

HIOKI

FT6380-50

Instruction Manual

CLAMP ON EARTH TESTER



EN

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FT6380B981-00 20-12H



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Introduction

Thank you for purchasing the Hioki FT6380-50 Clamp on Earth Tester. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

Verifying Package Contents

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 authorized Hioki distributor or reseller.

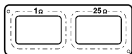
Confirm that these contents are provided.

- FT6380-50 Clamp on Earth Tester



Accessories

- Resistance check loop (1Ω±2%, 25Ω±1%)
- Instruction Manual (this manual)



- Carrying case
- Operating Precautions (0990A907)
- LR6 Alkaline battery ×2
- Strap



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

For other transportation notes, refer to the “Transporting” (p.64).

Option (sold separately)

The option listed below is available for the instrument. To order an option, please contact your authorized Hioki distributor or reseller. Options are subject to change. Check Hioki's website for the latest information.

Z3210 Wireless Adapter



Safety Information

This instrument is designed to conform to IEC 61010 Safety Standards and has been thoroughly tested for safety prior to shipment. However, using the instrument in a way not described in this manual may negate the provided safety features. Carefully read the following safety notes before using the instrument.

DANGER

Mishandling instrument could result in bodily injury or even death, as well as damage to the instrument.

Familiarize yourself with the instructions and precautions in this manual before use.

Symbols on equipment



Indicates the need for caution or the presence of a hazard. For more information about locations where this symbol appears on instrument components, see "Operating Precautions" (p.8), warning messages listed at the beginning of operating instructions, and the document entitled "Operating Precautions" that comes with the instrument.



Indicates a double-insulated device.



Indicates AC (Alternating Current).



Indicates that using the instrument in an external magnetic field of exceeding 30 A/m is prohibited.



Indicates that the instrument may be connected to or disconnected from a live circuit.



Indicates whether the power is on or off.

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



Indicates an imminently hazardous situation that, if not avoided, will result in death of or serious injury to the operator.



Indicates a potentially hazardous situation that, if not avoided, could result in death of or serious injury to the operator.



Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury to the operator.



Indicates the possibility of equipment damage.

Symbols for Various Standards



Indicates the Waste Electrical and Electronic Equipment Directive (WEEE Directive) in EU member states.



Indicates that the instrument complies with standards imposed by EU directives.

Other Symbols



Indicates a prohibited action.

(p. #)

Indicates the location of reference information.

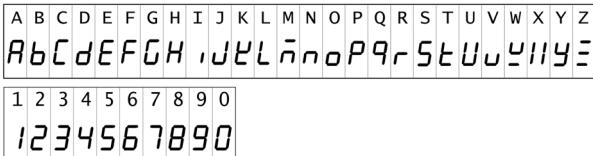
[]

Information displayed on the screen is enclosed in brackets.

Fn
(bold characters)

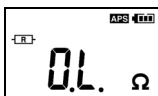
Bold text indicates alphanumeric characters shown on operation keys.

The screen of this instrument displays characters in the following manner.



Screen displays that differ from the above notation:

Over-range display



Resistance measurement: When the reading exceeds 1,600 Ω

Current measurement: When the reading exceeds 60.0 A.

Open display



This screen is displayed when the clamp sensor is not completely closed during use of the resistance measurement function.

Symbols for Various Standards

Hioki expresses accuracy as error limit values specified in terms of percentages of reading.

Reading
(displayed
value)

Refers to the displayed value of the measuring instrument. The limit values of reading errors are expressed in percent of reading (% of reading, % rdg).

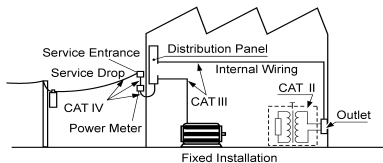
Measurement categories

This instrument complies with CAT IV 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.



Operating Precautions

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

Use of the instrument should confirm not only to its specifications, but also to the specifications of all accessories, options, batteries, and other equipment in use.

Preliminary Checks

Before using the instrument for 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 authorized Hioki distributor or reseller.

Instrument Installation

Operating temperature: -10°C to 50°C (14°F to 122°F)

(Be sure to use batteries that are suited for use under the environmental conditions in which you are using the instrument.)

Operating humidity: 80% RH or less (non condensating)

Avoid the following locations that could cause an accident or damage to the instrument.



Exposed to direct sunlight
Exposed to high temperature



In the presence of corrosive or explosive gases



Exposed to water, oil, other chemicals, or solvents
Exposed to high humidity or condensation



Exposed to strong electromagnetic fields
Near electromagnetic radiators



Exposed to high levels of particulate dust



Near electromagnetic radiators (e.g., high-frequency induction heating systems and IH cooking utensils)



Subject to vibration

Handling the Instrument

DANGER

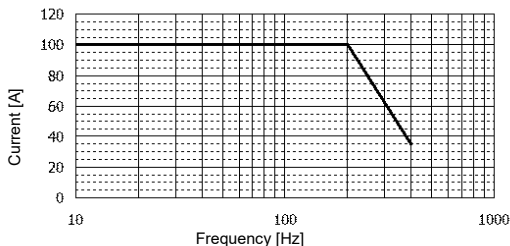
- To avoid short circuits and potentially life-threatening hazards, never attach the clamp to a circuit that operates at more than 600 V AC, or over bare conductors.
- The maximum rated voltage between input terminals and ground is 600 V AC. Measuring a voltage in excess of this rating relative to ground could damage the instrument and result in bodily injury.
- To avoid electric shock, do not remove the instrument's case. The internal components of the instrument carry high voltages and may become very hot during operation.
- When the clamp sensor is opened, do not allow the metal part of the clamp sensor to touch any exposed metal, or to short between two lines, and do not use over bare conductors.

WARNING

To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots and a safety helmet.

CAUTION

- Do not input a current in excess of the maximum allowable current. Doing so may damage the instrument or cause burns. The maximum allowable current is 100 A AC continuous or 200 A AC within 2 minutes at 50 Hz/60 Hz. For more information about the frequency derating characteristics during continuous input, see the following diagram:



- To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- Be careful to avoid dropping the instrument or otherwise subjecting them to mechanical shock, which could damage the mating surfaces of the core and adversely affect measurement.
- Although this instrument is dust resistant, it is not completely dust- or waterproof. To prevent possible damage, avoid using in dusty or wet environments.
- Do not slant the instrument or place it on top of an uneven surface. Dropping or knocking down the instrument can cause injury or damage to the instrument.

 CAUTION

- The protection rating for the enclosure of the instrument (based on EN60529) is IP40*. (The rating applies to the clamp sensor when in the closed position.)

*: 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.

12 *Operating Precautions*

Overview**Chapter 1****1.1 Product Overview**

The FT6380-50 Clamp on Earth Tester makes grounding resistance measurements simply by being clamped to multiple-grounded ground wires. No auxiliary grounding rod is needed, and there is no need to disconnect the ground wire from the grounding rod.

The instrument also provides AC current measurement functionality and can measure currents ranging from leakage current on the order of several mA to load currents of up to 60 A.

1.2 Features

◆ Compact, low-profile sensor

The compact, low-profile sensor can be used to clamp ground wires with ease. The sensor design dramatically speeds the measurement process by eliminating the need to pull out ground wires for clamping or dig around the ground rod or wire.

◆ Broad dynamic range

The instrument can easily measure grounding resistance of up to $0.02\ \Omega$ to $1,600\ \Omega$ with its auto-range function. Current measurement ranges from small leakage current (maximum resolution $10\ \mu\text{A}$) to a maximum of $60\ \text{A}$.

◆ Noise check function (p.31)

The instrument automatically detects noise that may affect grounding resistance measurement and displays a **[NOISE]** mark.

◆ True RMS display

True RMS calculation allows the instrument to accurately measure distortion waveform currents.

◆ Data hold function (p.37)

A large button that is easy to push lets you hold the measured value. The button notifies the user of the hold status by lights up while the value is being held.

◆ Backlight function (p.37)

The instrument uses a white LED for excellent visibility so that display values can be read clearly, even in dark locations.

◆ Auto-power-save (APS) function (p.53)

An auto-power-save function keeps batteries from running down when you forget to turn off the instrument.

◆ Alarm function (p.39)

By setting a threshold, you can have the instrument make a PASS/FAIL judgment and notify you of the result with a buzzer. You can set threshold values as you prefer for each resistance and current and choose between two judgment conditions: when the measured value exceeds the threshold (High) and when it falls below the threshold (Low).

◆ Filter function (p.38)

Widespread use of switching power supplies and inverters has led to cases where harmonic components are superimposed on leakage current waveforms. The instrument's filter function allows it to perform two types of measurement: leakage current as related to degradation of insulation, and leakage current including this harmonic component.

◆ Internal memory (p.42)

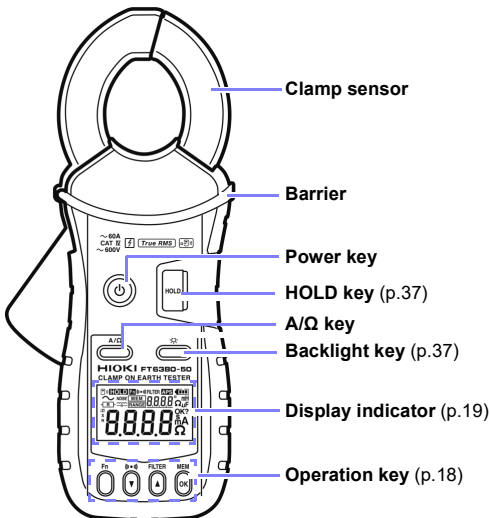
The instrument's internal memory can record up to 2,000 measured values.

◆ Automatic measurement report function using your mobile communication device (p.46)

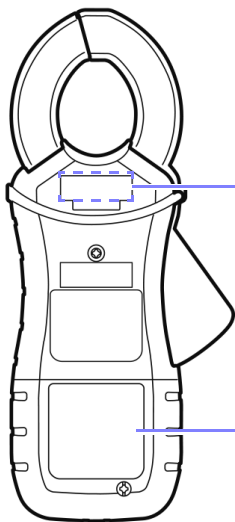
The wireless communication function enables your mobile communication device to create measurement reports on-site easily.

1.3 Names and Functions of Parts

Front



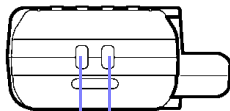
Power key	<ul style="list-style-type: none"> • Used to turn the instrument on and off. • To temporarily cancel the auto-power-save function, press the power key while holding down the HOLD key.
HOLD key	<ul style="list-style-type: none"> • Holds the measured value display or cancels hold mode. • To cancel auto-power-save mode, press the power key while holding down the HOLD key.
Backlight key	<ul style="list-style-type: none"> • Turns the backlight on and off.
A/Ω key	<ul style="list-style-type: none"> • Switches between resistance measurement mode and current measurement mode.

Back**Serial No.**

The serial number consists of nine digits. The first two digits indicate the year of manufacture, while the second two digits indicate the month of manufacture.

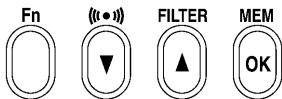
Do not remove this sticker as the number is important.





Battery cover (p.23)

Bottom

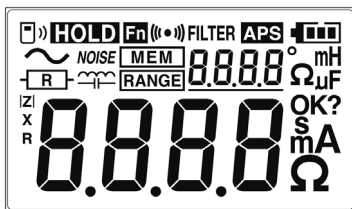
Strap hole
(p.22)

Operation key



Key	Description
	Switches to function mode, which is used to configure settings. Pressing this key again will return to resistance measurement mode or current measurement mode. (p.50)
	<ul style="list-style-type: none"> • Enables the alarm function. (p.39) • When the alarm function is enabled, the instrument will notify the user with the buzzer if a reading is greater than (or less than) a preset threshold. • Alarm function threshold settings can be configured in function mode. (p.41) <p>*In function mode, this key serves as the ▼ key, which is used to select setting items and values.</p>
	<ul style="list-style-type: none"> • Pressing this key while using the current measurement function enables the low-pass filter to reject unneeded harmonic components. (p.38) • Pressing it while using the resistance measurement function enables the moving average function, allowing more stable measurement. (p.38) <p>*In function mode, this key serves as the ▲ key, which is used to select setting items and values.</p>
	<p>Saves measurement data to the instrument's internal memory. (p.42)</p> <p>*In function mode, this key serves as the OK key, which is used to accept setting items and values.</p>

Display Indicators



HOLD	Lights up when data is being held. (p.37)
Fn	Lights up in function mode. (p.50) Flashes in subfunction mode. (p.51)
((••))	Lights up when the alarm function is on. (p.39)
FILTER	Lights up when the filter function is on. (p.38)
☐))	Lights up when the wireless communication function is on. Flashes when data is being sent or received. (p.46)
APS	Lights up when the auto-power-save function is on. (p.53)
🔋	Indicates the remaining battery power. (p.23)
~	Lights up in AC current measurement mode. (p.33)
☐R☐	Lights up in resistance measurement mode. (p.29)
NOISE	Lights up in resistance measurement mode when a current that could affect the measured value is detected. (p.31)
⚡	Lights up in resistance measurement mode when the measured ground loop has a high reactance component or capacitance component ($\pm 45^\circ$ or greater). (When the [⚡] mark lights up due to a low measured resistance value, it is likely that the displayed value indicates a shorted measurement loop rather than normal grounding resistance. When the [⚡] mark lights up, the loop may have a break in it. In this case, the mark indicates that the wires have been coupled by capacitance.) (p.32)

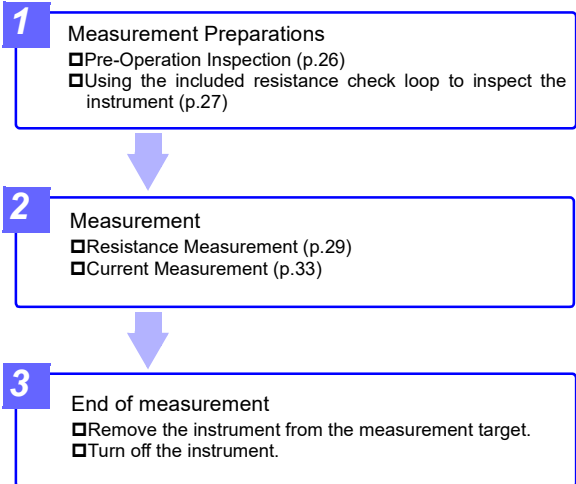
20 1.3 Names and Functions of Parts

MEM	Lights up during internal memory operations. (p.42) The number of measurement data points stored in memory is shown to the right.
RANGE	Lights up when the range display function is on. The measurement range is shown to the right.

Measurement

Chapter 2

2.1 Measurement process



2.2 Preparing for Measurement

After purchasing the instrument

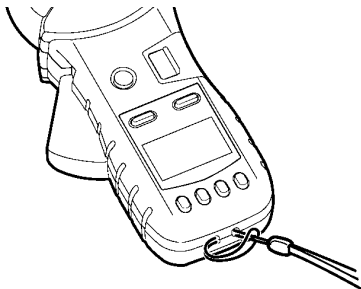
Complete the following steps before using the instrument to make measurements.

Attaching the Strap

CAUTION

Attach both ends of the Strap securely to the instrument. If insecurely attached, the instrument may fall and be damaged when carrying

Thread the strap through the strap hole as shown in the following diagram:







Installing (or Replacing) the Battery and Wireless Adapter

Before using the instrument for the first time, install two LR6 Alkaline batteries.(p.25) Verify that there is sufficient battery power remaining before measurement. If there is insufficient battery power remaining, replace the batteries.

Battery Status Indicator

This indicator is displayed at the top right corner.?

	When new alkaline batteries have been installed
	When 2/3 of the battery power remains
	When 1/3 of the battery power remains
	No battery power remains. Replace with new batteries.

When the Z3210 Wireless Adapter (option) is installed, the wireless communication function can be used.(p.46)


WARNING

- To avoid electric shock, disconnect the clamp from the measuring object before removing the battery cover.
- After replacing the batteries or after installing or removing the Z3210, install the battery cover and tighten the screws before use.
- 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
- To prevent instrument damage or an electric shock, use only the screws that are originally installed for securing the battery cover in place. If you have lost a screw or find that a screw is damaged, please contact your authorized Hioki distributor or reseller.

CAUTION

- Do not mix old and new batteries, or different types of batteries. Also, be careful to observe battery polarity during installation. Otherwise, poor performance or damage from battery leakage could result.
- To avoid corrosion from battery leakage, remove the batteries from the instrument if it is to be stored for a long time.
- After touching any metallic part, such as a doorknob, to eliminate static electricity from your body, connect/disconnect the Z3210. Failure to do so could cause static electricity to damage the Z3210.

NOTE

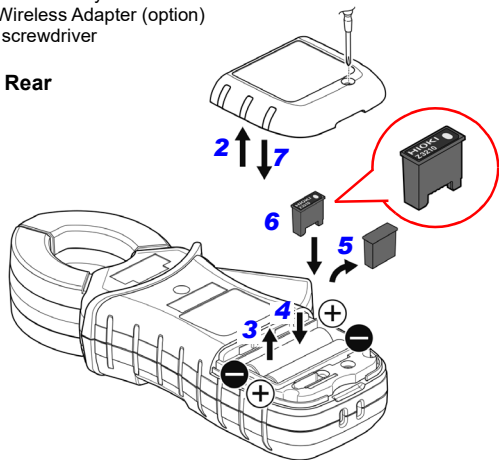
- The [] indicator lights when battery voltage becomes low. Replace the batteries as soon as possible.
- Before replacing the batteries, make sure to turn off the instrument.
- After use, always turn off the instrument.
- If the battery is completely exhausted, the display will show [bAtt → P.oFF], and the instrument will automatically turn off.

Installing (replacing) the batteries and wireless adapter

Start the following procedure after reading the safety precautions.(p.23)

Prepare the following.

- LR6 Alkaline battery ×2
- Z3210 Wireless Adapter (option)
- Phillips screwdriver

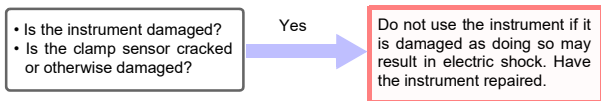
Rear

- 1.** Disconnect the instrument from the measuring object and turn off the power.
- 2.** Loosen the screws and remove the battery cover.
- 3.** Remove the old batteries (when replacing the batteries).
- 4.** Install new batteries, taking care to orient them properly.
- 5.** When installing the wireless adapter, remove the protective cap.
- 6.** Insert the wireless adapter all the way inside while carefully checking its orientation.
- 7.** Install the battery cover and tighten the screws.

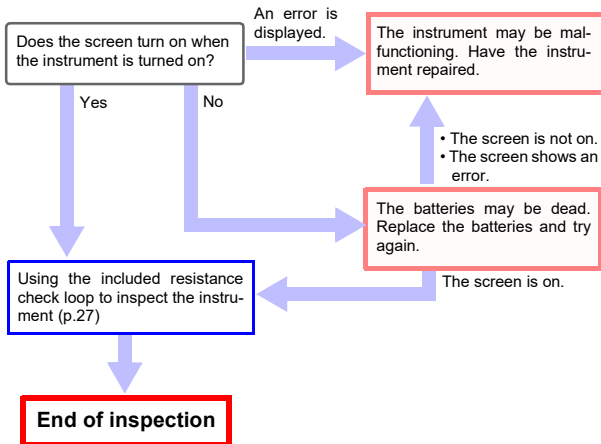
2.3 Pre-Operation Inspection

Before using the instrument for 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 authorized Hioki distributor or reseller.

1. Inspecting the instrument



2. Inspecting the instrument after turning it on

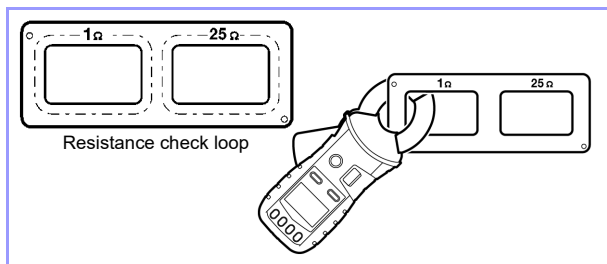


Using the included resistance check loop to inspect the instrument

Before turning on the instrument, be sure to read Operating Precautions (p.8).

Inspecting the instrument with the resistance check loop

Verify that there is no foreign matter lodged between the tips of the clamp sensor and that the sensor can be closed and opened smoothly. If so, clamp the included resistance check loop and verify that the instrument is operating properly. Verify that a value within the allowable range is displayed for each loop.



Test resistance	Allowable range
1 Ω	0.95 to 1.05 Ω
25 Ω	24.3 to 25.7 Ω

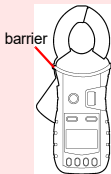
NOTE

- If the instrument displays a value outside the allowable range, it needs to be repaired. Contact your authorized Hioki distributor or reseller.
- The resistance check loop cannot be used to calibrate the instrument. To have the instrument calibrated, contact your authorized Hioki distributor or reseller.

2.4 Measurement Procedure

⚠ DANGER

- To avoid electric shock, do not touch the portion beyond the protective barrier during use.
- When the clamp sensor is opened, do not allow the metal part of the clamp sensor to touch any exposed metal, or to short between two lines, and do not use over bare conductors.
- The maximum allowable current is 100 A AC continuous or 200 A AC for 2 minutes (50 Hz/60 Hz). Currents in excess of these values must be avoided as they may damage the instrument or cause bodily injury.



NOTE

- The tips of the clamp sensor are precisely manufactured in order to provide a high level of precision. Exercise caution when handling the clamp so as to avoid subjecting it to excessive vibration, mechanical shock, or force.
- If foreign matter gets stuck between the tips of the clamp sensor, do not forcibly open or close the sensor, but rather use a soft brush or similar implement to carefully remove the foreign matter. Accurate measurements cannot be made while foreign matter is stuck between the tips of the clamp sensor or while the shape of the clamp sensor is deformed. If the tips of the clamp sensor become deformed, have the instrument inspected and calibrated by your authorized Hioki distributor or reseller.

Resistance Measurement

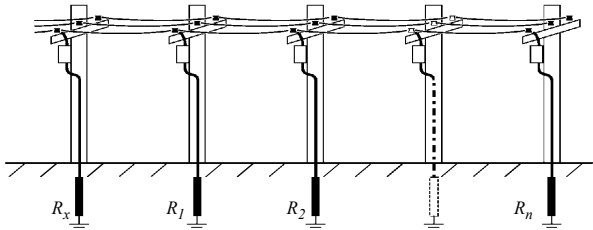
Measuring Principle

As illustrated below, the instrument is designed to measure grounding resistance at multiple grounding locations. (*For applications involving the measurement of grounding resistance at a single grounding site, use Hioki FT6031-50 Earth Tester or Hioki FT3151 Analog Earth Tester)

If the grounding resistance of the measurement target is represented by R_x and the grounding resistance values of other grounded locations are represented by R_1, R_2, \dots, R_n , the resistance value measured by the product is as follows:

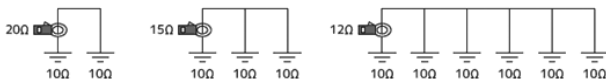
$$R_m = R_x + \frac{1}{\sum_{i=1}^n \frac{1}{R_i}}$$

If n is sufficiently large and each R_i value is sufficiently small, $R_x \ll \frac{1}{\sum_{i=1}^n \frac{1}{R_i}}$ and the second term can be ignored, allowing the value of R_x to be measured.



Example with actual measured values

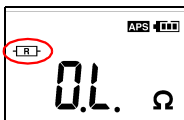
The following provides an example with actual measured values. The more grounding electrodes there are in the multiple-grounded installation, the higher the accuracy of the obtained values. Alternately, if even one grounding electrode has a small value (for example, 1 Ω), accurate values can be approached even if there are few grounding electrodes. Since most multiple-grounded systems have a large number of grounding electrodes, the error can be limited.



Measuring method

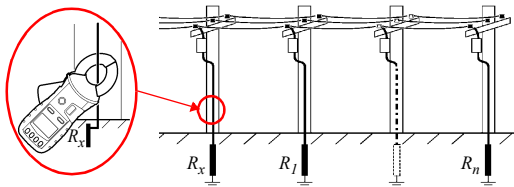
1. Select resistance measurement mode.

Select resistance measurement mode with the **A/Ω** key.



2. Clamp the grounding wire you wish to measure.

The resistance value will be displayed.



NOTE

- Do not measure the same location with two or more Clamp on Earth Testers at the same time. The instruments will interfere with each other, preventing accurate measurement.
- **Verify that the [NOISE] mark is not lit up.**

When the current flowing through the grounding wire is high (approximately 2.5 A or greater with a commercial frequency of 50 Hz/60 Hz, approximately 100 mA or greater with a harmonic component of 1 kHz), the current will affect measured values, making it impossible to measure the resistance. Check the current flowing through the grounding wire.

 - * The current level at which the [NOISE] mark lit up depends on individual differences as well as the frequency. The closer to the injected signal frequency, the smaller the noise current that will affect operation.
- **Open display**

The screen will show [OPEn] if the clamp sensor is not completely closed. Close the clamp sensor completely and repeat the measurement.

 - * If an extremely large current is flowing through the grounding wire or a DC current is superposed, the screen may display [OPEn] even if the clamp sensor is completely closed. This does not signal a malfunction. Check the current flowing through the grounding wire by using the instrument's current measurement mode or an instrument such as a clamp tester capable of DC current measurement.

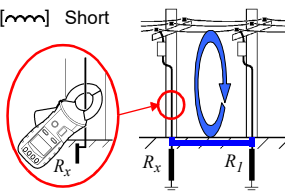
NOTE• **Inductor mark**

If the [∞] mark next to the resistance mark light up during measurement, there may be a short in the ground wire. It is recommended to verify that there are no shorts in the location being measured.

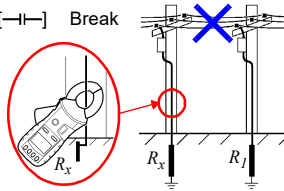
• **Capacitance mark**

If the [—|—] mark next to the resistance mark light up during measurement, there may be a break in the ground wire. It is recommended to verify that there are no wiring breaks in the location being measured.

[∞] Short



[—|—] Break



Current Measurement

Measuring Principle

The instrument is designed based on the principle of electromagnetic induction. The magnetic field corresponding to the current flowing through the conductor to be measured is detected by a current transformer that consists of a magnetic core and coil. The current transformer generates the current corresponding to the magnetic field. The detection resistor converts this current into the voltage to calculate the value of the current flowing through the conductor.

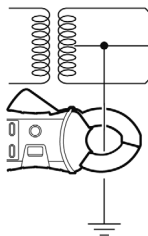
Measuring method

1. Select current measurement mode with the **A/Ω** key.



2. Position the conductor in the center of the clamp sensor.

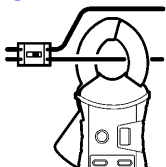
To perform measurement accurately, place the conductor to pass through the center of the clamp sensor at a right angle.



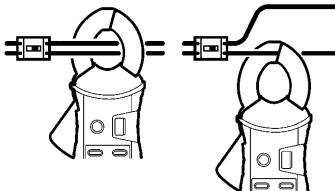
The current RMS value will be shown on the display.



OK



NG

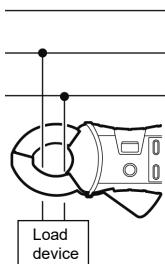
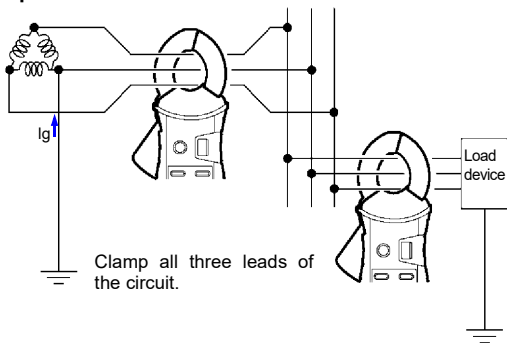


NOTE

- Always clamp the instrument around only one conductor. Clamping the instrument around two or more of conductors in a bundle prevents the instrument from measuring any current regardless of whether the measurement target is a single-phase or three-phase circuit.
- The frequency of special waveforms such as at the secondary side of an inverter may not be indicated correctly.
- Depending on the magnitude and frequency of the input current, resonances may be heard from the clamp jaw. This does not affect the measurement.
- Do not input a current in excess of the maximum allowable current for the current range being used.
- Displayed values can frequently fluctuate due to induction potential even when no voltage is applied. This, however, is not a malfunction.

Measuring zero-phase current

When measuring zero-phase current, clamp all of the circuits at once.

Single-phase, 2-lead circuits**three-phase 3-lead circuits**

NOTE

Do not input current that exceeds the maximum continuous input of the electric current range.

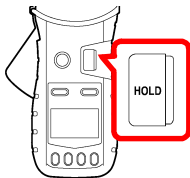
- Measurement may not be accurate in the cases below.
 - (1) When there is large current (of about 100 A) flowing through a nearby electric line
 - (2) Note that a value of several tens of amperes may be displayed when opening or closing the clamp sensor, or when changing the electric current range. This is not an error. It may take some time for the display to return to zero. However, starting measurement before the display returns to zero will not affect measurement.
- Enable the “Filter function (Rejecting noise) (p.38)” when conducting measurement in the cases below.
 - (1) When meaningless data is displayed due to noise.
 - (2) When using the instrument to measure special waveforms, such as those on the secondary side of an inverter
- The instrument may not be able to perform measurement in the cases below.
 - (1) When using input current that is 1/10 or less of the full electric current range
 - (2) When measuring high frequencies with the filter function enabled.

2.5 Convenient function

Data hold function (Holding the measured value)

This function holds the measured value and continues to display that value.

Press the **HOLD** key. The **[HOLD]** mark will be displayed, and the measured value will be held. The **HOLD** key will light up. To cancel hold mode, press the **HOLD** key again. The **[HOLD]** mark will disappear, and the **HOLD** key will turn off.



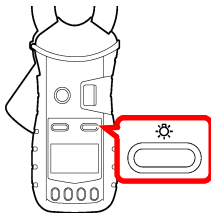
Backlight function (Making measurements in a dark location)

This function makes the display easier to see in dark locations.

Press the backlight key (☀). The backlight will turn on.

The backlight will turn off automatically when there has been no operation for about 2 minutes.

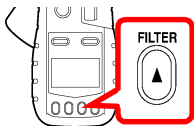
To turn off the backlight, press the backlight key (☀) again. The backlight will turn off.



Filter function (Rejecting noise)

This function allows you to reject unneeded frequency components such as high-frequency noise.

Press the **FILTER** key. The **[FILTER]** mark will be displayed. To cancel the filter, press the **FILTER** key again. The **[FILTER]** mark will disappear.



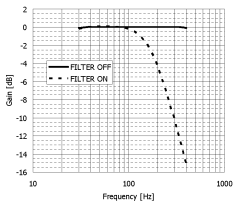
◆ During resistance measurement

Using the filter function when there is a significant amount of variation in measured values during resistance measurement will cause the measured values to stabilize.

*Note that noise rejection cannot be used when the **[NOISE]** mark is lit up.

◆ During current measurement

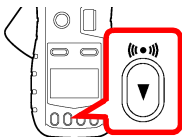
Using the filter function enables a low-pass filter, causing the harmonic component to be eliminated from measured values. Widespread use of switching power supplies and inverters has led to cases where harmonic components are superimposed on current waveforms; the filter function is effective in such cases. Canceling the filter function disables the low-pass filter, allowing measurement of current including harmonic components.



Alarm function (Judging measured values and sounding an alarm)

You can sound an alarm using previously set thresholds by pressing the **(((•)))** key. A high tone signifies a high alarm, while a low tone signifies a low alarm.

Thresholds and other settings must be configured in advance. To cancel the alarm function, press the **(((•)))** key again.



1. Configuring the alarm settings

Press the **Fn** key to switch to function mode. Using the **▼** and **▲** keys, select the resistance or current alarm settings screen and press the **OK** key.

***For more information about function mode, see (p.50).**



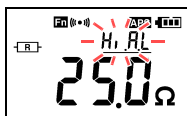
Alarm settings screen for resistance measurement



Alarm settings screen for current measurement

2. Set the alarm type (Hi/Lo).

Using the ▼ and ▲ keys, select the alarm type (Hi/Lo), and press the OK key. The next threshold setting will start flashing.



Hi: The alarm will sound if the measured value is greater than the set threshold value.



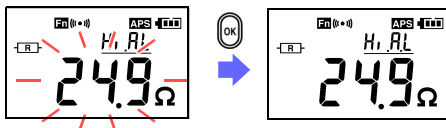
Lo: The alarm will sound if the measured value is less than the set threshold value.

*The Hi/Lo setting is saved once the following setting has been configured. If you press the **Fn** key after configuring the Hi/Lo setting but before saving the threshold and thereby cancel the configuration process, any changes to the Hi/Lo setting will not be saved.

3. Set the threshold.

After configuring the Hi/Lo setting, set the threshold. Using the **▼** and **▲** keys, set the threshold and press the **OK** key.

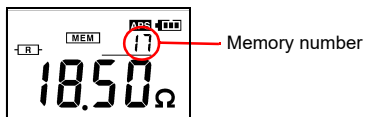
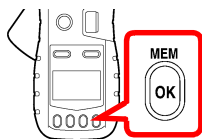
You can move more quickly through threshold values by pressing and holding the **▼** and **▲** keys.



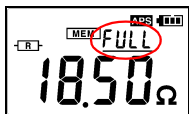
Once the settings are complete, the screen will switch to the alarm settings screen. To return to resistance measurement or current measurement mode, press the **Fn** key again or the **A/Ω** key.

Memory function (Saving measurement data)

Press the **MEM** key in either resistance measurement mode or current measurement mode. The instrument will beep three times and the displayed measured value will be stored along with the memory number (1 to 2000) in the instrument's internal memory.



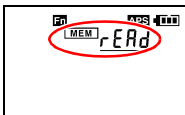
When the number of values saved in the instrument's memory reaches 2,000, the display will show "FULL," and you will not be able to save additional values. Delete unneeded values to free up space.



* Measured values, filter use, and the [AC/DC] and [NOISE] marks are saved in memory.

◆ Loading a value from the instrument's internal memory

1. Press the **Fn** key to enter function mode.
* For more information about function mode, see (p.50).
2. Using the **▼** and **▲** keys, select the read memory screen and press the **OK** key.



3. Using the **▼** and **▲** keys, increment or decrement the memory number to recall the measured value for the memory number you wish to load.
You can move more quickly through memory numbers by pressing and holding the **▼** and **▲** keys.



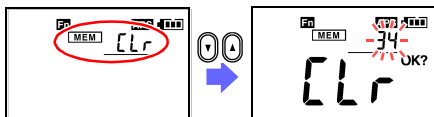
To exit the read memory screen, press the **Fn** key or the **OK** key.

* To return to resistance measurement or current measurement mode, press the **Fn** key again or the **A/Ω** key.

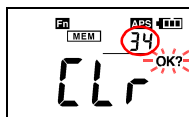
◆ Clearing stored data

You can clear the last stored data point (1 value) or all stored data points.

1. Press the **Fn** key to enter function mode.
* For more information about function mode, see (p.50).
2. Using the **▼** and **▲** keys, select the Clear Memory screen and press the **OK** key. The screen will show [CLr].

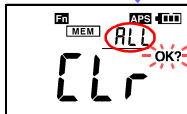


3. Using the **▼** and **▲** keys, select either the last stored data point or all data points and press the **OK** key.



To clear the last stored data point (1 value)

(The screenshot to the left indicates that 34 values have been saved in the instrument's memory.)



To clear all data points

(The screen will show [ALL].)

The [OK?] mark will flash on the LCD once you select the data to clear so that you can confirm your intentions. Press the **OK** key again to clear the data.

- To cancel, press the **Fn** key.
- To return to resistance measurement or current measurement mode, press the **Fn** key again or the **A/Ω** key.

Wireless Communication Function (GENNECT Cross)

When the wireless communications function is enabled, you can review measurement data and create measurement reports on mobile devices.

For more information about this functionality, see “GENNECT Cross Official Website” (application software, free of charge).



GENNECT Cross Official Website
<https://gennect.net/en/cross/index>



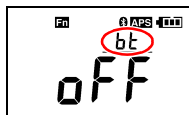
NOTE

- The communication distance is approx. 10 m (line of sight). The distance over which data can be sent and received varies greatly depending on whether there are any obstructions between the paired instruments (for example, walls, metal barriers, etc.) and on the distance between the instrument and the floor (or ground). To ensure stable communication, verify adequate signal strength.
- Although the GENNECT Cross is provided free of charge, downloading or using the application software may incur Internet connection charges. Such charges are the sole responsibility of the user.
- The GENNECT Cross is not guaranteed to operate on all mobile devices.
- The Z3210 uses 2.4 GHz band wireless technology. It may not be possible for the device to establish a wireless connection when used in the vicinity of other devices that use the same frequency band, for example Wi-Fi devices (IEEE 802.11.b/g/n).
- When the app is launched for the first time (before being paired with any instrument), the instrument settings screen will be displayed.

NOTE

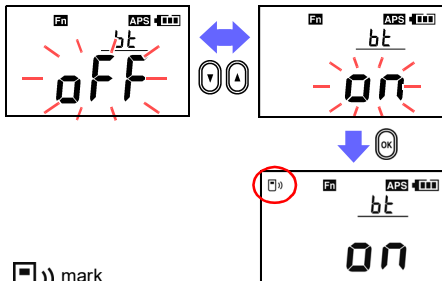
- While the mobile device is displaying the GENNECT Cross's instrument settings screen, simply move it close to the instrument to automatically pair it with the instrument (the app can be paired with up to 8 instruments).
- Allow about 5 s to 30 s for the instrument to pair with the app after being turned on. If the instrument fails to pair within 1 min., relaunch GENNECT Cross and cycle the instrument's power.

- 1.** Connect the Z3210 Wireless Adapter (option) to the instrument. (p.23)
- 2.** Install the GENNECT Cross on your mobile device.
- 3.** Turn on the instrument.
- 4.** Press the **Fn** key to enter function mode.
* For more information about function mode, see (p.50).
- 5.** Using the **▼** and **▲** keys, select the wireless communication setting screen and press the **OK** key.



- * When the Z3210 is not connected, the instrument will display [n.c.]. You cannot switch on/off the wireless communication setting.

6. Using the ▼ and ▲ keys, select [on] and press the OK key to enable the wireless communication function.



 mark

Lights up: Wireless communication function is on.
 Lights off: Wireless communication function is off.
 Flashes: Performing wireless communication

7. Launch the GENNECT Cross and pair it with the instrument.
8. Select the measurement function and start measurement.

Useful functionality of the Z3210

For detail information, please visit the Z3210's website.
<https://z3210.gennect.net>

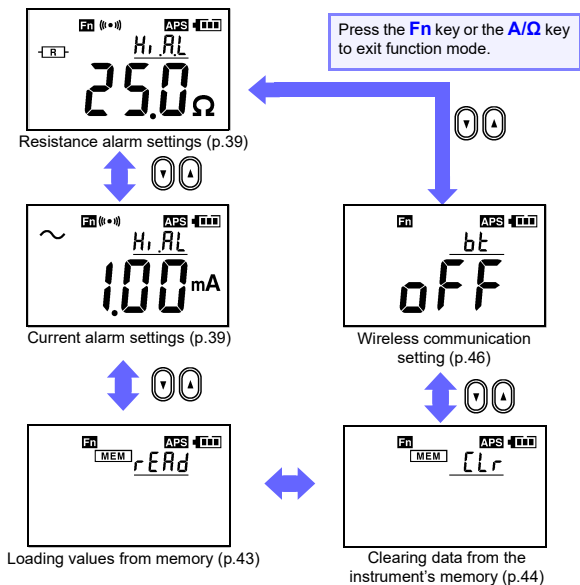
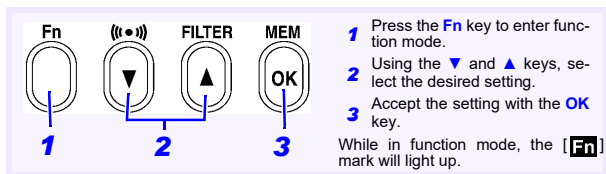


Learn more here!

Function mode

In function mode, the following settings and operations are available:

- Resistance alarm settings
- Current alarm settings
- Loading values from memory
- Clearing data from the instrument's memory
- Wireless communication settings

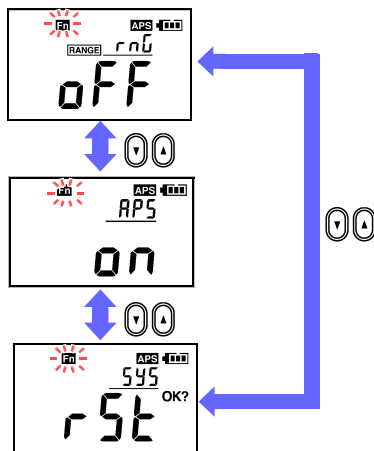
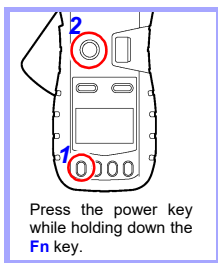


2.6 Advanced Settings and Functions

Advanced settings can be configured in sub-function mode. In sub-function mode, the following settings and operations are available:

- Measurement range display setting (p.52)
- Auto-power-saving (APS) setting (p.53)
- System reset (to revert to factory settings) (p.54)

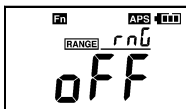
To enter sub-function mode, turn on the instrument by pressing the power key while holding down the **Fn** key.



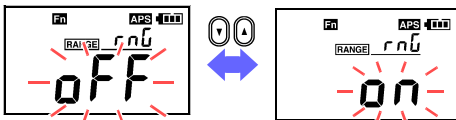
To exit sub-function mode, press the power key to turn off the instrument and then turn it back on.

Enabling/disabling the measurement range display function

1. Press the power key while holding down the **Fn** key.
The instrument will enter sub-function mode.
2. Using the **▼** and **▲** keys, select the range display setting screen and press the **OK** key.



3. Using the **▼** and **▲** keys, switch the range display function on or off and press the **OK** key.



NOTE The measurement range is displayed using values only.
(Example: 1,600 Ω range \rightarrow 1,600)
The units for the measurement range are the same as for the displayed measured value.

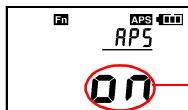
Enabling/disabling the auto-power-saving (APS) function

The auto-power-saving (APS) function prevents unintentional battery consumption when you forget to turn off the instrument. The APS function activates automatically when the instrument is turned on. The instrument will automatically turn off once about 5 minutes pass without any operation (an alarm will sound for about 10 seconds first).

Pressing any key while the alarm sounds will reset the time before the instrument turns off to about 5 minutes.

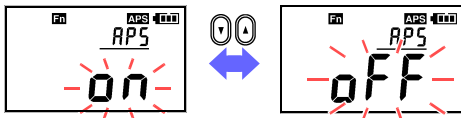
You can restart the instrument by pressing the power key.

1. Press the power key while holding down the **Fn** key.
The instrument will enter sub-function mode.
2. Using the **▼** and **▲** keys, select the APS setting screen and press the **OK** key.



The APS function is enabled when the screen shows [on].

3. Using the **▼** and **▲** keys, switch the APS function on or off and press the **OK** key.
When the APS function is disabled in sub-function mode, APS will remain disabled when the instrument's power is cycled.



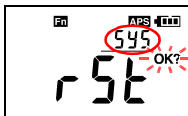
To disable APS temporarily

Turn on the instrument by pressing the power key while holding down the **HOLD** key to disable APS until the next time the instrument's power is cycled. The next time the power is cycled, APS will be enabled (as long as the APS setting is enabled in sub-function mode).

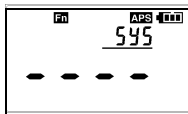
Reverting the instrument to factory settings (system reset)

This section describes how to initialize the instrument's settings. All measurement data (up to 2,000 values) will be deleted.

1. Press the power key while holding down the **Fn** key.
The instrument will enter sub-function mode.
2. Using the **▼** and **▲** keys, select the System Reset screen and press the **OK** key.
The [OK?] mark will flash.



3. Press the **OK** key again.
The instrument will revert to the factory settings.

**NOTE**

- If the System Reset screen is displayed by mistake, cycle the instrument's power without pressing the **OK** key. Instrument operation will be restored without a system reset having been performed.
- For more information about how to clear previously saved measurement data, see "Clearing stored data (p.44)"

Specifications**Chapter 3****3.1 General Specifications**

Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity range	-10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	-20°C to 60°C (-4.0°F to 140°F), 80% RH or less (non-condensation)
Dustproofness and waterproofness	IP40 (EN 60529) With clamp sensor closed.
Standards	Safety EN 61010 EN 61557 (EN 61557-13, Class2, 30 A/m) EMC EN 61326
Power supply	LR6 Alkaline battery ×2 Rated supply voltage: 1.5 V DC ×2 Maximum rated power: 450 mVA
Continuous operating time	When using two LR6 Alkaline batteries (reference value at 23°C) <ul style="list-style-type: none"> • Approx. 40 hours (25 Ω measurement, backlight off, Z3210 not installed) • Approx. 35 hours (25 Ω measurement, backlight off, Z3210 installed and wireless communication)
Dimensions	Approx. 73W × 218H × 43D mm (2.87"W × 8.58"H × 1.69"D) (excluding projections)
Maximum diameter of measurable conductor	φ32 mm
Mass	Approx. 620 g (21.9 oz) (excluding batteries)
Product warranty period	3 years
Accessories	Reference: p.2
Options	Reference: p.3

3.2 Input, Output, and Measurement Specifications

-1. Basic specifications

Measurement item	Resistance measurement Current measurement
Input specifications	Resistance range: 0.20 Ω/2.00 Ω/20.00 Ω/50.0 Ω/100.0 Ω/200.0 Ω/400 Ω/600 Ω/ 1200 Ω/1600 Ω Current range: 20.00 mA/200.0 mA/2.000 A/20.00 A/60.0 A Range switching: Auto range
Maximum rated terminal-to-ground voltage	600 V AC (Measurement category IV) Anticipated transient overvoltage 8000 V

-2. Measurement specifications/ Accuracy specifications

Common measurement specifications	
Accuracy guarantee conditions	Accuracy guarantee period: 1 year (Clamp sensor opening/closing count: Up to 10000 cycles) Accuracy guarantee period after adjustment made by Hioki: 1 year Accuracy guarantee temperature and humidity range: 23°C ±5°C, 80% RH or less
Temperature coefficient	(Measurement accuracy × 0.1)/°C is added to the measurement accuracy (Specified outside a range of 23°C ±5°C)
Nominal operating ranges	Operating temperature and humidity range: See "Operating temperature and humidity range" in "General Specifications" (p.55). Position (Reference position): The measurement target must be placed to pass through the clamp sensor's center perpendicularly to the clamp sensor. Battery voltage: Available effective battery voltage 2.3±0.19 V to 3.45 V Earth potential: 3 V rms (Direct current or sinusoidal wave) External magnetic field: 400 A/m or less (DC and frequency 50 Hz/60 Hz) 30 A/m or less (AC current measurement only, frequency 15 Hz to 400 Hz (excluding 50 Hz/60 Hz))

Resistance measurement

Accuracy guarantee conditions	No reactance component, no noise current, earth potential 0 V
Measurement Method	Analog synchronous detection method (effective resistance measurement)
Effective measuring range	0.02 Ω to 1600 Ω
Zero display range	Less than 0.02 Ω
Overrange	Greater than 1600 Ω
Injected signal frequency	2375 Hz \pm 25 Hz
Injected voltage level	9.0 mV \pm 1.0 mV rms (with load open)
Measurement response time	Filter: OFF: 3 s \pm 0.5 s or less Filter: OFF: 9 s \pm 0.5 s or less

Range (Accuracy Range)	Resolution	Accuracy (Intrinsic uncertainty A)
0.20 Ω (0.02 Ω to 0.20 Ω)	0.01 Ω	\pm 1.5% rdg \pm 0.02 Ω
2.00 Ω (0.18 Ω to 2.00 Ω)	0.01 Ω	\pm 1.5% rdg \pm 0.02 Ω
20.00 Ω (1.80 Ω to 20.00 Ω)	0.01 Ω	\pm 1.5% rdg \pm 0.05 Ω
50.0 Ω (18.0 Ω to 50.0 Ω)	0.1 Ω	\pm 1.5% rdg \pm 0.1 Ω
100.0 Ω (50.0 Ω to 100.0 Ω)	0.1 Ω	\pm 1.5% rdg \pm 0.5 Ω
200.0 Ω (100.0 Ω to 200.0 Ω)	0.2 Ω	\pm 3.0% rdg \pm 1.0 Ω
400 Ω (180 Ω to 400 Ω)	1 Ω	\pm 5% rdg \pm 5 Ω
600 Ω (400 Ω to 600 Ω)	2 Ω	\pm 10% rdg \pm 10 Ω
1200 Ω (600 Ω to 1200 Ω)	10 Ω	\pm 20% rdg
1600 Ω (1200 Ω to 1600 Ω)	20 Ω	\pm 35% rdg

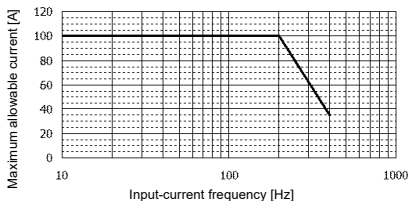
To obtain the measurement accuracy at a range boundary, apply the accuracy of the higher-accuracy range.

58 3.2 Input, Output, and Measurement Specifications

Items involved in EN 61557-5			
Measurement waveform	Sinusoidal wave (with a distortion factor of 5% or less)		
Effect of positioning (E_1)	Accuracy \times 2.0		
Effect of supply voltage (E_2)	Accuracy \times 0.5 and within the accuracy specifications		
Effects of temperature (E_3)	Accuracy \times 1.0 (18°C to 28°C), Accuracy \times (1 + 0.1/°C) (-10°C to 18°C, 28°C to 50°C)		
Series disturbance voltage (E_4)	16 2/3 Hz, 50 Hz, 60 Hz	0 V to 3 V	Accuracy \times 1.0
	DC	0 V to 3 V	Accuracy \times 1.0
Fiducial resistance 100 Ω	400 Hz	0 V to 3 V	Accuracy \times 1.0
Allowable ground potential	3 V rms (Direct current or sinusoidal wave)		
Effects of resistance of the auxiliary earth electrodes (E_5)	Not applicable		
Effects of system frequency (E_7)	Not applicable		
Effects of system voltage (E_8)	Not applicable		
Operation uncertainty	\pm 30% rdg		
Guaranteed operating-uncertainty range	3.00 Ω to 1600 Ω		

AC current measurement

Accuracy guarantee conditions	Sine wave input
Measurement method	Digital sampling method (true RMS measurement)
Crest factor	5.0 or less (for the 60 A range, 1.7 or less)
Conductor position effects	$\pm 0.5\%$ rdg or less (using the center of the sensor as the reference, in all positions)
Magnetic field interference	10 mA or less in an external magnetic field of 400 A/m at 50 Hz /60 Hz AC
Maximum allowable current	100 A AC continuous, 200 A AC for 2 minutes (50 Hz/60 Hz) For frequency derating characteristics during continuous input, see the following diagram:



Effective measuring range	0.05 mA to 60.0 A
Zero display range	Less than 0.05 mA
Overrange	Greater than 60.0 A
Measurement response time	Filter off/ Filter on: 1 s \pm 0.5s or less

60 3.2 Input, Output, and Measurement Specifications

Range (Accuracy Range)	Resolution	Guaranteed accuracy frequency range	Accuracy (Intrinsic uncertainty A)	
			Filter off	Filter on
20.00 mA (1.00 mA to 20.00 mA)	0.01 mA	45 Hz ≤ f ≤ 66 Hz	±2.0% rdg ±0.05 mA	±2.0% rdg ±0.05 mA
		30 Hz ≤ f < 45 Hz 66 Hz < f ≤ 400 Hz	±2.5% rdg ±0.05 mA	--
200.0 mA (18.0 mA to 200.0 mA)	0.1 mA	45 Hz ≤ f ≤ 66 Hz	±2.0% rdg ±0.5 mA	±2.0% rdg ±0.5 mA
		30 Hz ≤ f < 45 Hz 66 Hz < f ≤ 400 Hz	±2.5% rdg ±0.5 mA	--
2.000 A (0.180 A to 2.000 A)	0.001 A	45 Hz ≤ f ≤ 66 Hz	±2.0% rdg ±0.005 A	±2.0% rdg ±0.005 A
		30 Hz ≤ f < 45 Hz 66 Hz < f ≤ 400 Hz	±2.5% rdg ±0.005 A	--
20.00 A (1.80 A to 20.00 A)	0.01 A	45 Hz ≤ f ≤ 66 Hz	±2.0% rdg ±0.05 A	±2.0% rdg ±0.05 A
		30 Hz ≤ f < 45 Hz 66 Hz < f ≤ 400 Hz	±2.5% rdg ±0.05 A	--
60.0 A (18.0 A to 60.0 A)	0.1 A	45 Hz ≤ f ≤ 66 Hz	±2.0% rdg ±0.5 A	±2.0% rdg ±0.5 A
		30 Hz ≤ f < 45 Hz 66 Hz < f ≤ 400 Hz	±2.5% rdg ±0.5 A	--

Items involved in EN61557-13	
Fiducial current	5 mA
Effect of positioning (E_1)	Accuracy $\times 0.3$
Effect of supply voltage (E_2)	Accuracy $\times 0.3$ and within the accuracy specifications
Effects of temperature (E_3)	Accuracy $\times 0.5$ (18°C to 28°C), Accuracy $\times (1 + 0.05/^\circ\text{C}) \times 0.5$ (0°C to 18°C, 28°C to 45°C)
Effects of distortion waveform (E_9)	Accuracy $\times 0.3$
Effects of external magnetic field (E_{11})	0.15 mA (15 Hz to 400 Hz, in an external magnetic field of 10 A/m) 0.45 mA (15 Hz to 400 Hz, in an external magnetic field of 30 A/m)
Effects of load current (E_{12})	0.45 mA (60 A AC, 50 Hz/60 Hz)
Effects of common mode voltage (E_{13})	0.10 mA
Effects of frequency (E_{14})	Accuracy $\times 0.3$ (Specified in the accuracy list)
Reproducibility (E_{15})	Accuracy $\times 0.3$
Operation uncertainty and Guaranteed operating-uncertainty range	Class 3 10 A/m: Less than $\pm 15\%$ rdg (measurement current: 5.00 mA to 10.00 mA) Less than $\pm 10\%$ rdg (measurement current: 10.01 mA to 60.0 A) Class 2 30 A/m: Less than $\pm 20\%$ rdg (measurement current: 5.00 mA to 10.00 mA) Less than $\pm 12.5\%$ rdg (measurement current: 10.01 mA to 60.0 A)

3.3 Function specifications

underline: default value

LCD display	Up to 2000 counts
Display refresh rate	500 ms (approx. 2 times/s)
Data hold function	
Auto-power-save (APS) function	Instrument automatically turns off approx. 5 min. after last key operation.
Backlight function	Automatically turns off approx. 2 min. after last key operation.
Alarm function	
Resistance alarm function	Resistance measurement mode alarm: Beeps when measured value is less than or greater than threshold.
Current alarm function	Current measurement mode alarm: Beeps when measured value is less than or greater than threshold.
Alarm Hi/Lo	Separate Hi/Lo settings for resistance measurement and current measurement Resistance measurement: <u>Hi.AL/Lo.AL</u> Current measurement: <u>Hi.AL/Lo.AL</u>
Alarm threshold setting range	Resistance measurement: 0.02 Ω to 1600 Ω Resistance measurement initial value: <u>25.0 Ω</u> Current measurement: 0.05 mA to 200.0 mA, 0.201 A to 60.0 A Current measurement initial value: <u>1.00 mA</u>
Filter function	
Resistance measurement filter function	Moving average time: Max. 9 sec.
Current measurement filter function	Cutoff frequency: 180 Hz \pm 30 Hz (-3 dB)
Memory function	
Memory capacity	2000 values

Maintenance and Service

Chapter 4

4.1 Cleaning

CAUTION

If foreign matter gets stuck between the tips of the clamp sensor, do not forcibly open or close the clamp sensor, but rather use a soft brush or similar implement to carefully remove the foreign matter. Accurate measurements cannot be made while foreign matter is stuck between the tips of the clamp sensor or while the shape of the clamp sensor is deformed. If the tips of the clamp sensor become deformed, have the instrument inspected and calibrated by your dealer.

NOTE

- Wipe the LCD gently with a soft, dry cloth.
- 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.

4.2 Troubleshooting

Inspection and Repair

NOTE If damage is suspected, check the “Before returning for repair” section before contacting your authorized Hioki distributor or reseller.

Transporting

- 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.
- Use the original packing materials when transporting the instrument, if possible.

Before returning for repair

Symptom	Cause	Remedy
No screen is displayed even when the instrument is turned on.	<ul style="list-style-type: none"> • Are the batteries correctly inserted? • Is the useful battery life at an end? 	Insert the new batteries. (p.23)
The screen turns off after a little while.	<ul style="list-style-type: none"> • Is the useful battery life at an end? • Has the APS function been triggered? 	

4.3 Errors and Operating Status

If an error is shown on the LCD, the instrument needs to be repaired. Contact your authorized Hioki distributor or reseller.

Display	Description	Corrective action
Err 001	ROM error	Repair is required. Please contact your authorized Hioki distributor or reseller.
Err 002	Adjustment data error	
Err 004	EEPROM R/W error	
Err 008	Z3210 communication error (Connection failure, a Z3210 or hardware malfunction)	Take the following actions: <ul style="list-style-type: none"> • Reinstall the Z3210. • Install a different Z3210. (p.23) If the error persists, you are experiencing a instrument failure. Contact your authorized Hioki distributor or reseller to organize repair.
APS → P.oFF	Instrument powered off by APS	Cycle the power.
bAtt → P.oFF	Instrument powered off due to supply voltage drop	Replace the batteries. (p.23)

Warranty Certificate

HIOKI

Model	Serial number	Warranty period Three (3) years from date of purchase (___ / ___)
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Customer name: _____

Customer address: _____

Important

- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.

Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

1. The product is guaranteed to operate properly during the warranty period (three [3] years from the date of purchase).
If the date of purchase is unknown, the warranty period is defined as three (3) years from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warranted for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
 - 1. Malfunctions or damage of consumables, parts with a defined service life, etc.
 - 2. Malfunctions or damage of connectors, cables, etc.
 - 3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
 - 4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
 - 5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
 - 6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
 - 7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
 - 8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
 - 1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
 - 2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
 - 1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
 - 2. Damage arising from measurement results provided by the product
 - 3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

HIOKI E.E. CORPORATION

<http://www.hioki.com>

18-07 EN-3

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