

HIOKI

3451

MΩ HiTESTER

INSTRUCTION MANUAL

September 2006 Revised edition 5 Printed in Japan
3451A981-05 06-09H

HIOKI E. E. CORPORATION

HEAD OFFICE

81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 / FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp URL http://www.hioki.co.jp/

HIOKI USA CORPORATION

6 Corporate Drive, Cranbury, NJ 08512, USA
TEL +1-609-409-9109 / FAX +1-609-409-9108

Introduction

Thank you for purchasing the HIOKI "3451 MΩ HiTESTER". To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

Initial Inspection

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

Preliminary Checks

- Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.
- Before using the instrument, make sure that the insulation on the probes and connection cords is undamaged and that no bare conductors are improperly exposed. Using the product in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements. (Model 9292, or 9293)

Maintenance and Service

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- If the instrument seems to be malfunctioning, confirm that the batteries are not discharged, and that the probes are not open circuited before contacting your dealer or Hioki representative. When sending the instrument for repair, remove the batteries and pack carefully to prevent damage in transit. Include cushioning material so the instrument cannot move within the package. Be sure to include details of the problem. Hioki cannot be responsible for damage that occurs during shipment.

Safety

⚠ DANGER

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

Safety Symbol

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

	In the manual, the symbol indicates particularly important information that the user should read before using the instrument. The symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the symbol) before using the relevant function.
	Indicates that dangerous voltage may be present at this terminal.
	Indicates a double-insulated device.
	Indicates AC (Alternating Current).
	Indicates DC (Direct Current).

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

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

Measurement Categories (Overvoltage Categories)

This instrument conforms to the safety requirements for CAT III measurement instruments. To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called measurement categories. These are defined as follows.

CAT I : Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.

CAT II : Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.)

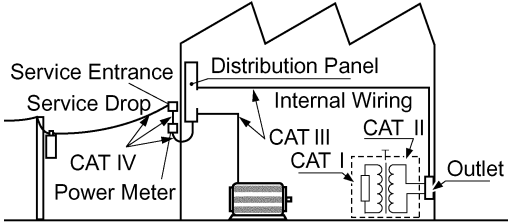
CAT III : Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.

CAT IV : The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).

Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measurement instrument designed for CAT III environments can endure greater momentary energy than one designed for CAT II.

Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided. Never use a CAT I measuring instrument in CAT II, III, or IV environments.

The measurement categories comply with the Overvoltage Categories of the IEC60664 Standards.



Fixed Installation

Specifications

General Specifications

Operating Temperature & Humidity	0 to 40°C (32 to 104°F), 90%RH max. (non-condensating)
Storage Temperature & Humidity	-20 to 50°C (-4 to 122°F), 90%RH max. (non-condensating)
Operating Environment	Indoors, <2000m (6562-ft.) ASL
Effect of temperature	• 1st effective measurement range: ±5% of reading, plus basic allowance • 2nd effective measurement range: ±10% of reading, plus basic allowance • 0 MΩ, ∞scale: ±0.7% of scale length, plus basic allowance • AC voltage measurement: ±5% of maximum scale length, plus basic allowance
Effect of position (at ±90 degrees to the horizontal):	Variation of needle deflection from horizontal reading not more than 2% (1.5mm) of scale length.
Degree of protection	IP40
Power source	Rated power voltage: 1.5 V DC X 4, R6P manganese battery X 4
Maximum rated power	3 VA (when battery check)
Continuous operating time	3451-11: 30 h approx. 3451-14: 35 h approx. 3451-12: 20 h approx. 3451-15: 15 h approx. 3451-13: 10 h approx.
Dielectric strength	5550 Vrms 50/60 Hz for one minute Between electric circuit and case
Dimensions (excluding protrusions)	152W X 95H X 47D mm approx. 5.98"W X 3.74"H X 1.85"D approx.
Mass	400 g, (14.11 oz.) approx. (including batteries)
Accessories	9292 TEST PROBE, 9384 CARRYING CASE, Instruction Manual, R6P manganese battery X 4
Options	9293 PIN TYPE EARTH PROBE, 9288 BREAKER PIN
Standards applying	Safety EN61010-1:2001 Measurement Category III, Pollution Degree 2 (Anticipated Transient Overvoltage:) EMC EN61326:1997+A1:1998+A2:2001 +A3:2003

Specifications of Each Instrument

Guaranteed for one year at 23°C±5°C (73°F ±9°F) and 90% RH.

Model	3451-11	3451-12	3451-13	3451-14	3451-15
Rated measurement voltage	125 VDC	250 VDC	500 VDC		1000 VDC
Maximum effective reading	20 MΩ	50 MΩ	100 MΩ	1000 MΩ	2000 MΩ
Center scale reading	0.5 MΩ	1 MΩ	2 MΩ	20 MΩ	50 MΩ
1st effective measurement range (MΩ)	0.02 - 10	0.05 - 20	0.1 - 50	1 - 500	2 - 1000
	±5% of scale reading				
2nd effective measurement range (MΩ)	0.01 - 0.02 or less, 10 - 20	0.01 - 0.05 or less, 20 - 50	0.05 - 0.1 or less, 50 - 100	0.5 - 1 or less, 500 - 1000	1 - 2 or less, 1000-2000
	±10% of scale reading				
0 MΩ, ∞ scale	0.7% of scale length (When needle center line is within width of scale markings at the extreme ends of the scale.)				
Open circuit voltage (when no load is applied)	1 - 1.2 times of rated measurement voltage (open circuit terminal voltage)				
Lower limit measurement resistance value to be maintained rated measurement voltage	0.125 MΩ	0.25 MΩ	0.5 MΩ	1 MΩ	2 MΩ
Rated measurement current	1 - 1.2 mA			0.5 - 0.6 mA	
	(current to be maintained rated measurement voltage)				
short circuit current	1.2 mA max.			0.6 mA max.	
Response time	Within 3 s (∞→ center value, ∞→ 0 MΩ)				

Model	3451-11	3451-12	3451-13	3451-14	3451-15
AC voltage scale and allowance (50/60 Hz)	0 - 250 V	0 - 300 V	0 - 500 V		
	±5% of maximum scale value				
Input resistance	110 kΩ min.				190 kΩ min.
Maximum input voltage	250 VAC	300 VAC	500 VAC		
Maximum rated voltage to earth	250 VAC	300 VAC	500 VAC		
Input error protection for 10 s	300 VAC	360 VAC	600 VAC		1200 VAC

Notes on Use



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

⚠ DANGER

- On the probe there is a label stating ~ 600 V, however this is only the probe's maximum rated voltage, and is not the maximum rated voltage of 3451.**
- Before connecting probes to the instrument, check that the probes are disconnected from the object to be measured.**

⚠ WARNING

- Do not use the instrument where it may be exposed to corrosive or combustible gases. The instrument may be damaged or cause an explosion.**
- Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.**

⚠ CAUTION

- This instrument is designed for use indoors. It can be operated at temperatures between 0 and 40°C without degrading safety.
- Do not store or use the instrument where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the instrument may be damaged and insulation may deteriorate so that it no longer meets specifications.
- For safety reasons, when taking measurements, only use the 9292 TEST PROBE provided with the instrument (or optional 9293).
- To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.

NOTE

- When refreshing the luminous scale outdoors, keep the meter in the shade.

Luminous Scale

The 3451 scales are marked with a phosphorescent paint. Once this is refreshed by exposure to light, it remains luminous for a while, allowing measurement in a dark place.

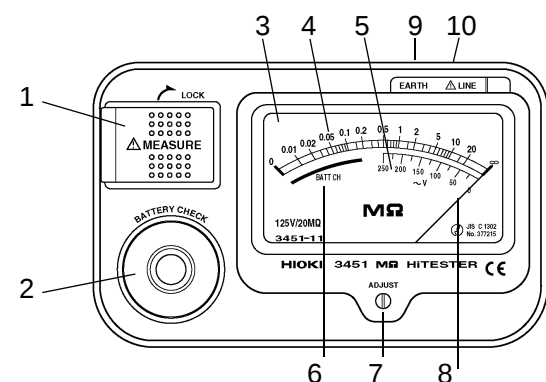
Brightness and exposure of refreshing light	length of time scale remains legible in the dark (at approx. 15 cm from eye)
Average living room lighting at night (approx. 200 lx for 5 minutes)	Approx. 5 minutes
In the office (approx. 1,000 lx for min. 30 seconds)	Approx. 10 minutes
Daylight outdoor (approx. min. 10,000 lx for min. 30 seconds)	Approx. 15 minutes

NOTE

- When using it outdoors, as far as possible keep in the shade.
- When the user moves from a light place to a dark place, because of the time eyes take to adjust to the light, the scale may not be legible immediately.

HIOKI DECLARATION OF CONFORMITY Manufacturer's Name: HIOKI E.E. CORPORATION Manufacturer's Address: 81 Koizumi, Ueda, Nagano 386-1192, Japan Product Name: MΩ HiTESTER Model Number: 3451-11, 3451-12, 3451-13, 3451-14, 3451-15 Accessory: 9292 TEST PROBE Option: 9293 PIN TYPE EARTH PROBE The above mentioned products conform to the following product specifications: Safety: EN61010-1:2001 EN61010-031:2002 EMC: EN61326:1997+A1:1998+A2:2001 +A3:2003 Class B equipment Portable test, measuring and monitoring equipment used in low-voltage distribution systems Supplementary Information: The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC. HIOKI E.E. CORPORATION 15 September 2006 T. Kito Tatsuyoshi Yoshike President 3452A998-09	HIOKI INSPECTION CERTIFICATE HIOKI E.E. CORPORATION hereby certifies that the under-mentioned product(s) has been tested and inspected in accordance with applicable HIOKI calibration procedures, and proven to meet or exceed published measurement specifications. We also certify that the measurement standards and instruments used in the calibration procedure are traceable to the national standards organization. Model: 3 4 5 1 S/N: _____ INSPECTOR T. Kito
---	--

Names and Functions of Parts



1. **MEASURE button**
Press to measure insulation resistance.
2. **BATTERY CHECK button**
3. **Display**
4. **Resistance**
5. **AC voltage scale**
6. **Battery effective range**
7. **ADJUST (Zero adjust)**
8. **Indicator needle**
9. **EARTH terminal (Earth measurement terminal)**
Connect the earth probe (black).
10. **LINE terminal (Line measurement terminal)**
Connect the line probe (red).

Using the carrying case

1. Open the cover
Remove the part of the top surface where "OPEN" is written.
Turn the cover you have removed round to the back, and attach for use.
2. Store the instruction manual
Can be put under the 3451.

Options

⚠ DANGER

To avoid electrical shock, be careful to avoid shorting live lines with the tip of BREAKER PIN.

- **9288 BREAKER PIN**
Attach this to the tip of the LINE probe or pin type earth probes. It allows the tip to be extended, when otherwise it would be too short to make a measurement. (This item does not conform to IEC 61010.)



- **9293 PIN TYPE EARTH PROBE**
The black EARTH probe is a pin type probe like the LINE probe. Use it for cases where it is not possible to clip onto the object being measured, or for measurement inside a small cavity.

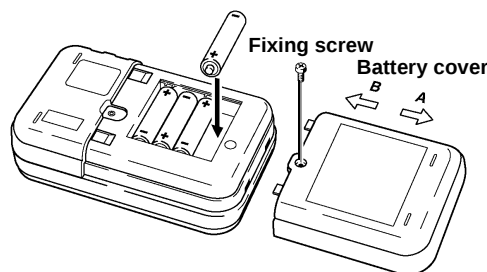
Replacing of Batteries



⚠ WARNING

- To avoid a shock hazard, disconnect the probes before replacing the batteries. After replacing the batteries, replace the cover and screws before using the instrument.
- Do not mix old and new batteries, or different types of batteries. Also, be careful to observe battery polarity during installation. Otherwise, poor performance or damage from battery leakage could result.
- To avoid the possibility of explosion, do not short circuit, disassemble or incinerate batteries.
- Handle and dispose of batteries in accordance with local regulations.

To avoid corrosion from battery leakage, remove the batteries from the instrument if it is to be stored for a long time.



1. For safety, remove the probe from the instrument.
2. Loosen the screw located at the center of the back of the instrument and remove the battery cover.
3. Replace all four batteries.
4. Reinstall the battery cover and fasten the screw.

Measurement Procedures



Preparing for Measurement

- First release the **MEASURE** button, then turn the zero adjuster (**ADJUST**) with a screwdriver so that needle is at the center of the infinity mark (∞).
- Check that the battery capacity is adequate. Replace with new batteries if the battery capacity is low.
- Connect the red line probe to the LINE terminal and black earth probe to the EARTH terminal.
- Probe plug comes with a protection cover. Remove the cover before connecting to the instrument.

Battery Check

1. Remove the probes from the object being measured. The end of the disconnected may be short-circuited or open-circuited, but if an external voltage is applied, an accurate battery check will not be obtained.
2. Press the **BATTERY CHECK** button.
3. If the needle is within the range indication (—), the batteries can be used. If it is to the right of the indication, replace the batteries with new ones.

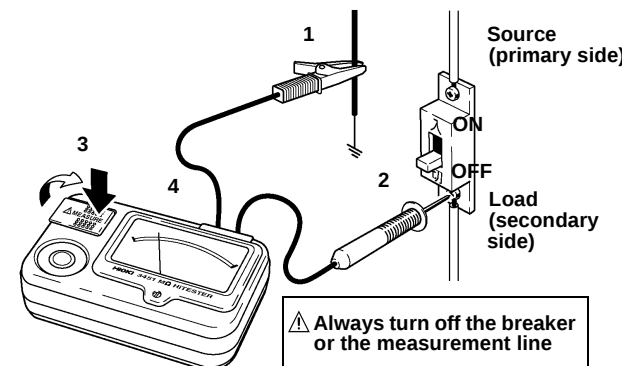
NOTE

The battery check function places the heaviest current drain. Check the battery promptly.

Insulation Resistance Measurement

⚠ WARNING

- Observe the following to avoid electric shock, short circuits, and damage to the instrument.
- When measuring insulation resistance, dangerous voltage is applied to the measurement terminals. To avoid electric shock, do not touch the probe.
- Never touch the object being measured immediately after measuring. There is a danger of electric shock from the charge accumulating during high voltage testing.
- Discharge the subject conductor after measurement.
- Do not attempt to measure insulation resistance on a live conductor. Doing so could damage the instrument or cause an accident that might result in injury or death. Always turn off power to the conductor being measured before starting



1. Connect the black earth probe to the ground side of the object being measured.
2. Connect the red line probe to the line to be measured.
3. Press the **MEASURE** button. (To make continuous measurements, pull the button up.)
4. Read the value after the needle has stabilized.

NOTE

- Insulation resistance is the ratio of leakage current to applied voltage, and is therefore unstable. Depending on the specific object being measured, the needle may not stabilize, but this is not a meter malfunction.
- Press the **MEASURE** button fully down until a click is heard. If the button is not pressed down fully, the needle will not move from ∞ and a proper measurement cannot be made.
- Always release the **MEASURE** button after use.

Discharge Function

When measuring an insulation resistance that contains a capacitance element, a charge proportional to the measurement voltage accumulates, and if undischarged could lead to an electric shock accident.

1. Without removing the probes from the item being measured, release the **MEASURE** button.
2. The built-in discharge circuit automatically discharges the item. During a discharge, the needle will return slowly to the infinity (∞) position.
3. The discharge is completed when the needle reaches the infinity mark. The time required for discharge depends on the capacitance value.

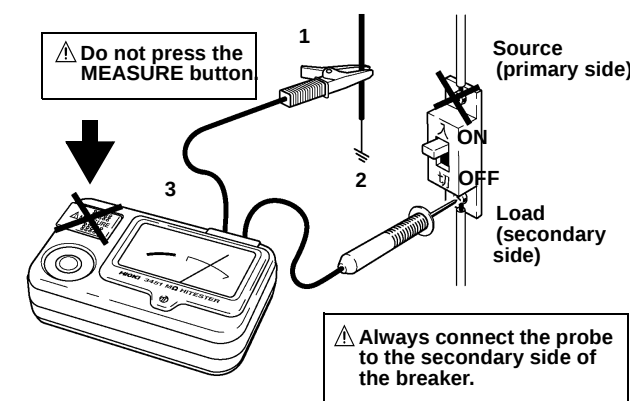
AC Voltage Measurement

⚠ DANGER

- Probes should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.
- Attempting to measure voltage in excess of the maximum input voltage and maximum rated voltage to earth could destroy the instrument and result in personal injury or death.
- To avoid electrical shock, be careful to avoid shorting live lines with the probe.

⚠ CAUTION

Never press the **MEASURE** button while measuring voltage. Doing so could damage the instruments connecting.



1. Connect the black earth probe to the ground.
2. Connect the red line probe to the line to be measured.
3. Read the voltage on the V scale after the needle stabilizes.