

## NEW 3155-01 LEAK CURRENT HiTESTER

Electronic Measuring Instrument



Compliant with IEC and UL standards

## Leakage Current Measurement Essential for Electrical Safety

**CE** CE marking relates to EU (European Union) safety regulations, and is required for specified products marketed within the EU. CE marking indicates that the product complies with all of the safety restrictions of relevant EC directives.  
\* The 3155-01 has been designed to comply with IEC 1010 and EMC standards, in accordance with EC directives.

**IEC 1010** International safety standard relating to electrical measurement, control and laboratory equipment. The object of this standard is to lay down conditions to be met by electronic equipment to provide appropriate protection against accident and injury to users, and to specify test procedures for showing that the conditions are met.

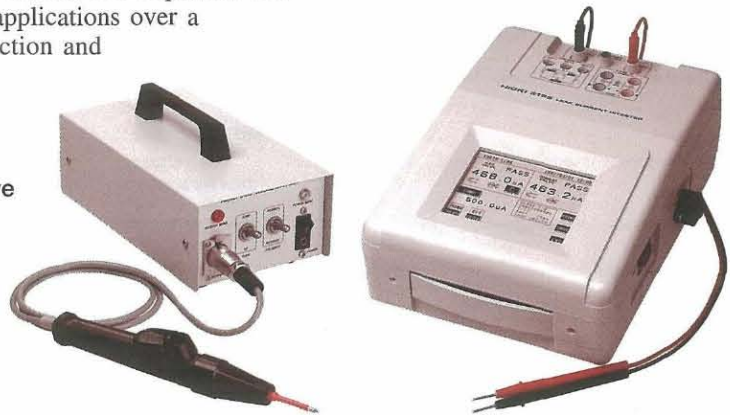
**EMC** Electromagnetic compatibility: when both EMI (electromagnetic interference: emission = not emitting electromagnetic interference) and EMS (electromagnetic susceptibility: immunity = not suffering from effects of electromagnetic interference) measures are taken, this is referred to as electromagnetic compatibility, and means that EMC measures have been taken.

Leakage currents can have serious effects on the human body, and the IEC and UL standards specify test methods, tester characteristics, limit values for leakage currents, and so on. The 3155-01 LEAKCURRENT HiTESTER is a single unit which, by changing the selection of a network, meets IEC requirements for measuring leakage currents in different applications from general-purpose electrical installations to medical electrical equipment and hospital electrical installations.

# Leakage current measurement complying with IEC and UL standards

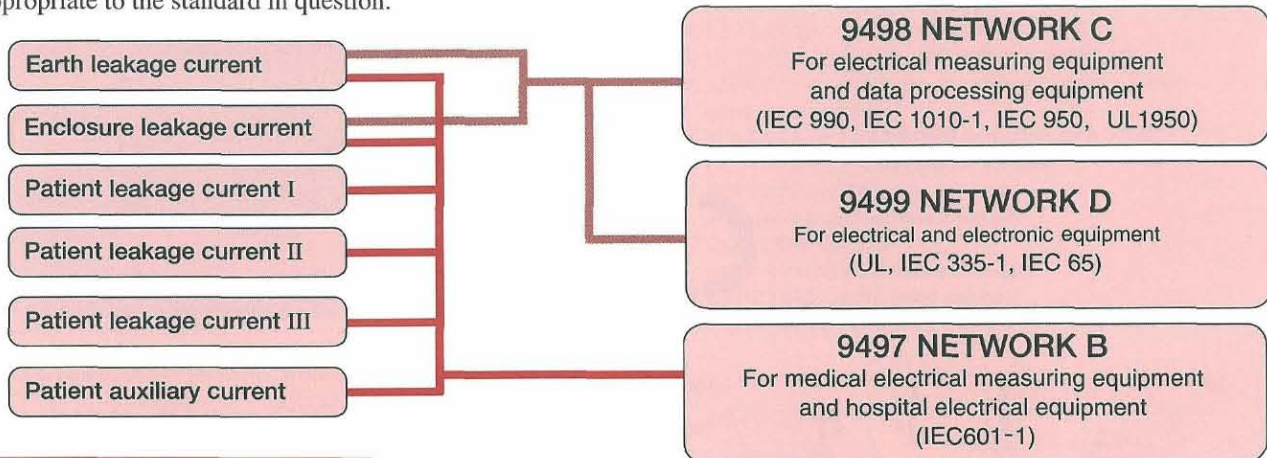
To prevent the danger of electric shock, live parts in electrical equipment are always insulated from the parts which might be touched. The insulation however, has only a finite resistance, and therefore, there are always leakage currents flowing, and over time, as the insulation deteriorates, the leakage currents correspondingly change. To ensure safe operation of the equipment, periodic checks are required. The 3155-01 LEAK CURRENT HiTESTER will find applications over a wide range from equipment manufacture to inspection and maintenance.

- Inspection, repair, maintenance, and testing of medical electrical equipment
- Work in progress on operating theaters, intensive care units, and coronary care units
- Type approval for general-purpose electrical equipment
- Equipment maintenance
- Inspection during manufacture
- Design and evaluation of equipment



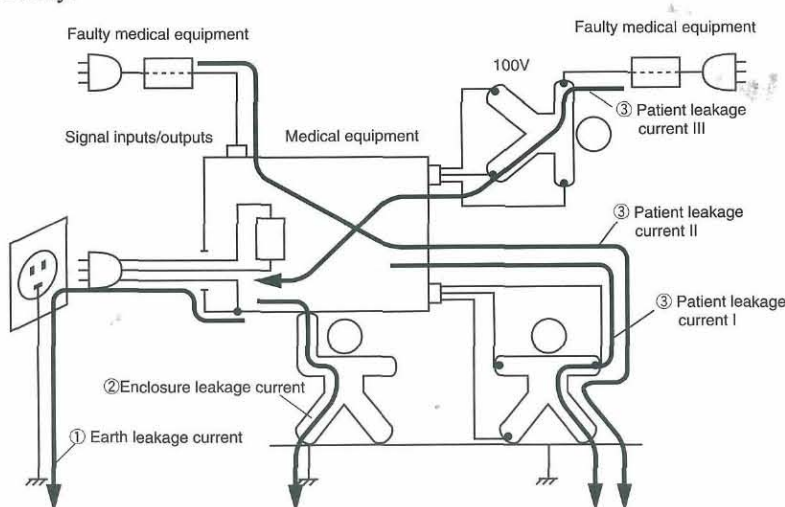
## Network types and applications

Different networks are required by different standards. When carrying out measurement, use the network appropriate to the standard in question.



## Types of leakage current

The leakage current is measured by with a network simulating the part of the circuit which corresponds to the human body.



### ① Earth leakage current

A current flowing from the power supply through the interior or surface of the insulation to the protective ground line.

### ② Enclosure leakage current

A current flowing from a part of the enclosure which during normal use can be touched by an operator or patient either to ground or to another part of the enclosure, through an external conductor other than the protective ground

### ③ Patient leakage current

A current flowing from the device through the patient to ground.

### ④ Patient auxiliary current

A current flowing between contacts which during normal use are connected through the patient, with no intended physiological effect.



# True rms value measurement, supporting distorted waveforms

## Principal Feature and Functions

### ■ Measurement standards

This unit meets IEC and UL standards for measuring leakage currents.

### ■ Automatic measurement

Measurement in a single-fault condition, such as a power supply line break, a grounding line break, or power supply polarity error, can be carried out automatically, and the maximum value displayed. An arbitrary delay time (0 to 99 s) can be set for measurement.

### ■ Simple interactive operating interface

The unit uses a matrix touch panel: simply touch the required item on the panel to select it. Operation is extremely straightforward.

### ■ Monitoring functions

It is possible to monitor the power supply voltage or the current consumption of the equipment being measured. It is also possible to check the grounding of the power supply line and other items from the indicators.

### ■ Breaker for measured equipment

The breaker shuts off an excess current flowing to the outlet for the measured equipment.

### ■ Stores data for 100 units

The tester holds 100 sets of data, including device number, model, grounding class, and measurement data.

### ■ RS-232C fitted as standard

Measurement results can be transferred to a computer, or the RS-232C interface can be used for complete remote control of the unit, for production line and other automatic testing applications.

### ■ Low resistance measurement mode

(Measurement current does not comply with standards.)

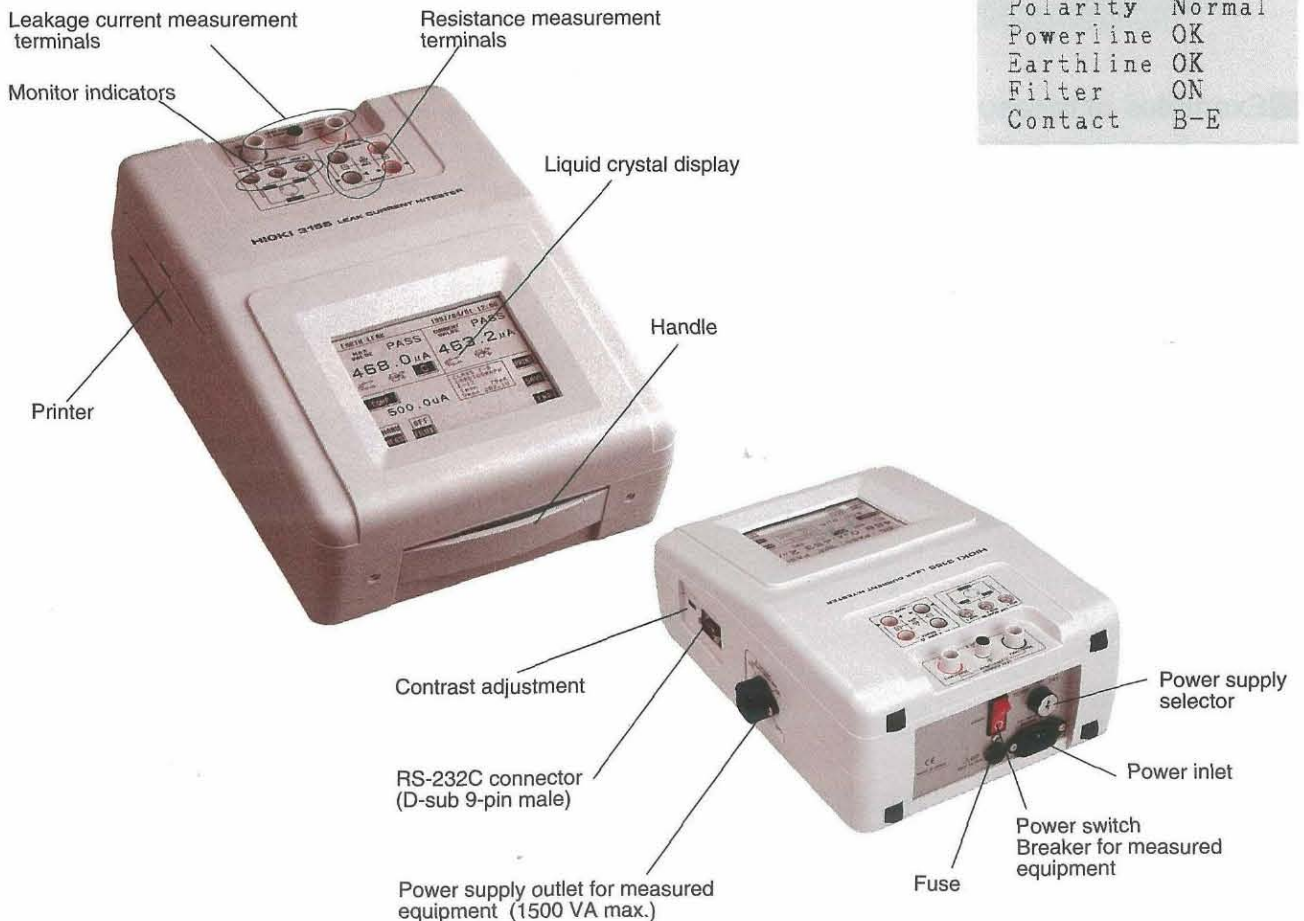
Low resistance values can be measured accurately with the four-terminal method. This provides a simple measurement of the resistance value at locations specified by the standards.

### ■ Data printing

The built-in printer can provide hard copy of measurement data and of stored values.

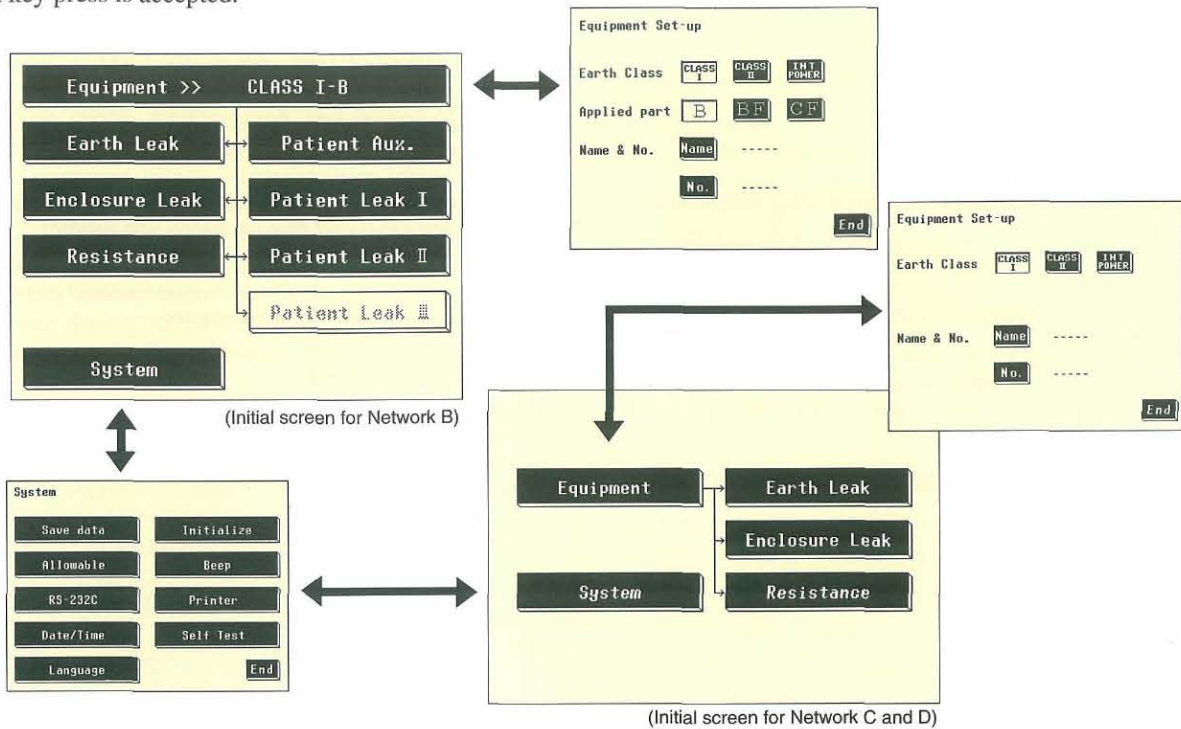
```
Date:1997/03/17
Name:ULTRASONIC
No.:E-12
Stat:Class I-B
Comment:
```

```
ENCLOSURE LEAKAGE:
 5.49µA
Judgment PASS
Polarity Normal
Powerline OK
Earthline OK
Filter ON
Contact B-E
```

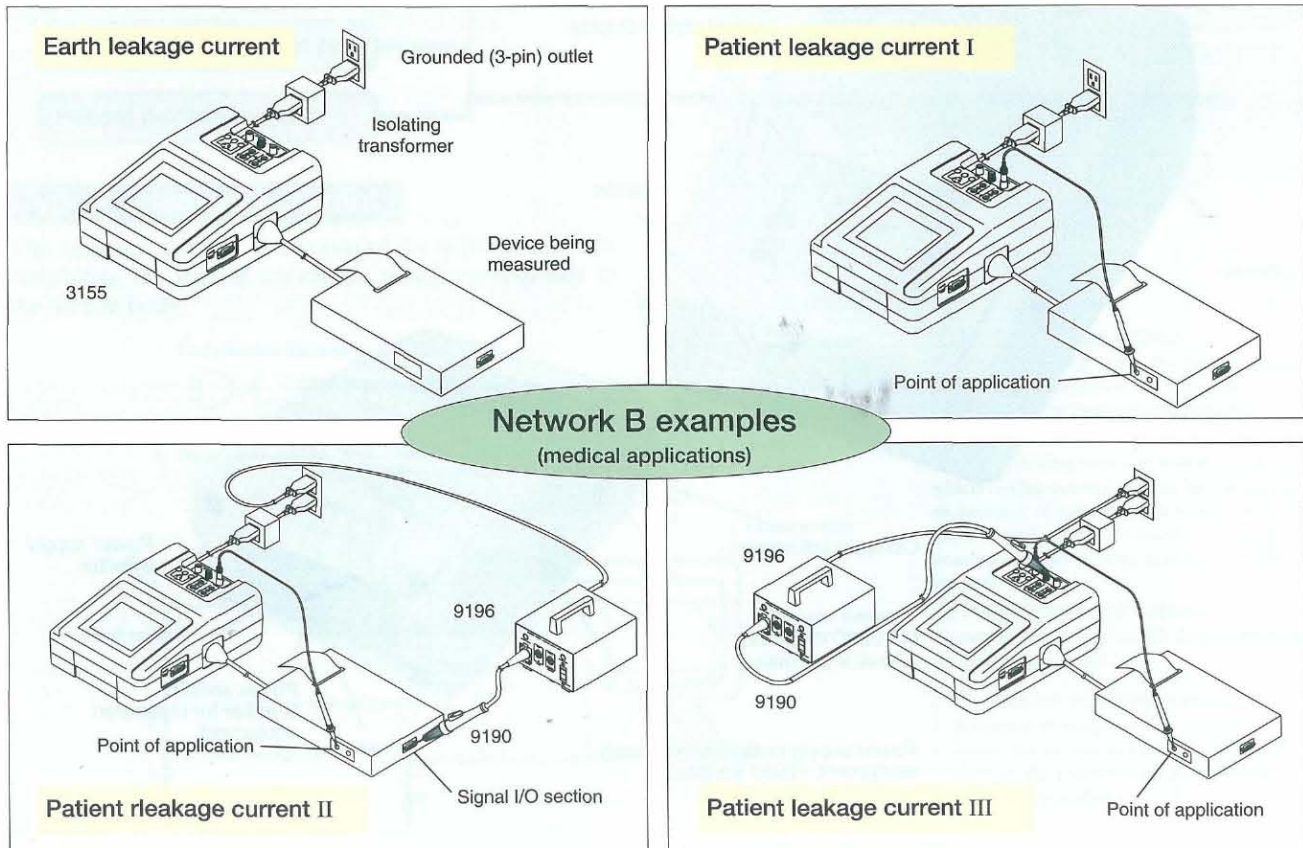


# High Functionality and Ease of Operation

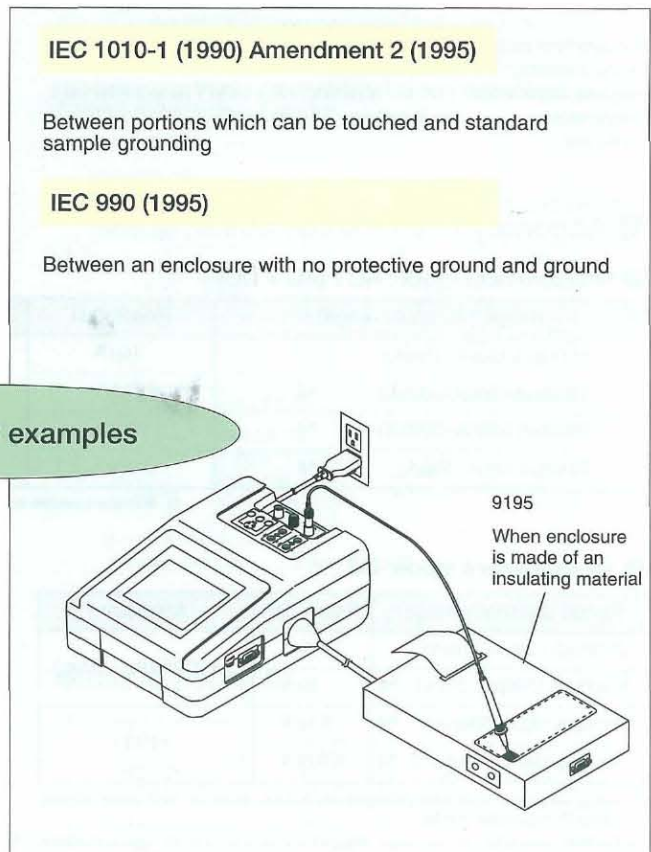
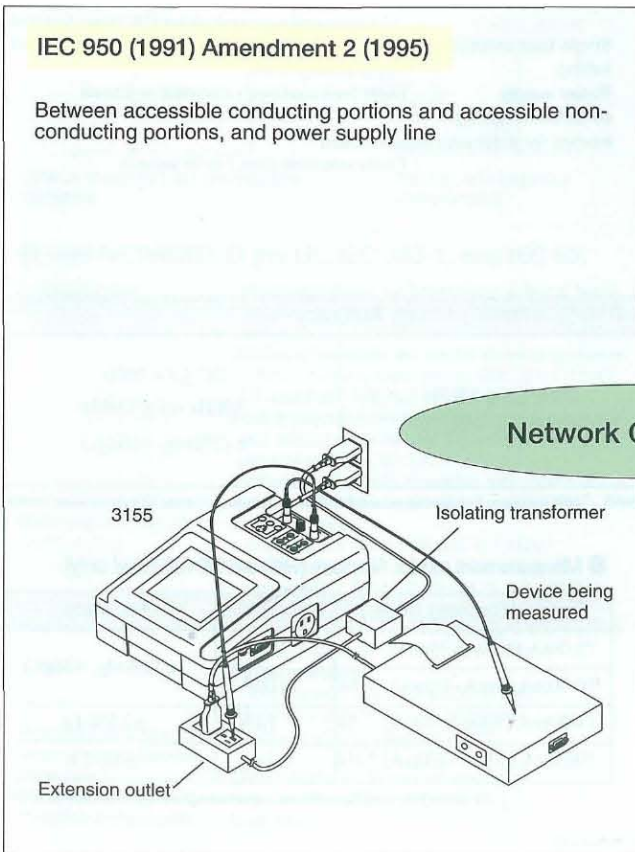
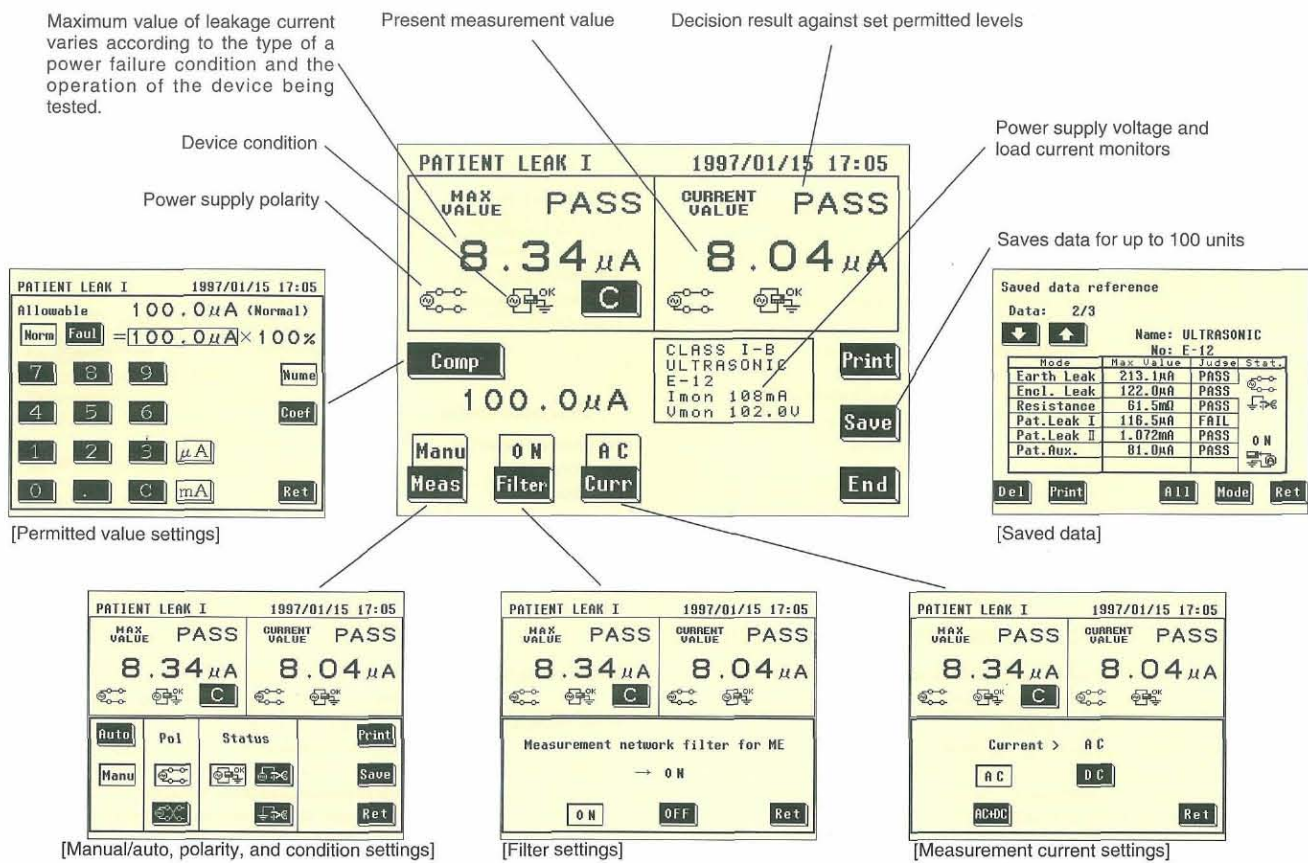
The measurement items specified by the standard are displayed, according to the type of network and the device settings. The display panel also shows at a glance where key input is possible, and all settings can be made by selecting items and numerical values. White lettering on a black background indicates the items where a key press is accepted.



## Examples of measurement (Measurement locations and methods depend on which standard applies.)







**Network C examples**

## General specification

Measurement functions	: Leakage current measurement and low resistance measurement
Monitor functions	: Line voltage, current consumption of measured device, and power supply grounding monitoring
Display	: LCD 320×240 pixels, approx. 5-inch (with backlighting)
Panel operation	: 6×6 matrix touch panel
Recording	: Thermal serial printer (paper width 58 mm)
Clock functions	: Auto calendar, leap year detection, 24-hour measurement
Data saving	: Samples for 100 units Values saved: device number, model, grounding class, and measurement data
Operating temperature and humidity ranges	: 5 °C to 40 °C, 35% to 80% RH (no condensation)
Storage temperature and humidity ranges	: -10 °C to 50 °C, 35% to 95% RH (no condensation)
Temperature and humidity ranges to guarantee accuracy	: 23 °C ±5 °C, 35% to 80% RH (no condensation)
Backup battery lifetime	: Average 8 years (25 °C reference value) (Maintains clock and setting conditions)
Power supply	: Rated supply voltage : 110 to 200/240 V AC (Switchable) Rated supply frequency: 50/60 Hz
Maximum rated power	: 30VA
Insulation resistance	: Power supply to chassis: At least 100 MΩ at 500 V DC
Withstand voltage	: Power supply to chassis: 2.3 kV AC (10 mA) for 1 minute
Maximum rated power of outlet for device measured	: 1500VA
Outlet overcurrent protection	: Overcurrent shutoff

External dimensions	: Approx. 212W×292H×110D mm
Mass	: Approx. 4.5 kg
Supplied accessories	: Power cord (1), 9170 Test Leads (1 set), 9195 Enclosure Probe (1), spare fuse (1), 9233 Recording Paper (1 roll), 9399 Accessory Case (1), Alligator Clips (red/black, one each)
Applicable standards	: EMC: EN55011, 1991 ; EN50082-1, 1992 ; EN61000-3-2, 1995 ; EN61000-3-3, 1995 Safety: EN61010-1:1993, A2 1995 Pollution level 2 ... overvoltage category II (Anticipated transient overvoltage 2500 V)

### 《Recorder》

Recording method	: Thermal serial printer
Number of dots	: 16 dots vertically
Effective paper width	: 47mm
Maximum printing speed	: 41 characters/second
Data printed	: Information for device measured (model, serial number, class), measurement item, measurement value, decision against standard value

### 《Miscellaneous》

Information saved in memory	: Information on device tested
Number of units	: 100
Interface	: RS-232C (D-sub 9-pin plug)
Self-test function	: RAM, built-in printer, LCD, touch panel

## Leakage current measurement functions

Measurement method	: Current value calculated from voltage drop across simulated resistance of human body, and displayed
A/D conversion	: $\Sigma - \Delta$ method
Display refresh rate	: 5 times/second (sliding average display)
Maximum value retention	: Maximum leakage current value and power supply condition
Permitted measurement current	: 25 mA AC/DC
Permitted in-phase voltage	: (Using measurement terminals T1 - T2) 250 V DC + AC peak (ranges other than 50 $\mu$ A) 20 V DC + AC peak (50 $\mu$ A range)
Measurement modes	: AC, DC, (AC + DC), and AC peak AC and AC+DC are true rms values. Peak measurement with 9498/9499 only
Measurement ranges	: 50 $\mu$ A, 500 $\mu$ A, 5 mA, 25 mA
Range switching	: Fully automatic
Frequency characteristics	: DC to 1 MHz (DC, AC + DC) / 7 Hz to 1 MHz (AC)
Temperature coefficient	: $\pm (0.04\% \text{ rdg.} + 0.5 \text{ dgt.}) / ^\circ\text{C}$

Input resistance	: Measurement terminals T1 and T2: each 1 MΩ ±2% Between measurement terminals T1 and T2: 2 MΩ ±2%
Input capacitance	: 30 pF or less (between measurement terminals T1 and T2, at 100 kHz)
CMRR	: Between measurement terminals T1 and T2 (within range of permitted in-phase voltage) 50 $\mu$ A range: 40 dB minimum (at 1 MHz) Ranges other than 50 $\mu$ A: 40 dB minimum (at 100 kHz)
Measured currents	: Earth leakage current, enclosure releakage current, patient releakage current I <sup>*1</sup> , patient releakage current II <sup>*2</sup> , patient releakage current III <sup>*2</sup> , patient auxiliary current <sup>*1</sup> *1 Possible only using 9497 Network B *2 Using external power supply such as 9196 Voltage Apply Unit
Single fault condition setting	: Power supply line break, grounding line break, power supply polarity error
Power supply condition switching	: Single fault condition - automatic or manual
Interval for automatic measurement	: Freely selectable from 1 to 99 seconds

## Accuracy (after 60 minutes warming-up time)

### ● Measurement mode: AC / (AC + DC)

Range (accuracy range)	Resolution	Accuracy	
25.00mA (5mA~25mA)	10 $\mu$ A	20Hz ≤ f ≤ 10kHz ± (1%rdg. +6dgt.)	DC ≤ f < 20Hz 10kHz < f ≤ 1MHz ± (2%rdg. +10dgt.)
5.000mA (500 $\mu$ A~5mA) *4	1 $\mu$ A		
500.0 $\mu$ A (40 $\mu$ A~500 $\mu$ A) *4	0.1 $\mu$ A		
50.00 $\mu$ A (4 $\mu$ A~50 $\mu$ A) *1 *4	0.01 $\mu$ A		

\*1 Setting not possible in the 9498 / 9499 enclosure leakage current and 9497 patient releakage current III measurement modes.

### ● Measurement mode: DC

Range (accuracy range)	Resolution	Accuracy
25.00mA (5mA~25mA)	10 $\mu$ A	± (0.2%rdg. +3dgt.)
5.000mA (500 $\mu$ A~5mA) *4	1 $\mu$ A	
500.0 $\mu$ A (5 $\mu$ A~500 $\mu$ A) *4	0.1 $\mu$ A	±1% f.s.
50.00 $\mu$ A (1 $\mu$ A~50 $\mu$ A) *2 *4	0.01 $\mu$ A	

\*2 Setting not possible in the 9498 / 9499 enclosure leakage current and 9497 patient releakage current III measurement modes.

\*4 For 9499, value is for the 1 kΩ range. When set to 1.5 kΩ or 2 kΩ, the value is divided by 1.5 or 2 respectively.

### ● Measurement mode: AC peak (with 9498/9499 fitted only)

Range (accuracy range)	Resolution	Accuracy
75.0mA (10mA~75mA)	100 $\mu$ A	± (2%rdg. +2dgt.)
10.00mA (1mA~10mA) *4	10 $\mu$ A	
1.000mA (100 $\mu$ A~1mA) *4	1 $\mu$ A	±2.5% f.s.
100.0 $\mu$ A (10 $\mu$ A~100 $\mu$ A) *3*4	0.1 $\mu$ A	±4% f.s.

\*3 Setting not possible in the enclosure leakage current measurement mode.



## Resistance measurement functions

Measurement method : DC four-terminal method  
 A/D conversion :  $\Sigma - \Delta$  method  
 Display refresh rate : 5 times/second (sliding average display)  
 Open-circuit terminal voltage : 5 V maximum  
 Range switching : Fully automatic  
 Temperature coefficient :  $\pm (0.04\% \text{ rdg.} + 0.5 \text{ dgt.}) / ^\circ\text{C}$

### Accuracy

Range	Resolution	Measurement current	Accuracy
500.0 $\Omega$	100m $\Omega$	1mA	$\pm (0.4\% \text{rdg.} + 5 \text{dgt.})$
50.00 $\Omega$	10m $\Omega$	10mA	
5.000 $\Omega$	1m $\Omega$	100mA	
500.0m $\Omega$	0.1m $\Omega$	100mA	$\pm 0.5\% \text{f.s.}$

## Monitoring functions

### Line voltage/current consumption of measured device

Display value : Current consumption: true effective value (crest factor = 5 reference value)  
 A/D conversion :  $\Sigma - \Delta$  method  
 Sampling : Switched on individual A/D converter values  
 Display refresh rate : 1 time/second  
 Frequency characteristics : 45 Hz to 1 kHz  
 Temperature coefficient :  $\pm (0.1\% \text{ rdg.} + 1 \text{ dgt.}) / ^\circ\text{C}$

### Accuracy

Monitored item	Measurement range	Resolution	Accuracy
Line voltage	Range of power supply voltage used	0.1V	$\pm (1.0\% \text{rdg.} + 10 \text{dgt.})$
Power consumption of measured device (auto-ranging)	2.00A~20.00A	10mA	$\pm (1.0\% \text{rdg.} + 6 \text{dgt.})$
	0~2.000A	1mA	

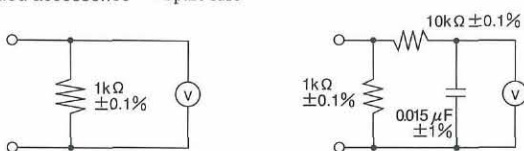
### Power supply grounding monitoring

Monitoring method : Neon indicator lamp  
 Monitored points : Three points (L1 - N, L1 - L2, L2 - N)

## Option specifications

### 9497 NETWORK B (for IEC 601-1)

Standards met : Medical electrical equipment part 1, general requirements for safety (IEC 601-1 1995)  
 Measurement circuit configuration : Basic measurement element 1 k $\Omega$   
 Frequency characteristics :  $\pm 0.5\%$ (DC to 1MHz)  
 Low-pass filter function : Cutoff frequency 1 kHz (-3 dB)  
 Configuration: CR filter (10 k $\Omega$  + 15 nF)  
 Filter setting: ON/OFF  
 Permitted deviation of measurement element : Resistance  $\pm 0.1\%$  capacitance  $\pm 1\%$   
 Fuse used : 250 VT 0.032 AL 20 mm  $\times$  5 mm dia.  
 Dimensions and Mass : Approx.140W  $\times$  35H  $\times$  29D mm; 70 g  
 Supplied accessories : Spare fuse



Network of exactly 1 k $\Omega$  non-inductive resistance

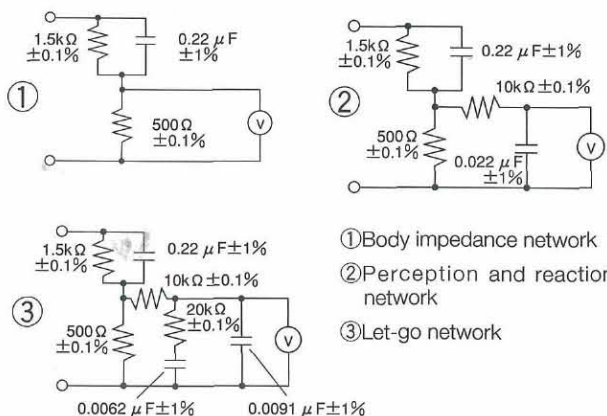
Network with frequency characteristics

### 9499 NETWORK D (for UL, IEC 335-1, and IEC 65)

Standards met : ①Ministerial decree for determining technical baselines for electrical equipment (Japanese standards only)  
 ②Safety of household and similar electrical appliance - Part 1: General requirements (IEC 335-1 1994)  
 UL standard : relevant standards  
 ③Safety requirements for mains operated electronic and related apparatus for household and similar general use (IEC 65 1992)  
 Additionally, standards coinciding with measurement circuit configurations ① to ③  
 Measurement circuit configuration : ① 1 k $\Omega$  resistance  
 Impedance: 1 k $\Omega$   $\pm$  0.5% (DC to 1 MHz)  
 ② 1.5 k $\Omega$  and 0.15  $\mu$ F parallel connection  
 Impedance: 1.5 k $\Omega$   $\pm$  0.5% (DC  $\leq$  f  $\leq$  400 Hz)  
 Theoretical value  $\pm$  (2% + 1 $\Omega$ )  
 (400 Hz < f  $\leq$  1 MHz)  
 Cutoff frequency: 707  $\pm$  15 Hz (-3 dB)  
 ③ 2 k $\Omega$  resistance  
 Impedance: 2 k $\Omega$   $\pm$  0.5% (DC to 1 MHz)  
 Selection of ① to ③ on main unit screen  
 Permitted deviation of measurement element : Resistance  $\pm 0.1\%$  capacitance  $\pm 2\%$   
 Fuse used : 250 VT 0.032 AL 20 mm  $\times$  5 mm dia.  
 Dimensions and Mass : Approx.140W  $\times$  35H  $\times$  29D mm; 80 g  
 Supplied accessories : Spare fuse

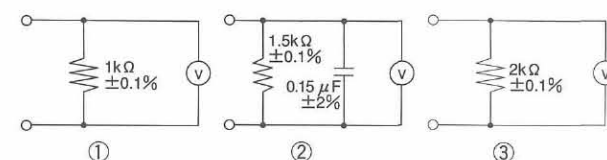
### 9498 NETWORK C (for IEC 990)

Standards met : Measurement of earth currents and current in protective grounding conductors (IEC 990 1995)  
 Safety requirements for measurement, control, and laboratory electrical equipment (IEC 1010-1)  
 Safety of data processing equipment, including office equipment (IEC 950) (UL1950)  
 Measurement circuit configuration : Basic measurement elements 1.5 k $\Omega$  + 500 $\Omega$   
 Filter configuration : Sensation and response correspondence: 10 k $\Omega$  + 22 nF  
 Let-go correspondence: 10 k $\Omega$  + (20 k $\Omega$  + 6.2 nF)/9.1 nF  
 Filter setting: ON1/ON2/OFF  
 Permitted deviation of measurement element : Resistance  $\pm 0.1\%$  capacitance  $\pm 1\%$   
 Fuse used : 250 VT 0.032 AL 20 mm  $\times$  5 mm dia.  
 Dimensions and Mass : Approx.140W  $\times$  35H  $\times$  29D mm; 90 g  
 Supplied accessories : Spare fuse



① Body impedance network  
 ② Perception and reaction network  
 ③ Let-go network

### 9499 NETWORK D



## ● 9196 Apply Unit

### 《General specification》

Output function	: AC voltage
Output indication	: Monitor indicator light (red)
Power supply indication	: Monitor indicator light (clear)
Type switching	: Toggle switch (B/BF/CF)
Polarity switching	: Toggle switch (NORMAL/REVERSE)
Output configuration	: Connector for 9190 Voltage Apply Probe
Auxiliary functions	: Output limit function (power supply shutoff) Voltage output only when 9190 voltage application button is pressed.
External dimensions	: Approx. 125W × 75H × 230D mm
Mass	: Approx. 2.5 kg
Supplied accessories	: Grounded power cord, 9190 Voltage Apply Probe

### 《Electrical characteristics》

Rated power supply voltage	: 100 to 240 V AC (Fluctuation of ±10% with respect to rated supply voltage taken into account.)
Rated power supply frequency	: 45 to 400 Hz
Maximum rated power	: 25VA
Insulation resistance	: Power supply to chassis: at 500 V DC, at least 100 MΩ
Withstand voltage	: Power supply to chassis: 2.3 kV AC 1 mA (50/60 Hz) for 1 minute
Output shutoff current	: 6 mA AC typ.
Output voltage	: 110% of input power supply voltage (V AC)
Accuracy	: ± (1% rdg. + 1 V) * BF range: with load current not exceeding 5 mA * CF range: with load current not exceeding 50 μA

### 《Environmental conditions》

Operating temperature and humidity ranges	: 5 °C to 40 °C, 35% to 95% RH (no condensation)
Storage temperature and humidity ranges	: -10 °C to 50 °C, 35% to 95% RH (no condensation)
Temperature and humidity ranges to guarantee accuracy	: 23 °C ±5 °C, 35% to 80% RH (no condensation)

### 《Applicable standards》

: EMC: EN55011, 1991 ; EN50082-1, 1992  
; EN61000-3-2, 1995 ; EN61000-3-3, 1995  
Safety: EN61010-1:1993 , A2 1995  
Pollution level 2 ... overvoltage category II  
(Anticipated transient overvoltage 2500 V)



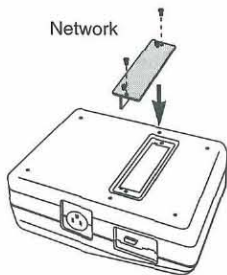
## ● 3155-01 LEAK CURRENT HiTESTER

Supplied with: power cord, 9170 Test Leads, 9195 Enclosure Probe, spare fuse, 9233 Recording Paper (1 roll), 9399 Carrying Case (for accessories), Alligator Clips (red/black, one each)

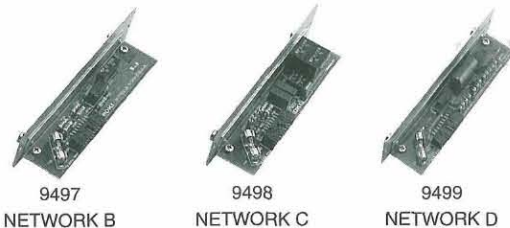


### Note when ordering

Measurement is not possible with the LEAK CURRENT HiTESTER alone. Measurement requires a network sold separately.



The network fits into the bottom of the main unit.



9497 NETWORK B

9498 NETWORK C

9499 NETWORK D

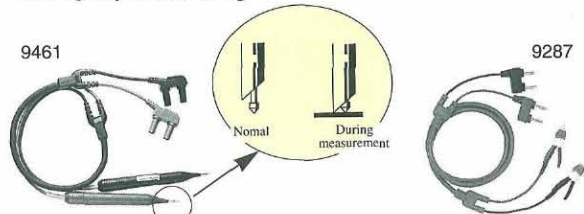


9388 CARRYING CASE

## ● Options

- 9497 NETWORK B (for IEC 601-1)
- 9498 NETWORK C (for IEC 990)
- 9499 NETWORK D (for UL, IEC 335-1, and IEC 65)
- 9196 APPLY UNIT (for measurement of patient leakage currents II and III)
- 9190 VOLTAGE APPLY PROBE (supplied with 9196)
- 9233 RECORDING PAPER (10 m, 10 rolls)
- 9461 PIN TYPE LEADS (for low resistance measurement)
- \* 9287 CLIP TYPE LEADS (for low resistance measurement)
- 9388 CARRYING CASE (with casters)

\* Do not qualify for CE marking.



Connector to fork: approx. 40 cm  
Fork to probes: approx. 25 cm

Connector to fork: approx. 85 cm  
Fork to probes: approx. 8 cm

**HIOKI**  
HIOKI E. E. CORPORATION

DISTRIBUTED BY

### HEAD OFFICE:

81 Koizumi, Ueda, Nagano, 386-1192, Japan  
FAX. 0268-28-0568 / TEL. 0268-28-0562  
E-mail: os-com@hioki.co.jp

Internet HIOKI web-page <http://www.hioki.co.jp/>

All information correct as of Feb.16, 1998. All specifications are subject to change without notice.

F3155E3-82M-03K Printed in Japan