

MR8875

HIOKI

MR8875-30

Instruction Manual

MEMORY HiCORDER



Video

Scan this code to watch the instructional video(s).
Carrier charges may apply.



 Be sure to read this manual before using the instrument.	▶ p.4
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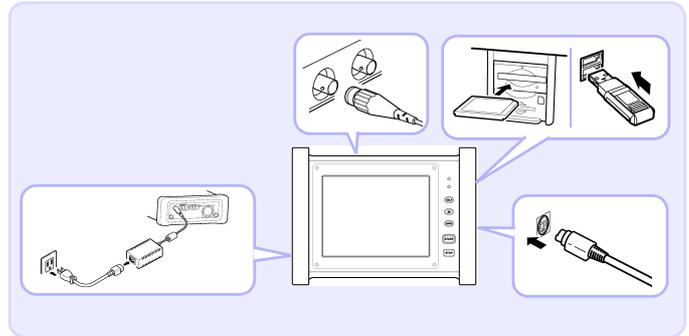
Index Index i

Basic Measurement Process

1 Install & Connect (p. 27)

Install the instrument
Insert the media
Connect the cords
Turn power on

Be sure to read "Operating Precautions" (p. 7) before using the instrument.



2 Configure (p. 51)

Setting measurement configuration
Configure input channels

- Measure using automatic settings (p. 82)
- Record variations in input signals (p. 171)
- Apply a trigger manually (forced trigger) (p. 187)
- Add comments (p. 142)
- Freely configure the way waveforms are displayed (p. 66)
- Copy settings to another channel (p. 163)
- Disable operation (key lock) (p. 84)
- Initialize media (p. 39)
- Convert and display measured values (p. 150)

3 Measure (p. 80)

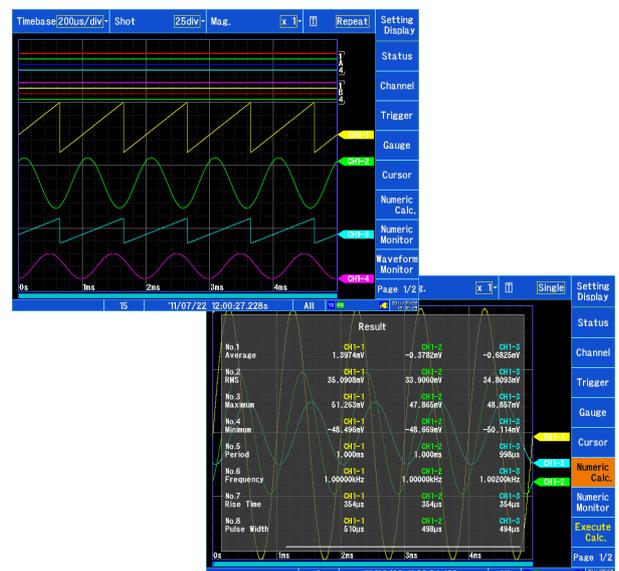
Start recording
Stop recording

4 Analyze (p. 111) and Save (p. 87)

Analysis
Optionally save

5 Finish (p. 44)

Turn the power off



Introduction

Thank you for purchasing the Hioki Model MR8875, MR8875-30 Memory HiCorder. To obtain maximum performance from the instrument, please read this manual carefully, and keep it handy for future reference.

The MR8875-30 can display data in English and Chinese.



The latest edition of the instruction manual
The contents of this manual are subject to change, for example as a result of product improvements or changes to specifications.
The latest edition can be downloaded from Hioki's website.
<https://www.hioki.com/global/support/download>



Product registration
Register your product in order to receive important product information.
<https://www.hioki.com/global/support/myhioki/registration>

An optional clamp-on probe (p. A 19) is required for current measurement with the Memory HiCorder. In this manual, all models of these probes are collectively referred to as "clamp sensors." For details, refer to the instruction manual of the particular clamp sensor to be used.

The following documents are provided with this instrument. Refer to them as appropriate for your application.

1 Measurement Guide	Offers an introduction to the Memory HiCorder's basic measuring method for first time users.
2 Instruction Manual (This document)	Contains explanation and instructions regarding the instrument's operating method and functions.

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Confirming Package Contents

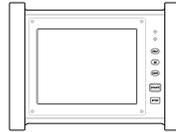
When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

Confirm that these contents are provided. (One each)

- MR8875, MR8875-30 Memory Hi-Corder

Accessories

- Instruction Manual
- Measurement Guide
- Application CD
(Waveform Viewer Wv (p. 321), communication commands, MR8904 instruction manual, MR8904 CAN Editor [CAN configuration software for the MR8904])
The latest version can be downloaded from our web site.



- Model Z1002 AC Adapter
(with supplied power cord) (p. 40)
- USB Cable (p. 313)
- Strap (p. 47)
- Protection sheet (p. 49)

Other options specified when ordered:
"Appendix 4 Options" (p. A19)

Note: When the MR8902 Voltage/TEMP Unit ships with the instrument, two ferrite clamps are included with each module.

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. Using the instrument in a way not described in this manual may negate the provided safety features.

Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

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

Safety Symbols

	In the manual, the  symbol indicates particularly important information that the user should read before using the instrument.
	The  symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the  symbol) before using the relevant function.
	Indicates DC (Direct Current).
	Indicates a grounding terminal.
	Indicates the ON side of the power switch.
	Indicates the OFF side of the power switch.

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

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

Symbols for Various Standards

	Indicates that the product conforms to regulations set out by the EU Directive.
 Ni-MH	This is a recycle mark established under the Resource Recycling Promotion Law (only for Japan).
	WEEE marking: This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).

Other Symbols

	Indicates the prohibited action.
(p.)	Indicates the location of reference information.
	Indicates quick references for operation and remedies for troubleshooting.
*	Indicates that descriptive information is provided below.
[]	Names of settings, buttons, and other screen elements are enclosed in brackets.
HELP	Bold characters within the text indicate operating key labels.
(Bold characters)	
Unless otherwise specified, "Windows" represents Windows XP, Windows Vista, Windows 7, Windows 8 or Windows 10.	
Click: Press and quickly release the left button of the mouse.	
Double click: Quickly click the left button of the mouse twice.	

Accuracy

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

	(maximum display value or scale length) The maximum displayable value or scale length.
f.s.	In this instrument, the maximum displayable value is the range (V/div) times the number of divisions (20) on the vertical axis. Example: For the 1 V/div range, f.s. = 20 V
rdg.	(reading or displayed value) The value currently being measured and indicated on the measuring instrument.
dgt.	(resolution) The smallest displayable unit on a digital measuring instrument, i.e., the input value that causes the digital display to show a "1" as the least-significant digit.

In this document, the terms "master" and "slave" used in the earlier editions have been replaced with "primary" and "secondary," respectively.

6

Safety Information

Measurement categories

The measurement category with which the instrument complies depends on which input modules are being used.

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

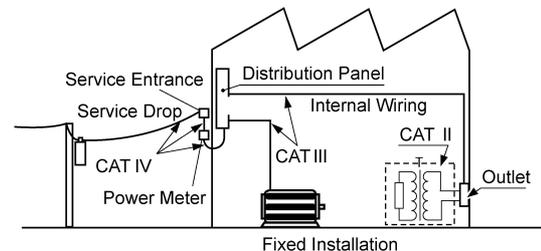
CAT II : Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.) CAT II covers directly measuring electrical outlet receptacles.

CAT III: Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets.

CAT IV: The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).

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

Use of a measurement instrument that is not CAT-rated in CAT II to CAT IV measurement applications could result in a severe accident, and must be carefully avoided.



NOTE The measurement category with which the instrument complies varies with the input module being used.
See: "Chapter 14 Specifications" (p. 331)

Operating Precautions



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

Before Use

Before using the instrument for the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.



WARNING

Before using the instrument, make sure that the insulation on the connection cords and connection cords is undamaged and that no bare conductors are improperly exposed. Using the instrument in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.

Instrument Installation

Operating temperature and humidity

Temperature -10°C to 50°C

Humidity -10°C to 40°C at 80% RH or less (non-condensing)
40°C to 45°C at 60% RH or less (non-condensing)
45°C to 50°C at 50% RH or less (non-condensing)

- When powering the instrument with the Z1003 Battery Pack: 0°C to 40°C at 80% RH or less (non-condensing)
- When charging the Z1003 Battery Pack: 10°C to 40°C at 80% RH or less (non-condensing)
- Temperature and humidity range for guaranteed accuracy: 23±5°C at 80% RH or less (non-condensing)

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



Exposed to direct sunlight
Exposed to high temperature



In the presence of corrosive or explosive gases



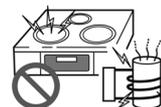
Exposed to water, oil, other chemicals, or solvents
Exposed to high humidity or condensation



Exposed to strong electromagnetic fields
Near electromagnetic radiators



Exposed to high levels of particulate dust



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



Subject to vibration

Installing

- Do not block the air vents (leave at least 5 cm of space on the left and right of the instrument).
- When using the MR8902 Voltage/TEMP Unit, allow the instrument to sit for at least 30 minutes before starting measurement after moving it to a location with a significant temperature variation.

Handling the Instrument**⚠ DANGER**

- Do not allow the instrument to get wet, and do not take measurements with wet hands. This may cause an electric shock.
- To avoid electric shock, do not remove the instrument's case. The internal components of the instrument carry high voltages and may become very hot during operation.

⚠ WARNING

- Do not attempt to modify, disassemble or repair the instrument; as fire, electric shock and injury could result.
- Avoid obstructing the ventilation holes on the sides of the instrument, as it could overheat and be damaged, or cause a fire.

⚠ CAUTION

- To avoid damage to the instrument, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.
- Before transporting the instrument, disconnect all cables and remove any SD memory card, USB flash drive and recording paper.
- Do not slant the device or place it on top of an uneven surface. Dropping or knocking down the device can cause injury or damage to the device.
- The instrument's operating temperature range is -10°C to 50°C. Do not use it outside this range.
- This instrument may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

NOTE

Correct measurement may be impossible in the presence of strong magnetic fields, such as near transformers and high-current conductors, or in the presence of strong electromagnetic fields such as near radio transmitters.

Touch panel**⚠ CAUTION**

- Use only a touch pen (with a radius of at least 0.8 mm) with a polyacetal resin tip or a finger with the touch screen. In particular, do not use objects with hard or sharp tips (ball-point pens, mechanical pencils, etc.) with the screen. Doing so may damage the screen. This product does not ship with a touch pen. If you intend to use a commercially available touch pen, purchase one with a tip made of polyacetal resin (and a radius of at least 0.8 mm).
- Exercise care to prevent sand, dirt, or other substances from adhering to the touch panel. Use a soft cloth or similar material to wipe the touch panel's screen. Using the screen while it is dirty may damage the touch panel.
- Do not use the touch panel while there is condensation on it. Doing so may damage the touch panel.

NOTE

The touch panel may not operate properly under the following circumstances, even when touched. Additionally, exercise caution concerning these conditions as they may cause the touch panel to malfunction.

- When a foreign object has been placed on the operating surface
 - When using your finger pad or another wide surface to operate it
-

Handling the Probes

⚠ WARNING To avoid electric shock, do not exceed the lower of the ratings shown on the instrument and connecting cords.

⚠ CAUTION

- Avoid stepping on or pinching cables, which could damage the cable insulation.
- To avoid breaking the cables, do not bend or pull them.
- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.
- When disconnecting the BNC connector, be sure to release the lock before pulling off the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable, can damage the connector.
- To prevent an electric shock accident, confirm that the white or red portion (insulation layer) inside the cable is not exposed. If a color inside the cable is exposed, do not use the cable.

NOTE

- Use only the specified connection cords. Using a non-specified cable may result in incorrect measurements due to poor connection or other reasons.
- Before using a clamp sensor or logic probe, read the instruction manual supplied with it.

Using the AC Adapter

⚠ WARNING

- Use only the supplied Model Z1002 AC Adapter. AC adapter input voltage range is 100 to 240 VAC (with $\pm 10\%$ stability) at 50 Hz/60 Hz. To avoid electrical hazards and damage to the instrument, do not apply voltage outside of this range.
- Before connecting to a power supply, make sure the supply voltage matches that indicated on the AC adapter. Connection to an improper supply voltage may damage the instrument or AC adapter and present an electrical hazard.
- Turn the instrument off before connecting the AC adapter to the instrument and to AC power.
- To avoid electrical accidents and to maintain the safety specifications of this instrument, connect the power cord only to a 3-contact (two-conductor + ground) outlet.

⚠ CAUTION

- If you wish to use a UPS (uninterruptible power supply) or DC-AC inverter to power the instrument, do not use a UPS or DC-AC inverter with square wave or pseudo sine wave output. Doing so may damage the instrument.
- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.

NOTE

- After use, always turn OFF the power.
- Brief power interruptions of 40 ms or less will not cause this instrument to malfunction. However, Longer interruptions may cause the Memory HiCorder to shut itself off, so consider local power conditions before installing, as appropriate.
- To ensure that recording is not interrupted by power outages, you can use the Z1002 AC Adapter and Z1003 Battery Pack together.

Battery Pack (Option)**⚠ WARNING**

Be sure to observe the following precautions. Incorrect handling may result in liquid leaks, heat generation, ignition, bursting and other hazards.

- For the battery pack, use the optional Z1003 Battery Pack. We do not take any responsibility for accidents or damage related to the use of any other batteries.
- To avoid the possibility of explosion, do not short circuit, disassemble or incinerate battery pack.
- When storing the instrument, make sure no objects that could short-circuit the connectors are placed near them.
- The battery pack contains lye, which may cause blindness if it comes into contact with the eyes. Should battery liquid get into your eyes, avoid rubbing them. Flush them with water and seek immediate medical attention.
- To avoid electric shock, turn off the power switch and disconnect the cables before replacing the battery pack.
- After installing or replacing the battery pack, replace the battery compartment cover and screws.
- Handle and dispose of battery pack in accordance with local regulations.

⚠ CAUTION

Observe the following to avoid damage to the instrument.

- Use the battery pack in an ambient temperature range of 0 to 40°C and charge it in an ambient temperature range of 10 to 40°C.
- If the battery pack fails to finish charging within the stipulated time, disconnect the AC adapter to stop charging and contact your dealer or Hioki representative.
- Consult your dealer or nearest service station should liquid leaks, strange odor, heat, discoloration, deformation and other abnormal conditions occur during use, charging or storage. Should these conditions occur during use or charging, turn off and disconnect the instrument immediately.
- Do not expose the instrument to water and do not use it in excessively humid locations or locations exposed to rain.
- Do not expose the instrument to strong impacts and do not throw it around.

NOTE

- The battery pack is a consumable. If you are able to use the instrument for only a limited period of time despite the battery pack being properly charged, the battery pack's service life is at an end, and it should be replaced.
 - When a battery pack that has not been used for a long time is used, charging may end before the battery pack is fully charged. In such a case, repeat charging and discharging a number of time before use. (A battery pack may also be in such a state immediately after purchase.)
 - The life of the battery pack (when capacity is 60% or more of initial capacity) is approximately 500 charge-discharge cycles. (The life differs depending on the conditions of use.)
 - To prevent battery pack deterioration when the battery will not be used for 1 month or longer, remove it and store it in a dry location with an ambient temperature range of between -20 to 30°C. Be sure to discharge and charge it every two months. Long-term storage at low battery capacity will reduce performance.
 - When a battery pack is used, the instrument turns off automatically when the capacity drops. Leaving the instrument in this state for a long time may lead to over discharge so be sure to turn off the power switch on the instrument.
 - The charging efficiency of the battery pack deteriorates at high and low temperatures.
-

Input Module

WARNING Preparations

- To avoid electric shock accident, before removing or replacing an input module, confirm that the instrument is turned off and that the connection cords are disconnected.
- The mounting screws must be firmly tightened or the input module may not perform to specifications, or may even fail.

When an input module is not used

- To avoid the danger of electric shock, never operate the instrument with an input module removed. To use the instrument after removing an input module, install a blank panel over the opening of the removed module.

CAUTION

- To avoid damaging input modules, do not touch the input module connectors on this instrument.
- Measurements made without a blank panel installed may fail to meet specifications because of temperature instability within the instrument.
- When carrying the instrument with the MR8902 Voltage/TEMP Unit installed, remove the MR8902's terminal block before transporting the instrument.

Connecting to the BNC jacks on input modules

- When disconnecting the BNC connector, be sure to release the lock before pulling off the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable, can damage the connector.

Connecting to the Terminals

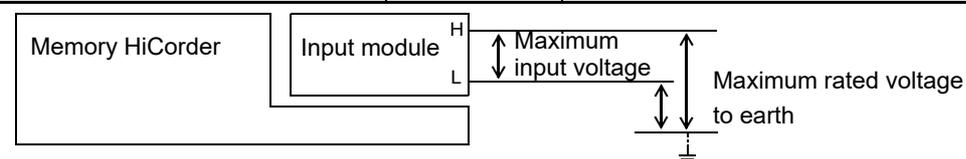
Connecting to the Analog Input Terminals



DANGER Note the following maximum input voltage and maximum rated voltage to earth. The following tables list the maximum input voltage and the maximum rated voltage to earth for connection cords. To avoid electric shock and instrument damage, do not input voltages in excess of these figures. The lower of the instrument's and the connection cord's maximum input voltages applies.

When these voltage levels are exceeded, the instrument will be damaged. Do not make measurements as doing so may result in bodily injury. The maximum rated voltage to earth does not change, even if you make measurements with an attenuator or other component connected to the input. Consider your connection method and do not exceed the maximum rated voltage to earth.

Input Modules	Maximum input voltage	Maximum rated voltage to earth
Model MR8901 Analog Unit	150 VDC	100 V AC/DC (CAT II)
Model MR8902 Voltage/TEMP Unit	100 VDC	100 V AC/DC (CAT II)
Model MR8903 Strain Unit	10 VDC	30 V rms/ 60 VDC
Model MR8905 Analog Unit	1000 VDC	1000 V AC/DC (CAT II) 600 V AC/DC (CAT III)
Measurement cables	Maximum input voltage	Maximum rated voltage to earth
Model L9197 Connection Cord	600 VAC/DC	600 V AC/DC (CAT III)
Model 9197 Connection Cord		300 V AC/DC (CAT IV)
Model L9198 Connection Cord	300 VAC/DC	600 V AC/DC (CAT II)
Model L9217 Connection Cord		300 V AC/DC (CAT III)
Model L9790 Connection Cord	600 VAC/DC	When using the 9790-03 Contact Pin and L9790-01 Alligator Clip 600 V AC/DC (CAT III) When using the 9790-02 Grabber Clip 300 V AC/DC (CAT II) 150 V AC/DC (CAT III)
Model 9322 Differential Probe	2000 VDC, 1000 VAC	When using the grabber clip 1500 V AC/DC (CAT II) 600 V AC/DC (CAT III) When using the alligator clip 1000 V AC/DC (CAT II) 600 V AC/DC (CAT III)
Model P9000-01 Differential Probe Model P9000-02 Differential Probe	1000 VAC/DC	1000 VAC/DC (CAT III)
Model L4940 Connection Cable	1000 VDC*	When using the L4935 Alligator Clip and L4932 Test Pin 600 V AC/DC (CAT IV) 1000 V AC/DC (CAT III) When the L9243 Grabber Clip and L4937 Magnetic Adapter is attached 1000 V AC/DC (CAT III) When using the L4934 Small Alligator Clip 300 V AC/DC (CAT III) 600 V AC/DC (CAT II)



⚠ DANGER

Connect the clamp sensors or connection cords to the instrument first, and then to the active lines to be measured. Observe the following to avoid electric shock and short circuits.

- To avoid short circuits and potentially life-threatening hazards, never attach the clamp to a circuit that operates at more than the maximum rated voltage to earth, or over bare conductors.
- Do not allow the connection cord clips to touch two wires at the same time. Never touch the edge of the metal clips.
- When the clamp sensor is opened, do not allow the metal part of the clamp to touch any exposed metal, or to short between two lines, and do not use over bare conductors.
- Do not leave the Memory HiCorder connected to test objects in environments where a voltage surge might exceed the dielectric withstand voltage. Doing so could result in damage to the Memory HiCorder, bodily injury or fatal accident.

⚠ WARNING

- Do not connect a cable to the instrument while it is connected to the object to be measured. Otherwise, an electric shock accident may occur.
- To avoid short-circuit accidents, make certain that connections are secure.

When measuring voltage**⚠ DANGER**

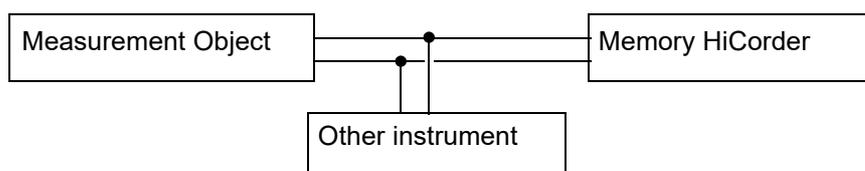
- The connection cords should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.
- When connecting clip-type test leads to live terminals, be very careful to avoid accidentally shorting conductors together and causing a serious accident.
- To prevent electrical shock and personnel injury, do not touch any input terminals on the VT (PT), CT or the instrument when they are in operation.

⚠ CAUTION

To prevent damage to the instrument and sensor, never connect or disconnect a sensor while the power is on, or while the sensor is clamped around a conductor.

NOTE

- Lay the connection cords and various cables away from the power supply line and ground wire.
- Connecting the connection cords and various cables in a parallel configuration with the inputs of another device (see the figure below) may result in variations in measurement values and incorrect operation of the instrument. When connecting with another device in a parallel configuration, be sure to verify operation.



Connecting to the logic terminals

⚠ DANGER

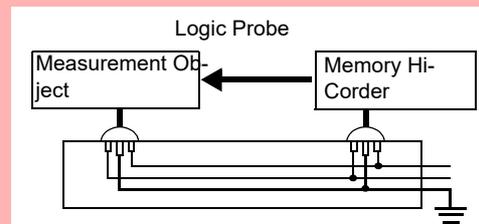
To avoid electric shock and short circuit accidents or damage to the instrument, pay attention to the following:

- Maximum logic probe input voltages are as follows. Do not measure if the maximum voltage would be exceeded, as damage the instrument or personal injury may result.

Model 9320-01: +50 VDC

Model MR9321-01: 250 V rms (HIGH range), 150 V rms (LOW range)

- The ground terminal for the 9320-01 Logic Probe is not isolated from the Memory HiCorder's ground (chassis ground). Therefore, if the measurement object connect to AC, it should have a grounded, polarized plug, and be connected to the same power outlet as the Memory HiCorder's AC adapter. If the Memory HiCorder and measurement object are connected to different mains circuits, or if an ungrounded power cord is used, the potential difference between the different grounding paths may result in current flow through a logic probe that could damage the measurement object or Memory HiCorder.



- Do not allow the metal tip of a logic probe to cause a short between conductors on the measurement object. Never touch the metal tip of a probe.

When connecting USB cable

⚠ CAUTION

- To prevent a malfunction, do not disconnect the USB cable during communication.
- The Memory HiCorder and PC should be connected to the same earth ground. If grounded separately, potential difference between the ground points can cause malfunctions or damage when connecting the USB cable.

NOTE

This instrument cannot be powered by the bus of a PC or USB hub. When using the instrument, connect the AC adapter or install batteries.

When connecting to external control terminals

For more information about the maximum input voltage for external control terminals, see "Chapter 13 External Control" (p. 323).

⚠ WARNING

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to external control terminals.

- Always turn off the power to the instrument and to any devices to be connected before making connections.
- Be careful to avoid exceeding the ratings of external control terminals.
- Ensure that devices and systems to be connected to the external control terminals are properly isolated.
- The ground of external control terminals and the ground of the instrument are common and not isolated. To prevent damage to the instrument, use a grounded power cord for the device to be connected with the external control terminals and this instrument, and supply power from the same line. Using different lines or an ungrounded power cord may result in a potential difference between the grounds depending on the wiring state, and current flowing through the wiring material may lead to damage of the measurement object or instrument.
- To prevent an electrical accident, use wiring material that has more than enough dielectric strength and current-carrying capacity.

NOTE If a cable of 3 meters or longer is connected, the instrument may be susceptible to the interference of external noise and other EMC environmental factors.

Using a SD memory card/ USB Flash Drive

Measurement data (data captured to internal buffer memory) is cleared when new measurements are started. If you want to keep any data, be sure to save it to external media.

CAUTION

- Inserting a SD memory card/USB flash drive upside down, backwards or in the wrong direction may damage the SD memory card, USB flash drive, or instrument.
- Never remove a SD memory card or USB flash drive during measurement while the instrument is accessing the SD memory card or USB flash drive. The SD memory card or USB flash drive and/or the data on it may be damaged. (During access, the **SAVE** key will turn blue.)
- Do not transport the instrument while a USB flash drive is connected. Damage could result.
- Some USB flash drives are susceptible to static electricity. Exercise care when using such products because static electricity could damage the USB flash drive or cause malfunction of the instrument.
- With some USB flash drives, the instrument may not start up if power is turned on while the USB flash drive is inserted. In such a case, turn power on first, and then insert the USB flash drive. It is recommended to try out operation with a USB flash drive before starting to use it for actual measurements.

NOTE

- The Flash memory in a SD memory card/USB flash drive has a limited operating life. After long-term usage, data storage and retrieval become difficult. In this case, replace the SD memory card/USB flash drive with a new one.
- **We cannot provide compensation for data loss in a SD memory card/USB flash drive, regardless of content or cause of the damage.** Furthermore, if a long time has elapsed since data was recorded to a file, the stored data may be lost. Always maintain a backup of important data stored on a SD memory card/USB flash drive.
- When saving or loading data, insert the media before specifying it. Failure to do so will prevent the file list from being displayed.

Observe the following to avoid corruption or loss of stored data:

- Do not touch the electrical contacts on the card or inside the insertion slot with your skin or metallic objects.
- While writing or reading data, avoid vibration or shock, and do not turn the power off or remove the card from the instrument.
- Before formatting (initializing) a card, confirm that it contains no important information (files).
- Do not bend or drop the card, or otherwise subject it to intense shock.

SD memory cards

Important

- Use only Hioki-approved SD memory cards. Proper operation is not guaranteed if other cards are used.
- Format new SD memory cards before use.

Handling 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 from the inside to the outside, and do not wipe with circular movements. Never use abrasives or solvent cleaners.
- Hioki shall not be held liable for any problems with a PC system that arises from the use of this CD, or for any problem related to the purchase of a Hioki product.

Overview

Chapter 1

1.1 Product Overview

The MR8875 is a portable recorder with a variety of measurement capabilities. Its easily portable body, the size of an A4 sheet of paper, supports mixed recording of multiple channels. It can record directly to an SD memory card for extended periods of time, and it can easily transfer large volumes of data to a PC. A touch panel keeps operation intuitive.

Measurement and recording

Measure voltage, temperature, strain, and CAN with various input modules.

Optional connection cords and clamp sensors enable a range of mixed recording capabilities.

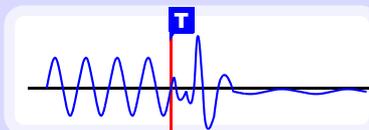
Timing measurement

Using a logic probe, you can measure control signal timing.

Easy touch panel operation
Continuous monitoring of input status

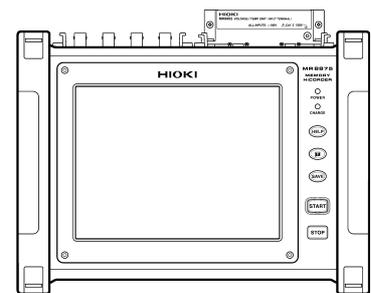
Record anomalies

Abnormal events can be analyzed by recording with the trigger function (p. 171).

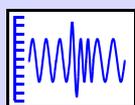


Saving and loading data File management

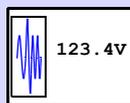
Measurement data can be stored to and read from an optional SD memory card or USB flash drive (p. 87).



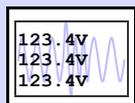
Analysis



Gauge display (p. 127)



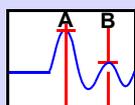
Check the current input status as both a waveform and with values (waveform monitor) (p. 124).



Numerical Calculations (p. 189)

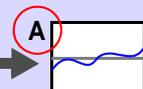


Zoom in/out (p. 121)

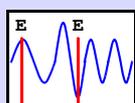


Cursor Measurements (p. 112)

mV



Display unit conversions (p. 150)

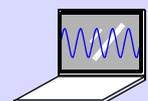


Event Mark (p. 134)

The MR8875 supports a range of other analytical functions. "Chapter 5 Waveform Monitoring and Analysis" (p. 111)

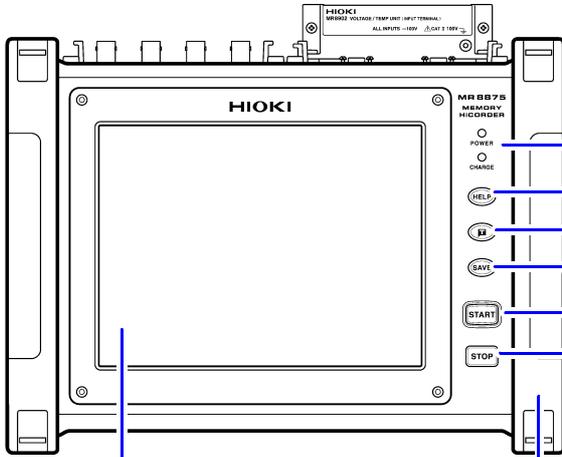
Analyze data using a PC

Using the included USB cable, you can transfer data from an SD memory card to a PC. You can also use a dedicated software application to analyze measurement data (p. 321).



1.2 Names and Functions of Parts

Front Panel



Display
LCD display with touch panel
About the screen layout (p. 23)

Protector
The strap can be attached. (p. 40)

LED
POWER: Turns green when the power is on.
CHARGE: Turns orange when the instrument is charging (p. 42).

HELP key
Displays an explanation of the screen display (p. 26).

(forced trigger) key
Applies a trigger (p. 187).
Turns or flashes white when a trigger occurs.

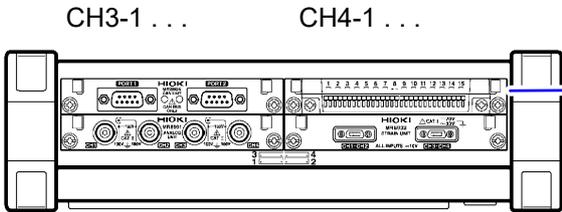
SAVE key
Saves data manually. Turns or flashes blue when media is being accessed.

START key
Starts measurement.
Turns green while measurement is in progress (p. 80).

STOP key
Stops measurement (p. 80).

Top

(Side on which input modules are installed)



CH3-1 ... CH4-1 ...

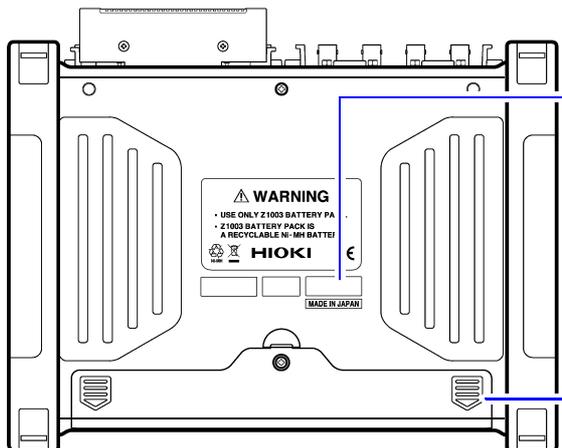
CH1-1 ... CH2-1 ...

You can verify information about installed input modules on the screen (p. 278).

Input module slot (x4)
Install optional input modules here (p. 28).

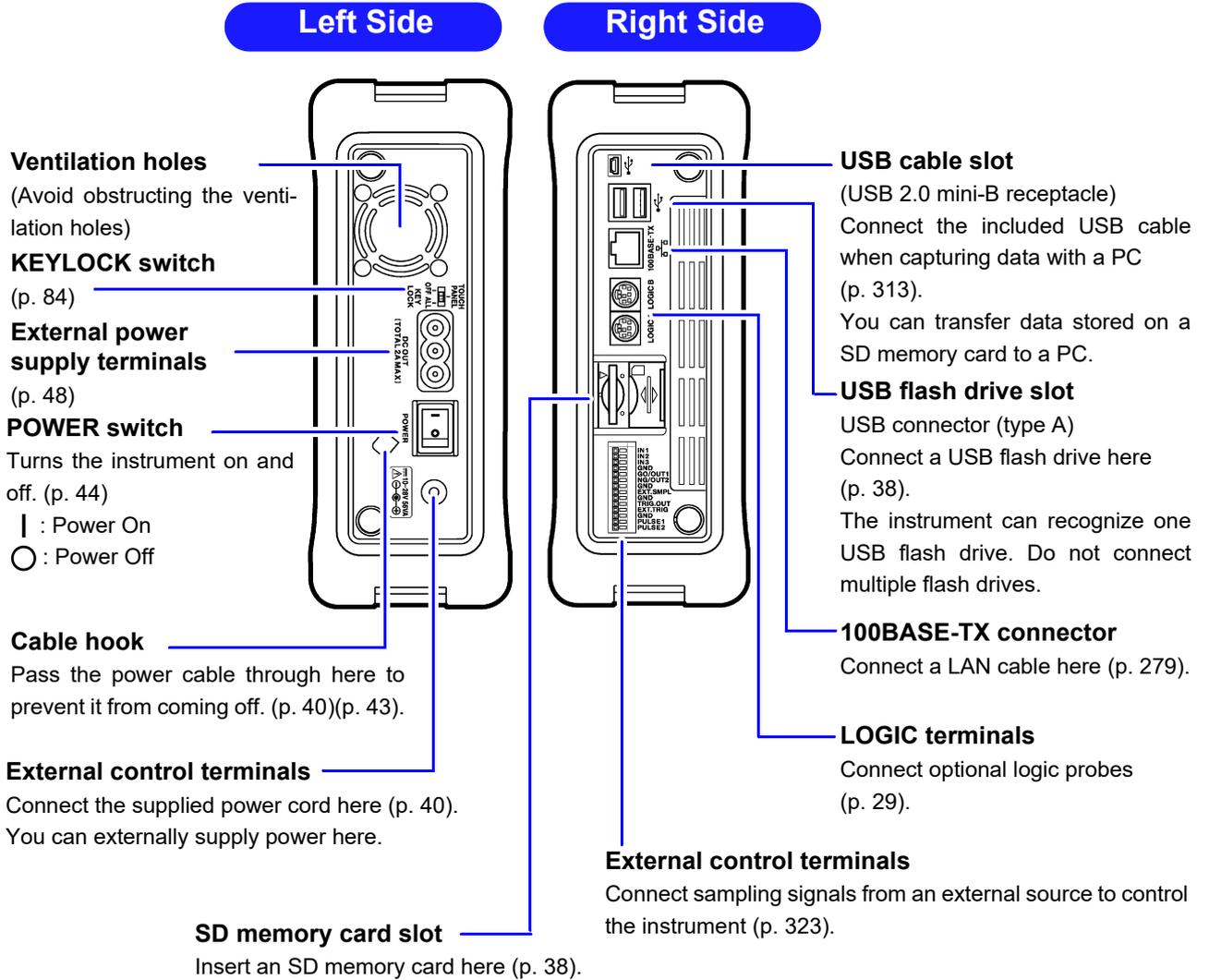
Analog input terminals
Connect optional connection cords and clamp sensors here (p. 29).

Back



Manufacturer's Serial Number
The serial number consists of 9 digits. The first two (from the left) indicate the year of manufacture, and the next two indicate the month of manufacture.
Required for product control. Do not peel off the label.

Battery compartment cover
Install the optional Z1003 Battery Pack here.

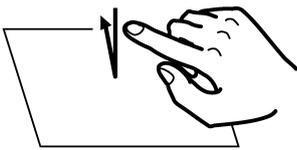


1.3 Basic Operation

Touch panel operation

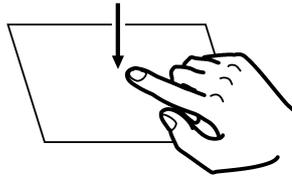
The instrument's display is a touch panel that supports the following operations:

Tap



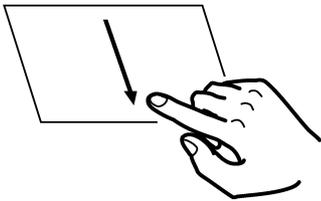
Touch the screen with your finger and then remove your finger.

Touch



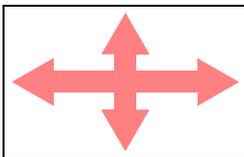
Touch the screen with your finger for a longer amount of time.

Drag



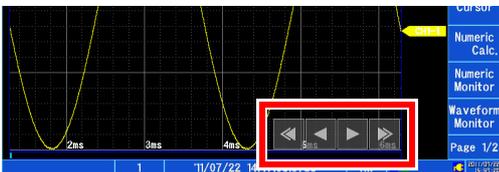
Move your finger while touching the screen.

Scrolling the screen



Drag your finger up, down, left, or right on screens that support scrolling.

Scrolling waveforms



On screens that support scrolling (screens on which the Arrow window is shown), you can scroll waveforms by tapping in the direction in which you wish to scroll.

See: "Scrolling waveforms" (p. 118)

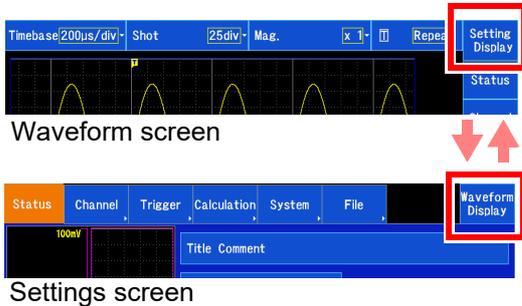


You can also tap the desired position on the scroll bar to display that position.

Scroll bar

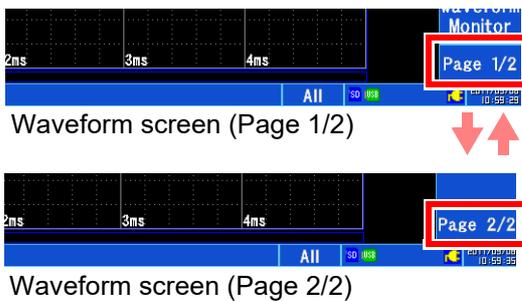
Changing the screen display and settings

Switching between the Waveform and Settings screens



You can switch between the Waveform screen and the Settings screen by tapping the tab on the right side of the screen.

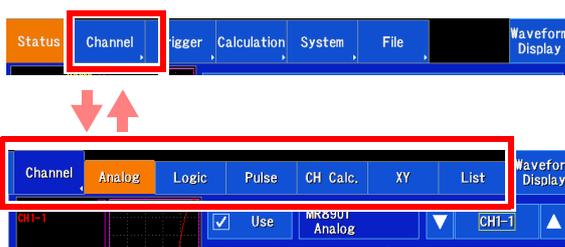
Switching among items on the right side of the Waveform screen



You can switch between Page 1/2 and Page 2/2 by tapping the item.

You can switch between settings windows and display content by tapping items on the right side of the Waveform screen.

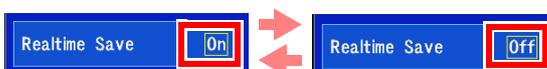
Switching screens on the Settings screen



Tapping on the main tab displays a series of sub-tabs. Tap the desired sub-tab to display the corresponding screen.

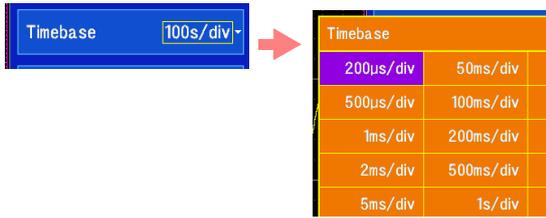
If the tab you wish to select is not shown on the screen
Tap the selected main tab again to hide the displayed sub-tabs. You can scroll through the tabs.

Changing settings: Tap to toggle



Tap inside the boundary to toggle the settings.

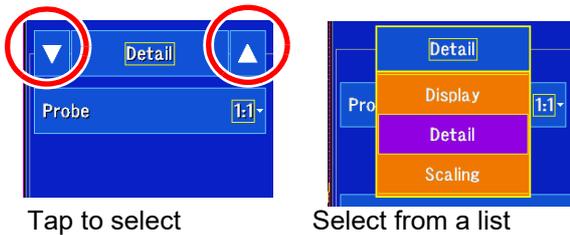
Changing settings: Select from a list



Tap inside the boundary to display a selection list. Then tap the desired setting on the list to select it.

If you wish to leave the setting unchanged, tap on the screen anywhere other than the list of settings to close the list without changing the setting.

Changing settings: Switch setting items (tap to switch/select from list)



There are two ways to switch setting items.

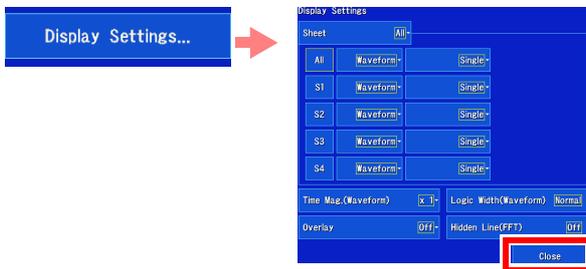
Method 1:

Tap inside the boundary to display a selection list. Then tap the desired setting on the list to select it. If there are numerous items on the list, you can scroll through the list.

Method 2:

Tap on the setting to switch settings.

Changing settings: Open a window



Tap to open a settings window. To close the window, tap **[Close]**.

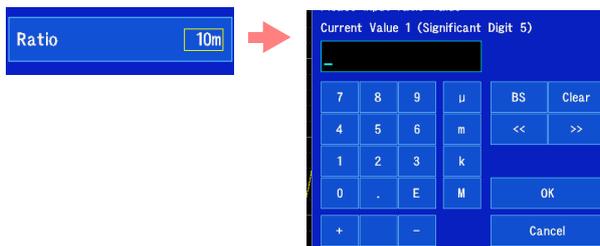
Changing settings: Change a value



Select a numerical setting to display a numerical setting panel.

See: "Changing values" (p. 145)

Changing settings: Enter text or a number



Select a textual or numerical setting to display a text or number input window.

About entering comments:

See: "6.1 Adding Comments" (p. 142)

About entering values:

See: "Entering values" (p. 145)

1.4 Screen Organization

Broadly speaking, the MR8875's interface consists of seven screens (the Waveform screen and six Settings screens). For more information about screen operation, see "1.3 Basic Operation" (p. 20). For examples of screens, see the Measurement Guide.

Main tab	Sub-tab	Settings overview	Reference
[Waveform Display]		Screen for checking measurement data. You can also configure measurement conditions and settings related to analysis and other functionality on the Waveform screen.	(p. 111)
[Setting Display]			
[Status]		Screen for configuring recording conditions and auto save functionality. You can also check input with the monitor display.	(p. 56)
[Channel]		Screen for configuring input channels and scaling and setting comments. You can also make settings while viewing the monitor display for input channels.	(p. 66)
	[Analog]	Sets the channels to measure using input modules.	
	[Logic]	Sets the channels to measure using logic probes.	
	[Pulse]	Sets the channels to measure using pulse signals (external control terminals).	
	[CH Calc.]	Sets the channels to measure when performing a calculation between two analog channels.	
	[XY]	Configures XY compositing.	
	[List]	Allows you to check a list of all channel settings.	
[Trigger]		Screen for configuring trigger functionality.	(p. 171)
	[General]	Configures triggers.	
	[Analog/CH Calc.]	Configures the application of triggers to analog channels and inter-channel calculation channels.	
	[Logic]	Configures the application of triggers to logic channels.	
[Calculation]	[Pulse]	Configures the application of triggers to pulse channels.	
		Screen for configuring settings related to waveform numerical calculations.	(p. 189)
	[Numeric Calculation]	Screen for configuring settings related to numerical calculations.	
[System]	[Waveform Calculation]	Screen for configuring settings related to waveform calculations.	
	[FFT Calculation]	Screen for configuring settings related to FFT calculations.	
		Screen for configuring environmental and communication settings and initializing the instrument.	(p. 259)
	[Env.]	Configures settings related to the instrument's system environment, for example the screen display and operation.	
	[External Terminal]	Configures settings related to external control terminal I/O and external triggers.	
[File]	[Initialize]	Allows you to initialize waveforms and settings, perform self-checks, and set the time.	
	[Setting]	Allows you to save and load settings data.	
	[Comm.]	Configures settings related to communicating with a PC.	
[File]		Screen for displaying and managing data files on storage media.	(p. 87)
	[Operation]	Displays and manipulates media files.	
	[SAVE Key]	Configures the method used to save data with the SAVE key.	

Using the Waveform screen

Setting

Trigger mark

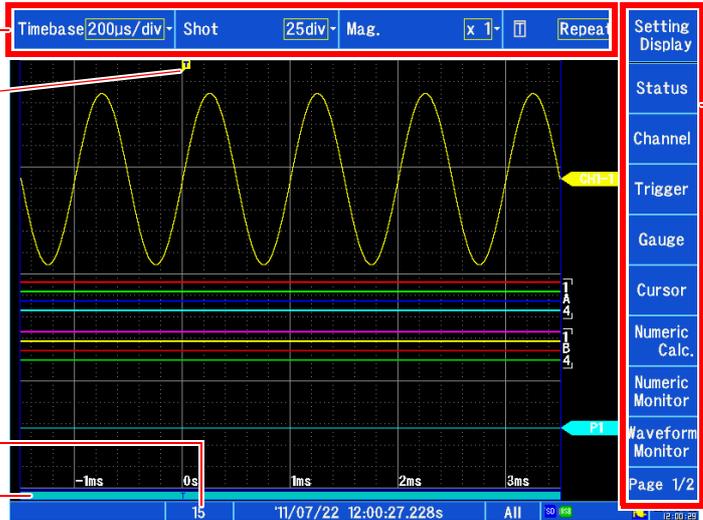
Indicates the location where a trigger occurred (p. 171).

Analog waveforms (p. 67)
 Logic waveforms (p. 71)
 Pulse waveforms (p. 73)

Waveform acquisition count

Scroll bar

Scrolls waveforms.
 The width of the scroll bar indicates the portion of the entire recorded waveforms that is being displayed (p. 117).



See "Description of items on the right side of the Waveform screen" below.

Trigger time

Displays the time at which the trigger occurred (p. 171).

Sheet display (p. 130)

Indicates the name of the sheet being displayed on the screen.

Description of items on the right side of the Waveform screen

Setting Display	Switches to the Settings screen.	Setting Display	Switches to the Settings screen.
Status	Displays the Measurement Settings window. See: "3.4 Setting Measurement Configuration" (p. 56)	Search	Allows you to perform a waveform search. See: "5.10 Searching for Waveforms" (p. 131)
Channel	Displays the Input Settings window. See: "3.5 Setting the Input Channels" (p. 66)	Jump	Allows you to use the jump function. See: "Moving the display position (jump function)" (p. 119)
Trigger	Displays the Trigger Settings window. See: "Chapter 7 Trigger Settings" (p. 171)	Sheet & History	Allows you to switch the sheets displayed on the Waveform screen and view past waveforms. See: "5.9 Allocating Measurement Data to Sheets and Switching Between Sheets" (p. 129), "5.13 Viewing Past Waveforms" (p. 139)
Gauge	Displays the gauge. See: "Displaying gauges" (p. 127)	Auto Range	Allows you to use the auto-ranging function. See: "3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)" (p. 82)
Cursor	Displays the cursors. See: "5.1 Reading Measured Values (Using Cursors)" (p. 112)	Zoom	Allows you to use the zoom function. "5.4 Magnifying and Compressing Waveforms" (p. 121)
Numeric Calc.	Displays the Numerical Calculation Results window. See: "8.3 Viewing Numerical Calculation Results" (p. 198)	CAN Send	Allows you to send a frame at user-specified timing when using the MR8904 CAN Unit. See the instruction manual on the included CD.
Numeric Monitor	Displays the Numerical Monitor. See: "5.6 Monitoring Values (Numeric Monitor)" (p. 125)	Page 2/2	Switches pages.
Waveform Monitor	Displays the waveform monitor. See: "5.5 Monitoring Input Waveforms (Waveform Monitor)" (p. 124)		
Page 1/2	Switches pages.		

Icon and status display (all screens)

Instrument information is shown at the bottom of the screen.



1. Status display (Waveform screen only)

Indicates the instrument's current processing status.

Storing	Measurement in progress
Trigger Wait	Trigger standby state
Pre-Trigger Wait	Before data acquisition (displayed only when a pre-trigger has been set)
Calculating	Numerical calculation or waveform calculation processing in progress
Numeric Calculating	Numerical calculation processing in progress
Waveform Calculating	Waveform calculation processing in progress
FFT Calculating	FFT calculation processing in progress
Saving(Waveform)	Waveform save processing in progress
Saving(Image)	Display image save processing in progress
Saving(calc.)	Numerical calculation result or waveform calculation result save processing in progress
Saving(FTP)	FTP transmit processing in progress
Saving(Mail)	E-mail transmit processing in progress

2. Media

Indicates the media status.

SD memory card	USB flash drive	Status
(Blank)	(Blank)	No memory card or flash drive has been inserted.
		No memory card or flash drive has been inserted, but the memory card or flash drive has been specified as the auto save or real-time save destination (will show the save mark).
		A memory card or flash drive has been inserted, but it cannot be accessed (light color).
		A memory card or flash drive has been inserted, but it cannot be accessed, and it has been specified as the auto save or real-time save destination (light color).
		A memory card or flash drive has been inserted and can be accessed.
		A memory card or flash drive has been inserted and can be accessed, and it has been specified as the auto save or real-time save destination.
	—	The SD memory card can be accessed and has been locked (write-protected).
	—	The SD memory card can be accessed. It has been specified as the auto save or real-time save destination, but it has been locked (write-protected).

3. LAN

Indicates the LAN status.

(Blank)	Not connected.
	Connected.

4. Key lock

Indicates the key lock status.

(Blank)	Not locked.
	Touch panel operation alone has been disabled.
	Touch panel and key operation have both been disabled.
	The instrument is being operated remotely from a PC.

5. Power display

Indicates the power status.

	Operating on the AC adapter.
	Operating on the battery pack (fully charged).
	Operating on the battery pack.
	Operating on the battery pack; low battery mark flashing (time to recharge).

6. Current time and date

How to set the clock (p. 45)

If consistently unable to access media

The following circumstances may result in a consistent inability to access media:

- Waiting for the UPS to charge (p. 264)
- Using unformatted media or media with an abnormal format (p. 39)

In the above circumstances, the media may be damaged. Replace with normal media.

Using the HELP key (example)

You can view on-screen help for items shown on the screen.

- 1 Display the screen for which you wish to view an explanation and press the **HELP** key.

The **HELP** key will light up, and the help function will be activated. A boundary will be shown around items with which the help function can be used. Pressing the **HELP** key again disables the help function.

- 2 Tap the item for which you wish to view an explanation.

The explanation will be displayed.

- 3 Tap **[Close]**.

You will return to the original screen.



Measurement Preparations

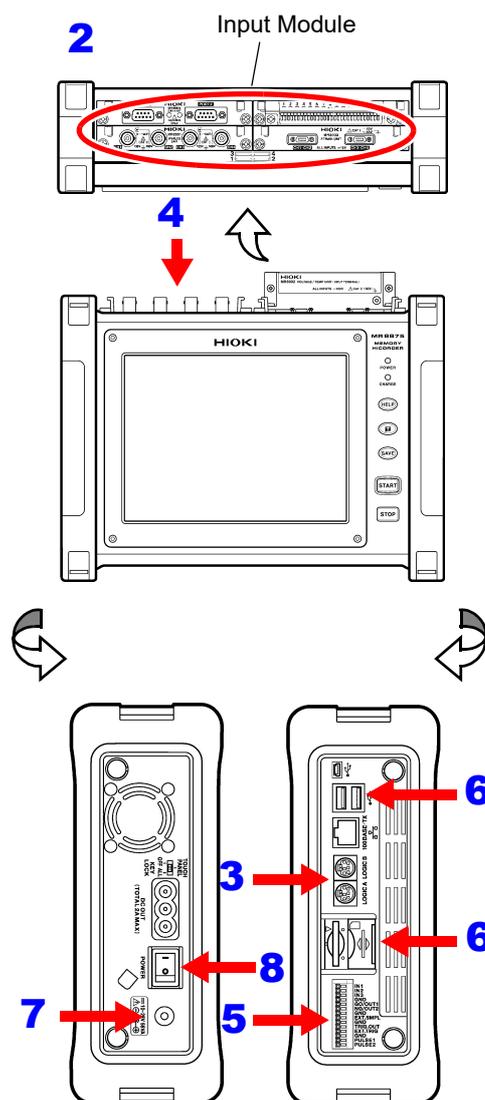
Chapter 2

2

Chapter 2 Measurement Preparations

Be sure to read "Operating Precautions" (p. 7) before connecting the instrument.

- 1** Install this instrument (p. 7)
- 2** (When adding or replacing input modules) Install an input module (p. 28)
- 3** (When measuring logic signals) Connect a logic probe to the LOGIC terminal (p. 36)
- 4** (When measuring analog signals) Connect the input cable(s) to the input module (p. 29)
The probes and cords connected vary with the measurement application.
- 5** (When measuring a pulse signal) Connect the wires to the pulse input terminals (external control terminals) (p. 37)
- 6** Insert the media (p. 38)
- 7** Connect the power supply (AC adapter/battery pack) (p. 40)
- 8** Turn the power on (p. 44)
- 9** Setting the clock (p. 45)
- 10** Adjust the zero position (p. 46)



To transfer data

See: "Chapter 12 Connection to a PC" (p. 279)

To use external control

See: "Chapter 13 External Control" (p. 323)

2.1 Install an Input Module



Input modules specified at the time the instrument is ordered are supplied pre installed. Use the following procedures to add or replace input modules, or to remove them from the instrument.

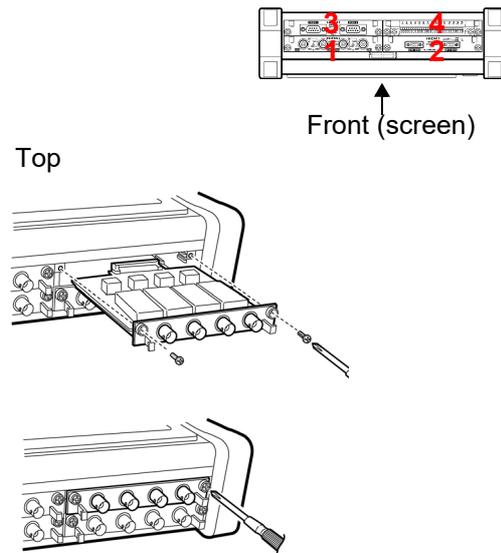
Before using the instrument, be sure to read "Input Module" (p. 11).

Installing an input module

Required item: One Phillips-head screwdriver

- 1** Turn off the instrument's **POWER** switch and disconnect the AC adapter and connection cords.
- 2** With attention to the orientation of the input module, insert it firmly all the way in.
- 3** Using the Phillips screwdriver, tighten the two input module mounting screws.

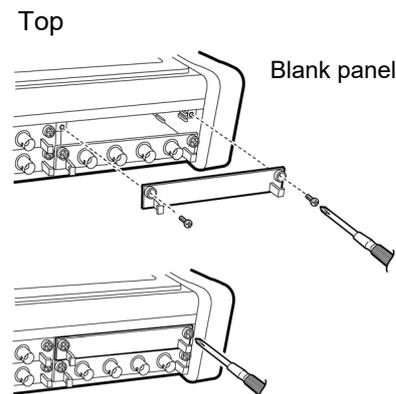
When removing a module, turn off the power and disconnect all cords connected to input modules. Then remove the input module by reversing the procedure described above.



If not installing another input module after removal

- 1** Turn off the instrument's **POWER** switch and disconnect the AC adapter and connection cords.
- 2** Install a blank panel and tighten securely in place with two fixing screws using a Phillips head screwdriver.

Measurements made without a blank panel installed may fail to meet specifications because of temperature instability within the instrument.



You can check information about installed input modules on the screen.

See: "11.6 System Configuration Check" (p. 278)

2.2 Connecting Cords



To measure analog signals, install an input module in the instrument and connect the connection cords, sensors, and other components.

To measure logic signals, connect logic probes to the instrument's logic terminals.

To measure pulse signals, connect wires to the pulse input terminals on the instrument's external control terminal block.

Input	Connect to	Measurement	Reference
Analog signals	MR8901 Analog Unit		Voltage, current (p. 29)
	MR8902 Voltage/TEMP Unit		Voltage, temperature (p. 31)
	MR8903 Strain Unit		Voltage, vibration/strain (p. 32)
	MR8904 CAN Unit		CAN signals (p. 34)
	MR8905 Analog Unit		Voltage (Instantaneous value, AC RMS value)
Logic signals	Logic terminals		(p. 36)
Pulse signals	External control terminals (Nos. 13 and 14)		(p. 37)

Connecting an MR8901 Analog Unit

Measuring Voltage

Connect the optional Hioki connection cord to the MR8901 Analog Unit's input terminal. If the measurement target exceeds the instrument's maximum input voltage (p. 51), use the optional 9322, P9000-01, or P9000-02 Differential Probe (p. A 19).

Before using the instrument, be sure to read "Handling the Probes" (p. 9).

Compatible connection cords

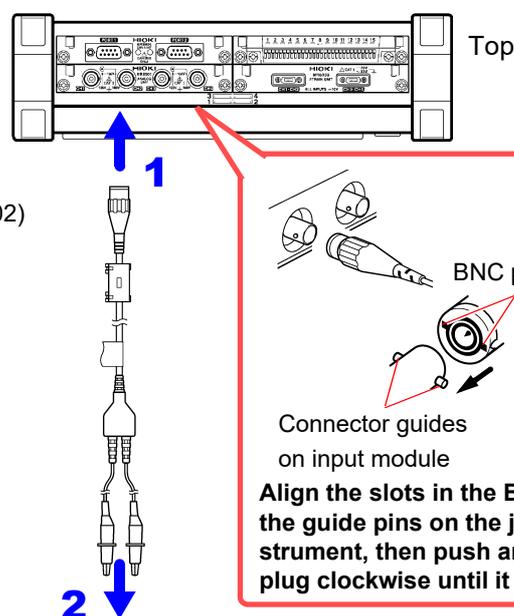
- Model L9197 Connection Cord
- Model 9197 Connection Cord
- Model L9198 Connection Cord
- Model L9217 Connection Cord
- Model L9790 Connection Cord
- Model 9322 Differential Probe
- Model P9000 (-01, -02) Differential Probe

1 Connect the connection cord's BNC connector to the analog input terminal.

2 Connect to the measurement object

Disconnecting BNC connectors

Push the BNC plug, twist it counterclockwise, and pull it out.



(Example: Model L9198 Connection Cord)

2.2 Connecting Cords

Measuring current

Connect the optional clamp sensor to the MR8901 Analog Unit. (This manual uses the term “clamp sensor” to refer to the sensor as well as the optional clamps.)

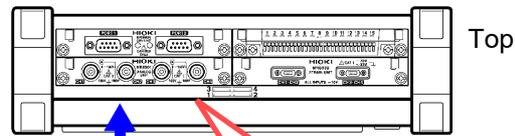
Before using the instrument, be sure to read "Handling the Probes" (p. 9). For more information about optional clamp sensors, see the instruction manual that came with the product in question.

Scaling must be configured appropriately for the clamp sensor being used.

See: "6.5 Converting Input Values (Scaling Function)" (p. 150)

Compatible connection cords

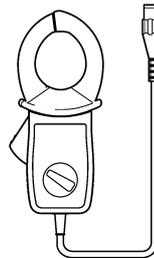
- Model 9018-50 Clamp-On Probe
- Model 9132-50 Clamp-On Probe
- Model 9675 Clamp-On Leak Sensor
- Model 9657-10 Clamp-On Leak Sensor



Top

- 1** Connect the clamp sensor's BNC connector to an analog input terminal.

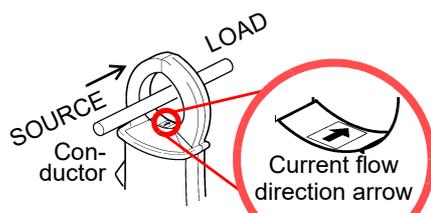
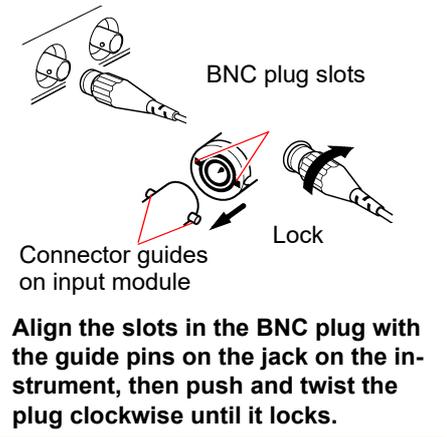
The same connection method as the connection cord is used.



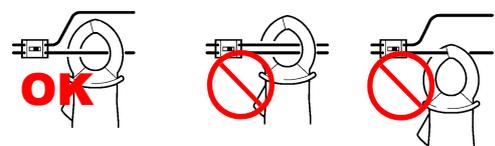
1

- 2** Connect to the measurement object

2



The arrows on the clamp indicating the direction of current flow should point toward the load side.



Attach the clamp around only one conductor. Single-phase (2-wire) or three-phase (3-wire) cables clamped together will not produce any reading.

Connecting an MR8902 Voltage/TEMP Unit

Connect measurement cables (when measuring voltage) or thermocouples (when measuring temperature) to the MR8902 Voltage/TEMP Unit's terminal block.

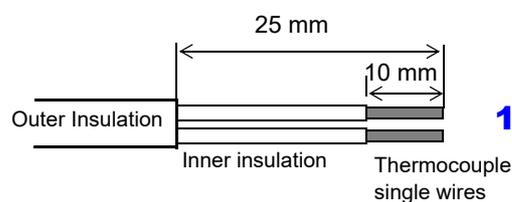
Before using the instrument, be sure to read "Handling the Probes" (p. 9).

NOTE Do not measure the same signal at the same time with the MR8902 Voltage/TEMP Unit and another input module. Channel switching noise from the MR8902 may affect the other input module.

Required item:

- Recommended cables
 - Single strand diameter: $\phi 0.65$ mm (AWG22)
 - Multi-strand: 0.32 mm² (AWG22)
- Usable cables
 - Single strand diameter: $\phi 0.32$ mm to $\phi 0.65$ mm (AWG28 to AWG22)
 - Multi-strand: 0.08 mm² to 0.32 mm² (AWG28 to AWG22)
 - Strand diameter: At least $\phi 0.12$ mm
- Standard insulation stripping length: 9 to 10 mm
- Button operation specified tool: Flat-blade screwdriver (tip width 2.6 mm)

Thermocouple (temperature measurement)

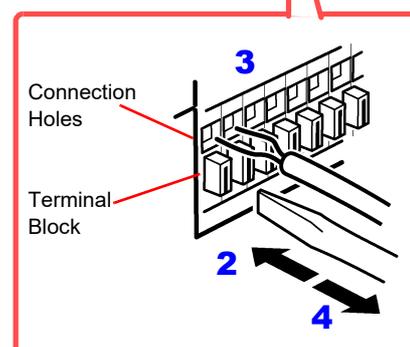
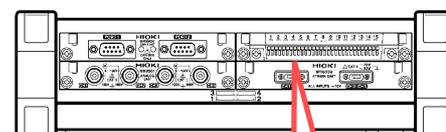


- 1 Strip the wire insulation.**
- 2 Push the blade of a flat screwdriver into the button on the terminal block of the input module.**
- 3 Insert the wire into the connection hole while holding down the button.**
Confirm proper polarity.
- 4 Release the button.**
The wire will be secured in place.
- 5 Attach to the measurement object.**

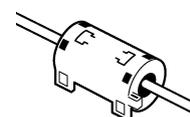
To remove the wire:

Hold the button while pulling the wire out.

Top



- NOTE**
- If line noise affects peripheral equipment, pass the measurement cable or thermocouple through the included ferrite clamp.
 - Type K and type E thermocouples may not measure temperature accurately in the range between 250°C and 600°C because of their physics, short-range ordering. Consult a thermocouple manufacturer to select a thermocouple.



Connecting a MR8903 Strain Unit

You can connect a measurement cable to the MR8903 Strain Unit and measure voltage, vibration, and displacement (strain).

See: "Scaling Method When Using Strain Gauges" (p. A12)

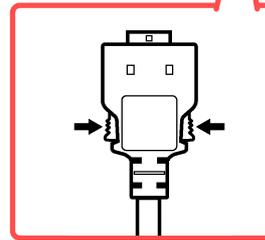
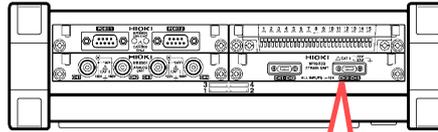
Required item:

Consult Hioki about voltage measurement cables.

When measuring strain

- Conversion cable
- Strain Gauge Converter

Top



1 Connect the cable's connector to the terminal on the MR8903 Strain Unit.

2 Attach to the measurement object.

When disconnecting the cable, release the lock by squeezing on both sides of the connector.

Example: When connecting a strain gauge converter

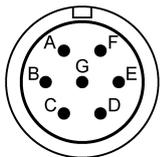
1 Connect the conversion cable to the terminal on the MR8903 Strain Unit.

2 Connect to the Strain Gauge Converter.

3 Attach to the measurement object.

There are marks at the point at which the cable branches (CH1, CH3) (CH2, CH4). Attach sensors after checking channel numbers on the module and the marker numbers.

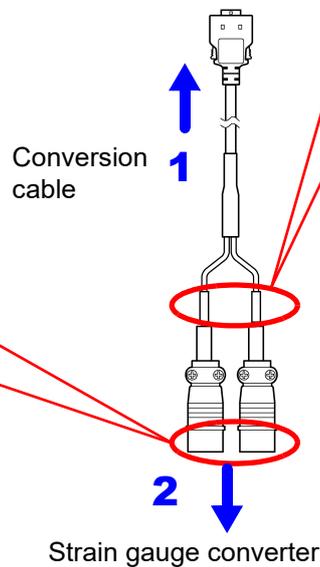
Sensor NDIS connector pin assignments



(Applied voltage)
Bridge voltage: 2 VDC

The metal shell is continuous with the instrument's ground

Pin symbol	Pin description
A	BRIDGE+
B	INPUT-
C	BRIDGE-
D	INPUT+
E	FLOATING COMMON
F, G	N.C.



- NOTE**
- Each of the MR8903's input connectors accommodates two channels. The conversion cable branches into connectors for each channel. The same conversion cable can be connected to the CH1/CH2 connector and the CH3/CH4 connector.
 - Do not measure the same signal from an MR8903 channel with other channels. The signal will be affected by the other channel, causing its waveform to oscillate.
 - Measurement using a strain gauge requires a bridge box, both of which are commercially available.
 - Some bridge boxes are susceptible to noise. Grounding the bridge box can probably improve its noise tolerance. Consult the instruction manual of the bridge box or its manufacturer about how to ground the bridge box.

Connecting an MR8904 CAN Unit

Connect the CAN cable when measuring a CAN bus signal. For more information, see the instruction manual on the included CD.

! DANGER

This device is designed to collect messages being transferred on the CAN bus and to send messages to the CAN bus. Do not connect it to anything other than the CAN bus. In addition to damaging the Memory HiCorder, CAN Unit, and measurement target, doing so may cause bodily injury.

! WARNING

Use of the CAN Unit may affect the operation of the CAN bus as well as systems connected to the CAN bus. The resulting operation may cause bodily injury or property damage. Verify how CAN Unit use, both proper and inadvertent, may affect associated systems before use.

! CAUTION

- When measuring low-speed CAN or single-wire CAN buses, the Memory HiCorder ground and measurement cable ground lines are not isolated. Wire the system so that no potential difference occurs between the ground lines. Failure to do so may damage the Memory HiCorder, CAN Unit, and measurement target.
- When connecting the CAN unit to a low-speed CAN or single-wire CAN bus, power must be supplied from an external source. Since the Memory HiCorder's ground and measurement cable ground lines are not isolated in this configuration, be sure to provide power from a circuit with the same ground. Failure to do so may damage the Memory HiCorder, CAN Unit, and measurement target.

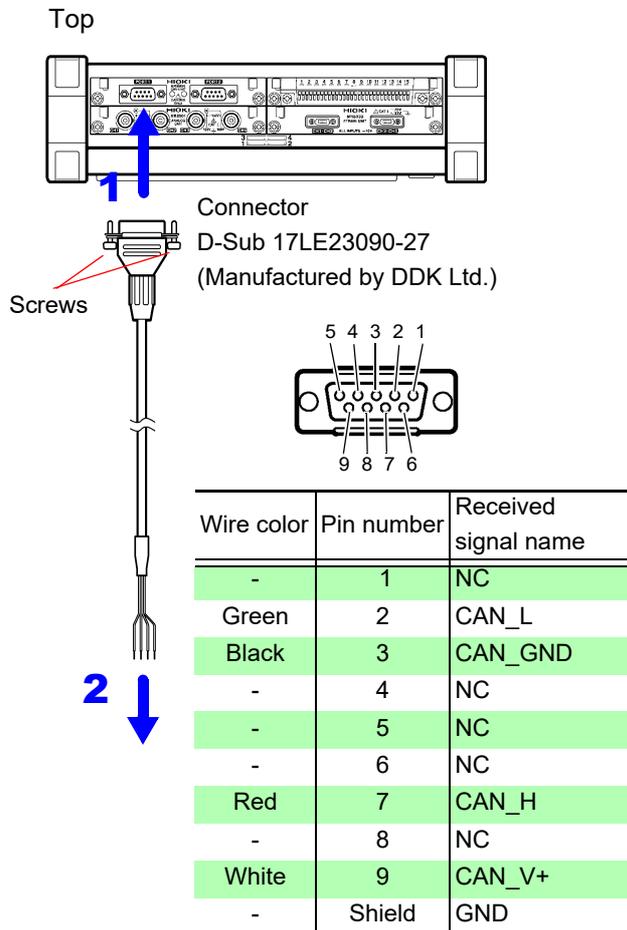
Required item:

- 9713-01 CAN Cable (Option)
- Phillips head screwdriver (No. 1)

1 Connect the CAN cable to the MR8904 CAN Unit's terminal.

Exercise care to align the connector properly. Tighten the fixing screws with a Phillips head screwdriver to secure the connector to the device.

2 Attach to the measurement object.



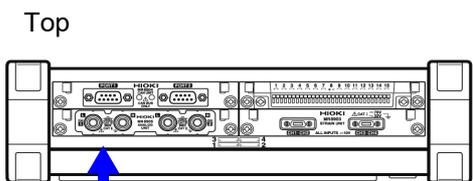
Connecting an MR8905 Analog Unit

Connect the optional Hioki connection cord to the MR8905 Analog Unit's input terminal. If the measurement target exceeds the instrument's maximum input voltage (p. 51), use the optional 9322, P9000 Differential Probe (p. A 19).

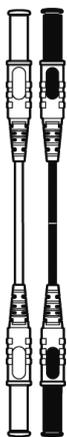
Before using the instrument, be sure to read "Handling the Probes" (p. 9).

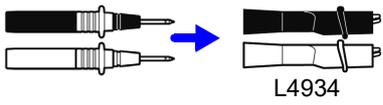
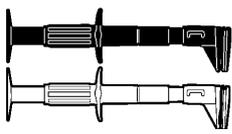
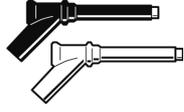
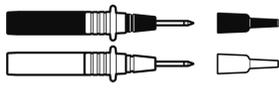
Compatible connection cords
 • Model L4940 Connection Cable

- 1** Connect the cable plugs to the terminals of the 8905 Analog Unit.
- 2** Insert the other ends of the cables into the supplied clips.
- 3** Attach the clips to the object to be measured.



Connect each plug to the terminal of the same color.



Supplied clips	
	Model L4934 Small Alligator Clip *Model L4932 is required to use Model L4934.
	Model L4935 Alligator Clip
	Model L9243 Grabber Clip
	Model L4936 Bus Bar Clip
	Model L4937 Magnetic Adapter
	Model L4932 Test Pin

3

Measuring logic signals

Connect an optional logic probe to the instrument's LOGIC terminal. When no logic probe is connected, a high-level waveform will be displayed on the screen.

**Before using the instrument, be sure to read "Handling the Probes" (p. 9).
For more information about logic probes, see the instruction manual that came with the product being used.**

Probes that can be connected to the instrument

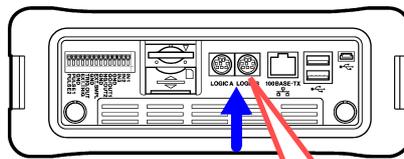
- Model 9320-01 Logic Probe
- Model MR9321-01 Logic Probe

If you already have a Model 9320 or Model 9321, you can use the 9323 Conversion Cable to make the connection.

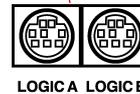
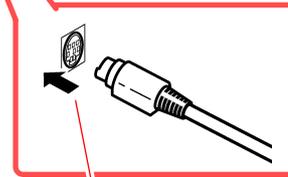
1 Connect the logic probe by aligning the grooves on the plug and a LOGIC terminal.

2 Attach to the measurement object.

Right side



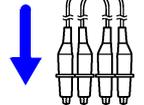
1



Align the notch in the logic probe's connection terminal with the LOGIC terminal.

(Example: Model MR9321-01 Logic Probe)

2

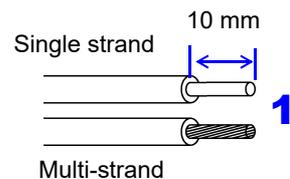


Measuring pulse signals

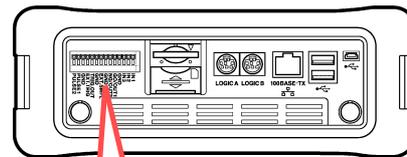
Connect wires to the pulse input terminals (PULSE1, PULSE2) on the instrument's external control terminal block. Connect so that the PULSE1 or PULSE2 terminal is the positive terminal and the GND terminal is the negative terminal. PULSE1 will be channel P1, while PULSE2 will be channel P2. For maximum input voltages, see "Chapter 13 External Control" (p. 323).

Required item:

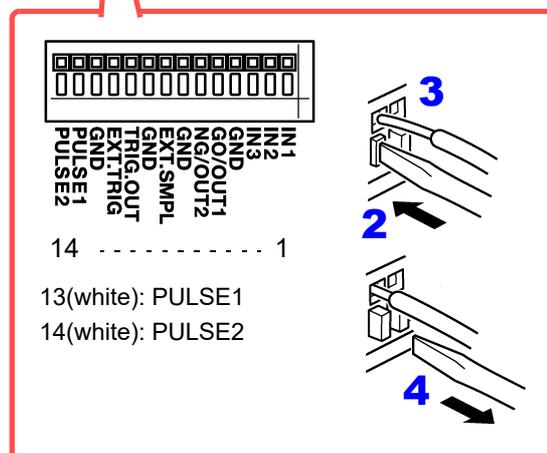
- Recommended cables
 - Single strand diameter: $\phi 0.65$ mm (AWG22)
 - Multi-strand: 0.32 mm² (AWG22)
- Usable cables
 - Single strand diameter: $\phi 0.32$ mm to $\phi 0.65$ mm (AWG28 to AWG22)
 - Multi-strand: 0.08 mm² to 0.32 mm² (AWG28 to AWG22)
 - Strand diameter: At least $\phi 0.12$ mm
- Standard insulation stripping length: 9 to 10 mm
- Button operation specified tool: Flat-blade screwdriver (tip width 2.6 mm)



Right side



- 1 Strip the wire insulation.**
- 2 Push the blade of a flat screwdriver into the buttons on the PULSE1, PULSE2, and GND terminals.**
- 3 Insert the wire into the connection hole while holding down the button.**
Confirm proper polarity.
- 4 Release the button.**
The wire will be secured in place.
- 5 Attach to the measurement object.**



To remove the wire:

Hold the button while pulling the wire out.

2.3 Preparing Storage Media

The MR8875 can use both SD memory cards and USB flash drives as storage media. However, real-time saving of data to USB flash drives is not supported.

Before using the instrument, be sure to read "Using a SD memory card/ USB Flash Drive" (p. 15).

SD memory cards

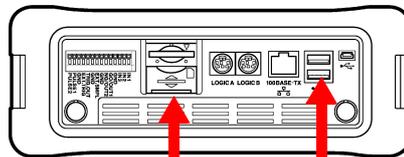
- Auto and manual save as well as real-time save functionality are supported.
- Use only Hioki-specified SD memory cards. Proper operation is not guaranteed when using other cards.
- Be sure to close the SD memory card slot's cover. Proper operation is not guaranteed if the cover is not closed.
- Format new SD memory cards before use.
- Format new SD memory cards with the instrument. Formatting cards with a PC may cause auto save functionality to take more time or data recording to fail to keep pace during real-time saving.
- Before inserting an SD memory card, verify that the card is not write-protected.

USB flash drives

- Insert only USB flash drives into the USB flash drive slot.
- Not all commercially available USB flash drives are supported.
- Proper operation of USB flash drives is not guaranteed.
- USB flash drives with security functionality such as fingerprint authentication are not supported.
- Auto and manual save functionality is supported. However, real-time save functionality is not supported.
- Use within the temperature and humidity ranges specified by the USB flash drive.
- The MR8875 can detect one USB flash drive. Do not connect multiple USB flash drives to the instrument.

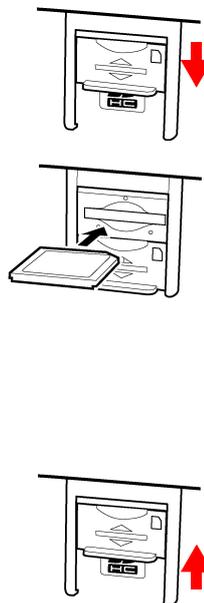
Inserting (ejecting) an SD memory card or USB flash drive

Be sure to close the SD memory card slot's cover.



SD memory card

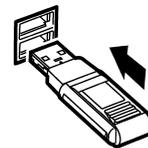
- 1 Open the SD memory card slot's cover.
- 2 **Insert the SD memory card**
Orienting the top of the SD memory card (bearing the ▲ mark) so that it faces the screen, insert the card as far as it will go in the direction indicated by the arrow to the left.
- Ejecting the SD memory card**
Be sure to verify that the instrument is not accessing the card (to save or load data, etc.).
Push the SD memory card (the card will move further into the slot), grip the card between your fingers, and pull it out.
- 3 Close the SD memory card slot's cover.



USB flash drive

Inserting a USB flash drive

Check that the USB flash drive is properly aligned with the USB flash drive slot and insert the flash drive as far as it will go.



Ejecting a USB flash drive

Be sure to verify that the instrument is not accessing the flash drive (to save or load data, etc.).

Pull out the USB flash drive. (There is no need to eject the flash drive with the instrument.)

Formatting Storage Media

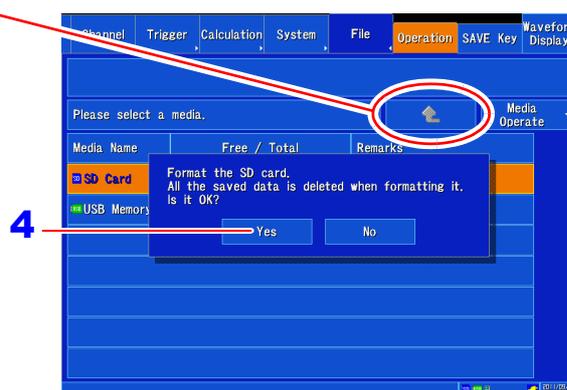
The instrument can format SD memory cards and USB flash drives. A folder named “HIO-KI_MR8875” will be created on the media when formatted.

NOTE Formatting irretrievably erases all data on the SD card/USB flash drive. Always backup important data from the SD card/USB flash drive before formatting.

- 1** Insert the storage media.
- 2** Open the screen.
[Setting Display] ► [File] ► [Operation]
- 3** Tap the media you wish to format (p. 103).
The selected media will be displayed in reverse video.
- 4** [Media Operate] (upper right) ► [Format] ► [Yes]



If folder names and filenames from the media are shown in the list, the media cannot be formatted. Tap until the name of the media is shown in the list.



2.4 Connecting a Power Supply

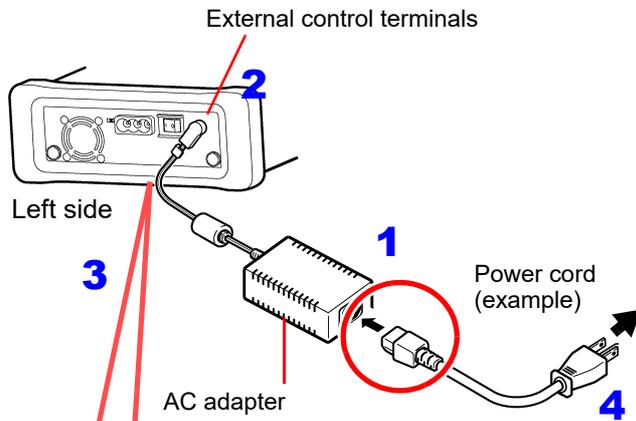
Using the AC adapter

Before using the instrument, be sure to read "Using the AC Adapter" (p. 9) and "Handling the Probes" (p. 9).

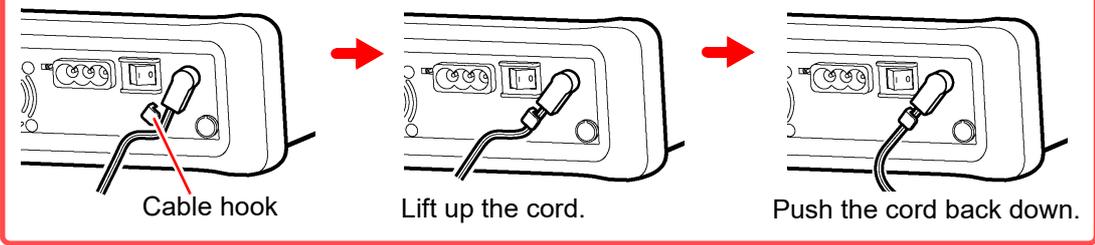
Connect the Z1002 AC Adapter and power cord that came with the instrument and connect the cord to a power outlet. You can use a sufficiently charged Model Z1003 Battery Pack together with the AC adapter to allow the instrument continue to operate in the event of a power failure. When used in combination with the battery pack, the AC adapter takes precedence.

Rated supply voltage is 100 to 240 VAC, and rated supply frequency is 50 or 60 Hz.

- 1** Connect the power cord to the AC adapter.
- 2** Connect the output plug of the external control terminal to the instrument.
- 3** Route the AC adapter's cord through the cable hook.
- 4** Plug the power cord into the mains outlet.



Be sure to route the cord through the cable hook to keep the AC adapter from being pulled out of the terminal.



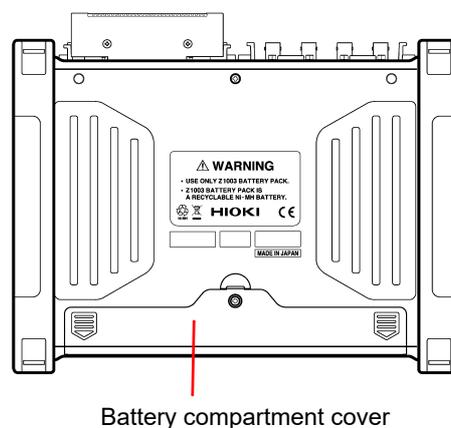
Using the battery pack

Before using the instrument, be sure to read "Battery Pack (Option)" (p. 10). Charge the battery pack sufficiently before using it for the first time.

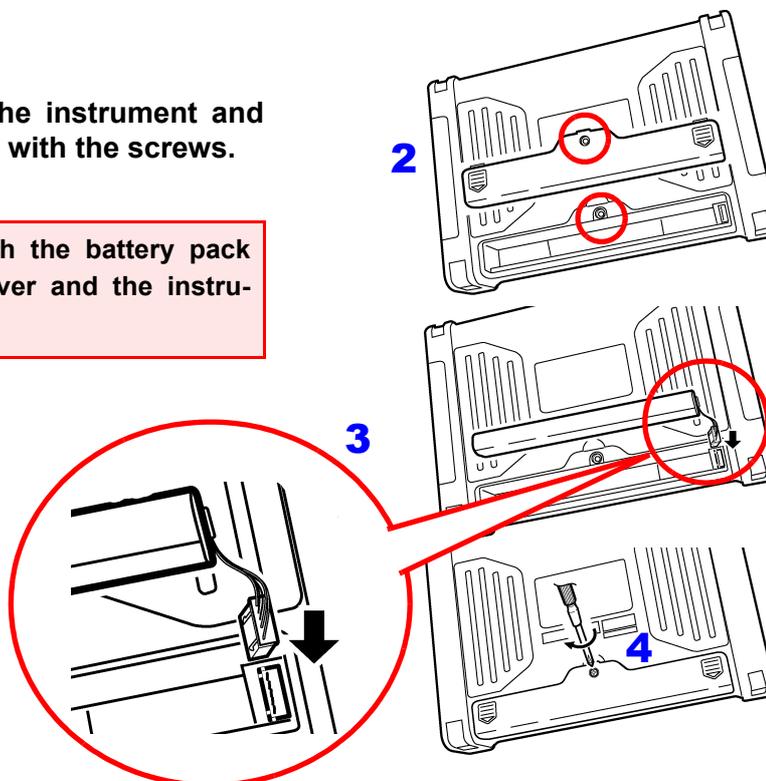
When not supplying commercial power via the AC adapter, the instrument can operate using just the optional Z1003 Battery pack. When using commercial power to operate the instrument, the battery pack can also be used to provide backup power in the event of a power failure.

- 1** Turn off the instrument.
If the AC adapter or any cables are connected to the instrument, disconnect them.
- 2** Turn the instrument over, remove the screws that hold the battery compartment cover in place, and remove the cover.
- 3** Connect the battery pack's plug to the connector.
Orient the two tabs to the left when connecting the plug.
- 4** Reattach the cover to the instrument and tighten securely in place with the screws.

Take care not to catch the battery pack wires between the cover and the instrument.



Battery compartment cover



CAUTION Observe the correct polarity when connecting the plug to the battery pack connector. Connecting the plug with the reverse polarity could cause damage to the instrument.

2.4 Connecting a Power Supply

Continuous operating time

When using the instrument at 23°C with a fully charged battery pack and the backlight saver function set to off (the initial setting):

Approx. 1 hour (when performing real-time measurement)

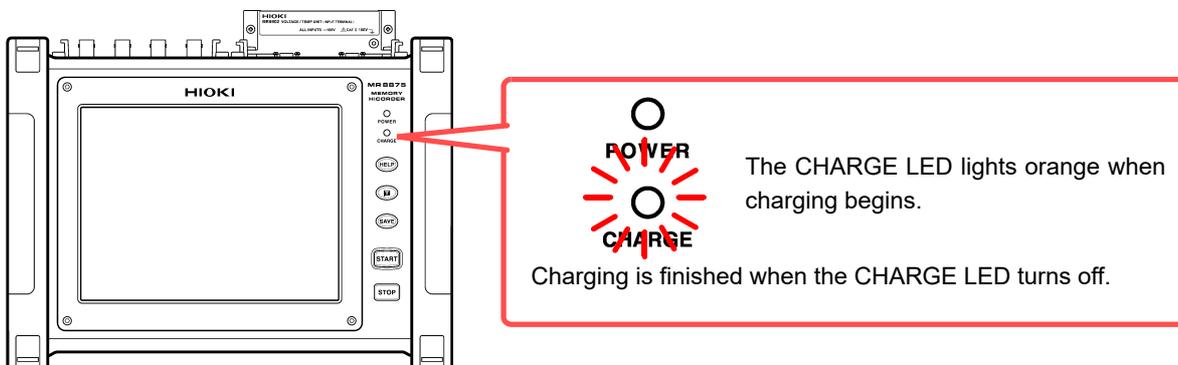
Charge timing

When using the instrument with the battery pack, the  mark on the screen will begin to flash when the battery capacity decreases.

Connect the Z1002 AC Adapter and charge the battery pack.

Charge the battery pack

You can charge the battery pack without removing it from the instrument by connecting the instrument to commercial power with the Z1002 AC Adapter. The battery pack will charge regardless of whether the instrument is on or off.



Approximate charging time:

Rapid charge time for a battery pack with little remaining charge: Approx. 3 hours

The CHARGE LED will turn off once about 1 hour of auxiliary charging has completed.

NOTE To start charging, connect the instrument to commercial power with the Z1002 AC Adapter after installing the battery pack. Charging may not begin if the battery pack is installed while the instrument is connected to commercial power.

Connecting the External Power Supply

The instrument are capable of externally-DC-powered operation.

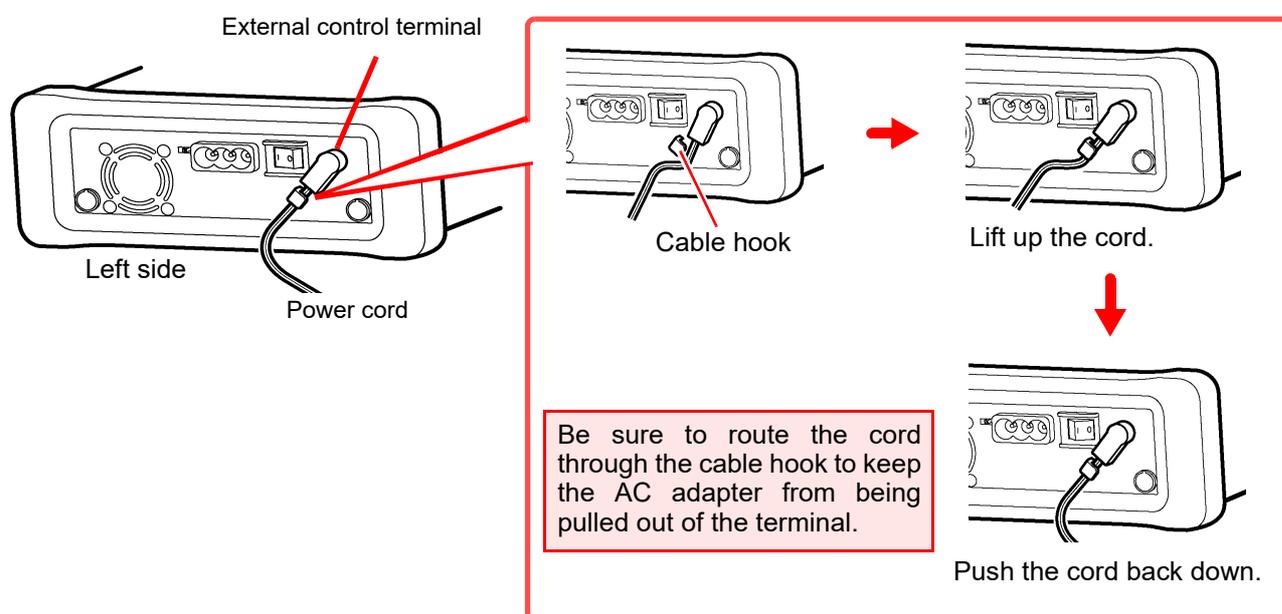
Hioki offers the DC power cord, which connects the instrument and an external power supply with each other. Contact your authorized Hioki distributor or reseller.

NOTE

- Externally supply power having only the instruments voltage to the instrument.
Rated supply voltage: 10 V to 28 V DC
- Turn off the instrument before plugging the DC power cords.
- Insert the output plugs into the instrument before supplying power.
- Observe the correct polarity when connecting the DC power cord.
Failure to do so could cause damage to the product.

Externally supplying DC power to the instrument

- 1** Insert the plug of the DC power cord into the instrument's external power terminal.
- 2** Route the DC power cord through the instrument's cable hook to prevent the cord from being unplugged.
- 3** Observing the correct polarity, connect another end of the DC power cord to an external power supply.



NOTE

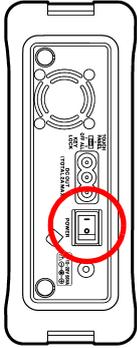
Using a DC power cord of 3 m or longer can subject the instrument to harmful electromagnetic environments such as external noises.

Turning the Power On and Off

This section describes how to turn the instrument on and off.

Turning Power On

Left side



Power On |

Verify that the instrument and any peripheral devices have been properly installed and connected.

Turn the **POWER** switch on (|).

The power LED will light up.
The power supply icon appears near the bottom right corner of the screen (p. 25).

Once the initial screen has been displayed, the instrument will display either **[Waveform Display]** or **[Setting Display]** ► **[Status]**.

If the "  " indicator is not displayed, the instrument is not being powered from the AC line. In this state, the battery charge will be depleted if measuring for a long time, and measurement may be interrupted. Verify that the AC adapter is securely connected to an AC power source and to the instrument.

NOTE

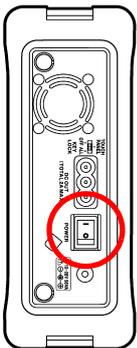
Before Starting Measurement

To obtain precise measurements, provide about 30 minutes warm-up after turning power on to allow the internal temperature of the input modules to stabilize. After that, perform zero adjustment before taking measurements.

Turning Power Off

Recording Data
When the **POWER** switch is turned off, internal recorded data is erased. If you don't want to lose recorded data, save it first to an SD memory card or USB flash drive.
See: "Chapter 4 Saving/Loading Data & Managing Files" (p. 87)

Left side



Power Off ○

Turn the **POWER** switch off (○).

When power is turned on again, the display appears with the settings that existed when power was last turned off.
When the auto setup function is enabled, settings will be loaded automatically (p. 106).

If a battery pack has been installed and the AC adapter is connected to a power outlet, the battery will be charged even if the instrument is turned off.

Wait for the power LED (green) to go completely out after turning off the **POWER** switch before turning the instrument back on.

2.5 Setting the Clock

The MR8875 incorporates an auto calendar, automatic leap year detection, and a 24-hour clock.

Verify that the date and time are correct before using the instrument as incorrect date and time information may affect the accuracy of measurement start times (trigger times) and detailed file properties.

The clock can be set by either of the following methods:

- Set with the instrument.

Setting with the instrument

1 Open the screen.

[Setting Display] ► [System] ►
[Initialize] ► [Time Setting]

The settings window will be displayed.

2 Set the time.

Tap the digit you wish to change and set the desired value using the displayed window.

See: "Changing values" (p. 145)

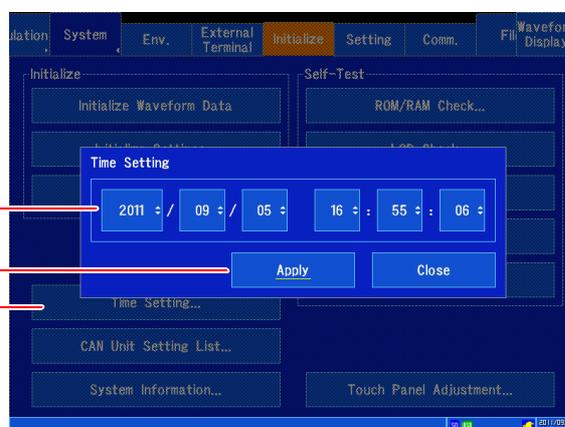
3 Tap [Apply].

The setting will be applied, and the instrument will return to the previous screen.

To cancel the setting:

Tap [Close].

The window will close, leaving the setting unchanged.



2.6 Performing Zero Adjustment

(Model MR8901 Analog Unit, MR8902 Voltage/TEMP Unit and MR8905 Analog Unit only)

This section describes how to compensate for input module differences and set the instrument's reference potential to 0 V. Compensation applies to all ranges.

Before performing zero adjustment

- To obtain precise measurements, provide about 30 minutes warm-up after turning power on to allow the internal temperature of the input modules to stabilize.
- Zero adjustment cannot be performed during measurement.
- Key and touch panel operations are not accepted while zero adjustment is being performed (the process may take several seconds).
- Perform zero adjustment only when no voltage is applied to any input terminal.

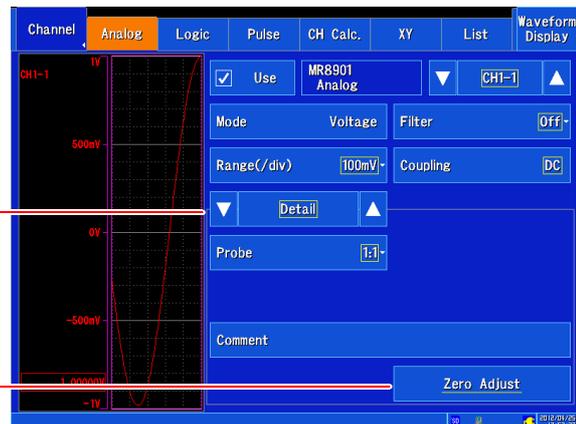
1 Open the screen.

[Waveform Display] / [Setting Display]
▶ [Channel] ▶ [Analog]

2 Select [Detail].

3 Tap [Zero Adjust].

[Zero Adjust] is only shown for Model MR8901 Analog Unit, MR8902 Voltage/TEMP Unit or MR8905 Analog Unit channels.



NOTE Zero adjustment cannot be performed for the MR8903 Strain Unit and MR8904 CAN Unit. (The MR8903 Strain Unit's zero position can be adjusted with auto balance functionality (p. 168).)

Perform zero adjustment in the following circumstances:

- When changing input modules
- When turning the instrument on or off
- When initializing settings (performing a system reset)
- When the ambient temperature changes rapidly (The zero position may drift.)

Changes in the zero position caused by temperature drift

The instrument requires a warm-up time of at least 30 minutes as a condition for guaranteed accuracy. The zero position will fluctuate to a comparatively significant extent for a period of 30 minutes after the instrument is turned on. Always perform zero adjustment before measurement to address this characteristic.

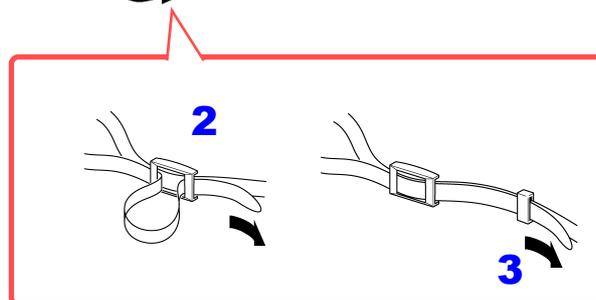
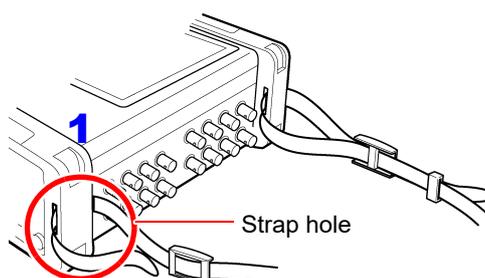
2.7 Attaching the Strap

Use the strap (included accessory) to keep the instrument from falling when carrying it or to suspend it from a hook during use.

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

Feed the strap through the buckle so that it is tight and not twisted.

- 1** Push the strap through one of the strap holes on the instrument.
- 2** Feed the strap through the buckle.
- 3** Put the end of the strap under the retaining loop.
- 4** Repeat the same procedure with the other end of the strap and the other strap hole.



2.8 Supplying Power to an External Device

The MR8875, MR8875-30 can generate an output voltage of 5 V from its external power supply terminals, outputting a total of up to 2 A.

See: "Setting external 5 V output" (p. 267)

CAUTION

Connect the external device's power cord to an external power supply terminal before turning the 5 V output on.

See: "Setting external 5 V output" (p. 267)

Connecting the external device's power cord to an external power supply terminal while 5 V is being output may damage the instrument.

2.9 Applying Protection Sheet to the Display

Apply the included Protection sheet to the instrument's LCD display to protect it from dirt, scratches, and dust.

- 1 Wipe any dirt off the LCD screen.

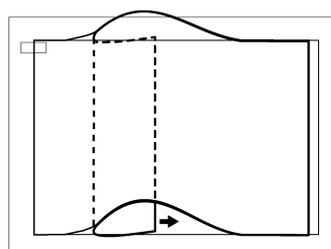
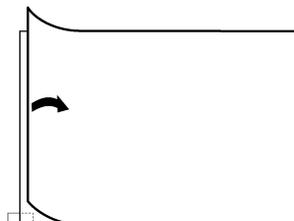
Use a soft, dry cloth to wipe the screen.

- 2 Peel off 5 cm of the backing from the protection sheet.

Static electricity may cause dirt to cling to the sheet when you peel off the backing. Remove the backing in an environment that is as free of dust as possible.

- 3 With the instrument turned off, align the side of the sheet from which the backing has been removed with the LCD screen, adjust the position of the entire sheet as necessary, and apply the sheet slowly while pushing lightly on it.

If you need to adjust the position of the Protection sheet once it has already been applied, peel it off gradually and adjust as desired. The sheet uses silicon adhesion and can be removed and reapplied multiple times.



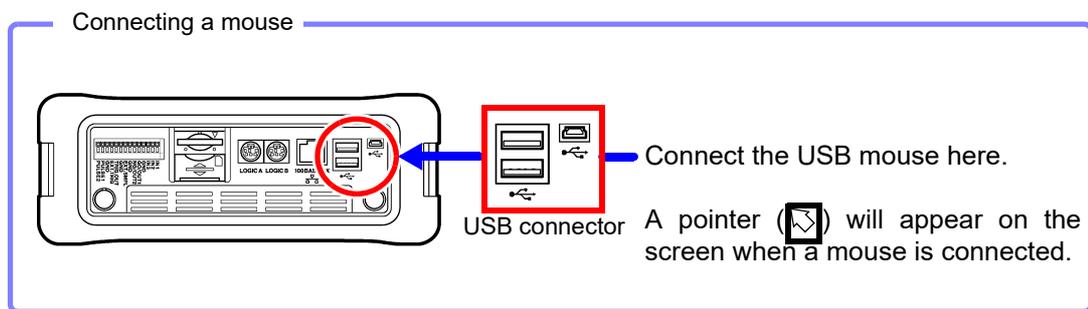
2.10 Using a USB Mouse and Keyboard

Using a USB mouse

You can control the instrument by connecting a commercially available USB mouse to the instrument's USB connector.

NOTE

When using a mouse, do so on an insulated surface. Many commercially available mice are prone to be affected by interference from the measuring environment, and use of the mouse on a metallic surface may cause the instrument to malfunction due to the effects of such interference.



Using a USB keyboard

You can enter text directly by connecting a commercially available USB keyboard to the instrument's USB connector.

NOTE

- When using a keyboard, do so on an insulated surface. Many commercially available keyboards are prone to be affected by interference from the measuring environment, and use of the keyboard on a metallic surface may cause the instrument to malfunction due to the effects of such interference.
- Do not use external USB hubs.
- Some mice and keyboards may not operate properly.

Measurement Procedure

Chapter 3

3.1 Making Safe Measurements



Observe the following precautionary information in order to ensure your ability to make safe measurements.

DANGER

Note the following maximum input voltage and maximum rated voltage to earth. The following tables list the maximum input voltage and the maximum rated voltage to earth for connection cords. To avoid electric shock and instrument damage, do not input voltages in excess of these figures. The lower of the instrument's and the connection cord's maximum input voltages applies.

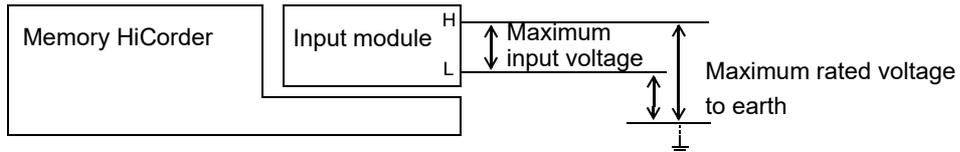
When these voltage levels are exceeded, the instrument will be damaged. Do not make measurements as doing so may result in bodily injury. The maximum rated voltage to earth does not change, even if you make measurements with an attenuator or other component connected to the input. Consider your connection method and do not exceed the maximum rated voltage to earth.

Input Modules	Maximum input voltage	Maximum rated voltage to earth
Model MR8901 Analog Unit	150 VDC	100 VAC/DC (CAT II)
Model MR8902 Voltage/TEMP Unit	100 VDC	100 VAC/DC (CAT II)
Model MR8903 Strain Unit	10 VDC	30 V rms/ 60 VDC
Model MR8905 Analog Unit	1000 VDC	1000 VAC/DC (CAT II) 600 VAC/DC (CAT III)

3.1 Making Safe Measurements



Measurement cables	Maximum input voltage	Maximum rated voltage to earth
Model L9197 Connection Cord	600 VAC/DC	600 VAC/DC (CAT III)
Model 9197 Connection Cord		300 VAC/DC (CAT IV)
Model L9198 Connection Cord	300 VAC/DC	600 VAC/DC (CAT II)
Model L9217 Connection Cord		300 VAC/DC (CAT III)
Model L9790 Connection Cord	600 VAC/DC	When using the 9790-03 Contact Pin and L9790-01 Alligator Clip 600 VAC/DC (CAT II) 300 VAC/DC (CAT III) When using the 9790-02 Grabber Clip 300 VAC/DC (CAT II) 150 VAC/DC (CAT III)
Model 9322 Differential Probe	2000 VDC, 1000 VAC	When using the grabber clip 1500 VAC/DC (CAT II) 600 VAC/DC (CAT III) When using the alligator clip 1000 VAC/DC (CAT II) 600 VAC/DC (CAT III)
Model P9000-01 Differential Probe Model P9000-02 Differential Probe	1000 VAC/DC	1000 VAC/DC (CAT III)
Model L4940 Connection Cable * When used with Model MR8905	1000 VDC*	When using the L4935 Alligator Clip and L4932 Test Pin 600 VAC/DC (CAT IV) 1000 VAC/DC (CAT III) When the L9243 Grabber Clip and L4937 Magnetic Adapter is attached 1000 VAC/DC (CAT III) When using the L4934 Small Alligator Clip 300 VAC/DC (CAT III) 600 VAC/DC (CAT II)



3.2 Measurement Workflow

1 Perform the pre-measurement inspection

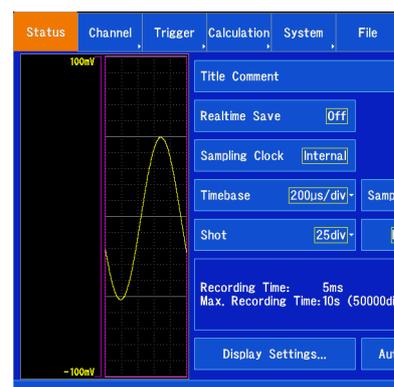
See: "3.3 Pre-Measurement Inspection" (p. 55)

2 Set the basic measurement settings

- Setting the acquisition speed (time-axis range [horizontal axis] and sampling speed) (p. 58)
- Determining the waveform length (recording length) (p. 61)
- Determining the format in which to display waveforms (p. 62)

Applied settings

See: "5.12 Compositing Waveforms (XY Compositing)" (p. 135)
 "6.3 Overlaying Previously Captured Waveforms (Overlaying)" (p. 146)
 "6.4 Setting Channels to Use (Increasing the Recording Length)" (p. 147)



3 Configure input channels

- Configuring analog channels (p. 67) (Advanced settings for individual input modules (p. 164))
- Configuring logic channels (p. 71)
- Configuring pulse settings (p. 73)
- Configuring inter-channel calculation channels settings (p. 78)

Applied settings

See: "6.1 Adding Comments" (p. 142), "6.5 Converting Input Values (Scaling Function)" (p. 150)
 "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)
 "6.7 Fine Adjustment of Input Values (Vernier Function)" (p. 161), "6.8 Inverting Waveforms" (p. 162)

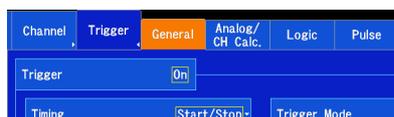


4 Configure triggers

See: "Chapter 7 Trigger Settings" (p. 171)

External control

See: "Chapter 13 External Control" (p. 323)



5 Start measurement

See: "3.6 Starting and Stopping Measurement" (p. 80)
 "Chapter 5 Waveform Monitoring and Analysis" (p. 111)

6 Finish

See: "3.6 Starting and Stopping Measurement" (p. 80)

After measurement

See: "Chapter 4 Saving/Loading Data & Managing Files" (p. 87), "Chapter 8 Numerical Calculation Function" (p. 189), "Chapter 9 Waveform Calculation Function" (p. 207)

**To check the signals being input**

Performing auto-ranging causes the input waveform's time-axis range, vertical axis (voltage axis) range, and zero position to be automatically set and measurement to be started.

See: "3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)" (p. 82)

To call up previously registered settings

Settings data can be loaded from the [\[Setting Display\]](#) ► [\[System\]](#) ► [\[Setting\]](#) screen.

See: "Loading settings data" (p. 104)

To load settings into the instrument automatically

Settings can be loaded automatically when the instrument is turned on. The instrument can be configured simply by inserting an SD memory card containing settings data registered with the instrument or an automatic settings file (start file) into the instrument and turning it on.

See: "4.5 Loading Settings Automatically (Auto Setup Function)" (p. 106)

- Verify that there are files in the folder "HIOKI_MR8875."
- Only automatic settings files stored on SD memory cards can be used.
- Startup file path and filename:
"/HIOKI_MR8875/CONFIG/STARTUP.SET"

To initialize settings (revert to basic settings)

You can initialize the instrument's settings by reverting them to their state at the time of its shipment on the [\[Setting Display\]](#) ► [\[System\]](#) ► [\[Initialize\]](#) screen. After initialization, settings return to a state that is suitable for simple measurement. Settings should be initialized when the instrument exhibits strange or complex operation.

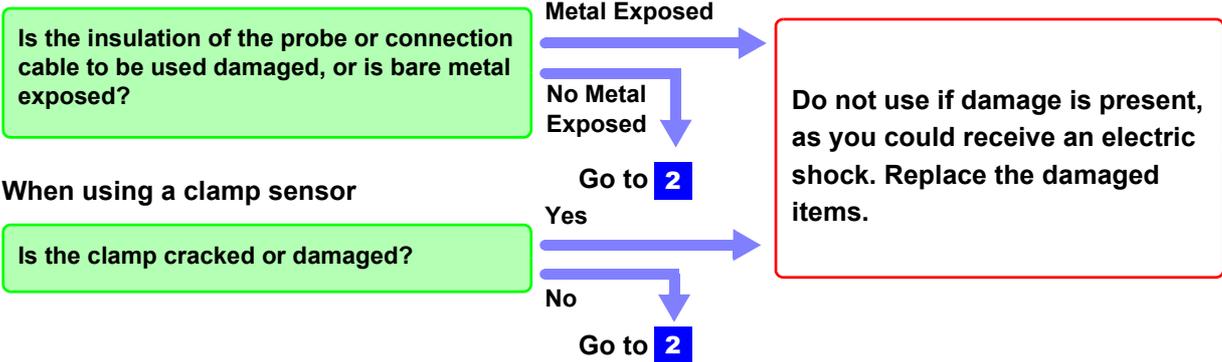
See: "11.3 Initializing the Instrument" (p. 271)

3.3 Pre-Measurement Inspection

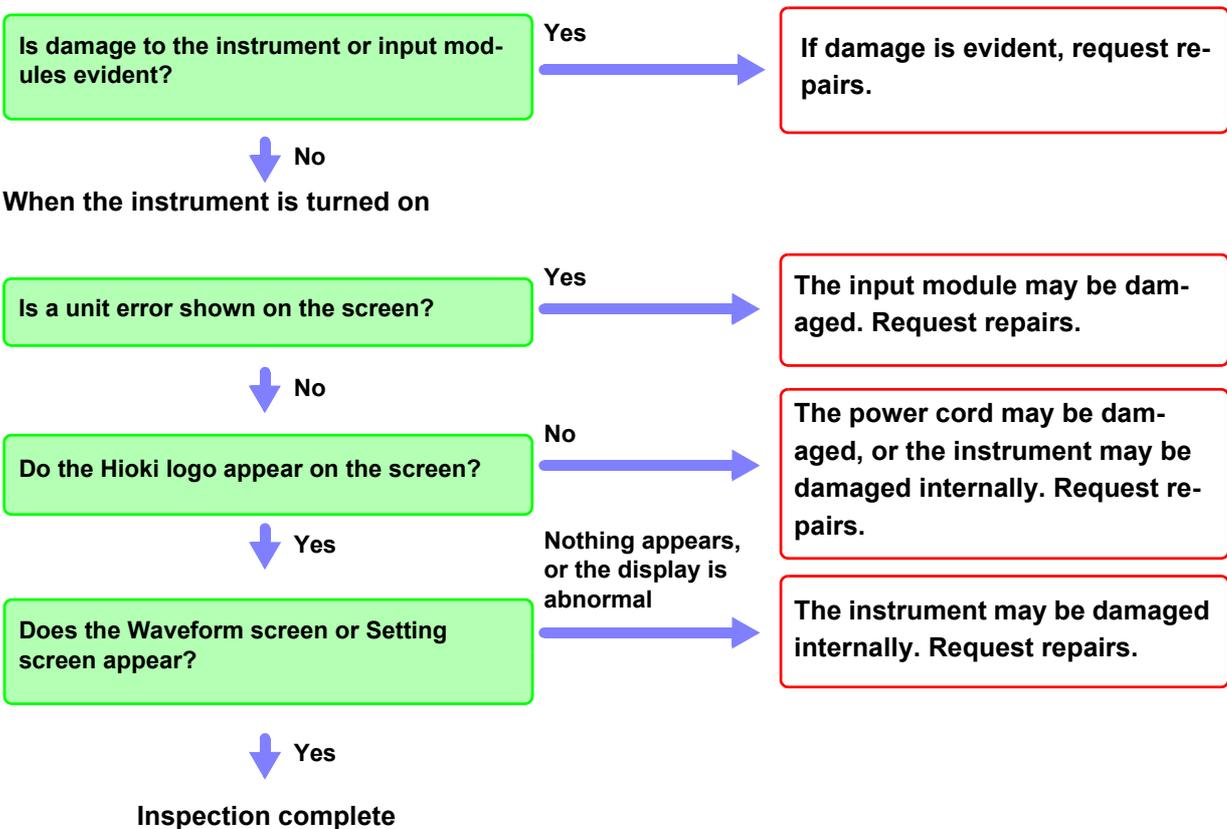
Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

1 Peripheral Device Inspection

When using probes and connection cables



2 Instrument and Input Module Inspection



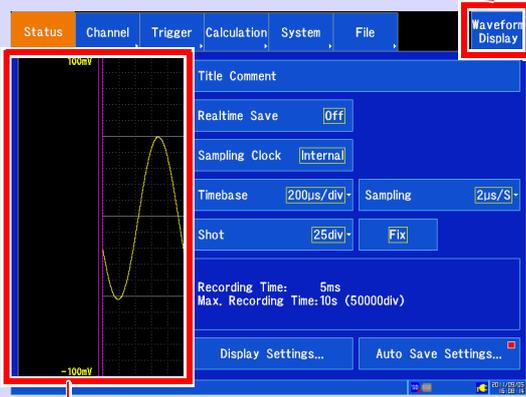
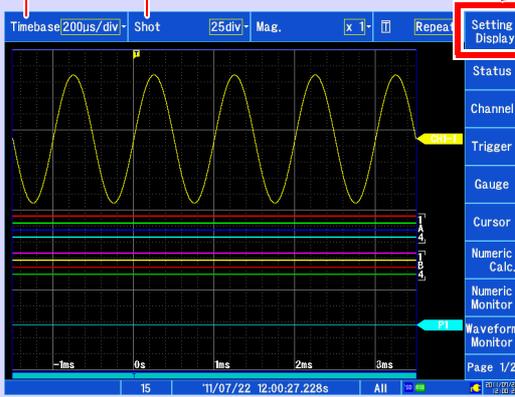
3.4 Setting Measurement Configuration

This section describes how to set measurement conditions. Basic settings can be configured using the items on the right side of the Waveform screen. Advanced settings can also be performed on the [Setting Display].

Sets the time-axis range (sampling speed) (p. 58).

Sets the recording length (number of divisions) (p. 61).

Switches between the Waveform screen and Settings screen.

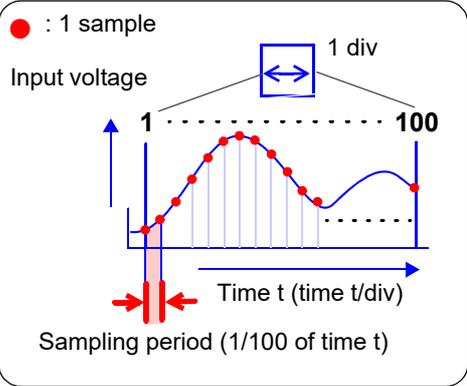
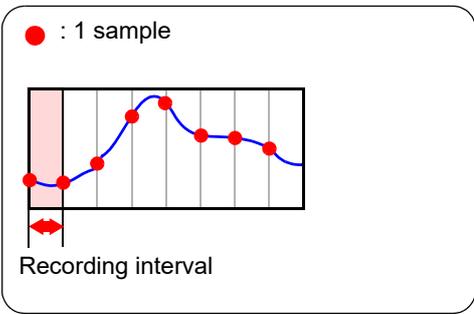


Allows you to monitor the waveform being currently input.

Setting whether to save data

When you select real-time saving, data is saved to the SD memory card as measurement is performed, allowing long-term measurement to be performed without regard to the instrument's internal memory capacity. The method used to set measurement conditions varies depending on whether real-time saving is turned on or off. For more information about how to set measurement conditions when real-time saving is on, see "Saving data in real time" (p. 96).

The difference between measurement with real-time saving on and real-time saving off

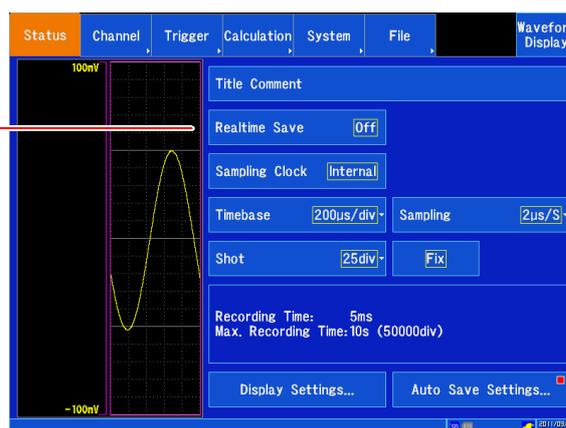
Real-time saving: Off	Real-time saving: On
Difference in internal operation	
<p>This mode of operation is recommended when measurements will not exceed the internal memory capacity. You can perform measurement with a high sampling speed. Data equivalent to the recording length is stored in the internal memory and then displayed and saved.</p>	<p>This mode of operation is recommended when measurements will exceed the internal memory capacity. As with a data recorder, data is recorded directly to the SD memory card while measurement is performed, allowing long-term measurement.</p>
Selecting the sampling speed	
<p>Set the time represented by 1 horizontal axis (time-axis) division. The highest time-axis value is 200 $\mu\text{s}/\text{div}$, which converts to a sampling speed of 500 kS/s (a data count of 100 per division using the zoom factor 1\times display).</p> <p>You can set the desired recording interval at which you wish to sample data as shown to the right by changing the setting.</p>	<p>Set the recording interval at which you wish to sample data. The valid recording interval settings are limited by the number of channels in use.</p>
	

- 1 Open the screen.
 [Waveform Display] ► [Status] ►
 [Basic] Or [Setting Display] ► [Status]

- 2 [Realtime Save] ► Tap to switch.

Select (*:Initial setting)

Off*	Records measurement data to the instrument's internal memory. See: When you wish to use auto saving (p. 93).
On	Performs real-time saving (p. 96).



Setting the horizontal axis (time-axis or sampling speed)

The time-axis range and sampling speed settings are linked.

The timebase setting establishes the rate of input signal waveform acquisition, specified as time-per-division on the horizontal axis (time/div). The sampling setting specifies the interval from one sample to the next.

Changing the time-axis range causes the sampling speed to change. The number of samples per division is fixed at 100, and the sampling speed is 1/100 of the set time-axis range. When the value given by (time-axis range ÷ display zoom factor) is greater than 50 ms, the waveform is automatically scrolled during measurement (known as the roll mode display function).

See: "Maximum recording time" (p. A5)

1 Open the screen

[Waveform Display] ► [Status] ►
[Basic] Or [Setting Display] ► [Status]

2 Set [Sampling Clock] to [Internal].

Tap to switch the setting values.

Select (*:Initial setting)

Internal* Selects the value (time-axis or sampling speed) previously set with the instrument. (Select this setting during normal operation.)

External Select this setting when you wish to sample data by inputting a signal from an external source.

See: "External Sampling (EXT.SMPL)"
(p. 327)

3 [Timebase] ► Select from the list.

Set the time per division (timebase) on the horizontal axis.

Select (*:Initial setting)

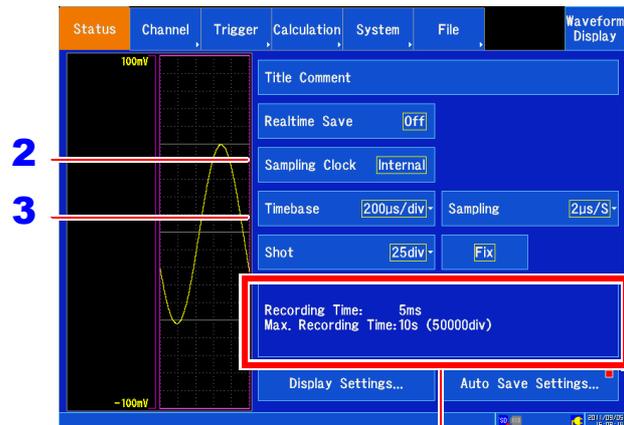
200*, 500 μ s/div

1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div

1, 2, 5, 10, 30, 50, 60, 100 s/div

2, 5 min/div

The sampling speed setting will change in response.
(You can also set this parameter by changing the sampling speed.)



The recording time and maximum recording time will be displayed based on the time-axis and recording length settings.

Time-axis range and maximum recording time
The maximum recording time varies with the set time-axis range. The maximum recording time is calculated using the following equation:

Maximum recording time =
Time-axis range × maximum recording length

Determining the time-axis range

Refer to the following table to set the time-axis range.

Example: To measure a 1 kHz waveform

Based on the table, the valid maximum display frequency range is 2 kHz to 20 kHz. To use a maximum display frequency of 8 kHz, select a time-axis range of 500 μ s/div.

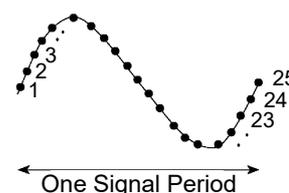
Timebase	Sampling Rate	Max. display frequency
200 μ s/div	2 μ s (500 kS/s)	20 kHz
500 μ s/div	5 μ s (200 kS/s)	8 kHz
1 ms/div	10 μ s (100 kS/s)	4 kHz
2 ms/div	20 μ s (50 kS/s)	2 kHz
5 ms/div	50 μ s (20 kS/s)	800 Hz
10 ms/div	100 μ s (10 kS/s)	400 Hz
20 ms/div	200 μ s (5 kS/s)	200 Hz
50 ms/div	500 μ s (2 kS/s)	80 Hz
100 ms/div	1 ms (1 kS/s)	40 Hz
200 ms/div	2 ms (500 S/s)	20 Hz
500 ms/div	5 ms (200 S/s)	8 Hz

Timebase	Sampling Rate	Max. display frequency
1 s/div	10 ms (100 S/s)	4 Hz
2 s/div	20 ms (50 S/s)	2 Hz
5 s/div	50 ms (20 S/s)	0.8 Hz
10 s/div	100 ms (10 S/s)	0.4 Hz
30 s/div	300 ms (3.33 S/s)	0.13 Hz
50 s/div	500 ms (2 S/s)	0.08 Hz
60 s/div	600 ms (1.67 S/s)	0.04 Hz
100 s/div	1 s (1 S/s)	0.067 Hz
2 min/div	1.2 s (0.83 S/s)	0.033 Hz
5 min/div	3 s (0.33 S/s)	0.013 Hz

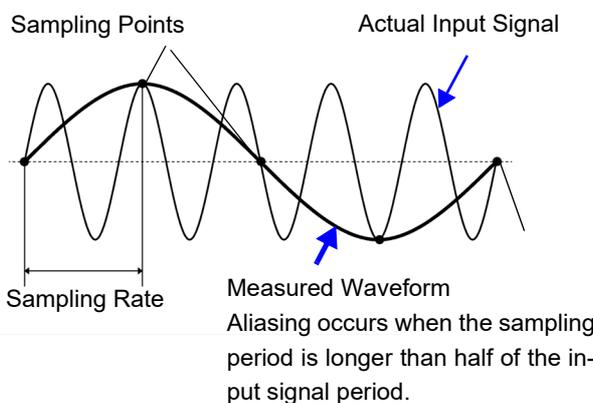


What is the maximum display frequency?

Displaying waveforms by their sampled values with adequate resolution of characteristics such as sine wave peaks requires a minimum of about 25 samples per waveform period. The maximum display frequency is determined by the timebase.



What to do if a non-existent waveform is recorded (dealing with aliasing)



If the signal to be measured changes too fast relative to the sampling rate, beginning at a certain frequency, non-existent slow signal fluctuations are recorded. This phenomena is aliasing.

The sampling rate can be significantly affected by the timebase setting, so care is necessary to avoid aliasing when selecting the timebase.

Because the timebase determines the maximum display frequency, the fastest possible timebase setting should be used.

When the signal can be recorded repeatedly,

the auto-ranging function (p. 82) may be used to select the optimum timebase.

The sampling speed is automatically set to 1/100 of the set time-axis range.

To set the time-axis range automatically

When you use the auto-ranging function, the instrument selects the appropriate time-axis range for the input signal and starts recording.

See: "3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)" (p. 82)

To reduce noise during measurement

Enable the input module's filter (p. 67).

3.4 Setting Measurement Configuration

NOTE The data refresh rate is not allowed to exceed the maximum sampling rate of the input module. The same data is measured during the interval that data is not updated, resulting in a staircase-shaped waveform. Even if the same signals were to be sampled simultaneously, differences in the modules' sampling speed, frequency band, and frequency characteristics would cause the data to differ.

Input module data update rates

Input modules	Maximum time-axis range	Maximum sampling rate
MR8901	200 μ s/div	2 μ s/S (500 kS/s)
MR8902	Based on data update setting	Based on data update setting
MR8903	500 μ s/div	5 μ s/S (200 kS/s)
MR8904	5 ms/div	50 μ s/S (20 kS/s)
MR8905	200 μ s/div	2 μ s/S (500 kS/s)

Setting the recording length (number of divisions)

This section describes how to set the length (number of divisions) for to record each time the instrument acquires data. You can select a waveform, XY composite waveform, or FFT calculated waveform for each sheet. Each division of the recording length consists of 100 data samples. The total number of data samples for a specified recording length = set recording length (divisions) × 100 + 1.

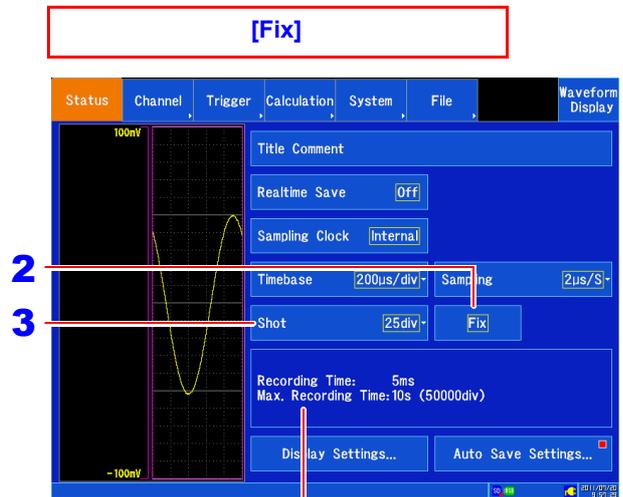
- 1 Open the screen.
 [Waveform Display] ► [Status] ► [Basic] Or [Setting Display] ► [Status]
 - 2 Set the recording length setting method.
 Tap to switch.
 Select (*:Initial setting)
- | | |
|-------------|--|
| Fix* | Selects the method based on a previously prepared value. |
| Any | Sets to the desired value in 1-division units. |
- 3 Set the recording length to use when acquiring waveforms.

When the recording length setting method is [Fix]

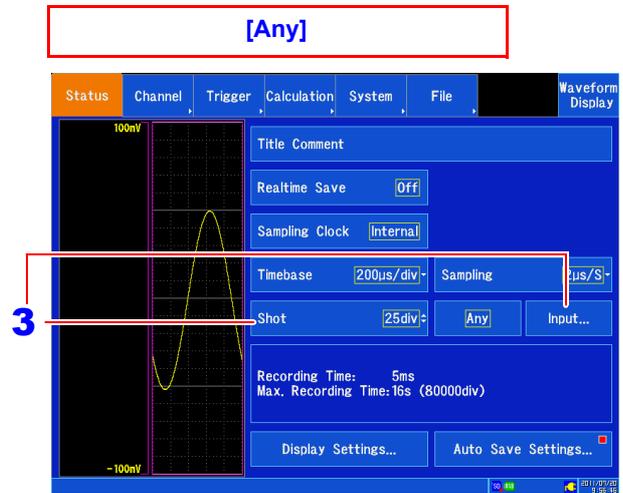
- [Shot] ► Select from the list.
 Select (*:Initial setting)
- | |
|--|
| 25*, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000div |
|--|

When the recording length setting method is [Any]

- You can configure the setting with either of the following two methods:
- [Shot] ► Change the value.
 [Input] ► Enter a value.
- Valid setting range (initial setting: 25)
- | |
|---------------|
| 5 to 80000div |
|---------------|
- See: "6.2 Changing and Entering Values" (p. 145)



The recording time and maximum recording time will be displayed in response to the time-axis and recording length settings.



Relationship between the number of channels in use and the recording length

The valid setting range for the recording length is limited by the number of channels in use. The number of channels is determined by the channels for which the [Use] setting is enabled on the [Channel] screen.

See: "6.4 Setting Channels to Use (Increasing the Recording Length)" (p. 147)



Configuring the screen layout

You can divide measurement data into four sheets for display on the Waveform screen, and you can select whether to display a waveform or XY composite waveform on each sheet. You can also divide the screen into multiple display screens (graphs), assigning analog, pulse, and inter-channel calculation channels to each graph.

You can generate XY composites of waveforms by setting the display format to XY composite.

See: "5.12 Compositing Waveforms (XY Compositing)" (p. 135)

- 1 **Open the screen.**
[Waveform Display] ▶ [Status] ▶ [Display] Or [Setting Display] ▶ [Status] ▶ [Display Settings]

Configure the following settings for the desired sheets.

- 2 **Tap the desired display format to select it.**

Select the format you wish to use for the display.

Select (*:Initial setting)

Waveform*	Displays waveforms.
X-Y	Displays XY composite waveforms.
FFT	Displays FFT calculation waveforms.

- 3 **Select the screen division from the list.**

Set the number of screen divisions. The available divisions will vary depending on the selected display format.

When [Waveform] is selected as the display format

Select (*:Initial setting)

Single*	Displays waveforms on 1 screen.
Dual	Displays waveforms on 2 screens.
Quad	Displays waveforms on 4 screens.

When [X-Y] is selected as the display format

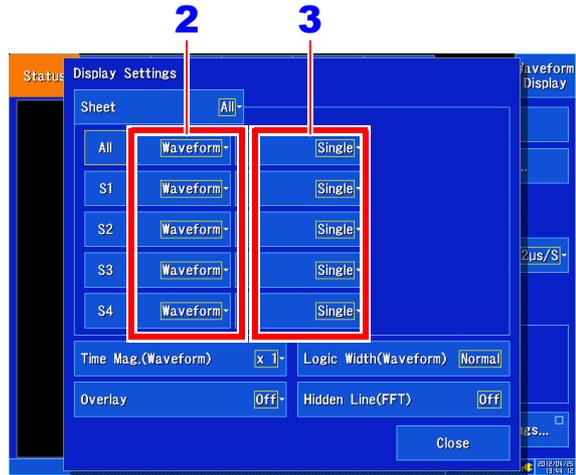
Select (*:Initial setting)

Single*	Displays the XY composite waveforms from XY1 to XY8 on 1 screen.
Dual	Displays the XY composite waveforms from XY1 to XY8 on 2 screens.
Waveform +XY	Displays waveforms on 1 screen and XY composite waveforms from XY1 to XY8 on 2 screens.

When [FFT] is selected as the display format

Select (*:Initial setting)

Single*	Displays the FFT calculation results on one screen. When multiple calculations have been set, waveforms are displayed on top of one another. However, analysis No. 1 alone may be displayed depending on the analysis mode settings.
----------------	--



Dual Displays the FFT calculation results on two screens. When multiple calculations have been set, a waveform will be displayed for each set calculation.

Quad Displays the FFT calculation results on four screens. Results are displayed by calculation number.

Waveform+FFT1 Displays a total of two screens, with the calculation target waveform on one screen and the FFT calculation results on one screen.

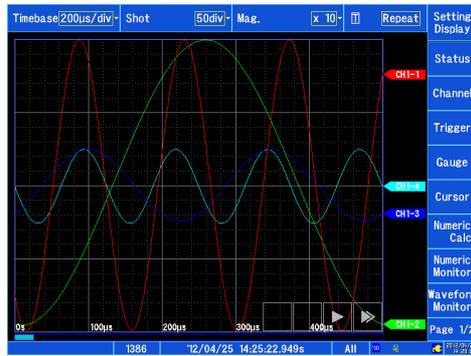
Waveform+FFT2 Displays a total of three screens, with the calculation target waveform on one screen and the FFT calculation results on two screens.

Waveform+FFT4 Displays a total of five screens, with the calculation target waveform on one screen and the FFT calculation results on four screens.

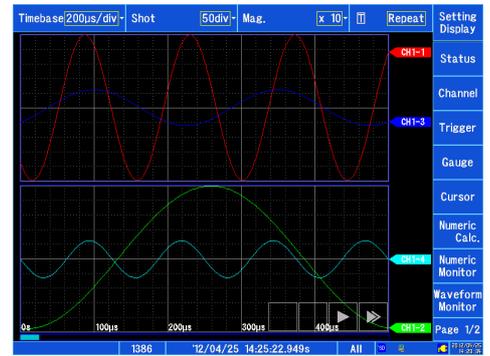
Running Spectrum When using one of the following analysis modes, generates a three-dimensional display from the three components of frequency, amplitude, and time:
 (Linear spectrum, RMS spectrum, power spectrum, transmission function, cross-power spectrum)
 When multiple calculations have been set, the No. 1 calculation is given priority on the display.
 "Displaying Running Spectrums" (p. 243)

There are 13 display configurations:

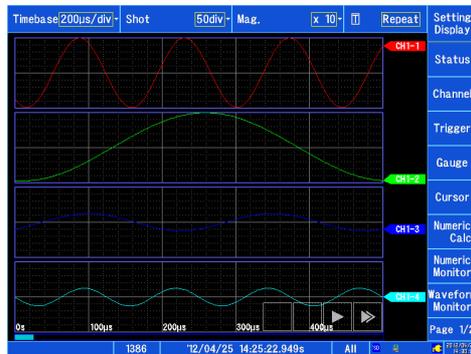
There are 13 display configurations:



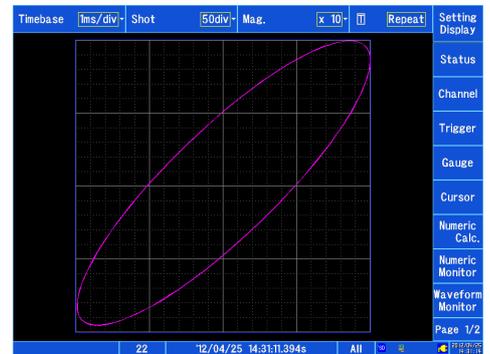
Single (Display format: [Waveform])



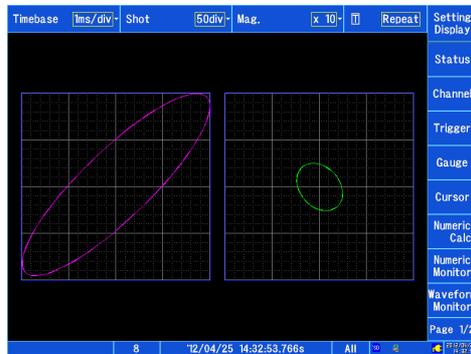
Dual (Display format: [Waveform])



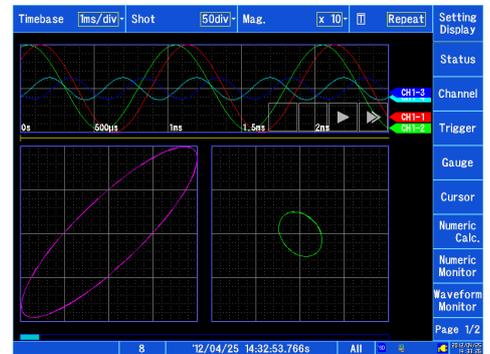
Quad (Display format: [Waveform])



Single (Display format: [X-Y])



Dual (Display format: [X-Y])



Waveform+XY (Display format: [X-Y])

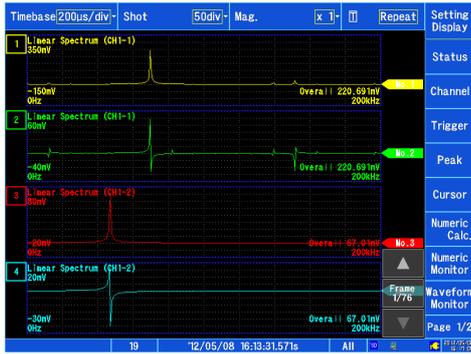


Single (Display format: [FFT])

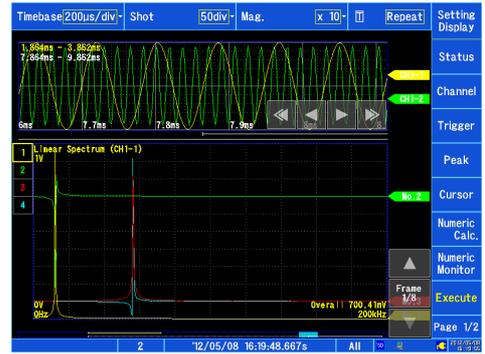


Dual (Display format: [FFT])

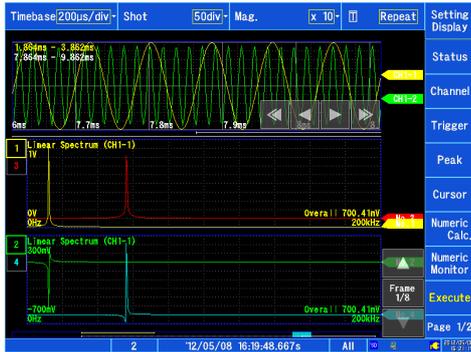
3.4 Setting Measurement Configuration



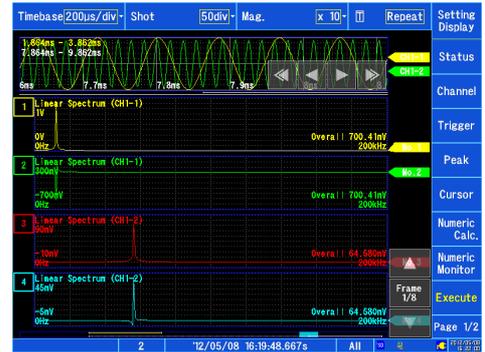
Quad (Display format: **[FFT]**)



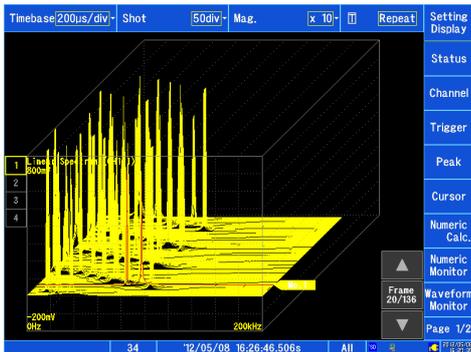
Waveform+FFT1 (Display format: **[FFT]**)



Waveform+FFT2 (Display format: **[FFT]**)



Waveform+FFT4 (Display format: **[FFT]**)



Running Spectrum (Display format: **[FFT]**)

Allocating channels to graphs (analog, pulse, and inter-channel calculation)

This section describes how to freely allocate analog and pulse channels to graphs.

1 Open the screen.
[Waveform Display]/[Setting Display]
 ▶ **[Channel]** ▶ **[Analog]/[Pulse]/[CH Calc.]** ▶ **[Display]**

2 Select the channel you wish to configure.

3 **[Graph]** ▶ **Select from the list.**

Select the graph you wish to display.

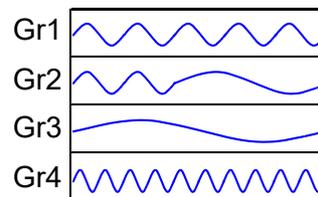
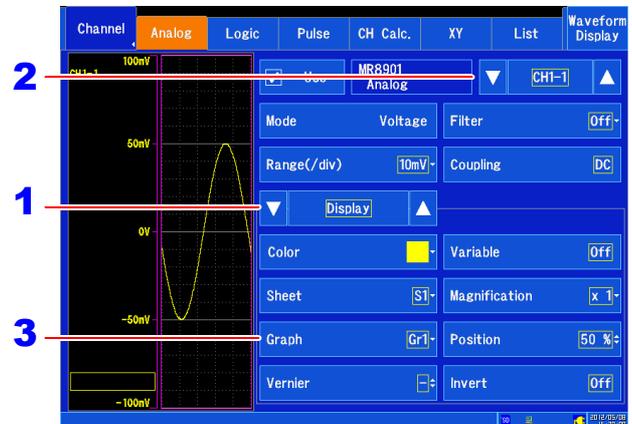
Select

Gr1, Gr2, Gr3, Gr4

Under the instrument's initial settings, analog channels are allocated in order by channel number to each module (Gr1, Gr2, Gr3, Gr4).

Pulse channels are allocated in order by channel number (Gr1, Gr2).

Inter-channel calculation channels are allocated in order by channel number to each module (Gr1, Gr2).



(When using 4 screens)

Graph allocation

The method used to allocate channels to graphs varies depending on the screen division settings (p. 62).

■ 1 screen

The channel is allocated to Gr1 regardless of the **[Graph]** settings.

■ 2 screens

When the **[Graph]** setting is Gr1 or Gr3, the channel is allocated to Gr1.

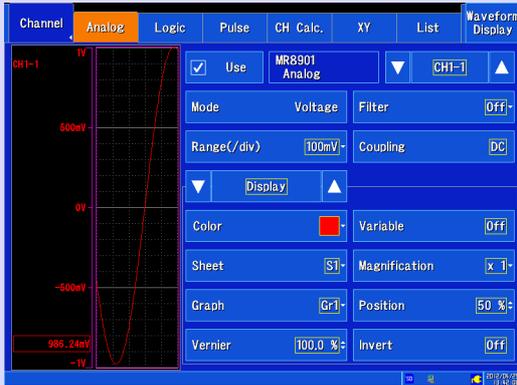
When the **[Graph]** setting is Gr2 or Gr4, the channel is allocated to Gr2.

■ 4 screens

Channels are allocated as per the **[Graph]** settings.

3.5 Setting the Input Channels

Input channels are set on the Input Settings (**[Channel]**) screen.

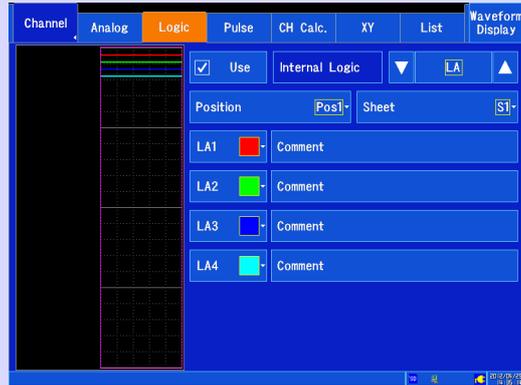


Analog channel settings

Use when making measurements with an input module.

See: "Configuring analog input channels" (p. 67)

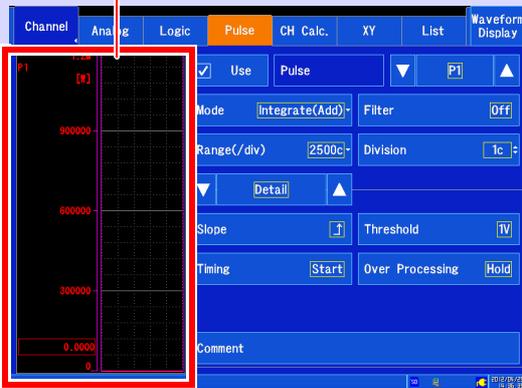
You can monitor the input waveform for the selected channel while you configure the settings.



Logic channel settings

Use when making logic measurements.

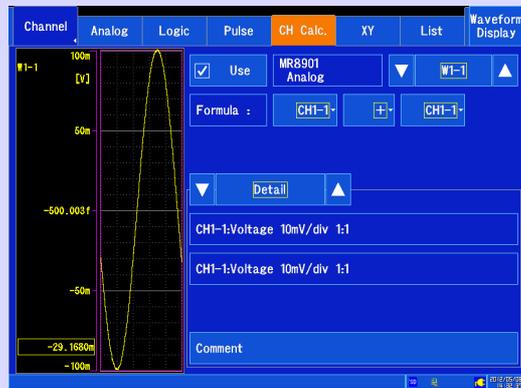
See: "Configuring logic channels" (p. 71)



Pulse channel settings

Use when making pulse (integration, rotational speed) measurements.

See: "Configuring pulse input (integration and rotational speed measurement)" (p. 73)



Inter-channel calculation channel settings

Use when measuring waveforms calculated between analog channels.

See: "Configuring inter-channel calculation channels" (p. 78)

The available settings vary with the input module being used. For more information, see "6.10 Configuring Detailed Input Module Settings" (p. 164).

Configuring analog input channels

This section describes how to configure analog channels. The available settings vary with the input module being used. For more information about input module-specific settings, see "6.10 Configuring Detailed Input Module Settings" (p. 164). For more information about the MR8904 CAN Unit, see the instruction manual on the included CD.

Configuring analog input channels

1 Configuring the channel being used

- Select the measurement mode for the input module being used (p. 164)
- Set the range for the measurement target (p. 68)
- Set input coupling. (p. 68)
(Model MR8901 Analog Unit, MR8905 Analog Unit only)
- Set the filter (p. 68) (when there is noise)
- Configure individual input module settings (as necessary) (p. 164)

2 Configuring screen display settings (as necessary)

- Convert input values (scaling function) (p. 150)
- Fine-tune the waveform amplitude (Vernier function) (p. 69)
- Magnify or compress the vertical axis (voltage axis) (p. 69)
- Set the display position and zoom factor as desired (variable function) (p. 159)
- Set the waveform display color (p. 69)
- Configure other display settings

3 Setting triggers (to record based on particular conditions)

See: "Chapter 7 Trigger Settings" (p. 171)

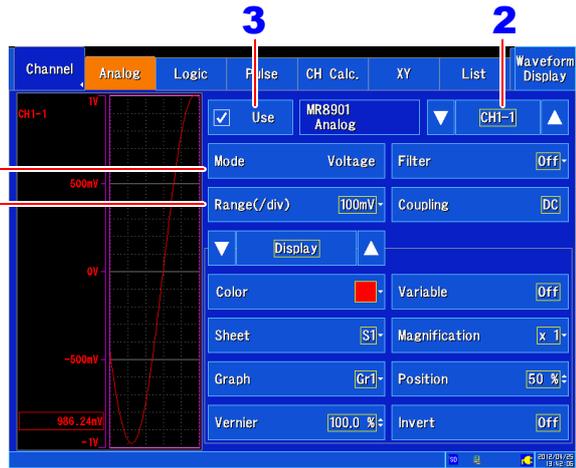
Configure other settings as necessary and start measurement.

NOTE

When setting triggers, set the vertical axis (voltage axis) range first. Changing the range after setting triggers will cause the trigger settings to change.

3.5 Setting the Input Channels

- 1 Open the screen.
 [Waveform Display]/[Setting Display] ►
 [Channel] ► [Analog]
- 2 Select the channel to configure.
- 3 Set [Use] to on (☑).
 (Initial setting: On)
- 4 [Mode] ► Tap to switch.
 Set the measurement mode.
 (Available modes vary with the input module being used. (p. 164))
- 5 [Range(/div)] ► Select from the list.



Set the vertical axis (voltage axis) range. The setting value indicates the voltage value for each step on the vertical axis. For more information about the valid setting range, see the specifications for individual input modules (p. 331).

Module full-scale:

See: "Input module full-scale resolution (LSB) at different vertical axis zoom factors" (p. 70)

When the variable function (p. 159) is on, the size of the waveform on the screen will not change when the vertical axis (voltage axis) range is changed.

- 6 **Configure other settings as necessary.**
 The available settings vary with the input module being used.

[Coupling]

(Model MR8901 Analog Unit and Model MR8905 Analog Unit only)

The available settings vary with the input module being used. Set the input signal coupling method. Set the input module coupling method. Normally, DC coupling should be used. Select (*:Initial setting)

DC*	Measures the input signal.
GND	Drops the signal to ground (allowing you to verify the zero position).

[Filter]

Configure the input module's internal filter. This functionality provides an effective way to cut unneeded high-frequency signal components. The available filter settings vary with the type of module being used. Set according to the input characteristics.

When the range is exceeded

When the signal exceeds the range that can be measured using the set range, the measured value will be shown as "+OVER" or "-OVER." Change the vertical axis (voltage axis) range to a lower sensitivity.

To convert values

You can convert and display values with the scaling function.

See: "Analog channel (input module) scaling settings" (p. 150)

About the filter of Model MR8902 Voltage/TEMP Unit

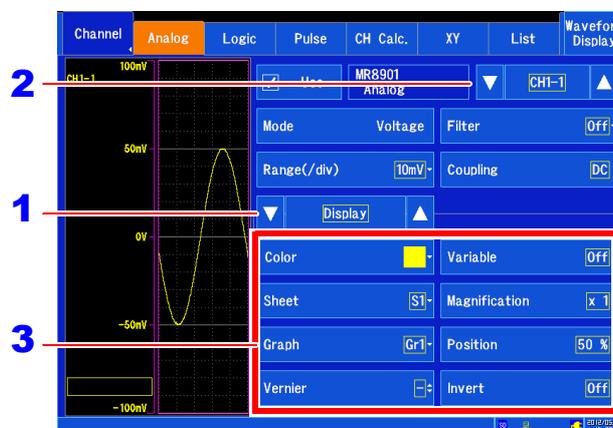
To conduct high-precision measurement with little variation, it is recommended to set the frequency to either 50 Hz or 60 Hz to match the local power supply frequency. The difference in measurement times between channels will increase when set to 50 Hz or 60 Hz, but this time can be minimized by setting the frequency to off (yielding a time difference of within 500 μs for adjacent channels or 10 ms for all channels).

NOTE Before using the [Filter], verify that the waveform does not exceed the range with the [Filter] set to [Off].

Configuring waveform display settings (as necessary)

You can change measured data after measurement.

- 1 Open the screen.
[Waveform Display]/[Setting Display] ► [Channel] ► [Analog] ► [Display]
- 2 Select the channel to configure.
- 3 Change the desired settings.



[Color]

Selects the color used to display the channel's waveform. You can also select the same color as other channels. To hide the waveform, select .

[Sheet]

Selects the sheet you wish to display. You can assign the waveform to any of up to four sheets.

See: "Configuring the screen layout" (p. 62)
"Switching between sheets" (p. 130)

[Graph]

Selects the graph you wish to display. You can assign the waveform to any of up to four graphs on the screen.

See: "Allocating channels to graphs (analog, pulse, and inter-channel calculation)" (p. 65)

[Vernier]

Fine-tunes the input voltage waveform as you monitor it (display adjustment only). This functionality allows you to easily adjust the amplitude when recording physical quantities using noise, temperature, acceleration, or other sensors, simplifying calibration work.

See: "6.7 Fine Adjustment of Input Values (Vernier Function)" (p. 161)

[Variable]

Sets the zoom factor as desired.

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)

[Magnification]

(Vertical axis [voltage axis])

Sets how much to magnify or compress the vertical axis (voltage axis) for each channel. Magnification and compression are performed relative to the zero position. Measurement resolution is not affected.

See: "Magnifying and Compressing Vertical Axis (Voltage Axis)" (p. 123)

[Position] ► Change the value.

Sets the 0 V level display position.(p. 70)

If the 0 V input level has shifted, perform zero adjustment.

See: "2.6 Performing Zero Adjustment" (p. 46)
"6.2 Changing and Entering Values" (p. 145)

[Invert]

Inverts the waveform when positive and negative values are inverted.

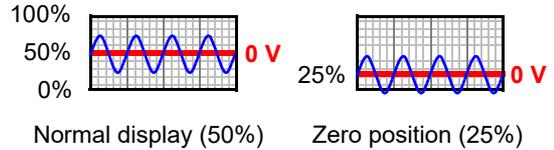
See: "6.8 Inverting Waveforms" (p. 162)

3.5 Setting the Input Channels



Zero position

Magnification and compression of the vertical axis (voltage axis) are performed relative to the zero position. The voltage range shown on the Waveform screen varies with the zero position and magnification/compression rate of the vertical axis, but the measurement range does not change. Simply moving the display position does not add an offset to input.

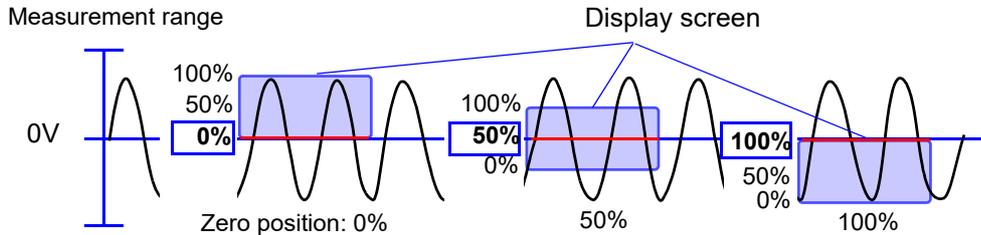


If the MR8903 Strain Unit's zero position is misaligned, use the auto-balance function.

See: "Configuring the MR8903 Strain Unit (Executing Auto-Balance)" (p. 168)

Zero position setting and screen display

Example: Model MR8901 Analog Unit
(Zoom factor: 1x)



The setting range varies with the vertical axis magnification/compression rate setting. The maximum setting range 100 yields values ranging from -10,000% to 10,100%.

To use the normal display (zero position: 50%, with the waveform's 0 V position in the center of the screen), set the **[Position]** setting to 50%. The waveform will be displayed in the center of the screen.

Input module full-scale resolution (LSB) at different vertical axis zoom factors

	1/10×	1/5×	1/2×	1×	2×	5×	10×	20×	50×	100×
MR8901	250000	125000	50000	25000	12500	5000	2500	1250	500	250
MR8903	(50000)	(50000)								
MR8905										
MR8902*	200000 (40000)	100000 (40000)	40000	20000	10000	4000	2000	1000	400	200

() Numbers in parentheses indicate the effective data range.

*The effective range for the MR8902 Voltage/TEMP Unit varies with the thermocouple used. For more information about the effective range, see the MR8902 Voltage/TEMP Unit specifications.

Full-scale value = Vertical-axis (voltage-axis) range × 20 divisions

Example: When the vertical-axis (voltage-axis) range is set to 1 V/div

$$1 \text{ V/div} \times 20 = 20 \text{ V}$$

The 1 V/div range has a full-scale value of 20 V.

Configuring logic channels

This section describes how to configure settings when performing logic measurements. You can configure internal logic as well as the MR8904 CAN Unit's logic channels. For more information about the MR8904, see the instruction manual on the included CD.

Configuring logic channels

1 Configuring the channel being used

- Select the channel to use

2 Configuring screen display settings (as necessary)

- Set the waveform display position (p. 72)
- Set the waveform display color (p. 72)
- Configure other display settings

3 Setting triggers (to record based on particular conditions)

See: "Chapter 7 Trigger Settings" (p. 171)

Configure other settings as necessary and start measurement.

NOTE Logic waveforms are not displayed on the XY Display screen.

3.5 Setting the Input Channels

1 Open the screen.

[Waveform Display]/[Setting Display] ▶ [Channel] ▶ [Logic]

2 Set [Use] to .

(Initial setting: Off)

This setting is linked to the internal logic (LA, LB) measurement on/off setting.

Example: Turning on measurement with LA causes LB measurement to be turned on, too.

3 Select the logic channel to configure.

Select

LA, LB

Configure the settings as necessary.

4 [Position] ▶ Select from the list.

Select the position at which to display the logic waveform. The display position varies with the logic recording width (Status screen) setting.

5 [Sheet] ▶ Select from the list.

Select the sheet to display. Content can be allocated to up to four sheets.

See: "Configuring the screen layout" (p. 62)
"Switching between sheets" (p. 130)

6 Select the display color for each channel.

To hide the channel, select .

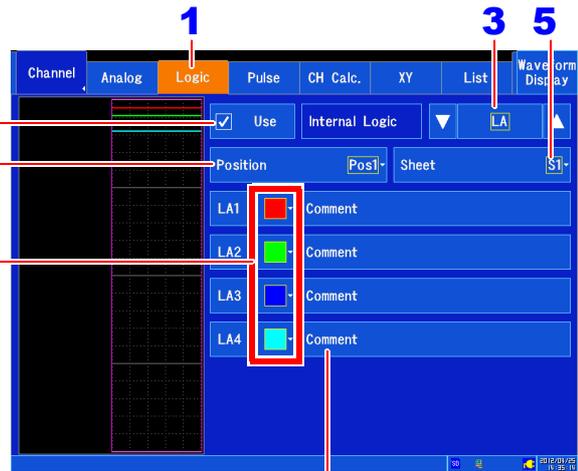
7 To change the display width

Opening the screen

[Waveform Display] ▶ [Status] ▶ [Display] ▶ [Logic Width(Waveform)] Or [Setting Display] ▶ [Status] ▶ [Display Settings] ▶ [Logic Width(Waveform)] ▶ Tap to switch.

You can change the display width for the logic waveform. Select (*:Initial setting)

Wide	Increases the display width.
Normal*	Uses the normal display width.

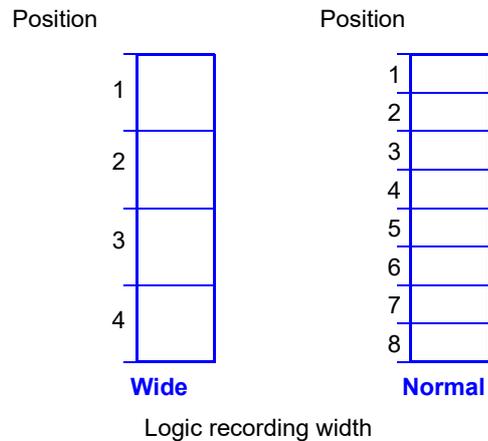


To add comments (p. 142)

To copy settings to another channel

See: "6.9 Copying Settings Between Channels (Copy Function)" (p. 163)

Display position and recording width settings

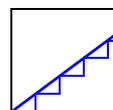


- NOTE**
- When internal logic (LA, LB) measurement is turned on, the available recording length or recording time settings may be limited.
 - When the screen division setting is set to the [Waveform+XY] screen, the screen will only be displayed at position 1 when the setting is set to [Wide] and at position 1 or 2 when the [Logic Width(Waveform)] setting is set to [Normal].

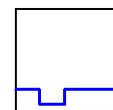
Configuring pulse input (integration and rotational speed measurement)

This section describes how to configure settings when inputting pulse signals to the external control terminals (PULSE1, PULSE2) to measure integration or rotational speed.

- **Integration:**
Measurement by integrating the number of pulses output from an integrating wattmeter, flowmeter, or other instrument. Integration includes adding and instant measurement methods.
- **Rotational speed:**
Measurement of pulses output in response to rotational speed by a rotary encoder, tachometer, or other instrument



Integrate
(Add)



Integrate
(Instant)

Configuring pulse input channels

1 Configuring the channel being used

- Select the measurement mode
- Set the range for the measurement target (p. 74)
- Set the filter (p. 74) (when there is noise)
- Configure individual pulse input settings (as necessary)

2 Configuring screen display settings (as necessary)

- Convert input values (scaling function) (p. 150)
- Magnify or compress the vertical axis (voltage axis) (p. 77)
- Set the display position and zoom factor as desired (variable function) (p. 159)
- Set the waveform display color (p. 77)
- Configure other display settings

3 Setting triggers (to record based on particular conditions)

See: "Chapter 7 Trigger Settings" (p. 171)

Configure other settings as necessary and start measurement.

NOTE

When setting triggers, set the vertical axis (voltage axis) range first. Changing the range after setting triggers causes the trigger settings to change.

3.5 Setting the Input Channels

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [Pulse]

2 Select the pulse channel to configure.

Select

P1, P2

Configure the settings as necessary.

3 Set [Use] to .

(Initial setting: Off)

4 [Mode] (measurement mode) ► Select from the list.

Select the measurement mode.

Select (*:Initial setting)

Integrate (Add)*	Counts the number of pulses acquired from the start of measurement.
-------------------------	---

Integrate (Instant)	Counts the number of pulses acquired during each recording interval. The pulse count is reset at the beginning of each recording interval.
----------------------------	--

Revolve	Measures the rotational speed by counting the number of input pulses per second.
----------------	--

5 Mode: When the mode is set to [Integrate (Add)] / [Integrate (Instant)]

[Range (/div)] ► Select from the list.

Select (*:Initial setting)

2500c*, 25kc, 250kc, 5Mc, 125Mc,

Mode: When the mode is set to [Revolve]

[Range (/div)] is fixed at 250 r/s.

6 [Filter] ► Tap to switch.

Select (*:Initial setting)

Off*	Turns the filter off.
-------------	-----------------------

On	Turns the filter on. This functionality can prevent erroneous counting due to chatter for output signals from mechanical contacts (relays).
-----------	---

7 [Division] ► Change the value.

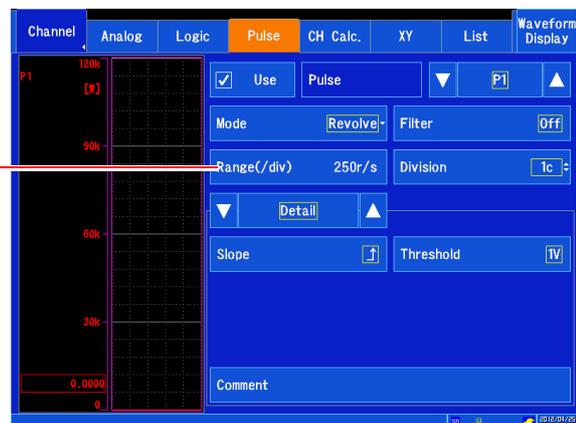
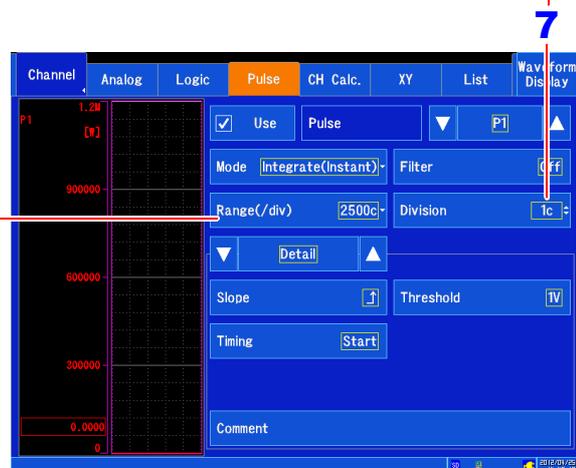
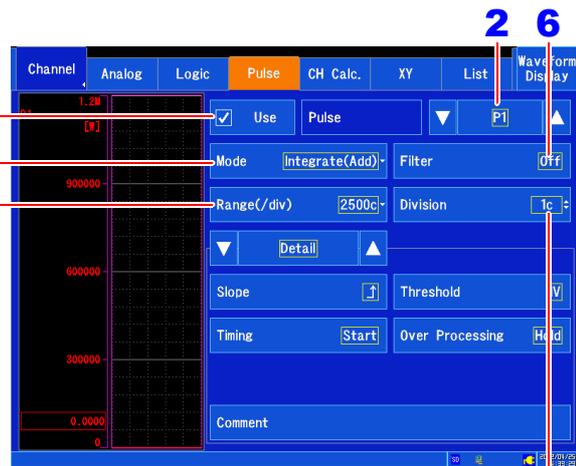
Set the division value.

Valid setting range (*:Initial setting)

1c* to 50000c

- Rotational speed: Number of pulses per revolution
 - Integration: Number of pulses per count
- Example: For an encoder that generates 360 pulses per revolution, you can measure the frequency for each revolution by setting the division value to 360. To disable division, set to 1.

See: "6.2 Changing and Entering Values" (p. 145)



8 Set the setting content to **[Detail]** (tap to switch or select from the list).

(Switch: Display, Detail, Scaling)

9 **[Slope]** ▶ Tap to switch.

Select the measurement standard (slope).

Select (*:Initial setting)

↑* Counts the number of Low - High transitions.

↓ Counts the number of High - Low transitions.

10 **[Threshold]** ▶ Tap to switch.

Select the high/low reference value (threshold).

Select (*:Initial setting)

1V* Judge 1.0 V and higher as high and 0 to 0.5 V as low.

4V Judge 4.0 V and higher as high and 0 to 1.5 V as low.

11 When the mode is set to **[Integrate (Add)]** / **[Integrate (Instant)]**

[Timing] ▶ Tap to switch.

Set the timing at which to set the integrated value to 0.

Select (*:Initial setting)

Start* Start integration when measurement starts.

Trigger Start integration after the trigger is applied.

When **[Trigger]** is selected

- When the set channel is the trigger source Starts counting at the start of measurement. Sets the integrated value to 0 when the trigger is applied and then resumes counting.
- When the set channel is not the trigger source Outputs 0 until the trigger is applied.
- The integrated value at the trigger point (the point at which the trigger is applied) provides data describing the point at which the trigger is applied. (When the set channel is not the trigger source, the integrated value will be 0.) The integrated value will be reset (to 0) at the first sampling point after the trigger point, and integration will start. The integrated value will be available at the second sampling point after the trigger point. In short, when **[Trigger]** is selected, integration starts 1 sample later than when **[Start]** is selected.

12 When the mode is set to **[Integrate (Add)]**

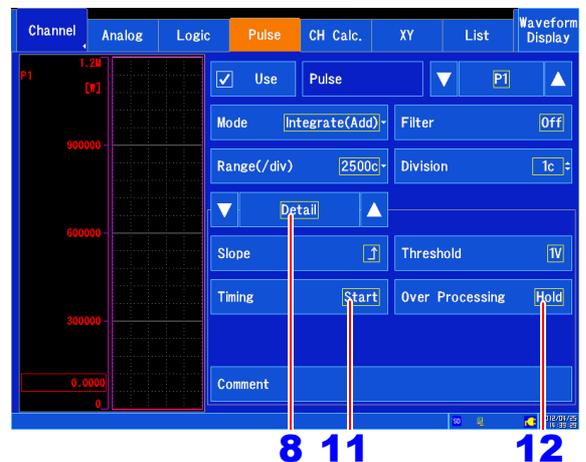
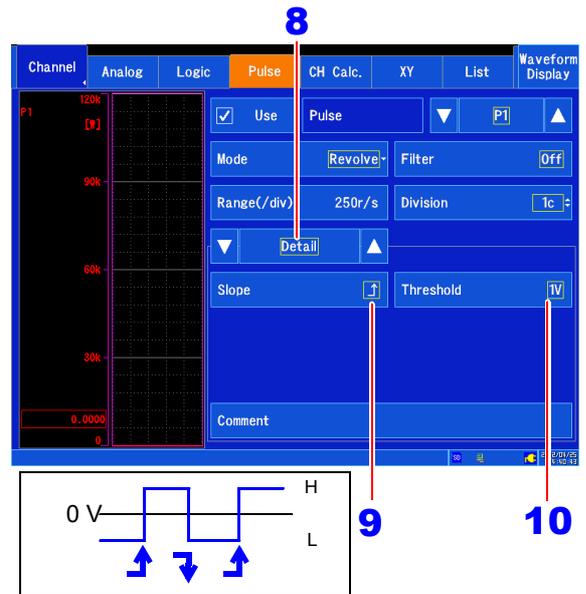
[Over Processing] ▶ Tap to switch.

Specify how the instrument should operate when the integrated value exceeds the valid measurement range.

Select (*:Initial setting)

Hold* Hold the value when the maximum measurable integrated value is reached.

Reset When the integrated value reaches 20 times the range, reset it to 0.



When **[Hold]** is selected and the set channel is the trigger source, the trigger will not be applied while the trigger level is exceeded during the pre-trigger wait period. If the trigger is not applied, check the integrated value on the waveform monitor.

Example: When the range/div setting is **[2500c]**

- When set to **[Hold]** The integrated value is held at 65535c when it reaches or exceeds 65535c (the maximum measurable value).
- When set to **[Reset]** The integrated value is reset to 0 when it reaches 50000c (20 times the range). (The value 50001c becomes 1c.)

Note: When set to **[Reset]** and the trigger is applied using the set channel, the trigger will not be applied when the trigger level setting is not set to "integration value that is less than or equal to 20 times the range."

Example: When the range/div setting is **[2500c]**

The trigger level will be 50000c or less.

(See note on the following page.)



To convert values

You can convert and display values with the scaling function.

When using the scaling function, you can display values obtained by converting the integrated pulse count to physical quantities for the measurement target (Wh, VA, etc.).

See: "Integration measurement (pulse signal) scaling settings" (p. 156)

When using the scaling function, you can display values obtained by converting rotational speed from revolutions per second (r/s) to revolutions per minute (r/m).

See: "Rotational speed measurement scaling settings" (p. 157)

To measure values in excess of 65,535 pulses using 1-pulse units

It is recommended to conduct measurements with **[Mode]** set to **[Integrate (Instant)]** and add values later with Excel[®] or similar software. The resolution will be decreased, but you can compensate for this by setting **[Mode]** to **[Integrate (Add)]** and setting **[Range]** to a low sensitivity.

See: Measurement example "Measuring electric energy by counting pulses" (p. A13)

NOTE

When setting overflow processing to [Reset] with the mode set to [Integrate (Add)]

When the sampling period is longer than the pulse period being integrated, setting the trigger level to around 50000c may prevent the trigger from being applied since the integrated value will not change every 1c.

Example: When the trigger level = 49999c, the pulse period being integrated = 200 μ s, and the sampling period = 20 ms/S

Since the integrated value increases every 100c, the following data will result:
49805c → 49905c → 5c (=50005c)

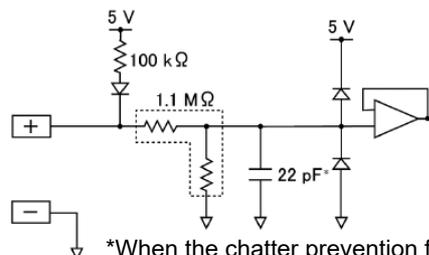
Consequently, the trigger will not be applied since the set trigger level (49999c) is not satisfied. Additionally, if the trigger level is 50000c, the trigger may not be applied since 50000c = 0c internally.

Revolution Measurement Theory

Internally, the pulse count is measured every 10 ms, and the result of adding readings for 1 s serves as the rotational speed (r/s) data. Values for 1 s are added every 10 ms. When connected to a 1,000 (r/s) pulse, the count increases from 0 to 1,000 (p/s) in 1 s. Similarly, when the 1,000 (r/s) pulse is disconnected, the count decreases from 1,000 to 0 (p/s) in 1 s. Rotational speed (r/s) data is not accurate once 1 s elapses. Consequently, a wait time of approximately 1 s occurs when starting measurement.

See: Note of the "3.6 Starting and Stopping Measurement" (p. 80)

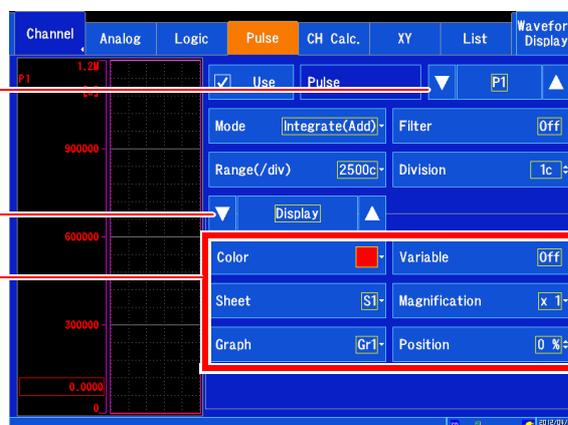
Pulse input circuit diagram



Configuring waveform display settings (as necessary)

You can also change measured data after measurement.

- 1** Open the screen.
[Waveform Display]/[Setting Display] ► [Channel] ► [Pulse] ► [Display]
- 2** Select the channel to configure.
- 3** Set the parameters you wish to change.
The available settings vary with the input module being used.



[Color]

Selects the color used to display the channel waveform. You can also select the same color as other channels. To hide the waveform, select .

[Sheet]

Selects the sheet you wish to display. You can assign the waveform to any of up to four sheets.

See: "Configuring the screen layout" (p. 62)
"Switching between sheets" (p. 130)

[Graph]

Selects the graph you wish to display. You can assign the waveform to any of up to four graphs on the screen.

See: "Allocating channels to graphs (analog, pulse, and inter-channel calculation)" (p. 65)

[Variable]

Sets the zoom factor as desired.

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)

[Magnification]

(Vertical axis [voltage axis])

Sets how much to magnify or compress the vertical axis (voltage axis) for each channel. Magnification and compression are performed relative to the zero position. Measurement resolution is not affected.

See: "Magnifying and Compressing Vertical Axis (Voltage Axis)" (p. 123)

[Position] **u** Change the value.

Sets the 0 display position. (p. 70)

See: "6.2 Changing and Entering Values" (p. 145)

Configuring inter-channel calculation channels

Inter-channel calculation channels enable you to perform sum (+), difference (-), and product (×) calculations between pairs of analog channels.

Inter-channel calculation channel configuration process

1 Configuring the channel being used

- Set the calculation formula (p. 78)

2 Configuring screen display settings (as necessary)

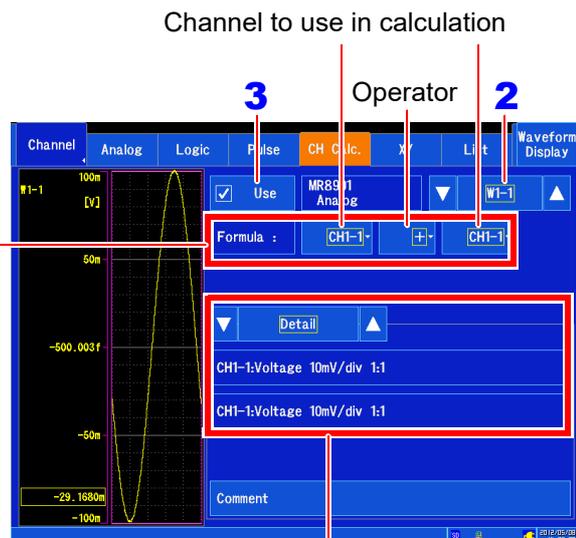
- Convert input values (scaling function) (p. 150)
- Magnify or compress the vertical axis (voltage axis) (p. 79)
- Set the display position and zoom factor as desired (variable function) (p. 159)
- Set the waveform display color (p. 79)
- Configure other display settings

3 Setting triggers (to record based on particular conditions)

See: "Chapter 7 Trigger Settings" (p. 171)

Configure other settings as necessary and start measurement.

- 1 Open the screen.
[Waveform Display] / [Setting Display] ►
[Channel] ► [CH Calc.]
- 2 Select the calculation channel to configure.
- 3 Set [Use] to on ().
(Initial setting: Off)
- 4 Set the calculation formula. ► Select from the list.

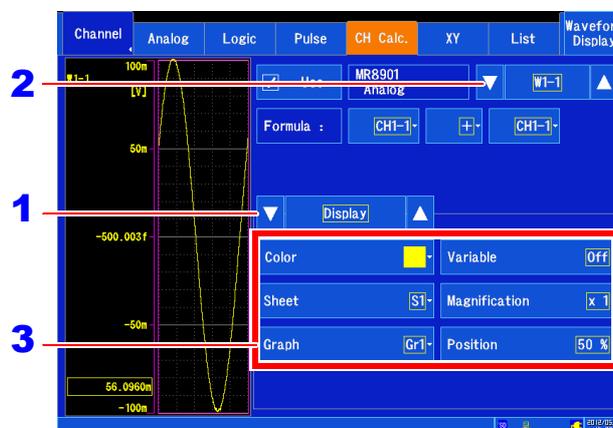


You can check the settings of the analog channels that have been allocated to the calculation formula by selecting [Detail].

Configuring waveform display settings (as necessary)

You can change measured data after measurement.

- 1** Open the screen.
[Waveform Display]/[Setting Display] ►
[Channel] ► [CH Calc.] ► [Display]
- 2** Select the channel to configure.
- 3** Change the desired settings.



[Color]

Selects the color used to display the channel's waveform. You can also select the same color as other channels. To hide the waveform, select .

[Sheet]

Selects the sheet you wish to display. You can assign the waveform to any of up to four sheets.

See: "Configuring the screen layout" (p. 62)
"Switching between sheets" (p. 130)

[Graph]

Selects the graph you wish to display. You can assign the waveform to any of up to four graphs on the screen.

See: "Allocating channels to graphs (analog, pulse, and inter-channel calculation)" (p. 65)

[Variable]

Sets the zoom factor as desired.

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)

[Magnification]

(Vertical axis [voltage axis])

Sets how much to magnify or compress the vertical axis (voltage axis) for each channel. Magnification and compression are performed relative to the zero position. Measurement resolution is not affected.

See: "Magnifying and Compressing Vertical Axis (Voltage Axis)" (p. 123)

[Position] ► Change the value.

Sets the 0 V level display position. (p. 70)

See: "6.2 Changing and Entering Values" (p. 145)

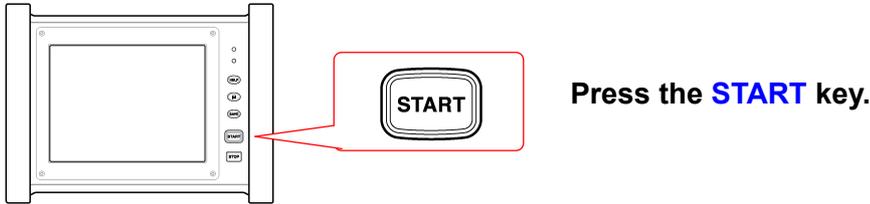
NOTE

- Calculations cannot be performed between voltage and temperature values for the MR8902 Voltage/TEMP Unit or between voltage and strain values for the MR8903 Strain Unit (The instrument's display will show "Calculation is not made between different physical quantity.")
- Calculations cannot be performed for the MR8904 CAN Unit.
- The calculation source channel's scaling, vernier, probe ratio, and inversion settings will not be applied to the calculation results.

3.6 Starting and Stopping Measurement

This section describes how to start and stop measurement.

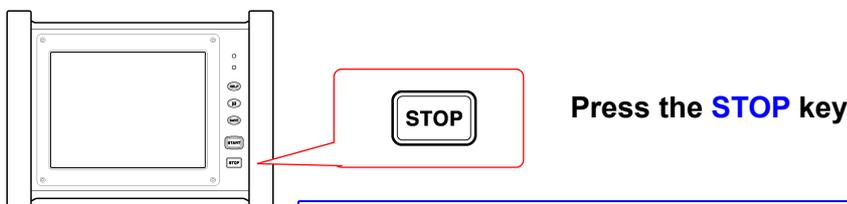
Starting measurement



- NOTE**
- When measurement starts, any waveform data shown on the screen will be cleared.
 - You can also start measurement by inputting a signal from the external control terminal.
See: "Chapter 13 External Control" (p. 323)
 - The following wait times will occur after measurement starts, depending on input module configuration and other factors.

Wait time	input module settings
200 ms	When an MR8901, MR8903 or MR8905's [Filter] parameter is set to a value other than [5 Hz] When an MR8902's [Filter] parameter is set to [Off]
600 ms	When an MR8901, MR8903 or MR8905's [Filter] parameter is set to [5 Hz] When an MR8902's [Update] parameter is set to [Fast] (when the MR8902's settings have not been changed)
1.02 s	When measuring a pulse channel with [Mode] set to [Revolve]
1.5 s	When an MR8902's [Update] parameter is set to [Fast] (when the MR8902's settings have been changed)
2 s	When an MR8902's [Update] parameter is set to [Normal] (when the MR8902's settings have not been changed)
6 s	When an MR8902's [Update] parameter is set to [Normal] (when the MR8902's settings have been changed)

Stopping measurement



Pressing the **STOP** key once: Continues measurement to the set recording length or recording time and then stops measurement.
Pressing the **STOP** key twice: Stops measurement immediately.

- NOTE**
- If you stop measurement by pressing the **STOP** key twice, the last data point may not be recorded.

Measurement and internal operation

Measurement methods are normal measurement (start recording when measurement starts) and trigger measurement (start recording when trigger condition are satisfied). In this manual, "Measurement start" means the instant when you press the **START** key, and "Recording start" means the instant when recording begins on the waveform screen.

Select the Trigger mode **to record upon either single or repeating trigger events** (p. 174).

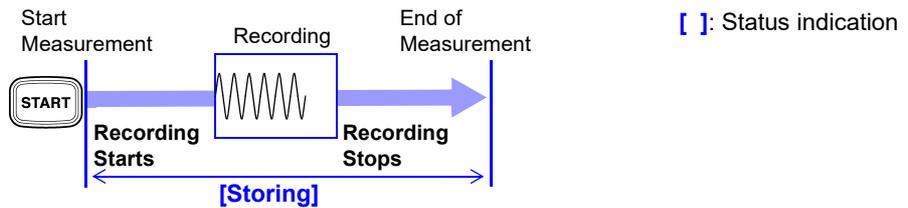
Enable pre-triggering **if you want to capture data measured prior to trigger events** (p. 178).

You can view data after the stop trigger by using the post-trigger function (p. 178).

Normal Measurement

Without triggering

Measurement stops after recording data for the recording length or recording time.

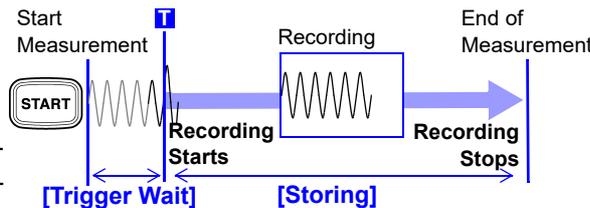


Trigger Measurement

Trigger mode: [Single]
Pre-triggering not enabled

Recording starts when the trigger is applied and ends after recording data for the recording length or recording time.

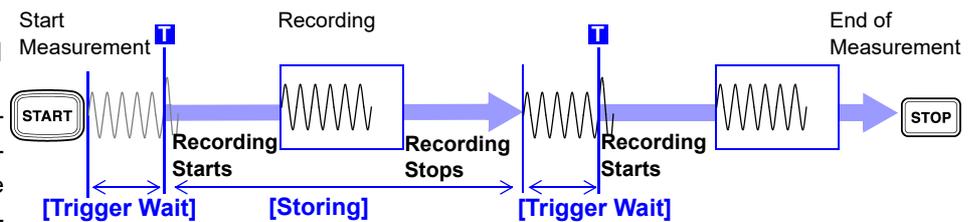
Single triggering



Trigger mode: [Repeat]
Pre-triggering not enabled

Recording starts when the trigger is applied. The instrument returns to the trigger wait state after recording data for the recording length or recording time.

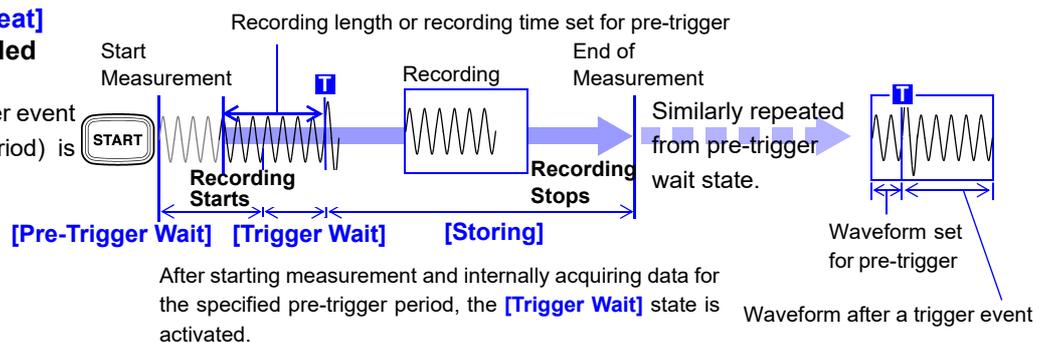
Repeated triggering



Trigger mode: [Repeat]
Pre-triggering enabled

The data before a trigger event (for the pre-trigger period) is recorded.

Repeated triggering and recording of phenomena before each event

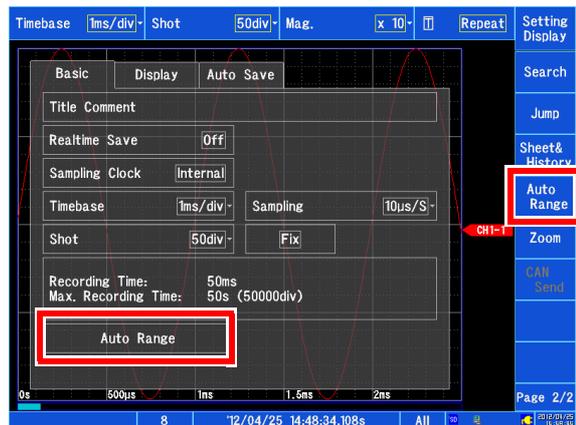


3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)

The auto-ranging function cannot be used when real-time saving is turned on. Additionally, auto-ranging is only available with the MR8901 Analog Unit and MR8905 Analog Unit. You can start measurement by inputting a signal from the MR8901 Analog Unit, MR8905 Analog Unit and allowing the instrument to automatically set the input waveform's horizontal axis (time axis) range, vertical axis (voltage axis) range, and zero position on the Waveform screen.

- 1 Input a signal from the analog unit.
- 2 Open the screen.
 [Waveform Display] ▶ [Status] ▶ [Basic] Or [Waveform Display (page2/2)]
- 3 Tap [Auto Range].

Recording will start once the settings have been automatically configured based on the input signal.



Auto-range settings

The range is determined for each channel that has its waveform enabled [On] for measuring. The timebase is automatically set so that 1 to 2.5 cycles are recorded within 25 divisions on the lowest-numbered channel being used.

When measuring using the auto-ranging function, the following items are changed.

Input-Module-Related Conditions (all channels)	
Vertical axis (Voltage axis) range	Auto setup value
Zero Position	
Vertical axis (Voltage axis) magnification	×1
Filter	Off
Input coupling	DC

[Status] conditions	
Timebase	Auto setting value (time axis magnification or compression rate of 1×, and zoom 2x)

Trigger Conditions	
Timing	Start
Trigger mode	Repeat
Start trigger condition	OR
Pre-Trigger	20%
Trigger type*	Level trigger
Trigger level*	Auto setup value
Slope*	↑
Filter*	Off

* Only the channel with the smallest number for which waveform display is enabled will be set. (However, if the difference between the maximum value and minimum value is 8 div or less, the next channel will be used.)

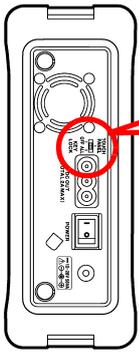
3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)

- NOTE**
- When measurement starts using auto-ranging, the trigger output signal will be output. Exercise caution when performing measurement using auto-ranging while using the trigger output terminal.
 - The auto-ranging function automatically configures settings for the input signal at the time measurement is performed. Start measurement using auto-ranging after inputting the input signal (waveform).
 - If input for the channel with the smallest number of the channels for which the waveform display is enabled is too small, the time-axis range will be reconfigured based on the input signal for the channel with the next highest number.
 - If the instrument is unable to determine the range for any channel for which the waveform display is enabled, a warning message will be displayed, and measurement will be canceled. At this time, all channels' trigger settings will be turned off. The time axis settings and Model MR8901 Analog Unit, MR8905 Analog Unit range settings will keep their values as of the failure of auto-ranging.
 - Auto-saving does not function during auto-ranging operation.
 - Automatic settings for signals with a frequency of less than 10 Hz cannot be configured properly, so they should be reconfigured manually.
 - Settings cannot be configured automatically for the following modules: Model MR8902 Voltage/TEMP Unit, MR8903 Strain Unit, and MR8904 CAN Unit.

3.8 Disabling Operation (Key Lock Function)

This section describes how to disable touch panel operation or key operation in order to prevent erroneous operation of the instrument during measurement. External control terminals and remote operation remain valid while the instrument is in the key-locked state.

Left side



TOUCH
PANEL
|
OFF ALL
KEY
LOCK



To disable only touch panel operation

Move the **KEY LOCK** switch toward **TOUCH PANEL**.



To disable touch panel and key operation

Move the **KEY LOCK** switch toward **ALL**.



To cancel the key lock state

Move the **KEY LOCK** switch toward **OFF**.

NOTE When the backlight is turned off by the backlight saver function (p. 266), you can turn it back on by touching the touch panel or pressing a key. However, other instrument operation is disabled.

3.9 Checking and Setting All Channels Using a List

This section describes how to check and change all channel settings. You can also copy settings to other channels.

See: "6.9 Copying Settings Between Channels (Copy Function)" (p. 163)

1 Open the screen.

[Setting Display] ► [Status] ► [Channel] ► [List]

2 Select the type of input channel.

Select

Analog, Logic, Pulse, CH, XY

3 Select the settings item.

Select

Basic, Comment, Display, Detail

4 Check or change the settings.



To configure channels

See: "3.5 Setting the Input Channels" (p. 66)



To change measurement on/off settings or waveform color on/off settings all at once by input channel type

[Operate]uSelect from the list.

- Store on (not available for XY channels)
- Store off (not available for XY channels)
- Display on
- Display off

To copy settings to other channels

You can copy analog channel settings to other channels.

See: "6.9 Copying Settings Between Channels (Copy Function)" (p. 163)

To perform zero adjustment^{*1} or auto balancing^{*2}

[Operate]uSelect from the list.

Use [Zero Adjust] or [Auto Balance].

*1: MR8901 Analog Unit, MR8902 Voltage/TEMP Unit and MR8905 Analog Unit only

*2: MR8903 Strain Unit only

Saving/Loading Data & Managing Files Chapter 4

Data can be saved and loaded and files can be managed.



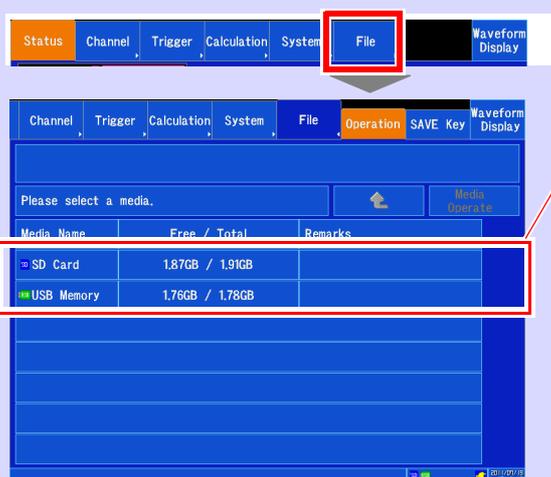
CAUTION

Do not remove media while it is being accessed by the instrument (saving or loading data). Doing so may damage the media, render files unreadable, and corrupt data.

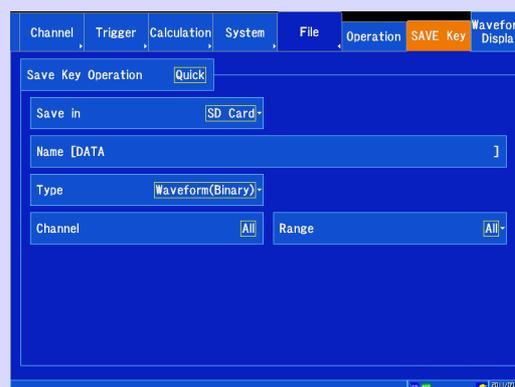
4

Displaying the screen: [Setting Display] ► [File] ► [Operation]/[SAVE Key]

See: About file sizes (p. A 3)



Displays the names of media inserted into the instrument.



- Loading Data (p. 103)
- Saving and Loading Automatic Settings Files (p. 106)
- Formatting Storage Media (p. 39)
- File Operations (p. 108)
 - "Deleting Files" (p. 109)
 - "Sorting Files" (p. 110)
 - "Renaming Files & Folders" (p. 110)

- Saving data (p. 91)

4.1 Data Capable of Being Saved & Loaded

File types and save and load operation

The instrument can save and load the following types of data:

●: Possible/ -:Not possible

File type	File format	Display	File extension	Save			Load	
				Auto	Real-time	Manual	Instrument	PC
Settings data*1	Binary		SET	-	-	●	●	-
Waveform data*2	Binary		MEM	●	●	●	●	- *5
	Text*3		CSV	●	-	●	-	●
Numerical calculation results	Text*3		TXT	●	-	●	-	●
			CSV	●	-	●	-	●
Display images	BMP*4		BMP	●	-	●	●	●
	PNG*4		PNG	●	-	●	-	●

*1: You can also load settings data automatically when the instrument is turned on (auto setup function) (p. 106).

*2: When loading data with the instrument, save data in binary format. Waveform data and some of the settings data at the time of measurement will be saved. When loading data with a PC, save data in text format. To save part of a waveform, save using the A/B and C/D cursors (p. 116).

*3: The extension ".TXT" will be used when a character other than the comma is selected as the **[Separator]** under **[Setting Display] ▶ [System] ▶ [Env.] ▶ [Region]**(p. 269).

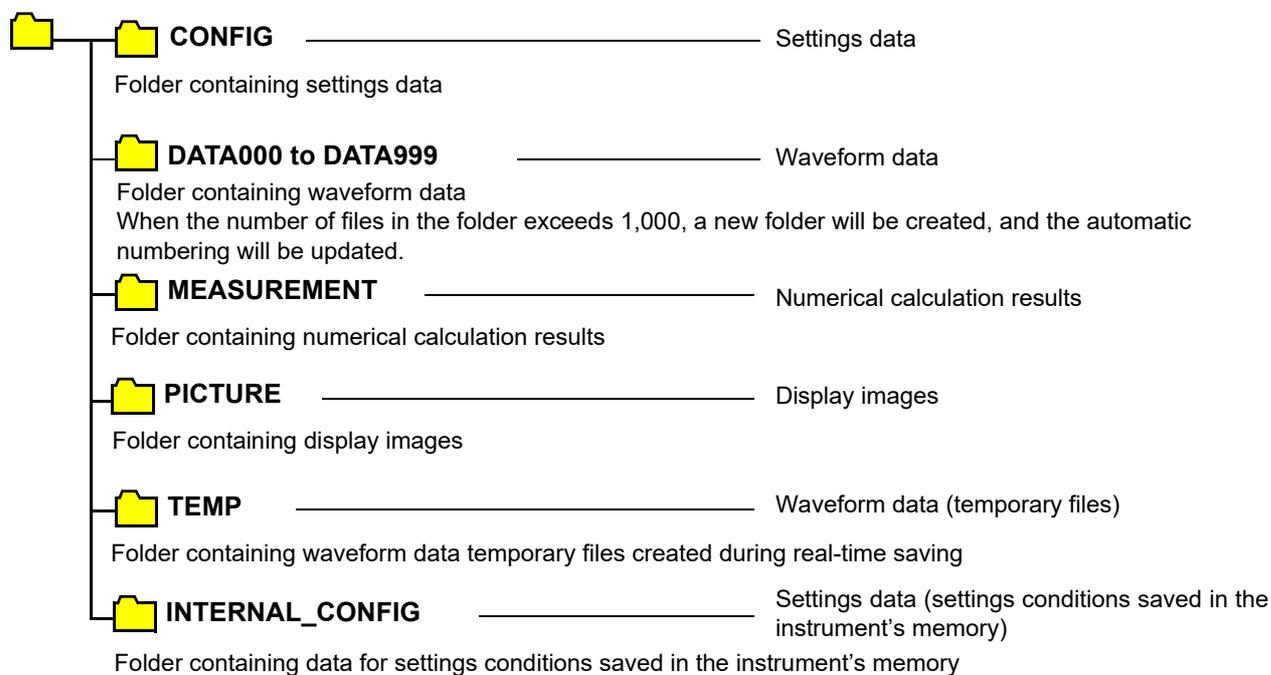
*4: BMP format: A standard Windows® graphics format. BMP files can be handled by many graphics applications.
PNG format: An image format subject to international standardization as ISO/IEC 15948.

*5: Can be loaded using the Waveform Viewer (Wv).

File hierarchy

When saving data, a folder named HIOKI_MR8875 is created, and files are stored in the folder as follows.

HIOKI_MR8875



Filenames

Filenames are assigned in accordance with the following rules:

Filename_Date_Time_(SegmentNumber)_(AutoNumber).Extension

Example: AUTO_20110518_105030_P00001_A00001.MEM

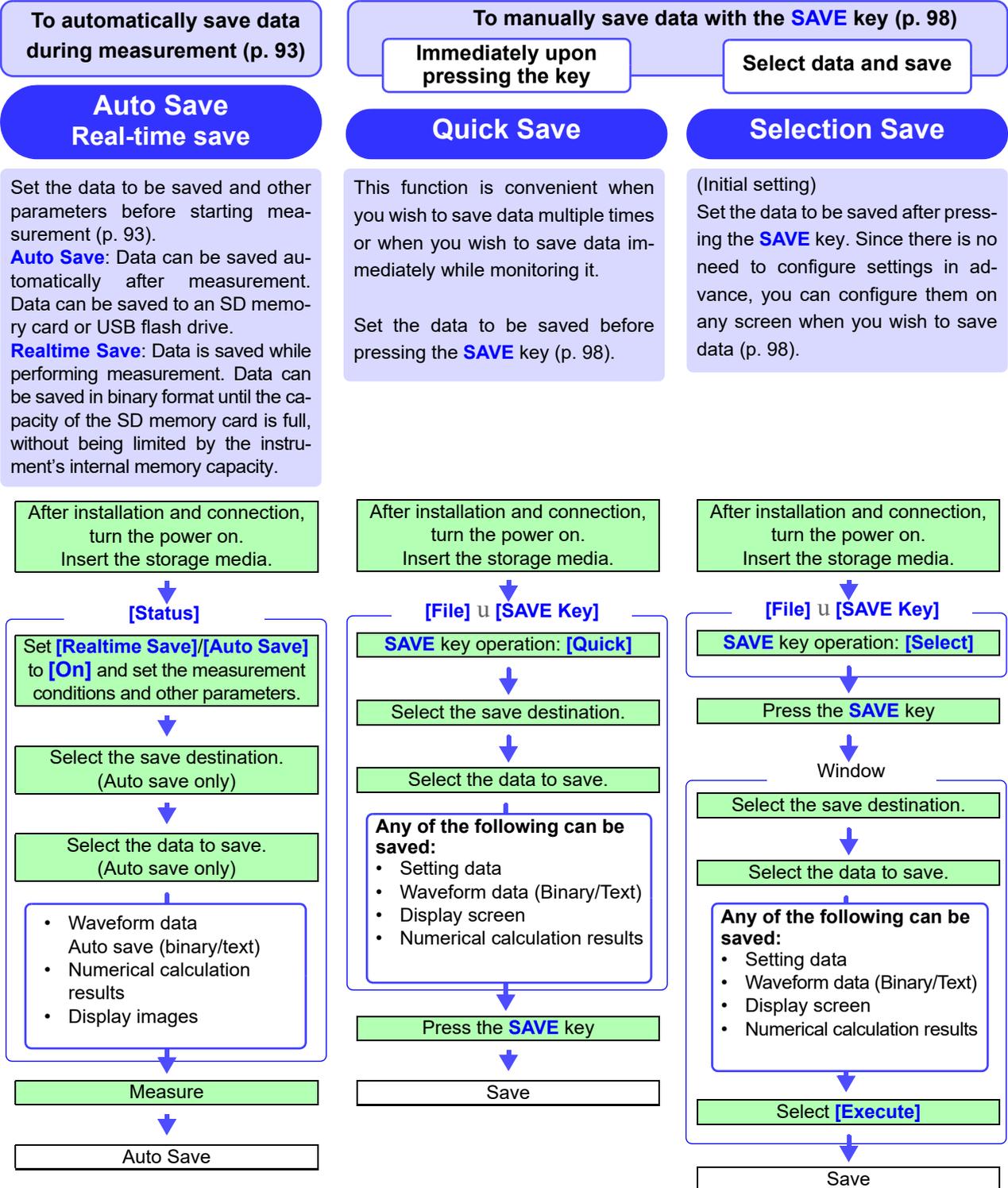
Auto save and real-time save filenames	By default, the name is set to "AUTO." The name can be changed as desired.
Manual save filenames	By default, the name is set to "DATA." If no name is added, a name will be automatically appended based on the type of file being saved: "CONF" (settings), "WAVE" (waveform), "MEAS" (numerical calculation), "SCRN" (display image), etc.
Date and time	<p>When saving waveform data, the name is set based on the trigger time and date. When saving numerical calculations, the name is set based on the trigger time and date for the numerical calculation result waveform that was first recorded. When saving display images, the name is set based on the time and date at which the image is saved. When saving settings data, no time and date are included.</p> <p>The date is formatted as follows: year (4 digits), month (2 digits), day (2 digits). Example: 05/18/2011 would be formatted as "_20110518."</p> <p>The time is formatted as follows: hours (2 digits), minutes (2 digits), seconds (2 digits). Example: The time 10:50:30 would be formatted as "_105030."</p>
Segment number	When the file is segmented before auto save (waveform text) or real-time save operation, a segment number such as "_P00001" is added to each filename. No segment number is added when segmented saving has been disabled or when there is no segmented save setting.
Auto number	When saving data with the same time and date into the same folder, an auto number such as "A00001" is added to each filename. No auto number is added when there is no data with the same time and date in the same folder.

- NOTE**
- Filenames when saving setting conditions stored in the instrument's memory together are generated by using CONF0001.SET to CONF0006.SET according to the number of the instrument's setting conditions.
 - Filenames
The path including the filename can be a maximum of 255 byte characters in length.

4.2 Saving Data

Save types and configuration processes

Broadly speaking, the following three types of save operation are supported:



- Check before saving:**
- Has the media been inserted and initialized? (p. 38), (p. 39)
 - Has the destination been properly specified?
 - When using auto save, is auto save set to [On]?

Differences between real-time saving and auto save

- The operation of real-time saving and auto saving differs.
- Real-time saving and auto saving cannot be used together.

	Real-time saving	Auto Save
Operation details	Saves data in parallel with measurement	Saves data after measurement
Type	Binary format only	Selectable from binary format and text format
Save in	An SD memory card only	Selectable from an SD memory card and a USB flash drive
Use of the pre-trigger and post-trigger	Not possible	Possible
Numerical calculation and waveform calculation during measurement	Not possible	Possible
XY composition during measurement	Not possible	Possible
Auto-Ranging Function	Not possible	Possible
External Sampling	Not possible	Possible
Continuous recording	Up to the capacity of the storage media	Only up to the capacity of the instrument's memory
Number of available channels	Limited according to the sampling speed	No limit

Automatically Saving

Data is saved automatically each time data is captured for the specified recording length. The destination and data to be saved must be set before measurement. Waveform data, numerical calculation results, and display images can be saved. When real-time save is enabled, auto save cannot be used.

1 Open the screen.

[Waveform Display] ► [Status] ► [Auto Save] or [Setting Display] ► [Status] ► [Auto Save Settings]

2 Tap [Auto Save] and set it to [On].

Default setting: Off (automatic saving is not performed)

3 [Save in] ► Select from the list.

Set the destination.

Select (*: Initial setting)

SD Card*, **USB Memory**, **Mail** (p. 306), **FTP** (p. 288)

When selecting FTP transmission or e-mail transmission, you can specify a destination at which to save a backup copy of the data if an error occurs.

4 Set the filename.

Default setting: AUTO

Tap [Name] and enter the filename.

(Up to 40 byte characters)

The filename is set in the same way that comments are entered (p. 142). (Some characters and symbols cannot be entered due to file system limitations.)

5 Set the save type and configure advanced settings.

The settings differ depending on the save type being set.

■ Saving waveforms

Tap [Waveform] and set it to [On].

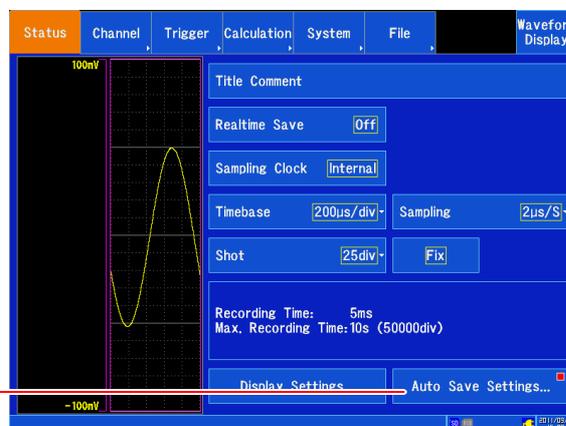
Default setting: Off

[Type] ► Tap to switch.

Select the save type.

Select (*: Initial setting)

Binary*	Saves waveform data in binary format. When loading data with the instrument, it must be saved in binary format.
Text	Saves waveform data in text format. Data can be thinned before saving. (Data can be opened in an editor or spreadsheet on a PC, but it cannot be loaded by the instrument.)
Numerical calculation results	Saves numerical calculation results.



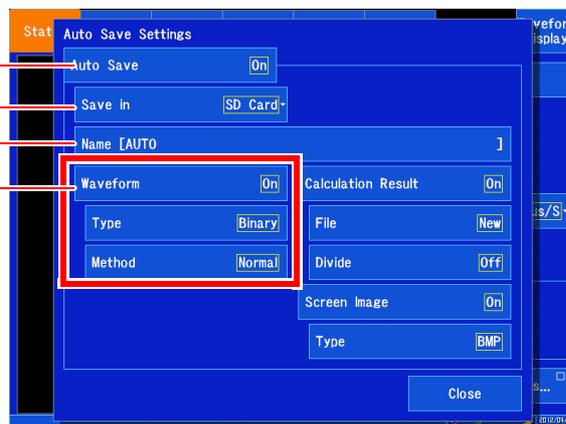
1

2

3

4

5



[Method] ► Tap to switch.

Set the save method for when the storage media runs out of space.

Select (*: Initial setting)

Normal*	Automatic saving stops when the storage media becomes full. Save operation is halted, but measurement continues.
Delete	Old files are deleted and automatic saving is performed when the storage media becomes full. (Waveform files only.)

4.2 Saving Data

When **[Text]** is selected as the save type

[Divide] ► Tap to switch.

Select the file segmentation method.
Select (*: Initial setting)

Off*	Files are not divided when saved.
60000 Data	Select the data for divided save.

[Thinout] ► Change the value.

Set the data thinning number.
Valid setting range (*: Initial setting)

Off*	Disables data thinning.
2 to 1000	Configures data thinning. One data point will be left out for every set number of data points.

See: "Changing values" (p. 145)

- A large amount of space is required for saving files in text format. Data thinning enables a reduction in file size.
- Example: When **[2]** is set, every second data item is saved. The number of data items is reduced to a 1/2.

■ Saving numerical calculation results

Tap **[Calculation Result]** and set it to **[On]**.

Default setting: Off

[File] ► Tap to switch.

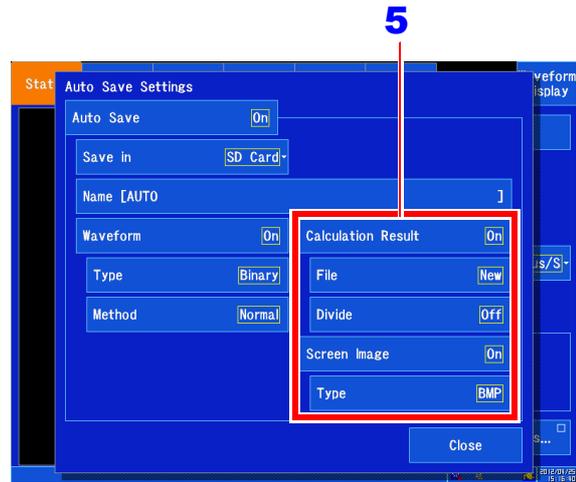
Set the method to use to save files.
Select (*: Initial setting)

New*	Creates a new file for each measurement session.
Append	Appends data to the same file.

[Divide] ► Tap to switch.

Set the file segmentation method.
Select (*: Initial setting)

Off*	Files are not divided when saved.
Split by Calc. No.	Segments the file after each numerical calculation number.



■ Saving display images

Screens are saved after the set recording length or recording time of data is measured.

Tap **[Screen Image]** and set it to **[On]**.

Default setting: Off

[Type] ► Tap to switch.

Set the save type.

Select (*: Initial setting)

BMP*	BMP format
PNG	PNG format

6 Confirm the measurement configuration and other settings, then start measurement (**START** key).

After the data is acquired, the data is saved automatically to the specified storage media.

NOTE **File specification**
The maximum file size is 2 GB. When the file size exceeds 1 GB, change media.

Filenames

The path including the filename can be a maximum of 255 byte characters in length.

Deletion of files during auto save operation

- When the media becomes full during measurement with **[Trigger Mode]** set to **[Repeat]**, old waveform files created starting when measurement began will be deleted in order of their creation to automatically free up space on the storage media. When using auto save, files will not be deleted automatically if the available space on the media at the start of measurement is equal to or less than (the size of the file that will be created + 1 MB).
- When numerical calculation results or display images are also set to auto save, waveform files alone will be deleted when the media runs out of space since deletion operation only applies to waveform files, causing waveform files alone to decrease in number or not be saved at all.
- The waveform files already stored in the media at the start of measurement do not become subject to deletion operation.

Saving data in real time

When real-time saving is enabled, data is saved to the SD memory card at the same time measurement is performed, allowing measurement to be performed for extended periods of time without regard to the amount of internal memory remaining.

The method used to set measurement conditions depends on whether real-time saving is turned off or on.

Maximum recording time

When real-time saving is turned on, the maximum recording time depends on the recording interval, SD memory card's available capacity, and number of channels in use. The valid setting range for the maximum recording time extends to 1,000 days.

See: "Maximum recording time" (p. A5)

NOTE When a large recording interval is set, the recording time will be set to an extended period (1 year or longer) depending on the conditions. However, proper operation is not guaranteed due to the effect of the warranty period and product service life.

Measurement data

When recording data with real-time saving turned on, measurement waveform data (.MEM) is saved directly to the SD memory card. When the file being saved is too large, it will be segmented automatically.

See: "Segment div count and file size (with real-time saving enabled)" (p. A8)

Functionality that is unavailable when performing measurements with real-time saving enabled

The following functionality cannot be used when real-time saving is turned on:

- Auto save
- Pre-triggers
- Performing numerical calculations and waveform calculations while making measurements
- XY compositing while making measurements
- Auto-ranging
- External sampling

NOTE

- The SD memory card cannot be removed or replaced during real-time save operation.
- Status and certain other windows cannot be displayed during real-time save operation.
- When **[File Protection]** is set to **[High]**, real-time saving will not start until UPS charging completes.
- If error 235 ("Real-time save was not in time.") is displayed, the waveform files saved to the SD memory card may not contain normal data.
- If the instrument determines that there is a risk that data cannot be saved in real time, operation may automatically be limited or the zoom factor changed.

1 Open the screen.

[Waveform Display] ► [Status] ►
[Basic] or [Setting Display] ► [Status]

2 Set [Realtime Save] to [On].

Default setting: Off

3 Set the filename.

Default setting: AUTO

Tap [Name] and enter the filename (up to 40 characters). The filename is set in the same way that comments are entered (p. 142).

(Some characters and symbols cannot be entered due to file system limitations.)

4 [Interval] ► Select from the list.

Set the interval per sample.

Select (*: Initial setting)

2*, 5, 10, 20, 50, 100, 200, 500 μ s/S
1, 2, 5, 10, 20, 50, 100, 300, 500, 600 ms/S
1, 1.2, 3 s/S

The recording interval that can be set is constrained by the number of channels in use.

See: "Number of channels in use and recording interval (real-time saving)" (p. A7)

5 [Recording Time] ► Change the value.

Specify the time for which to record data.

d	0 to 1000
h	0 to 23
m	0 to 59
s	0 to 59

6 [Method] ► Tap to switch.

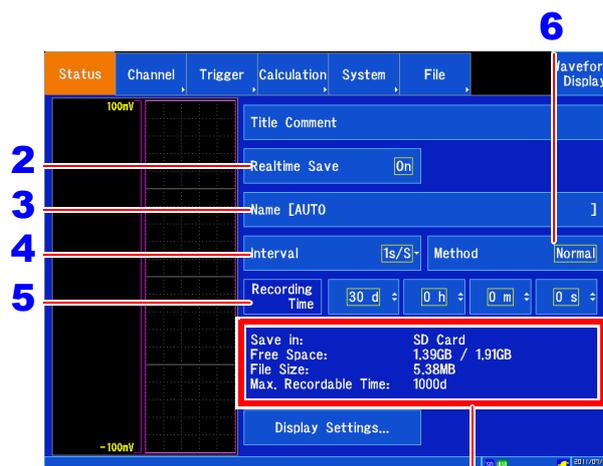
Set the save method for when the storage media runs out of space.

Select (*: Initial setting)

Normal*	Real-time saving stops when the storage media becomes full. Save operation is halted, but measurement continues.
Delete	Old files are deleted and real-time saving is performed when the storage media becomes full. (Waveform files only.)

7 Verify the input channel and other settings and start measurement (by pressing the **START** key).

Data will be saved in real time to the SD memory card while measurement is performed.



Displays the space available on the SD memory card, projected file size, and maximum recording time for the current measurement conditions.

The path including the filename can be a maximum of 255 characters in length.

Deletion of files during real-time saving

- When the media becomes full during measurement, old waveform files created starting when measurement began will be deleted in order of their creation to automatically free up space on the storage media. When using real-time saving, files cannot be deleted when the amount of free space on the SD memory card at the start of measurement is equal to or less than (the size of the file that will be created + 64 MB). Use an SD memory card with as much space available on it as possible.
- The waveform files already stored in the media at the start of measurement do not become subject to deletion operation.

Selecting and saving data (SAVE key)

To save data immediately by pressing the **SAVE** key, you must set in advance what data to save. The following data can be saved: waveform data, numerical calculation results, display screens, and settings.

1 Open the screen.

[Setting Display] ► [File] ► [SAVE Key]

2 [SAVE Key Operation] ► Tap to switch.

Set the save method to use when the **SAVE** key is pressed.

See: "Selecting and saving data (SAVE key)" (p. 98)

Select (*: Initial setting)

Select*	When the SAVE key is pressed, asks the user to set the data that is to be saved on a window and then saves the data.
Quick	When the SAVE key is pressed, immediately saves the previously configured data.

When [Select] is selected, the following settings are made in a window that is displayed when the **SAVE** key is pressed.

3 [Save in] ► Select from the list.

Set the destination.
Select (*: Initial setting)

SD Card* , USB Memory , Mail , FTP
--

4 Set the filename.

(Default setting: DATA)

See: "Filenames" (p. 90)

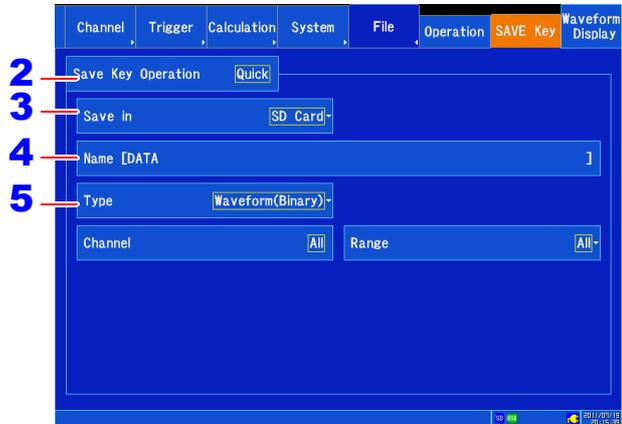
Tap [Name] and enter the filename (up to 40 byte characters). The filename is set in the same way that comments are entered (p. 142).

(Some characters and symbols cannot be entered due to file system limitations.)

5 [Type] ► Select from the list.

Set the save type.
Select (*: Initial setting)

Waveform (Binary)*	Saves waveform data in binary format. Select this setting when you wish to re-load the waveform into the instrument.
Waveform (Text)	Saves waveform data in text format. Select this setting when you wish to load the data into a PC. The instrument cannot load text data.
Calc. Result	Saves numerical calculation results.
Screen Image	Saves image data displayed on the screen in the BMP format. Data saved in the BMP format can be displayed on a PC using graphics software.
Setting	Save the settings data.



6 Configure detailed settings.

The available settings vary with the set save type.

■ When selecting **[Waveform(Binary)]** or **[Waveform(Text)]** as the save type

[Channel] ► Tap to switch.

Select the channel to save.

Select (*: Initial setting)

Display	Saves the channels of all sheets for which waveform display is set to [On] . (Channels allocated as <input type="checkbox"/> channels will be saved if the channels allocated as XY channel waveform and the XY channel waveform display is on.)
All*	Saves all measured channels. (Saves channels whose [Use] input setting is on <input checked="" type="checkbox"/> . Channels will be saved even if the waveform display color is set to <input type="checkbox"/> as long as [Use] is on <input checked="" type="checkbox"/> .

[Range] ► Select from the list.

Set the save range.

Select (*: Initial setting)

All*	Save all recorded data.
A/B	Saves data between the A/B cursors. If using the A or B cursor alone, data after the cursor being used will be saved.
C/D	Saves data between the C/D cursors. If using the C or D cursor alone, data after the cursor being used will be saved.

See: "5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116)

■ When selecting **[Waveform(Text)]** as the save type

[Data] ► Tap to switch.

Select (*: Initial setting)

All*	Saves all measured data.
Event	Saves event mark position data only. See: "5.11 Marking Events" (p. 134)

[Divide] ► Tap to switch.

Sets the file segmentation method.

Select (*: Initial setting)

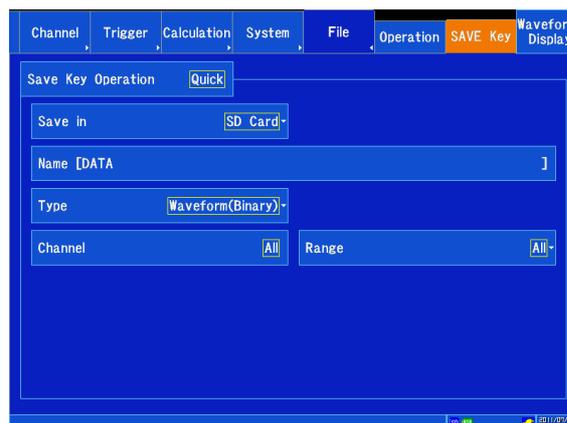
Off*	Disables segmentation. Files are not divided when saved. If a file is too large, it cannot be saved.
60000 Data	Segments and saves the set data. Select the data for divided save.

[Thinout] ► Change the value.

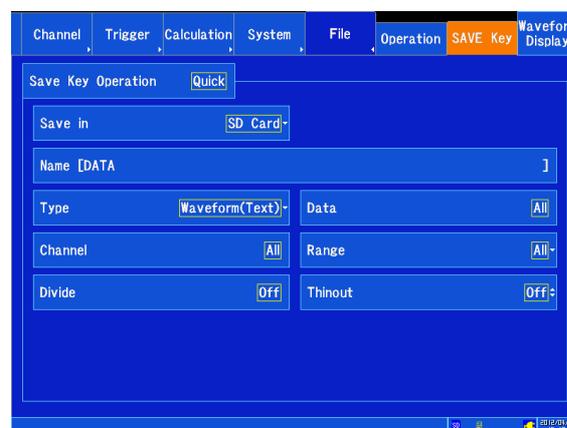
Set the data thinning number.

Select (*: Initial setting)

Off*	Disables data thinning.
2 to 1000	Sets the thinning number. One data point will be left out for each set number of data points.



Type: Waveform(Binary)



Type: Waveform(Text)

4.2 Saving Data

■ When selecting [Calc. Result] as the save type

[File] ▶ Tap to switch.

Specify the file save method.

Select (*: Initial setting)

New*	Creates a new file for each measurement session.
Append	Appends data to the same file.

[Divide] ▶ Tap to switch.

Set the file segmentation method.

Select (*: Initial setting)

Off*	Files are not divided when saved.
Split by Calc. No.	Segments the file after each numerical calculation number.

■ When selecting [Screen Image] as the save type

[Type] ▶ Select from the list.

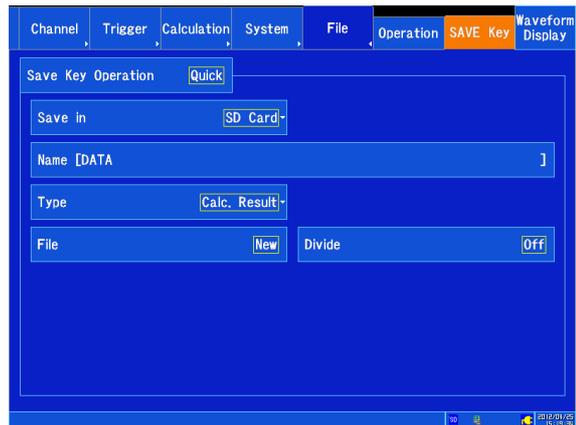
Set the save type.

Select (*: Initial setting)

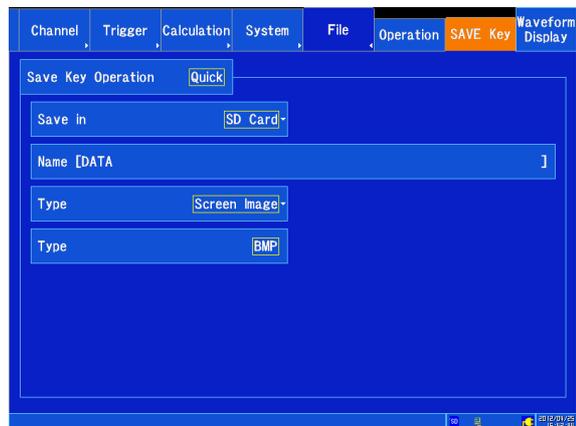
BMP*	BMP format
PNG	PNG format

■ When selecting [SAVE Key] as the save type

There are no settings available to be configured.



Type: Calc. Result



Type: Screen Image

NOTE The following settings are not saved in settings data:

- [System] ▶ [Comm.] screen settings
- [System] ▶ The [File Protection] and [Region] settings on the [Env.] screen

4.3 Saving Settings Data to the Instrument

When you wish to perform measurements under the same measurement conditions, you can save settings data and then load it on the instrument later for use in measurement. Up to six sets of settings data can be stored in the instrument's internal memory. Settings data stored in the instrument's memory can also be saved together in files on storage media.

NOTE The following settings are not saved as part of the settings data:

- [System] ► [Comm.] screen settings
- [System] ► The [File Protection] and [Region] settings on the [Env.] screen

Saving settings data in the instrument's memory

1 Open the screen.

[Setting Display] ► [System] ► [Setting]

2 Tap [Save] for the settings you wish to save.

A confirmation dialog box will be displayed.

3 Tap [Yes].

The settings will be saved in the instrument's memory.

To cancel:

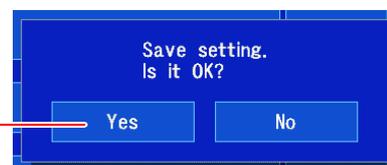
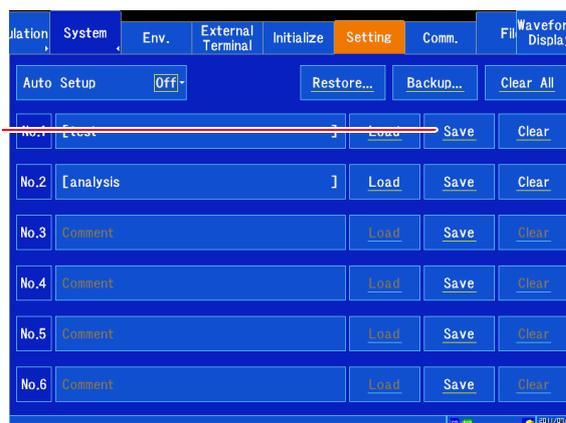
Tap [No].

You can set comments as necessary.

See: "6.1 Adding Comments" (p. 142)

To delete settings data

Select [Clear] for the number you wish to delete or select [Clear All] (to erase all settings data stored on the instrument).



Setting conditions stored in the instrument's memory are saved together in files.

You can also save all settings data (up to six sets) stored on the instrument together to media. The data will be saved to the [/HIOKI_MR8875/INTERNAL_CONFIG] folder on the media.

1 Open the screen.

[Setting Display] ► [System] ► [Setting]

2 Tap [Backup].

A window will be displayed.

3 Select the media to which you wish to save the settings.

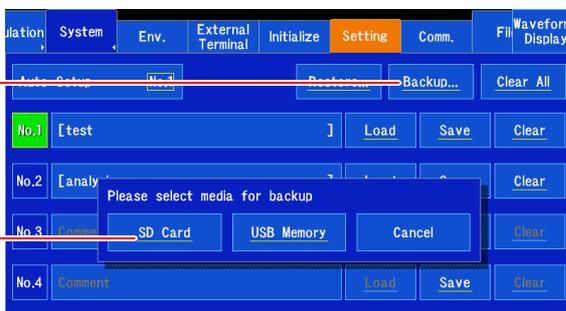
Select

SD Card, USB Memory

Selecting a media destination causes the settings to be saved.

To cancel:

Tap [Cancel].



4.3 Saving Settings Data to the Instrument

Saving setting conditions saved together in a single file to the instrument

Settings data saved in the [\[/HIOKI_MR8875/INTERNAL_CONFIG\]](#) folder on media can be saved in the instrument's memory.

1 Open the screen.

[Setting Display] ► [System] ► [Set- 2

2 Tap [Restore].

A window will be displayed.

3 Select the media on which the settings are saved.

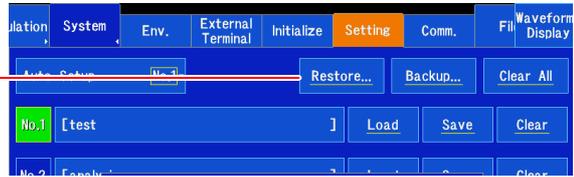
Select

SD Card, USB Memory

Selecting a media source causes the settings to be saved to the instrument.

To cancel:

Tap **[Cancel]**.



4.4 Loading Data

The instrument can load waveform data or settings data saved on storage media. Additionally, by creating an auto setup file (STARTUP.SET), you can have the instrument automatically load settings data from the media when it is turned on.

See: "Automatically configuring settings from an SD memory card (creating a startup file)" (p. 107)

Multiple sets of setting condition data can be registered on the instrument so that you can select and load the desired data. Similarly, data can be loaded automatically when the instrument is turned on.

See: "Loading settings data" (p. 104)

Selecting a file or folder on media

NOTE If no media has been inserted, a message to that effect will be displayed on the screen. Verify that the media has been properly inserted.

Open the screen.

[Setting Display] ► [File] ► [Operation]

The volume name for the inserted media or a file list will be displayed on the screen.

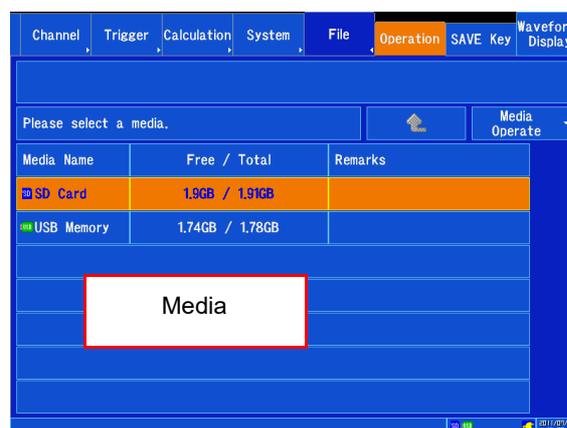
Select the media.

Tap the media you wish to select to display it in reverse video. Tap it again to display the files and folders on the media.

If the media's root directory includes a folder named [HIO-KI_MR8875], the contents of that folder will be displayed.

Functionality on this screen:

Initializing the media (p. 39)



Information for selected file

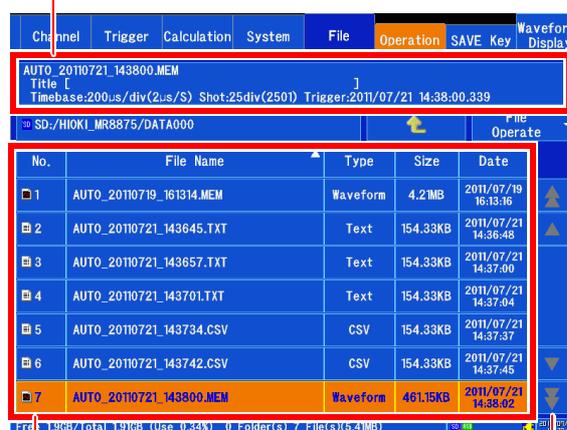
Select a folder or file.

Tap the folder or file you wish to select to display it in reverse video. Tapping a folder again displays the files inside that folder.

Functionality on this screen:

Loading files (p. 104), (p. 105)

Managing files (p. 108)



File list

The scroll bar is displayed when there are too many files and folders to fit on one screen. It allows you to scroll up and down in the list.

NOTE This file list can display up to 2,000 folders and files. Depending on the status of saved data, more than 2,000 folders and files may be created inside the folder, but they will not be shown on the file list, even if they are present on the media.

Loading settings data

Loading from media

- 1 Open the screen.
[Setting Display] ► [File] ► [Operation]
- 2 Select the file to load (p. 103).
(Files with the extension .SET)
A confirmation window will be displayed.
- 3 Tap [Yes].
The file will be loaded. Once it has been loaded, the display will switch to the Waveform screen.

To cancel:
Tap [No].

No.	File Name	Type	Size	Date
1	DATA.SET	Setting	264KB	2011/07/19 16:11:54
2	DATA_A00001.SET	Setting	264KB	2011/07/19 16:12:00
3	DATA_A00002.SET	Setting	264KB	2011/07/19 16:17:07
4	DATA_A00003.SET	Setting	264KB	2011/07/19 16:17:09
5	DATA_A00004.SET	Setting	264KB	2011/07/19 16:17:10
6	DATA_A00005.SET	Setting	264KB	2011/07/19 16:17:12
7	DATA_A00006.SET	Setting	264KB	2011/07/19 16:17:15



To automatically load settings data (media)

By creating an auto setup file (STARTUP.SET), you can have the instrument automatically load settings data from the media when it is turned on.

See: "4.5 Loading Settings Automatically (Auto Setup Function)" (p. 106)

Loading from the instrument's memory

- 1 Open the screen.
[Setting Display] ► [System] ► [Setting]
- 2 Tap [Load] for the number you wish to load.
A confirmation window will be displayed.
- 3 Tap [Yes].
The file will be stored in the instrument's memory.

To cancel:
Tap [No].

You can set comments as necessary.

See: "6.1 Adding Comments" (p. 142)

No.	Event	Load	Save	Clear
No.1	[]	Load	Save	Clear
No.2	[analysis]	Load	Save	Clear
No.3	Comment	Load	Save	Clear
No.4	Comment	Load	Save	Clear
No.5	Comment	Load	Save	Clear
No.6	Comment	Load	Save	Clear



To automatically load settings data (instrument memory)

You can have the instrument automatically load settings data when it is turned on.

See: "4.5 Loading Settings Automatically (Auto Setup Function)" (p. 106)

NOTE The following settings can be loaded but not changed:

- [System] ► Settings on the [Comm.] screen
- [System] ► [File Protection] and [Region] settings on the [Env.] screen

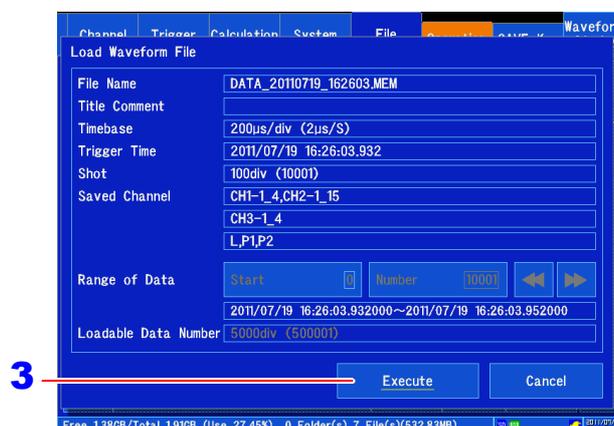
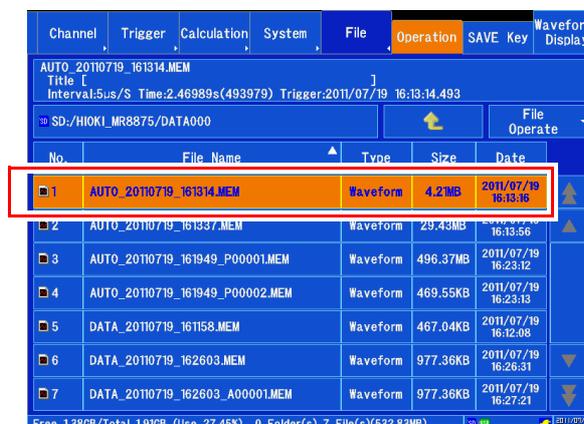
Loading waveform data

This section describes how to load waveform data that was saved in binary format into the instrument.

- 1 Open the screen.
[Setting Display] ► [File] ► [Operation]
- 2 Select the file to load (p. 103).
(Files with the extension .MEM)

- 3 Tap [Execute].
The file will be loaded. Once it has been loaded, the display will switch to the Waveform screen.

To cancel:
Tap [Cancel].

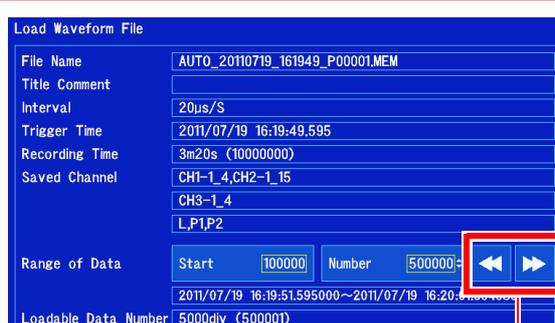


Loading waveforms saved using real-time save functionality

If the number of data points contained in the file being loaded exceeds the instrument's internal memory capacity, specify where to start loading waveform data ([Start]) and how many data points to load ([Number]).

You can load up to the number of data points indicated by [Loadable Data Number]. If the number of data points in the file fits into the instrument's internal memory, all data points can be loaded without configuring these settings.

Tap [Execute] to load the data.



Increases and decreases the [Start] value by the set [Number] value.

- NOTE**
- Data saved using Memory HiCorders other than the MR8875 cannot be loaded.
 - When waveform data is loaded, the instrument's settings will change to reflect its state at the time the waveform data was saved.
 - To revert the instrument's settings to their original values, you must first save them to a settings file and then restore them later. You can also load the instrument's internal settings.

4.5 Loading Settings Automatically (Auto Setup Function)

When you save an auto settings file, you can have the instrument load settings automatically when it is turned on.

In this way, the instrument's settings can be configured simply by turning it on based on settings data registered on the instrument or an auto settings file (startup file) saved on an SD memory card. To automatically configure settings from an SD memory card, you must create a startup file in advance.

See: "Automatically configuring settings from an SD memory card (creating a startup file)" (p. 107)

NOTE Settings data cannot be loaded in the following circumstances:

- When starting measurement using the auto start function at startup (p. 262)
- When starting measurement using the start backup function (p. 263)
- When the file protection level is set to **[High]** (p. 264)

Automatically configuring the instrument from the instrument's memory

You can set the number of the settings file to load in advance or select the number at startup.

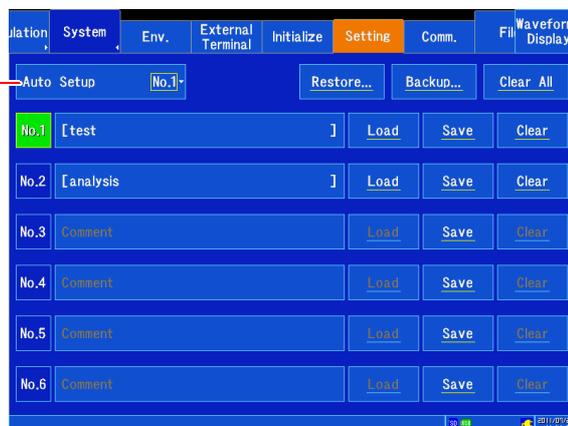
1 Open the screen.

[Setting Display] ► **[System]** ► **[Setting]**

2 **[Auto Setup]** ► Select from the list.

Select (*: Initial setting)

Off*	Disables auto setup.
No.1 to No.6	Performs auto setup at startup using the selected settings data number.
Select	Allows the user to select the number at startup and then performs auto setup using those settings.



The instrument will automatically configure itself using the selected method the next time it starts up.

When auto setup is enabled (any setting other than **[Off]**) and an SD memory card containing a startup file is inserted in the instrument when it is turned on, the settings file on the SD memory card takes precedence.

Automatically configuring settings from an SD memory card (creating a startup file)

By saving STARTUP.SET, the auto setup settings file, in the folder [/HIOKI_MR8875/CONFIG] on the SD memory card, you can have the instrument load settings data automatically from the SD memory card when it is turned on.

Startup file path and filename: "/HIOKI_MR8875/CONFIG/STARTUP.SET"

Method for automatically loading settings data that has been registered on the instrument (auto setup)

See: "Automatically configuring the instrument from the instrument's memory" (p. 106)

Even if auto setup has already been activated, when an auto setup settings file exists on the SD memory card, that file takes precedence.

Before saving the file

- Check the settings for which you wish to create the file.
- Verify that an SD memory card has been inserted into the instrument.

1 Open the screen.

[Setting Display] ► [File] ► [SAVE Key]

2 [SAVE Key Operation] ► Tap to switch.

See: "Selecting and saving data (SAVE key)" (p. 98)
Select (*: Initial setting)

Select* When the **SAVE** key is pressed, asks the user to set the data that is to be saved on a window and then saves the data.

Quick When the **SAVE** key is pressed, immediately saves the previously set data.

3 When [Select] is selected Press the SAVE key.

4 Select [SD Card] under [Save in].

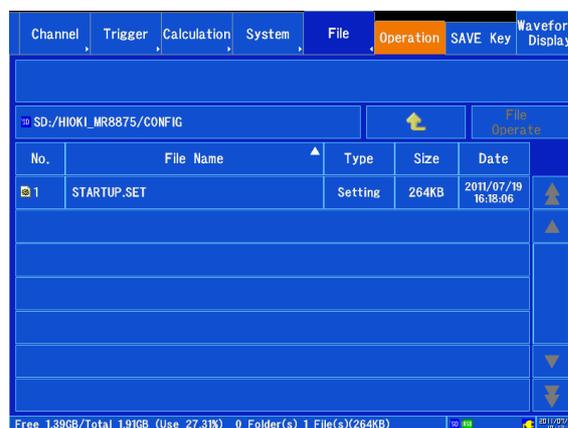
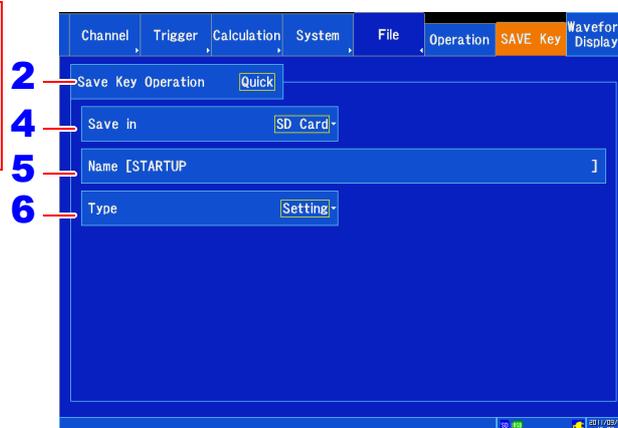
5 Select [Name] and enter [STARTUP].

Enter "STARTUP" in single-byte characters.

See: "6.1 Adding Comments" (p. 142)

6 Select [Setting] under [Type].

7 If you selected [Quick] Press the SAVE key. If you selected [Select] Select [Execute].



A file named "STARTUP.SET" will be created in the folder [/HIOKI_MR8875/CONFIG] on the SD memory card. The instrument's settings will be automatically configured the next time it is started with the SD memory card inserted.



To use previously saved settings data for auto setup

You can use a previously saved settings data file for auto setup by changing its name to "STARTUP.SET."

See: "Renaming Files & Folders" (p. 110)

4.6 Managing Files

You can manage data saved to media on the File screen (the **[Setting Display] ▶ [File] ▶ [Operation]** screen).

NOTE Before performing the operations described below, insert the media into the instrument. If no media has been inserted, “No media” will be shown under the file list (**[File] ▶ [Operation]**).

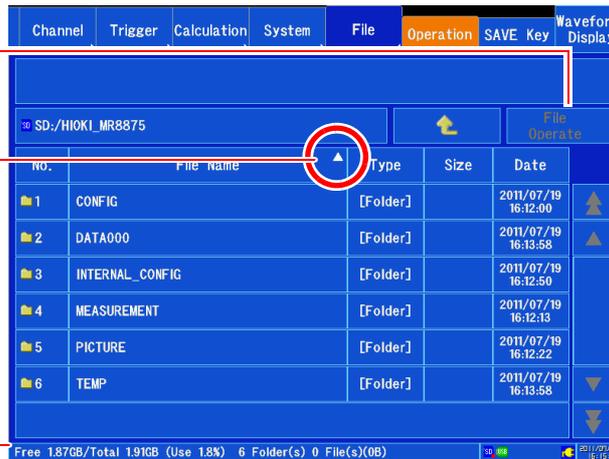
File operations

Allows you to manage files by deleting data, changing filenames, etc (p. 108).

Allows you to reorder the file list.

F: Ascending

S: Descending



Media information

Displays information about the selected media.

Number of File : Displays the number of files saved at the selected level.

Number of Folder : Displays the number of folders at the selected level.

Displays the total file size at the selected level.

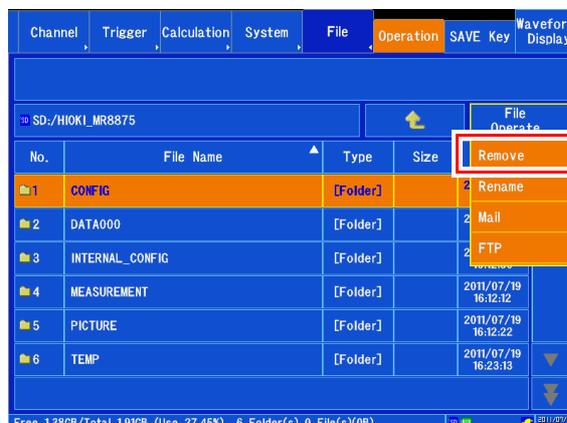
List of operations

Sort	Reorders the file list in the selected order.	(p. 110)
Load	Loads settings data and waveform data from files.	(p. 103)
Remove	Deletes a file or folder.	(p. 109)
Rename	Changes the name of a file or folder.	(p. 110)
Format	Formats the selected media.	(p. 39)
Mail	Sends a file as an e-mail attachment.	(p. 306)
FTP	Sends a file to an FTP server.	(p. 288)

Deleting Files

Delete a file or folder.

- 1** Open the screen.
[Setting Display] ► [File] ► [Operation]
 - 2** Select the file or folder you want to delete (p. 103).
 - 3** [File Operate] ► [Remove]
A confirmation message will be displayed.
 - 4** Tap [Yes].
The selected files or folders are deleted.
- To cancel deleting:
Tap [No].

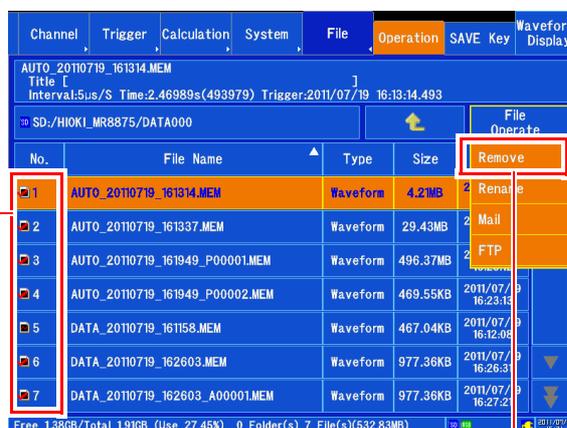


- NOTE**
- When a folder is deleted, the files and folders located in all folders contained in that folder will also be deleted.
 - Files for which the read-only, hidden, or system attribute has been set cannot be deleted.

Deleting multiple files

This section describes how to delete multiple files or folders.

- 1** Open the screen.
[Setting Display] ► [File] ► [Operation]
 - 2** Select the files or folders you wish to delete.
When you tap the “No.” portion of the files or folders you wish to delete, a check mark will appear in the display icon. To unselect the icon, tap the file or folder again.
 - 3** [File Operate] ► [Remove]
A confirmation message will be displayed.
 - 4** Tap [Yes].
The files or folders with check marks will be deleted.
- To cancel deleting:
Tap [No].



- NOTE**
- When a folder is deleted, the files and folders located in all folders contained in that folder will also be deleted.
 - If the read-only, hidden, or system attribute has been set for any of the selected files, an error message will be displayed, and deleting of files will stop.

Sorting Files

Sort files in the file list into a specified order.

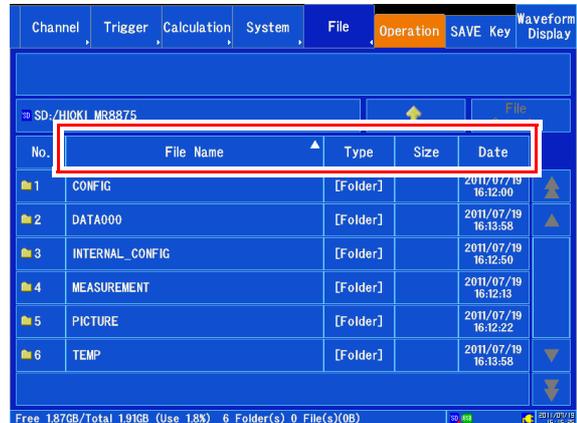
The file list can be sorted by filename, type, size, or date.

- 1 **Open the screen.**
[Setting Display] ► [File] ► [Operation]
- 2 **Display the file list you wish to view** (p. 103).
- 3 **Select the item by which you wish to sort the list.**

Tap the item by which you wish to sort the list. The sort order will switch between ascending and descending each time you tap the item.

Ascending A → Z →, old → new, small → large

Descending Reverse of ascending order



NOTE A ↑ (ascending) or s (descending) mark will be shown for the selected sort item. When there are both folders and files present, folders will be listed above any files.

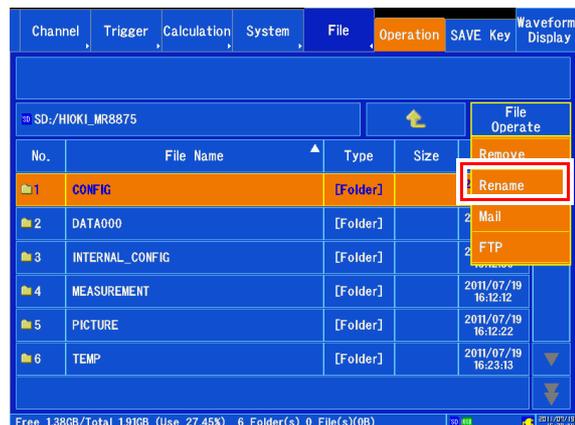
Renaming Files & Folders

Rename a file or folder.

- 1 **Open the screen.**
[Setting Display] ► [File] ► [Operation]
- 2 **Select the file or folder you want to rename** (p. 103).
- 3 **[File Operate] ► [Rename]**
The character entry screen will be displayed.
- 4 **Enter a filename.**

The filename is set in the same way that comments are entered (p. 142).

(Some characters and symbols cannot be entered due to file system limitations.)



NOTE Filenames cannot be changed for files for which the read-only, hidden, or system attribute has been set.

Waveform Monitoring and Analysis

Chapter 5

Analytical operations such as display magnification and compression, and search are available on the Waveform screen. You can also change measurement conditions and other settings.



Specify display values and positions

■ Reading values and specifying a range

- Measured values (cursor values) (p.112)
- Specifying a Waveform Range (p.116)

■ Moving the waveform display position

- Scrolling waveforms
- Moving the waveform position (jump function) (p.119)
- Marking events (p.134)

■ Searching for Waveforms

- Searching for trigger positions (p.132)
- Searching for peak values (p.133)

Change the display method

■ Magnifying and Compressing Waveforms

- Magnifying and Compressing Horizontal Axis (Time Axis) (p.121)
- Magnifying and Compressing Vertical Axis (Voltage Axis) (p.123)

■ Switching the Waveform screen display

- Gauge display (p.127)
- Comment display (p.128)
- Switching the display sheet (p.130)
- Monitoring the waveform input level (waveform monitor) (p.124)
- Numeric monitor (p.125)

■ Compositing waveforms

- Compositing entire waveforms (p.135)
- Compositing partial waveforms (p.137)

5.1 Reading Measured Values (Using Cursors)

Using the cursors, you can read measurement data as values. There are three cursor types: A/B, C/D, and E/F.

When you specify a waveform range with the A/B or C/D cursors, you can perform a partial calculation, save, or waveform XY compositing. You can also read measured values for the XY composite waveform.

When segmenting the screen, you can calculate the potential difference between the A/B cursors if they have been set to different graphs. The same applies to the C/D and E/F cursors.

Manipulating cursors

1 Open the screen.

[Waveform Display] ► [Cursor]

2 Turn the cursors you wish to use on.

Tapping a cursor toggles it on and off.

3 Select the cursor you wish to move.

To move one cursor, tap [□] underneath the cursor you wish to move. To move two cursors simultaneously (A/B, C/D, or E/F), tap [Sync] underneath the two cursors you wish to move.

4 Move the cursors.

▲▼◀▶	Light tap : Moves one data point. Strong tap* : Moves five data points.
▲▼◀▶	Light tap : Moves 1 div. Strong tap* : Moves 5 div.

Touching and holding a button causes the operation described above to repeat.

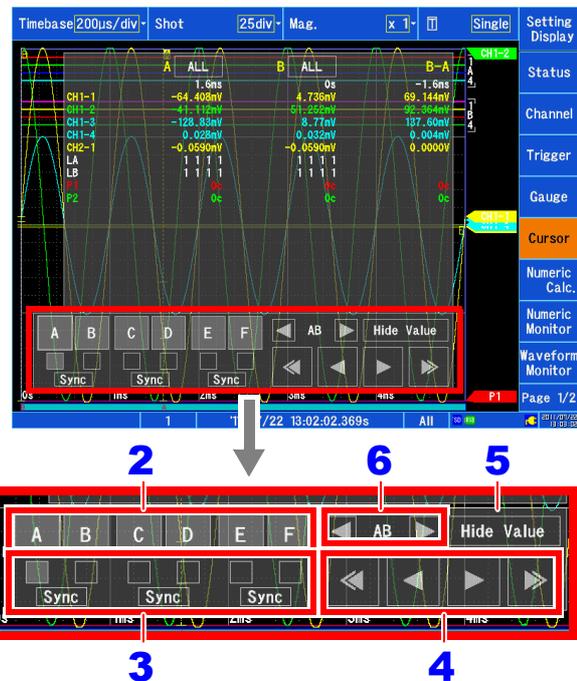
*: Strong taps with the touch pen cannot be detected.

5 Turn the read value display on or off.

Tapping toggles between [Show Value] and [Hide Value].

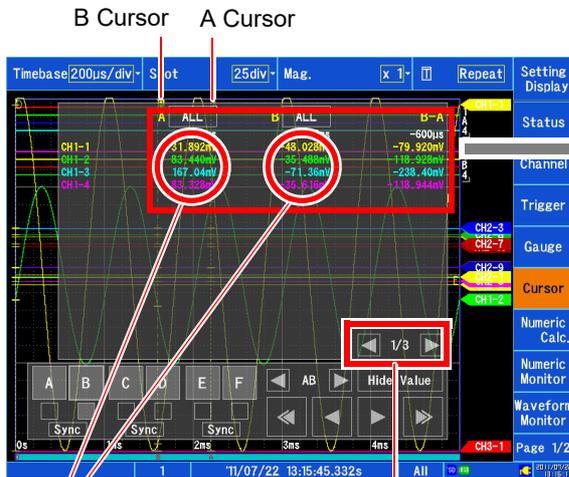
6 Select the read display cursors.

AB, CD, EF



Reading measured values on the Waveform screen (waveform display or waveform + XY display)

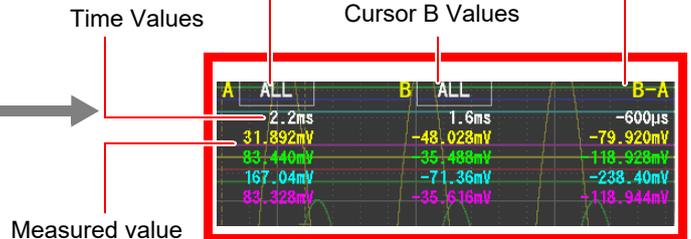
(Example: A and B cursors)



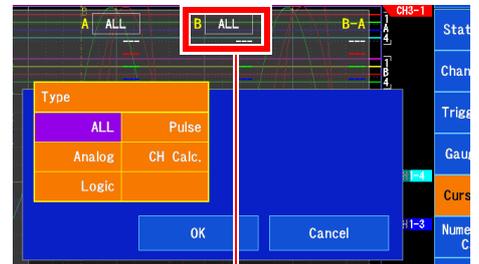
Waveform values at the intersection with each cursor are displayed.

When there are numerous channels, you can switch the display page.

Cursor A Values Values Between A/B cursors



To change the read value display channel

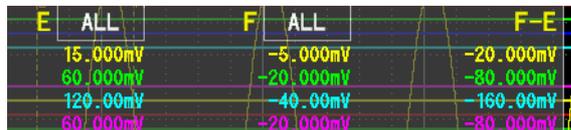


Tapping this button opens the Channel Settings window. You can select the channel for which you wish to display cursor read values.

You can select each channel with its respective cursor. However, if you select [All] with even a single cursor, the read value settings for all cursors will be set to [All].

[All]: Displays read values for all channels.

(Example: E and F cursors)



Cursor Type	Example	Description
Trace Cursors (Time values and measured values)		Time values A cursor value, B cursor value: Time from trigger position or start of recording B-A value: Time difference between A and B cursors
		Measured values A cursor value, B cursor value: Measured values B-A value: Measured value difference between A and B cursors (The same applies to the C and D cursors.)
Horizontal Cursors (Voltage values)		E cursor value, F cursor value: Channel voltage value F-E value: Voltage value difference between E and F cursors

NOTE When using external sampling: The time value indicates the number of data points.

**To hide the A/B or C/D cursors on the screen even though their display setting is on**

You can check the A/B or C/D cursor position with the scroll bar (p.117).

When the A/B or C/D cursors are moved, the cursors in question will be displayed on the screen. Even if the cursors are outside the screen, you can perform cursor measurement.

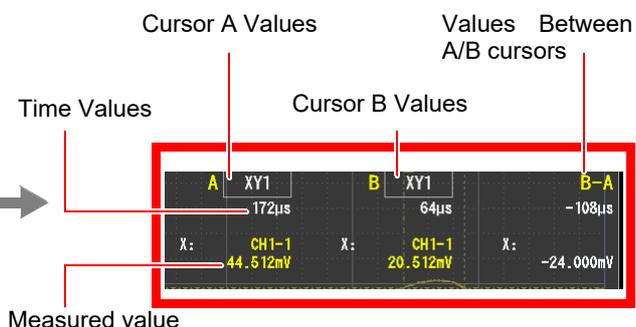
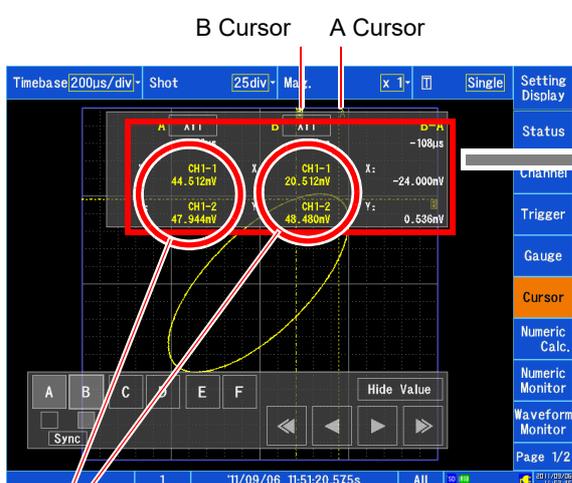
To display the waveform near the A/B or C/D cursors when they are outside the screen display

When using the A/B or C/D cursors, you can display the waveform above a cursor that is outside the screen using the jump function.

See: "5.3 Moving the Waveform Display Position" (p.117)

Reading measured values on the Waveform screen (XY composite display)

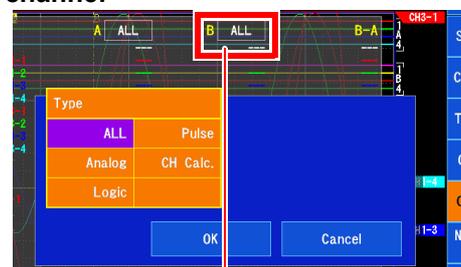
(Example: A/B cursors)



Waveform values at the intersection with each cursor are displayed.

Time display
You can change the time value display (p.261).

To change the read value display channel



Tapping this button opens the Channel Settings window. You can select the channel for which you wish to display cursor read values. You can select each channel with its respective cursor.

Cursor Type	Cursors used	Example	Example cursor value display
Trace Cursor (Time values and X- and Y-axis measured values)	A/B Cursor		
X-axis (X-axis voltage values)	C/D Cursor		
Y-axis (Y-axis voltage values)	E/F Cursor		

NOTE

On the waveform + XY display, the waveform display's trace cursors (A/B and C/D cursors) are also displayed on the XY display.

5.2 Specifying a Waveform Range (A/B, C/D Cursor)

You can specify a waveform range using the A/B or C/D cursors. The specified range can be used to save files, perform numerical calculations or waveform calculations, and generate XY composites. The specified range is saved, even if the waveform display format is changed.

1 Set the range with the A/B or C/D cursors.

See: "Manipulating cursors" (p.112)

2 Specify the range.

To save a waveform file:

[Setting Display] ► [File] ► [SAVE Key]
► [Range] ► Select from the list.

Select the cursors used to specify the range ([A/B] or [C/D]).

Even if the range is specified with the cursors, the entire waveform will be saved as long as [Range] is set to [All].

Configure the other save settings as necessary.

See: "Selecting and saving data (SAVE key)" (p.98)

To perform a numerical calculation:

[Setting Display] ► [Calculation] ►
[Numeric Calculation] ► [Range] ►
Select from the list.

See: "8.2 Settings for Numerical Value Calculation" (p.192)

To perform a waveform calculation:

[Setting Display] ► [Calculation] ►
[Waveform Calculation] ► [Range] ►
Select from the list.

See: "9.2 Settings for Waveform Value Calculation" (p.210)

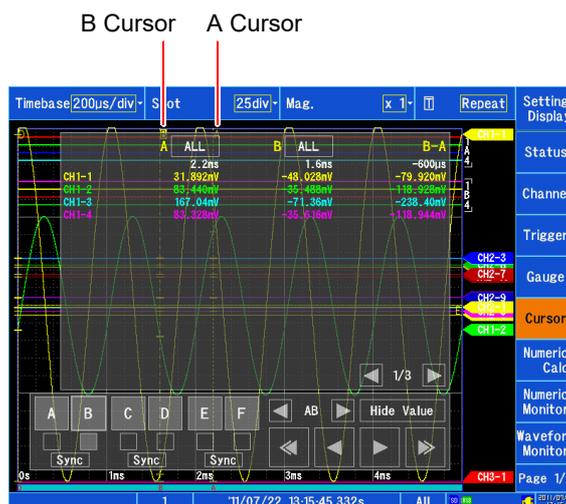
To generate an XY composite:

Specify the composite range for

[Waveform Display] ► [Status] ►

[Display] ► [X-Y] Or

[Setting Display] ► [Status] ►



About reading measurement values and cursor types:

See: "5.1 Reading Measured Values (Using Cursors)" (p.112)

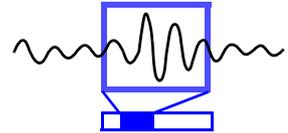
NOTE

Ranges specified on the XY Composite Display screen cannot be used as range specifications for saving files, performing numerical calculations or waveform calculations, or generating XY composites.

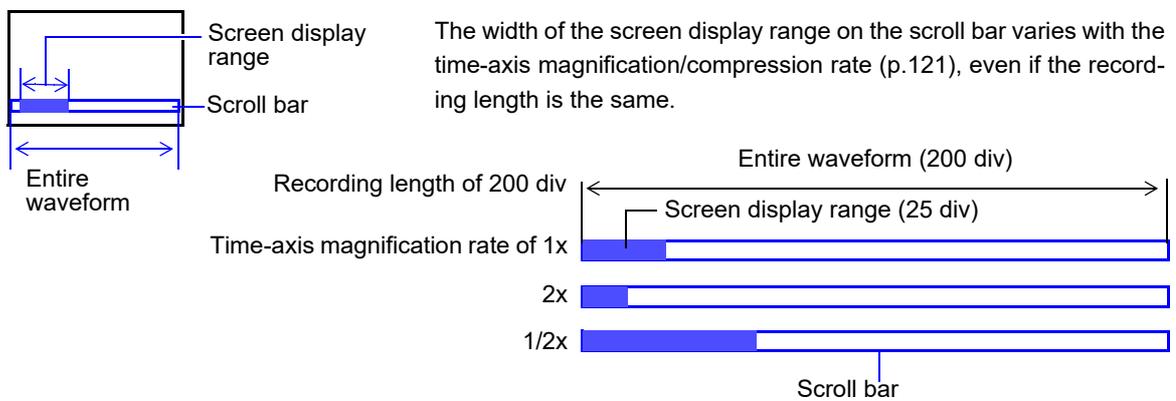
5.3 Moving the Waveform Display Position

About Display Position

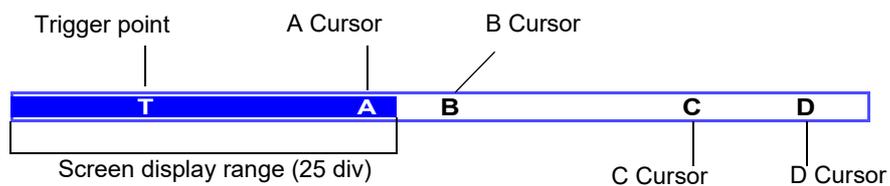
Using the scroll bar, you can check which position of the entire recorded waveform is being represented by the waveform displayed on the screen. The trigger time, trigger position, and trace cursor (A/B, C/D) position are also shown.



Checking the display range with the scroll bar



Checking the location of trigger points and cursors with the scroll bar

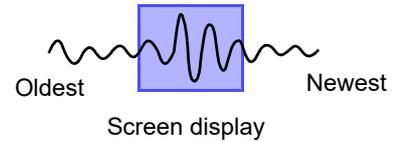


Scrolling waveforms

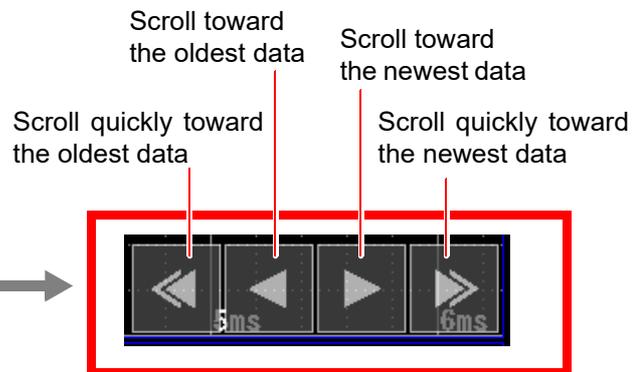
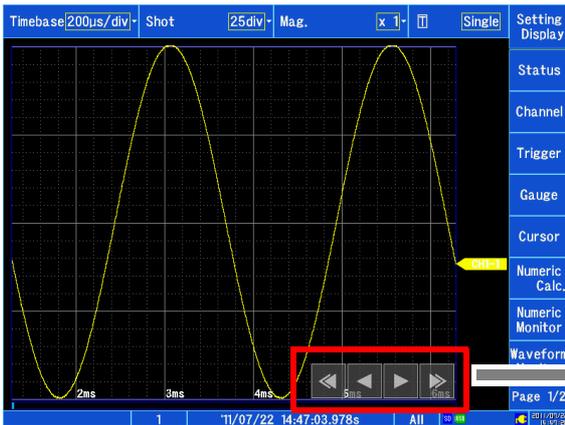
You can scroll waveforms during measurement as well as existing displayed waveforms on the Waveform screen.

There are two scrolling methods:

- Scroll using the arrow window on the Waveform screen.
- Display the desired location using the scroll bar on the Waveform screen.



To scroll using the arrow window on the Waveform screen



The waveform will scroll each time you tap a button. Strong taps* cause the waveform to scroll quickly, and continuing to touch a button causes the waveform to scroll continuously.

*: Strong taps with the touch pen cannot be detected.

To display the desired location using the scroll bar on the Waveform screen

You can tap the desired position on the scroll bar to display the portion of the waveform corresponding to the tapped position.

See: "1.3 Basic Operation" (p.20)



To display older waveform data in the roll mode view

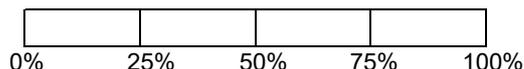
When you scroll a waveform in the roll mode view, the roll mode display will stop, and you will be able to view the waveform up to the most recently measured point. To return to the roll mode view, tap **[Follow Scroll]** on the right side of the Waveform screen.

Moving the display position (jump function)

You can specify a waveform position and immediately display it on the screen when the waveform's recording length is too long or the entire waveform cannot be shown on the screen.

The following positions can be specified:

- Trigger positions
- Positions identified with the search function
- A/B and C/D cursor positions
- Specified positions (when the overall waveform is set to 100%, 0% [start of the waveform] and 100% [end of the waveform])



- Event mark positions
- Time positions

Moving to a trigger point, search position, cursor position, or specified position

1 Open the screen.

[Waveform Display (page2/2)] ► [Jump]
► [General]

2 Tap the item you wish to display.

Start Trig. Pos.	Displays the position at which the start trigger was applied.* ²
Stop Trig. Pos.	Displays the position at which the stop trigger was applied.* ²
Search Pos.	Displays the position most recently identified with the search function.* ¹
A/B/C/D Cursor	Displays the cursor positions.*
0% to 100%	Displays specified positions.

*1 Perform a search with the search function (p.131) first. This item cannot be selected unless a search has been performed.

*2 This option cannot be selected when not using the start trigger, stop trigger, or the A/B or C/D cursors.

The selected position will be displayed on the screen.
(The display will move immediately when you select the item.)

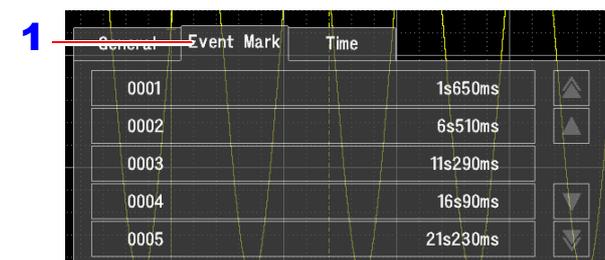
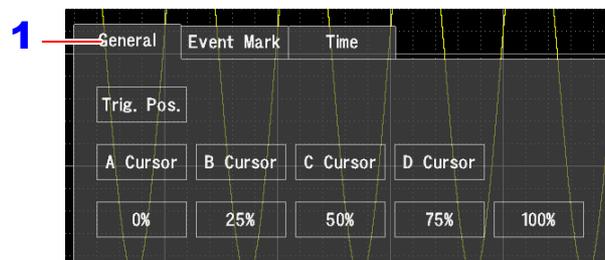
Moving to an event mark

1 Open the screen.

[Waveform Display (page2/2)] ► [Jump]
► [Event Mark]

2 Tap the event mark you wish to display.

You cannot select this option if there are no event marks.



Moving to a time position

1 Open the screen.

[Waveform Display(page2/2)] ► [Jump]
► [Time]

2 Set the time for which you wish to search.

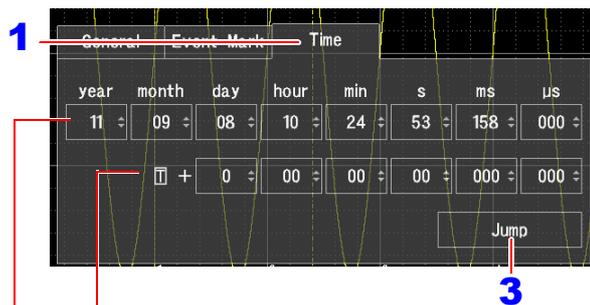
Set the time for which you wish to search using a time and date (absolute time) or the time from a trigger [T] (relative time).

- When setting the time with a time and date
Set the time and date you wish to search for.
- When setting the time from a trigger
Set the time from a trigger.

When the data in question was recorded using a pre-trigger, you can also search before the trigger.

See: "6.2 Changing and Entering Values" (p.145)

3 Tap [Jump] to display the position.



Time from a trigger (relative time)

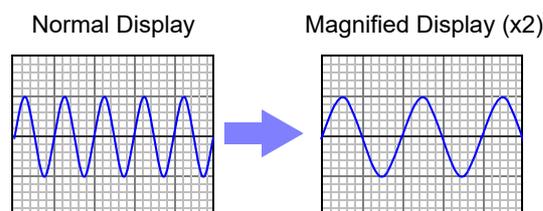
T+: After the trigger; T-: Before the trigger

Time and date (absolute time)

5.4 Magnifying and Compressing Waveforms

Magnifying and compressing waveforms along the horizontal axis (time axis)

You can view more detailed data by magnifying the waveform along the horizontal axis (time axis). Conversely, you can more quickly identify changes in the overall waveform by compressing the time axis. The magnification and compression rate can be changed during measurement. Magnification and compression of waveforms on the screen is performed relative to the left edge of the screen. However, when a cursor is displayed on the screen, magnification and compression are performed relative to the cursor position.

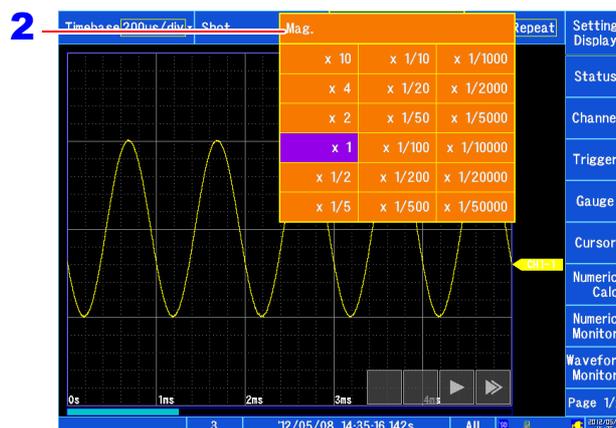


- 1** Open the screen.
[Waveform Display]
- 2** [Mag.] ► Select from the list.
Select the display zoom factor.

Select (*: Initial setting)

x10, x4, x2, x1*, x1/2, x1/5, x1/10,
x1/20, x1/50, x1/100, x1/200, 1/500,
x1/1000, x1/2000, x1/5000, x1/10000,
x1/20000, 1/50000

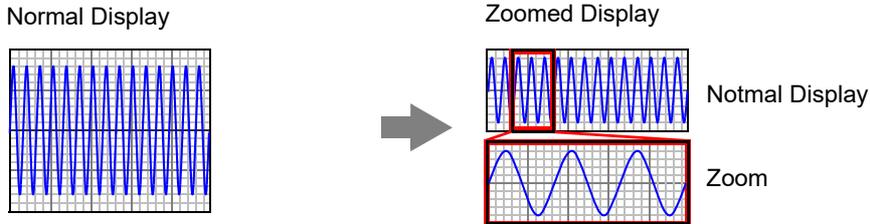
You can also change the zoom factor while measurement is not being performed using [Setting Display] u [Status] u [Display Settings] ► [Time Mag.(Waveform)].



Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis))

A magnified section of a waveform can be displayed together with the unmagnified view by splitting the screen horizontally.

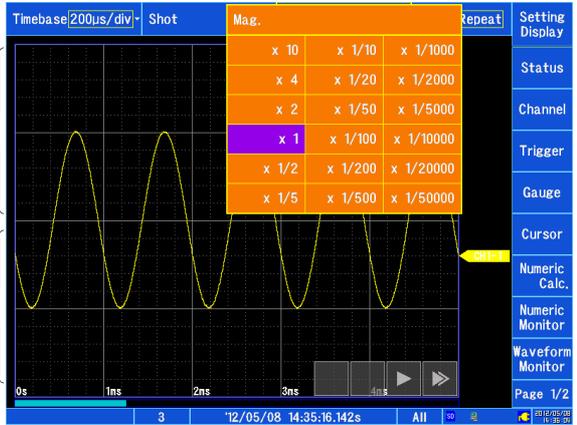
With the waveform displayed normally on the upper half of the screen, a section magnified along the time axis can be displayed on the lower half.



- 1** **Open the screen.**
[Waveform Display (page2/2)]
- 2** **Tap [Zoom].**
The Zoom function is enabled and the screen is split into upper and lower halves.
(Upper: waveform to be magnified, Lower: magnified (zoomed) section of waveform)
- 3** **Tap [Mag. Zoom].**
- 4** **[Zoom] ► Select from the list.**

Waveform displayed at set zoom factor

Waveform displayed at zoom factor



Select the zoom factor.

Select (*: Initial setting)

x10, x4, x2, x1*, x1/2, x1/5, x1/10, x1/20, x1/50, x1/100, x1/200, 1/500, x1/1000, x1/2000, x1/5000, x1/10000, x1/20000, 1/50000

The waveform on the upper half of the screen is magnified and displayed on the lower half of the screen. Using a zoom factor that is the same as or less than the set zoom factor will cause the zoom factor setting to automatically change to a value that is one step larger than the [Zoom] selection.

- 5** **Scrolls the zoomed section of the waveform.**
See: "Scrolling waveforms" (p.118)
- 6** **Display the position you wish to view.**
Tap a position on the top half of the screen to center the magnified display at that point.
To cancel Zoom:
Tap [Zoom].

NOTE **Screen divisions**
When displaying waveforms on multiple screen divisions, enabling the zoom function will cause all waveforms to be displayed together on one screen division. Canceling the zoom function will cause the waveforms to return to their original divisions.

About logic waveform display

Built-in logic

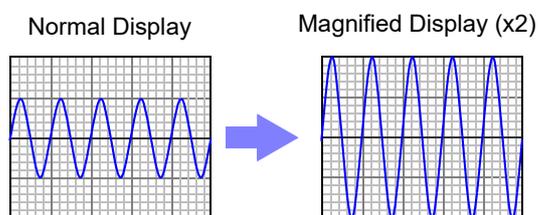
- When **[Logic Width (Waveform)]** is set to **[Normal]**, logic waveforms for which **[Display Position]** is set to **[Position 5]** to **[Position 8]** will not be displayed.
- When **[Logic Width (Waveform)]** is set to **[Wide]**, logic waveforms for which **[Display Position]** is set to **[Position 3]** or **[Position 4]** will not be displayed.

CAN logic

- When **[Logic Width (Waveform)]** is set to **[Normal]**, logic waveforms for which **[Display Position]** is set to **[Position 2]** will not be displayed.
- When **[Logic Width (Waveform)]** is set to **[Wide]**, CAN logic waveforms will not be displayed.

Magnifying and Compressing Vertical Axis (Voltage Axis)

Waveforms on each channel can be magnified or compressed along the vertical axis (voltage axis) for display. This setting can only be configured for analog, pulse, and inter-channel calculation channels. Magnification and compression based on zero position.



1 Open the screen.

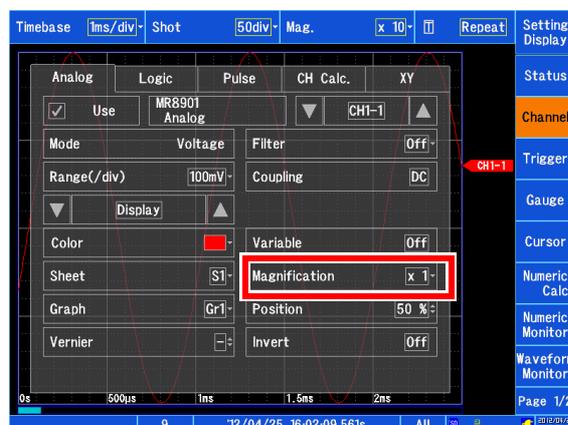
**[Waveform Display]/[Setting Display] ▶
[Channel] ▶ [Analog]/[Pulse]/[CH Calc.]
▶ [Display]**

2 [Magnification] ▶ Select from the list.

Select the zoom factor for the channel you wish to adjust.

Select (*: Initial setting)

x1/10, x1/5, x1/2,
x1*, x2, x5, x10, x20, x50, x100



Selecting **[Invert]** will invert the waveform's positive and negative orientation.

"6.8 Inverting Waveforms" (p.162)



To display a waveform using a specific zoom factor

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p.159)

5.5 Monitoring Input Waveforms (Waveform Monitor)

You can monitor input waveforms allocated to a sheet on the Waveform screen in real time, allowing you to check the input status, for example while waiting for a trigger to be applied. The waveforms will be displayed on one screen on the Waveform Monitor screen when the display format is set to **[Waveform]** and on a waveform + XY screen when the display format is set to **[X-Y]**, regardless of the screen division settings.

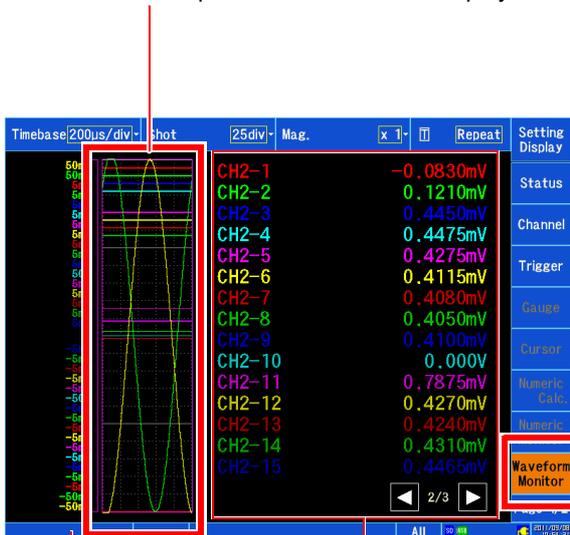
See: "Configuring the screen layout" (p.62), "Allocating measurement data to sheets" (p.129)

Open the screen.

[Waveform Display] ► **[Waveform Monitor]**

When the display format is **[Waveform]**

The status of the input waveforms will be displayed.

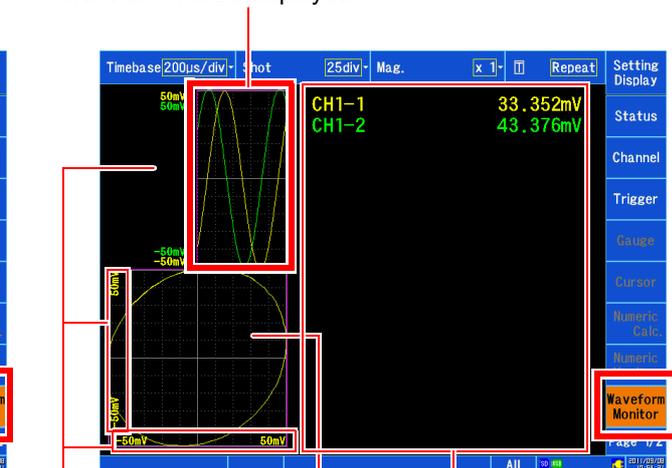


Gauge

The instantaneous values of the input waveforms will be displayed.

When the display format is **[X-Y]**

The status of the XY composite waveform and the input waveform of the channel allocated to the XY composite waveform will be displayed.



Gauge

XY composite waveform

The instantaneous values of the input waveforms will be displayed.



To cancel the waveform monitor

Tap **[Waveform Monitor]** again. Additionally, the waveform monitor will be automatically canceled if measurement starts or a trigger is applied.

NOTE

- The waveform monitor cannot be used during measurement or when data is being acquired.
- Input waveforms are not shown for channels for which measurement has been turned off in the input settings or for which the waveform display color is set to **[x]** (display off).
- The number of upper and lower limit values that can be shown on the gauge is limited when there are a large number of channels. Values for low module and channel numbers will be given priority in order from analog channels to pulse channels and then inter-channel calculation channels.
- Only the upper and lower limit values for one composite waveform will be shown on the XY composite waveform gauge.
- When the sampling clock is set to **[External]**, the waveform monitor cannot be displayed while waiting for a trigger to be applied. At other times, processing will operate on the **[Internal]** sampling clock, even if the sampling clock is set to **[External]**.

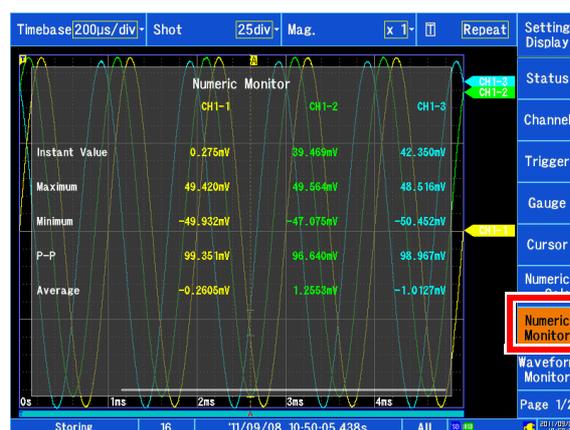
5.6 Monitoring Values (Numeric Monitor)

You can display the numeric monitor on the Waveform screen. This functionality allows you to display instantaneous values, maximum values, minimum values, P-P values, and average values while acquiring data. Instantaneous values are displayed for the latest data in real time.

See: "8.6 Numerical Calculations" (p.204)

Open the screen.

[Waveform Display] ► [Numeric Monitor]



To cancel the numeric monitor
Tap [Numeric Monitor] again.

When there are a large number of channels shown on the numeric monitor

You can scroll on the Numeric Monitor screen. When there are a large number of channels, you can scroll to display the calculation results.

See: "Touch panel operation" (p.20)

NOTE

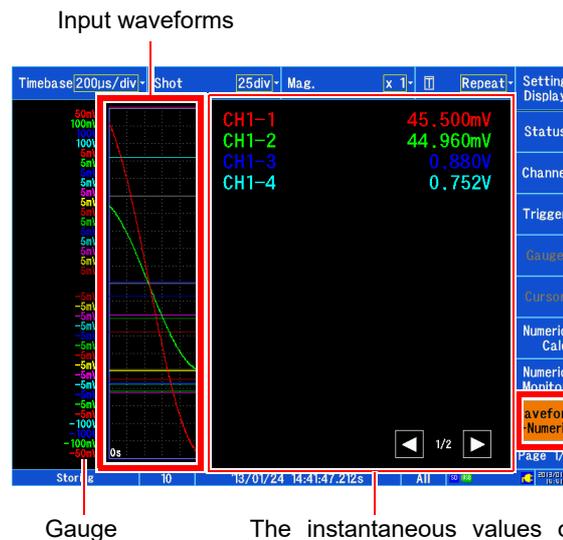
- Values are not shown for channels for which measurement has been turned off or for which the display color is set to [×] (display off).
- The numeric monitor function can only be used when the sampling clock is set to [Internal]. It cannot be used when the sampling clock is set to [External].
See: "Setting the horizontal axis (time-axis or sampling speed)" (p.58)
- When using a trigger, data prior to the trigger is not included in the calculations since the numeric monitor function displays a monitor for data following triggers.
- Numeric monitor function values cannot be saved to files.
- The maximum values, minimum values, P-P values, and average values shown on the Numeric Monitor screen are provided for monitoring values during measurement and may not completely match corresponding values calculated using the numerical calculation function.

5.7 Displaying Waveforms and Values simultaneously during measurement (Waveform+Numeric)

You can display input waveforms and instantaneous values simultaneously during measurement.

Open the screen.

[Waveform Display] ► [Waveform+Numeric]



To cancel Waveform+Numeric mode

Tap [Waveform+Numeric] again. Additionally, Waveform+Numeric mode will be automatically canceled if measurement ends.

NOTE

- While Waveform+Numeric mode, you will be unable to scroll waveforms.
- Input waveforms are not shown for channels for which measurement has been turned off in the input settings or for which the waveform display color is set to [x] (display off).
- The number of upper and lower limit values that can be shown on the gauge is limited when there are a large number of channels. Values for low module and channel numbers will be given priority in order from analog channels to pulse channels and then inter-channel calculation channels.

5.8 Displaying Gauges and Comments

You can display gauges and comments on the Waveform screen. You can also divide measurement data among four sheets.

Displaying gauges

You can display analog, pulse, waveform calculation, and inter-channel calculation channel gauges on the Waveform screen. Gauges are shown in the same color as the corresponding waveforms.

1 Open the screen.

[Waveform Display] ► [Gauge]

Gauges will be displayed on the left side of the screen.

Then, as necessary:

2 Tap the gauge display area.

A channel selection window will be displayed. If no channels have been allocated to the gauge, tapping the gauge display area will not cause the channel selection window to be displayed.

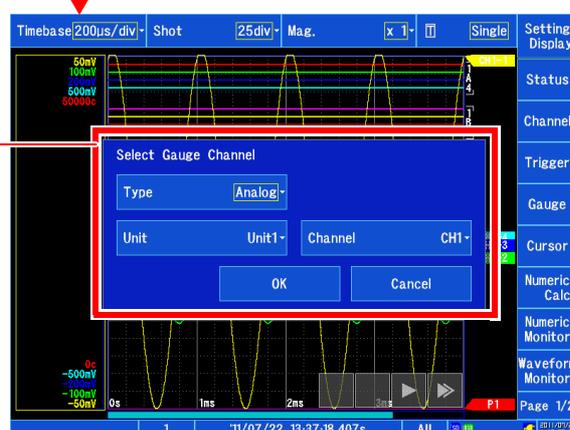
3 Select the channel for which you wish to display a gauge.

You can select from analog, pulse, waveform calculation, and inter-channel calculation channels. Channels for which measurement has been turned off or for which the waveform color has been set to [X] cannot be selected.

Selecting [All] will cause all the upper and lower limits for all analog, pulse, waveform calculation, and inter-channel calculation channels selected for the sheet in question to be displayed.



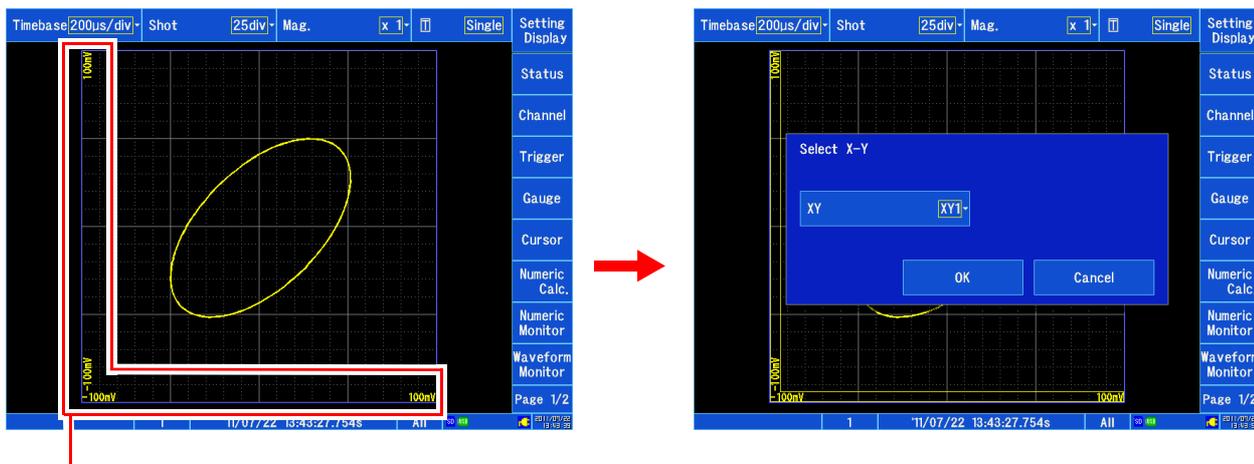
2 Tap the gauge display area.



3

NOTE The number of upper and lower limit values that can be shown on the gauge is limited when there are a large number of channels. Units and channel numbers are displayed in order from least to greatest in the following order: analog channels → pulse channels → waveform calculation channels → inter-channel calculation channels. Only the upper and lower limit values for one composite waveform will be shown on the XY composite waveform gauge.

Example display (one XY composite waveform screen)



Tap the gauge display area.

Displaying comments

When comments have been entered for individual channels, they can be shown on the Waveform screen.

See: "6.1 Adding Comments" (p.142)

The comment display setting can be configured under **[System]** ► **[Env.]** ► **[Display Comments]** on the Settings screen.

See: "Turning comments on or off" (p.260)



When comments overlap with other display elements

Shift the zero position or allocate channels to sheets so that the comments do not overlap other display elements.

5.9 Allocating Measurement Data to Sheets and Switching Between Sheets

Allocating measurement data to sheets

You can allocate measurement data to up to four sheets on the Waveform screen. Analog, logic, pulse, inter-channel calculation, and XY channels can be allocated freely to any given sheet.

1 Open the screen.

The method for opening the screen varies for each input channel.

To configure an analog, pulse, or inter-channel calculation channel

[Waveform Display]/[Setting Display] ▶ 1
[Channel] ▶ [Analog]/[Pulse]/[CH Calc.] ▶ 2
▶ [Display] ▶ 3

To configure a logic or XY channel

[Waveform Display]/[Setting Display] ▶ 1
[Channel] ▶ [Logic]/[XY]

2 Select the channel you wish to configure.

3 [Sheet] ▶ Select from the list.

Select the sheet on which you wish to display the channel.

S1, S2, S3, S4



Configuring an analog channel

Switching between sheets

You can switch which sheets to display on the Waveform screen. There are two methods for switching sheets.

When switching from [Status]

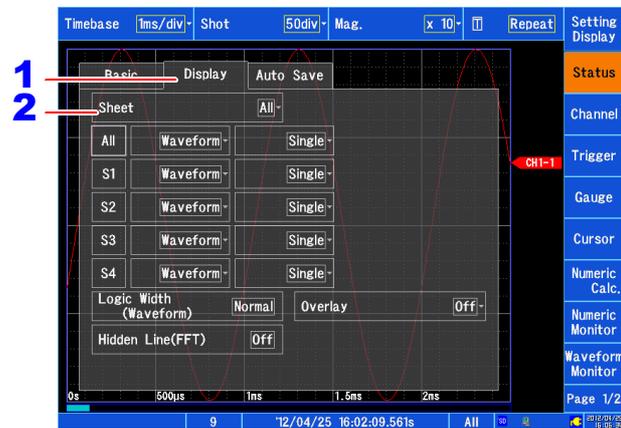
- 1 Open the screen.
[Waveform Display] Or
[Setting Display] ► [Status] ►
[Display Settings]

- 2 [Sheet] ► Select from the list.

Select which sheets you wish to display.

Select (*: Initial setting)

All*	Displays all channels allocated to S1 to S4 on the Waveform screen.
S1 to S4	Displays the specified sheet on the Waveform screen.



The sheet number is shown at the bottom of the screen.



When switching from [Sheet/History]

- 1 Open the screen.
[Page2/2] ► [Sheet & History]

- 2 [Sheet] ► Select from the list.

Select which sheets you wish to display.

ALL, S1, S2, S3, S4

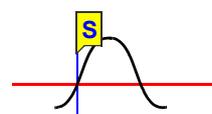
5.10 Searching for Waveforms

You can search for and display locations in the measured waveform data that meet the desired search conditions.

You can perform two types of search with the search conditions:

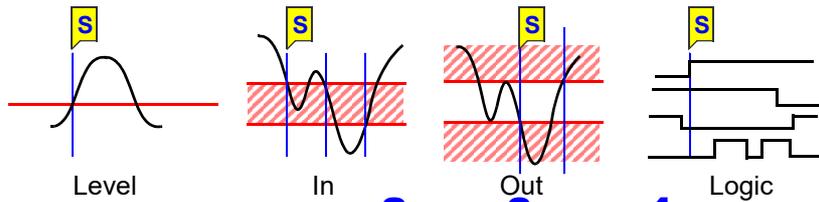
- **Trigger search**
Allows you to set trigger conditions and search for locations that satisfy those conditions.
- **Peak search**
Allows you to select and search for maximum values, minimum values, local maximum values, and local minimum values.

The search mark (S) will be shown at locations that satisfy the search conditions. You can also move the A/B and C/D cursors to search mark positions.



Searching for trigger positions

You can search data measured using trigger conditions.



1 Open the screen.

[Waveform Display (page2/2)] ► [Search]

2 Set [Method] to [Trigger].

Tapping toggles the setting.

3 Select the signal type and channel for which you wish to search.

A channel selection window will be displayed.

4 Select the search range.

Select(*: Initial setting)

Whole*	Searches the entire waveform.
A/B	Searches between A and B or between C and D. When there is a single cursor, searches from the cursor's position.
C/D	

5 Set the trigger search conditions.

Setting analog, pulse, or inter-channel calculation channel search conditions

Select the trigger type for which you wish to search.

Level, In, Out, OFF* (*: Initial setting)

Set the search conditions.

The displayed items vary depending on the trigger type.

L (Level)	Sets the trigger level for which to search. Searches for positions at which the waveform crosses the specified level.
Slope	Sets the slope for which to search (input signal rising edge or falling edge).
F (Filter)	Sets the filter width (trigger filter) for which to search. Prevents noise or other factors from satisfying the search conditions.
▲ ▼	Sets the upper and lower limit value for which to search.

The trigger search condition settings provide the same functionality as the trigger conditions set prior to measurement.

See: "7.7 Using Analog, Pulse, or Inter-Channel Calculation Signals to Apply Triggers" (p.180)

6 Tap [Search].

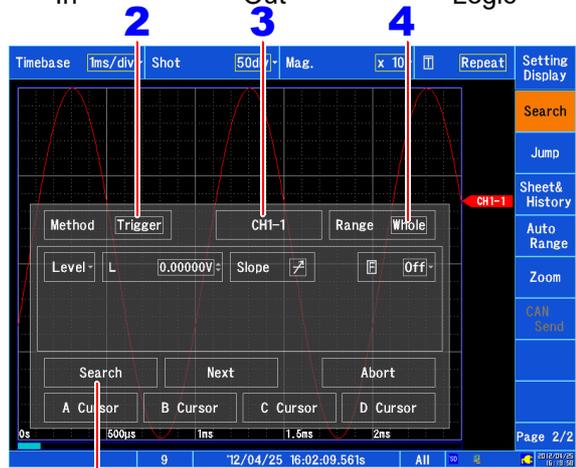
Locations at which the search conditions are satisfied will be displayed. A search mark (S) will be displayed at search locations.

To search for other locations

Tap [Next] to search for the next location.

To cancel the search

Tap [Abort].



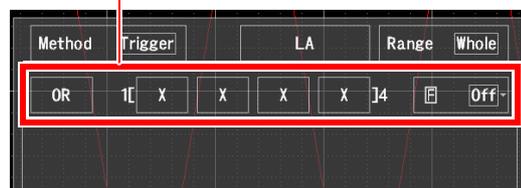
6 Setting logic channel search conditions
Set the trigger search conditions.

The trigger search condition settings provide the same functionality as the trigger conditions set prior to measurement.

See: "7.8 Triggering by Logic Signals (Logic Trigger)" (p.183)



Analog, pulse, or inter-channel calculation channel



Logic search conditions

If the search results differ from what you expected

Depending on the size of the acquired waveform, erroneous search results may be displayed. If this occurs, use the trigger filter. If the trigger conditions are already satisfied at the search start position in a logic trigger search, cancel the trigger conditions and search again for a location that satisfies the search conditions.

Searching for peak values

You can select and search for a maximum value, minimum value, local maximum value, or local minimum value in the measured data.

- 1 Open the screen.
[Waveform Display (page2/2)] ► [Search]
- 2 Set [Method] to [Peak].
- 3 Select the signal type and channel for which you wish to search.

A channel selection window will be displayed.

- 4 Select the search range.

Select (*: Initial setting)

Whole*	Searches the entire waveform.
A/B	Searches between A and B or between C and D.
C/D	When there is a single cursor, searches from the cursor's position.

- 5 Select the search type.

Select (*: Initial setting)

Maximum*	Searches for a maximum value.
Minimum	Searches for a minimum value.
Maximal	Searches for a local maximum value.
Minimal	Searches for a local minimum value.

- 6 (When local maximum value or local minimum value is selected)

Set the local maximum value or local minimum value conditions under [Filter].

Select (*: Initial setting)

Off	Treat values that are larger (or smaller) than the values 1 point before and after as local maximum (or minimum) values. (Initial setting)
10 to 1000S	Treat all values that are larger (or smaller) than the set number of points before and after as local maximum (or minimum) values.

- 7 Tap [Search].

Locations at which the search conditions are satisfied will be displayed. A search mark (S) will be displayed at search locations.

To search for other locations

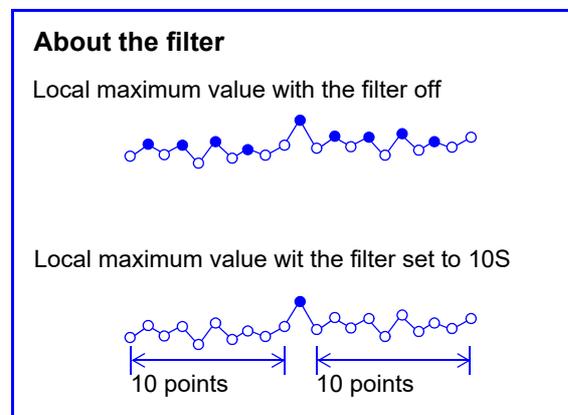
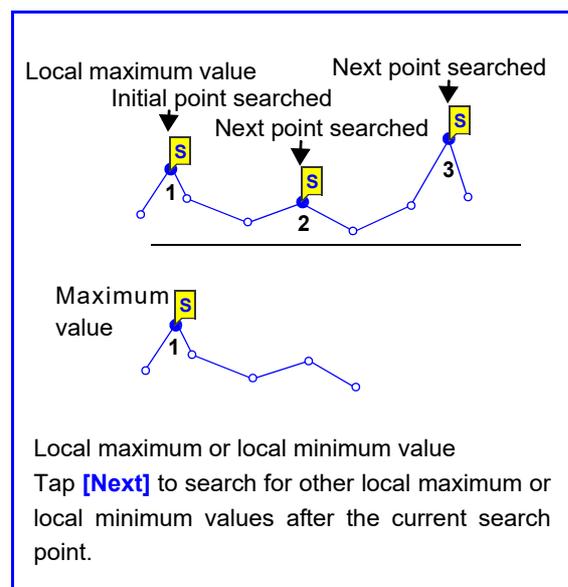
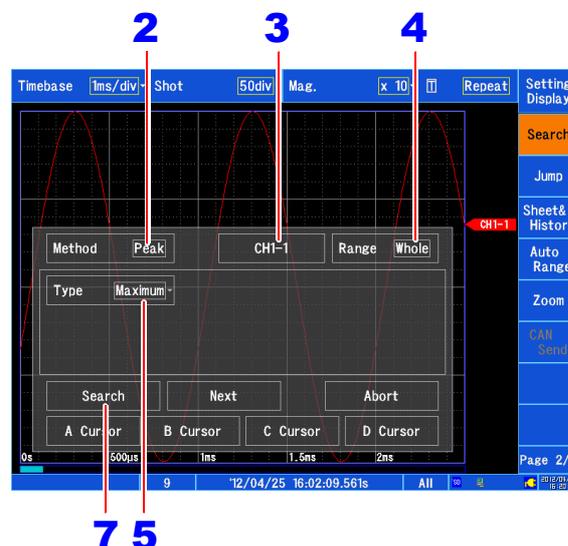
Tap [Next] to search for the next location.

To move the cursor to the search location

Select [A Cursor], [B Cursor], [C Cursor], or [D Cursor].

To cancel the search

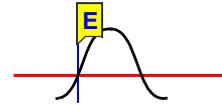
Tap [Abort].



5.11 Marking Events

You can place (up to 1,000) event marks at locations as desired during measurement. You can also search for event marks.

See: "Moving the display position (jump function)" (p.119)



There are two methods for placing event marks:

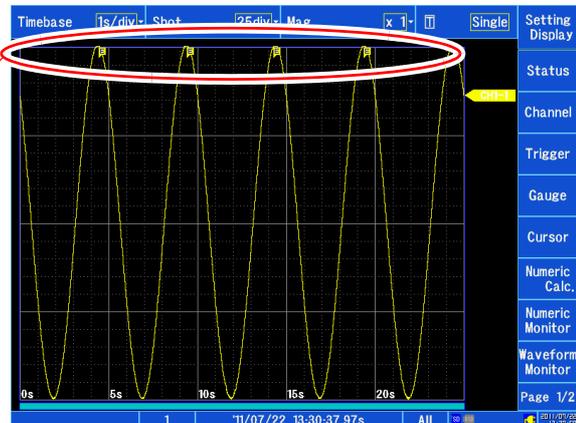
- Press the **START** key during measurement.
- Input a signal to an external input terminal (IN1, IN2, or IN3).

See: "13.2 External I/O" (p.325)

Placing event marks while viewing waveforms

Press the **START** key while viewing data on the Waveform screen during measurement to place a mark.

The mark will appear on the waveform when the **START** key is pressed. Event marks are displayed in the order they were placed.



5.12 Compositing Waveforms (XY Compositing)

Up to eight XY waveforms can be composited by assigning analog, pulse, and inter-channel calculation channels to the X- and Y-axes as desired either during or after measurement. Vertical axis (voltage axis) magnification and compression settings also apply to XY composite waveforms. In order to composite waveforms while measurement is ongoing, the settings must be configured before measurement starts.

You can composite either entire waveforms or certain specified ranges (p.137).

Compositing entire waveforms

1 Open the screen.

[Waveform Display] ► [Status] ► [Display] or [Setting Display] ► [Status] ► [Display Settings]

2 Set [X-Y] to the display format.

3 Select the screen division.

Select (*: Initial setting)

Single*	Displays the XY1 to XY8 waveforms on one screen.
Dual	Displays the XY1 to XY8 waveforms on two screens.
Wave-form+XY	Displays analog, pulse, and inter-channel calculation waveforms on one screen and the XY1 to XY8 waveforms on two screens.

4 Select the range for which to perform XY compositing.

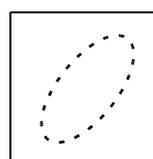
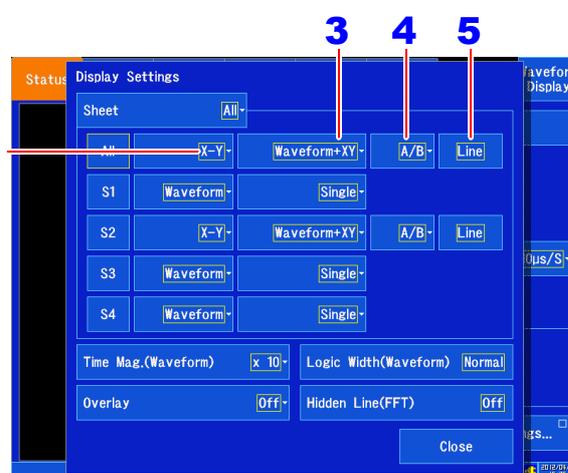
Select (*: Initial setting)

All*	Composites entire waveforms.
A/B	Composites from A to B or from C to D.
C/D	See: "5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p.116)

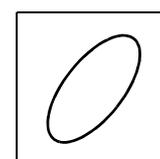
5 Selects the line interpolation.

Select (*: Initial setting)

Dot	Displays points for measurement data only. The order in which data was acquired to memory will be lost.
Line*	Displays waveforms while connecting measurement data with straight lines in the order in which it was acquired to memory.



Dot



Line

6 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [XY]

7 Select the channel to configure.

XY1 to XY8

8 Select the display color.

To hide the waveform, select .

9 [Sheet] ► Select from the list.

Select the sheet you wish to display. Data can be allocated to up to four sheets.

See: "Allocating measurement data to sheets" (p.129)

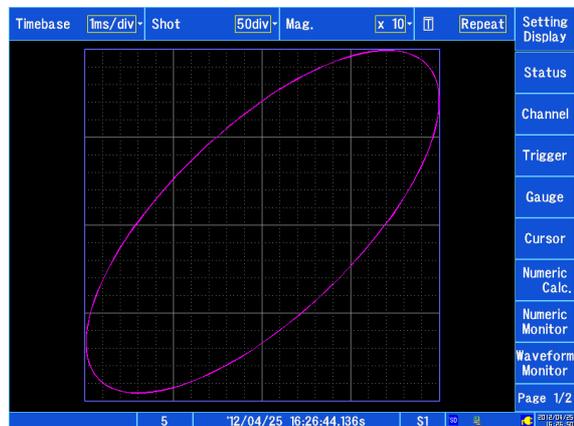
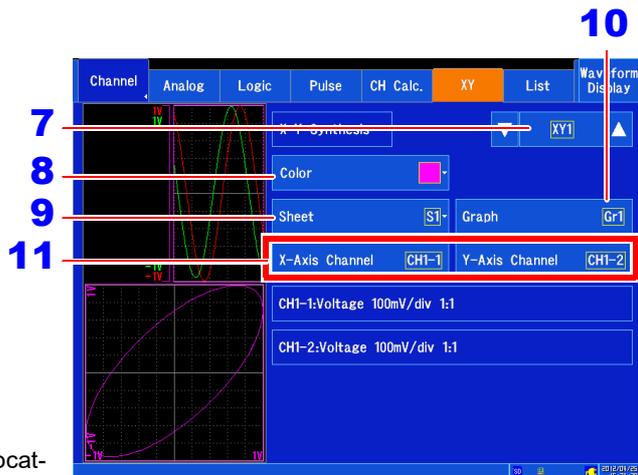
10 Select the graph to display.

Gr1, Gr2

By default, channels are assigned to Gr1 and Gr2 in order, starting with the smallest channel number.

11 Allocate channels to the X- and Y-axes.

The Channel Settings window will be displayed. Set [X-Axis Channel] and [Y-Axis Channel] to the channels to display. You can select any analog, pulse, or inter-channel calculation channel.

**To cancel waveform rendering**

When the recording length is long, it may take time to render the XY waveforms. To cancel before rendering is complete, press the **STOP** key. To restart rendering, tap the graph on the Waveform screen.

NOTE If the display format for the allocated sheet is other than [X-Y], the XY composite waveform will not be displayed. To display the waveform, change the sheet's display format to [X-Y].

See: "Configuring the screen layout" (p.62)

Compositing partial waveforms

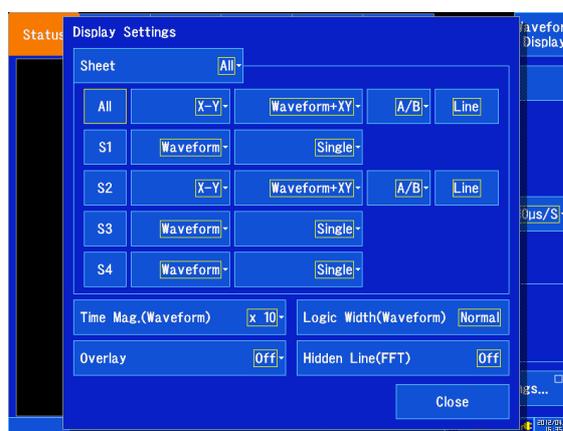
This section describes how to composite partial waveforms. To composite partial waveforms, specify the range of the normal waveforms to composite using the A/B or C/D cursors.

See: "5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p.116)

- NOTE**
- The partial compositing range cannot be specified using the E/F cursors.
 - When a single cursor is used, XY compositing is performed from the cursor to the end of the waveform.

Method 1. Viewing the normal waveform display and partial composite waveforms on separate sheets

- 1 Open the screen.
[Waveform Display] ► [Status] ► [Display] or [Setting Display] ► [Status] ► [Display Settings]



- 2 Configure the following settings:
 - Sheet 1 (S1)
Display format: [Waveform]
 - Sheet 2 (S2)
Display format: [X-Y]
Composite range: [A/B] or [C/D]
 - Configure other channels to composite and other settings as necessary.

- 3 Set the Waveform screen sheet to S1.

See: "Switching between sheets" (p.130)

- 4 Specify the waveform range to composite with the A/B or C/D cursors.

See: "Specifying a Waveform Range (A/B, C/D Cursor)" (p.116)

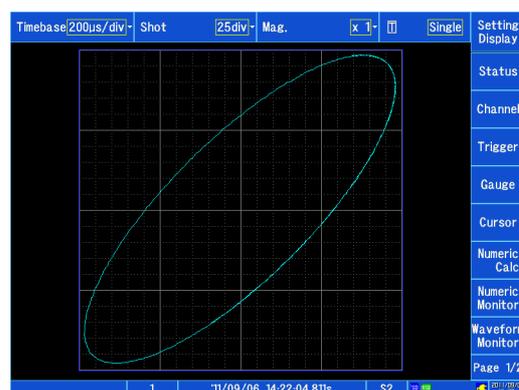
- 5 Set the Waveform screen sheet to S2.

See: "Switching between sheets" (p.130)

The composite waveform for the specified range will be displayed.



Sheet 1 (S1) normal waveform



Sheet 2 (S2) partial compositing

Method 2. Viewing the normal waveform display and partial compositing simultaneously

1 Open the screen.

[Waveform Display] ► [Status] ► [Display] or [Setting Display] ► [Status] ► [Display Settings]

2 Configure the following settings:

- Display format: [X-Y]
- Screen division: [Waveform+XY]
- Compositing range: [A/B]/[C/D]
- Configure other channels to composite and other settings as necessary.

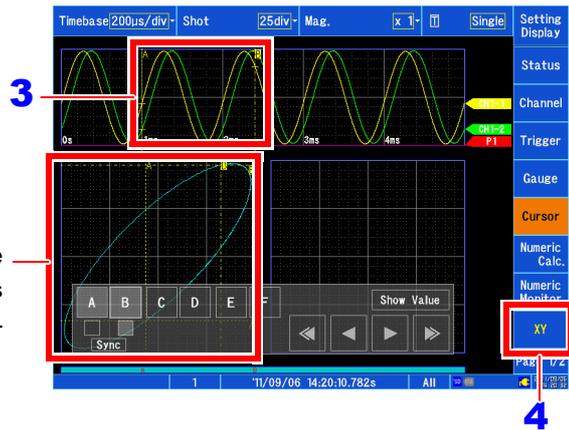
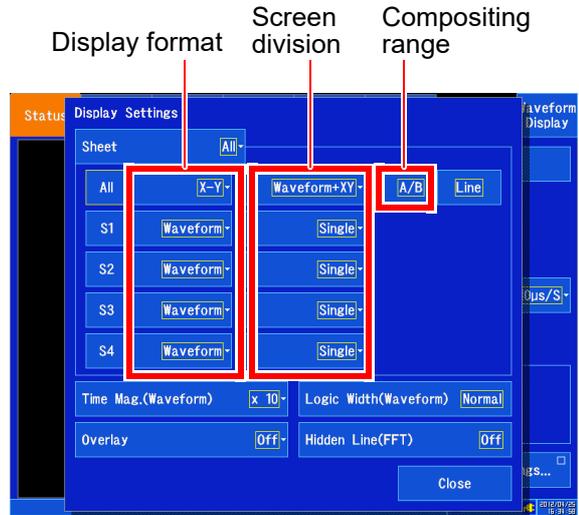
3 Specify the waveform range to composite with the A/B or C/D cursors.

See: "Specifying a Waveform Range (A/B, C/D Cursor)" (p.116)

4 [Waveform Display] ► [Cursor] ► [XY]

The composite waveform for the specified range will be displayed on the composite waveform graph.

The composite waveform for the specified range will be displayed. Marks indicate where XY compositing has been performed. You can check the compositing range after compositing by moving the A/B or C/D cursors.



NOTE

When performing compositing on the [Waveform+XY] screen, the compositing range will not change until you tap [XY].

5.13 Viewing Past Waveforms

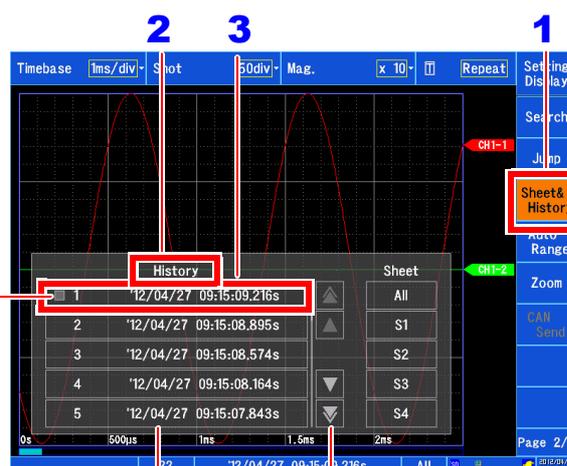
The instrument stores up to 16 previously measured waveforms (16 blocks)*1 in its internal memory. (For the purposes of this explanation, measurement data for one measurement session is referred to as “one block”.) This functionality allows previously measured waveforms to be viewed.

*1: Up to 16 blocks can be stored, but the number of blocks that can be stored declines as the recording length increases. When the maximum number of blocks that can be stored is exceeded, data is deleted starting with the oldest waveform.

- 1** Open the screen.
[Waveform Display(page2/2)] ►
[Sheet&History]
- 2** Tap the [History].
- 3** Tap the block you wish to display.

Currently selected history block.

No. 1 indicates the most recent block.



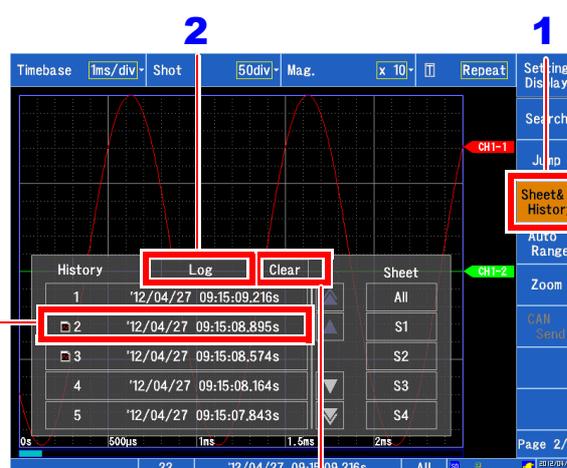
Block data trigger

Displayed when there are more blocks than can be displayed on the screen at once. This button allows you to scroll up and down in the list.

You can also check up to 200 events of the past trigger times (when the trigger is not used, the measurement start time).

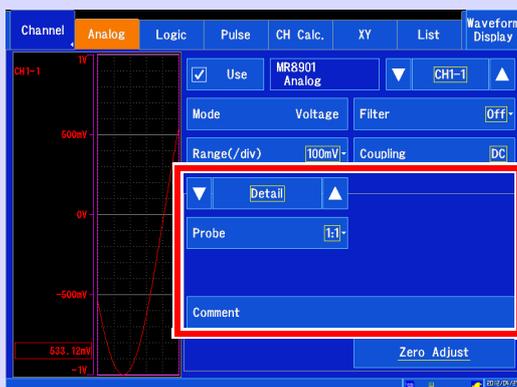
- 1** Open the screen.
[Waveform Display(page2/2)] ►
[Sheet&History]
- 2** Tap the [Log].

The measured data automatically stored in binary format is marked with the file icon. Tapping the file icon loads the corresponding waveform file.



Deletes the measurement log.

Utility Functions Chapter 6



Input module detailed settings (p.164)

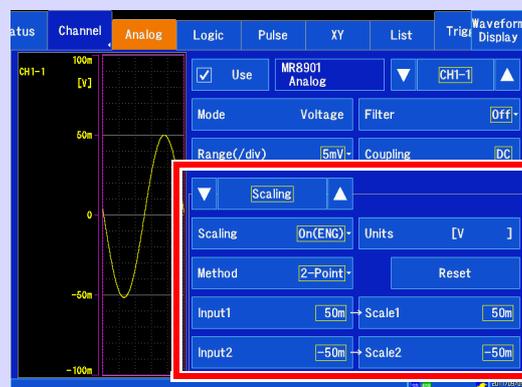
- MR8901 Analog Unit
- MR8902 Voltage/TEMP Unit
- MR8903 Strain Unit
- MR8905 Analog Unit

* For more information about the MR8904 CAN Unit, see the instruction manual on the included CD.



Changing settings

- Copying settings to other channels (p.163)
- Setting the channel to use (increasing the recording length) (p.147)



Changing the input display

- Converting input values (scaling) (p.150)
- Setting the display position and zoom factor as desired (variable function) (p.159)
- Fine Adjustment of Input Values (Vernier function) (p.161)
- Inverting the waveform (p.162)

Display settings can also be changed on the Waveform screen.

6.1 Adding Comments

This section describes how to enter comments and values.

Entering titles and comments

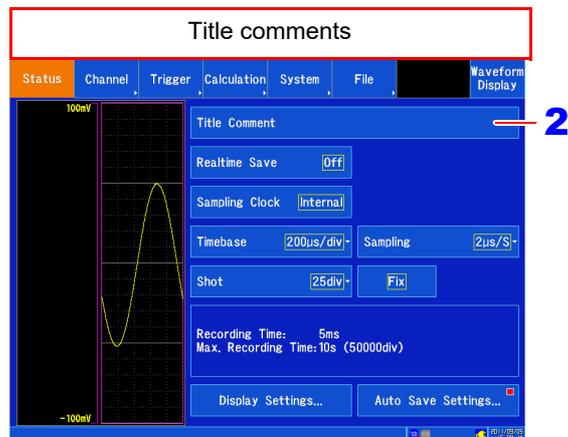
Comments of up to 40 characters can be entered as a title for the measurement data, and as a label for each input waveform.

You can display comments for input waveforms on the Waveform screen (p.260). You can also display comments when viewing data using the application on the PC.

1 Open the screen.

Title comments:

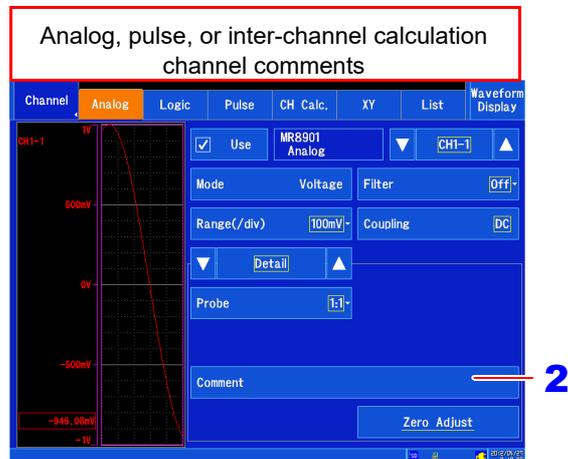
- [Waveform Display] ▶ [Status] ▶ [Basic] Or
- [Setting Display] ▶ [Status]



Input channel comments:

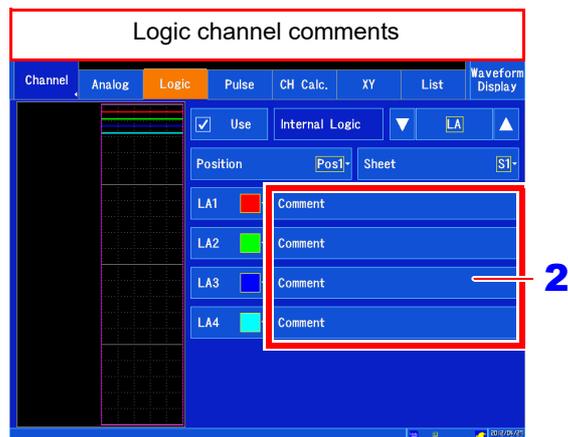
Analog, pulse, or inter-channel calculation channel

- [Waveform Display]/[Setting Display] ▶ [Channel] ▶ [Analog]/[Pulse]/[CH Calc.] ▶ [Detail]



Logic channel

- [Waveform Display]/[Setting Display] ▶ [Channel] ▶ [Logic]



2 Tap [Title Comment] or [Comment].

The character entry screen will be displayed.

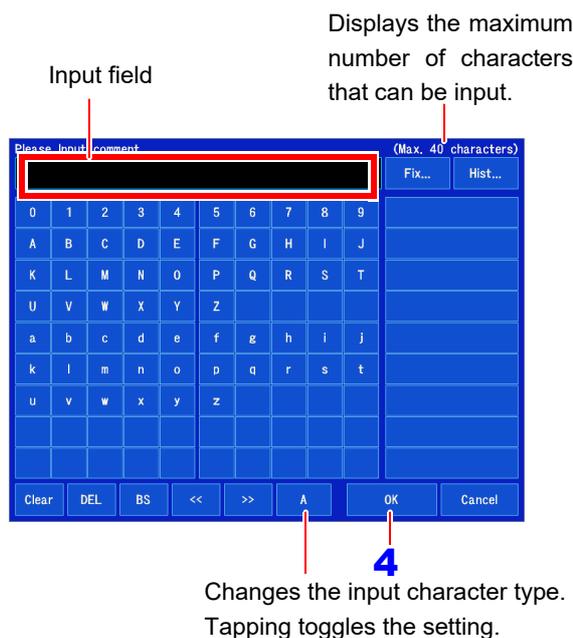
3 Tap the characters for the comment you wish to enter.

To enter a space, tap an empty cell. The tapped characters will appear in the input field.

4 Tap [OK].

The input field will be accepted, and you will return to the original Settings screen.

Tap **[Cancel]** to discard the entered comment.



- Clear: Deletes all entered characters.
- DEL: Deletes the selected characters.
- BS: Deletes the previous character.
- <<, >>: Moves the character entry position.
- Input character types

- NOTE**
- When entering a filename, you will be unable to enter characters that cannot be used in file-names (certain symbols).
 - The following characters are converted as follows when saved to a text file.

Entered character	²	³	μ	Ω	°	ε	±
Converted plain text equivalent	^2	^3	~u	~o	~c	~e	~+

When saving numerical calculation results or text-format files, units are converted as follows:
 μe (display only)→uE; °C (display only)→ C

Input character types

[A]									
0	1	2	3	4	5	6	7	8	9
A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z				
a	b	c	d	e	f	g	h	i	j
k	l	m	n	o	p	q	r	s	t
u	v	w	x	y	z				

Alphanumeric characters

[Symbol]									
!	"	#	\$	%	&	'	()	*
+	-	.	/	:	;	<	=	>	
?	@	[¥]	^	~	_	`	
{		}	°	²	³	μ	ε	Ω	±

Symbols

Selecting from fixed comments or the history

You can select a previously registered fixed comment or a comment that was entered in the past.

1 Open the screen.

Title comment:

[Waveform Display] ► [Status] ►
[Basic] Or [Setting Display] ► [Status]

Input channel comment:

Analog or pulse channel
[Waveform Display]/[Setting Display]
► [Channel] ► [Analog]/[Pulse] ►
[Detail]

Logic channel

[Waveform Display]/[Setting Display]
► [Channel] ► [Logic]

See: About display screens (p.142)

2 Tap [Title Comment] or [Comment].

The character entry screen will be displayed.

3 Tap [Fix] or [Hist].

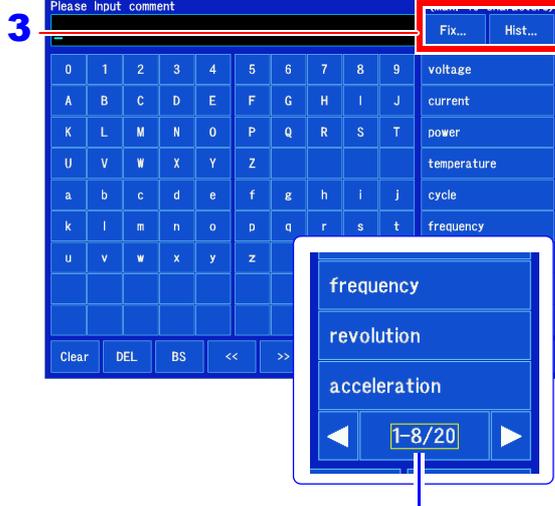
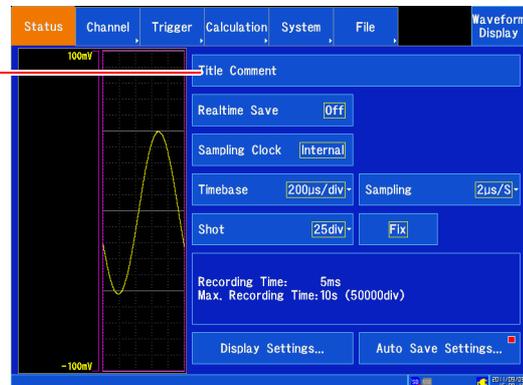
A list of candidates will be displayed to the right, and the number of items will be displayed under the list. You can switch display pages using the arrow marks to the left and right. Up to 24 comments can be stored in the history. Other comments are deleted, starting with the oldest.

4 Tap the fixed or history string you wish to enter into the comment.

5 Tap [OK].

The input field will be accepted, and you will return to the original Settings screen.

Select [Cancel] to discard the entered comment.



Displays the number of displayed items and the total number of items. Touch the arrow marks on the left and right to switch between pages.



To delete the history

Use the [System] ► [Initialize] ► [Initialize All] command on the Settings screen.

See: "11.3 Initializing the Instrument" (p. 271)

To copy comments to another channel

You can copy comments with [Channel] ► [List] ► [Operate] ► [Copy Setting].

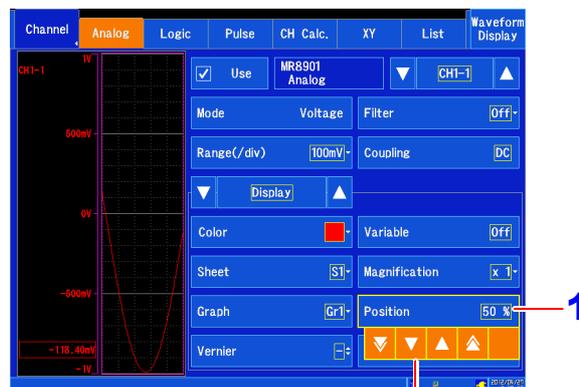
See: "6.9 Copying Settings Between Channels (Copy Function)" (p. 163)

6.2 Changing and Entering Values

You can change or enter values by tapping numerical settings.

Changing values

- 1 Tap a numerical setting.**
The numerical setting panel will be displayed.
- 2 Change the value.**
The increment/decrement size depends on the setting. Touching and holding a button causes the setting to vary continuously.
- 3 Tap any location on the screen outside the numerical setting panel.**
The numerical setting panel will close.



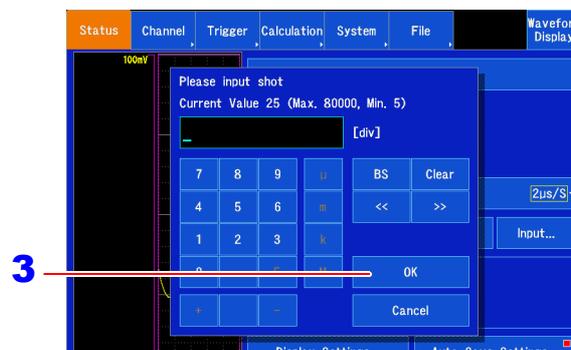
- 2**  Numerical setting panel
 - ▲ The value will increase each time the button is tapped. A strong tap* causes the value to increase by a larger margin.
 - ▲ The value will increase one step each time the button is tapped.
 - ▼ The value will decrease one step each time the button is tapped.
 - ▼ The value will decrease each time the button is tapped. A strong tap* causes the value to decrease by a larger margin.
 - Reverts the setting to the default value. (This button may not be displayed for some settings.)

*: Strong taps with the touch pen cannot be detected.

Entering values

- 1 Tap a numerical setting.**
The numerical entry window will be displayed.
- 2 Enter a value.**
- 3 Tap [OK].**
The input field will be accepted, and you will return to the original Settings screen.

Tap **[Cancel]** to discard the entered value.



- BS: Deletes the previous character.
- Clear: Deletes all entered characters.
- <<, >>: Moves the character entry position.

6.3 Overlaying Previously Captured Waveforms (Overlaying)

You can overlay multiple waveforms on the screen.

- This functionality allows data to be compared with the most recently recorded waveform (when using [Single] or [Repeat] trigger mode). (p.174)
- Waveforms can be overlaid automatically at the time of recording or manually as desired.

1 Open the screen.

[Setting Display] ► [Status] ► [Display Settings] ► [Overlay]

2 Select the overlay method.

Select (*: Initial setting)

Off	Does not overlay waveforms.
Auto*	Overlays waveforms automatically as each waveform is captured. When the trigger mode is [Single] or [Repeat], waveforms will be overlaid from the time measurement starts until it stops.
Manual	Overlays waveforms on the screen manually. Waveforms will remain on the screen without regard to the trigger mode.

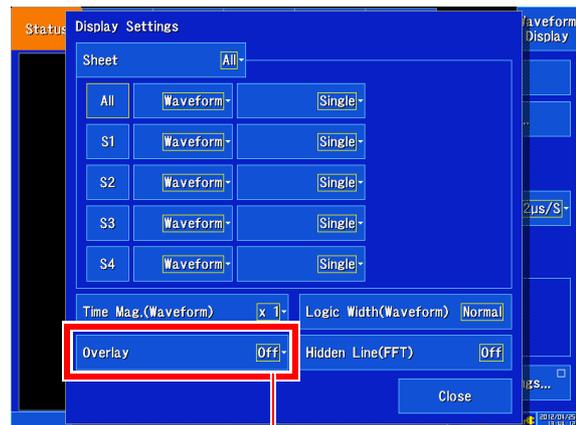
To overlay waveforms manually (to leave the desired waveforms on the screen)

3 [Waveform Display]

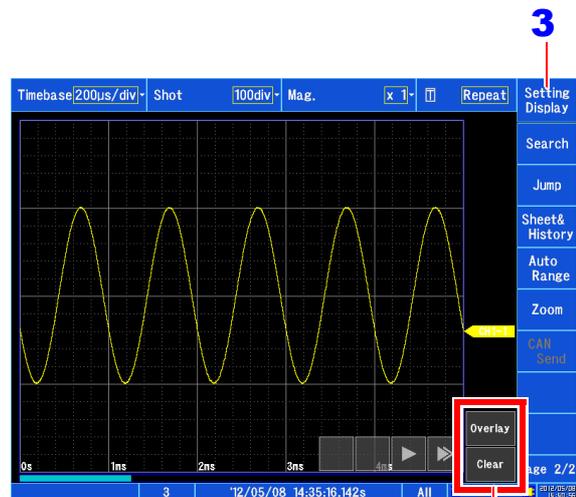
4

Select

Overlay	Press [Overlay] to leave the captured waveform on the screen. The overlaid display will remain until the waveform is cleared.
Clear	Clear all waveforms that have been overlaid on the screen. Cleared waveforms cannot be redisplayed.



1 2



3 4



When the overlay function is enabled (overlay: [Auto] or [Manual])

- Cursor A/B/C/D tracing is performed for the last captured waveform.
- The following operations cannot be performed on the Waveform screen:
Waveform scrolling, toggling the zoom function on and off, changing the zoom factor for the horizontal (time) axis, changing the zero position
- In the following circumstances, overlaid waveforms will be erased, and only the latest waveform will be displayed:
 - When the [Display Settings] are changed on the Settings screen
 - When input settings related to waveform display are changed (zoom factor, zero position, variables, waveform color)
- Up to 12 waveform colors may be used.

6.4 Setting Channels to Use (Increasing the Recording Length)

The maximum recording length is determined by the number of analog, logic, pulse, and inter-channel calculation channels for each input module for which measurement is enabled (the number of channels in use). The maximum recording length is constrained by the number of channels in use for the module with the most allocated channels (the module's maximum number of channels in use) as indicated below:

Module's max. no. of channels in use	Max. recording length (div)	Maximum recording length when inter-channel calculations are on (div)
9 to 16	5,000	2,500
5 to 8	10,000	5,000
3 to 4	20,000	10,000
2	40,000	10,000
1	80,000	10,000

Example 1:

Configuration 1

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 1	MR8901	On	On	On	Off	3
Unit 2	MR8901	On	Off	Off	Off	1
Unit 3	None	-	-	-	-	0
Unit 4	None	-	-	-	-	0

In the above configuration, the module's maximum number of channels in use is 3, and the maximum recording length is 20,000 div.

Configuration 2

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 1	MR8901	On	On	Off	Off	2
Unit 2	MR8901	On	On	Off	Off	2
Unit 3	None	-	-	-	-	0
Unit 4	None	-	-	-	-	0

In the above configuration, the module's maximum number of channels in use is 2, and the maximum recording length is 40,000 div. Comparing configurations 1 and 2, measurement has been enabled for a total of 4 channels in each, but configuration 2 yields the greater maximum recording length.

Internal logic and pulse (P1, P2) channels each use the capacity of 1 analog channel. Channels are allocated to yield the maximum recording length based on the number of the module's channels for which measurement has been enabled.

Example 2:

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 1	MR8901	On	On	On	On	4
Unit 2	MR8901	On	On	On	On	4

6.4 Setting Channels to Use (Increasing the Recording Length)

Example 2:

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 3	MR8901	On	On	On	On	4
Unit 4	MR8901	On	On	On	On	4

(The module's maximum number of channels in use is 4, and the maximum recording length is 20,000.)
In configuration 2 on the previous page, the following table will apply if internal logic measurement is enabled, bringing the module's maximum number of channels in use to 5 and the maximum recording length to 10,000 div.

Module no.	Installed module	Channel measurement state					No. of channels in use
		CH1	CH2	CH3	CH4	Internal logic	
Unit 1	MR8901	On	On	On	On	On	5
Unit 2	MR8901	On	On	On	On	-	4
Unit 3	MR8901	On	On	On	On	-	4
Unit 4	MR8901	On	On	On	On	-	4

Example 3:

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 1	MR8901	On	On	On	Off	3
Unit 2	MR8901	On	Off	Off	Off	1
Unit 3	None	-	-	-	-	0
Unit 4	None	-	-	-	-	0

(The module's maximum number of channels in use is 3, and the maximum recording length is 20,000 div.)

In the above configuration, the following table will apply if measurement is enabled for all internal logic and pulse (P1, P2) channels, bringing the module's maximum number of channels in use to 4 and the maximum recording length to 20,000 div.

Module no.	Installed module	Channel measurement state						No. of channels in use	
		CH1	CH2	CH3	CH4	Internal logic	Pulse P1		Pulse P2
Unit 1	MR8901	On	On	On	Off	On	-	-	4
Unit 2	MR8901	On	Off	Off	Off	-	On	-	2
Unit 3	None	-	-	-	-	-	-	On	1
Unit 4	None	-	-	-	-	-	-	-	0

Example 4:

Module no.	Installed module	Channel measurement state				No. of channels in use
		CH1	CH2	CH3	CH4	
Unit 1	MR8901	On	Off	Off	Off	1
Unit 2	MR8901	On	On	Off	Off	2
Unit 3	MR8901	On	Off	Off	Off	1
Unit 4	None	-	-	-	-	0

(The module's maximum number of channels in use is 2, and the maximum recording length is 40,000 div.)

6.4 Setting Channels to Use (Increasing the Recording Length)

In the above configuration, the following table will apply if measurement is enabled for all internal logic and pulse (P1, P2) channels, leaving the module's maximum number of channels in use at 4 and the maximum recording length at 40,000 div.

Module no.	Installed module	Channel measurement state							No. of channels in use
		CH1	CH2	CH3	CH4	Internal logic	Pulse P1	Pulse P2	
Unit 1	MR8901	On	Off	Off	Off	On	-	-	2
Unit 2	MR8901	On	On	Off	Off	-	-	-	2
Unit 3	MR8901	On	Off	Off	Off	-	On	-	2
Unit 4	None	-	-	-	-	-	-	On	1

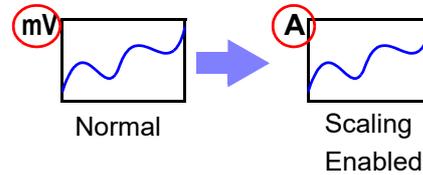
NOTE

Some maximum recording length values cannot be selected when the recording length setting method is **[Fix]**. In that case, change the recording length setting method to **[Any]** (p.61).

6.5 Converting Input Values (Scaling Function)

About the Scaling Function

Use the scaling function to convert the measured voltage units output from a sensor to the physical units of the parameter being measurement. Hereafter, "scaling" refers to the process of numerical value conversion using the Scaling function. Gauge scales, scale values (upper and lower limits of the vertical axis (voltage axis)) and A/B cursor measurement values can be displayed in scaled units. Scaling is available for each channel. Scaling settings vary for analog, pulse, and inter-channel calculation channels.



Analog channel (input module) scaling settings

Measurement data including voltage, temperature, vibration, and strain is converted to physical quantities (A, °C, etc.).

- 1 **Open the screen.**
 [Waveform Display]/[Setting Display] ►
 [Channel] ► [Analog] ► [Scaling]

- 2 **Select the channel you wish to configure.**

- 3 **[Scaling] ► Select from the list.**

Select the display format after scaling.

Select (*: Initial setting)

Off*	Disables scaling.
On(ENG)	Displays the quantity as a decimal value after scaling. (Example: 1.2345 mV)
On(SCI)	Displays the quantity as an exponent after scaling. (Example: 1.2345E-03V)

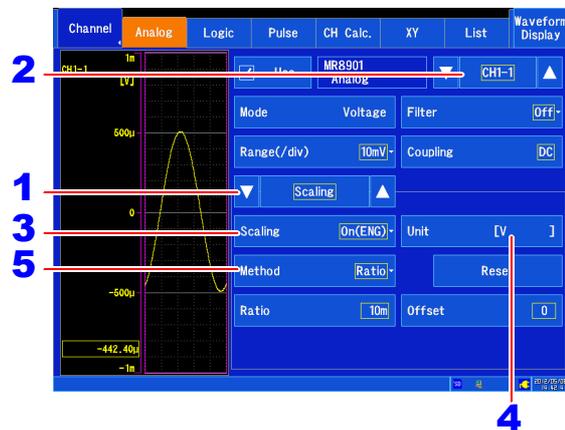
- 4 **[Units] u Enter characters.**

Enter the unit to which you wish to convert the quantity. (Up to seven characters can be entered). The units are set in the same way that comments are entered (p.142). Units may be converted to different characters when saving a text file or saving numerical calculation results (p.143).

- 5 **[Method] ► Select from the list.**

Select (*: Initial setting)

Ratio*	Sets a conversion ratio and offset (p.151).
2-Point	Specifies two input values and a post-conversion value (p.152).
Sensor	Selects the model and measurement range of the connected clamp sensor or differential probe (p.152).



Example: Conversion ratio ([Ratio])

Output Rate	Selects the clamp sensor's output rate (conversion ratio) or potential-dividing probe's attenuation (p.153).
dB	Specifies the input dB value and post-conversion value (p.153).
Rating	Set according to the rated capacity and output in accordance with the value on the test report of the strain sensor being used (p.153). (Model MR8903 Strain Unit only)

NOTE As a rule, the scaling value set with each setting method is applied to other setting methods.

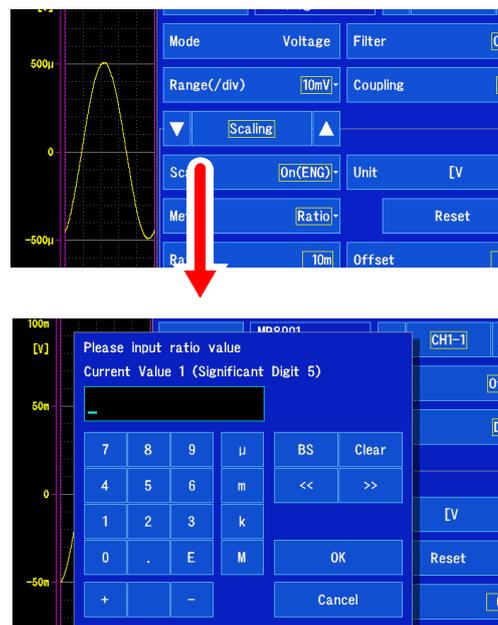
6 Configure detailed settings for the conversion method.

Settings vary with the conversion method. See "Scaling conversion methods and numerical settings" below.

See: "Entering values" (p. 145)

7 Tap [OK].

Example: Conversion ratio ([Ratio])



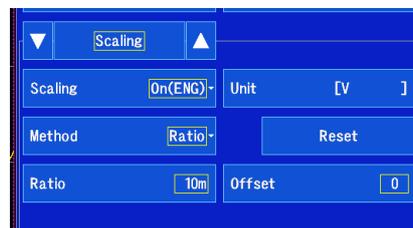
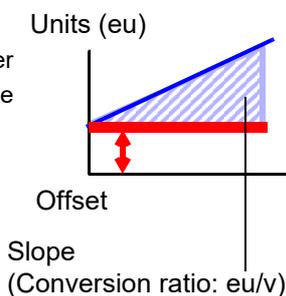
Setting the scaling conversion method and values

[Ratio]

Convert by specifying the ratio of physical units per volt of input signal (conversion ratio), offset, and the name of the units.

[Ratio], [Offset]

Set the respective values.



Valid setting ranges for conversion ratio and offset are as follows.

Conversion ratio : -9.9999E+9 to -1.0000E-9,+1.0000E-9 to +9.9999E+9

Offset : -9.9999E+19 to -1.0000E-9,0,+1.0000E-9 to +9.9999E+19

Values outside the above range cannot be set.

Scaled values are displayed as gauge gradations and read values when using cursors. Up to five significant digits can be set.

6.5 Converting Input Values (Scaling Function)

[2-Point]

Convert by specifying the input signal voltage at two points, the physical unit values at those points, and the name of the units.

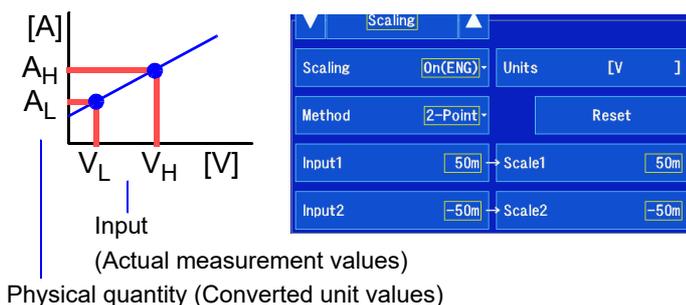
Valid setting range

-9.9999E+29 to -1.0000E-29,0,+1.0000E-29 to +9.9999E+29

Up to five significant digits can be set.

[Input1]: V_H value → **[Scale1]:** A_H value

[Input2]: V_L value → **[Scale2]:** A_L value



Physical quantity (Converted unit values)

$$Y = \underbrace{\frac{A_H - A_L}{V_H - V_L}}_{\text{Conversion Ratio}} \times X + \underbrace{\frac{V_H \times A_L - V_L \times A_H}{V_H - V_L}}_{\text{Offset}}$$

X: Voltage value
Y: Converted value

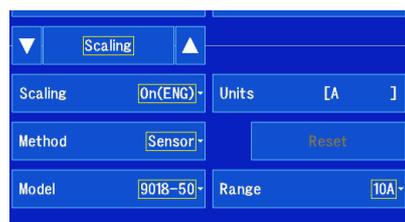
[Sensor]

Select the connected clamp sensor or differential probe.

Additionally, set the measurement range as appropriate for the clamp sensor.

Select (*: Initial setting)

[Model]	[Range]
3283*	10mA, 100mA, 1A, 10A, 200A
3284	20A, 200A
3285	200A, 2000A
9010-50	10A, 20A, 50A, 100A, 200A, 500A
9018-50	10A, 20A, 50A, 100A, 200A, 500A
9132-50	20A, 50A, 100A, 200A, 500A, 1000A
9322	
9657-10	10A
9675	10A



Example settings

To use a 9018-50 Clamp-On Probe to take measurements in the 10 A range and display measurement results as current values (with [A] as the unit):

Model: 9018-50
Range: 10A

A pre-scaling value of 0.2 V will result in a scaled value of 10 A.

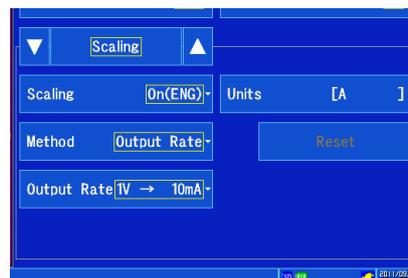
[Output Rate]

Select the clamp sensor's output rate (conversion ratio) or the potential-dividing probe's attenuation.

[Output Rate]

Select (*: Initial setting)

1V→	10mA*	1V→	1000A
1V→	100mA	1V→	2000A
1V→	1A	1V→	2500A
1V→	10A	1V→	5000A
1V→	20A	1V→	1000V
1V→	50A		
1V→	100A		
1V→	200A		
1V→	250A		
1V→	500A		

**[dB]**

The physical quantity (conversion ratio) for the input signal is converted using the dB value.

Valid setting range

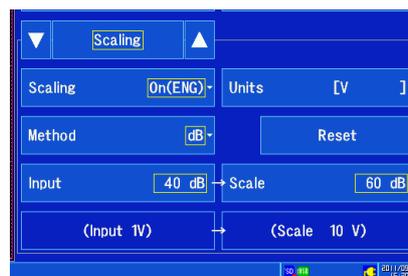
-200 to +200

Up to five significant digits can be set.

[Input]→[Scale]**Example settings**

To convert input of 40 dB to 60 dB:

[Input]: 40, [Scale]: 60

**[Rating]**

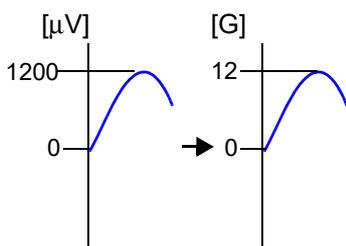
(When using the MR8903 Strain Unit with **[Mode]** set to **[Strain]**)

Set the rated capacity and rated output of the strain sensor being used.

Valid setting range

+1.0000E-9 to +9.9999E+9

Up to five significant digits can be set.



For the rated capacity and rated output, consult the calibration record of the sensor to be used.

[Capacity], [Output]**Example settings**

To take measurements with a sensor rated for a capacity of 20 G and output of 1,000 μV/V and display measurement results with **[G]** as the unit:

[Units]: G

[Capacity]: 20

[Output]: 1000

Set so that (rated capacity / (2 × rated output)) is less than or equal to ±9.9999±9.

**To reset Scaling settings**

Select **[Waveform Display]/[Setting Display] ▶ [Channel] ▶ [Analog] ▶ [Scaling]** and then select **[Reset]**.

To copy scaling settings to other channels

You can copy settings with **[Setting Display] ▶ [Channel] ▶ [List]**.

See: "6.9 Copying Settings Between Channels (Copy Function)" (p. 163)

Using the Scaling and Variable functions (p.159) in combination

The full span of output from a sensor can be displayed. (p.160)

NOTE

At factory shipping, automatic correction of the variable function (p.159) is set to **[On]**.

At this time, the Variable setting is altered so that it is linked to (dependent upon) the vertical axis (voltage axis) range and scaling settings. If you want the Variable function setting to take priority, use either of the following procedures:

- Set Scaling first, and then set the Variable function.
- Set a Variable value before Scaling, and then set Scaling.

When automatic correction of the Variable function (Variable Auto Adjustment) is disabled (Off), the Scaling and Variable settings are unlinked (independent of one another).

Example scaling settings for the MR8903 Strain Unit**When a calibration factor is stated in the sensor's inspection records**

Measure using a sensor with a calibration factor of 0.001442 G / 1×10^{-6} strain*, and display the measured data in **[G]** units.

Setting Items	Setting Choice	
Scaling	ENG	(* 10^{-6} strain = $\mu\epsilon$)
Units	G	
Method	Ratio	
Ratio (Conversion ratio)	0.001442	
Offset	0	

Using a strain gauge with a Gauge Factor other than 2.0

(The MR8903 Strain Unit measures with a gauge factor of 2.0.)

To take measurements with a strain gauge with a gauge factor of 2.1 and display measurement data with **[G] as the unit**

When using a strain gauge with a gauge factor other than 2.0, it is necessary to set the conversion ratio for the gauge factor.

(For example, if the Gauge Factor is 2.1, the conversion ratio is 0.952(\approx 2/2.1).

Setting Items	Setting Choice
Scaling	ENG
Units	G
Method	Ratio
Ratio (Conversion ratio)	Conversion ratio depending on the gauge factor (0.952) x ratio for converting to physical quantity (0.001442) = 0.0013728
Offset	0

Set the result of multiplying the gauge factor conversion ratio by the scaling conversion ratio as the conversion ratio.

The Gauge Factor component of the conversion ratio is 0.952, and the physical value component is 0.001442*

Conversion Ratio = 0.952 x 0.001442 = 0.0013728

* To convert measurement values to physical values when using a strain gauge, calculate using the Young's modulus or Poisson's ratio of the measurement object. The conversion method depends on the conditions in which the strain gauge is used.

See: " Scaling Method When Using Strain Gauges" (p. A12)

Integration measurement (pulse signal) scaling settings

Integrated pulse values can be converted for display as physical units of the measurement parameter (such as Wh or VA).

Pulse output devices determine the amplitude per pulse in physical units, or the number of pulses per fundamental unit (for example, per kWh, liter or m³).

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [Pulse] ► [Scaling]

2 Select the channel to set and the [Mode].

Mode: Integration (addition) or integration (instantaneous)

3 [Scaling] ► Select from the list.

Select the post-scaling display format.
Select (*: Initial setting)

Off*	Disables scaling.
On(ENG)	Displays the quantity as a decimal value after scaling. (Example: 1.2345 mV)
On(SCI)	Displays the quantity as an exponent after scaling. (Example: 1.2345E-03V)

4 [Units] ► Enter characters.

Enter the unit to which you wish to convert the quantity. (Up to seven characters can be entered). The units are set in the same way that comments are entered (p. 142). Some characters may be converted to different characters when saving a text file or saving numerical calculation results.

5 [Method] ► Tap to select.

Select the conversion method.
Select (*: Initial setting)

1*	1 pulse = [] c ^{*1} Sets the physical quantity per pulse.
2	1c ^{*1} = [] pulses Sets the number of pulses per fundamental unit.

*1: Unit

Example settings

To connect a 50,000 pulse/kWh watt-hour meter and perform integration:

Scaling: ENG

Unit: [kWh]

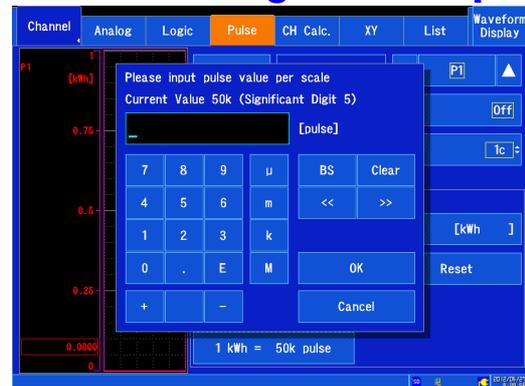
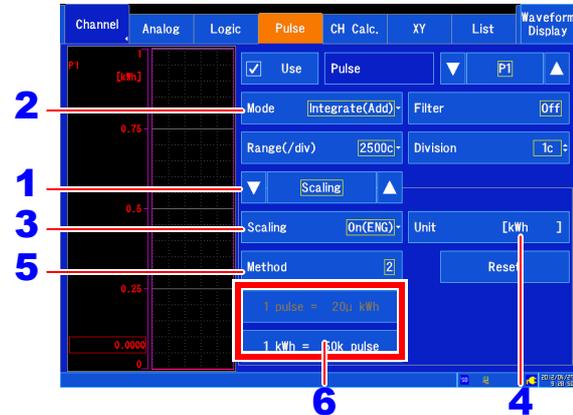
Setting method 2: 1 kWh = 50,000 pulses

To connect a 10 liter/pulse flow meter and perform integration:

Scaling: ENG

Unit: [L]

Setting method 1: 1 pulse = 10 L



6 Enter the scaling value.

Enter the physical quantity or number of pulses for the selected [Method].

Valid setting range

When entering for setting method 1

-9.9999E+9 to -1.0000E-9,
+1.0000E-9 to +9.9999E+9

When entering for setting method 2

-9.9999E+9 to -9.9999E-9,
9.9999E-9 to 9.9999E+9

Up to five significant digits can be set.

See: "Entering values" (p. 145)

The physical quantity per pulse and number of pulses per fundamental unit settings are linked.



To reset the scaling settings

Select [Waveform Display]/[Setting Display] ► [Channel] ► [Pulse] ► [Scaling] and tap [Reset].

Rotational speed measurement scaling settings

- 1 Open the screen.
[Waveform Display]/[Setting Display]
▶ [Channel] ▶ [Pulse] ▶ [Scaling]
- 2 Select the channel to set, and set [Mode] to [Revolve].
- 3 [Scaling] ▶ Select from the list.

Select the post-scaling display format.

Select (*: Initial setting)

Off*	Disables scaling.
On(ENG)	Displays the quantity as a decimal value after scaling. (Example: 1.2345 mV)
On(SCI)	Displays the quantity as an exponent after scaling. (Example: 1.2345E-03V)

- 4 [Units] ▶ Enter characters.

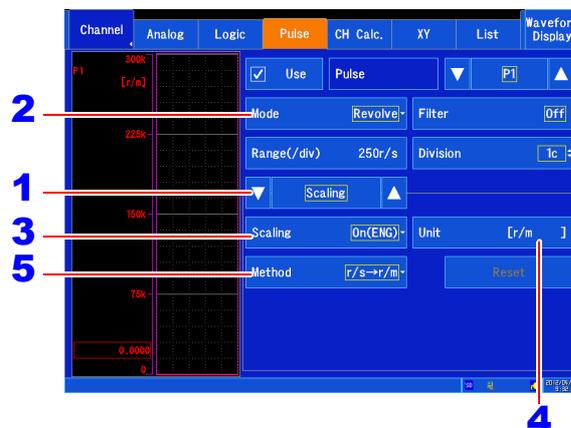
Enter the unit to which you wish to convert the quantity. (Up to seven characters can be entered). The units are set in the same way that comments are entered (p.142). Some characters may be converted to different characters when saving a text file or saving numerical calculation results.

- 5 [Method] ▶ Select from the list.

Set the conversion method and configure detailed settings.

Select (*: Initial setting)

Ratio*	Set a conversion ratio and offset (p.151).
2-Point	Specify two input values and a post-conversion value (p.152).
r/s -> r/m	Convert revolutions per second into revolutions per minute and display. This is equivalent to scaling with a conversion ratio of 60 and an offset of 0.



Example settings

To convert the unit for measurement results from [r/s] to [r/m]:

Scaling: ENG

Method: r/s -> r/m

(With the above settings, the unit will be [r/m].)

Setting inter-channel calculation channel scaling

This section describes how to convert inter-channel calculation results to the desired property (A, °C, etc.).

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog] ► [Scaling]

2 Select the channel you wish to configure.

3 [Scaling] ► Select from the list.

Select the display format after scaling.

Select (*: Initial setting)

Off*	Disables scaling.
On(ENG)	Displays the quantity as a decimal value after scaling. (Example: 1.2345 mV)
On(SCI)	Displays the quantity as an exponent after scaling. (Example: 1.2345E-03V)

4 [Units] ► Enter characters.

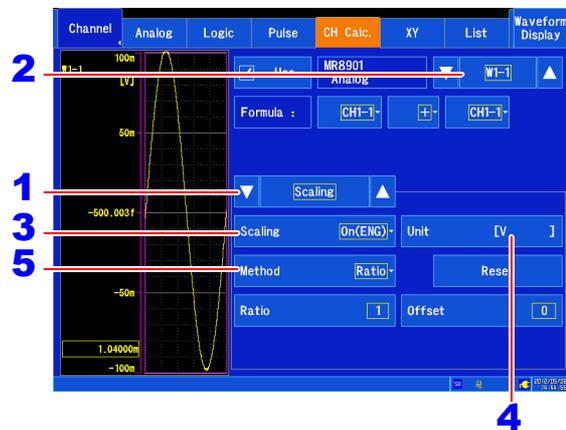
Enter the unit to which you wish to convert the quantity. (Up to seven characters can be entered). The units are set in the same way that comments are entered (p.142). Units may be converted to different characters when saving a text file or saving numerical calculation results (p.143).

5 [Method] ► Select from the list.

Select the conversion method.

Select (*: Initial setting)

Ratio*	Sets a conversion ratio and offset (p.151).
2-Point	Specifies two input values and a post-conversion value (p.152).
dB	Specifies the input dB value and post-conversion value (p.153).

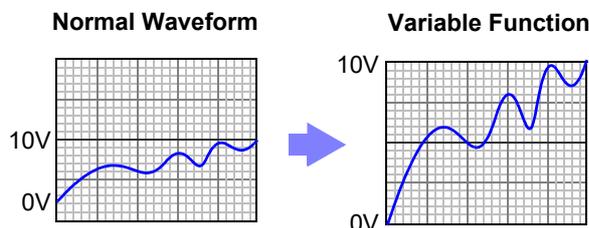


Example: Conversion ratio ([Ratio])

6.6 Variable Function (Freely Configuring Waveform Display)

The waveform height and display position can be arbitrarily set along the vertical axis (voltage axis).

You can set upper and lower limit values for the waveform on the vertical axis (voltage axis) and display the waveform at an amplitude that fills the screen.



NOTE Precautions for using the Variable Function

- Verify that the vertical axis (voltage axis) range is set properly for the input signal.
- The vertical axis (voltage axis) range is unaffected by changes to the upper and lower limits made by the Variable setting.

1 Open the screen.
[Waveform Display]/[Setting Display]
▶ [Channel] ▶ [Analog]/[Pulse]/[CH Calc.] ▶ [Display]

2 Set [Variable] to [On].
Selecting the setting toggles its value between on and off. (Default setting: Off)

3 [Upper], [Lower] ▶ Enter values.
Set the upper and lower limit values.
Valid setting range

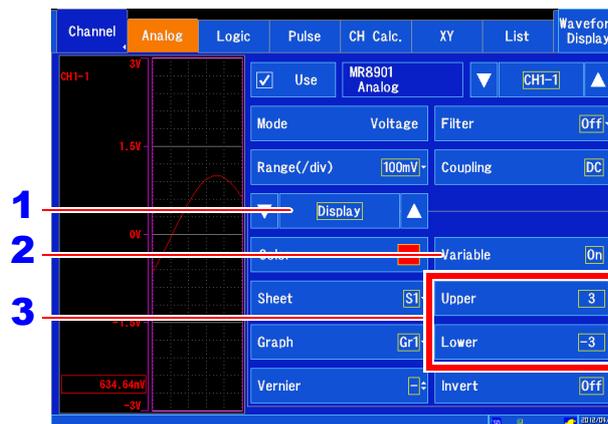
-9.9999E+29 to -1.0000E-29, 0, +1.0000E-29 to +9.9999E+29

Up to five significant digits can be set.

See: "Entering values" (p. 145)

After configuring the settings, tap **[OK]** to accept them.

You can display the waveform so that it fills the screen by setting upper and lower limit values.



NOTE You can use the scaling function and variable function in combination to display sensor output so that it fills the screen (p.160).

6.6 Variable Function (Freely Configuring Waveform Display)

When setting combined use of the Scaling and Variable functions

When Auto-Correction of the Variable function is enabled (On, default setting) (p.262)

The Variable function settings change according to Scaling and vertical axis (voltage axis) range settings. Set Scaling before setting the Variable function.

If you change Scaling settings after enabling the Variable function, the Variable setting voltage is automatically corrected so that the displayed size of waveforms is unchanged.

When Auto-Correction of the Variable function is disabled (Off)

Set the Variable function after setting Scaling.

If setting the Variable function first, enter post-scaling values (converted physical values).

To display the full span of output from a sensor

By using the Scaling function in combination, voltage from a sensor can be converted to the physical units of the measurement object.

Example

Set Scaling as follows:

Scaling: Decimal or Exponent, Two-Point Setting

Units: A

Sensor Output (Input1): 1.23 [V]→(Scale1): 0 [A]

Sensor Output (Input2): 5.78 [V]→(Scale2):10 [A]

(with Variable function Off)

Voltage from the sensor is displayed as voltage.

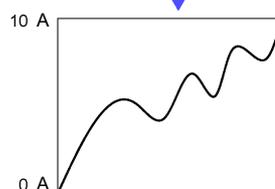
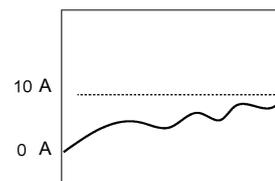
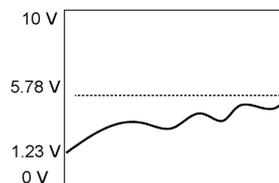
It is displayed with the vertical axis (voltage axis) range and at the zero position.

The Variable function is set as follows:

Variable: On, Set Upper/Lower Limits

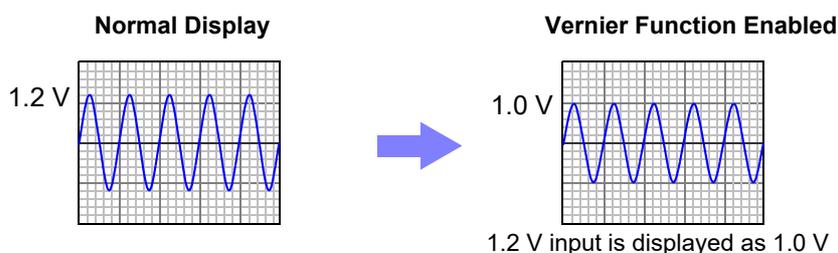
Lower Limit: 0 [A] Upper Limit: 10 [A]

The full span of output from the sensor is displayed.

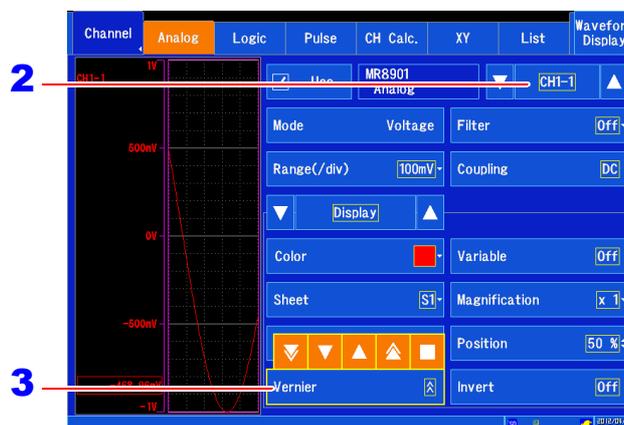


6.7 Fine Adjustment of Input Values (Vernier Function)

Fine adjustment of input voltage can be performed arbitrarily on the Waveform screen. When recording physical values such as noise, temperature and acceleration using sensors, amplitude can be adjusted to facilitate calibration.



- 1** Open the screen.
[Waveform Display]/[Setting Display] 2
▶ [Channel] ▶ [Analog]
- 2** Select the channel you wish to adjust.
- 3** Tap [Vernier] and set with the ▲ ▼ buttons.
See: "Changing values" (p. 145)



- NOTE**
- The adjustment range is from 50% to 200% of the original waveform. The magnification and compression ratios are not displayed.
 - Vernier adjustments cannot be verified on printed waveforms or lists.
 - Waveform data (the data that is saved to a file) reflects adjustment with the Vernier function.

6.8 Inverting Waveforms

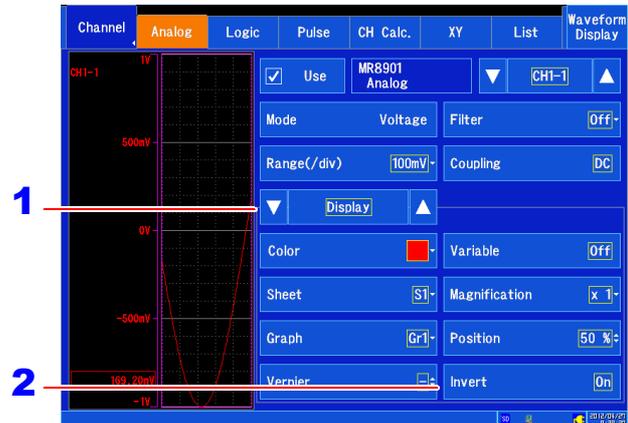
This section, which applies to analog channels only, describes how to invert the waveform's positive and negative orientation. The Waveform screen will display inverted data, and any saved data will also reflect the operation.

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog] ► [Display]

2 Set [Invert] to [On].

Selecting the setting toggles it between on and off.
(Default setting: Off)



To invert the sign of the measured values while leaving the waveform display alone

Use the scaling function.

See: "6.5 Converting Input Values (Scaling Function)" (p. 150)

To invert the display only while leaving measured values alone

Use the variable function.

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)

NOTE The waveform inversion function cannot be used with the MR8902 Voltage/TEMP Unit when [Mode] is set to [Temperature].

6.9 Copying Settings Between Channels (Copy Function)

You can copy channel settings to other channels. The following settings can be copied:

- Basic settings
- Display settings
- Comments
- Scaling settings

1 Open the screen.

[Setting Display] ► [Channel] ► [List]

2 [Operate] ► [Copy Setting]

A window will be displayed.

3 Select the settings you wish to copy.

Tap the settings you wish to copy to select the corresponding checkboxes.

4 Select the number of the channel that will serve as the source.

Select the module and channel number that will serve as the source.

5 Select the channel that will serve as the destination.

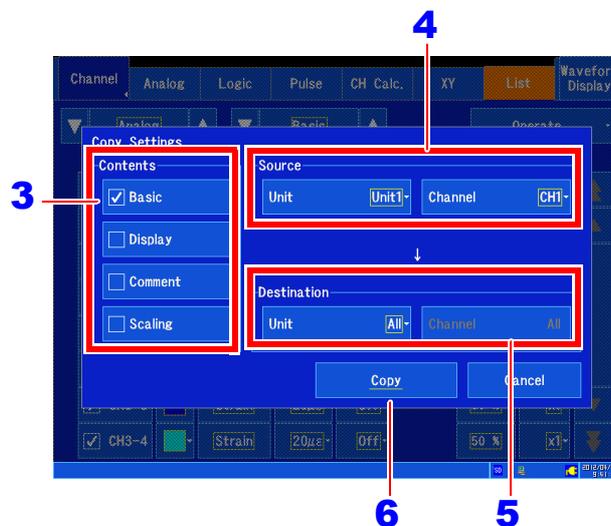
Select the module and channel number that will serve as the destination.

6 Tap [Copy].

The settings will be copied.

To cancel:

Tap [Cancel].



- NOTE**
- Some settings cannot be copied between different module types and measurement modes as the settings and valid setting ranges differ.
 - Display color, waveform reversal, and vernier settings cannot be copied.

6.10 Configuring Detailed Input Module Settings

You can configure detailed settings for input module channels on each [Channel] screen.

1 Open the screen.
 [Waveform Display]/
 [Setting Display] ►
 [Channel] ► [Analog]

2 Select a channel.

3 Configure settings.

Input modules and settings

Input module	Mode	Setting	See also
MR8901 Analog Unit	Voltage	Probe	(p.164)
MR8902 Voltage/TEMP Unit	Voltage	Update	(p.165)
	Temperature	Update, Sensor, RJC, Burn Out	(p.165)
MR8903 Strain Unit	Voltage	Auto balance	(p.168)
	Strain	Auto balance	(p.168)
MR8904 CAN Unit	See the instruction manual on the included CD.		
MR8905 Analog Unit	Instantaneous value	Probe	(p.164)
	RMS value	Probe	(p.164)

Configuring the MR8901 Analog Unit (probe attenuation)

This section describes how to connect cords and probes and make measurements.

- 1** Open the screen.
 [Waveform Display]/[Setting Display] ►
 [Channel] ► [Analog] ► [Detail]

- 2** Select the channel to set.

- 3** [Probe] ► Select from the list.

Select (*: Initial setting)

- 1:1*** Select this setting when measuring with the Model L9197, 9197, L9198 or L9217 cable connected to the input module.
- 10:1** (Select when using a 10:1 probe.)
- 100:1** (Select when using a 100:1 probe.)
- 1000:1** Select this setting when using the P9000-01, or P9000-02 Differential Probe.

2 Select the channel to set.

1 Open the screen.

3 [Probe] ► Select from the list.

Configuring the MR8902 Voltage/TEMP Unit (voltage measurement)

- 1 Open the screen.
[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog] ► [Detail]

- 2 Select the channel to set.

- 3 [Mode] ► [Voltage]

(Except when the filter is off)

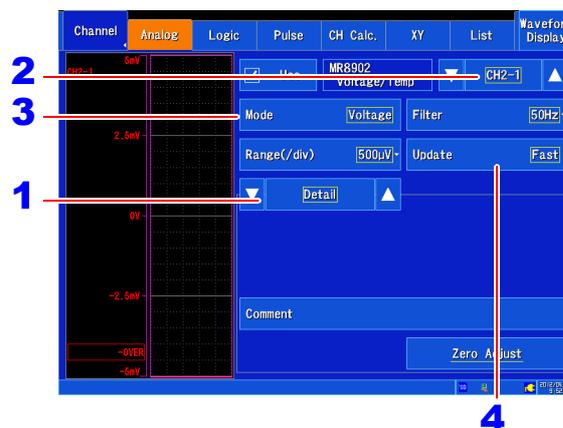
- 4 [Update] ► Tap to switch.

When the filter is set to 50 Hz/60 Hz, the data update time can be set to fast or standard.

Select (*: Initial setting)

Fast*	Data is updated approximately every 500 ms. (This setting facilitates noise rejection and stable measurement.)
Normal	Data is updated approximately every 2 s. (This setting facilitates more stable measurement.)

When the filter is off, the data update rate is fixed to 10 ms or 20 ms.



Configuring the MR8902 Voltage/TEMP Unit (temperature measurement)

- 1 Open the screen.
[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog] ► [Detail]

- 2 Select the channel to set.

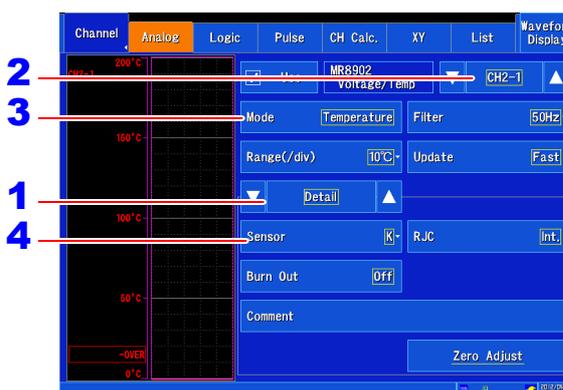
- 3 [Mode] ► [Temperature]

- 4 [Sensor] ► Select from the list.

Set to match the type of thermocouple being used.

Select (*: Initial setting)

Selections	Measurement Range
K*	-200 to 1350°C
J	-200 to 1200°C
E	-200 to 1000°C
T	-200 to 400°C
N	-200 to 1300°C



Selections	Measurement Range
R	0 to 1700°C
S	0 to 1700°C
B	400 to 1800°C
W	0 to 2000°C

The 10°C/div range cannot be selected for use with B thermocouples.

6.10 Configuring Detailed Input Module Settings

5 [RJC] ▶ Tap to switch.

Select whether to perform reference junction compensation internally in the input module.

Select (*: Initial setting)

Int.*	Reference junction compensation is provided within the input module. (Measurement Accuracy: The sum of the accuracies of the temperature measurement and the reference junction compensation.)
Ext.	Reference junction compensation is not provided within the input module. (Measurement Accuracy: The accuracy of temperature measurement only)

6 [Burn Out] ▶ Tap to switch.

A broken thermocouple wire can be detected during temperature measurement.

See: "Broken wire detection" (p. 167)

Select (*: Initial setting)

Off*	Broken wires are not detected. Normally when a thermocouple wire breaks, measured values exhibit random instability
On	Broken wires are detected by applying a minute current of approximately 5 μA to the thermocouple.

(Except when the filter is off)

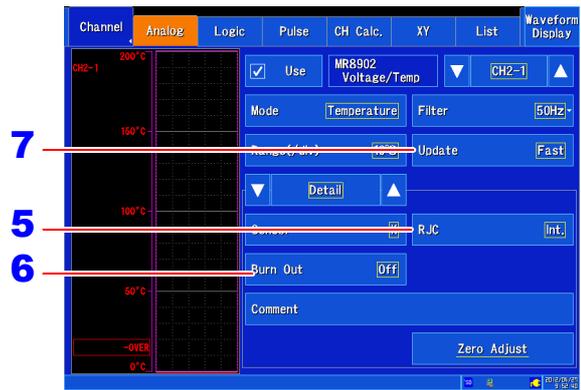
7 [Update] ▶ Tap to switch.

When the filter is set to 50 Hz/60 Hz, the data update time can be set to fast or standard.

Select (*: Initial setting)

Fast*	Data is updated approximately every 500 ms. (This setting facilitates noise rejection and stable measurement.)
Normal	Data is updated approximately every 2 s. (This setting facilitates more stable measurement.)

When the filter is off, the data update rate is fixed to 10 ms or 20 ms.



When connecting the thermocouple directly to the input module, select [Int.]. When connecting the thermocouple via a reference junction (0°C control tank, etc.), select [Ext.].

NOTE

- The data update rate cannot be set when the filter is off.
- The waveforms of channels whose input terminals are open may be displayed such that they are being affected by other channel signals. If you find these waveforms distracting or otherwise undesirable, either turn measurement channels with open input off or short the positive and negative terminals.

Broken wire detection

- When there is a broken wire, the value display and cursor value will indicate "BURNOUT," and calculated values and saved data will be as follows:
 - 327.66°C (10°C/div range)
 - 1638.3°C (50°C/div range)
 - 3276.6°C (100°C/div range)
- Detection is not performed at the same time as measurement, and measured values are not affected.
- When the filter is off, turning on broken wire detection causes the data update rate to be set to 20 ms.
- Burn-out is detected when thermocouple resistance exceeds the following values. When burn-out detection is enabled with extended thermocouple wires, be sure that the wire diameter is sufficient.

Unit: Ω

		Range		
		10°C/div	50°C/div	100°C/div
Thermo- couple	K	340	5200	2900
	J	480	2200	6600
	E	1240	5400	5400
	T	750	3900	3900
	N	110	1040	4200
	R	60	610	4000
	S	70	780	550
	B	-	350	1300
	W	140	480	1500

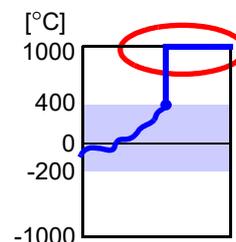
(Reference)

Since the resistivity is 12.2 Ω /m when using a K thermocouple with a wire diameter of 0.32 mm in the 10°C range, using a wire length that is greater or equal to approximately 28 m will trigger broken wire detection.

If Thermocouple Measurement Range is Exceeded

Example: Using a T thermocouple with a temperature measurement input range of -200°C to 400°C

If the thermocouple's measurable range is significantly exceeded during temperature measurement, even if the temperature falls within the measurable range of the set range, the waveform will become saturated and "stick" to the top of the screen. Conversely, if the temperature falls significantly below the measurable range, the waveform will "stick" to the bottom of the screen.



Measured values will be indicated as "+OVER" and "-OVER" in this case, just as they are when a range's measurable range is exceeded by a large margin, and calculated values and saved data will be as shown in the following table:

Input type	Input range	+OVER value	-OVER value
Thermocouple (Tc)	10°C/div	327.67	-327.68
	50°C/div	1638.4	-1638.4
	100°C/div	3276.7	-3276.8

When broken wire detection is enabled, readings that exceed the range's measurable range by a large margin will be treated as indicating a broken wire.

Configuring the MR8903 Strain Unit (Executing Auto-Balance)

The MR8903 Strain Unit (option) allows the converter's reference output level to be aligned with a specified zero position (auto-balancing). Auto-balancing can be performed for a specified channel or for all strain unit channels.

When performing scaling based on the gauge factor or converting measured values using strain sensor rated values, refer to the example scaling settings in "6.5 Converting Input Values (Scaling Function)" (p. 150).

Before executing auto-balance

- NOTE**
- Turn power on and wait 30 minutes to allow the internal temperature of the input module to stabilize.
 - Connect a sensor to the input module and perform auto-balancing in the absence of strain or other input.
 - Auto-balance cannot execute during measurement.
 - The instrument will ignore key and touch panel operation during auto-balancing
 - Measurement in voltage ranges of 100 $\mu\text{V}/\text{div}$ and below maybe affected by wire and connector thermal EMF. Perform auto-balancing using the same wires and connectors that you will use in actual measurement.

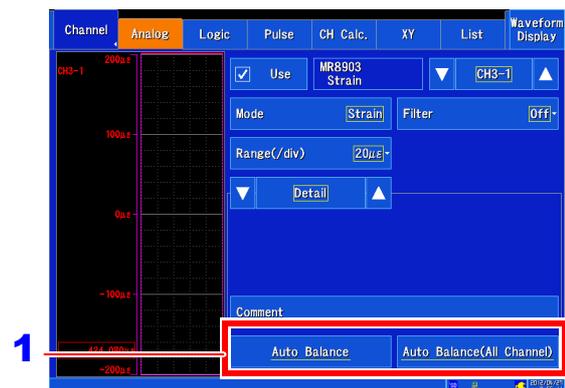
1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog] ► [Auto Balance] or
[Auto Balance(All Channel)]

A message will be displayed.

2 Select [Yes].

Once the message disappears, auto-balancing is complete.



NOTE In the following cases, auto-balance should be executed again.

- After changing the vertical axis (strain axis) range
- After an input module has been removed or inserted
- After the strain gauge transducer has been replaced
- After power has been turned off and on
- After performing a system reset
- When ambient temperature has changed significantly (the zero position may drift)
- When the cables or connectors used in measurement change



If "Warning: Auto balance failed." appears

The channel on which auto-balance failed is displayed.

Verify the following, and execute again:

- Is the sensor in a discharged state? (Make sure that it is not being subject to vibration, etc.)
- Is the sensor connected correctly?

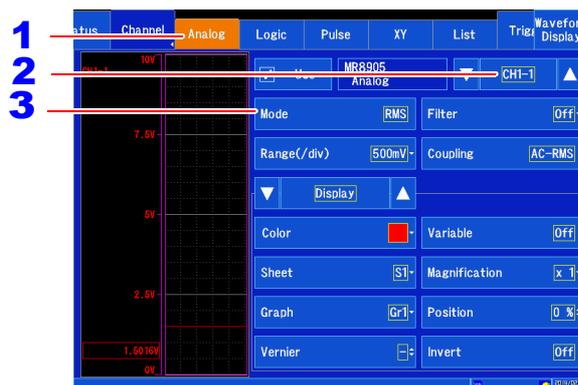
Configuring the MR8905 Analog Unit (Instantaneous value measurement)

- 1 Open the screen.
[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog]
- 2 Select the channel to set.
- 3 [Mode] ► [Instant]



Configuring the MR8905 Analog Unit (RMS measurement)

- 1 Open the screen.
[Waveform Display]/[Setting Display] ►
[Channel] ► [Analog]
- 2 Select the channel to set.
- 3 [Mode] ► [RMS]



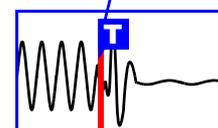
NOTE When the mode is set to RMS, RMS values of voltages with DC offsets will not be measured accurately because the input terminals are automatically AC coupled.

Trigger Settings Chapter 7

Triggering is the process of controlling the start and stop of recording by specific signals or conditions (criteria). When recording is started or stopped by a specific signal, we say the trigger is "applied" or "triggering occurs".

In this manual, **T** indicates a "trigger point", as the time at which a trigger is applied.

Trigger conditions met



Trigger settings



Searching for a trigger position (p.132)

You can configure settings and search for trigger positions on the Waveform screen.

Trigger Output (p.328)

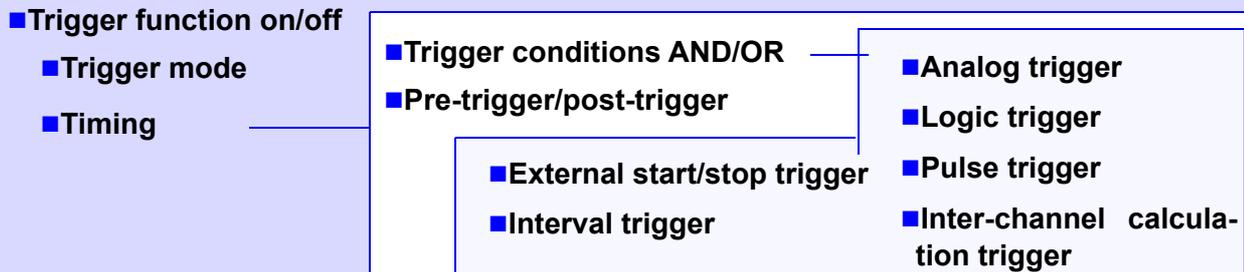
[\[Setting Display\]](#) ► [\[System\]](#)
► [\[External Terminal\]](#)

Signals that can be used for triggering (trigger sources) are as follows.

Trigger Source	Description	Ref.
Measurement timing and other conditions (p.175)	Start trigger	Starts measurement from the point at which the trigger is applied using the start trigger setting conditions. (p.175)
	Stop trigger	Stops measurement at the point at which the trigger is applied using the stop trigger setting conditions. When set to [Trigger Mode: Repeat] , measurement is resumed. (p.175)
	Pre-trigger	Allows you to measure phenomena that occur before the start trigger. (p.178)
	Post-trigger	Allows you to measure phenomena that occur after the stop trigger. (p.178)
	Triggering conditions	Allows you to specify measurement conditions (AND/OR). (p.176)
	Interval trigger	Allows you to measure at a specified interval. (p.185)
Signal trigger conditions	Analog Trigger	Applies a trigger using an analog channel input signal (level trigger, in-window trigger, out-of-window trigger). (p.180)
	Logic Trigger	Applies a trigger according to signals input on logic channels (LA to LB). Applies a trigger using a MR8904 CAN Unit logic signal. (p.183)
	Pulse trigger	Applies a trigger using a pulse channel (P1, P2) input signal (integrated value, rotational speed). (p.180)
	Inter-channel calculation trigger	Applies a trigger using a inter-channel calculation channel (W1-1 to W4-2) calculation signal. (p.180)
	External Trigger (start, stop)	Applies a trigger according to an input signal at the EXT.TRIG terminal (External Trigger Input) (p.186)
	Forced trigger	Applies a trigger when  (forced trigger) key is pressed. (p.187)

- With the exception of forced triggers and interval triggers, triggers are applied according to triggering conditions applied to trigger sources (AND/OR) (p.176).
- When a trigger is applied, the external control terminal's TRIG OUT signal is output (p.328).

7.1 Setting Workflow



1 Setting the trigger mode

Set whether to continue to accept triggers after measuring (p.174).

2 Setting the trigger timing

Set the start and stop timing for recording by triggers (p.175).

3 Setting the trigger conditions (AND/OR)

Set triggering conditions among triggers (p.176).

4 Setting the pre-trigger and post-trigger

Set the amount to record before and after a trigger point (p.178).

5 Setting the trigger type

Set the signal to which the trigger will be applied.

- **Analog trigger, Pulse trigger, Inter-channel calculation trigger (p.180)**
- **Logic trigger (p.183)**
- **Interval trigger (p.185)**
- **External trigger (p.186)**

6 Starting and stopping measurement

Press the **START** key to start measuring. (the key will turn green)
Data acquisition starts when trigger conditions are met.

To stop measurement: press the **STOP** key.

Press once: recording stops at the end of the specified recording length.

Press twice: recording stops immediately.

7.2 Enabling the Trigger Function

The MR8875 ships from the factory with the trigger function disabled (off), and this is the initial value for the setting. Before setting trigger conditions, enable the trigger function (turn it on).

1 Open the screen.

[Waveform Display]/[Setting Display] ►

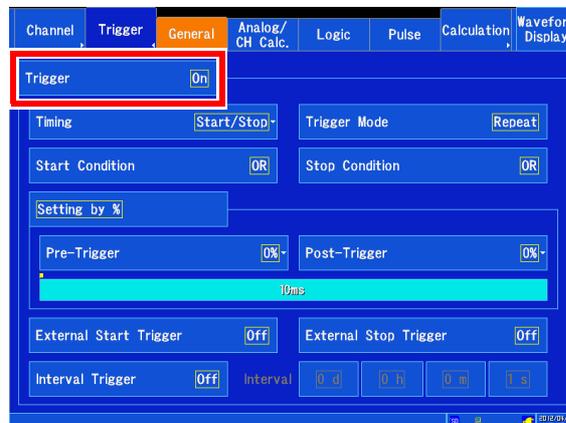
[Trigger] ► [General]

2 [Trigger] ► Tap to switch.

Select (*: Initial setting)

Off*, On

Setting this parameter to [On] causes the other settings to be displayed.

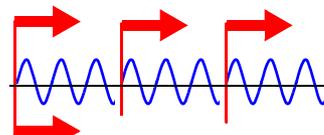


7.3 Setting the Trigger Mode

Set whether to continue to accept triggers after measuring.

If all trigger sources are disabled (Off, with no trigger setting), measurement starts immediately (free-running).

Repeated recording



Single (one) recording

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Trigger] ► [General]

2 [Trigger Mode] ► Tap to switch.

Select (*: Initial setting)

Single	Receives the trigger once. When the trigger is applied once after the START key is pressed, the waveform is recorded for the recording length or the recording time, and measurement stops.
Repeat*	Receives the trigger continuously. When the trigger is not applied, the instrument enters the trigger standby state. Pressing the STOP key stops measurement (see below).
Count	Receives the trigger of the specified number of times. (2 to 10000)

When the trigger mode is set to [Repeat]

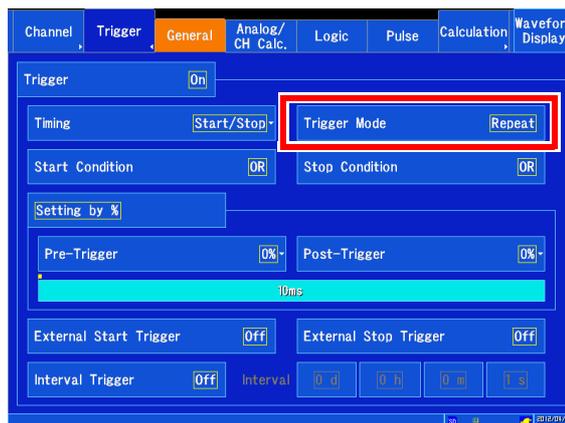
The trigger is not applied during processing performed after recording stops until the next trigger standby state (auto save, waveform display processing, calculation processing).

To Stop Measuring:

Press the **STOP** key.

Press once: Recording stops after capturing the recording length or recording time.

Press twice: recording stops immediately.



NOTE When using the numerical calculation judgment function, some judgment results may trigger repeated recording operation, even if the trigger mode is set to single operation.

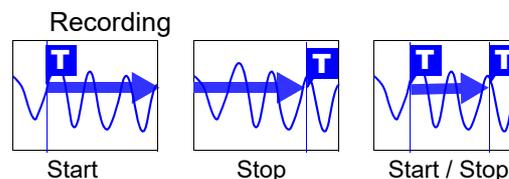
See: "8.4 Judging Calculation Results" (p. 199)

7.4 Setting Trigger Timing

This section describes how to set the timing at which the trigger is enabled (measurement start/stop).

Types of triggers for which the **[Timing]** setting can be configured

Trigger	Timing	
	Start	Stop
Analog input signal	•	•
Logic input signal	•	•
Pulse trigger	•	•
Inter-channel calculation trigger	•	•
External trigger	•	•
Interval trigger	•	-



1 Open the screen.

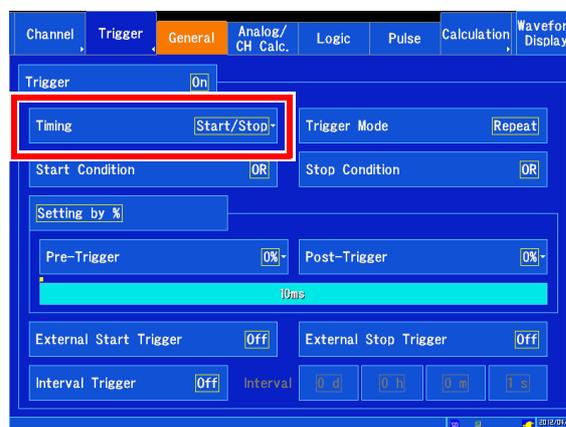
[Waveform Display]/[Setting Display] ▶ [Trigger] ▶ [General]

2 [Timing] ▶ Select from the list.

Select (*: Initial setting)

Start*	Uses the trigger as a measurement start condition.
Stop	Uses the trigger as a measurement stop condition.
Start/Stop	Uses the trigger as a measurement start and stop condition.

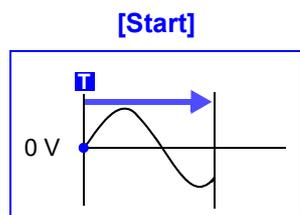
Settings that can be configured with the selected timing condition will be displayed.



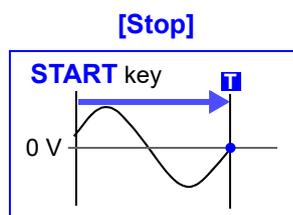
- NOTE**
- If the trigger conditions are not satisfied during the capture of the recording time set after measurement starts when using the **[Timing: Stop]** (or **[Start/Stop]**) setting, measurement will stop once data equivalent to the recording time has been captured.
 - When using **[Trigger Mode: Single]** with the **[Timing: Stop]** setting, measurement will stop when the stop condition is satisfied. However, measurement will start again if the **[Trigger Mode: Repeat]** setting is used.
 - When using the **[Timing: Start/Stop]** setting, the instrument will initially wait for the **[Start]** condition trigger to be applied. The interval from the reception of the start trigger until the reception of the stop trigger is dead time.

Example settings

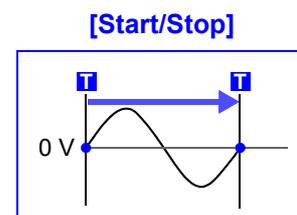
Example: When the trigger type is Level Trigger, Level = 0.000 V, and Slope = \uparrow (rising)



Records for specified recording length



Press **START** key to record
Records until a trigger occurs



Recording starts when a Start trigger event occurs
Records until a Stop trigger occurs

7.5 Setting Combining Logic (AND/OR) for Multiple Trigger Sources

This section describes how to set trigger conditions using AND/OR logic for analog, pulse, inter-channel calculation, logic, and external triggers. The conditions are valid only for channels for which triggers have been set.

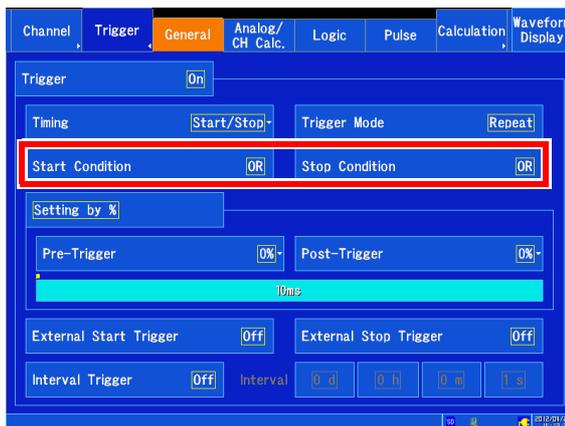
- 1 Open the screen.
 [Waveform Display]/[Setting Display]
 ▶ [Trigger] ▶ [General]

- 2 [Start Condition]/[Stop Condition] ▶
 Tap to switch.

Select (*: Initial setting)

OR* The trigger will be applied at the change point (edge) at which any of the set trigger conditions changes from not satisfied to satisfied. Consequently, even if the trigger conditions are satisfied at the start of measurement, no trigger will be applied until a change point is detected.
 Note: "Change point" refers to the point at which the trigger condition status changes from not satisfied to satisfied.

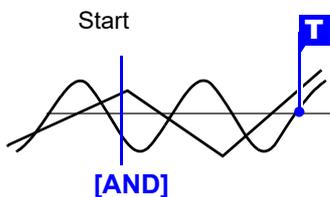
AND The triggers will be applied when all trigger conditions are satisfied. Consequently, triggers will be applied immediately if the trigger conditions are satisfied at the start of measurement.



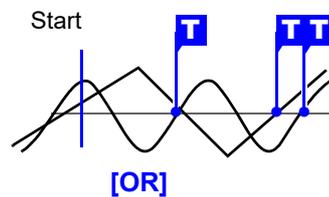
Setting Example:

To apply a trigger when the upslope (↑) of the waveform crosses zero volts

Channel 1, 2
 Trigger.....Level
 Level0 V
 Slope.....↑
 Filter.....Off

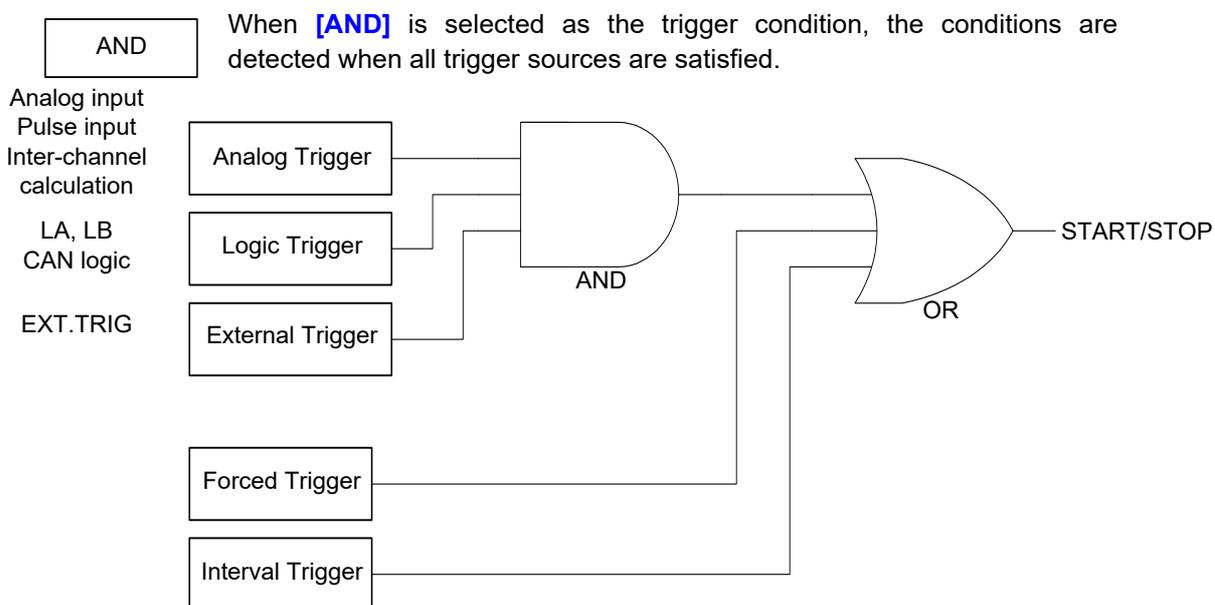
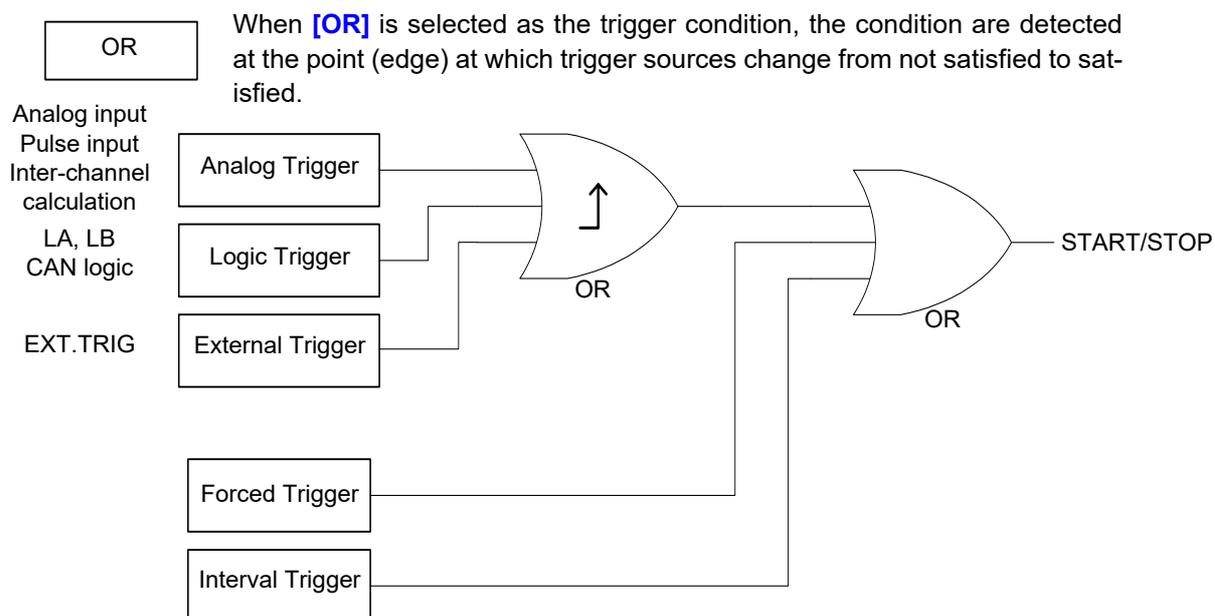


One waveform has crossed above 0 V as the other crosses on the up-slope



Either waveform crosses 0 V on the upslope

Trigger conditions (AND/OR) block diagram



NOTE

Forced triggers and interval triggers cannot be set as stop triggers.

7.6 Setting Pre-triggers and Post-triggers

In addition to recording a waveform after a start trigger is applied, you can record the waveform before the trigger is satisfied (pre-trigger).

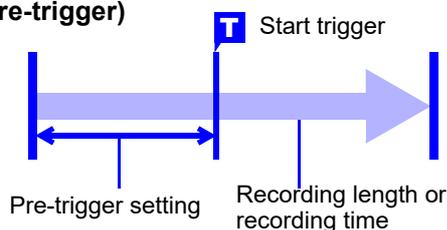
You can also record a waveform for a fixed interval after the stop trigger (post-trigger).

You can select whether to set pre- and post-triggers as a percentage of the recording length or as a number of divisions (recording length).

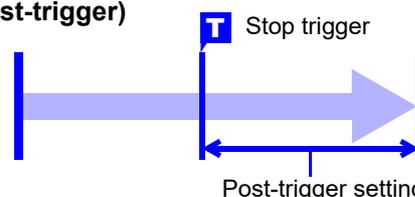
The conditions that can be set depend on the trigger timing settings.

	Timing settings
Pre-trigger	[Start]/[Start/Stop]
Post-trigger	[Stop]/[Start/Stop]

Recording data before the start trigger (Pre-trigger)



Recording data after the stop trigger (Post-trigger)



- NOTE**
- When all trigger sources (analog, interval trigger, etc.) are disabled (Off), pre-trigger and post-trigger settings are ignored.
 - When real-time saving is turned **[On]**, pre-triggers cannot be set.
 - When real-time saving is turned **[On]**, post-triggers cannot be set using percentages.

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Trigger] ► [General]

2 Select [Setting by %]/[Setting by div].

3 [Pre-Trigger]/[Post-Trigger]

(When setting as a percentage) ◻ Select from the list.
Select (*: Initial setting)

- Pre-trigger
0*, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100%
- Post-trigger
0*, 2, 5, 10, 20, 30, 40%

(When setting as a number of divisions) ◻ Change the value.

Valid setting range (Initial setting: 0 div)

When real-time saving is [Off]

- Pre-trigger: 0 to recording length × 100%
- Post-trigger: 0 to recording length × 40%

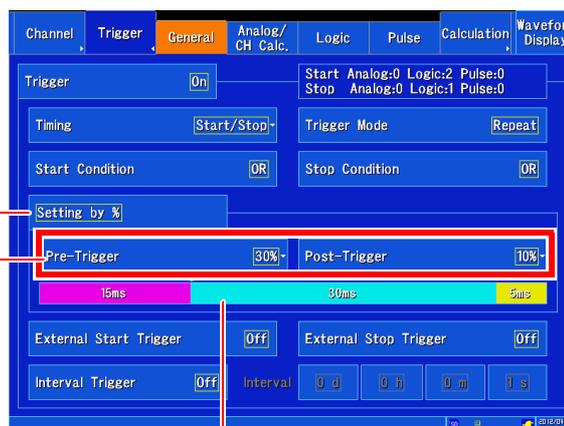
When real-time saving is [On]

0 to maximum valid recording length × 40% or 0 to recording time × 40%, whichever is smaller

See: "6.4 Setting Channels to Use (Increasing the Recording Length)" (p. 147)

See: "6.2 Changing and Entering Values" (p. 145)

2
3



You can check how the set pre-trigger or post-trigger time compares to the total recording time on the [Setting Display]◻[Trigger]◻[General] screen.

When setting a pre-trigger and post-trigger at the same time:

- When setting as a percentage
The settings can only be configured within the range such that the pre-trigger and post-trigger total is less than 80%.
- When setting in divisions
The settings can only be configured within the range such that at least 5 divisions remain when the pre-trigger and post-trigger total is subtracted from the set recording length.

- NOTE** The recording length or recording time setting has precedence over any post-trigger settings.
Example: If the stop trigger is applied after measuring 80 divisions with a recording length of 100 divisions and a post-trigger setting of 30%, only 20 divisions will be recorded after the stop trigger.

Difference between [Pre-Trigger Wait] and [Trigger Wait]

When measurement is started, the specified pre-trigger length is recorded. This period is indicated as the [Pre-Trigger Wait].

After the specified pre-trigger length has been recorded, the period indicated as [Trigger Wait] continues until a trigger occurs.

During [Pre-Trigger Wait], no triggers are applied, even if the trigger conditions are satisfied.

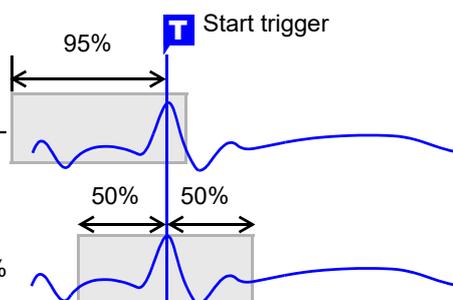
About pre-triggering, post-triggering and the recording period (recording length)**When using a pre-trigger when the start trigger is applied**

Pre-trigger setting: 95%

95% of the recording length is recorded before the trigger point

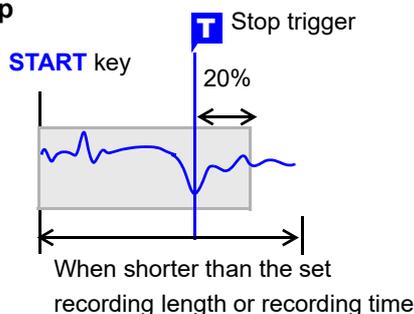
Pre-trigger setting: 50%

50% of the recording length is recorded before and 50% after the trigger point

**When using a post-trigger when the stop trigger is applied**

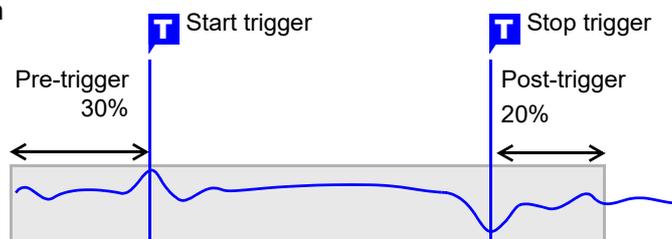
Post-trigger setting: 20%

20% is recorded after the stop trigger.

**When using a pre-trigger and post-trigger when the start and stop triggers are applied**

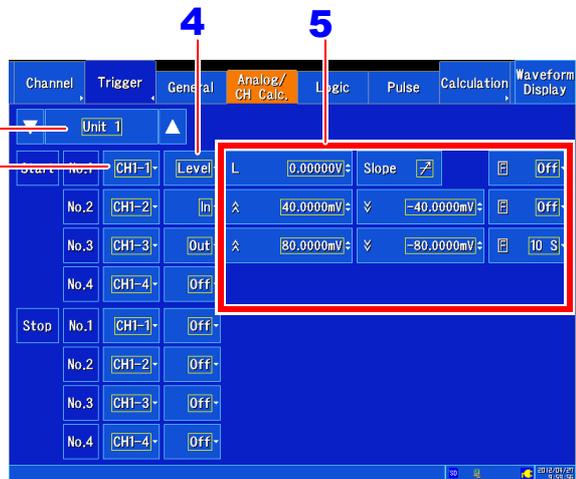
30% is recorded before the start trigger.

20% is recorded after the stop trigger.



7.7 Using Analog, Pulse, or Inter-Channel Calculation Signals to Apply Triggers

- 1** Open the screen.
 [Waveform Display]/[Setting Display] ► [Trigger] ► [Analog/CH Calc.]/ [Pulse]
- 2** Select the input module.
- 3** Select the channel.
 Pulse signals cannot be selected as the channel.
- 4** Select the trigger type.
 See: "Selecting the trigger type" (p. 180)
- 5** Set the conditions.
 See: "Applying a trigger at a specified value (level trigger)" (p. 181)
 "Applying a trigger with a specified range (upper and lower limits) (in-window triggers, out-of-window triggers)" (p. 182)



Selecting the trigger type

Set the trigger type. Depending on the trigger type, the available settings will change.

Select (*: Initial setting)

Off*, Level, In, Out

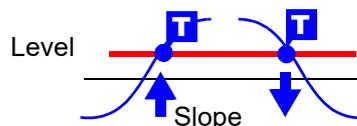


Type of Analog Trigger []: Displayed on screen	Trigger Example (when trigger condition is OR)	Description
Level Trigger [Level]		A trigger is applied when an input signal crosses the specified trigger level (threshold voltage). (However, when the trigger condition is AND, the trigger is applied when the signal level is greater than or less than the set trigger level.)
In-Window Trigger [In]		A trigger is applied when the input signal crosses into a range defined by upper and lower limits. (However, when the trigger condition is AND, the trigger is applied when the input signal falls inside the range defined by the set upper and lower limits.)
Out-of-Window Trigger [Out]		A trigger is applied when the input signal crosses out of a range defined by upper and lower limits. (However, when the trigger condition is AND, the trigger is applied when the input signal falls outside the range defined by the set upper and lower limits.)

NOTE When the measured value is the same as the set value, the trigger is applied.

Applying a trigger at a specified value (level trigger)

A trigger is applied when an input signal crosses the specified trigger level (threshold voltage).



1 Select [Level].

2 [L] ► Change the value.

Set the level (voltage value) at which to apply the trigger. Valid setting range (initial setting: 0)

- Analog/Inter-channel calculation triggers
 - From - (full-scale value) to + (full-scale value)
 - Full scale value = Vertical axis (voltage axis) range x 20 divisions
 - Example: If the vertical axis (voltage axis) range is 1 V/div:
 - 1 V/div x 20 = 20 V
 - The full-scale value is 20 V.
- Pulse triggers
 - 0 to + (full-scale value)

See: "Changing values" (p. 145)

When using the scaling function, the display will be split into two levels.

Upper level: Post-conversion value
Lower level: Pre-conversion value

3 [Slope] ► Tap to switch.

Set the direction in which the signal being used to apply the trigger crosses the threshold (trigger level). Available settings vary with the trigger conditions (AND/OR). Select (*: Initial setting)

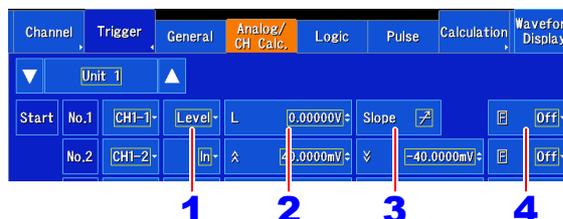
OR	↑*	The trigger is applied when the signal crosses the trigger level in the up direction (↑).
	↓	The trigger is applied when the signal crosses the trigger level in the down direction (↓).
AND	HIGH*	The trigger is applied when the signal is greater than the trigger level.
	LOW	The trigger is applied when the signal is less than the trigger level.

4 [F] (filter) ► Select from the list.

Set the filter width. The trigger will be applied when the trigger conditions are met for the set filter width. This setting provides an effective way to prevent false operation due to noise and other factors.

Select (*: Initial setting)

Off*, 10S, 20S, 50S, 100S, 200S, 500S, 1000S
(S = sample)



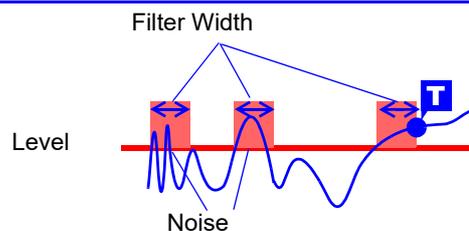
Example settings:

To view the data when the input signal is 200 mV or greater

Trigger: Level (Level Trigger)

Level: 200 mV

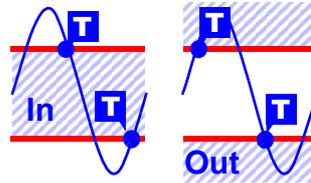
Slope: ↑ (rising)



The trigger is not applied in response to changes that fall within the filter width (sample count).

Applying a trigger with a specified range (upper and lower limits) (in-window triggers, out-of-window triggers)

This section describes how to set upper and lower limit trigger levels and apply a trigger when the input signal enters ("in") or exits ("out") the defined range.



- 1** Select [In]/[Out].
- 2** Change the upper and lower limits.

Set the upper and lower limits that will be used to apply the trigger.

Valid setting range

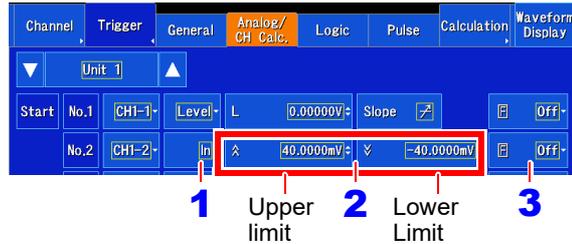
- Analog triggers
From - (full-scale value) to + (full-scale value)
- Pulse triggers
From 0 to + (full-scale value)

See: "Changing values" (p. 145)

When using the scaling function, the display will be split into two levels.

Upper level: Post-conversion value

Lower level: Pre-conversion value



Example settings:

To view the data when the input signal falls outside the range of 1 V to -1 V

Trigger : Out (Out-Window Trigger)
 Upper : 1 V
 Lower : -1 V

- 3** [F] (filter) ► Select from the list.

Set the filter width. The trigger will be applied when the trigger conditions are met for the set filter width. This setting provides an effective way to prevent false operation due to noise and other factors.

Select (*: Initial setting)

- Off***, 10S, 20S, 50S, 100S, 200S, 500S, 1000S
(S = sample)

NOTE

The operation of window-in and window-out triggers varies with the trigger conditions (AND/OR).

OR	In	The trigger is applied when the input signal crosses into the range defined by the trigger level's upper and lower limits.
	Out	The trigger is applied when the input signal crosses out of the range defined by the trigger level's upper and lower limits.
AND	In	The trigger is applied when the input signal falls inside the range defined by the trigger level's upper and lower limits.
	Out	The trigger is applied when the input signal falls outside the range defined by the trigger level's upper and lower limits.

7.8 Triggering by Logic Signals (Logic Trigger)

This section describes how to apply a trigger using a logic input signal. The trigger will be applied when the logic input signal's signal level (pattern) and trigger conditions (AND/OR) are satisfied.

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Trigger] ► [Logic]

2 (When the MR8904 CAN Unit is installed)

Select the [Logic] or module number
Model MR8904 is installed.

3 Set the logic trigger pattern's application triggering conditions (AND/OR).

Select (*: Initial setting)

Off*	Logic triggering is disabled
OR	The pattern (trigger conditions) will be fulfilled if the logic signal reaches even one of the set logic levels.
AND	The pattern (trigger conditions) will be fulfilled if the logic signal reaches all of the logic levels.

4 Set the trigger pattern.

Select (*: Initial setting)

X*	Ignore signal.
0	Trigger at LOW signal level.
1	Trigger at HIGH signal level.

5 Set the filter width (as necessary).

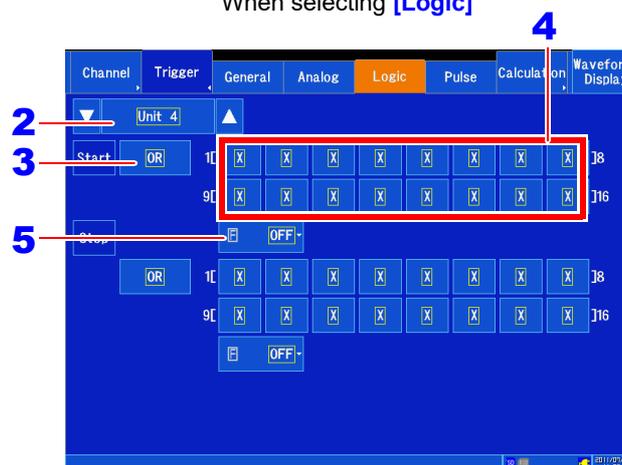
Suppresses triggering from noise.

Select (*: Initial setting)

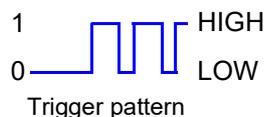
Off* , 10S , 20S , 50S , 100S , 200S , 500S , 1000S	(S = sample)
---	--------------



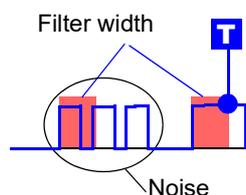
When selecting [Logic]



When selecting the module number



Sets the input signal state at which to apply the trigger.



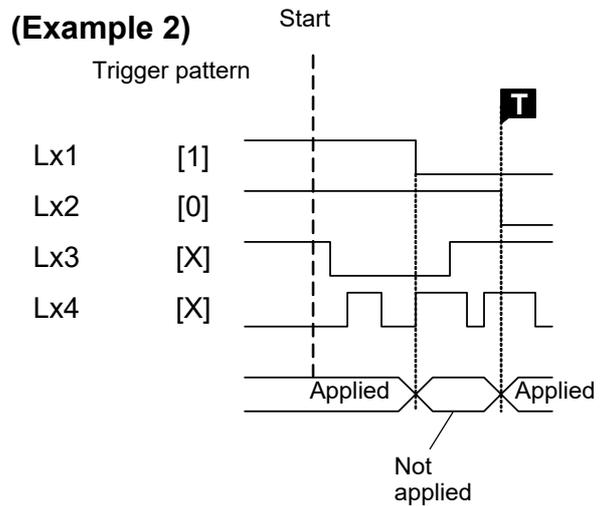
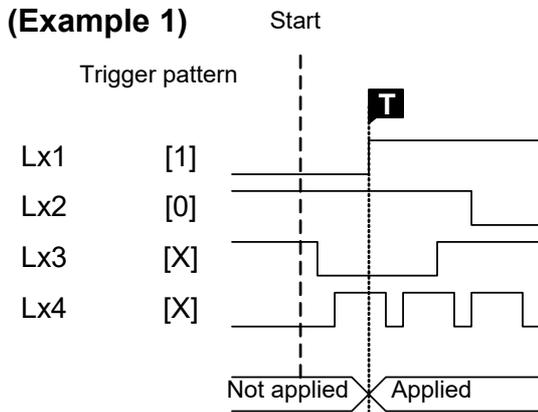
The filter width is set as the number of captured data samples.

Number of samples: 1 div = 100 samples (when the display magnification is set to 1).

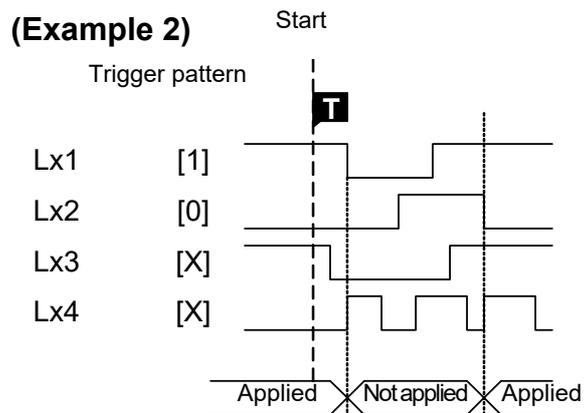
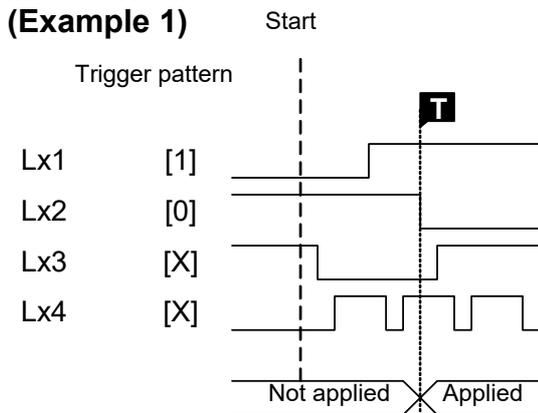
Example settings

The following illustrates the relationship between pattern and trigger application for logic triggers:

OR



AND



7.9 Applying a Trigger at a Fixed Interval (Interval Trigger)

This section describes how to apply a start trigger at a user-specified interval. By setting the trigger mode to **[Repeat]**, it is possible to perform regular recording operation.

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Trigger] ► [General]

2 Set [Interval Trigger] to [On].

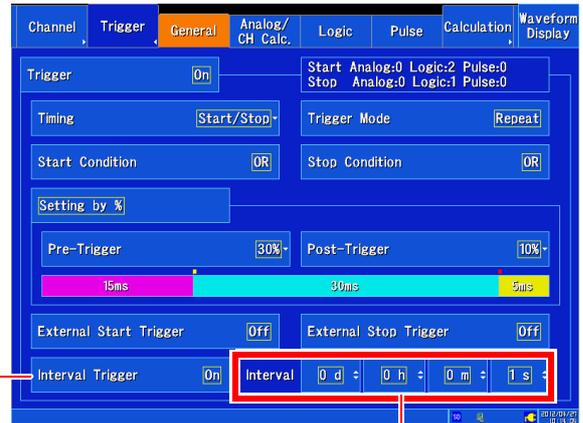
Select (*: Initial setting)

Off*	Interval triggering is disabled.
On	Interval triggering is enabled.

3 Set the [d][h][m][s] settings under [Interval Trigger] to the desired interval.

See: "6.2 Changing and Entering Values" (p. 145)

The trigger will be applied when measurement starts and then each time the specified measurement interval elapses.



3

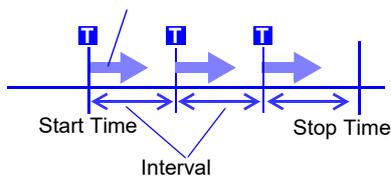
NOTE

- When using an interval trigger alone, set the trigger condition to OR.
- When using a pre-trigger, interval trigger time monitoring will start after the first pre-trigger time elapses following the start of measurement.
- The interval trigger will not be applied while waiting for the pre-trigger. The interval trigger will be applied while waiting for triggers after the pre-trigger time elapses.
- An interval trigger alone will start measurement even if other trigger conditions are not satisfied when the trigger condition is AND.

Capturing data with a time interval (relationship between the interval and recording length or recording time)

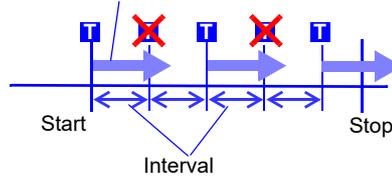
The next trigger will not be applied until the data corresponding to the recording length or recording interval is captured.

The specified recording length or recording time is shorter.



When the recording length or recording time is shorter than the interval

The specified recording length or recording interval is recorded.



When the recording length or recording time is longer than the interval

7.10 Applying an External Trigger

An external signal applied to the External Control terminal can serve as a trigger source. It can also be used to synchronously drive parallel triggering of multiple instruments.

See: "Synchronous Measurements with Multiple Instruments" (p. A14)

1 Open the screen.

[Waveform Display]/[Setting Display] ►
[Trigger] ► [General]

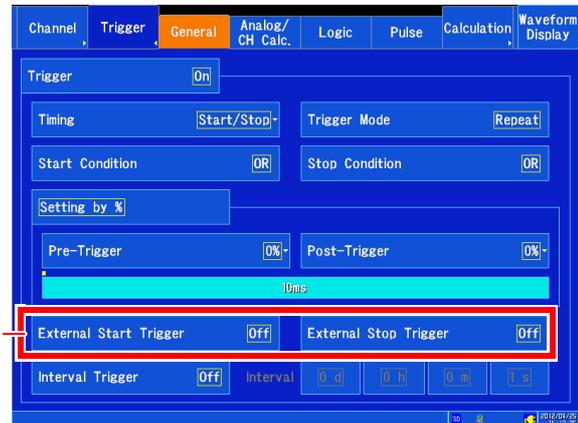
2 [External Start Trigger]/[External Stop Trigger] ► Tap to switch.

(The available settings will vary with the trigger timing settings.)

OR	Off*	No external trigger is used.
	↑	Applies the trigger when the external input signal changes from low to high.
	↓	Applies the trigger when the external input signal changes from high to low.
AND	Off*	No external trigger is used.
	HIGH	Applies the trigger when the external input signal is high.
	LOW	Applies the trigger when the external input signal is low.

3 Apply the input signal to the external trigger (EXT.TRIG) terminal.

See: "External trigger terminal (EXT.TRIG)" (p. 329)



7.11 Triggering Manually (Forced Trigger)

A user-specified trigger can be applied using the  (forced trigger) key during trigger standby operation. This functionality takes precedence over all other trigger conditions settings.

After starting measurement by pressing the **START** key, press the  (forced trigger) key when you wish to record.

During pre-trigger operation, forced triggers are not accepted (like other triggers).



To stop recording

Press the **STOP** key.

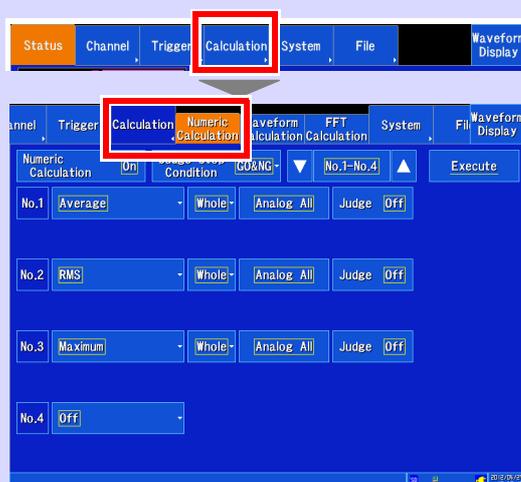
Press once: Recording will stop after data corresponding to the recording length or recording time is captured.

Press twice: Recording will stop immediately.

Numerical Calculation Function

Chapter 8

You can calculate parameters such as the maximum, minimum, and average values for waveform data stored in the instrument's memory. Similarly, you can perform up to eight calculations, and you can make judgments about calculation results.



Numerical Calculations

- Average
 - RMS (Root-Mean-Square)
 - P-P
 - Maximum
 - Time to Maximum
 - Minimum
 - Time to Minimum
 - Period
 - Frequency
 - Rise Time
 - Fall Time
 - Standard Deviation
 - Area
 - X-Y Area
 - Time to Level
 - Level at Time
 - Pulse Width
 - Duty Ratio
 - Pulse Count
 - Arithmetic Operation
 - Time Difference
 - Phase Contrast
 - High Level
 - Low Level
 - Specified calculation between cursors
- (Total of 24 types)

There are a total of 24 types of numerical calculations, and up to 8 can be performed simultaneously. When using the scaling function, numerical calculations are performed using scaled values.

Numerical calculation judgments (p. 199)

You can make GO/NG judgments by comparing numerical calculation results with a set reference range.

Saving numerical calculation results (p. 202)

- Auto saving of numerical calculation results
- User-triggered saving of existing numerical calculation results

8.1 Numerical Calculation Workflow

There are two calculation methods:

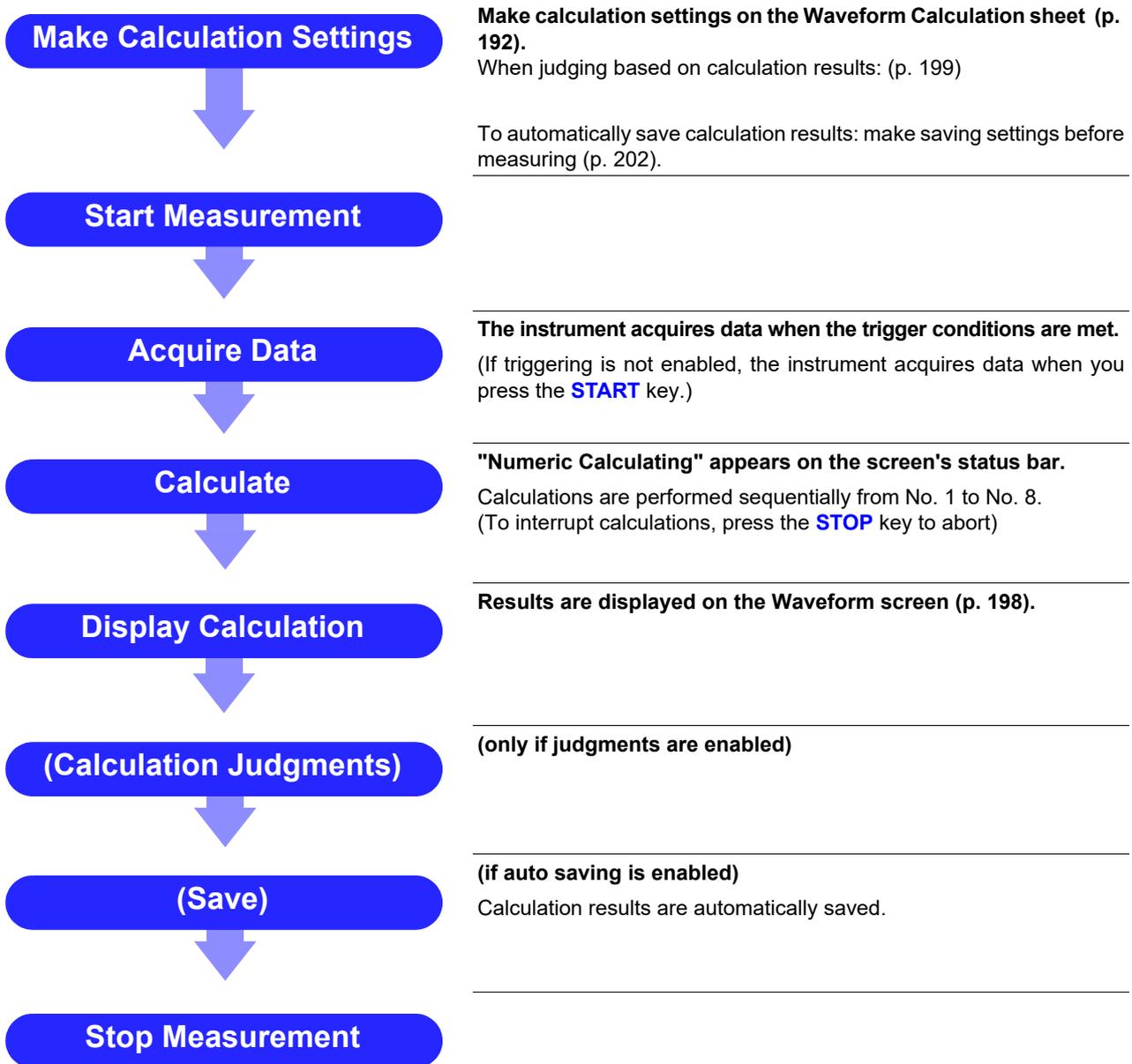
- **Calculating While Measuring**

The numerical calculation must be configured before measurement. (This functionality is not available when real-time saving is enabled.)

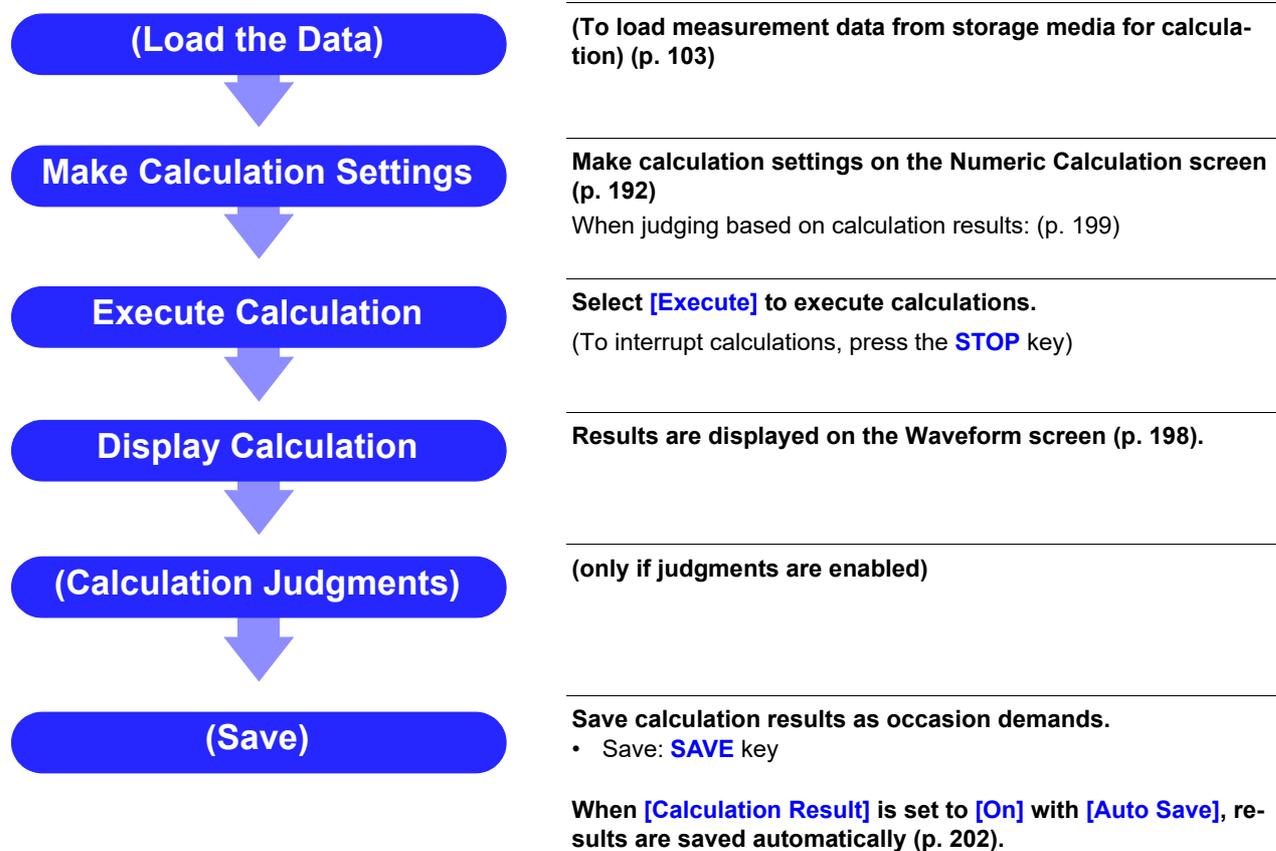
- **Applying Calculations to Existing Data**

Calculations can be performed using data after waveform acquisition or data stored on media.

Calculating While Measuring



Applying Calculations to Existing Data



When specifying a waveform range for calculation:

Before executing a calculation, specify the calculation range using the A/B, C/D cursors on the Waveform screen. Set the calculation range to **[A/B]** or **[C/D]**.

- E/F cursors cannot be used to specify the range.
- When one cursor is used, the calculation range is from the cursor to the end of the data.

See: "5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116)
"8.2 Settings for Numerical Value Calculation" (p. 192)

8.2 Settings for Numerical Value Calculation

1 Open the screen.

[Setting Display] ▶ [Calculation] ▶
[Numeric Calculation]

2 [Numeric Calculation] ▶ Set to [On].

(Default setting: Off)

3 Display the calculation number you wish to configure.

Select

No.1-No.4, No.5-No.8

4 Select the calculation type.

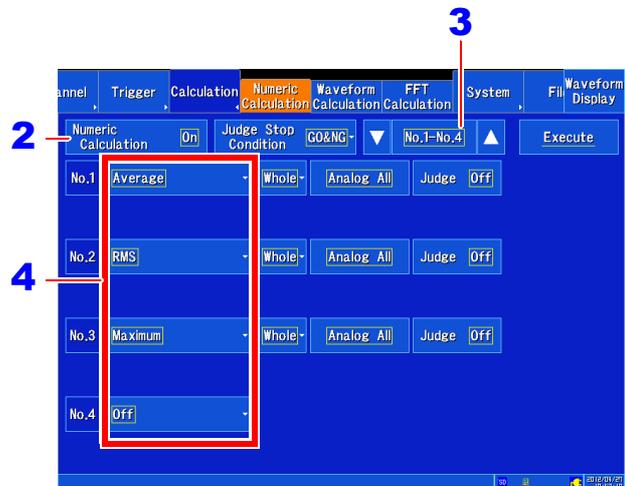
Tap the calculation type setting for the number you are configuring and select from the list.

See: Details: "Numerical Calculations" (p. 204)

Select (*: Initial setting)

Off*	No calculation.
Average	Average value of waveform data
RMS	RMS value of waveform data
P-P	Peak-to-peak value of waveform data
Maximum	Maximum value of waveform data
Time to Maximum	Time from trigger to maximum value
Minimum	Minimum value of waveform data
Time to Minimum	Time from trigger to minimum value
Period*1	Period of signal waveform
Frequency*1	Frequency of signal waveform
Rise Time	Rise time of waveform data
Fall Time	Fall time of waveform data
Standard Deviation	Standard deviation of waveform data
Area	Area enclosed by zero position and signal waveform
X-Y Area	Area of XY composite waveform
Time to Level*1	Time from trigger to specified level

*1 Calculations can also be performed for logic channels.



Select (*: Initial setting)

Level at Time*1	Measured value at specified time from trigger
Pulse Width*1	Pulse width of waveform data
Duty Ratio*1	Duty of waveform data
Pulse Count*1	Pulse count of waveform data
Arithmetic Operation	Four arithmetic operations on numerical calculation results
Time Difference*1	Time difference from waveform A to waveform B
Phase Contrast*1	Time difference from waveform A to waveform B displayed as a phase contrast
High Level	High-level value for waveform data
Low Level	Low-level value for waveform data

*1 Calculations can also be performed for logic channels.

Setting choices depend on the calculation type.

Also select **[Judge]** if you require judgment of calculation results (p. 199).

- When selecting **[A/B]/[C/D]**, specify the calculation range using the A/B or C/D cursors on the Waveform screen (p. 116).
- Once a measurement has been made and a range specified, calculations can be performed using that range starting with the next measurement.

5 Select the calculation range.

Select (*: Initial setting)

Whole*	Applies calculations to the whole waveform.
A/B	Applies calculations to the data between A/B cursors.
C/D	Applies calculations to the data between C/D cursors.

6 Select the calculation target channel.

You can set the calculation target channel. Tap to display the Channel Settings window.

You can configure analog channels with options such as all analog channels or CH1-1.

You can configure pulse channels with options such as all pulse channels or P1.

You can configure inter-channel calculation channels with options such as all inter-channel calculation channels or W1-1.

You can configure logic channels with options such as all logic channels or LA1.

(When a logic channel is set for a calculation other than period, frequency, time to level, level at time, pulse width, duty ratio, pulse count, time difference, or phase contrast, the number will be shown in red, and the calculation value will not be displayed.)

See: "Calculation target channel and calculation condition settings by calculation type" (p. 194)

7 Set the calculation conditions.

(not required for some calculation types)

Move the cursor to the parameter items, and make appropriate parameter settings.

See: "Calculation target channel and calculation condition settings by calculation type" (p. 194)

8 To judge the calculation results

Set **[Judge]** to **[On]** and set the judgment results.

See: "8.4 Judging Calculation Results" (p. 199)

9 To automatically save calculations after measurement:

Configure saving of calculation results.

See: "8.5 Saving Numerical Calculation Results" (p. 202)

10 Perform the calculation.

To perform the calculation automatically after measurement

Press the **START** key.

The calculation will be performed automatically after data is acquired following the start of measurement.

Applying Calculations to Existing Data

Tap **[Execute]**.

You can also use the **[Execute]** function on the Waveform screen (p. 198).

6 All-channel selection (You can select all channels of the selected input channel type.)

Input channel type

Input module number

Channel

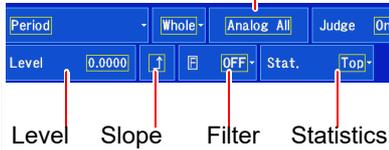
NOTE If measurement is disabled for a channel selected as a calculation target channel, the calculation will not be performed. Depending on the calculation type and input channel type, you may not be able to select all channels.

Calculation results can be saved with the **SAVE** key.

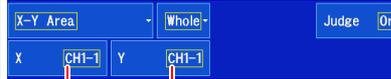
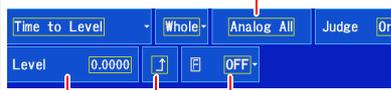
See: "Selecting and saving data (SAVE key)" (p. 98)

8.2 Settings for Numerical Value Calculation

Calculation target channel and calculation condition settings by calculation type

Calculation Type	Parameter	Description	Example screen
Average RMS P-P Maximum Time to Maximum Minimum Time to Minimum Standard Deviation Area High Level Low Level	Calculation target channel (Analog, Pulse, Inter-channel calculation, Waveform calculation)	Sets the calculation target channel.	Calculation target channel 
Period Frequency Pulse Width Duty Ratio Pulse Count	Calculation target channel (Analog, Logic, Pulse, Inter-channel calculation, Waveform calculation)	Sets the calculation target channel.	Calculation target channel 
	Level*	Calculated based on the interval (time) at which the level set here is crossed.	Level
	Slope (↑, ↓)	Sets whether to calculate using the interval at which the set level value is crossed from the bottom to the top (↑) or from the top to the bottom (↓). (The duty calculation type has no slope setting.)	Slope
	Filter (F) (Off to 1000S)	Sets the width upon which to judge that the set level value has been crossed. If, after the measurement signal crosses the level, the level value is not crossed again within the set filter width, the level value is judged to have been crossed. This setting is an effective way to prevent noise or other factors from causing the detection of erroneous level crossings.	Filter
Statistics (Stat.) (Top, Average, Max, Min)	Sets what kind of data to calculate based on the data in the calculation range determined above. Top calculates the first calculated value from the beginning of the calculation range. Average, maximum, and minimum calculate the average, maximum, and minimum of each parameter in the calculation range. (The pulse count calculation type has no statistics setting.)	Statistics	

* The valid setting range is -9.9999E+29 to -1.0000E-29, 0, and 1.0000E-29 to 9.9999E+29. Up to five significant digits can be set. (When setting the time for the level calculation type, up to eight significant digits can be set.)

Calculation Type	Parameter	Description	Example screen
Rise Time Fall Time	Calculation target channel (Analog, Pulse, Inter-channel calculation, Waveform calculation)	Sets the calculation target channel.	<p>Calculation target channel</p>  <p>Time (%) Statistics</p>
	Time (%) (5%→95% to 30%→70% or 95%→5% to 70%→30%)	Sets the part of the range between the waveform's upper and lower limit values for which to calculate the rising time (falling time). The range defined by narrowing the upper and lower limit values by the set percentage will be used as the calculation range.	
	Statistics (Stat.) (Top, Average, Max, Min)	Sets what kind of data to calculate based on the data in the calculation range determined above. Top calculates the first calculated value from the beginning of the calculation range. Average, maximum, and minimum calculate the average, maximum, and minimum of each parameter in the calculation range. (The pulse count calculation type has no statistics setting.)	
X-Y Area	X-axis channel, Y-axis channel (X, Y) (Analog, Pulse, Inter-channel calculation, Waveform calculation)	Sets the channels to allocate to the X- and Y-axes. All channels cannot be selected.	 <p>X-axis channel Y-axis channel</p>
Time to Level	Calculation target channel (Analog, Logic, Pulse, Inter-channel calculation, Waveform calculation)	Sets the calculation target channel.	<p>Calculation target channel</p>  <p>Level Slope Filter</p>
	Level*	Calculated based on the interval (time) at which the level set here is crossed.	
	Slope (↑, ↓)	Sets the direction in which the set level is crossed in calculating the time.	
	Filter (F) (Off to 1000S)	Sets the width upon which to judge that the set level value has been crossed. If, after the measurement signal crosses the level, the level value is not crossed again within the set filter width, the level value is judged to have been crossed. This setting is an effective way to prevent noise or other factors from causing the detection of erroneous level crossings.	

* The valid setting range is $-9.9999\text{E}+29$ to $-1.0000\text{E}-29$, 0, and $1.0000\text{E}-29$ to $9.9999\text{E}+29$. Up to five significant digits can be set. (When setting the time for the level calculation type, up to eight significant digits can be set.)

8.2 Settings for Numerical Value Calculation

Calculation Type	Parameter	Description	Example screen
Level at Time	Calculation target channel (Analog, Logic, Pulse, Inter-channel calculation, Wave-form calculation)	Sets the calculation target channel.	<p>Calculation target channel</p>  <p>Specification method Time or calculation result</p>
	Specification method (Time specification, Calculation specification)	Sets the time specification method. You can select whether to use the time from a trigger (time specification) or a numerical calculation result (calculation specification).	
	Time* or calculation result (When using a numerical calculation result: No.1 to No.8)	Sets the time at which to calculate the measured value using the trigger position as 0. When using a numerical calculation result, specify the numerical calculation number. When setting all channels (for example, all analog channels) as the channel for the specified numerical calculation number, the level calculation type is not available. Set to a single channel (for example, CH1-1). If a number greater than the set calculation number is specified, the calculation will not be able to be performed. Range specifications between the A/B or C/D cursors are not valid.	

* The valid setting range is $-9.9999E+29$ to $-1.0000E-29$, 0, and $1.0000E-29$ to $9.9999E+29$. Up to five significant digits can be set. (When setting the time for the level calculation type, up to eight significant digits can be set.)

8.2 Settings for Numerical Value Calculation

Calculation Type	Parameter	Description	Example screen
Time Difference Phase Contrast	Waveform A (reference), Waveform B channel (Analog, Logic, Pulse, Inter-channel calculation, Waveform calculation)	Sets the channels for waveform A (reference) and waveform B. You cannot select all channels (for example, all analog channels) for waveform A (reference).	<p>Waveform B display</p> <p>Tap to switch between waveform A(reference), waveform B and statistics settings.</p>  <p>Waveform B channel Slope (waveform B) Filter (waveform B)</p> <p>Level (waveform B) Waveform A (reference) channel</p> <p>Waveform A (reference) display</p>  <p>Waveform B channel Level (waveform A) Filter (waveform A)</p> <p>Waveform A (reference) channel Slope (waveform A)</p>
	Level*	Calculated based on the interval (time) at which the level set here is crossed.	
	Slope (↑, ↓)	Sets whether to calculate using the interval at which the set level value is crossed from the bottom to the top (↑) or from the top to the bottom (↓). (The duty calculation type has no slope setting.)	
	Filter (F) (Off to 1000S)	Sets the width upon which to judge that the set level value has been crossed. If, after the measurement signal crosses the level, the level value is not crossed again within the set filter width, the level value is judged to have been crossed. This setting is an effective way to prevent noise or other factors from causing the detection of erroneous level crossings.	
	Statistics (Stat.) (Top, Average, Max, Min)	Sets what kind of data to calculate based on the data in the calculation range determined above. Top calculates the first calculated value from the beginning of the calculation range. Average, maximum, and minimum calculate the average, maximum, and minimum of each parameter in the calculation range. (The pulse count calculation type has no statistics setting.)	
Arithmetic Operation	Numerical Calculation No. (No.1 to No.8)	Sets the numbers for two numerical calculations you wish to perform. When setting all channels (for example, all analog channels) as the channel for a specified numerical calculation number, the level calculation type is not available. Set to a single channel (for example, CH1-1).	 <p>Operator</p> <p>Numerical calculation no.</p>
	Operator (+, -, ×, ÷)	Sets one of the operators for the four fundamental arithmetic operations.	

* The valid setting range is -9.9999E+29 to -1.0000E-29, 0, and 1.0000E-29 to 9.9999E+29. Up to five significant digits can be set. (When setting the time for the level calculation type, up to eight significant digits can be set.)

NOTE

- The period, frequency, rise time, and fall time parameters may not be displayed as the instrument may be unable to generate the calculated value for some signal waveforms.
- In period and frequency calculations, it may not be possible to obtain accurate measurement results when the filter setting approaches 1/2 the period. (The integer value of the actual period may be calculated.)
- When scaling has been set, calculations are performed after scaling the waveform data. Parameter values use the same units as set for scaling.

See: About Scaling

"6.5 Converting Input Values (Scaling Function)" (p. 150)

8.3 Viewing Numerical Calculation Results

You can check calculation results on the Waveform screen.

[Waveform Display] ► [Numeric Calc.]

A numerical calculation results window will be displayed.

To clear the Numerical Calculation window:
Tap [Numeric Calc.] again.



You can also perform calculations while you have the Numerical Calculation window open.

NOTE

Maximum values, minimum values, P-P values, and average values displayed on the Numeric Monitor screen are provided as a monitor during measurement and may not completely match maximum values, minimum values, P-P values, and average values calculated using the numerical calculation function.



When there are a large number of channels for numerical calculation results

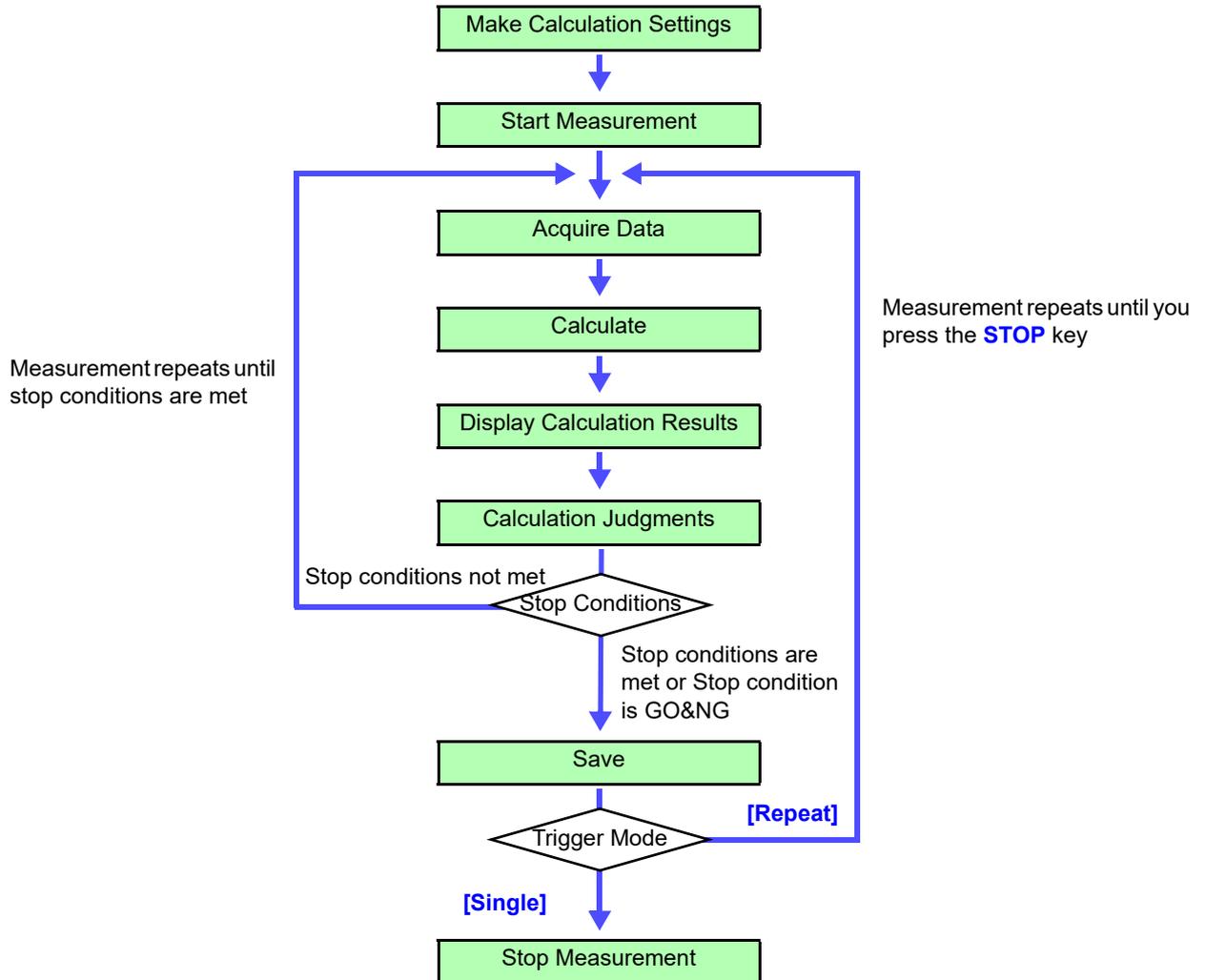
You can scroll on the numerical calculation results screen. When there are a large number of channels, you can scroll to display the calculation results.

See: "Touch panel operation" (p. 20)

8.4 Judging Calculation Results

Set the judgment conditions (upper and lower threshold values) by which to judge numerical calculation results. Judgment conditions can be set for every numerical calculation.

Waveform acquisition processing depends on the trigger mode setting (Single or Repeat) and the conditions specified to stop measuring upon judgment (GO, NG or GO & NG).



NOTE Auto saving is not performed until the stop condition is met after calculation judgment.

8.4 Judging Calculation Results

1 Make calculation settings (p. 192).

2 Set [Judge] for the calculation you wish to judge to [On].

Select (*: Initial setting)

Off*	Disables judgment.
On	Generates a NG judgment if the result falls outside the judgment reference range. Calculated values for the channel generating the NG judgment are shown in red.

3 Change the upper and lower limit values.

Set the judgment reference values so that the upper limit value is greater than the lower limit value.

Valid setting range

-9.9999E+29 to -1.0000E-29, 0, +1.0000E-29 to +9.9999E+29

Up to five significant digits can be set.

See: "Entering values" (p. 145)

4 [Judge Stop Condition] ► Tap to switch.

Set the stop condition for measurement operation.

Select (*: Initial setting)

GO	Stops measurement operation when the result falls inside the reference range (GO judgment).
NG	Stops measurement operation when the result falls outside the reference range (NG judgment).
GO&NG*	Stops measurement in the event of either a GO or NG judgment.

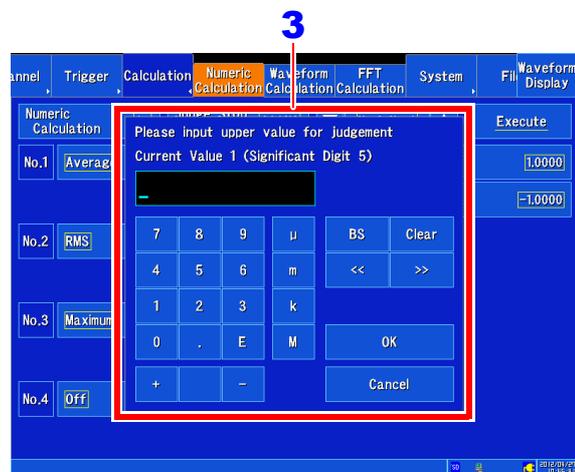
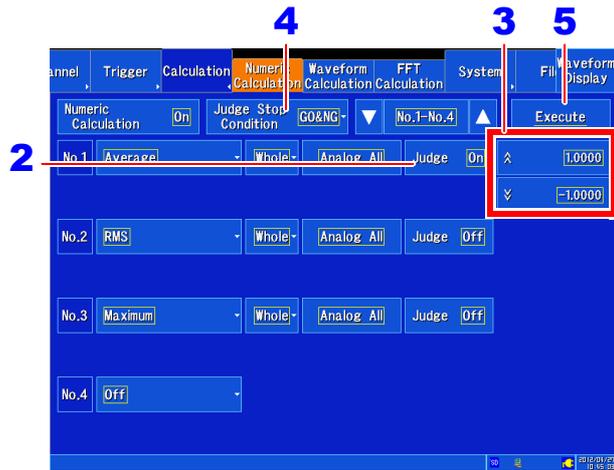
5 Perform the calculation.

To perform the calculation automatically after measurement

Press the **START** key.

The calculation will be performed automatically after data is acquired following the start of measurement.

To make a judgment using existing measurement data Tap [Execute].



NOTE About upper and lower threshold
The upper threshold of the period range cannot be set below the lower threshold, and vice-versa.

Performing calculations

Processing depends on the Trigger Mode setting. If calculating while acquiring waveforms, measurement is repeated until the Stop Conditions are met (p. 199).

To record all calculation results
Set the stop condition at judgment to **[GO&NG]**.

Displaying judgment results

Judgment results of numerical calculations are displayed on the Waveform screen.

[Waveform Display] ► [Numeric Calc.]

A numerical calculation result window will be displayed.

Within the judgment threshold range: GO judgment
 Out of the judgment threshold range: NG judgment
 (displayed in red)



Displays the judgment results.

Outputting judgment results

When the judgment result is GO

The GO signal is output at the GO/OUT1 external I/O terminal.

When the judgment result is NG

- The NG signal is output at the NG/OUT2 external I/O terminal. The NG judgment is asserted when any channel is judged as NG.
- When the beeper is enabled, a beep sounds when a result is out of the threshold range.

8.5 Saving Numerical Calculation Results

Calculate and automatically save during data acquisition. Before measurement begins, the calculation settings need to be set.

CAUTION When using auto save during measurement, do not remove the storage media specified as the save destination until the measurement operation is completely finished. Doing so may damage data on the storage media.

- 1** Open the screen.
 [Waveform Display] ▶ [Status] ▶ [Auto Save]
 Or [Setting Display] ▶ [Status] ▶ [Auto Save Settings]

- 2** Set [Calculation Result] to [On].
 (Default setting: Off)

- 3** [File] ▶ Tap to switch.
 Select the file creation method.
 Select (*: Initial setting)

New*	Creates a new file for each measurement.
Append	Always adds data to the same file.

- 4** [Divide] ▶ Tap to switch.
 Select the file segmentation method.
 Select (*: Initial setting)

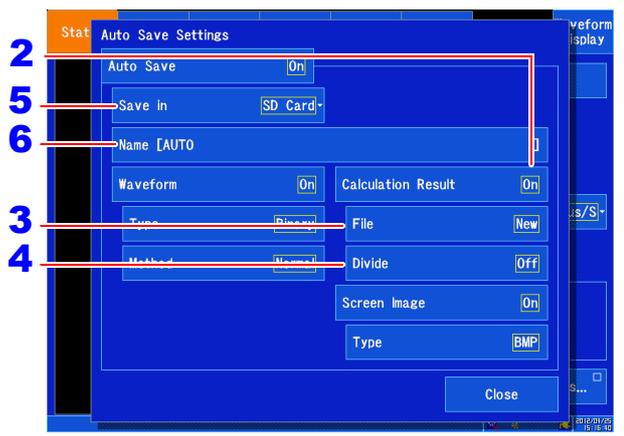
Off*	Disables file segmentation.
Split by Calc. No.	Segments files for each numerical calculation number.

- 5** [Save in] ▶ Select from the list.
 Set the destination.
 Select (*: Initial setting)

SD Card* , USB Memory , Mail (p. 306), FTP (p. 285)

When selecting FTP transmission or e-mail transmission, you can specify a destination at which to save a backup copy of the data if an error occurs.

- 6** Set the filename.
 (Default setting: AUTO)
 Tap [Name] and enter the filename.
 (Up to 40 characters)
 The filename is set in the same way that comments are entered (p. 142).
 (Some characters and symbols cannot be entered due to file system limitations.)



- 7** Press the **START** key to start measurement after checking the measurement condition and numerical calculation settings.

After the data is acquired and the numerical calculation process completes, the numerical calculation results (text) are saved automatically to the specified storage media.

Example of saved numerical calculation results

NOTE The following characters are converted as follows when saved as numerical calculation results to a text file:

The following characters are converted as follows when saved to a text file.

Entered character	Converted plain text equivalent
²	^2
³	^3
μ	~u
Ω	~o
°	~c
ε	~e
±	~+

Units are converted as follows:

μE (display only)→uE; °C (display only)→ C

When the calculation settings are as follows:

Calculation: Analog channel 1-1 maximum value

Calculation: Analog channel 1-2 minimum value

Calculation: Analog channel 1-3 maximum value

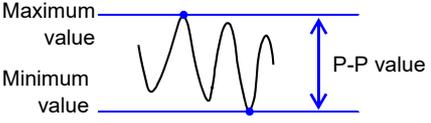
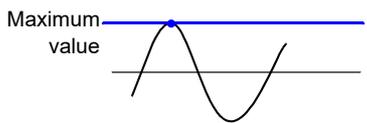
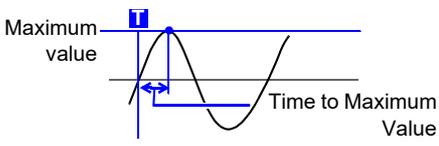
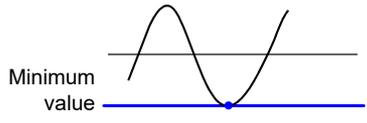
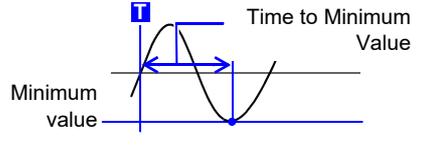
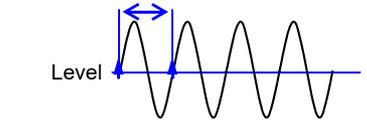
Calculation: Analog channel 1-4 minimum value

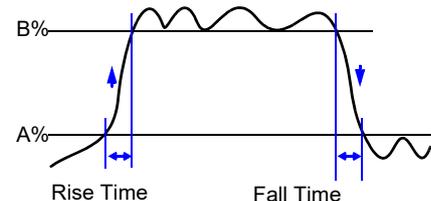
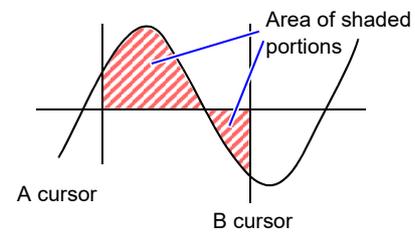
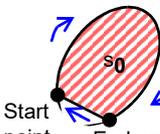
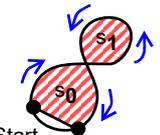
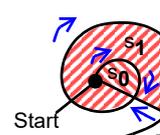
"Filename","AUTO_20110720_133351.CSV","V1.00",	1
"Trigger time","Trigger time (Under 1sec)","Maximum (ANALOG CH1-1)","Minimum (ANALOG CH1-2)","Maximum (ANALOG CH1-3)","Minimum (ANALOG CH1-4)"	2
","","[V]","[V]","[V]","[V]"	3
"2011/07/20 13:33:51","0.391000", 2.17200E-03,-3.23800E-02, 1.20000E-01, 1.20000E-01	4
"2011/07/20 13:33:52","0.920000", 9.36000E-04,-3.24680E-02, 1.20000E-01, 1.20000E-01	

- 1: Line 1 : Filename and version number
- 2: Line 2 : Calculation Settings
- 3: Line 3 : Calculation Result Unit
- 4: From Line 4 : Calculation Results

Recorded in the order of the calculation settings of line 2.

8.6 Numerical Calculations

Numerical Calculation Type	Description
Average	<p>Obtains the average value of waveform data.</p> $AVE = \frac{1}{n} \sum_{i=1}^n di$ <p> <i>AVE</i> : Average value <i>n</i> : Data count <i>di</i> : Data on channel number <i>i</i> </p>
RMS (Root-Mean-Square) value	<p>Obtains the RMS value of waveform data. If Scaling is enabled, calculations are applied to the waveform after scaling.</p> $RMS = \sqrt{\frac{1}{n} \sum_{i=1}^n di^2}$ <p> <i>RMS</i> : RMS value <i>n</i> : Data count <i>di</i> : Data on channel number <i>i</i> </p>
P-P value	<p>Obtains the value of the difference (peak-to-peak value) between maximum and minimum values of waveform data.</p> 
Maximum value	<p>Obtains the maximum value of waveform data.</p> 
Time to Maximum value	<p>Obtains the time (in seconds) from the last trigger point to the maximum value. If the maximum value occurs in two or more instances, the first instance is treated as the maximum value.</p> 
Minimum value	<p>Obtains the minimum value of waveform data.</p> 
Time to Minimum value	<p>Obtains the time (in seconds) from the last trigger point to the minimum value. If the minimum value occurs in two or more instances, the first instance is treated as the minimum value.</p> 
Period, Frequency	<p>Displays the period (s) and frequency (Hz) for the signal waveform. This information is calculated based on the time from when the rising or falling edge of the signal first passes the set level to the next time it does so.</p> 

Numerical Calculation Type	Description
<p>Rise Time Fall Time</p>	<p>The rise time of the acquired waveform from A% to B% (or fall time from B% to A%) is obtained by calculation using a histogram (frequency distribution) of the 0 and 100% levels of the acquired waveform.</p> <p>As waveform data is acquired, the rise time (or fall time) is obtained from the first rising (or falling) edge.</p> <p>When calculation of the range specified by the A/B or C/D cursors is selected, the obtained rise time (or fall time) is the first rising (or falling) edge between the cursors.</p>  <p>A: 5 to 30% B: 95 to 70%</p>
<p>Standard Deviation</p>	<p>Obtains the standard deviation of the waveform data.</p> $\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (d_i - AVE)^2}$ <p>σ : Standard Deviation AVE : Average n : Data count d_i : Data on channel number i</p>
<p>Area</p>	<p>Obtains the area value (V•s) enclosed by the zero position (point of zero potential) and the signal waveform.</p> <p>When calculation of the range specified by the A/B or C/D cursors is selected, the calculated area is constrained to the waveform between the cursors.</p>  $S = \sum_{i=1}^n d_i \cdot h$ <p>S : Area n : Data count d_i : Data on channel number i $h = \Delta t$: Sampling rate</p>
<p>X-Y Area</p>	<p>Obtains the area (V²) of an X-Y composite waveform. In the following figures, the areas within the lines are calculated. The calculation is available even if the X-Y composite waveform is not intended for display.</p> <p>You can also specify the calculation range for a waveform on a channel's horizontal axis (time axis) with the A/B or C/D cursors and then calculate the area for the XY composite waveform in that range. (The area cannot be specified directly by A/B or C/D cursors on the X-Y waveform.)</p> <p>See: About the A/B and CD cursors: "5.1 Reading Measured Values (Using Cursors)" (p. 112)</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="491 1456 925 1680"> <p>When the trace consists of multiple loops</p>  <p>$S = n \times S_0$ S : Area n : Number of loops</p> <p>Start/end point</p> </div> <div data-bbox="925 1456 1473 1680"> <p>When the trace is an open curve</p>  <p>$S = S_0$ S : Area (Area enclosed by the curve and line connecting start and end points)</p> <p>Start point End point</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div data-bbox="491 1702 925 1926"> <p>When the trace is a figure-8</p>  <p>$S = S_0 - S_1$ S : Area</p> <p>Start point End point</p> </div> <div data-bbox="925 1702 1473 1926"> <p>When the trace is an open curve</p>  <p>$S = S_0 \times 2 + S_1$ S : Area (The number of overlapping regions increases with the number of loops)</p> <p>Start point End point</p> </div> </div> <p>Setting Choices: Set the X- and Y-axis channels.</p>

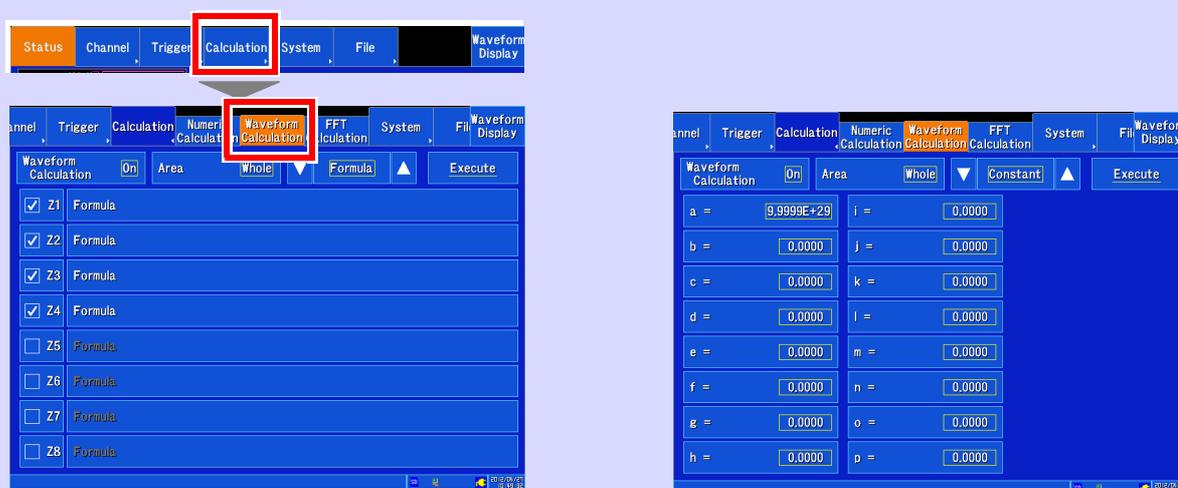
8.6 Numerical Calculations

Numerical Calculation Type	Description	
Time to Level	Searches for the point at which the set level is crossed from the start of the calculation range and calculates the time from the trigger to that point.	
Level at Time	Calculates the level for a specified time from the trigger. The time can also be specified using a previous calculation result.	
Pulse Width	Obtains pulse width as the time difference between one rising or falling intersection of the waveform through a specified level to the next intersection (with opposite slope).	
Duty Ratio	<p>Obtains the duty percentage based upon the ratio of the time from a rising intersection to the next falling intersection at a specified level, to the time from the same falling intersection to the next rising intersection at the same level.</p> $\text{Duty (\%)} = \frac{T_{u-d}}{T_{u-d} + T_{d-u}} \times 100(\%)$ <p>T_{u-d} : Time (seconds) after rising intersection to falling intersection T_{d-u} : Time (seconds) after falling intersection to the next rising intersection</p>	
Pulse Count	Obtains the count of pulses from the number of rising or falling intersections with a specified level. One pulse is counted when the signal falls back below the specified level after rising through it (or vice versa)	
Arithmetic Operation	Performs arithmetic operations (+, -, ×, ÷) upon arbitrarily selected results of numerical calculations.	
Time Difference	<p>Calculates the time difference T [s] between waveform A and waveform B crossing the specified level at the rising edge or falling edge.</p> <p>Time difference T = waveform B (time at which level was crossed) - waveform A (time at which level was crossed)</p>	
Phase Contrast	<p>Calculates the time difference between waveform A and waveform B crossing the specified level at the rising edge or falling edge and calculates the phase contrast [°] based on waveform A.</p> $\text{Phase contrast} = \frac{\text{Time difference T between waveform A and waveform B}}{\text{Period of waveform A}} \times 360^\circ$	
High Level Low Level	Calculates the high (100%) and low (0%) level for the acquired waveform data using a histogram (frequency distribution).	

Waveform Calculation Function

Chapter 9

A pre-specified calculation equation is applied to acquired waveform data, and the calculation results are displayed as a waveform on the Waveform screen. Up to eight calculations can be performed at the same time.



Waveform Calculations

- Four Arithmetic Operators (+, -, *, /)
 - Absolute Value (ABS)
 - Exponent (EXP)
 - Common Logarithm (LOG)
 - Square Root (SQR)
 - Differential Calculus: 1st derivative (DIF), 2nd derivative (DIF2)
 - Integral Calculus: 1st integral (INT), 2nd integral (INT2)
 - Moving Average (MOV)
 - Trigonometric functions (SIN, COS, TAN)
 - Movement parallel to the time axis (SLI)
 - Inverse Trigonometric functions (ASIN, ACOS, ATAN)
 - FIR Filter (LPFFIR, HPFFIR, BPFFIR, BSFFIR)
 - IIR Filter (LPFIIR, HPFIIR, BSFIIR, BERIIR)
 - Average (PAVE)
 - Maximum (PMAx)
 - Minimum (PMin)
 - Level at time (PLEVEL)
 - Specified calculation between cursors
- Waveform calculations can be limited to data within the range specified by A/B and C/D cursors.
- Calculation operator details:
"9.8 Waveform Calculation Operators and Results" (p. 223)

- In addition to the four arithmetic operators, 16 types of functions can be used. It is possible to set up to 8 calculation formulas.
When Scaling is enabled, numerical calculations are performed on scaled values.
- Arithmetic calculation results for average (PAVE), maximum (PMAx), minimum (PMin), and level at time (PLEVEL) calculations can be used in calculation formulas.

9.1 Waveform Calculation Workflow

There are two calculation methods:

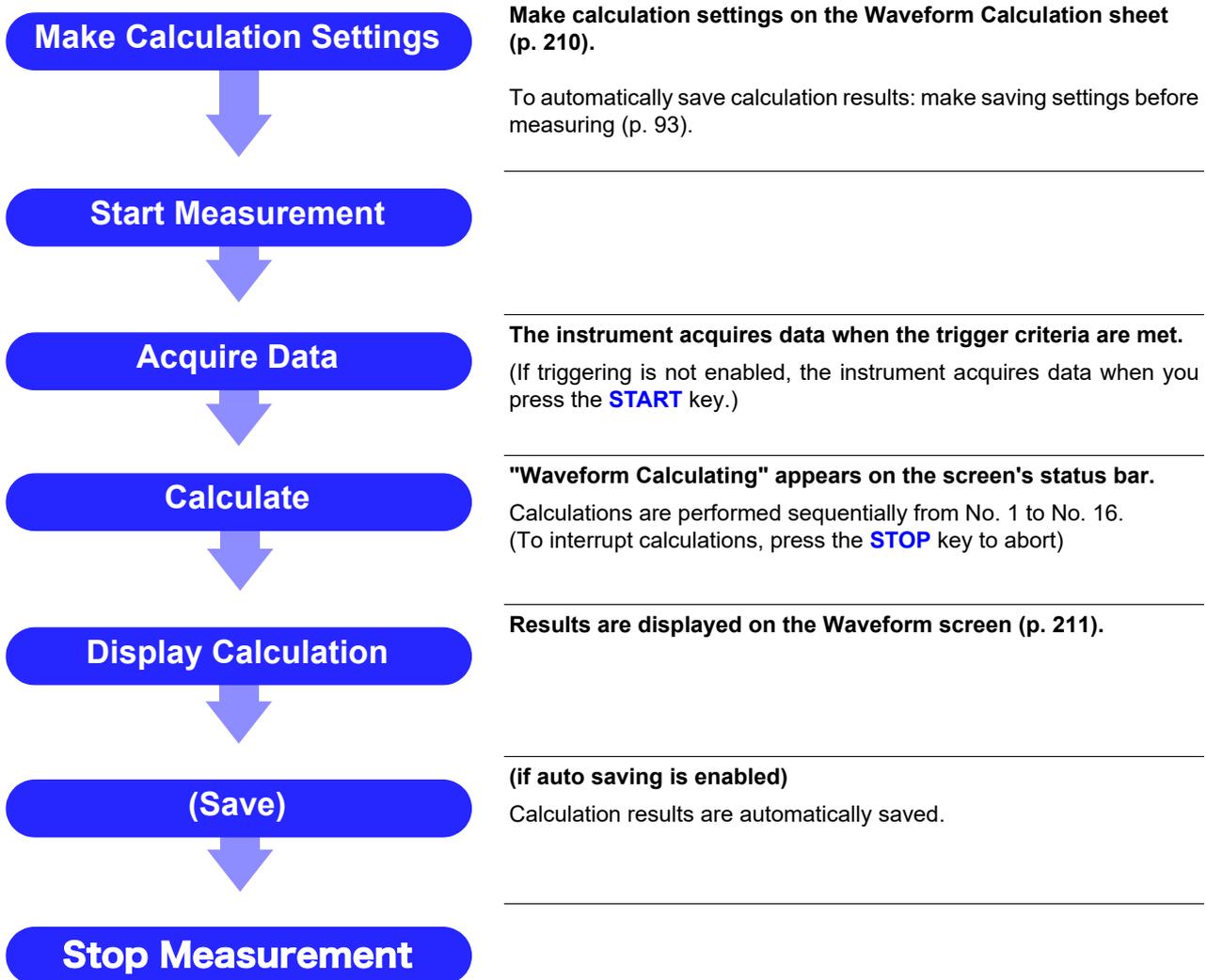
- **Calculating While Measuring**

The waveform calculation must be configured before measurement. (This functionality is not available when real-time saving is enabled.)

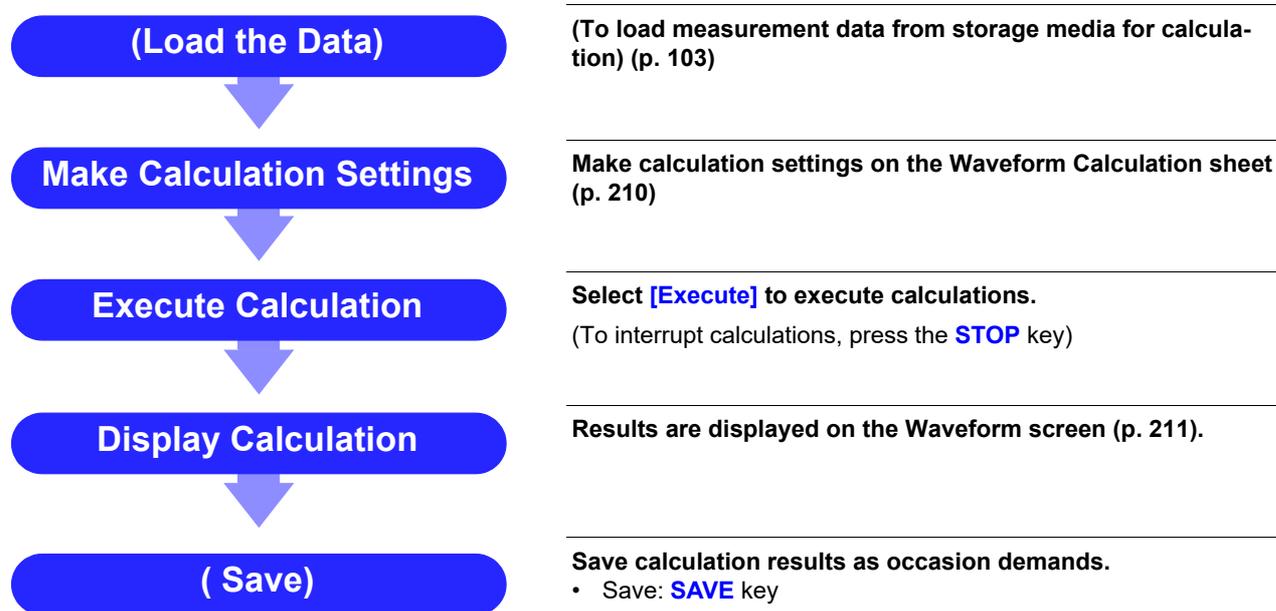
- **Applying Calculations to Existing Data**

Calculations can be performed using data after waveform acquisition or data stored on media.

Calculating While Measuring



Applying Calculations to Existing Data



NOTE

- The maximum recording length that can be used in calculations is 10,000 div. To perform calculations using waveforms measured over longer recording lengths, segment the data into files with recording lengths of 10,000 div or less and save them. Then load a file into the instrument and perform the desired calculation.
- The history function can be used to access up to 16 past measurement waveforms. However, performing a waveform calculation on a waveform from the history will cause all history data other than the waveform being accessed to be deleted.



When specifying a waveform range for calculation:

Before executing a calculation, specify the calculation range using the A/B, C/D cursors on the Waveform screen. Set the calculation range to **[A/B]** or **[C/D]**.

- E/F cursors cannot be used to specify the range.
- When one cursor is used, the calculation range is from the cursor to the end of the data. When performing a waveform calculation after measurement, waveforms measured with a recording length larger than 10,000 div cannot be used in calculations, even if they are selected with the cursor. To perform calculations using waveforms measured over longer recording lengths, segment the data into files with recording lengths of 10,000 div or less and save them. Then load a file into the instrument and perform the desired calculation.

See: "5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116)
"9.2 Settings for Waveform Value Calculation" (p. 210)



To change a previously executed calculation and re-execute it:

Make changes to calculation contents on the **[Waveform Calculation]** screen, and execute the calculation.

See: "9.2 Settings for Waveform Value Calculation" (p. 210)



To not display a calculation waveform, or to display only the desired waveform:

The displayed graph, sheet and calculation waveform to be displayed can be selected on the **[Waveform Calculation]** screen.

See: "9.5 Changing the display method for calculated waveforms" (p. 214)

9.2 Settings for Waveform Value Calculation

1 Open the screen.
 [Setting Display] ▶ [Calculation] ▶ [Waveform Calculation]

2 [Waveform Calculation] ▶ Set to [On].
 (Default setting: Off)

3 Select the calculation range.
 Select (*: Initial setting)

Whole*	Applies calculations to the whole waveform.
A/B	Applies calculations to the data between A/B cursors.
C/D	Applies calculations to the data between C/D cursors.

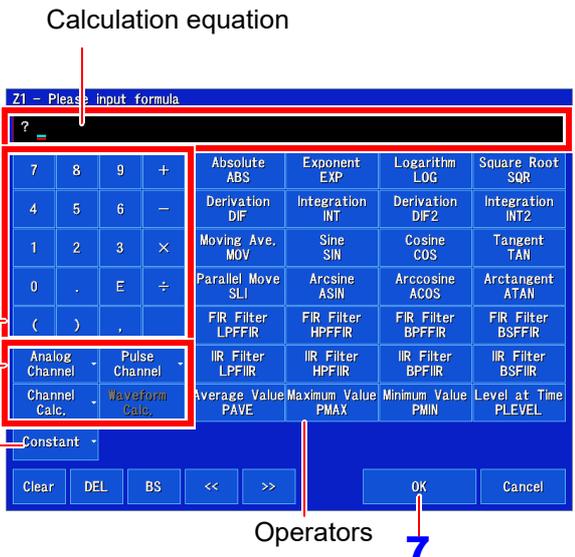
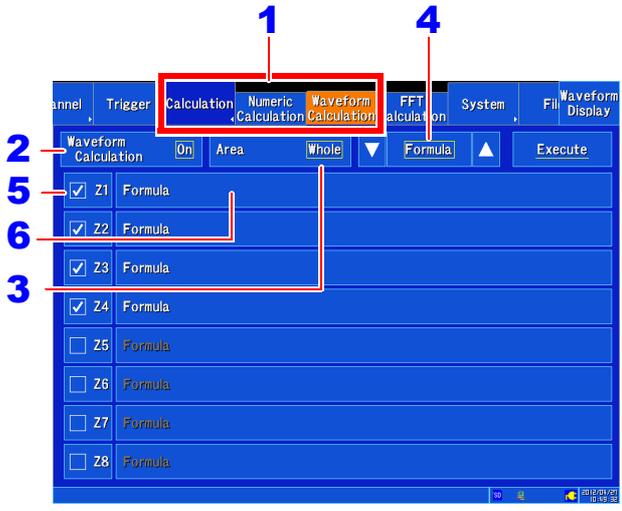
4 Set the setting type to [Formula].
 (Tap to switch or select from the list.)
 Select
Formula, Scale, Comment, Constant

5 Tap the checkbox for the number whose calculation you wish to perform to select it (☑).
 Enter numerical values and symbols
 Enter channels
 Enter constants
 (It is convenient to set constants beforehand (p. 213))

6 Perform calculation settings.
 Tap the formula for the calculation number you wish to configure. The formula configuration window will appear.
See: Calculation example: "9.6" (p. 215)

7 When finished entry, tap [OK].
 The entered equation is displayed
 The scale (maximum and minimum vales) of the calculation results has a default setting of [Auto]. If you want to scale the results, set the maximum and minimum values under [Manual].
See: "9.5 Changing the display method for calculated waveforms" (p. 214)

8 To automatically save calculations after measurement:
Configure saving of calculation results.
See: "Automatically Saving" (p. 93)



9 Perform the calculation.
 To perform the calculation automatically after measurement
Press the START key.

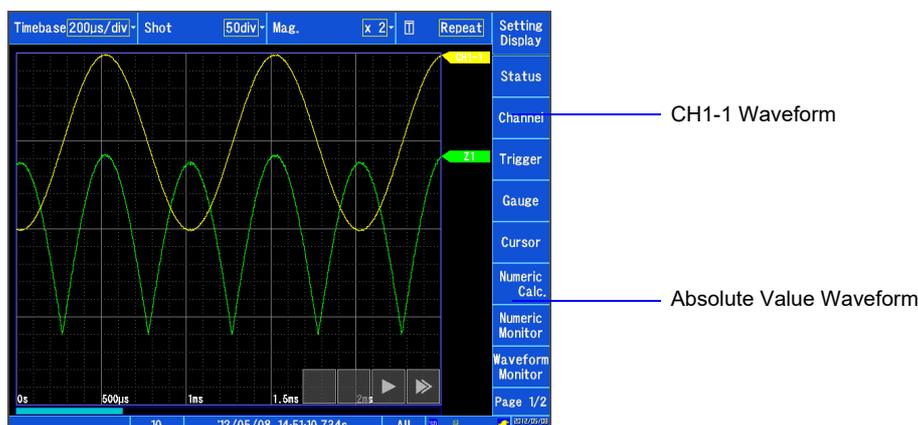
The calculation will be performed automatically after data is acquired following the start of measurement.

Applying Calculations to Existing Data
Tap [Execute].
 Calculation results can be saved with the **SAVE** key.
See: "Selecting and saving data (SAVE key)" (p. 98)

9.3 Displaying the waveform calculation results

Waveform calculation results are displayed on the Waveform screen

Example: Waveform of the calculated absolute value of the waveform of CH1-1.
Calculation equation = ABS(CH(1,1))



About calculation equations

Operators

Operator	Name	Operator	Name
ABS	Absolute Value	ACOS	Inverse Cosine
EXP	Exponent	ATAN	Inverse Tangent
LOG	Common Logarithm	LPFFIR	FIR Low Pass Filter
SQR	Square Root	HPFFIR	FIR High Pass Filter
DIF	1 st Derivative	BPFFIR	FIR Band Pass Filter
INT	1 st Integral	BSFFIR	FIR Band Pass Stop Filter
DIF2	2 nd Derivative	LPFIIR	IIR Low Pass Filter
INT2	2 nd Integral	HPFIIR	IIR High Pass Filter
MOV	Moving Average	BPFIIR	IIR Band Pass Filter
SIN	Sine	BSFIIR	IIR Band Pass Stop Filter
COS	Cosine	PAVE	Average
TAN	Tangent	PMAX	Maximum
SLI	Movement parallel to the time axis	PMIN	Minimum
ASIN	Inverse Sine	PLEVEL	Level at time

Entering Calculation Equations

- Each entered calculation equation may contain up to 80 characters.
- Each constant in a calculation equation may contain up to 30 digits.
- For multiplication, use [*]. For division, use [/].
- Entering a long, complex formula such as that shown below will cause "?" to be displayed. Separate the formula into two shorter formulas.

$$\text{ABS}(\text{CH}(1,1)) + \text{CH}(1,2) \times \text{CH}(1,3) - (\text{CH}(1,4) + \text{CH}(1,5)) \times \text{ABS}(\text{CH}(1,4)) / \text{DIF}(\text{CH}(1,1), 1)$$

1
2
3

- When dividing by 0, an overflow value is output.
(For positive values, +9.9999E+29. For negative values, -9.9999E+29.)
- Specify channel data by channel (unit number, channel number). (For example, enter "CH(1,2)" to specify data for unit 1 channel 2.)
- The result of calculation Zi can be used in other calculation equations. However, the Znth equation can only refer to the results of equations up to Zn-1.
(Example: Equation Z4 can include the results of equations Z1 through Z3.)

Using the MOV, SLI, DIF, DIF2 and PLEVEL operators in an equation

The number # after a comma within parenthesis (_,#) for each operation is set to the calculation operator.

Operator	Setting Choice	Setting Examples
MOV (Moving Average) SLI (Parallel Movement)	Set the number of points to move. Setting Range MOV (Moving Average): 1 to 5000 SLI: -5000 to 5000	Calculate the 10-point moving average of CH1-1: MOV(CH(1,1),10)
DIF (Derivative) DIF2 (2 nd Derivative)	Specify the sampling interval for differentiation. "1" is normally acceptable, but this should be set larger to capture fluctuation values of slowly changing waveforms. DIF and DIF2 Setting Range: 1 to 5000	Differentiate CH1-2 using a 20-point sampling interval: DIF(CH(1,2),20)
PLEVEL (Level at time)	Sets the time from the trigger (i.e., the specified time) in seconds.	Calculate the level for the position 1 ms after the CH1-3 trigger: PLEVEL(CH(1,3),0.001)

When calculation results overflow (OVER)

- The value that indicated by the A/B cursor or C/D cursor is not a correct value.
- When **[Scale]** of the calculation results is set to **[Auto]**, waveforms appear at the top or bottom edge of the screen. This makes calculation result overflow obvious.

9.4 Setting constants

- 1 Open the screen.
 [Setting Display] ▶ [Calculation] ▶
 [Waveform Calculation]
- 2 [Waveform Calculation] ▶ Set to [ON].
 (Default setting: Off)
- 3 Set the setting type to [Constant]. (Tap to switch or select from the list.)
 Select
 Formula, Scale, Comment, Constant
- 4 Tap the letter of the constant you wish to set.
 The value entry window will appear.
- 5 Enter the constant.

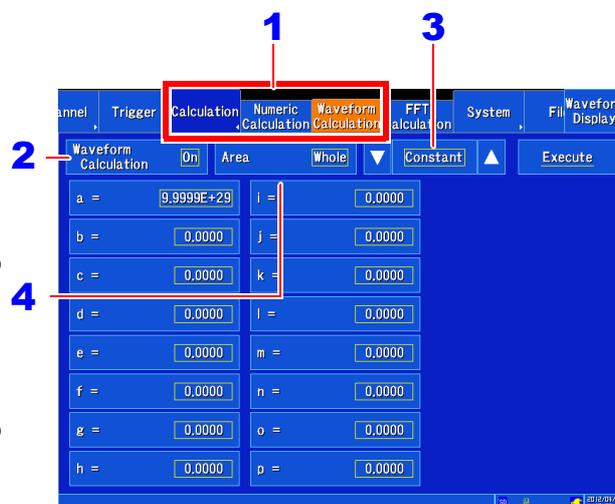
Valid setting range

-9.9999E+29 to -1.0000E-29, 0,
 +1.0000E-29 to +9.9999E+29

Up to five significant digits can be set.

See: "Entering values" (p. 145)

Defined constants are shown in the constant display of the calculation equation setting window.



9.5 Changing the display method for calculated waveforms

1 Open the screen.

[Setting Display] ► [Calculation] ► [Waveform Calculation]

2 Set the setting type to [Scale].
(Tap to switch or select from the list.)

Select

Formula	Scale	Comment	Constant
---------	-------	---------	----------

3 Enable waveform display, and display color

Select the waveform display color for the channel. You can select the same color as is used for other channels. To hide the waveform, select ×.

4 To set the screen division to 2 divisions or more:

[Sheet]/[Graph] ► Select from the list.

Select the sheet and graph to display.
 Sheet selection

S1	S2	S3	S4
----	----	----	----

See: "Configuring the screen layout" (p. 62)
 "Switching between sheets" (p. 130)

Graph selection

Gr1	Gr2	Gr3	Gr4
-----	-----	-----	-----

Depending on the screen division setting, graph allocation may differ.

See: "Graph allocation" (p. 65)

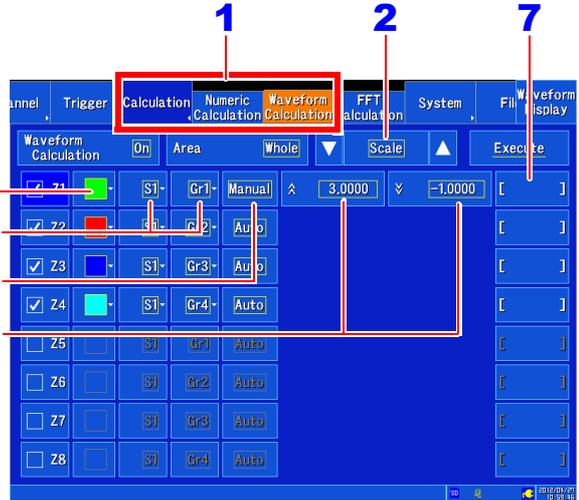
5 Select a method to set scaling

Tap the scale field for the calculation number you wish to configure.

Tapping the field toggles the setting.

Select (*: Initial setting)

Auto*	Automatically sets the display range of the vertical axis. (After calculation, the upper and lower limits are obtained from the results, and set automatically.)
Manual	Upper and lower limits of the vertical axis display range are entered manually.



6 Set the upper and lower limits of the display range
(when [Manual] is selected)

Tapping ▲ or ▼ displays the value entry window.
 Valid setting range

-9.9999E+29 to -1.0000E-29, 0, +1.0000E-29 to +9.9999E+29
--

Up to five significant digits can be set.

See: "Entering values" (p. 145)

7 [] ► Enter characters.

Enter the unit to which you wish to convert the value (up to 7 single-byte or 3 double-byte characters). The same text entry method is used as for comment entry (p. 142).

Saving data as text or arithmetic calculation results may cause the text to be converted to other characters. (p. 143)

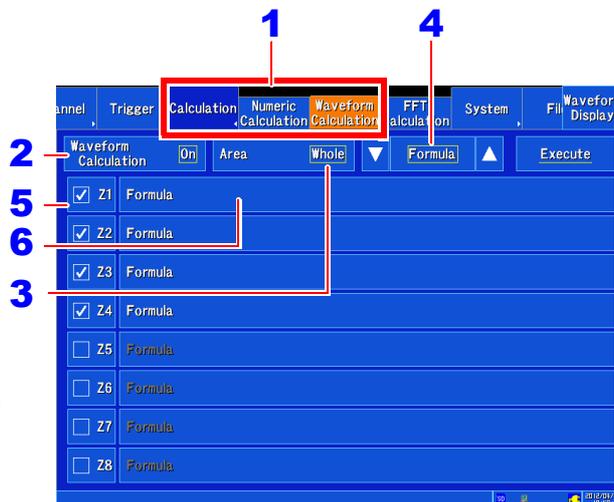
NOTE

Depending on calculation results, automatic scaling settings may be unsatisfactory, in which case the limits must be entered manually.

9.6 Waveform Calculation Example: Calculate the RMS waveform from the instantaneous waveform

The RMS values of the waveform input on Analog channel (CH1-1) are calculated and displayed. This example describes the calculation of waveform data measured for one cycle over two divisions.

- 1** Open the screen.
[Setting Display] ▶ [Calculation] ▶ [Waveform Calculation]
- 2** [Waveform Calculation] ▶ Set to [ON].
(Default setting: Off)
- 3** Set [Area] to [Whole].
- 4** Set the setting type to [Formula]. (Tap to switch or select from the list.)
- 5** Tap the checkbox for the number whose calculation you wish to perform to select it (☑).



- 6** Perform calculation settings.
Tap the calculation formula for No. Z1.
The formula configuration window will appear.

- 7** Entering the calculation equation
 $SQR(MOV(CH(1,1)*CH(1,1),200))$

The number of samples per cycle (1 division = 100 samples) Here, one cycle is two divisions (200 samples)



- 8** When finished entry, tap [OK].
The formula configuration window will close, and the set calculation formula will be displayed for No. Z1 on the [Waveform Calculation] screen.

- 9** Perform the calculation.
Press the **START** key to start measurement.
The calculation waveform is displayed after acquiring the input waveform.



To view calculated waveforms of loaded data, move to the [Waveform Calculation] screen and select [Execute].

Calculation waveform of RMS values

CH1-1 Waveform



9.7 Example Waveform Calculation: Configuring a Digital Filter

Configuring an FIR digital filter

LPFFIR and HPFFIR filters are configured by setting the channel number, cutoff frequency, filter order, and Kaiser window coefficient in the formula, as shown below.

LPFFIR: LPFFIR(CH(1,1),100000,127,10)

HPFFIR: HPFFIR(CH(1,1),200000,127,10)

BPFFIR and BSFFIR filters are configured by setting the low side cutoff frequency, high side cutoff frequency, filter order, and Kaiser window coefficient in the formula, as shown below.

BPFFIR: BPFFIR(CH(1,1),100000,200000,127,10)

BSFFIR: BSFFIR(CH(1,1),100000,200000,127,10)

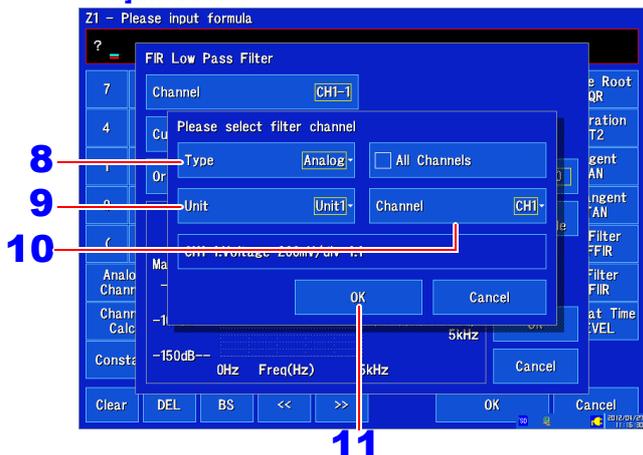
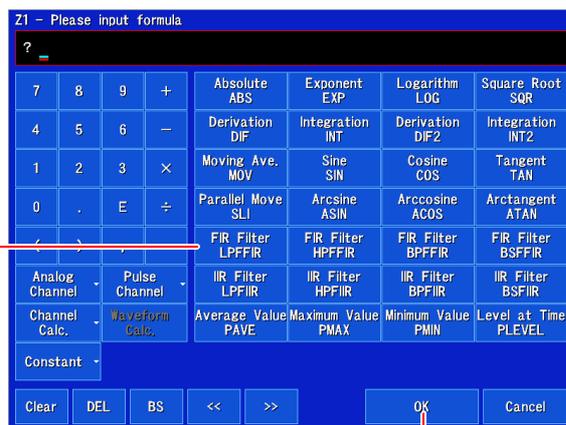
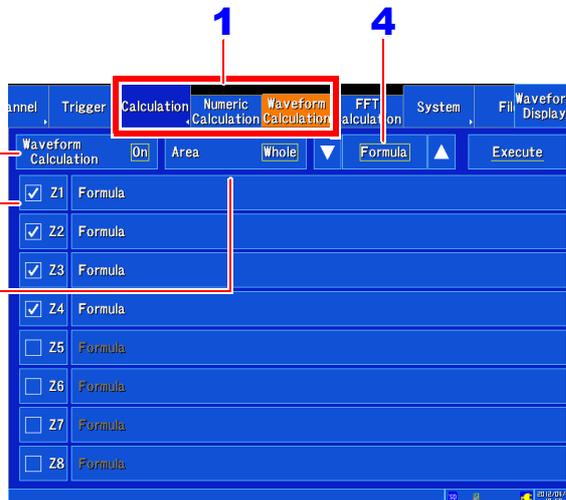
NOTE

- For the upper limits for the cutoff frequency, see Table A (p. 222). (Valid values are 1/2 of the sampling frequency, which is determined by the time axis setting).
- Set the BPFFIR and BSFFIR cutoff frequencies so that the low side value is less than the high side value.
- Set the FIR digital filter order within the range of 2 to 400. Higher orders provide steep cutoff characteristics but increase the calculation time.
- Set the FIR digital filter Kaiser window coefficient within the range of 0.0 to 20.0. Setting a value of 0.0 is the same as applying no Kaiser window. Larger Kaiser window coefficient values reduce passband ripple by means of the filter's amplification characteristics but increase attenuation outside the passband.

Example FIR digital filter settings (FIR-type LPF)

This section describes a FIR-type LPF filter using the Z1 calculation targeting channel 1-1 data with a cutoff frequency of 100 kHz (100,000 Hz), an order of 127, and a Kaiser window coefficient of 10. (It presumes a sampling frequency of 500 kHz [time axis of 200 μs/div = sampling speed of 2 μs/S].)

- 1** Open the screen.
[Setting Display] ► [Calculation] ► [Waveform Calculation]
- 2** [Waveform Calculation] ► Set to [ON].
(Default setting: Off)
- 3** Set [Area] to [Whole].
- 4** Set the setting type to [Formula]. (Tap to switch or select from the list.)
- 5** Set the calculation formula.
Tap the calculation formula for No. Z1.
The formula configuration window will appear.
- 6** Tap the [LPFFIR] calculation item.
The [FIR Low Pass Filter] window will appear.
- 7** Tap [Channel].
The channel configuration window will appear.
- 8** [Type] ► Select from the list.
Select (*: Initial setting)
Analog*, Pulse, Waveform Calc, Ch Calc
- 9** [Unit] ► Select from the list.
Select (*: Initial setting)
Unit1* to Unit4
- 10** [Channel] ► Select from the list.
Select (*: Initial setting)
CH1* to CH15
(The maximum number of channels varies with the unit.)
- 11** Tap [OK].
You will return to the [FIR Low Pass Filter Configuration] window.



(Continues on next page.)

9.7 Example Waveform Calculation: Configuring a Digital Filter

12 Tap [Cutoff Frequency].

The cutoff frequency configuration window will appear.

13 Tap the numeric keypad and set the desired value and unit.

14 Tap [OK].

You will return to the [FIR Low Pass Filter] window.

15 [Order] ► Change the value.

16 Tap [Kaiser Coefficient].

The Kaiser coefficient configuration window will appear.

17 Tap the numeric keypad and set the desired value.

18 Tap [OK].

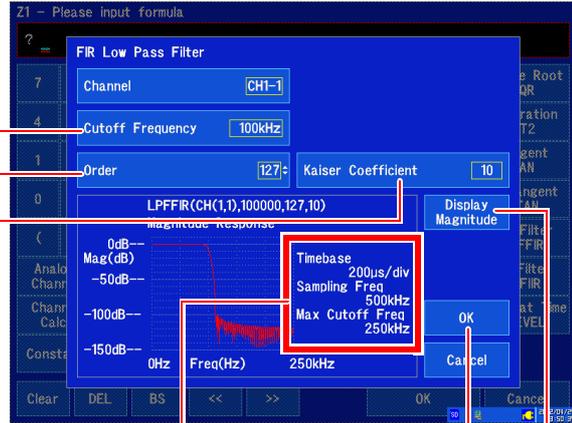
You will return to the [FIR Low Pass Filter] window.

19 Tap [OK].

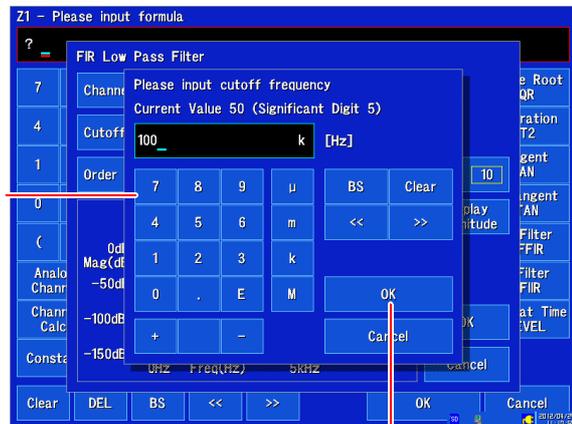
The set calculation formula will appear in the formula configuration window.

20 Tap [OK].

The formula configuration window will close, and the set calculation formula will be displayed for No. Z1 on the [Waveform Calculation] screen.



Calculated based on the time axis value set on the Measurement Settings and Waveform screens. An amplitude response can be displayed.



NOTE

Figures shown in the amplitude response diagram are calculated based on the time axis as configured on the Waveform and Measurement Settings screens. Even when the amplitude response diagram is displayed after changing the time axis following data measurement, the (changed) time axis set on the Waveform and Measurement screens is used to calculate the diagram.

Configuring an IIR digital filter

LPFIIR and HPFIIR filters are configured by setting the channel number, cutoff frequency, and filter order in the formula, as shown below.

LPFIIR: LPFIIR(CH(1,1),100000,2)

HPFIIR: HPFIIR(CH(1,1),200000,2)

BPFIIR and BSFIIR filters are configured by setting the channel number, low side cutoff frequency, high side cutoff frequency, and filter order in the formula, as shown below.

BPFIIR: BPFIIR(CH(1,1),100000,200000,2)

BSFIIR: BSFIIR(CH(1,1),100000,200000,2)

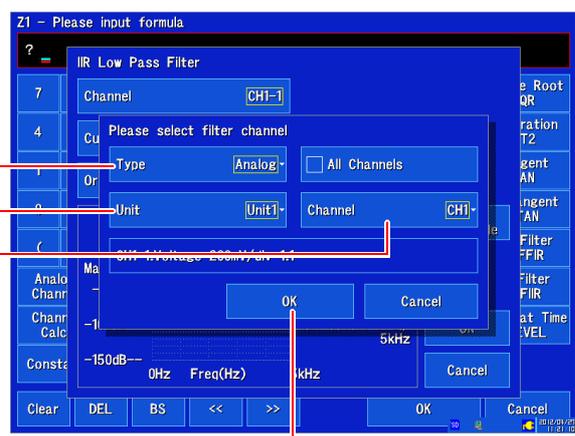
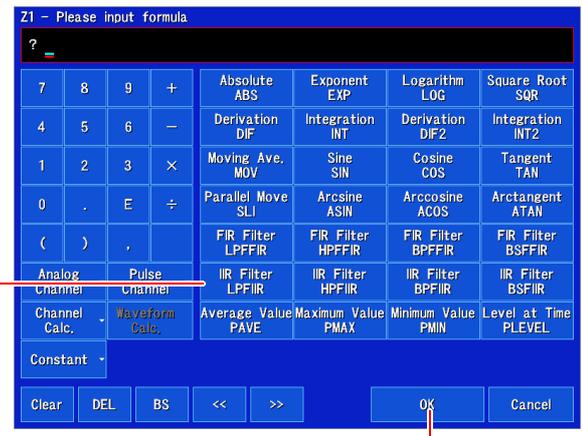
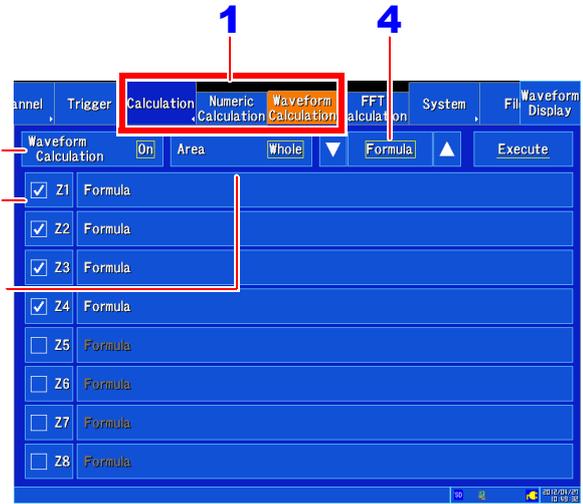
NOTE

- For the upper limits for the cutoff frequency, see Table A (p. 222). (Valid values are 1/2 of the sampling frequency, which is determined by the time axis setting).
- Set the BPFIIR and BSFIIR cutoff frequencies so that the low side value is less than the high side value.
- Set the IIR digital filter order within the range of 1 to 64. Higher orders provide steep cutoff characteristics.

Example IIR digital filter settings (IIR-type LPF)

This section describes an IIR-type LPF filter using the Z1 calculation targeting channel 1-1 with a cutoff frequency of 100 kHz (100,000 Hz) and an order of 2. (It presumes a sampling frequency of 500 kHz [time axis of 200 μs/div = sampling speed of 2 μs/S].)

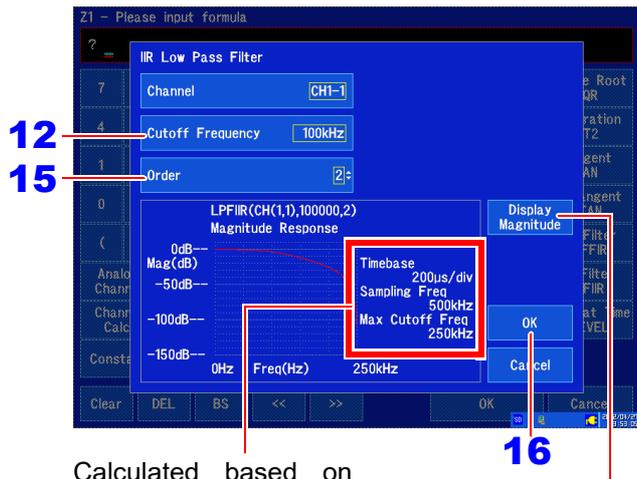
- 1 Open the screen.
[Setting Display] ► [Calculation] ► [Waveform Calculation]
- 2 [Waveform Calculation] ► Set to [ON].
(Default setting: Off)
- 3 Set [Area] to [Whole].
- 4 Set the setting type to [Formula]. (Tap to switch or select from the list.)
- 5 Set the calculation formula.
- 6 Tap the [LPFIIR] calculation item.
The [IIR Low Pass Filter] window will appear.
- 7 Tap [Channel].
- 8 [Type] ► Select from the list.
Select (*: Initial setting)
Analog*, Pulse, Waveform Calc, Ch Calc
- 9 [Unit] ► Select from the list.
Select (*: Initial setting)
Unit1* to Unit4
- 10 [Channel] ► Select from the list.
Select (*: Initial setting)
CH1* to CH15
(The maximum number of channels varies with the unit.)
- 11 Tap [OK].
You will return to the [IIR Low Pass Filter] window.



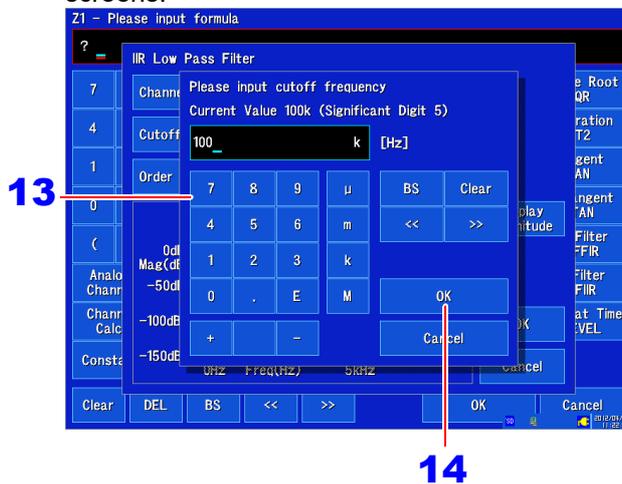
11

9.7 Example Waveform Calculation: Configuring a Digital Filter

- 12** Tap [Cutoff Frequency].
The cutoff frequency window will appear.
- 13** Tap the numeric keypad and set the desired value and unit.
- 14** Tap [OK].
You will return to the [IIR Low Pass Filter] window.
- 15** [Order] ► Change the value.
- 16** Tap [OK].
The set calculation formula will appear in the formula configuration window.
- 17** Tap [OK].
The formula configuration window will close, and the set calculation formula will be displayed for No. Z1 on the [Waveform Calculation] screen.



Calculated based on the time axis value set on the Measurement Settings and Waveform screens. An amplitude response can be displayed.



NOTE

Figures shown in the amplitude response diagram are calculated based on the time axis as configured on the Waveform and Measurement Settings screens. Even when the amplitude response diagram is displayed after changing the time axis following data measurement, the (changed) time axis set on the Waveform and Measurement screens is used to calculate the diagram.

9.7 Example Waveform Calculation: Configuring a Digital Filter

Table A: The Relationship between Time Axis Range, Sampling Period, Sampling Frequency, Cutoff Frequency, and Filter Frequency Resolution

Time axis range	Sampling period	Sampling frequency	Sampling frequency Upper limit for the cutoff frequency (Hz) (This is the maximum value that can be set.)	Filter frequency resolution
200 μ s/div	2 μ s/S	500000 Hz (500 kHz)	250000	500 Hz
500 μ s/div	5 μ s/S	200000 Hz (200 kHz)	100000	200 Hz
1 ms/div	10 μ s/S	100000 Hz (100 kHz)	50000	100 Hz
2 ms/div	20 μ s/S	50000 Hz (50 kHz)	25000	50 Hz
5 ms/div	50 μ s/S	20000 Hz (20 kHz)	10000	20 Hz
10 ms/div	100 μ s/S	10000 Hz (10 kHz)	5000	10 Hz
20 ms/div	200 μ s/S	5000 Hz (5 kHz)	2500	5 Hz
50 ms/div	500 μ s/S	2000 Hz (2 kHz)	1000	2 Hz
100 ms/div	1 ms/S	1000 Hz (1 kHz)	500	1 Hz
200 ms/div	2 ms/S	500 Hz (500 Hz)	250	500 mHz
500 ms/div	5 ms/S	200 Hz (200 Hz)	100	200 mHz
1 s/div	10 ms/S	100 Hz (100 Hz)	50	100 mHz
2 s/div	20 ms/S	50 Hz (50 Hz)	25	50 mHz
5 s/div	50 ms/S	20 Hz (20 Hz)	10	20 mHz
10 s/div	100 ms/S	10 Hz (10 Hz)	5	10 mHz
30 s/div	300 ms/S	3.33 Hz (3.33 Hz)	1.66	3.33 mHz
50 s/div	500 ms/S	2 Hz (2 Hz)	1	2 mHz
60 s/div	600 ms/S	1.66 Hz (1.66 Hz)	0.833	1.66 mHz
100 s/div	1 s/S	1 Hz (1 Hz)	0.5	1 mHz
2 min/div	1.2 s/S	833 mHz (0.833 Hz)	0.416	833 μ Hz
5 min/div	3 s/S	333 mHz (0.333 Hz)	0.166	166 μ Hz

NOTE

- When starting from here to perform measurement and waveform calculation, the upper limit for the cutoff frequency setting is determined by the time axis setting on the Measurement Settings and Waveform screens.
- When touching **[Execute]** on the Waveform Calculation screen to perform waveform calculation using previously measured data, the upper limit for the cutoff frequency setting is determined by the time axis of the measured waveform.
- When the sampling clock is set to **[External]**, 1 sample is calculated as 1 Hz.

9.8 Waveform Calculation Operators and Results

b_i : i th member of calculation result data, d_i : i th member of source channel data

Waveform Calculation Type	Description
Four Arithmetic Operators (+, -, *, /)	Executes the corresponding arithmetic operation.
Absolute Value (ABS)	$b_i = d_i $ ($i = 1, 2, \dots, n$)
Exponent (EXP)	$b_i = \exp(d_i)$ ($i = 1, 2, \dots, n$)
Common Logarithm (LOG)	<p>When $d_i > 0$, $b_i = \log_{10} d_i$ When $d_i = 0$, $b_i = -\infty$ (overflow value output) When $d_i < 0$, $b_i = \log_{10} d_i$ ($i = 1, 2, \dots, n$) Note: Use the following equation to convert to natural logarithm calculations. $\ln X = \log_e X = \log_{10} X / \log_{10} e$ $1 / \log_{10} e \approx 2.30$</p>
Square Root (SQR)	<p>When $d_i \geq 0$, $b_i = \sqrt{d_i}$ When $d_i < 0$, $b_i = -\sqrt{ d_i }$ ($i = 1, 2, \dots, n$)</p>
Moving Average (MOV)	<p>When k is odd number: $b_i = \frac{1}{k} \sum_{t=i-\frac{k}{2}}^{i+\frac{k}{2}} dt$ ($i = 1, 2, \dots, n$)</p> <p>When k is even number: $b_i = \frac{1}{k} \sum_{t=i-\frac{k}{2}+1}^{i+\frac{k}{2}} dt$ ($i = 1, 2, \dots, n$)</p> <p>dt: t^{th} member of source channel data k: number of points to move (1 to 5000) 1 div = 100 points.</p> <p>k is specified after a comma. (Ex.) To make Z1 the moving average of 100 points: MOV(Z1,100)</p>
Slides waveform data along the time axis (SLI)	<p>Moves along the time axis by the specified distance. $b_i = d_i - k$ ($i = 1, 2, \dots, n$) k: number of points to move (-5000 to 5000)</p> <p>k is specified after a comma. (Ex.) To slide Z1 by 100 points along the time axis: SLI(Z1,100) Note: When sliding a waveform, if there is no data at the beginning or end of the calculation result, the voltage value becomes zero. 1 div = 100 points.</p>
Sine (SIN)	<p>$b_i = \sin(d_i)$ ($i = 1, 2, \dots, n$) Trigonometric functions employ radian (rad) units.</p>
Cosine (COS)	<p>$b_i = \cos(d_i)$ ($i = 1, 2, \dots, n$) Trigonometric functions employ radian (rad) units.</p>
Tangent (TAN)	<p>$b_i = \tan(d_i)$ ($i = 1, 2, \dots, n$) Trigonometric functions employ radian (rad) units.</p>
Arcsine (ASIN)	<p>When $d_i > 1$, $b_i = \pi / 2$ When $-1 \leq d_i \leq 1$, $b_i = \text{asin}(d_i)$ When $d_i < -1$, $b_i = -\pi / 2$ Trigonometric functions employ radian (rad) units.</p>

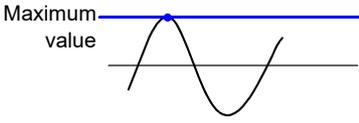
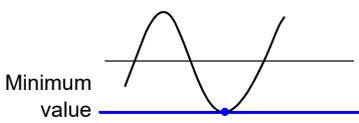
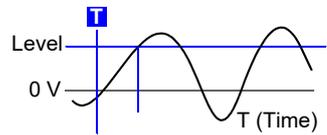
9.8 Waveform Calculation Operators and Results

b_i : i th member of calculation result data, d_i : i th member of source channel data

Waveform Calculation Type	Description
Arccosine (ACOS)	When $d_i > 1$, $b_i = 0$ When $-1 \leq d_i \leq 1$, $b_i = \text{acos}(d_i)$ When $d_i < -1$, $b_i = \pi$ ($i = 1, 2, \dots, n$) Trigonometric functions employ radian (rad) units.
Arctangent (ATAN)	$b_i = \text{atan}(d_i)$ ($i = 1, 2, \dots, n$) Trigonometric functions employ radian (rad) units.
First derivative (DIF) Second derivative (DIF2)	The first and second derivative calculations use a fifth-order Lagrange interpolation polynomial to obtain a point data value from five sequential points. d_1 to d_n are the derivatives calculated for sample times t_1 to t_n . Note: Scattering of calculation results increases as input voltage level decreases. If scattering is excessive, apply the moving average (MOV). Calculation formulas for the first derivative Point t_1 $b_1 = (-25d_1 + 48d_2 - 36d_3 + 16d_4 - 3d_5)/12h$ Point t_2 $b_2 = (-3d_1 - 10d_2 + 18d_3 - 6d_4 + d_5)/12h$ Point t_3 $b_3 = (d_1 - 8d_2 + 8d_4 - d_5)/12h$ ↓ Point t_i $b_i = (d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2})/12h$ ↓ Point t_{n-2} $b_{n-2} = (d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n)/12h$ Point t_{n-1} $b_{n-1} = (-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n)/12h$ Point t_n $b_n = (3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n)/12h$ b_1 to b_n : calculation results $h = \Delta t$: Sampling Period Calculation formulas for the second derivative Point t_1 $b_1 = (35d_1 - 104d_2 + 114d_3 - 56d_4 + 11d_5)/12h^2$ Point t_2 $b_2 = (11d_1 - 20d_2 + 6d_3 + 4d_4 - d_5)/12h^2$ Point t_3 $b_3 = (-d_1 + 16d_2 - 30d_3 + 16d_4 - d_5)/12h^2$ ↓ Point t_i $b_i = (-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - d_{i+2})/12h^2$ ↓ Point t_{n-2} $b_{n-2} = (-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n)/12h^2$ Point t_{n-1} $b_{n-1} = (-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n)/12h^2$ Point t_n $b_n = (11d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n)/12h^2$
First integral (INT) Second integral (INT2)	First and second integrals are calculated using the trapezoidal rule. d_1 to d_n are the integrals calculated for sample times t_1 to t_n . Calculation formulas for the first integral Point t_1 $I_1 = 0$ Point t_2 $I_2 = (d_1 + d_2)h/2$ Point t_3 $I_3 = (d_1 + d_2)h/2 + (d_2 + d_3)h/2 = I_2 + (d_2 + d_3)h/2$ ↓ Point t_n $I_n = I_{n-1} + (d_{n-1} + d_n)h/2$ I_1 to I_n : calculation results $h = \Delta t$: Sampling Period Calculation formulas for the second integral Point t_1 $II_1 = 0$ Point t_2 $II_2 = (I_1 + I_2)h/2$ Point t_3 $II_3 = (I_1 + I_2)h/2 + (I_2 + I_3)h/2 = II_2 + (I_2 + I_3)h/2$ ↓ Point t_n $II_n = II_{n-1} + (I_{n-1} + I_n)h/2$ II_1 to II_n : calculation results

9.8 Waveform Calculation Operators and Results

b_i : i th member of calculation result data, d_i : i th member of source channel data

Waveform Calculation Type	Description
Average (PAVE)	<p>The average value for the waveform data is calculated, and the result of that numerical calculation is used in waveform calculations.</p> $AVE = \frac{1}{n} \sum_{i=1}^n d_i$ <p> AVE : Average value n : Data count d_i : Data on channel number i </p>
Maximum value (PMAX)	<p>The maximum value for the waveform data is calculated, and the result of that numerical calculation is used in waveform calculations.</p> 
Minimum value (PMIN)	<p>The minimum value for the waveform data is calculated, and the result of that numerical calculation is used in waveform calculations.</p> 
Level at Time (PLEVEL)	<p>A time from the trigger is specified, the measured value during that time is calculated, and the result of that numerical calculation is used in waveform calculations.</p> 

9.9 Digital Filters

Role of digital filters

Digital filters can be used to eliminate high-frequency noise from measurement data.

Filter Name	Description
LPFFIR (Low Pass Filter Finite impulse response) LPFIIR (Low Pass Filter Infinite impulse response)	The low-frequency component is passed through the filter while high-frequency noise is rejected.
HPFFIR (High Pass Filter Finite impulse response) HPFIIR (High Pass Filter Infinite impulse response)	The high-frequency component is passed through the filter while low-frequency noise is rejected.
BPFFIR (Band Pass Filter Finite impulse response) BPFIR (Band Pass Filter Infinite impulse response)	The intermediate-frequency component is passed through the filter while low- and high-frequency noise is rejected.
BSFFIR (Band Stop Filter Finite impulse response) BSFIIR (Band Stop Filter Infinite impulse response)	The low- and high-frequency components are passed through the filter while intermediate-frequency noise is rejected.

FIR Digital Filter (LPFFIR, HPFFIR, BPFFIR, BSFFIR)

These filters are finite impulse response digital filters. FIR digital filters have the following characteristics:

Strengths : These filters exhibit linear phase characteristics with directly proportional phase shift dependent on frequency, reducing phase distortion (phase lag). Since only pre-calculation input signals are used in filter calculations, post-calculation output signals exhibit stability without dispersion.

Weaknesses : Higher orders can be used to acquire steep cutoff characteristics, but they also increase calculation times.

IIR Digital Filter (LPFIIR, HPFIIR, BPFIR, BSFIIR)

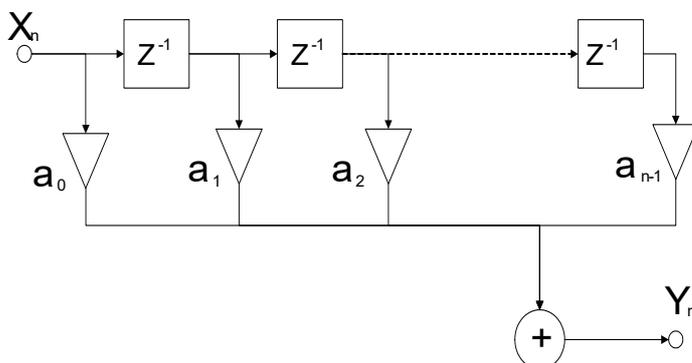
These filters are infinite impulse response digital filters. The HiTester's IIR digital filters are calculated using a Butterworth algorithm with flat passband characteristics. IIR digital filters have the following characteristics:

Strengths : Steep cutoff characteristics can be achieved with even low orders, reducing calculation times.

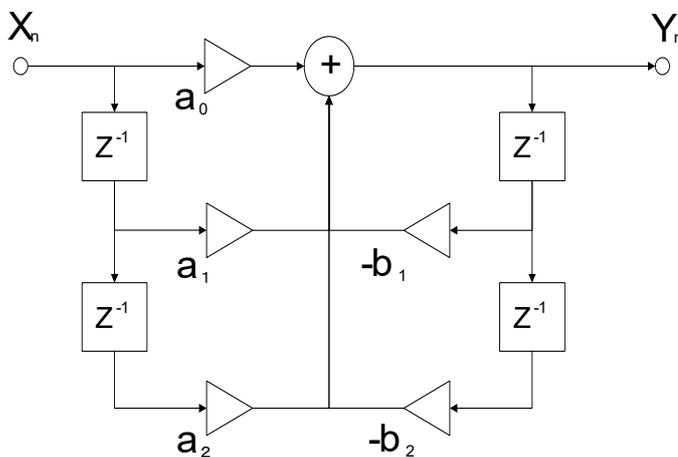
Weaknesses : Since these filters do not exhibit linear phase characteristics with directly proportional phase shift dependent on frequency, they result in increased phase distortion (phase lag). Since both pre-calculation input signals and post-calculation output signals are used in filter calculations, post-calculation output signals may exhibit instability and dispersion.

Digital filter architecture

FIR digital filter architecture (nth-order FIR digital filter)

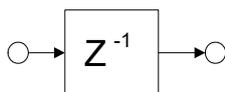


IIR digital filter architecture (2nd-order IIR digital filter)



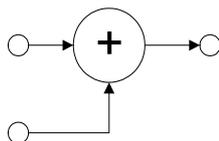
Delay circuit

Element that delays the input signal by 1 sample



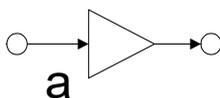
Adder circuit

Element that outputs the sum of two input signals



Multiplier circuit

Element that multiplies the input signal by the constant a and outputs the result.



FFT Calculation Function

Chapter 10

10.1 Overview and Features

The FFT (Fast-Fourier Transform) functions provide frequency analysis of input signal data. Use these functions for frequency analysis of rotating objects, vibrations, sounds and etc. For details, refer to "Appendix 5 FFT Definitions" (p. A21).

Calculations can be performed while measurement is in progress, or using existing analog waveforms and waveform calculation data stored in the instrument's internal memory.

Major Features

- FFT analysis frequency range: 133 mHz to 200 kHz
- FFT Analysis Modes (7 types)
 - Linear Spectrum
 - RMS Spectrum
 - Power Spectrum
 - Transfer Function
 - Cross-power Spectrum
 - Coherence Function
 - Phase Spectrum

For phase spectra, only the required phase information is highlighted and displayed.

See: "10.6 Scaling Using Overall Values" (p. 245)

NOTE

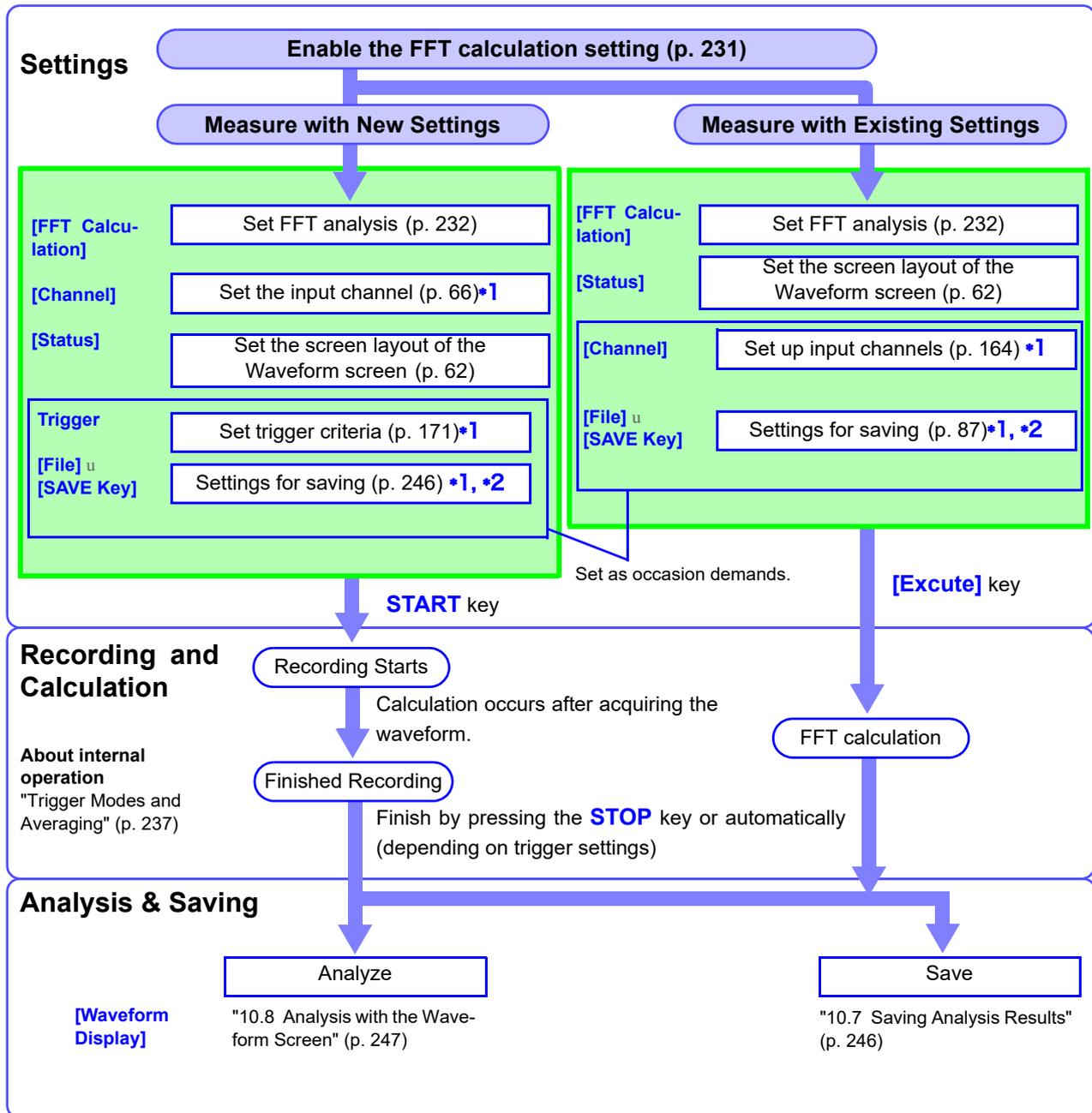
To suppress the effects of aliasing distortion

It is recommended to attach an anti-aliasing filter before the input amp.

See: [Aliasing Distortion and Anti-Aliasing Filters](#)
"Appendix 5 FFT Definitions" (p. 21)

Refer to the "Chapter 14 Specifications" (p. 331) for FFT calculation specifications.

10.2 Operation Workflow



*1: Setting is the same as normal measurement.

*2: Even after analysis, save settings can be set manually.

10.3 Enabling the FFT Calculation Setting

This section describes how to enable the FFT calculation setting. Analysis can be performed using newly measured data or existing data.

1 Open the screen.

[Setting Display] ► [Calculation] ► [FFT Calculation]

2 [FFT Calculation] ► Select [ON].

((Initial setting): OFF)

3 [Mode] ► Tap to switch.

Select (Initial setting)

Single* Performs 1 calculation for each calculation point starting at the calculation start position and displays the result.

Repeat Performs the number of calculations given by the number of calculation points repeatedly from the calculation start position to the end of the waveform data and displays the last analysis results.

4 When analyzing newly measured data

When measurement is started by pressing the **START** key, data for the number of calculation points set with [Point] (p. 232) is acquired, and FFT calculation is performed.

When analyzing existing data

Tapping the [Execute] button calculates the number of data points given by the number of calculation points set with [Point] (p. 232) from data displayed on the Waveform screen (data in internal memory that was just measured, or data captured from an SD memory card).

Select the frame for which you wish to perform the calculation. The larger the frame count, the further in the past the waveform is.

Calculations can also be performed by specifying a calculation start position.

See: "Analyzing after Specifying an Analysis Starting Point" (p. 247)

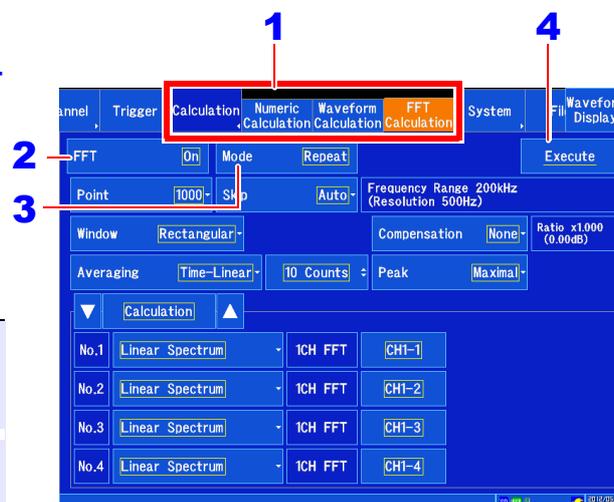
The frequency range is set automatically.

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (p. 233)

NOTE

When analyzing existing data

- Calculations are performed repeatedly for previously acquired waveform data up to the end of the data while skipping ahead the specified number of FFT calculation points. (No calculation is performed if there are not enough FFT calculation points.)
- The frequency is set automatically. The setting cannot be changed.



Frame selection (the larger the value, the older the waveform)

10.4 Setting FFT Analysis Conditions

This section describes how to set basic settings for the analysis conditions.

Setting the number of analysis

About the number of analysis points and frequency range

- The settings for the number of analysis points determine the frequency resolution.
- The frequency range is set automatically in conjunction with the time-axis range.
- See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (p. 233)
- The set number of analysis points specifies the amount of data to be analyzed with each measurement. Increasing the number of analysis points increases the frequency resolution, but also increases the time required for calculations.
- The skip count sets how far to skip ahead when each calculation starts when repeating FFT calculations within a single recording length. This setting is valid only in repeat calculation mode.
- See: "Trigger Modes and Averaging" (p. 237)

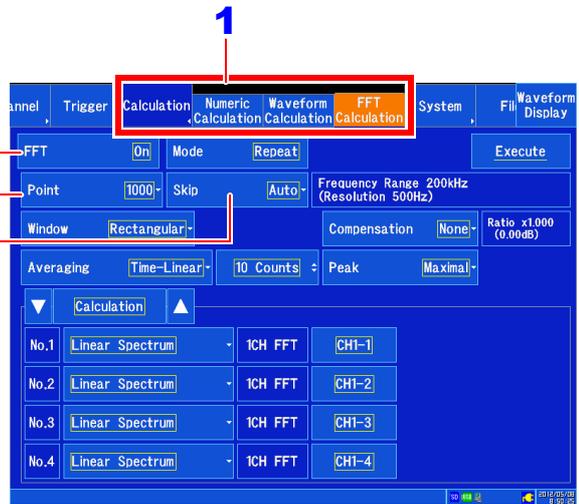


When using the external sampling to calculate:

Set the Sampling Clock to **[External]** (External sampling).

See: "Setting the horizontal axis (time-axis or sampling speed)" (p. 58)

- 1 Open the screen.**
[Setting Display] ▶ [Calculation] ▶ [FFT Calculation]
- 2 [FFT Calculation] ▶ Select [ON]**
 (Initial setting: OFF)
- 3 [Point] ▶ Select from the list.**
 Select (*: Initial setting)
1000*, 2000, 5000, 10000
- 4 [Skip] ▶ Select from the list.**
 When set to automatic, the number of calculation points is used.
 Select (*: Initial setting)
Auto*, 100, 200, 500, 1000, 2000, 5000, 10000



Frequency Resolution (during acquisition)

The resolution is affected by settings of frequency range and the number of analysis points. Not displayed for external sampling.

NOTE

- To control sampling by an external signal, select **[External]**.

When analyzing existing data

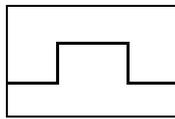
The frequency range is set automatically when analysis is started.

Relationship Between Frequency Range, Resolution and Number of Analysis Points

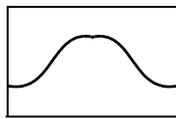
Range [Hz]	Sampling frequency [Hz]	Timebase [div] (MEM)	Sampling period	Number of FFT Analysis Points							
				1,000		2,000		5,000		10,000	
				Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval	Resolution [Hz]	Acquisition interval
200 k	500 k	200 μ s	2 μ s	500	2 ms	250	4 ms	100	10 ms	50	20 ms
80 k	200 k	500 μ s	5 μ s	200	5 ms	100	10 ms	40	25 ms	20	50 ms
40 k	100 k	1 ms	10 μ s	100	10 ms	50	20 ms	20	50 ms	10	100 ms
20 k	50 k	2 ms	20 μ s	50	20 ms	25	50 ms	10	100 ms	5	200 ms
8 k	20 k	5 ms	50 μ s	20	50 ms	10	100 ms	4	250 ms	2	500 ms
4 k	10 k	10 ms	100 μ s	10	100 ms	5	200 ms	2	500 ms	1	1 s
2 k	5 k	20 ms	200 μ s	5	200 ms	2.5	400 ms	1	250 ms	500 m	2 s
800	2 k	50 ms	500 μ s	2	500 ms	1	1 s	400 m	2.5 s	200 m	5 s
400	1 k	100 ms	1 ms	1	1 s	500 m	2 s	200 m	5 s	100 m	10 s
200	500	200 ms	2 ms	500 m	2 s	250 m	4 s	100 m	10 s	50 m	20 s
80	200	500 ms	5 ms	200 m	5 s	100 m	10 s	40 m	25 s	20 m	50 s
40	100	1 s	10 ms	100 m	10 s	50 m	20 s	20 m	50 s	10 m	100 s
20	50	2 s	20 ms	50 m	20 s	25 m	40 s	10 m	100 s	5 m	200 s
8	20	5 s	50 ms	20 m	50 s	10 m	100 s	4 m	250 s	2 m	500s
4	10	10 s	100 ms	10 m	100 s	5 m	200s	2 m	500 s	1 m	1 ks
1.33	3.33	30 s	300 ms	3.33 m	300 s	1.67 m	600s	667 μ	1.5 ks	333 μ	3 ks
800 m	2	50 s	500 ms	2 m	500 s	1 m	1 ks	400 μ	2.5 ks	200 μ	5 ks
667 m	1.67	60 s	600 ms	1.67 m	600 s	833 μ	1.2 ks	333 μ	3 ks	167 μ	6 ks
400 m	1	100 s	1 s	1 m	1 ks	500 μ	2 ks	200 μ	5 ks	100 μ	10 ks
333 m	833 m	120 s	1.2 s	833 μ	1.2 ks	417 μ	2.4 ks	167 μ	6 ks	83.3 μ	12 ks
133 m	333 m	300 s	3 s	333 μ	3 ks	167 μ	6 ks	66.7 μ	15 ks	33.3 μ	30 ks

Setting the Window Function

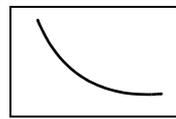
The window function defines the segment of the input signal to be analyzed. Use the window function to minimize leakage errors (p. A 27). There are three general types of window functions:



• Rectangular Window



- Hann window
- Hamming window
- Blackman window
- Blackman-Harris window
- Flat top window



• Exponential window

The non-rectangular window functions generally produce lower-level analysis results. By applying attenuation correction, the attenuation introduced by the non-rectangular window functions can be corrected to bring analysis results back to similar levels.

- 1** Open the screen.
 [Setting Display] ► [Calculation] ► [FFT Calculation]
- 2** [FFT Calculation] ► Select [ON]
 (Initial setting: OFF)
- 3** [Window] ► Select from the list.
 Select (*: Initial setting)
 Rectangular*, Hanning, Hamming, Blackman, Blackman Harris, Flat-top, Exponential

See: "Window Function" (p.A27)

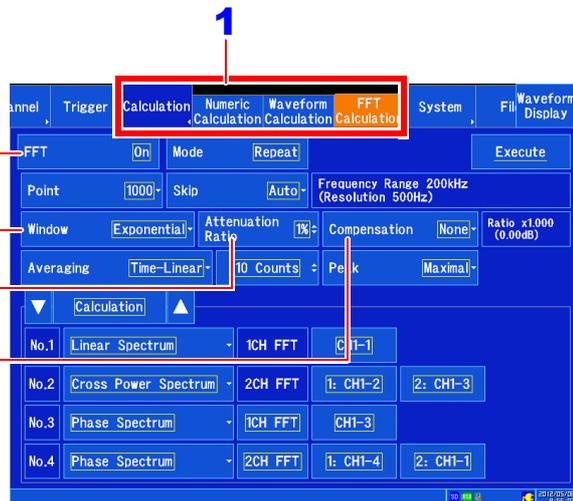
If [Exponential] is the selected type

- 4** Set the [Attenuation rate].
 Set the attenuation coefficient as a percentage.
 Select (*: Initial setting)
 0.1%* to 99.9%

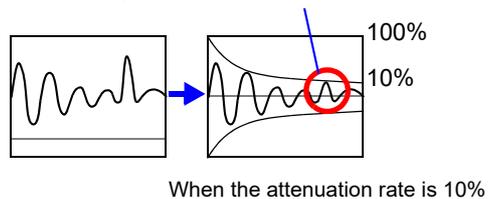
See: "Changing values" (p. 145)

- 5** [Compensation] ► Select from the list.
 Set attenuation correction.
 Select (*: Initial setting)

None*	Attenuated window function values are not corrected.
Power	The window function multiplies the power levels of the time-domain waveform so that output levels are comparable to those of a rectangular window.
Average	The window function multiplies the average value of the time-domain waveform so that output levels are comparable to those of a rectangular window.



Noise is suppressed in the attenuated waveform.



NOTE

For the rectangular window function:
 The correction value is always 1 (0 dB).

Setting Peak Values of Analysis Results

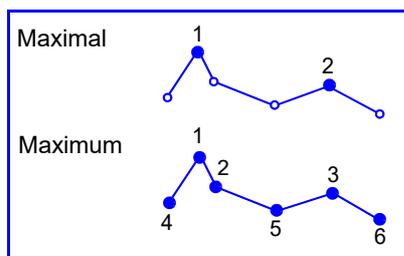
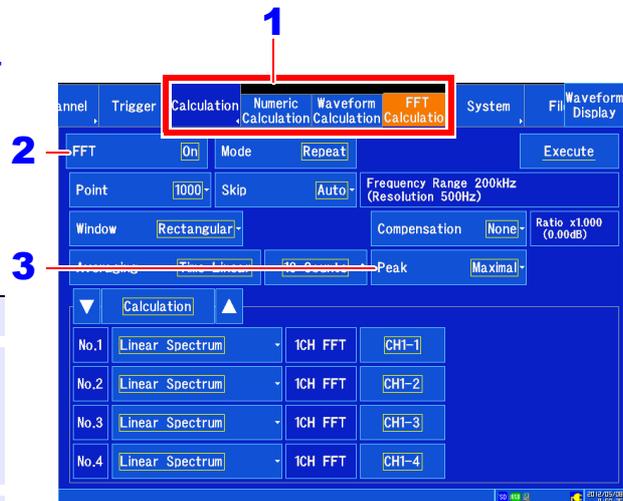
Either local or global maxima ([maximal]/ [maximum]) of the input signal and analysis results can be displayed on the Waveform screen.

1 Open the screen.
 [Setting Display] ▶ [Calculation] ▶ [FFT Calculation]

2 [FFT Calculation] ▶ Select [ON].
 (Initial setting: OFF)

3 [Peak] ▶ Select from the list.
 Select (*: Initial setting)

OFF*	Not displayed.
Maximal	(local maxima) When the value of data at a point is greater than that of the adjacent points, that data is considered a local maxima. The ten largest local maxima are displayed.
Maximum	(global maxima) Among all data values, the ten points with the greatest values are displayed.

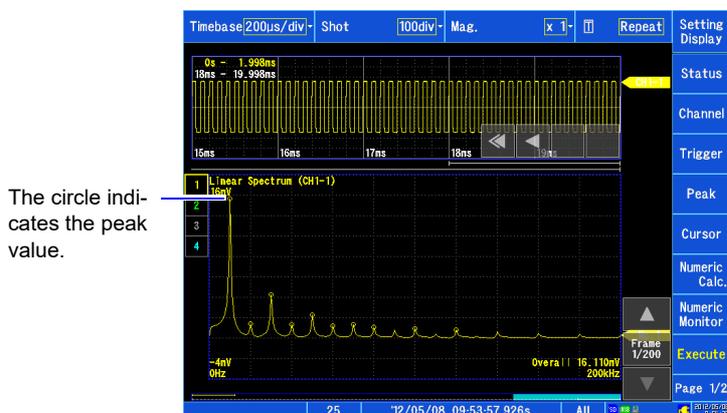


NOTE

- No display occurs if peak values cannot be detected.
- Peak values on the Waveform screen can be displayed, but cannot be saved as peak values in text files.

Example: Performing FFT calculations with existing data

Tapping [Peak] causes the peak value display window to open.



Averaging Waveforms

The averaging function calculates the average of the values obtained from multiple measurements of a periodic waveform. This can reduce noise and other non-periodic signal components. Averaging can be applied to a spectrum.

1 Open the screen.
[Setting Display] ▶ [Calculation] ▶ [FFT Calculation]

2 **[FFT Calculation] ▶ Select [ON].**
 (Initial setting: OFF)

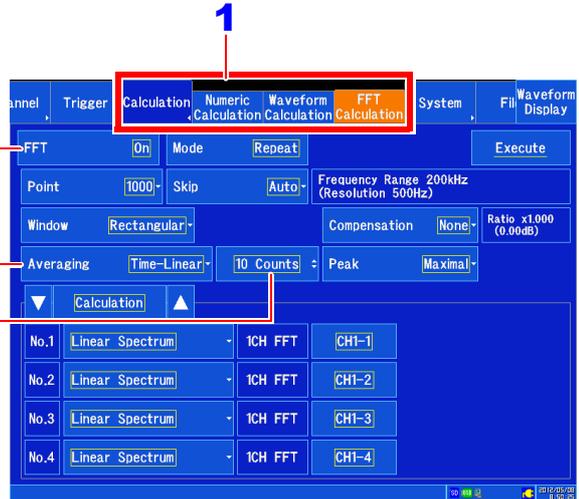
3 **[Averaging] ▶ Select from the list.**
 Select (*: Initial setting)

OFF*	Averaging is disabled.
Time-Linear	Time-domain waveforms are summed and averaged and then calculation is performed.
Time-Exponential	The exponential mean of time-domain waveforms is determined and then calculation is performed.
Freq-Peak Hold	The maximum value of frequency-domain waveforms is retained.

4 **Select the count for averaging.**
 Select (*: Initial setting)

2* to 10000

See: "Changing values" (p. 145)



See: "Trigger Modes and Averaging" (p. 237)

NOTE **About averaging calculation formulas**
 See: "Averaging" (p. A26)



Spectrum peak hold:

After performing FFT calculations on the acquired waveform, peak values are retained (held) and displayed within the frequency range.

FFT Analysis Modes and Averaging

●: Settable, ×: Cannot be set, ○: Partially settable

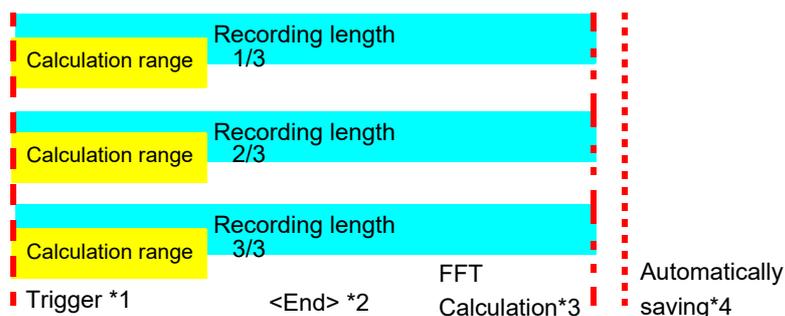
Analysis Mode	Averaging		
	Spectrum Averaging		
	Simple	Exponential	Peak Hold
OFF	×	×	×
Linear Spectrum	○*	○*	○*
RMS Spectrum	○*	○*	○*
Power Spectrum	●	●	●
Transfer Function	○*	○*	○*
Cross Power Spectrum	○*	○*	○*
Coherence Function	●	●	×
Phase Spectrum	×	×	×

* Not available when the y axis is real (linear) or imaginary (linear)

Trigger Modes and Averaging

If the trigger mode is [Single] or the calculation setting is [Once]

Example: When the averaging count is 3



*1: Trigger wait until the specified count is reached

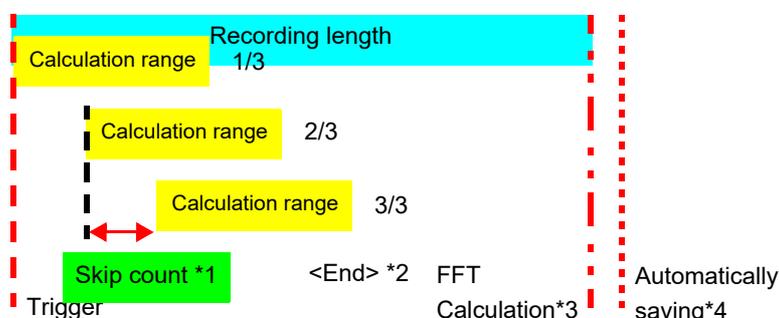
*2: Measurement is automatically ended when the specified number of data points is captured. Pressing the **STOP** key to halt measurement before the specified number of data points can be acquired will cause the averaging results up to that point to be displayed.

*3: FFT calculations are performed each time the measurement recording length is acquired.

*4: When the auto save setting is enabled, data is saved each time an FFT calculation completes.

When the trigger mode is [Single] and the calculation mode is [Repeat]

Example: When the averaging count is 3



*1: An upper limit is set for the skip count so that the calculation range does not exceed the end of the measurement recording length.

*2: Measurement is automatically ended when the specified number of data points is captured. Pressing the **STOP** key to halt measurement before the specified number of data points can be acquired will cause the averaging results up to that point to be displayed.

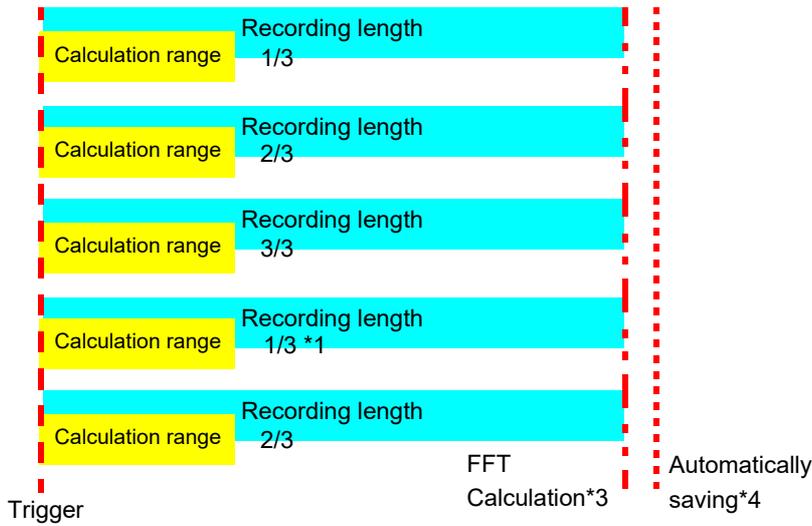
*3: FFT calculations are performed each time the measurement recording length is acquired.

*4: When the auto save setting is enabled, data is saved each time an FFT calculation completes.

10.4 Setting FFT Analysis Conditions

When the trigger mode is **[Repeat]** and the calculation mode is **[Once]**

Example: When the averaging count is 3



*1: Measurement continues even when the specified averaging count is exceeded.

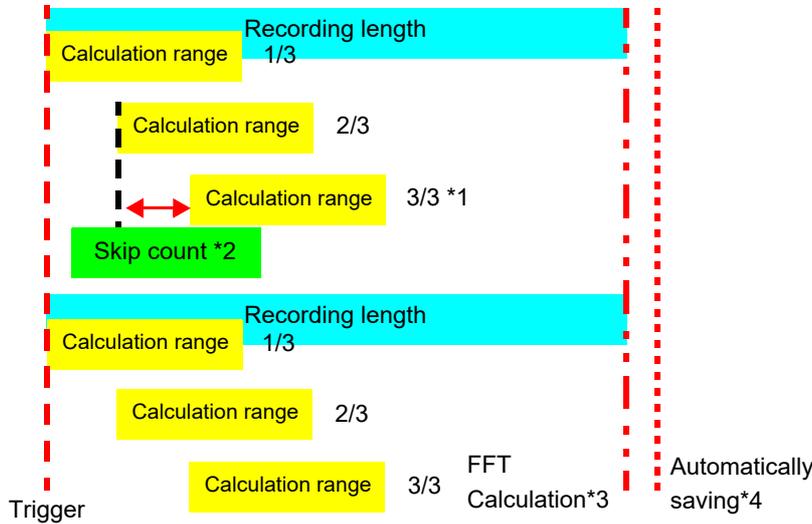
When the specified count is exceeded, the average is recalculated and measurement continues until the **STOP** key is pressed. When measurement ends before the specified count can be reached, the averaging results up to that point are displayed.

*2: FFT calculations are performed each time the measurement recording length is acquired.

*3: When the auto save setting is enabled, data is saved each time an FFT calculation completes.

When the trigger mode is **[Repeat]** and the calculation mode is **[Repeat]**

Example: When the averaging count is 3



*1: Measurement continues even when the specified averaging count is exceeded.

When the specified count is exceeded, the average is recalculated and measurement continues until the **STOP** key is pressed. When measurement ends before the specified count can be reached, the averaging results up to that point are displayed.

*2: FFT calculations are performed each time the measurement recording length is acquired.

*3: When the auto save setting is enabled, data is saved each time an FFT calculation completes.

Analysis Mode Settings

Select the type of FFT analysis, channel(s), waveform display color and x and y axes.

- 1 Open the screen.
[Setting Display] ► [Calculation] ► [FFT Calculation]

- 2 [FFT Calculation] ► Select [ON].
(Initial setting: OFF)

- 3 Tap and select [Calculation].

- 4 Select the calculation type from the list.

Select (*: Initial setting)

OFF*	No analysis.
Linear Spectrum	(p. 249)
RMS Spectrum	(p. 251)
Power Spectrum	(p. 252)
Transfer Function	(p. 253)
Cross Power Spectrum	(p. 254)
Coherence Function	(p. 255)
Phase Spectrum	(p. 256)

See: " Analysis Mode Functions" (p. 257)

- 5 Select the channel for analysis.

Tap to display the Channel Selection window. Configure the following settings:

[Type] ► Select from the list.

Select (*: Initial setting)

Analog*, Waveform Calc, CH Calc

[Unit] ► Select from the list.

Select (*: Initial setting)

Unit 1* to Unit 4

[Channel] ► Select from the list.

Select (*: Initial setting)

CH1* to CH15 (The maximum number of channels varies with the unit.)

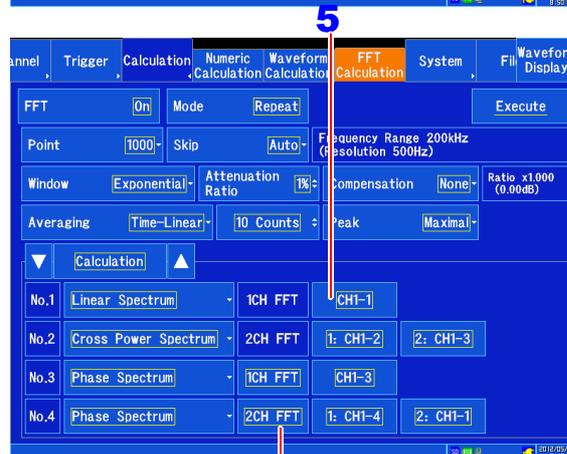
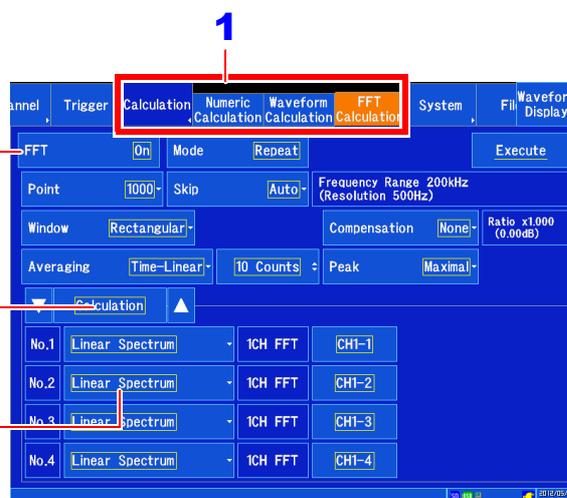
- 6 Tap and select [Display].

- 7 Tap and set whether to display the waveform and the display color.

Select to hide the waveform or a display color to display it.

- 8 Tap and set the graph to display.

- 9 Tap and set the sheet to display.



When [Phase Spectrum] is selected, tap here and select.

Select (*: Initial setting)

2CH FFT* Calculates the phase difference between CH1 and CH2.

1CH Calculates the phase for CH1.



10.4 Setting FFT Analysis Conditions

10 Set the calculation results to display on the horizontal or vertical axis.

(Available selections vary with the analysis mode.)

See: "Analysis mode and the X/Y axis display" (p. 240)

11 [X] ▶ Tap to switch.

Select (*: Initial setting)

Linear*	Frequency-axis is displayed linearly.
Log	Frequency-axis is displayed logarithmically. This is convenient when the data of interest is at the lower end of the frequency range, such as for sound and vibration.



12 [Y] ▶ Select from the list.

Select (*: Initial setting)

Lin-Mag*	Analysis results are displayed as amplitude values.
Log-Mag	Analysis results are displayed as dB values. The dB reference is 1 eu. (As a voltage example, 1 V is 0 dB.)
Lin-Real	The real-number component of analysis results are displayed.
Lin-Imag	The imaginary component of analysis results are displayed.

NOTE

To analyze using external sampling
The horizontal axis (x-axis) displays the number of data points.

Analysis mode and the X/Y axis display

●: Settable, ×: Unsettable

Analysis Mode	X axis		Y axis			
	Linear	Log	Amplitude (Linear)	Amplitude (dB)	Real part (Linear)	Lin-Imag
OFF	×	×	×	×	×	×
Linear Spectrum	●	●	●	●	●	●
RMS Spectrum	●	●	●	●	●	●
Power Spectrum	●	●	●	●	×	×
Transfer Function	●	●	●	●	●	●
Cross Power Spectrum	●	●	●	●	●	●
Coherence Function	●	●	●	×	×	×
Phase Spectrum	●	●	●	×	×	×

Total harmonic distortion (THD)

In the following analysis modes, displaying the cursor causes the linear spectrum, RMS spectrum, and power spectrum distortion to be calculated. Distortion is calculated as the fundamental wave at the cursor position. When multiple cursors are being displayed, the first cursor according to alphabetical order is used as the fundamental wave.

If the calculation results cannot be obtained, [--%] will be displayed. Depending on the window function setting, the distortion value may vary significantly.

$$\text{THD} = \sqrt{\frac{\sum (f_n)^2}{(f_0)^2}} \times 100 [\%]$$

f_0 = Fundamental wave

f_n = n -order harmonic

Setting the Display Range of the Vertical Axis (Scaling)

The display range of the vertical (y) axis can be set to automatically suit analysis results, and can be freely expanded and compressed.

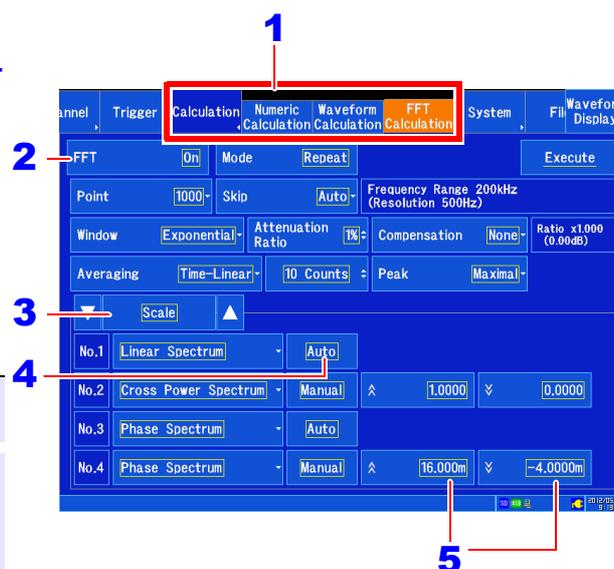
- 1** Open the screen.
[Setting Display] ► [Calculation] ► [FFT Calculation]
- 2** [FFT Calculation] ► Select [ON].
(Initial setting: OFF)
- 3** Tap and select [Scale].
- 4** Tap [Auto] or [Manual] to switch.
Select (*: Initial setting)

Auto* Scaling of the vertical (y) axis is automatically set according to analysis results.

Manual Scaling of the vertical (y) axis can be set as desired, to suit the purpose of the measurement. This is useful for magnifying or reducing the displayed amplitude, and for shifting the displayed waveform up or down.

When [Manual] is selected

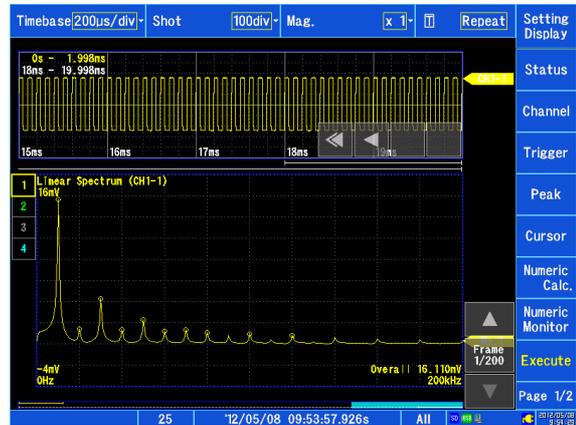
- 5** Set the upper and lower limits to display.
Tap to display the Conversion Ratio window.
Set the upper and lower limits to display the analysis results.
Setting range: -9.9999E+29 to +9.9999E+29
(with exponent from E-29 to E+29)
See: "Entering values" (p. 145)



10.5 Setting the Screen Display Method and Displaying a Waveform

Set the display method for FFT calculation results.

- 1 **Set the display method.**
See: "Configuring the screen layout" (p. 62)
- 2 **Open the screen.**
[Waveform Display]



NOTE

To use an existing memory waveform for analysis

See: "Enabling the FFT Calculation Setting" (p. 231)

To specify the analysis starting point

Specify the starting point on the memory waveform.

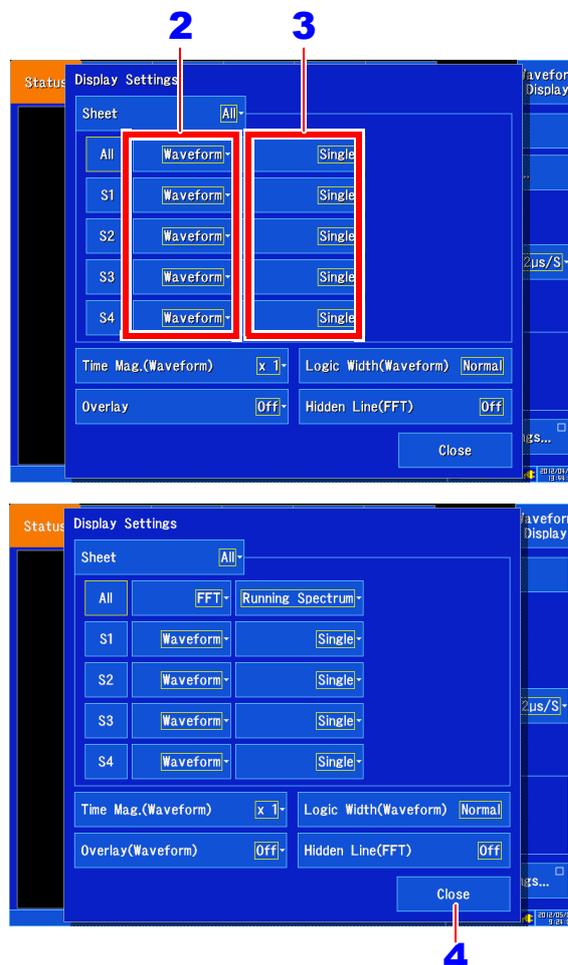
See: "Analyzing after Specifying an Analysis Starting Point" (p. 247)

Displaying Running Spectrums

Selecting **[Running spectrum]** for a screen division allows you to monitor changes in a varying frequency along with time.

See: "Configuring the screen layout" (p.A62)

- 1** Open the screen.
[Waveform Display]/[Setting Display] ▶
[Status] ▶ [Display Settings]
 Configure the desired sheet as follows:
- 2** Tap **[Format]** and select **[FFT]**.
- 3** Tap the screen division and select **[Running spectrum]**.
- 4** Close the screen.



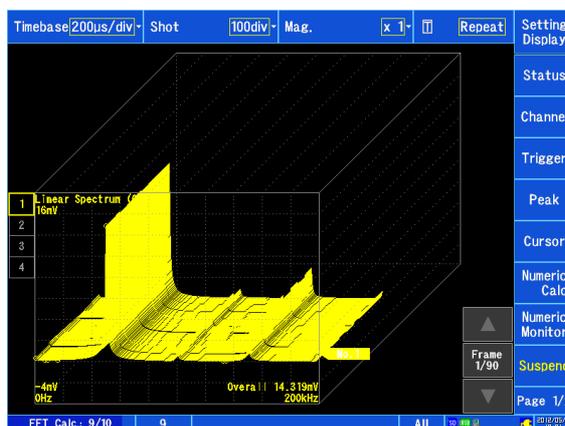
NOTE

The calculation interval (time interval of the running spectrum waveform and the waveform) is not regulated.

Stopping waveform movement during measurement

If the **Suspend** key is pressed during measurement, waveform movements can be stopped temporarily. The latest calculation results are displayed in the foreground.

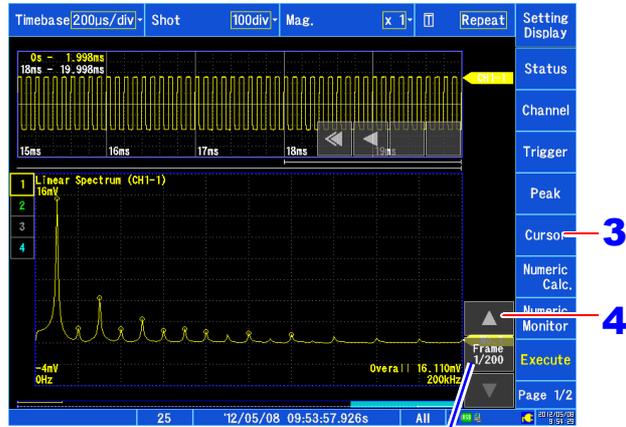
To restart, press the **RESUME** key again.



Reading measurement values of past waveforms by cursor

After measurement is finished, read the values of each waveform by cursor.

- 1** **Open the screen.**
[Waveform Display]
- 2** **Select a waveform.**
Select a waveform with the frame selection button. (The waveform number and waveform selection button are displayed at the bottom right of the screen.)
- 3** **Move the cursor.**
Manipulate the A and B cursors using the cursor commands and load the value at the cursor position.

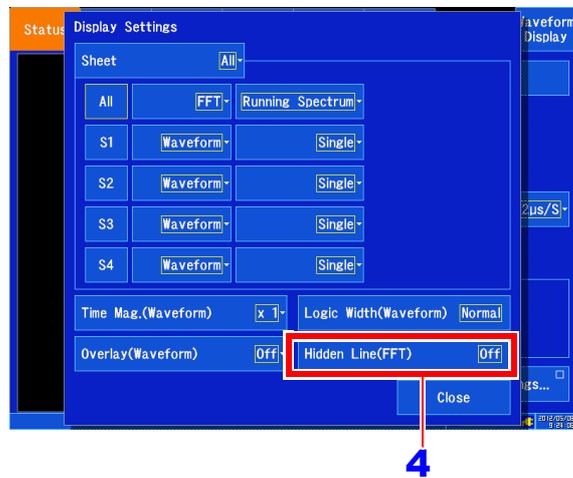


The older the waveform, the larger the number.

Hidden line processing (FFT)

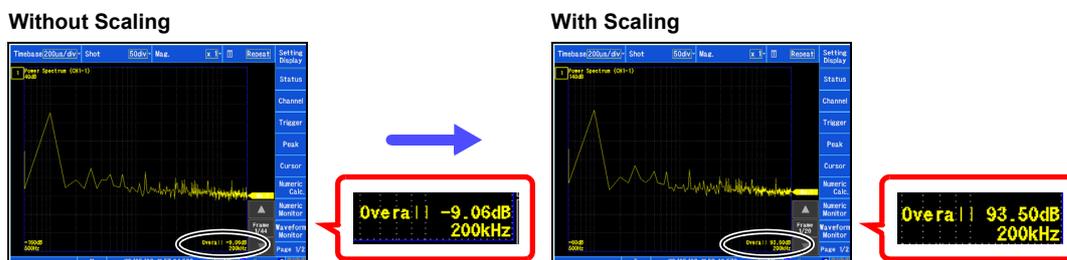
Enabling hidden line processing allows the overlapping part of the past waveform to be hidden when a past waveform and new waveform overlap. This setting is valid only when using the running

- 1** **Open the screen.**
[Waveform Display]/[Setting Display] ► [Status] ► [Channel]
- 2** **[Hidden Line (FFT)] ► Tap to switch to [ON].**



10.6 Scaling Using Overall Values

The scaling setting allows values displayed on this instrument to match the actual values read directly on a sound level meter or vibration meter.

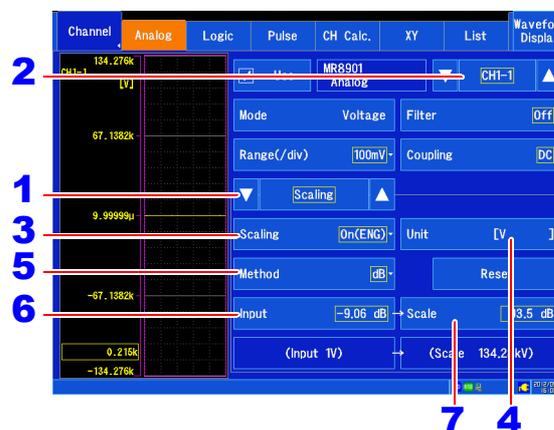


Setting example: To display measurement data on this instrument so that it corresponds to that on a sound level meter.

In a case where a sound level meter displays 93.5 dB and the overall value displayed on the Waveform screen of this instrument is -9.06 dB.



- 1** Open the screen.
[Waveform Display]/[Setting Display] ▶ [Channel] ▶ [Analog] ▶ [Scaling]
- 2** Select the channel to set.
- 3** [Scaling] ▶ Select [ON (ENG)] from the list.
- 4** [Unit] ▶ Input "V"
The same text entry method is used as for comment entry.
(p. 142)
- 5** [Method] ▶ Select [dB] from the list.
- 6** [Input] ▶ Enter the (overall) value "-9.06" displayed on the instrument.
- 7** [Scale] ▶ Enter the value "93.5" (from the sound level meter) that you want to read directly.
Scaling is performed automatically and the conversion value is set in the conversion rate column.



NOTE

0 dB reference differs depends on the physical quantity.

As an example for sound pressure, 20 μPa is 0 dB.

In dB scaling, the dB value can be directly read; however, it may not be possible to directly read instantaneous values.

Read the written standards and other materials regarding 0 dB references.

10.7 Saving Analysis Results

For more information about the save setting method, see "Chapter 4 Saving/Loading Data & Managing Files" (p. 87).

The size of saved files depends on the save format and analysis method.

See: "File Sizes" (p.A3)

When FFT Analysis Results are Saved as Text

Divide files by calculation item and then save.

Text Saving Example

```

[File name", "DATA_20120521_094119_A00001.CSV", "VO.10a"
Title comment", ""
"Frequency range", "Point", "Trigger date", "Trigger time", "Overall", "THD"
"200kHz", "1000", "12/05/21", "09:41:19.758", "1.136156E-01", "---%"
"No", "Analysis method", "Analysis Channel 1", "Units"
"No.1", "Linear Spectrum", "CH1-1", "[V]"
Comment", ""
Trigger date", "12/05/21"
Trigger time", "09:41:19.758"
Frequency[Hz]", "[1]"
"0.000000E+00", "1.495943E-03",
"5.000000E+02", "6.077000E-06",
"1.000000E+03", "1.512472E-01",
"1.500000E+03", "6.471593E-06",
"2.000000E+03", "2.873566E-03",
"2.500000E+03", "4.796684E-06",
"3.000000E+03", "4.641887E-02",
"3.500000E+03", "6.210951E-06",
"4.000000E+03", "2.535674E-03",
"4.500000E+03", "2.688931E-06",
"5.000000E+03", "2.340520E-02",
"5.500000E+03", "5.797564E-06",
"6.000000E+03", "2.026606E-03",
"6.500000E+03", "6.005192E-07",
"7.000000E+03", "1.253491E-02",
"7.500000E+03", "5.806407E-06",
"8.000000E+03", "1.418192E-03",
"8.500000E+03", "3.041760E-06",
"9.000000E+03", "6.164154E-03",
"9.500000E+03", "6.355053E-06",
"1.000000E+04", "7.957174E-04",
"1.050000E+04", "5.580901E-06",
"1.100000E+04", "2.224123E-03",
"1.150000E+04", "6.976811E-06",
"1.200000E+04", "2.675345E-04",

```

Line 1: File name
Line 2: Title comment
Line 4 to 5: Trigger Time
Line 7 to 8: Calculation information
Value in brackets: Frame count

Calculation information numbered two and above can be found below.

X-axis data Y-axis data

10.8 Analysis with the Waveform Screen

Analyzing after Specifying an Analysis Starting Point

Calculations can be performed by specifying the calculation start position in a measured waveform.

Operation differs by calculation execution settings.

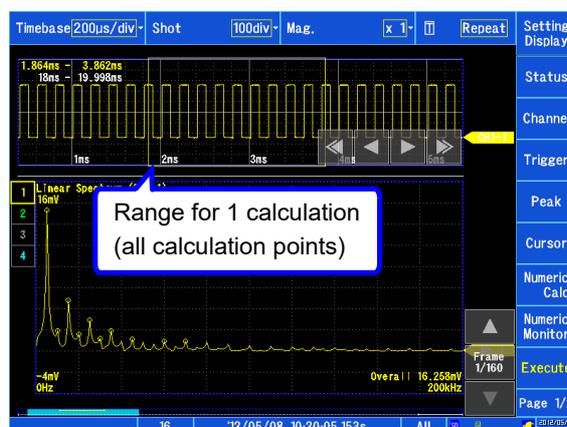
See: "" (p. 237)

- Calculation mode: **[Single]**
Analysis is performed once on the specified number of analysis points beginning with the specified starting point, and analysis results are displayed.
This is convenient for analyzing only a specific range. However, if averaging is enabled, analysis repeats for the specified averaging count.
- Calculation mode: **[Repeat]**
Analysis is performed repeatedly on the specified number of analysis points beginning with the specified starting point and ending with end of waveform data, and final analysis results are displayed
(Calculation is performed for the number of specified points so a good end point becomes the final analysis result.)

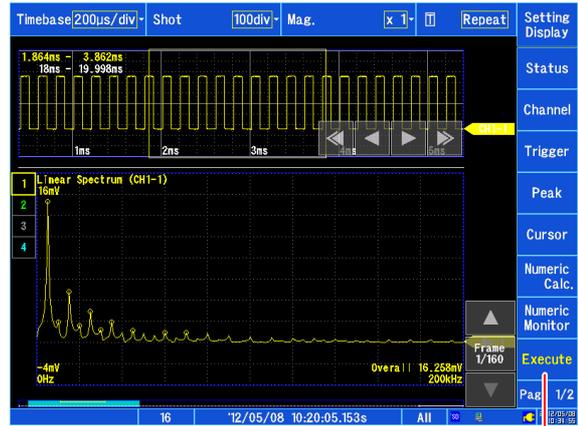
Verifying the analysis starting point while viewing analysis data

- 1 Open the screen.**
[Waveform Display]
The range for one calculation will be displayed in the memory waveform.
- 2 Drag the calculation cursor on the Waveform screen to specify the calculation position.**

(Continued on next page.)



3 Tap [Execute] to perform the analysis.

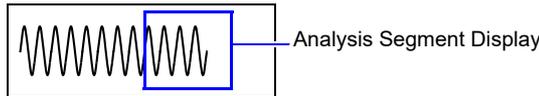


3

To change the number of analysis points Change the number of points with the FFT calculation settings on the Settings screen.

The range is determined by the number of analysis points.

If the analysis range (number of points) is larger than the memory waveform as shown below, analysis is not performed.



To analyze only a certain portion If [Exec] is [Single] in the setting items at the right side of the screen, only the calculation range currently displayed can be calculated.

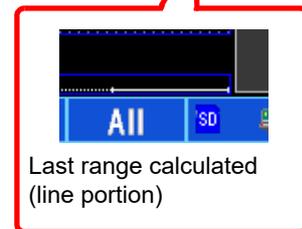
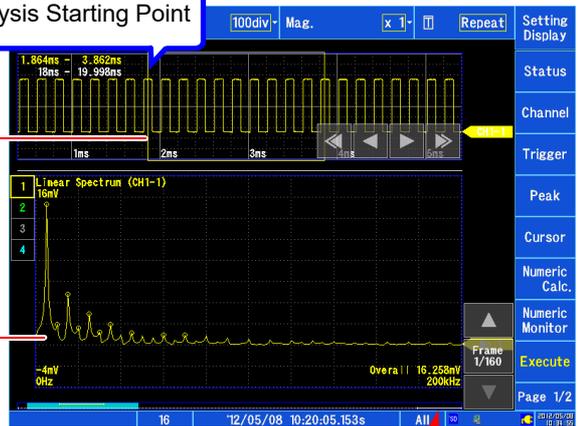
For settings other [Single], calculation points are calculated until the final data.

Analysis Starting Point

Calculation range (portion in square)

Analysis results are displayed on the lower graphs.

When the trigger mode is [Repeat], the number of analysis points up to the end of the waveform data is analyzed, and the last data is displayed.



10.9 FFT Analysis Modes

Analysis Modes and Display Examples

For the functions of each analysis mode, see "Analysis Mode Functions" (p. 257).

Linear Spectrum

The linear spectrum plots the input signal frequency.

Main Uses:

- To inspect the peak frequency contents of a waveform
- To inspect signal amplitudes at each frequency

See: About the Functions " Analysis Mode Settings" (p. 239)

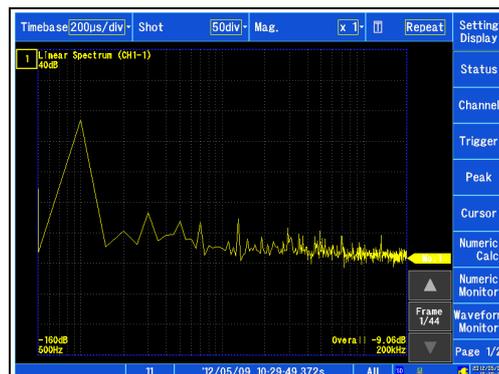
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis values are displayed linearly.
	Log-Mag	Analysis values are displayed as dB values. (0 dB reference value: 1eu)*
	Lin-Real	The real-number component of analysis values are displayed.
	Lin-Imag	The imaginary component of analysis values are displayed.

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

Waveform Example



Normal display
X axis:Log
Y axis:Lin-Mag



Normal display
X axis:Log
Y axis:Log-Mag



Normal display
X axis:Log
Y axis:Lin-Real



Normal display
X axis:Log
Y axis:Lin-Imag

NOTE

- If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed. When multiple cursors are being displayed, the first cursor according to alphabetical order is used as the fundamental wave. When results cannot be obtained, [---%] is displayed.
- When only sine waves are input, the level of this component becomes approximately 1.4 times (3 dB) larger than the overall value. To measure at a reference the same as the overall value, analyze using RMS spectrum or power spectrum.

See: "RMS Spectrum" (p. 251)

"Power Spectrum" (p. 252)

RMS Spectrum

The oscillation component (actual value) is calculated by the frequency axis waveform of the input signal. RMS and power spectra displays use the same analysis results displayed logarithmically (amplitude in dB).

Main Uses:

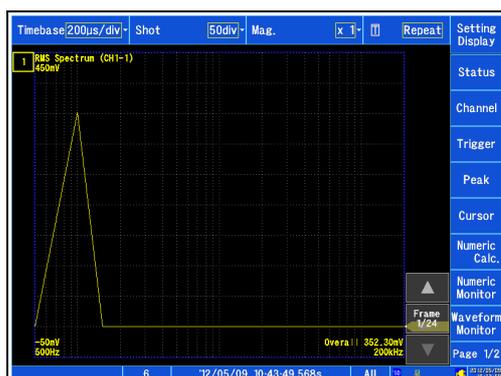
- To inspect the execution value of the frequency component of the waveform
- To inspect the RMS value at each frequency

See: About the Functions "Analysis Mode Settings" (p. 239)

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis values are displayed linearly.
	Log-Mag	Analysis values are displayed as dB values. (0 dB reference value: 1eu)*
	Lin-Real	The real-number component of analysis values are displayed.
	Lin-Imag	The imaginary component of analysis values are displayed.

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

Waveform Example



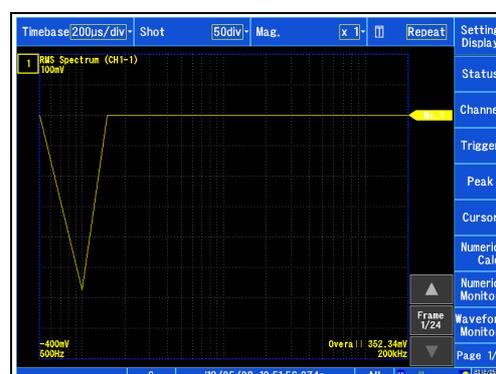
Normal display
X axis:Log
Y axis:Lin-Mag



Normal display
X axis:Log
Y axis:Log-Mag



Normal display
X axis:Log
Y axis:Lin-Real



Normal display
X axis:Log
Y axis:Lin-Imag

NOTE

If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed. When multiple cursors are being displayed, the first cursor according to alphabetical order is used as the fundamental wave. When results cannot be obtained, [---%] is displayed.

Power Spectrum

Displays input signal power as the amplitude component.

Main Uses:

- To inspect the peak frequency contents of a waveform
- To inspect the power level at each frequency

See: About the Functions " Analysis Mode Settings" (p. 239)

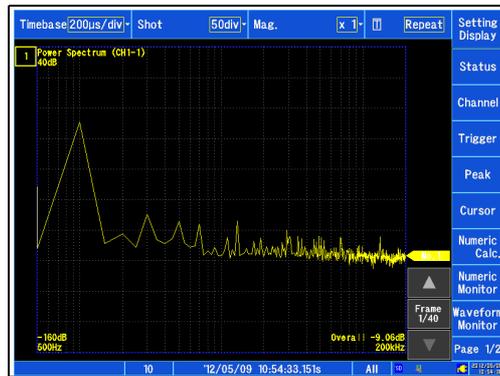
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis data is displayed linearly as squared values. Indicates the power component.
	Log-Mag (logarithm)	Analysis values are displayed as dB values. (0 dB reference value: 1eu^2)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, $0\text{ dB} = 1\text{ V}^2$)

Waveform Example



Normal display
X axis:Log
Y axis:Lin-Mag



Normal display
X axis:Log
Y axis:Log-Mag

NOTE

If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed. When multiple cursors are being displayed, the first cursor according to alphabetical order is used as the fundamental wave. When results cannot be obtained, [---%] is displayed.

Transfer Function

From the input and output signals, the transfer function (frequency characteristic) of a measurement system can be obtained.

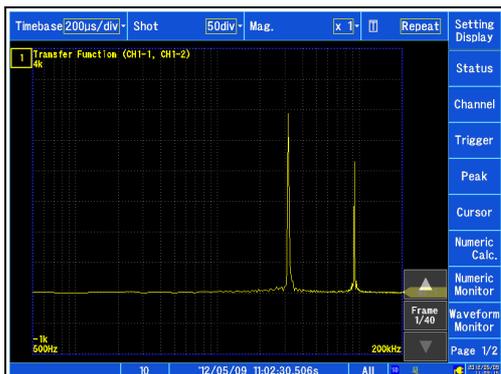
Main Uses:

- To inspect a filter's frequency characteristic
- To inspect the resonance characteristic of an object using an impulse hammer and pick-up sensor

See: "About the Functions" Analysis Mode Settings" (p. 239), "Linear Time-Invariant Systems" (p. A22)

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Displays the input-output ratio linearly (dimensionless units).
	Log-Mag (logarithm)	Displays the input-output ratio as dB values.
	Lin-Real	Displays the real-number component of the input-output ratio (dimensionless units).
	Lin-Imag	Displays the imaginary component of the input-output ratio (dimensionless units).

Waveform Example



Normal display
X axis:Log
Y axis:Lin-Mag



Normal display
X axis:Log
Y axis:Log-Mag



Normal display
X axis:Log
Y axis:Lin-Real



Normal display
X axis:Log
Y axis:Lin-Imag

Cross Power Spectrum

The product of the spectra of two input signals can be obtained. The common frequency components of two signals can be obtained.

Using the voltage and current waveforms as input signals, active power, reactive power and apparent power can be obtained at each frequency.

Main Uses:

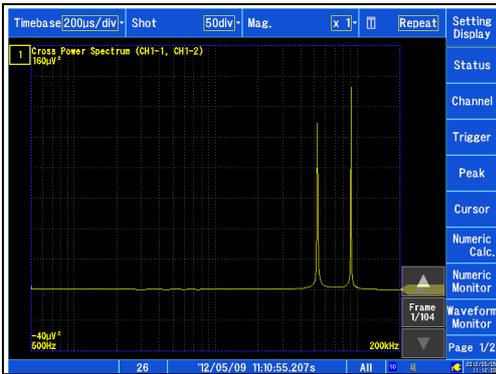
To inspect common frequency components of two signals

See: About the Functions " Analysis Mode Settings" (p. 239)

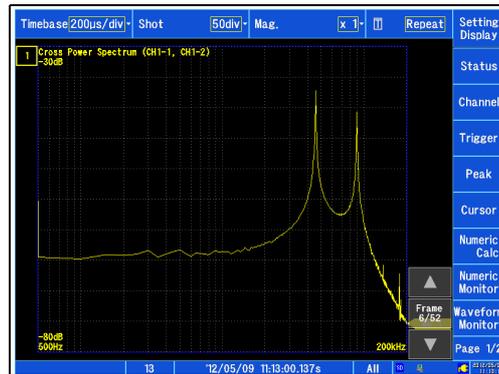
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Displays the squared value of amplitude contents of analysis data linearly.
	Log-Mag (dB)	Displays the amplitude contents of analysis data as dB values. (0 dB reference value: 1eu^2)*
	Lin-Real	Displays the squared values of the real component of analysis data linearly.
	Lin-Imag	Displays the squared values of the imaginary component of analysis data linearly.

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, $0\text{ dB} = 1\text{ V}^2$)

Waveform Example



Normal display
X axis:Log
Y axis:Lin-Mag



Normal display
X axis:Log
Y axis:Log-Mag



Normal display
X axis:Log
Y axis:Lin-Real



Normal display
X axis:Log
Y axis:Lin-Imag

Coherence Function

This function gives a measure of the correlation (coherence) between input and output signals. Values obtained are between 0 and 1.

Main Uses:

- To evaluate transfer functions
- In a system with multiple inputs, to inspect the effect of each input on the output

See: About the Functions " Analysis Mode Settings" (p. 239)

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Displays the causal relationship and degree of relationship between two input signals, as a value between 0 and 1 (dimensionless units).

Waveform Example



Normal display

X axis:Log

Y axis:Lin-Mag

NOTE

- With a single measurement, the coherence function gives a value of one for all frequencies. Spectrum (frequency-domain) averaging should always be performed before measurement.
- The coherence function has two general definition formulas. For the definition formulas, see "Analysis Mode Functions" (p. 257).

Phase Spectrum

Shows the phase characteristics of the input signal.

Main Uses:

- To inspect the phase spectrum of channel 1. Displays the phase of a cosine waveform as a reference (0°).
- To inspect the phase difference between channels 1 and 2.

See: About the Functions "Analysis Mode Settings" (p. 239)

1 Ch FFT: Displays the phase of the signal on channel 1. Displays the phase of a cosine waveform as a reference (0°). Unless the waveform is synchronous, phase values are unstable.

2 Ch FFT: Displays the phase difference between channels 1 and 2. Positive values indicate that the phase of channel 2 is leading.

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis values are displayed linearly.

Waveform Example



1chFFT
X axis:Log
Y axis:Lin-Mag

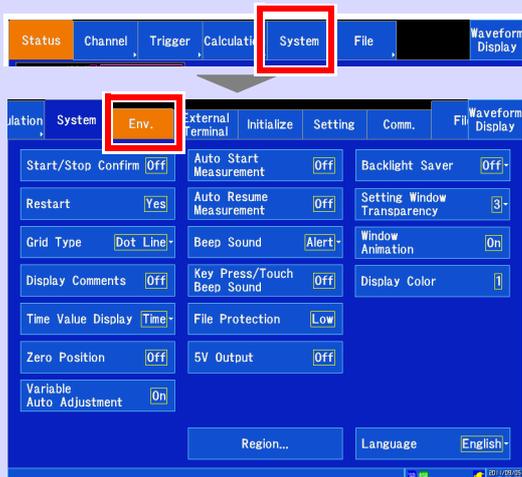


2chFFT
X axis:Log
Y axis:Lin-Mag

Analysis Mode Functions

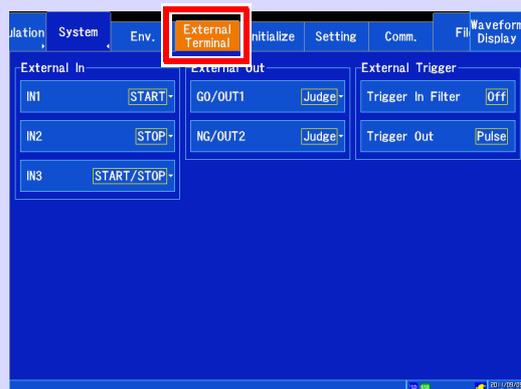
Analysis Mode	Internal analysis formula (linear, real, imag [imaginary], log [logarithm])
OFF	No analysis.
Linear Spectrum	$X(k) = \sum_{n=0}^{N-1} x(n)W^{kn} \quad F(k) = CX(k) \quad C = \begin{cases} 1/N(DC) \\ 2/N(AC) \end{cases}$ $linear = F(k) \quad real = \text{Re}\{F(k)\} \quad imag = \text{Im}\{F(k)\} \quad log = 20 \log F(k) $
RMS Spectrum	$F'(k) = C' F(k) \quad C' = \begin{cases} 1 (DC) \\ 1/\sqrt{2} (AC) \end{cases}$ $linear = F'(k) \quad real = \text{Re}\{F'(k)\} \quad imag = \text{Im}\{F'(k)\} \quad log = 20 \log F'(k) $
Power Spectrum	$P(k) = a F(k) ^2 \quad a = \begin{cases} 1 (DC) \\ 1/2 (AC) \end{cases}$ $linear = P(k) \quad log = 10 \log P(k) $
Transfer Function	$H(k) = Y(k) / X(k)$ $linear = H(k) \quad real = \text{Re}\{H(k)\} \quad imag = \text{Im}\{H(k)\} \quad log = 20 \log H(k) $
Cross Power Spectrum	$S_{yx}(k) = X^*(k)Y(k) \quad \text{: Cross Spectrum}$ $X_{power}(k) = AS_{yx}(k) \quad A = \begin{cases} 1/N^2 \\ 2/N^2 \end{cases}$ $linear = X_{power}(k) \quad real = \text{Re}\{X_{power}(k)\}$ $mag = \text{Im}\{X_{power}(k)\} \quad log = 10 \log X_{power}(k) $
Coherence Function	$coh(k) = \frac{\sqrt{S_{yx}(k)S_{yx}^*(k)}}{\sqrt{S_{xx}(k)S_{yy}(k)}}$
Phase Spectrum	$\theta(k) = 180/\pi \times \tan^{-1}(\text{Im}(F'(k))/\text{Re}(F'(k)))$ $\theta(k) = 180/\pi \times \tan^{-1}(\text{Im}(S_{yx}(k))/\text{Re}(S_{yx}(k)))$

System Environment Settings Chapter 11



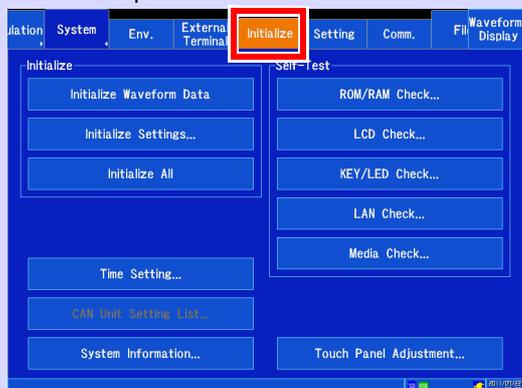
Configuring system environment settings (p. 260)

Configure settings related to the instrument's system environment, including the screen display and instrument operation.

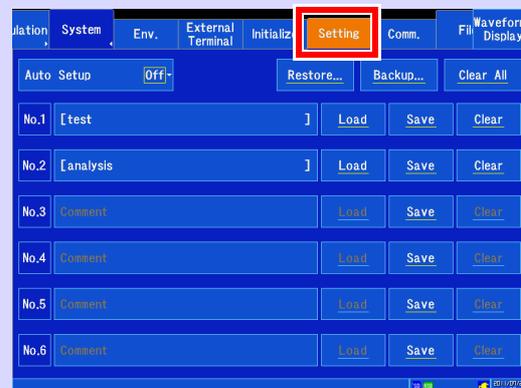


Configuring settings related to external control (p. 323)

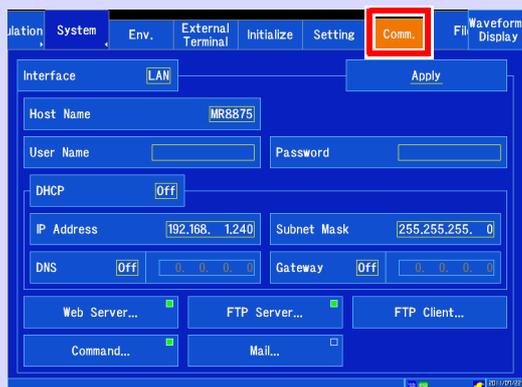
Configure settings related to external I/O and external triggers.



Initialization (p. 271), self-check (p. 273), architecture (p. 278), etc.



Saving (p. 101) and loading (p. 103) settings data

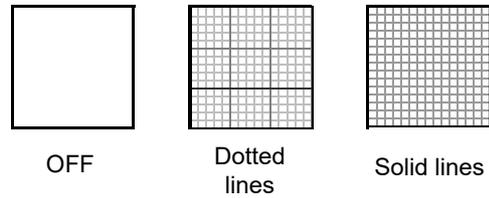


Communications settings (p. 279)

11.1 Screen and Operation Settings

Setting the grid type

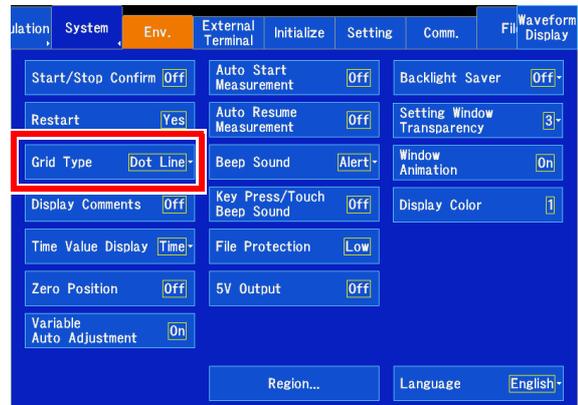
You can select whether to display the grid on the Waveform screen using dashed or solid lines, or to not display the grid at all.



- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Grid Type] ► Select from the list.

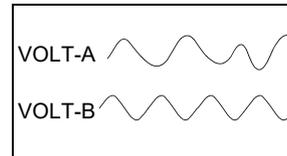
Select (*: Initial setting)

Off	Hides the grid.
Dot Line*	Displays the grid using dotted lines.
Solid Line	Displays the grid using solid lines.



Turning comments on or off

You can select whether to display comments for channels on the Waveform screen. Comments are shown at the zero position for each input.



Channel comments are set on the [Waveform Display]/[Setting Display] ► [Channel] ► [Analog]/[Pulse]/[CH Calc.] ► [Detail] screen (p. 142).

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Display Comments] ► Tap to switch.

Select (*: Initial setting)

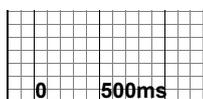
Off*	Hides comments.
On	Shows comments.



NOTE Logic channel comments are not shown.

Setting the time value display type

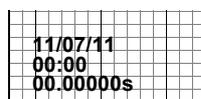
You can select where to display the horizontal axis on the Waveform screen as well as how to display the A/B and C/D cursor positions. The changes apply to files saved in the CSV format.



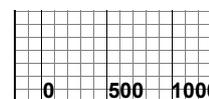
Time



Mode 60



Date

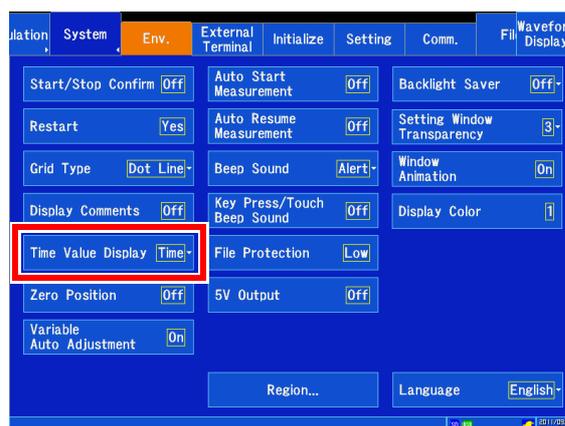


Samples

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Time Value Display] ► Select from the list.

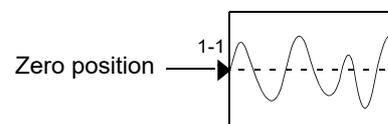
Select (*: Initial setting)

Time*	Displays the relative time from the start of measurement (example: 100 s). However, if there are trigger settings, the time is shown from the trigger point.
Mode 60	Displays the relative time from the start of measurement as a base-60 value (example: 1m40s).
Date	Displays the date and time at which data was captured. The format can also be changed. See: "Setting the date grouping and format" (p. 270)
Samples	Displays the number of data points that have been captured since the start of measurement. However, when the trigger setting is enabled, the number of data points after the trigger point is displayed.



Setting the zero position display

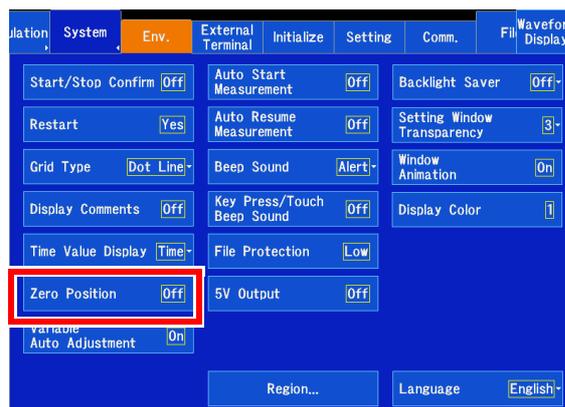
You can display zero position markers for each input channel on the time-axis waveform display. The markers will be displayed on the left side of the Waveform screen when the setting is on.



- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Zero Position] ► Tap to switch.

Select (*: Initial setting)

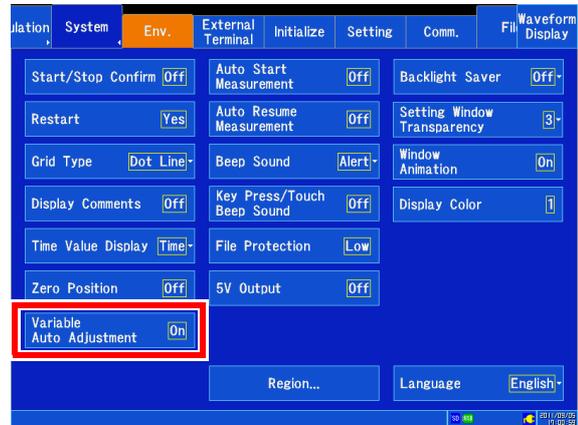
Off*	Hide the zero position.
On	Display the zero position.



Automatically adjusting variables

You can change the variable function operation and display in response to measured value conversions using the scaling function and changes to the voltage axis range.

See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)



Setting screen colors

You can select which colors to use on the Waveform screen, including for the background and text.

- 1 **Open the screen.**
 [Setting Display] ► [System] ► [Env.]
- 2 **[Display Color] ► Tap to switch.**
 Select (*: Initial setting)

1*, 2, 3, 4



Setting measurement operation at power-on (auto-start at power-on)

You can automatically start measurement when the instrument changes from the off-state to the on-state. When using triggers, the instrument will enter the trigger standby state.

- 1 **Open the screen.**
 [Setting Display] ► [System] ► [Env.]
- 2 **[Auto Start Measurement] ► Tap to switch.**

Select (*: Initial setting)

- Off*** Disables the auto-start function at power-on.
- On** Enables the auto-start function at power-on.



Setting operation when the power is cycled (start backup)

You can restart recording automatically when the instrument is turned back on after its power supply is interrupted, for example due to a power outage, during recording operation (while the **START** key turns green). When using triggers, the instrument will enter the trigger standby state.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Auto Resume Measurement] ► Tap to switch.

Select (*: Initial setting)

Off*	Disables the start backup function.
On	Enables the start backup function.



- NOTE**
- Measurement data that was stored in internal memory when the power outage occurred will be erased. To save measurement data from both before and after any power outage, configure auto-saving (p. 93).
 - When measurement is started with [Auto Resume Measurement: On], the auto setup function and the automatic setting function for reading settings automatically at power-on cannot be used (p. 106)(p. 107).

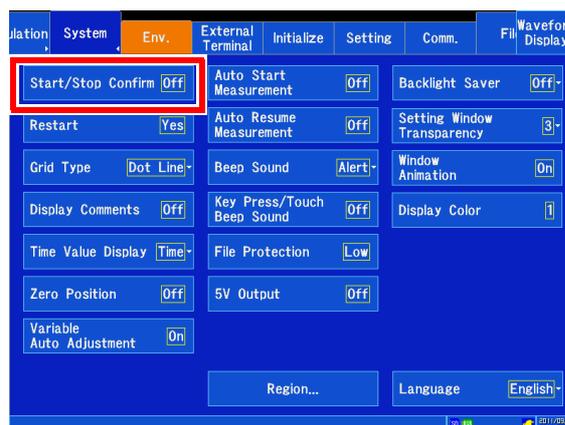
Setting whether to issue start and stop confirmation messages

To help avoid operator errors, confirmation messages can be displayed when measurement is manually started or stopped.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Start/Stop Confirm] ► Tap to switch.

Select (*: Initial setting)

Off*	Confirmation messages are not displayed. Pressing START and STOP start and stop measurement immediately.
On	Displays confirmation messages. Measurement will start when "Start" is tapped and stop when "Yes" is tapped.

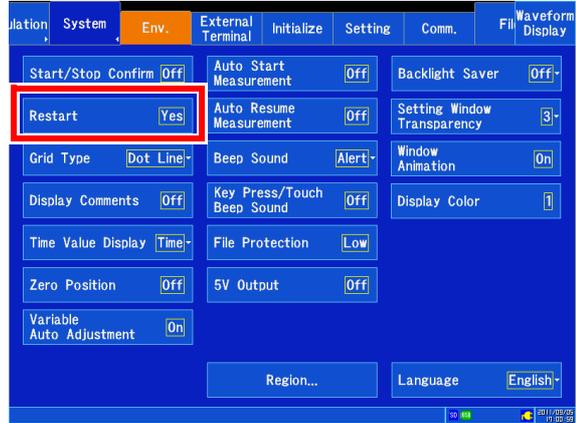


Setting whether to apply setting changes during measurement (enabling restart operation)

You can set whether to restart measurement immediately when settings that affect measurement are changed during measurement.

- 1 **Open the screen.**
 [Setting Display] ► [System] ► [Env.]
- 2 **[Restart] ► Tap to switch.**
 Select (*: Initial setting)

No	Does not restart measurement. Settings cannot be change during measurement.
Yes*	When settings are changed during measurement, applies the changes and re-starts measurement.



NOTE You cannot switch to the Settings screen while measurement is in progress.

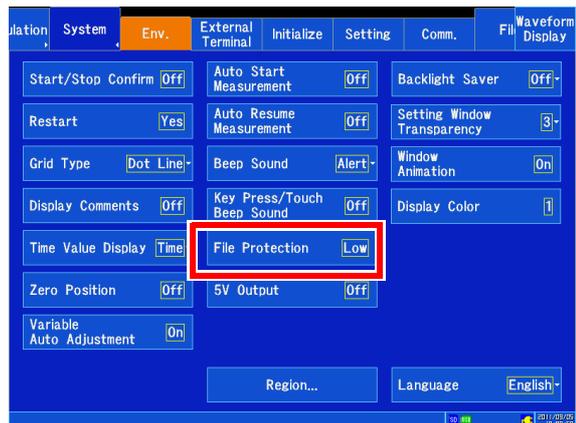
File Protection Level Setting

The MR8875 includes functionality to protect files with a UPS function that uses a electrical double layer capacitor. This functionality becomes available only when the UPS is fully charged. You can select what type of file operation to use while the UPS function is charging (a maximum of about 15 minutes after the instrument is turned on).

- 1 **Open the screen.**
 [Setting Display] ► [System] ► [Env.]
- 2 **[File Protection] ► Tap to switch.**

Select (*: Initial setting)

Low*	Allow access to files on the SD memory card/USB flash drive while the UPS is charging. If a power outage occurs while media is being accessed while the UPS is charging, files on the media may be corrupted, rendering them unreadable.
High	Prevent access to the SD memory card/USB flash drive until the UPS is fully charged, protecting those files.



NOTE

- Selecting the **[High]** setting prevents use of auto setup (p. 106).
- When changing the file protection level, cycle the instrument's power. Instrument operation will not change after the setting is modified until the power is cycled.
- When set to **[High]**, real-time saving will not start until UPS charging completes.

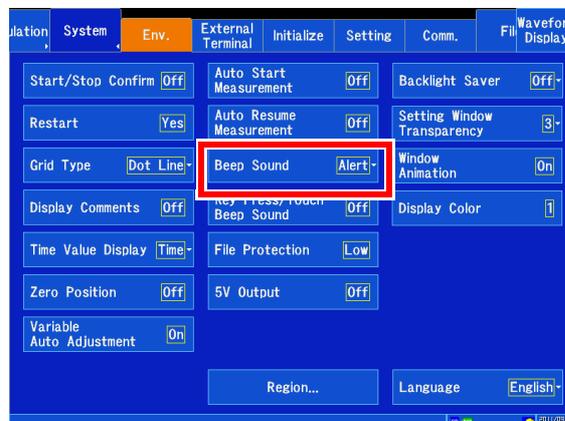
Setting the beep tone

You can configure the instrument to inform the operator of warnings and/or its operational state with a beep.

- 1 **Open the screen.**
[Setting Display] ► [System] ► [Env.]
- 2 **[Beep Sound] ► Select from the list.**

Select (*: Initial setting)

Off	Disable the beeper.
Alert*	Sound a beep when a warning or error occurs.
Alert+Action	Sound a beep when a warning or error occurs, when starting or stopping recording, and when a trigger is applied.



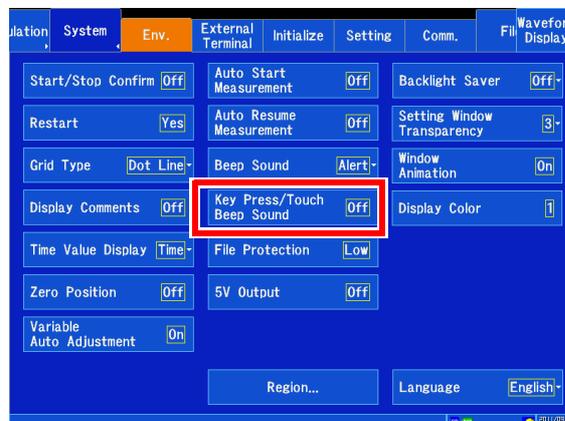
Selecting the operation sound

You can set whether to generate an operation sound when keys on the instrument's front panel are pressed and when buttons on the screen are touched.

- 1 **Open the screen.**
[Setting Display] ► [System] ► [Env.]
- 2 **[Key Press/Touch Beep Sound] ► Tap to switch.**

Select (*: Initial setting)

Off*	Disable the operation sound.
On	Generate an operation sound when keys are pressed and when the screen is touched.



Enabling and disabling the backlight saver

The LCD backlight can be automatically turned off after a set amount of time (in minutes) elapses during which no operation is performed, known as the backlight saver. By using the backlight saver, it is possible to reduce power consumption and extend the life of the LCD.

To reactivate the backlight, simply touch any key or the screen. The state of the **START** key can be used to verify the instrument's status while the backlight saver is active (measurement in progress: continuous green; other status: off).

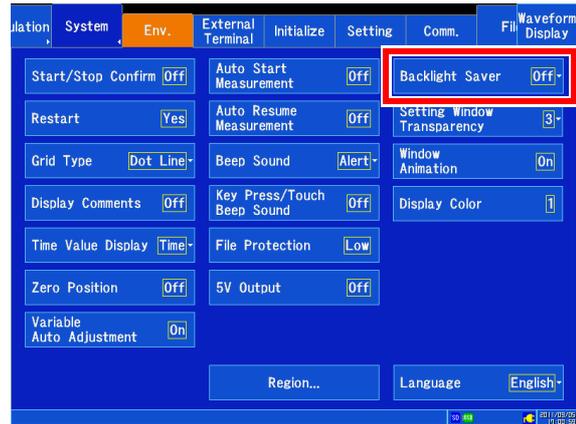
1 Open the screen.

[Setting Display] ► [System] ► [Env.]

2 [Backlight Saver] ► Select from the list.

Select (*: Initial setting)

Off*	Turns off the backlight saver function. The screen will be displayed continuously.
1 min,	Turns off the screen after the set amount of time has elapsed and the instrument enters power-saving mode.
2 min,	
3 min,	
4 min,	
5 min	



- NOTE**
- The instrument continues to consume power even while the backlight saver is active. The instrument should be turned off when not in use.
 - When the screen is off but the power LED is on, the backlight saver may be active.

Setting external 5 V output

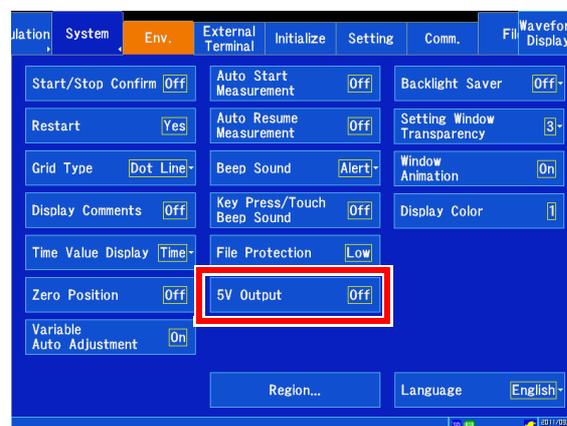
You can generate a 5 V output voltage from the MR8875's external power supply terminals for a total of up to 2 A.

See: "2.8 Supplying Power to an External Device" (p. 48)

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [5V Output] ► Tap to switch.

Select (*: Initial setting)

Off*, On



Setting the window opacity

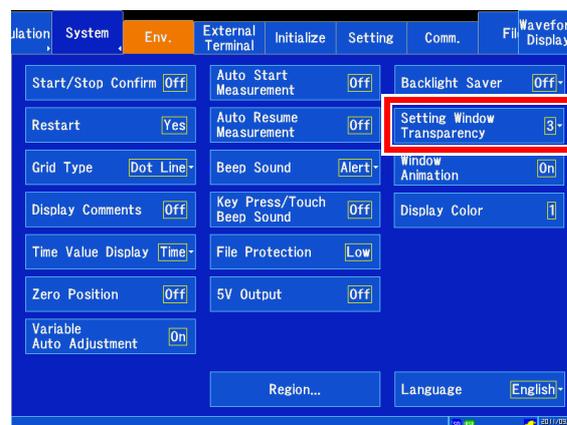
You can set the opacity with which windows are shown on the Waveform screen.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Setting Window Transparency] ►
Select from the list.

Select (*: Initial setting)

1, 2, 3*, 4, 5

1 (Low opacity) - - - - - ► 5 (High opacity)

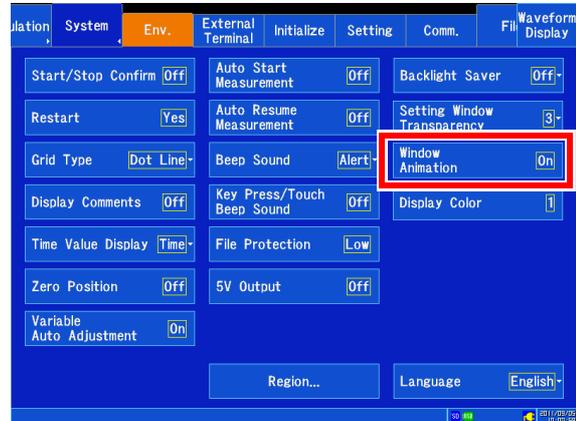


Setting window animations

You can select whether to use animations when displaying windows. The use of animations when switching between the Waveform and Settings screens is set at the same time.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Window Animation] ► Tap to switch.
Select (*: Initial setting)

Off, On*



11.2 System Settings

Selecting the display language

This section describes how to set the instrument's display language.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
- 2 [Language] ► Select from the list.

Select:(*: Initial setting)

English*	Uses English as the display language.
Chinese	Uses Chinese as the display language.
Japanese	Uses Japanese as the display language.

The default setting for the MR8875-30 is Chinese.



Setting the decimal point and delimiter characters

Select decimal point and separator characters for CSV file data.

- 1 Open the screen.
[Setting Display] ► [System] ► [Env.]
► [Region]
- 2 [Decimal Point] ► Select from the list.

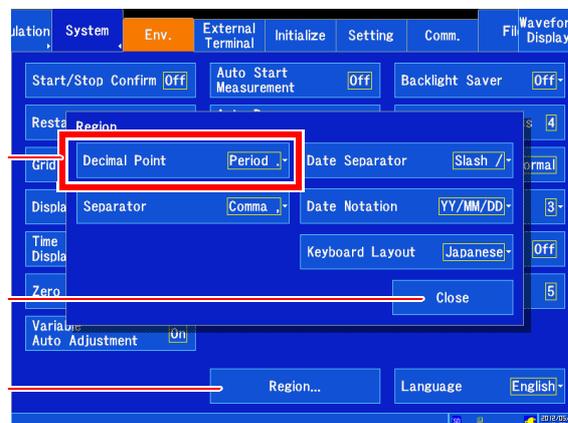
Select(*: Initial setting)

Period .* , Comma ,

- 3 Tap [Close].

Select(*: Initial setting)

Comma ,* , Period . , Space _ , Tab > , Semicolon ;



- 3 Tap [Close].

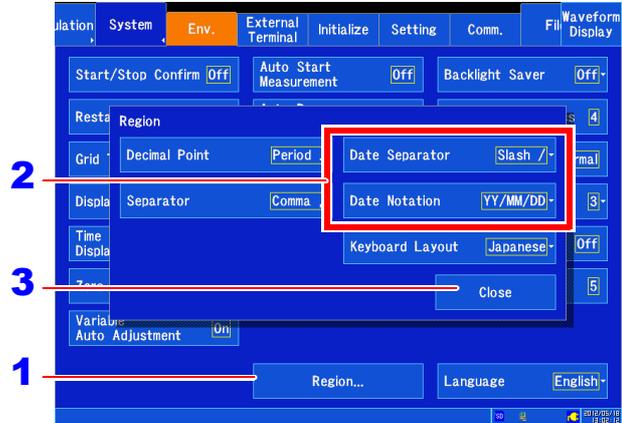
NOTE

- The decimal point and delimiter characters cannot both be set to the comma or period.
- When selecting the comma as the delimiter character, “.CSV” is used as the file extension. Otherwise, “.TXT” is used as the extension.

Setting the date grouping and format

This section describes how to set the grouping and format for dates shown on the screen and included in data saved to files.

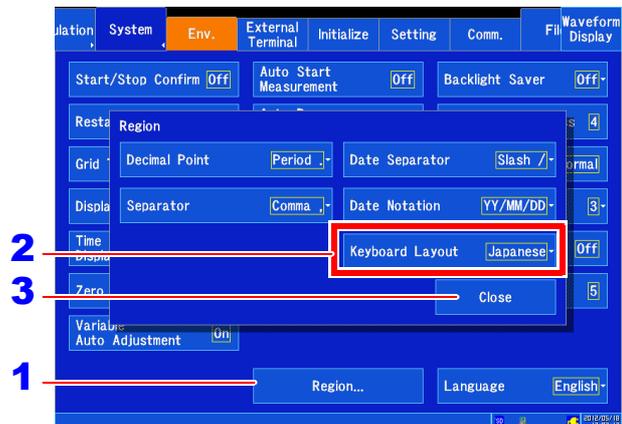
- 1** Open the screen.
 [Setting Display] ▶ [System] ▶ [Env.]
 ▶ [Region]
- 2** [Date Separator] ▶ Select from the list.
 Select(*: Initial setting)
 Slash /*, Hyphen-, Period .
- [Date Notation] ▶ Select from the list.
 Select(*: Initial setting)
 YY/MM/DD*, MM/DD/YY, DD/MM/YY
 YY: year; MM: month; DD: day
- 3** Tap [Close].



Setting the external keyboard layout

You can select the layout of the external keyboard.

- 1** Open the screen.
 [Setting Display] ▶ [System] ▶ [Env.]
 ▶ [Region]
- 2** [Keyboard Layout] ▶ Select from the list.
 Select(*: Initial setting)
 Japanese*, English
- 3** Tap [Close].



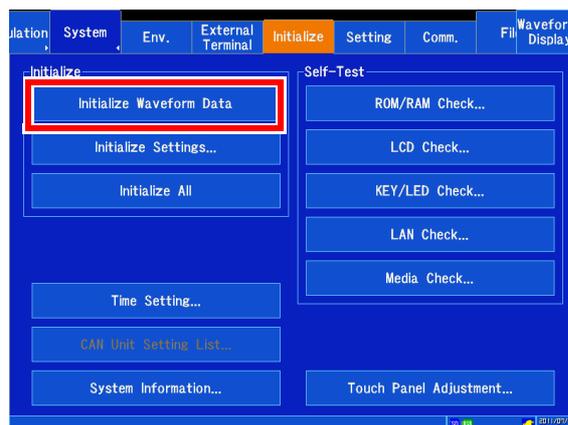
11.3 Initializing the Instrument

Initializing waveforms

This section describes how to initialize waveforms by discarding waveform data stored in the instrument's memory.

- 1** Open the screen.
[Setting Display] ► [System] ►
[Initialize]
- 2** [Initialize Waveform Data] ► [Yes]

When the following message is displayed, the initialization process is complete: "Waveform data has been initialized." To cancel, tap "No."



Initializing settings (system reset)

This section describes how to select and initialize instrument settings. Initializing settings causes them to be returned to their state at the time of shipment.

See: "Appendix 1 Initial Values for Principal Settings" (p. A1)

1 Open the screen.

[Setting Display] ► [System] ► [Initialize]

2 Tap [Initialize Settings].

The window will be displayed.

3 Select the setting you wish to initialize.

Tapping a setting selects it and causes a checkmark to appear.

Select (*: Initial setting)

Settings* Waveform data, measurement settings, input settings, triggers, calculation settings, and tab settings (excluding settings configured using the CAN unit application)
You can also perform a system reset by turning on the instrument while pressing the **STOP** key.

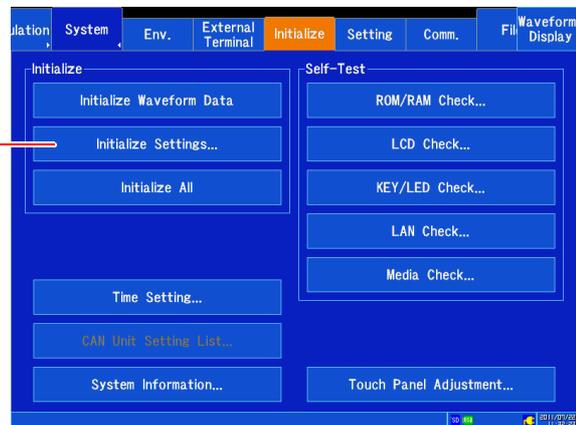
CAN Waveform data and CAN unit settings configured with the application

System System tab environment, external terminal settings (excluding settings configured with [System] u [Env.] u [Region])

Communication System tab communications settings

4 [OK] ► [Yes]

When the following message is displayed, the initialization process is complete: "The settings have been initialized." To cancel, tap "No."



- You can select all settings at once by tapping [Select All].
- Setting conditions stored in the instrument's memory will not be reset.

Initializing all settings (system reset)

[Initialize All] u [Yes]

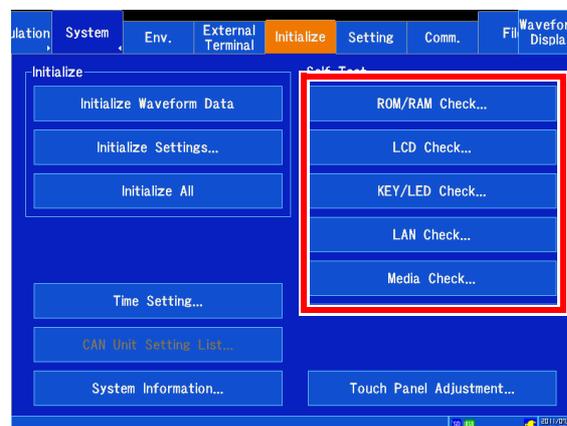
Or, turn on the instrument while pressing the **START** key and **STOP** key.

Setting conditions are not initialized by [Initialize Settings], but they can be initialized by using [Initialize All].

11.4 Self-check Functionality

This section describes how to perform a self-check. The results will be displayed on the screen. If an error or malfunction is found, the instrument will need to be repaired. Contact your dealer or Hioki representative.

- 1 Open the screen.
 [Setting Display] ► [System] ► [Initialize]
- 2 Tap the self-check you wish to perform.
 Follow the instructions on the screen.



Checking ROM/RAM

This section describes how to check the instrument's internal memory (ROM and RAM). RAM contents are not affected.

Tap [ROM/RAM Check].

The ROM/RAM self-check will begin.

The following items are checked in this order:

Program ROM → Backup RAM → Work RAM → Address bus → Storage RAM

Do not turn off the instrument while the self-check is in progress.

To abort the self-check:

Press the **STOP** key or tap [Abort]. The instrument cannot be operated (except the **STOP** key) while the self-check is in progress.

A judgment result will be displayed when the self-check completes.

[OK]: Normal

[NG]: Error/malfunction

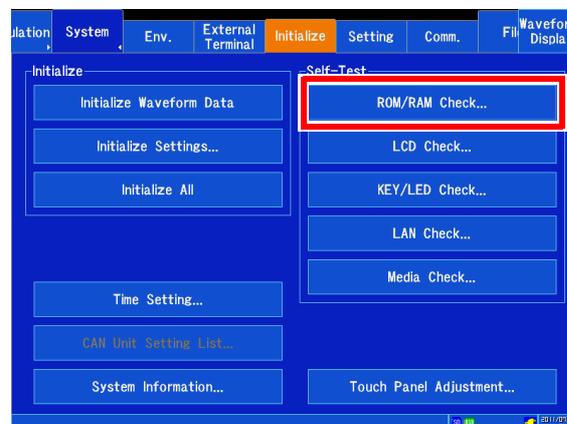
If [NG] is displayed, have the instrument repaired.

To perform the self-check again:

Tapping [Execute] after canceling the self-test or after the self-check completes causes the self-check to start again from the first item. Tapping [Close] returns to the original screen.

To check detailed NG results:

Tap [Detail] for the item that generated the [NG] result.



Checking the LCD

This section describes how to check the screen's display status.

1 Tap [LCD Check].

2 Check the display status.

The screen will change each time you press a key or tap the screen.

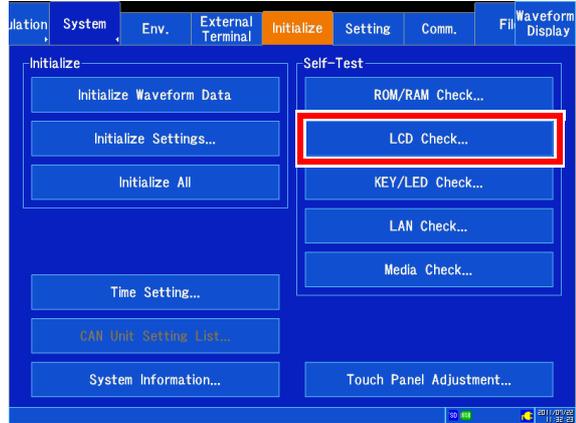
Screen changes:

Solid-color self-check (red, green, blue, black, white)
 → color pattern → text self-check → original screen

If a screen malfunction is found, have the instrument repaired.

To abort the self-check:

Press the **START** key and the **STOP** key at the same time. The instrument will return to the original screen.



Checking keys and LEDs

This section describes how to verify that the keys can be input normally and that the LEDs are operating normally.

1 Tap [KEY/LED Check].

2 Touch each key at least once.

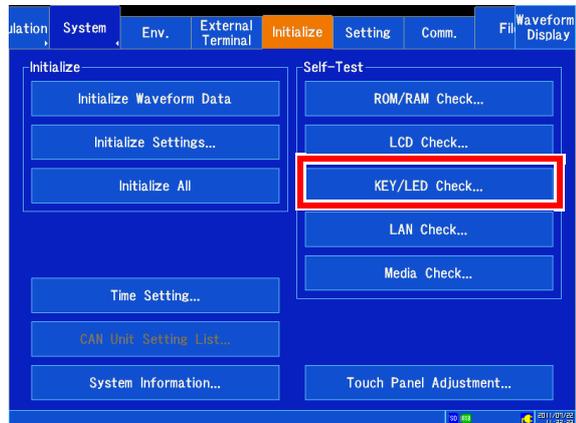
The color of the corresponding button will change.

With the exception of the **STOP** key, each key's LEDs are checked at the same time. Verify that each key's LED lights up when it is pressed.

Once you have pressed all the keys, the check is complete.

To abort the check:

Press the **START** key and the **STOP** key at the same time. The instrument will return to the original screen.



If any key malfunctions or is not recognized, you will be unable to end the key check. If this occurs, you can return to the original screen by pressing the **START key and the **STOP** key at the same time. The instrument may be experiencing an error or malfunction and should be repaired.**

If the **START key or **STOP** key is malfunctioning, you will be unable to return to the original screen. Instead, turn off the instrument and have it repaired.**

If you press a key but its LED does not light up, have the instrument repaired.

Checking the LAN

This section describes how to check the LAN's current settings and status. You can also check the instrument's ability to communicate with other equipment.

Checking the connection status (LAN connection status)

1 Tap [LAN Check].

If the interface is set to **[USB]**, you will be unable to select this button.

Checking the connected device (when you wish to check the status of the connection with a specified device)

2 [IP Address] ► Change the value.

Set the IP address of the device.

See: "6.2 Changing and Entering Values" (p. 145)

3 Tap [Start].

The connection confirmation will begin.

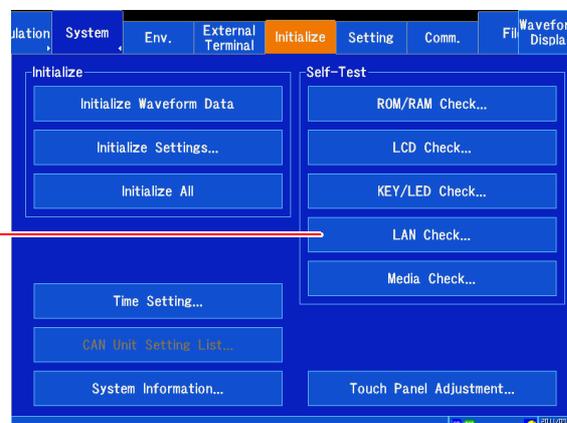
The connection result will be displayed.

If "LOST=0" is displayed, the device is connected normally.

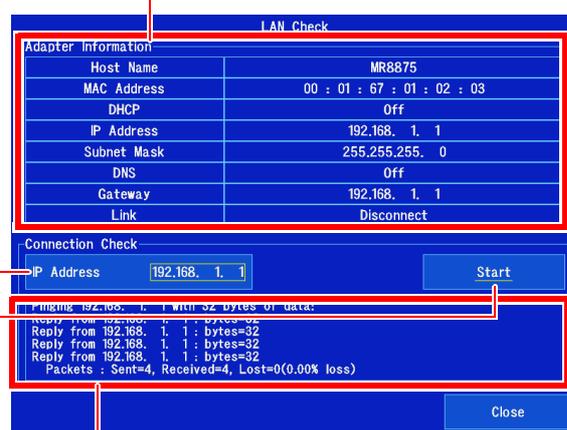
Tapping **[Close]** returns to the original screen.

To abort the check:

Press the **START** key and the **STOP** key at the same time.



Current connection settings



Connection results

NOTE

The IP address 127.0.0.1 indicates the instrument. Consequently, setting **[IP Address]** to 127.0.0.1 and checking the connection will always yield a result of "LOST=0."



If there is no reply

- Verify that the LAN cable is properly connected.
- Check the communications settings and repeat the LAN check (p. 280).
- If a firewall has been configured for the device, there may be no reply.

Checking media

This section describes how to check the status of media. Before performing this self-check, verify that the media you wish to check has been inserted into the instrument.

- 1 Tap **[Media Check]**.
- 2 **[Media]** ► Tap to switch.

Select the media you wish to check.
Select(*: Initial setting)

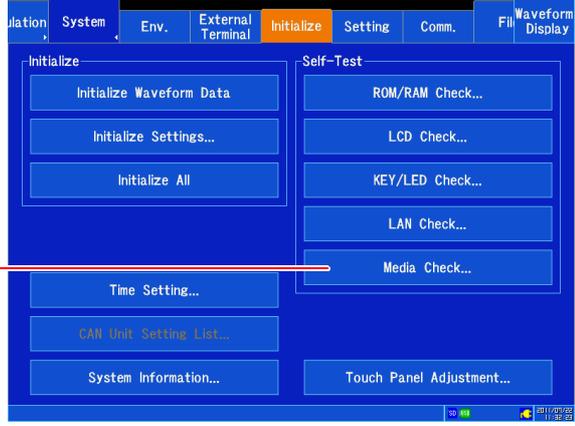
SD Card*, USB Memory

Information about the selected media will be displayed on the screen.

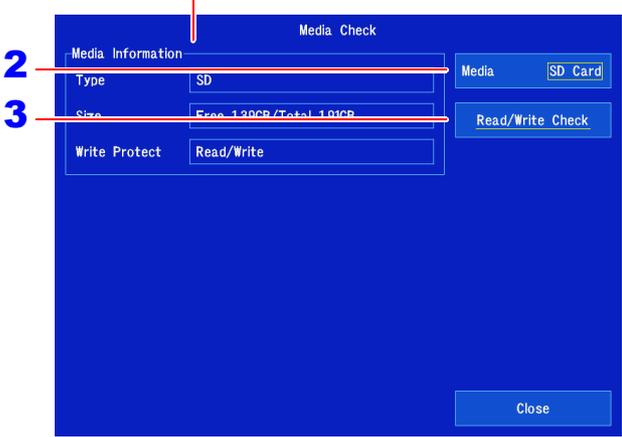
- 3 Tap **[Read/Write Check]**.

The check results will be displayed.

Tapping **[Close]** returns to the original screen.



Current connection settings



CAUTION

Because **[Read/Write Check]** actually writes data to the media, it may cause the media or data to be corrupted. Do not use this feature with media on which you have stored important data.

11.5 Correcting the Touch Panel

This section describes how to correct the touch panel when it fails to respond properly or when touch locations are not detected accurately.

1 Open the screen.

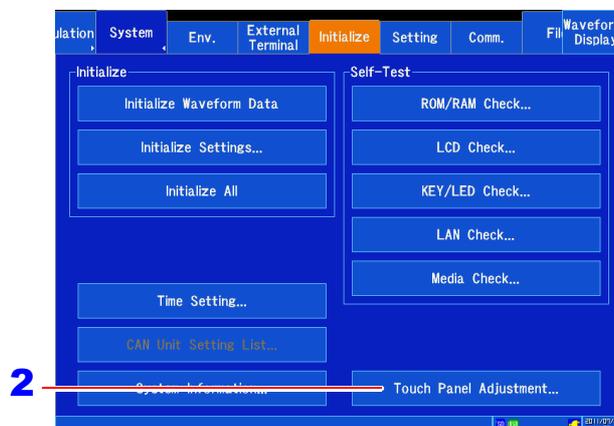
[Setting Display] ► [System] ► [Initialize]

2 Tap [Touch Panel Adjustment].

Follow the instructions on the screen. If you are unable to proceed with the correction process by touching the screen, the screen may be malfunctioning. Have the instrument repaired.

3 Tap [Yes].

The display will return to the original screen.



To cancel the operation:

Tap [No].

Alternately, if you do nothing, the operation will be automatically cancelled in 10 seconds.

To abort the operation:

Press the **START** key and the **STOP** key at the same time to return to the original screen.

NOTE

- Cancel the key lock before correcting the touch panel.
- The touch panel cannot be corrected by means of remote operation (via the Web).



If you are unable to operate the screen because the touch panel is misaligned

You can display the touch panel correction screen by turning on the instrument while pressing the **HELP** key.

11.6 System Configuration Check

This section describes how to check the functions and hardware installed on the instrument. The process it describes can also be used to check the MR8904 CAN Unit settings. For more information about the MR8904 CAN Unit, see the instruction manual on the included CD.

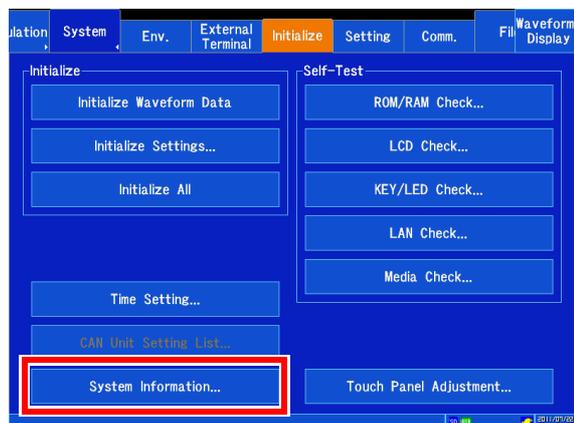
1 Open the screen.

[Setting Display] ► [System] ►
[Initialize]

2 Tap [System Information].

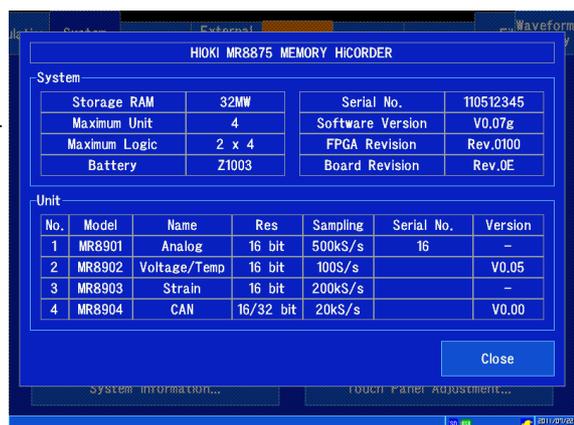
The Screen Configuration List window will be displayed.

Tapping [Close] returns to the original screen.



Information about built-in functionality

Information about connected input modules



Connection to a PC

Chapter 12

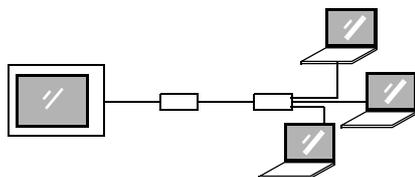
This instrument is equipped with an Ethernet 100BASE-TX interface for LAN communications. You can control the instrument from PCs and other devices by connecting it to a network with 10BASE-T or 100BASE-TX cable (maximum length 100 m).

You can also connect the instrument directly to a PC with a USB cable.

CAUTION When connecting the instrument to your LAN using a LAN cable of more than 30 m or with a cable laid outdoors, take appropriate countermeasures that include installing a surge protector for LANs. Such signal wiring is susceptible to induced lighting, which can cause damage to the instrument.

LAN connections and settings (p. 280)

- Connecting the instrument and a PC over a network



- Connecting the instrument to a single PC



Controlling the instrument by command communications (p. 311)

You can control the instrument by creating programs and connecting to the command communications port by TCP (p. 311).

The instrument can also be controlled using a USB (p. 313).

For more information about commands, refer to the communications operation manual on the supplied application disk.

Manipulating instrument files using the FTP server function (p. 285)

The MR8875 includes an FTP server function.

By using FTP client software on your PC, you can transfer files on the instrument's media to the PC and perform other file operations.

Sending instrument data using the FTP client function (p. 288)

You can send data to an FTP server on your PC. Once measurement is complete, measurement data can be sent. Additionally, you can send data manually.

Controlling the instrument remotely using an Internet browser (p. 301)

Sending e-mail (p. 306)

You can automatically or manually send measurement data by e-mail after measurement.

Communicating using a USB cable (p. 313)



Analyzing data with the Waveform Viewer (included) (p. 321)

12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)

Before using an FTP client or Internet browser on a PC or using command communications, it is necessary to configure the LAN port with the instrument and connect the instrument and PC with a LAN cable.

NOTE Always make LAN settings before connecting to the network. If you change settings while connected to the network, IP addresses may overlap or invalid address data may flow over the network.

Things to Check Before Making Settings

Settings differ depending on whether you wish to connect the instrument to an existing network or create a new network consisting of a PC and the instrument.

When Connecting the instrument to an Existing Network

The following items must be assigned in advance by your network administrator. Be sure that there is no conflict with other devices.

- **Whether to use DHCP:** Yes/No
- **The host name and address of the instrument**
 Hostname (up to 15 characters): _____
 IP address: _____._____._____._____
 Subnet mask: _____._____._____._____
 (The IP address and subnet mask do not need to be set when using DHCP.)
- **DNS settings**
 Whether to use DNS: Yes/No
 IP address (if using): _____._____._____._____
 (The IP address does not need to be set when using DHCP since it is acquired automatically.)
- **Gateway**
 Whether to use the gateway: Yes/No
 IP address (if using): _____._____._____._____
 (There is no need to set the IP address when using DHCP since it is acquired automatically.)
- **Port number to use for communications commands:** ____ (default: 8802)

When Configuring a New Network with a PC and This Instrument

(Using as Local Network Without External Connections)

If there is not administrator for your network, or if you have been entrusted with settings, the following addresses are recommended.

```

(Example settings)
IP address
PC: 192.168.0.1
First recorder: 192.168.0.2
Second recorder: 192.168.0.3
Third recorder: 192.168.0.4 ...and so forth in order.
      ↓                ↓
Hostname ..... Set as desired (Give each device a unique name.)
Subnet mask..... 255.255.255.0
Gateway ..... Off
DNS ..... Off
DHCP ..... Off
Port no. .... 880X

```

12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)

Setting Items

Interface	Select LAN or USB. When set to LAN, the USB communications function cannot be used. When set to USB, the LAN communications function cannot be used.
DHCP (Dynamic Host Configuration Protocol)	DHCP is a method for allowing a device to automatically acquire its IP address and other information. When DHCP is enabled and there is a DHCP server operating on the same network, the IP address, subnet mask, and gateway can be automatically acquired. If there is no DHCP server operating, the default IP address will be assigned.
Host Name	The hostname identifies the instrument. Set so that the same name is not shared with other devices. The host does not support dynamic DNS, so the set hostname should not be registered with the DNS.
IP Address	The IP address identifies individual devices that are connected to the network. Set so that the same address is not shared with other devices. When DHCP is enabled, the IP address is automatically set by DHCP.
Subnet Mask	The subnet mask is used to separate the IP address into an address identifying the network and an address identifying the device. Devices on the same network should share the same subnet mask. When DHCP is enabled, the subnet mask is automatically set by DHCP.
DNS (Domain Name System)	When DNS is enabled, devices can be specified by name rather than IP address. (IP addresses consist of multiple numbers and are hard to remember. It is easier to specify devices by name than by IP address.) When a server for converting IP addresses into names is operating on the network, the server can be queried to find a device's IP address based on its name. When DHCP is enabled, DNS information is acquired from DHCP.
Gateway IP address	<ul style="list-style-type: none"> When connected to a network When the PC to be used (for communications) exists on a different network from the instrument, set to [On] and specify the device that will serve as the gateway. When the PC exists on the same network, the default gateway with which the PC is configured can generally be used. When connecting the instrument to a single PC Since this functionality is not necessary when connecting the instrument and PC to the same hub, set to [Off]. When DHCP is enabled, the gateway IP address is acquired from DHCP.
Port Number	The port number specifies the TPC/IP port number to use when making a communication command connection.
Header On/Off	This setting is used when controlling the instrument with communication commands. The header setting controls whether a header will be appended to command responses. For more information about commands, see the communications instruction manual on the included applications disc.
Delimiter	The delimiter sets whether to use LF or CR+LF as the command response line break. The instrument accepts either LF or CR+LF.

Authorization User Name and Password

These are used when you login to the instrument by FTP, or use a PC browser (with the authorization setting set to on).

When authorization is enabled, login is not possible unless a correct user name and password are entered. This setting is recommended if you wish to restrict the users who can access the instrument.

The "Password" item is displayed as "*****".

If you want to allow anyone to access, or you wish to login as "anonymous" with a FTP client, leave the user name and password fields blank.

NOTE Hostnames

Valid characters:

Letters (uppercase), numbers, symbols (hyphen and underscore only)

Characters other than the above cannot be used. Hostnames cannot begin with a number or symbol or end with a symbol.

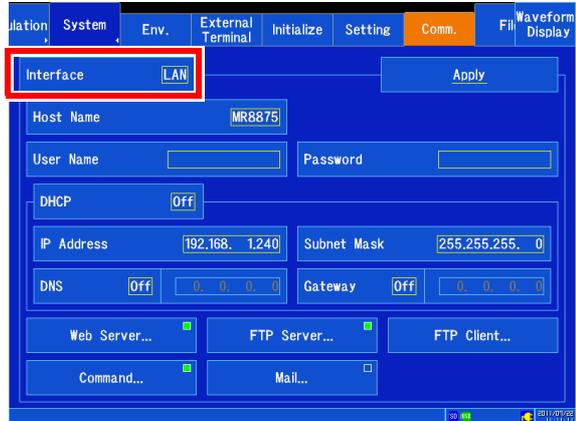
For IP addresses and other information about the network in use, contact your network's system administrator.

Configuring LAN settings with the instrument

This section describes how to configure LAN settings according to your objective.

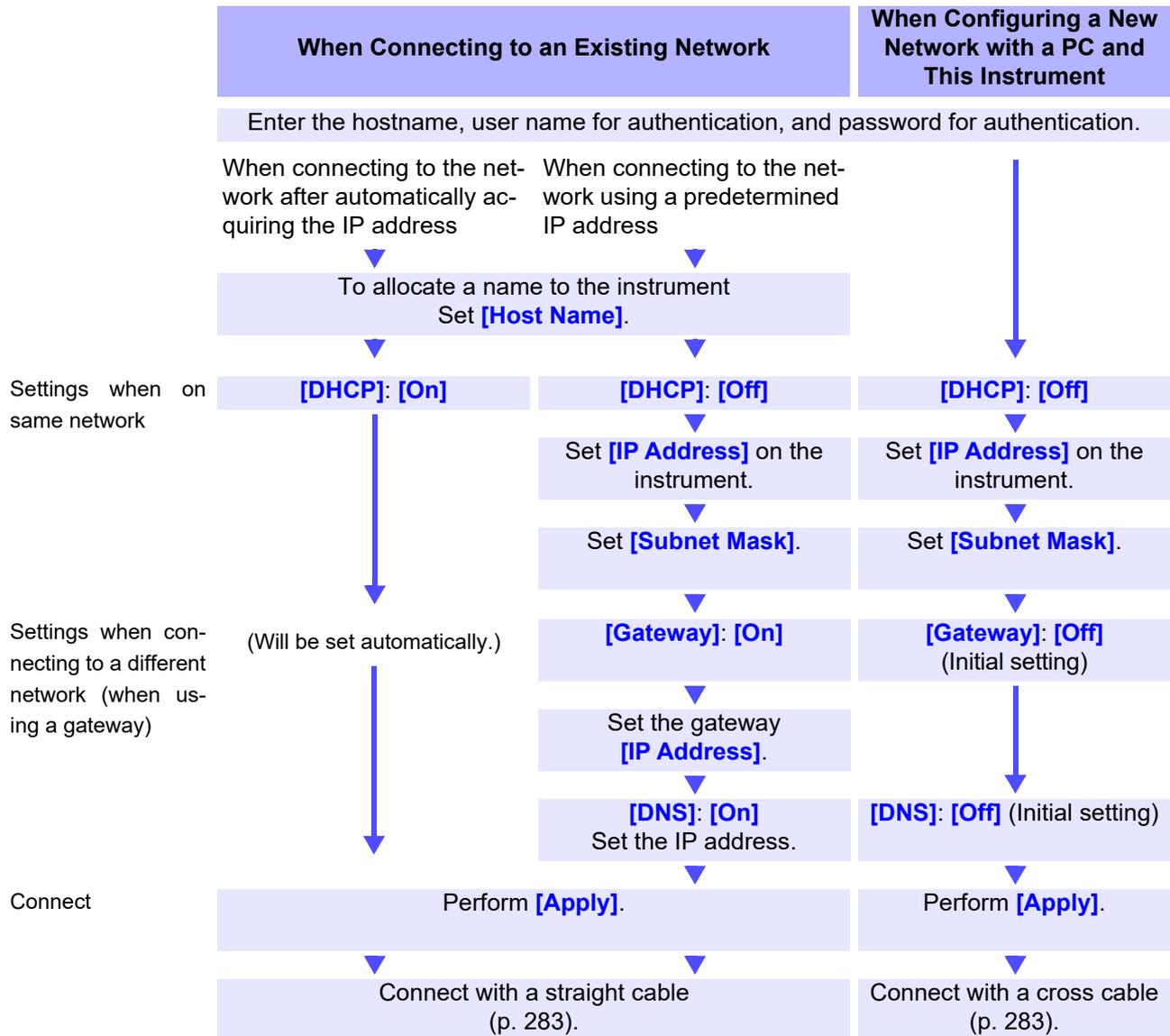
1 Open the screen.
 [Setting Display] ► [System] ► [Comm.]

2 Set [Interface] to [LAN].
 Configure the LAN settings.



For more information about each setting, see "Setting Items" (p. 281).

About the network
 For IP addresses and other information about the network in use, contact your network's system administrator.



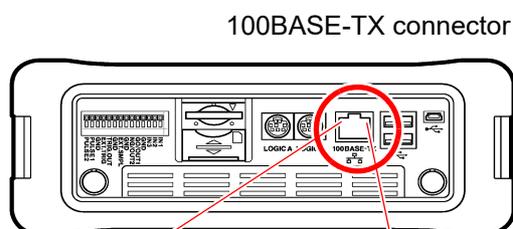
12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)

Connecting the instrument and PC with a LAN cable

Connect the instrument and PC with a LAN cable.

There are two ways to accomplish this connection:

- Connect the instrument to an existing network.
- Connect the instrument to a single PC (p. 284).



Orange LED

Lights up when the communications speed is 100 Mbps and turns off when the communications speed is 10 Mbps.

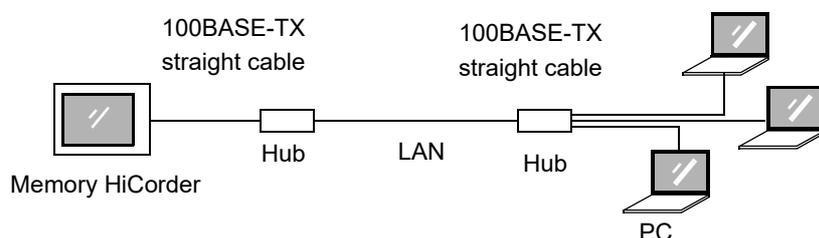
Green LED

Lights up when a link is established and flashes when communications are in progress.

- 1 Connect a LAN cable (that is compatible with 100BASE-TX) to the 100BASE-TX connector on the right side of the instrument.
- 2 Connect the LAN cable to the PC.

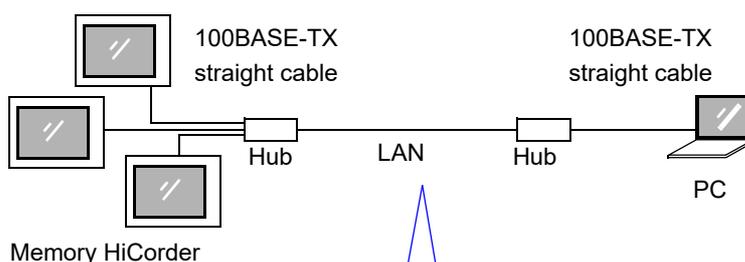
NOTE If the green LED fails to light up when the instrument is connected to a LAN, there may be an issue with the instrument, the target device, or the connection cable.

When connecting the instrument to an existing network

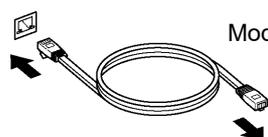


You can monitor and control the instrument from a PC by connecting the instrument to a hub with LAN cable (100BASE-TX cable).

When connecting multiple instruments to a single PC



100BASE-TX connector on instrument



Model 9642 LAN Cable

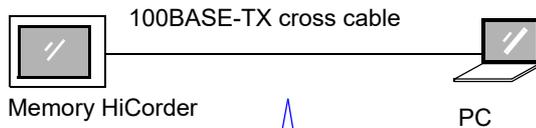
Connect to hub

Connection cable: Use one of the following.

- 100BASE-TX straight-through cable (maximum length 100 m, commercially available) (10BASE-T cable may also be used for 10BASE communications)
- Model 9642 LAN Cable (option)

12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)

Making 1:1 Connections Between the Instrument and a PC

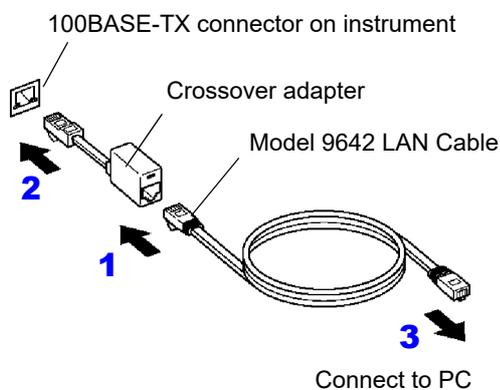


You can monitor and control the instrument from a PC by connecting the instrument to the PC with LAN cable (100BASE-TX cable)

Connecting with the 9642 LAN Cable and crossover adapter (supplied)

Connection cable: Use one of the following.

- 100BASE-TX crossover cable (maximum length 100 m)
- 100BASE-TX straight-through cable with crossover adapter (maximum length 100 m)
- Model 9642 LAN Cable (option, supplied with crossover adapter)



- 1** Connect the 9642 LAN Cable to the supplied crossover adapter.
- 2** Connect the crossover adapter to the 100BASE-TX connector on the instrument.
- 3** Connect the 9642 LAN Cable to the 100BASE-TX connector on the PC.

This completes the process of connecting the instrument and PC.

The next section describes how to access instrument files from the PC.

See: "12.2 Using the FTP Server Function to Access Instrument Data" (p. 285)

"12.4 Operating the Instrument from a PC's Browser" (p. 301)

"12.5 Sending E-mail" (p. 306)

"12.6 Controlling the Instrument with Command Communications" (p. 311)

12.2 Using the FTP Server Function to Access Instrument Data

FTP client software on the PC can be used to transfer files on the instrument's media to the PC and perform other file operations.

- The instrument provides FTP server functionality.
- This functionality can be used from Explorer or via free software.

Procedure

- 1** Configure the LAN port and connect the instrument (p. 280).
- 2** Configure the FTP function on the instrument (p. 286).
- 3** Using the FTP function from a PC, transfer data from the instrument and perform other file operations (p. 287).

Before connecting the instrument

- NOTE**
- The instrument's FTP server supports only one connection. You cannot access data simultaneously from multiple PCs.
 - If no command is sent for 1 minute after establishing an FTP connection, the connection may be disconnected. If this happens, re-connect.
 - FTP server operation is aborted during real-time saving (while measurement is in progress).
 - Disconnect any FTP connection before inserting or removing an SD memory card or USB flash drive.
 - Do not perform file operations while the FTP server is operating.
 - The file modification date and time shown by Internet Explorer[®] may not match that shown by the instrument.
 - Internet Explorer[®] retains data from the previous access in the form of Internet temporary files and may acquire old data instead of the most recent data.
 - When moving files or folders with some PC FTP clients and browsers, canceling the operation before it has completed may cause all associated files or folders to be deleted, regardless of whether they had been sent. Avoid using move functionality, instead downloading files with the copy function and then deleting them.
 - Exercise caution as FTP clients send usernames and passwords over the network as plain text.
 - When uploading a file, it will be assigned the time at which it was uploaded.
 - The FTP server presents media as directories.
 - Directory structure
 - /SD (SD memory card)
 - /USB (USB flash drive)
 - /STORAGE (internal instrument measurement data) (*No write access)

Configuring FTP on the instrument

1 Open the screen.
 [Setting Display] ► [System] ► [Comm.] ► [Interface: LAN]

2 Set [Host Name], [User Name], and [Password].

Tap to display the character entry screen. These settings are entered in the same way as comments.

See: "6.1 Adding Comments" (p. 142),
 About host names and authentication user-names and passwords (p. 281)

3 Tap [FTP Server].

A window will open.

4 Set [Use] to [On].

Initial setting: On (use FTP)

5 [Access Restrictions] ► Tap to switch.

Set access privileges.

Select (*: Initial setting)

Read Only	Performs read access only, preventing instrument files from being deleted or changed from outside the instrument.
Full Access*	Writes (uploads) files to the media in addition to deleting files and changing filenames.

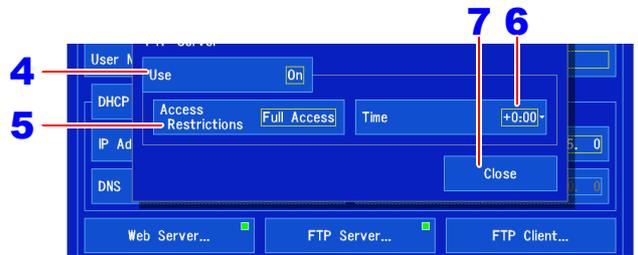
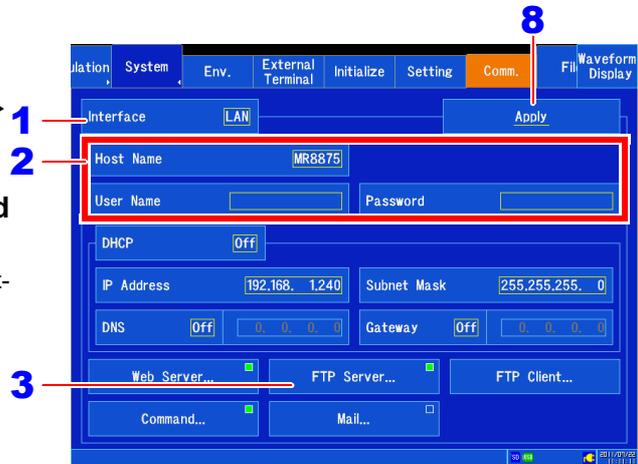
6 [Time] ► Select from the list.

The initial setting of [+0:00] can typically be used.

7 Tap [Close].

The window will close.

8 [Apply] ► Tap [Yes].



Setting the file time difference
 When certain versions of Internet Explorer® are used, file times will differ by the difference between the PC time and the instrument time. If this occurs, you can correct the time by the set difference. Conversely, the setting will cause a discrepancy in the time associated with files accessed from an FTP client other than Internet Explorer®.

Example: -9:00

Accessing the instrument from a PC (FTP server function)

This section describes how to access the instrument from Windows 7 Explorer as an example.

1 Launch File Explorer on the PC.

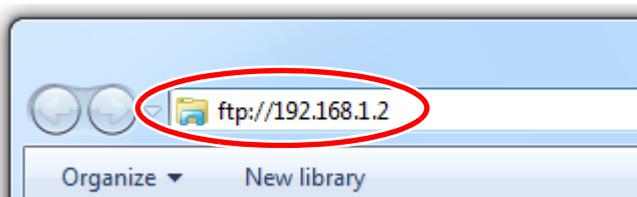
Click the Explorer icon on the Windows 7 task bar to launch File Explorer.



2 Enter the IP address.

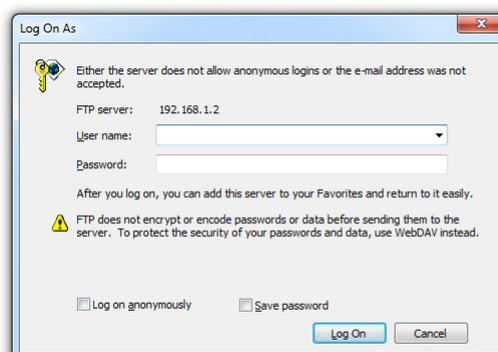
Click the File Explorer address field and enter the IP address.

Enter "ftp://" followed by the instrument's IP address.



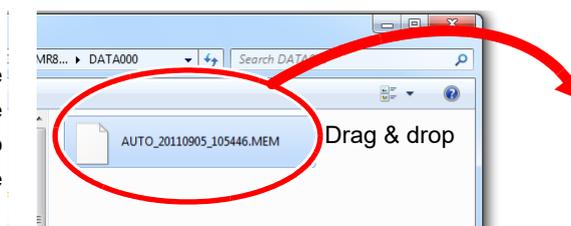
3 Log in.

If an authentication username and password have been set for the instrument, a login screen will be displayed. Log in by entering the username and password.



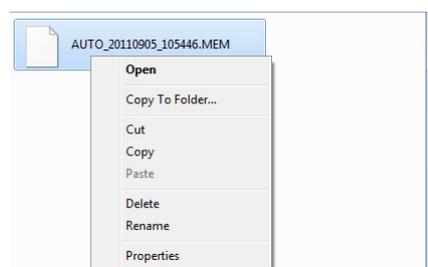
4 Download files.

Select the file you wish to download from the file list and drag and drop it with the mouse to the download destination (click the file and move it to the desired location while holding down the mouse button).



5 Delete files or change filenames.

Right-click the files in the FTP folder list and select "Delete" or "Rename" from the pull-down menu.



12.3 Sending Data to a PC Using the FTP Client Function

The instrument includes an FTP file transmission function (FTP client), allowing you to send data over the network to an FTP server.

Sending data using FTP

Sending auto-save data	Sends measurement data automatically at the completion of measurement. Enable the auto-save function and configure the FTP function with the save location. See: "Automatically Saving" (p. 93)
Sending data using the SAVE key	You can send waveforms and other data stored in the instrument's memory by pressing the SAVE key when you use the manual save setting and configure the FTP function with the save location. See: "Selecting and saving data (SAVE key)" (p. 98)
Sending a selected file	You can send a file by selecting it from the file list on the File screen: [File] ► [Operation] ► Select the file. ◀ [File Operate] ► [FTP] . See: "4.6 Managing Files" (p. 108)

- NOTE**
- Sent files assume the date on which they were sent.
 - The ability to send data to all FTP servers is not guaranteed due to differences in server operation.
 - If a file of the same name exists at the destination, it will be overwritten.
 - Exercise caution as FTP clients send usernames and passwords over the network as plain text.

- 1** Configure the LAN port and connect the instrument (p. 280).
- 2** Set up an FTP server on the PC (p. 289).
- 3** Configure FTP transmission on the instrument (p. 299).
- 4** Set the destination depending on the transmission method.

Setting up an FTP server on a PC

This section describes how to set up an FTP server on a PC using Windows XP and Windows 7 as the examples.

- NOTE**
- The necessary settings may differ depending on the environment. Refer to the FTP server's help as necessary or consult with your network administrator.
 - You will need Windows® administrator privileges in order to make these settings.

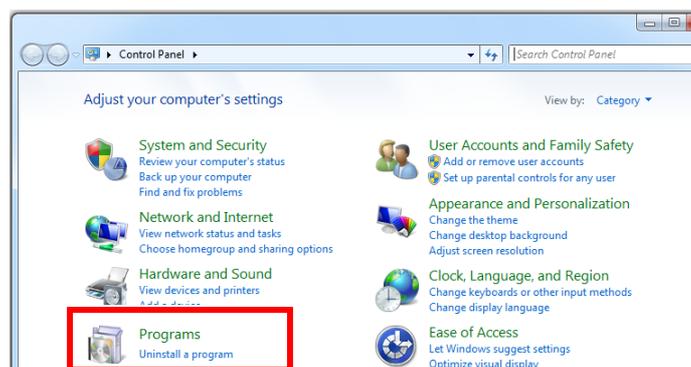
(Windows® Home Edition does not include an FTP server. Instead use FileZilla Server or another freeware alternative.)

- NOTE** The necessary settings may differ depending on the environment. If unable to establish a connection, refer to the FTP server's help or consult with your network administrator.

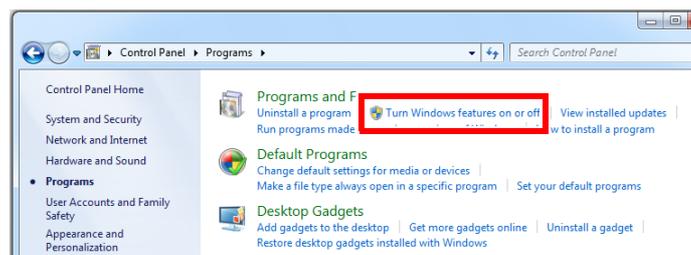
Windows 7

Installing the FTP server

- 1 Select **[Programs]** under **[Control Panel]**.



- 2 Select **[Turn Windows features on or off]**.

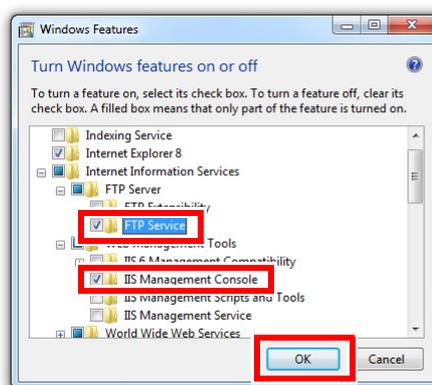


- 3 On Windows®, click the **[+]** button to the left of **[Internet Information Services]** to expand the list of functions.

Click the **[+]** button to the left of **[FTP Server]** and check **[FTP Service]**. Click the **[+]** button to the left of **[Web Management Tools]** and check **[IIS Management Console]**.

Click **[OK]**.

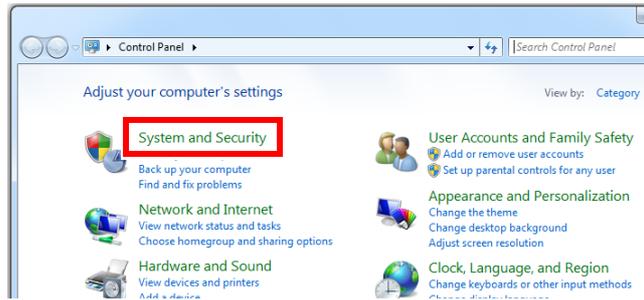
This completes the installation of the FTP server.



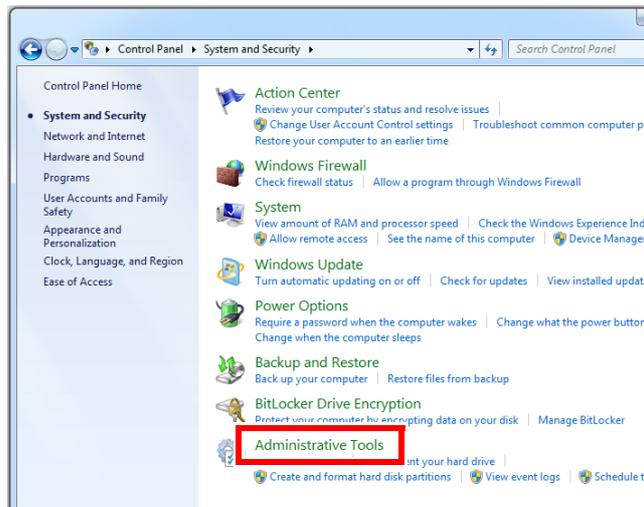
12.3 Sending Data to a PC Using the FTP Client Function

Configuring the FTP server

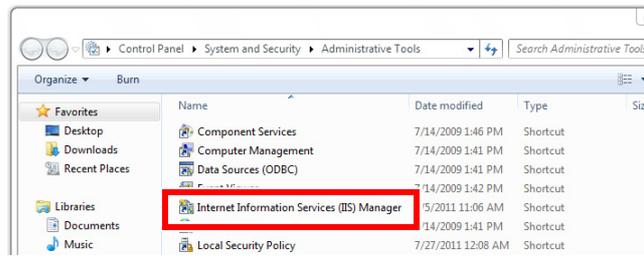
4 Select the [System and Security] control panel.



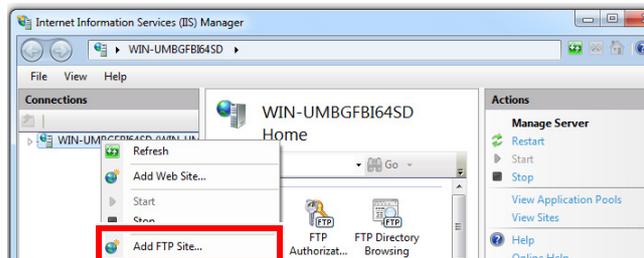
5 Select [Administrative Tools].



6 Select [Internet Information Services (IIS) Manager] from [Administrative Tools].



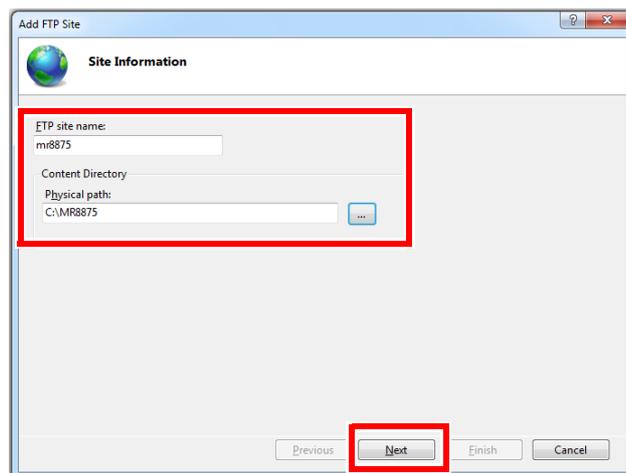
7 Right-click on the item listed as a connection in the left box to display the menu and select [Add FTP Site].



NOTE Communications may be blocked depending on the settings for software (for example, a firewall) used to protect the computer.

- 8** Enter the site information and click the **[Next]** button.

Use an FTP site name such as **[mr8875]**. Set the directory into which you wish to save data from the FTP client as the content directory.



- 9** Configure the bind and SSL settings and click the **[Next]** button.

Configure the settings as follows:

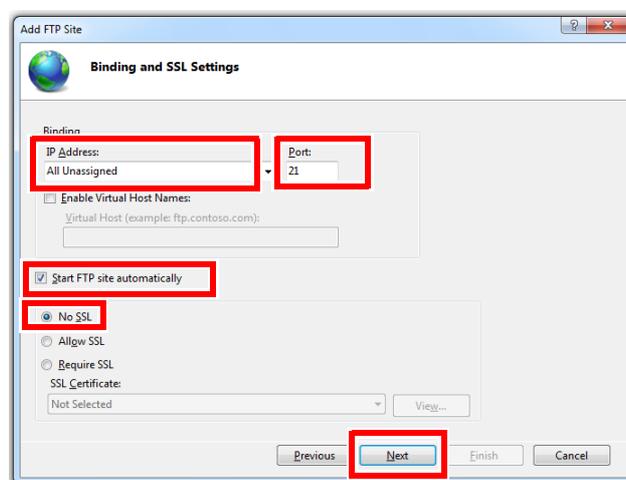
Bind settings

IP address: All Unassigned

Port: 21

Start FTP site automatically: Check

SSL: No SSL



- 10** Enter authentication and approval information and click the **[Finish]** button.

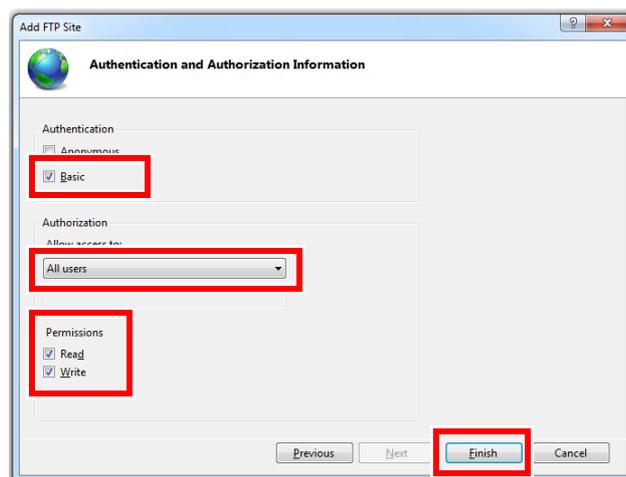
Configure the settings as follows:

Authentication: Basic

Authorization: All users

Permissions: Check both Read and Write.

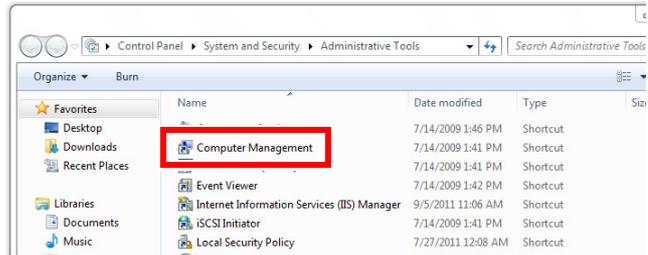
This completes the configuration of the FTP server.



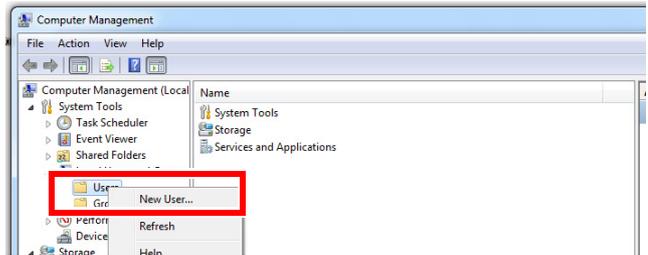
12.3 Sending Data to a PC Using the FTP Client Function

Setting the users that will access the server

11 Select **[Computer Management]** from the management tool in step "6" (p. 290).



12 Right-click on local users and group users to display the menu and select **[New User]**.

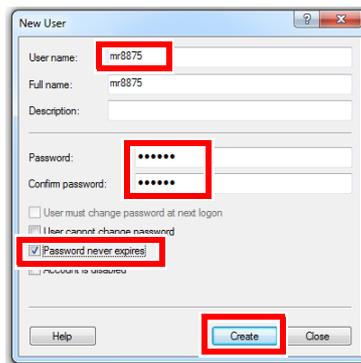


13 Set the user and click the **[Create]** button.

Set the username and password and select the **[Password never expires]** check box.

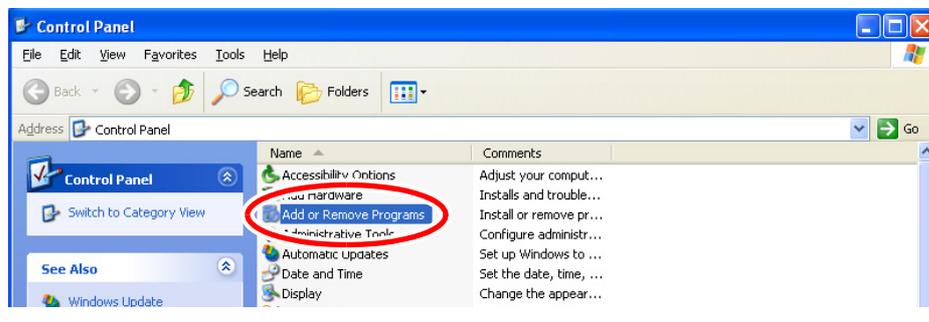
This completes the user configuration process.

You can use the FTP server by using the created username and password.

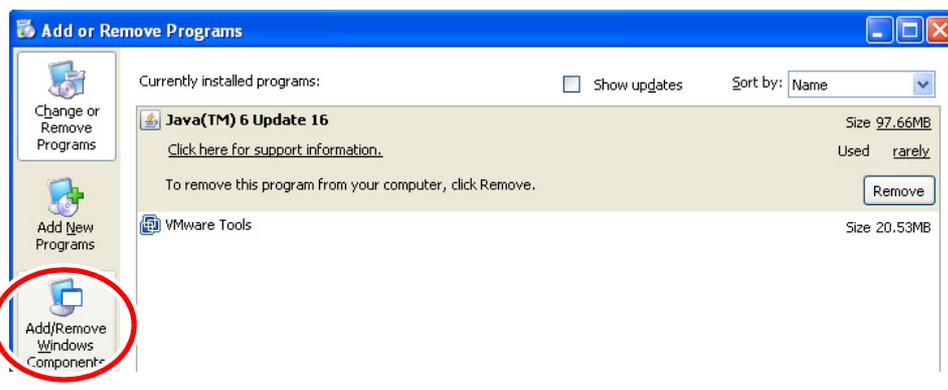


Windows XP

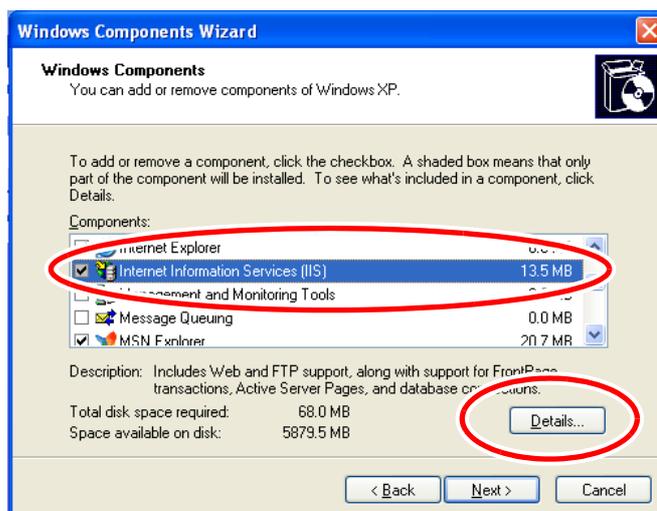
- 1 In the [Control Panel], select [Add or Remove Programs].



- 2 Select [Add/Remove Windows Components].

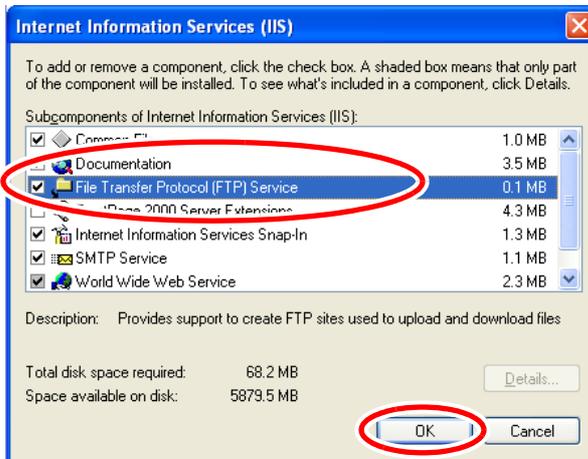


- 3 Select [Internet Information Services (IIS)], and then [Details].

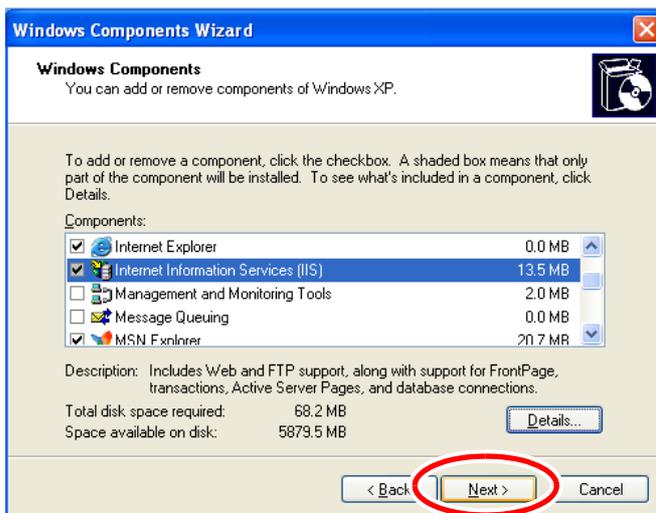


12.3 Sending Data to a PC Using the FTP Client Function

- 4 Select [File Transfer Protocol (FTP) Service], and click [OK].



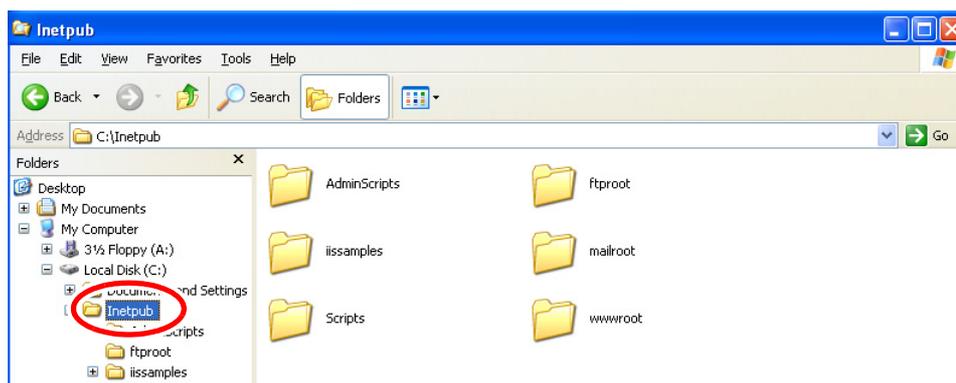
- 5 Click [Next].
At this point, your Windows XP CD is requested.



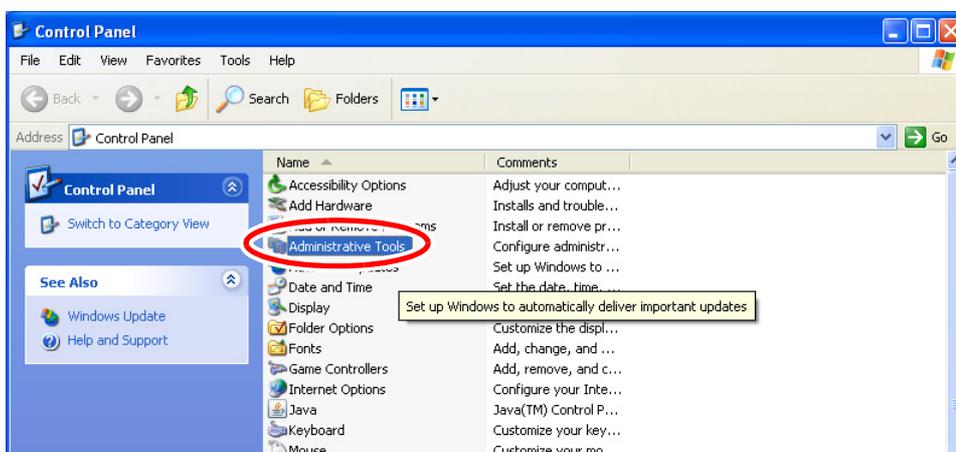
6 Click [Finish].



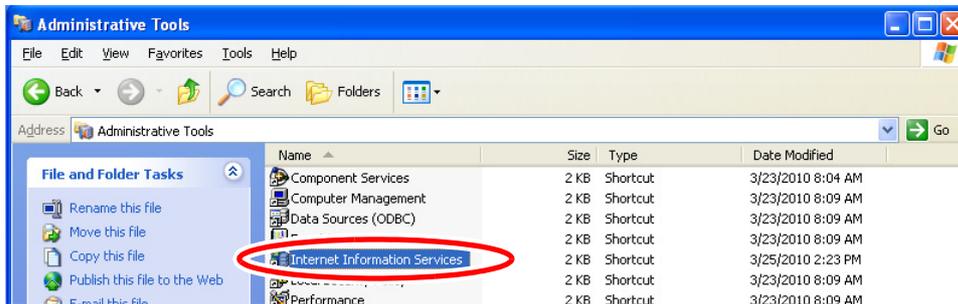
When installation is finished, the [InetPub] folder is created.



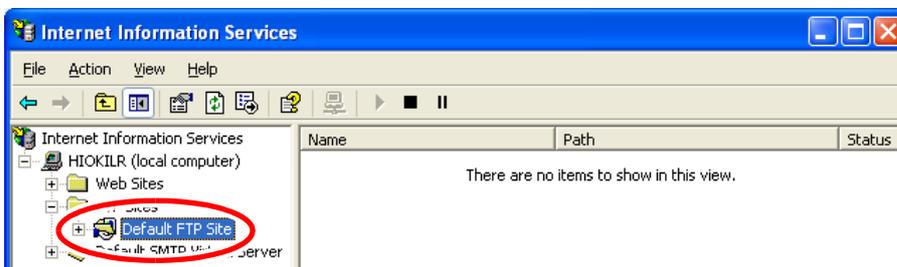
7 In the [Control Panel], select [Administrative Tools].



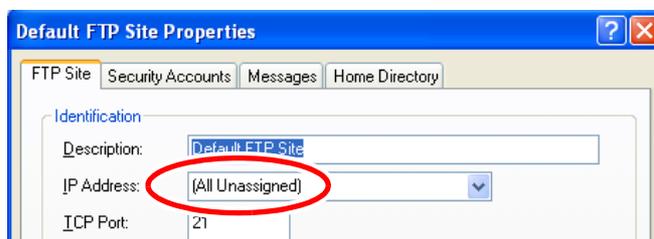
8 Select [Internet Information Services].



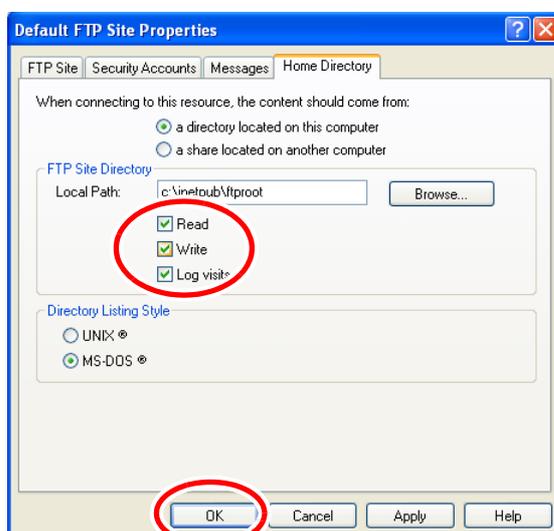
9 Select [Default FTP Site], and right click to select [Properties].



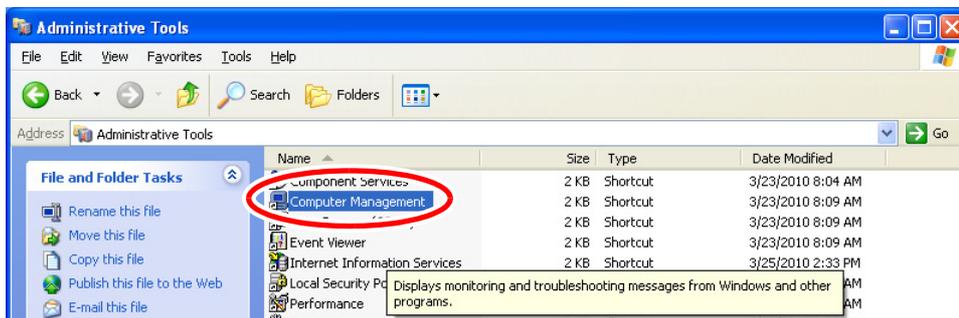
10 For the IP Address, select [(All Unassigned)].



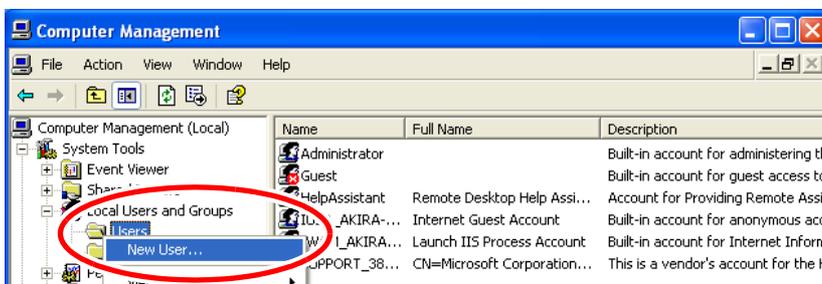
11 On the [Home Directory] tab, select [Read], [Write], and [Log visits], and click [OK].



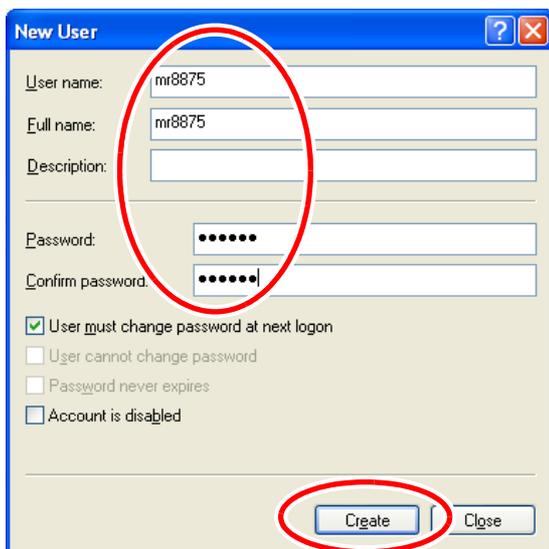
- 12** Back in the [Administrative Tools], select [Computer Management].



- 13** In [Local Users and Groups], select [Users] then right click in the right pane and select [New User].

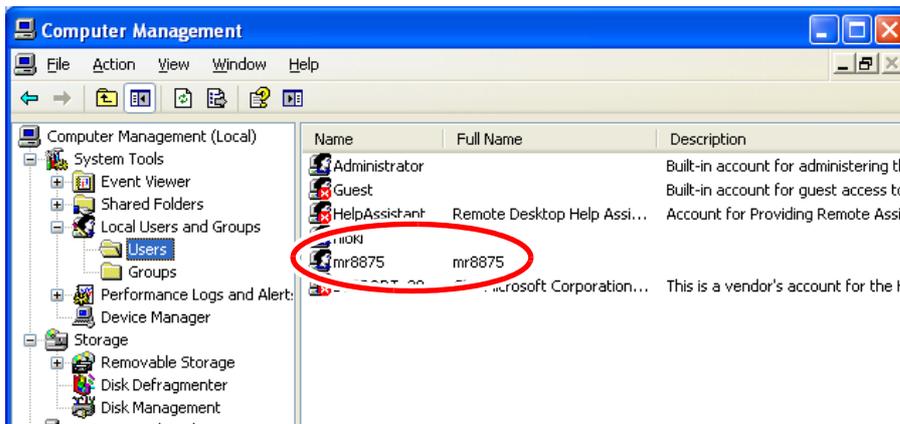


- 14** Enter a user name, full name, password and confirmation (e.g., "mr8875"), and click [Create].



12.3 Sending Data to a PC Using the FTP Client Function

The created **[mr8875]** user is registered.



This completes FTP setup on the PC.

FTP functionality can be accessed by using the created username and password.

Configuring FTP transmission with the instrument

1 Open the screen.

[Setting Display] ► [System] ► [Comm.] ► [FTP Client]

2 Set [Server] and [Port].

Enter the FTP server's address. Tap to display the character input screen and the number change panel. The character input method is the same as used for comments.

See: "6.1 Adding Comments" (p. 142)

If not using the standard port number of 21, set the FTP server port number.

Set [Server] to the hostname or IP address.

Example: For an IP address, enter 192.168.0.1.

3 [Directory] ► Enter characters.

Specify the directory into which to save files sent to the FTP server.

When saving [Calc. Results] either automatically or manually, another directory ("measurement") will be created in the specified directory, and the data will be saved in that directory.

See: "6.1 Adding Comments" (p. 142)

4 [Login]/[Password] ► Enter characters.

Enter the username and password used to log into the FTP server.

Use the same username and password with which you configured the FTP server.

See: "6.1 Adding Comments" (p. 142)

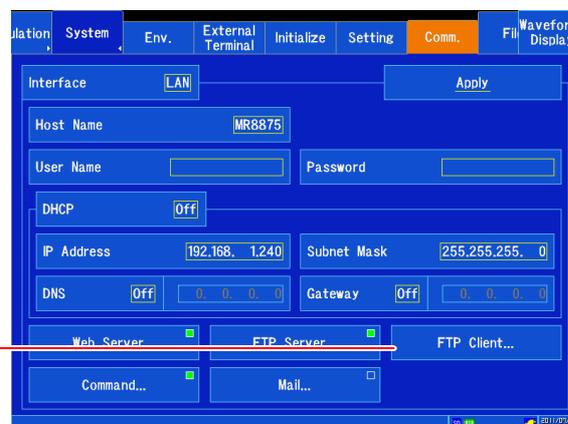
5 [PASV Mode] ► Tap to switch.

Specify if using PASV mode when sending data.
Select(*: Initial setting)

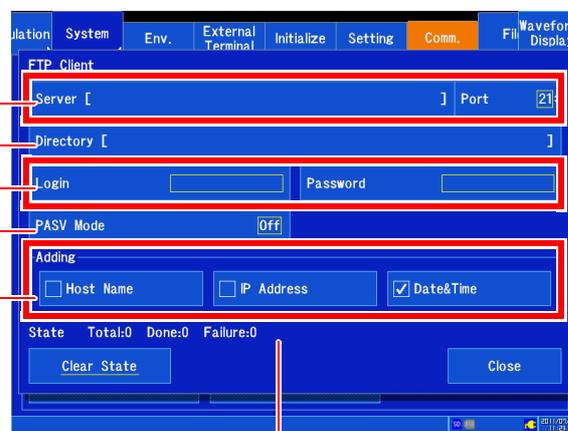
Off*	Disables PASV mode.
On	Enables PASV mode.

6 [Adding]

Select this check box if you wish to append an identifier to the filename.



1



2

3

4

5

6

Indicates the communications status.

- When sending a file by selecting it on the File screen, the identifier is not appended. Files with the same name will be overwritten.
- When saving [Calc. Results] with [Append] as the file specification, the time will not be added to the identifier. Additionally, if a file with the same name exists, the function will attempt to add the data to that file.
- When not selecting the [Adding] setting, files with the same name will be overwritten. If [Date&Time] is not checked, for example during continuous measurement, all files will be overwritten with the same file.

**To check the FTP communications status or reset the communications status**

You can check the FTP transmission status with the **[State]** item.

- **[Total]**: Total number of files sent using FTP
- **[Done]**: Number of files sent using FTP
- **[Failure]**: Number of files whose transmission failed using FTP

Files whose transmission fails using FTP are discarded.

[Clear State]

Deletes the FTP communications status.

**To back up data when an error occurs while sending auto-save data**

You can save the measurement data or other data that was to have been sent to the specified instrument media when the transmission of auto-save data fails.

Using the **[Waveform Display]** ► **[Status]** ► **[Auto Save]** setting or **[Setting Display]** ► **[Status]** u **[Auto Save Settings]** setting, set the **[Save in]** setting to **[FTP]** and set the media to which you wish to save data to **[Backup]**.

12.4 Operating the Instrument from a PC's Browser

You can configure, operate, and capture data from the instrument using a PC Web browser such as Internet Explorer®.

Note: It is recommended to use Internet Explorer® Version 7 or later.

Connecting and configuring the LAN port

See: "12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)" (p. 280)

Configuring the Web server

1 Open the screen.

[Setting Display] ► [System] ► [Comm.] ► [Interface: LAN]

2 (If you wish to authenticate)

Set the authentication login name and password.

These are the same as the [User Name] and [Password] set with the FTP server.

See: "Configuring FTP on the instrument" (p. 286)

3 Tap [Web Server].

A window will open.

4 [Use] ► Tap to switch.

To use, set to on.
Select (*: Initial setting)

On*	Use.
Off	Do not use.

5 [Access Restrictions] ► Tap to switch.

Set whether to allow operation of the instrument via a Web browser.

Select (*: Initial setting)

Full Access*	Enables operation and configuration of the instrument from a browser.
Monitor only	Limits browser access to viewing screens and instrument status information. (You will be able to capture measurement data.)

6 [Authorization] ► Tap to switch.

Configures authentication.

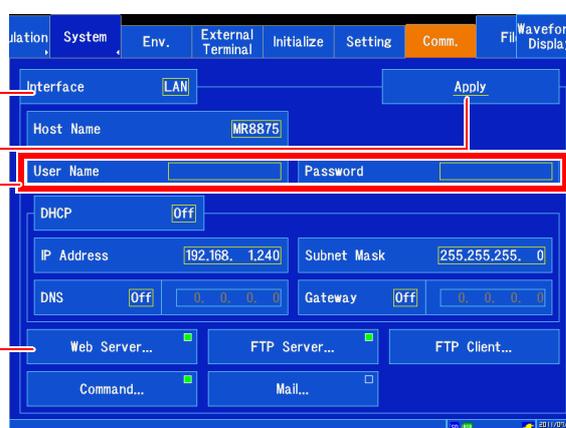
Select (*: Initial setting)

No*	Uses the Web server without authentication.
Yes	Uses the Web server with authentication.

7 Tap [Close].

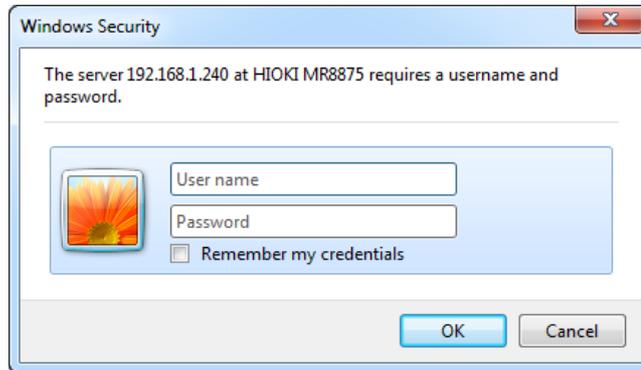
A window will open.

8 [Apply] ► Tap [Yes].

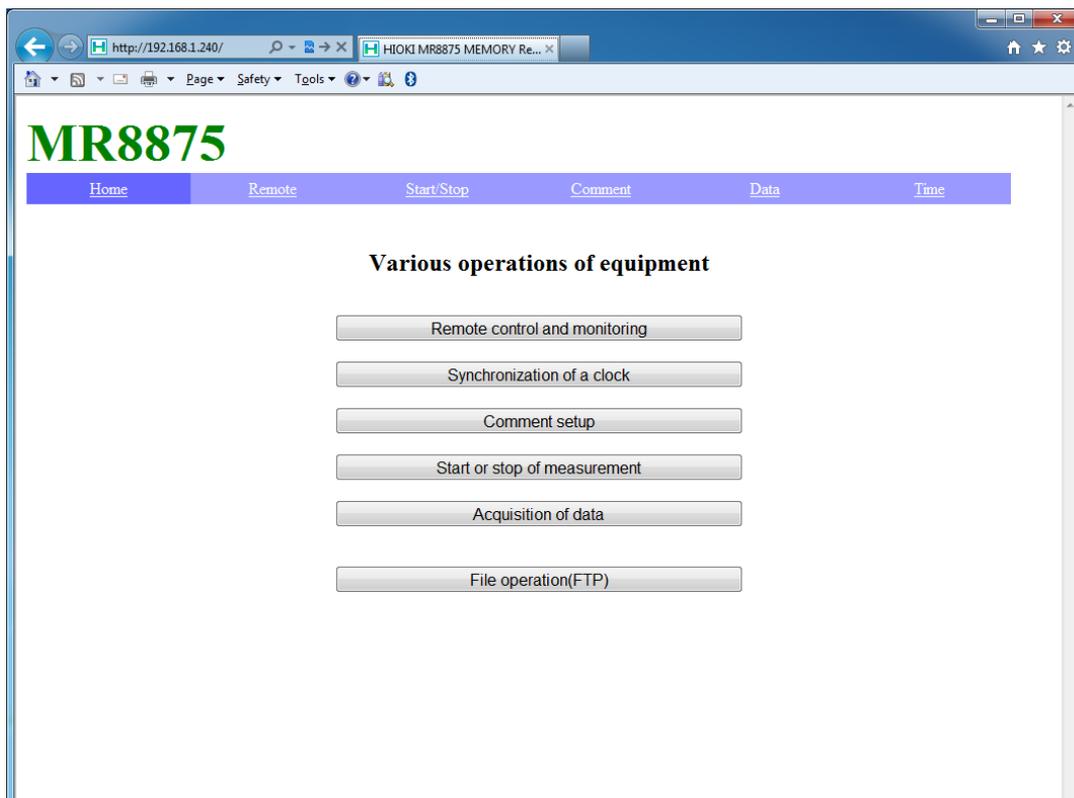


Displaying the home page

Launch Internet Explorer® on the PC and enter the instrument's IP address or hostname into the address bar ("http://"). If authentication has been configured, enter your username and password on the login screen to log in.



The home screen will be displayed when you connect.



Operating the instrument remotely

Selecting **[Remote]** on the menu displays the Remote Operation screen. The screen shown on the instrument will be shown as-is in the browser window.

The buttons on the control panel correspond to the buttons on the instrument. You can also operate the instrument remotely by clicking the screen with the mouse (which has the same effect as tapping the instrument's screen).



You can select how often the screen is updated (update speeds are about 0.3 sec **[High]**, 1 sec **[Normal]**, and 10 sec **[Low]**).

You can save a BMP-format screenshot by clicking the **[Screen copy]** button.

When using Internet Explorer[®], the zoom in/out function at the bottom right of the screen can be used to zoom in and out. You can also zoom in and out on most browsers by using **CTRL + "+"** to zoom in, **CTRL + "-"** to zoom out, and **CTRL + "0"** to select normal size.

Starting and stopping measurement

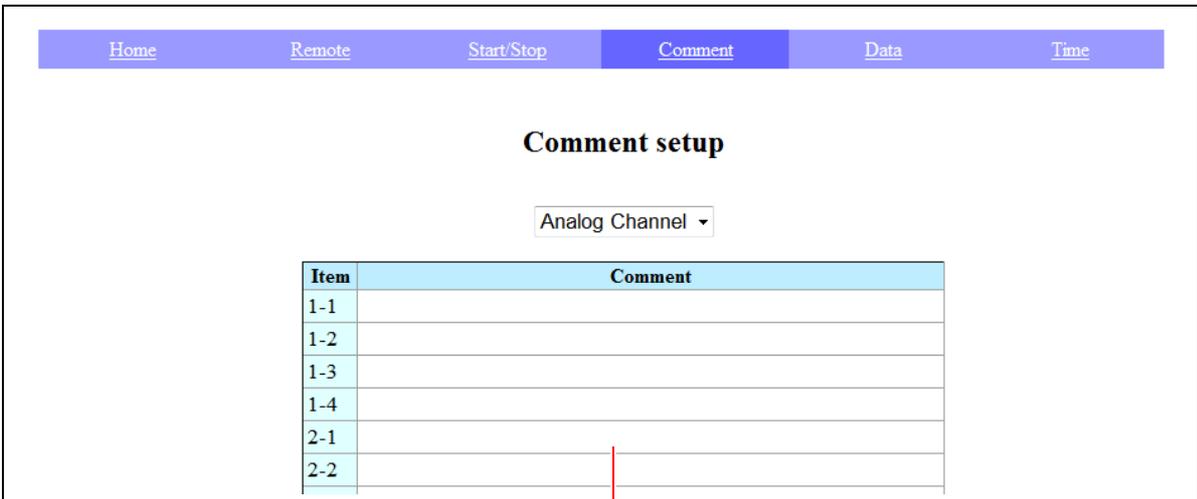
You can start and stop measurement.



- [START]:** Starts measurement.
- [STOP]:** Stops measurement.
- [ABORT]:** Forcibly aborts measurement.
(Post-measurement processing such as numerical calculations and auto-save will not be performed.)

Setting comments

You can set title comments, analog channel comments, logic channel comments, pulse channel comments, inter-channel calculation comments, waveform calculation comments, and FFT calculation comments.



You can set instrument comments by entering comments in the comment field.

Acquiring instrument data

You can acquire data from the instrument's memory.

Select the file format (binary or text) and the data range (all, between the A/B cursors, or between the C/D cursors), and then click "Download" to download the data or "Open by Spreadsheet" to open it in Excel®.

- NOTE**
- Only text files can be opened in Excel®. Excel® may be unable to open datasets normally.
 - You may be unable to open the file normally if the decimal character setting for the instrument's region settings differs from the Windows® setting, or if the delimiter is set to a character other than the comma or tab.

Synchronizing the time

You can synchronize the instrument's time with the PC.

The PC and recorder's times are shown. Click **[SET]** to set the recorder's time to the PC's time.

Note: The time cannot be set while measurement is in progress. There may be an error of about 1 second.

File operations

You can send internal instrument files.

See: "Accessing the instrument from a PC (FTP server function)" (p. 287)

12.5 Sending E-mail

The instrument includes functionality for sending e-mail. You can send e-mail via an SMTP server to a PC on the same network or to a remote PC. You can also place the instrument in a remote location and collect measurement data by attaching files to e-mail messages.

Sending e-mail

How to send e-mail

Auto save e-mail	Attach measurement data to an e-mail message and send it automatically after measurement completes. Configure the auto save setting ([Status] ► [Auto Save] or [Auto Save Settings]) and set the destination to [Mail] (p. 93).
Sending e-mail with the SAVE key	Set manual save functionality ([File] u [Operation]) and set the save destination to [Mail] (p. 98).
Sending e-mail by selecting a file	Select the file you wish to send from the file list on the File screen and attach it to a message to send it. [File] ► [Operation] ► Select the file. ► [File Operate] ► [Mail] The e-mail will be sent when [Mail] is selected.
Test e-mail	Use to check whether e-mail messages are being properly sent (p. 310). A screenshot will be attached in the format selected with [Encrypt Attached File].

Encrypting attachments

You can encrypt screen data, measurement data, and other attachments in order to prevent data from falling into the hands of a third party.

NOTE

- If the transmission conditions occur frequently, e-mail will be sent frequently.
- Attachment data may be very large in size. When too large, the instrument may be unable to send the e-mail normally depending on the communications environment.
- Encryption is performed using the WinZip/AE-2/AES 128-bit ZIP format. The files can be unencrypted and uncompressed using Corel's WinZip utility or freeware such as 7z. The WinZip/AES format provides safer and more robust encryption than the standard ZIP format but is only supported by limited software. WinZip/AES files cannot be uncompressed using the built-in Windows® ZIP utility.
- Encryption is performed using the AES 128-bit algorithm. This algorithm provides robust encryption strength, but there is no guarantee that it cannot be deciphered.
- Store encryption passwords so that they do not fall into the hands of a third party. Note that if you forget your password or make a mistake entering it during the encryption process, you will not be able to decrypt the data.
- When setting or changing the password, always send a test e-mail to verify that the attached data can be uncompressed before using it for critical data.
- When using encryption, ZIP files are not compressed.
- When using ZIP and encryption, conversion can take some time, slowing the transmission process.
- The instrument supports POP-before-SMTP and SMTP-auth (PLAIN/LOGIN/CRAM-MD5) authentication for SMTP. (It does not support IMPA, SSL, or STARTTLS, making it incapable of sending e-mail through certain servers such as Gmail.)
- Due to server-side differences, the instrument is not guaranteed to be able to send e-mail to all SMTP servers.
- AES is the encryption standard of Federal Information Processing Standard (FIPS) 197.
- The instrument can send e-mail but does not provide functionality for receiving messages.
- Compressed/encrypted data cannot be loaded as-is by the instrument or the Waveform Viewer (Wv).

Connecting to and configuring the LAN port

See: "12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)" (p. 280)

Entering text characters

See: "6.1 Adding Comments" (p. 142)

Changing and entering numerical values

See: "6.2 Changing and Entering Values" (p. 145)

Configuring e-mail transmission

1. Configure the e-mail basic settings.

1 Open the screen.

[Setting Display] ► [System] ► 1
[Comm.] ► [Interface: LAN]

2 Tap [Mail].

A window will open.

3 Set [Use] to [On].

(Initial setting: Off)

This setting enables e-mail transmission.

4 Display the [Basic] settings. (Tap to switch or select from the list.)

(Switching: Basic/Body/Advanced)

5 Set the recipient's address.

Enter the e-mail's recipient. Up to three can be set.

[Address1] ► (enabled)

Tap to switch.

[] u Enter an e-mail address for recipient 1.

Tap to display the character entry screen.

(Up to 64 characters)

To send the e-mail to multiple recipients, repeat for [Address2] and [Address3].

You can change the transmission method for recipients 2 and 3 (TO or BCC) by tapping [TO].

6 [Sender Address] ► Enter characters.

Enter the sender's address.

(Up to 64 characters)

7 [Sender Name] ► Enter the recipient's name.

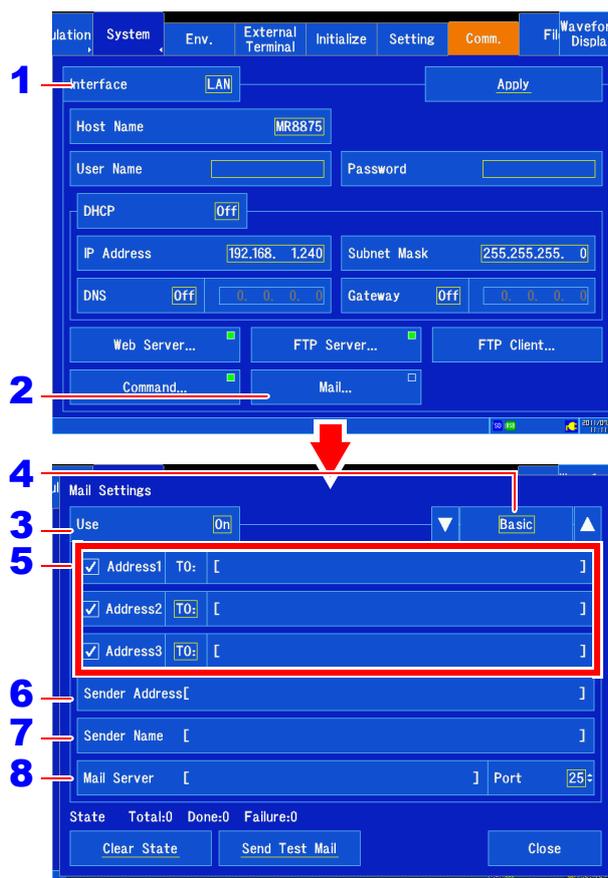
Enter a name so that the recipient can recognize e-mails received from the instrument.

8 [Mail Server] ► Enter characters.

Enter the e-mail server's address. Tap to display the character entry screen.

(Up to 64 characters)

If the SMTP server uses a port number other than the standard setting of 25, enter that port number. Enter a hostname or IP address for the server's address (example: for an IP address, enter 192.168.0.1).



The instrument cannot receive e-mail. If not address has been set for the instrument, the SMTP server e-mail server will not accept e-mail transmission requests from the instrument.

E-mail server
Enter the server name specified by your network system administrator or Internet service provider.

2. Set the e-mail's content.

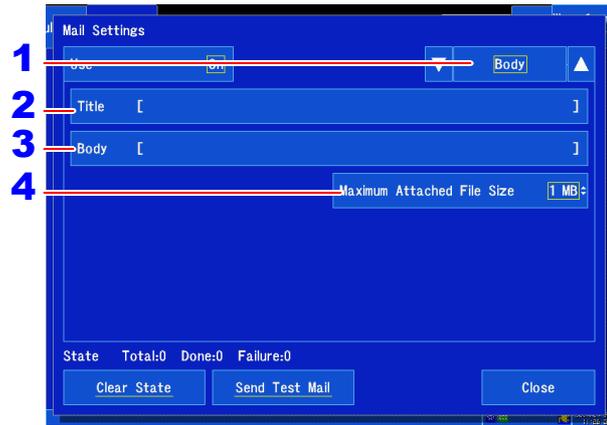
- 1** Display the **[Body]** settings.
(Tap to switch or select from the list.)
- 2** **[Title]** ► Enter characters.
Enter the subject of the e-mail.
- 3** **[Body]** ► Enter characters.
The set text will appear on the first line of the message. (Enter up to 80 characters.)

- 4** **[Maximum Attached File Size]** ► Change the value.

Set an upper limit for the file size so that excessively large data files are not sent to the e-mail server. When using auto save functionality, the e-mail will not be sent if the waveform data exceeds this size.

Valid setting range (*: Initial setting)

1MB* to 2048MB



Attachment file size

- Depending on server and other limitations, the instrument may not be able to send data that falls within the set size limit.
- Although attachments are converted for attachment purposes (base-64/compression/encryption), the size limit applies to the data before conversion. Consequently, the actual e-mail data may be larger (by about 4/3) than the specified size limit.

3. Configure authentication, compression, and encryption.

1 Display the **[Advanced]** settings.
(Tap to switch or select from the list.)

2 **[Sncrypt Attached File]** ► Tap to switch.

Set how to compress and encrypt attachments.

Select (*: Initial setting)

Off*	Attaches the file without changing its format.
ZIP	Compresses the file using ZIP.
ZIP+AES	Sends the attachment as an encrypted ZIP file. The file will not be compressed.

3 (If encrypting attachments)

[Password] ► Enter characters.

Enter a password (up to 16 characters).

4 (If e-mail authentication is required)

[Authorization] ► Tap to switch.

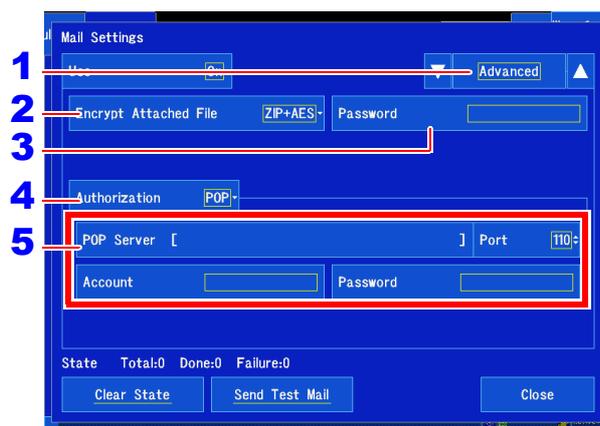
Specify the authentication type.

Select (*: Initial setting)

Off*	Disables authentication.
POP	Uses POP (APOP) before SMTP.
SMTP	Uses SMTP authentication (CRAM-MD5, PLAIN, and LOGIN are supported).

5 Set the authentication information.

- When using POP authentication
Set the POP server and port. If left blank, the address of the e-mail server used to send the message will be used (normally the same address is used).
Enter the username and password for authentication.
- When using SMTP authentication
Set the SMTP server and port. Enter the username and password for authentication.



Encryption of attachments

- Encryption is performed using the WinZip/AE-2/AES 128-bit ZIP format. The files can be unencrypted and uncompressed using Core's WinZip utility or freeware such as 7z.
- Enabling ZIP/encryption causes it to take longer to send messages.

Encryption password

- Store encryption passwords so that they do not fall into the hands of a third party.
- Note that if you forget your password or make a mistake entering it during the encryption process, you will not be able to decrypt the data.
- When setting or changing the password, always send a test e-mail to verify that the attached data can be uncompressed before using it for critical data.

E-mail authentication

The instrument supports POP before SMTP and SMTP authentication when sending e-mails.



To back up data when an error occurs while sending auto-save data

You can save the measurement data or other data that was to have been sent to the specified instrument media when the transmission of auto-save data fails.

Using the **[Waveform Display]** ► **[Status]** ► **[Auto Save]** setting or **[Setting Display]** ► **[Status]** u **[Auto Save Settings]** setting, set the **[Save in]** setting to **[Mail]** and set the media to which you wish to save data to **[Backup]**.

4. Verify e-mail transmission and reset the communications status.

Check whether e-mail can be sent normally.

[Send Test Mail]

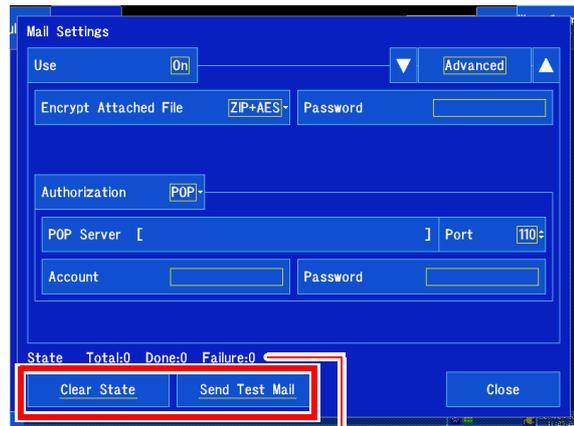
A test e-mail will be sent using the configured settings. Check whether the e-mail can be received normally. If you are unable to receive the test e-mail at the set recipient's address, check the settings.

If the encryption of attachments is turned on, the test e-mail's image will be encrypted. Try decrypting it to check if the password has been set correctly.

Reset the communications status.

[Clear State]

Delete the e-mail communications status.



Displays the communications status.



To check the e-mail communications status

You can check the e-mail transmission status under [State].

- [Total] : Number of e-mails that have been sent
- [Done] : Number of e-mails that have been received
- [Failure] : Number of e-mails whose transmission failed
E-mails whose transmission fails are deleted.

12.6 Controlling the Instrument with Command Communications

The instrument can be controlled using commands from an external source by means of its communications interfaces. Communications can be accomplished with a LAN connection or USB cable. For more information about commands, see the communications instruction manual on the included application disc.

Communications using a LAN connection

Before communications can be performed, you must configure the LAN connection.

See: "12.1 Configuring and Connecting to the LAN Port (Before Using Command Communications)" (p. 280)

Communications using a USB cable

See: "12.8 Loading Data into a PC Using a USB Cable" (p. 313)

Configuring commands

1 Open the screen.

[Setting Display] ► [System] ► [Comm.] ► [Interface: LAN]

2 Set [Host Name], [User Name], and [Password].

Tap to display the character entry screen. These settings are entered in the same way as comments.

See: "6.1 Adding Comments" (p. 142)

About host names and authentication user-names and passwords (p. 281)

3 Tap [Command].

The Communication Command Settings window will be displayed.

4 Set [Use] to [On].

(Initial setting: On [use communication commands])

5 [Delimiter] ► Tap to switch.

Select the character code (line break code) to use to indicate divisions in the data.

Select (*: Initial setting)

LF	Sends the character code 0x0a.
CR+LF*	Sends the character code 0x0d and 0x0a.

6 [Header] ► Tap to switch.

Set whether to attach a header to the command response.

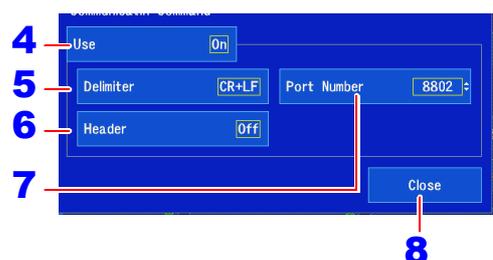
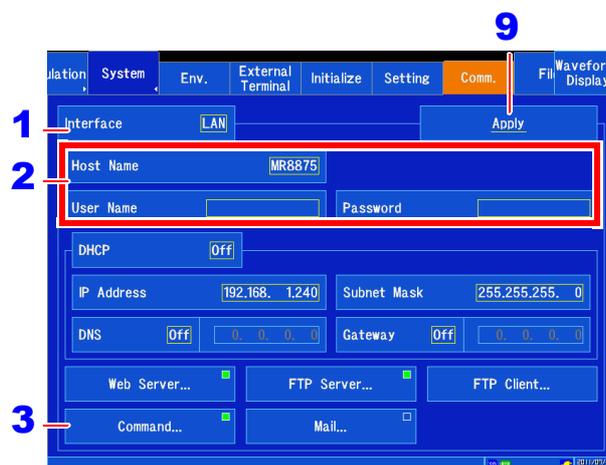
Select (*: Initial setting)

Off*	Does not attach a header to the response data.
On	Attaches a header to the response data.

7 [Port Number] ► Change the value.

Set the port number. (Initial setting: 8802)

See: "6.2 Changing and Entering Values" (p. 145)



8 Tap [Close].

The window will close.

9 [Apply] ► Tap [Yes].

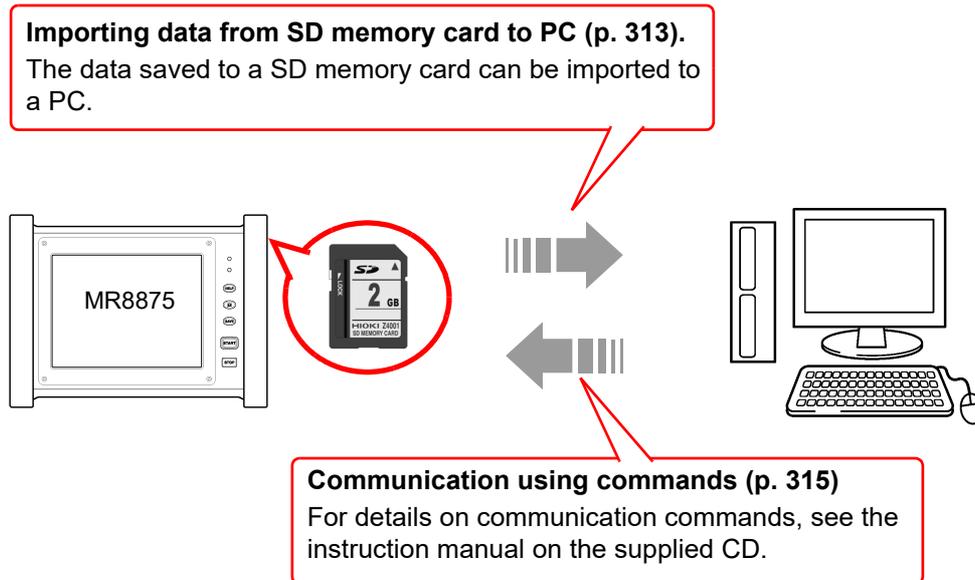
Port number

Specify only the upper three digits of the four-digit port number. The final digit is fixed at 2.

12.7 USB Settings and Connections

Connecting the instrument to a PC via a USB cable allows you to import the data on a SD memory card to the PC (p. 313), and perform command communication (p. 315).

After configuring and connecting USB



12.8 Loading Data into a PC Using a USB Cable

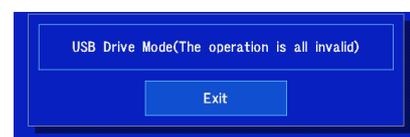
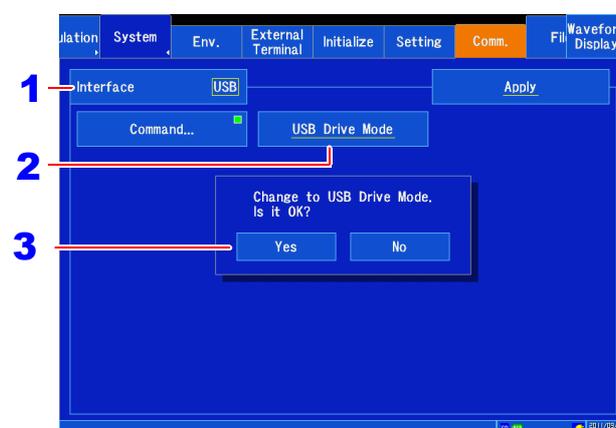
You can control the instrument from a PC by connecting it to the PC with the included USB cable. Before connecting the USB cable to the instrument, set **[USB Drive Mode]**.

CAUTION USB Drive Mode cannot be used with Windows 2000.

Select the USB Drive Mode

- 1** Open the screen.
[Setting Display] ▶ [System] ▶ [Comm.] ▶ [Interface: USB]
- 2** Tap [USB Drive Mode].
- 3** Tap [Yes].
- 4** Connect the USB cable (p. 314).

To cancel USB drive mode:
Tap [Exit].



- NOTE**
- In USB Drive Mode, no operation other than disabling USB Drive Mode can be performed on the instrument.
 - When disconnecting the instrument from the PC, always use the PC's "Remove hardware" command.

Connecting the Instrument and PC

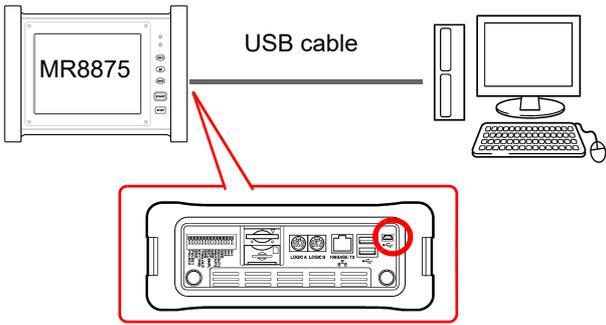
PC Requirements: A personal computer running Windows XP, Windows Vista®, Windows 7, Windows 8 or Windows 10.

CAUTION

- Do not eject the SD memory card and USB flash drive, or pull out the USB cable during data transfer. Doing so would prevent proper data transfer.
- The Memory HiCorder and PC should be connected to the same earth ground. If grounded separately, potential difference between the ground points can cause malfunctions or damage when connecting the USB cable.

NOTE Before connecting the USB cable to the HiCorder, select the USB Drive Mode on the **[Setting Display] ▶ [System] ▶ [Comm.]** screen. If you connect the USB cable without setting **[USB Drive Mode]**, the data on the SD memory card of the instrument are not able to be accessed.

- 1** Connect one end of the USB cable to the USB cable slot on the instrument while making sure the plug is oriented correctly.
- 2** Connect the other end of the cable to a USB port on the PC.
The PC should recognize the Memory HiCorder as a removable disk when the cable is connected.



To exit USB Drive Mode

- 1** Click the Safely Remove Hardware () icon in the Windows® notification area.
- 2** Click the appropriate line “Safely remove USB Mass Storage Device – Drive(H:)” where H is the drive letter that Windows® assigned to the HiCorder.
- 3** When “Safe to remove hardware” appears, click **[X]** or **[OK]**.
- 4** Disconnect the USB cable.



12.9 Communicating with Commands Using a USB Cable

If you use the supplied USB cable to connect the instrument to the PC, you can perform command communication using communication commands. The first time you perform communication between the instrument and PC, install the USB driver (p. 316).

NOTE This instrument cannot be powered by the bus of a PC or USB hub. When using the instrument, connect the AC adapter or install battery packs.

This instruction manual only describes the instrument settings. For details on communication commands, refer to the Communication Commands Instruction Manual (HTML format) on the supplied CD.

Setting Communication (when using communication commands)

1 Open the screen.

[Setting Display] ► [System] ► 1
[Comm.] ► [Interface: USB]

2 Tap [Command].

The Communication Command Settings window will be displayed.

3 [Delimiter] ► Tap to switch.

Select the character code (line break code) to use to indicate divisions in the data.

Select (*: Initial setting)

LF	Send character code 0x0a.
CR+LF*	Send character codes 0x0d and 0x0a.

4 [Header] ► Tap to switch.

Set whether to attach a header to the command response.

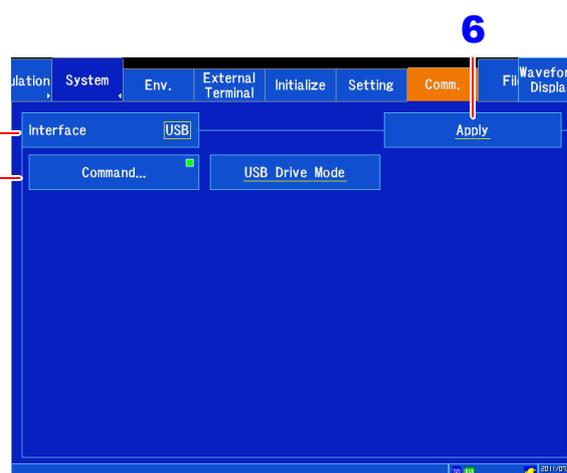
Select (*: Initial setting)

Off*	Does not add a header.
On	Adds a header.

5 Tap [Close].

The window will close.

6 [Apply] ► Tap [Yes].



Installing the USB Driver

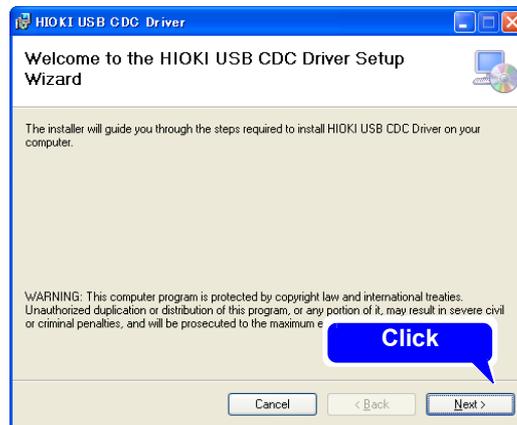
Before connecting the instrument by USB, perform the following procedure to install the USB driver.

NOTE Install the driver using an account with administrator privileges.

- 1 Run **[HiokiUsbCdcDriver.msi]** in the **CD X:\Driver** folder.
([X] indicates the CD-ROM drive. The letter will differ depending on the PC.)

NOTE Depending on the environment, the dialog box may take some time to appear so please wait till it does so.

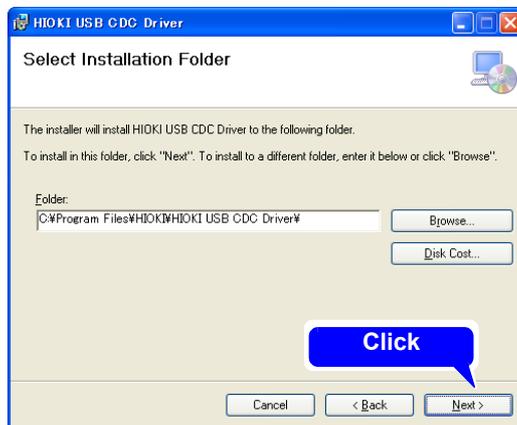
- 2 Click **[Next]**.



- 3 Click **[Next]**.

When you want to change the installation destination

Click **[Browse]** to change the folder to install into. Normally, there is no need to change.



- 4 Click **[Next]** to start installing.

Installing

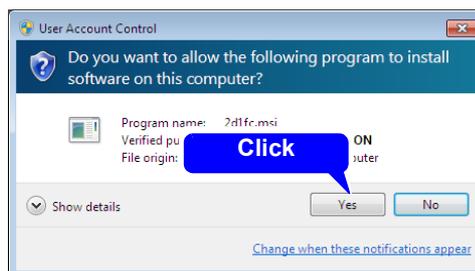


For Windows XP

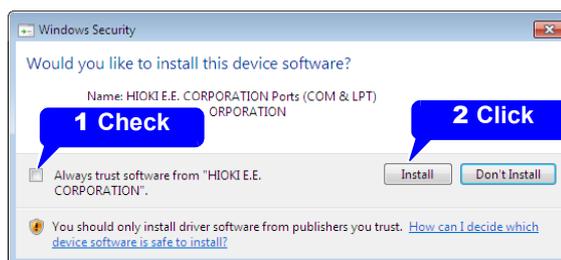
During the installation, a message saying that the software has not passed Windows[®] Logo testing will appear a few times, click **[Continue Anyway]** to continue installing.

**For Windows Vista[®], Windows 7, Windows 8, and Windows 10**

When a dialog box requesting your permission to continue the program appears, click **[Yes]**.



Sometimes another dialog box requesting your permission to install the software may appear. When it does, check **[Always trust software from "HIOKI E.E. CORPORATION"]** and click **[Install]** to continue.

**5 When installation is completed and the dialog box appears, click [Close] to exit.**

This completes the driver installation.

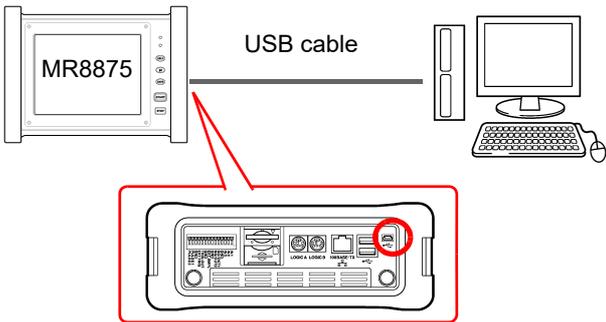


Connecting the Instrument and PC

PC Requirements: A personal computer running Windows XP, Windows Vista®, Windows 7, Windows 8 or Windows 10.

- CAUTION**
- To prevent a malfunction, do not disconnect the USB cable during communication.
 - The Memory HiCorder and PC should be connected to the same earth ground. If grounded separately, potential difference between the ground points can cause malfunctions or damage when connecting the USB cable.

- 1** Connect one end of the USB cable to the USB cable slot on the instrument while making sure the plug is oriented correctly.
- 2** Connect the other end of the cable to a USB port on the PC.



The first time you connect the instrument and PC, perform the following procedure to enable the PC to recognize the instrument.

For Windows Vista®, Windows 7, Windows 8 and Windows 10

The instrument is recognized automatically, and the preparation to use the device completes.

For Windows XP

A message indicating that new hardware was detected will be displayed on the screen, and the "Found New Hardware Wizard" will open.

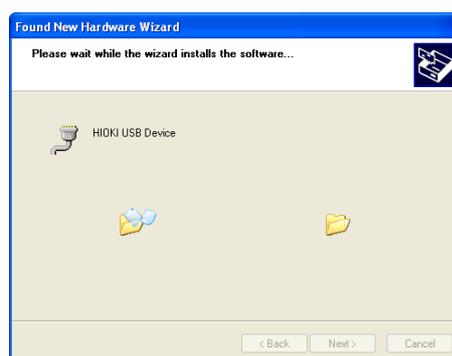
- 1** Check **[No, not this time]** and click **[Next]**.



- 2** Check [Install the software automatically (Recommended)] and click [Next].



Please wait while the driver is being installed.



- 3** Click [Continue Anyway].

A message saying that the software has not passed Windows Logo testing will appear a few times, click [Continue Anyway] to continue installing.



- 4** When installation is completed and the dialog box appears, click [Finish] to exit.

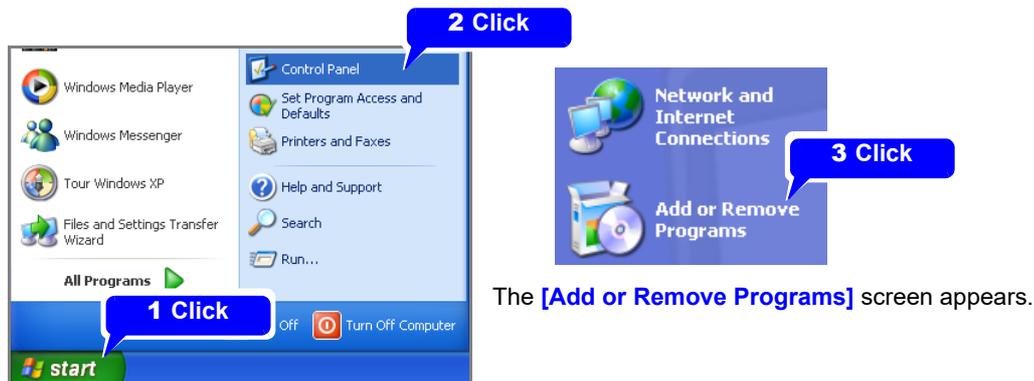
This completes the driver installation.



Uninstalling the USB Driver

When the USB driver is no longer needed, uninstall it with the following procedure.

- 1 From the Windows® Start menu, select the [Control Panel], and double click [Add or Remove Programs].



- 2 From the list of installed programs, select [HIOKI USB CDC Driver], and remove it.
You are returned to the [Add or Remove Programs] screen.

12.10 Using the Waveform Viewer (Wv)

The viewer has a CSV conversion function. Converted files may be read by a spreadsheet program.

This section describes how to install and uninstall the Waveform Viewer as well as how to launch and exit the software.

System requirements

For a PC running Windows XP, Windows Vista®, Windows 7, Windows 8 or Windows 10.

Installation

- 1** When you insert the Application Disk (CD) into the CD-ROM drive, the opening page should appear automatically.
If it does not appear, open the "index.htm" file with your Web browser.
- 2** Select the language to display (click the English icon).
- 3** Click the **[Wave viewer (Wv)]** icon to view Wv specifications and revision history.
- 4** Click the **[Install]** icon at the top right of the page to open the **[File Download]** dialog.
- 5** Click **[Open]** to display the confirmation dialog to proceed with installation.
- 6** Click **[Next]** to open the installation destination selection window.
Click the **[Browse]** button to change the installation folder.
- 7** Click **[Next]** to start installation.
The program is now installed.

Launching and exiting the software

Launching the software

Read the text file "Read me" before using the software.

In the Windows® Start menu, select **[Programs]-[HIOKI]-[Wv.]** This starts the waveform viewer application.

Exiting the software

Select **[File] - [Exit]** on the Waveform Viewer Application menu. Alternately, you can use the "Close" button on the top right of the window.

Uninstalling the software

- 1** Open the Windows® Start menu and click **[Control panel]** **u** **[Add or remove programs]**.
- 2** Select **[HIOKI Wave Viewer (Wv)]** and delete it.

External Control Chapter 13

This chapter describes how to operate the instrument using the external control terminals. We use the term external control terminals generically to refer to all of the terminals.

DANGER

To avoid electrical hazards and damage to the instrument, do not apply voltage exceeding the rated maximum to the input terminals.

I/O pin	Maximum input voltage
IN1, IN2, IN3	10 V DC
GO/OUT1, NG/OUT2	50 V DC 50 mA 200 mW
EXT.SMPL	10 VDC
TRIG.OUT	50 V DC 50 mA 200 mW
EXT.TRIG	10 V DC
PULSE1, PULSE2	50 V DC

WARNING

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to external control terminals.

- Always turn off the power to the instrument and to any devices to be connected before making connections.
- Be careful to avoid exceeding the ratings of external terminals and connectors.
- Ensure that devices and systems to be connected to the External control terminals are properly isolated.

CAUTION

The ground pins of external control connectors are not isolated from the instrument's ground. Connect so that no potential difference arise between external control connector ground and the ground of the connection object. Failure to observe this precaution can result in damage to the connection object and the instrument.

NOTE

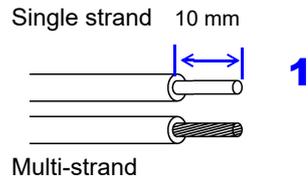
- Signals input to the external control terminals take effect even when the operating keys are locked.
- External control terminals are unstable when turning the instrument on and off. Connected devices should address this status in an appropriate manner.

13.1 Connecting External Control Terminals

The method for connecting to the external control terminals is as follows.

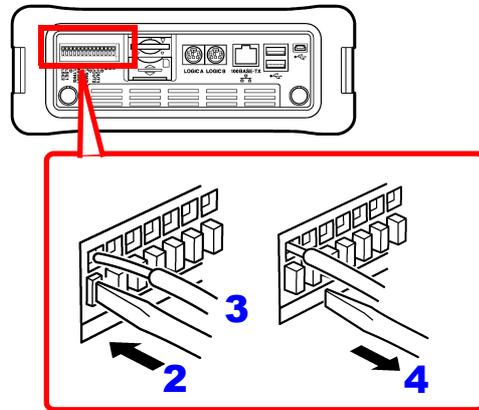
Required item:

- Recommended cables
 - Single strand diameter: $\phi 0.65$ mm (AWG22)
 - Multi-strand: 0.32 mm² (AWG22)
- Usable cables
 - Single strand diameter: $\phi 0.32$ mm to $\phi 0.65$ mm (AWG28 to AWG22)
 - Multi-strand: 0.08 mm² to 0.32 mm² (AWG28 to AWG22)
 - Strand diameter: At least $\phi 0.12$ mm
- Standard insulation stripping length: 9 to 10 mm
- Button operation specified tool: Flat-blade screwdriver (tip width 2.6 mm)



Connecting the terminals

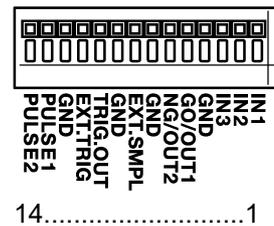
- 1** Remove the insulation from the wire.
- 2** Push in the button on the connector with a flat-blade screwdriver or other tool.
- 3** Insert each thermocouple wire into the appropriate terminal hole while pressing the button.
Confirm proper polarity.
- 4** Release the button.
The thermocouple is connected.



To remove the thermocouple

Hold the button while pulling the thermocouple wire out.

Terminal no.	Terminal color		Operation
1	Blue	IN1	Input of signals from an external source, performing: <ul style="list-style-type: none"> • Start and stop of measurement • Saving of data • Event mark input
2	Blue	IN2	
3	Blue	IN3	
4	Black	GND	
5	Green	GO/OUT1	Output of signals based on the instrument's state
6	Red	NG/OUT2	
7	Black	GND	
8	Gray	EXT.SMPL	Input of signals from an external source to set the desired sampling speed
9	Black	GND	
10	Yellow	TRIG.OUT	Output of signal when a trigger is applied
11	Brown	EXT.TRIG	Input of signal from an external source for use as the trigger source
12	Black	GND	
13	White	PULSE1	Input of pulse signals
14	White	PULSE2	



13.2 External I/O

External Input (IN1, IN2, IN3)

You can input signals from an external source and use them to start and stop input and save data. Additionally, you can assign event marks. The initial settings for [IN1], [IN2], and [IN3] (at the time of shipment) are [START], [STOP], and [START/STOP].

- 1 **Connect the cables for the corresponding external input signals to IN1, IN2, IN3, and GND terminals.**

See: "13.1 Connecting External Control Terminals" (p. 324)

- 2 **Open the screen.**
[Setting Display] ► [System] ► [External Terminal]

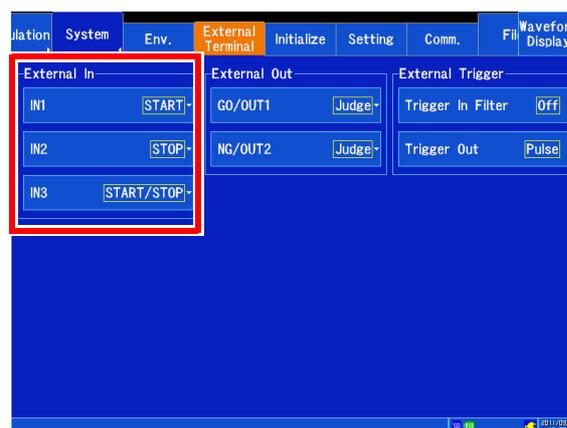
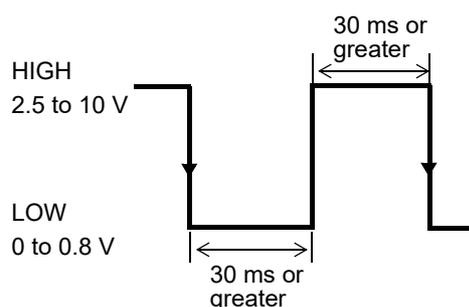
- 3 **[IN1]/[IN2]/[IN3] ► Select from the list.**

Select the operation performed by the instrument in response to external signal input.

START	Starts measurement.
STOP	Stops measurement. (Performs post-measurement processing such as numerical calculations and auto save.)
START/STOP	Starts measurement at low level and stops measurement at high level.
ABORT	Forcibly ends measurement. (Does not perform post-measurement processing such as numerical calculations and auto save.)
SAVE	Saves data using the save media and conditions configured with the SAVE key settings. (Select at execution (p. 98) is invalid.)
EVENT	Adds an event mark.

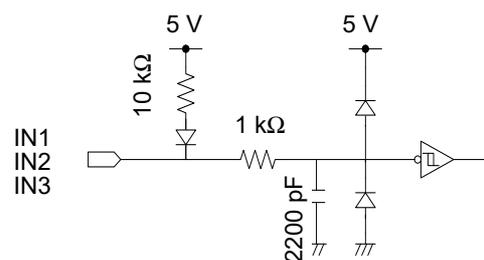
- 4 **Short the terminal and ground, or input a high-level (2.5 to 10 V) or low-level (0 to 0.8 V) pulse waves or rectangular wave to the terminal.**

The last data point may not be recorded when aborting operation.



External input is ignored while the Help screen and Manual Save window are being displayed as well as during self-check and touch panel correction operation.

Max. input voltage	10 VDC
Input voltage	High level: 2.5 to 10 V Low level: 0 to 0.8 V
Response pulse width	High interval: 30 ms or greater Low interval: 30 ms or greater



NOTE

When operation is aborted, the last data point may not be recorded.

External Output (GO/OUT1, NG/OUT2)

The external terminals normally generate high-level output. You can generate a low-level signal when set conditions are met.

- 1 **Connect the GO/OUT1, NG/OUT2, and GND terminals to the device(s) to be controlled by single wires.**

See: "13.1 Connecting External Control Terminals" (p. 324)

- 2 **Open the screen.**

[Setting Display] ► [System] ► [External Terminal]

- 3 **[GO/OUT1], [NG/OUT2] ► Select from the list.**

Select the conditions under which the instrument outputs a signal.

(When the [GO/OUT2] item is selected)

Select (*: Initial setting)

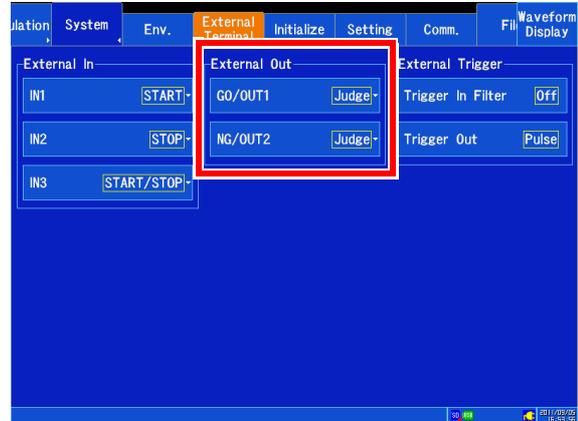
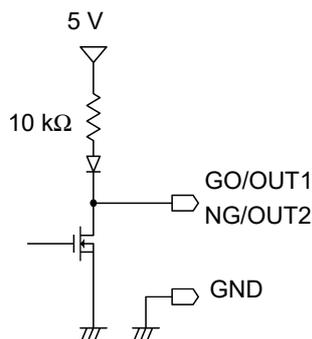
Judge*	Outputs a low-level signal when the numerical calculation judgment result is GO (PASS).
Error	Outputs a low-level signal when an error occurs.
BUSY	Outputs a low-level signal when external start operation is disabled, such as during startup and saving.
Waiting Trigger	Outputs a low-level signal while waiting for a trigger.

(When the [NG/OUT2] item is selected)

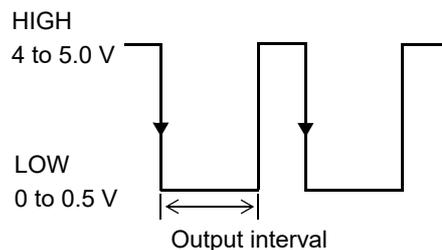
Select (*: Initial setting)

Judge*	Outputs a low-level signal when the judgment result is FAIL.
Error	Outputs a low-level signal when an error occurs.
BUSY	Outputs a low-level signal when external start operation is disabled, such as during startup and saving.
Waiting Trigger	Outputs a low-level signal while waiting for a trigger.

Signal output is determined by the instrument's state.



Output signal	Open drain output (with voltage output) active LOW
Output voltage range	High level: 4.0 to 5.0 V Low level: 0 to 0.5 V
Maximum input voltage	50 VDC, 50 mA, 200 mW



External Sampling (EXT.SMPL)

You can set the sampling speed by inputting an external signal. When the real-time saving function is enabled, external sampling cannot be activated.

- 1 Connect the cables for the corresponding output signals to EXT.SMPL and GND terminals.

See: "13.1 Connecting External Control Terminals" (p. 324)

- 2 Open the screen.

[Waveform Display] ► [Status] ► [Basic] Or [Setting Display] ► [Status]

- 3 Set [Sampling Clock] to [External].

- 4 [Sampling Slope] ► Tap to switch.

Select the input waveform sampling method.

Select (*: Initial setting)

- | | |
|----|---|
| ↑ | Samples the signal at the rising edge. |
| ↓* | Samples the signal at the falling edge. |

- 5 [Sample(/div)] ► Change the value.

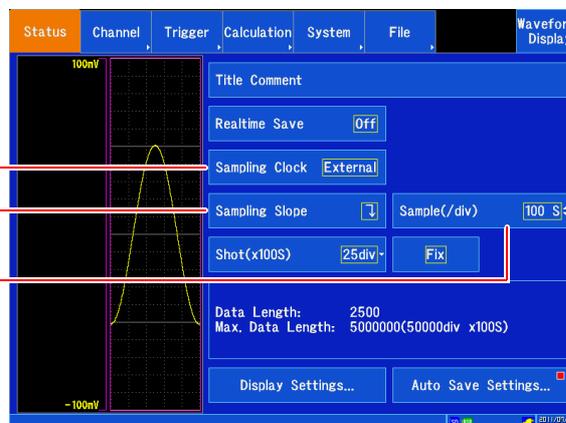
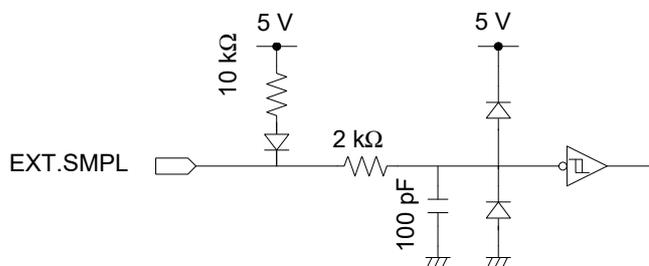
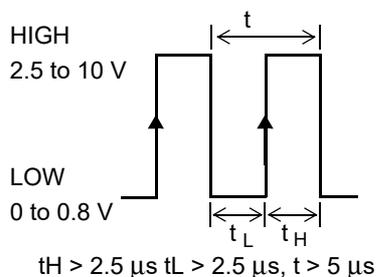
Set the number of data points to display per horizontal (time) axis division.

Valid input range: 10 to 1,000 (initial setting: 100)

See: "Changing values" (p.145)

- 6 Input HIGH level (2.5 to 5.0 V) and LOW level (0 to 0.8 V) pulse waves or rectangular waves to the EXT.SMPL terminal.

Data is sampled on the rising edge or falling edge of the input waveform. Note that the sampling frequency is limited by the selected edge. For proper operation, pulse width must be at least as shown in the right table.



Maximum input voltage	10 VDC
Input voltage	High level: 2.5 to 10 V Low level: 0 to 0.8 V
Response pulse width	High, low interval: At least 2.5 μs
Maximum input frequency	200 kHz

NOTE

- The numerical calculation monitor function is disabled when external sampling is active.
- When the external sampling input signal is faster than 200 kHz, accurate sampling may be impossible.
- Input (number of data points needed + 1) pulses to EXT.SMPL.
Example: If 1,000 data points are need, input 1,001 pulses.

Trigger Output (TRIG. OUT)

You can output a signal when a trigger is applied. Additionally, you can implement parallel synchronous operation using multiple instruments.

See: "Synchronous Measurements with Multiple Instruments" (p. A14)

1 Connect the cables for the output signals to TRIG. OUT and GND terminals.

See: "13.1 Connecting External Control Terminals" (p. 324)

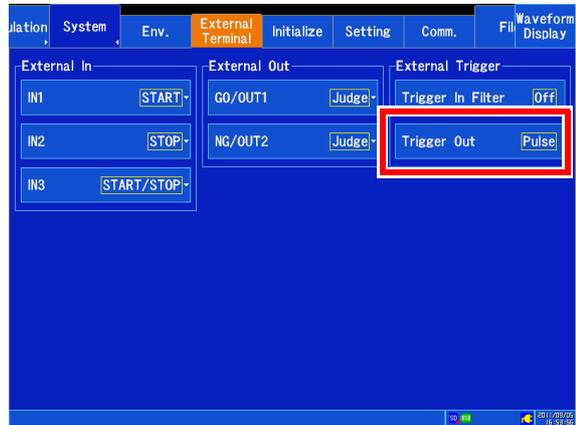
2 Open the screen.

[Setting Display] ► [System] ► [External Terminal]

3 [Trigger Out] ► Tap to switch.

Select the output method for the signal to be output from the trigger output terminal.

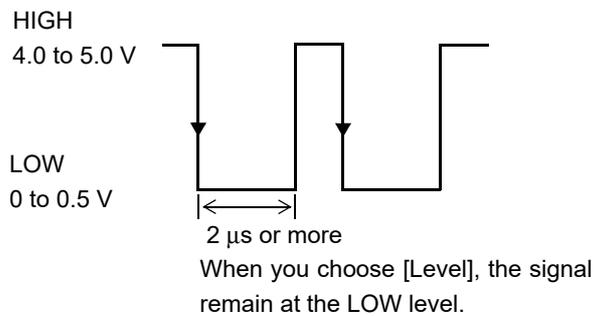
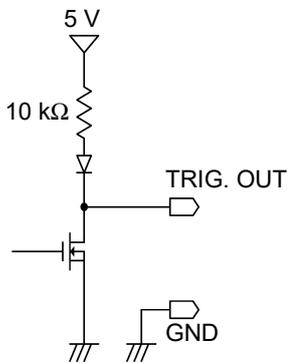
Select (*: Initial setting)



Pulse*	After LOW level output, the signal goes HIGH after a specified interval.
Level	After the trigger condition is satisfied, the low-level signal is output while the instrument is acquiring the waveform.

When a trigger is applied, a pulse that changes from high level (4.0 to 5.0 V) to low level (0 to 0.5 V) is output.

Output signal	Open drain output (with voltage output) active LOW
Output voltage range	High level: 4.0 to 5.0 V Low level: 0 to 0.5 V
Pulse width	Level: At least sampling period x (number of data points after trigger - 1) (at least 2 μs) (For trigger synchronous operation) Pulse: 2 ms ± 10% (external synchronization)
Maximum input voltage	50 VDC, 50 mA, 200 mW



NOTE

- The signal is output during measurement even if no triggers have been set.
- When using the auto-ranging function, triggers are applied and signals are output. Exercise caution when measuring with the auto-ranging function while using the trigger output terminal.

External trigger terminal (EXT.TRIG)

You can input signals from an external source as trigger sources. Additionally, you can implement parallel synchronous operation using multiple instruments.

See: "Synchronous Measurements with Multiple Instruments" (p. A14)

- 1 Connect the cables for the corresponding external input signals to the EXT. TRIG and GND terminals.

See: "13.1 Connecting External Control Terminals" (p. 324)

- 2 Open the screen.

[Setting Display] ► [Trigger] ► [General]

- 3 Set [External Start Trigger] or [External Stop Trigger].

See: "7.10 Applying an External Trigger" (p. 186)

- 4 Open the screen.

[Setting Display] ► [System] ► [External Terminal]

- 5 [Trigger In Filter] ► Tap to switch.

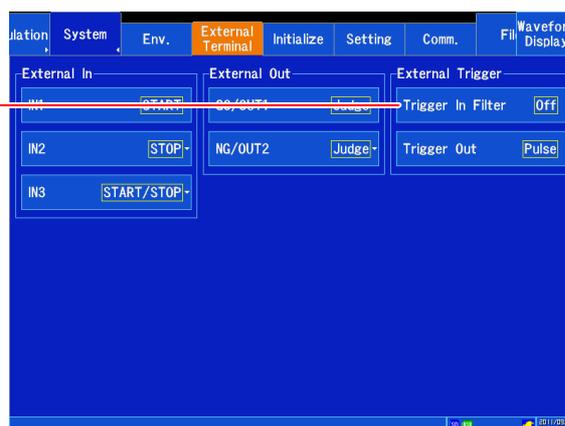
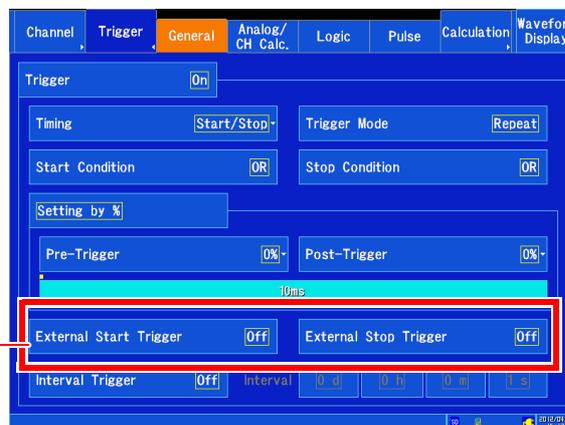
Configure the filter.

Select (*: Initial setting)

Off*	Disables the filter. Always set this parameter to [Off] when you wish to synchronize multiple units using an external trigger.
On	Provides an effective means of preventing erroneous operation due to noise. Triggers will not be applied unless the trigger conditions are met for a specified interval.

- 6 Short-circuit the EXT. TRIG terminal and GND, or input a HIGH level (2.5 to 10 V) or LOW level (0 to 0.8 V) pulse wave or rectangular wave to the EXT TRIG terminal.

A trigger event occurs on the rising or falling edge of the input waveform.

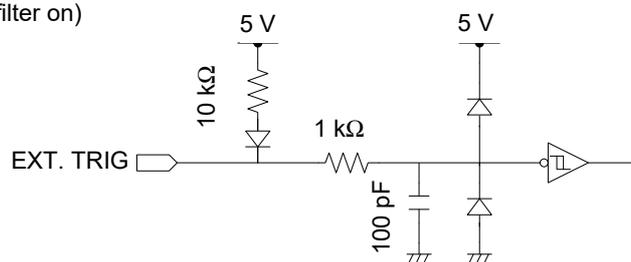
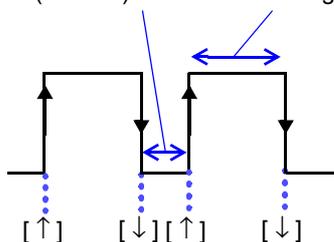


Input voltage	Low level: 0 to 0.8 V High level: 2.5 to 10 V
Max. input voltage	10 VDC
Response pulse width	When the trigger input filter is off High interval: 1 ms or greater Low interval: 2 μs or greater
	When the trigger input filter is on High interval: 2.5 ms or greater Low interval: 2.5 ms or greater

2 μs or greater (filter off) 1 ms or greater (filter off)
2.5 ms or greater (filter on) 2.5 ms or greater (filter on)

HIGH
2.5 to 10 V

LOW
0 to 0.8 V



Input of pulse signals (PULSE1, PULSE2)

Connect wires to the pulse input terminals (PULSE1, PULSE2) on the instrument's external control terminal block.

See: "Measuring pulse signals" (p.37)

See: "Configuring pulse input (integration and rotational speed measurement)" (p.73)

Specifications Chapter 14

For more information about the optional MR8904 CAN Unit specifications, see the instruction manual on the included CD.

14.1 MR8875, MR8875-30 Memory HiCorder Specifications

Basic Specifications

Product warranty period	3 years
Measurement functions	High-speed recording (previous Memory Recorder function)
No. of units that can be installed	4 slots (ships standard with 2 pulse channels and 8 logic channels; ground is common with the instrument)
External terminals	External trigger, trigger output, external sampling input, 2 pulse input terminals, 3 external input terminals, 2 external output terminals
External power supplies	3 external power supplies Output voltage: 5 V \pm 10% Supplied current: Total 2 A
Storage memory capacity	Total 32 MW (8 MW/module)
Maximum sampling rate	500kS/s (All channels simultaneously) (when using Model MR8901 Analog Unit) External sampling (200kS/s)
Timebase accuracy	\pm 0.0005%
Clock functions	Auto calendar, auto leap year judgment, 24-hour timer
Clock accuracy	\pm 3s/day (@23°C [73.4°F])
Backup battery life	Approx. ten years for clock and settings (@23°C [73.4°F])
Operating temperature and humidity	Temperature: -10°C to 50°C (14°F to 122°F), Humidity: -10°C to 40°C (14°F to 104°F) 80% RH or less (non-condensing) 40°C to 45°C (104°F to 113°F) 60% RH or less (non-condensing) 45°C to 50°C (113°F to 122°F) 50% RH or less (non-condensing) (When powered by the Z1003 Battery Pack) Temperature: 0°C to 40°C (32°F to 104°F), Humidity: 80% RH or less (non-condensing) (When charging the Z1003 Battery Pack) Temperature: 10°C to 40°C (32°F to 104°F), Humidity: 80% RH or less (non-condensing)
Period of guaranteed accuracy	1 year
Conditions of guaranteed accuracy	After 30 minutes warm-up
Temperature and humidity range for guaranteed accuracy	Temperature: 23°C \pm 5°C (73 \pm 9°F) humidity: 80% RH or less (non-condensing)
Storage temperature and humidity	Temperature: -20°C to 60°C (-4°F to 140°F), Humidity: -20°C to 40°C (-4°F to 104°F) 80% RH or less (non-condensing) 40°C to 45°C (104°F to 113°F) 60% RH or less (non-condensing) 45°C to 60°C (113°F to 140°F) 50% RH or less (non-condensing) (Z1003 Battery Pack) Temperature: -20°C to 40°C (-4°F to 104°F), Humidity: 80% RH or less (non-condensing)
Operating environment	Indoors, Pollution degree 2, up to 2000 m (6562-ft.) ASL

Basic Specifications

Power source	<ol style="list-style-type: none"> Model Z1002 AC Adapter Rated output voltage: 12 VDC Rated supply voltage: 100 to 240 VAC (assumes voltage fluctuations of $\pm 10\%$) Rated supply frequency: 50 Hz/60 Hz Assumed overvoltage: 2,500 V Model Z1003 Battery Pack (when used in combination with the AC adapter, priority is given to the AC adapter.) Rated supply voltage: 7.2 VDC DC power supply input 10 to 28 VDC (input from the AC adapter jack is possible with a custom-ordered cable) The cable between the batteries and instrument must be within 3 m
Maximum rated power	When using the Z1002 AC Adapter (external DC power supply): 56 VA When using the Z1003 Battery Pack: 36 VA (Real-time saving with the backlight on for both [reference value at 23°C [73.4°F])
Continuous operating time	Approx. 1 hour (when using the Z1003 Battery Pack, real-time measurement, backlight on [reference value at 23°C [73.4°F])
Charging function	With the Z1003 Battery Pack installed; AC adapter can also be connected. Charging time: approx. 3 hours (reference value at 23°C [73.4°F])
Dimensions (sans protrusions)	Approx. 298W × 224H × 84D mm (11.73"W x 8.82"H x 3.31"D)
Mass	Instrument: Approx. 2.4 kg (84.7 oz.) (not including Model Z1003 Battery Pack)
Applicable Standards	Safety : EN61010 EMC : EN61326 Class A
Vibration endurance	JIS D 1601:1995 5.3(1), Category 1: Vehicle, Condition: Category A equiv. (45 m/s ² oscillating acceleration on X-axis for 4 h, and on Y- and Z-axes for 2 h)

Display Section

Display character	English/ Japanese/ Chinese* selectable (*: Model MR8875-30 only)
Display type	8.4-in SVGA TFT Color LCD with touch panel
Display resolution	Waveform: 25 div (time axis) × 20 div (voltage axis) (1 div = 25 dots [time axis] × 25 dots [voltage axis])
Backlight lifespan	Approx. 100,000 hours (brightness lifespan defined as 50% of initial value; reference value at 25°C [77°F])
Backlight saving function	Select from off, 1 min, 2 min, 3 min, 4 min, 5 min. The backlight turns off when no key is pressed

External Storage

SD memory card	
Slot	1, SD standard compliant (supports SD memory cards and SDHC memory cards)
Usable card	Model Z4001 SD Memory Card (2 GB) Model Z4003 SD Memory Card (8 GB)
Formats	FAT16, FAT32
USB flash drive	
Standard compliance	USB2.0 compliant
Connector	Series A receptacle
Format	FAT16, FAT32

Communications functionality

USB	
Standard compliance	USB2.0 compliant High Speed
Connector	Series-mini B receptacle
Function	<ol style="list-style-type: none"> Setting and measurement by communications commands USB Drive Mode (to transfer data from SD memory card to a PC)
LAN	
Standard compliance	Ethernet 100Base-TX/10Base-T (auto-detect)
Connector	RJ-45
Function	HTTP, FTP, e-mail transmission, command control

Pulse input

Measurement target	Pulses
No. of channels	2
Supported input configurations	No-voltage a contact, no-voltage b contact, open collector, or voltage input
Input voltage range	0 to 50 V DC
Input resistance	1.1 M Ω \pm 5%
Max. channel-to-channel voltage	Not isolated (common ground with instrument)
Max. terminal-to-ground voltage	Not isolated (common ground with instrument)
Measurement modes	Rotational speed/integration
Chatter prevention filter	On/off switchable
Pulse input period	With filter off: 200 μ s or more (however, high and low intervals must be at least 100 μ s) With filter on: 100 ms or more (however, high and low intervals must be at least 50 ms)
Threshold voltage	Switchable between 2 levels [4V] High: 4.0 V or higher; low: 0 to 1.5 V [1V] High: 1.0 V or higher; low: 0 to 0.5 V
Slope	\uparrow (counted at rising edge) / \downarrow (counted at falling edge) switchable
Division (rotational speed/integration)	Division: 1 to 50,000 c (Rotational speed: number of pulses per revolution; integration: number of pulses per count)

Pulse input

**Range
(rotational speed/
integration)**

Integration			Rotational speed		
Range [div]	Resolution [LSB]	Measurement range	Range [div]	Resolution [LSB]	Measurement range
2,500c	1c	0 to 65,535 c			
25kc	10c	0 to 655,350 c	250 r/s	1 r/s	0 to 5,000 r/s
250kc	100c	0 to 6,553,500 c			
5Mc	2kc	0 to 131,070,000 c			
125Mc	50kc	0 to 3,276,750,000 c			

**Timing
(integration mode only)**

Either trigger or start can be selected as the timing at which counting starts.

Trigger : Counting starts when the trigger is applied.

Start : Counting starts at the start of measurement.

Note: When using the trigger setting

When the corresponding channel is the trigger source, integration starts with the start of measurement. The integrated value is reset when the trigger is applied, after which integration starts again. If the channel is not the trigger source, the value 0 is output until the trigger is output.

**Integration mode
(integration mode only)**

Integration : Counting of the integrated value starts with the start of measurement.

Instantaneous : The integrated value is counted at each sampling period.

(The integrated value is reset at each sampling period.)

**Overflow processing
(integration mode only)**

Processing of integration overflows

Select either reset (value returns to 0 and counting continues) or hold (the overflow state persists).

Miscellaneous

Accessories

Instruction Manual.....	1
Measurement Guide	1
Model Z1002 AC Adapter.....	1
Protection sheet	1
USB Cable	1
Strap	1
Application disc (CD)	1

**Accessories sold separately
Standard options**

- Model MR8901 Analog Unit
- Model MR8902 Voltage/TEMP Unit
- Model MR8903 Strain Unit
- Model MR8904 CAN Unit
- Model MR8905 Analog Unit (MR8875: Applicable for Ver. 2.13 or later, MR8875-30: Applicable for Ver. 3.13 or later)
- Model Z1002 AC Adapter
- Model Z1003 Battery Pack (NiMH, 7.2 V, 4500 mAh)
- Model C1004 Carrying Case (with space for storing options)
- Model Z4001 SD Memory Card (2 GB)
- Model Z4003 SD Memory Card (8 GB)
- Model Z4006 USB Drive (16 GB)
- Model 9642 LAN Cable

Miscellaneous

Measurement probes, etc.	<ul style="list-style-type: none"> • Model L9197 Connection Cord (600 V CAT III, 300 V CAT IV, 1 A, Isolated BNC/Alligator Clip) • Model 9197 Connection Cord (600 V CAT III, 300 V CAT IV, 1 A, Isolated BNC/Alligator Clip) • Model L9198 Connection Cord (600 V CAT II, 300 V CAT III, 0.2 A, Isolated BNC/Alligator Clip) • Model 9199 Conversion Adaptor (Isolated BNC/Banana jack with rigid insulating sleeve) • Model L9217 Connection Cord (600 V CAT II, 300 V CAT III, 0.2 A, Isolated BNC/Isolated BNC) • Model L9790 Connection Cord (Isolated BNC/Banana Plug with rigid insulating sleeve) • Model L4940 Connection Cable (for Model MR8905, Maximum input voltage 1000 V DC, Banana Plug/Banana Plug) 1000 V CAT III, 600 V CAT IV, 10 A • Model L9790-01 Alligator Clip (600 V CAT II, 300 V CAT III, 1 A, for Model L9790) • Model 9790-02 Grabber Clip (300 V CAT II, 150 V CAT III, 1 A, for Model L9790) • Model 9790-03 Contact Pin (600 V CAT II, 300 V CAT III, 1 A, for Model L9790) • Model L4935 Alligator Clip (Attached to tips of Model L4940), 600 V CAT IV, 1000 V CAT III, 10 A • Model L9243 Grabber Clip (Attached to tips of Model L4940), 1000 V CAT III, 1 A • Model L4936 Bus Bar Clip (Attached to tips of Model L4940), 600 V CAT III, 5 A • Model L4937 Magnetic Adapter (Attached to tips of Model L4940), 1000 V CAT III, 2 A • Model L4931 Extension Cable (Extends length of Model 4940 by 1.5 m), 600 V CAT IV, 1000 V CAT III, 10 A • Model L4932 Test Pin (Attached to tips of Model L4940), 600 V CAT IV, 1000 V CAT III, 10 A • Model L4934 Small Alligator Clip 300 V CAT III, 600 V CAT II, 3 A *Model L4932 is required to use Model L4934. • Model 9322 Differential Probe • Model P9000-01 Differential Probe • Model P9000-02 Differential Probe
Logic probes	<ul style="list-style-type: none"> • Model 9320-01 Logic Probe (4 digital channels, contact point signal on/off detection) • Model MR9321-01 Logic Probe (Four isolated channels, for detecting AC/DC voltage on/off)
Current measurement probes, etc.	<ul style="list-style-type: none"> • Model 9018-50 Clamp-On Probe (AC 10 A to 500 A, 40 Hz to 3 kHz) • Model 9132-50 Clamp-On Probe (AC 10 A to 500 A, 40 Hz to 1 kHz) • Model 9675 Clamp-On Leak Sensor (AC10 A, 40 Hz to 5 kHz) • Model 9657-10 Clamp-On Leak Sensor (AC10 A, 40 Hz to 5 kHz)

Trigger Function

Trigger method	Digital comparison
Trigger mode	Single, Repeat
Trigger timing	Start, stop, start&stop , Count (2 to 10000) (conditions can be set for each of start and stop)
Trigger conditions	AND or OR possible between all trigger sources

Trigger Function

Trigger source	<p>Trigger source selectable for each channel</p> <p>Free-running when all trigger sources are Off</p> <ol style="list-style-type: none"> 1. Analog inputs Select up to 4 channels for each module. 2. Inter-channel calculation results W1-1 to W4-2 3. Logic inputs LA1 to LA4, LB1 to LB4 (4 channels x 2 probes), CANL1 to 16 (for each Model MR8904 CAN Unit) Pattern triggers can be configured for each of the above trigger sources. 4. Pulse input P1, P2 (2 channels) 5. External input Input signal to external trigger terminal
Forcible trigger	Yes (forcible triggers can be given priority over all trigger sources)
Interval trigger	<p>Fixed interval recording at specified measurement interval (day, hour, minute, second) is possible.</p> <p>A trigger is applied simultaneously with start of measurement, and then a trigger is subsequently applied at the set measurement interval.</p>
Trigger types (analog, pulse, Inter-channel calculation)	<ol style="list-style-type: none"> 1. Level trigger A trigger is applied when rise or fall to set voltage value. 2. Window trigger Set the upper and lower limits of trigger level
Trigger types (logic)	<p>Pattern trigger: Settable to 1/0/x for each input (ignore x)</p> <ul style="list-style-type: none"> • Configure the pattern setting for each probe. • The trigger condition (AND/OR) can be set between logic input channels in each probe. • The trigger condition between probes is in accordance with overall trigger condition (AND/OR).
Trigger types (external trigger)	<p>Rising and falling selectable</p> <p>Rising : A trigger is applied when rise from low (0 to 0.8 V) to high (2.5 to 10 V).</p> <p>Falling : A trigger is applied when fall from high (2.5 to 10 V) to low (0 to 0.8 V), or terminal short.</p> <p>Maximum input voltage: 10 VDC</p> <p>External trigger filter: On/Off selectable</p> <p>Response pulse width:</p> <p>H period 1 ms or greater, L period 2 μs or greater (when external trigger filter Off)</p> <p>H period 2.5 ms or greater, L period 2.5 ms or greater (when external trigger filter On)</p>
Trigger filter	Set by number of samples (Off, 10, 20, 50, 100, 200, 500, 1000)
Trigger level resolution	<p>(Analog) 0.1%f.s. (f.s. = 20 div) However, varies with the bit length of the CAN definition handled by the MR8904.</p> <p>(Pulse) Integration: 0.002%f.s., rotational speed: 0.02%f.s. (f.s.= 20 div)</p>
Pre-trigger	0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100%
Post-trigger	0% to 40%
Trigger output	<p>Open-drain output (with 5 V output, Active Low)</p> <p>Output voltage HIGH level: 4.0 to 5.0 V, Low level: 0 to 0.5 V</p> <p>Output pulse width: Level/ Pulse selectable</p> <p>Level : Sampling period x (number of data since trigger -1) or longer (2 μs or longer)</p> <p>Pulse : 2 ms \pm10%</p>
Trigger input and output terminals	Terminal Block

14.2 Measurement Functionality

Timebase	200, 500 μ s/div 1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div 1, 2, 5, 10, 30, 50, 60, 100 s/div 2, 5 min/div, external sampling (100 samples/div)
Recording interval with real-time saving enabled	2 μ s/S (with 2 or fewer channels in use), 5 μ s/S (with 8 or fewer channels in use), 10 μ s/S (with 16 or fewer channels in use), 20 μ s/S (with 30 or fewer channels in use), 50 μ s/S (with no limit on number of channels in use)
Time axis resolution	100 points/div
Sampling period	1/100th of timebase (time axis can be set based on the sampling period), external sampling
Recording length	25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000(*1, *2), 50000(*3) User-configurable from 5 to 80,000 (*3) div in 1 div increments (*1) 4 channels/module (*2) 2 channels/module (*3) 1 channel/module (with four MR8901 installed; logic and pulse measurement disabled)
Data types	Instantaneous values only
Display screen	Waveform display Simultaneous waveform and gauge display Simultaneous waveform, gauge, and settings display Simultaneous waveforms and numerical calculation results display Waveform and A/B, C/D, E/F cursor values displayed at the same time Simultaneous waveform and instantaneous value display
Screen settings	Single, Dual, Quad, X-Y (Dot, Line) Sheet display (switchable between all sheets and sheets 1 to 4)
Waveform compression and magnification	Horizontal axis (time axis): $\times 10$, $\times 4$, $\times 2$, $\times 1$ $\times 1/2$, $\times 1/5$, $\times 1/10$, $\times 1/20$, $\times 1/50$, $\times 1/100$, $\times 1/200$, $\times 1/500$ $\times 1/1000$, $\times 1/2000$, $\times 1/5000$, $\times 1/10000$, $\times 1/20000$, $\times 1/50000$ Vertical axis (voltage axis): $\times 100$, $\times 50$, $\times 20$, $\times 10$, $\times 5$, $\times 2$, $\times 1$, $\times 1/2$, $\times 1/5$, $\times 1/10$ When setting by position, you can set the zero position (%) and zoom factor. When setting by upper and lower limits, you can set the upper and lower limits. The display is as follows when the measurement value is over the set range. "+OVER" when over on + side, "-OVER" when over on - side
Zoom function	Yes (splits the screen vertically; supports waveform magnification and overall display)
Waveform overlay	Select from off, automatic, and manual Automatic: Performs overlay for each measurement. Manual: Performs overlay at user-selected timing.
Waveform scrolling	Horizontal scrolling Waveform display and scrolling without waiting for measurement to complete (Roll mode: Time axis and waveform compression rate limitations apply.) Past waveform data can be viewed by scrolling backward during measurement.

14.2 Measurement Functionality

Auto save	Select from off, waveform data (binary format), waveform data (CSV format), numerical calculation results, and image data (compressed bitmap or PNG format). Data is saved to either SD memory card or USB flash drive. Data is saved at once after the specified recording length is acquired.
(Delete-and-save)	Selectable Off or On On : Old files are deleted as media capacity becomes inadequate, and new files are created and saved. Off : Data is saved until the storage media is full and then measurement ends.
Real-time saving	Select from off and on (cannot be used with auto saving). Waveform data can be saved to an SD memory card in binary format while measurement is performed.
(Delete-and-save)	Selectable Off or On On : Old files are deleted as media capacity becomes inadequate, and new files are created and saved. Off : Data is saved until the storage media is full and then measurement ends.

14.3 Other Functions

Zero adjustment function	The effect of temperature drift of the analog circuit of the input section can be cancelled. Possible with zero adjustment item on the Settings screen
Real-time inter-channel calculations	Up to 2 real-time inter-channel calculations per unit can be performed simultaneously.
(Calculation target)	MR8901 Analog Unit, MR8902 Voltage/TEMP Unit, MR8903 Strain Unit, MR8905 Analog Unit * Inter-channel calculations are limited to single units. * Scaling and probe settings for calculation channels targeted for calculations are disabled. * Calculation results can be scaled. * Calculations using different MR8902, MR8903 and MR8905 modes are not supported (voltage and temperature, strain and voltage, etc.).
(Calculations)	+, -, ×
Numerical calculations	Eight calculations are available at the same time
(Calculation target)	Internal memory
(Calculations)	Average value, RMS value, P-P value, maximum value, time to maximum value, minimum value, time to minimum value, period, frequency, rise time, fall time, area value, X-Y area value, standard deviation, time to level, level at time, pulse width, duty ratio, pulse count, time difference, phase contrast, high level, low level, four arithmetic operations Calculation results can be saved to SD memory card or USB flash drive.
(Calculation range)	Select from all measurement data or between A/B or C/D cursors.
(Automatic saving of calculation results)	Calculates the final calculation value automatically after measurement stops, and then saves it in CSV format to the SD memory card or USB flash drive.
Waveform calculations	Up to 8 calculations can be performed simultaneously.
(Calculation target)	Internal memory
(Calculations)	Basic arithmetic, absolute value, exponents, common logarithms, square roots, differentials (1st and 2nd order), integrals (1st and 2nd order), moving averages, time-axis moving averages, trigonometric operations (SIN, COS, TAN), inverse trigonometric operations (ASIN, ACOS, ATAN), FIR filter operations (LPFFIR, HPFFIR, BPFFIR, BSFFIR), IIR filter operations (LPFIIR, HPFIIR, BPFIIR, BSFIIR), average value (PAVE), maximum value (PMAX), minimum value (PMIN), level at time (PLEVEL)
(Calculation range)	All measurement data; areas between the A/B and C/D cursors can be selected.
FFT calculations	Up to 4 calculations can be performed simultaneously.
(Calculation target)	Internal memory
(Calculation modes)	Single, repeat
(No. of points)	1000,2000,5000,10000
(No. of skips)	Automatic, 100, 200, 500, 1,000, 2,000, 5,000 *Can be set only when the calculation mode is "repeat."
(Window functions)	Rectangular window, Hanning, Hamming, Blackman, Blackman-Harris, flat top, exponential
(Averaging)	Off, simple average, indexed average, peak hold (settable from 2 to 10,000 iterations) *When the calculation mode is "repeat," the maximum number of averaging iterations is limited.
(Compensation)	None, power, average
(Peak value display)	Off, local maximum value, maximum value
(Analysis mode)	Off, linear spectrum, RMS spectrum, power spectrum, transmission function, cross-power spectrum, coherence function, phase spectrum
(Display scale)	Linear scale, log scale
Real-time value monitor	Values for all channels can be monitored during measurement.

14.3 Other Functions

(Display)	Instantaneous value, average value, P-P value, maximum value, minimum value (targeting measurement data after trigger point)
(Results output)	Displayed on screen only.
Event mark function	Event input under the following conditions is possible (max. 1000 marks). 1. When pressing START key while measuring 2. When inputting a signal to the external input terminal
Jump	Jump to trigger, cursor, time, event mark, or 0% / 25% / 50% / 75% / 100% position.
Cursor measurement functions	Select from vertical, horizontal, and vertical & horizontal.
(Measurement items)	Cursor A/cursor B/cursor C/cursor D: Potential, time from trigger Cursor E/cursor F: Potential Between cursors A and B, Between cursors C and D: Time difference, potential difference, frequency Between cursors E and F: Potential difference
(Cursor movement)	Select from individual cursor or simultaneous movement.
Scaling functions	Select from conversion ratio, 2-point, sensor, output rate, dB, rating, or off for each channel. Ratio: Set an output rate and attenuation. 2-Point : Set the voltage at 2 points and a post-conversion value. Sensor : Select from clamp model and Model 9322 Differential Probe. Output Rate: Select from the sensor's output rate and potential-dividing probe's attenuation. dB : Specify the input dB value and post-conversion value. Rating : Set according to the value on the test report of the strain sensor being used (Model MR8903 Strain Unit only).
Data protection	In the event of a power outage during saving to storage media, the file is closed and then the power is shut down. Note: This function is enabled 15 minutes after the power is turned on.
Manual saving	Data can be saved by pressing the SAVE key while measurement is stopped. Save types: Setting conditions, waveform data (binary format), waveform data (CSV format), numerical calculation results, and screen data (compressed bit-map format and PNG format)
SAVE key operation setting	The operation for when the SAVE key is pressed is selectable from Select & Save and Quick Save. When Quick Save is selected, set the save type, format, and range.
Loading waveform data	The instrument can load data saved in binary format. Waveform data saved in real time can be loaded starting at a specified position up to the maximum storage memory capacity.
Comment entry	A title or a comment for each channel can be entered (up to 40 characters). (Numerical values, alphabet letters, symbols)
Gauge	Gauges can be displayed on the Waveform screen (can be switched on and off)
Retain start condition function	Provided
Auto setup function	Setting conditions in the instrument or SD memory card can be loaded automatically at power-on.
Setting configuration saving function	Up to 6 setting configurations can be stored in HiCorder memory.
Inadvertent START/STOP prevention	Displays a confirmation message when pressing START/STOP keys. Confirmation message: Select enable/disable (Default: disable)
Time value display	Select from time, date, and number of data for the horizontal axis display. The time, date, or number of data from the start of measurement is displayed. Time : Displays the time (in hours, minutes, and seconds) from the start of measurement. However, if a trigger is set, the time from the trigger point is displayed. Date : Displays the date and time that the data was acquired. Number of data: Display the number of data from the start of measurement. However, if a trigger is set, the number of data from the trigger point is displayed. This setting is applied to CSV format waveform data files.

Key-Lock function	Two-stage setting with sliding switch: Touch panel only or touch panel and hardware keys
System reset	All setting items can be restored to their factory defaults.
Beeper	On/Off
Auto range	Available (The most suitable time axis and voltage axis for the input waveform are selected automatically.)
Self-Test function	Self-test for keys/LEDs, LCD, ROM/RAM, LAN, and media
Waveform monitor function	You can check the waveform without saving data to memory (Settings screen, Trigger Standby screen).
Waveform search function	Search for locations that fulfill specified conditions for the desired channel. Trigger, peak *One measurement channel can be selected.
Waveform history	Up to 16 past measurement data sets can be selected and displayed.
External terminals	
External sampling	Maximum input voltage : 10 VDC Input voltage : High level of 2.5 to 10 V; low level of 0 to 0.8 V Response pulse width : High, low period of at least 2.5 μ s Maximum input frequency : 200 kHz
External input	Set any of the following functions for input 1, input 2, and input 3: Start, stop, start & stop, save, abort, event. Maximum input voltage : 10 VDC Input voltage : High level of 2.5 to 10 V; low level of 0 to 0.8 V Response pulse width : High period of at least 30 ms; low period of at least 30 ms
External output	Set any of the following functions for output 1 or output 2: GO (value judgment), NG (value judgment), error, busy, trigger wait. Open-drain output (with 5 V output, active low) Output voltage : High level 4.0 to 5.0 V, low level 0 to 0.5 V Maximum input voltage: 50 VDC, 50 mA, 200 mW
Externally connected equipment	USB mouse, USB keyboard

14.4 MR8901 Analog Unit Specifications

Accuracy applies to $23\pm 5^{\circ}\text{C}$ ($73\pm 9^{\circ}\text{F}$), 20 to 80%RH (when zero adjustment is executed 30 minutes after power on).

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	4 channels
Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV/div 1, 2, 5, 10 V/div
Measurement accuracy	$\pm 0.5\%$ f.s. (filter 5 Hz ON)
Temperature characteristic	$\pm 0.05\%$ f.s./ $^{\circ}\text{C}$
Frequency characteristic	DC to 100 kHz -3dB
Noise	1.5 mV p-p typ., 2 mV p-p max. (sensitivity range, with input shorted)
Common mode rejection ratio	80 dB minimum (at 50/60 Hz and with signal source resistance 100 Ω maximum)
Low-pass filter	Off, $5\pm 50\%$, $50\pm 50\%$, $500\pm 50\%$, $5k\pm 50\%$ (Hz), -3 dB
Input type	Unbalanced (floating)
Input coupling	DC/ GND
Input resistance	1 M Ω $\pm 1\%$
Input capacitance	10 ± 5 pF (at 100 kHz)
A/D resolution	16 bits
Maximum sampling rate	500 kS/s
Input terminals	Isolated BNC terminal
Maximum input voltage	150 VDC
Dielectric strength	2.7 kVAC/1 min., between input module and instrument and between input modules
Maximum rated voltage to earth	100 V AC, DC (between each input channel and instrument and between input channels) Measurement category II (anticipated transient overvoltage 800 V)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the MR8901 is installed
Operating environment	Same as the Memory HiCorder in which the MR8901 is installed
Storage temperature and humidity	Temperature: -20 to 60°C (-4 to 140°F) Humidity: -20 to 40°C (-4 to 104°F) 80% RH or less (non-condensing) 40 to 45°C (104 to 113°F) 60% RH or less (non-condensing) 45 to 60°C (113 to 140°F) 50% RH or less (non-condensing)
Dimensions	Approx. 119.5W x 18.8H x 151.5D mm (4.70"W x 0.74"H x 5.96"D)
Mass	Approx. 180 g (6.3 oz.)
Accessory	Instruction Manual (when module is shipped alone)
Effect of radiated radio-frequency electromagnetic field	$\pm 5\%$ f.s. at 3 V/m (max)
Effect of conducted radio-frequency electromagnetic field	$\pm 5\%$ f.s. at 3 V (max) (100 mV/div with 1 VDC input)
Applicable Standards	Safety : EN61010 EMC : EN61326 Class A

14.5 MR8902 Voltage/TEMP Unit Specifications

Accuracy figures are defined for 23±5°C (73±9°F) and 20% to 80% RH when mounted in Memory HiCorder, obtained with a 50 Hz/60 Hz digital filter after zero adjustment having been performed 30 minutes after power-on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	15 channels
Input terminals	Push-button terminals (two terminals per channel)
Measurement object	Voltage, Temperature (Thermocouple K, J, E, T, N, R, S, B, W)
Measurement range/ resolution/range/accuracy	See Table 1
Reference junction compensation	Selectable internal or external (temperature measurement)
Reference junction compensation accuracy	±0.5°C (Reference junction compensation: added on to temperature measurement accuracy for internal mode)
Temperature characteristic	To the measurement accuracy add (measurement accuracy x 0.1) per °C
Thermocouple broken-wire detection	The unit checks for a broken wire during temperature measurement. On/off switchable (setting applies to all unit functionality) Detection current: 5 µA ±20%
Normal mode rejection ratio	50dB minimum (With 50 Hz digital filter for 50 Hz input) (With 60 Hz digital filter for 60 Hz input)
Common mode rejection ratio	With signal source resistance of 100 Ω or less 100 dB or greater (with digital filter off for 50/60 Hz input) 140 dB or greater (with 50 Hz digital filter for 50 Hz input and 10 mV f.s. range setting) (with 60 Hz digital filter for 60 Hz input and 10 mV f.s. range setting)
Digital filter	Off / 50 Hz / 60 Hz
Cutoff frequency	Digital filter off: 17.361 kHz 60 Hz digital filter: 60 Hz 50 Hz digital filter: 50 Hz
Data update	Fast or normal (selectable with 50/60 Hz digital filter)
Data update rate	Digital filter (off) and broken-wire detection (off) : 10 ms Digital filter (off) and broken-wire detection (on) : 20 ms Digital filter (50 Hz/60 Hz), data update (fast) : 500 ms Digital filter (50 Hz/60 Hz), data update (normal): 2 s
Input resistance	1 MΩ±5%
Maximum input voltage	100 VDC
Max. channel-to-channel voltage	100 VDC
Maximum rated voltage to earth	100 V AC, DC (between each analog input channel and instrument) Measurement category II (anticipated transient overvoltage 800 V)
Dielectric strength	2.7 kVAC/1 min. (between each channel and instrument, between each input modules), 350 VAC for 15 seconds (between channels)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the MR8902 is installed
Operating environment	Same as the Memory HiCorder in which the MR8902 is installed
Storage temperature and hu- midity ranges	Temperature: -20 to 60°C (-4 to 140°F) Humidity: -20 to 40°C (-4 to 104°F) 80% RH or less (non-condensing) 40 to 45°C (104 to 113°F) 60% RH or less (non-condensing) 45 to 60°C (113 to 140°F) 50% RH or less (non-condensing)
Dimensions	Approx. 119.5W×18.8H×184.8D mm (4.70"W x 0.74"H x 7.28"D)
Mass	Approx. 190 g (6.7 oz.)

14.5 MR8902 Voltage/TEMP Unit Specifications

Accessories	Instruction Manual (when module is shipped alone), 2 ferrite clamps
Effect of radiated radio-frequency electromagnetic field	±5% f.s. at 3 V/m (max) (at 5 mV/div)
Effect of conducted radio-frequency electromagnetic field	±5% f.s. at 3 V (max) (at 5 mV/div)
Applicable standards	Safety: EN61010, EMC: EN61326, Class A

Table 1**Measurement object: Voltage**

Range (/div)	Max. resolution	Measurement Range	Measurement Accuracy
500 μ V	500 nV	-10 mV to 10 mV	±10 μ V
1 mV	1 μ V	-20 mV to 20 mV	±20 μ V
5 mV	5 μ V	-100 mV to 100 mV	±100 μ V
10 mV	10 μ V	-200 mV to 200 mV	±200 μ V
50 mV	50 μ V	-1 V to 1 V	±1 mV
100 mV	100 μ V	-2 V to 2 V	±2 mV
500 mV	500 μ V	-10 V to 10 V	±10 mV
1 V	1 mV	-20 V to 20 V	±20 mV
5 V	5 mV	-100 V to 100 V	±100 mV

Measurement object: Thermocouple (not including reference junction compensation accuracy)

*1: JIS 1602-1995, IEC584

*2: ASTM E-988-96

Sensor	Range (/div)	Max. resolution	Measurement Range	Measurement Accuracy
K *1	10°C	0.01°C	-100 to less than 0°C 0 to 200°C	±0.8°C ±0.6°C
	50°C	0.05°C	-200 to less than -100°C -100 to 1000°C	±1.5°C ±0.8°C
	100°C	0.1°C	-200 to less than -100°C -100 to 1350°C	±1.5°C ±0.8°C
J *1	10°C	0.01°C	-100 to less than 0°C 0 to 200°C	±0.8°C ±0.6°C
	50°C	0.05°C	-200 to less than -100°C -100 to 1000°C	±1.0°C ±0.8°C
	100°C	0.1°C	-200 to less than -100°C -100 to 1200°C	±1.5°C ±0.8°C
E *1	10°C	0.01°C	-100 to less than 0°C 0 to 200°C	±0.8°C ±0.6°C
	50°C	0.05°C	-200 to less than -100°C -100 to less than 0°C 0 to 1000°C	±1.5°C ±0.8°C ±0.6°C
	100°C	0.1°C	-200 to less than -100°C -100 to less than 0°C 0 to 1000°C	±1.5°C ±0.8°C ±0.6°C
T *1	10°C	0.01°C	-100 to less than 0°C 0 to 200°C	±0.8°C ±0.6°C
	50°C	0.05°C	-200 to less than -100°C -100 to less than 0°C 0 to 400°C	±1.5°C ±0.8°C ±0.6°C
	100°C	0.1°C	-200 to less than -100°C -100 to less than 0°C 0 to 400°C	±1.5°C ±0.8°C ±0.6°C
N *1	10°C	0.01°C	-100 to less than 0°C 0 to 200°C	±1.2°C ±1.0°C
	50°C	0.05°C	-200 to less than -100°C -100 to less than 0°C 0 to 1000°C	±2.2°C ±1.2°C ±1.0°C
	100°C	0.1°C	-200 to less than -100°C -100 to less than 0°C 0 to 1300°C	±2.2°C ±1.2°C ±1.0°C

Sensor	Range (/div)	Max. resolution	Measurement Range	Measurement Accuracy
R *1	10°C	0.01°C	0 to 200°C	±4.5°C
	50°C	0.05°C	0 to less than 100°C 100 to less than 300°C 300 to less than 1000°C	±4.5°C ±3.0°C ±2.2°C
	100°C	0.1°C	0 to less than 100°C 100 to less than 300°C 300 to 1700°C	±4.5°C ±3.0°C ±2.2°C
S *1	10°C	0.01°C	0 to 200°C	±4.5°C
	50°C	0.05°C	0 to less than 100°C 100 to less than 300°C 300 to less than 1000°C	±4.5°C ±3.0°C ±2.2°C
	100°C	0.1°C	0 to less than 100°C 100 to less than 300°C 300 to less than 1700°C	±4.5°C ±3.0°C ±2.2°C
B *1	50°C	0.05°C	400 to less than 600°C 600 to 1000°C	±5.5°C ±3.8°C
	100°C	0.1°C	400 to less than 600°C 600 to less than 1000°C 1000 to 1800°C	±5.5°C ±3.8°C ±2.5°C
W *2	10°C	0.01°C	0 to 200°C	±1.8°C
	50°C	0.05°C	0 to 1000°C	±1.8°C
	100°C	0.1°C	0 to 2000°C	±1.8°C

14.6 MR8903 Strain Unit Specifications

Accuracy figures are defined for 23 ±5°C (73 ±9°F) and 20% to 80% RH, with auto-balancing having been performed at least 30 minutes after power-on.

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	4 channels
Measurement object	Voltage, Strain gauge adapter
Gauge rate	2.0
Bridge voltage	2 ±0.05 V
Bridge resistance	120 Ω to 1 kΩ
Balancing	Electronic auto-balancing
Balance adjustment range	Voltage : ±10 mV max Strain : ±10000 με max
Measurement ranges	Voltage : 50, 100, 200, 500, 1000 μV/div Strain : 20, 50, 100, 200, 500, 1000 με/div
Measurement accuracy	With 5 Hz filter on Voltage: ±(0.5% f.s.+4 μV) (50 μV/div) ±0.5% f.s. (100, 200, 500, 1000 μV/div) Strain : ±(0.5% f.s.+4 με) (20, 50 με/div) ±0.5% f.s. (100, 200, 500, 1000 με/div)
Temperature characteristic	Gain : ±0.05% f.s./°C Zero position Voltage: ±2.5 μV/°C (after auto-balancing) Strain : ±2.5 με/°C (after auto-balancing)
Frequency characteristic	DC to 20 kHz+1/-3dB
Low-pass filter	OFF, 5±30%, 10±30%, 100±30%, 1k±30% (Hz) -3 dB
Input terminals	Honda Tsushin Kogyo Co., Ltd. HDR-EC14LFDTG2-SLE+ (2 channels/terminal)
Resolution	1/1250 of range
Maximum sampling rate	200 kS/s
Maximum input voltage	10 VDC
Input resistance	1 MΩ or more
Maximum rated voltage to earth	30 V rms or 60 VDC (between each input channel and instrument, and between input channels), anticipated transient overvoltage 330 V
Dielectric strength	350 VAC for 15 seconds (between input channels and instrument, between input channels)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the MR8903 is installed
Operating environment	Same as the Memory HiCorder in which the MR8903 is installed
Storage temperature and humidity ranges	Temperature: -20 to 60°C (-4 to 140°F) Humidity: -20 to 40°C (-4 to 104°F) 80% RH or less (non-condensing) 40 to 45°C (104 to 113°F) 60% RH or less (non-condensing) 45 to 60°C (113 to 140°F) 50% RH or less (non-condensing)
Dimensions	Approx. 119.5W × 18.8H × 151.5D mm (4.70"W × 0.74"H × 5.96"D) (excluding projections)
Mass	Approx. 173 g (6.1 oz.)
Accessories	Instruction Manual (when module is shipped alone) Conversion cable × 2 (Compatible sensor connector: PRC03-12A10-7M10.5 by TAJIMI)
Effect of radiated radio-frequency electromagnetic field	±5% f.s. at 3 V/m
Effect of conducted radio-frequency electromagnetic field	±5% f.s. at 3 V (max)
Applicable standards	Safety: EN 61010, EMC: EN 61326 Class A

14.7 MR8905 Analog Unit Specifications

MR8875: Applicable for Ver. 2.13 or later, MR8875-30: Applicable for Ver. 3.13 or later

Accuracy applies to 23±5°C (73±9°F), 20 to 80%RH (when zero adjustment is executed 30 minutes after power on).

Product warranty period	3 years
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Measurement Functions	instantaneous values and AC RMS value (Individually switchable for each channel)
Measurement ranges	500 mV/div 1, 2, 5, 10, 20, 50 V/div
Measurement accuracy	±0.5% f.s. (filter 5 Hz ON)
Effective value measurement accuracy	±1.5% f.s. (30 Hz to less than 1 kHz, sine wave), ±3% f.s. (1 kHz to 10 kHz, sine wave) Crestfactor: 2 (Sine wave with a peak voltage of up to 1000 V)
Effective value measurement response time	300 ms (with low-pass filter Off) • Rising: Response time of up to 0% f.s. → 90% f.s. when 0%f.s.→100% f.s. input 600 ms (with low-pass filter Off) • Falling: Response time of up to 100% f.s. → 10% f.s. when 100% f.s.→0% f.s. input
Temperature characteristic	±0.05% f.s./°C
Frequency characteristic	DC to 100 kHz -3dB
Noise	30 mV p-p typ., 50 mV p-p max. (sensitivity range, with input shorted)
Common mode rejection ratio	80 dB minimum (at 50/60 Hz and with input shorted)
Low-pass filter	Off, 5±50%, 50±50%, 500±50%, 5k±50% (Hz), -3 dB
Input type	balanced (floating)
Input coupling	DC/ AC- RMS/ GND
Input resistance	4 MΩ ±1%
Input capacitance	1 pF maximum (at 100 kHz)
A/D resolution	16 bits
Maximum sampling rate	500 kS/s
Input terminals	Banana jack input terminals
Maximum input voltage	1000 VDC, 700 VAC
Dielectric strength	4.29 kVAC/1 min., between input module and instrument and between input modules
Maximum rated voltage to earth	1000 V AC, DC (between each input channel and instrument and between input channels) Measurement category II (anticipated transient overvoltage 6000 V) 600 V AC, DC (between each input channel and instrument and between input channels) Measurement category III (anticipated transient overvoltage 6000 V)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the MR8905 is installed
Operating environment	Same as the Memory HiCorder in which the MR8905 is installed
Storage temperature and humidity	Temperature: -20 to 60°C (-4 to 140°F) Humidity: -20 to 40°C (-4 to 104°F) 80% RH or less (non-condensing) 40 to 45°C (104 to 113°F) 60% RH or less (non-condensing) 45 to 60°C (113 to 140°F) 50% RH or less (non-condensing)
Dimensions	Approx. 119.5W x 18.8H x 151.5D mm (4.70"W x 0.74"H x 5.96"D)
Mass	Approx. 185 g (6.5 oz.)
Accessory	Instruction Manual (when module is shipped alone)
Effect of radiated radio-frequency electromagnetic field	±5%f.s. at 3 V/m (max)

14.7 MR8905 Analog Unit Specifications

Effect of conducted radio-frequency electromagnetic field	±5%f.s. at 3 V (max) (500 mV/div with 1 VDC input)
Applicable Standards	Safety : EN61010 EMC : EN61326 Class A
Options*	<ul style="list-style-type: none"> • Model L4940 Connection Cable (1.5 m) 1000 V CAT III, 600 V CAT IV, 10 A • Model L4935 Alligator Clip (Attached to tips of Model L4940) 1000 V CAT III, 600 V CAT IV, 10 A • Model L9243 Grabber Clip (Attached to tips of Model L4940) 1000 V CAT III, 1A • Model L4936 Bus Bar Clip (Attached to tips of Model L4940) 600 V CAT III, 5 A • Model L4937 Magnetic Adapter (Attached to tips of Model L4940) 1000 V CAT III, 2 A • Model L4931 Extension Cable (Extends length of Model L4940 by 1.5 m) 1000 V CAT III, 600 V CAT IV, 10 A • Model L4932 Test Pin (Attached to tips of Model L4940) 1000 V CAT III, 600 V CAT IV, 10 A • Model L4934 Small Alligator Clip 600 V CAT II, 300 V CAT III, 3 A <p>*Model L4932 is required to use Model L4934.</p>

*: The options listed above are available for the instrument. To order an option, please contact your authorized Hioki distributor or reseller. Options are subject to change. Please check Hioki's website for the latest information.

Maintenance and Service

Chapter 15

15

Chapter 15 Maintenance and Service

15.1 Inspection, Repair, and Cleaning

**WARNING**

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

Transporting

Use the original packing materials when transporting the instrument, if possible. Pack the instrument so that it will not sustain damage during shipping, and include a description of existing damage. We cannot accept responsibility for damage incurred during shipping.

**CAUTION**

To avoid damaging the instrument, remove the SD memory card and USB flash drive from the instrument before transporting it.

Replaceable Parts and Operating Lifetimes

Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods. For replacement parts, contact your dealer or Hioki representative.

Part	Life
Z1003 Battery Pack	60% of initial battery capacity can be expected to remain after 500 complete charge/discharge cycles.
Battery pack connectors	Disconnection/connection times: 30 (the number of times that provides stable connection)
Fan motor	Approx. 30000 hours (ambient temperature: 25°C; humidity: 45% to 85% RH [reference values])
Backlight (to half brightness)	Approx. 100,000 hours (ambient temperature: 25°C [reference value])
Electrolytic Capacitors	Approx. 10 years The useful life of electrolytic capacitors varies greatly according to the operating environment. In severe operating environments (40°C ambient temperature), degradation occurs in about four years, so they should be replaced periodically.
Electric double-layer capacitor	Approx. 3 years The instrument has a built-in electric double-layer capacitor to protect files. When the file protection function ceases to operate during a power outage, the capacitor's service life is over. Contact your dealer or Hioki representative.
Lithium Battery	Approx. 10 years The instrument contains a built-in backup lithium battery, which offers a service life of about ten years. If the date and time deviate substantially when the instrument is switched on, it is the time to replace that battery. Contact your dealer or Hioki representative.

Note: Service life may be dramatically shortened in hot environments.

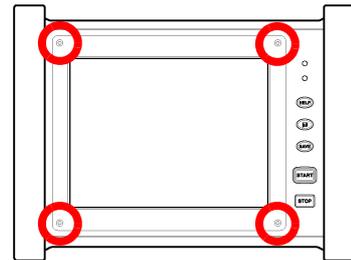
Cleaning**NOTE**

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- Wipe the LCD gently with a soft, dry cloth.
- To keep the vents from getting blocked, clean them periodically.
- You may be unable to operate the instrument normally if dust or other foreign matter gets caught in the gap between the instrument's frame and the touch panel. Clean periodically using the following procedure:

You will need:

Allen wrench (2.5 mm size)

1. Remove the instrument's four hexagonal head screws with the Allen wrench and remove the frame.
2. Remove any dust or foreign matter.
3. Reattach the frame and firmly tighten the four hexagonal head screws.



15.2 Trouble Shooting

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

Before Returning for Repair

If the Display or Operations Malfunction

Symptom	Check Item, or Cause	Remedy and Reference
The display does not appear when you turn the power on.	Is the power cord disconnected? Are connections made correctly?	Verify that the power cord is connected properly. See: "2.4 Connecting a Power Supply" (p. 40)
Keys do not work.	<ul style="list-style-type: none"> Is any key being held down? Is the key-lock state active (Key-Lock message displayed)? 	Verify key operation. Clear the key-lock state. See: "3.8 Disabling Operation (Key Lock Function)" (p. 84)
The screen does not change when you touch the touch panel.	<ul style="list-style-type: none"> Is the instrument in the key-lock state? Is there any dust or foreign matter between the instrument and the touch panel? 	<ul style="list-style-type: none"> Clear the key-lock state. See: "3.8 Disabling Operation (Key Lock Function)" (p. 84) <ul style="list-style-type: none"> Remove any dust or foreign matter. See: "Cleaning" (p. 350)
There is a discrepancy between the position on the screen being touched and the detected touch position.	The touch panel maybe misaligned.	Realign the touch panel. See: "11.5 Correcting the Touch Panel" (p. 277)
Blank screen	Is the backlight saver enabled? Touch a control key or touch the touch panel.	Turn the backlight saver off.
A waveform does not appear when you press the START key.	<ul style="list-style-type: none"> Is the "Pre-Trigger Wait" message displayed? "Trigger Wait" message displayed? 	When pre-triggering is enabled, triggering is ignored until the pre-trigger portion of the waveform has been acquired. Recording starts when a trigger occurs.
No changes occur in the displayed waveform.	<ul style="list-style-type: none"> Is the clamp sensor or connection cable connected correctly? Is the vertical axis (voltage axis) range set properly? Is the filter enabled? 	Verify that the clamp sensor or connection cable is connected correctly. Verify the input channel settings.
A much lower frequency was displayed during measurement than the actual frequency.	An aliasing error may be occurring.	Change the timebase to use a faster sampling rate. See: "Setting the horizontal axis (time-axis or sampling speed)" (p. 58)
The displayed waveform size does not change when the input range is changed.	Is the Variable function enabled?	Turn the Variable function off. See: "6.6 Variable Function (Freely Configuring Waveform Display)" (p. 159)

If you are unable to save data

Symptom	Check Item, or Cause	Remedy and Reference
If saving is not possible to the storage media.	<ul style="list-style-type: none"> Is your SD memory card Hioki certified? Is the storage media inserted properly? Has the storage media been properly formatted? Is there enough space left on the storage media? Are there too many files in the folder? 	<p>See: "2.3 Preparing Storage Media" (p. 38)</p> <p>See: "Media information" (p. 108)</p>
You are unable to use the USB flash drive.	The type of USB flash drive you are using may not be supported.	The type of USB flash drive you are using may not be supported. Try using another type of USB flash drive.

Others

Symptom	Check Item, or Cause	Remedy and Reference
You are unable to communicate over USB.	Is the instrument configured to use USB communications?	See: "Setting Communication (when using communication commands)" (p. 315)
You are unable to install the USB driver.	<ul style="list-style-type: none"> Is the [Interface] parameter set to [USB]? Did the driver installation fail? 	<p>Set the [Interface] parameter to [USB].</p> <p>See: "Setting Communication (when using communication commands)" (p. 315)</p> <p>Delete [Other Devices] under the PC's [device manager] and reconnect the USB cable.</p>

If the cause is unknown

Try performing a system reset. All settings are returned to their factory defaults.

See: "11.3 Initializing the Instrument" (p. 271)

15.3 Resolving Error and Warning Messages

A screen message appears whenever an error occurs. In either case, take the remedial action indicated.

A beep will sound when the **[Setting Display] ▶ [System] ▶ [Env.] ▶ [Beep Sound]** setting is **[Alert]** or **[Alert+Action]**.

See: "Setting the beep tone" (p. 265)

(Example: **Warning Display**)

Displayed Message Number —

Message —

Appears just once when an error occurs. Disappears within a few seconds. The display can be canceled by pressing any key or touching the touch panel. When an error occurs, the display will persist until the **STOP** key is pressed.

Warnings

Display no.	Message	Remedial action	Reference page
10	Please set media.	Insert an SD memory card or USB flash drive.	
12	Please release write-protection.	The media is write-protected. Disable the write protection.	"2.3 Preparing Storage Media" (p. 38)
13	Disk full.	Files cannot be saved because there is no space on the media. Delete unneeded files to create sufficient space or use new media.	
14	Cannot load this file.	The selected file cannot be loaded.	—
16	The file name already exists. Cannot save.	Unable to save or rename the file because another file with the same name exists on the media. Change the filename.	"Renaming Files & Folders" (p. 110)
20	Path name exceeds 255 characters.	Use a path name of 255 characters or less.	—
21	File not found.	The file may have been deleted. Verify that the save destination or file being loaded is correct.	—
24	Could not rename file because of the same as the former file name.	Unable to change the filename because the new filename is the same as the original filename. Use a different filename.	"Renaming Files & Folders" (p. 110)
29	An invalid character is present.	The filename contains one or more characters that cannot be used.	—
30	Auto-ranging failed.	Check the input signal.	"3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)" (p. 82)
31	Invalid cursor position.	The cursor is improperly positioned (outside the waveform range). Check the cursor position.	"5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116)
32	Cannot start Auto-range (Only MR8901 and MR8905 is effective).	Auto-ranging is only valid with the MR8901 Analog Unit and MR8905 Analog Unit.	"3.7 Measuring Using the Auto-ranging Function (Auto-Ranging Function)" (p. 82)

Warnings

Display no.	Message	Remedial action	Reference page
34	Invalid operation (Overlay).	This operation cannot be performed because Overlay is set to [Auto] or [Manual]. Clear the waveforms that have been overlaid, and then try again.	"6.3 Overlaying Previously Captured Waveforms (Overlaying)" (p. 146)
37	Invalid operation.	This operation cannot be performed while processing is in progress. Try again once processing has completed.	–
38	Invalid operation (measuring).	This operation cannot be performed while processing is in progress. Try again once measurement has completed.	–
39	Invalid operation (Temperature malfunction).	Zero-adjustment, auto-balance, measurement start, and auto-ranging operation cannot be performed when a temperature error has occurred. Check the operating temperature and installation environment.	–
40	Invalid operation (Under CAN transmission).	This operation cannot be performed because the communication with MR8904 CAN Unit is in progress. Try again once the communication has completed.	–
42	There is no calculation result.	No calculation results. Perform a calculation.	"Chapter 8 Numerical Calculation Function" (p. 189)
43	Over event mark count (1000).	Up to 1,000 event marks can be recorded.	"5.11 Marking Events" (p. 134)
45	Out of range.	Check the valid setting range and reconfigure the setting.	–
46	Number of digits has exceeded.	Enter up to five significant digits.	–
47	Cannot set by a present measurement condition.	Check the setting conditions.	–
60	No waveform data.	Acquire measurement data.	–
72	Zero-adjustment failed.	Perform zero-adjustment again.	"2.6 Performing Zero Adjustment" (p. 46)
74	Auto balance failed.	Check whether the sensor is in the no-load state or whether it has been properly connected.	"Configuring the MR8903 Strain Unit (Executing Auto-Balance)" (p. 168)
78	The recording length is too long.	If the recording length is too long, save part of the data and then perform the calculation after re-loading it.	"5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116)
82	No calculation formula has been set.	Set the waveform calculation formula.	"9.2 Settings for Waveform Value Calculation" (p. 210)
83	No channel selected for use.	Select the channel to use.	–
85	Invalid search condition.	Check the search condition settings.	"5.10 Searching for Waveforms" (p. 131)

Warnings

Display no.	Message	Remedial action	Reference page
86	The free space of media doesn't suffice. The record time shortens.	Measurement cannot be performed for the set recording time because there is not enough space on the SD memory card. Measurement will stop when the card runs out of space. Delete unneeded files to create sufficient space or use new media.	—
97	Operation kind is not set.	Set the calculation type.	"Chapter 8 Numerical Calculation Function" (p. 189)
98	Record time is not set.	Set the recording time.	"Saving data in real time" (p. 96)
100	Set the waveform calculation filter's cutoff frequency so that it is less than 1/2 the sampling frequency.	Set the waveform calculation digital filter's cutoff frequency so that it is less than 1/2 the sampling frequency.	
101	Set the waveform calculation filter's cutoff frequency low-side value so that it is less than the high-side value.	Set the waveform calculation digital filter's cutoff frequency low-side value so that it is less than the high-side value.	
102	Set the waveform calculation filter's cutoff frequency.	Set the waveform calculation digital filter's cutoff frequency.	"9.7 Example Waveform Calculation: Configuring a Digital Filter" (p. 216)
103	Set both the low-side value and high-side value for the waveform calculation filter's cutoff frequency.	Set both the low-side value and high-side value for the waveform calculation digital filter's cutoff frequency.	
112	Stopped.	Processing was canceled.	—
113	Save processing was interrupted.	Forcible termination was selected while data was being saved.	—
114	Load processing was interrupted.	Forcible termination was selected while data was being loaded.	—
119	Unit (module) configuration has changed. Verify each setting.	The actual unit configuration and settings do not match. Turn the instrument off and then on again, initialize settings, or perform measurement once so that the unit and settings match.	—
123	No data matching the search conditions was found.	Check the search condition settings.	"5.10 Searching for Waveforms" (p. 131)
124	No waveform, or recording length is too short.	Acquire measurement data or set the recording time.	"Chapter 10 FFT Calculation Function" (p. 229)
130	Prohibit changing settings.	Restart has been disabled. Change the setting once measurement has stopped.	"Setting whether to apply setting changes during measurement (enabling restart operation)" (p. 264)
131	Operation is locked.	The instrument is in the key-locked state. Cancel the key lock.	"3.8 Disabling Operation (Key Lock Function)" (p. 84)
175	Internal temperature is rising. Please confirm the use temperature and the installation environment.	The instrument's internal temperature is abnormally high. Check the operating temperature and installation environment.	—

Warnings

Display no.	Message	Remedial action	Reference page
200	Invalid IP address.	The IP address setting is incorrect. Check the setting.	
201	DHCP failed.	Check the connection and network environment. The network's DHCP server may not be operating.	
202	DNS setup is not right	The DNS settings have not been configured, or they have been configured incorrectly. DNS is necessary to connect to the set e-mail server or FTP server.	
203	DNS not found.	Unable to connect to the DNS server. Check the DNS settings.	
204	DNS can not connect.	Check the DNS settings. The set DNS server may not be operating.	
205	DNS fail.	Check the e-mail or FTP server address.	"Chapter 12 Connection to a PC" (p. 279)
206	Server not found.	Check the e-mail or FTP server address.	
207	Server not connect.	Check the e-mail or FTP server address. The specified e-mail or FTP server may not be operating, or the connection may have been denied for security reasons.	
208	Server communication fault	Communications are unreliable, or the e-mail or FTP server may not be supported. For FTP, you may be able to achieve a connection by enabling PASV or changing the server's security settings.	
209	Lan disconnect.	Check the network environment.	
210	Lan Timeout.	Check the network environment.	
211	Lan authentication required.	Authentication is required in order to connect to the e-mail or FTP server. Enable authentication.	

Warnings

Display no.	Message	Remedial action	Reference page
212	Lan authentication fail.	Failed to log in to the e-mail or FTP server. The username or password may be incorrect.	
213	Authentication setup is not right.	Authentication is required, but the username or password has not been set.	
214	Cipher password setup is not right.	Encryption is enabled, but no password has been set.	
215	Server address setup is not right.	Check the address setting.	
216	POP3 Server not found.	Check the POP3 server address.	
217	POP3 Server not connect.	Check the POP3 server address. The specified POP3 server may not be operating.	"Chapter 12 Connection to a PC" (p. 279)
218	E-mail 'to' or 'from' setup is not right.	Check the recipient and sender in the e-mail settings.	
219	Cannot E-mail to the sender.	The message to the specified recipient was denied by the e-mail server. Check the recipient.	
220	Cannot E-mail to the address.	The message from the specified sender address was denied by the e-mail server. Check the sender address.	
221	E-mail is too large.	The message size exceeded the setting. Shorten the measurement length or increase the setting.	—
222	E-mail size is over server restrictions.	The message size exceeded the e-mail server's limits. Shorten the measurement length or change the data being attached to the message.	—
223	Ftp transfer failed.	Check the network environment. The connection may have been denied by the FTP server, so check the FTP server setting. For example, DIR/file creation may be prohibited, or the server's capacity limit may have been reached.	—
224	E-mail transfer failed.	Check the network environment. The message may have been denied by the e-mail server, so check the e-mail server transmission conditions and other settings. For example, the server's capacity limit or maximum number of messages may have been reached.	—
225	Lan aborted.	Transmission was canceled. Exercise care as incomplete data may have been sent as part of the FTP upload or e-mail transmission.	—
226	Network error.	A network error occurred during the communications process. Check the network environment.	—
227	Folder cannot be transmitted.	Unable to send folders. Only files can be sent.	—

Warnings

Display no.	Message	Remedial action	Reference page
233	Verify error occurred.	The SD memory card or USB flash drive being used is not operating normally. Replace with different media.	–
234	Error occurred by the file output to LAN.	A network error occurred during the communications process. Check the network environment.	–
236	No writing permission of the file.	Unable to write to files for which the write-protect, system, or hidden attribute is set. The file may already be open for access.	–
239	Path name is not correct.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Turn the instrument off and then on again.	–
241	File processing error.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Replace the media or turn the instrument off and then on again.	–
520	File may be corrupted.	File information for the SD memory card or USB flash drive is inconsistent. Back up the files on a PC and then format the media.	–
521	Charging UPS battery.	Wait for the battery to charge, or set file protection to “Low” and turn the instrument off and then on again.	–
522	Folder is too deep.	The folder was too many levels down in the hierarchy and could not be deleted. Delete the folder on a PC.	–
523	Please set the SD card.	Unable to start real-time recording because no SD memory card has been inserted into the instrument. Insert an SD memory card.	–
525	Can't read file.	The file is corrupt. Do not turn off the instrument or remove media while data is being saved.	–
526	Since the load of real-time save is high, time-axis magnification is changed.	The time axis zoom factor was automatically changed because the instrument was unable to keep up with the waveform display due to the load imposed by real-time saving.	–
527	Since the load of real-time save is high, it cannot set up.	Unable to make the setting because the instrument is unable to keep up with the waveform display due to the load imposed by real-time saving.	–

Errors

Display no.	Message	Remedial action
176	Internal temperature is abnormal. Please turn the power off after preserving necessary data.	The instrument's internal temperature is abnormally high. Save data as necessary and turn off the instrument.
188	IIC bus error occurred.	The device malfunctioned. Turn the instrument off and back on again. If an error message is displayed when the instrument is turned back on, it needs to be repaired.
232	File processing was not able to be ended normally.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Replace the media or turn the instrument off and then on again.
235	Real-time save was not in time.	The instrument was unable to keep up with recording (saving) data to the media being used for real-time saving. Replace the media, use a slower recording time, or reduce the number of channels in use.
237	File or task doesn't open it any further.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Turn the instrument off and then on again.
238	Memory of the file system is insufficient.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Turn the instrument off and then on again.
240	Error occurred by reading media or writing.	An unexpected error occurred while processing files on the SD memory card or USB flash drive. Replace the media or turn the instrument off and then on again.
524	The free space of SD card doesn't suffice for real-time save.	There is no longer enough space on the SD memory card. Free up space on the SD memory card.

15.4 Disposing of the Instrument (Lithium Battery Removal)

The instrument contains a lithium battery for memory backup. Remove this battery before disposing of the instrument.

⚠ WARNING

- To avoid electric shock, turn off the power switch and disconnect the power cord and connection cords before removing the lithium battery.
- Keep batteries away from children to prevent accidental swallowing.
- Battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.

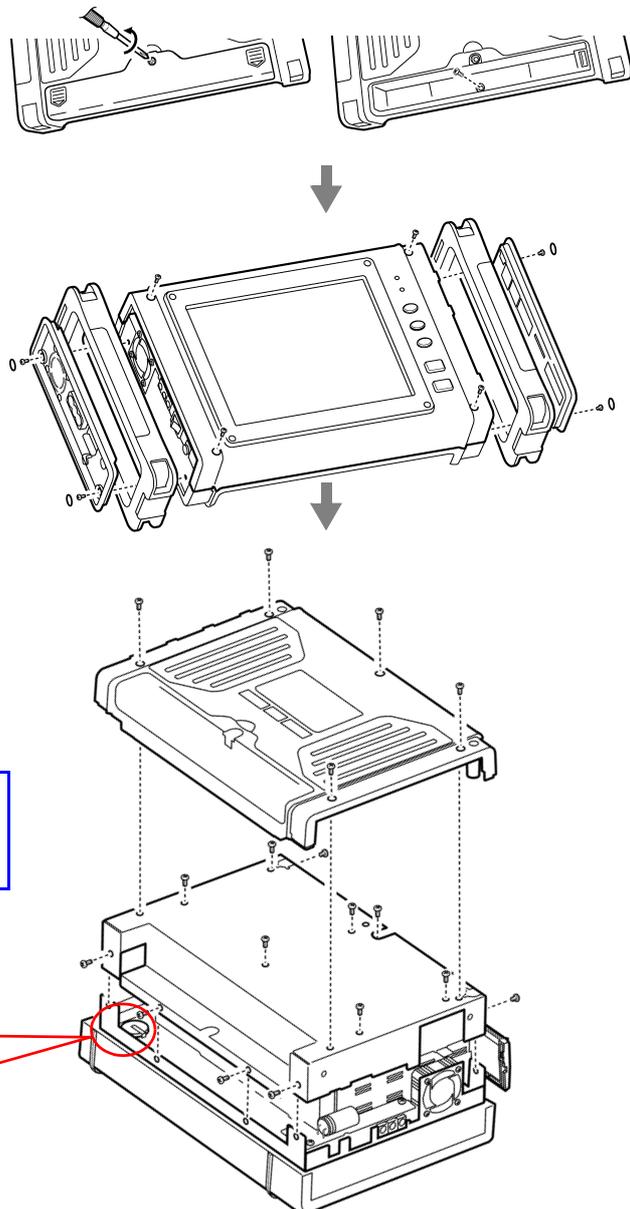
⚠ CAUTION

When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

You will need

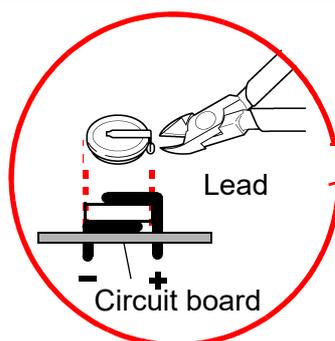
- One Phillips head screwdriver (No. 1)
- One pair of nippers (for removing the lithium battery)

- 1** Verify that the power is off, and remove the measurement cables and power cord.
- 2** Turn the instrument over and remove the screw on the battery pack compartment's cover (there is one).
- 3** Remove the battery pack compartment cover and remove the battery pack.
- 4** Remove screws as shown in the diagram below.
- 5** Lift up the lithium battery on the printed circuit board and cut the two positive and negative leads with the nippers.



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Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate



Appendix

Appendix 1 Initial Values for Principal Settings

The following table lists initial values for principal settings.

Screen	Tab	Items	Settings	Screen	Tab	Items	Settings
Status	-	Title Comment	Blank	System	Env.	Start/Stop Confirm	Off
		Realtime Save	Off			Restart	Yes
		Sampling Clock	Internal			Grid Type	Dot Line
		Timebase	200 μ s/div (Sampling speed 2 μ s/S)			Display Comments	Off
		Shot	25div			Time Value Display	Time
		Recording length setting method	Fix			Zero Position	Off
		Sheet	All			Variable Auto Adjustment	On
		Display format	Waveform			Auto Start	Off
		Screen division	Single			Measurement	Off
		Time Mag. (Waveform)	$\times 1$			Auto Resume Measurement	Off
		Logic Width (Waveform)	Normal			Beep Sound	Alert
		Overlay	Off			Key Press/Touch Beep Sound	Off
		Auto Save	Off			File Protection	Low
		Save in	SD Card			5V Output	Off
		Name	AUTO			Backlight Saver	Off
		Waveform	Off			Backlight Brightness	4
		Calculation Result	Off			LCD Direction	Normal
Screen Image	Off	Setting Window	3				
Channel	Analog	Each input module settings	(p. A 2)	External Terminal		Transparency	On
		Logic	Position			Pos1	Window Animation
	Comment		Blank			Display Color	1
	Pulse	Mode	Integrate (Add)			Language	English
		Filter	Off			Decimal Point	Period .
		Range (/div)	2500c			Separator	Comma ,
		Division	1c			Date Separator	Slash /
		Variable	Off			Date Notation	YY/MM/DD
		Mag.	$\times 1$			IN1	START
	Position	0%	IN2			STOP	
	CH Calc.	Variable	Off			IN3	START/STOP
Mag.		$\times 1$	GO/OUT1	Judge			
Position		50%	NG/OUT2	Judge			
Trigger	General	Trigger	Off	Trigger In Filter	Off		
Calculation	Numeric Calculation	Numeric Calculation	Off	Trigger Out	Pulse		
		Waveform Calculation	Off	Setting	Auto Setup	Off	
	FFT Calculation	FFT	Off		Comment	Blank	
					Comm.	Interface	USB
File	SAVE key	SAVE key Operation	Select				

Appendix 1 Initial Values for Principal Settings

Input module initial settings

MR8901 Analog Unit

Items	Settings
Mode	Voltage
Range (/div)	5mV
Filter	Off
Coupling	DC
Variable	Off
Mag.	×1
Position	50%
Vernier	-
Invert	Off
Probe	1:1
Comment	Blank
Scaling	Off

MR8902 Voltage/TEMP Unit

Items	Settings
Mode	Voltage
Range (/div)	500μV
Filter	Off
Variable	Off
Mag.	×1
Position	50%
Vernier	-
Invert	Off
Comment	Blank
Scaling	Off

MR8903 Strain Unit

Items	Settings
Mode	Strain
Range (/div)	20μ ϵ
Filter	Off
Variable	Off
Mag.	×1
Position	50%
Vernier	-
Invert	Off
Comment	Blank
Scaling	Off

MR8905 Analog Unit

Items	Settings
Mode	Instantaneous value
Range (/div)	500 mV
Filter	Off
Coupling	DC
Variable	Off
Mag.	×1
Position	50%
Vernier	-
Invert	Off
Probe	1:1
Comment	Blank
Scaling	Off

Appendix 2 Reference

File Sizes

Waveform files

File size (bytes) = setting size^{*1} + data size^{*2}

*1: Setting size=(885 + no. of analog channels × 2 + no. of pulse channels × 2 + no. of internal logic channels × 2 + no. of inter-channel calculation channels × 2 + no. of waveform calculation channels × 1 + no. of CAN logic channels × 4 + no. of CAN 32-bit channels × 2) × 512

*2: Data size=(No. of analog channels + no. of pulse channels + no. of internal logic channels + no. of inter-channel calculation channels × 2 + no. of waveform calculation channels × 2 + no. of CAN 32-bit channels × 2) × no. of measurement data points × 2

- The number of internal logic channels is calculated as 1 if measurement is enabled.
- The number of CAN logic channels is calculated as 1 when using logic channels with the MR8904 CAN Unit. If using logic channels with multiple MR8904 units, the number of channels increases with the number of units.
- The number of CAN 32-bit channels indicates the number of channels for which 17 to 32 bits have been allocated.

The following table provides a reference list of waveform file sizes when using only analog channels:

Unit: KB

Recording length (div)	No. of analog channels						
	1	2	4	8	16	30	60
25	481	487	499	522	569	652	828
100	496	516	557	639	804	1091	1707
1000	671	868	1260	2046	3616	6364	12254
2000	867	1258	2042	3608	6741	12224	23973
5000	1453	2430	4385	8296	16116	29802	59129
10000	2429	4383	8292	16108	31741	-	-
20000	4382	8290	16104	31733	62991	-	-

CSV (text) files

$$\text{File size (bytes)} = \text{header size}^{*1} + \text{data size}^{*2}$$

*1: Header size = Max. of about 12 KB (varies with setting conditions)

*2: Data size = No. of data points × (37 + (no. of analog channels + no. of pulse channels + no. of inter-channel calculation channels + no. of waveform calculation channels) × 13 + no. of internal logic channels × 16 + no. of CAN logic channels × 32 + no. of CAN 32-bit channels × 17)

- The number of internal logic channels is calculated as 1 if measurement is enabled.
- The number of CAN logic channels is calculated as 1 when using logic channels with the MR8904 CAN Unit. If using logic channels with multiple MR8904 units, the number of channels increases with the number of units.
- The number of CAN 32-bit channels indicates the number of channels for which 17 to 32 bits have been allocated.

The actual size varies somewhat from the equation described above depending on the setting conditions. Leave a margin of about 20% above the file size calculated with the above equation.

The following table provides a reference list of text file sizes when using only analog channels:

Unit: KB

Recording length (div)	No. of analog channels						
	1	2	4	8	16	30	60
25	130	162	225	352	606	1051	2003
100	489	616	870	1378	2394	4171	7980
1000	4796	6065	8604	13683	23839	41612	79699
2000	9581	12120	17198	27354	47667	83214	159386
5000	23936	30284	42979	68370	119151	208019	398449
10000	47862	60557	85948	136729	238292	-	-
20000	95714	121104	171886	273448	476573	-	-

Settings data files

Settings data files are 264 KB in size.

Maximum recording time

When real-time saving is disabled

The maximum recording time varies with the set time axis. The maximum recording time can be calculated as shown below:

$$\text{Maximum recording time} = \text{Time axis} \times \text{maximum recording length}$$

You can check the maximum recording time on the [\[Waveform Display\]](#) ► [\[Status\]](#) ► [\[Basic\]](#) screen or the [\[Setting Display\]](#) ► [\[Status\]](#) screen (maximum recording time).

NOTE

- When the time axis is set to a slow time, the recording time will be set to an extended period (1 year or longer) depending on the conditions. However, proper operation is not guaranteed due to the effect of the warranty period and product service life.
- The maximum recording length varies with the unit's maximum number of channels in use*.
See: "6.4 Setting Channels to Use (Increasing the Recording Length)" (p. 147)

Maximum recording time

(d: days; h: hours; m: minutes; s: seconds)

Time axis (/div)	Sampling speed (/S)	Unit's max. no. of channels in use* / max. recording length				
		9 to 16	5 to 8	3 to 4	2	1
		5000div	10000div	20000div	40000div	80000div
200 μs	2 μs	1s	2s	4s	8s	16s
500 μs	5 μs	2.5s	5s	10s	20s	40s
1 ms	10 μs	5s	10s	20s	40s	1min20s
2 ms	20 μs	10s	20s	40s	1min20s	2min40s
5 ms	50 μs	25s	50s	1min40s	3min20s	6min40s
10 ms	100 μs	50s	1min40s	3min20s	6min40s	13min20s
20 ms	200 μs	1min40s	3min20s	6min40s	13min20s	26min40s
50 ms	500 μs	4min10s	8min20s	16min40s	33min20s	1h6min40s
100 ms	1 ms	8min20s	16min40s	33min20s	1h6min40s	2h13min20s
200 ms	2 ms	16min40s	33min20s	1h6min40s	2h13min20s	4h26min40s
500 ms	5 ms	41min40s	1h23min20s	2h46min40s	5h33min20s	11h6min40s
1 s	10 ms	1h23min20s	2h46min40s	5h33min20s	11h6min40s	22h13min20s
2 s	20 ms	2h46min40s	5h33min20s	11h6min40s	22h13min20s	1d20h26min40s
5 s	50 ms	6h56min40s	13h53min20s	1d3h46min40s	2d7h33min20s	4d15h6min40s
10 s	100 ms	13h53min20s	1d3h46min40s	2d7h33min20s	4d15h6min40s	9d6h13min20s
30 s	300 ms	1d17h40min	3d11h20min	6d22h40min	13d21h20min	27d18h40min
50 s	500 ms	2d21h26min40s	5d18h53min20s	11d13h46min40s	23d3h33min20s	46d7h6min40s
60 s	600 ms	3d11h20min	6d22h40min	13d21h20min	27d18h40min	55d13h20min
100 s	1 s	5d18h53min20s	11d13h46min40s	23d3h33min20s	46d7h6min40s	92d14h13min20s
2 min	1.2 s	6d22h40min	13d21h20min	27d18h40min	55d13h20min	111d2h40min
5 min	3 s	17d8h40min	34d17h20min	69d10h40min	138d21h20min	277d18h40min

*: The number of channels in use for the unit with the most channels allocated for use

Number of channels in use and recording interval (real-time saving)

The recording interval that can be set with real-time saving is limited by the number of channels in use, as indicated below. Channels for which 17 to 32 bits have been allocated with the MR8904 CAN Unit are calculated as 2 channels.

No. of channels in use	Recording interval
2 or less	2 μ s/S
8 or less	5 μ s/S
16 or less	10 μ s/S
30 or less	20 μ s/S
No limit	50 μ s/S

Segment div count and file size (with real-time saving enabled)

When segmenting files with real-time saving enabled, the segment div count and file size vary with the number of channels in use.

(File size: Data portion only)

No. of channels in use	Segment div count	Segment div count File size [MB]
1	2000000	381
2	1000000	381
3	500000	286
4	500000	381
5	500000	476
6	400000	457
7	400000	534
8	200000	305
9	200000	343
10	200000	381
11	200000	419
12	200000	457
13	200000	495
14	200000	534
15	200000	572
16	100000	305
17	100000	324
18	100000	343
19	100000	362
20	100000	381
21	100000	400
22	100000	419
23	100000	438
24	100000	457

No. of channels in use	Segment div count	Segment div count File size [MB]
25	100000	476
26	100000	495
27	100000	514
28	100000	534
29	100000	553
30	100000	572
31	100000	591
32	50000	305
33	50000	314
34	50000	324
35	50000	333
36	50000	343
37	50000	352
38	50000	362
39	50000	371
40	50000	381
41	50000	391
42	50000	400
43	50000	410
44	50000	419
45	50000	429
46	50000	438
47	50000	448
48	50000	457

No. of channels in use	Segment div count	Segment div count File size [MB]
49	50000	467
50	50000	476
51	50000	486
52	50000	495
53	50000	505
54	50000	514
55	50000	524
56	50000	534
57	50000	543
58	50000	553
59	50000	562
60	50000	572
61	50000	581
62	50000	591
63	50000	600
64	50000	610

Filenames

Filenames are assigned as follows depending on the save method and type of data.

When the date and time are included in the filename:

Date: year (4 digits), month (2 digits), day (2 digits); time: hours (2 digits), minutes (2 digits), seconds (2 digits) (in that order)

Waveform files

Manual saving

- WAVE_20111224_200000.MEM
- WAVE_20111224_200000.CSV
- WAVE_20111224_200000.TXT
- WAVE_20111224_200000_A00001.MEM
- WAVE_20111224_200000_A00001.CSV
- WAVE_20111224_200000_A00001.TXT

WAVE: Default filename (If a filename has been specified, that filename will be used.)

Auto saving

- AUTO_20111224_200000.MEM
- AUTO_20111224_200000.CSV
- AUTO_20111224_200000.TXT
- AUTO_20111224_200000_P00001.CSV
- AUTO_20111224_200000_P00001.TXT
- AUTO_20111224_200000_A00001.MEM
- AUTO_20111224_200000_A00001.CSV
- AUTO_20111224_200000_A00001.TXT
- AUTO_20111224_200000_P00001_A00001.CSV
- AUTO_20111224_200000_P00001_A00001.TXT

AUTO: Default filename (If a filename has been specified, that filename will be used.)

Example filename

- _20111224: Trigger date
- _200000: Trigger time
- _P00001: Segment number
- _A00001: Auto number appended if a data file with the same trigger date and time has already been saved

Real-time saving

- AUTO_20111224_200000.MEM
- AUTO_20111224_200000_P00001.MEM
- AUTO_20111224_200000_A00001.MEM
- AUTO_20111224_200000_P00001_A00001.MEM

AUTO: Default filename (If a filename has been specified, that filename will be used.)

Example filename

- _20111224: Trigger date
- _200000: Trigger time
- _P00001: Segment number
- _A00001: Auto number appended if a data file with the same trigger date and time has already been saved

Numerical calculation results files

Manual saving

- MEAS_20111224_200000.CSV
- MEAS_20111224_200000.TXT
- MEAS_20111224_200000_A00001.CSV
- MEAS_20111224_200000_A00001.TXT

MEAS: Default filename (If a filename has been specified, that filename will be used.)

_20111224: Trigger date for the waveform for which numerical calculation results were first recorded

_200000: Trigger time for the waveform for which numerical calculation results were first recorded

_A00001: Auto number appended if a data file with the same trigger date and time has already been saved

.CSV: Text format

.TXT: Text format

Numerical calculation results files

Auto saving

- AUTO_20111224_200000.CSV
- AUTO_20111224_200000.TXT
- AUTO_20111224_200000_A00001.CSV
- AUTO_20111224_200000_A00001.TXT

AUTO: Default filename (If a filename has been specified, that filename will be used.)

_20111224: Trigger date for the waveform for which numerical calculation results were first recorded

_200000: Trigger time for the waveform for which numerical calculation results were first recorded

_A00001: Auto number appended if a data file with the same trigger date and time has already been saved

.CSV: Text format

.TXT: Text format

Settings files

Manual saving

- CONF.SET
- CONF_A00001.SET

CONF: Default filename (If a filename has been specified, that filename will be used.)

_A00001: Auto number appended if a data file with the same save date and time has already been saved

Batch save of internal settings

- CONF0001.SET (Internal setting conditions 1)
- CONF0002.SET (Internal setting conditions 2)
- CONF0003.SET (Internal setting conditions 3)
- CONF0004.SET (Internal setting conditions 4)
- CONF0005.SET (Internal setting conditions 5)
- CONF0006.SET (Internal setting conditions 6)

Image files

Manual saving

- SCRN_20111224_200000.BMP
- SCRN_20111224_200000_A00001.BMP

SCRN: Default filename (If a filename has been specified, that filename will be used.)

_20111224: Save date

_200000: Save time

_A00001: Auto number appended if a data file with the same save date and time has already been saved

Auto saving

- AUTO_20111224_200000.BMP
- AUTO_20111224_200000_A00001.BMP

AUTO: Default filename (If a filename has been specified, that filename will be used.)

_20111224: Save date

_200000: Save time

_A00001: Auto number appended if a data file with the same save date and time has already been saved

Internal text format

Text files consist of header and data portions. The header includes the following information related to measurement data.

- | | |
|---------------------------------|---|
| (1) File name and version | (7) Comment |
| (2) Title comment | (8) Scaling setting |
| (3) Start trigger time | (9) Scaling ratio |
| (4) Channel number of each line | (10) Scaling offset |
| (5) Measurement contents | (11) Channel number and input unit of each line |
| (6) Range | |

Example of saved data

```

"File name","MR8875_20110622_194902.CSV","v1.00" ..... (1)
"Title comment","" ..... (2)
"Trigger time","2011/6/22 19:49:11","0.266000" ..... (3)
"CH","ANALOG 1-1","ANALOG 2-1","ANALOG 3-1","PULSE 1" ..... (4)
"Mode","VOLT","TEMP","STRAIN","INTEGRATION" ..... (5)
"Range","5mV","10°C","20uE","count" ..... (6)
"Comment","","","","" ..... (7)
"Scaling","OFF","OFF","OFF","OFF" ..... (8)
"Ratio","1.000000000E+00","1.000000000E+00","1.000000000E+00"," 1.000000000E+00" ..... (9)
"Offset","0.000000000E+00","0.000000000E+00","0.000000000E+00"," 0.000000000E+00" ..... (10)
"TIME[s]","ANALOG 1-1[V]","ANALOG 2-1[C]","ANALOG 3-1[uE]","PULSE 1[c]","EVENT" ..... (11)
0.000000000E+00,3.96000E-04,3.19300E+01,2.14992E+02,0.00000E+00,0
2.000000000E-06,1.12000E-04,3.19300E+01,2.15904E+02,0.00000E+00,0
4.000000000E-06,1.48000E-04,3.19300E+01,2.15904E+02,0.00000E+00,0
6.000000000E-06,1.60000E-05,3.19300E+01,2.15904E+02,0.00000E+00,0
8.000000000E-06,8.00000E-06,3.19300E+01,2.17568E+02,0.00000E+00,0
1.000000000E-05,1.40000E-04,3.19300E+01,2.17568E+02,0.00000E+00,0

```

Scaling Method When Using Strain Gauges

This section describes how to determine the scaling conversion ratio when measuring with strain gauges and the Model MR8903 Strain Unit.

When measuring with a strain gauge, a separate bridge box is necessary. Connect the strain gauge to a commercially available bridge box and then connect the bridge box to the MR8903 with a converter cable.

The appropriate conversion formula for stress depends on how the strain gauges are used. Three methods are available depending on whether one, two or four strain gauges are used for measurement. The two-gauge method is used for temperature compensation.

E: Young modulus, ν : Poisson ratio, ϵ : Distortion measurement value

Tensile and Compressive Stress Measurement: Stress (σ) = E \times ϵ

For temperature compensation with two or four gauges, position the gauges perpendicularly. Stress (σ) is obtained by $1 / (1 + \nu)$ for two gauges, and by $1 / \{2 (1 + \nu)\}$ for four gauges.

Bending Stress Measurement: Stress (σ) = E \times ϵ

For temperature compensation with two or four gauges, stress (σ) is obtained as a multiple of $1/2$ or $1/4$, respectively.

Torsional Stress Measurement: Stress (σ) = E / {2 (1 + ν)} \times ϵ (two-gauge case)

For the four-gauge case, it is half of that.

Refer to the strain gauge instruction manual for combinations of strain gauges for each measurement.

Example. Measuring Compressive Stress

Using the one-gauge method for an aluminum measurement object having a Young's modulus of 73 (GPa) according to the following Table,

$$\begin{aligned}\sigma &= 73 \times 10^9 \times \text{Measurement Value (in } \mu\epsilon \text{ units)} \times 10^{-6} \text{ (in } \mu\epsilon \text{ units)} \\ &= 73 \times \text{Measurement Value (in kPa units)} \\ &= 7.44^* \times \text{Measurement Value (in gf/mm}^2 \text{ units)} \\ &*: 1 \text{ Pa} = 1.01971621 \times 10^{-7} \text{ kgf/mm}^2\end{aligned}$$

Unit: gf/mm^2 , Conversion Ratio = 7.44 gf/mm^2
Enter this value as the scaling conversion ratio

Mechanical properties of industrial materials

Material	Modulus of Elasticity (Young's Modulus)	Poisson's Ratio
	E(GPa)	ν
Carbon Steel (0.1 to 0.25% C)	205	0.28 to 0.3
Carbon Steel (> 0.25% C)	206	0.28 to 0.3
Spring Steel (Quenched)	206 to 211	0.28 to 0.3
Nickel Steel	205	0.28 to 0.3
Cast Iron	98	0.2 to 0.29
Brass (Cast)	78	0.34
Phosphor Bronze	118	0.38
Aluminum	73	0.34
Concrete	20 to 29	0.1

See: "6.5 Converting Input Values (Scaling Function)" (p. 150)

Measuring electric energy by counting pulses

This section introduces two methods: acquiring pulses from a watt-hour meter (with 50,000 pulses/kWh voltage pulse output) and measuring daily energy use with P2, and measuring instantaneous power use as updated every 3 seconds with P1.

1 Prepare for measurement.

Install the instrument and connect it to any peripheral equipment.

2 Set the measurement conditions. Open the screen.

[Waveform Display] ▶ [Status] ▶ [Basic]

Or [Setting Display] ▶ [Status]

Set as follows:

Sampling	3s/S
Shot	288 div, (Any)

(Recording Time 1d)

3 Configure the input channels.

Open the screen.

[Waveform Display]/[Setting Display] ▶

[Channel] ▶ [Pulse]

Set as follows:

Channel	P1	P2
Use	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mode	Integrate(Instant)	Integrate(Add)
Range(/div)	2500c	125Mc
Prescaler	1c	1c

[Scaling]

Channel	P1	P2
Scaling	On(SCI)	On(SCI)
Units	W	Wh
Method	1	2
	1 pulse = 24W ^{*1}	1Wh = 50 pulse ^{*2}

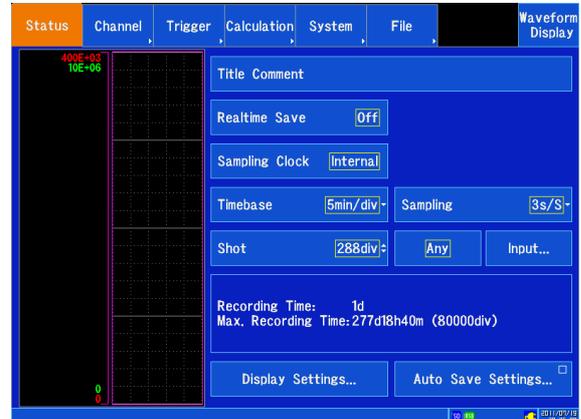
*1: Since 50,000 pulses = 1,000 Wh, 1 pulse = 0.02 Wh. When converting electric energy for a 3-second period to power, 1 pulse = 0.02 Wh × 3,600 / 3 = 24 W (since 1 hour = 3,600 seconds).

*2: Since there are 50,000 pulses per kWh, 1 Wh = 50 pulses.

[Display]

Channel	P1	P2
Variable	On	On
Display upper limit	400k	10M
Display lower limit	0	0

When the scaling and variable functions are configured, the display range is automatically applied, allowing the electric energy to be directly read in W and Wh.



5 Configure other settings as necessary.

Measurement can be performed using the default values for other settings, but these should be configured as necessary. For example, you can eliminate the effects of chatter when using a watt-hour meter with mechanical contact (relay) output by enabling the chatter prevention filter.

6 Start measurement.

START key

Note:

Since the pulse input period is greater than or equal to 200 μs (due to the hardware specifications), proper measurement at 5,000 pulses/second cannot be guaranteed. The measurement range for the example settings (channel P1) extends to 360 kW. Since 50,000 pulses = 1,000 Wh, 5,000 pulses = 100 Wh. Converting electric energy for 1 second (5,000 pulses/second) to power yields 100 Wh × 3,600 = 360 kW (since 1 hour = 3,600 seconds).

Synchronous Measurements with Multiple Instruments

NOTE

- The measurement start times of multiple instruments can be synchronized using an external trigger, but sampling itself is not synchronized. When performing measurement over an extended period of time, variations in individual instruments' sampling clocks will result in differences in data acquisition times.
- When using an external trigger to synchronize multiple instruments, be sure to configure the following settings on the **[Setting Display] ▶ [System] ▶ [External Terminal]** screen:
 - Set **[Trigger In Filter]** to **[Off]**.
 - Set **[Trigger Out]** to **[Level]**.

Multiple instruments can be synchronized using the external control terminals. Operation can be synchronized using the following two methods:

Daisy chain configuration

Set all to primary (master) instruments.

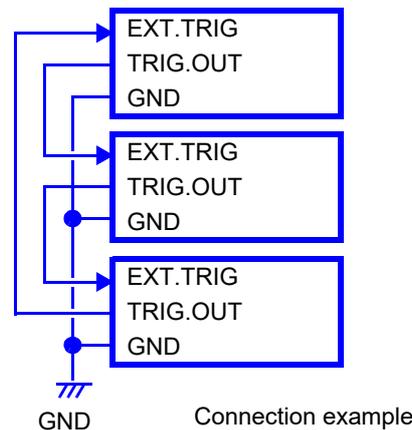
Setting method:

[Waveform Display]/[Setting Display] ▶ [Trigger] ▶ [General]

Set **[External Start Trigger: ↓]** for all instruments (p. 186).

When a trigger event occurs on any of the connected instruments, it also occurs on the others.

As more instruments are connected, the difference between trigger timing on different instruments becomes larger.



Parallel synchronization

Set one to a primary (master) instrument and the others to secondary (slave) instruments.

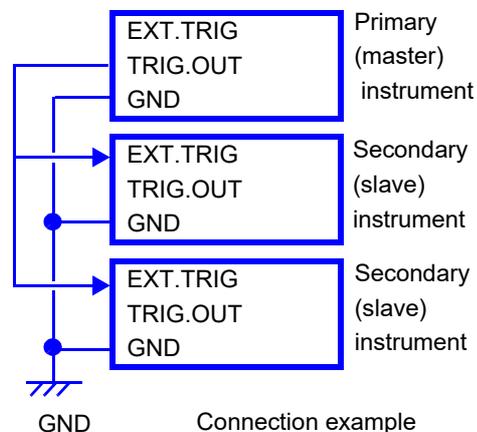
Setting method:

[Waveform Display]/[Setting Display] ▶ [Trigger] ▶ [General]

Set secondary (slave) instruments to **[External Start Trigger: ↓]** (p. 186).

When using the primary (master) instrument as the trigger source, the other instruments start measuring simultaneously when a trigger event occurs.

This gives the least difference in trigger timing between instruments.



Appendix 3 Frequently Asked Questions

Here are some common questions and answers about the HiCorder.

Installation and Settings

Question	Remedial Action	Reference page
How long can measurement be performed with the battery pack?	The instrument can be used for about 1 hour when powered with the battery pack (reference value at 23°C).	"Using the battery pack" (p. 41)
If the power goes out, can recording be started automatically when it comes back on?	Enable the start backup setting. Recording will start automatically when the power comes back on following an outage. Measurement data from before the outage will not be stored in the internal memory, so it is recommended to save it automatically to an SD memory card or USB flash drive.	"Setting operation when the power is cycled (start backup)" (p. 263)

Triggers

Question	Remedial action	Reference page
[Trigger Wait] is displayed, and I can't start measurement.	A trigger has been set. Turn all trigger conditions off if you wish to start recording immediately with the START key.	"Chapter 7 Trigger Settings" (p. 171)
How can I acquire data from before the trigger?	Pre-triggers allow you to acquire data from before the trigger.	"7.6 Setting Pre-triggers and Post-triggers" (p. 178)
How can I acquire data only when an external signal is high?	Input the external signal to the EXT.TRIG terminal and make the following settings: [External Start Trigger: ↑ (rising)] [External Stop Trigger: ↓ (falling)] You will be able to acquire data only when the external signal is high.	"7.10 Applying an External Trigger" (p. 186)
How can I synchronize measurements between two instruments?	You can synchronize the start of measurement by using an external trigger. Sampling itself cannot be synchronized.	"Synchronous Measurements with Multiple Instruments" (p. A14)

Measurement

Question	Remedial action	Reference page
I'm concerned about shifts in the zero point when inputs are shorted.	You can correct shifts in the zero point when inputs are shorted by performing zero adjustment.	"2.6 Performing Zero Adjustment" (p. 46)
I'm only inputting a signal to channel 1, but the same waveform is shown for channels with no connections.	If input terminals are left in the open state, you may see waveforms that seem to be influenced by other measurement channels. If these terminals are not left open, you will be able to perform measurement properly. To eliminate the waveforms, disable the display of channels you are not using or short the positive and negative terminals.	"3.5 Setting the Input Channels" (p. 66)
I want to view data as numerical values.	You can check waveforms and values for signals that are currently being input with the Waveform Monitor. While data is being acquired, you can check values with the Numeric Monitor. You can also read the value at a specified location using cursors.	"5.5 Monitoring Input Waveforms (Waveform Monitor)" (p. 124) "5.6 Monitoring Values (Numeric Monitor)" (p. 125)
I want to leave marks during measurement to make it easier to search later.	You can add event marks.	"5.11 Marking Events" (p. 134)

Saving data

Question	Remedial action	Reference page
Can I use commercially available SD memory cards?	Proper operation is not guaranteed with all SD memory cards. Additionally, compatibility problems may cause instrument operation to become unstable. Please use genuine Hioki cards to ensure that you will be able to utilize the instrument with peace of mind.	"2.3 Preparing Storage Media" (p. 38)
Can I use commercially available USB flash drives?	Commercially available USB flash drives can be used, but only Hioki's optional SD memory card can be used for real-time saving. USB flash drives with security functionality such as fingerprint authentication cannot be used.	"2.3 Preparing Storage Media" (p. 38)
Can the media be changed during measurement?	Media cannot be changed while measurement is in progress.	
How much data can be recorded?	The amount of data that can be recorded varies with the setting conditions (number of channels in use and recording interval). Up to 1,000 days of data can be recorded.	"Maximum recording time" (p. A5)

Question	Remedial action	Reference page
I want to process saved data with Excel®.	Binary files saved on an SD memory card or USB flash drive can be converted to text (CSV) format with the included Waveform Viewer and opened with Excel®. Data saved in text (CSV) format can be opened directly with Excel®. However, note that the instrument is not able to open text data.	"File types and save and load operation" (p. 88)
I want to read data stored on the instrument's SD memory card into my PC, but my PC doesn't have an SD memory card slot.	After placing the instrument in USB drive mode, you can use the included USB cable to load the data into your PC.	"12.8 Loading Data into a PC Using a USB Cable" (p. 313)
Is there a limit on the number of files when auto-saving data to an SD memory card or USB flash drive?	Although 2,000 or more files can be saved in a single folder (depending on the file size and the capacity of the SD memory card), only 2,000 files can be displayed on the file screen. Since having a large number of files on the card will cause it to take longer to start and stop measurement, it is recommended to configure the instrument so that there are 2,000 or fewer files in the folder. (The folder "HIOKI_MR8875" will be created when data is saved to the card. Different types of files will be saved in the folder for different types of data.)	"Selecting a file or folder on media" (p. 103)
I turned off the instrument after measurement. I wasn't using auto saving. Is the data left in the instrument's internal memory?	Data stored in internal memory is erased when the instrument is turned off. When performing measurement for an extended period of time, it is recommended to prepare for a possible power failure, for example by using the battery pack along with the AC adapter and enabling auto-saving.	"Using the battery pack" (p. 41)
I saved data after measurement to an SD memory card or USB flash drive, but only some data was saved.	When you set the save range with cursors, only the selected range of data will be saved. Additionally, data saved after measurement includes only that data which remains in the instrument's internal memory. To save data beyond what can be saved in the internal memory, enable real-time saving from the beginning.	"5.2 Specifying a Waveform Range (A/B, C/D Cursor)" (p. 116) "Saving data in real time" (p. 96)
I'm saving data as a text file after measurement, but the screen indicates that the data is being saved, and the process never ends.	Saving all data in the instrument's internal memory after measurement takes about one and a half hours. To cancel save processing, press the STOP key or tap [Abort] . After saving data as a binary file, it can be converted to text data with the included Waveform Viewer in several seconds.	
How can I view data saved in binary format on a PC?	The included CD includes the Waveform Viewer application. Install it on your PC, and use it to open the data you wish to view.	"12.10 Using the Waveform Viewer (Wv)" (p. 321)

Appendix 3 Frequently Asked Questions

Question	Remedial action	Reference page
What happens to event marks when data is converted to text (CSV) format?	<p>When converting data to text format with the instrument: Event numbers are added next to the measurement data. This provides a convenient way to extract only data with marks later.</p> <p>When converting data to text format with the Waveform Viewer: Event numbers and times are included as information in the header.</p>	"5.11 Marking Events" (p. 134)

Appendix 4 Options

For details of cables and clamps for connecting to the input modules and the instrument, refer to manual supplied with them.

The following options are available for the instrument. Contact your authorized Hioki distributor or reseller when ordering. The options are subject to change. Visit our website for updated information.

Input modules	<ul style="list-style-type: none"> ■ Model MR8901 Analog Unit ■ Model MR8902 Voltage/TEMP Unit ■ Model MR8903 Strain Unit ■ Model MR8904 CAN Unit ■ Model MR8905 Analog Unit (MR8875: Applicable for Ver. 2.13 or later, MR8875-30: Applicable for Ver. 3.13 or later)
Power supply	<ul style="list-style-type: none"> ■ Model Z1002 AC Adapter ■ Model Z1003 Battery Pack (NiMH, 7.2 V, 4500 mAh)
Media	<ul style="list-style-type: none"> ■ Model Z4001 SD Memory Card (2 GB) ■ Model Z4003 SD Memory Card (8 GB) ■ Model Z4006 USB Drive (16GB)
Other	<ul style="list-style-type: none"> ■ Model C1004 Carrying Case (with space for storing options) ■ Model 9642 LAN Cable
Measurement probes, etc.	<ul style="list-style-type: none"> ■ Model L9197 Connection Cord (600 V CAT III, 300 V CAT IV, 1 A, Isolated BNC/Alligator Clip) ■ Model 9197 Connection Cord (600 V CAT III, 300 V CAT IV, 1 A, Isolated BNC/Alligator Clip) ■ Model L9198 Connection Cord (600 V CAT II, 300 V CAT III, 0.2 A, Isolated BNC/Alligator Clip) ■ Model 9199 Conversion Adaptor (Isolated BNC/Banana jack with rigid insulating sleeve) ■ Model L9217 Connection Cord (600 V CAT II, 300 V CAT III, 0.2 A, Isolated BNC/Isolated BNC) ■ Model L9790 Connection Cord (Isolated BNC/Banana Plug with rigid insulating sleeve) ■ Model L4940 Connection Cable (for Model MR8905, Maximum input voltage 1000 V DC, Banana Plug/Banana Plug) 1000 V CAT III, 600 V CAT IV, 10 A ■ Model L9790-01 Alligator Clip (600 V CAT II, 300 V CAT III 1 A, for Model L9790) ■ Model 9790-02 Grabber Clip (300 V CAT II, 150 V CAT III 1 A, for Model L9790) ■ Model 9790-03 Contact Pin (600 V CAT II, 300 V CAT III 1 A, for Model L9790) ■ Model L4935 Alligator Clip (Attached to tips of Model L4940), 600 V CAT IV, 1000 V CAT III, 10 A ■ Model L9243 Grabber Clip (Attached to tips of Model L4940), 1000 V CAT III, 1 A ■ Model L4936 Bus Bar Clip (Attached to tips of Model L4940), 600 V CAT III, 5 A ■ Model L4937 Magnetic Adapter (Attached to tips of Model L4940), 1000 V CAT III, 2 A ■ Model L4931 Extension Cable (Extends length of Model 4940 by 1.5 m), 600 V CAT IV, 1000 V CAT III, 10 A ■ Model L4932 Test Pin (Attached to tips of Model L4940), 600 V CAT IV, 1000 V CAT III, 10 A ■ Model L4934 Small Alligator Clip 300 V CAT III, 600 V CAT II, 3 A *Model L4932 is required to use Model L4934. ■ Model 9322 Differential Probe ■ Model P9000-01 Differential Probe ■ Model P9000-02 Differential Probe
Logic probes	<ul style="list-style-type: none"> ■ Model 9320-01 Logic Probe (4 digital channels, for detecting voltage and closed/open contact points) ■ Model MR9321-01 Logic Probe (for line use) (Four isolated channels, for detecting AC/DC voltage on/off)

Current measurement probes, etc.

- Model 9018-50 Clamp-On Probe (AC10 A to AC500 A, 40 Hz to 3 kHz)
 - Model 9132-50 Clamp-On Probe (AC10 A to AC500 A, 40 Hz to 1 kHz)
 - Model 9675 Clamp-On Leak Sensor (AC10 A, 40 Hz to 5 kHz)
 - Model 9657-10 Clamp-On Leak Sensor (AC10 A, 40 Hz to 5 kHz)
-

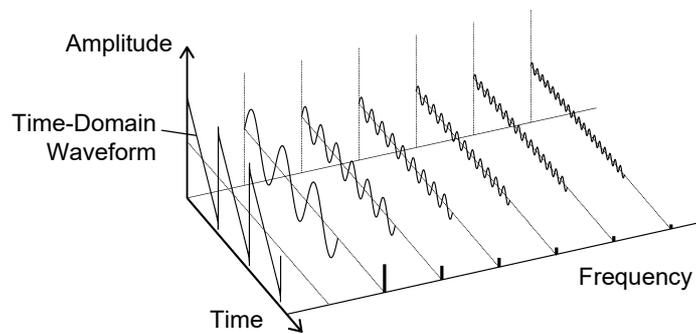
Appendix 5 FFT Definitions

What is FFT?

FFT is the abbreviation for Fast Fourier Transform, an efficient method to calculate the DFT (Discrete Fourier Transform) from a time-domain waveform. Also, the reverse process of transforming frequency data obtained by the FFT back into its original time-domain waveform is called the IFFT (Inverse FFT). The FFT calculations perform various types of analysis using FFT and IFFT.

Time and Frequency Domain Considerations

All signals are input to the instrument as a function of the time domain. This function can be considered as a combination of sine waves at various frequencies, such as in the following diagram. The characteristics of a signal that may be difficult to analyze when viewed only as a waveform in the time domain can be easier to understand by transforming it into a spectrum (the frequency domain).



Discrete Fourier Transforms and Inverse FFT

For a discrete signal $x(n)$, the DFT is $X(k)$ and the number of Analysis points is N , which relate as follows:

$$X(k) = DFT \{x(n)\} = \sum_{n=0}^{N-1} x(n)W_N^{kn} \dots \dots \dots (1)$$

$$x(n) = IDFT \{X(k)\} = \frac{1}{N} \sum_{k=0}^{N-1} X(k)W_N^{-kn} \dots \dots \dots (2)$$

$$W_N = \exp\left(-j \frac{2\pi}{N}\right) \dots \dots \dots (3)$$

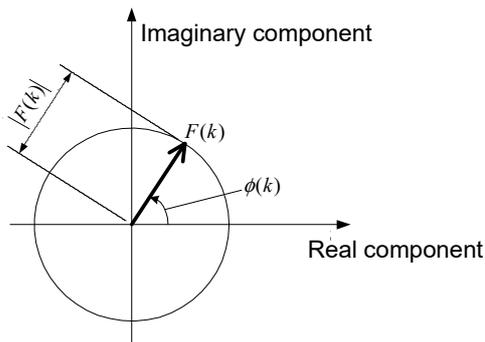
$X(k)$ is typically a complex number, so expression (1) can be transformed again and written as follows:

$$F(k) = |F(k)| \exp\{j\phi(k)\} = |F(k)| \angle \phi(k) \dots \dots \dots (4)$$

$$\phi(k) = \tan^{-1} \frac{\text{Im}\{X(k)\}}{\text{Re}\{X(k)\}} \dots \dots \dots (5)$$

$|F(k)|$: Amplitude spectrum, $\phi(k)$: Phase spectrum

Representing the above relationship on a complex flat surface produces the following figure.



Linear Time-Invariant Systems

Consider a linear time-invariant (LTI) system $y(n)$ that is a response to discrete time-domain signal $x(n)$.

In such an LTI system, the following expression applies to any integer A_i when the response to $x_i(n)$ is $y_i(n) = L[x_i(n)]$.

$$L[A_1x_1(n) + A_2x_2(n)] = A_1y_1(n) + A_2y_2(n) \dots \dots \dots (6)$$

If the system function of an LTI system is $h(n)$, the input/output relationship can be obtained by the next expression.

$$y(n) = \sum_{m=0}^{\infty} h(n)x(n-m) = \sum_{m=-\infty}^{\infty} h(n-m)x(m) \dots \dots \dots (7)$$

Therefore, when a unit impulse $\delta(n)$ (which is 1 when $n = 0$, and 0 when $n \neq 0$) is applied to $x(n)$, the input/output relationship is:

$$y(n) = h(n) \dots \dots \dots (8)$$

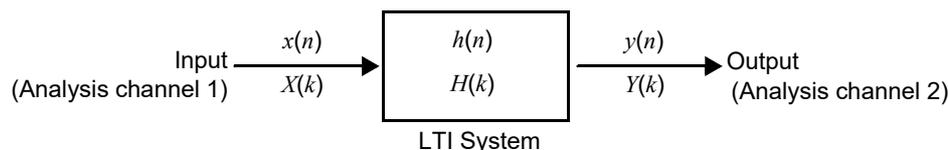
This means that when the input signal is given as a unit impulse, the output is the LTI system characteristic itself.

The response waveform of a system to a unit impulse is called the **impulse response**.

On the other hand, when the discrete Fourier transforms of $x(n)$, $y(n)$ and $h(n)$ are $X(k)$, $Y(k)$ and $H(k)$, respectively, expression (7) gives the following:

$$Y(k) = X(k)H(k) \dots \dots \dots (9)$$

$H(k)$ is also called the transfer function, calculated from $X(k)$ and $Y(k)$. Also, the inverse discrete Fourier transform function of $H(k)$ is the unit impulse response $h(n)$ of the LTI system. The transfer function of this instrument are calculated using the relationships of expression (9).



Aliasing

When the frequency of a signal to be measured is higher than the sampling rate, the observed frequency is lower than that of the actual signal, with certain frequency limitations. This phenomena occurs when sampling occurs at a lower frequency than that defined by the Nyquist-Shannon sampling theorem, and is called **aliasing**.

If the highest frequency component of the input signal is f_{max} and the sampling frequency is f_s , the following expression must be satisfied:

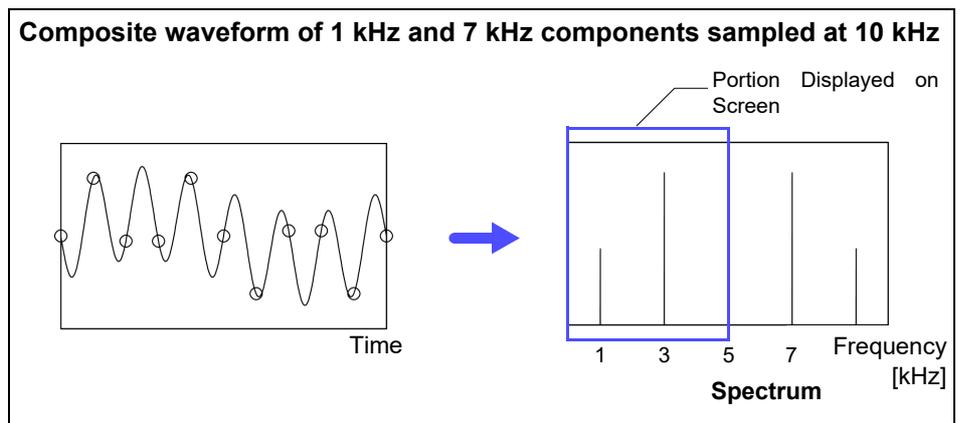
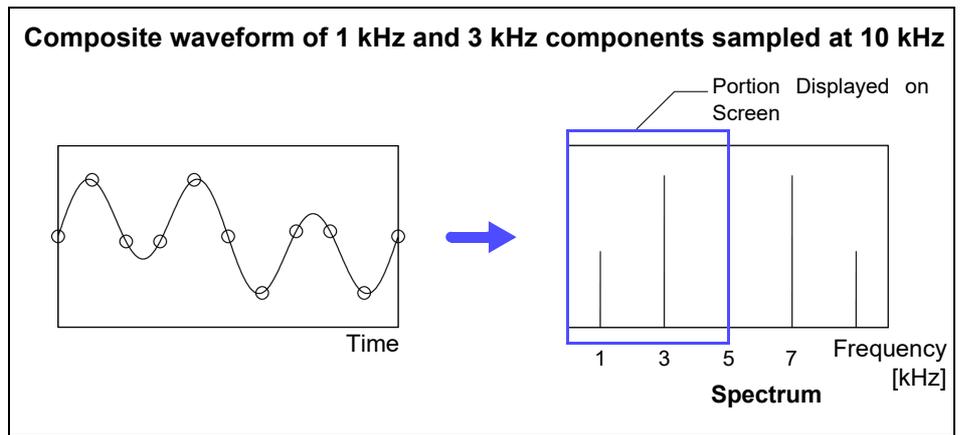
$$f_s = 2f_{max} \dots \dots \dots (10)$$

Therefore, if the input includes a frequency component higher than $f_s/2$, it is observed as a lower frequency (alias) that does not really exist.

The following diagrams show the results of spectrum analysis of composite waveforms having components of 1 kHz and 3 kHz, and of 1 kHz and 7 kHz.

If sampling frequency f_s is 10 kHz, the spectral component of an input frequency above 5 kHz (in this case, 7 kHz) is observed as an alias at 5 kHz or below.

In this example the difference between the 3 and 7 kHz components is indiscernible.



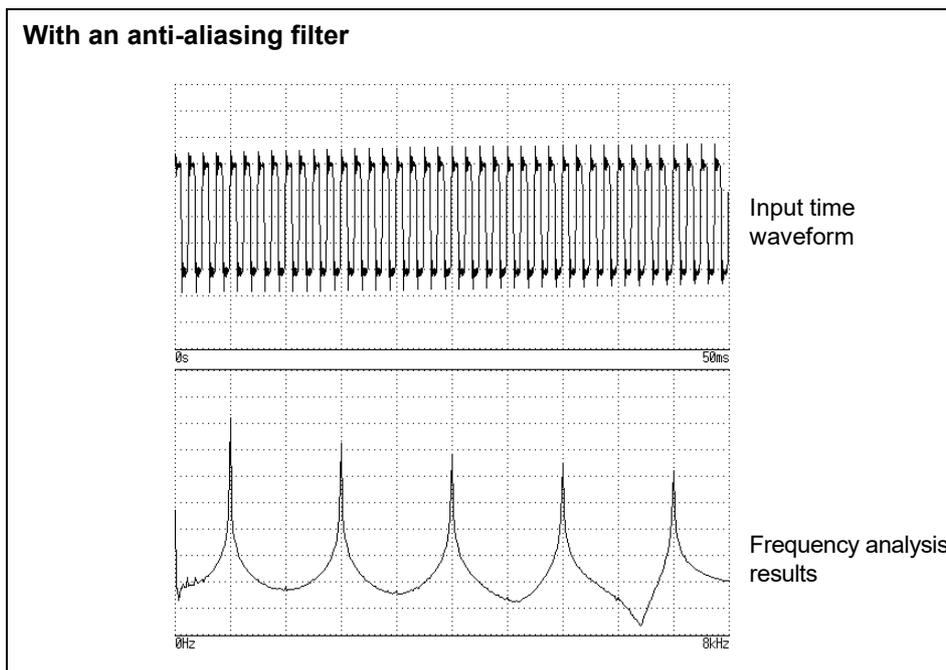
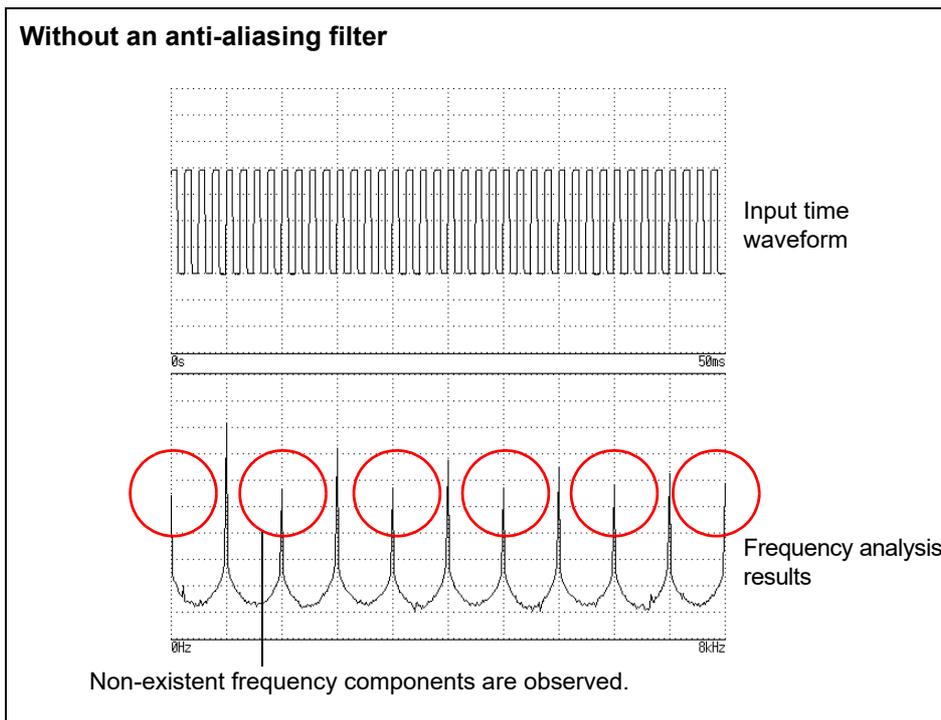
Anti-Aliasing Filters

When the maximum frequency component of the input signal is higher than one-half of the sampling frequency, aliasing distortion occurs. To eliminate aliasing distortion, a low-pass filter can be used that cuts frequencies higher than one-half of the sampling frequency. Such a low-pass filter is called an anti-aliasing filter.

The following figures show the effect of application of an anti-aliasing filter on a square wave input waveform.

NOTE

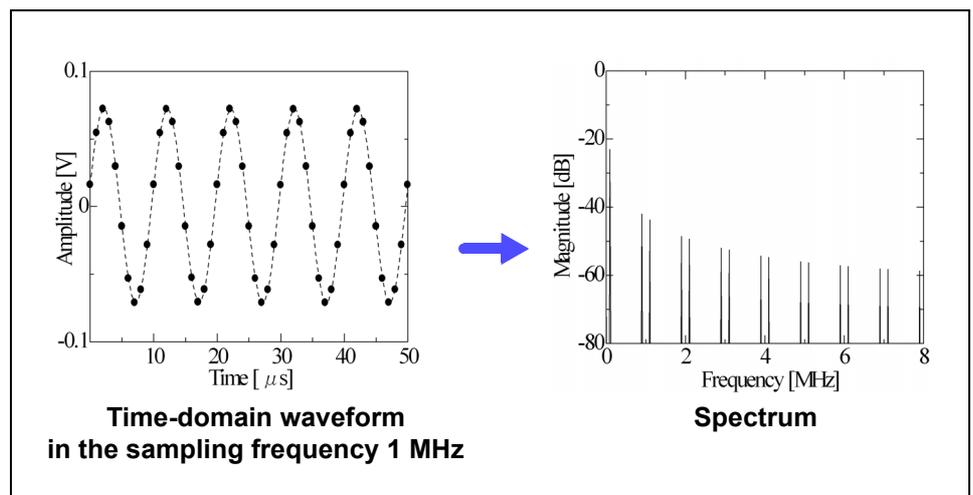
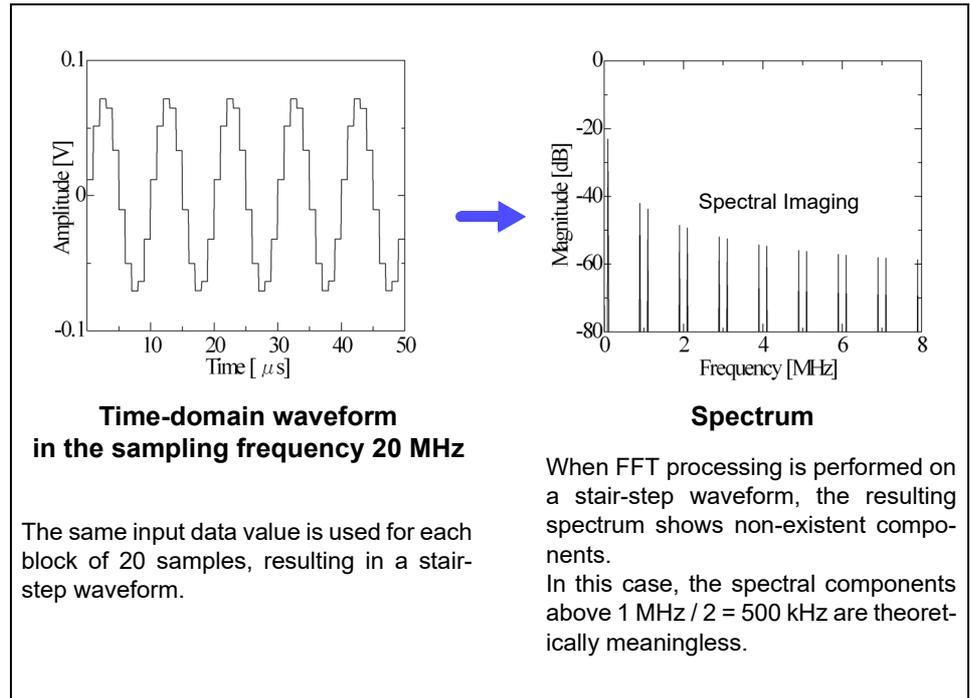
MR8875 units do not implement antialiasing filters.



Imaging

When the instrument is set to a measurement frequency range that requires a higher sampling rate than the maximum capability of the input module, intermediate data points are interpolated between successive data samples. In this case, the time-domain waveform exhibits a stair-step shape. When FFT analysis is performed in this situation, non-existent high frequency spectral components appear. This phenomena is called zero-order hold characteristic **imaging**.

The following figure displays the time waveform and spectrum when a sine wave is applied with a time-axis setting that is faster than the unit's maximum sampling speed:



To avoid imaging phenomena when analyzing waveforms with the FFT calculation function, verify the maximum sampling frequency of the input module before measuring.

Averaging

With the FFT calculation function, averaging is performed according to the following analytical expressions.

1. Simple Averaging (Frequency Domains)

Sequences of acquired data are summed and divided by the number of acquisitions.

$$A_n = \frac{(n-1)A_{n-1} + Z_n}{n} \dots\dots\dots (11)$$

n : count of measurements to average

A_n : averaging results of n counts

Z_n : measurement data of n counts

2. Exponential Averaging (Frequency Domains)

Before averaging, newer data is given exponentially greater significance than older data.

$$A_n = \frac{(N-1)A_{n-1} + Z_n}{N} \dots\dots\dots (12)$$

N : Specified number of counts to average

n : count of measurements to average

A_n : averaging results of n counts

Z_n : measurement data of n counts

Overall Value

The overall value is the sum of the power spectrum at each frequency. This value is equal to the positive sum of the squares of the (RMS) input signals, except when frequency averaging is performed. The FFT calculation function of this instrument calculates and displays the RMS values for stored waveforms and the overall value from the sum of the power spectrum for the frequency domain.

$$(Over\ all) = \sum_{i=0} P_i \dots\dots\dots (13)$$

P_i : power spectrum of value i

Total harmonic distortion (THD)

Total harmonic distortion (THD) indicates the proportion of the higher harmonics to the fundamental harmonic

This means that the larger the value, the more distorted the waveform.

$$THD = \sqrt{\frac{\sum(f_n)^2}{(f_0)^2}} \times 100 [\%]$$

f_0 = fundamental wave

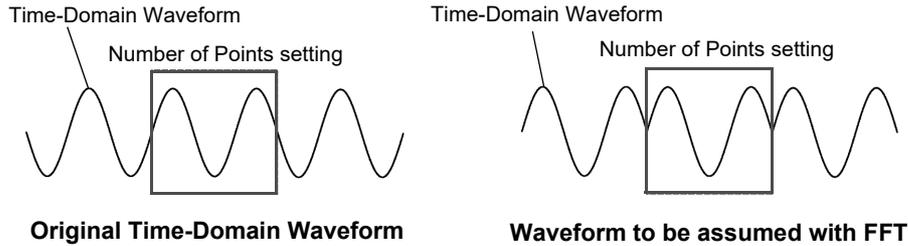
f_n = n next higher harmonic

Window Function

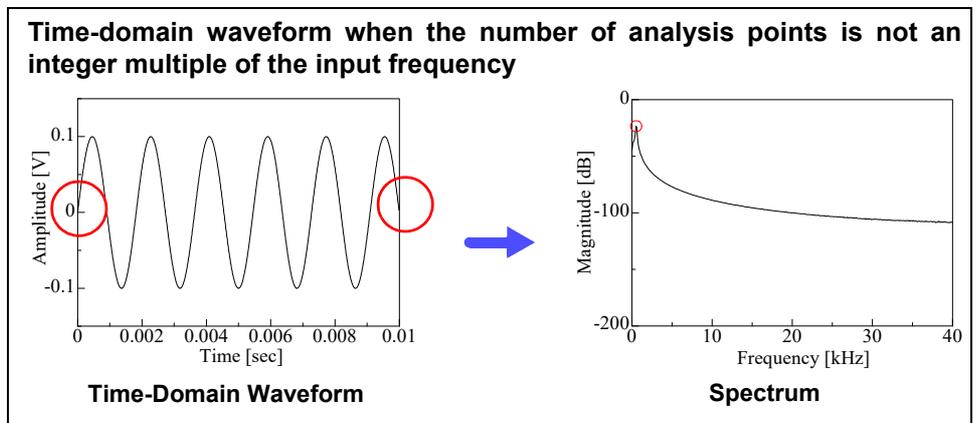
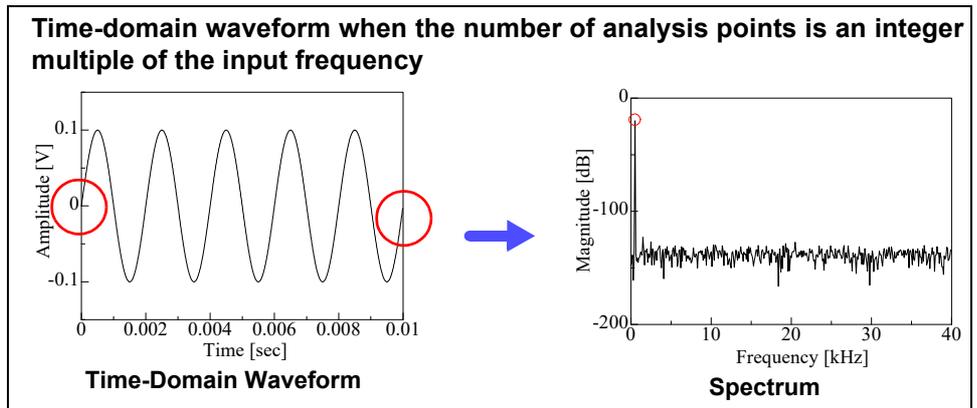
The Fourier transform of a continuous system is defined by the integral Calculus in expression (14) for the time range from minus infinity to plus infinity.

$$X(f) = \int_{-\infty}^{\infty} x(t)\mathcal{E}^{-2\pi ft} dt \dots\dots\dots (14)$$

However, because expression (14) cannot be calculated with actual measurements, the Analysis is performed on a segment between finite limits. Processing the waveform segment within these limits is called window processing. For FFT analysis, the waveform segment within these limits is assumed to repeat periodically (as shown below).

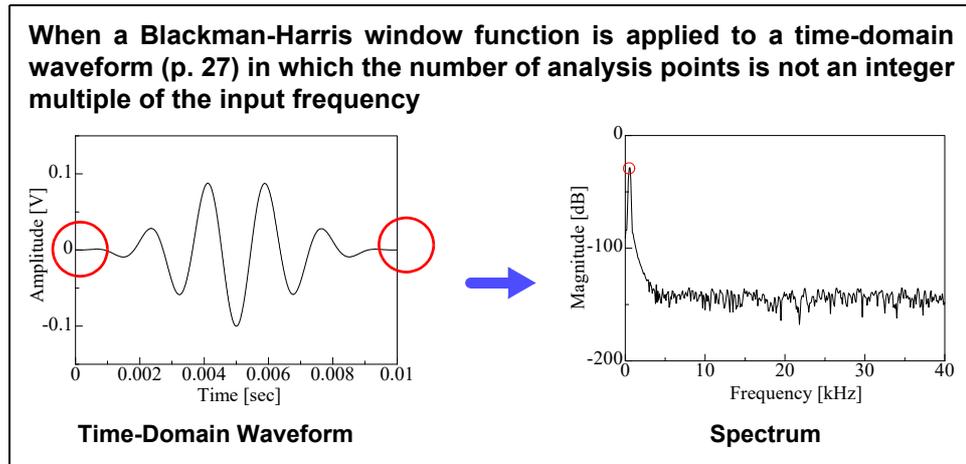


When the number of points for FFT analysis is an integer multiple of the input signal frequency, a single-line spectrum is obtained. However, if it is not an integer multiple of the frequency (when the waveform assumed with FFT includes discontinuous points), the spectrum is scattered, and a line spectrum cannot be obtained. This phenomena is called leakage error (as shown below).



The window function was created to suppress such leakage errors. The window function smoothly connects each end of the time-domain waveform where it is cut off. The following figure presents an example of spectral analysis by applying a window function to a time-domain waveform.

Using the window function, discontinuous points on the time-domain waveform are eliminated, so the wave shape approaches a line spectrum.



The following figure shows the time-domain waveform of the window function and its spectrum.

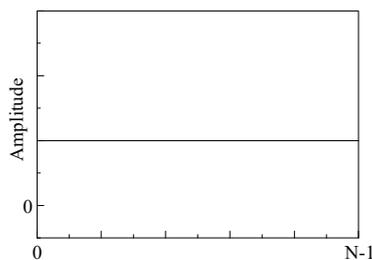
Each spectrum shows a large peak at a low frequency, and many smaller peaks at higher frequencies. The largest peak is called the **main lobe**, and the smaller peaks are the **side lobes**.

The most accurate results of the FFT calculation function are obtained when the width of the main lobe and the amplitude of the side lobes are minimized, although both conditions cannot be satisfied at the same time.

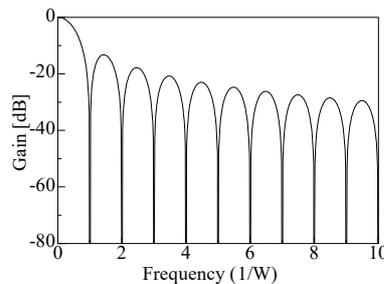
Therefore, a window function having a wide main lobe is used when amplitude values are important, while a window function having a small main lobe is used to observe fine spectral details, and a window function having small side lobe amplitudes is used to exclude the effects of the surrounding spectrum.

However, because the main lobe width is proportional to the width ($1/W$) of the window, increasing the number of analysis points increases the frequency resolution.

Rectangular window

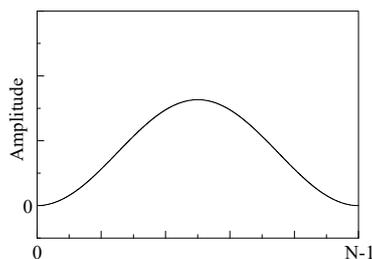


Time-Domain Waveform

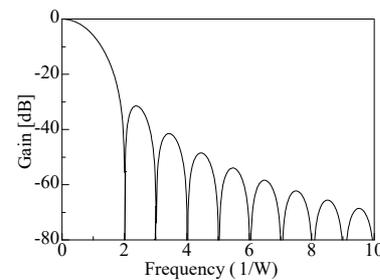


Spectrum

Hann window

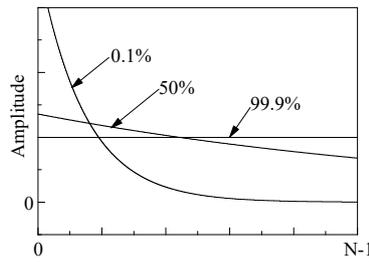


Time-Domain Waveform

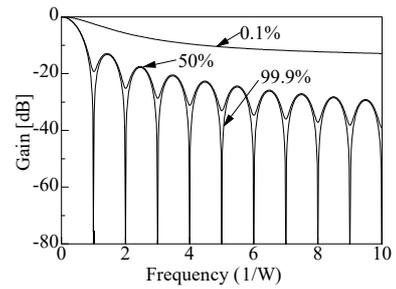


Spectrum

Exponential window

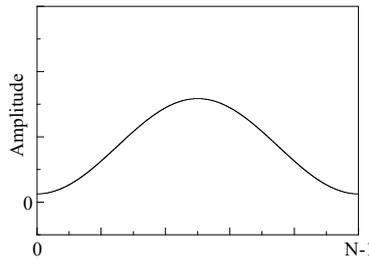


Time-Domain Waveform

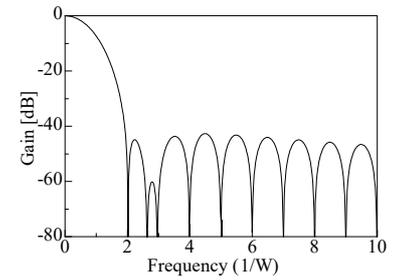


Spectrum

Hamming window

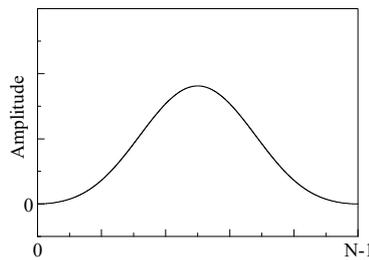


Time-Domain Waveform

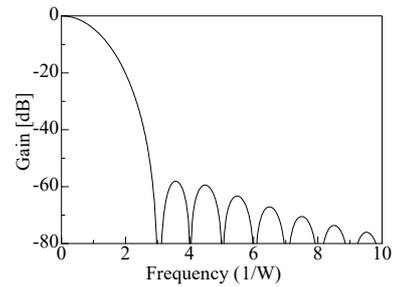


Spectrum

Blackman window

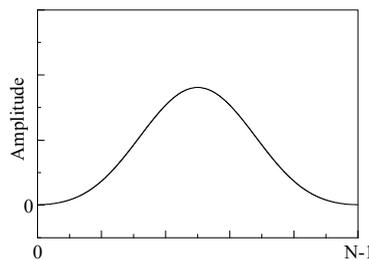


Time-Domain Waveform

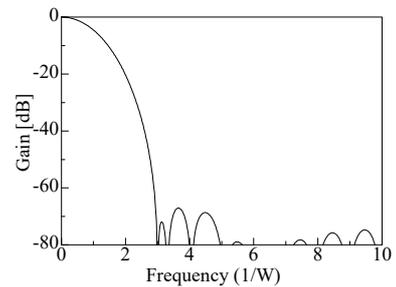


Spectrum

Blackman-Harris window

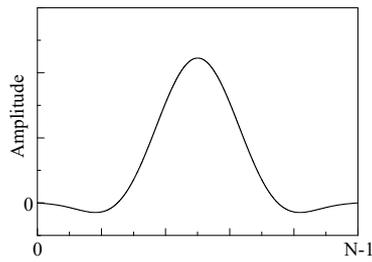


Time-Domain Waveform

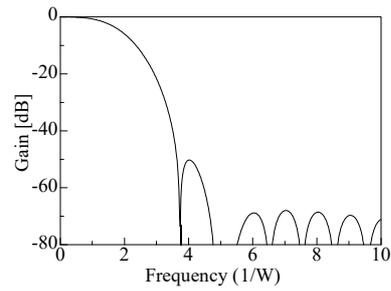


Spectrum

Flat top window

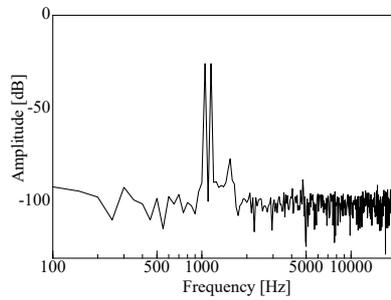


Time-Domain Waveform

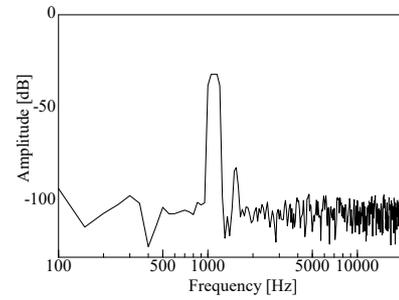


Spectrum

The following example shows input sine waves of 1050 and 1150 Hz analyzed with different window functions. Because the frequencies in this example are close to one another, a rectangular window with a narrow main lobe is able to separate and display both frequencies, but a Hann window with a wide main lobe displays the two as a single spectral component.



Analysis Using a Rectangular Window



Analysis Using a Hann Window

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Warranty Certificate

HIOKI

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

Customer name: _____
Customer address: _____

Important

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

This document certifies that the product has been inspected and verified to conform to Hioki's standards. Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

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

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18-07 EN-3

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