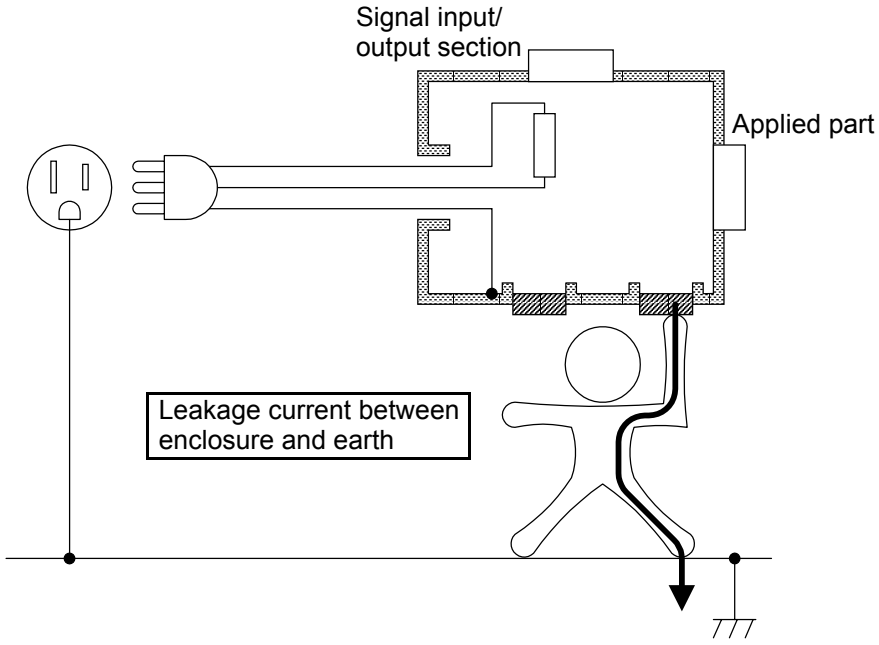
Earth leakage current	This refers to electric current that flows through a protective grounding wire to the ground.
Enclosure leakage current	This refers to electric current that flows through the body of someone who touches the equipment. This does not include current that flows to the human body in contact with an applied part.
Patient leakage current	There are three types of patient leakage current (I, II, and III). Patient leakage current flows through the body of someone connected to the applied part. Test items vary based on the type of applied part.
Patient auxiliary current	This refers to electric current allowed to flow between applied parts via a patient in normal equipment operation. This current is not intended to have any physiological effect.

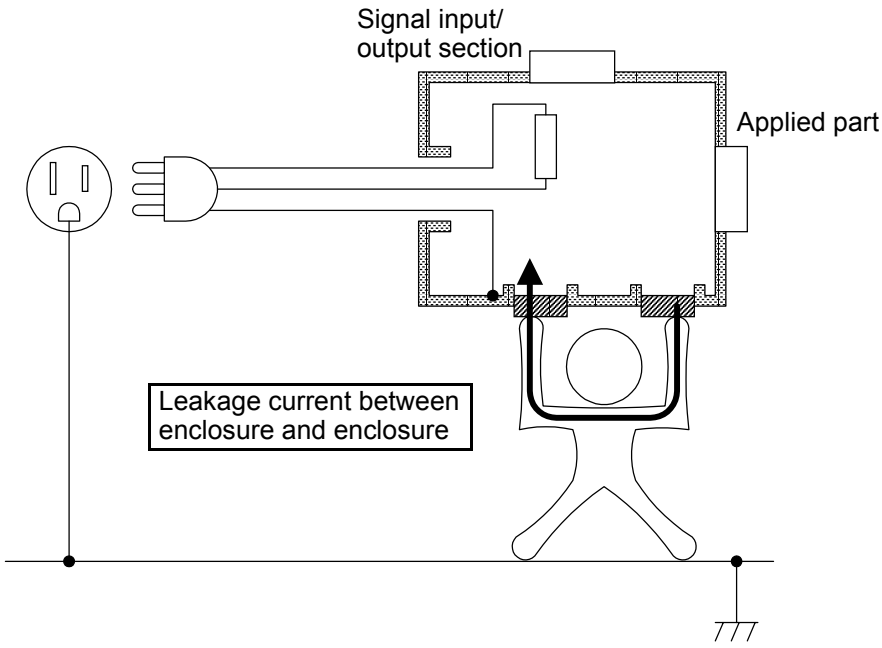
(1) Earth leakage current



Earth leakage current is electric current that flows through a protective grounding wire to the ground. Class-II equipment does not require the measurement of earth leakage current since it has no protective grounding wire.
Some people may think that earth leakage current can be measured by simply attaching a clamp to the protective grounding wire. However, IEC60601-1 specifies the measurement of current that flows through the human body.

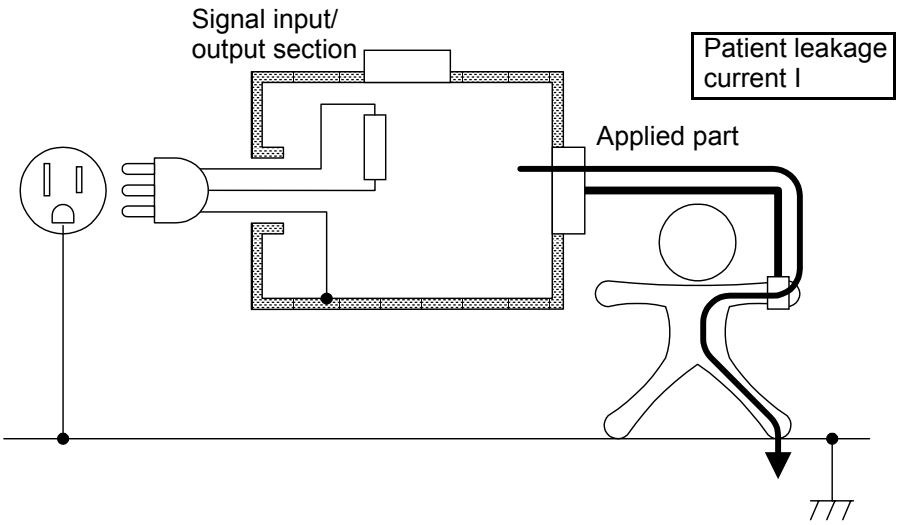
(2) Enclosure leakage current





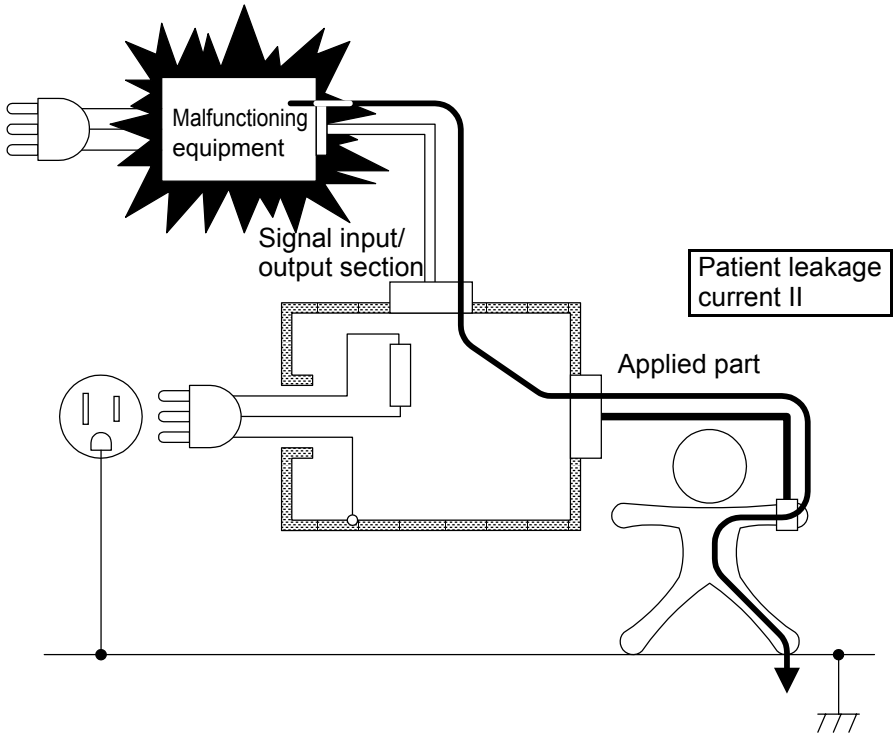
Enclosure leakage current is electric current that flows through a person who touches an ungrounded enclosed section of equipment. It does not include current that flows to the human body in contact with an applied part.
Class-I equipment does not require the measurement of enclosure leakage current since metal enclosures must be grounded for electrical protection. Because metal enclosures are tested in earth leakage current measurement, only ungrounded enclosures are tested.
For Class-II equipment, all enclosures are ungrounded for electrical protection and must be tested. Ungrounded enclosures are often made of insulating materials such as plastics and ABS. Since standards define leakage current as electric current that flows through the human body, for leakage current measurement a probe is applied to a metal foil the size of a hand pressed against the insulated material. The 9195 ENCLOSURE PROBE comes with the instrument.
There are two paths for enclosure leakage current to flow: "enclosure → human body → ground" and "enclosure → human body → enclosure." Note that, for "enclosure → human body → enclosure," a person must touch two separate enclosed sections that are electrically isolated (i.e., completely separate). However, this rarely applies to actual instruments since such condition results from a very complex equipment structure, of which few instruments feature.

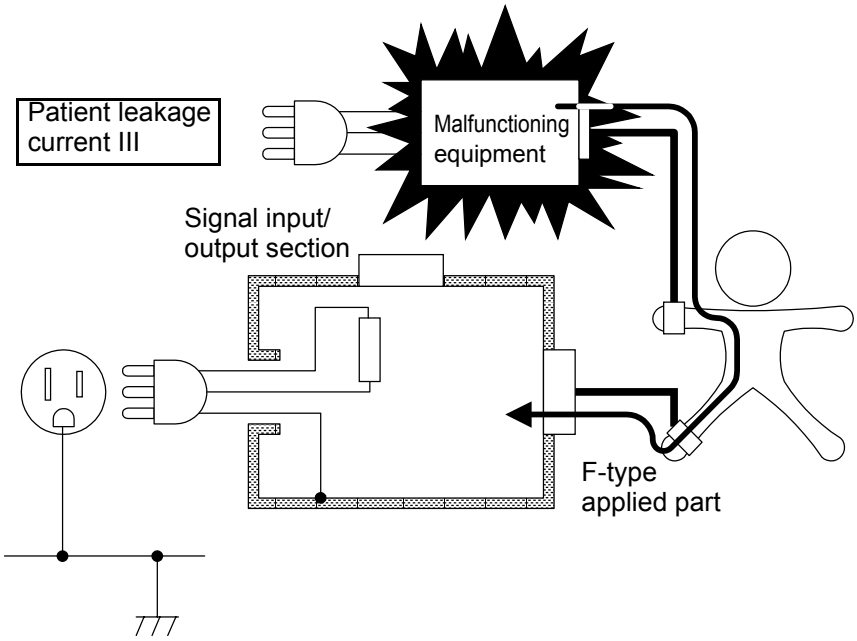
(3) Patient leakage current



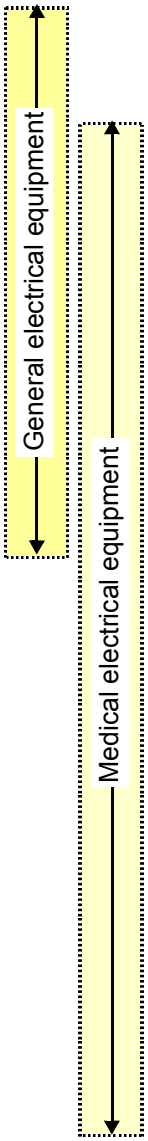
There are three types of patient leakage current (I, II, and III). Patient leakage current is electric current that flows through the human body in contact with an applied part. Test items vary based on the type of applied part.

Patient leakage current I	This is electric current that flows through an "applied part → human body → ground" path. The measurement of this leakage current is required for all medical devices with an applied part regardless of the class, type of applied part, or inclusion of a signal input/output section. For this test, both AC and DC must be measured.
Patient leakage current II	The measurement of this leakage current is required for medical devices that do not have an F-type isolated applied part, but have a signal input/output section and an applied part. For this measurement, equipment under test must assume a condition in which its signal input/output section is connected with a malfunctioning medical device. Under the single-fault condition (page 11), instead of connecting a malfunctioning medical device, 110% of the rated power supply voltage is input to equipment under test. Patient leakage current II flows through the following path: applied part → human body → ground. It is patient leakage current I that results in a single-fault condition.
Patient leakage current III	The measurement of this leakage current is required only for medical devices with an F-type applied part. This leakage current is electric current that flows in a human body in contact with an F-type applied part and applied part of another malfunctioning medical device. In the same way as for measuring patient leakage current II, 110% of the rated power supply voltage is input to simulate a malfunctioning medical device. Patient leakage current III flows through the following path: applied part of malfunctioning medical equipment → human body → F-type applied part.


Malfunctioning equipment
Signal input/ output section
Patient leakage current II
Applied part


Patient leakage current III
Malfunctioning equipment
Signal input/ output section
F-type applied part

List of Leakage-Current Measurement Items

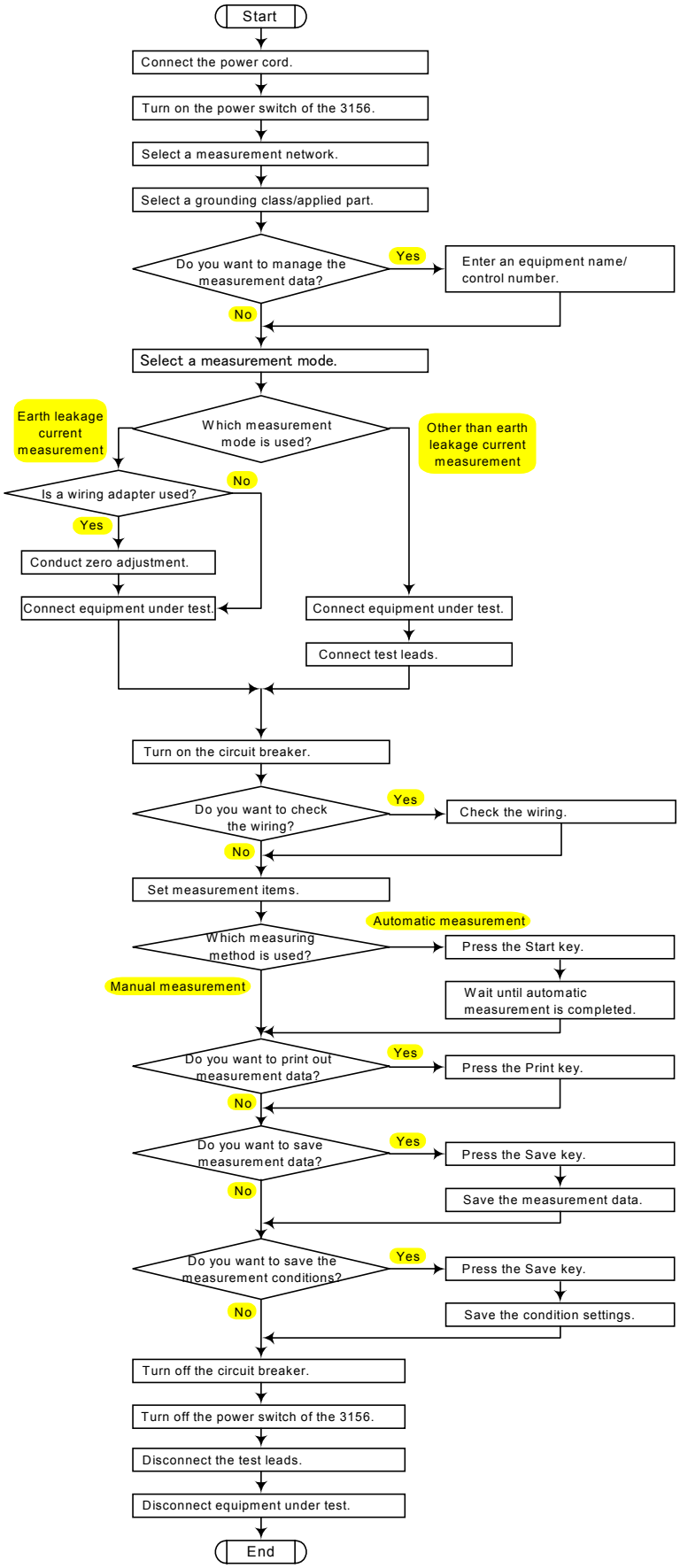


	Normal condition	Single-fault condition	(Description of fault)
Enclosure leakage current	Yes	Yes	1. One wire in the power cord is disconnected. 2. The protective grounding wire is disconnected. *1 3. Apply 110% of the rated power supply voltage between the insulated signal input/output section and ground.
Earth leakage current	Yes	Yes	1. One wire in the power cord is disconnected.
Patient leakage current I	Yes	Yes	1. One wire in the power cord is disconnected. 2. The protective grounding wire is disconnected. *1
Patient leakage current II	No	Yes	1. Apply 110% of the rated power supply voltage between the insulated signal input/output section and ground.
Patient leakage current III	No	Yes	1. Apply 110% of the rated power supply voltage between the F-type applied part and ground.
Patient auxiliary current	Yes	Yes	1. One wire in the power cord is disconnected. 2. The protective grounding wire is disconnected. *1

*1: Measurement with a disconnected protective grounding wire is applicable only to Class-I equipment.

(Description of measurement)	Remarks
Electric current that flows between: Enclosure and Line *2	*2 The leakage current measurement between enclosure line not applicable to testing medical electrical
or Enclosure and Ground or Enclosure and Enclosure	
Electric current that flows between: Protective ground terminal and Ground	This test is applicable only to Class-I equipment.
Electric current that flows between: Applied part and Ground	
Electric current that flows between: and Ground	This test is applicable to medical electrical equipment with a type B applied part.
Electric current that flows between: and Malfunctioning medical equipment	This test is applicable to medical electrical equipment with a type F (BF or CF) applied part.
Electric current that flows between: Applied part and Applied part	

1.4 Measurement Flowchart



❖3.1, "Connecting the Power Cord" (page 27)

❖3.3, "Turning Power On" (page 31)

❖5.1, "Selecting a Network" (page 51)

❖5.2, "Selecting the Grounding Class of Equipment Under Test" (page 52)
(only when network B is selected.)

❖5.2.1, "Registering an Equipment Name/Control Number" (page 53)

❖5.3, "Selecting a Measurement Mode" (page 54)

❖4.1, "Using the Terminal Block" (page 38)

❖5.4.1, "Performing Zero Adjustment" (page 58)

❖Chapter 4, "Connection" (page 37)

❖3.2, "Connecting the 9170-10 TEST LEAD" (page
3.2.1, "Using the 9195 ENCLOSURE PROBE" (page 30)
3.2.2, "Using Alligator Clips" (page 30)

❖3.5, "Turning the Circuit Breaker ON and OFF" (page 34)

❖6.8, "Checking the Power Line for Equipment Under Test" (page 94)

❖5.4, "Setting Measurement Items" (page 56)

❖5.4.6, "Changing the Measurement Method (Auto/Manual)" (page 71)

❖5.4.9, "Printing Measurement Data" (page 77)

❖5.4.10, "Saving Measurement Data" (page 78)

❖5.4.10, "Saving measurement data (Panel save function)" (page 79)

❖3.5, "Turning the Circuit Breaker ON and OFF" (page 34)

❖3.4, "Turning Power Off" (page 33)

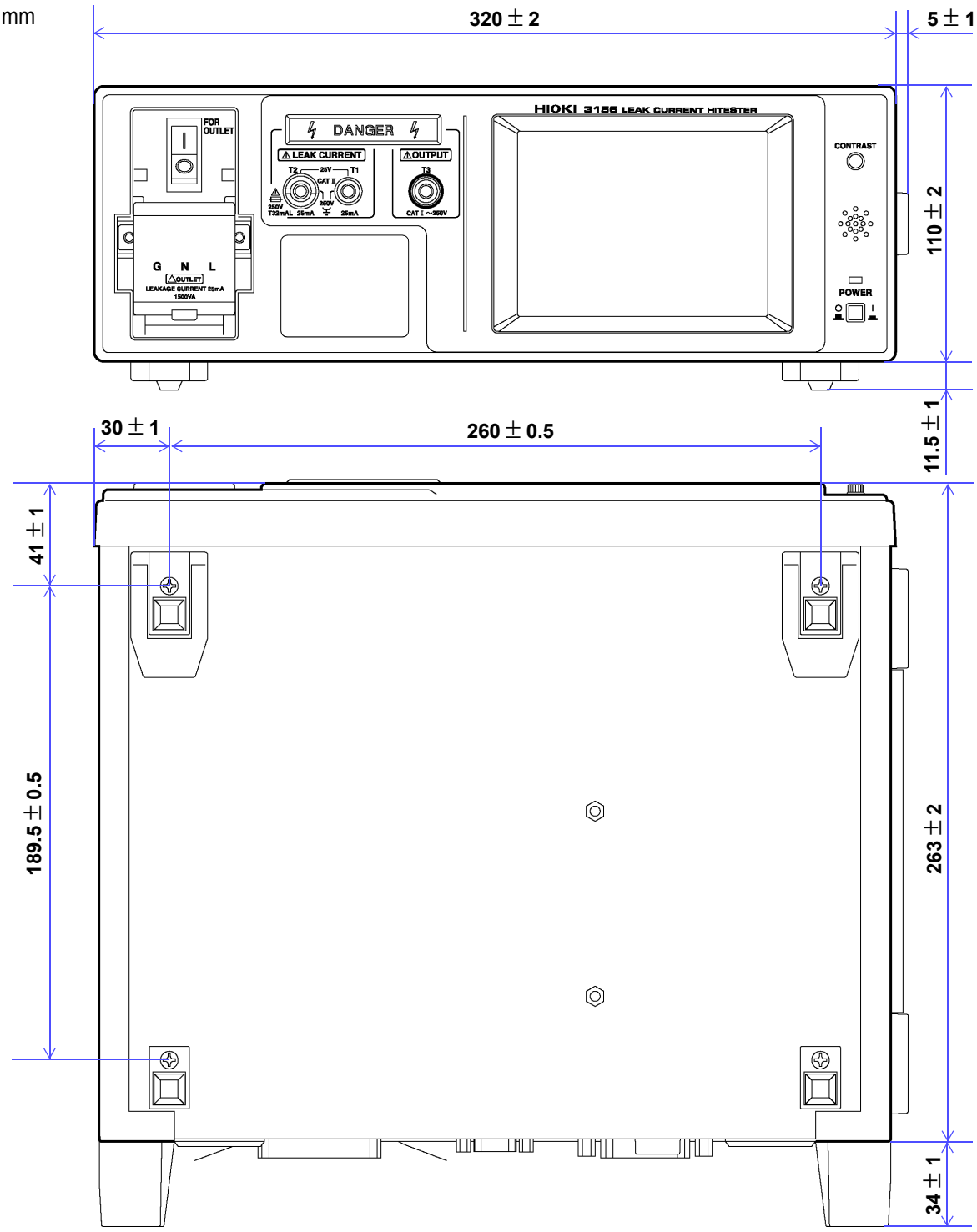
Note

The flowchart does not show the detailed procedures but the rough workflow.

Chapter 2 Parts Names

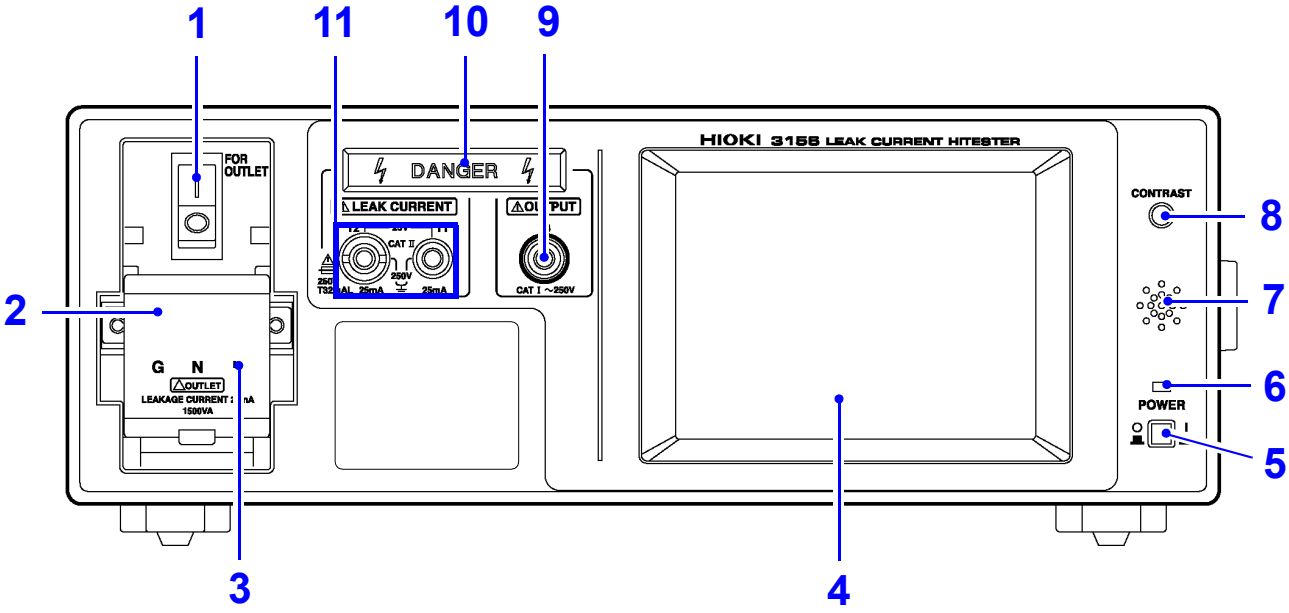
2.1 External Dimensions

Unit: mm



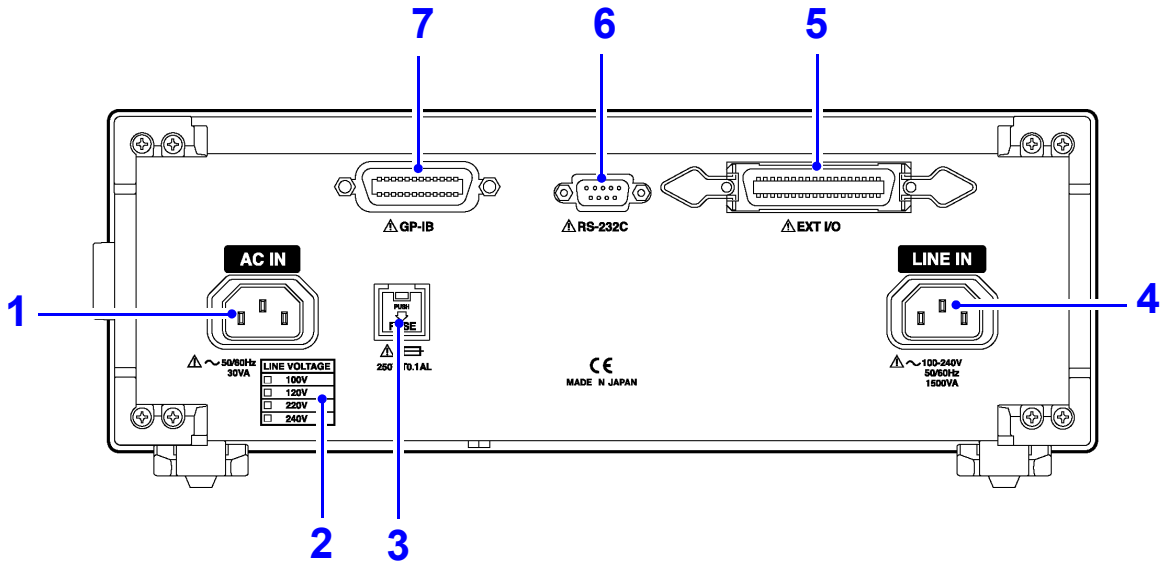
2.2 Instrument Labels and Functions

Front Panel



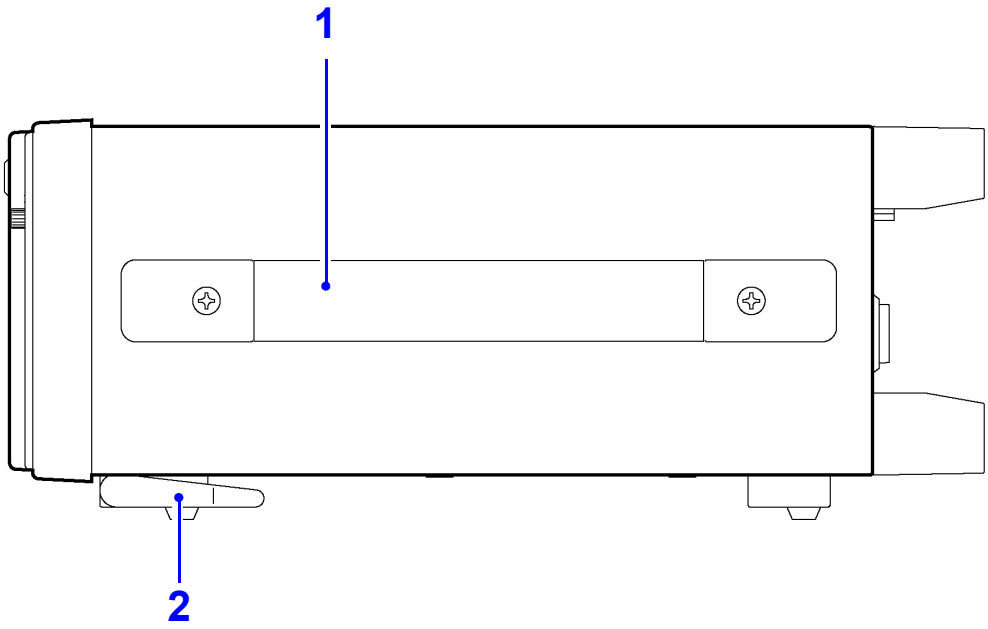
1 Circuit breaker	Detects overcurrent in the power line for equipment under test and activates a protective device. (Rated current: 15 A) ❙ : ON (for normal measuring operation) ◯ : OFF (idle condition or when overcurrent protection device has been triggered)
2 Terminal block cover	Covers the terminal block to prevent electric shock. Turn the circuit breaker off (◯) before opening the cover.
3 Terminal block	Outputs voltage based on the power supplied to [LINE IN]. Also used to connect the power cord of equipment under test.
4 Liquid crystal display unit (LCD)	Five-inch liquid crystal display unit with a touch panel function. Also provided with input key functions. The backlight can be set to turn OFF automatically. ❖6.5, "Setting the Backlight" (page 90)
5 Power switch	Turns the main instrument ON and OFF. ❙ : ON ◯ : OFF
6 Power indicator	Indicates the power ON/OFF status. Remains lit while the backlight is in automatic OFF mode. Indicator ON : Power switch of the instrument turned ON Indicator OFF : Power switch of the instrument turned OFF
7 Buzzer	Generates a beep sound when a key is pressed, and activates a warning buzzer.
8 Contrast adjustment dial	Used to adjust screen contrast. Turning the dial to the right darkens the display; turning to the left lightens the display. Use this dial when the display requires adjustment.
9 110% voltage output terminal (terminal T3)	Insulates the voltage supplied to [LINE IN] using the built-in transformer, and outputs a 1:1 voltage from terminal T3. Effective only when network B is selected.
10 Warning lamp	Lights when high voltage is generated at terminal T1, T2, or T3.
11 Measuring terminals (terminals T1 and T2)	Used to measure leakage current other than earth leakage current. Terminal T2 is provided with a protective fuse. (fuse rating: 250 V, T32mAL) ❖11.3, "Replacing Fuses" (page 236)

Rear Panel



1 Power inlet [AC IN]	Used for input of the power supply to operate the instrument. Used to connect the power cord provided.
2 Power source rating	Marked with a black dot (●) in the power line voltage specification section.
3 Fuse holder	Contains a power fuse. (fuse: 250 V, T0.1AL) ❖11.3, "Replacing Fuses" (page 236)
4 Inlet for power line of equipment under test [LINE IN]	Used for input of the power supply for equipment under test. Used to connect the power cord provided.
5 EXT I/O connector	Input/output terminal for external control (The proper connector is required for connection.) ❖Chapter 8, "EXT I/O Terminal" (page 197)
6 RS-232C connector	Used to connect an RS-232C cable or 9444 CONNECTION CABLE (for the 9442 PRINTER). (The 9442 PRINTER, 9444 CONNECTION CABLE, and other accessories are optional products.)
7 GP-IB connector	Used to connect a GP-IB cable.

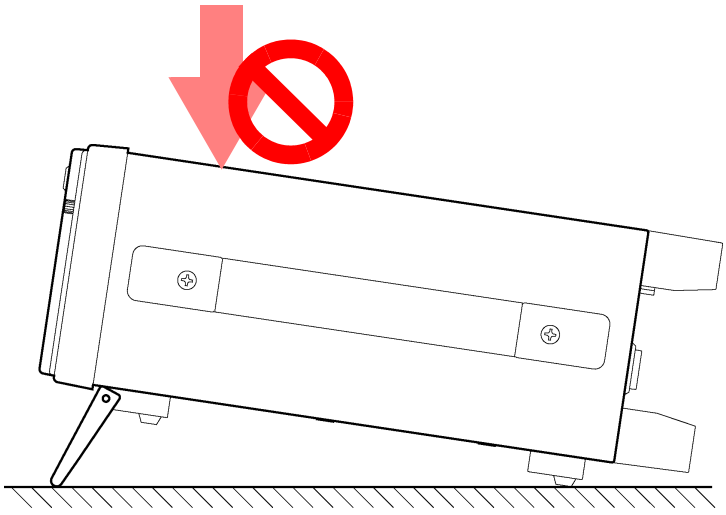
Side Panell



1 Handle	Used to carry the instrument.
2 Stand	Used to tilt the instrument.

⚠CAUTION

Do not apply strong downward pressure with the stand extended. Damage to the stand will result.



2.3 About the Touch Panel

⚠CAUTION

Do not use excessive force on the touch panel, and do not use sharp objects that could damage the touch screen.

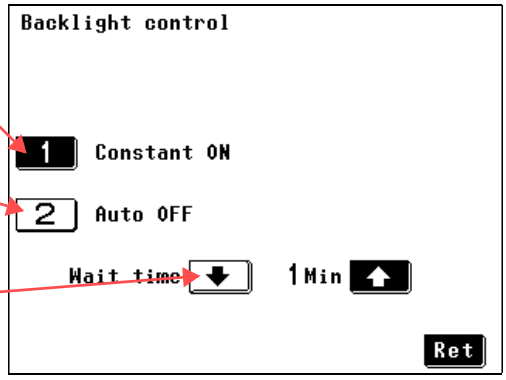
The 3156 uses a touch panel for setting and changing all of the measurement conditions. Simply by touching the LCD screen at certain areas - termed soft keys - which appear in reverse video, the items associated with these soft keys, and numerical values, can be selected.
In this manual, lightly touching a soft key area on the screen is termed "pressing" a key.

Keys on screen

Selectable keys (indicated in black and protruding)

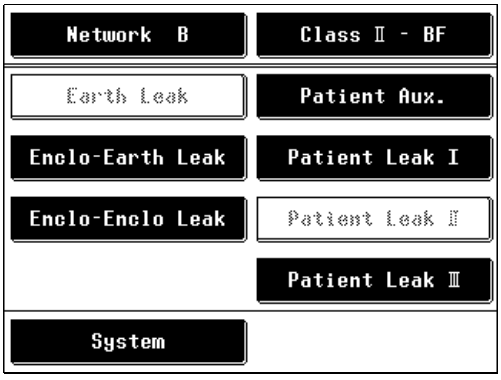
Selected keys (indicated in white and pushed in)

Non-selectable keys (indicated in white and protruding)



NOTE

Keys with characters written in dotted lines indicate measurement modes that do not require measurement due to settings entered on the equipment under test setting screen.

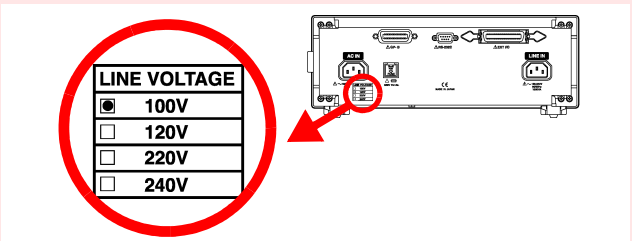


Measurement Preparations Chapter 3

3.1 Connecting the Power Cord

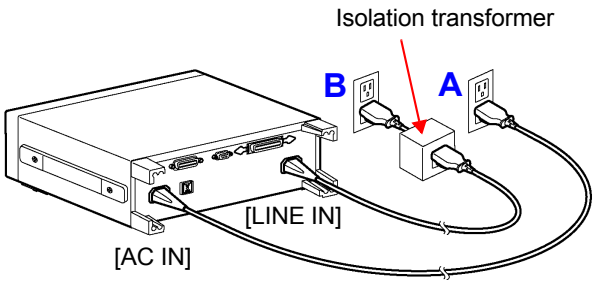
⚠WARNING

Before connecting the power cord, confirm that the voltage of the power source matches the voltage specification indicated on the instrument's power connector ([AC IN]). (The voltage specification (100, 120, 220 or 240 V) ordered by the customer is marked with a black dot ● in the line voltage column on the rear panel.)
Note that using the power supply with improper voltage may damage the instrument and result in electrical hazards.



The instrument's power rating is 30 VA.
The protective grounding terminal of the instrument connects to a grounding wire via the grounded two-prong power cord provided. To prevent electric hazards, be sure to use the grounded two-prong power cord provided and a power outlet with a grounding pole.

Connecting the power cord



1. Confirm that the main power switch on the front panel of the main instrument and the circuit breaker are turned off.
2. Connect the power cord to the [AC IN] power inlet on the rear panel of the main instrument, and insert the power cord plug into a power outlet (A in the diagram) that supplies the voltage specified for the instrument.
3. Connect the other power cord to the [LINE IN] inlet, on the rear panel of the main instrument, for the power line of equipment under test, and insert the power cord plug into a power outlet (B in the diagram) that supplies the voltage specified for the equipment under test.

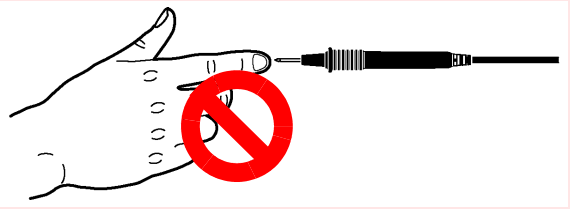
NOTE

- When network B is selected, it is necessary to connect an isolation transformer that outputs voltage equivalent to 110% of the rated power source voltage specified for the equipment under test. However, the neutral wire on the secondary side of the isolation transformer must be grounded.
- When network C is selected, an isolation transformer is required. Grounding of the secondary side may be or may not be required.

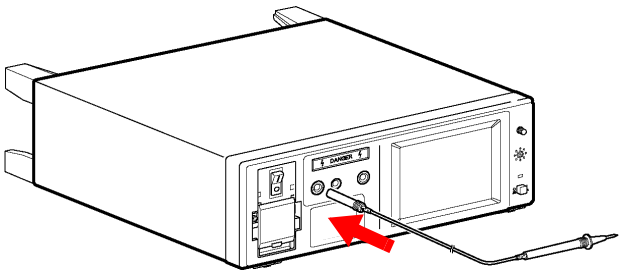
3.2 Connecting the 9170-10 TEST LEAD

⚠WARNING

To avoid the risk of electric shock, do not touch the tips of test leads connected to terminals T1, T2, and T3.
In some measurement modes, high voltage is output from the terminals.

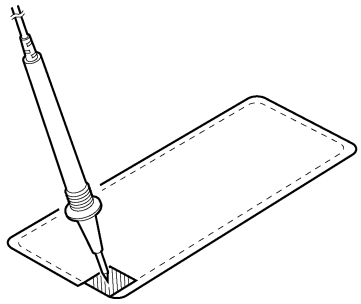


Connect the 9170-10 TEST LEAD to a measuring terminal (T1, T2, or T3).
The terminal to be used varies depending on the measurement mode.



3.2.1 Using the 9195 ENCLOSURE PROBE

When measuring enclosure leakage current, position the surface contact probe on the enclosure of the equipment under test, then set the test lead on the surface contact probe.
Ensure full contact of the surface contact probe on the enclosure by applying about 0.5 N/cm^2 of pressure.



3.2.2 Using Alligator Clips

Position the test lead on the enclosure or terminal of the equipment under test to measure leakage current. When using two or three lead wires, alligator clips may be used to ensure a secure connection.

Attach one of the alligator clips provided to the tip of the 9170-10 TEST LEAD.

3.3 Turning Power On

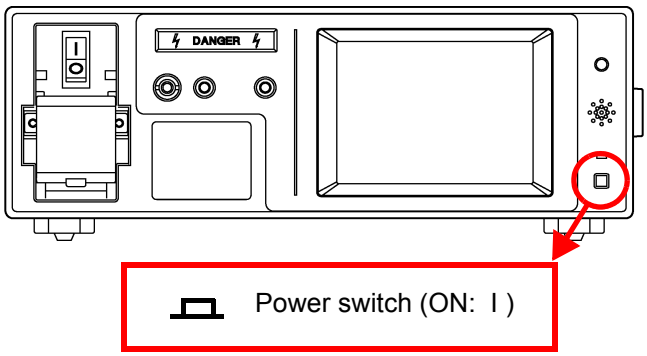
⚠WARNING

Before turning on the instrument, confirm that the voltage of the power source matches the voltage specification indicated on the instrument's power connector ([AC IN]). (The voltage specification (100, 120, 220 or 240 V) ordered by the customer is marked with a black dot ● in the line voltage column on the rear panel.)
Note that using the power supply with improper voltage may damage the instrument and result in electrical hazards.

⚠CAUTION

Before turning on the power switch, confirm that the circuit breaker is turned off. Even if the instrument was turned off in fault mode (i.e., disconnection of one wire in the power line) at last use, the instrument will be initialized to normal condition when the power switch is turned on. Therefore, the terminal block outputs voltage.

Turning on the power



1. Turn on the power switch (ON: I) on the front panel.
2. The LCD shows the opening message.
3. The network select screen appears by default.
   If the instrument was turned off with the LCD showing the measurement screen at last use, that measurement screen appears.
   If the instrument was turned off with the LCD showing a screen other than the measurement screen, the initial screen appears.
4. Use the contrast adjustment dial to set the LCD for easy viewing.
5. After turning the power on, let the instrument warm up for about 30 minutes before starting measurement operation.

NOTE

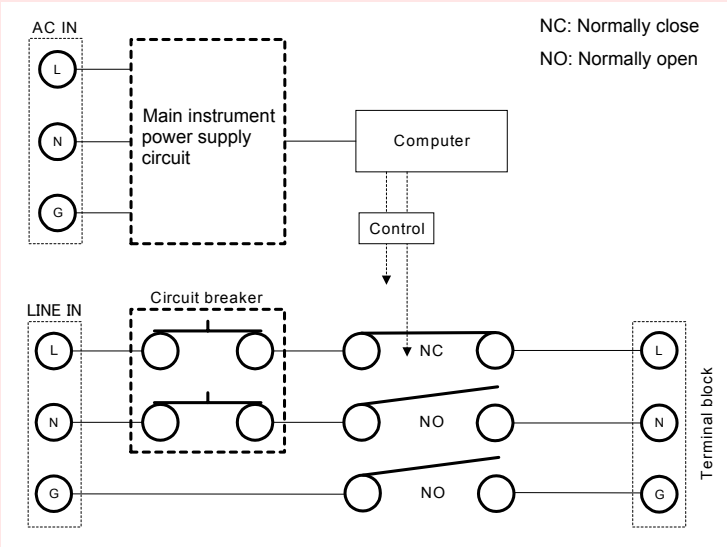
When "Check at each power ON operation" is enabled on the connection/VA check screen, the connection/VA check screen appears after the power switch is turned on.

❖6.8, "Checking the Power Line for Equipment Under Test" (page 94)

3.4 Turning Power Off

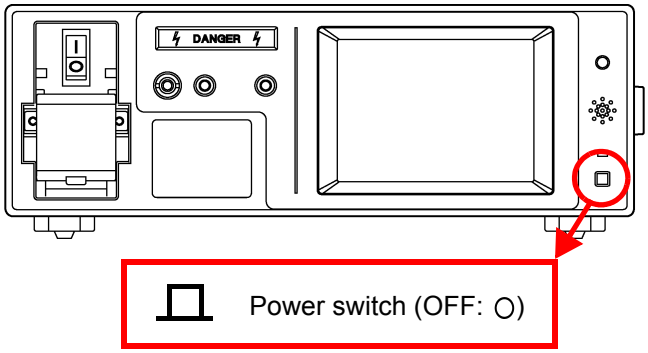
⚠CAUTION

Always turn off the power switch of equipment under test before turning off power of the instrument to avoid damaging the equipment under test. The instrument uses an internal relay for switching the power line for equipment under test. Therefore, turning off the power switch of the instrument disconnects one wire in the power line.



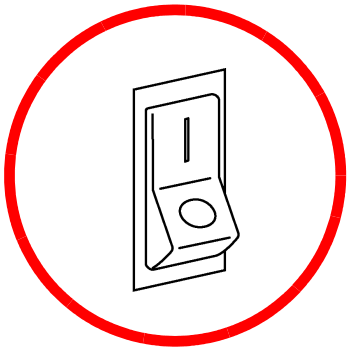
Condition of power line for equipment under test with the main instrument pov switch turned OFF (schematic diagram)

Turning off the power

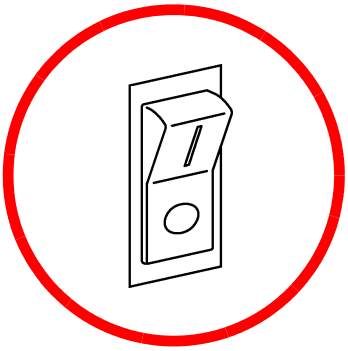


1. Turn off the power switch of equipment under test connected to the terminal block.
2. Turn off the circuit breaker.
3. Turn off the power switch (OFF: ○) on the front panel.
   When the power switch is turned off, the measurement conditions are saved. In case of power supply failure (e.g., power outage), the instrument restores the conditions held immediately before power failure occurred.

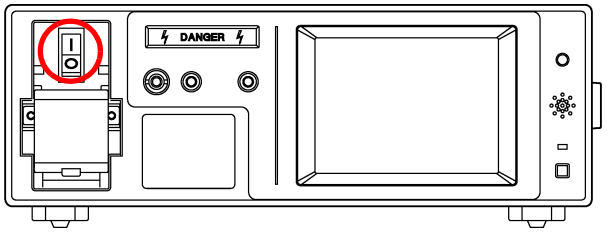
3.5 Turning the Circuit Breaker ON and OFF



Circuit breaker ON



Circuit breaker OFF

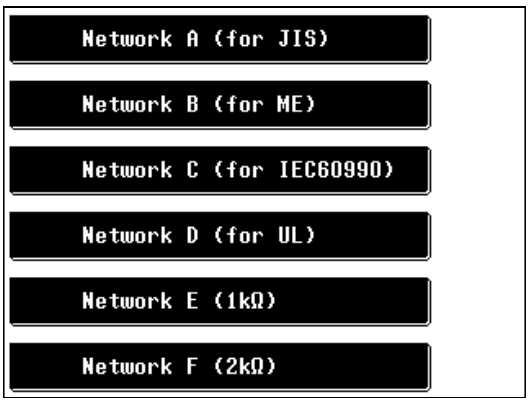


3.6 Pre-Test Inspection

The instrument's current detection circuit includes a fuse.
If the fuse blows due to miswiring or over-current conditions, current cannot be detected.
Before measuring, confirm that the fuse has not blown.
Perform the pre-test inspection according to the following procedure.

Required items:
- Power cord
- A device for which the resistance value can be measured (for example, a tester).

When measuring using a mode other than earth leakage current.



Network select screen

1. Connect the power cord to the AC IN connector on the back of the instrument, and turn the power on.

2. Display the network select screen shown at the left.
   - From the measurement screen, press Ret and then Network.
   - From the initial (measurement mode selection) screen, press Network.

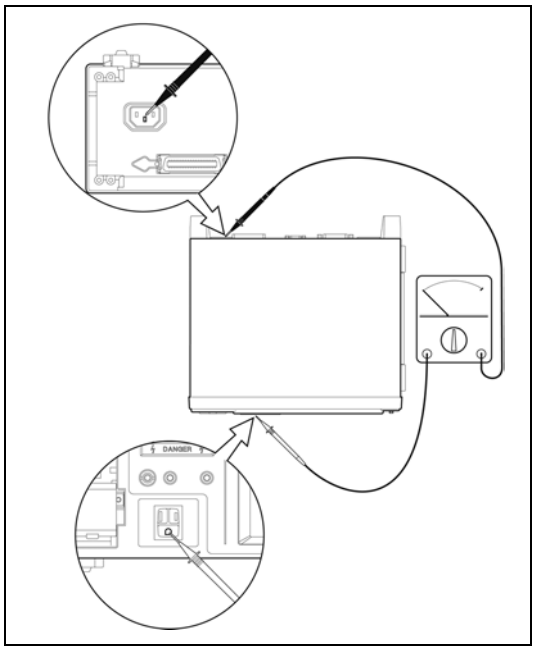
3. Measure the resistance between T1 and T2.

4. Confirm that the value is 1060 ±10Ω.

NOTE

If the resistance is not 1060 ±10Ω,
The fuse at the T2 terminal on the front of the instrument may be blown.
Refer to 11.3, "Replacing Fuses" (page 236) to replace the fuse.

When using the earth leakage mode



Resistance Measurement Example

1. Select the network to use.

2. Press Earth Leak .

3. Measure the resistance as shown at the left.

4. Confirm that the resistance is as follows:

   -1. When selecting network A, B or E,
   The resistance should be 1060 ±10Ω.

   -2. When selecting network C or F,
   The resistance should be 2060 ±10Ω.

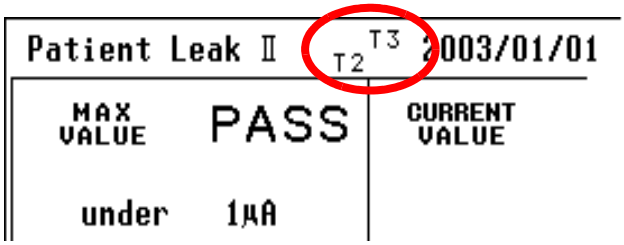
   -3. When selecting network D,
   The resistance should be 1560 ±10Ω.

NOTE

If the resistance is not 1060 ±10Ω, 2060 ±10Ω, or 1560 ±10Ω,
A fuse within the instrument may have blown.
Contact your dealer (Hioki agent) or nearest Hioki sales office.

Chapter 4 Connection ⚠

When a measurement mode is selected, the measuring terminals (T1, T2, and T3) to be used for measurement are indicated at the top of the screen. Connect the test leads based on the indications displayed.



When earth leakage current measurement mode is selected, no test lead is used. Therefore, the screen does not indicate terminal T1, T2, or T3.

The list of the measuring terminals to be used

When selecting network A, C, D, E, or F (All except B)

		Class-I equipment	Class-II equipment	Internally powered equipment
Earth leakage current		unused	--	--
Leakage current between enclosure and earth		T2	T2	T2
Leakage current between enclosure and enclosure		T1, T2	T1, T2	T1, T2
Leakage current between enclosure and line	Line selection: INT	T2	T2	--
	Line selection: EXT	T1, T2	T1, T2	--

When selecting network B

		Class-I equipment			Class-II equipment			Internally powered equipment		
		Type B	Type BF	Type CF	Type B	Type BF	Type CF	Type B	Type BF	Type CF
Earth leakage current		unused			--	--	--	--	--	--
Leakage current between enclosure and earth	Normal	T2	T2	T2	T2	T2	T2	T2	T2	T2
	Fault	T2, T3	T2, T3	T2, T3	T2, T3	T2, T3	T2, T3	T2, T3	T2, T3	T2, T3
Leakage current between enclosure and enclosure	Normal	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2
	Fault	T1 to T3	T1 to T3	T1 to T3	T1 to T3	T1 to T3	T1 to T3	T1 to T3	T1 to T3	T1 to T3
Patient auxiliary current		T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2
Patient leakage current I		T2	T2	T2	T2	T2	T2	T1, T2	T1, T2	T1, T2
Patient leakage current II	Type B	T2, T3	--	--	T2, T3	--	--	T2, T3	--	--
Patient leakage current III	Type F	—	T2	T2	—	T2	T2	—	T2	T2

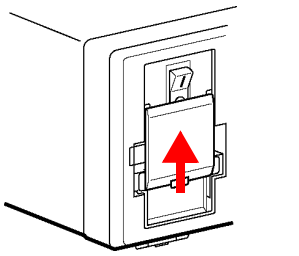
4.1 Using the Terminal Block

When connecting the 3156 instrument to equipment under test with a power cord, use the terminal block.

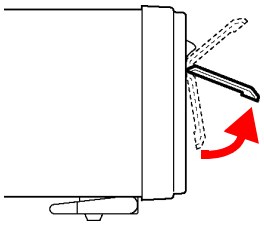
⚠CAUTION

When reinstalling the terminal block cover, hang the connected wires straight down to prevent the wires from being pinched by the cover. Otherwise, the wires may be disconnected when pinched by the cover.

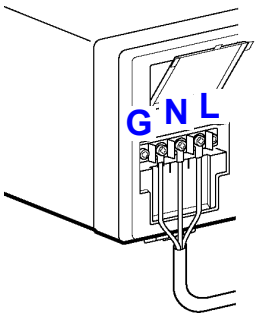
Connecting wires to the terminal block



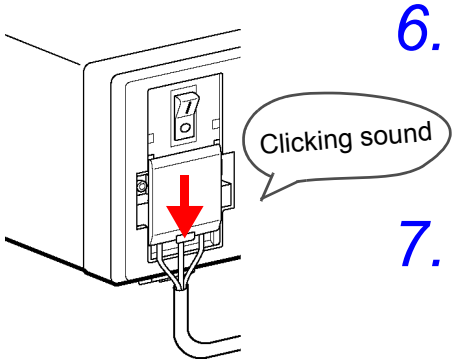
1. Turn off the power switch of the main instrument.
2. Turn off the circuit breaker.
3. Slide the terminal block cover up.
   (The cover may feel hard to move since it is latched into position.)



4. Pull the terminal block cover forward as shown in the diagram on the left.
   The cover is secured into place after being moved up to the circuit breaker position.



5. Properly connect the wires to terminals G, N, and L.
   G : For grounding wire connection
   (Class-I equipment only)
   N : For neutral wire connection
   L : For live wire connection

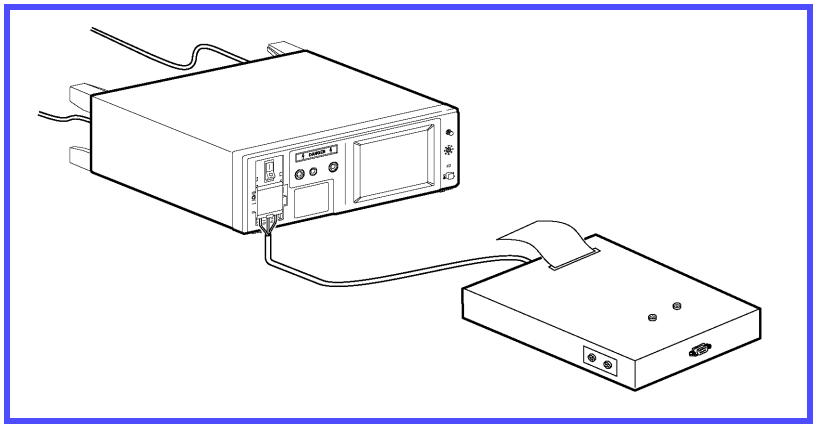


6. Lower the terminal block cover. Align the right and left protrusions on the terminal block cover with the slits on the panel, then insert the protrusions into the slits.
7. Press down the terminal block cover until a clicking sound is heard.

4.2 Earth Leakage Current Measurement

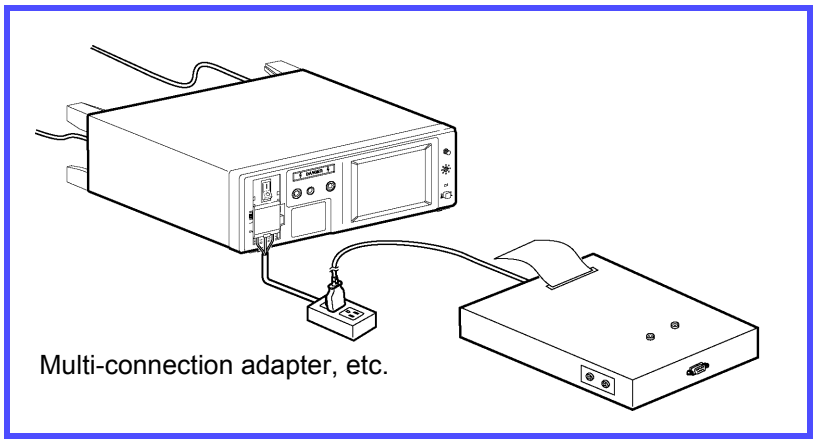
1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.

2. Start earth leakage current measurement.



Using a wiring adapter

Obtain and use a wiring adapter as shown below.



NOTE

- Turn off the circuit breaker before connecting a wiring adapter or equipment. The terminal block continuously output the voltage based on the power supplied to [LINE IN].
- The current capacity of the terminal block is 15 A. Exceeding this capacity triggers the circuit breaker and cuts off the supply of power to the equipment under test.

4.3 Enclosure Leakage Current Measurement

4.3.1 Measuring Leakage Current between Enclosure and Earth

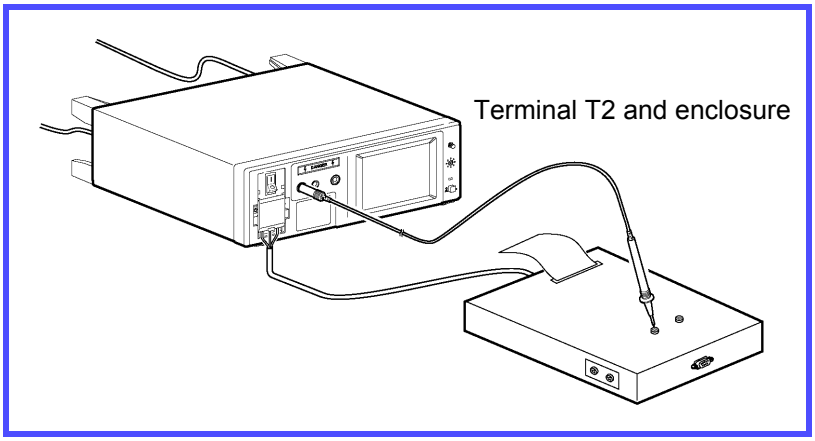
1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.

2. Connect a test lead to terminal T2.

3. Position the tip of the test lead on the equipment under test, then begin leakage current measurement between enclosure and earth.

NOTE

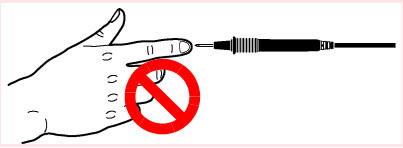
- Conduct measurement at an ungrounded enclosure section.
- The terminal block is not used for internally powered equipment, although power must be supplied to [LINE IN] by a grounded two-plug power cord.



When network B is selected and measurement conducted with 110% voltage application (N 110%, R 110%)

WARNING

To avoid electric shock, do not touch the tip of the test lead connected with terminal T3. Terminal 3 outputs high voltage.



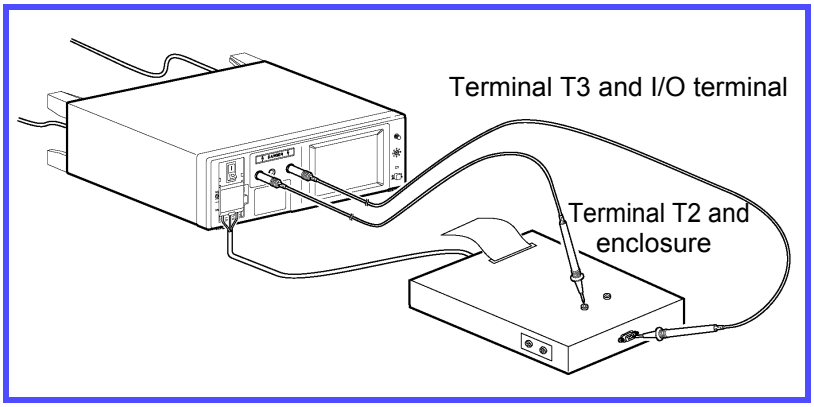
1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.

2. Connect test leads to terminals T2 and T3.

3. Position the tip of the test lead connected to terminal T2 on an ungrounded enclosure section of the equipment under test.

4. Position the tip of the test lead connected to terminal T3 on an ungrounded signal input section or signal output section of the equipment under test.

5. On the measurement screen, press Apply to start leakage current measurement between enclosure and earth under the single-fault condition.
   When Apply is pressed, the test lead connected to terminal T3 outputs a high voltage. Press Stop to stop high-voltage output.



NOTE

- Note that when Start is pressed in automatic measurement mode, the instrument generates high voltage without Apply displayed on the screen.
- The terminal block is not used for internally powered equipment, although power must be supplied to [LINE IN] by a grounded two-plug power cord. Also, high voltage occurring at Terminal T3 depends on this power source.

4.3.2 Measuring Leakage Current between Enclosure and Enclosure

1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.

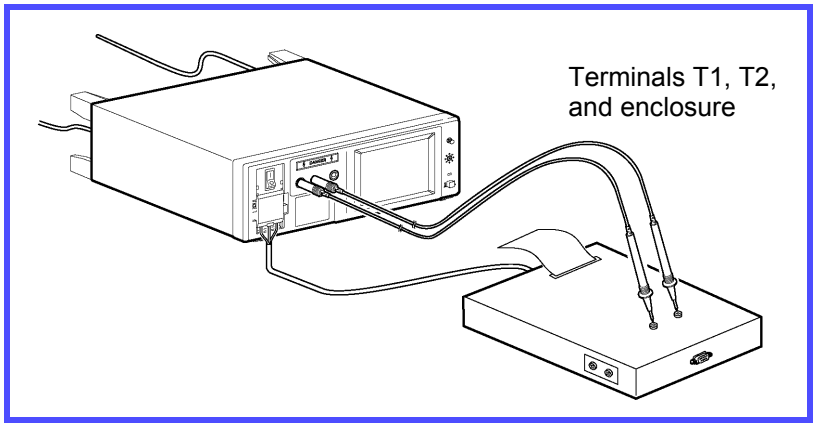
2. Connect test leads to terminals T1 and T2.

3. Position the tips of test leads on the enclosure of the equipment under test, then start leakage current between enclosure and enclosure measurement.

NOTE

- Conduct leakage current measurement between enclosure and enclosure using two ungrounded locations on the enclosure.
- The terminal block is not used for internally powered equipment.

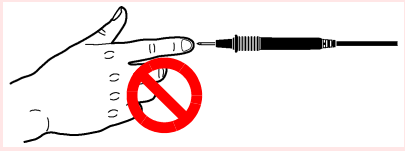
Position the tips of test leads connected to terminals T1 and T2 on the enclosure of the equipment under test.



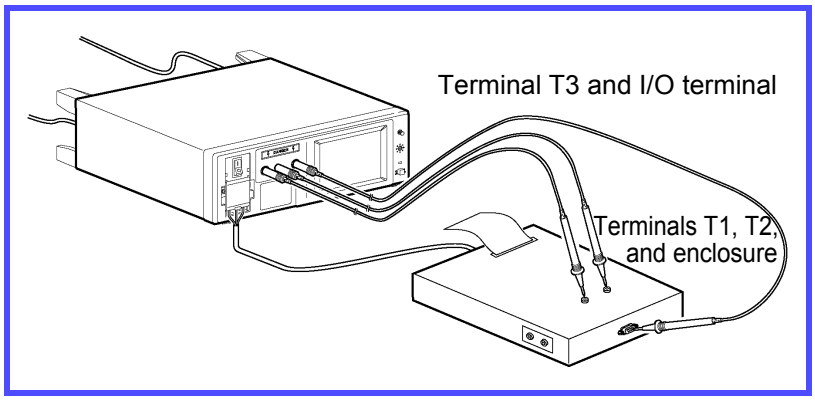
When network B is selected and measurement conducted with 110% voltage application (N 110%, R 110%)

WARNING

To avoid electric shock, do not touch the tip of the test lead connected with terminal T3. Terminal 3 outputs high voltage.



1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.
2. Connect test leads to terminals T1, T2, and T3.
3. Position the tips of test leads connected to terminals T1 and T2 on the enclosure of the equipment under test.
4. Position the tip of the test lead connected to terminal T3 on an ungrounded signal input section or signal output section of the equipment under test.
5. On the measurement screen, press Apply to start leakage current measurement between enclosure and enclosure under the single-fault condition.
   When Apply is pressed, the test lead connected to terminal T3 outputs a high voltage.
   Press Stop to stop high-voltage output.



NOTE

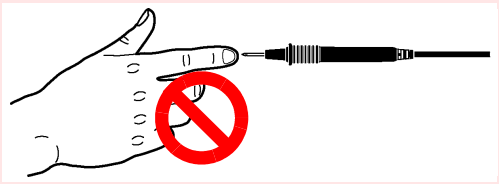
- Note that when Start is pressed in automatic measurement mode, the instrument generates high voltage without Apply displayed on the screen.
- The terminal block is not used for internally powered equipment. However, power must be supplied to this instrument's [LINE IN] connector to obtain high voltage from Terminal T3.

4.3.3 Measuring Leakage Current between Enclosure and Line

(only when selecting a network other than B)

WARNING

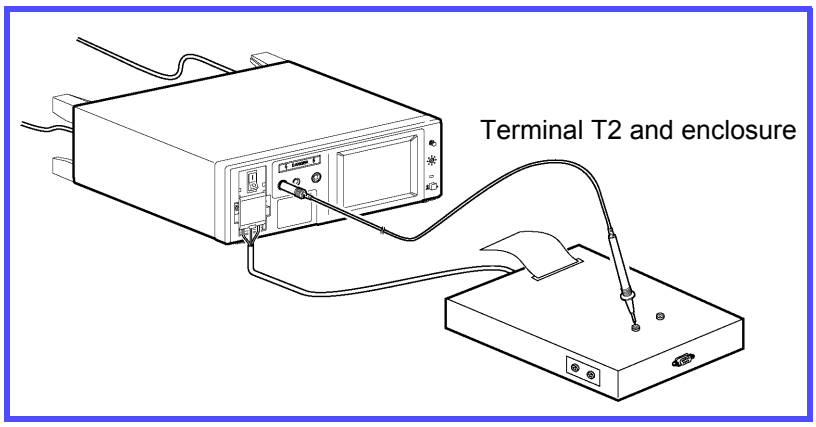
To avoid electric shock, do not touch the tip of the test lead connected with terminal T2. Terminal 2 outputs high voltage.



1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.
2. Connect a test lead to terminal T2.
3. Position the tip of the test lead on the enclosure of the equipment under test.
4. On the measurement screen, press Apply to start leakage current measurement between enclosure and line.
   Press Stop to stop high-voltage output.

NOTE

- Conduct measurement at an ungrounded enclosure section.
- A pre-check is conducted to avoid a possible ground fault immediately after Apply is pressed. If this check detects a ground fault, measurement is aborted.
- Note that positioning the probe on a grounded section after the pre-check will result in a ground fault and blown fuse for measuring operation.



NOTE

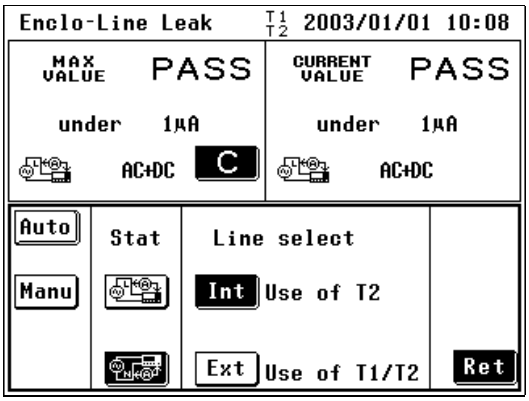
Note that when Start is pressed in automatic measurement mode, the instrument generates high voltage without Apply displayed on the screen.

Application of leakage current measurement between enclosure and line

The power terminal block of the instrument cannot be connected with equipment under test over 1500 VA. Leakage current between enclosure and line can be measured with equipment over 1500 VA, however, by using terminals T1 and T2.

NOTE

- Automatic measurement mode cannot be selected.
- The pre-check function is not activated automatically. Therefore, be extra careful to ensure proper connections. Testing a grounded enclosure section of the equipment under test will result in a ground fault and blown fuse for measuring operation.



1. On the measurement screen, press Meas and select Manu. The screen for line selection then appears.
2. Press Ext to set [Use of T1/T2].
3. Connect test leads to terminals T1 and T2.
4. Press to return to the measurement screen.

   Connect the tip of the test lead connected to terminal T2 to the L (live) terminal of the power line for equipment under test.

   Connect the tip of the test lead connected to terminal T1 to an ungrounded enclosure section of the equipment under test.
   Read (or save) the measurement data.
5. When is selected, same as **4** above, connect the tip of the test lead connected to terminal T2 to the N (neutral) terminal of the power line for equipment under test, then connect the tip of the test lead connected to terminal T1 to an ungrounded enclosure section of the equipment under test.
   Read (or save) the measurement data.

NOTE

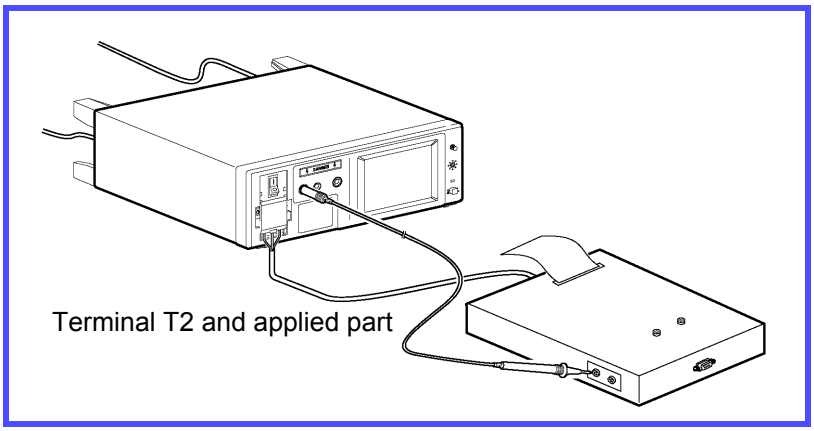
- and are switched for managing saved measurement data. When data is not saved, measurement may be conducted with either of the settings described in **4** and **5** above.
- T2 becomes a Hi terminal; T1 becomes a Lo terminal.

4.4 Patient Leakage Current I Measurement

(only when selecting a network B)

Measuring the class-I equipment and class-II equipment

1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.
2. Connect a test lead to terminal T2.
3. Position the tip of the test lead on the applied part of the equipment under test, then start patient leakage current I measurement.

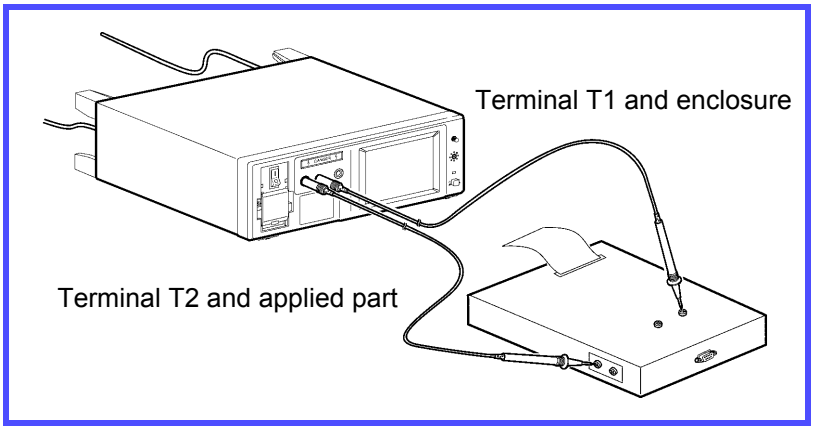


Measuring the internally powered equipment

NOTE

Measurement of Patient leakage current I in internally powered equipment is supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

1. Connect test leads to terminal T1 and T2.
2. Position the tip of the test lead connected to terminal T1 on the enclosure of the equipment under test.
3. Position the tips of test lead connected to terminal T2 on the applied part of the equipment under test, then start patient leakage current I measurement.



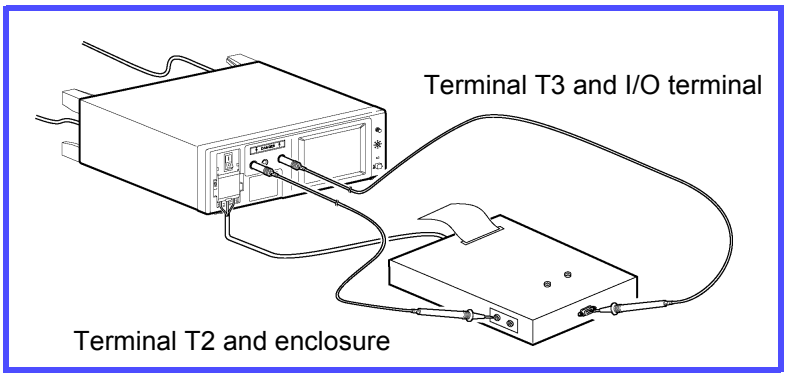
4.5 Patient Leakage Current II Measurement

(only when selecting network B and providing equipment with a Type B applied part)

⚠WARNING

To avoid electric shock, do not touch the tip of the test lead connected with terminal T3. Terminal 3 outputs high voltage.

1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.
2. Connect test leads to terminals T2 and T3.
3. Position the tip of the test lead connected to terminal T2 on the applied part of the equipment under test.
4. Position the tip of the test lead connected to terminal T3 on an ungrounded signal input section or signal output section of the equipment under test.
5. On the measurement screen, press Apply to start patient leakage current II measurement.
   When Apply is pressed, the test lead connected to terminal T3 outputs a high voltage.
   Press Stop to stop high-voltage output.



NOTE

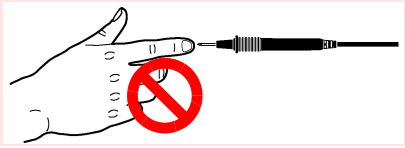
- Note that when Start is pressed in automatic measurement mode, the instrument generates high voltage without Apply displayed on the screen.
- If insulation of the signal input/output section and applied part is low due to the output impedance (22.5 k ± 1 kΩ) of the 110% voltage application function, a value at or below the allowable value may be detected. Take this into consideration when setting the allowable value.
- The terminal block is not used for internally powered equipment. However, power must be supplied to this instrument's [LINE IN] connector to obtain high voltage from Terminal T3.

4.6 Patient Leakage Current III Measurement

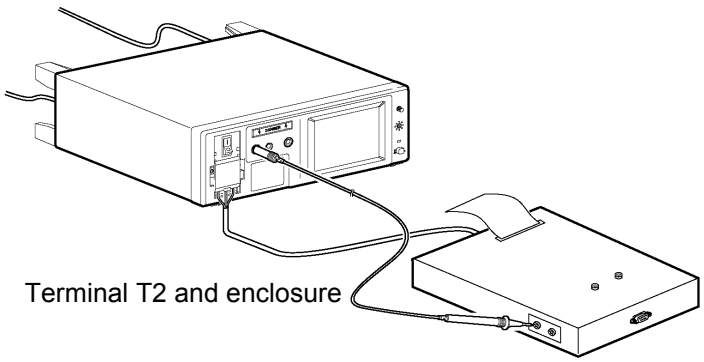
(only when selecting network B and providing equipment with a Type BF or Type CF applied part)

WARNING

To avoid electric shock, do not touch the tip of the test lead connected with terminal T2. Terminal 2 outputs high voltage.



1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.
2. Connect a test lead to terminal T2.
3. Position the tip of the test lead on the applied part of the equipment under test.
4. On the measurement screen, press Apply to start patient leakage current III measurement.
   When Apply is pressed, the test lead connected to terminal T2 outputs a high voltage.
   Press Stop to stop high-voltage output.



NOTE

- Note that when Start is pressed in automatic measurement mode, the instrument generates high voltage without Apply displayed on the screen.
- If insulation of the signal input/output section and applied part is low due to the output impedance (22.5 k ± 1 kΩ) of the 110% voltage application function, a value at or below the allowable value may be detected. Take this into consideration when setting the allowable value.
- The terminal block is not used for internally powered equipment. However, power must be supplied to this instrument's [LINE IN] connector to obtain high voltage from Terminal T2. Also, the enclosure of the equipment under test (internally powered equipment) must be grounded.

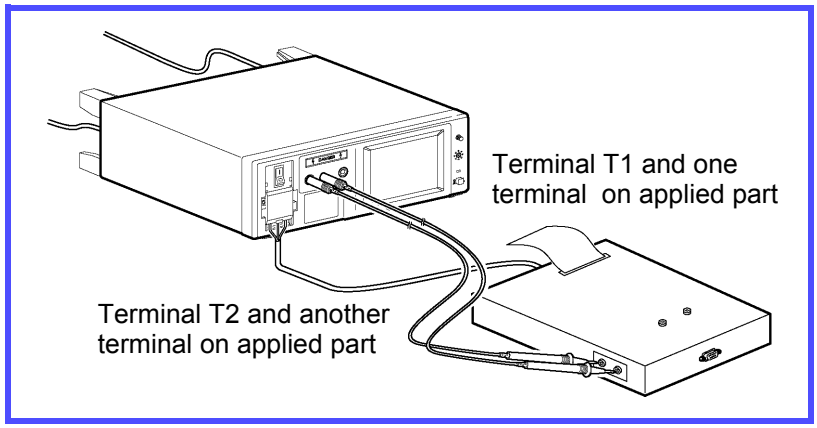
4.7 Patient Auxiliary Current Measurement

(only when selecting a network B)

1. As shown in the diagram, connect the 3156 instrument to equipment under test with a power cord.

2. Connect test leads to terminals T1 and T2.

3. Position the tips of test leads on the applied part of the equipment under test, then start patient auxiliary current measurement.

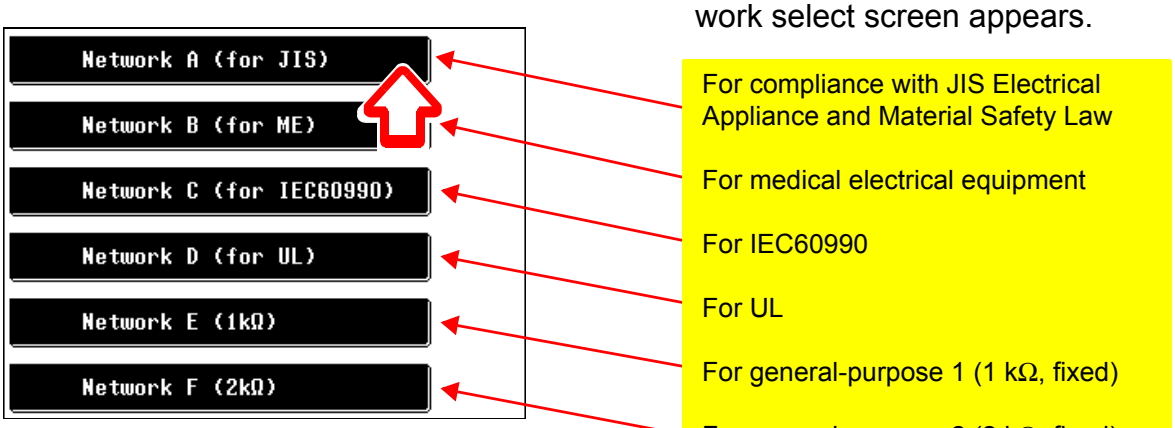


NOTE The terminal block is not used for internally powered equipment.

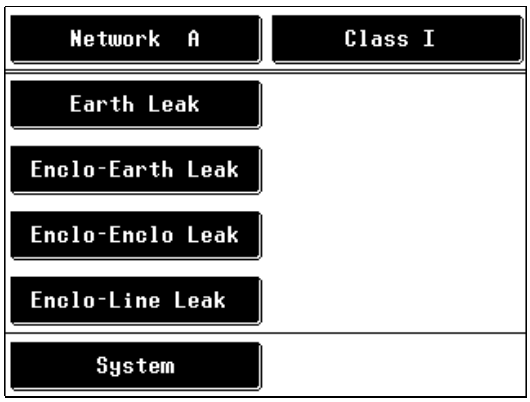
Measurement Method Chapter 5

5.1 Selecting a Network

1. After the power switch of the 3156 instrument is set to ON (|), the network select screen appears.



Network select screen



Initial screen

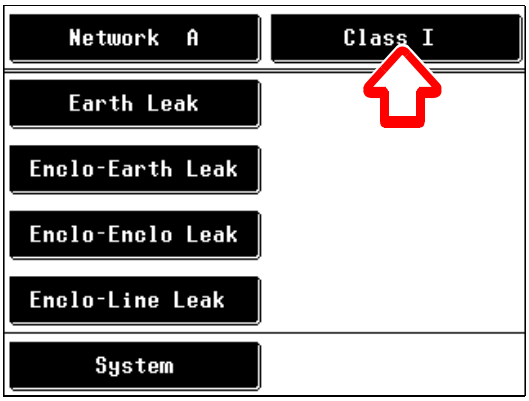
2. After the desired network is selected, the initial screen appears.

To change the network, return to the network select screen by pressing the Network A key.

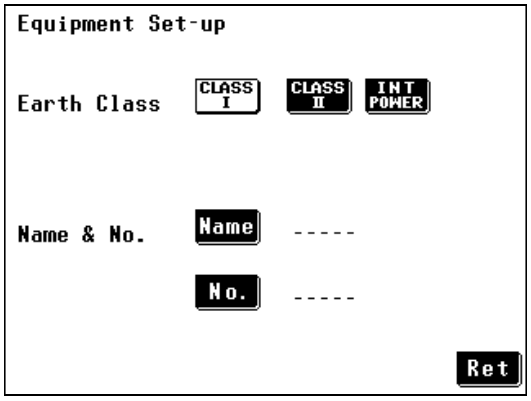
NOTE

- The instrument ordinarily operates as an ammeter, but the voltmeter function can be selected on the mode setting screen. When using the instrument as a voltmeter, it is possible to connect an original network if networks A through F do not conform to the required network configuration.
  To use a network other than networks A through F:
  ❖6.9, "Setting the Mode" (page 97)
- Once a network is selected, the initial screen appears the next time power is turned on. If turning the power switch off with the measurement screen displayed, the measurement screen is redisplayed the next time power is on.

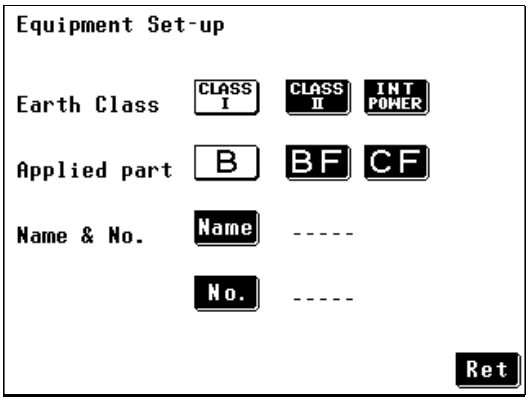
5.2 Selecting the Grounding Class of Equipment Under Test



Initial screen



Setting screen of equipment under test
(when selecting network A, C, D,E, or F)



Setting screen of equipment under test
(when selecting network B)

1. On the initial screen, press the [Class I] key to display the setting screen of the equipment under test.

2. Set the grounding class of the equipment under test.

CLASS I	Inspection of Class-I equipment
CLASS II	Inspection of Class-II equipment
INT POWER	Inspection of internally powered equipment*
B	Inspection of equipment with Type B applied part (when selecting network B)
BF	Inspection of equipment with Type BF applied part (when selecting network B)
CF	Inspection of equipment with Type CF applied part (when selecting network B)

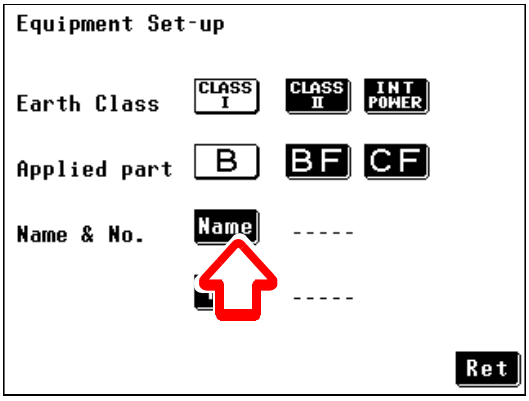
* Measurement of Patient leakage current I in internally powered equipment is supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

3. Register the equipment name/control number.
❖(page 53)

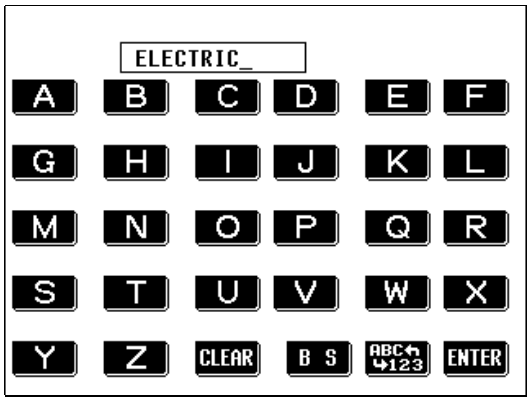
4. Press [Ret] to return to the initial screen.
The keys displayed indicate inspection items required by the selected class.

5.2.1 Registering an Equipment Name/Control Number

An equipment name and a control number can be registered. The name and number registered are included in the data that is printed or saved.
Once a name and number are registered, both are included in printed and saved data until the setting is changed.
Up to 12 characters can be entered. Since the entered information is saved along with measurement data, entering information can be useful.



Setting screen of equipment under test



Alphabetic character input screen

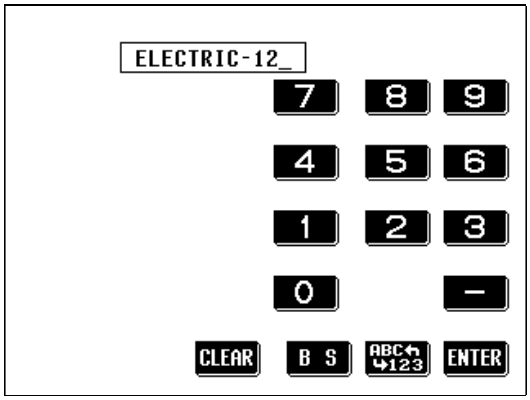
1. On the setting screen of the equipment under test, press Name to display the alphabetic character input screen.

   The input screen shows "-----" by default.

   Before entering, be sure to press CLEAR to clear the input box.

2. Enter an equipment name.

CLEAR	Clears the equipment name or control number.
B S	Backspace
ABC 123	Switches between the alphabetic character input screen and numeric character input screen.



Numeric character input screen

3. Press ENTER to register the input and return to the setting screen of the equipment under test.

4. Press No. to display the numeric character input screen.

5. Enter a control number.

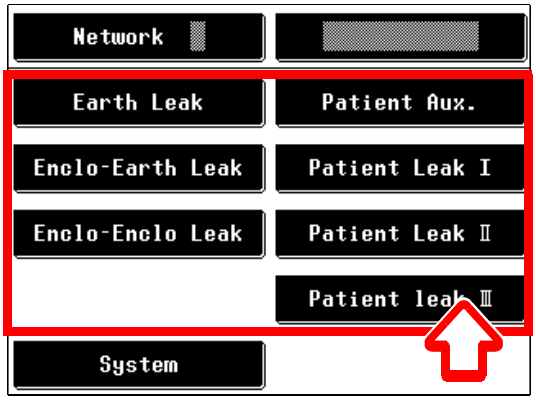
6. Press ENTER to register the input and return to the setting screen of the equipment under test.

7. Press Ret to return to the initial screen.

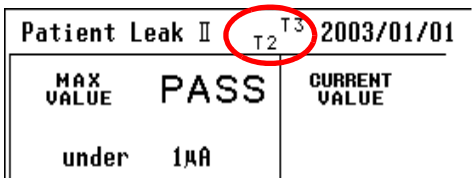
NOTE

When the grounding class set for the equipment under test is changed, the condition settings on the measurement screen are initialized except for the allowable value factor.

5.3 Selecting a Measurement Mode



1. After a measurement mode is selected on the initial screen, the measurement screen appears.
The terminals (T1, T2, T3) used for measurement are indicated at the top of the screen.



NOTE

- The number of measurement modes displayed on the screen varies depending on the network and class settings selected.
- Some measurement modes may not be available for selection depending on the class and applied part settings.

Selectable measurement modes

When selecting network A, C, D, E, or F (all except B)

Grounding class / Measurement mode	Class-I equipment	Class-II equipment	Internally powered equipment
Earth leakage current	●	--	--
Leakage current between enclosure and earth	●	●	●
Leakage current between enclosure and enclosure	●	●	●
Leakage current between enclosure and line	●	●	--

●: Can be set., --: Cannot be set.

When selecting network B

Grounding class / Applied part / Measurement mode	Class-I equipment			Class-II equipment			Internally powered equipment		
	Type B	Type BF	Type CF	Type B	Type BF	Type CF	Type B	Type BF	Type CF
Earth leakage current	●	●	●	--	--	--	--	--	--
Leakage current between enclosure and earth	●	●	●	●	●	●	●	●	●
Leakage current between enclosure and enclosure	●	●	●	●	●	●	●	●	●
Patient auxiliary current	●	●	●	●	●	●	●	●	●
Patient leakage current I	●	●	●	●	●	●	●	●	●
Patient leakage current II	●	--	--	●	--	--	●	--	--
Patient leakage current III	--	●	●	--	●	●	--	●	●

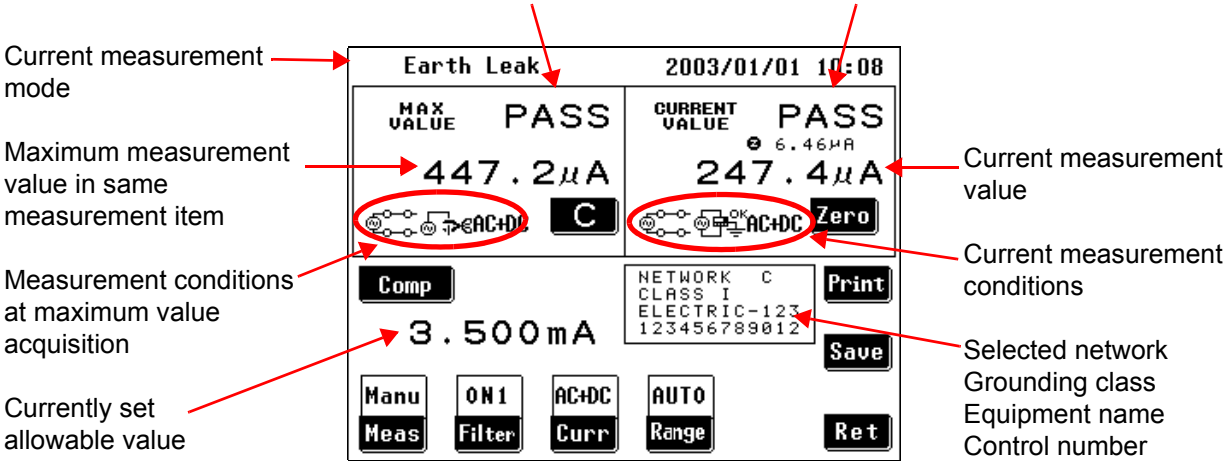
●: Can be set., --: Cannot be set.

5.4 Setting Measurement Items

When the measurement method is set to [MANUAL] on the measurement screen, the measurement starts. The measurement conditions can be changed during measurement. The following example shows the earth leakage current measurement screen.

Result of comparison between maximum value and allowable value
PASS: Maximum value is equal to or less than the allowable value.
FAIL : Maximum value is greater than the allowable value.

Result of comparison between current measurement value and allowable value
PASS: Current measurement value is equal to or less than the allowable value.
FAIL : Current measurement value is greater than the allowable value.



Measurement screen (manual measurement)

C	Clears the maximum value. Unless this key is pressed, the maximum value is not cleared even if measurement conditions are changed in the same measurement mode. Changing the measurement mode clears the maximum value.
Zero	Starts zero adjustment. This key is displayed only in earth leakage current measurement mode. ❖(page 58)
Comp	Displays the allowable value setting screen. ❖(page 60)
Meas	Switches the measurement method between manual and automatic. ❖(page 71)
Filter	Displays the filter setting screen. Used to turn the filter ON and OFF, or change the setting of the filter. ❖(page 62)
Curr	Displays the screen for setting the target current. ❖(page 64)
Range	Displays the screen for setting the measurement range. Switches the range between Auto and Hold. ❖(page 66)
Save	Displays the screen for selecting data to be saved. ❖(page 78)
Print	Starts transmitting data to the 9442 PRINTER (option). This key is displayed only when the interface setting is set to "Printer." ❖(page 77)
Ret	Exits the currently selected measurement mode, and returns to the system screen.

About indication of "equipment status" in currently executed measurement (or at maximum value acquisition)

The indication below the measurement value (or maximum value) on the measurement screen describes the conditions under which the value was obtained.
The indication varies depending on the network, class setting, and measurement mode selected.

1. In manual measurement, pressing **Meas** allows the following items to be changed:

Power supply polarity

	Indicates "positive phase."
	Indicates "negative phase."

State of equipment under test (power supply)

	Indicates "normal condition" (not under either of the following two conditions).
	Indicates "fault condition" (disconnection of one wire in the power line).
 ※	Indicates "fault condition" (disconnection of the protective grounding wire).

* Shown only when the grounding class is set to "Class-I equipment."

Line phase in leakage current measurement between enclosure and line *

	Indicates the application of voltage from the L (live) side of power supplied to [LINE IN].
	Indicates the application of voltage from the N (neutral) side of power supplied to [LINE IN].

* Shown when network A, C, D, E, or F is selected.

Measurement with 110% voltage application and voltage phase *

	Indicates the application of voltage in the same phase as power supplied to [LINE IN]. (**N**: Normal)
	Indicates the application of voltage in the reversed phase of power supplied to [LINE IN]. (**R**: Reverse)

* Shown only when network B is selected.

2. On the measurement screen, pressing **Curr** enables selection of the following items:

Target current *

AC	Indicates an rms value for AC.
DC	Indicates a value for DC.
AC+DC	Indicates AC and DC.
AC PEAK	Indicates an AC peak value (crest value).

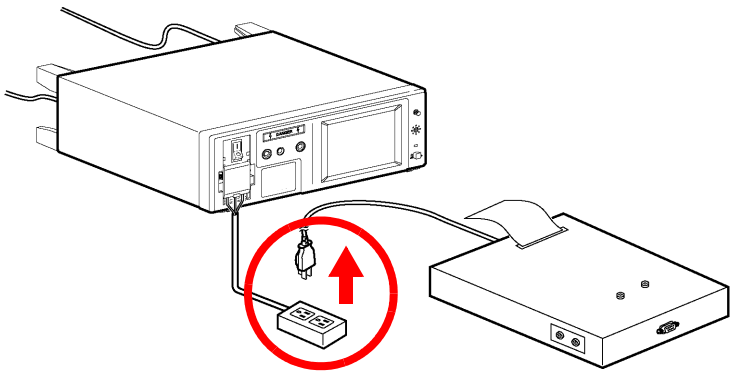
* The target current varies depending on the network and measurement mode selected.

5.4.1 Performing Zero Adjustment

(in earth leakage current measurement mode only)

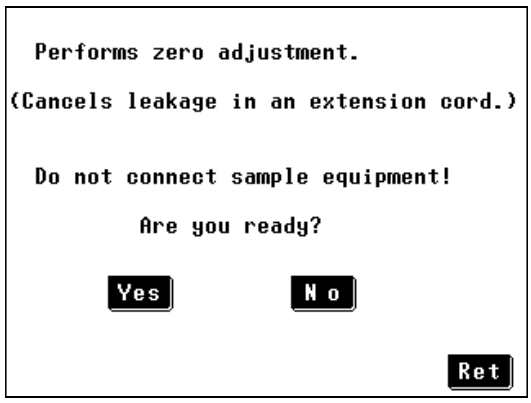
Perform zero adjustment before conducting earth leakage current measurement.
Zero adjustment eliminates measurement deviation caused by the leakage current from a wiring adapter (extension cord).

1. Disconnect the power cord of the equipment under test.



NOTE

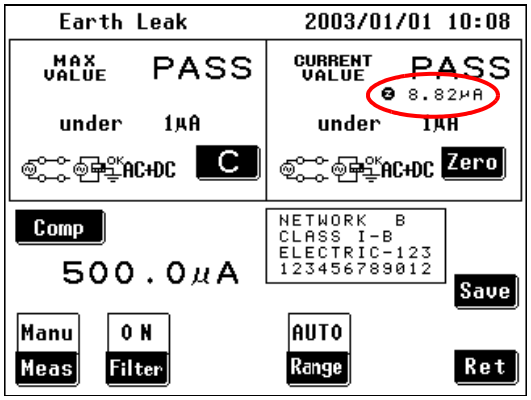
- When connecting a wiring adapter (extension cord) to the terminal block be sure to perform zero adjustment.
- Zero adjustment negates the effect of the wiring adapter. When a wiring adapter (extension cord) is not used, there is no need to perform zero adjustment.
- When the target current is set to "DC," there is no need to perform zero adjustment. (Zero appears as a white, protruding key, thus disabling its operation.)

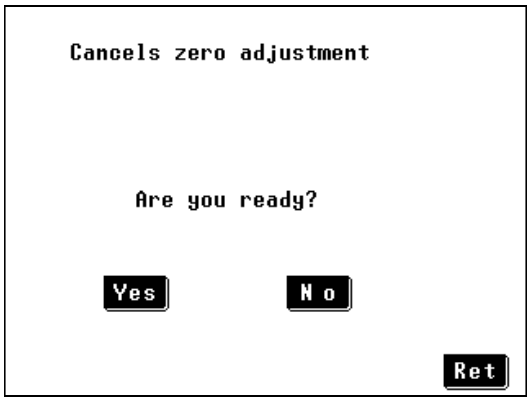


2. On the measurement screen, press Zero. The zero adjustment confirmation screen then appears.
(Zero is displayed only in earth leakage current measurement mode.)

3. Press Yes to perform zero adjustment. It takes about 10 seconds to complete zero adjustment.

Press No to cancel zero adjustment and return to the measurement screen.





4. After zero adjustment is completed, display returns to the measurement screen.
When zero adjustment is effective, a ⊖ symbol and the amount cancelled (i.e., amount of leakage current from wiring adapter) are displayed, as in the screen shown at left, to indicate that compensation by zero adjustment is being applied.

5. Pressing Zero again while zero adjustment is effective displays the zero adjustment cancellation confirmation screen.

6. Press Yes to cancel zero adjustment and return to the measurement screen.

Press No to return to the measurement screen without cancelling zero adjustment.

NOTE

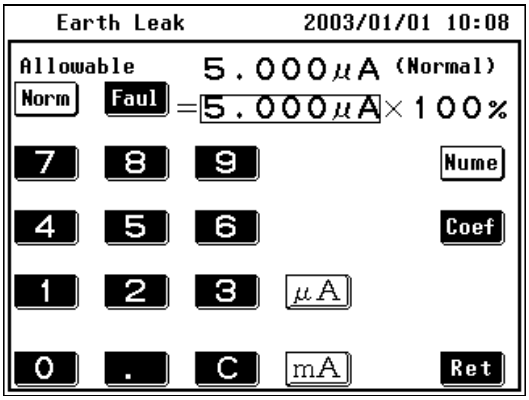
- If "0 μA" is indicated as the amount cancelled (i.e., amount of leakage current from wiring adapter) after zero adjustment, zero adjustment does not become effective since it is not necessary. In that case, the ⊖ symbol is not indicated.
- When the network, grounding class, or filter ON/OFF setting is changed, zero adjustment is cancelled.
- When the wiring adapter is replaced, repeat zero adjustment.
  Failure to repeat zero adjustment will result in inaccurate measurement results.
  (Example)
  The adapter leakage current is 100 μA, which is used as the compensation value. When the adapter is disconnected, the measurement of 40 μA leakage current produces the following result:
  40 μA - 100 μA = -60 μA
  Therefore, the display shows "-OVERFLOW" and the allowable value judgement indicates "**FAIL**."
- Depending on the results of zero adjustment calculation of the measurement range and measurement data, the high sensitivity range may not be selected. In that case, the display shows "less than (minimum indication value in range)."
- In zero adjustment, the power supply polarity and equipment status are switched internally within the instrument.
- If the power switch of the instrument is turned off during zero adjustment, an accurate zero adjustment value cannot be obtained. If this occurs, perform zero adjustment after turning on the power switch for the next measuring operation.
- Note that turning off the power switch of the instrument during zero adjustment may change the power supply polarity, equipment status, and range setting.

5.4.2 Setting the Allowable Value

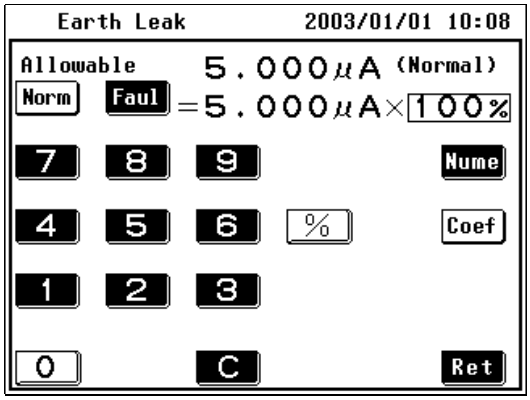
Set the allowable value (upper-limit leakage current value) for the measurement value and maximum value.
According to the status (normal condition, single-fault condition) of the equipment under test, two values can be set.
The allowable value setting is based on "Numeric value x Factor."
Use the allowable value setting to provide a margin or compensate for measurement error. The factor is set to "100%" by default.

The instrument indicates the result (PASS or FAIL indication) of comparison between the measurement value and allowable value.
In automatic measurement, the judgement result is output from EXT I/O.
❖8.2, "Connecting to the EXT I/O Terminal" (page 199)

The buzzer that sounds based on the judgement result can be disabled.
❖6.3, "Setting the Beep Sound" (page 87)



Allowable value setting screen
(Normal condition, numeric value setting mode)

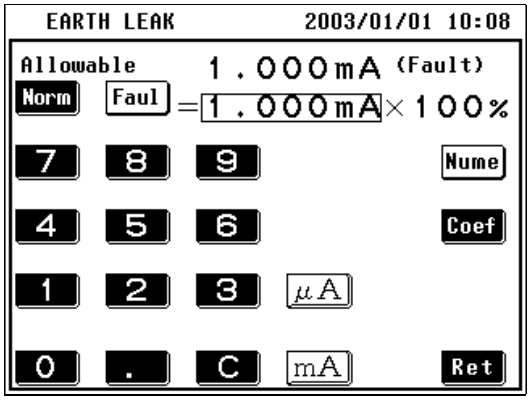


Allowable value setting screen
(Normal condition, factor setting mode)

1. On the measurement screen, press Comp to display the allowable value setting screen.
2. Press Norm to activate the allowable value setting condition for normal condition.
3. Enter a numeric value by using numeric keys (0 through 9, and .).

   To correct an input error, press the Clear (C) key, then reenter the input.
4. Enter the unit of allowable value.

   Pressing a Unit key (μA, mA) immediately confirms the numeric input.
5. Press Coef to enter a factor for the set allowable value.



Allowable value setting screen
(fault condition, numeric value setting mode)

6. Enter a numeric value by using numeric keys (0 through 9).

   To correct an input error, press the Clear (C) key, then reenter the input.

7. Pressing the Unit key (%) immediately confirms the factor input.

8. Press Faul to activate the allowable value setting condition for fault condition.

9. In the same way as for setting the normal condition, make the necessary settings by following steps **3** through **7**.

10. Press Ret to return to the measurement screen.

NOTE

- The allowable value setting range is from 5 µA to 20 mA.
  If a value less than 5 µA is entered, the setting is automatically adjusted to "5 µA."
  If a value greater than 20 mA is entered, the setting is automatically adjusted to "20 mA."
- If the screen is changed without pressing µA, mA or %, the new allowable value setting does not take effect.
- The Unit keys (µA, mA, %) cannot be operated until a numeric key is pressed.
- **About allowable value judgement**
  When the indication unit is fixed to "mA," FAIL judgement may result even if the measurement value (or maximum value) and allowable value are the same. This is because internally retained data contains lower-order digits even if the unit is fixed to "mA," and judgement is made using the values with lower-order digits.
- An allowable value setting lower than the accuracy guarantee range results in an unconditional judgement result of "**FAIL**."
- When using network B, different allowable values for DC and AC tests can be set for both patient leakage current I and patient auxilary current measurements.
  This function is supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.
  For measurements other than these, the same allowable value is used for both AC and DC. Set the value as required.

5.4.3 Setting the Filter

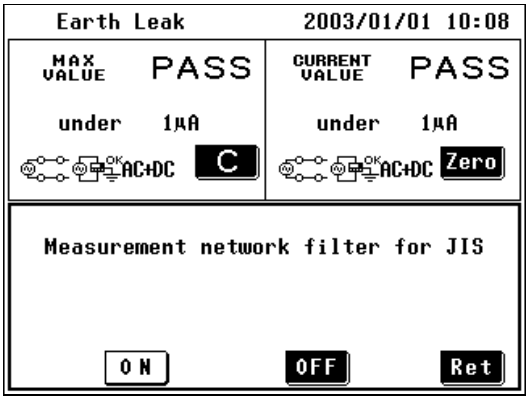
(when selecting network A, B, or C)

Turn the filter for the measurement network ON and OFF or change the setting of the filter.
In manual measurement, the measurement value can be checked while switching the filter ON and OFF.

NOTE

When selecting network A or B : The filter is switched ON and OFF.
When selecting network C : The filter is set to ON1, ON2, or OFF.
When selecting network D, E, or F: No setting for filter.

(1) When selecting network A

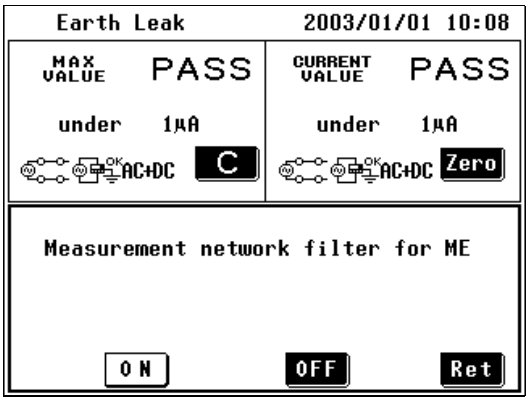


1. On the measurement screen, press Filter to display the network filter setting screen.
2. Change the setting of the filter for the network.

ON	Sets the multi-frequency network.
OFF	Sets the single-frequency network.

3. Press Ret to return to the measurement screen.

(2) When selecting network B

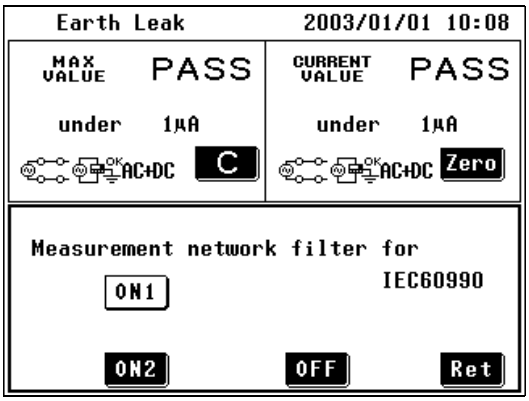


1. On the measurement screen, press Filter to display the network filter setting screen.
2. Change the setting of the filter for the network.

ON	Sets the network with a frequency characteristic.
OFF	Sets the network with only 1 kΩ non-inductive resistance.

3. Press Ret to return to the measurement screen.

(3) When selecting network C



1. On the measurement screen, press Filter to display the network filter setting screen.
2. Change the setting of the filter for the network.

ON1	Sets a network compatible with perception/reaction.
ON2	Sets a network compatible with abandonment.
OFF	Sets the body impedance network.

3. Press Ret to return to the measurement screen.

NOTE
When the target current is set to "AC Peak," the filter cannot be turned OFF. (The OFF key is not displayed.)

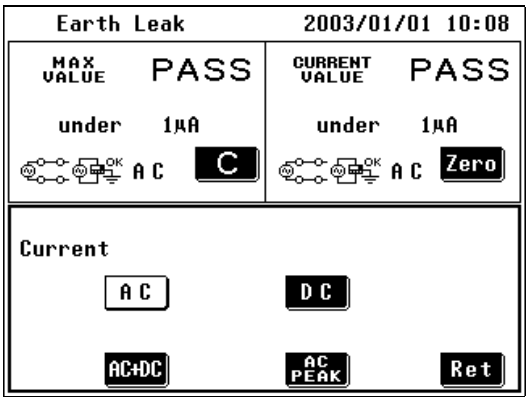
5.4.4 Selecting the Type of Target Current

NOTE

- The measurement screen shows Curr only when the target current is selectable.
- When network C is selected with the filter setting OFF, setting the target current to "AC Peak" automatically sets the filter for the measurement network to "ON1." (*)

Selectable target currents

Network / Measurement mode	A	B	C	D	E	F
Earth leakage current	AC DC AC+DC Not selectable	Not selectable Not selectable AC+DC Not selectable	AC DC AC+DC ACpeak*	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak
Leakage current between enclosure and line	AC DC AC+DC Not selectable	Not applicable	AC DC AC+DC ACpeak*	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak
Leakage current between enclosure and earth	AC DC AC+DC Not selectable	Not selectable Not selectable AC+DC Not selectable	AC DC AC+DC ACpeak*	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak
Leakage current between enclosure and enclosure	AC DC AC+DC Not selectable	Not selectable Not selectable AC+DC Not selectable	AC DC AC+DC ACpeak*	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak	AC DC AC+DC ACpeak
Patient auxiliary current	Not applicable	AC DC Not selectable Not selectable	Not applicable	Not applicable	Not applicable	Not applicable
Patient leakage current I	Not applicable	AC DC AC+DC Not selectable	Not applicable	Not applicable	Not applicable	Not applicable
Patient leakage current II	Not applicable	Not selectable Not selectable AC+DC Not selectable	Not applicable	Not applicable	Not applicable	Not applicable
Patient leakage current III	Not applicable	Not selectable Not selectable AC+DC Not selectable	Not applicable	Not applicable	Not applicable	Not applicable

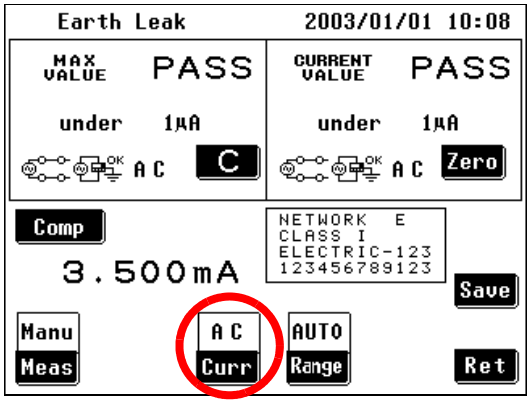


1. On the measurement screen, press Curr to display the target current setting screen.

2. Select the type of target current.

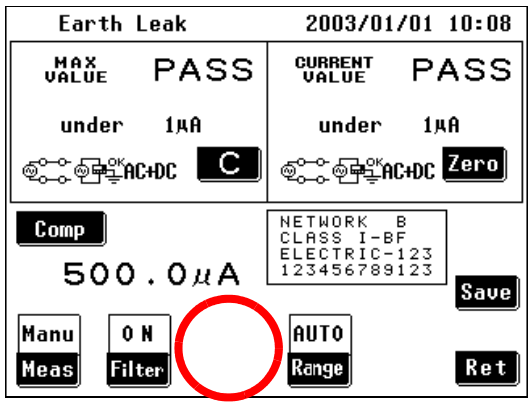
A C	For AC measurement
D C	For DC measurement
AC+DC	For AC + DC measurement
AC PEAK	For AC peak measurement

3. Press Ret to return to the measurement screen.



When setting the target current to "AC"

In the diagram on the left, the target current is set to "AC" (alternating current).



When selecting network B

When selecting network B
The screen does not display either Curr or the current setting since the target current cannot be set in modes other than the patient auxiliary current and patient leakage current I measurement modes.

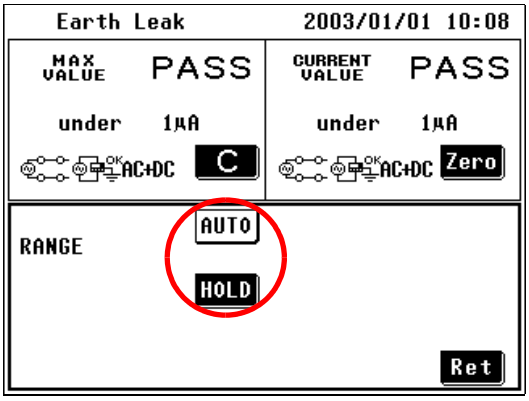
When network B is selected in the patient auxiliary current and patient leakage current I measurement modes, the screen does not display either Curr or the current setting when the automatic measurement method is used. Target current is set in the automatic measurement items.

5.4.5 Setting the Measurement Range (Auto/Hold)

NOTE

- If the range is exceeded, all indications show "**OVER FLOW**".
- The maximum indication value differs for network D and network F. (The range name indicated is the name of the representative network whose basic element is 1 kΩ.)
- The minimum indication value in the Hold range setting varies depending on the network selected.
- The range configuration differs only when the target current is set to "AC Peak."
- If you cannot have the faintest idea about the current type and size, please measure it by "AC+DC" to have a rough idea and decide the measurement range.

- **Caution on using the Hold range**
  When "!" is displayed and then a lower sensitivity range is chosen, the judgement result may be out of the guaranteed accuracy range.
  (Please refer to page 70)
- **Caution on measuring DC**
  In case of AC(except 50/60Hz) overlay, DC measuring value may not be stable .
- As for AC Peak measurement, please set the allowable value to a bigger one than the minimum indication value in the range.
  Setting a value less than the minimum indication value disables any numeric comparison, along with an unconditional judgement result of "**FAIL**."
  ❖Range of indication: (page 68), (page 69)

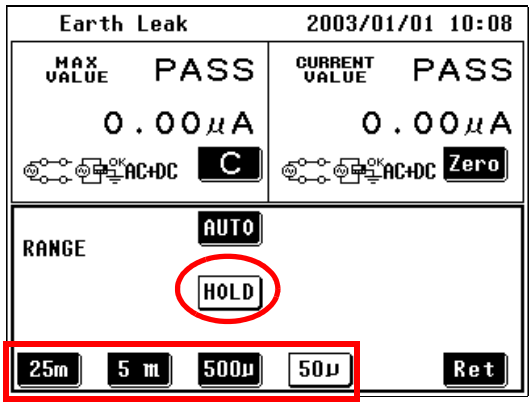


1. On the measurement screen, press Range to display the measurement range setting screen.

2. Select a measurement range.

AUTO	Sets the current range to the Auto (automatic) range.
HOLD	Sets the current range to the Hold (fixed) range.

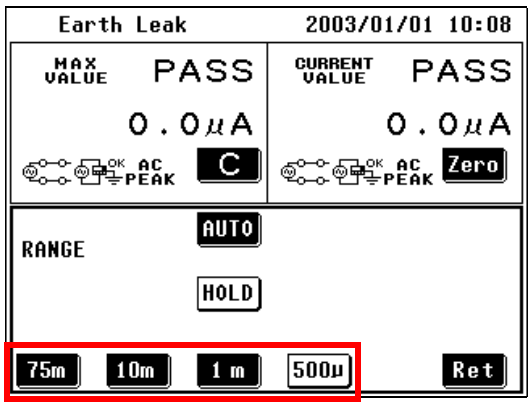
3. Selecting the Hold range displays a set of range setting keys. Use these keys to select a range.



When setting the target current to AC, DC, or AC+DC

25m	Sets the fixed 25 mA range.
5 m	Sets the fixed 5 mA range.
500μ	Sets the fixed 500 μA range.
50μ	Sets the fixed 50 μA range.

The "fixed 50 μA range" is selected in the screen shown on the left.



When setting the target current to AC Peak

75m	Sets the fixed 75 mA range.
10m	Sets the fixed 10 mA range.
1 m	Sets the fixed 1 mA range.
500μ	Sets the fixed 500 μA range.

The "fixed 500 μA range" is selected in the screen shown on the left.

4. Press Ret to return to the measurement screen.

Range of indication when setting unit of current measurement to Auto (automatic) mode

❖For details of accuracy guaranteed range:
10.5, "Accuracy" (page 220)

When selecting network A, B, C, or E

(Measurement of AC, DC, or AC+DC)

Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	25.00 mA to 0.00 mA (0.00 mA)	5.000 mA to 0.000 mA (0.000 mA)	500.0 µA to 0.0 µA (0.0 µA)	50.00 µA to 1.01 µA (0.00 µA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	75.0 mA to 8.0 mA (8 mA or less)	10.00 mA to 0.80 mA (0.8 mA or less)	1.000 mA to 0.100 mA (0.1 mA or less)	500.0 µA to 40.0 µA (0.0 µA)

When selecting network D

(Measurement of AC, DC, or AC+DC)

Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	16.00 mA to 0.00 mA (0.00 mA)	3.300 mA to 0.000 mA (0.000 mA)	330.0 µA to 0.0 µA (0.0 µA)	33.00 µA to 1.01 µA (0.0 µA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	50.0 mA to 6.0 mA (6 mA or less)	6.60 mA to 0.60 mA (0.6 mA or less)	0.660 mA to 0.070 mA (0.07 mA or less)	330.0 µA to 30.0 µA (0.0 µA)

When selecting network F

(Measurement of AC, DC, or AC+DC)

Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	12.50 mA to 0.00 mA (0.00 mA)	2.500 mA to 0.000 mA (0.000 mA)	250.0 µA to 0.0 µA (0.0 µA)	25.00 µA to 1.01 µA (0.00 µA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	37.5 mA to 4.0 mA (4 mA or less)	5.00 mA to 0.40 mA (0.4 mA or less)	0.500 mA to 0.050 mA (0.05 mA or less)	250.0 µA to 20.0 µA (0.0 µA)

Range of indication when setting unit of current measurement to Hold (fixed) mode

❖For details of setting the unit of current measurement to mA:
6.9, "Setting the Mode" (page 97)
❖For details of accuracy guaranteed range:
10.5, "Accuracy" (page 220)

When selecting network A, B, C, or E

(Measurement of AC, DC, or AC+DC)

Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	25.00 mA to 0.00 mA (0.00 mA)	5.000 mA to 0.000 mA (0.000 mA)	0.500 mA to 0.000 mA (0.000 mA)	0.050 mA to 0.002 mA (0.000 mA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	75.0 mA to 8.0 mA (8 mA or less)	10.00 mA to 0.80 mA (0.8 mA or less)	1.000 mA to 0.100 mA (0.1 mA or less)	0.500 mA to 0.040 mA (0.000 mA)

When selecting network D

(Measurement of AC, DC, or AC+DC)

Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	16.00 mA to 0.00 mA (0.00 mA)	3.300 mA to 0.000 mA (0.000 mA)	0.330 mA to 0.000 mA (0.000 mA)	0.033 mA to 0.002 mA (0.000 mA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	50.0 mA to 6.0 mA (6 mA or less)	6.60 mA to 0.60 mA (0.6 mA or less)	0.660 mA to 0.070 mA (0.07 mA or less)	0.330 mA to 0.030 mA (0.000 mA)

When selecting network F

(Measurement of AC, DC, or AC+DC)

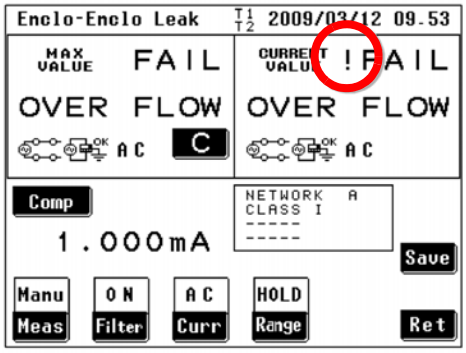
Range	25.00 mA	5.000 mA	500.0 µA	50.00 µA
Maximum indication value to Minimum indication value (In Hold range setting)	12.50 mA to 0.00 mA (0.00 mA)	2.500 mA to 0.000 mA (0.000 mA)	0.250 mA to 0.000 mA (0.000 mA)	0.025 mA to 0.002 mA (0.000 mA)

(Measurement of AC Peak)

Range	75.0 mA	10.00 mA	1.000 mA	500.0 µA
Maximum indication value to Minimum indication value (In Hold range setting)	37.5 mA to 4.0 mA (4 mA or less)	5.00 mA to 0.40 mA (0.4 mA or less)	0.500 mA to 0.050 mA (0.05 mA or less)	0.250 mA to 0.020 mA (0.000 mA)

NOTE

About "!"

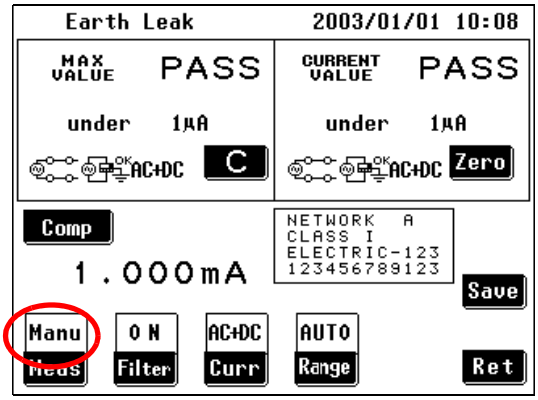


- When measuring in Hold (fixed) range setting, if a portion of measuring current goes over the input allowable range for the circuit, "!" together with "**FAIL**" may be displayed on the measuring screen. "!" means that some of the instantaneous values go over the input allowable range. In this case, please select a lower sensitivity range to measure.
- When measuring in Auto (automatic) range, if some of the instantaneous values goes over the input allowable range and then a lower sensitivity range is chosen, the judgement result may be out of the guaranteed accuracy range.
- "!" will be displayed only in ammeter mode and not in voltmeter mode. "!" information is not available for RS-232C or GP-IB communication or printers. In case of displaying "!", the judgement will result in "**FAIL**" and "**OVER FLOW**".

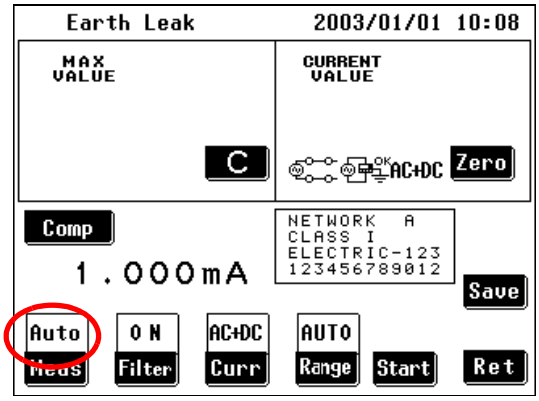
5.4.6 Changing the Measurement Method (Auto/Manual)

(1) Manual measurement
The measurement value can be checked while changing the target current, filter setting, power supply polarity, and equipment status.

(2) Automatic measurement
The power supply polarity and equipment status are automatically switched during measurement.
The item to be switched automatically can be selected and the measuring time set.



Measurement screen (manual)



Measurement screen (auto)

1. On the measurement screen, press Meas to display the manual/auto measurement setting screen.
2. Select a measurement mode.

Manu	For manual measurement
Auto	For automatic measurement

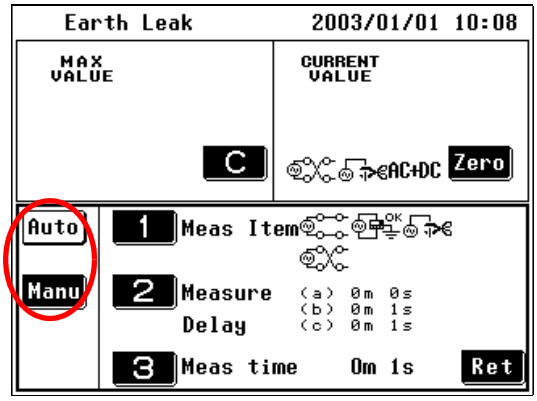
3. Press Ret to return to the measurement screen.

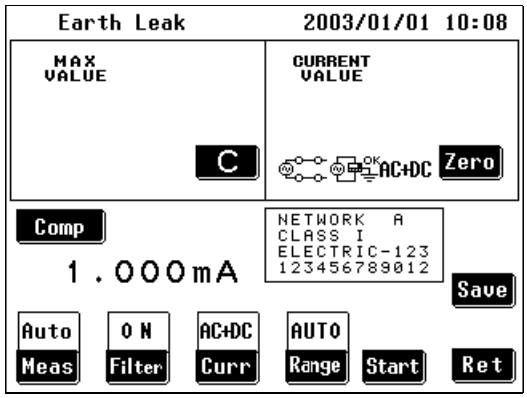
5.4.7 Manual Measurement

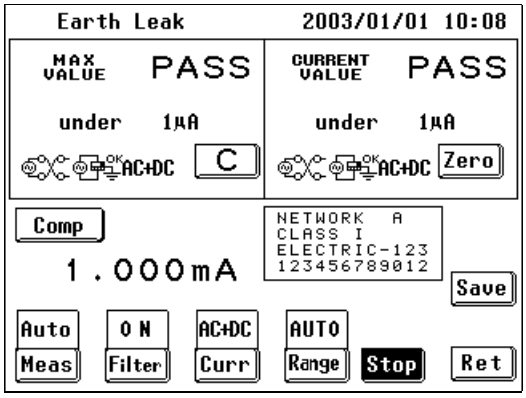
When the measurement method is set to [MANUAL] on the measurement screen, the measurement starts.
The measurement conditions can be changed during measurement.
❖(page 57)

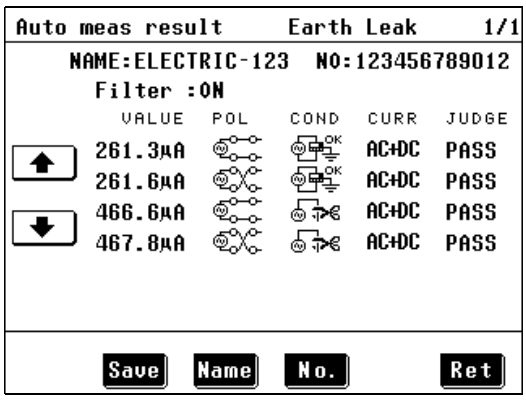
5.4.8 Automatic Measurement

The power supply polarity and equipment status are automatically switched during measurement. The item to be switched automatically can be selected and the measuring time set.



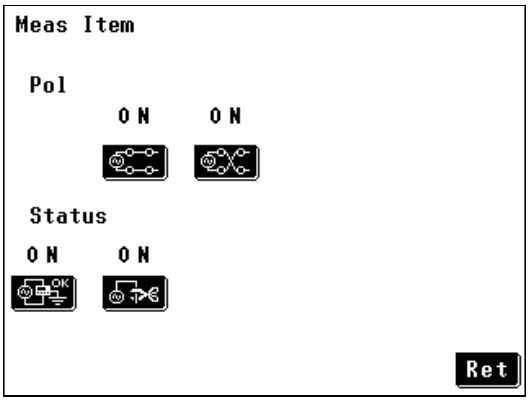






1. On the measurement screen, press **Meas** to display the manual/auto measurement setting screen.
2. Press **Auto** to display the automatic measurement setting screen.
3. Press **1** and select an item for automatic measurement.
❖(page 73)
4. Press **2** and set the measurement delay (delay time).
❖(page 75)
5. Press **3** and set the measuring time.
❖(page 76)
6. Press **Ret** to return to the automatic measurement screen. This screen displays the **Start** key.
7. Press **Start** to begin automatic measurement. During automatic measurement, only the **Stop** key is effective.
During the measurement in each condition, an intermittent beep sound is generated.
No beep sound is generated when the beep sound for "Key input" is turned OFF.
8. When automatic measurement is completed, the screen shown on the left appears.
The measurement results are displayed in a list. To save the data, enter [Name], [No] and press **Save**.
Note
When a remote command is received during automatic measurement (when remote status is activated), the automatic measurement result screen is not displayed.
9. To repeat automatic measurement, press **Ret**.

(1) Setting automatic measurement items



Automatic measurement item setting screen in earth leakage current measurement mode

1. On the automatic measurement setting screen, press 1 to display the automatic measurement item setting screen.

2. The ON/OFF indication above each key indicates whether automatic measurement is conducted for that item. Set the necessary items for automatic measurement.
Each time a key is pressed, the indication switches between ON and OFF.

Power supply polarity

- Conducts measurement in the "positive phase" condition.
- Conducts measurement in the "negative phase" condition.

* Both "positive phase" and "negative phase" cannot be set to OFF at the same time.

Condition of equipment under test (power supply)

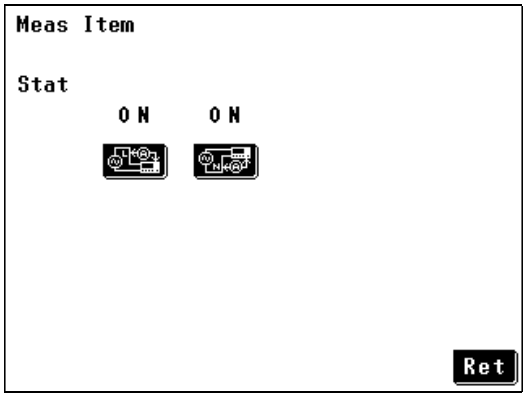
- Conducts measurement in "normal condition" (i.e., not in either of the following two conditions).
- Conducts measurement in "fault condition" (disconnection of one wire in the power line).
- Conducts measurement in "fault condition" (disconnection of the protective grounding wire).
  * Shown only when the grounding class is set to "Class-I equipment."

* These three settings cannot be set to OFF at the same time.

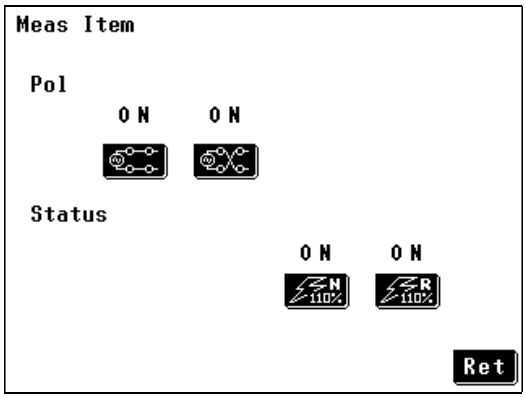
Target current

- AC Conducts AC measurement.
- DC Conducts DC measurement.
- AC+DC Conducts AC+DC measurement.

* These three target current settings cannot be set to OFF at the same time.
* The target current can be selected as an automatic measurement item only when network B is selected with the patient leakage current I or patient auxiliary current measurement mode set.



Automatic measurement item setting measurement between enclosure and line



Automatic measurement item setting screen for network B and patient leakage current II measurement

Line phase in leakage current measurement between enclosure and line

Conducts measurement with voltage of the L (live) side of power supplied to [LINE IN].

Conducts measurement with voltage of the N (neutral) side of power supplied to [LINE IN].

* Shown when network A, C, D, E, or F is selected.

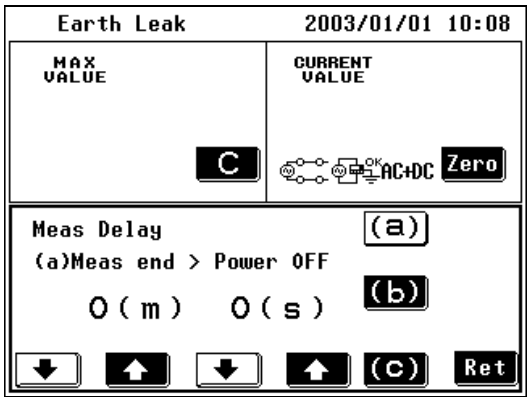
Measurement with 110% voltage application and voltage phase

Conducts measurement with voltage that is in the same phase as power supplied to [LINE IN]. (N: Normal)

Conducts measurement with voltage that is in the reversed phase of power supplied to [LINE IN]. (R: Reverse)

* These two settings cannot be set to OFF at the same time.
* Shown only when network B is selected.

(2) Setting the measurement delay (delay time)



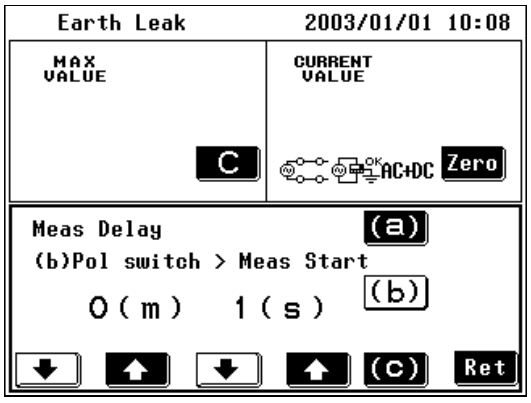
1. On the automatic measurement setting screen, press 2 to display the measurement delay time setting screen.

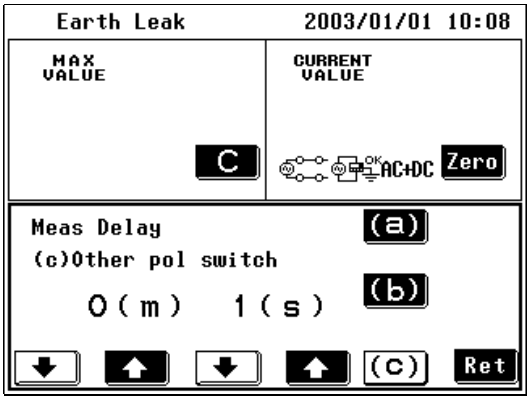
(a)	Period from when measurement ends to when one wire is disconnected (when next measurement item is "disconnection of one wire in power cord")
(b)	Period from when power supply polarity is switched to when next measurement starts
(c)	Time until next measurement starts in a condition other than (b) above

2. Press (a) and set Delay (a).
(0 sec. to 30 min.
(in 1 sec. increments)

▲	Increments the numeric value.
▼	Decrements the numeric value.

Since an instantaneous interruption of power can cause problems in such equipment under test as computers, adjust this delay setting to prevent equipment problems.





3. Press (b) and set Delay (b).
(1 sec. to 30 min.
(in 1 sec. increments)

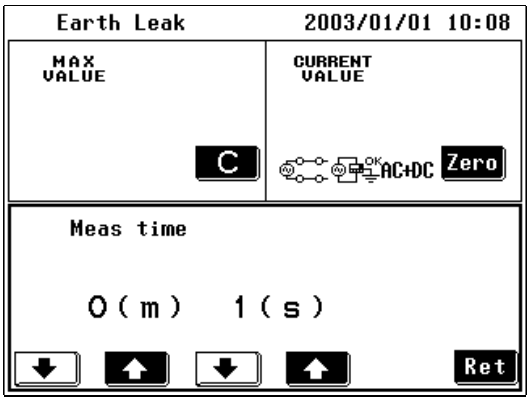
▲	Increments the numeric value.
▼	Decrements the numeric value.

Switching the power supply polarity results in a condition similar to a momentary power outage.
If a momentary power outage resets the equipment under test and it is necessary to wait for equipment operation to stabilize, adjust this delay setting.
After automatic measurement starts, the instrument pauses for the delay time set in (b).

4. Press (c) and set Delay (c).
(1 sec. to 30 min. (in 1 sec. increments)
Set the delay time for items other than polarity switching.

▲	Increments the numeric value.
▼	Decrements the numeric value.

(3) Setting the measuring time



Press 3 and set the measuring time.
(1 sec. to 5 min. (in 1 sec. increments)

▲	Increments the numeric value.
▼	Decrements the numeric value.

NOTE During automatic measurement, if the measurement value is not fixed due to a sudden input change, the measurement will be terminated.

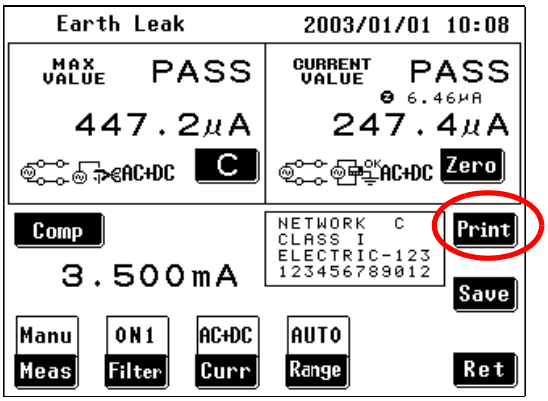
5.4.9 Printing Measurement Data

Measurement data (maximum values) can be printed out.

NOTE

- The 9442 PRINTER (option) is required for printing measurement data.
- Set the interface to "Printer" before printing.
  ❖6.7, "Selecting an Interface" (page 92)

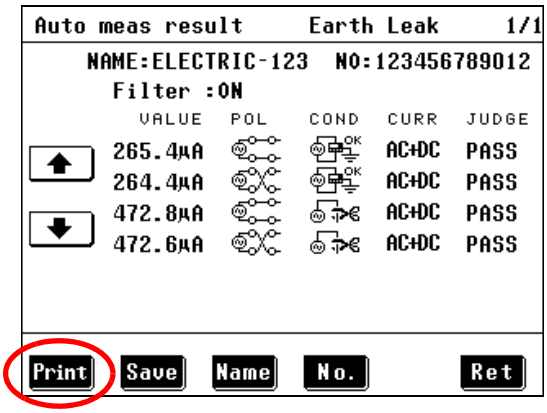
(1) When setting measurement method to Manual



Manual measurement screen

On the measurement screen, press Print to start printing.

(2) When setting measurement method to Auto



Screen displayed after automatic measurement ends

After automatic measurement ends, press Print on the measurement result screen to start printing.

NOTE

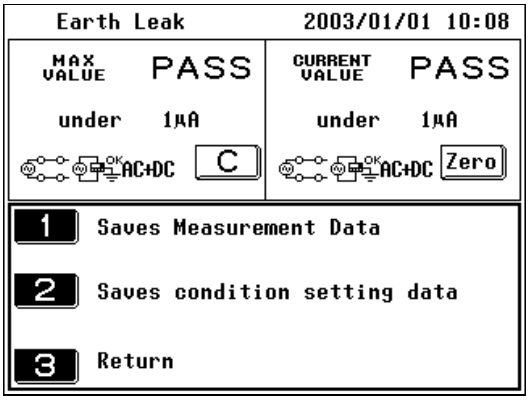
The Stop key is displayed during printing.

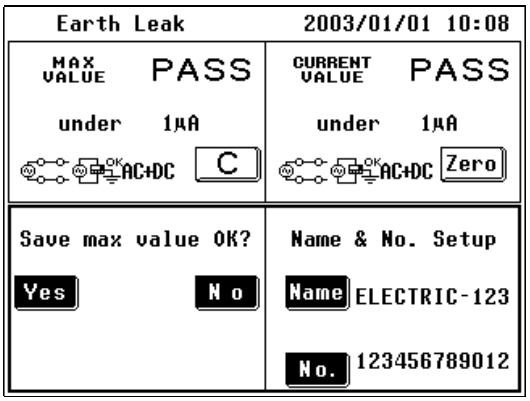
To abort printing, press Stop.

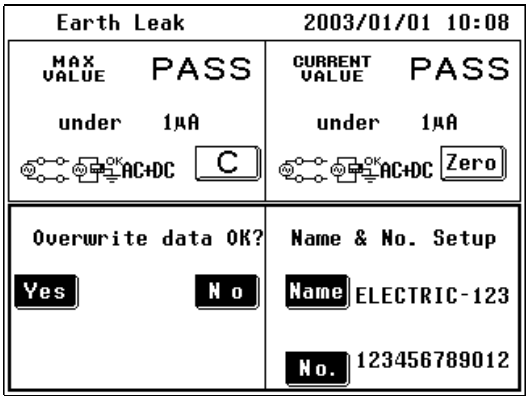
5.4.10 Saving Measurement Data

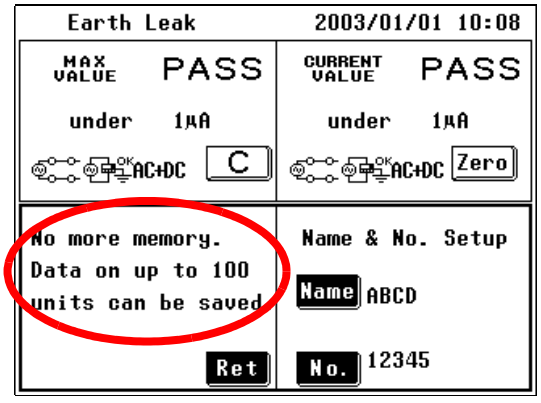
Measurement data (maximum values) can be saved in internal memory. Saved data can be checked on the saved data reference screen after measurement is completed.

❖6.10, "Checking Saved Measurement Data" (page 99)









1. On the measurement screen, press **Save** to display the screen for selecting the data to be saved.

2. Press **1**. A screen appears to confirm whether to save the measurement data.
   To change the equipment name or control number, press **Name** or **No** and enter the new name or number.
   ❖5.2.1, "Registering an Equipment Name/ Control Number" (page 53)

3. Press **Yes** to save the data.
   Press **No** to return to the measurement screen without saving the data.

4. If the data is already saved, a message appears and asks whether to overwrite the existing data.
   Press **Yes** to overwrite the existing data.
   To switch the memory used to save data, register the data under a different equipment name and control number.
   Press **No** to return to the measurement screen without saving the data.
   Each registered equipment name/control number represents one unit. The instrument can save up to 100 units. Each unit can be saved with the results of all measurement items corresponding to the network and grounding class. If the 100 unit memory capacity is exceeded, the screen shown on the left appears.
   Up to 2,000 maximum values can be saved. If this limit is exceeded, the screen displays "No more memory."
   ❖6.10.1, "Deleting Saved Data" (page 100)

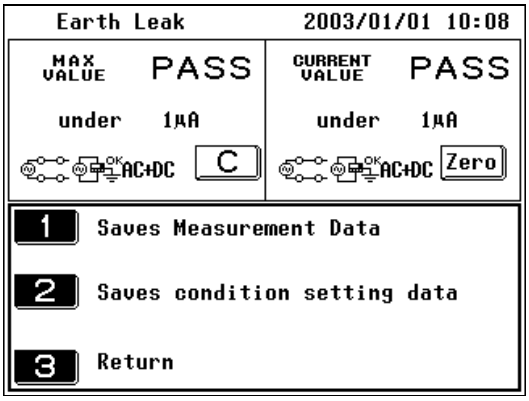
5.4.11 Saving Measurement Conditions (Panel Save Function)

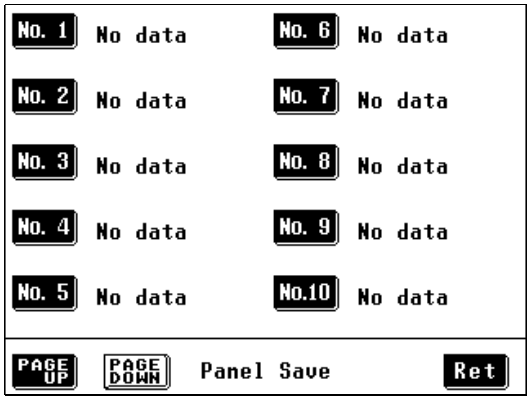
Up to 30 panels of measurement condition data can be saved in internal memory.
Saved measurement conditions can be read at a later date.
❖6.11, "Loading Saved Measurement Conditions" (page 104)

The following conditions are saved in a panel.

- Network
- Measurement mode
- Filter ON/OFF
- Grounding class
- Registered equipment name/control number
- Allowable value (normal condition, fault condition)
- Manual/auto measurement
- Measurement range
- Target current
- Equipment status (power supply polarity, fault mode, combination of items for automatic measurement)
- Measuring time/measurement delay time for automatic measurement

Saved panels can be initialized.
❖6.1, "Initializing the Instrument" (page 84)

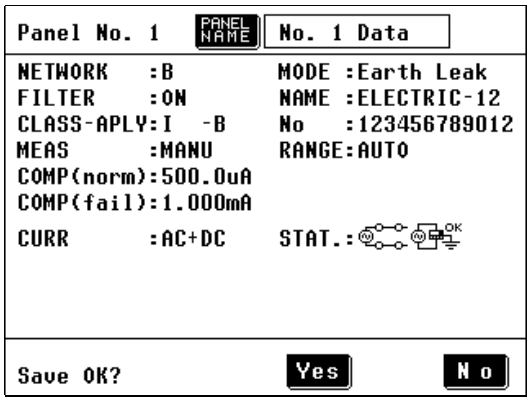




1. On the measurement screen, press Save to display the screen for selecting the data to be saved.

2. Press 2 to display the screen for selecting a panel number for saving measurement conditions.

3. Select a panel number for saving data. (Select a panel with "No Data" indicated.)
If a panel is not displayed on the screen, press PAGE UP or PAGE DOWN to display the page showing the desired panel.
Note that if the selected panel already contains data, the existing data will be overwritten by new data.



4. When a panel number is selected, a panel save confirmation screen then appears.

5. Press PANEL NAME and enter a panel name.
Entering a panel name enables data to be easily identified when read out later.
If no panel name is entered, the panel is automatically assigned a name consisting of the selected panel number followed by "Data"
(e.g., "No. 1 Data").

6. Press Yes to save the data and return to the previous screen.

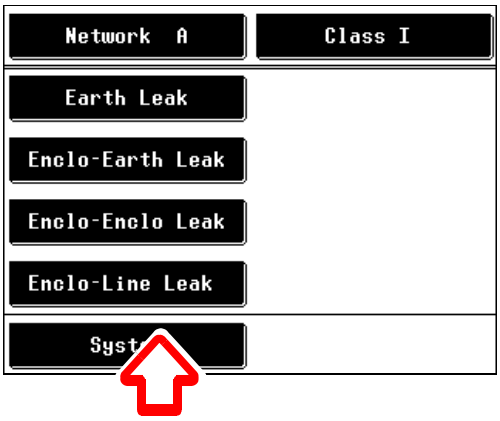
Press No to return to the previous screen without saving the data.

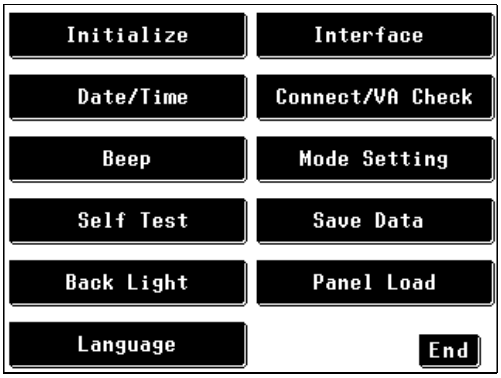
NOTE

- When the conditions for leakage current between enclosure and line, patient leakage current II, or patient leakage current III measurements are included, measurement does not have allowable values in normal condition. Therefore, the confirmation screen does not display "COMP (norm): (value)."
- Each panel can be assigned a panel name.
  A file name can be entered after pressing PANEL NAME.
  ❖For details of the method of assigning a panel name:
  5.2.1, "Registering an Equipment Name/Control Number" (page 53)

System Screen Chapter 6

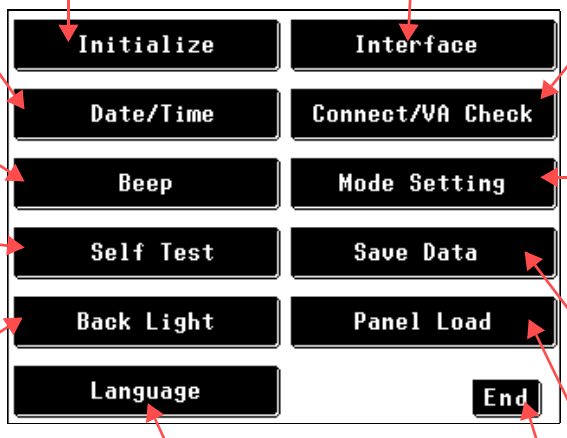
Initial screen → **System Screen**





The system screen shows the setting items for main instrument functions and data management. Press a key to display the corresponding function screen.

System screen



For system initialization
❖6.1 (page 84)

For selecting interface and setting communication condition
❖6.7 (page 92)

For setting date and time
❖6.2 (page 86)

For checking power line connection for measurement, input voltage measurement, and current consumption and power consumption of equipment under test
❖6.8 (page 94)

For ON/OFF setting of the beep sound and warning buzzer for key entry
❖6.3 (page 87)

For setting the unit of measurement data and setting the instrument for use as a voltmeter
❖6.9 (page 97)

For main instrument operation check
❖6.4 (page 88)

For viewing saved measurement data
❖6.10 (page 99)

For setting backlight constant ON/auto OFF
❖6.5 (page 90)

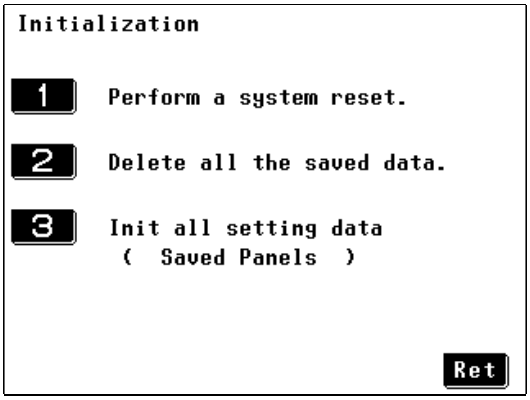
For loading saved measurement condition data
❖6.11 (page 104)

Switches the display language between Japanese and English.
❖6.6 (page 91)

Returns to the initial screen.

❖: Reference pages

6.1 Initializing the Instrument



Initialization screen

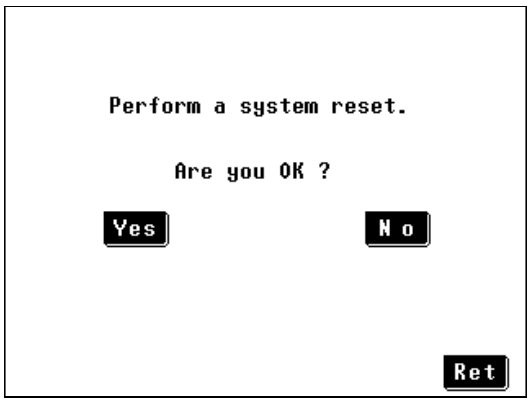
1. Press System on the initial screen to display the system screen.

2. Press Initialize to display the initialization screen.

3. After an initialization condition is selected, a confirmation screen appears.

1	Deletes all data including measurement conditions and measurement data. The date and time settings are not deleted.
2	Deletes all saved measurement data. Use this key when saved measurement data is no longer necessary.
3	Deletes all condition setting data including saved panels.

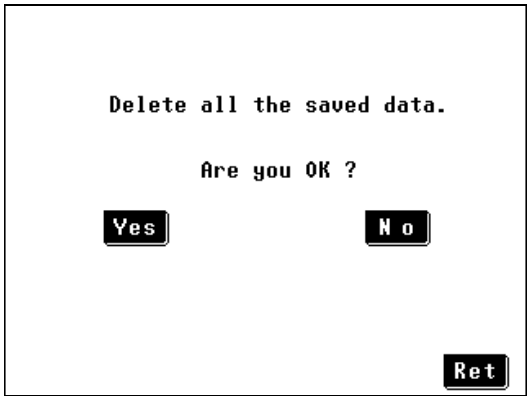
1 When "Default condition" is selected



Press **Yes** to reset the system (i.e., restore the default conditions set at the factory). The network select screen is displayed.

Press **No** to return to the initialization screen without executing system initialization.

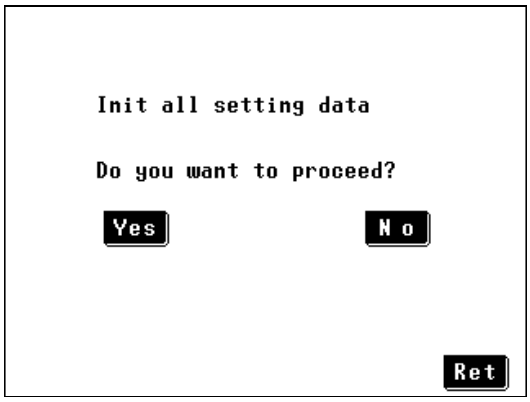
2 When "Initialization of all measurement data" is selected



Press **Yes** to delete all saved measurement data. The initialization screen is displayed.

Press **No** to return to the initialization screen without executing system initialization.

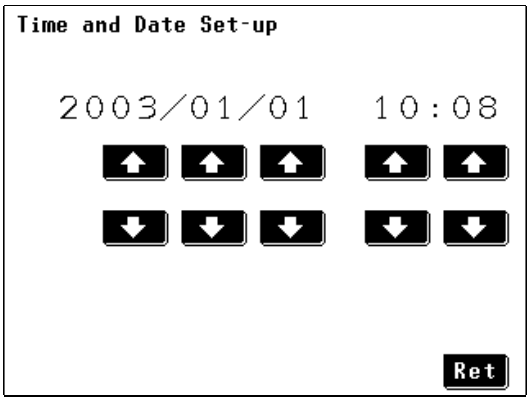
3 When "Initialization of all condition setting data (saved panels)" is selected



Press **Yes** to delete all saved test condition data including saved panels. The network select screen is displayed.

Press **No** to return to the initialization screen without executing system initialization.

6.2 Setting Date and Time



Date/time setting screen

1. Press System on the initial screen to display the system screen.
2. Press Date/Time to display the date/time setting screen.
   (The screen shows the present time.)
3. Set the date and time.
   From left to right, the displayed setting keys are assigned to year, month, day, hours, and minutes.

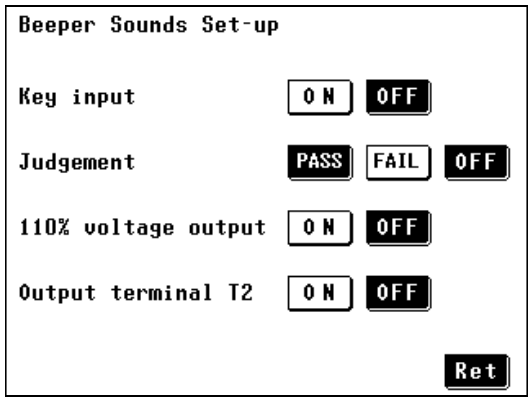
▲	Increments the numeric value.
▼	Decrements the numeric value.

4. Press Ret to return to the system screen.

NOTE

- The entered setting becomes effective when Ret is pressed.
- Each key only changes the corresponding setting item; it does not change the left item.
  For example, incrementing the "minutes" setting from "10:59" results in "10:00."
- When the date/time setting screen appears, the clock stops at the displayed time. Note that pressing Ret without pressing ▲ or ▼ does not make the displayed clock indication effective, but restores the original clock setting.
- The clock is accurate within about 4 minutes per month.

6.3 Setting the Beep Sound



Beep sound setting screen

1. Press **System** on the initial screen to display the system screen.
2. Press **Beep** to display the beep sound setting screen.
3. Enter beep sound settings.

Setting beep sound for key entry

- **ON** Generates a beep sound when key entry is made.
- **OFF** Disables the beep sound for key entry.

Setting beep sound for allowable value judgement

- **PASS** Generates a beep sound when the measurement value is within the allowable value.
- **FAIL** Generates a beep sound when the measurement value exceeds the allowable value.
- **OFF** Disables the beep sound for allowable value judgement.

Setting beep sound for voltage output at terminal T3 (in 110% voltage output mode)

- **ON** Generates a beep sound when a dangerously high voltage is applied to terminal T3.
- **OFF** Disables the beep sound for a hazardous voltage warning for terminal T3.

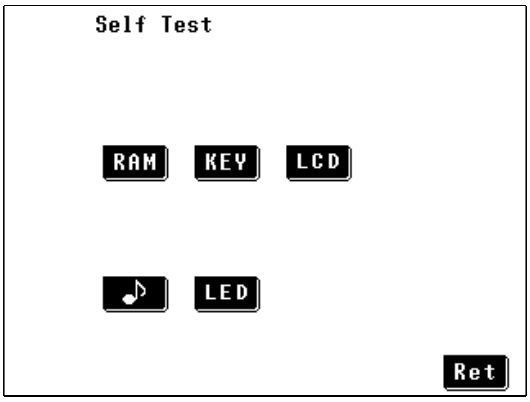
Setting beep sound for voltage output at terminal T2

- **ON** Generates a beep sound when a dangerously high voltage is applied to terminal T2.
- **OFF** Disables the beep sound for a hazardous voltage warning for terminal T2.

4. Press **Ret** to return to the system screen.

NOTE Dangerous voltage may be applied to terminal T3 only when network B is selected.

6.4 Self-Test

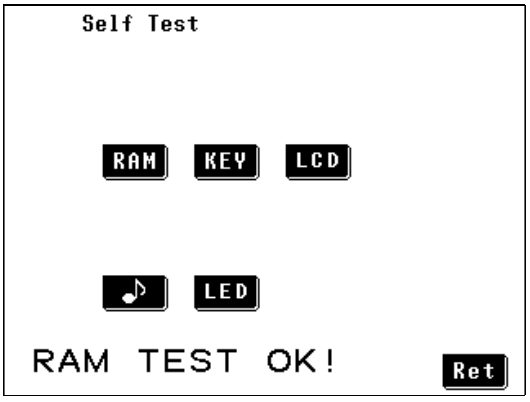


Self-test screen

1. Press System on the initial screen to display the system screen.
2. Press Self Test to display the self-test screen.
3. Select a self-test item.

RAM	Checks internal SRAM (Static RAM: read/write memory for data backup) of the main instrument.
KEY	Checks the keys.
LCD	Checks the LCD panel condition.
♪	Checks the beep sound.
LED	Checks the LED lamps, warning lamp, and LCD panel backlight.

When RAM is selected

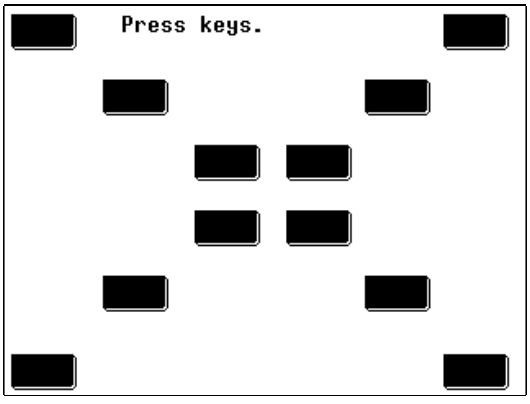


The screen shows "**RAM TEST OK!**"

Press Ret to return to the system screen.

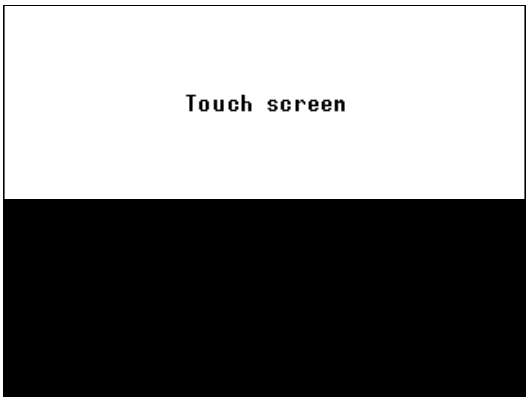
If the screen shows "**RAM TEST NG!**", the instrument is malfunctioning.
Contact your dealer (Hioki agent) or the nearest Hioki sales office.

When KEY is selected



The screen shows 12 black keys. Press these keys one by one.
When a key is pressed, it turns white. When all the keys are pressed one after another, display returns to the self-test screen.
If a key does not change to white even after repeated pressing, the key may be malfunctioning. Contact your dealer (Hioki agent) or the nearest Hioki sales office.

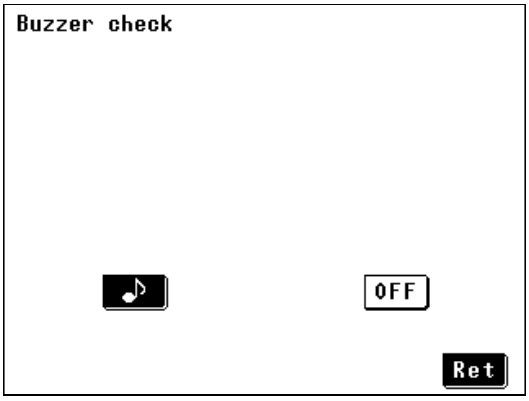
When LCD is selected



The black and white sections alternate on the screen. Check the screen for any malfunctioning dots.

After the check, touch any location on the screen to exit test mode and return to the self-test screen.

When ♪ is selected



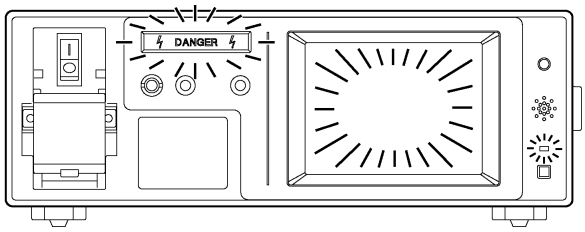
Press ♪ to activate the buzzer.

Press OFF to stop the buzzer.

If the buzzer does not sound, the instrument requires repair. Contact your dealer (Hioki agent) or the nearest Hioki sales office.

Press Ret to return to the self-test screen.

When LED is selected

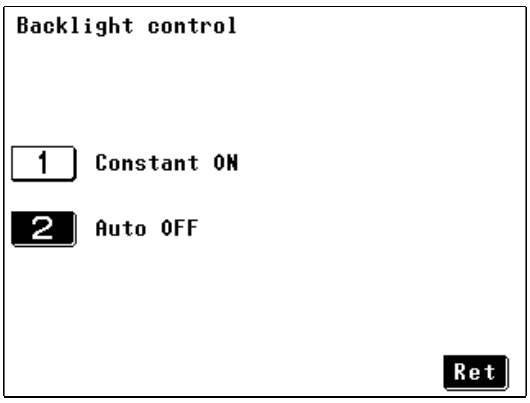


The **DANGER** lamp and power indicator lamp (located above the Power switch) on the front panel, and the LCD backlight flash alternately. Confirm that all the lamps operate.
If any lamp does not turn on, the instrument requires repair. Contact your dealer (Hioki agent) or the nearest Hioki sales office.

Press Ret to return to the self-test screen.

6.5 Setting the Backlight

The backlight of the LCD panel on the front panel can be set to Constant ON or Auto OFF.
When a PC is connected for measurement control and the instrument display is not used, the backlight is turned off to prolong the service life of LCD parts and save energy.
(Backlight service life expectancy: Approx. 10,000 hours, as estimated by the manufacturer)

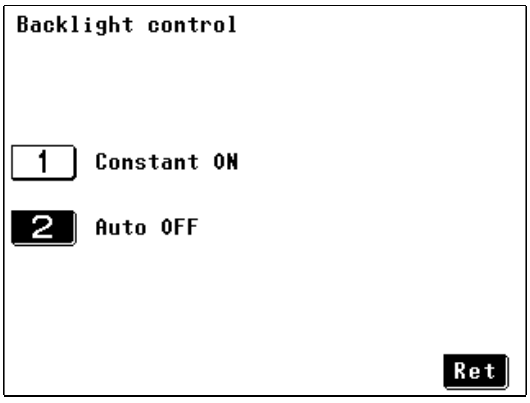


Backlight setting screen

1. Press [System] on the initial screen to display the system screen.
2. Press [Back Light] to display the backlight setting screen.
3. Set the backlight control mode.

1	Keeps the backlight turned on at all times.
2	Automatically turns off the backlight after a preset time.

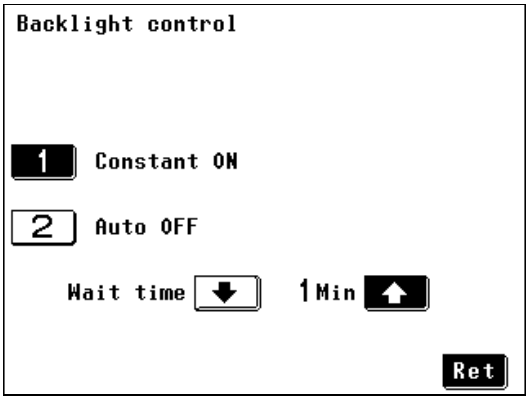
1 When "Constant ON" is selected



Press [Ret] to return to the system screen.

The backlight has been set to "Constant ON" by default.

2 When "Auto OFF" is selected



Set a desired time for the backlight auto OFF function. (1 to 30 min. (in 1 min. increments))

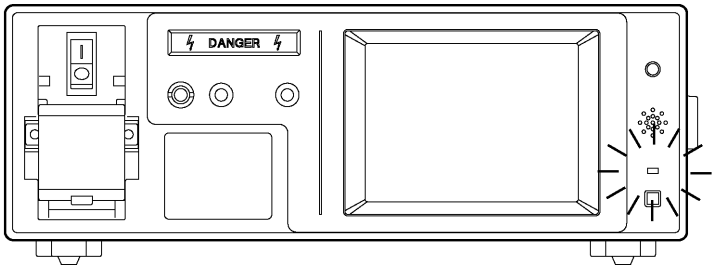
▲	Increments the numeric value.
▼	Decrements the numeric value.

Press Ret to return to the system screen.

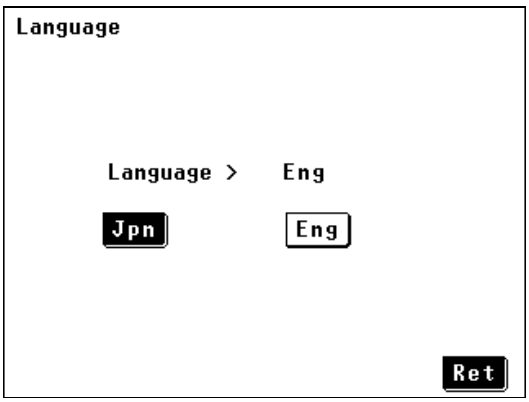
NOTE

- The wait time for the automatic backlight OFF function can be set from 1 to 30 minutes in 1 minute increments.
- When the preset time elapses from the last key operation, the backlight automatically turns off. The backlight turns on again when the panel surface is touched. When keys are not operated for the preset time, the backlight turns off again.

Even if the backlight is OFF, the power indicator lamp (located above the Power switch) remains lit to indicate instrument ON status.



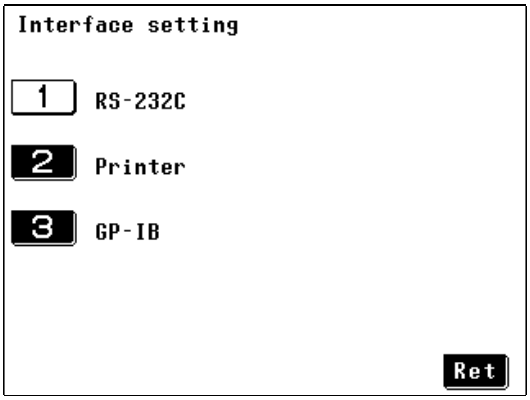
6.6 Setting the Display Language



Language setting screen

1. Press System on the initial screen to display the system screen.
2. Press Language to display the language setting screen.
3. Select Japanese or English.
4. Press Ret to return to the system screen.

6.7 Selecting an Interface



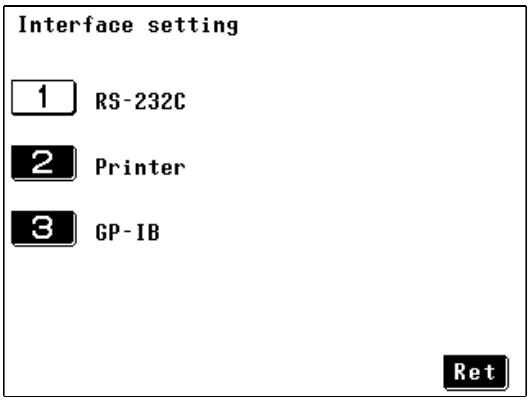
Interface setting screen

1. Press System on the initial screen to display the system screen.
2. Press Interface to display the interface setting screen.
3. Select an interface.

1	Sets the interface connection destination to RS-232C.
2	Sets the interface connection destination to Printer.
3	Sets the interface connection destination to GP-IB.

NOTE The interface is set to RS-232C by default.

1 When "RS-232" is selected

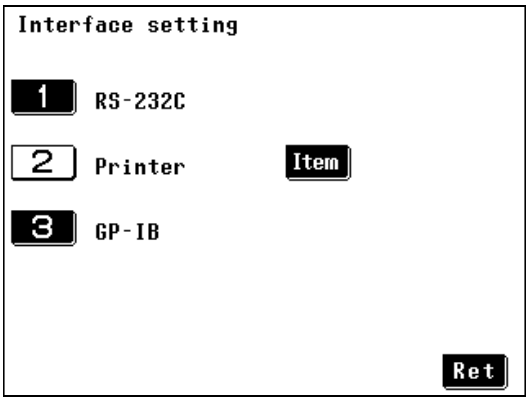


The communication condition is fixed.

❖For details of the method of using the interface:
Chapter 7, "GP-IB/RS-232C Interface" (page 105)

Press Ret to return to the system screen.

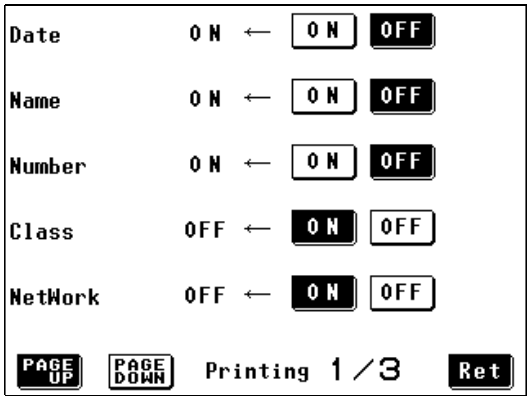
2 When "Printer" is selected



Data can be printed by connecting the optional 9442 PRINTER to the RS-232C port on the rear panel of the main instrument. When the printer is connected, RS-232C or GP-IB cannot be used to communicate with a PC.

❖Chapter 9, "Using the Printer" (page 209)

Press Ret to return to the system screen.



Selection of printing items

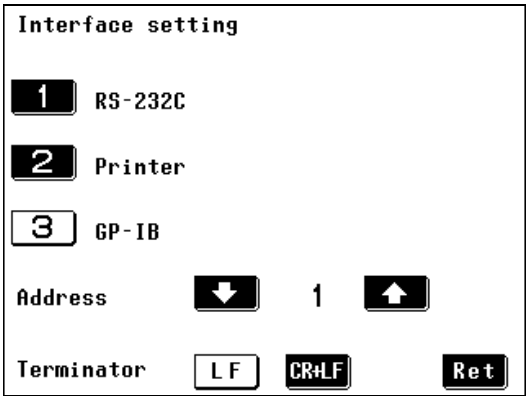
Pressing Item displays a list of printing items for selection.
It may not be necessary to print some items in repeated printing. In such cases, press OFF to cancel the printing of selected items.

To show setting items not displayed on the screen, press PAGE UP or PAGE DOWN. Set each item on the screen.

NOTE

- The following printing items can be set to ON or OFF.
  Date of measurement, equipment name, control number, class, network, measurement mode, filter setting, target current, allowable value, maximum value, judgement result, power supply polarity, and fault condition
- All items are turned ON for printing by default.

3 When "GP-IB" is selected



Set the GP-IB address of the instrument by using the software switches.

Use ▲ and ▼ to set a GP-IB address value. A value from 0 to 30 can be entered. The default setting is "1."
The software switches are provided for setting the communication terminator.
Select the desired condition by pressing LF or CR+LF.

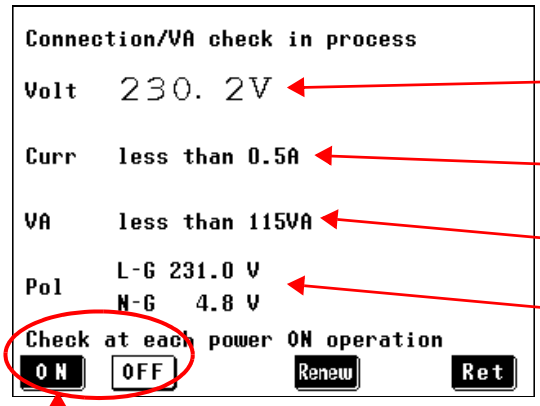
❖For details of the method of using the interface:
Chapter 7, "GP-IB/RS-232C Interface" (page 105)

Press Ret to return to the system screen.

6.8 Checking the Power Line for Equipment Under Test

Various tests can be conducted on the power line for equipment under test.

1. Press System on the initial screen to display the system screen.
2. Turn on the circuit breaker of the instrument.
   ❖3.5, "Turning the Circuit Breaker ON and OFF" (page 34)
3. Press Connect/VA check to display the connection/VA check screen.
   The check is made automatically.



Connection/VA check screen

Indicates the voltage of power supplied to [LINE IN].

Indicates the current consumption of the equipment under test.

Indicates the power consumption.

Measures voltage between the terminals of [LINE IN] to check the polarity.
Indicates the voltages between phase L and terminal G and between phase N and terminal G on the terminal block.

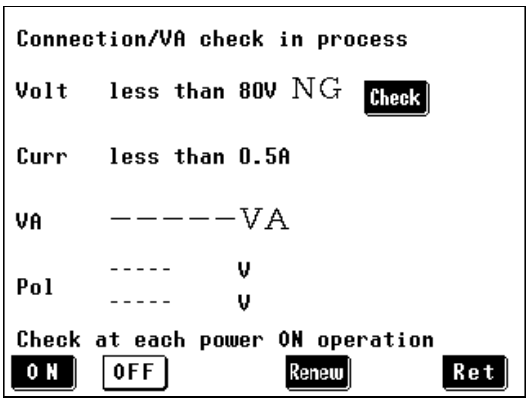
Press ON or OFF to select whether the check is to be conducted each time power is turned.

4. Press Ret to return to the system screen.

NOTE

- Data on voltage, current, and power consumption is continuously updated while the screen above is displayed.
  The polarity check is only made when this screen is displayed.
  The polarity check can be repeated by pressing Renew.
- When the voltage is less than 80 V, the indication shows "**less than 80 V**." (Guaranteed accuracy range: 85 to 300 V)
- When the current consumption is less than 0.5 A, the indication shows "**less than 0.5 A**." (Guaranteed accuracy range: 0.5 to 16 A)
- The voltage indicated by the polarity check should only be used as a guideline. (Accuracy not guaranteed)

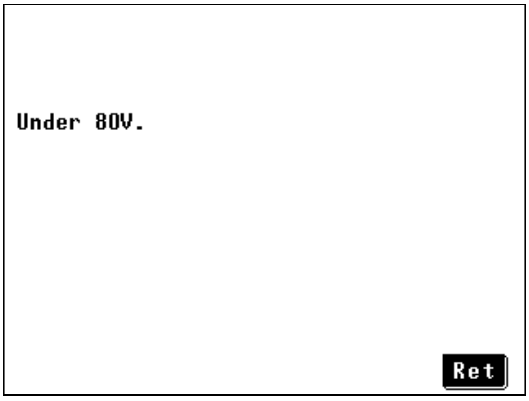
6.8.1 About the NG Indication



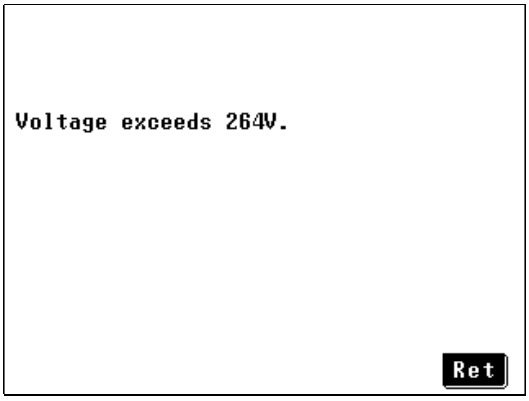
1. If the result of a check is judged not normal, an "**NG**" indication appears to the right of the corresponding item, along with a Check key for the display of details.
(In the screen example shown on the left, the voltage is not normal (NG).)

2. Press Check to display the screen that shows advice concerning the present condition. According to the displayed advice, check the current consumption, power cord connection, and other aspects of the equipment under test.

(1) If the voltage check results in NG

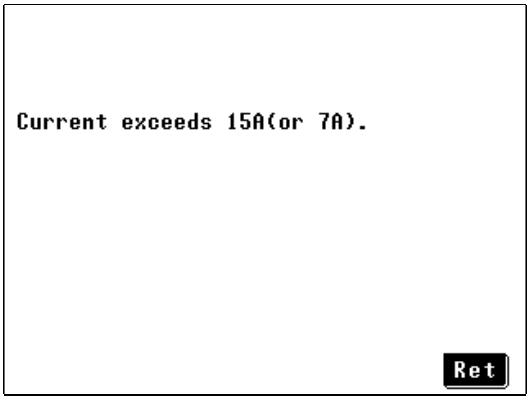


- Check the voltage of the power supply.
- Check whether the circuit breaker is ON.



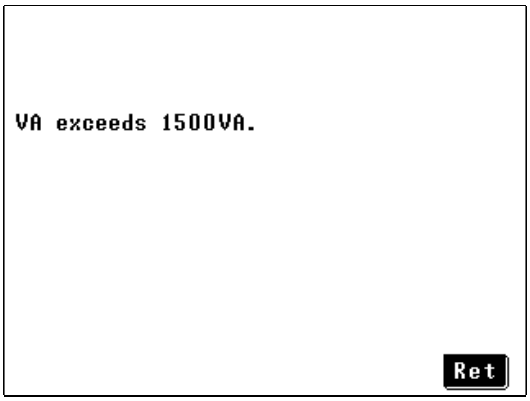
- The maximum allowed power supply voltage is 264 V.

(2) If the current check results in NG



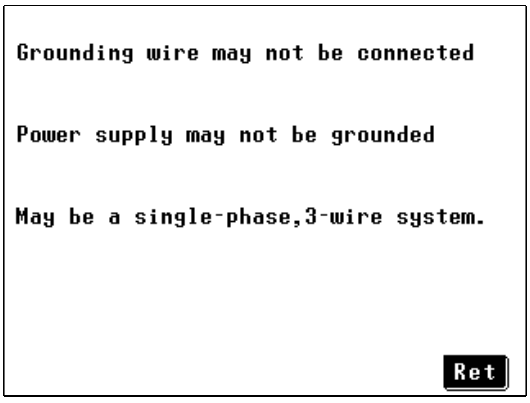
- If the power supply voltage is lower than 150 V, the current must be 15 A or lower.
- If the power supply voltage is 150 V or higher, the current must be 7 A or lower.

(3) If the VA check results in NG



- The VA (voltage x current) must be 1,500 V or lower.

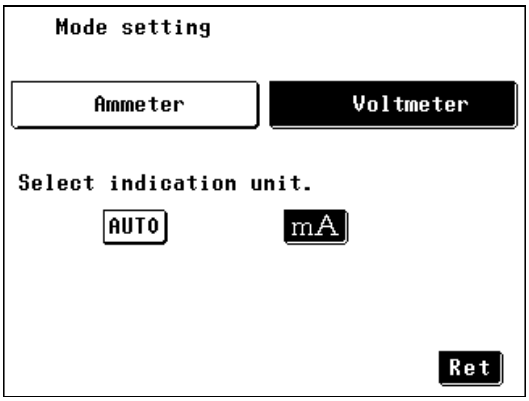
(4) If the polarity check results in NG



- The grounding wire may be disconnected.
- The power supply may be a floating power supply.
- The power supply may be a single-phase, 3-wire power source.

- The polarities of the power supply are reversed.
- Reverse the L and N wire connections on [LINE IN].

6.9 Setting the Mode

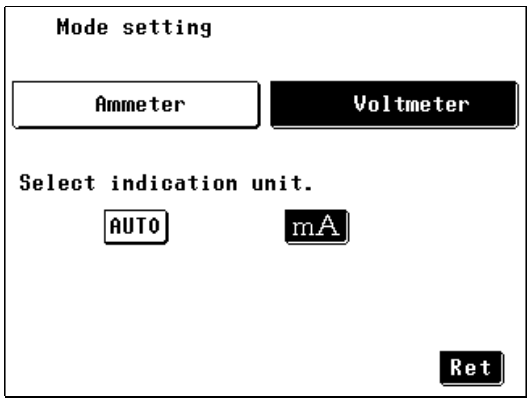


Mode setting screen

1. Press System on the initial screen to display the system screen.
2. Press Mode Setting to display the mode setting screen.
3. Select a mode.

When Ammeter mode is selected

Use the instrument in ammeter mode for normal use.
In ammeter mode, the unit of measurement data can be set.
Leakage current standards specify current criteria in "mA." When "mA" is selected, measurement values in "µA" are converted to "mA" values for easy judgement of test results.



Select the unit of measurement data indication.

AUTO	Automatically selects the unit of measurement data according to the measurement range. (default setting).
mA	Sets the unit of measurement data to "mA" in all ranges. (Display resolution is 0.01 mA for the 25 mA range, and 0.001 mA for all other ranges.)

Press Ret to return to the system screen.

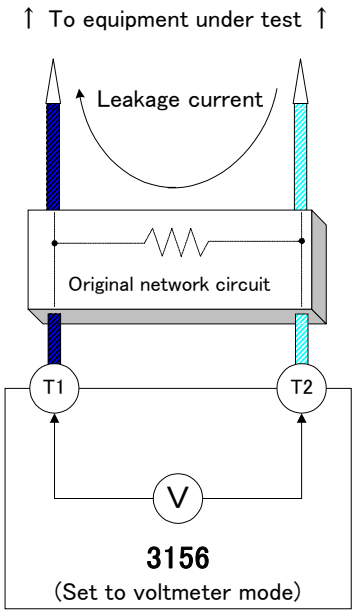
NOTE

- See the "Range of indication when setting unit of current measurement to Hold (fixed) mode" on page 63 for details of the ranges of indication when the unit is fixed to "mA."
  ❖, "Range of indication when setting unit of current measurement to Hold (fixed) mode" (page 69)
- **About allowable value judgement**
  When the unit of indication is fixed to "mA," a FAIL judgement may result even if the measurement value and allowable value are the same. This is because internally retained data contains low-order digits even if the unit is fixed to "mA," with judgement made using the values having low-order digits.

When [Voltmeter] mode is selected

WARNING

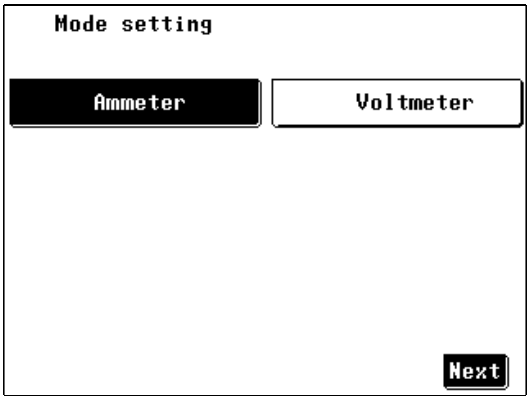
The maximum input voltage is 25 VDC/25 Vrms. Attempting to measure voltage in excess of the maximum input could destroy the instrument and result in personal injury or death.



The instrument ordinarily operates as an ammeter, but the voltmeter function can be selected on the mode setting screen.
By using the instrument as a voltmeter, it is possible to connect an original network if networks A through F do not conform to the required network configuration.
The instrument can also be used as a general high-frequency voltmeter.

NOTE

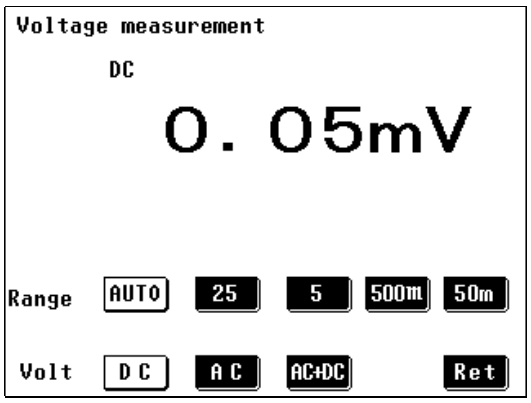
When the instrument is used as a voltmeter, it does not function as a leakage current tester.



Setting to voltmeter mode results in an open internal network circuit.

The input voltage between terminals T1 and T2 can be measured.

T2	: Becomes a Hi terminal.
T1	: Becomes a Lo terminal.



Press [Next] to display the voltage measurement screen.

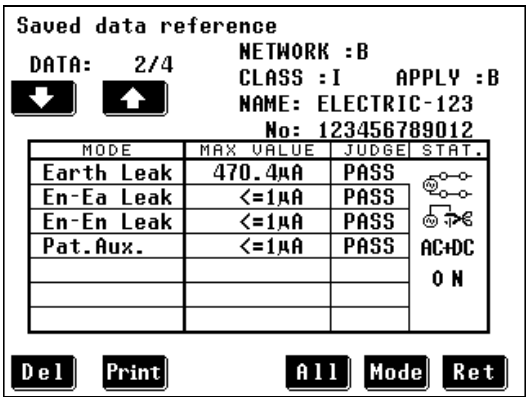
Select the measurement range from AUTO, 25 V, 5 V, 500 mV, and 50 mV.

Select the target voltage from DC, AC, and AC+DC.

Press [Ret] to return to the mode setting screen.

6.10 Checking Saved Measurement Data

This screen displays the measurement data saved by using the measurement screen.
It also allows the deletion and printing of measurement data (when the optional 9442 PRINTER is connected).

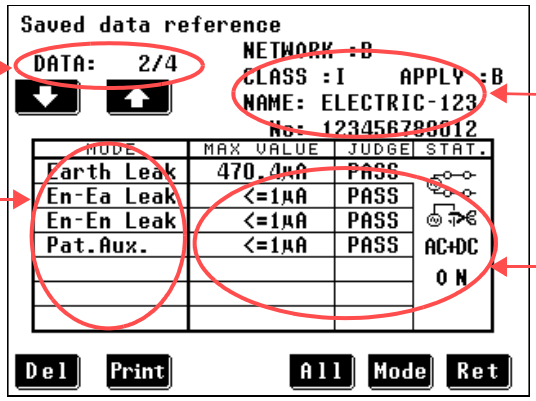


Measurement data reference screen

1. Press **System** on the initial screen to display the system screen.
2. Press **Save Data** to display the measurement data reference screen.

Unit number of data on screen
Total number of data units

Measurement mode

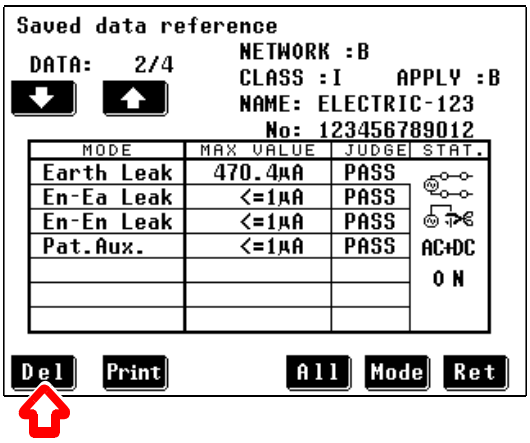


Measurement data reference screen

Network : Type of network
CLASS : Grounding class
APPLY : Applied part
NAME : Equipment name
No : Control number

Combinations of maximum value, judgement result, and measurement conditions at maximum value acquisition in each mode

6.10.1 Deleting Saved Data



1. Use ▲ and ▼ to select a data unit to delete.
2. Press **Del**.
   A confirmation screen appears.
3. Press **Yes** to delete the selected data unit.

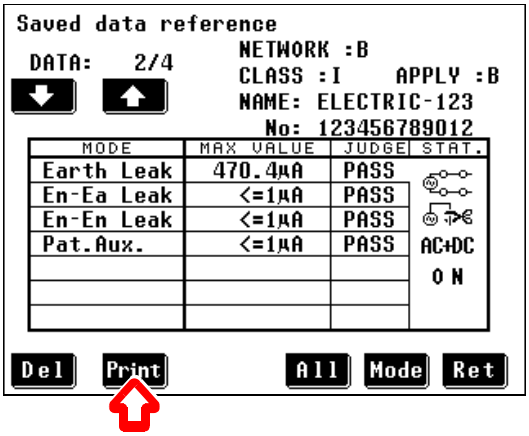
   To delete two or more data units, repeat steps **1** through **3**.
4. Press **Ret** to return to the system screen.

NOTE

The initialization screen can be used to delete all saved data.
❖6.1, "Initializing the Instrument" (page 84)

6.10.2 Printing Saved Data (with 9442 PRINTER connected)

* The 9442 PRINTER (option) is required to print saved data.

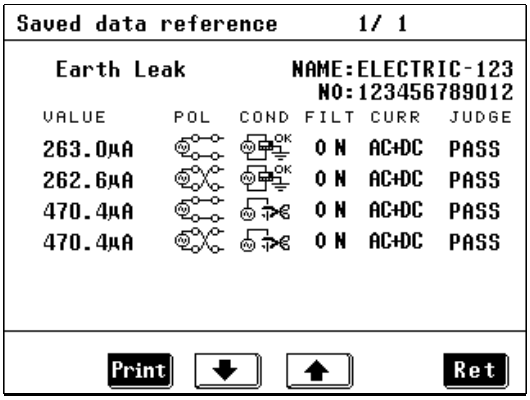


1. Use ▲ and ▼ to select a data unit to print.
2. Press **Print** to print the data of the selected data unit.

   To print data of two or more units, repeat steps 1 through 2.
3. After printing, press **Ret** to return to the system screen.

NOTE The **Stop** key is displayed during printing. To abort printing, press **Stop**.

6.10.3 Displaying All Measurement Reference Information for Selected Mode



Measurement data reference (details) screen

VALUE : Maximum value
POL : Power supply polarity
COND : Equipment status (normal condition, fault condition)
FILT : Network filter setting
CURR : Target current
JUDGE : Judgement result

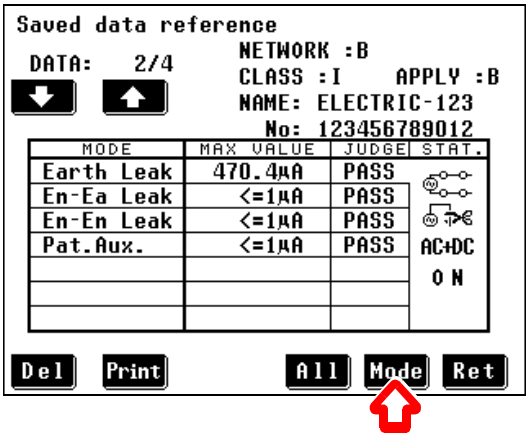
1. Press **All** on the measurement data reference screen to display the measurement data reference (details) screen.

When there are six or more combinations, use ▲ and ▼ to scroll the page.

The sample screen on the left shows four combinations. The "1/1" indication at the top of the screen means that the data is shown only on one page.

2. Press **Ret** to return to the measurement data reference screen.

6.10.4 Changing the Data Unit Mode



1. Press **Mode** to switch the mode used for the data unit.
On the sample screen, the mode changes in the following order:
Earth Leak → **En-Ea Leak** → **En-En Leak** → **Pat.Aux.**

List of measurement modes (varies depending on network types)

Earth Leak	Earth leakage current
En-Ea Leak	Leakage current between enclosure and earth
En-En Leak	Leakage current between enclosure and enclosure
En-Li Leak	Leakage current between enclosure and line
Pat.Aux.	Patient auxiliary current
Pat.Leak I	Patient leakage current I
Pat.Leak II	Patient leakage current II
Pat.Leak III	Patient leakage current III

2. Press **Ret** to return to the system screen.

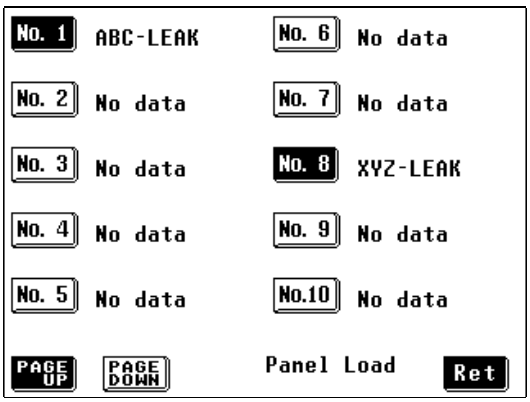
NOTE

About data unit sorting
The sort function rearranges data unit numbers in sequence based on the equipment name (1st character (A, B, C, ..., Z, 0, 1, 2, ..., 9, -), 2nd character, ..., 12th character), and control number. When a new data unit is added, the data units are sorted again.

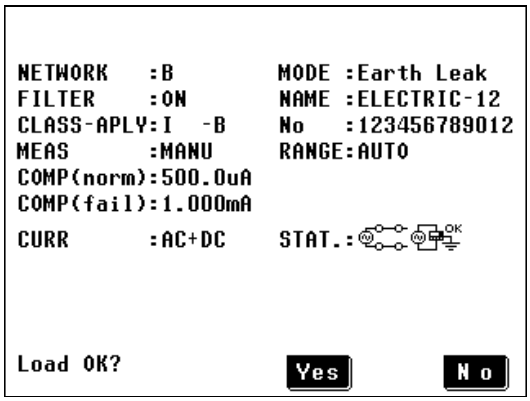
6.11 Loading Saved Measurement Conditions

Measurement conditions saved by using the measurement screen can be loaded (read).
The following lists the saved measurement conditions.

Measurement items, target current mode, network, measurement range, filter setting, comparator allowable value (normal condition, fault condition), fault condition setting, power supply polarity, measurement class, applied part condition, equipment name, control number, measurement items for automatic measurement, measuring time, measurement delay time



Panel load screen



Panel load confirmation screen

1. Press System on the initial screen to display the system screen.
2. Press Panel Load to display the panel load screen.
   The screen shows the keys of saved panel numbers. The protruding black keys can be selected.
   Press PAGE UP to display panel numbers 11 and higher. (total of 3 pages)
   Press PAGE DOWN to return to the previous page.
3. Press a key showing the panel number to load. A confirmation screen appears.
4. Press Yes to load data. The read measurement conditions are shown on the screen.
   Press No to return to the previous screen.

NOTE

- Measurement condition data is saved in the instrument's internal SRAM. The lithium battery provides power for memory backup. When battery power becomes depleted, the saved measurement condition data in memory will be lost.
  If this happens, contact our service center for a battery replacement (at a charge). The average service life of the lithium battery is about four years.
- When the conditions for leakage current between enclosure and line, patient leakage current II, or patient leakage current III measurements are included, measurement does not have allowable values in normal condition. Therefore, the confirmation screen does not display "COMP (norm): (value)."

GP-IB/RS-232C Interface

Chapter 7

This chapter contains information relating to the GP-IB and RS-232C interfaces, and uses the following symbols to identify which information is relevant to each interface. Sections without these symbols pertain to both interfaces.

GP-IB : GP-IB only

RS-232C : RS-232C only

Before Use

- Always be sure to secure the GP-IB/ RS-232C cable to the interface connector by tightening up the fixing screws.
- It is vital that the proper data format is used when inputting commands with data values to the 3156.

7.1 Overview and Features

All functions except for the power switch and self-test functions can be controlled via GP-IB/RS-232C.

- The instrument can be reset.

GP-IB

- IEEE 488.2-1987 standard (essential) commands can be used.
- This instrument is compliance with the following standard.
  Compliance standard : IEEE 488.1-1987
- This instrument is designed with reference to the following standard:
  Reference standard : IEEE 488.2-1987
- If the output queue becomes full, it is cleared and a query error is generated. This differs from the IEEE 488.2 specification, which only stipulates the clearing of the output queue and the outputting of a query error when a deadlock state occurs, that is, when both the input buffer and the output queue have become full, and continuation of processing has become impossible.

7.2 Specifications

7.2.1 Specifications of RS-232C

RS-232C

Transfer system	Communication : Full duplex Synchronization : Start-stop synchronization
Baud rate	9600 bps
Data length	8 bits
Parity	none
Stop bit	1 bit
Message terminator (delimiter)	Receiving data : CR+LF, CR Sending data : CR+LF
Flow control	None
Electrical characteristic	Input voltage levels 5 to 15 V ON -15 to -5 V OFF Output voltage levels 5 to 9 V ON -9 to -5 V OFF
Connector	RS-232C Interface Connector Pin Assignments (D-sub miniature 9Pin male connector with M2.6 set screws) The connector is for terminal (DTE). Recommended cable: • 9637 RS-232C CABLE (for PC/AT machines) • 9638 RS-232C CABLE (for PC98 series) ❖7.3.1 "Attaching the Connector" (page 108)

7.2.2 Specifications of GP-IB

GP-IB

Interface Functions

SH1	All source handshake functions
AH1	All acceptor handshake functions
T6	Basic talk functions Serial poll function No talk-only mode The talker cancellation function with MLA (My Listen Address)
L4	Basic listener functions No listen-only mode The listener cancellation function with MTA (My Talk Address) is provided.
SR1	All service request functions
RL1	All remote/local functions
PP0	No parallel polling function
DC1	All device clear functions
DT0	No device trigger functions
C0	No controller function

ASCII codes are used.

7.3 Connection and Setting

7.3.1 Attaching the Connector

⚠WARNING

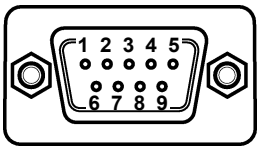
- **To avoid electrocution, turn off the power to all devices before plugging or unplugging any of the interface connectors.**
- **To avoid damage to the instrument, do not short-circuit the output terminal and do not input voltage to the output terminal.**

⚠CAUTION

The mounting screws must be firmly tightened or the instrument may not perform to specifications, or may even fail.

RS-232C

RS-232C connector



D-sub 9Pin male connector
with M2.6 set screws

Connect the RS-232C cable.

To connect the 3156 to the controller (DTE), use a crossing cable compatible with the connectors on both the 3156 and the controller.

The I/O connector is designed for the terminal (DTE).
The 3156 uses pins Nos. 2, 3, and 5. All other pins are not used.

Pin No.	Functions		CCITT	EIA	JIS	Signal Name
			Circuit No.	Code Addr.	Code Addr.	
1	(Unused)					
2	Receive Data	Receive Data	104	BB	RD	RxD
3	Send Data	Send Data	103	BA	SD	TxD
4	Data Terminal Ready	Data Terminal Ready	108/2	CD	ER	DTR
5	Signal Ground	Signal Ground	102	AB	SG	GND
6	(Unused)					
7	Request to Send	Request to Send	105	CA	RS	RTS
8	Clear to Send	Clear to Send	106	CB	CS	CTS
9	(Unused)					

RS-232C

When connecting the 3156 and PC/AT (DOS/V)

Use a crossing cable comprising two D-sub 9Pin female connectors.

Cross connection

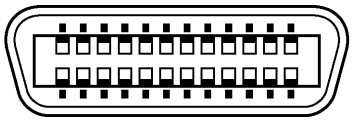
D-sub 9pin female 3156		D-sub 9pin femal PC/AT	
Pin No.		Pin No.	
DCD	1	1	DCD
RxD	2	2	RxD
TxD	3	3	TxD
DTR	4	4	DTR
GND	5	5	GND
DSR	6	6	DSR
RTS	7	7	RTS
CTS	8	8	CTS
	9	9	

Recommended cable:

HIOKI
9637 RS-232C CABLE (1.8 m)

GP-IB

GP-IB connector



GP-IB connector

Recommended cable:

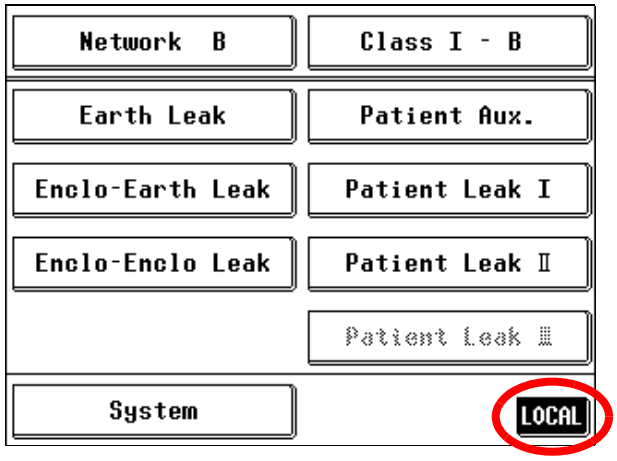
HIOKI
9151-02 GP-IB CONNECTOR CABLE (2 m)
9151-04 GP-IB CONNECTOR CABLE (4 m)

7.3.2 Communication Conditions

❖6.7 "Selecting an Interface" (page 92)

7.3.3 Screen Display

During communications (in the remote state), the LOCK key to release the remote state is displayed on the screen.
Press this key to resume the normal state (local state).

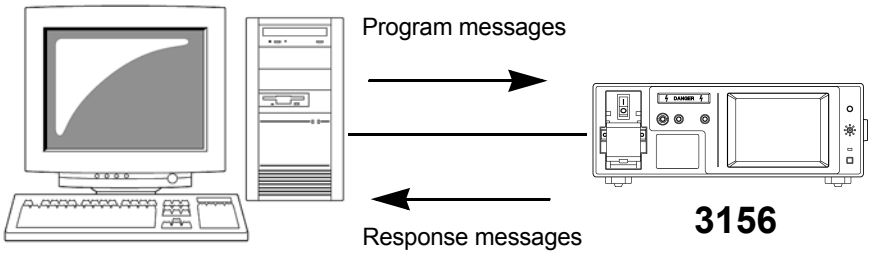


GP-IB

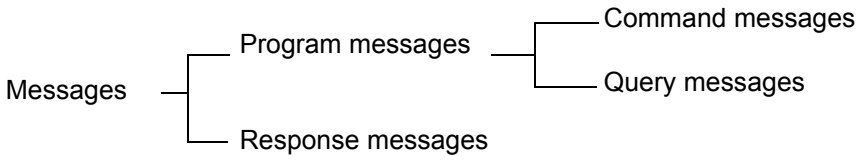
This key is disabled if the GP-IB controller has put the instrument into the local lock out state. (Pressing the LOCAL key has no effect.)

7.4 Communication Methods

Various messages are supported in order to control the 3156 through the interface.
Messages are divided into program messages, which are sent to the 3156 from the PC, and response messages, which are sent to the PC from the 3156.



The message system has the following hierarchy.



7.4.1 Message Format

Program Message

Program messages can be divided into either command messages or query messages.

- Command Message
  Orders for controls of the instrument, such as for making measurement condition settings or for reset or the like.
  (example)

```
:EQUIPMENT CLASS1
```

Header portion | Space | Data portion

(command for setting the grounding class of equipment under test)

- Query Message
  Orders for responses relating to results of operation, results of measurement, or the state of device settings.
  (example)

```
:EQUIPMENT?
```

Header portion | Question mark

(command for querying the grounding class of equipment under test)

Response messages

After a query message has been received, a response message is produced the moment that its syntax has been checked.
Whether or not headers are prefixed to response messages is set by the "HEADer" command.

Header ON `:EQUIPMENT CLASS1`
Header OFF `CLASS1`
(grounding class of equipment under test is set to Class I)

After power-on, Header OFF is selected as a default setting.
If an error occurs when the query message is received, the query does not produce response message.

Command Syntax

The names of commands for the 3156 are as far as possible mnemonic. Furthermore, all commands have a long form, and an abbreviated short form.
In command references in this manual, the short form is written in upper case letters, and then this is continued in lower case letters so as to constitute the long form.
Either of these forms will be accepted during operation, but intermediate forms will not be accepted. Further, during operation both lower case letters and upper case letters will be accepted without distinction.

`:NETWork` OK (long form)
`:NETW` OK (short form)
`:NETWO` Error
`:NET` Error

Response messages generated by the 3156 are in long form and in upper case letters.

Headers

It is essential to prefix headers to program messages.

(1) Command program headers

There are three types of command: simple commands, compound commands, and standard commands.

- Simple command header
  This header is a sequence of letters and digits.
  `:HEADer`
- Compound command header
  This header is made up from a plurality of simple command type headers marked off by colons ":".
  `:CONFigure:POLarity`
- Standard command header
  This header begins with an asterisk "*", and continues with a standard command stipulated by IEEE 488.2.
  `*CLS`

(2) Query program headers

These are for commands used for interrogating the instrument about the results of operations, about measured values, or about the current states of settings for the instrument. As shown by the following examples, they can be recognized as queries by a question mark "?" appearing after the program header.

`:MEASure?`
`:MEASure:MAXimum?`

Message Terminators

The 3156 supports the following message terminators.

GP-IB

- LF
- CR+LF
- EOI
- LF with EOI

RS-232C

- CR
- CR+LF

The following response message terminators can be selected depending on the interface setting.

GP-IB

- LF with EOI (initial setting)
- CR + LF with EOI

RS-232C

- CR+LF

❖For details of the method of setting an interface:
6.7 "Selecting an Interface" (page 92)

Separators

(1) Message unit separator

A semicolon ";" is used as a message unit separator when it is desired to set out several messages on a single line.

```
:NETWork A;*IDN?
```

When messages are combined in this way, if a syntax error occurs, all subsequent messages up to the next terminator will be ignored.

(2) Header separator

In a message which has a header and data, a space " " is used as the header separator to separate the header from the data.

```
:NETWork A
```

(3) Data separator

If a message has several data items, commas are required as data separators for separating these data items from one another.

```
:CONFigure:COMParator +1.000E-3,+5.000E-3
```

Data Formats

The main instrument uses character string data and decimal numeric data, and the type used varies according to the command in question.

(1) Character data

Character string data must always begin with an alphabetic character, and the following characters can be either alphabetic characters or numerals. Although in character data either upper case letters or lower case letters are accepted, response messages output by the main instrument are always in upper case letters.

```
:CONFigure:CONDition NORMal
```

(2) Decimal data

The numeric data values are all represented in decimal, in three formats identified as NR1, NR2 and NR3, and each of these can appear as either a signed number or an unsigned number. Unsigned numbers are taken as positive.
Further, if the accuracy of a numerical value exceeds the range with which the main instrument can deal, it is rounded off. (5 and above is rounded up; 4 and below is rounded down).

- NR1 integer data .....(examples: +12, -23, 34)
- NR2 fixed point numbers .....(examples: +1.23, -23.45, 3.456)
- NR3 floating point numbers ..(examples: +1.0E-2, -2.3E+4)

The term "NRf format" includes all these three formats.
A format is specified for each command used by the instrument.

- If data overflow occurs: `+9.999E+09`
- If data negative overflow occurs: `-9.999E+09`
- If the data displayed by the main instrument is "less than XX," the largest value that is less than the numeric value of the data is returned.
  (Example)
  Display : Less than 40 μA
  Data : +39.99E-06
- If the measurement value is not fixed due to Auto range mode, `+9.999E+10` will be displayed.

GP-IB

The 3156 does not completely support IEEE 488.2. Use the data shown in Section 7.5 "Message Reference" (page 123) as far as possible, but be warned that the input buffer or output queue may overflow by a single command.

Abbreviation of Compound Commands

When several compound commands have a common head portion, for example :CONFigure:CONDition and :CONFigure:POLarity, then, when and only when writing them directly following on from one another, this common portion (:CONFigure: in this example) can be omitted from each command.
This common portion is called "the current path", by analogy with the general concept of the current directory in the directory structure of UNIX or MS-DOS, and until it is cleared the analysis of following commands is performed by deeming them to be preceded by the current path which has been curtailed in the interests of brevity. This manner of using the current path is shown in the following example:

Normal expression

```
:CONFigure:CONDition NORMal;:CONFigure:POLarity NORMal
```

Abbreviated expression

```
:CONFigure:CONDition NORMal;POLarity NORMal
```

This becomes the current path, and can be curtailed from the following messages.

The current path is cleared when the power is turned on, when a colon ":" appears at the start of a command, and when a message terminator is detected.
Messages of standard command form can be executed without relation to the current path. Further, they have no effect upon the current path.

It is not necessary to prefix a colon ":" at the start of headers of simple commands and compound commands. However, in order to prevent confusion with abbreviated forms and mistakes in operation, it is recommended practice always to prefix ":" to headers.

On the 3156, the current paths are as follows (common in GP-IB and RS-232C).

```
:CONFigure:
:CONFigure:WTIMe:
:EQUipment:
:SYSTem:
:SYSTem:BEEPer:
```

7.4.2 Output Queue and Input Buffer

Output Queue

Response messages accumulate in the output queue and are read out as data and cleared by the controller. The output queue is also cleared in the following circumstances:

RS-232C

- When the power is turned off and turned on again.

GP-IB

- When a device clear is issued.
- When the power is turned off and turned on again.
- When a query error is generated.

The 3156 has an output queue of 1 K byte capacity. If the response messages overflow this limit of 1 K byte, a query error is generated, and the output queue is cleared. Further, if a new message is received while the output queue still contains data, the output queue is cleared, and a query error is generated.

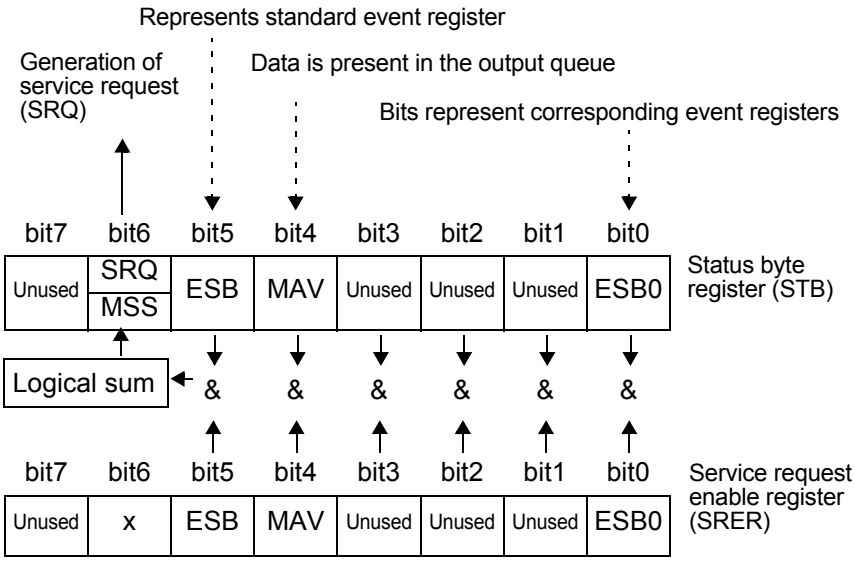
Input Buffer

The 3156 has an input buffer of 1 K byte capacity.
Messages which are received are put into this buffer and executed in order. If the data accumulated in this buffer exceeds 1 K byte the buffer becomes full, and until a space again becomes available in the buffer the GP-IB interface bus goes into the waiting state.
The RS-232C does not accept data in excess of 1 K bytes.

NOTE The length of a single command should be less than 1 K bytes.

7.4.3 Status Byte Register GP-IB

In its implementation of the serial polling function using service requests, the 3156 employs the status model specified by IEEE 488.2. The term "event" refers to any phenomenon which generates a service request.



Generation of service requests

The status byte register holds information relating to the event registers and the output queue. It is further possible to use the service request enable register as a mask to select the items required. If any of the bits selected by the mask becomes 1, bit 6 (MSS; the master summary status) is also set to 1, an SRQ message is generated, and this generates a service request.

Status byte register (STB)

The status byte register is an 8-bit register whose contents are output from the main instrument to the controller, when serial polling is being performed.
If even only one bit in the status byte register has changed from 0 to 1 (provided that it is a bit which has been set in the service request enable register as a bit which can be used), then the MSS bit is set to 1. Simultaneously with this the SRQ bit is set to 1, and a service request is generated.
The SRQ bit is synchronized with service requests, and is read out and simultaneously cleared when serial polling is being performed. Although the MSS bit is only read out on an `*STB?` query, on a `*CLS` command for example it is not cleared until the event is cleared.

Bit 7	Unused
Bit 6 SRQ MSS	 Set to 1 when a service request is dispatched. Logical sum of the other bits of the status byte register
Bit 5 ESB	Standard event summary (logical sum) bit Shows a logical sum of the standard event status register.
Bit 4 MAV	Message available Indicates that there is at least one message in the output queue.
Bit 3	Unused
Bit 2	Unused
Bit 1	Unused
Bit 0 ESB0	Event summary bit 0 Bitwise logical sum of event status register 0

Service request enable register (SRER)

This register masks the status byte register. Setting a bit of this register to 1 enables the corresponding bit of the status byte register to be used.

7.4.4 Event Registers

Standard event status register (SESR)

The standard event status register is an 8-bit register.

RS-232C

It is possible to determine the status of the instrument by reading these registers.

GP-IB

If any bit in the standard event status register is set to 1 (after masking by the standard event status enable register), bit 5 (ESB) of the status byte register is set to 1.

❖Standard event status register (SESR) and Standard event status enable register (SESER)(page 120)

The standard event status register is cleared in the following situations:

- When a *CLS command is received.
- When an *ESR? query is received.
- When the instrument is powered on.

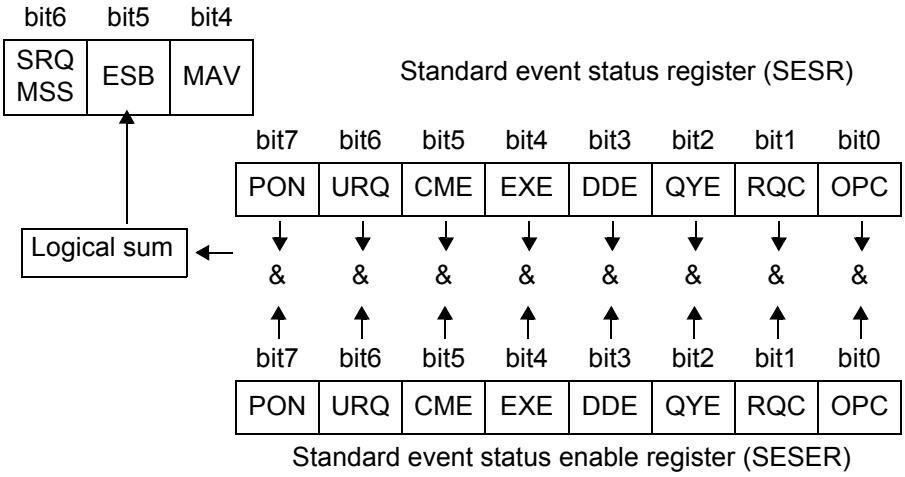
Standard event status enable register (SESR)		
Bit 7	PON	Power on flag. When the power is turned on, or on recovery from a power cut, this bit is set to 1.
Bit 6		User request. Unused
Bit 5	CME	Command error. (The command to the message terminator is ignored.) When a command which has been received contains a syntactic or semantic error, this bit is set to 1. • There is a mistake in a program header. • The number of data parameters is wrong. • The format of the parameters is wrong. • Unsupported commands are received.
Bit 4	EXE	Execution error. When for some reason a command which has been received cannot be executed, this bit is set to 1. • The designated data value is outside the set range. • The designated data value is not acceptable. • Some other function is being performed
Bit 3	DDE	Device dependent error. When a command cannot be executed due to some cause other than a command error, a query error, or an execution error, this bit is set to 1. • Execution is impossible due to an abnormality inside the main instrument. • The result of the pre-check (to prevent ground faults) for leakage-current measurement between the enclosure and the line is N.G. • When abnormally terminated in automatic mode.
Bit 2	QYE	Query error. (output queue is cleared) This bit is set to 1 when a query error is detected by the output queue control. • When an attempt has been made to read the output queue when it is empty. (GP-IB only) • When the data overflows the output queue. • When data in the output queue has been lost.
Bit 1	RQC	Communication error flag for RS-232C.
Bit 0	OPC	Operation terminated. (GP-IB only) This bit is set to 1 when an *OPC command is executed • When the operation of all the messages up to the *OPC command has been completed.

Standard event status enable register (SESER)

GP-IB

Setting any bit of the standard event status enable register to 1 enables the corresponding bit of the standard event status register to be accessed.

Standard event status register (SESR) and Standard event status enable register (SESER)



Event status registers specific to the 3156 (ESR0)

The 3156 has two event status registers.
The event status registers are each 8-bit registers.

RS-232C

It is possible to determine the status of the instrument by reading these registers.

GP-IB

If any bit in one of these event status registers is set to 1 (after masking by the corresponding event status enable register), the following happens:

- For event status register 0, bit 0 of the status byte register (ESB0) is set to 1.

Event status register 0 and event status register 1 are cleared in the following three situations:

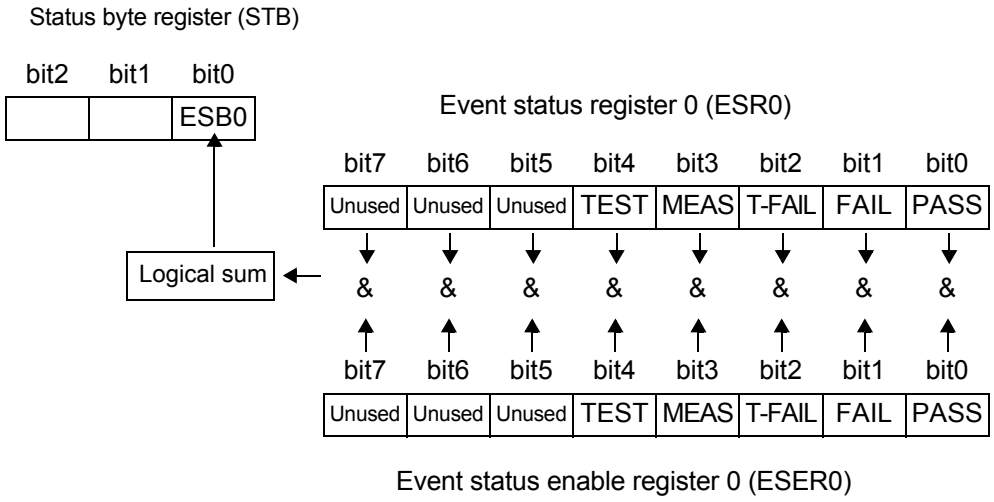
- When a "`*CLS`" command is received.
- When an `:ESR0?` query (for event status register 0) is received.
- When the instrument is powered on.

Event Status Register 0 (ESR0)		
Bit 7		Unused
Bit 6		Unused
Bit 5		Unused
Bit 4	TEST	In automatic measurement
Bit 3	MEAS	Performing automatic measurement under each condition
Bit 2	T-FAIL	Total failure
Bit 1	FAIL	Failure
Bit 0	PASS	Pass

Event status register 0 is set only when automatic measurement is performed.

GP-IB

Event status registers 0 (ESR0), 1 (ESR1) and event status enable registers 0 (ESER0), 1 (ESER1)



Summary of commands for writing and reading each of the registers

GP-IB

Register	Read	Write
Status byte register	*STB?	-
Service request enable register	*SRE?	*SRE
Standard event status register	*ESR?	-
Standard event status enable register	*ESE?	*ESE
Event status register 0	:ESR0?	-
Event status enable register 0	:ESE0?	:ESE0

GP-IB command

The following commands are used for performing interface functions:

Command	Function	
GTL	Go To Local	The remote state is canceled, and the system goes into the local state.
LLO	Local Lock Out	All keys, including the LOCAL key, become inoperable.
DCL	Device CLear	Clears the input buffer and the output queue.
SDC	Selected Device Clear	Clears the input buffer and the output queue.

7.4.5 Initialization Items

RS-232C

●: initialized / --: not initialized

Item \ Initialization method	Power on	*RST command	*CLS command
Device specific functions (ranges etc.)	--	●	--
Output queue	●	--	--
Input buffer	●	--	--
Event registers	● *1	--	●
Current path	●	--	--
Headers on/off	●	●	--

*1 Except the PON bit (bit 7).

RS-232C

●: initialized / --: not initialized

Item \ Initialization method	Power on	*RST command	Device clear	*CLS command
Device specific functions (ranges etc.)	--	●	--	--
Output queue	●	--	●	--
Input buffer	●	--	●	--
Status byte register	●	--	-- *1	● *2
Event register	● *3	--	--	●
Enable register	●	--	--	--
Current path	●	--	●	--
Headers on/off	●	●	--	--

*1 Only the MAV bit (bit 4) is cleared.
*2 All bits except the MAV bit are cleared.
*3 Except the PON bit (bit 7).

7.5 Message Reference

The command specific to GP-IB interface is identified with GP-IB.

NOTE Any typographical mistakes in the message will result in a command error.

7.5.1 Common Messages

Message		Explanation	Ref page
*CLS		Clears event registers and status byte registers	130
*ESE	GP-IB	Sets the standard event status enable register (SESER)	130
*ESE?	GP-IB	Queries the standard event status enable register (SESER)	130
*ESR?		Queries the event status register	131
*IDN?		Queries the equipment ID	131
*OPC	GP-IB	Requests SRQ at operation completion	132
*OPC?	GP-IB	Queries about operation completion	132
*RST		Restores the default settings (factor settings)	132
*SRE	GP-IB	Sets SRER	133
*SRE?	GP-IB	Queries SRER	133
*STB?	GP-IB	Queries the status byte register	133
*TST?		Queries the self-test and result	134
*WAI		Waits for operation to be completed	134

7.5.2 Messages Specific to the 3156

Setting of the equipment under test

Message	Explanation	Ref page
:EQUipment	Sets the grounding class of equipment under test	156
:EQUipment?	Queries the grounding class of equipment under test	156
:EQUipment:IDENtity	Sets the equipment name/control number of equipment under test	157
:EQUipment:IDENtity?	Queries the equipment name/control number of equipment under test	157
:EQUipment:TYPE	Sets the applied part of equipment under test (Network B only)	158
:EQUipment:TYPE?	Queries the applied part of equipment under test (Network B only)	158

Network

Message	Explanation	Ref page
:NETWork	Sets the network	173
:NETWork?	Queries the network	173

Measurement mode

Message	Explanation	Ref page
:MODE	Sets the measurement mode	172
:MODE?	Queries the measurement mode	172

Measurement method

Message	Explanation	Ref page
:CONFigure:AUTO	Sets the measurement method (automatic/manual)	137
:CONFigure:AUTO?	Queries the measurement method (automatic/manual)	137

Measurement items

Message	Explanation	Ref page
:APPLy	Sets the voltage application ON/OFF	136
:APPLy?	Queries the voltage application ON/OFF	136
:CONFigure:COMParator	Sets the allowable value	140
:CONFigure:COMParator?	Queries the allowable value	140
:CONFigure:COMParator:DC	Sets the allowable value (when making DC measurements)*	142
:CONFigure:COMParator:DC?	Queries the allowable value (when making DC measurements)*	142
:CONFigure:COMParator:AC	Sets the allowable value (when making AC measurements)*	143
:CONFigure:COMParator:AC?	Queries the allowable value (when making AC measurements)*	143
:CONFigure:CURRent	Sets the target current	147
:CONFigure:CURRent?	Queries the target current	147
:CONFigure:FILTer	Sets the measurement network filter	148
:CONFigure:FILTer?	Queries the measurement network filter	148
:CONFigure:RANGe	Sets the current range	151
:CONFigure:RANGe?	Queries the current range	151
:LINE	Sets the application line for leakage current measurement between enclosure and line	161
:LINE?	Queries the application line for leakage current measurement between enclosure and line	161
:MAXimum:CLEar	Clears the maximum value	162

* Supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

Manual measurement

Message	Explanation	Ref page
:CONFigure:CONDition	Sets the status of equipment under test in manual measurement	144
:CONFigure:CONDition?	Queries the status of equipment under test in manual measurement	144
:CONFigure:POLarity	Sets the power supply polarity in manual measurement	150
:CONFigure:POLarity?	Queries the power supply polarity in manual measurement	150

Automatic measurement

Message	Explanation	Ref page
:AMC?	Queries the automatic measurement completion	135
:CONFigure:AUTO:KIND	Sets the type of automatic measurement	138
:CONFigure:AUTO:KIND?	Queries the type of automatic measurement	138
:CONFigure:MTIMe	Sets the measuring time of automatic measurement	149
:CONFigure:MTIMe?	Queries the measuring time of automatic measurement	149
:CONFigure:WTIMe:ETC	Sets the wait time for switching operation in automatic measurement (Other)	153
:CONFigure:WTIMe:ETC?	Queries the wait time for switching operation in automatic measurement (Other)	153
:CONFigure:WTIMe:LINE	Sets the wait time for switching operation in automatic measurement (Line)	154
:CONFigure:WTIMe:LINE?	Queries the wait time for switching operation in automatic measurement (Line)	154
:CONFigure:WTIMe:POLarity	Sets the wait time for switching operation in automatic measurement (Polarity)	155
:CONFigure:WTIMe:POLarity?	Queries the wait time for switching operation in automatic measurement (Polarity)	155
:STARt	Starts automatic measurement	174
:STOP	Stops automatic measurement	174

Zero adjustment

Message	Explanation	Ref page
:ADJust	Executes and cancels zero adjustment	135
:ADJust?	Queries the zero adjustment enable/disable status	135

Measurement data

Message	Explanation	Ref page
:MEASure?	Queries the measurement value	162
:MEASure:AUTO?	Queries the maximum value after automatic measurement	163
:MEASure:MAXimum?	Queries the maximum value	165
:MEASure:VOLTage?	Queries the voltage measurement value	166

Saved data

Message	Explanation	Ref page
:MEMory:CLEar	Deletes the saved data	166
:MEMory:NUMBer?	Queries the number of models in the saved data	167
:MEMory:READ:IDENtity?	Queries the equipment name/control number of the saved data	167
:MEMory:READ:MEASure?	Reads saved data	168
:MEMory:SAVE:AUTO	Saves automatic measurement results	170
:MEMory:SAVE:MAXimum	Saves the maximum value	171

Voltmeter mode

Message	Explanation	Ref page
:CONFigure:VOLTage	Sets the target voltage	152
:CONFigure:VOLTage?	Queries the target voltage	152
:CONFigure:VOLTage:RANGe	Sets the voltage range	152
:CONFigure:VOLTage:RANGe?	Queries the voltage range	152

Event register

Message		Explanation	Ref page
:ESE0	GP-IB	Sets the event status enable register 0 (ESER0)	159
:ESE0?	GP-IB	Queries the event status enable register 0 (ESER0)	159
:ESR0?		Queries the event status register 0	160

Header

Message	Explanation	Ref page
:HEADer	Sets the response header	160
:HEADer?	Queries the response header	160

System

Message	Explanation	Ref page
:SYSTem:BACKlight	Sets the backlight automatic OFF function	175
:SYSTem:BACKlight?	Queries the backlight automatic OFF function	175
:SYSTem:BEEPer:COMParator	Sets the beep sound (Judgement of allowable value)	176
:SYSTem:BEEPer:COMParator?	Queries the beep sound (Judgement of allowable value)	176
:SYSTem:BEEPer:KEY	Sets the beep sound (Key entry)	177
:SYSTem:BEEPer:KEY?	Queries the beep sound (Key entry)	177
:SYSTem:BEEPer:T2OUt	Sets the beep sound (T2 output)	177
:SYSTem:BEEPer:T2OUt?	Queries the beep sound (T2 output)	177
:SYSTem:BEEPer:T3OUt	Sets the beep sound (T3 output)	178
:SYSTem:BEEPer:T3OUt?	Queries the beep sound (T3 output)	178
:SYSTem:CLEar	Clears the panel	178
:SYSTem:DATE	Sets the date	179
:SYSTem:DATE?	Queries the date	179
:SYSTem:FILE?	Queries the content of a panel	180
:SYSTem:LANGuage	Sets the display language	184
:SYSTem:LANGuage?	Queries the display language	184
:SYSTem:LOAD	Loads a panel	184
:SYSTem:MODE	Sets the mode	185
:SYSTem:MODE?	Queries the mode	185
:SYSTem:SAVE	Saves a panel	185
:SYSTem:RESet	Initializes the 3156	186
:SYSTem:TEST:VA?	Queries the VA check	187
:SYSTem:TIME	Sets the time	188
:SYSTem:TIME?	Queries the time	188
:SYSTem:UNIT	Sets the unit of current measurement	189
:SYSTem:UNIT?	Queries the unit of current measurement	189

Terminator

Message	Explanation	Ref page
:TRANsmit:TERMinator GP-IB	Sets the response message terminator	190
:TRANsmit:TERMinator? GP-IB	Queries the response message terminator	190

7.6 Message Reference

Shows the command message that contains numerical or character parameters.
<numerical value>: Numeric data values
(NR1) integer data
(NR2) fixed point numbers
(NR3) floating point numbers
(NRf) format that contains NR1, NR2, and NR3
<characters>: Character string data

Shows the command description.

Describes the message syntax.

Explains the message.

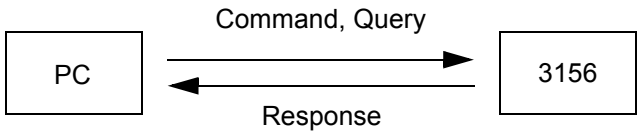
Illustrates the actual command application. (Generally, the explanation is directed to the “HEADER ON” case, except for the HEADER command.)

Describes errors that may occur due to command execution. "Command" is displayed only when the error is related to command.

Describes important notes regarding use of the command. "Command" is displayed only when the note is related to command.

Executes and cancels zero adjustment
Queries the zero adjustment enable/disable status

Syntax	Command	:ADJust <characters>
	Query	:ADJust?
	Response	<characters> = ON/OFF ON : Zero adjustment enabled OFF:Zero adjustment disabled
Function	Command	Executes zero adjustment.
	Query	Returns zero adjustment condition as alphabetic characters.
Example	Command	:ADJust ON Executes zero adjustment.
	Query	:ADJust? (Headers: ON) ON (Headers: OFF) Zero adjustment is enabled.
Error		An execution error occurs in the following cases: • The mode is set to "voltmeter mode." • The measurement mode is not set to "earth leakage current." • The target current is "DC." (Command) • In automatic measurement (Command)
Note		Use this command after executing the :MODE command to activate earth leakage current mode.



7.6.1 Message Reference

The command specific to GP-IB interface is identified with GP-IB.

Clears event registers and status byte registers

Syntax
Command: *CLS

Function
Command: Clears the content of event registers (SESR, ESR0) as well as the bits of the corresponding status byte registers.
There is no effect on the output queue, enable registers, or bit 4 (MAV) of status byte registers.

Example
Command: *CLS

Error
Any data following a command results in a command error.

Sets and queries the standard event status enable register (SESER)

GP-IB

Syntax
Command: *ESE <numerical value>
Query: *ESE?
Response: <numerical value>
<numerical value> = 0 to 255 (NR1)

Function
Command: Sets a pattern for using the standard event status register (SESR) in SESER.

Query: Returns the setting content of SESER as a numeric value.
No header is prefixed to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Example
Command: *ESE 20
Sets bits 2 and 4 of SESER to 1.

Query: *ESE?
Response: 20
Bits 2 and 4 of SESER have been set to 1.

Error
- If the set numeric value is not within the specified range, an execution error occurs.
- If the response message exceeds the output queue size, a query error occurs.

Note
- A numeric value in NRf format is accepted, but fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.
- Data is initialized to 0 at power-on.

Queries the event status register

Syntax

Query: `*ESR?`

Response: <numerical value>

<numerical value> = 0 to 255 (NR1)

Function

Query: Returns the setting content of SESER as a numeric value, then clears the content. No header is prefixed to the response message.

Example

Query: `*ESR?`

Response: `32`

Bit 5 of SESR has been set to 1.

Error

If the response message exceeds the output queue size, a query error occurs.

Queries the equipment ID

Syntax

Query: `*IDN?`

Response: <character value 1>,<character value 2>,<character value 3>, <character value 4>

<character value 1> = Manufacturer's name

<character value 2> = Model name

<character value 3> = 0, fixed (NR1)

<character value 4> = Software version

Function

Query: Returns the equipment manufacturer name, model name, and version of software. No header is prefixed to the response message.

Example

Query: `*IDN?`

Response: `HIOKI,3156,0,V1.00`

The equipment ID is "HIOKI, 3156, 0, 1.00 (software version)."

Error

If the response message exceeds the output queue size, a query error occurs.

Requests and queries SRQ at operation completion

GP-IB

Syntax

Command: *OPC

Query: *OPC?

Response: <numerical value>
<numerical value> = 1 (NR1)

Function

Command: Sets bit 0 (OPC bit) of SESR to 1 when the operation executed by a command immediately before an *OPC command on the same line is completed.

Query: Operates the same way as the *OPC command. Returns "1" as the response message, instead of setting bit 0 (OPC bit) of SESR to 1. No header is prefixed to the response message.

Example

Command: *OPC
Requests SRQ at operation completion.

Query: *OPC?
Response: 1
Queries the operation completion.

Error

Any data following a command results in a command error.
If the response message exceeds the output queue size, a query error occurs.

Restores the default settings (factor settings)

Syntax

Command: *RST

Function

Command: The initial screen appears after initialization is completed.
Same as specifying ALL with 3156 initialization command :SYSTem:RESet

Example

Command: *RST
Initializes the instrument settings.

Error

Any data following a command results in a command error.

Note

The communication conditions are not initialized.

Sets and queries SRER

GP-IB

Syntax

Command `*SRE <numerical value>`
Query `*SRE?`
Response <numerical value>
<numerical value> = 0 to 255 (NR1)

Function

Command: Sets a pattern for using the status byte register (STB) in the service request enable register (SRER).

Query: Returns the setting content of SRER as a numeric value. No header is prefixed to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Not used	X	ESB	MAV	Not used	Not used	Not used	ESE0

Example

Command `*SRE 33`
Sets bits 0 and 5 of SRER to 1.

Query `*SRE?`
Response `33`
Bits 0 and 5 of SRER have been set to 1.

Error

- If the set numeric value is not within the specified range, an execution error occurs.
- If the response message exceeds the output queue size, a query error occurs.

Note

- A numeric value in NRf format is accepted, but fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.
- The settings of unused bits (bits 1, 2, 3, and 7) and bit 6 are ignored.
- Data is initialized to 0 at power-on.

Queries the status byte register

GP-IB

Syntax

Query `*STB?`
Response <numerical value>
<numerical value> = 0 to 255 (NR1)

Function

Query: Returns the setting content of STB as a numeric value. No header is prefixed to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Not used	MSS	ESB	MAV	Not used	Not used	Not used	ESE0

Example

Query `*STB?`
Response `16`
Bit 4 of STB has been set to 1.

Error

If the response message exceeds the output queue size, a query error occurs.

Queries the self-test and result

Syntax

Query: `*TST?`

Response: <numerical value>

<numerical value> = 0, 2 (NR1)
0: No error
2: RAM error

Function

Query: Conducts a self-test of main instrument and returns the result as a numeric value of 0 or 2.

Example

Query: `*TST?`

Response: `2`

A RAM error has occurred.

Error

If the response message exceeds the output queue size, a query error occurs.

Note

A self-test initiated by a communications command is a RAM test only. The key test, LCD test, (zzz) test, and LED test on the self-test screen are not conducted by a communications command.

Waits for operation to be completed

Syntax

Command: `*WAI`

Function

Command: Sets the instrument in standby status until the operation executed by the previous command is completed.

Example

Command: `*WAI`

Sets operation completion status.

Error

Any data following a command results in a command error.

Note

`*WAI` command is accepted since it is a common command that complies with IEEE-488.2 1987 standard. However, using the `*WAI` command has no effect since all commands specific to the 3156 instrument are sequential commands, except for `:START`.

7.6.2 Messages Specific to the 3156

Executes and cancels zero adjustment
Queries the zero adjustment enable/disable status

Syntax

Command `:ADJust <characters>`

Query `:ADJust?`

Response `<characters>`

`<characters>` = ON/OFF
ON : Zero adjustment enabled
OFF : Zero adjustment disabled

Function

Command: Executes zero adjustment.

Query: Returns zero adjustment condition as alphabetic characters.

Example

Command `:ADJust ON`
Executes zero adjustment.

Query `:ADJust?`
Response `:ADJUST ON` (Headers: ON)
`ON` (Headers: OFF)
Zero adjustment is enabled.

Error

An execution error occurs in the following cases:
- The mode is set to "voltmeter mode."
- The measurement mode is not set to "earth leakage current."
- The target current is "DC." (Command)
- In automatic measurement (Command)

Note

Use this command after executing the `:MODE` command to activate earth leakage current mode.

Queries the automatic measurement completion

Syntax

Query `:AMC?`

Response `<numerical value>`

`<numerical value>` = 0/1 (NR1)
0: In automatic measurement
1: Automatic measurement completed

Function

Query: Returns automatic measurement condition as a numeric value.

Example

Query `:AMC?`
Response `:AMC 1` (Headers: ON)
`1` (Headers: OFF)
Automatic measurement has been completed.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected

Note

Use this command after executing the `:MODE` command to activate the measurement mode.

Sets and queries the voltage application ON/OFF

Syntax

Command `:APPLy <characters>`

Query `:APPLy?`

Response `<characters>`

`<characters>` = ON/OFF
ON : Starts applying voltage.
OFF : Stops applying voltage.

Function

Command
- When network A, C, D, E, or F is selected
  In manual measurement, the application of line voltage starts.
- When network B is selected
  In manual measurement, the output of a single-fault condition (application of 110% voltage) starts.

Query
Returns the voltage application condition as alphabetic characters.

Example

Command `:APPLy ON`
Starts the output of a single-fault condition (application of 110% voltage). (When network B is selected)

Query `:APPLy?`

Response `:APPLY ON` (Headers: ON)
`ON` (Headers: OFF)
The voltage application status has been set.

Error

In leakage current measurement between enclosure and line, if the pre-check performed to prevent a ground fault results in NG judgement, an equipment-dependent error occurs.

An execution error occurs in the following cases:
- The mode is set to "voltmeter mode."
- In a condition other marked *

Note

This command is valid in the following cases.
- When network A, C, D, E, or F is selected
  Measurement mode: Leakage current between enclosure and line
  Measurement method: Manual measurement
  When the application line is set to internal contact
- When network B is selected
  Measurement modes: Leakage current between enclosure and earth, leakage current between enclosure and enclosure, patient leakage current II, patient leakage current III
  Measurement method: Manual measurement
  When in a single-fault condition (application of 110% voltage)

Sets and queries the measurement method (automatic/manual)

Syntax

Command `:CONFigure:AUTO <characters>`

Query `:CONFigure:AUTO?`

Response
<characters>
<characters> = ON/OFF
ON : Automatic
OFF : Manual

Function

Command
Sets the measurement method.
When set to Auto, measurement can be started by any of the following:
(1) Start on the measurement screen
(2) START of EXIT I/O
(3) :STARt interface command
When set to Manual, the instrument performs continuous measurement.

Query
Returns the measurement method setting as alphabetic characters.

Example

Command `:CONFigure:AUTO OFF`
Sets to manual measurement.

Query `:CONFigure:AUTO?`
Response `:CONFIGURE:AUTO OFF` (Headers: ON)
`OFF` (Headers: OFF)
Manual measurement has been set.

Error

An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)
- If automatic measurement is selected in a measurement mode in which automatic measurement cannot be selected (Command)
- If automatic measurement is selected when the voltage application line is set to "external" for leakage current measurement between enclosure and line (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- Since the settable power supply polarity and status of the equipment under test vary depending on the equipment under test settings and measurement mode, the combination for automatic measurement differs.

Queries the type and setting of automatic measurement

Syntax

Command `:CONFigure:AUTO:KIND <numerical value>`
Query `:CONFigure:AUTO:KIND?`
Response `<numerical value>`
`<numerical value>` = 1 to 4095 (NR1)

Function

Command: Sets the type of automatic measurement.
Sets the bit of the item for automatic measurement to 1.
Sets other bits to 0.

Query: Returns the automatic measurement type setting as a numeric value.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
AC+DC	Negative phase	Positive phase	110% voltage application (negative phase)	110% voltage application (positive phase)	Disconnection of protective earth conductor	Disconnection on one wire in power line	Normal

32768 bit 15	16384 bit 14	8192 bit 13	4096 bit 12	2048 bit 11	1024 bit 10	512 bit 9	256 bit 8
Not used	Not used	Not used	Not used	Application of line voltage N	Application of line voltage L	AC	DC

Example

Command `:CONFigure:AUTO:KIND 97`
Sets the type of automatic measurement as follows:
Equipment under test status: Normal condition
Power supply polarity: Positive phase, negative phase

Query `:CONFigure:AUTO:KIND?`
Response `:CONFIGURE:AUTO:KIND 99` (Headers: ON)
`99` (Headers: OFF)
The type of automatic measurement has been set as follows:
equipment under test status: Normal condition, disconnection of one wire in power line
Power supply polarity: Positive phase, negative phase

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Queries the type and setting of automatic measurement

Note

- Use this command after executing the :MODE command to activate the measurement mode.
- Depending on the equipment under test settings and measurement mode, the settable power supply polarity and the status of equipment under test vary.
- Set unused bits (bit 12 through bit 15) to 0.
- For network A, C, D, E, or F, automatic measurement cannot be set for internally powered equipment.

<table>
<tr><th rowspan="2">Bit</th><th rowspan="2">Item</th><th colspan="3">Explanation</th></tr>
<tr><th>Leakage current between enclosure and line</th><th colspan="2">Other than leakage current between enclosure and line</th></tr>
<tr><td>bit0</td><td>Normal condition</td><td rowspan="10">Set all bits to 0.</td><td rowspan="6">Set at least one of bits 0 to 4 to 1.</td><td>For patient leakage currents II and III, set to 0.</td></tr>
<tr><td>bit1</td><td>Disconnection of one wire in power line</td><td>For internally powered equipment, set to 0 for patient leakage currents II and III.</td></tr>
<tr><td>bit2</td><td>Disconnection of earth conductor in power line</td><td>For Class-II equipment and internally powered equipment, set to 0 for patient leakage currents II and III.</td></tr>
<tr><td>bit3</td><td>Application of 110% voltage (positive phase)</td><td rowspan="3">For network B, set to 0 for measurement of other than leakage current between enclosure and earth, leakage current between enclosure and enclosure, and patient leakage currents II and III.</td></tr>
<tr><td>bit4</td><td>Application of 110% voltage (negative phase)</td></tr>
<tr><td>bit5</td><td>Positive phase</td><td rowspan="2">Set at least one of bits 5 and 6 to 1.</td></tr>
<tr><td>bit6</td><td>Negative phase</td><td>For internally powered equipment, set all bits to 0.</td></tr>
<tr><td>bit7</td><td>AC+DC</td><td colspan="2" rowspan="3">For patient leakage current I, set at least one of bits 7 to 9 to 1. For patient auxiliary current, set at least one of bits 8 and 9 to 1. In other cases, set all bits to 0.</td></tr>
<tr><td>bit8</td><td>DC</td></tr>
<tr><td>bit9</td><td>AC</td></tr>
<tr><td>bit10</td><td>Application of line voltage L</td><td rowspan="2">Set at least one of bits 10 and 11 to 1. For internally powered equipment, the setting cannot be made.</td><td colspan="2" rowspan="6">Set all bits to 0.</td></tr>
<tr><td>bit11</td><td>Application of line voltage N</td></tr>
<tr><td>bit12</td><td>Not used</td><td rowspan="4">Set all bits to 0.</td></tr>
<tr><td>bit13</td><td>Not used</td></tr>
<tr><td>bit14</td><td>Not used</td></tr>
<tr><td>bit15</td><td>Not used</td></tr>
</table>

Sets and queries the allowable value

Syntax

Command `:CONFigure:COMParator` <numerical value 1>,<numerical value 2>

Query `:CONFigure:COMParator?`

Response <numerical value 1>,<numerical value 2>
<numerical value 1> = allowable value data (NR3) for normal condition
<numerical value 2> = allowable value data (NR3) for fault condition

Function

Command

Sets the allowable value.
The instrument calculates the allowable value by multiplying the numeric value by the factor, but the factor is set to 100% by the interface command.
The range of numeric values is from 5.000E-06 to 20.00E-03 (unit: A).

- When network A, C, D, E, or F is selected
  Earth leakage current, leakage current between enclosure and earth, leakage current between enclosure and enclosure:
  Sets one allowable value each for normal condition and single-fault condition.
  Leakage current between enclosure and line:
  Sets the allowable value for normal condition to zero (+0.000E+00).
  Leakage current between enclosure and earth, leakage current between enclosure and enclosure (for internally powered equipment): Sets the allowable value for fault condition to zero (+0.000E+00).
- When network B is selected
  Earth leakage current, leakage current between enclosure and earth, leakage current between enclosure and enclosure:
  Sets one allowable value each for normal condition and single-fault condition.
  Patient leakage current I, patient auxiliary current:
  When testing normal and single fault conditions, sets two allowable values to use when making DC and AC measurements. (Supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.)
  Patient leakage current II, patient leakage current III:
  Sets the allowable value for normal condition to zero (+0.000E+00).
  Patient leakage current I, patient auxiliary current (for internally powered equipment):
  Sets the allowable value for fault condition to zero (+0.000E+00).

Sets and queries the allowable value

Function Query

Returns the allowable value setting as four-digit numeric data in NR3 format (unit: A).

- When network A, C, D, E, or F is selected
  Earth leakage current, leakage current between enclosure and earth, leakage current between enclosure and enclosure:
  Returns one allowable value each for normal condition and single-fault condition.
  Leakage current between enclosure and line:
  Returns zero (+0.000E+00) as the allowable value for normal condition. Leakage current between enclosure and earth, leakage current between enclosure and enclosure (for internally powered equipment): Returns zero (+0.000E+00) as the allowable value for fault condition.
- When network B is selected
  Earth leakage current, leakage current between enclosure and earth, leakage current between enclosure and enclosure:
  Returns one allowable value each for normal condition and single-fault condition.
  Patient leakage current I, patient auxiliary current:
  Returns one allowable value to use when making AC measurement each for normal condition and single-fault condition. (Supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.)
  Patient leakage current II, patient leakage current III:
  Returns zero (+0.000E+00) as the allowable value for normal condition. Patient leakage current I, patient auxiliary current (for internally powered equipment):
  Returns zero (+0.000E+00) as the allowable value for fault condition.

Example Command

```
:CONFigure:COMParator +500.0E-06,+1.000E-03
```

Sets the allowable value for normal condition to 500.0 µA, and the allowable value for single-fault condition to 1.000 mA.

Query

```
:CONFigure:COMParator?
```

Response

```
:CONFIGURE:COMPARATOR +500.0E-06,+1.000E-03
```

(Headers: ON)

```
+500.0E-06,+1.000E-03
```

(Headers: OFF)

The allowable value for normal condition has been set to 500.0 µA, and the allowable value for single-fault condition has been set to 1.000 mA.

Error

An execution error occurs in the following cases:

- When the measurement mode is not selected
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

Use this command after executing the `:MODE` command to activate the measurement mode.

Sets and queries the allowable value (when making DC measurements)

Syntax

Command `:CONFigure:COMParator:DC` <numerical value 1>, <numerical value 2>

Query `:CONFigure:COMParator:DC?`

Response <numerical value 1>,<numerical value 2>
<numerical value 1> = allowable value data (NR3) for normal condition
<numerical value 2> = allowable value data (NR3) for fault condition

Function

Command

Sets the allowable value to use when making DC measurements.
The instrument calculates the allowable value by multiplying the numeric value by the factor, but the factor is set to 100% by the interface command.
The range of numeric values is from 5.000E-06 to 20.00E-03 (unit: A).
Sets one allowable value each for normal condition and single-fault condition.

Function

Query

Returns the allowable value setting as four-digit numeric data in NR3 format (unit: A).
Returns one allowable value each for normal condition and single-fault condition.

- Internally powered equipment
  The allowable value of fault condition returns zero (+0.000E+00).

Example

Command `:CONFigure:COMParator:DC +500.0E-06, +1.000E-03`

Sets the allowable value to use when making DC measurements for normal condition to 500.0 μA, and the allowable value for single-fault condition to 1.000 mA.

Query `:CONFigure:COMParator:DC?`

Response `:CONFIGURE:COMPARATOR:DC +500.0E-06, +1.000E-03` (Headers: ON)
`+500.0E-06,+1.000E-03` (Headers: OFF)

The allowable value to use when making DC measurements for normal condition has been set to 500.0 μA, and the allowable value for single-fault condition has been set to 1.000 mA.

Error

An execution error occurs in the following cases:

- When the selected measurement mode is not patient auxiliary current or patient leakage current I.
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the patient leakage current I mode or the patient auxiliary current mode.
- This command is supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

Sets and queries the allowable value (when making AC measurements)

Syntax

Command `:CONFigure:COMParator:AC` <numerical value 1>, <numerical value 2>

Query `:CONFigure:COMParator:AC?`

Response <numerical value 1>,<numerical value 2>
<numerical value 1> = allowable value data (NR3) for normal condition
<numerical value 2> = allowable value data (NR3) for fault condition

Function

Command

Sets the allowable value to use when making AC (AC+DC) measurements.
The instrument calculates the allowable value by multiplying the numeric value by the factor, but the factor is set to 100% by the interface command.
The range of numeric values is from 5.000E-06 to 20.00E-03 (unit: A).
Sets one allowable value each for normal condition and single-fault condition.

Function

Query

Returns the allowable value setting as four-digit numeric data in NR3 format (unit: A).
Returns one allowable value each for normal condition and single-fault condition.

- Internally powered equipment
  The allowable value of fault condition returns zero (+0.000E+00).

Example

Command `:CONFigure:COMParator:AC +500.0E-06, +1.000E-03`
Sets the allowable value to use when making AC measurements for normal condition to 500.0 μA, and the allowable value for single-fault condition to 1.000 mA.

Query `:CONFigure:COMParator:AC?`

Response `:CONFIGURE:COMPARATOR:AC +500.0E-06, +1.000E-03` (Headers: ON)
`+500.0E-06,+1.000E-03` (Headers: OFF)
The allowable value to use when making AC measurements for normal condition has been set to 500.0 μA, and the allowable value for single-fault condition has been set to 1.000 mA.

Error

An execution error occurs in the following cases:

- When the selected measurement mode is not patient auxiliary current or patient leakage current I.
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the patient leakage current I mode or the patient auxiliary current mode.
- This command is supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

Sets and queries the status of equipment under test in manual measurement

Syntax

Command `:CONFigure:CONDition <characters>`

Query `:CONFigure:CONDition?`

Response `<characters>`

`<characters>` = NORMal/ EARTh/ POWersource/ NAPPly/ RAPPly/ LLINe/ NLINe

NORMal	: Normal condition
EARTh	: Single-fault condition (disconnection of protective earth conductor)
POWersource	: Single-fault condition (disconnection of one wire in power line)
NAPPly	: Single-fault condition (110% voltage application: positive phase)
RAPPly	: Single-fault condition (110% voltage application: negative phase)
LLINe	: Single-fault condition (line voltage application: L)
NLINe	: Single-fault condition (line voltage application: N)

Function

Command: Sets the status of equipment under test for manual measurement.

Query: Returns the status of equipment under test for manual measurement as alphabetic characters.

Example

Command `:CONFigure:AUTO OFF;:CONFigure:CONDition NORMal`
Sets the equipment under test to normal condition.

Query `:CONFigure:AUTO OFF;:CONFigure:CONDition?`
Response `:CONFIGURE:CONDITION NORMAL` (Headers: ON)
`NORMAL` (Headers: OFF)
The equipment under test has been set to normal condition.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "automatic measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- When the setting cannot be made in the present condition
  See the table on the next page for details.

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- Depending on the equipment under test settings and measurement mode, the setting cannot be made in some cases. See the table on the next page for details.

When network A, C, D, E, or F is selected

Equipment status / Measurement mode	Class-I equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	Line voltage application: L	Line voltage application: N
Earth leakage current	●	●	--	--	--
Leakage current between enclosure and line	--	--	--	●	●
Leakage current between enclosure and earth	●	●	●	--	--
Leakage current between enclosure and enclosure	●	●	●	--	--

Equipment status / Measurement mode	Class-II equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	Line voltage application: L	Line voltage application: N
Earth leakage current	--	--	--	--	--
Leakage current between enclosure and line	--	--	--	●	●
Leakage current between enclosure and earth	●	●	--	--	--
Leakage current between enclosure and enclosure	●	●	--	--	--

Equipment status / Measurement mode	Internally powered equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	Line voltage application: L	Line voltage application: N
Earth leakage current	--	--	--	--	--
Leakage current between enclosure and line	--	--	--	--	--
Leakage current between enclosure and earth	●	--	--	--	--
Leakage current between enclosure and enclosure	●	--	--	--	--

●: Can be set., --: Cannot be set.

When network B is selected

Equipment status / Measurement mode	Class-I equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	110% voltage application: positive phase	110% voltage application: negative phase
Earth leakage current	●	●	--	--	--
Leakage current between enclosure and earth	●	●	●	●	●
Leakage current between enclosure and enclosure	●	●	●	●	●
Patient auxiliary current	●	●	●	--	--
Patient leakage current I	●	●	●	--	--
Patient leakage current II	--	--	--	●	●
Patient leakage current III	--	--	--	●	●

Equipment status / Measurement mode	Class-II equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	110% voltage application: positive phase	110% voltage application: negative phase
Earth leakage current	--	--	--	--	--
Leakage current between enclosure and earth	●	●	--	●	●
Leakage current between enclosure and enclosure	●	●	--	●	●
Patient auxiliary current	●	●	--	--	--
Patient leakage current I	●	●	--	--	--
Patient leakage current II	--	--	--	●	●
Patient leakage current III	--	--	--	●	●

Equipment status / Measurement mode	Internally powered equipment				
	Normal condition	Single-fault condition			
		Power line disconnection	Earth conductor disconnection	110% voltage application: positive phase	110% voltage application: negative phase
Earth leakage current	--	--	--	--	--
Leakage current between enclosure and earth	●	--	--	●	●
Leakage current between enclosure and enclosure	●	--	--	●	●
Patient auxiliary current	●	--	--	--	--
Patient leakage current I	●	--	--	--	--
Patient leakage current II	--	--	--	●	●
Patient leakage current III	--	--	--	●	●

●: Can be set., --: Cannot be set.

Sets and queries the target current

Syntax

Command `:CONFigure:CURRent <characters>`

Query `:CONFigure:CURRent?`

Response
<characters>
<characters> = ACDC/ AC/ DC/ ACPeak
ACDC : AC+DC
(alternating current and direct current)
AC : Alternating current
DC : Direct current
ACPeak: Alternating current peak

When network A or B is selected
ACDC/ AC/ DC
When network C is selected
ACDC/ AC/ DC/ ACPeak
(For AC Peak, the filter for the measurement network is automatically set to ON1.)
When network D, E, or F is selected
ACDC/ AC/ DC/ ACPeak

Function

Command Sets the target current.

Query Returns the target current setting as alphabetic characters.

Example

Command `:CONFigure:CURRent ACDC`
Sets AC+DC as the target current.

Query `:CONFigure:CURRent?`
Response `:CONFIGURE:CURRENT ACDC` (Headers: ON)
`ACDC` (Headers: OFF)
The target current has been set to AC+DC.

Error

An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

- When network B is selected
  When the measurement mode is not selected
  When in a mode other than patient leakage current I or patient auxiliary current mode
  When the measurement method is set to "automatic measurement" (Command)

Note

- When network A, C, D, E, or F is selected
  Use this command after executing the `:MODE` command to activate the measurement mode.
- When network B is selected
  Use this command after executing the `:MODE` command to set the measurement mode to "patient leakage current I" or "patient auxiliary current."
  ACDC cannot be set for patient auxiliary current.

Sets and queries the measurement network filter

Syntax

Command `:CONFigure:FILTer <characters>`

Query `:CONFigure:FILTer?`

Response <characters>

<characters> = ON/ ON1/ ON2/ OFF

When network A is selected
- OFF : Single-frequency network
- ON : Multi-frequency network

When network B is selected
- ON : Network with a frequency characteristic
- OFF : Network with 1 kΩ non-inductive resistance only

When network C is selected
- ON1 : Network compatible with perception/reaction
- ON2 : Network compatible with abandonment
- OFF : Body impedance network

When network D is selected
- OFF: 1.5 kΩ//0.15 μF network

When network E is selected
- OFF: 1 kΩ network

When network F is selected
- OFF: 2 kΩ network

Function

Command: Sets the measurement network filter.

Query: Returns the setting of the measurement network filter as alphabetic characters.

Example

Command `:CONFigure:FILTer OFF`

Sets the network only with 1 kΩ non-inductive resistance. (When network B is selected)j

Query `:CONFigure:FILTer?`

Response `:CONFIGURE:FILTER OFF` (Headers: ON)

`OFF` (Headers: OFF)

The network only with 1 kΩ non-inductive resistance has been set. (When network B is selected)

Error

An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- If network C has been selected with the target current set to "AC Peak," setting the filter to OFF results in an execution error.

Sets and queries the measuring time of automatic measurement

Syntax

Command `:CONFigure:MTIMe <numerical value>`

Query `:CONFigure:MTIMe?`

Response <numerical value>
<numerical value> = 1 to 300 (NR1)

Function

Command Sets the measuring time of automatic measurement.

Query Returns the measuring time of automatic measurement as a numeric value.

Example

Command `:CONFIGURE:MTIME 5`
Sets the measuring time of automatic measurement to 5 seconds.

Query `:CONFigure:MTIMe?`

Response `:CONFIGURE:MTIME 5` (Headers: ON)
`5` (Headers: OFF)
The measuring time of automatic measurement has been set to 5 seconds.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- The unit is [s]. Fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.

Sets and queries the power supply polarity in manual measurement

Syntax

Command `:CONFigure:POLarity <characters>`

Query `:CONFigure:POLarity?`

Response
<characters>
<characters> = NORMal/ REVerse
NORMal: Positive phase
REVerse: Negative phase

Function

Command: Sets the power supply polarity for manual measurement.

Query: Returns the power supply polarity setting for manual measurement as alphabetic characters.

Example

Command `:CONFigure:AUTO OFF;:CONFigure:POLarity NORMal`
Sets the power supply polarity to positive phase.

Query `:CONFigure:AUTO OFF;:CONFigure:POLarity?`
Response `:CONFIGURE:POLARITY NORMAL` (Headers: ON)
`NORMAL` (Headers: OFF)
The power supply polarity has been set to positive phase.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "automatic measurement"
- The mode is set to "voltmeter mode."
- When the measurement mode is set to "leakage current between enclosure and line" or the measurement mode is not set
- When the type of equipment under test is set to "internally powered equipment"

Note

Use this command after executing the `:MODE` command to activate the measurement mode.

Sets and queries the current range

Syntax

Command `:CONFigure:RANGe <characters>`

Query `:CONFigure:RANGe?`

Response
<characters>
<characters> = AUTO/ HOLD1/ HOLD2/ HOLD3/ HOLD4
AC, DC, AC+DC
AUTO : Auto range
HOLD1: 25.00 mA range
HOLD2: 5.000 mA range
HOLD3: 500.0 µA range
HOLD4: 50.00 µA range
ACpeak
AUTO : Auto range
HOLD1: 75.00 mA range
HOLD2: 10.00 mA range
HOLD3: 1.000 mA range
HOLD4: 500.0 µA range

Function

Command Sets the current range.

Query Returns the current range setting as alphabetic characters.

Example

Command `:CONFigure:RANGe AUTO`
Sets the current range to the Auto range.

Query `:CONFigure:RANGe?`
Response `:CONFIGURE:RANGE AUTO` (Headers: ON)
`AUTO` (Headers: OFF)
The current range has been set to the Auto range.

Error

An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Sets and queries the target voltage

Syntax

Command `:CONFigure:VOLTage <characters>`
Query `:CONFigure:VOLTage?`
Response `<characters>`
`<characters>` = ACDC/ AC/ DC
ACDC : AC+DC
(Alternating current + Direct current)
AC : Alternating current
DC : Direct current

Function

Command: Sets the target voltage.

Query: Returns the target voltage setting as alphabetic characters.

Example

Command `:CONFigure:VOLTage ACDC`
Sets the target voltage to AC+DC.

Query `:CONFigure:VOLTage?`
Response `:CONFIGURE:VOLTAGE ACDC` (Headers: ON)
`ACDC` (Headers: OFF)
The target voltage has been set to AC+DC.

Error

If the mode is set to "ammeter mode," an execution error occurs.

Note

Use this command after executing the `:SYSTem:MODE` command to set the instrument into voltmeter mode.

Sets and queries the voltage range

Syntax

Command `:CONFigure:VOLTage:RANGe <characters>`
Query `:CONFigure:VOLTage:RANGe?`
Response `<characters>`
`<characters>` = AUTO/ HOLD1/ HOLD2/ HOLD3/ HOLD4
AUTO : Auto range
HOLD1 : 25.00 V range
HOLD2 : 5.000 V range
HOLD3 : 500.0 mV range
HOLD4 : 50.00 mV range

Function

Command: Sets the voltage range.

Query: Returns the voltage range setting as alphabetic characters.

Example

Command `:CONFigure:VOLTage:RANGe AUTO`
Sets the voltage range to the Auto range.

Query `:CONFigure:VOLTage:RANGe?`
Response `:CONFIGURE:VOLTAGE:RANGE AUTO` (Headers: ON)
`AUTO` (Headers: OFF)
The voltage range has been set to the Auto range.

Error

If the mode is set to "ammeter mode," an execution error occurs.

Note

Use this command after executing the `:SYSTem:MODE` command to set the instrument into voltmeter mode.

Sets and queries the wait time for switching operation in automatic measurement (Other)

Syntax

Command `:CONFigure:WTIMe:ETC <numerical value>`
Query `:CONFigure:WTIMe:ETC?`
Response <numerical value>
<numerical value> = 1 to 1800 (NR1)

Function

Command: Sets the wait time for switching operation in automatic measurement (other than polarity switching).

Query: Returns the wait time setting (other than polarity switching) for switching operation in automatic measurement as a numeric value.

Example

Command `:CONFigure:AUTO ON;:CONFigure:WTIMe:ETC 10`
Sets the wait time (other than polarity switching) for switching operation in automatic measurement to 10 seconds.

Query `:CONFigure:AUTO ON;:CONFigure:WTIMe:ETC?`
Response `:CONFIGURE:WTIME:ETC 1200` (Headers: ON)
`1200` (Headers: OFF)
The wait time (other than polarity switching) for switching operation in automatic measurement has been set to 1,200 seconds.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- The unit is [s]. Fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.

Sets and queries the wait time for switching operation in automatic measurement (Line)

Syntax

Command `:CONFigure:WTIMe:LINE <numerical value>`
Query `:CONFigure:WTIMe:LINE?`
Response <numerical value>
<numerical value> = 0 to 1800 (NR1)

Function

Command: Sets the wait time (from the completion of measurement to power line disconnection) for switching operation in automatic measurement.

Query: Returns the wait time setting (from the completion of measurement to power line disconnection) for switching operation in automatic measurement as a numeric value.

Example

Command `:CONFigure:AUTO ON;:CONFigure:WTIMe:LINE 10`
Sets the wait time (from the completion of measurement to power line disconnection) for switching operation in automatic measurement to 10 seconds.

Query `:CONFigure:AUTO ON;:CONFigure:WTIMe:LINE?`
Response `:CONFIGURE:WTIME:LINE 1200` (Headers: ON)
`1200` (Headers: OFF)
The wait time (from the completion of measurement to power line disconnection) for switching operation in automatic measurement has been set to 1,200 seconds.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- The unit is [s]. Fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.

Sets and queries the wait time for switching operation in automatic measurement (Polarity)

Syntax

Command `:CONFigure:WTIMe:POLarity <numerical value>`

Query `:CONFigure:WTIMe:POLarity?`

Response <numerical value>

<numerical value> = 1 to 1800 (NR1)

Function

Command: Sets the wait time (from switching power supply polarity to the start of measurement) for switching operation in automatic measurement.

Query: Returns the wait time setting (from switching power supply polarity to the start of measurement) for switching operation in automatic measurement as a numeric value.

Example

Command
```
:CONFigure:AUTO ON;:CONFigure:WTIMe:
POLarity 10
```
Sets the wait time (from switching power supply polarity to the start of measurement) for switching operation in automatic measurement to 10 seconds.

Query `:CONFigure:AUTO ON;:CONFigure:WTIMe:POLarity?`

Response `:CONFIGURE:WTIME:POLARITY 1200`
(Headers: ON)
`1200` (Headers: OFF)
The wait time (from switching power supply polarity to the start of measurement) for switching operation in automatic measurement has been set to 1,200 seconds.

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- The unit is [s]. Fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.

Sets and queries the grounding class of equipment under test

Syntax

Command `:EQUipment <characters>`

Query `:EQUipment?`

Response
<characters>
<characters> = CLAss1(CLA1)/ CLAss2(CLA2)/ INTernal
CLAss1 : Class-I equipment
CLAss2 : Class-II equipment
INTernal : Internally powered equipment

Function

Command Sets the grounding class of equipment under test.

Query Returns the grounding class setting of equipment under test as alphabetic characters.

Example

Command `:MODE OFF;:EQUipment CLAss1`
Sets the grounding class of equipment under test to "Class-I equipment."

Query `:EQUipment?`

Response `:EQUIPMENT CLASS1` (Headers: ON)
`CLASS1` (Headers: OFF)
The grounding class of equipment under test has been set to "Class-I equipment."

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Sets and queries the equipment name/control number of equipment under test

Syntax

Command `:EQUipment:IDENtity` <character value 1>,<character value 2>

Query `:EQUipment:IDENtity?`

Response <character value 1>,<character value 2>

<character value 1> = Equipment name
(text data with 1 to 12 characters)

<character value 2> = Equipment control number
(text data with 1 to 12 characters)

Function

Command: Sets the equipment name/control number of equipment under test.

Query: Returns the equipment name/control number setting of equipment under test.

Example

Command `:EQUipment:IDENtity ABC,NO-111`

Sets the equipment name/control number of equipment under test to "ABC" and "NO-111," respectively.

Query `:EQUipment:IDENtity?`

Response `:EQUIPMENT:IDENTITY ABC,NO-111` (Headers: ON)

`ABC,NO-111` (Headers: OFF)

The equipment name/control number of equipment under test have been set to "ABC" and "NO-111," respectively.

Error

An execution error occurs in the following cases:

- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)
- If the character string does not conform to the specified format (Command)

Note

- Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).
- Alphanumeric characters and hyphens (-) can be used. All letters are treated as uppercase (not case-sensitive).
  The equipment name and control number need not be set except when measurement data is saved in memory.

Sets and queries the applied part of equipment under test (Network B only)

Syntax

Command `:EQUipment:TYPE <characters>`

Query `:EQUipment:TYPE?`

Response
<characters>
<characters> = B/ BF/ CF
B : Type B applied part
BF : Type BF applied part
CF : Type CF applied part

Function

Command: Sets the applied part of equipment under test.

Query: Returns the applied part setting of equipment under test.

Example

Command `:EQUipment:TYPE B`
Sets the applied part of equipment under test to Type B applied part.

Query `:EQUipment:TYPE?`

Response `:EQUIPMENT:TYPE B` (Headers: ON)
`B` (Headers: OFF)
The applied part of equipment under test has been set to Type B applied part.

Error

An execution error occurs in the following cases:
- When network A, C, D, E, or F is selected
- The mode is set to "voltmeter mode."
- When network B is selected
  When the measurement mode is selected (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the event status enable register 0 (ESER0)

GP-IB

Syntax

Command `:ESE0 <numerical value>`

Query `:ESE0?`

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function

Command Sets a pattern for using ESER0 in event status enable register 0 (ESER0).
The settings of unused bits (bits 5, 6, and 7) are ignored.

Query Returns the setting content of ESER0 as a numeric value. No header is prefixed to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Not used	Not used	Not used	TEST	MEAS	T-FAIL	FAIL	PASS

Example

Command `:ESE0 1`
Sets bit 0 of ESER0 to 1.

Query `:ESE0?`

Response `1`
Bit 0 of ESER0 has been set to 1.

Error

- If the response message exceeds the output queue size, a query error occurs.
- If the set numeric value is not within the specified range, an execution error occurs.

Note

- A numeric value in NRf format is accepted, but fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.
- Data is initialized to 0 at power-on.
- The settings of unused bits (bits 5, 6, and 7) are ignored.

Queries the event status register 0

Syntax

Query `:ESR0?`

Response <numerical value>

<numerical value> = 0 to 255 (NR1)

Function

Query Returns the setting content of event status register 0 (ESR0) as a numeric value, then clears the content. No header is prefixed to the response message.

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Not used	Not used	Not used	TEST	MEAS	T-FAIL	FAIL	PASS

Example

Query `:ESR0?`

Response `1`

Bit 0 of ESR0 has been set to 1.

Error

If the response message exceeds the output queue size, a query error occurs.

Sets and queries the response header

Syntax

Command `:HEADer <characters>`

Query `:HEADer?`

Response <characters>

<characters> = ON/OFF

ON : With response header

OFF: Without response header

Function

Command Sets the response header of the query. (default setting: OFF)

Query Returns the response header setting as alphabetic characters.

Example

Command `:HEADer OFF`

Sets the response header to OFF.

Query `:HEADer?`

Response `:HEADER ON` (Headers: ON)

The response header has been set to ON.

`OFF` (Headers: OFF)

The response header has been set to OFF.

Sets and queries the application line for leakage current measurement between enclosure and line

Syntax

Command `:LINE <characters>`

Query `:LINE?`

Response `<characters>`

`<characters>` = INT/ EXT

INT : Uses internal contact.
(internal contact and terminal T2)

EXT: Uses external contact.
(terminals T1 and T2)

Function

Command: Sets the application line for leakage current measurement between enclosure and line.

Query: Returns the setting of the application line for leakage current measurement between enclosure and line.

Example

Command `:LINE INT`

Sets the application line for leakage current between enclosure and line to "internal contact."

Query `:LINE?`

Response `:LINE INT` (Headers: ON)

`INT` (Headers: OFF)

Use of internal contact has been set.

Error

An execution error occurs in the following cases:

- When the measurement mode is not set to "leakage current between enclosure and line"
- The mode is set to "voltmeter mode."
- When the measurement method is set to "automatic measurement" (Command)

Clears the maximum value

Syntax Command `:MAXimum:CLEar`

Function Command Clears the maximum value.

Example Command `:MAXimum:CLEar`
Clears the maximum value.

Error An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)

Note Use this command after executing the `:MODE` command to activate the measurement mode.

Queries the measurement value

Syntax Query `:MEASure?`
Response <numerical value 1>,<numerical value 2>
<numerical value 1> = Measurement value (NR3)
<numerical value 2> = Judgement (NR1)
0: Equal to or less than the allowable value (PASS)
1: Greater than the allowable value (FAIL)

Function Query Returns the measurement value and judgement result as numeric values.
The data is arranged as follows: <measurement value>, <judgement>. (unit: A)

Example Query `:MEASure?`
Response `:MEASURE +2.345E-03,1` (Headers: ON)
`+2.345E-03,1` (Headers: OFF)
The example of response data is shown below:

Measurement value	Judgement
2.345 mA	FAIL

Error An execution error occurs in the following cases:
- When the measurement method is set to "automatic measurement"
- When the measurement mode is not selected

Note
- Use this command after executing the `:MODE` command to activate the measurement mode.
- When [MEASure?] command is transmitted before the appropriate measurement range is selected in the Auto range, there is the case that the right measurement value is not received by PC.

Queries the maximum value after automatic measurement

Syntax

Query `:MEASure:AUTO?`

Response <numerical value 1>,<numerical value 2>,<numerical value 3>,<numerical value 4>,<numerical value 5>....

<numerical value 1> = Maximum value (NR3)

<numerical value 2> = Judgement (NR1)

0: Equal to or less than the allowable value (PASS)
1: Greater than the allowable value (FAIL)

<numerical value 3> = Power supply polarity (NR1)

0: Positive phase
1: Negative phase
(0 for leakage current measurement between enclosure and line when the type of equipment under test is set to "internally powered equipment")

<numerical value 4> = Equipment status (NR1)

0: Normal condition
1: Single-fault condition
(disconnection of one wire in power line)
2: Single-fault condition
(disconnection of protective earth conductor)
3: Single-fault condition
(110% voltage application: positive phase)
4: Single-fault condition
(110% voltage application: negative phase)
5: Single-fault condition (line voltage application: L)
6: Single-fault condition (line voltage application: N)

<numerical value 5> = Target current (NR1)

When network A is selected

0: AC+DC
1: AC
2: DC

When network B is selected

0: AC+DC
1: AC
2: DC
(0 except for patient leakage current I and patient auxiliary current)

When network C, D, E, or F is selected

0: AC+DC
1: AC
2: DC
3: ACpeak

Queries the maximum value after automatic measurement

Function Query

Returns all measurement results at once after automatic measurement.
Returns the maximum value in each combination of power supply polarity and equipment under test status, the corresponding judgement, power supply polarity, and equipment status as numeric values.
The data is arranged as follows: <(1) maximum value>, <(2) judgement>, <(3) power supply polarity>, <(4) equipment under test status>, <(5) target current>, ...
Data (1) through (5) are repeated as many times as the number of automatic measurement combinations.
(unit of (1) maximum value: A)

Example

Query
```
:MEASure:AUTO?
```
Response
```
:MEASURE:AUTO +2.345E-03,0,0,0,0,
+2.362E-03,0,1,0,0,+2.510E-03,0,0,2,0,
+2.610E-03,1,1,2,0,+2.456E-03,0,0,1,0,
+2.459E-03,0,1,1,0
```
(Headers: ON)
```
+2.345E-03,0,0,0,0,+2.362E-03,0,1,0,0,
+2.510E-03,0,0,2,0,+2.610E-03,1,1,2,0,
+2.456E-03,0,0,1,0,+2.459E-03,0,1,1,0
```
(Headers: OFF)

The example of response data is shown below:

Maximum value	Judgement	Power supply polarity	Equipment status	Target current
2.345 mA	PASS	Positive phase	Normal condition	AC + DC
2.362 mA	PASS	Negative phase	Normal condition	AC + DC
2.510 mA	PASS	Positive phase	Single-fault condition (disconnection of protective earth conductor)	AC + DC
2.610 mA	FAIL	Negative phase	Single-fault condition (disconnection of protective earth conductor)	AC + DC
2.456 mA	PASS	Positive phase	Single-fault condition (disconnection of one wire in power line)	AC + DC
2.459 mA	PASS	Negative phase	Single-fault condition (disconnection of one wire in power line)	AC + DC

Error

An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- Before the start of automatic measurement

Note

- Use this command after executing the `:MODE` command to activate the measurement mode.
- Execute this command after confirming the completion of automatic measurement (`:AMC?` command). If the command is executed during automatic measurement, correct measurement results cannot be obtained.

Queries the maximum value

Syntax

Query `:MEASure:MAXimum?`

Response <numerical value 1>,<numerical value 2>,<numerical value 3>,<numerical value 4>,<numerical value 5>

<numerical value 1> = Maximum value(NR3)

<numerical value 2> = Judgement(NR1)

0: Equal to or less than the allowable value(PASS)
1: Greater than the allowable value(FAIL)

<numerical value 3> = Power supply polarity (NR1)

0: Positive phase
1: Negative phase
(0 for leakage current measurement between enclosure and line when the type of equipment under test is set to "internally powered equipment")

<numerical value 4> = Equipment status (NR1)

0: Normal condition
1: Single-fault condition
(disconnection of one wire in power line)
2: Single-fault condition
(disconnection of protective earth conductor)
3: Single-fault condition
(110% voltage application: positive phase)
4: Single-fault condition
(110% voltage application: negative phase)
5: Single-fault condition (line voltage application: L)
6: Single-fault condition (line voltage application: N)

Syntax

Response <numerical value 5> = Target current (NR1)

When network A is selected

0: AC+DC
1: AC
2: DC

When network B is selected

0: AC+DC
1: AC
2: DC
(0 except for patient leakage current I and patient auxiliary current)

When network C, D, E, or F is selected

0: AC+DC
1: AC
2: DC
3: ACpeak

Function

Query Returns the maximum value, corresponding judgement, power supply polarity, and equipment under test status as numeric values.
The data is arranged as follows: <(1) maximum value>, <(2) judgement>, <(3) power supply polarity>, <(4) equipment under test status>, and <(5) target current>.
(unit of (1) maximum value: A)

Queries the maximum value

Example

Query `:MEASure:MAXimum?`

Response `:MEASURE:MAXIMUM +2.345E-03,1,1,2,0`
(Headers: ON)
`+2.345E-03,1,1,2,0` (Headers: OFF)
The example of response data is shown below:

Maximum value	Judgement	Power supply polarity	Equipment status	Target current
2.345 mA	FAIL	Negative phase	Single-fault condition (disconnection of protective earth conductor)	AC+DC

Error

If the measurement mode is not set, an execution error occurs.

Note

- To obtain the maximum value acquired in automatic measurement, execute this command after confirming the completion of automatic measurement (`:AMC?` command). If the command is executed during automatic measurement, the maximum value at command execution is obtained.
- Use this command after executing the `:MODE` command to activate the measurement mode.

Queries the voltage measurement value

Syntax

Query `:MEASure:VOLTage?`

Response <numerical value>
<numerical value> = Measurement value (NR3)

Function

Query Returns the voltage measurement value as numeric values. (unit: V)

Example

Query `:MEASure:VOLTage?`

Response `:MEASURE:VOLTAGE +2.345E+00` (Headers: ON)
`+2.345E+00` (Headers: OFF)
The voltage measurement value is 2.345 V.

Error

If the mode is set to "ammeter mode," an execution error occurs.

Note

- Use this command after executing the `:SYSTem:MODE` command to set the instrument into voltmeter mode.
- When [MEASure:VOLTage?] command is transmitted before the appropriate measurement range is selected in the Auto range, there is the case that the right measurement value is not received by PC.

Deletes the saved data

Syntax

Command `:MEMory:CLEar`

Function

Command Deletes all saved data from memory.

Example

Command `:MEMory:CLEar`
Deletes all saved data.

Error

An execution error occurs in the following cases:

- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode."

Queries the number of models in the saved data

Syntax

Query: `:MEMory:NUMBer?`

Response: <numerical value>

<numerical value> = 0 to 100 (NR1)

Function

Query: Returns the number of models (total number of data units) in the saved data as a numeric value.

Example

Query: `:MEMory:NUMBer?`

Response: `:MEMORY:NUMBER 10` (Headers: ON)

`10` (Headers: OFF)

Data on 10 models (data units) is saved.

Queries the equipment name/control number of the saved data

Syntax

Query: `:MEMory:READ:IDENtity?` <numerical value>

Response: <numerical value> = Data unit number (NR1)
Numeric value from 1 to the number of models (total number of data units)

<character value 1>,<character value 2>,<character value 3>

<character value 1> = Equipment name
(text data with 1 to 12 characters)

<character value 2> = Control number
(text data with 1 to 12 characters)

<character value 3> = Date of last update

Function

Query: Returns the equipment name, control number, and date of the last update of the specified data unit.

❖7.7 "Loading All Saved Data" (page 191)

Example

Query: `:MEMory:READ:IDENtity? 1`

Response: `:MEMORY:READ:IDENTITY ABC,NO-111,2002/7/31`
(Headers: ON)

`ABC,NO-111,2002/7/31` (Headers: OFF)

The equipment name, control number, and date of the last update of data unit 1 are "ABC," "NO-111," and "2002/7/31," respectively.

Error

If the set data unit number is greater than the total number of data units, an execution error occurs.

Reads saved data

Syntax Query

:MEMory:READ:MEASure? <numerical value>,<characters>

<numerical value> = Data unit number (NR1)
Numeric value from 1 to the number of models (total number of data units)

<characters> = Measurement mode
EARTh/ ENCLosure1(ENCL1)/
ENCLosure2(ENCL2)/ENCLosure3(ENCL3)/
PATient1(PAT1)/PATient2(PAT2)/
PATient3(PAT3)/ PAUXiliary

When network A, C, D, E, or F is selected
- EARTh : Earth leakage current
- ENCLosure1: Leakage current between enclosure and earth
- ENCLosure2: Leakage current between enclosure and enclosure
- ENCLosure3: Leakage current between enclosure and line

When network B is selected
- EARTh : Earth leakage current
- ENCLosure1: Leakage current between enclosure and earth
- ENCLosure2: Leakage current between enclosure and enclosure
- PATient1 : Patient leakage current I
- PATient2 : Patient leakage current II
- PATient3 : Patient leakage current III
- PAUXiliary : Patient auxiliary current

Syntax Response

<numerical value 1>,<numerical value 2>,<numerical value 3>,
<numerical value 4>,<numerical value 5>,<numerical value 6>

<numerical value 1> = Maximum value (NR3)

<numerical value 2> = Judgement (NR1)
- 0: Equal to or less than the allowable value (PASS)
- 1: Greater than the allowable value (FAIL)

<numerical value 3> = Power supply polarity (NR1)
- 0: Positive phase
- 1: Negative phase
- (0 for leakage current measurement between enclosure and line when type of equipment under test is set to "internally powered equipment")

<numerical value 4> = Equipment status (NR1)
- 0: Normal condition
- 1: Single-fault condition (disconnection of one wire in power line)
- 2: Single-fault condition (disconnection of protective earth conductor)
- 3: Single-fault condition (110% voltage application: positive phase)
- 4: Single-fault condition (110% voltage application: negative phase)
- 5: Single-fault condition (line voltage application: L)
- 6: Single-fault condition (line voltage application: N)

Reads saved data

Syntax

Response

<numerical value 5> = Measurement network filter (NR1)
When network A is selected
0: OFF, 1: ON
When network B is selected
0: OFF, 1: ON
When network C is selected
0: OFF, 2: ON1, 3: ON2
When network D, E, or F is selected
0: OFF
<numerical value 6> = Target current (NR1)
When network A is selected
0: AC+DC
1: AC
2: DC
When network B is selected
0: AC+DC
1: AC
2: DC
(0 except for patient leakage current I and patient auxiliary current)
When network C, D, E, or F is selected
0: AC+DC
1: AC
2: DC
3: ACpeak
❖7.7 "Loading All Saved Data" (page 191)

Function

Query

Returns the saved data of the designated measurement mode for the specified data unit.
The data is arranged as follows: <(1) maximum value>, <(2) judgement>, <(3) power supply polarity>, <(4) equipment under test status>, <(5) measurement network filter>, <(6) target current>, ...
(unit of (1) maximum value: A)
In all cases, data items (1) through (6) are repeated as many times as the number of data units.
Returns only "0" when there is no saved data.

Example

Query

```
:MEMory:READ:IDENtity? 1,ENCLosure1
```

Response

```
MEMORY:READ:IDENTITY +2.345E-03,0,0,0,1,0,
+2.362E-03,0,1,0,1,0,+2.510E-03,0,0,2,1,0,
+2.610E-03,1,1,2,1,0,+2.456E-03,0,0,1,1,0,
+2.459E-03,0,1,1,1,0
```

(Headers: ON)

```
+2.345E-03,0,0,0,1,0,+2.362E-03,0,1,0,1,0,
+2.510E-03,0,0,2,1,0,+2.610E-03,1,1,2,1,0,
+2.456E-03,0,0,1,1,0,+2.459E-03,0,1,1,1,0
```

(Headers: OFF)

The example of response data is shown below:

Reads saved data

Maximum value	Judgement	Power supply polarity	Equipment status	Filter	Target current
2.345 mA	PASS	Positive phase	Normal condition	ON	AC+DC
2.362 mA	PASS	Negative phase	Normal condition	ON	AC+DC
2.510 mA	PASS	Positive phase	Single-fault condition (disconnection of protective earth conductor)	ON	AC+DC
2.610 mA	FAIL	Negative phase	Single-fault condition (disconnection of protective earth conductor)	ON	AC+DC
2.456 mA	PASS	Positive phase	Single-fault condition (disconnection of one wire in power line)	ON	AC+DC
2.459 mA	PASS	Negative phase	Single-fault condition (disconnection of one wire in power line)	ON	AC+DC

Error If the set data unit number is higher than the total number of data units, an execution error occurs.

Saves automatic measurement results

Syntax Command `:MEMory:SAVE:AUTO`

Function Command Saves automatic measurement results (date, equipment name, control number, grounding class, applied part*, network, measurement mode, maximum value, test condition setting at maximum value acquisition, judgement result) in memory.
* When network B is selected

Example Command `:MEMory:SAVE:AUTO`
Saves automatic measurement results.

Error An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)
- When there is not enough memory space
- When the equipment name and control number are the same as those of saved data, but the network, grounding class, and applied part differ
- When there is no data
- In manual measurement

Note
- Use this command after executing the `:MODE` command to activate the measurement mode.
- After automatic measurement, save data before starting the next automatic measurement.

Saves the maximum value

Syntax Command `:MEMory:SAVE:MAXimum`

Function Command Saves the date, equipment name, control number, grounding class, applied part*, network, measurement mode, maximum value, test condition setting at maximum value acquisition, and judgement result of the present measurement in memory.
* When network B is selected

Example Command `:MEMory:SAVE:MAXimum`
Saves the maximum value.

Error An execution error occurs in the following cases:
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."
- In automatic measurement (Command)
- When there is not enough memory space
- When the equipment name and control number are the same as those of saved data, but the network, grounding class, and applied part differ
- When there is no data

Note Use this command after executing the `:MODE` command to activate the measurement mode.

Sets and queries the measurement mode

Syntax

Command `:MODE <characters>`

Query `:MODE?`

Response `<characters>`

`<characters>` = OFF/ EARTh/ ENCLosure1(ENCL1)/ ENCLosure2(ENCL2)/ENCLosure3(ENCL3)/ PATient1(PAT1)/ PATient2(PAT2)/ PATient3(PAT3)/ PAUXiliary

When network A, C, D, E, or F is selected

OFF	: Mode not selected (Initial screen: command) (Initial screen, system screen: query)
EARTh	: Earth leakage current
ENCLosure1	: Leakage current between enclosure and earth
ENCLosure2	: Leakage current between enclosure and enclosure
ENCLosure3	: Leakage current between enclosure and line

When network B is selected

OFF	: Mode not selected (Initial screen: command) (Initial screen, system screen: query)
EARTh	: Earth leakage current
ENCLosure1	: Leakage current between enclosure and earth
ENCLosure2	: Leakage current between enclosure and enclosure
PATient1	: Patient leakage current I
PATient2	: Patient leakage current II
PATient3	: Patient leakage current III
PAUXiliary	: Patient auxiliary current

Function

Command Sets the measurement mode and changes the screen.

Query Returns the measurement mode setting as alphabetic characters.

Example

Command `:MODE EARTH`
Sets earth leakage current measurement mode.

Query `:MODE?`

Response `:MODE EARTH` (Headers: ON)
`EARTH` (Headers: OFF)
Earth leakage current measurement mode has been set.

Sets and queries the measurement mode

Error

An execution error occurs in the following cases:
- The mode is set to "voltmeter mode." (Command)
- When network is OFF
- When network A, C, D, E, or F is selected
  When earth leakage current measurement mode is set for equipment under test whose grounding class is not Class I
  When set to patient leakage current I, patient leakage current II, patient leakage current III, or patient auxiliary current mode
- When leakage current measurement between enclosure and line mode is set for equipment under test whose grounding class is "internally powered equipment"
- When network B is selected
  When earth leakage current measurement mode is set for equipment under test whose grounding class is not Class I
  When patient leakage current III mode is set for equipment under test whose applied part is set to Type B
  When patient leakage current II mode is set for a Type BF or Type CF applied part
  When leakage current between enclosure and line mode is set
- In automatic measurement (Command)

Sets and queries the network

Syntax

Command `:NETWork <characters>`

Query `:NETWork?`

Response `<characters>`

`<characters>` = A/ B/ C/ D/ E/ F/ OFF

A : Network A
B : Network B
C : Network C
D : Network D
E : Network E
F : Network F
OFF: No network setting

Function

Command: Sets the network.

Query: Returns the network setting as alphabetic characters.

Example

Command `:NETWork A`
Sets network A.

Query `:NETWork?`
Response `:NETWORK A` (Headers: ON)
`A` (Headers: OFF)
Network A has been set.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Sets and queries the network

Note Use this command after executing the :MODE command to activate OFF mode (i.e., measurement mode not selected).

Starts automatic measurement

Syntax Command :STARt

Function Command Starts measurement when automatic measurement is set.

Example Command :CONFigure:AUTO ON;:STARt
Starts automatic measurement.

Error An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."

For leakage current between enclosure and line, if the pre-check to prevent a ground fault results in NG judgement, an equipment-dependent error occurs.

Note Use this command after executing the :MODE command to activate the measurement mode.

Stops automatic measurement

Syntax Command :STOP

Function Command Stops measurement when automatic measurement is set.

Example Command :STOP
Stops automatic measurement.

Error An execution error occurs in the following cases:
- When the measurement method is set to "manual measurement"
- When the measurement mode is not selected
- The mode is set to "voltmeter mode."

Note Use this command after executing the :MODE command to activate the measurement mode.

Sets and queries the backlight automatic OFF function

Syntax

Command `:SYSTem:BACKlight <numerical value>`

Query `:SYSTem:BACKlight?`

Response <numerical value>

<numerical value> = 0 to 30 (NR1)

0 : Constant ON

1 to 30 : Auto OFF (1 to 30 minutes)

Function

Command: Sets the backlight automatic OFF function.

Query: Returns the setting of the backlight automatic OFF function as a numeric value.

Example

Command `:SYSTem:BACKlight 5`

Sets the backlight automatic OFF function to 5 minutes.

Query `:SYSTem:BACKlight?`

Response `:SYSTEM:BACKLIGHT 5` (Headers: ON)

`5` (Headers: OFF)

The function has been set to 5 minutes.

Error

An execution error occurs in the following cases:

- If the setting does not conform to the specified value range (Command)
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the beep sound (Judgement of allowable value)

Syntax

Command `:SYSTem:BEEPer:COMParator <characters>`

Query `:SYSTem:BEEPer:COMParator?`

Response
<characters>
<characters> = FAIL/PASS/OFF
FAIL : Generates a beep sound for "FAIL" judgement.
PASS : Generates a beep sound for "PASS" judgement.
OFF : Does not generate a beep sound.

Function

Command Sets the beep sound for notification of allowable value judgement.

Query Returns the beep sound setting for notification of allowable value judgement.

Example

Command `:SYSTem:BEEPer:COMParator FAIL`
Sets the beep sound to be generated for "FAIL" judgement.

Query `:SYSTem:BEEPer:COMParator?`

Response `:SYSTEM:BEEPER:COMPARATOR FAIL`(Headers: ON)
`FAIL` (Headers: OFF)
The setting has been made to generate a beep sound for "FAIL" judgement.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the beep sound (Key entry)

Syntax

Command: `:SYSTem:BEEPer:KEY <characters>`

Query: `:SYSTem:BEEPer:KEY?`

Response: `<characters>`

`<characters>` = ON/OFF
ON : Generates a beep sound.
OFF : Does not generate a beep sound.

Function

Command: Sets the beep sound for notification of key entry.

Query: Returns the beep sound setting for notification of key entry.

Example

Command: `:SYSTem:BEEPer:KEY ON`
Sets the beep sound to ON.

Query: `:SYSTem:BEEPer:KEY?`
Response: `:SYSTEM:BEEPER:KEY ON` (Headers: ON)
`ON` (Headers: OFF)
The beep sound has been set to ON.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the beep sound (T2 output)

Syntax

Command: `:SYSTem:BEEPer:T2OUt <characters>`

Query: `:SYSTem:BEEPer:T2OUt?`

Response: `<characters>`

`<characters>` = ON/OFF
ON : Generates a beep sound.
OFF : Does not generate a beep sound.

Function

Command: Sets the beep sound to be generated while line voltage is output from terminal 2.

Query: Returns the beep sound setting for notification of line voltage output from terminal T2.

Example

Command: `:SYSTem:BEEPer:T2OUt ON`
Sets the beep sound to ON.

Query: `:SYSTem:BEEPer:T2OUt?`
Response: `:SYSTEM:BEEPER:T2OUT ON` (Headers: ON)
`ON` (Headers: OFF)
The beep sound has been set to ON.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the beep sound (T3 output)

Syntax

Command `:SYSTem:BEEPer:T3OUt <characters>`

Query `:SYSTem:BEEPer:T3OUt?`

Response `<characters>`

`<characters>` = ON/OFF
ON : Generates a beep sound.
OFF: Does not generate a beep sound.

Function

Command: Sets the beep sound to be generated while 110% voltage is output from terminal 3.

Query: Returns the beep sound setting for notification of 110% voltage output from terminal T3.

Example

Command `:SYSTem:BEEPer:T3OUt ON`
Sets the beep sound to ON.

Query `:SYSTem:BEEPer:T3OUt?`

Response `:SYSTEM:BEEPER:T3OUT ON` (Headers: ON)
`ON` (Headers: OFF)
The beep sound has been set to ON.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Clears the panel

Syntax

Command `:SYSTem:CLEar`

Function

Command: Initializes all test condition setting data including the contents of all panels.

Example

Command `:SYSTem:CLEar`
Initializes all test condition setting data including the contents of all panels.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode."

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the date

Syntax

Command `:SYSTem:DATE <numerical value 1>,<numerical value 2>,<numerical value 3>`

Query `:SYSTem:DATE?`

Response <numerical value 1>,<numerical value 2>,<numerical value 3>
<numerical value 1> = Year : 2000 to 2099 (NR1)
<numerical value 2> = Month: 1 to 12 (NR1)
<numerical value 3> = Day : 1 to 31 (NR1)

Function

Command Sets the date in order of year, month, and day.

Query Returns the date setting as a numeric value.

Example

Command `:SYSTem:DATE 2002,7,31`
Sets the date to 2002, July 31.

Query `:SYSTem:DATE?`

Response `:SYSTEM:DATE 2002,7,31` (Headers: ON)
`2002,7,31` (Headers: OFF)
The date has been set to 2002, July 31.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode." (Command)
- If the character string does not conform to the specified format (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Queries the content of a panel

Syntax Query

:SYSTem:FILE? <numerical value>
<numerical value> = 1 to 30 (NR1)
<character value 1>,<character value 2>,<character value 3>,
<character value 4>,<character value 5>,<numerical value 1>,
<numerical value 2>,<numerical value 3>,<numerical value 4>,
<numerical value 5>,<numerical value 6>...

Syntax Response

<character value 1> = Equipment name
<character value 2> = Control number
<character value 3> = Grounding class
CLA1: Class-I equipment
CLA2: Class-II equipment
INT : Internally powered equipment
<character value 4> = Applied part
B : Type B applied part
BF : Type BF applied part
CF : Type CF applied part
(Returns 0 for network A, C, D, E, or F)
<character value 5> = Network
A: Network A
B: Network B
C: Network C
D: Network D
E: Network E
F: Network F
<numerical value 1> = Measurement mode
When network A, C, D, E, or F is selected
0: Earth leakage current
1: Leakage current between enclosure and earth
2: Leakage current between enclosure and enclosure
3: Leakage current between enclosure and line
When network B is selected
0: Earth leakage current
1: Leakage current between enclosure and earth
2: Leakage current between enclosure and enclosure
4: Patient leakage current I
5: Patient leakage current II
6: Patient leakage current III
7: Patient auxiliary current
<numerical value 2> = Measurement method
0: Manual
1: Automatic

Queries the content of a panel

Response <numerical value 3> = Target current
When network A is selected
0: AC+DC
1: AC
2: DC
When network B is selected
0: AC+DC
1: AC
2: DC
(0 except for patient leakage current I and patient auxiliary current)
When network C, D, E, or F is selected
0: AC+DC
1: AC
2: DC
3: ACpeak
<numerical value 4> = Measurement range
AC, AC+DC, DC
0: Auto range
1: 25.00 mA range
2: 5.000 mA range
3: 500.0 µA range
4: 50.00 µA range
ACpeak
0: Auto range
1: 75.00 mA range
2: 10.00 mA range
3: 1.000 mA range
4: 500.0 µA range
<numerical value 5> = Filter
When network A is selected
0: OFF, 1: ON
When network B is selected
0: OFF, 1: ON
When network C is selected
0: OFF, 2: ON1, 3: ON2
When network D, E, or F is selected
0: OFF
<numerical value 6> = Allowable value in normal condition (NR3) (unit: A)
<numerical value 7> = Allowable value in single-fault condition (NR3) (unit: A)

*<numerical value 8> = Normal condition allowable value to use when making DC measurements (NR3) (unit: A)

*<numerical value 9> = Single fault condition allowable value to use when making DC measurements (NR3) (unit: A)
* Supported from version 1.12 of the 3156. Version information is displayed when the 3156 is turned on.

Queries the content of a panel

Response <numerical value 10> = Equipment under test status
0: Normal condition
1: Single-fault condition
(disconnection of one wire in power line)
2: Single-fault condition
(disconnection of protective earth conductor)
3: Single-fault condition
(110% voltage application: positive phase)
4: Single-fault condition
(110% voltage application: negative phase)
5: Single-fault condition (line voltage application: L)
6: Single-fault condition (line voltage application: N)
<numerical value 11> = Power supply polarity
0: Positive phase
1: Negative phase
(0 for leakage current measurement between enclosure and line when type of equipment under test is set to "internally powered equipment")
<numerical value 12> = Measurement item in automatic measurement
1 to 4095 (NR1)

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
AC+DC	Negative phase	Positive phase	110% voltage application (negative phase)	110% voltage application (positive phase)	Disconnection of protective earth conductor	Disconnection of one wire in power line	Normal condition

32768 bit 15	16384 bit 14	8192 bit 13	4096 bit 12	2048 bit 11	1024 bit 10	512 bit 9	256 bit 8
Not used	Not used	Not used	Not used	line voltage application: N	line voltage application: L	AC	DC

<numerical value 13> = Measuring time in automatic measurement (NR1) (unit: s)
<numerical value 14> = Wait time in automatic measurement (line) (NR1) (unit: s)
<numerical value 15> = Wait time in automatic measurement (polarity) (NR1) (unit: s)
<numerical value 16> = Wait time in automatic measurement (other) (NR1) (unit: s)

Function Query Returns the content of the panel of the specified number.

Queries the content of a panel

Example

Query
```
:SYSTem:FILE? 1
```
Response
```
:SYSTEM:FILE ABC,NO-111,CLA1,0,A,1,0,0,0,
0,+100.0E-06,+500.0E-06,+0.000E+00,
+0.000E+00,0,0,0,0,0,0,0
```
(Headers: ON)
```
ABC,NO-111,CLA1,0,A,1,0,0,0,0,+100.0E-06,
+500.0E-06,+0.000E+00,+0.000E+00,0,0,0,0,
0,0,0
```
(Headers: OFF)

The following settings have been made:

<Equipment name> : ABC
<Control number> : NO-111
<Grounding class> : Class-I equipment
<Applied part> : None
<Network> : Network A
<Measurement mode> : Leakage current between enclosure and earth
<Measurement method> : Manual
<Target current> : AC+DC
<Measurement range> : Auto range
<Filter> : OFF
<Allowable value in normal condition> : 0.1 mA
<Allowable value in single-fault condition> : 0.5 mA
<Normal condition allowable value (DC measurements)> : None
<Single fault-condition allowable value (DC measurements)> : None
<Equipment under test status> : Normal condition
<Power supply polarity> : Normal phase
<Measurement item in automatic measurement> : None
<Measuring time in automatic measurement> : None
<Wait time in automatic measurement> : None
<Wait time in automatic measurement> : None
<Wait time in automatic measurement (other)> : None

Error

If the designated panel number does not conform to the specified range, an execution error occurs.

Note

Returns 0 in the following cases:

- <numeric value 10> (equipment under test status) <numeric value 11> (power supply polarity) in automatic measurement
- <numeric value 12> to <numeric value 16> in manual measurement
- When there is no data

Sets and queries the display language

Syntax

Command: `:SYSTem:LANGuage <characters>`

Query: `:SYSTem:LANGuage?`

Response: `<characters>`

`<characters>` = JAPanese/ ENGlish
JAPanese: Japanese language
ENGlish : English language

Function

Command: Sets the display language.

Query: Returns the display language setting.

Example

Command: `:SYSTem:LANGuage JAPanese`
Sets the display language to Japanese.

Query: `:SYSTem:LANGuage?`
Response: `:SYSTEM:LANGUAGE JAPANESE` (Headers: ON)
`JAPANESE` (Headers: OFF)
The display language has been set to Japanese.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode." (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Loads a panel

Syntax

Command: `:SYSTem:LOAD <numerical value>`
`<numerical value>` = 1 to 30 (NR1)

Function

Command: Loads (reads) the content of the panel of the specified number.

Example

Command: `:SYSTem:LOAD 10`
Loads the content of panel number 10.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- If the designated panel number does not conform to the specified range
- When the panel of the specified number is not stored
- The mode is set to "voltmeter mode."

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the mode

Syntax

Command `:SYSTem:MODE <characters>`

Query `:SYSTem:MODE?`

Response `<characters>`

`<characters>` = ON/OFF
ON : Voltmeter mode
OFF : Ammeter mode

Function

Command Sets the mode.Sets the mode.

Query Returns the mode setting.

Example

Command `:SYSTem:MODE OFF`
Sets the mode to ammeter mode.

Query `:SYSTem:MODE?`

Response `:SYSTEM:MODE OFF` (Headers: ON)
`OFF` (Headers: OFF)
The mode has been set to ammeter mode.

Error

If the measurement mode has been selected, an execution error occurs. (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Saves a panel

Syntax

Command `:SYSTem:SAVE <numerical value>`
`<numerical value>` = 1 to 30 (NR1)

Function

Command Saves (stores) the present settings in the panel of the specified number.

Example

Command `:SYSTem:SAVE 5`
Saves setting data in panel number 5.

Error

An execution error occurs in the following cases:
- When the measurement mode is not selected
- If the designated panel number does not conform to the specified range
- The mode is set to "voltmeter mode."

Initializes the 3156

Syntax

Command `:SYSTem:RESet <characters>`

<characters> = ALL/ CONDition/ SAVEdata

ALL : Initializes the instrument to the default settings (factory settings). (Same as `*RST` command)

CONDition: Initializes the instrument to the default settings except for saved measurement data.

SAVEdata: Initializes only the saved measurement data.

Function

Command Initializes the 3156.
After initialization, the initial screen is displayed.

Example

Command `:SYSTem:RESet SAVEdata`
Initializes only the saved measurement data.

Note

The communication conditions are not initialized.

Queries the VA check

Syntax

Query `:SYSTem:TEST:VA?`

Response <numerical value 1>,<numerical value 2>,<numerical value 3>,<numerical value 4>,<numerical value 5>,<numerical value 6>
<numerical value 1> = Voltage value (between L and N) (NR3)
<numerical value 2> = Current value (NR3)
<numerical value 3> = VA value (NR3)
<numerical value 4> = Voltage value (between L and G) (NR3)
<numerical value 5> = Voltage value (between N and G) (NR3)
<numerical value 6> = Judgement (NR1)
* See the table below.

Function

Query Conducts the VA check and returns the results.

Example

Query `:SYSTem:TEST:VA?`

Response `:SYSTEM:TEST:VA +100.0E+00,+12.00E+00,+1.200E+03,+100.0E+00,+0.000E+00,0`
(Headers: ON)
`+100.0E+00,+12.00E+00,+S1.200E+03,+100.0E+00,+0.000E+00,0`(Headers: OFF)

The results of the VA check are as follows:
<voltage> : 100.0 V (between L and N)
<current> : 12.0 A
<VA value> : 1200 VA
<voltage> : 100.0 V (between L and G)
<current> : 0.0 V (between N and G)
<judgement> : No error

128 bit 7	64 bit 6	32 bit 5	16 bit 4	8 bit 3	4 bit 2	2 bit 1	1 bit 0
Not used	Not used	Not used	Not used	Grounding error	VA error	Current error	Voltage error

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode."

Note

- Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).
- When data displayed by the instrument is "less than XX," the largest value that is less than the numeric value of the data is returned. When the voltage is less than 80.0 V, +9.999E+09 is returned as the VA value, voltage (between L and G), and voltage (between N and G).

Sets and queries the time

Syntax

Command `:SYSTem:TIME` <numerical value 1>,<numerical value 2>

Query `:SYSTem:TIME?`

Response <numerical value 1>,<numerical value 2>
<numerical value 1> = Time 0 to 23 (NR1)
<numerical value 2> = Minute 0 to 59 (NR1)

Function

Command Sets the time in order of hours and minutes.

Query Returns the time setting in numeric values.

Example

Command `:SYSTem:TIME 12,34`
Sets the time to 12:34.

Query `:SYSTem:TIME?`

Response `:SYSTEM:TIME 12,34` (Headers: ON)
`12,34` (Headers: OFF)
The time has been set to 12:34.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- If the set numeric value is not within the specified range (Command)
- The mode is set to "voltmeter mode." (Command)
- If the character string does not conform to the specified format (Command)

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the unit of current measurement

Syntax

Command `:SYSTem:UNIT <characters>`

Query `:SYSTem:UNIT?`

Response <characters>

<characters> = AUTO/HOLD
AUTO: Automatic
HOLD: mA, fixed

Function

Command Sets the unit of current measurement.

Query Returns the unit of current measurement setting.

Example

Command `:SYSTem:UNIT AUTO`
Sets the unit of current measurement to Auto.

Query `:SYSTem:UNIT?`

Response `:SYSTEM:UNIT AUTO` (Headers: ON)
`AUTO` (Headers: OFF)
Auto has been set.

Error

An execution error occurs in the following cases:
- When the measurement mode is selected (Command)
- The mode is set to "voltmeter mode."

Note

Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

Sets and queries the response message terminator

GP-IB

Syntax

Command `:TRANsmit:TERMinator` <numerical value>
Query `:TRANsmit:TERMinator?`
Response <numerical value>
<numerical value> = 0/1 (NR1)
0: LF+EOI
1: CR, LF+EOI

Function

Command: Sets the response message terminator.

Query: Returns the response message terminator setting as a numeric value.

Example

Command `:TRANsmit:TERMinator 0`
Sets the terminator to LF+EOI.

Query `:TRANsmit:TERMinator?`
Response `:TRANSMIT:TERMINATOR 0` (Headers: ON)
`0` (Headers: OFF)
The terminator has been set to LF+EOI.

Error

If the response message exceeds the output queue size, a query error occurs.

An execution error occurs in the following cases:
- If the set numeric value is not within the specified range (Command)
- When the measurement mode is selected (Command)

Note

- A numeric value in NRf format is accepted, but fractions are rounded up when 0.5 or greater and rounded off when less than 0.5.
- Use this command after executing the `:MODE` command to activate OFF mode (i.e., measurement mode not selected).

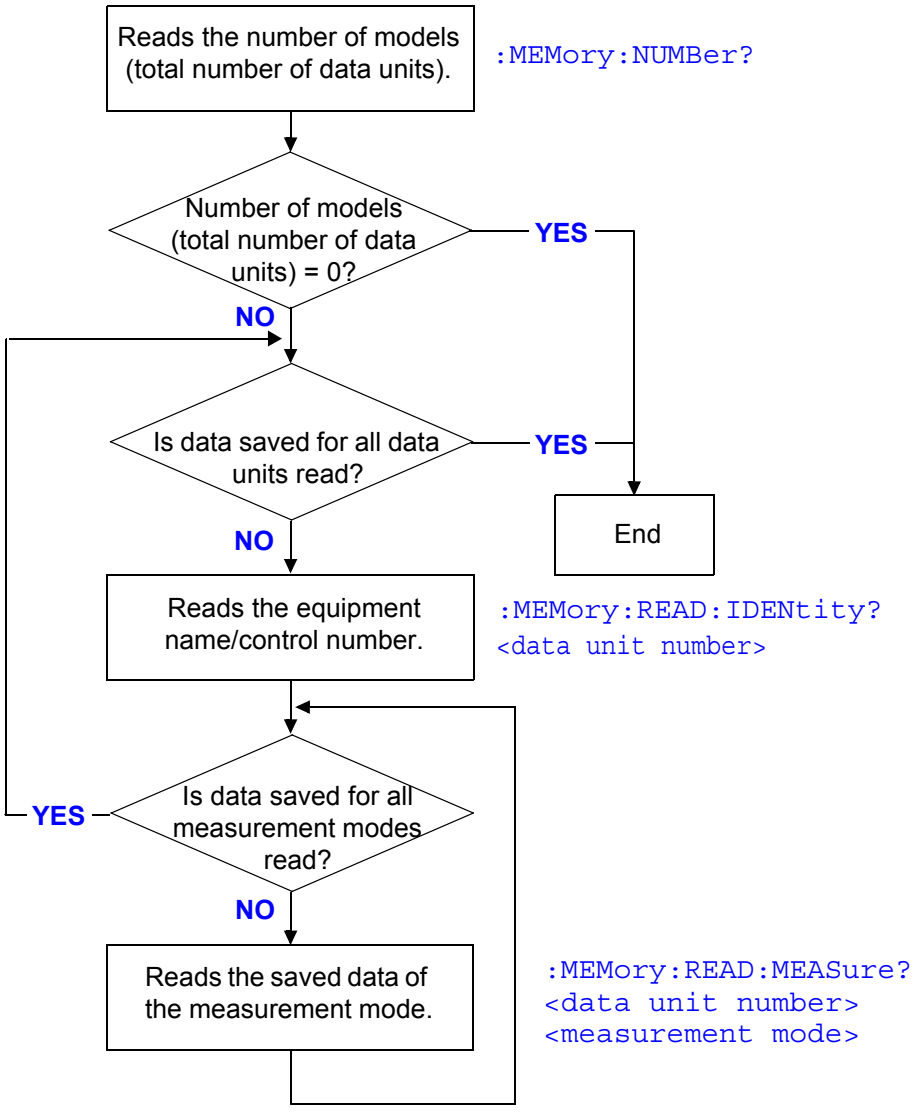
7.7 Loading All Saved Data

1. Transmit `:MEMory:NUMBer?` to read the number of models (total number of data units).

2. Transmit `:MEMory:READ:IDENtity?` <data unit number> to read the equipment name and control number of the specified data unit.

   (1) Transmit `:MEMory:READ:MEASure?` <data unit number>, <measurement mode> to read the saved data of the designated measurement mode for the specified data unit.
   If only "0" is received as data, there is no saved data for that mode.
   (2) Step (1) above is repeated as many times as the number of specified measurement modes.

3. When there are two or more models (total number of data units), the process in step **2**. above is repeated.



7.8 Troubleshooting

When the 3156 is malfunctioning, attempt checking and troubleshooting according to the instructions shown below.
The causes/treatments without mark is common to both the RS-232C and GP-IB.

Symptom	Cause / Treatment
The RS-232C/ GP-IB has stopped working completely.	• Are the cables properly connected? • Are all the devices powered on? • Are correct cables used? • Has the communication condition been correctly set? RS-232C • Is the device address for the 3156 set correctly? GP-IB • Does some other device have the same device address? GP-IB
Communication failure with RS-232C/GP-IB.	• Does the RS-232C have the same settings (baud rate, data length, parity, stop bit)? RS-232C • Ensure the message terminators (delimiters) for the controller are set. GP-IB ❖ "Message Terminators" (page 113)
After transmission on the RS-232C/ GP-IB bus, the keys on the 3156 freeze up and have no effect.	• Press the LOCAL key on the front panel of the 3156 to release the remote state. • Has a LLO (Local Lock-Out) command been transmitted? Transmit a GTL command to put the 3156 into the local state. GP-IB
When attempting to read data using a BASIC INPUT statement, the RS-232C bus hangs. RS-232C	• Be sure to transmit one query before each INPUT statement. • Have any of these transmitted queries resulted in as error?
When attempting to read data using a HP-Basic ENTER statement, the GP-IB bus hangs. GP-IB	• Be sure to transmit one query before each ENTER statement. • Have any of these transmitted queries resulted in an error?
The RS-232C/ GP-IB has stopped working completely.	• Using the *ESR? query, inspect the standard event status register, and check what type of error has occurred.
Sending several queries, produces only one response.	• Has an error occurred? • Send the queries one at a time, and read the responses individually. When you want to read them in all at once, try doing so by putting them all on one line separated by the message separator character. • Have you used the *IDN? query? GP-IB
The response message to a query differs from the display on the front panel.	• Due to the response message being produced at the instant that the 3156 receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.
Sometimes service requests are not generated. GP-IB	• Have the service request enable register and the various event status enable registers been correctly set? • Clear all the event registers at the end of SRQ processing subroutines by using the *CLS command. If an event bit is not cleared, no service request will be generated for that event.

7.9 Device Compliance Statement

GP-IB

“Information on compliance to standards” based on the IEEE 488.2 standard

(1) IEEE 488.1 interface functions
These are detailed in 7.2.2 "Specifications of GP-IB" (page 107)

(2) Operation with a device address other than 0 through 30
The bus is disabled.

(3) Timing of changed device address recognition
A change of address is recognized immediately after changing.

(4) Device settings at power on.
The status information is cleared, and all other items are preserved. However, the header on/off setting, and response message separator and terminator are all reinitialized.

(5) List of message exchange options
- Input buffer capacity and operation
  These are detailed in "Input Buffer" (page 116)
- Queries to which multiple response message units are returned

```
:CONFigure:COMParator?
:EQUipment:IDENtity?
:MEASure:AUTO?
:MEASure:MAXimum?
:MEASure?
:MEMory:READ:IENtity?
:MEMory:READ:MEASure?
:SYSTem:FILE?
```

- Queries producing responses as syntax checking is performed:
  All queries produce responses when syntax checking is performed.
- Whether any queries produce responses when read:
  There are no queries which produce response messages at the instant they are read in by the controller.
- Whether any commands are coupled:
  There are no relevant commands.

(6) Summary of functional elements for use when constructing device specific commands, and whether compound commands or program headers can be used:
The followings can be used
- Program message
- Program message terminator
- Program message unit
- Program message unit separator
- Command message unit
- Query message unit
- Command program header
- Query program header
- Program data
- Character program data
- Decimal program data
- Compound commands and program headers

(7) Buffer capacity limitations for block data
Block data is not used.

(8) Summary of program data elements used in expressions, and deepest nesting level allowable in sub-expressions, including syntax restrictions imposed by the device.
Sub-expressions are not used. Character data and decimal data are the only program data elements used.

(9) Response syntax for queries
Response syntax is detailed in 7.6 "Message Reference" (page 129)

(10) Transmission congestion relating to device-to-device messages which do not conform to the general principles for basic response messages
There are no device to device messages.

(11) Response capacity for block data
Block data does not appear in responses.

(12) Summary of standard commands and queries used
This appears in 7.5 "Message Reference" (page 123)

(13) Device state after a calibration query has been completed without any problem
The `*CAL?` query is not used.

(14) Existence/nonexistence of `*DDT` command
When using the `*DDT` command, the maximum length of block used in a trigger macro definition
The `*DDT`command is not used.

(15) Existence/nonexistence of macro command
When a macro command is being executed, the maximum length of macro label, the maximum length of block for defining a macro, and how echoing is managed when expanding a macro
Macros are not used.

(16) For queries related to identification, explanation of the response to the *IDN? query
This is detailed in 7.6 "Message Reference" (page 129)

(17) Capacity of the user data storage area reserved for when the *PUD command and the *PUD? query are being executed
The *PUD command and the *PUD? query are not used. Further, there is no user data storage area.

(18) Resources when the *RDT command and the *RDT? query are being used
The *RDT command and the *RDT? query are not used.

(19) Conditions which are influenced when *RST, *LRN?, *RCL?, and *SAV are used
*LAN?, *RCL?, and *SAV are not used. The *RST command returns the instrument to its initial state.
❖7.6.1 "Message Reference" (page 130)
❖7.4.5 "Initialization Items" (page 122)

(20) Scope of the self-testing executed as a result of the *TST? query
This is detailed in 7.6.1 "Message Reference" (page 130)

(21) Additional organization of the status data used in a device status report
This is detailed in 7.4.4 "Event Registers" (page 119)

(22) Whether commands are overlap or sequential type
All commands are sequential commands.

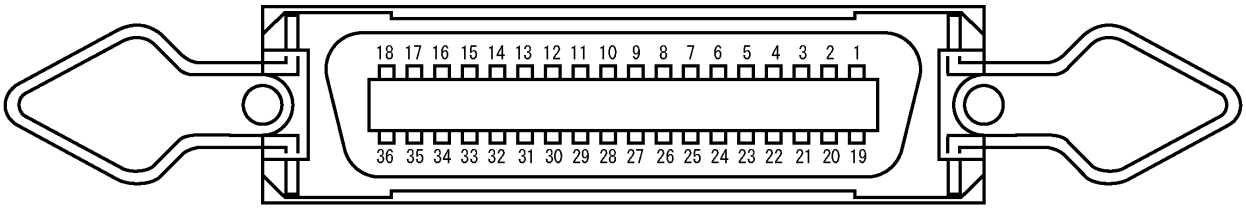
(23) Criterion relating to the functions required at the instant that the termination message is produced, as a response to each command
Termination occurs when the command has been parsed.

EXT I/O Terminal Chapter 8

(1) EXT I/O terminal functions
Input of start/stop signals
Selection of panel number for data loading
Output of measurement end signal
Output of comparator judgement signal
Others

(2) Connector type
57RE-40360-730B (D29) (manufactured by DDK)

(3) Mating connector
RC30-36P (manufactured by Hirose Electric) or equivalent instrument (to be procured by the user)



⚠EXT I/O

EXT I/O connector pin layout (on main instrument)

8.1 Description of Signals

⚠WARNING

To prevent electrical hazards, observe the following cautions:

- **Turn off the instrument's power switch before connecting a cable to the terminal. Ensure secure connection to prevent the cable from disconnecting during operation and contacting a conductive part (e.g., chassis, test leads).**
- **Note that INT.GND is grounded. Therefore, electric potential in the controller may result in short-circuiting and cause an electrical hazard.**

⚠CAUTION

To prevent damage to the instrument, observe the following cautions:

- Do not input voltage or current exceeding the rating to the EXT I/O terminal.
- When using a relay, be sure to install a diode for absorbing counter-electromotive force.
- Do not short-circuit between the input and output terminals in the EXT I/O.
- Do not short-circuit between INT.DCV and INT.GND.
- Be sure to ground the equipment connected to the EXT I/O terminal. Failure to provide protective earthing may damage the insulation of the measurement system.
- The EXT I/O terminal is operable only when the measurement screen is displayed.

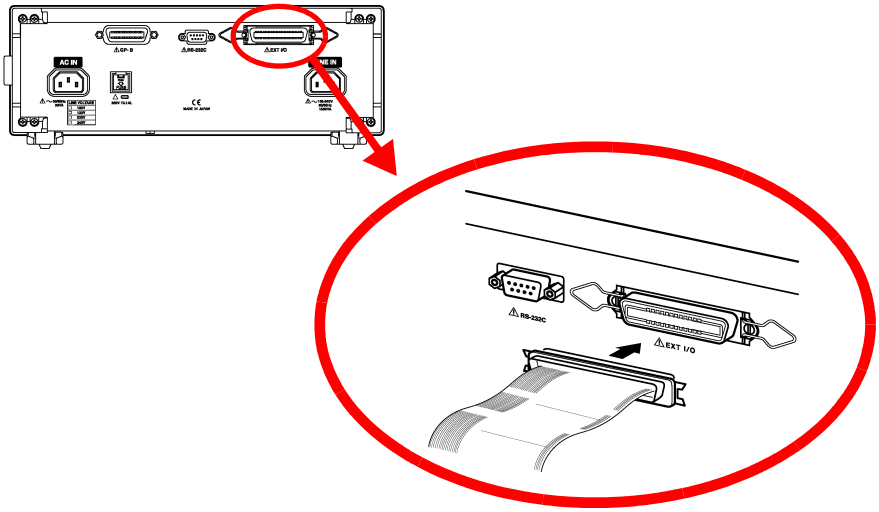
Pin No.	Input/ output	Signal line name	Pin No.	Input/ output	Signal line name
1	Input	$\overline{\text{START}}$	19	--	(Reserved)
2	Input	$\overline{\text{STOP}}$	20	Input	$\overline{\text{KEYLOCK}}$
3	Input	$\overline{\text{0ADJ}}$	21	Input	$\overline{\text{LOAD0}}$
4	Input	$\overline{\text{LOAD1}}$	22	Input	$\overline{\text{LOAD2}}$
5	Input	$\overline{\text{LOAD3}}$	23	Input	$\overline{\text{LOAD4}}$
6	--	(Reserved)	24	--	(Reserved)
7	Output	$\overline{\text{TEST}}$	25	Output	$\overline{\text{MEAS}}$
8	Output	$\overline{\text{PASS}}$	26	Output	$\overline{\text{FAIL}}$
9	Output	$\overline{\text{T-FAIL}}$	27	--	(Reserved)
10	--	(Reserved)	28	--	(Reserved)
11	Input	EXT.DCV	29	Output	INT.DCV
12	Input	EXT.DCV	30	Output	INT.DCV
13	Input	EXT.DCV	31	Output	INT.DCV
14	Input	EXT.DCV	32	Output	INT.DCV
15	Input	EXT.COM	33	Output	INT.GND
16	Input	EXT.COM	34	Output	INT.GND
17	Input	EXT.COM	35	Output	INT.GND
18	Input	EXT.COM	36	Output	INT.GND

8.2 Connecting to the EXT I/O Terminal

⚠CAUTION

Connect an EXT I/O cable connector before turning on the instrument's power switch. Connecting or disconnecting a cable connector after turning the instrument on may cause a fault.

Follow the procedure described below when connecting an EXT I/O cable connector.



1. Connect an EXT I/O cable connector to the EXT I/O terminal of the main instrument.
2. Use the clamps located on both sides of the EXT I/O terminal of the main instrument to secure the EXT I/O cable connector in place.

Except for power supply terminals, all input and output terminals are negative logic.

Terminal name	Input/output	Function
$\overline{\text{START}}$	Input	Sets the instrument to automatic measurement mode. When this terminal is set to Low level, automatic measurement starts. When $\overline{\text{LOAD0}}$ to $\overline{\text{LOAD4}}$ are set with this terminal set to Low level, the selected panel number is read and measurement starts.
$\overline{\text{STOP}}$	Input	During automatic measurement with this terminal set to Low level, the measurement ends (interrupted).
$\overline{\text{0ADJ}}$	Input	When this terminal is set to Low level, zero adjustment is executed.
$\overline{\text{KEYLOCK}}$	Input	When this terminal is set to Low level, the key lock function is activated. Only Start, Apply, and Stop on the touch panel are effective.
$\overline{\text{LOAD0}}$ to $\overline{\text{LOAD4}}$	Input	Selects the number of the panel to be loaded. When the $\overline{\text{START}}$ signal is input, the panel of the selected number is read and measurement starts. Negative-logic binary numbers are input to $\overline{\text{LOAD4}}$ through $\overline{\text{LOAD0}}$. MSB is input to $\overline{\text{LOAD4}}$, and LSB to $\overline{\text{LOAD0}}$.
$\overline{\text{TEST}}$	Output	When automatic measurement starts, the terminal changes to Low level and holds the level until all measurements are completed.
$\overline{\text{MEAS}}$	Output	During automatic measurement, this terminal outputs Low level for each measurement item.
$\overline{\text{PASS}}$	Output	During automatic measurement, this terminal changes to Low level when the allowable value judgement for each measurement value results in $\overline{\text{PASS}}$.
$\overline{\text{FAIL}}$	Output	During automatic measurement, this terminal changes to Low level when the allowable value judgement for each measurement value results in $\overline{\text{FAIL}}$.
$\overline{\text{T-FAIL}}$	Output	During automatic measurement, this terminal changes to Low level when the allowable value judgement results in $\overline{\text{FAIL}}$ even once for any measurement item.
INT.DCV INT.GND	Output	Outputs the instrument's internal 5 VDC and GND.
EXT.DCV EXT.COM	Input	Terminal for power input from external equipment Allowed input voltage range: +5 to +24 VDC
(Reserved)	--	Do not use this terminal.

Table of $\overline{\text{LOAD0}}$ - $\overline{\text{LOAD4}}$ control and corresponding panel numbers

Number of panel to be loaded	$\overline{\text{LOAD4}}$	$\overline{\text{LOAD3}}$	$\overline{\text{LOAD2}}$	$\overline{\text{LOAD1}}$	$\overline{\text{LOAD0}}$
1	1	1	1	1	0
2	1	1	1	0	1
3	1	1	1	0	0
4	1	1	0	1	1
5	1	1	0	1	0
6	1	1	0	0	1
7	1	1	0	0	0
8	1	0	1	1	1
9	1	0	1	1	0
10	1	0	1	0	1
11	1	0	1	0	0
12	1	0	0	1	1
13	1	0	0	1	0
14	1	0	0	0	1
15	1	0	0	0	0
16	0	1	1	1	1
17	0	1	1	1	0
18	0	1	1	0	1
19	0	1	1	0	0
20	0	1	0	1	1
21	0	1	0	1	0
22	0	1	0	0	1
23	0	1	0	0	0
24	0	0	1	1	1
25	0	0	1	1	0
26	0	0	1	0	1
27	0	0	1	0	0
28	0	0	0	1	1
29	0	0	0	1	0
30	0	0	0	0	1

1: High level, 0: Low level

NOTE Invalid setting results when all terminals from $\overline{\text{LOAD0}}$ to $\overline{\text{LOAD4}}$ are set to "1" or "0."

8.3 Electrical Specifications

Input signal specifications

(Names of applicable signals:

$\overline{\text{START}}$, $\overline{\text{STOP}}$, $\overline{\text{0ADJ}}$, $\overline{\text{LOAD0}}$ to $\overline{\text{LOAD4}}$, $\overline{\text{KEYLOCK}}$)

Input signal	Active Low input
Maximum applied voltage	Input voltage to EXT.DCV terminal
High level	Input voltage to EXT.DCV terminal, or open
Low level	0.3 VDC or lower

Output signal specifications

(Names of applicable signals: $\overline{\text{TEST}}$, $\overline{\text{MEAS}}$, $\overline{\text{PASS}}$, $\overline{\text{FAIL}}$, $\overline{\text{T-FAIL}}$)

Output signal	Open collector output
Maximum load voltage	24 VDC (when not using EXT.DCV terminal)
Maximum output current	60 mA DC/1 signal (at Low level)

Maximum input voltage to EXT.DCV terminal: 24 VDC to EXT.COM terminal

Internal power supply output (between INT.DCV and INT.GND terminals)

Output voltage	5 VDC
Maximum load current	100 mA DC

The output signal is open collector output from the photocoupler.
Inside the instrument, the photocoupler is connected to the EXT.DCV terminal with a 3.3 kΩ pull-up resistor.

When not using the EXT.DCV terminal
When a load is directly connected to the output terminal without using the EXT.DCV terminal, the following relationship should exist among the external DC power supply voltage (connected to the other end of the load), output signal voltage, and current flowing to the output terminal.

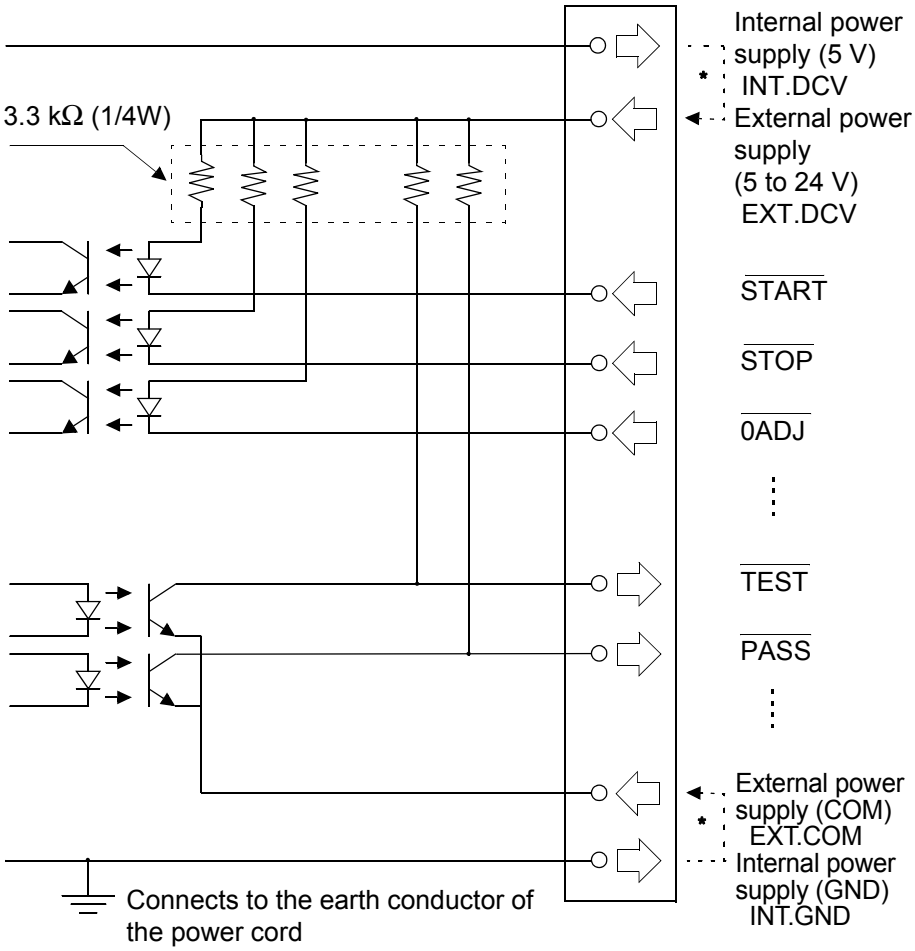
External DC power supply	Output signal voltage			
	High level	Low level		
		10 mA output current	40 mA output current	60 mA output current (max.)
5 V	5 V	0.9 V	1.1 V	1.2 V
12 V	12 V	0.9 V	1.1 V	1.2 V
24 V	24 V	0.9 V	1.1 V	1.2 V

8.4 Internal Circuit Configuration

⚠CAUTION

- Insulating the signal wires prevents signal interference. Be sure to ground external equipment connected to the instrument. If protective earthing is not provided, insulation damage may result.
- The maximum Low-level output current of the output photocoupler is 60 mA. If current higher than 60 mA is required, connect an external current amplification transistor circuit that operates on an external power supply.

The following shows the EXT I/O terminal circuit configuration.

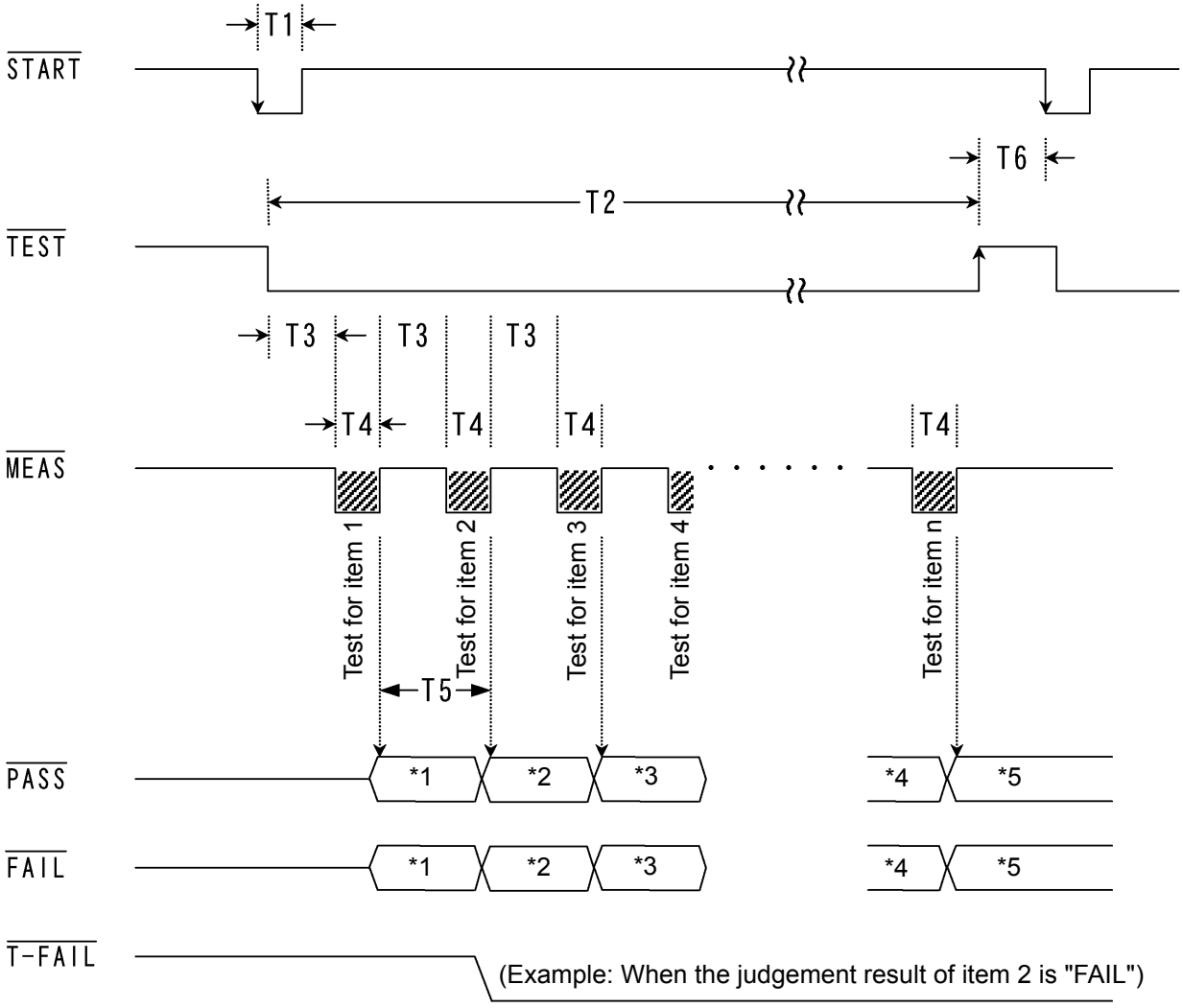


* To be connected when using internal DC power supply (5 V)

8.5 Timing Chart

The following shows the output signal timing chart for automatic measurement.
The number of measurement items (n) varies depending on [number of polarity conditions] x [number of equipment status] set with 1 displayed on the automatic measurement setting screen.

(Example)
Polarity: Positive polarity ON, negative polarity ON 2
Equipment status: Normal condition ON,
earth conductor disconnection ON 2
With the above settings, the number of measurement items (n) is 4 (2 x 2 = 4).



*1: Judgement result of item 1
*2: Judgement result of item 2
*3: Judgement result of item 3
*4: Judgement result of item (n - 1)
*5: Judgement result of item n

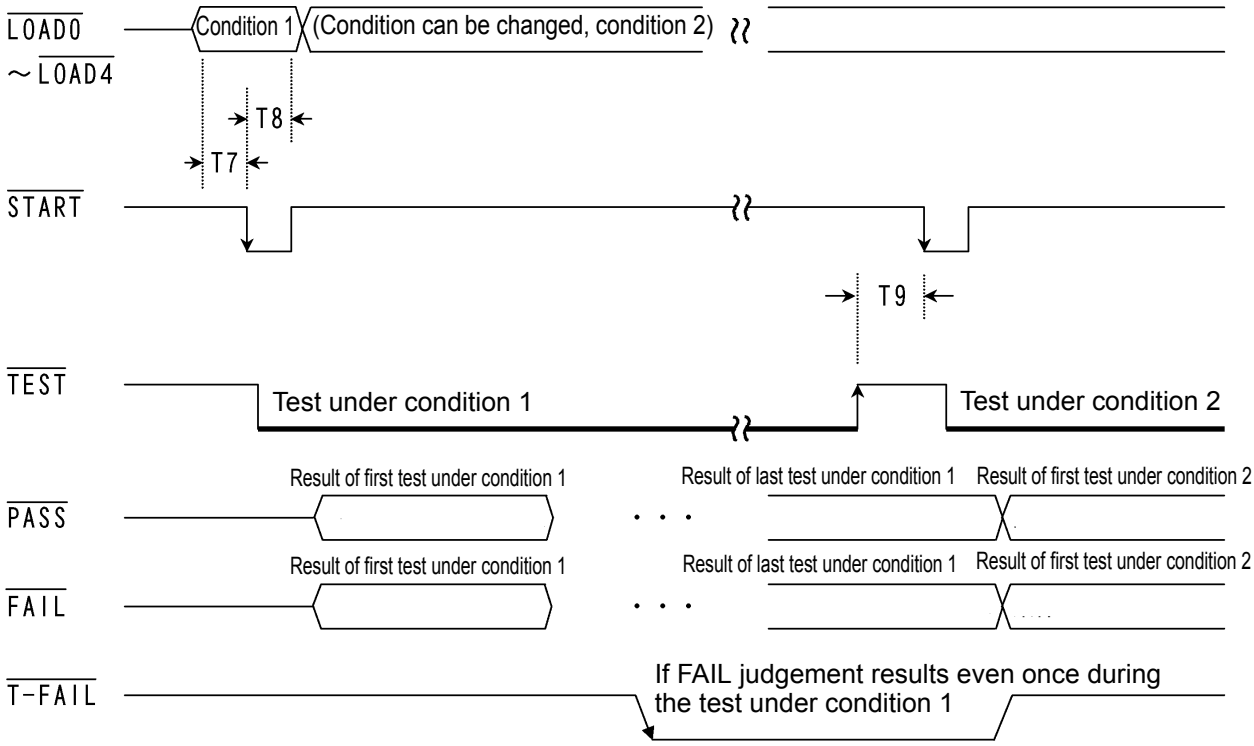
Description		Time	
		MIN	MAX
T1	Measurement start signal pulse width	1 ms	--
T2	Automatic measurement time	2 s	(T3 + T4) x number of measurement items
T3	Wait time between setting items	1 s	According to measurement delay setting for automatic measurement
T4	Measuring time of each setting item	1 s	According to measuring time setting for automatic measurement
T5	Judgement result output time	2 s	Until measurement completion of next measurement item
T6	Time from the completion of automatic measurement to next measurement start signal input	0 ms	--

8.5.1 Panel load function at EXT I/O start

Saved measurement conditions can be read and measurement conducted according to the conditions read.
The number of the panel to be read is specified by LOAD0 through LORD4 before START signal input.

❖Table of LOAD0-LORD4 control and corresponding panel numbers (page 201).

TEST, PASS, FAIL, and T-FAIL are only output in automatic measurement.



Description		Time MIN	Explanation
T7	From setting LOAD0 to LOAD4 to START input	1 ms	Low level must be held for at least 1 ms before starting.
T8	From START input to changing the condition in LOAD0 to LOAD4 (change of condition for next measurement)	1 ms	After START signal input, the panel load condition must be held for at least 1 ms.
T9	From completion of automatic measurement to next START input	0 ms	When the condition is the same as T6, but the panel to be loaded is changed for measurement, it is necessary to change LOAD0 to LOAD4 in advance.

8.5.2 Zero Adjustment Function by External I/O

NOTE

Zero adjustment is available only in the measurement mode for earth leakage current.

❖5.4.1, "Performing Zero Adjustment" (page 58)

When not using the panel load function

The $\overline{0ADJ}$ signal is set to Low level. (Low level must be held for at least 1 ms.)
At this time, $\overline{LOAD0}$ to $\overline{LOAD4}$ must be "all at High level" or "all at Low level."
Zero adjustment starts and takes about 10 seconds to complete.

When using the panel load function

When using the panel load function explained in 8.5.1, "Panel load function at EXT I/O start" (page 206), measurement can be started immediately after loading the data.
When the loaded panel calls for earth leakage current measurement and requires zero adjustment, follow the directions explained below.

1. Before $\overline{START}$ signal input, specify the panel number to be read by using LOAD0 through LOAD4.

   ❖See 8.2, "Connecting to the EXT I/O Terminal" (page 199) and the Table of $\overline{LOAD0}$-$\overline{LOAD4}$ control and corresponding panel numbers for how to specify a panel.

2. Set $\overline{0ADJ}$ to Low level.
   (Low level must be held for at least 1 ms.)

3. After panel load, when the read panel calls for earth leakage current measurement, zero adjustment starts and takes about 10 seconds to complete.

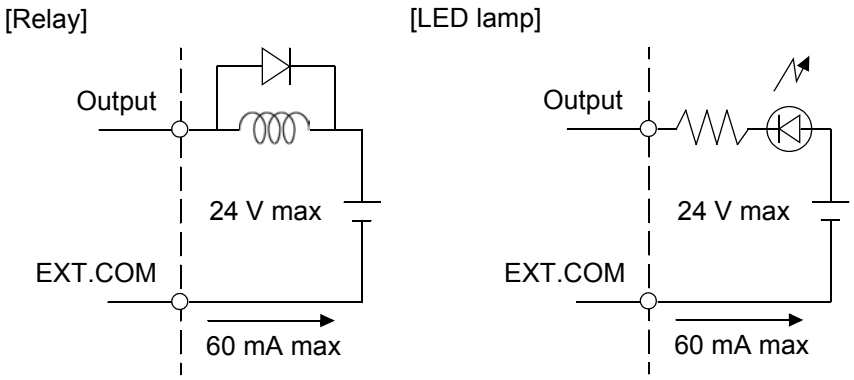
(The following steps are required for automatic measurement.)

4. After zero adjustment, cancel the settings of $\overline{LOAD0}$ to $\overline{LOAD4}$.
   (Set to "all at High level" or "all at Low level.")

5. When the loaded panel calls for automatic measurement, $\overline{START}$ signal input starts automatic measurement.

8.6 Example of Output Signal Connection

(1) When not using the INT.DCV, INT.GND, and EXT.DCV terminals

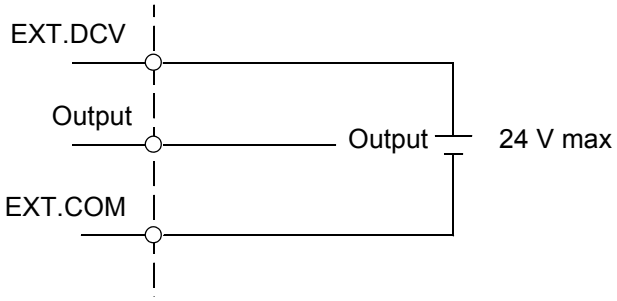


NOTE When using a relay, be sure to install a diode for absorbing counter-electro-motive force.

(2) When using the EXT.DCV and EXT.COM terminals

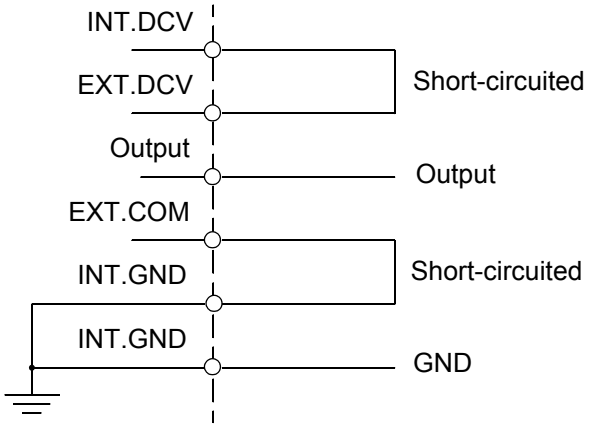
High (5 to 24 VDC) and Low signals can be obtained.

[Connection of negative-logic output]



(3) When INT.DCV and EXT.DCV, and INT.GND and EXT.COM are short-circuited

High (5 VDC) and Low signals are obtained, respectively.



Chapter 9 Using the Printer

9.1 Preparation before Connection

The maximum value, measurement conditions, and other data can be printed when the optional 9442 PRINTER is connected with the 9444 CONNECTION CABLE.

Necessary items

- 9442 PRINTER (DPU-414 Seiko Instruments Inc.)
- 9443-01 AC ADAPTER (for Japan) PW-4007-J1-E or PW-4007-JU1-E (power cord CB-JP01-18B-E) Seiko Instruments Inc.
- 9443-02 AC ADAPTER (for EU) PW-4007-E1-E Seiko Instruments Inc.
- 9443-03 AC ADAPTER (for America) PW-4007-U1-E Seiko Instruments Inc.
- 1196 RECORDING PAPER

To connect the main instrument and printer:

- 9444 CONNECTION CABLE

Setting of the 9442 PRINTER

Change the settings of the software dip switches (DIP SW) to use the 9442 for the 3156.

- The 9442 is shipped with the function settings for use with the Hioki 3166 CLAMP ON POWER HiTESTER. Before using, always change the settings of the DIP switches.
- For details on the operations and handling of the printer, refer to the operation manual supplied to the printer.
- For the printer, use the 1196 RECORDING PAPER (thermal paper, 10 rolls) or an equivalent.

Procedure

1. Turn off the power of the 9442.
2. Turn on the power while pressing the ON LINE button. Release the button after a list of the current settings starts printing out.

   The print out of the current settings is followed by the prompt:

   ```
   Continue? :Push 'On-line SW'
   Write?    :Push 'Paper feed SW'
   ```

3. Press the ON LINE button to change the settings.
   "Dip SW-1" is printed to make a settings for DIP SW 1.
4. For switches one to eight of the DIP SW1, set the ON/OFF status as shown in the table below.

   To set to ON, press the ON LINE button once and to set to OFF, press the FEED button once.

   The setting is printed out after the **ON LINE** or **FEED** button is pressed to allow to confirm the new setting.
   To change the settings, repeat from step ***1.***

: Use these settings for the 3156

Software DIP SW 1 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Input method	Parallel	Serial
2	Printing speed	High	Low
3	Auto loading	Enable	Off
4	CR function	Carriage return and line feed	Carriage return
5	Setting command	Enable	Disable
6	Printing density (set to 100%)		OFF
7		ON	
8		ON	

After switch eight is set, the following messages are printed out.

```
Continue? :Push 'On-line SW'
Write?    :Push 'Paper feed SW'
```

5. Press the ON LINE button and provide the following settings for DIP SW2 and DIP SW3.

Software DIP SW 2 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Print mode	Normal printing (40 columns)	Condensed printing (80 columns)
2	User-defined characters back-up	Enable	Disable
3	Character type	Ordinary characters	Special characters
4	Zero font	0	Ø
5	International character set	ON	
6		ON	
7		ON	
8		ON	

Software DIP SW 3 settings

Switch No.	Function	ON (Press ON LINE)	OFF (Press FEED)
1	Data bit length	8 bits	7 bits
2	Parity permission	Without	With
3	Parity condition	Odd	Even
4	Flow control	H/W BUSY	XON/XOFF
5	Baud rate (19200bps)		OFF
6		ON	
7		ON	
8			OFF

6. After setting for the switch number 8 of DIP SW 3 is made, press the ON LINE or FEED switch to complete settings.

The following message is printed out.

```
Dip SW setting complete!!
```

9.2 Connection Method

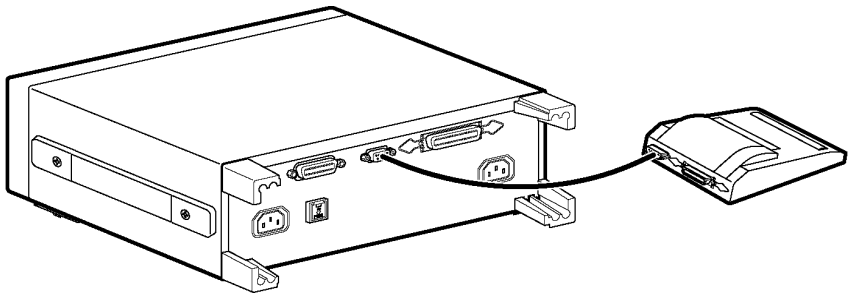
WARNING

To avoid electrocution, turn off the power to all devices before plugging or unplugging any cables or peripherals.

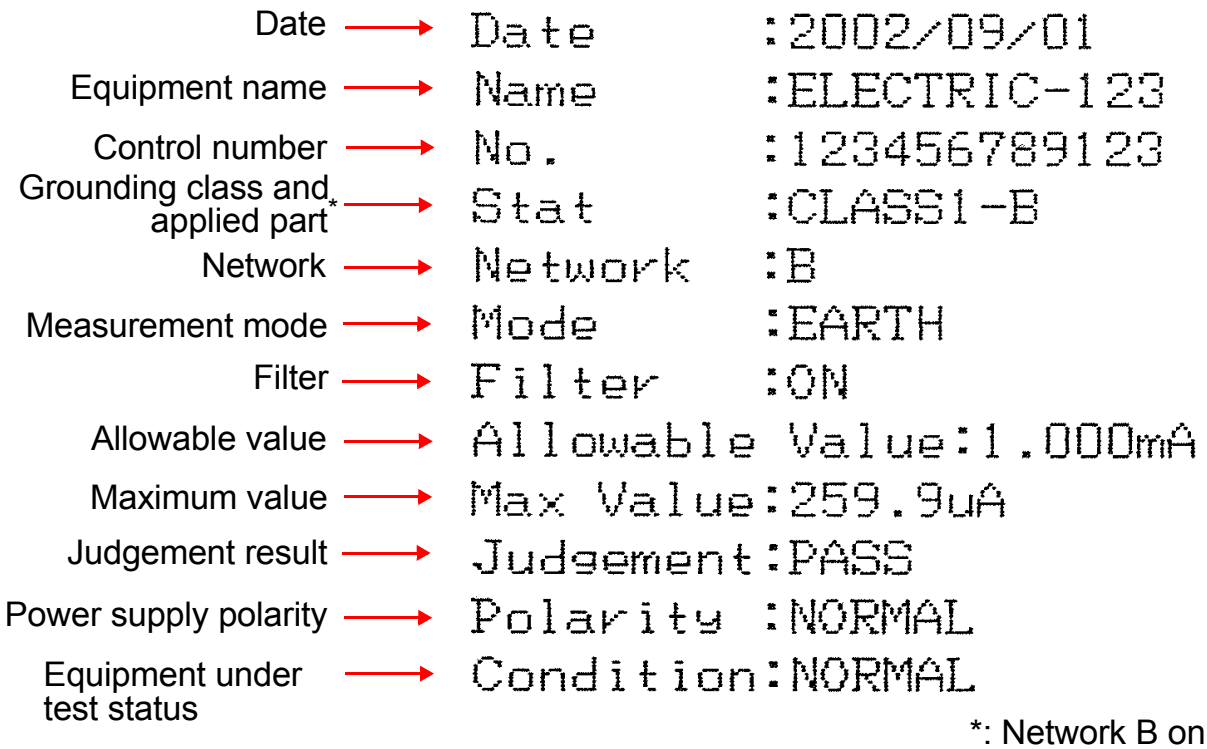
Connect the 9442 PRINTER to the RS-232C connector of the 3156. Before connection, complete any necessary settings on both the printer and the 3156.

Procedure

1. Turn off the power of the main instrument and printer.
2. Connect the 9444 CONNECTION CABLE between the main instrument and the printer.



Print example



*: Network B only

Description of printed information

Item	Explanation	Printed item	Explanation
Date	Date	(2002/09/01)	--
Name	Equipment name	(ELECTRIC-123)	--
No.	Control number	(123456789123)	--
Stat	Grounding class	CLASS1	Class-I equipment
		CLASS2	Class-II equipment
		INTERNAL	Internally powered equipment
	Applied part (Network B only)	B	Type B applied part
		BF	Type BF applied part
		CF	Type CF applied part
Network	Network	A	Network A
		B	Network B
		C	Network C
		D	Network D
		E	Network E
		F	Network F
Mode	Measurement mode	EARTH	Earth leakage current
		ENCLOSURE1	Leakage current between enclosure and earth
		ENCLOSURE2	Leakage current between enclosure and enclosure
		ENCLOSURE3	Leakage current between enclosure and line
		PAUXILIARY	Patient auxiliary current
		PATIENT1	Patient leakage current I
		PATIENT2	Patient leakage current II
		PATIENT3	Patient leakage current III

Item	Explanation	Printed item	Explanation
Filter	Filter	Network A	
		OFF	Network with a frequency characteristic
		ON	Multi-frequency network
		Network B	
		ON	Network with a frequency characteristic
		OFF	Network with 1 kΩ non-inductive resistance only
		Network C	
		ON1	Network compatible with perception/reaction
		ON2	Network compatible with abandonment
		OFF	Human body impedance network
		Network D	
		OFF	Network with 1.5 kΩ // 0.15 μF
		Network E	
		OFF	Network with 1 kΩ
		Network F	
		OFF	Network with 2 kΩ
Current	Target current	ACDC	Alternating current and direct current
		DC	Direct current
		AC	Alternating current
		ACPEAK	AC peak
Allowable Value	Allowable value	(1.000 mA)	--
Max Value	Maximum value	(259.9 μA)	--
Judgement	Judgement result	PASS	Equal to or less than the allowable value
		FAIL	Greater than the allowable value
Polarity	Power supply polarity	NORMAL	Positive phase
		REVERSE	Negative phase
		NONE	None
Condition	Equipment under test status	NORMAL	Normal condition
		EARTH	Single-fault condition (disconnection of protective earth conductor)
		POWERSOURCE	Single-fault condition (disconnection of one wire in power line)
		NAPPLY	Single-fault condition (110% voltage application: positive phase)
		RAPPLY	Single-fault condition (110% voltage application: negative phase)
		LLINE	Single-fault condition (line voltage application: L)
		NLINE	Single-fault condition (line voltage application: N)

Specifications Chapter 10

10.1 Measurement Functions

Measurement mode (single item selection)	• Earth leakage current • Leakage current between enclosure and earth • Leakage current between enclosure and enclosure • Leakage current between enclosure and line • Patient auxiliary current • Patient leakage current I • Patient leakage current II • Patient leakage current III (Some modes cannot be selected when the network and class settings decide they are unnecessary.)
Target current	DC, AC, AC+DC, ACpeak
Allowable value measurement current	25 mA maximum * 75 mA maximum for AC Peak measurement (See the accuracy table for details of measurement ranges.)
Measurement range	• 25 mA range (maximum indication: 25.00 mA,resolution: 0.01 mA) • 5 mA range (maximum indication: 5.000 mA,resolution: 0.001 mA) • 500 µA range (maximum indication: 500.0 µA, resolution: 0.1 µA) • 50 µA range (maximum indication: 50.00 µA, resolution: 0.01 µA) Note 1: If the range is exceeded, "**OVERFLOW**" is displayed. Note 2: When the range is set to Hold, the indication is up to 0 (except for the ACpeak). Note 3: When using network D, the full-scale value of each range is approximately 1/1.5. When using network F, the full-scale value of each range is approximately 1/2.
Range switch	Auto range (indication: AUTO, initial setting) Hold range (indication: HOLD)
110% voltage application (measurement auxiliary function)	Equipped with a voltage output terminal (T3) that applies 110% power supply voltage between the functionally insulated signal input/output section (or Type F applied part) and ground. No-load output voltage: From -0% to +5% of power supply voltage of line input for equipment under test 1 MΩ resistance load: Within ± 2% of power supply voltage of line input for equipment under test Output impedance: 22.5 ± 1 kΩ (including output protective resistance of 10 kΩ at 50/60 Hz) Output ON/OFF selection • Applied when positive phase (to input power supply voltage) • Applied when negative phase (to input power supply voltage) Automatic switching function (automatic measurement function)

10.2 Measurement System

Measurement terminals	Terminal T1, terminal T2 (with built-in fuse holder), terminal T3 (110% voltage application terminal)
Line output terminals	Terminal block (100 to 240 V)
Measurement system	Indication of a current value calculated based the measured drop in voltage caused by simulated resistance of the human body Measurement of true effective value The measurement section: chassis-grounded and floating
Simulated resistance of human body (current detection circuit)	Selected from the following six types. The filter can be turned ON/OFF. • For Electrical Appliance and Material Safety Law Basic measurement element: 1 kΩ Filter : 10 kΩ + 11.22 nF + 579 Ω • For medical electrical equipment Basic measurement element: 1 kΩ Filter : 10 kΩ + 15 nF • For IEC 60990 Basic measurement element: 1.5 kΩ + 500 Ω Filter 1 : 10 kΩ + 22 nF Filter 2 : 10 kΩ + (20 kΩ+ 6.2 nF) // 9.1 nF • For UL Basic measurement element : 1.5 kΩ // 0.15 μF • General-purpose 1 Basic measurement element 1: 1 kΩ • General-purpose 2 Basic measurement element 2: 2 kΩ
A/D conversion system	ΔΣ system (20 bits)
Input resistance	1 MΩ ± 1% (single-ended input) excluding voltmeter section, simulated resistance of the human body (current detection circuit)
Input capacity (between terminals T1 and T2)	200 pF or lower (f = 100 kHz, with network circuit isolated)
Grounding capacity (between terminals T1/T2 and chassis)	200 pF or lower
CMRR (between terminals T1/T2 and chassis)	60 dB or higher, at 60 Hz, 10 kHz (with network circuit isolated and when fuse is short-circuited) 40 dB or higher, at 100 kHz, 1 MHz (with network circuit isolated and when fuse is short-circuited)

10.3 Other Functions

Setting the grounding class of equipment under test	Selected from Class-I equipment, Class-II equipment, or internally powered equipment * When selecting network B, select the applied part from the following Type B applied part, Type BF applied part, or Type CF applied part
Trigger system	• Manual (automatic generation of internal trigger, and free-run measurement) • Automatic (measurement started by external start signal) (1) Started by pressing Start key on the operation screen. (2) Asserted by the START terminal on the EXT I/O connector. (3) Started by the :START interface command.
Measurement speed	Trigger-system manual measurement: 100 ± 3 ms (indication of moving average of 16 measurements) Trigger-system automatic measurement: 100 ± 3 ms (min.) - measurement setting time
Wiring check function	Conducted by wiring check mode entered at system screen • Polarity check (voltage monitor) • VA check (voltage monitor x current monitor)
Automatic measurement function	• Setting of measuring time • Setting of delay (wait) time for changing setting conditions • Selection of possible automatic measurement items (default setting: all possible combinations in each mode) Setting of single-fault condition Switching of power line polarity for equipment under test
Voltage application line selection function	Selected from the following for leakage current measurement between enclosure and line: • Use of T2 and internal contact (default) • Use of T1 and T2
Ground fault prevention function	Pre-check of current value between connection terminals to prevent a ground fault Only effective for leakage current measurement between enclosure and line
Setting of single-fault condition	• Setting of fault mode for power line for equipment under test Disconnection of one wire in power line (neutral side), disconnection of protective earth conductor (Automatic switching possible, including polarity change, when using automatic measurement function) • Application of 110% voltage for simulated connection of malfunctioning equipment Positive phase, negative phase (Automatic switching possible when using automatic measurement function) • Selection of application line for leakage current measurement between enclosure and line Application of voltage of L (live) side of line input Application of voltage of N (neutral) side of line input (Automatic switching possible when using automatic measurement function)
Power line for equipment under test (switching power supply polarity)	Positive/negative phase (Automatic switching possible when using automatic measurement function)
Setting of measuring time	Setting of measuring time for each item Setting range: 1 sec. to 5 min., in 1 sec. increments Effective only in automatic measurement

Measurement delay (setting) function	• Setting of wait time from the completion of measurement to power supply disconnection (default: OFF) • Setting of wait time from switching power supply polarity to the start of measurement (default: 1 sec.) • Setting of wait time for operations other than switching polarity (default: 1 sec.) Setting range: 1 sec. to 30 min., in 1 sec. increments
Maximum value hold function	Effective in all measurement modes Reset by Clear key during sampling Reset by changing allowable value Reset by START signal (EXT I/O, communication command)
Allowable value judgement function	Allowable value: Sets the upper-limit current value. Judgement : PASS measurement value ≦ upper-limit value FAIL measurement value > upper-limit value Processing : Indication, buzzer, judgement output from EXT I/O Buzzer : Selectable from "ON when PASS," "ON when FAIL," and "OFF"
Mode selection function	• Current measurement function Unit of current measurement: Auto Unit of current measurement: mA, fixed Normal leakage current measurement function, selectable unit of current measurement (default setting) • Voltage measurement function Isolates the internal network for using the instrument as a voltmeter between terminals T1 and T2. Selectable target voltage and measurement range Maximum measurement voltage: 25 V

10.4 System-related Functions

Beep sound setting	• Allowable value judgement: Selectable from "ON when Pass," "ON when FAIL," and "OFF" • Key input: ON/OFF • T3 (110% voltage application terminal) output: ON/OFF • Line voltage output from T2: ON/OFF
Save/load function	30 panels for saving the following setting data (measurement mode, network, equipment name, control number, grounding class, applied part, measurement range, filter, target current, allowable value setting, fault condition setting, power supply polarity switching, automatic measurement items, automatic measuring time, measurement delay time)
Data save function	Saved content : Equipment under test information (equipment name, control number), measurement data, date Memory capacity : Data on up to 100 units
Clock function	Auto calendar, automatic leap-year adjustment, 24 hour clock Clock accuracy: Deviation of about 4 minutes a month
Data backup function	SRAM (test condition data), RTC Backup battery life: Approx. 4 years (reference value at 25°C (77°F))
Backlight automatic OFF function	• Constant ON (default setting) • Auto OFF (1 min. to 30 min., in 1 min. increments) The backlight automatically turns off after the set time elapses, turns ON when a key is pressed, then turns OFF again after the set time elapses.
Self-test function	• MEM (internal RAM) • KEY (6 x 6 matrix touch panel) • LCD (front LCD panel) • LED (power indicator lamp, warning lamp, LCD backlight) • Buzzer
Language setting	Japanese or English
System reset	• Clears all data including measurement conditions and measurement data. The date and time settings are retained. • Clears all saved measurement data. • Clears all saved condition setting data including panels.

10.5 Accuracy

10.5.1 Current Measurement Section

Operating temperature and humidity for guaranteed accuracy:
23 ± 5°C (73±41°F), 80%RH or lower (no dew condensation allowed)
Temperature coefficient: 0.1 x basic accuracy x (T-23) weighted --- operating temperature T [°C]
Warm-up time: 30 min.

- Value calculated based on voltage detected at terminals of network having non-inductive resistance of 1 kΩ (theoretical value).
- Measurements in voltmeter mode conform to the following accuracy level.
- When using networks D and F, the guaranteed accuracy ranges are 1/1.5 and 1/2, respectively.
- Actual leakage current measurement values are affected by network accuracy.
- Accuracy of voltmeter and network is specified respectively.
- As for each current measurement, the input allowable value is up to 1.5 times of the measurement range.
  As for DC measurement, overlay AC frequency is limited to 50/60 Hz only.

Measurement of DC

Range	Guaranteed accuracy range	Measurement resolution	Accuracy
25.00 mA	4 mA or more	10 µA	± (0.2%rdg.+3dgt.)
5.000 mA	400 µA or more	1 µA	± (0.2%rdg.+3dgt.)
500.0 µA	40 µA or more	0.1 µA	±1.0%f.s.
50.00 µA	4 µA or more	0.01 µA	±1.0%f.s.

Measurement of AC*1, AC+DC

Range	Guaranteed accuracy range	Measurement resolution	Accuracy	
			DC < f ≦ 100 kHz	100 kHz < f ≦ 1 MHz
25.00 mA	4 mA or more	10 µA	±2.0%rdg.+6dgt.	± (2.0%rdg.+10dgt.)
5.000 mA	400 µA or more	1 µA	±2.0%rdg.+6dgt.	± (2.0%rdg.+10dgt.)
500.0 µA	40 µA or more	0.1 µA	±2.0%rdg.+6dgt.	± (2.0%rdg.+10dgt.)
50.00 µA	4 µA or more	0.01µA	±2.0%f.s.	±2.0%f.s.

Measurement of AC Peak*2

Range	Guaranteed accuracy range	Measurement resolution	Accuracy	
			20 Hz < f ≦ 1 kHz	1 kHz < f ≦ 10 kHz
75.0 mA	8 mA or more	100 µA	± (2%rdg.+2dgt.)	± (5.0%rdg.+10dgt.)
10.00 mA	0.8 mA or more	10 µA	± (2%rdg.+2dgt.)	± (5.0%rdg.+10dgt.)
1.000 mA	100 µA or more	1 µA	±2.5%f.s.	±5.0%f.s.
500.0 µA	40 µA or more	0.1 µA	±4.0%f.s.	±5.0%f.s.

Power supply voltage monitor accuracy

Range	Guaranteed accuracy range	Measurement resolution	Accuracy
300 V	85 V or more*3	0.1 V	±5.0%f.s.

Current consumption monitor accuracy (measurement method: average value response, effective value conversion)

Range	Guaranteed accuracy range	Measurement resolution	Accuracy
16 A	0.5 A or more*4	0.1 A	± (2%rdg.+5dgt.)

*1: Weighted with frequency characteristic (fc = 4 Hz) of high-pass filter.
*2: Cannot be set when network A or B is selected.
*3: "less than 80 V" is indicated for a value less than 80 V.
*4: "less than 0.5 A" is indicated for a value less than 0.5 A.

10.5.2 Network Section

Network accuracy

Network name /filter status	Characteristic[*1, *2]			Other
	DC input resistance	Frequency range with ±1% deviation	Cut-off frequency (-3 dB points[*4])	
A/Filter OFF[*3]	1 kΩ ± 0.5%	100 kHz or lower	--	
A/Filter ON	1 kΩ ± 0.5%	--	1326±20 Hz	Passband attenuation: 0 dB ± 2% (at 100 Hz) High pass attenuation: -25 dB ± 1 dB (at 100 kHz)
B/Filter OFF[*3]	1 kΩ ± 0.5%	100 kHz or lower	--	
B/Filter ON	1 kΩ ± 0.5%	--	1047±16 Hz	Passband attenuation: 0 dB ± 2% (at 100 Hz) Attenuation characteristic: -20 log (f/fc) ± 1 dB (at 10 kHz ≦ f ≦ 1 MHz)
C/Filter OFF	2 kΩ ± 0.5%	--	1811±27 Hz	Passband attenuation: 0 dB ± 2% (at 100 kHz) Low pass attenuation: -11.87 ± 0.3 dB (at 100 Hz) Allowable value between 100 kHz and 1 MHz: ±1 dB
C/Filter ON1	2 kΩ ± 0.5%	--	3470±104 Hz[*4]	Passband attenuation: -12.05 ± 0.3 dB (at 100 Hz) High pass attenuation: -42.8 ±1 dB (at 100 kHz) Allowable value at 1 MHz: ±3 dB
C/Filter ON2	2 kΩ ± 0.5%	--	9100±273 Hz[*4]	Passband attenuation: -12.03 ± 0.3 dB (at 100 Hz) High pass attenuation: -35.1 ± 1 dB (at 100 kHz) Allowable value at 1 MHz: ±3 dB
D	1.5 kΩ ± 0.5%	--	705±15 Hz	Impedance: Theoretical value ±0.5% (at DC ≦ f ≦ 400 Hz) Theoretical value ±(2% + 1 Ω) (at 400 Hz < f ≦ 1 MHz)
E[*3]	1 kΩ ± 0.5%	100 kHz or lower	--	
F	2 kΩ ± 0.5%	100 kHz or lower	--	

*1: Measurement (including cable capacity) between T1 and T2 in leakage current between enclosure and enclosure mode
*2: Including voltmeter (1 MΩ load) at network output section
Input protective fuse is short-circuited.
*3: Network A (filter OFF)
Network B (filter OFF)
Same circuit for network E
*4: -15 dB points for network C (filter ON1, ON2)

10.6 Interfaces

EXT I/O

Connector: D-sub 36-pin, female
Insulation
Negative logic
Open collector output
Output: Internal +5 V power supply, internal GND (equivalent to chassis grounding)

(1) Input

$\overline{\text{START}}$	: Measurement starts when this signal is set to Lo.
$\overline{\text{STOP}}$	: Forcibly terminated when this signal is set to Lo.
$\overline{\text{KEYLOCK}}$	: Disable all except Start switch.
$\overline{\text{LOAD0(to 4)}}$	: Reads saved panel (30 panels).
$\overline{\text{0ADJ}}$	: Zero adjustment start signal (effective only in earth leakage current mode)
(EXT.DCV)	: External power (5 to 24 V) input
(EXT.COM)	: External COM input

(2) Output

$\overline{\text{TEST}}$	: Outputs Lo in automatic measurement.
$\overline{\text{MEAS}}$	: Generates as many outputs as measurement items in automatic measurement.
$\overline{\text{PASS}}$	: Outputs PASS judgement result for each measurement item in automatic measurement.
$\overline{\text{FAIL}}$	: Outputs FAIL judgement result for each measurement item in automatic measurement.
$\overline{\text{T-FAIL}}$	: Generates output if even one FAIL judgement result is produced.
(INT.DCV)	: Internal 5 VDC output (non-insulated from internal circuits)
(INT.GND)	: Internal GND output (equivalent to chassis grounding)

PC interfaces

(1) GP-IB interface
Communication content:
Remote control, measurement data output
Compliance with IEEE-488.1 1987
Reference: IEEE-488.2 1987
Connector: D-sub 24-pin, female

(2) RS-232C interface

Communication content	: Remote control, measurement data output
Transmission system	: Synchronous communication, full duplex
Transmission speed	: 9,600 bps, fixed
Data bit length	: 8 bits
Stop bit	: 1
Parity bit	: None
Delimiter	: CR+LF
Handshake	: None
XON/XOFF	: Not used
Connector	: D-sub 9-pin, male, connector retaining screws (#4-40)

10.7 Printer

NOTE The 9442 PRINTER (option) is required for printing measurement data.

Printer output

RS-232C interface terminal used
Printer, printer cable, AC adapter, and recording paper are optional.

(Printed information)	(Print example)	
• Date of measurement	Date	: 2002/10/01
• Equipment name	Name	: ELECTRIC-123
• Control number	No.	: 123456789012
• Class (applied part) *	Stat	: CLASS1
• Network	Network	: A
• Measurement mode	Mode	: EARTH
• Filter setting	Filter	: ON
• Target current	Current	: ACDC
• Allowable value	Allowable Value	: 1.000 mA
• Maximum value	Max Value	: 0.567 mA
• Judgement result	Judgement	: PASS
• Power supply polarity	Polarity	: NORMAL
• Equipment status	Condition	: NORMAL

(Information to be printed can be selected from the items above.)

* Applied part: Also prints -B, -BF, and -CF when network B is selected.

Connector: D-sub 9-pin, male, connector retaining screws (#4-40)

10.8 General Specifications

Display section	320 x 240 dot matrix LCD (with backlight) Equipped with automatic backlight OFF function (Backlight OFF time can be set in 1 minute increments.) Backlight turns ON when panel is touched in backlight OFF mode. LCD contrast adjustment: Dial provided on front panel
Operation section	6 x 6 matrix touch panel Equipped with key lock function (asserts KEYLOCK terminal on EXT I/O)
Power source for main instrument	Rated power source voltage: 100, 120, 220, 240 VAC (default setting) (Power supply voltage fluctuations of ±10% are taken into consideration.) Rated power source frequency: 50/60 Hz Rated power: 30 VA
Power line for equipment under test and power output	Rated power supply voltage : 100 to 240 VAC Rated power supply frequency : 50/60 Hz Rated power : 1500 VA
Power output Maximum allowable leakage current	25 mA
Withstand voltage	• [All power supply terminals] - [Protective earthing] 1.39 kV AC, 15 sec. Cut-off current 5 mA • [All measurement terminals] - [All power supply terminals] 2.30 kV AC, 1 min. Cut-off current 5 mA • [All measurement terminals] - [Control circuit] 2.30 kV AC, 1 min. Cut-off current 5 mA
Measurement terminals	Terminals T1, T2: Rated voltage 25 V, rated current 25 mA, earth voltage 250 V Terminal 3: Maximum output voltage 250 VAC
Fuses	Power supply section : 250V T0.1AL Measurement terminal section : 250V T32mAL
Size&Weight	320W X 110H X 263D mm (12.60”W X 4.33”H X 10.35”D) approx. (excluding protruding sections) 4.0 kg (141.1 oz.) approx.
Accessories	9170-10 TEST LEAD (2 red, 2 black, 1 spare included) 2 sets 9195 ENCLOSURE PROBE 1 9399 CARRYING CASE 1 Alligator clips 3 (2 red, 1 black) Power cord (for main instrument, for power line of equipment under test, two 15 A cables for 100 V system, two 7 A cables for 200 V system:) 2 Spare fuse for main instrument power supply 250V T0.1AL (for 100/120/220/240 V) 1 Spare fuse for measurement operation 250V T32mAL 1 Instruction manual 1

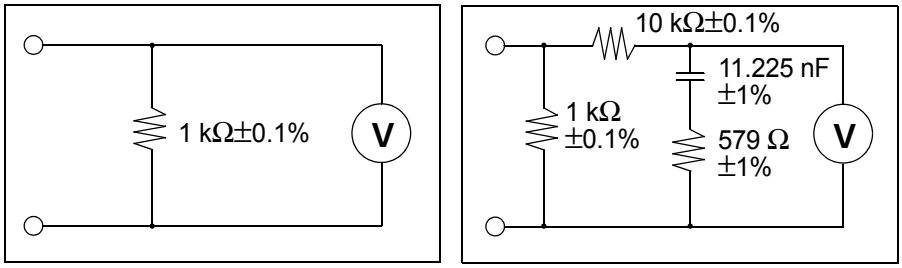
Options	9637 RS-232C CABLE (9-pin to 9-pin., crossing cable) 9638 RS-232C CABLE (9-pin to 25-pin., crossing cable) 9151-02 GP-IB CABLE (2 m) 9151-04 GP-IB CABLE (4 m) 9442 PRINTER (DPU-414 Seiko Instruments Inc.) 9443-01 AC ADAPTER (for printer / Japan) (PW-4007-J1-E or PW-4007-JU1-E (power cord CB-JP01-18B-E), Seiko Instruments Inc.) 9443-02 AC ADAPTER (for printer / EU) (PW-4007-E1-E, Seiko Instruments Inc.) 9443-03 AC ADAPTER (for printer / USA) (PW-4007-U1-E, Seiko Instruments Inc.) 9444 CONNECTION CABLE (for printer, 9-pin to 9-pin, straight cable) 1196 RECORDING PAPER (for printer, 112 mm x 25 m, 10 rolls) 9686 CARRYING CASE (with casters) 9267 SAFETY TEST DATA MANAGEMENT SOFTWARE
Operating temperature and humidity	0 to 40°C (32 to 104°F), 80%RH or less (non-condensating)
Storage temperature and humidity	-10 to 50°C (14 to 122°F), 80%RH or less (non-condensating)
Operating temperature and humidity for guaranteed accuracy	23 ± 5°C (73 ± 41°F), 80%RH or less (non-condensating)
Period of guaranteed accuracy	6 months
Effect of conducted radio-frequency electromagnetic field	16%f.s. at 3 V (typical value for measurement in AC 500 μA range)
Operating Environment	Indoors, altitude up to 2000 m (6562-ft.)
Applicable Standards	EMC EN61326 EN61000-3-2 EN61000-3-3 Safety EN61010 Polution Degree 2 Terminals T1, T2: Measurement category II (Anticipated Transient Overvoltage: 2.5 kV) Terminal T3: Measurement category I (Anticipated Transient Overvoltage: 1.5 kV)

10.9 Measurement Networks

10.9.1 Network A (for Electrical Appliance and Material Safety Law)

Network A is a measurement network that complies with the Electrical Appliance and Material Safety Law.
Network A complies with the following law:

(1) Ordinance Concerning Technical Requirements for Electrical Appliances and Materials
Filter setting for single-frequency network (OFF) and multi-frequency network (ON)



Single-frequency network (OFF)　　Multi-frequency network (ON)

When network A is selected, the instrument can also be used in compliance with the following standards on testing leakage current:

(2) Automatic vending machines - Test method - (JIS B8561-93)

(3) Microwaves (JIS C9250-92)
In addition to the Electrical Appliance and Material Safety Law, many JIS standards specify the use of a single-frequency network (with 1 kΩ non-inductive resistance only) for testing leakage current.

Applicable law	Ordinance Concerning Technical Requirements for Electrical Appliances and Materials
Measurement circuit configuration	Basic measurement element: 1 kΩ Frequency characteristic : ± 0.5% (DC to 1 MHz)
Low-pass filter function	Filter configuration (ON setting): RC filter (10 kΩ + 11.22 nF + 579 Ω) Filter setting: ON/OFF (1 kΩ only at OFF) (when input protective fuse is short-circuited)
Element tolerance	Resistance : ± 0.1% (1 kΩ, 10 kΩ), ± 1% (579 Ω) Capacitor : ± 1%

10.9.2 Network B (for medical electrical equipment)

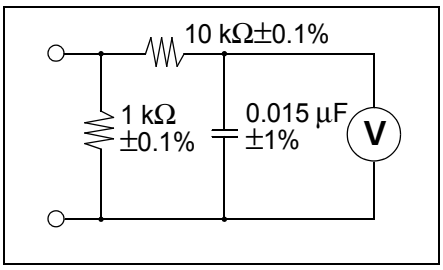
Network B is a measurement network for medical electrical equipment.
Network B complies with the following standards:

(1) Medical electrical equipment - Part 1: General requirements for safety
(IEC 60601-1(1988-12) + am1 (1991-11) + am2 (1995-03))
(Not compliant with IEC 60601-1(2005) Third Edition)

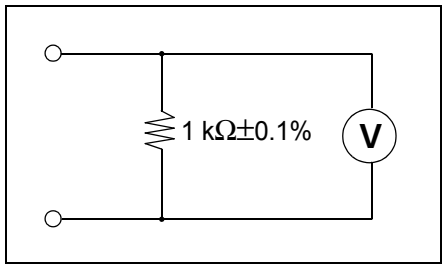
(2) General safety regulations for medical electrical equipment
(JIS T1001:92)

(3) General regulations for method of testing safety of medical electrical equipment (JIS T1002:92)

Filter setting for network with a frequency characteristic (ON) and network with 1 kΩ non-inductive resistance only (OFF)



Network with a frequency characteristic (ON)



Network with 1 kΩ non-inductive resistance only (OFF)

When network B is selected, the instrument can also be used in compliance with the following standards on testing leakage current:

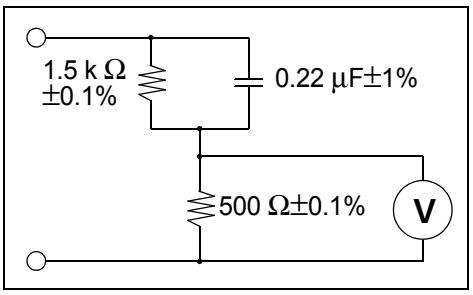
(4) JIS standards for medical X-ray equipment
The instrument can be used for testing leakage current in isolation transformers in compliance with the safety standard for electrical facilities for hospitals (JIS T1022:96).
In addition to medical electrical equipment standards, many JIS standards specify the use of a network with 1 kΩ non-inductive resistance for testing leakage current.

Applicable standards	Medical electrical equipment - Part 1: General requirements for safety (IEC 60601-1 (1988-12)+ am1(1991-11)+ am2 (1995-03)) (JIS T 0601-1:99) General safety regulations for medical electrical equipment (JIS T1001:92) General regulations for method of testing safety of medical electrical equipment (JIS T1002:92)
Measurement circuit configuration	Basic measurement element: 1 kΩ Frequency characteristic : ±0.5% (DC to 1 MHz)
Low-pass filter function	Filter configuration (ON setting): RC filter (10 kΩ + 15 nF) Filter setting : ON/OFF (1 kΩ only at OFF) (with short-circuited input protective fuse)
Element tolerance	Resistance : ± 0.1% Capacitor : ± 1%

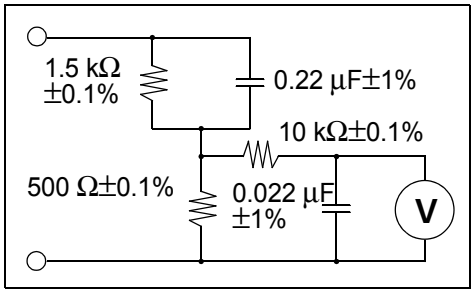
10.9.3 Network C (for IEC 60990)

Network C is a measurement network that complies with IEC 60990. Network C complies with the following standards:

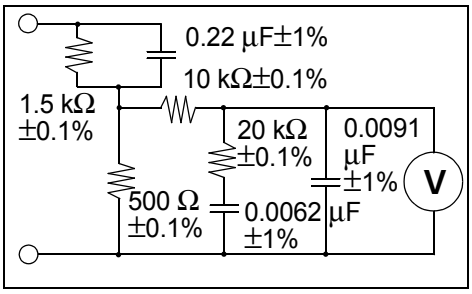
(1) Methods of measurement of touch current and protective conductor current (IEC/TR 60990 (1990-06))
Filter setting for human body impedance network (OFF), network compatible with perception/reaction (ON1), and network compatible with abandonment (ON2)



Human body impedance network (OFF)



Network compatible with perception/reaction (ON1)



Network compatible with abandonment (ON2)

When network C is selected, the instrument can also be used in compliance with the following standards on testing leakage current:

(2) Safety requirements for electrical equipment for measurement, control, and laboratory use
(IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07))

(3) Safety of equipment for measurement, control, and laboratory use - Part 1: General requirements (JIS C1010-1:98)

(4) Safety of information technology equipment
(IEC 60950 (1991-10) + am4 (1996-07))

(5) Audio, video, and similar electronic apparatus - Safety requirements (IEC 60065 (1998-07))

(6) Applicable UL standards (e.g., UL 1419, UL 3101-1, UL 3111-1)
There are many other applicable standards.

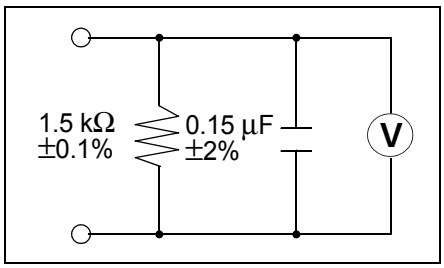
Applicable standards	Methods of measurement of touch current and protective conductor current (IEC/TR 60990 (1990-06))
Measurement circuit configuration	Basic measurement element: 1.5 kΩ + 500 Ω
Filter configuration	• OFF setting: High-pass filter • ON1 setting: (compatible with perception): 10 kΩ + 22 nF • ON2 setting (compatible with abandonment): 10 kΩ + (20 kΩ + 6.2 nF) // 9.1 nF (when input protective fuse is short-circuited)
Element tolerance	Resistance : ± 0.1% Capacitor : ± 1%

10.9.4 Network D (for UL)

Network D is a measurement network that complies with UL.
Network D complies with the following standards:

(1) Safety of household and similar electrical appliances (IEC 60335-1 (1991-06) + am1 (1994-11))

(2) Applicable UL standards



Network (1.5 kΩ) with 1.5 kΩ and 0.15 µF

When network D is selected, the instrument can also be used in compliance with the following standards on testing leakage current:

(3) Ordinance Concerning Technical Requirements for Electrical Appliances and Materials (single-frequency only)

(4) Safety of household and similar electric appliances - Part 1: General requirements (JIS C9335-1:98)

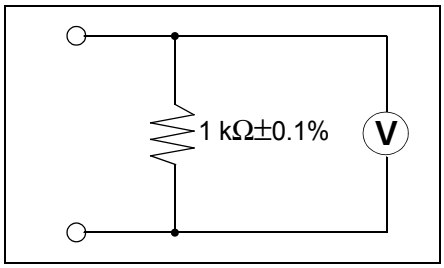
(5) Safety of home electronic equipment (JIS C6065:98)

(6) There are many other applicable standards.

Applicable standards	Safety of household and similar electrical appliances (IEC 60335-1 (1991-06) + am1 (1994-11)) Applicable UL standards (e.g., UL 471, UL 1310, UL 1437, UL 1492)
Measurement circuit configuration	Network with 1.5 kΩ and 0.15 µF (when input protective fuse is short-circuited)
Element tolerance	Resistance : ± 0.1% Capacitor : ± 2%

10.9.5 Network E (General-purpose 1)

Network E is a general-purpose measurement network.
The circuit configuration is as follows:



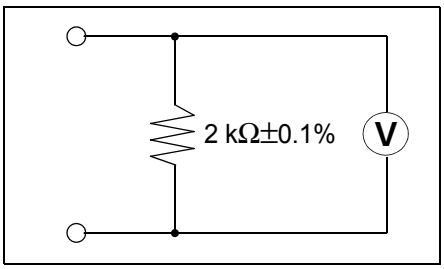
Network (1 kΩ) with 1 kΩ

This network can be used to perform leakage current tests in compliance with applicable standards.

Measurement circuit configuration	Network with 1 kΩ Impedance: 1 kΩ (0.5% (DC to 1 MHz) (when input protective fuse is short-circuited)
Element tolerance	Resistance: ± 0.1%

10.9.6 Network F (General-purpose 2)

Network F is a general-purpose measurement network.
The circuit configuration is as follows:



Network (2 kΩ) with 2 kΩ

This network can be used to conduct leakage current tests in compliance with applicable standards.

Measurement circuit configuration	Network with 2 kΩ Impedance: 2 kΩ (0.5% (DC to 1 MHz) (when input protective fuse is short-circuited)
Element tolerance	Resistance: ± 0.1%

Maintenance and Service Chapter 11

11.1 Cleaning and Storage

Cleaning

To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.

NOTE

Wipe the LCD gently with a soft, dry cloth.

Storage

- Storage temperature and humidity should be kept between -10 and 50°C, at less than 80% RH.
- Do not store or use the instrument where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the instrument may be damaged and insulation may deteriorate so that it no longer meets specifications.
- When storing the instrument for a long time (6 months or more), the specifications are no longer guaranteed. Therefore, before use, have the instrument recalibrated.

11.2 Repair and Servicing

⚠CAUTION

- Adjustments and repairs should be made only by technically qualified personnel.
- If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.
- Pack the instrument carefully so that it will not be damaged during shipment, and include a detailed written description of the problem. Hioki cannot be responsible for damage that occurs during shipment.

- Use the original packing materials when reshipping the instrument, if possible.
- If the instrument has been subject to moisture, or if oil and dust have accumulated in the instrument interior, the danger of electrical shock or fires resulting from the deterioration of insulation increases greatly. If the instrument is ever subject to excessive moisture, oil, or dust, cease use immediately, and return the instrument to us for maintenance.
- The instrument uses a lithium battery for memory backup. When this battery runs out, the data saved in memory is lost and measurement condition data can no longer be saved. If this happens, contact our service center for a battery replacement (at a charge).
  The average service life of the lithium battery for memory backup is approximately four years under normal use.

Troubleshooting

If the instrument operates abnormally, check as described below.
If the instrument continues to operate abnormally after taking the specified corrective action, the instrument may be malfunctioning. Turn off the instrument's power switch immediately, then contact your dealer (Hioki agent) or the nearest Hioki sales office.

Symptom	Check item	Corrective action
The display remains blank after the power switch is turned on.	Is the power cord disconnected?	Check the power supply inlet indicated [AC IN] (located on the left side when viewed from the rear of the main instrument). Confirm that the power source voltage of the instrument matches the power supply voltage, then connect the power cord.
	Is the LCD panel contrast adjustment set to the lightest setting?	Adjust the contrast of the LCD panel by turning the black dial located on the right side of the LCD panel.
Keys are ineffective.	Is RS-232C or GP-IB used for external remote control?	Stop using RS-232C or GP-IB. When the instrument is remotely controlled, the keys are ineffective.
	Is the $\overline{\text{KEYLOCK}}$ terminal of EXT I/O set to Low level (EXT.COM level)?	Set the $\overline{\text{KEYLOCK}}$ terminal of EXT I/O to High level (EXT.VCC level), or leave the terminal open.
The power line for equipment under test does not provide power.	Is the power cord disconnected?	Check the power supply inlet indicated [LINE IN] (located on the right side when viewed from the rear of the main instrument), then connect the power cord.
	Is the circuit breaker located at the upper left on the instrument's front panel turned OFF?	Check the power consumption of equipment under test, then turn on the circuit breaker. (15 A max.) ❙ side: ON, ◯ side: OFF
Leakage current measurement cannot be conducted.	Is the fuse for terminal T2 on the front panel blown?	Replace the fuse. (designated fuse: 250 V T32 mA L)
The clock loses or gains time.	The clock may lose or gain up to 4 minutes per month.	The built-in lithium battery provides backup power for the clock. When the battery becomes depleted, the instrument may display an incorrect date and time. If this happens, request battery replacement (at a charge). The service life of the backup battery is about 4 years.
The instrument displays "**ERROR 1**."	Does the power supply voltage match the specified power source voltage of the main instrument?	Confirm that the power supply voltage matches the specified power source voltage of the 3156 instrument.
	Is the power fuse blown?	Replace the fuse located on the rear panel of the main instrument. (designated fuse: 250 V T0.1 A L)
The instrument displays "**ERROR 2**."	This error indication should not appear in normal use.	The instrument is malfunctioning. Turn off the power switch of the main instrument immediately, then contact your dealer (Hioki agent) or the nearest Hioki sales office.

If the cause of the problem is unknown, reset the system.
This restores to instrument to the default conditions set at the factory.
❖6.1, "Initializing the Instrument" (page 84)
Stop using the instrument in the cases described below. Disconnect the power cord and test leads, then contact your dealer (Hioki agent) or the nearest Hioki sales office.

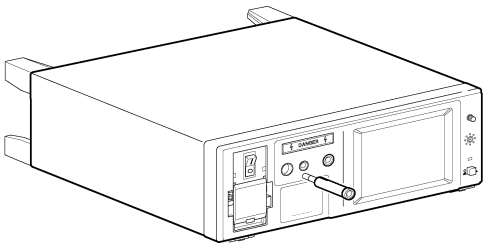
- When instrument damage can be confirmed
- When the instrument cannot be operated for measurement
- When the instrument has been stored under high temperature and humidity for an extended time
- When the instrument has been subjected to rough handling under adverse transport conditions

11.3 Replacing Fuses

⚠WARNING

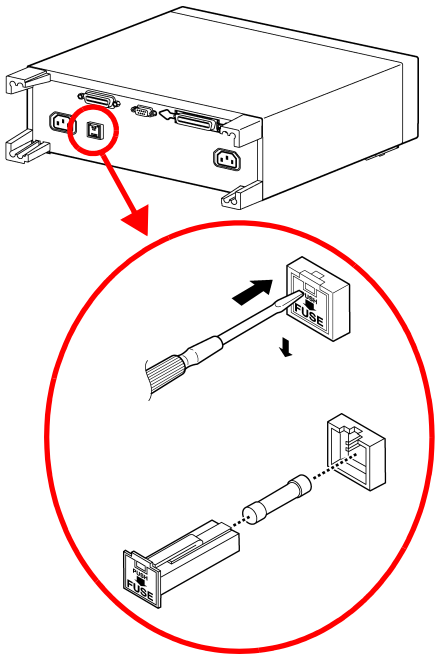
- **Replace the fuse only with one of the specified characteristics and voltage and current ratings. Using a non-specified fuse or shorting the fuse holder may cause a life-threatening hazard.**
  Power supply section : F250V T0.1AL
  Measurement terminal section : F250V T32mAL
- **To avoid electric shock, turn off the power switch and disconnect the power cord and test leads before replacing the fuse.**

Replacing the fuse for measurement operation (front panel)



1. Turn the power switch OFF (○), then disconnect the power cord and test leads.
2. Turn off the circuit breaker.
3. Gently press the red holder at terminal T2, turn it 90 degrees, then remove the fuse holder.
4. Replace the fuse for measurement operation with one of the specified rating.
5. With the indented section on the fuse holder facing up, insert the fuse holder into the socket on the main instrument, then turn it 90 degrees.

Replacing the power fuse (rear panel)



1. Turn the power switch OFF (○), then disconnect the power cord and test leads.
2. Use a flathead screwdriver to gently push down the hole on the fuse holder. The fuse holder is pushed out.
3. Replace the power fuse with one of the specified rating.
4. With the indented section on the fuse holder facing up, insert the fuse holder into the socket on the main instrument.

11.4 Instrument Disposal

The instrument contains a lithium battery for system memory backup.

⚠WARNING

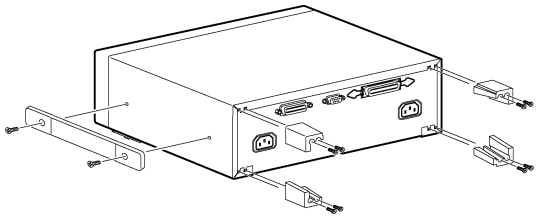
To avoid electric shock, turn off the power switch and disconnect the power cord and test leads before replacing the lithium batteries.

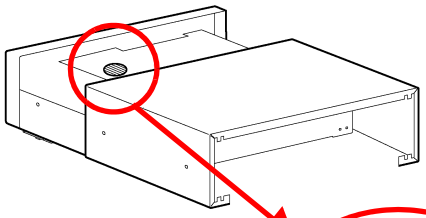
⚠CAUTION

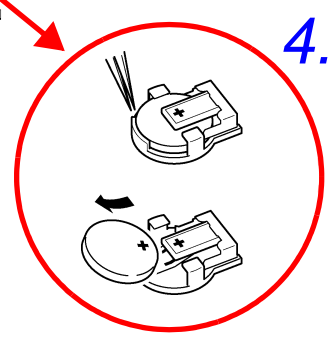
- If the protective functions of the instrument are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.
- When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

Removing the lithium battery

Required tools
- Phillips screwdriver 1 pc.
- Forceps 1 set







1. Turn the power switch OFF (○), then disconnect the power cord and test leads.
2. Remove the 8 screws that secure the legs on the rear panel, and the 2 screws used to mount the handle on the side panel.
3. Remove the top case section by sliding it to the back of the instrument.
4. Locate the battery installed at the corner of the circuit board. Insert the tip of forceps between the battery holder and battery to lift the battery for removal.

CALIFORNIA, USA ONLY
This product contains a CR Coin Lithium Battery which contains Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Appendix

Terminology

(excerpt from IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)

Equipment part	
Type B applied part 	Applied part complying with the specified requirements of the standard to provide protection against electric shock, particularly regarding allowable leakage current, and marked with the symbol indicated at the left. Note: Type B applied parts are not suitable for direct cardiac application. (JIS T1001-92 describes such parts as "Type B equipment.")
Type BF applied part 	F-type applied part complying with the specified requirements of the standard to provide a higher degree of protection against electric shock than that by Type B applied parts, and marked with the symbol indicated at the left. Note: Type BF applied parts are not suitable for direct cardiac application. (JIS T1001-92 describes such parts as "Type BF equipment.")
Type CF applied part 	F-type applied part complying with the specified requirements of the standard to provide a higher degree of protection against electric shock than that by Type BF applied parts, and marked with the symbol indicated at the left. (JIS T1001-92 describes such parts as "Type CF equipment.")
F-type isolated applied part	F-type isolated (floating) applied part (or simply F-type applied part) in which the patient connections are isolated from other parts of the medical equipment so that current higher than the patient leakage current allowed in a single-fault condition does not flow if an unintended voltage originating from an external source is connected to the patient, and thereby applied between the patient connection and ground.
Accessible metal part	Metal part of equipment which can be touched without the use of a tool.
Applied part	A part of the equipment which in normal use: - must come into physical contact with the patient for the equipment to perform its function; or - can be brought into contact with the patient; or - needs to be touched by the patient (differently described in JIS T1001-92)
Live	State of a part which, when connection is made to that part, can cause a current exceeding the allowable leakage current for the part concerned to flow from that part to earth or from that part to an accessible part of the same equipment.

Equipment part	
Signal input section	Part of equipment, excluding applied parts, intended to receive voltage or current as input signals, for example, for display, recording, or data processing.
Signal output section	Part of equipment, excluding applied parts, intended to deliver voltage or current as output signals, for example, for display, recording, or data processing.
Patient connection section	Each individual part of an applied part through which current can flow between the patient and medical equipment in normal condition or single-fault condition (not described in JIS T1001-92).

Equipment type (classification)	
Medical electrical equipment	Electrical equipment, provided with no more than one connection to a particular supply mains and intended to diagnose, treat or monitor the patient under medical supervision and which makes physical or electrical contact with the patient and/or transfers energy to or from the patient and/or detects such energy transfer to or from the patient. The equipment includes those accessories as defined by the manufacturer which are necessary to enable the normal use of the equipment. (JIS T1001-92 does not include the description, "The equipment includes those accessories as defined by the manufacturer which are necessary to enable the normal use of the equipment.")
Class-I equipment	Equipment in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in that means are provided for the connection of the equipment to the protective earth conductor in the fixed wiring of the installation in such a way that accessible metal parts cannot become live in the event of a failure of basic insulation.
Class-II equipment	Equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions.
Class-01 equipment	Class-01 equipment has at least basic insulation and a protective conductive terminal. It cannot be connected to a fixed main power socket with an earth terminal using a main power cord that contains a protective earth conductor. (excerpt from JIS C 1010-1-98)
Internally powered equipment	Equipment that can be operated using an internal electrical power source.
Mobile equipment	Transportable equipment that can be moved from one location to another between periods of use while supported by its own wheels or equivalent means.
Permanently installed equipment	Equipment that is electrically connected to a power supply by a permanent connection that can only be detached by using a tool.

Others	
Basic insulation	Insulation applied to live parts to provide basic protection against electric shock.
Double insulation	Insulation comprising both basic insulation and supplementary insulation. (JIS T1001-92 adds a supplementary description "...which can be individually tested when necessary.")
Reinforced insulation	Single insulation system applied to live parts which provide a degree of protection against electric shock equivalent to double insulation under the conditions specified in IEC 60601-1. (JIS T1001-92 does not include the description "under the conditions specified in IEC 60601-1.")
Supplementary insulation	Independent insulation applied in addition to basic insulation in order to provide protection against electric shock in the event of a failure of basic insulation.
Protective earth conductor	Conductor to be connected between the protective earth terminal and an external protective earthing system.
Protective earth terminal	Terminal connected to conductive parts of Class-I equipment for safety purposes. This terminal is intended to be connected to an external earthing system by a protective earth conductor.
Normal condition	Condition in which all means provided for protection against hazards are intact.
Single-fault condition	Condition in which a single means of reducing the risk resulting from a hazard is defective or a single abnormal condition exists.

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HIOKI

DECLARATION OF CONFORMITY

Manufacturer's Name:	HIOKI E.E. CORPORATION
Manufacturer's Address:	81 Koizumi, Ueda, Nagano 386-1192, Japan
Product Name:	LEAK CURRENT HiTESTER
Model Number:	3156
Accessories:	9170-10 TEST LEAD 9195 ENCLOSURE PROBE
Options:	9637 RS-232C CABLE 9638 RS-232C CABLE 9151-02 GP-IB CABLE 9151-04 GP-IB CABLE 9444 CONNECTION CABLE

The above mentioned products conform to the following product specifications:

Safety:	EN61010-1:2001 EN61010-031:2002
EMC:	EN61326-1:2006 ClassB equipment Basic Immunity test requirement EN61000-3-2:2006 EN61000-3-3:1995+A1:2001+A2:2005

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC.

HIOKI E.E. CORPORATION

16 January 2009

Atsushi Mizuno

Director of Quality Assurance

3156A999-04

HIOKI

HIOKI E. E. CORPORATION

HEAD OFFICE
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp URL http://www.hioki.com/
(International Sales and Marketing Department)

HIOKI USA CORPORATION
6 Corporate Drive, Cranbury, NJ 08512, USA
TEL +1-609-409-9109 FAX +1-609-409-9108

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