HIOKI

Instruction Manual

3470

MAGNETIC FIELD HiTESTER

HIOKI E. E. CORPORATION

December 2008 Revised edition 4 3470A981-04 08-12H

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Introduction

Thank you for purchasing the HIOKI "Model 3470 Magnetic Field HiTester." To obtain maximum performance from the instrument, please read this manual first, and keep it handy for future reference.

This instruction manual contains instructions for use of the device with the3471 and 3472 Magnetic Field Sensor.

Note

While every effort has been made to ensure that the content of this manual is correct, we would appreciate it if you notified your dealer or local Hioki agent should you notice any unclear, incorrect or missing information.

Trademarks in this manual

Microsoft, Windows, and Windows NT are registered trademarks of Microsoft Corporation in the United States and/or other countries.

Notation

- Unless otherwise specified, "Windows" represents Windows 98, Me, Windows NT, Windows 2000, Windows XP.
- Dialog box represents a Windows dialog box.
- Menus, commands, dialogs, buttons in a dialog, and other names on the screen and the keys are indicated in brackets.

Mouse Operation

Click:	Press and quickly release the left button of the mouse.
Right-click:	Press and quickly release the right button of the mouse.
Double click:	Quickly click the left button of the mouse twice.
Drag:	While holding down the left button of the mouse, move the mouse and then release the left button to deposit the chosen item in the desired position.
Activate:	Click on a window on the screen to activate that window.

Inspection

Verifying Package Contents

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

3470-01 Magnetic Field HiTester

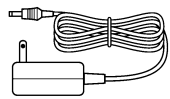
3470 (1)

CD (PC application software) (1)

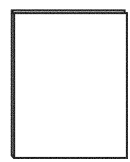
LR6 alkaline battery (4)

USB cable (1)

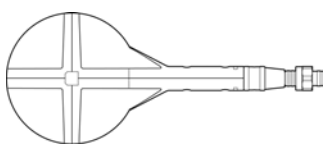
9445-02 AC Adapter
or
9445-03 AC Adapter (EU)
(1)



Instruction manual (1)



3471 Magnetic Field Sensor (1)



Carrying Case (1)

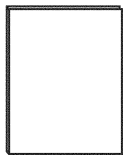
3470-02 Magnetic Field HiTester

3470 (1)

CD (PC application software) (1)

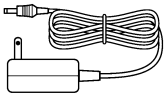
USB cable (1)

Instruction manual (1)

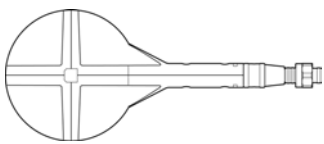


LR6 alkaline battery (4)

9445-02 AC Adapter
or
9445-03 AC Adapter (EU)
(1)

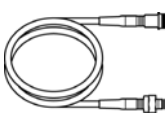


3471 Magnetic Field Sensor (1)

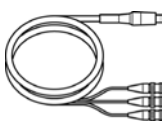


3472 Magnetic Field Sensor (1)

9758 Extention Cable (1)



9759 Output Cable (1)



Carrying Case (1)

NOTE This instrument has been calibrated to operate with the provided sensor and should be used only with this sensor. Thus if multiple instruments are used, Before use make sure that the matching number (up to the hyphen) on the tester and the sensor are identical.

Shipping precautions

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

Safety Information

DANGER

This instrument is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the instrument. 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 DC (Direct Current).

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.

Other Symbols

❖ (⇒ p.)	Indicates the location of reference information.
*	Indicates that descriptive information is provided below.
⃠	Indicates a prohibited action.

Measurement Categories (Overvoltage categories)

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

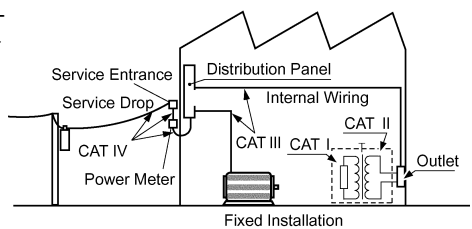
CAT I : Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.

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

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).

Higher-numbered categories correspond to electrical environments with greater momentary energy. So a measurement device designed for CAT III environments can endure greater momentary energy than a device designed for CAT II.



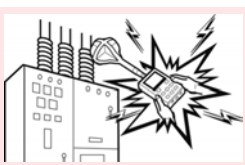
Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.

Never use a CAT I measuring instrument in CAT II, III, or IV environments.

The measurement categories comply with the Overvoltage Categories of the IEC60664 Standards.

DANGER

Do not touch high voltage lines with the sensor or the instrument. They are not insulated and the application of high voltage to this instrument may expose testing personnel to high voltage that may at worst lead to electric shock and death.



Operating Precautions

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

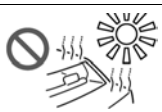
Preliminary Checks

- Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.
- Before using the instrument, make sure that the insulation on the cables is undamaged and that no bare conductors are improperly exposed. Using the instrument in such conditions could cause an electric shock, so contact your dealer or Hioki representative for repair.

Installation Environment

Operating temperature/humidity range: 0 to 40°C, 80%RH or less (no condensation)
Temperature and humidity for guaranteed accuracy: -10 to 50°C, 80%RH or less (no condensation)

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 liquids Exposed to high humidity or condensation		Exposed to strong electromagnetic fields Near electromagnetic radiators
	Exposed to high levels of particulate dust		Subject to vibration

Connections

⚠CAUTION

Connect only designated devices to the instrument terminals. To prevent damage, do not apply a voltage that is outside the specified range to the instrument.

Handling

⚠CAUTION

- The instrument and the 3471 and 3472 Magnetic Field Sensors are built mainly from nonmagnetic metals and contain hardly any magnetic materials. Thus if the instrument is heated by an all metal IH and other induction heating system the sensor may melt or be damaged, because of the nonmagnetic metals.
- The 3471 and 3472 Magnetic Field Sensors have a plastic housing that may melt if brought into contact with a hot measurement object (cookpot or other hot object).
- Do not expose cables to excessive stress as they may break. Especially, the 9758 Extention Cable and 9759 Output Cable should be handled with care.

Handling with the CD

⚠CAUTION

- Always hold the disc by the edges, so as not to make fingerprints on the disc or scratch the printing.
- Never touch the recorded side of the disc. Do not place the disc directly on anything hard.
- Do not wet the disc with volatile alcohol or water, as there is a possibility of the label printing disappearing.
- To write on the disc label surface, use a spirit-based felt pen. Do not use a ball-point pen or hard-tipped pen, because there is a danger of scratching the surface and corrupting the data. Do not use adhesive labels.
- Do not expose the disc directly to the sun's rays, or keep it in conditions of high temperature or humidity, as there is a danger of warping, with consequent loss of data.
- To remove dirt, dust, or fingerprints from the disc, wipe with a dry cloth, or use a CD cleaner. Always wipe radially from the inside to the outside, and do no wipe with circular movements. Never use abrasives or solvent cleaners.
- Hioki shall not be held liable for any problems with a computer system that arises from the use of this CD, or for any problem related to the purchase of a Hioki product.

Overview 1

1.1 Product Overview

The 3470 Magnetic Field HiTester is designed to measure magnetic flux density and level of magnetic field exposure.

- It can be used to assess conformance to ICNIRP 1998 and EN50366 (IEC62233) and in research on magnetic field exposure.
- The instrument is designed to be used with the 3471 and 3472 Magnetic Field Sensors.
  Make sure that the matching number (up to the hyphen) on the tester and the magnetic field sensor are identical.

- Magnetic field exposure refers to the exposure that may affect human health.
  The 3470 Magnetic Field HiTester can be used to measure conformance to **Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields** (ICNIRP 1998) and a standard for **measuring magnetic fields of electrical household appliances** (EN50366).

❖For more information on ICNIRP: "Appendix" (P.111)

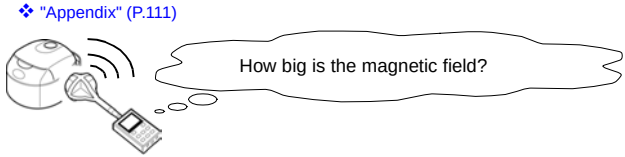
- This tester can measure magnetic flux density and magnetic field exposure generated by products manufactured at a customer site or produced by devices in a customer environment.
  It can measure magnetic flux density and magnetic field exposure generated by products manufactured at a customer site or produced by devices in a customer environment.

Functions		Functions in detail	Reference
Basic	Magnetic flux density *1 measurements	Measuring the magnetic flux density of appliances and environments **Magnetic flux density (10 Hz to 400 kHz):** For wide range measurements of magnetic flux density **Magnetic flux density (10 Hz to 2 kHz):** For magnetic flux density of power frequencies **Magnetic flux density (2 kHz to 400 kHz):** For magnetic flux density of high frequencies other than power frequencies	❖3.3 (P. 38)
	Exposure level*2 measurements	Measuring the exposure level of appliances and environments **Exposure level (general public):** **This level is used for measuring exposure to magnetic fields prevalent in environments where we can assume the presence of people of all age groups and health conditions (people who are not normally aware of the presence of magnetic fields) as well as exposure to magnetic fields generated by appliances and other consumer devices manufactured to conform to EN50366 (or IEC6233) and other standards.** **This level corresponds to the general public exposure level in ICNIRP 1998.** **Exposure level (occupational):** **This level applies to measurements of exposure to magnetic fields in environments that involve adults only who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions.** **This level corresponds to the occupational exposure level in ICNIRP 1998.**	❖3.4 (P. 41) 3.5 (P. 48)
Application	Output functions	A function that makes it possible to output waveforms and resultant RMS value of magnetic flux density or exposure levels.	❖6.1 (P. 95)
	Application software use	• This function allows you to do the following: • to set up the 3470 from your PC • to upload data saved on the 3470 to your PC • to monitor RMS values	❖5 (P. 73)

*1: Available units are T, G, and A/m and the magnetic permeability of air being $4\pi\times10^{-7}$ H/m, the relationships between the different units are as follows: $1T=10^4$ G, 1 A/m=$4\pi\times10^{-7}$ T.

*2: This value is obtained by inverse filtering of magnetic flux density values stated in the ICNIRP1998 Guideline.
Use the exposure level figures indicated for the general public in IEC62233 or Since the reference levels for magnetic field exposure indicated in ICNIRP1998 for occupational exposure is approximately five times that of general public exposure, the indicated values for occupational exposure is roughly a fifth of general public exposure.

❖ "Appendix" (P.111)



1.2 Features

Easy to view LCD display

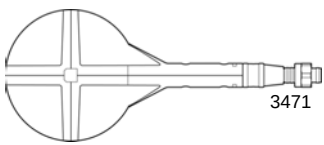
The large LCD display makes for ease of viewing measurement values.

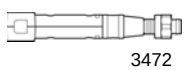
Automatic recognition of magnetic field sensors

Two magnetic field sensors of different sizes, the 3471 and 3472, are available for the tester

The 3471, intended for normal application, has a cross-sectional area of 100 cm^2.
The 3472 sensor has a cross-sectional area of 3 cm^2 and is designed for measuring detailed distribution.

The 3470 automatically recognizes an attached sensor so there is no need to set a conversion rate whenever a sensor is connected.





Switchable measurement methods

The tester allows the user to switch between the following measurement modes: magnetic flux density, exposure (General Public), and exposure (Occup.).

Switchable axis

The user can switch between different axes (x-axis, y-axis and z-axis and resultant values) in each measurement mode

Waveform and resultant RMS value output

Both waveform (MON) and resultant RMS (REC) output can be selected.
With a 9759 Output Cable you can connect the 3470 to an oscilloscope or recorder for output of waveforms and resultant RMS values.

Waveform output :	enables measurement of magnetic field waveforms when the tester is connected to an oscilloscope or recorder.
Resultant RMS value output :	permits recording of resultant values on a recorder or logger, which is convenient for long-term measurements.

Memory function

Records up to 99 measurement data.

Function for saving settings

Measuring conditions can be stored to enable quick access to the same operating conditions each time you power up.

Dual power supply

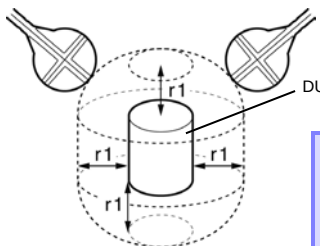
The tester can be powered both by battery and AC power to enable measurements in the field as well as permitting installation for long-term measurements.

1.3 Measurement Example

This section provides a measurement example using this tester.

Objective: to measure magnetic field exposure generated by products to determine whether they pass or fail the requirements to obtain a CE marking.

Measurement location : Anechoic chamber*1
Device under test : exposure level (general public) of magnetic fields generated by an electric rice cooker
Measurement location, distance*2 : around, 30 cm *3
State of device under test *2 : Half-filled with water, and maximum heat setting
Measurement time : a few seconds at each measurement point



Be sure to measure areas that generate maximum exposure to magnetic fields.

In this example, r1 = 30 cm.

Storage of measurement data : tester memory and PC memory
Required equipment : 3470
3471 or 3472 sensor
Batteries
AC adapter
Product whose magnetic field is to be tested
PC

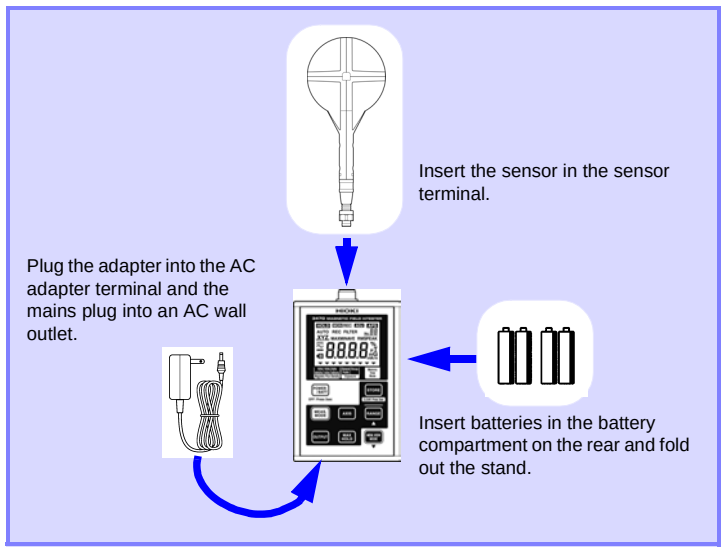
*1: A location where magnetic fields other than that generated by the DUT is minimal and where there are no magnetic fields or metal objects in the vicinity that could be affected by the measurements. An anechoic chamber is not required if the above conditions can be met.
Measurements performed in an anechoic chamber should be performed at a certain distance from the walls, which are made of a magnetic material.

*2 : Since this state depends on the DUT, refer to the IEC62233, EN50366 or other relevant specifications to determine the required state of the DUT during testing.

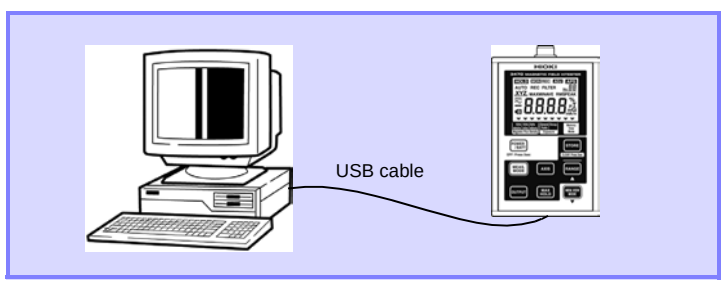
*3 : This value comes from IEC62233 Ed.1.0. Note that it may change when the standard is revised.

1 Preparations

1. Insert batteries in the tester or connect it to the AC adapter and fold out the stand. Also connect the 3471 or 3472 Magnetic Field Sensors.



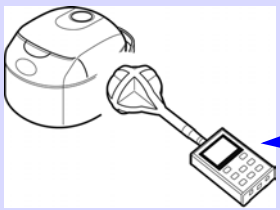
2. Connect the tester to a PC using a USB cable.



3. Install the driver and the PC software on the PC.

2 Setup, measurements and data storage

1. Select Exposure (general public) measurement mode.
2. Select Auto range. ([**AUTO**] on the display lights.)
3. Place the magnetic field sensor near the DUT. (A distance of 30 cm if the DUT is an electric cooker)

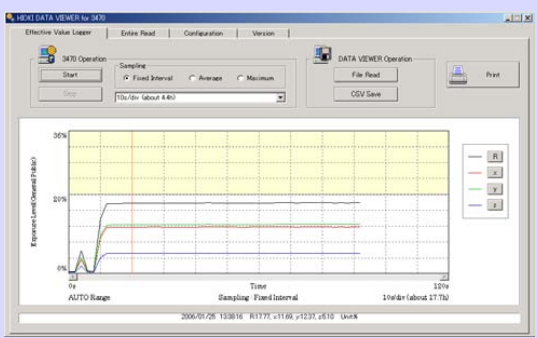


Read the indicated value and press STORE to save the measurement data.

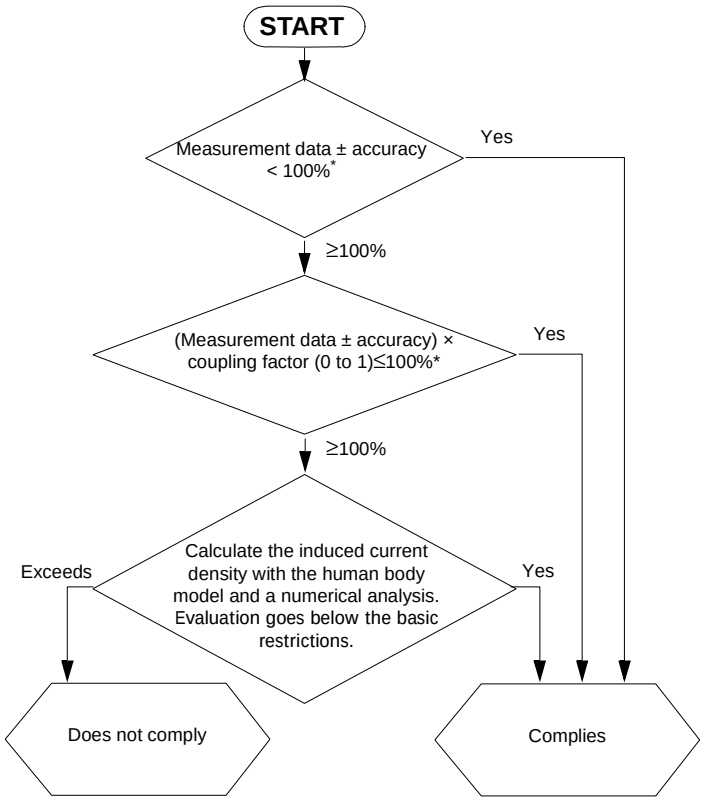
4. Read the indicated value and store the measurement data in the tester.

3 Processing data after measurement

1. Start up the software and transfer the measurement data stored in the instrument to the PC.
2. Analyze the data transferred to the PC using Excel or other spreadsheet program.



Analysis flow chart



* : Whether tester accuracy should be added or subtracted depends on the standpoint of testing personnel. Refer to the instructions in the IEC62233 standards.
For details on the coupling factor, refer to Appendix 2 "Coupling Factor in the IC-NIRP Guidelines" (P.112).

*2 : This cannot be measured by a magnetic field tester.

1.4 Names and Functions of Parts

1.4.1 3470 Magnetic Field HiTester

Front

Sensor terminal
Connect the 3471, 3472 Magnetic Field Sensor or a 9758 Extention Cable.
❖2.2 (P. 32)

Display
❖(P. 20)

Keys
❖(P. 18)

AC adapter terminal
Connect the AC adapter here.
❖2.1.1 (P. 29)

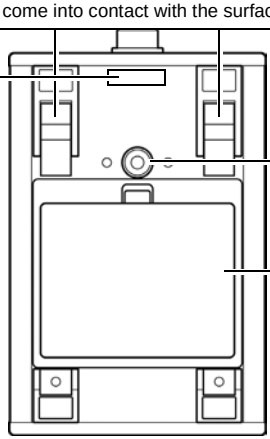
USB terminal
Connect a USB cable.

Output terminal
Connect a 9759 Output Cable.
❖6.1 (P. 95)

Back

Stand
When setting up the meter on a desk or other flat surface fold out the stand to make sure that the magnetic field sensor does not come into contact with the surface underneath.

Matching number
Use the tester with a sensor that has an identical matching number (up to the hyphen).

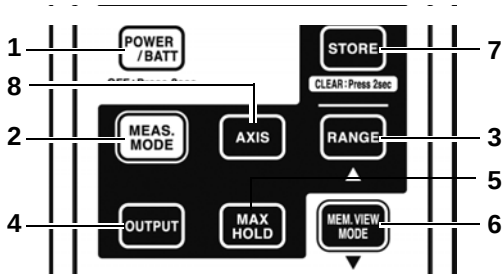


Camera tripod screw
Attach a commercially available camera tripod here.

Battery compartment lid
Open to insert or replace batteries.
❖2.1.2 (P. 30)

⚠CAUTION
When using the handle as a stand for the device, do not press down too hard on the device as this can damage the handle.

keys

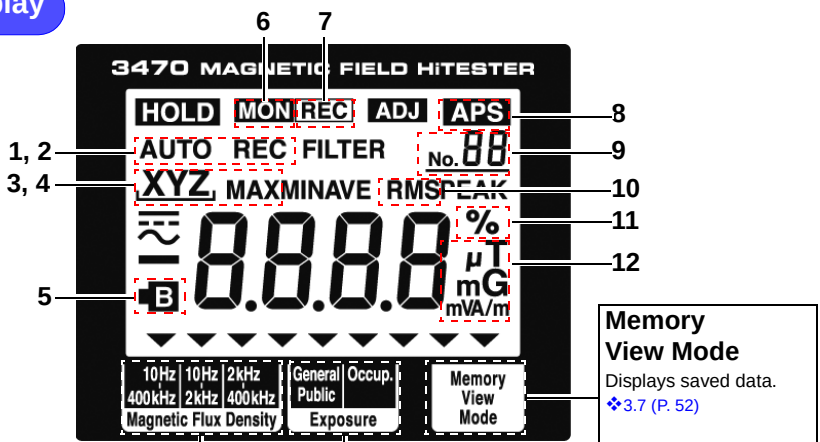


	Keys	Description
1	POWER /BATT	• Turns the power on and off. • Holding down STORE while turning on the power initializes the memory and the saved settings (returning them to their factory defaults). ❖For details on the factory defaults: 4.3 (P. 61) • Holding down the MEM. VIEW MODE while powering up allows you to set the Auto power off, audible key feedback, unit indication, slow function, and MEM.MODE key enable/disable. ❖4.4 (P. 62)
2	MEAS. MODE	Switches magnetic field measurement modes as show below: Magnetic flux density (10 Hz to 400 kHz) → magnetic flux density (10 Hz to 2 kHz) → magnetic flux density (2 kHz to 400 kHz) → exposure level (General Public) → exposure level (Occup.) → magnetic field density (10 Hz to 400 kHz) → ... ❖3.3 (P. 38)
3	RANGE	• Switches between Auto and Manual ranges. **Manual range:** (magnetic flux density mode) AUTO → **r0** (2 µT/20 mG/1.6 A/m)→ **r1** (20 µT/200 mG/16 A/m) → **r2** (200 µT/2 G/160 A/m) → **r3** (2 mT/ 20 G/1600 A/m)→ AUTO... (exposure level mode) AUTO → **r0** (20%) → **r1** (200%) → **r2** (2000%) → AUTO... **Auto range:** automatically selects appropriate range during measurements. • Switches measurement ranges during manual range. ❖3.3 (P. 38) • Magnetic flux density switching is performed by converting from T (Tesla). For this reason, for example, 1.592 A/m is the maximum indicated value in the 1.6 A/m range.
4	OUTPUT	• Use to output. • Switches between the following output functions. OFF → Waveform output → resultant RMS value output → OFF... • This mode disables the auto power off mode. ❖6.1 (P. 95)
5	MAX HOLD	• Holds the maximum value. (Each new maximum value updates the indicated value.) • Press this key again to unhold. • 3.6 (P. 51)
6	MEM. VIEW MODE	Shows saved measurement data. ❖3.7 (P. 52)

	Keys	Description
7		• Stores measurement data in memory. • Clears displayed measurement data when viewing memory data. ❖3.7 (P. 52)
8		Switches the displayed axis as shown below: XYZ→X→Y→Z→XYZ...(XYZ indicates a resultant value*) *: $\sqrt{X^2+Y^2+Z^2}$ ❖1.5 "Definition of Measurement Items" (P.23)

Display

Note: Icons not described below cannot be used with this tester.



Memory View Mode
Displays saved data.
❖3.7 (P. 52)

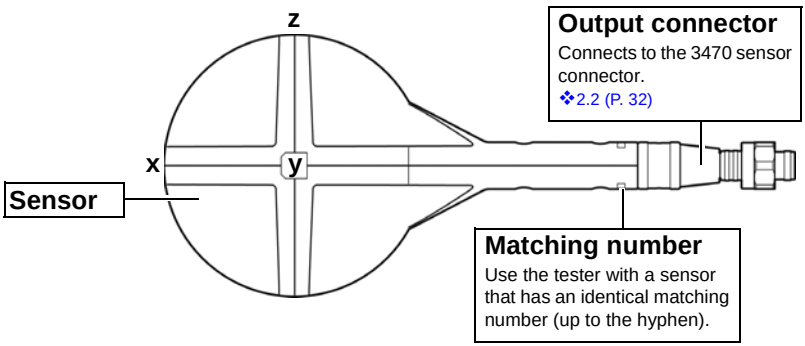
Magnetic flux density mode
Displays the selected magnetic flux density mode.
❖3.3 (P. 38)

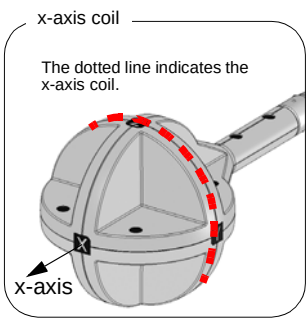
Exposure level mode
Displays the selected exposure level modes as follows:
General Public
Occup. (Occupational)
❖3.4 (P. 41) ,3.5 (P. 48)

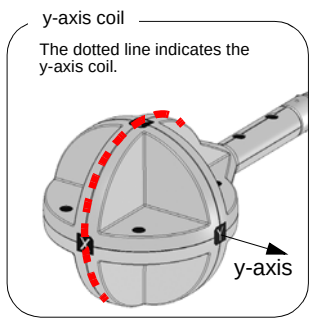
	Icons	Description
1	AUTO	Lights when Auto Range is selected.
2	REC	Lights when measurement data is being stored.
3	XYZ	Shows displayed axis. (XYZ indicates a resultant value*.) * $\sqrt{X^2+Y^2+Z^2}$ ❖1.5 "Definition of Measurement Items" (P.23)
4	MAX	Lights when holding a maximum value. ❖3.6 "Holding Maximum Value of the Resultant RMS Values" (P.51)
5	B	Lights when battery voltage becomes too low. (Replace the batteries when this icon lights.) ❖ "Function for checking low battery voltage" (P.36)
6	MON	Lights during output of waveform.
7	REC	Lights during output of a resultant RMS value.
8	APS	Lights when automatic power off is on.
9	No. 88	Indicates the number of the measurement data stored in memory. ❖3.7 "Checking and Deleting Saved Data" (P.52)
10	RMS	Indicates that a measurement value is an RMS value. Flashes during the slow function is on.
11	%	Indicates the unit used for indicating exposure level. ❖3.4 "Measuring Exposure Level (General Public)" (P.41) ,3.5 "Measuring Exposure Level (Occup.)" (P.48)
12	μT mG mVA/m	• Indicates the unit used for indicating magnetic flux density. ❖3.3 "Measuring Magnetic Flux Density" (P.38) • "mV" indication isn't used in this instrument.

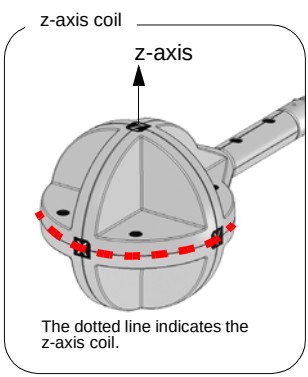
1

1.4.2 3471 Magnetic Field Sensor

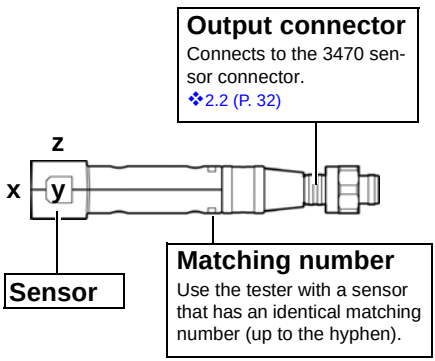


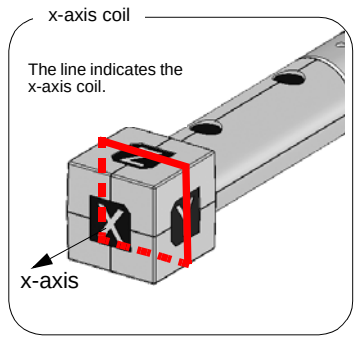


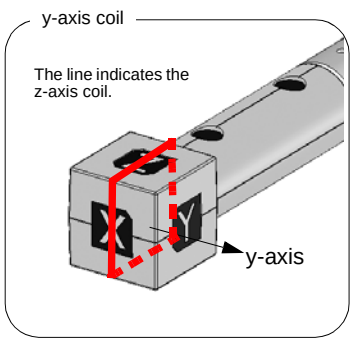


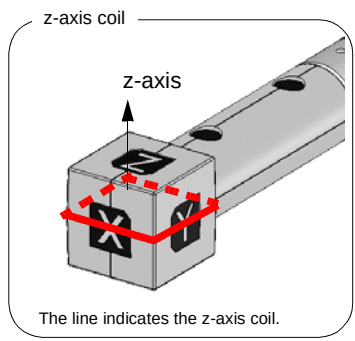


1.4.3 3472 Magnetic Field Sensor









1.5 Definition of Measurement Items

Instantaneous values obtained from the x-axis, y-axis and z-axis sensors at time t are referred to as, respectively, $x(t)$, $y(t)$ and $z(t)$ while the RMS values are respectively $\hat{x}(t)$, $\hat{y}(t)$ and $\hat{z}(t)$. The RMS values used by this tester represent the values shown below. (T when the slow function is turned off is about 0.12 s and about 1 s when the function is on.)

$$\hat{x}(t) = \sqrt{\frac{1}{T}\int_{t-T}^{t} \{x(t)\}^2 dt}$$

$$\hat{y}(t) = \sqrt{\frac{1}{T}\int_{t-T}^{t} \{y(t)\}^2 dt}$$

$$\hat{z}(t) = \sqrt{\frac{1}{T}\int_{t-T}^{t} \{z(t)\}^2 dt}$$

A resultant RMS value $\hat{R}(t)$ represents the following.

$$\hat{R}(t) = \sqrt{\{\hat{x}(t)\}^2 + \{\hat{y}(t)\}^2 + \{\hat{z}(t)\}^2}$$

NOTE

- The IEC62233 and EN50366 standards state that "Transient magnetic fields with a duration of less than 200 ms, e.g. during switching events, are disregarded. If a switching action occurs during the measurements, the measurement has to be repeated."
  Transient responses may not be correctly measured when slow function is off. Make a new measurement if this happens.
- To make a 1 s measurement that includes transient responses, measure using the slow function while being mindful of the timing that transient responses occur.

❖4.4.4 "Setting the Slow Function" (P.68)

The above can be summarized as shown below.

Resultant RMS value:	$\hat{R}(t)$	:	LCD reading, RMS output (**REC**)
RMS value (per axis):	$\hat{x}(t)$, $\hat{y}(t)$, $\hat{z}(t)$	:	LCD reading
Instantaneous value (per axis):	$x(t)$, $y(t)$, $z(t)$	:	Waveform output (**MON**)

These are the same both in magnetic flux density mode and exposure level mode.

NOTE

Resultant RMS and RMS values (for each axis) can be viewed on a PC using the application software (on CD) supplied with the tester.

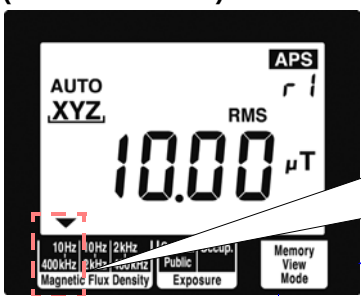
❖5.1 "Overview" (P.73)

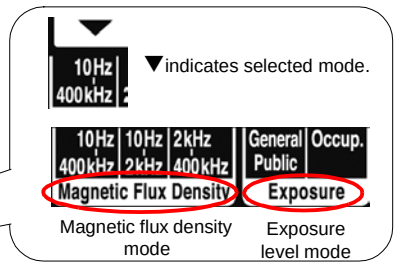
1.6 Screen Configuration and Key Operation Work Flow

Measurement mode

❖3.3 (P. 38)

Magnetic flux density mode (10 Hz to 400 kHz)

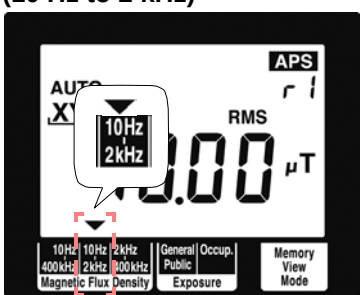




Press MEAS. MODE.

❖3.3 (P. 38)

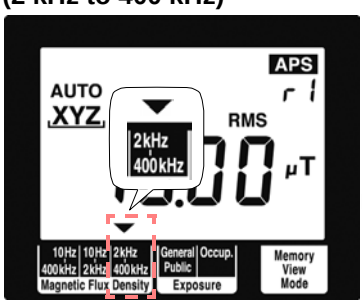
Magnetic flux density mode (10 Hz to 2 kHz)



Press MEAS. MODE.

❖3.3 (P. 38)

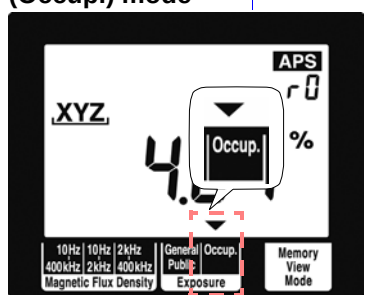
Magnetic flux density mode (2 kHz to 400 kHz)



Press MEAS. MODE.

❖3.5 (P. 48)

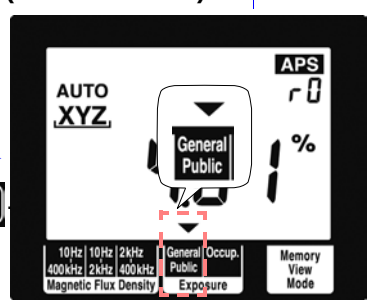
Exposur level (Occup.) mode



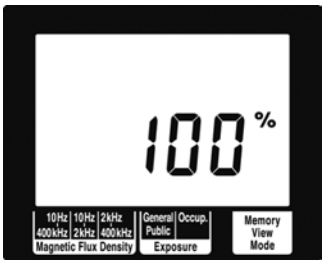
Press MEAS. MODE.

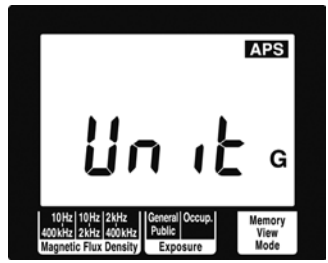
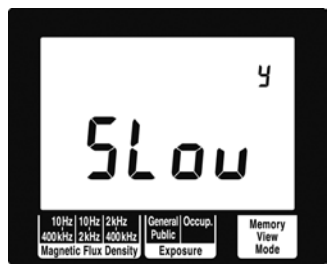
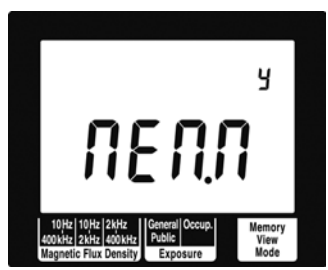
❖3.4 (P. 41)

Exposure level (General Public) mode



Screens for verifying and setup

Screen name	Screen access method	Screen displayed
Check Battery status	Press POWER /BATT to view battery status. ❖3.1 (P. 35), 4.1 (P. 59)	
Check Saved Data	Press MEM. VIEW MODE in each measurement mode. ❖3.7.1 (P. 52)	
Set Auto Power Off	When the power is off, hold down MEM. VIEW MODE and POWER /BATT and press RANGE or MEM. VIEW MODE to turn on [**APS**]. ❖4.4.1 (P. 62)	
Set Audible Key Feedback	When the power is off, hold down MEM. VIEW MODE and POWER /BATT. And press RANGE or MEM. VIEW MODE to turn on [**BEEP**]. ❖4.4.2 (P. 64)	

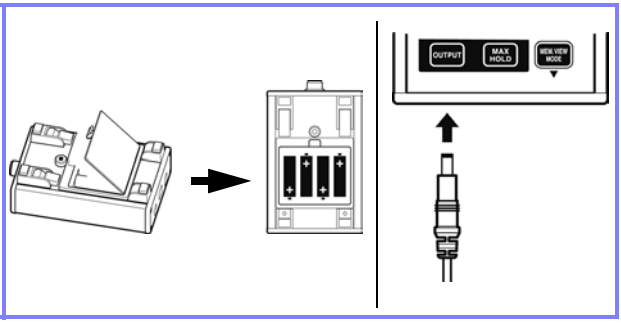
Screen name	Screen access method	Screen displayed
Change Unit Indication	When the power is off, hold down MEM. VIEW MODE and POWER /BATT. And press RANGE or MEM. VIEW MODE to turn on [**Unit**]. ❖4.4.3 (P.66)	
Set Slow Function	When the power is off, hold down MEM. VIEW MODE and POWER /BATT. And press RANGE or MEM. VIEW MODE to turn on [**SLou**]. ❖4.4.4 (P. 68)	
Enable/disable MEM. MODE Key in MAX. HOLD or Output Mode	When the power is off, hold down MEM. VIEW MODE and POWER /BATT. And press RANGE or MEM. VIEW MODE to turn on [**MEM.M**]. ❖4.4.5 (P. 70)	
QuickSet The slow function is on in Exposure level (General Public) mode when powering on.	When the power is off, hold down MEAS. MODE and POWER /BATT. ❖ (P. 42)	

1.7 Measurement Work Flow

This section describes measurement work flow.

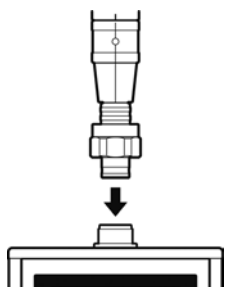
1. Supplying power

❖2.1.1 "Connecting the AC Adapter" (P.29)
❖2.1.2 "Inserting and Replacing Batteries" (P.30)



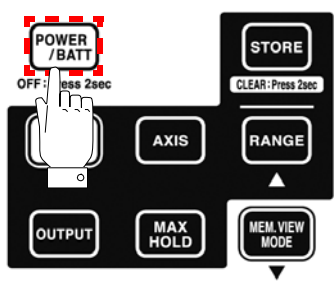
2. Connect a magnetic field sensor.

❖2.2 "Connecting a Magnetic Field Sensor" (P.32)



3. Turn on the power.

❖2.3 "Turning the Power On and Off" (P.33)

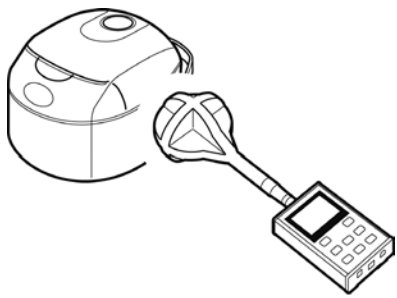


4. Pre-measurement check

❖3.2 "Pre-measurement Check" (P.37)

5. Measuring magnetic fields

❖3.3 "Measuring Magnetic Flux Density" (P.38)



6. Transfer the measurement data to a PC and use the application software to analyze the data.

❖5.3 "Graphic Representation of Measurement Values" (P.85)
❖5.4 "Transferring Recorded Data to a PC" (P.88)

Measurement Preparations 2

2.1 Supplying Power

2.1.1 Connecting the AC Adapter

WARNING

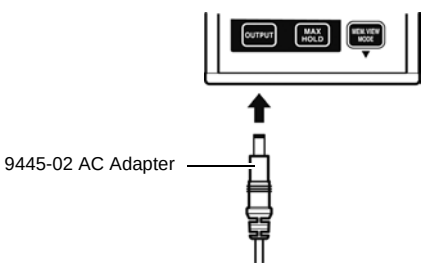
Use only the specified Model 9445-02 AC Adapter (SA110-09S-I, SINO-AMERICAN) AC adapter input voltage range is 100 to 240 VAC (with ±10% stability) at 50/60 Hz. To avoid electrical hazards and damage to the instrument, do not apply voltage outside of this range.

NOTE

- Make sure the power is turned off before connecting or disconnecting the AC adapter.
- Use the AC adapter for long-term measurements.

Connect the AC adapter according to the steps below

1. Connect the 9445-02 AC Adapter to the AC adapter terminal.



2. Connect the AC adapter plug to an AC wall outlet.

This completes AC adapter connection.

2.1.2 Inserting and Replacing Batteries

WARNING

- **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 the possibility of explosion, do not short circuit, disassemble or incinerate batteries.**
- **Handle and dispose of batteries in accordance with local regulations.**

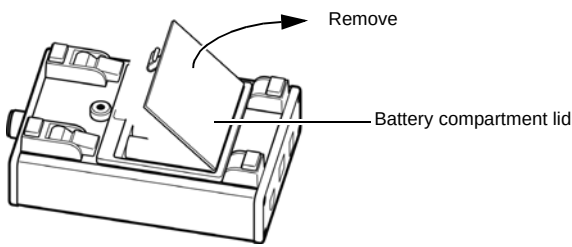
NOTE

- The B indicator appears when battery voltage becomes low. Replace the batteries as soon as possible.
- Use battery power to run the tester for brief measurement sessions in locations without AC power.
- Disconnecting and connecting the AC adapter during measurements when the tester is both battery and AC powered may cause the measurement values to fluctuate greatly.

Use the following steps to insert (replace) the batteries.

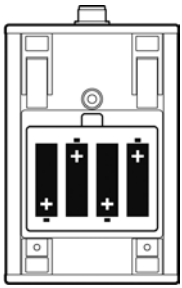
Required batteries: LR6 alkaline battery

1. Remove the battery compartment lid.

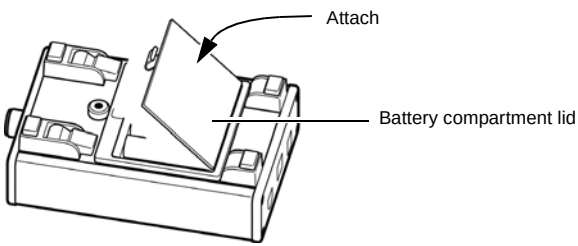


2. When replacing batteries, first remove the old batteries.

3. Insert the batteries taking care to match the polarity correctly.



4. Attach the battery compartment lid.



This completes the battery insertion (replacement) procedure.

2.2 Connecting a Magnetic Field Sensor

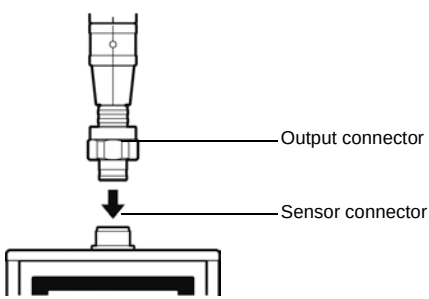
WARNING

Use the sensor within its specified range. In a high frequency and strong magnetic field, the sensor will output a high voltage that may cause electric shock or sensor damage when someone touches an unconnected output terminal.
Observe the rating and the derating curve of the sensor during operation.

Connect the magnetic field sensor (3471 or 3472) according to the steps below.

The 3471, intended for normal application, has a cross-sectional area of 100 cm^2.
The 3472 sensor has a cross-sectional area of 3 cm^2 and is designed for measuring detailed magnetic field distribution.

Locate the Z-axis of the magnetic field sensor facing forward, insert the output connector of the sensor in the 3470 sensor connector and screw the nut of the sensor in to firmly attach the sensor.
The sensor automatically recognizes the connected magnetic field sensor.



NOTE

To avoid damaging the output cable, grasp the connector, not the cable, when unplugging the cable.

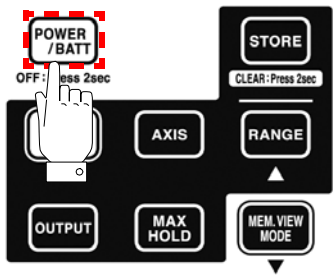
This completes connection of 3471 and 3472 magnetic field sensors.

2.3 Turning the Power On and Off

Turn the power on (off) according to the steps below.

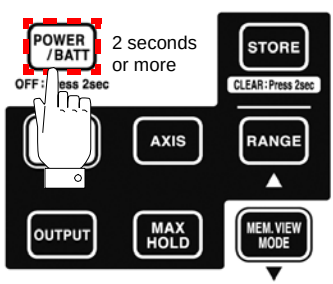
Turning on the power

Press POWER /BATT.



Turning the power off

Hold down POWER /BATT for 2 seconds or more.

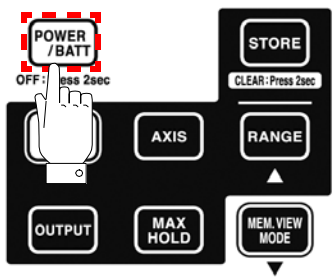


Measurement Procedure 3

3.1 Measurement Preparations

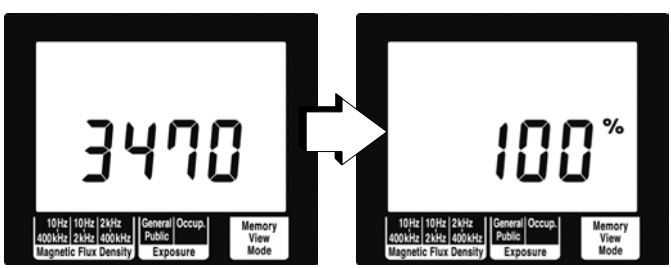
Before the start of measurements, make the following preparations in the stated order.

1. Press POWER /BATT to turn on the power.



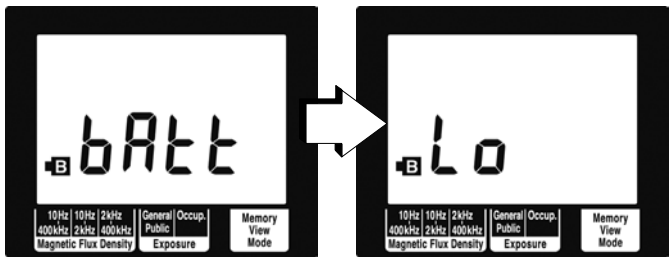
2. Make sure that all segments on the LCD display light.

After this it will display the model name (3470) and battery status.



Function for checking low battery voltage

When battery voltage goes low and B lights, the power is forcibly turned off. At this time, [BAtt] [Lo] also appear.



3. The magnetic flux density mode screen appears.

This ends measurement preparations.

NOTE

- When a setup has been saved (for details refer to 4.2 "Function for Saving Settings (Saving Set Modes and Measurement Ranges)" (P.60)), the set measurement mode screen appears.
- To initialize the tester (to return it to its factory defaults), turn off the power and then hold down STORE and press POWER /BATT.

❖4.3 "Initializing Function (Returning Settings to Their Factory Defaults)" (P.61)

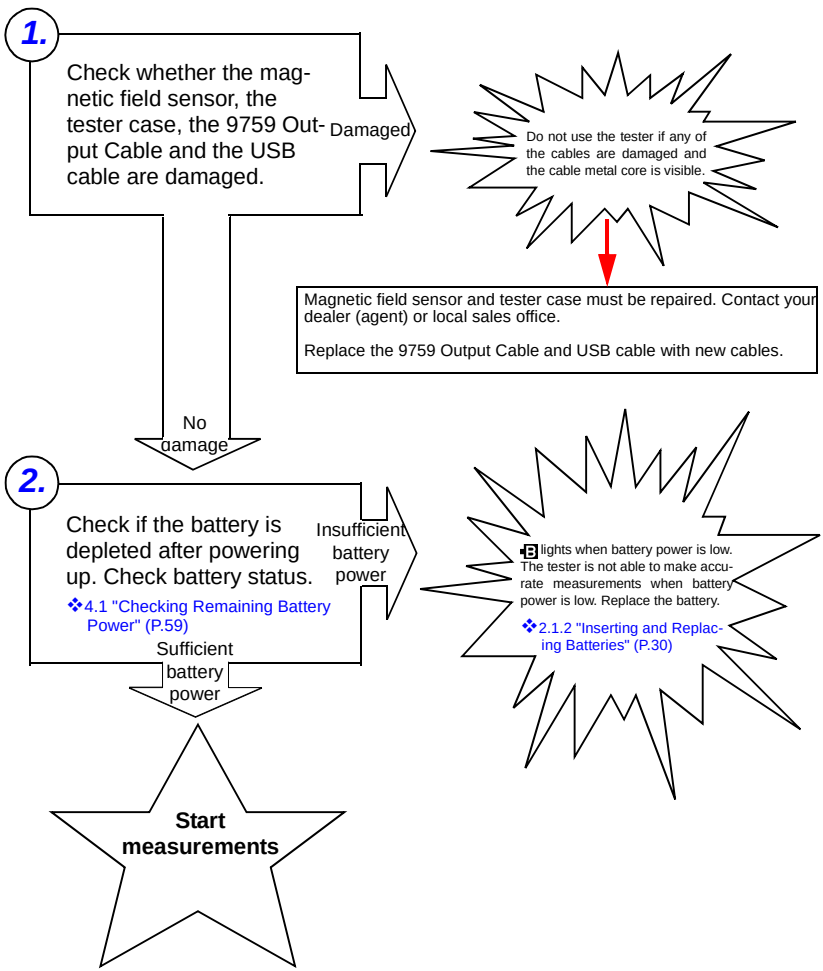
3.2 Pre-measurement Check

NOTE

This instrument has been calibrated to operate with the optional sensors and should be used only with these sensors. Thus if multiple instruments are used, make sure that each instrument is combined with the correct sensor.

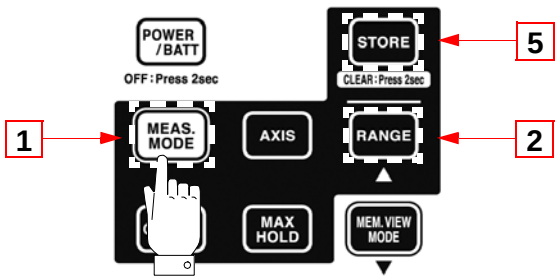
Check the following before using the tester.

Inspection flow chart

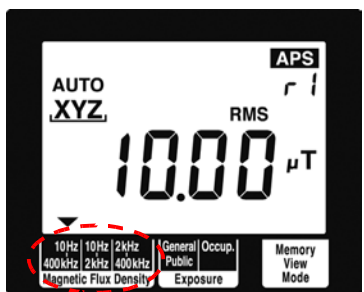


3.3 Measuring Magnetic Flux Density

Measure magnetic flux density according to the steps below.



1. Press MEAS. MODE to open the magnetic flux density mode screen.

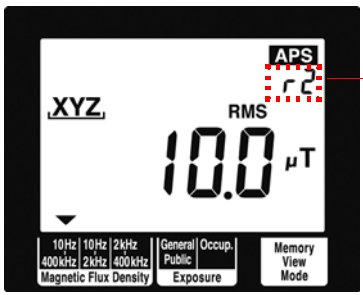


10Hz - 400kHz : wide range measurements

10Hz - 2kHz : power frequency range measurements

2kHz - 400kHz : extended power frequency range measurements

2. Press RANGE to select measurement range.



Range number

Ranges are switched in the order shown below.

AUTO → r0 → r1 → r2 → r3

Range type	Range number	Range
Auto-range	**AUTO** appears on the display	Automatically selects appropriate range during measurements.
Manual range	r0	2 µT/20 mG/1.6 A/m
	r1	20 µT/200 mG/16 A/m
	r2	200 µT/2 G/160 A/m
	r3	2 mT/20 G/1600 A/m

Magnetic flux density switching is performed by converting from T (Tesla).
For this reason, for example, 1.592 A/m is the maximum indicated value in the 1.6 A/m range.

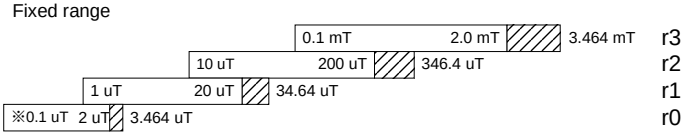
NOTE

- The ranges for the x, y and z axes are interlocked with maximum range and are automatically switched.

Range of guaranteed accuracy

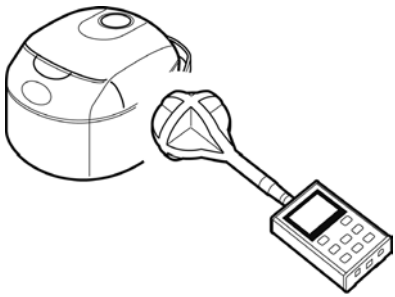
At resultant value R, a count of less than 100 is outside guaranteed accuracy.
Use an appropriate range.

Guaranteed accuracy range for resultant value R
Magnetic flux density (10 Hz - 400 kHz, 10 Hz - 2 kHz, 2 kHz - 400 kHz)
Fixed range



※The magnetic flux density for 3472 (10 Hz - 400 kHz, 10 Hz - 2 kHz) is 0.4 uT.

3. Place the magnetic field sensor near the DUT.



NOTE

- For accurate measurements, the tester should be located further away from the DUT than the sensor.
- Although few magnetic materials are used in the magnetic field tester, the battery is a magnetic material and may affect measurements if located close to the DUT. In this situation, it may be a good idea to use an extension cable to increase the distance between the sensor and the tester or to remove the battery and use the AC adapter.

4. Read the indicated value.

5. Press STORE to save the measurement data.

This ends magnetic flux density measurements.

3.4 Measuring Exposure Level (General Public)

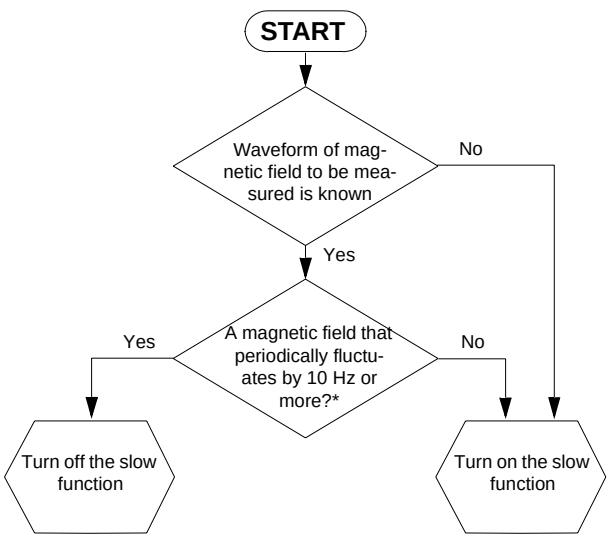
Use this mode to make measurements that conform to EN50366 and IEC62233.

3.4.1 Preparing for Exposure Measurements

Use the flow chart below to determine whether to use the slow function setting.

Slow function setting assessment flow chart

Use this test to determine whether the test of a household appliance should conform to IEC62233 or EN50366.

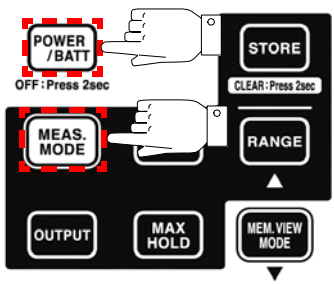


*: Since turning the slow function on or off will not change the value of a magnetic field that periodically fluctuates by 10 Hz or more, turn the slow function off to speed up measurements.
This is because moving the sensor causes the detection of AC current generated by a DC magnetic field such as the terrestrial magnetic field and other AC magnetic fields. Twice the integral time is then required including processing time for the measurement value to stabilize.

The result of the flow chart assessment is "Turn on the slow function."

Use the steps below to open the "QuickSet" screen. (An exposure level (General Public) measurement can be started after turning on the slow function.)

When the power is off, hold down [MEAS. MODE] and press [POWER /BATT].



The "QuickSet" screen opens

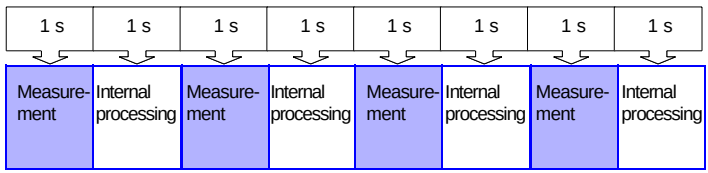
After this follow the procedures 2. (P.46) described in 3.4.3 "Measurement Procedure" to perform an exposure level (General Public) measurement.

The result of the flow chart assessment is "Turn off the slow function."

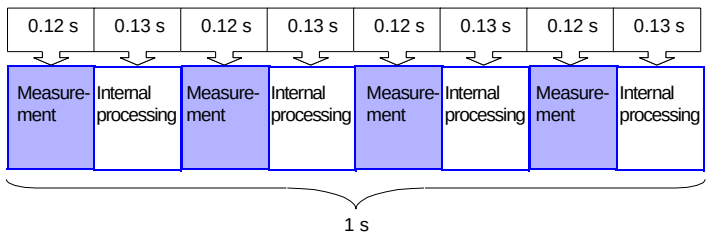
The result of the flow chart assessment is "Turn off the slow function." Turn off the slow function as described in 4.4.4 "Setting the Slow Function" (P.68). (The default setting is "Off.")

The table below shows the measurement and internal processing times with the slow function on and when it is off.

Slow function on



Slow function off



3.4.2 Exposure Level

NOTE

- Values obtained in an exposure measurement are not measures of the risk a specific magnetic field poses.
- In Exposure Level mode, first order filters are used to approximate magnetic density flux levels in the ICNIRP guideline. Thus corner frequencies cause a difference of at most 3 dB, but this corresponds to the "smoothed edges" referred to in IEC62233 or EN50366.

- A discussion of acute health effects of exposure must account for coupling factors such as the human body and magnetic fields, threshold values under basic restrictions and safety factors (reduction factor) for general public and occupational exposure.

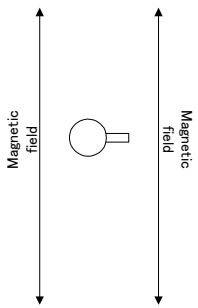
Reference:
In IEC62233, the coupling factor at 10 cm as described in ICNIRP is "0.14" for small and "0.16" for large ones while the safety factor (reduction factor) (the reduction factor for public exposure is "50" (1/50 of the threshold value) for threshold values for occupational exposure is "10" (1/10 of the threshold value).

❖For details, see "Appendix" (P.111).

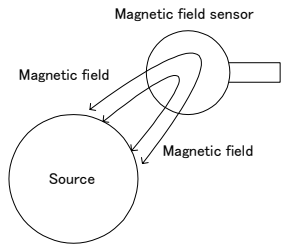
- In measuring non-uniform magnetic fields (see figure below) where the sensor may come into contact with a source, it is recommended that measurements be conducted at a distance from the three coils and at an angle (indicated by ● in the figure below) to maintain isotropy of each axis.
  The IEC62233 and EN50366 standards do not mention sensor angle.

Reference

Uniform magnetic field

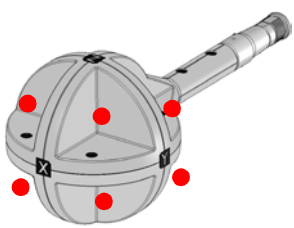


Non-uniform magnetic field



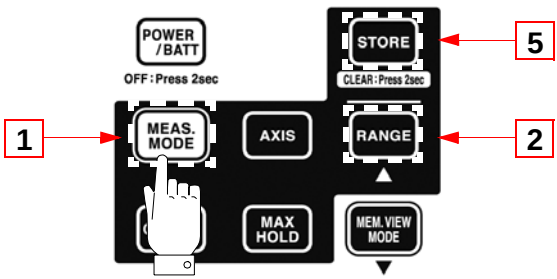
Measure at an angle away from the three coils

The locations indicated by ● (8 points on the spherical sensor surface) should be maintained in a vertical attitude relative to the DUT.

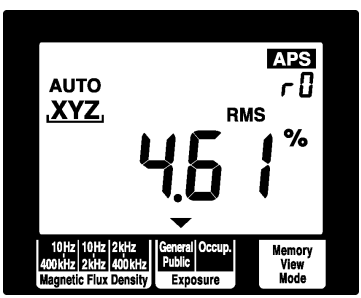


3.4.3 Measurement Procedure

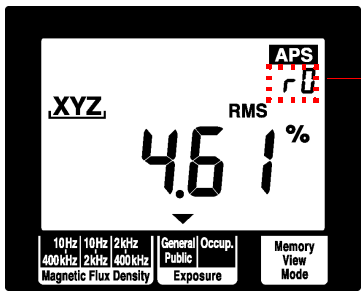
Measure exposure level (General Public) according to the steps below



1. Press MEAS. MODE to open the exposure level (General Public) mode screen.



2. Press RANGE to select measurement range.



Ranges are switched in the order shown below.

AUTO → r0 → r1 → r2

Range type	Range number	Range
Auto-range	**AUTO** appears on the display	Automatically selects appropriate range during measurements.
Manual range	r0	20%
	r1	200%
	r2	2000%

NOTE

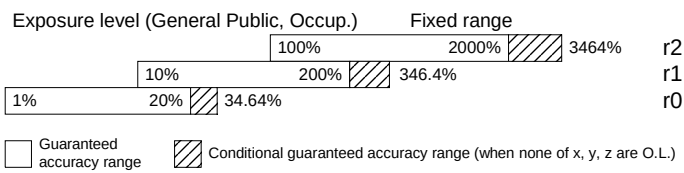
Range of guaranteed accuracy

At resultant value R, a count of less than 100 is outside guaranteed accuracy.

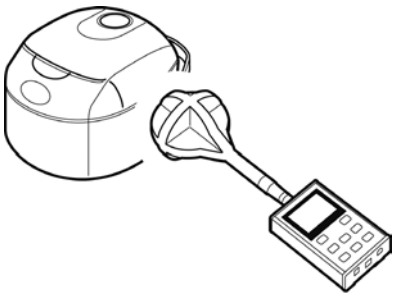
As a result, when R is 99% or less in range r2, it is not within guaranteed accuracy.

Use an appropriate range.

Guaranteed accuracy range for resultant value R

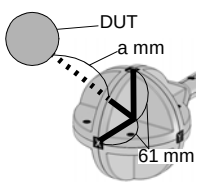


3. Place the magnetic field sensor near the DUT.



NOTE

- For accurate measurements, the tester should be located further away from the DUT than the sensor.
- Although few magnetic materials are used in the magnetic field tester, the battery is a magnetic material and may affect measurements if located close to the DUT. In this situation, it may be a good idea to use an extension cable to increase the distance between the sensor and the tester or to remove the battery and use the AC adapter.
- For details on measuring distance from DUT, sensor location and operating conditions, refer to the following documents. (IEC62233 or EN50366)
- The center of the 3471 sensor is located at right angles to the x, y and z axes. Since the distance from the center to the spherical surface is 61 mm and the distance to the DUT is a mm, locate the tester so that the distance from the surface of the DUT to the center of the sensor is (a + 61 mm). Calculate the measurement distance from the surface of protrusions on the DUT.



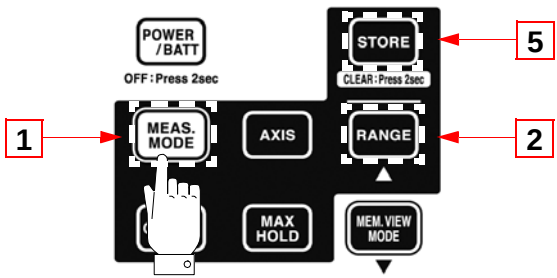
4. Read the indicated value.

5. Press STORE to save the measurement data.

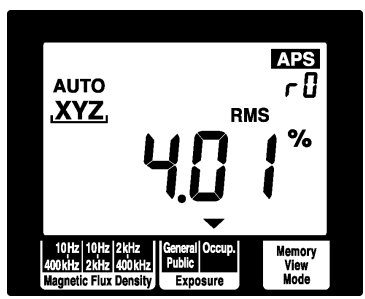
This ends exposure (General Public) measurements.

3.5 Measuring Exposure Level (Occup.)

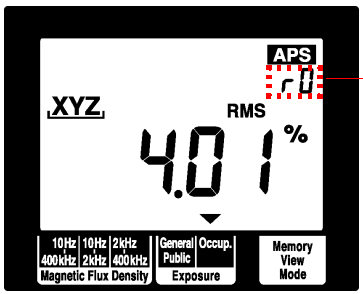
Measuring Exposure Level (Occup.)



1. Press MEAS. MODE to open the exposure level (Occup.) mode screen.



2. Press RANGE to select measurement range.



Range number

Ranges are switched in the order shown below.

AUTO → r0 → r1 → r2

Range type	Range number	Range type
Auto-range	**AUTO** appears on the display	Automatically selects appropriate range during measurements.
Manual range	r0	20%
	r1	200%
	r2	2000%

NOTE

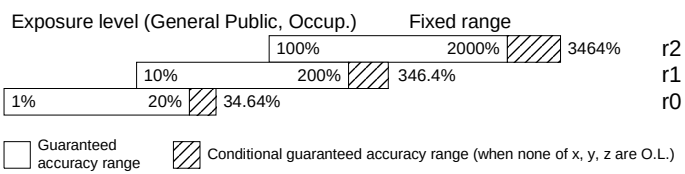
Range of guaranteed accuracy

At resultant value R, a count of less than 100 is outside guaranteed accuracy.

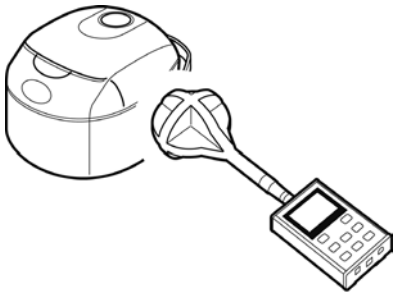
As a result, when R is 99% or less in range r2, it is not within guaranteed accuracy.

Use an appropriate range.

Guaranteed accuracy range for resultant value R



3. Place the magnetic field sensor near the DUT.



NOTE

- For accurate measurements, the tester should be located further away from the DUT than the sensor.
- Although few magnetic materials are used in the magnetic field tester, the battery is a magnetic material and may affect measurements if located close to the DUT. In this situation, it may be a good idea to use an extension cable to increase the distance between the sensor and the tester or to remove the battery and use the AC adapter.

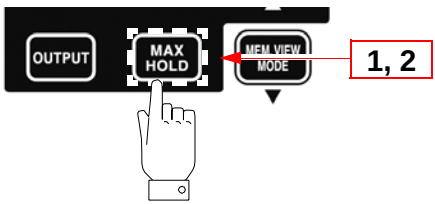
4. Read the indicated value.

5. Press STORE to save the measurement data.

This ends exposure level (Occup.) measurements.

3.6 Holding Maximum Value of the Resultant RMS Values

This function holds the maximum value of the resultant RMS value R and the values of each axis.



1. Press MAX HOLD to hold the maximum value of the resultant RMS value R and the **MAX** icon lights.

NOTE The update of the maximum value will occur as a bigger resultant RMS value is observed. Therefore it is possible that the value of x, y, or z axis may decrease.

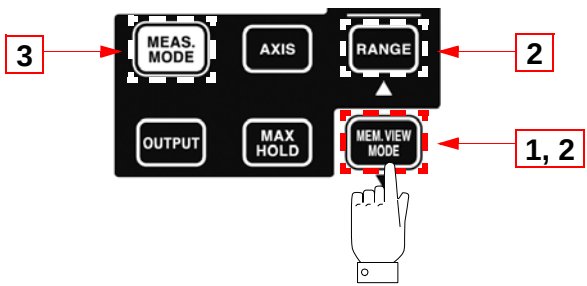
2. Press MAX HOLD again to turn off **MAX** and clear held maximum data value.

The screen returns to the state it had before MAX HOLD was pressed.

3.7 Checking and Deleting Saved Data

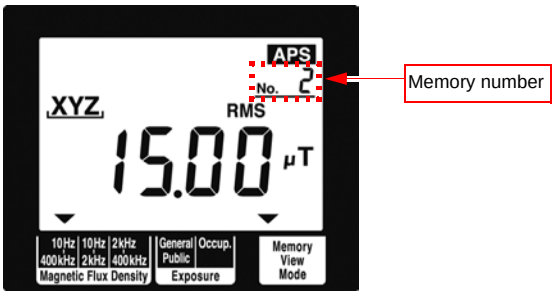
3.7.1 Checking Saved Data

Use the following steps to check saved measurement data.
You can save up to 99 data.



1. Press MEM. VIEW MODE to open the screen with the saved data.

2. Press RANGE (▲) or MEM. VIEW MODE (▼) to select the memory number of measurement data you wish to check.



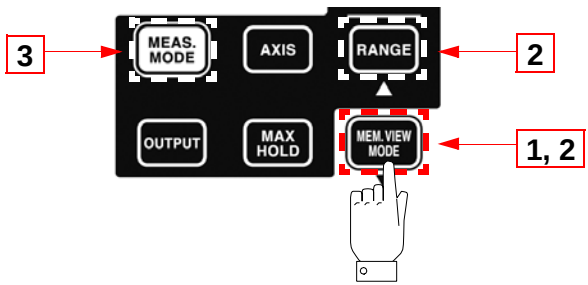
3. Press MEAS. MODE to return to the measurement mode screen.

This completes saving measurement data

NOTE **RMS** blinks when measurement data is saved with the slow function ON.

3.7.2 Deleting Saved Data

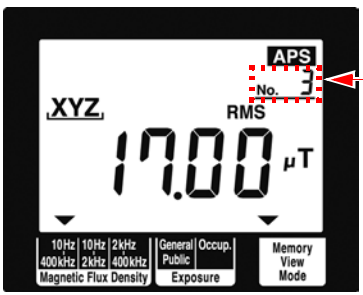
Use the following steps to delete saved measurement data.



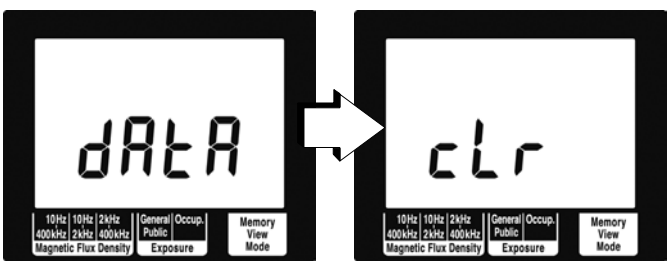
1. Press MEM. VIEW MODE to open the screen with the saved data.

2. Press and hold STORE for 2 seconds or more.

This deletes the measurement data with the highest memory number.
Data can deleted only when moved to the highest memory number.

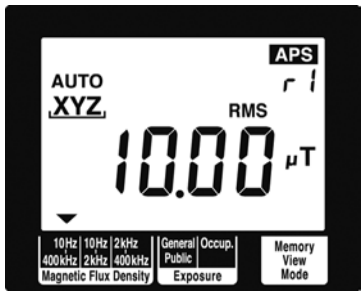


[**dAtA**] [**cLr**] appear when data is deleted.



The data for the next highest memory number appears.

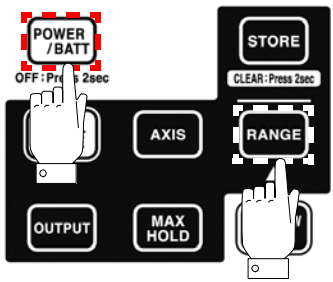
3. Press MEAS. MODE to return to the measurement mode screen.



This completes deleting measurement data.

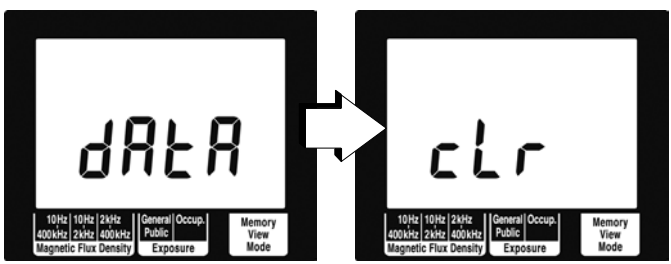
3.7.3 Deleting All Saved Data

Use the following steps to delete all saved measurement data.

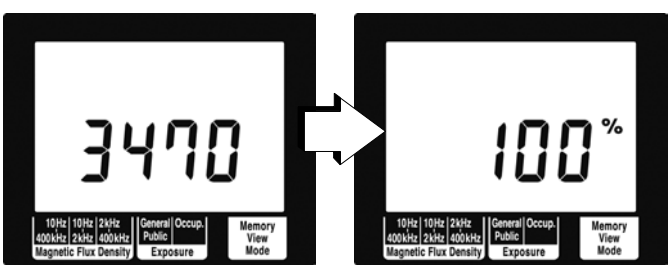


When the power is off, hold down RANGE and press POWER /BATT.
This deletes all saved data.

[**dAtA**] [**cLr**] appear when data is deleted.



Then the model name (3470), battery status and the measurement mode screen appear.



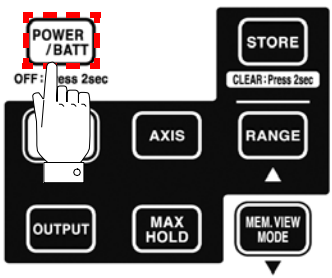
This completes deleting all saved data.

Advanced Functions 4

4.1 Checking Remaining Battery Power

Use the procedure below to check remaining battery power.

Press POWER /BATT.



The measurement mode screen appears after showing battery status.

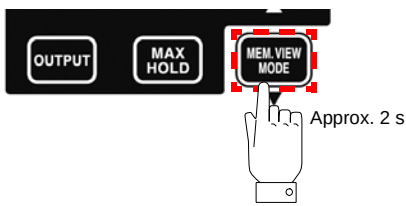
NOTE The screen indicates 100% battery power regardless of battery status when the 9445-02 AC Adapter is connected. (A reading of 100% may not appear when the USB cable is connected.)

4.2 Function for Saving Settings (Saving Set Modes and Measurement Ranges)

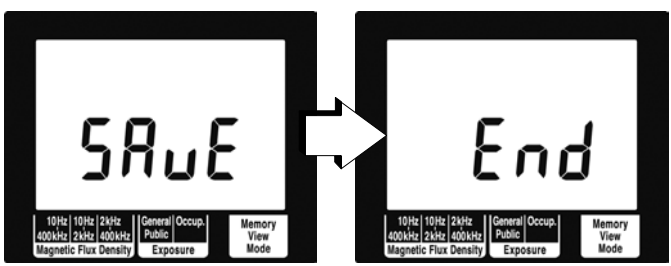
A frequently used mode can be saved for immediate access.
The saved mode appears as soon as the tester is powered up.

Follow the steps given below.

Select the mode or range you wish to access upon powering up and hold down MEM. VIEW MODE for 2 seconds or more.



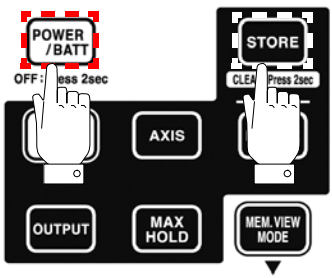
[**SAvE**] [**End**] appear and the tester returns to the screen prior to saving settings.



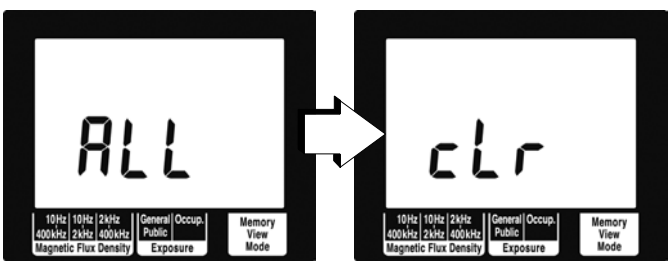
4.3 Initializing Function (Returning Settings to Their Factory Defaults)

This function initializes all settings returning them to their factory defaults and deletes all saved data. Follow the steps given below.

When the power is off, hold down STORE to press POWER /BATT.



[**All clr**] appears.



After this it displays the model name (3470) and battery status, and is restarted using the factory default settings.

The factory default settings are listed in the table below.

Item	Settings
Mode	Magnetic flux density (10 Hz to 400 kHz)
Range	AUTO
Output	None
Auto power off	Enabled
Buzzer	Enabled
Axis	XYZ
Slow function	OFF
Unit	T

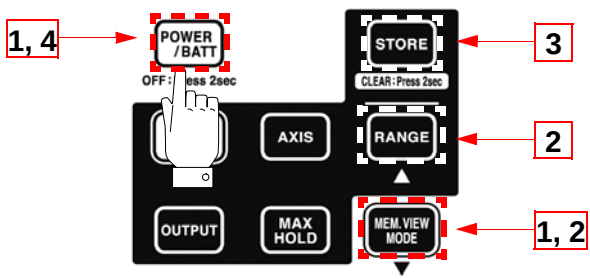
4.4 Other Functions

The following sections describe other functions that a user should know.

4.4.1 Setting Auto Power Off (Saving Battery Power)

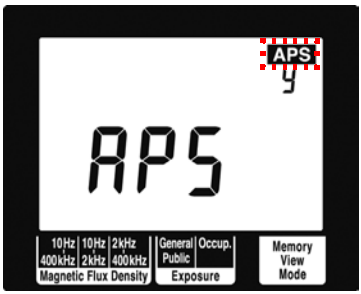
- This function saves battery power when the user forgets to turn off the power.
- The tester is automatically turned off 10 minutes after the last key press.
- APS lights when the auto power off function is on. Before turning off the tester, the APS icon flashes and sounds a buzzer tone (for about 30 s). Pressing any key during this interval postpones shutdown by 10 minutes.

Follow the steps given below.



1. When the power is off, hold down MEM. VIEW MODE and press POWER /BATT.

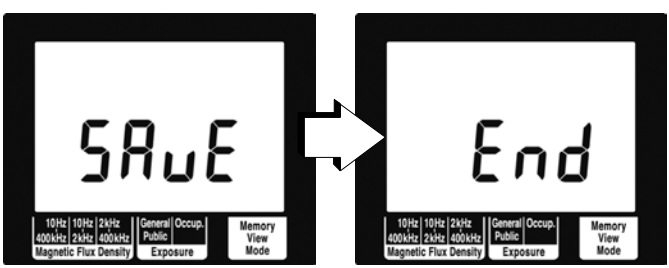
2. Press RANGE (▲) or MEM.VIEW MODE (▼) to turn on APS.



3. Press STORE and select [y] or [n].

[y]	:	set auto power off.
[n]	:	cancel auto power off.

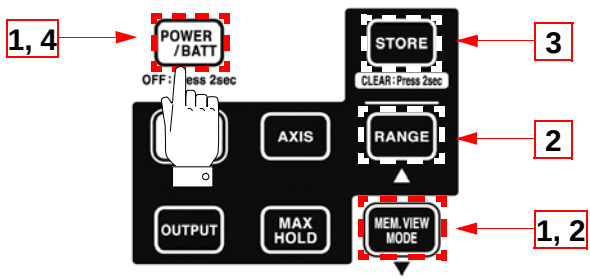
4. Press POWER /BATT to save the setting.
[SAvE] [End] appear and the power is turned off.



4.4.2 Setting Audible Key Feedback

This function causes the keys to generate a beep when pressed.

Follow the steps given below.



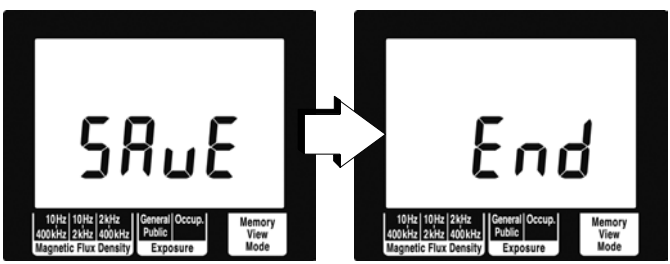
1. When the power is off, hold down [MEM. VIEW MODE] and press [POWER /BATT].

2. Press [RANGE] (▲) or [MEM. VIEW MODE] (▼) to turn on [**bEEP**].

3. Press STORE and select [y] or [n].

[y]	:	audible key feedback is on.
[n]	:	audible key feedback is off.

4. Press POWER /BATT to save the setting.
[SAvE] [End] appear and the power is turned off.

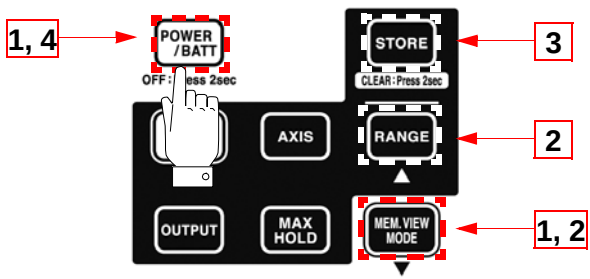


4

4.4.3 Changing Unit Indication

Use this function to change the unit indication. (The default unit is T.)

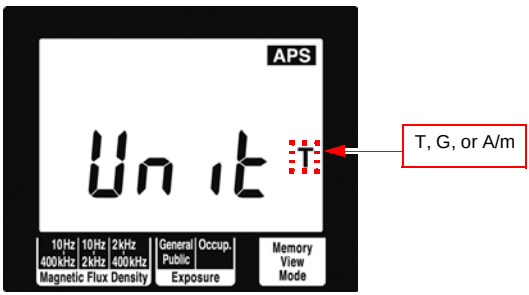
Follow the steps given below.



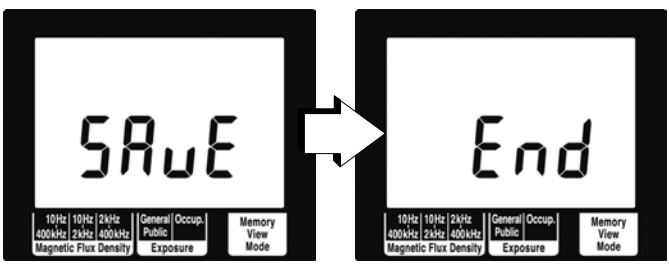
1. When the power is off, hold down [MEM. VIEW MODE] and press [POWER /BATT].

2. Press [RANGE] (▲) or [MEM. VIEW MODE] (▼) to turn on [**Unit**].

3. Press STORE and select [**T**], [**G**], or [**A/m**].



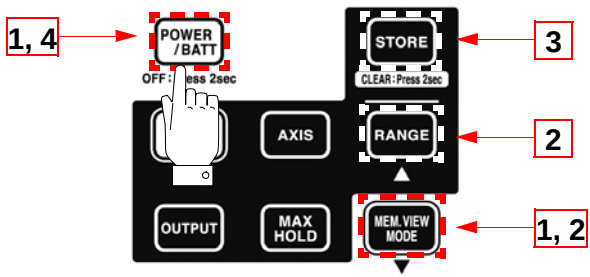
4. Press POWER /BATT to save the setting.
[**SAvE**] [**End**] appear and the power is turned off.



4.4.4 Setting the Slow Function

This function performs 1 s sampling and then displays the measurement value.

Follow the steps given below.



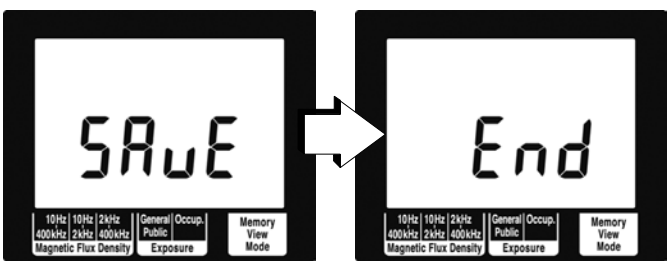
1. When the power is off, hold down MEM. VIEW MODE and press POWER /BATT.

2. Press RANGE (▲) or MEM. VIEW MODE (▼) to turn on [**SLou**].

3. Press STORE and select [y] or [n].

[y]	:	sets the slow function.
[n]	:	cancels the slow function.

4. Press POWER /BATT to save the setting.
[SAvE] [End] appear and the power is turned off.



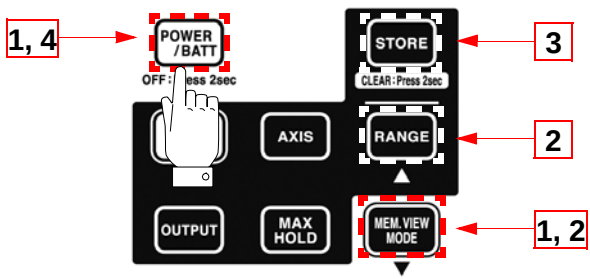
NOTE **RMS** blinks while measuring with the slow function on.

4.4.5 Turning on the MEM. MODE key in MAX. HOLD or output mode

Use this function to turn on or off the MEM.VIEW MODE during MAX. HOLD or during output.

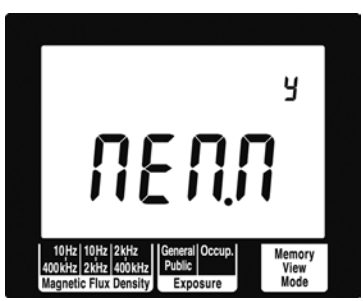
NOTE Checking saved data during output results in output off

Follow the steps given below.



1. When the power is off, hold down MEM.VIEW MODE and press POWER /BATT.

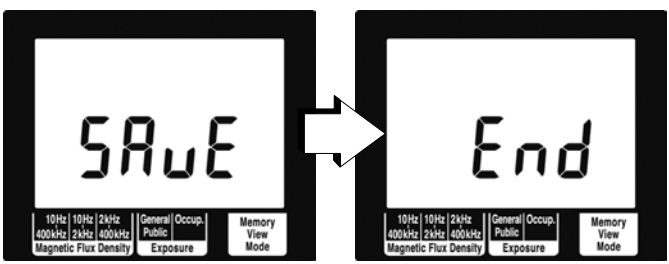
2. Press RANGE (▲) or MEM.VIEW MODE (▼) to turn on [**MEM.M**].



3. Press STORE and select [y] or [n].

[y]	:	enables MEM. VIEW MODE in MAX. HOLD mode and output modes.
[n]	:	disables MEM. VIEW MODE in MAX. HOLD mode and output modes.

4. Press POWER /BATT to save the setting.
[**SAvE**] [**End**] appear and the power is turned off.



4

Using Application Software 5

5.1 Overview

The application software supplied with the 3470 provides the following functions.

Functions	Functions in detail	See:
Graphic representation of measurement values	Analyzing measurement data on a PC	5.3 (P. 85)
Transfer recorded data to a PC		5.4 (P. 88)
Configure the 3470 from a PC	Configuring the 3470 from a PC	5.5 (P. 91)
View application software version	Checking version of application software	5.6 (P. 93)

The supplied PC driver and the application software must be installed on a PC to enable downloading data from the 3470 tester.

❖5.2 "Installing" (P.74)

Operating environment

Supported operating system	• Windows 98, Me, 2000, XP • The hardware environment comprising CPU, memory, display, etc. must conform to operating system recommendations.
Hard disk capacity	• 10 MB or more free disk space
Interface	• USB Ver. 1.1 or greater • One 3470 unit can be connected at any one time

NOTE USB hubs with a power consumption exceeding 100 mA must be self-power hubs.

CD configuration

Folder	Japanese English	Folder containing the application configuration file
File	HiUsbSgl.inf	File for installing driver
	HiUsbSgl.sys	3470 USB device driver
	accuracy.dat	Accuracy file

NOTE Select "small font" for the operating system since "large font" may cause irregularities in screen indications.

5.2 Installing

The major installation procedures are listed below.

1 Install the driver.
❖5.2.1 "Installing the Driver" (P.74)

2 Install the PC software.
❖5.2.2 "Installing software" (P.82)

5.2.1 Installing the Driver

The driver installation procedures are described below.

CAUTION Do not connect and disconnect the USB cable during operations. Disconnecting the USB cable will prevent normal completion of the installation procedure.

NOTE
- Only one 3470 tester can be connected to one PC.
- You may be informed that a new device has been detected also when a 3470 tester with a different serial number is connected. Install the device driver according to the on-screen instructions.

1. Turn on the tester.

2. Use the supplied USB cable to connect the 3470 tester with the PC where the driver is to be installed.

(PC operations)
The 3470 tester is recognized as "**HIOKI Single USB Products**."
After the "**Found New Hardware**" screen, the "**Found New Hardware Wizard**" appears.

The procedures for "**Found New Hardware Wizard**" depends on the PC operating system.

Insert the CD according to the instructions that appear to install the driver.
Installation procedures for each operating system are provided below.

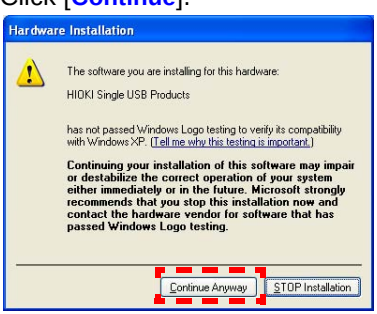
❖ "WindowsXP" (P.75)
❖ "Windows2000" (P.76)
❖ "WindowsMe" (P.78)
❖ "Windows98" (P.79)

WindowsXP

1. Insert the supplied CD in the CD-ROM drive.
The "**Found New Hardware Wizard**" appears.

2. Select "**Install the software automatically**" and click [**Next**].

3. Click [**Continue**].



Clicking this button starts file copying. When the operating system detects the software, a message notifies the user that this software is not recognized by Microsoft. Select [**Continue Anyway**].

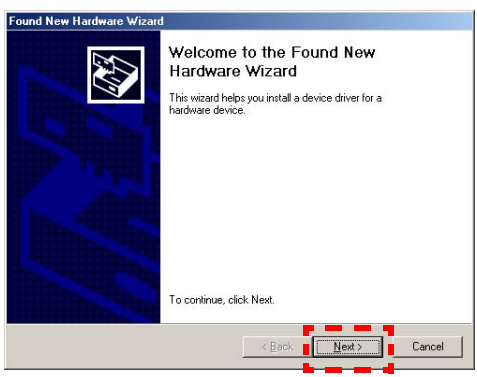
4. Click [**Finish**].

5. Remove the CD from the CD-ROM drive when the "**Found New Hardware Wizard**" screen closes.

❖To install further software, go to Section 5.2.2 "Installing software" (P.82)

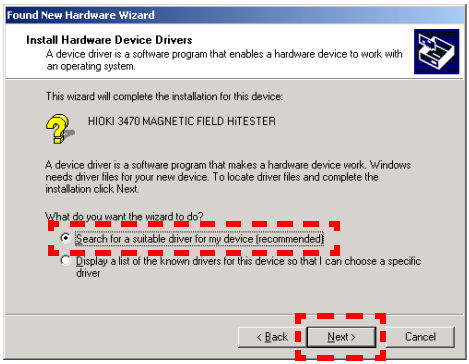
Windows2000

1. Click [**Next**] when the "**Found New Hardware Wizard**" appears.

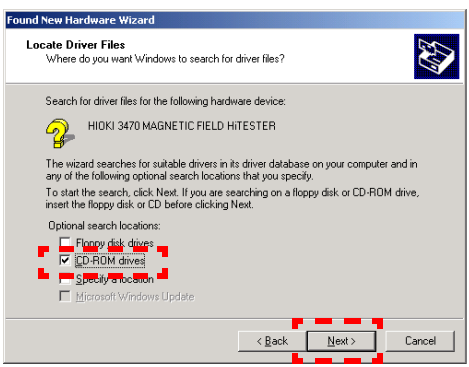


2. Insert the supplied CD in the CD-ROM drive.

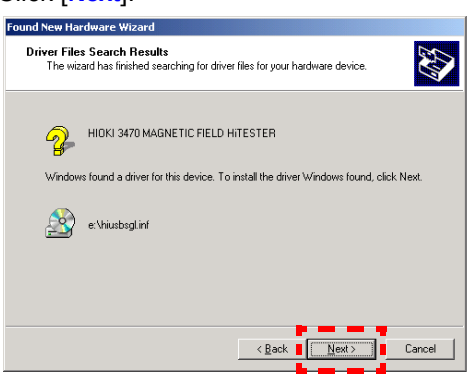
3. Select "**Search for a suitable driver for my device**" and click [**Next**].



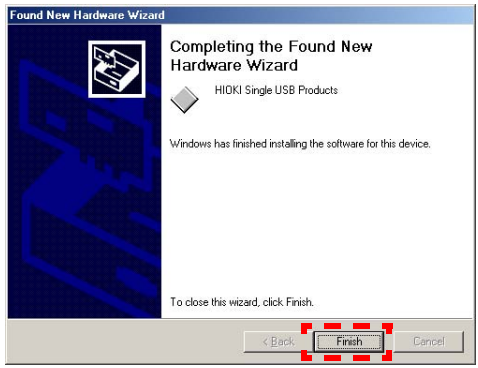
4. Select "**CD-ROM drives**" (deselect other alternatives) and click [**Next**].



5. Click [**Next**].



6. Click [**Finish**].



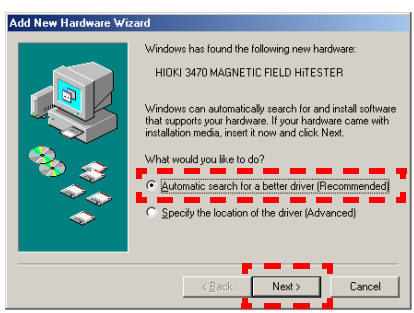
7. Remove the CD from the CD-ROM drive when the "**Found New Hardware Wizard**" screen closes.

❖To install further software, go to Section 5.2.2 "Installing software" (P.82)

WindowsMe

1. Insert the supplied CD in the CD-ROM drive.
The "**Add New Hardware Wizard**" appears.

2. Select "**Automatic search for a better driver**" and click [**Next**].



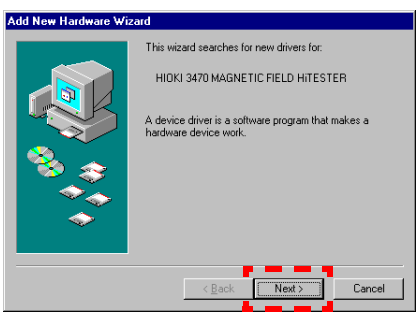
3. Click [**Finish**].

4. Remove the CD from the CD-ROM drive when the "**Add New Hardware Wizard**" screen closes.

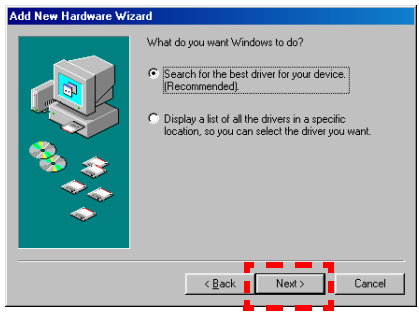
❖To install further software, go to Section 5.2.2 "Installing software" (P.82)

Windows98

1. Click [**Next**] when the "**Add New Hardware Wizard**" appears.

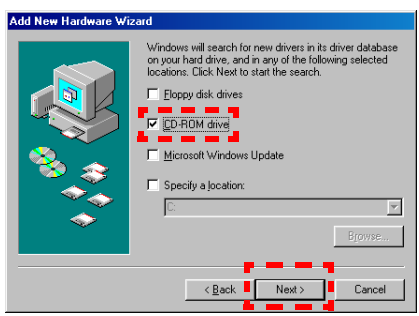


2. Select "**Search for the best driver for your device**" and click [**Next**].



3. Insert the supplied CD in the CD-ROM drive.

4. Select "**CD-ROM drive**" (deselect other alternatives) and click [**Next**].



5. Click [**Next**].

Clicking this button starts file copying.

6. Click [**Finish**] in the next screen that appears.

7. Remove the CD from the CD-ROM drive when the "**Add New Hardware Wizard**" screen closes.

❖To install further software, go to Section 5.2.2 "Installing software" (P.82)

5.2.2 Installing software

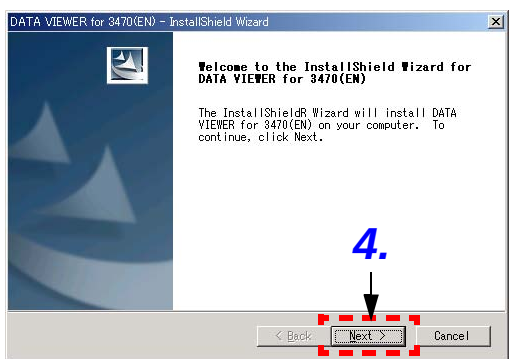
The software installation procedures are described below.

1. Close all currently active applications on the PC.

2. Insert the CD (PC application software) supplied with the instrument into the CD-ROM drive.

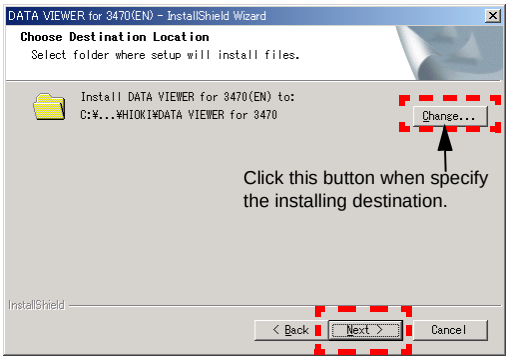
3. Open the folder [**English**] included on the CD, then execute Setup.exe.

   This will activate the installer and open the "DATA VIEWER for 3470 (EN)" window.

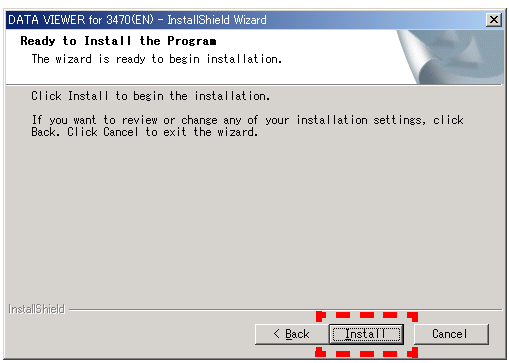


4. Click [**Next**].

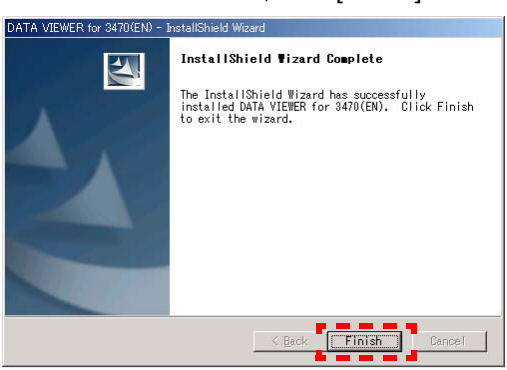
5. Click [**Change**], then specify the installing destination folder. Click [**Next**].



6. Click [**Install**].



7. When installation ends, click [**Finish**] in the checking window.



Installation is now complete.

Select [**Program**] - [**HIOKI**] - [**DATA VIEWER for 3470**] - [**DATA VIEWER for 3470 (EN)**] from the [**Start**] menu of Windows to activate the application.

Uninstallation

1. Select [**Setup**] - [**Control Panel**] from the [**Start**] menu, then click [**Add/Remove Programs**].

2. Select "**DATA VIEWER for 3470 (EN)**," then click [**Remove**] or [**Change/Remove**].

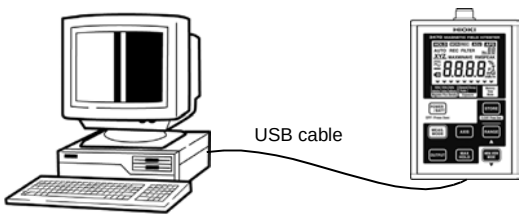
3. Uninstall the program by following the procedure appearing on the screen.

5.3 Graphic Representation of Measurement Values

Measurement values obtained using the 3470 tester can be imported to a PC for graphic representation.

1. Turn on the 3470 and select [**HIOKI**]-[**DATA VIEWER for 3470**]-[**DATA VIEWER for 3470 (EN)**] from the Start button on the PC.

2. Connect the tester to a PC using the supplied USB cable. (Push the cable plugs all the way in.)

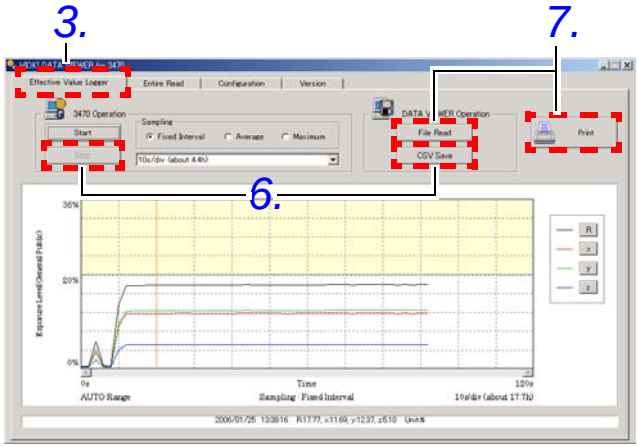


HOLD on the 3470 lights and all key operations other than the POWER /BATT are disabled.

NOTE

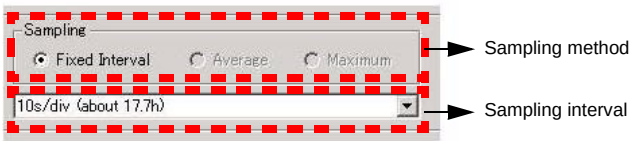
- Only one 3470 tester can be connected to a PC at one time.
- The effective value logger can obtain up to 32000 data.

3. Click the "**Effective Value Logger**" tab in the "**HIOKI DATA VIEWER for 3470**" window to open the "**Effective Value Logger**" screen.

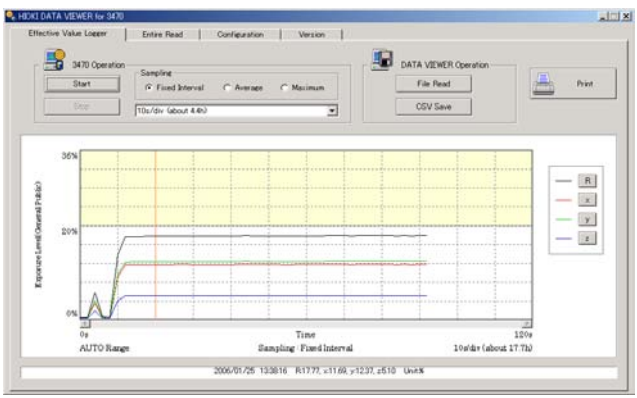


Menu item	Description
Fixed Interval	Samples at fixed intervals to obtain 20 points per division.
Average	Calculates the average of sampling data obtained in drawing 1 point. (Equation) $\hat{x} = \sqrt{\frac{1}{T}\int_{t-T}^{t} x^2 dt} = \sqrt{\frac{1}{N}\sum_{n=1}^{N} \hat{x}_n{}^2}$ $\hat{y} = \sqrt{\frac{1}{T}\int_{t-T}^{t} y^2 dt} = \sqrt{\frac{1}{N}\sum_{n=1}^{N} \hat{y}_n{}^2}$ $\hat{z} = \sqrt{\frac{1}{T}\int_{t-T}^{t} z^2 dt} = \sqrt{\frac{1}{N}\sum_{n=1}^{N} \hat{z}_n{}^2}$ $\hat{R} = \sqrt{\hat{x}^2 + \hat{y}^2 + \hat{z}^2}$
Maximum	Indicates data when resultant RMS value R is at its maximum among the sampling data obtained in drawing 1 point.
Drop-down list box for sampling interval	Selects sampling interval. When the slow function is set to ON, 1 s/div and 5 s/div are not available.
R/ x/ y/ z	Turn R, x, y and z data indication On and Off.
File Read	Represents saved data in graphic form and saves it as graph data.
CSV Save	Saves graph data.
Start	Starts measurements.
Stop	Stops measurements.
Print	Prints graphs

4. Set sampling method, sampling interval and start measurements.



5. Click the mouse to move the vertical lines in the graph and to indicate the data for the corresponding time interval at the bottom of the screen.



6. Click [**Stop**] to stop measuring. Then click [**CSV Save**] to save the graph data.

Click [**File Read**] to read out saved data. Or click [**Print**] to print the graph.

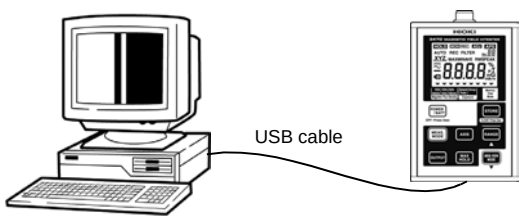
7. Disconnect the USB cable from the tester and the PC and turn off the tester.

5.4 Transferring Recorded Data to a PC

Use this function to transfer data from the 3470 tester to a PC. The data can be saved in the CSV format on the PC.

1. Turn on the 3470 and select [**HIOKI**]-[**DATA VIEWER for 3470**]-[**DATA VIEWER for 3470 (EN)**] from the Start button on the PC.

2. Connect the tester to a PC using the supplied USB cable. (Push the cable plugs all the way in.)



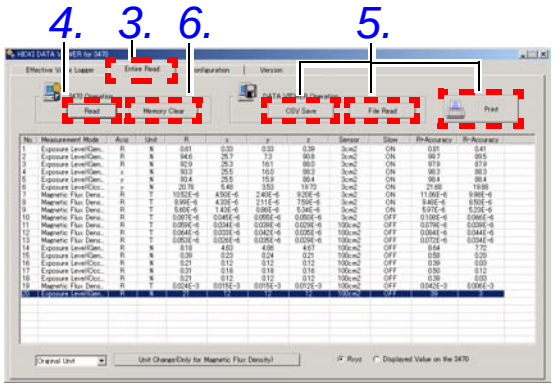
HOLD on the 3470 lights and all key operations other than the POWER /BATT are disabled.

NOTE

- Only one 3470 tester can be connected to a PC at one time.
- The prescribed accuracy range is not considered in R+Accuracy and R-Accuracy*.

  *: R+Accuracy and R-Accuracy are the results of + and - accuracy calculations of resultant RMS values and indicates that R is within this range. These values may be used in the standard.

3. Click the "**Entire Read**" tab in the "**HIOKI DATA VIEWER for 3470**" window to open the "**Entire Read**" screen.



Screen item	Description
Read	Transfers data from the 3470 tester to a PC.
Memory Clear	Deletes data recorded on the 3470.
CSV Save	Saves displayed data.
File Read	Displays saved data.
Unit Change drop-down list box	Selects unit for magnetic flux density data.
Unit Change	Changes unit for indicated magnetic flux density data to unit selected in the Unit Change drop-down list box.
Rxyz / Displayed Value on the 3470	Selects Rxyz or value displayed on the 3470.
Print	Prints displayed data.

4. Click [**Read**] to transfer recorded data to a PC.

NOTE Do not disconnect the USB cable during transfer or the transfer will not end normally.

5. Then click [**CSV Save**] to save the displayed data.

   Click [**File Read**] to read out saved data. Or click [**Print**] to print the displayed data.

6. Use [**Memory Clear**] to delete recorded data on the 3470 that is no longer needed.

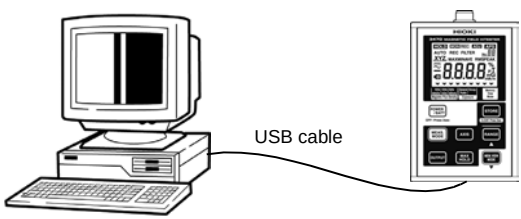
7. Disconnect the USB cable from the tester and the PC and turn off the tester.

5.5 Configuring the 3470

Use the instructions below to configure and store the settings that the 3470 use when powered up.

1. Turn on the 3470 and select [**HIOKI**]-[**DATA VIEWER for 3470**]-[**DATA VIEWER for 3470 (EN)**] from the Start button on the PC.

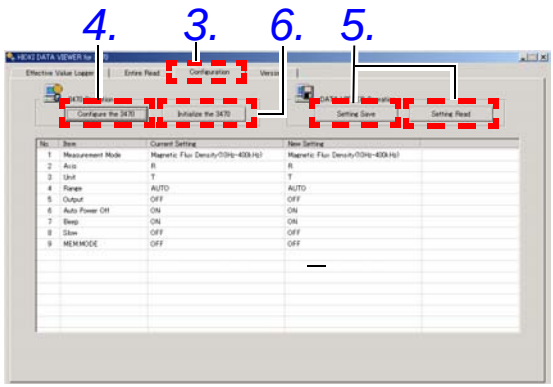
2. Connect the tester to a PC using the supplied USB cable. (Push the cable plugs all the way in.)



HOLD on the 3470 lights and all key operations other than the POWER /BATT are disabled.

NOTE Only one 3470 tester can be connected to a PC at one time.

3. Click the "**Configuration**" tab in the "**HIOKI DATA VIEWER for 3470**" window to open the "Configuration" screen.



Screen item	Description
Configure the 3470	Configures the 3470.
Initialize the 3470	Returns the 3470 to its factory defaults.
Setting Save	Saves made settings.
Setting Read	Reads saved settings.

4. Click [**Configure the 3470**] to set up the 3470 tester.

5. Then click [**Setting Save**] to save the displayed data.

   Click [**Setting Read**] to read out saved data.

NOTE Be sure not to change the file extension as this will prevent normal reading of file data.

6. Use [**Initialize the 3470**] to return the 3470 settings to their factory defaults.

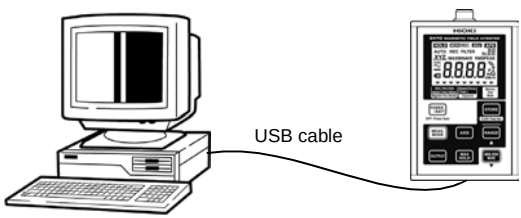
7. Disconnect the USB cable from the tester and the PC and turn off the tester.

5.6 Viewing Version Information

Use this function to view the version of the "**HIOKI DATA VIEWER for 3470**".

1. Turn on the 3470 and select [**HIOKI**]-[**DATA VIEWER for 3470**]-[**DATA VIEWER for 3470 (EN)**] from the Start button on the PC.

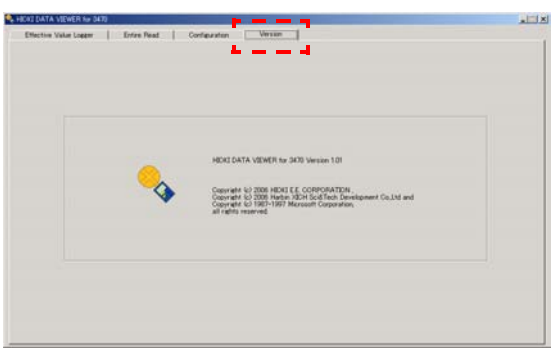
2. Connect the tester to a PC using the supplied USB cable. (Push the cable plugs all the way in.)



HOLD on the 3470 lights and all key operations other than the POWER /BATT are disabled.

NOTE Only one 3470 tester can be connected to a PC at one time.

3. Click the "**Version**" tab in the "**HIOKI DATA VIEWER for 3470**" window to open the "**Version**" screen.



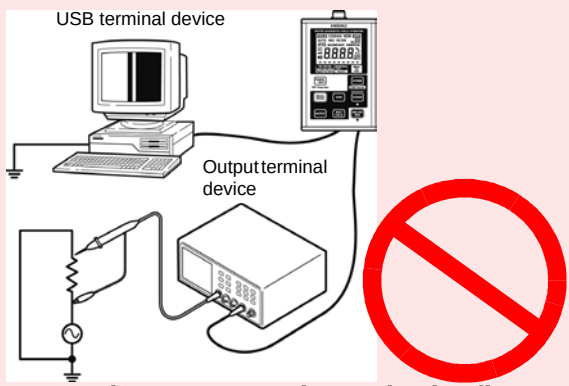
4. Disconnect the USB cable from the tester and the PC and turn off the tester.

Advanced Measurements 6

6.1 Outputting Waveform and Resultant RMS Values

⚠WARNING

Do not simultaneously connect the USB and output terminals of the tester to external devices.
If the ground potential of the device connected to the USB terminal differ from that of the device connected to the output terminal, a short circuit current could flow via the 3470 and damage the device connected to the USB terminal by fire.
When both terminals need to be used to connect, for example, a PC to the USB terminal and an oscilloscope to the output terminal, make sure that both devices are connected to ground or use a device (for example, a recorder) with insulated input terminals on the output terminal side.



Never connect the tester as shown in the figure.

⚠CAUTION

- Do not short circuit the output terminals or apply a voltage as this could damage them.
- When connecting the tester to an insulation BNC, connect the 9759 Output Cable to a 9489 Extension Cable before connecting it to an insulation BNC. The 9759 Output Cable is a metal BNC that could damage an insulation BNC if connected to it directly.
  The 9489 Extension Cable should function as a safe insulation BNC. These are consumables that should be replaced with new ones when damaged.

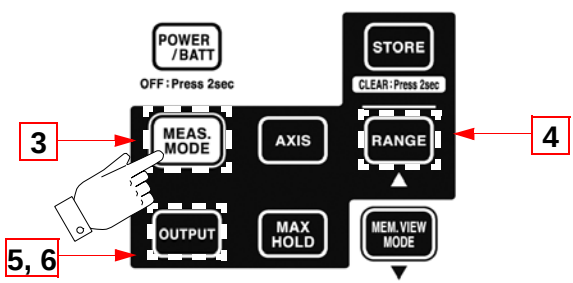
With a 9759 Output Cable you can connect the 3470 to an oscilloscope or recorder for output of waveforms and resultant RMS values.

Waveform output	:	enables measurement of magnetic field waveforms when the tester is connected to an oscilloscope or recorder.
Resultant RMS value output	:	permits recording of resultant values on a recorder or logger, which is convenient for long-term measurements.

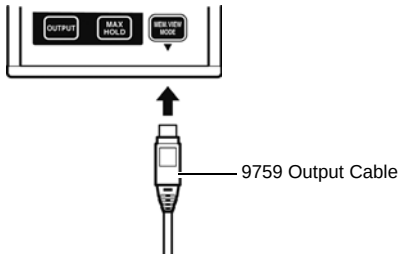
NOTE

- The output may become unstable during switching of measurement modes or ranges.
- The extremely high amplification of output during measurements in low ranges makes noise inherent to the device more noticeable. Select an appropriate range on an oscilloscope before viewing the waveform output.
  (Example: in the lowest magnetic flux density mode (r0) a waveform of 0.1 µT is converted to a 10 mV output. Then set the oscilloscope to a range appropriate for 50 mV/div measurements)
  During the output of waveform and resultant RMS values, the auto range is canceled, and the range is fixed in the selected range.
- Output of waveform and resultant RMS values cancels the auto range and the tester is locked in the selected range.
- Use a high input impedance connection to connect the tester to an oscilloscope.
- Checking saved data during output turns off output.

Output waveforms and resultant RMS values according to the steps below.

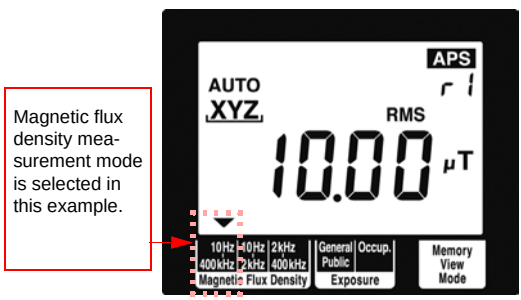


1. Push the 9759 Output Cable all the way into the 3470 output terminal.

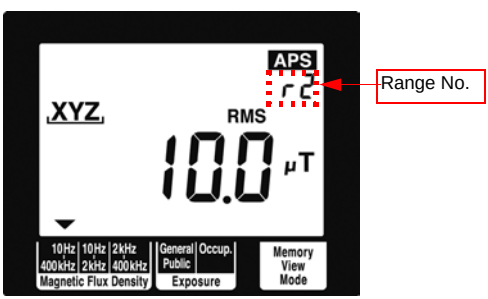


2. Insert the output cable plug in the oscilloscope , recorder, or etc. connector.

3. Press MEAS. MODE and select a measurement mode.



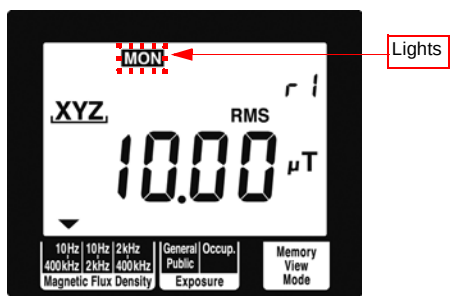
4. Press RANGE to confirm measurement range selection.



Mode	Range No.	Range	Waveform output/ resultant RMS value output
Magnetic flux density	r0	2 µT/20 mG/1.6 A/m	100 mV/µT
	r1	20 µT/200 mG/16 A/m	10 mV/µT
	r2	200 µT/2 G/160 A/m	1 mV/µT
	r3	2 mT/20 G/1600 A/m	100 mV/mT
Exposure level	r0	20%	10 mV/%
	r1	200%	1 mV/%
	r2	2000%	0.1 mV/%

Magnetic flux density switching is performed by converting from T (Tesla).
For this reason, for example, 1.592 A/m is the maximum indicated value in the 1.6 A/m range.

5. Pressing OUTPUT enables output and automatically cancels auto power off (APS goes off)



(During waveform output)

6. Each press of the OUTPUT, changes the display as follows: Output OFF → Waveform (MON lights) → Resultant RMS value (**REC** lights) → OFF
(resultant RMS values are output via the X-axis.)

(During resultant RMS value output)

This completes output of waveforms and resultant RMS values.

Specifications 7

7.1 3470 Magnetic Field HiTester

This specification applies the 3470 Magnetic Field HiTester tester.
The 3471 or 3472 Magnetic Field Sensor is attached to the 3470.

7.1.1 Basic Specifications

Measurement accuracy will be maintained when the tester and sensor are used in the environment where the temperature is 23°C±5°C, and humidity is 80% RH or less and no condensation.

1. Measurement mode	
Magnetic flux density	10Hz to 400kHz / 10Hz to 2kHz / 2kHz to 400kHz
Exposure level	General Public/Occupational (Exposure level is here defined as the time domain evaluation introduced in EN50366 and IEC62233 applied to the magnetic flux density indicated in the ICNIRP1998 Guidelines.)

2. Measurement range

Range No.	r0	r1	r2	r3	
Magnetic flux density	2.000 µT	20.00 µT	200.0 µT	2.000 mT	At single axis
Exposure level	20.00%	200.0%	2000%	–	

Range switching: auto/manual

3. Indication	
Display	LCD display
Digital indication	2000 count for single axis and 3464 count for resultant value R (This must be less than a count of 2000 for x, y and z axes.)
Indicated axes	x, y, z, R
Magnetic flux density units	T
Exposure level unit	%
Switching magnetic flux density	G ($1T=10^4G$), A/m ($1A/m=4\pi\times10^{-7}T$ as magnetic permeability of air: $4\pi\times10^{-7}$ H/m)
Battery low warning	B icon lights (measurement accuracy is not guaranteed when this icon is on)
Maximum value hold indication	MAX
Auto power off enabled indication	APS

Display update rate approx. 250 ms (slow function off)/ approx. 2 s (slow function on)

4. Measurement Item

Measured axes x, y, z

Measurement method True RMS

Maximum display value

Measurement item	Measurement mode	Maximum display value	Remarks
x,y,z	Magnetic flux density mode	2.000 mT	
	Exposure level mode	2000%	
R	Magnetic flux density mode	3.464 mT	When x, y and z are 2.000 mT
	Exposure level mode	3464%	When x, y and z are 2000%

Combined indication accuracy

±3.5%rdg.±0.5%f.s

When the tester is combined with a 3471 or 3472 Magnetic Field Sensor with the same matching number.

Measurement item	Measurement mode	Prescribed accuracy range	f.s.	Remarks
x,y,z	Magnetic flux density mode	0.050 µT to 2 mT	2000 count	Specified at 50 counts or more of the range
	Exposure level mode	0.50% to 2000%		
R	Magnetic flux density mode	0.100 µT to 3.464 mT	3464 count	Specified at 100 counts of the range and where x, y and z inputs are all 2000 counts or less.
	Exposure level mode	1.00% to 3464%		

However, the following describes magnetic flux density mode range r0 (10 Hz to 400 kHz and 10 Hz to 2 kHz) for the 3472 magnetic field sensor.

Measurement item	Measurement mode	Prescribed accuracy range	f.s.	Remarks
x,y,z	Magnetic flux density mode (10 Hz to 400 kHz, 10 Hz to 2 kHz)	0.200 µT to 2.000 µT	2000 count	Specified at 200 counts or more of the range r0.
R		0.400 µT to 3.464 µT	3464 count	Specified at 400 counts or more of the range and where x, y and z inputs are all 2000 counts or less.

Prescribed accuracy range (frequency)

Measurement mode	Prescribed accuracy range (frequency)
Magnetic flux density mode (10Hz to 400kHz)	50Hz to 120kHz
Magnetic flux density mode (10Hz to 2kHz)	50Hz to 1kHz
Magnetic flux density mode (2kHz to 400kHz)	5kHz to 120kHz
Exposure level mode (General Public)	Defined by 50 Hz and 10 kHz for the 10 Hz to 400 kHz band specified by ICNIRP 1998. (Corner frequencies correspond to smoothed edges in IEC62233 and differ from ICNIRP1998 by at most 3 dB±1 dB.)
Exposure level mode (Occup.)	

Crest factor	3 or less (But exposure level (occupational) for r1 and r2 is 1.45 or less.)

Noise level (reference value)

Magnetic flux density mode (10 Hz to 400 kHz), resultant R

3471 Magnetic Field Sensor	0.050 µT
3472 Magnetic Field Sensor	0.150 µT

Effect of exposure to power-frequency fields

In a 20 kV/m, 60 Hz field at resultant value R

Measurement mode	Magnetic flux density mode (10Hz to 400kHz)	Exposure level mode (General Public)
3471 Magnetic Field Sensor	0.02 µT or less	0.1 % or less
3472 Magnetic Field Sensor	0.15 µT or less	0.6 % or less

Effect of tester on magnetic field

With magnetic sensor directly connected to the tester and at resultant value R

3471 Magnetic Field Sensor	±1.5%rdg. or less
3472 Magnetic Field Sensor	±2.5%rdg. or less

RMS integral time	Approx. 0.12 s (slow function off)/approx. 1 s (slow function on)

5. Output

Output mode	Magnetic flux density (T or G, and A/m indication are T converted values) or Exposure level (%)
Output voltage rate	200 mV/f.s.(f.s. for single axis of each range)
Output type	3-axis waveform output, resultant RMS output
Output accuracy	Display accuracy ±2 mV

7.1.2 General Specifications

Interface	USB 1.1
Memory function	Records up to 99 measurements
Auto power off	10.5 min after last operation, buzzer warning before shutdown/wait period can be extended/function can be cancelled after activation
Buzzer sound	Can be turned on/off
Temperature characteristics	0.1 x accuracy specification/°C at 0 to 40°C
Place of use	Indoors, up to an altitude of 2000 m

Storage temperature and humidity	-10°C to 50°C, 80% RH or less (no condensation)
Operating temperature and humidity	0°C to 40°C, 80% RH or less (no condensation)
Period of guaranteed accuracy	1 year
Power supply	Four LR6 alkaline battery 1.5V or 9445-02 AC Adapter (SA110C-09S-I, SINO-AMERICAN) Rated power supply voltage: 100 VAC to 240 VAC, Rated power supply frequency: 50 Hz/ 60 Hz (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.)
Battery life	Approx. 10 hours (with sensor connected, continuous, low load operation)
Rated power consumption	1.0 VA (AC adapter), 0.8 VA (Battery)
External dimensions	Approx 100 × 150 × 42 mm (3.94”W × 5.91”H × 1.65”D) (not including protrusions)
Weight	Approx 870 g (30.7 oz) (batteries included)
Standards Applying	Safety EN61010 Pollution degree 2 EMC EN61326 EN61000-3-2 EN61000-3-3
Accessories	Instruction manual .....1 CD (PC application software) .....1 USB cable .....1 LR6 alkaline battery.....1 Carrying Case 1
3470-01 Magnetic Field HiTester Packing contents	3470 Magnetic Field HiTester.....1 3471 Magnetic Field Sensor(3-axis 100 cm^2 sensor) .....1 9445-02 AC Adapter (SA110C-09S-I, SINO-AMERICAN) .....1, or 9445-03 AC Adapter (SA110C-09GS-I, SINO-AMERICAN) (EU) 1
3470-02Magnetic Field HiTester Packing contents	3470 Magnetic Field HiTester.....1 3471 Magnetic Field Sensor(3-axis 100 cm^2 sensor) .....1 3472 Magnetic Field Sensor(3-axis 3 cm^2 sensor) .....1 9445-02 AC Adapter (SA110C-09S-I, SINO-AMERICAN) .....1, or 9445-03 AC Adapter (SA110C-09GS-I, SINO-AMERICAN) (EU) 1 9758 Extention Cable.....1 9759 Output Cable 1
Options	9445-02 AC Adapter (SA110C-09S-I, SINO-AMERICAN) 9445-03 AC Adapter (SA110C-09GS-I, SINO-AMERICAN) (EU) 9758 Extention Cable 9759 Output Cable

7.1.3 Application Software

Supported operating system	Windows 98, Me, 2000, XP
Language	English or Japanese
Function	Effective value logger, Entire read, Configuration
Maximum number of data handled	32000 data (Effective value logger), 99 data (Entire read)
Recording method	CSV format

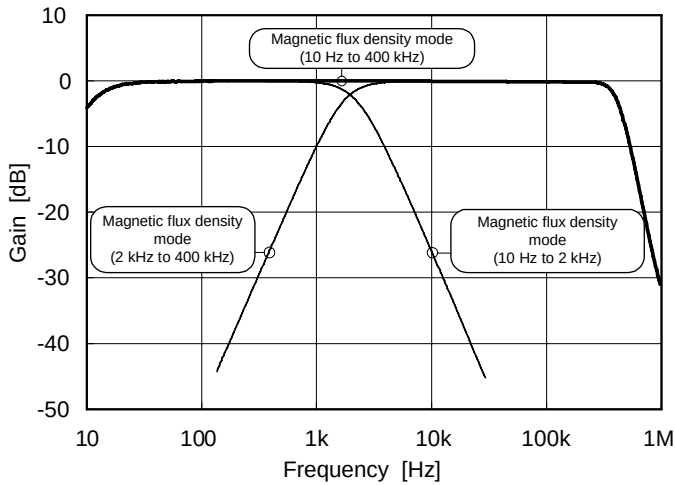
7.1.4 Equations and Functions

Equations

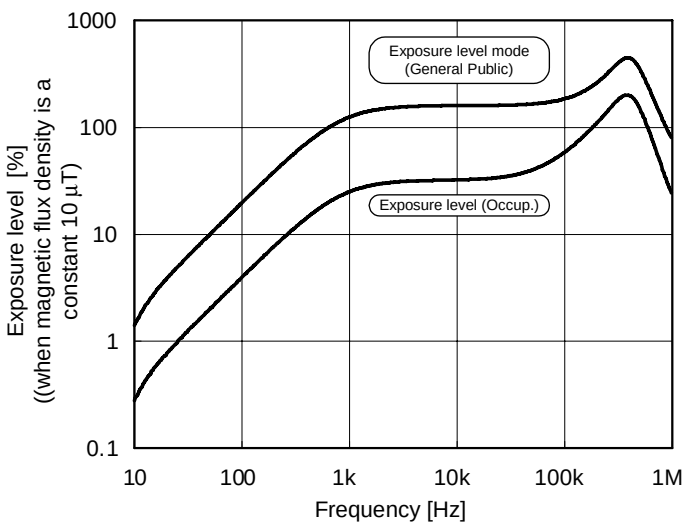
Function	Item	Symbol	Equation	
			Continuous	Discrete
Waveform output	Instantaneous value for each axis at time t	$x(t)$	-	-
		$y(t)$	-	-
		$z(t)$	-	-
-	Resultant value at time t	$R(t)$	$\sqrt{\{x(t)\}^2+\{y(t)\}^2+\{z(t)\}^2}$	-
LCD display (effective value logger)	RMS value for each axis at time t (Integral time = T, interval [t - T, t])	$\hat{x}(t)$	$\sqrt{\frac{1}{T}\int_{t-T}^{t}\{x(t)\}^2\,dt}$	Where RMS value per Δt interval is $\hat{x}_n\ (1\le n\le N, N\Delta t=T)$, $\sqrt{\frac{1}{N}\sum_{n=1}^{N}\hat{x}_n^{\,2}}$
		$\hat{y}(t)$	$\sqrt{\frac{1}{T}\int_{t-T}^{t}\{y(t)\}^2\,dt}$	Where RMS value per Δt interval is $\hat{y}_n\ (1\le n\le N, N\Delta t=T)$, $\sqrt{\frac{1}{N}\sum_{n=1}^{N}\hat{y}_n^{\,2}}$
		$\hat{z}(t)$	$\sqrt{\frac{1}{T}\int_{t-T}^{t}\{z(t)\}^2\,dt}$	Where RMS value per Δt interval is $\hat{z}_n\ (1\le n\le N, N\Delta t=T)$, $\sqrt{\frac{1}{N}\sum_{n=1}^{N}\hat{z}_n^{\,2}}$
LCD display resultant RMS output (effective value logger)	Resultant RMS value (Integral time = T, interval [t - T, t])	$\hat{R}(t)$	$\sqrt{\{\hat{x}(t)\}^2+\{\hat{y}(t)\}^2+\{\hat{z}(t)\}^2}$	$\sqrt{\{\hat{x}(t)\}^2+\{\hat{y}(t)\}^2+\{\hat{z}(t)\}^2}$

- *x*, *y* and *z* in the table can be used to represent both magnetic flux density and exposure values.
- 1 G=1×10^{-4} T, 1 A/m=4π×10^{-7} T (magnetic permeability of air: 4π×10^{-7} H/m)
- Actual RMS values are calculated using a discrete algorithm.

Example of characteristics when tester is used with a sensor
(magnetic flux density mode)



Example of characteristics when tester is used with a sensor
(exposure level mode)

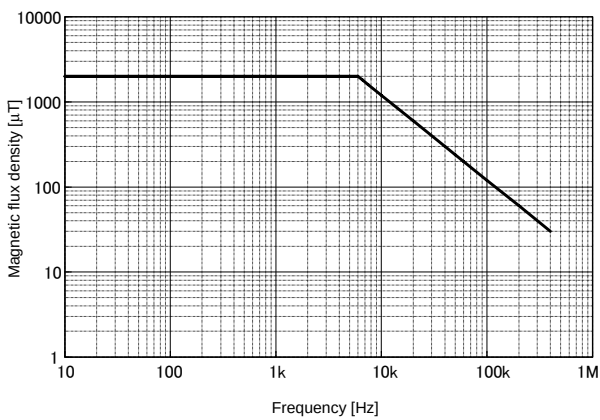


7.2 3471 Magnetic Field Sensor

Specifications

	Accuracy at 23°C±5°C, 80% RH or less (no condensation)
Sensor cross-sectional area	100 cm^2
Rated magnetic flux density	2 mT at a single axis (There is a derating characteristics dependent on frequency)
Frequency characteristics	10 Hz to 400 kHz
Measured axes	x, y, z
Place of use	Indoors, up to an altitude of 2000 m
Storage temperature and humidity	-10°C to 50°C, 80% RH or less (no condensation)
Operating temperature and humidity	0°C to 40°C, 80% RH or less (no condensation)
Period of guaranteed accuracy	1 year
External dimensions	Approx. $\phi 122 \times 295$ (L) mm
Weight	Approx. 220 g (7.8 oz)
Application Standard	Safety EN61010 Pollution degree 2 EMC EN61326

Frequency-dependent derating characteristics



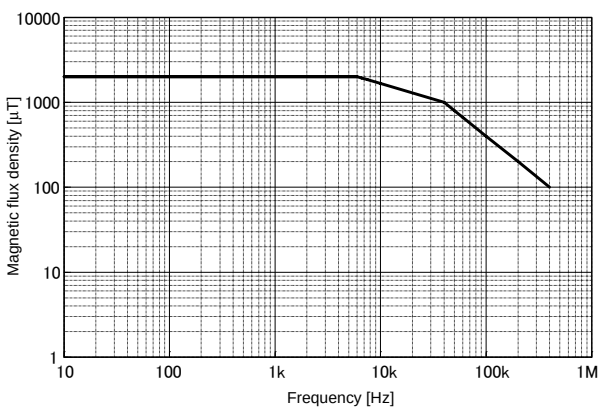
7.3 3472 Magnetic Field Sensor

Specifications

Accuracy at 23°C±5°C, 80% RH or less (no condensation)

Sensor cross-sectional area	3 cm^2
Rated magnetic flux density	2 mT at a single axis (There is a derating characteristics dependent on frequency)
Frequency characteristics	10 Hz to 400 kHz
Measured axes	x, y, z
Place of use	Indoors, up to an altitude of 2000 m
Storage temperature and humidity	-10°C to 50°C, 80% RH or less (no condensation)
Operating temperature and humidity	0°C to 40°C, 80% RH or less (no condensation)
Period of guaranteed accuracy	1 year
External dimensions	Approx. □27 × 165 (L) mm
Weight	Approx. 105 g (3.7 oz)
Application Standard	Safety EN61010 Pollution degree 2 EMC EN61326

Frequency-dependent derating characteristics



Maintenance and Service 8

8.1 Troubleshooting

If damage is suspected, check the "Before returning for repair" section before contacting your dealer or Hioki representative.

Before returning for repair

Symptom	Check	Remedy
Tester does not go on.	• Check whether batteries have been inserted. • Check if battery power is low. • Check whether batteries are properly inserted.	• Replace batteries with new ones. • Insert batteries properly.
Power turns off during use*		
B goes on.	-	Replace batteries with new ones.
Power turns off soon after B goes on		

*: When auto power off is on (APS lights), the tester will shut down 10 minutes after the last key was pressed

❖4.4.1 "Setting Auto Power Off (Saving Battery Power)" (P.62)

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.

8.2 Error Indication

If any of error indications E.001 to E.005 appear on the display, the tester requires repair and should be returned to the dealer or local service station.

Error number	Description	Remedy
E.001	Microprocessor ROM checksum error	Requires repair.
E.002	Microprocessor RAM R/W error	
E.003	Memory checksum error	
E.004	Model name error	
E.005	Memory R/W error	

8.3 Version Display

In order to display the version of the 3470, hold down AXIS while powering up. The version will be displayed after the model name (3470).

8.4 Cleaning

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

8.5 Service

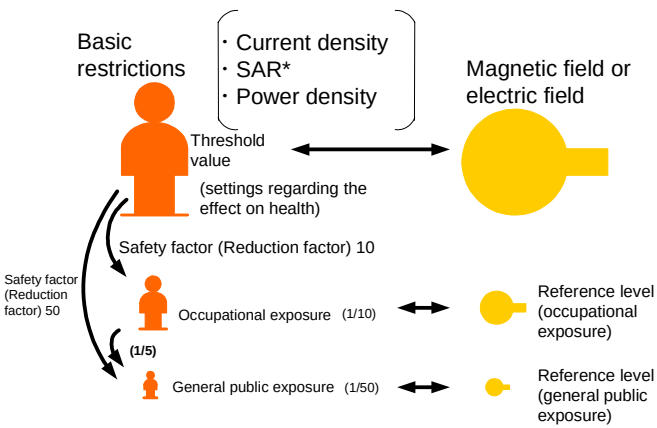
- Since the tester must be calibrated together with the sensor, send in both the tester and the sensor when re-calibration is required.
- Since the tester must be calibrated together with the sensor, the tester must be returned when a sensor requires repair or when other sensors are purchased to enable calibration with the repaired (or new) sensor.

Appendix

Appendix 1 ICNIRP Guideline (Basic Restrictions)

The exposure levels set for this tester are based on the ICNIRP (International Commission on Non-Ionizing Radiation Protection) Guidelines.

Basic restrictions apply to current density, SAR and power density. Threshold values have been set on the levels of these physical quantities that affect human health (for example, headaches). Occupational exposure level is 1/10 and general public exposure level is 1/50 of this threshold value. (See figure below.)
The ICNIRP Guidelines provide reference levels - for assessing the basic restrictions - that state the magnetic field and electric field levels when the coupling of the human body, magnetic field and electric field are at maximum (coupling factor 1).

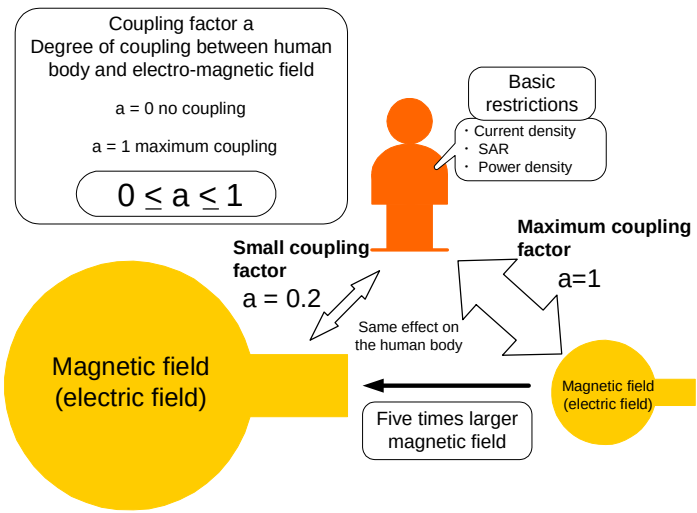


*: Specific energy absorption rate

As can be inferred from the above, there is a margin, a safety factor (reduction factor) between the exposure level measured by this tester and the threshold values in the basic restrictions. Thus an exposure level of 100% measured by this tester does not mean to affect the human body.

Appendix 2 Coupling Factor in the ICNIRP Guidelines

The degree of coupling (coupling factor) of the human body and a magnetic field changes the effect on the human body.
Coupling factor a is 0 ≤a ≤ 1, where 0 is no coupling and 1 is maximum coupling. The greater the coupling factor the greater the effect the magnetic field has on the human body. (See figure below.)

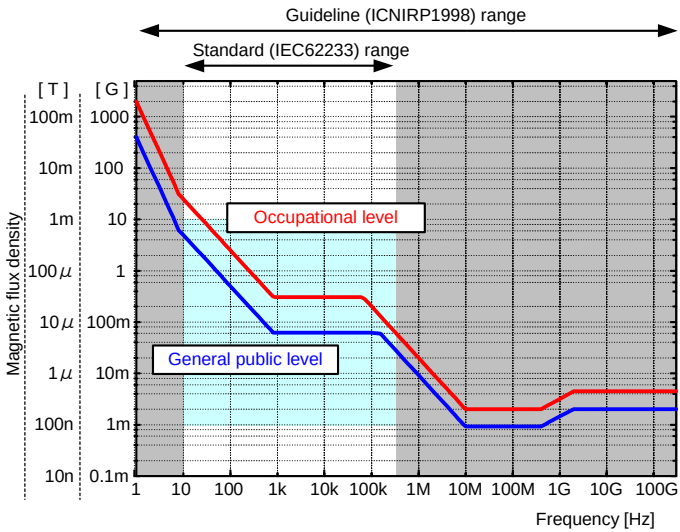


The ICNIRP reference level represents a coupling factor of 1.

Consequently, although the tester tells us the ratio of a measurement to the ICNIRP reference level, it cannot measure the coupling factor and therefore does not indicate the direct effect on the human body.

Appendix 3 Graph Showing the Range of ICNIRP 1998 Guidelines

The graph below shows the range of the ICNIRP 1998 guidelines.



HIOKI

DECLARATION OF CONFORMITY

Manufacturer's Name:	HIOKI E.E. CORPORATION
Manufacturer's Address:	81 Koizumi, Ueda, Nagano 386-1192, Japan
Product Name:	MAGNETIC FIELD HiTESTER
Model Number:	3470
Accessories:	3471 MAGNETIC FIELD SENSOR 3472 MAGNETIC FIELD SENSOR
Options:	9445-03 AC ADAPTER (SA110C-09GS-I, SINO-AMERICAN) 9758 EXTENSION CABLE 9759 OUTPUT CABLE

The above mentioned products conform to the following product specifications:

Safety:	EN61010-1:2001
EMC:	EN61326-1:2006 Class B equipment Basic Immunity test requirement EN61000-3-2:2006 EN61000-3-3:1995+A1:2001+A2:2005

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC.

HIOKI E.E. CORPORATION

22 December 2008

Atsushi Mizuno

Director of Quality Assurance

3470A999-02

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Edited and published by Hioki E.E. Corporation
Technical Support Section

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