HIOKI

# 3555

Instruction Manual

# BATTERY HiTESTER

EN

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## Contents

# Introduction

Thank you for purchasing the HIOKI "3555 BATTERY HiTESTER." To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

# Inspection

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

### Accessories

9461 PIN TYPE LEAD
Six LR6 alkaline batteries
Instruction Manual

### Shipping

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

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

### Safety symbols

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

| | |
|---|---|
|  | ・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.<br>・In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument. |
|  | Indicates DC (Direct Current). |
|  | Indicates the ON side of the power switch. |
|  | Indicates the OFF side of the power switch. |

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

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

### Measurement categories

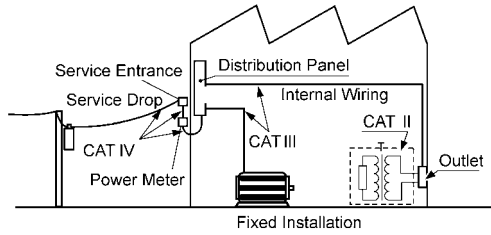
To ensure safe operation of measurement instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as CAT II to CAT IV, and called measurement categories. These are defined as follows.

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.



# Precautions

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

### Preliminary Check

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.

**⚠ DANGER**

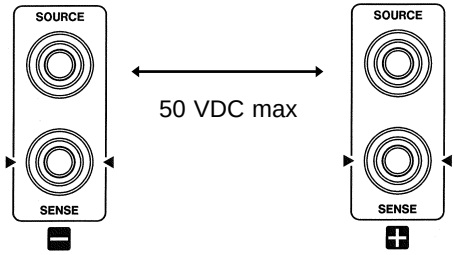
- **The floating voltage between input terminals and ground is 60 V AC/DC. Do not attempt to measure voltages exceeding 60 V with respect to ground. This could result in injury or damage to the instrument.**
- **When measuring batteries, always ensure sufficient ventilation. Sometimes sparks may occur when the test leads are connected to batteries, which can ignite any accumulated inflammable gases such as hydrogen.**

**⚠WARNING**

- **Before using the instrument, make sure that the insulation on the test leads is undamaged and that no bare conductors are improperly exposed. Using the instrument in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements (Model 9461, Model 9287-10).**

**⚠WARNING**

- **Be sure to connect the SOURCE and SENSE terminals correctly. See Section 4.2, "Measurement" for details of the connections.**
- **To avoid injury or damage to the instrument, do not attempt to measure AC voltage, or DC voltage exceeding 50 V.**




- **Do not apply a voltage between the SOURCE(+) and SENSE(+) or SOURCE(-) and SENSE(-) terminals. This could result in damage to the instrument.**

**⚠CAUTION**

- This instrument is not designed to be entirely water- or dust-proof. To avoid damage, do not use it in a wet or dusty environment.
- Do not 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.
- Do not use the instrument near a source of strong electromagnetic radiation, or near a highly electrically charged object. These may cause a malfunction.

NOTE

- Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.
- For safety reasons, when taking measurements, only use the 9461 PIN TYPE LEAD provided with the instrument, or an optional lead specified by Hioki.

### Service

- 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.

# Organization of This Manual

This manual consists of the following chapters.

"Introduction", "Inspection", "Safety", "Precautions" include some important notes which you should read before using the instrument.

Chapter 1 Overview
describes an outline of the instrument, and lists its features.

Chapter 2 Names and Functions of Parts
lists the names of the parts of the instrument, and the functions of all of the indications, terminals, and switches.

Chapter 3 Specifications
lists the specifications of the instrument.

Chapter 4 Standard Measurement
describes the basic operation of the instrument.

Chapter 5 Advanced Measurement Functions
describes miscellaneous functions.

Chapter 6 Maintenance
gives troubleshooting information.

# Chapter 1
# Overview

## 1.1 Product Overview

The 3555 is designed for measuring the internal resistance and open-circuit voltage of secondary batteries, including lead storage cells, nickel-cadmium batteries, and nickel-metal hydride batteries.

## 1.2 Features

(1) Since it uses the AC four-terminal method to measure the internal resistance, it provides accurate results with the lead resistances and contact resistances eliminated.

(2) It is possible to display the readings for the battery internal resistance and voltage without changing functions.

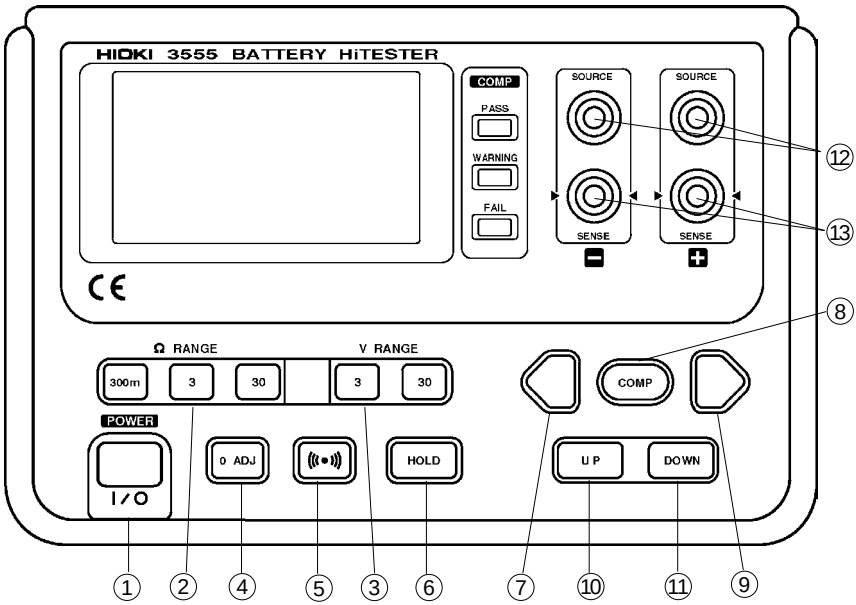
(3) A composite comparator function, which can be set on resistance and voltage values, enables reliable detection of battery deterioration.

(4) Pin type leads which can easily contact the battery electrodes are supplied as standard, allowing high-accuracy four-terminal measurement.

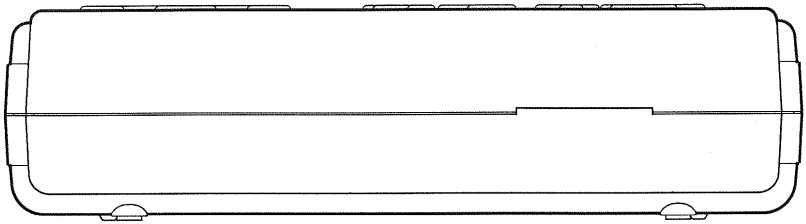
# Chapter 2
# Names and Functions of Parts

This chapter explains the keys, input and output terminals, display, LED indicators, and leads.

## Front panel



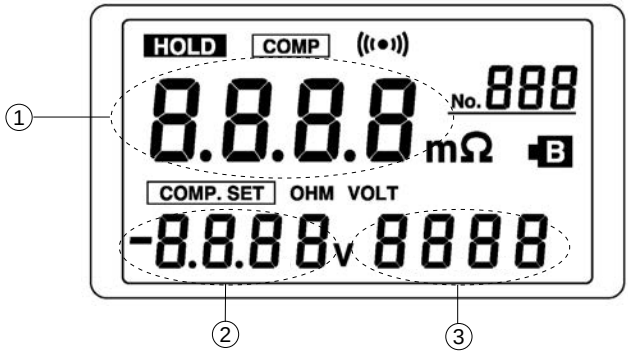

## Side panel



- Keys and input/output terminals

| | |
|---|---|
| ① **POWER** key | Turns the power on or off. |
| ② 300m Ω key<br>3 Ω key<br>30 Ω key | Selects the resistance range. |
| ③ 3 V key<br>30 V key | Selects the voltage range. |
| ④ 0 ADJ key | Zero adjustment key |
| ⑤ (((•))) key | Turns the beeper on and off. |
| ⑥ HOLD key | Locks out changes to the display. |
| ⑦ 〈 key | Left cursor (flashing) key |
| ⑧ COMP key | Switches the comparator on and off, and changes display to the comparator setting screen. |
| ⑨ 〉key | Right cursor (flashing) key |
| ⑩ UP key | Increases the value of a numeric setting. |
| ⑪ DOWN key | Decreases the value of a numeric setting. |
| ⑫ **SOURCE** | Connects to the 9461 banana plug on the SOURCE side. |
| ⑬ **SENSE** | Connects to the 9461 banana plug on the SENSE side. |

● LCD (view with all elements displayed)




● Display

① Measured resistance

② Measured voltage **[**comparator resistance upper limit setting and comparator voltage setting**]**

③ **[**Comparator resistance lower limit setting**]**

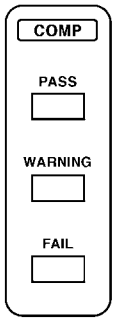
**[ ]**: Appears in on the comparator setting screen

| | |
|---|---|
| **mΩ** | Indicates the unit of resistance. |
| **V** | Indicates the unit of voltage. |
| **HOLD** | Appears when the display is locked. |
| **COMP** | Appears when the comparator function is on. |
| (((•))) | Appears when the beeper is turned on. |
| **No.** | The comparator table number. |
| B | Appears when the battery voltage of the tester is low, to prompt the user to replace the battery. |
| **COMP.SET** | Appears during display of the comparator setting screen. |

**OHM** Appears during display of the screen for setting the comparator resistance upper and lower limit values.

**VOLT** Appears during display of the screen for setting the comparator voltage threshold value.

- LEDs



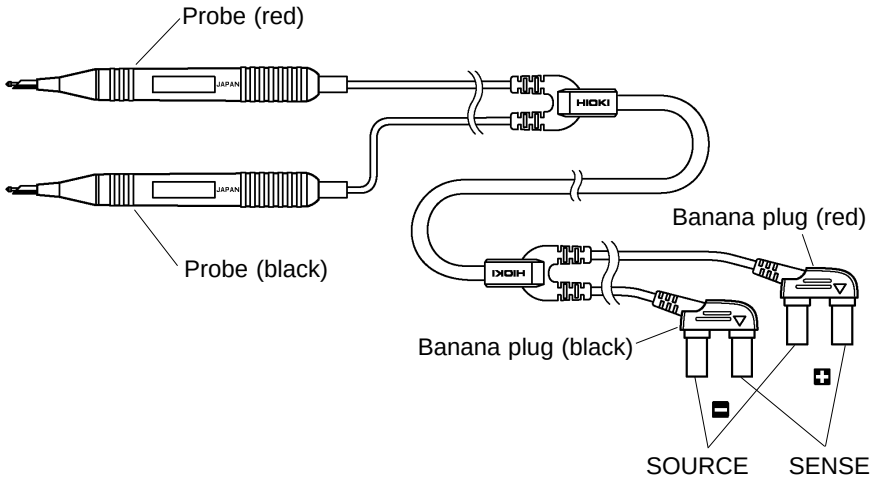

**PASS** Indicates that the tested battery is satisfactory for operation.

**WARNING** Indicates that the tested battery is beginning to deteriorate.

**FAIL** Indicates that the tested battery has deteriorated.

These indications appear when the upper and lower comparator limits for internal resistance and the comparator threshold value for voltage are all set.

● 9461 PIN TYPE LEAD




**⚠CAUTION** The ends of the 9461 PIN TYPE LEAD are sharp. Be careful to avoid injury.

# Chapter 3
# Specifications

## 3.1 General Specification

| | |
|---|---|
| ■ Measurement method | Resistance: AC four-terminal method |
| ■ A/D conversion | Double integration method |
| ■ Display | LCD and LEDs (comparator output) |
| ■ Panel abbreviations and symbols | **HOLD**, COMP, (( • )), No. , **m**, **Ω**, B, COMP.SET, **OHM**, **VOLT**, **V** |
| ■ Sampling rate | 1.25 sets (resistance and voltage measurements)/second |
| ■ Open-circuit terminal voltage | 5 V max. |
| ■ Input overflow | "OF" indication |
| ■ Battery low detection | " B " indication (indicates at 6.4 V with LR6 ×6) |
| ■ Constant current fault detection | "----" indication |
| ■ Auto power off | Power off automatically after about 30 minutes. |
| ■ Zero adjustment function | Circuit offset voltage is displayed as 0 V. |
| ■ Hold function | Display is held. |
| ■ Beeper function | Audible output for warning and fail results<br>Can be turned on and off. |

■ Comparator settings — Resistance upper and lower limits and voltage lower limit

■ Number of comparator settings — Ten sets

■ Comparator output — LEDs for pass (green), warning (amber), and fail (red) results
Audible tone for warning and fail results

| Voltage \ Resistance | LO | IN | HI |
|---|---|---|---|
| LO | **WARNING** (Amber)*1 | **WARNING** (Amber) | **FAIL** (Red) |
| HI | **PASS** (Green) | **WARNING** (Amber) | **FAIL** (Red) |

*1 Voltage low and internal resistance low: amber flashing

■ Operating temperature and humidity range — 0°C to 40°C(32°F to 104°F) 80% RH (no condensation)

■ Storage temperature and humidity range — -10°C to 50°C(14°F to 122°F) 80% RH (no condensation)

■ Power source — Six LR6 alkaline batteries or six R6P manganese batteries

■ Rated supply voltage — 1.5 VDC×6 (Voltage fluctuations of 10% from the rated supply voltage are taken into account.)

■ Maximum value usable — 2000 m or less

■ Maximum power consumption — 1.0 VA

■ Continuous operating time — Approx. 18 hours (at 300 mΩ range, comparator ON, beeper ON, with LR6 batteries)

■ Dimensions — Approx.196W×130H×50D mm (7.72"W×5.12"H×1.97"D)

■ Mass — Approx. 680 g (25 oz) (including batteries)

| | |
|---|---|
| ■ Effect of radiated radio-frequency electromagnetic field | at 3V/m<br>Resistance measurement<br>±3.0%f.s.<br>Voltage measurement<br>±3.0% f.s. |
| ■ Standards applying | |
| EMC | EN 61326 |
| Safety | EN 61010<br>Pollution Degree 1<br>(anticipated transient overvoltage330 V) |
| ■ Accessories | 9461 PIN TYPE LEAD<br>Instruction Manual<br>Six LR6 alkaline batteries |
| ■ Options | 9452 CLIP TYPE LEAD<br>9453 FOUR TERMINAL LEAD<br>9770 PIN TYPE LEAD<br>9771 PIN TYPE LEAD<br>9382 CARRYING CASE |

### Accuracy

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

f.s. (maximum display value or scale length)

The maximum displayable value or the full length of the scale. This is usually the maximum value of the currently selected range.

rdg. (reading or displayed value)

The value currently being measured and indicated on the measuring instrument.

dgt. (resolution)

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

## 3.2 Measurement Range

Conditions to guarantee accuracy:

- Temperature 23℃±5℃
- Humidity 80% RH or less (no condensation)
- Zero adjustment After zero adjustment for each range
- Warming up time At least 10 minutes
- "B" indicator Not appear
- Period of guaranteed accuracy 1 year

(1) Resistance Measurement

Temperature coefficient: (±0.01% rdg.±0.5 dgt.)/℃
Measurement current frequency: 1 kHz±5 Hz

| Range | Maximum indication | Resolution | Measurement current | Accuracy |
|---|---|---|---|---|
| 300 mΩ | 300.0 mΩ | 100 μΩ | 5 mA | Six months ±0.8% rdg.±6 dgt.<br>1 year ±1.2% rdg.±6 dgt. |
| 3 Ω | 3.000 mΩ | 1 mΩ | 500 μA | Six months ±0.8% rdg.±6 dgt.<br>1 year ±1.2% rdg.±6 dgt. |
| 30 Ω | 30.00 Ω | 10 mΩ | 50 μA | Six months ±0.8% rdg.±6 dgt.<br>1 year ±1.2% rdg.±6 dgt. |

(2) Voltage Measurement

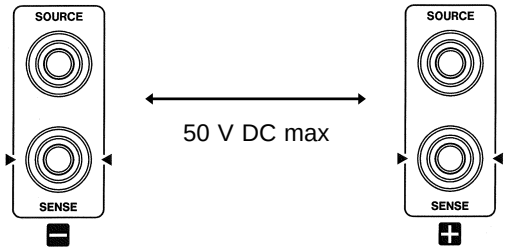
Temperature coefficient: (±0.005% rdg.±0.5dgt.)/℃

| Range | Maximum indication | Resolution | Accuracy |
|---|---|---|---|
| 3 V | ±3.000 V | 1 mV | Six months ±0.1% rdg.±6 dgt.<br>1 year ±0.15% rdg.±6 dgt. |
| 30 V | ±30.00 V | 10 mV | Six months ±0.1% rdg.±6 dgt.<br>1 year ±0.15% rdg.±6 dgt. |

## 3.2.1 Maximum Input Voltage

**⚠ DANGER**

- **The maximum input voltage is 50V DC. Attempting to measure voltage in excess of the maximum input could destroy the instrument and result in personal injury or death.**
- **To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the maximum input to the measurement terminals.**

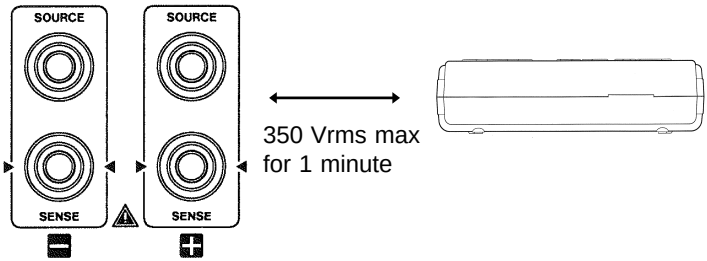



**50 V DC maximum**
**No AC voltage input**
**Between input terminals and ground, 60 V DC and AC maximum**

## 3.2.2 Dielectric Strength

**⚠ DANGER**

**Between input terminals and case:**
**350 V rms for 1 minute.**



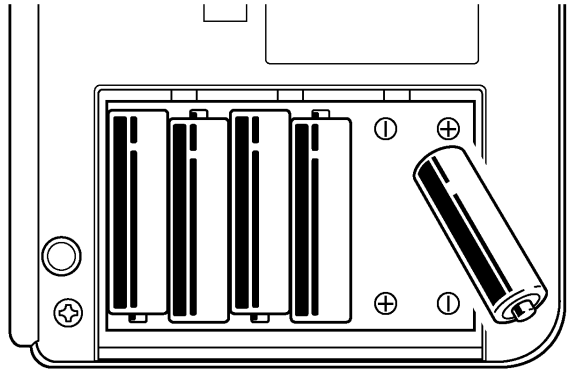
# Chapter 4
# Standard Measurement

## 4.1 Preparing for Measurement

**⚠WARNING**

- **To avoid electric shock when replacing the batteries, first disconnect the test leads from the object to be measured.**
- **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.**
- **After replacing the batteries, replace the cover before using the instrument.**

1. Remove the battery cover.
2. Insert the batteries into the battery compartment as shown in the figure below.



**⚠WARNING**

- **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**

- The "B" indicator lights up when the remaining battery capacity is low. In this case, the instrument's reliability is not guaranteed. Replace the battery immediately.
- After replacing the batteries, the auto power off function is set to 30 minutes, with the beeper on.
- Be sure to press the **POWER** key to power the instrument off before removing the batteries. If the batteries are removed while the instrument is powered on, the previous comparator number may not be recovered.
- To avoid problems with battery operation, remove the batteries from the instrument if it is to be stored for a week or more.
  Even when the power to the main instrument is switched off, a very small current (approximately 0.7 mA) is drawn from the batteries to back up internal data. Therefore if the instrument is left switched off with new batteries installed, they will become fully drained within 2 to 2.5 months.

## 4.2 Measurement

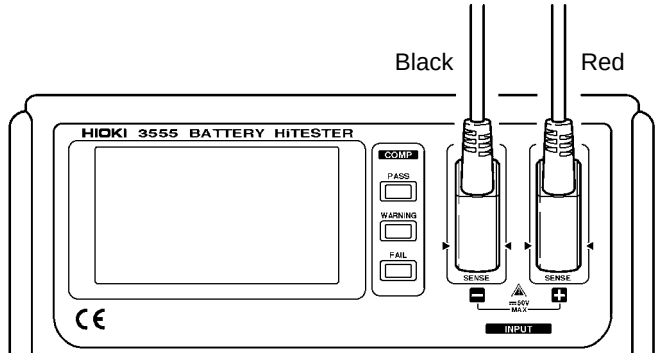
**⚠WARNING**

**To avoid injury or damage to the instrument, do not attempt to measure AC voltage, or DC voltage exceeding 50 V.**

**⚠CAUTION**

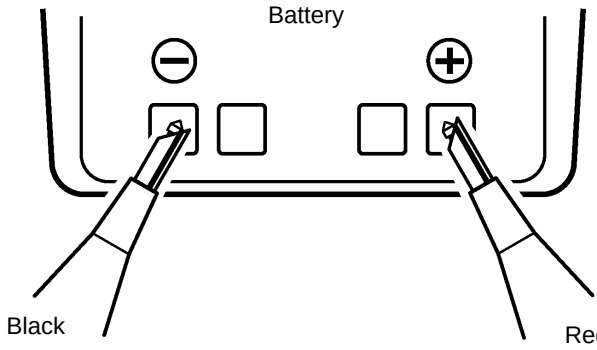
- Do not attempt to measure the voltage of a generator. This would result in an AC voltage being applied to the voltage-generating output terminals, which is dangerous.
- After measuring a high-voltage battery, before continuing to measure a low-voltage battery first short the test leads together. This will discharge the DC-elimination capacitor which is connected across the leads. Otherwise an excess voltage may be applied to the low-voltage battery, which is dangerous.

1. Connect the 9461 PIN TYPE LEAD as shown in the figure below. Connect leads to all four terminals; SOURCE +/− and SENSE +/−.



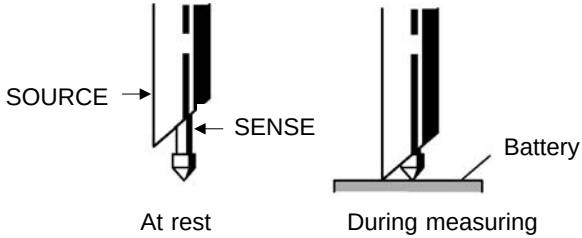

2. Press the **POWER** key to turn on the power and start measurement.
   After pressing the **POWER** key to power on, it is necessary to wait for ten minutes of warming-up time, to allow the instrument to stabilize.

3. Contact the red probe of the 9461 with the positive battery terminal, and the black probe with the negative terminal.




**NOTE**

- As shown in the figure below, the outer shield conductors of the leads are connected to the SOURCE terminals, and the inner pin conductors are connected to the SENSE terminals. When contacting the probes with the battery terminals, press so that the inner pin conductors are pushed inside, and all of the SOURCE and SENSE conductors make good contact.




- Be sure to contact the Pin Type Lead tip vertically against the battery as shown in Figure 1.
  To avoid damage, do not contact the Pin Type Lead tip against the battery at a tilted angle as shown in Figure 2.

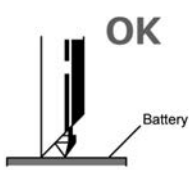



Figure 1

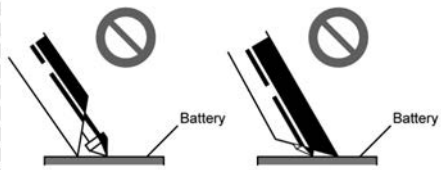
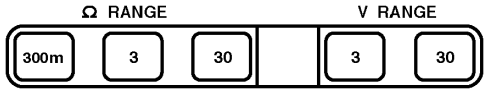



Figure 2

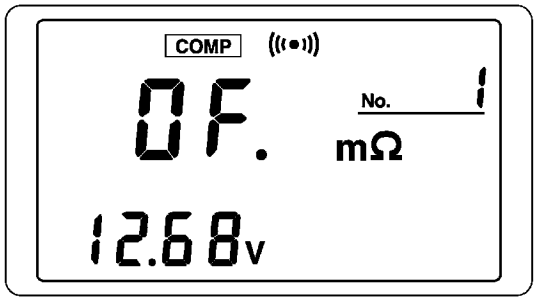
4. Using the range keys, select the voltage and resistance measurement ranges.



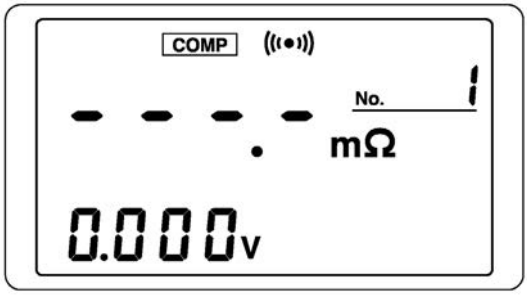

5. When the measurement is completed, disconnect the leads from the tested battery and press the **POWER** key to turn off the power.

**NOTE**

- When measuring the contact resistance of a relay or connector, be careful of the open-circuit voltage across the test leads. It may not always be possible to destroy an oxide layer on the terminals of the object being measured in order to obtain an accurate reading.
- When the indication for a measurement value is "OF", this indicates that the measured voltage or resistance value is outside the measurement range.



- A resistance indication "----" means that the measurement could not be made because there is a break in the test lead circuit. The "----" indication may also appear if the leads are not making good contact with the object to be measured, or if its resistance is extremely large compared with the measurement range.
- The "----" indication may also appear immediately after changing the resistance or voltage measurement range.




- Except for setting the auto power off mode, do not press the **POWER** key in combination with other keys. (For details of the auto power off settings, see Section 5.6, "Auto Power Off.")
- If you do press a combination of the **POWER** key and other keys, and an "INSP" or "Adju" indication appears, immediately press the **POWER** key to power off and on again. Otherwise, continuing with key operations may destroy the calibration data for the instrument, and correct measurement will no longer be possible.
- If the leads are open-circuit, a spurious voltage indication may sometimes be given. This is not a malfunction.

# Chapter 5
# Advanced Measurement Functions

## 5.1 Comparator Function

### 5.1.1 What is the Comparator Function?

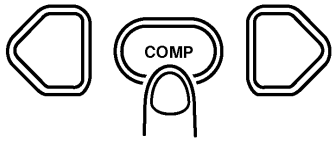
The comparator function compares the measurement values with preset lower and upper limit values for internal resistance and voltage level, and determines which range the measurement falls into, based on the following conditions. It then lights the corresponding LED, and sounds a beeper for the WARNING and FAIL cases. (Refer to Section 5.2, "Beeper On/Off Function.")

## 5.1.2 Changing the Comparator Settings

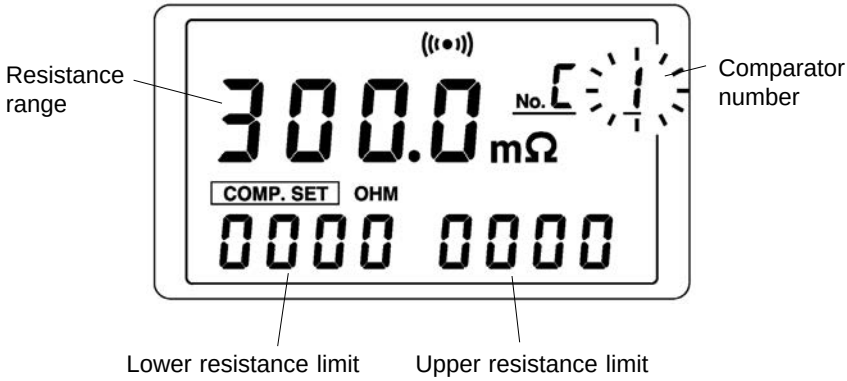
### (1) Before changing the settings

To change the comparator settings (upper and lower resistance limits and voltage comparison value), do the following:

1. Press and hold the (COMP) key for at least 3 seconds. The upper and lower resistance limit settings appear.



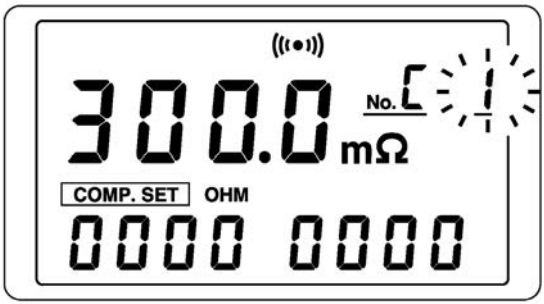

2. "COMP.SET" appears at the lower left of the screen, showing that you are ready to change the comparator settings.

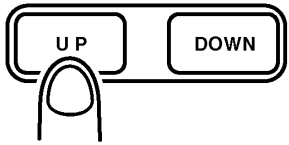


### (2) Setting the comparator number

When the comparator setting screen appears, set the comparator number corresponding to the battery to be tested.

1. Using the 〈 and 〉keys, move the flashing number to the comparator number at the upper right of the screen.
2. Change the comparator number with the **UP** and **DOWN** keys. You can select any comparator number up to 10.

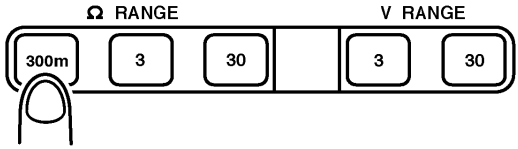



### (3) Setting the resistance range

Press the resistance range key (**Ω RANGE:** **300m** , **3** , **30** ) corresponding to the resistance to be measured.

The currently selected resistance range is displayed at the center on the screen.



### (4) Setting the resistance limits

1. Using the ▷ key, move the flashing number to the most significant digit of the lower resistance limit setting at the lower left of the screen.

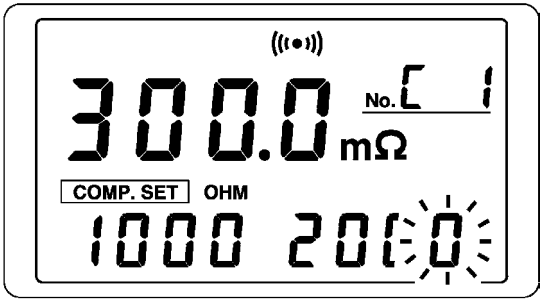


2. Set the lower and upper resistance limits with the **UP** and **DOWN** keys.

   Both the upper and lower resistance limits can be set to any value in the range 0 to 3000.

(5) Setting the voltage range

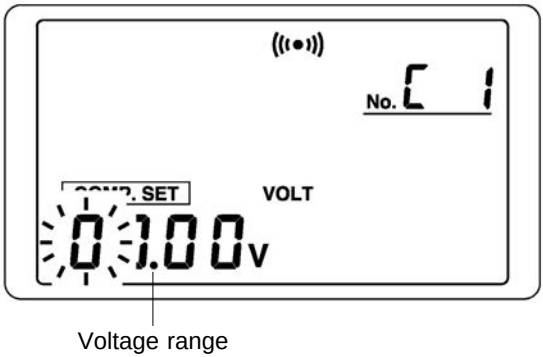
1. Using the ▷ key, move the flashing number to the least significant digit of the upper resistance limit setting at the lower right of the screen.





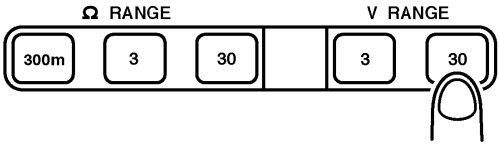
2. Press the ▷ key again to display the voltage comparison value setting screen will appear.

"**COMP.SET**" and "**VOLT**" appear while setting the voltage comparison value.



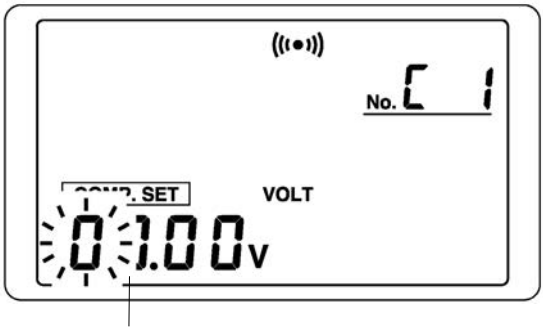

3. Press the voltage range key (**V RANGE:** 3 , 30) corresponding to the voltage to be measured.

The position of the decimal point corresponds to the currently selected voltage range.



### (6) Setting the voltage comparison value

1. Using the ▷ key and the UP and DOWN keys, set the voltage comparison value at the lower left of the screen. The allowable range of settings for the voltage comparison value is -3000 to 3000.




2. Move the flashing number to the least significant digit with the ▷ key.
3. Press the ▷ key again to display the upper and lower resistance limit settings.
4. Go on to set the next comparator number. You can make voltage comparison values for up to 10 comparator numbers.

### (7) Ending setup

When done with comparator selection, press the COMP key. Display returns to the previous measurement screen.

**NOTE**

- When the settings are made by setting a comparator number, they are saved in memory at the point at which the comparator setting screen is exited.
- Comparator setting is not possible while the display is locked.

## 5.1.3 Comparator Decision Result Table

The decision result is indicated by the LEDs and by the beeper, as shown in the following table.

| Voltage \ Resistance | Lower resistance limit ↓ LO | IN | Upper resistance limit ↓ HI |
|---|---|---|---|
| Voltage comparison value → LO | **WARNING** Amber *1 | **WARNING** Amber | **FAIL** Red |
| Voltage comparison value → HI | **PASS** Green | **WARNING** Amber | **FAIL** Red |

*1 Voltage low and resistance low: amber flashing
Beeper sounds when the comparator result is WARNING or FAIL.
(Refer to Section 5.2, "Beeper On/Off Function")

- A "Pass" result is shown by the green LED, a "Warning" by the amber LED, and a "Fail" by the red LED.
- The boundary conditions are as follows.

Resistance LO ≦ Lower resistance limit < Resistance IN
Resistance IN ≦ Upper resistance limit < Resistance HI
Voltage LO ≦ Voltage comparison value < Voltage HI

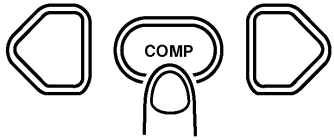
● Interpreting the comparator output table

Example 1 When the measured resistance is at or below the lower resistance limit, and the measured voltage is greater than the voltage comparison value (that is, resistance: LO and voltage: HI), the LED for **PASS** (green) lights. The beeper does not sound.

Example 2 When the measured resistance is greater than the lower resistance limit and lower than the upper resistance limit value, and the measured voltage is greater than the voltage comparison value (that is, resistance: IN, voltage: HI) the LED for **WARNING** (amber) lights and the beeper sounds.

## 5.1.4 Switching the Comparator On and Off

- Pressing the (COMP) key toggles the comparator function on and off. When the comparator is on, the "COMP" indication appears in the display, and the comparator operates as measurements are taken. When the comparator is off, the "COMP" indication disappears from the display, and the comparator does not operate.

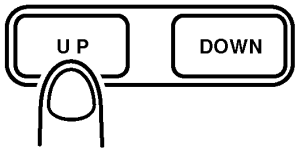



- When the one of the range keys (300m Ω, 3 Ω, 30 Ω, 3 V, 30 V) is pressed and the range is changed, comparator operation stops even if the comparator function is being used. To use comparator function again, press the (COMP) key. The range reverts to the setting extant prior to the change.
- When you turn on the power, the comparator is always set to ON.
- When the UP or DOWN key is pressed to change the comparator number, the comparator is set to ON.

NOTE If there is no measurement value, "----" is displayed and comparator operation is not enabled.

### 5.1.5 Changing the Comparator Number

To change the comparator number, press the UP or DOWN key.




NOTE

- When the comparator number is changed, the range is also automatically changed and comparator is set to on.
- The selected comparator number remains in memory even when the power is turned off.

## 5.2 Beeper On/Off Function

Pressing the key toggles the beeper on and off. When the beeper is on, the "((•))" indication appears in the display, and the beeper sounds when there is a "Warning" or "Fail" result. When the beeper is off, the "((•))" indication disappears from the display, and the beeper does not operate.

## 5.3 Hold Function

This suspends measurement, with the display values held the same.

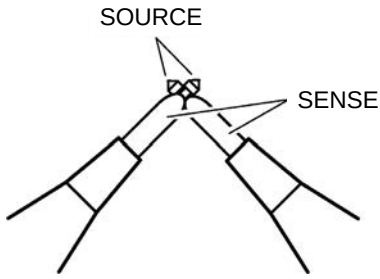
Press the [HOLD] key. "**HOLD**" is displayed on the screen and the display is locked to prevent it from changing.


**NOTE** While the display is locked, the resistance and voltage range keys ([300m]Ω, [3]Ω, [30]Ω, [3]V, [30]V), and the [0 ADJ], (COMP), 〈, 〉, [UP], and [DOWN] keys are not effective.

## 5.4 Zero Adjust Function

The zero adjustment function adjusts the zero position of the resistance and voltage ranges of this instrument. The value read during zero adjustment is taken as zero, and used to calibrate subsequent measurements.

1. Short the SOURCE and SENSE of the 9461 PIN TYPE LEAD together as shown in the figure below.



2. Press the **0 ADJ** key. During zero adjustment, "0Adj" is displayed in the resistance measurement display position.


3. When "0Adj" disappears and measurement starts, connect the leads to the battery to be tested.

**NOTE**

- Keep the leads shorted together throughout the zero adjustment process.
- The zero adjustment is valid for the currently selected range only, as long as the power remains on. Powering on the instrument resets all zero adjustment values.
- When the resistance or voltage value is displayed as "----", or when the reading is more than "200", "FAIL" is displayed. The zero adjustment is not carried out.
- Shorting only the **SENSE** terminals will not display 0 V. Always make sure that both the **SENSE** and **SOURCE** terminals are shorted together.
- If the leads are shorted but their ends are brought close to metal parts, the measured value may fluctuate as a result of electromagnetic induction. In this case, move the ends of the leads away from the metal parts.

## 5.5 Battery Low Warning

When the remaining battery capacity is low, the "B " indicator appears at the right of the display.
In this case, the instrument's reliability is not guaranteed. Replace the battery immediately, referring to Section 4.1, "Preparing for Measurement."


**NOTE**

- If the batteries are exhausted, you may be able to turn on the power, but soon the "B " mark will appear and the power will go off. (Momentary operation is possible because the battery partially regains its former voltage after resting, but soon declines to the exhausted state.) When the batteries wear out, replace them in accordance with the specified procedure.
- Note that measurements taken when the "B " indicator is appeared will be outside the guaranteed accuracy, even though the measurement values may be displayed.

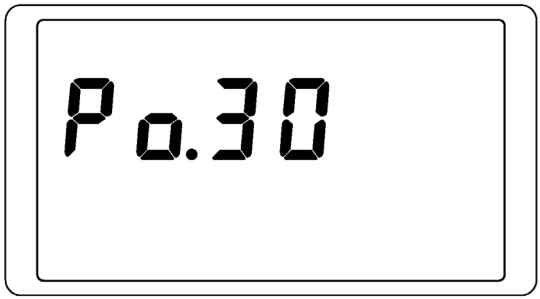
## 5.6 Auto Power Off

In the following states, if there is no switch operation for 30 minutes the instrument automatically powers off.

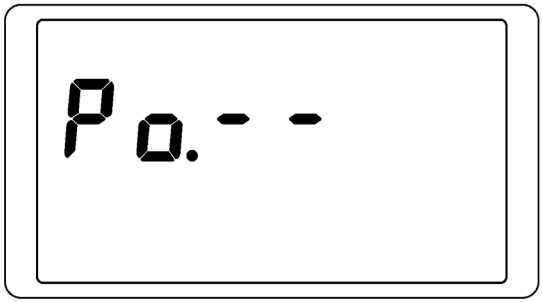
- When the resistance value is "----" indication.
- During hold
- On the comparator setting screen

For continuous measurement, in some cases it may be necessary to disable the auto power off function. Do this as follows.

1. Turn the power off.
2. Press the **POWER** key on the instrument while holding down the **HOLD** key simultaneously.
3. Press the **HOLD** key for a while. The auto-power off setting screen will appear.



4. Press the HOLD key again.



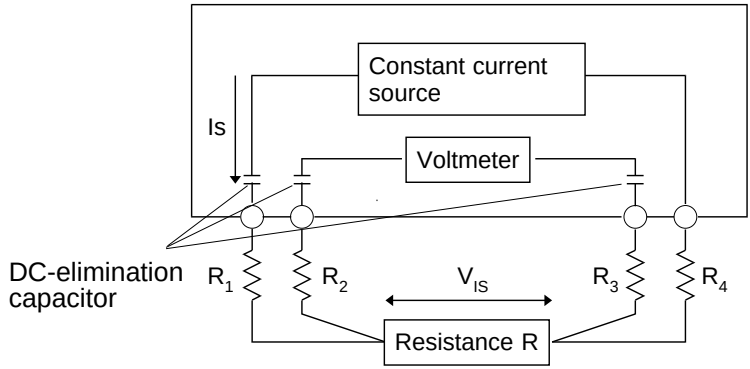

5. When the above screen appears, press the POWER key to turn off the power.
6. Press the POWER key again to turn the power on.
7. To set to the auto-power off, press the HOLD key in the auto power off setting screen and set the auto power off to 30 minutes.

NOTE

- If the POWER key is pressed while another key, other than the HOLD key, is held down, and an "INSP" or "Adju" indication appears, immediately press the POWER key to power off and on again. Otherwise, continuing with key operations may destroy the calibration data for the instrument, and correct measurement will no longer be possible.
- After the batteries are replaced, the auto power off is set to 30 minutes.
- The set time of auto power off cannot be changed.

# 5.7 AC Four-Terminal Method

The 3555 uses the AC four-terminal method, so that resistance measurement can be carried out with the resistance of the leads and the contact resistance between the object to be measured and the leads canceled out. The following figure shows the principle of the AC four-terminal measurement method.




Resistance measurement circuit

Values R1 to R4 are the resistances of the test leads plus contact resistances.

An AC current (Is) is supplied from the **SOURCE** terminals of the 3555 across the tested battery.

The voltage drop across the internal impedance of the battery ($V_{IS}$) is measured by the **SENSE** terminals. At this point, since the **SENSE** terminals are connected to an internal voltmeter with a high impedance, almost no current flows through the resistances R2 and R3 which represent the lead resistances and contact resistances.

As a result, there is almost no voltage drop across the resistances R2 and R3. Thus the voltage drop due to the lead resistances and contact resistances is very small, and these can be canceled out.

**NOTE** In the 3555, a synchronized wave detection system is used, whereby the internal impedance is separated into resistance and reactance, and the resistive component only displayed.

# Chapter 6
# Maintenance

If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.

## 6.1 Troubleshooting

| Symptom | Cause | Follow-up |
|---|---|---|
| Nothing appears on the screen when the **POWER** key is pressed. | Batteries are exhausted, or not inserted. | Replace the batteries or reinsert them correctly. See Section 4.1, "Preparing for Measurement." |
| Measurement values are wrong.<br><br>"---" is displayed.<br>"OF" is displayed. | Leads are not correctly connected. | Connect leads correctly. See Section 4.1, "Preparing for Measurement." |
| | There is an electrical discontinuity in the leads. | Replace with a new lead. |
| | Zero adjustment is not correct. | Perform correctly zero adjustment. See Section 5.4, "Zero Adjust Function." |
| | The measurement range is not appropriate. | Select the appropriate range with the range key. See Section 4.2, "Measurement." |
| Comparator result is not correct. | The comparator setting is not correct. | Set the comparator correctly. See Section 5.1, "Comparator Function." |

NOTE

- To avoid problems with battery operation, remove the batteries from the instrument if it is to be stored for a week or more.

- Do not attempt modify, disassemble or repair the instrument; as fire, electric shock and injury could resuit.

## 6.2 Message Reference

| Message | Meaning | Follow-up |
|---|---|---|
| FAIL | Zero adjustment cannot be carried out. | Connect correctly the lead and execute the zero adjustment. See Section 5.4 "Zero Adjust Function." |
| 0Adj | Zero adjustment is being carried out. | Disappears when zero adjustment is completed. |
| INI | Initialization after battery replacement. | This is not a malfunction. |
| INSP<br>Adju | Inspection and adjustment modes for factory use. | Press the **POWER** key to turn the power on. |
| Er10<br>Er11<br>Er12<br>Er20<br>Er21<br>Er22<br>Er23<br>Er24 | Internal variable error. | Servicing is required. |

## 6.3 Cleaning

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- Wipe the LCD gently with a soft, dry cloth.

# Warranty Certificate

| Model | Serial No. | Warranty period<br>One (1) year from date of purchase (___ / ___) |
|---|---|---|

This product passed a rigorous inspection process at Hioki before being shipped.

In the unlikely event that you experience an issue during use, please contact the distributor from which you purchased the product, which will be repaired free of charge subject to the provisions of this Warranty Certificate. This warranty is valid for a period of one (1) year from the date of purchase. If the date of purchase is unknown, the warranty is considered valid for a period of one (1) year from the product's date of manufacture. Please present this Warranty Certificate when contacting the distributor.
Accuracy is guaranteed for the duration of the separately indicated guaranteed accuracy period.

1. Malfunctions occurring during the warranty period under conditions of normal use in conformity with the Instruction Manual, product labeling (including stamped markings), and other precautionary information will be repaired free of charge, up to the original purchase price. Hioki reserves the right to decline to offer repair, calibration, and other services for reasons that include, but are not limited to, passage of time since the product's manufacture, discontinuation of production of parts, or unforeseen circumstances.
2. Malfunctions that are determined by Hioki to have occurred under one or more of the following conditions are considered to be outside the scope of warranty coverage, even if the event in question occurs during the warranty period:
   a. Damage to objects under measurement or other secondary or tertiary damage caused by use of the product or its measurement results
   b. Malfunctions caused by improper handling or use of the product in a manner that does not conform with the provisions of the Instruction Manual
   c. Malfunctions or damage caused by repair, adjustment, or modification of the product by a company, organization, or individual not approved by Hioki
   d. Consumption of product parts, including as described in the Instruction Manual
   e. Malfunctions or damage caused by transport, dropping, or other handling of the product after purchase
   f. Changes in the product's appearance (scratches on its enclosure, etc.)
   g. Malfunctions or damage caused by fire, wind or flood damage, earthquakes, lightning, power supply anomalies (including voltage, frequency, etc.), war or civil disturbances, radioactive contamination, or other acts of God
   h. Damage caused by connecting the product to a network
   i. Failure to present this Warranty Certificate
   j. Failure to notify Hioki in advance if used in special embedded applications (space equipment, aviation equipment, nuclear power equipment, life-critical medical equipment or vehicle control equipment, etc.)
   k. Other malfunctions for which Hioki is not deemed to be responsible

*Requests
- Hioki is not able to reissue this Warranty Certificate, so please store it carefully.
- Please fill in the model, serial number, and date of purchase on this form.

13-09

**HIOKI E.E. CORPORATION**
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL: +81-268-28-0555
FAX: +81-268-28-0559

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HIOKI E. E. CORPORATION

**HEADQUARTERS**
81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 FAX +81-268-28-0568
os-com@hioki.co.jp
(International Sales Department)

**www.hioki.com**

**HIOKI USA CORPORATION**
hioki@hiokiusa.com www.hiokiusa.com

**HIOKI (Shanghai) SALES & TRADING CO., LTD.**
info@hioki.com.cn www.hioki.cn

**HIOKI INDIA PRIVATE LIMITED**
hioki@hioki.in www.hioki.in

**HIOKI SINGAPORE PTE. LTD.**
info@hioki.com.sg

1502EN

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