

FT6380

HIOKI

FT6381

Instruction Manual

CLAMP ON EARTH TESTER



EN

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Contents

Introduction	1
Verifying Package Contents	2
Safety Information	3
Operating Precautions	7
Chapter 1 Overview	11
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1.1 Product Overview	11
1.2 Features	12
1.3 Names and Functions of Parts	14
■ Operation key	16
■ Display Indicators.....	17
Chapter 2 Measurement	19
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2.1 Measurement process	19
2.2 Preparing for Measurement	20
■ Attaching the Strap.....	20
■ Installing (or Replacing) the Battery	21
2.3 Pre-Operation Inspection	23
■ Using the included resistance check loop to inspect the instrument	24
2.4 Measurement Procedure	25
■ Resistance Measurement	26
■ Current Measurement	29
2.5 Convenient function	33
■ Data hold function (Holding the measured value)	33
■ Backlight function (Making measurements in a dark location).....	33
■ Filter function (Rejecting noise)	34
■ Alarm function (Judging measured values and sounding an alarm).....	35
■ Memory function (Saving measurement data) ...	38

FT6380A981-04

■ Making measurements with an Android™ handset (FT6381 only).....	42
■ Enabling the Bluetooth® function on the FT6381	43
■ Pairing the instrument with an Android™ handset (first use only).....	44
■ Installing the FT6381 Communication Software on the Android™ handset	45
■ Registering the instrument you wish to connect with the FT6381 Communication Software	46
■ Switching the FT6381 to connect with the Android™ handset	48
■ Using the FT6381 Communication Software (second and subsequent use).....	48
2.6 Advanced Settings and Functions	51
■ Enabling/disabling the measurement range display function	52
■ Enabling/disabling the auto-power-saving (APS) function	53
■ Reverting the instrument to factory settings (system reset)	54
Chapter 3 Specifications	55
3.1 Measurement Specifications	55
3.2 General Specifications	59
Chapter 4 Maintenance and Service	63
4.1 Cleaning	63
4.2 Troubleshooting	64
■ Inspection and Repair.....	64
■ Before returning for repair	64
4.3 Error Display	65

Introduction

Thank you for purchasing the HIOKI Model FT6380, FT6381 CLAMP ON EARTH TESTER. To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

Registered Trademarks

- Bluetooth® is a registered trademark of Bluetooth SIG, Inc. (USA).
- Android™ Google Play™ is a registered trademark of Bluetooth® Google, Inc.
- Adobe and Reader are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and /or other countries.

2 Verifying Package Contents

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 dealer or Hioki representative.

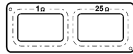
Package Contents

Confirm that these contents are provided.

- FT6380 or FT6381 Clamp On Earth Tester (1)



- Resistance Check Loop (1)
- Instruction Manual (1)



- Carrying Case (1)
- LR6 alkaline batteries (2)
- Strap (1)

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

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

Safety Information


WARNING



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

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

Safety Symbols



In the manual, the  symbol indicates particularly important information that the user should read before using the instrument.

The  symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the  symbol) before using the relevant function.



Indicates a double-insulated device.



Indicates AC (Alternating Current).






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







Indicates the power on/off button.

4 Safety Information

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

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

Symbols for Various Standards

	WEEE marking: This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).
	This symbol indicates that the product conforms to regulations set out by the EC Directive.
	Indicates that the product incorporates Bluetooth® wireless technology. Bluetooth® is a registered trademark of Bluetooth SIG, Inc., and is used under license by HIOKI E.E. CORPORATION.
	Indicates that the product conforms to the domestic Japanese technical standards set forth by the Radio Act (type certification).
FCC ID	Indicates the ID number of the wireless module certified by the U.S. Federal Communications Commission (FCC).

IC	Indicates the number of the wireless module certified by Industry Canada.
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Other Symbols

	Indicates a prohibited action.
(p. #)	Indicates the location of reference information.
[]	Information displayed on the screen is enclosed in brackets.
Fn <small>(bold characters)</small>	Bold text indicates alphanumeric characters shown on operation keys.

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

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	b	c	d	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	0																
1	2	3	4	5	6	7	8	9	0																

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.

6 Safety Information

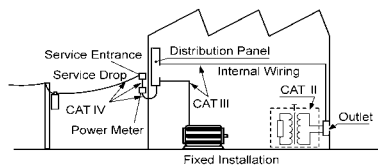
Measurement categories

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.








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 dealer or Hioki representative.

Instrument Installation

Operating temperature: -10 to 50°C (14 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

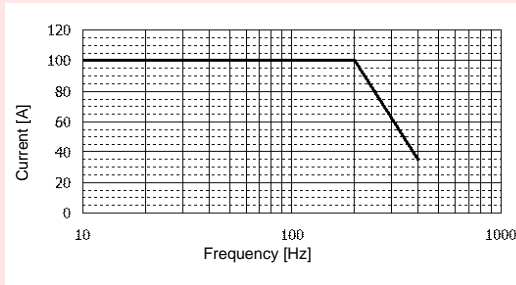
- To avoid short circuits and potentially life-threatening hazards, never attach the clamp to a circuit that operates at more than 600 V, or over bare conductors.
- The maximum rated voltage between input terminals and ground is 600 VAC. Measuring a voltage in excess of this rating relative to ground 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 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 AAC continuous or 200 A AC within two minutes at 50/60 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 device or place it on top of an uneven surface. Dropping or knocking down the device can cause injury or damage to the device.

10 *Operating Precautions*

CAUTION

- The protection rating for the enclosure of this device (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.

Overview

Chapter 1

1.1 Product Overview

The FT6380 and FT6381 Clamp On Earth Tester make 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 instruments also provide 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.

The FT6381 emits radio radiation. Because use of devices that emit radio radiation requires approval in the country of use, be careful that use of the instrument in a country or region other than those listed on the attached cautionary leaflet, "Precautions Concerning Use of Equipment That Emits Radio Waves" or the HIOKI products website may be subject to penalty as a violation of law.

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 to 1,600 Ω with its auto-range function. Current measurement ranges from small leakage current (maximum resolution 10 μ A) to a maximum of 60 A.

◆ Noise check function (p.28)

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.33)

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

◆ Backlight function (p.33)

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.35)

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 separate thresholds for resistance and current measurements and select judgment criteria (whether to generate a FAIL result when the reading is greater than or less than the threshold).

◆ **Filter function** (p.34)

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.

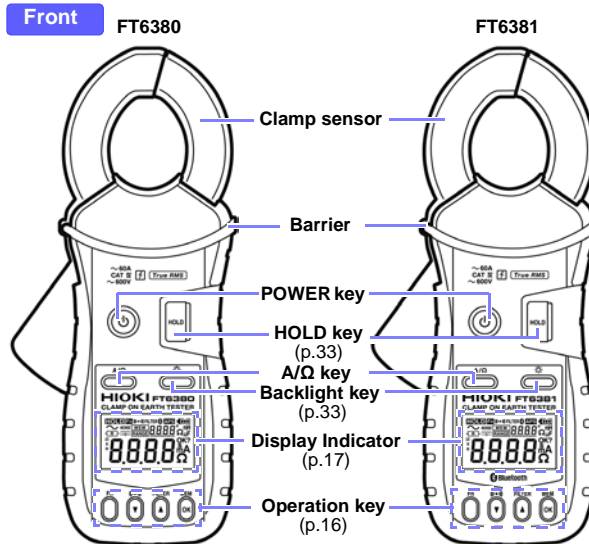
◆ **Internal memory** (p.38)

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

◆ **Automatic measurement report function with Android™ connectivity (*FT6381 only)** (p.42)

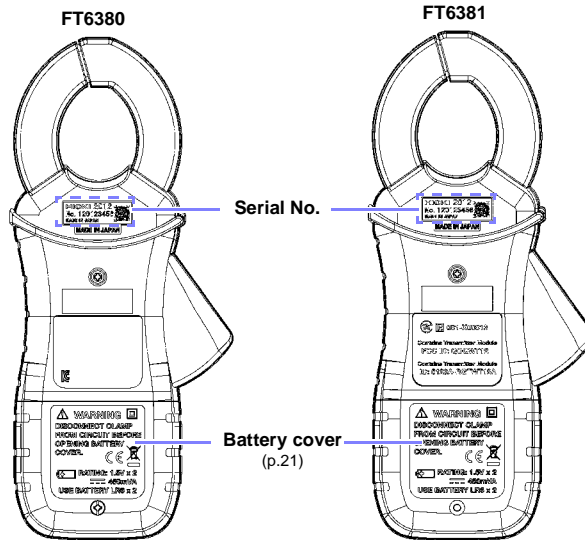
The FT6381 features Bluetooth® wireless technology and can be connected to a smartphone running the Android operating system to easily create measurement reports in the field. (FT6381 availability is limited to certain countries. For more information, contact your dealer or Hioki representative.)

1.3 Names and Functions of Parts

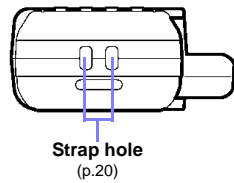


POWER key	<ul style="list-style-type: none"> Used to turn the instrument on and off. To temporarily cancel the auto-power-save function, press the POWER key while holding down the HOLD key.
HOLD key	<ul style="list-style-type: none"> Holds the measured value display or cancels hold mode. To cancel auto-power-save 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

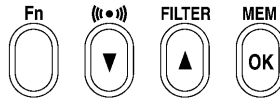






Bottom



16 1.3 Names and Functions of Parts

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.
	<ul style="list-style-type: none"> • Enables the alarm function. (p.35) • 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.37) <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.34) • Pressing it while using the resistance measurement function enables the moving average function, allowing more stable measurement. (p.34) <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.38)</p> <p>*In function mode, this key serves as the OK key, which is used to accept setting items and values.</p>

Display Indicators



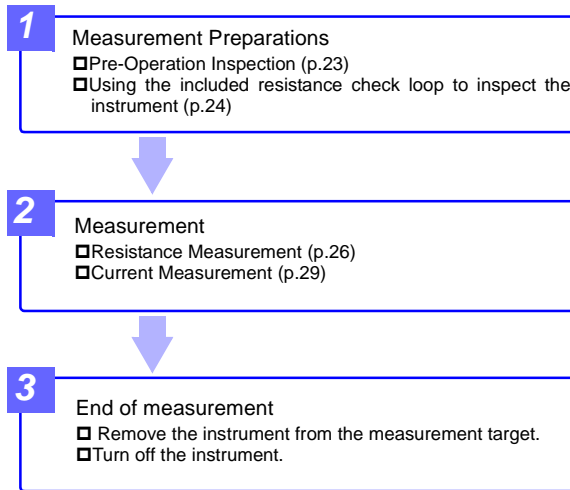
HOLD	Lights up when data is being held. (p.33)
Fn	Lights up in function mode. (p.50) Flashes in subfunction mode. (p.51)
((••))	Lights up when the alarm function is on. (p.35)
FILTER	Lights up when the filter function is on. (p.34)
	Lights up when the Bluetooth® function is on. Flashes when data is being sent or received. (model FT6381 only) (p.42)
APS	Lights up when the auto-power-save function is on. (p.53)
	Indicates the remaining battery power. (p.22)
	Lights up in AC current measurement mode. (p.29)
	Lights up in resistance measurement mode. (p.26)
NOISE	Lights up in resistance measurement mode when a current that could affect the measured value is detected. (p.28)
	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.28)
MEM	Lights up during internal memory operations. (p.38) The number of measurement data points stored in memory is shown to the right.

18 1.3 *Names and Functions of Parts*

RANGE	Lights up when the range display function is on. The measurement range is shown to the right.
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Measurement Chapter 2

2.1 Measurement process



2.2 Preparing for Measurement

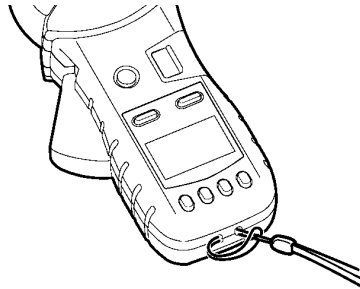
After purchasing the instrument
Complete the following steps before using the instrument to
make measurements.

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 follow-
ing diagram:



Installing (or Replacing) the Battery

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


⚠ WARNING

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

⚠ 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.

NOTE

- The  indicator lights when battery voltage becomes low. Replace the batteries as soon as possible.
- Before replacing the batteries, make sure that the Slide Switch is OFF.
- After use, always turn OFF the power.
- If the battery is completely exhausted, the display will show [BAttLo], and the instrument will automatically turn off.

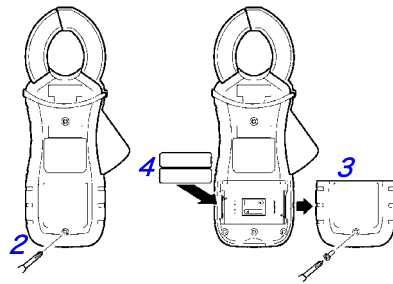
22 2.2 Preparing for Measurement

Required Items:

- Phillips screwdriver
- LR6 alkaline battery (2)





Normal procedure

1. Verify that the instrument is off.
2. Remove the fastening screws of the battery cover, using a Phillips screwdriver.
3. Remove the battery cover.
4. Insert two new batteries (LR06 alkaline batteries), taking care to orient them properly.
5. Replace the battery cover and tighten the fastening screws.



Battery Status Indicator

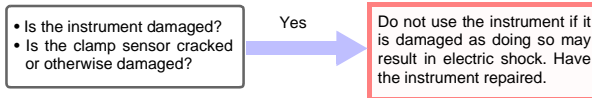
This indicator is displayed at the top right corner.?

	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.

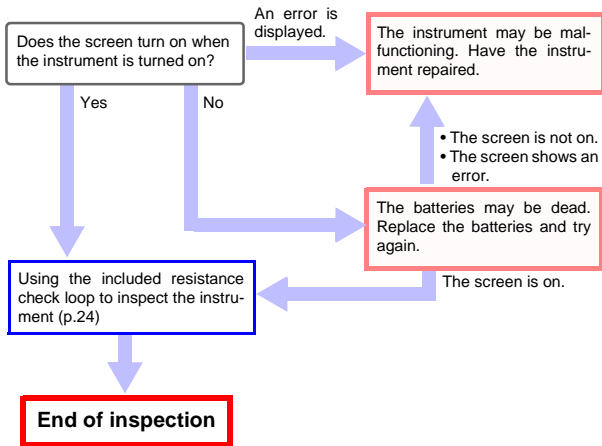
2.3 Pre-Operation Inspection

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 dealer or Hioki representative.

1. Inspecting the instrument



2. Inspecting the instrument after turning it on



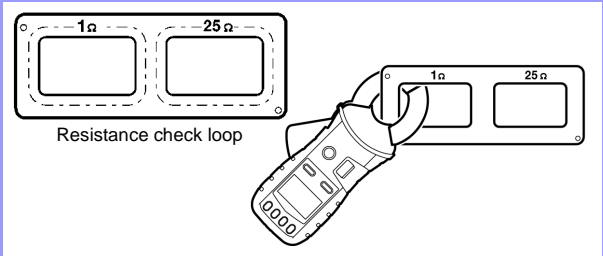
24 2.3 Pre-Operation Inspection

Using the included resistance check loop to inspect the instrument

Before turning on the instrument, be sure to read Operating Precautions (p.7).

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

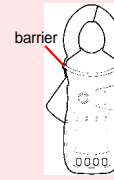
- NOTE**
- If the instrument displays a value outside the allowable range, it needs to be repaired. Contact your dealer or Hioki representative.
 - The resistance check loop cannot be used to calibrate the instrument. To have the instrument calibrated, contact your dealer.

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 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 (50/60 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 dealer.

Resistance Measurement

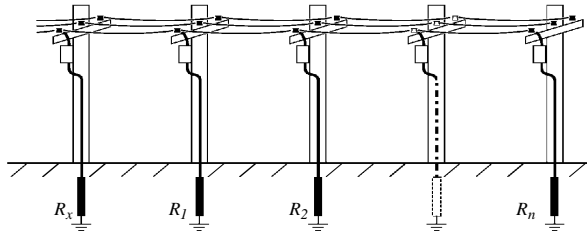
Measuring Principle

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's 3151 EARTH HiTESTER.)

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, $R_x \gg \frac{1}{\sum_{i=1}^n \frac{1}{R_i}}$ and the second term can be ignored, allowing the value of R_x to be measured.



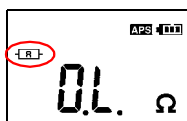
Example with actual measured values

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.

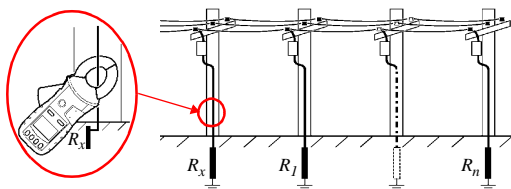


Measuring method

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



- Clamp the grounding wire you wish to measure.**
The resistance value will be displayed.



28 2.4 Measurement Procedure

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 50/60 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 is not completely closed. Close the clamp completely and repeat the measurement.

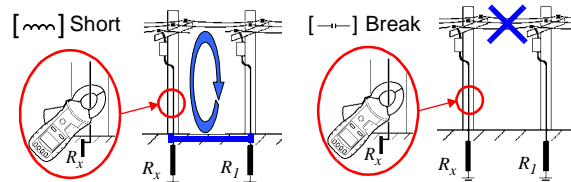
*If an extremely large current is flowing through the grounding wire or a DC current is superposed, the screen may display [OPEn] even if the clamp is completely closed. This does not signal a malfunction. Check the current flowing through the grounding wire by using the instrument's current measurement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

- **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.

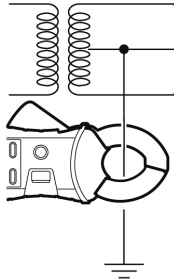


Current Measurement

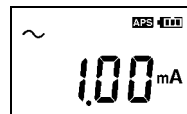
1. Select current measurement mode with the **A/Ω** key.



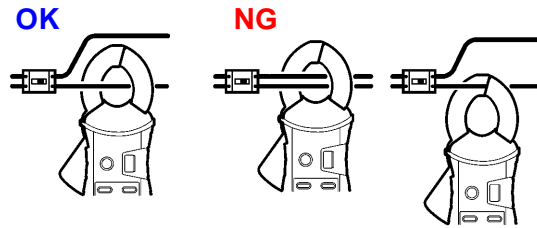
2. Position the conductor in the center of the clamp sensor.



3. The current RMS value will be shown on the display.



30 2.4 Measurement Procedure



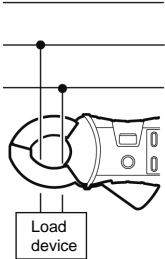
NOTE

- 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.

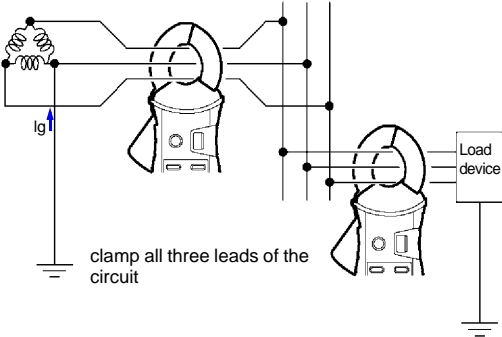
Measuring zero-phase current

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

Single-phase, 2-lead circuits



three-phase 3-lead circuits



32 2.4 Measurement Procedure

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.34)" 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.

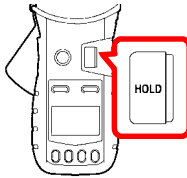
- (1) When using input current that is 1/10 or less of the full electric current range
- (2) When measuring high frequencies with the filter function enabled.

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 instrument will beep twice and the **[HOLD]** mark will be displayed, and the measured value will be held. The **HOLD** key will flash. To cancel hold mode, press the **HOLD** key again. The instrument will beep once and the **[HOLD]** mark will disappear, and the **HOLD** key will stop flashing.



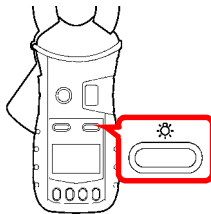
Backlight function (Making measurements in a dark location)

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.

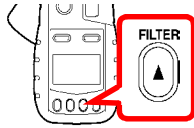


34 2.5 Convenient function

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.



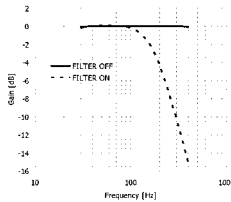
◆ During resistance measurement

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

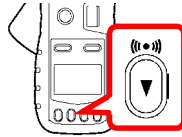
Using the filter function enables a low-pass filter, causing the harmonic component to be eliminated from measured values. Widespread use of switching power supplies and inverters has led to cases where harmonic components are superimposed on current waveforms; the filter function is effective in such 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 (A high tone signifies a high alarm, while a low tone signifies a low alarm.) using previously set thresholds by pressing the **(H/L)** key.

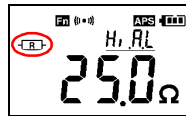
Thresholds and other settings must be configured in advance. To cancel the alarm function, press the **(H/L)** key again.



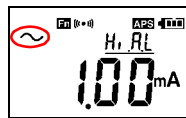
1. Configuring the alarm settings

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

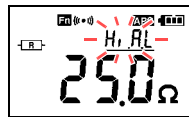


Alarm Settings screen for current measurement

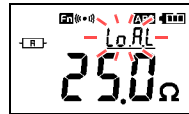
36 2.5 Convenient function

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.



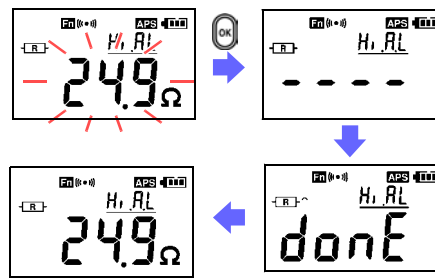
Lo: The alarm will sound if the measured value is less than the set threshold value.

*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.

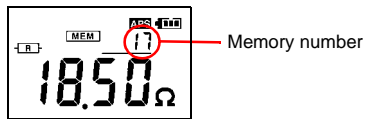
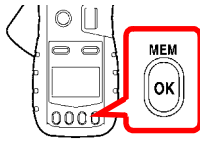


Once the settings are complete, the screen will switch to the Alarm Settings screen. To return to resistance measurement or current measurement mode, press the **Fn** key again or the **A/Ω** key.

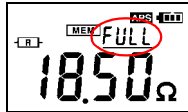
38 2.5 Convenient function

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 2,000) in the instrument's internal memory.



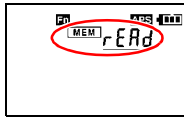
When the number of values saved in the instrument's memory reaches 2,000, the display will show "FULL," and you will not be able to save additional values. Delete unneeded values to free up space.



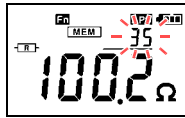
* Measured values, filter use, and the [m—i] and [NOISE] marks are saved in memory.

◆ Loading a value from the instrument's internal memory

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



2. 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.

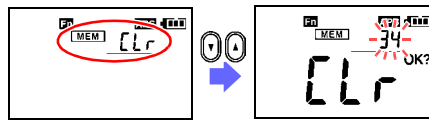
40 2.5 Convenient function

◆ **Clearing stored data**

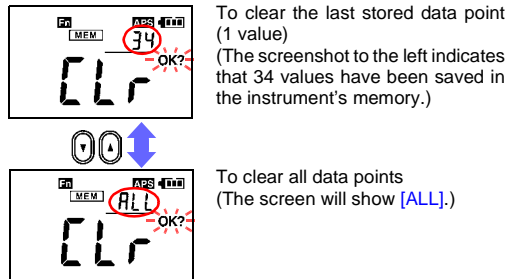
You can clear the last stored data point (1 value) or all stored data points.

1. Press the **Fn** key to enter function mode. Using the **▼** and **▲** keys, select the Clear Memory screen and press the **OK** key. The screen will show **[CLR]**.

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

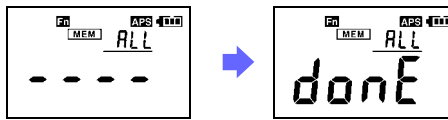


2. Using the **▼** and **▲** keys, select either the last stored data point or all data points and press the **OK** key.



2.5 Convenient function 41

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.

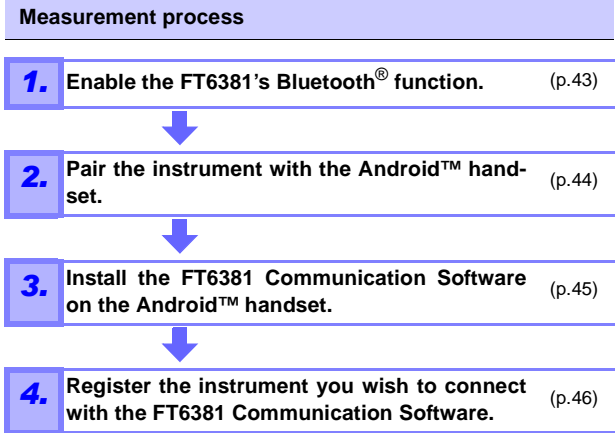
Making measurements with an Android™ handset (FT6381 only)

By enabling the FT6381's Bluetooth® function, you can transfer measurement data to an Android™ handset to create measurement reports. For more information, refer to the help function of the FT6381 Communication Software, an app for Android™ handsets.

In addition to installing the application, the following two sets of connection settings must be configured in order to use the Bluetooth® function:

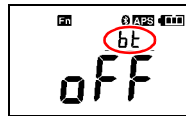
- Pairing the Android™ handset and FT6381
- Registering the FT6381 connection with the FT6381 Communication Software

Use the following procedure to configure the connection settings:

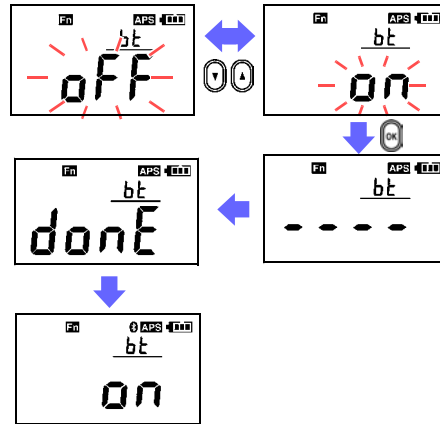


Enabling the Bluetooth® function on the FT6381

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 Bluetooth® Setting screen and press the **OK** key.



Using the **▼** and **▲** keys, select "on" on the Bluetooth® Setting screen and press the **OK** key to enable the Bluetooth® function.

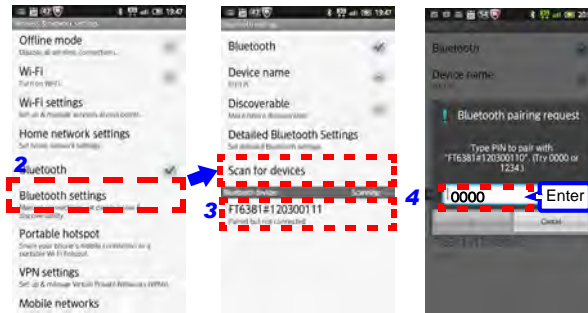


NOTE Use of Bluetooth® functionality shortens the battery life compared to normal use. It is recommended to turn off Bluetooth® functionality when not in use.

44 2.5 Convenient function

Pairing the instrument with an Android™ handset (first use only)

1. Select [Wireless and Networks] from the Android™ handset's Settings button.
2. After enabling the Bluetooth® function, select [Scan for devices] from [Bluetooth settings] (exact words varies with the specific Android™ handset being used; variants include "Search for devices" and "Detect nearby terminals").
3. When the handset discovers [FT6381#XXXXXXXX] (where "XXXXXXXX" is the serial number found on the back of the instrument), pair the instrument.
Note that previously paired devices may appear in a separate column labeled with language such as "Paired devices" rather than in the search results.
4. Enter [0000] as the PIN number.



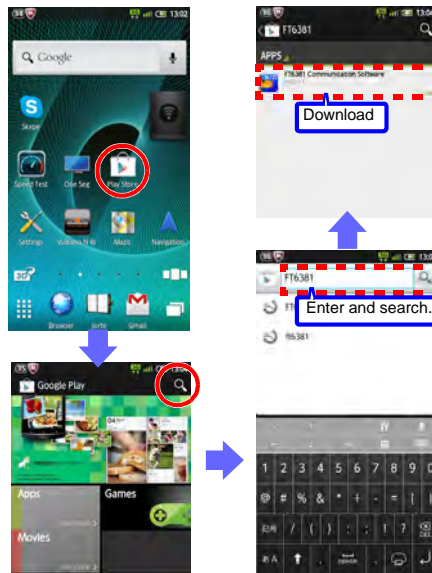
Pairing is only necessary the first time you use the instrument with the handset. When using multiple FT6381 instruments, you will need to pair each instrument.

2.5 Convenient function **45**

*The screen contents vary with the specific Android™ handset being used. For more information about Bluetooth® device pairing methods and related procedures, see your Android™ handset's instruction manual.

Installing the FT6381 Communication Software on the Android™ handset

Search for "FT638" on the Google Play™ store and download and install the FT6381 Communication Software. A Google account is required in order to download applications from the Google Play™ store. For more information about how to register for a Google account, contact the store from which you purchased the Android™ handset.

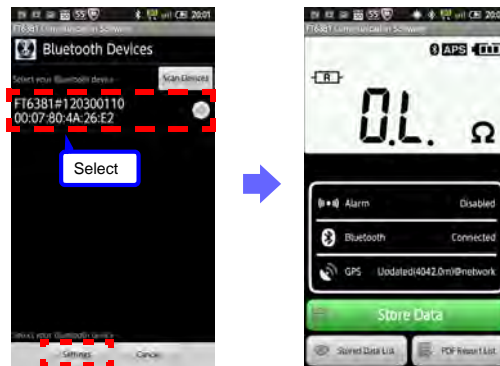


46 2.5 Convenient function

NOTE The application is free, but the user is responsible for any Internet connection costs incurred in the course of downloading or using the application. Since such costs may be incurred during use of the application, it is recommended to use a fixed-price plan. Hioki is not liable for any Internet connection costs.

Registering the instrument you wish to connect with the FT6381 Communication Software

1. Turn on the FT6381.
Launch the FT6381 Communication Software on the Android™ handset. If you wish to use the map function, enable the GPS function.
2. From the list of Bluetooth® devices, select [FT6381#XX XXXXXXX] and press the [Settings] button. The FT6381 will be registered.



Once the instrument has been paired, it will connect automatically, and FT6381 measured values will be sent to the Android™ handset in real time. The instrument will not be able to connect to the handset if it has not been paired. Refer to "Pairing the instrument with an Android™ handset (first use only) (p.44)" to pair the instrument.

NOTE

- The screen contents vary with the specific Android™ handset being used. For more information about Bluetooth® device pairing methods and related procedures, see your Android™ handset's instruction manual.
- Communications between the FT6381 and Android™ handset are limited to a range of about 10 m, but obstacles (walls, metal shielding, etc.) can shorten this distance or prevent communications from being established.
- The FT6381's wireless function uses Bluetooth® wireless technology that utilizes the 2.4 GHz band. It may not be possible to establish communications if there is a wireless LAN (IEEE 802.11.b/g/n) or other network/device using the same frequency band nearby.
- The application supports Android OS 2.1 or later, but proper operation is not guaranteed on all Android™ handsets. For more information about the devices on which proper operation has been confirmed, see the Google Play™ Store FT6381 Communication Software instructions.
- Adobe's Adobe Reader, which is available free of charge on the Google Play™ store, is required in order to view PDF reports. Install the application before attempting to view reports.
- The confidentiality of information contained in Bluetooth® communications sent from the FT6381 is not guaranteed. Hioki is not liable for any unauthorized disclosure or other issue with measured values caused by Bluetooth® communications.
- The FT6381 emits radio radiation. Because use of devices that emit radio radiation requires approval in the country of use, be careful that use of the instrument in a country or region other than those listed on the attached cautionary leaflet, "Precautions Concerning Use of Equipment That Emits Radio Waves" or the HIOKI products website may be subject to penalty as a violation of law.

48 2.5 Convenient function

Using the FT6381 Communication Software (second and subsequent use)

After turning on the FT6381, launch the FT6381 Communication Software on the Android™ handset. If you wish to use the map function, enable the GPS function. Once the instrument has been paired, it will connect automatically, and FT6381 measured values will be sent to the Android™ handset in real time. The instrument will not be able to connect to the handset if it has not been paired. Refer to "Pairing the instrument with an Android™ handset (first use only) (p.44)" to pair the instrument.

Switching the FT6381 to connect with the Android™ handset

If you have multiple FT6381 instruments and wish to change the unit to connect to the handset, press the Settings button after pressing the menu button on the Android™ handset and reconfigure the Bluetooth® device settings.

If you are unable to establish a Bluetooth® connection

Check the following if you are unable to establish a Bluetooth® connection between the FT6381 and the Android™ handset:

- Is the Bluetooth® function enabled on both the Android™ handset and the FT6381?
- Has the FT6381 in question been paired on the Android™ handset's Bluetooth® settings screen? If the instrument has not been paired, refer to "Pairing the instrument with an Android™ handset (first use only) (p.44)" to pair it.

About the FT6381 Communication Software

The application provides the following functionality:

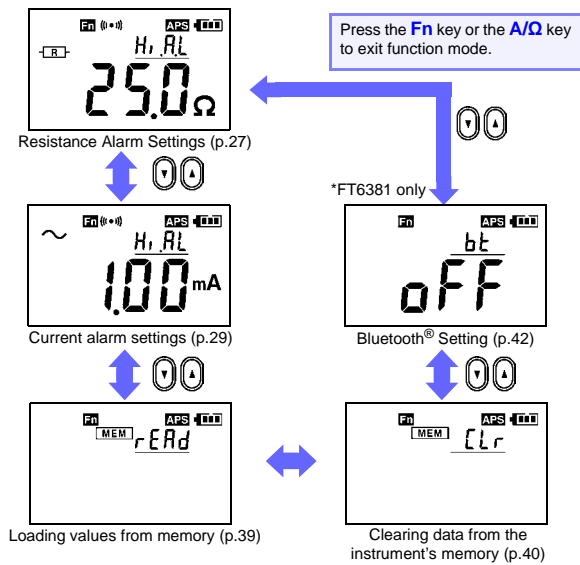
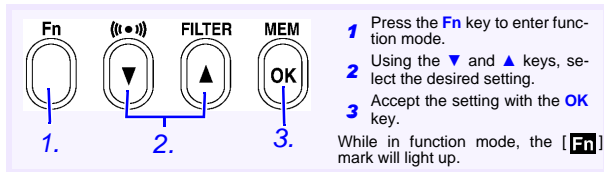
- ◆ Sending measurement data (from the LCD display) to the Android™ handset in real time
- ◆ Saving and viewing measurement data (including time stamp, GPS position data for the measurement location, and map data)
- ◆ Creating reports from measurement data
 - Single reports created from measurement data from one location
 - Summary reports that present a summary of multiple sets of measurement data (with the ability to add comments and change header and footer information)
- ◆ Outputting measurement data as a CSV file
- ◆ Sending measurement data as an e-mail
- ◆ Downloading the contents of the FT6381's internal memory

For more information about the FT6381 Communication Software application, refer to the application help.

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
- Bluetooth® setting

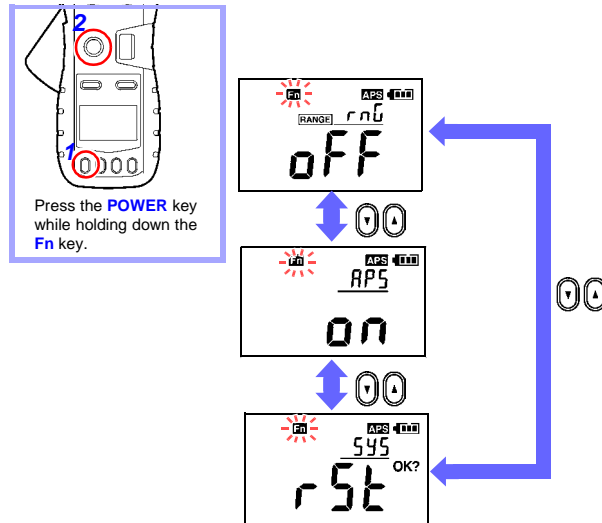


2.6 Advanced Settings and Functions

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)

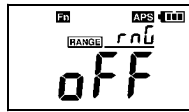
To enter sub-function mode, turn on the instrument by pressing the **POWER** key while holding down the **Fn** key.



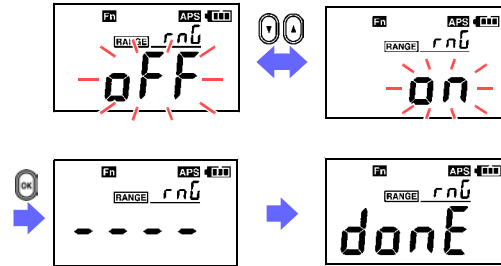
To exit sub-function mode, press the **POWER** key to turn off the instrument and then turn it back on.

Enabling/disabling the measurement range display function

1. Enter sub-function mode.
Press the **POWER** key while holding down the **Fn** key.
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.



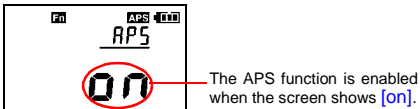
NOTE The measurement range is displayed using values only.
 (Example: 1,600 Ω range → 1,600)
 The units for the measurement range are the same as for the displayed measured value.

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

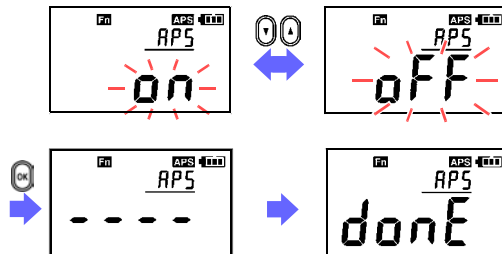
The auto-power-saving (APS) function prevents unintentional battery consumption when you forget to turn off the instrument. The APS function activates automatically when the instrument is turned on. The instrument will automatically turn off once about 5 minutes pass without any operation (an alarm will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

1. Enter sub-function mode.
Press the **POWER** key while holding down the **Fn** key.
2. Using the **▼** and **▲** keys, select the APS Setting screen and press the **OK** key.



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.



54 2.6 Advanced Settings and Functions

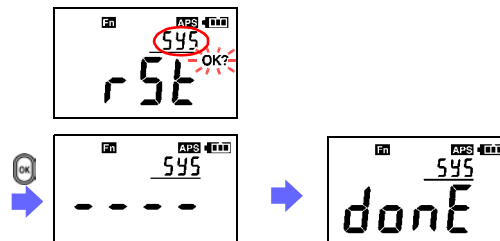
To disable APS temporarily

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. Enter sub-function mode.
Press the **POWER** key while holding down the **Fn** key.
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.40)".

Specifications

Chapter 3

3.1 Measurement Specifications

Common measurement specifications	
Guaranteed accuracy period	1 year (Opening and Closing of the Sensor: Maximum 10000 times)
Accuracy guarantee for temperature and humidity	23°C±5°C (73°F±9°F) 80%RH or less (non-condensation)
Temperature characteristics	-10 to 50°C Measurement accuracy x 0.1/°C (except 23°C±5°C)
Maximum rated voltage to earth	600 VAC measurement category IV (anticipated transient overvoltage 8000 V)
Resistance measurement specifications	
Guaranteed accuracy conditions	No reactance component, no noise current
Measurement Method	Analog synchronous detection method (effective resistance measurement)
Injected signal frequency	Approx. 2.4 kHz
Injected voltage level	Approx. 9.0 mV (with load open)
Effective measuring range	0.02 Ω to 1600 Ω
Zero suppression	Less than 0.02 Ω
Overrange	Greater than 1600 Ω
Measurement response time	Filter: OFF/ON Approx. 3 sec /Approx. 9 sec.

56 3.1 Measurement Specifications

Range (Accuracy Range)	Resolution	Accuracy
0.20 Ω (0.02 Ω to 0.20 Ω)	0.01 Ω	$\pm 1.5\% \text{rdg.} \pm 0.02 \Omega$
2.00 Ω (0.18 Ω to 2.00 Ω)	0.01 Ω	$\pm 1.5\% \text{rdg.} \pm 0.02 \Omega$
20.00 Ω (1.80 Ω to 20.00 Ω)	0.01 Ω	$\pm 1.5\% \text{rdg.} \pm 0.05 \Omega$
50.0 Ω (18.0 Ω to 50.0 Ω) [*]	0.1 Ω	$\pm 1.5\% \text{rdg.} \pm 0.1 \Omega$
100.0 Ω (50.0 Ω [*] to 100.0 Ω) [*]	0.1 Ω	$\pm 1.5\% \text{rdg.} \pm 0.5 \Omega$
200.0 Ω (100.0 Ω [*] to 200.0 Ω)	0.2 Ω	$\pm 3.0\% \text{rdg.} \pm 1.0 \Omega$
400 Ω (180 Ω to 400 Ω) [*]	1 Ω	$\pm 5\% \text{rdg.} \pm 5 \Omega$
600 Ω (400 Ω [*] to 600 Ω) [*]	2 Ω	$\pm 10\% \text{rdg.} \pm 10 \Omega$
1200 Ω (600 Ω [*] to 1200 Ω) [*]	10 Ω	$\pm 20\% \text{rdg.}$
1600 Ω (1200 Ω [*] to 1600 Ω)	20 Ω	$\pm 35\% \text{rdg.}$

^{*}To obtain the measurement accuracy at a range boundary, apply the accuracy of the higher-accuracy range.

Current measurement specifications	
Guaranteed accuracy conditions	ac- 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	Within $\pm 0.5\%$ rdg. (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 50/60 Hz AC
Maximum allowable input	100 A AC continuous, 200 A AC for 2 minutes (50/60 Hz) For frequency derating characteristics during continuous input, see the following diagram:
	<p>The diagram is a Bode plot with Gain [dB] on the vertical axis and Frequency [Hz] on the horizontal axis. Both axes are logarithmic. The vertical axis ranges from 0 to 120 dB in increments of 20 dB. The horizontal axis ranges from 10 to 1000 Hz in increments of 10 Hz. A solid line represents the gain characteristic: it is constant at 100 dB from 10 Hz to 100 Hz, and then decreases linearly to approximately 40 dB at 1000 Hz.</p>
Effective measuring range	0.05 mA to 60.0 A
Zero-suppression	Less than 0.05 mA
Overrange	Greater than 60.0 A
Measurement response time	Approx. 1 sec. regardless of whether the filter is set to OFF or ON.








58 3.1 Measurement Specifications

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

3.2 General Specifications

Location for use	Pollution Degree 2, altitude up to 2000 m (6562-ft.)	
Storage temperature and humidity	-20 to 60°C (-4.0°F to 140°F), 80%RH or less (non-condensation, except for the battery)	
Operating temperature and humidity	Temperature	: -10 to 50°C (14°F to 122°F)
	Humidity	: 80%RH or less (non-condensation)
Dielectric strength	Between the Case and the Clamp core 7400 Vrms 1 minute	
Applicable standards	Safety	: EN61010
	EMC	: EN61326
	Effects of radiated, radiofrequency, electromagnetic field: At 3 V/m, 5X accuracy specifications or less (resistance measurement)	
Dust and water protection	IP40 (EN60529) *With clamp sensor closed.	
Power supply	LR06 alkaline battery × 2 (3 VDC)	
Maximum rated power	450 mVA	
Continuous operating time	Approx. 35 hours (25 Ω measurement, backlight off, Bluetooth® OFF (Model FT6381), 23°C reference)	
Dimensions	Approx. 73 W×218 H×43 D mm (2.87"W×8.58"H×1.69"D) (excluding projections)	
Maximum measurable conductor diameter	φ32 mm	
Mass	Approx. 620g (21.9 oz) Except for the battery	
Product warranty period	3 years	
Accessories	Carrying case (1), Resistance check loop (1), Strap (1), LR06 alkaline battery × 2, Instruction manual (1)	
Display specifications		
LCD display	Max. 2,000 count	
Display refresh rate	Approx. 2 times/sec.	
Range switching	Auto-range	
Overrange display	[O.L] display	
Data hold display	HOLD mark lights up.	

60 3.2 General Specifications

Function mode display	Fn mark lights up. Flashes in subfunction mode.
Filter display	FILTER mark lights up.
Auto-power-save display	APS mark lights up
Remaining battery display	Display of remaining battery power in 4 stages ()
Memory number display	MEM mark lights up.
Range display	RANGE mark lights up.
Alarm display	(t • i) mark lights up.
Confirmation of memory erasure and reset operation	OK? mark lights up.
Noise mark display	NOISE mark lights up. (When there is a superimposed noise current during resistance measurement, accuracy cannot be guaranteed.)
mA/A unit display	mA mark or A mark lights up.
Ω unit display	Ω mark lights up.
AC current mark display	 mark lights up (during AC current measurement).
Resistance mark display	R mark lights up (during resistance measurement).
Inductance mark display	 mark lights up (when the phase angle $\theta >$ approx. 45° during resistance measurement).
Capacitance mark display	 mark lights up (when the phase angle $\theta <$ approx. -45° during resistance measurement).
Bluetooth® display	Bluetooth® function off:  mark turns off (Model FT6381). Bluetooth® function on/communications inactive:  mark lights up (Model FT6381). Bluetooth® function on/communications active:  mark flashes (Model FT6381).

Function specifications (underline: default value)

Data hold function	
Backlight function Automatically turns off approx. 2 min. after last key operation.	
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)
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</u> /AL/Lo.AL Current measurement: <u>Hi</u> .AL/Lo.AL
Alarm threshold setting range	Resistance measurement: 0.02 Ω to 1,600 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>
Memory function	
Memory capacity	2,000 values
Auto-power-save function	Instrument automatically turns off approx. 5 min. after last key operation.
Function mode	
Moving between items	After selecting setting item with \blacktriangledown and \blacktriangle keys, accept with OK key.
Resistance alarm function	AL Ω : Resistance Hi/Lo, threshold settings
Current alarm function	AL A: Current Hi/Lo, threshold settings
Loading values	MEM READ: Load memory values.
Clearing memory values	MEM CLR: Clear last saved memory value or all values.
Bluetooth [®] operating setting	BT: ON/ <u>OFF</u> (FT6381)

62 3.2 General Specifications

Sub-function mode	
Range display function	RNG: <u>ON</u> /OFF
Auto-power-save function	APS: <u>ON</u> /OFF
System reset	SYS RST
Bluetooth® function (FT6381)	Bluetooth® 2.1+ EDR (Class 2) Communication range: 10 m (Line-of-sight) Displays measured values on the screen of an Android™ handset via Bluetooth®.

**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 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 dealer or Hioki representative.

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.21)
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 Error Display

If an error is shown on the LCD, the instrument needs to be repaired. Contact your dealer or Hioki representative.

Error Display	Meaning	Remedial Action
E001	Main CPU program error	Please contact your dealer or Hioki representative.
E002	Sub CPU program error	
E003	EEPROM R/W error	
E004	Adjustment data error	

Warranty Certificate

HIOKI

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

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

18-07 EN-3