HIOKI

3281, 3282

DIGITAL CLAMP ON HiTESTER

Instruction Manual

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Please visit our website at http://www.hioki.com for the following:
- Regional contact information
- The latest revisions of instruction manuals and manuals in other languages.
- Declarations of Conformity for instruments that comply with CE mark requirements.

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 one (1) year 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 "HIOKI 3281, 3282 Digital Clamp-on 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.

Safety

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

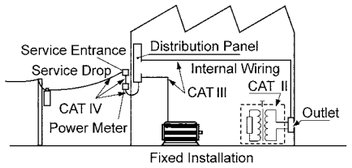
⚠DANGER	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
⚠WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
⚠CAUTION	Indicates that incorrect operation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

Safety Symbols

⚠	• 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. • In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument.
⚠	Indicates that dangerous voltage may be present at this terminal
⧈	Indicates a double-insulated device.
⎓	Indicates DC (Direct Current).
~	Indicates AC (Alternating Current).
⏚	Indicates a grounding terminal.
⚡	Indicates that the instrument may be connected to or disconnected from a live circuit.

■ Measurement categories

This instrument conforms to the safety requirements for CAT III(3281), CAT IV(3282) measurement instruments. 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 ⚠

⚠ DANGER

This instrument is designed to conform to 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.

Do not use on the voltage lines exceeding 600 Vrms.

Do not use on the primary side of the breaker.

Do not input voltage in the resistance measurement, continuity checking and temperature measurement.

⚠ WARNING

To prevent electric shock, when measuring the voltage of a power line use a test lead that satisfies the following criteria:
- Conforms to safety standards IEC61010 or EN61010
- Of measurement category III or IV
- Its rated voltage is higher than the voltage to be measured

The test leads provided with this instrument conform to the safety standard EN61010.
Use a test lead in accordance with its defi ned measurement category and rated voltage.

⚠ WARNING

During current measurement, do not connect the test leads or temperature probe to the instrument.

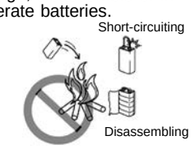
Do not input voltages exceeding 600 Vrms. (1000 V max.)

Avoid touching the exposed metallic parts of the clamp sensor while measuring voltage.

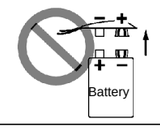
Do not use when your hands are wet.

Do not use the unit with the back casing removed.

Do not short circuit, recharge, disassemble or incinerate batteries.



Be sure to insert the battery with the polarity correct.



- Handle and dispose of batteries in accordance with local regulations.
- To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots and a safety helmet.
- 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. Replace the test leads and probes with the specified Hioki Model L9207-10.

⚠ CAUTION

Do not use or store the instrument where it is exposed to direct sunlight, high temperatures, high humidity, or condensation.

Do not input subject the instrument to vibrations or shocks.
Do not drop the instrument.

- 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.
- When replacing the battery, make sure that the metal battery snap fitting is firmly connected. If the metal fitting is loose, adjust it and recheck the connection. If it isn't connected securely, the power may not be turned on, and a power may be turned off during the use.
- 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 and CAT IV measurement categories . In the CATII environment, if the tips of the test leads do not reach the measurement object, remove the rigid insulating sleeve before measuring. For details on measurement categories, see "Measurement categories" in the instruction manual.
- When performing measurements with the sleeves attached, be careful to avoid damaging the sleeves. If the sleeves are inadvertently removed during measurement, be especially careful in handling the test leads to avoid electric shock.
- To prevent an electric shock accident, confirm that the white or red portion (insulation layer) inside the cable is not exposed. If a color inside the cable is exposed, do not use the cable.

NOTE
- Accurate 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.
- 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.

Specification

The 3281 and 3282 are different in the maximum range.(3281: 600 A, 3282: 1000 A)

1. Measurement specification
- Temperature and humidity for guaranteed accuracy: 23℃±5℃ (73°F±9°F), 80% RH or less (This is guaranteed when "B" mark is not lighting.)
- Guaranteed accuracy period:1 year, or opening and closing of the Clamp Sensor 10,000 times, whichever comes first
- ( ) in the current ranges: 3282
- Maximum rated voltage to earth: Max. 600 Vrms
- **Accuracy is guaranteed for over 10% input of the range in current and voltage.**

Function	Mode	Range	Accuracy (±%rdg. ±dgt.)	Muximum permissible input
AC current (A)	RMS (Effective value)	30.00	40 to 1 kHz: ±1.0%rdg. ±0.7%f.s.	3281: 600 AAC continuous 1000 A max. 3282: 600 AAC continuous 1000 AAC (5 minutes) 1700 A max.
		300.0	45 to 66 Hz: ±1.0%±5	
		600(1000)	40 to 45, 66 to 1 kHz: ±1.5%±5	
		Auto-ranging	As per the above range	
	PEAK (Peak value)	30.0	40 to 1 kHz: ±5%±5	
		300	40 to 1 kHz: ±3%±5	
		600 (1000)	40 to 1 kHz: ±3%±5	
		Auto-ranging	As per the above range	
AC voltage (V)	RMS	300.0/600	45 to 66 Hz: ±1.0%±3	600 VAC continuous 1000 V max.
		Auto-ranging	40 to 45, 66 to 1 kHz: ±1.5%±3	
	PEAK	300/600	40 to 1 kHz: ±3%±5	
Crest factor		1.00 to 5.00	±10%±5	See the currents and voltages above
Frequency (Hz)		Auto-ranging (100.0/1000)	30 to 99.9 Hz: ±0.3%±1	
			95 to 1000 Hz: ±1%±1	
Resistance (Ω)		Auto-ranging (1000/10.00k)	10 to 10.00 kΩ: ±1.5%±5	Open terminal voltage: 3 VDC max. Overload protection: 600 Vrms
Continuity		1000 Ω	Buzzer at approx. 30 Ω or less	

2. General specifications

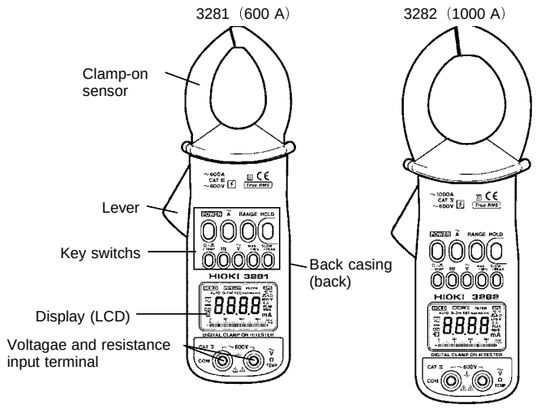
Diameter of measurable conductor	3281: 33 mm dia. max. (1.3"), 3282: 46 mm dia. max. (1.8")
Effect of conductor position	At any position based on the center of the clamp sensor 3281: Within±4.0%, 3282: Within±1.0%
Effect of external magnetic field	In an external magnetic field of 400 AAC/m 3281: 1.5 A max., 3282: 0.2 A max.
Function	Record (displays the maximum (MAX), minimum (MIN) and average (AVE) values in the AC current, AC voltage and frequency measurements), data hold (holds the display), auto-power off (approx. 10 minutes, the buzzer alarms just before the instrument is powered off, can be extended and released), buzzer (can be turned on or off)
Display	LCD, digital (3000 counts), bar graph (35 segments) Over range display: "**O.L.**" or "▶" (bar graph input over) Battery consumption warning: "B" (When this mark is lighting, the accuracy is not guaranteed) Data hold display: "HOLD" Auto power-off display: "APS" Units (A, V, Hz, Ω, kΩ, ℃*, °F*) Zero suppressor: 5 counts max. * : The temperature measurement function is only available for customers who have the THERMISTOR TEMPERATURE PROBE 9462. Model 9462 will be discontinued effective May 18, 2011
Display update rate	Digital display: approx. twice per second, SLOW: approx. once per 3 seconds, FAST: approx. 4 times per second Bar graph display: approx. 4 times per second (fixed)
Response time	Current, voltage, frequency: approx. 2.2 seconds Resistance, continuity check: approx. 1.1 seconds
Range selection	Auto-ranging/manual ranging (fixed range) selectable (excluding the frequency, resistance and continuity check)
Circuit dynamic (Crest factor)	2.5 max. (600 A (3281), 1000 A (3282), 600 V range: 1.7)
Dielectric strength	3281 Between the case and input terminals AC 8540Vrms /1 minute Between the case and clamp cores AC 5312 Vrms /15 sec 3282 Between the case and input terminals AC 8540Vrms /1 minute Between the case and clamp cores AC 8540 Vrms /1 minute
Location for use	Altitude up to 2000 m (6562 feet), Indoors
Standards applying Safety	EN 61010 3281(current):600 VAC(Measurement Category III) Anticipated transient overvoltage 6000 V Pollution Degree 2 3281(voltage):600 VAC(Measurement Category IV) Anticipated transient overvoltage 8000 V Pollution Degree 2 3282(current):600 VAC(Measurement Category IV) Anticipated transient overvoltage 8000 V Pollution Degree 2 3282(voltage):600 VAC(Measurement Category IV) Anticipated transient overvoltage 8000 V Pollution Degree 2
EMC	EN 61326
Dust resistance	EN 60529 IP40
Operating temperature and humidity range	0 to 40℃ (32 to 104°F), 80% RH max. (no condensation)

Temperature characteristics	0.05 x accuracy specifications/℃(℉) at 0 to 40℃ (32 to 104℉)
Storage temperature range	-10 to 50℃ (14 to 122℉) (no condensation)
Power source	Rated power voltage 9 VDC 6F22 layer-built manganese battery x 1
Maximum rated power	100 mVA
Battery lifetime	Approx. 45 hours (continuous, no load)
External dimensions and mass	Approx. 62W x 216.5H x 39D mm, Approx. 350 g (3281) Approx. 2.44"W x 8.58"H x 1.54"D, Approx. 12.3 oz. (3281) Approx. 62W x 231H x 39D mm, Approx. 400 g (3282) Approx. 2.44"W x 9.06"H x 1.54"D, Approx. 14.1 oz. (3282)

3. Accessories

Model L9207-10 Test Lead (black and red set), Instruction manual,Model 9399 Carrying Case, Hand strap, 6F22 (006P) battery

Names and Functions of Parts



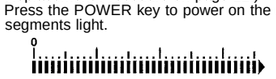
∼	Alternating current
AUTO	Auto-ranging
SLO	Display update: approx. once per three seconds
REC	Record function
MAX	Maximum value
MIN	Minimum value
AVE	Average value = (maximum value + minimum value) / 2
min	One minute: one segment (bar graph)
hour	One hour: one segment (bar graph)
HOLD	Data hold
APS	Auto power-off
°C*	Centigrade
°F*	Fahrenheit
Ω, kΩ	Resistance
	Continuity
Hz	Frequency
V	Voltage
A	Current
RMS	True RMS value
PEAK	Peak value
C.F.	Crest factor = Peak value / Effective value
▶	Input over (bar graph)
	Battery consumption warning

∗ : The temperature measurement function is only available for customers who have the THERMISTOR TEMPERATURE PROBE 9462. Model 9462 will be discontinued effective May 18, 2011

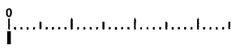
Measurement Procedure

Preparation

1. Loosen the case back screw, and load the battery in the unit. (Refer to Battery Replacement Procedure on page 11.)
2. Press the POWER key to power on the unit. Check to make sure that all display segments light.



New battery



Battery depleted.
"B" lights.
The buzzer beeps three times to warn that the battery must be replaced. Measurements taken at this battery level is not guaranteed for accuracy.

3. The instrument is in the AC current measurement state.

Low battery voltage detection function

After the B mark lights and battery voltage drops below a certain level, the power goes off automatically. When this occurs, **bAtt** and **Lo** are displayed.
When power goes off after display of these marks, replace the exhausted battery with a new one.

AC current (ACA) measurement A

1. Press the Ã key.
2. Position the conductor within the clamp sensor centered.
   Make sure that only one conductor is in the clamp sensor.
   The effective value (**RMS**) of current is displayed in the digital and bar graph.
   Ranging is automatic (**AUTO**).

NOTE

- Use data hold function when you abolish indication and want to read it.
- Please note that waveforms that include elements outside the frequency characteristic range may not be measured correctly.
- Current measurements exceeding 600 A AC should be of short duration. Heat builds up in the clamp sensor proportionate to the current value, and will reach a dangerous level over a long period of time.

Range selection

Pressing the RANGE key repeatedly cycles through the 30 A, 300 A, 600 A and **AUTO** ranges.

Changing the display update SLOW

When the readings fluctuate and are difficult to take, it is possible to make the display update slow (approx. once per three seconds), and the readings easy to take. The screen-updating speed cannot be changed for the bar-graph display.
Pressing the SLOW/PEAK key repeatedly changes the display as follows.

→ SLOW→PEAK→C.F.→RMS

Peak value display PEAK

The peak value is displayed. The effective value is displayed in the bar graph.

NOTE

- Mode displaying the PEAK (peak value) of a continuous wave which lasts for more than 250 ms.
  To keep the displayed value, use the recording function in the PEAK display mode (refer to recording function REC 1.).
- As there is a period whereby no sampling is done on this instrument, it may not be possible to measure an instantaneous peak current that does not reach 250 ms, such as the motor starting current, even when the recording function is used.
- To accurately measure an instantaneous peak current such as an inrush current, please use HIOKI's 3284, 3285, and 3285-20.

Crest factor display C.F.

The crest factor of a waveform is displayed.
Crest factor = Peak value / Effective value
The crest factor of a sine waveform where no distorted, and the harmonic components are included.
When the crest factor of current is being displayed, "A" flashes. The effective value is displayed in the bar graph.

Wave form	Sine wave	Triangular wave	Square wave
	Peak	Peak	Peak
C.F.	1.41	1.73	1

Frequency display Hz

1. Press the Hz key.
2. Pressing the Hz key changes the display.
3. The frequency of the current being measured is displayed.
   When no input is applied, "----" is displayed. When measuring the current frequency, "**A**" flashes. The effective value is displayed in the bar graph.

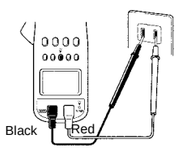
→ Hz→RMS

NOTE

- When the frequency is lower than 30 Hz, "----" is displayed.
- The AUTO range display indicates the current range.

AC voltage measurement V

1. Press the Ṽ key.
2. The effective value (**RMS**) of voltage is displayed in the digital display and bar graph.
   The display update changing, and the peak value, crest factor and frequency displays are possible as well as in the AC current measurement.



Plug in the test leads

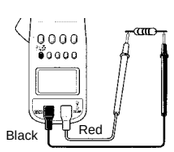
NOTE

- Be sure to use the test leads with the sleeves attached when performing measurements in the CAT III and CAT IV measurement categories. In the CATII environment, if the tips of the test leads do not reach the measurement object, remove the rigid insulating sleeve before measuring.
- Please note that waveforms that include elements outside the frequency characteristic range may not be measured correctly.

Resistance measurement

1. Insert test lead in the instrument as the figure.
2. Attach or remove the rigid insulating sleeve as required by the measurement object.
3. Pressing the Ω/TEMP key repeatedly, and let me indicate Ω. Changes the display as follows.

→ Ω → → °C* → °F* →
(Centigrade) (Fahrenheit)



Plug in the test leads

∗ : The temperature measurement function is only available for customers who have the THERMISTOR TEMPERATURE PROBE 9462. Model 9462 will be discontinued effective May 18, 2011

4.The resistance value is displayed in the digital display and bar graph. Ranging is automatic (**AUTO**).

NOTE

- If a voltage is input, a warning beep will sound. Stop measurement immediately. (The internal circuit is protected against up to AC 600 V.)
- In some cases, the alarm does not beep for DC or DC weighted components.

Continuity check

1. Let me indicate "" in the same way as the resistance measurement.
2. The buzzer beeps at less than approximately 30 Ω, and "" flashes.

NOTE

- The digital display indicates the measured resistance value.
- If a voltage is input, a warning beep will sound. Stop measurement immediately. (The internal circuit is protected against up to AC 600 V.)
- In some cases, the alarm does not beep for DC or DC weighted components.

Data hold function HOLD

Data hold functions to "stop" the display at its present reading.

1. Press the HOLD key. "HOLD" appears, and the digital and bar graph displays are held.
   This function is effective for all measurement functions and modes.
   To release this function, press the HOLD key again.

Auto power-off function APS

When "APS" is being displayed, the auto power-off function is effective.
The unit is powered off in approx. 10 minutes unless any key is pressed.
"APS" flashes and the alarm beeps for approx. 30 seconds just before the unit is powered off.
Pressing a key other than the POWER key prolongs the auto power-off function for 10 minutes.
To release the auto power-off function, press the POWER key while holding down the HOLD key to power on the unit. In this case, "APS" does not appear.
When using the record function, the auto power-off function is ineffective.

Battery consumption warning

If B is indicated, the battery power is running low and accuracy cannot be guaranteed. Replace with a new battery. Refer to "Preparation" for the confirmation of the capacity of the battery.

Buzzer

To turn off the buzzer, press the POWER key while holding down the RANGE key to power on the instrument. The alarm and continuity buzzers cannot be turned off.

FAST mode

Make it FAST mode when you measure load currents with variations.
The digital display update can be set to approx. 4 times per second.

1. Press the Ã key twice to set to the FAST mode.
   "**F**" appears for an instance, and the unit enters the FAST mode.
   Then "**F**" appears each time the Ã or Ṽ key is pressed.
2. Press the RANGE key to fix the current range.
3. It is convenient for taking readings to hold the maximum value (MAX) by using the record function.
4. To release the FAST mode, press the Ã key twice again.

NOTE

- The stable measurement cannot be made unless the waveform lasts for more than 250 ms.
- Push a Ṽ key in the case of the voltage measurement as well after it is made FAST mode.
- This mode is not effective for the resistance, continuity and temperature measurements.
- If setting to the **SLOW** display in the FAST mode, the display update is the same as in the normal mode (approx. twice per second).

Record function REC

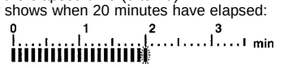
Use the recording function to hold the maximum and minimum measured values and maximum/minimum averages.

1. Measurement indicated value
   Pressing the MAX/MIN key during measurements of current, voltage, or frequency activates the recording function. **REC** flashes and the instrument saves the maximum value (MAX), minimum value (MIN), and average value (AVE) in internal memory from the instant you press the MAX/MIN key. Pressing the MAX/MIN key with the recording function activated switches the display as shown below. If MAX, MIN, or AVE is not displayed, an instantaneous value is assumed.

→ MAX → MIN → AVE → Instantaneous value (No display)

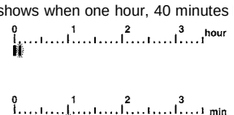
Data (MAX, MIN, AVE) remains displayed while the display is switched. If maximum or minimum data is updated in the meantime, however, the data values will change.
With the recording function activated, the auto power-off function remains disabled. (APS off.)
The average value (AVE) displayed is calculated by: Average Value = [(Maximum value + Minimum Value)/2].
After pressing the SLOW/PEAK key to display the peak value, activate the recording function and select MAX. The peak hold function will be activated.

2. Display of Elapsed Time
   When you press the MAX/MIN key to activate the recording function, the bar graph segments flash and the elapsed time appears.
   When "**min**" is shown in the right-hand corner of the bar graph, each segment of the bar graph corresponds to one minute. Every time one minute elapses, one segment of the flashing bar graph goes on. When all segments on the bar graph go on, the elapsed time is 30 minutes.
   When the elapsed time exceeds 30 minutes, one segment of the flashing bar graph goes off every time one minute elapses.
   When the segments left of a flashing segment remain on: the number of "on" segments represents the elapsed time (0 to 29).
   The illustration below shows when 20 minutes have elapsed:



   When the segments right of a flashing segment remain on: the number of "off" segments (+30) represents the elapsed time (30 to 59).
   The illustration below shows when 50 minutes have elapsed:

   When digital display switches the average value (AVE) to a instantaneous value when you press the MAX/MIN key, the right corner of the bar graph indicates hours. In this mode, each segment of the bar graph corresponds to one hour. The way to read the bar graph here is similar to reading it in minutes. When all bar graph segments remain on, the elapsed time is 29 hours.
   The illustration below shows when one hour, 40 minutes have elapsed.



3. Deactivation of Recording Function
   Pressing the HOLD key deactivates the recording function. HOLD goes on, REC stops flashing and goes on, and the elapsed time stops incrementing. While the recording function is being deactivated, data is not updated, even if the clamp sensor is disconnected from the conductor.
   Pressing the HOLD key again cancels HOLD display and activates the recording function again, with REC flashing again.
4. Cancellation and Resetting of Recording Function
   To cancel the recording function, press the related function key (A, V or Hz) for the measurement in progress. Once the recording function is canceled, the auto power-off function becomes effective. (APS goes on.)
   To restart the unit after resetting the data, temporarily cancel the recording function, then activate it again by pressing the MAX/MIN key.

Note

- An instantaneous power failure and a surge cannot be detected. The record function is not effective for the resistance and temperature measurements.
- The maximum recording duration depends on the remaining battery capacity.
- The lowest possible frequency that can be displayed is 30 Hz.
- If changing the range when "**O.L.**" is being displayed in any of the displays, the held data and elapsed time are cleared.
- When you need minimum value and average value data, make sure to activate the recording function during measurement. If the function is activated when there is no input, the minimum value will remain zero. To deactivate the recording function, press the HOLD key to terminate measurement. If you disconnect the clamp sensor or test lead from the circuit under measurement without deactivating the recording function beforehand, the minimum value will be zero.
- When the unit is turned off, accumulated data are lost.

Battery Replacement Procedure

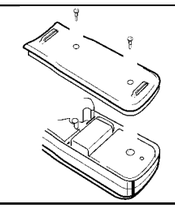
⚠ WARNING

When replacing the battery, be sure to insert them with the correct polarity.
Otherwise, poor performance or damage from battery leakage could result. Replace battery only with the specified type.

⚠ CAUTION

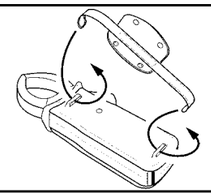
Do not fix the back casing screws too tightly.T
he torque about 0.5N·m is recommended.

1. Remove the two back casing screws, and take off the back casing.
2. Remove the old battery without pulling the codes of the snap.
3. Install a new battery in the battery snap securely.
4. Attach the back casing.



How to Attach the Hand Strap

The hand strap improves the operation.



Troubleshooting

Although the instrument seems to be out of order in the following cases, there may be the causes of the troubles. Check it again before you send it for repair.

Symptom	Battery	Battery snap	Test leads
The instrument cannot be powered on.			-
Power is cut off immediately after it is turned on.*		-	-
"B " lights.		-	-
The instrument is powered off during operation.*			-
Voltage measurement does not function.	-	-	
Resistance measurement does not function.	-	-	
Remedy: If the trouble cannot be remedied, send the instrument for repair.	Replace with a new battery.	The terminals of the battery snap are poorly contact.	Check the test leads wiring.

An indication E.001 to E.005 appears.	Send the instrument for repair.

∗ : When the battery is drained, the relay may be operated immediately after the power is turned on or when the measurement function is changed, and the power may suddenly be cut off. Replace the battery with a new one when this arises.

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.
- The shortest period for possession of the repair parts is 5 years after stopping the production.
- For inquiries about service, contact your dealer or Hioki representative.
- Pack the instrument carefully so that it will not be damaged during shipment, and include a detailed written description of the problem. Hioki cannot be responsible for damage that occurs during shipment.