HIOKI

INSTRUCTION MANUAL

3155-01

LEAK CURRENT HiTESTER

HIOKI E. E. CORPORATION

Contents

Introduction

Thank you for purchasing this HIOKI "3155 LEAK CURRENT HiTESTER." To get the maximum performance from the unit, please read this manual first, and keep this at hand.

Inspection

When the unit is delivered, check and make sure that it has not been damaged in transit. If the unit is damaged, or fails to operate according to the specifications, contact your dealer or HIOKI representative.

Checking the main unit and accessories

Main unit
"3155 LEAK CURRENT HiTESTER"

Accessories

Verify that the following standard accessories are complete.
(1) Grounded three-core power cord
(2) 9170 TEST LEADS
(3) Instruction Manual
(4) 9195 ENCLOSURE PROBE
(5) Spare fuse 3155 (120 V): 250 V T0.5 AL
3155 (200/240 V): 250 V T0.25 AL
3155-01: 250 V T0.2 AL
(6) 9233 RECORDING PAPER (1 roll)
(7) 9399 CARRYING CASE (for accessories)
(8) Alligator clips (red and black)
(9) Outlet power plug (3155 (200/240 V), 3155-01)
(10) Voltage selector key (3155-01 only) 2

NOTE

The NETWORKS (9497 to 9499), 9461 PIN- TYPE LEADS, 9287 CLIP-TYPE LEADS, and 9196 APPLY UNIT are not included. Please purchase separately according to your needs.

Shipment of the unit

If reshipping the unit, preferably use the original packing.

Warranty

HIOKI cannot be responsible for losses caused either directly or indirectly by the use of the 3155 with other equipment, or if ownership is transferred to a third party.

Safety Notes

⚠ DANGER

This equipment is designed according to IEC 61010-1 Safety Standards, and has been tested for safety prior to shipment. During high voltage measurement, incorrect measurement procedures could result in injury or death, as well as damage to the equipment. Please read this manual carefully and be sure that you understand its contents before using the equipment. The manufacturer disclaims all responsibility for any accident or injury except that resulting due to defect in its product.

This Instruction Manual provides information and warnings essential for operating this equipment in a safe manner and for maintaining it in safe operating condition. Before using this equipment, be sure to carefully read the following safety notes.

Safety symbols

	• This symbol is affixed to locations on the equipment where the operator should consult corresponding topics in this manual (which are also marked with the ⚠ symbol) before using relevant functions of the equipment. • In the manual, this mark indicates explanations which it is particularly important that the user read before using the equipment.
	Indicates a fuse.
	Indicates a grounding terminal.
	Indicates DC (Direct Current).
	Indicates AC (Alternating Current).
	Indicates both DC (Direct Current) and AC (Alternating Current).
	Indicates the ON side of the power switch.
	Indicates the OFF side of the power switch.

The following symbols are used in this Instruction Manual to indicate the relative importance of cautions and warnings.

⚠ DANGER	Indicates that incorrect operation presents extreme danger of accident resulting in death or serious injury to the user.
⚠ WARNING	Indicates that incorrect operation presents significant danger of accident resulting in death or serious injury to the user.
⚠ CAUTION	Indicates that incorrect operation presents possibility of injury to the user or damage to the equipment.
NOTE	Denotes items of advice related to performance of the equipment or to its correct operation.

Notes on Use

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.

Before measurement

⚠ WARNING

- **Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit. (3155: specified at order, 3155-01: set by the voltage selector)**
- **If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.**
- **The unit is constructed so as to be connected to a ground line via a three-core power cord that is supplied with the unit. In order to avoid electric shock, connect the unit to a properly grounded (3-pin) outlet using the power cord provided.**
- **Before using the unit, make sure that the sheathing on the leads / probes is not damaged and that no bare wire is exposed. If there is damage, using the unit could cause electric shock. Replace the lead / probe with the specified 9195 or 9170, or optional 9461 or 9287.**
- **To avoid the danger of electric shock, never operate the unit with a measurement network removed.**
- **Do not swithc the voltage selector when the power is turned on.**

⚠ CAUTION

Do not press hard upon the touch screen, or operate it using a hard object or one with a sharp end. Doing so could scratch or damage the screen or the soft keys.

NOTE

- Of the three optional Measurement Networks (9497, 9498 and 9499), one must be installed with the 3155 or no measurements can be made. If the power to the 3155 is turned on without having installed one of the networks, the message 'Measurement Network not installed.' will appear on the LCD. In which case, please install a measurement network as described in Section 4.1, "Installing the Measurement Network."
- Because the current consumption monitor is AC coupled, errors occur when measuring an AC current which includes a DC offset. (Example: half-wave rectified current)

Connection

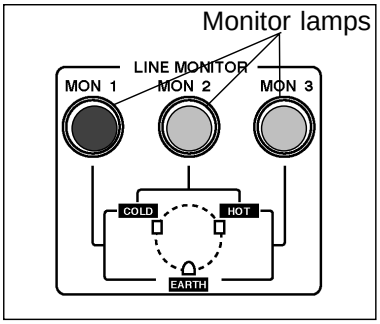
⚠ CAUTION

- In order to avoid electric shock, turn off the power to all devices before plugging in or unplugging the measurement network or RS-232C connector.
- When unplugging the power cord from the power receptacle or from the unit, grasp the plug, not the cord, in order to avoid damaging the cable.
- To avoid damaging the leads or probes, do not bend or pull the leads or probes.
- Use caution when taking measurements in circuits where the power line are hot.
- For safety reasons, only use the 9195 or 9170 probe / test lead provided with the unit, or the optional 9461 or 9287 for measurement.
- The changing of the function when replacing the test terminals requires disconnection of the test leads from the equipment being measured and then the disconnection of the test leads from the terminals.
- To avoid damage to the unit, do not short the output terminal and do not input voltage to the output terminal.
- Use the unit near the power receptacle.

During measurement

⚠ WARNING

- **The 9196 APPLY UNIT used in the measurement of enclosure leakage current, patient leakage current Ⅱ and patient leakage current Ⅲ continuously outputs voltage while the voltage application button is being pressed. Care is required to avoid accidents caused by electrical shock.**
- **The leakage current measurement terminals, the resistance measurement terminals and the RS-232C connector are not insulated. Handle these items carefully in order to avoid electric shock or a short circuit accident.**
- **If the end of a lead or a probe short-circuits lines with a voltage between them, this is very dangerous and can lead to a serious accident. Exercise great care when measuring voltages.**
- **In the event that the equipment malfunctions in any manner during use, turn off the power immediately, and contact your dealer or HIOKI representative.**



NOTE

When the power to the 3155 is turned on, if the MON2 and MON3 lamps are illuminated, an accurate measurement can be obtained. (The unit can also be wired so that MON1 and MON2 illuminate.)
For details, refer to Section 4.3, "Powering on and off the Unit."

Input

⚠ DANGER **To avoid electric shock and damage to the unit, do not input a voltage exceeding the permissible common mode voltage to the leakage current measurement terminals. The permissible common mode voltage is 250 V (DC+AC peak). (In the 50 µA range, 20 V (DC+AC peak))**

⚠ CAUTION When the power is turned off, do not apply voltage or current to the leakage current measurement terminals or resistance measurement terminals. Doing so may damage the unit.

Replacement

⚠ WARNING

- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death.**
  (120 V: 250 V T0.5 AL, 200/240 V: 250 V T0.25 AL 20 mm × 5 mm dia. (3155))
  (110 to 120/200/240 V: 250 V T0.2 AL 20 mm × 5 mm dia. (3155-01))
- **When replacing the fuse and measurement network, always power off the unit.**

Operating environment

⚠ WARNING

- **To prevent electric shock, do not allow the unit to become wet and do not use the unit when your hands are wet.**
- **The interior of the 3155 contains some components which are subject to high voltage, and therefore dangerous. Absolutely do not remove the cover panel. In particular, be careful of the 9196 APPLY UNIT, which is subject to high voltage.**
- **To avoid damage to the unit, do not subject the equipment to vibrations or shocks during transport or handling. Be especially careful to avoid dropping the equipment.**
- **The unit should always be operated indoors in a range from 5℃ to 40℃ and 35% to 80% rh. Do not use the unit in direct sunlight, dusty conditions, or in the presence of corrosive gases.**
- **Do not use the unit near any device which generates strong electromagnetic radiation or near a static electrical charge, as these may cause errors.**

NOTE

- Accurate measurement may be impossible in locations subject to strong external magnetic fields, such as transformers and high-current conductors, or in locations subject to strong external electric fields, such as radio transmission equipment.
- Do not use the 3155 in operating rooms, ICUs, CCUs or other areas where an isolated electrical supply is used. To do so will result in inaccurate readings.

Printer and recording paper

Printer

- Using the printer in a high-temperature or high-humidity environment should be avoided at all costs. This can seriously reduce the printer life.
- Because the thermal printing head is subject to high temperatures during printing, do not touch the head itself or its support sections either during or directly after printing. Care is also necessary when replacing the paper or during maintenance. For paper replacement, refer to Section 4.4, "Loading Recording Paper."
- Because the motor is subject to high temperature during operation, do not touch it either during or directly after printing.
- To prevent the motor from being overheated, do not press the feed switch continuously for more than 3 minutes.

Recording paper

- This unit uses a thermal printer. The recording paper supplied has characteristics finely tuned for use with the printer.
  Using recording paper of a different specification may not only result in impaired printing quality, but even prevent the printer from operating.
  Always use the HIOKI specified product.
- If light reaches the paper over a long period, the paper will discolor. Do not unwrap rolls of paper until you are ready to use them.
- The recording paper uses a thermochemical reaction. Note the following points:
  - To avoid discoloration, do not leave recording paper in direct sunlight. Store at not more than 40℃ and 90% rh.
  - To keep definitive data, make photocopies of the recordings.
  - If the thermal paper absorbs an organic solvent such as alcohols or ketones it may no longer develop properly, and recorded information may fade. Soft PVC film and transparent contact adhesive tape contain such solvents, so avoid using them with recordings.
  - Avoid interleaving the thermal recordings with damp diazo copies.

Contents of this Manual

The operating methods of the 3155 LEAK CURRENT HiTESTER will vary depending upon the type of measurement network used. The various operating methods for each type of measurement network are shown in Chapters 5 to 7. Although there is some repetition between chapters, to ensure safe operation please read thoroughly the chapter pertaining to the measurement network you use.

Chapter 1: Overview
Gives an overview and features of the unit.

Chapter 2: Names of Functions of Parts
Describes the names and functions of the parts of the unit.

Chapter 3: Options
Describes the options (measurement networks and application units) of the unit.

Chapter 4: Preparations for Measurement
Describes the installation and preparatory work.

Chapter 5: Medical Electrical Equipment Measurement
(9497 NETWORK B installed)
Describes the medical electrical equipment measurement.

Chapter 6: Ordinary Electrical Equipment Measurement (for IEC/TR 60990)
(9498 NETWORK C installed)
Describes the ordinary electrical equipment measurement (for IEC/TR 60990).

Chapter 7: Ordinary Electrical Equipment Measurement (Universal)
(9499 NETWORK D installed)
Describes the ordinary electrical equipment measurement (universal).

Chapter 8: Command Reference
Describes the RS-232C communications and their operation examples.

Chapter 9: Specifications
Contains the unit specifications such as the general specifications, measurement ranges, accuracy, etc. of the unit.

Chapter 10: Maintenance and Servicing
Covers the maintenance and servicing.

Appendices: Covers the error messages, leakage current measurement, standards and glossary.

Chapter 1
Overview

1.1 Product Introduction

The HIOKI 3155 LEAK CURRENT HiTESTER is a leakage current measuring instrument for use in testing electrical equipment used in a wide variety of applications from computers to medical care. Not only does it conform to all standards for testing medical electrical equipment, but also to laws and standards applicable to equipment for non-medical care as well.
By using one of three (optional) measurement networks that simulate the human body, measurements that conform to a variety of laws and standards for electrical equipment can be made.
Once the measurement network for the equipment to be measured is attached, a measurement screen conforming to the applicable requirements is displayed. By using the 'touch keys' on the screen, measurements are easily made. (For patient leakage current Ⅱ, patient leakage current Ⅲ and enclosure leakage current, the 9196 APPLY UNIT is necessary.)
To ensure safety in the use of electrical equipment, a wide variety of tests for characteristics such as insulation resistance, earth resistance, leakage current, etc., need be made. The 3155 is designed to be used in leakage current testing in a variety of fields.

Used by:

Manufacturers of medical electrical equipment	For formal inspections and pre-shipping inspections
Sales agents of medical electrical equipment	For inspection and maintenance
Personnel performing repairs on medical electrical equipment	For inspection and maintenance
Clinical engineering technologists at hospital	For inspection and maintenance
Clinical engineering technologists training schools	For educational purposes
Electrical contractors qualified to install operating rooms, ICUs and CCUs	For inspections of insulated transformers
Public agencies	For formal inspections
Manufacturers of electrical equipment	For formal and pre-shipping inspections
Users of electrical equipment	For inspection and maintenance
Electrical contractors	For inspection and maintenance
Electrical repair technicians	For inspection and maintenance
Manufacturers of electrical components	For formal and pre-shipping inspections
Manufacturers of electric generators	For formal and pre-shipping inspections

1.2 Features of the 3155

(1) Measurement networks that conform to a variety of laws and standards

In order to perform a variety of tests that conform to the various laws and standards applicable to leakage current testing, it is necessary to utilize a measurement network that simulates the human body when making measurements. Different measurement networks conform to different laws and standards:

① 9497 NETWORK B: IEC 60601-1
② 9498 NETWORK C: IEC/TR 60990
③ 9499 NETWORK D: IEC 60065, IEC 60335-1, UL

These measurement networks can also be used to perform tests that conform to a variety of other standards as well. For details, refer to Section 3.1, "Measurement Networks."

(2) Superior operability

All operations are performed via the display screen touch panel. The operational keys are displayed on the screen for interactive operation.

(3) Measuring mode

Once a measurement network has been attached to the back of the 3155 unit and the power is turned on, the measuring modes available in that network are displayed on the screen.

① Earth leakge current
② Enclosure leakage current
③ Patient leakage current Ⅰ
④ Patient leakage current Ⅱ
⑤ Patient leakage current Ⅲ
⑥ Patient auxiliary current
⑦ Low resistance measurement

(4) Leakage current measurement

The user can select a measuring mode from the ones available in the measurement network. The configuration of the instrument will also effect which modes are available. The necessary modes are displayed from ① to ⑥.

(5) Low resistance measurement

Low resistance measurement of a protective earth conductor is performed at a current of 25 AAC or DC as prescribed in all standards. The 3155 is equipped with a DC 4-terminal method measurement (at 100 mADC max.) function for easy measurement. Measurement is also possible using RS-232C interfacing with the 3157 AC GROUNDING HiTESTER (max. 31A AC, conforming to various standards), available separately.

(6) Interface

An RS-232C interface is standard equipment to allow for easy transfer of measurement data to a computer.

(7) Built-in printer

The built-in thermal serial printer allows for easy printout of saved data.

(8) Monitor function

Equipped with a line voltage and current consumption monitor.

(9) Voltage selector (3155-01 only)

The equipment with the power voltages of 110 to 240 V can be measured with a single unit.

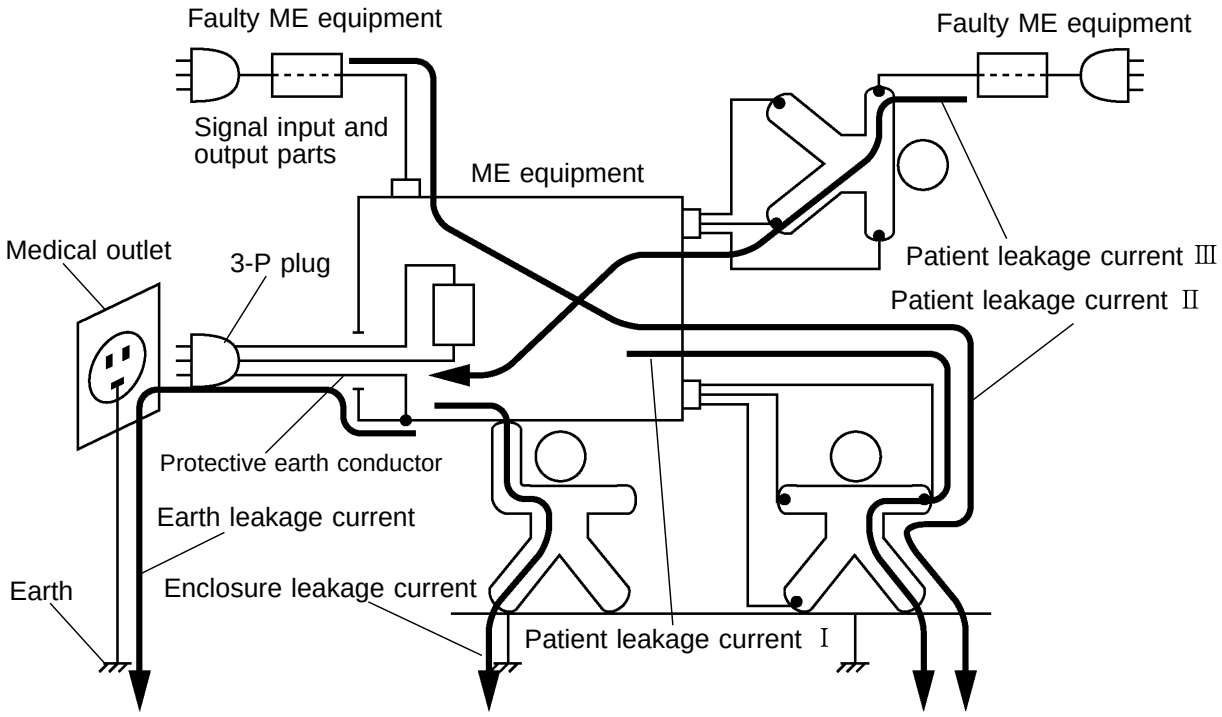
1.3 Measuring Mode of the 3155

The 3155 has been designed with the idea in mind that leakage current testing is the most important of all tests for electrical safety. In particular, for medical electrical equipment, leakage current has the greatest potential for harming human beings, and is therefore strictly regulated even with regard to single fault conditions. Through the use of measurement networks B, C and D, the 3155 can perform leakage current testing for all types of electrical equipment from ordinary electrical equipment to medical electrical equipment. For details, refer to Section 3.1, "Measurement Networks."

Measurement network types	Available measuring modes
9497 NETWORK B	① Earth leakage current ② Enclosure leakage current ③ Patient leakage current Ⅰ ④ Patient leakage current Ⅱ ⑤ Patient leakage current Ⅲ ⑥ Patient auxiliary current ⑦ Low resistance measurement
9498 NETWORK C	① Earth leakage current ② Enclosure leakage current ⑦ Low resistance measurement
9499 NETWORK D	① Earth leakage current ② Enclosure leakage current ⑦ Low resistance measurement

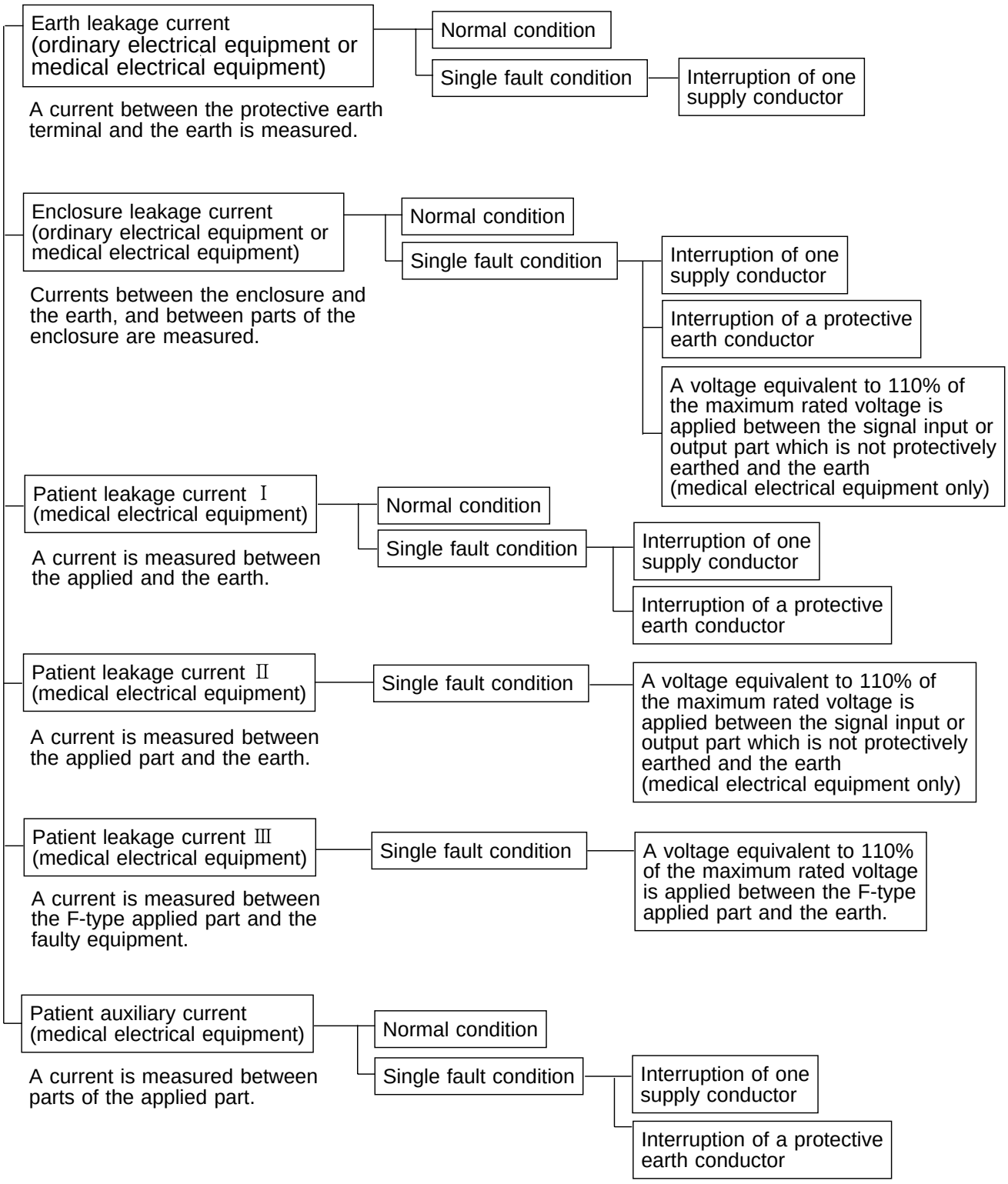
NOTE Setting for normal condition or single fault conditions is possible. The polarity of the power source can also be set.
The voltage input from the power inlet is directly output to the auxiliary outlet for the equipment to be measured.
When testing with the 110% power voltage, input it to the power inlet.

Leakage current route of the medical electrical equipment (ME equipment)



For details, refer to Appendix 2, "Leakage Current Measurement."

1.4 Leakage Measurement Types

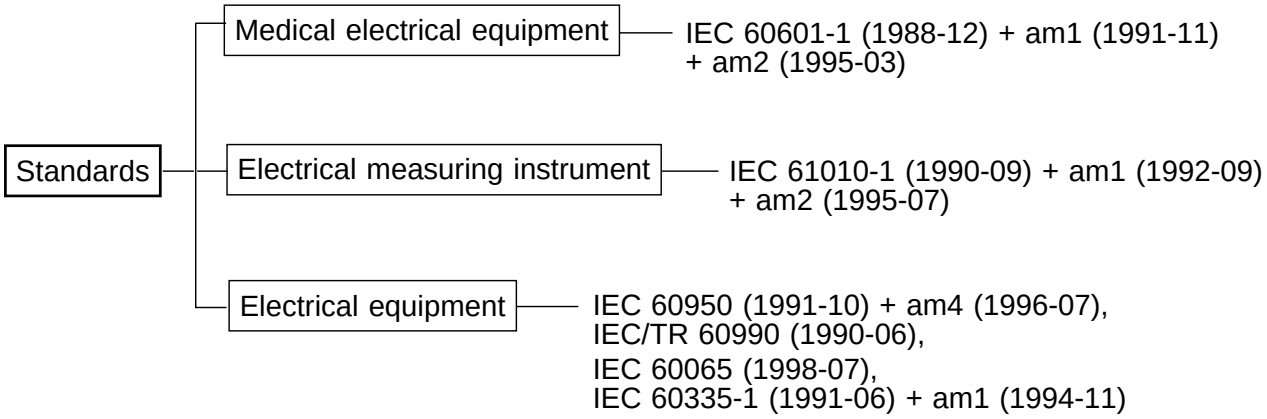


NOTE

- Measurements including the combined single fault conditions is not possible.
- The optional 9196 APPLY UNIT is required to apply a voltage equivalent to 110% of the maximum rated voltage.

1.5 Standards Regarding Leakage Current

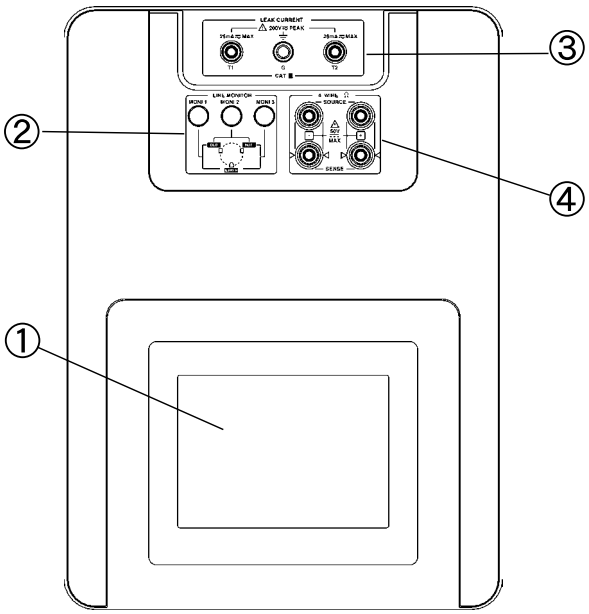
The measurement network you use will vary depending upon the standards to which you must conform.
There are instances where testing for leakage current is required by standard to be included in formal testing, or in ownership transfer testing as well.

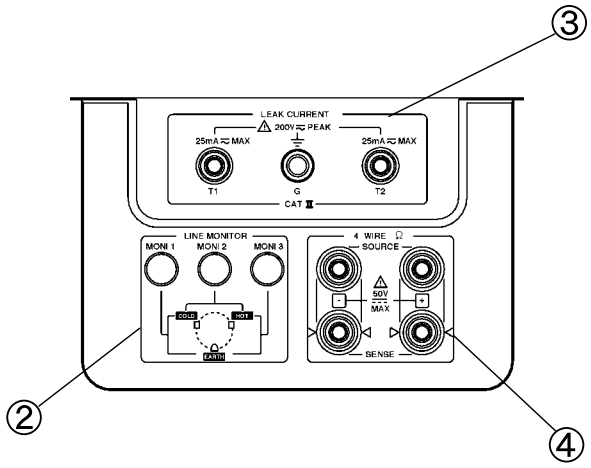


NOTE The standards above are subject to amendment. For details, refer to each standard.

Chapter 2
Names and Functions of Parts

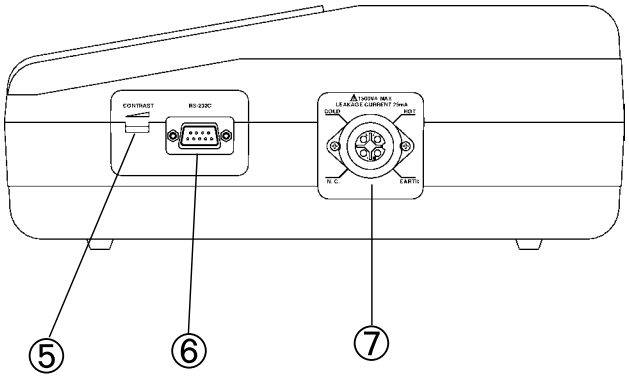
Top view





Enlarged diagram of the terminal section

Right side view



① Liquid crystal display

This 5-inch display includes a touch panel which performs the role of the input keys.

② Monitor lamps

The condition of elements such as the power line ground are indicated by these monitor lamps.

When the power to the 3155 is turned on, if the MON2 and MON3 lamps are illuminated, an accurate measurement can be obtained. (The unit can also be wired so that MON1 and MON2 illuminate.)

For details, refer to Section 4.3, " Powering on and off the Unit."

③ Leakage current measurement terminals

There are three terminals available.

G: G terminal (connects to the earth terminal of the equipment to be measured)

T1: Leakage current measurement terminal T1 (Location of connection to the equipment to be measured varies with the measuring mode.)

T2: Leakage current measurement terminal T2 (Location of connection to the equipment to be measured varies with the measuring mode.)

④ Resistance measurement terminals

There are four terminals available.

SOURCE(+), SENSE(+), SENSE(-), SOURCE(-)

The SOURCE banana plug of the 9461 or 9287 is to be connected to SOURCE, and the SENSE to SENSE.

⑤ Contrast adjustment knob

Use this knob to adjust the screen contrast.

⑥ RS-232C connector (Dsub 9 pin male)

Connect a RS-232C cable here to communicate with an external controller such as a computer.

⑦ Auxiliary power socket (for the equipment to be measured)

(earthed 3-pin socket - 1500 VA max.)

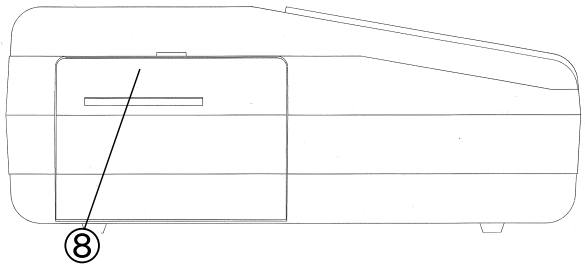
Plug the equipment to be measured in here.

Outputs the voltage input from the power inlet ⑬ directly.

When testing with the 110% power voltage, input it to the power inlet ⑬.

Use the supplied power plug for connection.

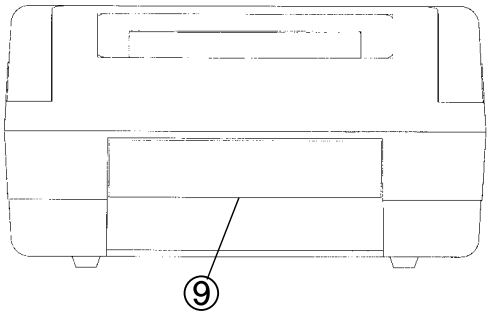
Left side view



⑧ Internal printer

Prints out the measurement results etc.

Front view

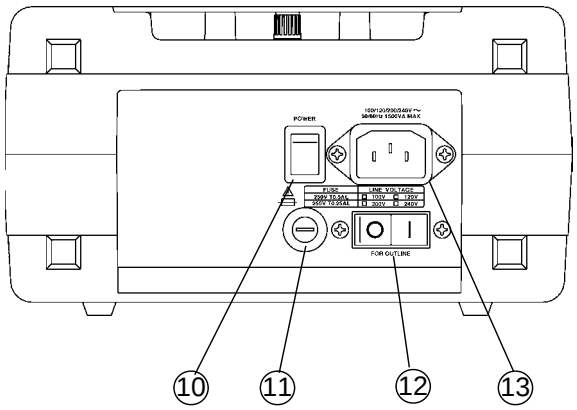


⑨ Handle

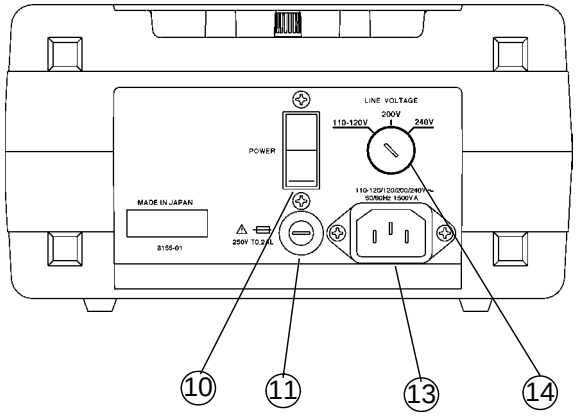
This is used for transporting the 3155.

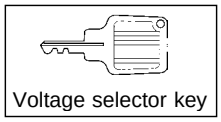
Rear view

3155



3155-01





⑩ Main power switch

Powers the 3155 on (|) or off (○).
(With the 3155-01, includes the function of the auxiliary power outlet circuit breaker.)

⑪ Fuse holder

Insert the proper fuse here, as indicated on the label.

⑫ Auxiliary power outlet circuit breaker (3155 only)

In the event that the current to the auxiliary power outlet ⑦ exceeds 1500 VA, this breaker will trip.
ON (|) : Current is being supplied to the auxiliary power outlet.
OFF (○) : Current is not being supplied to the auxiliary power outlet.

⑬ Power inlet

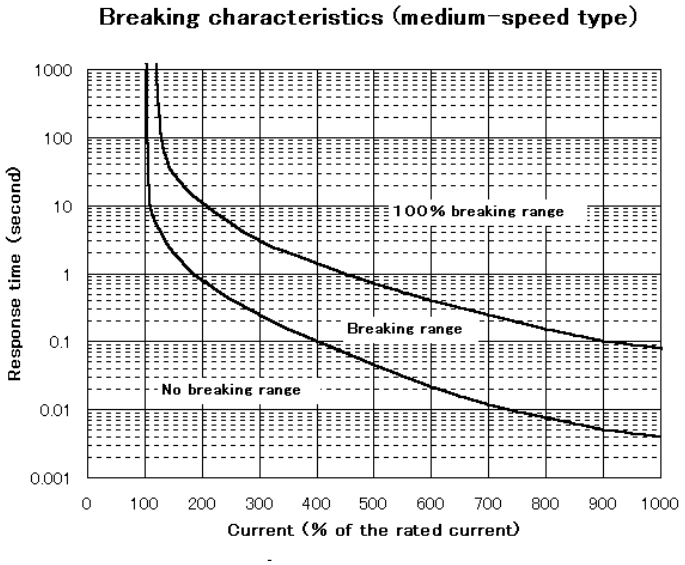
Connect the grounded three-core power cord supplied here.

⑭ Voltage selector key (3155-01 only)

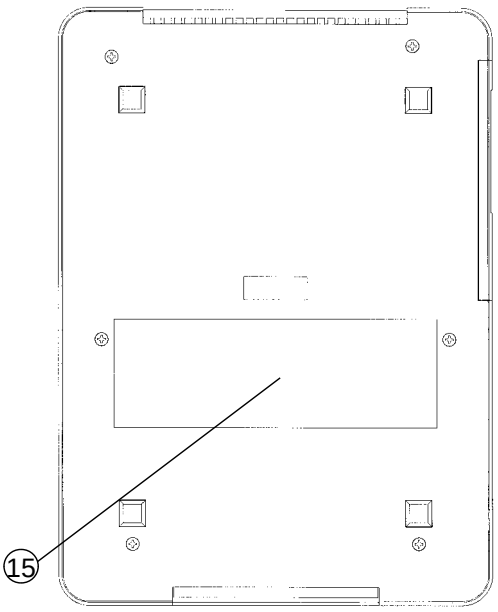
Insert the supplied voltage selector key into the keyhole of the voltage selector, and select the power voltage by setting it to the required power voltage.
For details, refer to Section 4.2, " Power Cord Connection."

Auxiliary power outlet circuit breaker

The unit uses the medium-speed breaker for the rush current of the equipment to be measured.
Refer to the following table for breaking characteristics.



Bottom view



⑮ Measurement network socket

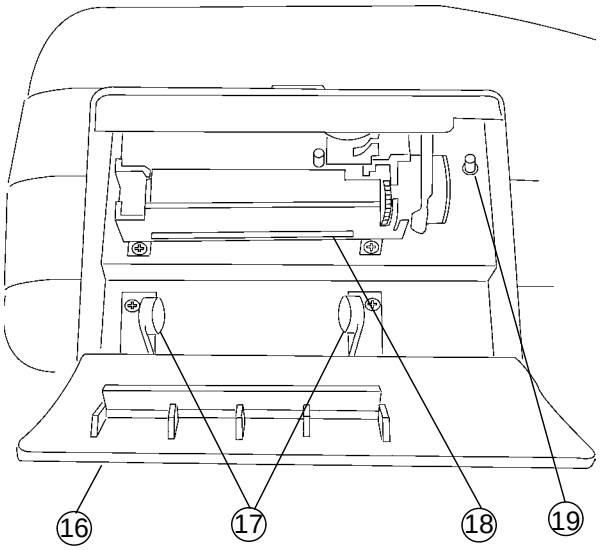
Use this socket to attach the measurement network that conforms to your needs.
The following measurement networks are available:

a. 9497 NETWORK B: Medical electrical equipment
b. 9498 NETWORK C: IEC/TR 60990
c. 9499 NETWORK D: IEC 60065, IEC 60335-1, UL

NOTE

For measurement networks, refer to Section 3.1, "Measurement Networks," and for installation, Section 4.1, "Installing the Measurement Network."

Interior of the built-in printer



⑯ Printer cover

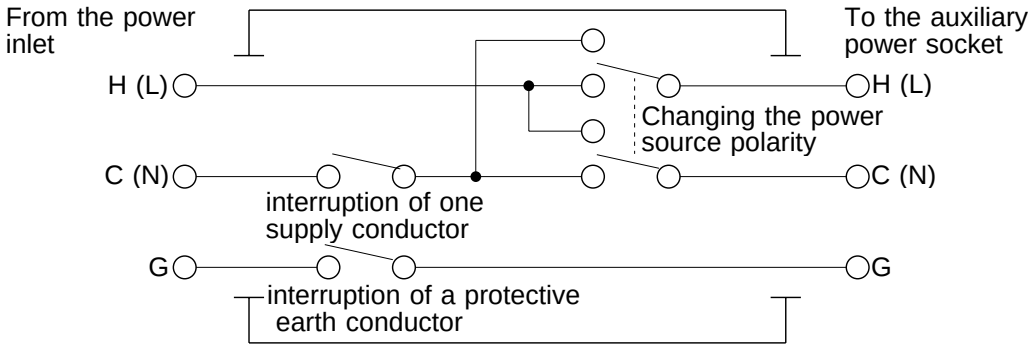
⑰ Recording paper holder

⑱ Paper feed

⑲ Feed switch

Inside the changeover box

A changeover box is built into the 3155.
It is built between the power inlet and the auxiliary power socket.
It outputs changing the power source polarity and the condition. So the power source polarity (normal or reverse polarity) can be changed easily, and the single fault condition (interruption of one supply conductor or interruption of a protective earth conductor) can be set easily.

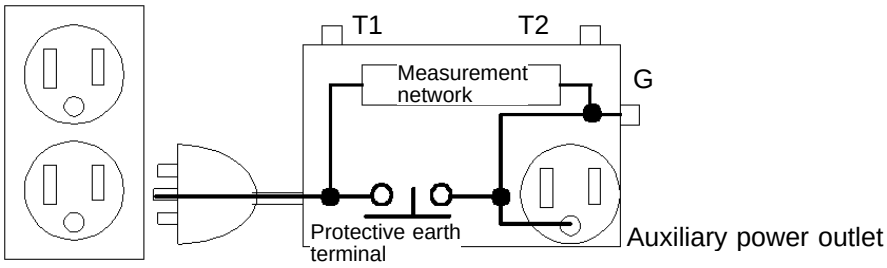


Connections of G, T1 and T2

(1) In the earth leakage current measurement mode

G and the earth electrode of the auxiliary power outlet are connected to one side of the measurement network.

The other side of the measurement network is connected through the protective earth terminal and its conductor to the ground.

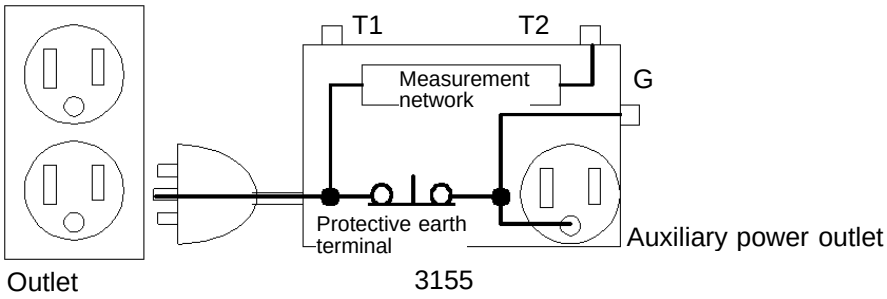


(2) In the enclosure leakage current mode (contact condition: between the enclosure and the earth) and patient leakage current Ⅰ (Class Ⅰ, Ⅱ equipment) and Ⅱ measurement modes

T2 is connected to one side of the measurement network.

The other side of the measurement network is connected through the protective earth terminal and its conductor to the ground.

G and the earth electrode of the auxiliary power outlet are connected through the protective earth terminal and its conductor to the ground.

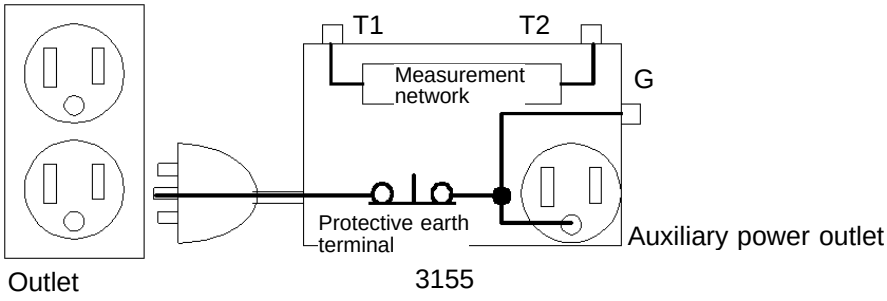


(3) In the enclosure leakage current mode (contact condition: between parts of the enclosure (when the 9497 is installed) and between the enclosure and the power line (when the 9498 or 9499 is installed)), patient leakage current Ⅰ (Internally powered equipment) measurement modes, patient leakage current Ⅲ measurement mode and patient auxiliary current measurement modes

T2 is connected to one side of the measurement network.

T1 is connected to the other side of the measurement network.

G and the earth electrode of the auxiliary power outlet are connected through the protective earth terminal and its conductor to the ground.



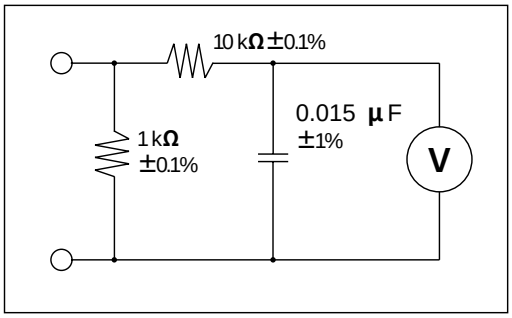
Chapter 3
Options

3.1 Measurement Networks

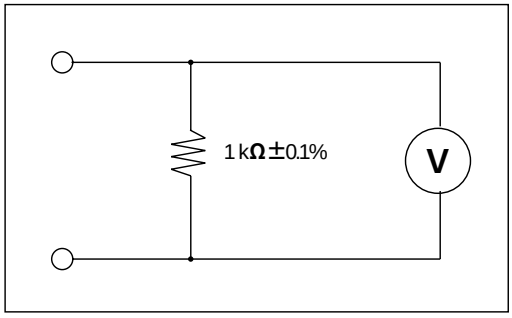
Please choose one of the three measurement networks that simulate the human body to perform measurements conforming to standards for electrical equipment to be tested.
The measurement networks cannot be used separately, but must always be installed on the 3155.
For the installation procedure, refer to Section 4.1, "Installing the Measurement Network," and for the fuse replacement, Section 10.2.2, "Replacement of the Measurement Network Fuse."

3.1.1 9497 NETWORK B (for the Medical Electrical Equipment)

This measurement network is for the medical electrical equipment.
Measurement network B conforms to the following standard:
Medical electrical equipment Part 1: General requirements of safety (IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))
By installing on the 3155 and making the appropriate settings from the screen, a configuration with a network with frequency characteristics for ON, and a network with only 1 kΩ of uninduced resistance for OFF is established.



Network with frequency characteristics (ON)



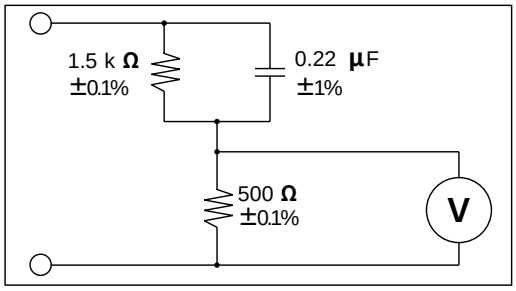
Network with only 1 kΩ of uninduced resistance (OFF)

Specifications

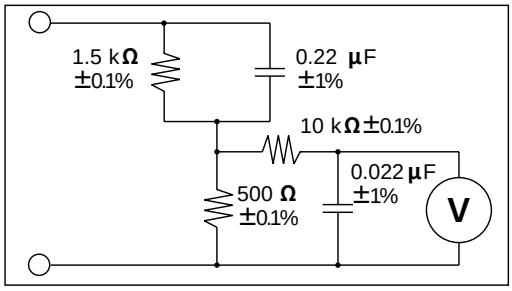
Standard	Medical electrical equipment Part 1: General requirements ofsafety (IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))
Measuring circuit configuration	Basic measuring element 1 kΩ, frequency characteristics ±0.5% (DC to 1 MHz)
Low pass filter function	(1MΩ load with input protection fuse shorted) Filter configuration (ON setting): RC filter (10 kΩ+15 nF) Cutoff frequency, fc (at -3 dB): 1061 Hz±16 Hz Passband attenuation: 0 dB±2% (at 100 Hz) Attenuation: -20 log (f/fc) ±1dB (10 kHz≦f≦1 MHz) Filter setting: On/off switch (off: 1 kΩ only)
Approved tolerances for element	±0.1% for resistance, ±1% for capacitor
Fuse	250 V T0.032 AL 20 mm×5 mm dia.
Dimensions and mass	140W × 35H × 29D mm(5.51"W × 1.38"H × 1.14"D), approx. 70 g(2.5 oz.)
Accessories	Instruction Manual, spare fuse

3.1.2 9498 NETWORK C (for IEC/TR 60990)

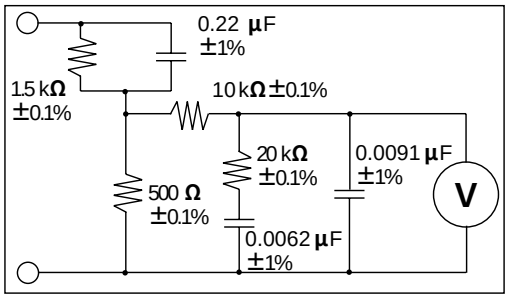
This measurement network conforms to IEC/TR 60990.
Measurement network C conforms to the following standard:
Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))
By installing on the 3155 and making the appropriate settings from the screen, a configuration with a body impedance network for OFF, a perception and reaction network for ON1, and a let-go network for ON2 is established.



Body impedance network (OFF)



Perception and reaction network (ON1)



Let-go network (ON2)

Installation of measurement network C will enable leakage current testing that conforms to the following standards:

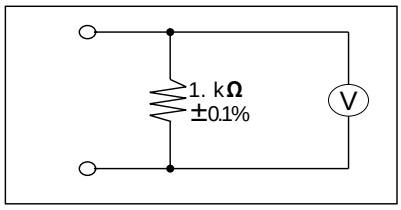
- Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements (IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07))
- Safety of information technology equipment (IEC 60950 (1991-10) + am4 (1996-07))
- Audio, video and similar electronic apparatus - Safety requirements (IEC 60065 (1998-07))
- Applicable UL standards：（Examples：UL1419, UL3101-1, UL3111-1, etc.）

Specifications

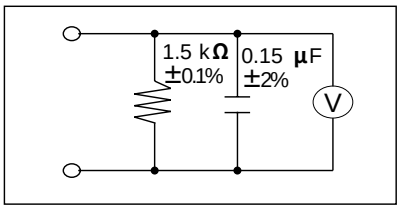
Standard	Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))
Measuring circuit configuration	Basic measuring element 1.5 kΩ+500 Ω
Filter configuration and characteristics	(1MΩ load with input protection fuse shorted) OFF setting: High pass filter Cutoff frequency (at -3 dB): 1805 Hz±27 Hz Passband attenuation: 0 dB±2% (at 100 kHz) Low-frequency attenuation: -12 dB±0.3 dB (at 100 Hz) ON1 setting: (perception) 10 kΩ+22 nF Passband attenuation: -12 dB±0.3 dB (at 100 Hz) High-frequency attenuation: -42.8 dB±1 dB (at 100 kHz) ON2 setting: (let-go) 10 kΩ+(20 kΩ+6.2 nF)//9.1 nF Passband attenuation: -12 dB±0.3 dB (at 100 Hz) High-frequency attenuation: -35.1 dB±1 dB (at 100 kHz)
Approved tolerances for element	±0.1% for resistance, ±1% for capacitor
Fuse	250 V T0.032 AL 20 mm×5 mm dia.
Dimensions and mass	140W × 35 H × 29D mm(5.51"W × 1.38"H × 1.14"D), approx. 90 g(3.2 oz.)
Accessories	Instruction Manual, spare fuse

3.1.3 9499 NETWORK D (Universal)

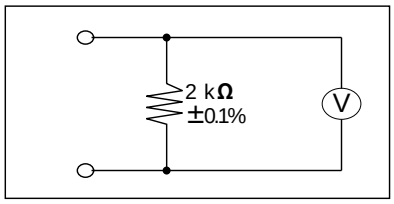
This is a universal measurement network.
Measurement network D conforms to the following standards:
Safety of household and similar electrical appliances - Part 1: General requirements (IEC 60335-1 (1991-06) + am1 (1994-11))
Applicable UL standards:
By installing on the 3155 and making the appropriate settings from the screen, a configuration with a network of 1 kΩ for 1 kΩ, a network of 1.5 kΩ and 0.15 μF for 1.5 kΩ, and a network of 2 kΩ for 2 kΩ is established.



Network of 1 kΩ (1 kΩ)



Network of 1.5 kΩ and 0.15 μF (1.5 kΩ)



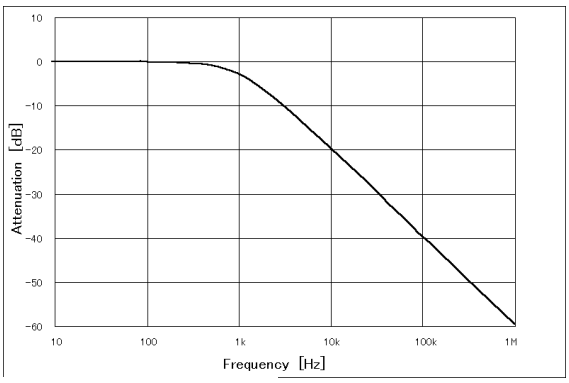
Network of 2 kΩ (2 kΩ)

In addition, there are many applicable standards.

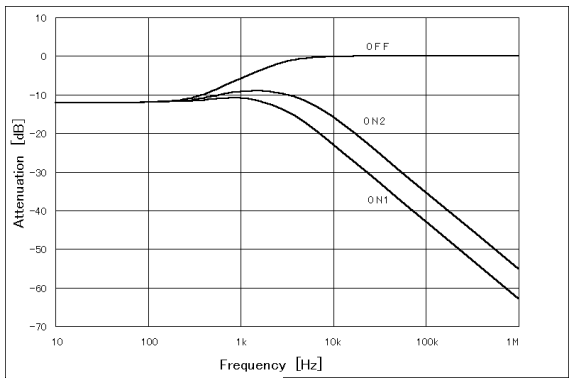
Specifications

Standard	Safety of household and similar electrical appliances - Part 1: General requirements (IEC 60335-1 (1991-06) + am1 (1994-11)) Applicable UL standards: (Examples: UL471, UL1310, UL1437, UL1492, etc.)
Measuring circuit configuration/accuracy	(a) Network of 1 kΩ Impedance: 1 kΩ±0.5% (DC to 1 MHz) (b) Network of 1.5 kΩ and 0.15 μF Impedance: Theoretical value±0.5% (DC≦f≦400 Hz) Theoretical value±(2%+1Ω) (400 Hz<f≦1 MHz) Cutoff frequency (at -3 dB): 707 Hz±15 Hz (c) Network of 2 kΩ Impedance: 2 kΩ±0.5% (DC to 1 MHz)
Filter configuration and characteristics	(1MΩ load with input protection fuse shorted) OFF setting: High pass filter Cutoff frequency (at -3 dB): 1805 Hz±27 Hz Passband attenuation: 0 dB±2% (at 100 kHz) Low-frequency attenuation: -12 dB±0.3 dB (at 100 Hz) ON1 setting: (perception) 10 kΩ+22 nF Passband attenuation: -12 dB±0.3 dB (at 100 Hz) High-frequency attenuation: -42.8 dB±1 dB (at 100 kHz) ON2 setting: (let-go) 10 kΩ+(20 kΩ+6.2 nF)//9.1 nF Passband attenuation: -12 dB±0.3 dB (at 100 Hz) High-frequency attenuation: -35.1 dB±1 dB (at 100 kHz)
Approved tolerances for element	±0.1% for resistance, ±2% for capacitor
Fuse	250 V T0.032 AL 20 mm×5 mm dia.
Dimensions and mass	140W × 35 H × 29D mm(5.51"W × 1.38"H × 1.14"D), approx. 80 g(2.8 oz.)
Accessories	Instruction Manual, spare fuse

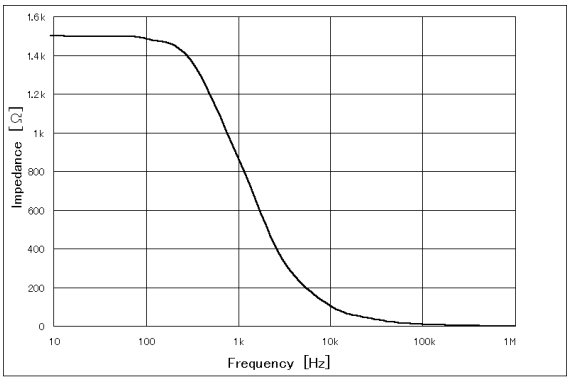
Typical frequency response graphs of measurement networks



9497 NETWORK B



9498 NETWORK C



9499 NETWORK D
Impedance vs input frequency (1.5 kΩ//0.15 μF)

3.2 9196 APPLY UNIT

3.2.1 9196 APPLY UNIT

The 9196 APPLY UNIT is an instrument which outputs 110% of the input power voltage.
Also, it has a function to break the circuit to prevent damage to the equipment to be measured and electric shock to the user if an output current exceeding 6 mA.
Combined with the 3155 LEAK CURRENT HiTESTER, it is used to test leakage current in medical electrical equipment. Leakage current from medical electrical equipment has the greatest potential for harming human beings, and is therefore strictly regulated even with regard to single fault conditions. The following 6 types of testing for leakage current in medical electrical equipment are available.

① Earth leakage current ② Enclosure leakage current
③ Patient leakage current Ⅰ ④ Patient leakage current Ⅱ
⑤ Patient leakage current Ⅲ ⑥ Patient auxiliary current

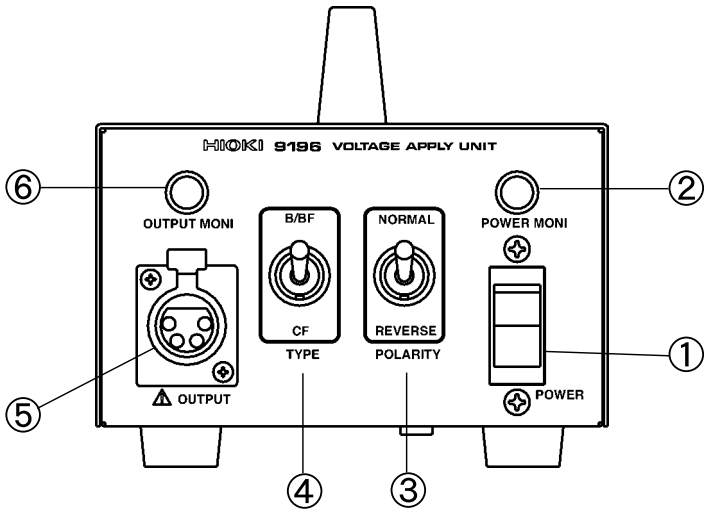
The 9196 is used in testing for types ②, ④, and ⑤.

NOTE

For the fuse replacement, refer to Section 10.2.3, "Replacement of the 9196 APPLY UNIT Power Source Fuse."

3.2.2 Names and Functions of the Parts of the 9196 APPLY UNIT

Front view



① Main power switch (POWER)
Powers the 9196 on and off.

Main power switch indication: | : ON ○: OFF

② Main power monitor (POWER MONI): Clear monitor lamp
The status of the main power is shown by this monitor lamp.
If illuminated, the power is ON.
If not illuminated, the power is OFF.

③ Polarity toggle switch (POLARITY)
This switch is used to toggle the polarity of the voltage output from the voltage application probe. (in respect to the voltage input from the power inlet)
NORMAL: Polarity conforms with that of the voltage input from the power inlet.
REVERSE: Polarity does not conform with that of the voltage input from the power inlet.

④ Type toggle switch (TYPE)
Changes per the type of applied part of the equipment to be measured to which voltage is applied.
B/BF: No protective resistance connected to the output point of the voltage application probe.
C F: Protective resistance (10 kΩ) connected to the output point of the voltage application probe in series.

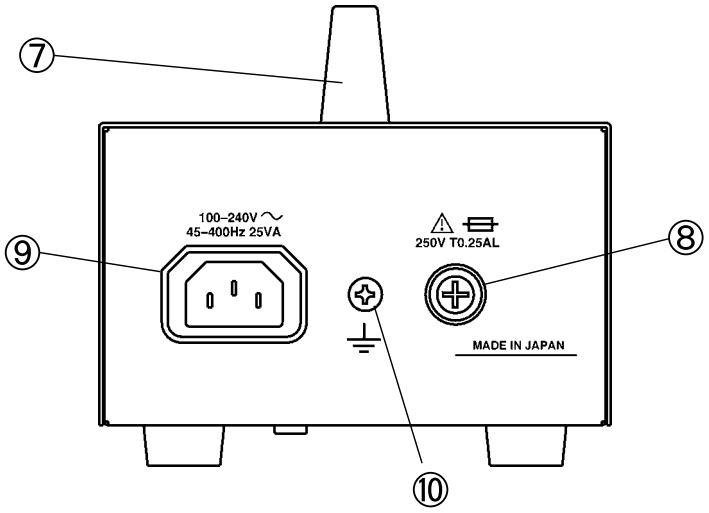
NOTE When the type toggle switch of the 9196 APPLY UNIT is set to CF, there is a 10 kΩ protective resistance connected to the output point of the voltage application probe in series. If the leakage current is large, the current flowing from the output point will be subject to a reduction in voltage due to the protective resistance, thereby reducing the actual output voltage.

⑤ Voltage application probe connection terminal (OUTPUT)
Connect the 9190 VOLTAGE APPLY PROBE.

⑥ Output monitor (OUTPUT MONI): Red monitor lamp
The condition of the output to the voltage application probe is shown by this monitor lamp.
If illuminated, the output is ON. (The voltage application button to the voltage application probe is being held down.)
If not illuminated, the output is OFF.

⑦ Handle

Rear view

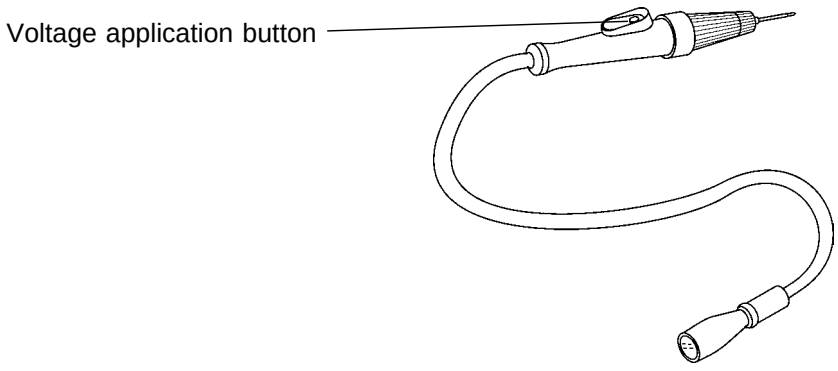


⑧ Fuse
Use the HIOKI specified fuse. (250 V T0.25 AL 20 mm×5 mm dia.)

⑨ Power inlet
The rated power voltage of the 9196 is 100 to 240 VAC (45 to 400 Hz), and the maximum rated power is 25 VA.
Connect a grounded three-core power cord that is supplied with the unit.

⑩ Function earth terminal
If the protective ground terminal cannot be connected to the ground via a grounded three-core power cord supplied, connect the function earth terminal to the ground.

9190 VOLTAGE APPLY PROBE



3.2.3 9196 APPLY UNIT Operation

⚠ WARNING

- **Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit. (100 to 240 VAC)**
- **The unit has no protective ground terminal, and is connected to a ground line via a three-core power cord that is supplied with the unit. In order to prevent electric shock, always connect the unit to a properly grounded power outlet using the power cord provided.**
- **The voltage application probe continuously outputs voltage while the voltage application button is being pressed. While it is outputting, or any time that the voltage application button is being pressed intentionally, a dangerous amount voltage is present is at the tip of the probe. To avoid electrical shock, do not touch either the device under test or the probe tip.**
- **Before using the unit, make sure that the sheathing on the probes is not damaged and that no bare wire is exposed. If there is damage, using the unit could cause electric shock. Replace the probe with the specified 9190.**
- **To prevent electric shock, do not allow the unit to become wet and do not use the unit when your hands are wet.**

⚠ CAUTION

- To avoid damaging the probes, do not bend or pull the probes.
- Do not store or use the unit where it will be exposed to direct sunlight, high temperatures, high humidity, or condensation. If exposed to such conditions, the unit may be damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
- When unplugging the power cord from the power receptacle or from the unit, grasp the plug, not the cord, in order to avoid damaging the cable.
- Use the unit near the power outlet.

NOTE

- The 9196 is only able to operate to its full capability after it has been properly grounded. Always use the power cord (grounded three-core power cord) that is supplied with the unit to ground the unit.
- If operating the voltage application button to the 9190 VOLTAGE APPLY PROBE quickly, the main power of the 9196 may be turned off.

(1) Be sure that the main power switch is turned to OFF.

(2) Being sure that the power source is of the correct voltage, connect the grounded three-core power cord provided to the power inlet on the back of the 9196.

(3) Insert the plug into the outlet. The cord is automatically grounded.

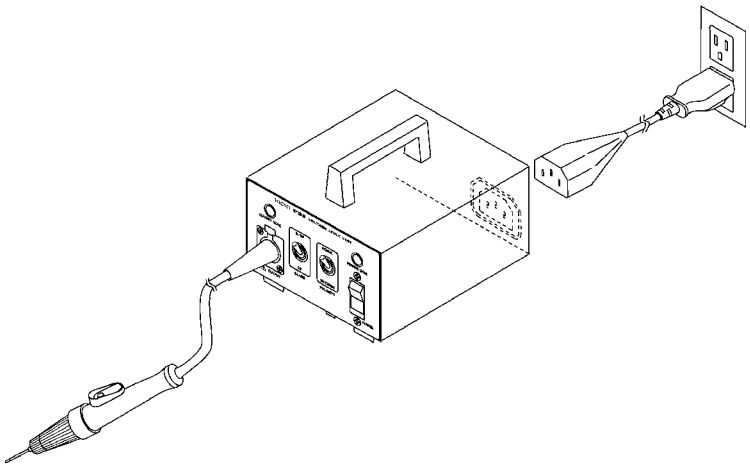
(4) Attach the 9190 VOLTAGE APPLY PROBE.
Attach the 9190 VOLTAGE APPLY PROBE provided to the connecting terminal on the front of the 9196.

(5) Turning the power on and off.

1. Turning the power on
   Set the main power switch on the front of the unit to ON.
   Verify that the main power monitor lamp is illuminated when the switch is set to ON.
2. Turning the power off
   Set the main power switch on the front of the unit to OFF.

(6) Applying voltage

1. Make the appropriate settings based on the type and voltage polarity of the equipment to be measured.
   Set the type based on the type of applied part of the equipment to be measured.
   B/BF: No protective resistance connected to the output point of the voltage application probe.
   C F: Protective resistance (10 kΩ) connected to the output point of the voltage application probe in series.
   Set the voltage polarity.
   NORMAL: Polarity conforms with that of the voltage input from the power inlet.
   REVERSE: Polarity does not conform with that of the voltage input from the power inlet.
2. Apply the voltage
   If the 3155 LEAK CURRENT Hi TESTER and the equipment to be measured are ready, touch the tip of the 9190 VOLTAGE APPLY PROBE to the contact point. After verifying that there is no danger of electrical shock, press the voltage application button to the 9190 VOLTAGE APPLY PROBE with your finger. If the red output monitor lamp is illuminated while pressing the voltage application button, the voltage is being output.
3. Cease application of voltage
   Release your finger from the voltage application button.



3.2.4 9196 APPLY UNIT Specifications

General specifications

Output function	Alternating current (AC V)
Output indication	Red monitor lamp
Power indication	Clear monitor lamp
Type toggle	Toggle switch (B/BF, CF)
Polarity toggle	Toggle switch (NORMAL /REVERSE)
Output configuration	Voltage application probe (9190) connector receptacle
Additional functions	Output control function (power cutoff) Output only when the voltage application button to the 9190 is being pressed.
Dimensions	125W × 75H × 230D mm(4.92"W × 2.95"H × 9.06"D) (excluding projections)
Mass	Approx. 2.5 kg(88.2 oz.) (excluding accessories)
Accessories	Grounded three-core power cord Instruction Manual 9190 VOLTAGE APPLY PROBE
Fuse	250 V T0.25 AL 20 mm × 5 mm dia.

Electric characteristics

Rated power voltage	100 to 240 VAC (Voltage fluctuations of 10% from the rated supply voltage are taken into account.)
Rated power frequency	45 to 400 Hz
Maximum rated power	25 VA
Insulation resistance	500 VDC, 100 MΩ min. between power supply and frame
Dielectric strength	2.3 kVAC sin (50/60 Hz), 1 minute between power supply and frame
Output breaking current	6 mAAC typical
Output voltage	110% voltage of the input supply voltage (VAC)
Accuracy	±(1.0% rdg.+1 V) B/BF range: In a load current of 5 mA or less CF range: In a load current of 50 μA or less

Environmental conditions

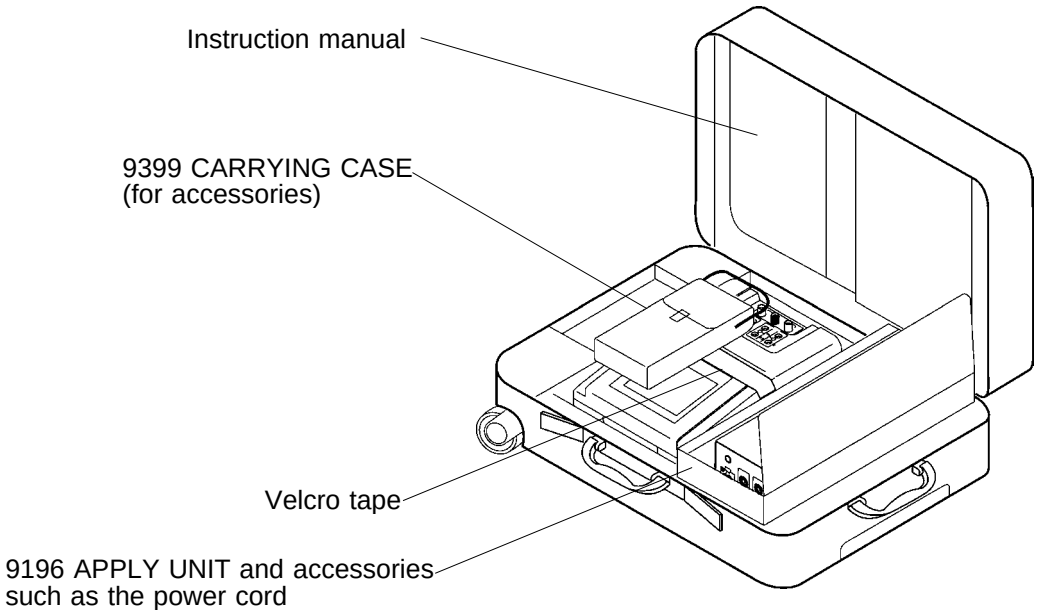
Operating temperature and humidity range	5 to 40℃(40 to 104˚F), 35 to 95% rh (no condensation)
Storage temperature and humidity range	-10 to 50℃(14 to 122˚F), 35 to 95% rh (no condensation)
Accuracy assurance	23±5℃(73±41˚F), 35 to 80% rh (no condensation)
Operating place	Indoors, max. 2000 m(6562 feet) height
Standards applying	EMC EN55011:1991 EN50082-1:1992 EN61000-3-2:1995 EN61000-3-3:1995 Safety EN61010-1:1993+A.2:1995 Pollution Degree 2, Overvoltage Category II (anticipated transient overvoltage 2500 V)

3.3 9388 CARRYING CASE (with Casters)

The 9388 CARRYING CASE (with casters) is made for storage and transport of the 3155. In addition to the 3155, it accommodates accessories, including the optional 9196 APPLY UNIT

Storage of the 3155

In the carrying case, the 3155 is immobilized with Velcro tape.
Accessories such as the power cord and optional 9196 APPLY UNIT are housed in a covered case.
If necessary, cushioning material may be added to the case to provide extra protection.
When storing the 9399 CARRYING CASE (for accessories), position it so that the end with the metal fixtures is oriented toward the top cover of the case.
Manuals and other documents can be stored in the top cover.



Chapter 4
Preparations for Measurement

4.1 Installing the Measurement Network

(1) Be sure that both the 3155 and the equipment to be measured are powered off. Be sure that the power cord, probe, leads etc. are not connected to the 3155.

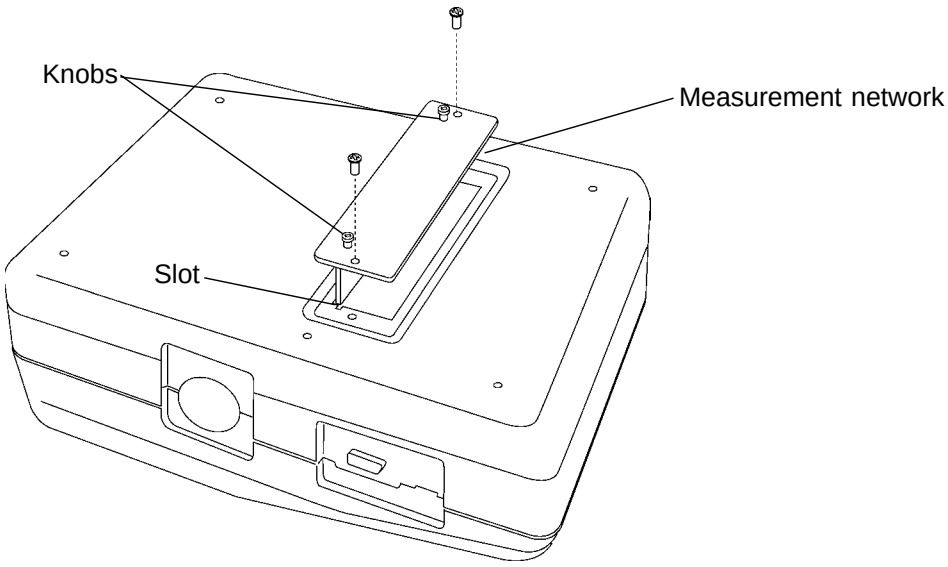
(2) Attach one of the three optional measurement networks (9497, 9498 and 9499). Hold the measurement network by the two knobs, and insert into the slotted connector on the 3155. After inserting firmly in place, attach the two screws.

NOTE

・After turning on the power, a measurement network is checked.

1. In the event that a measurement network is not installed, or has not been installed properly, the message 'Measurement Network not installed.' will appear on the liquid crystal display screen.
2. In the event that a fuse of a measurement network is not installed, or is blown, the message 'Measurement Network Fuse blown.' will appear on the liquid crystal display screen.
   This message may also appear when the signal is being input to the leakage current measurement terminal T1. Check with nothing connected to the leakage current measurement terminal T1.
   For the fuse replacement, refer to Section, 10.2.2, "Replacement of the Measurement Network Fuse."

・The type of measurement network currently installed on the 3155 can be verified by opening the 'Measurement Network Filter Set-up Window,' where one of the following messages is displayed:
9497 NETWORK B: Measurement network filter for ME
9498 NETWORK C: Measurement network filter for IEC 60990
9499 NETWORK D: Universal measurement network filter



4.2 Power Cord Connection

⚠ WARNING

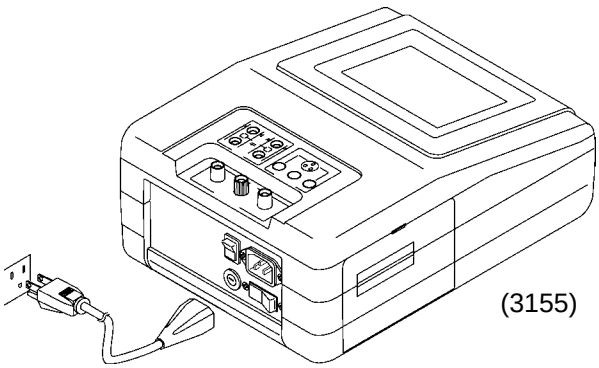
- **Versions of the 3155 that operate on 120 V, 200 V and 240 V of the supply voltage are available. The 3155-01 operates on 110 to 120 V, 200 V and 240 V with the voltage selector.**
  Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit. The maximum rated power of the 3155 is 30 VA.
- **The protective ground terminal of the unit is connected to a ground line via a three-core power cord that is supplied with the unit.**
  In order to prevent electric shock, always connect the unit to a properly grounded power outlet using the power cord provided.

⚠ CAUTION

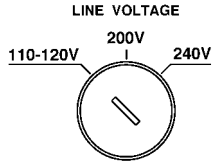
- To prevent an error, always remove the key and keep it after setting the power supply voltage. (3155-01 only)
- When changing the supply voltage, always turn off the power and disconnect the power cord before beginning. (3155-01 only)
- This unit is provided with a grounded three-core power cord that is suitable for use with power supply conditions in the country or region in which the unit is sold. When using this unit in any other country or region, be sure to obtain a grounded three-core power cord which is suitable for use with the power supply conditions in that area.

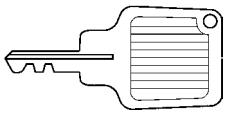
NOTE

The 3155 is a leakage current measuring instrument, and thererfore is only able to operate to its full capability after it has been properly grounded. Always use the power cord (grounded three-core power cord) that is supplied with the unit to ground the unit.



(3155)





(1) Be sure that the main power switch is turned to OFF.

(2) Set the power voltage with the voltage selector. (3155-01 only)
Insert the supplied voltage selector key into the keyhole of the voltage selector, and select the power voltage by setting it to the required power voltage. (110 to 120/200/240 V)
Voltage selector key (2 supplied)

(3) Being sure that the power source is of the correct voltage, connect the grounded three-core power cord provided to the power inlet on the back of the unit.

(4) Insert the plug into the outlet. The cord is automatically grounded.

4.3 Powering on and off the Unit

⚠ WARNING

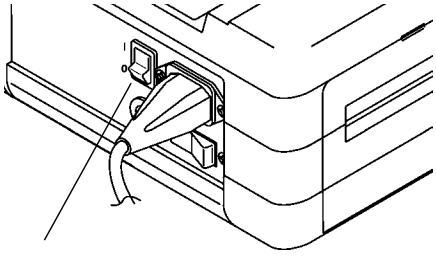
- **Before turning on the power, make sure that the voltage of the power supply being used matches the supply voltage indicated on the rear panel of the unit.**
  (3155: Specify when ordering, 3155-01: Set with the voltage selector)
- **If an attempt is made to use an improper supply voltage, there is danger of damage to this unit and of life-threatening risk to the operator.**

⚠ CAUTION

Before turning main power switch ON, turn the power OFF or unplug power cord of the equipment to be measured.
(Briefly before the 3155 display screen appears, power is supplied.)

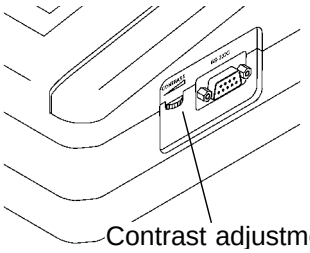
NOTE

- When measuring medical electrical equipment using an insulating transformer, connect one of the insulating transformer's output terminals to ground before measurement.
  When a floating power supply which uses an insulating transformer, such as is used in operating rooms, ICUs and CCUs is used, measurements made using such a power source will not be accurate.
- Allow 60 minutes warming up after powering on before starting measurement.
- Either turn off the power to the equipment to be measured or disconnect the power supply cord, and then turn the main power switch to ON. (Power may be fed during the instant before the 3155 screen appears.) Automatic measurement may not be possible for equipment fitted with a shutdown function. When equipment that form an induction load are measured, the relay contacts inside the 3155 may fuse together if the current flowing exceeds 60A.0.2s.

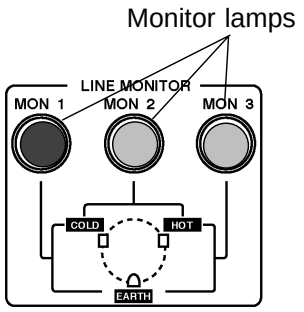


Main power switch

(1) Turn the main power switch on the back of the unit to ON (|). First the model name and software version are displayed on the liquid crystal display screen, and then the initial screen is displayed after a measurement network is checked.
When using MEASUREMENT NETWORK D, use a 3155 that is equipped with software version 1.10 or later. Display output will not be correct if MEASUREMENT NETWORK D is installed with an older version.
When performing tests with the 3157 using RS-232C interfacing, use a 3155 with software version 1.20 or later. Tests are not possible with the 3157 using RS-232C communication if older versions are used.



(2) Turn the contrast adjustment knob until the screen is easy to read.



(3) After turning on the power, be sure to check the grounding condition of the power line using the monitor lamp.
Proper grounding is required in order to use the functions of the 3155.

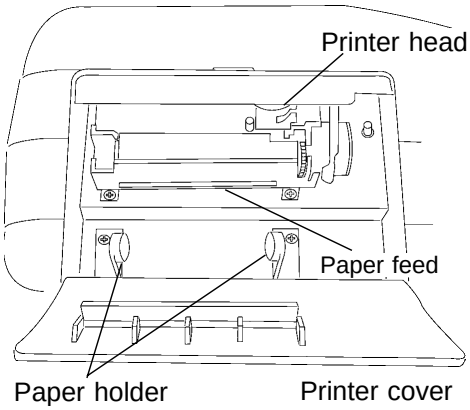
MON1: Voltage between the COLD and EARTH lines
MON2: Voltage between the HOT and COLD lines
MON3: Voltage between the HOT and EARTH lines

- For an ordinary power supply with single sided grounding, the MON2 and MON3 lamps are illuminated when the power supply is grounded. (If the HOT and COLD lines are reversed, the MON1 and MON2 lamps are illuminated. When measurement is set to single fault - open power lead, accurate measurement cannot be made.)
- The use of a floating power supply which uses an insulating transformer, other than a power supply with single sided grounding, will result in mulfunctions of the power line monitor lamp.

(4) After the measurement has finished, turn the main power switch on the back of the unit to OFF. In which case, the current settings are all preserved when the unit is next turned on. If there has been a power failure or other malfunction of the power supply, the settings in effect at the time the malfunction occurred are preserved.

4.4 Loading Recording Paper

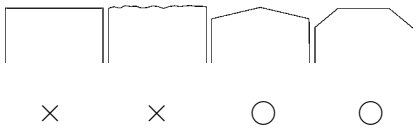
Paper is placed in the built-in printer on the left side of the 3155.



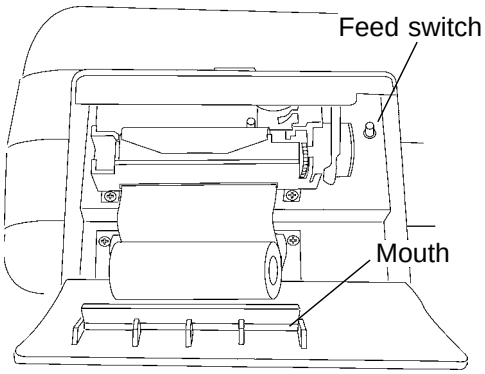
(1) Power on the 3155.

(2) Open the printer cover.

(3) Check that the printer head is in the home position (at the right end in the figure).
To set the printer head in the home position, power off the 3155 and then on again.



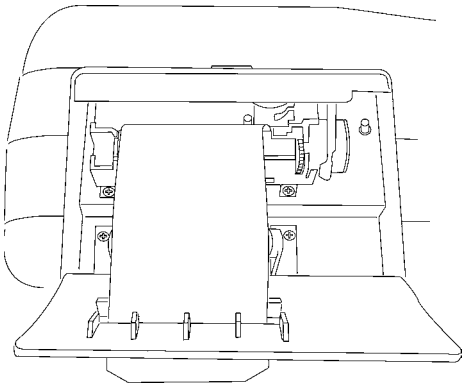
(4) Cut the end of the paper roll as shown in the figure.



(5) Slide the end of the paper roll as far as it will go into the printer paper feed, and push the feed switch.

(6) After the end of the paper roll comes out of the printer, pull it straight out to ensure that it is aligned properly.

(7) Place the paper in the paper holder.



(8) Slide the end of the paper through the mouth in the printer cover, and close the cover.

NOTE

- If the paper is not inserted into the paper feed properly, it is fed into the printer crookedly. In which case, continue feeding the paper until it is properly aligned.
- If a paper jam occurs, power off the unit, and place the paper properly. Be careful not to fold or wrinkle the paper when inserting it into the printer.
- Do not block the printer mouth.

Chapter 5 Medical Electrical Equipment Measurement Network B Installed

5.1 Leakage Current Measurement Types and Their Allowable Values for Medical Electrical Equipment

The following six types of leakage currents in medical electrical equipment can be tested.

① Earth leakage current (Class Ⅰ equipment only)
② Enclosure leakage current
③ Patient leakage current Ⅰ
④ Patient leakage current Ⅱ (Equipment with the type B applied part only)
⑤ Patient leakage current Ⅲ (Equipment with the type BF or CF applied part only)
⑥ Patient auxiliary current

The allowable values are determined by the condition of the equipment to be measured (normal condition or single fault condition) as well as its grounding class and applied part type. Allowable values for earth leakage current measurements exclusive to class Ⅰ equipment vary per the installation conditions of the equipment to be measured.

Leakage current measurement types and their allowable values for medical electrical equipment (taken from IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))

Class Ⅰ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied
Earth leakage current	General equipment	0.5mA	1mA	—	—	0.5mA	1mA	—	—	0.5mA	1mA	—	—
	Special equipment and mobile equipment	2.5mA	5mA	—	—	2.5mA	5mA	—	—	2.5mA	5mA	—	—
	Permanently installed equipment	5mA	10mA	—	—	5mA	10mA	—	—	5mA	10mA	—	—
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA
	B Between parts of the enclosure	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA
Patient leakage current Ⅰ	Direct current	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—
	Alternating current	0.1mA	0.5mA	0.5mA	—	0.1mA	0.5mA	0.5mA	—	0.01mA	0.05mA	0.05mA	—
Patient leakage current Ⅱ		—	—	—	5mA	—	—	—	—	—	—	—	—
Patient leakage current Ⅲ		—	—	—	—	—	—	—	5mA	—	—	—	0.05mA
Patient auxiliary current	Direct current	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—
	Alternating current	0.1mA	0.5mA	0.5mA	—	0.1mA	0.5mA	0.5mA	—	0.01mA	0.05mA	0.05mA	—

Class Ⅱ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA
	B Between parts of the enclosure	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA
Patient leakage current Ⅰ	Direct current	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—
	Alternating current	0.1mA	0.5mA	—	—	0.1mA	0.5mA	—	—	0.01mA	0.05mA	—	—
Patient leakage current Ⅱ		—	—	—	5mA	—	—	—	—	—	—	—	—
Patient leakage current Ⅲ		—	—	—	—	—	—	—	5mA	—	—	—	0.05mA
Patient auxiliary current	Direct current	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—
	Alternating current	0.1mA	0.5mA	—	—	0.1mA	0.5mA	—	—	0.01mA	0.05mA	—	—

Internally powered equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1
	B Between parts of the enclosure	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1
Patient leakage current Ⅰ	Direct current	0.01mA	—	—	—	0.01mA	—	—	—	0.01mA	—	—	—
	Alternating current	0.1mA		—	—	0.1mA	—	—	—	0.01mA	—	—	—
Patient leakage current Ⅱ		—	—	—	5mA Notes 1 and 2	—	—	—	—	—	—	—	—
Patient leakage current Ⅲ		—	—	—	—	—	—	—	5mA Notes 1 and 2	—	—	—	0.05mA Notes 1 and 2
Patient auxiliary current	Direct current	0.01mA	—	—	—	0.01mA	—	—	—	0.01mA	—	—	—
	Alternating current	0.1mA	—	—	—	0.1mA	—	—	—	0.01mA	—	—	—

*1: Interruption of one supply conductor

*2: Interruption of a protective earth conductor

Note 1: 110% voltage application to internally powered equipment can be either normal or reverse polarity.

Note 2: For 250 V applications under IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards, 110% voltage of the 3155's power source voltage is applied via the 9196 APPLY UNIT.

NOTE

- Values shown as hyphens cannot be set.
- The measurements shown in these tables, with the exception of those for internally powered equipment, can be set to either normal or reverse polarity.
- Measurements shown in the shaded portions of the tables (110% voltage application) require the optional 9196 APPLY UNIT. The 9196 APPLY UNIT applies 110% of the voltage it receives through its power supply inlet. The polarity of the applied voltage can also be set to either normal or reverse.
  (Other voltage application units can also be used to make measurements.)

Conditions that cannot be established with the 3155

The following conditions are defined in IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03), but cannot be established with the 3155.

(1) Connection to a power supply at the maximum frequency rating

(2) Connection to a power supply at 110% of the maximum voltage rating
(The 3155 supplies the power input into the power inlet directly to the equipment to be measured.)

(3) Application of 250 V to internally powered equipment

Handling conditions that cannot be established with the 3155

For items (1) and (2), because the specifications for maximum frequency rating and maximum voltage rating will vary per equipment to be measured, a regulated power supply with variable voltage and frequency is necessary.

Recommended power supply:
HIOKI 7032 UNIVERSAL HiPOWER
Output rating: 2 kVA (20 A/100 V range,
10 A/200 V range)
Frequency range of 40 to 500 Hz
For item (3), attach the 9196 APPLY UNIT to a regulated power supply with variable voltage and frequency. Because the 9196 APPLY UNIT outputs 110% of the input voltage, to effect an output of 250 V, the regulated power supply should be set to 227.3 V.

5.2 Screens (ME Equipment)

About the Touch Panel

> **⚠ CAUTION** Do not press hard upon the touch screen, or operate it using a hard object or one with a sharp end. Doing so could scratch or damage the screen or the soft keys.

The 3155 uses a touch panel for setting and changing all of the test 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.

About the display of 'touch keys'

The following is an explanation of the types of 'touch keys' shown on the 3155's display screen.
There are 3 types of key displays. Selectable keys (raised, black background), selected keys (recessed, white background), and non-selectable keys (raised, white background)

(1) Selectable keys (raised, black background)

Example: 

, 

, 

(2) Selected keys (recessed, white background)

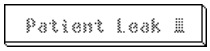
Example: 

, 

(3) Non-selectable keys (raised, white background)

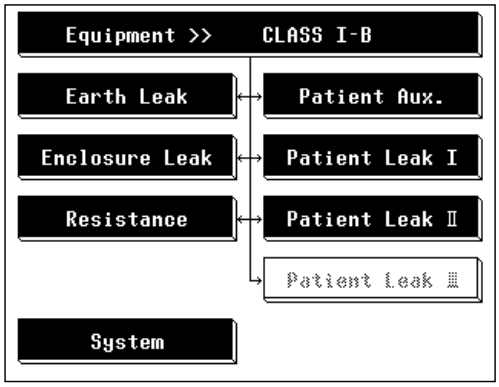
Example: 

, 

, 

The keys shown with dotted lettering indicate items that need not be measured per the settings performed on the equipment set-up screen.

5.2.1 Initial Screen (ME Equipment)



When the power is first turned on, the basic screen for controlling the 3155 immediately appears, called the initial screen.

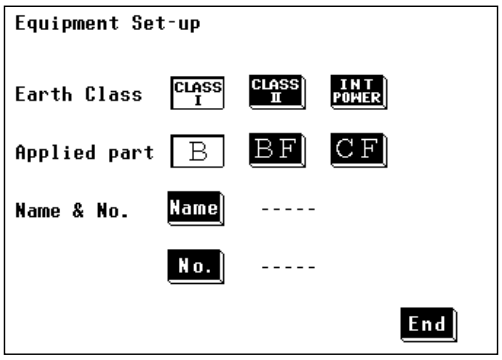
Equipment set-up: The grounding class and applied part type of the equipment to be measured

Measuring mode: Earth leakage current, enclosure leakage current, patient leakage current Ⅰ, patient leakage current Ⅱ,patient leakage current Ⅲ, patientauxiliary current, low resistance measurement

System: Clock, beeper, RS-232C communications etc.

5

5.2.2 Equipment Set-up Screen (ME Equipment)



On the initial screen, press the Equipment >> CLASS I-B key to open the equipment set-up screen.

On the equipment set-up screen, settings for the grounding class and applied part type of the equipment to be measured, and registration of the model name and number can be made.

Press the End key to return to the initial screen.

Grounding class setting

CLASS I: Class Ⅰ equipment

CLASS II: Class Ⅱ equipment

INT POWER: Internally powered equipment

NOTE

If changing the setting for the grounding class of the equipment to be measured, the condition settings on each measuring mode screen are initialized, except for the coefficient of the allowable value.

Applied part type setting

B: Type B applied part

BF: Type BF applied part

CF: Type CF applied part

NOTE

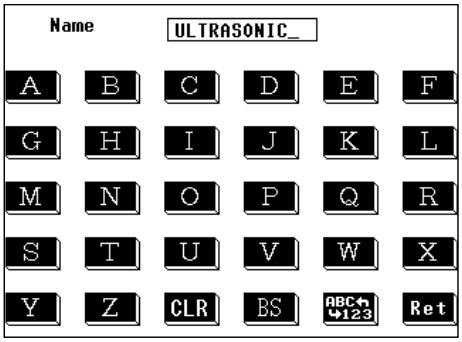
If changing the setting for the applied part type of the equipment to be measured, the allowable value on each measuring mode screen is initialized. For details, refer to Section 5.10.1, "Allowable Value Setting (For Leakage Current Measurement)," and Section 5.10.2, "Allowable Value Setting (For Low Resistance Measurement)."

Registering the model name and number.

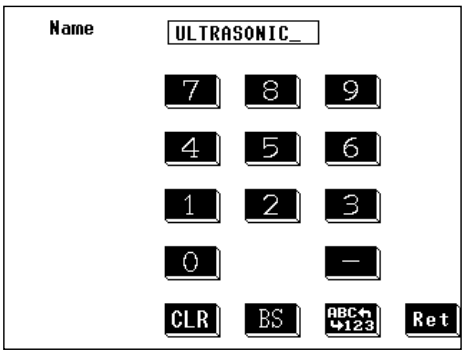
It is possible to register the model name and number before printing out or saving data. Once registered, these items will be included with the maximum values for each printout or save, unless changed.

Name: Change to the model name input screen.

No.: Change to the model number input screen.



Alphabet input screen



Numeric input screen

Setting

Shown on the left are examples of the model name input screens.

A maximum of 12 characters can be input.

CLR: Clear the model name or number

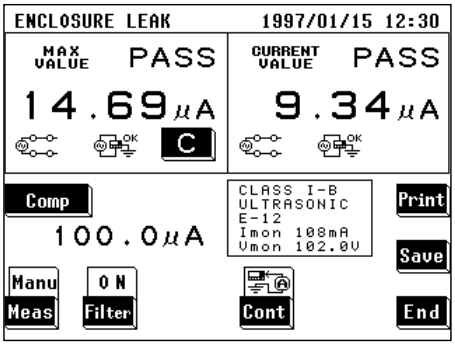
BS: Back space

ABC 123: Toggle between alphabet input and numeric input

Ret: Close the input window

5.2.3 Measuring Mode Screen (ME Equipment)

On the measuring mode screen, press the any one of the following keys to open a window where the settings in question for that measuring mode can be changed.
The following explanation uses the enclosure leakage current measurement screen as an example:



C: Clear the maximum value.

Comp: Open the allowable value set-up window.

Meas: Open the polarity and equipment condition set-up window in the bottom half of the screen.

Filter: Open the measurement network filter set-up window in the bottom half of the screen.

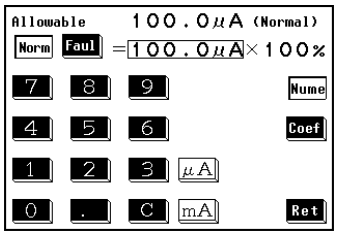
Cont: Open the contact condition set-up window in the bottom half of the screen.

Print: Open the print-out window in the bottom half of the screen.

Save: Open the save data window in the bottom half of the screen.

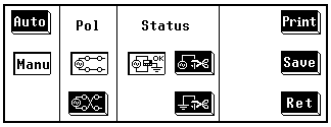
End: Return to the initial screen.

(1) Allowable value set-up window

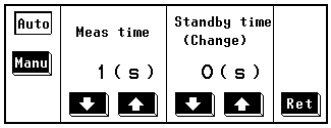


(2) Polarity and equipment condition set-up window

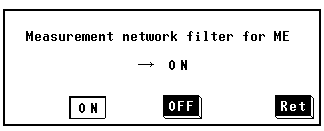
Manual



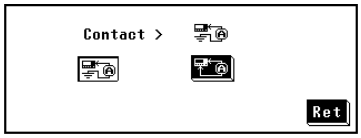
Automatic



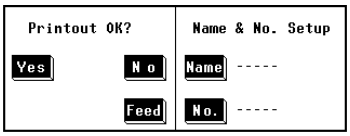
(3) Measurement network filter set-up window



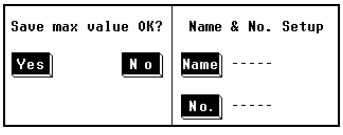
(4) Contact condition set-up window



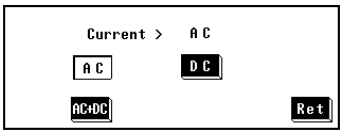
(5) Print-out window



(6) Save data window



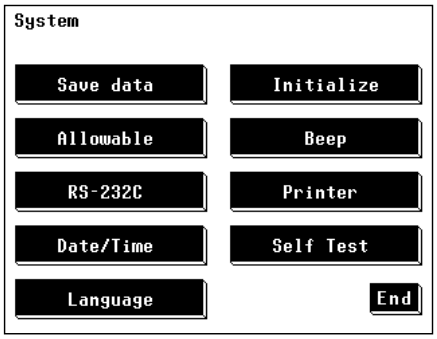
(7) Measurement current set-up window



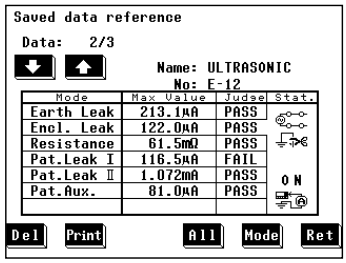
NOTE It is possible to set the measurement current when making patient leakage current Ⅰ and patient auxiliary current settings. Also, when making patient auxiliary current settings, the AC+DC option is not available.

5.2.4 System Screen (ME Equipment)

On the system screen, references to saved data as well as settings for beep sound, time and date, communications, and execution of self-testing can be made.

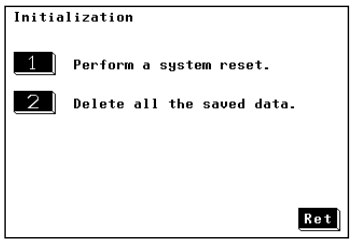


Save data : Move to the saved data reference screen.
Initialize : Move to the initilization screen.
Allowable : Move to the allowable value judgment set-up screen.
Beep : Move to the beep sound set-up screen.
RS-232C : Move to the communications set-up screen.
Printer : Move to the printer set-up screen.
Date/Time : Move to the time and date set-up screen.
Self Test : Move to the self-test screen.
Language : Move to the language set-up screen.
End : Return to the initial screen.



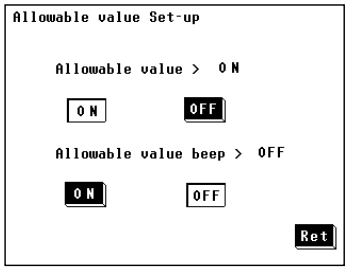
(1) Saved data reference screen

For details, refer to Section 5.11.2, "Saved Data Reference Screen."



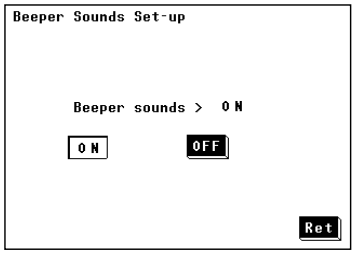
(2) Initialization screen

For details, refer to Section 5.11.3, "Initialization Screen."



(3) Allowable value judgment set-up screen

- Set the allowable value judgment (comparison of the set allowable value with the maximum value and measured value) to either ON or OFF. When set to ON, the beep sound setting for the allowable value judgement becomes effective. When set to OFF, the allowable values are not shown on the measuring mode screen.
- Press either the ON or OFF key for the beep sound for the allowable value judgment.



(4) Beep sound set-up screen

Turn the beeper on or off.

Press either the ON key or OFF key.

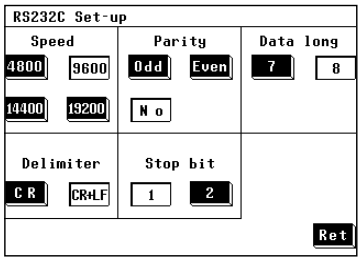
If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

The beep sound is emitted when:

- The power is turned on.
- A key is pressed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

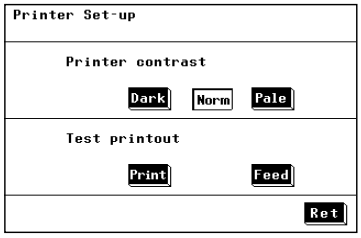
The beep sound is emitted irrespective of the beep sound setting when:

An error has occurred in the RS-232C system.



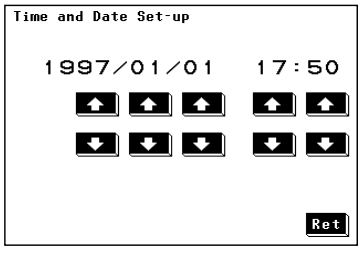
(5) Communications set-up screen

For details, refer to Section 8.5.1, "Communication Conditions Setting."



(6) Printer set-up screen

For details, refer to Section 5.11.7, "Printer Set-up Screen."



(7) Time and date set-up screen

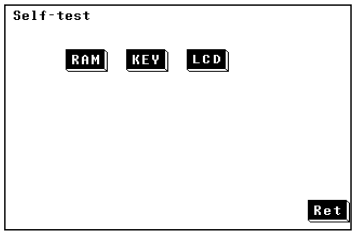
Make the time and date settings.

On the time and date set-up screen, press the keys as necessary.

Use the ▲ and ▼ keys found beneath the time and date to set as desired.

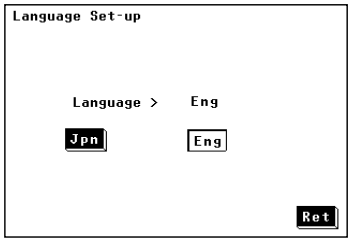
The year may be set from 1997 to 2096.

Press the Ret key to finalize the settings.



(8) Self-testing screen

For details, refer to Section 5.11.9, "Self-test screen."



(9) Language set-up screen

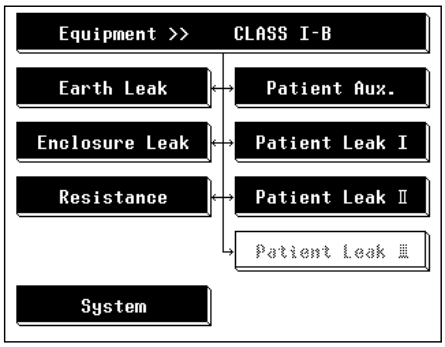
For details, refer to Section 5.11.10, "Language Set-up screen."

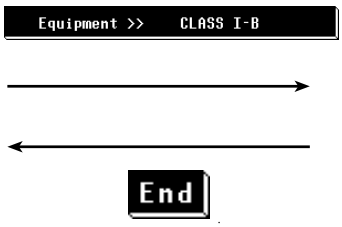
5.2.5 Flow of Screens for Basic Operations (for ME Equipment)

・Change of screens during basic operation is as follows.
・On the measuring mode screen, measured values can be checked in real time.

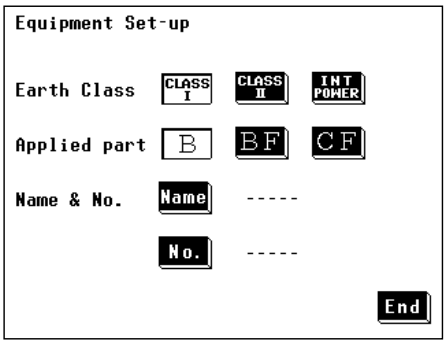
Example: When performing enclosure leakage current measurement

Initial screen

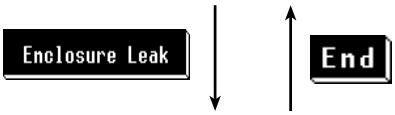




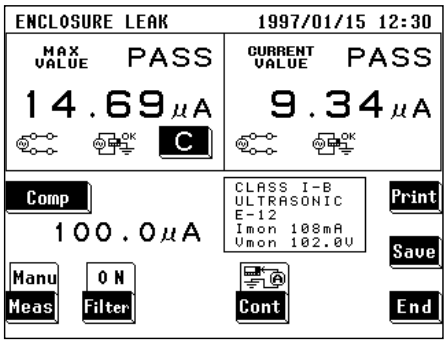
Equipment set-up screen



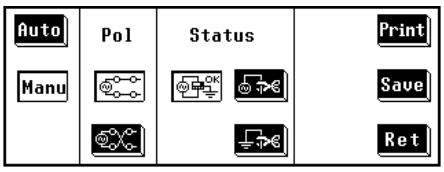
Set the grounding class and applied part type of the equipment to be measured, and register the model name and number.



Measuring mode screen



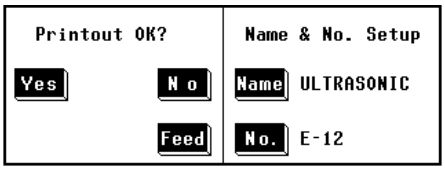
Polarity and equipment condition set-up window



Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3," Automatic Measurement Setting."

Measurement starts automatically.

Print-out window



For a detailed set-up procedure, refer to Section 5.10.5, "Printing out the Maximum Values."
For saving, refer to Section 5.10.6, "Saving the Maximum Values ."

NOTE

Setting conditions for each measuring mode is saved with each measuring mode. However, the model name and number are held in common. Changing the measuring mode will clear the maximum and current values.

5.3 Earth Leakage Current Measurement Mode (ME Equipment)

5.3.1 Earth Leakage Current Measurement Mode

Earth leakage current measurement for medical electrical equipment is performed only when class Ⅰ equipment has been set. When either class Ⅱ or internally powered equipment has been set, the earth leakage current key on the initial screen is non-selectable.
Measurement is possible only when the power cord of the equipment to be measured has been plugged into the auxiliary power socket of the 3155.
The following combinations are measured under the earth leakage current measurement.

Condition of the equipment to be measured		Power source polarity
Normal condition		Normal polarity
		Reverse polarity
Single fault condition	Open power lead	Normal polarity
		Reverse polarity

The measurement current is set to "AC+DC rms."
For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

NOTE

By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 5.10.3, "Automatic Measurement Setting."

Measurement types and their allowable values

Class Ⅰ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1				Open power lead				Open power lead		
Earth leakage current	General equipment	0.5mA	1mA	—	—	0.5mA	1mA	—	—	0.5mA	1mA	—	—
	Special equipment and mobile equipment	2.5mA	5mA	—	—	2.5mA	5mA	—	—	2.5mA	5mA	—	—
	Permanently installed equipment	5mA	10mA	—	—	5mA	10mA	—	—	5mA	10mA	—	—

*1: Interruption of one supply conductor

5.3.2 Connecting Equipment for Earth Leakage Current Measurement (ME Equipment)

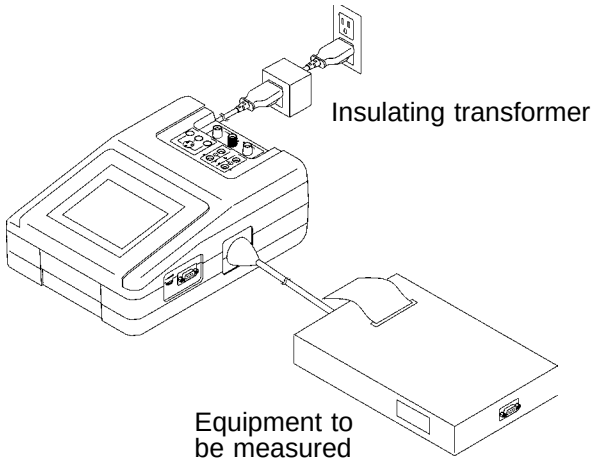
⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- Use an insulating transformer.

NOTE

When measuring earth leakage current (for class Ⅰ equipment only), do not make any connections to the leakage current measurement terminals. The measurement network is connected via internal wiring.

Plug the power cord of the equipment to be measured to the auxiliary power socket found on the right side of the 3155.

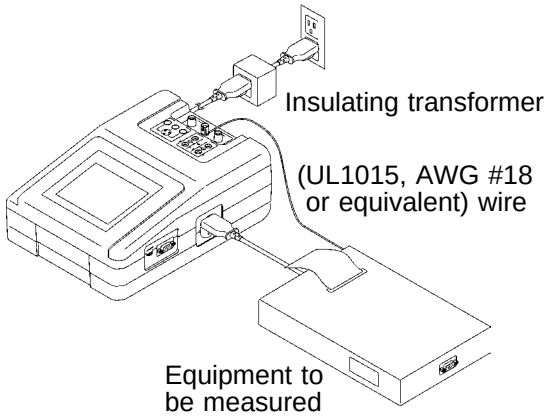


NOTE

- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- Use wire for connecting the functional earth terminals of the equipment to be measured, or an F-type applied part to the ground.
- When the equipment to be measured requires the use a single phase power source, connect the 3155 between the power source and the single phase power source, as well as between the single phase power source and the equipment to be measured.

NOTE

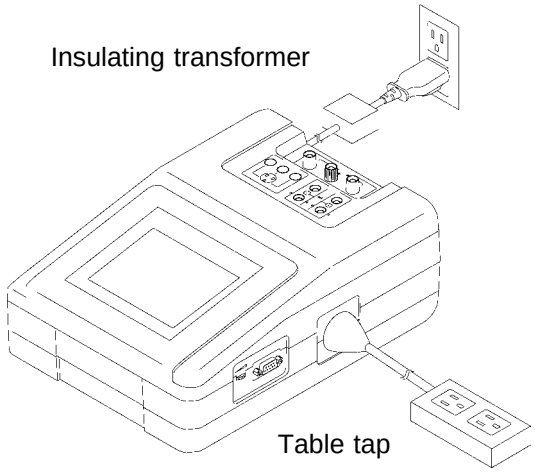
When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.



5.3.3 Zero Adjustment (Earth Leakage Current)

In cases where the extension cable (power socket conversion cable, table tap, etc.) is connected to the auxiliary power socket when making a measurement, the measured value may be subject to leakage current of the extension cable. In which case, to obtain an accurate measurement, perform zero adjustment before measuring.
Value of leakage current in the extension cable to be offset by zero adjustment varies depending on if voltage is applied or not. Zero adjustment is performed in the condition that voltage is applied.
Value determined by zero adjustment is saved after power is turned off. It is effective unless changing supply voltage and/or the extension cable.

Zero Adjustment



1. Display the earth leakage current measurement screen.
2. Connect the extension cable to the auxiliary power socket. In this case, do not connect the equipment to be measured to the extension cable.
3. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, ⏀ is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again, and zero adjustment is cancelled, the normal measured value returns and ⏀ disappears.

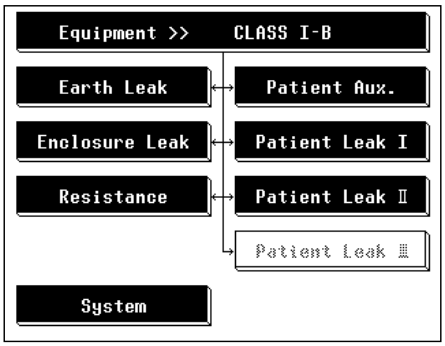
NOTE

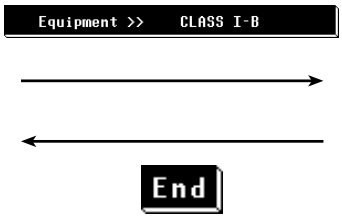
In all equipment to be measured, zero adjustment defaults to the combination of normal condition with normal polarity and switches back to previous condition and polarity of the equipment to be measured.
During manual measurement, condition and polarity settings may cause zero adjustment value to fail to set to zero.

5.3.4 Basic Settings for Earth Leakage Current Measurement (ME Equipment)

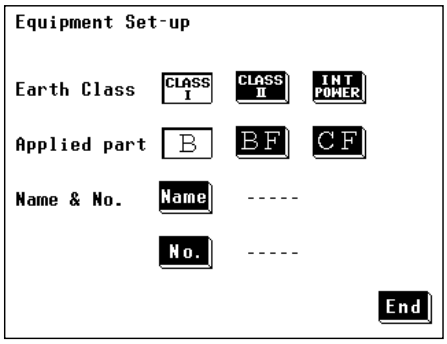
This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 5.3.2, "Connecting Equipment for Earth Leakage Current Measurement."

Initial screen

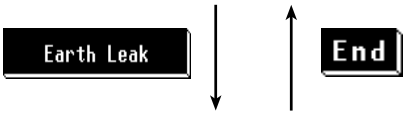




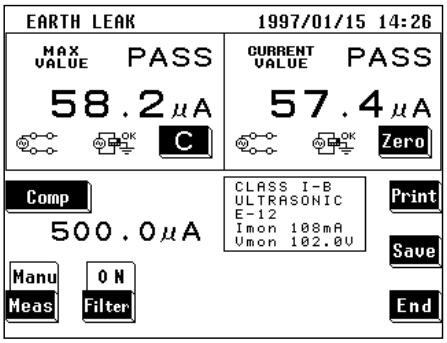
Equipment set-up screen



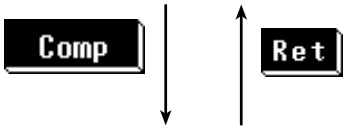
Set the grounding class to class I.
Set the applied part type.



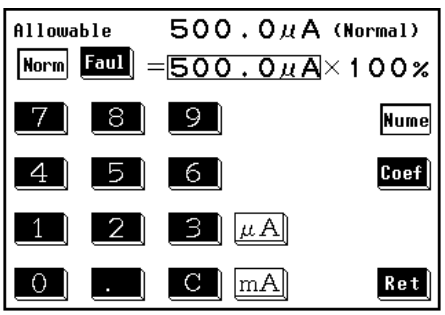
Earth leakage current measurement mode screen



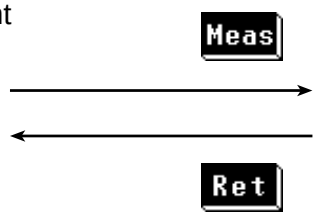
Measurement starts automatically.



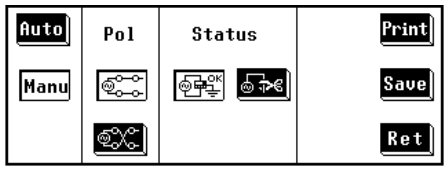
Allowable value set-up window



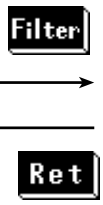
Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")



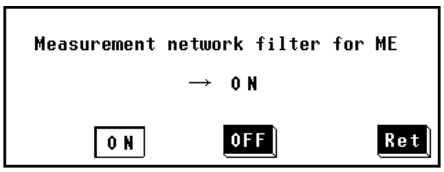
Polarity and equipment condition set-up window



Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."



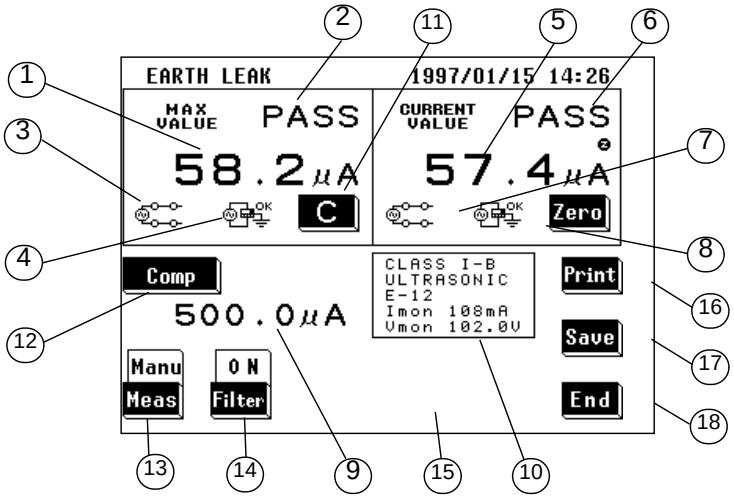
Measurement network filter set-up window



Set the filter.

5.3.5 Earth Leakage Current Measurement Screen (ME Equipment)

Measurement of earth leakage current is made on the earth leakage current measurement screen. The current measured value, maximum value, and setting condition are shown on the earth leakage current measurement screen. Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring will clear this value. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower, FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal condition: Single fault condition (open power lead):
⑤ Current value	Value obtained from the current measurement (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower, FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal: , Reverse:
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition: Single fault condition (open power lead):
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead): 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective, ↻ is displayed on the screen. For details, refer to Section 5.3.3, "Zero Adjustment (ME Equipment - Earth Leakage Current)."
⑯ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑰ Save	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑱ End	Exits the earth leakage current measurement, and returns to the initial screen.

5.4 Enclosure Leakage Current Measurement Mode (ME Equipment)

5.4.1 Enclosure Leakage Current Measurement Mode

The measurement of enclosure leakage current for medical electrical equipment is performed in two places: between the enclosure and the earth, and between parts of the enclosure. With class Ⅰ equipment, the enclosure is each part of the enclosure which is not protectively earthed.
Plug the power cord of the equipment to be measured into the auxiliary power socket for the 3155, and make a measurement by touching either the 9170 TEST LEAD or 9195 ENCLOSURE PROBE to the test point.
The following combinations are measured under the enclosure leakage current measurement.

Condition of the equipment to be measured		Power source polarity	Contact condition
Normal condition		Normal polarity	Between parts of the enclosure
			Between the enclosure and the earth
		Reverse polarity	Between parts of the enclosure
			Between the enclosure and the earth
Single fault condition	Open power lead	Normal polarity	Between parts of the enclosure
			Between the enclosure and the earth
		Reverse polarity	Between parts of the enclosure
			Between the enclosure and the earth
	Open ground	Normal polarity	Between parts of the enclosure
			Between the enclosure and the earth
		Reverse polarity	Between parts of the enclosure
			Between the enclosure and the earth
	110% voltage applied (normal polarity)	Normal polarity	Between parts of the enclosure
			Between the enclosure and the earth
		Reverse polarity	Between parts of the enclosure
			Between the enclosure and the earth
	110% voltage applied (reverse polarity)	Normal polarity	Between parts of the enclosure
			Between the enclosure and the earth
		Reverse polarity	Between parts of the enclosure
			Between the enclosure and the earth

The measurement current is set to "AC+DC rms."
For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

NOTE

- In the application of 110% voltage, 110% voltage is applied externally with the 3155 set to the normal condition. Because the allowable value setting is quite different from that of conventional normal condition settings, care is necessary when making this setting.
- When making an external application of voltage, the optional 9196 APPLY UNIT is necessary. (Other voltage application units can also be used to make measurements.)

- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.
- By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 5.10.3, "Automatic Measurement Setting."
- When making measurements of internally powered equipment, there is no polarity setting.

Measurement types and their allowable values

Class Ⅰ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied		Open power lead *1	Open ground *2	110% voltage applied
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA
	B Between parts of the enclosure	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA	0.1mA	0.5mA	0.5mA	0.5mA

Class Ⅱ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1		110% voltage applied		Open power lead *1		110% voltage applied		Open power lead *1		110% voltage applied
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA
	B Between parts of the enclosure	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA	0.1mA	0.5mA	—	0.5mA

Internally powered equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
					110% voltage applied				110% voltage applied				110% voltage applied
Enclosure leakage current	**A** Between enclosure and earth	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1
	B Between parts of the enclosure	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1	0.1mA	—	—	0.5mA Note 1

*1: Interruption of one supply conductor *2: Interruption of a protective earth conductor

Note 1: 110% voltage application to instruments with internal power sources can be either normal or reverse polarity.

NOTE Measurements shown in the shaded portions of the tables (110% voltage application) require the optional 9196 APPLY UNIT or other power sources.

5.4.2 Connecting Equipment for Enclosure Leakage Current Measurement (ME Equipment)

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- If the voltage application button to the 9196 APPLY UNIT is ON, the danger of electrical shock is present. Turn the voltage application button OFF when not making measurements.
- Use an insulating transformer.

(1) Measurement between the enclosure and the earth. (With class Ⅰ equipment, between each part of the enclosure which is not protectively earthed and the earth)

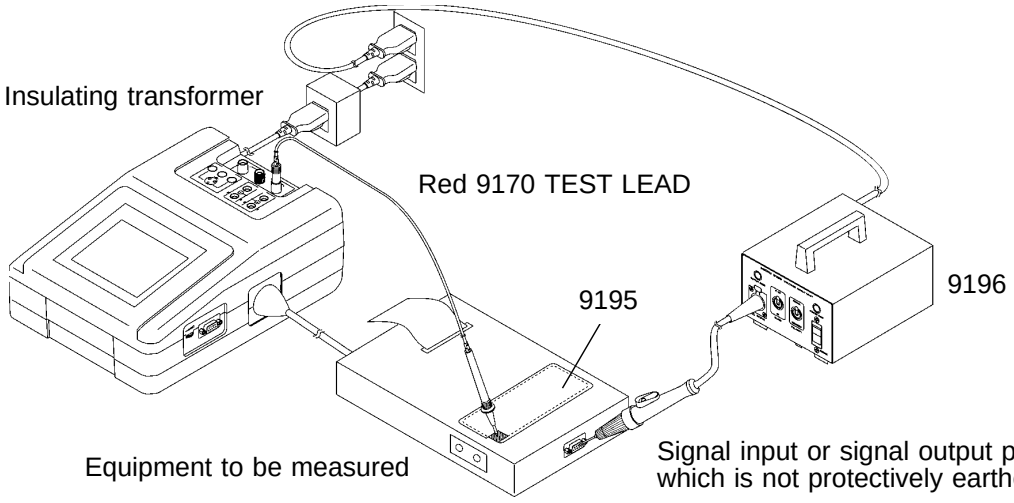
1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the earth."
2. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
3. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
4. Touch the red 9170 TEST LEAD to the enclosure of the equipment to be measured.

For 110% applied voltage

Make the appropriate output settings for the 9196 APPLY UNIT.
Set the polarity toggle switch and the type toggle switch to match the applied part type of the equipment to be measured.
POLARITY: NORMAL or REVERSE
APPLIED PART (TYPE): B/BF, CF
Touch the voltage application probe of the 9196 APPLY UNIT to the signal input or signal output part which is not protectively earthed of the equipment to be measured.
Press the voltage application button on the voltage application probe.
The application of voltage is in effect only as long as the button is being pressed.

NOTE

110% voltage application is performed under single fault condition, but because this cannot be set by the 3155, the setting is normal condition.
Because the allowable value setting is quite different from that of conventional normal condition settings, care is necessary when making this setting.



If the enclosure or any part thereof is made of material with insulating characteristics

If the enclosure or any part thereof is made of material with insulating characteristics, attach the 9195 ENCLOSURE PROBE to the enclosure at approximately 0.5 N/cm^2 across the entire surface.

NOTE

- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.
- Use wire for connecting the functional earth terminals of an equipment to be measured, or an F-type applied part to the ground.
- When the equipment to be measured requires the use a single phase power source, connect the 3155 between the power source and the single phase power source, as well as between the single phase power source and the equipment to be measured.

(2) Measurement between parts of the enclosure (With class Ⅰ equipment, between parts of the enclosure which is not protectively earthed)

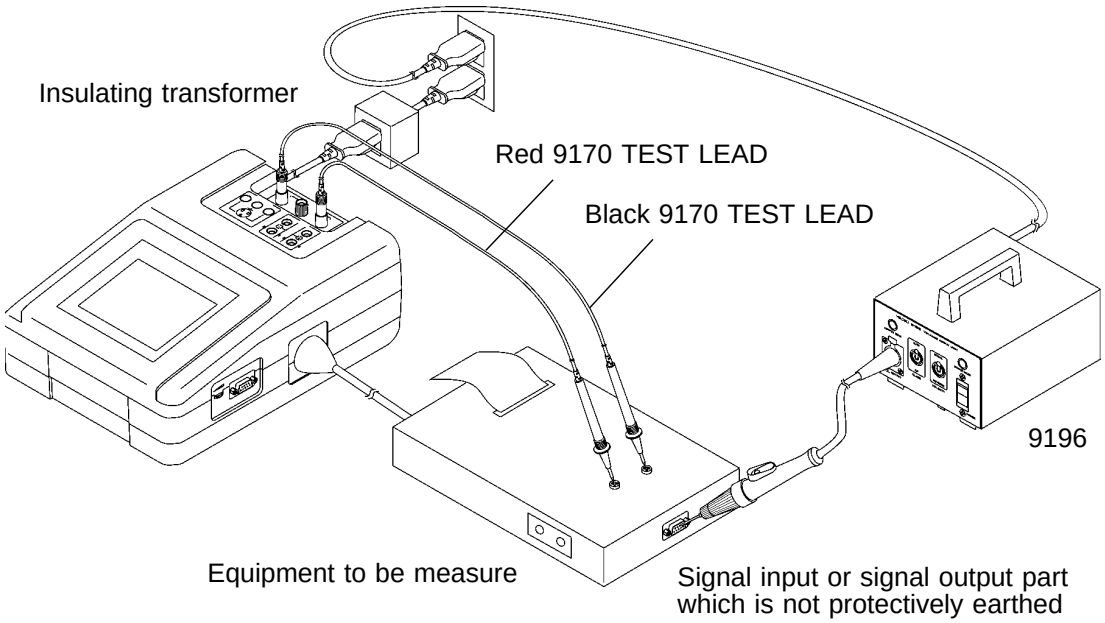
1. On the enclosure leakage current measurement screen, set the contact condition to "between parts of the enclosure."
2. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
3. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2, and the black one to T1.
4. Touch the red and black 9170 TEST LEADS between parts of the enclosure of the equipment to be measured.

For 110% applied voltage

Make the appropriate output settings for the 9196 APPLY UNIT.
Set the polarity toggle switch and the type toggle switch to match the applied part type of the equipment to be measured.
POLARITY: NORMAL or REVERSE
APPLIED PART (TYPE): B/BF, CF
Touch the voltage application probe of the 9196 APPLY UNIT to the signal input or signal output part which is not protectively earthed of the equipment to be measured.
Press the voltage application button on the voltage application probe.
The application of voltage is in effect only as long as the button is being pressed.

NOTE

110% voltage application is performed nder single fault condition, but because this cannot be set by the 3155, the setting is normal condition.
Because the allowable value setting is quite different from that of conventional normal condition settings, care is necessary when making this setting.



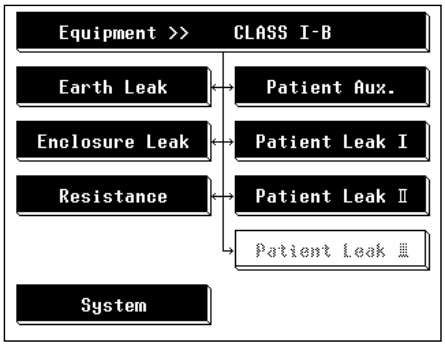
NOTE

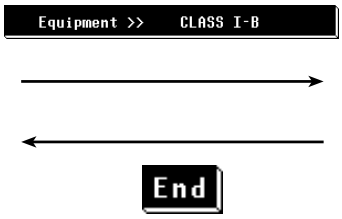
- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- Use wire for connecting the functional earth terminals of an equipment to be measured, or an F-type applied part to the ground.
- When the equipment to be measured requires the use a single phase power source, connect the 3155 between the power source and the single phase power source, as well as between the single phase power source and the equipment to be measured.

5.4.3 Basic Settings for Enclosure Leakage Current Measurement (ME Equipment)

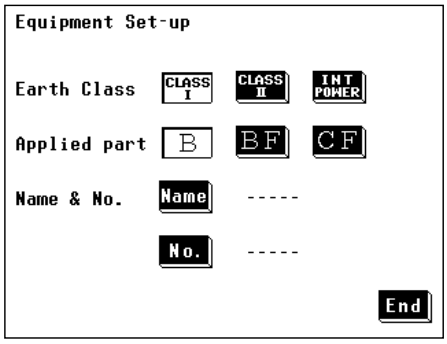
This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 5.4.2, "Connecting Equipment for Enclosure Leakage Current Measurement."

Initial screen

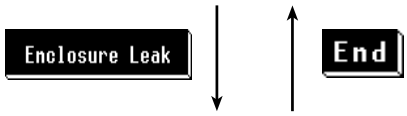




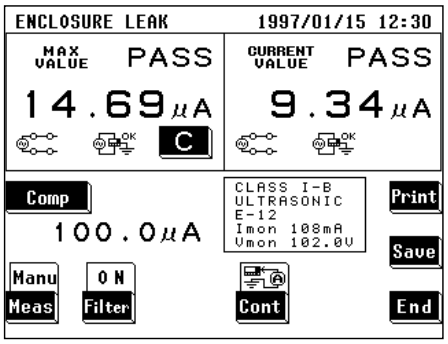
Equipment set-up screen



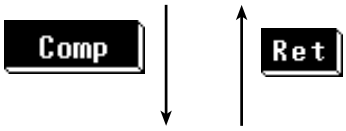
Set the grounding class and applied part type of the equipment to be measured, and register the model name and number.



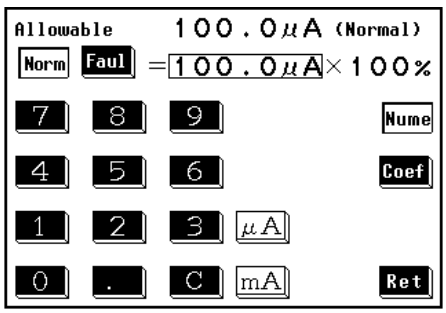
Enclosure leakage current measurement mode screen



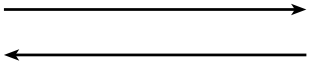
Measurement starts automatically



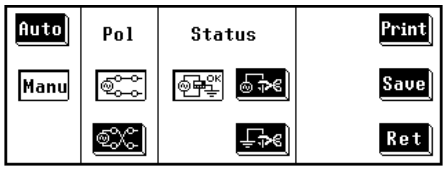
Allowable value set-up window



Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen."

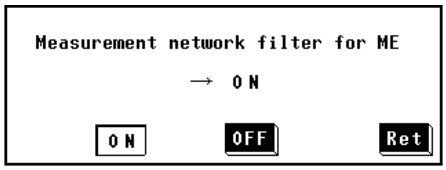


Polarity and equipment condition set-up window



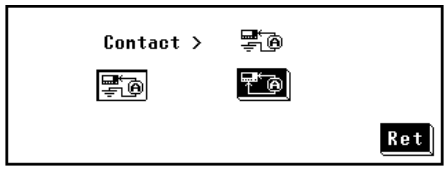
Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."

Measurement network filter set-up window

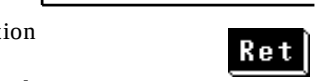


Set the filter.

Contact condition set-up window

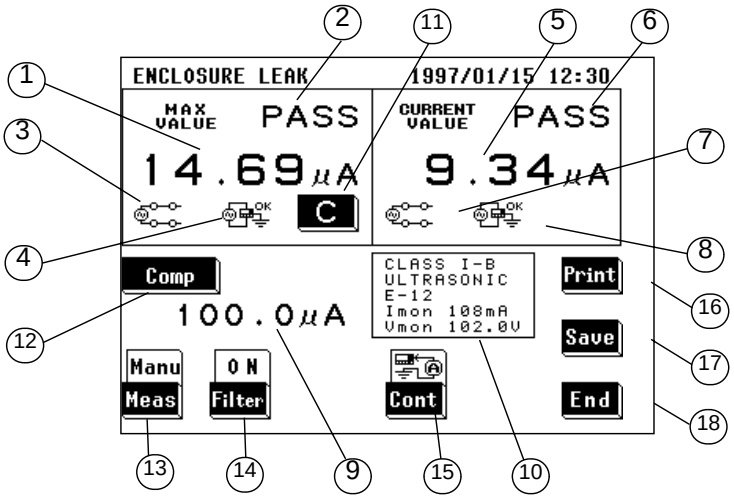


Set the contact condition.



5.4.4 Enclosure Leakage Current Measurement Screen (ME Equipment)

Measurement of enclosure leakage current is made on the enclosure leakage current measurement screen.
The current measured value, maximum value, and setting condition are shown on the enclosure leakage current measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower, FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal operation: Single fault condition (open power lead): Single fault condition (open ground):
⑤ Current value	Value obtained from the current measurement (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower, FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal: , Reverse:
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition: Single fault condition (open power lead): Single fault condition (open ground):

⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Cont	Opens the contact condition set-up window. Set the contact condition.  : Between the enclosure and the earth  : Between parts of the enclosure
⑯ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑰ Save	Opens the save data window. For details, refer to Section 6.10.6, "Saving the Maximum Values."
⑱ End	Exits the enclosure leakage current measurement, and returns to the initial screen.

5.5 Patient Leakage Current Ⅰ Measurement Mode

5.5.1 Patient Leakage Current Ⅰ Measurement Mode

Explanations made in this Instruction Manual conform to IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards. Measurements made in accordance with IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards are made with both alternating (AC) and direct (DC) current.

Plug the power cord of the equipment to be measured into the auxiliary socket for the 3155, and make a measurement by touching the 9170 TEST LEADS to the test point (applied part).
The following combinations are measured under the patient leakage current Ⅰ measurement. These are determined per the condition of the equipment to be measured, and the grounding class. Refer to the list of measurement types and their allowable values.

Condition of the equipment to be measured		Power source polarity	Measurement current (IEC)
Normal condition		Normal polarity	AC
			DC
		Reverse polarity	AC
			DC
Single fault condition	Open power lead	Normal polarity	AC
			DC
		Reverse polarity	AC
			DC
	Open ground	Normal polarity	AC
			DC
		Reverse polarity	AC
			DC

For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

NOTE

- When making measurements of internally powered equipment, only the normal condition (no polarity setting) is measured.
- By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 5.10.3, "Automatic Measurement Setting."

Measurement types and their allowable values

Class Ⅰ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2			Open power lead *1	Open ground *2			Open power lead *1	Open ground *2	
Patient leakage current Ⅰ	Direct current	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—
	Alternating current	0.1mA	0.5mA	0.5mA	—	0.1mA	0.5mA	0.5mA	—	0.01mA	0.05mA	0.05mA	—

Class Ⅱ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1				Open power lead *1				Open power lead *1		
Patient leakage current Ⅰ	Direct current	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—
	Alternating current	0.1mA	0.5mA	—	—	0.1mA	0.5mA	—	—	0.01mA	0.05mA	—	—

Internally powered equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition				Normal condition				Normal condition			
Patient leakage current Ⅰ	Direct current	0.01mA	—	—	—	0.01mA	—	—	—	0.01mA	—	—	—
	Alternating current	0.1mA		—	—	0.1mA	—	—	—	0.01mA	—	—	—

*1: Interruption of one supply conductor

*2: Interruption of a protective earth conductor

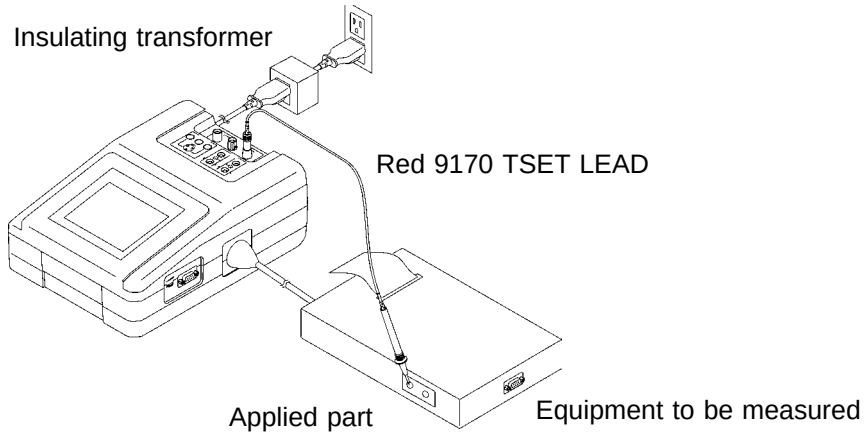
5.5.2 Connecting Equipment for Patient Leakage Current Ⅰ Measurement

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off.
  (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket.
  (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- Use an insulating transformer.

(1) Class Ⅰ and class Ⅱ equipment

1. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155.
2. Connect the red 9170 TEST LEAD earth to the leakage current measurement terminal T2.
3. Touch the red 9170 TEST LEAD to the applied part of the equipment to be measured.

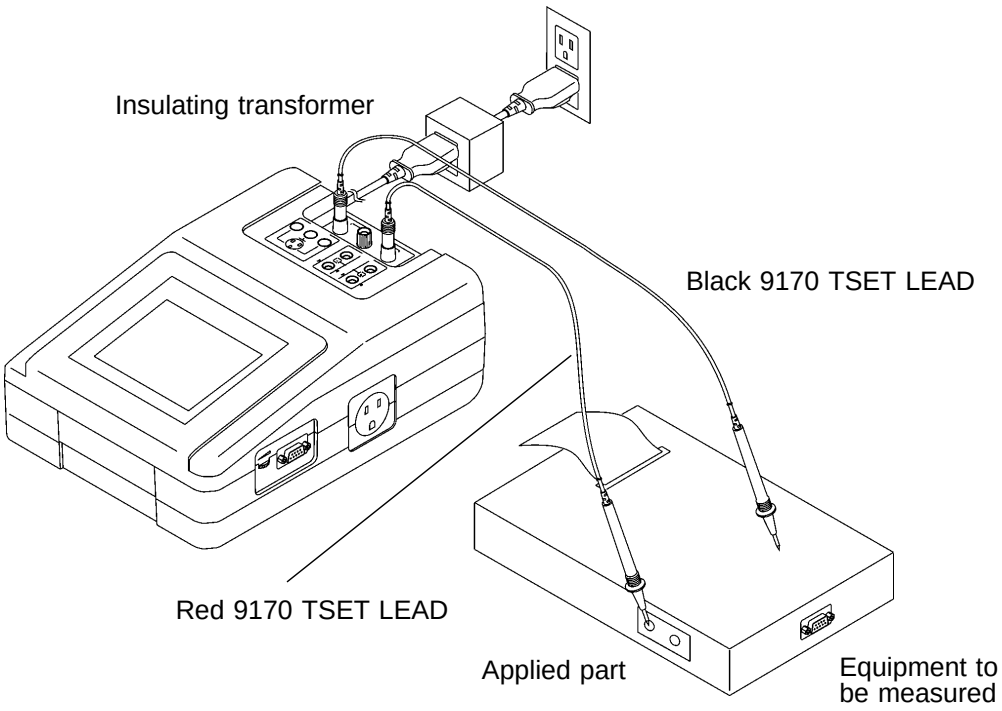


NOTE

- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- When measuring all patient connections simultaneously (type B applied part), or measuring patient connections simultaneously for each function (type BF applied part), have on hand a measuring instrument that can handle multiple measurements.
- Use wire for connecting the functional earth terminals of the equipment to be measured, or the accessible metal part which is not an applied part nor is earthed to the ground.

(2) Internally powered equipment

1. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2, and the black one to T1. No power cord connection is made.
2. Touch the red 9170 TEST LEAD to the applied part, and the black one to the enclosure of the equipment to be measured.



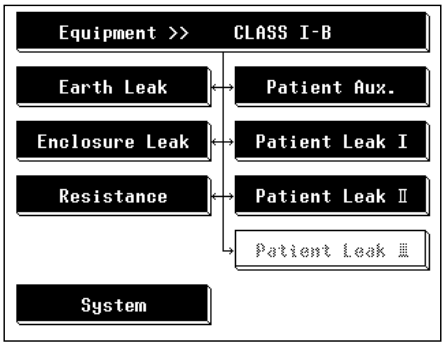
NOTE

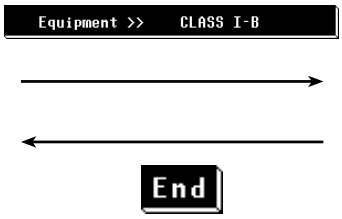
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- When measuring all patient connections simultaneously (type B applied part), or measuring patient connections simultaneously for each function (type BF applied part), have on hand a measuring instrument that can handle multiple measurements.

5.5.3 Basic Settings for Patient Leakage Current Ⅰ Measurement

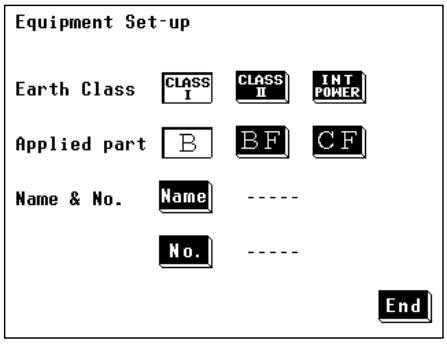
This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 5.5.2, "Connecting Equipment for Patient Leakage Current Ⅰ."

Initial screen



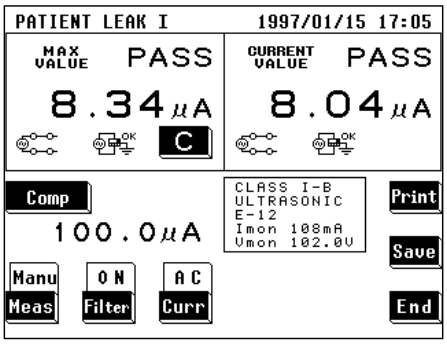


Equipment set-up screen

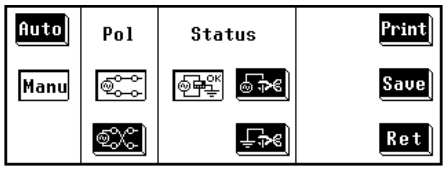


Set the grounding class and applied part type of the equipment to be measured, and register the model name and number.

Patient leakage current Ⅰ measurement mode screen

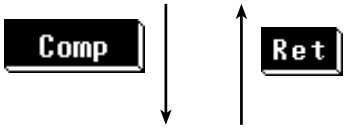


Polarity and equipment condition set-up window

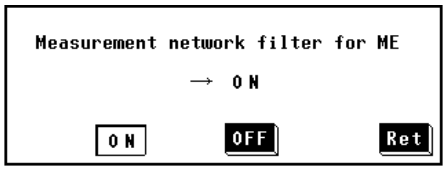


Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."

Measurement starts automatically

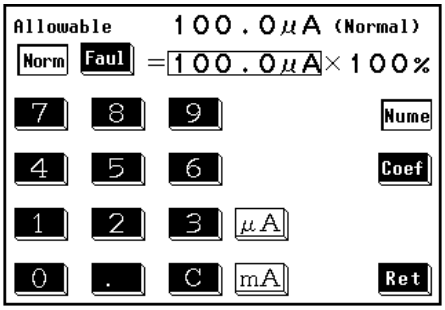


Measurement network filter set-up window



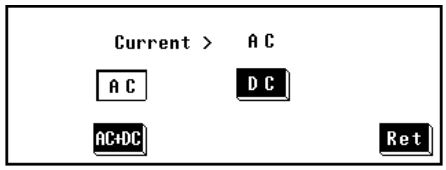
Set the filter.

Allowable value set-up window



Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")

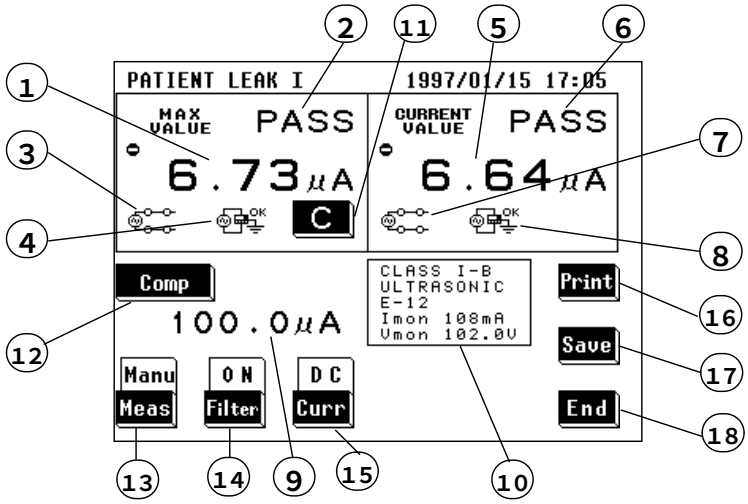
Measurement current set-up window



Set the measurement current.

5.5.4 Patient Leakage Current Ⅰ Measurement Screen

Measurement of patient leakage current Ⅰ is made on the patient leakage current Ⅰ measurement screen.
The current measured value, maximum value, and setting condition are shown on the patient leakage current Ⅰ measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal:  , Reverse: 
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value

⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Curr	Opens the measurement current set-up window. Set the current. AC: AC, DC: DC, AC+DC: AC+DC For details, refer to Section 5.10.4, "Measurement Current Setting."
⑯ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑰ Save	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑱ End	Exits the patient leakage current I measurement, and returns to the initial screen.

5.6 Patient Leakage Current Ⅱ Measurement Mode

5.6.1 Patient Leakage Current Ⅱ Measurement Mode

Patient leakage current Ⅱ measurement for medical electrical equipment is performed only for equipment with a type B applied part.
Plug the power cord of the equipment to be measured into the auxiliary socket for the 3155, and make a measurement by touching 9170 TEST LEADS to the test point (applied part), and applying voltage from the optional 9196 APPLY UNIT. For internally powered equipment, to achieve 250 V output, use the 9196 APPLY UNIT in combination with a regulated power supply. (Other voltage application units can also be used to make measurements.)
The following combinations are measured under the patient leakage current Ⅱ measurement.

Condition of the equipment to be measured		Power source polarity
Single fault condition	110% voltage applied (normal polarity)	Normal polarity
		Reverse polarity
	110% voltage applied (reverse polarity)	Normal polarity
		Reverse polarity

Measurement types and their allowable values

Class Ⅰ equipment	Type B applied part											
		Single fault condition										
				110% voltage applied								
Patient leakage current Ⅱ	—	—	—	5mA	—	—	—	—	—	—	—	—

Class Ⅱ equipment	Type B applied part											
		Single fault condition										
				110% voltage applied								
Patient leakage current Ⅱ	—	—	—	5mA	—	—	—	—	—	—	—	—

Internally powered equipment	Type B applied part											
		Single fault condition										
				110% voltage applied								
Patient leakage current Ⅱ	—	—	—	5mA Notes 1 and 2	—	—	—	—	—	—	—	—

Note 1: 110% voltage application to internally powered equipment can be either normal or reverse polarity.

Note 2: For internally powered equipment, for 250 V applications under IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards, 110% voltage of the 3155's power source voltage is applied via the 9196 APPLY UNIT.

NOTE

- Measurements shown in the shaded portions of the tables (110% voltage application) require the optional 9196 VOLTAGE APPLY UNIT or other power sources.
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.

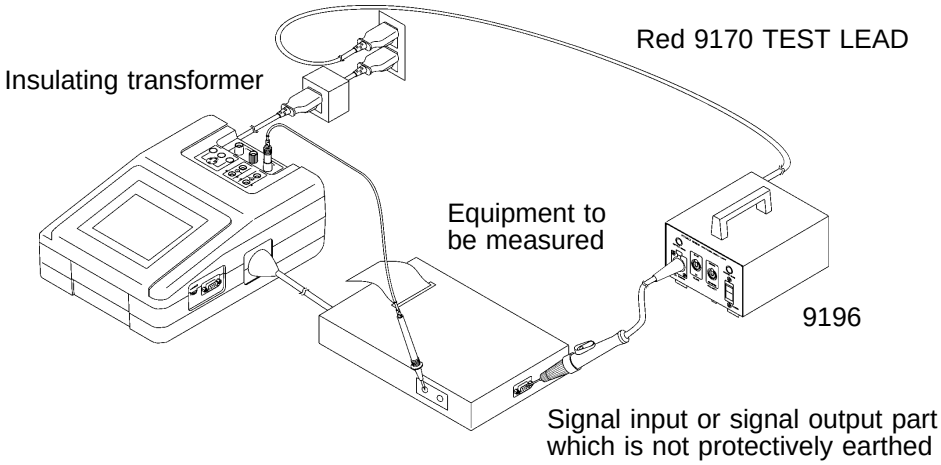
The measurement current is set to "AC+DC rms."
For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

5.6.2 Connecting Equipment for Patient Leakage Current Ⅱ Measurement

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- If the voltage application button to the 9196 APPLY UNIT is ON, the danger of electrical shock is present. Turn the voltage application button OFF when not making measurements.
- Use an insulating transformer.

1. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
2. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
3. Touch the red 9170 TEST LEAD to the applied part of the equipment to be measured.
4. For 110% applied voltage
   Make the appropriate output settings for the 9196 APPLY UNIT.
   Set the polarity toggle switch and the type toggle switch to match the applied part type of the equipment to be measured.
   POLARITY: NORMAL or REVERSE
   APPLIED PART (TYPE): B/BF (Set the type toggle switch to B/BF.)
   Touch the voltage application probe of the 9196 APPLY UNIT to the signal input or signal output part without protective grounding of the equipment to be measured.
   Press the voltage application button on the voltage application probe.
   The application of voltage is in effect only as long as the button is being pressed.



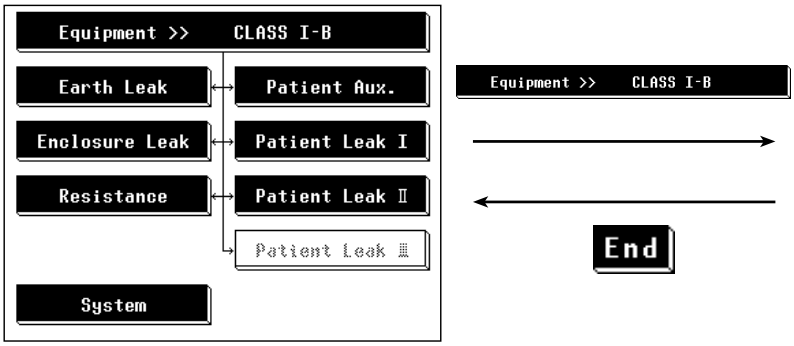
NOTE

- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- When measuring all patient connections simultaneously (type B applied part), or measuring patient connections simultaneously for each function (type BF applied part), have on hand a measuring instrument that can handle multiple measurements.
- Use wire for connecting the functional earth terminals of the equipment to be measured, or the accessible metal part which is not an applied part nor is earthed to the ground.
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.

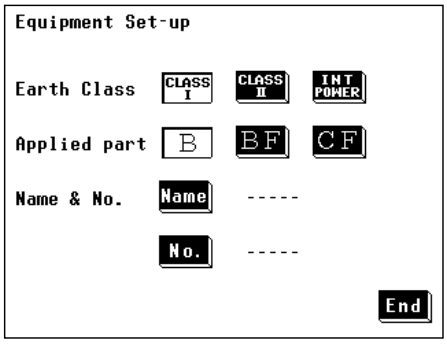
5.6.3 Basic Settings for Patient Leakage Current Ⅱ Measurement

This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 5.6.2, "Connecting Equipment for Patient Leakage Current Ⅱ."

Initial screen

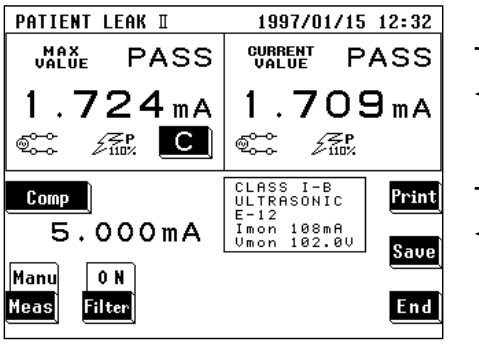


Equipment set-up screen

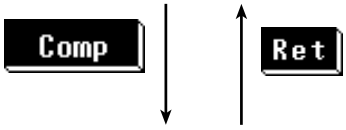


Set the grounding class of the equipment to be measured.
Select the type B applied part.

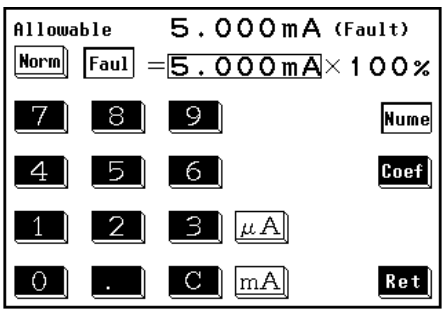
Patient leakage current Ⅱ measurement mode screen



Measurement starts automatically



Allowable value set-up window

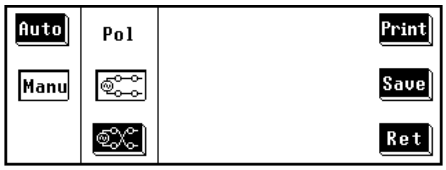


Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")

Meas

Ret

Polarity and equipment condition set-up window

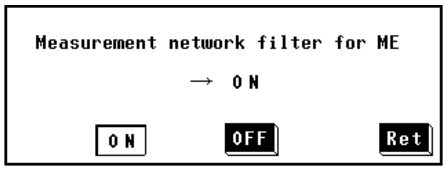


Select and press the key for the power source polarity to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."

Filter

Ret

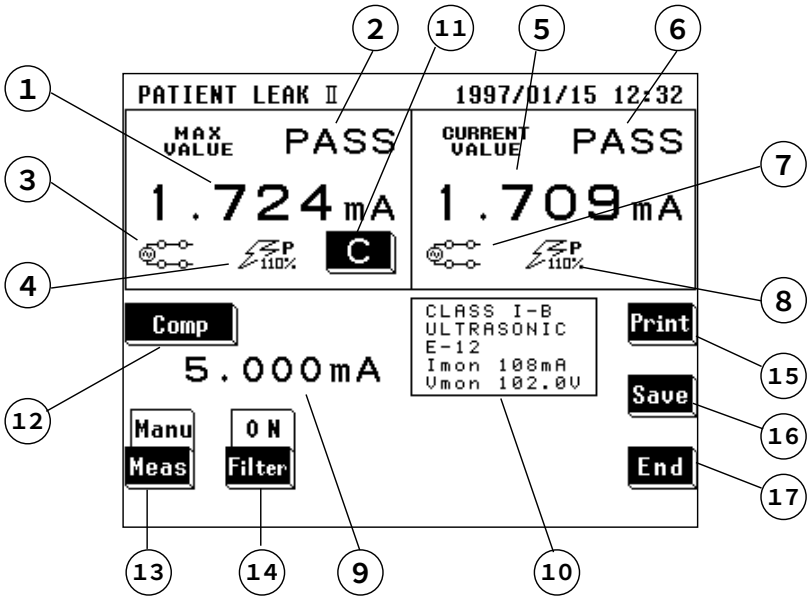
Measurement network filter set-up window



Set the filter.

5.6.4 Patient Leakage Current Ⅱ Measurement Screen

Measurement of patient leakage current Ⅱ is made on the patient leakage current Ⅱ measurement screen.
The current measured value, maximum value, and setting condition are shown on the patient leakage current Ⅱ measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Single fault condition (110% voltage applied):
⑤ Current value	Value obtained from the current measurement (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal: , Reverse:
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Single fault condition (110% voltage applied):

⑨ Allowable value	Current setting of the allowable value (Single fault condition only)
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. (Single fault condition only) Range of the allowable value: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE: 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑯ Manu	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑰ End	Exits the patient leakage current Ⅱ measurement, and returns to the initial screen.

5.7 Patient Leakage Current Ⅲ Measurement Mode

5.7.1 Patient Leakage Current Ⅲ Measurement Mode

Patient leakage current Ⅲ measurement for medical electrical equipment is performed only for equipment with a type BF or type CF applied part.
Plug the power cord of the equipment to be measured into the auxiliary socket for the 3155, and make a measurement by touching 9170 TEST LEADS to the test point (applied part), and applying voltage from the optional 9196 APPLY UNIT. For internally powered equipment, to achieve 250 V output, use the 9196 APPLY UNIT in combination with a regulated power supply. (Other voltage application units can also be used to make measurements.)
The following combinations are measured under the patient leakage current Ⅲ measurement.

Condition of the equipment to be measured		Power source polarity
Single fault condition	110% voltage applied (normal polarity)	Normal polarity
		Reverse polarity
	110% voltage applied (reverse polarity)	Normal polarity
		Reverse polarity

NOTE

- In the patient leakage current Ⅲ measurement mode, the 50 μA range is not used.
- For internally powered equipment, use wire for connecting the signal input and output parts which are not protectively earthed to the ground.

Measurement types and their allowable values

Class Ⅰ equipment					Type BF applied part				Type CF applied part			
						Single fault condition				Single fault condition		
								110% voltage applied				110% voltage applied
Patient leakage current Ⅲ	—	—	—	—	—	—	—	5mA	—	—	—	0.05mA

Class Ⅱ equipment					Type BF applied part				Type CF applied part			
						Single fault condition				Single fault condition		
								110% voltage applied				110% voltage applied
Patient leakage current Ⅲ	—	—	—	—	—	—	—	5mA	—	—	—	0.05mA

Internally powered equipment					Type BF applied part				Type CF applied part			
						Single fault condition				Single fault condition		
								110% voltage applied				110% voltage applied
Patient leakage current Ⅲ	—	—	—	—	—	—	—	5mA Notes 1 and 2	—	—	—	0.05mA Notes 1 and 2

Note 1: 110% voltage application to internally powered equipment can be either normal or reverse polarity

Note 2: For internally powered equipment, for 250 V applications under IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards, 110% voltage of the 3155's power source voltage is applied via the 9196 APPLY UNIT.

NOTE

- Measurements shown in the shaded portions of the tables (110% voltage application) require the optional 9196 APPLY UNIT or other power sources.
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.

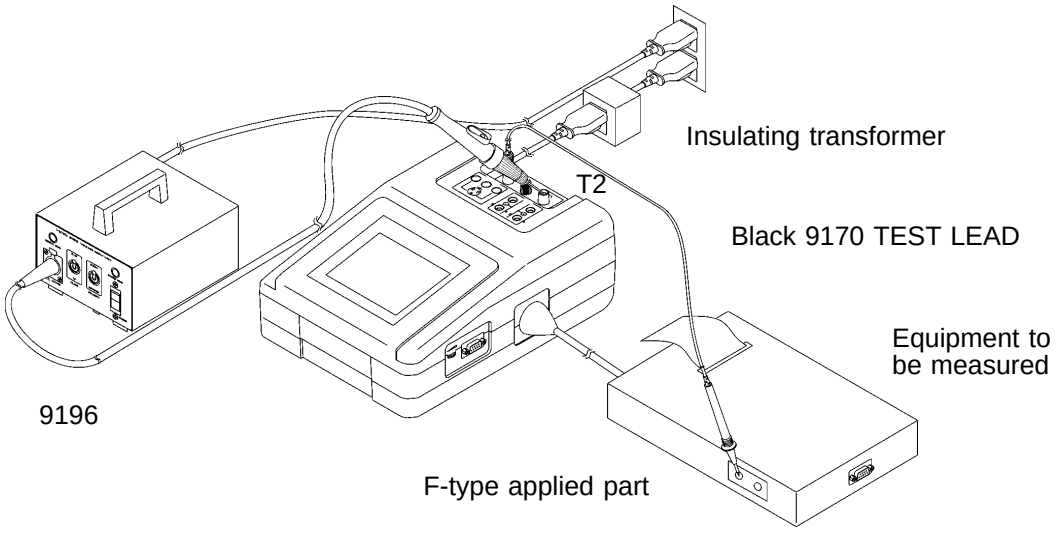
The measurement current is set to "AC+DC rms."
For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

5.7.2 Connecting Equipment for Patient Leakage Current Ⅲ Measurement

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off.
  (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket.
  (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- If the voltage application button to the 9196 APPLY UNIT is ON, the danger of electrical shock is present. Turn the voltage application button OFF when not making measurements.
- Use an insulating transformer.

1. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No power cord connection is made for internally powered equipment.
2. Connect the black 9170 TEST LEAD to the leakage current measurement terminal T1.
3. Make the appropriate output settings for the 9196 APPLY UNIT. Set the polarity toggle switch and the type toggle switch to match the applied part type of the equipment to be measured.
   POLARITY: NORMAL or REVERSE
   APPLIED PART (TYPE): B/BF, CF
4. Perform zero adjustment. For details, refer to Section 5.7.3, "Zero Adjustment (ME Equipment - Patient Leakage Current Ⅲ)."
5. Touch the black 9170 TEST LEAD to the applied part of the equipment to be measured.
6. Touch the tip of the voltage application probe of the 9196 APPLY UNIT to the leakage current measurement terminal T2 of the 3155.
7. For 110% applied voltage
   Press the voltage application button on the voltage application probe. The application of voltage is in effect only as long as the button is being pressed.



NOTE

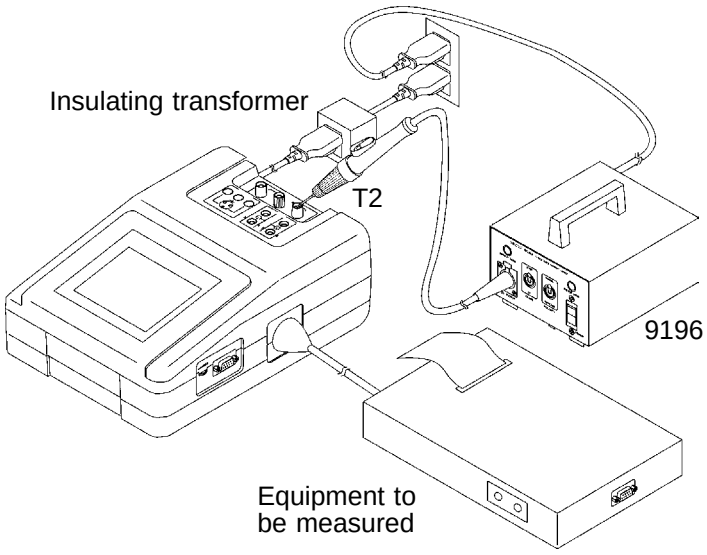
- Do not apply 110% voltage if there is any chance that circuitry or other physical components of the instrument might be damaged.
- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- Use wire for connecting the accessible metal part which is not an applied part nor is earthed of the equipment to be measured to the ground, and connect it to the functional earth terminal on the rear panel of the 9196 APPLY UNIT.
- When the enclosure of the internally powered equipment is insulating material, make a measurement on a metal plate larger than the equipment to be measured.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- When measuring all patient connections simultaneously (type B applied part), or measuring patient connections simultaneously for each function (type BF applied part), have on hand a measuring instrument that can handle multiple measurements.

5.7.3 Zero Adjustment (ME Equipment - Patient Leakage Current Ⅲ)

In cases where the voltage from the 9196 APPLY UNIT or other voltage application devices is applied to the 3155 when making a measurement, the measured value may be subject to synchronous voltage. In which case, an accurate measurement cannot be obtained without first performing zero adjustment. Always perform zero adjustment before measuring.
After performing zero adjustment, the value remains in memory even if the measuring mode is changed. If the voltage of the voltage application device is changed, perform zero adjustment again. Zero adjustment is possible in a range from 0 to 500 μA.

Zero Adjustment

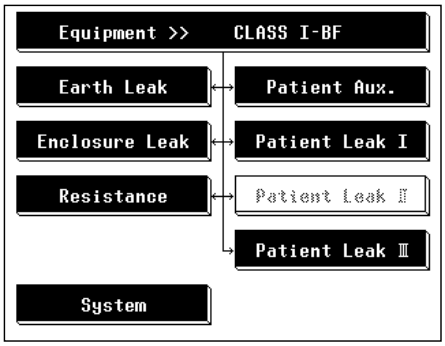
1. Touch the tip of the voltage application probe of the 9196 APPLY UNIT to the leakage current measurement terminal T2 of the 3155.
   In this case, do not connect the black 9170 TEST LEAD to the leakage current measurement terminal T1 and the applied part of the equipment to be measured.
2. Make any necessary settings for the 9196 APPLY UNIT output.
3. Press the voltage application button to the probe. Voltage is applied only when the button is being pressed.
4. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, Z is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again to release zero adjustment.
5. Turn OFF the voltage application button to the probe.

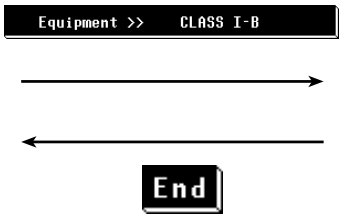


5.7.4 Basic Settings for Patient Leakage Current Ⅲ Measurement

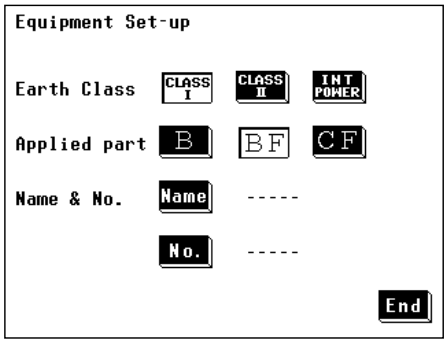
This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 5.7.2, "Connecting Equipment for Patient Leakage Current Ⅲ."

Initial screen

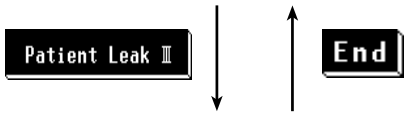




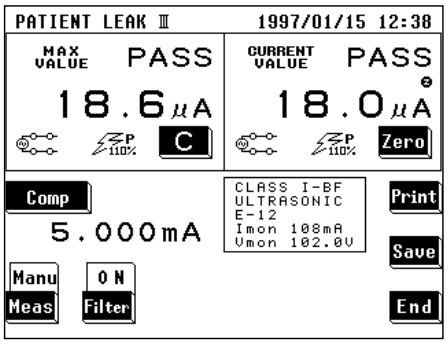
Equipment set-up screen



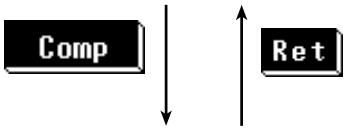
Set the grounding class of the equipment to be measured.
Select the type BF or CF applied part.



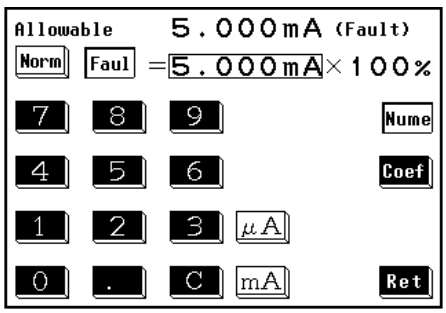
Patient leakage current Ⅲ measurement mode screen



Measurement starts automatically

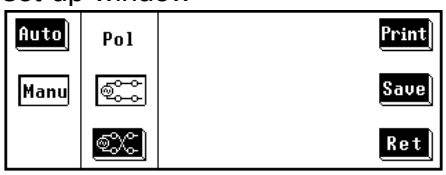


Allowable value set-up window

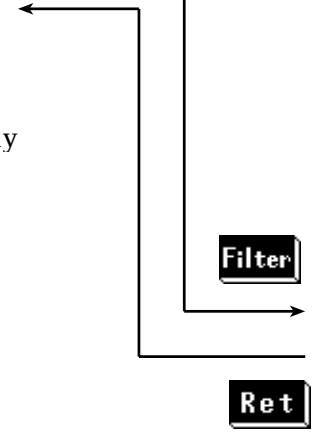


Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")

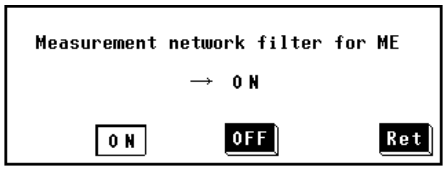
Polarity and equipment condition set-up window



Select and press the key for the power source polarity to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."



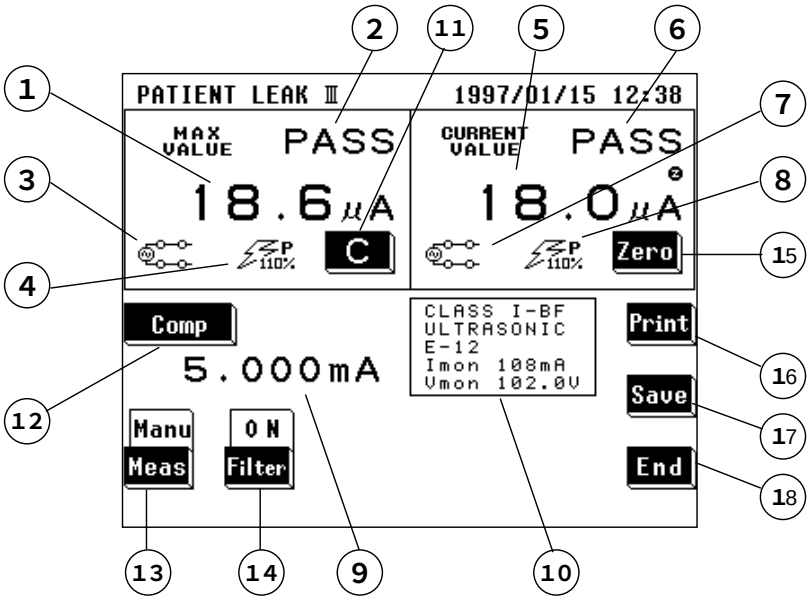
Measurement network filter set-up window



Set the filter.

5.7.5 Patient Leakage Current Ⅲ Measurement Screen

Measurement of patient leakage current Ⅲ is made on the patient leakage current Ⅲ measurement screen.
The current measured value, maximum value, and setting condition are shown on the patient leakage current Ⅲ measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Set-up status display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Single fault condition (110% voltage applied):
⑤ Current value	Value obtained from the current measurement (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal: , Reverse:

⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Single fault condition (110% voltage applied): 
⑨ Allowable value	Current setting of the allowable value (Single fault condition only)
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. (Single fault condition only) Range of the allowable value: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE: 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective,  is displayed on the screen. For details, refer to Section 5.7.3, "Zero Adjustment (ME Equipment - Patient Leakage Current Ⅲ)."
⑯ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑰ Save	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑱ End	Exits the patient leakage current III measurement, and returns to the initial screen.

5.8 Patient Auxiliary Current Measurement Mode

5.8.1 Patient Auxiliary Current Measurement Mode

Patient auxiliary current measurement for medical electrical equipment is made with both alternating (AC) and direct (DC) current.
Plug the power cord of the equipment to be measured into the auxiliary socket for the 3155, and make a measurement by touching the 9170 TEST LEADS to the test point (applied part).
The following combinations are measured under the patient auxiliary current measurement.

Condition of the equipment to be measured		Power source polarity	Measurement current
Normal condition		Normal polarity	AC
			DC
		Reverse polarity	AC
			DC
Single fault condition	Open power lead	Normal polarity	AC
			DC
		Reverse polarity	AC
			DC
	Open ground	Normal polarity	AC
			DC
		Reverse polarity	AC
			DC

NOTE When making measurements of internally powered equipment, only the normal condition is measured.
For the concept of leakage current in medical electrical equipment and its wiring when using the 3155, refer to Appendix 2.1, "IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)."

Measurement types and their allowable values

Class Ⅰ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1	Open ground *2			Open power lead *1	Open ground *2			Open power lead *1	Open ground *2	
Patient auxiliary current	Direct current	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—	0.01mA	0.05mA	0.05mA	—
	Alternating current	0.1mA	0.5mA	0.5mA	—	0.1mA	0.5mA	0.5mA	—	0.01mA	0.05mA	0.05mA	—

Class Ⅱ equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition	Single fault condition			Normal condition	Single fault condition			Normal condition	Single fault condition		
			Open power lead *1				Open power lead *1				Open power lead *1		
Patient auxiliary current	Direct current	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—	0.01mA	0.05mA	—	—
	Alternating current	0.1mA	0.5mA	—	—	0.1mA	0.5mA	—	—	0.01mA	0.05mA	—	—

Internally powered equipment		Type B applied part				Type BF applied part				Type CF applied part			
		Normal condition				Normal condition				Normal condition			
Patient auxiliary current	Direct current	0.01mA	—	—	—	0.01mA	—	—	—	0.01mA	—	—	—
	Alternating current	0.1mA	—	—	—	0.1mA	—	—	—	0.01mA	—	—	—

*1: Interruption of one supply conductor

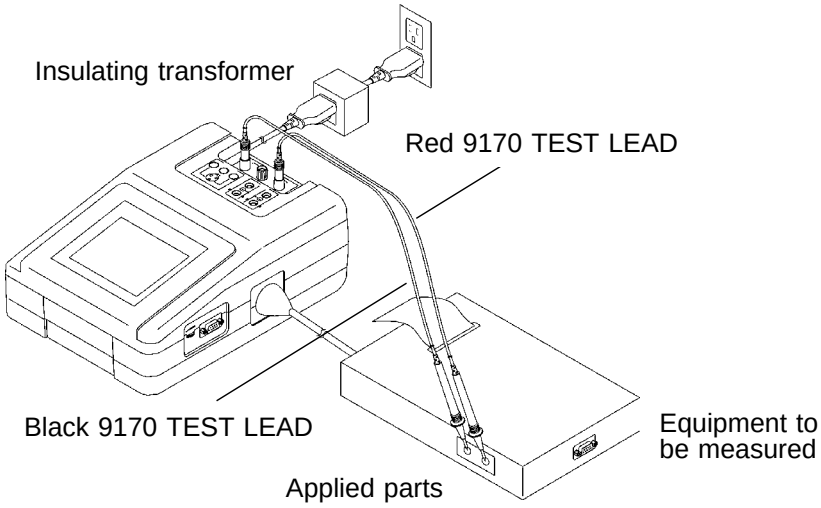
*2: Interruption of a protective earth conductor

5.8.2 Connecting Equipment for Patient Auxiliary Current Measurement

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- Use an insulating transformer.

1. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
2. Connect the black 9170 TEST LEAD to the leakage current measurement terminal T1, and the red one to T2.
3. Touch the red and black 9170 TEST LEADS between the applied parts of the equipment to be measured.



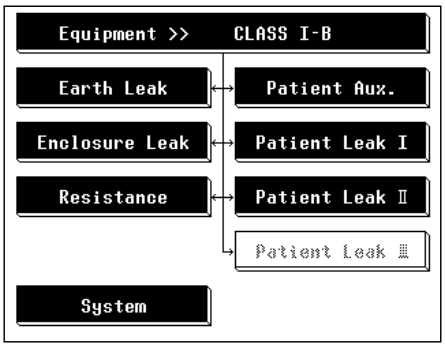
NOTE

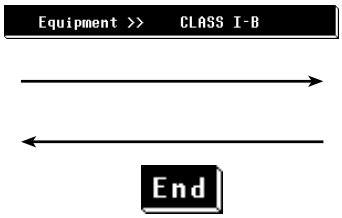
- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- Use wire for connecting the functional earth terminals of an equipment to be measured to the ground.

5.8.3 Basic Settings for Patient Auxiliary Current Measurement

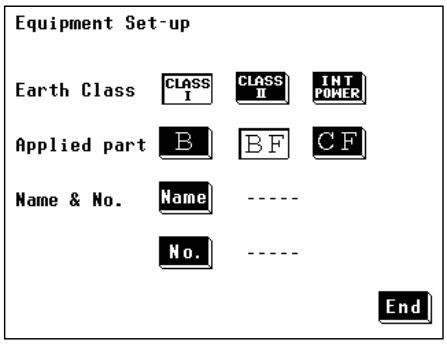
This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 5.8.2, "Connecting Equipment for Patient Auxiliary Current Measurement."

Initial screen

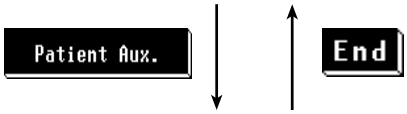




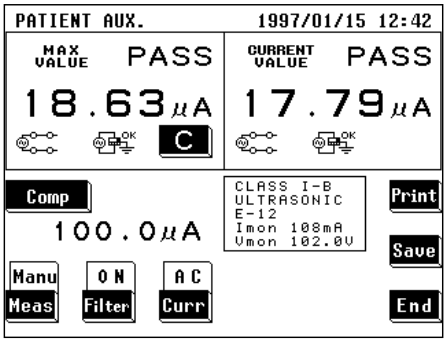
Equipment set-up screen



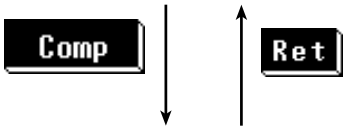
Set the grounding class and applied part type of the equipment to be measured, and register the model name and number.



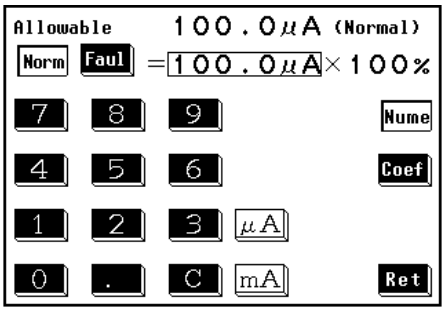
Patient auxiliary current measurement mode screen



Measurement starts automatically

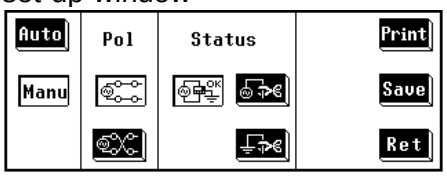


Allowable value set-up window



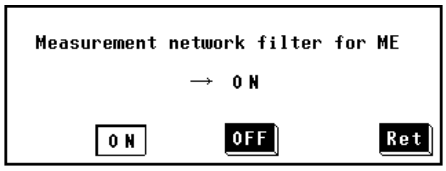
Set the allowable value referring to Section 5.10.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")

Polarity and equipment condition set-up window



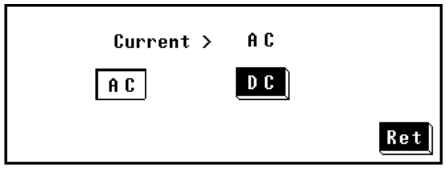
Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting."

Measurement network filter set-up window



Set the filter.

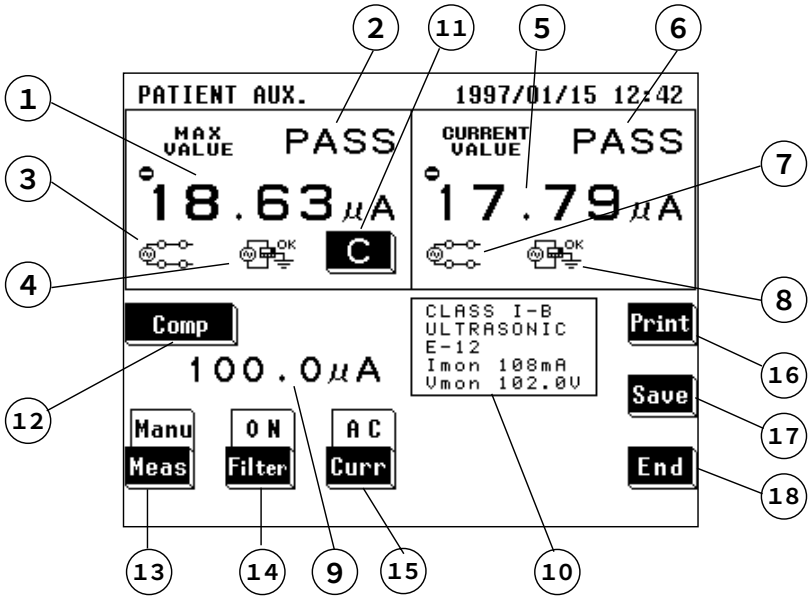
Measurement current set-up window



Set the measurement current.

5.8.4 Patient Auxiliary Current Measurement Screen

Measurement of patient auxiliary current is made on the patient auxiliary current measurement screen. The current measured value, maximum value, and setting condition are shown on the patient auxiliary current measurement screen. Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal condition: Single fault condition (open power lead): Single fault condition (open ground):
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value

⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 5.10.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 5.10.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑭ Filter	Opens the measurement network filter set-up window. Select either filter ON or OFF. ON: Network with frequency characteristics OFF: Network with uninducted resistance of only 1 kΩ
⑮ Curr	Opens the measurement current set-up window. Set the current. AC: AC, DC: DC For details, refer to Section 5.10.4, "Measurement Current Setting."
⑯ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑰ Save	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑱ End	Exits the patient auxiliary current measurement, and returns to the initial screen.

5.9 Low Resistance Measurement Mode (ME Equipment)

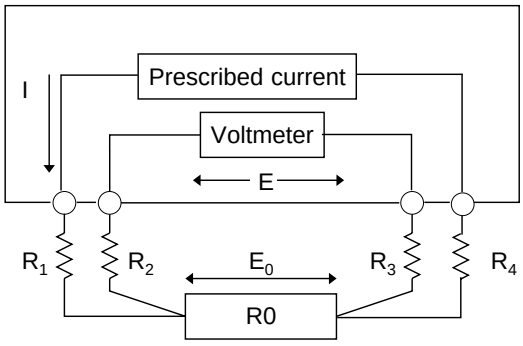
5.9.1 Low Resistance Measurement Mode

Under IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03), measurement of resistance of the protective earth conductor is to be made at 25 AAC of current. The 3155, however, makes this measurement simply using the DC four-terminal method (at 100 mADC max.).
This measurement is made for Class Ⅰ equipment only.
Measurement is made by touching either the optional 9461 PIN-TYPE LEADS or 9287 CLIP-TYPE LEADS to the test point. Measurement is also possible using RS-232C interfacing with the 3157 AC GROUNDING HiTESTER (max. 31A AC, conforming to various standards), available separately.

Four-terminal method

When measuring low levels of resistance, ordinarily the resistance of the measuring lead and the connector are included, which results in errors. By using the four-terminal method, this error can be eliminated.
The resistance measuring circuit measures the drop in voltage at the prescribed current, and calculates the resistance. As shown in the figure, however, the input resistance at the voltmeter is extremely high, and all of current I flows into the measured resistance R_0. Therefore the drop in voltage from R_2 to R_3 becomes 0, the voltage E and the voltage drop E_0 at both ends of the measured resistance R_0 become equal, and the resistance is measured without the influence of R_1 to R_4.
(R1 to R4 indicate the measuring lead and connector resistance.)

Resistance measuring circuit



R1 to R4 are the measuring lead and connector resistance.

5.9.2 Connecting Equipment for Low Resistance Measurement (ME Equipment)

⚠ WARNING **Do not input a voltage exceeding 30 Vrms, 42.4 Vpeak or 50 VDC between the resistance measurement terminals, and between the resistance measurement terminal and the ground.**

⚠ CAUTION

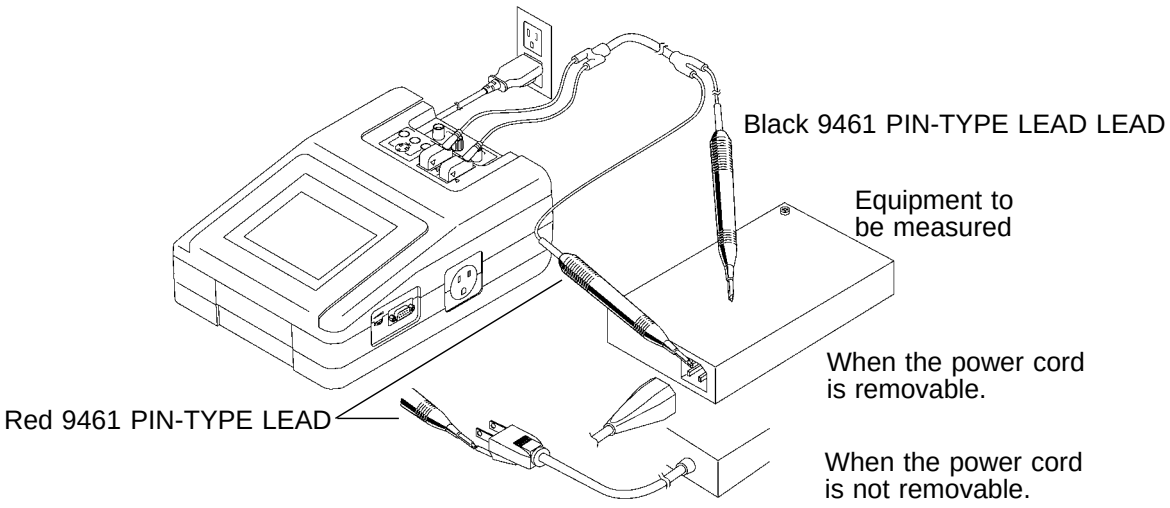
- Be careful not to hurt yourself on the end of the 9461 PIN-TYPE LEADS, which is pointed.
- Do not connect anything other than the 9461 PIN-TYPE LEADS and the 9287 CLIP-TYPE LEADS to the resistance measurement terminal.

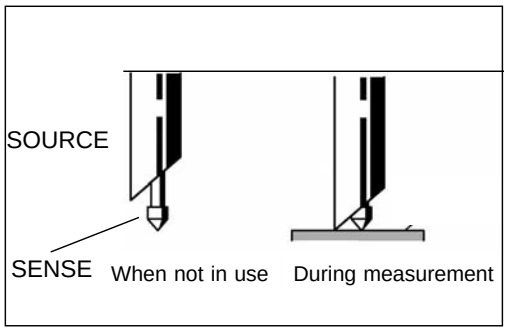
NOTE Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.

(1) When using the 9461 PIN-TYPE LEADS

The 9461 PIN-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.

1. When the power cord is removable.
   Touch the pin-type leads between the protective earth terminal and the enclosure which is not protectively earthed.
   Allowable value: 100 mΩ
2. When the power cord is not removable.
   Touch the pin-type leads between the protective earth pin of the power plug and the enclosure which is not protectively earthed.
   Allowable value: 200 mΩ





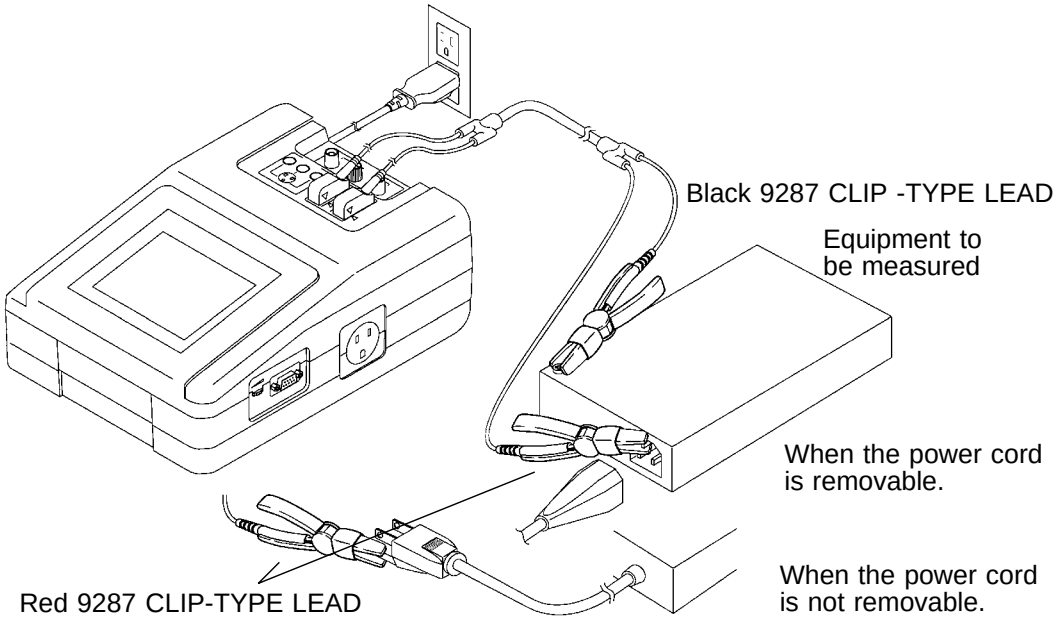
NOTE

As shown in the figure, the 9461 PIN-TYPE LEAD has a SENSE sheathed by the SOURCE. When touched to the equipment to be measured, both the SENSE and the SOURCE must be in contact with the equipment to be measured.

(2) When using the 9287 CLIP-TYPE LEADS

The 9287 CLIP-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.

1. When the power cord is removable.
   Touch the clip-type leads between the protective earth terminal and the enclosure which is not protectively earthed.
   Allowable value: 100 mΩ
2. When the power cord is not removable.
   Touch the clip-type leads between the protective earth pin of the power plug and the enclosure which is not protectively earthed.
   Acceptable value: 200 mΩ



(3) When using 3157 AC GROUNDING HiTESTER

⚠ CAUTION

- Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.
- Do not touch the equipment to be measured until measurement is complete.

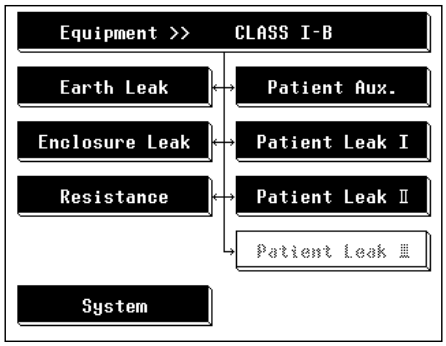
When measuring in low resistance measurement mode using optional 3157 AC GROUNDING HiTESTER, using the RS-232C interface enable the 3155 to control the 3157.
For usage, connection and communication settings for the 3157, see 3157/ 3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.

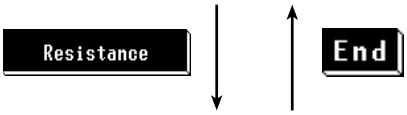
1. Leave power OFF for both 3155 and 3157 while connecting each RS-232C connector with the RS-232C cable. For connection with the RS-232C connector, see Section 8.4, "Connecting Method."
2. Turn the power ON for both 3155 and 3157. Connect 3157 with equipment to be measured. The 3155 allowable value and measuring points apply to 3157.

5.9.3 Basic Settings for Low Resistance Measurement (ME Equipment)

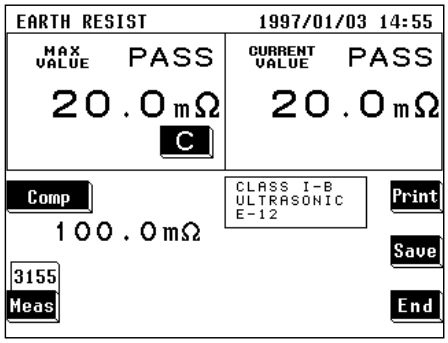
This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 5.9.2, "Connecting Equipment for Low Resistance Measurement."

Initial screen

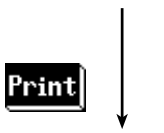




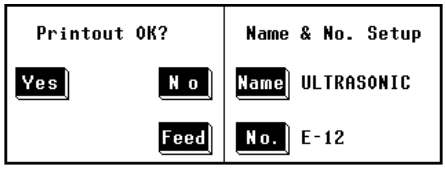
Low resistance measurement mode screen



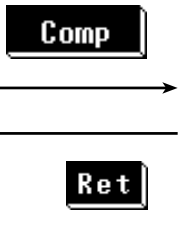
Measurement starts automatically. When measuring with 3157 measuring equipment settings, measurement is executed on measurement window.

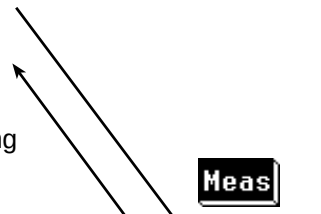


Print-out window

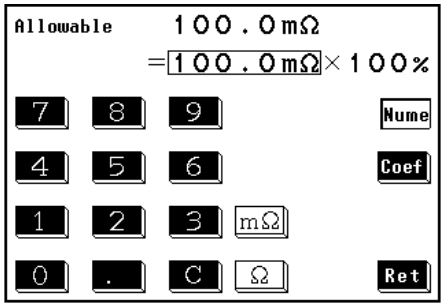


For a detailed set-up procedure, refer to Section 5.10.5, "Printing out the Maximum values."
For saving, refer to Section 5.10.6, "Saving the Maximum Values."





Allowable value set-up window



Set the allowable value referring to Section 5.10.2, "Allowable Value Setting." (For enabling or disabling the allowable value judgment, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen.")

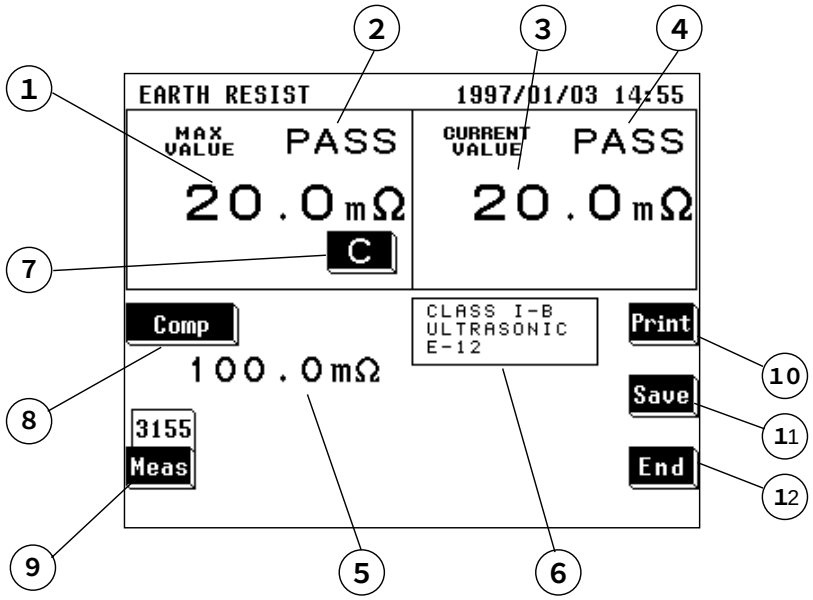
Measurement window

When measuring with 3157 measuring equipment settings, allowable value set-up window cannot be selected. Measuring defaults to 3157 allowable value (at maximum test value).

5.9.4 Low Resistance Measurement Screen (ME Equipment)

With 3155 measuring equipment settings selected on low resistance measurement screen, measurement starts immediately and displays current value.

When measuring with 3157 measuring equipment settings, measurement does not start until pressing the Yes key.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. When measuring with 3157 measuring equipment settings, value obtained as measured value is displayed.
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Current value	Value obtained from the current measurement When measuring with 3157 measuring equipment settings, measured value of 3157 is displayed after data transfer is complete.
④ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
⑤ Allowable value	Current setting of the allowable value
⑥ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number

(2) Settings

Key	Description of the function
⑦ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode. When measuring with 3157 measuring equipment settings, measuring starts by pressing the Yes key and clears maximum value.
⑧ Comp	Opens the allowable value set-up window. Range of the allowable value: 10 mΩ to 500 Ω When measuring with 3157 measuring equipment settings, allowable value is determined by 3157 and allowable value set-up window cannot be selected. When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157. For details, refer to Section 5.10.2, "Allowable Value Setting."
⑨ Meas	Opens measurement window. 1. Choose 3155 or 3157 for measuring. 2. When measuring with 3157 measuring equipment settings, measurement starts immediately. When measuring with 3157 measuring equipment settings, measurement and data transfer status are displayed. Yes: Measurement begins. For details, refer to Section 5.10.7, "Low Resistance Measurement with 3157."
⑩ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 5.10.5, "Printing out the Maximum Values."
⑪ Save	Opens the save data window. For details, refer to Section 5.10.6, "Saving the Maximum Values."
⑫ End	Exits the low resistance measurement, and returns to the initial screen.

NOTE

- When the maximum value and measured value overflow, "------" will be displayed. Moreover, no judgment can be made in this case.
- When measuring with 3157 measuring equipment settings, "------" will be displayed until data transfer is complete normally. Moreover, no judgment can be made in this case.

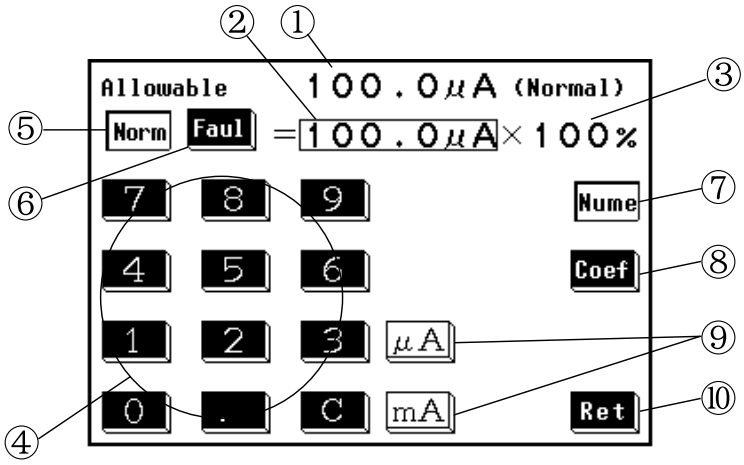
5.10 Condition Set-up Window Setting (ME Equipment)

5.10.1 Allowable Value Setting (For Leakage Current Measurement)

The allowable value setting may be revised as necessary to accommodate the measuring mode and condition of the equipment to be measured (normal condition or single fault condition).
The 3155 can set two allowable values in normal condition and single fault condition.
When shipped, the allowable values are set in accordance with IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03).
For details, refer to Section 10.4.2, "Default Settings."

Settings

(1) On the measuring mode screen, press the Comp key to open the allowable value set-up window.



Screen during input of the value in normal condition
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 5 μA to 20 mA

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Normal: Press to set the allowable value in normal condition
⑥ Fault: Press to set the allowable value in single fault condition
⑦ Numerals: Press to input numerals
⑧ Coefficient: Press to input coefficient
⑨ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑩ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 5 μA is input, the value is automatically revised to 5 μA. If a value of more than 20 mA is input, the value is automatically revised to 20 mA.

(2) Press the normal or fault key to select the desired allowable value.
(3) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.
(4) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.
(5) After making the setting, press the Ret key to close the allowable value set-up window.
(6) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

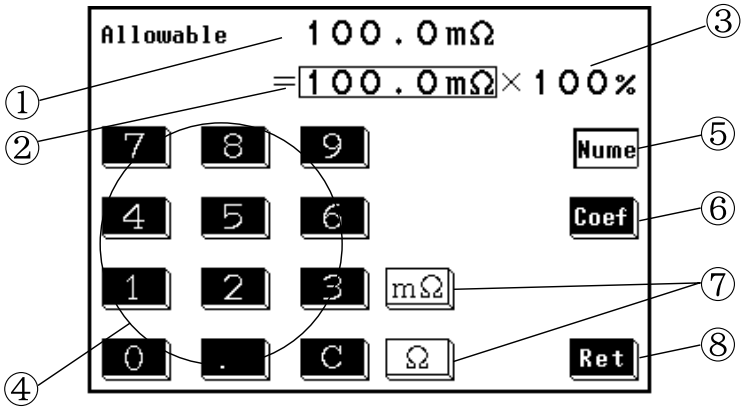
- To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.
  If the screen is changed before the unit is finalized, the setting is not revised.
- The maximum value is cleared after the setting is revised.
- Because 110% voltage is applied in normal condition in the enclosure leakage current measurement mode, set the allowable value in normal condition again.
- The numeral is initialized but the coefficient is not after the settings on the equipment set-up screen are changed.

5.10.2 Allowable Value Setting (For Low Resistance Measurement)

Low resistance measurement is performed only for grounding class Ⅰ equipment. The allowable value setting may be revised as necessary. When shipped, 100 mΩ is set.

Settings

(1) On the measuring mode screen, press the Comp key to open the allowable value set-up window.



Screen during input
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 10 mΩ to 500 Ω

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Numerals: Press to input numerals
⑥ Coefficient: Press to input coefficient
⑦ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑧ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 10 mΩ is input, the value is automatically revised to 10 mΩ. If a value of more than 500 Ω is input, the value is automatically revised to 500 Ω.

(2) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.

(3) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.

(4) After making the setting, press the Ret key to close the allowable value set-up window.

(5) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.

If the screen is changed before the unit is finalized, the setting is not revised. The maximum value is cleared after the setting is revised.

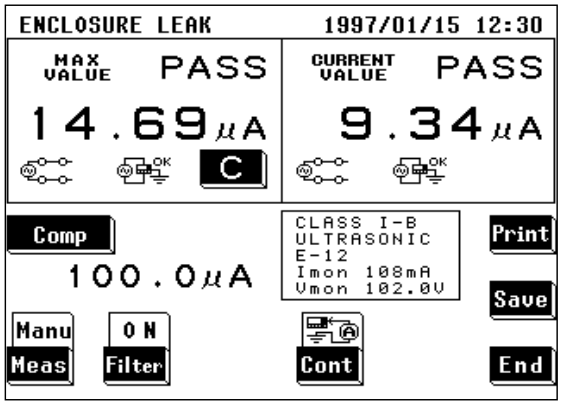
5.10.3 Automatic Measurement Setting (ME Equipment)

In each of the leakage current measurement modes, automatic measurement can be performed, in which the polarity and condition of the equipment to be measured are automatically changed. The combinations shown below are all set, and the maximum value of each combination is measured.
After measurement, the results will be displayed on the automatic measurement result screen. Printing and saving are possible on this screen.

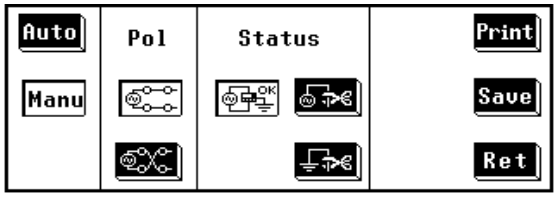
(1) Power source polarity (Normal and reverse)
(2) Condition of the equipment to be measured
  ① Normal condition
  ② Single fault condition (Open power lead, open ground)

NOTE Automatic measurement is not possible for 110% voltage application. Use the optional 9196 APPLY UNIT to make this measurement manually.

Settings

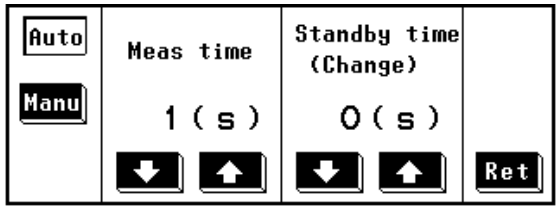


(1) On the leakage current measurement mode screen, press the **Meas** key to open the polarity and equipment condition set-up window. Measurement continues even when this window is open.



(2) Press the key for the desired measurement method.
  1. **Manu**: Sets the measurement method to manual.
  2. **Auto**: Sets the measurement method to automatic.

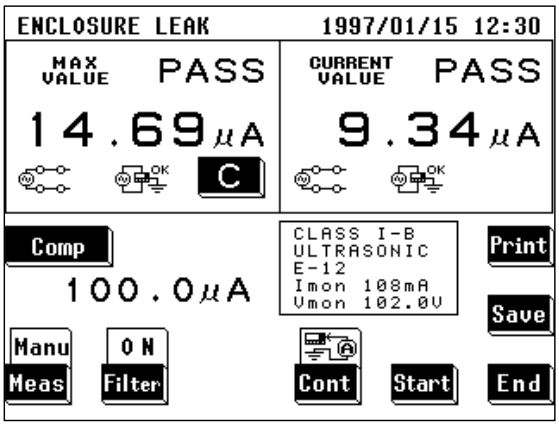
  After pressing the automatic key, the measuring time and standby time set-up window opens.



(3) Set the measuring and standby times. Use the ▲ and ▼ keys to make the settings as desired.
(4) Press the **Ret** key to close the measuring time and standby time set-up window.

Range Standby time: 0 to 99 seconds
Measuring time: 1 to 99 seconds

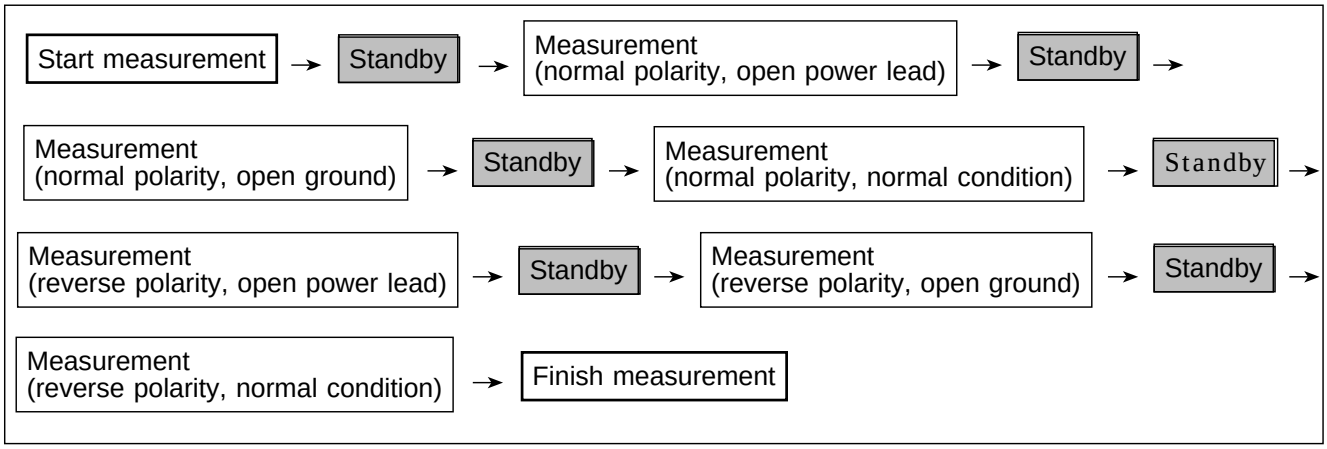
NOTE The equipment to be measured may take time to stabilize after changing the polarity and equipment condition. Set the standby time considering this time.



(5) On the measuring mode screen, press the **Start** key to start automatic measurement. When the measurement of a particular condition is finished, if it exceeds the current maximum value, the maximum value is revised to the new value. During measurements, the **Stop** key is displayed. Press the **Stop** key to interrupt the measuring process. After the measurements have been completed, the **Start** key is displayed.
During the measuring time, the beeper sounds.

(6) After the measurements have been completed, the automatic measurement result screen opens.

Example: Enclosure leakage current measurement



NOTE

Automatic measurements are carried out in the following order:
Polarity: normal, then reverse
Status: open power lead, open ground, normal condition
In cases where the single fault condition has not been set according to the standards, it is omitted.

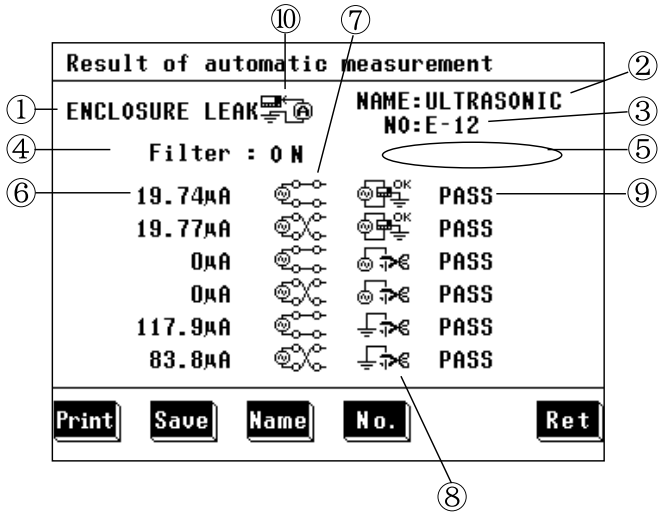
Categories to be set prior to automatic measurement

- Filter ON or OFF for all the measuring modes
- Contact condition
- Measurement current

It is necessary to have set the above categories manually prior to performing automatic measurement.

Automatic measurement result screen

After the automatic measurements have been completed, the automatic measurement result screen is displayed.



① Measuring mode
② Model name
③ Number
④ Measurement network filter setting
⑤ Measurement current
⑥ Maximum value
⑦ Power source polarity
⑧ Condition of the equipment to be measured
⑨ Judgment
⑩ Contact condition

Print: Print all the automatic measurement results.

Save: Save all the automatic measurement results.

Name: Display the model name input screen.

No.: Display the number input screen.

Ret: Return to the measuring mode screen.

NOTE

If returning to the measurement screen without first either saving or printing out the current data, that data will be lost.

(1) Printing the automatic measurement results

Press the **Print** key on the automatic measurement result screen to print all the automatic measurement results.
Press the **Yes** key to print. Press the **No** key to disable printing.
During printing, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing.
After printing, press the **Ret** key.

(2) Saving the automatic measurement results

Press the **Save** key on the automatic measurement result screen to save all the automatic measurement results.
Press the **Yes** key to save. Press the **No** key to disable saving.
If data with the same model name and number already exists, a request for confirmation appears.

(3) Changing the model name and number

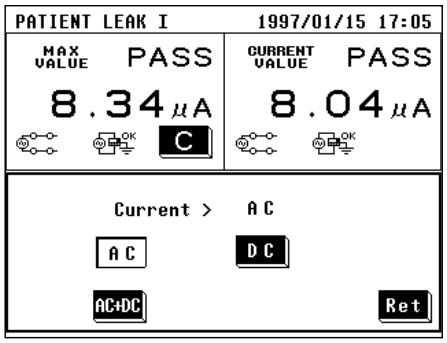
For details, refer to Section 5.2.2, "Equipment Set-up Screen (ME Equipment)."

Example of the automatic measurement results printout
Printout of the automatic measurements in the enclosure leakage current

```
--------------------
Date:1998/08/26
Name:ULTRASONIC
No.  :E-12
Stat:ClassI-B
Comment:

ENCLOSURE LEAKAGE:
 Filter     ON
 Contact    B-E

  1.22μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  OK

  1.22μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  OK

  1.22μA
 Judgment   PASS
 Polarity   Normal
 Powerline  Cut
 Earthline  OK

  1.22μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  Cut
 Earthline  OK

  380.1μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  Cut

  386.3μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  Cut
--------------------
```

5.10.4 Measurement Current Setting (ME Equipment)

This is where the measurement current is set.
Explanations made in this Instruction Manual conform to IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03) standards.



Settings

(1) Press the **Curr** key on the leakage current measurement mode screen to open the measurement current set-up window.
Measurement continues even when this window is open.

(2) On the measurement current set-up window, press the key for the type of current you wish to use.

AC: AC rms

DC: DC

AC+DC: AC+DC rms

(3) Press the **Ret** key to close the measurement current set-up window.

NOTE

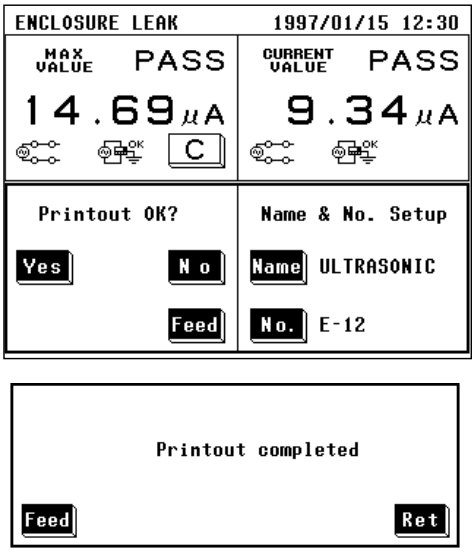
- Measurement current setting can be made only for the patient leak current Ⅰ measurement mode and the patient auxiliary current measurement mode.
- Even if changing the measurement current setting in the patient leakage current Ⅰ measurement mode and the patient auxiliary current measurement mode, the allowable value is not changed.
  When changing the allowable value, set the applied part type again on the equipment set-up screen after setting the measurement current on the measuring mode screen, and return to the measuring mode screen again.

5.10.5 Printing out the Maximum Values (ME Equipment)

The printer can be used to print out the maximum values and measurement settings for each measuring mode. When printing out the maximum values, the model name and number registered on the equipment set-up screen can be changed.
Once registered, these items will be included with the maximum values for each printout, unless changed. The registration of the model name and number input on the printout window is common to the save data window as well. When saving data, the model name and number are saved as well.

NOTE

- In cases where you wish to print out for the measurement settings (the power source polarity, condition of the equipment to be measured, etc) for each measuring mode individually, clear the maximum values each time, and make the measurements before printing out.
- For changing the model name and number, refer to Section 5.2.2, "Equipment Set-up Screen."



Settings

(1) On the measuring mode screen, press the **Print** key.

(2) At the bottom of the screen, the printout window will open.
Press the **Yes** key to print out the maximum values on the built-in printer.
Press the **No** key to close the printout window without printing out.
Press the **Feed** key to feed paper to the printer.
During printing out, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing out.

(3) Once the "Printout completed" message appears on the screen, press the **Ret** key to close the printout window.
Press the **Feed** key to feed paper to the printer. If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.

Example of a Maximum Value Printout (ME Equipment)
The printer can be used to print out the registered model name and number, as well as the maximum value and measurement settings for each of the measuring modes. The comment space is used for a memo.

```
--------------------
Date:1998/08/26
Name:ULTRASONIC
No.  :E-12
Stat:ClassI-B
Comment:

ENCLOSURE LEAKAGE:
  1.25μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline OK
 Filter    ON
 Contact   B-E
--------------------
```

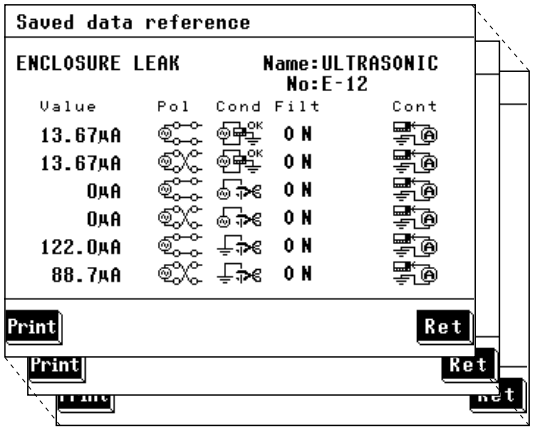
Example of a printout of the maximum value in the enclosure leakage current

5.10.6 Saving the Maximum Values (ME Equipment)

The maximum values are saved with the model name and number registered on the equipment set-up screen. The power source polarity, condition of the equipment to be measured, etc. during measurement are also saved.
When saving the maximum values, the model name and number can be changed.
The saved data units can be viewed on the saved data reference screen of the system screen. For details, refer to Section 5.11.2, "Saved Data reference Screen."

Data save format

The maximum values with the same model name and number are saved in a data unit.
The maximum values in each measuring mode can be saved in a data unit.
Up to 100 individual data units can be recorded. However, up to 2000 data (maximum values) can be recorded.



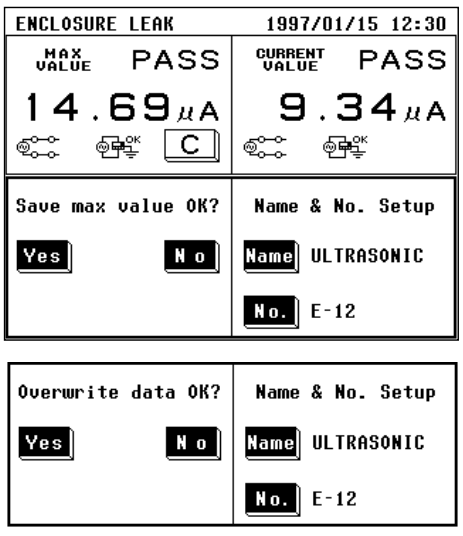
Measuring mode		Power source polarity		Condition of the equipment to be measured
Earth leakage current		Normal polarity		Normal condition
Enclosure leakage current	×	Reverse polarity	×	Single fault condition (Interruption of one supply conductor)
Patient leakage current Ⅰ				Single fault condition (Interruption of a protective earth conductor)
Patient leakage current Ⅱ				Single fault condition (110% voltage applied)
Patient leakage current Ⅲ				
Patient auxiliary current				
Low resistance measurement				

- There is no single fault condition (interruption of a protective earth conductor) for earth leakage current.
- There is single fault condition (110% voltage applied) only for patient leakage current Ⅱ and Ⅲ.
- There are no power source polarity and condition of the equipment to be measured for low resistance measurement.

- A part of the condition of the equipment to be measured is omitted depending on the settings of the grounding class and applied part type of the equipment to be measured.
- In the following cases, model name and number must be changed for storage as a different data unit.
  - When the measurement network filter setting is changed.
  - When the measurement current setting is changed.
  - When any of the following conditions pertain enclosure leakage current.
    When the contact condition setting is changed.
    When 110% voltage (normal polarity) is applied.
    When 110% voltage (reverse polarity) is applied.
  - When the polarity of applied 110% voltage is changed in patient leakage current Ⅱ.
  - When the polarity of applied 110% voltage is changed in patient leakage current Ⅲ.

Notes when saving data

- Even if the filter setting, measurement current and contact condition have changed, as long as the registered data unit is the same, the data for that data unit will be overwritten. (after a request for confirmation)
- When saving data manually for each setting condition (power source polarity and condition of the equipment to be measured), clear the maximum value prior to each measurement and save after changing the model name and number. For automatic measurement, refer to Section 5.10.3, Automatic Measurement Setting (ME Equipment)."
- For changing the model name and number, refer to Section 5.2.2, "Equipment Set-up Screen."



Settings

(1) On the measuring mode screen, press the **Save** key.

(2) At the bottom of the screen, the save data window will open.

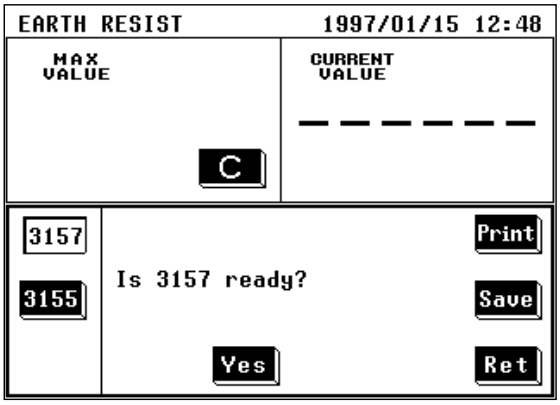
Press the **Yes** key to save the maximum values.
If a data unit with the same name already exists, a request for confirmation appears.

Press the **No** key to close the save data window without saving.
If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.

5.10.7 Low Resistance Measurement with 3157

Low resistance measurement mode allows measurement with optional 3157 AC GROUNDING HiTESTER (maximum 31 AAC, in accordance with multiple standards). Using the RS-232C interface enable the 3155 to control the 3157. Prior to set up, connect 3157 to equipment to be measured and 3157 to 3155 with connection cable. Synchronize 3157 communication settings with 3155. 3157 communication settings are applied when power is turned ON. Set up and configure while power is OFF.
See "When using 3157" on the previous page.
See also Section 8.5.1, "Communication Conditions Setting."

Settings



(1) On the low resistance measurement mode screen, press the Meas key to open the measurement window.

(2) Press the key for the desired measuring equipment.

1. 3155: Select 3155.
2. 3157: Select 3157.

When 3157 is selected, the Yes key is displayed. Measurement and data transfer status are displayed.

(3) Set up 3157 test settings. Measurement does not start unless the following conditions are met.

1. Test settings
   - Unit of the maximum and minimum test values: Resistance
   - Test time: ON
   - Maximum test value: ON

   When the optional minimum test value setting function is ON.
   - Minimum test value: OFF

2. Optional function setting
   Endless timer function: Not set

(4) Verify 3157 is set to READY. Press the Yes key to start measurement. Automatically 3157 maximum test value is loaded as an allowable value. After measuring, measurement results are displayed. Unless 3157 judgment is either PASS or FAIL (UPPER FAIL), test results are not displayed.

(5) Press the Ret key to close the measurement window.

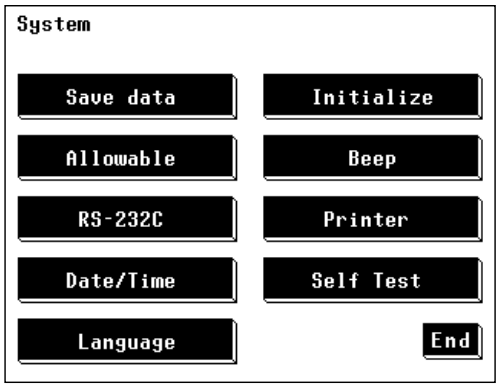
NOTE

- For usage, connection and communication settings for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.

- Measurement cannot be carried out for approximately five seconds after turning the 3157 power ON.
- When the 3157 optional function setting screen is set, measurement cannot be carried out.
- Do not press the Yes key before connecting RS-232C cable and 3157.
- When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157.
- 3157 optional function settings may result in test failure. Make sure to set up as shown below before testing.
  1.Momoentary OUT: Not set
  2. Test mode: Soft start mode or normal mode
  3. Printer output: Not used
- Measurement and data transfer status display
  1. "Check the settings.": 3157 settings are improper.
  2. "Time out error": Time out error occurred.
  3. "Communication error": Data transfer error occurred.

5.11 System Screen (ME Equipment)

5.11.1 System Screen



On the initial screen, press the System key to move to the system screen.

On the system screen, processing of saved data as well as settings for sounds, time and date, and communications, and execution of self-testing can be made.

Save data: Move to the saved data reference screen.
For details, refer to Section 5.11.2, "Saved Data Reference Screen."

Initialize: Move to the initialization screen.
For details, refer to Section 5.11.3, "Initialization Screen."

Allowable: Move to the allowable value judgment set-up screen
For details, refer to Section 5.11.4, "Allowable Value Judgment Set-up Screen."

Beep: Move to the beep sound set-up screen.
For details, refer to Section 5.11.5, "Beep Sound Set-up Screen."

RS-232C: Move to the communications set-up screen.
For details, refer to Section 8.5.1, "Communication Conditions Setting."

Printer: Move to the printer set-up screen.
For details, refer to Section 5.11.7, "Printer Set-up Screen."

Date/Time: Move to the time and date set-up screen.
For details, refer to Section 5.11.8, "Time and Date Set-up Screen."

Self Test: Move to the self-test screen.
For details, refer to Section 5.11.9, "Self-test Screen."

Language: Move to the language set-up screen.
For details, refer to Section 5.11.10, "Language Set-up Screen."

End: Return to the initial screen.

5.11.2 Saved Data Reference Screen (ME Equipment)

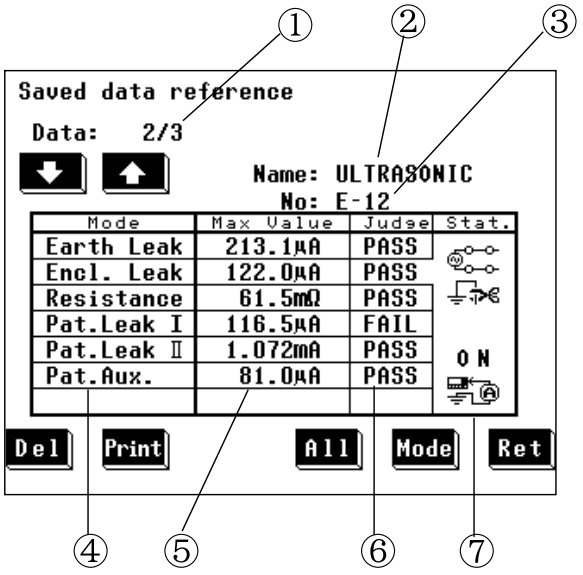
The following is an explanation of how to use the saved data.
Up to 100 data units can be saved. However, up to 2000 data can be saved.
For the model name and number settings, refer to Section 5.2.2, "Equipment Set-up Screen (ME Equipment)."

(1) Settings

1. On the initial screen, press the System key to move to the system screen.
2. On the system screen, press the Save data key to move to the saved data reference screen.

(2) Saved data reference screen display

On the saved data reference screen, saved data can be viewed, deleted or printed out.



In the example shown in the figure, there are a total of three data units, of which the one being displayed is the second. The data shown is for enclosure leakage current measurement.

① Number of current data unit / total number of data units
② Model name
③ Number
④ Measuring modes (up to 7 entries)
- Earth Leak: Earth leakage current measurement
- Encl. Leak: Enclosure leakage current measurement
- Resistance: Low resistance measurement
- Pat.Leak Ⅰ: Patient leakage current Ⅰ measurement
- Pat.Leak Ⅱ: Patient leakage current Ⅱ measurement
- Pat.Leak Ⅲ: Patient leakage current Ⅲ measurement
- Pat.Aux: Patient auxiliary current measurement

⑤ Maximum value
⑥ Maximum value judgment
⑦ Condition at time of maximum value judgment
- Polarity
- Condition of the equipment to be measured
- Measurement current setting
- Measurement network filter setting
- Contact condition setting
- Measuring equipment in low resistance measurement mode

NOTE When the maximum value is 1 μA or lower, "UNDER 1 μA" is displayed.

(3) Keys

[↓]: Used to select an entry

[↑]: Used to select an entry

[Del]: Delete the data unit for the current entry

[Print]: Print the data unit for the current entry

[All]: Details of the saved data reference screen are displayed.

[Mode]: Select an entry, and display its condition at time of maximum value judgment.

[Ret]: Return to the system screen

Sorting data units

The data unit number is determined by sorting data units by their model names and numbers. First the model name, and then the model number is sorted in the following order: <0, 1, , , 9, A, B, , , Z, ->. If a new data unit is registered, the list is re-sorted.

(4) Printing out saved data

1. On the saved data reference screen, select the data unit to be printed out.
   Use the [↑] and [↓] keys to display the desired data unit.
2. Press the [Print] key to print the data unit.
   Press the [Yes] key to print. Press the [No] key to disable printing.
3. After printing has been completed, press the [Ret] key.
   Repeat steps 1. and 2. as necessary for multiple printouts.
   During printing, the [Stop] key is displayed. Press the [Stop] key to stop printing.

(5) Deleting out saved data

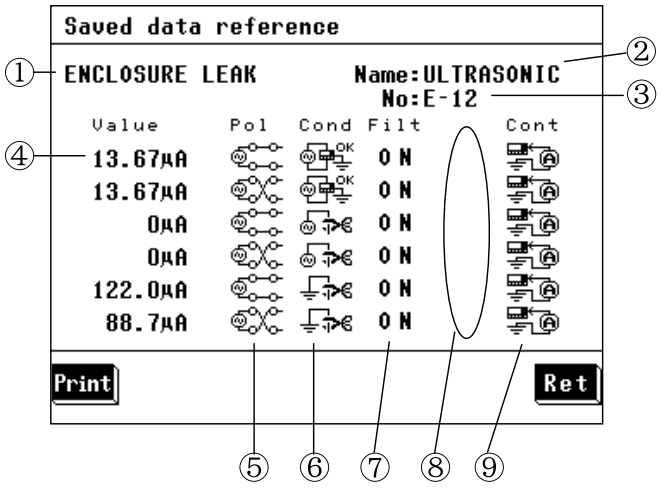
1. On the saved data reference screen, select the data unit to be deleted.
   Use the [Manu] and [↓] keys to display the desired data unit.
2. Press the [Del] key to delete the data unit.
   Press the [Yes] key to delete. Press the [No] key to disable deleting.
   Repeat steps 1. and 2. as necessary for multiple deletions.
   Erase all the saved data on the initialization screen.
   For details, refer to Section 5.11.3, "Initialization Screen."

(6) Details of the saved data reference screen

Use the Mode key to select the desired measuring mode for the details to display.

Press the All key to display the details of the saved data for the selected measuring mode.

The maximum values for each combination of the power source polarity and condition of the equipment to be measured are displayed.



Example: Maximum values display for six combinations in the enclosure leakage current measurement mode

① Measuring mode
② Model name
③ Number
④ Maximum value
⑤ Power source polarity
⑥ Condition of the equipment to be measured
⑦ Measurement network filter setting
⑧ Measurement current (for patient leakage current Ⅰ and patient auxiliary current)
⑨ Contact condition

Print: Print out the details (for each combination of the power source polarity and condition of the equipment to be measured)

Press the Yes key to print. Press the No key to disable printing.

During printing, the Stop key is displayed. Press the Stop key to stop printing.

Ret: Return to the saved data reference screen

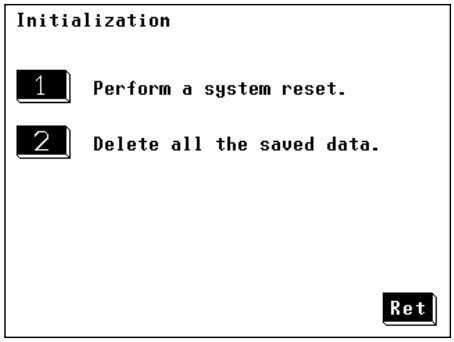
Example of a data unit printout:

```
--------------------
Date:1998/08/26
Name:ULTRASONIC
No.  :E-12
Stat:ClassI-B
Comment:

EARTH LEAKAGE:
  388.8μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Filter    ON
ENCLOSURE LEAKAGE:
  386.3μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    ON
 Contact   B-E
PATIENT LEAKAGE I:
  238.3μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    ON
 Current   AC
PATIENT LEAKAGE II:
  43.81μA
 Judgment  PASS
 Polarity  Normal
 Filter    ON
PATIENT AUXILIARY:
  59.6μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline Cut
 Filter    ON
 Current   AC
RESISTANCE:
   1.0mΩ
 Judgment  PASS
--------------------
```

Example of a details printout:

```
--------------------
Date:1998/08/26
Name:ULTRASONIC
No.  :E-12
Stat:ClassI-B
Comment:

ENCLOSURE LEAKAGE:

  1.22μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline OK
 Filter    ON
 Contact   B-E

  1.22μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline OK
 Filter    ON
 Contact   B-E

  1.22μA
 Judgment  PASS
 Polarity  Normal
 Powerline Cut
 Earthline OK
 Filter    ON
 Contact   B-E

  1.22μA
 Judgment  PASS
 Polarity  Reverse
 Powerline Cut
 Earthline OK
 Filter    ON
 Contact   B-E

  380.1μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline Cut
 Filter    ON
 Contact   B-E

  386.3μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    ON
 Contact   B-E
--------------------
```

5.11.3 Initialization Screen

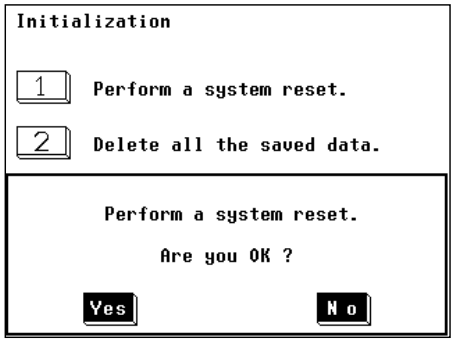


Initialize the 3155.

1: Perform a system reset.
(Delete all the saved data.)

2: Delete all the saved data.

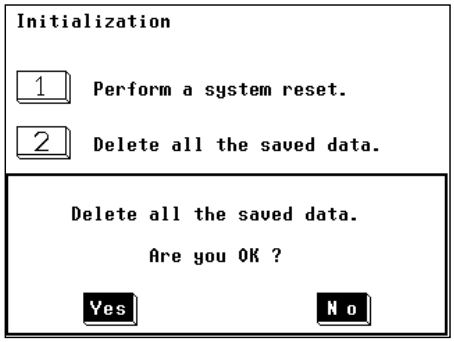
Ret: Return to the system screen.



(1) System reset

Press the 1 key to open the window to confirm a system reset.
Press the Yes key to perform a system reset.
Press the No key and a system reset is not performed.

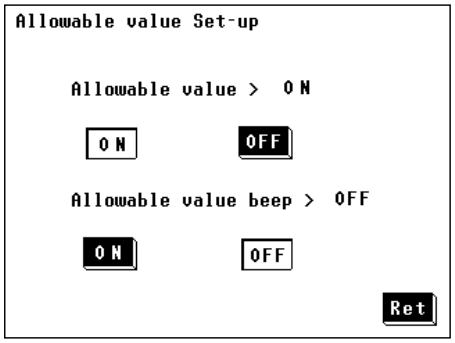
For details of the system reset, refer to Section 10.4, "System Reset."



(2) Deleting all the saved data

Press the 2 key to open the window to confirm that all the saved data are deleted.
Press the Yes key to delete.
Press the No key to disable deleting.

5.11.4 Allowable Value Judgment Set-up Screen



Setting the allowable value judgment (comparison with the maximum value and current value)

ON: Perform the allowable value judgment. If the maximum value and current value are less than or equal to the allowable value, PASS is displayed, if higher than the allowable value, FAIL. Also, the allowable value beep sound setting becomes effective.

OFF: Do not perform the allowable value judgment. The allowable values are not shown on the measuring mode screen.

Setting the beep sound for the allowable value judgment

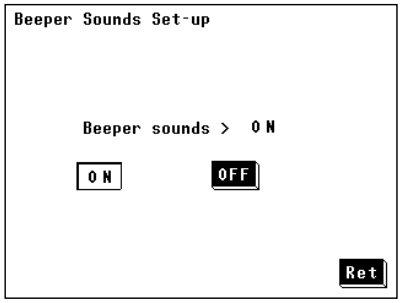
ON: If the allowable value judgment for the maximum value is FAIL, the beep sound is emitted.

OFF: The beep sound is not emitted for the allowable value judgment.

Ret: Return to the system screen.

NOTE If the **C** key is pressed, the beep sound stops.

5.11.5 Beep Sound Set-up Screen



Turn the beeper on or off.

ON: Turn the beeper on

OFF: Turn the beeper off

If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

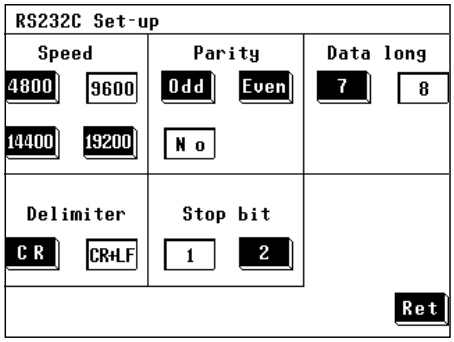
The beep sound is emitted when:

- The power is turned on.
- A key is pressed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

The beep sound is emitted irrespective of the beep sound setting when:

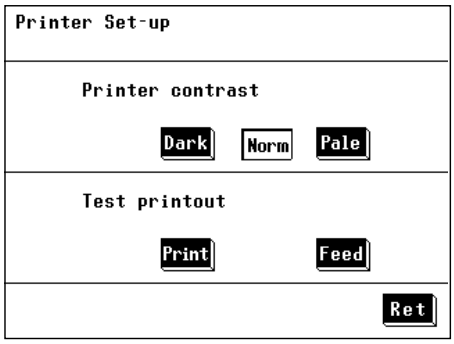
An error has occurred in the RS-232C system.

5.11.6 Communications Set-up Screen



For details, refer to Section 8.5.1, "Communication Conditions Setting."

5.11.7 Printer Set-up Screen



The following is an example of how to adjust the contrast and perform a test printout.
The printer contrast is easily affected by the temperature of the surrounding area.
Adjust the contrast as necessary to produce easy to read printouts.

Printer contrast set-up

Use the following keys to adjust the printer contrast:

Dark: Increase the contrast of the printout.

Norm: The default contrast setting.

Pale: Decrease the contrast of the printout.

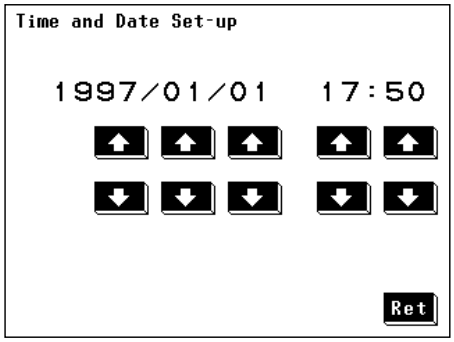
Test printout

Print: Perform a test printout.

Feed: Feed paper to the printer.

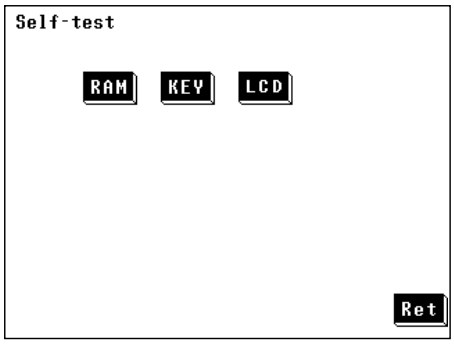
Ret: Return to the system screen.

5.11.8 Time and Date Set-up Screen



Make the time and date settings.
On the time and date set-up screen, press the keys as necessary.
Use the ▲ and ▼ keys found beneath the time and date to set as desired.
The year may be set from 1997 to 2096.
Press the Ret key to finalize the settings.

5.11.9 Self-test Screen



The self-test function is used to check the operation of the 3155 unit.
The following keys are used to perform a variety of tests:

RAM: Test the RAM.

KEY: Test key operation.

LCD: Test the LCD.

Ret: Return to the system screen.

(1) RAM test

Press the RAM key to test the RAM for proper operation.

- If the RAM operates properly, the "RAM TEST OK!" message is displayed.
- If the RAM does not operate properly, the "RAM TEST NG!" message is displayed.
  In this case, contact your dealer or HIOKI representative.

(2) KEY test

Press the KEY key to test the touch panel for proper operation. Each of the 36 different keys are displayed in black on the screen. Press each one to confirm its operation.

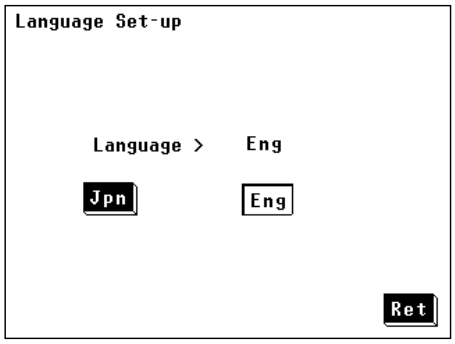
- If all the keys are pressed, the screen returns to the self-test screen.
- If any key fails to change to white, it is malfunctioning. Contact your dealer or HIOKI representative.

(3) LCD test

Press the LCD key to test the LCD for proper operation.
After pressing this key, half the screen is displayed as black and half as white, after which one color changes to the other. If the entire screen is illuminated, then it is operating properly. If there is any section of the screen that is not illuminated, it could indicate an LCD malfunction. Contact your dealer or HIOKI representative.

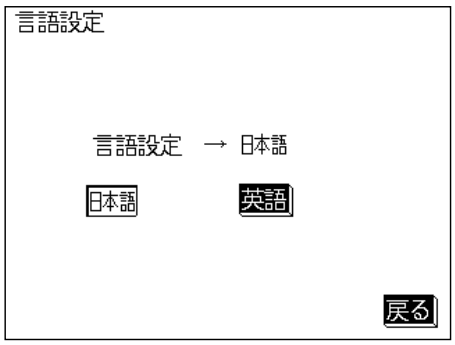
5.11.10 Language Set-up Screen

Set the language displayed on the screen.



(1) English → Japanese

Jpn: Set the display language to Japanese.



(2) Japanese → English

英語: Set the display language to English.

Chapter 6
Ordinary Electrical Equipment Measurement Network C Installed

6.1 Measurement Network C

The 9498 NETWORK C (conforms to IEC/TR 60990) is used for the electrical measuring instrument and information technology equipment. Measurement network C conforms to the following standard.
Methods of measurement of touch-current and and protective conductor current (IEC/TR 60990 (1990-06))
By changing the filter setting to a body impedance network (OFF), a perception and reaction network (ON1) or a let-go network (ON2), the following tests can be performed:

(1) Body impedance network (OFF)

- Touch-current measurement of IEC/TR 60990 (1990-06)
- Earth leakage current measurement of IEC 60950 (1991-10) + am4 (1996-07)
- Current measurement of IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)
- Applicable UL standards：（Examples：UL3101-1, UL3111-1, etc.）

(2) Perception and reaction network (ON1)

- Touch-current measurement of IEC/TR 60990 (1990-06)
- Current measurement of IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)
- Touch-current of IEC 60065(1998-07)
- Applicable UL standards：（Examples：UL1419, UL3101-1, UL3111-1, etc.）

(3) Let-go network (ON2)
Touch-current measurement of IEC/TR 60990 (1990-06)

NOTE

IEC/TR 60990 (1990-06) sets standard measurement methods for leakage current. Measurement methods for each type of equipment were incorporated into IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07) etc.

6.1.1 Leakage Current Measurement Types and Their Allowable Values for Ordinary Electrical Equipment

The 3155 unit contains an allowable value judgment function, which compares the maximum value to the allowable value.
To use this function, set the judgment function to ON, and set each of the allowable values.

(1) Leakage current measurements for ordinary electrical equipment

The 3155 can perform the following leakage current measurements:
- Earth leakage current (for class Ⅰ equipment only)
- Enclosure leakage current

(2) Allowable values

The allowable values vary per the applicable regulations.
Example:
Allowable values per IEC 60950 (1991-10) + am4 (1996-07)
- Class Ⅰ equipment (hand-held): 0.75 mA
- Class Ⅰ equipment (movable (other than hand-held)): 3.5 mA
- Class Ⅰ equipment (stationary, pluggable type A): 3.5 mA
- Class Ⅰ equipment (stationary, permanently connected or pluggable type B)
  Equipment with earth leakage current not exceeding 3.5 mA: 3.5 mA
  Equipment with earth leakage current exceeding 3.5 mA: 5% of input current
- Class Ⅱ equipment: 0.25 mA

NOTE Allowable values vary per the applicable laws and regulations, but when using the 9498 NETWORK C (conforms to IEC/TR 60990), the default value is 3.5 mA (0.25 mA for other than class Ⅰ equipment). Set the allowable value as necessary.

6.2 Screens (for IEC/TR 60990)

About the Touch Panel

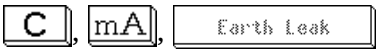
⚠ CAUTION	Do not press hard upon the touch screen, or operate it using a hard object or one with a sharp end. Doing so could scratch or damage the screen or the soft keys.

The 3155 uses a touch panel for setting and changing all of the test 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.

About the display of 'touch keys'
The following is an explanation of the types of 'touch keys' shown on the 3155's display screen.
There are 3 types of key displays. Selectable keys (raised, black background), selected keys (recessed, white background), and non-selectable keys (raised, white background)

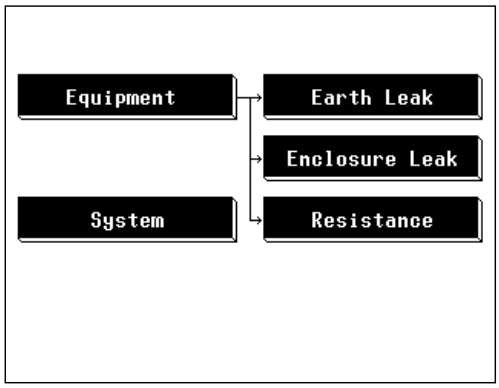
(1) Selectable keys (raised, black background)
Example: 

(2) Selected keys (recessed, white background)
Example: 

(3) Non-selectable keys (raised, white background)
Example: 

The keys shown with dotted lettering indicate items that need not be measured per the settings performed on the equipment set-up screen.

6.2.1 Initial Screen (for IEC/TR 60990)



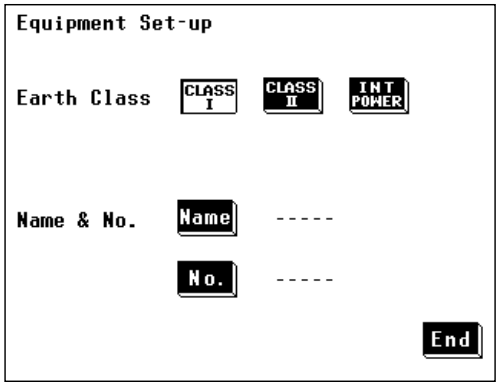
When the power is first turned on, the basic screen for controlling the 3155 immediately appears, called the initial screen.

Equipment set-up: The grounding class of the equipment to be measured

Measuring mode: Earth leakage current, enclosure leakage current, low resistance measurement

System: Clock, beeper, RS-232C communications etc.

6.2.2 "Equipment Set-up" Screen (for IEC/TR 60990)



On the initial screen, press the Equipment key to open the equipment set-up screen.
On the equipment set-up screen, a setting for the grounding class of the equipment to be measured, and registration of the model name and number can be made.
Press the End key to return to the initial screen.

Grounding class setting

CLASS I: Class Ⅰ equipment

CLASS II: Class Ⅱ equipment

INT POWER: Internally powered equipment

NOTE

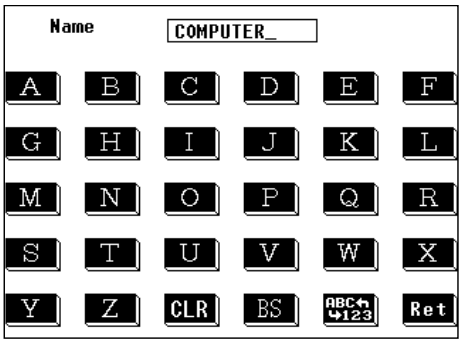
If changing the setting for the grounding class of the equipment to be measured, the condition settings on each measuring mode screen are initialized, except for the coefficient of the allowable value.
For details, refer to Section 6.6.1, "Allowable Value Setting (For Leakage Current Measurement)," and Section 6.6.2, "Allowable Value Setting (For Low Resistance Measurement)."

Registering the model name and number.

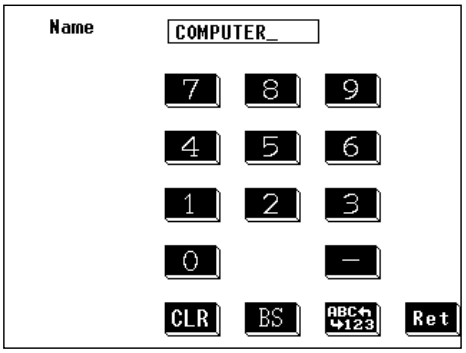
It is possible to register the model name and number before printing out or saving data. Once registered, these items will be included with the maximum values for each printout or save, unless changed.

Name: Change to the model name input screen.

No.: Change to the model number input screen.



Alphabet input screen



Numeric input screen

Setting

Shown on the left are examples of the model name input screens.

A maximum of 12 characters can be input.

CLR: Clear the model name or number

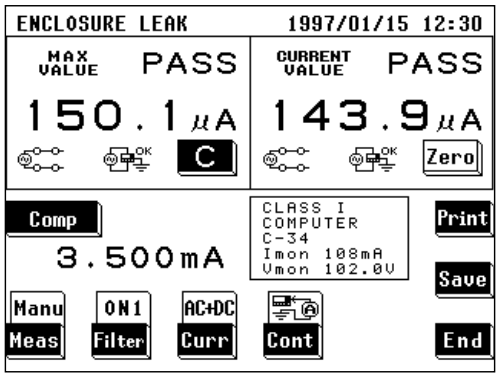
BS: Back space

ABC 123: Toggle between alphabet input and numeric input

Ret: Close the input window

6.2.3 Measuring Mode Screen (for IEC/TR 60990)

On the measuring mode screen, press the any one of the following keys to open a window where the settings in question for that measuring mode can be changed.
The following explanation uses the enclosure leakage current measurement screen as an example:



C: Clear the maximum value.

Comp: Open the allowable value set-up window.

Meas: Open the polarity and equipment condition set-up window in the bottom half of the screen.

Filter: Open the measurement network filter set-up window in the bottom half of the screen.

Curr: Open the measurement current set-up window in the bottom half of the screen.

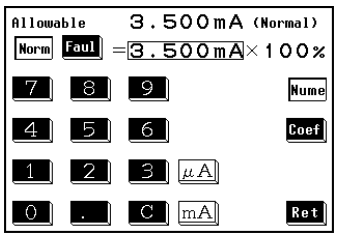
Cont: Open the contact condition set-up window in the bottom half of the screen.

Print: Open the print-out window in the bottom half of the screen.

Save: Open the save data window in the bottom half of the screen.

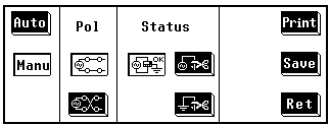
End: Return to the initial screen.

(1) Allowable value set-up window

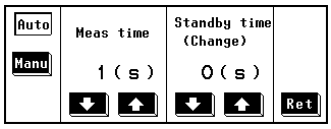


(2) Polarity and equipment condition set-up window

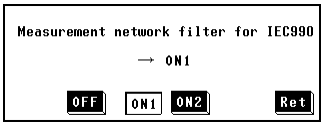
Manual



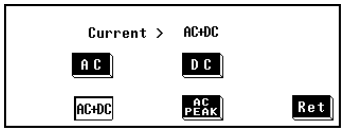
Automatic



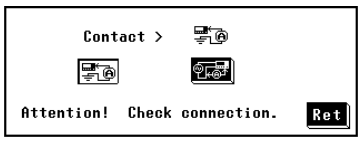
(3) Measurement network filter set-up window



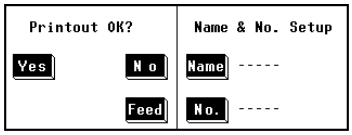
(4) Measurement current set-up window



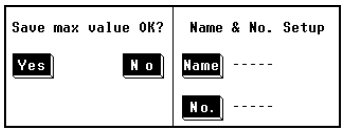
(5) Contact condition set-up window



(6) Print-out window

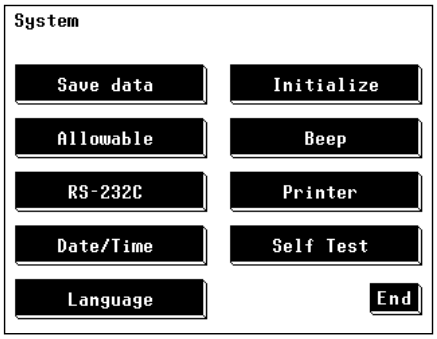


(7) Save data window

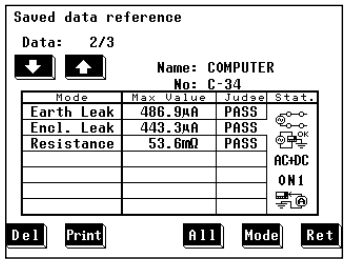


6.2.4 System Screen (for IEC/TR 60990)

On the system screen, references to saved data as well as settings for beep sound, time and date, communications, and execution of self-testing can be made.

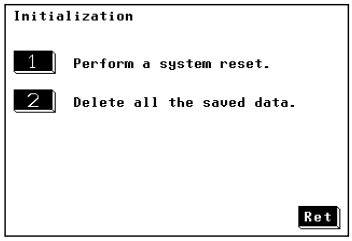


Save data: Move to the saved data reference screen.
Initialize: Move to the initilization screen.
Allowable: Move to the allowable value judgment set-up screen.
Beep: Move to the beep sound set-up screen.
RS-232C: Move to the communications set-up screen.
Printer: Move to the printer set-up screen.
Date/Time: Move to the time and date set-up screen.
Self Test: Move to the self-test screen.
Language: Move to the language set-up screen.
Ret: Return to the initial screen.



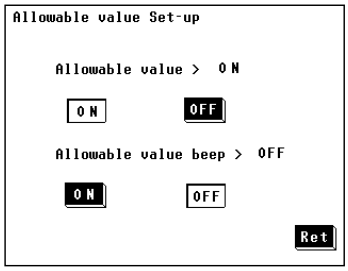
(1) Saved data reference screen

For details, refer to Section 6.7.2, "Saved Data Reference Screen."



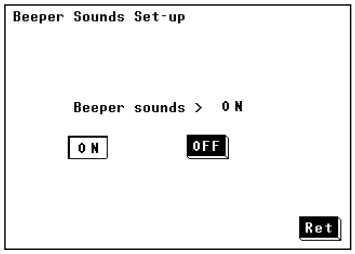
(2) Initialization screen

For details, refer to Section 6.7.3, "Initialization Screen



(3) Allowable value judgment set-up screen

- Set the allowable value judgment (comparison of the set allowable value with the maximum value and measured value) to either **ON** or **OFF**. When set to ON, the beep sound setting for the allowable value judgement becomes effective. When set to OFF, the allowable values are not shown on the measuring mode screen.
- Press either the **ON** or **OFF** key for the beep sound for the allowable value judgment.



(4) Beep sound set-up screen

Turn the beeper on or off.

Press either the ON key or OFF key.

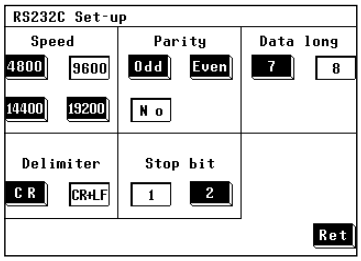
If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

The beep sound is emitted when:

- The power is turned on.
- A key is pushed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

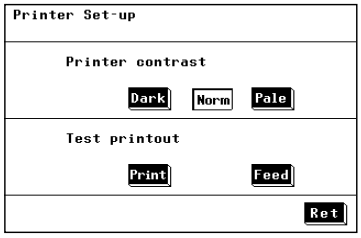
The beep sound is emitted irrespective of the beep sound setting when:

An error has occurred in the RS-232C system.



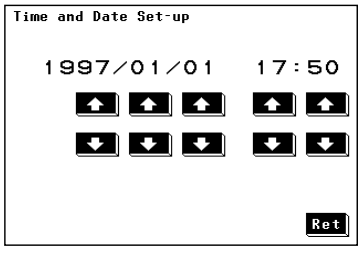
(5) Communications set-up screen

For details, refer to Section 8.5.1, "Communication Conditions Setting."



(6) Printer set-up screen

For details, refer to Section 6.7.7, "Printer Set-up Screen."



(7) Time and date set-up screen

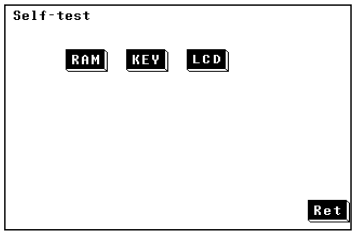
Make the time and date settings.

On the time and date set-up screen, press the keys as necessary.

Use the ▲ and ▼ keys found beneath the time and date to set as desired.

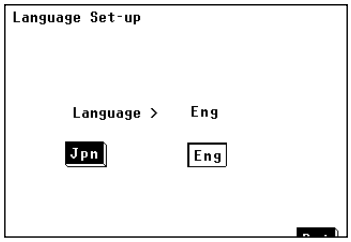
The year may be set from 1997 to 2096.

Press the Ret key to finalize the settings.



(8) Self-testing screen

For details, refer to Section 6.7.9, "Self-test screen."



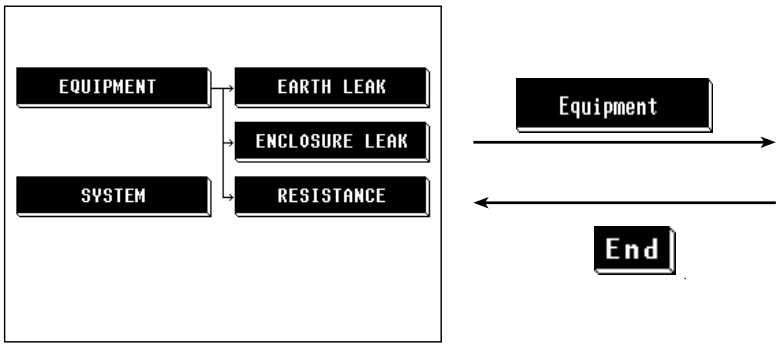
(9) Language set-up screen

For details, refer to Section 6.7.10, "Language Set-up screen."

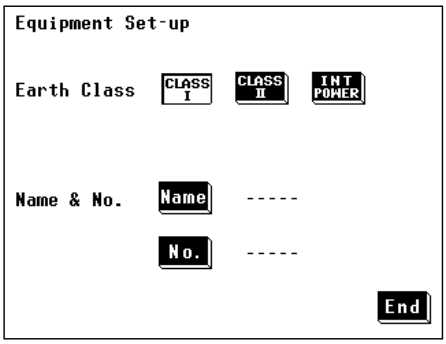
6.2.5 Flow of Screens for Basic Operations (for IEC/TR 60990)

- Change of screens during basic operation is as follows.
- On the measuring mode screen, measured values can be checked in real time.

Initial screen

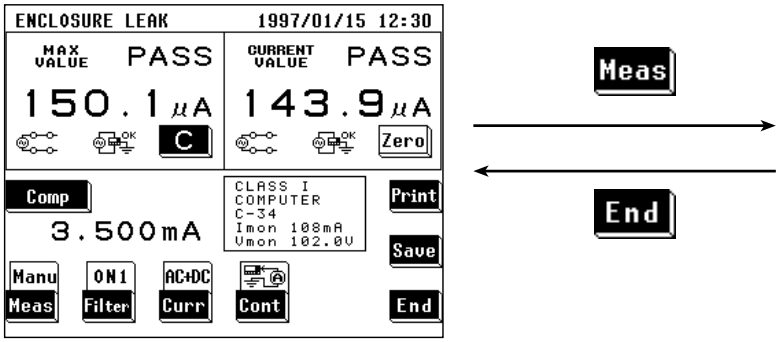


Equipment set-up screen



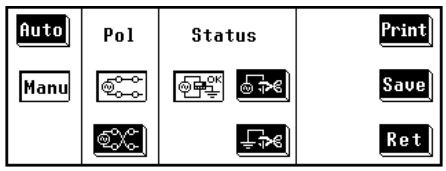
Set the grounding class of the equipment to be measured, and register the model name and number.

Measuring mode screen

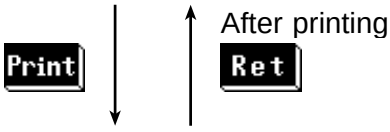


Measurement starts automatically.

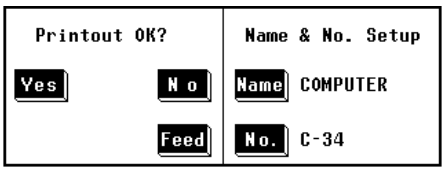
Polarity and equipment status set-up window



Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 6.6.3, " Automatic Measurement Setting."



Print-out window



For a detailed set-up procedure, refer to Section 6.6.5, "Printing out the Maximum Values."
For saving, refer to Section 6.6.6, "Saving the Maximum Values ."

NOTE

Setting conditions for each measuring mode is saved with each measuring mode. However, the model name and number are held in common. Changing the measuring mode will clear the maximum and current values.

6.3 Enclosure Leakage Current Measurement Mode (for IEC/TR 60990)

The enclosure leakage current measurement is performed in two places: between the enclosure and the earth, and between the enclosure and the power line.
With class Ⅰ equipment, the enclosure is each part of the enclosure which is not protectively earthed.
Plug the power cord of the equipment to be measured into the auxiliary power socket for the 3155, and make a measurement by touching either the 9170 TEST LEAD or 9195 ENCLOSURE PROBE to the test point.
The following combinations can be measured under the enclosure leakage current measurement.

Condition of the equipment to be measured		Power source polarity	Test point
Normal condition		Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth
Single fault condition	Open power lead	Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth
	Open ground	Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth

NOTE

- By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 6.6.3, "Automatic Measurement Setting."
- When making measurements of internally powered equipment, there is no polarity setting.
- In the enclosure leakage current measurement mode, the 50 μA range is not used.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- Measurement between enclosure to enclosure is available.

6.3.1 Measurement Accompanying IEC 60950 (1991-10) + am4 (1996-07)

IEC/TR 60990 (1990-06) sets standard measurement methods for current. IEC 60950 (1991-10) + am4 (1996-07), IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07), etc. use the methods of IEC/TR 60990 (1990-06).

(1) Earth leakage current measurement

When performing earth leakage current measurements with the 3155 intended to conform to IEC 60950 (1991-10) + am4 (1996-07), use the enclosure leakage current measurement mode. Connect the power plug of the equipment to be measured to the power outlet, using the insulating transformer and the table tap, and touch the test points with the 9170 TEST LEADS or 9195 ENCLOSURE PROBE.
Test points taken between the accessible conductive part or accessible non-conductive part and the power line are defined as between the enclosure and the power line.
The measurement network filter is to be ON1, and the measurement current is AC+DC.

Measurement screen settings
Measuring mode: Enclosure leakage current

Item	IEC 60950 (Earth leakage current)
Allowable values	0.25 mA / 0.75 mA / 3.5 mA
Measurement method	Manual
Power source polarity	Normal polarity
Condition of the equipment to be measured	Normal condition
Filter setting	ON1
Measurement current	AC+DC
Contact condition	Between the enclosure and the power line

(2) Measurement of leakage current to a telecommunication network

Use the enclosure leakage current mode.
Connect the power plug of the equipment to be measured to the power outlet, using the insulating transformer and the table tap, and touch the test point with the 9170 TEST LEAD.
See Appendix 2.2, "IEC 60950 (1991-10) + am4 (1996-07)" for wiring applicable when using the 3155 to measure earth leakage current for IEC 60950 grounding.

Measurement screen settings
Measuring mode: Enclosure leakage current

Item	IEC 60950 (Leakage current to a telecommunication network)
Allowable values	0.25 mA
Measurement method	Manual
Power source polarity	Normal polarity
Condition of the equipment to be measured	Normal condition
Filter setting	ON1
Measurement current	AC+DC
Contact condition	Between the enclosure and the earth

6.3.2 Connecting Equipment for Measurement Accompanying IEC 60950 (1991-10) + am4 (1996-07)

⚠ CAUTION

- Always use the insulating transformer for measurement accompanying IEC 60950 (1991-10) + am4 (1996-07).
- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- If enclosure leakage current is to be measured between the enclosure and the power supply line, or the power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- The table tap is subject to line voltage. Watch out for electrical shocks.
- In cases where the voltage is applied directly to the leakage current measurement terminals of the the 3155 when making a measurement, the measured value may be subject to synchronous voltage. In which case, an accurate measurement cannot be obtained without first performing zero adjustment. Always perform zero adjustment before measuring.

(1) Earth leakage current measurement

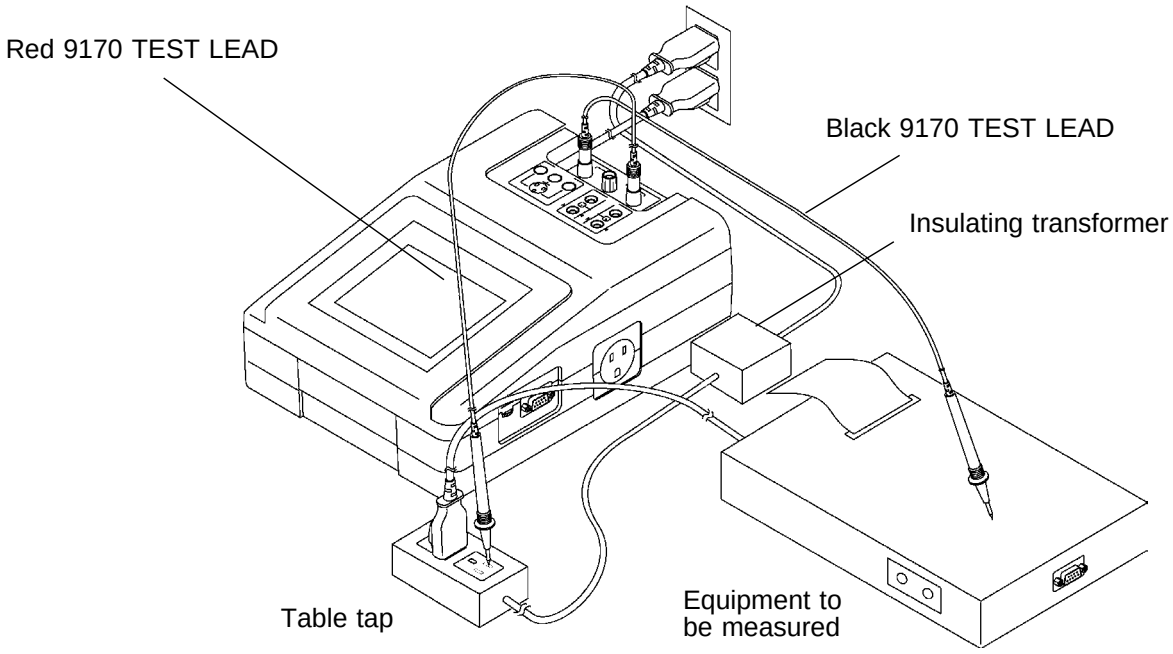
Measurement between the accessible conductive part or accessible non-conductive part and the power line
No measurement is made for internally powered equipment.

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the power line."
2. Plug the power cord of the equipment to be measured into a table tap.
3. Plug the table tap into an insulating transformer.

4. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2, and the black one to T1.
5. Plug the red 9170 TEST LEAD into the table tap.
6. Perform zero adjustment. For details, refer to "Zero Adjustment (for IEC/TR 60990 - Earth Leakage Current).
7. Touch the black 9170 TEST LEAD to the conductive part or non-conductive part of the equipment to be measured.

NOTE

- To change the power source polarity, connect the red 9170 TEST LEAD to the other pole of the table tap.
- In the enclosure leak current measuring mode, the 50 μA range is not used.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.



If the enclosure or any part thereof is made of material with insulating characteristics

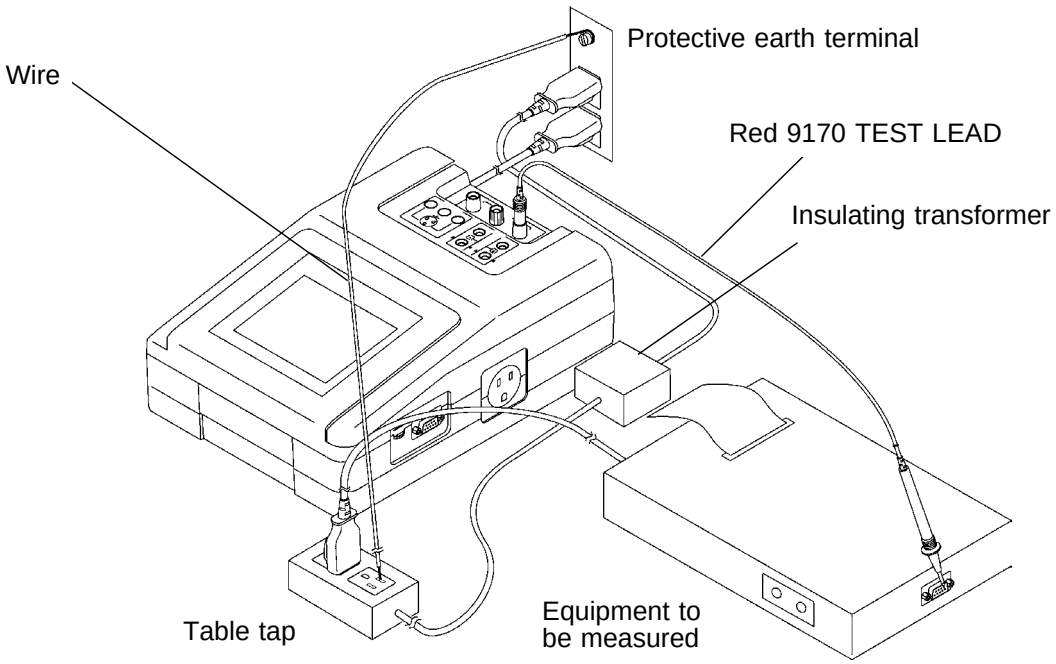
If the enclosure or any part thereof is made of material with insulating characteristics, attach the 9195 ENCLOSURE PROBE to the enclosure at approximately 0.5 N/cm^2 across the entire surface.

(2) Measurement of leakage current to a telecommunication network

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the earth."
2. Plug the power cord of the equipment to be measured into a table tap.
3. Use wire to connect the outlet earth with the table tap.
4. Plug the table tap into an insulating transformer.
5. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
6. Touch the red 9170 TEST LEAD to the connection for a telecommunication network of the equipment to be measured.

NOTE

- To change the power source polarity, connect wire connecting the protective earth terminal of the outlet and one pole of the table tap to the other pole.
- To change the connection for a telecommunication network, change the red 9170 TEST LEAD connection.
- In the enclosure leak current measuring mode, the 50 μA range is not used.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.

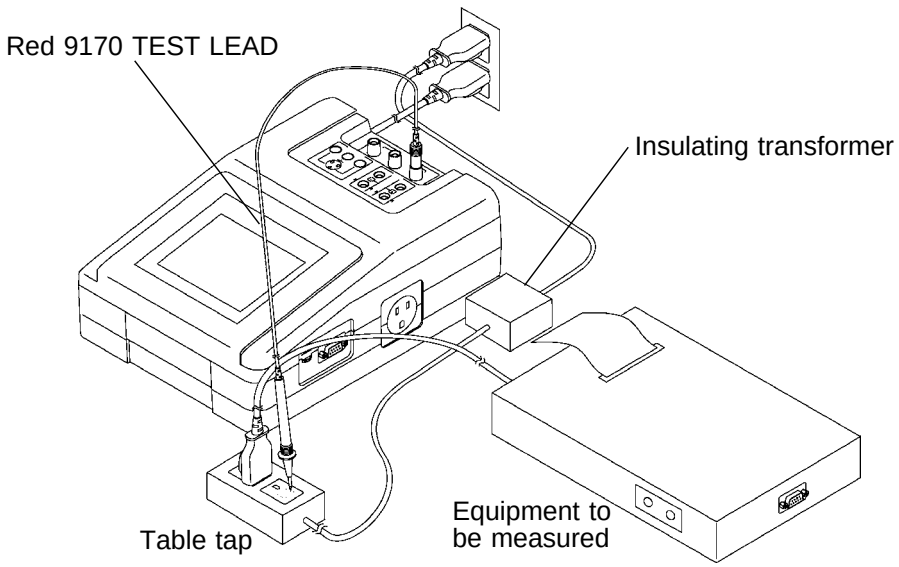


6.3.3 Zero Adjustment (for IEC/TR 60990 - Enclosure Leakage Current)

In cases where the direct power line is connected to the 3155 leakage current measurement terminal when making a measurement, the measured value may be subject to synchronous voltage. In which case, an accurate measurement cannot be obtained without first performing zero adjustment. Zero adjustment is effective only for measurements between the enclosure and the power line. After performing zero adjustment, the value remains in memory even if the measuring mode is changed. When the power is turned off, zero adjustment is ineffective. If the voltage of the power line changes, perform zero adjustment again.
Zero adjustment is possible in a range from 0 to 500 μA.

Zero adjustment

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the power line."
2. Plug the power cord of the equipment to be measured into a table tap.
3. Plug the table tap into an insulating transformer.
4. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
5. Plug the red 9170 TEST LEAD into the table tap.
   In this case, do not connect the black 9170 TEST LEAD to the leakage current measurement terminal T1 and the enclosure of the equipment to be measured.
6. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, ⓩ is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again, and zero adjustment is cancelled, the normal measured value returns and ⓩ disappears.
7. Unplug the red 9170 TEST LEAD from the table tap.



6.3.4 Measurement Accompanying IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)

IEC/TR 60990 (1990-06) sets standard measurement methods for current. IEC 60950 (1991-10) + am4 (1996-07), IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07), etc. use the methods of IEC/TR 60990 (1990-06).
When performing current measurements with the 3155 intended to conform to IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07), use the enclosure leakage current measurement mode. Plug the power cord of the equipment to be measured into the auxiliary power socket, and touch the test point with the 9170 TEST LEAD.
Test points taken between the accessible part and the reference test earth are defined as between the enclosure and the earth.

NOTE

- In the enclosure leakage current measurement mode, the 50 μA range is not used.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.

Measurement screen settings

Measuring mode: Enclosure leakage current

Item	IEC 61010-1
Measurement method	Manual /automatic
Power source polarity	Normal polarity / reverse polarity
Contact condition	Between the enclosure and the earth

Condition of the equipment to be measured		Filter setting	Measurement current	Allowable value	Measuring object
Normal condition		ON1	AC+DC	0.5 mA	Sinusoidal waveforms
			AC peak	0.7 mA	Non-sinusoidal waveforms or mixed frequencies
			DC	2 mA	
Single fault condition	Open power lead	ON1	AC+DC	3.5 mA	Sinusoidal waveforms
			AC peak	5 mA	Non-sinusoidal waveforms or mixed frequencies
			DC	15 mA	
	Open ground	ON1	AC+DC	3.5 mA	Sinusoidal waveforms
			AC peak	5 mA	Non-sinusoidal waveforms or mixed frequencies
			DC	15 mA	

NOTE

Since the maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC), if the measurement network filter setting is OFF, measurements are impossible up to the standard allowable values.

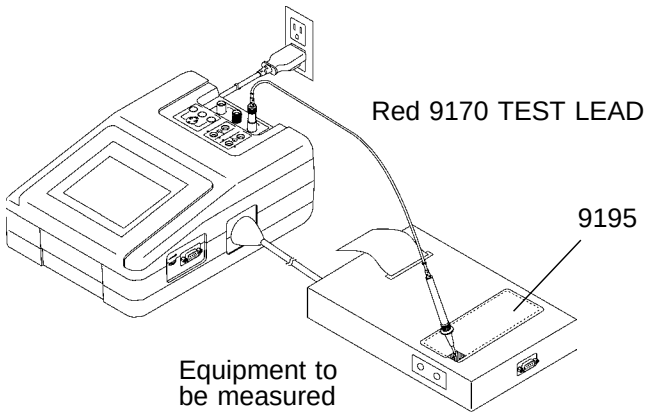
6.3.5 Connecting Equipment for Measurement Accompanying IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.

Measurement between the accessible part and the reference test earth
IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the earth."
2. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
3. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
4. Touch the red 9170 TEST LEAD to the enclosure of the equipment to be measured.



NOTE

When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.

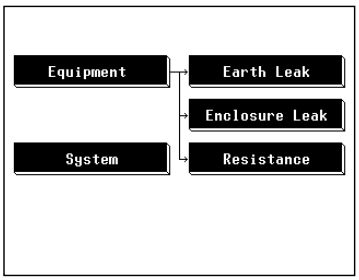
If the enclosure or any part thereof is made of material with insulating characteristics

If the enclosure or any part thereof is made of material with insulating characteristics, attach the 9195 ENCLOSURE PROBE to the enclosure at approximately 0.5 N/cm^2 across the entire surface.

6.3.6 Basic Settings for Enclosure Leakage Current Measurement (for IEC/TR 60990)

This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 6.3.2, "Connecting Equipment for Enclosure Leakage Current Measurement", and 6.3.5, "Connecting Equipment for Measurement Accompanying IEC 1010-1 '90 Amendment 2 '95."

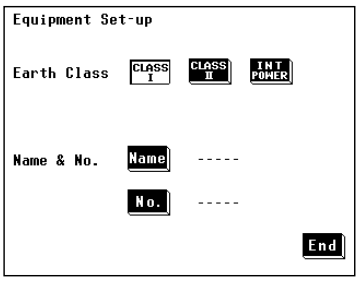
Initial screen



Equipment

End

Equipment set-up screen

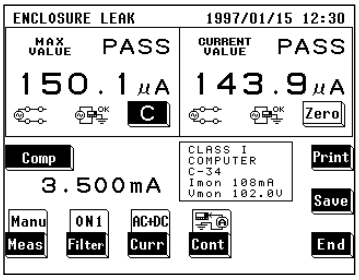


Set the grounding class of the equipment to be measured, and register the model name and number.

Enclosure Leak

End

Enclosure leakage current measurement mode screen

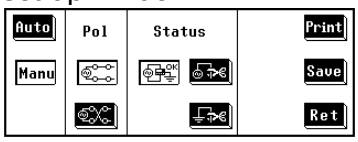


Measurement starts automatically.

Meas

Ret

Polarity and equipment status set-up window



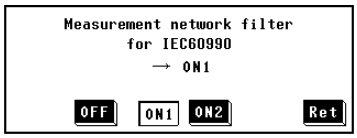
Select and press the keys for the power source polarity and equipment to bemeasured to set. Measurement continues even while the window is open.
For automatic measurement, refer to Section 6.6.3, "Automatic Measurement Setting."

Comp

Ret

Measurement network filter set-up window

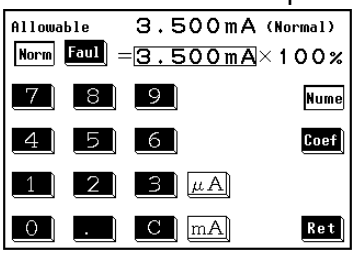
Filter



Ret

Set the filter.

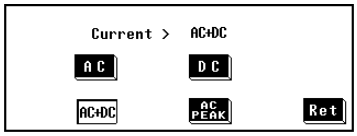
Allowable value set-up window



Set the allowable value referring to Section 6.6.1, "Allowable Value Setting."
For enabling or disabling the allowable value judgment, refer to Section 6.7.4, "Allowable Value Judgment Set-up Screen."

Measurement current set-up window

Curr

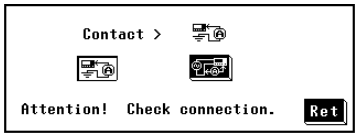


Ret

Set the measurement current.

Contact condition set-up window

Cont

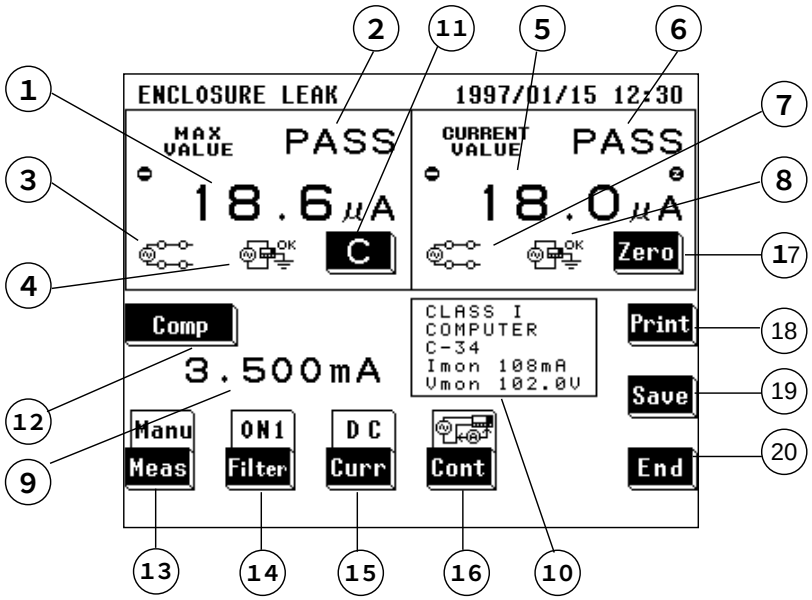


Ret

Set the contact condition.

6.3.7 Enclosure Leakage Current Measurement Screen (for IEC/TR 60990)

Measurements of enclosure leakage current are made on the enclosure leakage current measurement screen.
The current measured value, maximum value, and set-up status are shown on the enclosure leakage current measurement screen.
Further, windows for changing the designations for each measurement can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal operation: Single fault condition (open power lead): Single fault condition (open ground):
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)

⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Setting for the class of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 6.6.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 6.6.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑭ Filter	Opens the measurement network filter set-up window. Select filter OFF, ON1 or ON2. OFF: Body impedance network ON1: Perception and reaction network ON2: Let-go network

⑮ Curr	Opens the measurement current set-up window. Set the measurement current. When set to AC peak, the filter cannot be set to OFF. If set to OFF, it automatically changes to ON1. When set to DC, the filter cannot be set to ON2. If set to ON2, it automatically changes to OFF. AC: AC, DC: DC, AC+DC: AC+DC, AC PEAK: AC peak For details, refer to Section 6.6.4, "Measurement Current Setting (for IEC/TR 60990)."
⑯ Cont	Opens the contact condition set-up window. Set the contact condition.  : Between the enclosure and the earth  : Between the enclosure and the power line
⑰ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective,  is displayed on the screen. For details, refer to Section 6.3.3, "Zero Adjustment (for IEC/TR 60990 - Enclosure Leakage Current)."
⑱ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 6.6.5, "Printing out the Maximum Values."
⑲ Save	Opens the save data window. For details, refer to Section 6.6.6, "Saving the Maximum Values."
⑳ End	Exits the enclosure leakage current measurement, and returns to the initial screen.

6.4 Earth Leakage Current Measurement Mode (for IEC/TR 60990)

6.4.1 Earth Leakage Current Measurement Mode

Earth leakage current measurement is performed only when class Ⅰ equipment has been set. When either class Ⅱ or internally powered equipment has been set, the earth leakage current key on the initial screen is non-selectable.
Measurement is possible only when the power cord of the equipment to be measured has been plugged into the auxiliary power socket of the 3155.
The following combinations can be set as well as the measurement network filter and measurement current under the earth leakage current measurement.

Condition of the equipment to be measured		Power source polarity
Normal condition		Normal polarity
		Reverse polarity
Single fault condition	Open power lead	Normal polarity
		Reverse polarity

NOTE

- IEC/TR 60990 (1990-06), IEC 60950 (1991-10) + am4 (1996-07) and IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07) do not require earth leakage current measurements. However, although the measurement network for medical electrical equipment differs, making measurements at regular intervals as well as for medical electrical equipment is useful for maintaining your equipment.
- By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 6.6.3, "Automatic Measurement Setting."

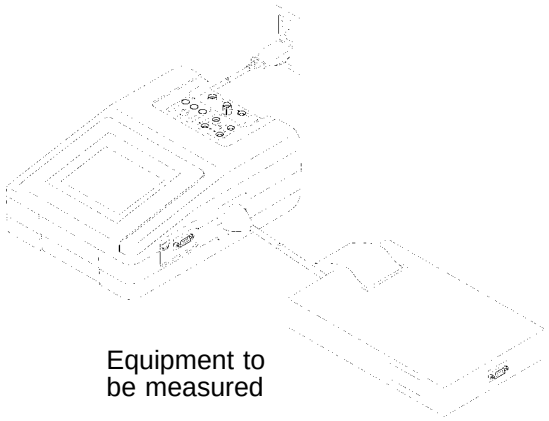
6.4.2 Connecting Equipment for Earth Leakage Current Measurement (for IEC/TR 60990)

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.

NOTE

- When measuring earth leakage current (for class Ⅰ equipment only), do not make any connections to the leakage current measurement terminals. The measurement network is connected via internal wiring. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155.
- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.

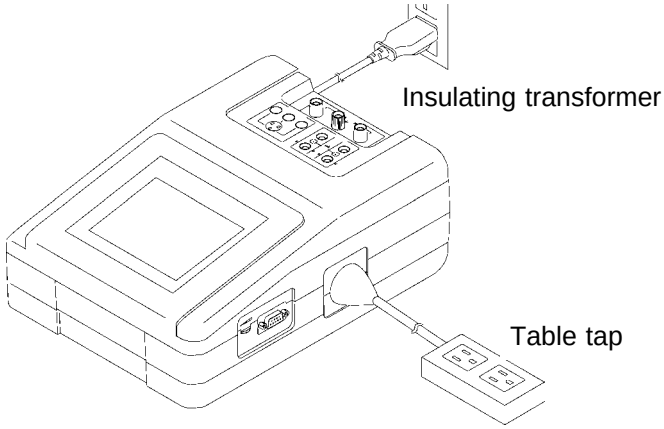


6.4.3 Zero Adjustment (Earth Leakage Current)

In cases where the extension cable (power socket conversion cable, table tap, etc.) is connected to the auxiliary power socket when making a measurement, the measured value may be subject to leakage current of the extension cable. In which case, to obtain an accurate measurement, perform zero adjustment before measuring.
Value of leakage current in the extension cable to be offset by zero adjustment varies depending on if voltage is applied or not. Zero adjustment is performed in the condition that voltage is applied.
Value determined by zero adjustment is saved after power is turned off. It is effective unless changing supply voltage and/or the extension cable.

Zero Adjustment

1. Display the earth leakage current measurement screen.
2. Connect the extension cable to the auxiliary power socket. In this case, do not connect the equipment to be measured to the extension cable.
3. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, ⓩ is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again, and zero adjustment is cancelled, the normal measured value returns and ⓩ disappears.



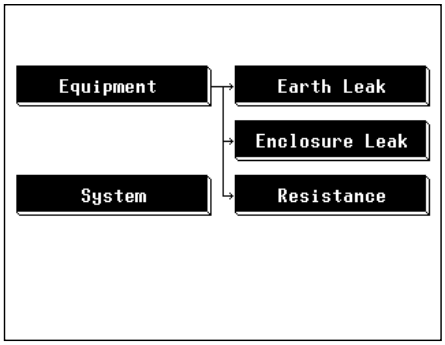
NOTE

In all equipment to be measured, zero adjustment defaults to the combination of normal condition with norm al polarity and switches back to previous condition and polarity of the equipment to be measured.
During manual measurement, condition and polarity settings may cause zero adjustment value to fail to set to zero.

6.4.4 Basic Settings for Earth Leakage Current Measurement (for IEC/TR 60990)

This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 6.4.2, "Connecting Equipment for Earth Leakage Current Measurement."

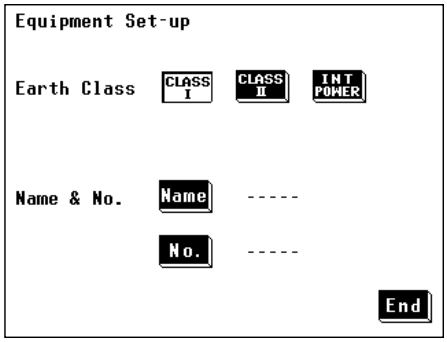
Initial screen



Equipment

End

Equipment set-up screen

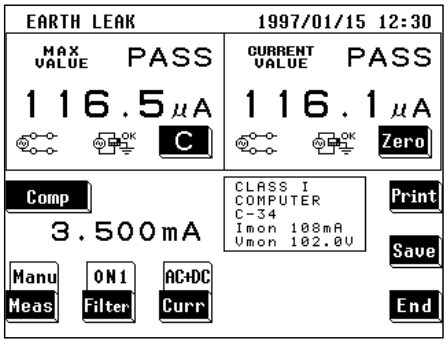


Set the grounding class of the equipment to be measured to class I.

Earth Leak

End

Earth leakage current measurement mode screen

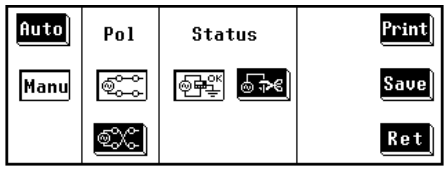


Measurement starts automatically.

Meas

Ret

Polarity and equipment condition set-up window



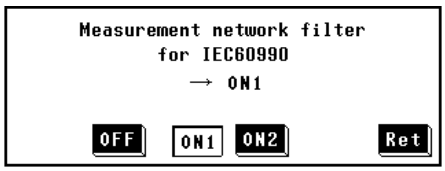
Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 6.6.3, "Automatic Measurement Setting."

Comp

Ret

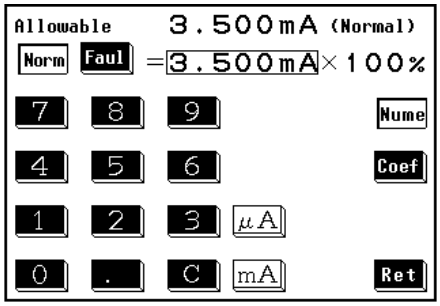
Filter

Measurement network filter set-up window



Set the filter.

Allowable value set-up window

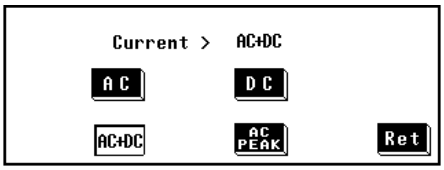


Set the allowable value referring to Section 6.6.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 6.7.4, "Allowable Value Judgment Set-up Screen.")

Curr

Ret

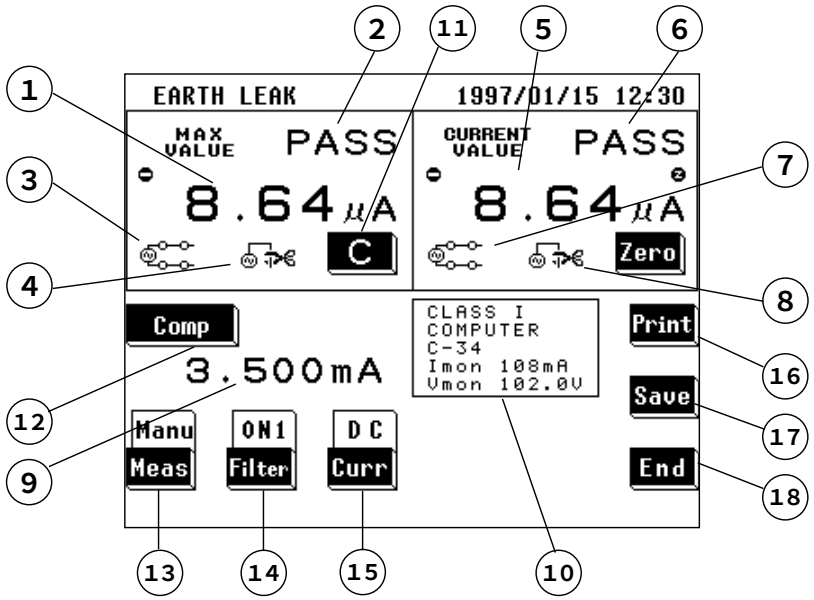
Measurement current set-up window



Set the measurement current.

6.4.5 Earth Leakage Current Measurement Screen (for IEC/TR 60990)

Measurement of earth leakage current is made on the earth leakage current measurement screen.
The current measured value, maximum value, and setting condition are shown on the earth leakage current measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal operation: Single fault condition (open power lead):
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)

⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Setting for the class of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 6.6.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 6.6.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead): 
⑭ Filter	Opens the measurement network filter set-up window. Select filter OFF, ON1 or ON2. OFF: Body impedance network ON1: Perception and reaction network ON2: Let-go network

⑮ Curr	Opens the measurement current set-up window. Set the measurement current. When set to AC peak, the filter cannot be set to OFF. If set to OFF, it automatically changes to ON1. When set to DC, the filter cannot be set to ON2. If set to ON2, it automatically changes to OFF. AC: AC, DC: DC, AC+DC: AC+DC, AC PEAK: AC peak For details, refer to Section 6.6.4, "Measurement Current Setting (for IEC/TR 60990)."
⑯ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective, ⓩ is displayed on the screen. For details, refer to Section 6.4.3, "Zero Adjustment (for IEC/TR 60990 - Earth Leakage Current)."
⑰ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 6.6.5, "Printing out the Maximum Values."
⑱ Save	Opens the save data window. For details, refer to Section 6.6.6, "Saving the Maximum Values."
⑲ End	Exits the earth leakage current measurement, and returns to the initial screen.

6.5 Low Resistance Measurement Mode (for IEC/TR 60990)

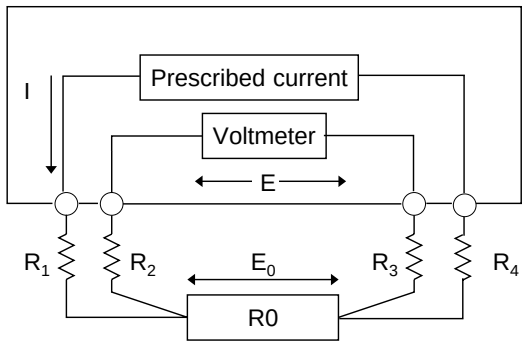
6.5.1 Low Resistance Measurement Mode

Under IEC 60950 (1991-10) + am4 (1996-07), measurement of resistance between the protective earth terminal or earth contact and the part required to be earthed is to be made at not more than 25 AAC or DC of current. (The resistance is calculated from the voltage drop.) The 3155, however, makes this measurement simply using the DC four-terminal method (at 100 mADC max.). This measurement is made for Class Ⅰ equipment only.
Measurement is made by touching either the optional 9461 PIN-TYPE LEADS or 9287 CLIP-TYPE LEADS to the test point. Measurement is also possible using RS-232C interfacing with the 3157 AC GROUNDING HiTESTER (max. 31A AC, conforming to various standards), available separately.

Four-terminal method

When measuring low levels of resistance, ordinarily the resistance of the measuring lead and the connector are included, which results in errors. By using the four-terminal method, this error can be eliminated.
The resistance measuring circuit measures the drop in voltage at the prescribed current, and calculates the resistance. As shown in the figure, however, the input resistance at the voltmeter is extremely high, and all of current I flows into the measured resistance R_0. Therefore the drop in voltage from R_2 to R_3 becomes 0, the voltage E and the voltage drop E_0 at both ends of the measured resistance R_0 become equal, and the resistance is measured without the influence of R_1 to R_4.
(R1 to R4 indicate the measuring lead and connector resistance.)

Resistance measuring circuit



R1 to R4 are the measuring lead and connector resistance.

6.5.2 Connecting Equipment for Low Resistance Measurement (for IEC/TR 60990)

⚠ WARNING **Do not input a voltage exceeding 30 Vrms, 42.4 Vpeak or 50 VDC between the resistance measurement terminals, and between the resistance measurement terminal and the ground.**

⚠ CAUTION

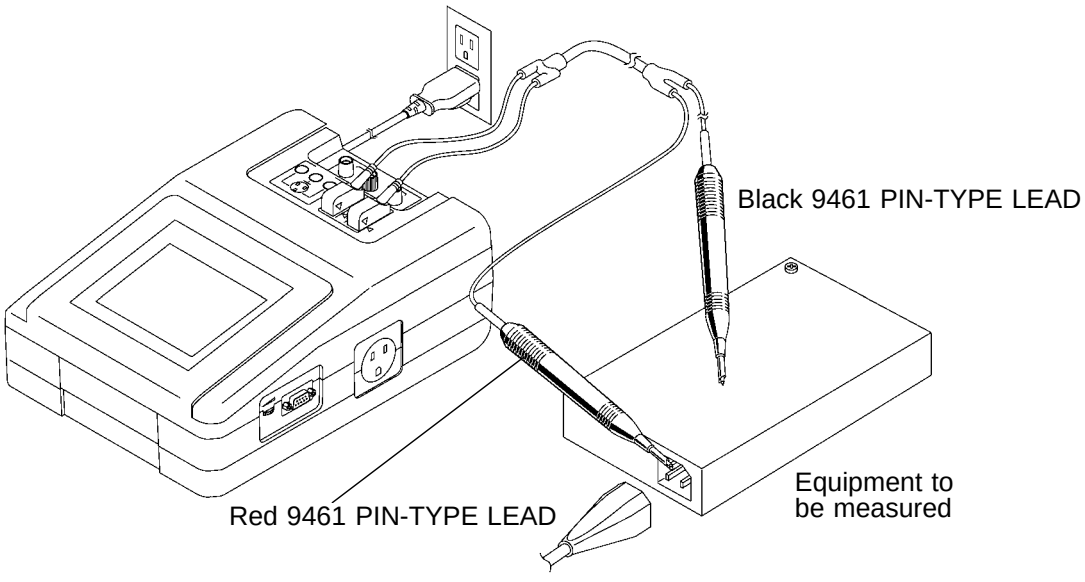
- Be careful not to hurt yourself on the end of the 9461 PIN-TYPE LEAD, which is pointed.
- Do not connect anything other than the 9461 PIN-TYPE LEAD and the 9287 CLIP-TYPE LEAD to the resistance measurement terminal.

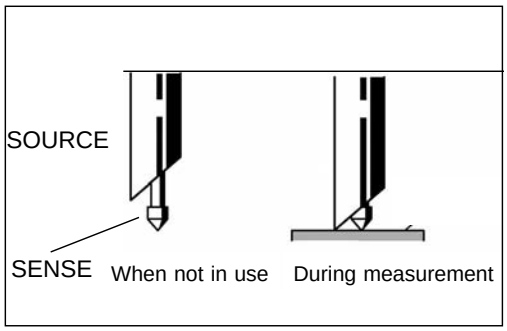
NOTE Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.

(1) When using 9461 PIN-TYPE LEADS

The 9461 PIN-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.

Touch the pin-type leads between the protective earth terminal or earth contact and the part required to be earthed.
Allowable value: 100 mΩ



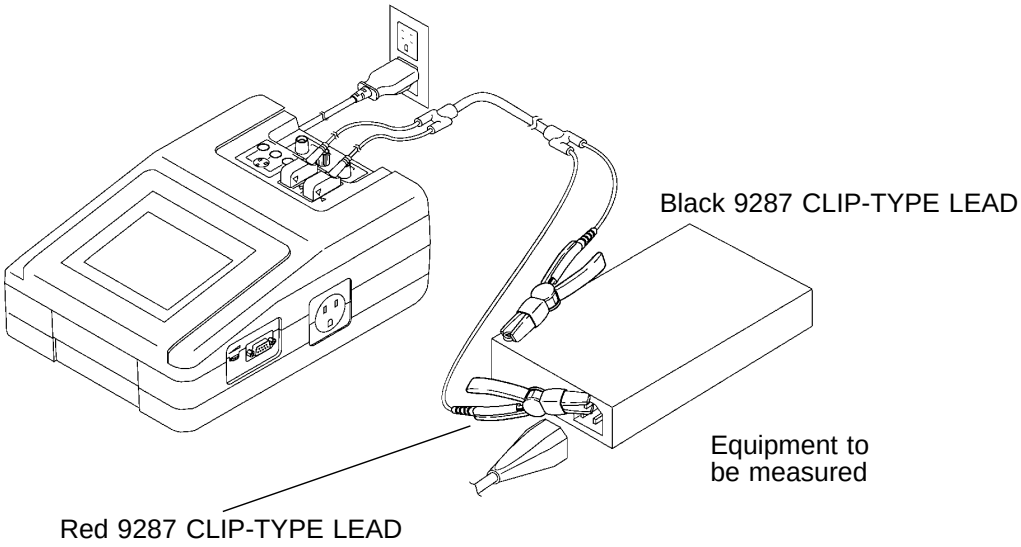


NOTE

As shown in the figure, the 9461 PIN-TYPE LEAD has a SENSE sheathed by the SOURCE. When touched to the equipment to be measured, both the SENSE and the SOURCE must be in contact with the equipment to be measured.

(2) When using the 9287 CLIP-TYPE LEADS

The 9287 CLIP-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.
Touch the clip-type leads between the protective earth terminal or earth contact and the part required to be earthed.
Allowable value: 100 mΩ



(3) When using 3157 AC GROUNDING HiTESTER

⚠ CAUTION

- Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.
- Do not touch the equipment to be measured until measurement is complete.

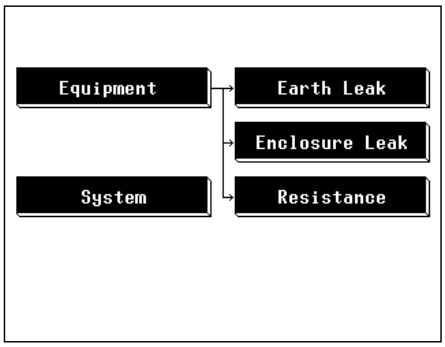
When measuring in low resistance measurement mode using optional 3157 AC GROUNDING HiTESTER, using the RS-232C interface enable the 3155 to control the 3157. For usage, connection and communication settings for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.

1. Leave power OFF for both 3155 and 3157 while connecting each RS-232C connector with the RS-232C cable. For connection with the RS-232C connector, see Section 8.4, "Connecting Method."
2. Turn the power ON for both 3155 and 3157. Connect 3157 with equipment to be measured. The 3155 allowable value and measuring points apply to 3157.

6.5.3 Basic Settings for Low Resistance Measurement

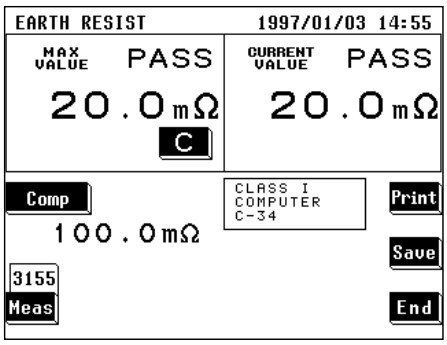
This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 6.5.2, "Connecting Equipment for Low Resistance Measurement."

Initial screen



Resistance → End

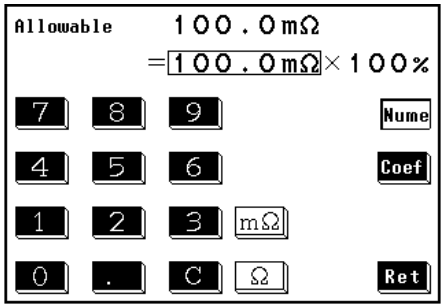
Low resistance measurement mode screen



Measurement starts automatically. When measuring with 3157 measuring equipment settings, measurement is executed on measurement window.

Comp → Ret

Allowable value set-up window

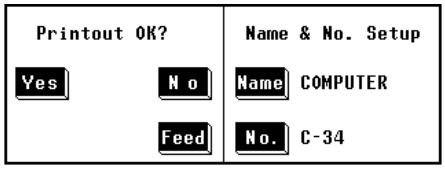


Set the allowable value referring to Section 6.6.2, "Allowable Value Setting." (For enabling or disabling the allowable value judgment, refer to Section 6.7.4, "Allowable Value Judgment Set-up Screen.")

Meas → Ret

Print → After printing Ret

Print-out window



For a detailed set-up procedure, refer to Section 6.6.5, "Printing out the Maximum values."
For saving, refer to Section 6.6.6, "Saving the Maximum Values."

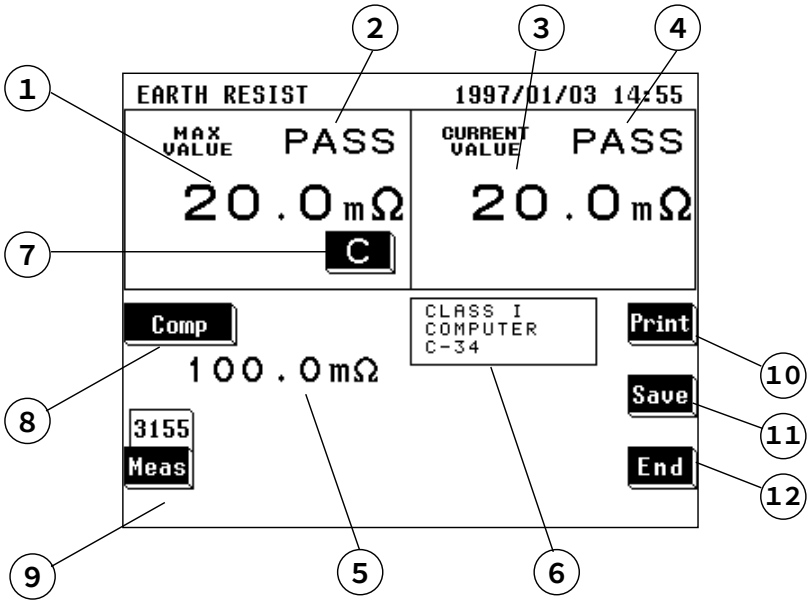
Measurement window

When measuring with 3157 measuring equipment settings, allowable value set-up window cannot be selected. Measuring defaults to 3157 allowable value (at maximum test value).

6.5.4 Low Resistance Measurement Screen

With 3155 measuring equipment settings selected on low resistance measurement screen, measurement starts immediately and displays current value.

When measuring with 3157 measuring equipment settings, measurement does not start until pressing the Yes key.



* Screen: for ME equipment

(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. When measuring with 3157 measuring equipment settings, value obtained as measured value is displayed.
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Current value	Value obtained from the current measurement When measuring with 3157 measuring equipment settings, measured value of 3157 is displayed after data transfer is complete.
④ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
⑤ Allowable value	Current setting of the allowable value
⑥ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name, Number

(2) Settings

Key	Description of the function
⑦ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode. When measuring with 3157 measuring equipment settings, measuring starts by pressing the Yes key and clears maximum value.
⑧ Comp	Opens the allowable value set-up window. Range of the allowable value: 10 mΩ to 500 Ω When measuring with 3157 measuring equipment settings, allowable value is determined by 3157 and allowable value set-up window cannot be selected. When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157. For details, refer to Section 6.6.2, "Allowable Value Setting."
⑨ Meas	Opens measurement window. 1. Choose 3155 or 3157 for measuring. 2. When measuring with 3157 measuring equipment settings, measurement starts immediately. When measuring with 3157 measuring equipment settings, measurement and data transfer status are displayed. Yes: Measurement begins. For details, refer to Section 6.6.7, "Low Resistance Measurement with 3157."
⑩ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 6.6.5, "Printing out the Maximum Values."
⑪ Save	Opens the save data window. For details, refer to Section 6.6.6, "Saving the Maximum Values."
⑫ End	Exits the low resistance measurement, and returns to the initial screen.

NOTE

- When the maximum value and measured value overflow, "------" will be displayed. Moreover, no judgment can be made in this case.
- When measuring with 3157 measuring equipment settings, "------" will be displayed until data transfer is complete normally. Moreover, no judgment can be made in this case.

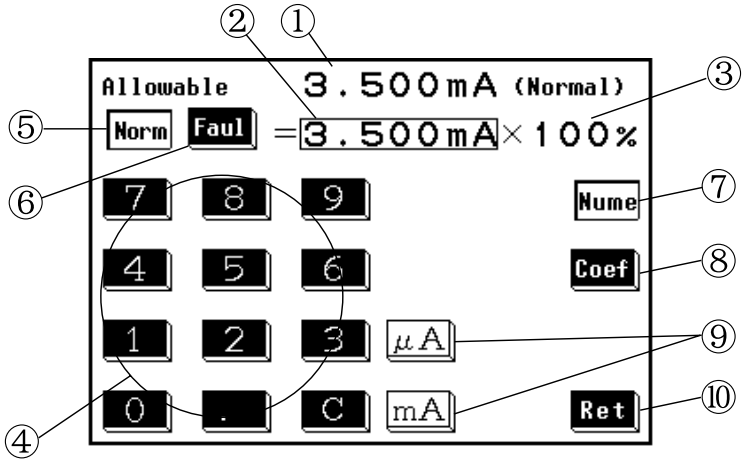
6.6 Condition Set-up Window Setting (for IEC/TR 60990)

6.6.1 Allowable Value Setting (For Leakage Current Measurement)

The allowable value setting may be revised as necessary to accommodate the standards.
The 3155 can set two allowable values in normal condition and single fault condition.
When shipped, the settings are as follows in accordance with IEC 60950 (1991-10) + am4 (1996-07):
When the grounding class of the equipment to be measured is class Ⅰ: 3.5 mA
When the grounding class of the equipment to be measured is other than class Ⅰ: 0.25 mA

Settings

(1) On the measuring mode screen, press the **Comp** key to open the allowable value set-up window.



Screen during input
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 5 μA to 20 mA

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Normal: Press to set the allowable value in normal condition
⑥ Fault: Press to set the allowable value in single fault condition
⑦ Numerals: Press to input numerals
⑧ Coefficient: Press to input coefficient
⑨ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑩ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 5 μA is input, the value is automatically revised to 5 μA. If a value of more than 20 mA is input, the value is automatically revised to 20 mA.

(2) Press the normal or fault key to select the desired allowable value.
(3) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.
(4) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.
(5) After making the setting, press the Ret key to close the allowable value set-up window.
(6) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

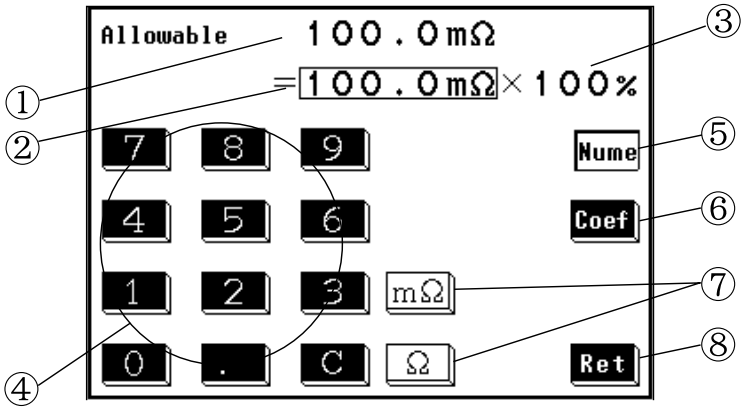
- To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.
  If the screen is changed before the unit is finalized, the setting is not revised.
- The maximum value is cleared after the setting is revised.
- The numeral is initialized but the coefficient is not after the settings on the equipment set-up screen are changed.

6.6.2 Allowable Value Setting (For Low Resistance Measurement)

Low resistance measurement is performed only for grounding class Ⅰ equipment. The allowable value setting may be revised as necessary. When shipped, 100 mΩ is set.

Settings

(1) On the measuring mode screen, press the Comp key to open the allowable value set-up window.



Screen during input
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 10 mΩ to 500 Ω

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Numerals: Press to input numerals
⑥ Coefficient: Press to input coefficient
⑦ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑧ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 10 mΩ is input, the value is automatically revised to 10 mΩ. If a value of more than 500 Ω is input, the value is automatically revised to 500 Ω.

(2) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.

(3) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.

(4) After making the setting, press the Ret key to close the allowable value set-up window.

(5) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.

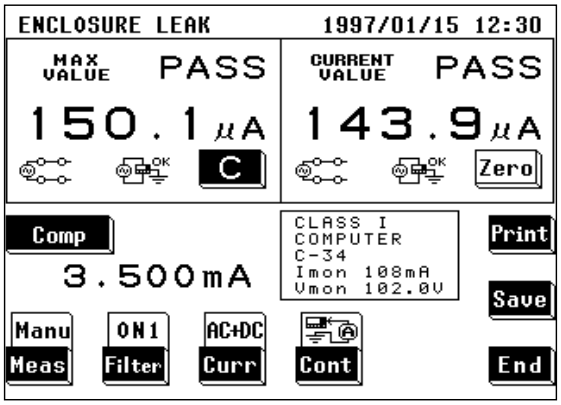
If the screen is changed before the unit is finalized, the setting is not revised. The maximum value is cleared after the setting is revised.

6.6.3 Automatic Measurement Setting (for IEC/TR 60990)

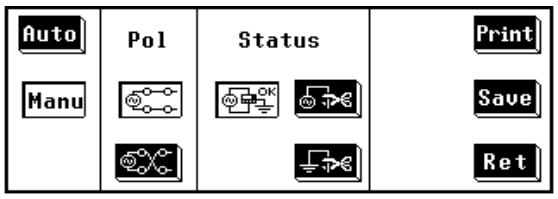
In each of the leakage current measurement modes, automatic measurement can be performed, in which the polarity and condition of the equipment to be measured are automatically changed. The combinations shown below are all set, and the maximum value of each combination is measured.
After measurement, the results will be displayed on the automatic measurement result screen. Printing and saving are possible on this screen.

(1) Power source polarity (Normal and reverse)
(2) Condition of the equipment to be measured
① Normal condition
② Single fault condition (Open power lead, open ground)

Settings

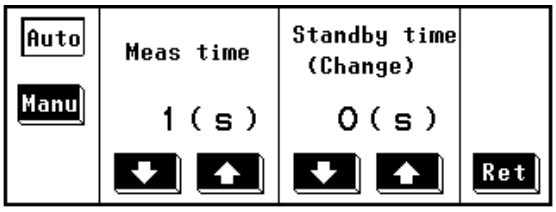


(1) On the leakage current measurement mode screen, press the Meas key to open the polarity and equipment condition set-up window. Measurement continues even when this window is open.



(2) Press the key for the desired measurement method.
1. Manu: Sets the measurement method to manual.
2. Auto: Sets the measurement method to automatic.

After pressing the automatic key, the measuring time and standby time set-up window opens.

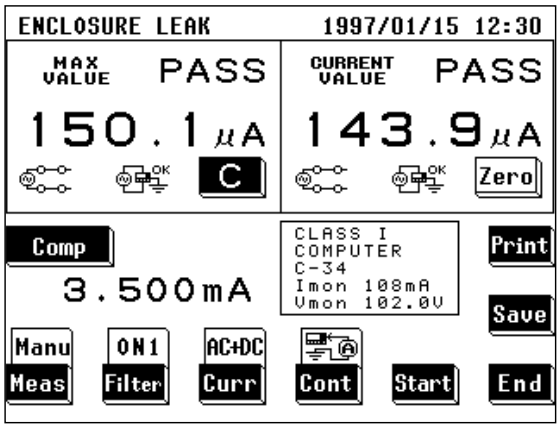


(3) Set the measuring and standby times.
Use the ▲ and ▼ keys to make the settings as desired.
(4) Press the Ret key to close the measuring time and standby time set-up window.

Range Standby time: 0 to 99 seconds
Measuring time: 1 to 99 seconds

NOTE

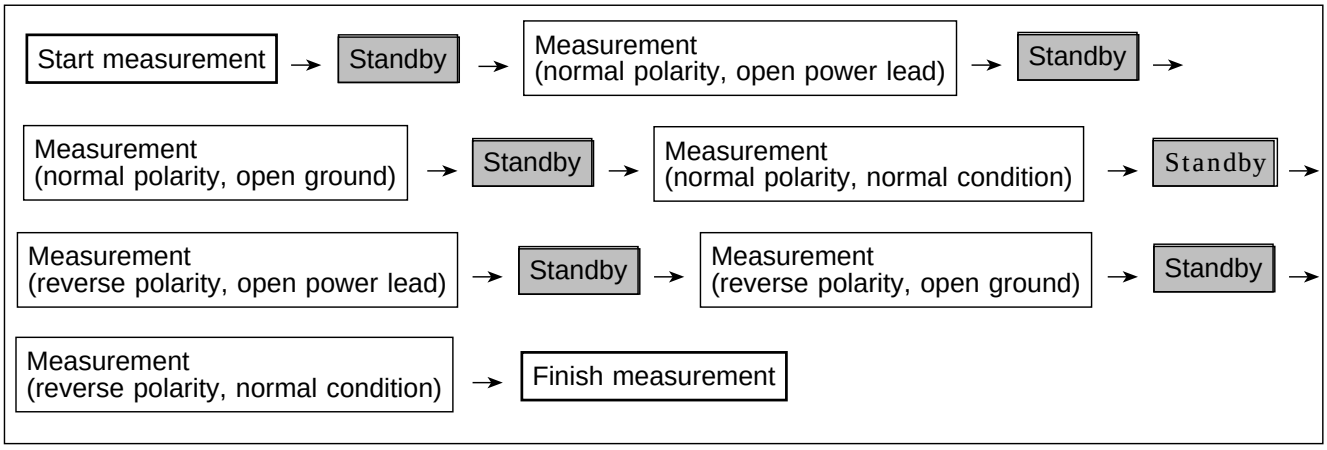
The equipment to be measured may take time to stabilize after changing the polarity and equipment condition. Set the standby time considering this time.



(5) On the measuring mode screen, press the **Start** key to start automatic measurement. When the measurement of a particular condition is finished, if it exceeds the current maximum value, the maximum value is revised to the new value. During measurements, the **Stop** key is displayed. Press the **Stop** key to interrupt the measuring process. After the measurements have been completed, the **Start** key is displayed.
During the measuring time, the beeper sounds.

(6) After the measurements have been completed, the automatic measurement result screen opens.

Example: Enclosure leakage current measurement



NOTE

Automatic measurements are carried out in the following order:
Polarity: normal, then reverse
Status: open power lead, open ground, normal condition
A part of the single fault condition is omitted according to the grounding class setting.

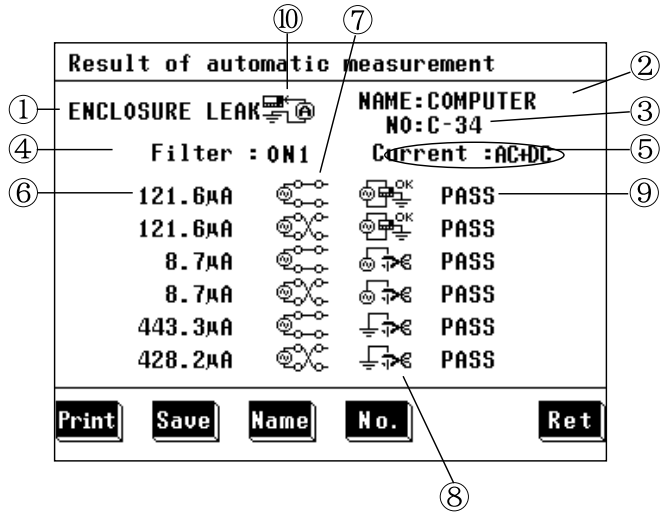
Categories to be set prior to automatic measurement

- Filter ON or OFF for all the measuring modes
- Contact condition
- Measurement current

It is necessary to have set the above categories manually prior to performing automatic measurement.

Automatic measurement result screen

After the automatic measurements have been completed, the automatic measurement result screen is displayed.



① Measuring mode
② Model name
③ Number
④ Measurement network filter setting
⑤ Measurement current
⑥ Maximum value
⑦ Power source polarity
⑧ Condition of the quipment to be measured
⑨ Judgment
⑩ Contact condition

Print: Print all the automatic measurement results.

Save: Save all the automatic measurement results.

Name: Display the model name input screen.

No.: Display the number input screen.

Ret: Return to the measuring mode screen.

NOTE

If returning to the measurement screen without first either saving or printing out the current data, that data will be lost.

(1) Printing the automatic measurement results

Press the **Print** key on the automatic measurement result screen to print all the automatic measurement results.
Press the **Yes** key to print. Press the **No** key to disable printing.
During printing, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing.
After printing, press the **Ret** key.

(2) Saving the automatic measurement results

Press the **Save** key on the automatic measurement result screen to save all the automatic measurement results.
Press the **Yes** key to save. Press the **No** key to disable saving.
If data with the same model name and number already exists, a request for confirmation appears.

(3) Changing the model name and number

For details, refer to Section 6.2.2, "Equipment Set-up Screen (for IEC 990)."

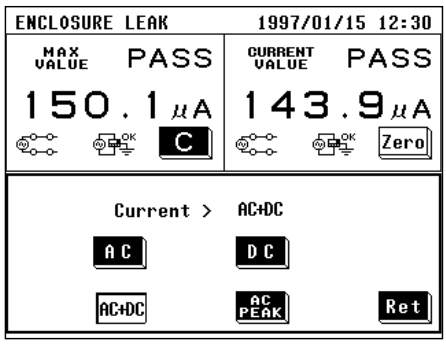
Example of the automatic measurement results printout

Printout of the automatic measurements in the enclosure leakage current

```
--------------------
Date:1998/08/26
Name:COMPUTER
No.  :C-34
Stat:Class I
Comment:

ENCLOSURE LEAKAGE:
 Filter     ON1
 Current    AC+DC
 Contact    B-E

  15.0μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  OK

  15.0μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  OK

  15.0μA
 Judgment   PASS
 Polarity   Normal
 Powerline  Cut
 Earthline  OK

  15.0μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  Cut
 Earthline  OK

  377.7μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  Cut

  384.6μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  Cut
--------------------
```

6.6.4 Measurement Current Setting (for IEC/TR 60990)

This is where the measurement current is set.



Settings

(1) Press the Curr key on the leakage current measurement mode screen to open the measurement current set-up window.
Measurement continues even when this window is open.

(2) On the measurement current set-up window, press the key for the type of current you wish to use.

AC: AC rms

DC: DC

AC+DC: AC+DC rms

AC PEAK: AC peak

(3) Press the Ret key to close the measurement current set-up window.

NOTE

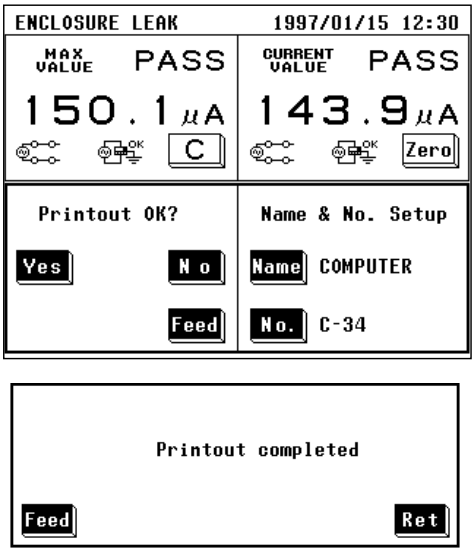
- When set to measurement current AC peak, the measurement network filter cannot be set to OFF. If set to OFF, it automatically changes to ON1.
- When set to measurement current DC, the measurement network filter cannot be set to ON2. If set to ON2, it automatically changes to OFF.

6.6.5 Printing out the Maximum Values (for IEC/TR 60990)

The printer can be used to print out the maximum values and measurement settings for each measuring mode. When printing out the maximum values, the model name and number registered on the equipment set-up screen can be changed.
Once registered, these items will be included with the maximum values for each printout, unless changed. The registration of the model name and number input on the printout window is common to the save data window as well. When saving data, the model name and number are saved as well.

NOTE

- In cases where you wish to print out for the measurement settings (the power source polarity, condition of the equipment to be measured, etc) for each measuring mode individually, clear the maximum values each time, and make the measurements before printing out.
- For changing the model name and number, refer to Section 6.2.2, "Equipment Set-up Screen."



Settings

(1) On the measuring mode screen, press the **Print** key.

(2) At the bottom of the screen, the printout window will open.
Press the **Yes** key to print out the maximum values on the built-in printer.
Press the **No** key to close the printout window without printing out.
Press the **Feed** key to feed paper to the printer.
During printing out, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing out.

(3) Once the "Printout completed" message appears on the screen, press the **Ret** key to close the printout window.
Press the **Feed** key to feed paper to the printer. If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.

```
--------------------
Date:1998/08/26
Name:COMPUTER
No.  :C-34
Stat:ClassI
Comment:

ENCLOSURE LEAKAGE:
  12.3μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline OK
 Filter    ON1
 Current   AC+DC
 Contact   B-E
--------------------
```

Example of a printout of the maximum value in the enclosure leakage current

Example of a Maximum Value Printout (for IEC/TR 60990)

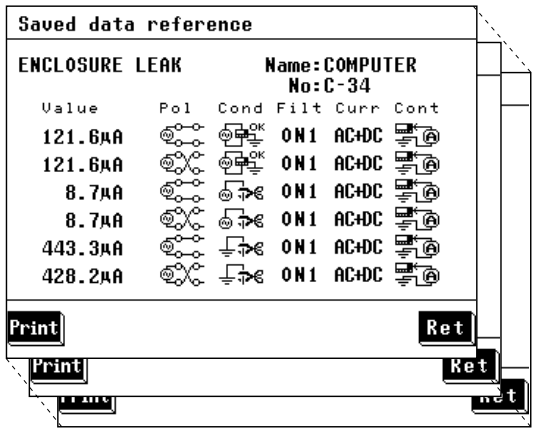
The printer can be used to print out the registered model name and number, as well as the maximum value and measurement settings for each of the measuring modes. The comment space is used for a memo.

6.6.6 Saving the Maximum Values (for IEC/TR 60990)

The maximum values are saved with the model name and number registered on the equipment set-up screen. The power source polarity, condition of the equipment to be measured, etc. during measurement are also saved.
When saving the maximum values, the model name and number can be changed. The saved data units can be viewed on the saved data reference screen of the system screen. For details, refer to Section 6.7.2, "Saved Data reference Screen."

Data save format

The maximum values with the same model name and number are saved in a data unit. The maximum values in each measuring mode can be saved in a data unit. Up to 100 individual data units can be recorded. However, up to 2000 data (maximum values) can be recorded.



Measuring mode
- Earth leakage current
- Enclosure leakage current
- Low resistance measurement

×

Power source polarity
- Normal polarity
- Reverse polarity

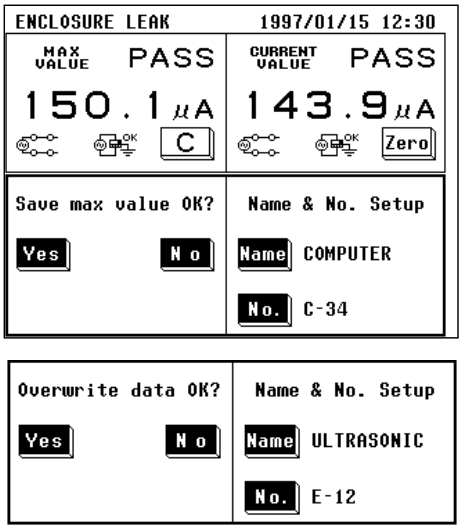
×

Condition of the equipment to be measured
- Normal condition
- Single fault condition (Interruption of one supply conductor)
- Single fault condition (Interruption of a protective earth conductor)

- There is no single fault condition (interruption of a protective earth conductor) for earth leakage current.
- There are no power source polarity and condition of the equipment to be measured for low resistance measurement.
- A part of the condition of the equipment to be measured is omitted depending on the settings of the grounding class and applied part type of the equipment to be measured.
- In the following cases, model name and number must be changed for storage as a different data unit.
  - When the measurement network filter setting is changed.
  - When the measurement current setting is changed.
  - When the contact condition setting is changed in enclosure leakage current.

Notes when saving data

- Even if the filter setting, measurement current and contact condition have changed, as long as the registered data unit is the same, the data for that data unit will be overwritten. (after a request for confirmation)
- When saving data manually for each setting condition (power source polarity and condition of the equipment to be measured), clear the maximum value prior to each measurement and save after changing the model name and number. For automatic measurement, refer to Section 6.6.3, Automatic Measurement Setting (for IEC 990)."
- For changing the model name and number, refer to Section 6.2.2, "Equipment Set-up Screen."



Settings

(1) On the measuring mode screen, press the **Save** key.

(2) At the bottom of the screen, the save data window will open.

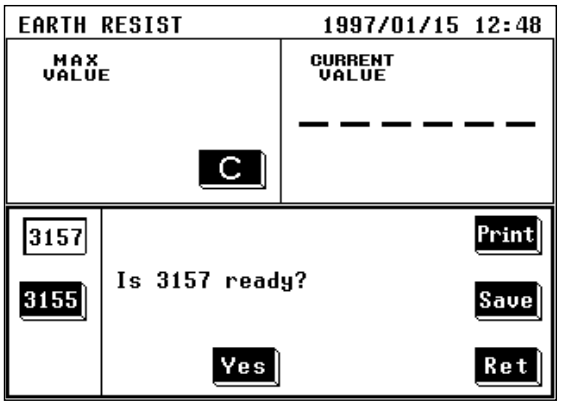
Press the **Yes** key to save the maximum values.
If a data unit with the same name already exists, a request for confirmation appears.

Press the **No** key to close the save data window without saving.
If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.

6.6.7 Low Resistance Measurement with 3157

Low resistance measurement mode allows measurement with optional 3157 AC GROUNDING HiTESTER (maximum 31 AAC, in accordance with multiple standards). Using the RS-232C interface enable the 3155 to control the 3157. Prior to set up, connect 3157 to equipment to be measured and 3157 to 3155 with connection cable. Synchronize 3157 communication settings with 3155. 3157 communication settings are applied when power is turned ON. Set up and configure while power is OFF.
See "When using 3157" on the previous page.
See also Section 8.5.1, "Communication Conditions Setting."

Settings



(1) On the low resistance measurement mode screen, press the Meas key to open the measurement window.

(2) Press the key for the desired measuring equipment.

1. 3155: Select 3155.
2. 3157: Select 3157.

When 3157 is selected, the Yes key is displayed. Measurement and data transfer status are displayed.

(3) Set up 3157 test settings. Measurement does not start unless the following conditions are met.

1. Test settings
   - Unit of the maximum and minimum test values: Resistance
   - Test time: ON
   - Maximum test value: ON

   When the optional minimum test value setting function is ON.
   - Minimum test value: OFF
2. Optional function setting
   Endless timer function: Not set

(4) Verify 3157 is set to READY. Press the Yes key to start measurement. Automatically 3157 maximum test value is loaded as an allowable value. After measuring, measurement results are displayed. Unless 3157 judgment is either PASS or FAIL (UPPER FAIL), test results are not displayed.

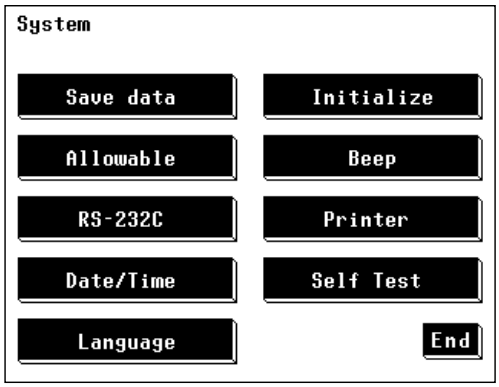
(5) Press the Ret key to close the measurement window.

NOTE

- For usage, connection and communication settings for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.
- Measurement cannot be carried out for approximately five seconds after turning the 3157 power ON.
- When the 3157 optional function setting screen is set, measurement cannot be carried out.
- Do not press the Yes key before connecting RS-232C cable and 3157.
- When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157.
- 3157 optional function settings may result in test failure. Make sure to set up as shown below before testing.
  1.Momoentary OUT: Not set
  2. Test mode: Soft start mode or normal mode
  3. Printer output: Not used
- Measurement and data transfer status display
  1. "Check the settings.": 3157 settings are improper.
  2. "Time out error": Time out error occurred.
  3. "Communication error": Data transfer error occurred.

6.7 System Screen (for IEC/TR 60990)

6.7.1 System Screen



On the initial screen, press the System key to move to the system screen.

On the system screen, processing of saved data as well as settings for sounds, time and date, and communications, and execution of self-testing can be made.

Save data: Move to the saved data reference screen.
For details, refer to Section 6.7.2, "Saved Data Reference Screen."

Initialize: Move to the initialization screen.
For details, refer to Section 6.7.3, "Initialization Screen."

Allowable: Move to the allowable value judgment set-up screen
For details, refer to Section 6.7.4, "Allowable Value Judgment Set-up Screen."

Beep: Move to the beep sound set-up screen.
For details, refer to Section 6.7.5, "Beep Sound Set-up Screen."

RS-232C: Move to the communications set-up screen.
For details, refer to Section 8.5.1, "Communication Conditions Setting."

Printer: Move to the printer set-up screen.
For details, refer to Section 6.7.7, "Printer Set-up Screen."

Date/Time: Move to the time and date set-up screen.
For details, refer to Section 6.7.8, "Time and Date Set-up Screen."

Self Test: Move to the self-test screen.
For details, refer to Section 6.7.9, "Self-test Screen."

Language: Move to the language set-up screen.
For details, refer to Section 6.7.10, "Language Set-up Screen."

End: Return to the initial screen.

6.7.2 Saved Data Reference Screen (for IEC/TR 60990)

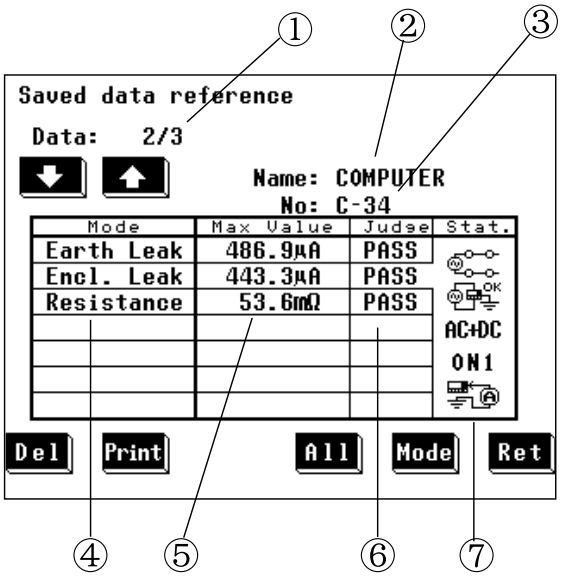
The following is an explanation of how to use the saved data.
Up to 100 data units can be saved. However, up to 2000 data can be saved.
For the model name and number settings, refer to Section 6.2.2, "Equipment Set-up Screen (for IEC/TR 60990)."

(1) Settings

1. On the initial screen, press the System key to move to the system screen.
2. On the system screen, press the Save data key to move to the saved data reference screen.

(2) Saved data reference screen display

On the saved data reference screen, saved data can be viewed, deleted or printed out.



In the example shown in the figure, there are a total of three data units, of which the one being displayed is the second. The data shown is for enclosure leakage current measurement.

① Number of current data unit / total number of data units
② Model name
③ Number
④ Measuring modes (up to 3 entries)
Earth Leak: Earth leakage current measurement
Encl. Leak: Enclosure leakage current measurement
Resistance: Low resistance measurement
⑤ Maximum value
⑥ Maximum value judgment
⑦ Condition at time of maximum value judgment
Power source polarity
Condition of the equipment to be measured
Measurement current setting
Measurement network filter setting
Contact condition setting
Measuring equipment in low resistance measurement mode

NOTE When the maximum value is 1 µA or lower, "UNDER 1 µA" is displayed.

(3) Keys

↓: Used to select an entry
↑: Used to select an entry
Del: Delete the data unit for the current entry
Print: Print the data unit for the current entry
All: Details of the saved data reference screen are displayed.
Mode: Select an entry, and display its condition at time of maximum value judgment.
Ret: Return to the system screen

Sorting data units

The data unit number is determined by sorting data units by their model names and numbers. First the model name, and then the model number is sorted in the following order: <0, 1, , , 9, A, B, , , Z, ->. If a new data unit is registered, the list is re-sorted.

(4) Printing out saved data

1. On the saved data reference screen, select the data unit to be printed out.
   Use the ↑ and ↓ keys to display the desired data unit.
2. Press the Print key to print the data unit.
   Press the Yes key to print. Press the No key to disable printing.
3. After printing has been completed, press the Ret key.
   Repeat steps 1. and 2. as necessary for multiple printouts.
   During printing, the Stop key is displayed. Press the Stop key to stop printing.

(5) Deleting out saved data

1. On the saved data reference screen, select the data unit to be deleted.
   Use the ↑ and ↓ keys to display the desired data unit.
2. Press the Del key to delete the data unit.
   Press the Yes key to delete. Press the No key to disable deleting.

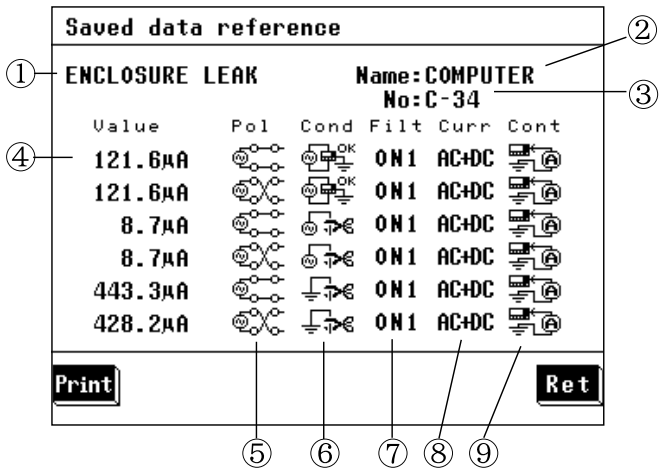
   Repeat steps 1. and 2. as necessary for multiple deletions.
   For details, refer to Section 6.7.3, "Initialization Screen."
   Erase all the saved data on the initialization screen.

(6) Details of the saved data reference screen

Use the Mode key to select the desired measuring mode for the details to display.

Press the All key to display the details of the saved data for the selected measuring mode.

The maximum values for each combination of the power source polarity and condition of the equipment to be measured are displayed.



Example: Maximum values display for six combinations in the enclosure leakage current measurement mode

① Measuring mode
② Model name
③ Number
④ Maximum value
⑤ Power source polarity
⑥ Condition of the equipment to be measured
⑦ Measurement network filter setting
⑧ Measurement current
⑨ Contact condition

Print: Print out the details (for each combination of the power source polarity and condition of the equipment to be measured)

Press the Yes key to print. Press the No key to disable printing.

During printing, the Stop key is displayed. Press the Stop key to stop printing.

Ret: Return to the saved data reference screen

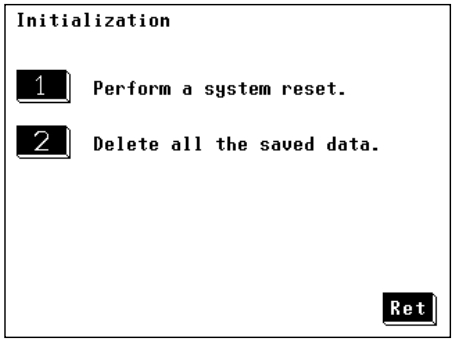
Example of a data unit printout:

```
--------------------
Date:1998/08/26
Name:COMPUTER
No.  :C-34
Stat:ClassI
Comment:

EARTH LEAKAGE:
  385.2μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Filter    ON1
 Current   AC+DC
ENCLOSURE LEAKAGE:
  384.6μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    ON1
 Current   AC+DC
 Contact   B-E
RESISTANCE:
   1.0mΩ
 Judgment  PASS
--------------------
```

Example of a details printout:

```
--------------------
Date:1998/08/26
Name:COMPUTER
No.  :C-34
Stat:ClassI
Comment:

ENCLOSURE LEAKAGE:

  15.0μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline OK
 Filter    ON1
 Current   AC+DC
 Contact   B-E

  15.0μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline OK
 Filter    ON1
 Current   AC+DC
 Contact   B-E

  15.0μA
 Judgment  PASS
 Polarity  Normal
 Powerline Cut
 Earthline OK
 Filter    ON1
 Current   AC+DC
 Contact   B-E

  15.0μA
 Judgment  PASS
 Polarity  Reverse
 Powerline Cut
 Earthline OK
 Filter    ON1
 Current   AC+DC
 Contact   B-E

  377.7μA
 Judgment  PASS
 Polarity  Normal
 Powerline OK
 Earthline Cut
 Filter    ON1
 Current   AC+DC
 Contact   B-E

  384.6μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    ON1
 Current   AC+DC
 Contact   B-E
--------------------
```

6.7.3 Initialization Screen

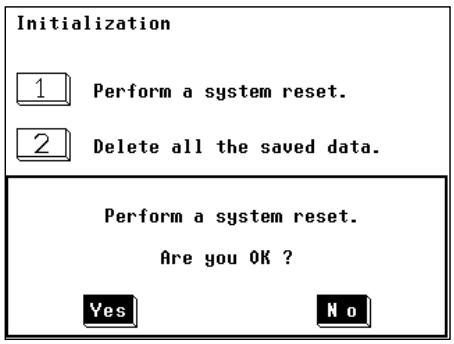


Initialize the 3155.

1: Perform a system reset.
(Delete all the saved data.)

2: Delete all the saved data.

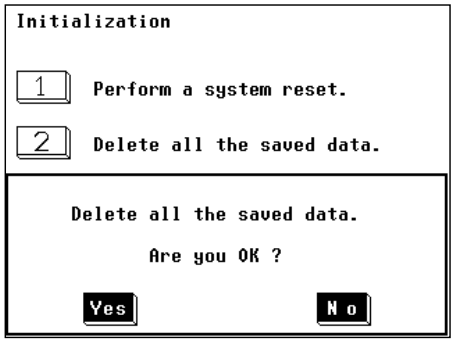
Ret: Return to the system screen.



(1) System reset

Press the 1 key to open the window to confirm a system reset.
Press the Yes key to perform a system reset.
Press the No key and a system reset is not performed.

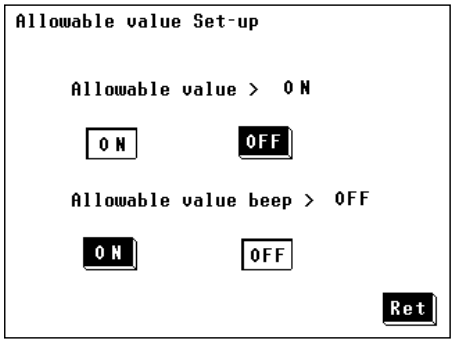
For details of the system reset, refer to Section 10.4, "System Reset."



(2) Deleting all the saved data

Press the 2 key to open the window to confirm that all the saved data are deleted.
Press the Yes key to delete.
Press the No key to disable deleting.

6.7.4 Allowable Value Judgment Set-up Screen



Setting the allowable value judgment (comparison with the maximum value and current value)

ON: Perform the allowable value judgment. If the maximum value and current value are less than or equal to the allowable value, PASS is displayed, if higher than the allowable value, FAIL. Also, the allowable value beep sound setting becomes effective.

OFF: Do not perform the allowable value judgment. The allowable values are not shown on the measuring mode screen.

Setting the beep sound for the allowable value judgment

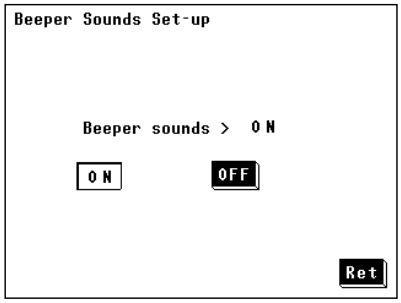
ON: If the allowable value judgment for the maximum value is FAIL, the beep sound is emitted.

OFF: The beep sound is not emitted for the allowable value judgment.

Ret: Return to the system screen.

NOTE If the **C** key is pressed, the beep sound stops.

6.7.5 Beep Sound Set-up Screen



Turn the beeper on or off.

ON: Turn the beeper on

OFF: Turn the beeper off

If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

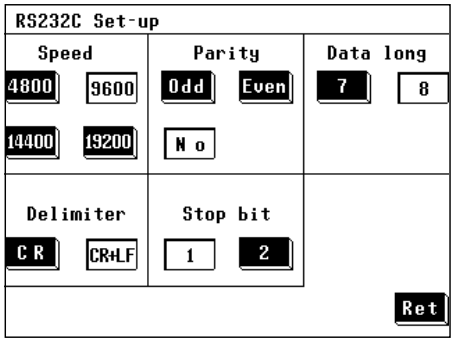
The beep sound is emitted when:

- The power is turned on.
- A key is pressed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

The beep sound is emitted irrespective of the beep sound setting when:

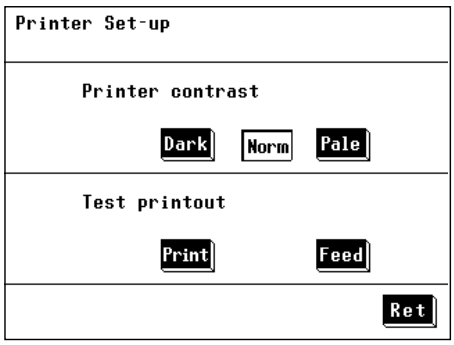
An error has occurred in the RS-232C system.

6.7.6 Communications Set-up Screen



For details, refer to Section 8.5.1, "Communication Conditions Setting."

6.7.7 Printer Set-up Screen



The following is an example of how to adjust the contrast and perform a test printout.
The printer contrast is easily affected by the temperature of the surrounding area.
Adjust the contrast as necessary to produce easy to read printouts.

Printer contrast set-up

Use the following keys to adjust the printer contrast:

Dark: Increase the contrast of the printout.

Norm: The default contrast setting.

Pale: Decrease the contrast of the printout.

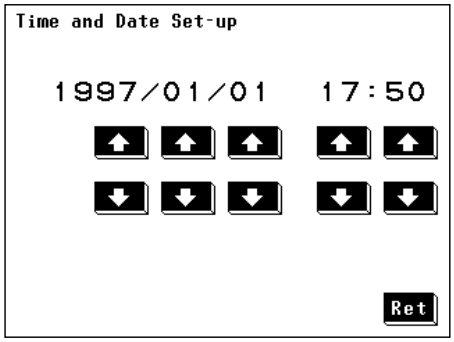
Test printout

Print: Perform a test printout.

Feed: Feed paper to the printer.

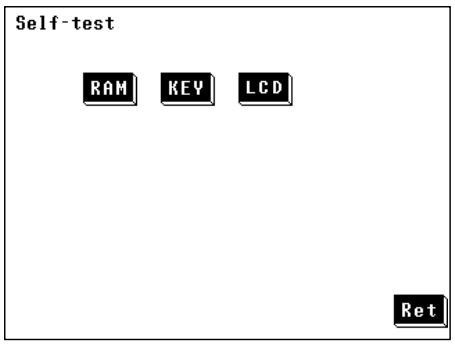
Ret: Return to the system screen.

6.7.8 Time and Date Set-up Screen



Make the time and date settings.
On the time and date set-up screen, press the keys as necessary.
Use the ▲ and ▼ keys found beneath the time and date to set as desired.
The year may be set from 1997 to 2096.
Press the Ret key to finalize the settings.

6.7.9 Self-test Screen



The self-test function is used to check the operation of the 3155 unit.
The following keys are used to perform a variety of tests:

RAM: Test the RAM.

KEY: Test key operation.

LCD: Test the LCD.

Ret: Return to the system screen.

(1) RAM test

Press the RAM key to test the RAM for proper operation.

- If the RAM operates properly, the "RAM TEST OK!" message is displayed.
- If the RAM does not operate properly, the "RAM TEST NG!" message is displayed.
  In this case, contact your dealer or HIOKI representative.

(2) KEY test

Press the KEY key to test the touch panel for proper operation. Each of the 36 different keys are displayed in black on the screen. Press each one to confirm its operation.

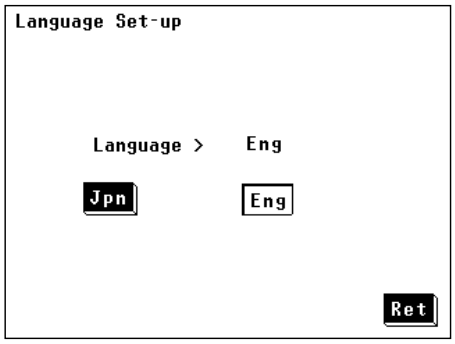
- If all the keys are pressed, the screen returns to the self-test screen.
- If any key fails to change to white, it is malfunctioning. Contact your dealer or HIOKI representative.

(3) LCD test

Press the LCD key to test the LCD for proper operation.
After pressing this key, half the screen is displayed as black and half as white, after which one color changes to the other. If the entire screen is illuminated, then it is operating properly. If there is any section of the screen that is not illuminated, it could indicate an LCD malfunction. Contact your dealer or HIOKI representative.

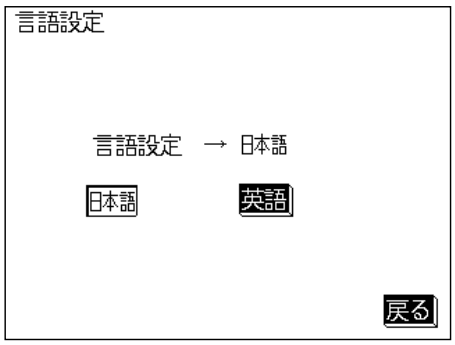
6.7.10 Language Set-up Screen

Set the language displayed on the screen.



(1) English → Japanese

Jpn: Set the display language to Japanese.



(2) Japanese → English

英語: Set the display language to English.

Chapter 7
Ordinary Electrical Equipment Measurement Network D Installed

7.1 Measurement Network D

The 9499 NETWORK D (universal) is used for the electrical measuring instrument. Measurement network D conforms to the following standards.

By changing the filter setting to a network of 1 kΩ (1 kΩ), a network of 1.5 kΩ and 0.15 μF (1.5 kΩ) or a network of 2 kΩ (2 kΩ), the following tests can be performed:

(1) Network of 1 kΩ (1 kΩ)

(2) Network of 1.5 kΩ and 0.15 μF (1.5 kΩ)

- Safety of household and similar electrical appliances - Part 1: General requirements (IEC 60335-1 (1991-06) + am1 (1994-11))
- Applicable UL standards: (Examples: UL471, UL1310, UL1437, UL1492, etc.)

(3) Network of 2 kΩ (2 kΩ)

The 3155 unit contains an allowable value judgment function, which compares the maximum value to the allowable value.
To use this function, set the judgment function to ON, and set each of the allowable values.

Allowable values

The allowable values vary per the applicable regulations.
Example:
Allowable value per IEC 60335-1 (1991-06) + am1 (1994-11)
Stationary class Ⅰ motor-operated appliances: 3.5 mA

NOTE

Allowable values vary per the applicable laws and regulations, but when using the 9499 NETWORK D (universal), the default value is 3.5 mA. Set the allowable value as necessary.

7.2 Screens (Universal)

About the Touch Panel

The 3155 uses a touch panel for setting and changing all of the test 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.

⚠ CAUTION	Do not press hard upon the touch screen, or operate it using a hard object or one with a sharp end. Doing so could scratch or damage the screen or the soft keys.

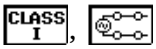
About the display of 'touch keys'

The following is an explanation of the types of 'touch keys' shown on the 3155's display screen.
There are 3 types of key displays. Selectable keys (raised, black background), selected keys (recessed, white background), and non-selectable keys (raised, white background)

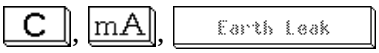
(1) Selectable keys (raised, black background)

Example: 

(2) Selected keys (recessed, white background)

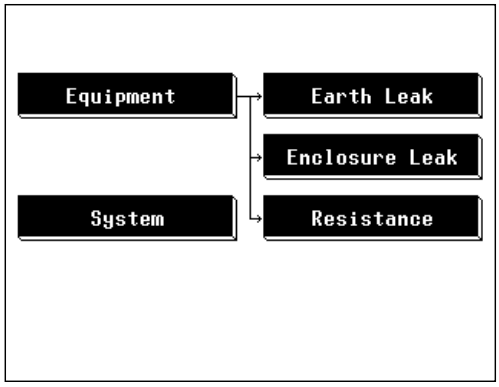
Example: 

(3) Non-selectable keys (raised, white background)

Example: 

The keys shown with dotted lettering indicate items that need not be measured per the settings performed on the equipment set-up screen.

7.2.1 Initial Screen (Universal)



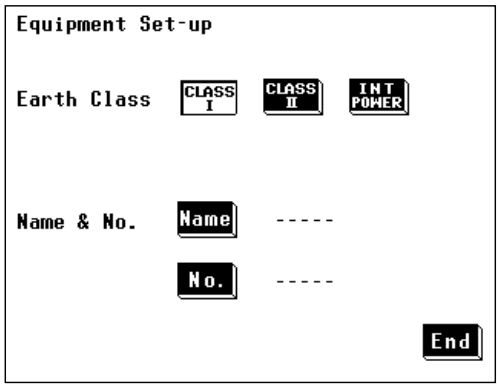
When the power is first turned on, the basic screen for controlling the 3155 immediately appears, called the initial screen.

Equipment set-up: The grounding class of the equipment to be measured

Measuring mode: Earth leakage current, enclosure leakage current, low resistance measurement

System: Clock, beeper, RS-232C communications etc.

7.2.2 "Equipment Set-up" Screen (Universal)



On the initial screen, press the Equipment key to open the equipment set-up screen.

On the equipment set-up screen, a setting for the grounding class of the equipment to be measured, and registration of the model name and number can be made.

Press the End key to return to the initial screen.

Grounding class setting

CLASS I: Class Ⅰ equipment

CLASS II: Class Ⅱ equipment

INT POWER: Internally powered equipment

NOTE

If changing the setting for the grounding class of the equipment to be measured, the condition settings on each measuring mode screen are initialized, except for the coefficient of the allowable value.

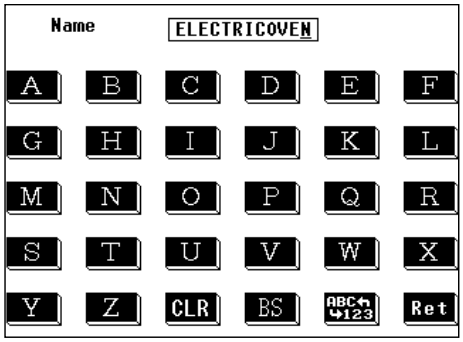
For details, refer to Section 7.6.1, "Allowable Value Setting (For Leakage Current Measurement)," and Section 7.6.2, "Allowable Value Setting (For Low Resistance Measurement)."

Registering the model name and number.

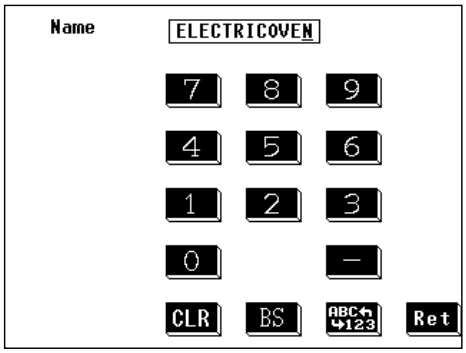
It is possible to register the model name and number before printing out or saving data. Once registered, these items will be included with the maximum values for each printout or save, unless changed.

Name: Change to the model name input screen.

No.: Change to the model number input screen.



Alphabet input screen



Numeric input screen

Setting

Shown on the left are examples of the model name input screens.

A maximum of 12 characters can be input.

CLR: Clear the model name or number

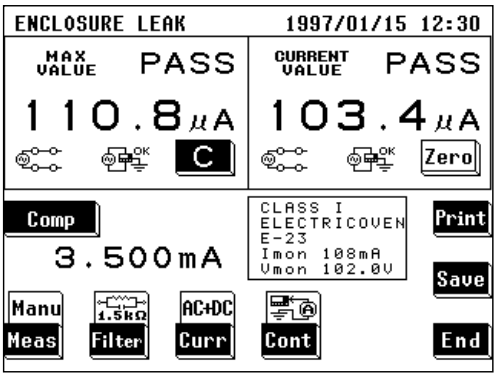
BS: Back space

ABC 123: Toggle between alphabet input and numeric input

Ret: Close the input window

7.2.3 Measuring Mode Screen (Universal)

On the measuring mode screen, press the any one of the following keys to open a window where the settings in question for that measuring mode can be changed.
The following explanation uses the enclosure leakage current measurement screen as an example:



C: Clear the maximum value.

Comp: Open the allowable value set-up window.

Meas: Open the polarity and equipment condition set-up window in the bottom half of the screen.

Filter: Open the measurement network filter set-up window in the bottom half of the screen.

Curr: Open the measurement current set-up window in the bottom half of the screen.

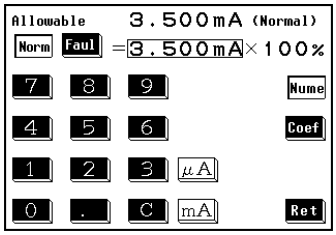
Cont: Open the contact condition set-up window in the bottom half of the screen.

Print: Open the print-out window in the bottom half of the screen.

Save: Open the save data window in the bottom half of the screen.

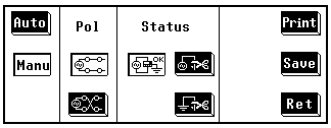
End: Return to the initial screen.

(1) Allowable value set-up window

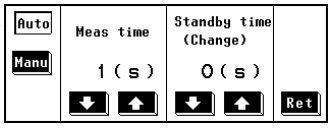


(2) Polarity and equipment condition set-up window

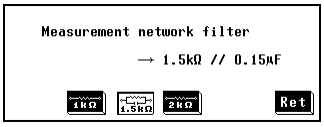
Manual



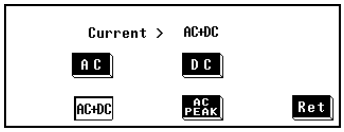
Automatic



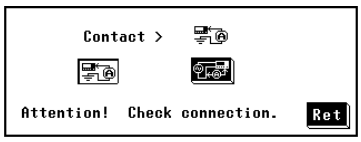
(3) Measurement network filter set-up window



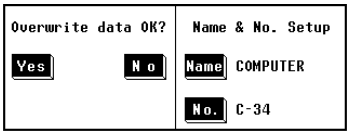
(4) Measurement current set-up window



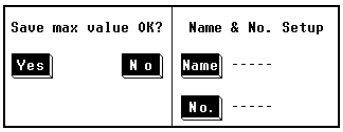
(5) Contact condition set-up window



(6) Print-out window

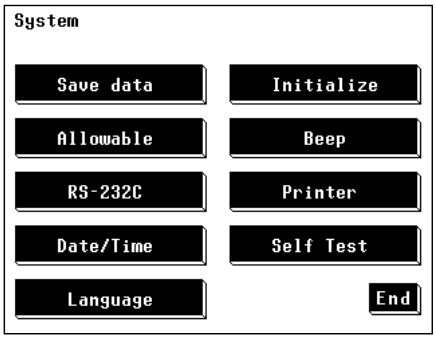


(7) Save data window

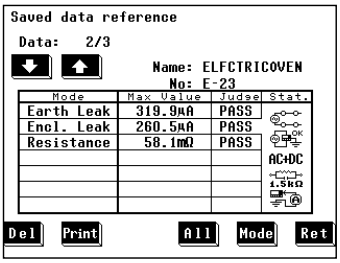


7.2.4 System Screen (Universal)

On the system screen, references to saved data as well as settings for beep sound, time and date, communications, and execution of self-testing can be made.

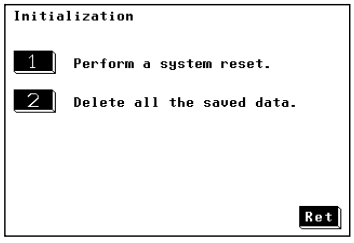


Save data : Move to the saved data reference screen.
Initialize : Move to the initilization screen.
Allowable : Move to the allowable value judgment set-up screen.
Beep : Move to the beep sound set-up screen.
RS-232C : Move to the communications set-up screen.
Printer : Move to the printer set-up screen.
Date/Time : Move to the time and date set-up screen.
Self Test : Move to the self-test screen.
Language : Move to the language set-up screen.
End : Return to the initial screen.



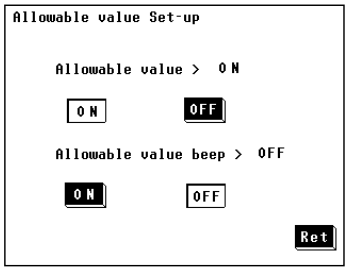
(1) Saved data reference screen

For details, refer to Section 7.7.2, "Saved Data Reference Screen."



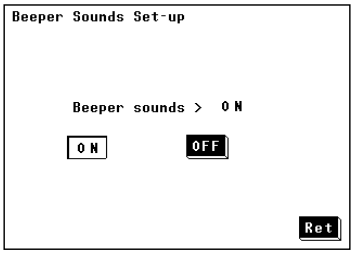
(2) Initialization screen

For details, refer to Section 7.7.3, "Initialization Screen



(3) Allowable value judgment set-up screen

- Set the allowable value judgment (comparison of the set allowable value with the maximum value and measured value) to either ON or OFF. When set to ON, the beep sound setting for the allowable value judgement becomes effective. When set to OFF, the allowable values are not shown on the measuring mode screen.
- Press either the ON or OFF key for the beep sound for the allowable value judgment.



(4) Beep sound set-up screen

Turn the beeper on or off.

Press either the ON key or OFF key.

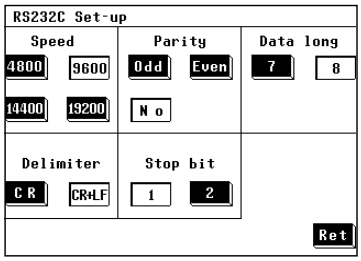
If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

The beep sound is emitted when:

- The power is turned on.
- A key is pushed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

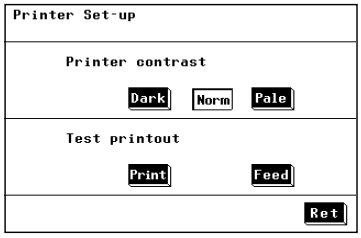
The beep sound is emitted irrespective of the beep sound setting when:

An error has occurred in the RS-232C system.



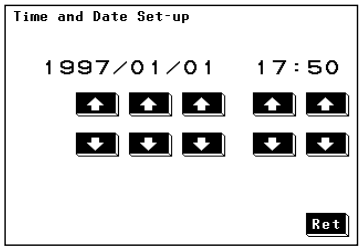
(5) Communications set-up screen

For details, refer to Section 8.5.1, "Communication Conditions Setting."



(6) Printer set-up screen

For details, refer to Section 7.7.7, "Printer Set-up Screen."



(7) Time and date set-up screen

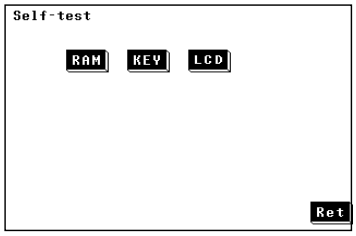
Make the time and date settings.

On the time and date set-up screen, press the keys as necessary.

Use the ▲ and ▼ keys found beneath the time and date to set as desired.

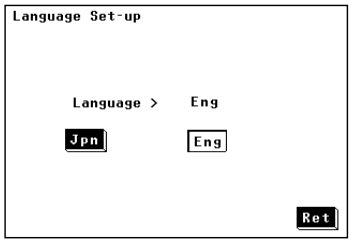
The year may be set from 1997 to 2096.

Press the Ret key to finalize the settings.



(8) Self-testing screen

For details, refer to Section 7.7.9, "Self-test screen."



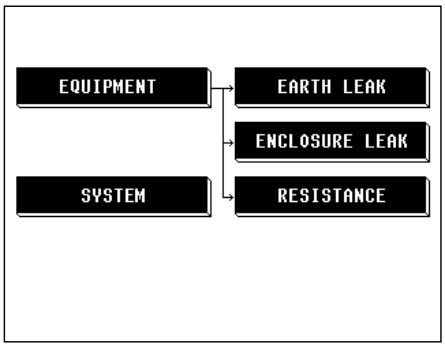
(9) Language set-up screen

For details, refer to Section 7.7.10, "Language Set-up screen."

7.2.5 Flow of Screens for Basic Operations (Universal)

- Change of screens during basic operation is as follows.
- On the measuring mode screen, measured values can be checked in real time.

Initial screen



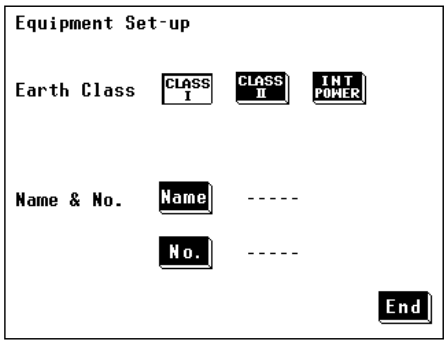
Equipment

End

Enclosure Leak

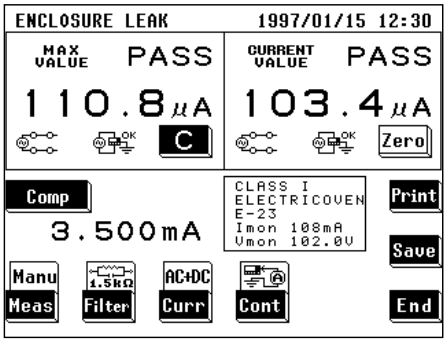
End

Equipment set-up screen



Set the grounding class of the equipment to be measured, and register the model name and number.

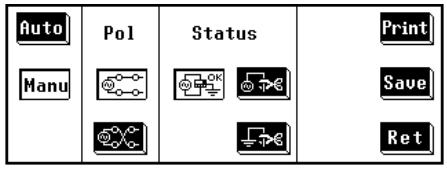
Measuring mode screen



Meas

Ret

Polarity and equipment status set-up window



Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 7.6.3, " Automatic Measurement Setting."

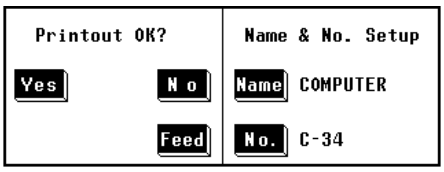
Measurement starts automatically.

Print

After printing

Ret

Print-out window



For a detailed set-up procedure, refer to Section 7.6.5, "Printing out the Maximum Values."
For saving, refer to Section 7.6.6, "Saving the Maximum Values ."

NOTE

Setting conditions for each measuring mode is saved with each measuring mode. However, the model name and number are held in common. Changing the measuring mode will clear the maximum and current values.

7.3 Enclosure Leakage Current Measurement Mode (Universal)

7.3.1 Enclosure Leakage Current Measurement Mode

The enclosure leakage current measurement is performed in two places: between the enclosure and the earth, and between the enclosure and the power line.
With class Ⅰ equipment, the enclosure is each part of the enclosure which is not protectively earthed.
Plug the power cord of the equipment to be measured into the auxiliary power socket for the 3155, and make a measurement by touching either the 9170 TEST LEAD or 9195 ENCLOSURE PROBE to the test point.
The following combinations can be measured under the enclosure leakage current measurement.

Condition of the equipment to be measured		Power source polarity	Test point
Normal condition		Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth
Single fault condition	Open power lead	Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth
	Open ground	Normal polarity	Between the enclosure and the power line
			Between the enclosure and the earth
		Reverse polarity	Between the enclosure and the power line
			Between the enclosure and the earth

NOTE

- When making measurements of internally powered equipment, there is no polarity setting.
- In the enclosure leakage current measurement mode, the 50 μA range is not used.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.
- Measurement between enclosure to enclosure is available.

7.3.2 Leakage Current Measurement with the Universal Measurement Network

When performing leakage current measurements with the 3155, use the enclosure leakage current measurement mode, and make a measurement by touching either the 9170 TEST LEAD or 9195 ENCLOSURE PROBE to the test point.

Contact condition	Test point
Between the enclosure and the earth	Between exposed (conductive) surfaces and ground Between the accessible parts and the grounded supply conductor
Between parts of the enclosure	Between contacts Between any part or contact and either pole of the supply source Between any pole of the supply and accessible metal parts connected to metal foil Between exposed (conductive) surfaces and other exposed (conductive) surfaces Between one part of equipment and another

Set the measurement network and measurement current.

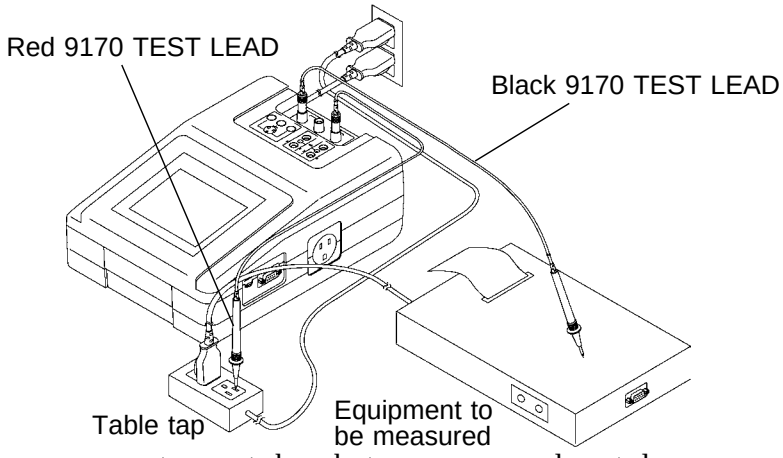
7.3.3 Connecting Equipment for Leakage Current Measurement

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- If enclosure leakage current is to be measured between the enclosure and the power supply line, or the power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.
- The table tap is subject to line voltage. Watch out for electrical shocks.
- In cases where the voltage is applied directly to the leakage current measurement terminals of the the 3155 when making a measurement, the measured value may be subject to synchronous voltage. In which case, an accurate measurement cannot be obtained without first performing zero adjustment. Always perform zero adjustment before measuring.

(1) When setting to "between the enclosure and the power line."
No measurement is made for internally powered equipment.

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the power line."
2. Plug the power cord of the equipment to be measured into a table tap.
3. Plug the table tap into an outlet.
4. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2, and the black one to T1.
5. Perform zero adjustment. For details, refer to Section 7.3.4, "Zero Adjustment (Universal - Enclosure Leakage Current)."
6. Plug the red 9170 TEST LEAD into the table tap.
7. Touch the black 9170 TEST LEAD to the enclosure of the equipment to be measured.

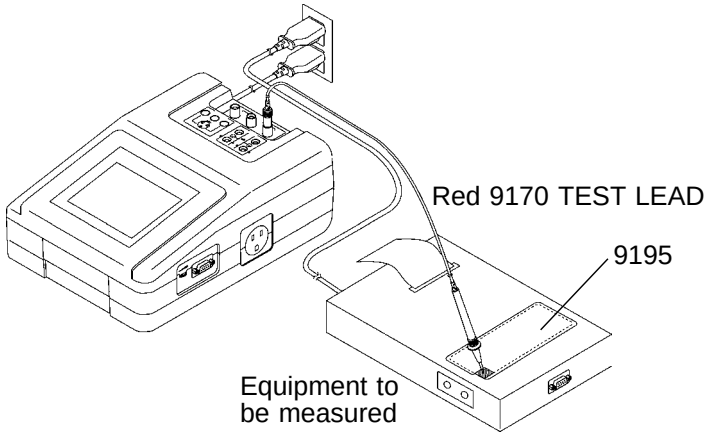


NOTE

- If measurements are taken between exposed metal components (components that are electrically connected to ground) and hot power lines, the resulting condition is the same as a short to ground and the leakage breaker trips. For class I equipments, disconnect the protective earth conductor before measuring.
- Use the insulating transformer when the standard requires it. Do not alter the contact conditions with the test lead left connected to the leakage current measurement terminal. In some cases, this may be the same as the earth.

(2) When setting to "between the enclosure and the earth."

1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the earth."
2. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155. No connection is made for internally powered equipment.
3. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
4. Touch the red 9170 TEST LEAD to the enclosure of the equipment to be measured.



If the enclosure or any part thereof is made of material with insulating characteristics

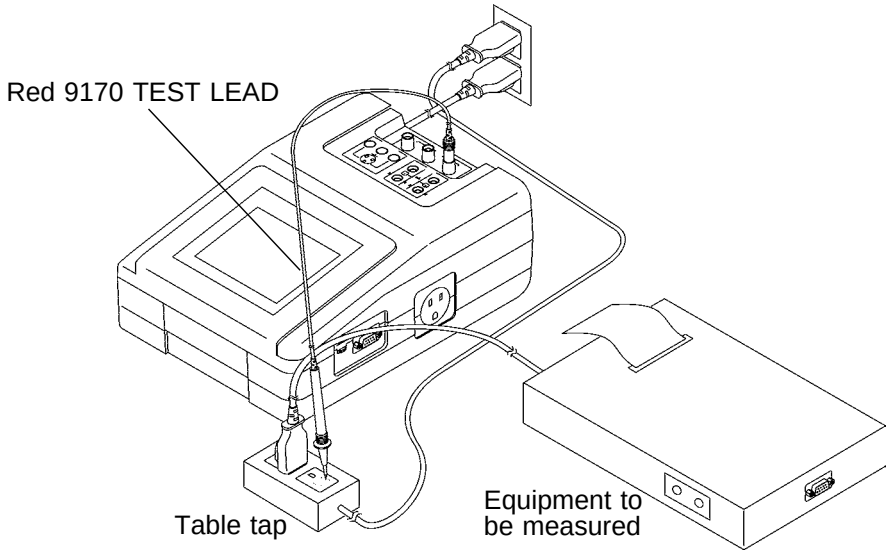
If the enclosure or any part thereof is made of material with insulating characteristics, attach the 9195 ENCLOSURE PROBE to the enclosure across the entire surface.

7.3.4 Zero Adjustment (Universal - Enclosure Leakage Current)

Zero adjustment is effective only for measurements between the enclosure and the power line. After performing zero adjustment, the value remains in memory even if the measuring mode is changed. When the power is turned off, zero adjustment is ineffective. If the voltage of the power line changes, perform zero adjustment again.
Zero adjustment is possible in a range from 0 to 500 μA.

Zero adjustment

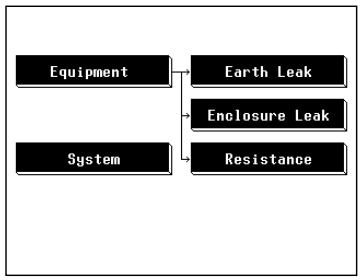
1. On the enclosure leakage current measurement screen, set the contact condition to "between the enclosure and the power line."
2. Plug the power cord of the equipment to be measured into a table tap.
3. Plug the table tap into an outlet.
4. Connect the red 9170 TEST LEAD to the leakage current measurement terminal T2.
5. Plug the red 9170 TEST LEAD into the table tap.
   In this case, do not connect the black 9170 TEST LEAD to the leakage current measurement terminal T1 and the enclosure of the equipment to be measured.
6. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, ⟲ is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again, and zero adjustment is cancelled, the normal measured value returns and ⟲ disappears.
7. Unplug the red 9170 TEST LEAD from the table tap.



7.3.5 Basic Settings for Enclosure Leakage Current Measurement (Universal)

This illustrates basic settings and reference categories until measurement. Preparations for measurement follow Section 7.3.3, "Connecting Equipment for Leakage Current Measurement."

Initial screen



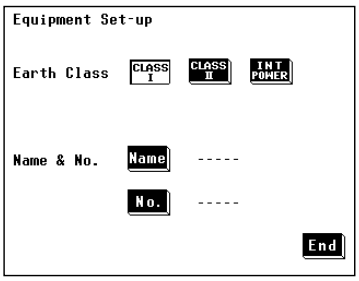
Equipment

End

Enclosure Leak

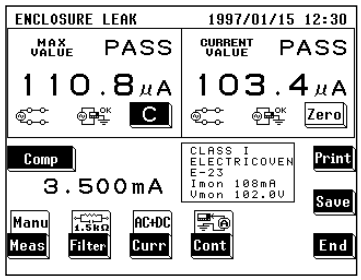
End

Equipment set-up screen



Set the grounding class of the equipment to be measured, and register the model name and number.

Enclosure leakage current measurement mode screen



Meas

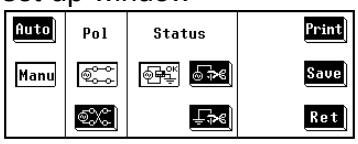
Ret

Measurement starts automatically

Comp

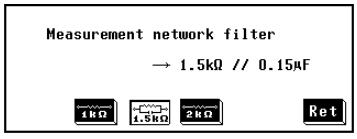
Ret

Polarity and equipment status set-up window



Select and press the keys for the power source polarity and equipment to bemeasured to set. Measurement continues even while the window is open.
For automatic measurement, refer to Section 7.6.3, "Automatic Measurement Setting."

Measurement network filter set-up window

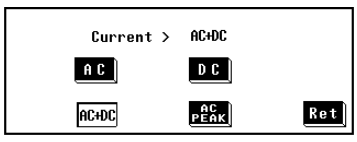


Filter

Ret

Set the filter.

Measurement current set-up window

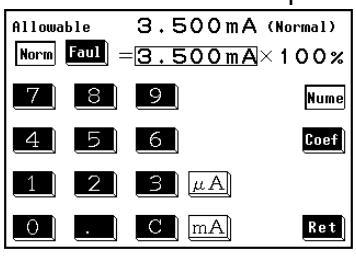


Curr

Ret

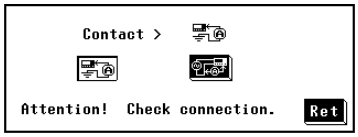
Set the measurement current.

Allowable value set-up window



Set the allowable value referring to Section 7.6.1, "Allowable Value Setting."
For enabling or disabling the allowable value judgment, refer to Section 7.7.4, "Allowable Value Judgment Set-up Screen."

Contact condition set-up window



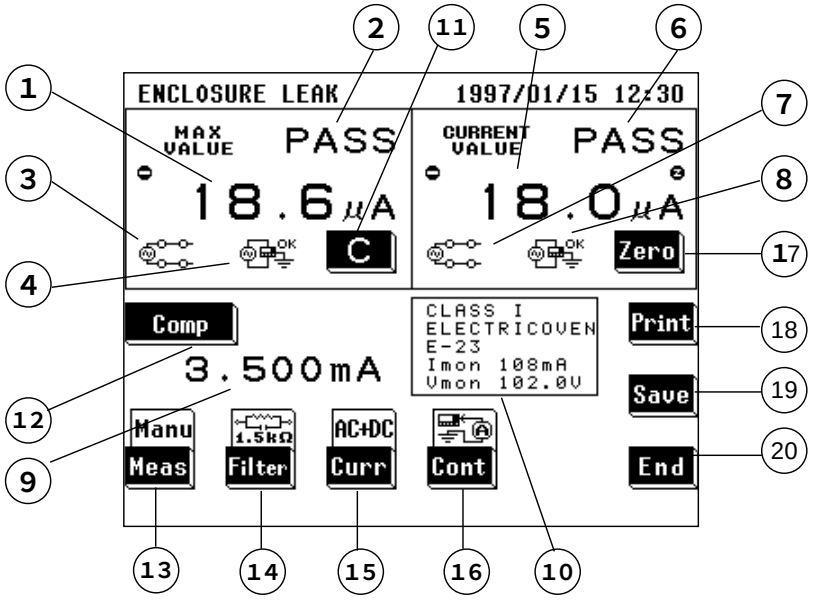
Cont

Ret

Set the contact condition.

7.3.6 Enclosure Leakage Current Measurement Screen (Universal)

Measurements of enclosure leakage current are made on the enclosure leakage current measurement screen.
The current measured value, maximum value, and set-up status are shown on the enclosure leakage current measurement screen.
Further, windows for changing the designations for each measurement can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal operation: Single fault condition (open power lead): Single fault condition (open ground):
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)

⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Setting for the class of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 7.6.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 7.6.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead):  Single fault condition (open ground): 
⑭ Filter	Opens the measurement network set-up window. Select the network.  : Network of 1 kΩ  : Network of 1.5 kΩ and 0.15 μF  : Network of 2 kΩ

⑮ Curr	Opens the measurement current set-up window. Set the measurement current. AC: AC, DC: DC, AC+DC: AC+DC, AC PEAK: AC peak For details, refer to Section 7.6.4, "Measurement Current Setting (Universal)."
⑯ Cont	Opens the contact condition set-up window. Set the contact condition.  : Between the enclosure and the earth  : Between the enclosure and the power line
⑰ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective, ⓩ is displayed on the screen. For details, refer to Section 7.3.4, "Zero Adjustment (Universal - Enclosure Leakage Current)."
⑱ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 7.6.5, "Printing out the Maximum Values."
⑲ Save	Opens the save data window. For details, refer to Section 7.6.6, "Saving the Maximum Values."
⑳ End	Exits the enclosure leakage current measurement, and returns to the initial screen.

7.4 Earth Leakage Current Measurement Mode (Universal)

7.4.1 Earth Leakage Current Measurement Mode

Earth leakage current measurement is performed only when class Ⅰ equipment has been set. When either class Ⅱ or internally powered equipment has been set, the earth leakage current key on the initial screen is non-selectable.
Measurement is possible only when the power cord of the equipment to be measured has been plugged into the auxiliary power socket of the 3155.
The following combinations can be set as well as the measurement network filter and measurement current under the earth leakage current measurement.

Condition of the equipment to be measured		Power source polarity
Normal condition		Normal polarity
		Reverse polarity
Single fault condition	Open power lead	Normal polarity
		Reverse polarity

NOTE

- The standards to which the measurement network D conforms do not require earth leakage current measurements. However, although the measurement network for medical electrical equipment differs, making measurements at regular intervals as well as for medical electrical equipment is useful for maintaining your equipment.
- By using the automatic measurement mode, it is possible to measure changing automatically the power source polarity and condition of the equipment to be measured, and obtain the maximum value of the combination. For details, refer to Section 7.6.3, "Automatic Measurement Setting."

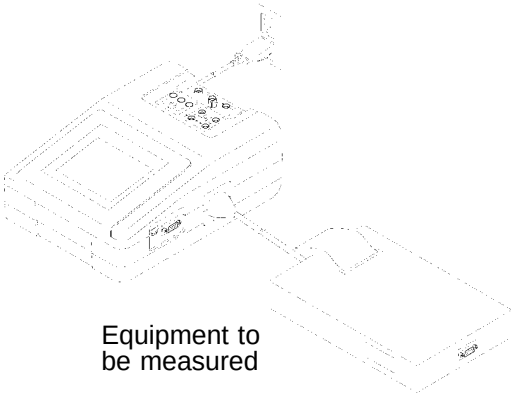
7.4.2 Connecting Equipment for Earth Leakage Current Measurement (Universal)

⚠ CAUTION

- The maximum current that can be input into the leakage current measurement terminals of the 3155 is 25 mA (AC+DC). The input of any larger current will cause the beeper to sound (when the beeper is turned on), after which continued input may cause the fuse in the measurement network to fail. In this case, input must be terminated immediately.
  Afterwards, a fuse check is performed automatically upon returning to the initial screen from the leakage current measurement mode. Therefore, do not connect anything to leakage current measurement terminal T1. (If anything is connected, the display may show "Measurement Network Fuse blown.")
- The rated capacity of the auxiliary power socket is 1500 VA or less. If this capacity is exceeded, the auxiliary power outlet circuit breaker will actuate, and the power supply to the equipment to be measured will be cut off. (With the 3155-01, the main power switch is turned off.)
- When power of the equipment to be measured exceeds 1500VA, make the connection directly to the outlet; do not use the auxiliary power socket. (When measuring class Ⅰ equipment, connect the protective earth conductor of the equipment to be measured to the G terminal of the 3155.)
  In this case, the power source polarity and the condition of the equipment to be measured cannot be set on the 3155.

NOTE

When measuring earth leakage current (for class Ⅰ equipment only), do not make any connections to the leakage current measurement terminals. The measurement network is connected via internal wiring. Plug the power cord of the equipment to be measured into the auxiliary power socket found on the right side of the 3155.



NOTE

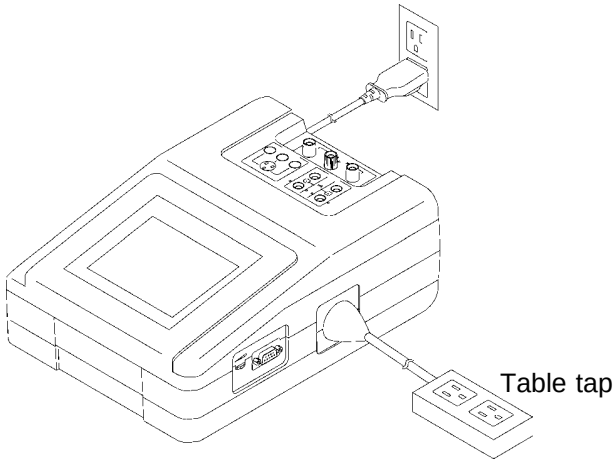
- When the auxiliary power socket does not fit the power plug of the equipment to be measured, use the supplied power plug.
- When testing class 0I or other older models, use (UL1015, AWG #18 or equivalent) wire to connect the G terminal with the protective earth terminal of the equipment to be measured.

7.4.3 Zero Adjustment (Earth Leakage Current)

In cases where the extension cable (power socket conversion cable, table tap, etc.) is connected to the auxiliary power socket when making a measurement, the measured value may be subject to leakage current of the extension cable. In which case, to obtain an accurate measurement, perform zero adjustment before measuring.
Value of leakage current in the extension cable to be offset by zero adjustment varies depending on if voltage is applied or not. Zero adjustment is performed in the condition that voltage is applied.
Value determined by zero adjustment is saved after power is turned off. It is effective unless changing supply voltage and/or the extension cable.

Zero Adjustment

1. Display the earth leakage current measurement screen.
2. Connect the extension cable to the auxiliary power socket. In this case, do not connect the equipment to be measured to the extension cable.
3. Press the Zero key on the screen to perform zero adjustment. When zero adjustment is finished, ⓩ is displayed on the measuring mode screen, and indicates that zero adjustment is effective. Press the Zero key again, and zero adjustment is cancelled, the normal measured value returns and ⓩ disappears.



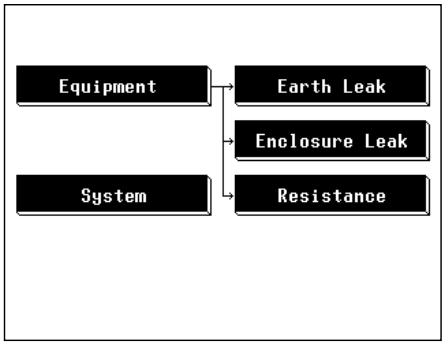
NOTE

In all equipment to be measured, zero adjustment defaults to the combination of normal condition with normal polarity and switches back to previous condition and polarity of the equipment to be measured.
During manual measurement, condition and polarity settings may cause zero adjustment value to fail to set to zero.

7.4.4 Basic Settings for Earth Leakage Current Measurement (Universal)

This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 7.4.2, "Connecting Equipment for Earth Leakage Current Measurement."

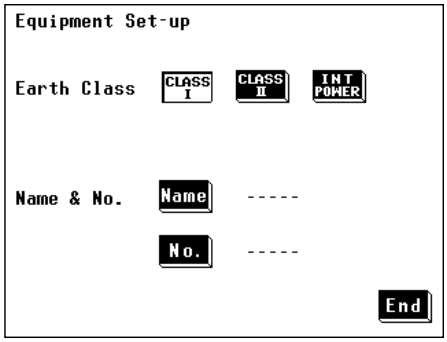
Initial screen



Equipment

End

Equipment set-up screen

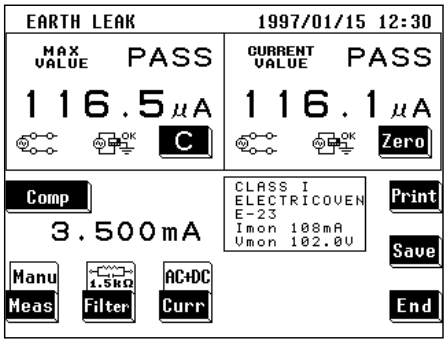


Set the grounding class of the equipment to be measured to class I.

Earth Leak

End

Earth leakage current measurement mode screen

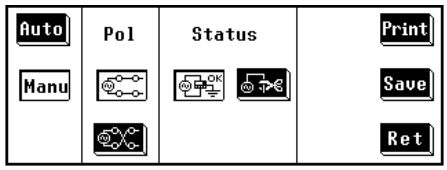


Measurement starts automatically.

Meas

Ret

Polarity and equipment condition set-up window

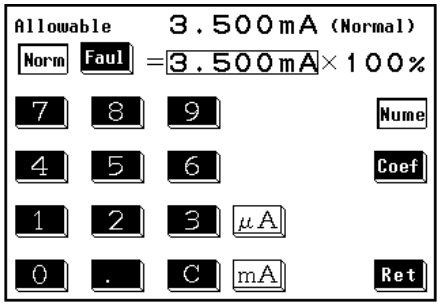


Select and press the keys for the power source polarity and equipment to be measured to set.
Measurement continues even while the window is open.
For automatic measurement, refer to Section 7.6.3, "Automatic Measurement Setting."

Comp

Ret

Allowable value set-up window

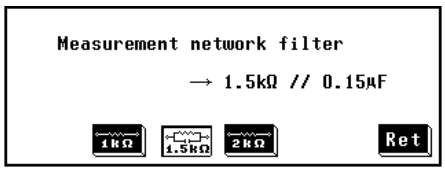


Set the allowable value referring to Section 7.6.1, "Allowable Value Setting."
(For enabling or disabling the allowable value judgment, refer to Section 7.7.4, "Allowable Value Judgment Set-up Screen.")

Filter

Ret

Measurement network filter set-up window

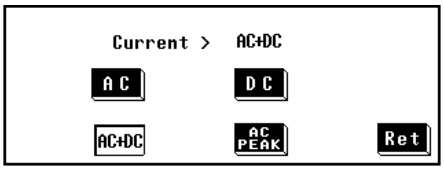


Set the filter.

Curr

Ret

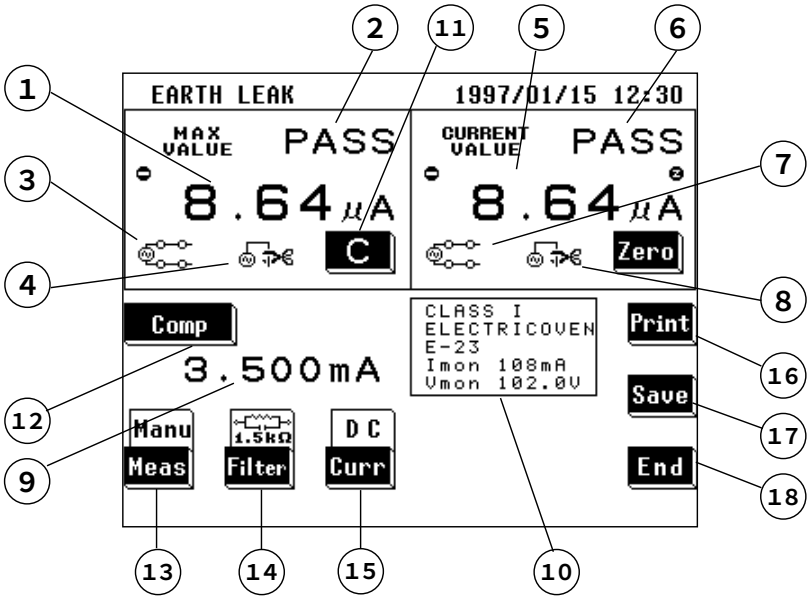
Measurement current set-up window



Set the measurement current.

7.4.5 Earth Leakage Current Measurement Screen (Universal)

Measurement of earth leakage current is made on the earth leakage current measurement screen.
The current measured value, maximum value, and setting condition are shown on the earth leakage current measurement screen.
Further, windows for changing the measurement settings can be opened from this screen.



(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)
② Maximum value judgment	Result of comparison of the maximum value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Power source polarity for the maximum value	Connection with the power source Normal: , Reverse:
④ Condition of the equipment to be measured for the maximum value	Condition of the equipment to be measured Normal operation: Single fault condition (open power lead):
⑤ Current value	Value obtained from the current measurement In cases where the measurement current is DC, and a minus value is measured, ⊖ is displayed. (When this value is 1 μA or lower, "UNDER 1 μA" is displayed.)

⑥ Current value judgment	Result of comparison of the current value with the allowable value (In cases where the measurement current is DC, an absolute value.) PASS: Allowable value or lower FAIL: Higher than the allowable value
⑦ Power source polarity for the current value	Connection with the power source Normal:  , Reverse: 
⑧ Condition of the equipment to be measured for the current value	Condition of the equipment to be measured Normal condition:  Single fault condition (open power lead): 
⑨ Allowable value	Current setting of the allowable value in normal condition or single fault condition
⑩ Setting display for the equipment to be measured	The following parameters are displayed: Setting for the class of the equipment to be measured Model name, Number, Current consumption monitor value, Line voltage monitor value

(2) Settings

Key	Description of the function
⑪ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode.
⑫ Comp	Opens the allowable value set-up window. Two allowable values in normal condition and single fault condition can be set. Range of the allowable values: 5 μA to 20 mA For details, refer to Section 7.6.1, "Allowable Value Setting."
⑬ Meas	Opens the polarity and equipment condition set-up window. 1. Select either the Manu or Auto mode. For automatic measurement, refer to Section 7.6.3, "Automatic Measurement Setting." 2. When in the manual mode, in addition to making measurements while changing the polarity and condition of the equipment to be measured, the maximum value data can be printed out or saved. Power source polarity selection: NORMAL:  , REVERSE:  Condition of the equipment to be measured: Normal condition:  Single fault condition (open power lead): 
⑭ Filter	Opens the measurement network set-up window. Select the network.  : Network of 1 kΩ  : Network of 1.5 kΩ and 0.15 μF  : Network of 2 kΩ
⑮ Curr	Opens the measurement current set-up window. Set the measurement current. AC: AC, DC: DC, AC+DC: AC+DC, AC PEAK: AC peak For details, refer to Section 7.6.4, "Measurement Current Setting (Universal)."

⑯ Zero	Zero adjustment function Press this key to perform zero adjustment before measuring. When zero adjustment is effective, ⓩ is displayed on the screen. For details, refer to Section 7.4.3, "Zero Adjustment (Universal - Earth Leakage Current)."
⑰ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 7.6.5, "Printing out the Maximum Values."
⑱ Save	Opens the save data window. For details, refer to Section 7.6.6, "Saving the Maximum Values."
⑲ End	Exits the earth leakage current measurement, and returns to the initial screen.

7.5 Low Resistance Measurement Mode (Universal)

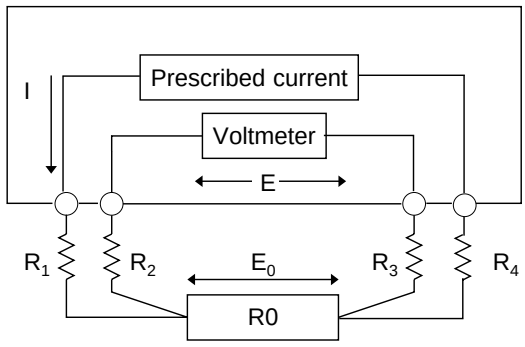
7.5.1 Low Resistance Measurement Mode

The 3155 makes low resistance measurement simply using the DC four-terminal method (at 100 mADC max.).
This measurement is made for Class Ⅰ equipment only.
Measurement is made by touching either the optional 9461 PIN-TYPE LEADS or 9287 CLIP-TYPE LEADS to the test point. Measurement is also possible using RS-232C interfacing with the 3157 AC GROUNDING HiTESTER (max. 31A AC, conforming to various standards), available separately.

Four-terminal method

When measuring low levels of resistance, ordinarily the resistance of the measuring lead and the connector are included, which results in errors. By using the four-terminal method, this error can be eliminated.
The resistance measuring circuit measures the drop in voltage at the prescribed current, and calculates the resistance. As shown in the figure, however, the input resistance at the voltmeter is extremely high, and all of current I flows into the measured resistance R_0. Therefore the drop in voltage from R_2 to R_3 becomes 0, the voltage E and the voltage drop E_0 at both ends of the measured resistance R_0 become equal, and the resistance is measured without the influence of R_1 to R_4.
(R1 to R4 indicate the measuring lead and connector resistance.)

Resistance measuring circuit



R1 to R4 are the measuring lead and connector resistance.

7.5.2 Connecting Equipment for Low Resistance Measurement (Universal)

⚠ WARNING **Do not input a voltage exceeding 30 Vrms, 42.4 Vpeak or 50 VDC between the resistance measurement terminals, and between the resistance measurement terminal and the ground.**

⚠ CAUTION

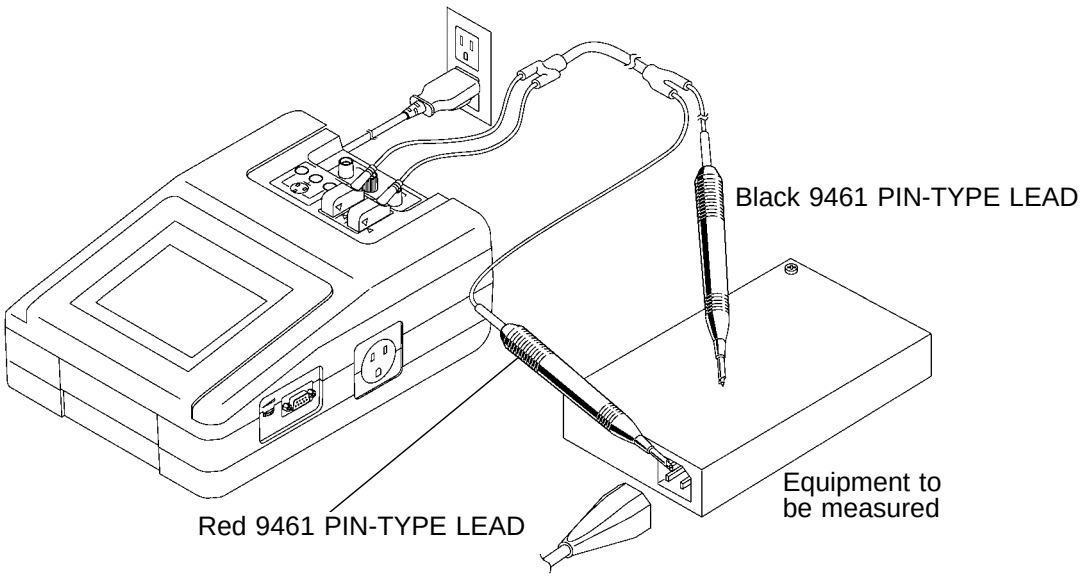
- Be careful not to hurt yourself on the end of the 9461 PIN-TYPE LEAD, which is pointed.
- Do not connect anything other than the 9461 PIN-TYPE LEAD and the 9287 CLIP-TYPE LEAD to the resistance measurement terminal.

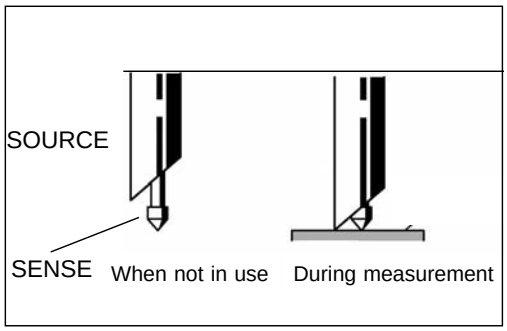
NOTE Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.

(1) When using 9461 PIN-TYPE LEADS

The 9461 PIN-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.

Touch the pin-type leads between the protective earth terminal or earth contact and the part required to be earthed.



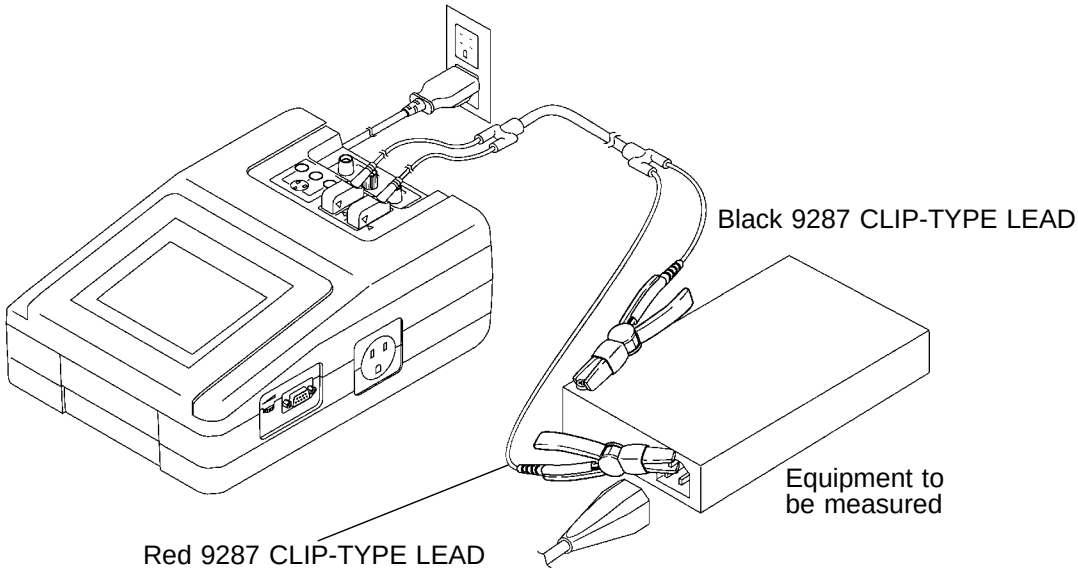


NOTE

As shown in the figure, the 9461 PIN-TYPE LEAD has a SENSE sheathed by the SOURCE. When touched to the equipment to be measured, both the SENSE and the SOURCE must be in contact with the equipment to be measured.

(2) When using the 9287 CLIP-TYPE LEADS

The 9287 CLIP-TYPE LEADS are connected as shown in the figure. Connect to all four terminals.
Do not connect anything to the auxiliary power outlet of the 3155.
Touch the clip-type leads between the protective earth terminal or earth contact and the part required to be earthed.



(3) When using 3157 AC GROUNDING HiTESTER

⚠ CAUTION

- Do not make measurements if the power cord of the equipment to be measured is plugged into the auxiliary power outlet of the 3155.
- Do not touch the equipment to be measured until measurement is complete.

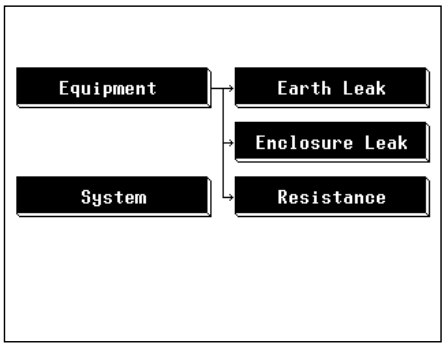
When measuring in low resistance measurement mode using optional 3157 AC GROUNDING HiTESTER, using the RS-232C interface enable the 3155 to control the 3157. For usage, connection and communication settings for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.

1. Leave power OFF for both 3155 and 3157 while connecting each RS-232C connector with the RS-232C cable. For connection with the RS-232C connector, see Section 8.4, "Connecting Method."
2. Turn the power ON for both 3155 and 3157. Connect 3157 with equipment to be measured. The 3155 allowable value and measuring points apply to 3157.

7.5.3 Basic Settings for Low Resistance Measurement

This illustrates basic setting and reference categories until measurement. Preparations for measurement follow Section 7.5.2, "Connecting Equipment for Low Resistance Measurement."

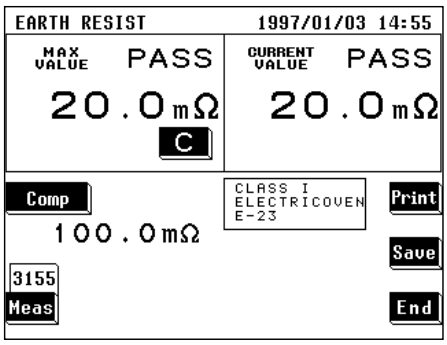
Initial screen



Resistance

End

Low resistance measurement mode screen

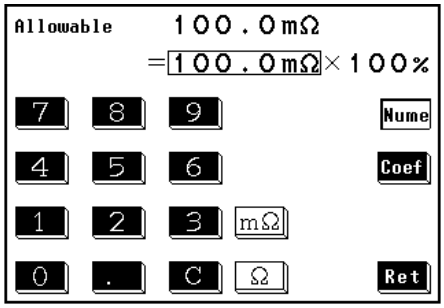


Measurement starts automatically. When measuring with 3157 measuring equipment settings, measurement is executed on measurement window.

Comp

Ret

Allowable value set-up window



Set the allowable value referring to Section 7.6.2, "Allowable Value Setting." (For enabling or disabling the allowable value judgment, refer to Section 7.7.4, "Allowable Value Judgment Set-up Screen.")

Meas

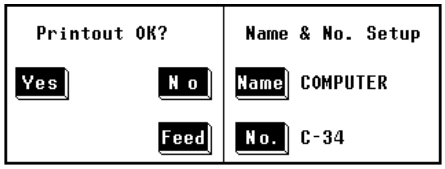
Print

After printing

Ret

Ret

Print-out window



For a detailed set-up procedure, refer to Section 7.6.5, "Printing out the Maximum values."
For saving, refer to Section 7.6.6, "Saving the Maximum Values."

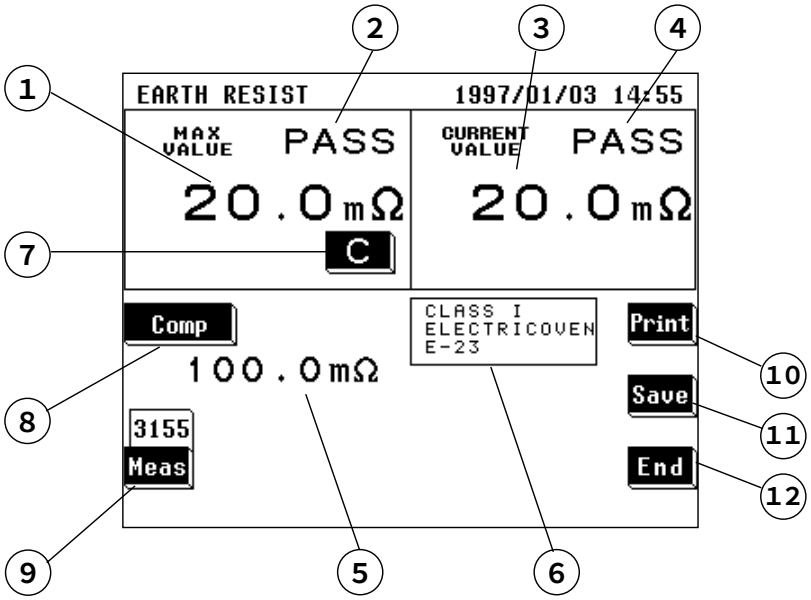
Measurement window

When measuring with 3157 measuring equipment settings, allowable value set-up window cannot be selected. Measuring defaults to 3157 allowable value (at maximum test value).

7.5.4 Low Resistance Measurement Screen

With 3155 measuring equipment settings selected on low resistance measurement screen, measurement starts immediately and displays current value.

When measuring with 3157 measuring equipment settings, measurement does not start until pressing the Yes key.



* Screen: for ME equipment

(1) Setting condition display

Parameter	Explanation
① Maximum value	The maximum measured value obtained in the current measuring mode Changing the measuring mode will clear this value. When measuring with 3157 measuring equipment settings, value obtained as measured value is displayed.
② Maximum value judgment	Result of comparison of the maximum value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
③ Current value	Value obtained from the current measurement When measuring with 3157 measuring equipment settings, measured value of 3157 is displayed after data transfer is complete.
④ Current value judgment	Result of comparison of the current value with the allowable value PASS: Allowable value or lower FAIL: Higher than the allowable value
⑤ Allowable value	Current setting of the allowable value
⑥ Setting display for the equipment to be measured	The following parameters are displayed: Settings of the equipment to be measured Model name Number

(2) Settings

Key	Description of the function
⑦ C (Clear the maximum value)	Use as necessary to clear unnecessary data and start new measurements. As long as this key is not pressed, the maximum value is not cleared even after changing measurement settings in the same measuring mode. The maximum value is cleared after changing the measuring mode. When measuring with 3157 measuring equipment settings, measuring starts by pressing the Yes key and clears maximum value.
⑧ Comp	Opens the allowable value set-up window. Range of the allowable value: 10 mΩ to 500 Ω When measuring with 3157 measuring equipment settings, allowable value is determined by 3157 and allowable value set-up window cannot be selected. When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157. For details, refer to Section 7.6.2, "Allowable Value Setting."
⑨ Meas	Opens measurement window. 1. Choose 3155 or 3157 for measuring. 2. When measuring with 3157 measuring equipment settings, measurement starts immediately. When measuring with 3157 measuring equipment settings, measurement and data transfer status are displayed. Yes: Measurement begins. For details, refer to Section 7.6.7, "Low Resistance Measurement with 3157."
⑩ Print	Opens the print-out window. Prints out the maximum value displayed on the screen. For details, refer to Section 7.6.5, "Printing out the Maximum Values."
⑪ Save	Opens the save data window. For details, refer to Section 7.6.6, "Saving the Maximum Values."
⑫ End	Exits the low resistance measurement, and returns to the initial screen.

NOTE

- When the maximum value and measured value overflow, "------" will be displayed. Moreover, no judgment can be made in this case.
- When measuring with 3157 measuring equipment settings, "------" will be displayed until data transfer is complete normally. Moreover, no judgment can be made in this case.

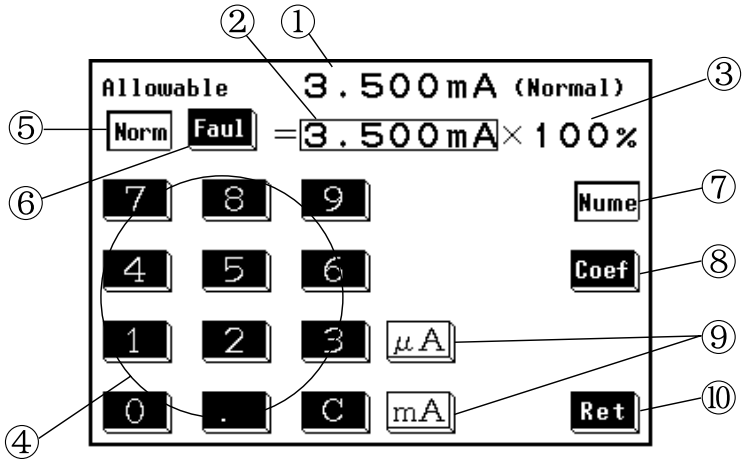
7.6 Condition Set-up Window Setting (Universal)

7.6.1 Allowable Value Setting (For Leakage Current Measurement)

The allowable value setting may be revised as necessary to accommodate the standards.
The 3155 can set two allowable values in normal condition and single fault condition.
When shipped, the settings are 3.5 mA.

Settings

(1) On the measuring mode screen, press the Comp key to open the allowable value set-up window.



Screen during input
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 5 μA to 20 mA

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Normal: Press to set the allowable value in normal condition
⑥ Fault: Press to set the allowable value in single fault condition
⑦ Numerals: Press to input numerals
⑧ Coefficient: Press to input coefficient
⑨ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑩ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 5 μA is input, the value is automatically revised to 5 μA. If a value of more than 20 mA is input, the value is automatically revised to 20 mA.

(2) Press the normal or fault key to select the desired allowable value.
(3) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.

(4) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.

(5) After making the setting, press the Ret key to close the allowable value set-up window.

(6) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

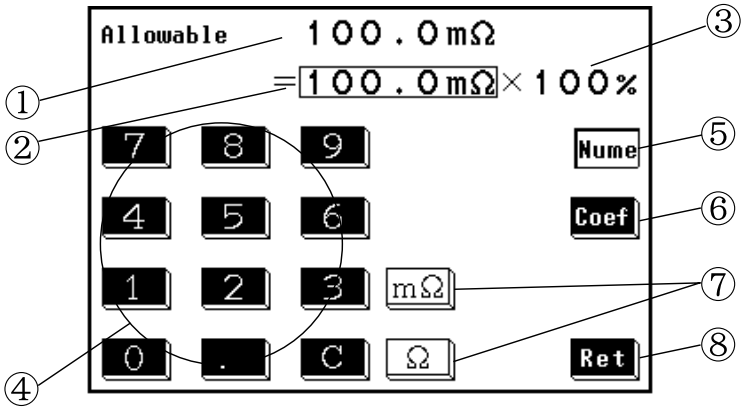
- To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.
  If the screen is changed before the unit is finalized, the setting is not revised.
- The maximum value is cleared after the setting is revised.
- The numeral is initialized but the coefficient is not after the settings on the equipment set-up screen are changed.

7.6.2 Allowable Value Setting (For Low Resistance Measurement)

Low resistance measurement is performed only for grounding class Ⅰ equipment. The allowable value setting may be revised as necessary. When shipped, 100 mΩ is set.

Settings

(1) On the measuring mode screen, press the Comp key to open the allowable value set-up window.



Screen during input
(Numerals are displayed in the input cell.)
Set value = numeral × coefficient
Range: 10 mΩ to 500 Ω

① Current setting
② Input numeral
③ Input coefficient
④ Keys for numerical input
⑤ Numerals: Press to input numerals
⑥ Coefficient: Press to input coefficient
⑦ Units: Highlighted in white during numerical input. Press after numerical input to finalize units.
⑧ Return: Press to close the allowable value set-up window.

NOTE

If a value of less than 10 mΩ is input, the value is automatically revised to 10 mΩ. If a value of more than 500 Ω is input, the value is automatically revised to 500 Ω.

(2) Using the numerical keys, input the desired value. (After pressing the numerals key) Press the C key to clear mistakes.

(3) After the numeric value is input correctly, press either unit key to finalize the input. If the screen is changed before the unit is finalized, the setting is not revised. The unit keys are inoperative until a numeral has been input.

(4) After making the setting, press the Ret key to close the allowable value set-up window.

(5) The allowable value judgment can be turned ON or OFF on the allowable value judgment set-up screen of the system screen. If set to OFF, the allowable values are not displayed on the measuring mode screen.

NOTE

To apply a coefficient to a value that is already input, press the Coef key, and input the coefficient with the numeric keys. Next, press the % key to finalize the setting.

If the screen is changed before the unit is finalized, the setting is not revised. The maximum value is cleared after the setting is revised.

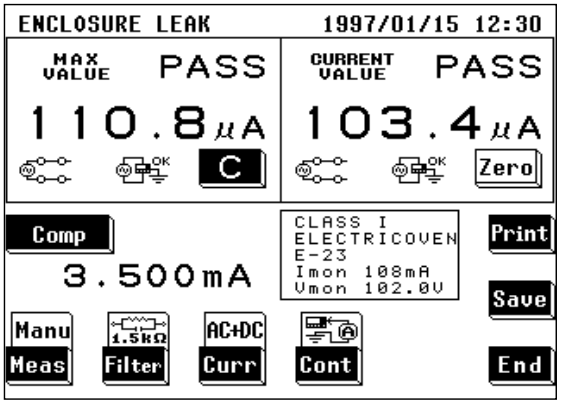
7.6.3 Automatic Measurement Setting (Universal)

In each of the leakage current measurement modes, automatic measurement can be performed, in which the polarity and condition of the equipment to be measured are automatically changed. The combinations shown below are all set, and the maximum value of each combination is measured.
After measurement, the results will be displayed on the automatic measurement result screen. Printing and saving are possible on this screen.

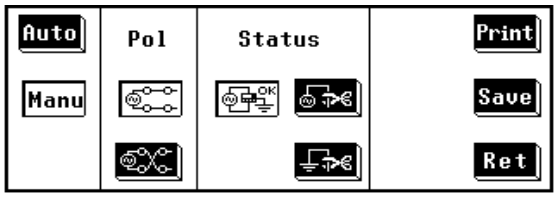
(1) Power source polarity (Normal and reverse)

(2) Condition of the equipment to be measured
① Normal condition
② Single fault condition (Open power lead, open ground)

Settings

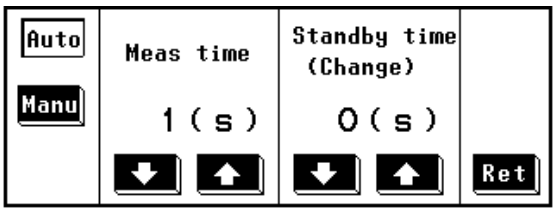


(1) On the leakage current measurement mode screen, press the Meas key to open the polarity and equipment condition set-up window. Measurement continues even when this window is open.



(2) Press the key for the desired measurement method.
1. Manu: Sets the measurement method to manual.
2. Auto: Sets the measurement method to automatic.

After pressing the automatic key, the measuring time and standby time set-up window opens.

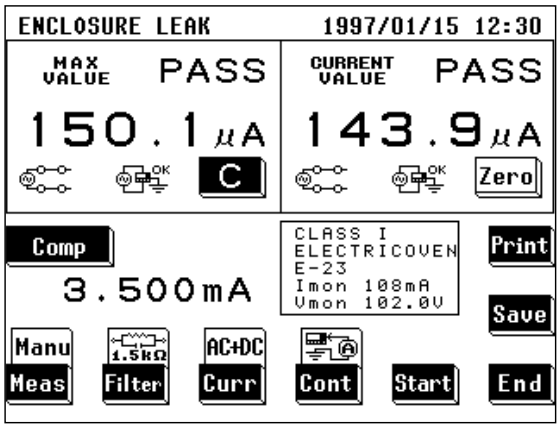


(3) Set the measuring and standby times.
Use the ▲ and ▼ keys to make the settings as desired.
(4) Press the Ret key to close the measuring time and standby time set-up window.

Range	Standby time: 0 to 99 seconds Measuring time: 1 to 99 seconds

NOTE

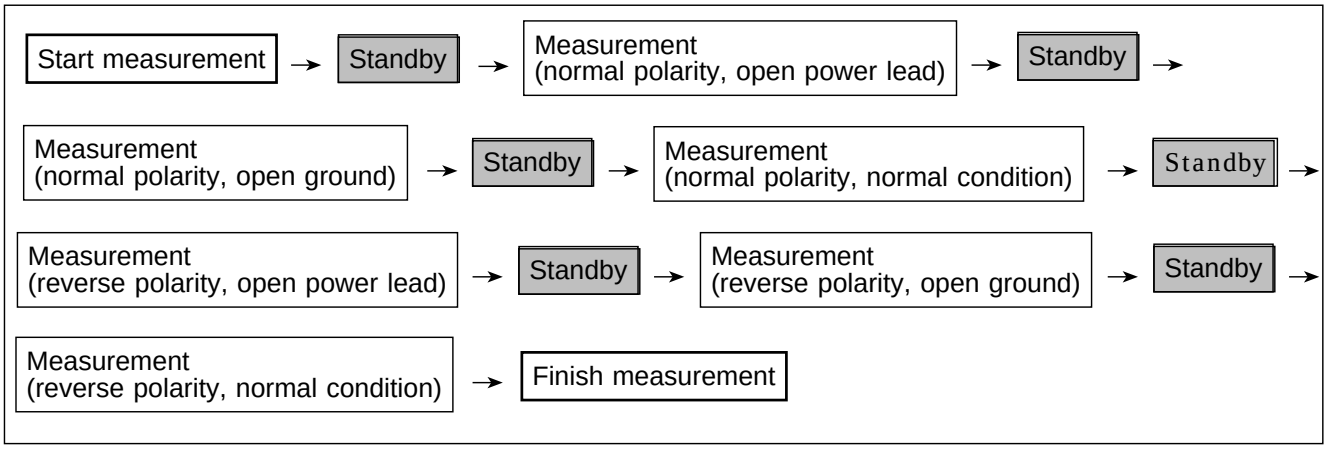
The equipment to be measured may take time to stabilize after changing the polarity and equipment condition. Set the standby time considering this time.



(5) On the measuring mode screen, press the Start key to start automatic measurement. When the measurement of a particular condition is finished, if it exceeds the current maximum value, the maximum value is revised to the new value. During measurements, the Stop key is displayed. Press the Stop key to interrupt the measuring process. After the measurements have been completed, the Start key is displayed.
During the measuring time, the beeper sounds.

(6) After the measurements have been completed, the automatic measurement result screen opens.

Example: Enclosure leakage current measurement



NOTE

Automatic measurements are carried out in the following order:
Polarity: normal, then reverse
Status: open power lead, open ground, normal condition
A part of the single fault condition is omitted according to the grounding class setting.

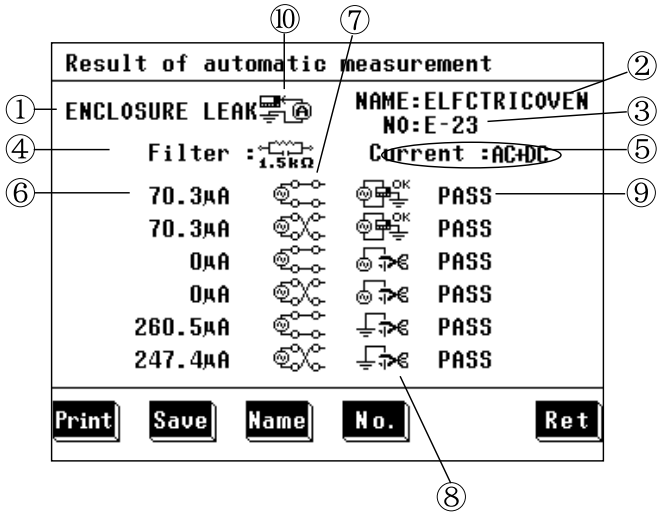
Categories to be set prior to automatic measurement

- Filters for all the measuring modes
- Contact condition
- Measurement current

It is necessary to have set the above categories manually prior to performing automatic measurement.

Automatic measurement result screen

After the automatic measurements have been completed, the automatic measurement result screen is displayed.



① Measuring mode
② Model name
③ Number
④ Measurement network filter setting
⑤ Measurement current
⑥ Maximum value
⑦ Power source polarity
⑧ Condition of the quipment to be measured
⑨ Judgment
⑩ Contact condition

Print: Print all the automatic measurement results.

Save: Save all the automatic measurement results.

Name: Display the model name input screen.

No.: Display the number input screen.

Ret: Return to the measuring mode screen.

NOTE

If returning to the measurement screen without first either saving or printing out the current data, that data will be lost.

(1) Printing the automatic measurement results

Press the **Print** key on the automatic measurement result screen to print all the automatic measurement results.
Press the **Yes** key to print. Press the **No** key to disable printing.
During printing, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing.
After printing, press the **Ret** key.

(2) Saving the automatic measurement results

Press the **Save** key on the automatic measurement result screen to save all the automatic measurement results.
Press the **Yes** key to save. Press the **No** key to disable saving.
If data with the same model name and number already exists, a request for confirmation appears.

(3) Changing the model name and number

For details, refer to Section 7.2.2, "Equipment Set-up Screen (Universal)."

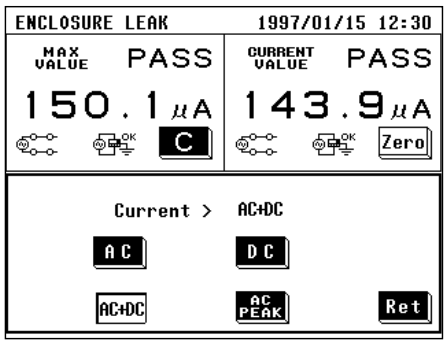
Example of the automatic measurement results printout

Printout of the automatic measurements in the enclosure leakage current

```
--------------------
Date:1998/08/26
Name:ELECTRICOVEN
No. :E-23
Stat:ClassI
Comment:

ENCLOSURE LEAKAGE:
 Filter     1.5kΩ
 Current    AC+DC
 Contact    B-E

  UNDER 1μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  OK

  UNDER 1μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  OK

  UNDER 1μA
 Judgment   PASS
 Polarity   Normal
 Powerline  Cut
 Earthline  OK

  UNDER 1μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  Cut
 Earthline  OK

  371.1μA
 Judgment   PASS
 Polarity   Normal
 Powerline  OK
 Earthline  Cut

  385.4μA
 Judgment   PASS
 Polarity   Reverse
 Powerline  OK
 Earthline  Cut
--------------------
```

7.6.4 Measurement Current Setting (Universal)

This is where the measurement current is set.



Settings

(1) Press the Curr key on the leakage current measurement mode screen to open the measurement current set-up window.
Measurement continues even when this window is open.

(2) On the measurement current set-up window, press the key for the type of current you wish to use.

AC: AC rms

DC: DC

AC+DC: AC+DC rms

AC PEAK: AC peak

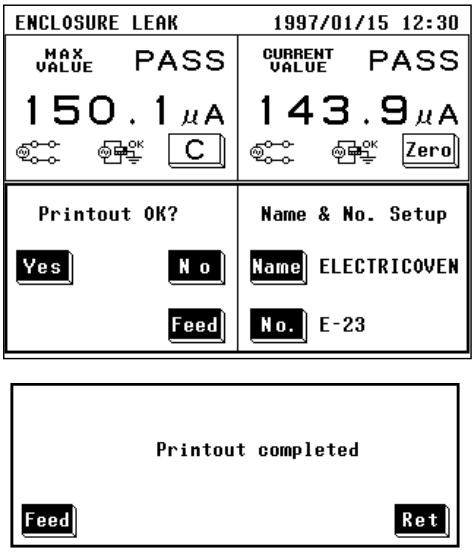
(3) Press the Ret key to close the measurement current set-up window.

7.6.5 Printing out the Maximum Values (Universal)

The printer can be used to print out the maximum values and measurement settings for each measuring mode. When printing out the maximum values, the model name and number registered on the equipment set-up screen can be changed.
Once registered, these items will be included with the maximum values for each printout, unless changed. The registration of the model name and number input on the printout window is common to the save data window as well. When saving data, the model name and number are saved as well.

NOTE

- In cases where you wish to print out for the measurement settings (the power source polarity, condition of the equipment to be measured, etc) for each measuring mode individually, clear the maximum values each time, and make the measurements before printing out.
- For changing the model name and number, refer to Section 7.2.2, "Equipment Set-up Screen."

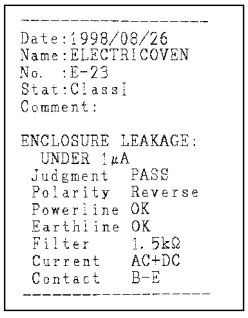


Settings

(1) On the measuring mode screen, press the **Print** key.

(2) At the bottom of the screen, the printout window will open.
Press the **Yes** key to print out the maximum values on the built-in printer.
Press the **No** key to close the printout window without printing out.
Press the **Feed** key to feed paper to the printer.
During printing out, the **Stop** key is displayed on the screen. Press the **Stop** key to stop printing out.

(3) Once the "Printout completed" message appears on the screen, press the **Ret** key to close the printout window.
Press the **Feed** key to feed paper to the printer. If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.



Example of a printout of the maximum value in the enclosure leakage current

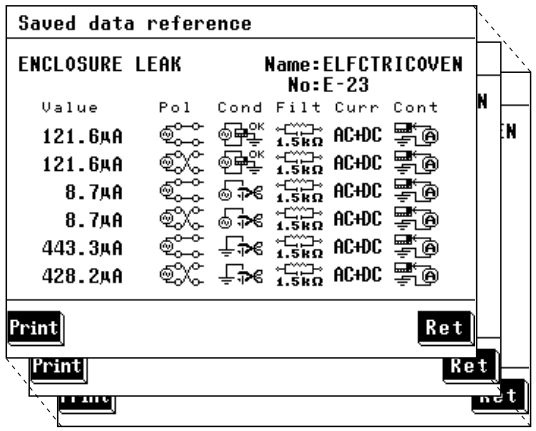
Example of a maximum value printout (universal)
The printer can be used to print out the registered model name and number, as well as the maximum value and measurement settings for each of the measuring modes. The comment space is used for a memo.

7.6.6 Saving the Maximum Values (Universal)

The maximum values are saved with the model name and number registered on the equipment set-up screen. The power source polarity, condition of the equipment to be measured, etc. during measurement are also saved.
When saving the maximum values, the model name and number can be changed.
The saved data units can be viewed on the saved data reference screen of the system screen. For details, refer to Section 7.7.2, "Saved Data reference Screen."

Data save format

The maximum values with the same model name and number are saved in a data unit.
The maximum values in each measuring mode can be saved in a data unit.
Up to 100 individual data units can be recorded. However, up to 2000 data (maximum values) can be recorded.



Measuring mode
- Earth leakage current
- Enclosure leakage current
- Low resistance measurement

×

Power source polarity
- Normal polarity
- Reverse polarity

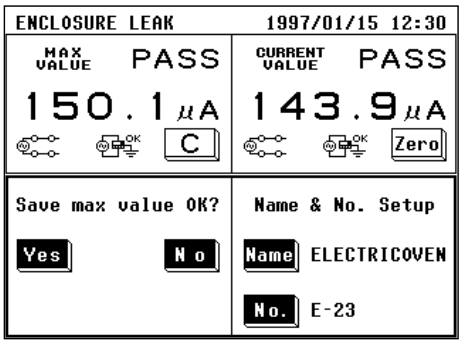
×

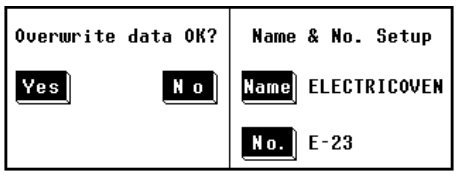
Condition of the equipment to be measured
- Normal condition
- Single fault condition (Interruption of one supply conductor)
- Single fault condition (Interruption of a protective earth conductor)

- There is no single fault condition (interruption of a protective earth conductor) for earth leakage current.
- There are no power source polarity and condition of the equipment to be measured for low resistance measurement.
- A part of the condition of the equipment to be measured is omitted depending on the settings of the grounding class of the equipment to be measured.
- In the following cases, model name and number must be changed for storage as a different data unit.
  - When the measurement network filter setting is changed.
  - When the measurement current setting is changed.
  - When the contact condition setting is changed in enclosure leakage current.

Notes when saving data

- Even if the filter setting, measurement current and contact condition have changed, as long as the registered data unit is the same, the data for that data unit will be overwritten. (after a request for confirmation)
- When saving data manually for each setting condition (power source polarity and condition of the equipment to be measured), clear the maximum value prior to each measurement and save after changing the model name and number. For automatic measurement, refer to Section 7.6.3, Automatic Measurement Setting (Universal)."
- For changing the model name and number, refer to Section 7.2.2, "Equipment Set-up Screen."





Settings

(1) On the measuring mode screen, press the **Save** key.

(2) At the bottom of the screen, the save data window will open.

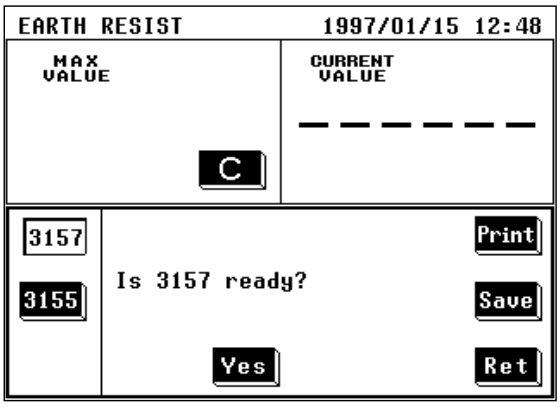
Press the **Yes** key to save the maximum values.
If a data unit with the same name already exists, a request for confirmation appears.

Press the **No** key to close the save data window without saving.

If the **End** key is pressed on the measuring mode screen without first either saving or printing out the current data, that data will be lost.

7.6.7 Low Resistance Measurement with 3157

Low resistance measurement mode allows measurement with optional 3157 AC GROUNDING HiTESTER (maximum 31 AAC, in accordance with multiple standards). Using the RS-232C interface enable the 3155 to control the 3157. Prior to set up, connect 3157 to equipment to be measured and 3157 to 3155 with connection cable. Synchronize 3157 communication settings with 3155. 3157 communication settings are applied when power is turned ON. Set up and configure while power is OFF. See "When using 3157" on the previous page. See also Section 8.5.1, "Communication Conditions Setting."



Settings

(1) On the low resistance measurement mode screen, press the **Meas** key to open the measurement window.

(2) Press the key for the desired measuring equipment.

1. **3155**: Select 3155.
2. **3157**: Select 3157.

When 3157 is selected, the **Yes** key is displayed. Measurement and data transfer status are displayed.

(3) Set up 3157 test settings. Measurement does not start unless the following conditions are met.
1. Test settings
・Unit of the maximum and minimum test values: Resistance
・Test time: ON
・Maximum test value: ON
When the optional minimum test value setting function is ON.
・Minimum test value: OFF
2. Optional function setting
Endless timer function: Not set

(4) Verify 3157 is set to READY. Press the Yes key to start measurement. Automatically 3157 maximum test value is loaded as an allowable value. After measuring, measurement results are displayed. Unless 3157 judgment is either PASS or FAIL (UPPER FAIL), test results are not displayed.

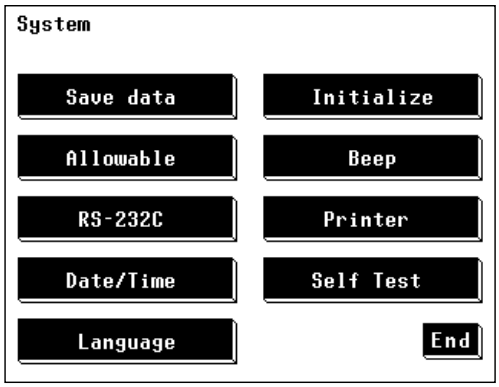
(5) Press the Ret key to close the measurement window.

NOTE

・For usage, connection and communication settings for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual and 9593-02 RS-232C INTERFACE Instruction Manual.
・Measurement cannot be carried out for approximately five seconds after turning the 3157 power ON.
・When the 3157 optional function setting screen is set, measurement cannot be carried out.
・Do not press the Yes key before connecting RS-232C cable and 3157.
・When 3157 maximum test value is set under 0.010 Ω, 3155 allowable value defaults to 0.010 Ω and judgment may differ between 3155 and 3157.
・3157 optional function settings may result in test failure. Make sure to set up as shown below before testing.
1.Momoentary OUT: Not set
2. Test mode: Soft start mode or normal mode
3. Printer output: Not used
・Measurement and data transfer status display
1. "Check the settings.": 3157 settings are improper.
2. "Time out error": Time out error occurred.
3. "Communication error": Data transfer error occurred.

7.7 System Screen (Universal)

7.7.1 System Screen



On the initial screen, press the System key to move to the system screen.

On the system screen, processing of saved data as well as settings for sounds, time and date, and communications, and execution of self-testing can be made.

Save data: Move to the saved data reference screen.
For details, refer to Section 7.7.2, "Saved Data Reference Screen."

Initialize: Move to the initialization screen.
For details, refer to Section 7.7.3, "Initialization Screen."

Allowable: Move to the allowable value judgment set-up screen
For details, refer to Section 7.7.4, "Allowable Value Judgment Set-up Screen."

Beep: Move to the beep sound set-up screen.
For details, refer to Section 7.7.5, "Beep Sound Set-up Screen."

RS-232C: Move to the communications set-up screen.
For details, refer to Section 8.5.1, "Communication Conditions Setting."

Printer: Move to the printer set-up screen.
For details, refer to Section 7.7.7, "Printer Set-up Screen."

Date/Time: Move to the time and date set-up screen.
For details, refer to Section 7.7.8, "Time and Date Set-up Screen."

Self Test: Move to the self-test screen.
For details, refer to Section 7.7.9, "Self-test Screen."

Language: Move to the language set-up screen.
For details, refer to Section 7.7.10, "Language Set-up Screen."

End: Return to the initial screen.

7.7.2 Saved Data Reference Screen (Universal)

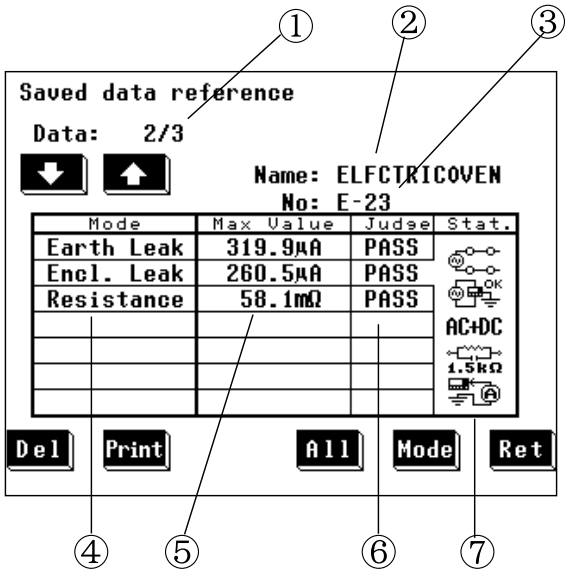
The following is an explanation of how to use the saved data.
Up to 100 data units can be saved. However, up to 2000 data can be saved.
For the model name and number settings, refer to Section 7.2.2, "Equipment Set-up Screen (Universal)."

(1) Settings

1. On the initial screen, press the System key to move to the system screen.
2. On the system screen, press the Save data key to move to the saved data reference screen.

(2) Saved data reference screen display

On the saved data reference screen, saved data can be viewed, deleted or printed out.



In the example shown in the figure, there are a total of three data units, of which the one being displayed is the second. The data shown is for enclosure leakage current measurement.

① Number of current data unit / total number of data units
② Model name
③ Number
④ Measuring modes (up to 3 entries)
Earth Leak: Earth leakage current measurement
Encl. Leak: Enclosure leakage current measurement
Resistance: Low resistance measurement
⑤ Maximum value
⑥ Maximum value judgment
⑦ Condition at time of maximum value judgment
Power source polarity
Condition of the equipment to be measured
Measurement current setting
Measurement network filter setting
Contact condition setting
Measuring equipment in low resistance measurement mode

NOTE When the maximum value is 1 µA or lower, "UNDER 1 µA" is displayed.

(3) Keys

[↓]: Used to select an entry
[↑]: Used to select an entry
[Del]: Delete the data unit for the current entry
[Print]: Print the data unit for the current entry
[All]: Details of the saved data reference screen are displayed.
[Mode]: Select an entry, and display its condition at time of maximum value judgment.
[Ret]: Return to the system screen

Sorting data units

The data unit number is determined by sorting data units by their model names and numbers. First the model name, and then the model number is sorted in the following order: <0, 1, , , 9, A, B, , , Z, ->. If a new data unit is registered, the list is re-sorted.

(4) Printing out saved data

1. On the saved data reference screen, select the data unit to be printed out.
   Use the [↑] and [↓] keys to display the desired data unit.
2. Press the [Print] key to print the data unit.
   Press the [Yes] key to print. Press the [No] key to disable printing.
3. After printing has been completed, press the [Ret] key.

   Repeat steps 1. and 2. as necessary for multiple printouts.

   During printing, the [Stop] key is displayed. Press the [Stop] key to stop printing.

(5) Deleting out saved data

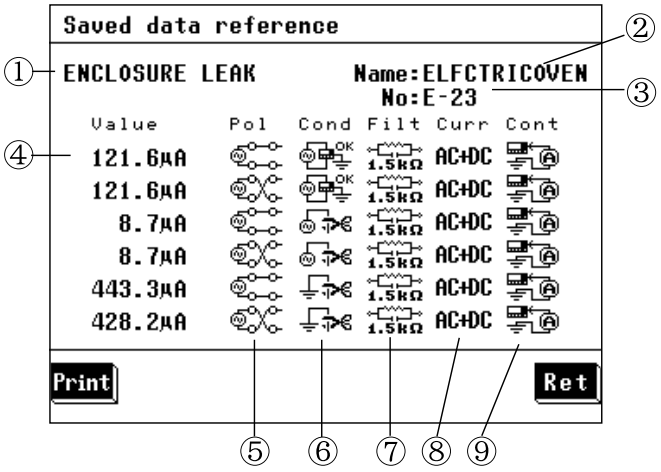
1. On the saved data reference screen, select the data unit to be deleted.
   Use the [↑] and [↓] keys to display the desired data unit.
2. Press the [Del] key to delete the data unit.
   Press the [Yes] key to delete. Press the [No] key to disable deleting.
   Repeat steps 1. and 2. as necessary for multiple deletions.
   For details, refer to Section 7.7.3, "Initialization Screen."
   Erase all the saved data on the initialization screen.

(6) Details of the saved data reference screen

Use the Mode key to select the desired measuring mode for the details to display.

Press the All key to display the details of the saved data for the selected measuring mode.

The maximum values for each combination of the power source polarity and condition of the equipment to be measured are displayed.



Example: Maximum values display for six combinations in the enclosure leakage current measurement mode

① Measuring mode
② Model name
③ Number
④ Maximum value
⑤ Power source polarity
⑥ Condition of the equipment to be measured
⑦ Measurement network filter setting
⑧ Measurement current
⑨ Contact condition

Print: Print out the details (for each combination of the power source polarity and condition of the equipment to be measured)

Press the Yes key to print. Press the No key to disable printing.

During printing, the Stop key is displayed. Press the Stop key to stop printing.

Ret: Return to the saved data reference screen

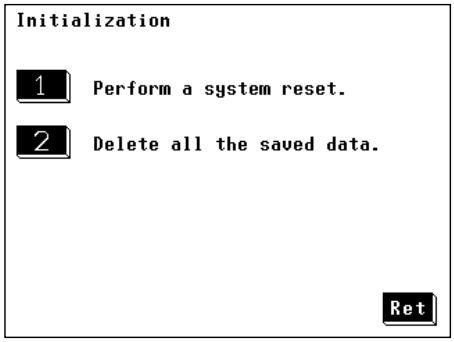
Example of a data unit printout:

```
--------------------
Date:1998/08/26
Name:ELECTRICOVEN
No.  :E-23
Stat:ClassI
Comment:

EARTH LEAKAGE:
  378.9μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Filter    1.5kΩ
 Current   AC+DC
ENCLOSURE LEAKAGE:
  385.4μA
 Judgment  PASS
 Polarity  Reverse
 Powerline OK
 Earthline Cut
 Filter    1.5kΩ
 Current   AC+DC
 Contact   B-E
RESISTANCE:
   1.0mΩ
 Judgment  PASS
--------------------
```

Example of a details printout:

```
--------------------
Date:1998/08/26
Name:ELECTRICOVEN
No.  :E-23
Stat:ClassI
Comment:

ENCLOSURE LEAKAGE:

 UNDER 1μA
Judgment  PASS
Polarity  Normal
Powerline OK
Earthline OK
Filter    1.5kΩ
Current   AC+DC
Contact   B-E

 UNDER 1μA
Judgment  PASS
Polarity  Reverse
Powerline OK
Earthline OK
Filter    1.5kΩ
Current   AC+DC
Contact   B-E

 UNDER 1μA
Judgment  PASS
Polarity  Normal
Powerline Cut
Earthline OK
Filter    1.5kΩ
Current   AC+DC
Contact   B-E

 UNDER 1μA
Judgment  PASS
Polarity  Reverse
Powerline Cut
Earthline OK
Filter    1.5kΩ
Current   AC+DC
Contact   B-E

 371.1μA
Judgment  PASS
Polarity  Normal
Powerline OK
Earthline Cut
Filter    1.5kΩ
Current   AC+DC
Contact   B-E

 385.4μA
Judgment  PASS
Polarity  Reverse
Powerline OK
Earthline Cut
Filter    1.5kΩ
Current   AC+DC
Contact   B-E
--------------------
```

7.7.3 Initialization Screen

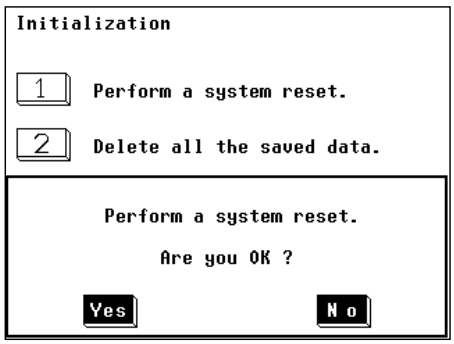


Initialize the 3155.

1: Perform a system reset.
(Delete all the saved data.)

2: Delete all the saved data.

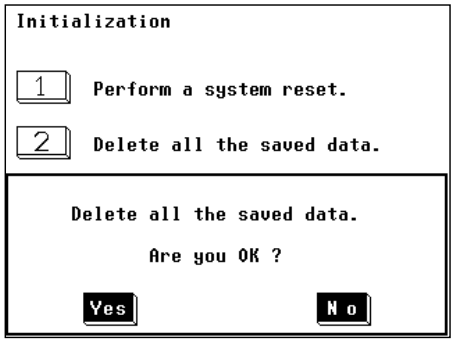
Ret: Return to the system screen.



(1) System reset

Press the 1 key to open the window to confirm a system reset.
Press the Yes key to perform a system reset.
Press the No key and a system reset is not performed.

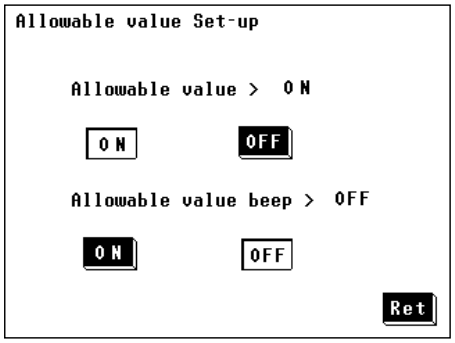
For details of the system reset, refer to Section 10.4, "System Reset."



(2) Deleting all the saved data

Press the 2 key to open the window to confirm that all the saved data are deleted.
Press the Yes key to delete.
Press the No key to disable deleting.

7.7.4 Allowable Value Judgment Set-up Screen



Setting the allowable value judgment (comparison with the maximum value and current value)

ON: Perform the allowable value judgment. If the maximum value and current value are less than or equal to the allowable value, PASS is displayed, if higher than the allowable value, FAIL. Also, the allowable value beep sound setting becomes effective.

OFF: Do not perform the allowable value judgment. The allowable values are not shown on the measuring mode screen.

Setting the beep sound for the allowable value judgment

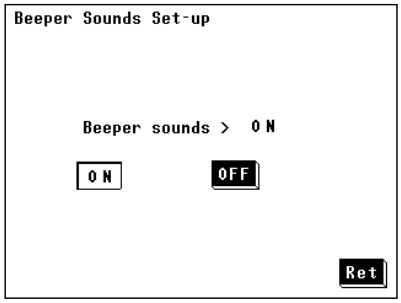
ON: If the allowable value judgment for the maximum value is FAIL, the beep sound is emitted.

OFF: The beep sound is not emitted for the allowable value judgment.

Ret: Return to the system screen.

NOTE If the **C** key is pressed, the beep sound stops.

7.7.5 Beep Sound Set-up Screen



Turn the beeper on or off.

ON: Turn the beeper on

OFF: Turn the beeper off

If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.

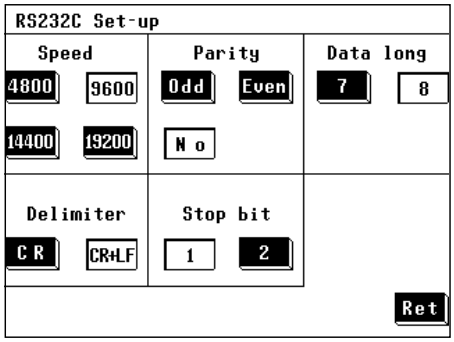
The beep sound is emitted when:

- The power is turned on.
- A key is pressed.
- Making a measurement in the automatic measurement mode.
- An input of 25 mA or more is detected in the leakage current measurement mode.

The beep sound is emitted irrespective of the beep sound setting when:

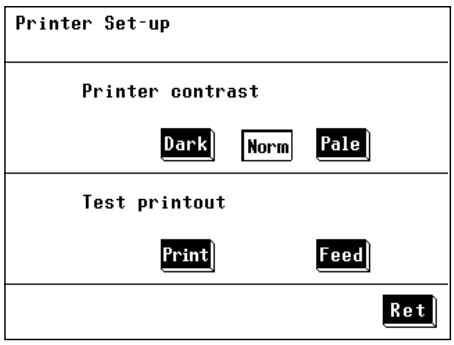
An error has occurred in the RS-232C system.

7.7.6 Communications Set-up Screen



For details, refer to Section 8.5.1, "Communication Conditions Setting."

7.7.7 Printer Set-up Screen



The following is an example of how to adjust the contrast and perform a test printout.
The printer contrast is easily affected by the temperature of the surrounding area.
Adjust the contrast as necessary to produce easy to read printouts.

Printer contrast set-up

Use the following keys to adjust the printer contrast:

Dark: Increase the contrast of the printout.

Norm: The default contrast setting.

Pale: Decrease the contrast of the printout.

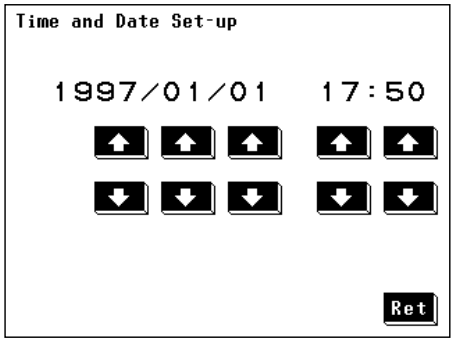
Test printout

Print: Perform a test printout.

Feed: Feed paper to the printer.

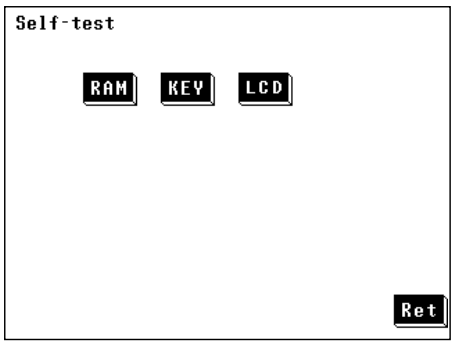
Ret: Return to the system screen.

7.7.8 Time and Date Set-up Screen



Make the time and date settings.
On the time and date set-up screen, press the keys as necessary.
Use the ▲ and ▼ keys found beneath the time and date to set as desired.
The year may be set from 1997 to 2096.
Press the Ret key to finalize the settings.

7.7.9 Self-test Screen



The self-test function is used to check the operation of the 3155 unit.
The following keys are used to perform a variety of tests:

RAM: Test the RAM.

KEY: Test key operation.

LCD: Test the LCD.

Ret: Return to the system screen.

(1) RAM test

Press the RAM key to test the RAM for proper operation.

- If the RAM operates properly, the "RAM TEST OK!" message is displayed.
- If the RAM does not operate properly, the "RAM TEST NG!" message is displayed.
  In this case, contact your dealer or HIOKI representative.

(2) KEY test

Press the KEY key to test the touch panel for proper operation. Each of the 36 different keys are displayed in black on the screen. Press each one to confirm its operation.

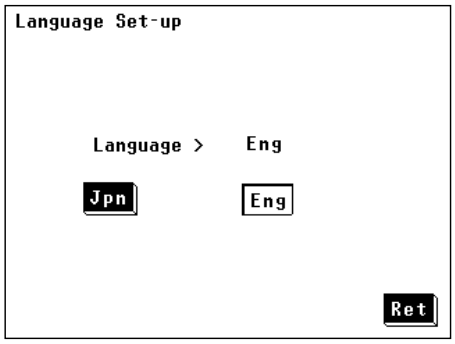
- If all the keys are pressed, the screen returns to the self-test screen.
- If any key fails to change to white, it is malfunctioning. Contact your dealer or HIOKI representative.

(3) LCD test

Press the LCD key to test the LCD for proper operation.
After pressing this key, half the screen is displayed as black and half as white, after which one color changes to the other. If the entire screen is illuminated, then it is operating properly. If there is any section of the screen that is not illuminated, it could indicate an LCD malfunction. Contact your dealer or HIOKI representative.

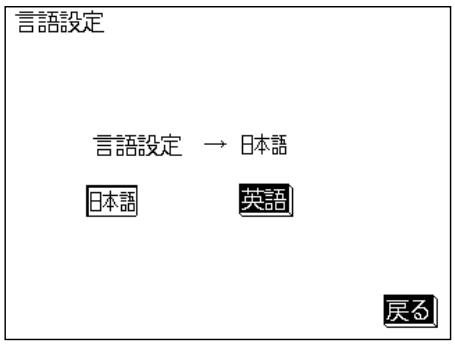
7.7.10 Language Set-up Screen

Set the language displayed on the screen.



(1) English → Japanese

Jpn: Set the display language to Japanese.



(2) Japanese → English

英語: Set the display language to English.

Chapter 8
Command Reference

8.1 Overview

All of the functions of the 3155 main unit , except for powering on and off, controlling the printer, and controlling the 3157, can be controlled via the RS-232C interface.

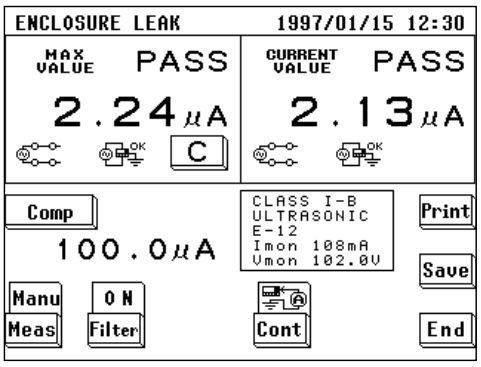
8.2 Specifications

(1) Transfer system Start-stop synchronization, full-duplex
(2) Transfer rate 4800, 9600, 14400, 19200 bits/s
(3) Data length 7 or 8 bits
(4) Parity Even, odd, or none
(5) Stop bits 1 or 2 bits
(6) Delimiter CR, CR+LF
(7) Handshake Hardware
(8) Electrical characteristic

Input voltage levels	+5 V to +15 V -15 V to -5 V	ON OFF
Output voltage levels	+5 V to +9 V -9 V to -5 V	ON OFF

8.3 Names of Parts

(1) Screen during communications

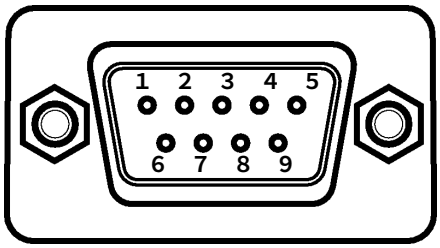


Example:
When performing communications while measuring the enclosure leakage current

During communications, keys on the display changes to non-reversed video. After communications have been finished, the previous screen automatically returns.
If performing communications on the screen other than the measuring mode screen, the initial screen returns.
When a window was opened on the measuring mode screen, the measuring mode screen returns.

(2) RS-232C connector

RS-232C connector pin assignments (D-subminiature 9-pin male)



Signal assignments and explanation

Connector(Dsub) Pin number	Circuit		Description
	RS-232C	CCITT	
①			Unused
②	BB(RxD)	104	Received data
③	BA(TxD)	103	Transmitted data
④	CD(DTR)	108/2	Data terminal ready
⑤	AB(GND)	102	Signal ground
⑥			Unused
⑦	CA(RTS)	105	Request to send
⑧	CB(CTS)	106	Clear to send
⑨			Unused

NOTE The connector on the 3155 is for terminal (DTE). Connect the RS-232C cable.

8.4 Connecting Method

⚠ WARNING **In order to avoid electric shock, turn off the power to all devices before plugging in or unplugging the RS-232C connector.**

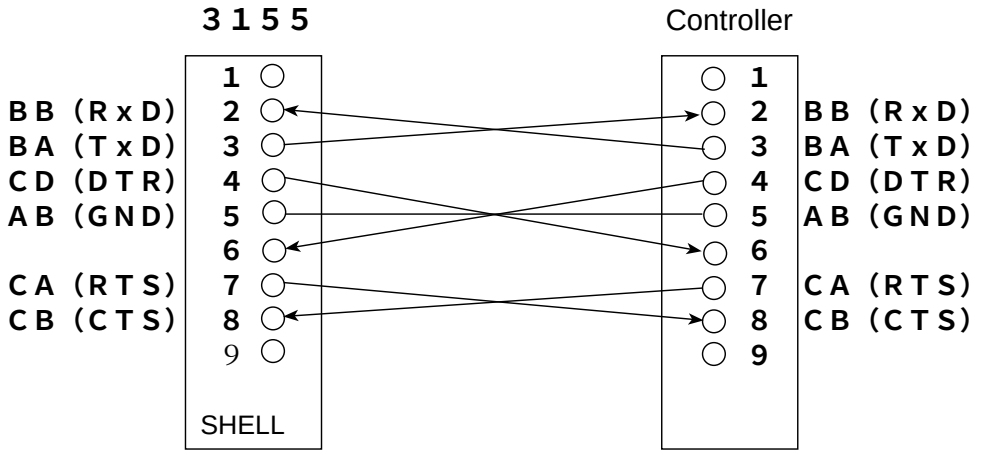
⚠ CAUTION

- To avoid damage to the unit, do not short the connector and do not input voltage to the connector.
- Always fix the screws to connect the RS-232C cable.

When connecting the controller (DTE), use a cross cable which meets the connector specifications of both sides of the 3155 and the controller.

(1) Commands that contain data must be input in the specified data format.
(2) Refer to Chapters 5 to 7 for details about the various functions.

Example:
When connecting to the controller using a D-submiature 9-pin connector



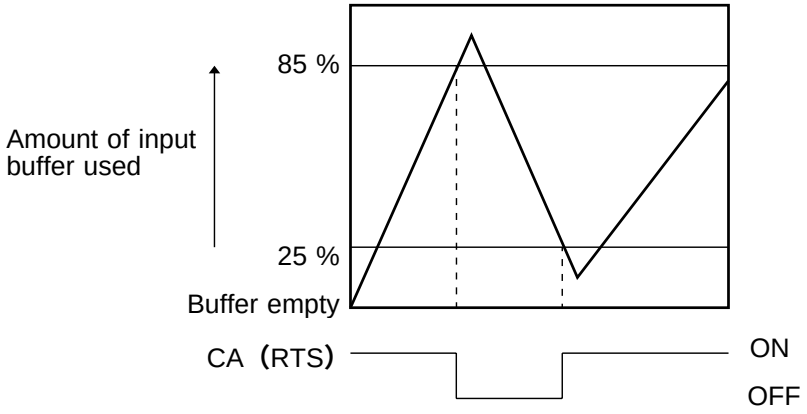
Specification:
D-subminiature 9-pin female to D-subminiature 9-pin female connectors, with "crossed" data connections

Handshake

Buffer flow control

- Controls when receiving

When the receiving buffer is more than 85 % full, CA (RTS) is set to OFF to indicate to the controller that the empty buffer capacity is low.
Processing of data in the buffer continues, and when the receiving buffer is less than 25 % full, CA (RTS) is set to ON to indicate to the controller that there is ample buffer capacity.



- Controlls when transmitting

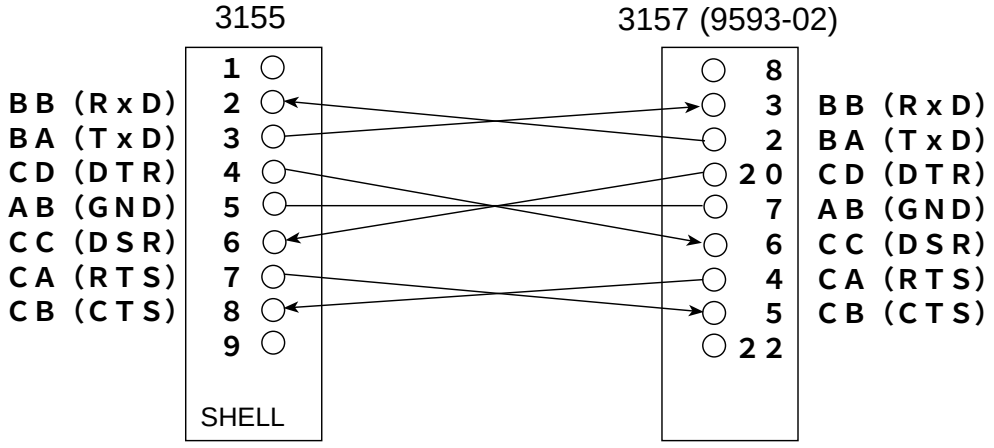
When CB (CTS) is found to be OFF, transmission is suspended; it is found to be ON transmission resumes.

Connecting with 3157

NOTE

- Synchronize 3155 data settings with 3157 (9593-02) before testing.
- For usage for the 3157, see 3157/3157-01 AC GROUNDING HiTESTER Instruction Manual.

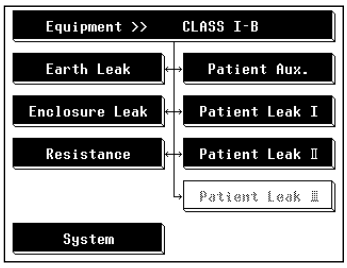
When connecting 3155 with 3157 (9593-02), use connection cable as specified below.



Specification:
D-subminiature 25-pin male to D-subminiature 9-pin female connectors, with "crossed" data connections

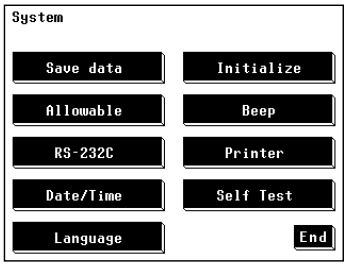
8.5 Operation

8.5.1 Communication Conditions Setting

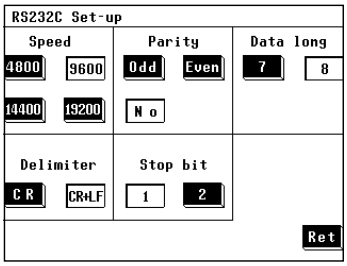


RS-232C communication conditions setting is made on the communication conditions set-up screen.

On the initial screen, press the System key to open the system screen.



On the system screen, press the RS-232C key to open the communication conditions set-up screen.



Press the keys for the desired conditions.

(1) Transfer rate

4800	4800 bits/s
9600	9600 bits/s
14400	14400 bits/s
19200	19200 bits/s

(2) Parity

Odd	Odd parity
Even	Even parity
No	None

(3) Data length

7	7 bits
8	8 bits

(4) Stop bits

1	1 bit
2	2 bits

(5) Delimiter

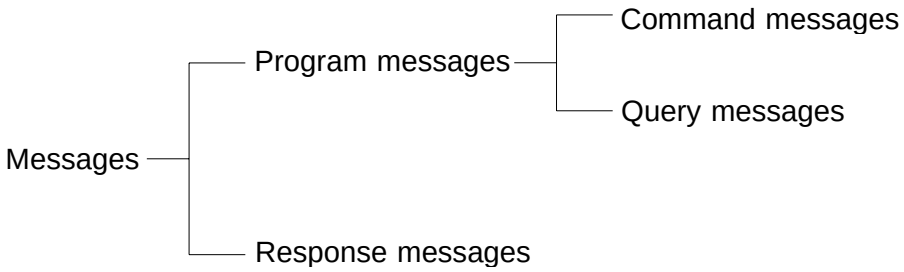
CR	CR (Carriage return)
CR+LF	CR+LF (Carriage return + linefeed)

Ret	Save the setting conditions and return to the system screen.

NOTE The raised black background keys are selectable keys. The recessed white background keys are selected keys.

8.5.2 Communication Methods by the RS-232C

・In order to control the 3155 by the RS-232C, there are several kinds of messages.
・Of these, program messages are those received by the 3155 from the computer, while response messages are those sent from the 3155 to the computer.



(1) Program messages

Program messages are command messages or query messages.

・Command messages are orders for control of the 3155, such as for making measurement condition settings or for reset or the like.

Example :EQUIPMENT_<data>
(Command message which sets the grounding class of the equipment to be measured)

・Query messages are orders for responses relating to the results of operation, results of measurement, or the state of 3155 settings. (A question mark "?" is suffixed at the end of the command.)

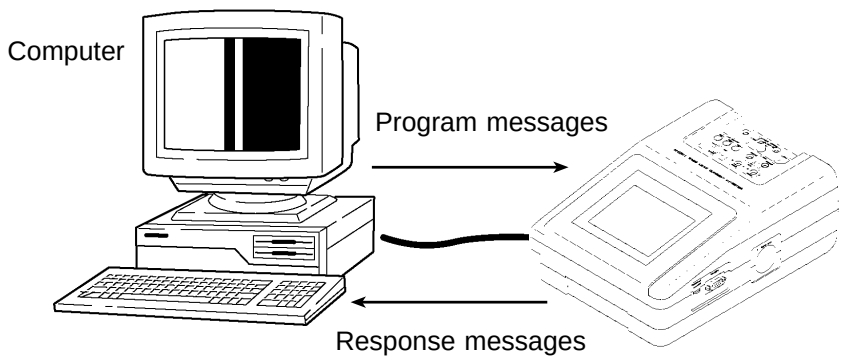
Example :EQUIPMENT?
(Queries the grounding class of the equipment to be measured)

(2) Response messages

It represents the response data for query messages from the 3155.

Example :EQUIPMENT_CLASS1
(The grounding class of the equipment to be measured is set to class 1.)

NOTE A space is represented by "_" in the examples.



8.5.3 Message Format

The commands for the 3155 are as far as possible mnemonic. Furthermore, all commands have a long form, and an abbreviated short form.

(1) Program message

The program message is made up from header and data portions.

Example: Command message to set the grounding class of the equipment to be measured to class 1.

:EQUIPMENT_CLASS1

Header portion Data portion: ASCII-format text or numeric values. Some messages (query messages etc.) have no data portions.

A command header can be abbreviated. The whole command form is referred to as the "long form" and the abbreviated form as the "short form."
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.

For "EQUIPMENT", either "EQUipment" (the long form) or "EQU" (the short form) will be accepted. However, any one of "EQUI", or "EQ" is wrong and will generate an error.

(2) Response message

It represents the response message for query messages from the 3155.
Response messages generated by the 3155 are in long form and in upper case letters.

Example :EQUIPMENT_CLASS1
(The grounding class of the equipment to be measured is set to class 1.)

8.5.4 Headers

(1) Program message headers

There are simple headers and compound headers.

- Simple header

  A header consisting of a single word beginning with a letter.

  Examples :HEADer etc.

- Compound header

  A header consisting of a sequence of words separated by colons.

  Examples :SYSTem:BEEPer, :MEMory:CLEar, etc.

(2) Response message headers

Headers in response messages can be enabled or disabled by using the "HEADer" command.

Example: When the grounding class is set to class 1:

:EQUIPMENT?

(Query message asking for the grounding class setting of the equipment to be measured.)

Response message when headers are on.

:EQUIPMENT_CLASS1

(Header portion) (Data portion)

Response message when headers are off.

CLASS1

(Data portion only)

NOTE When powering on, headers are set off.

8.5.5 Data Formats

The 3155 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 characters following 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 3155 are always in upper case letters.

Example :HEADer_ON

(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 limit which the 3155 can deal, it is rounded off. (4 and above is rounded up; 4 and below is rounded down.)

NR1 format - integer data.
Examples +12, -23, 34
NR2 format - fixed point numbers.
Examples +1.23, -23.45, 3.456
NR3 format - floating point numbers.
Examples +1E-2, -2.3E+4

The term "NRf format" includes all these three formats.
When the 3155 is receiving it accepts NRf format, but when it is sending response messages it utilizes whichever one of the formats NR1 to NR3 is indicated in the specified command.

Examples :MEMory:READ:IDENtity?_6
:MEMory:READ:IDENtity?_+6.012
:MEMory:READ:IDENtity?_0.0006E4

NOTE

- When the data overflows, it reads 9.999E+09.
- When the data underflows, it reads 0.000E+00.

8.5.6 Delimiters

The term "delimiter" is used to refer to the following two possibilities for separating data sequences.
The 3155 recognizes either a carriage return character (CR) or a carriage return plus linefeed (CR+LF) as delimiters.

(1) CR (carriage return only)
(2) CR+LF (carriage return plus linefeed)

Make the setting on the communications set-up screen.

8.5.7 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.
Example :EQUipment_CLAss1;:SYSTem:BEEPer_ON

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

(2) Header separator
In a message which has a header and data, a space (represented by "_" in the examples) is used as the header separator to separate the header from the data.
Example :EQUipment_CLAss1

(3) Data separator
If a message has several data items, commas (,) are required as data separators for separating these data items from one another.
Example :SYSTem:DATE_97,1,1

8.5.8 Abbreviating Messages with Compound Headers

When several compound headers have a common head portion (for example, :SYSTem:BEEPer and SYSTem:RESet etc.), then, when and only when writing them directly following on from one another, this common portion (:SYSTem: in this example) can be omitted.
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 MSDOS, 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 examples:

Normal expression

:SYSTem:BEEPer_ON;:SYSTem:RESet

Abbreviated expression

:SYSTem: BEEPer_ON;RESet

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

The current path is cleared when the power is turned on, when a colon (:) appears at the start of a command, and when delimiter is detected.

With the 3155, there are seven possible current paths:

:CONFigure:
:EQUipment:
:MEASure:
:MEMory:
:SYSTem:
:MEMory:READ:
:SYSTem:COMParator:

8.5.9 Output Queue

Response messages accumulate in the output queue and all data are received and cleared.
The output queue is also cleared when the power is turned off and turned on again.
The 3155 has an output queue of 300 bytes capacity. If the response messages overflow this limit of 300 bytes, a query error is generated, and the output buffer is cleared.

8.5.10 Input Buffer

The 3155 has an input buffer of 300 bytes capacity.
When more than 300 bytes of data are transmitted, when the buffer is full any subsequent bytes received will be ignored.
(When the controller handshake setting is not the same as the 3155.)

8.5.11 Error Register

The error register is a 8-bit resister which indicates the command execution and commumication conditions, and when an error occurs, the corresponding bit is set to 1. The error resister is cleared by reading it by a ":SYSTem:ERRor?" command.

128	64	32	16	8	4	2	1
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Unused	CME	EXE	DDE	QYE	OVE	FRE	PAE

Error register bit assignments

Bit 7	Unused.
Bit 6 **CME**	Command error. When a command which has been received contains a syntactic or semantic error, this bit is set to 1. ・The command is not supported by the 3155. ・There is a mistake in a program header. ・The number of data parameters is wrong. ・The format of the parameters is wrong.
Bit 5 **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. ・Execution is impossible in the current measuring mode.
Bit 4 **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 3155.
Bit 3 **QYE**	Query error. When data in the output queue has been lost, this bit is set to 1.
Bit 2 **OVE**	During communications when an overrun error has occurred, this bit is set to 1.
Bit 1 **FRE**	During communications when a framing error has occurred, this bit is set to 1.
Bit 0 **PAE**	During communications when a parity error has occurred, this bit is set to 1.

8.6 Command Summary

Command	Function	Ref. page
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8.7 Initialization Items

The following table shows which items are initialized and which not, under various conditions.

Item	Power on	:SYSTem:RESet command
RS-232C communication conditions *1	No	No
Device specific functions	No	Yes
Output queue	Yes	No
Input buffer	Yes	No
Current path	Yes	No
Headers on/off	Yes	No

*1 When the communication conditions set-up screen is closed, item is discriminated.

8.8 Command Reference

8.8.1 Format of Command Explanations

Syntax Specifies the syntax for the command (a space is represented by "_" in this syntax).

data For a command that has parameters, specifies their format.

Function Specifies the function of the command.

Note Specifies precautions to be taken when using the command.

Example These are simple examples of the use of the command.

Error Specifies what types of error may occur.
There are errors for ME equipment and for ordinary equipment.

8.8.2 Commands

:AMC?

■ Queries completion of automatic measurement.

Syntax :AMC?

Function If automatic measurement is in progress, returns a "0", if completed, a "1".

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:AMC?**

Response Headers ON **:AMC 1**

Headers OFF **1**

Automatic measurement has been completed.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:CONFigure:AUTO

■ Sets the measuring mode as automatic or manual.

Syntax :CONFigure:AUTO_<*data*>

data ON/OFF

Function Sets the toggling of the polarity and condition of the equipment to be measured to either automatic or manual.
ON for automatic
OFF for manual
After setting the automatic mode, measurement is started with the ":STARt" command.
After setting the manual mode, measurements can be performed at any time.

Note The settings available for polarity and condition of the equipment to be measured will vary per the setting for the condition of the equipment to be measured and measuring mode, so the combination of the automatic measurement will vary.
Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO OFF**
The measuring mode is set to manual.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or if the toggling of the condition of the equipment to be measured is set to automatic for the internally powered equipment, an error occurs.

:CONFigure:AUTO?

■ Queries the measuring mode (automatic or manual).

Syntax :CONFigure:AUTO?

Function Returns the setting for the toggling of the polarity and condition of the equipment to be measured as <data>.
ON The toggling has been set to automatic.
OFF The toggling has been set to manual, or the measuring mode in which only manual measurement is possible has been set.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO?**

Response Headers ON **:CONFigure:AUTO OFF**
Headers OFF **OFF**

The measuring mode has been set to manual.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:CONFigure:COMParator

■ Sets the allowable value.

Syntax When the measuring mode has one allowable value:
:CONFigure:COMParator_<*data*>
When the measuring mode has two allowable values:
:CONFigure:COMParator_<*data1*>, <*data2*>

data <data> Allowable value (Numerical value in NR3 format)
<data1> Allowable value in normal condition (Numerical value in NR3 format)
<data2> Allowable value in single fault condition (Numerical value in NR3 format)

Function Sets the allowable value.
The main unit displays allowable value as a product of the numerical value and the coefficient, but when using RS-232C communications, the coefficient is set as 100%. When setting the low resistance measurement, the unit is Ω and the range is 10.00E-03 to 500.0E+00. Otherwise the unit is A and the range is 5.000E-06 to 20.00E-03.
The patient leakage current Ⅱ and Ⅲ, and low resistance measurement modes have one allowable value.
Sets one allowable value.
The earth leakage current, enclosure leakage current, patient leakage current Ⅰ, and patient auxiliary current measurement modes have two allowable values.
Sets each allowable value in normal condition and single fault condition.

Note Use this command only after using the ":SYSTem:COMParator" command to enable allowable value judgment, and the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:COMParator 0.5E-3**
The allowable value is set to 500.0 μA.

Transmission **:CONFigure:COMParator 0.1E-3,0.5E-3**
The allowable value in normal condition is set to 100.0 μA, and the allowable value in single fault condition is set to 500.0 μA.

Error (ME equipment) (ordinary equipment)
If the allowable value judgment is disabled, or if the measuring mode has not been set, or if the numerical value exceeding the range has been set, an error occurs.
If the number of allowable values that can be set is not equal to the number of data, an error occurs.

:CONFigure:COMParator?

■ Queries the allowable value.

Syntax :CONFigure:COMParator?

Function Returns the allowable value setting as a 4-digit numerical value in NR3 format.
Returns one allowable value in the patient leakage current Ⅱ and Ⅲ, and low resistance measurement modes, and returns each allowable value in normal condition and single fault condition in the earth leakage current, enclosure leakage current, patient leakage current Ⅰ, and patient auxiliary current measurement modes.

Note Use this command only after using the ":SYSTem:COMParator" command to enable allowable value judgment, and the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:COMParator?**

Response Headers ON **:CONFIGURE:COMPARATOR +500.0E-06**
Headers OFF **+500.0E-06**

The allowable value has been set to 500.0 μA.

Transmission **:CONFigure:COMParator?**

Response Headers ON **:CONFIGURE:COMPARATOR +100.0E-06,+500.0E-06**
Headers OFF **+100.0E-06,+500.0E-06**

The allowable value in normal condition has been set to 100.0 μA, and the allowable value in single fault condition has been set to 500.0 μA

Error (ME equipment) (ordinary equipment)
If the allowable value judgment is disabled, or if the measuring mode has not been set, an error occurs.

:CONFigure:CONDition

■ Sets the condition of the equipment to be measured in the manual measurement.

Syntax :CONFigure:CONDition_<*data*>

data NORMal/EARTh/POWersource

Function Sets the condition of the equipment to be measured in the manual measurement.
NORMal Normal condition.
EARTh Single fault condition (open ground)
POWersource Single fault condition (open power lead)

Note The setting cannot be made depending on the the condition of the equipment to be measured setting and measuring mode.
For details, refer to the table below.
Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO OFF;**
:CONFigure:CONDition NORMal
The condition of the equipment to be measured is set to the nomal condition.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in automatic measurement mode, or if the setting cannot be made in the current condition, an error occurs.

Conditions available by the "CONFigure:CONDition" command

Condition of the equipment to be measured / Measuring mode	Class Ⅰ equipment			Class Ⅱ equipment			Internally powered equipment		
	N.C	S.F.C		N.C	S.F.C		N.C	S.F.C	
		Open power lead	Open ground		Open power lead	Open ground		Open power lead	Open ground
Earth leakage current	Yes	Yes	No	—	—	—	—	—	—
Enclosure leakage current	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Low resistance measurement	—	—	—	—	—	—	—	—	—
Patient auxiliary current	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Patient leakage current Ⅰ	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Patient leakage current Ⅱ	No	No	No	No	No	No	No	No	No
Patient leakage current Ⅲ	No	No	No	No	No	No	No	No	No

N.C: Normal condition
S.F.C: Single fault condition

:CONFigure:CONDition?

■ Queries the condition of the equipment to be measured in the manual measurement.

Syntax :CONFigure:CONDition?

Function Returns the setting for the condition of the equipment to be measured as <data>.

<data>

NORMAL	Normal condition
EARTH	Single fault condition (open ground)
POWERSOURCE	Single fault condition (open power lead)

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO OFF;:CONFigure:CONDition?**

Response Headers ON **:CONFIGURE:CONDITION NORMAL**

Headers OFF **NORMAL**

The equipment to be measured has been set to the normal condition.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in automatic measurement mode, an error occurs.

:CONFigure:CONTact

■ Sets the contact condition in the enclosure leakage current mode.

Syntax :CONFigure:CONTact_<*data*>

data EQUipment/EARTh

Function Sets the contact condition in the enclosure leakage current mode.

EQUipment	Sets to between parts of the enclosure.
EARTh	Sets to between te enclosure and the earth.

Note Use this command only after using the ":MODE" command to set the measuring mode to the enclosure leakage current.
When the 9498 NETWORK C or the 9499 NETWORK D is installed, select "EQUipment" to set to between the enclosure and the power line.

Example Transmission **:CONFigure:CONTact EARTh**

The contact condition is set to between the enclosure and the earth.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in a mode other than the enclosure leakage current mode, an error occurs.

:CONFigure:CONTact?

■ Queries the contact condition in the enclosure leakage current mode.

Syntax :CONFigure:CONTact?

Function Returns the contact condition in the enclosure leakage current mode as <data>.

<data>

EQUIPMENT	The contact condition has been set to between parts of the enclosure.
EARTH	The contact condition has been set to between the enclosure and the earth.

Note Use this command only after using the ":MODE" command to set the measuring mode to the enclosure leakage current.
When the 9498 NETWORK C or the 9499 NETWORK D is installed, "EQUIPMENT" means between the enclosure and the power line.

Example Transmission **:CONFigure:CONTact?**

Response Headers ON **:CONFIGURE:CONTACT EARTH**

Headers OFF **EARTH**

The contact condition has been set to between the enclosure and the earth.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in a mode other than the enclosure leakage current mode, an error occurs.

:CONFigure:CURRent

■ Sets the measurement current.

Syntax :CONFigure:CURRent_<*data*>

data ACDC/AC/DC/ACPeak

Function Sets the measurement current.
(ME equipment)
9497 NETWORK B
ACDC Sets the measurement current to AC+DC.
AC
DC

(Ordinary equipment)
9498 NETWORK C
ACDC Sets the measurement current to AC+DC.
AC
DC
ACPeak AC peak (The measurement network filter is automtically set to ON1.)

9499 NETWORK D
ACDC Sets the measurement current to AC+DC.
AC
DC
ACPeak AC peak

Note For ME equipment, use this command only after using the ":MODE" command to set the measuring mode to the patient leakage current Ⅰ or patient auxiliary current.
For ordinary equipment, use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:CURRent ACDC**
The measurement current is set to AC+DC.

Error (ME equipment)
If the measuring mode has not been set, or when in a mode other than the patient leakage current Ⅰ mode or patient auxiliary current mode, an error occurs.
(Ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:CONFigure:CURRent?

■ Queries the measurement current.

Syntax :CONFigure:CURRent?

Function Returns the measurement current setting as <data>.
(ME equipment)
<data>
ACDC The measurement current has been set to AC+DC.
AC AC
DC DC

(Ordinary equipment)
<data>
ACDC The measurement current has been set to AC+DC.
AC
DC
ACPeak AC peak (Only when the 9498 NETWORK C or the 9499 NETWORK D is installed.)

Note For ME equipment, use this command only after using the ":MODE" command to set the measuring mode to the patient leakage current Ⅰ or patient auxiliary current.
For ordinary equipment, use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:CURRent?**

Response Headers ON **:CONFIGURE:CURRENT ACDC**
Headers OFF **ACDC**

The measurement current has been set to AC+DC.

Error (ME equipment)
If the measuring mode has not been set, or when in a mode other than the patient leakage current Ⅰ mode or patient auxiliary current mode, an error occurs.
(Ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:CONFigure:FILTer

■ Sets the measurement network filter.

Syntax :CONFigure:FILTer_<*data*>

data ON/ON1/ON2/OFF/OFF1/OFF2

Function Sets the measurement network filter.
(ME equipment)
9497 NETWORK B
ON Sets to the network with frequency characteristics.
OFF Sets to the network with only 1 kΩ of uninduced resistance.

(Ordinary equipment)
9498 NETWORK C
ON1 Sets to the perception and reaction network.
ON2 Sets to the let-go network.
OFF Sets to the body impedance network.

9499 NETWORK D
OFF1 Sets to the network of 1 kΩ.
ON Sets to the network of 1.5 kΩ and 0.15 μF.
OFF2 Sets to the network of 2 kΩ.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:FILTer OFF**
The measurement network filter is set to the network with only 1 kΩ of uninduced resistance. (ME equipment)

Error (ME equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.
(Ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.
When the 9498 NETWORK C is installed, and the measurement current is AC peak, if set to OFF, an error occurs.

:CONFigure:FILTer?

■ Queries the measurement network filter.

Syntax :CONFigure:FILTer?

Function Returns the measurement network filter setting as <data>.
(ME equipment)
9497 NETWORK B
<data>
ON The measurement network filter has been set to the network with frequency characteristics.
OFF The measurement network filter has been set to the network with only 1 kΩ of uninduced resistance.

(Ordinary equipment)
9498 NETWORK C
ON1 The measurement network filter has been set to the perception and reaction network.
ON2 The measurement network filter has been set to the let-go network.
OFF The measurement network filter has been set to the body impedance network.

9499 NETWORK D
OFF1 The measurement network filter has been set to the network of 1 kΩ.
ON The measurement network filter has been set to the network of 1.5 kΩ and 0.15 μF.
OFF2 The measurement network filter has been set to the network of 2 kΩ.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:FILTer?**

Response Headers ON **:CONFIGURE:FILTER OFF**
Headers OFF **OFF**

The measurement network filter has been set to the network with only 1 kΩ of uninduced resistance. (ME equipment)

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:CONFigure:MTIMe

■ Sets the measurement time in automatic measurement.

Syntax :CONFigure:MTIMe_<*data*>

data Numerical data in NR1 format from 1 to 99

Function Sets the measurement time in automatic measurement.
The numerical value is 1 to 99, and the unit is [s]. Any digit after the decimal point will be rounded.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO ON;:CONFigure:MTIMe 5**
The measurement time in automatic measurement is set to 5 seconds.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:CONFigure:MTIMe?

■ Queries the measurement time in automatic measurement.

Syntax :CONFigure:MTIMe?

Function Returns the measurement time setting in automatic measurement as a numerical value in NR1 format.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO ON;:CONFigure:MTIMe?**

Response Headers ON **CONFIGURE:MTIME 5**
Headers OFF **5**

The measurement time in automatic measurement has been set to 5 seconds.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:CONFigure:POLarity

■ Sets the power source polarity in manual measurement.

Syntax :CONFigure:POLarity_<*data*>

data NORMal/REVerse

Function Sets the power source polarity in manual measurement.
NORMal Sets to the normal polarity.
REVerse Sets to the reverse polarity.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO OFF;:CONFigure:POLarity NORMal**
The power source polarity is set to the normal polarity.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in automatic measurement mode, or if the equipment to be meaured is set to the internally powered equipment, an error occurs.

:CONFigure:POLarity?

■ Queries the power source polarity in manual measurement.

Syntax :CONFigure:POLarity?

Function Queries the power source polarity setting in manual measurement.
<data>
NORMAL The power source polarity has been set to the normal polarity.
REVERSE The power source polarity has been set to the reverse polarity.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO OFF;:CONFigure:POLarity?**

Response Headers ON **:CONFIGURE:POLARITY NORMAL**
Headers OFF **NORMAL**

The power source polarity has been set to the normal polarity.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in automatic measurement mode, or if the equipment to be meaured is set to the internally powered equipment, an error occurs.

:CONFigure:WTIMe

■ Sets the standby time in automatic measurement.

Syntax :CONFigure:WTIMe_<*data*>

data Numerical data in NR1 format from 1 to 99

Function Sets the standby time in automatic measurement.
The numerical value is 0 to 99, and the unit is [s]. Any digit after the decimal point will be rounded.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO ON;:CONFigure:WTIMe 10**
The standby time in automatic measurement is set to 10 seconds.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:CONFigure:WTIMe?

■ Queries the standby time in automatic measurement.

Syntax :CONFigure:WTIMe?

Function Returns the standby time setting in automatic measurement as a numerical value in NR1 format.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO ON;:CONFigure:WTIMe?**

Response Headers ON **:CONFIGURE:WTIME 10**
Headers OFF **10**

The standby time in automatic measurement has been set to 10 seconds.

Error (ME equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:EQUipment

■ Sets the grounding class of the equipment to be measured.

Syntax :EQUipment_<*data*>

data CLAss1 (CLA1) /CLAss2 (CLA2) /INTernal

Function Sets the grounding class of the equipment to be measured.
CLAss1 Class Ⅰ equipment
CLAss2 Class Ⅱ equipment
INTernal Internally powered equipment

Note Use this command only after using the ":MODE" command to set to OFF (the measuring mode is not selected).

Example Transmission **:MODE OFF;:EQUipment CLAss1**
The grounding class of the equipment to be measured is set to the class Ⅰ equipment.

Error (ME equipment) (ordinary equipment)
If the measuring mode has been selected, an error occurs.

:EQUipment?

■ Queries the grounding class of the equipment to be measured.

Syntax :EQUipment?

Function Returns the setting of the grounding class of the equipment to be measured as <data>.
CLASS1 Class Ⅰ equipment
CLASS2 Class Ⅱ equipment
INTERNAL Internally powered equipment

Example Transmission **:EQUipment?**

Response Headers ON **:EQUIPMENT CLASS1**
Headers OFF **CLASS1**

The grounding class of the equipment to be measured has been set to the class Ⅰ equipment.

:EQUipment:IDENtity

■ Sets the model name and number of the equipment to be measured.

Syntax :EQUipment:IDENtity_<*data*>

data Character data of 1 to 12 characters, <model name> and <number> in order

Function Sets the model name and number of the equipment to be measured. Available characters include the alphabet, numerals and the hyphen. No distinction is made between uppercase and lowercase letters, and both letters are read as uppercase letters.
There is no need to set the model name and number for making measurements, but they are necessary for saving data.

Example Transmission **:EQUipment:IDENtity ABC,NO-111**
The model name of the equipment to be measured is set to "ABC", and the number to "NO-111".

Error Use of any characters other than those described above generates an error.

:EQUipment:IDENtity?

■ Queries the model name and number of the equipment to be measured.

Syntax :EQUipment:IDENtity?

Function Returns the setting of the model name and number of the equipment to be measured as <model name> and <number> in order.

Example Transmission **:EQUipment:IDENtity?**

Response Headers ON **:EQUIPMENT:IDENTITY ABC,NO-111**
Headers OFF **ABC,NO-111**

The model name of the equipment to be measured has been set to "ABC", and the number to "NO-111".

:EQUipment: TYPE

■ Sets the applied part type of the equipment to be measured. (ME equipment only)

Syntax :EQUipment:TYPE_<*data*>

data B/BF/CF

Function Sets the applied part type of the equipment to be measured.
B Type B applied part
BF Type BF applied part
CF Type CF applied part

Note Use this command only after using the ":MODE" command to set to OFF (the measuring mode is not selected).

Example Transmission **:MODE OFF;:EQUipment:TYPE B**
The applied part type of the equipment to be measured is set to the type B.

Error (ME equipment)
If the measuring mode has been selected, an error occurs.
(Ordinary equipment)
An error always occurs.

:EQUipment: TYPE?

■ Queries the applied part type of the equipment to be measured. (ME equipment only)

Syntax :EQUipment:TYPE?

Function Returns the setting of the applied part type of the equipment to be measured as <data>.
<data>
B Type B applied part
BF Type BF applied part
CF Type CF applied part

Example Transmission **:EQUipment:TYPE?**

Response Headers ON **EQUIPMENT:TYPE B**
Headers OFF **B**

The applied part type of the equipment to be measured has been set to the type B.

Error (Ordinary equipment)
An error always occurs.

:HEADer

■ Sets the response headers.

Syntax :HEADer_<*data*>

data ON/OFF

Function Sets the response headers for queries.
ON Response headers
OFF No response headers
The response headers are set to OFF when powering on.

Example Transmission **:HEADer OFF**
The response headers are set to OFF.

:HEADer?

■ Queries the response headers.

Syntax :HEADer?

Function Returns the response headers setting as <data>.
<data>
ON Response headers
OFF No response headers

Example Transmission **:HEADer?**

Response Headers ON **:HEADER ON**
Headers OFF **OFF**

:MAXimum:CLEar

■ Clears the maximum value.

Syntax :MAXimum:CLEar

Function Clears the maximum value.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MAXimum:CLEar**
The maximum value is cleared.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, an error occurs.

:MEASure:AUTO?

■ Queries the maximum values after automatic measurement.

Syntax :MEASure:AUTO?_<*data*>

Function Returns the measurement results collectively.
Returns the maximum values of the combinations of the power source polarity and condition of the equipment to be measured, their judgments, power source polarities, and conditions of the equipment to be measured, as numerical values in NR3 and NR1 format.
The data are ordered as follows: <① maximum value>, <② judgment>, <③ power source polarity> and <④ condition of the equipment to be measured>, and the available combination of the automatic measurement is read in a format of ① to ④.
<Judgment>
(If the allowable value judgment is disabled, 0)
Allowable value or lower (PASS): 0
Higher than allowable value (FAIL): 1
<Power source polarity>
(If the equipment to be measured is set to the internally powered equipment, 0)
Normal polarity: 0
Reverse polarity: 1
<Condition of the equipment to be measured>
Normal condition: 0
Single fault condition (open power lead): 1
Single fault condition (open ground): 2
Single fault condition (110% voltage applied): 3

Note Execute this command after verifying that the automatic measurement is finished (:AMC? command). Executing this command during automatic measurement will not obtain the correct result.
Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEASure:AUTO?**

Response Headers ON **:MEASURE:AUTO +2.345E-03,0,0,0,+2.456E-03,0,0,1,+2.510E-03,0,0,2,+2.362E-03,0,1,0,+2.459E-03,0,1,1,+2.610E-03,1,1,2**

Headers OFF **+2.345E-03,0,0,0,+2.456E-03,0,0,1,+2.510E-03,0,0,2,+2.362E-03,0,1,0,+2.459E-03,0,1,1,+2.610E-03,1,1,2**

The response data mean the following.

Measured value	Judgment	Power source polarity	Condition of the equipment to be measured
2.345 mA	PASS	Normal polarity	Normal condition
2.456 mA	PASS	Normal polarity	Single fault condition (open power lead)
2.510 mA	PASS	Normal polarity	Single fault condition (open ground)
2.362 mA	PASS	Reverse polarity	Normal condition
2.459 mA	PASS	Reverse polarity	Single fault condition (open power lead)
2.610 mA	FAIL	Reverse polarity	Single fault condition (open ground)

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:MEASure:CURRent?

■ Queries the consumed current monitored parameter.

Syntax :MEASure:CURRent?

Function Returns the consumed current monitored parameter as a 4-digit numerical value in NR3 format.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEASure:CURRent?**

Response Headers ON **:MEASURE:CURRENT +2.000E+00**

Headers OFF **+2.000E+00**

The current monitored parameter is 2 A.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:MEASure:MAXimum?

■ Queries the maximum value.

Syntax :MEASure:MAXimum?

Function Returns the maximum value, its judgment, power source polarity, and condition of the equipment to be measured, as numerical values in NR3 and NR1 format.
The data are ordered as follows: <maximum value>, <judgment>, <power source polarity> and <condition of the equipment to be measured>.
<Judgment>
(If the allowable value judgment is disabled, 0)
Allowable value or lower (PASS): 0
Higher than allowable value (FAIL): 1
<Power source polarity>
(If the equipment to be measured is set to the internally powered equipment, or if measuring the low resistance, 0)
Normal polarity: 0
Reverse polarity: 1
<Condition of the equipment to be measured>
(If measuring the low resistance, 0)
Normal condition: 0
Single fault condition (open power lead): 1
Single fault condition (open ground): 2
Single fault condition (110% voltage applied): 3

Note In order to learn the maximum value, execute this command after verifying that the automatic measurement is finished (:AMC? command). Executing this command during automatic measurement will obtain only the most recent value.
Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEASure:MAXimum?**

Response Headers ON **:MEASURE:MAXIMUM +2.345E-03,1,1,2**
Headers OFF **+2.345E-03,1,1,2**

The power source polarity is reverse polarity, the condition of the equipment to be measured is single fault condition (open ground), and the maximum value is 2.345 mA. And the result of allowable value judgment is "higher than allowable value (FAIL)."

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, an error occurs.

:MEASure:VOLTage?

■ Queries the line voltage monitored parameter.

Syntax :MEASure:VOLTage?

Function Returns the line voltage monitored parameter as a 4-digit numerical value in NR3 format.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEASure:VOLTage?**

Response Headers ON **:MEASURE:VOLTAGE +99.90E+00**
Headers OFF **+99.90E+00**

The line voltage monitored parameter is 99.9 V.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, an error occurs.

:MEASure?

■ Queries the measured value.

Syntax :MEASure?

Function Returns the measured value and its judgment as numerical values in NR3 and NR1 format.
The data are ordered as follows: <measured value> and <judgment>.
<Judgment>
(If the allowable value judgment is disabled, 0)
Allowable value or lower (PASS): 0
Higher than allowable value (FAIL): 1

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEASure?**

Response Headers ON **:MEASURE +2.345E-03,1**
Headers OFF **+2.345E-03,1**

The measured value is 2.345 mA, and the allowable value judgment is "higher than allowable value (FAIL)."

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, an error occurs.

:MEMory:CLEar

■ Erases the saved data.

Syntax :MEMory:CLEar

Function Erases all the data saved in memory.

Example Transmission **:MEMory:CLEar**
The saved data are erased.

:MEMory:NUMBer?

■ Queries the number of models of the saved data.

Syntax :MEMory:NUMBer?

Function Returns the number of models (total number of data units) of the saved data as a numerical value in NR1 format.

Example Transmission **:MEMory:NUMBer?**

Response Headers ON **:MEMORY:NUMBER 10**
Headers OFF **10**

Data of 10 models (data units) are saved.

:MEMory:READ:IDENtity?

■ Reads out the model name and number of the saved data.

Syntax :MEMory:READ:IDENtity?_<*data*>

data Data unit number: Numerical data in NR1 format from 1 to the number of models (total number of data units)

Function Returns the model name and number of the specified data unit as <model name>, <number> and <date of renewal> in order.
For details, refer to Section 8.9, "Reading in All the Saved Data."

Example Transmission **:MEMory:READ:IDENtity? 1**

Response Headers ON **:MEMORY:READ:IDENTITY ABC,NO-111,1997/1/15**
Headers OFF **ABC,NO-111,1997/1/15**

The model name of the data unit 1 is "ABC", the number is "NO-111", and the date of renewal is "1997/1/15".

Error (ME equipment) (ordinary equipment)
If the data unit number exceeding the total number of data units is set, an error occurs.

:MEMory:READ:MEASure?

■ Reads out the saved data.

Syntax :MEMory:READ:MEASure?_<*data*>

data Numerical data in NR1 format and character data, <data unit number> and <measuring mode> in order
<Data unit number> Numerical value from 1 to the number of models (total number of data units)
<Measuring mode> EARTh/ENCLosure/RESistance/PATient1 (PAT1)/ PATient2 (PAT2)/PATient3 (PAT3)/PAUXiliary

(ME equipment)
EARTh Earth leakage current
ENCLosure Enclosure leakage current
RESistance Low resistance measurement
PATient1 Patient leakage current Ⅰ
PATient2 Patient leakage current Ⅱ
PATient3 Patient leakage current Ⅲ
PAUXiliary Patient auxiliary current

(Ordinary equipment)
EARTh Earth leakage current
ENCLosure Enclosure leakage current
RESistance Low resistance measurement

Function Returns the saved data of the specified measuring mode of the specified data unit.
The data are orderd as follows, and the available data is read in a format from ① to ⑥ (for enclosure leakage current, ① to ⑦, and for low resistance measurement, ① to ②). If there is no saved data, returns "0" only.

For earth leakage current, patient leakage current Ⅰ, patient leakage current Ⅱ, patient leakage current Ⅲ and patient auxiliary current
<① maximum value>, <② judgment>, <③ power source polarity>, <④ condition of the equipment to be measured>, <⑤ measurement network filter> and <⑥ measurement current>
For enclosure leakage current
<① maximum value>, <② judgment>, <③ power source polarity>, <④ condition of the equipment to be measured>, <⑤ measurement network filter>, <⑥ measurement current> and <⑦ contact condition>
For low resistance measurement
<① maximum value> and <② judgment>

<Judgment>
(If the allowable value judgment is disabled, 0)
Allowable value or lower (PASS): 0
Higher than allowable value (FAIL): 1
<Power source polarity>
(If the equipment to be measured is set to the internally powered equipment, 0)
Normal polarity: 0
Reverse polarity: 1
<Condition of the equipment to be measured>
Normal condition: 0
Single fault condition (open power lead): 1
Single fault condition (open ground): 2
Single fault condition (110% voltage applied): 3
<Filter>
OFF 0
ON 1
ON1 2
ON2 3
OFF1 4
OFF2 5
<Measurement current>
ME equipment
(Except for patient leakage current Ⅰ and patient auxiliary current, 0)
AC+DC 0
AC 1
DC 2
Ordinary equipment
AC+DC 0
AC 1
DC 2
ACPEAK 3 (Only when the 9498 NETWORK C or the 9499 NETWORK D is installed)
<Contact condition>
Between the enclosure and the earth 0
Between parts of the enclosure 1

For details, refer to Section 8.9, "Reading in All the Saved Data."

Example Transmission **:MEMory:READ:MEASure? 1,EARTh**

Response Headers ON **:MEMORY:READ:MEASURE +2.345E-03,0,0,0,1,0, +2.456E-03,0,0,1,1,0,+2.510E-03,0,0,2,1,0**

Headers OFF **+2.345E-03,0,0,0,1,0,+2.456E-03,0,0,1,1,0, +2.510E-03,0,0,2,1,0**

The saved data of earth leakage current of the data unit 1 are as follows.

Maximum value Measurement current	Judgment	Power source polarity	Condition of the equipment to be measured	Filter
2.345 mA AC+DC	PASS	Normal polarity	Normal condition	ON
2.456 mA AC+DC	PASS	Normal polarity	Single fault condition (open power lead)	ON
2.510 mA AC+DC	PASS	Normal polarity	Single fault condition (open ground)	ON

Error (ME equipment) (ordinary equipment)
If the data unit number exceeding the total number of data units is set, an error occurs

:MEMory:SAVE

■ Saves the maximum value.

Syntax :MEMory:SAVE

Function Saves in memory the maximum value of the current measuring mode, and the set-up condition and the model name and number of the equipment to be measured when measuring the maximum value.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:MEMory:SAVE**

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, an error occurs.
If there is insufficient memory available, an error occurs.

:MODE

■ Selects the measuring mode.

Syntax :MODE_<*data*>

data OFF/EARTh/ENCLosure/RESistance/PATient1 (PAT1)/PATient2 (PAT2)/PATient3 (PAT3)/PAUXiliary
Sets the measuring mode. The screen changes.

(ME equipment)

OFF	No mode selection (initial screen)
EARTh	Earth leakage current
ENCLosure	Enclosure leakage current
RESistance	Low resistance measurement
PATient1	Patient leakage current Ⅰ
PATient2	Patient leakage current Ⅱ
PATient3	Patient leakage current Ⅲ
PAUXiliary	Patient auxiliary current

(Ordinary equipment)

OFF	No mode selection (initial screen)
EARTh	Earth leakage current
ENCLosure	Enclosure leakage current
RESistance	Low resistance measurement

Note There are some measuring modes which cannot be set under certain settings for the equipment to be measured (the grounding class and applied part). Refer to the text for details.
When set to low resistance measurement mode, measuring equipment settings default to 3155 settings.

Example Transmission **:MODE EARTh**
The earth leakage current measurement mode is set.

Error (ME equipment)
If the earth leakage current mode is set, when the grounding class of the equipment to be measured is set to other than class Ⅰ, or
if the patient leakage current Ⅲ mode is set, when the applied part of the equipment to be measured is set to the B-type applied part, or
if the patient leakage current Ⅱ mode is set, when set to the BF- or CF-type applied part, an error occurs.
(Ordinary equipment)
If the earth leakage current mode is set, when the grounding class of the equipment to be measured is set to other than class Ⅰ, an error occurs.
If the patient leakage current Ⅰ, Ⅱ or Ⅲ, or patient auxiliary current mode is set, an error occurs.

:MODE?

■ Queries the measuring mode.

Syntax :MODE?

Function Returns the measuring mode setting as <data>.

<data>
(ME equipment)

OFF	No mode selection (initial screen)
EARTH	Earth leakage current
ENCLOSURE	Enclosure leakage current
RESISTANCE	Low resistance measurement
PATIENT1	Patient leakage current Ⅰ
PATIENT2	Patient leakage current Ⅱ
PATIENT3	Patient leakage current Ⅲ
PAUXILIARY	Patient auxiliary current

(Ordinary equipment)

OFF	No mode selection (initial screen)
EARTH	Earth leakage current
ENCLOSURE	Enclosure leakage current
RESISTANCE	Low resistance measurement

Example Transmission **:MODE?**

Response Headers ON **:MODE EARTH**
Headers OFF **EARTH**

The earth leakage current measurement mode has been set.

:STARt

■ Starts automatic measurement.

Syntax :STARt

Function Starts automatic measurement.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:CONFigure:AUTO ON;:STARt**
Automatic measurement is started.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:STOP

■ Stops automatic measurement.

Syntax :STOP

Function Stops automatic measurement.

Note Use this command only after using the ":MODE" command to set the measuring mode.

Example Transmission **:STOP**
Automatic measurement is stopped.

Error (ME equipment) (ordinary equipment)
If the measuring mode has not been set, or when in the low resistance measurement mode, or when in manual measurement mode, an error occurs.

:SYSTem:COMParator

■ Sets the allowable value judgment.

Syntax :SYSTem:COMParator_<*data*>

data ON/OFF

Function Sets the allowable value judgment.
ON Perform the allowable value judgment. If the maximum value and current value are less than or equal to the allowable value, PASS, if higher than the allowable value, FAIL.
OFF Do not perform the allowable value judgment.

Example Transmission **:SYSTem:COMParator ON**
The allowable value judgment is enabled.

:SYSTem:COMParator?

■ Queries the allowable value judgment.

Syntax :SYSTem:COMParator?

data ON/OFF

Function Returns the allowable value judgment setting as <data>.
ON Perform the allowable value judgment. If the maximum value and current value are less than or equal to the allowable value, PASS, if higher than the allowable value, FAIL.
OFF Do not perform the allowable value judgment.

Example Transmission **:SYSTem:COMParator?**

Response Headers ON **:SYSTEM:COMParator ON**
Headers OFF **ON**

The allowable value judgment has been enabled.

:SYSTem:COMParator:BEEPer

■ Sets the beep sound for the allowable value judgment.

Syntax :SYSTem:COMParator:BEEPer_<*data*>

data ON/OFF

Function Sets the beep sound produced when the allowable value judgment is FAIL.
ON A beep sound is emitted.
OFF No beep sound is emitted.

Note If set to ON, the beep sound is also set to ON.

Example Transmission **:SYSTem:COMParator:BEEPer ON**
When the judgment result is FAIL, a beep sound is emitted.

:SYSTem:COMParator:BEEPer?

■ Queries the beep sound for the allowable value judgment.

Syntax :SYSTem:COMParator:BEEPer?

Function Returns the beep sound setting for the allowable value judgment as <data>.
ON A beep sound is emitted.
OFF No beep sound is emitted.

Example Transmission **:SYSTem:COMParator:BEEPer?**

Response Headers ON **:SYSTEM:COMParator:BEEPer ON**
Headers OFF **ON**

A beep sound has been enabled.

:SYSTem:BEEPer

■ Sets the beep sound.

Syntax :SYSTem:BEEPer_<*data*>

data ON/OFF

Function Sets the beep sound.
ON A beep sound is emitted.
OFF No beep sound is emitted.

Note If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.
The beep sound is emitted when:
・The power is turned on.
・A key is pressed.
・Making a measurement in the automatic measurement mode.
・An input of 25 mA or more is detected in the leakage current measurement mode.
When an error has occurred in the RS-232C system, the beep sound is always emitted irrespective of this setting.

Example Transmission **:SYSTem:BEEPer ON**
A beep sound is emitted.

:SYSTem:BEEPer?

■ Queries the beep sound.

Syntax :SYSTem:BEEPer?

Function Queries the beep sound setting as <data>.
ON A beep sound is emitted.
OFF No beep sound is emitted

Note If the beep sound has been set to ON, it will be emitted under the following conditions, and the beep sound setting for the allowable value judgment become effective as well.
The beep sound is emitted when:
・The power is turned on.
・A key is pressed.
・Making a measurement in the automatic measurement mode.
・An input of 25 mA or more is detected in the leakage current measurement mode.
When an error has occurred in the RS-232C system, the beep sound is always emitted irrespective of this setting.

Example Transmission **:SYSTem:BEEPer?**

Response Headers ON **:SYSTEM:BEEPER ON**
Headers OFF **ON**

A beep sound has been enabled.

:SYSTem:DATE

■ Sets the date.

Syntax :SYSTem:DATE_<*data*>

data Numerical data in NR1 format, <year>, <month> and <day> in order
Sets the function date.
Sets as <year>, <month> and <day> in order separated by commas.
Year Numerical data in NR1 format from 1997 to 2096
Month Numerical data in NR1 format from 1 to 12
Day Numerical data in NR1 format from 1 to 31

Example Transmission **:SYSTem:DATE 1997,1,1**
The date is set to January 1, 1997.

Error (ME equipment) (ordinary equipment)
If the nemerical value exceeding the range has been set, or if any numerical data other than those described above have been set, an error occurs,

:SYSTem:DATE?

■ Queries the date.

Syntax :SYSTem:DATE?

Function Returns the date setting as <year>, <month> and <day> in order separated by commas.
Year Numerical data in NR1 format from 1997 to 2096
Month Numerical data in NR1 format from 1 to 12
Day Numerical data in NR1 format from 1 to 31

Example Transmission **:SYSTem:DATE?**

Response Headers ON **:SYSTEM:DATE 1997,1,1**
Headers OFF **1997,1,1**

The date has been set to January 1, 1997.

:SYSTem:ERRor?

■ Queries errors.

Syntax :SYSTem:ERRor?

Function Returns the value of error register as a numerical value in NR1 format, and then clears error register.

Note For the error register, refer to Section 7.5.11, "Error Register."

Example Transmission **:SYSTem:ERRor?**

Response Headers ON **:SYSTem:ERRor 64**

Headers OFF **64**

A command error has occurred.

:SYSTem:LANGuage

■ Sets the language displayed on the screen.

Syntax :SYSTem:LANGuage_<*data*>

data JAPanese/ENGlish

Function Sets the language displayed on the screen.

JAPanese Sets the display language to Japanese.

ENGlish Sets display language to English.

Example Transmission **:SYSTem:LANGuage JAPanese**

The display language is set to Japanese.

Error (ME equipment) (ordinary equipment)

If the measuring mode has been selected, an error occurs.

:SYSTem:LANGuage?

■ Queries the language displayed on the screen.

Syntax :SYSTem:LANGuage?

Function Queries the setting of the language displayed on the screen as <data>.
JAPANESE The display language has been set to Japanese.
ENGLISH The display language has been set to English.

Example Transmission **:SYSTem:LANGuage?**
The display language has been set to Japanese.

Error (ME equipment) (ordinary equipment)
If the measuring mode has been selected, an error occurs.

:SYSTem:RESet

■ Initializes the 3155.

Syntax :SYSTem:RESet

Function Returns the 3155 to its default settings. For the default settings, refer to Section 10.4.2, "Default Settings." After the initialization is completed, the initial screen returns.

Example Transmission **:SYSTem:RESet**

:SYSTem:TIME

■ Sets the time.

Syntax :SYSTem:TIME_<*data*>

data Numerical data in NR1 format, <hour> and <minute> in order

Function Sets the time.
Sets as <hour> and <minute> in order separated by a comma.
Hour Numerical data in NR1 format from 0 to 23
Minute Numerical data in NR1 format from 0 to 59

Example Transmission **:SYSTem:TIME 12,34**
The time is set to 12:34.

Error (ME equipment) (ordinary equipment)
If the nemerical value exceeding the range has been set, or if any numerical data other than those described above have been set, an error occurs,

:SYSTem:TIME?

■ Queries the time.

Syntax :SYSTem:TIME?

Function Returns the time setting as <hour> and <minute> in order separated by a comma.
Hour Numerical data in NR1 format from 0 to 23
Minute Numerical data in NR1 format from 0 to 59

Example Transmission **:SYSTem:TIME?**

Response Headers ON **:SYSTEM:TIME 12,34**
Headers OFF **12,34**

The time has been set to 12:34.

:SYSTem:VERSion?

■ Queries the version data.

Syntax :SYSTem:VERSion?

Function Returns the 3155 version data as a 3-digit nemerical value in NR2 format.

Example Transmission **:SYSTem:VERSion?**

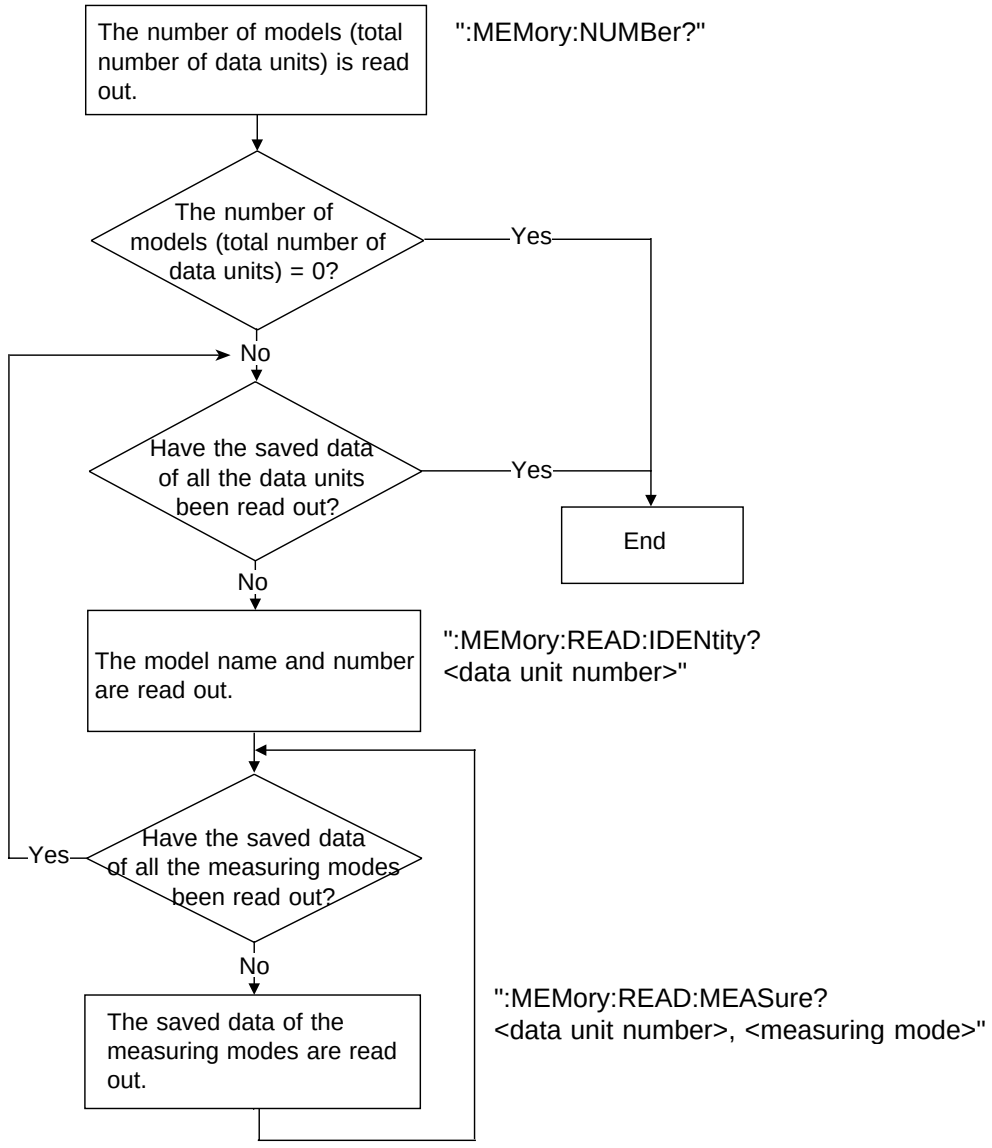
Response Headers ON **:SYSTEM:VERSION 1.00**
Headers OFF **1.00**

The version is 1.00.

8.9 Reading in All the Saved Data

This section describes how to read in all the saved data.

1. ":MEMory:NUMBer?" is transmitted, and the number of models (total number of data units) is read out.
2. ":MEMory:READ:IDENtity? <data unit number>" is transmitted, and the model name and number of the specified data unit are read out.
   (1) ":MEMory:READ:MEASure? <data unit number>, <measuring mode>" is transmitted, and the saved data of the specified measuring mode of the specified data unit is read out. If the data received is only "0", there is no data saved for that mode.)
   (2) (1) is repeated for the number of the specified measuring modes only.
3. If the number of models (total number of data units) is plural, (2) will be repeated.



8.10 Sample Programs

The following sample programs operate under the Microsoft Quick BASIC (*1) and QBasic running on MS-DOS 6.2/V (English mode) (*2). For details about the Microsoft Quick BASIC and QBasic, refer to the appropriate manuals.

All commands in the sample programs are written in the short form.
The settings for communications used in the programs are as follows:
transfer rate: 9600 bps, parity: none, data length: 8 bits, stop bit: 1 bit and delimiter: CR.

(*1) (*2): Quick BASIC, QBasic is a registered trade mark of Microsoft Corporation.

1. Basic settings and measurement (manual measurement)

For measuring the earth leakage current of the equipment to be measured of the grounding class Ⅰ.

```
10  OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
20  PRINT #1,":HEAD OFF"
30  PRINT #1,"MODE OFF;:EQU CLA1"
40  PRINT #1,":MODE EART"
50  PRINT #1,":CONF:AUTO OFF"
60  PRINT #1,":CONF:POL NORM"
70  PRINT #1,":CONF:COND POW"
80  PRINT #1,":CONF:FILT ON"
90  PRINT #1,":MEAS?"
100 INPUT #1,MV$,JUDG$
110 PRINT "Leakage Current: ";MV$
120 CLOSE
130 END
```

Line	Explanation of program
10	Open the RS-232C circuit file.
20	Set the response header to OFF.
30	Set the grounding class of the equipment to be measured to class Ⅰ.
40	Set the earth leakage current measurement.
50	Set the manual measurement.
60	Set the power source polarity to the normal polarity.
70	Set the condition of the equipment to be measured to the single fault condition (open power lead).
80	Set the measurement network filter to ON.

Lines 50 to 80 can be written as a single command as follows:

```
PRINT #1,":CONF:AUTO OFF;POL NORM;COND POW;FILT ON"
```

90	Query the measured value.
100	Judge the measured value.
110	Display the measured value.

2. Automatic measurement

For automatically measuring the enclosure leakage current of the equipment to be measured of the grounding class Ⅰ.

```
10  OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
20  PRINT #1,":HEAD OFF"
30  PRINT #1,":MODE OFF;:EQU CLA1"
40  PRINT #1,":SYST:COMP ON"
50  PRINT #1,":MODE ENCL"
60  PRINT #1,":CONF:AUTO ON"
70  PRINT #1,":CONF:CONT EART"
80  PRINT #1,":CONF:FILT ON"
90  PRINT #1,":CONF:MTIM 4"
100 PRINT #1,":CONF:WTIM 10"
110 PRINT #1,":CONF:COMP 0.100E-3,0.500E-3"
120 PRINT #1,":MAX:CLE"
130 PRINT #1,":STAR"
140 MEAS.WAIT:
150 PRINT #1,":AMC?"
160 INPUT #1,A
170 IF A = 0 THEN GOTO MEAS.WAIT
180 PRINT #1,":MEAS:MAX?"
190 INPUT #1,MV$,JUDG,POL,COND
200 PRINT "Leakage Current: ";MV$
210 IF JUDG = 0 THEN
220 PRINT "      Judgement: PASS"
230 ELSE
240 PRINT "      Judgement: FAIL"
250 END IF
260 IF POL = 0 THEN
270 PRINT "       Polarity: NORMAL"
280 ELSE
290 PRINT "       Polarity: REVERSE"
300 END IF
310 IF COND = 0 THEN
320 PRINT "      Condition: NORMAL"
330 ELSEIF COND = 1 THEN
340 PRINT "      Condition: POWER"
350 ELSE
360 PRINT "      Condition: EARTH"
370 END IF
380 CLOSE
390 END
```

Example of display

```
Leakage Current: +978.2E-06
      Judgement: PASS"
       Polarity: REVERSE"
      Condition: EARTH"
```

Line	Explanation of program
10	Open the RS-232C circuit file.
20	Set the response header to OFF.
30	Set the grounding class of the equipment to be measured to class Ⅰ.
40	Perform the allowable value judgment.
50	Set the enclosure leakage current measurement.
60	Set the automatic measurement.
70	Set the contact condition to the enclosure to earth.
80	Set the measurement network filter to ON.
90	Set the measurement time to 4 seconds.
100	Set the standby time for switch-over to 10 seconds.
110	Set the allowable value in normal condition to 0.1 mA, and the allowable value in single fault condition to 0.5 mA.
120	Clear the maximum value.
130	Start the automatic measurement.
140-170	Wait until the automatic measurement is finished.
180	Query the maximum value.
190	Read the maximum value, judgment, power source polarity and condition of the equipment to be measured.
200	Display the maximum value.
210-250	Display the judgment result.
260-300	Display the power source polarity at the time of the maximum value.
310-370	Display the condition of the equipment to be measured at the time of the maximum value.

3. Reading the saved data

All the data saved in the 3155 are read and output to the DATA.CSV file.
A CSV format (comma separated format) file can be directly read in that form by various types of spreadsheet software.

```
10  OPTION BASE 1
20  OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
30  PRINT #1, ":HEAD OFF"
40  PRINT #1, ":MEM:NUMB?"
50  INPUT #1, NUM
60  IF NUM = 0 THEN
70    PRINT "NOTHING SAVE DATA!"
80    CLOSE
90    END
100 END IF
110   '
120 FOR I = 1 TO 7
130    READ MODE$(I)
140 NEXT I
150 DATA ",EARTH", ",ENCLOSURE", ",RESISTANCE", ",PAUXILIARY",
",PATIENT1"
160 DATA ",PATIENT2", ",PATIENT3"
170 FOR I = 1 TO 7
180    READ DATANUM(I)
190 NEXT I
200 DATA 6, 7, 2, 6, 6, 6, 6
210   '
220 OPEN "DATA.CSV" FOR OUTPUT AS #2
230 FOR I = 1 TO NUM
240    PRINT #1, ":MEM:READ:IDEN? " + STR$(I)
250    LINE INPUT #1, IDEN$
260    PRINT #2, IDEN$
270    FOR J = 1 TO 7
280       PRINT #1, ":MEM:READ:MEAS? " + STR$(I) + MODE$(J)
290       LINE INPUT #1, ALLDATA$
300       IF ALLDATA$ = "0" THEN GOTO NODATA
310       DO WHILE 1
320          START = 1
330          FOR K = 1 TO DATANUM(J)
340             P = INSTR(START, ALLDATA$, ",")
350             START = P + 1
360          NEXT K
370          IF P = 0 THEN
380             PRINT #2, ALLDATA$
390             EXIT DO
400          ELSE
410             PRINT #2, LEFT$(ALLDATA$, P - 1)
420             ALLDATA$ = MID$(ALLDATA$, P + 1, LEN(ALLDATA$) - P)
430          END IF
440       LOOP
```

```
450 NODATA:
460     NEXT J
470 NEXT I
480 CLOSE
490 END
```

Line	Explanation of program
10	Set so that the format annotations start with 1.
20	Open the RS-232C circuit file.
30	Set the response header to OFF.
40-100	Query the number of saved models. If the number of models is 0, exit.
120-160	Create an argument character allocation for the ":MEMory:READ:MEASure?" command.
170-200	Create the number of elements of the saved data by allotting them for each measuring mode. Enclosure leakage current The number of elements is 7, <maximum value>, <judgment>, <power source polarity>, <condition of the equipment to be measured>, <measurement network filter setting>, <measurement current> and <contact condition> in order. Low resistance measurement The number of elements is 2, <maximum value> and <judgment> in order. Other measurements The number of elements is 6, <maximum value>, <judgment>, <power source polarity>, <condition of the equipment to be measured>, <measurement network filter setting> and <measurement current> in order.
220	Open the output file.
230	Repeat the number of times equal to the number of saved data.
240-260	Query the model name, number and date of renewal, and output them to the file.
270	Loop for querying the earth leakage current to patient auxiliary current data
280-300	Read the saved data. If the character returned is only "0", this indicates that there is no data saved for that measuring mode.
310-360	Comma separating positions are searched for one measurement of the data that has been read.
370-430	The measurement data is output to the file. If there is no comma following it, there is no more measurement data, so leave the loop. If there is still a comma, the character string variable is updated to extract the next measurement data.

Example of the output file: DATA.CSV

```
TEST1,001,1997/1/1
+12.12E-03,1,0,1,1,0
+10.23E-03,1,1,2,1,0,0
+4.827E+00,1
+14.32E-03,1,0,2,1,1
+11.42E-03,1,0,2,1,1
+9.871E-03,1,1,3,1,0
+10.01E-03,0,0,3,1,0
TEST1,002,1997/1/1
+13.42E-03,1,0,1,1,0
+10.51E-03,1,1,2,1,0,0
+4.628E+00,1
+13.48E-03,1,0,2,1,1
+11.76E-03,1,0,2,1,1
+9.973E-03,1,1,3,1,0
+10.18E-03,0,0,3,1,0
```

8.11 Troubleshooting

If the RS-232C appears to be malfunctioning, refer to the information below before calling for servicing.

Symptom	Cause / Treatment
The RS-232C has stopped working completely.	Check the cable connection. Check that all the devices are powered on. Check the communication condition setting.
Transmission on the RS-232C is not taking place properly.	Is the controller delimiter set correctly? (Refer to Section 8.5.6, "Delimiters.")
When attempting to read data, the RS-232C bus hangs.	Has any of these transmitted queries resulted in an error? Using the ":SYSTem:ERRor?" query, inspect the error register, and check what type of error has occurred.
Although a command has been transmitted, nothing has happened.	Using the ":SYSTem:ERRor?" query, inspect the error 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.
The response message to a query differs from the display on the front panel of the 3155.	Due to the response message being produced at the instant that the 3155 receives the query, there is a possibility that it may not agree with the display at the instant that the controller reads it in.
Although transmission has been finished, the keys on the 3155 screen remain displayed with a white background, and do not operate.	Did the transmitted data have a delimiter? The 3155 will continue to analyze until a delimiter is received. Stop the program, and transmit a delimiter.
The keys on the 3155 screen do not operate, even if they are pressed.	The keys do not operate during RS-232C communication. Press them after RS232C communication is finished.

Chapter 9
Specifications

9.1 General Specifications

Measurement functions	Leakage current measurement Low resistance measurement
Monitor functions	Line voltage Current consumption of the equipment to be measured Power line ground
Display	5-inch LCD, 320×240 dots (back light)
Operation keys	6×6 matrix touch panel
Recording	Thermal serial printer (paper width: 58 mm)
Clock functions	Auto-calendar, automatic leap year calculation, 24-hour system
Data Storage	Space to store data for 100 unit Data stored: number, model name, maximum value and condition of the equipment to be measured
Operating temperature and humidity range	5 to 40℃(41 to 104˚F), 35 to 80% rh (no condensation)
Storage temperature and humidity range	-10 to 50℃(14 to 122˚F), 35 to 95% rh (no condensation)
Temperature and humidity range to guarantee specification	23±5℃(73±41˚F), 35 to 80% rh (no condensation)
Operating place	Indoors, max. 2000 m(6562 feet) height
Backup battery lifetime	Average of 8 years (at 25℃(17˚F) reference value), for clock, settings, etc.
Backup battery lifetime	Average of 8 years (at 25℃(17˚F) reference value), for clock, settings, etc.
Power supply	Rated power voltage 3155: 120/200/240 VAC (Specify at order.) 3155-01: 110 to 120/200/240 VAC (switchable) (Voltage fluctuations of 10% from the rated supply voltage are taken into account.) Rated power frequency 50/60 Hz
Maximum rated power	30 VA
Insulation resistance	500 VDC, 100 MΩ min. between power supply and frame
Dielectric strength	2.3 kVAC (10 mA), 1 minute between power supply and frame
Maximum rated power of the auxiliary outlet	1500 VA max.
Outlet over-current protection	Over-current cutoff

Dimensions and Mass	212W × 292H × 110D mm(8.35"W × 11.5"H × 4.33"D) (excluding projections), Approx. 4.5 kg (15.9 oz.)
Accessories	Grounded three-core power cord 9170 TEST LEADS Instruction Manual 9195 ENCLOSURE PROBE Spare fuse (3155 120 V: 250 V T0.5 AL) (3155 200/240 V: 250 V T0.25 AL) (3155-01: 250 V T0.2 AL) 9233 RECORDING PAPER (1 roll) 9399 CARRYING CASE (for accessories) Alligator clips (red and black) Outlet power plug (3155 200/240 V and 3155-01 only) Voltage selector key (3155-01 only)2
Options	9497 NETWORK B (for medical electrical equipment) 9498 NETWORK C (for IEC/TR 60990) 9499 NETWORK D (universal) 9461 PIN-TYPE LEADS 9287 CLIP-TYPE LEADS (do not conform to IEC 61010-2-031) 9233 RECORDING PAPER (10 m, 10 rolls) 9196 APPLY UNIT (for patient leakage current II and III measurements, and part of enclosure leakage current measurement) 9190 VOLTAGE APPLY PROBE (attached to the 9196) 9388 CARRYING CASE (with casters)
Standards applying	EMC EN55011:1991 EN50082-1:1992 * EN61000-3-2:1995 EN61000-3-3:1995 Safety EN61010-1:1993+A2:1995 Pollution Degree 2, Overvoltage Category II (anticipated transient overvoltage 2500 V) EN61010-2-031:1994

*Note: Accurate measurement may be impossible in locations subject to strong external electromagnetic fields.
Measurement data by HIOKI:
Electromagnetic field intensity 3V/m (at 27 M to 500 MHz)
Leakage current measurement accuracy +20% rdg. (25 mA range,10 mADC input)
Low resistance measurement accuracy +30% rdg. (50 Ω range, 10 Ω input)

[Recording]

Recording method	Thermal serial printer
Number of dots	16 dots
Recording paper	58 mm × 10 m
Effective recording width	47 mm
Maximum printing speed	41 characters/s
Printed data	1) Data on the equipment to be measured (model name, number and grounding class), 2) Measuring mode, 3) Maximum value, 4) Settings, 5) Judgment

[Storage]

Data stored	Data on the equipment to be measured
Storage capacity	100 units

[Interface]

Interface	RS-232C (1ch)
Connector	D-subminiature 9-pin plug (male)

9.2 Measuring Mode Specifications

9.2.1 Leakage Current Measurement

Measurement method	A current value is calculated and displayed by measuring the voltage drop across a simulated human body resistance (measurement network).
A/D conversion format	Sigma-delta format
Display update rate	5 times/second (moving average display)
Maximum value hold	Maximum leakage current value and power source condition
Permissible measured current	25 mAAC/DC
Permissible common mode voltage	(When using the measurement terminals T1 and T2) 250 VDC+AC peak (for ranges other than 50 μA) 20 VDC+AC peak (for the 50 μA range)
Measured currents	① Earth leakage current ② Enclosure leakage current ③ Patient leakage current I *1 ④ Patient leakage current II *1, *2 ⑤ Patient leakage current III *1, *2 ⑥ Patient auxiliary current*1 (*1: measurable only when using the 9497 NETWORK B) (*2: measurable when using the external power source such as the 9196 APPLY UNIT)
Power source polarity setting	Normal polarity / reverse polarity
Single fault condition setting	Open power lead / open ground
Measurement method setting	Manual / automatic (for a period from 1 to 99 seconds)
Measuring mode	AC / DC / AC+DC / AC peak (Peak measurement can be made only when using the 9498 NETWORK C or the 9499 NETWORK D.)
Measurement range	25 mA /5 mA / 500 μA / 50 μA
Range switching	Full automatic
Frequency characteristics	DC to 1 MHz (DC, AC+DC) / 7 Hz (-3 dB) to 1 MHz (AC)
Temparature coefficient	±(0.04% rdg.+0.5 dgt.)/°C
Input resistance	Measurement terminals T1 and T2: 1 MΩ±2% (with no measurement network installed) Between measurement terminals T1 and T2: 2 MΩ±2% (with no measurement network installed)
Input capacity	terminals T1 and T2) (with no measurement network installed)
CMRR	Between measurement terminals T1 and T2, and frame (within the permissible common mode voltage) 50 μA range: 40 dB min. (at 1 MHz) Ranges other than 50 μA: 40 dB min. (at 100 kHz)

9.2.2 Low Resistance Measurement

Measurement method	DC 4-terminal method
A/D conversion forma	Sigma-delta format
Display update rate	5 times/second (moving average display)
Open terminal voltage	5 V max.
Range switching	Full automatic
Temparature coefficient	±(0.04% rdg.+0.5 dgt.)/℃

9.2.3 Monitor Function

Line voltage / current consumption of the equipment to be measured

Display value	Current consumption (true effective value: crest factor=5 reference value)
A/D conversion format	Sigma-delta format
Sampling	A/D converter toggle
Frequency characteristics	45 Hz to 1 kHz
Temparature coefficient	±(0.1% rdg.+1 dgt.)/℃

Accuracy

Monitored item	Measurement range	Resolution	Accuracy	Display update rate
Line voltage	Operating power voltage range	0.1 V	±(1.0% rdg.+10 dgt.)	Once per second
Current consumption of the equipment to be measured (auto-ranging)	2.00 A to 20.00 A	10 mA	±(1.0% rdg.+6 dgt.)	Once per second
	0 to 2.000 A	1 mA		

Note: Current consumption: auto-ranging

Power source ground monitor

Monitor type	Monitor lamp
Number of monitors	3 (L1-N, L1-L2, L2-N)

9.3 Accuracy Tables

Temperature and humidity range to guarantee specification:
23±5℃, 35 to 80% rh (no condensation)
Warm-up time: 60 minutes min.

Accuracy

The specifications in this manual include figures for "measurement accuracy" when referring to digital measuring instruments, and for "measurement tolerance" when referring to analog instruments.

f.s. (maximum display or scale value, or length of scale)
Signifies the maximum display (scale) value or the length of the scale (in cases where the scale consists of unequal increments or where the maximum value cannot be defined).
In general, this is the range value (the value written on the range selector or equivalent) currently in use.

rdg. (displayed or indicated value)
This signifies the value actually being measured, i.e., the value that is currently indicated or displayed by the measuring instrument.

dgt. (resolution)
Signifies the smallest display unit on a digital measuring instrument, i.e., the value displayed when the last digit on the digital display is "1".

Accuracy of the leakage current meter

NOTE

The accuracy of the leakage current meter is the sum of the following two accuracy values;

- Accuracy value of the 3155 voltmeter (varies depending on the measurement networks fitted)
- Accuracy values of measurement network obtained with specification of measurement networks.

Accuracy value of the 3155 VOLTMETER are shown below.

(1) Ranges for the 9497 NETWORK B

1. Measuring mode: AC/AC+DC

Range (accuracy range)	Resolution	Accuracy: 20 Hz≦f≦10 kHz	Accuracy: DC≦f<20 Hz, 10 kHz<f≦1 MHz
25.00 mA (5 to 25 mA) *1	10 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
5.000 mA (500 μA to 5 mA) *1	1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
500.0 μA (40 to 500 μA) *1	0.1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
50.00 μA (4 to 50 μA) *1, *2	0.01 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)

*1: In the AC measurement mode, frequency response of the high pass filter (fc = 7 Hz) is added.

*2: The setting cannot be made in the patient leakage current Ⅲ measurement mode.

2. Measuring mode: DC

Range (accuracy range)	Resolution	Accuracy
25.00 mA (5 to 25 mA)	10 μA	±(0.2% rdg.+3 dgt.)
5.000 mA (500 μA to 5 mA)	1 μA	±(0.2% rdg.+3 dgt.)
500.0 μA (5 to 500 μA)	0.1 μA	±1.0% f.s.
50.00 μA (1 to 50 μA) *2	0.01 μA	±1.0% f.s.

*2: The setting cannot be made in the patient leakage current Ⅲ measurement mode.

(2) Ranges for the 9498 NETWORK C

1. Measuring mode: AC/AC+DC

Range (accuracy range)	Resolution	Accuracy: 20 Hz≦f≦10 kHz	Accuracy: DC≦f<20 Hz, 10 kHz<f≦1 MHz
25.00 mA (5 to 25 mA) *3	10 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
5.000 mA (500 μA to 5 mA) *3	1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
500.0 μA (40 to 500 μA) *3	0.1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
50.00 μA (4 to 50 μA) *3, *4	0.01 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)

*3: In the AC measurement mode, frequency response of the high pass filter (fc = 7 Hz) is added.

*4: The setting cannot be made in the enclosure leakage current measurement mode.

2. Measuring mode: DC

Range (accuracy range)	Resolution	Accuracy
25.00 mA (5 to 25 mA)	10 μA	±(0.2% rdg.+3 dgt.)
5.000 mA (500 μA to 5 mA)	1 μA	±(0.2% rdg.+3 dgt.)
500.0 μA (5 to 500 μA)	0.1 μA	±1.0% f.s.
50.00 μA (1 to 50 μA) *4	0.01 μA	±1.0% f.s.

*4: The setting cannot be made in the enclosure leakage current measurement mode.

3. Measuring mode: AC peak

Range (accuracy range)	Resolution	Accuracy
75.0 mA (10 to 75 mA)	100 μA	±(2% rdg.+2 dgt.)
10.00 mA (1 to 10 mA)	10 μA	±(2% rdg.+2 dgt.)
1.000 mA (100 μA to 1 mA)	1 μA	±2.5% f.s.
100.0 μA (10 to 100 μA) *4	0.1 μA	±4% f.s.

*4: The setting cannot be made in the enclosure leakage current measurement mode.

(3) Ranges for the 9499 NETWORK D

1. Measuring mode: AC/AC+DC

Range (accuracy range)	Resolution	Accuracy: 20 Hz≦f≦10 kHz	Accuracy: DC≦f<20 Hz, 10 kHz<f≦1 MHz
25.00 mA (5 to 25 mA) *5	10 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
5.000 mA (500 μA to 5 mA) *5, *6	1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
500.0 μA (40 to 500 μA) *5, *6	0.1 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)
50.00 μA (4 to 50 μA) *5, *6, *7	0.01 μA	±(1% rdg.+6dgt.)	±(2% rdg.+10 dgt.)

*5: In the AC measurement mode, frequency response of the high pass filter (fc = 7 Hz) is added.
*6: Indicated ranges are for a resistance of 1 kΩ. For 1.5 kΩ and 2 kΩ, the ranges are 1/1.5 and 1/2 times those indicated above.
*7: The setting cannot be made in the enclosure leakage current measurement mode.

2. Measuring mode: DC

Range (accuracy range)	Resolution	Accuracy
25.00 mA (5 to 25 mA)	10 μA	±(0.2% rdg.+3 dgt.)
5.000 mA (500 μA to 5 mA) *6	1 μA	±(0.2% rdg.+3 dgt.)
500.0 μA (5 to 500 μA) *6	0.1 μA	±1.0% f.s.
50.00 μA (1 to 50 μA) *6, *7	0.01 μA	±1.0% f.s.

*6: Indicated ranges are for a resistance of 1 kΩ. For 1.5 kΩ and 2 kΩ, the ranges are 1/1.5 and 1/2 times those indicated above.
*7: The setting cannot be made in the enclosure leakage current measurement mode.

3. Measuring mode: AC peak

Range (accuracy range)	Resolution	Accuracy
75.0 mA (10 to 75 mA)	100 μA	±(2% rdg.+2 dgt.)
10.00 mA (1 to 10 mA) *6	10 μA	±(2% rdg.+2 dgt.)
1.000 mA (100 μA to 1 mA) *6	1 μA	±2.5% f.s.
100.0 μA (10 to 100 μA) *6, *7	0.1 μA	±4% f.s.

*6: Indicated ranges are for a resistance of 1 kΩ. For 1.5 kΩ and 2 kΩ, the ranges are 1/1.5 and 1/2 times those indicated above.
*7: The setting cannot be made in the enclosure leakage current measurement mode.

Accuracy of the low resistance meter

When measuring with 3157 measuring equipment settings, the accuracy of the 3157 AC GROUNDING HiTESTER is applied.

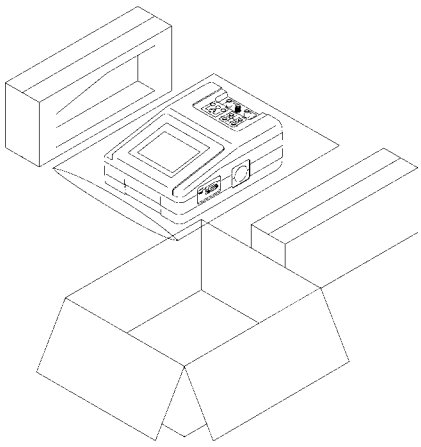
Range	Resolution	Measured current	Accuracy
500.0 Ω	100 mΩ	1 mA	±(0.4% rdg.+5 dgt.)
50.00 Ω	10 mΩ	10 mA	±(0.4% rdg.+5 dgt.)
5.000 Ω	1 mΩ	100 mA	±(0.4% rdg.+5 dgt.)
500.0 mΩ	0.1 mΩ	100 mA	±0.5% f.s.

Chapter 10
Maintenance and Servicing

10.1 Maintenance and Inspection

To ensure the safe operation of this unit, perform maintenance regularly.

- If the unit has been subject to moisture, or if oil and dust have accumulated in the unit interior, the danger of electrical shock or fires resulting from the deterioration of insulation increases greatly. If the unit is ever subject to excessive moisture, oil, or dust, cease use immediately, and return the unit to us for maintenance.
- Periodic calibration is necessary to verify and maintain accuracy. If calibration becomes necessary, return the unit to us for maintenance.
- This product uses a lithium battery to back up it's memory. As the battery power is consumed, it's ability to store saved data and measurement conditions diminishes. In the event that measurement conditions can no longer be stored, please contact the manufacturer for repair service.
- Spare and replacement parts for this product are guaranteed to be available only until 7 years after manufacture of this model is terminated.
- If the unit is not functioning properly, check the batteries, the probe and leads wiring, fuse blowing, and the "Troubleshooting" list. If a problem is found, contact your dealer or HIOKI representative.



Cleaning

- Gently wipe dirt from the surface of the unit with a soft cloth moistened with a small amount of water or mild detergent. Do not try to clean the unit using cleaners containing organic solvents such as benzine, alcohol, acetone, ether, ketones, thinners, or gasoline. They may cause discoloration or damage.
- Wipe the touch panel gently with a dry, soft cloth.

Shipment of the unit

If reshipping the unit, preferably use the original packing.

10.2 Fuse Replacement

10.2.1 Replacement of the 3155 Power Source Fuse

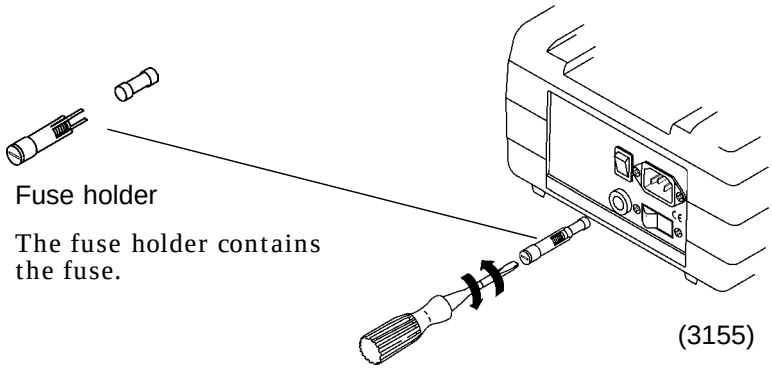
⚠ WARNING

- **To prevent electric shock when replacing the power source fuse, always turn the power switch off and disconnect the power cord, leads and probe before beginning.**
- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death.**

Specified fuses:
3155 (power supply voltage 120 VAC): 250 V T0.5 AL 20 mm × 5 mm dia.
3155 (power supply voltage 200/240 VAC): 250 V T0.25 AL 20 mm ×5 mm dia.
3155-01: 250 V T0.2 AL 20 mm × 5 mm dia.

The power source fuse is on the back of the 3155. Before shipping, the unit is configured to conform to the electricity of the locality where it will be used, and the proper fuse is installed. (A proper spare fuse is also included.) Please consult with us before using the unit with a power source of any other specification.

Replace the blown fuse as follows. (See Figure.)
1. Turn the power OFF, and disconnect the power cord, leads and probe.
2. Using an ordinary screwdriver, press and rotate the fuse holder counter-clockwise to open.
3. Replace the fuse with an equivalent replacement.
4. Replace the fuse holder, and press and rotate it clockwise to close.



(3155)

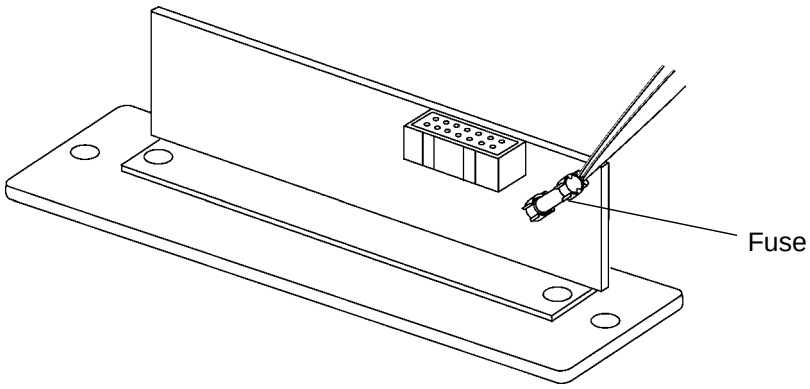
Opening and closing the fuse holder
Opening: Press and rotate it counter-clockwise.
Closing: Press and rotate it clockwise.

10.2.2 Replacement of the Measurement Network Fuse

⚠ WARNING

- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death. Specified fuse: 250 V T0.032 AL 20 mm × 5 mm dia.**
- **When replacing the measurement network, always power off the 3155 before beginning.**

1. Check that both the 3155 and the equipment to be measured are powered off.
   Ckeck that the power cord, probe, leads etc. are not connected to the 3155.
2. Remove the measurement network from its socket in the back of the 3155. After removing the two screws, hold the network by the two knobs, and pull out.
3. The fuse is attached to a fuse holder found on the measurement network board. Slide tweezers lengthwise underneath the fuse, and lift out of the holder.
4. Replace the fuse with an equivalent replacement.
5. Replace the measurement network as described in Section 4.1, "Installing the Measurement Network."



10.2.3 Replacement of the 9196 APPLY UNIT Power Source Fuse

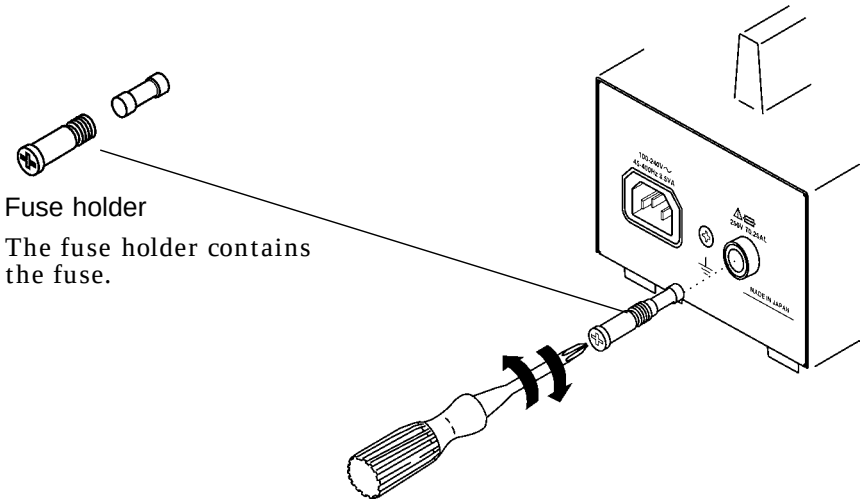
⚠ WARNING

- **To prevent electric shock when replacing the power source fuse, always turn the power switch off and disconnect the power cord and probe before beginning.**
- **Only use fuses of the specified type that is rated for the specified current and voltage. Using a fuse that does not meet the specifications or shorting the fuse holder may cause an accident that might result in injury or death. Specified fuse: 250 V T0.25 AL 20 mm × 5 mm dia.**

The power source fuse is on the back of the 9196.

Replace the blown fuse as follows. (See Figure.)

1. Turn the power OFF, and disconnect the power cord and probe.
2. Using a Phillips screwdriver, rotate the fuse holder counter-clockwise to open.
3. Replace the fuse with an equivalent replacement.
4. Replace the fuse holder, and rotate it clockwise to close.



Opening and closing the fuse holder
Opening: Rotate it counter-clockwise.
Closing: Rotate it clockwise.

10.3 Troubleshooting

If the unit is not functioing properly, check the following items before sending it for repair.

Symptom	What to check	Solution
The screen does not illuminate when the power is turned on.	Is the power cord disconnected?	Connect the power cord.
	Is the contrast setting of the LCD at the lowest?	Adjust the contrast setting.
	Has the fuse blown?	Replace the fuse.
The keys on the LCD do not operate.	Is the unit being remotely controlled through the RS-232C interface?	Stop the RS-232C operation. (The keys do not operate during RS-232C communication.)
There is no power available to the equipment to be measured.	Is the auxiliary outlet breaker turned OFF?	After double checking to be sure that the electrical consumption of the equipment to be measured is less than 1500 VA, turn the breaker ON.
‘The measurement network fuse has blown." is displayed on the LCD.	Is a signal being input to the leakage current measurement terminal T1?	Check after turning the power off and on with nothing connected to to the leakage current measurement terminal T1.

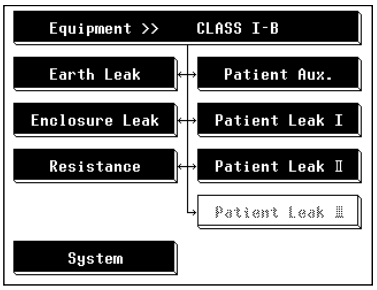
If other operating problems occur which cannot solved immediately, try carrying out a system reset referring to Section 10.4.1, "System Reset." In which case, the time and date settings and saved data are lost

If any of the following should occur, stop using the unit, disconnect the power cord, leads and probe, and contact your dealer or HIOKI representative.

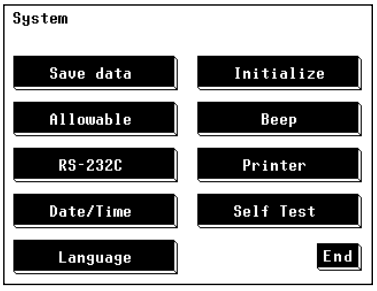
- If you are certain that the unit is damaged.
- If the measurement you wish to perform is inoperative.
- If the unit was stored for a long period of time in high temperatures and humidity, or other undesirable conditions.
- If the unit was damaged in transit.

10.4 System Reset

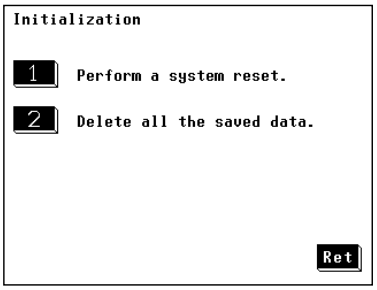
10.4.1 Resetting the system



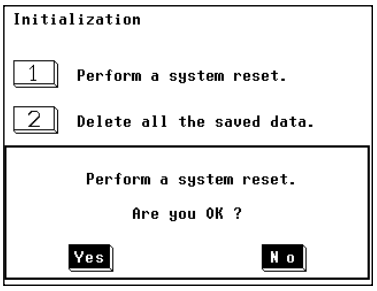
1. On the initial screen, press the System key to move to the system screen.
   (Example: Initial screen for medical electrical equipment)



2. On the system screen, press the Initialize key to move to the initialization screen.



3. Press the 1 key on the initialization screen. A window requesting confirmation will open.



4. Select to either reset the system, or cancel the operation.
   Yes: Return the 3155 to its default settings.
   No: The system is not resetted.

10.4.2 Default Settings

Common settings

The 3155 is shipped without any measurement network installed in it, but the default settings with a measurement network installed are as follows:

Grounding class of the equipment to be measured: Class Ⅰ

System settings			
Saved data	None	Printer contrast	Normal
Beep sound	ON	Allowable value judgment	ON
Time and date	Current (set at time of shipping)	Beep sound for allowable value judgment	OFF
Communications			
Transfer rate	9600 bps	Stop bit	1 bit
Parity	None	Delimiter	CR+LF
Data length	8 bits		
Low resistance measurement			
Allowable value	0.1 Ω		

When the 9498 NETWORK C is installed

Settings for earth leakage current			
Allowable value	3.5 mA	Condition of the equipment to be measured	Normal condition
Measurement method	Manual	Measurement network filter	ON1 (perception and reaction)
Power source polarity	Normal	Measured current	AC+DC
Settings for enclosure leakage current			
Allowable value	3.5 mA	Measurement network filter	ON1 (perception and reaction)
Measurement method	Manual	Measured current	AC+DC
Power source polarity	Normal	Contact condition	Between the enclosure and the earth
Condition of the equipment to be measured	Normal condition		

NOTE When the 9498 NETWORK C is installed, the allowable value of 0.25 mA is set for other than class Ⅰ equipment.

When the 9499 NETWORK D is installed

Settings for earth leakage current			
Allowable value	3.5 mA	Condition of the equipment to be measured	Normal condition
Measurement method	Manual	Measurement network filter	1.5 kΩ
Power source polarity	Normal	Measured current	AC+DC
Settings for enclosure leakage current			
Allowable value	3.5 mA	Measurement network filter	1.5 kΩ
Measurement method	Manual	Measured current	AC+DC
Power source polarity	Normal	Contact condition	Between the enclosure and the earth
Condition of the equipment to be measured	Normal condition		

When the 9497 NETWORK B is installed

Applied part: Type B

Settings for earth leakage current			
Measurement method	Manual	Condition of the equipment to be measured	Normal condition
Power source polarity	Normal	Measurement network filter	ON (frequency characteristics)
Settings for enclosure leakage current			
Measurement method	Manual	Condition of the equipment to be measured	Normal condition
Power source polarity	Normal	Contact condition	Between the enclosure and the earth
		Measurement network filter	ON (frequency characteristics)
Settings for patient leakage current Ⅰ			
Measurement method	Manual	Condition of the equipment to be measured	Normal condition
Power source polarity	Normal	Measurement network filter	ON (frequency characteristics)
		Measured current	AC
Settings for patient leakage current Ⅱ			
Measurement method	Manual	Condition of the equipment to be measured	Single fault condition (110% voltage applied)
Power source polarity	Normal		
		Measurement network filter	ON (frequency characteristics)
Settings for patient auxiliary current			
Measurement method	Manual	Condition of the equipment to be measured	Normal condition
Power source polarity	Normal	Measurement network filter	ON (frequency characteristics)
		Measured current	AC

NOTE

- Single fault condition (110% voltage applied) is performed with the optional 9196 APPLY UNIT etc.
- After a system reset, because the default applied part type setting is type B, the patient leakage current Ⅲ measurement mode is inoperable. After changing the applied part type setting, the following default settings are effected:

Settings for patient leakage current Ⅲ			
Measurement method	Manual	Condition of the equipment to be measured	Single fault condition (110% voltage applied)
Power source polarity	Normal		
		Measurement network filter	ON (frequency characteristics)

Allowable values when the 9497 NETWORK B is installed

Class Ⅰ equipment		Type B applied part		Type BF applied part		Type CF applied part	
		Normal condition	Single fault condition	Normal condition	Single fault condition	Normal condition	Single fault condition
Earth leakage current		0.5 mA	1 mA	0.5 mA	1 mA	0.5 mA	1 mA
Enclosure leakage current		0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.1 mA	0.5 mA
Patient leakage current Ⅰ	DC	0.01 mA	0.05 mA	0.01 mA	0.05 mA	0.01 mA	0.05 mA
	AC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA
	AC+DC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA
Patient leakage current Ⅱ			5 mA				
Patient leakage current Ⅲ					5 mA		0.05 mA
Patient auxiliary current	DC	0.01 mA	0.05 mA	0.01 mA	0.05 mA	0.01 mA	0.05 mA
	AC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA

Class Ⅱ equipment		Type B applied part		Type BF applied part		Type CF applied part	
		Normal condition	Single fault condition	Normal condition	Single fault condition	Normal condition	Single fault condition
Enclosure leakage current		0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.1 mA	0.5 mA
Patient leakage current Ⅰ	DC	0.01 mA	0.05 mA	0.01 mA	0.05 mA	0.01 mA	0.05 mA
	AC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA
	AC+DC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA
Patient leakage current Ⅱ			5 mA				
Patient leakage current Ⅲ					5 mA		0.05 mA
Patient auxiliary current	DC	0.01 mA	0.05 mA	0.01 mA	0.05 mA	0.01 mA	0.05 mA
	AC	0.1 mA	0.5 mA	0.1 mA	0.5 mA	0.01 mA	0.05 mA

Internally powered equipment		Type B applied part		Type BF applied part		Type CF applied part	
		Normal condition	Single fault condition	Normal condition	Single fault condition	Normal condition	Single fault condition
Enclosure leakage current		0.1 mA		0.1 mA		0.1 mA	
Patient leakage current Ⅰ	DC	0.01 mA		0.01 mA		0.01 mA	
	AC	0.1 mA		0.1 mA		0.01 mA	
	AC+DC	0.1 mA		0.1 mA		0.01 mA	
Patient leakage current Ⅱ			5 mA				
Patient leakage current Ⅲ					5 mA		0.05 mA
Patient auxiliary current	DC	0.01 mA		0.01 mA		0.01 mA	
	AC	0.1 mA		0.1 mA		0.01 mA	

10.5 Ultimate Disposal

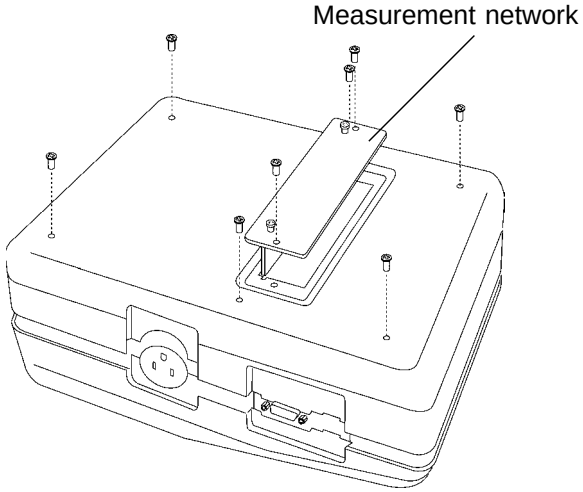
⚠ WARNING

- **To prevent electric shock when removing the lithium battery, always disconnect the power cord, leads and probe.**
- **Dispose of the removed lithium battery in accordance with local regulations.**
- **If the protective functions of the 3155 are damaged, either remove the unit from service or post warnings to prevent others from using the unit inadvertently.**

This unit uses a lithium battery as a power source for recording measurement settings. When disposing of this unit, open the unit, remove the lithium battery and dispose of it properly.

Tools necessary for opening the unit:

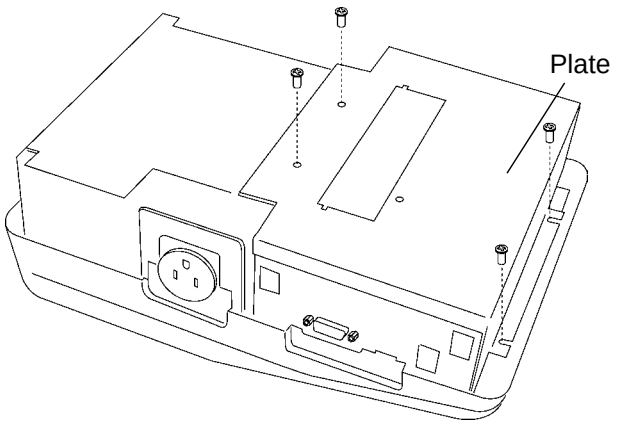
・Phillips screwdriver ・Clippers
・Box wrench (5M)



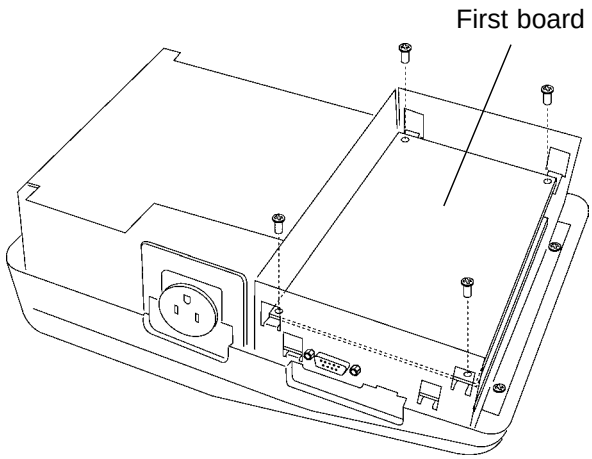
Procedure

(1) Turn OFF the power switch, and disconnect the power cord, lead and probe.

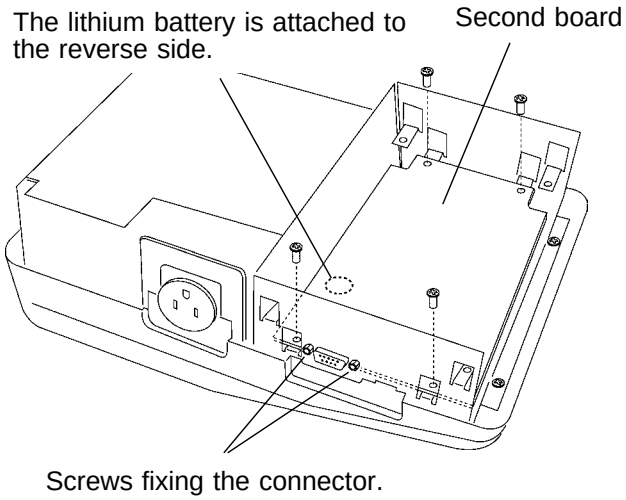
(2) Turn the unit over, and remove the measurement network (2 screws). Next, remove the case bottom (6 screws).



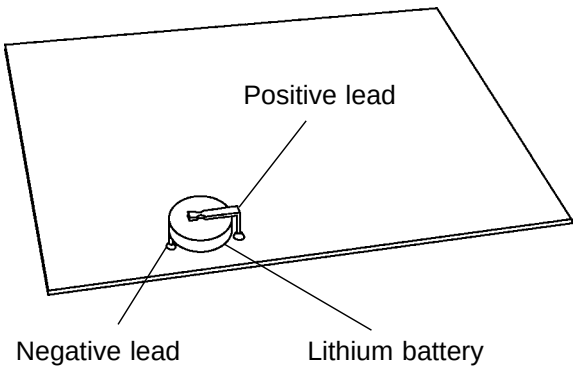
(3) Remove the plate (4 screws).



(4) Remove the 6 cables connected to the first board, and then remove the first board itself (4 screws).



(5) Remove the 6 cables connected to the second board. Use the box wrench to remove the 2 screws fixing the RS-232C connector (D-subminiature 9-pin male), and remove the second board (4 screws).

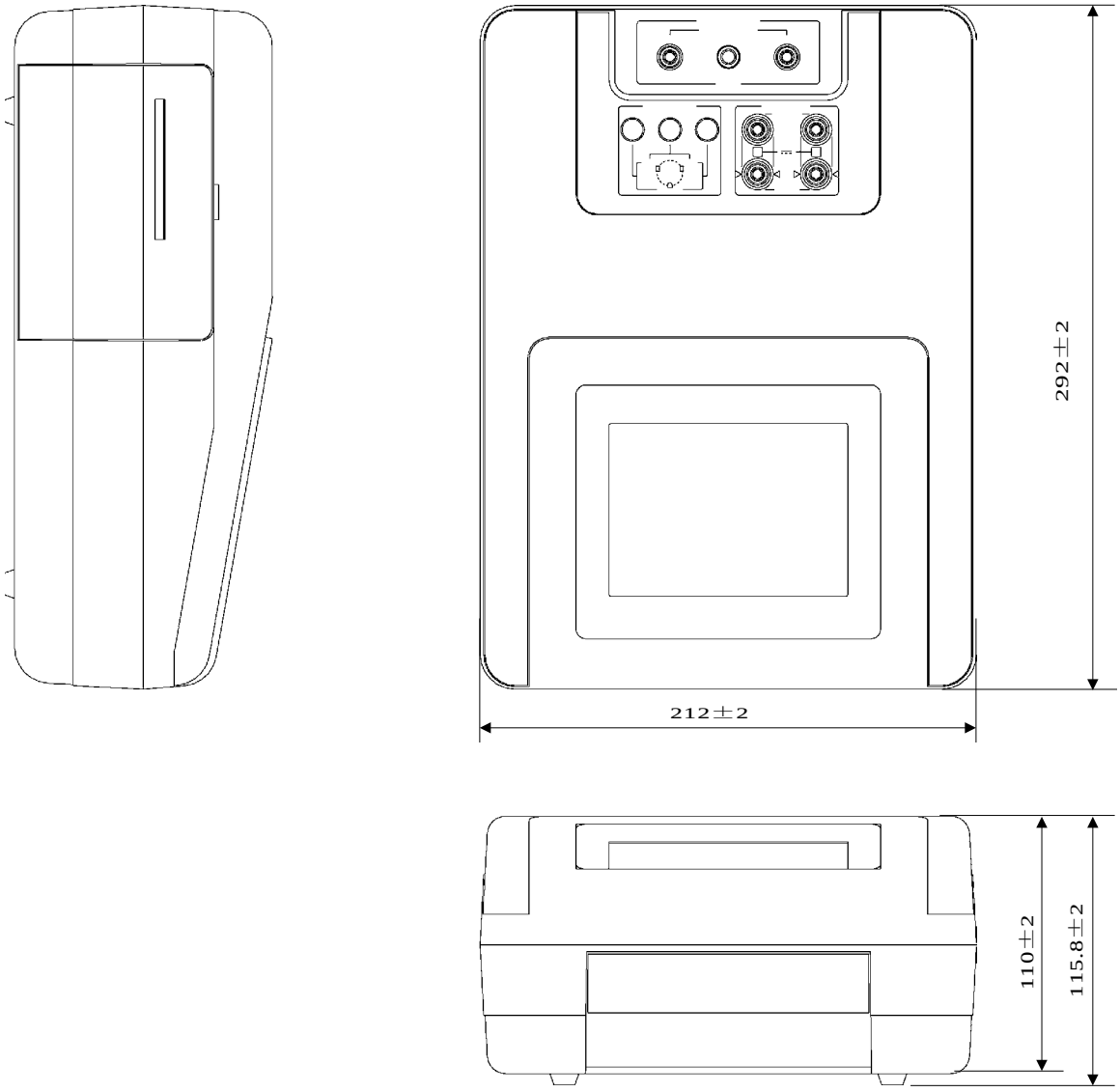


(6) The lithium battery is attached to the reverse side of the second board. Pull out the battery, and cut the positive lead with the clippers.

(7) Pull the battery out a little further.

(8) Cut the negative lead, which was concealed beneath the battery, with the clippers.

10.6 External Dimensions



Appendices

Appendix 1 Error Messages

In the event of an error, the 3155 displays the following messages:

"Measurement Network Fuse blown"

Cause The measurement network fuse is not attached or is blown.
Solution Remove the measurement network and replace the fuse.
For details, refer to Section 10.2.2, "Replacement of the Measurement Network Fuse."

Cause This message may be displayed when a signal is being input to the leakage current measurement terminal T1.
Solution Check after turning the power off and on with nothing connected to it.

"Measurement Network not installed."

Cause No measurement network has been installed on the 3155.
Solution Install the measurement network.
For details, refer to Section 4.1, "Installing the Measurement Network."

"Printout error"

Cause An error has occurred in the built-in printer.
Solution Turn the power off and on to clear the error.

"Print Paper is empty"

Cause Either the printer has no paper, or the paper is not set properly.
Solution Put new paper in the printer if necessary, or set the paper properly.
For details, refer to Section 4.4, "Loading Recording Paper."

"Rest memory is empty"

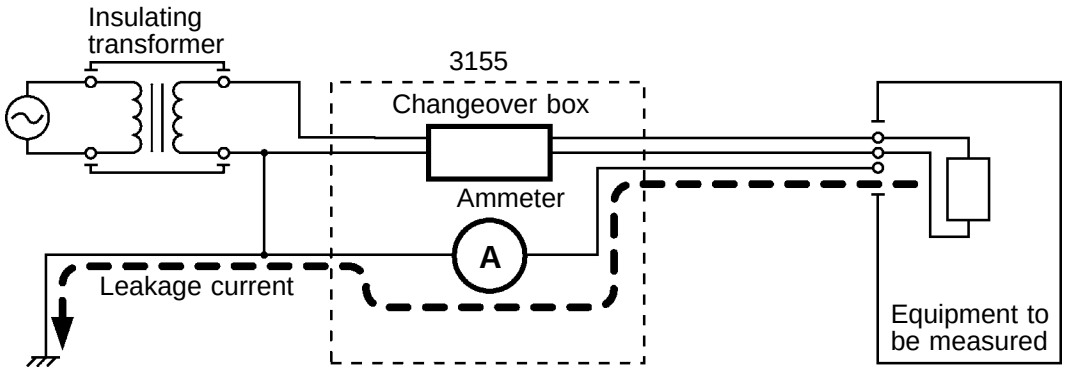
Cause The save data memory is full.
Solution Delete any unnecessary data units before saving the current one.
Up to 2000 entries in 100 data units (models) may be saved.
For details, refer to Section 5.11.2, 6.7.2 or 7.7.2, "Saved Data Reference Screen."

Appendix 2 Leakage Current Measurement

Appendix 2.1 IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03)

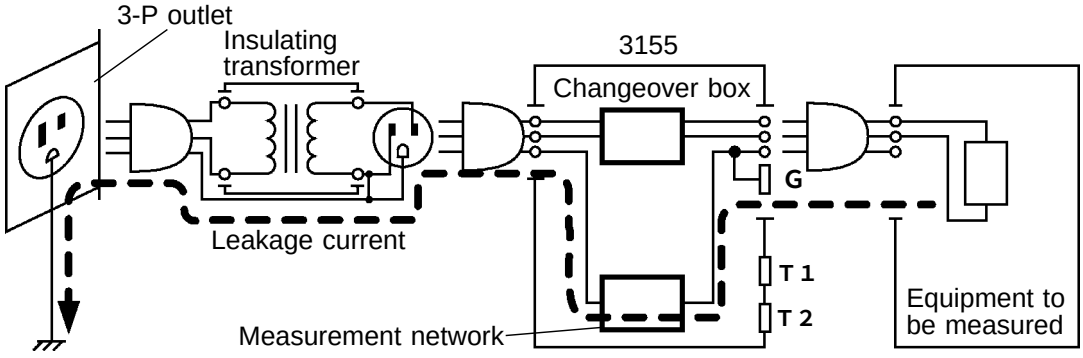
2.1.1 Earth Leakage Current

The term 'earth leakage current' refers to leakage current that flows from the protective earth terminal of the equipment to be measured (class Ⅰ equipment) through the ground wire into the earth.



Earth leakage current concept diagram

The 3155 connects a measurement network between the protective earth conductor of the equipment to be measured and the earth, and measures the current that flows there.



Earth leakage current wiring diagram

NOTE The changeover box in the diagram is a circuit that changes the power source polarity and the condition of the equipment to be measured.

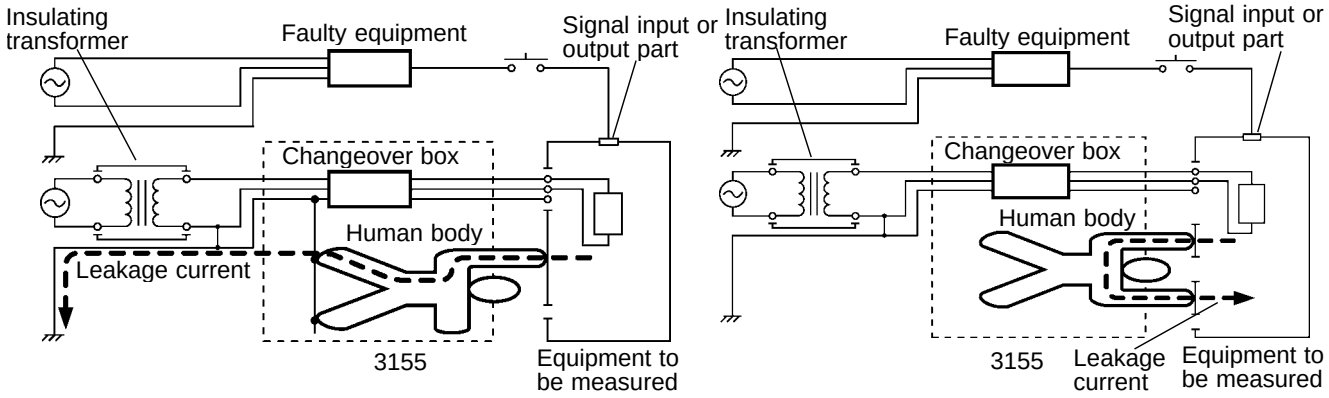
2.1.2 Enclosure Leakage Current

The term 'enclosure leakage current' refers to leakage current that flows from the enclosure of the equipment to be measured, through the body of a person touching the equipment, and into the earth.
The following points are measured.

1. Between the enclosure and the earth (With class Ⅰ equipment, between each part of the enclosure which is not protectively earthed and the earth)
   Using a single 9170 TEST LEAD, connect the measurement network between the enclosure of the equipment to be measured and the earth, and measure the current.
2. Between parts of the enclosure (With class Ⅰ equipment, between parts of the enclosure which is not protectively earthed)
   Using two 9170 TEST LEADS, connect the measurement network between parts of the enclosure of the equipment to be measured, and measure the current. When applying the 110% maximum rated voltage, use the 9196 APPLY UNIT etc. to set the single fault condition.

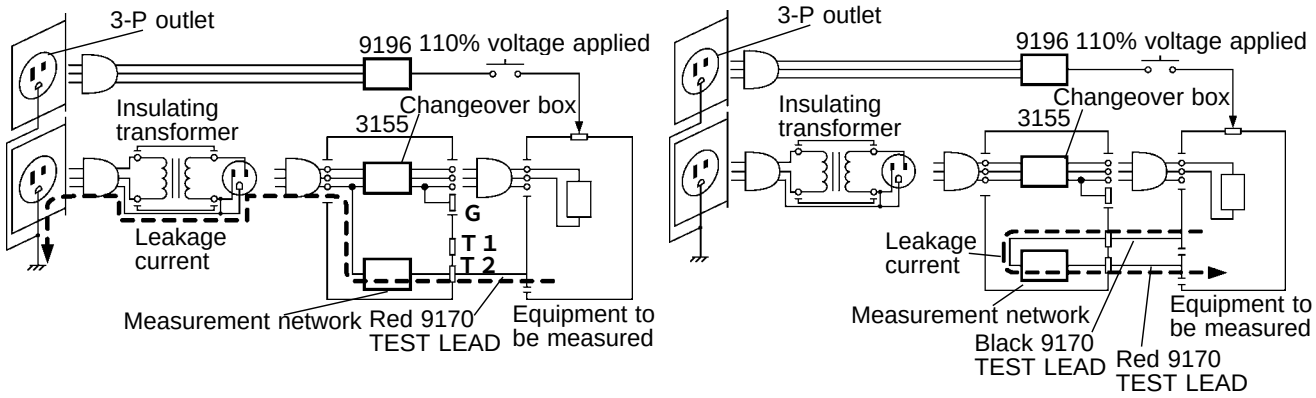
NOTE

For measurements of medical electrical equipment, an additional measurement is made in a single fault condition with the application of 110% of the maximum rated voltage between the signal input or output part which is not protectively earthed and the earth.



1. Between the enclosure and the earth
2. Between parts of the enclosure

Enclosure leakage current concept diagram

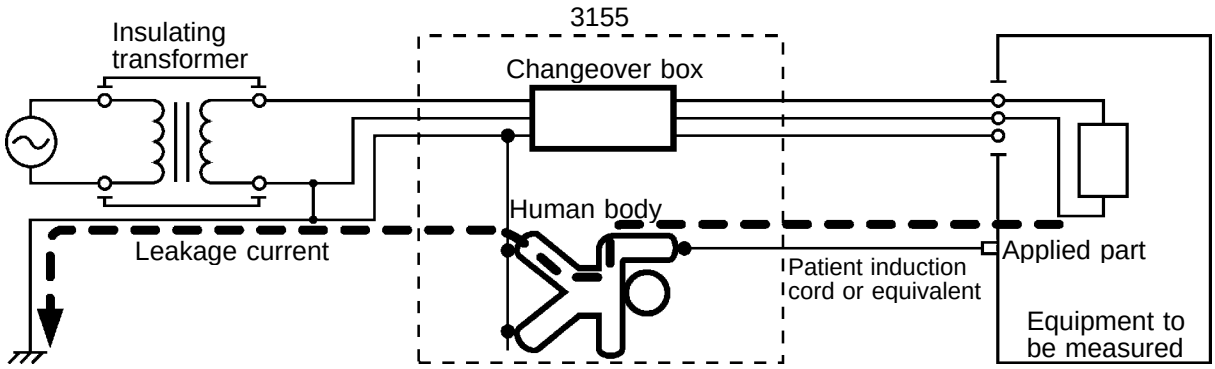


1. Between the enclosure and the earth
2. Between parts of the enclosure

Enclosure leakage current wiring diagram

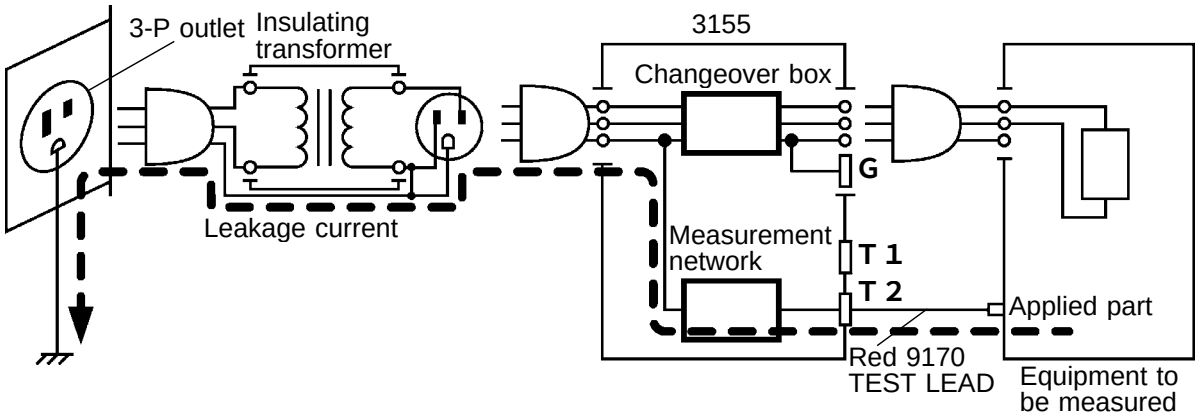
2.1.3 Patient Leakage Current I

The term 'patient leakage current I' refers to leakage current that flows from the applied part of the equipment to be measured, through an induction cord and the body of the patient connected to the equipment to be measured via the induction cord, and into the earth.



Patient leakage current I concept diagram

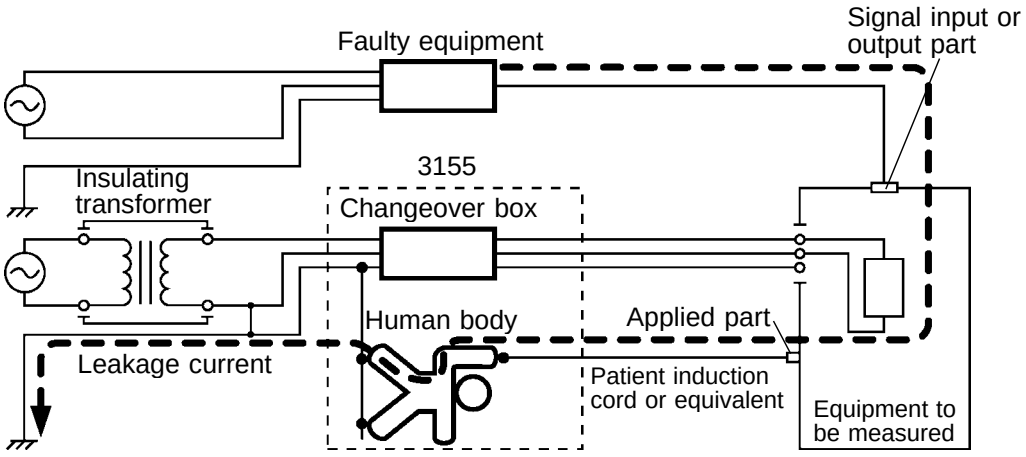
The 3155 connects the measurement network between the applied part of the equipment to be measured and the earth with a single 9170 TEST LEAD, and measure the current.



Patient leakage current I wiring diagram

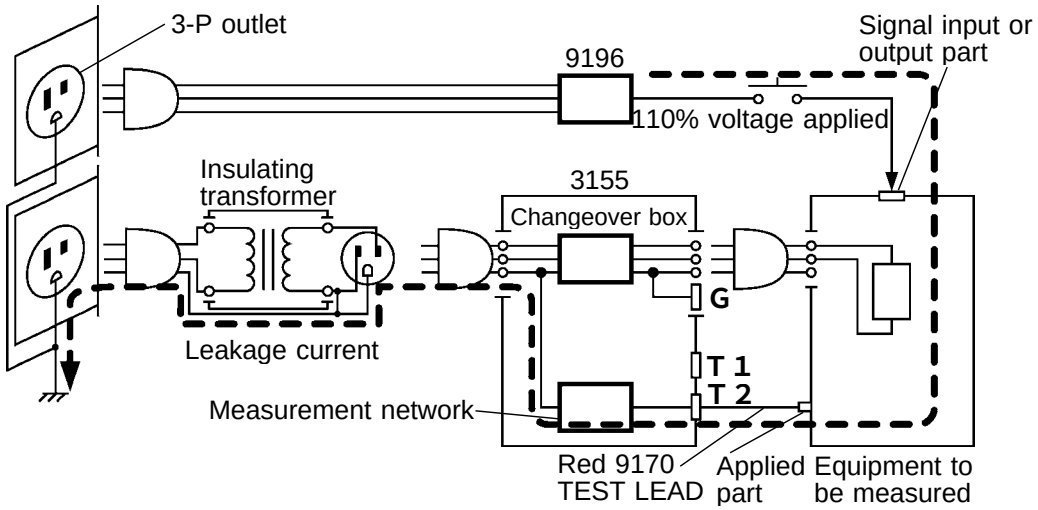
2.1.4 Patient Leakage Current Ⅱ

The term 'patient leakage current Ⅱ' refers to leakage current that flows from the applied part of the equipment to be measured, through an induction cord and the body of the patient connected to the equipment to be measured via the induction cord, and into the earth, when a malfunction of the external equipment connected to the signal input or output part of the equipment to be measured results in ordinary commercial voltage being applied to the signal input or output part of the equipment to be measured.



Patient leakage current Ⅱ concept diagram

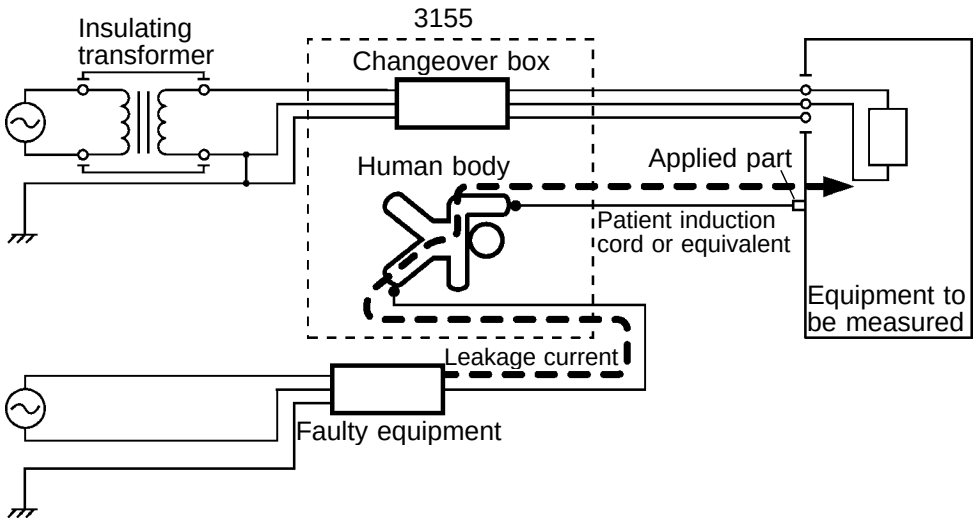
The 3155 connects the measurement network between the applied part of the equipment to be measured and the earth with a single 9170 TEST LEAD, and measure the current. Voltage application to the signal input or output part of the equipment to be measured is made with the 9196 APPLY UNIT or equivalent device.



Patient leakage current Ⅱ wiring diagram

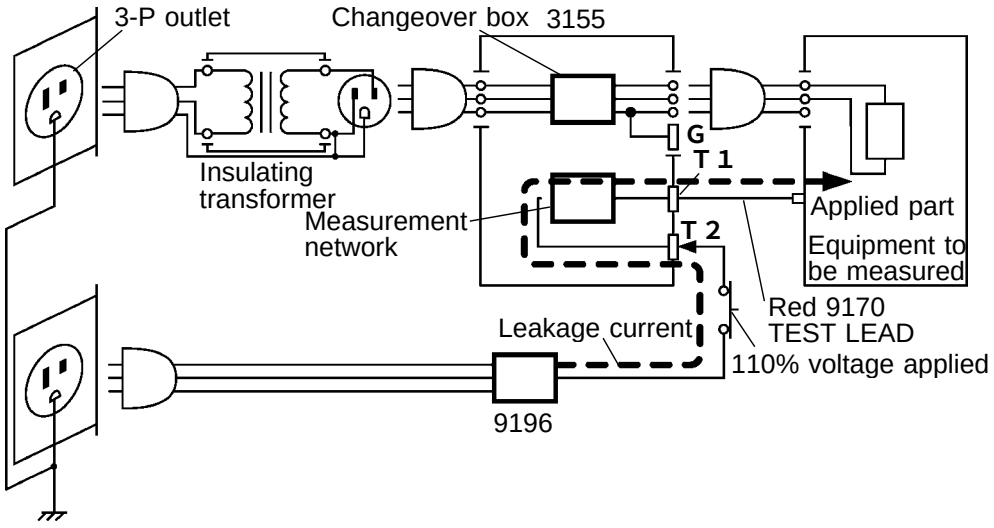
2.1.5 Patient Leakage Current Ⅲ

The term 'patient leakage current Ⅲ' refers to leakage current that flows from the equipment other than the equipment to be measured, through the body of the patient, and into the equipment to be measured, when the patient is connected to both the equipment to be measured and the equipment other than the equipment to be measured, and a malfunction of the equipment other than the equipment to be measured results in ordinary commercial voltage being applied to the patient.
This measurement is made only for the equipment with the F-type applied part.



Patient leakage current Ⅲ concept diagram

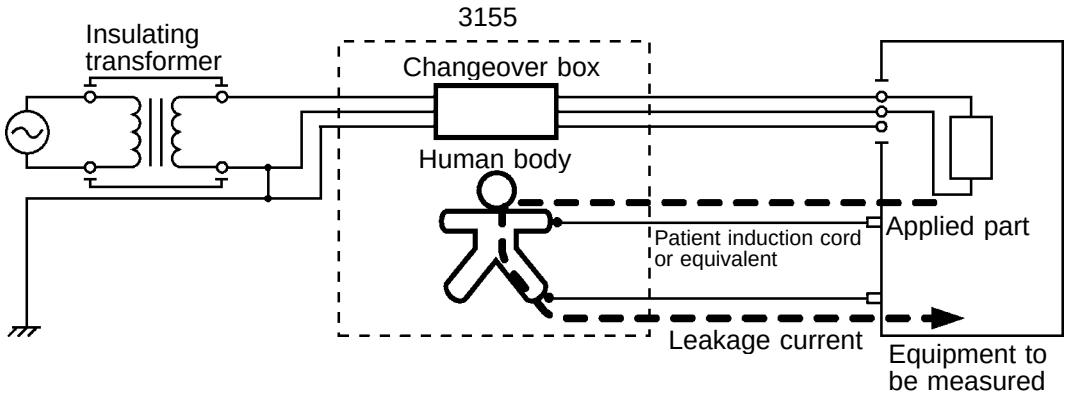
The 3155 connects the measurement network between the voltage application unit (9196 APPLY UNIT or equivalent) and the F-type applied part of the equipment to be measured with a single 9170 TEST LEAD, and measures the current that flows from the measurement network through the F-type applied part and protective earth conductor of the equipment to be measured, and into the earth. Voltage application to the patient (measurement network) is made with the 9196 APPLY UNIT or equivalent device.



Patient leakage current Ⅲ wiring diagram

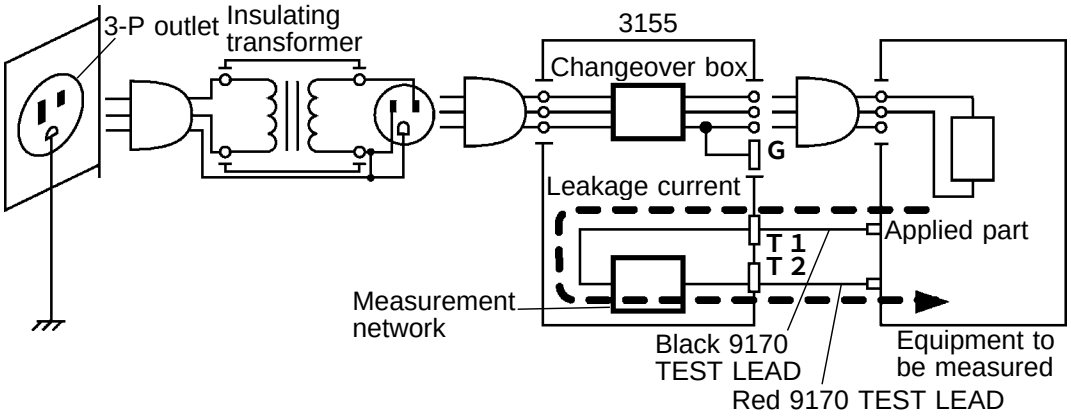
2.1.6 Patient Auxiliary Current

The term 'patient auxiliary current' refers to the current that flows from the applied part to the patient, and back to the applied part, when the patient is connected to the equipment to be measured with an induction cord.



Patient auxiliary current concept diagram

The 3155 connects the measurement network between parts of the applied part of the equipment to be measured with a pair of 9170 TEST LEADS, and measures the current that flows from the applied part to the measurement network, and back to the applied part.



Patient auxiliary current wiring diagram

Appendix 2.2 IEC 60950 (1991-10) + am4 (1996-07)

(1) Earth leakage current measurement (Single-phase equipment)

In this measurement, the auxiliary power socket is not used.

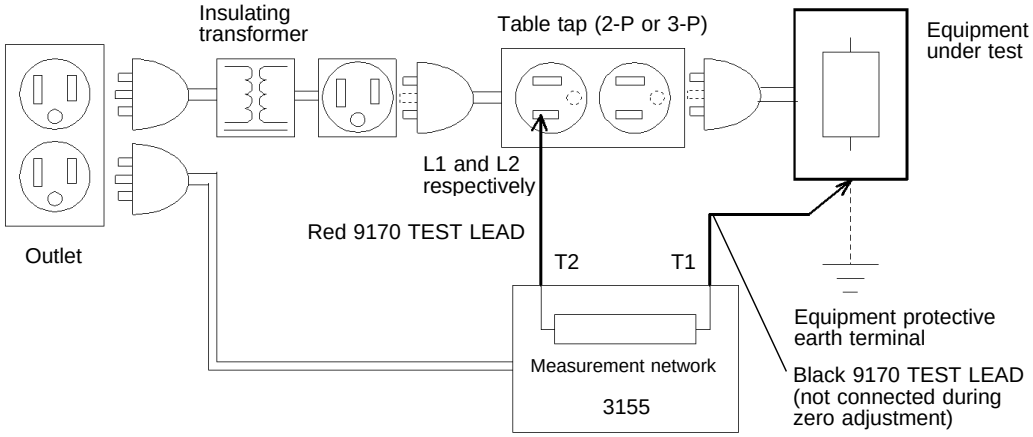
Connect the equipment to be measured to the power source via the table tap and insulating transformer.

Connect the measurement network between the accessible conductive part or accessible non-conductive part and the power line with a pair of 9170 TEST LEADS, and measures the current that flows there.

Main settings of the 3155

Measuring mode: Enclosure leakage current

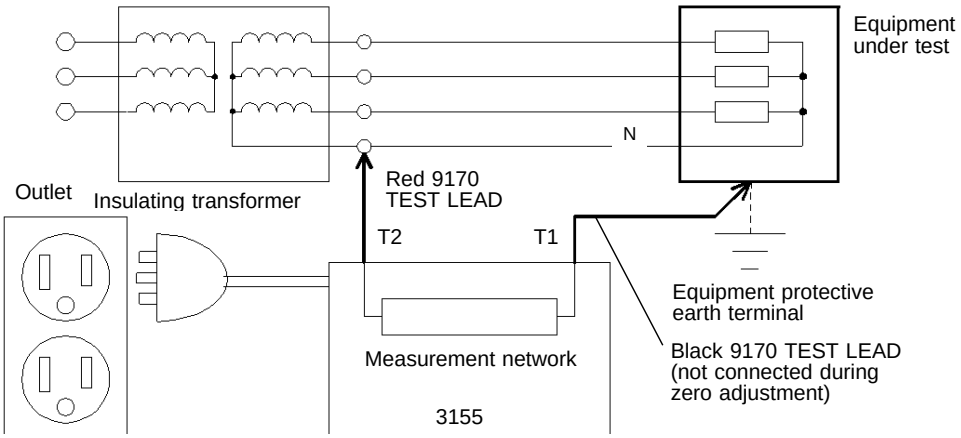
Contact condition: Between the enclosure and the power line



IEC 60950 (1991-10) + am4 (1996-07),
Measurement of earth leakage current on single-phase equipment

(2) Earth leakage current measurement (Three-phase equipment)

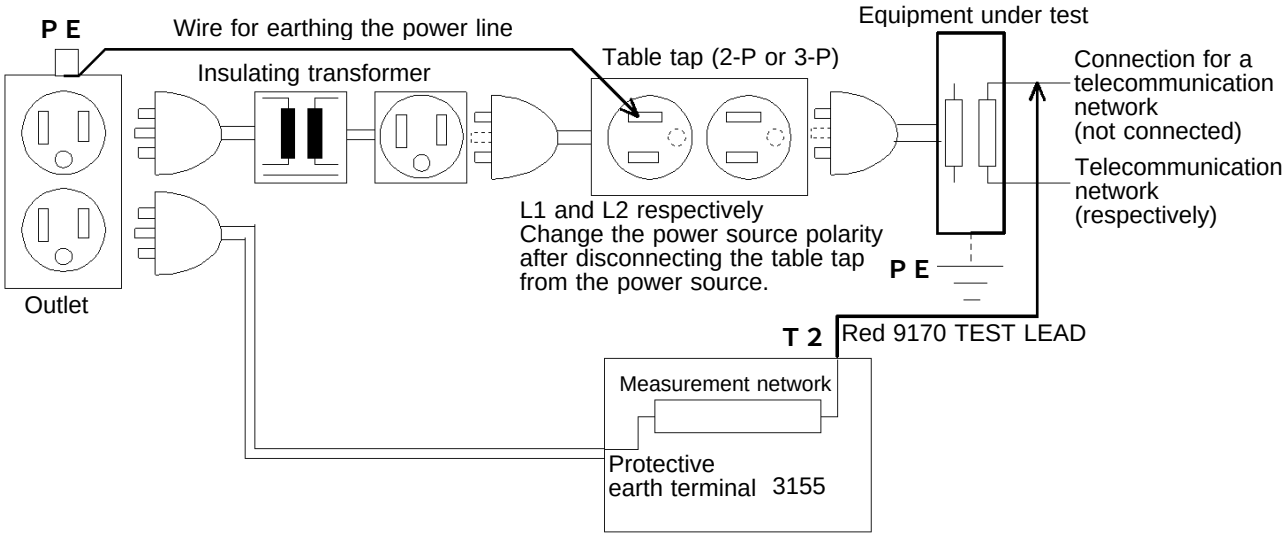
In this measurement, the auxiliary power socket is not used.
Connect the equipment to be measured to the power source via the table tap and insulating transformer.
Connect the measurement network between the accessible conductive part or accessible non-conductive part and the power line (neutral) with a pair of 9170 TEST LEADS, and measures the current that flows there.
Main settings of the 3155
Measuring mode: Enclosure leakage current
Contact condition: Between the enclosure and the power line



IEC 60950 (1991-10) + am4 (1996-07),
Measurement of earth leakage current on three-phase equipment

(3) Measurement of leakage current to a telecommunication network (Single-phase equipment)

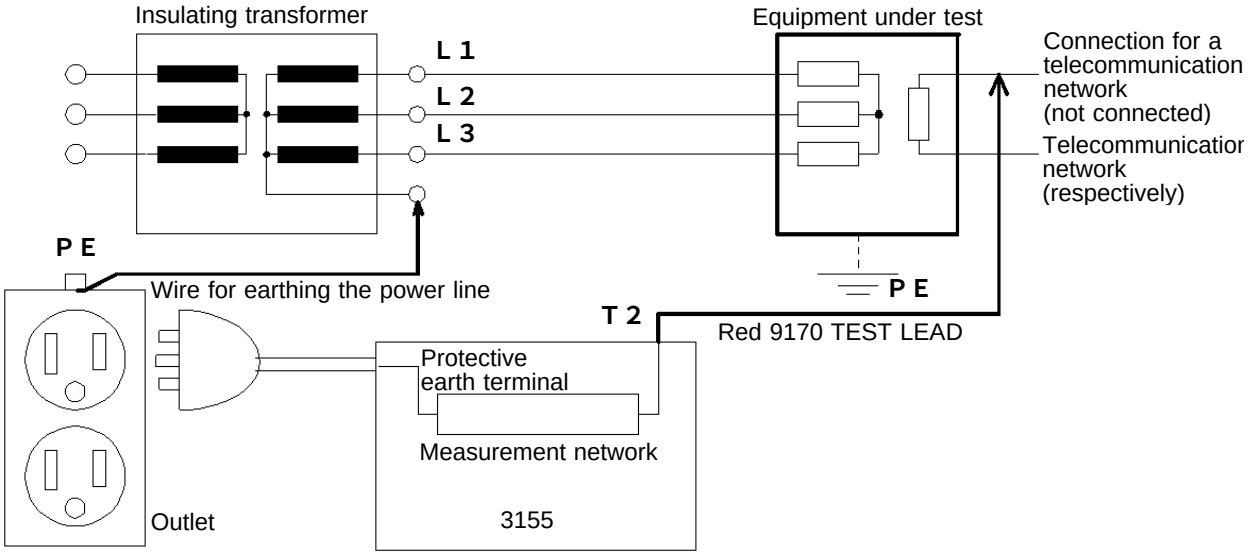
This is measurement of leakage current between the connection for a telecommunication network with nothing connected and the earthed power line.
In this measurement, the auxiliary power socket is not used.
Use wire to earth the power line. Connect the equipment to be measured to the power source via the table tap and insulating transformer.
Connect the measurement network between the connection for a telecommunication network with nothing connected and the earthed power line with a single 9170 TEST LEAD, and measures the current that flows there.
Main settings of the 3155
Measuring mode: Enclosure leakage current
Contact condition: Between the enclosure and the earth



IEC 60950 (1991-10) + am4 (1996-07),
Measurement of leakage current to a telecommunication network (Single-phase equipment)

(4) Measurement of leakage current to a telecommunication network (Three-phase equipment)

This is measurement of leakage current between the connection for a telecommunication network with nothing connected and the earthed power line.
In this measurement, the auxiliary power socket is not used.
Use wire to earth the power line (neutral).
Connect the equipment to be measured to the power source via the insulating transformer.
Connect the measurement network between the connection for a telecommunication network with nothing connected and the earth with a single 9170 TEST LEAD, and measures the current that flows there.
Main settings of the 3155
Measuring mode: Enclosure leakage current
Contact condition: Between the enclosure and the earth



IEC 60950 (1991-10) + am4 (1996-07),
Measurement of leakage current to a telecommunication network (Three-phase equipment)

Appendix 3 Standards for Leakage Current and Current Measurements

Appendix 3.1 When the 9497 NETWORK B is installed

When the 9497 NETWORK B is installed, measurement conforming to the following standard can be made.
Medical electrical equipment Part 1: General requirements of Safety (IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))

3.1.1 Medical Electrical Equipment Part 1: General Requirements of Safety (IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))

The polarity must be switched for leakage current and patient auxiliary current measurements.

(1) Leakage current measurement

Power supply	Maximum rated frequency and 110% of the maximum rated power voltage
Points of measurement	Between the protective earth terminal and the earth (Earth leakage current measurement) Between the enclosure and the earth (Enclosure leakage current measurement) Between parts of the enclosure (Enclosure leakage current measurement) Between the applied part and the earth (Patient leakage current I and II measurements) Between the F-type applied part and the earth (Patient leakage current III measurement) For equipment with the enclosure made of insulated material, attach a 10 cm×20 cm sheet of metallic foil.
Measurement network	1 kΩ // (10k +0.015 μF) (Use an appropriate measurement procedure when current or composite current higher than 10mA with frequency higher than 1kHz is likely to exist.)
Allowable value	0.01 to 5 mA (Refer to Section 5.1, "Leakage Current Measurement Types and Their Allowable Values for Medical Electrical Equipment.")
Condition of the equipment to be measured	Normal condition and single fault condition (Refer to Section 5.1, "Leakage Current Measurement Types measured and Their Allowable Values for Medical Electrical Equipment.")
Measurement	Measure with a voltmeter.

(2) Patient auxiliary current measurement

Points of measurement	Between the applied parts
Allowable value	0.01 to 0.5 mA (Refer to Section 5.1, "Leakage Current Measurement Types and Their Allowable Values for Medical Electrical Equipment.") (The others are the same as leakage current measurement.)

For details, refer to "Medical electrical equipment Part 1: General requirements of Safety (IEC 60601-1 (1988-12) + am1 (1991-11) + am2
(1995-03))."

Appendix 3.2 When the 9498 NETWORK C is Installed

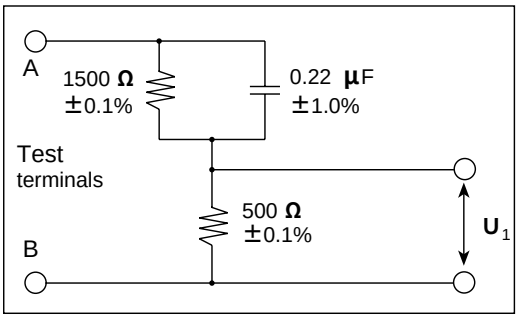
When the 9498 NETWORK C is installed, measurement conforming to the following standard can be made. Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))
The unit also conforms to the following standards:

- Safety of information technology equipment (IEC 60950 (1991-10) + am4 (1996-07))
- Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements (IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07))
- Audio, video and similar electronic apparatus - Safety requirements (IEC 60065(1998-07))
- Applicable UL standards : (Examples : UL1419, UL3101-1, UL3111-1, etc.)

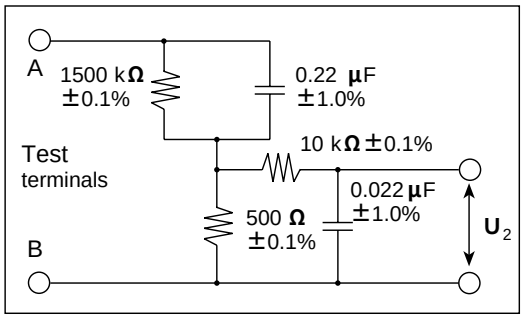
3.2.1 Methods of Measurement of Touch-current and Protective Conductor Current (IEC/TR 60990 (1990-06))

(1) Touch-current measurement

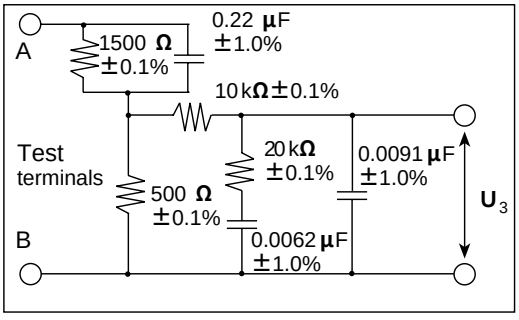
Power supply	For simple voltage rated equipment, the rated voltage + a tolerance that anticipates variances in supply For rated equipment within the nominal voltage range, the maximum voltage in the range + a tolerance that anticipates variances in supply Maximum rated nominal frequency
Point of measurement	Between the accessible part (connected to terminal A) and the earth (connected to terminal B) Between any two accessible parts
Measurement network	(1) Measurement network, unweighted touch-current (2) Measurement network, touch-current weighted for perception/reaction (3) Measurement network, touch-current weighted for let-go



Measurement network, unweighted touch-current



Measurement network, touch-current weighted for perception / reaction



Measurement network, touch-current weighted for let-go

Unweighted touch-current = $U_1/500$ (rms)

Weighted touch-current (perception / reaction) = $U_2/500$ (peak)

Weighted touch-current (let-go) = $U_3/500$ (peak)

Test electrode	Test clip, 10 cm×20 cm sheet of metallic foil
Condition of the equipment to be measured	Normal condition Single fault condition (1) Loss of protective earth connection (2) Neutral open (3) Each phase conductor faulted to earth (4) Each phase conductor open (5) Other faults • Toggle the phase to ground selector and measure. • Toggle the power polarity. • Measure accidental connections.
Measurement	Measure with a voltmeter. • Measured current: DC, true rms, peak • Variance: 2% • Input resistance: 1 MΩ min. • Input capacity: 200 nF • Frequency range: 15 Hz to 1 MHz (For cases of higher frequencies, a higher range is used.) • CMRR: 40 dB min. (up to 1 MHz) • Input section: Floating input or differential input.

(2) Protective conductor current measurement

Point of measurement	Within the protective conductor
Measurement	Measurement taken by inserting an ammeter (with negligible impedance (example: 0.5 Ω) in series with the unit's protective conductor.

Measure in a non-arithmetic manner. For details, refer to "Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))."

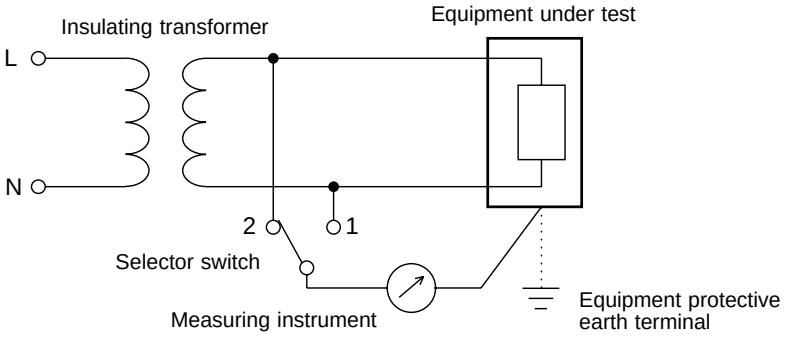
・Audio, video and similar electronic apparatus - Safety requirements (IEC 60065(1998-07))

・Applicable UL standards：（Examples：UL1419、UL3101-1、UL3111-1、etc.）

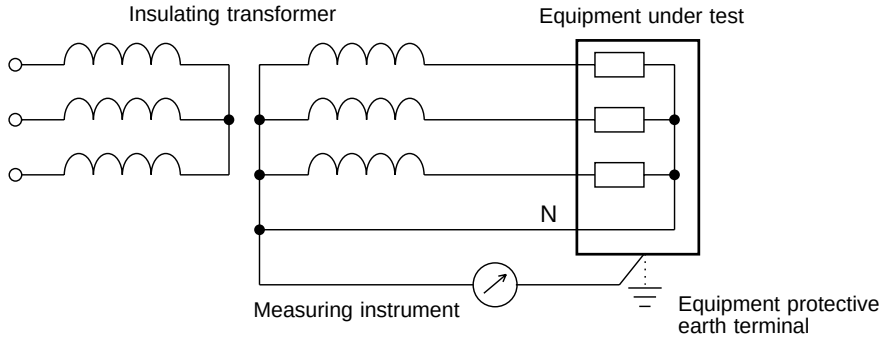
3.2.2 Safety of Information Technology Equipment (IEC 60950 (1991-10) + am4 (1996-07))

(1) Earth leakage current measurement

Power supply	Most unfavorable voltage
Point of measurement	Between the accessible conductive part or accessible measurement non-conductive part and the power line (For class II equipment, use a 10 cm×20 cm sheet of metallic foil.)
Measurement network	Same as "Measurement network, touch-current weighted for perception / reaction" in Appendix 3.2.1, "Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))"
Measurement	Measure with an insulated transformer. Measure with a voltmeter. • Measured current: true rms • Variance: 2% max. • Input resistance: 1 MΩ min. • Input capacity: 200 nF max. • Frequency range: 15 Hz to 1 MHz
Allowable values	(1) Class II equipment (all types) 0.25 mA (2) Class I equipment • Hand-held type 0.75 mA • Movable type 3.5 mA • Fixed / pluggable type 3.5 mA • Fixed / permanently connected or pluggable type B 3.5 mA (for currents of more than 3.5 mA, 5% input current)



Test circuit for earth leakage current on single-phase equipment



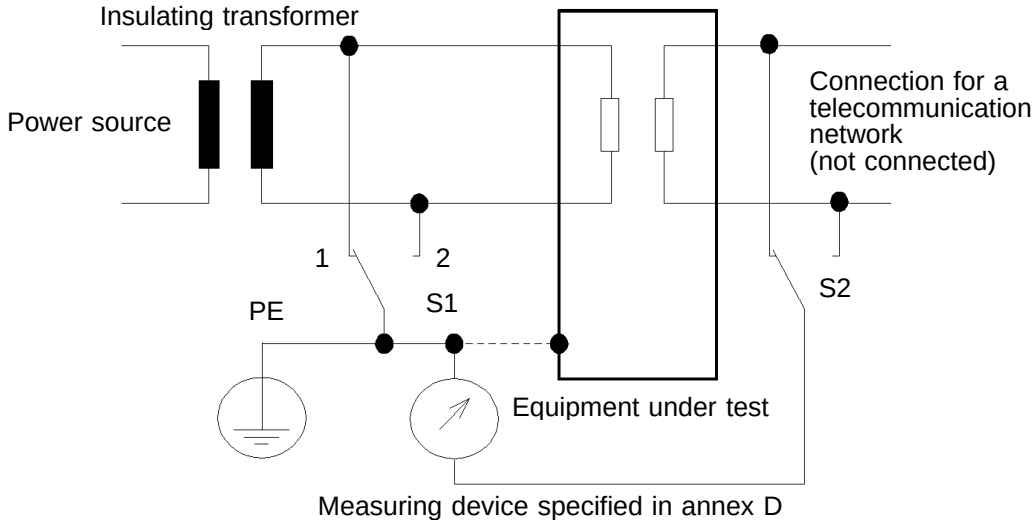
Test circuit for earth leakage current on three-phase equipment

(2) Measurement of leakage current to a telecommunication network

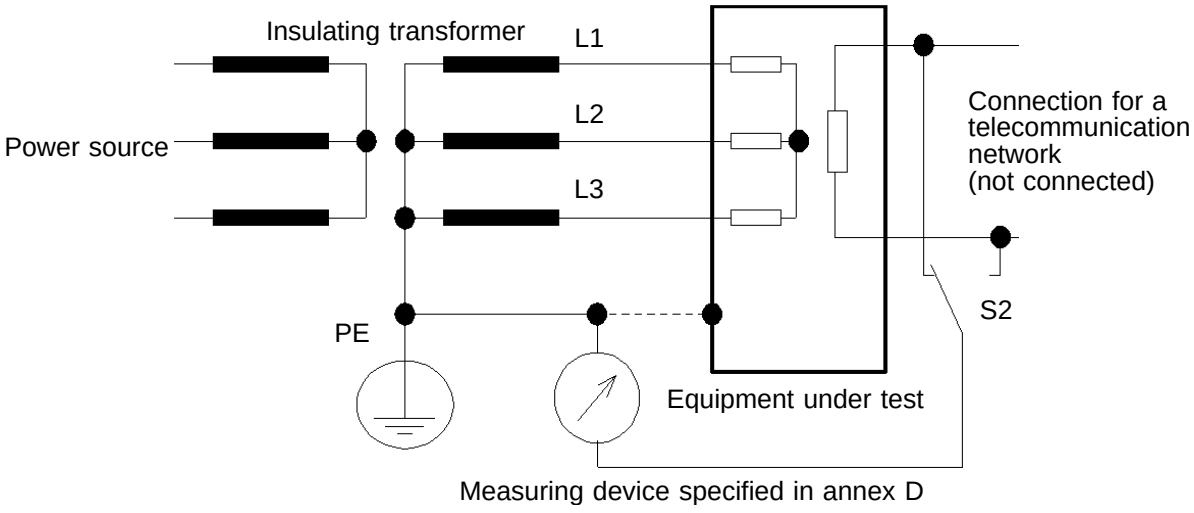
Point of measurement	Between the connection for a telecommunication network and the power line (Nothing other than the measuring device is not connected to the connection for a telecommunication network.)
Allowable value	0.25 mA (rms)

(The others are the same as earth leakage current measurement.)

* Change the power source polarity (normal polarity / reverse polarity) and the connection for a telecommunication network, and measure.



Test circuit for leakage current to a telecommunication network (Single-phase equipment)



Test circuit for leakage current to a telecommunication network (Three-phase equipment)

For details, refer to "Safety of information technology equipment (IEC 60950 (1991-10) + am4 (1996-07))."

3.2.3 IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07)

Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements (IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07))

Current measurement	For cases where the voltage between the accessible part and the reference test earth is larger than the values shown below, measure the voltage and capacity. In the normal condition 30 Vrms as well as 42.4 V peak or 60 VDC In the single fault condition 50 Vrms as well as 70 V peak or 120 VDC (for transient voltage, value measured at both ends of a 50 kΩ resistor)
Current measurement (allowable limit for the accessible part)	For cases where the voltage between the accessible part and the reference test earth is larger than the values shown below, measure the voltage and capacity. In the normal condition 30 Vrms as well as 42.4 V peak or 60 VDC In the single fault condition 50 Vrms as well as 70 V peak or 120 VDC (for transient voltage, value measured at both ends of a 50 kΩ resistor)
Power supply	90 to 110% of the rated power voltage Any rated frequency
Point of measurement	Between the accessible part and the reference test earth
Measurement network	(1) A.1 (DC and AC frequencies up to 1 MHz) 1.5 kΩ // 0.22 μF+500 Ω // (10 kΩ+0.022 μF) Same as "Measurement network, touch-current weighted for perception / reaction" in Appendix 3.2.1, "Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))" (2) A.2 (DC and AC with sinusoidal frequencies up to 100 Hz) 2000 Ω (3) A.3 (Electrical burn at high frequencies) 1.5 kΩ // 0.22 μF+500 Ω Same as "Measurement network, unweighted touch-current" in Appendix 3.2.1, "Methods of measurement of touch-current and protective conductor current (IEC/TR 60990 (1990-06))"
Allowable values In normal condition	• Measured with A.1 Sine wave, 0.5 mArms Non-sine wave or mixed frequencies, 0.7 mA paek or 2 mADC (For frequencies of less than 100Hz, measurement with A.2 is permissible.) • Measured with A.3, 70 mArms In single fault condition • Measured with A.1 Sine wave, 3.5 mArms Non-sine wave or mixed frequency, 5 mA paek or 15 mADC (For frequencies of less than 100Hz, measurement with A.2 is permissible.)
Measurement	Measure with a voltmeter. (For A.2, measurement with an ammeter is permissible.)

For details, refer to "Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements (IEC 61010-1 (1990-09) + am1 (1992-09) + am2 (1995-07))."

Appendix 4 Glossary (Extracted from IEC 60601-1 (1988-12) + am1 (1991-11) + am2 (1995-03))

EQUIPMENT parts	
TYPE B APPLIED PART 	APPLIED PART complying with the specified requirements of this Standard to provide protection against electric shock, particularly regarding allowable LEAKAGE CURRENT and marked with the symbol on the left. NOTE: TYPE B APPLIED PARTS are not suitable for DIRECT CARDIAC APPLICATION.
TYPE BF APPLIED PART 	F-TYPE APPLIED PART complying with the specified requirements of this Standard to provide a higher degree of protection against electric shock than that provided by TYPE B APPLIED PARTS and marked with the symbol on the left. NOTE: TYPE BF APPLIED PARTS are not suitable for DIRECT CARDIAC APPLICATION.
TYPE CF APPLIED PART 	F-TYPE APPLIED PART complying with the specified requirements of this Standard to provide a higher degree of protection against electric shock than that provided by TYPE BF APPLIED PARTS and marked with the symbol on the left.
F-TYPE ISOLATED (FLOATING) APPLIED PART (hereinafter referred to as F-TYPE APPLIED PART)	APPLIED PART isolated from other parts of the EQUIPMENT to such a degree that no current higher than the PATIENT LEAKAGE CURRENT allowable in SINGLE FAULT CONDITION flows if an unintended voltage originating from an external source is connected to the PATIENT, and thereby applied between the APPLIED PART and earth.
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: - necessarily comes 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.
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.
SIGNAL INPUT PART	Part of EQUIPMENT, not being an APPLIED PART, intended to receive input signal voltages or currents from other equipment, for example, for display, recording or data processing.

SIGNAL OUTPUT PART	Part of EQUIPMENT, not being an APPLIED PART, intended to deliver output signal voltages or currents to other equipment, for example, for display, recording or data processing.
PATIENT CONNECTION	Every individual part of the APPLIED PART through which current can flow between the PATIENT and the EQUIPMENT in NORMAL CONDITION or SINGLE FAULT CONDITION.

EQUIPMENT types (classification)	
MEDICAL ELECTRICAL EQUIPMENT (hereinafter referred to as EQUIPMENT)	Electrical EQUIPMENT, provided with not 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.
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 the 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.
INTERNALLY POWERED EQUIPMENT	EQUIPMENT able to operate from an INTERNAL ELECTRICAL POWER SOURCE.
MOBILE EQUIPMENT	TRANSPORTABLE EQUIPMENT intended to 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 the SUPPLY MAINS by means of a permanent connection which can only be detached by the use of a TOOL.

Miscellaneous	
BASIC INSULATION	Insulation applied to LIVE parts to provide basic protection against electric shock.
DOUBLE INSULATION	Insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION.
REINFORCED INSULATION	Single insulation system applied to LIVE parts which provides a degree of protection against electric shock equivalent to DOUBLE INSULATION under the conditions specified in this Standard.
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 protective earthing system by a PROTECTIVE EARTH CONDUCTOR.
NORNAL CONDITION	Condition in which all means provided for protection against SAFETY HAZARDS are intact.
SINGLE FAULT CONDITION	Condition in which a single means for protection against a SAFETY HAZARD in EQUIPMENT is defective or a single external abnormal condition is present.

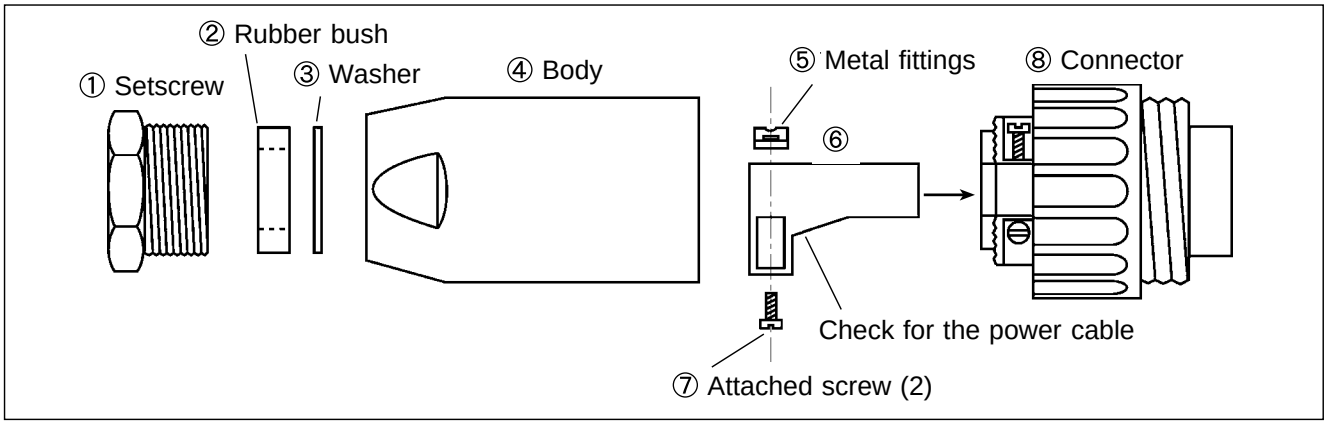
Appendix 5 Assembling the Supplied Power Plug

This section describes how to assemble the supplied power plug.

Procedure

(1) Pass the power plug through ① to ④.
(2) Strip each wire of the power cable as much as required, and fix them in ⑧ with the screws.
1: HOT
2: COLD
3: N.C
⏚: EARTH (GROUND)
(Use an ordinary screwdriver with the tip width of 3 mm.)
(3) Attach ⑥ to ⑧, hold the power cable with ⑤, and fix it with ⑦.
(Use an ordinary screwdriver with the tip width of 3 mm.)
(4) Screw ④ into ⑧.
(5) Attach ③, ② and ① to ④ in order, and fix the power cable firmly by turning ①.

Exploded view



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- T -

- U -

- V -

- W -

- Z -

- Others -

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: 3155, 3155-01
Product Options: 9497 NETWORK B
9498 NETWORK C
9499 NETWORK D
9170 TEST LEADS
9461 PIN-TYPE LEADS
Separately Available Accessories:
9196 APPLY UNIT
9190 VOLTAGE APPLY PROBE

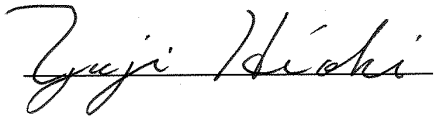
The above mentioned product conforms to the following product specifications:

Safety: EN61010-1:1993+A2:1995
EN61010-2-031:1994
EMC: EN55011:1991 Group1 ClassB
IEC801-2:1991/EN50082-1:1992 ±4kV CD ±8kV AD
IEC801-3:1984/EN50082-1:1992 3V/m
IEC801-4:1988/EN50082-1:1992 1kV
EN61000-3-2:1995
EN61000-3-3:1995

Supplementary Information:
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

HIOKI E.E. CORPORATION

1 September 1998



Yuji Hioki
President

3155A999-02

HIOKI 3155 (-01) LEAK CURRENT HiTESTER

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