

# IR4016, IR4017, IR4018

## ANALOG MΩ HiTESTER

### Instruction Manual

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# HIOKI

HIOKI E. E. CORPORATION

#### Headquarters

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

1307

For regional contact information, please go to our website at <http://www.hioki.com>.

The Declaration of Conformity for instruments that comply to CE mark requirements may be downloaded from the HIOKI website.

#### Warranty

Warranty malfunctions occurring under conditions of normal use in conformity with the Instruction Manual and Product Precautionary Markings will be repaired free of charge. This warranty is valid for a period of three (3) years from the date of purchase. Please contact the distributor from which you purchased the product for further information on warranty provisions.

#### Introduction

Thank you for purchasing the HIOKI Model IR4016, IR4017, IR4018 ANALOG MΩ HiTESTER. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

## Overview

This instrument is a powerful insulation resistance tester that measures the insulation level of electrical wires or equipment.

This instrument is not designed for the production line and is not suitable for that purpose. Please use the 3154 Digital MΩ HiTester for the production line.

## Inspection and Maintenance

#### 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.

#### 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, contact your dealer or Hioki representative.

Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.

## Safety

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.

## **⚠ 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. Using the instrument in a way not described in this manual may negate the provided safety features. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

#### Safety Symbol

	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).

#### Other Symbol

	Indicates a prohibited action.
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#### Symbols for Various Standards

	This symbol indicates that the product conforms to regulations set out by the EC Directive.
	WEEE marking: This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).

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

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

#### Measurement categories

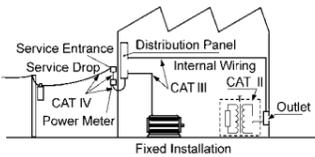
This instrument complies with CATIII safety requirements. To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, and called measurement categories.

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

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).

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. Use of a measurement instrument that is not CAT-rated in CAT II to CAT IV measurement applications could result in a severe accident, and must be carefully avoided.



## Usage Notes

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

#### Preliminary Checks

Before using the instrument the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

## **⚠ DANGER**

• 1000 V or 600 V may be labeled depending on the supplied test leads, but this is the rating of the test lead and not the rating performance of the IR4016, IR4017, IR4018. Please refer to the Specifications for the rating performance of this instrument. Before attaching to or removing the test lead from the instrument, please remove the Test Lead from the tested object and turn the function selector to OFF.

## **⚠ 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 use the instrument where it may be exposed to oil, chemicals, or solvents. Contact with these substances may cause cracking in the instrument, resulting in damage or electric shock.  
• Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.  
• Please only use batteries for electrical supply. Any other electrical supply may damage the instrument and tested object and cause electric shock.  
• To prevent an electric shock accident, confirm that the white portion (insulation layer) inside the cable is not exposed. If a color inside the cable is exposed, do not use the cable.

## **⚠ CAUTION**

• This instrument is designed for use indoors. It can be operated at temperatures between 0 and 50°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.  
• To prevent accidents, please use the supplied L9787 Test Leads (or the optional L9787, L9788-11).  
• To avoid breaking the test lead, do not bend or pull them.  
• Removable sleeves are attached to the metal pins at the ends of the test leads.  
• To prevent a short circuit accident, be sure to use the test leads with the sleeves attached when performing measurements in the CAT III measurement category. Remove the sleeves from the test leads when performing measurements in the CAT II measurement category. For details on measurement categories, see "Measurement categories in the instruction manual."  
• To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.  
• If the protective functions of the instrument are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.  
• Although this instrument is dust resistant, it is not completely dust- or waterproof. To prevent possible damage, avoid using in dusty or wet environments.  
• The protection rating for the enclosure of this device (based on EN60529) is \*IP40.

#### \*IP40:

This indicates the degree of protection provided by the enclosure of the device against use in hazardous locations, entry of solid foreign objects, and the ingress of water.

4: Protected against access to hazardous parts with wire measuring 1.0 mm in diameter. The equipment inside the enclosure is protected against entry by solid foreign objects larger than 1.0 mm in diameter.

0: The equipment inside the enclosure is not protected against the harmful effects of water.

#### NOTE

• To avoid battery depletion, turn the function selector OFF after use. Battery may drain if the switch is not turned to OFF.  
• The test lead plug comes with a protective cap. Please remove this cap before attaching it to the instrument.  
• After measurement, please turn the function selector to OFF. The cover will not close if the switch is not at OFF.

## Specifications

#### Standard Specifications

Functions	Insulation Resistance measurement: DC voltage supply, current detection AC Voltage measurement: Average responding type
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Live circuit indicator	When 20 VAC or higher exists between LINE terminal and EARTH terminal or 20VDC or higher exists during automatic discharge, the red LED lights up.
Automatic electric discharge	Automatically discharges the electric charge still present in the capacitance of the test object.
Auto Power Save	The power will only go off automatically 15 minutes after the last live circuit alert has been displayed.
Indicator	Meter (Internal magnet type taut band method) Light device: LED Light goes off about 3 minutes after MEASURE key is switched to OFF or when LIGHT key is pressed.

#### General Specifications

Guaranteed accuracy period	1 year
Operating Environment	Indoors, Pollution Degree 2, Altitude up to 2000 m (6562-ft.)
Operating Temperature & Humidity	0 to 40°C (32 - 104°F), 90%RH or lower (non-condensating), 40 to 50°C (104 - 122°F) and below relative with linear decrease up to 50%RH
Storage Temperature & Humidity	-10 to 50°C (14 - 122°F), 90%RH or lower (non-condensating)
Degree of protection	IP40
Maximum rated voltage to terminal	600 V AC (AC voltage function)
Maximum rated voltage to earth	600 V AC, Measurement Category III, Anticipated Transient Overvoltage: 6000 V
Dielectric strength	7060 V AC, 50/60 Hz, Measurement terminals - electrical enclosure, 1 minute, current sensitivity 1 mA
Power source	Rated power voltage: 1.5 V DC × 4, LR6 alkaline battery × 4
Maximum rated power	3 VA
Drop Proof	On concrete: 1 m
Dimensions	Approx. 159W × 177H × 53D mm (6.26"W × 6.97"H × 2.09"D)
Mass	Approx. 610g (21.5oz) (including battery, not including test lead)
Accessory	L9787 Test Lead, LR6 alkaline battery × 4, Instruction manual, Shoulder Strap
Options	L9787 Test Lead, L9788-10 Test Lead with Remote Switch, L9788-11 Test Lead Set with Remote Switch, L9788-90 Tip Pin (for Model L9788-10), L9788-92 Breaker Pin (for Model L9788-10), 9804-02 Magnetic Adapter
Standards	EMC EN61326 Safety EN61010, EN61557-1/-2
Nominal system voltage	600 VAC max.

#### Measurement Specifications

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

Model name	IR4016-20	IR4017-20	IR4018-20
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#### Insulation Resistance Measurement

Rated output voltage (DC)	500 V	500 V	1000 V
Effective maximum indicated value	100 MΩ	1000 MΩ	2000 MΩ
Center scale value	2 MΩ	20 MΩ	50 MΩ
Response time	Within 3 sec. (∞ → center value, ∞ → 0 MΩ)		
Possible number of measurements on fully charged batteries	1000 times (at 0.5 MΩ)	1000 times (at 0.5 MΩ)	1000 times (at 1 MΩ)
Effect of position (Horizontal ±90°)	±15% of indicated value 2% of scale length (0 MΩ, ∞)		
Effect of supply voltage	±5% of indicated value		
Overload protection	600 VAC (10sec)	660 VAC (10sec)	

Accuracy	0.1 to 50 MΩ	1 to 500 MΩ	2 to 1000 MΩ
1st effective measuring range	±5% of indicated value		
2nd effective measuring range	0.01 to 0.1 MΩ 50 to 100 MΩ	0.5 to 1 MΩ 500 to 1000 MΩ	1 to 2 MΩ 1000 to 2000 MΩ
0 M, ∞ scale	±10% of indicated value		
	0.7% of scale length		

#### Measurement terminal voltage characteristic

Open circuit voltage (when no load is applied)	1 to 1.2 times of rated output voltage	
Lower limit measurement resistance value to be maintained rated output voltage	0.5 MΩ	1 MΩ
Rated current	1 mA (The current flow when rated output voltage is maintained)	
Short circuit current	1.2 mA max.	

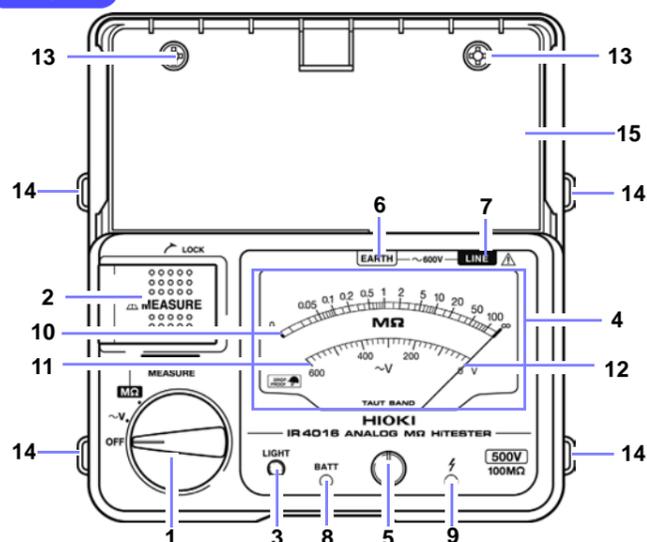
Effect of temperature		
1st effective measuring range	±5% of indicated value	
2nd effective measuring range	±10% of indicated value	
0 MΩ, ∞ scale	0.7% of scale length	
Effect of humidity (90%RH max)	±5% of indicated value ±10% of indicated value	
Continuous operating time	Approx. 20 hours (no load)	Approx. 15 hours (no load)

Voltage Measurement		
Measuring range	0 to 600 V	
Accuracy	±5% of maximum scale value	
Frequency range	50/60 Hz	
Input resistance	500 kΩ or more (50 Hz/60 Hz)	
Effect of temperature	±5% of maximum scale value	
Effect of position (Horizontal ±90°)	±2% of maximum scale value	
Overload protection	600 VAC	660 V AC
<ul style="list-style-type: none"> <li>Effect of temperature is applicable to the temperature range other than 18 to 28°C</li> <li>Accuracy is applicable after adjustment by meter movement zero adjuster</li> </ul>		

## Names and Function of Parts

### Front

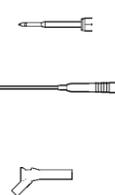
\*This figure is the IR4016.



- Function selector: Select measurement functions
- MEASURE key: Press to measure insulation resistance.
- LIGHT key: Press to turn on the light
- Scale plate
- Meter movement zero adjuster
- EARTH terminal: Connect the black test lead
- LINE terminal: Connect the red test lead
- Effective battery range indicator: Green when battery power is high, red when batter power is decreasing and no light when battery is drained
- Live circuit indicator: Lights up when voltage remains between input terminals
- Insulation resistance scale
- AC voltage scale
- Indicator needle
- Sleeve stand: Attach the sleeve removed from the tip of the test lead.
- Strap opening: Pass the supplied strap through the opening.
- Test lead storage space: Stores the test lead without having to remove it from the measurement terminal.

## Options

- L9787 Test Lead (1.2 m)**
- L9787-91 Breaker Pin**  
(Pin length 70 mm and 48 mm from the tip has width 2.5 mm. The rest have width 3.8 mm.)  
Breaker pin for L9787.
- L9788-10 Test Lead with Remote Switch (1.2 m)**  
Test lead with MEASURE key for the line side measurement. Measurement can be started by pressing the key. There is a light at the tip which can be switched on by pressing the LIGHT key on the IR4000 Series. Earth side lead is NOT attached.
- L9788-11 Test Lead Set with Remote Switch**  
Model L9788-10 with an EARTH side lead.



- L9788-90 Tip Pin (for Model L9788-10)**  
Replacement Tip Pin for L9788-10.
- L9788-92 Breaker Pin (for Model L9788-10)**  
(Pin length 123 mm and 65 mm from the tip has width 2.6 mm.) Replacement Tip Pin for the L9788-10.
- 9804-02 Magnetic Adapter**  
(Ø11 mm, Corresponding standard screw: M6 Button head screw)  
Adaptor for connecting a Test lead to the round head screw by means of magnetism. The tip of adaptor is a concave shape in order to fit the round head screw. Put an adaptor on the tip of the earth side lead of a L9787 Test Lead or L9788-11 Complete Test Lead.

L9787 Test Lead, L9788-10 Test Lead with Remote Switch and L9788-11 Test Lead Set with Remote Switch are all exclusively designed for theHIOKI IR 4000 ANALOG MΩ HITESTER series. Do not use for any other purpose.

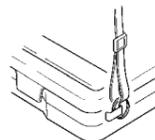
## Measurement Procedures

### Preparing for Measurement

- Attach the strap.
- Insert the batteries.
- Remove the sleeve from the tip of the test lead.
- Connect the test lead (connect the black test lead to the EARTH terminal, and the red test lead to the LINE terminal)
- Adjust the needle to point to zero before measuring.  
With the function selector at OFF, turn the meter movement zero adjuster with a screwdriver until the needle points to the center part of the ∞ in the scale.

### Attaching the strap

Pass the ring on both ends of the supplied strap through each of the four holes in the instrument.



### Pre-measurement inspection

- Confirming the battery power.**  
Set the function selector away from OFF and confirm the effective battery range indicator. Battery power is high when a green light is shown. Battery power is low when a red light is shown and replacement is recommended. Battery is drained when no light is shown. Please replace the batteries then.
- Ensure that the test leads are not disconnected.**  
1. Use the function selector to select Insulation Resistance.  
2. Short the test lead tips.  
3. Confirm that the indicator needle points at 0 MΩ when pressing the MEASURE key.
- When using the L9788-10 Test Lead with Remote Switch, please check the following as well.**

- Turn the function selector to select the Insulation Resistance Measurement function.
- Upon pressing the MEASURE key on the L9788-10, the MEASURE key lights up in red.

### Insulation Resistance Measurement

#### WARNING

Observe the following to avoid electric shock, short circuits, and damage to the instrument.

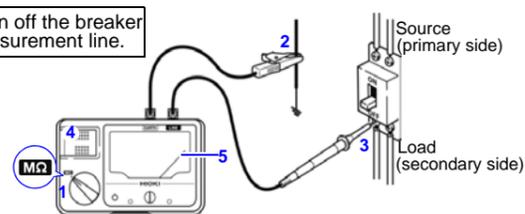
- When measuring insulation resistance, dangerous voltage is applied to the measurement terminals. To avoid electric shock, do not touch the probe.
- Never touch the object being measured immediately after measuring. There is danger of electric shock from the charge accumulated during high voltage testing.
- 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.

#### 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 key fully down until a live circuit indicator lights up. 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 key after use.

- When inspecting on an electric power circuit including an appliance whose withstand voltage is lower than the test voltage or including an appliance or components whose withstand voltage is unknown, it is recommendable to remove that from the circuit for measurement.
- During measuring, do not switch over to the other function or rated voltage.

Always turn off the breaker of the measurement line.



- Use the function selector to select **MΩ**.
- Connect the black test lead to the ground side of the object being measured.
- Connect the red test lead to the line to be measured.
- Press the MEASURE key. (To make continuous measurements, pull the button up.)
- Read the value after the needle has stabilized.

\*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.

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

### Voltage Measurement

#### DANGER

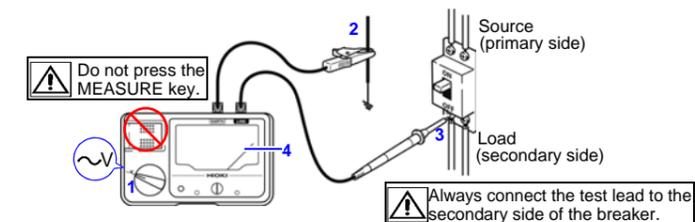
- Test leads should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.**
- The maximum input voltage and maximum rated voltage to earth is 600 Vrms. If their voltages are exceeded, this device will be damaged and personal injury will result. Therefore, do not perform measurement in this case.**
- To avoid electrical shock, be careful to avoid shorting live lines with the test leads.**

#### WARNING

Never press the MEASURE key while measuring voltage. Doing so could damage the circuitry or cause a life-threatening accident.

#### NOTE

- During measuring, do not switch over to the other function.
- For waveforms other than sine waves, some errors may occur.



- Use the function selector to select the **~V** function.
- Connect the black test lead to the ground side of the object being measured.
- Connect the red test lead to the line to be measured.
- Read the value after the needle has stabilized.

### Operation Uncertainty

The operation uncertainty and the variations of measurement value for the respective influence quantity approved by EN61557 are as follows:

	Intrinsic uncertainty/ Influence quantity	Operation range	Variation
A	Intrinsic uncertainty	Reference condition	±5%
E <sub>1</sub>	Position	Horizontal ±90°	±15%

E <sub>2</sub>	Supply voltage	4.5 V to 6.8 V	±5%
E <sub>3</sub>	Temperature	0°C to 35°C	±5%
B	Operation uncertainty		±25%
Guaranteed range of operation uncertainty			1st effective measurement range

Influencing factor non-applicable for E<sub>4</sub> to E<sub>10</sub>

### Measurement principles

#### 1. Insulation Resistance Measurement

The insulation resistance of test object Rx is obtained by supplying a voltage V to the test object and measuring the current leaking from the test object and the voltage supplied using the formula (Voltage supplied, V)/(current leakage, I).

#### 2. Voltage Measurement

This is obtained from converting the value of the current flowing from the voltage source through the instrument to a voltage value.

### Auto power save (power-saving function)

#### NOTE

To avoid battery depletion, turn the function selector OFF after use. Battery may drain if the switch is not turned to OFF.

When the function selector is not at OFF, the power save function automatically kicks in 15 minutes after the last time the MEASURE key is pressed and the effective battery range indicator goes off. The automatic power save function cannot be cancelled.

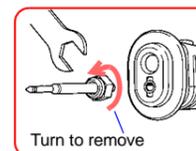
#### Reviving from power save

Turn off the function selector and then return it to the original position.

### Replacing the Pin (Option)

The pin at the front of the Model L9788-10 (option) can be replaced when it has worn away or is damaged. Replacement pins are available at any Hioki dealer. (Model L9788-90 Tip Pin)

- Turn off the power of the Insulation Resistance Tester and disconnect the test leads.
- Rotate the socket with a spanner (7 mm width) to remove it. Remove the front pin.
- Exchange the L9788-10 front pin with a new one, turn the socket with a spanner and attach it to the test lead. (tightening torque: 0.3N•m)
- Check the performance. Measure an object with a known resistance. Make sure that the measured resistance is correct before using the L9788-10.



## Replacing Batteries

#### WARNING

- To avoid electric shock, turn OFF the function selector and disconnect the test leads before replacing the batteries or fuse.
- After replacing the batteries, place back the cover and tighten the 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.
- Battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.
- Handle and dispose of batteries in accordance with local regulations.

#### NOTE

- To avoid corrosion from battery leakage, remove the batteries from the instrument if it is to be stored for a long time.
- Please use only alkali batteries. Please do not use manganese, nickel-metal hydride or oxyride batteries.

- Turn the function selector to OFF and remove the test lead from the instrument as a precaution.
- Loosen the central fastening screw at the back of the instrument and remove the battery cover.
- Replace all 4 batteries.
- Slide the battery cover back into place and tighten the screw.

