HIOKI

Instruction Manual

8847

MEMORY HiCORDER

HIOKI E. E. CORPORATION

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Basic Workflow

(⇒ p.17)

1 Install & Connect

- Install the instrument
- Install the input modules
- Connect the cords
- Install the recording paper
- Turn power on

(⇒ p.37)

2 Make Instrument Settings

- Select the function
- Setting measurement configuration
- Select the input channels

(⇒ p.56)

3 Measure

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4 Analyze, Save and Print

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Introduction

Thank you for purchasing the HIOKI "Model 8847 Memory HiCorder". To obtain maximum performance from the instrument, please read this manual carefully, and keep it handy for future reference.

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

Document		Description
1	**Measurement Guide**	**Read first.** 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.

Registered trademarks

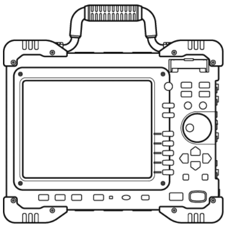
- Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.
- CompactFlash is a registered trademark of Sandisk Corporation (USA).

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.

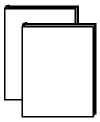
Confirm that these contents are provided. (One each)

☐ 8847 Memory HiCorder



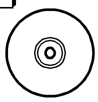
Accessories

☐ Instruction Manual



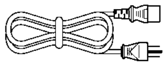
☐ Measurement Guide

☐ Application CD (⇒ p.277)

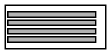


The latest version can be downloaded from our web site.

☐ Power Cord

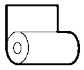


☐ Input Cable Labels

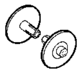


☐ USB Cable

☐ 9231 Recording Paper



☐ Paper Roll Axle



☐ Ferrite clamp-on choke (for LAN/USB Cable)

Other options specified when ordered

See: Options List (⇒ p. A10)

NOTE

If the 8967 TEMP Unit is installed in the 8847, two ferrite clamp-on chokes (small) will be supplied per unit.

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. However, using the instrument in a way not described in this manual may negate the provided safety features.
Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from instrument defects.

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

Safety Symbols

⚠	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the instrument. The ⚠ symbol printed on the instrument indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
⎓	Indicates DC (Direct Current).
∼	Indicates AC (Alternating 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

	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).
CE	This symbol indicates that the product conforms to safety regulations set out by the EC Directive.

Notation

Symbols in This Manual

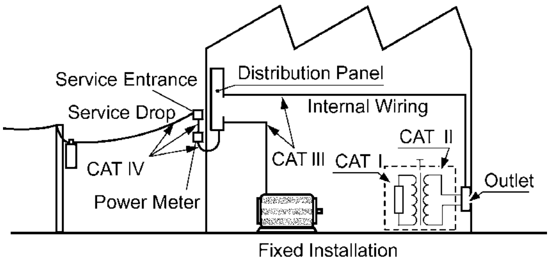
⊘	Indicates the prohibited action.
(⇒ p.)	Indicates the location of reference information.
?	Indicates quick references for operation and remedies for troubleshooting.
*	Indicates that descriptive information is provided below.
[ ]	Menus, commands, dialogs, buttons in a dialog, and other names on the screen and the keys are indicated in brackets.
CURSOR (Bold characters)	Bold characters within the text indicate operating key labels.
	Unless otherwise specified, "Windows" represents Windows 2000, Windows XP, or Windows Vista. "IE" represents Internet Explorer.
MEM	Indicates Memory function support.
REC	Indicates Recorder function support.
X−Y	Indicates X-Y Recorder function support.
FFT	Indicates FFT Recorder function support.

Accuracy

We define measurement tolerances in terms of f.s. (full scale) values, with the following meanings:
f.s. (maximum display value or scale length)
The maximum displayable value or scale length. 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

Overvoltage Categories (CAT)

This instrument complies with CAT II safety requirements. This instrument's input modules comply with CAT I or CAT II safety requirements. To ensure safe operation of measurement instruments, IEC 60664 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called overvoltage categories. These are defined as follows.



CAT I	Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device.
CAT II	Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.) CAT 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).

Higher-numbered categories correspond to electrical environments with greater momentary energy. So a measurement device designed for CAT III environments can endure greater momentary energy than a device designed for CAT II. Using a measurement instrument in an environment designated with a higher-numbered category than that for which the instrument is rated could result in a severe accident, and must be carefully avoided.

NOTE

The applicable measurement category is determined by the input module being used. Refer to "17.6 Input Modules Specifications" (⇒ p.304).

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 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.

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: -10 to 40°C, 20 to 80%RH (non-condensating)
When printing: 0 to 40°C, 20 to 80%RH (non-condensating)
When using a hard disk: 5 to 40°C, 20 to 80%RH (non-condensating)
Temperature and humidity range for guaranteed accuracy: 23 ± 5°C, 20 to 80%RH (non-condensating)

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

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

Exposed to liquids
Exposed to high humidity or condensation

Exposed to strong electromagnetic fields
Near electromagnetic radiators

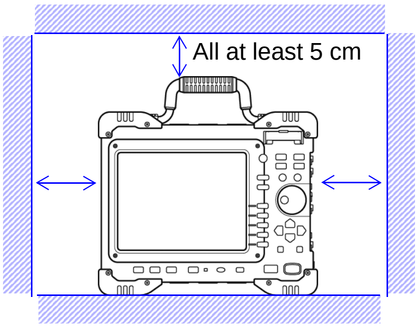
Exposed to high levels of particulate dust

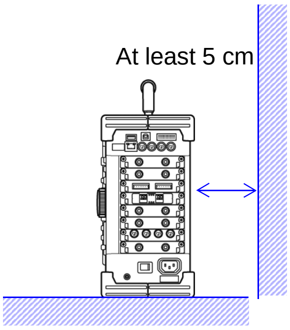
Subject to vibration

Installing

To prevent overheating, be sure to leave the specified clearances around the unit.

- The instrument should be operated only with the bottom or rear side downwards.
- Vents must not be obstructed.
- Do not install the instrument at a slanted angle.





Handling the Instrument

⚠DANGER

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

Never modify the instrument. Only Hioki service engineers should disassemble or repair the instrument. Failure to observe these precautions may result in fire, electric shock, or injury.

⚠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 CF card, USB memory stick and recording paper.

Handling the Probes

⚠CAUTION

- Avoid stepping on or pinching cords, which could damage the probe insulation.
- To avoid breaking the cords, do not bend or pull them.

NOTE

Use only the specified connection cords. Using a non-specified cable may result in incorrect measurements due to poor connection or other reasons.

Handling the CD

⚠CAUTION

- Always hold the disc by the edges, so as not to make fingerprints on the disc or scratch the printing.
- Do not wet the disc with volatile alcohol or water, as there is a possibility of the label printing disappearing.
- To write on the disc label surface, use a spirit-based felt pen. Do not use a ball-point pen or hard-tipped pen, because there is a danger of scratching the surface and corrupting the data. Do not use adhesive labels.
- Do not expose the disc directly to the sun's rays, or keep it in conditions of high temperature or humidity, as there is a danger of warping, with consequent loss of data.
- To remove dirt, dust, or fingerprints from the disc, wipe with a dry cloth, or use a CD cleaner. Always wipe radially from the inside to the outside, and do no wipe with circular movements. Never use abrasives or solvent cleaners.
- Hioki shall not be held liable for any problems with a 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 Memory HiCorder 8847 is easy to operate and allows quick and efficient measurement and analysis.
Major applications include equipment diagnosis, preventive maintenance, and troubleshooting. The product offers the following features.

Sturdy finish and convenient carrying handle

Easily take the unit anywhere.

Logic modules allow measurement in 64 channels

Ideal for multi-point measurements.

Easy loading of recording paper
High-speed printing

One-touch insertion allows quick and trouble-free operation.

Immediately ready for measurement after power-on *

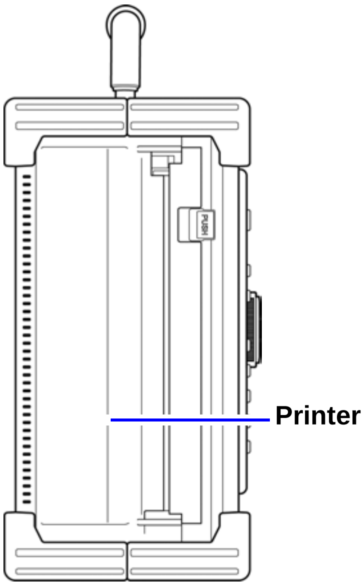
High-speed sampling: 20 Ms/s

Enables responsive evaluation and analysis.

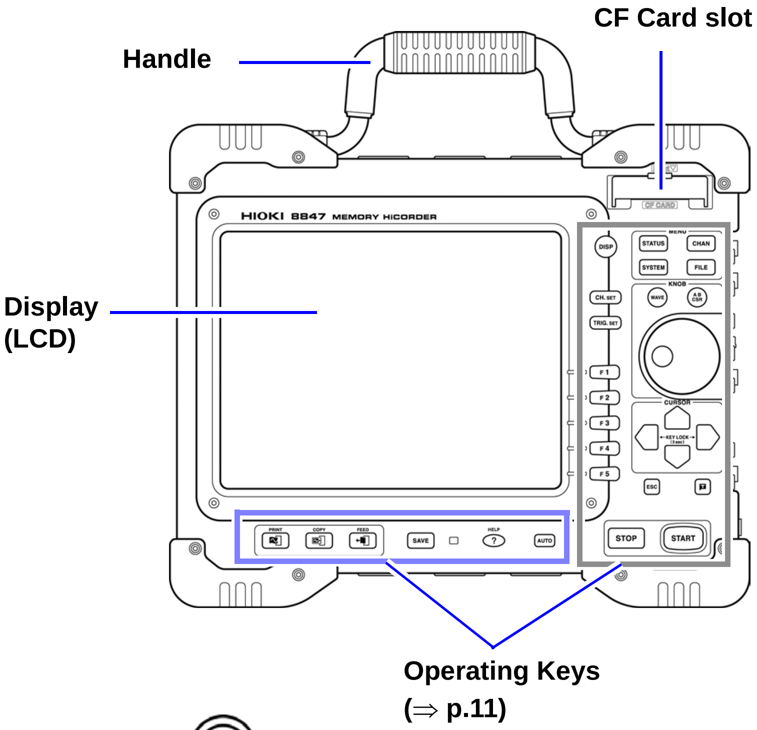
* For best measurement precision, a warm-up period of about 30 minutes after power-on is recommended, to allow the internal temperature of the input modules to stabilize.
Then perform zero-adjust and start the measurement.

1.2 Names and Functions of Parts

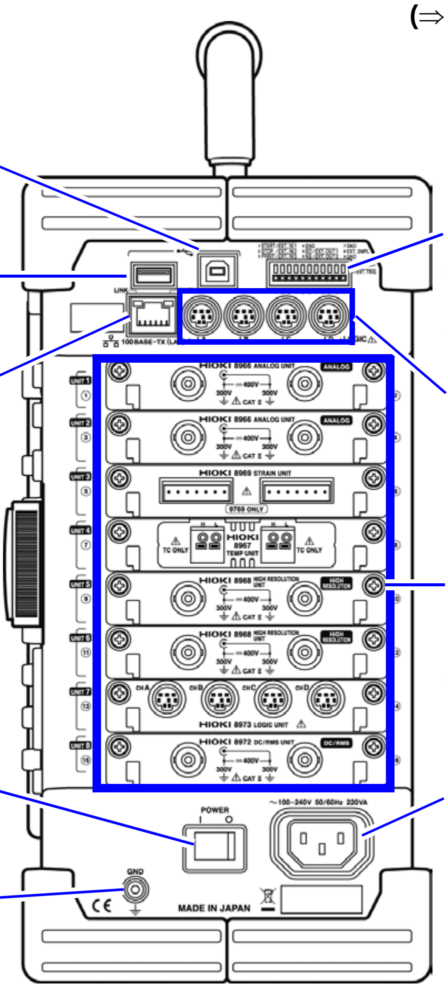
Left Side



Front Panel



Right Side



USB Connector (Type B)
Connect a USB cable here.
(⇒ p.278)

USB Connector (Type A)
Connect a USB memory stick here. (⇒ p.28)

100BASE-TX Connector
Connect a LAN cable here.
(⇒ p.259)

POWER Switch
Turns the instrument on and off.
| : Power On
○ : Power Off (⇒ p.34)

GND Terminal (Functional Earth)
Connect to Earth ground.(⇒ p.33)

External control terminals
An external sampling signal can be connected here. (⇒ p.287)
Allows control of the instrument.

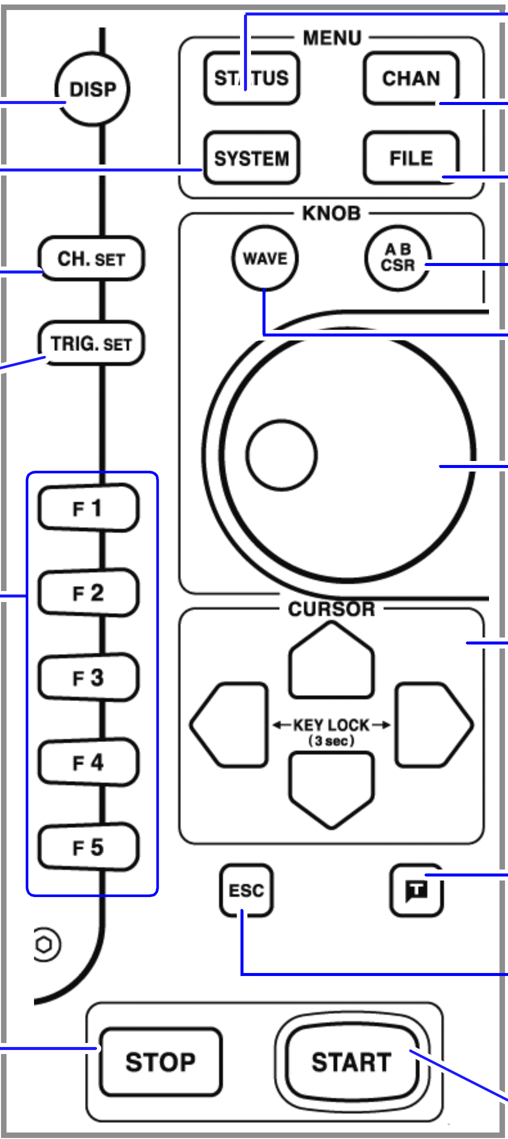
Standard LOGIC terminals
Input connectors for proprietary logic probes. (⇒ p.20)

Various Input Modules
(⇒ p.18), (⇒ p.20)

(For details, see the documentation of the respective input module.)

Power Inlet
Connect the supplied power cord here.(⇒ p.33)

Operating Keys



DISP key
Displays the Waveform screen

SYSTEM key
Displays the System screen (⇒ p.255)

CH.SET key
Displays the channel settings window on the Waveform screen. (⇒ p.49)

TRIG.SET key
Displays the trigger settings window on the Waveform screen.(⇒ p.151)

F key
Select setting items

STOP key
Stops measurements

1 press:	Measurement stops after the set recording length
2 presses:	Stop measurement

See: "Stop Action" (⇒ p.257)

STATUS key
Displays the Status screen

CHAN key
Displays the Channel screen

FILE key
Displays the File screen (⇒ p.80)

AB CSR key
Sets A/B cursors (⇒ p.102)

WAVE key
Assigns the Jog & Shuttle knobs to waveform scrolling. (⇒ p.106)

Inner**: Jog**
Outer**: Shuttle**
Scrolls waveforms (⇒ p.106)

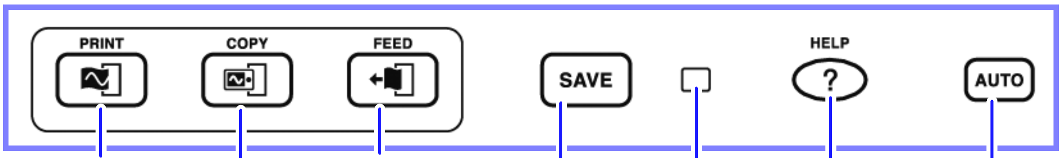
CURSOR key
Moves the cursor up, down, left and right on the screen.

KEY LOCK:
Press and hold the right and left **CURSOR** keys for three seconds to disable key operations.
To cancel key-lock, hold the keys again for three seconds.

Manual Trigger key
Issues a manual trigger event. (⇒ p.165)

ESC key
Cancels an operation.
Removes the displayed dialog and window

START key
Starts measurements
The key lights green during measurement.
See: "Start Action" (⇒ p.257)



PRINT key
Prints waveforms and lists (⇒ p.89)

FEED key
Feeds paper

HELP key
Opens help information (⇒ p.15)

COPY key
Prints a hard copy of the display screen (⇒ p.98)

Lights up during media access.

AUTO key
Starts auto-range measurement (⇒ p.58)

SAVE key
Saves data to storage media. (⇒ p.65)
Turns dialog box display during Auto Save on or off.

1.3 Screen Organization

The screen configuration is as listed below. The display appears when a key is pressed.
On the Waveform screen, the trigger settings window and channel settings window can be brought up.

Waveform Screen

DISP

This screen serves for observing the waveform.
The settings window at the right shows the measurement parameters.

Trigger settings window/Channel settings window

TRIG. SET	Shows details about the trigger settings.
CH. SET	Shows details about the analog channel and logic channel settings.

Status Screen

STATUS

This screen serves for making settings for the measurement method and the numerical calculation of waveform data.

Each push of the **STATUS** key toggles between the following two sheets.

- **[Status]** sheet
- **[Num Calc]** sheet
- **[Memory Div]** sheet
- **[Wave Calc]** sheet

Channel Screen

CHAN

This screen serves for making channel settings, scaling settings, and comment settings.

Each push of the **CHAN** key cycles through the following sheets.

- **[Unit List]** sheet
- **[Each Ch]** sheet
- **[Scaling]** sheet
- **[Comment]** sheet

System Screen

SYSTEM

This screen serves for making environment settings, saving and printing files, making interface settings, and for performing data initialization.

Each push of the **SYSTEM** key cycles through the following sheets.

- **[Environment]** sheet
- **[File Save]** sheet
- **[Printer]** sheet
- **[Interface]** sheet
- **[Init]** sheet

File Screen

FILE

This screen serves for viewing data files saved on media (CompactFlash cards, hard disk drive, USB memory stick, internal memory).

Explanation of Screen Contents

Waveform screen

Title comment
Shows the specified title comment. (⇒ p.118)

Trigger time
Shows the date and time of the last trigger event. (⇒ p.151)

Media icon
Shows the media status. (⇒ p.28)

Current date and time
Shows the date and time as set for the internal clock. (⇒ p.35)

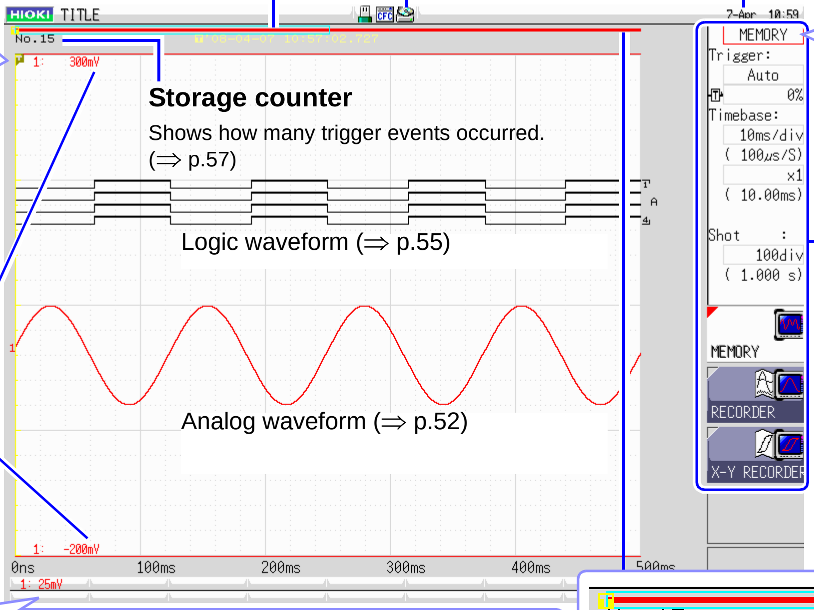
Trigger symbol
Shows the point where the trigger event occurred. (⇒ p.151)

Storage counter
Shows how many trigger events occurred. (⇒ p.57)

MEMORY

Settings cursor
The current cursor location is indicated by flashing.

Settings window
Measurement parameters are set here. (⇒ p.41)



MEMORY
Trigger: Auto
0%
Timebase: 10ms/div
(100µs/S)
x1
(10.00ms)
Shot : 100div
(1.000 s)

Logic waveform (⇒ p.55)

Analog waveform (⇒ p.52)

Upper and lower limit
The upper and lower limit values for each channel are shown here. (⇒ p.114)

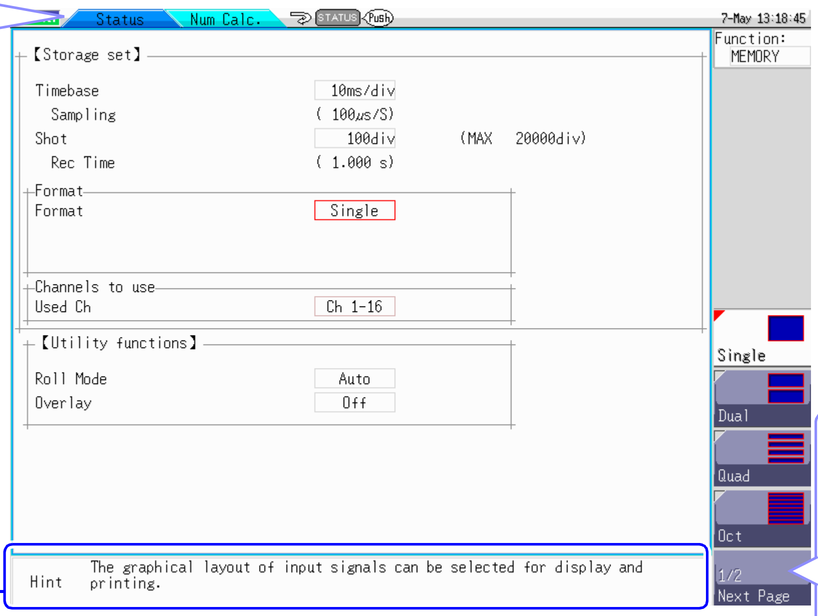
Vertical axis display 1: 25mV
Shows the value per increment for each channel. This is linked to the range setting. (⇒ p.52)

Scroll bar
The stored waveform is indicated by a red bar, and the displayed waveform by a blue frame. (⇒ p.106)

Elements common to Status screen, Channel screen, System screen, and File screen

Sheet tab
Shows names of sheets that can be selected.

Use the **MENU** keys to switch to a different sheet.



Function: MEMORY

【Storage set】

Timebase 10ms/div
Sampling (100µs/S)
Shot 100div (MAX 20000div)
Rec Time (1.000 s)

Format
Format Single

Channels to use
Used Ch Ch 1-16

【Utility functions】

Roll Mode Auto
Overlay Off

Hint The graphical layout of input signals can be selected for display and printing.

Next Page
This is shown if there are more than six setting items.

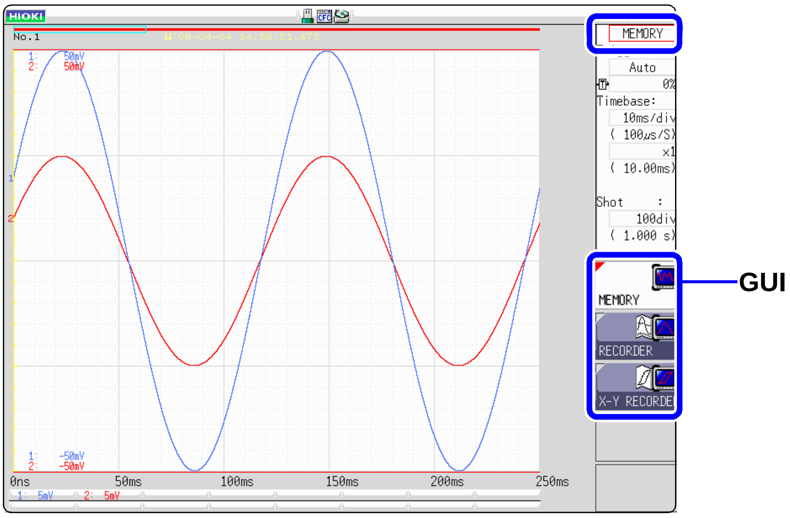
Selecting this button brings up other items.

Hint
Shows details about the item where the settings cursor is currently located.

Messages such as "Online", "Key Lock active." and error messages are also shown here.

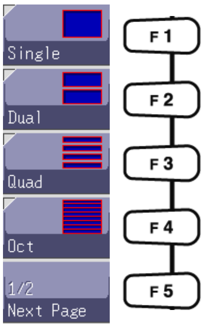
1.4 Basic Key Operations

1 Press the **CURSOR** key and move the cursor to the item on screen which you want to change.



2 Check the GUI illustration and press the function key (**F** key) for the setting that you want to change.
The assignment of the **F** keys will be different for each item.

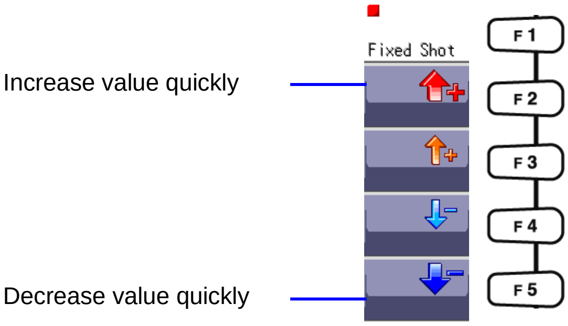
Selecting a setting item



Press the **F** key to change the setting item.

When there are more than six setting items, press **F5 [Next Page]** to switch to the next page.

Increasing or decreasing a setting value



Press **F** key to change the setting value.

3. For some setting items, the **CH.SET** key selects **[Exec]** and the **TRIG.SET** key selects **[Cancel]**.

To enter text or numbers
See: "8.1.3 Alphanumeric Input" (⇒ p.121)

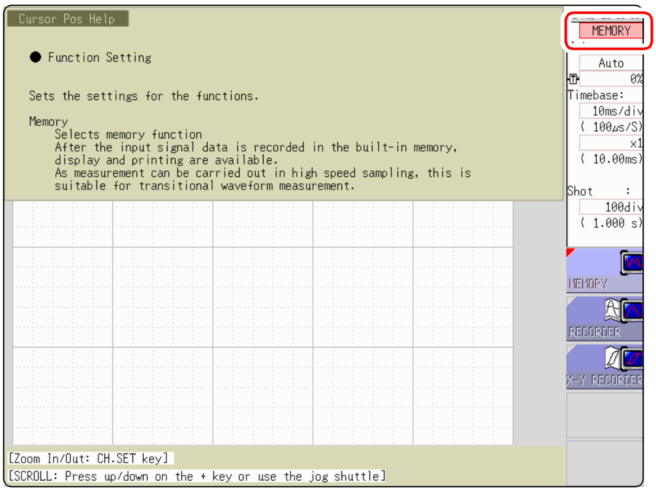
1.4.1 Example for Using the HELP Key

A simple explanation will appear at the cursor position. Help information can also be searched.

Cursor Position Help

1. Move the cursor to the item for which you want to display help.
2. Press the **HELP** key. A **[Cursor Pos Help]** sheet is displayed at the cursor position.

You can scroll the information using the cursor up/down keys and the Jog knob.



Cursor Pos Help

● Function Setting

Sets the settings for the functions.

Memory
    Selects memory function
    After the input signal data is recorded in the built-in memory, display and printing are available.
    As measurement can be carried out in high speed sampling, this is suitable for transitional waveform measurement.

[Zoom In/Out: CH.SET key]
[SCROLL: Press up/down on the + key or use the jog shuttle]

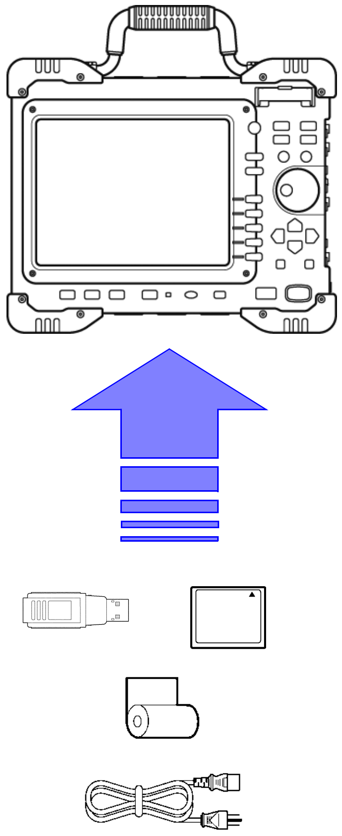
- You can change the size of the Help sheet with the **CH.SET** key. Available settings are full, top half, and bottom half. The example above is for top half.
- Each push of the **HELP** key cycles through the following settings: Cursor Position Help, Help off.

Measurement Preparations

Chapter 2

Work Flow

1	Install this instrument	(⇒ p.6)
2	Install an input module (Adding or replacing an input module)	(⇒ p.18)
3	Connect a logic probe to the Standard LOGIC terminals **(When measuring logic signals)**	(⇒ p.20)
4	Connect the input cable(s) to the input module **(When measuring analog signals)** Probes and cables will differ depending on the measurement purpose.	(⇒ p.20)
5	Insert media (CF Card, USB memory stick)	(⇒ p.28)
6	Load recording paper	(⇒ p.31)
7	Connect the power cord	(⇒ p.33)
8	Ground the Functional Earth of this instrument (For measurement in noise-prone environments)	(⇒ p.33)
9	Turn the power on	(⇒ p.34)
10	Setting the clock	(⇒ p.35)
11	Perform zero-adjust	(⇒ p.36)



When preparations are complete, let's start a measurement (⇒ p.37)

Using communication functions
See: "Chapter 15 Connection to a Computer" (⇒ p.259)

Using external control functions
See: "Chapter 16 External Control" (⇒ p.287)

2.1 Install an input module ⚠

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

⚠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.

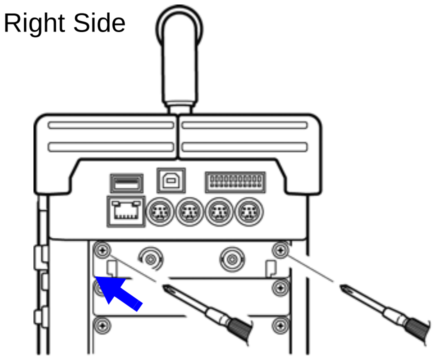
⚠CAUTION

- 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.

NOTE

For information on analog channel accuracy when using logic channels, see "8.10 Making Detailed Settings for Input Modules" (⇒ p.140).

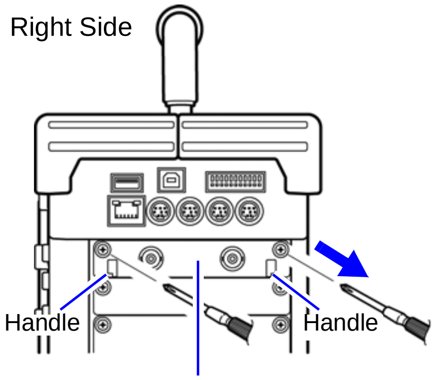
Installing an input module



Required item: One Phillips-head screwdriver

1. Turn the instrument's **POWER** switch Off.
2. With attention to the orientation of the input module, insert it firmly all the way in.
   Make certain that the labels on the input module's panel face the same direction as the labels on the right side of the instrument.
3. Using the Phillips screwdriver, tighten the two input module mounting screws.

Removing an input module

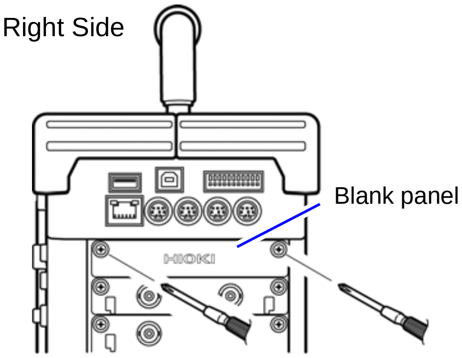


(Example:8966)

Required item: One Phillips-head screwdriver

1. Turn the instrument’s **POWER** switch Off.
2. Remove any cables or thermocouples connected to the input module.
3. Remove the power cord.
4. Using the Phillips screwdriver, loosen the two input module mounting screws.
5. Grasp the handle and pull the module out.

If not installing another input module after removal



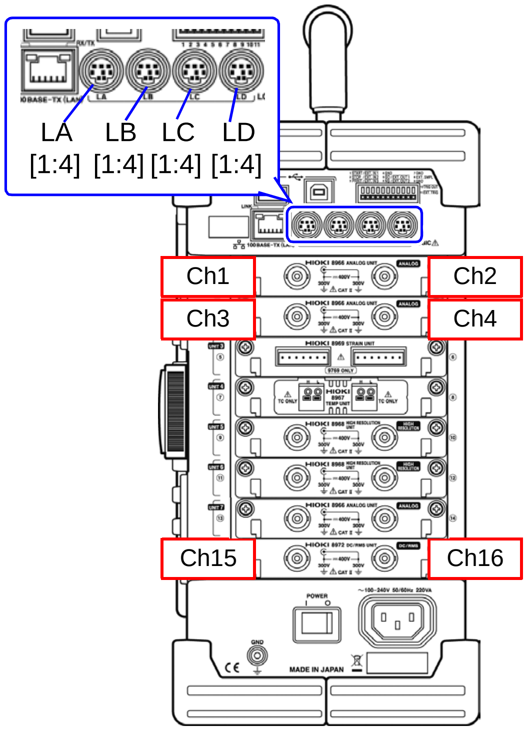
Using the Phillips screwdriver, tighten the two mounting screws.

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

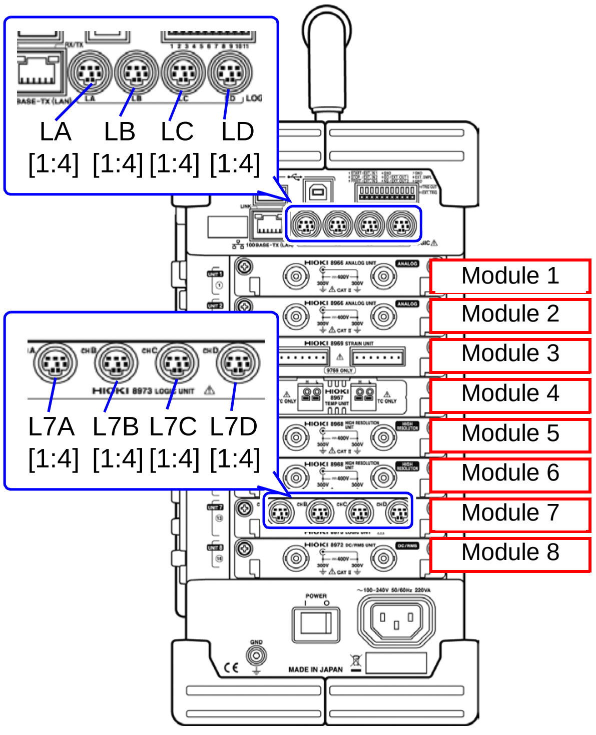
About channel allocation

When the instrument is positioned vertically as illustrated, module number one is at the top, and channel number one is at the left of the top.

Information about the input modules installed in the instrument can be verified in the System Configuration list **[System Information]**.



Analog channels only



Mix including logic modules

2.2 Connecting Cords

When measuring analog signals

Connect the cables or sensors to the input module.

When measuring logic signals

Connect the logic probe(s) to the LOGIC terminal(s) on the instrument.

DANGER

When measuring power line voltage

- 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.
- Do not permanently connect the device in an environment where voltage surges exceeding the maximum input voltage may occur. Failure to observe this precaution could result in damage to the device and personal injury.

CAUTION

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.

For voltage

CAUTION

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.

For temperature measurement

NOTE

When connecting a thermocouple using a wire run of more than 3 meters, the EMC environment including possible influence of external noise must be taken into consideration.

For detailed precautions and instructions regarding connections, refer to the documentation of input modules, connection cords, etc.

Measuring Voltage

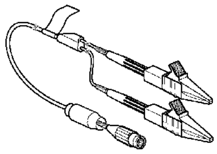
Applicable Input Modules
- 8966 Analog Unit
- 8968 High Resolution Unit
- 8972 DC/RMS Unit

Connect to the BNC jack on an input module.

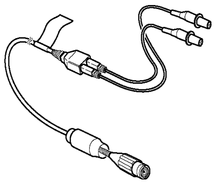
*: A power cord option or AC adapter may be required, depending on the input module used.

Use to connect: Connection cords

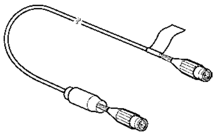
- 9197 Connection Cord
(Maximum input voltage: 500 V)
Large alligator clip type



- L9198 Connection Cord
(Maximum input voltage: 300 V)
Small alligator clip type

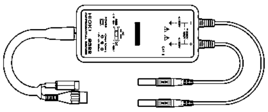


- L9217 Connection Cord
(Maximum input voltage: 300 V)
For measuring BNC output



If the voltage to be measured exceeds the maximum input rating of the input module being used:

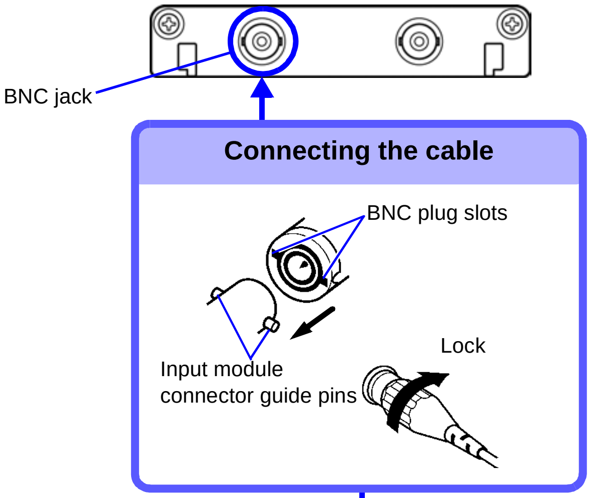
- 9322 Differential Probe*
- 9665 10:1 Probe
- 9666 100:1 Probe



Example: 9322 Differential Probe

Connect to BNC jack

Example: 8966 Analog Unit



Connect to the measurement object

Required item: One of the above cables

1. Connect the BNC plug on the cable to a BNC jack on the input module.
2. Align the slots in the BNC plug with the guide pins on the jack on the input module, then push and twist the plug clockwise until it locks.
3. Connect the cable clips to the measurement object.

Disconnecting BNC connectors

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

Measuring frequency, number of rotations and Count

Applicable Input Modules

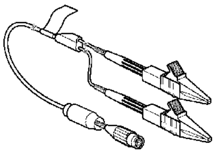
- 8970 Freq Unit

Connect to the BNC jack on an input module.

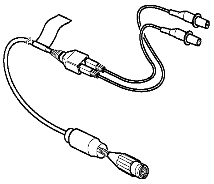
* A power cord option or AC adapter may be required.

Use to connect: Connection cords

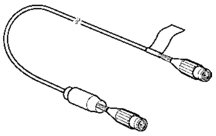
- 9197 Connection Cord
(Maximum input voltage: 500 V)
Large alligator clip type



- L9198 Connection Cord
Maximum input voltage: 300 V)
Small alligator clip type

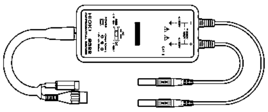


- L9217 Connection Cord
(Maximum input voltage: 300 V)
For measuring BNC output



If the voltage to be measured exceeds the maximum input rating of the input module being used:

- 9322 Differential Probe*



Example: 9322 Differential Probe

See p.21 for details for how to connect to a BNC terminal.

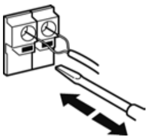
Measuring Temperature

Applicable Input Modules
- 8967 Temp Unit

Connect to the terminal block on the input module.

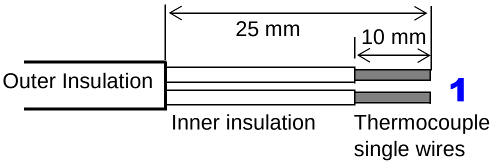
Use to connect: Thermocouple

(Compatible wire: AWG 16 to 26, 0.4 to 1.2 mm diameter)

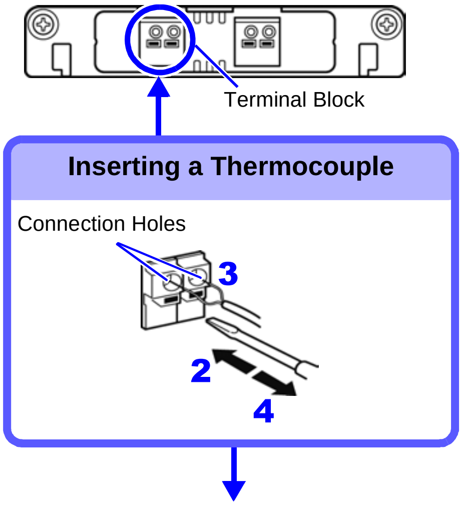


Connect to terminal block

Insert to terminal block



Required item:
Thermocouple, Ferrite clamp-on choke (8967's option), flat-blade screwdriver (2.6-mm blade)
Recommended wire:
Compatible wire:Single-strand thermocouple wire, 0.4 to 1.2-mm diameter

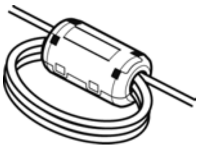


5 Attach to the measurement object

1. Strip insulation from the thermocouple wires as shown at the left.
   Stripping length: approx. 10 mm
2. Push the blade of a flat screwdriver into the button on the terminal block of the input module.
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.
5. Attach to the measurement object.

To remove the thermocouple
Hold the button while pulling the thermocouple wire out.

NOTE If surrounding equipment is affected by noise, coil the thermocouple several times and then attach the included ferrite clamp-on choke (as seen in the diagram to the right).



Using a Strain Gauge to Measure Vibration or Displacement (Strain)

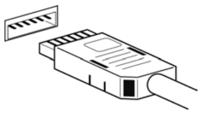
Applicable Input Modules

- 8969 Strain Unit

Connect Model 9769 Conversion Cable to the input module jack.

Use to connect: Sensor

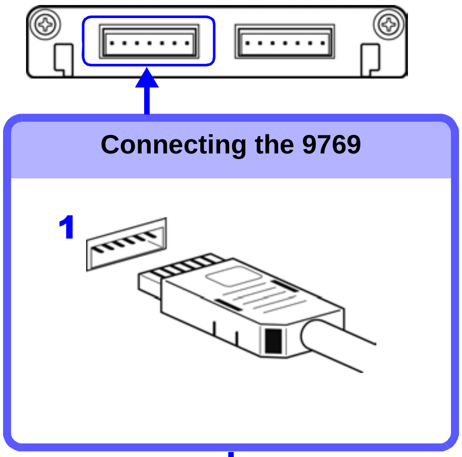
- Strain Gauge Transducer (Not available from Hioki)
- 9769 Conversion Cable



Connecting using a 9769 Conversion Cable

Connect to input module's terminal

Example: Connecting the 9769 Conversion Cable with the supplied conversion cable



2 **Connect to the Strain Gauge Converter**

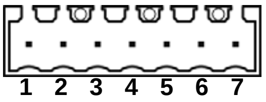
3 **Attach to the measurement object**

Required item:
9769 Conversion Cable, Strain Gauge Converter

1. Connect the 9769 to a terminal on the input module.

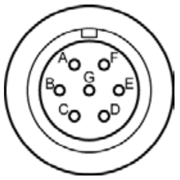
   The orange section of the 9769 must face up.
2. Connect the strain gauge transducer to the conversion cable.
3. Attach to the measurement object.

Connector Pinout of the 8969
(1 is on left when unit top side is facing up)



Pin No.	Description
1	BRIDGE+
2	SENSE+
3	INPUT+
4	INPUT-
5	BRIDGE-
6	SENSE-
7	FLOATING COMMON

Connector pinout of 9769 on sensor side



Bridge voltage:
2 V is supplied.

Metal shell is connected to GND of the 8969.

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

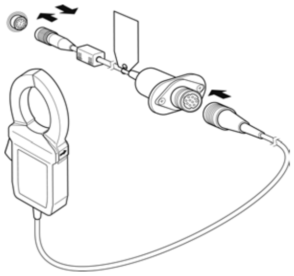
Measuring Current

Applicable Input Modules
- 8971 Current Unit

Coneect Model 9318 Conversion Cable to the input module jack.

Use to connect: Clamps

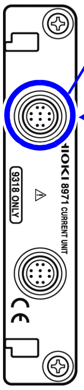
- Clamp-On Sensor
  9272-10
- Universal Clamp-On CTs
  9277, 9278, 9279
- AC/DC Current Sensors
  9709, CT6862, CT6863



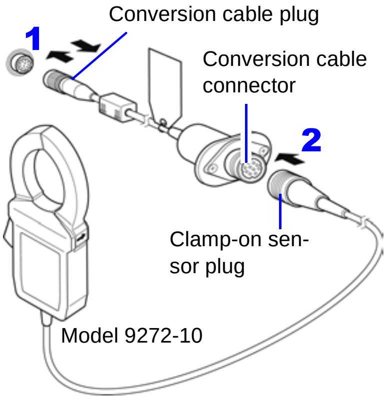
Example:
9272-10+9318

Connect to input module's terminal

Example: When connecting the 9272-10 Clamp-On Sensor



Connecting the 9318 Conversion Cable and clamp



3 **Attach to the measurement object**

Required item:
9318 Conversion Cable、9272 Clamp-On Sensor

1. Align the grooves of the unit sensor connector and the conversion cable plug. Insert the plug until it locks.
2. Align the grooves of the conversion cable connector and the plug of the clamp-on sensor to be used. Insert the plug until it locks.
3. Connect the clamp sensor to the item to be measured.

To disconnect the conversion cable:

Slide the plug to release the lock and then unplug the cable.

Measuring Logic Signals

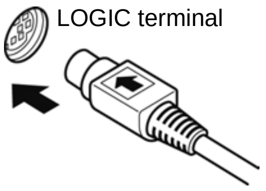
Applicable Input Modules
- 8973 Logic Unit

LA to LD are supplied as standard equipment with the unit.

Use to connect: Logic Probe

- 9320 Logic Probe*
- 9320-01 Logic Probe
- MR9321 Logic Probe*
- MR9321-01 Logic Probe
- 9327 Logic Probe

*: Use 9323 Conversion Cable for connection.



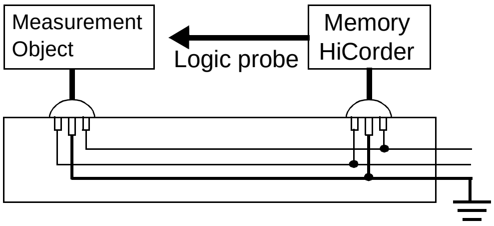
Before connecting a logic probe to the measurement object

DANGER

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

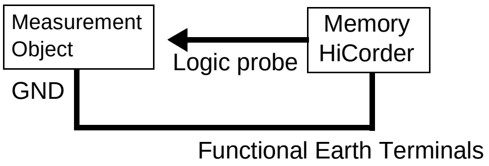
- **The ground pin in the LOGIC connector (plug) of the Model 9320-01 and 9327 Logic Probes (and legacy Models 9306 and 9320) is not isolated from this instrument's ground (common ground).**
  Use grounding-type polarized power cords for the measurement object and this instrument, and obtain power from the same mains circuit.
  Connecting to different mains circuits or using a non-grounding power cord may cause damage to the measurement object or this instrument because of current flow through the logic probes resulting from potential difference between the grounds of the different wiring systems.
  To avoid these problems, we recommend the following connection procedure:

Connect this instrument to the same outlet as the measurement object using the (supplied) grounding polarized power cord.



Connect the measurement object's ground to the GND terminal of this instrument. (Always obtain power from the same mains circuit.)

"GND Terminal (Functional Earth)" (⇒ p.10)

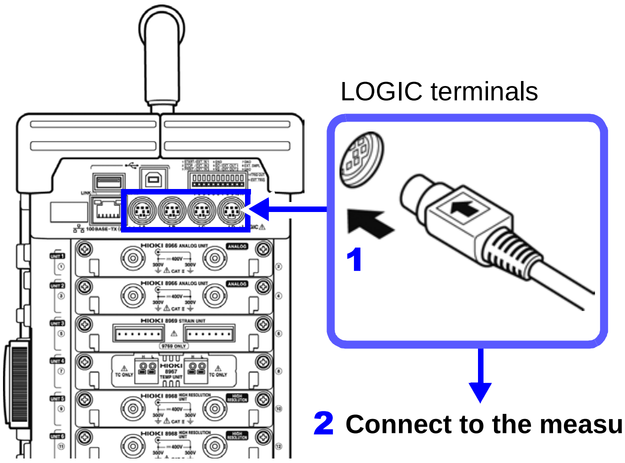


- **Maximum logic probe input voltages are as follows. Do not measure if the maximum voltage would be exceeded, as damage the instrument or personal injury may result.**
  Model 9327 Logic Probe: +50 VDC
  Model 9320-01 Logic Probe: +50 VDC
  Model MR9321-01 Logic Probe: 250 Vrms (HIGH range), 150 Vrms (LOW range)

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.

Connect to LOGIC Terminals

Example: Connecting the 9327 Logic Probe



Required item: 9327 Logic Probe

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

2 Connect to the measurement object.

2.3 Recording Media Preparation

2.3.1 Storage Media (Inserting a CF Card and USB Memory Stick)

⚠CAUTION

- If damage occurs to the hard disk or internal memory, we cannot restore or analyze the lost data. No compensation will be provided, regardless of the type or cause of the problem or damage.We therefore recommend maintaining a backup of any important data.
- Be careful to avoid inserting a media backwards or upside-down. The media or the instrument could be damaged.
- Never insert or eject a media while it is being accessed by the instrument (while LED next to **SAVE** key is lit). Data on the media could be lost.
- Do not transport the instrument while a USB memory stick is connected. Damage could result.
- Do not subject the hard disk to extreme shock or vibration. Doing so may damage the hard disk.
- Use the hard disk in an environment with a temperature of 5°C to 40°C, and humidity of 20%RH to 80%RH (non-condensation).
- Do not operate the instrument at a slanted angle. It may not work properly.
- Some USB memory sticks are susceptible to static electricity. Exercise care when using such products because static electricity could damage the USB memory stick or cause malfunction of the instrument.
- With some USB memory sticks, the instrument may not start up if power is turned on while the USB memory stick is inserted. In such a case, turn power on first, and then insert the USB memory stick. It is recommended to try out operation with a USB memory stick before starting to use it for actual measurements.

NOTE

- When saving or loading data, insert the storage media before specifying it. If the media is not inserted, the file list display will not appear.
- Media have a limited service life. After extensive use over a long period, data retention and readout may become non-functional. In such a case, you should procure new media.
- Automatic saving of data is possible only on hard disk or CF Card media.

Important

Use only PC Cards sold by Hioki.

Compatibility and performance are not guaranteed for PC cards made by other manufacturers. You may be unable to read from or save data to such cards.

■ Hioki options PC cards (CF Card and adapter)

9726 PC Card 128M, 9727 PC Card 256M, 9728 PC Card 512M, 9729 PC Card 1G, 9830 PC Card 2G

Media icons

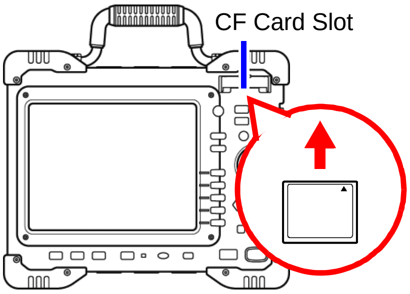
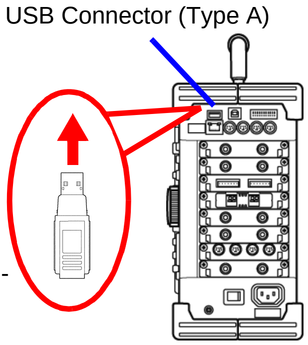
USB memory stick　CF Card　Hard disl

Icons indicating the status of storage media are always shown at the top of the screen.

: Media is inserted

: Media is inserted and selected as save target (Icon color is red)

: Media is not inserted but selected as save target (Icon color is black)

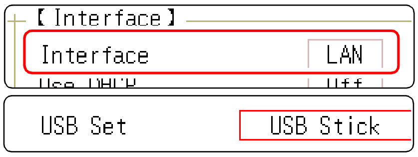
Storage Media	Inserting procedure, Remarks, and Notes
CF Card CF	**Inserting a CF Card** With the Front mark (▲) pointing toward the slot, insert the card in the direction of the arrow all the way in. When the Eject button has popped out, press it down first before inserting the CF card all the way in. Inserting the CF card when the Eject button is not pressed down may cause damage to the instrument. If the CF card cannot go all the way in, do not force it in. Press the Eject button to pop it out, and then press it down again before inserting in the CF card all the way in. **Removing a CF Card** Press the Eject button. When the button pops out, press it again to eject the CF Card. 
HDD (Hard disk) HDD	9664 HD Unit (capacity: 80 GB 1GB=1,000,000,000 bytes) The optional 9664 HD Unit (factory option) is required. The hard disk is formatted at the factory.
RAM (Internal memory) Memory (INT)	• Memory integrated in the unit is used. Only settings can be stored. • Automatic saving of data is not possible.
USB memory stick USB Stick	• Do not connect any devices other than USB memory stick. • Not all commonly available USB memory sticks are supported. • Automatic saving of data is not possible. • To use a USB memory stick, suitable unit settings must be made, as described below. **Inserting a USB memory stick** Ensure correct orientation of the USB memory stick and push it all the way into the connector. **Remove a USB memory stick** Verify that the unit is not accessing the USB memory stick (for saving or loading data, etc.). Then pull the USB memory stick out. (No special steps are required at the instrument.) 

Depending on the intended use of the USB memory stick, connector types and settings at the instrument will differ, as listed in the table below.

USB use	Connector	8847 setting		Reference information
		Interface	USB setting	
As USB memory stick	Type A	LAN	USB Stick	Reference procedure
For transfer of files from hard disk of PC (using a USB cable)	Type B	LAN	Mass Storage	"15.4"(⇒ p.276)
For communication with PC (using a USB cable)	Type B	USB	Interface	"15.6.1"(⇒ p.278)

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet



[Interface]
Interface LAN
USB Set USB Stick

1 Move the cursor to the **[Interface]**, and select **[LAN]**.

2 Move the cursor to the **[USB Set]**, and select **[USB Stick]**.

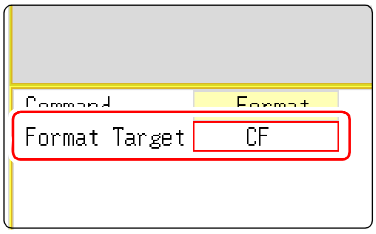
2.3.2 Formatting Storage Media

Possible targets for formatting are CF Card, USB memory stick, hard disk, and internal memory. During the formatting process, a folder named "HIOKI8847" will be created.

NOTE Note that formatting used storage media deletes all the information on the storage media and that deleted information is unrecoverable.

Procedure

To open the screen: Press the FILE key → File screen



Command Format

Format Target CF

1 Insert the storage media.

2 Select **[Next Page]**.
Select **[Format]**.

The cursor moves to the **[Format Target]** item.

3 Select the storage media to format, and select **[Exec]**.
The specified storage media is formatted.

A confirmation window will be displayed.
Select **[Yes]** to proceed, or **[No]** to cancel.

2.4 Loading Recording Paper

⚠WARNING

The print head and surrounding metal parts can become hot. Be careful to avoid touching these parts.

⚠CAUTION

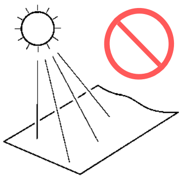
Be careful not to cut yourself with the paper cutter.

NOTE

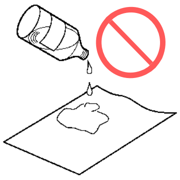
- Please use only the specified recording paper. Using non-specified paper may not only result in faulty printing, but printing may become impossible.
- If the recording paper is skewed on the roller, paper jams may result.
- Printing is not possible if the front and back of the recording paper are reversed.
- Always use the paper cutter to cut the printed paper. Excessive paper dust can accumulate on the roller if the paper is cut by the print head.

Handling and Storing Recording Paper

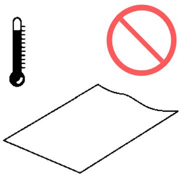
The recording paper is thermally and chemically sensitized. Observe the following precautions to avoid paper discoloration and fading.



Avoid exposure to direct sunlight.

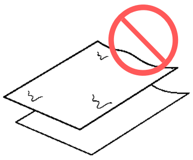


Avoid exposure to volatile organic solvents like alcohol, ethers and ketones.



Do not store thermal paper above 40°C or 90% RH.

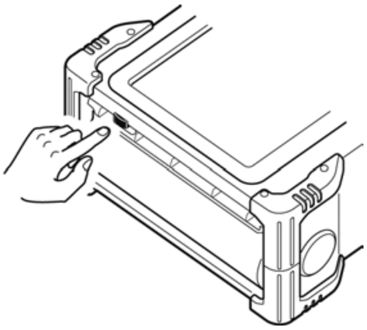
Avoid contact with adhesive tapes like soft vinyl chloride and cellophane tape.



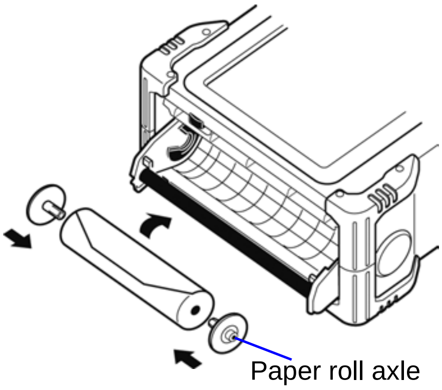
Avoid stacking with wet Diazo copy paper.

Procedure

Required item: 9231 Recording Paper,
Paper roll axle (Supplied with the instrument)

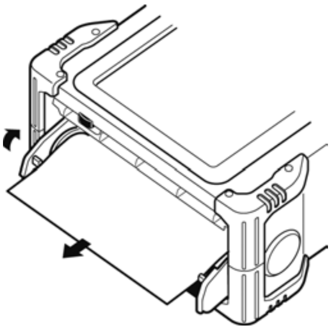


1. Press the Eject button to open the printer cover.



2. Insert the paper roll axle into the paper roll core and mount the recording paper in the holder. Push the paper in until you hear a click.

NOTE The printing side of the recording paper must be on the display side.
If the printer paper is mounted without attaching the paper roll axle, the printer cover may not open and the printer may be damaged.



3. Pull the paper out and then close the printer cover while pushing the paper against the side of the cover.

NOTE The surface of the paper may become sticky from the residue left behind by the adhesive tape and cause the printing on that area to become unreadable. After loading the paper, feed about 20cm before use.

2.5 Supplying Power

2.5.1 Connecting the Power Cord

Connect the power cord to 8847 and plug it into an AC outlet.

⚠WARNING

- When supplying power from an inverter or uninterruptible power supply (UPS), ensure that the following requirements are met. If the rated power supply voltage or frequency range is exceeded, or if a source with square wave output is used, the instrument may be fatally damaged and an electrical accident may occur.
  (1) Rated mains supply voltage is 100 to 240 VAC.
  (2) Rated mains supply frequency is 50/60 Hz.
  (3) Sine wave output (Do not use sources with unstable output)
- 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.

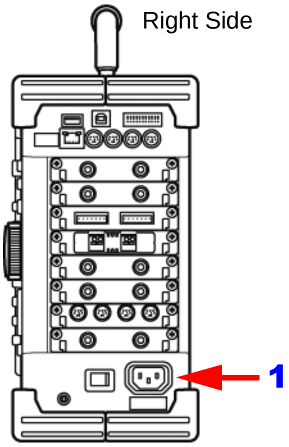
⚠CAUTION

To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.

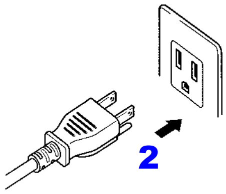
NOTE

Turn off the power before disconnecting the power cord.

Connection Procedure



1. Connect the power cord to the power inlet on the instrument.
2. Plug the power cord into the mains outlet.

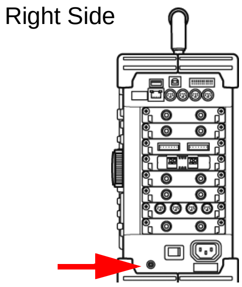


2.5.2 Grounding the Instrument's Functional Earth

Ground the instrument's functional earth.

When measuring in an electrically noisy environment, the effects of noise can be minimized by grounding the Functional Earth terminals.

When using a potential transformer (PT) for AC power line measurements or similar, the GND terminal of the PT must also be grounded.



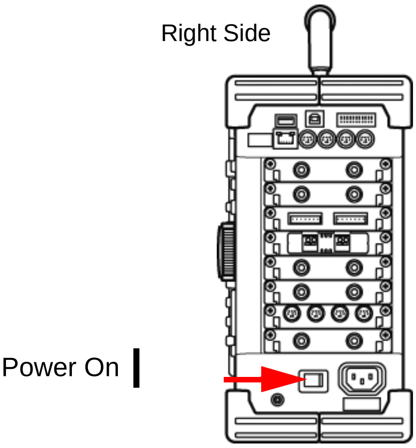
2.5.3 Turning the Power On and Off

This section explains the correct procedure for powering the unit up or down.

⚠WARNING

Before turning the instrument on, make sure the supply voltage matches that indicated on the its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.
Rated power voltage: 100 to 240 VAC
Rated power frequency: 50/60 Hz

Turning Power On



Turn the POWER switch on (|).

The startup screen appears first, and then the Waveform screen is shown.

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

Before 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 a CF Card or external storage media.
See: "Chapter 5 Saving/Loading Data & Managing Files" (⇒ p.65)

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 and established automatically. (⇒ p.79)

2.6 Setting the Clocks

Set date and time for the built-in clock as follows.
The clock has an automatic calendar with leap year correction and 24-hour format.
The functions listed below make use of the clock. Ensure that the clock is set correctly before using these functions.

- Measurement with timer-based trigger
- Printout of data including count of trigger events
- Saving measurement data

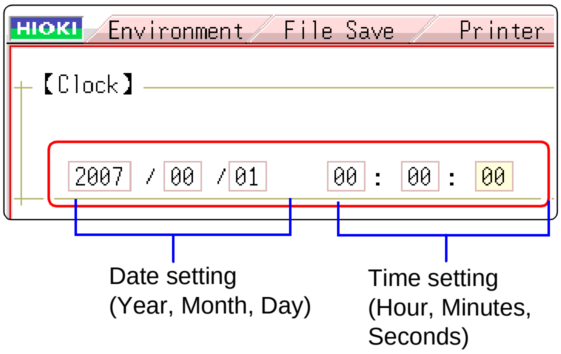
Procedure

To open the screen: Press the SYSTEM key → [Init] sheet

1 Move the cursor to the **[Clock]** item.

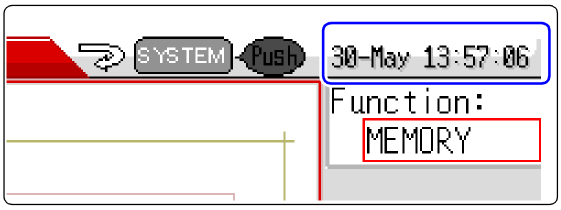
2 Select the digit to change and set the numeric value.

3 When you select **[Apply]** while the cursor is on the **[Clock]** item, the clock is set to the current date and time values.



【Clock】
2007 / 00 / 01 00 : 00 : 00

The date and time indication is shown at the top right of the screen.



30-May 13:57:06
Function: MEMORY

NOTE 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.

2.7 Adjusting the Zero Position (Zero-Adjust)

This procedure compensates for input module differences and sets the reference potential of the instrument to 0 V.
The compensation applies to the selected range.

Before starting zero-adjust

- 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.
- Note that zero-adjust cannot be performed during a measurement.
- During zero-adjust, the operation keys of the unit are inactive. (The procedure may take several seconds.)

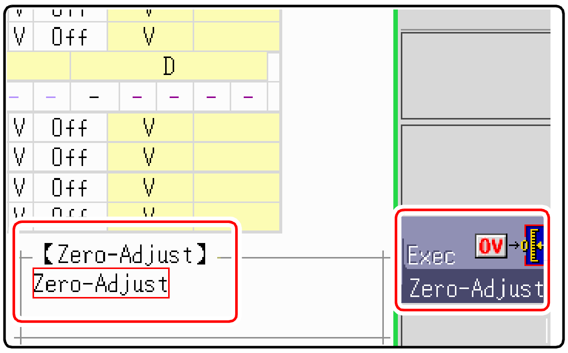
Procedure

To open the screen: Press the CHAN key → [Unit List] sheet

1 Move the cursor to the **[Zero-Adjust]** item.

2 Select **[Exec Zero-Adjust]**.

The zero-adjust procedure is carried out.



NOTE

Zero-adjust has no effect on the 8969 Strain Unit. (**Perform zero-adjust using Auto Balance.** (⇒ p.144))

Perform zero-adjust in the following cases.

- When an input module was changed.
- When power was turned off and on again.
- When settings were initialized (system reset).
- When DC/RMS is switched at the 8971 Current Unit and the 8972 DC/RMS Unit
- When the ambient temperature has changed significantly.
  Zero-position drift* may occur.

* Drift: This refers to spurious output caused by a shift in the operating point of an operational amprifier. Drift can occur due to changes in temperature and due to component aging over a period of use.

Measurement Procedure

Chapter 3

3.1 Ensuring Measurement Safety

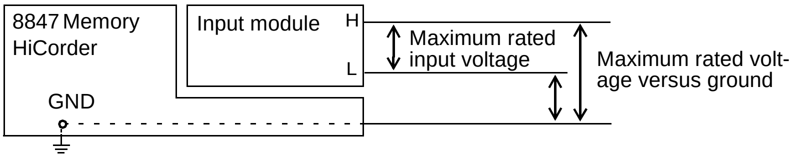
Be sure to observe the following points, to ensure safe measurement.

DANGER

The maximum rated input voltage and maximum rated voltage versus ground values for input modules and connection cables are listed in the table below. In order to prevent the risk of electric shock and damage to the equipment, make sure that these voltages are not exceeded.
The maximum rated voltage versus ground does not change also when an attenuator or similar is used at the input. Take the connection method into consideration and make sure that the rating is not exceeded.

Input module	Maximum rated input voltage	Maximum rated voltage versus ground
8966 Analog Unit	400 VDC	300 VAC/DC
8967 Temp Unit	-	300 VAC/DC
8968 High Resolution Unit	400 VDC	300 VAC/DC
8969 Strain Unit	-	33 V rms / 70 VDC
8970 Freq Unit	400 VDC	300 VAC/DC
8971 Current Unit	-	Not insulated.
8972 DC/RMS Unit	400 VDC	300 VAC/DC
8973 Logic Unit	-	Not insulated.

Connection cord	Maximum rated input voltage	Maximum rated voltage versus ground
9790 Connection Cord	300 VAC/DC	300 VAC/DC
9197 Connection Cord	500 VAC/DC	600 VAC/DC
L9198 Connection Cord	300 VAC/DC	600 VAC/DC



3.2 Measurement Workflow

1 Pre-Measurement Inspection

See:
"3.3 Pre-Measurement Inspection" (⇒ p.40)

2 Make basic settings for measurement

Select suitable recording method for measurement target	See: "3.4.1 Measurement Function" (⇒ p.41)
Set data acquisition speed	"3.4.2 Time Axis Range and Sampling Rate" (⇒ p.43)
Set waveform length	"3.4.3 Recording Length (number of divisions)" (⇒ p.46)
Set waveform display format and printing format	"3.4.4 Screen Layout" (⇒ p.48)

Application examples

See:
"7.4 Performing Waveform X-Y Synthesis" (⇒ p.108)
"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.124)
"8.3 Displaying New Waveforms Over Past Waveforms (Overlay)" (⇒ p.125)
"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)
"Chapter 10 Numerical Calculation Functions" (⇒ p.173)

3 Input Channel Settings

Make analog channel settings	See: "3.5.2 Analog Channel" (⇒ p.52)
Make logic channel settings	"3.5.3 Logic Channel" (⇒ p.55)

Application examples

See:
"8.1 Adding Comments" (⇒ p.118)
"8.5 Converting Input Values (Scaling Function)" (⇒ p.128)
"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)
"8.7 Fine Adjustment of Input Values (Vernier Function)" (⇒ p.137)

4 Make trigger settings

See:
"Chapter 9 Trigger Settings" (⇒ p.151)

5 Starting Measurement

See:
"3.6 Starting and Stopping Measurement" (⇒ p.56)
"Chapter 5 Saving/Loading Data & Managing Files" (⇒ p.65)
"Chapter 6 Printing" (⇒ p.89)
"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.102)
"7.3.2 Scrolling With Jog and Shuttle Knobs (Scroll)" (⇒ p.106)
"7.5 Magnifying and Compressing Waveforms" (⇒ p.110)

6 Stopping Measurement

See:
"3.6 Starting and Stopping Measurement" (⇒ p.56)

To check the input signal

Press the **AUTO** key. Input waveform time axis range setting, vertical axis (voltage axis) range setting, and zero-adjust are performed automatically and measurement starts.

See: "3.7 Measurement With Automatic Range Setting (Auto-Ranging Function)" (⇒ p.58)

To reuse previously stored settings

Load the settings file from the File screen.
Saving the settings for different measurement targets or applications enhances operation convenience.

See: "5.3 Loading Data" (⇒ p.77)

To automatically restore previous settings at power-up

A file with stored measurement settings can be automatically loaded when the unit is turned on. Simply make sure that a CF Card with an Auto Settings file is inserted when the unit is turned on.

See: "5.4 Automatically Loading Settings (Auto Setup Function)" (⇒ p.79)

NOTE

Make sure that the file is stored in the "HIOKI8847" folder of the media.

To return settings to the original (basic default) condition

From the System screen, select the **[Init]** sheet to return the unit to the factory default settings. In this condition, the unit is set up to easily perform simple measurements. If operation of the unit seems unusual or overly complex, perform the initialization procedure.

See: "18.2 Initializing the Instrument" (⇒ p.314)

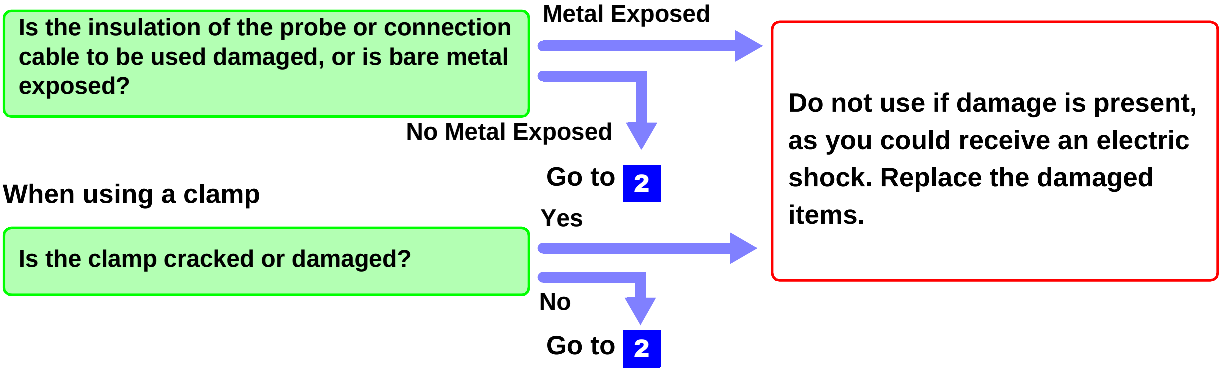
3.3 Pre-Measurement Inspection

The following steps should be performed before measurement.

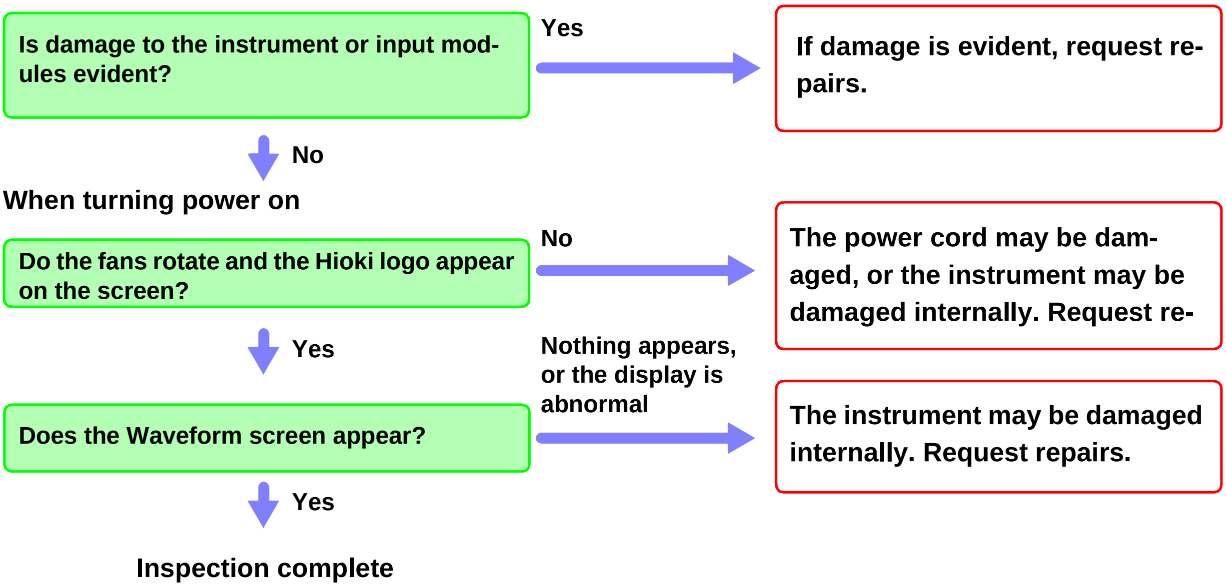
Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

1 Peripheral Device Inspection

When using probes and connection cables



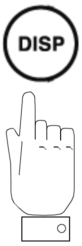
2 Instrument and Input Module Inspection



3.4 Setting Measurement Configuration

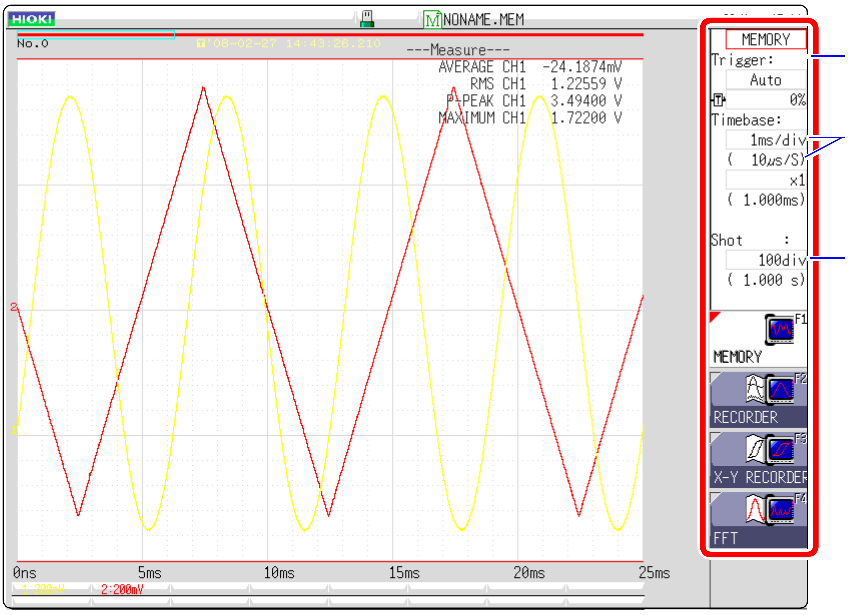
Set measurement conditions as follows.
By calling up the Waveform screen and then using the Settings window to make basic settings, you can immediately verify the effect of settings on the waveform. Basic settings can also be made by calling up the Status screen and selecting the **[Status]** sheet.

Opening the Settings window



Press this key.

Settings window



```
---Measure---
AVERAGE CH1  -24.1874mV
    RMS CH1   1.22559 V
 P-PEAK CH1   3.49400 V
MAXIMUM CH1   1.72200 V
```

```
MEMORY
Trigger:
      Auto
         0%
Timebase:
   1ms/div
(  10µs/S)
        x1
( 1.000ms)

Shot     :
    100div
( 1.000 s)
```

(⇒ p.41)

Timebase setting (Sampling rate) (⇒ p.43)

Recording Length (Number of divisions) (⇒ p.46)

3.4.1 Measurement Function

Select the function according to the measurement and recording target.

Procedure

To open the screen: Press the DISP key → Waveform screen

Move the cursor to the function item (topmost field in the settings window).

Select

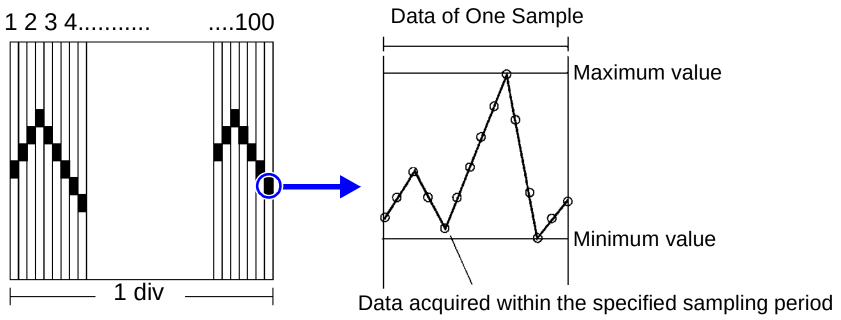
MEMORY (default setting)/ RECORDER/ X-Y RECORDER/ FFT

MEMORY	**This function is most suitable for oscilloscope-type measurements, such as instantaneous waveforms and transient phenomena.** Trigger functions and calculation functions can be used.
RECORDER	**This function is suitable for use instead of pen recorders and pen oscilloscopes, to record long-term fluctuations and create records for observing slow phenomena.** Real-time printing of data is possible.
X-Y RECORDER	**An endless X-Y waveform can be displayed.** Pen up/down operation as in an X-Y pen recorder is possible. See: "Chapter 4 X-Y Recorder Function" (⇒ p.59)
FFT	**Analyze the frequency.** **Various types of spectrum and octave analysis can be performed.** See: "Chapter 13 FFT Function" (⇒ p.207)

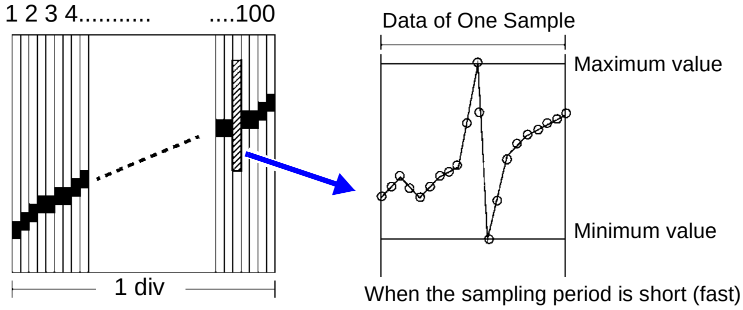
Description

Recorder Function Values

With the Recorder function, each data sample consists of the maximum and minimum values acquired in the specified sampling period. So each data sample has its own amplitude breadth.



When input waveform variation is slight, the difference between maximum and minimum values (breadth, or width) can be inordinately large if the sampling period is short and if severe fluctuations are present due to noise.
This phenomena may be prevented by setting a longer sampling period.

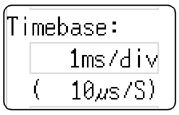


3.4.2 Time Axis Range and Sampling Rate

MEM **REC**

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.

(The setting is shown in brackets under the time axis range for the Memory function (see illustration at right). The indication changes with the time axis range.)



```
Timebase:
     1ms/div
(   10µs/S)
```

Procedure

To open the screen: Press the DISP key → Waveform screen

Memory Function case

1 Move the cursor to the **[Timebase]** item.

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

Select

5 (default setting), 10, 20, 50, 100, 200, 500 µs/div
1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div
1, 2, 5, 10, 30, 50 s/div, 1 min/div, 100 s/div
2, 5 min/div

To control sampling by an external signal, select **[External]**.
When external sampling is selected, the number of samples per division can be set in the range from 10 - 10000 S/div.

See: "16.2.3 External Sampling (EXT.SMPL)" (⇒ p.291)

Recorder Function case

1 Move the cursor to the **[Timebase]** item.

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

Select

10 (default setting), 20, 50, 100, 200, 500 ms/div
1, 2, 5, 10, 30, 50 s/div, 1 min/div, 100 s/div
2, 5, 10, 30 min/div, 1 h/div

3 Move the cursor to the **[Sampling]** item.

4 Set the sampling rate.

Select

1 (default setting), 10, 100 µs
1, 10, 100 ms
(Select a sampling rate less than 1/100 of the time axis)

The range of choices depends on the selected timebase.
The higher the sampling rate, the more detailed changes can be observed.

Description

Selecting the time axis range

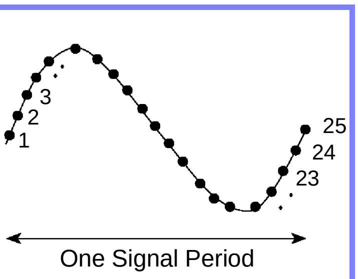
MEM

Refer to the table below when setting the time axis range.
For example, to measure a 100 kHz waveform, the maximum display frequency setting range according to the table is 200 kHz - 800 kHz. If the maximum display frequency is set to 400 kHz, setting the time axis range to 10 µs/div is recommended.

Timebase	Sampling Rate (Speed)	Maximum display frequency
5 µs/div	50 ns (20 MS/s)	800 kHz
10 µs/div	100 ns (10 MS/s)	400 kHz
20 µs/div	200 ns (5 MS/s)	200 kHz
50 µs/div	500 ns (2 MS/s)	80 kHz
100 µs/div	1 µs (1 MS/s)	40 kHz
200 µs/div	2 µs (500 kS/s)	20 kHz
500 µs/div	5 µs (200 kS/s)	8 kHz
1 ms/div	10 µs (100 kS/s)	4 kHz
2 ms/div	20 µs (50 kS/s)	2 kHz
5 ms/div	50 µs (20 kS/s)	800 Hz
10 ms/div	100 µs (10 kS/s)	400 Hz
20 ms/div	200 µs (5 kS/s)	200 Hz
50 ms/div	500 µs (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
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
1 min/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

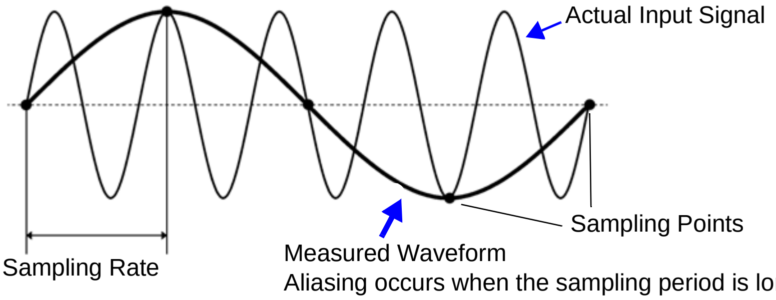
What is the maximum display frequency?

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.
Maximum display frequency is determined by the timebase.



What is aliasing (recording of non-existent waveforms)?

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.



Aliasing occurs when the sampling period is longer than half of the input signal period.

With the Memory function, 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.58) may be used to select the optimum timebase.

The sampling rate is automatically set to 1/100 of the selected time axis range.

To automatically set the time axis range

When you press the **AUTO** key, a suitable time range for the input signal is selected and measurement starts. (This applies only to the Memory Function.)

See: "3.7 Measurement With Automatic Range Setting (Auto-Ranging Function)" (⇒ p.58)

REC

- The timebase and sampling rate can be set independently. The sampling rate is selected depending on the timebase setting.
- When the following timebase values are selected, displayed waveforms are compressed in the horizontal (time axis) direction as shown.
  20 ms/div → x1/2
  10 ms/div → x1/5

To minimize noise during measurement

If the sampling rate is set too fast, when the input waveform amplitude is small, the difference between maximum and minimum values may become quite large as a result of sudden impulses such as noise. To prevent such phenomena, select a slower sampling rate or enable the input module's lowpass filter (⇒ p.52).

MEM **REC** Common

NOTE

The data refresh rate is not allowed to exceed the maximum sampling rate of the input module.

During the period when data are not updated, the same data are measured, resulting in a stair-shaped waveform. Even when the same signal is sampled simultaneously by two units, the data may differ due to differences in sampling rate, frequency bandwidth, and frequency response.

Data refresh rate for various units

Module	Max. time axis range	Max. sampling setting	See
8966	5 µs/div	50 ns (20 MS/s)	-
8967	Dependent on data refresh setting	Dependent on data refresh setting	See: "8.10.5"(⇒ p.145)
8968	100 µs/div	1 µs (1 MS/s)	-
8969	500 µs/div	5 µs (500 ks/s)	-
8970	Dependent on setting	Dependent on setting	See: "8.10.5"(⇒ p.145)
8971	100 µs/div	1 µs (1 MS/s)	See: "8.10.6"(⇒ p.148)
8972	Dependent on response setting	Dependent on response setting	See: "8.10.7"(⇒ p.149)
8973	5 µs/div	50 ns (20 MS/s)	-

3.4.3 Recording Length (number of divisions)

MEM REC

Set the length (number of divisions) to record each time data is acquired.

Procedure

To open the screen: Press the DISP key → Waveform screen

Memory Function case

1. Move the cursor to the **[Shot]** item.

2. Select the type.

Select

Fixd Shot	Select from a a range of preset values.
User Shot	Freely specify any value in 1-division units.

3. Set the recording length.

Select

(Fixed Shot)

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 div,
50000 div (2, 4, 8 channel mode),
100000 div (2, 4 channel mode),
200000 div (2 channel mode)

(User Shot)

1 to 40000 div (16 channel mode)
1 to 80000 div (8 channel mode)
1 to 160000 div (4 channel mode)
1 to 320000 div (2 channel mode)

Recorder Function case

1. Move the cursor to the **[Shot]** item.

2. Select the type.

Select

Fixd Shot	Select from a a range of preset values.
User Shot	Freely specify any value in 1-division units.

3. Set the recording length.

Select

(Fixed Shot)

Cont.	When **[On]** is selected, measurement is carried out while continuously overwriting data in memory. At the point where measurement is stopped, data for the preceding 20,000 divisions can be saved and printed again.
25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 div	

(User Shot)

1 to 20000 div

Description

MEM

Recording Length and Data Samples

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.

Recording Length and Number of Channels

The available recording length is subject to limitations depending on the number of channels as selected from Status screen - **[Status]** sheet - **[Used Ch]**.

See: "8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)

REC

Each recording length division = 100 pairs of data points, with each pair composed of two values: the maximum and minimum measured values within each sampling period.

When recording length is set to [Cont.]

- Data for up to 20,000 divisions from the end of measurement can be recorded in the internal memory of the unit.
- For range settings of 10 to 200 ms/div, when the printer setting (real-time print) is On, the real-time print is not performed. Perform printing manually after measurement is completed. (⇒ p.93)
- When Auto-saving is On, the saving is not performed during the measurement. At the forced shutdown point, the remaining data in memory will be saved.

To change recording length while measuring

Recording length can be changed on the Waveform screen.
The measurement will restart with the newly set recording length.

3.4.4 Screen Layout

MEM **REC**

You can specify the format in which the input signal is shown on the Waveform screen or printed out.

NOTE Selecting X-Y1 screen or X-Y4 screen allows waveform X-Y synthesis. (This applies to the Memory function and X-Y recorder function.)

See: "7.4 Performing Waveform X-Y Synthesis" (⇒ p.108)

Procedure

To open the screen: Press the STATUS key → [Status] sheet

Memory Function case

Move the cursor to the **[Format]** item.

Select

Single	Display and record using 1 graph. (default setting)
Dual	Display and record using 2 graphs.
Quad	Display and record using 4 graphs.
Oct	Display and record using 8 graphs.
XYSingle	Set input signal to X-Y and display and record the correlation using 1 graph.
XYQuad	Set input signal to X-Y and display and record the correlation using 4 graphs.

Recorder Function case

Move the cursor to the **[Format]** item.

Select

Single	Display and record using 1 graph. (default setting)
Dual	Display and record using 2 graphs.
Quad	Display and record using 4 graphs.
Oct	Display and record using 8 graphs.

Analog Channel Assignment

With 2, 4, or 8 screens, analog channels can be freely assigned to the respective graphs.

Procedure

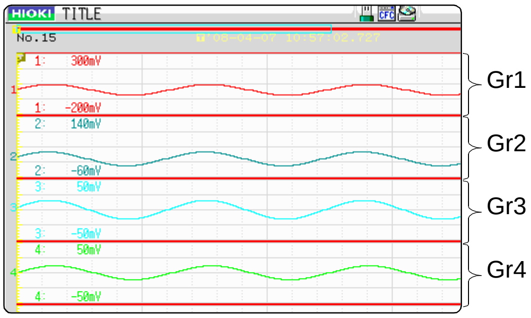
To open the screen: Press the CHAN key →[Unit List] sheet

1 Move the cursor to the **[Graph]** item.

2 Select the display screen for each channel.

The sequence is Gr1, Gr2, Gr3... from the top.

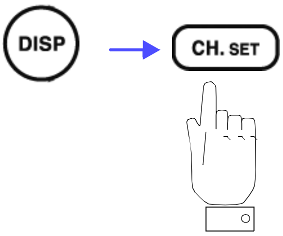
<Sample screen after setting>



3.5 Input Channel Setting

Set the analog channel and logic channel.

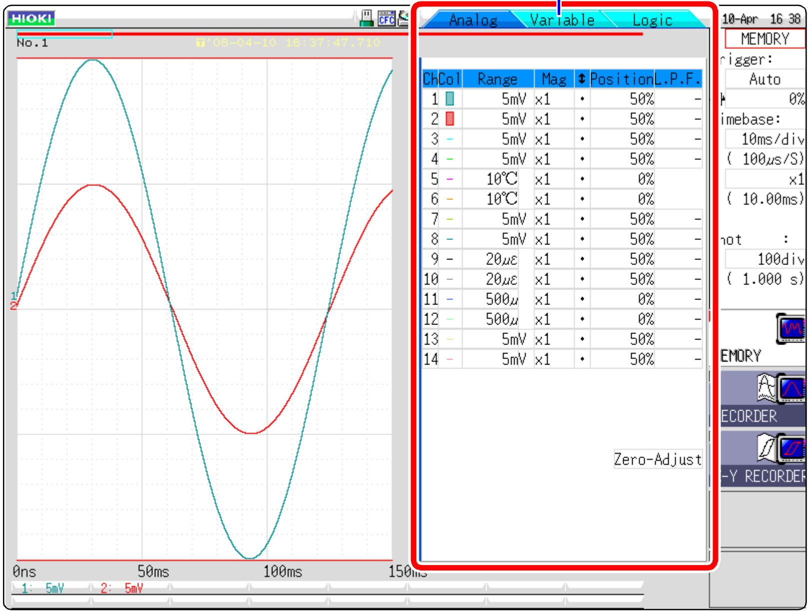
Opening the Channel settings window



Pressing **[CH.SET]** key repeatedly displays the various sheets.

[Analog]
↓
[Variable]
↓
[Logic]
↓
[WaveCalc]
(When [Wave Calculation] is [On].)
↓
No display

See: "Displaying All Channels for Making the Variable Function Setting" (⇒ p.135)



Ch	Col	Range	Mag	↕	Position	L.P.F.
1	▨	5mV	x1	•	50%	-
2	▨	5mV	x1	•	50%	-
3	-	5mV	x1	•	50%	-
4	-	5mV	x1	•	50%	-
5	-	10℃	x1	•	0%	
6	-	10℃	x1	•	0%	
7	-	5mV	x1	•	50%	-
8	-	5mV	x1	•	50%	-
9	-	20με	x1	•	50%	-
10	-	20με	x1	•	50%	-
11	-	500μ	x1	•	0%	-
12	-	500μ	x1	•	0%	-
13	-	5mV	x1	•	50%	-
14	-	5mV	x1	•	50%	-

To perform waveform interpolation

Set the waveform display color in the channel setting window to Off.

See: "1. Waveform Display Color" (⇒ p.52)

To make the recording length as long as possible

By limiting the number of channels that are used, more memory can be allocated to channels using storage memory.

See: "8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)

To copy the settings of one channel to another

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

3.5.1 Channel Setting Workflow

Explains the workflow to make settings for the analog channels (Ch1 - Ch16).

1 Select the channels to use (Memory function) only)

See:
"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)

2 Make input and screen display related settings

	See:
Select input coupling	"3. Coupling" (⇒ p.52)
Match range to measurement target input value (as necessary)	"2. Vertical axis (Voltage axis) Range" (⇒ p.52)
Convert input value (as necessary)	"8.5 Converting Input Values (Scaling Function)" (⇒ p.128)
Make filter settings (if noise occurs)	"7. Low-pass filtering" (⇒ p.54)
Fine-tune waveform amplitude (as necessary)	"5. Vernier" (⇒ p.53)
Set zoom on vertical axis (voltage axis) direction (as necessary)	"4. Vertical axis (Voltage axis) Zoom" (⇒ p.53)

3 Make trigger settings (as necessary)

See:
"Chapter 9 Trigger Settings" (⇒ p.151)

4 Make display color and display position settings

	See:
Set waveform display color	"1. Waveform Display Color" (⇒ p.52)
Set display position and scaling (as necessary)	"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)

4 Make graph display settings

	See:
For 1, 2, 4, 8 screens	"Analog Channel Assignment" (⇒ p.48)
For X-Y1, X-Y4 screens	Procedures "4" and “5” of "7.4 Performing Waveform X-Y Synthesis" (⇒ p.109)

NOTE

- If the number of channels in use is low, not all channels may be selectable.
- When input coupling is set to GND, the waveform will have no amplitude and range setting is not possible.
- Due to the influence of filter attenuation, correct range setting may sometimes not be possible.
- When making trigger settings, set the vertical axis (voltage axis) range first. If the range is changed after specifying the trigger, the trigger setting may change.
- When using the Variable function, set the vertical axis (voltage axis) range first. If the range is changed after specifying the Variable setting, observation with sufficient precision may not be possible.
- When using the Variable and Scaling functions together, make the Scaling settings first. If Scaling settings are made after selecting the Variable function, the intended display result may not be achieved.

The setting workflow for logic channels (standard LOGIC terminals L0A - L0D, expansion LOGIC terminals L1A - L8D) is explained below.

1 Make screen display related settings

Setting logic recording width

See:
"1. Logic Width" (⇒ p.55)

2 Make display color and display position settings

Set waveform display position

See:
"2. Waveform Display Position" (⇒ p.55)

Set waveform display color

"3. Waveform Display Color" (⇒ p.55)

NOTE

- Waveform display position can be specified in 1% increments.
- Not displayed for X-Y1 and X-Y4 screens.

3.5.2 Analog Channel

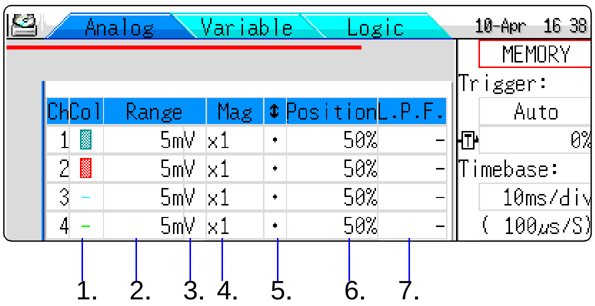
Set the analog channel.
For information on specific settings for 8967 Temp Unit, 8969 Strain Unit, and 8972 DC/RMS Unit, see "8.10"(⇒ p.140).

Procedure

To open the screen: Press the DISP key →Waveform screen →Press the CH.SET key →Channel settings window ([Analog] sheet)

1. Move the cursor to the channel for which to make settings.

2. Select settings with the **F** keys.



ChCol	Range	Mag	⇕	Position	L.P.F.
1 ▨	5mV	x1	•	50%	-
2 ▨	5mV	x1	•	50%	-
3 -	5mV	x1	•	50%	-
4 -	5mV	x1	•	50%	-

To copy the settings of one channel to another
See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

1. Waveform Display Color

Specifies the color in which the waveform of the selected channel is displayed. You can also select the same color as another channel.

Select

Off	The waveform is not displayed. If the Auto Save setting for **[Save Channel]** is **[Disp Ch]**, data for the channel will also not be saved. See: "Select the channel to save." (⇒ p.71)
On	The waveform is displayed. Select the color with the **F** keys **[↑]** and **[↓]**.
All On-Off	Switches the waveform display of all channels to all ON or all OFF

2. Vertical axis (Voltage axis) Range

Sets the vertical axis (voltage axis) range for each channel. The value set here is the voltage of one increment on the vertical axis.
For information on the full-scale value for the respective modules, see the table in the section "6. Zero Position" (⇒ p.53).
If the Variable function is set to On, the size of the waveform on screen will not change when the vertical axis (voltage axis) range is changed.

An over-range condition has occurred
Change the vertical axis (voltage axis) range to a lower sensitivity setting.

3. Coupling

Set the input signal coupling method. Normally, DC coupling should be selected.

Select

DC (V)	Both DC components and AC components of the input signal will be measured. (default setting)
AC (Ṽ)	Only AC components of the input signal will be measured. DC components are blocked.
GND (⏚)	Input is shorted to ground. (Allows checking the zero position.)

4. Vertical axis (Voltage axis) Zoom

Vertical axis (voltage axis) zoom-up or zoom-down settings can be made separately for each channel. The settings will be used for display and printout.

Zooming is carried out using the zero position as reference. The measurement resolution does not change.

See: "7.5.3 Magnifying and Compressing Vertical Axis (Voltage Axis)" (⇒ p.112)

To achieve a user-specified zoom setting, the Variable function is used. By reversing plus/minus, the waveform can be inverted.

See: "8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)
"8.8 Inverting the Waveform (Invert Function)" (⇒ p.138)

5. Vernier

Fine adjustment of input voltage can be performed arbitrarily on the Waveform screen (display only). When recording physical values such as noise, temperature and acceleration using sensors, amplitude can be adjusted to facilitate calibration.

See: "8.7 Fine Adjustment of Input Values (Vernier Function)" (⇒ p.137)

6. Zero Position

Sets the 0 V level display position. If the 0 V input level has shifted, perform zero-adjust.

See: "2.7 Adjusting the Zero Position (Zero-Adjust)" (⇒ p.36)

NOTE

- Only the display position is shifted. No offset is applied to the input.
- Vertical axis (voltage axis) zooming is performed using the zero position as reference.
- Zero position adjustment and vertical axis (voltage axis) zooming only change the voltage range as displayed on the Waveform screen. The actual measurement range does not change.

By using the zero position preset (Press the **F1 [Preset]**), the zero position of all channels can be changed at the same time.

Select

Ascending (10%→85%)	The zero position of Ch1 is set to 10% and the following channels up to Ch16 are increased by 5% each.
Descending (85%→10%)	The zero position of Ch1 is set to 85% and the following channels up to Ch16 are decreased by 5% each.
All Ch 0%	The zero position of all channels is set to 0%.
All Ch 50%	The zero position of all channels is set to 50%.

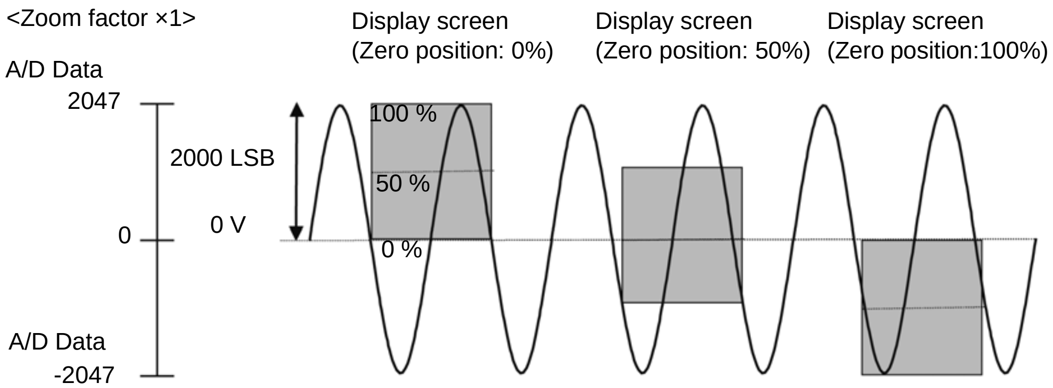
If the zero position of the 8969 Strain Unit is out of alignment, perform auto balance.

See: "8.10.4 Settings for the 8969 Strain Unit" (⇒ p.144)

NOTE

- Simply moving the display position will not apply an offset to the input.
- Zoom of the vertical axis direction (voltage axis) is based on the zero position.
- The voltage range displayed in the waveform screen changes with zero position and zoom of the vertical axis (voltage axis) but the measurable range does not change.

The zero position is as shown in the illustration below.
(Example: 8966 Analog Unit)



Full-scale resolution for input units at various vertical axis zoom factors (LSB)

Input module	Zoom factor									
	×1/10	×1/5	×1/2	×1	×2	×5	×10	×20	×50	×100
8966 (Analog) 8971 (Current) 8972 (DC/RMS)	20000 (4000)	10000 (4000)	4000	2000	1000	400	200	100	40	20
8967 (Temperature)*	200000	10000	40000	20000	10000	4000	2000	1000	400	200
8968 (High resolution)	320000 (64000)	160000 (64000)	64000	32000	16000	6400	3200	1600	640	320
8969 (Strain)	250000 (64000)	125000 (64000)	50000	25000	12500	5000	2500	1250	500	250
8970 (Power frequency)	20000	10000	4000	2000	1000	400	200	100	40	20
8970 (Count)	400000	200000	80000	40000	20000	8000	4000	2000	800	400
8970 (Excluding power frequency and count)	100000	50000	20000	10000	5000	2000	1000	500	200	100

Brackets indicate valid data range

*: With the 8967 Temp Unit, the valid range differs depending on the thermocouple. For information on the minimum resolution, see the specifications of the 8967 Temp Unit.

7. Low-pass filtering

Make settings for the low-pass filter of the input module. This is useful for eliminating unwanted high-frequency components. The filter type depends on the module. Make the setting according to the input characteristics.

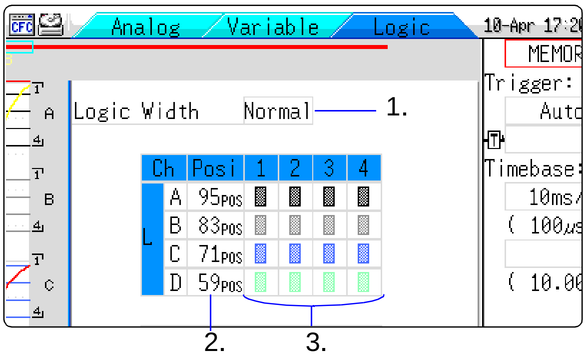
3.5.3 Logic Channel

Make settings for the logic channels. The channel settings window (Logic sheet) is shown when the display format is 1, 2, 4, or 8 screens.

Procedure

To open the screen: Press the DISP key →Waveform screen →Press the CH.SET key →Channel settings window ([Logic] sheet)

1. Move the cursor to the channel for which to make settings.
2. Select settings with the **F** keys.



Logic Width Normal

To copy the settings of one channel to another

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

1. Logic Width

Allows changing the display width of the logic waveform.
Making waveforms more narrow can enhance the readability of the display when there are a high number of waveforms.

Select

Wide	Make the waveform wider.
Normal	Display the waveform at normal width. (default setting)
Narrow	Make the waveform more narrow.

2. Waveform Display Position

Determines where on the screen the logic waveform is displayed.

The position can be freely moved within the range of the display.

3. Waveform Display Color

Specifies the color in which the waveform of the selected channel is displayed. You can also select the same color as another channel.
For logic modules, the color can be specified for each module and each channel separately.

Select

Off	The waveform is not displayed. If the **[Save Channel]** setting is **[Disp Ch]**, data for the channel will not be automatically saved. See: "5.2.2 Automatically Saving Waveforms" (⇒ p.69)
On	The waveform is displayed. Select the color with the **F** keys.
Probe On-Off	Switches the waveform display of the same probes to all ON or all OFF.
All On-Off	Switches the display of all logic waveforms to all ON or all OFF. This can be selected when the cursor at in the waveform display position item.

NOTE

When the standard logic display (LA, LB, LC, and LD) is on, the 8970 Freq Unit installed on unit 1 or 2 can no longer be used. Furthermore, the 16-bit resolution 8967 Temp Unit, 8968 High Resolution Unit and 8969 Strain Unit have a resolution of 12 bits.

3.6 Starting and Stopping Measurement

This section explains how to initiate and terminate a measurement.

Procedure

To open the screen: Press the DISP key →Waveform screen

Starting Measurement

Press the **START** key to start measuring.

NOTE

- When a measurement is started, waveform data that were displayed on the screen are cleared.
- Measurement can also be started by inputting a signal at the external control terminal.
  See:"Chapter 16 External Control" (⇒ p.287)

To prevent inadvertent measurement start
To reduce the risk of accidentally starting a measurement through an operation error, operation conditions can be set for the **START** key.
See: "Start Action" (⇒ p.257)

To automatically save data during measurement
See: "5.2.2 Automatically Saving Waveforms" (⇒ p.69)

To print the waveform
See: "Chapter 6 Printing" (⇒ p.89)

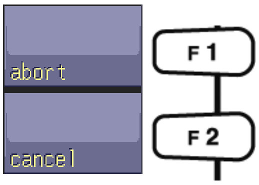
Stopping Measurement

Press the **STOP** key once, recording stops at the end of the specified recording length.
Press the **STOP** key again, recording stops immediately.

The operation conditions for the **START** key and **STOP** key can be changed.

See: "Chapter 14 System Environment Settings" (⇒ p.255)

Note When the **STOP** key is pressed, the following indication may appear on the screen.



The measurement will stop at the point where the key is pressed.
(Pressing the **STOP** key twice has the same effect.)

The stopping procedure is canceled and measurement continues.

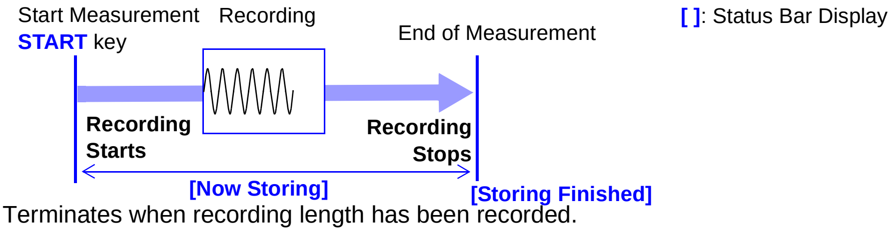
Measurement and Internal Operations

Measurement methods are normal measurement (start recording when measurement starts) and trigger measurement (start recording when trigger criteria 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.153)
- Enable pre-triggering if you want **to capture data measured prior to trigger events**.(⇒ p.166)

Normal Measurement

Without triggering

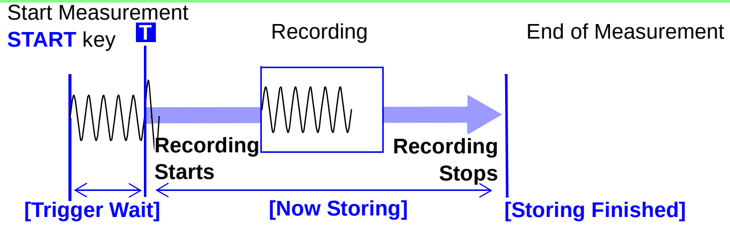


Terminates when recording length has been recorded.

Trigger Measurement

Trigger mode: **[Single]**
Pre-triggering not enabled

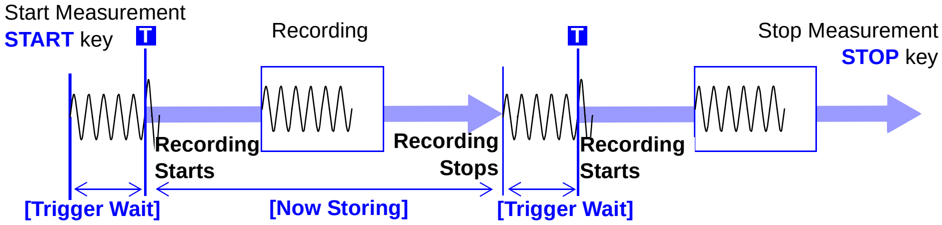
Single triggering



Recording starts when a trigger event occurs and continues for the specified recording length.

Trigger mode: **[Repeat]**
Pre-triggering not enabled

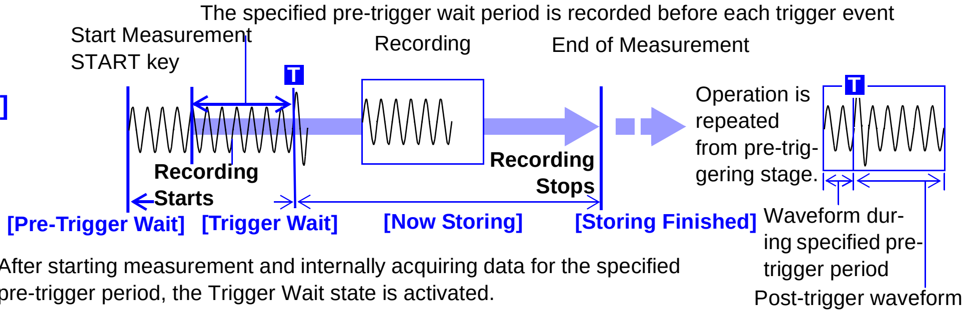
Repeated triggering



Recording starts when a trigger event occurs, continues for the specified recording length, and returns to the Trigger Wait state.

Trigger mode: **[Repeat]**
Pre-triggering enabled

Repeated triggering and recording of phenomena before each event



After starting measurement and internally acquiring data for the specified pre-trigger period, the Trigger Wait state is activated.

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

When the trigger mode is set to **[Repeat]** or **[Auto]** (Memory function only), the number of trigger events is shown in the top part of the screen (Storage Counter).

See: "Explanation of Screen Contents" (⇒ p.13)

3.7 Measurement With Automatic Range Setting (Auto-Ranging Function) MEM

This applies only to the Memory function and analog modules.

When you press the **AUTO** key after inputting a signal to an analog unit, and select **[Auto Range]**, the horizontal axis (time axis) range, vertical axis (voltage axis) range, and zero-adjust point will be set automatically for the input waveform, and measurement starts.
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
Low-pass filter	Off
Input coupling	DC

Trigger Criteria (one channel only)	
Trigger mode	Auto
Trigger source AND/OR	OR
Pre-Trigger	20%
Internal Trigger	Out of waveform display On channels, channel with lowest number only is On (next channel if difference between maximum and minimum value is 8 divisions or less).
Trigger type	Level trigger : Slope, Rising Trigger level : Auto setup value Filter : Off

Status screen - **[Status]** sheet Conditions	
Timebase	Auto setting value (time axis magnification ×1)

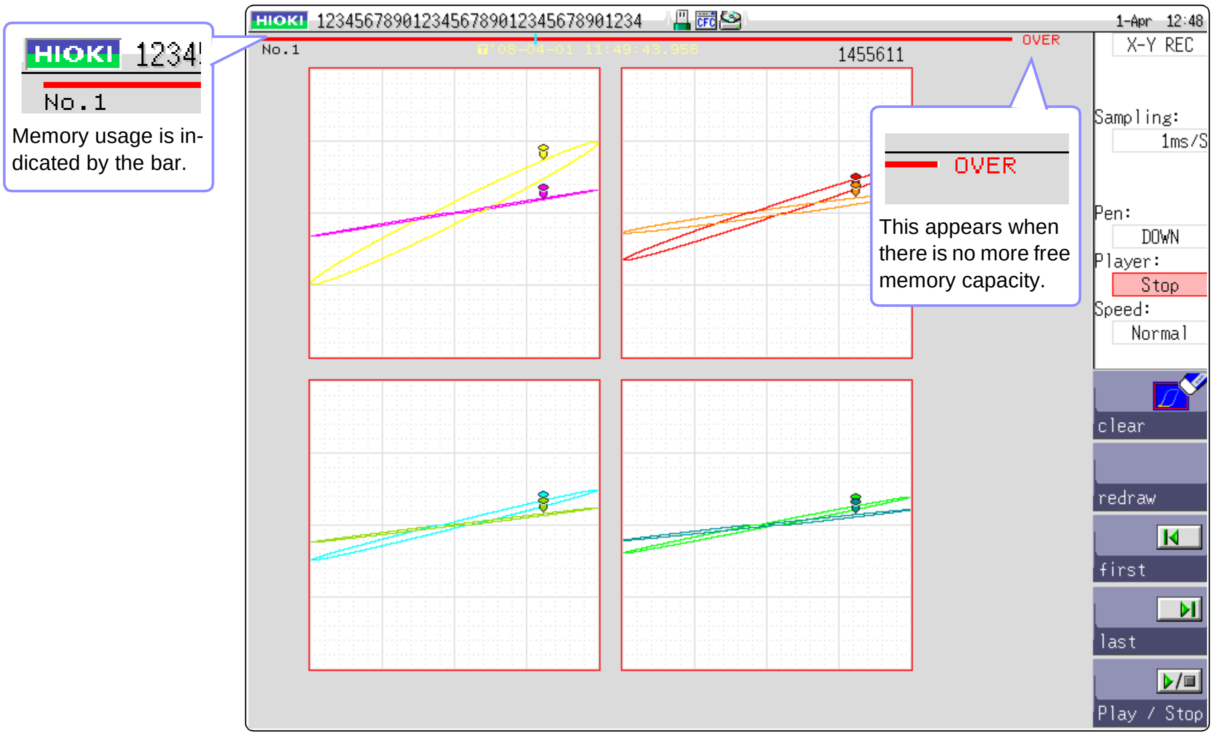
NOTE

- When measurement is started with the auto-ranging setting, the trigger output signal is output. Keep this in mind when performing auto-range measurement while using the trigger output terminal.
- The auto-ranging function automatically makes settings for the input signal that is present when the function is enabled. Start auto-ranging measurement after supplying the input signal (waveform).
- If the input signal of the lowest numbered channel selected for waveform display is extremely small, the time axis range will be set according to the input signal of the next lowest channel.
- If range could not be set for all waveform display On channels, a warning message appears and the measurement is interrupted.
- The Auto Save and Auto Print functions do not operate during auto-ranging.
- For low-frequency signals of less than 10 Hz, automatic setting is not possible. Make the required setting manually.
- Automatic setting is not possible for the following modules:
  8967 Temp Unit, 8969 Strain Unit, 8970 Freq Unit

X-Y Recorder Function X−Y Chapter 4

- The X-Y waveform generated from the input signal is displayed in real time.
- By saving the displayed data in memory, data can be stored as well as printed.
- X-Similar to an X-Y pen recorder, waveform drawing can be controlled by simulated pen up/down operation.
- Simultaneous observation of up to X-Y8 phenomena is possible.
- Because waveform information is stored in memory, settings can be changed after measurement for repeated synthesis.

X-Y recorder waveform screen example (X-Y4 screen)



Sampling: 1ms/S

Pen: DOWN

Player: Stop

Speed: Normal

Memory usage is indicated by the bar.

This appears when there is no more free memory capacity.

4.1 Measurement Workflow

1 Pre-Measurement Inspection

See:
"3.3 Pre-Measurement Inspection" (⇒ p.40)

2 Make basic settings for measurement

	See:
Select X-Y recorder as measurement function	"Function" (⇒ p.61)
Set sampling rate	"Sampling" (⇒ p.61)
Determine screen layout format	"Format" (⇒ p.61)
Determine whether to perform waveform interpolation	"Dots-Line (interpolation)" (⇒ p.61)
Determine whether to clear previous waveform data	"Disp Clear" (⇒ p.61)

3 Input Channel Settings

	See:
Make analog channel settings	"3.5.2 Analog Channel" (⇒ p.52)

Logic channels cannot be used.

Application examples

See:
"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)
"8.7 Fine Adjustment of Input Values (Vernier Function)" (⇒ p.137)
"8.1 Adding Comments" (⇒ p.118)
"8.5 Converting Input Values (Scaling Function)" (⇒ p.128)

4 Starting Measurement

See:
"4.3 Starting and Stopping Measurement" (⇒ p.62)
"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.102)

5 Stopping Measurement

See:
"4.3 Starting and Stopping Measurement" (⇒ p.62)
"4. Redrawing Waveforms" (⇒ p.62)
"5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)
"6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.93)

NOTE

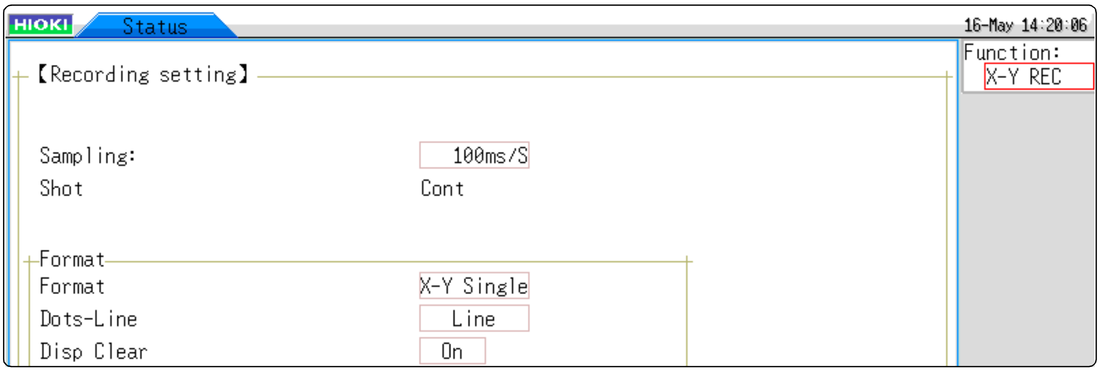
With the X-Y recorder function, the following operations are not available.

- Trigger setting
- Auto saving
- Auto printing

4.2 Setting Measurement Configuration

To set various measurement parameters, press the **STATUS** key to bring up the Status screen and select the **[Status]** sheet. (Settings for measurement function and sampling rate can also be made on the Waveform screen.)

Description of setting items



Function: X-Y REC

【Recording setting】

Sampling: 100ms/S
Shot Cont

Format
Format X-Y Single
Dots-Line Line
Disp Clear On

Function

Set the measurement function to X-Y recorder.

Sampling

Select the sampling rate.

1 ms / 10 ms / 100 ms (default setting)

NOTE

[1 ms] can be selected only when **[Dots]** is selected for **[Dots-Line]** item.

Format

Select the graph format for Waveform screen display or printout of the input signal. Up to 8 phenomena can be observed simultaneously.

X-Y Single	Waveform graphs from 1 up to 8 are displayed and recorded on one screen. (default setting)
X-Y Quad	Waveform graphs from 1 up to 8 are displayed and recorded on four screens.

Dots-Line
(interpolation)

Determines whether to display and print the input waveform (sampling data) as dots (sampling points) or perform linear interpolation. The dot display allows faster sampling.

Dots	Display and print sampling data as dots.
Line	Display and print sampling data using linear interpolation.(default setting)

Disp Clear

If past waveforms remain at the start of measurement, you can either clear or keep them. If you keep them, the new waveforms will be displayed as an overlay.

Off	Overlay on existing waveforms
On	Clear existing waveforms(default setting)

This completes the measurement configuration settings.
Next, make analog channel settings.
For details, see "3.5.2 Analog Channel" (⇒ p.52)

To set the channels for X-Y synthesis
See: "7.4 Performing Waveform X-Y Synthesis" (⇒ p.108)

4.3 Starting and Stopping Measurement

Press the **DISP** key to go to the Waveform screen.

1. Starting Measurement

Press the **START** key to start measuring.

2. Pen Up/Down Operation

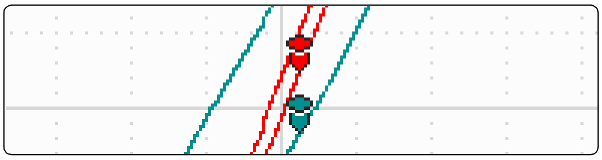
Make this setting either during or before measurement. When the pen is set to Down, the waveform is being drawn. When the pen is set to Up, the waveform is not drawn. This setting applies to all channels.

Move the cursor to the **[Pen]** item to make the setting.

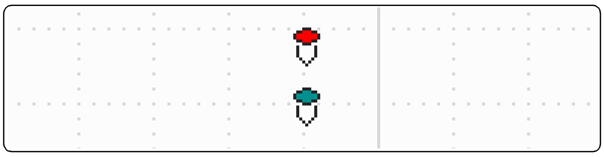
Select

Up	Waveform is not drawn.
Down	Waveform is drawn.

Up/Down operation is also possible using the **TRIG.SET** key or the manual trigger key.



Pen in Down position
Pen is shown in color and waveform is being drawn.



Pen in Up position
Pen is shown in white and waveform is not being drawn.

3. Stopping Measurement

Press the **STOP** key to stop measuring.

4. Redrawing Waveforms

When measurement is stopped, waveform data for up to 4,000,000 samples before the current point can be played back (redrawn) by the pen, similar to using a video recorder, starting from any specified point. This operation applies to all channels. The playback speed can be specified. (It can also be changed during playback.) Waveform is only playbacked on the screen and will not affect the printout data. To print the same waveforms as shown on the screen, use hard copy (⇒ p.98).

Move the cursor to the **[Player]** item.

Select

Clear	Clear only waveform display. (Waveform data are not cleared.)
Redraw	Redraw measurement data. Measurement settings can also be changed for redrawing.
First	Move pen to start of waveform.
Last	Move pen to end of waveform.
Play/Stop	Start/stop waveform playback.

Move the cursor to the **[Speed]** item.

With the **[Normal]** setting, playback occurs at the same speed as during recording.

Select

Very Fast/ Fast / Normal (default setting) / Slow / Very Slow

NOTE Measurement start/stop and pen up/down can be controlled via the external control terminal. (⇒ p.289)

Redrawing with different waveform display settings

- Also after clearing the waveform display, waveform data are still retained by the unit. This makes it possible to change settings for display format, display color, synthesis channels, channel zoom and offset before redrawing the waveform by selecting **[Redraw]**.
  When **[Redraw]** is executed, the screen and printout data will be renewed.
  (As long as **[Redraw]** is not run, the screen and print data are not refreshed, even if the setting is changed.)
- Using the Jog & Shuttle knobs for redrawing is also possible.

Jog	Move back and forth in the redrawing process in increments of 1 sample.
Shuttle	Move back and forth in the redrawing process at a speed corresponding to the rotation angle.

NOTE

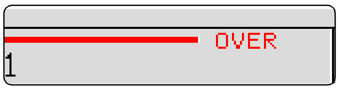
- When moving backwards, the waveform will be drawn in the direction towards earlier data. Erasing the waveform is not possible.
- If the measurement exceeds 4,000,000 samples, redrawing is possible only up to 4,000,000 samples in the past, counting backwards from the point where measurement was stopped. Earlier waveform data are lost.
- Redrawing with the jog-shuttle is only reflected on the screen and will not affect the printout data. To print the same waveforms as shown on the screen, use hard copy (⇒ p.98).

4.4 Waveform Observation

Waveform data for up to 4,000,000 samples are stored in memory, and an A/B cursor pair can be used to trace measurement values. (⇒ p.102)
The amount of memory used is indicated by the bar at the top of the screen.

NOTE

When the number of samples exceeds 4,000,000, the indication **[OVER]** appears at the top of the screen.



4.4.1 Saving and Printing Waveform

Saving

The **SAVE** key or the controls on the File screen can be used to save waveform data stored in memory as a file.

See: "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)

NOTE

Data stored in this way as a file can be loaded again into the instrument, but they cannot be read by a PC.

Printing

The **PRINT** key can be used to print out waveforms.

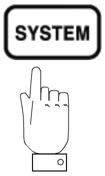
See: "6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.93)

Saving/Loading Data & Managing Files Chapter 5

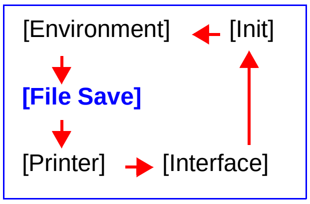
Data can be saved and loaded and files can be managed.

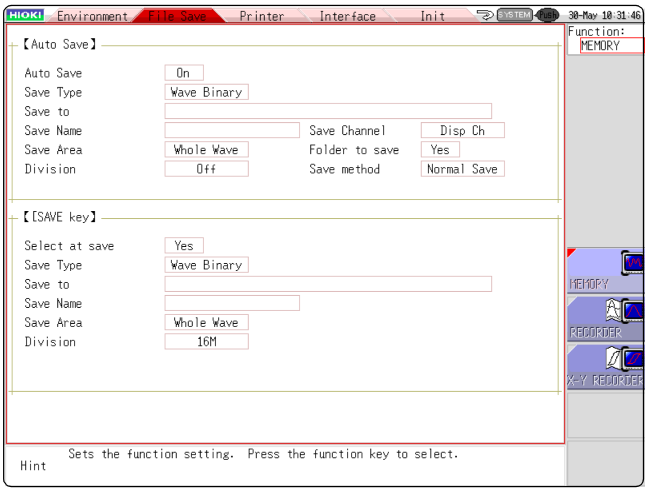
Before saving data, configure the save settings on the **[File Save]** sheet.
Load data and manage files from the File screen.

Opening the **[File Save]** sheet



Pressing this key repeatedly displays the various sheets.





Function: MEMORY

【Auto Save】

Auto Save: On
Save Type: Wave Binary
Save to:
Save Name:
Save Channel: Disp Ch
Save Area: Whole Wave
Folder to save: Yes
Division: Off
Save method: Normal Save

【[SAVE key】

Select at save: Yes
Save Type: Wave Binary
Save to:
Save Name:
Save Area: Whole Wave
Division: 16M

Hint: Sets the function setting. Press the function key to select.

Operations available from the **[File Save]** sheet

Saving Data (⇒ p.68)

Save Method
- Auto save
- Manual save by pressing the **SAVE** key
  (Selection save, Quick save)

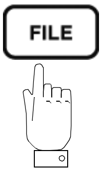
Save Types

(Auto Save)
- Waveform data

(Manual save by pressing the **SAVE** key)
- Settings data
- Waveform data
- Display screens
- Waveform screen
- Numerical calculation results (⇒ p.183)

Saving an Auto Settings file (⇒ p.79)

Opening the File screen



The file order will be displayed.

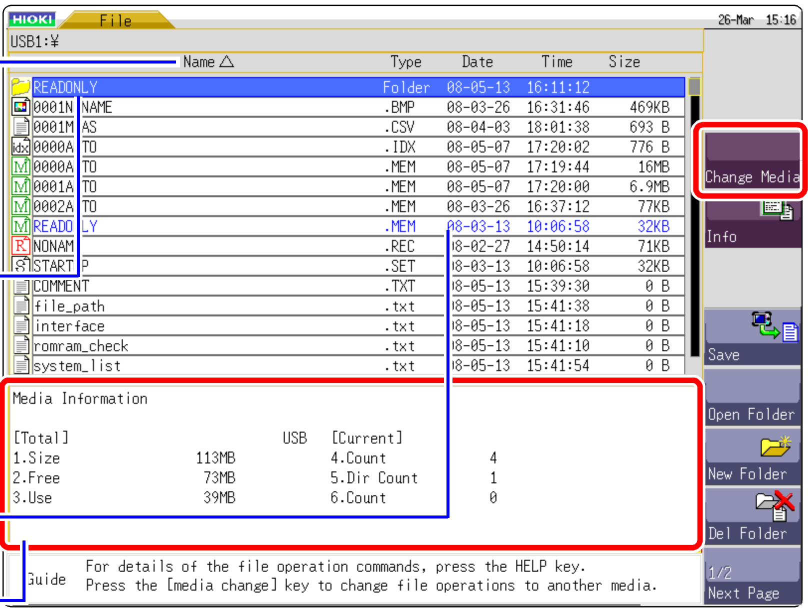
△: Ascending order
▽: Descending order

Press this key.

The selected file is indicated by a flashing cursor.

Use the **CURSOR** keys ◁ ▷ to move between folder levels.
Use the **CURSOR** keys △ ▽ to select a file.

Read-only files and folders are shown in blue. Deleting or renaming such files is not possible.

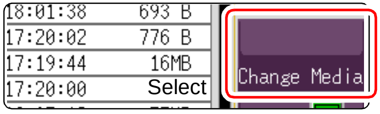

```
HIOKI  File                                               26-Mar  15:16
USB1:¥
                      Name △            Type    Date      Time      Size
READONLY                                Folder  08-05-13  16:11:12
0001N NAME                              .BMP    08-03-26  16:31:46  469KB
0001M AS                                .CSV    08-04-03  18:01:38  693 B
0000A TO                                .IDX    08-05-07  17:20:02  776 B
0000A TO                                .MEM    08-05-07  17:19:44   16MB
0001A TO                                .MEM    08-05-07  17:20:00  6.9MB
0002A TO                                .MEM    08-03-26  16:37:12   77KB
READO LY                                .MEM    08-03-13  10:06:58   32KB
NONAM                                   .REC    8-02-27   14:50:14   71KB
START P                                 .SET    8-03-13   10:06:58   32KB
COMMENT                                 .TXT    8-05-13   15:39:30    0 B
file_path                               .txt    8-05-13   15:41:38    0 B
interface                               .txt    8-05-13   15:41:18    0 B
romram_check                            .txt    8-05-13   15:41:10    0 B
system_list                             .txt    8-05-13   15:41:54    0 B

Media Information

[Total]                 USB   [Current]
1.Size           113MB        4.Count          4
2.Free            73MB        5.Dir Count      1
3.Use             39MB        6.Count          0

Guide  For details of the file operation commands, press the HELP key.
       Press the [media change] key to change file operations to another media.
```

Media information

Shows information about the selected media.

4. Count	:Shows the number of saved files in the selected folder level.
5. Dir Count	:Shows the number of folders in the selected folder level.
6. Count	:Shows the number of files and folders that can be created in the selected folder level.

To change the media


```
18:01:38   693 B
17:20:02   776 B
17:19:44    16MB
17:20:00  Select
```

1 Verify that a storage media is inserted.

See: "2.3 Recording Media Preparation" (⇒ p.28)

2 Select **[Change Media]** and select a storage media.

The files on the selected storage media are shown in the file list.

NOTE In the file screen, when Media is not displayed and operation cannot be carried out, set **[USB Set]** to other settings except for **[Mass Storage]**.

Operations available from the File screen

Formatting Storage Media (⇒ p.30)

Loading Data (⇒ p.77)

Saving/loading an Auto Settings file (⇒ p.79)

Managing Files (⇒ p.68)

- Saving data(⇒ p.81)
- Creating new folders (⇒ p.83)
- Copying files (⇒ p.86)
- Sorting files (⇒ p.85)
- Deleting files (⇒ p.84)
- Renaming files (⇒ p.85)
- Printing the File List(⇒ p.87)

5.1 Data capable of Being Saved & Loaded

The following kinds of data can be saved by and loaded into the instrument.

Data the Instrument Can Save & Load

O: Possible/ -: Not Possible

File Type	File Format	Indication	File Extension & Description		Save		Load	PC Readable
					Auto	Manual		
Settings Data[*1]	Binary	S	SET	Settings data (Measurement Configuration)	-	O	O	-
Waveform Data[*2] Whole of the waveform acquired by the instrument or a section of the waveform specified with the A and B cursors.	Binary	M	MEM	Memory Function waveform data	O	O	O	-[*4]
		R	REC	Recorder Function waveform data	O	O	O	-[*4]
		XY	XYC	X-Y Recorder Function waveform data	-	O	O	-
		F	FFT	FFT Function data	O	O	O	-
	Text	📄	CSV	Text Data	O	O	-	O
Waveform Management Data[*3] (Divided Saving)	(Index file)	idx	IDX	Index data for divided saving	O	O	O	-
		SEQ	SEQ	Index data for memory division (automatically created during batch saving)	O	O	O	-
Captured Screen Image (Display/Waveform screens)	BMP[*5]	🖼	BMP	Image Data	-	O	-	O
Numerical Calculation Results	Text	📄	CSV	Text Data	O	O	-	O
Comment for Printing	Text	📄	TXT	Text Data	-	-	O[*6]	O

*1: Multiple data can be saved in the instrument, and loaded selectively. Automatic loading at power-on is also possible. (⇒ p.79)

*2: When the data is to be reloaded on the instrument, save it in binary format. Waveforms and some measurement settings are saved.
When the data is to be loaded on a PC, save it in text format. (⇒ p.68)
When saving a section of a waveform, use the A and B cursors to set the section. (⇒ p.102), (⇒ p.105)

*3: When you want to use memory division and load all blocks at the same time:
Save measurement data using **[All blocks]**. A directory is automatically created and waveform data for each block and index data (SEQ) is created. When loading, load this index data.
When loading waveform data of divided saving: Import the IDX index data.

*4: Loading is possible with the Wave Viewer (Wv).

*5: This is a standard Windows graphics format. File in this format can be handled by many graphics programs.

*6: It is possible to print out the text file created by a PC together with loaded waveforms. Other processing operations are not available.

? : File type cannot be handled by 8847.

NOTE Files larger than 2 GB cannot be saved.

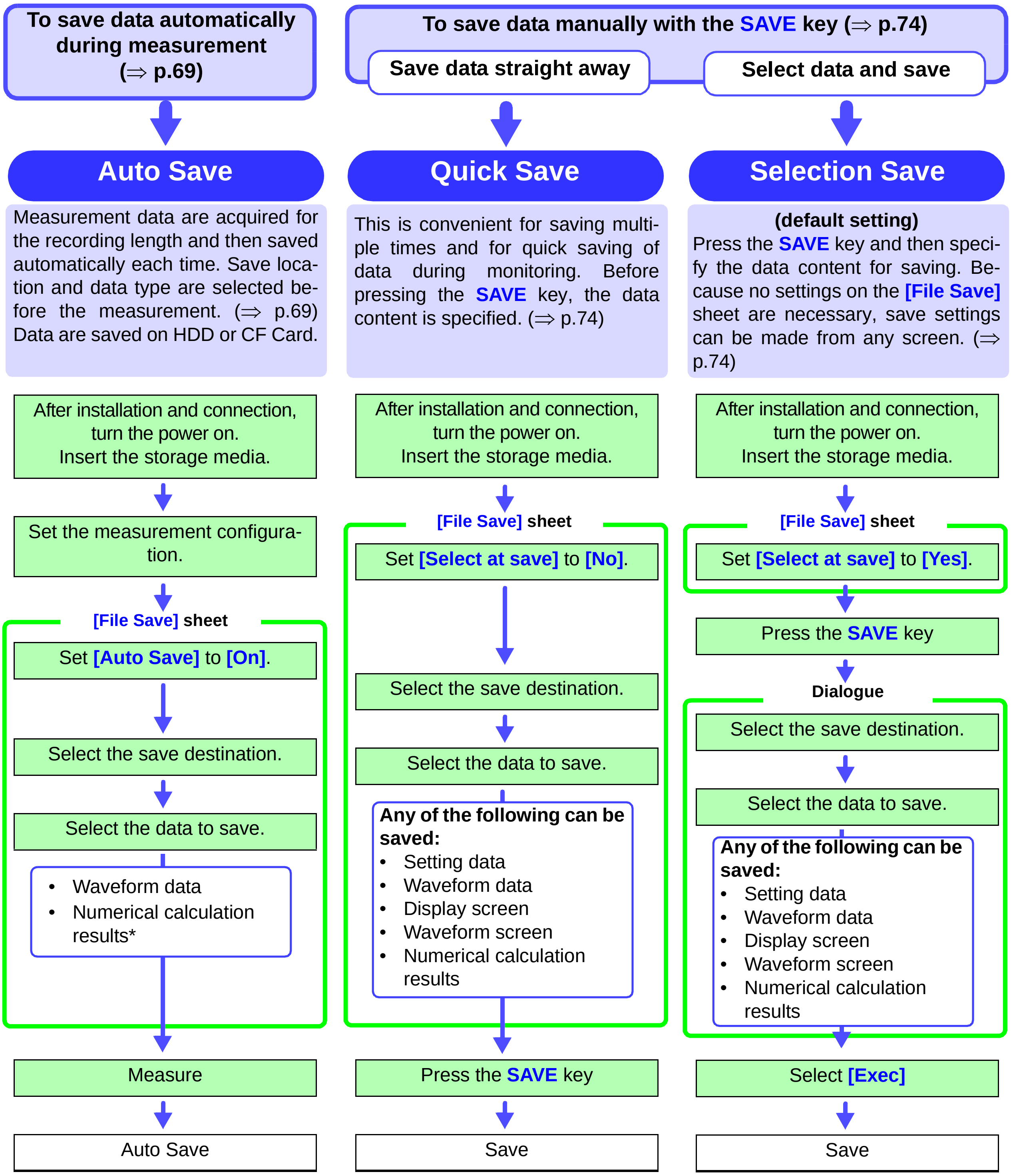
Data Not Loadable on the Instrument

- Data saved on devices other than the 8847 Memory HiCorder.
- Image file (🖼)
- ? file

5.2 Saving Data

5.2.1 Save Types and Workflow

There are basically three types of save operations.



To save data automatically during measurement (⇒ p.69)

Auto Save

Measurement data are acquired for the recording length and then saved automatically each time. Save location and data type are selected before the measurement. (⇒ p.69) Data are saved on HDD or CF Card.

After installation and connection, turn the power on.
Insert the storage media.

Set the measurement configuration.

[File Save] sheet

Set **[Auto Save]** to **[On]**.

Select the save destination.

Select the data to save.

- Waveform data
- Numerical calculation results*

Measure

Auto Save

To save data manually with the SAVE key (⇒ p.74)

Save data straight away

Quick Save

This is convenient for saving multiple times and for quick saving of data during monitoring. Before pressing the **SAVE** key, the data content is specified. (⇒ p.74)

After installation and connection, turn the power on.
Insert the storage media.

[File Save] sheet

Set **[Select at save]** to **[No]**.

Select the save destination.

Select the data to save.

Any of the following can be saved:
- Setting data
- Waveform data
- Display screen
- Waveform screen
- Numerical calculation results

Press the **SAVE** key

Save

Select data and save

Selection Save

(default setting)
Press the **SAVE** key and then specify the data content for saving. Because no settings on the **[File Save]** sheet are necessary, save settings can be made from any screen. (⇒ p.74)

After installation and connection, turn the power on.
Insert the storage media.

[File Save] sheet

Set **[Select at save]** to **[Yes]**.

Press the **SAVE** key

Dialogue

Select the save destination.

Select the data to save.

Any of the following can be saved:
- Setting data
- Waveform data
- Display screen
- Waveform screen
- Numerical calculation results

Select **[Exec]**

Save

Check points before saving:
- Media inserted and initialized? (⇒ p.28), (⇒ p.30)
- Save target specified correctly?
- Auto Save set to **[On]**? (For auto-saving)

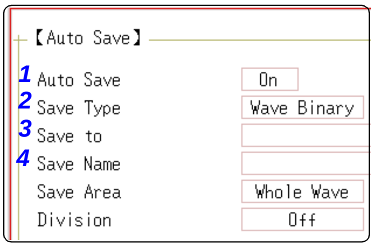
***: To save numerical calculation results**
See: "10.4 Saving Numerical Calculation Results" (⇒ p.183)

5.2.2 Automatically Saving Waveforms

Measurement data are acquired for the recording length and then saved automatically each time. Save location and data type are selected before the measurement.
Waveform data can be saved.

Procedure

To open the screen: Press the SYSTEM key → [File Save] sheet



【Auto Save】

1 Auto Save On
2 Save Type Wave Binary
3 Save to
4 Save Name
Save Area Whole Wave
Division Off

1 **Enable auto save.**

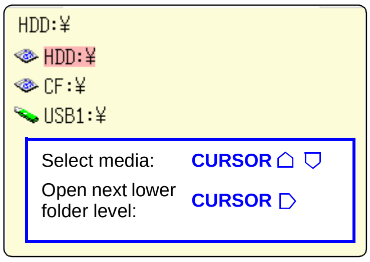
Move the cursor to the **[Auto Save]** item, and select **[On]**.
Default setting: Off (automatic saving is not performed)

2 **Set the save type.**

Move the cursor to the **[Save Type]** item.

Select

Wave Binary	Save the waveform data in binary format. (Data saved in binary format can only be loaded to this instrument.)
Wave Text	Save the waveform data in text format. The data can be thinned out and then saved. (This data can be opened by a computer editor or spreadsheet software, but it cannot be loaded to this unit.)



HDD:¥
HDD:¥
CF:¥
USB1:¥

Select media: CURSOR ⌂ ⌂
Open next lower folder level: CURSOR ▷

3 **Set the save destination.**

Move the cursor to the **[Save To]**, and select **[Edit]**.
The Browse folders dialog box appears (at bottom right).

Move the cursor to the save target media* and confirm the setting with **[Confirm]**.

When the root directory (topmost folder on media) was selected, a folder named "**HIOKI8847**" is created automatically. (If the media was initialized in the instrument, the folder will already have been created.) This folder is then used as save target.

To create a new folder, select **[New Folder]**.

***: Save target media**

When Auto Save is used, only HDD and CF Card can be used as save target media.

4 **Set the file name.**

Move the cursor to the **[Save Name]**, and enter the save name.
See: "8.1.3 Alphanumeric Input" (⇒ p.121)

NOTE

File name

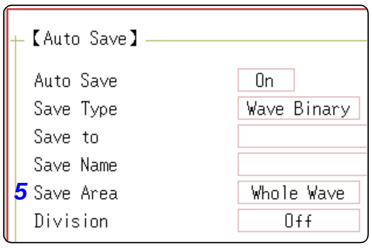
The maximum number of characters for the **[Save Name]** string is 123. The maximum path length including file name is 255 characters.

5 Select the save area.

Move the cursor to the **[Save Area]** item.

Select

Whole Wave	Save all recorded data. (default setting)
A-B Wave	Save the data between the A and B cursors. If only the A cursor is used, the range from the A cursor position to the end of the data is saved. A/B cursor Specification Method (⇒ p.102)


【Auto Save】
Auto Save On
Save Type Wave Binary
Save to
Save Name
5 Save Area Whole Wave
Division Off

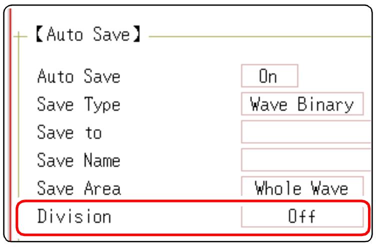
6 (When [Wave Binary] is the selected save type)

Select whether to save divided files

Move the cursor to the **[Division]** item.

Select

Off	Files are not divided when saved.
16M, 32M	Select the size for divided save.


【Auto Save】
Auto Save On
Save Type Wave Binary
Save to
Save Name
Save Area Whole Wave
Division Off

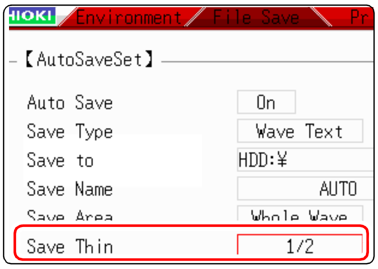
(When [Wave Text] is selected as the save type)

Set the data thinning number.

Move the cursor to the **[Save Thin]** item.

Select

Off	Data thinning (sub-sampling) is not carried out.
1/2 to 1/1000	Set the thinning number (out of how many data items to leave one data item remaining).



【AutoSaveSet】
Auto Save On
Save Type Wave Text
Save to HDD:¥
Save Name AUTO
Save Area Whole Wave
Save Thin 1/2

NOTE

About divided saving

- Large quantities of waveform data can be divided and saved as multiple files.
- Saving divided data makes a folder automatically, and creates one or more waveform files and an index (IDX) file in the folder.
- Then by loading the IDX file, the data in the waveform file(s) is loaded as a batch.
- When divided saving is selected, delete save is not available.
- When using the memory division function, divided saving cannot be performed automatically.

See: "Batch load of waveform data" (⇒ p.78)
"Chapter 12 Memory Division Function" (⇒ p.201)

Thinning

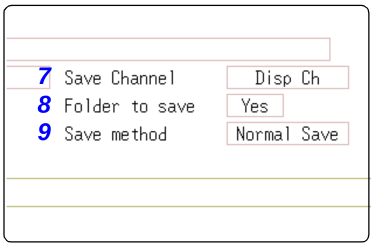
A large amount of space is required for saving files in text format. Data thinning enables a reduction in file size.
Example: When **[1/2]** is set, every second data item is saved. The number of data items is reduced to a 1/2.

7 Select the channel to save.

Move the cursor to the **[Save Channel]** item.

Select

Disp Ch	Saves the channels of all sheets for which waveform display is set to **[On]**. (default setting)
All Ch	Saves all measured channels (in the case of the memory function, channels has been set as **[Used Ch]** on the Status settings screen).



7 Save Channel Disp Ch

8 Folder to save Yes

9 Save method Normal Save

8 Set whether to create folders.

Move the cursor to the **[Folder to save]** item.

Select

No	A folder is not created when measurement starts.
Yes	A folder is created automatically when measurement starts and files are saved in the folder.

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

Move the cursor to the **[Save method]** item.

Select

Normal Save	Automatic saving stops when the storage media becomes full.
Delete Save	Old files are deleted and automatic saving is performed when the storage media becomes full. (Waveform files only.) The **[Folder to save]** setting is set automatically to **[Yes]**.

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

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

NOTE

Maximum number of files per folder

The combined maximum for files and folders created in one folder is 5,000.

See: "Auto Save Operations" (⇒ p.72)

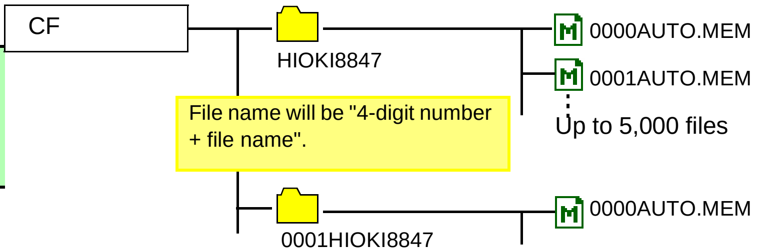
To clear the Auto Save dialog box

Press the **SAVE** key to turn the dialog box display on and off.

Auto Save Operations

Example 1: Saving Files to the Topmost Directory of the Storage Media (A folder named "HIOKI8847" is created and file is saved there)

Save To:	CF:\HIOKI8847
Save method:	Normal Save
Folder to save:	No



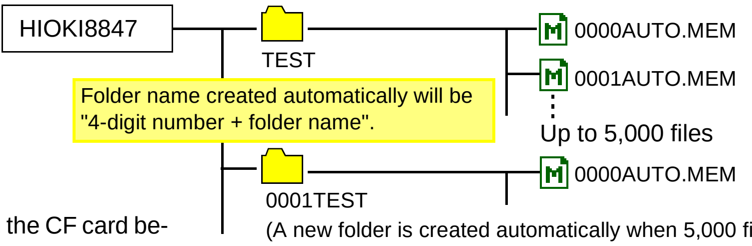
File name will be "4-digit number + file name".

(A new folder is created automatically when 5,000 files have been saved in the HIOKI8847 folder.)

When the storage media becomes full:
Automatic saving stops.

Example 2: Saving Files to a Folder on Storage Media

Save To:	CF:\HIOKI8847\TEST
Save method:	Normal Save
Folder to save:	No



Folder name created automatically will be "4-digit number + folder name".

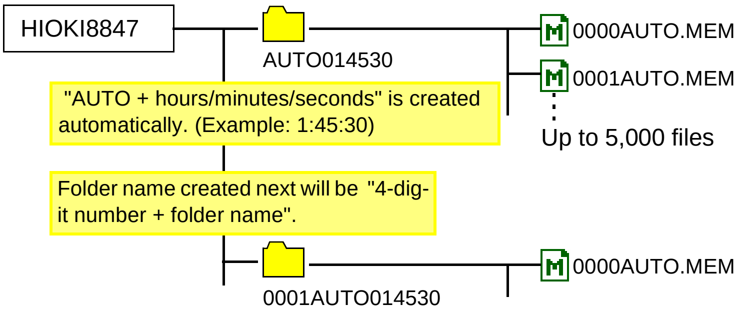
(A new folder is created automatically when 5,000 files have been saved in the TEST folder.)

Create a folder named "TEST" on the CF card beforehand.)

When the storage media becomes full: Automatic saving stops.

Example 3: Create folder on media automatically and save data there

Save To:	CF:\HIOKI8847
Save method:	Normal Save
Folder to save:	Yes



"AUTO + hours/minutes/seconds" is created automatically. (Example: 1:45:30)

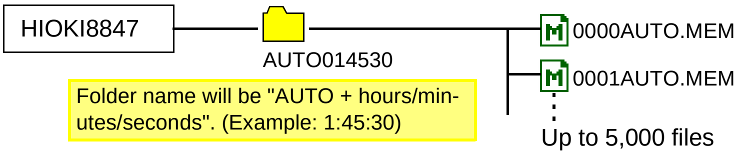
Folder name created next will be "4-digit number + folder name".

(A new folder is created automatically when 5,000 files have been saved in the AUTO014530 folder.)

When the storage media becomes full:
Automatic saving stop.

Example 4: Using Delete/Save to Automatically Save Data

Save To:	CF:\HIOKI8847 or specified folder in "HIOKI8847" folder
Save method:	Delete Save
Folder to save:	No



Folder name will be "AUTO + hours/minutes/seconds". (Example: 1:45:30)

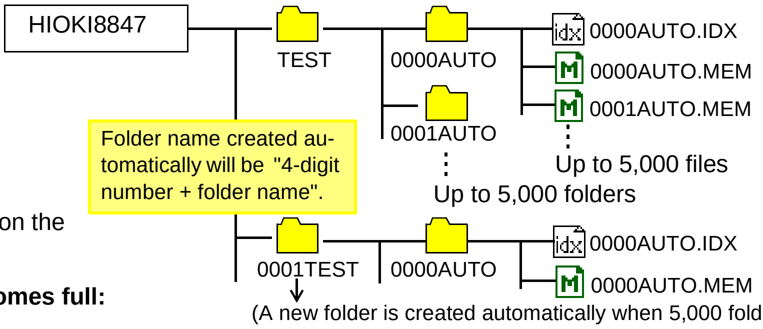
When the number of files in the folder has reached 5,000, or when the storage media has become full, files in the AUTO014530 folder (or specified folder) will automatically be deleted in sequence, starting from the oldest file, and replaced by new files. (Only waveform files are deleted.)

Example 5: Saving data in an existing folder on the media using divided saving

Save To:	CF:\HIOKI8847\TEST
Save method:	Normal Save
Folder to save:	No

Create a folder named "TEST" on the CF card beforehand.)

When the storage media becomes full:
Automatic saving stops.



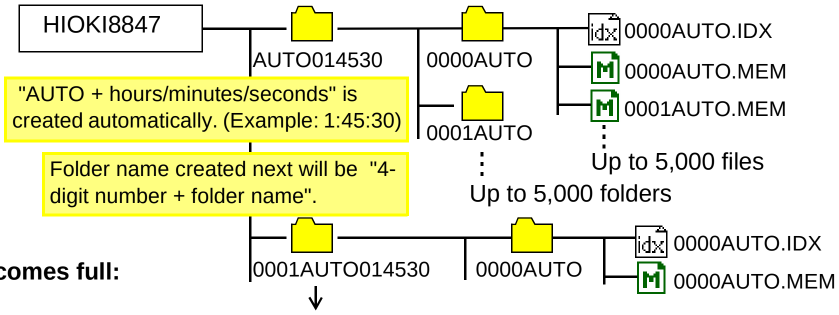
Folder name created automatically will be "4-digit number + folder name".

(A new folder is created automatically when 5,000 folders have been saved in the TEST folder.)

Example 6: Saving data in an automatically created folder on the media using divided saving

Save To:	CF:\HIOKI8847
Save method:	Normal Save
Folder to save:	Yes

When the storage media becomes full:
Automatic saving stop.



"AUTO + hours/minutes/seconds" is created automatically. (Example: 1:45:30)

Folder name created next will be "4-digit number + folder name".

(A new folder is created automatically when 5,000 folders have been saved in the 0001AUTO folder.)

5.2.3 Saving Data Selectively (SAVE Key)

To use the **SAVE** key for quick saving, the saving conditions have to be set beforehand. The type of data to be saved are as following. (Settings data, waveform data, display screens, waveform screen, numerical calculation results)

Procedure

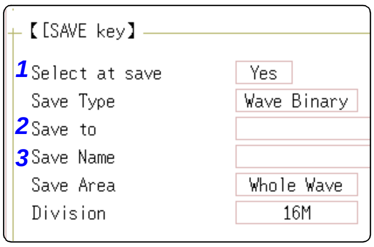
To open the screen: Press the SYSTEM key → [File Save] sheet

1 **Set the save method for when the SAVE key is pressed.**

Move the cursor to the **[Select at save]** item, and select **[No]**.

Select

Yes	After pressing the **SAVE** key, set the data to save in the dialog box, then save the data. (default setting) See: "Selection Save" (⇒ p.68)
No	The preset data is saved upon pressing the **SAVE** key. See: "Quick Save" (⇒ p.68)



【SAVE key】

1 Select at save Yes

Save Type Wave Binary

2 Save to

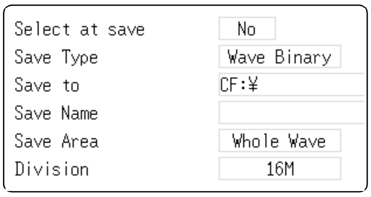
3 Save Name

Save Area Whole Wave

Division 16M

When **[Yes]** is selected, the following setting determines which dialog box appears when pressing the **SAVE** key. (Middle screen at right)

However, this is not applicable when other dialogs such as “Folder Reference Dialog” are shown on the screen.



Select at save No

Save Type Wave Binary

Save to CF:¥

Save Name

Save Area Whole Wave

Division 16M

2 **Set the save destination.**

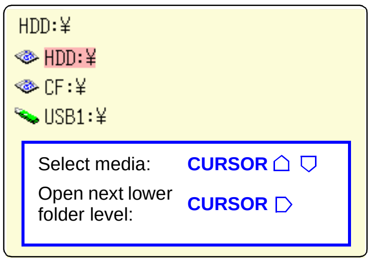
Move the cursor to the **[Save To]**, and select **[Edit]**.

The Browse folders dialog box appears (at bottom right).

Move the cursor to the save target media* and confirm the setting with **[Confirm]**.

When the root directory (topmost folder on media) was selected, a folder named "**HIOKI8847**" is created automatically. (If the media was initialized in the instrument, the folder will already have been created.) This folder is then used as save target.

To create a new folder, select **[New Folder]**.



HDD:¥

HDD:¥

CF:¥

USB1:¥

Select media: CURSOR △ ▽

Open next lower folder level: CURSOR ▷

3 **Set the file name.**

Move the cursor to the **[Save Name]**, and enter a save name.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

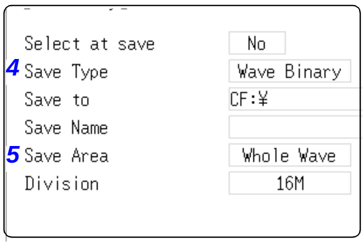
NOTE

File Name

The maximum number of characters for the **[Save Name]** string is 123. The maximum path length including file name is 255 characters.

4 Set the data to save.

Move the cursor to the **[Save Type]** item.



Select at save No
4 Save Type Wave Binary
Save to CF:¥
Save Name
5 Save Area Whole Wave
Division 16M

Select

Set	Save the settings data.
Wave Binary	Save waveform data in binary format. Select this to reload the waveform into the instrument.
Wave Text	Save waveform data in text format. Select this to use the waveform in a PC. (Memory/Recorder Function only)
ALL-Wave Bin	Data of all blocks is saved in binary format. (Only when the memory division setting is On.)
ALL-Wave Txt	Data of all blocks is saved in text format. (When the memory division setting is On)
Screen Copy	Save screen display data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
Wave Image	Save printer output data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
Calc Result	Save the numerical calculation results. (Memory Function only)

5 (When Wave Binary or Wave Text was selected)
Set the save area.

Move the cursor to the **[Save Area]** item.

Select

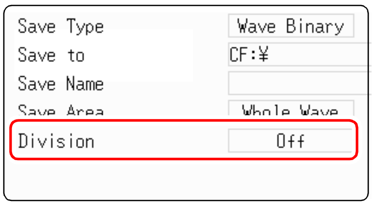
Whole Wave	Save all recorded data.(default setting)
A-B Wave	Data between the A/B cursor pair are saved. If only cursor A is used, all data after the cursor are saved. (A/B Cursor Specification Method (⇒ p.105))

The channel displayed on the screen will be saved.

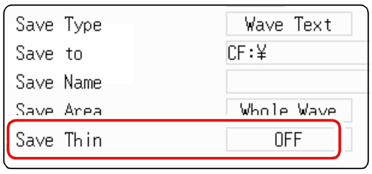
6 Making advanced settings

Available settings will differ, depending on the save type. Refer to the table below.

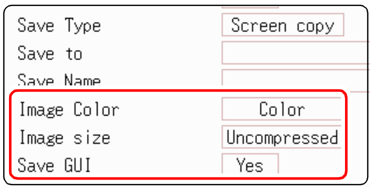
Save Type	Settings	Description
Setting	-	-
Wave Binary	**Division**	**(Off, 16 M, 32 M)** Select this to divide a large file into several files for saving. A folder with the specified name is created and data are saved as multiple files in that folder.
Wave Text	**Save Thin**	**(Off, 1/2 to 1/1000)** Select this to use thinning (sub-sampling) when saving data. Only a specified subset (one out of several data) is retained.
Screen Copy (Hard copy of the display)	**Image Color**	**(Color, Gray, Mono, Mono (Rev))** Specifies the color for the created image file.
	Image size	**(UnCompressed, Compressed)** Determines whether the image file is compressed.
	Save GUI	**(Yes, No)** Determines whether the GUI section is also saved.
Wave Image (Print Image)	**Output File**	**(All, 1 to 250)** Specifies the number of files to save. To specify a range, open the **[Printer]** sheet from the System screen and set the printing area to **[A-B Wave]**. (Memory/Recorder Function only)
	Wave Image Shot	**(1 to 60 div)** Specifies the data volume per file. If the number of measurement data is lower than the number of selected divisions, only the number of measurement data will be saved. (Memory/Recorder Function only)
Calc Result	**Folder to save**	**(New File, Existing File)** Determines whether data are saved under a new file name every time (with automatically incremented number if the same file name exists), or appended to the same file.



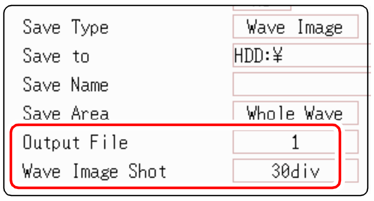
Save Type	Wave Binary
Save to	CF:¥
Save Name	
Save Area	Whole Wave
Division	Off



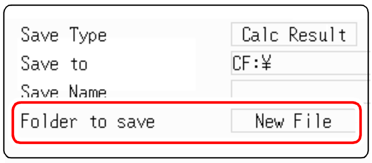
Save Type	Wave Text
Save to	CF:¥
Save Name	
Save Area	Whole Wave
Save Thin	OFF



Save Type	Screen copy
Save to	
Save Name	
Image Color	Color
Image size	Uncompressed
Save GUI	Yes



Save Type	Wave Image
Save to	HDD:¥
Save Name	
Save Area	Whole Wave
Output File	1
Wave Image Shot	30div



Save Type	Calc Result
Save to	CF:¥
Save Name	
Folder to save	New File

7 (For memory function)

When using the memory division function

Select the blocks to be saved

Move the cursor to the **[Save Block]**.

Select

All Blks	Blocks with waveforms are all saved.
Start-End	All used blocks from the start block are saved.

This completes the data save settings.
When the **SAVE** key is pressed, the saving operation will use these settings.

NOTE If **[Image size]** is used when saving a display image file, the image may not be viewable with some image viewer applications.

5.3 Loading Data

Data saved on media or in the internal memory of the instrument can be reloaded.

Data Loading Workflow

Before attempting to load data, make sure that the storage media is inserted and the loading target is correctly specified.

Only settings and measurement data saved in binary format can be loaded into the instrument.

Waveform Data

Insert media
↓
Select a loading data. (Extension: **.MEM**, **.REC**, **.XYC**, **.IDX**, **.SEQ**)
↓
Select **[Load]**
↓
Select **[Exec]**
↓
Loading

Settings Data

Insert media
↓
Select a loading data. (Extension: **.SET**)
↓
Select **[Load]**
↓
Select **[Exec]**
↓
Loading

Text Comment

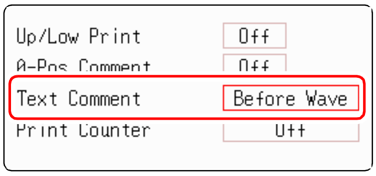
On Printer sheet, set **[Text Comment]** to **[Before Wave]** (or **[After Wave]**).
↓
Insert media
↓
Select a loading data. (Extension: **.TXT**)
↓
Select **[Load]**
↓
Select **[Exec]**
↓
Loading

Procedure

To open the screen: Press the FILE key → File screen

1 **(To load a text comment)**
Press the **SYSTEM** key and bring up the **[Printer]** sheet.

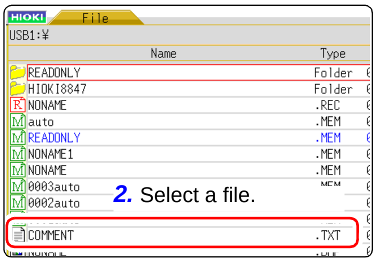
Move the cursor to the **[Text Comment]**, and select **[Before Wave]** (or **[After Wave]**).



Up/Low Print	Off
A-Pos Comment	Off
Text Comment	Before Wave
Print Counter	Off

2 **Select a file.**
Use the **CURSOR** keys to select the file to load.
(The file type is indicated by the extension)

Refer to "(Extension)" in the above workflow.



USB1:¥

Name	Type
READONLY	Folder
HIOKI8847	Folder
NONAME	.REC
auto	.MEM
READONLY	.MEM
NONAME1	.MEM
NONAME	.MEM
0003auto	.MEM
0002auto	
COMMENT	.TXT

2. Select a file.

3 **Carry out the loading operation.**
Select **[Exec]**. The file is loaded.

The name of the loaded file will appear on the screen.

To cancel loading:
Select **[Cancel]**.

NOTE

When loading from a source other than the built-in HDD
Insert the storage media before making the media selection.

Other limitations

- Data saved with a Memory HiCorder model other than the 8847 cannot be loaded into the 8847.
- When loading waveform data, the settings for the instrument are the same settings as when the data is saved. To reset to the instrument settings, carry out **[Clear Wave Data]** (⇒ p.314) or start the measurement.

Batch load of waveform data

When the following index files are loaded, waveform data can be loaded as a batch. With the following settings, index files are created along with waveform files.

Extension	Explanation
IDX	Divided files are loaded together. (To create index files: Use **[Division]** at the **[File Save]** sheet of the System screen to set the dividing size and then save. Note: If **[Save type]** is not **[Wave Binary]**, index files are not created) See: "5.2.2 Automatically Saving Waveforms" (⇒ p.69) "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)
SEQ	(When using the memory division function of the memory function) Waveform data of all blocks is loaded together. (To create index files: At the **[Memory Div]** sheet of the Status Screen, set **[Memory Div]** to **[On]**. At the **[File Save]** sheet of the System Screen, set **[Save Type]** to **[ALL-Wave Bin]**.) See: "12.1 Recording Settings" (⇒ p.203) "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)

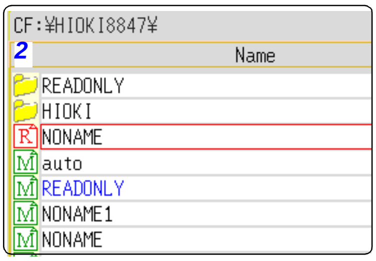
5.4 Automatically Loading Settings (Auto Setup Function)

When settings are saved as described below, they can be loaded automatically at power-up.

NOTE The Auto setup function is compatible with CF cards only.
If the STARTUP file is on the HDD, USB memory stick, or RAM (internal memory), it is not referenced. Always create the STARTUP file on a CF card.

Procedure

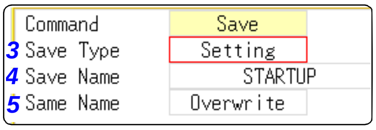
To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**



CF:¥HIOKI8847¥

2 Name

READONLY
HIOKI
R NONAME
M auto
M READONLY
M NONAME1
M NONAME



Command	Save
3 Save Type	Setting
4 Save Name	STARTUP
5 Same Name	Overwrite

1. Select **[Change Media]** and specify CF Card.

2. If a folder named "**HIOKI8847**" exists in the root directory (topmost folder on media), move the cursor to that folder.

   If the folder does not exist, go to the root directory. (A folder named "**HIOKI8847**" will be created automatically and used as save target.)

3. Select **[Save]** and set the **[Save Type]** to **[Setting]**.

4. Move the cursor to the **[Save Name]**, and enter "STARTUP".
   See: "8.1.3 Alphanumeric Input" (⇒ p.121)

5. Move the cursor to the **[Same Name]** item, and select **[Overwrite]**.

6. Select **[Exec]**.

   To cancel:
   Select **[Cancel]**.

   The next time the instrument is turned on, the settings will be automatically loaded.

5.5 Managing Files

Press the **FILE** key to display the File screen. Data saved to storage media can be managed on the File screen.
Use the **CURSOR** keys to select a file from the file list.

NOTE Before performing an operation, insert the storage media (except for the optional hard disk). When no storage media is inserted, "NO FILE" appears in the file list of the File screen.

List of File Operations

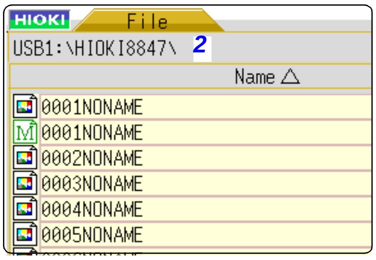
Operation key	Function indication (GUI)	Description	Reference page
CH.SET	**Media Change**	Change media.	(⇒ p.66)
F1	**Save**	Select channels and save settings data and waveform data as files.	(⇒ p.81)
	Sort	Sort files on file list in selected order.	(⇒ p.85)
F2	**Open Folder**	Open the selected folder.	(⇒ p.83)
	Load	Load settings data or waveform data from a file.	(⇒ p.77)
	Copy	Copy a file to a specified folder. If selected item is a folder, move to that folder.	(⇒ p.86)
F3	**New Folder**	Create a new folder.	(⇒ p.83)
	Rename	Change a file name or folder name.	(⇒ p.85)
F4	**Delete**	Delete a file or folder.	(⇒ p.84)
	Format	Format selected storage media.	(⇒ p.30)
F5	**Next Page**	Switch F key operation indication (GUI).	

5.5.1 Saving

You can save settings data or waveform data on storage media. Data will be saved in the folder indicated by the cursor. By using the A/B cursor pair, waveform data can be saved partially.

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**



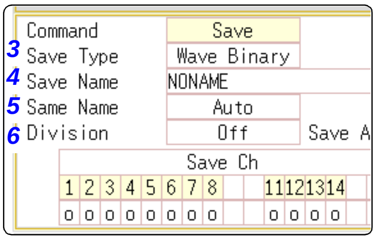
HIOKI File
USB1:\HIOKI8847\ 2
Name △
0001NONAME
0001NONAME
0002NONAME
0003NONAME
0004NONAME
0005NONAME

1 **Select storage media for saving.**
See: **"To change the media"** (⇒ p.66)

2 **Move the cursor into the folder to save.**

3 **Set the data to save.**
Select **[Save]** and then select **[Save Type]**.

Setting	Settings data
Wave Binary	Waveform data (Binary)
Wave Text	Waveform data (Text) (Memory/Recorder Function only)



Command: Save
3 Save Type: Wave Binary
4 Save Name: NONAME
5 Same Name: Auto
6 Division: Off
Save A
Save Ch
1 2 3 4 5 6 7 8 11 12 13 14
o o o o o o o o o o o o

4 **Set the file name.**
Move the cursor to the **[Save Name]** item.
Enter the save name.
See: "8.1.3 Alphanumeric Input" (⇒ p.121)

5 **Specify the action if a file with the same name exists in the target folder.**
Move the cursor to the **[Same Name]** item.

Select

Auto	When saving with the same file name, a 4-digit number is automatically added to the beginning of the file name. If the first character of the file name is a numeral, the added number will continue sequentially from there.
Overwrite	If a file with the same name exists, it will be overwritten by the new file.
Error	If a file with the same name exists, an error message will be shown.

6 **(When [Wave Binary] is the selected save type)**
Select whether to save divided files.
Move the cursor to the **[Division]** item.

Select

Off	Files are not divided when saved. If a file is too large, it cannot be saved.
16M, 32M	Select the size for Divided Save.

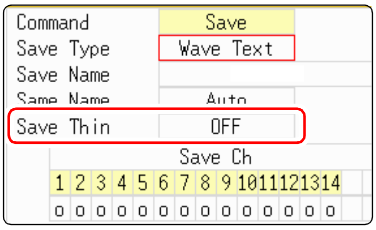
See: "About divided saving" (⇒ p.82)

- The "Text" option is only for loading the data to a PC. Data saved with this option cannot be loaded back into the 8847. To reload the data later into the 8847, use the "Binary" option.
- When **[Memory (Int)]** is selected as storage media, only settings data can be saved.

(When [Text] is the selected save type)

Set the data thinning number.

Move the cursor to the **[Save Thin]** item.



Command Save

Save Type Wave Text

Save Name

Same Name Auto

Save Thin OFF

Save Ch

1 2 3 4 5 6 7 8 9 10 11 12 13 14

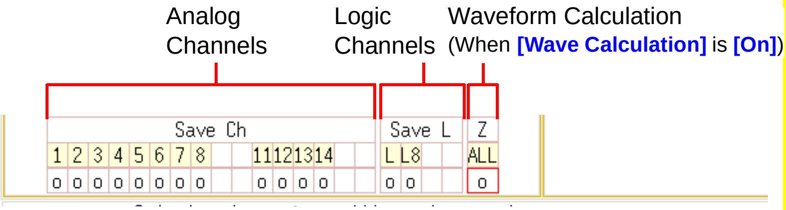
o o o o o o o o o o o o o o

Select

Off	Data thinning (sub-sampling) is not carried out.
1/2 to 1/1000	Set the thinning number (out of how many data items to leave one data item remaining).

7 Select the channels to save.

Move the cursor to the save channel item.



When saving settings data, a settings file for automatic loading of settings can be created as follows: Specify the folder **[HIOKI8847]** on the CF card as save target folder and use **[STARTUP]** as **[Save Name]**.

See: "5.4 Automatically Loading Settings (Auto Setup Function)" (⇒ p.79)

Select

-	Channel will not be saved.
o	Channel will be saved.
Reset	Return to previous settings.

8 Execute the save operation.

Select **[Exec]**.

To cancel saving:

Select **[Cancel]**.

NOTE

File name

The maximum number of characters for the **[Save Name]** string is 123. The maximum path length including file name is 255 characters.

About divided saving

Large quantities of waveform data can be divided and saved as multiple files. Saving divided data creates one or more waveform files and an index (IDX) file. Then by loading the IDX file, the data in the waveform file(s) is loaded as a batch.

See: "Batch load of waveform data" (⇒ p.78)

Other limitations

Text format data cannot be loaded into the 8847.

5.5.2 Checking the Contents of a Folder (Open a Folder)

See the contents of a selected folder (by opening that folder).

Procedure

To open the screen: Press the FILE key→ File screen **To change the media: (⇒ p.66)**

1. Move the cursor to the folder whose contents you want to see.
2. Select the **[Open Folder]**. (or press the **CURSOR ▷** key.)
   A list with the folder contents appears.

To return to a higher folder
Press the **CURSOR ◁** key.

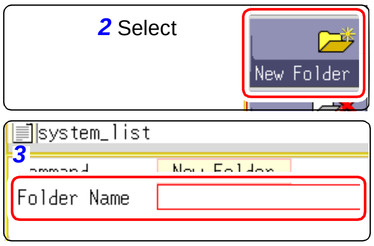
5.5.3 Creating New Folders

You can create a new folder in the currently displayed folder level.

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**

1. Display a screen with the folder level where you want to create a new folder.



2. Select **[New Folder]**.
3. Enter **[Folder Name]**.
   See: "8.1 Adding Comments" (⇒ p.118)
4. Select **[Exec]**.
   A new folder is created.

   To cancel creating:
   Select **[Cancel]**.

NOTE

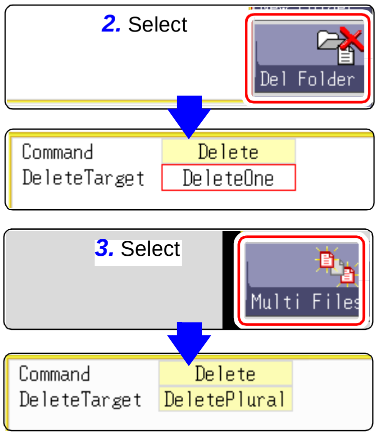
Folder name
The maximum number of characters for the **[Save Name]** string is 127. The maximum path length including folder name is 255 characters.

5.5.4 Deleting Files & Folders

Delete a file or folder.

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**



Command Delete
DeleteTarget DeleteOne

Command Delete
DeleteTarget DeletePlural

1 Select the file or folder you want to delete.

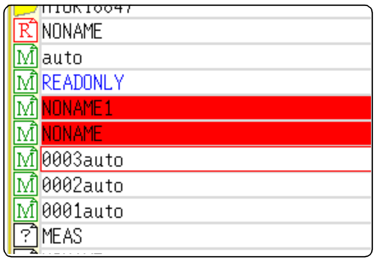
2 Select **[Delete]**.
[DeleteOne] is shown as **[DeleteTarget]**.

3 **(When multiple files are to be deleted)**
Select **[Multi Files]**.
[DeletePlural] is shown as deletion target.

Select

Slct/Deslct	Select the individual file or folder at the cursor. If something is currently selected, the selection is cleared.
Slct/Deslct All	Select all files or folders. If something is currently selected, the selection is cleared.
Rev Slct	Currently selected files or folders are deselected, and currently not selected files or folders are selected.

Selected files or folders are shown in red (see illustration at right).



```
R NONAME
M auto
M READONLY
M NONAME1
M NONAME
M 0003auto
M 0002auto
M 0001auto
? MEAS
```

4 Select **[Exec]**.
The selected files or folders are deleted.

To cancel deleting:
Select **[Cancel]**.

5.5.5 Sorting Files

Sort files in the file list into a specified order.

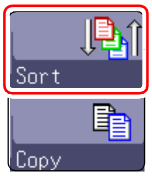
Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**

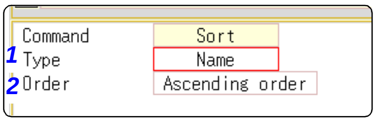
1 Select **[Sort]**, and select **[Type]**.

Off	No sorting.
Name	Sorts files by file name characters.
Type	Sorts files by type (file format) of data (settings, MEM waveforms, etc.)
Date	Sorts files by time and date of creation.
Size	Sorts files by size.

Folders/files are sorted by specified item.



1. Select



Command Sort
1 Type Name
2 Order Ascending order

2 Move the cursor to the **[Order]**.

Select

Ascending order	A → Z → , Old → New, Small → Large
Descending order	Reverse sort order

Folders/files are sorted in specified order.

3 Select **[OK]**.
The sort screen closes.

NOTE The order format will be displayed in the file list (with △: Ascending order ▽: Descending order mark) and marked by the GUI.
When there are both files and folders, folders are listed at the top and files at the bottom.

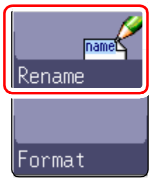
5.5.6 Renaming Files & Folders

Rename a file or folder.

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**

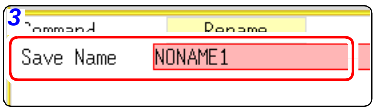
1 Select the file or folder you want to rename.



2. Select

2 Select **[Rename]**.

3 Select **[Enter Char]**, and enter **[Save Name]**.
See: "8.1 Adding Comments" (⇒ p.118)



3 Command Rename
Save Name NONAME1

4 Select **[Exec]**.
The file or folder is renamed.

To cancel renaming:
Select **[Cancel]**.

5.5.7 Copying a File Into a Specified Folder

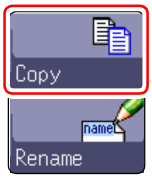
You can copy a file into a specified folder.

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**

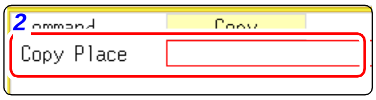
1 Move the cursor to the file you want to copy.

2 Select **[Copy]**.
Move the cursor to the **[Copy Place]** item.

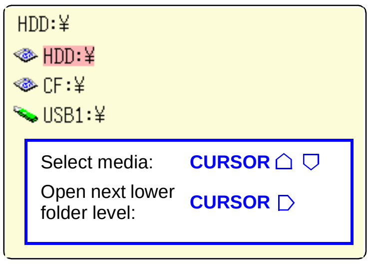


2. Select

3 Select **[Edit]**.
The Browse folders dialog box appears (at bottom right).



4 Move the cursor to the copy target folder and confirm the setting with **[Confirm]**.



Select media: **CURSOR △ ▽**
Open next lower folder level: **CURSOR ▷**

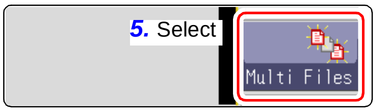
5 **(When there are multiple copy targets)**
Select **[Multi Files]**.

Select

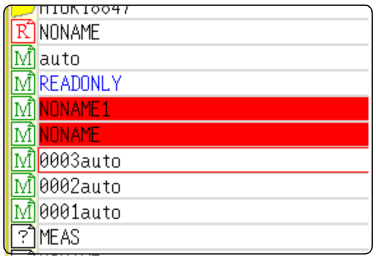
Slct/Deslct	Select the individual file or folder at the cursor. If something is currently selected, the selection is cleared.
Slct/Deslct All	Select all files or folders. If something is currently selected, the selection is cleared.
Rev Slct	Currently selected files or folders are deselected, and currently not selected files or folders are selected.

Selected files or folders are shown in red (see illustration at right).

Select **[Select End]**.



5. Select



6 Select **[Exec]**.
The file is copied to the specified target location.

To cancel copying:
Select **[Cancel]**.

5.5.8 Printing the File List

The file list of the File screen can be printed. Details for all display items in the file list are printed. Only folder names are printed for folders. Information on the contents of folders is not printed.

Before printing, make sure the recording paper is loaded correctly.
See: "2.4 Loading Recording Paper" (⇒ p.31)

Procedure

To open the screen: Press the FILE key → File screen **To change the media: (⇒ p.66)**

Press the **PRINT** key.
The file list is printed.

To cancel printing before it has finished:
Press the **STOP** key.

The file list will print as shown below.

Print Example

```
No.   File Name  Type   Date                Size    Attribute
--------------------------------------------------------------
1     0001AUTO   MEM    08-06-16 00:00:00   21kB    [     ]
2     0002AUTO   MEM    08-06-16 00:01:00   21kB    [     ]
.
.
.
```

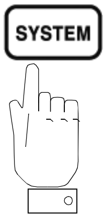
File attributes are represented by a single letter corresponding to the following.

R	For Loading only
H	Hidden File
S	System File
D	Folder
A	Archive (Backup)

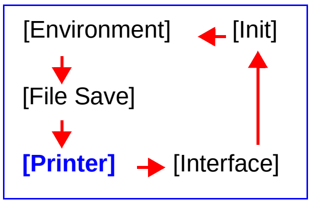
Printing Chapter 6

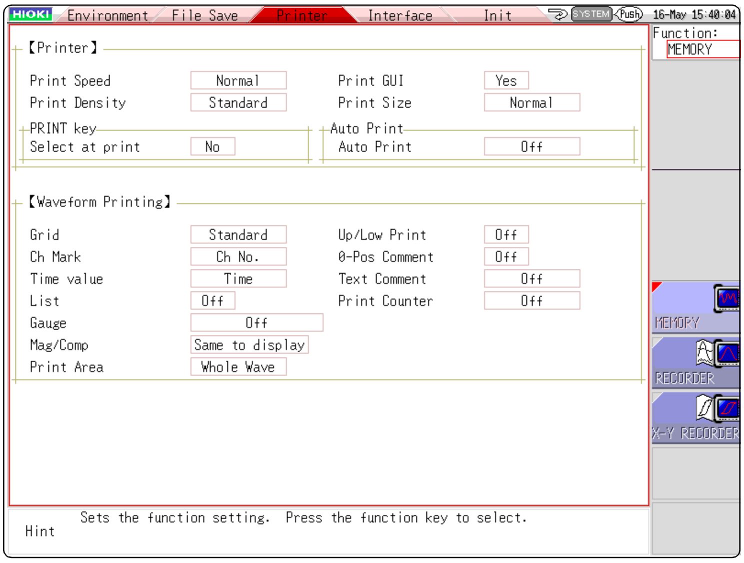
The **[Printer]** sheet lets you specify the print method and make other printing related settings.

Opening the [Printer] sheet



Pressing this key repeatedly displays the various sheets.





Function: MEMORY

【Printer】

Print Speed	Normal	Print GUI	Yes
Print Density	Standard	Print Size	Normal

PRINT key
Select at print: No

Auto Print
Auto Print: Off

【Waveform Printing】

Grid	Standard	Up/Low Print	Off
Ch Mark	Ch No.	0-Pos Comment	Off
Time value	Time	Text Comment	Off
List	Off	Print Counter	Off
Gauge	Off		
Mag/Comp	Same to display		
Print Area	Whole Wave		

Hint: Sets the function setting. Press the function key to select.

Operations available from the [Printer] sheet

Selecting the print method

See: "6.1 Printing Type and Workflow" (⇒ p.90)
- Auto Print (⇒ p.91)
- Manual Print (⇒ p.93)

See: "6.6.1 Screen Hard Copy" (⇒ p.98)

See: "6.6.2 Report Print (A4 Size Print)" (⇒ p.98)

See: "6.6.3 List Print" (⇒ p.99)

See: "6.6.4 Text Comment Printing" (⇒ p.99)

Making printer settings

- Print Speed (⇒ p.95)
- Grid Type (⇒ p.95)
- Channel Marker Type (⇒ p.95)
- Horizontal Axis Display Value (Time Value) (⇒ p.96)
- List (⇒ p.96)
- Gauge (⇒ p.96)
- Printer Density (⇒ p.95)
- Horizontal axis (Time axis) Zoom (Mag/Comp) (⇒ p.96)
- Print size (⇒ p.95)
- Upper/Lower Limit Print (⇒ p.97)
- Zero Position Comment Print (⇒ p.97)
- Print Counter (⇒ p.97)

6.1 Printing Type and Workflow

There are basically three types of printing operations.

To print data automatically during measurement

↓

Auto Print

When the Memory function* is used, data are acquired for the recording length and then printed automatically.
When the Recorder function is used, printing is carried out in real time along with recording.
When the FFT function is used, data is printed automatically after FFT analysis is exited.
In both cases, print contents are selected before the measurement.

To selectively print data after measurement

↓

Selection Print

(default setting)
When the **PRINT** key is pressed at the File screen, print contents can be selected before printing. This is convenient to print different items each time.
At the File screen, the file list is printed. At other screens, a list is printed.

To print data in bulk after measurement by pressing the PRINT key

↓

Quick Print

Print content when **PRINT** key is pressed
At Waveform screen: Waveform
At File screen: File list
At other screen: List
During waveform printing, the range specified with **[Slct Print Area]** is printed.

*: When the Roll Mode function is used, printing can be carried out simultaneously with waveform display.
(However, at time axis range settings higher than 500 ms/div, the print timing will be slower.)

Auto Print

- Load recording paper
After installation and connections are completed, turn power on
- ↓ Set measurement configuration
- ↓ **[Printer] sheet**
  - Set print target for **[Auto Print]**
  - ↓ Set the data to save
  - **The followings can be printed simultaneously.**
    - Waveform data
    - Numeric value calculation results
- ↓ Measurement
- ↓ Print

Selection Print

- Load recording paper
After installation and connections are completed, turn power on
- ↓ **[Printer] sheet**
  - Set **[Print Select]** to **[Yes].**
- ↓ Start and Stop Measurement
- ↓ Press the **PRINT** key.
- ↓ **Settings window**
  - Set the data to save
  - **Either of the following can be printed.**
    - Whole waveforms
    - A-B waveforms
    - Post-/Pre-Trigger waveforms
    - Lists (Settings List)
- ↓ Print

Quick Print

- Load recording paper
After installation and connections are completed, turn power on
- ↓ **[Printer] sheet**
  - Set **[Print Select]** to **[No]**.
  - ↓ Set the save area
  - **During waveform printing, either of the following can be printed.**
    - Whole waveforms
    - A-B waveforms
- ↓ Start and Stop Measurement
- ↓ Press the **PRINT** key.
- ↓ Print

NOTE When both Auto Print and Auto Save are enabled, Auto Save is executed first. However, when the Roll Mode function (default setting: Auto) is used with the Memory function, Auto Print has priority.

6.2 Making Auto Print Settings

MEM REC FFT

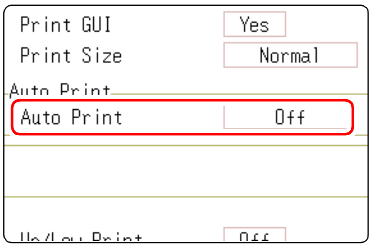
This applies to the Memory function, Recorder function, and FFT function.
Make these settings before measurement. Check to be sure that recording paper is loaded correctly. Measurement data is printed automatically when you press the **START** key to start measurement.

Procedure

To open the screen: Press the SYSTEM key → [Printer] sheet

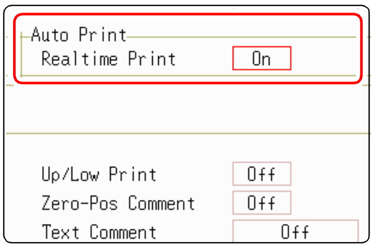
1 **Enable Auto Print.**

(Memory Function, FFT Function case:)
Move the cursor to the **[Auto Print]** item.
Select **[On]**.
Default setting: Off (Auto Print is not carried out)



Print GUI Yes
Print Size Normal
Auto Print
Auto Print Off
Up/Low Print Off

(Recorder Function Case:)
Move the cursor to the **[Realtime Print]** item.
Select **[On]**.



Auto Print
Realtime Print On
Up/Low Print Off
Zero-Pos Comment Off
Text Comment Off

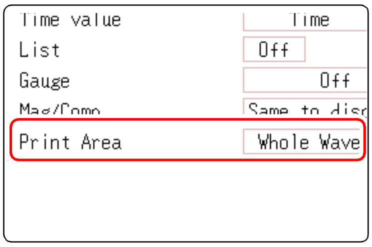
2 **Make print settings as required for the printer. (⇒ p.95)**

3 **(Memory Function case:)**
Make print area settings as required.
Move the cursor to the **[Print Area]** item.

Select

Whole Wave	Print all waveform data in internal memory of instrument. (default setting)
A-B Wave	Print only A/B cursor defined range of waveform data in internal memory of instrument.

When using the Recorder function, all waveform data will be printed, regardless of any print range setting.



Time value Time
List Off
Gauge Off
Mag/Comp Same to disp
Print Area Whole Wave

4 **Check the measurement conditions and start the measurement. (Press the START key.)**

Memory Function case:
Data are acquired for the recording length and then printed automatically.

Recorder Function case:
Printing is carried out in real time along with recording.

FFT Function case:
Data is printed automatically after FFT analysis is exited.

To stop printing before it has finished:
Press the **STOP** key. Measurement also stops.

Printing can be paused and restarted during Real-Time Printing (Recorder Function) by pressing F key.
Move the cursor to the **[Realtime Print]** item, and select On or Off.
When printing is carried out again after stopping, the range selection will be used.

NOTE

- When both Auto Print and Auto Save are enabled, Auto Save is executed first.
- However, when the Roll Mode function (default setting: Auto) is used with the Memory function, Auto Print has priority.
- If A/B cursor is On during manual printing after acquiring waveform data, the range will be printed.

Timebase (Time/div)	Measurement conditions	Printing
Up to 200 ms/div	Memory Function or Recorder Function Recording length: Other than Continuous (Cont.)	Data are acquired for the recording length and then printed automatically
	Recorder Function Recording length: Continuous (Cont.)	Printing disabled
More than 500 ms/div	Memory Function Roll Mode: On	Printing is carried out in real time along with recording.
	Recorder Function	

Simultaneous printing of numerical calculation results

From the Status screen, select the **[Num Calc]** sheet and set the **[Print Calc Result]** item to **[On]**.

See: "10.5 Printing Numerical Calculation Results" (⇒ p.184)

6.3 Manual Printing With PRINT key (Selective Printing)

Using the **PRINT** key from the Waveform screen, you can specify a range and data type for printing. This is also useful to prevent inadvertent printing due to operation errors.

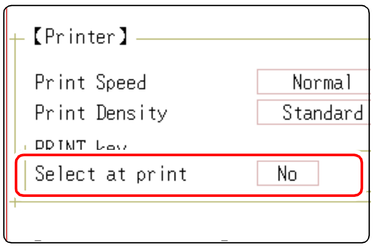
Procedure

To open the screen: Press the SYSTEM key → [Printer] sheet

1 Enable data selection at time of printing

Move the cursor to the **[Select at print]** item.
Select **[Yes]**.

2 Make print settings as required for the printer. (⇒ p.95)



【Printer】

Print Speed	Normal
Print Density	Standard
PRINT key	
Select at print	No

Procedure

To open the screen: Press the DISP key → File screen

3 Start and stop the measurement.

Press the **START** key to start the measurement.
Press the **STOP** key to finish the measurement.

During measurement, printing is not possible. Measurement must be stopped before starting to print.

4 Select print contents and execute printing

When you press the **PRINT** key, the "PrintSelect" GUI appears on the right side of the screen.

Select

Whole Wave	Print all waveform data in internal memory of instrument. (default setting)
A-B Wave	Print only A/B cursor defined range of waveform data in internal memory of instrument. (Memory Function and Recorder Function only)
About Trig	Print waveform data for 10 divisions before and after trigger position. (Memory Function only)
List	Print main settings.
Report	Print the report. See: "6.6.2 Report Print (A4 Size Print)" (⇒ p.98)

When the selection (except for **[Cancel]**) has been made, printing starts.

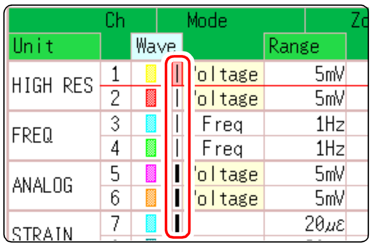
To stop printing before it has finished:
Press the **STOP** key.

6.4 Setting the Print Concentration of the Waveform

The printing concentration of the waveform can be set for each channel.

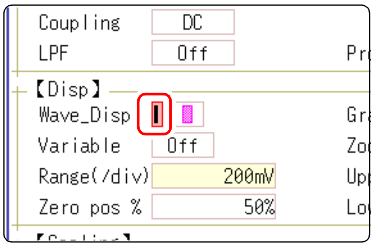
Procedure

To open the screen: Press the CHAN key → [Unit List] sheet, or [Each Ch] sheet



Unit	Ch	Wave	Mode	Range
HIGH RES	1	🟨	'oltage	5mV
	2	🟥	'oltage	5mV
FREQ	3	🟦	Freq	1Hz
	4	🟩	Freq	1Hz
ANALOG	5	🟪	'oltage	5mV
	6	🟧	'oltage	5mV
STRAIN	7	🟦		20με

[Unit List] sheet



Coupling DC

LPF Off

【Disp】

Wave_Disp

Variable Off

Range(/div) 200mV

Zero pos % 50%

[Each Ch] sheet

Move the cursor to the [Wave], or [Wave_Disp].

Select

Light, Midlight Standard (default setting), Middark, Dark

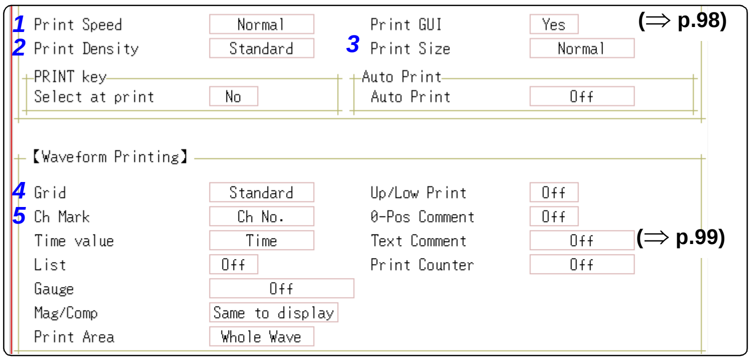
NOTE When the waveform print concentration is Light, a temporary drop in power voltage (for example, a momentary power failure) during printing may cause the print to jump.

6.5 Making Printer Settings

Make settings on the **[Printer]** sheet of the System screen.

Printer settings

To open the screen: Press the SYSTEM key → [Printer] sheet



1 Print Speed	Normal	Print GUI	Yes
2 Print Density	Standard	3 Print Size	Normal

(⇒ p.98)

PRINT key

Select at print	No

Auto Print

Auto Print	Off

【Waveform Printing】

4 Grid	Standard	Up/Low Print	Off
5 Ch Mark	Ch No.	0-Pos Comment	Off
Time value	Time	Text Comment	Off
List	Off	Print Counter	Off
Gauge	Off		
Mag/Comp	Same to display		
Print Area	Whole Wave		

(⇒ p.99)

1 **Select the print quality.**
Move the cursor to the **[Print Speed]** item.

Select

Fast/Coarse (default setting), Normal , Slow/Fine

2 **Select the printer density.**
Move the cursor to the **[Printer Density]** item.

Select

Light, Midlight Standard (default setting), Middark, Dark

3 **Select the print size.**
Move the cursor to the **[Print Size]** item.

Select

Small	Print on lower half of recording paper.
Normal	(default setting)

4 **Select the grid type.**
Move the cursor to the **[Grid]** item.

Select

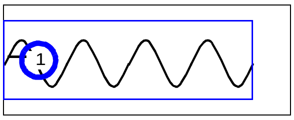
Off, Standard (default setting), Fine, Std Dark, Fine Dark

5 **Select the channel marker type.**
Move the cursor to the **[Ch Mark]** item.

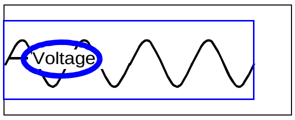
Select

Off	Do not print the channel number or comments on the recording paper.
Ch No.	Print the channel number on the recording paper. (default setting)
Comment	Print the comments entered in the Channel Settings screen over the waveform on the recording paper. A comment setting must have been made. See: "8.1 Adding Comments" (⇒ p.118)

<Print Example>



Channel number.



Comment

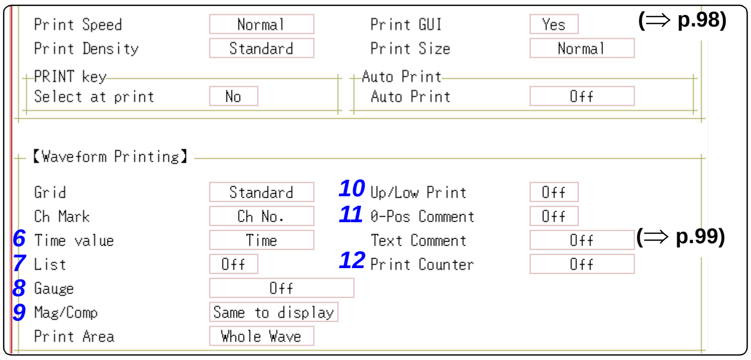
NOTE

Grid Type
Grids displayed on the screen are not reflected in the printout.

Print Quality
While **[USB Set]** is set to **[Mass Storage]**, printing speed is always Slow/Fine.

Printer settings

To open the screen: Press the SYSTEM key → [Printer] sheet



Print Speed	Normal	Print GUI	Yes
Print Density	Standard	Print Size	Normal

(⇒ p.98)

PRINT key
Select at print No

Auto Print
Auto Print Off

【Waveform Printing】

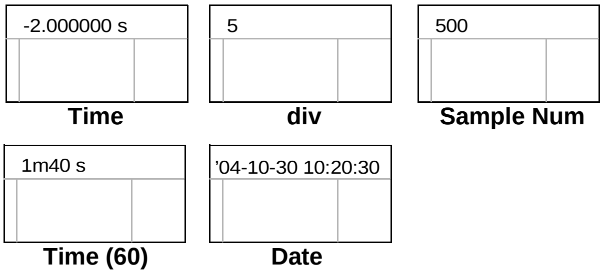
Grid	Standard	10 Up/Low Print	Off
Ch Mark	Ch No.	11 0-Pos Comment	Off
6 Time value	Time	Text Comment	Off
7 List	Off	12 Print Counter	Off
8 Gauge	Off		
9 Mag/Comp	Same to display		
Print Area	Whole Wave		

(⇒ p.99)

6 Select the horizontal axis (time axis) display value.

Move the cursor to the **[Time Value]** item.

<Print Example>



Select

Time*	Print the time from trigger event (unit is fixed). (default setting)
Time (60)*	Print the time from trigger event (unit is modulo 60).
div	Print the number of divisions from trigger event.
Date*	Print the date and time when waveform was acquired.
Sample Num	Print the number of samples from trigger event.

* Printing for external sampling is done according to the **[Sample]** setting.

7 Print a list of settings

Move the cursor to the **[List]** item.

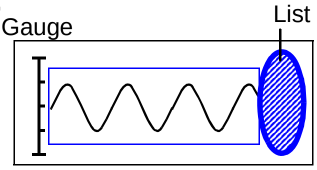
Select

Off	Do not print a list. (default setting)
On	Print list after waveform.

8 Select the type of gauge.

Move the cursor to the **[Gauge]** item.

<Print Example>



Select

Off	Do not print a gauge. (default setting)
Before Wave	Print gauge before waveform.
After Wave	Print gauge after waveform.
Before&Aft Wave	Print gauge before and after waveform.

9 Set the horizontal axis (time axis) magnification and compression.

Move the cursor to the **[Mag/Comp]** item.

Select

x10 to x1/10000 (Memory Function case) **x1 to x1/20000 (Recorder Function case)**	Print using the magnification or compression ratio set here.
Same to display	Print using the magnification or compression ratio set for the waveform screen. (default setting)

NOTE

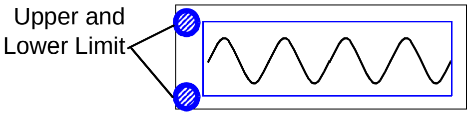
Horizontal axis (Time axis) zoom

When time axis zoom has been set, printing will be carried out using this zoom setting, regardless of the zoom setting on the Waveform screen.

10 Set the upper and lower limit value

Move the cursor to the **[Up/Low Print]** item.

<Print Example>



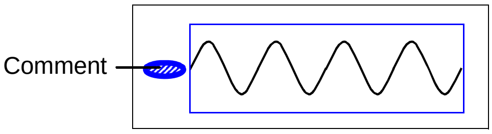
Select

Off	Do not print upper and lower limits. (default setting)
On	Print upper and lower limits.

11 Set the zero-position comment

Move the cursor to the **[Zero-Pos Comment]** item.

<Print Example>



Select

Off	Print the channel number. (default setting)
On	Print zero position comment.

The zero position comment is not printed in the following case:

- When the waveform screen format has been set to X-Y, or FFT display
- When no comment has been set for a channel

See: "8.1 Adding Comments" (⇒ p.118)

12 Select the counter print.

Move the cursor to the **[Print Counter]** item.

Select

Off	Do not print a counter. (default setting)
Date	Print the date of printing and a waveform acquisition count. (Example: 04-8-1-0001)
Name	Print a counter name and a waveform acquisition count. (Example: DeviceA-0001)

(When [Date] or [Name] is selected)

If you want to begin from an arbitrary count

Move the cursor to the **[Counter Num]**, and set an arbitrary count.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

The count is automatically cleared to zero when the instrument is powered on.
The count is increased by 1 each time a waveform is acquired. (Maximum count 9999)

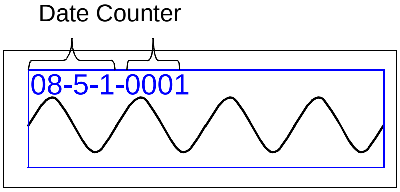
(When [Name] is selected)

Enter a counter name.

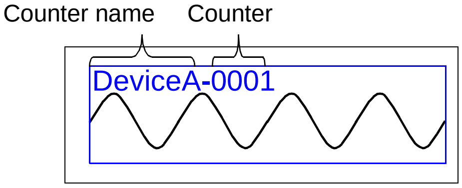
Move the cursor to the **[Counter Name]**, and enter a counter name (up to 10 characters).

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

<Print Example of Data and Counter>



<Print Example of Counter name and Counter>



6.6 Miscellaneous Printing Functions

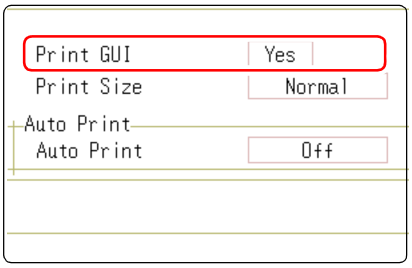
You can produce a hard copy of the screen display, perform report printing or list printing.

6.6.1 Screen Hard Copy

Press **COPY** key while the screen to print is displayed. The printer will produce a hard copy of the screen contents. The GUI section can also be printed.

GUI print setting

To open the screen: Press the SYSTEM key → [Printer] sheet

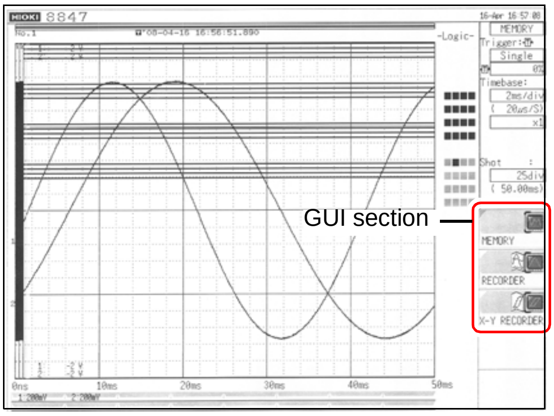


Print GUI Yes
Print Size Normal
Auto Print
Auto Print Off

Set the [Print GUI] item to **[Yes]**.

To stop printing before it has finished:
Press the **STOP** key.

<Print Example>



6.6.2 Report Print (A4 Size Print)

The waveform range as displayed on the Waveform screen, upper and lower limit values, and channel settings are printed in A4 size. When zoom display is enabled, two zoom display screens are printed.
The A/B cursor pair shown on the Waveform screen is also printed.
If the comment type is set to **[Comment]** or **[Set&Com]** on the Comment sheet of the Channel screen, the title comment can also be printed. (See: "8.1.1 Adding a Title Comment" (⇒ p.118))

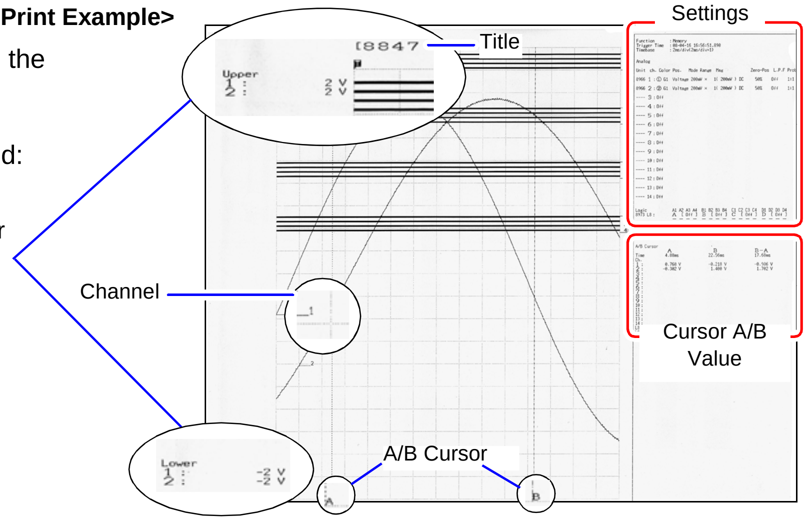
Procedure

To open the screen: Press the DISP key → File screen, Press the DISP key → Select the [WAVE WIDTH] menu

Hold down the **FEED** key and press the **COPY** key.

To stop printing before it has finished:
Press the **STOP** key.

<Print Example>



6.6.3 List Print

This function prints out function status information and channel setting information in list format. The list settings are the same as for the List function. (See: "Print a list of settings" (⇒ p.96))

Press the **PRINT** key at a screen other than the Waveform screen.

To stop printing before it has finished:
Press the **STOP** key.

NOTE

The printed list contains the setting parameters for the acquired waveform data. The list content will not change even if the settings were changed after the waveform data were acquired.

6.6.4 Text Comment Printing

A text document edited on a PC can be printed together with a waveform.

1. Create a text file using **[Notepad]** or another suitable application on the PC.

The maximum size of the text comment that can be imported to the 8847 is 104 x 200.
Print width will be adjusted to the widest line.

2. Press the **SYSTEM** key and set **[Text Comment]** on the **[Printer]** sheet.

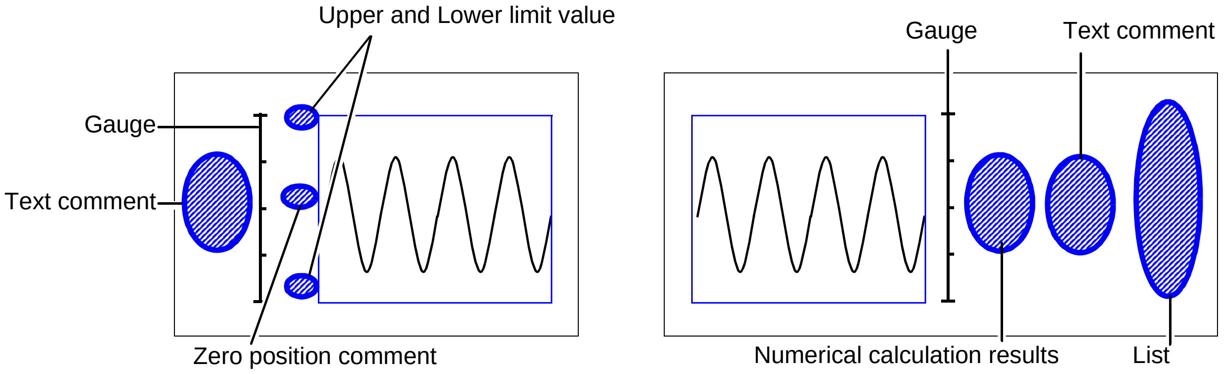
Select

Off	Text comment is not printed. (default setting)
Before Wave	Text comment is printed before waveform.
After Wave	Text comment is printed after waveform.

3. Press the **FILE** key and use the File screen to import the text file created on the PC into the 8847.
See: "5.3 Loading Data" (⇒ p.77)

The text file content will be printed along with the waveform when printing.

Print Example _ Positioning with regard to other print items



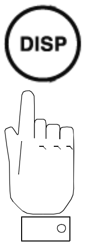
<Printing before waveform selected> **<Printing after waveform selected>**

Waveform Screen Monitoring and Analysis

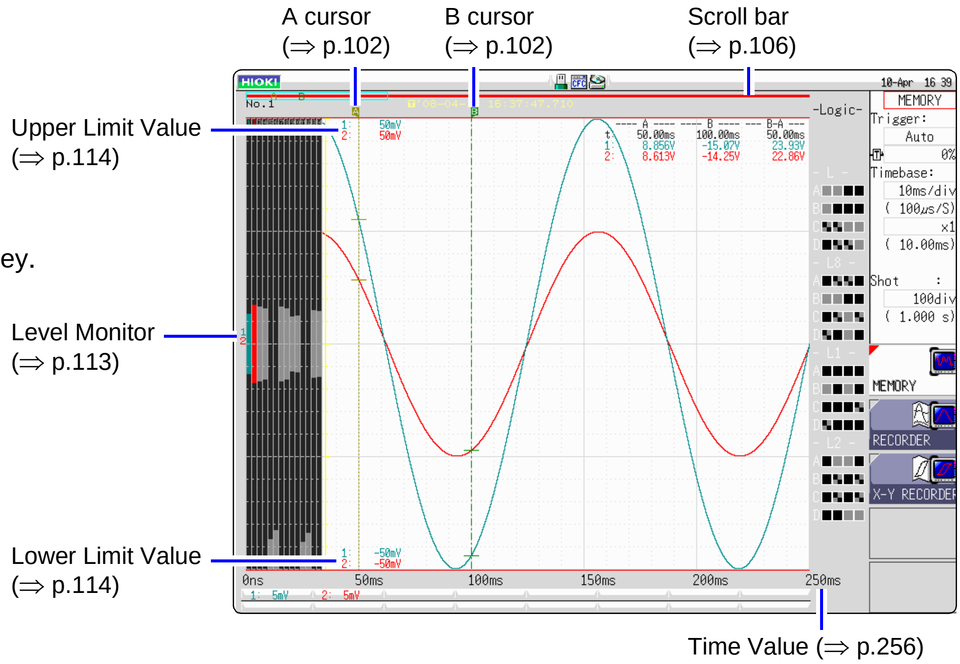
Chapter 7

Analytical operations such as display magnification, compression, and search are available on the Waveform screen.

Opening the Waveform screen



Press this key.



Operations available from the Waveform screen

A/B Cursor

- Read measurement value (⇒ p.102)
- Specifying a Waveform Range (⇒ p.105)

Moving the Waveform Display Position

- Using the Jog & Shuttle knobs (⇒ p.106)
- Moving the position (⇒ p.107)

Performing X-Y Synthesis (⇒ p.108)

Magnifying and Compressing Waveforms

- Magnifying and Compressing Horizontal Axis (Time Axis) (⇒ p.110)
- Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis))(⇒ p.111)
- Magnifying and Compressing Vertical Axis (Voltage Axis) (⇒ p.112)

Monitoring Input Levels (⇒ p.113)

Switching the Waveform Screen (⇒ p.114)

- Displaying upper and lower limit values
- Displaying comments
- Switching the waveform display width

7.1 Reading Measurement Values (Using the A/B Cursors)

- Time difference, frequency and potential difference (and when scaling is enabled, scaling values) can be read as numerical values using the A/B cursors on the Waveform screen. The cursors also allow specifying the calculation and print X-Y synthesis range.
- When displaying the X-Y waveform, the A/B cursors can be used to read the measurement values. Also with a split screen, A/B cursors can be used separately in the graphs to read the potential difference between the A and B points.

A/B Cursor Settings

To open the screen: Press the DISP key → Waveform screen → Press the AB CSR key → A/B cursors settings window

1 Select the Cursor Type.

Move the cursor to the **[A/B Cursors]** item.

Select

Off	A/B cursors are not used.
div	Move in horizontal axis (time axis) direction (X axis for X-Y synthesis)
Range	Move in vertical axis (voltage axis) direction (Y axis for X-Y synthesis)
Trace	Trace waveform data.

2 Select the movement target for the A/B cursors

Move the cursor to the **[Kind]** item.

Select

A	Use only cursor A.
A-b	Use A/B cursors but move only cursor A.
a-B	Use A/B cursors but move only cursor B.
A&B	Move both cursor A and cursor B together.

3 Select the measurement target channel ([Subject CH]) for A and B

Move the cursor to the **[A]** and **[B]** items.

Select

ALL	Shows measurement values for all channels. (When cursor type is **[Trace]** or **[Range]**)
Ch1 to Ch16	Show measurement values in selected channels out of Ch1 - Ch16 (for 1, 2, 4, 8 screens).
Gr1 to Gr8	Specify X-Y synthesis for Gr1 to Gr8 (for X-Y screen)
Analog Ch↔Calc Ch	When there is data on which waveform calculation has been performed, the cursor target is switched by analog channel and waveform calculation data.

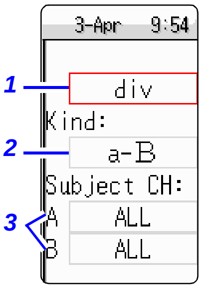
4 Move the A/B cursors with the Jog & Shuttle knobs

(While the **AB CSR** key is lit, the cursors can be moved with the Jog & Shuttle knobs. Pressing a key other than the **AB CSR** key closes the setup screen.)

If numerical values are hard to read
Press the **DISP** key to display the waveform and measurement values separately.
See: "7.7.3 Switching the Waveform Display Width" (⇒ p.114)

If A/B cursors are activated but do not show up on screen
The position of the A/B cursors can be checked on the scroll bar.(⇒ p.106)
Turning the Jog & Shuttle knobs will show the respective cursor on the screen.
If the cursor type is **[div]** or **[Trace]** cursors, cursor measurements can be made even if the A or B cursor is off-screen.

To view the waveform before or after the A/B cursors when these are off the screen
When using the A/B cursors, the waveform at an off-screen cursor location can be displayed using the Jump function.
See: "7.3.3 Moving the Position (Jump Function)" (⇒ p.107)

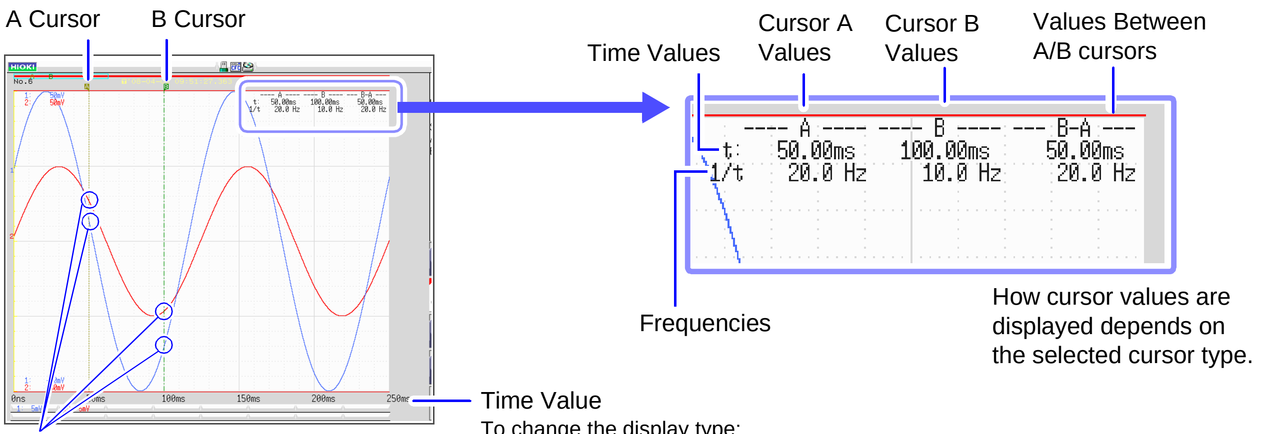


3-Apr 9:54
div
Kind:
a-B
Subject CH:
A ALL
B ALL

Reading Measurement Values on Waveform Screen (for 1, 2, 4, 8 screens)

To open the screen: Press the DISP key → Waveform screen

<Screen display (time axis cursor)>



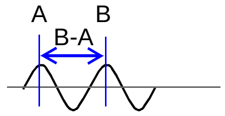
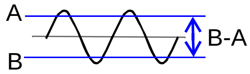
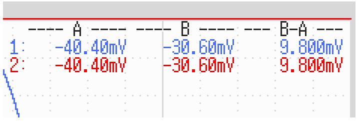
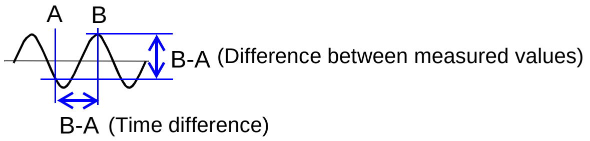
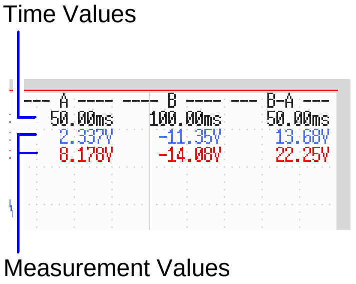
```
---- A ---- ---- B ---- --- B-A ---
t:   50.00ms    100.00ms    50.00ms
1/t  20.0 Hz     10.0 Hz    20.0 Hz
```

How cursor values are displayed depends on the selected cursor type.

Waveform values at the intersection with each cursor are displayed.

Time Value
To change the display type:
"Time Value" (⇒ p.256)

<Cursor Value>

Cursor Type	Cursor Value	Cursor Value Display Example (with two cursors)
div **(Time Value and Frequency)**	**t:** A, B each cursor value: Time from trigger point or recording start B-A value: Time difference between A/B cursors  **1/t:** Frequency for which t is 1 cycle	See "Screen display" above
Range **(Measurement Values)**	A, B each cursor value: Measured value of channel B-A value: Difference between measured values at A/B cursors 	 ---- A ---- ---- B ---- --- B-A --- 1: -40.40mV -30.60mV 9.800mV 2: -40.40mV -30.60mV 9.800mV
Trace **(Time and Measurement Values)**	Time Values A, B each cursor value: Time from trigger point or recording start B-A value: Time difference between A/B cursors **Measurement Values** A, B each cursor value: (Memory function) measurement value (Recorder function) maximum, minimum values B-A value: Difference between measured values at A/B cursors 	 ---- A ---- ---- B ---- --- B-A --- : 50.00ms 100.00ms 50.00ms 2.337V -11.35V 13.68V 8.178V -14.08V 22.25V

You can press the **DISP** key to display the waveform and cursor values separately.
See: "7.7.3 Switching the Waveform Display Width" (⇒ p.114)

NOTE

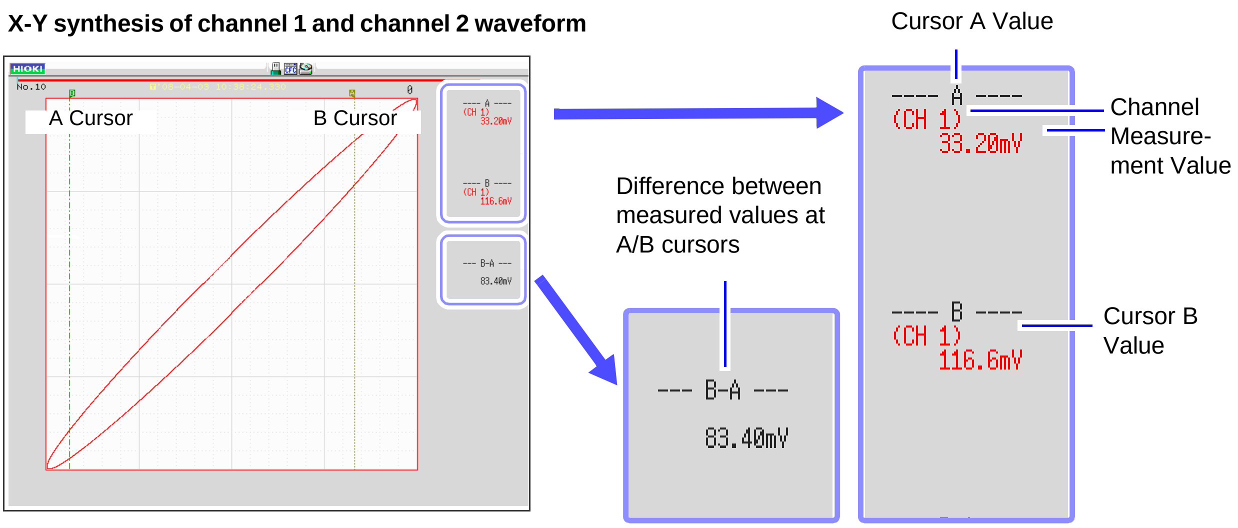
- When Using External Sampling: Value t is the number of samples.
- When the voltage range is changed during measurement by the recorder function or X-Y recorder function: Trace measurement values are acquired at the range settings when measurement was stopped.

Reading Measurement Values on Waveform Screen (for X-Y1, 4 screens)

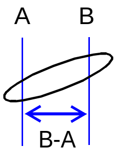
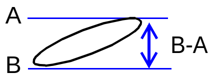
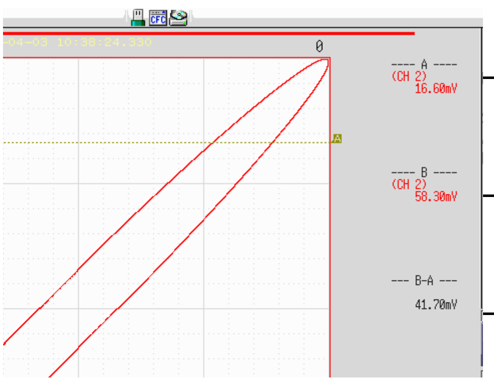
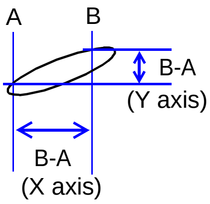
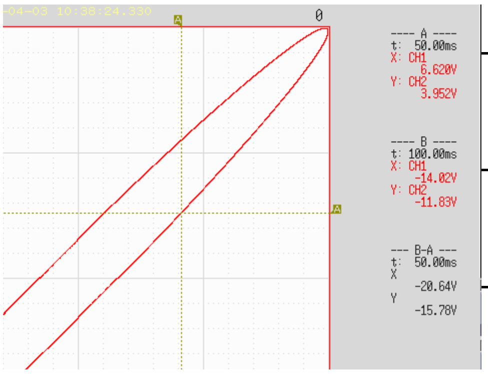
To open the screen: Press the DISP key → Waveform screen

<Screen display (X axis measurement value)>

X-Y synthesis of channel 1 and channel 2 waveform

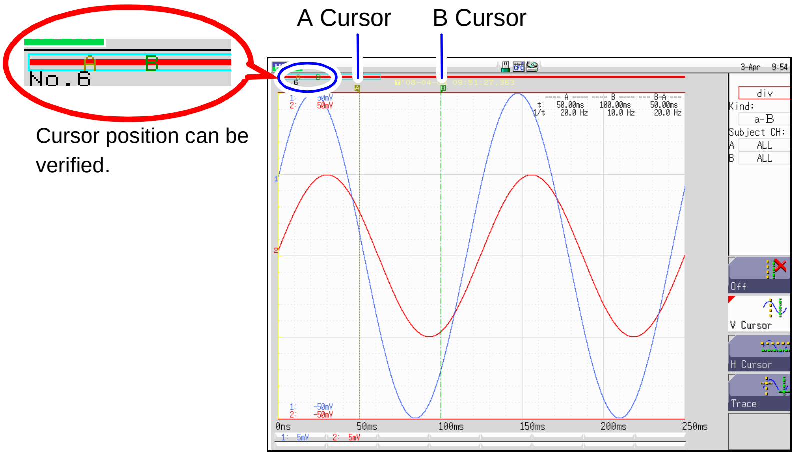


<Cursor Value>

Cursor Type	Cursor Value	Cursor Value Display Example (with two cursors)
X **(X axis measure-ment value)**	 A B B-A	See "Screen display" above
Y **(Y axis measure-ment value)**	 A B B-A	 ---- A ---- (CH 2) 16.60mV ---- B ---- (CH 2) 58.30mV --- B-A --- 41.70mV **(Y axis channels)** Cursor A measurement value Cursor B measurement value Difference between mea-sured values at A/B cursors
Trace **(Time and X axis, Y axis measure-ment value)**	 A B B-A (Y axis) B-A (X axis)	 ---- A ---- t: 50.00ms X: CH1 6.620V Y: CH2 3.952V ---- B ---- t: 100.00ms X: CH1 -14.02V Y: CH2 -11.83V --- B-A --- t: 50.00ms X -20.64V Y -15.78V **(X axis and Y axis channels)** Cursor A time and measurement value Cursor B time and measurement value Time and measure-ment value differen-tial between cursor A and B

7.2 Specifying a Waveform Range (A/B Cursor)

When the waveform is shown as a time display, the range can be specified with the div cursor or Trace cursor.
The specified range will be used for file saving, printing, X-Y synthesis, and numerical calculation.
The range selection will be retained also when the waveform display format is changed.



Cursor position can be verified.

The general procedure is as follows.

1. Set A/B cursors

See: "A/B Cursor Settings" (⇒ p.102)

2. Specify a range

- **For file saving:**
  System screen - **[File Save]** sheet - **[Save Area]** item: Select **[A-B Wave]**.
  See:"5.2.2 Automatically Saving Waveforms" (⇒ p.69)
  "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)

- **For printing:**
  System screen - **[Printer]** sheet - **[Slct Print Area]** item: Select **[A-B Wave]**.
  See:"6.2 Making Auto Print Settings" (⇒ p.91)
  "6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.93)

- **For X-Y synthesis:**
  Status screen - **[Status]** sheet - **[Combo Area]** item: Select **[A-B Wave]**.
  See:"7.4 Performing Waveform X-Y Synthesis" (⇒ p.108)

- **For numerical calculation:**
  Status screen - **[Num Calc]** sheet - **[Calc Area]** item: Select **[A-B Wave]**.
  See:"6.2 Making Auto Print Settings" (⇒ p.91)

NOTE

About reading measurement values and cursor types:

See: "7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.102)

Available range for A/B cursor

The available range depends on the function.

- Memory function: Recorded measurement data for one measurement
- Recorder function: Recorded measurement data for one measurement, or max. 20,000 internally stored divisions before measurement end point

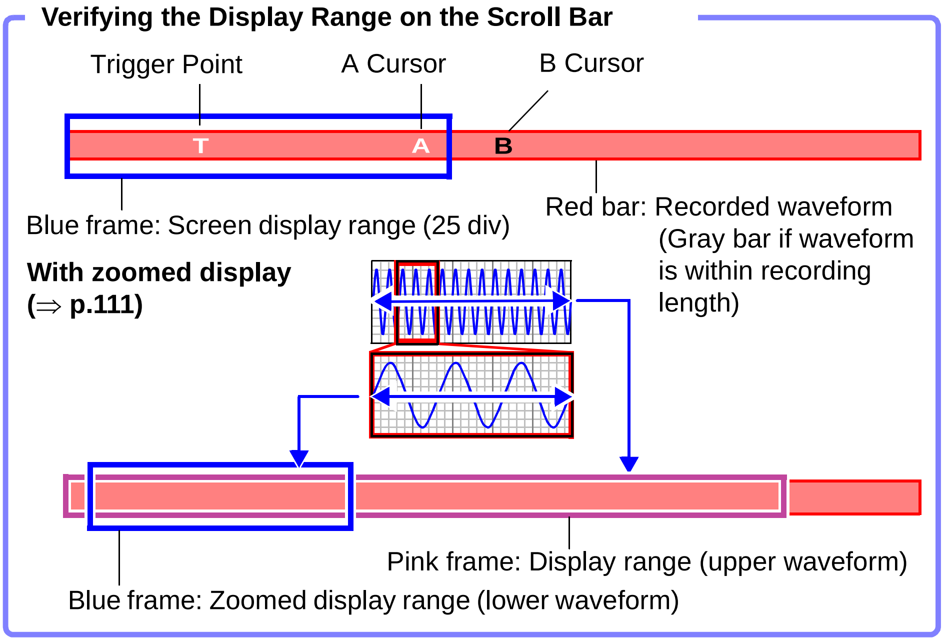
7.3 Moving the Waveform Display Position

MEM REC

This applies to the Memory function and Recorder function.

7.3.1 About Display Position

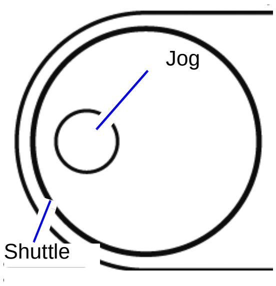
From the scroll bar you can verify the relative position and size of the displayed portion of a waveform within the overall recorded waveform.
Trigger time, trigger position and A/B cursor positions (when using voltage axis cursor or trace cursors) are also displayed.



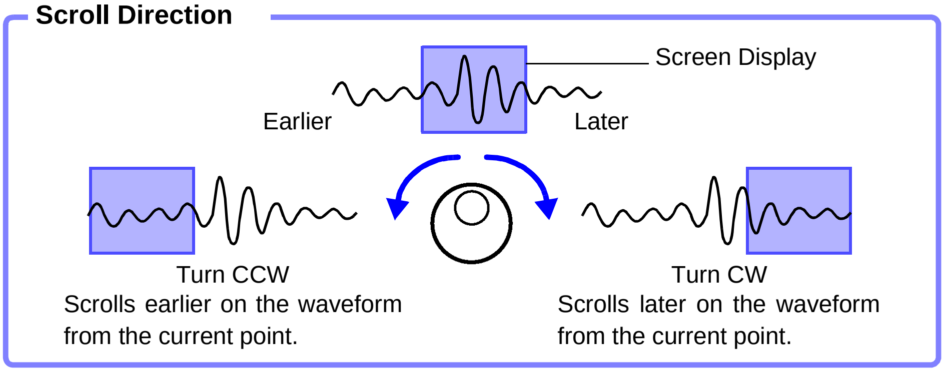
Verifying the Display Range on the Scroll Bar

7.3.2 Scrolling With Jog and Shuttle Knobs (Scroll)

When measuring or displaying an existing waveform, use the Jog and Shuttle knobs to scroll.



The scrolling speed is controlled by the rotation angle of the Shuttle knob.
Press the **WAVE** key to assign the Jog & Shuttle knobs to waveform scrolling.
(While the **WAVE** key is lit, the Jog & Shuttle knobs can be used for scrolling.)



Scroll Direction

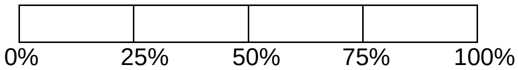
To see past waveforms in Roll Mode
The Jog & Shuttle knobs can be used to view past waveforms during measurement.
To redisplay a waveform, select **[Scroll]**.

7.3.3 Moving the Position (Jump Function)

You can specify the portion to be displayed immediately.

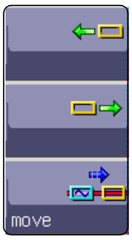
Display location can be specified as follows:

- Trigger point
- A/B cursor location
- Specified location (from the beginning **[0%]** to the end **[100%]** of the waveform)



Procedure

To open the screen: Press the DISP key → Waveform screen → Press the WAVE key → WAVE settings GUI is shown

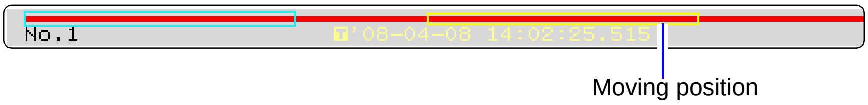


1 Use the **F** keys **[←]**, **[→]** to specify the position.

The yellow frame on the scroll bar indicates the moving position.

2 Select **[Move]**.

The selected display position appears on the screen.



Moving the position when [Memory Div: On] with the Memory function:
Press the **F1** key **[pos↔block]**. With no block displayed in the upper part of the screen, move the position.
(When a block is displayed in the upper part of the screen, the desired block can be selected and the recorded waveform can be displayed. (⇒ p.115)

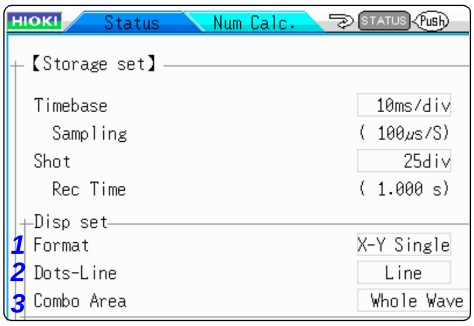
7.4 Performing Waveform X-Y Synthesis MEM X-Y

This applies to the Memory function and X-Y recorder function.

- To perform **waveform X-Y synthesis**, go to the Status screen, select the **[Status]** sheet, and set **[Format]** to X-Y1 screen or X-Y4 screen. By assigning any analog channel to the X axis and Y axis, up to 8 X-Y combo displays can be generated.
- Vertical axis (voltage axis) zoom also applies to X-Y synthesis.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

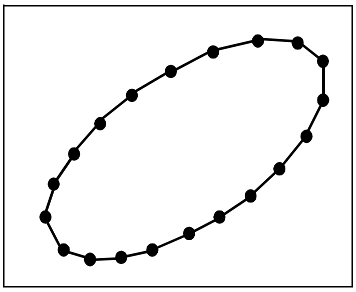


【Storage set】

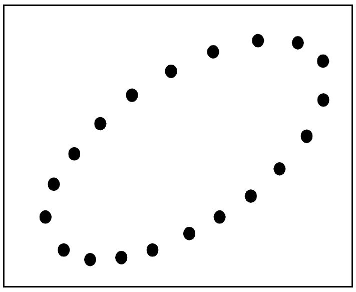
Timebase 10ms/div
Sampling (100µs/S)
Shot 25div
Rec Time (1.000 s)

Disp set

1 Format X-Y Single
2 Dots-Line Line
3 Combo Area Whole Wave



Line



Dot

1 Move the cursor to the **[Format]** item.

Select

X-Y Single	The waveforms of graphs 1 - 8 are shown and recorded on a single screen.
X-Y Quad	The waveforms of graphs 1 - 8 are shown and recorded on a quadruplet screens.

2 Move the cursor to the **[Dots-Line]** item.

Select

Dots	Measurement data only are shown as dots. Order stored in memory will no longer be known.
Line	Measurement data are linked by a line in the order stored in memory and shown as a waveform. (default setting)

3 Move the cursor to the **[Combo Area]** item.

See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)

Select

Whole Wave	All data are used for X-Y synthesis.
A-B Wave	Only data range marked by A/B cursors is used for X-Y synthesis.

To speed up the time between measurement and waveform display

- When **[Dots]** is selected for the Dot-Line interpolation setting, the waveform will be displayed faster.
- Specify a range using the A/B cursors. (Memory Function only)

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the CH.SET key → X-Y settings window

4 Set the waveform color in the graph display.

Move the cursor to the for which you want to set the color, and make the selection.

You can also select the same color as for another channel.

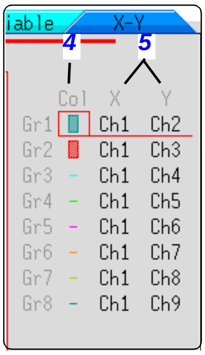
Select

Off	Waveform display is off. When a save channel is specified as display channel, Auto Save will not be carried out. "Select the channel to save." (⇒ p.71)
On	Waveform is displayed. Select the display color with the **F** keys **[↑]**, **[↓]**.

5 Select the channels for X-Y synthesis.

Move the cursor to the items for the X (time axis) and Y (voltage axis) and assign a channel.

The same channel can also be assigned multiple times.



	Col	X	Y
Gr1	▨	Ch1	Ch2
Gr2	▨	Ch1	Ch3
Gr3	-	Ch1	Ch4
Gr4	-	Ch1	Ch5
Gr5	-	Ch1	Ch6
Gr6	-	Ch1	Ch7
Gr7	-	Ch1	Ch8
Gr8	-	Ch1	Ch9

Synthesis for A/B section of a waveform

Perform the following steps.

1. Press the **STATUS** key to bring up the Status screen, and select the **[Status]** sheet.
2. Select 1, 2, 4, or 8 screens as **[Format]**.
3. Press the **DISP** key to display the waveform.
4. Use the A/B cursors to specify the range for synthesis. See the following pages. (⇒ p.102), (⇒ p.105)
5. Press the **STATUS** key to bring up the Status screen, and select the **[Status]** sheet.
6. Select **[X-Y Single]** or **[X-Y Quad]** for **[Format]**.

To move pen on synthesized waveform

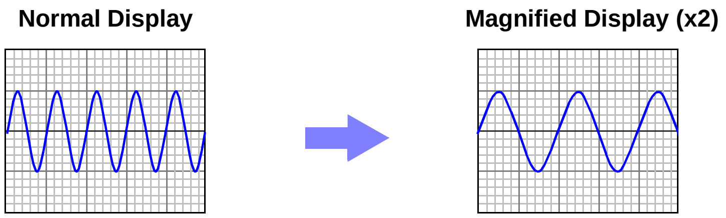
Press the **WAVE** key so that the key is lit. The pen can now be moved over the entire waveform with the Jog & Shuttle knobs. The time at the pen position is shown at the top right of the screen.

7.5 Magnifying and Compressing Waveforms

7.5.1 Magnifying and Compressing Horizontal Axis (Time Axis)

MEM **REC**

This applies to the Memory function and Recorder function. (However, with the Recorder function, waveform magnification is not available.)
Data details can be observed by magnifying the waveform along the horizontal axis (time axis). Also, by compressing the time axis, overall waveform fluctuations can be readily seen.
On-screen magnification and compression is based on the left edge of the screen. However, when A/B cursor appears on the screen, use the cursor as the standard to expand or compress.
The amount of magnification/compression can be changed after measurement.



Procedure

To open the screen: Press the DISP key → Waveform screen

1 Move the cursor to the Magnification.

2 Select display magnification.

Memory Function

Select

x10, x5, 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, x1/100000

When **[Zoom On]** is selected, a section of the time axis will be magnified.

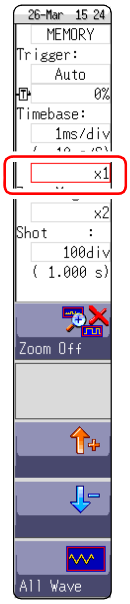
See: "7.5.2 Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis)" (⇒ p.111)

When **[All Wave]** is selected, the entire recording length waveform will be displayed.

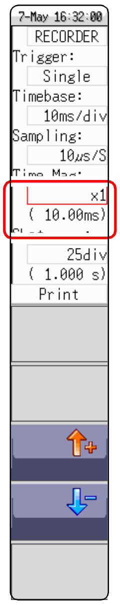
Recorder Function

Select

x1, x1/2, x1/5, x1/10, x1/20, x1/50, x1/100, x1/200, x1/500, x1/1000, x1/2000, x1/5000, x1/10000, x1/20000



26-Mar 15 24
MEMORY
Trigger:
Auto
0%
Timebase:
1ms/div
x1
x2
Shot :
100div
(1.000 s)

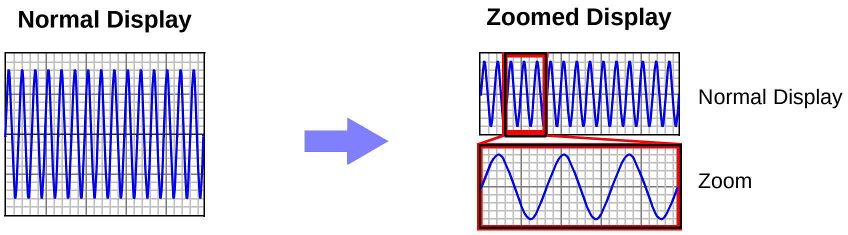


7-May 16:32:00
RECORDER
Trigger:
Single
Timebase:
10ms/div
Sampling:
10μs/S
x1
(10.00ms)
25div
(1.000 s)

To print at a different zoom ratio from the display
Specify the ratio on the **[Printer]** sheet.
See: "Set the horizontal axis (time axis) magnification and compression." (⇒ p.96)
When a waveform loaded from media is displayed at a high compression ratio, the display may be slow to update.

7.5.2 Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis)) MEM

This applies to the Memory function only.
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.



NOTE When you press the **PRINT** key while using the Zoom function, the waveform displayed on the lower half of the screen is printed. (The print format will be as for a single screen waveform. If the A/B cursors are used, the selected section will be printed.)

Procedure

To open the screen: Press the DISP key → Waveform screen

1 Move the cursor to the magnification.

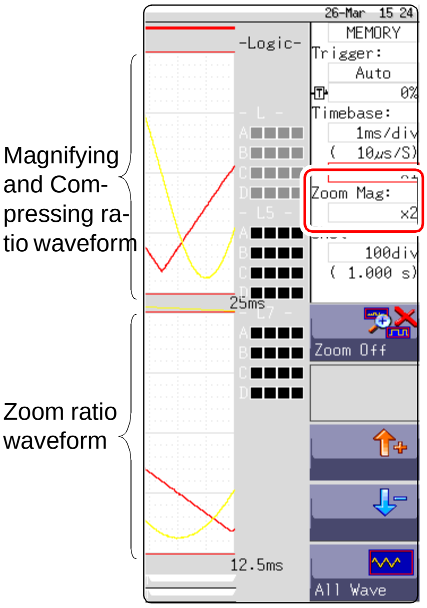
2 Select **[Zoom On]**.

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 Select display magnification for the zoomed waveform section.

Move the cursor to the **[Zoom Mag]**, and set the magnification.

The zoomed waveform section at the lower half of the screen is magnified. When the same value or a smaller value than the magnification/compression ratio is specified, the ratio is automatically set to a setting one step higher than the **[Zoom Mag]** setting.



4 Scrolls the zoomed section of the waveform.

See: "7.3.2 Scrolling With Jog and Shuttle Knobs (Scroll)" (⇒ p.106)

To cancel Zoom:
Move the cursor to the magnification, and select **[Zoom Off]**.
(The condition is canceled while keeping the inherited zoom ratio.)

Example: When the zoom ratio was set to x5 and zoom is canceled, the ratio setting will be **[x5]**.

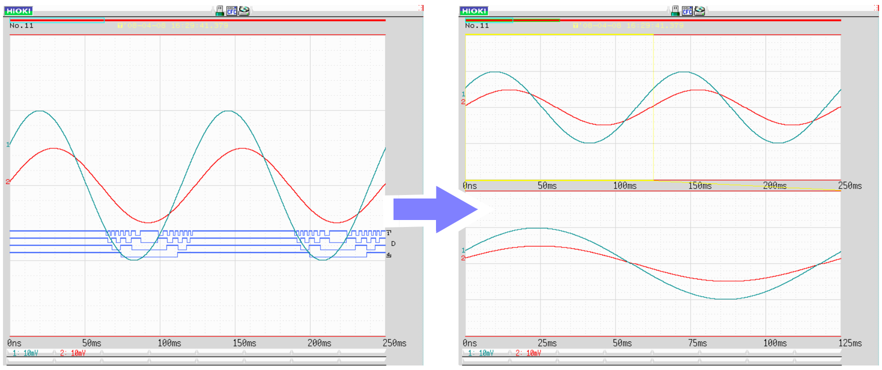
To view the entire waveform (Memory function only)
Move the cursor to the ratio item in the settings window and select **[All Wave]**.
The waveform information for the entire recording length is displayed.

Description

About logic waveform display

When the Zoom function is enabled, and the logic waveform display position is at less than **[50pos]**, the logic waveform will not be displayed.

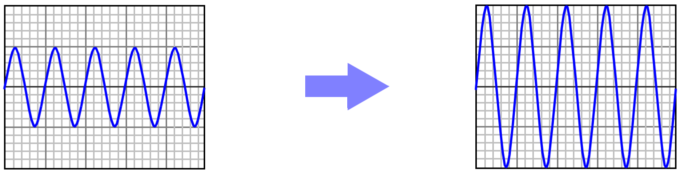
Example: Display position **[30pos]**


Normal Display
Zoomed Display

7.5.3 Magnifying and Compressing Vertical Axis (Voltage Axis)

MEM **REC**

This applies to the Memory function and Recorder function.
Waveforms on each channel can be magnified or compressed along the vertical axis (voltage axis) for display or printing.
Magnification and compression based on zero position.


Normal Display
Magnified Display

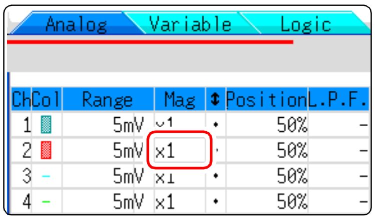
Procedure

To open the screen: Press the DISP key → Waveform screen → Press the CH.SET key → Channel settings window ([Analog] sheet)

Move the cursor to the **[Mag]** item of the channel to adjust.

Select

x1/10, x1/5, x1/2, x1, x2, x5, x10, x20, x50, x100



Ch	Col	Range	Mag	↕	Position	L.P.F.
1	▨	5mV	x1	•	50%	-
2	▨	5mV	x1	•	50%	-
3	-	5mV	x1	•	50%	-
4	-	5mV	x1	•	50%	-

Selecting **[Invert]** will invert plus and minus in the waveform.
See: "8.8 Inverting the Waveform (Invert Function)" (⇒ p.138)

To display at an arbitrary ratio
See: "8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)

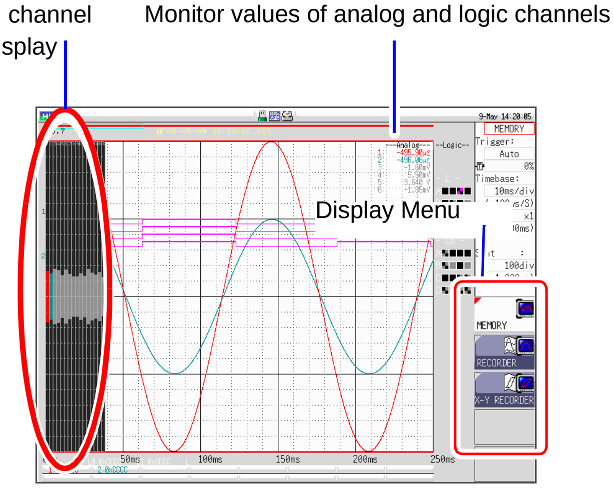
7.6 Monitoring Input Levels (Level Monitor)

All input waveform levels can be monitored in real time.
Analog channels and logic channels can be displayed at the same time.

Procedure

To open the Menu**: Press the DISP key → Display Menu**

Selecting **[Monitor]** brings up the analog channel level display in the left part of the Waveform screen, and the logic channel level display in the right part of the Waveform screen.

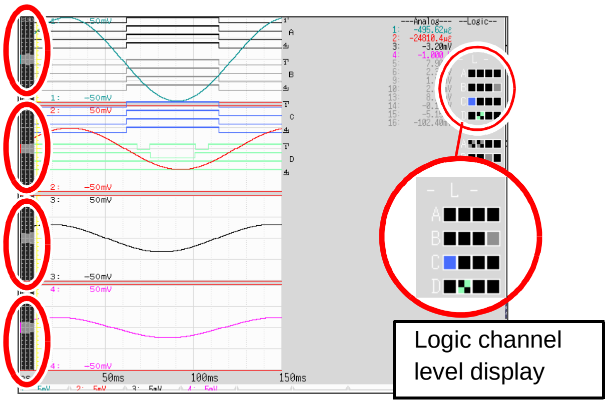


To hide the level monitor:
Select **[Monitor]** again.

Display format 2 - 8 screens (⇒ p.48)
Level monitors are displayed for each graph.

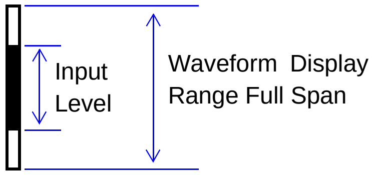
Upper and lower limit indication is combined with level monitor.

See: "7.7.1 Showing Upper/Lower Limit On Waveform Screen" (⇒ p.114)



How to View a Level Monitor

Level display of an analog channel



Level display of logic channels

☐ — High
▚ — Hi gh& Low
■ — Low

When the display setting is On, the part indicated in white takes the color specified for the waveform display. When the setting is Off, the part becomes gray. The part indicated in black takes the background color.

NOTE

- Input levels are not displayed for channels having no corresponding input module installed.
- Channels higher than the number specified for **[Used Ch]** do not display the analog input level.
  (Example: When **[Used Ch]** is set to **[Ch1-4]**, the level for channel 5 and higher numbers is not displayed.)

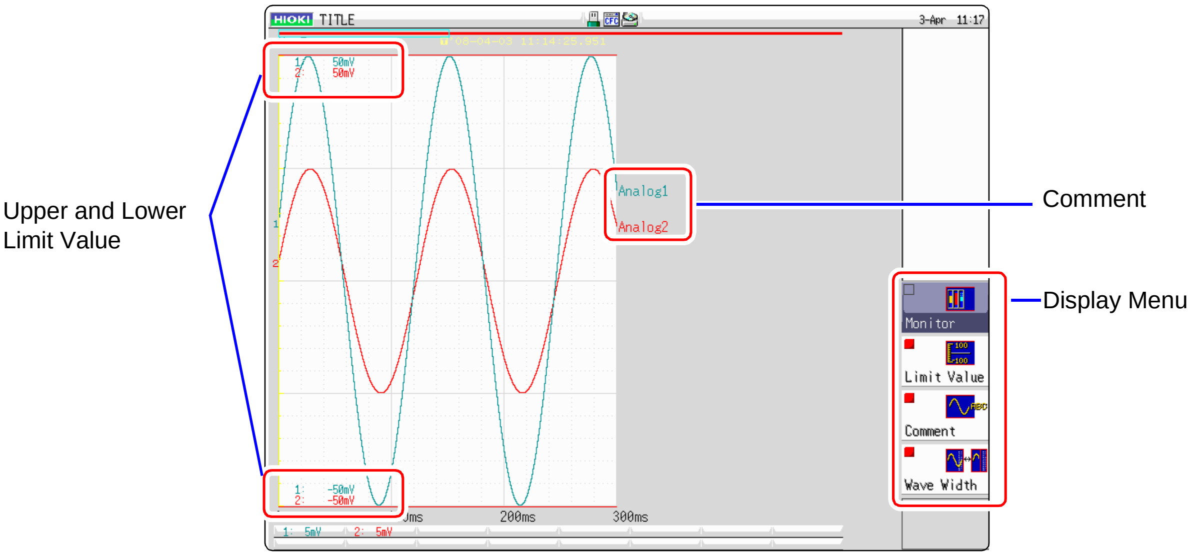
7.7 Switching the Waveform Screen Display (Display Menu)

The display menu allows you to bring up additional information such as upper/lower limit value indication and comment display. It also allows you to set the waveform display width.

See: About level monitor (⇒ p.113)

Procedure

To open the menu Press the DISP key → Waveform screen Press the DISP key → Display Menu



To hide the menu:
Select the same menu again.

7.7.1 Showing Upper/Lower Limit On Waveform Screen

Select **[Limit Value]** to show the upper/lower limit value indication on the Waveform screen.

7.7.2 Showing Comments On Waveform Screen

Select **[Comment]** to show the comment indication on the Waveform screen.

- Comment information must have been entered via the **[Comment]** sheet on the Channel screen.
  See:"8.1 Adding Comments" (⇒ p.118)
- When overlapped with other displayed elements, the comments may not display properly. Hide the Channel Settings Window, Trigger Settings Window, Level Monitor, etc., or decrease the **[Wave Width]**.

7.7.3 Switching the Waveform Display Width

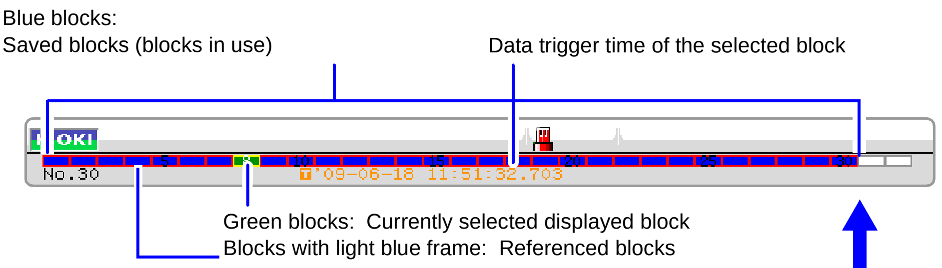
Select **[Wave Width]** to change the display width of the Waveform screen.
If a waveform is hard to see because of numeric value and settings information, this function can be used to separate the waveform and other information.
The function is also active for the Channel settings window and Trigger settings window.

7.8 Seeing Block Waveforms

MEM

This applies to the Memory function only.
If recorded by memory division, the usage status of blocks can be checked. Furthermore, the desired block can be selected and the recorded waveform can be displayed.
When memory division is not used, depending on the record length, it is possible to display the last 16 measured waveforms.

See: "7.3 Moving the Waveform Display Position" (⇒ p.106)

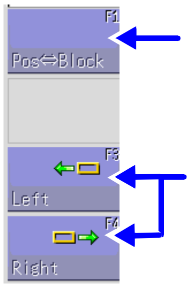

Blue blocks:
Saved blocks (blocks in use)

Data trigger time of the selected block

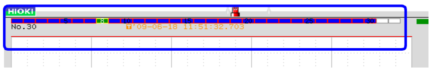
Green blocks: Currently selected displayed block
Blocks with light blue frame: Referenced blocks

1. **Press the DISP key to display the waveform screen.**

2. **Press the WAVE key.**



3. **Select [Pos↔Block].**
The block is displayed in the upper part of the screen.



4. **Use [Left] or [Right] to move the displayed block.**

When you want to overlap with other blocks (reference blocks)
Open the Status screen to the **[Memory Div]** sheet and set **[Ref Block]** to **[On]** and select **[All Blks On]**.
See: "12.2 Display Settings" (⇒ p.204)

Utility Functions Chapter 8

Various utility functions are described in the section.

Utility Functions

Adding Comments (⇒ p.118)

Setting the channels to use (Making recording length longer) (⇒ p.127)

Converting input values (Scaling) (⇒ p.128)

Setting the waveform display freely(⇒ p.134)

Fine Adjustment of Input Values (⇒ p.137)

Inverting a waveform (⇒ p.138)

Copying a setting to another channel(⇒ p.139)

Applicable measurements and settings

- Displaying Waveforms During Recording (⇒ p.124)
- Overlaying with past recorded waveforms (⇒ p.125)

Detailed input module settings (⇒ p.140)

- Making anti-aliasing filter settings
- Selecting the thermocouple type
- Making reference point compensation settings
- Making wire break detection settings
- Making data updating settings
- Executing auto balance
- Making probe attenuation settings
- Making response settings
- Making measurement mode settings

8.1 Adding Comments

This section explains how to enter title comments and channel comments.
Information about alphanumeric input is also provided.

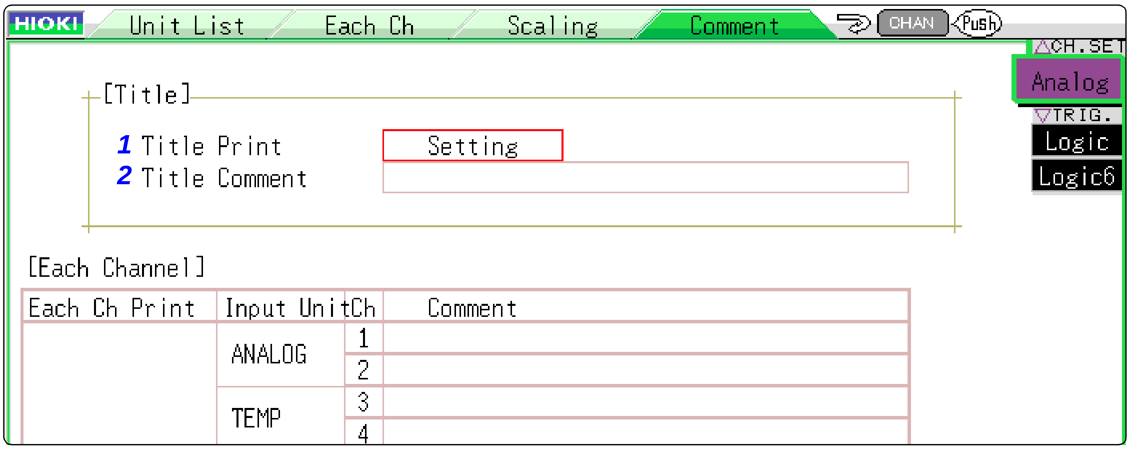
8.1.1 Adding a Title Comment

When you enter a title comment, it can be displayed at the top of the Waveform screen, and it can also be printed. (Allowed number of characters: up to 40)

See: "6.6.2 Report Print (A4 Size Print)" (⇒ p.98)

Procedure

To open the screen: Press the CHAN key → [Comment] sheet



[Title]

1 Title Print	Setting
2 Title Comment	

[Each Channel]

Each Ch Print	Input Unit	Ch	Comment
	ANALOG	1	
		2	
	TEMP	3	
		4	

1 **Set the print title content**

Move the cursor to the **[Title Print]** item for the title.

Select

Off	Title comment is not printed.
Setting	Equipment settings are printed.
Comment	Title is printed.
Set&Com	Both equipment settings and title are printed.

2 **Enter a title comment.**

Move the cursor to the **[Title Comment]** item.

Select

Input	Enter comment text. See: "Entering Text" (⇒ p.121)
Clear	Clear entered information
Undo	Return to condition of preceding step

To select from preset terms

Pressing the **WAVE** key after activating text input brings up a list of preset terms.

It is also possible to select words from previously entered titles (History function).

See: "Entering Text From a Term List Or History List" (⇒ p.122)

8.1.2 Adding a Channel Comment

Comments added for each channel can be displayed on-screen. Comments can also be printed on recording paper. (Allowed number of characters: up to 40)

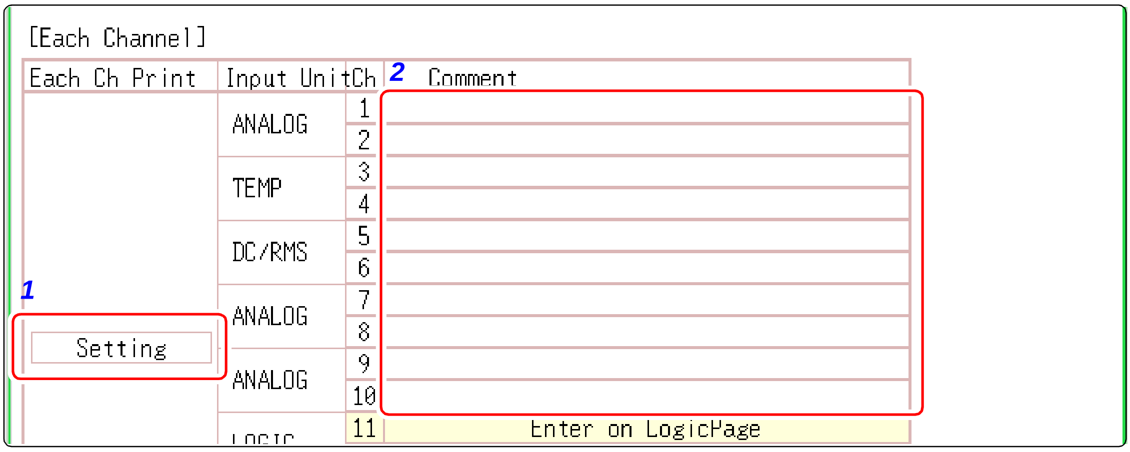
To copy a comment to another channel

The **[Comment]** sheet can be used to copy a comment.

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

Procedure

To open the screen: Press the CHAN key → [Comment] sheet



[Each Channel]

Each Ch Print	Input Unit	Ch	Comment
	ANALOG	1	
		2	
	TEMP	3	
		4	
	DC/RMS	5	
		6	
Setting	ANALOG	7	
		8	
	ANALOG	9	
		10	
	LOGIC	11	Enter on LogicPage

1 **Select the print content for each analog channel.**

Move the cursor to the **[Each Ch Print]** item for each channel.

Select

Off	No channel comment is printed.
Setting	Settings for each channel are printed. (Not displayed on screen)
Comment	Comments for each channel are printed.
Set&Com	Both settings and comments for each channel are printed.

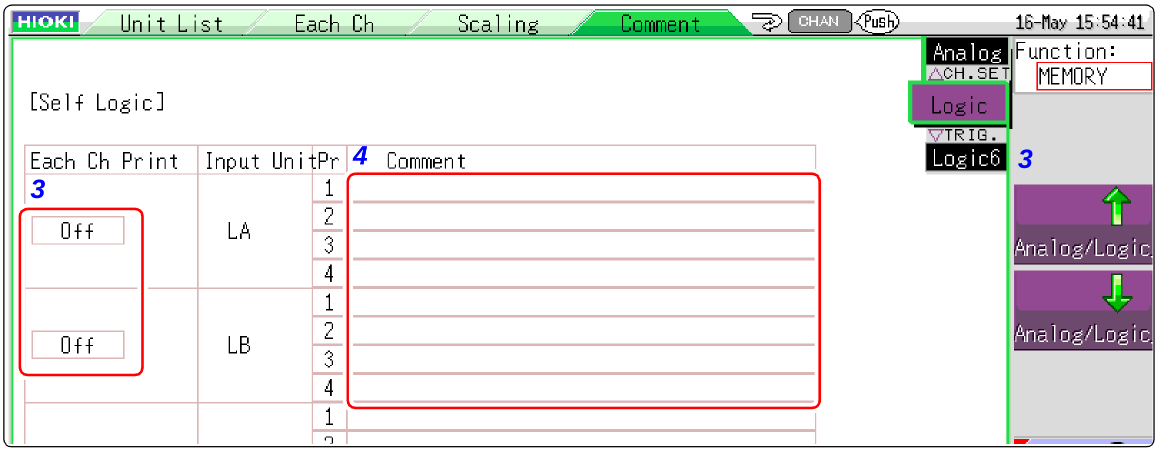
2 **Enter the comment for each analog channel.**

Move the cursor to the **[Comment]** item.

Select

Input	Enter comment text. See: "Entering Text" (⇒ p.121)
Clear	Clear entered information
Undo	Return to condition of preceding step

To select from preset terms
Pressing the **WAVE** key after activating text input brings up a list of preset terms.
It is also possible to select words from previously entered titles (History function).
See: "Entering Text From a Term List Or History List" (⇒ p.122)



3 Select the print content for each logic channel.

Select **[Analog/Logic]** to display logic channel page.

Move the cursor to the **[Each Ch Print]** item.

Select

Off	Comments are not printed.
Comment	Comments are printed.

4 Enter the comment for each logic channel.

Move the cursor to the **[Comment]** item.

Select

Input	Enter comment text. See: "Entering Text" (⇒ p.121)
Clear	Clear entered information
Undo	Return to condition of preceding step

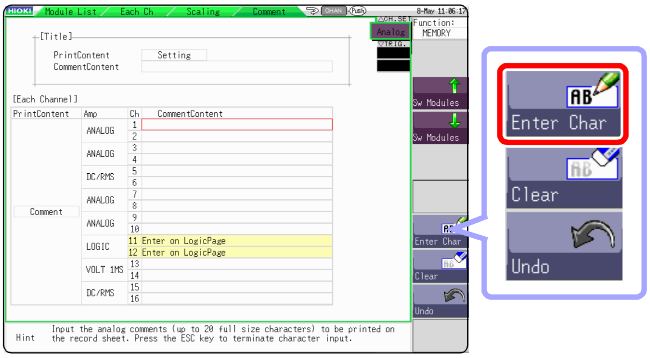
To select from preset terms
Pressing the **WAVE** key after activating text input brings up a list of preset terms.
It is also possible to select words from previously entered titles (History function).
See: "Entering Text From a Term List Or History List" (⇒ p.122)

8.1.3 Alphanumeric Input

Move the cursor to the setting item for which to make the input, and choose the content with the **F** keys.

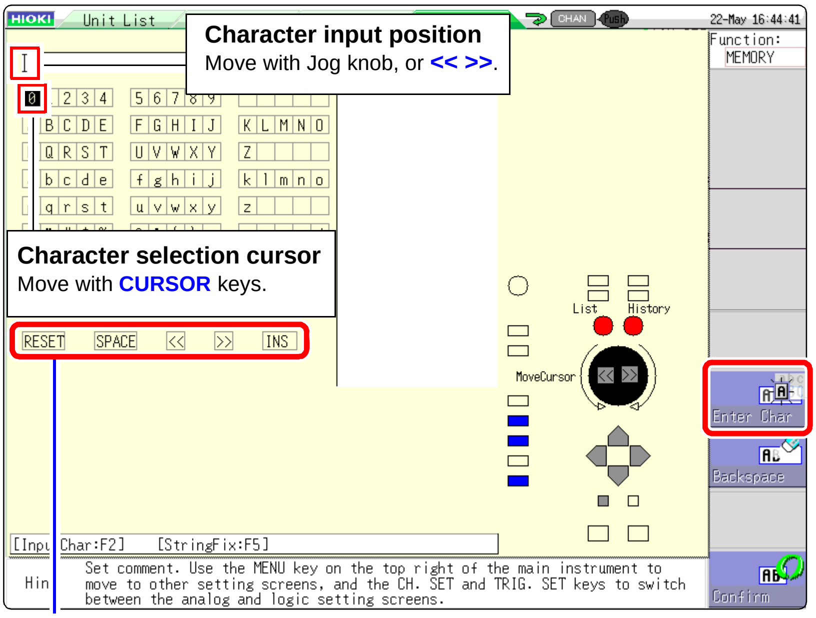
Entering Text

1. Move the cursor to the comment field and select **[Enter Char]**.
A virtual keyboard appears.



Hint Input the analog comments (up to 20 full size characters) to be printed on the record sheet. Press the ESC key to terminate character input.

2. Select a character with the **CURSOR** key from the virtual keyboard, and select **[Enter Char]** to enter it.



Character input position
Move with Jog knob, or **<< >>**.

Character selection cursor
Move with **CURSOR** keys.

Hint Set comment. Use the MENU key on the top right of the main instrument to move to other setting screens, and the CH. SET and TRIG. SET keys to switch between the analog and logic setting screens.

RESET: Deletes all entered characters (Move the cursor to the **RESET**, and push the **[Enter Char]**.)
SPACE: Inserts a space (Move the cursor to the **SPACE**, and push the **[Enter Char]**.)
OVWR/INS: Toggles between Overwrite (OVWR) and Insert (INS) mode (Move the cursor to the **[OVWR/INS]**, and push the **[Enter Char]** to switch OVWR/INS)
<<: Move the character input position left.
>>: Move the character input position right.

3. Select **[Confirm]** to accept the entry.
Press the **ESC** key to cancel the input.
(Pressing the **ESC** key again closes the virtual keyboard)

NOTE

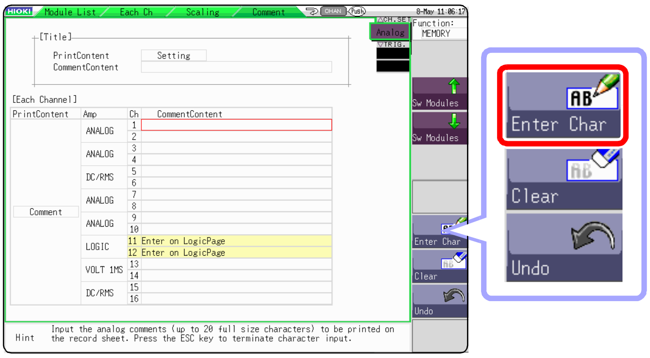
Entering units and symbols
Characters entered at the unit may be saved differently.
Save (saving of numerical calculation results or text format information)
^{2} → ^2, ^{3} → ^3 , μ→ ~u, Ω→ ~o, ε → ~e, °→ ~c ,
±→ ~+, με (display only)→uE, °C (display only)→ C

Characters not allowed in the file name have been detected. (Please use only uppercase letters.)

Entering Text From a Term List Or History List

While the virtual keyboard is displayed, pressing the **WAVE** key brings up a "Term List" and pressing the **AB CSR** key brings up a "History List".
This can be used to enter preset terms or reuse text from a previous input session.

1. Move the cursor to the comment field and select **[Enter Char]**.
The virtual keyboard appears.



[Title]

PrintContent Setting
CommentContent

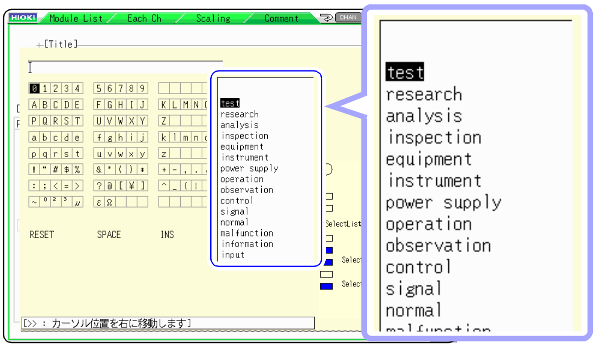
[Each Channel]

PrintContent	Amp	Ch	CommentContent
Comment	ANALOG	1	
		2	
	ANALOG	3	
		4	
	DC/RMS	5	
		6	
	ANALOG	7	
		8	
	ANALOG	9	
		10	
	LOGIC	11	Enter on LogicPage
		12	Enter on LogicPage
	VOLT 1MS	13	
		14	
	DC/RMS	15	
		16	

Hint Input the analog comments (up to 20 full size characters) to be printed on the record sheet. Press the ESC key to terminate character input.

2. (To select from preset terms)

Press the **WAVE** key.
A list of preset terms appears.

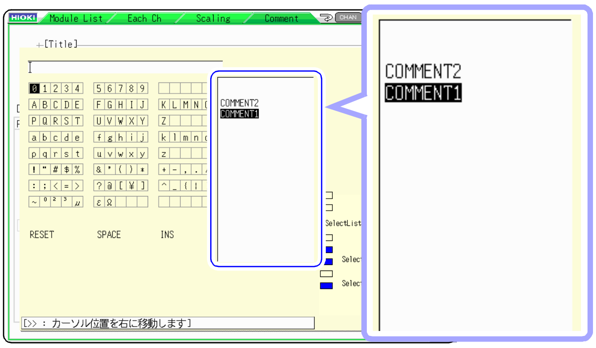


test
research
analysis
inspection
equipment
instrument
power supply
operation
observation
control
signal
normal
malfunction
information
input

[▷ : カーソル位置を右に移動します]

(To select from past input)

Press the **AB CSR** key.
A History list appears.



COMMENT2
COMMENT1

[▷ : カーソル位置を右に移動します]

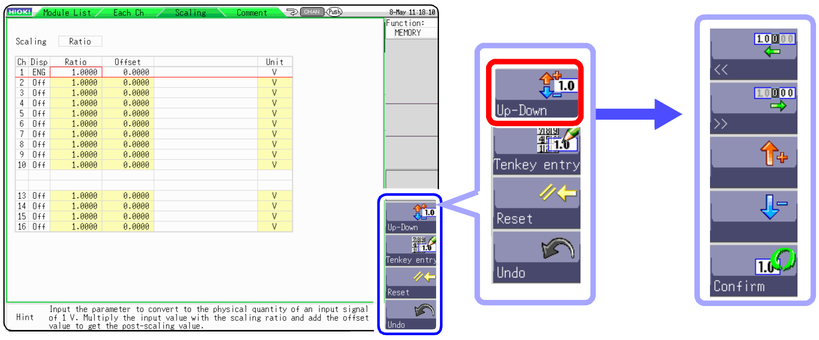
Press the **ESC** key to cancel selection from the history list.

3. Use the **CURSOR** ⌂ ▽ keys or the Jog knob to select a term from the list, and select **[Enter Char]**.

4. Select **[Confirm]** to accept the entry. The virtual keyboard disappears.
To return the edited field to the original condition, select **[Undo]**.

Entering Numerals By Up/Down Action

1. Move the cursor to the numeric input field and select **[Up-Down]**.
A virtual keyboard for digit input appears.

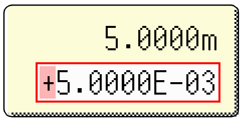


Scaling Ratio

Ch	Disp	Ratio	Offset		Unit
1	ENG	1.0000	0.0000		V
2	Off	1.0000	0.0000		V
3	Off	1.0000	0.0000		V
4	Off	1.0000	0.0000		V
5	Off	1.0000	0.0000		V
6	Off	1.0000	0.0000		V
7	Off	1.0000	0.0000		V
8	Off	1.0000	0.0000		V
9	Off	1.0000	0.0000		V
10	Off	1.0000	0.0000		V
13	Off	1.0000	0.0000		V
14	Off	1.0000	0.0000		V
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

Hint Input the parameter to convert to the physical quantity of an input signal of 1 V. Multiply the input value with the scaling ratio and add the offset value to get the post-scaling value.

2. Use the virtual keyboard to enter the numerals.
(Use **F1** and **F2** to move digit position, and use **F3** and **F4** to increase or decrease the value.)

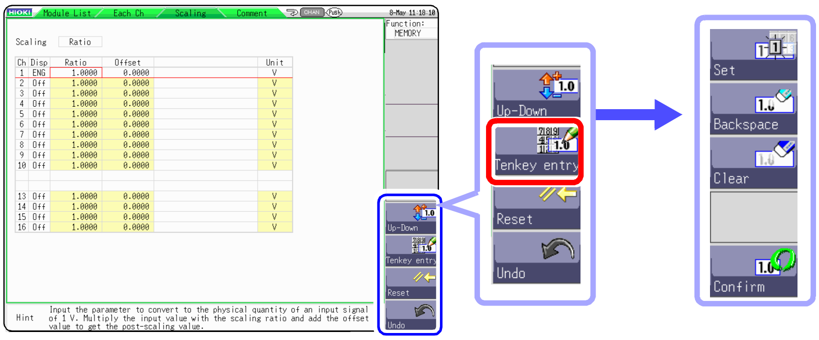


5.0000m
+5.0000E-03

3. Select **[Confirm]** to accept the entry.
Press the **ESC** key to cancel the input.

Entering Numerals With a Numeric Keypad

1. Move the cursor to the numeric input field and select **[Tenkey Entry]**.
A virtual keyboard for numeric keypad input appears.

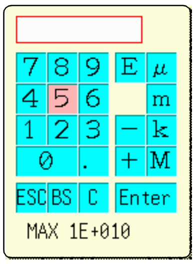


Scaling Ratio

Ch	Disp	Ratio	Offset		Unit
1	ENG	1.0000	0.0000		V
2	Off	1.0000	0.0000		V
3	Off	1.0000	0.0000		V
4	Off	1.0000	0.0000		V
5	Off	1.0000	0.0000		V
6	Off	1.0000	0.0000		V
7	Off	1.0000	0.0000		V
8	Off	1.0000	0.0000		V
9	Off	1.0000	0.0000		V
10	Off	1.0000	0.0000		V
13	Off	1.0000	0.0000		V
14	Off	1.0000	0.0000		V
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

Hint Input the parameter to convert to the physical quantity of an input signal of 1 V. Multiply the input value with the scaling ratio and add the offset value to get the post-scaling value.

2. Use the virtual keyboard for numeric keypad input.



ESC: Cancel the input
BS: Delete 1 character
C: Delete all characters
Enter: Accept the entry

3. Select **[Confirm]** to accept the entry.
Press the **ESC** key to cancel the input.

8.2 Displaying Waveforms During Recording (Roll Mode)

MEM

This applies to the Memory function only.
You can display and print the waveform at the same time as the data are acquired (if Auto Print is enabled). (⇒ p.91)

- If measurement is carried out at low sampling speed settings using the Memory function, a long time will be required until data for the entire recording length have been collected. In such cases, the Roll Mode function is convenient.
- The new waveform scrolls automatically.

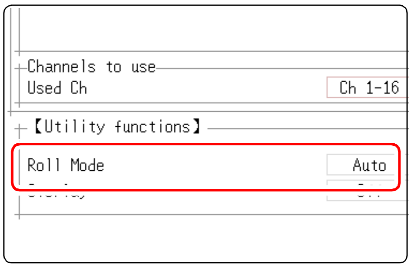
Procedure

To open the screen: Press the STATUS key → [Status] sheet

Move the cursor to the **[Roll Mode]** item.

Select

Off	Normal recording. Data is displayed only after acquiring the specified recording length.
On	Waveforms are displayed while recording (with 10 ms and slower settings). When the timebase is set to 5 ms/div or faster, waveforms are not displayed until after acquisition has finished.
Auto	Regardless of the timebase setting, whether or not the waveform is displayed depends on the waveform display magnification settings while the data is being recorded.However, if the waveform display is set for a faster timebase than 20 ms/div, it is only displayed after acquisition has finished.



Channels to use
Used Ch Ch 1-16
【Utility functions】
Roll Mode Auto

NOTE During longer recording operations, the waveform will scroll, so that you can always observe the latest signal.

Description

When the Roll mode function is On

- **Roll Mode and Overlay cannot be used together.**
  When Roll Mode is enabled, the Overlay setting is forced to **[Off]**. When Overlay is enabled, the Roll Mode setting is forced to **[Auto]**. (⇒ p.125)
- The roll mode, memory division and waveform calculation functions cannot be used simultaneously.

Roll Mode Function	Memory Division Function	Waveform Calculation Function
On	Off	Off
Off	On	Off
Off	Off	On

Note: When one function is set to On, the other functions are automatically set to Off.

- When Auto Print (⇒ p.91) is enabled, printing is available simultaneously with waveform display (if the internal printer is installed). However, for X-Y waveforms, all data must be acquired before printing.
  In addition, during evaluation by numerical calculation, automatic printing is carried out according to the evaluation conditions at the end of the numerical calculation.

When the Roll Mode function is Off

Waveforms are displayed after the data has been acquired for the entire recording length, so with slow sampling there may be a long wait after starting measurement before the waveform is displayed.

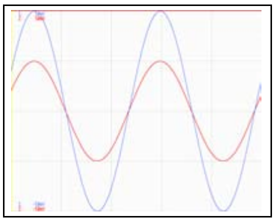
8.3 Displaying New Waveforms Over Past Waveforms (Overlay)

MEM

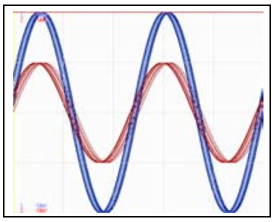
This applies to the Memory function only.
Displayed waveforms are retained on-screen and overlaid with new waveforms.

- Use this to compare new waveforms with those recorded immediately before. (When the trigger mode is **[Repeat]** or **[Auto]**) (⇒ p.153)
- There are two overlay methods: automatic overlay during measurement and manual overlay.

Normal Display



Waveforms with the Overlay Function



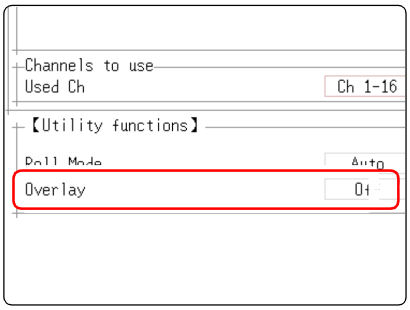
Procedure

To open the screen: Press the STATUS key → [Status] sheet

Move the cursor to the **[Overlay]** item.

Select

Off	Overlay disabled.(default setting)
Auto	Each time a waveform is acquired, it is automatically displayed as an overlay. When the trigger mode is **[Cont.]** or **[Auto]**, waveforms will be overlaid from start until stop.
Manual	Overlay waveforms on the screen manually. Regardless of the trigger mode, the waveform is left on the screen. (⇒ p.125)



Channels to use
Used Ch Ch 1-16
【Utility functions】
Roll Mode Auto
Overlay Of

This mode cannot be used simultaneously with the Roll Mode.
"When the Overlay function is enabled ([Auto] or [Manual])." (⇒ p.126)

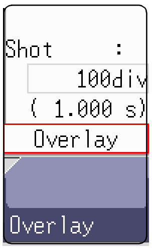
Manual Overlay (Any waveform can be retained on-screen)

To open the screen: Press the DISP key →Waveform screen

Move the cursor to the **[Overlay]**.

Select

Overlay (F1 key)	Pressing F1 key **[Overlay]** leaves the loaded waveform on the screen. The overlay is displayed until the waveform is cleared.
Clear (F5 key)	Clears the screen of all overlaid waveforms. Cleared waveforms cannot be displayed again.



Shot :
100div
(1.000 s)
Overlay
Overlay

Description

When the Overlay function is enabled ([Auto] or [Manual]).

- The Roll Mode function (⇒ p.124) and Overlay functions (⇒ p.125) cannot both be enabled at the same time. When the Roll Mode is enabled, the Overlay function is automatically set **[Off]**. And when Overlay function is enabled, automatically turns the Roll Mode **[Auto]**.
- Printing and A/B Cursor tracing apply only to the last-acquired waveform.
- The following operations are not available on the Waveform screen.
  Waveform scrolling, Zoom function On/Off, Changing horizontal axis (time axis) magnification/compression, Changing zero position
- In the following cases, overlaid waveforms are cleared and only the most recent waveform is displayed.
  - When **[Format]** was changed on the **[Status]** sheet
  - When the **[Combo Area]** setting has been changed (**[Format]** set to **[X-Y Single]** or **[X-Y Quad]**)
  - Waveform display setting was changed on **[Unit List]** sheet or **[Each Ch]** sheet (Display magnification, zero position, variable, display on/off, waveform color)

8.4 Setting Channels to Use (Extending the Recording Length)

MEM

This applies to the Memory function only.
Select the analog and logic channels to use.
Maximum recording length is available when the fewest necessary channels are enabled for use.

Minimizing the number of channels in use allows memory to be reallocated to those channels being used.

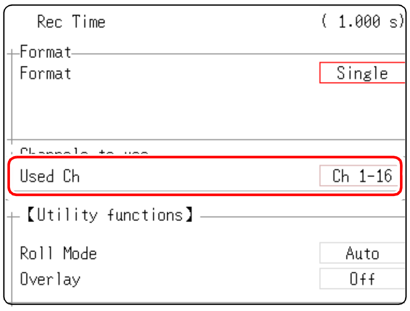
Procedure

To open the screen: Press the STATUS key → [Status] sheet

Move the cursor to the **[Used Ch]**, and select the number of channels to use.

Select

Ch1 - 2 / Ch1 - 4 / Ch1 - 8 / Ch1 - 16 (default setting)



Rec Time (1.000 s)

Format

Format: Single

Channels to use

Used Ch: Ch 1-16

【Utility functions】

Roll Mode: Auto

Overlay: Off

NOTE The standard logic channels LA - LD are stored using 4 bits of the analog channels Ch1 - Ch4.

Logic channels that can be used

When **[Used Ch]** is set, the available logic channels of Model 8973 are as follows.

Used channel	Available logic channel
Ch1-2	L1
Ch1-4	L1 and L2
Ch1-8	L1 to L4
Ch1-16	L1 to L8

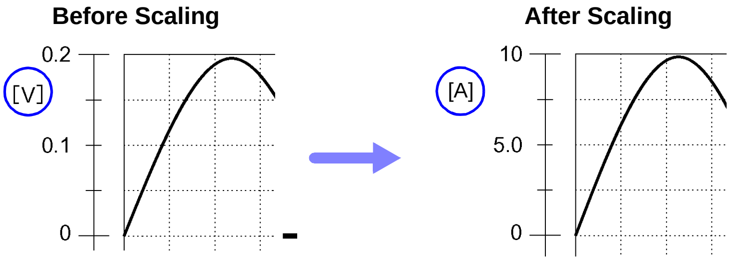
Note that the maximum number of logic modules that can be used is three.

8.5 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.



Before Scaling **After Scaling**

Scaling Setting Example

See: When using a clamp sensor (⇒ p.130) (Example: Converting [V] →[A])
When using the Strain Unit (⇒ p.131) (Example: Converting [με] → [G])

Scaling Methods

Two scaling methods are available:

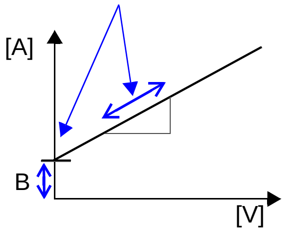
- Conversion Ratio Setting
- Two-Point Setting

(:Example: Converting [V] → [A])

Conversion Ratio Setting

Set the physical value per volt (conversion ratio: eu/V) of the input signal, an offset value and measurement unit name (eu: engineering units) for conversion, so measurement values acquired as voltage are converted to the specified units.
Example:
Conversion ratio: A value per volt, Offset value: B, Unit name: A

Convert from slope (conversion ratio) and offset value



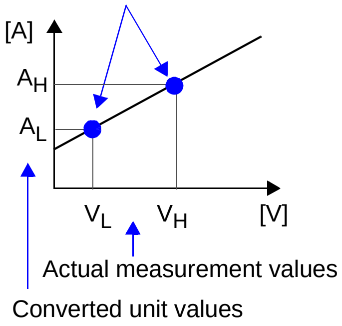
Two-Point Setting

Set the voltage values of two points of the input signal, the converted unit value of these two points and the name of the converted measurement units, so measurement values acquired as voltage are converted to the specified units.
Example:

Voltage value at 2 points		Voltage of units to convert	
V_H:	Higher potential point	A_H:	Value for higher potential point
V_L:	Lower potential point	A_L:	Value for lower potential point

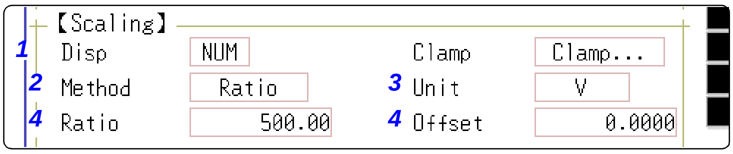
Unit name: A

Conversion ratio and offset value are calculated from the two points and converted



Procedure

To open the screen: Press the CHAN key →[Each Ch] sheet



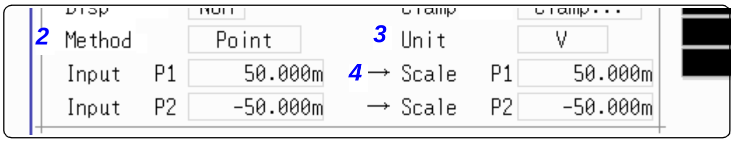
【Scaling】

Disp NUM Clamp Clamp...

Method Ratio Unit V

Ratio 500.00 Offset 0.0000

Display selecting **[Ratio]** for **[Method]** item



Method Point Unit V

Input P1 50.000m → Scale P1 50.000m

Input P2 -50.000m → Scale P2 -50.000m

Display selecting **[Point]** for **[Method]** item

1 Enable the Scaling function.

Move the cursor to the **[Disp]** item.

Select

Off	No scaling.
NUM	Displayed as a decimal and includes a unit (m, k, etc.).
SCI	Displayed as an exponent (the power of ten)

2 Select the scaling conversion method.

Move the cursor to the **[Method]** item.

Select

Ratio	Specify by conversion ratio.
Point	Specify by two points.

3 Specify the physical units.

Move the cursor to the **[Unit]**, and enter the physical unit name. (Up to 7 characters)

See: "Entering Text" (⇒ p.121)

Input example:
Decimal1.2345 mV
Exponent1.2345E-03V

4 Enter the numerical values for conversion.

When you have selected [Ratio] (set conversion ratio and offset)

Move the cursor to the **[Ratio]** and **[Offset]** items.

Enter numerical values in each field.

-9.9999E+9 to 9.9999E+9

When you have selected [2-Point] (set input values for two points and the values after conversion)

Move the cursor to the **[Input P1]**, **[Scale P1]**, **[Input P2]**, and **[Scale P2]**.

Enter numerical values in each field.

-9.9999E+9 to 9.9999E+9

NOTE

- When saving text or results of numerical calculation, some characters and symbols used for display on the instrument will be converted as follows. (8847 display → saved string)
- ^{2} → ^2, ^{3} → ^3 , µ → ~u, Ω→ ~o, ε→ ~e, °→ ~c , ±→ ~+, µε (display only) →uE, °C (display only)→ C

To enter the current input value as is for P1 or P2
Select **[Monitor Val]**.

To reset Scaling settings:
Move the cursor to the **[Method]**, and select **[Reset]**.

To copy the scaling setting to another channel
The Channel screen - **[Scaling]** sheet can be used to copy a setting.
See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

Using the Scaling and Variable functions (⇒ p.134) in combination:
The full span of output from a sensor can be displayed. (⇒ p.136)

NOTE

At factory shipping, automatic correction of the variable function (⇒ p.257) 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.

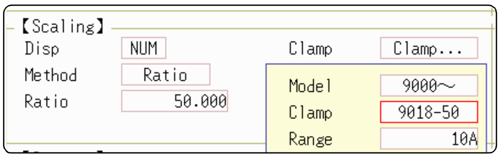
When automatic correction of the Variable function (Variable Auto Adjustment) is disabled (Off), the Scaling and Variable settings are unlinked (independent of one another).

8.5.1 Scaling Setting Examples

Using a Clamp-On Probe

Example 1 **Measure with the 10 A range of the Model 9018-10 Clamp-On Probe and display the measured data in units of [A] (Amperes)**

The 9018-50 Clamp-On Probe provides 0.2 V output when measuring 10 A. So Scaling should be set to display 10 A with 0.2 V input (and 0 A with 0 V input).



【Scaling】
Disp NUM
Method Ratio
Ratio 50.000
Clamp Clamp...
Model 9000～
Clamp 9018-50
Range 10A

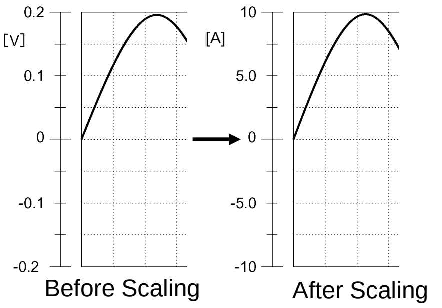
Setting Items	Setting Choice
Disp	NUM or SCI
Clamp	9018-50
Unit*	A
Method*	Ratio
Ratio*	50.000

*: Set automatically when clamp is selected.

Selecting a Clamp Type

1. Move the cursor to the **[Clamp]** item, and select **[Select]**.
   The cursor moves to the **[Model]** item.
2. Select **[9000 ～]**.
   The cursor moves to the **[Clamp]**.
3. Select **[9018-50]** from the clamp list with F key, and select **[Confirm]**.
   Units, scaling method, and ratio are set automatically.
4. Select the same range of the clamp when using the range selection type. Select **[10A]** here.

However, you may need to switch the vertical axis (voltage axis) range to suit actual input values.
For example, to display ±0.2 V at full scale, set the vertical display to 20 mV per division (the instrument's 20 mV/div range)



Before Scaling After Scaling

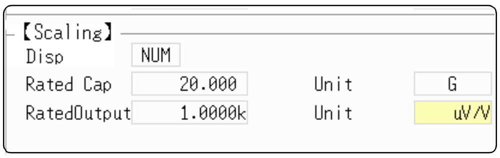
With scaling, signals from the sensor are acquired as current values.
A/B cursors and gauges are displayed and printed with current (Ampere) values.

See: Gauge: (⇒ p.96)
Cursor A/B value: (⇒ p.91)

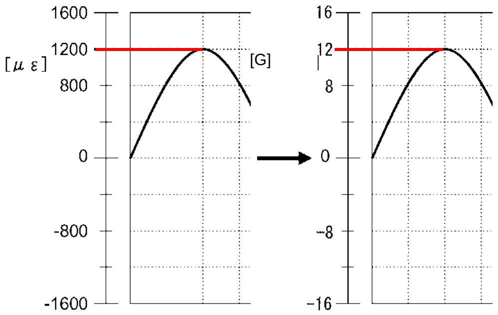
Using Model 8969 Strain Unit

Example 2 **Using the 20 G rated capacity and a sensor with 1000 µV/V rated output, display measured data in units of [G]**

For the rated capacity and rated output, consult the calibration record of the sensor to be used. Set as follows:


【Scaling】
Disp NUM
Rated Cap 20.000 Unit G
RatedOutput 1.0000k Unit uV/V

Setting Items	Setting Choice
Disp	NUM
Unit	G
Rated Cap (Rated capacity)	20 [G]
Rated Output	1k



Before Scaling After Scaling

By using the Scaling function, signals from the sensor are acquired as physical values.
A/B cursors and gauges are displayed and printed as physical (G) values.

See: Gauge: (⇒ p.96)
Cursor A/B value: (⇒ p.91)

NOTE Set the rated capacity (2 x rated output) to be less than ±9.9999±9.

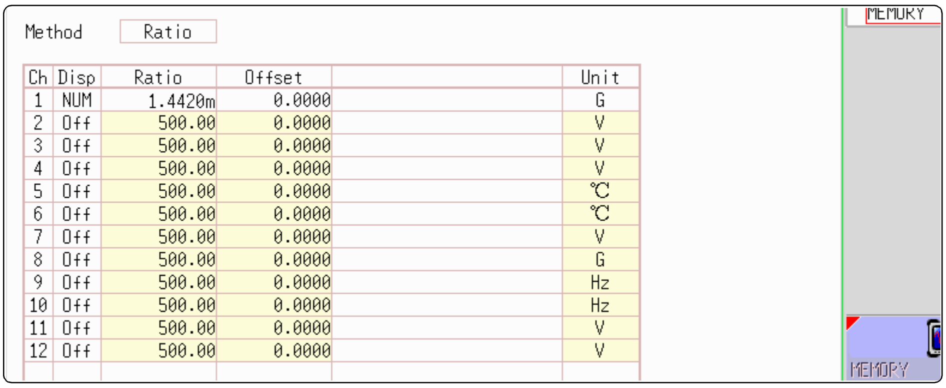
When a calibration factor is stated in the sensor's inspection records

Set the **[Method]** item on the **[Scaling]** sheet to **[Ratio]**.

Example 3 **Measure using a sensor with a calibration factor of 0.001442 G / 1 x 10^{-6} strain*, and display the measured data in [G] units.**

The value of the calibration factor (0.001442 [G]) is set as the conversion ratio. (* 10^{-6} strain = με)
Move the cursor to the channel to set, and making settings as follows.

Setting Items	Setting Choice
Disp	NUM
Unit	G
Ratio (Conversion ratio)	0.001442 [G] (displays as 1.4420m)

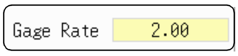


Method Ratio

Ch	Disp	Ratio	Offset	Unit
1	NUM	1.4420m	0.0000	G
2	Off	500.00	0.0000	V
3	Off	500.00	0.0000	V
4	Off	500.00	0.0000	V
5	Off	500.00	0.0000	℃
6	Off	500.00	0.0000	℃
7	Off	500.00	0.0000	V
8	Off	500.00	0.0000	G
9	Off	500.00	0.0000	Hz
10	Off	500.00	0.0000	Hz
11	Off	500.00	0.0000	V
12	Off	500.00	0.0000	V

Using a strain gauge with a Gauge Factor other than 2.0

The 8969 Strain Unit measures the Gauge Rate as 2.0. When using the other strain gauge, the Gauge Factor needs to be set as the conversion ratio. For example, if the Gauge Factor is 2.1, the conversion ratio is 0.952 (2÷2.1).



Gage Rate 2.00

This value cannot be changed.

Example 4 **Measure using a strain gauge (2.1 Gauge Factor), and display the measured data in [G] units.**

The scaling (conversion ratio) needs to be calculated to include both Gauge Factor and physical value conversions. In this case, the conversion ratio setting is the product of the conversion ratios of the Gauge Factor and measurement unit scaling.

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

As in Example 3, enter **[0.0013728]** as the conversion ratio.

* 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.

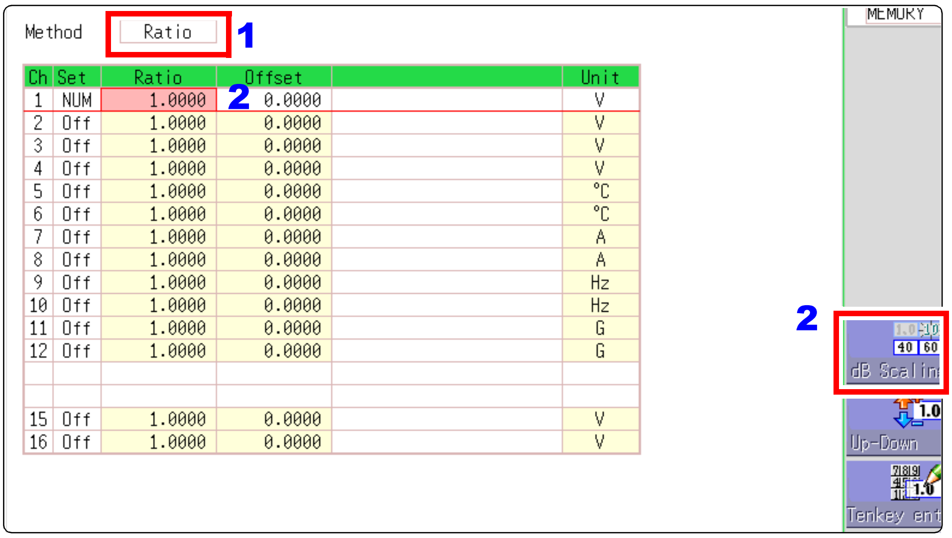
See: "Appendix 2.5 Scaling Method When Using Strain Gauges"(⇒ p.A9)

Using the dB value

Example 5 **Acquiring the conversion rate to convert 40 dB input to 60 dB**

1. For scaling, set the **[Method]** to **[Ratio]**.

2. Point the cursor to the conversion rate setting. Select **[dB Scaling]** in the function column.

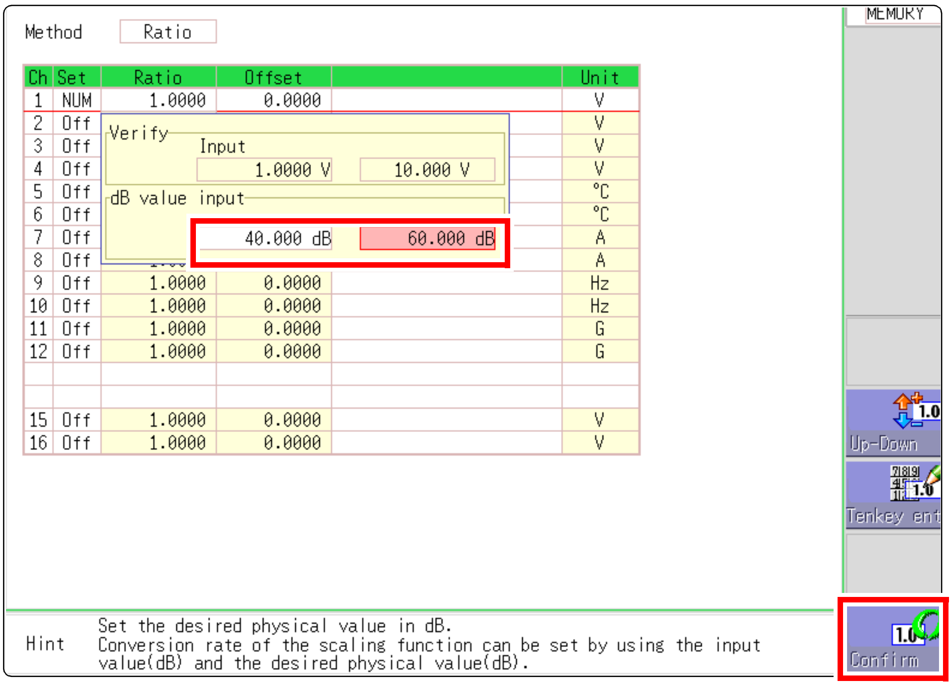


Method Ratio

Ch	Set	Ratio	Offset		Unit
1	NUM	1.0000	0.0000		V
2	Off	1.0000	0.0000		V
3	Off	1.0000	0.0000		V
4	Off	1.0000	0.0000		V
5	Off	1.0000	0.0000		°C
6	Off	1.0000	0.0000		°C
7	Off	1.0000	0.0000		A
8	Off	1.0000	0.0000		A
9	Off	1.0000	0.0000		Hz
10	Off	1.0000	0.0000		Hz
11	Off	1.0000	0.0000		G
12	Off	1.0000	0.0000		G
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

3. In the displayed entry field and physical quantity field, enter 40 dB and 60 dB, respectively.
   After entering the values, select **[Confirm]**.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)



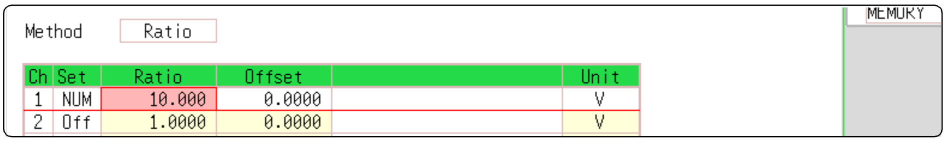
Method Ratio

Ch	Set	Ratio	Offset		Unit
1	NUM	1.0000	0.0000		V
2	Off				V
3	Off				V
4	Off				V
5	Off				°C
6	Off				°C
7	Off				A
8	Off				A
9	Off	1.0000	0.0000		Hz
10	Off	1.0000	0.0000		Hz
11	Off	1.0000	0.0000		G
12	Off	1.0000	0.0000		G
15	Off	1.0000	0.0000		V
16	Off	1.0000	0.0000		V

Verify
Input 1.0000 V 10.000 V
dB value input 40.000 dB 60.000 dB

Hint Set the desired physical value in dB.
Conversion rate of the scaling function can be set by using the input value(dB) and the desired physical value(dB).

The conversion rate for the entered dB value is entered. (The offset becomes 0.)



Method Ratio

Ch	Set	Ratio	Offset		Unit
1	NUM	10.000	0.0000		V
2	Off	1.0000	0.0000		V

8.6 Variable Function (Setting the Waveform Display Freely)

The waveform height and display position can be arbitrarily set along the vertical axis (voltage axis).

NOTE

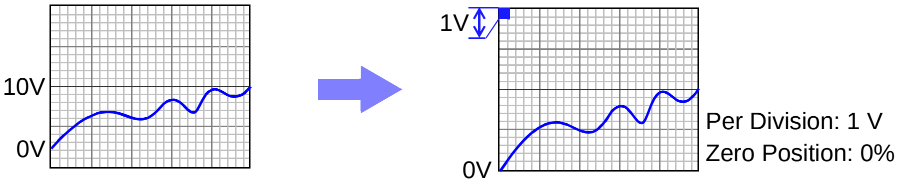
Precautions for using the Variable Function

- 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.

The following two setting methods are available:

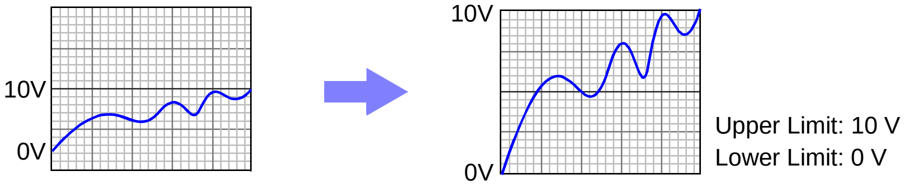
- Set the displayed amplitude per division (1div setting)
  Set the amplitude to be displayed per vertical division and the zero position of the waveform on the vertical axis (voltage axis).

Normal Waveform **Variable Function (Per-Division setting)**



- Set the Upper and Lower Limits (Upper-Lower setting)
  The upper and lower limits on the vertical axis (voltage axis) can be set to display the waveform amplitude full-screen.

Normal Waveform **Variable Function (Set Upper/Lower Limits)**

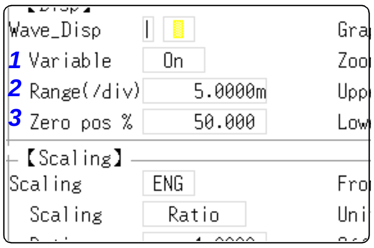


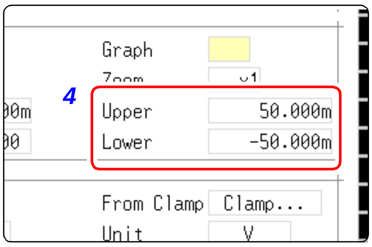
Settings for the Variable function can be made for each individual channel, using the **[Each Ch]** sheet accessed from the Channel screen (⇒ p.135), or for all channels using the Display range window (⇒ p.135).

Make the Valiable Function Setting per channel

Procedure

To open the screen: Press the CHAN key → [Each Ch] sheet


Wave_Disp
1 Variable On
2 Range(/div) 5.0000m
3 Zero pos % 50.000
【Scaling】
Scaling ENG
Scaling Ratio


Graph
4
Upper 50.000m
Lower -50.000m
From Clamp Clamp...
Unit V

1 **Enable the Variable function.**

Move the cursor to the **[Variable]**, and select **[On]**.

2 **Set the display range per division**

Move the cursor to the **[Range(div)]**, and enter numerical value.
(Measurement units depend on the measurement mode of the input module.)
(When this is changed, the upper/lower limit values for the display also change accordingly.)

3 **Set the waveform zero position to display on the vertical axis (vertical axis).**

Move the cursor to the **[Zero pos%]**, and enter numerical % value.
(When this is changed, the upper/lower limit values for the display also change accordingly.)

4 **(When setting upper and lower values)**

Move the cursor to the **[Upper]** and **[Lower]**, and specify the values.
(When this is changed, the display range and zero position values also change accordingly.)

- When upper and lower values are set, waveforms can be displayed at full span on the screen.
- Depending on the scaling setting, the upper and lower display values may be less than 1. In such cases, set **[Variable]** to **[On]** and then select **[Auto Set]**. Easy-to-read upper and lower limit values are set based on the currently set values.

To reset the settings

Select **[Reset]** to return the settings to the default values.

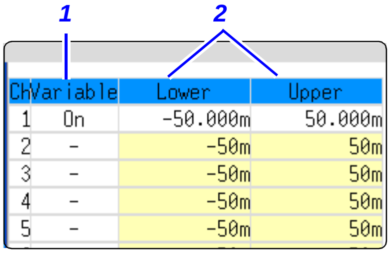
NOTE

- For information on numeric input, see "8.1.3 Alphanumeric Input" (⇒ p.121).
- The **[Unit List]** sheet accessed from the Channel screen also lets you turn the Variable function On or Off individually for each channel.
- By using the Scaling and Variable functions together, the full span of a sensor's output can be displayed. (⇒ p.136)
- When Scaling is enabled, values are displayed in scaling units. When these settings are changed, the numerical values indicating the display range on the level monitor are changed accordingly.

Displaying All Channels for Making the Variable Function Setting

Procedure

To open the screen: Press the DISP key → Waveform screen→ Press the CH.SET key → Display range window



Ch	Variable	Lower	Upper
1	On	-50.000m	50.000m
2	-	-50m	50m
3	-	-50m	50m
4	-	-50m	50m
5	-	-50m	50m

1 **Enable the Variable function.**

Move the cursor to the **[Variable]**, and select **[On]**.

2 **Set the upper and lower limits.**

Move the cursor to the **[Upper]** and **[Lower]**, and enter numerical value.

Description

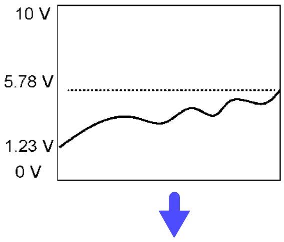
When setting combined use of the Scaling and Variable functions

When Auto-Correction of the Variable function is enabled (On, default setting) (⇒ p.257)
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.

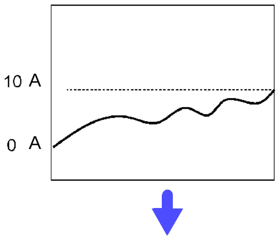
When Auto-Correction of the Variable function is disabled (Off)
Set the Variable function after setting Scaling.
If setting the Variable function first, enter post-scaling values (converted physical values).

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.

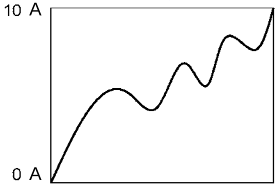
Example:
Set Scaling as follows:
Scaling: Decimal or exponent, Two-Point Setting
Units: A
Sensor Output (Input 1): 1.23 [V]→(Scale 1): 0 [A]
Sensor Output (Input 2): 5.78 [V]→(Scale 2):10 [A]



(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 set on the Channel settings window (**[Analog]** sheet).

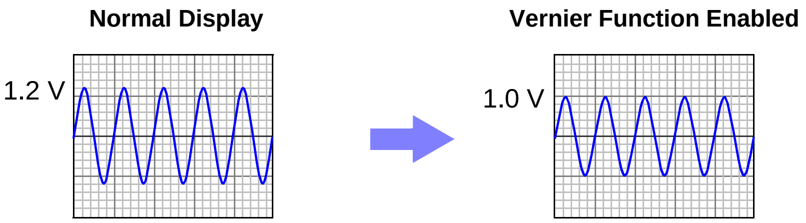


The Variable function is set as follows:
Variable: On, Set Upper/Lower Limits
Lower Limit: 0 [A] Upper Limit: 10 [A]
The full span of output from the sensor is displayed.



8.7 Fine Adjustment of Input Values (Vernier Function)

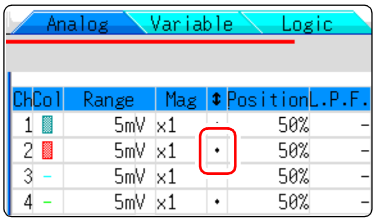
Fine adjustment of input voltage can be performed arbitrarily on the Waveform screen. When recording physical values such as noise, temperature and acceleration using sensors, amplitude can be adjusted to facilitate calibration.



1.2 V input is displayed as 1.0 V

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the CH.SET key → Channel settings window ([Analog] sheet)



Ch	Col	Range	Mag	⇕	Position	L.P.F.
1	▨	5mV	x1	·	50%	-
2	🟥	5mV	x1	•	50%	-
3	-	5mV	x1	•	50%	-
4	-	5mV	x1	•	50%	-

1 Move the cursor to the **[⇕]** vernier setting item of the channel to adjust.

2 Make the adjustment with the **F** keys while watching the waveform.

Vernier ↑	Magnify waveform
Vernier ↓	Compress waveform
Vernier Reset	Return waveform to original position

NOTE

- The adjustment range is 50 - 200% of the original waveform. The magnification/compression ratio is not displayed.
- Vernier adjustments cannot be verified on printed waveforms or lists.
- The waveform data (print data, saved file data) is adjusted by the Vernier function.

8.8 Inverting the Waveform (Invert Function)

This applies to the analog channels only. You can invert the plus and minus sides of the waveform.

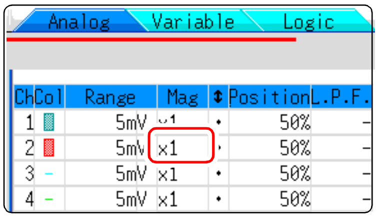
Example: With a spring or similar, if pulling it towards the observer is taken as the minus direction and pushing it away from the observer as the plus direction, the output will be minus (negative) for pulling and plus (positive) for pushing.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the CH.SET key → Channel settings window ([Analog] sheet)

1 Move the cursor to the **[Mag]** item for the channel whose waveform you want to invert.

2 Select **[Invert]**.



Ch	Col	Range	Mag	↕	Position	L.P.F.
1	🟦	5mV	x1	•	50%	–
2	🟥	5mV	x1	•	50%	–
3	–	5mV	x1	•	50%	–
4	–	5mV	x1	•	50%	–

NOTE The waveform data (print data, saved file data) is adjusted by the Invert function.

8.9 Copying settings to other channels (calculation No.) (Copy function)

At the following screens, settings can be copied to other channels and calculation No. (When the FFT function is used).

- Channel settings window
- Display range window
- Trigger settings window
- Status screen-**[Status]** sheet- **[Analysis]** list and **[Scale]** list (with FFT function only)
- Status screen - **[Num Calc]** sheet
- Status screen-**[Wave Calc]** sheet
- Channel screen - **[Unit List]** sheet
- Channel screen - **[Scaling]** sheet
- Channel screen - **[Comment]** sheet

The procedure is explained for the Display range window.

Procedure

To open the screen: Press the DISP key →Waveform screen→Press the CH.SET key→Display range window

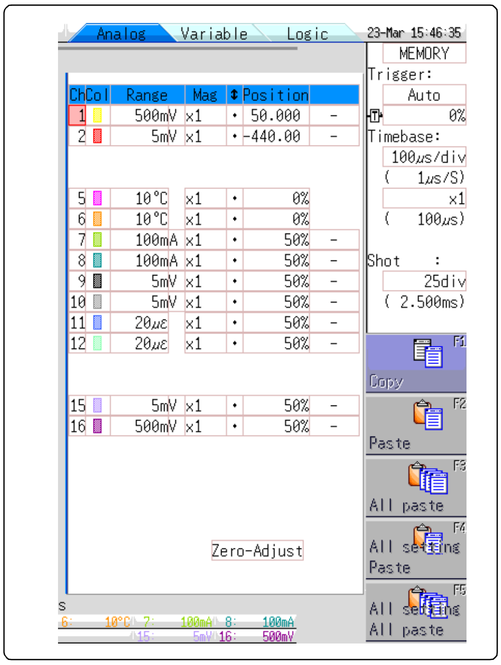
1 Move the cursor to the copy source channel number (calculation No.).

2 Select **[Copy]**.

3 Move the cursor to the channel number (calculation No.) where you want to paste the settings.

4 Select **[Paste]**.

To copy to all channels (calculations), point the cursor at a channel number (calculation No.) other than the copy source and select **[All Paste]**.
When you want to copy all the settings on the Unit list/ Scaling/Variable sheets, select the **[All setting Paste]** button or **[All setting All paste]** button.



23-Mar 15:46:35

Ch	Col	Range	Mag	⇕	Position	
1	▨	500mV	x1	•	50.000	–
2	▨	5mV	x1	•	-440.00	–
5	▨	10°C	x1	•	0%	
6	▨	10°C	x1	•	0%	
7	▨	100mA	x1	•	50%	–
8	▨	100mA	x1	•	50%	–
9	▨	5mV	x1	•	50%	–
10	▨	5mV	x1	•	50%	–
11	▨	20με	x1	•	50%	–
12	▨	20με	x1	•	50%	–
15	▨	5mV	x1	•	50%	–
16	▨	500mV	x1	•	50%	–

MEMORY
Trigger:
Auto
0%
Timebase:
100μs/div
(1μs/S)
x1
(100μs)
Shot :
25div
(2.500ms)

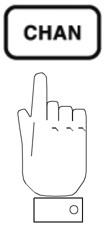
6: 10°C 7: 100mA 8: 100mA
15: 5mV 16: 500mV

NOTE When channel settings are copied among different model units, the settings other than scaling cannot be performed. (Scaling copy is available.)

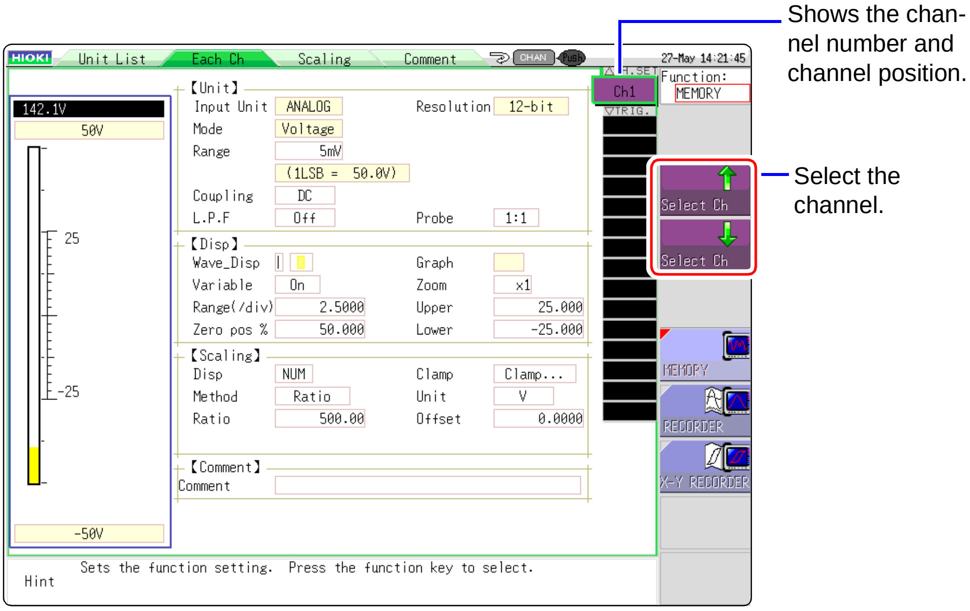
8.10 Making Detailed Settings for Input Modules

Using the **[Each Ch]** sheet accessed from the Channel screen, you can make detailed settings.

Opening the [Each Ch] sheet, Making a Channel Selection



Press this key.



Function: MEMORY

【Unit】
Input Unit ANALOG
Resolution 12-bit
Mode Voltage
Range 5mV
(1LSB = 50.0V)
Coupling DC
L.P.F Off
Probe 1:1

【Disp】
Wave_Disp
Graph
Variable On
Zoom x1
Range(/div) 2.5000
Upper 25.000
Zero pos % 50.000
Lower -25.000

【Scaling】
Disp NUM
Clamp Clamp...
Method Ratio
Unit V
Ratio 500.00
Offset 0.0000

【Comment】
Comment

Hint Sets the function setting. Press the function key to select.

Shows the channel number and channel position.

Select the channel.

Logic channel allocation when using Standard LOGIC terminals

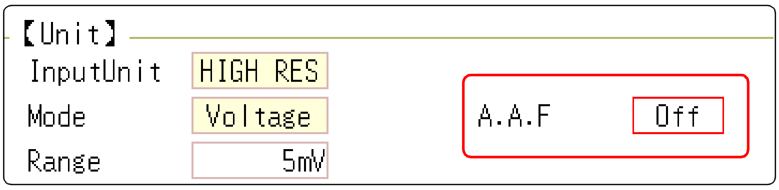
	Module	Memory for each channel (16 bits)			
		4 bits	4 bits	4 bits	4 bits
Ch1*	Analog	Analog Ch1			LA
Ch2*		Analog Ch2			LB
Ch3*	Logic	L2A	L2B	-	LC
Ch4*		L2C	L2D		LD
Ch5	Analog	Analog Ch5			
Ch6		Analog Ch6			
Ch7	Logic	L4A	L4B	-	
Ch8		L4C	L4D		
Ch9	Analog	Analog Ch9			
Ch10		Analog Ch10			
Ch11	Analog	Analog Ch11			
Ch12		Analog Ch12			
Ch13	Analog	Analog Ch13			
Ch14		Analog Ch14			
Ch15	Analog	Analog Ch15			
Ch16		Analog Ch16			

*: Ch1 - Ch4 provide 12-bit precision when logic channels LA - LD are used. When Ch1 to Ch4 are 8970 Freq Unit and standard logic channels LA to LD are used, the units of corresponding channels can no longer be used.

8.10.1 Making Settings for the Anti-Aliasing Filter (A.A.F.) (8968 High Resolution Unit)

MEM

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)


【Unit】
InputUnit HIGH RES
Mode Voltage
Range 5mV
A.A.F Off

A.A.F

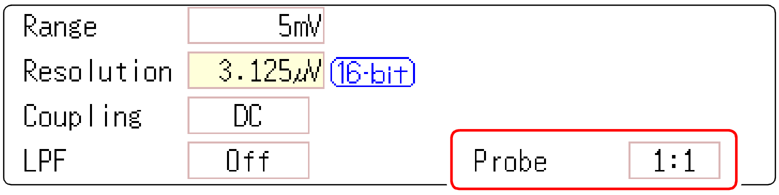
Enable the anti-aliasing filter to remove aliasing distortion.
The cutoff frequency automatically changes according to the time axis range or (when the FFT function is used) the frequency range setting.

Select

Selections	Description
Off	The anti-aliasing filter is disabled. (default setting)
On	The anti-aliasing filter is enabled. (When the External sampling is used, the antialiasing filter (AAF) is not available.)

8.10.2 Probe Attenuation Selection

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)


Range 5mV
Resolution 3.125μV (16-bit)
Coupling DC
LPF Off
Probe 1:1

Probe

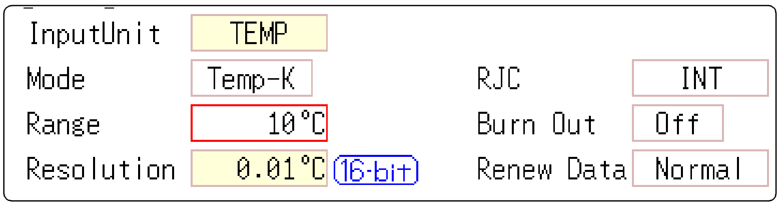
Make the setting when performing measurement with a connection cable or probe.

Select

Selections	Description
1:1	Select this setting when measuring with the Model 9197, L9198 or L9217 Connection Cord connected to the input module. (default setting)
10:1	Select this setting when measuring with the Model 9665 10:1 Probe connected to the input module.
100:1	Select this setting when measuring with the Model 9666 100:1 Probe connected to the input module.
1000:1	Select this setting when using the 9322 Differential Probe.

8.10.3 Settings for the 8967 Temp Unit

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)



InputUnit TEMP

Mode Temp-K

Range 10°C

Resolution 0.01°C 16-bit

RJC INT

Burn Out Off

Renew Data Normal

Mode

Set to match the type of thermocouple being used.

Select

Selections	Measurement Range	Selections	Measurement Range
Temp- K	-200 to 1350°C	**Temp- R**	0 to 1700°C
Temp- J	-200 to 1100°C	**Temp- S**	0 to 1700°C
Temp- E	-200 to 800°C	**Temp- B**	400 to 1800°C
Temp- T	-200 to 400°C	**Temp- W**	0 to 2000°C
Temp- N	-200 to 1300°C		

RJC (Reference Junction Compensation)

When connecting a thermocouple directly to the input module, select **[Int]**. Reference junction compensation is performed within the input module. When connecting through a reference junction device (e.g., a 0°C control tank), select **[Ext]**.

Select

Selections	Description
INT	Reference junction compensation is provided within the input module. (default setting) (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)

Burn Out

A broken thermocouple wire can be detected during temperature measurement. Normally when a thermocouple wire breaks, measured values exhibit random instability.

Select

Selections	Description
Off	Broken wires are not detected.
On	Broken wires are detected. Wire breakage is detected by sensing a miniscule current flow (about 100 nA) through the thermocouple. If the thermocouple wires are long or composed of a high-resistance material, set **[Burn Out]** to **[Off]** to avoid measurement errors.

Renew Data (Data Refresh)

The data refresh rate can be set to Fast, Normal, or Slow.

The default setting is **[Normal]**. This allows stable measurement while removing noise. For quicker response, select **[Fast]**, but note that this will make the measurement more susceptible to noise. For further improved measurement stability, select **[Slow]**.

Select

Selections	Description
Fast	Data are updated approximately every 1.2 ms.
Normal	Data are updated approximately every 100 ms. (default setting)
Slow	Data are updated approximately every 500 ms.

8.10.4 Settings for the 8969 Strain Unit

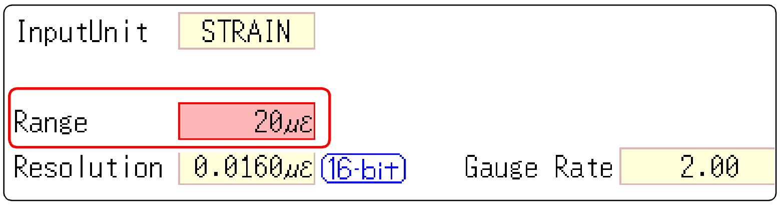
The 8969 Strain Unit can perform auto balance.
When auto balance is performed, the reference output level of the conversion unit can be matched with the specified zero position.
It is applicable only to a 8969 Strain Unit.

Before executing auto-balance

- Turn power on and wait 30 minutes to allow the internal temperature of the input module to stabilize.
- With the sensor connected to the input module, execute auto-balance under stable input conditions.
- Auto-balance cannot execute during measurement.
- Key operations are not accepted while auto-balance is executing.

To execute auto-balance

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)



InputUnit STRAIN

Range 20με

Resolution 0.0160με 16-bit

Gauge Rate 2.00

Setting Item: **[Range]**

Selections	Description
Auto Bal All Chs	Auto Balance is executed for all channels where the 8969 Strain Unit is installed.
Auto Bal Ch 1	Auto Balance is executed for the currently selected channel.

Auto Balance can also be executed from the Channel settings window (Analog sheet) (if the range of a channel with installed 8969 Strain Unit is selected).
See: Opening the Channel settings window (**[Analog]** sheet): (⇒ p.52)

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)

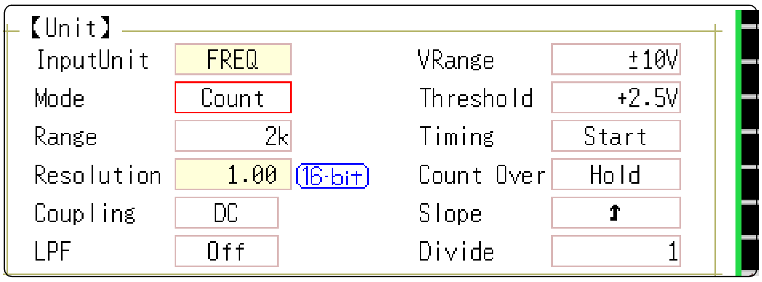
If "Warning: Auto balance failed." appears:
The channel on which auto-balance failed is displayed.
Verify the following, and execute again:

- Is the sensor in a discharged state? (Make sure that it is not being subject to vibration, etc.)
- Is the sensor connected correctly?

8.10.5 Settings for the 8970 Freq Unit

NOTE When the display of standard logic channels (LA, LB, LC, and LD) is on, the 8970 Freq Unit installed on unit 1 or 2 can no longer be used.

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)



【Unit】

InputUnit	FREQ	VRange	±10V
Mode	Count	Threshold	+2.5V
Range	2k	Timing	Start
Resolution	1.00 16-bit	Count Over	Hold
Coupling	DC	Slope	↑
LPF	Off	Divide	1

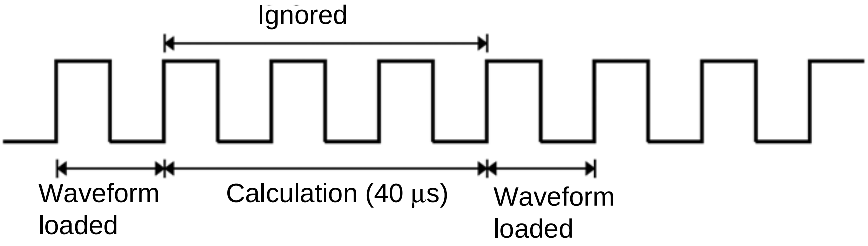
Mode

Changes the measurement mode.

Select

Selections	Description
Frequency	Measure the frequency of the measurement waveform (Hz hertz) (default setting)
RPM	Measure the number of rotations of the measurement target (r/min rotations/minutes)
P-Freq	Measure the power frequency variation (Hz hertz)
Count	Add up the number of input pulses
Duty	Measure the duty rate of the measurement waveform (% percent)
Pulse Width	Measure the pulse width (s second)

NOTE Pulses with rises during dead time (calculation) (25 kHz or higher) cannot be measured.



VRange (Input voltage)

Set the maximum level for the input signal.

Select

±10 V (default setting), ±20 V, ±50 V, ±100 V, ±200 V, ±400 V

Select the value using the **F** key.

Threshold

- When the measurement waveform exceeds the threshold value, the measurement value is acquired based on the time interval and the number of times the threshold was exceeded.
- The threshold value upper and lower limits and increases and decreases in width depend on the input voltage (**[VRange]**) setting.
- While setting the threshold, the voltage level is displayed on the level monitor.
- Select the value using the **F** key.

NOTE To prevent measurement errors due to noise, the threshold has a hysteresis of approximately 3% versus the input voltage. (When **[VRange]** is **[±10 V]**, it is around ±0.3 V.)
Set a threshold in excess of the hysteresis width versus the voltage peak.

Slope

For each measurement mode, set the direction the specified level is exceeded.

Select

Selections	Description
↑	Rises above the specified level are detected. (default setting)
↓	Drops below the specified level are detected.

Devide

Determines the frequency for each set pulse.

Select

1(default setting) to 4096

Select the value using the **F** key.

Example: When the encoder is at 360 pulses per rotation, the frequency of each rotation can be measured by setting the number of divisions to 360. When frequency dividing is not used, set to 1.

Timing

This is enabled only when **[Mode]** is **[Count]**.
Sets the start timing for the sum count.

Select

Selections	Description
Start	When the **START** key is pushed, summing is started. (default setting)
Trig	When a trigger is applied, summing is started.

NOTE

- When the **[Start]** is set, there is some internal processing time between pressing of the **START** key and the start of measurement. Therefore, the count value is not zero at the start point.
- When the **[Start]** is set and the trigger level is exceeded while waiting for the pre-trigger, the trigger is not enacted. Furthermore, the time for internal processing at start and the trigger priority setting may cause the trigger not to be enacted at the specified trigger level.
- When memory division is used, there are cases when the last data in the previous block remains in the first part of the block.

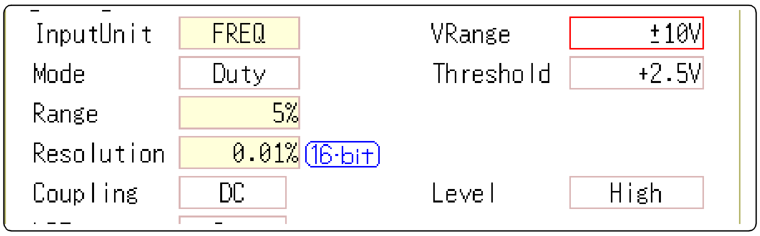
Count Over

This is enabled only when **[Mode]** is **[Count]**.

Select

Selections	Description
Hold	Counting is performed to the maximum (at 2k range, 65535) and no higher.
Back	If counting is performed up to 25 times the range (at 2 k range, up to 5000) the count value returns to 0.

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)


InputUnit FREQ
Mode Duty
Range 5%
Resolution 0.01% 16-bit
Coupling DC
VRange ±10V
Threshold +2.5V
Level High

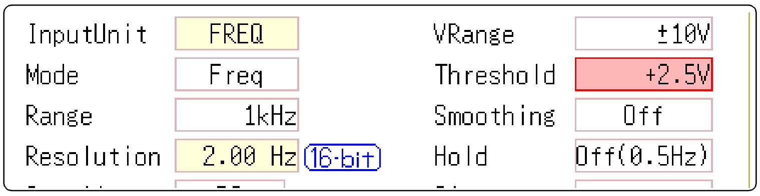
Level

This is enabled only when **[Mode]** is **[Pulse Width]** or **[Duty]**.
In pulse width/ duty rate measurements, set which level is detected when the threshold is exceeded.

Select

Selections	Description
High	Measures above the threshold value. (default setting)
Low	Measures below the threshold value.

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)


InputUnit FREQ
Mode Freq
Range 1kHz
Resolution 2.00 Hz 16-bit
VRange ±10V
Threshold +2.5V
Smoothing Off
Hold Off(0.5Hz)

Smoothing

This is enabled only when **[Mode]** is **[Frequency]** or **[RPM]**.
Set smoothing.

Select

Selections	Description
Off	The measured data is recorded as is. (A step waveform.) (default setting)
On	The measured data is interpolated so that the waveform is smooth and then it is output. (Further delayed from upper limit 10 kHz and Off.)

Hold

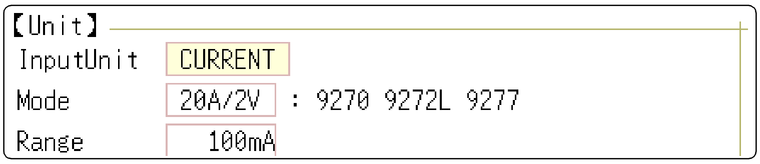
This is enabled only when **[Mode]** is **[Frequency]** or **[RPM]**.
Set hold for the frequency and summing.

Select

Selections	Description
Off (1Hz/0.5Hz/ 0.2Hz/0.1Hz)	When the frequency in the brackets is reached but not determined, it is defined as a stopped item and the measurement value becomes 0 Hz (0 rpm). (default setting)
On	The value defined last time is retained.

8.10.6 Settings for the 8971 Current Unit

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)


【Unit】
InputUnit CURRENT
Mode 20A/2V : 9270 9272L 9277
Range 100mA

Mode

There is no need to change the setting since it is set when the clamp sensor is automatically recognized.

Select

Selections	Description
20A/2V	Set when a 9272-10 (20 A range) or 9277 Clamp Sensor is connected. (default setting)
200A/2V	Set when a 9272-10 (200 A range), 9277, or CT6863 Clamp Sensor is connected.
50A/2V	Set when a CT6862 Clamp Sensor is connected.
500A/2V	Set when a 9279 or 9209 Clamp Sensor is connected.

Range

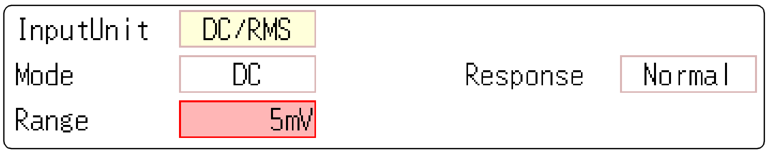
Change the measurement of the 8971 Current Unit between DC and RMS.

Select

Selections	Description
DC	Current measurement (default setting)
RMS	RMS measurement

8.10.7 Settings for the 8972 DC/RMS Unit

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.140)



InputUnit DC/RMS
Mode DC
Range 5mV
Response Normal

Mode

Switches between voltage measurement and RMS measurement.

Select

Selections	Description
DC	Voltage measurement (default setting)
RMS	RMS measurement

Response

Response can be set to three speeds: Fast, Normal and Slow.
Normally set to **[Fast]**, this can be changed to **[Normal]** or **[Slow]** to stabilize the display when measuring low frequencies, or when severe fluctuations are present.

Select

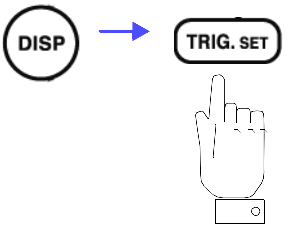
Selections	Description
Fast	Sets the response time to about 100 ms. (default setting)
Normal	Sets the response time to about 800 ms.
Slow	Sets the response time to about 5 s.

Trigger Settings Chapter 9

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".
Trigger settings are made in the Trigger settings window of the Waveform screen.

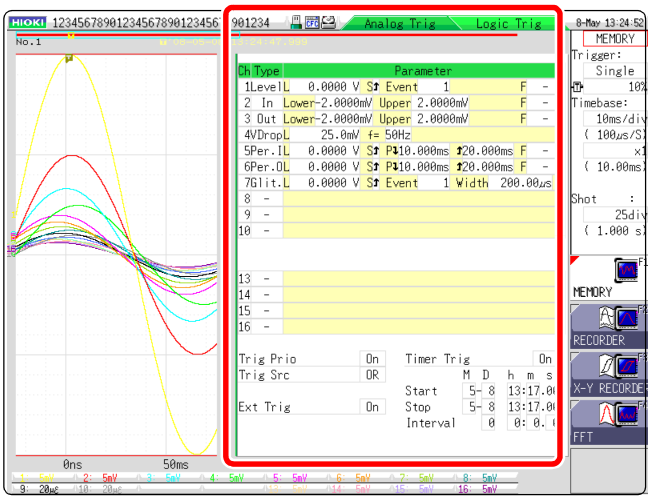
For the X-Y Recorder function, trigger settings cannot be made.

Opening theTrigger settings window



Pressing **[TRIG.SET]** key repeatedly displays the various sheets.

[Analog Trig]
↓
[Logic Trig]
↓
No display



Ch	Type	Parameter
1	Level	L 0.0000 V S↑ Event 1 F -
2	In	Lower -2.0000mV Upper 2.0000mV F -
3	Out	Lower -2.0000mV Upper 2.0000mV F -
4	VDrop	L 25.0mV f= 50Hz
5	Per.I	L 0.0000 V S↑ P↓10.000ms ↑20.000ms F -
6	Per.O	L 0.0000 V S↑ P↓10.000ms ↑20.000ms F -
7	Glit.	L 0.0000 V S↑ Event 1 Width 200.00μs
8	-	
9	-	
10	-	
13	-	
14	-	
15	-	
16	-	

Trig Prio On
Trig Src OR
Ext Trig On
Timer Trig On
Start 5-8 13:17.0
Stop 5-8 13:17.0
Interval 0 0: 0.

Operations available from the Trigger settings window

Trigger Settings

- Trigger mode setting (⇒ p.153)
- Combining logic (AND/OR) for multiple trigger sources (⇒ p.170)
- Pre-trigger settings (⇒ p.166)
- Trigger timing settings (⇒ p.169)

Trigger Source Settings

Analog Trigger Settings (⇒ p.154)

- Level trigger
- Window trigger
- Period trigger
- Glitch trigger
- Slope trigger

Timer Trigger Settings (⇒ p.162)

External Trigger Settings (⇒ p.165)

Manual Trigger Settings (⇒ p.165)

Logic Trigger Settings (⇒ p.160)

- Setting combining logic for logic triggers
- Trigger filter settings
- Trigger pattern settings

Trigger Output (⇒ p.292)

Searching for trigger positions (⇒ p.171)

9.1 Setting Workflow

The procedure for making trigger settings is as follows.

Trigger Mode Settings	Set whether to continue to accept triggers after measuring.	**(⇒ p.153)**
Trigger Type Settings	Make trigger source-related settings.	
	• Analog trigger	**(⇒ p.154)**
	• Logic trigger	**(⇒ p.160)**
	• Timer trigger	**(⇒ p.162)**
	• External trigger	**(⇒ p.165)**
	• Manual trigger	**(⇒ p.165)**
MEM FFT Pre-Trigger Settings	Set the amount to record before and after a trigger point.	(⇒ **p.166)**
REC Trigger Timing Settings	Set the start and stop timing for recording by triggers.	(⇒ **p.169)**
Setting AND/OR Between Trigger Sources	Select AND/OR logical combination of analog, logic, external and timer triggers to be applied.	(⇒ **p.170)**
Start Measurement	Press the **START** key to start measuring. (The key lights green.) (However, operation differs according to the setting for **START** key behavior (⇒ p.257).) Data acquisition starts when trigger criteria 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. Available settings for the respective items depend on the function.	

NOTE

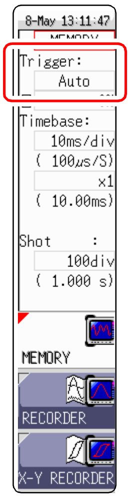
- Except for manual trigger, triggering is based on the AND/OR combination of trigger sources. (⇒ p.170)
- When triggering occurs, the TRIG OUT terminal for control of external devices carries an output signal. (⇒ p.292)

9.2 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).

Procedure

To open the screen: Press the DISP key → Waveform screen


8-May 13:11:47
Trigger: Auto
Timebase: 10ms/div (100µs/S) x1 (10.00ms)
Shot : 100div (1.000 s)

1 Move the cursor to the **[Trigger]** item.

2 Select the trigger mode.

Select

Single	Only one trigger is recognized. After pressing the **START** key, once a trigger is applied, a waveform is recorded for the specified recording length, and measurement then stops.
Repeat	Triggers are accepted continuously. When no trigger is applied, the instrument enters the Trigger Wait state. Press the **STOP** key to stop measuring. (See below)
Auto	MEM FFT Triggers are accepted continuously. If no trigger is applied within about one second, a waveform of the specified recording length is automatically recorded. Press the **STOP** key to stop measuring.

Description

Available selections depend on the function.

Trigger Mode	Function	
	MEM FFT	REC
Single	O	O (default setting)
Repeat	O	O
Auto	O (default setting)	×

To Stop Measuring:
Press the **STOP** key.
Press once: recording stops at the end of the specified recording length.
Press twice: recording stops immediately.

When the trigger mode is set to [Repeat]

During the processing interval from the end of recording until entering the next trigger standby condition (Auto Save, Auto Print, waveform display processing, numerical calculation), triggering will not be accepted.

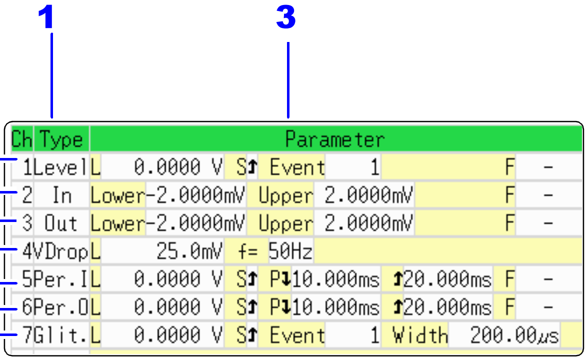
9.3 Triggering by Analog Signals

9.3.1 Analog Trigger Settings and Types

The steps for making settings and selecting the type of analog trigger are described below.
The Trigger settings window (**[Analog Trg.]** sheet) is used.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window ([Analog Trg.] sheet)



Ch	Type	Parameter							
1	Level	L	0.0000 V	S↑	Event	1		F	-
2	In	Lower	-2.0000mV	Upper	2.0000mV			F	-
3	Out	Lower	-2.0000mV	Upper	2.0000mV			F	-
4	VDrop	L	25.0mV	f=	50Hz				
5	Per.I	L	0.0000 V	S↑	P↓10.000ms	↑20.000ms		F	-
6	Per.O	L	0.0000 V	S↑	P↓10.000ms	↑20.000ms		F	-
7	Glit.	L	0.0000 V	S↑	Event	1	Width	200.00μs	

1. Level Trigger (⇒ p.155)
2. In-Window Trigger
   Out-of-Window Trigger (⇒ p.155)
3. Voltage Sag Trigger (⇒ p.156)
4. In-Period Trigger
   Out-of-Period Trigger (⇒ p.157)
5. Glitch Trigger (⇒ p.157)

1 Move the cursor to the **[Type]** item of the channel for which to make the setting.

2 Select the trigger type with the **F** keys.

3 Move the cursor to the parameter item with the **CURSOR** keys.

4 Select the parameter value with the **F** keys.

To copy the setting to another channel

The Trigger settings window (**[Analog Trig]** sheet) can be used to copy a setting.

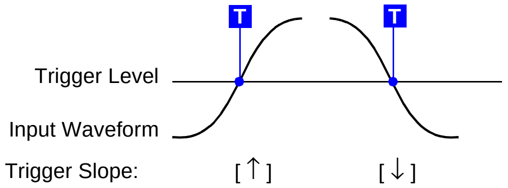
See:"8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

NOTE

When the FFT function is used and **[Reference]** item on the **[Status]** sheet is set to **[From Memory]**, an analog trigger cannot be set.

1. Level Trigger

A trigger is applied when an input signal crosses the specified trigger level (threshold voltage).



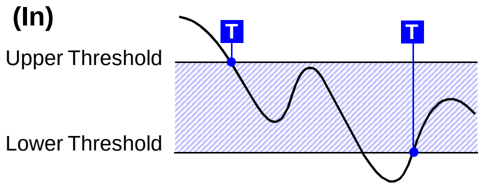
NOTE

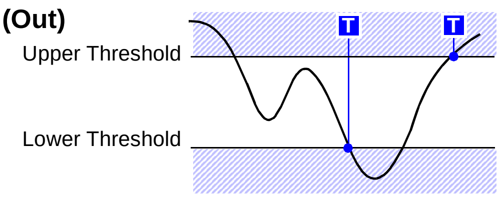
In this manual, **T** indicates a "trigger point", as the time at which a trigger is applied.

Type	Parameters	
[Level]	**[L]** (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the upslope (rising edge) or on the downslope (falling edge). With the [↕] setting, triggering occurs in either direction.) (↑, ↓, ↕)
	[Event]	The number of signal rising edge (or falling edge) events is counted, and triggering occurs when the Event number set here is exceeded. (1 to 4000)
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT: Off, 0.1 - 10 div, REC: Off, On*) *: Filter width is 10 ms.

2. In-Window Trigger, Out-of-Window Trigger

Upper and lower limit values are set for the trigger level, and triggering occurs when the input signal enters this range (In) or leaves this range (Out).

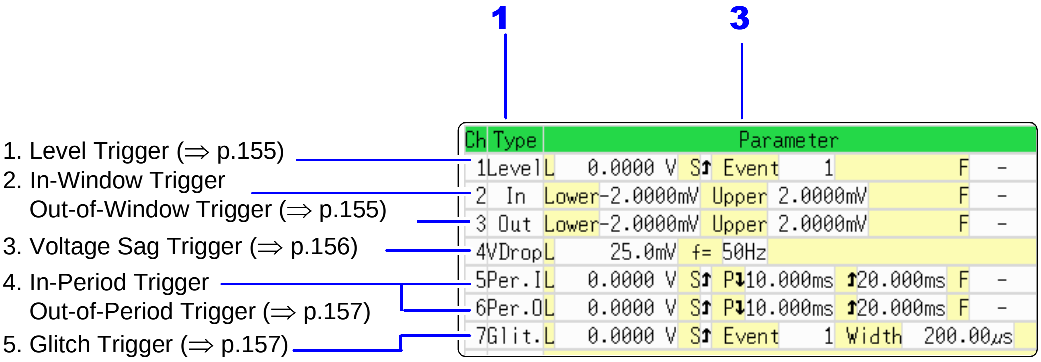




Type	Parameters	
[In] or **[Out]**	**[Lower]**	Set the lower limit value. (The setting can be made in 1/50 increments.)
	[Upper]	Set the upper limit value. (The setting can be made in 1/50 increments.)
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT: Off, 0.1 - 10 div, REC: Off, On*) *: Filter width is 10 ms.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window ([Analog Trg.] sheet)



1. Level Trigger (⇒ p.155)
2. In-Window Trigger
   Out-of-Window Trigger (⇒ p.155)
3. Voltage Sag Trigger (⇒ p.156)
4. In-Period Trigger
   Out-of-Period Trigger (⇒ p.157)
5. Glitch Trigger (⇒ p.157)

```
Ch Type              Parameter
 1Level L     0.0000 V  S↑ Event     1            F   -
 2  In  Lower-2.0000mV  Upper 2.0000mV            F   -
 3 Out  Lower-2.0000mV  Upper 2.0000mV            F   -
 4VDrop L      25.0mV   f= 50Hz
 5Per.I L     0.0000 V  S↑ P↓10.000ms ↑20.000ms  F   -
 6Per.O L     0.0000 V  S↑ P↓10.000ms ↑20.000ms  F   -
 7Glit. L     0.0000 V  S↑ Event     1 Width  200.00µs
```

1 Move the cursor to the **[Type]** item of the channel for which to make the setting.

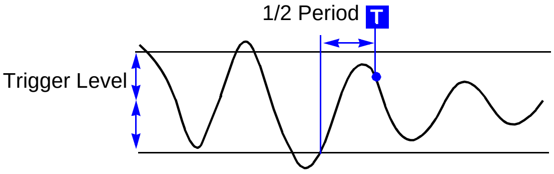
2 Select the trigger type with the **F** keys.

3 Move the cursor to the parameter item with the **CURSOR** keys.

4 Select the parameter value with the **F** keys.

3. Voltage Sag Trigger (MEM FFT only)

Triggering occurs when the voltage peak drops below a preset level for more than half a cycle. The allowable time axis range is 20 µs - 50 ms/div.

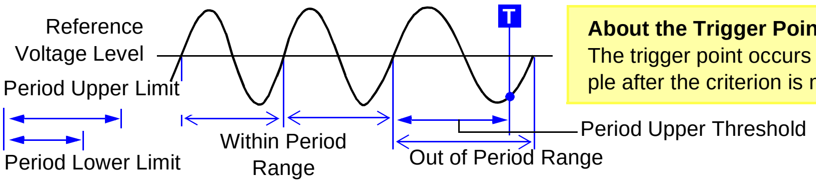


Type	Parameters	
[VDrop]	**[L]** (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[f=] (Frequency)	Select 50 or 60 Hz.

4. In-Period Trigger, Out-of-Period Trigger

The rising edge and falling edge cycle of the reference voltage is measured, and triggering occurs when the cycle enters the preset range (In) or leaves the preset range (Out).

See: "Description" (⇒ p.159)



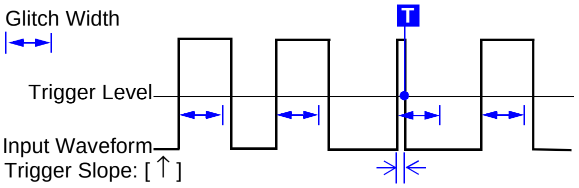
About the Trigger Point
The trigger point occurs one sample after the criterion is met.

Type	Parameters	
[Per.I] or **[Per.O]**	**[L]** (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the upslope (rising edge) or on the downslope (falling edge). (↑, ↓)
	[P ↓] (Period lower limit)*1	Available settings are 0 and more than 5 times the sampling frequency. Settings higher than the upper limit value are not accepted. (When the setting is 0, the lower limit is disregarded, and triggering occurs only on the upper limit.)
	[↑] (Period upper limit)*1	The setting range extends to 20,000 times the sampling frequency. Lower settings than the lower limit value are not accepted.
	[F] (Filter)	Triggering occurs when the trigger criteria are met within the specified filter width. This is useful to prevent spurious triggering due to noise. (MEM FFT: Off, 0.1 - 10 div, REC: Off, On*) *: Filter width is 10 ms.

*1: Changes in sync with the time axis range.

5. Glitch Trigger(MEM FFT only)

Triggering occurs when the input signal crosses the trigger level (threshold voltage) if its pulse width is shorter than the specified width.

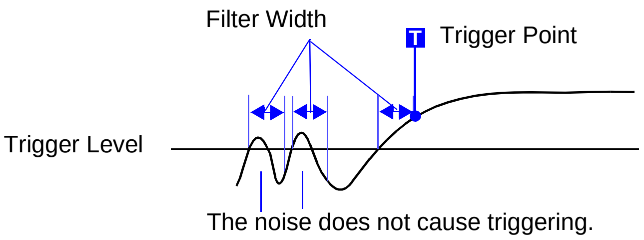


Type	Parameters	
[Grit.]	**[L]** (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the upslope (rising edge) or on the downslope (falling edge). (↑, ↓)
	[Event]	The number of signal rising edge (or falling edge) events is counted, and triggering occurs when the Event number set here is exceeded. (1 to 4000)
	[Width]	Sets the pulse width (time) that is used to determine a glitch. Triggering occurs when the width is lower than this value. (The available setting range depends on the sampling frequency. Lower limit: sampling frequency x 2, upper limit: sampling frequency x 4000)

When Using Noisy Signals for Triggering

Method 1: Enable the trigger filter

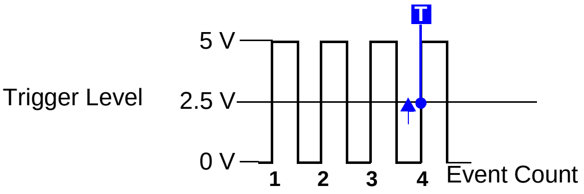
By setting the filter width to prevent triggering on noise, triggering occurs only when the trigger criteria continue to be met for at least the specified width (interval).



Method 2: Setting an Event Count

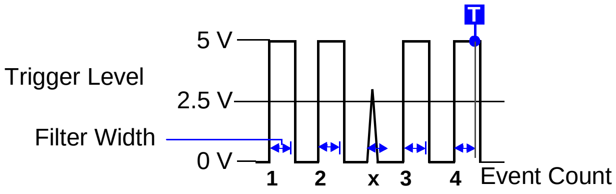
If triggering occurs too frequently, an event count can be specified so that a trigger is accepted only after the specified number of trigger events has occurred.

Example: When the event count is set to **[4]** (Slope: ↑)



Suppressing Noise Effect

Noise near the trigger level can erroneously increment the event count. Set the trigger filter to avoid such effects.



Description

About period range settings

The period range settings for period triggering depend on the sampling period (sampling rate). (Changing the timebase also changes the period setting range.)
The sampling rate setting can be verified on the Status screen - Status sheet.
The upper threshold of the period range cannot be set below the lower threshold, and vice-versa.
Lower threshold: can be set either to zero, or to at least five times the sampling period.
Upper threshold: can be set to no more than 2,000 times the sampling period.

To apply a trigger when the frequency increases (shorter period) above the upper threshold:

Set the period trigger type to **[Per.I]**, and the lower threshold to **[0]**. The lower threshold is ignored, and triggering occurs when the frequency exceeds that corresponding to the upper threshold.

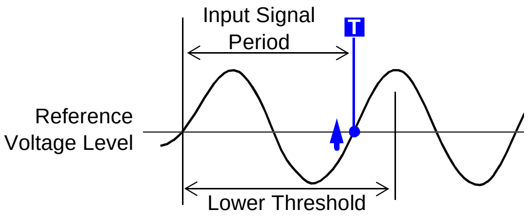
To apply a trigger when the frequency decreases (longer period) below the upper threshold:

Set the period trigger type to **[Per.O]**, and the lower threshold to **[0]**. The lower threshold is ignored, and triggering occurs when the frequency drops below that corresponding to the upper threshold.

About the trigger point of the Out-of-Period trigger

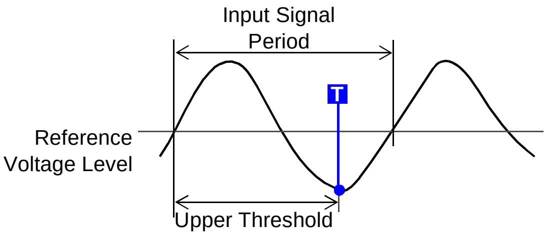
Triggering occurs when the period of sequential crossings of the specified reference voltage exceeds the period range.
The point at which triggering occurs depends on the specified period range and the period of the measured signal.

When the input signal period is shorter than the specified lower threshold (Trigger Slope: ↑)



Triggering occurs when the rising edge (↑ trigger slope) of the input signal crosses the reference voltage level, before reaching the lower period threshold.

When the input signal period is longer than the specified upper threshold (Trigger Slope: ↑)



Triggering occurs when the upper threshold period is reached, before the rising edge (↑ trigger slope) of the input signal crosses the reference voltage level.
Therefore, the trigger point is determined by the upper threshold of the period range.

9.4 Triggering by Logic Signals (Logic Trigger)

The steps for making settings and selecting the type of logic trigger are described below.
The Trigger settings window (**[Logic Trig]** sheet) is used.

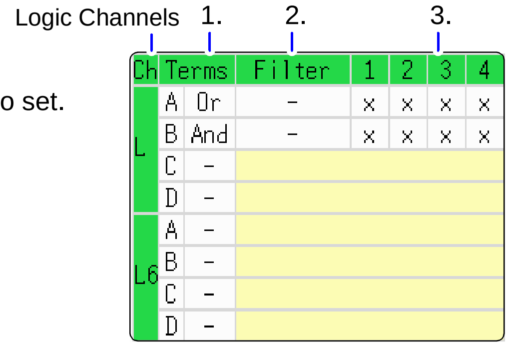
- Input signals on logic channels serve as the trigger source. Triggering occurs when the specified trigger pattern and logical probe combining criteria (AND/OR) are met.
- The trigger detection method can be selected according to whether a trigger is applied or not when the criteria are already met at the start of measurement.
- By using the trigger filter, triggering can be limited so as to occur only when trigger criteria are met for at least the specified filter width.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window ([Logic Trig] sheet)

1 Move the cursor to the channel you want to set.

2 Use the **F** keys to make the setting.



Ch		Terms	Filter	1	2	3	4
L	A	Or	-	×	×	×	×
	B	And	-	×	×	×	×
	C	-					
	D	-					
L6	A	-					
	B	-					
	C	-					
	D	-					

1. Trigger

Sets the trigger probe combining logic (AND/OR).

Select

Off	Logic triggering is disabled. (default setting)
OR	Triggering occurs when input signal logic matches any setting in the trigger pattern.
AND	Triggering occurs only when input signal logic matches all settings in the trigger pattern.

2. Filter

Sets the filter width (trigger filter) for triggering. (as occasion demands)
Suppresses triggering from noise.(⇒ p.158)

Select

MEM

Off	Trigger filtering is disabled. (default setting)
0.1 to 10	Trigger filtering is enabled. The filter width is set as a number of divisions.

REC

Off	Trigger filtering is disabled. (default setting)
On	Trigger filtering is enabled. Filter width is 10 ms (or 5 ms when the sampling rate is 100 ns/S)

3. Trigger Pattern

Make the settings of the logic trigger pattern.

Select

X	Ignore signal. (default setting)
0	Trigger at LOW signal level.
1	Trigger at HIGH signal level.

To copy the setting to another channel

The Trigger settings window (**[Logic Trig]** sheet) can be used to copy a setting.

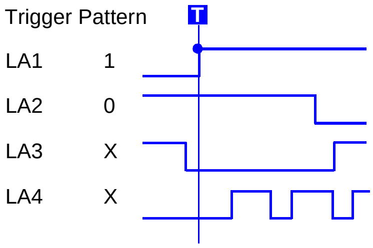
See:"8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

Setting Example

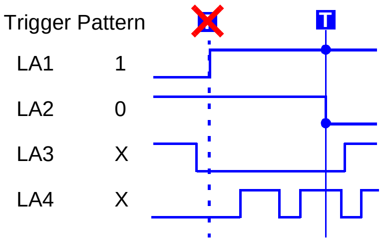
Example 1: Trigger when the input signal matches any of the following criteria:

Channel 1 (LA1): HIGH level
Channel 2 (LA2): LOW level
Trigger: OR
LA [1, 2, 3, 4]: [1 0 X X]

Triggering occurs when the LA1 or LA2 trigger criteria are met.



Example 2: Triggering occurs when the input signal matches both of the following criteria:



Channel 1 (LA1): HIGH level
Channel 2 (LA2): LOW level
Trigger: AND
LA [1, 2, 3, 4]: [1 0 X X]

NOTE

- If the conditions are met already when measurement is started (AND: all trigger patterns are met, OR: one trigger pattern is met), triggering does not occur. Triggering only occurs if the conditions are removed and then met again.
- Triggers for standard logic channels (LA, LB, LC, and LD) are enabled regardless of the logic waveform display or unit type.

9.5 Trigger by Timer or Time Intervals (Timer Trigger)

Set this to record at fixed times.

- Triggering occurs at the specified interval from the specified Start time until the Stop time.
- Before setting, verify that the clock is set to the correct time. If not, set the clock on the System screen - Init sheet. (⇒ p.35)

Procedure

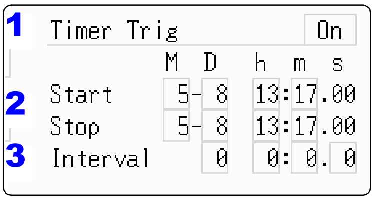
To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window

1 **Enable or disable the timer trigger.**

Move the cursor to the **[Timer Trig]** item.

Select

Off	Timer triggering is disabled.
On	Timer triggering is enabled.



1 Timer Trig On

M D h m s

2 Start 5- 8 13:17.00

Stop 5- 8 13:17.00

3 Interval 0 0: 0. 0

2 **(When [On] is selected)**

Set Start and Stop times.

Move to cursor to the **[M]**, **[D]**, **[h]** and **[m]** items to set recording Start and Stop times.

Set the date and time.

To set the current date and time:
Select **[Present Time]**.

3 **(To apply a trigger through the specified interval, from Start to Stop)**

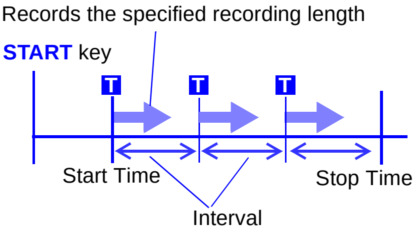
Set the Interval.

Move to cursor to the **[D]**, **[h]**, **[m]** and **[s]** items of **[Interval]**.

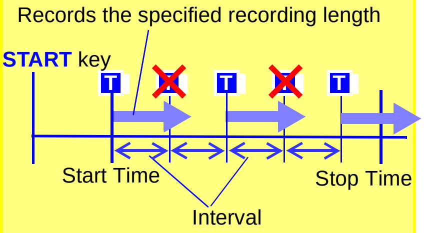
Set the recording interval.

After pressing the **START** key, recording starts at the specified Start time.

To stop recording early:
Press the **STOP** key.



When the specified interval is shorter than the specified recording length:



When the recording length exceeds the specified interval

The next trigger is not applied until the data for the specified recording length has been acquired.

When the recording length exceeds the stop time

Recording time depends on the operating function.
"About Stop Time and Recording Length" (⇒ p.163)

When the interval is set to zero

If the **[Repeat]** trigger mode is selected, or REC&MEM function is used, recording is repeated from Start to Stop times.

Description

About start and stop times

- Start and Stop times should be set as times elapsed since the **START** key was pressed.
- When the trigger mode is **[Single]** and the timer trigger is **[On]**, only one timer trigger specified as the Start trigger is recognized. Interval and Stop time triggers are ignored.

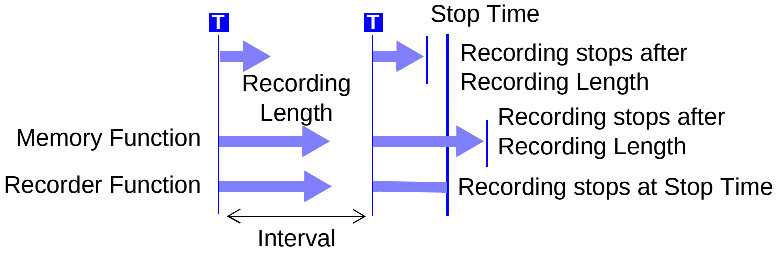
To record an interval with specified Start and Stop times

Set the trigger mode to **[Repeat]**, and set all other trigger sources **[Off]**.
However, triggering is disabled during processing (auto save, auto print, waveform display processing and calculation) from the end of recording to the next Trigger Wait state, so depending on measurement settings, recording may not occur within the specified interval.

About Stop Time and Recording Length

The stop time is function-dependent:
Memory function: Measurement data is acquired for the specified recording length, then recording stops.
Recorder function: Measurement data continues to be acquired until the specified Stop time.

Relationship Between Last Recording Length and Stop Time



When a trigger is applied from a trigger source other than a timer trigger

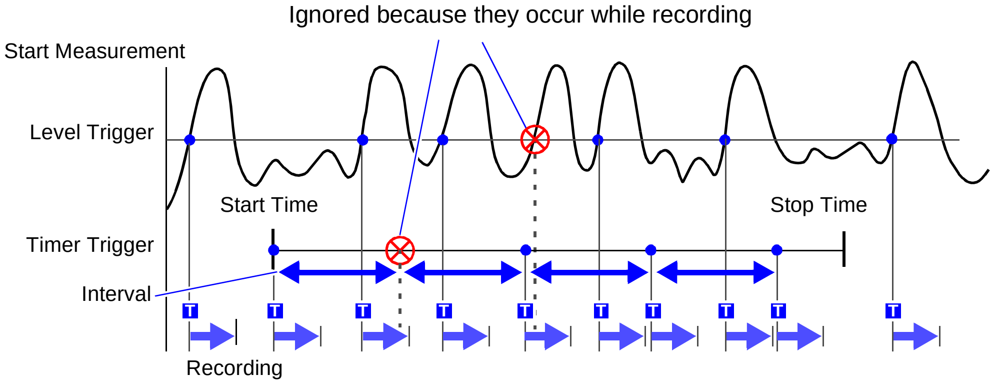
Trigger sources set to On are all enabled.
However, trigger timing depends on the trigger source settings.

- When trigger criteria are ORed together (Trigger Source: OR)
  Depending on the other trigger sources, triggering can occur before the specified trigger Start time, after the specified Stop time, or outside of the specified Interval.

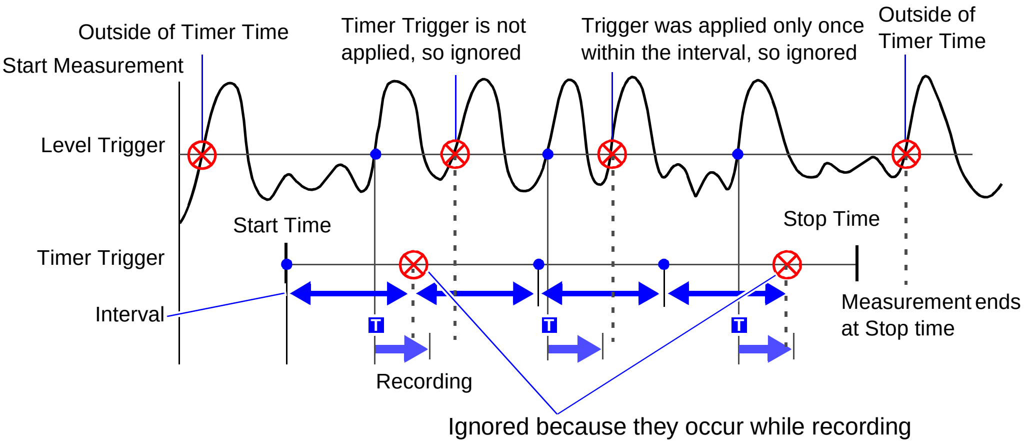
- When trigger criteria are ANDed together (Trigger Source: AND)
  Triggering occurs between the specified Start and Stop times when criteria for all trigger sources set within the specified interval are satisfied.
  If the interval is set to zero, triggering occurs when criteria for all trigger sources set between specified Start and Stop times are satisfied.

Example: measuring when both timer trigger and level triggers (Slope: ↑) are enabled.

When trigger criteria are ORed together (Trigger Source: OR)



When trigger criteria are ANDed together (Trigger Source: AND)



9.6 Applying an External Trigger (External Trigger)

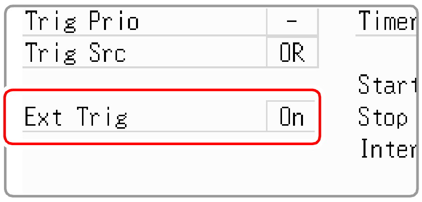
An external signal applied to the External Control terminal can serve as a trigger source. It can also be used to synchronously drive parallel triggering of multiple instruments.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window

1 **Enable external triggering.**

Move the cursor to the **[Ext Trig]** item.



Trig Prio -
Trig Src OR
Ext Trig On

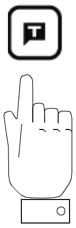
Select

Off	Disables external triggering.(default setting)
On	Enables external triggering.

2 **Apply the input signal to the external trigger (EXT.TRIG) terminal.**

See: "16.2.5 External Trigger terminal (EXT.TRIG)" (⇒ p.293)

9.7 Triggering Manually (Manual Trigger)



Triggers can be applied manually by pressing Manual trigger key. Manual triggering takes priority over all other trigger sources, regardless of settings.

To stop recording:

Press the **STOP** key.

One keypress	Recording is carried out for one recording length and then stops.
Two keypresses	Recording stops when key is pressed.

NOTE

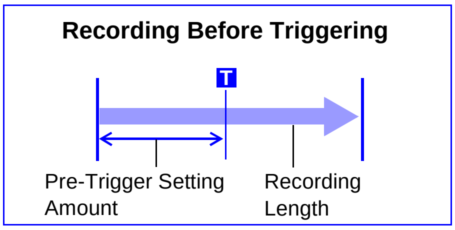
As for other trigger types, triggering does not occur during pre-trigger standby. Set the trigger priority function to **[On]**.

See: "9.8.2 Setting Trigger Acceptance (Trigger Priority)" (⇒ p.168)

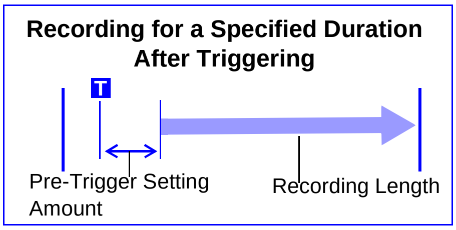
9.8 Pre-Trigger Settings

MEM **FFT**

This applies to the Memory function, and FFT function only.
By setting a portion (number of divisions or percentage) of the recording length to occur before triggering, the waveform is recorded before as well as after the trigger point.
You can also set the duration of a waveform to be recorded after a trigger point.



Recording Before Triggering



Recording for a Specified Duration After Triggering

NOTE

- When all trigger sources (analog, timer trigger, etc.) are disabled (Off), pre-trigger settings are ignored.
- Pre-triggers cannot be set by div with the FFT function.

9.8.1 Setting the Trigger Start Point (Pre-Trigger)

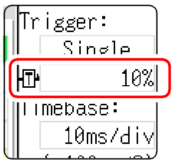
Set the position of the trigger point relative to the specified recording length.
There are two setting methods. (Setting by percent and setting by div)

Procedure

To open the screen: Press the DISP key → Waveform screen

1 **Select the unit to set the pre-trigger.**

Move the cursor to the Pre-trigger.



Trigger:
Single
10%
Timebase:
10ms/div

Select

%	Settings are by percent. (default setting)
div	Settings are by number of div. For external sampling, set by number of samples.

2 **Enter the numerical value.**

(When [%] is selected)

With the recording start point as 0% and the recording end point as 100%, set the % for the trigger point.

Select

-95%, 100%, 95%, 90%, 80%, 70%, 60%, 50%, 40%, 30%, 20%, 10%, 5%, 2%, 0%

(When [div] is selected)

With the recording start point as 0div and the recording end point as the set recording length, set the number of div for the trigger point.

Select

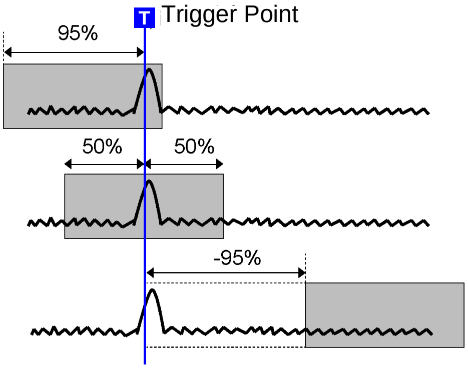
-Recording length (div) to +Recording length (div)

Description

About pre-triggering and the recording period (recording length)

Pre-Trigger setting examples

95%	95% of the recording length is recorded before the trigger point
50%	50% of the recording length is recorded before and 50% after the trigger point
-95%	95% of the recording length is recorded after the trigger point



NOTE

- Trigger events during the specified pre-trigger recording period are ignored. To enable recognition of such triggers, set Trigger Priority to **[On]**.

See: "9.8.2 Setting Trigger Acceptance (Trigger Priority)" (⇒ p.168)

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.

See: "Measurement and Internal Operations" (⇒ p.57)

9.8.2 Setting Trigger Acceptance (Trigger Priority)

MEM

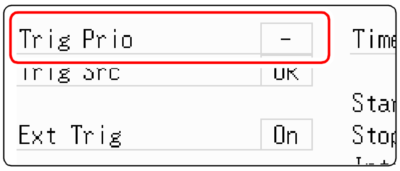
This applies to the Memory function only.
You can set whether a trigger is recognized (accepted) if trigger criteria are met during this period.

- When pre-triggering is enabled, trigger events are normally ignored for a certain period after measurement starts (while recording the specified pre-trigger period).
- This period is indicated on the Status bar as [Pre-Trigger wait].

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window

Move the cursor to the **[Trig Prio]** item.



Trig Prio -
Ext Trig On

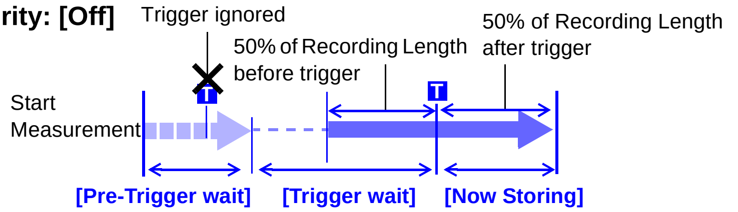
Select

Off	Trigger events are ignored during **[Pre-Trigger wait]** (default setting)
On	Trigger events are recognized (accepted) during **[Pre-Trigger wait]**.

Description

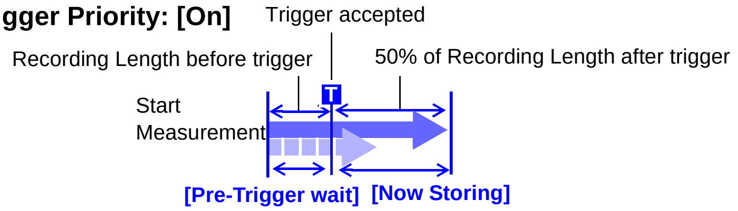
When trigger criteria are met during [Pre-Trigger wait]
Example: When the pre-trigger period is set to 50%

Trigger Priority: [Off]



(After 50% of the Recording Length is recorded internally, the **[Trigger wait]** state begins)

Trigger Priority: [On]



(A trigger event occurs while 50% of the Recording Length is being recorded internally)

When a trigger event occurs during pre-trigger recording, the data actually recorded may be shorter than the specified recording length. (In this case, the pre-trigger recording length is shortened. The recording length after the trigger event is the specified recording length minus the specified pre-trigger period.

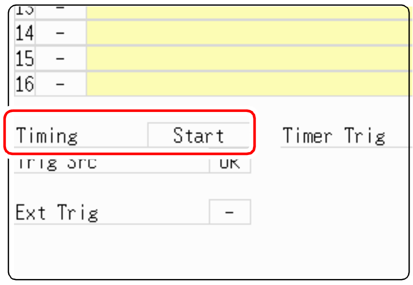
9.9 Setting Trigger Timing

REC

This applies to the Memory function only.
Set waveform recording operation when a trigger event occurs.

Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window



Timing Start

Timer Trig

Move the cursor to the **[Timing]** item.

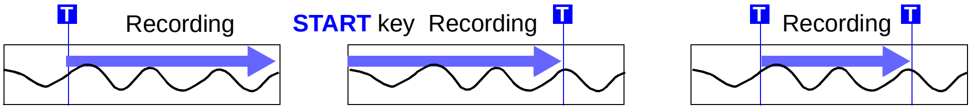
Select

Start	Start recording when a trigger event occurs, and stop after the specified recording length.(default setting)
Stop	Start recording when the **START** key is pressed, and stop when a trigger event occurs.
Start & Stop	Record the interval from one trigger event until the next trigger event.

Description

About trigger timing

The selected trigger mode determines how recording stops.



	[Start]	**[Stop]**	**[Start & Stop]**
Recording Starts	Recording starts when a trigger event occurs	Recording starts when you press the **START** key	Recording starts when a Start trigger event occurs
Recording Stops With **[Single]** trigger mode	Recording stops after data has been acquired for the specified recording length	Recording stops when a trigger event occurs	Recording stops when a Stop trigger event occurs

If no trigger event occurs before the specified recording length elapses:
[Stop] or **[Start & Stop]**: Recording stops after data has been acquired for the specified recording length

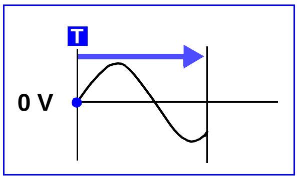
	[Start]	**[Stop]**	**[Start & Stop]**
With **[Repeat]** trigger mode	The Trigger Wait state begins after data has been acquired for the specified recording length When another trigger event occurs, data is again acquired for the specified recording length, then Trigger Wait resumes (repeats)	When a trigger event occurs, recording stops and then starts again (repeats)	When a trigger event occurs, recording stops and the Trigger Wait state resumes. When another trigger event occurs, recording continues until the next trigger occurs (repeats)

If no trigger event occurs before the specified recording length elapses:
[Stop] : After data is acquired for the specified recording length, recording restarts. This repeats until a trigger event occurs.
[Start & Stop]: The Trigger Wait state begins after data has been acquired for the specified recording length (Start Trigger)

Example: When the trigger type is Level Trigger, Level = 0.000 V, and Slope = ↑(rising)

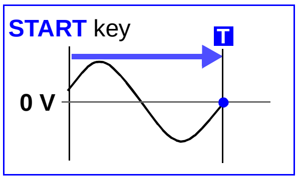
Setting of **[Timing]**

[Start]



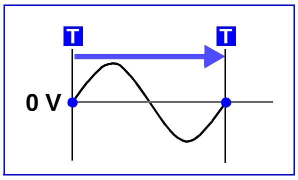
Records for specified recording length

[Stop]



Press **START** key to record Records until a trigger occurs

[Start & Stop]



Recording starts when a Start trigger event occurs Records until a Stop trigger occurs

The above sequences repeat when the trigger mode is **[Repeat]**.

9.10 Setting Combining Logic (AND/OR) for Multiple Trigger Sources

Analog, logic, external and timer trigger criteria can be combined by AND/OR logic to define complex trigger criteria.

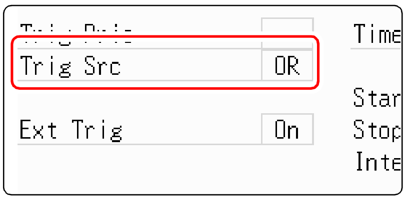
Procedure

To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key → Trigger settings window

Move the cursor to the **[Trig Src]** item.

Select

OR	Triggering occurs when any one of the specified trigger source criteria is met. (default setting)
AND	Triggering occurs only when all of the specified trigger source criteria are met.



Trig Src OR

Ext Trig On

(Memory Function case)

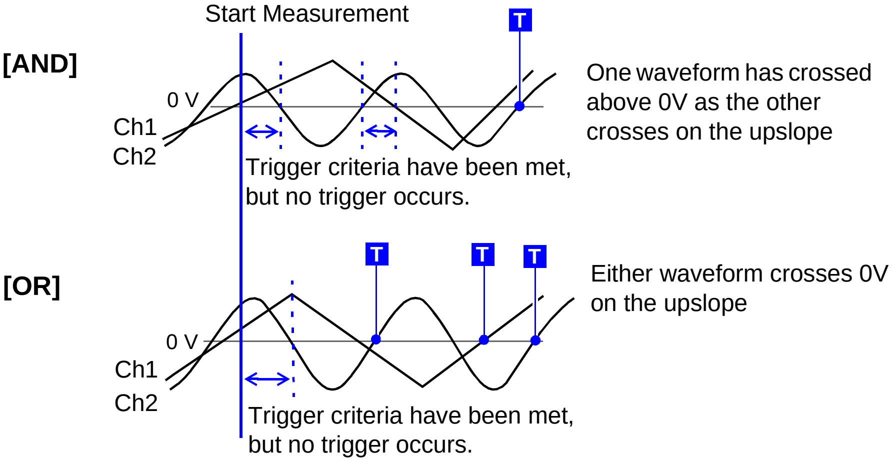
Description

When the trigger combining logic (Source (AND/OR)) is set to [AND]

If trigger criteria are already met when you press the **START** key, no triggering occurs. Triggering occurs only after all trigger sources have ceased to meet the criteria at once, and are subsequently met again.

Setting Example:
To apply a trigger when the upslope (↑) of the waveform crosses zero volts
Triggering occurs as follows in the AND and OR cases.

Channel	Trigger	Trigger Level	Slope	Filter
Ch1, Ch2	Level	0.00 V	↑	Off



One waveform has crossed above 0V as the other crosses on the upslope

Trigger criteria have been met, but no trigger occurs.

Either waveform crosses 0V on the upslope

Trigger criteria have been met, but no trigger occurs.

If both **[Start]** and **[Stop]** trigger timing criteria are combined, the simultaneous trigger sources are logically ANDed.

9.11 Using trigger settings to search measurement data

Trigger settings can be used to search measurement data.
Locations that match the set trigger criteria in the measurement data are searched for and displayed sequentially.
Using the same method to set triggers, it is possible to search for criteria different to those at the time of measurement.

Example 1: The measurement trigger criteria is trigger level 0 V and the data search condition is level 100 V.
Example 2: After measurement with a free run without a trigger, locations that exceed 100 V are searched for.

Procedure

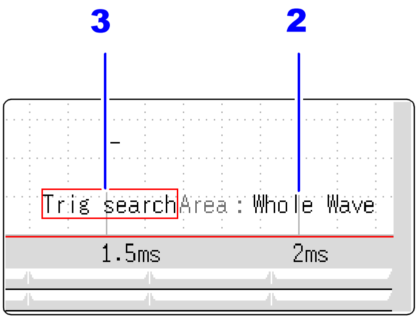
To open the screen: Press the DISP key → Waveform screen → Press the TRIG.SET key→ Trigger settings window ([Analog Trig], or [Logic Trig] sheet)

1 After measurement is finished, set the search criteria.

The setting method is the same as described in "9.3 Triggering by Analog Signals" (⇒ p.154) and "9.4 Triggering by Logic Signals (Logic Trigger)" (⇒ p.160).

2 Specify the search range.

Move the cursor to the [Area] item.



Select

Whole Wave	Search all measured data. (default setting)
A-B Wave	Search in the range between A/B cursor.

(When using memory division)

Select

Whole Display Blocks	Applies search to the whole display blocks.
A/B Display Blocks	When setting the A/B cursors on the display blocks, applies search to the range between the A and B cursors on the display blocks.
Whole Blocks	Applies search to the data in the whole blocks.
A/B Whole Blocks	When setting the A/B cursors for the whole blocks, applies search to the range between the A and B cursors for the whole blocks.

- **When selecting A/B range and only A cursor is shown on the screen, search will be performed on the data after A cursor.**
- **The search range for [Whole Blocks] and [A/B Whole Blocks] will be defined according to the start block and the number of blocks to be measured.**

3 Execute search.

Move the cursor to the [Trig search] item.

Select

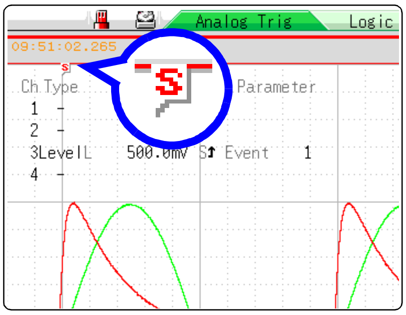
Execute search	Start the search from the beginning of the measurement data.
Search next	Search for the next search condition from the current position.
Move A cursor	Move A cursor to the searched position.
Move B cursor	Move B cursor to the searched position.
Clear	Clear the searched position.

Search and search for next can be performed using the T (manual trigger) key as well.

Description

Search results

Locations that match the criteria are displayed in the center of the screen and an S mark is displayed in this position.



When no matches are found, a message stating that no matches were found is displayed.

NOTE

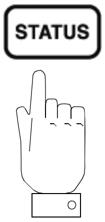
- Pre-triggers, trigger priorities, external triggers and timer triggers cannot be used as search conditions.
- The trigger position and search results may not match.

Numerical Calculation Functions

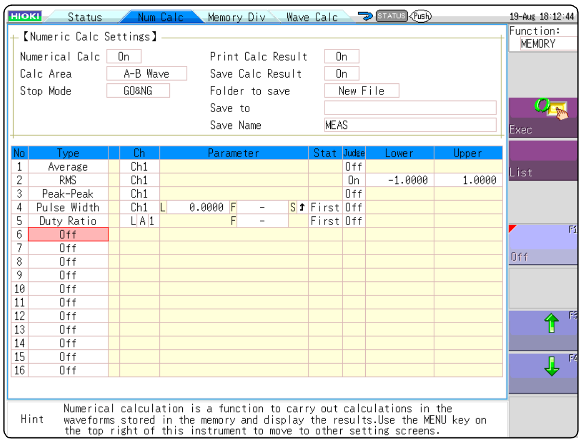
Chapter 10

Numerical calculations can only be used with the Memory function.
Results calculated from the acquired waveform are displayed as numerical values on the Waveform screen. Numerical calculation settings are made on the Status screen - **[Num Calc]** sheet.

Opening the [Num Calc] sheet



Pressing this key repeatedly displays the various sheets.



【Numeric Calc Settings】

Numerical Calc: On
Calc Area: A-B Wave
Stop Mode: GO&NG
Print Calc Result: On
Save Calc Result: On
Folder to save: New File
Save to:
Save Name: MEAS

No	Type	Ch	Parameter	Stat	Judge	Lower	Upper
1	Average	Ch1			Off		
2	RMS	Ch1			On	-1.0000	1.0000
3	Peak-Peak	Ch1			Off		
4	Pulse Width	Ch1	L 0.0000 F - S ↑	First	Off		
5	Duty Ratio	L A 1	F -	First	Off		
6	Off						
7	Off						
8	Off						
9	Off						
10	Off						
11	Off						
12	Off						
13	Off						
14	Off						
15	Off						
16	Off						

Hint: Numerical calculation is a function to carry out calculations in the waveforms stored in the memory and display the results.Use the MENU key on the top right of this instrument to move to other setting screens.

Operations available from the **[Num Calc]** sheet

Numerical Calculations

- Average
- RMS (Root-Mean-Square) value
- Peak-to-Peak Value
- Maximum Value
- Time to Maximum Value
- Minimum Value
- Time to Minimum Value
- Period
- Frequency
- Rise Time
- Fall Time
- Standard Deviation
- Area
- X-Y Area
- Time to Level
- Level at Time
- Pulse Width
- Duty Ratio(%)
- Pulse Count
- Four Arithmetic Operations
- Time difference calculation
- Phase contrast calculation
- High level calculation
- Low level calculation

(Total of 24 types)

- Specified calculation between A/B cursors

Waveform calculations can be limited to data within the range specified by A/B cursors.

Calculation operator details:
"10.6 Numerical Calculation Type and Description" (⇒ p.185)

Numerical Calculation Judgment (⇒ p.180)

The result of a numerical calculation can be compared to a preset reference range, for GO/NG (Pass/Fail) evaluation.

Save/Print Numerical Calculation Results

- Auto Save numerical calculation results
- Save specified existing numerical calculation result

See: "10.4 Saving Numerical Calculation Results" (⇒ p.183)

- Auto Print
- Arbitrary printing

See: "10.5 Printing Numerical Calculation Results" (⇒ p.184)

There are a total of 24 types of numerical calculations, 16 of which can be performed simultaneously.

When the Scaling function is used, numerical calculation is performed on the scaled value.

10.1 Numerical Calculation Workflow

There are two different ways of performing calculation.

- Calculating While Measuring: Settings for numerical calculation must be made before the measurement.
- Applying Calculations to Existing Data: Calculation is possible for waveform data after measurement is completed, and for data saved on media.

Calculating While Measuring

Make Calculation Settings	**Make calculation settings on the [Num Calc] sheet.**	**(⇒ p.176)**
	When judging based on calculation results:	(⇒ p.180)
	To automatically print or save calculation results: make printing and saving settings before measuring.	
	• Saving calculation results automatically	(⇒ p.183)
	• Printing calculation results automatically	(⇒ p.184)
Start Measurement		
Acquire Data	**The instrument acquires data when the trigger criteria are met.** (If triggering is not enabled, the instrument acquires data when you press the **START** key.)	
Calculate	**"Measurement" appears on the screen's status bar.** Calculations are performed sequentially from No. 1 to No. 16. (To interrupt calculations, press the **STOP** key to abort)	
Display Calculation Results	**Results are displayed on the Waveform screen.**	**(⇒ p.179)**
(Calculation Judgments)	**(only if judgments are enabled)**	
(Print or Save)	**(if auto printing or auto saving are enabled)** Calculation results are automatically printed or saved.	
Stop Measurement		

Applying Calculations to Existing Data

(Load the Data)	**(To load measurement data from storage media for calculation)**	**(⇒ p.77)**
Make Calculation Settings	**Make calculation settings on the Numerical Calculation sheet ([Num Calc] sheet)** When judging based on calculation results:	**(⇒ p.176)** (⇒ p.180)
Execute Calculation	**Select [Exec] to execute calculations.** (To interrupt calculations, press the **STOP** key)	
Display Calculation Results	**Results are displayed on the Waveform screen.**	**(⇒ p.179)**
(Calculation Judgments)	**(only if judgments are enabled)**	
(Print or Save)	**Print or save calculation results as occasion demands.** • Print: **PRINT** key • Save: **SAVE** key **When [Print Calc Result] (⇒ p.184) or [Save Calc Result] (⇒ p.183) is set to [On], results are automatically printed or saved.**	

When specifying a waveform range for calculation:

Before executing a calculation, specify the calculation range using the A/B cursors (div or Trace cursors) on the Waveform screen. Set the calculation range on the **[Num Calc]** sheet to **[A-B Wave]**.

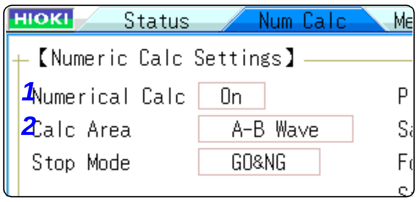
- Range cursors cannot be used to specify the range.
- When one cursor is used, the calculation range is from the cursor to the end of the data.

See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)
"10.2 Settings for Numerical Value Calculation" (⇒ p.176)

10.2 Settings for Numerical Value Calculation

Procedure

To open the screen: Press the STATUS key → [Num Calc] sheet



【Numeric Calc Settings】
1 Numerical Calc On
2 Calc Area A-B Wave
Stop Mode GO&NG

1 **Enable the Numerical Calculation function.**

Move the cursor to the **[Numerical Calc]** item.

Select **[On]**.

2 **Specify the Numerical Calculation range.**

Move the cursor to the **[Calc Area]** item.

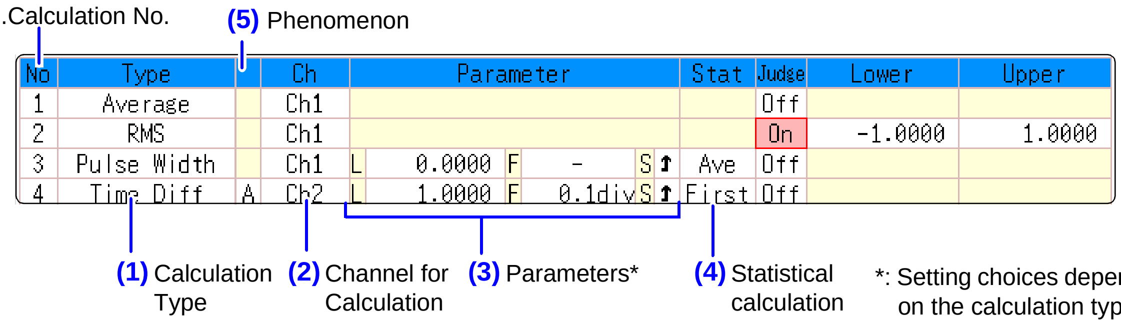
Select

WholeWave	Applies calculations to the whole waveform. (default setting)
A-B Wave	Applies calculations to the data between A/B cursors.

See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)

When selecting **[A-B Wave]**, specify the calculation range using the A/B cursors on the Waveform screen.
If no measurement data has been acquired by the instrument, first measure once so that the range can be specified for calculations to be applied to subsequent measurements.

3 **Perform calculation settings.**



No	Type		Ch	Parameter	Stat	Judge	Lower	Upper
1	Average		Ch1			Off		
2	RMS		Ch1			On	-1.0000	1.0000
3	Pulse Width		Ch1	L 0.0000 F – S↑	Ave	Off		
4	Time Diff	A	Ch2	L 1.0000 F 0.1div S↑	First	Off		

*: Setting choices depend on the calculation type.

(1) **Select the calculation type.**

Move the cursor to the number of the calculation type for which to make settings, and select the calculation type.

(When you select **[List]** a list of calculation types appears. To clear the display, press the **TRIG.SET** key once more.)

Also select **[Judge]** if you require judgment of calculation results.(⇒ p.180)

Off	No calculation. (default setting)
Average	Average value of waveform data
Rms	RMS value of waveform data
Peak-Peak	Peak-to-peak value of waveform data
Maximum	Maximum value of waveform data
Max-Time	Time from trigger to maximum value
Minimum	Minimum value of waveform data
Min-Time	Time from trigger to minimum value
Period	Period of signal waveform
Frequency	Frequency of signal waveform
RiseTime	Rise time of waveform data
FallTime	Fall time of waveform data
Std Dev	Standard deviation of waveform data
Area	Area enclosed by zero position and signal waveform

X-Y Area	Area of X-Y composite waveform
Time to Lev*	Time from trigger to specified level
Lev-time	Measurement value at a specified time point after triggering
Pulse Width*	Pulse width of waveform data
Duty Ratio*	Duty of waveform data
Pulses*	Pulse count of waveform data
Calculation	Four arithmetic operations on numerical calculation results
Time Diff*	Time difference between phenomenon A and B.
Phase Diff*	Time difference between phenomenon A and B displayed as a phase contrast.
High Level	High level value for waveform data
Low Level	Low level value for waveform data

***: Setting can also be made for logic channels**

(2) **Select the channel for calculations.**

Move the cursor to the item for the calculation target, and select the channel.

(A logic channel can also be selected for Time to Level, Pulse Width, Duty Cycle, and Pulse Count.)

(3) **Set parameters.**

Settings may not be necessary for some calculation types When calculating time differences and phase contrast, makes settings for A and B channels.

Move the cursor to the parameter items, and make appropriate parameter settings.

See: "Parameter table" (⇒ p.178)

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

(4) **Set the statistical calculation.**

Move the cursor to the [Stat] column.

Select

First	Calculate at the first condition of the measurement data.
Average	Acquire the average value of the calculation result in the measurement data.
Max	Acquire the maximum value from the calculation result in the measurement data.
Min	Acquire the minimum value from the calculation result in the measurement data.

(5) **When time difference calculation or phase contrast calculation has been selected, set Ch (channel) and parameters for A and B.**

4 **Execute the calculations. (when judging calculations (⇒ p.180))**

Applying Calculations to Existing Data

Select **[Exec]**.

When calculating automatically after measurement

Press the **START** key to start measurement.

When printing or saving calculation results during measurement

Settings must be made before the measurement.

See: "10.4 Saving Numerical Calculation Results" (⇒ p.183)
"10.5 Printing Numerical Calculation Results" (⇒ p.184)

When printing or saving existing data

Use **PRINT** key or **SAVE** key.

See: "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)
"6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.93)

To copy a calculation setting to another calculation number

Use the **[Num Calc]** sheet.

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

Parameter table

Calculation Type	Parameter	Parameter description
Period **Frequency** **Pulse Width** **Pulses** **Duty Ratio*** **Time Diff** **Phase Diff** ***: Level and Filter only**	**L (Level)**	Calculation is based on the interval (time) when this level is crossed.
	F (Filter)	Only when the measurement signal has crossed the level and has not crossed the level again within the specified filter width, it is taken as a valid event. This is useful to exclude level crossing events due to noise.
	S (Slope(↑, ↓))	Calculation is based on the interval (time) when the level is crossed. Depending on this setting, either crossing on the upward slope (↑) or downward slope (↓) is used for calculation.
Risetime **Falltime**	**P (%)**	Determines which section of the waveform between the upper and lower limits is used for risetime (or falltime) calculation. The range is narrowed from the upper and lower limit values by the percentage set here.
Time to Lev	**L (Level)**	Calculates the time specified level is crossed.
	F (Filter)	Only when the measurement signal has crossed the level and has not crossed the level again within the specified filter width, it is taken as a valid event. This is useful to exclude level crossing events due to noise.
	S (Slope(↑, ↓))	Determines whether the time is calculated until the signal crosses the specified level on the upward slope or on the downward slope.
Lev-Time	**Time or Measure (Calculation results)**	Specifies the time for calculating the measurement value, using the trigger position as zero. To use the numerical calculation result, specify the numerical calculation number. The range specified by A/B cursors is not available.
Calculation	**Numerical Calculation No.**	Sets the numerical calculation number.
	+, - , ×, ÷	Sets the operators for the four arithmetic operations.

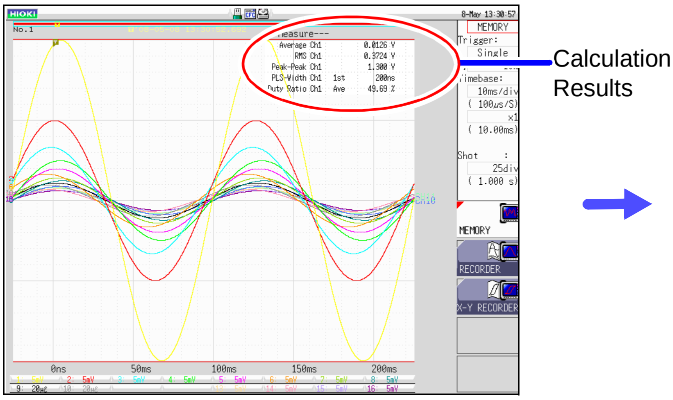
NOTE

- Depending on the signal waveform, calculation values for the Period, Frequency, Risetime, and Falltime parameters may not be displayed.
- When Scaling is enabled, the waveform data are scaled before numerical calculation. The units for parameter values are derived from the units set for the Scaling function.

See: About Scaling: "8.5 Converting Input Values (Scaling Function)" (⇒ p.128)

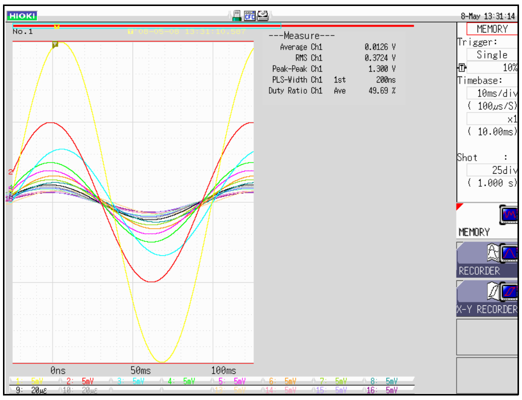
10.2.1 Displaying Numerical Calculation Results

Numerical calculation results are displayed on the Waveform screen



```
---Measure---
     Average Ch1           0.0126 V
         RMS Ch1           0.3724 V
   Peak-Peak Ch1           1.300 V
   PLS-Width Ch1   1st       200ns
  Duty Ratio Ch1   Ave     49.69 %
```

If the display is hard to view because of overlapping numerical values and waveforms



```
---Measure---
     Average Ch1           0.0126 V
         RMS Ch1           0.3724 V
   Peak-Peak Ch1           1.300 V
   PLS-Width Ch1   1st       200ns
  Duty Ratio Ch1   Ave     49.69 %
```

Press the **DISP** key.
Numerical values and waveforms are displayed separately.

See: "7.7.3 Switching the Waveform Display Width" (⇒ p.114)

To save calculation results after measuring:

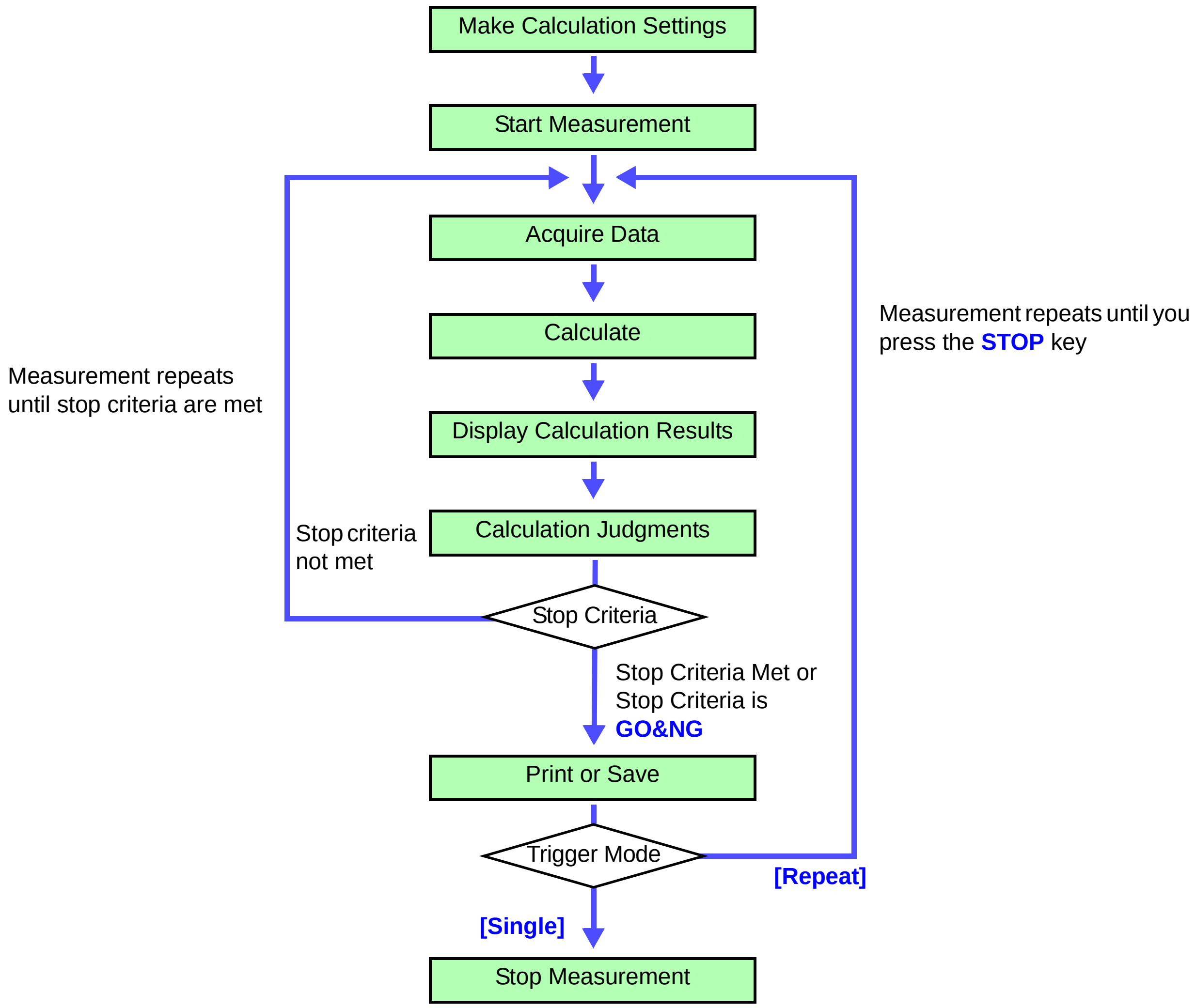
Set the **[Select at save]** item to **[Yes]**. When you press the **SAVE** key after measurement, you can select the content to be saved. (Select **[Calc Result]**.)

See: "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)

10.3 Judging Calculation Results

Set the judgment criteria (upper and lower threshold values) by which to judge numerical calculation results. Judgment criteria can be set for every numerical calculation.

Waveform acquisition processing depends on the trigger mode setting (Single or Repeat) and the criteria specified to stop measuring upon judgment (GO, NG or GO & NG).

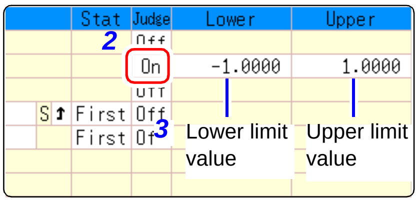


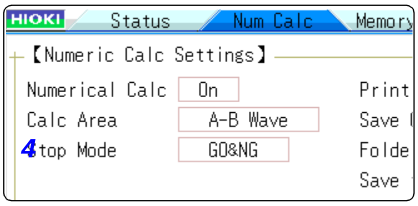
NOTE Automatic saving and automatic printing will not be carried out before termination conditions are fulfilled at the end of the calculation evaluation.

Procedure

To open the screen: Press the STATUS key → [Num Calc] sheet

1 **Make calculation settings. (⇒ p.176)**





【Numeric Calc Settings】

Numerical Calc On

Calc Area A-B Wave

Stop Mode GO&NG

2 **Enable the judgment function.**

Move the cursor to the **[Judge]** setting for Calculation No. to judge, and select **[On]**.

Select

Off	Judgment is not carried out.
On	Result will be NG (Fail) if judgment range is exceeded. Any channel in which result was NG is shown in red.

3 **Specify the judgment thresholds.**

Move the cursor to the **[Lower]** and **[Upper]** items.

Select an entry method and enter the threshold values.
Input range:-9.9999E+29 to +9.9999E+29

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

4 **Select the Stop Criteria upon judgment.**

Move the cursor to the **[Stop Mode]** item.

Select

GO	Continue to the next process when within the threshold range (PASS judgment)
NG	Continue to the next process when outside of the threshold range (FAIL judgment)
GO&NG	Continue to the next process regardless of judgment result.

Execute the calculations.

Applying Calculations to Existing Data

Select **[Exec].**

When judging automatically after measurement

Press the **START** key to start measurement.

NOTE

About upper and lower threshold
The upper threshold of the period range cannot be set below the lower threshold, and vice-versa.

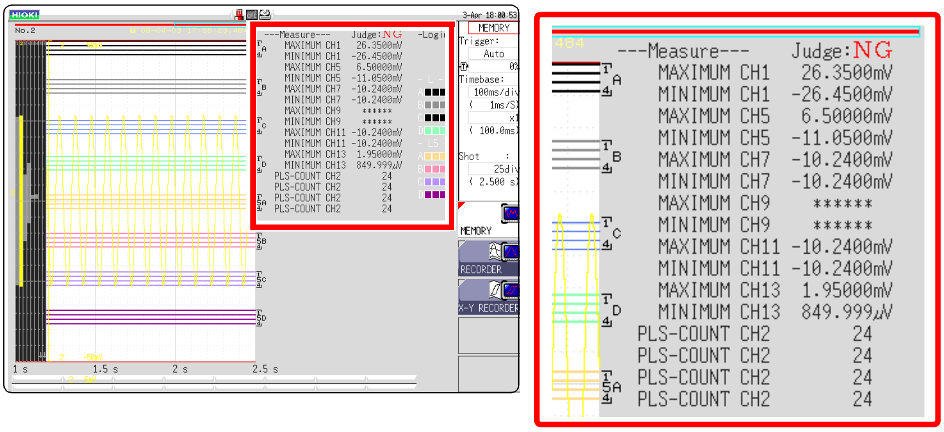
About executing the calculation
Processing depends on the Trigger Mode setting.
If calculating while acquiring waveforms, measurement is repeated until the Stop Criteria are met. (⇒ p.180)

To record all calculation results
Set the Stop Mode item to **[GO&NG]**.

10.3.1 Display of Judgment Results and Signal Output

Judgment results of numerical calculations are displayed on the Waveform screen.

Within the judgment threshold range: GO judgment
Out of the judgment threshold range: NG judgment (displayed in red)



```
---Measure---      Judge:NG
  MAXIMUM CH1    26.3500mV
  MINIMUM CH1   -26.4500mV
  MAXIMUM CH5    6.50000mV
  MINIMUM CH5   -11.0500mV
  MAXIMUM CH7   -10.2400mV
  MINIMUM CH7   -10.2400mV
  MAXIMUM CH9     ******
  MINIMUM CH9     ******
  MAXIMUM CH11  -10.2400mV
  MINIMUM CH11  -10.2400mV
  MAXIMUM CH13   1.95000mV
  MINIMUM CH13   849.999μV
PLS-COUNT CH2        24
PLS-COUNT CH2        24
PLS-COUNT CH2        24
PLS-COUNT CH2        24
```

When printing, judgment results for each parameter are also printed.

When the judgment result is GO

- The GO signal is output at the $\overline{\text{GO}}$/$\overline{\text{EXT.OUT.1}}$ external I/O terminal.

When the judgment result is NG

- The NG signal is output at the $\overline{\text{NG}}$/$\overline{\text{EXT.OUT.2}}$ 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.

10.4 Saving Numerical Calculation Results

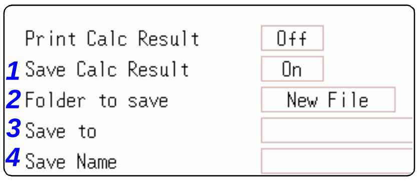
Calculate and automatically save during data acquisition. Before measurement begins, the calculation settings need to be set.

⚠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.

Procedure

To open the screen: Press the STATUS key → [Num Calc] sheet



	Print Calc Result	Off
1	Save Calc Result	On
2	Folder to save	New File
3	Save to	
4	Save Name	

1 **Enable the saving of numerical calculation results.**

Move the cursor to the **[Save Calc Result]** item.

Select **[On]**. (default setting: Off)

2 **Select the file creation method.**

Move the cursor to the **[Folder to save]** item.

Select

New File	Creates a new file for each measurement.
Existing File	Adds calculation results to one file.

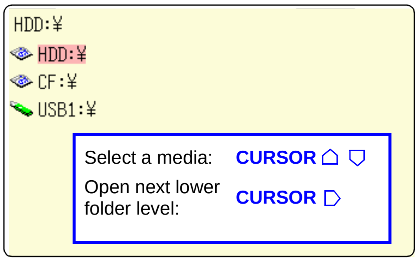
3 **Set the save target**

Move the cursor to the **[Save To].**

Select **[Edit]**.
The Browse folders dialog box appears. (See illustration at right.)

Move the cursor to the save target media.
Select **[Confirm]** to confirm the selection.

To create a new folder to use as target, select **[New Folder]**.



HDD:¥
HDD:¥
CF:¥
USB1:¥

Select a media:	CURSOR △ ▽
Open next lower folder level:	CURSOR ▷

4 **Enter a save name (if you want to use a different name).**

Move the cursor to the **[Save Name]** item.

Enter the save name. (default setting: MEAS)
See: "8.1 Adding Comments" (⇒ p.118)

Confirm the measurement configuration and numerical calculation result settings, then start measurement (Press the START key).

After the data is acquired and the numerical calculation process completes, the numerical calculation results (text) are saved automatically to the specified storage media.

Save Name
- The maximum length of the Save Name string is 123 characters. The maximum path length is 255 characters.
- A sequential number starting from 0001 is automatically appended to the Save Name (when **[New File]** is selected).

Example for saving numerical calculation results

NOTE If you save numerical calculation results, characters or display items used on the instrument are converted as shown below.

Characters used on the instrument	Saved characters
^{2}	^2
^{3}	^3
µ	~u
Ω	~o
e	~e
°	~c
±	~+
µε (display only)	uE
°C (display only)	C

<When calculation settings are as follows>

Calculation No. 1: Maximum value of analog channel 1
Calculation No. 2: Maximum value of analog channel 1
Calculation No. 3: Maximum value of analog channel 2
Calculation No. 4: Maximum value of analog channel 2

```
"Trig Time" ,"No1 Maximum Ch1" ,"No2 Minimum Ch1" ,"No3 Maximum Ch2" ,"No4 Minimum Ch2"
"","V","V","V","V"
"08-04-11 17:40:33.351","+3.00078E-05","+2.12000E-04","+2.00000E-03","+1.30000E-03"
"08-04-11 17:44:25.976","+3.06078E-05","+2.39996E-04","+2.00000E-03","+1.10000E-03"
```

Recorded in the order of the calculation settings of line 1.

Line 1: Calculation Settings
Line 2: Calculation Result Unit
From Line 3: Calculation Results

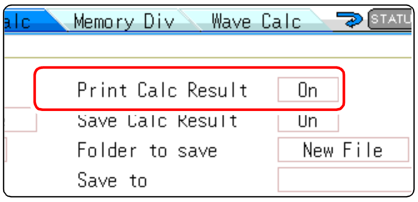
10.5 Printing Numerical Calculation Results

You can print the calculation results.
When Auto Print is enabled, the result data are printed after waveform printing.

Procedure

To open the screen: Press the STATUS key → [Num Calc] sheet

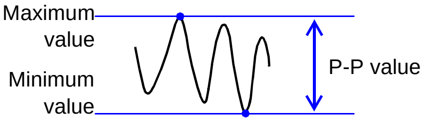
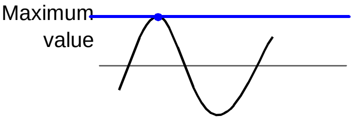
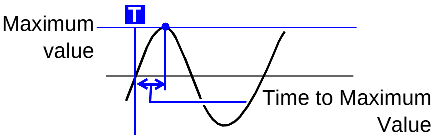
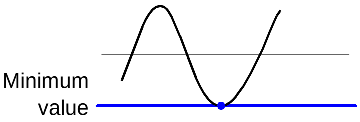
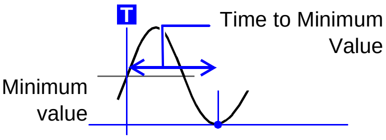
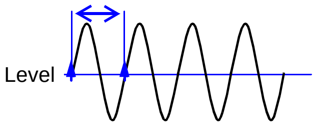
Move the cursor to the **[Print Calc Result]**, and select **[On]**.

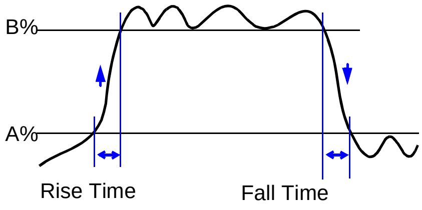
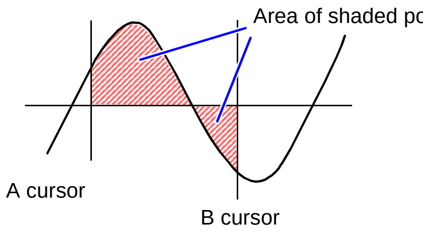
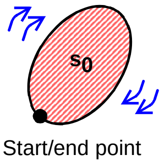
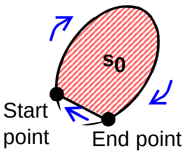
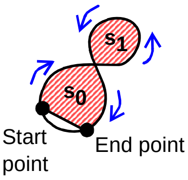
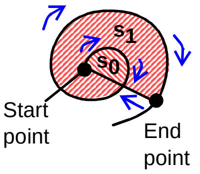


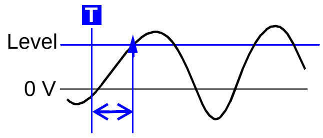
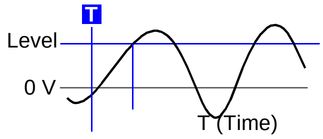
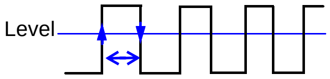
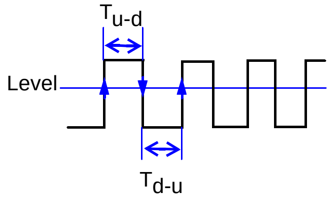
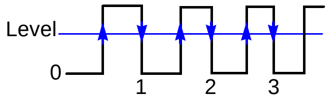
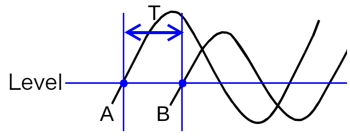
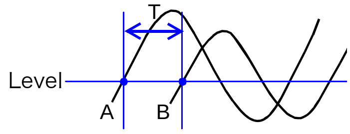
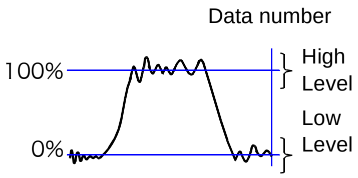
Print Calc Result On
Save Calc Result On
Folder to save New File
Save to

NOTE Printing is also carried out when only calculation but no measurement was performed.

10.6 Numerical Calculation Type and Description

Numerical Calculation Type	Description
Average	Obtains the average value of waveform data. $AVE = \frac{1}{n}\sum_{i=1}^{n} di$ *AVE*: Average value *n*: Data count *di*: Data on channel number i
RMS (Root-Mean-Square) value (Rms)	Obtains the RMS value of waveform data. If Scaling is enabled, calculations are applied to the waveform after scaling. $RMS = \sqrt{\frac{1}{n}\sum_{i=1}^{n} di^2}$ *RMS*: RMS value *n*: Data count *di*: Data on channel number i
Peak-to-Peak value (Peak-Peak)	Obtains the value of the difference (peak-to-peak value) between maximum and minimum values of waveform data. 
Maximum Value (Maximum)	Obtains the maximum value of waveform data. 
Time to Maximum Value (Max-Time)	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. 
Minimum Value (Minimum)	Obtains the minimum value of waveform data. 
Time to Minimum Value (Min-Time)	Obtains the time (s) from the trigger point to the minimum value. When there are two or more minimum value points, the first point of the first waveform for which calculation was carried out is taken as the minimum value. 
Period/Frequency	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. 

Numerical Calculation Type	Description
Rise Time and Fall Time	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. As waveform data is acquired, the rise time (or fall time) is obtained from the first rising (or falling) edge. When calculation of the range specified by the A/B cursors is selected, the obtained rise time (or fall time) is the first rising (or falling) edge between the cursors.  A: 5 to 30% B: 95 to 70%
Standard Deviation (Std Dev)	Obtains the standard deviation of the waveform data. $\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(di - AVE)^2}$ σ: Standard Deviation *AVE*: Average *n*: Data count *di*: Data on channel number i
Area	Obtains the area value (V•s) enclosed by the zero position (point of zero potential) and the signal waveform. When calculation of the range specified by the A/B cursors is selected, the calculated area is constrained to the waveform between the cursors. $S = \sum_{i=1}^{n} \lvert di \rvert \bullet h$ *S*: Area *n*: Data count *di*: Data on channel number i *h*=Δt: Sampling rate 
X-Y Area	Obtains the area (V^2) 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. To enable area calculation, specify the calculation range using the A/B cursors (Voltage axis or Trace) on the waveform of each channel for X-Y composition. (The area cannot be specified directly by A/B cursors on the X-Y waveform.) See: About A/B Cursor:"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.102) **When the trace consists of multiple loops**  $S = n \times s_0$ *S*: Area *n*: Number of loops **When the trace is an open curve**  $S = s_0$ *S*: Area (Area enclosed by the curve and line connecting start and end points) **When the trace is a figure-8**  $S = \lvert s_0 - s_1 \rvert$ *S*: Area **When the trace is an open curve**  $S = s_0 \times 2 + s_1$ *S*: Area (The number of overlapping regions increases with the number of loops) **Setting Choices: Set the X- and Y-axis channels.**

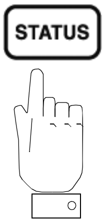
Numerical Calculation Type	Description
Time to Level (Time-Lev)	Finds the point where the signal crosses a specified level from the start of the calculation range, and obtains the time elapsed from the last trigger event. 
Specified Time Level (Lev-Time)	Obtains the level at a specified time point after the trigger event. The time can also be specified using other calculation results obtained earlier. 
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 (%)	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.  $Duty\ (\%) = \frac{Tu\text{-}d}{Tu\text{-}d + Td\text{-}u} \times 100\ (\%)$ T_{u-d}: Time (seconds) after rising intersection to falling intersection T_{d-u}: (s) Time (seconds) after falling intersection to the next rising intersection
Pulses	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) 
Four Arithmetic Operations (Calculation)	Performs arithmetic operations (+, - , ×, ÷) upon arbitrarily selected results of numerical calculations.
Time difference calculation (Time Diff)	Obtain T[s], the time difference that passes between rises above or drops below the level specified for A and B waveforms. Time difference T = B waveform (time where the level was exceeded) - A waveform (time where the level was exceeded). 
Phase contrast calculation (Phase Diff)	Obtain the time difference that passes between rises above or drops below the level specified for A and B waveforms and then obtain the phase contrast [°], based on A waveform.  $\text{Phase contrast} = \frac{\text{Time difference of A and B waveform [T]}}{\text{Cycle of A waveform}} \times 360°$
High Level **Low Level**	With 0% of the loaded waveform data as the Low level and 100% as the High level, a histogram (frequency distribution) is used for calculation. 

Waveform Calculation Functions MEM

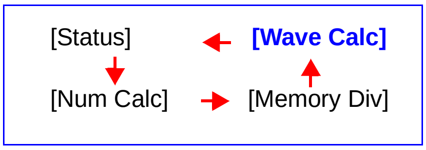
Chapter 11

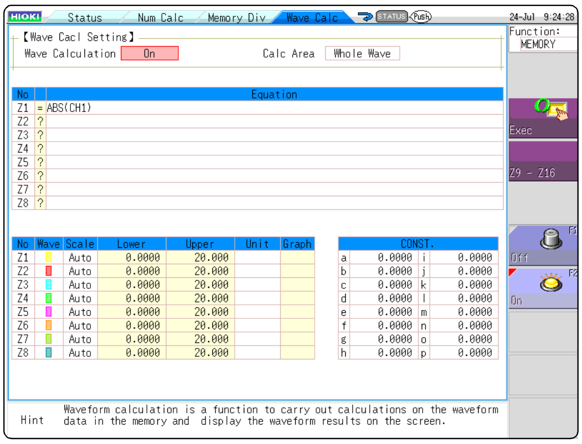
Waveform calculations can only be used with the Memory function.
A pre-specified calculation equation is applied to acquired waveform data, and the calculation results are displayed as a waveform on the Waveform screen.
Waveform calculation settings are made on the Status screen - **[Wave Calc]** sheet.

Opening the [Wave Calc] sheet



Pressing this key repeatedly displays the various sheets.





Function: MEMORY

【Wave Cacl Setting】

Wave Calculation On

Calc Area Whole Wave

No		Equation
Z1	=	ABS(CH1)
Z2	?	
Z3	?	
Z4	?	
Z5	?	
Z6	?	
Z7	?	
Z8	?	

No	Wave	Scale	Lower	Upper	Unit	Graph
Z1	🟨	Auto	0.0000	20.000		
Z2	🟥	Auto	0.0000	20.000		
Z3	🟦	Auto	0.0000	20.000		
Z4	🟩	Auto	0.0000	20.000		
Z5	🟪	Auto	0.0000	20.000		
Z6	🟧	Auto	0.0000	20.000		
Z7	🟩	Auto	0.0000	20.000		
Z8	🟦	Auto	0.0000	20.000		

CONST.			
a	0.0000	i	0.0000
b	0.0000	j	0.0000
c	0.0000	k	0.0000
d	0.0000	l	0.0000
e	0.0000	m	0.0000
f	0.0000	n	0.0000
g	0.0000	o	0.0000
h	0.0000	p	0.0000

Hint Waveform calculation is a function to carry out calculations on the waveform data in the memory and display the waveform results on the screen.

Operations available from the [Wave Calc] sheet

Waveform Calculations

- Four Arithmetic Operators (+, -, *, /)
- Absolute Value (ABS)
- Exponent (EXP)
- Common Logarithm (LOG)
- Square Root (SQR)
- Moving Average (MOV)
- Slide along the time axis
- Differential Calculus: 1st derivative (DIF), 2nd derivative (DIF2)
- Integral Calculus: 1st integral (INT), 2nd integral (INT2)
- Trigonometric functions (SIN, COS TAN)
- Inverse Trigonometric functions (ASIN, ACOS ATAN)

(Total 11 types)

- Specified calculation between A/B cursors

Waveform calculations can be limited to data within the range specified by A/B cursors.

Calculation operator details:
"11.3 Waveform Calculation Operators and Results" (⇒ p.198)

In addition to the four arithmetic operators, 10 types of functions can be used. It is possible to set up to 16 calculation formulas.
When Scaling is enabled, numerical calculations are performed on scaled values.

11.1 Waveform Calculation Workflow

There are two different ways of performing calculation.

- Calculating While Measuring: Settings for waveform calculation must be made before the measurement.
- Applying Calculations to Existing Data: Calculation is possible for waveform data after measurement is completed, and for data saved on media.

Calculating While Measuring

Make Calculation Settings ↓	**Make calculation settings on the [Wave Calc] sheet.** To automatically print or save calculation results: make printing and saving settings before measuring. • Saving calculation results automatically • Printing calculation results automatically	(⇒ p.192) (⇒ p.69) (⇒ p.91)
Start Measurement ↓		
Acquire Data ↓	**The instrument acquires data when the trigger criteria are met.** (If triggering is not enabled, the instrument acquires data when you press the **START** key.)	
Calculate ↓	**[Calculating...] appears on the screen.** Calculations are performed sequentially from No. 1 to No. 16. (To interrupt calculations, press the **STOP** key to abort)	
Display Calculation Results ↓	**Results are displayed on the Waveform screen.**	(⇒ p.193)
(Print or Save) ↓	**(if auto printing or auto saving are enabled)** Calculation results are automatically printed or saved.	
Stop Measurement		

NOTE

- Waveform calculation is not available when using Roll Mode and Memory Division.
- If waveform calculation is performed while measuring and is forcibly exited during calculation, the result at that time of exit is displayed. To re-calculate, select the **[Exec]** button at the waveform calculation sheet.

Applying Calculations to Existing Data

After measurement with calculation OFF (Or with data loading)	**(To load measurement data from storage media for calculation)**	**(⇒ p.77)**
↓		
Make Calculation Settings	**Make calculation settings on the Waveform Calculation sheet ([Wave Calc] sheet)**	**(⇒ p.192)**
↓		
Execute Calculation	**Select [Exec] to execute calculations.** (To interrupt calculations, press the **STOP** key)	
↓		
Display Calculation Results	**Results are displayed on the Waveform screen.**	**(⇒ p.193)**
↓		
(Print or Save)	**Print or save calculation results as occasion demands.** • Print: **PRINT** key • Save: **SAVE** key	

NOTE

- The maximum record length that can be calculated is 10,000 div.
  To perform calculation for waveforms measured at longer record lengths, save to files in sections at a range shorter than 10,000 div, reload to this instrument and then calculate.
- When memory division is not used, it is possible to reference the last 16 measured waveforms. However, when waveform calculation is performed for this waveform, waveform data other than that of the currently referenced blocks (the blocks in the data to be calculated) is deleted.

When specifying a waveform range for calculation:

Before executing a calculation, specify the calculation range using the A/B cursors (div or Trace cursors) on the Waveform screen. Set the calculation range on the **[Wave Calc]** sheet to **[A-B Wave]**.

- Range 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.

If waveform calculation is performed after measurement, measured waveforms with a record length of 10,001 div or more cannot be calculated, even if the range is specified by the A/B cursor.

See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)
"11.2 Settings for Waveform Calculation" (⇒ p.192)

Changing calculation settings while measuring:

Changes made to calculation settings while measuring are applied after measurement is finished.

To change calculation settings and recalculate:

Make changes to calculation contents on the **[Wave Calc]** sheet, and execute the calculation.

See: "11.2 Settings for Waveform Calculation" (⇒ p.192)

To not display a calculation waveform, or to display only the desired waveform:

The displayed sheet and calculation waveform to be displayed can be selected on the **[Wave Calc]** sheet.

See: "11.2.3 Changing the display method for calculated waveforms" (⇒ p.196)

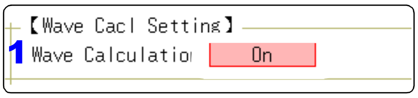
11.2 Settings for Waveform Calculation

Procedure

To open the screen: Press the STATUS key → [Wave Calc] sheet

1 Enable the Waveform Calculation function.

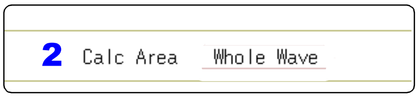
Move the cursor to the **[Wave Calculation]** item, and select **[On]**.



Wave Calculatio On

2 Specify the waveform calculation range.

Move the cursor to the **[Calc Area]** item.



Calc Area Whole Wave

Select

Whole Wave	Applies calculations to the whole waveform. (default setting)
A-B Wave	Applies calculations to the data between A/B cursors.

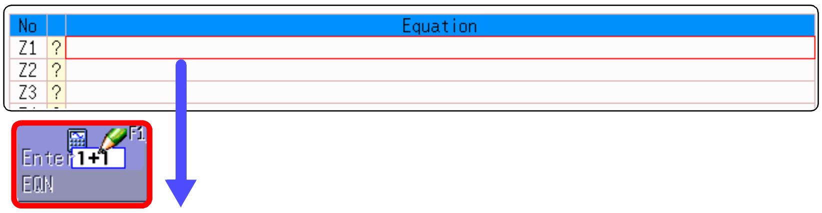
See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)

When selecting [A-B Wave], specify the calculation range using the A/B cursors on the Waveform screen.
If no measurement data has been acquired by the instrument, first measure once so that the range can be specified for calculations to be applied to subsequent measurements.

3 Perform calculation settings.

Move the cursor to the **[Equation]** column of the calculation to be set and select **[Enter EQN]**.
A dialog is displayed for entering a calculation equation.

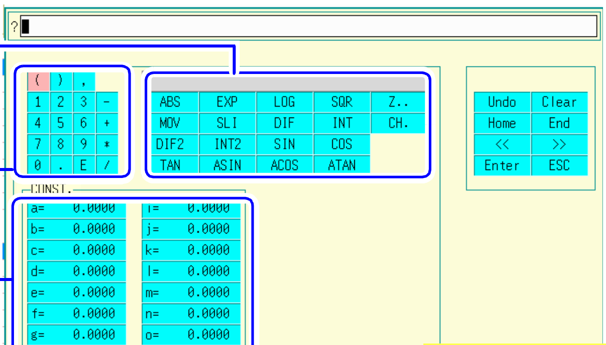
.Calculation No.



Enter calculation operators

Enter numerical values and symbols

Enter constants
Constants must have been previously entered on the **[CONST.]** (⇒ p.195)



If "=" is displayed
The entered calculation equation is syntactically correct.
If "?" is displayed
The equation has a syntax error.
The cursor is placed at the location of the error to facilitate correction.

- Are parentheses correctly matched?
- Has a multiplication operator "*" been omitted?

4 Select a calculation equation.

See: "Waveform Calculation Example" (⇒ p.197)

5 When finished entry, select **[Confirm]**.
The entered equation is displayed in the **[Equation]** field.

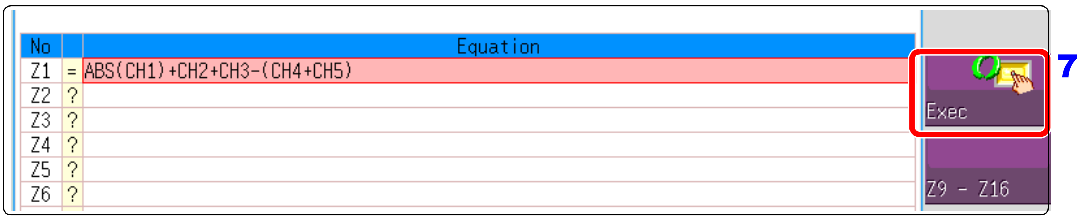
The scale (maximum and minimum vales) of the calculation results has a default setting of **[Auto]**. If you want to scale the results, set the maximum and minimum values under **[Manual]**.
See: "Changing the display method for calculated waveforms" (⇒ p.196)

6 **(As occasion demands)**
Set auto saving (⇒ p.69) and auto printing (⇒ p.91).

7 **Execute the calculations.**

Applying Calculations to Existing Data

At the **[Wave Calc]** sheet, select **[Exec]**.



No		Equation
Z1	=	ABS(CH1)+CH2+CH3-(CH4+CH5)
Z2	?	
Z3	?	
Z4	?	
Z5	?	
Z6	?	

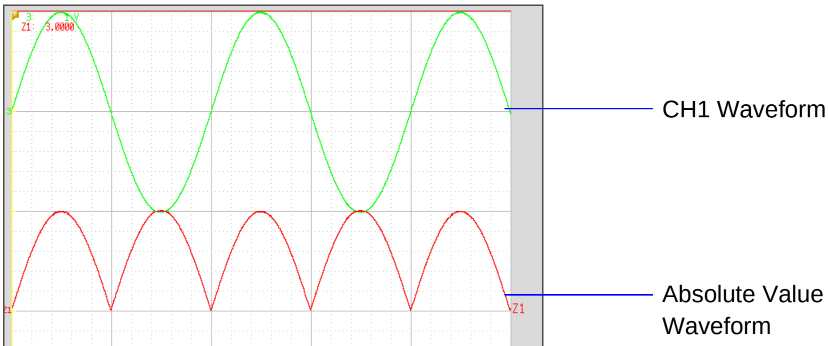
To calculate while measuring

Press the **START** key to start measurement.
Calculation waveforms are displayed after loading waveforms.

11.2.1 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. Calculation equation = ABS(CH1)



To copy settings from one calculation to another:
Settings can be copied at the **[Wave Calc]** sheet.
See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

About calculation equations

Operators

Operator	Name	Operator	Name
ABS	Absolute Value	DIF2	2nd Derivative
EXP	Exponent	INT2	2nd Integral
LOG	Common Logarithm	SIN	Sine
SQR	Square Root	COS	Cosine
MOV	Moving Average	TAN	Tangent
SLI	Movement parallel to the time axis	ASIN	Inverse Sine
DIF	1st Derivative	ACOS	Inverse Cosine
INT	1st Integral	ATAN	Inverse Tangent

See: "11.3 Waveform Calculation Operators and Results" (⇒ p.198)

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 [/].
- If a long complicated formula is entered, a question mark (?) is displayed. Divide the formula into 2 or more parts.

$$\underbrace{\text{ABS(CH1)}}_{\mathbf{1}}+\underbrace{\text{CH2*CH3}}_{\mathbf{2}}-\underbrace{\text{(CH4+CH5)*ABS(CH4)/DIF(CH1,1)}}_{\mathbf{3}}$$

- When dividing by 0, an overflow value is output.
  (For positive values, +9.9999E+29. For negative values, -9.9999E+29.)
- The result of calculation Z_i can be used in other calculation equations. However, the Z_nth equation can only refer to the results of equations up to Z_{n-1}.
  (Example: Equation Z_4 can include the results of equations Z_1 through Z_3.)

Using the MOV, SLI, DIF and DIF2 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: MOV(CH1,10)
DIF (Derivative) DIF2 (2nd 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 CH2 using a 20-point sampling interval: DIF(CH2,20)

When calculation results overflow (OVER)

- The value that indicated by the A/B cursor is not a correct value.
- When [Scale] is set to [Auto], waveforms appear at the top or bottom edge of the screen. This makes calculation result overflow obvious.

11.2.2 Setting constants

Procedure

To open the screen: Press the STATUS key → [Wave Calc] sheet

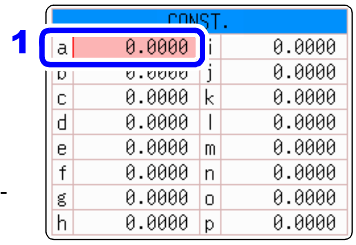
1 **Move the cursor to the No. to be set as [CONST.].**

2 Select an entry method, and enter the constant.

Setting range: -9.9999E+29 to +9.9999E+29

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

Defined constants are shown in the constant display of the calculation equation setting dialog.



CONST.

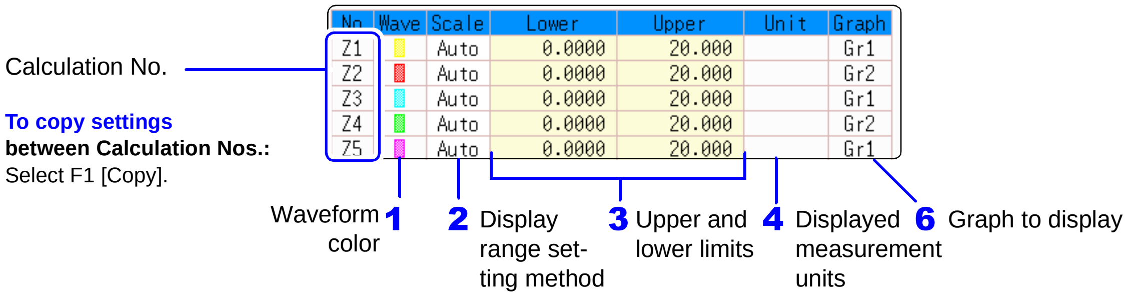
a	0.0000	i	0.0000
b	0.0000	j	0.0000
c	0.0000	k	0.0000
d	0.0000	l	0.0000
e	0.0000	m	0.0000
f	0.0000	n	0.0000
g	0.0000	o	0.0000
h	0.0000	p	0.0000

11.2.3 Changing the display method for calculated waveforms

M E M

Procedure

To open the screen: Press the STATUS key → [Wave Calc] sheet



No	Wave	Scale	Lower	Upper	Unit	Graph
Z1	🟨	Auto	0.0000	20.000		Gr1
Z2	🟥	Auto	0.0000	20.000		Gr2
Z3	🟦	Auto	0.0000	20.000		Gr1
Z4	🟩	Auto	0.0000	20.000		Gr2
Z5	🟪	Auto	0.0000	20.000		Gr1

To copy settings between Calculation Nos.:
Select F1 [Copy].

1 Enable waveform display, and display color

Move the cursor to the **[Wave]** column.

Select

On-Off	Set On to display the waveform of the flashing cursor column (default setting). Set to Off to hide display.
↑↓	Select the waveform color.
All On-Off	Select On to display all waveforms. Select Off to hide all waveforms.

2 Select a method to set scaling

Move the cursor to the [Scale] column for the Calculation No. to be set.

Select

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.

Depending on calculation results, automatic scaling settings may be unsatisfactory, in which case the limits must be entered manually.

3 Set the upper and lower limits of the display range (when [Manual] is selected)

Select **[Lower]** and **[Upper]**.

Select an entry method and enter the limit values.
Entry range: -9.9999E+29 to +9.9999E+29

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

4 Specify the physical units

Move the cursor to the **[Unit]** column.

Select an entry method and enter the physical units.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

5 Select the graph to be displayed.

(When split screen (**[Format]** item on the **[Status]** sheet) is **[Dual]** or higher)

Move the cursor to the **[Graph]** column and select the graph number.

Waveform Calculation Example

Calculate the RMS waveform from the instantaneous waveform

The RMS values of the waveform input on Channel 1 are calculated and displayed. This example describes the calculation of waveform data measured for one cycle over two divisions.

1 **Enable the Waveform Calculation function.**

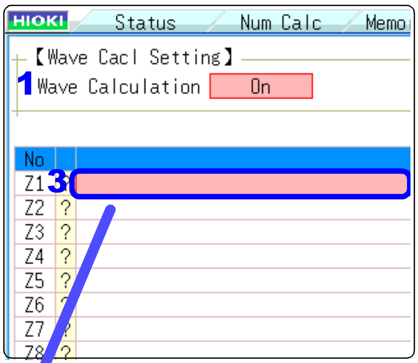
Move the cursor to the **[Wave Calculation]** item, and select **[On]**.

2 **Specify the waveform calculation range.**

Move the cursor to the **[Calc Area]** item, and select **[Whole Area]**.

3 **Perform calculation settings.**

Move the cursor to the **[Equation]** column of No. Z1 and then select **[Enter EQN]**.
A dialog is displayed for entering a calculation equation.



Wave Calculation On

After selecting the channel number, select the **[Enter Char]** button.

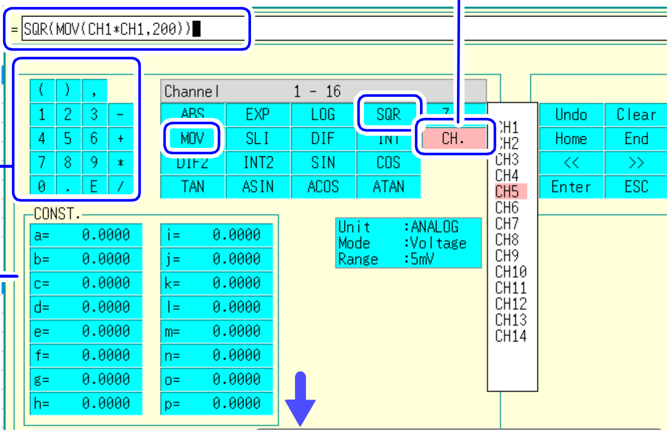
Entering the calculation equation

SQR(MOV(CH1*CH1,200))

The number of samples per cycle (1 division = 100 samples) Here, one cycle is two divisions (200 samples)

Enter numerical values and symbols

It is convenient to set constants beforehand on the [CONST.] (⇒ p.195)

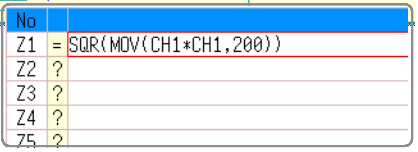


= SQR(MOV(CH1*CH1,200))

a=	0.0000	i=	0.0000
b=	0.0000	j=	0.0000
c=	0.0000	k=	0.0000
d=	0.0000	l=	0.0000
e=	0.0000	m=	0.0000
f=	0.0000	n=	0.0000
g=	0.0000	o=	0.0000
h=	0.0000	p=	0.0000

Unit :ANALOG
Mode :Voltage
Range :5mV

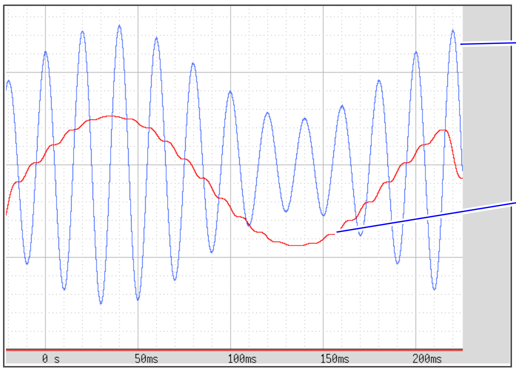
4 When finished entry, select **[Confirm]**.
The entered equation is displayed in the **[Equation]** field.



No	
Z1	= SQR(MOV(CH1*CH1,200))
Z2	?
Z3	?
Z4	?
Z5	?

5 **Execute the calculations.**

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 [Wave Calc] sheet and select [Exec].

11.3 Waveform Calculation Operators and Results

b_i: ith member of calculation result data, d_i: ith 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, ... n)
Exponent (EXP)	$b_i = exp(d_i)$ (i = 1, 2, ... n)
Common Logarithm (LOG)	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, ... n) Note: Use the following equation to convert to natural logarithm calculations. $LnX = log_e X = log_{10} X / log_{10} e$ $1 / log_{10} e \approx 2.30$
Square Root (SQR)	When $d_i \geq 0$, $b_i = \sqrt{d_i}$ When $d_i < 0$, $b_i = -\sqrt{\|d_i\|}$ (i = 1, 2, ... n)
Moving Average (MOV)	When k is odd number: $bi = \frac{1}{k} \sum_{t = i - \frac{k}{2}}^{i + \frac{k}{2}} dt$ (i = 1, 2, ... n) When k is even number: $bi = \frac{1}{k} \sum_{t = i - \frac{k}{2} + 1}^{i + \frac{k}{2}} dt$ (i = 1, 2, ... n) dt: tth member of source channel data k : number of points to move (1 to 5000) 1 div = 100 points. k is specified after a comma. (Ex.) To make Z1 the moving average of 100 points: MOV(Z1,100)
Slides waveform data along the time axis (SLI)	Moves along the time axis by the specified distance. $b_i = d_i - k$ (i = 1, 2, ... n) k : number of points to move (-5000 to 5000) 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.
Sine (SIN)	$b_i = sin(d_i)$ (i = 1, 2, ... n) Trigonometric functions employ radian (rad) units.
Cosine (COS)	$b_i = cos(d_i)$ (i = 1, 2, ... n) Trigonometric functions employ radian (rad) units.
Tangent (TAN)	$b_i = tan(d_i)$ (i = 1, 2, ... n) where $-10 \leq b_i \leq 10$ Trigonometric functions employ radian (rad) units.
Arcsine (ASIN)	When $d_i > 1$, $b_i = \pi / 2$ When $-1 \leq d_i \leq 1$, $b_i = asin(d_i)$ When $d_i < 1$, $b_i = -\pi / 2$ Trigonometric functions employ radian (rad) units.

b_i: ith member of calculation result data, d_i: ith member of source channel data

Waveform Calculation Type	Description
Arccosine (ACOS)	When $d_i > 1,$ $b_i = 0$ When $-1 \le d_i \le 1,$ $b_i = acos(d_i)$ When $d_i < -1$, $b_i = \pi$ (i = 1, 2, ... n) Trigonometric functions employ radian (rad) units.
Arctangent (ATAN)	$b_i = atan(d_i)$ (i = 1, 2, ... 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 $b_n = (11d_{n-4} -56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n)/12h^2$

b_i: ith member of calculation result data, d_i: ith member of source channel data

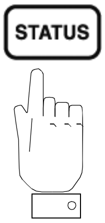
Waveform Calculation Type	Description
First integral (INT) **Second integral (INT2)**	First and second integrals are calculated using the trapezoidal rule. d_1 to d_n are the integrals calculated for sample times t_1 to t_n. Calculation formulas for the first integral Point t_1 $I_1 = 0$ Point t_2 $I_2 = (d_1 + d_2)h/2$ 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

Memory Division Function MEM

Chapter 12

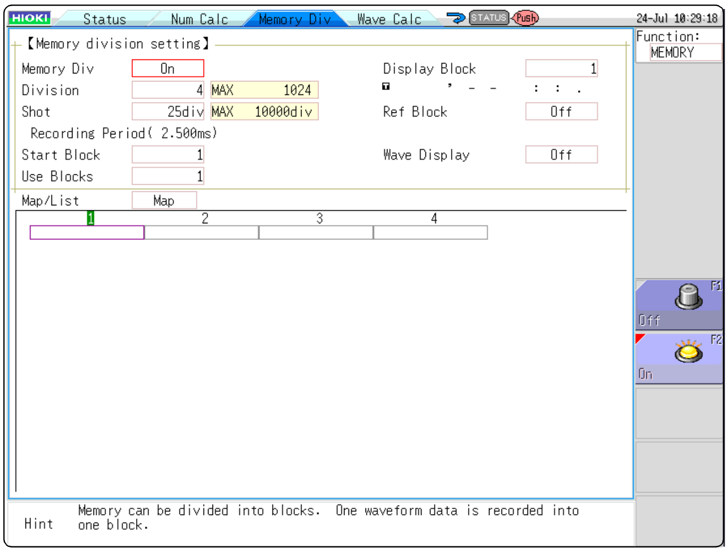
Memory division function can only be used with the Memory function.
Memory division settings are made on the Status screen - **[Memory Div]** sheet.
Blocks to be displayed can also be selected on the Waveform screen (⇒ p.115).

Opening the [Memory Div] sheet



Pressing this key repeatedly displays the various sheets.

[Status] ← [Wave Calc]
↓ ↑
[Num Calc] → **[Memory Div]**



24-Jul 10:29:18

【Memory division setting】

Memory Div: On
Division: 4 MAX 1024
Shot: 25div MAX 10000div
Recording Period(2.500ms)
Start Block: 1
Use Blocks: 1
Display Block: 1
Ref Block: Off
Wave Display: Off
Map/List: Map

1 2 3 4

Hint: Memory can be divided into blocks. One waveform data is recorded into one block.

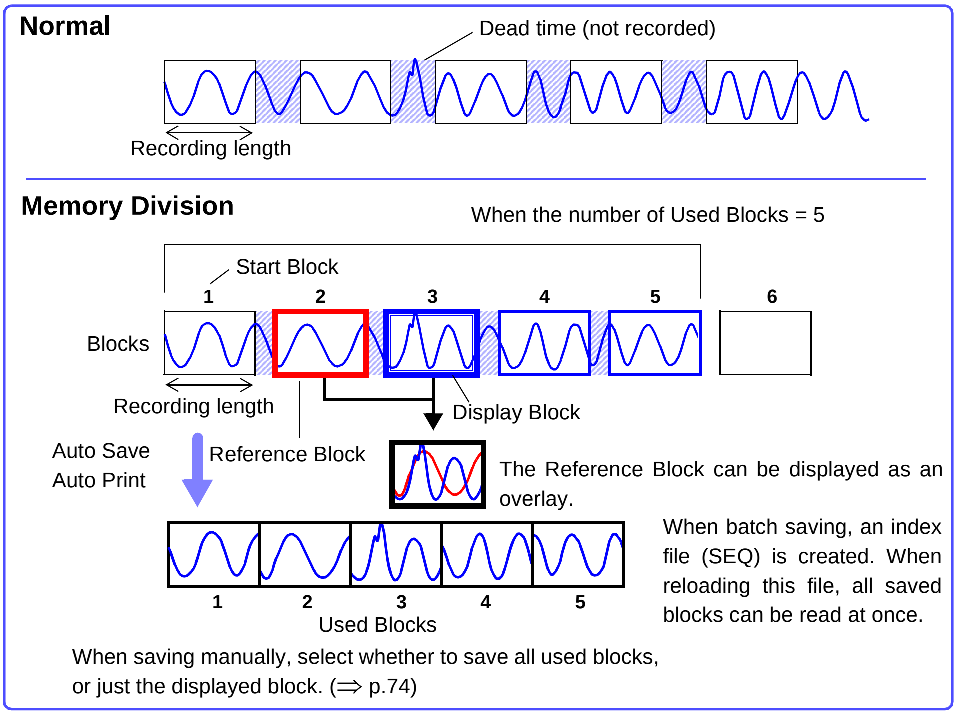
NOTE When using memory division, the trigger output (TRIG_OUT terminal output) may output the Low level or output erratically in the following conditions.

- The time axis range is 5 µs/div to 100 µs/div
- The record (measurement) time is 5 ms or less
- Tracking wave display is **[OFF].**

Operations available from the **[Memory Div]** sheet

- Waveforms can be recorded into individual blocks by dividing memory space into multiple blocks.
- You can record waveforms beginning at any block (Start Block), choose which blocks to display (Display Block), or display multiple overlaid blocks (Reference Block).
- The maximum number of blocks for memory division depends on the installed memory board and recording length (up to 1024 divisions).
- Triggered waveform data can be acquired continuously and recorded sequentially in specified blocks (at the Start Block, for the specified Used Blocks). Dead time while displaying or printing (during which triggers are ignored) can be minimized.
- Even if the Memory Division function is not used, up to 16 blocks of data (depending on the specified recording length) can be saved to each block, so that previously recorded data can be selected for display on the Waveform Screen.

See:"7.8 Seeing Block Waveforms" (⇒ p.115)



The Reference Block can be displayed as an overlay.

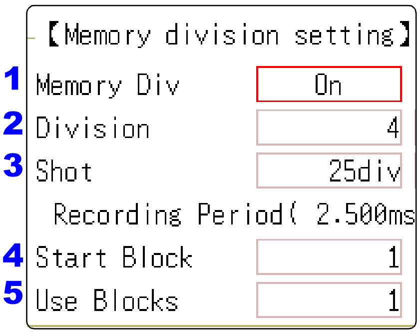
When batch saving, an index file (SEQ) is created. When reloading this file, all saved blocks can be read at once.

When saving manually, select whether to save all used blocks, or just the displayed block. (⇒ p.74)

12.1 Recording Settings

Procedure

To open the screen: Press the STATUS key → [Memory Div] sheet



【Memory division setting】
Memory Div On
Division 4
Shot 25div
Recording Period(2.500ms
Start Block 1
Use Blocks 1

1 **Enable the Memory Division function.**

Move the cursor to the **[Memory Div]** item.

Select **[On]**.

Off	Memory Division is disabled.(default setting)
On	Memory Division is enabled.

2 **Set the number of divisions.**

Move the cursor to the **[Division]** item.

Set the number of blocks for division.
Default setting: 4

3 **Set the recording length.**
(This is linked to the recording length setting on the [Status] sheet.)

Move the cursor to the **[Shot]** item.

Set the recording length.
The maximum recording length and number of divisions are determined automatically according to memory capacity and the number of channels used.
Setting range: "Appendix 2.4 Maximum record length and number of divisions (Memory division function)"(⇒ p.A8)

4 **Set the start block.**

Move the cursor to the **[Start Block]** item.

Set the block number at which to start recording.
Default setting: 1

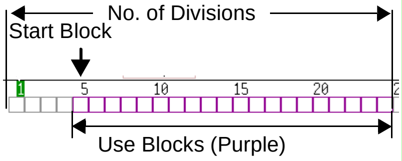
5 **Set the Used Block number.**

Move the cursor to the **[Use Blocks]** item.

Set the number of blocks to use.
Default setting: 1

Memory Division, Waveform Calculation, and Roll Mode cannot be enabled at the same time.

When the number of divisions is 32, the Start Block is 5 and the Used Block number (number of blocks to use) is 20



About Recording
When a fast timebase is selected, displaying, printing and saving operation are not available while measuring.
Selecting the display screen for auto saving lengthens dead time.

To display any block on the waveform screen when finished measuring:
Set the number of blocks to display (⇒ p.204).
(This can also be set on the Waveform screen (⇒ p.115).)

To display overlaid waveforms:
Set the number of blocks for reference (⇒ p.204).

12.2 Display Settings

Procedure

To open the screen: Press the STATUS key → [Memory Div] sheet

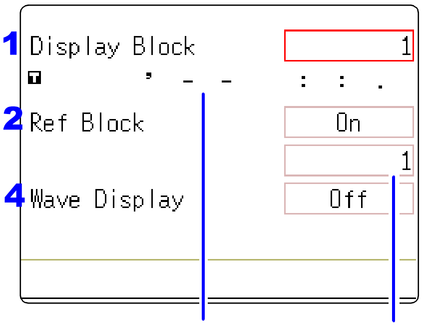
1 To display any block on the Waveform screen

Set the display blocks

Set after measurement is complete.(This can also be set on the Waveform screen (⇒ p.115).)

Move the cursor to the **[Display Block]** item.

Set the number of blocks to display on the Waveform screen.



1 Display Block 1

2 Ref Block On 1

4 Wave Display Off

2 To display multiple blocks as overlaid waveforms

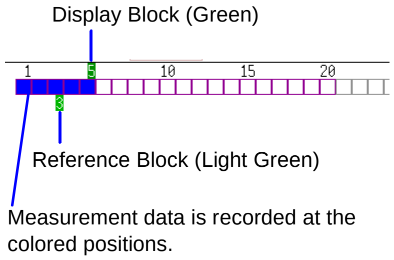
Enable the Reference Block function

Move the cursor to the **[Ref Block]** item.

Select **[On]**.

Off	Reference Blocks are not displayed (default setting)
On	Reference Blocks overlay Display blocks on the display.

When the Display Block is 5 and the Reference Block is 3



3 (When Reference Blocks are enabled [On]) Select whether to reference every block

To overlay all waveforms, select **[All Blks On]**.

All Blks Off	Set reference to all blocks to Off.
All Blks On	Set reference to all blocks to On.

To overlay selected waveforms, move the cursor to the number column of the reference block and select the block number.

Select

Ref On-Off	Set On or Off. If [On] is selected, the block frame of the selected block number is displayed as a green square.
↑↓	Select a block.

Reference Block Selection
Reference Blocks can also be selected and deselected in the **[Ref Block]** item on the **[List]** display.
See: "Getting Details on Each Block:" (⇒ p.205)

4 To display every block as its waveform is acquired

Enable tracking waveform display.

Move the cursor to the **[Wave Display]** item.

Select **[On]**.

Off	The waveform of the specified Display Block is displayed after recording the specified number of Used Blocks. (default setting)
On	Waveforms are displayed one block at a time as they are acquired at each trigger event.

Enabling the Trace Waveform display lengthens dead time.
About Dead Time:
See: "Difference Between Dead Times During Normal and Memory Division Recording" (⇒ p.206)

Even if the Roll Mode is enabled (other than Off), it is not usable when the Trace Waveform display is disabled.

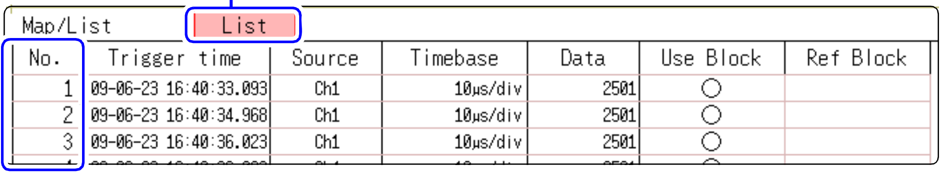
Viewing Memory Division waveforms on the Waveform screen

See: "7.8 Seeing Block Waveforms" (⇒ p.115)

Getting Details on Each Block:

The trigger time and measurement status of each block can be viewed on the list.

Move the cursor to the **[Map/List]** , and select **[List]**.



Block No.

Map/List: List

No.	Trigger time	Source	Timebase	Data	Use Block	Ref Block
1	09-06-23 16:40:33.093	Ch1	10µs/div	2501	○	
2	09-06-23 16:40:34.968	Ch1	10µs/div	2501	○	
3	09-06-23 16:40:36.023	Ch1	10µs/div	2501	○	

A block can be selected by the ⌂ ⌂ **CURSOR** keys or **F** keys.

You can move the cursor to the Reference Block column to set a block's on/off state as a Reference Block.

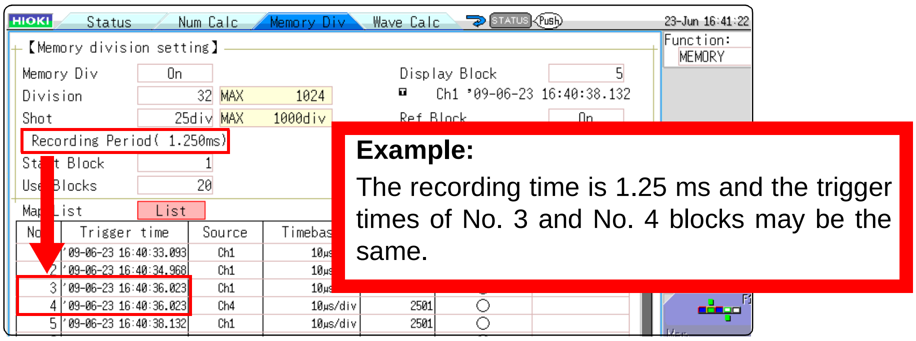
To switch block waveforms on the Waveform screen:

To be able to select the block you want to see, press the **WAVE** key at the Waveform screen and switch Pos to Block.

See: "7.8 Seeing Block Waveforms" (⇒ p.115)

NOTE

- When displaying memory division blocks as a list, blocks may have the same trigger times. This occurs because the minimum resolution of the clock used by this unit is 1/128th of a second (7.8125 ms) and measurement occurs during this interval.



【Memory division setting】

Memory Div: On
Division: 32 MAX 1024
Shot: 25div MAX 1000div
Recording Period(1.250ms)
Start Block: 1
Use Blocks: 20
Display Block: 5
Ch1 '09-06-23 16:40:38.132
Ref Block: On
Map/List: List

No	Trigger time	Source	Timebase		
	'09-06-23 16:40:33.093	Ch1	10µs		
2	'09-06-23 16:40:34.968	Ch1	10µs		
3	'09-06-23 16:40:36.023	Ch1	10µs		
4	'09-06-23 16:40:36.023	Ch4	10µs/div	2501	○
5	'09-06-23 16:40:38.132	Ch1	10µs/div	2501	○

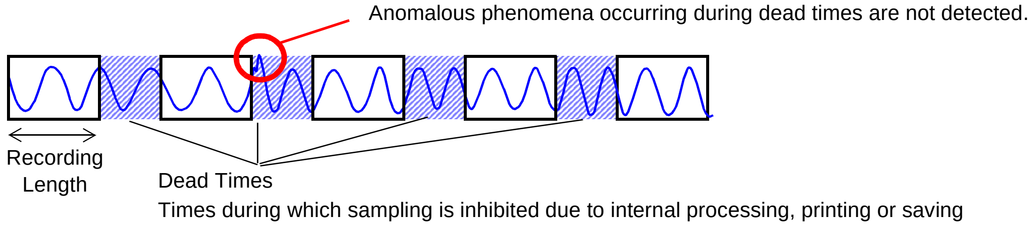
Example:

The recording time is 1.25 ms and the trigger times of No. 3 and No. 4 blocks may be the same.

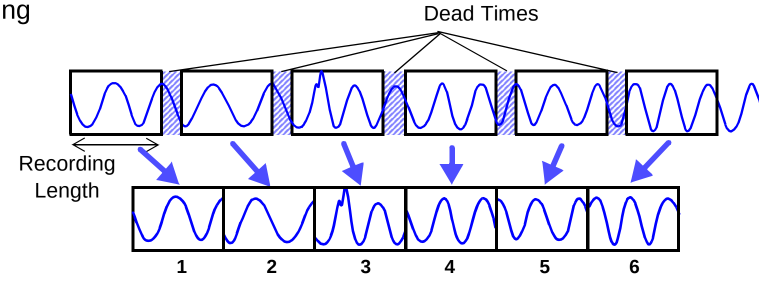
- If triggers occur continuously within an interval shorter than 500 µs, the displayed trigger time may indicate a time slower than reality.

Difference Between Dead Times During Normal and Memory Division Recording

When both printer recording (Auto Print) and Auto Save are set for continuous triggering [Repeat]



When the Trace Waveform Display is disabled (Off) during Memory Division recording



The waveform data of each recording length is recorded in one block.

When recording with Memory Division, dead time is shorter than with normal recording.

NOTE

- The dead time (time where no sampling occurs between blocks) of memory division is as follows.
  5 µs/div to 20 µs/div: 1 to 8 samples
  Time axis slower than 50 µs/div: 1 samples
  Note: Dead time lengthens during calculation of a number of values or when the time axis is 5 to 20 µs/div and tracking waveform display is **[On]**.
- When measuring with an 8970 FREQ Unit, dead time is approximately 230 ms. When measuring in integral value (**[Count]**) mode, there are cases when the last data in the previous block remains in the first part of the block.
- When tracking waveform display is **[Off]**, the roll mode function cannot be used, even when roll mode is enabled (not Off).
- When triggering occurs very often, pressing the **STOP** key may not stop measurement until enough data has been acquired to fill the blocks specified for use.

Auto Save and Auto Print for Memory Division Recording

Measuring conditions	Auto Save and Auto Print
With Numerical calculation ON	Auto Save and Auto Print are performed every time one block is measured. When Tracking wave display is ON, Waveform is also displayed.
When time axis is 5 to 20 µs/div with Tracking wave display ON.	Auto Save, Auto Print and Waveform Display are performed every time one block is measured.
When time axis is 5 to 20 µs/div with Tracking wave display OFF.	Auto Save and Auto Print are performed after all blocks are measured.
Other than above	Auto Save and Auto Print are performed simultaneously with measuring. When Tracking wave display is ON, Waveform is also displayed.

FFT Function

FFT

Chapter 13

13.1 Overview and Features

FFT analysis can only be used with the FFT function.
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.A15).

Analysis can be performed on data as it is being measured, on pre-existing analog waveform data previously acquired with the Memory function, and on data output from waveform calculations.
When using Model 8968 High Resolution Unit equipped with an anti-aliasing filter, the cut-off frequency can be automatically set by linking with the frequency range setting.

Major Features

•FFT analysis frequency range: 133 mHz to 8 MHz
•FFT Analysis Modes (16 types)

- Storage Waveform
- Histogram
- Linear Spectrum
- RMS Spectrum
- Power Spectrum
- Power Spectrum Density*
- LPC analysis (Power Spectrum Density)*
- Transfer Function
- Cross-power Spectrum
- Impulse Response
- Coherence Function
- Phase Spectrum
- Auto-correlation Function
- Cross-correlation Function
- 1/1 Octave Analysis*
- 1/3 Octave Analysis*

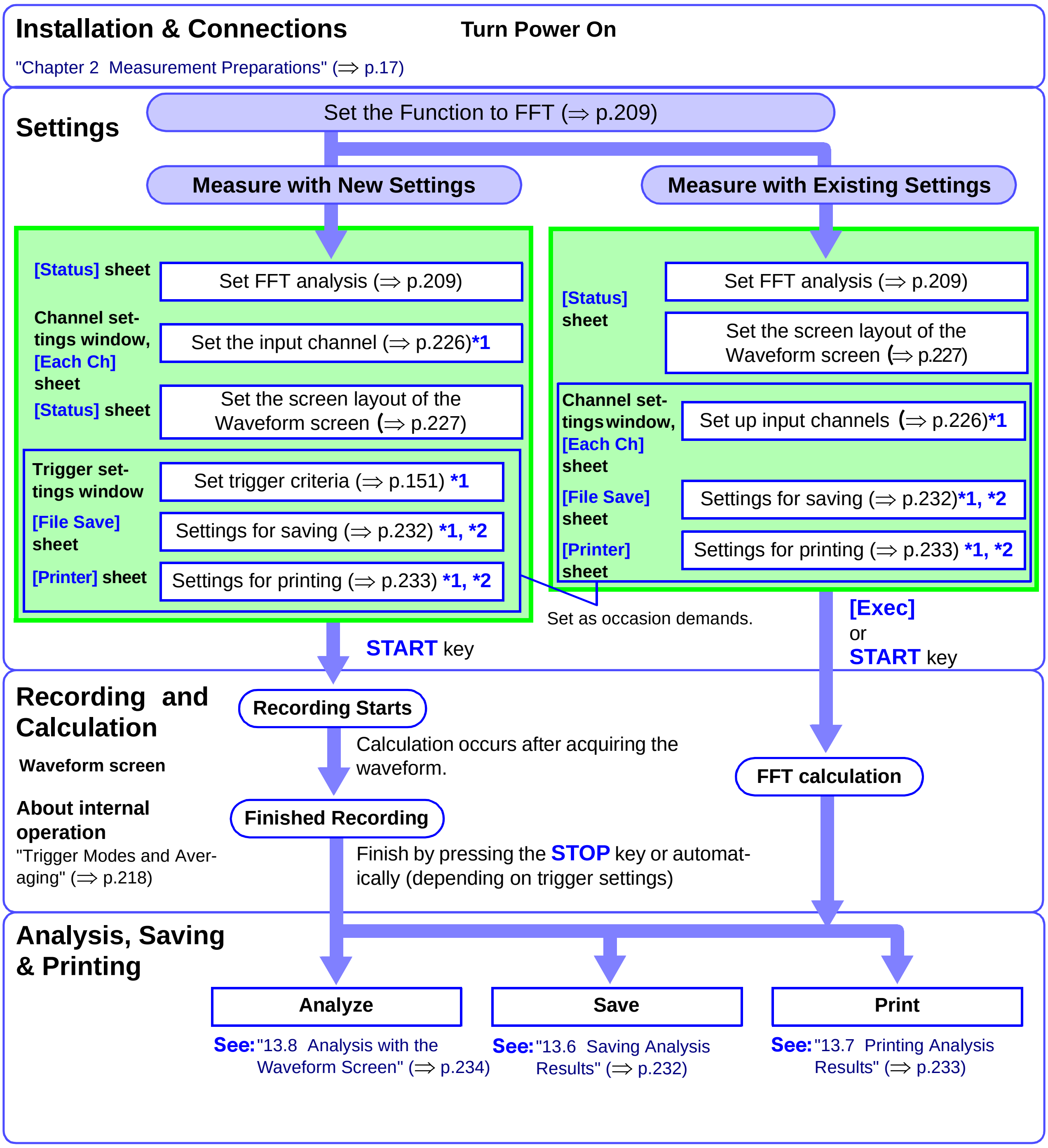
* Not available when using external sampling.
For phase spectra, only the required phase information is highlighted and displayed.
See:"13.3.8 Emphasizing Analysis Results (phase spectra only)" (⇒ p.219)

so, when performing FFT analysis with the instrument connected to a sound level or vibration meter, scaling by dB can be set from the Channel Settings screen if you want to read values directly in calibrated units of measurement.
See:"Scaling" (⇒ p.226)

NOTE **To suppress the effects of aliasing distortion**
We recommend using Model 8968 High Resolution Unit that are equipped with anti-aliasing filtering to suppress the effects of aliasing distortion when sampling.
See: Aliasing Distortion and Anti-Aliasing Filters
"Appendix 5 FFT Definitions"(⇒ p.A15)

Refer to the "17.2.4 FFT Function" (⇒ p.299) for FFT function specifications.

13.2 Operation Workflow



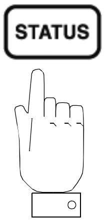
*1: Settings are the same as for the Memory function.

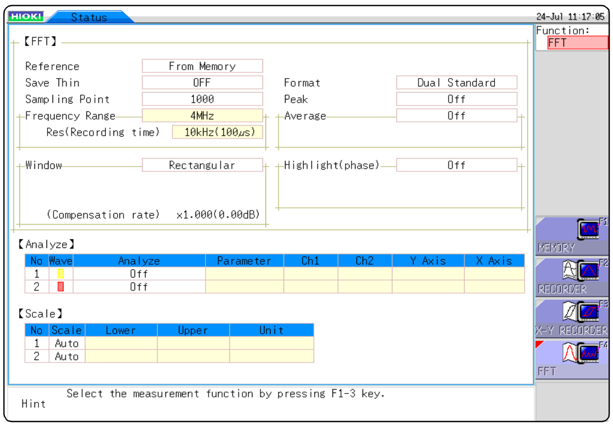
*2: Even after analysis, save and print settings can be set manually.

13.3 Setting FFT Analysis Conditions

Basic measurement configuration settings are performed on the Status screen-**[Status]** sheet. Measurement configuration can be performed from the Waveform screen (⇒ p.225).

Opening the [Status] sheet





24-Jul 11:17:05
Function: FFT

【FFT】

Reference: From Memory
Save Thin: OFF
Sampling Point: 1000
Frequency Range: 4MHz
Res(Recording time): 10kHz(100μs)
Format: Dual Standard
Peak: Off
Average: Off
Window: Rectangular
(Compensation rate) x1.000(0.00dB)
Highlight(phase): Off

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

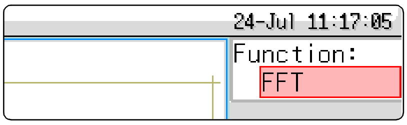
Hint: Select the measurement function by pressing F1-3 key.

13.3.1 Selecting the FFT Function

The FFT function can be selected at screens other than the file screen.

Procedure

1 Move the cursor to the function item (the upper most column of the Settings window).



24-Jul 11:17:05
Function: FFT

2 Select **[FFT]**.

13.3.2 Selecting the Data Source for Analysis

Select the data to be used for FFT analysis.
There are two analysis methods: analysis using new measurements and analysis of data measured using the memory function.

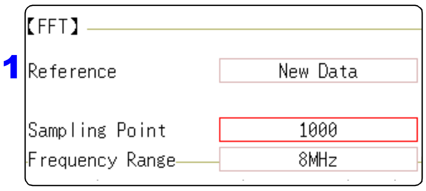
Procedure

To open the screen: Press the STATUS key → [Status] sheet

See: To set from the Waveform screen (⇒ p.225)

1 **Select the input data source.**

Move the cursor to the **[Reference]** item.


【FFT】
1 Reference New Data
Sampling Point 1000
Frequency Range 8MHz

Select

New Data	Acquire a new waveform for analysis.
From Memory	Calculates data measured using the memory function.

2 **When finished making settings, press the START key**

For the [New Data] case

Measurement starts to acquire data for the number of analysis points specified as the **[Sampling Point]**, and FFT analysis is performed.

For the [From Memory] case

Analysis is performed on the number of specified points from data previously recorded in memory (Memory function data) .

When the input data [Reference] is [From Memory]

Analysis is performed until the specified number of FFT analysis points have been processed, then the data is shifted by that amount and analysis repeats until all of the previously acquired data has been processed. (If the amount of data is less than the specified number of FFT analysis points, no analysis occurs.)

The analysis starting point can also be specified.

See: "13.8.1 Analyzing after Specifying an Analysis Starting Point" (⇒ p.234)

The frequency range is selected automatically.

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.212)

When no trace is displayed after pressing the START key

Analysis is impossible if **[From Memory]** is selected as the input data source and no recorded data exists in the instrument's memory.
Either select **[New Data]** as the input data source, or load the data to be analyzed before pressing the **START** key again.

NOTE When the **[Reference]** is set to **[From Memory]**, the frequency is automatically set.
The setting cannot be changed.

13.3.3 Setting the Frequency Range and Number of Analysis Points

About the frequency range and number of analysis points

- The settings for the frequency range and number of analysis points determine the input signal acquisition time and frequency resolution.
- The frequency range setting for the FFT function corresponds to the timebase setting of the Memory function. Changing the frequency range also changes the data sampling period.

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.212)

- The cut-off frequency of the anti-aliasing filter is the same as the frequency range setting.

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.212)

- 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.

See: "Number of Analysis Points"(⇒ p.A17)

When using the external sampling to calculate:
Set the Sampling Clock to **[External]** (External sampling).
In this case, octave analysis, power spectrum density and LPC Analysis(power spectrum density) are not available.

NOTE

When the [Reference] is [From Memory], the frequency is automatically set.
The setting cannot be changed.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

See: To set from the Waveform screen (⇒ p.225)

1 **Set the number of FFT analysis points.**

Move the cursor to the **[Sampling Point]** item.

Select

1000 (default setting), 2000, 5000, 10000

See: "Number of Analysis Points"(⇒ p.A17)

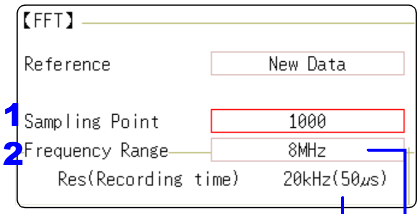
2 **Select the frequency range.**

Move the cursor to the **[Frequency Range]** item.

Select

8 MHz(default setting), 4 MHz, 2 MHz, 800 kHz, 400 kHz, 200 kHz, 80 kHz, 40 kHz, 20 kHz, 8 kHz, 4 kHz , 2 kHz, 800 Hz, 400 Hz, 200 Hz, 80 Hz, 40 Hz, 20 Hz, 8 Hz, 4 Hz, 1.33 Hz, 800 mHz, 667 mHz, 400 mHz, 333 mHz, 133 mHz, External

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.212)



【FFT】

Reference New Data

1 Sampling Point 1000

2 Frequency Range 8MHz

Res(Recording time) 20kHz(50μs)

Frequency Resolution (during acquisition)
The resolution is affected by settings of frequency range and the number of analysis points. Not displayed for external sampling.

To control sampling by an external signal, select **[External]**

When the input data [Reference] is [From Memory]

The frequency range is set automatically when analysis is started.

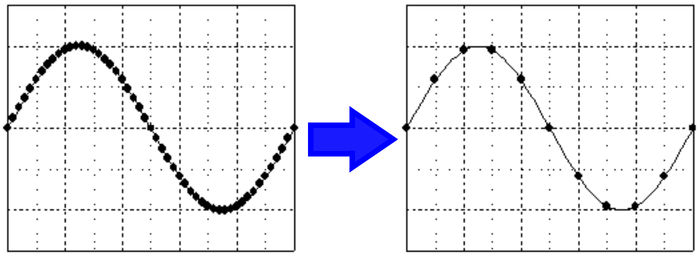
Relationship Between Frequency Range, Resolution and Number of Analysis Points

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
8 M *1	20 M	5 µs	50 ns	20 k	50 µs	10 k	100 µs	4 k	250 µs	2 k	500 µs
4 M *1	10 M	10 µs	100 ns	10 k	100 µs	5 k	200 µs	2 k	500 µs	1 k	1 ms
2 M *1	5 M	20 µs	200 ns	5 k	200 µs	2.5 k	400 µs	1 k	1 ms	500	2 ms
800 k *1	2 M	50 µs	500 ns	2 k	500 µs	1 k	1 ms	400	2.5 ms	200	5 ms
400 k *1	1 M	100 µs	1 µs	1 k	1 ms	500	2 ms	200	5 ms	100	10 ms
200 k *1	500 k	200 µs	2 µs	500	2 ms	250	4 ms	100	10 ms	50	20 ms
80 k *1	200 k	500 µs	5 µs	200	5 ms	100	10 ms	40	25 ms	20	50 ms
40 k	100 k	1 ms	10 µs	100	10 ms	50	20 ms	20	50 ms	10	100 ms
20 k	50 k	2 ms	20 µs	50	20 ms	25	50 ms	10	100 ms	5	200 ms
8 k	20 k	5 ms	50 µs	20	50 ms	10	100 ms	4	250 ms	2	500 ms
4 k	10 k	10 ms	100 µs	10	100 ms	5	200 ms	2	500 ms	1	1 s
2 k	5 k	20 ms	200 µs	5	200 ms	2.5	400 ms	1	250 ms	500 m	2 s
800	2 k	50 ms	500 µs	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 *2	20	5 s	50 ms	20 m	50 s	10 m	100 s	4 m	250 s	2 m	500s
4 *2	10	10 s	100 ms	10 m	100 s	5 m	200s	2 m	500 s	1 m	1 ks
1.33 *2	3.33	30 s	300 ms	3.33 m	300 s	1.66 m	600s	666 µ	1.5 ks	333 µ	3 ks
800 m *2	2	50 s	500 ms	2 m	500 s	1 m	1 ks	400 µ	2.5 ks	200 µ	5 ks
667 m *2	1.67	60 s	600 ms	1.66 m	600 s	833 µ	1.2 ks	333 µ	3 ks	166 µ	6 ks
400 m *2	1	100 s	1 s	1 m	1 ks	500 µ	2 ks	200 µ	5 ks	100 µ	10 ks
333 m *2	833 m	120 s	1.2 s	833 µ	1.2 ks	416 µ	2.4 ks	166 µ	6 ks	83.3 µ	12 ks
133 m *2	333 m	300 s	3 s	333 µ	3 ks	166 µ	6 ks	66.6 µ	15 ks	33.3 µ	30 ks

The cut-off frequency of the anti-aliasing filter is the same as the frequency range.
*1. The anti-aliasing filter is turned off.
*2. Cut-off frequency is 20 Hz.

13.3.4 Thinning Out and Calculating Data

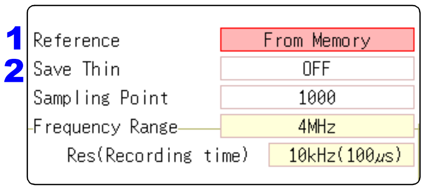
When performing FFT analysis of data measured using the memory function, the measurement data can be thinned before calculation. If the sampling frequency is too high and the expected results are not obtained, thin the data before calculation to increase the frequency resolution.



Original waveform Thinned waveform

Procedure

To open the screen: Press the STATUS key → [Status] sheet



Reference	From Memory
Save Thin	OFF
Sampling Point	1000
Frequency Range	4MHz
Res(Recording time)	10kHz(100μs)

1 **Select the reference data.**

Move the cursor to the **[Reference]** item, and select **[From Memory]**.

2 **Select the thinning amount.**

Move the cursor to the **[Save Thin]** item.

Select

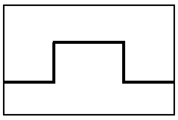
Off	Do not thin out.. (default setting)
1/10	Skip every 10 data points.
1/100	Skip every 100 data points.
1/1000	Skip every 1000 data points.

NOTE

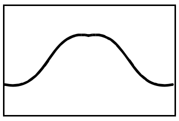
- The **[Save Thin]** setting can only be set when the **[Reference]** is set to **[From Memory]**.
- The range that can be set for thinning changes depending on the time axis range measured by the memory function.
- The frequency range is automatically determined. This setting cannot be changed.
- When thinning, aliasing occurs and waveforms that did not originally exist may be observed. Make settings after sufficient consideration of the frequencies included in waveforms.

13.3.5 Setting the Window Function

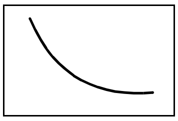
The window function defines the segment of the input signal to be analyzed.
Use the window function to minimize leakage errors. There are three general types of window functions:



- 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.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

See: To set from the Waveform screen (⇒ p.225)

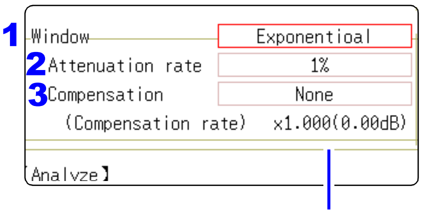
1 **Select the window function.**

Move the cursor to the **[Window]** item.

Select

Rectangular (default setting), Hanning, Hamming, Blackman, Blackman Harris, Flat-top, Exponential

See: "Window Function"(⇒ p.A22)



Window Exponentioal
Attenuation rate 1%
Compensation None
(Compensation rate) x1.000(0.00dB)
[Analyze]

Correction value

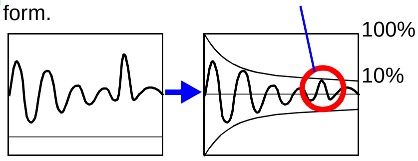
2 **If [Exponential] is the selected type**

Set the attenuation coefficient (percentage).

Move the cursor to the **[Attenuation rate]** item.

Set the attenuation coefficient as a percentage.

Noise is suppressed in the attenuated waveform.



When the attenuation rate is 10%

3 **Set attenuation correction.**

Move the cursor to the **[Compensation]** item.

Select

None	Attenuated window function values are not corrected. (default setting)
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.

For the rectangular window function:
The correction value is always 1 (0 dB).

13.3.6 Setting Peak Values of Analysis Results

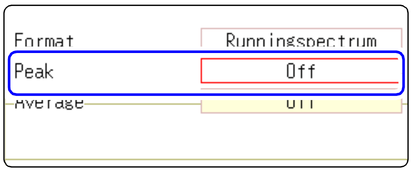
Either local or global maxima (**[maximal]**/ **[maximum]**) of the input signal and analysis results can be displayed on the Waveform screen. However, if Nyquist display is selected on the Status screen-**[Status]** sheet, no peak values are displayed.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

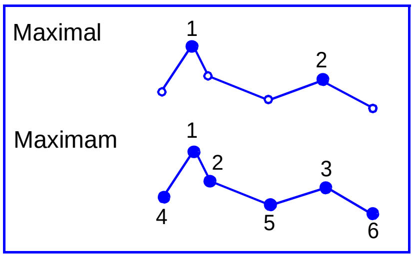
Selecting peak value display.

Move the cursor to the **[Peak]** item.



Select

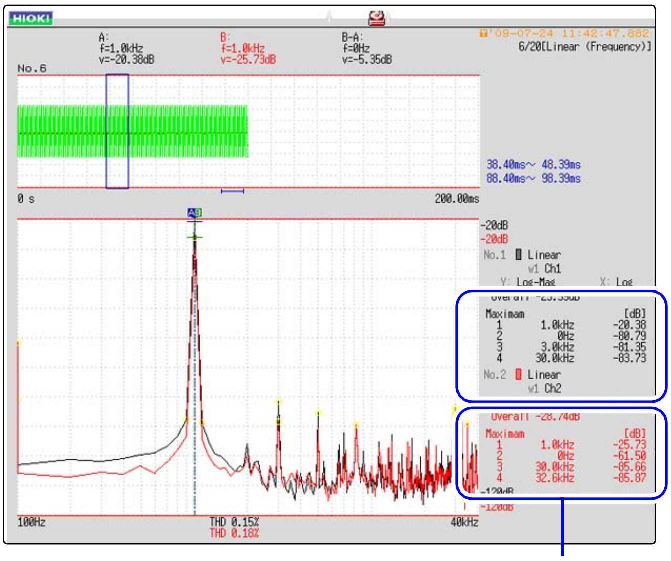
Off	Not displayed. (default setting)
Maximal	(local maxima) When the value of data at a point is greater than that of the adjacent points, that data is considered a local maxima. The ten largest local maxima are displayed.
Maximam	(global maxima) Among all data values, the ten points with the greatest values are displayed.



NOTE

- No display occurs if peak values cannot be detected.
- Peak values on the Waveform screen can be displayed and printed, but cannot be saved as peak values in text files.
- Depending on the split screen status, display ten peak values may not be possible. In such cases, only the displayable number is displayed, starting from large items.

Example: When the reference data setting is **[From Memory]**



```
Maximam                [dB]
 1        1.0kHz     -20.38
 2           0Hz     -80.79
 3        3.0kHz     -81.35
 4       30.0kHz     -83.73
```

```
Overall -28.74dB
Maximam                [dB]
 1        1.0kHz     -25.73
 2           0Hz     -61.50
 3       30.0kHz     -85.66
 4       32.6kHz     -85.87
```

Peak value display
From 1 to 4

13.3.7 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 time-domain waveform or to a spectrum.

Procedure

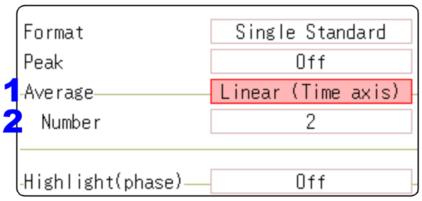
To open the screen: Press the STATUS key → [Status] sheet

1 **Enable averaging.**

Move the cursor to the **[Average]** item.

Select

Off	Averaging is disabled. (default setting)
Linear (Time axis)	Time-domain waveforms are summed and averaged and then calculation is performed.
Expo. (Time axis)	The exponential mean of time-domain waveforms is determined and then calculation is performed.
Linear (Frequency)	Frequency-domain waveforms are summed and averaged and then the calculation result is output.
Expo. (Frequency)	The exponential mean of frequency-domain waveforms is determined and then the calculation result is output.
Peak (Frequency)	The maximum value of frequency-domain waveforms is retained.



Format Single Standard
Peak Off
1 Average Linear (Time axis)
2 Number 2
Highlight(phase) Off

About averaging calculation formulas
See: "Averaging"(⇒ p.A21)

When averaging and auto saving or auto printing are enabled at the same time

Data is saved or printed after the specified count of values have been averaged.

See: "Trigger Modes and Averaging" (⇒ p.218)

2 **Select the count for averaging.**

Move the cursor to the **[Number]** item.

Select the number of measurements to be averaged.
Setting range: 2 to 10,000

NOTE

- After measuring with averaging enabled, display is not available when the channel is changed. Also, when the analysis mode is changed, the analysis modes that can be displayed are limited.
- When averaging is performed with the analysis mode disabled (Off), no trace is displayed when the analysis mode is changed after measurement.
- When **[Format]** is set to **[Running spectrum]**, **[Average]** cannot be set.

When averaging time-domain waveform values:

Waveforms are acquired and averaged within the time domain. After averaging, FFT calculation is performed.
When the trigger mode is **[Auto]**: Data is acquired when the **START** key is pressed, even if trigger criteria are not met after a certain interval. So if averaging is applied to an asynchronous signal, the resulting data is meaningless.
Synchronous signals have better SNR (signal-to-noise ratio) and are more suitable for analysis.

When averaging spectrum values:

Acquired data is first subject to FFT analysis. After analysis, averaging is performed within the frequency range, and the result is displayed. This differs from time-domain averaging in that averaging can be performed without trigger synchronization. However, if the characteristics of the input waveform allow triggering, using the trigger for synchronization is recommended.

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, **O**: Partially settable

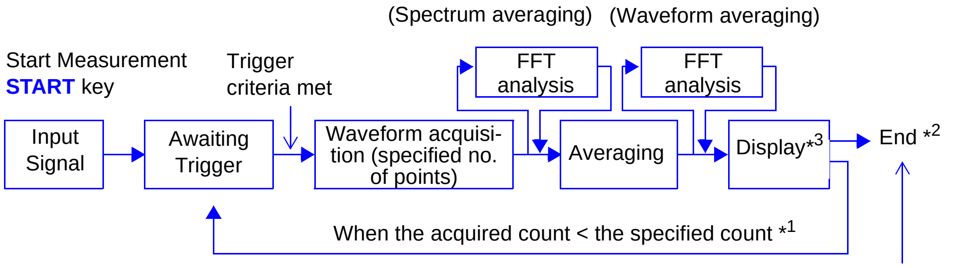
Analysis Mode	Averaging				
	Waveform Averaging		Spectrum Averaging		
	Simple	Exponential	Simple	Exponential	Peak Hold
OFF	×	×	×	×	×
Storage Waveform	●	●	×	×	×
Histogram	●	●	×	×	×
Linear Spectrum	●	●	**O** *2	**O** *2	**O** *2
RMS Spectrum	●	●	**O** *2	**O** *2	**O** *2
Power Spectrum	●	●	●	●	●
Power Spectrum Density *1	●	●	●	●	●
LPC analysis(Power Spectrum Density) *1	●	●	×	×	×
Transfer Function	●	●	**O** *2	**O** *2	**O** *2
Cross Power Spectrum	●	●	**O** *2	**O** *2	**O** *2
Impulse Response	●	●	●	●	●
Coherence Function	×	×	●	●	×
Phase Spectrum	●	●	×	×	×
Auto-correlation Function	●	●	●	●	●
Cross-correlation Function	●	●	●	●	●
1/1 Octave Analysis *1	●	●	●	●	●
1/3 Octave Analysis *1	●	●	●	●	●

*1. Not available for external sampling
*2. Not available when the y axis is real (linear) or imaginary (linear), or for Nyquist plots

■ Trigger Modes and Averaging

If the trigger mode is [Single] or the calculation setting is [Once]

Measurements continue until the specified number of averaging points is acquired.



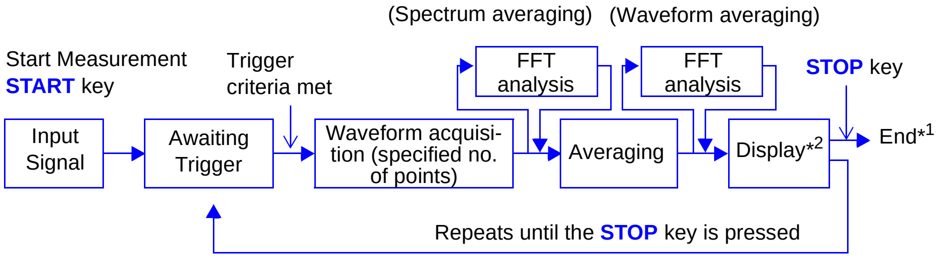
*1. Awaiting trigger continues until the specified count is reached.

*2. Measurement stops automatically when the specified count is reached. If measurement was interrupted by the **STOP** key, the averaging result up to that point is displayed.

*3 If **[Reference]** is **[New Data]** and the automatic saving or automatic print setting is ON, data is saved or printed when the specified number of times is reached.

If the trigger mode is [Continue] or the calculation setting is [Repeat]

Measurement continues after the specified averaging count has been acquired.
When the specified averaging count is exceeded, averaging is repeated and measurement continues until the **STOP** key is pressed.



*1 When stopped before the specified count, the average up to that point is displayed.

*2 If **[Reference]** is **[New Data]** and the automatic saving or automatic print setting is On, data is saved or printed when the specified number of times is reached.

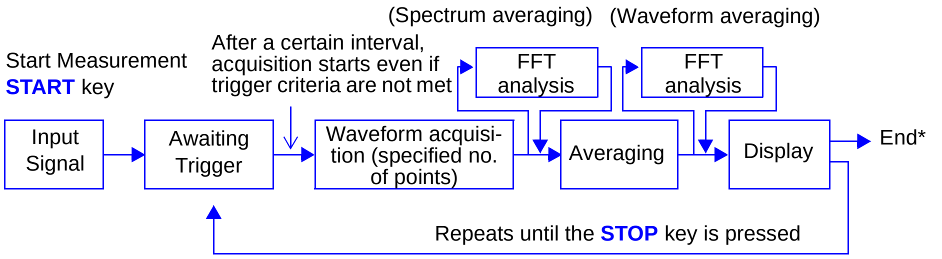
When the trigger mode is [Auto]

- For time-domain waveforms:

  Data is acquired when the **START** key is pressed, even if trigger criteria are not met after a certain interval. So if averaging is applied to an asynchronous signal, the resulting data is meaningless.

- For spectrum values:

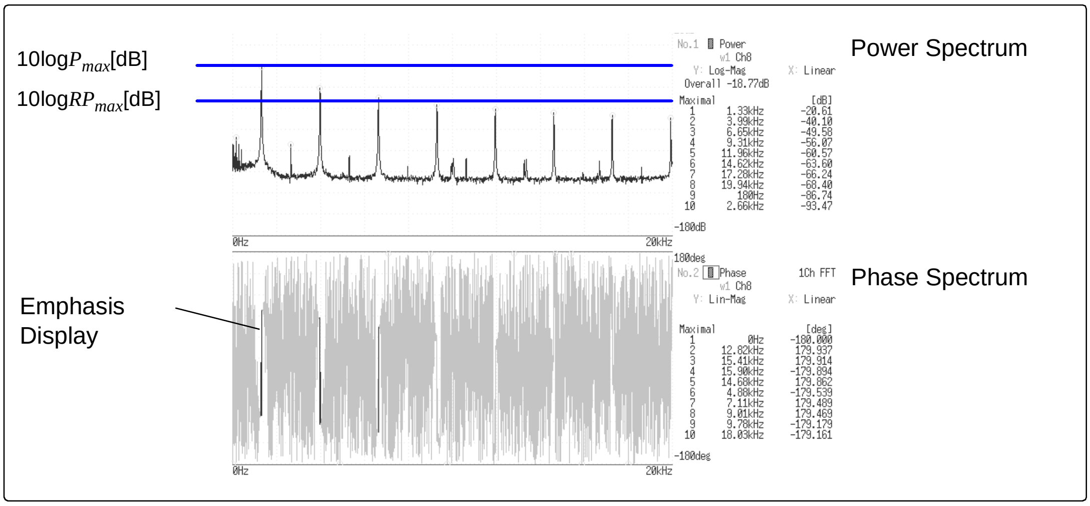
  When the **START** key is pressed, measurement starts. Even if the trigger criteria are not met, the specified amount of data is acquired, and after FFT analysis, the results are averaged.
  When the specified averaging count is exceeded, averaging is repeated and measurement continues until the **STOP** key is pressed.



* When stopped before the specified count, the average up to that point is displayed.

13.3.8 Emphasizing Analysis Results (phase spectra only)

By specifying a setting factor (rate) to be applied to the input signal, the display of data exceeding the resulting threshold can be emphasized. This feature is useful for viewing waveforms that may otherwise be obscured by noise.
The reliability of phase spectrum values is poor when discrete Fourier transform values are extremely small. For example, in the case of a pure sine wave, almost all phase values at frequencies other than the input frequency result from calculation errors. By treating the maximum value of the power (or cross-power) spectrum of the input signal, P_{max}, as a reference value, data that exceeds that value multiplied by rate R can be displayed with emphasis.

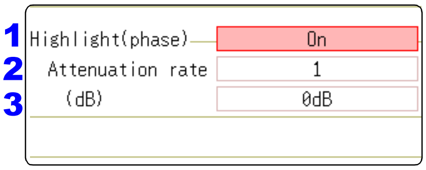


```
No.1  Power
        w1 Ch8
   Y: Log-Mag           X: Linear
  Overall -18.77dB
 Maximal                     [dB]
  1       1.33kHz          -20.61
  2       3.99kHz          -40.10
  3       6.65kHz          -49.58
  4       9.31kHz          -56.07
  5      11.96kHz          -60.57
  6      14.62kHz          -63.60
  7      17.28kHz          -66.24
  8      19.94kHz          -68.40
  9        180Hz           -86.74
 10       2.66kHz          -93.47
```

```
No.2  Phase            1Ch FFT
        w1 Ch8
   Y: Lin-Mag           X: Linear

 Maximal                    [deg]
  1           0Hz        -180.000
  2      12.82kHz         179.937
  3      15.41kHz         179.914
  4      15.90kHz        -179.894
  5      14.68kHz         179.862
  6       4.88kHz        -179.539
  7       7.11kHz         179.489
  8       9.01kHz         179.469
  9       9.78kHz        -179.179
 10      18.03kHz        -179.161
```

Procedure

To open the screen: Press the STATUS key → [Status] sheet



1 Highlight(phase) On
2 Attenuation rate 1
3 (dB) 0dB

1 **Enable the highlighting function.**

Move the cursor to the **[Highlight(phase)]** item.

Select

Off	Emphasis display disabled. (default setting)
On	Emphasis display enabled.

2 **Set the attenuation rate or attenuation value.**

To set an attenuation rate

Move the cursor to the **[Attenuation rate]** item.

Enter the attenuation rate.
See: "8.1.3 Alphanumeric Input" (⇒ p.121)

To set an attenuation value [dB]

Move the cursor to the **[(db)]** item.

Enter the attenuation value.
See: "8.1.3 Alphanumeric Input" (⇒ p.121)

Attenuation Rate and Value
Attenuation value: A [dB]
Attenuation rate: R

$-A = 10\log_{10}R$
$1 \times 10^{-6} \leq R \leq 1$
$0 \leq A \leq 60$

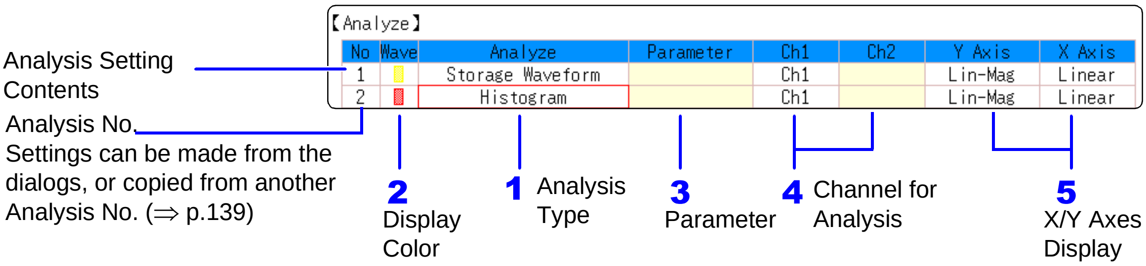
13.3.9 Analysis Mode Settings

Select the type of FFT analysis, channel(s), waveform display color and x and y axes.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

See: To set from the Waveform screen (⇒ p.225)



【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Storage Waveform		Ch1		Lin-Mag	Linear
2	🟥	Histogram		Ch1		Lin-Mag	Linear

Settings can be made from the dialogs, or copied from another Analysis No. (⇒ p.139)

1 Select the FFT analysis mode.

Move the cursor to the **[Analyze]** column of the Analysis No. to set.

Select

Off	No analysis. (default setting)
Storage Waveform	(⇒ p.236)
Histgram	(⇒ p.236)
Linear Spectrum	(⇒ p.237)
RMS Spectrum	(⇒ p.238)
Powre Spectrum	(⇒ p.240)
Powre Spectrum density*	(⇒ p.241)
LPC (density)*	(⇒ p.242)

Transfer Function	(⇒ p.243)
Cross Power Spectrum	(⇒ p.244)
Impulse Response	(⇒ p.245)
Coherance Function	(⇒ p.246)
Phase Spectrum	(⇒ p.247)
Auto-Correlation	(⇒ p.248)
Cross-correlation	(⇒ p.249)
1/1 Octave*	(⇒ p.249)
1/3 Octave*	(⇒ p.249)

*Not available with external sampling enabled.

See: "13.9.2 Analysis Mode Functions" (⇒ p.254)

(When [List] is selected, a list of calculation types appears. To clear the display, push the CH. SET key again.)

2 Select whether to display the waveform, and its color.

Move the cursor to the **[Wave]** column.

Select whether the waveform is to be displayed (On) or not, and its color if displayed.

3 When [Parameter] setting contents are displayed

Set the parameter.

Move the cursor to the **[Parameter]** column of the Analysis No. to set.

Select

Analyze	Parameter	Setting Contents
1/1 Octave, 1/3 Octave	**Filter: Normal** **Filter: Sharp**	nables the octave filter. **See:** "Octave Filter Setting" (⇒ p.222)
Phase Spectrum	**1ch FFT**	Calculates the phase of **[Ch1]**.
	2ch FFT	Calculates the phase difference between **[Ch1]** and **[Ch2]**.
LPC (dencity)	**Order :2 to 64**	Larger numerical values make finer spectrum components visible.

4 Select the channel for analysis.

Move the cursor to the **[Ch1]** item.

Select which channel number to use.

5 Set the horizontal and vertical axes displaying the calculation results.

Move the cursor to the **[X Axis]** or **[Y Axis]**.

Set the contents of the calculation results to be displayed on the horizontal and vertical axes.
(Selectable display contents vary by analysis mode.)

See: "Analysis Modes and X/Y Axis Display" (⇒ p.222)

Analysis channel setting

For any of the following analysis modes, set both channels 1 and 2.

Transfer Function, Impulse Response, Cross-correlation Function, Cross Power Spectrum, Coherence Function, Phase Spectrum (2ch FFT)

Y-axis display

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.

To analyze using external sampling

The horizontal axis (x-axis) displays the number of data points.

X-axis display

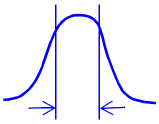
Linear	Frequency-axis is displayed linearly.
Log	Frequency-axis is displayed logarithmically. This is convenient when the data of interest is at the lower end of the frequency range, such as for sound and vibration.

How do I copy settings to other calculation No.?

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

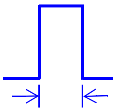
■ Octave Filter Setting

Filter features are based on JIS C1513-2002 class 1, class 2 (IEC61260).



Normal

Filter characteristics approximate those of an analog filter.



Sharp

Only those spectral component within the octave band are used for analysis. Spectral components outside of the octave band are totally ignored.

After determining the entire power spectrum, the instrument performs octave analysis on the spectral bands defined by the above filter characteristics.

See:"Octave Filter Characteristics"(⇒ p.A26)

■ Analysis Modes and X/Y Axis Display

●: Settable, ×: Unsettable

Analysis Mode	X axis		Y axis				Nyquist display
	Linear	Log	Lin-Mag	Log-Mag	Lin-Real	Lin-Imag	
OFF	×	×	×	×	×	×	×
Storage Waveform	●	×	●	×	×	×	×
Histogram	●	×	●	×	×	×	×
Linear Spectrum	●	●	●	●	●	●	●
RMS Spectrum	●	●	●	●	●	●	×
Power Spectrum	●	●	●	●	×	×	×
Power Spectrum Density	●	●	●	●	×	×	×
LPC analysis (Power Spectrum Density)	●	●	●	●	×	×	×
Transfer Function	●	●	●	●	●	●	●
Cross Power Spectrum	●	●	●	●	●	●	●
Impulse Response	●	×	●	×	×	×	×
Coherence Function	●	●	●	×	×	×	×
Phase Spectrum	●	●	●	×	×	×	×
Auto-correlation Function	●	×	●	×	×	×	×
Cross-correlation Function	●	×	●	×	×	×	×
1/1 Octave	×	●	●	●	×	×	×
1/3 Octave	×	●	●	●	×	×	×

The x/y axes cannot be set when Nyquist Display is selected.

■ Total harmonic distortion (THD)

When the analysis mode is one of the following, the cursor appears and the distortion rate is calculated.
(Linear spectrum, RMS spectrum, power spectrum)
The distortion rate calculates the cursor position as the fundamental wave. When 2 cursors appear, the A cursor becomes the fundamental wave.
When calculation results cannot be obtained, [---%] is displayed.
Note that distortion rate values may become higher depending on the window function settings.

$$\mathrm{THD} = \sqrt{\frac{\Sigma(f_n)^2}{(f_0)^2}} \times 100\ [\%]$$

f_0 =fundamental wave
f_n = n next higher harmonic

13.3.10 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.

Procedure

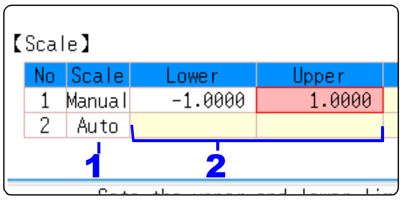
To open the screen: Press the STATUS key → [Status] sheet

1 **Select automatic or manual scaling of the y-axis display.**

Move the cursor to the **[Scale]** column of the Analysis No. to set.

Select

Auto	Scaling of the vertical (y) axis is automatically set according to analysis results. (default setting)
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.



【Scale】

No	Scale	Lower	Upper
1	Manual	-1.0000	1.0000
2	Auto		

2 **When [Manu] is selected**

Set the upper and lower limits to display.

Move the cursor to the **[Lower]** or **[Upper]** item.

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: "8.1.3 Alphanumeric Input" (⇒ p.121)

How do I copy settings to other calculation No.?
See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.139)

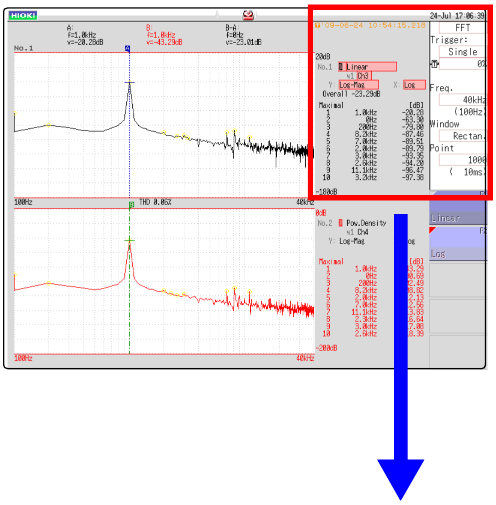
13.3.11 Setting and Changing Analysis Conditions on the Waveform Screen

The following settings can be made on the Waveform screen.
Changes to the displayed analysis results become effective when the settings are changed.

- Available settings are frequency range, number of analysis points, type of window function, trigger mode and pre-triggering
- Available settings are analysis number, analysis mode, waveform color, analysis channel and x/y axis display type
- Trigger settings(⇒ p.154)
  (Note: If **[Reference]** is **[From Memory]**, triggers cannot be set.)

Setting details

To open the screen: Press the DISP key → Waveform screen



Setting method

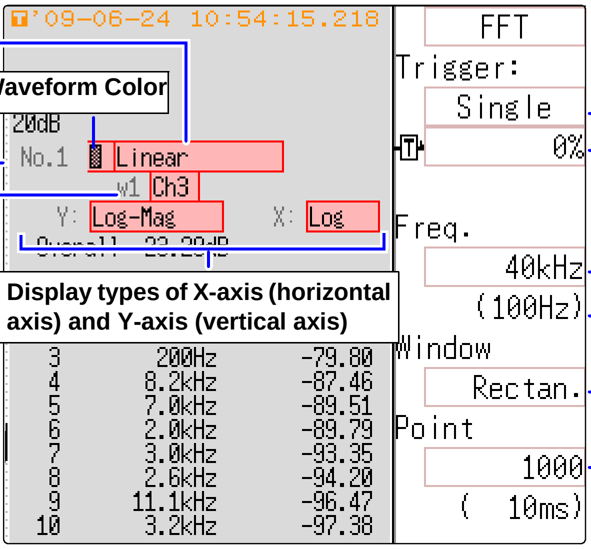
Use the CURSOR keys to move the cursor to each setting item, and select your choice with the F keys.

Trigger mode and Pre-trigger

Select the trigger mode and pre-triggering (same as fo the Memory function).

Trigger Mode: Single, Repeat, Auto
Pre-trigger: Select from list

See: "9.2 Setting the Trigger Mode" (⇒ p.153)
"9.8 Pre-Trigger Settings" (⇒ p.166)



```
'09-06-24 10:54:15.218        FFT
                              Trigger:
20dB                            Single
No.1  Linear                        0%
     w1 Ch3
  Y: Log-Mag      X: Log      Freq.
                                 40kHz
                               (100Hz)
                              Window
                               Rectan.
 3      200Hz    -79.80       Point
 4     8.2kHz    -87.46           1000
 5     7.0kHz    -89.51        (  10ms)
 6     2.0kHz    -89.79
 7     3.0kHz    -93.35
 8     2.6kHz    -94.20
 9    11.1kHz    -96.47
10     3.2kHz    -97.38
```

Analysis Mode

Waveform Color

Analysis Numbe*(⇒ p.220)

Analysis Channel

*Coupled with the **[Analysis]** list at the **[Status]** sheet of the Status screen.

Display types of X-axis (horizontal axis) and Y-axis (vertical axis)

Select the frequency range (133 mHz to 8 MHz). (⇒ p.211)

Frequency Resolution (during acquisition)

FFT Window Function Type (⇒ p.214)

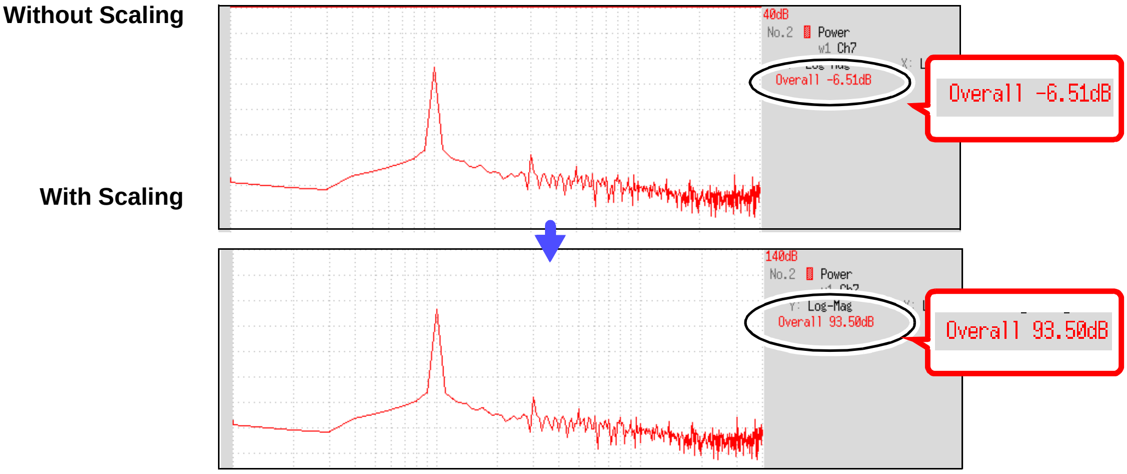
Number of Analysis Points (⇒ p.211)
(1000, 2000, 5000, 10000)

13.4 Selecting Channels

Channel selection is the same for all functions.
For the setting method, refer to "3.5 Input Channel Setting" (⇒ p.49) and "8.10 Making Detailed Settings for Input Modules" (⇒ p.140).

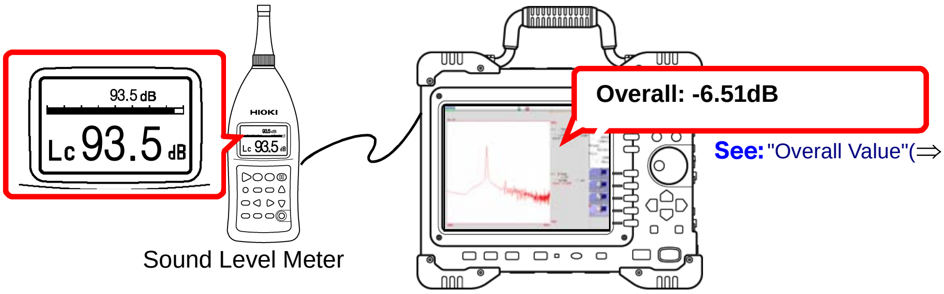
■ Scaling

The scaling setting allows values displayed on this instrument to match the actual values read directly on a sound level meter or vibration meter.

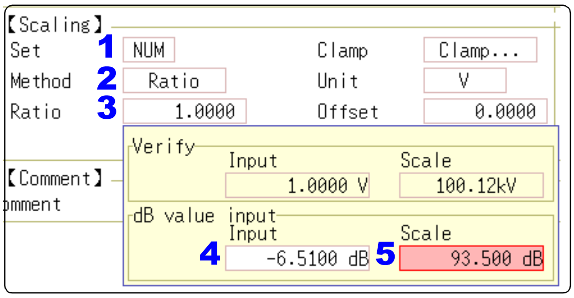


Setting example: To display measurement data on this instrument so that it corresponds to that on a sound level meter.

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 -6-51 dB.



See: "Overall Value"(⇒ p.A21)



【Scaling】
Set 1 NUM Clamp Clamp...
Method 2 Ratio Unit V
Ratio 3 1.0000 Offset 0.0000
Verify
Input 1.0000 V Scale 100.12kV
【Comment】
omment
dB value input
Input 4 -6.5100 dB 5 Scale 93.500 dB

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.

1. Select **[Num]**.
2. Select **[Ratio]**.
3. **Move the cursor to [Ratio], and press the F1 [dB Scaling] key.**
   The dB Scaling dialog appears.
4. **Enter the (overall) value "-6.51" displayed on the instrument.**
5. **Enter the value "93.5" (from the sound level meter) that you want to read directly.**
6. **Press F5 [Confirm] key to perform scaling.**
   Scaling is performed automatically and the conversion value is set in the conversion rate column.

13.5 Setting Screen Displays

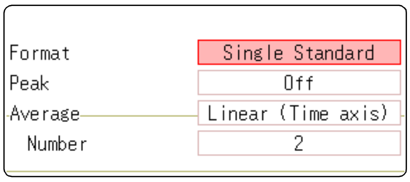
Set the display method for FFT calculation results.

Procedure

To open the screen: Press the STATUS key → [Status] sheet

1 Select the display format.

Move the cursor to the **[Format]** item.



1

Format: Single Standard
Peak: Off
Average: Linear (Time axis)
Number: 2

Select the format of data to be displayed.
The display format depends on the input data selected for analysis.

Single Standard	The FFT calculation results are displayed in one screen. If the calculations have multiple settings, waveforms are overlaid. Note: Depending on the analysis mode settings, analysis No1 only may be preferentially displayed.
Dual Standard	The FFT calculation results are displayed in two screens. If the calculations have multiple settings, waveforms are displayed for each specified calculation.
Single Nyquist*	If the analysis mode is linear spectrum, transfer function or cross power spectrum, the FFT calculation result is displayed in Nyquist display on one screen. If the calculations have multiple settings, waveforms are overlaid.
Dual Nyquist*	If the analysis mode is linear spectrum, transfer function or cross power spectrum, the FFT calculation result is displayed in Nyquist display on two screens. If the calculations have multiple settings, waveforms are displayed for each specified calculation.
Running spectrum	If the analysis mode is one of the following, analysis results are displayed three-dimensions: frequency, oscillation and time. (Linear spectrum, RMS spectrum, power spectrum, power spectrum density, LPC analysis, transfer function, cross power spectrum, 1/1 octave analysis, 1/3 octave analysis) If the calculations have multiple settings, No1 is preferentially displayed.

*: The horizontal axis and vertical axis display the real parts and the imaginary parts of calculation results, respectively.

To use an existing memory waveform for analysis

Select **[From Memory]**as the input data source **[Reference]**.

See: "13.3.2 Selecting the Data Source for Analysis" (⇒ p.210)

To specify the analysis starting point

Specify the starting point on the memory waveform.

See: "13.8.1 Analyzing after Specifying an Analysis Starting Point" (⇒ p.234)

2 Press the DISP key to display the Waveform screen.

When “Drawing failed”:

- **NG: Nyquist, Running Spectrum**
  The display format settings and analysis mode do not match.

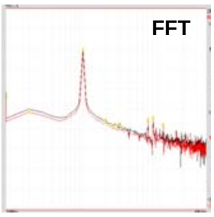
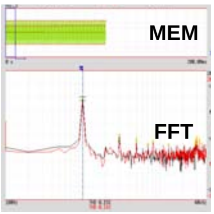
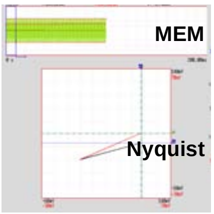
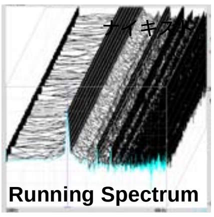
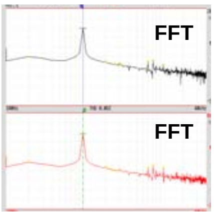
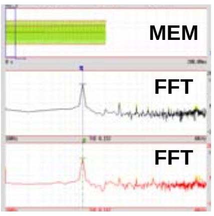
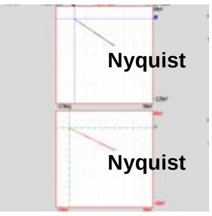
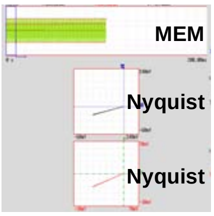
- **NG: X-Axis**
  Either change the **[Format]** setting and increase the number of screen divisions or change the display setting of the X-axis.
  Linear and logarithm X-axes cannot exist in one graph.

- **NG:X-unit**
  Set **[Format]** and increase the number of screen divisions. Different horizontal axis units cannot coexist in 1 graph.

- **NG: EXT**
  Analysis mode cannot perform external sampling.

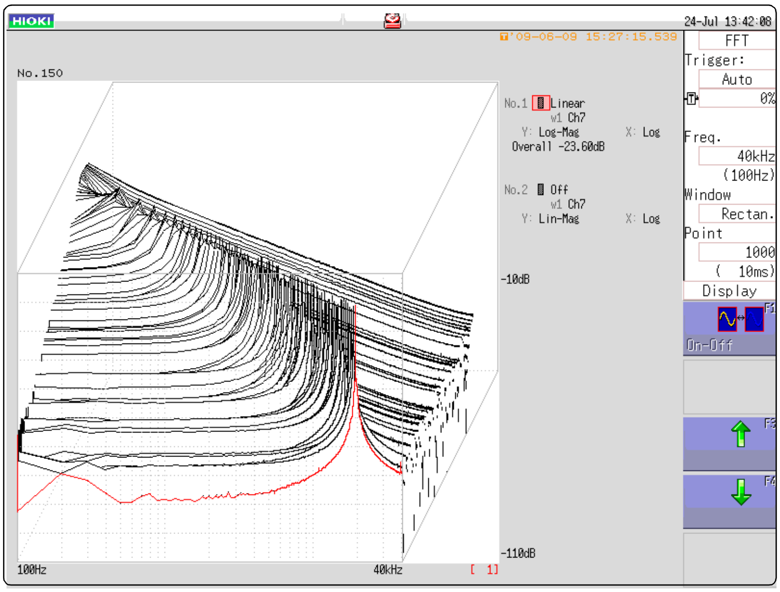
■ Display Types and Split-Screen Settings

Nine display arrangements are available.

	Standard		Nyquist		Running Spectrum
	Single Standard	Dual Standard	Single Nyquist	Dual Nyquist	Running spectrum
[Reference] setting	**[New Data]**	**[From Memory]**	**[New Data]**	**[From Memory]**	**[New Data]**
One division					
Two divisions					

13.5.1 Displaying running spectrums

If **[Format]** is set to **[Running spectrum]**, changes in frequency over time can be observed.



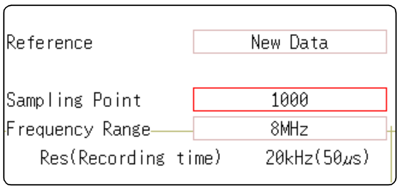
Procedure

To open the screen: Press the STATUS key → [Status] sheet

1 **Select the reference data.**

Move the cursor to the **[Reference]**, and select **[New Data]**.

1

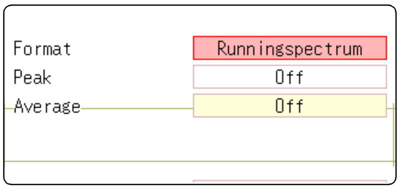


Reference New Data
Sampling Point 1000
Frequency Range 8MHz
Res(Recording time) 20kHz(50μs)

2 **Select the display format.**

Move the cursor to the **[Format]**, and select **[Running spectrum]**.

2



Format Runningspectrum
Peak Off
Average Off

NOTE

- [Running spectrum] can only be set when the **[Reference]** is **[New Data]**.
- The calculation interval (time interval of the running spectrum waveform and the waveform) is not regulated.
- Averaging cannot be used.
- Calculations that can be analyzed by running spectrum are limited to the following. When other calculations are selected or calculation settings are changed after measurement stops, waveforms are not displayed.
  (Linear spectrum, RMS spectrum, power spectrum, power spectrum density, LPC analysis, transfer function, cross power spectrum, 1/1 octave analysis, 1/3 octave analysis)

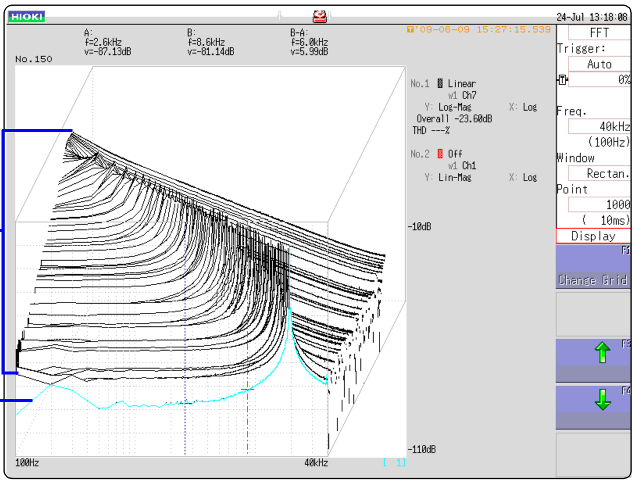
Procedure

To open the screen: Press the DISP key → Waveform screen

Stopping waveform movement during measurement

If the **AUTO** key is pressed during measurement, waveform movements can be stopped temporarily.
The latest calculation results are displayed in the foreground.

To restart, press the **AUTO** key again.



Past waveforms

The latest waveform displayed during pausing of measurement

Reading measurement values of past waveforms by cursor

After measurement is finished, read the values of each waveform by cursor.

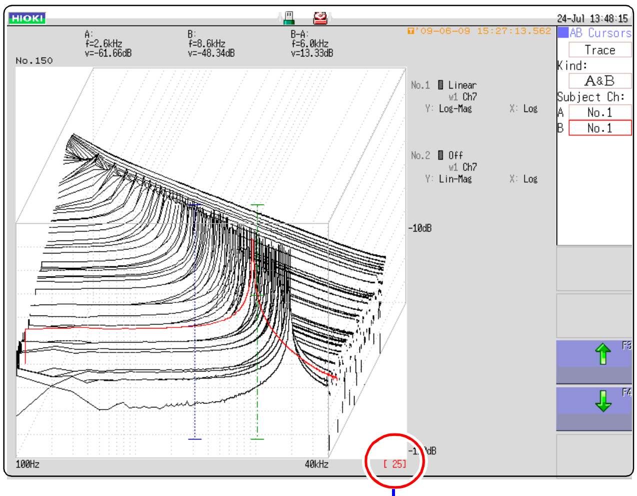
1 **Press the WAVE key on the panel of the unit.**

2 **Select a waveform.**

Rotate the jog and shuttle of the unit panel and select the waveform.
(The waveform number is displayed in the lower right of the screen.)

3 **Move the cursor.**

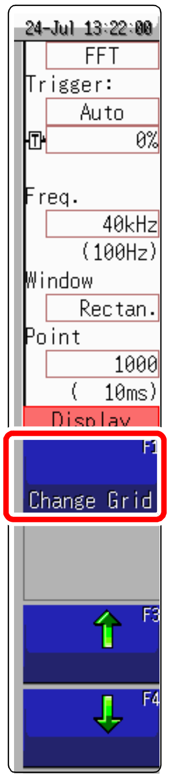
Press the **AB CSR** key on the unit panel, rotate the jog and shuttle to read the cursor value.



The older the waveform, the larger the number.

Changing the grid display

The display format of the grid can be switched.

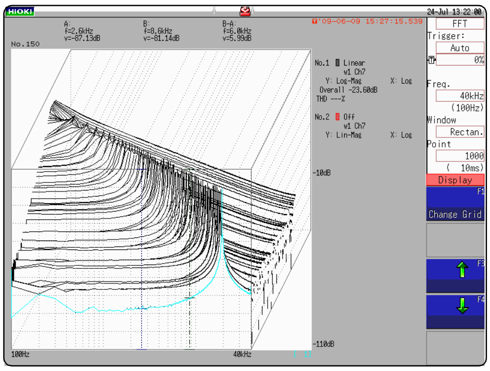

24-Jul 13:22:00
FFT
Trigger:
Auto
0%
Freq.
40kHz
(100Hz)
Window
Rectan.
Point
1000
(10ms)
Display

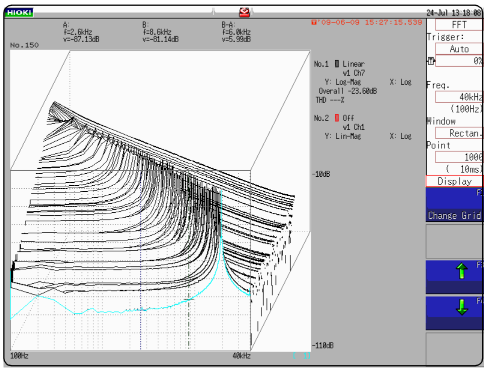
1 **Press the WAVE key on the panel of the unit.**

2 **Move the cursor to the [Display].**

3 **Change the grid display**

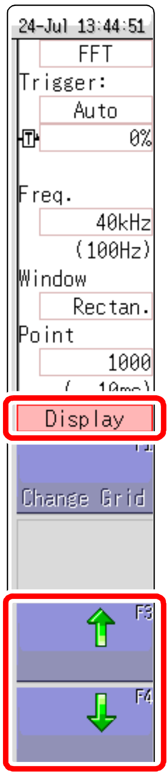
Press **F1 [Change Grid]** key and change the grid display. Each time the key is pressed, the display format changes.


Grid Type 1


Grid Type 2

Changing the number of waveforms to be displayed

The number of waveforms to be displayed can be changed.
The following number of waveforms can be selected: 10, 20, 50, 100, and 200.

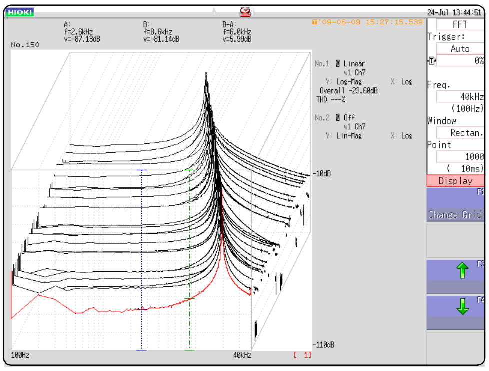

24-Jul 13:44:51
FFT
Trigger:
Auto
0%
Freq.
40kHz
(100Hz)
Window
Rectan.
Point
1000
(10ms)
Display

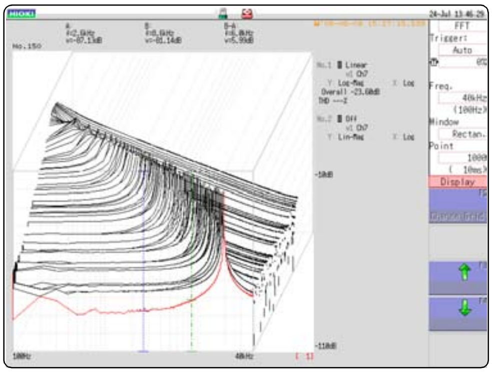
1 **Press the WAVE key on the panel of the unit.**

2 **Move the cursor to the [Display].**

3 **Change the number of waveforms to be displayed.**

Using either the **F3 [↑]** or **F4 [↓]** key, adjust the number of waveforms to be displayed.


50 waveforms displayed


100 waveforms displayed

13.6 Saving Analysis Results

The saving procedure is the same as for the Memory and Recorder functions.

See: "Chapter 5 Saving/Loading Data & Managing Files" (⇒ p.65)

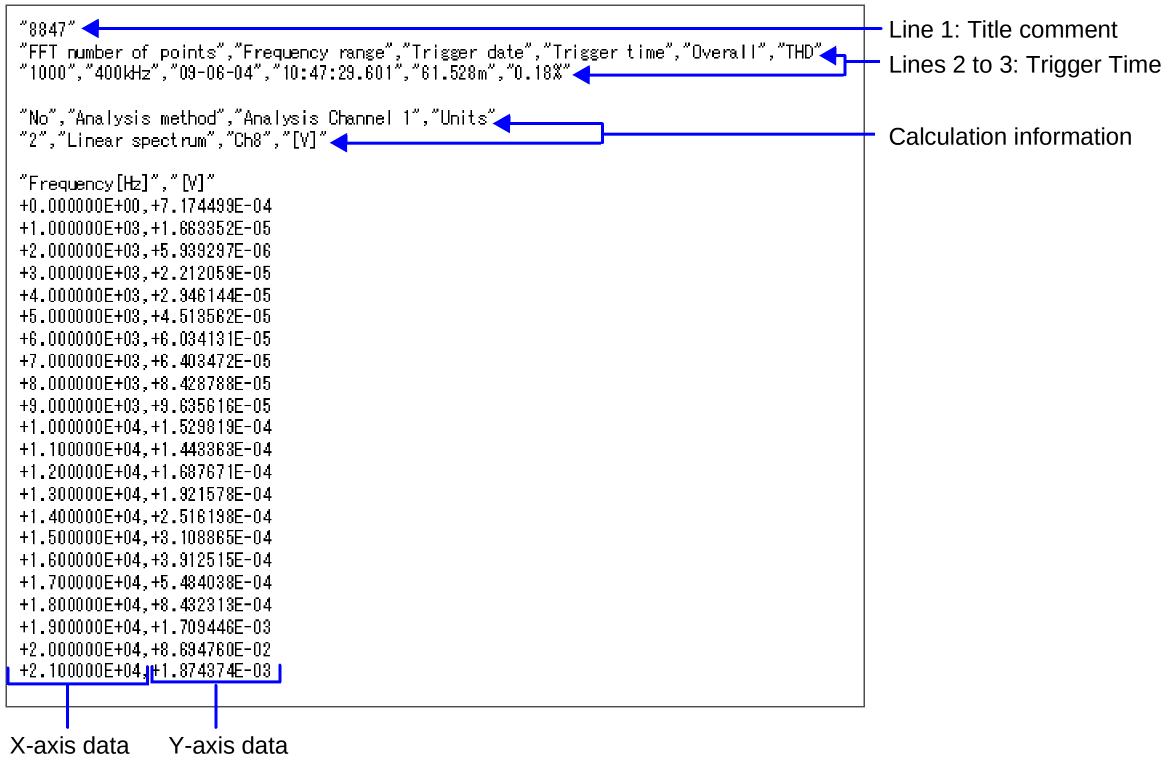
The size of saved files depends on the save format and analysis method.

See: "Appendix 2.1 Waveform File Sizes"(⇒ p.A2)

■ When FFT Analysis Results are Saved as Text

Divide files by calculation item and then save.

Text Saving Example



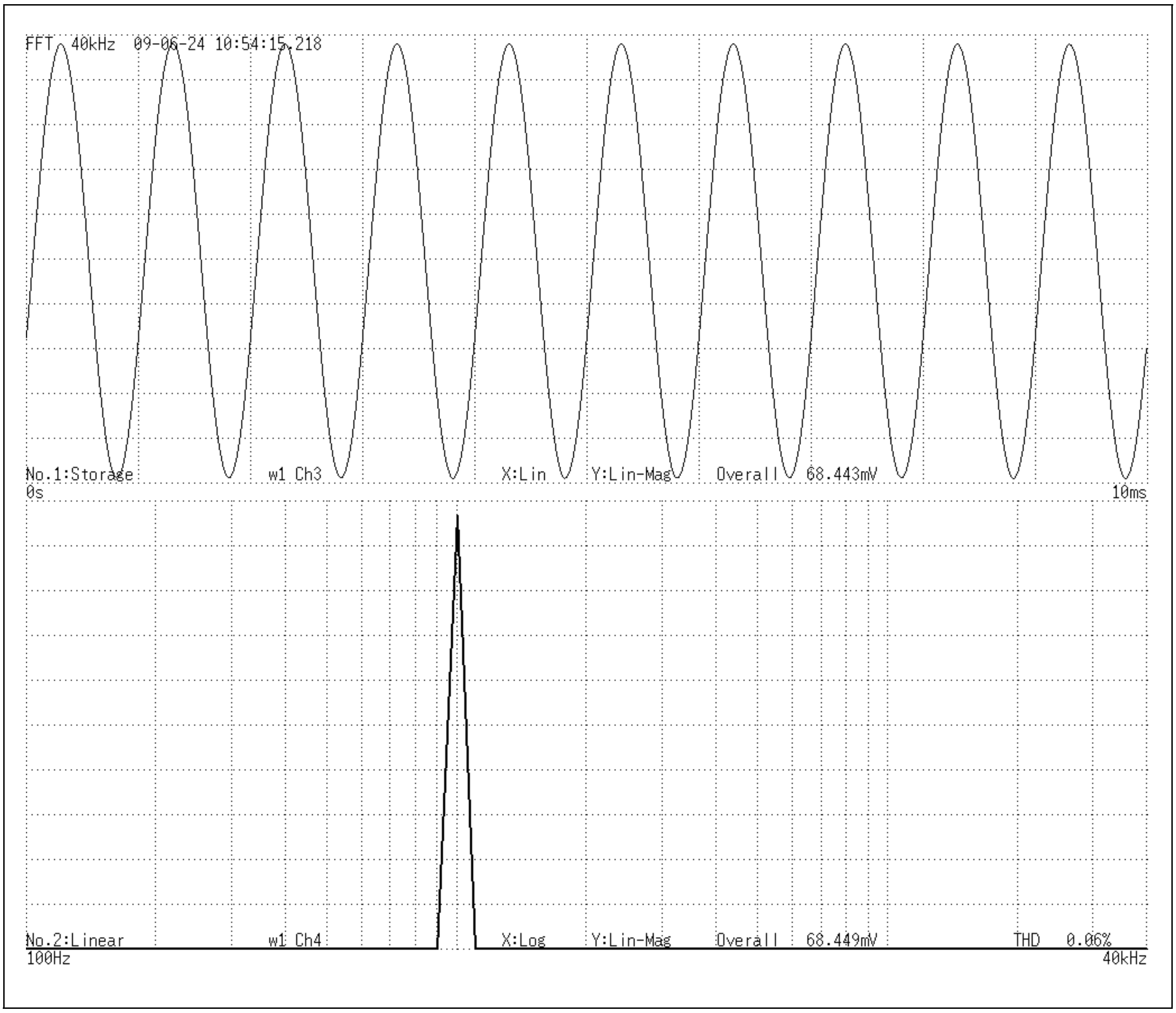
```
"8847"
"FFT number of points","Frequency range","Trigger date","Trigger time","Overall","THD"
"1000","400kHz","09-06-04","10:47:29.601","61.528m","0.18%"

"No","Analysis method","Analysis Channel 1","Units"
"2","Linear spectrum","Ch8","[V]"

"Frequency[Hz]","[V]"
+0.000000E+00,+7.174499E-04
+1.000000E+03,+1.663352E-05
+2.000000E+03,+5.939297E-06
+3.000000E+03,+2.212059E-05
+4.000000E+03,+2.946144E-05
+5.000000E+03,+4.513562E-05
+6.000000E+03,+6.034131E-05
+7.000000E+03,+6.403472E-05
+8.000000E+03,+8.428788E-05
+9.000000E+03,+9.635616E-05
+1.000000E+04,+1.529819E-04
+1.100000E+04,+1.443363E-04
+1.200000E+04,+1.687671E-04
+1.300000E+04,+1.921578E-04
+1.400000E+04,+2.516198E-04
+1.500000E+04,+3.108865E-04
+1.600000E+04,+3.912515E-04
+1.700000E+04,+5.484038E-04
+1.800000E+04,+8.432313E-04
+1.900000E+04,+1.709446E-03
+2.000000E+04,+8.694760E-02
+2.100000E+04,+1.874374E-03
```

13.7 Printing Analysis Results

The printing procedure is the same as for the Memory and Recorder functions.

See: "Chapter 6 Printing" (⇒ p.89)

Example of Waveform Printout



13.8 Analysis with the Waveform Screen

13.8.1 Analyzing after Specifying an Analysis Starting Point

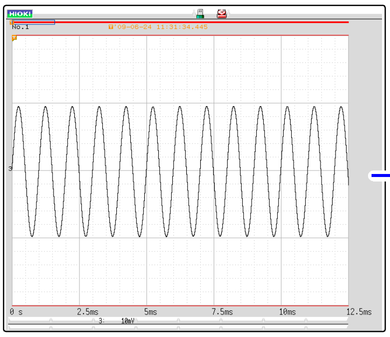
The FFT function can specify the calculation start position for waveforms measured by the memory function before calculation.

Operation differs by calculation execution settings.
See:"Trigger Modes and Averaging" (⇒ p.218)

•Calculation execution: **[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 execution: **[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.)

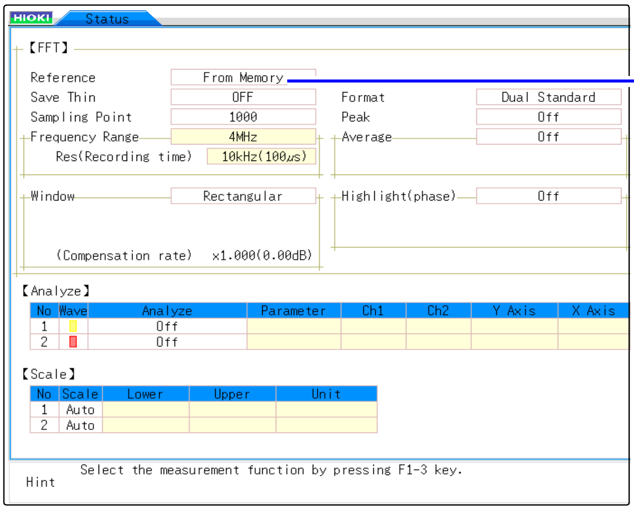
Verifying the analysis starting point while viewing analysis data



1 **Display the waveform with the Memory function.**

2 **Switch to FFT function.**

3 **Press the STATUS key to display the [Status] sheet of the Status screen.**



【FFT】
Reference From Memory
Save Thin OFF
Sampling Point 1000
Frequency Range 4MHz
Res(Recording time) 10kHz(100μs)
Format Dual Standard
Peak Off
Average Off
Window Rectangular
Highlight(phase) Off
(Compensation rate) x1.000(0.00dB)

【Analyze】

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	🟨	Off					
2	🟥	Off					

【Scale】

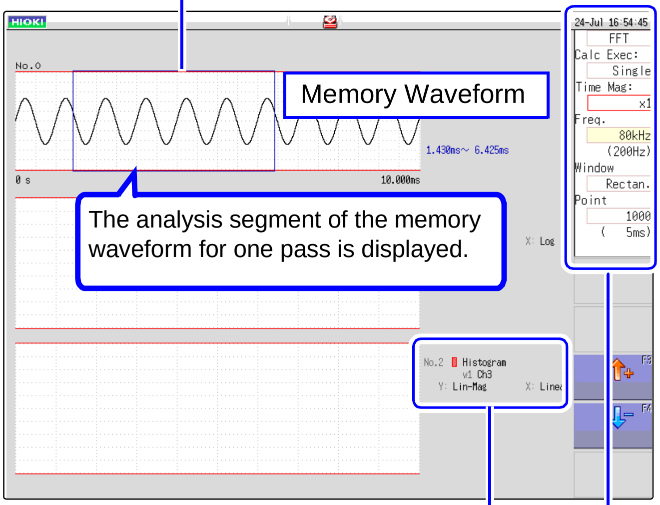
No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

Hint Select the measurement function by pressing F1-3 key.

4 **Set the [Reference] item to [From Memory].**
Set analysis conditions such as the analysis mode and number of analysis points (these can also be set on the Waveform screen).

5 **Press the DISP key to display the Waveform screen.**
The one-time calculation range is displayed for the memory waveform.

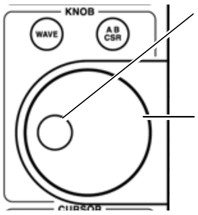
6 **Specify the location of the analysis input data using the jog and shuttle controls.**



Memory Waveform

The analysis segment of the memory waveform for one pass is displayed.

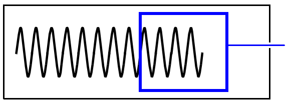
24-Jul 16:54:45
FFT
Calc Exec:
Single
Time Mag:
x1
Freq.
80kHz
(200Hz)
Window
Rectan.
Point
1000
(5ms)



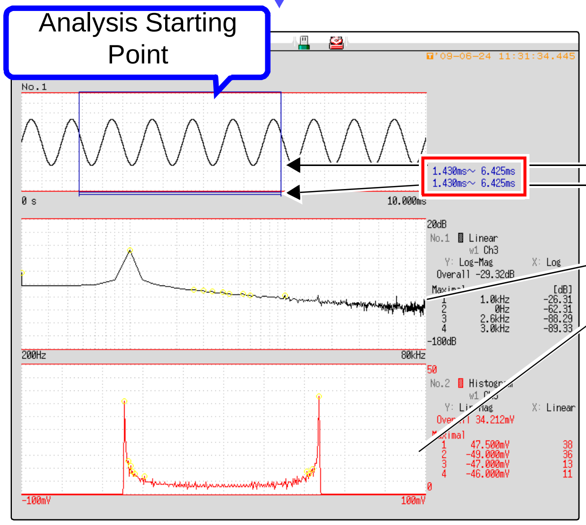
Jog
Moves the analysis starting point.

Shuttle
Scrolls the Memory waveform.

7 **Select analysis conditions as occasion demands.**

To change the number of analysis points	The setting can be changed at the top of the Waveform 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.  Analysis Segment Display
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. To stop mid-way, press the **STOP** key.

8 **Use [Exec] or press the START key to perform analysis.**



Analysis Starting Point

Calculation range (portion in square)

Last range calculated (line portion)

Analysis results are displayed on the lower graphs.

When the trigger mode is **[Auto]** or **[Repeat]**, the number of analysis points up to the end of the waveform data is analyzed, and the last data is displayed.

Memory waveforms are not printed.

13.9 FFT Analysis Modes

13.9.1 Analysis Modes and Display Examples

For the functions of each analysis mode, see"13.9.2 Analysis Mode Functions" (⇒ p.254).

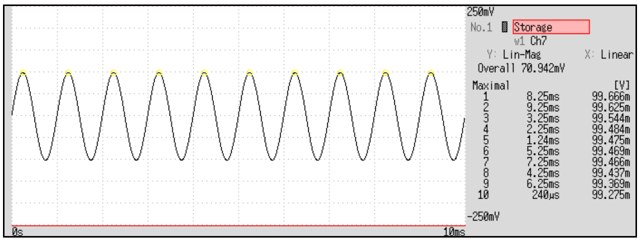
Storage

Displays the time axis waveform of the input signal.

When the window function setting is other than rectangular, the window function is applied to the waveform and displayed.

Axis	Display Type	Description
X axis	**Linear**	Time-domain display Displays the value of the time-domain waveform corresponding to the set frequency range. See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.212)
Y axis	**Lin-Mag**	Displays the input module waveform

Waveform Example



```
No.1 ▩ Storage
       w1 Ch7
  Y: Lin-Mag          X: Linear
 Overall 70.942mV
Maximal                    [V]
  1       8.25ms      99.666m
  2       9.25ms      99.625m
  3       3.25ms      99.544m
  4       2.25ms      99.484m
  5       1.24ms      99.475m
  6       5.25ms      99.469m
  7       7.25ms      99.466m
  8       4.25ms      99.437m
  9       6.25ms      99.369m
 10        240µs      99.275m
```

Window: Rectangular
X axis: Linear
Y axis: Lin-Mag

Histogram

Acquires the amplitude distribution of the input signal.

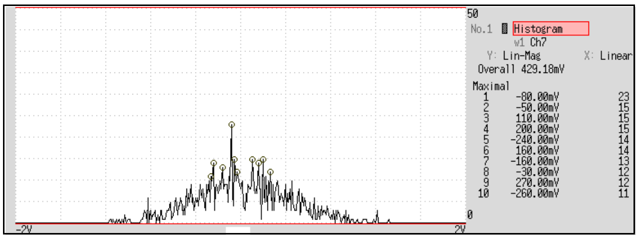
Main uses:

- To inspect deviations in the amplitude range of a waveform
- With analysis point distribution, to ascertain whether a waveform is artificial or natural (natural forms exhibiting regular distribution

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	**Linear**	Displays input level of the input signal.
Y axis	**Lin-Mag**	Displays analysis data distribution.

Waveform Example



```
No.1 ▩ Histogram
       w1 Ch7
  Y: Lin-Mag          X: Linear
 Overall 429.18mV
Maximal
  1     -80.00mV          23
  2     -50.00mV          15
  3     110.00mV          15
  4     200.00mV          15
  5    -240.00mV          14
  6     160.00mV          14
  7    -160.00mV          13
  8     -30.00mV          12
  9     270.00mV          12
 10    -260.00mV          11
```

Normal display
X axis: Linear
Y axis: Lin-Mag

Linear Spectrum

The linear spectrum plots the input signal frequency. It can be displayed as a Nyquist plot.

Main uses:

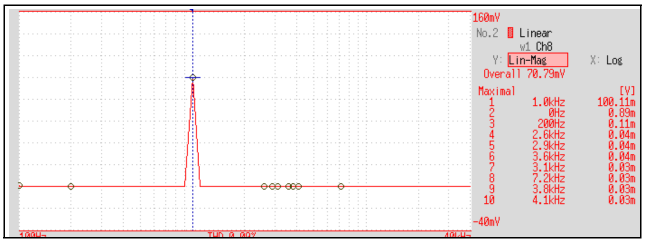
- To inspect the peak frequency contents of a waveform
- To inspect signal amplitudes at each frequency

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	**Linear**	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
	Nyquist display	The real-number component of analysis values are displayed linearly.
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.
	Nyquist display	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)

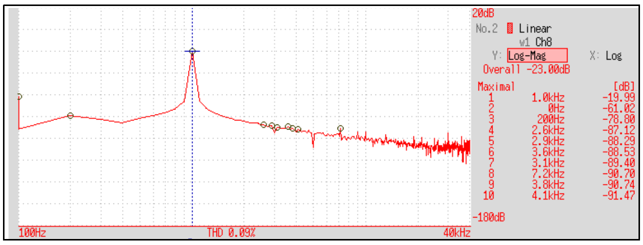
Waveform Example



No.2 Linear
w1 Ch8
Y: Lin-Mag X: Log
Overall 70.79mV

Maximal		[V]
1	1.0kHz	100.11m
2	0Hz	0.89m
3	200Hz	0.11m
4	2.6kHz	0.04m
5	2.9kHz	0.04m
6	3.6kHz	0.04m
7	3.1kHz	0.03m
8	7.2kHz	0.03m
9	3.8kHz	0.03m
10	4.1kHz	0.03m

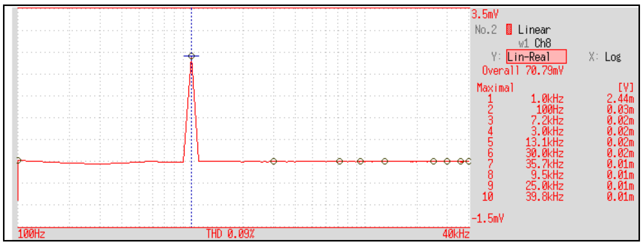
Normal display
X axis: Log
Y axis: Lin-Mag



No.2 Linear
w1 Ch8
Y: Log-Mag X: Log
Overall -23.00dB

Maximal		[dB]
1	1.0kHz	-19.99
2	0Hz	-61.02
3	200Hz	-78.80
4	2.6kHz	-87.12
5	2.9kHz	-88.29
6	3.6kHz	-88.53
7	3.1kHz	-89.40
8	7.2kHz	-90.70
9	3.8kHz	-90.74
10	4.1kHz	-91.47

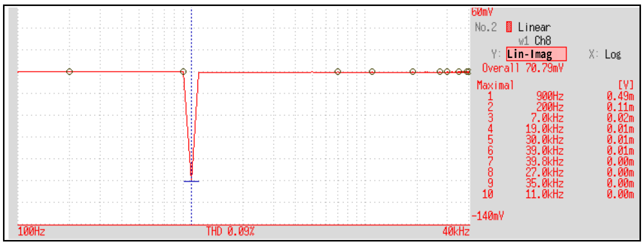
Normal display
X axis: Log
Y axis: Log-Mag



No.2 Linear
w1 Ch8
Y: Lin-Real X: Log
Overall 70.79mV

Maximal		[V]
1	1.0kHz	2.44m
2	100Hz	0.03m
3	7.2kHz	0.02m
4	3.0kHz	0.02m
5	13.1kHz	0.02m
6	30.0kHz	0.02m
7	35.7kHz	0.01m
8	9.5kHz	0.01m
9	25.0kHz	0.01m
10	39.8kHz	0.01m

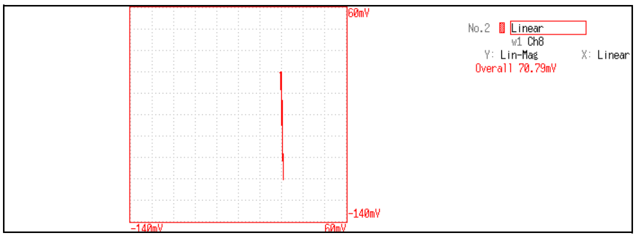
Normal display
X axis: Log
Y axis: Lin-Real



No.2 Linear
w1 Ch8
Y: Lin-Imag X: Log
Overall 70.79mV

Maximal		[V]
1	900Hz	0.49m
2	200Hz	0.11m
3	7.0kHz	0.02m
4	19.0kHz	0.01m
5	30.0kHz	0.01m
6	39.0kHz	0.01m
7	39.8kHz	0.00m
8	27.0kHz	0.00m
9	35.0kHz	0.00m
10	11.0kHz	0.00m

Normal display
X axis: Log
Y axis: Lin-Imag



```
No.2 Linear
     w1 Ch8
  Y: Lin-Mag        X: Linear
 Overall 70.79mV
```

Nyquist display

NOTE

- If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed. When 2 cursors appear, the one with the low frequency becomes the fundamental. 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.238), Power Spectrum (⇒ p.240)

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"13.9.2 Analysis Mode Functions" (⇒ p.254)

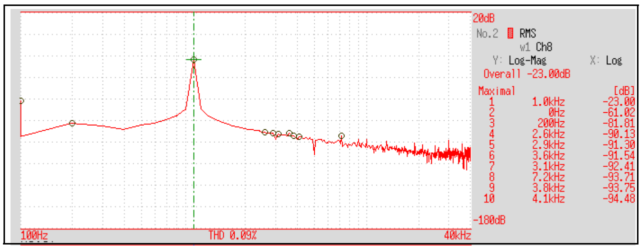
Axis	Display Type	Description
X axis	**Linear**	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	**Lin-Mag**	Analysis values are displayed linearly.
	Log-Mag	Analysis values are displayed as dB values. (0 dB reference value: 1eu)*
	Lin-Real	The real-number 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

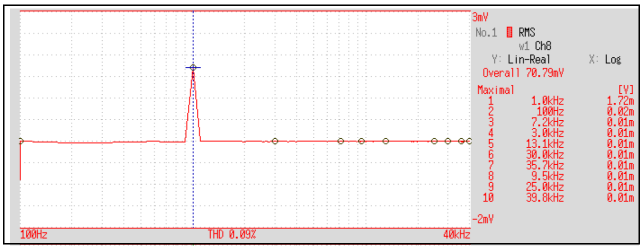
```
90mV
No.1 RMS
     w1 Ch8
  Y: Lin-Mag        X: Log
 Overall 70.79mV
Maximal                [V]
  1      1.0kHz    70.79m
  2         0Hz     0.89m
  3       200Hz     0.08m
  4      2.6kHz     0.03m
  5      2.9kHz     0.03m
  6      3.6kHz     0.03m
  7      3.1kHz     0.02m
  8      7.2kHz     0.02m
  9      3.8kHz     0.02m
 10      4.1kHz     0.02m
-10mV
```

Normal display
X axis: Log
Y axis: Lin-Mag



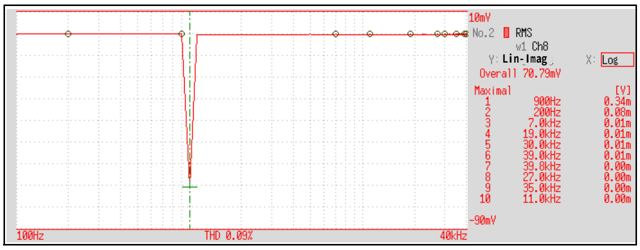
```
No.2 ▨ RMS
        w1 Ch8
   Y: Log-Mag        X: Log
 Overall -23.00dB

Maximal                [dB]
  1       1.0kHz     -23.00
  2          0Hz     -61.02
  3        200Hz     -81.81
  4       2.6kHz     -90.13
  5       2.9kHz     -91.30
  6       3.6kHz     -91.54
  7       3.1kHz     -92.41
  8       7.2kHz     -93.71
  9       3.8kHz     -93.75
 10       4.1kHz     -94.48
```

Normal display
X axis: Log
Y axis: Log-Mag



```
No.1 ▨ RMS
        w1 Ch8
   Y: Lin-Real       X: Log
 Overall 70.79mV

Maximal                 [V]
  1       1.0kHz      1.72m
  2        100Hz      0.02m
  3       7.2kHz      0.01m
  4       3.0kHz      0.01m
  5      13.1kHz      0.01m
  6      30.0kHz      0.01m
  7      35.7kHz      0.01m
  8       9.5kHz      0.01m
  9      25.0kHz      0.01m
 10      39.8kHz      0.01m
```

Normal display
X axis: Log
Y axis: Lin-Real



```
No.2 ▨ RMS
        w1 Ch8
   Y: Lin-Imag       X: Log
 Overall 70.79mV

Maximal                 [V]
  1        900Hz      0.34m
  2        200Hz      0.08m
  3       7.0kHz      0.01m
  4      19.0kHz      0.01m
  5      30.0kHz      0.01m
  6      39.0kHz      0.01m
  7      39.8kHz      0.00m
  8      27.0kHz      0.00m
  9      35.0kHz      0.00m
 10      11.0kHz      0.00m
```

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 2 cursors appear, the one with the low frequency becomes the fundamental. When results cannot be obtained, **[---%]** is displayed.

Power Spectrum

Displays input signal power as the amplitude component.

Main uses:

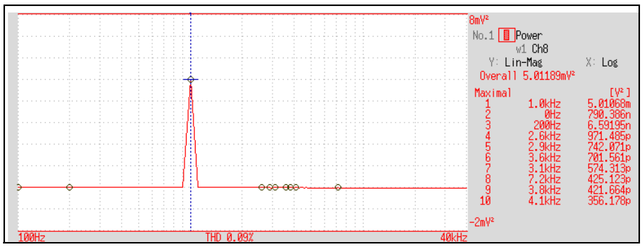
- To inspect the peak frequency contents of a waveform
- To inspect the power level at each frequency

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

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)*

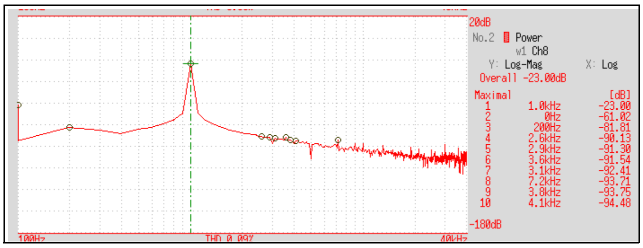
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2)

Waveform Example



```
8mV²
No.1 ▩ Power
        w1 Ch8
   Y: Lin-Mag          X: Log
 Overall 5.01189mV²
Maximal                      [V²]
  1        1.0kHz       5.01068m
  2           0Hz       790.386n
  3         200Hz       6.59195n
  4        2.6kHz       971.485p
  5        2.9kHz       742.071p
  6        3.6kHz       701.561p
  7        3.1kHz       574.313p
  8        7.2kHz       425.123p
  9        3.8kHz       421.664p
 10        4.1kHz       356.178p
-2mV²
100Hz          THD 0.09%          40kHz
```

Normal display
X axis: Log
Y axis: Lin-Mag



```
20dB
No.2 ▩ Power
        w1 Ch8
   Y: Log-Mag          X: Log
 Overall -23.00dB
Maximal                      [dB]
  1        1.0kHz         -23.00
  2           0Hz         -61.02
  3         200Hz         -81.81
  4        2.6kHz         -90.13
  5        2.9kHz         -91.30
  6        3.6kHz         -91.54
  7        3.1kHz         -92.41
  8        7.2kHz         -93.71
  9        3.8kHz         -93.75
 10        4.1kHz         -94.48
-180dB
100Hz          THD 0.09%          40kHz
```

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 2 cursors appear, the one with the low frequency becomes the fundamental. When results cannot be obtained, **[---%]** is displayed.

Power Spectrum Density

Indicates the power spectrum density of the input signal with only the amplitude component included. This is the power spectrum divided by the frequency resolution.

Main uses:

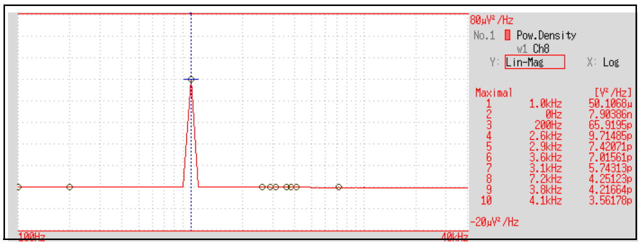
To acquire a power spectrum with 1-Hz resolution for highly irregular waveforms such as white noise

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

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(logarithm)	Analysis values are displayed as dB values. (0 dB reference value: 1eu^2/Hz)*

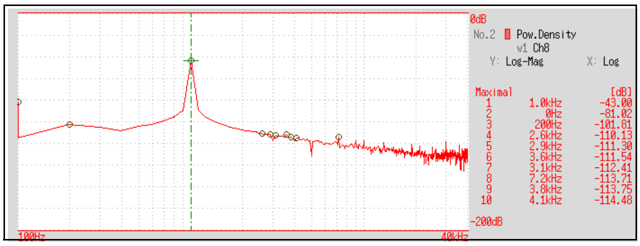
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2/Hz)

Waveform Example



```
80μV²/Hz
No.1   Pow.Density
          w1 Ch8
     Y: Lin-Mag        X: Log

 Maximal             [V²/Hz]
   1      1.0kHz   50.1068μ
   2         0Hz   7.90386n
   3       200Hz   65.9195p
   4      2.6kHz   9.71485p
   5      2.9kHz   7.42071p
   6      3.6kHz   7.01561p
   7      3.1kHz   5.74313p
   8      7.2kHz   4.25123p
   9      3.8kHz   4.21664p
  10      4.1kHz   3.56178p

-20μV²/Hz
```

Normal display
X axis: Log
Y axis: Lin-Mag



```
0dB
No.2   Pow.Density
          w1 Ch8
     Y: Log-Mag        X: Log

 Maximal                [dB]
   1      1.0kHz      -43.00
   2         0Hz      -81.02
   3       200Hz     -101.81
   4      2.6kHz     -110.13
   5      2.9kHz     -111.30
   6      3.6kHz     -111.54
   7      3.1kHz     -112.41
   8      7.2kHz     -113.71
   9      3.8kHz     -113.75
  10      4.1kHz     -114.48

-200dB
```

Normal display
X axis: Log
Y axis: Log-Mag

NOTE Not available with external sampling enabled.

LPC (Power Spectrum Density)

When the spectrum shape is complex and hard to comprehend with either linear or power spectra, a rough spectrum structure can be obtained.Main uses:

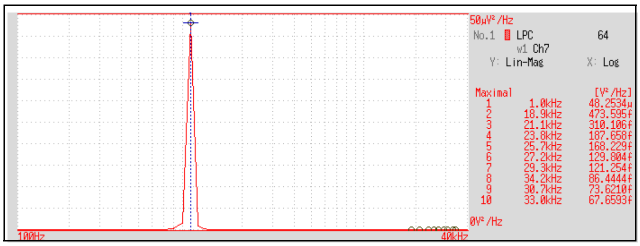
To obtain a spectral envelope using statistical methods

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	The analysis data is displayed linearly.
	Log-Mag(**logarithm**)	Analysis values are displayed as dB values. (0 dB reference value: 1eu^2/Hz)*

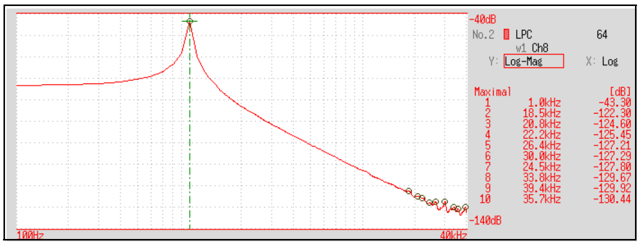
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2/Hz)

Waveform Example



```
No.1   LPC          64
      w1 Ch7
   Y: Lin-Mag     X: Log

Maximal          [V²/Hz]
  1     1.0kHz  48.2534μ
  2    18.9kHz  473.595f
  3    21.1kHz  310.106f
  4    23.8kHz  187.658f
  5    25.7kHz  168.229f
  6    27.2kHz  129.804f
  7    29.3kHz  121.254f
  8    34.2kHz  86.4444f
  9    30.7kHz  73.6210f
 10    33.0kHz  67.6593f
```

X axis: Log
Y axis: Lin-Mag



```
No.2   LPC          64
      w1 Ch8
   Y: Log-Mag     X: Log

Maximal             [dB]
  1     1.0kHz    -43.30
  2    18.5kHz   -122.30
  3    20.8kHz   -124.60
  4    22.2kHz   -125.45
  5    26.4kHz   -127.21
  6    30.0kHz   -127.29
  7    24.5kHz   -127.80
  8    33.8kHz   -129.67
  9    39.4kHz   -129.92
 10    35.7kHz   -130.44
```

X axis: Log
Y axis: Log-Mag

NOTE

- Always specify the order (from 2 to 64). Higher orders can expose finer spectral details.
- Amplitude values provided by LPC are not always the same as the power spectrum density.
- If an error occurs during analysis, no waveform is displayed.
- Noise-like phenomena can strongly affect the spectrum shape.
- Not available with external sampling enabled.

Transfer Function

From the input and output signals, the transfer function (frequency characteristic) of a measurement system can be obtained. It can also be displayed as a Nyquist plot.

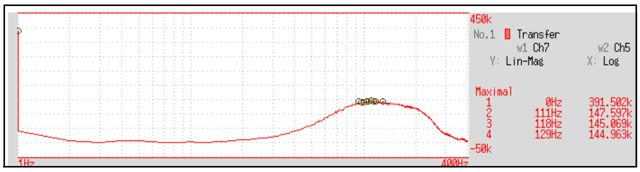
Main uses:

- To inspect a filter's frequency characteristic
- To inspect the stability of a feedback control system (using the Nyquist plot)
- To inspect the resonance characteristic of an object using an impulse hammer and pick-up sensor

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254), "Linear Time-Invariant Systems"(⇒ p.A16)

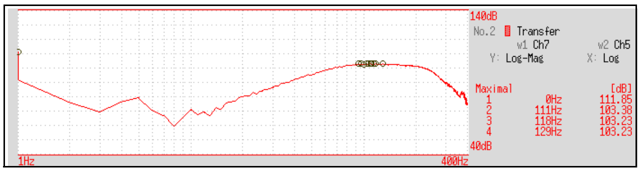
Axis	Display Type	Description
X axis	**Linear**	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
	Nyquist display	Displays the real-number component of the input-output ratio.
Y axis	**Lin-Mag**	Displays the input-output ratio linearly (dimensionless units).
	Log-Mag(logarithm)	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).
	Nyquist display	Displays the imaginary component of the input-output ratio.

Waveform Example



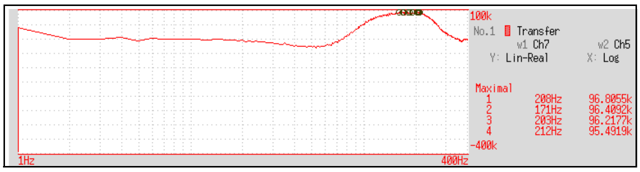
```
No.1 ▓ Transfer
      w1 Ch7         w2 Ch5
   Y: Lin-Mag     X: Log

Maximal
  1       0Hz   391.502k
  2     111Hz   147.597k
  3     118Hz   145.069k
  4     129Hz   144.963k
```

Normal display
X axis: Log
Y axis: Lin-Mag



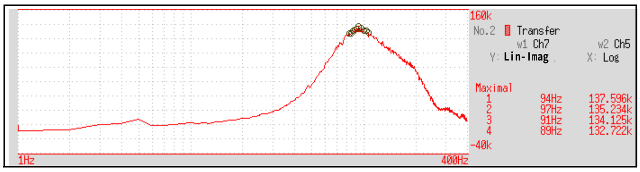
```
No.2 ▓ Transfer
      w1 Ch7         w2 Ch5
   Y: Log-Mag     X: Log

Maximal              [dB]
  1       0Hz     111.85
  2     111Hz     103.38
  3     118Hz     103.23
  4     129Hz     103.23
```

Normal display
X axis: Log
Y axis: Log-Mag



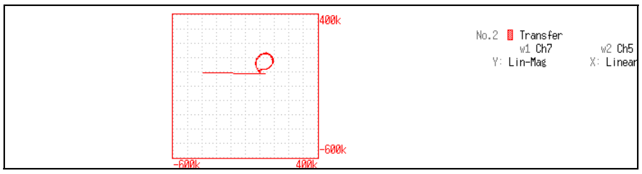
```
No.1 ▓ Transfer
      w1 Ch7         w2 Ch5
   Y: Lin-Real    X: Log

Maximal
  1     208Hz   96.8055k
  2     171Hz   96.4092k
  3     203Hz   96.2177k
  4     212Hz   95.4919k
```

Normal display
X axis: Log
Y axis: Lin-Real



```
No.2 ▓ Transfer
      w1 Ch7         w2 Ch5
   Y: Lin-Imag    X: Log

Maximal
  1      94Hz   137.596k
  2      97Hz   135.234k
  3      91Hz   134.125k
  4      89Hz   132.722k
```

Normal display
X axis: Log
Y axis: Lin-Imag



```
No.2 ▓ Transfer
      w1 Ch7         w2 Ch5
   Y: Lin-Mag     X: Linear
```

Nyquist display

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:

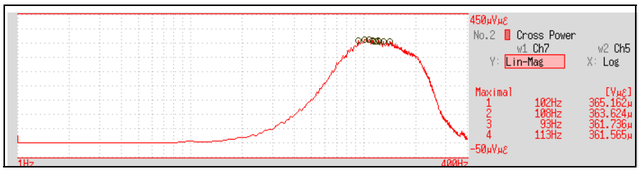
To inspect common frequency components of two signals

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	**Linear**	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
	Nyquist display	Displays the real-number component of the input-output ratio linearly.
Y axis	**Lin-Mag**	Displays the squared value of amplitude contents of analysis data linearly.
	Log-Mag(logarithm)	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.
	Nyquist display	Displays the imaginary component of analysis data linearly.

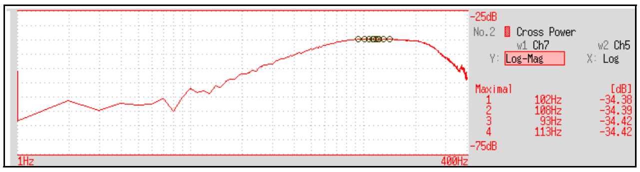
* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V^2)

Waveform Example



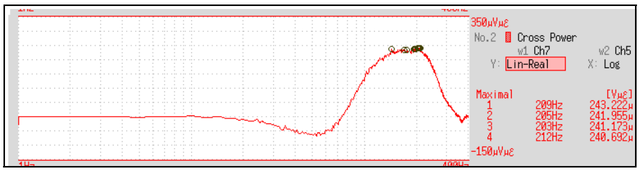
```
No.2 Cross Power
     w1 Ch7          w2 Ch5
  Y: Lin-Mag         X: Log

Maximal                 [Vμε]
  1          102Hz   365.162μ
  2          108Hz   363.624μ
  3           93Hz   361.736μ
  4          113Hz   361.565μ
```

Normal display
X axis: Log
Y axis: Lin-Mag



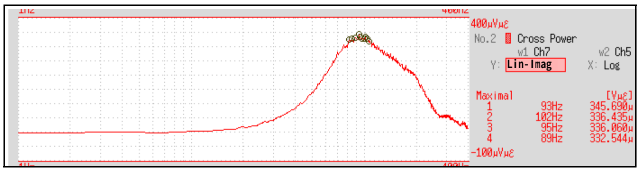
```
No.2 Cross Power
     w1 Ch7          w2 Ch5
  Y: Log-Mag         X: Log

Maximal                  [dB]
  1          102Hz     -34.38
  2          108Hz     -34.39
  3           93Hz     -34.42
  4          113Hz     -34.42
```

Normal display
X axis: Log
Y axis: Log-Mag



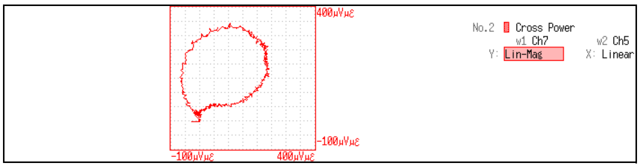
```
No.2 Cross Power
     w1 Ch7          w2 Ch5
  Y: Lin-Real        X: Log

Maximal                 [Vμε]
  1          209Hz   243.222μ
  2          205Hz   241.955μ
  3          203Hz   241.173μ
  4          212Hz   240.692μ
```

Normal display
X axis: Log
Y axis: Lin-Real



```
No.2 Cross Power
     w1 Ch7          w2 Ch5
  Y: Lin-Imag        X: Log

Maximal                 [Vμε]
  1           93Hz   345.690μ
  2          102Hz   336.435μ
  3           95Hz   336.060μ
  4           89Hz   332.544μ
```

Normal display
X axis: Log
Y axis: Lin-Imag



```
No.2 Cross Power
     w1 Ch7          w2 Ch5
  Y: Lin-Mag         X: Linear
```

Nyquist display

Impulse Response

The transfer characteristic of a system is obtained as a time-domain waveform.
Utilizing both output and input signals of the measurement system, a unit impulse is applied to the system and the corresponding response waveform is obtained.

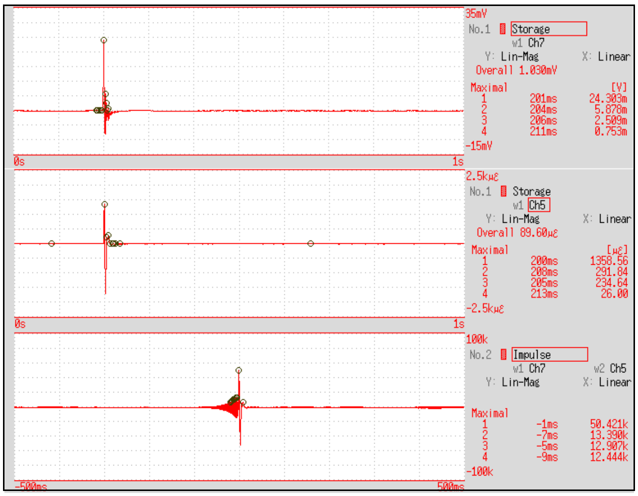
Main uses:

To inspect circuit time constants

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254), "Linear Time-Invariant Systems"(⇒ p.A16)

Axis	Display Type	Description
X axis	**Linear**	Time display The center (*t* = 0) is the reference. To the right is lag time (+*t*), and to the left is lead time (-*t*)
Y axis	**Lin-Mag**	This value is the transfer function provided by inverse Fourier transformation.

Waveform Example



Normal display
X axis: Linear
Y axis: Lin-Mag

Input signal 1

Input signal 2

Impulse response

Coherence Function

This function gives a measure of the correlation (coherence) between input and output signals. Values obtained are between 0 and 1.

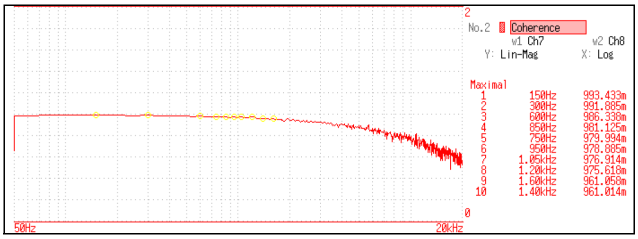
Main uses:

- To evaluate transfer functions
- In a system with multiple inputs, to inspect the effect of each input on the output

See: "13.9.2 Analysis Mode Functions" (⇒ p.254)

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



No.2 Coherence
w1 Ch7 w2 Ch8
Y: Lin-Mag X: Log

Maximal

1	150Hz	993.433m
2	300Hz	991.885m
3	600Hz	986.338m
4	850Hz	981.125m
5	750Hz	979.994m
6	950Hz	978.885m
7	1.05kHz	976.914m
8	1.20kHz	975.618m
9	1.60kHz	961.058m
10	1.40kHz	961.014m

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 (analysis is not available with time-domain averaging).
- The coherence function has two general definition formulas. For the definition formulas, see"13.9.2 Analysis Mode Functions" (⇒ p.254).

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 (0º).
- To inspect the phase difference between channels 1 and 2.

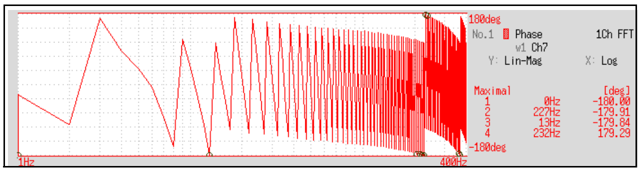
See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

1 Ch FFT: Displays the phase of the signal on channel 1. Displays the phase of a cosine waveform as a reference (0º). 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.

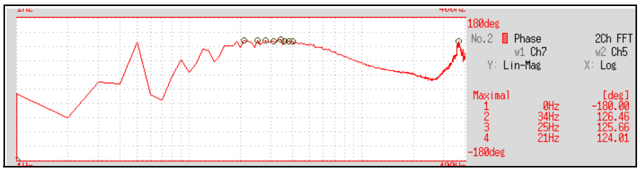
Axis	Display Type	Description
X axis	**Linear**	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	**Lin-Mag**	Analysis values are displayed linearly.

Waveform Example



```
No.1 ▓ Phase        1Ch FFT
     w1 Ch7
   Y: Lin-Mag       X: Log

 Maximal             [deg]
  1         0Hz    -180.00
  2       227Hz    -179.91
  3        13Hz    -179.84
  4       232Hz     179.29
```

1chFFT
X axis: Log
Y axis: Lin-Mag



```
No.2 ▓ Phase        2Ch FFT
     w1 Ch7          w2 Ch5
   Y: Lin-Mag       X: Log

 Maximal             [deg]
  1         0Hz    -180.00
  2        34Hz     126.46
  3        25Hz     125.66
  4        21Hz     124.01
```

2chFFT
X axis: Log
Y axis: Lin-Mag

■ Emphasizing only a Specific Portion (Highlighted Display)

A specific portion of a phase spectrum can be emphasized and displayed.

See: "13.3.8 Emphasizing Analysis Results (phase spectra only)" (⇒ p.219)

Auto Correlation Function

Shows the correlation of two points on the input signal at time differential *t*.

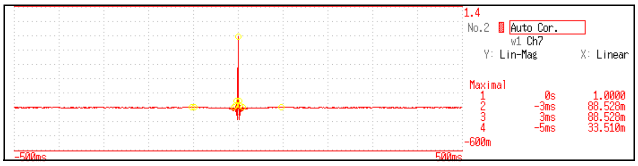
Main uses:

- To detect periodicy in irregular signals (improving and detecting SNR)
- To inspect periodic components in a noisy waveform.

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	**Linear**	Time display The center (*t* = 0) is the reference. To the right is lag time (+*t*), and to the left is lead time (-*t*)
Y axis	**Lin-Mag**	+1 to -1 (dimensionless units) The closest correlation at time differential *t* is +1, and the least correlation is 0. -1 indicates completely reversed polarity. Because of the characteristics of the function, *t* = 0 becomes +1.

Waveform Example



X axis: Linear
Y axis: Lin-Mag

NOTE This instrument provides a circular auto-correlation function. Analysis results are normalized to the maximum value.

Cross-Correlation Function

Using two input signals, shows the correlation of two points on the input signal at time differential *t*. Output is displayed as a function of differential time *t*.

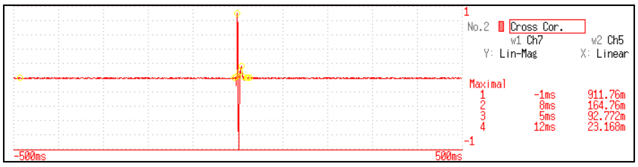
Main uses:

- To determine the phase shift of two signals per unit of time
- To determine the speed and distance of time lag between two signals

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254)

Axis	Display Type	Description
X axis	**Linear**	Time display The center (*t* = 0) is the reference. To the right is lag time (+*t*), and to the left is lead time (-*t*)
Y axis	**Lin-Mag**	+1 to -1 is displayed in dimensionless units. At time differential *t*, this value is +1 when the correlation of input and output signals is the closest, and 0 when correlation is the least. -1 indicates completely reversed polarity.

Waveform Example



Maximal

1	-1ms	911.76m
2	8ms	164.76m
3	5ms	92.772m
4	12ms	23.168m

X axis: Linear
Y axis: Lin-Mag

NOTE This instrument provides a circular cross-correlation function.
Analysis results are normalized to the maximum value.

1/1 and 1/3 Octave Analysis

Analyze spectrums such as noise using fixed rate spectrum filters of 1/1 octave band or 1/3 octave band.

Main uses:

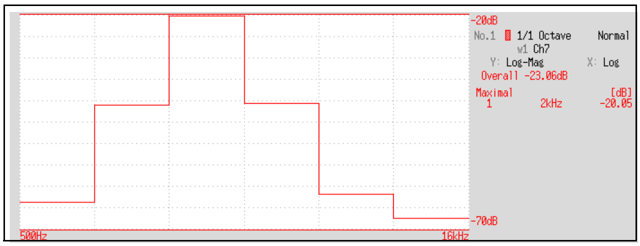
To analyze noise frequency

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.254), "Octave Filter Characteristics"(⇒ p.A26)

Axis	Display Type	Description
X axis	**Log**	Displays the center frequency of each band.
Y axis	**Lin-Mag**	Octave analysis values are displayed linearly.
	Log-Mag	Octave analysis values are displayed as dB values. (0 dB reference value: 1eu)*

* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

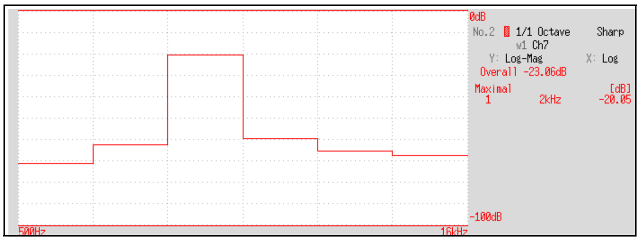
Waveform Example



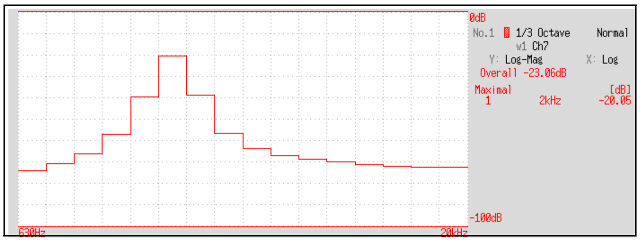
Overall -23.06dB

Maximal		[dB]
1	2kHz	-20.05

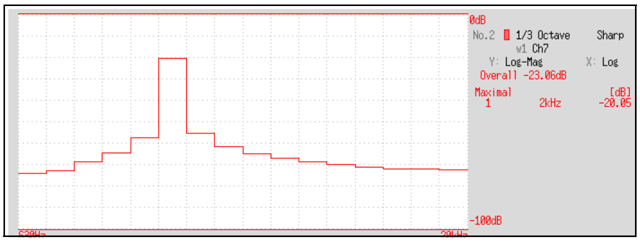
1/1 Octave
X axis: Log
Y axis: Log-Mag
Filter: Normal



1/1 Octave
X axis: Log
Y axis: Log-Mag
Filter: Sharp



1/3 Octave
X axis: Log
Y axis: Log-Mag
Filter: Normal



1/3 Octave
X axis: Log
Y axis: Log-Mag
Filter: Sharp

NOTE Not available with external sampling enabled.

■ Octave Analysis

Octave analysis consists of frequency analysis of the signal passed through a constant-width band-pass filter. The power spectrum displays the power level in each subband after dividing the spectrum into fixed-width segments (subbands), while octave analysis scales the spectrum logarithmically and displays each octave (subband) as a bar graph.

The center frequency of the octave bands and filter characteristics are determined according to IEC61260 standards. With this instrument, 1/1- and 1/3-octave analyses are calculated using power spectrum Analysis results.
1/1 Octave Analysis: 6 subbands
1/3 Octave Analysis: 16 subbands

The octave analysis results of this unit are displayed based on the oscillation level as a reference. Therefore, when only sine waves are input, the value doubles (3.01 dB) versus the overall value. To directly read by energy base, adjust the level by the setting scaling in advance.
See: "8.5 Converting Input Values (Scaling Function)" (⇒ p.128)

Measurable Ranges with Octave Analysis

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1μ	2μ	5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1.2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3.33	2	1.66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1.33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
-8	-24	4m																										●
	-23	5m																										○
-7	-22	6.3m																										○
	-21	8m																									●	● ○
	-20	10m																									○	○
-6	-19	12.5m																								○	○	○
	-18	16m																							●	● ○	● ○	● ○
	-17	20m																							○	○	○	○
-5	-16	25m																						○	○	○	○	○
	-15	31.5m																					●	● ○	● ○	● ○	● ○	● ○
	-14	40m																					○	○	○	○	○	○
-4	-13	50m																					○	○	○	○	○	○
	-12	63m																					● ○	● ○	● ○	● ○	● ○	● ○
	-11	80m																					○	○	○	○	○	○
-3	-10	100m																					○	○	○	○	○	○
	-9	125m																				● ○	● ○	● ○	● ○	● ○	● ○	● ○
	-8	160m																				○	○	○	○	○	○	○
-2	-7	200m																				○	○	○	○	○	○	
	-6	250m																			● ○	● ○	● ○	● ○	● ○	● ○	● ○	
	-5	315m																			○	○	○	○	○	○	○	
-1	-4	400m																			○	○	○	○	○	○		
	-3	500m																		●	● ○	● ○	● ○	● ○	● ○	●		
	-2	630m																		○	○	○	○	○	○			
0	-1	800m																		○	○	○	○	○				
	0	1																	●	● ○	● ○	● ○	● ○	●				
	1	1.25																	○	○	○	○	○					
1	2	1.6																	○	○	○	○						
	3	2																●	● ○	● ○	● ○	● ○						
	4	2.5																○	○	○	○	○						
2	5	3.15																○	○	○	○	○						
	6	4																● ○	● ○	● ○	● ○	● ○						
	7	5																○	○	○	○							
3	8	6.3															○	○	○	○	○							
	9	8															● ○	● ○	● ○	● ○	● ○							
	10	10															○	○	○	○								
4	11	12.5														○	○	○	○	○								
	12	16														● ○	● ○	● ○	● ○	● ○								
	13	20														○	○	○	○	○								
5	14	25													○	○	○	○	○									
	15	31.5													● ○	● ○	● ○	● ○	● ○									
	16	40													○	○	○	○	○									
6	17	50													○	○	○	○										
	18	63												● ○	● ○	● ○	● ○	● ○										
	19	80												○	○	○	○	○										

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1μ	2μ	5μ	10μ	20μ	50μ	100μ	200μ	500μ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1.2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3.33	2	1.66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1.33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
7	20	100												○	○	○	○											
	21	125											● ○	● ○	● ○	● ○	● ○											
	22	160											○	○	○	○	○											
8	23	200											○	○	○	○	○											
	24	250										● ○	● ○	● ○	● ○	● ○	●											
	25	315										○	○	○	○	○												
9	26	400										○	○	○	○	○												
	27	500									●	● ○	● ○	● ○	● ○	●												
	28	630									○	○	○	○	○													
10	29	800									○	○	○	○	○													
	30	1k								●	● ○	● ○	● ○	● ○	●													
	31	1.25k								○	○	○	○	○														
11	32	1.6k								○	○	○	○	○														
	33	2k							●	● ○	● ○	● ○	● ○	● ○														
	34	2.5k							○	○	○	○	○															
12	35	3.15k							○	○	○	○	○															
	36	4k							● ○	● ○	● ○	● ○	● ○															
	37	5k							○	○	○	○																
13	38	6.3k						○	○	○	○	○																
	39	8k						● ○	● ○	● ○	● ○	● ○																
	40	10k						○	○	○	○																	
14	41	12.5k					○	○	○	○	○																	
	42	16k					● ○	● ○	● ○	● ○	● ○																	
	43	20k					○	○	○	○	○																	
15	44	25k				○	○	○	○	○																		
	45	31.5k				● ○	● ○	● ○	● ○	● ○																		
	46	40k				○	○	○	○	○																		
16	47	50k				○	○	○	○																			
	48	63k			● ○	● ○	● ○	● ○	● ○																			
	49	80k			○	○	○	○	○																			
17	50	100k			○	○	○	○																				
	51	125k		● ○	● ○	● ○	● ○	● ○																				
	52	160k		○	○	○	○	○																				
18	53	200k		○	○	○	○	○																				
	54	250k	● ○	● ○	● ○	● ○	● ○	●																				
	55	315k	○	○	○	○	○																					
19	56	400k	○	○	○	○	○																					
	57	500k	● ○	● ○	● ○	● ○	●																					
	58	630k	○	○	○	○																						
20	59	800k	○	○	○	○																						
	60	1M	● ○	● ○	● ○	●																						
	61	1.25M	○	○	○																							
21	62	1.6M	○	○	○																							
	63	2M	● ○	● ○	● ○																							
	64	2.5M	○	○																								

(●: 1/1 OCT, ○: 1/3 OCT)

Timebase			5µ	10µ	20µ	50µ	100µ	200µ	500µ	1m	2m	5m	10m	20m	50m	100m	200m	500m	1	2	5	10	30	50	60	100	120	300
Period [s]			50n	100n	200n	500n	1µ	2µ	5µ	10µ	20µ	50µ	100µ	200µ	500µ	1m	2m	5m	10m	20m	50m	100m	300m	500m	600m	1	1. 2	3
Sampling frequency [Hz]			20M	10M	5M	2M	1M	500k	200k	100k	50k	20k	10k	5k	2k	1k	500	200	100	50	20	10	3. 33	2	1. 66	1	833m	333m
Frequency range [Hz]			8M	4M	2M	800k	400k	200k	80k	40k	20k	8k	4k	2k	800	400	200	80	40	20	8	4	1. 33	800m	667m	400m	333m	133m
1/1 OCT	1/3 OCT	Center frequency [Hz]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
22	65	3. 15M	○	○																								
	66	4M	● ○	● ○																								
	67	5M	○																									
23	68	6. 3M	○																									
	69	8M	● ○																									
	70	10M																										
24	71	12. 5M																										

13.9.2 Analysis Mode Functions

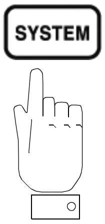
Analysis Mode	Internal analysis formula (linear, real, imag **[imaginary]**, log **[logarithm]**)
OFF	No analysis.
Storage Waveform	A waveform obtained by applying the window function to a time-domain waveform.
Histogram	Counts amplitude data.
Linear Spectrum	$X(k) = \sum_{n=0}^{N-1} x(n)W^{kn} \quad F(k) = CX(k) \qquad C = \begin{cases} 1/N(DC) \\ 2/N(AC) \end{cases}$ $linear = \lvert F(k) \rvert \quad real = \mathrm{Re}\{F(k)\} \qquad imag = \mathrm{Im}\{F(k)\} \quad \log = 20\log\lvert F(k)$
RMS Spectrum	$F'(k) = C'F(k) \qquad C' = \begin{cases} 1 \quad (DC) \\ 1/\sqrt{2}(AC) \end{cases}$ $linear = \lvert F'(k) \rvert \quad real = \mathrm{Re}\{F'(k)\} \qquad imag = \mathrm{Im}\{F'(k)\} \quad \log = 20\log\lvert F'(k)$
Power Spectrum	$P(k) = a\lvert F(k) \rvert^2 \qquad a = \begin{cases} 1 \quad (DC) \\ 1/2(AC) \end{cases}$ $linear = P(k) \quad \log = 10\log\lvert P(k)$
Power Spectrum Density	$P'(k) = P(k)/\delta f$ $\qquad \delta f$: Frequency resolution $linear = P'(k) \quad \log = 10\log\lvert P'(k)$
LPC analysis(Power Spectrum Density)	(Abbr.) Spectrum approximation from Linear Predictive Coding. **See:** "Linear Predictive Coding (LPC)"(⇒ p.A27)
Transfer Function	$H(k) = Y(k)/X(k)$ $linear = \lvert H(k) \rvert \quad real = \mathrm{Re}\{H(k)\} \qquad imag = \mathrm{Im}\{H(k)\} \quad \log = 20\log\lvert H(k)$
Cross Power Spectrum	$S_{yx}(k) = X^*(k)Y(k)$: Cross Spectrum $X_{power}(k) = AS_{yx}(k) \qquad A = \begin{cases} 1/N^2 \\ 2/N^2 \end{cases}$ $linear = \lvert X_{power}(k) \rvert \quad real = \mathrm{Re}\{X_{power}(k)\}$ $mag = \mathrm{Im}\{X_{power}(k)\} \quad \log = 10\log\lvert X_{power}(k)$
Impulse Response	$h(n) = \frac{1}{N}\sum_{k=0}^{N-1}\frac{Y(k)}{X(k)}W^{-kn}$
Coherence Function	$coh(k) = \sqrt{\frac{S_{yx}(k)S_{yx}^*(k)}{S_{xx}(k)S_{yy}(k)}}$
Phase Spectrum	$\theta(k) = 180/\pi \times \tan^{-1}(\mathrm{Im}(F'(k))/\mathrm{Re}(F'(k))$ $\theta(k) = 180/\pi \times \tan^{-1}(\mathrm{Im}(S_{yx}(k))/\mathrm{Re}(S_{yx}(k))$
Auto-correlation Function	$R_{xx}(n) = \frac{1}{N}\sum_{k=0}^{N-1}\lvert X(k) \rvert^2 W^{-kn}$ $\qquad$ (recursive convolution)
Cross-correlation Function	$R_{yx}(n) = \frac{1}{N}\sum_{k=0}^{N-1} S_{yx}(k)W^{-kn}$ $\qquad$ (recursive convolution)
1/1 Ovtave Analysis	(Abbr.)
1/3 Ovtave Analysis	(Abbr.)

System Environment Settings

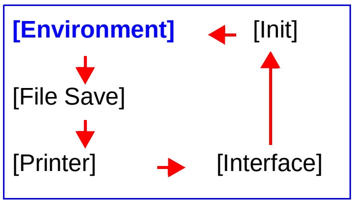
Chapter 14

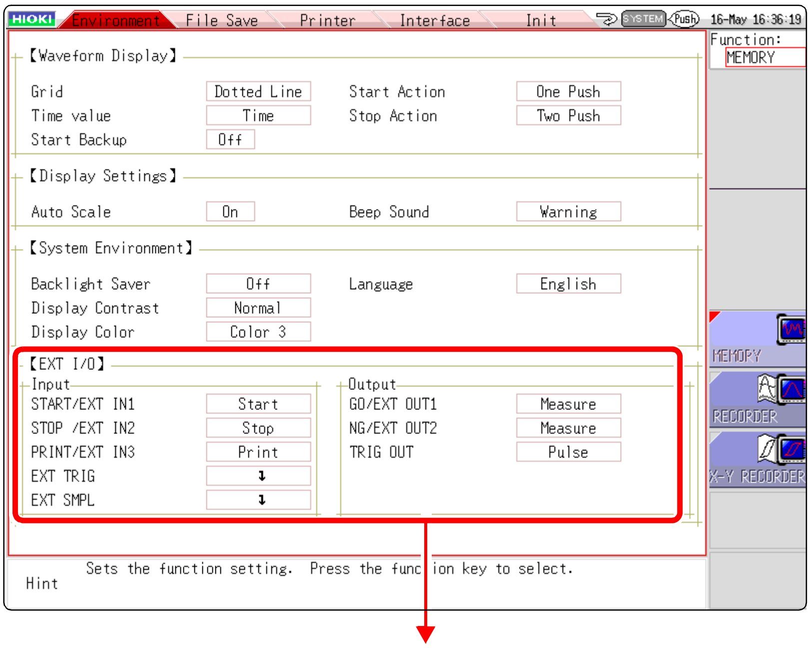
Use the System screen **- [Environment]** sheet to make system-related settings.

Opening the **[Environment]** sheet



Pressing this key repeatedly displays the various sheets.





Function: MEMORY

【Waveform Display】

Grid	Dotted Line	Start Action	One Push
Time value	Time	Stop Action	Two Push
Start Backup	Off		

【Display Settings】

Auto Scale	On	Beep Sound	Warning

【System Environment】

Backlight Saver	Off	Language	English
Display Contrast	Normal		
Display Color	Color 3		

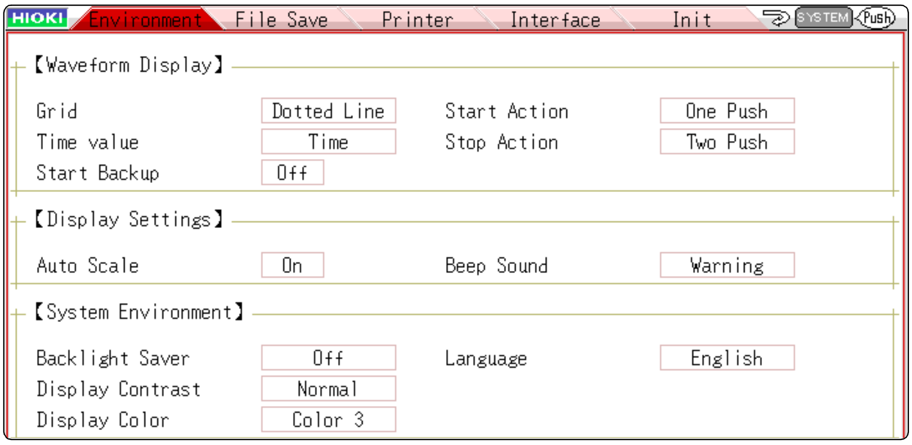
【EXT I/O】

Input		Output	
START/EXT IN1	Start	GO/EXT OUT1	Measure
STOP /EXT IN2	Stop	NG/EXT OUT2	Measure
PRINT/EXT IN3	Print	TRIG OUT	Pulse
EXT TRIG	↓		
EXT SMPL	↓		

Hint Sets the function setting. Press the function key to select.

See: "Chapter 16 External Control" (⇒ p.287)

Setting Descriptions



【Waveform Display】

Grid	Dotted Line	Start Action	One Push
Time value	Time	Stop Action	Two Push
Start Backup	Off		

【Display Settings】

Auto Scale	On	Beep Sound	Warning

【System Environment】

Backlight Saver	Off	Language	English
Display Contrast	Normal		
Display Color	Color 3		

Grid

Select the grid (graticule) type for the waveform screen.

Off	No grid displayed.
Dotted Line	Display a dotted-line grid. (default setting)
Solid Line	Display a solid-line grid.

Time Value

Display the time from the trigger point on the display.

Time	Display the time from the trigger point (fixed units). (default setting)
Time (60)	Display the time from the trigger point (sexagesimal (base-60) system).
div	Display the number of divisions (div) from the trigger point.
Date	Display time of waveform acquisition.
Sample Num	Display the number of data points from the trigger point.

- During external sampling, the number of points is fixed.
- These settings affect the values read at the A/B cursors.

Start Backup

Preserves measurement condition settings. If a power outage occurs while recording, it resumes automatically when power is restored. When triggering is enabled, the awaiting-trigger state is activated.

Off (default setting) / On

- Valid only during recording.
- This function does not start automatically when the instrument is turned on.

Backlight Saver

The screen blanks automatically after the specified period (minutes) with no key operation.
The screen reappears when any key is pressed.

Off	Disables the backlight saver function. (default setting) The screen remains visible all the time.
(Setting the time)	Setting range: 1 to 30 min (1 minutes)

- When the screen is blanked by the backlight saver, pressing a key only reactivates the backlight, and the normal key function is ignored. Press the key again for its normal operation.
- Using the backlight saver conserves energy, and extends the life of the backlight.

Display Contrast

Selects one of three backlight brightness levels.

Light / Normal / Dark

Display Color

Screen background and character colors on the Waveform screen can be set as desired. Select **[Color Edit]** change the **[R]** (red), **[G]** (green) and **[B]** (blue) values of each item to change its color. (⇒ p.258)

Color 1 / Color 2 / Color 3 / Color Edit

Beep Sound

This function audibly indicates warnings and operating conditions by beep sounds.

Off	Beep sounds are disabled.
Warning	Beeps sound for error messages (warning displays) and upon NG (fail) judgments. (default setting)
Warn+Act	In addition to the warning beeps above, beeps sound to indicate start, trigger, stop and auto-save-finish.

Language

Selects the display language.

English (default setting)/ Japanese / Korean/ Chinese

Auto Scale

Variable values are automatically changed according to changes in scaling and voltage range.

See: "8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)

Off / On (default setting)

Start Action

To prevent operating mistakes from unintentionally starting measurement, the **START** key operation method can be changed. This setting does not affect external control terminal functions.

One Push	Measurement starts by pressing once. (default setting)
Two Push	Measurement starts by pressing twice.
Hold 2s*	Measurement starts by pressing for two seconds.

* When the **START** key is pressed, "Hold START key down." appears. After pressing for two seconds, the message disappears and measurement starts.

Stop Action

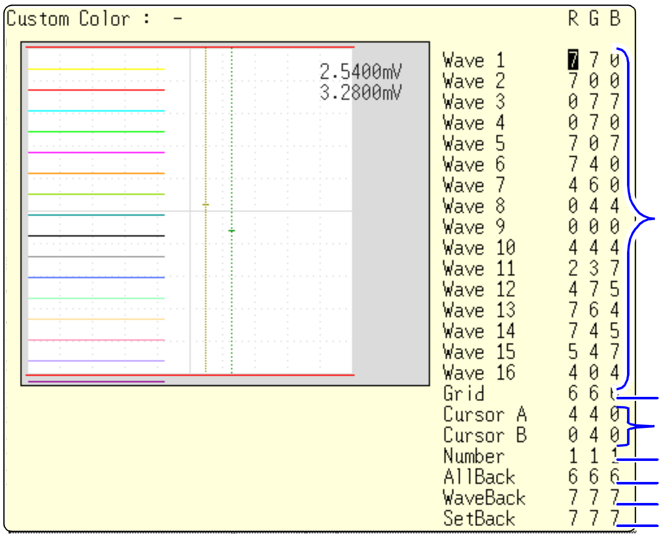
Normally, pressing the **STOP** key once causes measurement to stop after the specified recording length is completed, and pressing it twice stops measurement immediately. However, this setting is provided to allow a single press to stop measurement.

Two Push	Press the key twice to stop measurement. (default setting)
One Push	Press the key once to stop measurement.

Additional Description

Selecting a Screen Color	Select **[Color Edit]** to display the **[Custom Color]** screen. Change the **[R]** (red), **[G]** (green) and **[B]** (blue) values of each item to change its color. See: "8.1.3 Alphanumeric Input" (⇒ p.121)

[Custom Color] screen



Custom Color : -

	R	G	B
Wave 1	7	7	0
Wave 2	7	0	0
Wave 3	0	7	7
Wave 4	0	7	0
Wave 5	7	0	7
Wave 6	7	4	0
Wave 7	4	6	0
Wave 8	0	4	4
Wave 9	0	0	0
Wave 10	4	4	4
Wave 11	2	3	7
Wave 12	4	7	5
Wave 13	7	6	4
Wave 14	7	4	5
Wave 15	5	4	7
Wave 16	4	0	4
Grid	6	6	6
Cursor A	4	4	0
Cursor B	0	4	0
Number	1	1	1
AllBack	6	6	6
WaveBack	7	7	7
SetBack	7	7	7

Color setting for each waveform

Grid (graticule) color

Colors of cursor A and B lines

Color of numerical values

Background color

Background color of the Waveform screen

Background color of the setting screen

Select

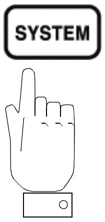
Done	Applies the settings.
Reset	Reverts to the default settings.

Connection to a Computer

Chapter 15

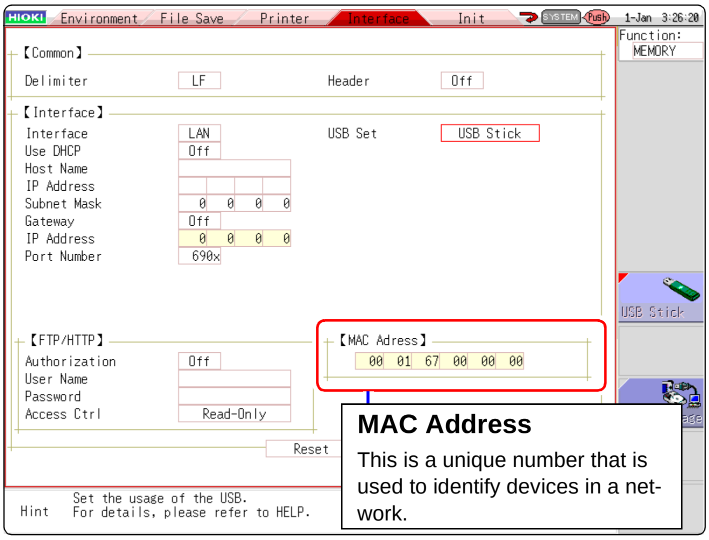
This instrument is equipped with an Ethernet 100BASE-TX interface for LAN communications. You can control the instrument from PCs and other devices by connecting it to a network with 10BASE-T or 100BASE-TX cable (maximum length 100 m). It is also possible to directly connect the instrument to a computer via USB.

Opening the [Interface] sheet



Pressing this key repeatedly displays the various sheets.

[Environment] ← [Init]
↓ ↑
[File Save]
↓
[Printer] → **[Interface]**



Function: MEMORY

【Common】

Delimiter LF Header Off

【Interface】

Interface LAN USB Set USB Stick
Use DHCP Off
Host Name
IP Address
Subnet Mask 0 0 0 0
Gateway Off
IP Address 0 0 0 0
Port Number 690x

【FTP/HTTP】

Authorization Off
User Name
Password
Access Ctrl Read-Only

【MAC Adress】

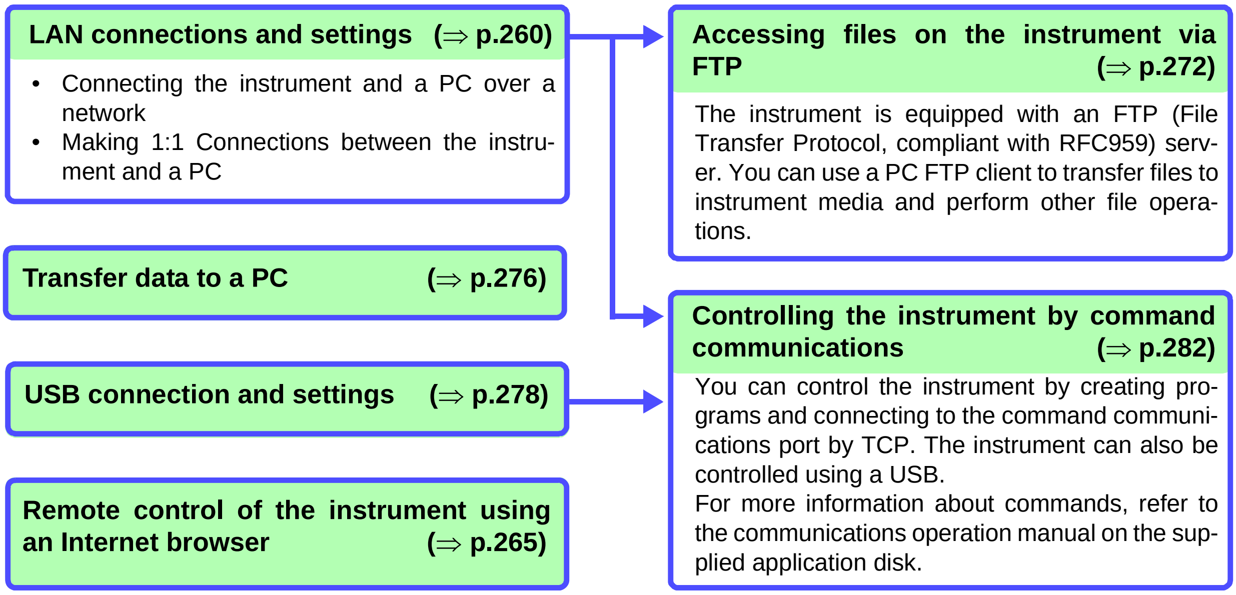
00 01 67 00 00 00

Hint Set the usage of the USB.
For details, please refer to HELP.

MAC Address

This is a unique number that is used to identify devices in a network.

Operations available from the **[Interface]** sheet



LAN connections and settings (⇒ p.260)

- Connecting the instrument and a PC over a network
- Making 1:1 Connections between the instrument and a PC

Transfer data to a PC (⇒ p.276)

USB connection and settings (⇒ p.278)

Remote control of the instrument using an Internet browser (⇒ p.265)

Accessing files on the instrument via FTP (⇒ p.272)

The instrument is equipped with an FTP (File Transfer Protocol, compliant with RFC959) server. You can use a PC FTP client to transfer files to instrument media and perform other file operations.

Controlling the instrument by command communications (⇒ p.282)

You can control the instrument by creating programs and connecting to the command communications port by TCP. The instrument can also be controlled using a USB.
For more information about commands, refer to the communications operation manual on the supplied application disk.

15.1 LAN Settings and Connection (Before Using FTP/ Internet Browser/Command Communications)

The required settings are different, depending on whether the instrument is to be connected to an existing network or directly to a PC.

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.

15.1.1 Making LAN Settings at the Instrument

Things to Check Before Making Settings

The required settings are different, depending on whether the instrument is to be connected to an existing network or whether a new network consisting only of the instrument and one computer is to be configured.

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**
  Host name (up to 12 characters): ____________
  IP address:............................... ___.___.___.___
  Subnet mask:............................ ___.___.___.___
  (When DHCP is used, the IP address and subnet mask are not required)
- **Gateway**
  Whether to use a gateway:........ Yes/No
  IP address (when used): ___.___.___.___
  (When DHCP is used, the gateway address is obtained from the DHCP server, so it does not need to be specified here)
- **The TCP/IP port number to use**: ___X (default 880x)
  (Specify the most significant 3 digits of the 4-digit number. The least significant digit (0 to 9) is reserved for use by the instrument. Specify when the default 8800 to 8809 cannot be used.)

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.

(Settings example)

IP address
PC: 192.168.0.1
First recorder: 192.168.0.2
Second recorder: 192.168.0.3 and so on, in sequence.
↓ ↓
Host name .... Any name (However, must be unique)
Subnet mask....................... 255.255.255.0
Gateway............................. Off
DHCP .... Off
Port number 880X

Setting Items

Interface	Select LAN or USB.
Use DHCP* *: Short for "Dynamic Host Configuration Protocol"	DHCP is a protocol that allows devices to automatically obtain and set their own IP addresses. If you enable DHCP and there is a DHCP server operating in the same network, the instrument's IP address, subnet mask, and gateway can be obtained and set automatically.
Host Name	This is a name that identifies the instrument on the network. Assign a host name that is different from the names of all other devices. This instrument does not support dynamic DNS, the name that you set is not registered with a DNS server.
IP Address	This is an address that identifies an individual device on a network. Assign an address that is different from the addresses of all other devices. If DHCP is enabled, the address is assigned automatically by the DHCP server.
Subnet Mask	This is a setting used to divide an IP address shown to the network into a network address and a host address. Use the same subnet mask for all devices in the same network. If DHCP is enabled, the subnet mask is assigned automatically by the DHCP server.
Gateway IP Address	**For network connections:** When your PC (or the communicating device) is on another network than this instrument, set this to **[On]** and specify the gateway device. When the PC is on the same network, this is usually set to the same address as the default gateway in the PC communications settings.

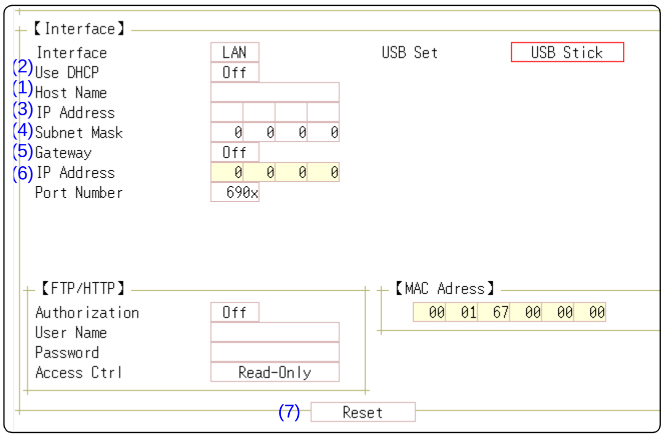
Authorization User Name and Password

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 "************".
Valid characters: Alphabetic characters and symbols (however, ":" (colon) cannot be used)

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.

LAN Setup Workflow

Press the **SYSTEM** key and bring up the Communications sheet. According to the intended use, make settings as outlined below.



【Interface】

Interface LAN USB Set USB Stick

(2) Use DHCP Off

(1) Host Name

(3) IP Address

(4) Subnet Mask 0 0 0 0

(5) Gateway Off

(6) IP Address 0 0 0 0

Port Number 690x

【FTP/HTTP】

Authorization Off

User Name

Password

Access Ctrl Read-Only

【MAC Adress】

00 01 67 00 00 00

(7) Reset

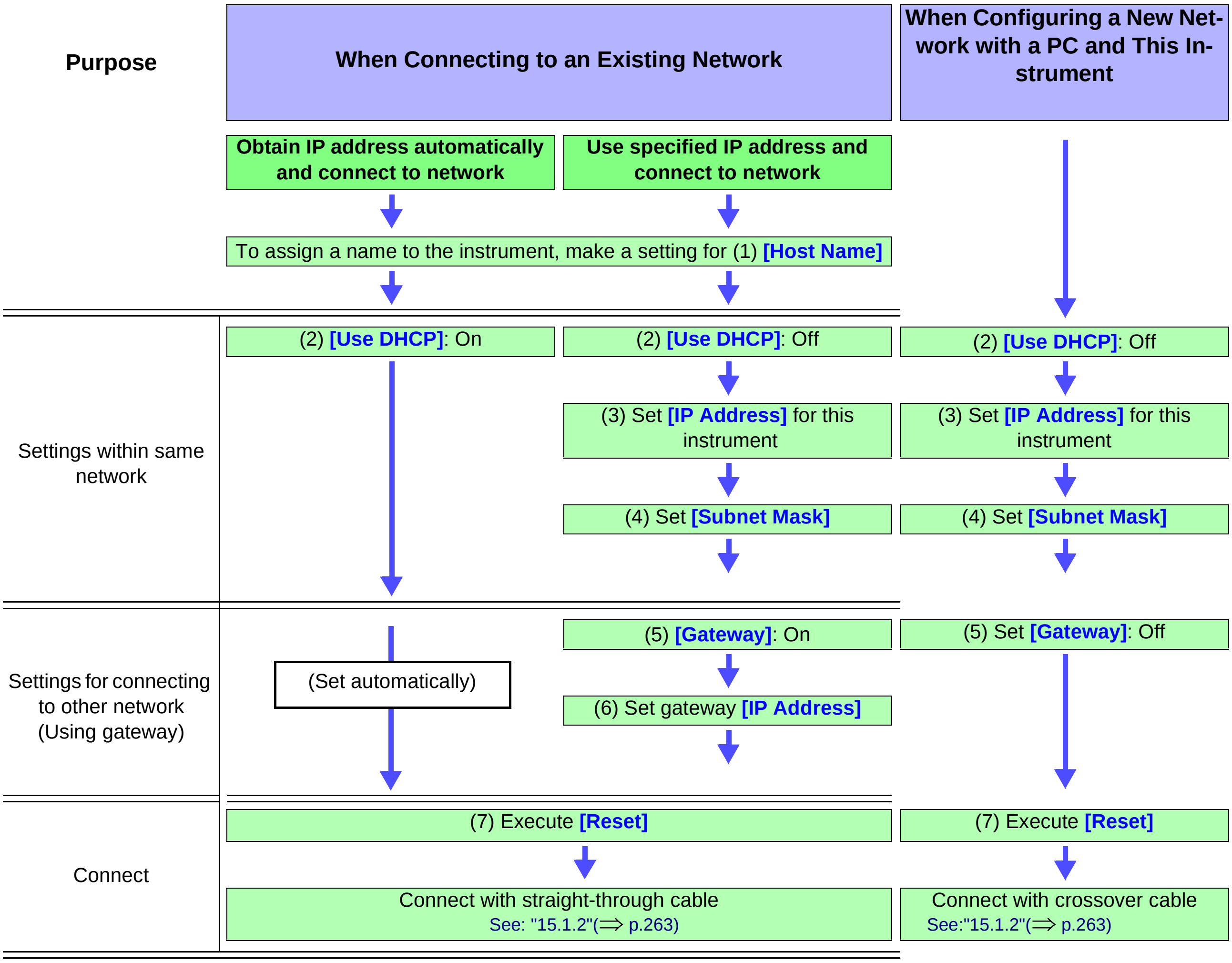
Use the **CURSOR** keys to move the settings cursor, and use the **F** keys to select a setting item.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)

For details on each setting, see "Setting Items" (⇒ p.261).

About the network

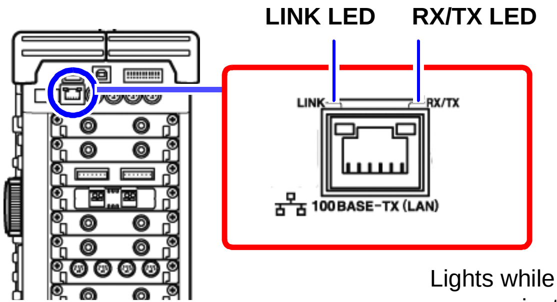
For IP address information and other details about the network you are using, contact your network administrator.



15.1.2 Connecting Instrument and PC With LAN Cable

Connect the instrument to a PC with a LAN cable as follows.

1. Plug the LAN cable (100BASE-TX compliant) into the 100BASE-TX connector on the right side of the instrument.



Flashes while data is being sent or received.

Lights while the instrument is capable of communications with a destination device.

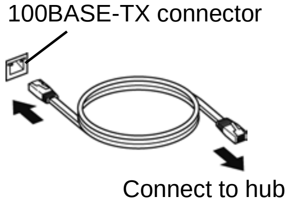
2. Connect the above LAN cable to the PC. There are two ways to do this.

1. Connecting the Instrument to a Network (Connecting the Instrument to a Hub)

You can monitor and control the instrument from a PC by connecting the instrument to a hub with LAN cable (100BASE-TX cable).

Connection cable: Use one of the following.

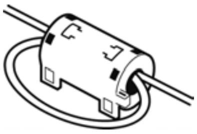
- 100BASE-TX straight-through cable (maximum length 100 m, commercially available)
  (10BASE-T cable may also be used for 10BASE communications)
- 9642 LAN Cable (option)



Connect the crossover adapter to the 100BASE-TX connector on the instrument.

NOTE

If there is a possibility of noise interference to other equipment in the vicinity, wind the LAN cable once around the supplied ferrite clamp-on choke (for LAN/USB cable), as shown in the illustration at right.



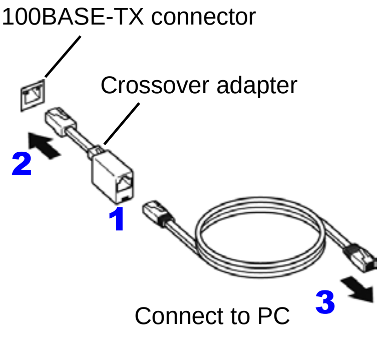
2. Making 1:1 Connections Between the Instrument and a PC (Connecting the Instrument to a PC)

You can monitor and control the instrument from a PC by connecting the instrument to the PC with LAN cable (100BASE-TX cable)

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)
- 9642 LAN Cable (option, supplied with crossover adapter)

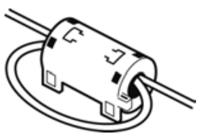
Connecting with the 9642 LAN Cable and crossover adapter (supplied)



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.

NOTE

If there is a possibility of noise interference to other equipment in the vicinity, wind the LAN cable once around the supplied ferrite clamp-on choke (for LAN cable), as shown in the illustration at right.



This completes the connection procedure.

Files on the instrument can now be accessed from the PC.

See: "15.2 Performing Remote Operations on the Instrument (Use an Internet Browser)" (⇒ p.265)
"15.3 Accessing the Files on the Instrument From a Computer (Using FTP)" (⇒ p.272)
"15.7 Controlling the Instrument with Command Communications (LAN/USB)" (⇒ p.282)

15.2 Performing Remote Operations on the Instrument (Use an Internet Browser)

You can perform remote operations on the instrument from a PC by using an Internet browser.

NOTE

Attempting to control the instrument simultaneously from multiple computers may result in unintended operation. Use only one computer to perform remote operations.

To use an Internet browser, the instrument must be properly set up and connected via LAN cable to the PC. (⇒ **p.260), (**⇒ **p.263)**

Microsoft Internet Explorer Version 5 or later is recommended as the browser. Set the security level to "Medium". If **[REMOTE CONTROL]** and **[MEMORY DATA GET]** do not work, install JRE from the application disc. And invalidate the pop-up blok.

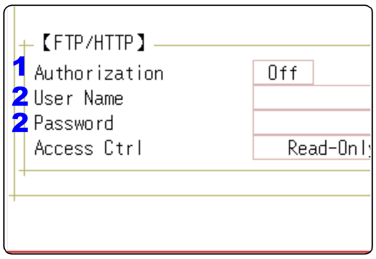
Installing JRE

1. When you insert the supplied application disc (CD-R) into the CD-ROM drive of the PC, the top page will automatically be displayed. If the page does not appear, open the file "index.htm" with your web browser.
2. Select the display language to use. Click on the **[English]** icon.
3. Click on the **[JRE installation]** icon.
4. Click on the **[Install]** icon. Then follow the prompts that appear to complete the installation.

15.2.1 Making HTTP Settings on the Instrument

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet



【FTP/HTTP】
1 Authorization Off
2 User Name
2 Password
Access Ctrl Read-Onl

1 Make authorization settings.

Move the cursor to the **[Authorization]** item.

Select

Off	Use the Web server without authorization. (default setting)
On	Use the Web server with authorization.

2 (When **[On]** is selected)
Set the user name and password for authentication.

The user name and password for authentication are used both for access via an Internet browser and FTP.

Move the cursor to the **[User Name]** and **[Password]** items and enter suitable information.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)
"Authorization User Name and Password" (⇒ p.261)

3 Apply the setting.

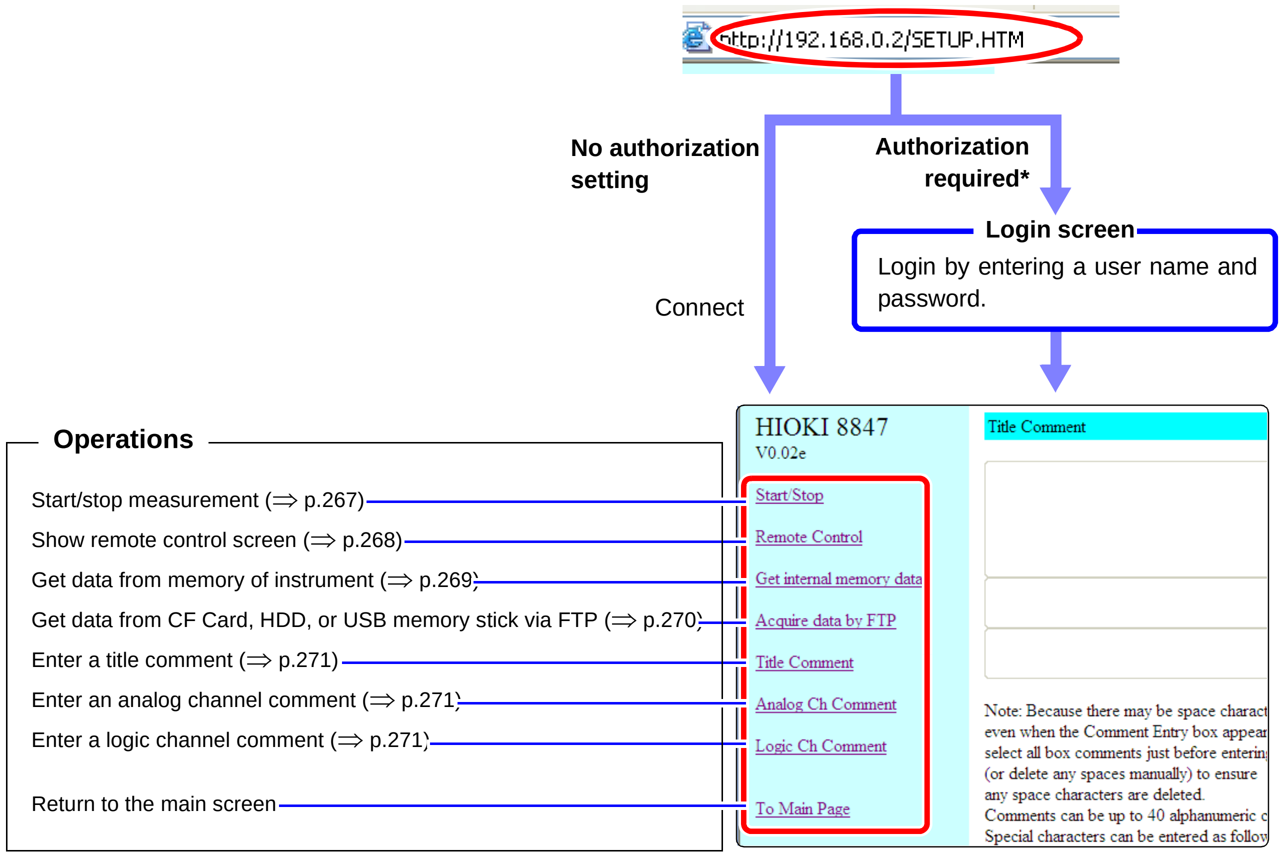
Move the cursor to the **[Reset]** item.
Select **[Reflect Set]**.
The indication "LAN was reconnected" appears at the bottom of the screen.

15.2.2 Connecting to the Instrument With an Internet Browser

The following example shows how to use the IE (Internet Explorer) browser on Windows XP.

Launch IE on the PC and enter "http://" plus the IP address of the instrument in the address bar.

If the IP address of the instrument is "192.168.0.2"



http://192.168.0.2/SETUP.HTM

Login by entering a user name and password.

HIOKI 8847
V0.02e

- Start/Stop
- Remote Control
- Get internal memory data
- Acquire data by FTP
- Title Comment
- Analog Ch Comment
- Logic Ch Comment
- To Main Page

Title Comment

Note: Because there may be space charact
even when the Comment Entry box appear
select all box comments just before enterin
(or delete any spaces manually) to ensure
any space characters are deleted.
Comments can be up to 40 alphanumeric c
Special characters can be entered as follov

Operations

- Start/stop measurement (⇒ p.267)
- Show remote control screen (⇒ p.268)
- Get data from memory of instrument (⇒ p.269)
- Get data from CF Card, HDD, or USB memory stick via FTP (⇒ p.270)
- Enter a title comment (⇒ p.271)
- Enter an analog channel comment (⇒ p.271)
- Enter a logic channel comment (⇒ p.271)
- Return to the main screen

*: When user name and password for authentication were set via System screen - **[Interface]** sheet
See:"15.2.1 Making HTTP Settings on the Instrument" (⇒ p.265)

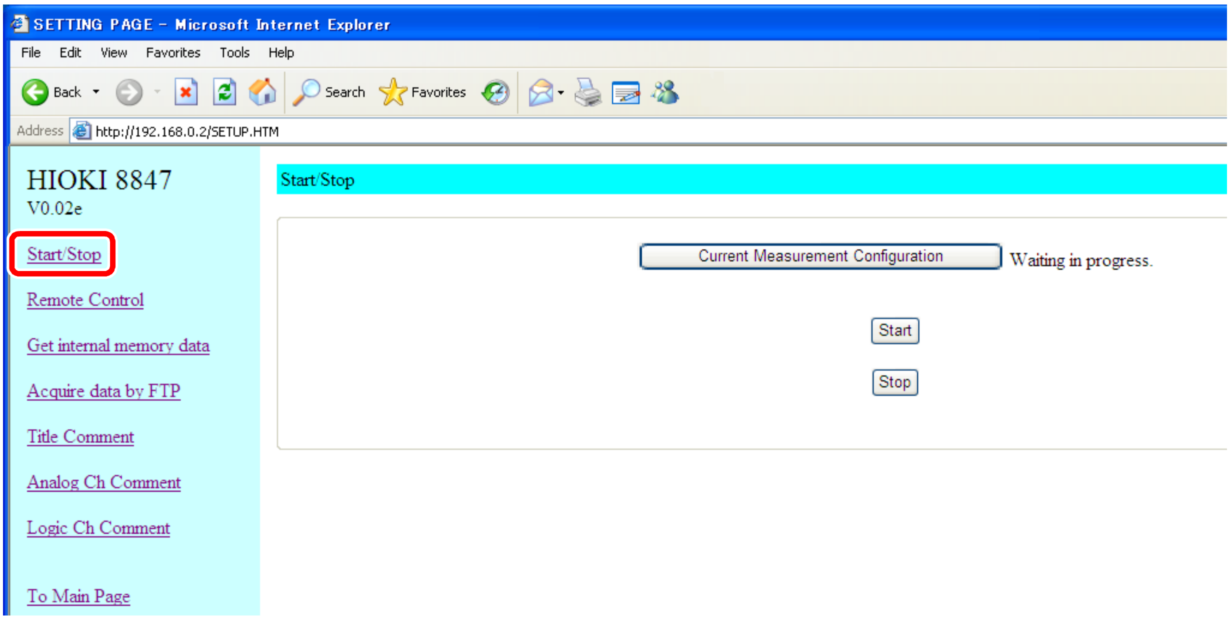
15.2.3 Operating the Instrument With an Internet Browser

Start/Stop Measurement

You can start and stop a measurement.

Measurement start/stop screen

To open the screen: Click **[Start/Stop]** on list of operations.



Waiting in progress.

Procedure

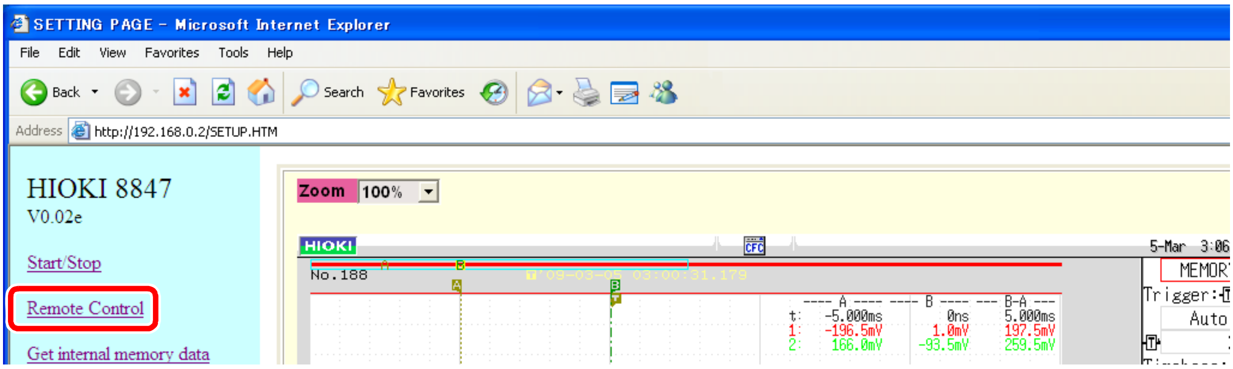
Click **[Start]** to start the measurement.
Click **[Stop]** to stop the measurement.
Click **[Current Measurement Configuration]** to bring up information about the current measurement configuration on the screen.

Remote Operation

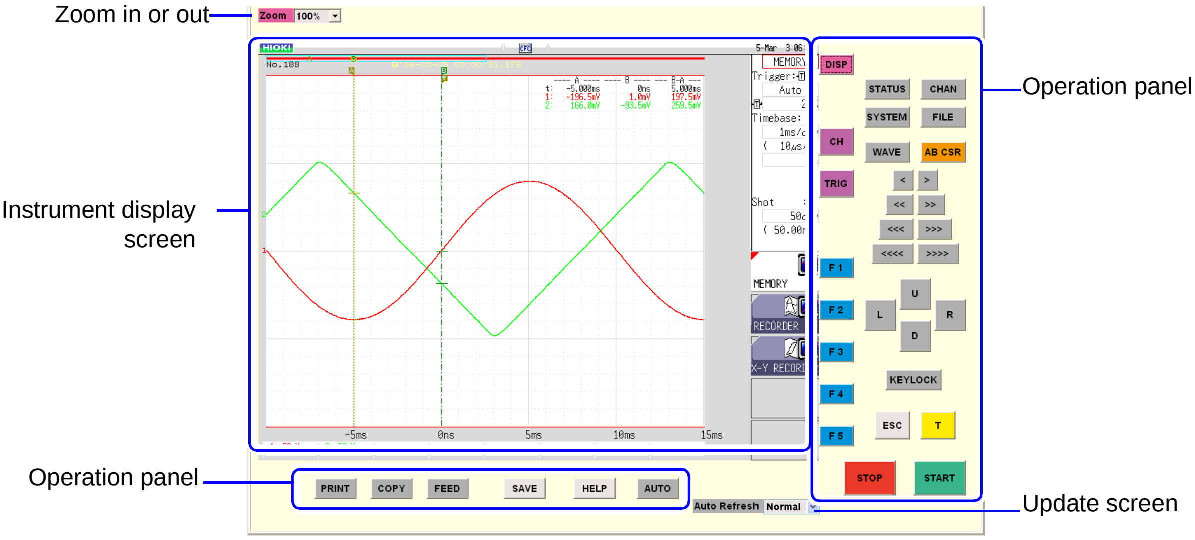
The instrument can be controlled from a remote location.

Remote Control Screen

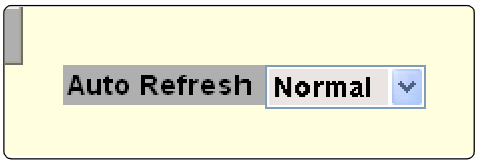
To open the screen: Click **[Remote Control]** on list of operations.



The remote control screen is divided into the instrument display section and operation panel.



When Auto Update is enabled, screen information is sent from the instrument to the PC in regular intervals to keep the display updated.



Set display update speed.

Available settings:
Normal / Slow / Very Slow

Basic Operations

When you click a button on the operation panel, the instrument performs the same action is if the corresponding key on the unit was pressed. However, simultaneously activating more than one button is not possible.
The keys and controls on the instrument are active also during remote operation.

NOTE

- Remote control may not be possible when JRE has not been installed. (⇒ p.265)
- The printing may be interrupted, if the printing has been made during the remote operation. Set display update speed to **[Slow]** or **[Very Slow]**.

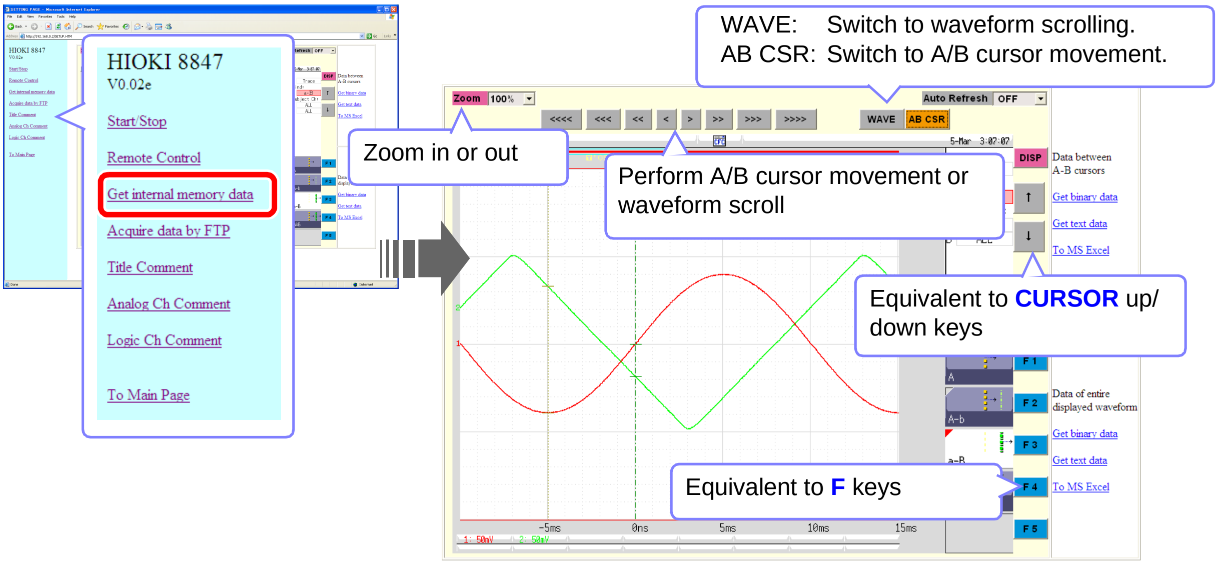
Downloading Memory Data From Instrument

You can download all data or data for a range specified by the A/B cursors. The data format can be binary, text, or Excel*.

*: Microsoft Excel

Memory Data Download Screen

To open the screen: Click **[Get internal memory data]** on list of operations



WAVE: Switch to waveform scrolling.
AB CSR: Switch to A/B cursor movement.

Zoom in or out

Perform A/B cursor movement or waveform scroll

Equivalent to **CURSOR** up/down keys

Equivalent to **F** keys

Procedure

Getting data for range specified by A/B cursors

1 Use the A/B cursors to specify the data range (by remote operation).

See: "Remote Operation" (⇒ p.268)
"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.102)

2 Select one of the following choices for **[Data between A-B cursors]**.

Select

Get binary data	Get binary data for range specified by A/B cursors.
Get text data	Get text data for range specified by A/B cursors.
To MS Excel	Get Excel data for range specified by A/B cursors. (Data can be opened with Microsoft Excel*)

Getting all data

Select one of the following choices for **[Data of entire displayed waveform]**.

Select

Get binary data	Get all data in binary format.
Get text data	Get all data in text format.
To MS Excel	Get all data in Excel format. (Data can be opened with Microsoft Excel)

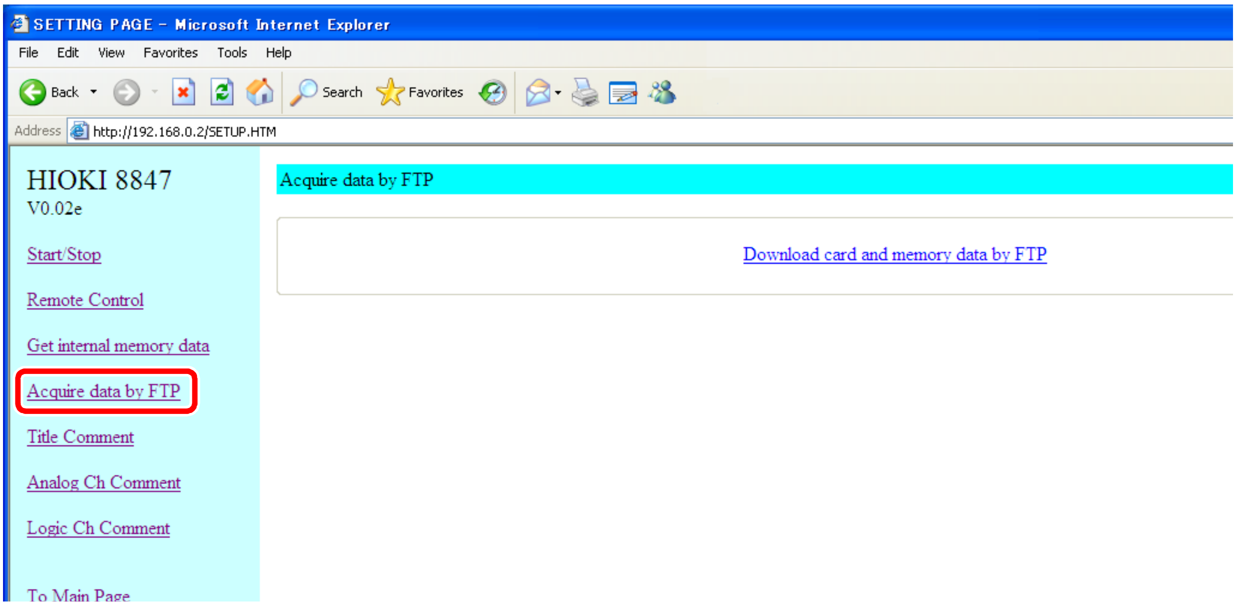
NOTE Getting data may not be possible when JRE has not been installed. (⇒ p.265)

Downloading Data By FTP

You can use FTP to download data from CF Card, HDD, or a USB memory stick.

Data Download Screen for FTP

To open the screen: Click **[Acquire data by FTP]** on list of operations.



http://192.168.0.2/SETUP.HTM

HIOKI 8847
V0.02e

Start/Stop

Remote Control

Get internal memory data

Acquire data by FTP

Title Comment

Analog Ch Comment

Logic Ch Comment

To Main Page

Acquire data by FTP

Download card and memory data by FTP

Procedure

Click **[Download card and memory data by FTP]**.
A list of folders is displayed.

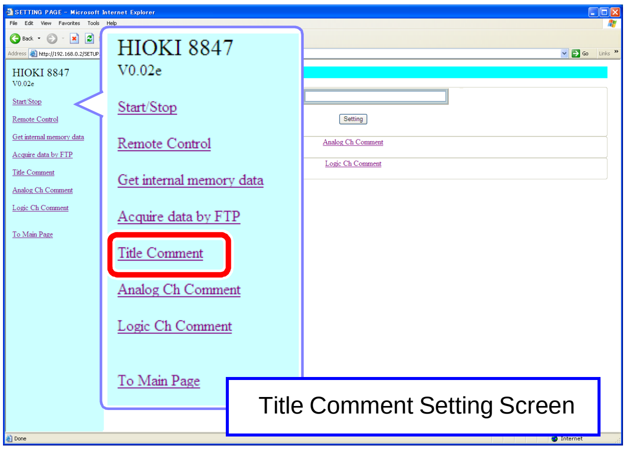
For information on how to perform file operations, see "15.3.3 Using FTP for File Operations" (⇒ p.275).

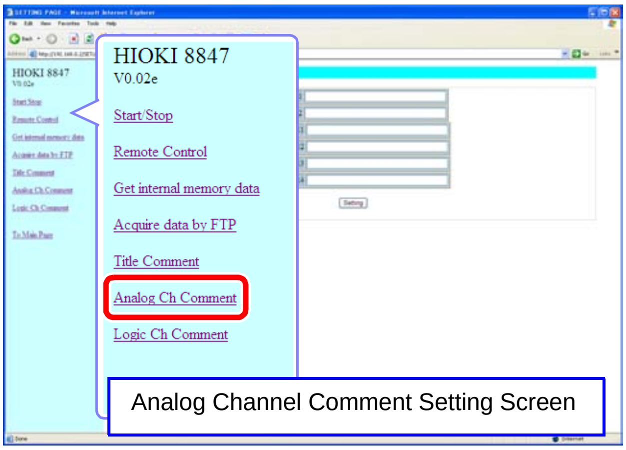
Entering a Comment

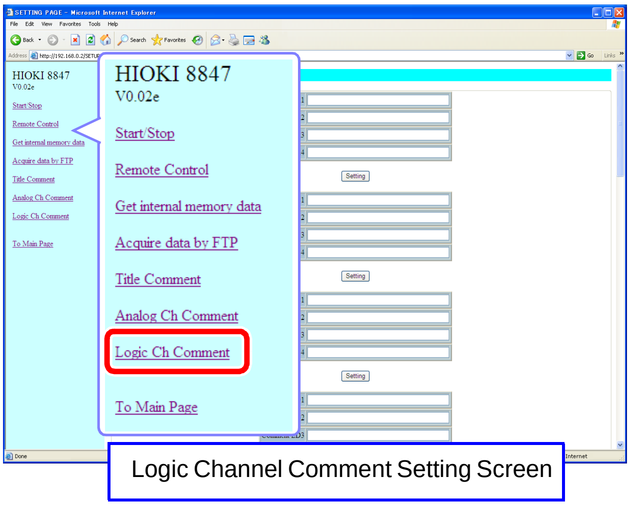
You can specify strings to be used as title comment, logic channel comment, and analog channel comment.
Information about the module type and channel (installation location in the instrument) can be obtained and used only for the respective channel.

Comment Setting Screen

To open the screen: Click **[Title Comment]**, **[Analog Ch Comment]**, or **[Logic Ch Comment]** on list of operations.

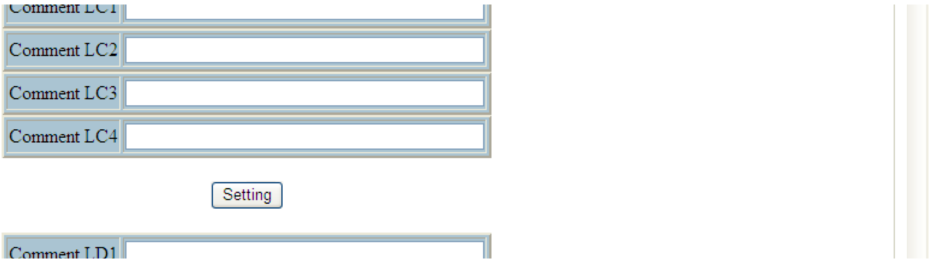






Procedure

Enter a string in the comment input field and click the **[Setting]** button.
The comment string can be up to 40 characters long.



15.3 Accessing the Files on the Instrument From a Computer (Using FTP)

By using a PC FTP client, you can transfer files from the instrument's media to the PC and perform other file operations.

- This instrument is equipped with an FTP (File-Transfer-Protocol, RFC959 compliant) server.
- You can use IE (Internet Explorer) or other popular FTP clients.

NOTE

- The FTP server of the instrument allows only one connection at a time. More than one PC cannot access the server simultaneously.
- If no command is sent from a PC for more than one minute after connecting to the FTP server, the FTP may disconnect the PC. Reconnect the FTP.
- FTP operation will be interrupted when measurement is started.
- Before inserting or removing a CF card or USB memory stick, terminate the FTP connection.
- Do not perform file operations while FTP is being used.
- With IE, the refresh date of files may not match those of the main instrument.
- With IE, temporary internet files may retain data from their previous access, so the previous data may be obtained instead of the newest data.

To use FTP, the instrument must be properly set up and connected via LAN cable to the PC.

See: "15.1.1 Making LAN Settings at the Instrument" (⇒ p.260)
"15.1.2 Connecting Instrument and PC With LAN Cable" (⇒ p.263)

NOTE

Be careful when moving files by FTP, as some FTP client/browser programs may delete all selected files or folders from the source if you cancel a transfer before completion. Rather than moving files in one step, we recommend copying (downloading) and then manually deleting from the source.

Things to Check Before Using FTP

Relationship Between Storage Media and Directories

Each of the various types of storage media appears as a directory on the FTP server.

/CF .... CF Card
/HDD .... Hard disk
/RAM .... Internal memory
/USB1......... USB memory stick

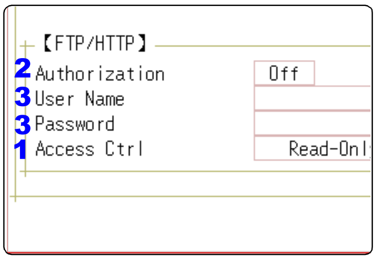
Limitations

During measurement, file access is not possible.

15.3.1 Making FTP Settings at the Instrument

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet



【FTP/HTTP】

2 Authorization Off

3 User Name

3 Password

1 Access Ctrl Read-Onl

1 **Set the access restrictions.**

Move the cursor to the **[Access Ctrl]** item.

Select

Read/ Write	Writing to the media of the instrument (uploading), and file deletion and renaming are permitted.
Read-Only	File reading only is permitted. This prevents files from being deleted or changed from outside the instrument.

2 **Make authorization settings.**

Move the cursor to the **[Authorization]** item.

Select

Off	Web server authentication is not used. (default setting)
On	Web server authentication is used.

The user name and password for authentication are the same for the Internet browser and for FTP.

3 **When [On] is selected**

Set up a user name and password.

Move the cursor to the **[User Name]** and **[Password]** items and enter suitable information.

See: "8.1.3 Alphanumeric Input" (⇒ p.121)
"Authorization User Name and Password" (⇒ p.261)

4 **Apply the settings.**

Move the cursor to the **[Reset]** item.
Select **[Reflect Set].**

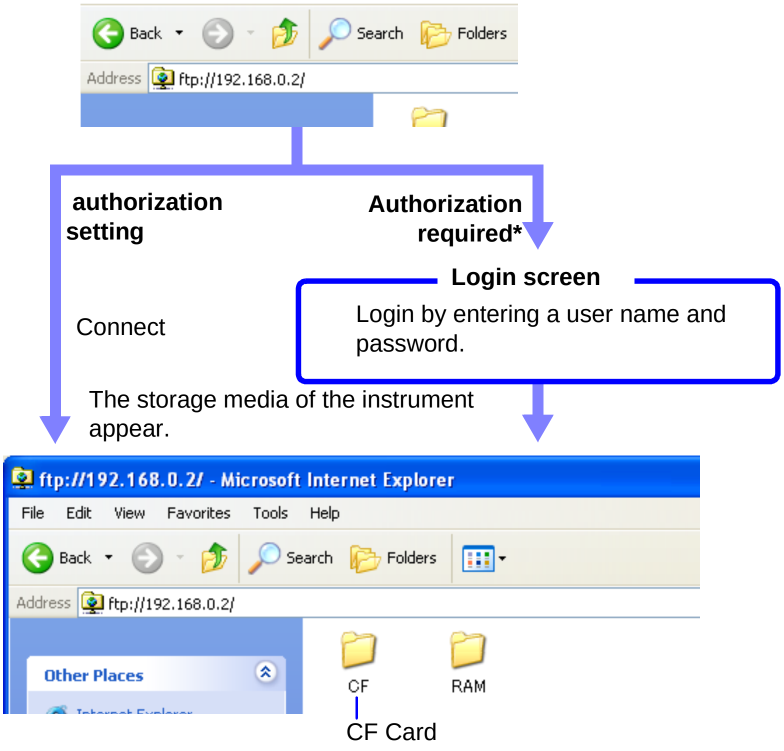
The indication "LAN was reconnected" appears at the bottom of the screen.

15.3.2 Using FTP to Connect to the Instrument

The following example shows how to use the IE (Internet Explorer) browser on Windows XP.

Launch IE on the PC and enter "ftp://" plus the IP address of the instrument in the address bar.

If the IP address of the instrument is "192.168.0.2":



authorization setting

Authorization required*

Login screen

Login by entering a user name and password.

Connect

The storage media of the instrument appear.

Click to display the file stored on the media.

* An authorization user name and password have been set in the System screen - **[Interface]** sheet.
See:"15.3.1 Making FTP Settings at the Instrument" (⇒ p.273)

You can also enter the user name and password, delimited by ':' and '@', in front of the normal IP address.

[ftp:// Username:Password@ instrument IP address]

Example: When the user name is "hioki" and the password is "1234":
Enter [ftp://hioki:1234@192.168.0.2].

If the connection fails

Check the communications settings of the instrument.

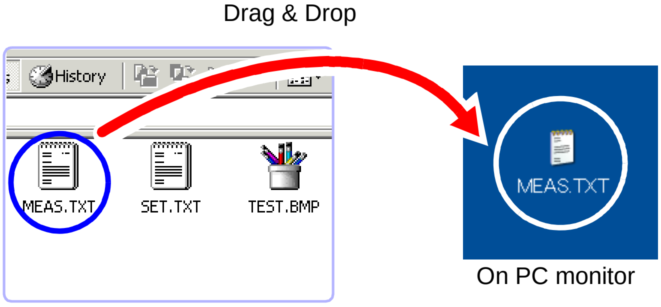
See: " LAN Setup Workflow" (⇒ p.262)

15.3.3 Using FTP for File Operations

Downloading Files

Select the file to download from the folder list and drag and drop* it on the download destination (the desktop or a folder outside the IE window).

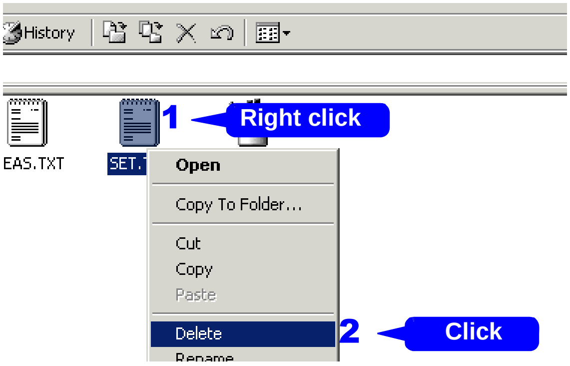
*: Click the file and hold the button down. Move the mouse pointer to the target destination, and then release the button



Minutes and seconds may not be reflected on the file stamp (date) of the file.

Deleting and Renaming Files

Right click a file in the FTP folder list, and select **[Delete]** or **[Rename]** from the pull-down menu.



15.4 Transferring Data to the PC

The supplied USB Cable can be used to transfer data from the HDD to a PC.

For information on how to use the supplied application software for data analysis, refer to the application's Help function.

See: Installing and starting the application software:"15.5"(⇒ p.277)

Supported hardware
PC capable of running Windows 2000, XP, or Vista

CAUTION

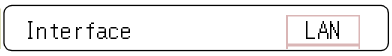
- During data transfer, do not disconnect the USB cable. Otherwise the transfer will not be completed normally.
- Ground the instrument and the PC at the same ground point. If the equipment is connected to different ground points, an electric potential will exist between the PC ground and the instrument ground. If a USB Cable is connected in this condition, operation problems and damage can occur.

Instrument Settings

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet

1 Move the cursor to the **[Interface]**, and select **[LAN]**.



Interface LAN

2 Move the cursor to the **[USB Set]**, and select **[Mass Storage]**.

USB Set Mass Storage

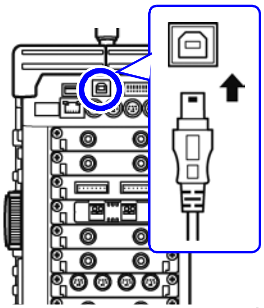
NOTE

Operations to the USB memory stick or HDD from the instrument are restricted during **[Mass Storage]**.Furthermore, the printer prints at Slow/Fine, regardless of the print speed setting.

Connecting the USB Cable

Preparations
Stop measurement and make sure that the File screen is not displayed.

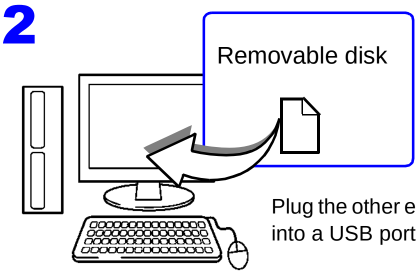
1



USB Connector (Type B)

Insert the plug of the USB cable into the USB port on the instrument, observing correct orientation of the plug.

2



Plug the other end of the USB cable into a USB port on the PC.

When the connection is established, the PC will recognize the instrument as a removable disk. The PC can now access data on the HDD of the instrument.

Disconnecting the USB Cable

To disconnect the USB Cable of the instrument from a PC that is currently running, use the "Safely Remove Hardware" icon and follow the prescribed steps.

15.5 Wave Viewer (Wv)

The viewer has a CSV conversion function. Converted files may be read by a spreadsheet program.

This section explains how to install and uninstall and how to start and quit the Wave Viewer.

System requirements

For a PC running Windows 95, 98, Me, Windows NT4.0 SP3 or later, Windows 2000, or Windows XP

Installation (Windows XP)

1. When you insert the Application Disk (CD-R) 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. And go on the procedure.
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.

Startup

Before using the program, review the "READ ME" text file.

In the Windows Start menu, select **[Programs]** - **[HIOKI]** - **[Wv.]** This starts the Wave Viewer application.

Shutdown

Access the menus of the Wave Viewer application and select **[File]** - **[Exit]** to shut down the program. Alternatively, you can click the Close button at the top right of the screen.

Uninstallation

1. From the Windows Start button, open the **[control panel]** and click on **[Add or remove programs]**.
2. Select **[HIOKI Wave Viewer (Wv)]** and uninstall the application.

To upgrade to a newer version, uninstall the old version first and then install the new version.

15.6 USB Settings and Connection (Before Command Communications)

Use the USB cable supplied with the instrument to connect the instrument to the PC. The instrument can then be controlled from the PC. Before command communication is possible, certain USB settings must be made and the connection must be established.

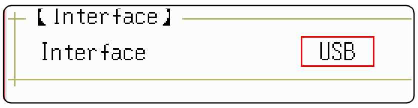
15.6.1 Making USB Settings at the Instrument

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet

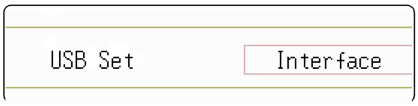
Move the cursor to the **[Interface]**, and select **[USB]**.

The **[USB Set]** item is automatically set to **[Interface]**.



【Interface】

Interface USB



USB Set Interface

NOTE When the interface has been set to **[USB]**, the following functions are not available.

- Using a USB memory stick
- Viewing data of the instrument on a PC

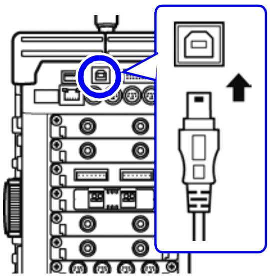
15.6.2 Installing the USB Driver

Install the USB driver before you use the instrument with a USB connection.

CAUTION Do not plug in or unplug the USB cable while the instrument is operating.

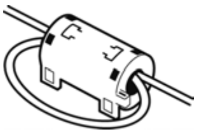
1. Connect the AC adapter to the instrument and turn the power on.

2. Using the enclosed USB cable, connect the instrument to the PC to which the driver will be installed.

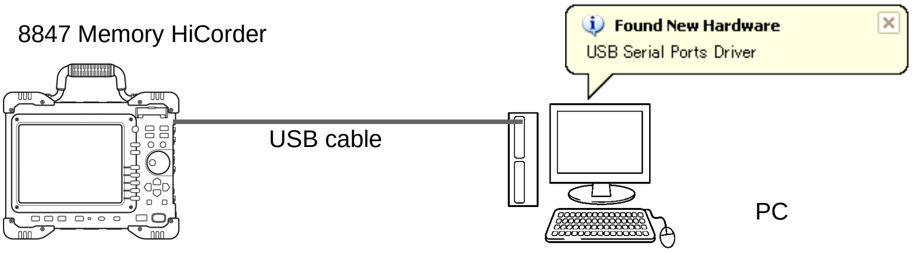


1. Plug the USB cable supplied with the instrument into the USB connector (Type B) on the right side of the instrument.
2. Connect the other end of the cable to the USB port on the PC.

NOTE If there is a possibility of noise interference to other equipment in the vicinity, wind the USB cable once around the supplied ferrite clamp-on choke (for LAN/USB cable), as shown in the illustration at right.

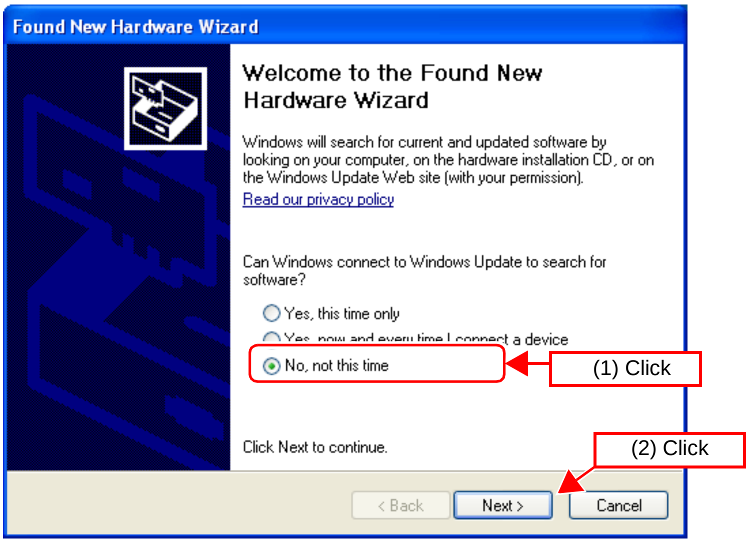


After the "Found New Hardware" window appears, the [Found New Hardware Wizard] dialog box will appear.



NOTE If after installing the driver you connect the instrument to the personal PC using a different USB port, the "Found New Hardware" window will appear again and the Found New Hardware Wizard will start up. Use this wizard to install the driver again for this port.

3. Click **[No:not this time]** and click the **[Next]** button.



Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).

Read our privacy policy

Can Windows connect to Windows Update to search for software?

○ Yes, this time only

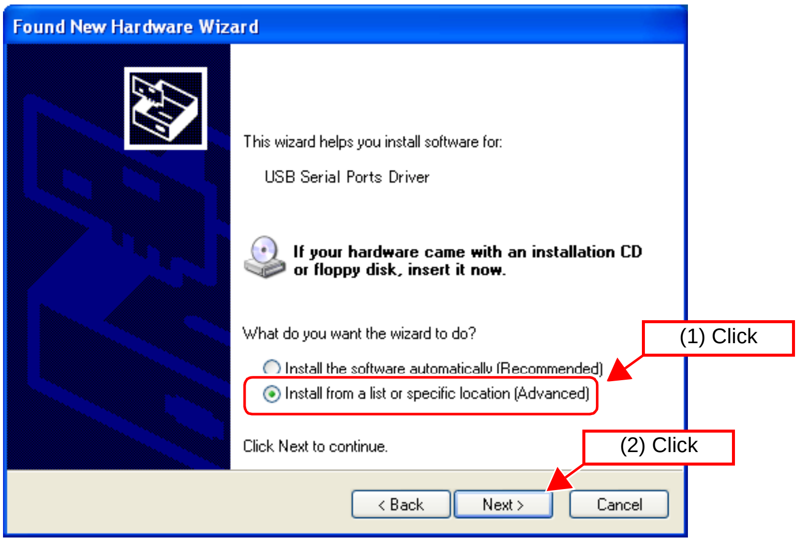
○ Yes, now and every time I connect a device

● No, not this time

Click Next to continue.

4. Select **[Install from a list or specific location]** and then click **[Next]**.

Depending on the version of Windows XP used, instead of displaying this dialog box the PC might go directly to the dialog box in Step "6." instead.



Found New Hardware Wizard

This wizard helps you install software for:

USB Serial Ports Driver

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

○ Install the software automatically (Recommended)

● Install from a list or specific location (Advanced)

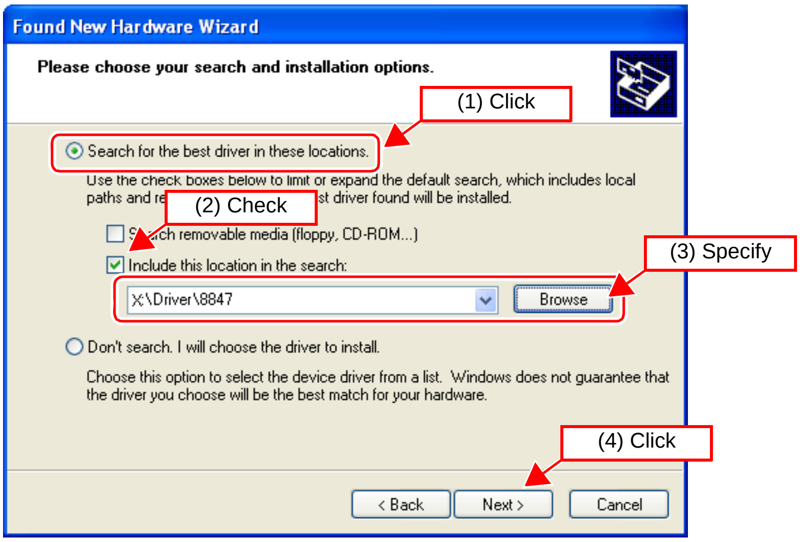
Click Next to continue.

5. Select **[Search for the best driver in these locations]**.

Place a checkmark by **[Include this location in the search]** (if there are checkmarks next to any other items, uncheck them).

Insert the included CD into the PC's CD-ROM derive and entering **[X:/Driver/8847]** in the location field.
(**[X]** in the above file location indicates the CD-ROM drive. The letter allocated to the CD-ROM drive may vary by PC.)

Click **[Next]** button.



Found New Hardware Wizard

Please choose your search and installation options.

● Search for the best driver in these locations.

Use the check boxes below to limit or expand the default search, which includes local paths and re... ...st driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)

☑ Include this location in the search:

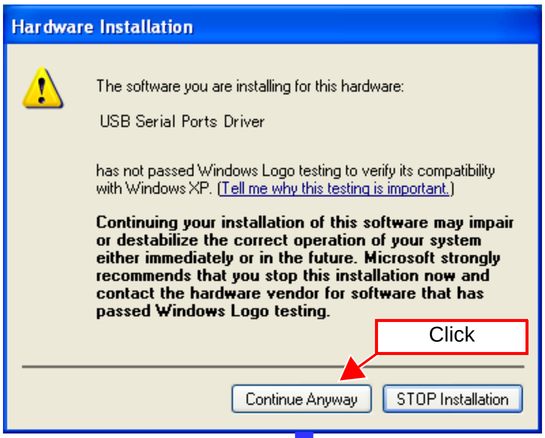
X:\Driver\8847

○ Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

6. Click **[Continue Anyway]**.

After Windows XP checks the software, it will display a warning stating that the software has not been certified by Microsoft. Click **[Continue Anyway]**.



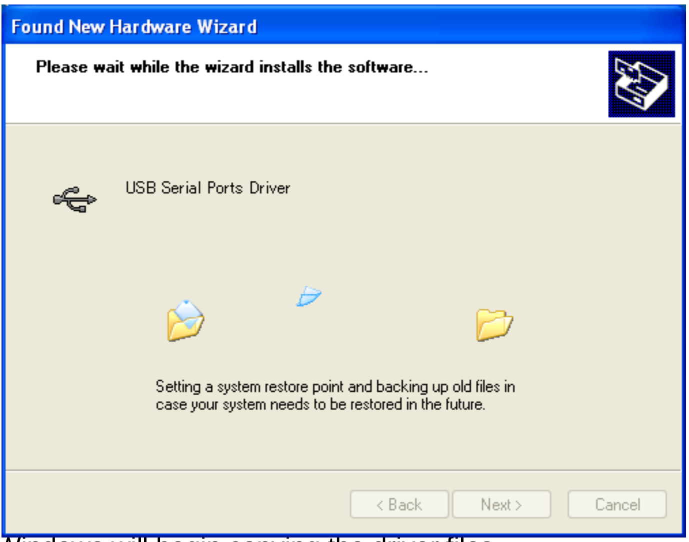
Hardware Installation

The software you are installing for this hardware:

USB Serial Ports Driver

has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)

Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.



Found New Hardware Wizard

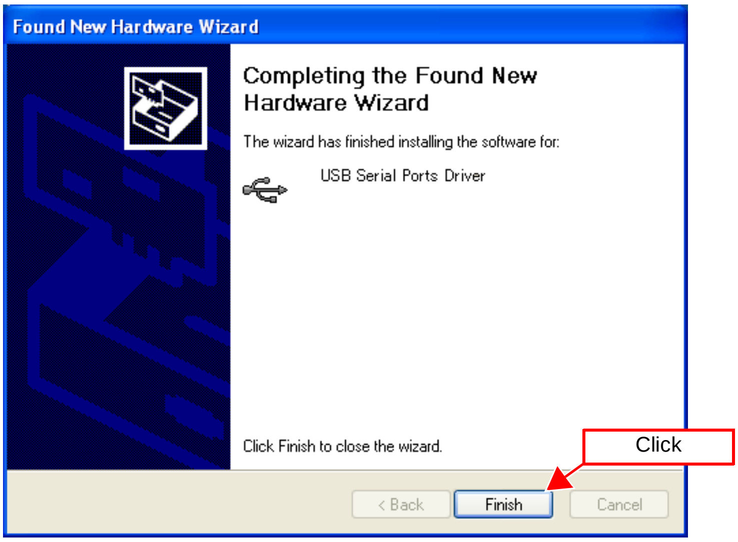
Please wait while the wizard installs the software...

USB Serial Ports Driver

Setting a system restore point and backing up old files in case your system needs to be restored in the future.

Windows will begin copying the driver files.

7. When installation is complete, the next dialog will appear. Click **[Finish]**.



Found New Hardware Wizard

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

USB Serial Ports Driver

Click Finish to close the wizard.

This completes the USB driver installation.

15.7 Controlling the Instrument with Command Communications (LAN/USB)

You can control the instrument remotely over the communications interface (LAN or USB).

- For details, see the communications related documentation on the supplied application disc.
- Before using command communications, the LAN settings or USB settings and connection must have been established properly.

See: LAN"15.1"(⇒ p.260), USB"15.6"(⇒ p.278)

⚠CAUTION

In an environment where noise from inverters or similar devices is present, errors may occur when controlling the instrument remotely. Take care to ensure that the environment is not subject to excessive noise.

About Setting Items

Delimiter	The Delimiter item specifies LF or CR+LF as the newline delimiter in command response messages. The instrument understands all three settings: LF or CR+LF.
Header	Use for control of communications commands. The Header item specifies whether to prefix headers to command response messages. For more information about commands, refer to the Communications operation manual on the supplied CD.
Command Port (Port number) (LAN only)	The instrument uses the TCP/IP protocol for communications. TCP/IP allows communicating devices to establish multiple connections, which are distinguished by port numbers. By default the instrument uses port numbers 8800 to 8809. •8800 to 8801 reserved •8802 (instrument is server): For communications command control •8803 to 8809 reserved Normally these ports do not need to be changed. You can change them if certain ports cannot be used for security reasons, or if certain ports are not available on the communicating PC. Set only the most significant three digits. The least significant digit (0 to 9) is used by the instrument, or reserved for use by the instrument.

15.7.1 Making Settings on the Instrument

Set items related to command communications.

Procedure

To open the screen: Press the SYSTEM key → [Interface] sheet

1 **Set the delimiter.**

Move the cursor to the **[Delimiter]** item.

Select

LF	Send character code 0x0a.
CR+LF	Send character codes 0x0d and 0x0a.

2 **Make header settings.**

Move the cursor to the **[Header]** item.

Select

Off	Do not add a header to response data.
On	Add a header to response data.

3 **Set the communications command port. (LAN only)**

Move the cursor to the **[Port Number]** item, and enter the port number.

About headers

The response to a :FUNCTION? query command from the PC differs according to the header setting.

On .... :FUNCTION MEM

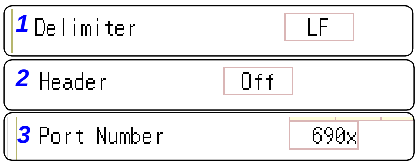
Off .... MEM

About port numbers

Specify only the most significant 3 digits of the 4-digit port number.

If you specify "880x", port number 8802 is used.

"Command Port (Port number) (LAN only)" (⇒ p.282)



1 Delimiter LF

2 Header Off

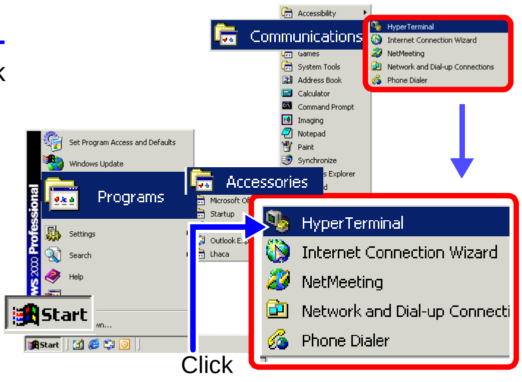
3 Port Number 690x

15.7.2 Communication Command Setting

The following example shows how to make a connection using the telnet software (HyperTerminal) supplied with Windows XP.

1 **Launch HyperTeminal.**

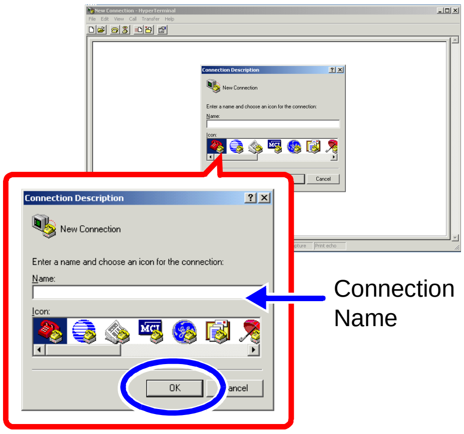
Click **[Start]**, **[Programs]** - **[Accessories]** - **[Communications]** - **[HyperTerminal]**, and then click **[HyperTerminal]**.



The HyperTerminal screen appears.

2 **Specify a connection name.**

Enter a name in the **[Name]** field and click the **[OK]** button.(You can enter any name.)



A **[Connect To]** dialog appears.

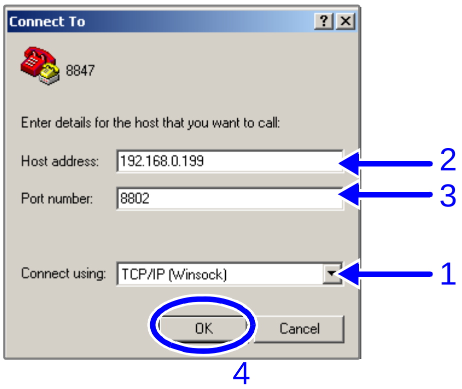
3 **Make the connection settings.**

1. In **[Connect using]** select **[TCP/IP (Winsock)]**.
2. In **[Host address]**, enter the IP address of the instrument.
3. In **[Port number]**, enter the port number specified in the **[Interface]** sheet.

   About port numbers

   On the instrument, only the most significant 3 digits of the 4-digit instrument port number are specified.
   If you specified "880x" on the instrument, enter "8802" here.
   "Command Port (Port number) (LAN only)" (⇒ p.282)

4. Click the **[OK]** button.



8847

Enter details for the host that you want to call:

Host address: 192.168.0.199

Port number: 8802

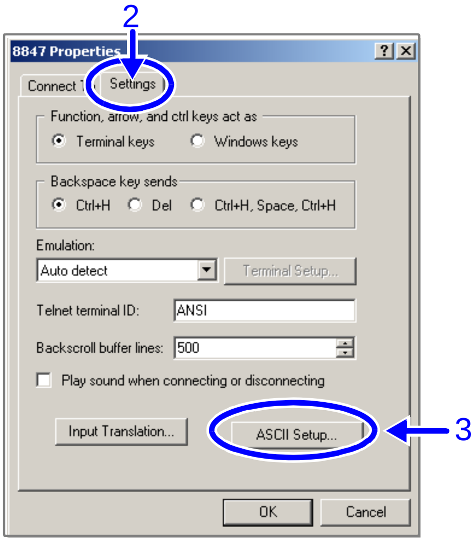
Connect using: TCP/IP (Winsock)

The connection is made.

4 Make detailed connection settings.

1. Select **[Properties]** in the **[File]** menu.
   The Properties dialog for the specified connection name appears.
2. Click the **[Settings]** tab.
3. Click the **[ASCII Setup...]** button.

The **[ASCII Setup]** dialog appears.



Function, arrow, and ctrl keys act as: ● Terminal keys ○ Windows keys

Backspace key sends: ● Ctrl+H ○ Del ○ Ctrl+H, Space, Ctrl+H

Emulation: Auto detect

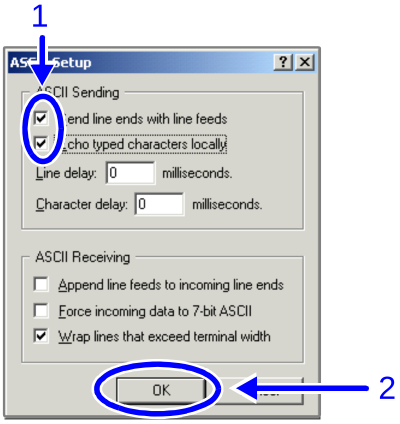
Telnet terminal ID: ANSI

Backscroll buffer lines: 500

☐ Play sound when connecting or disconnecting

5 Make detailed settings

1. Check the **[Send line ends with line feeds]** and **[Echo typed characters locally]** check boxes.
2. Click the **[OK]** button to return to the Properties dialog.
3. Click the **[OK]** button to return to the HyperTerminal window.



ASCII Sending

☑ end line ends with line feeds

☑ cho typed characters locally

Line delay: 0 milliseconds.

Character delay: 0 milliseconds.

ASCII Receiving

☐ Append line feeds to incoming line ends

☐ Force incoming data to 7-bit ASCII

☑ Wrap lines that exceed terminal width

6 Try sending a command.

Enter "*idn?" and press the Enter key.

A response is returned from the instrument.

```
*idn?
HIOKI,8847,0,V1.00_
```

When using the USB interface for command communications, the following differences exist, compared to using a LAN connection.

- Select **[COMX]** as **[Connect using]** in 3-1. (X is a letter that will differ depending on the environment.)
- After completing 3-4., make the following settings.

Bits per second	19200
Data bit	8
Parity	None
Stop bit	1
Flow control	None

External Control Chapter 16

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 terminals	Maximum input voltage
START/EXT.IN1	-0.5 to 7 VDC
STOP/EXT.IN2	-0.5 to 7 VDC
PRINT/EXT.IN3	-0.5 to 7 VDC
GO/EXT.OUT1	50 VDC 50 mA 200 mW
NG/EXT.OUT2	50 VDC 50 mA 200 mW
EXT.SAMP	-0.5 to 7VDC
TRIG OUT	50 VDC 50 mA 200 mW
EXT.TRIG	-0.5 to 7 VDC

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.

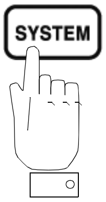
CAUTION

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.

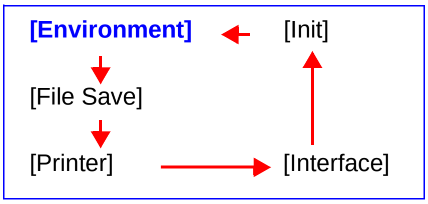
NOTE

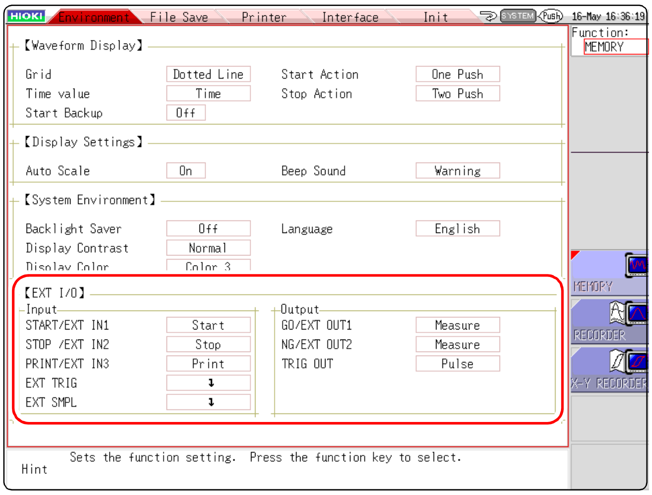
Signals input to the external control terminals take effect even when the operating keys are locked.

Opening the [Environment] sheet



Pressing this key repeatedly displays the various sheets.





Function: MEMORY

【Waveform Display】

Grid Dotted Line

Time value Time

Start Backup Off

Start Action One Push

Stop Action Two Push

【Display Settings】

Auto Scale On

Beep Sound Warning

【System Environment】

Backlight Saver Off

Display Contrast Normal

Display Color Color 3

Language English

【EXT I/O】

Input

START/EXT IN1 Start

STOP /EXT IN2 Stop

PRINT/EXT IN3 Print

EXT TRIG ↓

EXT SMPL ↓

Output

GO/EXT OUT1 Measure

NG/EXT OUT2 Measure

TRIG OUT Pulse

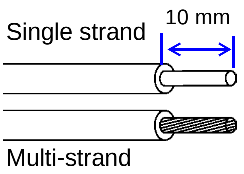
Hint Sets the function setting. Press the function key to select.

16.1 Connecting External Control Terminals

The method for connecting to the external control terminals is as follows.

Connecting External I/O Terminals (Connector Blocks)

Cables to connect



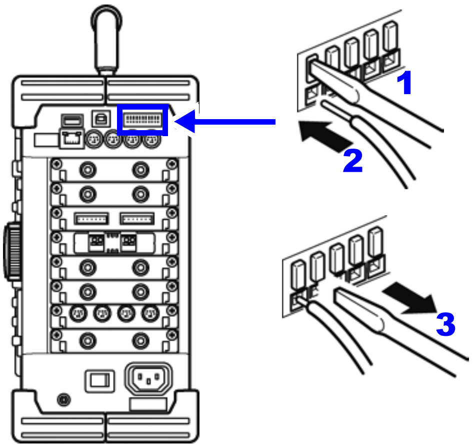
Recommended cables:
single strand diameter: ϕ 1.0 mm (AWG18)
multi-strand: 0.75 mm^2 (AWG20)

Usable cables:
Single strand diameter: ϕ 0.4 - 1.0 mm (AWG26 to 18)
Multi-strand: 0.3 - 0.75 mm^2 (AWG22 - 20)
Strand diameter: ϕ 0.18 mm or greater (per wire)

Standard insulation stripping length: 10 mm

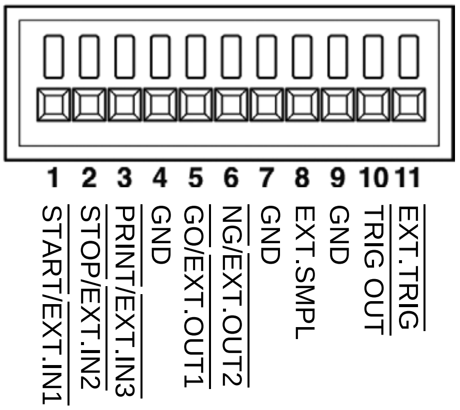
Button operation specified tool: Flat-blade screwdriver (tip width 2.6 mm)

Connection procedure



1. Push in the button on the connector with a flat-blade screwdriver or other tool.
2. With the button held in, insert the cable into the cable connection hole.
3. Release the button.

   The cable is locked.



Terminal No.	Terminal Color	Operation
1	Blue	Input external signal and execute the following • Start/end measurement • Print/save data • Pen up/down (for X-Y recorder operation)
2	Purple	
3	White	
4	Black	-
5	Green	Output instrument status as a signal
6	Red	
7	Black	-
8	Gray	Input external signal and set sampling rate
9	Black	-
10	Yellow	Output signal when triggering occurs

16.2 External I/O

16.2.1 External Input (START/EXT.IN1) (STOP/EXT.IN2) (PRINT/EXT.IN3)

External control signals can be applied to start and stop measurement, and to print and save data. The factory-default settings are to **[Start]**, **[Stop]**, and **[Print]**.

Signal Input Procedure

1. Connect the cables for the corresponding external input signals to START/EXT.IN1, STOP/EXT.IN2, PRINT/EXT.IN3, and GND terminals.

See: "16.1 Connecting External Control Terminals" (⇒ p.288)

2. Move the cursor to the Press the **SYSTEM** key to open the Environment sheet, and move the cursor to **[START/EXT IN1]**, **[STOP/EXT IN2]**, or **[PRINT/EXT IN3]**.

3. Select the operation performed by the instrument in response to external signal input.

Select

Start	Start measurement. (Is not affected by **[START Action]** (⇒ p.257))
Stop	Stop measurement. (Operations after measurement, such as numerical calculations and automatic saving will be carried out)
Start/Stop	Start measurement on LOW level, and stop measurement on HIGH level.
Abort	Stop measurement immediately. (Operations after measurement, such as numerical calculations and automatic saving will not be carried out)
Print	Same operation as **PRINT** key (Not valid during Selective Printing (⇒ p.93))
Save	Save to the media specified for the **SAVE** key, according to the specified conditions. (Not valid during Selective Saving (⇒ p.74))
Pen Up/Down	A LOW level signals 'pen-down' operation and a HIGH level signals 'pen-up' operation (for X-Y recording).

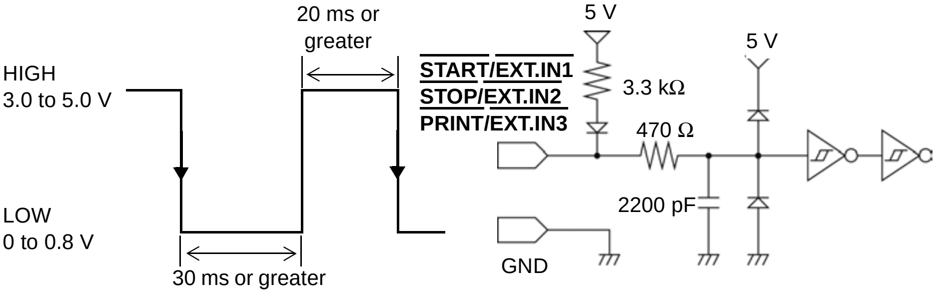
NOTE

- For STOP operation, follow **[STOP Action]** (⇒ p.257).
- External input is not available when the HELP screen or a dialog window is being displayed.

4. Short circuit the terminal and GND, or input a HIGH level (3.0 to 5.0 V) or LOW level (0 to 0.8 V) pulse wave or rectangular wave to the terminal.

Control with the LOW level of the input waveform.

Voltage range	HIGH level: 3.0 to 5.0 V , LOW level: 0 to 0.8 V
Pulse width	HIGH level: 20 ms or greater, LOW level: 30 ms or greater
Maximum input voltage	-0.5 to 7 V



16.2.2 External Output (GO/EXT.OUT1) (NG/EXT.OUT2)

Signals can be output that indicate the instrument's judgment state.

Signal Output Procedure

1. Connect the GO/EXT.OUT1, NG/EXT.OUT2, and GND terminals to the device(s) to be controlled by single wires.

See: "16.1 Connecting External Control Terminals" (⇒ p.288)

2. Press the **SYSTEM** key to open the **[Environment]** sheet, and move the cursor to **[GO/EXT OUT1]** or **[NG/EXT OUT2]**.

3. Select the conditions under which the instrument outputs a signal.
(when the **[GO/EXT OUT1]** item is selected)

Select

Measure	A LOW signal is output when the judgment result is GO (pass).
Error	Output a LOW level signal when an error occurs.
Busy	A LOW signal is output when external start operation is disabled, such as during startup, saving, and printing.
Trigger	Output a LOW level signal while instrument is waiting for a trigger.

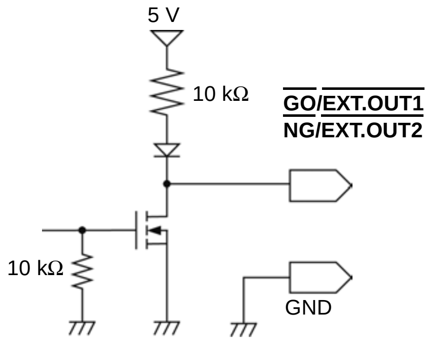
(when the **[NG/EXT OUT2]** item is selected)

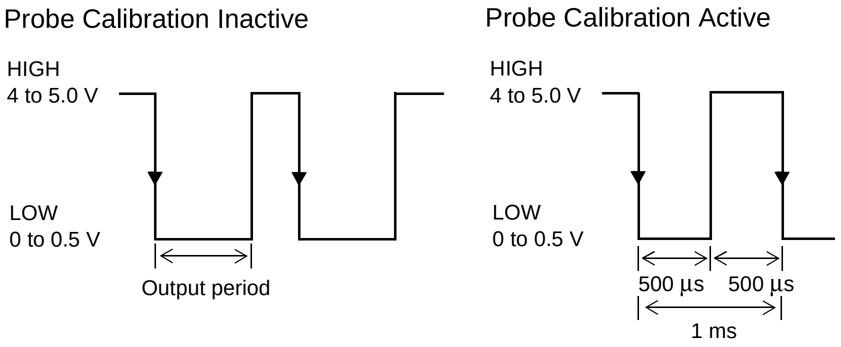
Select

Measure	A LOW signal is output when the judgment result is NG (fail).
Error	Output a LOW level signal when an error occurs.
Busy	A LOW signal is output during measurement, saving, and printing, and when it's finished, a HIGH signal is output.
Trigger	Output a LOW level signal while instrument is waiting for a trigger.
Calibration	1 kHz output for calibrating Model 9665 10:1 Probe and the 9666 100:1 Probe.

4. The signal for the specified state 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
Maximum input voltage	50 VDC, 50 mA, 200 mW




Probe Calibration Inactive

Probe Calibration Active

16.2.3 External Sampling (EXT.SMPL) MEM

External sampling is possible only when the Memory Function is enabled.
The sampling speed can be controlled by applying an external signal.

Signal Input Procedure

1. Connect the cables for the corresponding output signals to EXT.SMPL and GND terminals.

2. Press the **SYSTEM** key to open the **[Environment]** sheet, and move the cursor to **[EXT SMPL]**.

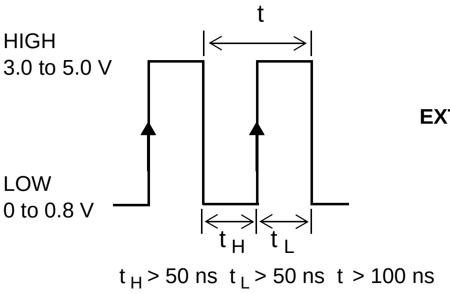
3. Select whether the sampling event occurs on the rising edge (↑) of the waveform or the falling edge (↓).

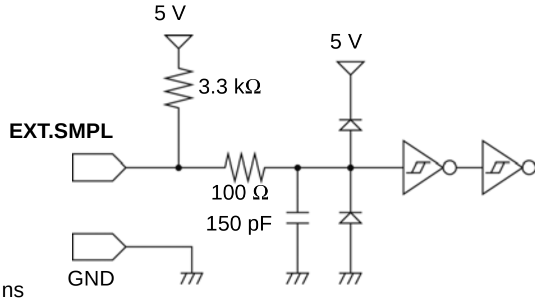
4. Input HIGH level (3.0 to 5.0 V) and LOW level (0 to 0.8 V) pulse waves or rectangular waves to the EXT.SMPL terminal.
Data is sampled on the rising edge or falling edge of the input waveform. Note that the sampling frequency is limited by the selected edge.
For proper operation, pulse width must be at least as shown in the following table.

Minimum external sampling pulse width

Setting (EXT.SMPL)	Pulse width					
	When the Roll Mode is set to **[On]**			When the Roll Mode is set to **[Off]**		
	t_H	t_L	t	t_H	t_L	t
↑	> 5 μs	> 5 μs	> 10 μs	> 50 ns	> 50 ns	> 100 ns
↓	> 5 μs	> 5 μs	> 10 μs	> 50 ns	> 50 ns	> 100 ns

Voltage range	HIGH level: 3.0 to 5.0 V, LOW level: 0 to 0.8 V
Pulse width	HIGH, LOW level: 50 ns or greater
Response frequency	10 MHz or lower
Maximum input voltage	-0.5 to 7 V





NOTE

- When a sampling signal of 5 MHz or greater is input, trigger points are delayed by 1 sample.
- When set to **[Auto]** or **[On]**, the Roll Mode can be used with external sampling. However, it is disabled if the external sampling input is faster than 100 kHz, to avoid degraded sampling accuracy.
- When using the 8968 High Resolution Unit, it is disabled if the anti-aliasing filter (AAF) is enabled on the Channel screen - **[Each Ch]** sheet.
- When Roll Mode is set to ON, externally sampled signals will not be accepted for the following periods:
  (1) 150 μs to 200 μs after the first sampling clock has been entered, and
  (2) Clock 2 when no signals are detected in the period (1) above.

16.2.4 Trigger Output (TRIG OUT)

You can output a signal when a trigger event occurs. In addition, multiple instruments can be controlled for parallel synchronous operation.

Signal Output Procedure

1. Connect the cables for the output signals to TRIG OUT and GND terminals.
See: "16.1 Connecting External Control Terminals" (⇒ p.288)

2. Press the **SYSTEM** key to open the **[Environment]** sheet, and move the cursor to **[TIRG OUT]**.

3. Select the output signal type for the trigger output terminal.

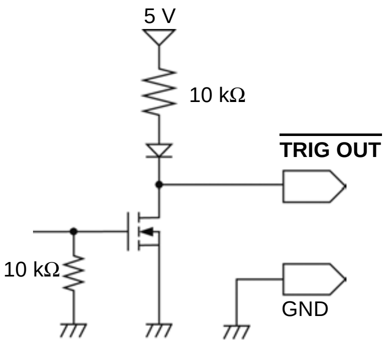
Select

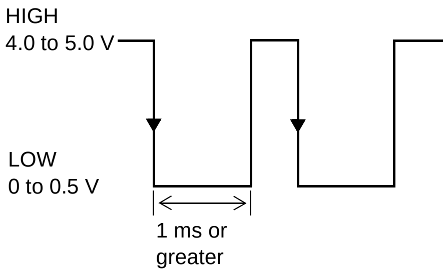
Pulse	After LOW level output, the signal goes HIGH after a specified interval.
Level	After LOW level output, the signal remains low until specified criteria are met.

4. When trigger event occurs, a pulse wave changing from the HIGH level (4.0 to 5.0 V) to the LOW level (0 to 0.5 V) is output from the TRIG OUT terminal.

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	Pulse width at pulse setting time : 2 ms ± 1 ms Pulse width at level setting time: (sampling rate × no. of data points after trigger) or more
Maximum input voltage	50 VDC, 50 mA, 200 mW

*: Triggering should occur when the signal voltage level changes from HIGH to LOW.





NOTE

- Trigger events occur and signals are output when the auto-ranging function is used with the Memory Function. You should be aware of this if you are using the trigger output terminal together with the auto-ranging function.
  - When using memory division, the trigger output (TRIG_OUT terminal output) may output the Low level or output erratically in the following conditions.
  - The time axis range is 5 µs/div to 100 µs/div
  - The record (measurement) time is 5 ms or less
  - Tracking wave display is [OFF].

16.2.5 External Trigger terminal (EXT.TRIG)

You can input external signals as trigger sources. In addition, multiple instruments can be controlled for parallel synchronous operation.

Signal Input Procedure

1. Connect the cables for the corresponding external input signals to the EXT.TRIG and GND terminals.
See: "16.1 Connecting External Control Terminals" (⇒ p.288)

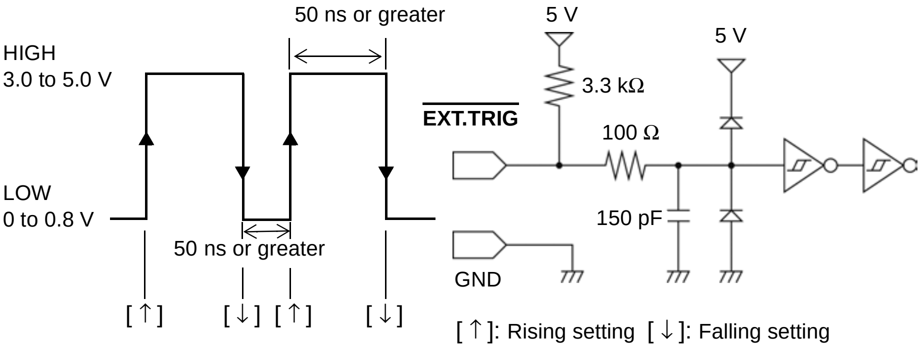
2. In the Trigger Settings window, set External trigger to **[On]**.

3. Press the **SYSTEM** key to open the **[Environment]** sheet, and move the cursor to **[EXT TRIG]**.

4. Select whether the trigger event occurs on the rising edge (↑) of the waveform or the falling edge (↓).

5. Short-circuit the EXT.TRIG terminal and GND, or input a HIGH level (3.0 to 5.0 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.

Output signal	HIGH level: 3.0 to 5.0 V, LOW level: 0 to 0.8 V
Pulse width	HIGH level: 50 ns or greater, LOW level: 50 ns or greater
Maximum input voltage	-0.5 to 7 V



Specifications Chapter 17

17.1 General Specifications

Basic Specifications

Measurement functions	• Memory Function (high-speed data saving) • Recorder Function (real time recording) • X-Y Recorder Function • FFT Function
No. of channels (max.)	Analog 16 channels + Logic 16 channels (using the included logic probe input connector, ground is common with the GND terminal) or Analog 10 channels + Logic 64 channels (using supplied equipment plus up to three Model 8973 Logic Units)
Memory capacity	16 channels : 4 MW /channel, 8 channels : 8 MW /channel 4 channels : 16 MW /channel, 2 channels : 32 MW /channel
Maximum sampling rate	20 MS / s (All channels simultaneously)
Timebase accuracy	± 0.01% (Relative grid timing error)
External control terminals	External Trigger Input, Trigger Output, External Sampling Input, GND, External Output 2 terminals (GO, NG), External Input 3 terminals (START, STOP, PRINT)
Clock functions	Auto calendar, auto leap year judgment, 24-hour timer Accuracy: ±100 ppm (within the operating temperature range) Reference value: ± 10 ppm (25°C)
Backup battery life	Approx. Ten years for clock and settings (@25°C, 77°F)
Operating environment	Indoors, Pollution degree 2, up to 2000 m (6562-ft.) ASL
Operating temperature and humidity	-10 to 40°C (14 to 104°F), 20 to 80%RH (non-condensation) • When using the printer: 0 to 40°C (32 to 104°F), 20 to 80%RH (non-condensation) • When using the 9664 HD Unit: 5 to 40°C (41 to 104°F), 20 to 80%RH (non-condensation)
Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73.4 ± 41°F), 20 to 80%RH (non-condensation)
Period of guaranteed accuracy	1 year
Storage temperature and humidity	-20 to 50°C (-4 to 422°F), 90%RH or less (non-condensation)
Isolation resistance and withstand voltage	Between chassis and power line: 1.69 kVAC for 15 s at least 100 MΩ at 500 VDC Between input module and chassis: 2.704 kVAC for 15s at least 100 MΩ at 500 VDC
Power source	Rated power supply voltage: 100 to 240 VAC (continuous input) (Voltage fluctuations of ±10% from the rated supply voltage are taken into account.) Rated power supply frequency: 50/60 Hz DC power supply input: 10 to 28 VDC (compatible with Model 9784 DC Power Unit) Overvoltage category II (anticipated transient overvoltage 2500 V)
Maximum rated power	130 VA max. / When using the printer: 220 VA max.
Dimensions	Approx. 351W × 261H × 140D mm (13.82"W × 10.28"H × 5.51"D) (sans protrusions), Approx. 365W × 307H × 164D mm (14.37"W × 12.09"H × 6.46"D) (within protrusions)
Mass	Approx. 7.5 kg (Instrument)
Applicable standards	Safety EN61010 EMC EN61326 Class A, EN61000-3-2, EN61000-3-3

Recording Section

Recording system	Thermosensitive recording system using thermal line head
Recording paper	Approx. 216 mm × 30 m (8.50” x 98.43-ft) roll-type thermosensitive paper (9231 Recording Paper)
Recording width	Overall recording width Approx. 208 mm ±1mm (8.19”±0.04”), Waveform portion Approx. 200 mm ±1 mm (7.87”±0.04”)
Recording speed	Maximum 50 mm/s
Paper feeding accuracy	± 1% (25°C (77°F), 60%RH)
Recording paper loading	One-touch system

Display Section

Display character	Japanese/English
Display type	10.4-in TFT Color LCD (800 × 600 dots)
Display resolution	T-Y waveform display: Normal 25 div (horizontal axis (time axis)) × 20 div (vertical axis (voltage axis)) X-Y waveform display: Normal 20 div (X axis) × 20 div (Y axis)
Dot pitch	0.264 (Vertical) × 0.264 (Horizontal) mm
Backlight	On/Off
Operating life	Approx. 50,000 hours

External Storage

CF Card

Slots	50 pin 1 slot
Card types	CompactFlash
Card Capacity	9726 PC Card 128MB, 9727 PC Card 256MB, 9728 PC Card 512MB, 9729 PC Card 1GB, 9830 PC Card 2G
Data formats	FAT, FAT32
Storage contents	Setting configurations, Measurement data (binary, text) (data between A-B cursors can be saved), Screen images (BMP), Printing images (BMP), Calculation results, Thinned storage (simple text)

Hard Disk Drive (Model 9664 HD Unit: option must be specified when ordering)

Storage system	2.5-inch magnetic hard drive
Storage capacity	80 GB
Format	FAT32
Storage contents	Setting configurations, Measurement data (binary, text) (data between A-B cursors can be saved), Screen images (BMP), Printing images (BMP), Calculation results, Thinned storage (simple text)

USB

Compliant standards	USB2.0compliant
Connector	Series-A receptacle: Connecting device: USB memory stick (mass storage device)

External Interfaces

USB

Compliant standards	USB2.0compliant
Host	Connector: Series-A receptacle Connecting device: USB memory stick (mass storage device)
Function	Connector: Series-B receptacle Connecting device: PC Functions:mass storage device (for file transfer from internal hard drive to PC) Communications support (PC-controlled)

LAN

Compliant standards	IEEE802.3 Ethernet 100BASE-TX DHCP-compliant, DNS-compliant, FTP server, HTTP server
Connector	RJ-45

Modules/Waveform Display

Measurement mode	Module model-dependent
Measurement range	Module model-dependent
Input coupling	Module model-dependent
Low-pass filter	Module model-dependent
Attenuating probe compensation	Included (Auto-scaling for different attenuating probes)
Displayed graphs	On-screen settings for displayed graphs and multi-graph printing (up to 8 graphs)
Waveform display	Select Off, or from 16 colors
Printing density	Four levels
Waveform display position	1% gradients, preset (select from ascending order, descending order, 0%, or 50%)
Zero adjust	All channels and ranges together

Waveform display magnification	Horizontal axis (Time axis): ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, ×1/500, ×1/1000, ×1/2000, ×1/5000, ×1/10000, ×1/20000 (expansion only with Memory function) Vertical axis (Voltage axis): ×100, ×50, ×20, ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10
Variable display function	Included (Upper and lower display limits, or specified vertical divisions)
Scaling	Automatic scrolling (10:1, 100:1, 1000:1, selectable for different attenuating probes) Manual scrolling (conversion ratio setting, two-point setting and unit settings)
Invert function	Included (Polarity reversal)
Vernier function	Included
Commenting	Alphanumeric and Japanese characters (title and comments for each analog and logic channel)
Comment entry method	Single character, stored string and historical string entry (pre-stored and previously used strings can be recalled, inserted and edited)
Copy channel settings	Included
Logic setting	Included
Recording printout width	Selectable from three types
Display position	Freely settable in 1% steps
Display bits	Off, or select from 16 colors
Zoom function	Included (The waveform screen is divided two. Upper displays normal waveforms, Lower displays zoomed waveforms)

Accessories/Options

Accessories **For information about options: (⇒ p. A10)**	Instruction Manual and Measurement Guide.. Each one Application CD..1 Power Cord...1 Input Cable Labels..1 USB cable...1 9231 Recording Paper.. 1 roll Paper Roll Holders ....1 pair Ferrite clamp-on choke (for LAN/USB cable) 1

17.2 Measurement Specifications

17.2.1 Memory Function

Timebase	5, 10, 20, 50, 100, 200, 500 µs/div 1, 2, 5, 10, 20, 50, 100, 200, 500 ms/div 1, 2, 5, 10, 30, 50, 100 s/div 1, 2, 5 min/div External sampling (100 S/div, adjustable settings)
Time axis resolution	100 points/div
Sampling period	1/100th of timebase
Recording length	• Fixed recording length 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 div 50000 div (2, 4, or 8 channel mode) 100000 div (2 or 4 channel mode) 200000 div (2 channel mode) • Adjustable recording length Can be set in units of divisions (up to 320,000div)
Screen and Printing Settings	1, 2, 4, 8 or X-Y (1 or 4) screens
Interpolation function	Line (exc. X-Y), dot or line (with X-Y)
Waveform scrolling	Left-right scrolling by Jog and Shuttle knobs, Backward scrolling is available during Roll Mode display
Overlay function	Auto: Always overdraws when starting, and clears by restarting Manual: Overdraws waveforms only when necessary, and clears as needed
Automatic saving	Automatically saves data on CF card or hard disk after measuring (binary or text) When sampling is slow, saving starts during recording.
Auto Print	Automatically prints recording waveforms after the measurement (When slow sampling is used, printing is available even while recording.)
Manual Print	By the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Selection printing	Included Prints the waveform between A/B cursors (Print All and Print Selection)
Report printing	Included
Channel modes	Selectable 2, 4, 8 or 16 channel modes

17.2.2 Recorder Function

Timebase	10, 20, 50, 100, 200, 500 ms/div 1, 2, 5, 10, 30, 50, 100 s/div 1, 2, 5, 10, 30 min/div, 1 h/div
Time axis resolution	100 points/div
Sampling period	1, 10, 100 µs 1, 10, 100 ms (not more than 1/100th of the selected timebase)
Recording length	Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 div Adjustable recording length: Can be set in units of divisions (up to 20,000div) Continuous
Screen and Printing Settings	1, 2, 4 or 8 screens
Waveform Storage	The most recent 20,000 divisions of measurement data is retained in internal memory
Waveform Scrolling	Left-right scrolling by Jog and Shuttle knobs. Including backward scrolling during measurement
Automatic saving	Automatically saves data on CF card or hard disk after measuring (binary or text) When sampling is slow, saving starts during recording.
Realtime printing	Available with 500 ms/div and slower recording (start and stop printing by **F** key while recording), With 10 to 200 ms/div recording, prints after recording stops (except during Continuous Recording), During continuous recording at 10 to 200 ms/div, print manually after measurement stops
Manual Print	By the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Selection printing	Included Prints the waveform between A/B cursors (Print All and Print Selection)
Logging recording	None
Report printing	Included

17.2.3 X-Y Recording

Sampling period	1, 10, 100 ms
Recording length	Continuous
Screen and Printing Settings	X-Y 1 screen, X-Y 4 screens
No. of X-Y display	Up to 8 phenomena
X-Y setting	Select 8 channels out of 16 for X axis and Y axis
Interpolation function	Dot/Line (smooth trace)
Waveform Clear	On/Off
Waveform Storage	The most recent 4000000 samples of measurement data is retained in internal memory
Pen Up/Down	Included (all phenomena simultaneously)
External Pen Control	Controllable by external control terminals (all phenomena simultaneously Up/Down)
Auto Print	None
Manual Print	By the **PRINT** key (prints up to 50 mm/s, depending on print coverage)
Automatic saving	None

17.2.4 FFT Function

Frequency range	133 mHz to 8 MHz, external
Dynamic range	72 dB(Theoretical value), 96dB (Theoretical value)(When the 8968 High Resolution Unit is used)
Number of sampling points	1000 points, 2000 points, 5000 points, 10000 points
Frequency resolution	1/400, 1/800, 1/2000, 1/4000
Anti-aliasing filter	Coupled with the frequency range, the cutoff frequency is automatically set.
Analysis channel setting	Can be selected from desired channels
FFT analysis modes	Storage waveform, linear spectrum, RMS spectrum, power spectrum, cross power spectrum, auto-correlation function, histogram, transfer function, cross-correlation function, impulse response, coherence function, 1/1 octave analysis, 1/3 octave analysis, LPC analysis, phase spectrum
Display formats	Single , Dual, Nyquist display, running spectrum display
Window	Rectangular window, Hanning, Hamming, Blackman, Blackman Harris, Flat top, Exponential
Display scale	Linear
Print Function	Based on the memory function. Note: Sectional printing is not possible.
Averaging	Time axis, simple average of frequency axis, indexed average, peak hold (frequency axis), number of times (2 to 10,000)

17.3 Trigger Section

Trigger method	Digital comparison
Trigger modes	• Memory Function, FFT Function: Single, Repeat, or Automatic • Recorder Function: Single or Repeat
Trigger source	Analog Unit (Ch1 to Ch16), Standard Logic 16 Channels + Logic Unit (Max. 3 units, 48 Channels) External Trigger occurs by applying a 2.5 V falling edge signal, or shorted terminals Independent trigger criteria settable for each channel Free-run operation occurs when all trigger types are off.
Manual trigger	Included
Trigger criteria	AND or OR of each trigger source
Trigger types (analog)	• Level Trigger Set digitally as a voltage value below full-scale • Voltage Sag Trigger (Drop) Triggering occurs when peak voltage falls below the specified level (for commercial power). (for 50/60 Hz commercial power) • Window Trigger Upper and lower trigger threshold levels are specified Triggering occurs when the signal enters or exits the defined threshold range. • Period Trigger A trigger period reference voltage level and period range are specified The period of the signal rising (or falling) through the specified level is measured, and triggering occurs when the period is outside of the specified range. • Glitch Trigger Set voltage level and pulse width (glitch width) Triggering occurs when the signal pulse width is narrower than the specified pulse width defined as rising or falling through a specified voltage level. • Event Trigger Triggering occurs when the event values specified for the level or glitch trigger are exceeded. Triggering occurs when the input rises above (or falls below) the specified trigger voltage level.
Trigger types (logic)	Pattern (mask) trigger by 1, 0, or x (x: don't care)
Trigger filter	• Memory Function, FFT Function : Off, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 2.5, 5.0, 10.0 div • Recorder Function : Off/On (10 ms fixed)
Trigger types (external trigger)	External signal is used as trigger.
Trigger types (timer trigger)	Triggering occurs at a preset time.
Trigger level resolution	0.1% f.s. (f.s. = 20 div)
Pre-trigger	Memory Function, FFT Function % setting: 0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, -95% div setting: Setting by units of 1 div
Trigger priority	Off/On
Trigger timing	Start, Stop and Start & Stop (Recorder Function)
Trigger output	Open-collector output (with 5 V output, Active Low) Pulse width at level setting time: (sampling rate × no. of data points after trigger) or more Pulse width at pulse setting time :2 ms ± 1 ms
Trigger input and output terminals	Terminal Block
Level display function	Included
Trigger marker	Trigger marks indicate positions of trigger events
Trigger search function	Searches for positions that meet trigger criteria

17.4 File Specifications

Data Saving

Supported storage media	CF Card, HDD, USB memory stick, Internal RAM
Saved data	Setting data, Measurement data, Analysis data, Screen image, Print image
Saving types	• Setting data (.SET) Setting configurations can only be saved to internal RAM • Measurement data Binary format (.MEM, .REC, FFT., .XYC), Text format (.TXT) • Index , Memory division (.SEQ), division save (.IDX) • Screen image (.BMP) • Print image (.BMP) • Startup (STRATUP.SET)
File name entry	Alphanumerics and Japanese
Saving range	Whole range, or between A/B cursors
Data thinning save	Included (Text only) Off, 1/2, 1/5, 1/10, 1/20, 1/50, 1/100, 1/200, 1/500, 1/1000
Division save	Included (Text only) 16 MB, 32 MB
Duplicate file name handling	Auto: Auto-saves with appended serial numbering Overwriting: Overwriting save Error: Reports an error
Selection of blocks to be saved	Included (for memory division only)
Selection of channels to be saved	Included (Select channels to be saved)

Data Loading

Supported storage media	CF Card, HDD, USB memory stick, Internal RAM
Loadable data types	Setting data, Measurement data, Analysis data, Text comments
Loadable data formats	• Setting data (.SET) Setting configurations can only be saved to internal RAM • Measurement data Text comments(.TXT) Binary format (.MEM, .REC, FFT., .XYC) • Index memory division (.SEQ), division save (.IDX)
Loading method	New
Loadable communication settings	None

Others

File information display	Included
Data deletion	Single or multiple file selections
File sorting	By name, date, size or extension, in ascending or descending order
File renaming	Included
Folders	Create, rename and delete
Copy file	Included
Print file list	Included
One-Touch saving	Included (By **SAVE** key) The save method can be selected beforehand for one-touch saving with the **SAVE** key.
Bundled application program	"Wv" Wave Viewer

17.5 Built-In Functions

Calculation-related functions

Calculation functions	Memory Function supported
Number of calculations	Up to 16 calculations can be applied to any channel
Calculation range	Whole range, or between A/B cursors
Calculation types	Average, RMS or P-P values, maximum, minimum and time to max/min values, period, frequency, rise time, fall time, standard deviation, squared value, X-Y squared value, time to level, level at time, pulse width, duty ratio, pulse count, four basic arithmetic operations, Time difference calculation, phase contrast calculation, High level calculation, Low level calculation
Print calculation results	Included
Auto-save calculation results	After measuring, automatically saves to CF card or hard disk (text format)
Judgment of calculation results	GO, NG, GO&NG stop according to max/min value of calculation result
Judgment output	GO, NG signal at open-collector output from external control terminal (5 V, active LOW), Pulse width: at least 1.8 ms

Waveform calculation function

Calculation support function	Memory Function
Number of calculations	Up to a maximum of 16 calculations for desired channels
Calculation range	All range, between A/B cursor selections
Calculation record length	Up to 1/4 maximum memory capacity
Operators	Four arithmetic operations, absolute vales, indexes, common logarithms, square root, moving average, differential (primary, secondary) Integral (primary, secondary), parallel displacement of time axis direction, trigonometric function, reverse trigonometric function
Printing of calculation results	Included
Automatic saving of calculation results	After measurement, automatic saving to CF card or HDD (binary, .txt file)

Memory division function

Division support function	Memory Function
Number of memory divisions	2 to 1024
Divided record length	Can be set as desired (but depends on the number of divisions)
Sequential saving	Possible by specifying start and end blocks
Sequential saving dead time	When block display is OFF: 1 to 8 samples (time axis 5 ms/div to 20 ms/div) : 1 sample (time axis 50 ms/div or more) When block display is ON: 40 ms or more (time axis 5 ms/div to 20 ms/div) : 1 sample (time axis 50 ms/div or more)
Multi-block saving	Saving of waveforms is possible by specifying the desired blocks of divisions
Block display	Display can be set to ON or OFF
Block overlaying	Desired blocks or all blocks
Automatic saving of calculation results	After measurement, automatic batch saving to CF card or HDD (binary, .txt file)

Cursor measurement functions

Cursor Functions	All functions supported
Number of cursors	Two (Cursors A and B)
Cursor types	Line (vertical or horizontal) and Trace
Cursor movements	A Cursor, B Cursor, A&B Cursors
Measurement function	A Cursor : Amplitude at each cursor, time from trigger event AB Cursor: Time, amplitude and frequency (period) differences between cursors
Cursor-supported channels	All channels (default), or any specified channel
Included functions	Partial printout, partial saving (specified time span)

Monitor functions

Level monitor display	Press the **DISP** key and select Level Monitor from the Switching window
Numerical value display	Instantaneous value display
Sampling rate	10 kS/s (fixed)
Refresh rate	Instantaneous value display 0.5 s

Position Display (VIEW) Functions

Display function	All types of positions, memory division blocks (only when using memory division), waveform search results, past waveform history (when memory division is OFF, depends on record length)
Relative position display	Displays the relative position of the currently displayed waveform within the overall recording length, and locations of cursors and trigger events
Block display	Block usage status (when memory division is ON) or past waveform history status (when memory division is OFF) Displayed block position
Jump function	Jump to trigger position/cursor position, jump to desired block, jump to past waveform (when memory division is OFF), and jump to waveform search position

Others

On-line help function	Pressing the **HELP** key displays help for the item at the currently selected (blinking) item (the whole screen is not used) Basic help (when making settings, displays a brief description of the selected (blinking) item along the bottom of the screen)
Grid types	Display: Off, normal or normal (dark) Printouts: Off, normal, fine, normal (dark) or fine (dark)
Comment display	Comments are displayed with channel numbers on the screen and in printouts (channel markers)
Time scale display	Time (seconds, base-60), divisions, Date, sample number (screen and printouts)
Variable auto-compensation	Included
Start backup function	Included
Backlight Saver	Off, or 1 to 30 min
Display color	Color 1 to 3, or user-defined
Beep sound	Off, warnings, or warnings and operations
Language	Japanese/English/Korean
Start key function	Press once, twice or hold for two seconds
Stop key function	Press once, or twice
External I/O terminals	Trigger I/O terminals (EXT_TRIG, TRIG_OUT), External sampling input terminal (EXT_SAMP) Remote control input terminal (START, STOP, PRINT),* Judgment output terminals (GO/NG) *:User selectable
Remote control	Select external I/O terminals for remote control (Start, Stop, Abort, Start&Stop, Pen_Up, Pen_Down, Print, Save)
Internal status output	For the GO/NG terminals, select (Error, Busy, Awaiting Trigger or Numerical Judgment)
Probe calibration output	Output from NG/EXT OUT2 terminal
Keylock function	Included
Recording printout content	Waveform
Printout magnification	Prints waveforms magnified or compressed on the time axis, regardless of Waveform screen display
Print size	Standard (A4) or Reduced (A6)
Print density	5 levels
Print Speed	Fast/Coarse, Normal or Slow/Fine
Upper/lower limit printing	Off / On
Zero-position comments	Off/On But not overlaid
Text comment printing	Load text file and print at printing start time.
Counter printing	Off, date or counter name and count value
GUI partial printing/saving	Off / On
List	Prints a list of settings
Gauge	Prints gauges for measurement channels (the same range is displayed on the same gauge) Gauges can be displayed
Waveform backup function	None
Auto setup function	When switched on, settings are automatically loaded from a file on the CF card, hard disk or internal memory.
Auto measurement function	Automatically selects the optimal timebase and voltage range for the input waveform
Backlight brightness	Selectable from 3 levels
Time setting	Included
Initialization	System reset, or clear waveform only
Self-Test function	ROM/RAM, Printer, Display, Key

17.6 Input Modules Specifications

17.6.1 8966 Analog Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when zero adjustment is executed 30 minutes after power on)
Period of guaranteed accuracy	1 year
No. of input channels	2 channels
Measurement range	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	± 0.5% f.s.(Filter 5 Hz On)
Temperature characteristic	± 0.06% f.s./°C
Frequency characteristic	DC Coupling: DC to 5 MHz -3 dB AC Coupling: 7 Hz to 5 MHz -3 dB (low cut-off frequency 7 Hz ± 50%)
Noise	1.5 mVp-p (typ), 2 mVp-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 ± 50%, 50 ± 50%, 500 ± 50%, 5k ± 50%, 50 k ± 50%, 500 k ± 50%(Hz)-3dB
Input type	Unbalanced (floating)
Input coupling	AC/ DC/ GND
Input resistance	1 MΩ ± 1%
Input capacitance	30 pF ± 10 pF (at 100 kHz)
A/D resolution	12 bit
Maximum sampling rate	20 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 VDC
Isolation resistance and Withstand voltage	2.704 kVAC for 15 seconds, (between input module and chassis, and between input modules) at least 100 MΩ at 500 VDC,
Maximum rated voltage to earth	300 VAC/DC (between input channels and chassis, and between input channels), Measurement category II (anticipated transient overvoltage 2500 V)
Operating temperature and humidity	Same as the host Memory HiCorder
Operating environment	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature -10 to 50°C Humidity 80% RH or less (non-condensating)
Dimensions	Approx. 106 mmW × 19.8 mmH × 207.5 mmD (4.17"W × 0.78"H × 8.17"D)
Mass	Approx. 250 g (8.8 oz)
Effect of radiated ratio-frequency electromagnetic field	± 15% f.s. (max) at 3 V/m
Effect of conducted radio- frequency electromagnetic field	±45% f.s. (max) at 3 V (100 mV/div range, with 1 VDC input)
Applicable standards	Safety EN61010 EMC EN61326 Class A

17.6.2 8967 Temp Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when zero adjustment is executed 30 minutes after power on)
Period of guaranteed accuracy	1 year
No. of input channels	2 channels
Input terminals	Pushbutton-type terminal block (2 terminals/ch)
Sensor	Thermocouple (K, E, J, T, N, W, R, S, B)

Measurement ranges
Measurable range
Resolution
Measurement accuracy (f.s.=20 div)

Sensor	Range		Measurable range	Resolution	Measurement accuracy
Thermocouple (not including standard junction compensation accuracy)	K[*1]	10°C/div	-100°C to 200°C	0.01°C	±0.1% f.s. ± 1°C ± 0.1% f.s. ± 2°C (-200°C to 0°C)
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1350°C	0.1°C	
	J[*1]	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1100°C	0.1°C	
	E[*1]	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 800°C	0.05°C	
		100°C/div	-200°C to 800°C	0.1°C	
	T[*1]	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 400°C	0.05°C	
		100°C/div	-200°C to 400°C	0.1°C	
	N[*1]	10°C/div	-100°C to 200°C	0.01°C	
		50°C/div	-200°C to 1000°C	0.05°C	
		100°C/div	-200°C to 1300°C	0.1°C	
	R[*1]	10°C/div	0°C to 200°C	0.01°C	± 0.1% f.s. ± 3.5°C (0°C to 400°C) (except B, for which accuracy is not guaranteed below 400°C) ± 0.1% f.s. ± 3°C (400°C and higher)
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 1700°C	0.1°C	
	S[*1]	10°C/div	0°C to 200°C	0.01°C	
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 1700°C	0.1°C	
	B[*1]	50°C/div	400°C to 1000°C	0.05°C	
		100°C/div	400°C to 1800°C	0.1°C	
	W[*2] (WRe5-26)	10°C/div	0°C to 200°C	0.01°C	
		50°C/div	0°C to 1000°C	0.05°C	
		100°C/div	0°C to 2000°C	0.1°C	

*1: JIS C 1602-1995, *2: ASTM E-988-96

Reference junction compensation accuracy	± 1.5°C (Reference junction compensation: When internal, add to thermocouple measurement accuracy)
Reference junction compensation	Selectable internal or external (during thermocouple measurement)
Temperature characteristic	Add (meas. accuracy × 0.1)°C to meas. accuracy
Data refresh	Selectable from normal, fast or slow

Selection	Fast	Normal	Slow
Data Refresh Rate	1.2 ms	100 ms	500 ms

Open-circuit detection	Selectable On or Off
Input resistance	≥100MΩ (with open-circuit detection Off) or 5.1 MΩ ± 5% with open-circuit detection On)
Common mode rejection ratio	80 dB minimum (at 50/60 Hz, with signal source ≥100Ω, and Fast data refresh setting) 100 dB minimum (at 50/60Hz, with signal source ≥100Ω, and Normal data refresh setting)
Input type	Unbalanced (floating)
Maximum rated voltage to earth	300 VAC/DC (between input channels and chassis, and between input channels) Measurement category II, (anticipated transient overvoltage 2500 V)
Dielectic strength	2.704 kVAC for 15 seconds (between input channels and chassis, and between input channels)
Operating temperature and humidity	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature-20 to 50°C, Humidity90% RH or less (non-condensating)
Operating environment	Same as the host Memory HiCorder
Dimensions	Approx. 106 mmW × 19.8 mmH × 204.5mmD (4.17"W × 0.78"H × 8.05"D)
Mass	Approx. 240 g (8.5 oz)
Option	Ferrite clamp-on choke..2
Effect of radiated ratio-frequency electromagnetic field	± 2% f.s. (max) at 3 V/m
Effect of conducted radio- frequency electromagnetic field	± 2% f.s. (max) at 3 V
Applicable standards	Safety EN61010 EMC EN61326 Class A

17.6.3 8968 High Resolution Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when zero adjustment is executed 30 minutes after power on)
Period of guaranteed accuracy	1 year
No. of input channels	2 channels
Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	±0.3% f.s. (Filter 5 Hz On, after zero adjustment)
Temperature characteristic	±0.045% f.s./°C
Frequency characteristic	DC coupling: DC to 100 kHHz -3 dB AC coupling: 7 Hz to 100 kHz -3 dB (low-cut frequency: 7 Hz±50%)
Noise	500 µVp-p (typ), 1 mVp-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±50%, 50±50%, 500±50%, 5 k±50%, 50k±50%(Hz)-3 dB
Anti-aliasing filter	Cutoff frequency (fc) 20, 40, 80, 200, 400, 800, 2k, 4k, 8k, 20k, 40k (Hz) (Automatic setting when the anti-aliasing filter is ON) Attenuation property at 1.5 fc, -66 dB or higher
Input type	Unbalanced (floating)
Input coupling	AC/DC/GND
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
A/D resolution	16 bit
Maximum sampling rate	1 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 VDC
Isolation resistance and Withstand voltage	2.704 kVAC for 1 minute, (between input module and chassis, and between input modules) At least 100 MΩ at 500 VDC
Maximum rated voltage to earth	300 VAC/DC (between input channels and chassis, and between input channels) Measurement category II (anticipated transient overvoltage 2500 V)
Operating temperature and humidity	Same as the host Memory HiCorder
Operating environment	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature -10 to 50°C Humidity 80% RH or less (non-condensating)
Dimensions	Approx. 106 mmW × 19.8 mmH × 207.5 mmD (4.17"W × 0.78"H × 8.17"D)
Mass	Approx. 250 g (8.8 oz)
Effect of radiated ratio-frequency electromagnetic field	±15% f.s. (max) at 3 V/m
Effect of conducted radio- frequency electromagnetic field	±20% f.s. (max) at 3 V (at 100 mV/div range, 1 VDC input)
Applicable standards	Safety EN61010 EMC EN61326 Class A

17.6.4 8969 Strain Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when auto balance is executed 30 minutes after power on)
Period of guaranteed accuracy	1 year
No. of input channels	2 channels
Input terminals	Weidmüller SL3.5/7/90G
Measurement Object	Strain gauge converter
Gauge ratio	2.0
Bridge voltage	2±0.05 V
Bridge resistance	120 Ω to 1 kΩ
Balance adjustment range	±10000 με or less
Balancing	Electronic auto-balancing
Measurement ranges	20, 50, 100, 200, 500, 1000 με/div
Measurement accuracy	±(0.5% f.s.+4 με)(Filter 5 Hz On)
Temperature characteristic	Gain: ±0.05% f.s./°C, Zero position: ±2.5 με/°C (After auto-balancing)
Frequency characteristic	DC to 20 kHz +1/-3 dB
Low-pass filter	Off, 5±30%, 10±30%, 100±30%, 1k±30%(Hz) -3 dB
Resolution	Range ÷ 1250
Maximum sampling rate	200 kS/s
Maximum rated voltage to earth	33 Vrms AC or 70 VDC (between input channels and chassis, and between input channels) Measurement category I (anticipated transient overvoltage 330 V)
Dielectic strength	350 VAC for 15 seconds (between input channels and chassis, and between input channels)
Operating temperature and humidity	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature -20 to 50°C, Humidity90% RH or less (non-condensating)
Operating environment	Same as the host Memory HiCorder
Dimensions	Approx. 106 mmW × 19.8 mmH × 196.5 mmD (4.17"W × 0.78"H × 7.74"D)
Mass	Approx. 220 g (7.8 oz)
Effect of radiated ratio-frequency electromagnetic field	± 10% f.s. (max) at 3 V/m
Effect of conducted radio- frequency electromagnetic field	± 10% f.s. (max) at 3 V
Accessories	9769 Conversion Cable × 2 (Compatible sensor connector : PRC03-12A10-7M10.5 by TAJIMI)
Applicable standards	Safety EN61010 EMC EN61326 Class A

17.6.5 8970 Freq Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH
Measurement functions	Based on voltage input, measures frequency, rotation speed, power frequency, integral values, pulse duty ratio, and pulse width.
Connection terminal	Insulated BNC terminal
Input resistance	1 MΩ±1%
Input capacitance	30pF±10pF
Maximum input voltage	400 VDC
Maximum rated voltage to earth	300 VAC, DC (Measurement category II), anticipated transient overvoltage 2500 V (between each input channel and main unit, and between input channels)
Isolation resistance Dielectric strength	DC2.704 kVAC for 15 seconds (between input module and main unit, and between input modules), 100 MΩ and over/500 V
Input type	Unbalanced (input isolated from output)
Guaranteed accuracy period	1 year
Frequency mode	
Measurement ranges	1, 5, 10, 50, 100, 500, 1k, 5 kHz/div (f.s.=20div)
Measurement accuracy	±0.1%f.s. (except for 5 kHz/div range) ±0.7%f.s.(5 kHz/div range)
Measurement ranges	DC to 100 kHz (min. pulse width 2 µs)
Rotation speed mode	
Measurement ranges	100, 500, 1k, 5k, 10k, 50k, 100 kr/min /div (f.s.=20div)
Measurement accuracy	±0.1%f.s. (except for 100 kr/min range) ±0.7%f.s.(100 kr/min range)
Measurement ranges	0 to 2 kr/min (min. pulse width 2 µs)
Power frequency mode	
Measurement ranges	50 Hz (40 to 60 Hz), 60 Hz (50 to 70 Hz), 400 Hz (390 to 410 Hz) (f.s.=20div)
Measurement accuracy	±0.03 Hz (50 Hz, 60 Hz) ±0.1 Hz (400 Hz)
Integral values mode	
Measurement ranges	2k, 10k ,20k ,100k ,200k ,1M counts/div
Measurement accuracy	±range/2000
Measurement ranges	DC to 100 kHz (min. pulse width 2 µs)
Pulse duty ratio mode	
Measurement ranges	5%/div (f.s.=20div)
Measurement accuracy	±1% (10 to 10 kHz) ±4% (10k to 100 kHz)
Measurement ranges	10 to 100 kHz (min. pulse width 2 µs)
Pulse width mode	
Measurement ranges	500µ, 1m, 5m, 10m, 50m, 100 ms/div (f.s.=20div)
Measurement accuracy	±0.1%f.s.
Measurement ranges	2 µ to 2 s
Measurement resolution	Integral values mode: 2000LSB/DIV (f.s.=20 DIV) Power frequency mode: 100LSB/DIV (f.s.=20 DIV) Except for Integral values mode and Power frequency mode: 500LSB/DIV (f.s.=20 DIV)
Response time	Less than 40 µs + sampling interval of instrument in which the device is installed.
Input voltage range	±10 V, ±20 V, ±50 V, ±100 V, ±200 V, ±400 V
Threshold value	±10 V range : -10 to +10 V variable (0.1 V steps), ±20 V range: -20 to +20 V variable (0.2 V steps), ±50 V range : -50 to +50 V variable (0.5 V steps), ±100 V range: -100 to +100 V variable (1 V steps), ±200 V range: -200 to +200 V variable (2 V steps), ±400 V range: -400 to +400 V variable (5 V steps)
Slope	Rising, falling (Frequency, Rotation speed, Power frequency, Integral values mode)
Level	High, Low (Duty ratio, Pulse width mode)
Hold	Frequency mode/ Rotation speed mode: ON/OFF (1 Hz, 0.5 Hz, 0.2 Hz, 0.1 Hz) :When OFF is selected and the next measurement value is not determined within the waiting time period, the frequency or the rotation speed will be determined using the value which is calculated based on the time period between the timing of the last measurement and the timing of the sampling. Put it to 0 when the measurement value is below the fixed value.
Smoothing	OFF, ON* (Frequency mode,Rotation speed mode) *:The permissible smoothing frequency is up to 10 kHz.
Low-pass filter	OFF, 5, 50, 500, 5k, 50 kHz
Input Coupling	DC, AC (Low frequency cut-off in AC-coupled mode : 7 Hz)
Frequency dividing function	Setting range: 1 to 4096, by one step (Frequency ,Rotation speed ,Integral values mode)
Integration start timing	Start, Trigger (Integral values mode)
Integration limit	Hold, Loop (Integral values mode)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the 8970 is installed

Storage temperature and humidity ranges	Same as the Memory HiCorder in which the 8970 is installed
Operating environment	Same as the Memory HiCorder in which the 8970 is installed
Applicable standards	Safety EN 61010, EMC EN 61326 Class A
Dimensions and mass	Approx. 106W x 19.8H x 196.5D mm (4.17"W x 0.78"H x 7.74"D) (excluding projections), Approx. 250 g (8.8 oz.)

17.6.6 8971 Current Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when zero adjustment is executed 30 minutes after power on)
Guaranteed accuracy period	1 year
Number of input channels	2 channels
Applicable current sensors	9272-10, 9277, 9278, 9279, 9709 , CT6862, CT6863 (To connect with Model 8971, using Model 9318 Conversion Cable)
Measurement ranges	When using the Model 9272-10 (20A), 9277: 100m, 200m, 500m, 1, 2, 5 A/div When using the Model 9272-10 (200A), 9278,CT6863: 1, 2, 5, 10, 20, 50 A/div When using the Model 9279, 9709: 2, 5, 10, 20, 50, 100 A/div When using the Model CT6862: 200m, 500m, 1, 2, 5, 10 A/div
Measurement accuracy*	±0.65%f.s. (filter 5 Hz ON) ±0.85%f.s. (filter 5 Hz ON, for using with Model 9278 or 9279)
RMS accuracy*	±1%f.s. (DC, 30 to 1 kHz), ±3%f.s. (1 kHz to 10 kHz), (Sine wave input, filter 5 Hz ON)
Response time*	100 ms (rise 0→90%f.s.)
Crest factor	2
Temperature characteristic*	±0.075%f.s./°C
Frequency characteristic*	DC Coupling: DC to 100 kHz ±3 dB AC Coupling: 7 Hz to 100 kHz ±3 dB (low cut-off frequency 7 Hz±50%)
Noise*	10 mAp-pmax (sensitivity range, with input shorted) (for 20 A/2V range)
Low-pass filter	OFF, 5, 50, 500, 5k, 50 k±50%(Hz)-3 dB
Input type	Unbalanced (Not insulated)
Input coupling	AC/DC/GND
Input resistance	1MΩ±1%
A/D resolution	12 bit
Maximum sampling rate	1 MS/s
Input terminals	Sensor connector HR10A-10R-S (HIROSE)
Operating temperature and humidity ranges	Same as the Memory HiCorder in which the 8971 is installed
Operating environment	Same as the Memory HiCorder in which the 8971 is installed
Storage temperature and humidity ranges	-10 to 50°C (14 to 122°F), 80% RH or less (no condensation)
Dimensions	Approx. 106W x 19.8H x 196.5D mm (4.17"W x 0.78"H x 7.74"D) (excluding projections)
Mass	Approx. 250 g (8.8 oz.)
Applicable Standards	Safety EN 61010 EMC EN 61326 Class A
Accessories	For connecting the clamp sensor: Model 9318 Conversion Cable x 2, Instruction Manual
Number of the 8971 available for Memory HiCoder	Max. 4 unit (for Model 8847)

*: During current measurement, add the accuracy and characeristic of clamp sensor using with Model 8971.

17.6.7 8972 DC/RMS Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9F°), 20 to 80% RH (when zero adjustment is executed 30 minutes after power on)
Period of guaranteed accuracy	1 year
No. of input channels	2 channels
Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV, 1, 2, 5, 10, 20 V/div
Measurement accuracy	±0.5% f.s. (Filter 5 Hz On)
RMS accuracy	±1% f.s. (DC, 30 Hz to 1 kHz), ±3% f.s. (1 kHz to 100 kHz) (Sine wave input, response time: SLOW)
Response time	Slow 5 s (during rise 0 to 90% f.s.), Mid 800 ms (during rise 0 to90% f.s.), Fast 100 ms (during rise 0 to 90% f.s.)
Crest factor	2
Temperature characteristic	±0.045% f.s./°C
Frequency characteristic	DC coupling: DC to 400 kHz ±3 dB AC coupling: 7 Hz to 400 kHz ±3 dB (low cut-off frequency: 7 Hz±50%)
Noise	500 µVp-p (typ), 750 µVp-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±50%, 50±50%, 500±50%, 5k±50%, 100k±50%(Hz)-3 dB
Input type	Unbalanced (floating)
Input coupling	AC/DC/GND
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
A/D resolution	12 bit L
Maximum sampling rate	1 MS/s
Input terminals	Insulated BNC terminal
Maximum input voltage	400 VDC
Isolation resistance and Withstand voltage	2.704 kVAC for 15 seconds, (between input module and chassis, and between modules), At least 100 MΩ at 500 VDC
Maximum rated voltage to earth	300 VAC/DC (between input channels and chassis, and between input channels) Measurement category II (anticipated transient overvoltage 2500 V)
Operating temperature and humidity	Same as the host Memory HiCorder
Operating environment	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature -10 to 50°C, Humidity 80% RH or less (non-condensating)
Dimensions	Approx. 106 mmW × 19.8 mmH × 207.5 mmD (4.17"W × 0.78"H × 8.17"D)
Mass	Approx. 250 g (8.8 oz)
Effect of radiated ratio-frequency electromagnetic field	±15% f.s. (max) at 3 V/m
Effect of conducted radio- frequency electromagnetic field	±20% f.s. (max) at 3 V (100 mV/div range, with1 VDC input)
Applicable standards	Safety EN61010 EMC EN61326 Class A

17.6.8 8973 Logic Unit

Period of guaranteed accuracy	1 year
No. of input channels	4 Probes (16channels)
Input terminals	Mini DIN
Applicable probes	9320-01 Logic Probe, MR9321-01 Logic Probe, 9327 Logic Probe
Operating temperature and humidity	Same as the host Memory HiCorder
Operating environment	Same as the host Memory HiCorder
Storage temperature and humidity	Temperature -10 to 50°C Humidity 80% RH or less (non-condensating)
Dimensions	Approx. 106 mmW × 19.8 mmH × 204.5 mmD (4.17"W × 0.78"H × 8.05"D)
Mass	Approx. 190 g (6.7 oz)
Applicable standards	Safety EN61010 EMC EN61326 Class A

Maintenance and Service

Chapter 18

Transporting

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

⚠CAUTION

To avoid damage, observe the following when shipping the instrument:

- Remove the CF card, USB memory stick, and recording paper before shipping.
- If the optional printer module is installed, remove the paper. If the paper is left in the instrument, the paper-handling components may be damaged by vibration.

When the instrument is not to be used for a long time, or when transporting

To avoid straining some parts of the printer, and to prevent dirt adhering to the print head, set the printer cover closed.

After storing the printer without use for a long time, inspect the following before use:
Perform test printing (printer check) three or four times.

Replaceable Parts

Certain parts require replacement periodically and at the end of their useful life: (Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods)

Part	Life	Part	Life
Fan Motor	Approx. 4 years	**9664 HD Unit**	Approx. 20,000 hours
Printer	After using approx. 1,000 rolls of the recording paper	**LCD**	Approx. 74,000 hours
Backlight (to half brightness)	Approx. 50,000 hours		
Electrolytic Capacitors	Approx. 4 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.)		
Lithium Battery	Approx. 10 years This instrument contains a built-in lithium battery to back up settings and the real-time clock. Have the battery replaced if the date and time are found to lag substantially or if settings are not retained when power is turned off and back on. Contact your dealer or Hioki representative.		

The fuse is housed in the power unit of the instrument. If the power does not turn on, the fuse may be blown. If this occurs, a replacement or repair cannot be performed by customers. Please contact your dealer or Hioki representative.

18.1 Trouble Shooting

If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.

If Power and Operating Keys 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. **"2.5 Supplying Power" (⇒ p.33)**
Keys do not work.	• Is any key being held down? • Is the key-lock state active (Key-Lock message displayed)?	• Verify key operation. • Deactivate the key-lock state. (Hold the ◁ ▷ **CURSOR** keys for three seconds)

If the Display or Operations Malfunction

Symptom	Check Item, or Cause	Remedy and Reference
Blank screen	Is the backlight saver active? Press any key to check.	Turn the backlight saver off.
A waveform does not appear when you press the **START** key.	• Is the “Pre-Trigger wait” message displayed? • Is the "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.	• Is the clamp sensor or connection cable connected correctly? • Is the vertical axis (voltage axis) range set properly? • Is the low-pass filter enabled?	Verify that the clamp sensor or connection cable is connected correctly. Verify the input channel settings.
While measuring with the memory function, the displayed frequency is much lower than the actual frequency.	Aliasing may be occurring.	Change the timebase to use a faster sampling rate. **"3.4.2 Time Axis Range and Sampling Rate" (⇒ p.43)**
Some channels are unusable.	Is the channel enabled for use?	**"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)**
The displayed waveform size does not change when the input range is changed.	Is the Variable function enabled?	Turn the Variable function off. **"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.134)**

Cannot Print, or Printing Malfunctions

Symptom	Check Item, or Cause	Remedy and Reference
Nothing prints on the paper.	Is the paper reversed (back to front)?	Verify that the recording paper is loaded correctly. **"2.4 Loading Recording Paper" (⇒ p.31)**
Printout is too light.	• Is the specified recording paper being used? • Is the print density setting correct? • Is the print head dirty?	Try changing the print density setting. **"6.5 Making Printer Settings" (⇒ p.95)** Clean the print head. **"" (⇒ p.321)**
Recording traces are too wide.	The input signal may have a ripple component.	Enable the filter in the input module settings. **"3.5.2 Analog Channel" (⇒ p.52)**
Recording traces are doubled.	Is the waveform printing density set to **[Light]**? In this case, printed dots are spaced out in the vertical direction. Therefore, a slightly varying waveform prints sometimes as one line, and sometimes as two.	Change to waveform printing density setting to something other than **[Light]**. (**[Printer]** sheet) **"6.5 Making Printer Settings" (⇒ p.95)**

If Saving is Not Possible

Symptom	Check Item, or Cause	Remedy and Reference
If saving is not possible to the storage media.	• Is your CF card Hioki certified? • Is the storage media inserted properly? • Is the storage media formatted? • Is the remaining capacity of the storage media too low? • Has the number of files in the folder reached the limit?	**"2.3 Recording Media Preparation" (⇒ p.28)** **"Media information"(⇒ p.66)**
Cannot use USB memory stick	Have settings for using USB memory stick been made?	**"USB use"(⇒ p.29)**

Others

Symptom	Check Item, or Cause	Remedy and Reference
Cannot use USB communications	Have USB communication settings been made?	**"15.6.1 Making USB Settings at the Instrument" (⇒ p.278)**
Cannot install USB driver	• Is the **[Interface]** item set to **[USB]**? • Has driver installation failed?	• Set **[Interface]** item to **[USB]**. **"15.6.1 Making USB Settings at the Instrument" (⇒ p.278)** • Access the **[device manager]** on the PC and delete **[Other Devices]**. Then reconnect the USB cable.
The response of remote control is very slow.	Check the java settings.	About the java settings, see the application disk supplied with the instrument.

If the cause is unknown

Try performing a system reset. All settings are returned to their factory defaults.

See: "18.2 Initializing the Instrument" (⇒ p.314)

18.2 Initializing the Instrument

18.2.1 Initializing System Settings (System Reset)

Select groups of settings currently in force on the instrument, and initialize the settings. Initialization returns the instrument to the factory default state. By default, the setting of [Setting (Stat, Ch, Trig)] and [Setting (Env)] are selected for initialization in this screen.

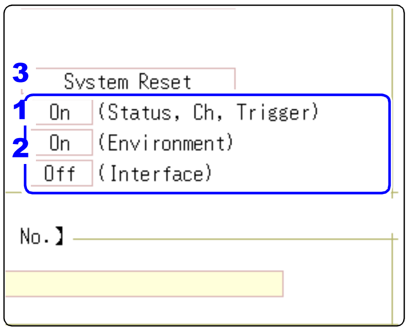
Procedure

To open the screen: Press the SYSTEM key →[Init] sheet

1 Move the cursor to the item you want to initialize.

2 Select **[On].**
Select **[Off]** for the groups of settings that you do not want to initialize.

(Status, Ch, Trigger)	Current settings in Status screen, Channel screen, and Trigger setting window (Default setting: On)
(Environment)	Current settings in the Environment sheet, File Save sheet, and Printer sheet (Default setting: On)
(Interface)	Current settings in the Interface sheet (Default setting: Off)



System Reset
On (Status, Ch, Trigger)
On (Environment)
Off (Interface)
No.】

3 Move the cursor to the **[System Reset]**.

4 Select **[Exec].**

A confirmation dialog box appears.

[WARN] Enabled setting reset!
Okay?

F1 : YES
F2 : NO

5 Select **[Yes].**

To cancel initializing:
Select **[No].**
Initialization is complete when "System initialized" appears.

18.2.2 Initializing Waveform Data

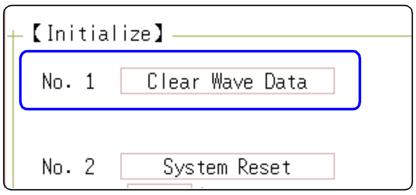
Discard the waveform data saved in memory and initialize the data.

Procedure

To open the screen: Press the SYSTEM key →[Init] sheet

1 Move the cursor to the **[Clear Wave Data]**.

2 Select **[Exec].**



【Initialize】
No. 1 Clear Wave Data
No. 2 System Reset

Initialization is complete when "Waveform data erased." appears.

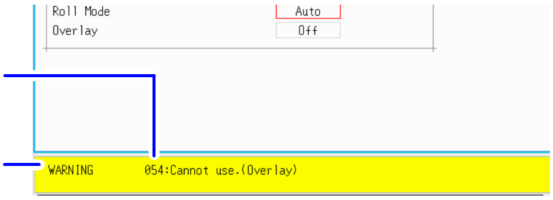
18.3 Error Messages

A screen message appears whenever an error occurs. In either case, take the remedial action indicated.

A beep may sound if the beeper setting on the **[Environment]** sheet is **[Warn]** or **[Warn+Action]**.

See: "Chapter 14 System Environment Settings" (⇒ p.255)

Warning Display



Roll Mode Auto
Overlay Off

WARNING 054:Cannot use.(Overlay)

Displayed Message Number (Msg No.)

Message

Appears just once when an error occurs. Disappears within a few seconds.
Also disappears when any key is pressed.

Displayed Warnings

Msg No.	Message	Remedial Action	Reference
3	**Out of paper.**	Load more paper.	"2.4 Loading Recording Paper" (⇒ p.31)
4	**Printer lever is opened.**	Close the printer lever.	
5	**Recording length is set to Continuous.**	When the Recording Length (Shot) is set to Continuous (Cont.), real-time printing is not available with fast timebase settings.	"3.4.3 Recording Length (number of divisions)" (⇒ p.46)
6	**Cannot set.(Time/Div 10ms-200ms).**	When the Recording Length (Shot) is set to Continuous (Cont.), the printer cannot be used.	
10	**Mount media.**	Set the recording media.	"2.3 Recording Media Preparation" (⇒ p.28)
11	**Illegal format.**	Wrong recording format. Reformat the media.	"2.3.2 Formatting Storage Media" (⇒ p.30)
12	**Can not write.**	Write-protection is enabled on the storage media. Disable it.	-
13	**Disk full while accessing the file.**	Saving is not possible because of insufficient space on the storage media. Delete files or replace the storage media. If measuring, Stop measurement, then replace the storage media.	"5.5.4 Deleting Files & Folders" (⇒ p.84)
14	**File is read only.**	File is read only. Deletion is not permitted.	-
15	**Access to the file was denied.**	An internal fault may have occurred in the instrument. Turn the instrument off and back on	-
16	**The file name already exists: cannot save.**	Change the file name.	"5.5.6 Renaming Files & Folders" (⇒ p.85)
17	**The folder name already exists.**	Change the folder name.	
18	**Not enough free space in the folder to create file.**	Either delete files in the saving destination folder, or change to another saving destination.	-
19	**Folder not empty.**	The folder is not empty, be sure you want to delete.	-
20	**The maximum length of a file name, including its path, is 255 characters.**	File names including the path must not exceed 255 characters.	-
21	**Internal error.**	An internal error occurred. Check the storage media.	-
22	**No waveform data to save.**	Acquire waveform data.	-
24	**There is no calculation result.**	There is no calculation result. Print results after performing calculation.	"Chapter 10 Numerical Calculation Functions" (⇒ p.173)
25	**Can not select this media.**	Automatic saving can only be specified in CF/HDD.	-
26	**Invalid folder path.**	Route cannot be specified.	-

Displayed Warnings

Msg No.	Message	Remedial Action	Reference
27	**When executing, select "No" as the save property.**	As other dialogs are displayed, selective saving cannot be carried out. Either set the selective saving during execution to [No] or close the dialog and re-save.	"5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.74)
29	**The record length was restricted.**	-	-
30	**Auto-ranging failed.**	Check the input signal.	"3.7 Measurement With Automatic Range Setting (Auto-Ranging Function)" (⇒ p.58)
31	**A/B cursor positions invalid.**	The A/B cursors overlap. Check the cursor positions.	"7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.105)
32	**Zero-adjustment needed.**	Perform zero-adjustment.	"2.7 Adjusting the Zero Position (Zero-Adjust)" (⇒ p.36)
33	**Disabled key.**	Close the dialog.	-
34	**Invalid key pressed (Overlay)**	The key operation is prohibited because Overlay is enabled.	"8.3 Displaying New Waveforms Over Past Waveforms (Overlay)" (⇒ p.125)
36	**No trigger has been set.**	Set trigger criteria.	"Chapter 9 Trigger Settings" (⇒ p.151)
38	**Use of logic channels has reduced analog waveform resolution from 16 to 12 bits.**	Using channels LA - LD reduces resolution of Ch1 - Ch4 to 12 bits.	"8.10 Making Detailed Settings for Input Modules" (⇒ p.140)
39	**Auto balance failed.**	Check whether a sensor is in an uncharged state, and that it is connected correctly.	"8.10.4 Settings for the 8969 Strain Unit" (⇒ p.144)
40	**Voltage Sag triggering is disabled. (Valid time base range: 20 µs/div to 50 ms/div)**	Voltage Sag triggering can be used only when the time base is between 20 µs/div to 50 ms/div	"9.3.1 Analog Trigger Settings and Types" (⇒ p.154)
41	**Channels that are not measurable will be assigned to X-Y.**	Channel with specification exceeding [Used Ch] is selected. Change channel selection.	"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.127)
42	**There is not enough data in the memory.**	Measure the data portion required for calculation.	"11.1 Waveform Calculation Workflow" (⇒ p.190)
43	**Stopped.**	-	-
44	**Current clamp/sensor was recognized.**	-	-
45	**Current clamp/sensor was disconnected.**	Check the connection of the current clamp/ sensor.	-
46	**Channels may no longer be able to be used by frequency units due to logic use.**	If logic channels A, B, C, and D of the machine are used, the respective frequency units at channels 1, 2, 3, and 4 cannot be used.	"3.5.3 Logic Channel" (⇒ p.55)
47	**:This unit cannot be used because it is not AAF aligned.**	Press the SYSTEM key to display the **[Init]** sheet. Execute the **[System Information]** and check the software items. If **[Not AAF aligned]** is displayed, send the unit for repairs.	-
48	**There are units on which AAF cannot be set to On because of lack of adjustment.**		
50	**Roll Mode is not available.**	The Roll Mode cannot be used when Overlay is enabled.	"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.124)
51	**Cannot use. (Pre Trigger)**	The pre-trigger function is not available when using external sampling.	"Chapter 16 External Control" (⇒ p.287)
52	**Cannot use .(Roll Mode, Memory Division)**	If the waveform calculation function is used, these functions cannot be used.	"11.1 Waveform Calculation Workflow" (⇒ p.190)
53	**Cannot use. (Roll Mode, Memory Division, Wave Calculation)**	If one function is used, the other functions cannot be used.	"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.124)

Displayed Warnings

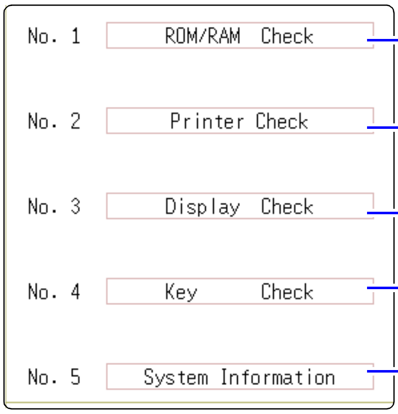
Msg No.	Message	Remedial Action	Reference
54	**Cannot use.(Overlay)**	The overlay function is not available when using the Roll mode.	"8.3 Displaying New Waveforms Over Past Waveforms (Overlay)" (⇒ p.125)
55	**Cannot use. (Overlay, Memory Division, Wave Calculation)**	If roll mode is used, these functions cannot be used.	"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.124)
56	**Real-time printing is not available.**	Recording Length (Shot) is set to Continuous (Cont.). Real-time printing is not available when using the Recorder function and Fast timebase setting.	"3.4.3 Recording Length (number of divisions)" (⇒ p.46) "6.2 Making Auto Print Settings" (⇒ p.91)
57	**Cannot set.(External sampling)**	Cannot use roll mode when using external sampling.	"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.124)
58	**Rated capacity/rated output error.**	Rated capacity/Rated output has exceeded selected range. Input correct value.	Note (⇒ p.131)
59	**Cannot use. (Roll Mode, Wave Calculation)**	If the memory division function is used, these functions cannot be used.	"12.1 Recording Settings" (⇒ p.203)
60	**No waveform data.**	Acquire waveform data.	-
65	**When sampling rate is 1 ms/S, line interpolation is not available.**	Select a slower sampling rate setting.	"4.2 Setting Measurement Configuration" (⇒ p.61)
68	**Recording length is too long.**	Shorten the measurement record length. (The maximum record length that can be calculated is 10,000 div.)	"3.4.3 Recording Length (number of divisions)" (⇒ p.46)
80	**In key lock.**	Keylock is engaged. Cancel the Key-Lock function.	"KEY LOCK:"(⇒ p.11)
91	**LAN: Bad IP address.**	Check the IP address.	"15.1 LAN Settings and Connection (Before Using FTP/Internet Browser/Command Communications)" (⇒ p.260)
95	**LAN: Connection timed out.**	Check the transmission setting.	
97	**LAN: Network error.**	Check the connections between the instrument and connection destination.	
99	**LAN: DHCP failed.**	Check the DHCP server.	
100	**Inappropriate setting of time axis for waveform data.**	Return the time axis to the time axis setting when the waveform was measured.	"3.4.2 Time Axis Range and Sampling Rate" (⇒ p.43) "9.11 Using trigger settings to search measurement data" (⇒ p.171)
101	**Some blocks are different in time axis setting from the others.**	Set the same time axis setting for all search target blocks. If they cannot be the same, set the search range to display blocks only.	
102	**Some blocks are different in units configuration from the others.**	Unify the unit configuration of search target blocks. If they cannot be the same, set the search range to display blocks only.	"9.11 Using trigger settings to search measurement data" (⇒ p.171)
103	**No data matching your search condition.**	Check the trigger setting.	
104	**There is no data in the search target channel.**	Select channels with measurement data in the inspection target.	
105	**There is a block with no data in the search target channel.**	Select blocks with measurement data in the inspection target.	

18.4 Self-Test (Self Diagnostics)

The following self-test checks are available.

Procedure

To open the screen: Press the SYSTEM key →[Init] sheet



No. 1 ROM/RAM Check	Check the instrument's internal memory (ROM and RAM). The results are displayed on the screen. (⇒ p.318)
No. 2 Printer Check	Check printing by the printer and clean print heads. (⇒ p.321)
No. 3 Display Check	Check the screen display (color check, gradation check). (⇒ p.319)
No. 4 Key Check	Check whether instrument keys are functioning correctly. (⇒ p.319)
No. 5 System Information	Check the system configuration. (⇒ p.320)

18.4.1 ROM/RAM Check

This check tests the instrument's internal memory (ROM and RAM).
RAM contents are unaffected by the ROM/RAM check.

1 Move the cursor to the **[ROM/RAM Check]** item.

2 Select **[Exec]**.

The ROM/RAM check starts.

The following checks are performed in the sequence shown.
Program ROM⟶Address bus⟶Backup RAM⟶ Work RAM⟶
Video RAM⟶Storage RAM

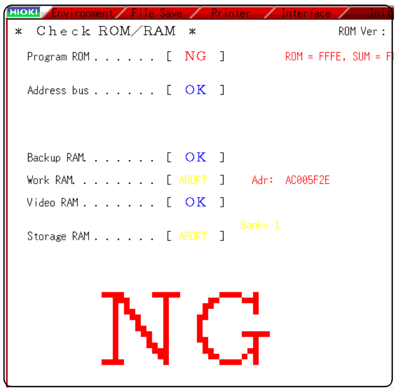
Do not turn the power off during the check.

To cancel the check:
Press the **STOP** key
The current check is interrupted and the next one starts.
All operation key (except **STOP** key) are disabled during execution of the check.

The judgment results appear when the check finishes.
OK: Normal
NG: Error
ABORT: When any check is interrupted

If "NG" appears, ask to have the instrument repaired.

Press any key, and the original screen reappears



```
*  Check ROM/RAM  *                              ROM Ver :
  Program ROM . . . . . . [  NG  ]       ROM = FFFE, SUM = F

  Address bus . . . . . . [  OK  ]


  Backup RAM. . . . . . . [  OK  ]
  Work RAM. . . . . . . . [ ABORT ]   Adr:  AC005F2E
  Video RAM . . . . . . . [  OK  ]
                                    Bank= 1
  Storage RAM . . . . . . [ ABORT ]

              NG
```

Procedure (Common for Printer Check, Display Check, Key Check, System Configuration Check)

To open the screen: Press the SYSTEM key →[Init] sheet

18.4.2 Printer Check

This check tests the condition of the printer.
Before executing, check to be sure that recording paper is loaded.

1 Move the cursor to the **[Printer Check]** item.

2 Select **[Exec]**.
A test pattern is printed.
About 5 cm of each of the following are printed, in this order: Checkerboard →Vertical lines →Slanted lines →Characters

To cancel the check:
Press the **STOP** key.

Things to check for after printer check
Check the printed recording paper for white streaks. If there are any white streaks, clean the print heads(⇒ p.321)

Print quality (print speed) and print density settings will be reflected in the test printout.

18.4.3 Display Check

This check tests the condition of the display screen.

1 Move the cursor to the **[Display Check]** item.

2 Select **[Exec]**.
A red screen appears.

3 Press any key to check the display condition.
The screen changes each time you press an operation key.

To chancel the check:
Press the **ESC** key.
The original screen reappears

Screen Changes
Color check (Red, Green, Blue, Black, White)→ Gradiation check (Red, Green, Blue, Black, White)→ Color pattern→Original screen.

If the display screen seems abnormal, request repairs.

18.4.4 Key Check

This check tests operation of the keys and jog/shuttle controls.

1 Move the cursor to the **[Key Check]** item.

2 Select **[Exec]**.
Operation keys appear.

3 Press each operation key once or more.
The corresponding key is painted over.

Jog : Rotate to the left and right, one time or more in each direction.
Shuttle: Turn slowly all the way in each direction.
(**START** key also functions as an LED light check key.)

The check is finished when you have operated all the keys.

To cancel the check:
Press the **START** key and **STOP** keys simultaneously
The original screen reappears.

The key check does not finish if there is a problem that prevents even one of the keys from being recognized. If this occurs, press the **STOP** and **START** keys simultaneously to display the original screen.

There may be a malfunction in the instrument, so request repairs.
If there is a problem with the **STOP** or **START** key, you cannot return to the original screen. Power the instrument off and request repairs.

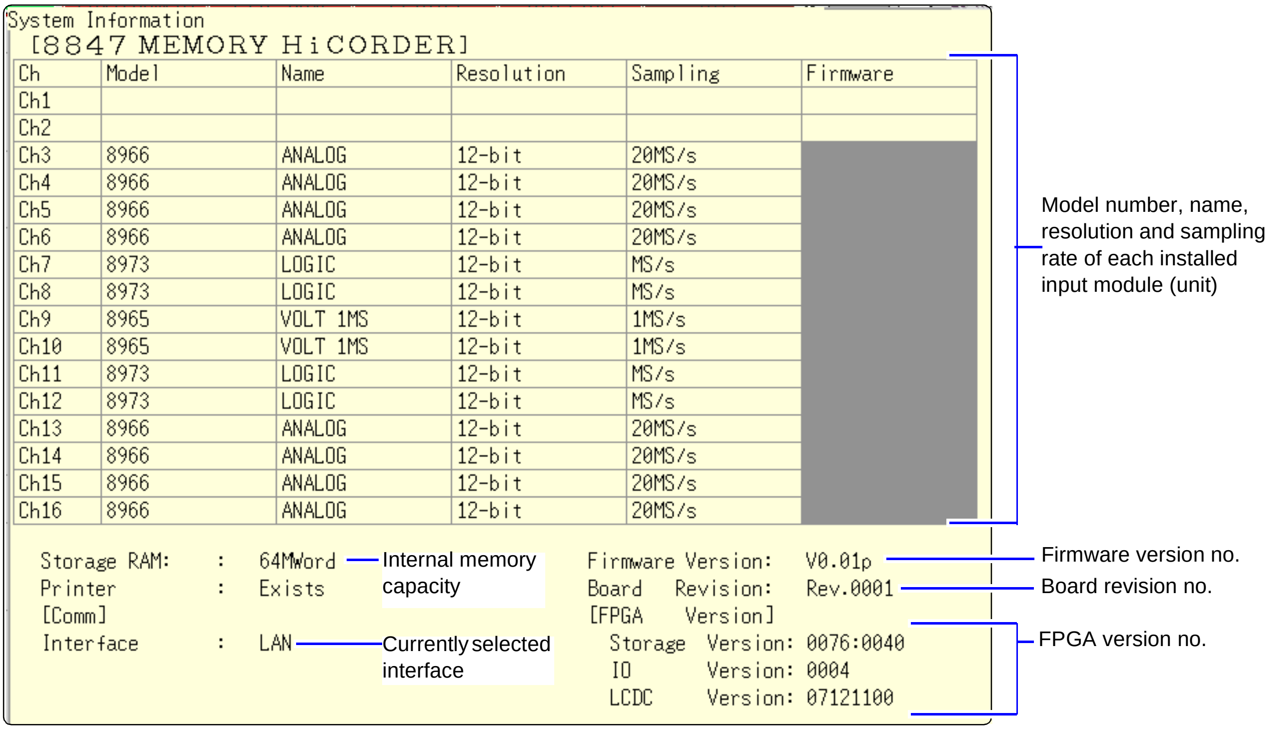
18.4.5 System Configuration Check

The list of installed options and other system information appears in a separate window.

1 Move the cursor to the **[System Information]** item.

2 Select **[Exec]**.
The System Configuration List appears.

To reappear the original screen:
Press any key.



System Information
[8847 MEMORY HiCORDER]

Ch	Model	Name	Resolution	Sampling	Firmware
Ch1					
Ch2					
Ch3	8966	ANALOG	12-bit	20MS/s	
Ch4	8966	ANALOG	12-bit	20MS/s	
Ch5	8966	ANALOG	12-bit	20MS/s	
Ch6	8966	ANALOG	12-bit	20MS/s	
Ch7	8973	LOGIC	12-bit	MS/s	
Ch8	8973	LOGIC	12-bit	MS/s	
Ch9	8965	VOLT 1MS	12-bit	1MS/s	
Ch10	8965	VOLT 1MS	12-bit	1MS/s	
Ch11	8973	LOGIC	12-bit	MS/s	
Ch12	8973	LOGIC	12-bit	MS/s	
Ch13	8966	ANALOG	12-bit	20MS/s	
Ch14	8966	ANALOG	12-bit	20MS/s	
Ch15	8966	ANALOG	12-bit	20MS/s	
Ch16	8966	ANALOG	12-bit	20MS/s	

Storage RAM : 64MWord
Printer : Exists
[Comm]
Interface : LAN

Firmware Version: V0.01p
Board Revision: Rev.0001
[FPGA Version]
Storage Version: 0076:0040
IO Version: 0004
LCDC Version: 07121100

Model number, name, resolution and sampling rate of each installed input module (unit)

Internal memory capacity

Currently selected interface

Firmware version no.

Board revision no.

FPGA version no.

18.5 Cleaning

Print Head Cleaning

⚠WARNING

The print head and surrounding metal parts can become hot. Perform cleaning only after making sure that the parts have fully cooled down.Be careful to avoid touching these parts.

Normally, no maintenance is required. However, depending on usage conditions, dirt and paper dust may accumulate on the thermal head over the long term, causing light or smeared printing. In this case, clean the head by the following procedure.

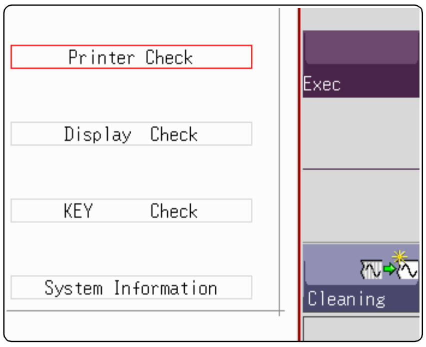
Print Head Cleaning

Before Cleaning
Recording paper is required to clean the print head. Verify that the recording paper is loaded correctly.

1. Press the **SYSTEM** key to display the **[Init]** sheet.
2. Move the cursor to the **[Printer Check]** item.
3. Select **[Cleaning]**.

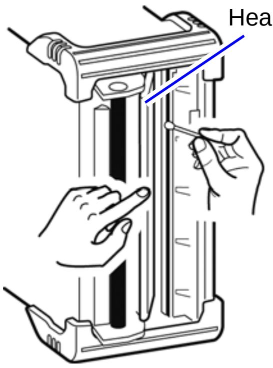
The paper should print solid (100%) black.

If sufficient improvement is not obtained even after cleaning several times, wash the print head (⇒ p.321).



Washing the Print Head

Required item: Undiluted alcohol, Cotton swab



1. Moisten the end of a cotton swab with undiluted alcohol.

Be careful not to apply too much undiluted alcohol

2. Flip the head cover open and wipe the print head with the tip of the cotton swab.

NOTE

About the Print Head

Note the following precautions to avoid discoloring or deforming the instrument.

- Do not use organic solvents such as thinner or benzene.
- After washing, allow the printer to dry completely before use.

About the Roller Surface

- White powder such as paper dust may accumulate on the roller surface after long-term use. A small amount should have no effect on printing, but can be removed with a commonly available camera blower brush if it causes concern.
- Always use the paper cutter to cut the printed paper. Excessive paper dust can accumulate on the roller if the paper is cut by the print head.

Cleaning the Instrument and Input Modules

- To clean the instrument and input modules wipe it gently with a soft cloth moistened with water or mild detergent.
- Wipe the LCD gently with a soft, dry cloth.

NOTE

Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.

18.6 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

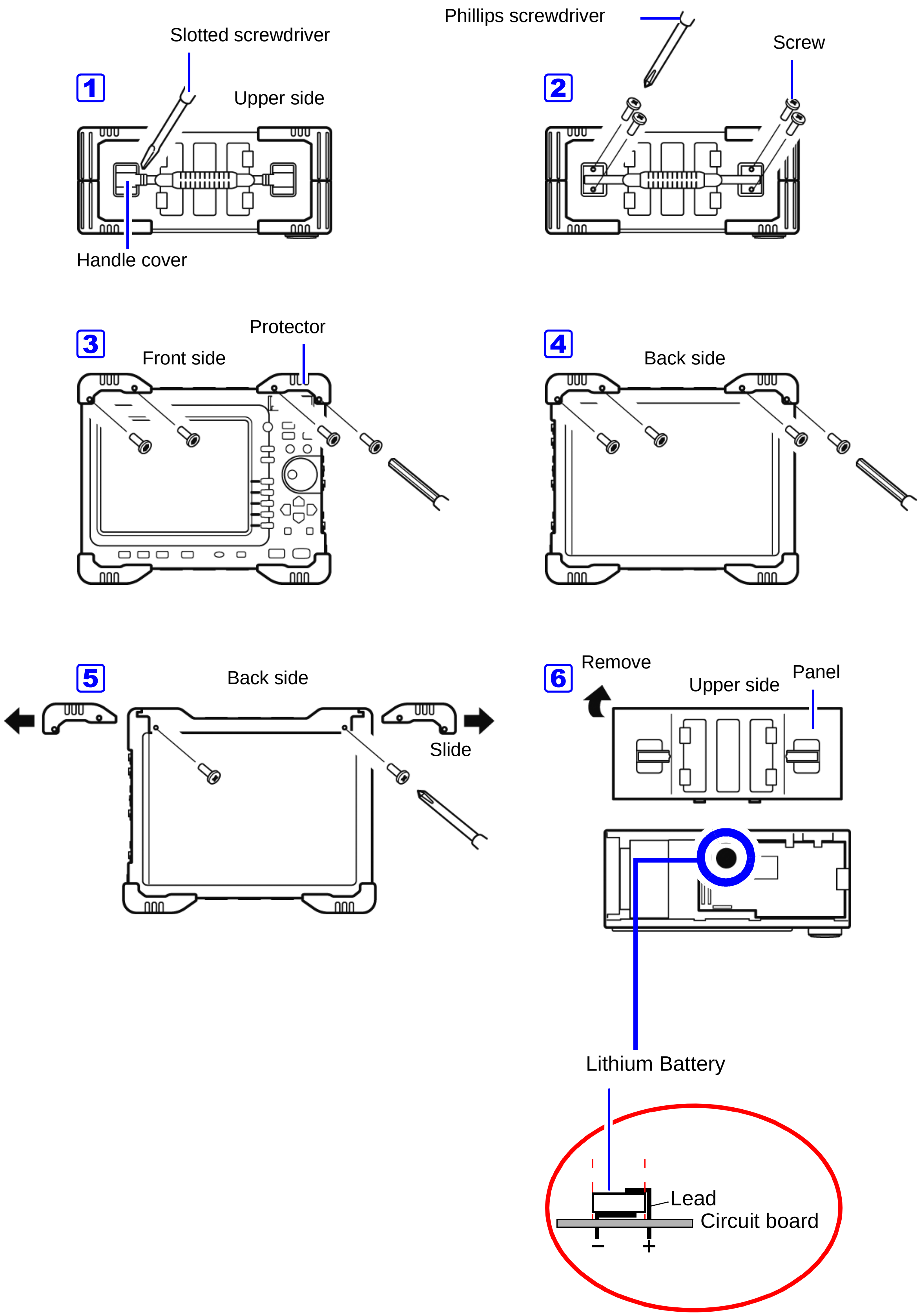
When disposing of this instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

Procedure

Required tools:
Slotted screwdriver, Phillips screwdriver, wire cutter: One each
Box wrench or long-nosed pliers

1. Verify that the power is off, and remove the connection cables and power cord.
2. Remove the screws and each parts as indicated in the next page diagram.
3. Pull the lithium battery up from the circuit board, and cut the two leads with a wire cutter.
4. Remove the battery from the board.

Lithium Battery Removal



Appendix

Appendix 1 Default Values for Major Settings

Default values for major settings are listed below.

Screen	Sheet / Window	Items	Settings
Status	Status	Timebase	
		Memory	5 µs/div
		Recorder	10 ms/div
		Sampling (X-Y Recorder)	100 ms/S
		Shot	25 div
		Format	
		Memory / Recorder	Single
		X-Y Recorder	X-Y Single
		Roll Mode (Memory)	Auto
		Used Ch (Memory)	Ch 1-16
		Dots-Line (X-Y Recorder)	Line
	Num Calc.	Numerical Calc	Off
System	Environment	Grid	Doted Line
		Time Val	Time
		Beep Sound	Warn
		Auto Scal	On
	File Save	Auto Save	Off
	Printer	Auto Print	Off
		Grid	Standard
		Ch Mark	Ch No.
		Time Val	Time
		Mag/Comp	Same to display
		Copy GUI	Yes
		Print Area	All Wave
	Interface	Interface	LAN
		USB Set	USB Memory
Channel	Unit List	Wave_Disp (analog)	Color 1 - 16
		Wave Density	Standard
		Wave_Disp (Logic)	Off
		Logic Width	Normal
		Range	Maximum sensitivity
		Coupling	DC
	Scaling	Disp	Ratio
		Each channel	Off
	Comment	Print Comment (Title)	Setting
		Print Comment (Analog)	Setting
		Print Comment (Logic)	Off
Waveform	Trigger settings window	Trigger Mode	
		Memory	Auto
		Recorder	Single
		PreTrigger (Memory)	0%
		Trigger Source	OR
		Timing	Start
		Trigger for each module	Off
		Timer Trigger	Off
		External Trigger	Off

Appendix 2 Reference

Appendix 2.1 Waveform File Sizes

Refer to the following table for information about the waveform file sizes.

References

File Type	Function	Sizes	Calculation method
MEM File	Memory Function	(⇒ p.A2)	(⇒ p.A4)
REC File	Recorder Function	(⇒ p.A2)	(⇒ p.A4)
FFT File	FFT Function	(⇒ p.A3)	(⇒ p.A4)
XYC File	X-Y Recorder Function	(⇒ p.A3)	(⇒ p.A4)
CSV (Text) File	Memory Function	(⇒ p.A3)	(⇒ p.A4)
	Recorder Function	(⇒ p.A3)	(⇒ p.A4)

References of the file size

MEM File Size (Memory Function)

File size = setting size + data size
Calculation method: "MEM File" (⇒ p.A4)

Recording length (div)	Data Quantity	Saved Channels				
		1	**2**	**4**	**8**	**16**
100	10,001	43 KB	63 KB	103 KB	183 KB	344 KB
1,000	100,001	219 KB	415 KB	806 KB	1.6 MB	3.0 MB
10,000	1,000,001	1.9 MB	3.8 MB	7.7 MB	15 MB	31 MB
100,000	10,000,001	19 MB	38 MB	76 MB	-	-

REC File Size (Recorder Function)

Filesize = setting size + data size
Calculation method: "REC File" (⇒ p.A4)

Recording length (div)	Data Quantity	Saved Channels				
		1	**2**	**4**	**8**	**16**
100	10,001	63KB	102KB	181KB	340KB	656KB
1,000	100,001	414KB	805KB	1.6MB	3.1MB	6.1MB
10,000	1,000,001	3.8MB	7.7MB	15MB	31MB	61MB
20,000	2,000,001	7.7MB	15MB	31MB	61MB	122MB

FFT File Size (FFT Function)

File size = header size + The size of the time axis data + the size of the mid-term data
Calculation method:"**FFT File**" (⇒ p.A4)

Data Quantity	Number of calculations	
	1	2
1,000	360KB	694KB
2,000	692KB	1.3MB
5,000	1.6MB	3.3MB
10,000	3.3MB	6.5MB

XYC File Size (X-Y Recorder Function)

File size = setting size + data size
Calculation method: "XYC File" (⇒ p.A4)

Data Quantity	Saved Channels				
	1	2	4	8	16
10,000	44 KB	64 KB	104 KB	184 KB	345 KB
100,000	220 KB	416 KB	807 KB	1.6 MB	3.1 MB
1,000,000	1.9 MB	3.9 MB	7.7 MB	15 MB	31 MB
2,000,000	3.8 MB	7.7 MB	15 MB	31 MB	61 MB

CSV (Text) File Size (Memory Function)

File size = header size + data size
Calculation method: "CSV (Text) File" (⇒ p.A4)

Recording length (div)	Data Quantity	Saved Channels				
		1	2	4	8	16
100	10,001	313 KB	450 KB	723 KB	1.2 MB	2.3 MB
1,000	100,001	3.1 MB	4.4 MB	7.1 MB	12 MB	23 MB
10,000	1,000,001	31 MB	44 MB	71 MB	124 MB	231 MB
100,000	10,000,001	305 MB	439 MB	706 MB	-	-

CSV (Text) File Size (Recorder Function)

File size = header size + data size
Calculation method: "Recorder Function" (⇒ p.A4)

Recording length (div)	Data Quantity	Saved Channels				
		1	2	4	8	16
100	10,001	450 KB	723 KB	1.2 MB	2.3 MB	4.4 MB
1,000	100,001	4.4 MB	7.1 MB	12 MB	23 MB	44 MB
10,000	1,000,001	44 MB	71 MB	124 MB	231 MB	444 MB
20,000	2,000,001	88 MB	141 MB	248 MB	432 MB	889 MB

Waveform File Size Calculation Method

MEM File

File size (bytes) = setting size[*1] + data size[*2]

*1: Setting size =23552 + 512 (analog channel portion + 4 x logic channel portion +Number of waveform calculation channels)
*2: Data size = 2 x (analog channel portion+logic channel portion + 2 xNumber of waveform calculation channels) x number of data

REC File

File size (bytes) = setting size[*1] + data size[*2]

*1: Setting size = 23552 + 512 (analog channel portion + 4 x logic channel portion)
*2: Data size = 4 x (analog channel portion+logic channel portion) x number of data

FFT File

File size (bytes) =header size[*1] + the size of the time axis data[*2] + the size of the mid-term data[*3]

*1: Header size = 25600 + 512(analog channel portion +Number of waveform calculation channels+Number of FFT calculation channels + 1)
*2: the size of the time axis data = (analog channel portion + 2 xNumber of waveform calculation channels) x data (*4)
*3: the size of the mid-term data = (346 x Number of FFT points + 836) x Number of FFT calculation channels(*4)

(Depending on the measurement conditions, the file size may also increase or decrease from calculation formula result)

XYC File

File size (bytes) = header size[*1] + data size[*2]

*1: Header size = 24576 + 512 (analog channel portion)
*2: Data size = 2 x saved analog channel portion x number of data

CSV (Text) File

Memory Function

File size (bytes) = header size[*1] + data size[*2]

*1: Header size = 194 + 103 x (saved analog channels + saved logic channels)
*2: Data size = (18 + 14 x saved analog channels + 2 x logic channels) x number of data

Recorder Function

File size (bytes) = header size[*1] + data size[*2]

*1: Header size = 194 + 130 x (saved analog channels + saved logic channels)
*2: Data size = (18 + 28 x saved analog channels + 4 x logic channels) x number of data

Appendix 2.2 Setting Configuration and Image Data File Sizes

For information on the size of setting and image data files, see the table below.

File	Size
Setting file	33 KB
BMP (No color compression)	470 KB
BMP (Gray scale/No compression)	470 KB
BMP (B/W/No compression)	59 KB
BMP (B/W Reverse/No compression)	59 KB

Appendix 2.3 Timebase and Maximum Recordable Time

The maximum available recording time depends on the selected timebase.
The maximum recording time can be obtained by the following formula.

Recordable Time = Timebase x Recording Length

Recordable time can be verified on the Status screen - **[Status]** sheet. (**[Recording period]**)

NOTE

- Setting a slow timebase may result in a very long recording time (over a year) which may exceed the guarantee period or product life, in which case we cannot guarantee operation.
- The maximum recording length depends on the number of channels used.
- When using the X-Y Recorder function, the maximum number of samples is 4,000,000.

Refer to the following tables for the information about recordable time.

Recorder Function

Timebase (Time/div)	Maximum Recording Length: 20,000 div*
10 ms	3 min 20 s
20 ms	6 min 40 s
50 ms	16 min 40 s
100 ms	33 min 20 s
200 ms	1 h 6 min 40 s
500 ms	2 h 46 min 40 s
1 s	5 h 33 min 20 s
2 s	11 h 6 min 40 s
5 s	1 d 3 h 46 min 40 s
10 s	2 d 7 h 33 min 20 s
30 s	6 d 22 h 40 min 0 s
50 s	11 d 13 h 46 min 40 s
1 min	13 d 21 h 20 min 0 s
100 s	23 d 3 h 33 min 20 s
2 min	27 d 18 h 40 min 0 s
5 min	69 d 10 h 40 min 0 s
10 min	138 d 21 h 20 min 0 s
30 min	
1 h	

(d: days/ h: hours/ min: minutes/ s: seconds)

*: Also when recording length is set to **[Cont.]**, the maximum recording length is 20,000 div.

Memory Function

Timebase (Time/div)	Sampling Speed	Channels used Maximum Recording Length			
		16 channels 40,000 div	8 channels 80,000 div	4 channels 160,000 div	2 channels 320,000 div
5 µs	50 ns	200 ms	400 ms	800 ms	1.6 s
10 µs	100 ns	400 ms	800 ms	1.6 s	3.2 s
20 µs	200 ns	800 ms	1.6 s	3.2 s	6.4 s
50 µs	500 ns	2 s	4 s	8 s	16 s
100 µs	1 µs	4 s	8 s	16 s	32 s
200 µs	2 µs	8 s	16 s	32 s	1 min 4 s
500 µs	5 µs	20 s	40 s	1 min 20 s	2 min 40 s
1 ms	10 µs	40 s	1 min 20 s	2 min 40 s	5 min 20 s
2 ms	20 µs	1 min 20 s	2 min 40 s	5 min 20 s	10 min 40 s
5 ms	50 µs	3 min 20 s	6 min 40 s	13 min 20 s	26 min 40 s
10 ms	100 µs	6 min 40 s	13 min 20 s	26 min 40 s	53 min 20 s
20 ms	200 µs	13 min 20 s	26 min 40 s	53 min 20 s	1h 46 min 40 s
50 ms	500 µs	33 min 20 s	1h 6 min 40 s	2h 13 min 20 s	4h 26 min 40 s
100 ms	1 ms	1 h 6 min 40 s	2 h 13 min 20 s	4 h 26 min 40 s	8 h 53 min 20 s
200 ms	2 ms	2 h 13 min 20 s	4 h 26 min 40 s	8 h 53 min 20 s	17 h 46 min 40 s
500 ms	5 ms	5 h 33 min 20 s	11 h 6 min 40 s	22 h 13 min 20 s	1 d 20 h 26 min 40 s
1 s	10 ms	11 h 6 min 40 s	22 h 13 min 20 s	1 d 20 h 26 min 40 s	3 d 16 h 53 min 20 s
2 s	20 ms	22 h 13 min 20 s	1 d 20 h 26 min 40 s	3 d 16 h 53 min 20 s	7 d 9 h 46 min 40 s
5 s	50 ms	2 d 7 h 33 min 20 s	4 d 15 h 6 min 40 s	9 d 6 h 13 min 20 s	18 d 12 h 26 min 40 s
10 s	100 ms	4 d 15 h 6 min 40 s	9 d 6 h 13 min 20 s	18 d 12 h 26 min 40 s	37 d 0 h 53 min 20 s
30 s	300 ms	13 d 21 h 20 min 0 s	27 d 18 h 40 min 0 s	55 d 13 h 20 min 0 s	111 d 2 h 40 min 0 s
50 s	500 ms	23 d 3 h 33 min 20 s	46 d 7 h 6 min 40 s	92 d 14 h 13 min 20 s	185 d 4 h 26 min 40 s
1 min	600 ms	27 d 18 h 40 min 0 s	55 d 13 h 20 min 0 s	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s
100 s	1 s	46 d 7 h 6 min 40 s	92 d 14 h 13 min 20 s	185 d 4 h 26 min 40 s	370 d 08 h 53 min 20 s
2 min	1.2 s	55 d 13 h 20 min 0 s	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s	
5 min	3 s	138 d 21 h 20 min 0 s	277 d 18 h 40 min 0 s		

(d: days/ h: hours/ min: minutes/ s: seconds)

Appendix 2.4 Maximum record length and number of divisions (Memory division function)

The maximum record length is automatically determined by settings for the number of channels used and the number of divisions.

Desired record length

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	160,000	80,000	40,000	20,000
4	80,000	40,000	20,000	10,000
8	40,000	20,000	10,000	5,000
16	20,000	10,000	5,000	2,500
32	10,000	5,000	2,500	1,200
64	5,000	2,500	1,200	600
128	2,500	1,200	600	300
256	1,200	600	300	150
512	600	300	150	70
1024	300	150	70	30

Fixed record length

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	100,000	50,000	20,000	20,000
4	50,000	20,000	20,000	10,000
8	20,000	20,000	10,000	5,000
16	20,000	10,000	5,000	2,000
32	10,000	5,000	2,000	1,000
64	5,000	2,000	1,000	500
128	2,000	1,000	500	200
256	1,000	500	200	100
512	500	200	100	50
1024	200	100	50	25

Appendix 2.5 Scaling Method When Using Strain Gauges

This section describes how to determine the scaling conversion ratio when measuring with strain gauges and the Model 8969 Strain Unit.

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 × 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 × ε
For temperature compensation with two or four gauges, stress (σ) is obtained as a multiple of ½ or ¼, respectively.

Torsional Stress Measurement: Stress (σ) = $E / \{2 (1 + \nu)\} \times \varepsilon$ (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,

$\sigma = 73 \times 10^{9} \times$ Measurement Value (in $\mu\varepsilon$ units) $\times 10^{-6}$ (in $\mu\varepsilon$ units)
) = 73 × Measurement Value (in kPa units)
= 7.44^{*} × Measurement Value (in gf/mm^2 units)
*: 1 Pa = $1.01971621 \times 10^{-7}$ kgf/mm^2

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 Copper (0.1 to 0.25% C)	205	0.28 to 0.3
Carbon Copper (> 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: "8.5 Converting Input Values (Scaling Function)" (⇒ p.128)

Appendix 3 About Options

Appendix 3.1 Options

For details of cables and clamps for connecting to the input modules and the instrument, refer to manual supplied with them.

Items indicated "specify when ordering" are not user-installable. For new purchases, contact your supplier (agent) or nearest Hioki office.

Input modules (Measurement amplifiers)

These are installed by insertion into the compartments on the right side of the instrument. Modules can be swapped out as needed.

		Channels	Max Sampling Rate	A/D Resolution	Maximum input voltage
Voltage Measurements	8966 Analog Unit	2	20 MS/s	12 bit	400 VDC
	8968 High Resolution Unit	2	1 MS/s	16 bit	400 VDC
RMS Voltage Measurements	8972 DC/RMS Unit	2	1 MS/s	12 bit	400 VDC
Temperature (Thermometer) Measurements	8967 Temp Unit	2	-	16 bit	-
Frequency, Count, Pulse Duty, and Pulse Width Measurements	8970 Freq Unit	2	-	16 bit	400 VDC
For Current Measurement	8971 Current Unit	2	1 MS/s	12 bit	-
Strain (Strain Gauge Type Converter) Measurements	8969 Strain Unit	2	200 kS/s	16 bit	10 VDC
For Digital Signals and Contact Signal Measurement	8973 Logic Unit	16	20 MS/s	-	-

See: "17.6 Input Modules Specifications" (⇒ p.304)

Measurement probes, cords, and clamps

			Maximum input voltage
For Voltage Measurement	9197 Connection Cord	For high voltage	500 V
	L9198 Connection Cord	For low voltage	300 V
	L9217 Connection Cord	Isolated BNC-BNC	300 V
	9322 Differential Probe	For high voltage Following item is required for connection. • Voltage measurement with an input modulerequires the Model 9418-15 AC Adapter*	(CAT II) 2000 VDC, 1000 VAC (CAT III) 600 VAC, DC
	9665 10:1 Probe	Maximum rate voltage above ground is that of the input module.	1 kVrms (up to 500 kHz)
	9666 100:1 Probe	Maximum rate voltage above ground is that of the input module.	5 kVpeak (up to 1 MHz)
	*: 9418-15 AC Adapter	For Model 9322	
For Logic Signal Input	9320-01 Logic Probe	Four channels, for detecting voltage and closed/open contact points	
	MR9321-01 Logic Probe	Four isolated channels, for detecting AC/DC voltage on/off (for small terminal types and for lines)	
	9327 Logic Probe	Four channels, for detecting voltage and closed/open contact points (high-speed type)	

AC/DC Following item (1) or (2) is required for connection	9277 Universal Clamp-On CT(1),(2)	20 A, DC to 100 kHz
	9278 Universal Clamp-On CT (1),(2)	200 A, DC to 100 kHz
	9279 Universal Clamp-On CT*(1),(2)	500 A, DC to 20 kHz
	9709 AC/DC Current Sensor (1),(2)	500 A, DC to 100 kHz
	CT6862 AC/DC Current Sensor	50 A
	CT6863 AC/DC Current Sensor	200 A
For AC Following item (1) or (2) is required for connection.	9272 Clamp-On Sensor* (1),(2)	20/200 A, 1 Hz to 100 kHz
For AC	9010-50 Clamp-On Probe	10 to 500 A, 40 Hz to 1 kHz
	9018-50 Clamp-On Probe	10 to 500 A, 40 Hz to 3 kHz
	9132-10 Clamp-On Probe*	20 to 1000 A, 40 Hz to 1 kHz
For Leakage Current	9657-10 Clamp-On Leak Sensor	1 A, 45 to 66 Hz
Miscellaneous For connecting to an input module for voltage measurement	(1) 9555-01 Sensor Unit *	for Model 9272-10, 9277 to 9279, 9709, CT6862, CT6863
For connecting to the Model 8971 Current Unit	(2) 9318 Conversion Cable	for Model 9272-10, 9277 to 9279, 9709, CT6862, CT6863

* : Not applicable to CE Marking

Printer

Recording Paper	9231 Recording Paper	One set of 6 rolls, 30 m
	TEPTOM-220H Paper Winder*	(Auto winder for recording paper)

* : Not applicable to CE Marking

Storage medias

Drives	9664 HD Unit	Internal Hard Disk Drive, specify when ordering
PC Card	9726 PC Card 128M	128MB, with adapter
	9727 PC Card 256M	256MB, with adapter
	9728 PC Card 512M	512MB, with adapter
	9729 PC Card 1G	1GB, with adapter
	9830 PC Card 2G	2GB, with adapter

Software

Application Software	9335 Wave Processor	

Others

Power Supply	9784 DC Power Unit	Power supply for DC operation , specify when ordering
Case	9783 Carrying Case	with casters

Appendix 3.2 Model 9783 Carrying Case

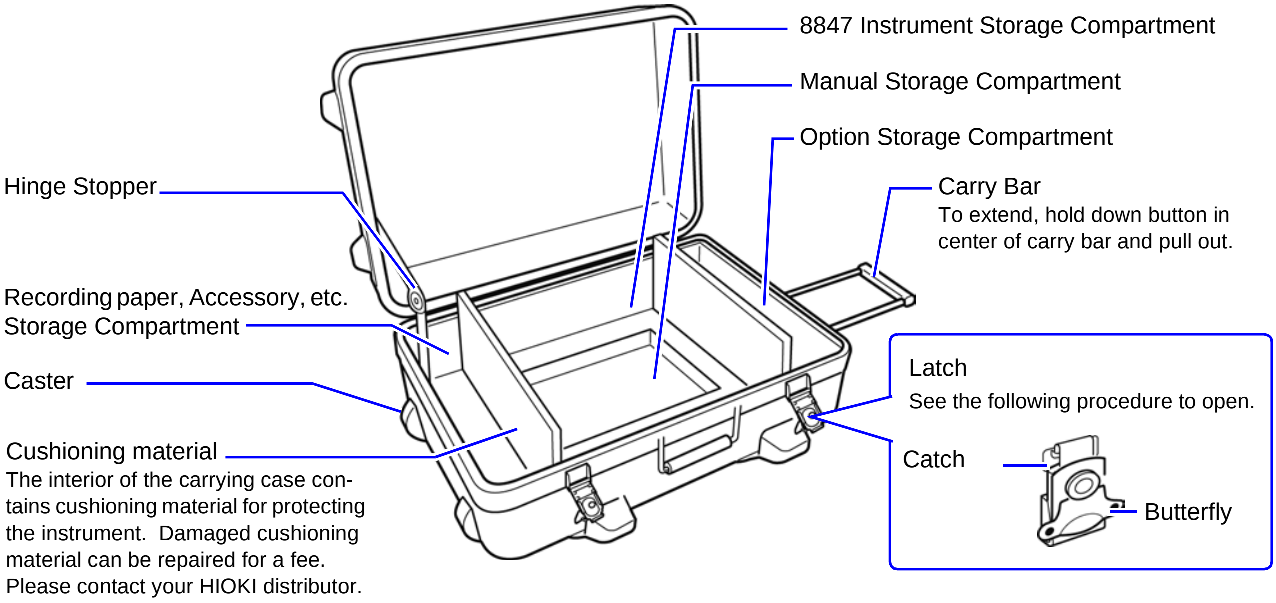
⚠WARNING

- Observe the following precautions to avoid injury or damage from having the case fall.
  - Do not sit or stand on the case.
  - Do not use the casters on unstable, sloping or soft surfaces.
- Be careful to avoid pinched fingers or other accidental injuries when installing and removing the casters.

⚠CAUTION

- Observe the following precautions to avoid damage to the case.
  - Do not exceed the load limit of 15 kg (33 lb).
  - Do not open or close the case in the upright position.
- The case includes flammable materials, so do not place it near open flame or any object hotter than 100°C, as the case could catch fire.

Parts Names



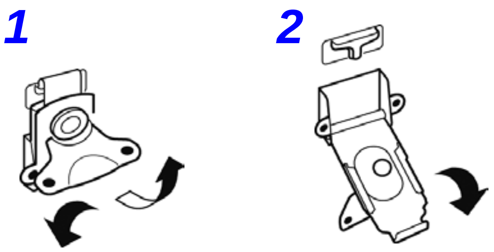
Carry Bar: To extend, hold down button in center of carry bar and pull out.

Latch: See the following procedure to open.

Cushioning material: The interior of the carrying case contains cushioning material for protecting the instrument. Damaged cushioning material can be repaired for a fee. Please contact your HIOKI distributor.

Opening the Latch

1. Pull the butterfly up, and rotate it 1/2-turn counter-clockwise.
2. When the catch releases, pull the butterfly towards you.



Appendix 4 If the Model 9784 DC Power Unit is Installed

The Model 9784 enables the instrument to be operated from a DC power source such as a battery.

When both AC power and the Model 9784 DC Power Unit are connected to the instrument, the AC power source has priority. However, when the instrument is operating from AC power and the power switch of the Model 9784 is on, the 9784 is in standby state, and some power is still consumed from the DC source.

We therefore recommend turning the Model 9784 off when it is not being used.

The input voltage range of Model 9784 is 10 V DC to 28 V DC. (Voltage fluctuations of ±10% from the supply voltage are taken into account.)

⚠WARNING

- Before connecting to a battery, confirm that the power switch on the Power Unit is turned off. Connecting to a battery while the Power Unit is turned on may produce sparks and could damage the instrument.
- Make sure that the Power Unit's ventilation holes are not obstructed. Otherwise, the instrument could be damaged or a fire could result.

⚠CAUTION

Whenever making DC power connections to the Power Unit, observe polarity carefully, and make connections securely. Reversed-polarity connections may damage the Power Unit.

9784 DC Power Unit Specifications

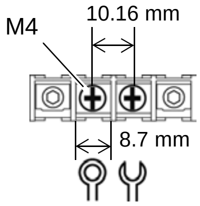
Accuracy is specified at 23±5°C and 20 to 80% RH, 30 minutes after power on

Rated input voltage	12 VDC
Input voltage range	10 to 28 VDC
Maximum rated power	200 VA
Operating temperature and humidity	Same as 8847
Storage temperature and humidity	Same as 8847
Operating environment	Same as 8847
Withstand voltage	700 V DC for 1 min. (between input and output, and between input and instrument chassis)
Isolation voltage	100 MΩ or more @ 500 V DC (between input and output, and between input and instrument chassis)
Dimensions	Adds approx. 29 mm (D) (1.14"D) to dimensions of Models 8847
Mass	Adds approx. 1.20 kg (42.3 oz.) to the weight of Models 8847

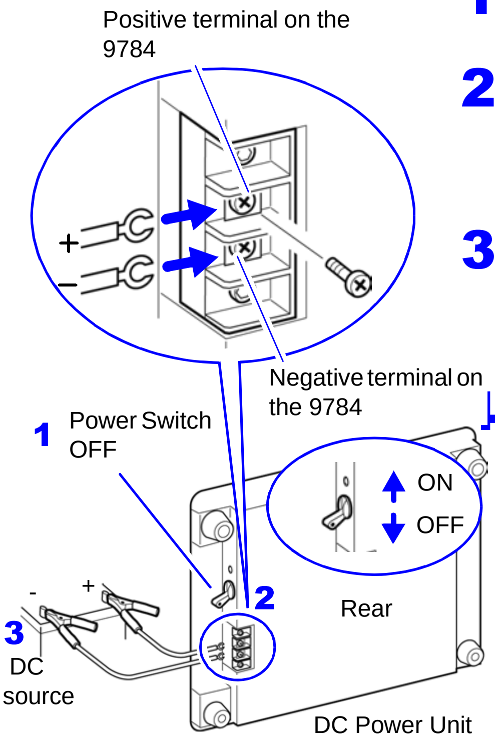
NOTE

- When using the DC Power Unit, printer specifications change as follows.
  1. Maximum paper feed rate is 1 cm/s. (Consequently, real-time printing for continuous recording length operation is available at timebase settings slower than 1 s/div.)
  2. The **[Print Speed]** setting has no effect.
- When using the printer, ensure that the input voltage does not drop below 10 V DC. Otherwise printer malfunction may occur.

Connection Procedure



Required items: Cable to connect the DC source to the Model 9784 DC Power Unit
Recommended cable rating:
at least 25 A current capacity
Cable terminations:compatible with the terminal block shown at the left



1. Verify that the power switch on the Power Unit is turned off.
2. Connect the positive lead of the connection cable to the positive terminal on the Power Unit, and the negative lead to the negative terminal.
3. Connect the positive lead of the connection cable to the positive terminal of the DC source, and the negative lead to the negative terminal.
4. Turn the power switch on.

NOTE

- The Power Unit has no external battery charging function.
- When using batteries, be careful to avoid overdischarging.
- The Power Unit shuts off output if it detects overcurrent or overvoltage.
  If this occurs, turn the switch on the Power Unit off for about one minute, and then back on.

Battery Operating Time

(Nominal values at normal room temperature)
Battery used: 12 V, 38 Ah, fully charged

	8966 full installation
Printer not printing (awaiting trigger state, etc.)	Approx. 9 h
Printer printing (Recorder Function, 1 s/div, all black)	Approx. 5 h

The above times are affected by battery age and state of charge, ambient temperature and other factors.
Even when operating from AC power, some power is consumed from the DC source if the DC Power Unit is in the standby state (the power switch is on). In this state, battery operating time is about 5000 hours.

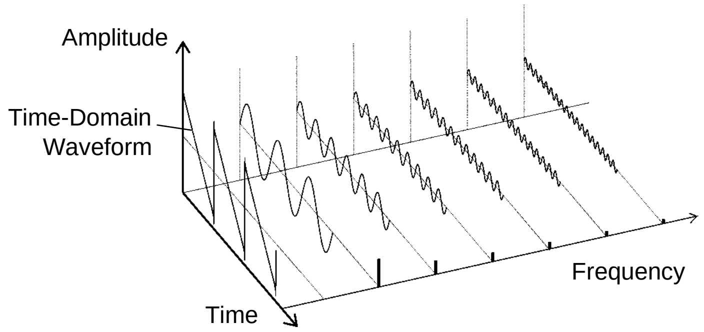
Appendix 5 FFT Definitions

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 functions 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:

$$X(k) = DFT\{x(n)\} = \sum_{n=0}^{N-1} x(n) W_N^{kn} \quad \text{- -} \quad (1)$$

$$x(n) = IDFT\{X(k)\} = \frac{1}{N} \sum_{n=0}^{N-1} X(k) W_N^{-kn} \quad \text{- -} \quad (2)$$

$$W_N = \exp\left(-j\frac{2\pi}{N}\right) \quad \text{- -} \quad (3)$$

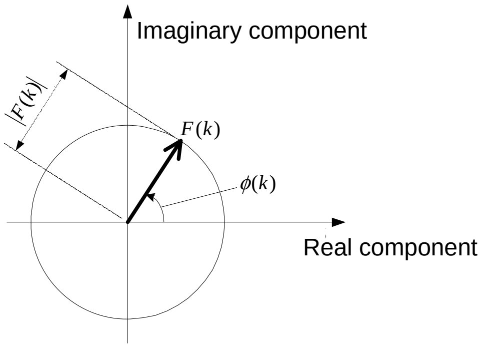
$X(k)$ is typically a complex number, so expression (1) can be transformed again and written as follows:

$$F(k) = |F(k)| \exp\{j\phi(k)\} = |F(k)| \angle \phi(k) \quad \text{- - - - - - - - - - - - - - - - - - - -} \quad (4)$$

$$\phi(k) = \tan^{-1} \frac{\mathrm{Im}\{X(k)\}}{\mathrm{Re}\{X(k)\}} \quad \text{- -} \quad (5)$$

$|F(k)|$: 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 $y_i(n) = L[x_i(n)]$.

$$L[A_1x_1(n)+A_2x_2(n)]=A_1y_1(n)+A_2y_2(n) \text{ - } (6)$$

If the system function of an LTI system is $h(n)$, the input/output relationship can be obtained by the next expression.

$$y(n)=\sum_{m=0}^{\infty}h(n)x(n-m)=\sum_{m=-\infty}^{\infty}h(n-m)x(m) \text{ - - - - - - - - - - - - - - - - - - - } (7)$$

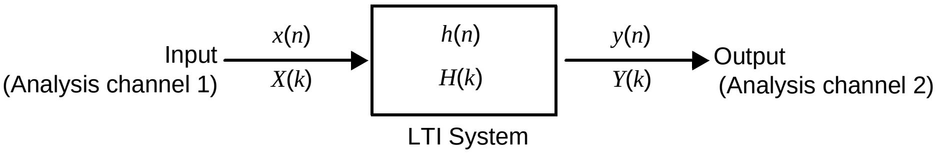
Therefore, when a unit impulse $\delta(n)$ (which is 1 when $n = 0$, and 0 when $n \neq 0$) is applied to $x(n)$, the input/output relationship is:

$$y(n)=h(n) \text{ - } (8)$$

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:

$$Y(k)=X(k)H(k) \text{ - } (9)$$

$H(k)$ 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 impulse response and transfer function of this instrument are calculated using the relationships of expression (9).



Number of Analysis Points

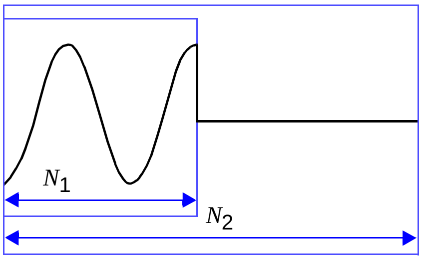
The FFT functions of this instrument can perform frequency analysis of time-domain waveforms consisting of 1000, 2000, 5000, or 10,000 points. However, when the following conditions are satisfied, previously analyzed data can be reanalyzed with a different number of analysis points.

A. When measurements are made with the averaging function disabled (Off)
B. When measurements are made with the averaging function enabled for time-domain averaging (simple or exponential).

When the number of analysis points at measurement time is N_1 and the number of analysis points is changed to N_2 after measurement, the instrument performs as follows.

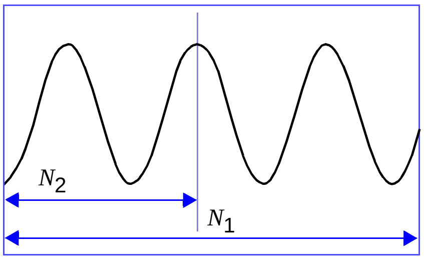
(1) When $N_1 < N_2$

- Because not enough data has been collected, zero is inserted for time after the end of the measured waveform.
- The window function applies only to the N_1 segment.
- Frequency resolution is increased. For example, if $N_1 = 1000$ and $N_2 = 2000$, frequency resolution is doubled.
- The average energy of the time-domain waveform is reduced, so the amplitude of the linear spectrum is also reduced.



(2) When $N_1 > N_2$

- The specified (N_2) segment is extracted from the head of the (N_1) data.
- The window function applies only to the N_2 segment.
- Frequency resolution is decreased. For example, if $N_1 = 2000$ and $N_2 = 1000$, frequency resolution is halved.
- The average energy of the time-domain waveform is unchanged, so the amplitude of the linear spectrum is not significantly affected.



Aliasing

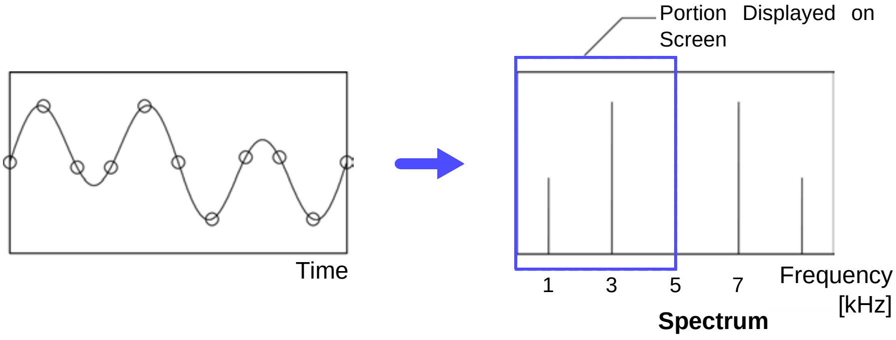
When the frequency of a signal to be measured is higher than the sampling rate, the observed frequency is lower than that of the actual signal, with certain frequency limitations. This phenomena occurs when sampling occurs at a lower frequency than that defined by the Nyquist-Shannon sampling theorem, 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:

$$f_s = 2 f_{\max} \quad (10)$$

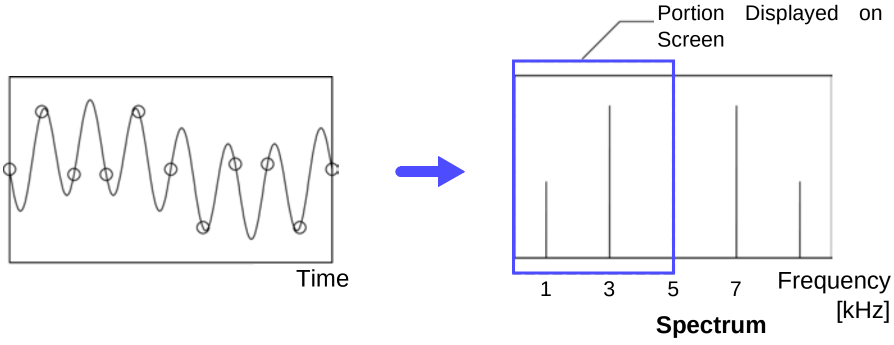
Therefore, if the input includes a frequency component higher than $f_{\mathrm{S}}/2$, it is observed as a lower frequency (alias) that does not really exist.

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.

Composite waveform of 1 kHz and 3 kHz components sampled at 10 kHz



Composite waveform of 1 kHz and 7 kHz components sampled at 10 kHz

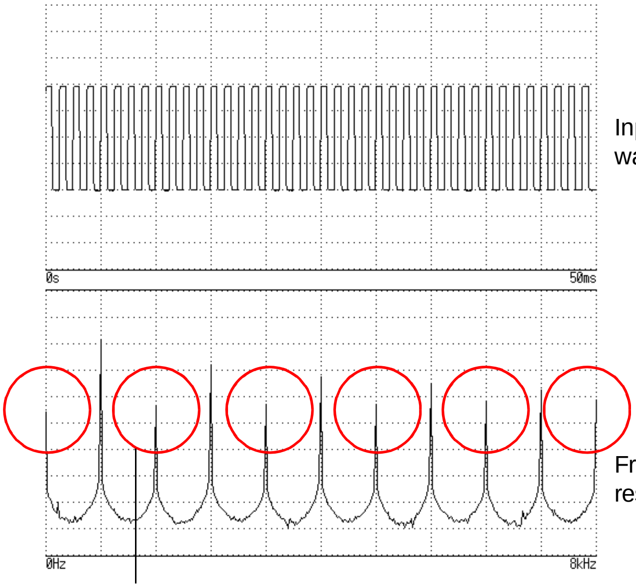


Anti-Aliasing Filters

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.

Without an anti-aliasing filter

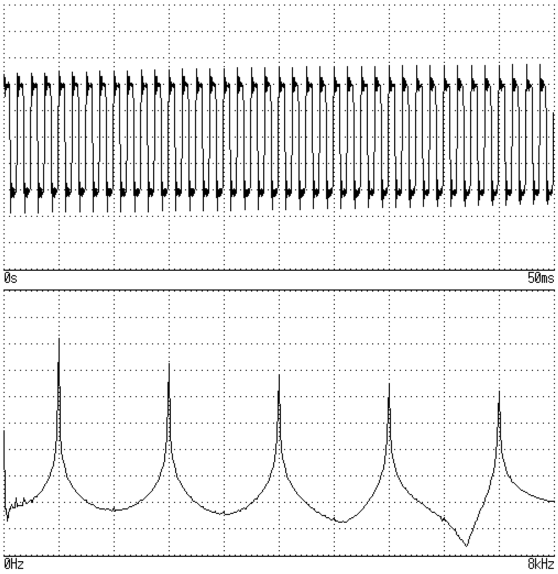


Input time waveform

Frequency analysis results

Non-existent frequency components are observed.

With an anti-aliasing filter



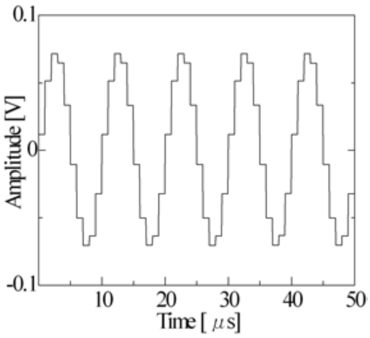
Input time waveform

Frequency analysis results

Imaging

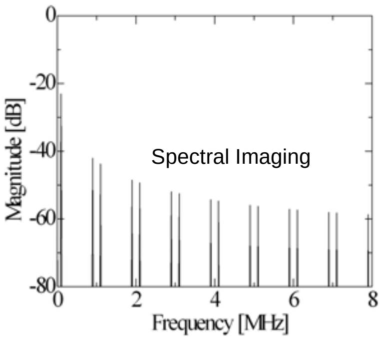
When the instrument is set to a measurement frequency range that requires a higher sampling rate than the maximum capability of the input module, intermediate data points are interpolated between successive data samples. In this case, the time-domain waveform exhibits a stair-step shape. When FFT analysis is performed in this situation, non-existent high frequency spectral components appear. This phenomena is called zero-order hold characteristic **imaging**.

The following figures show the time-domain waveform and spectrum of a sine wave applied to the Model 8968 High Resolution Unit.



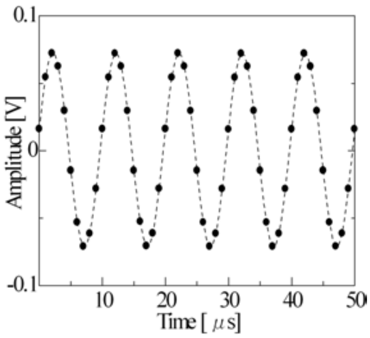
Time-domain waveform
in the 8 MHz frequency range
(sampling frequency = 20 MHz)

The highest sampling frequency of the Model 8968 is 1 MHz, so the same input data value is used for each block of 20 samples, resulting in a stair-step waveform.



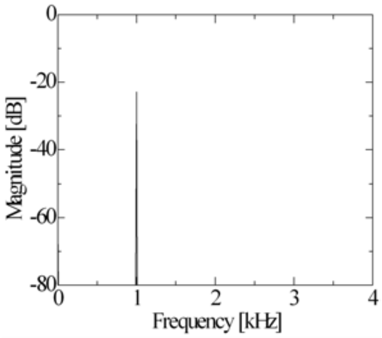
Spectrum

When FFT processing is performed on a stair-step waveform, the resulting spectrum shows non-existent components.
In this case, the spectral components above 1 MHz / 2 = 500 kHz are theoretically meaningless.



Time-domain waveform
in the 400 kHz frequency range
(sampling frequency = 1 MHz)

Here, the frequency range matches the sampling frequency of the Model 8968 so no interpolation is performed on the time-domain data.



Spectrum

To avoid imaging phenomena when analyzing waveforms with the FFT function, verify the maximum sampling frequency of the input module before measuring.

Averaging

With the FFT function, averaging is performed according to the following analytical expressions. Averaging in the time domain produces meaningless data if performed with inconsistent trigger criteria.

1. Simple Averaging (Time and Frequency Domains)

Sequences of acquired data are summed and divided by the number of acquisitions.

$$A_n = \frac{(n-1)A_{n-1} + Z_n}{n} \tag{11}$$

n: count of measurements to average
A_n: averaging results of n counts
Z_n: measurement data of n counts

2. Exponential Averaging (Time and Frequency Domains)

Before averaging, newer data is given exponentially greater significance than older data.

$$A_n = \frac{(N-1)A_{n-1} + Z_n}{N} \tag{12}$$

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 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.

$$(Over\ all) = \sum_{i=0} P_i \tag{13}$$

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.

$$\mathrm{THD} = \sqrt{\frac{\Sigma(f_n)^2}{(f_0)^2}} \times 100\ [\%]$$

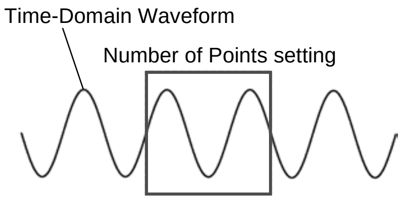
f_0 = fundamental wave
f_n = n next higher harmonic

Window Function

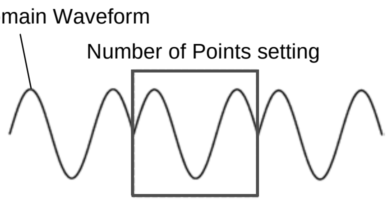
The Fourier transform of a continuous system is defined by the integral Calculus in expression (14) for the time range from minus infinity to plus infinity.

$$X(f) = \int_{-\infty}^{\infty} x(t)\varepsilon^{-2\pi ft} dt \text{ - } (14)$$

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).



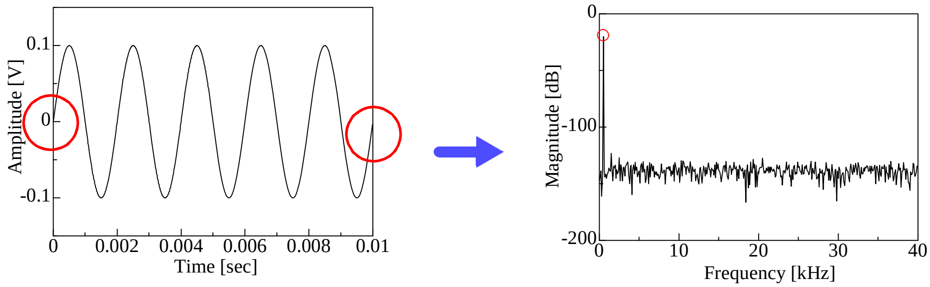
Original Time-Domain Waveform



Waveform to be assumed with FFT

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).

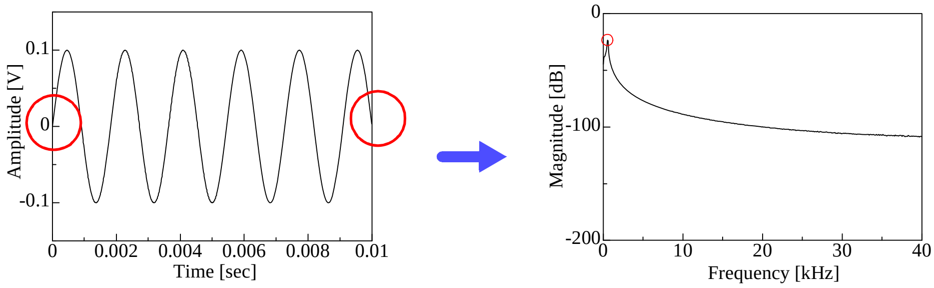
Time-domain waveform when the number of analysis points is an integer multiple of the input frequency



Time-Domain Waveform

Spectrum

Time-domain waveform when the number of analysis points is not an integer multiple of the input frequency



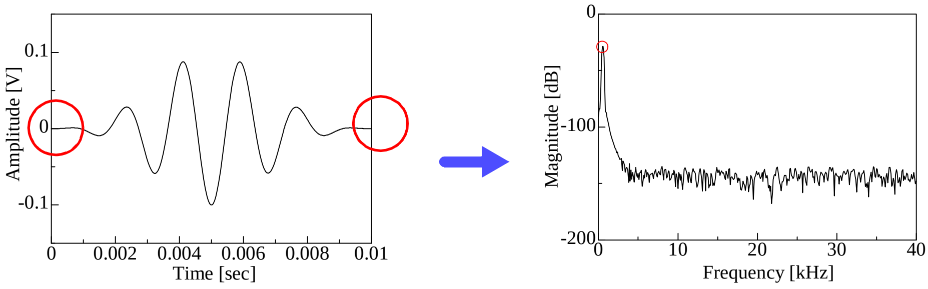
Time-Domain Waveform

Spectrum

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.

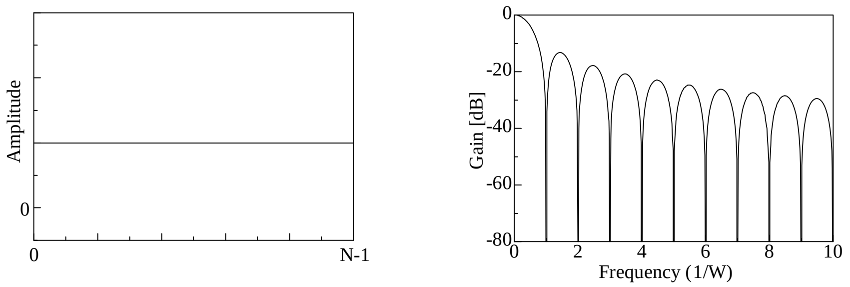
When a Blackman-Harris window function is applied to a time-domain waveform (⇒ p.22) in which the number of analysis points is not an integer multiple of the input frequency



Time-Domain Waveform **Spectrum**

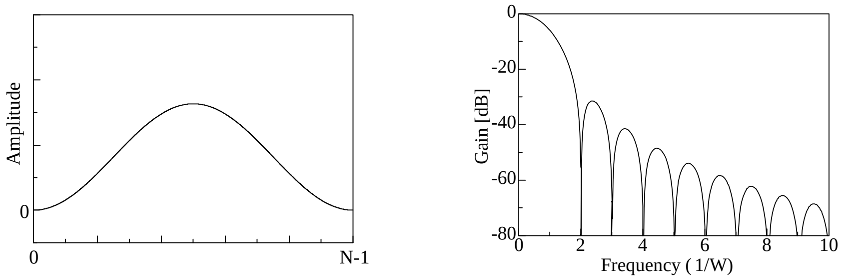
The following figure shows the time-domain waveform of the window function and its spectrum.
Each spectrum shows a large peak at a low frequency, and many smaller peaks at higher frequencies. The largest peak is called the **main lobe**, and the smaller peaks are the **side lobes**.
The most accurate results of the FFT 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



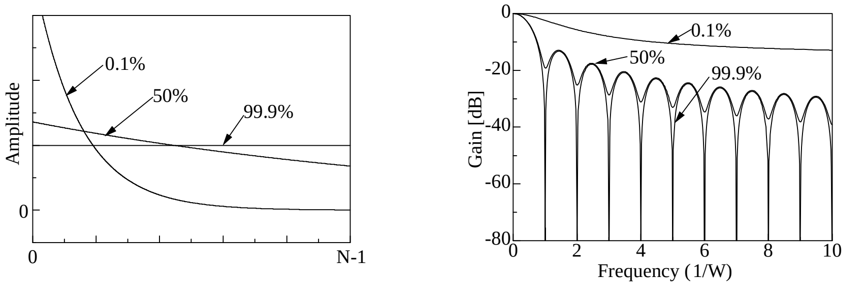
Time-Domain Waveform **Spectrum**

Hann window



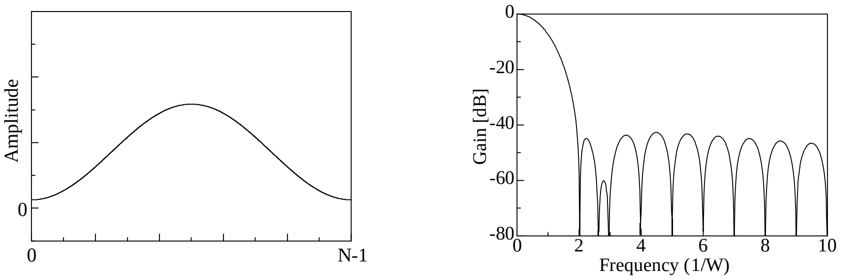
Time-Domain Waveform **Spectrum**

Exponential window



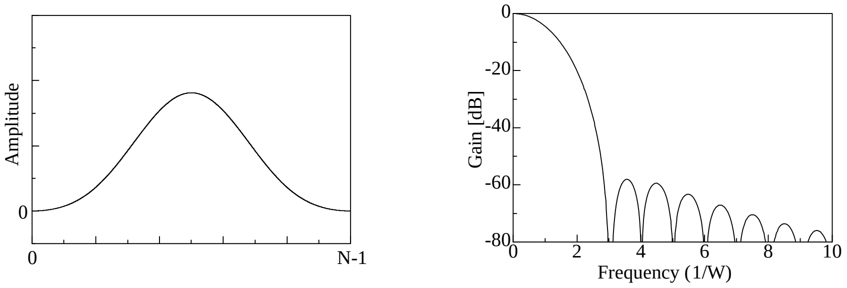
Time-Domain Waveform **Spectrum**

Hamming window



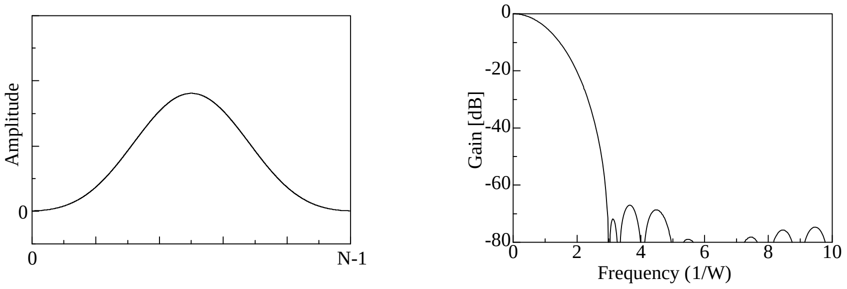
Time-Domain Waveform **Spectrum**

Blackman window



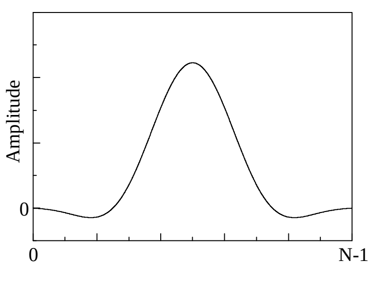
Time-Domain Waveform **Spectrum**

Blackman-Harris window

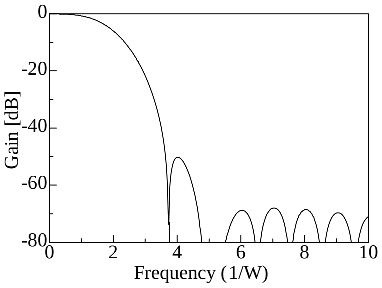


Time-Domain Waveform **Spectrum**

Flat top window

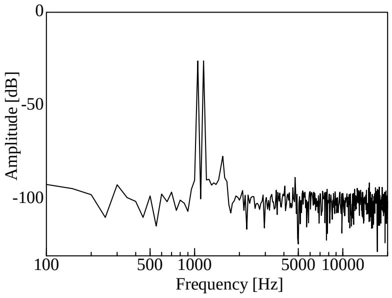


Time-Domain Waveform

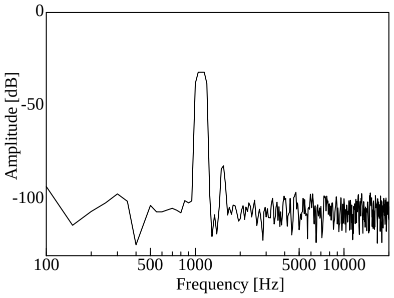


Spectrum

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

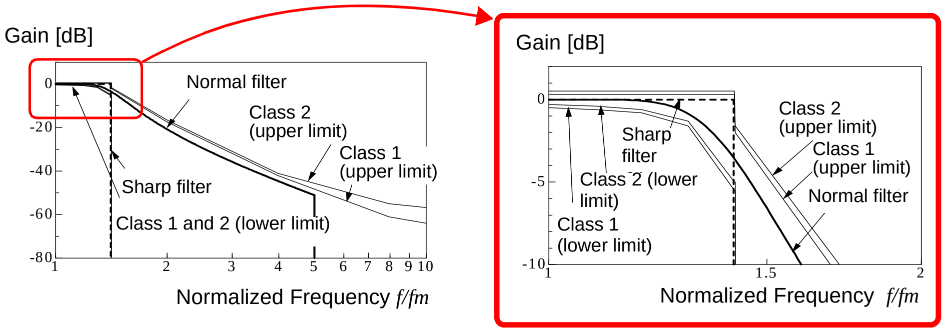


Analysis Using a Hann Window

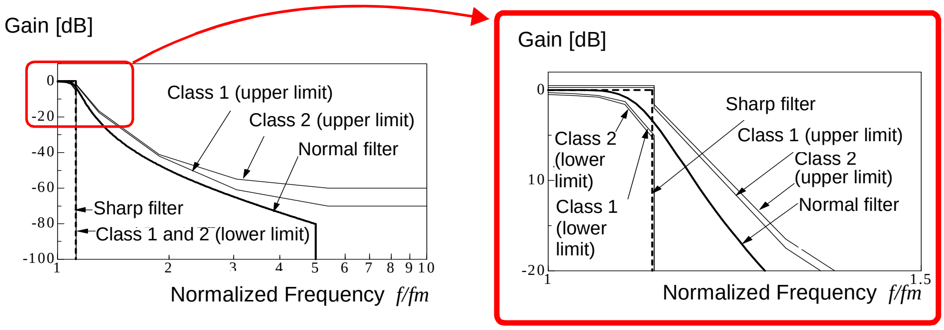
Octave Filter Characteristics

Octave filter characteristics are determined according to IEC61260 standards. The figures below show these standards and the filter characteristics of this instrument.

1/1 Octave Filter Characteristic

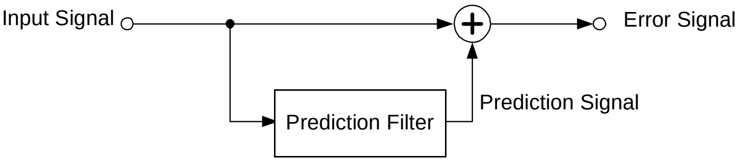


1/3 Octave Filter Characteristic



Linear Predictive Coding (LPC)

In the following figure, linear predictive coding is implemented by passing a sample of the input signal through the prediction filter while altering the filter so as to minimize errors in the original signal.



Given a time-discrete signal $\{x_t\}$ (t is an integer) where the input signal is sampled at interval ΔT, LPC analysis presumes the following relationship between current sample value x_t and the value of previous sample p.

$$x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \cdots + \alpha_p x_{t-p} = \varepsilon_t \quad (15)$$

However, $\{\varepsilon_t\}$ is an uncorrelated random variable with average value 0 and the dispersion σ^2.
Expression (15) shows how current sample value x_t can be "linearly predicted" from previous sample values. If the predicted value of x_t is actually $\hat{x}_t$, expression (15) can be transformed as follows.

$$x_t = \hat{x}_t + \varepsilon_t = -\sum_{i=1}^{p} \alpha_i x_{t-i} + \varepsilon_t \quad (16)$$

Here, α_i is called the **linear predictor coefficient**.
For LPC analysis, this coefficient is calculated using the Levinson-Durbin algorithm, and a spectrum is obtained. In this instrument, the order of the coefficient can be set from 2 to 64. Larger orders reveal fine spectral components, while small orders reveal the overall spectrum shape.

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HIOKI

DECLARATION OF CONFORMITY

Manufacturer's Name: HIOKI E.E. CORPORATION

Manufacturer's Address: 81 Koizumi, Ueda, Nagano 386-1192, Japan

Product Name: MEMORY HiCORDER

Model Number: 8847

Options:

9664 HD UNIT
9784 DC POWER UNIT
8966 ANALOG UNIT
8967 TEMP UNIT
8968 HIGH RESOLUTION UNIT
8969 STRAIN UNIT
8970 FREQ UNIT
8971 CURRENT UNIT
8972 DC/RMS UNIT
8973 LOGIC UNIT
9327 LOGIC PROBE
9320-01 LOGIC PROBE
MR9321-01 LOGIC PROBE
9197 CONNECTION CORD
L9198 CONNECTION CORD
L9217 CONNECTION CORD
9665 10:1PROBE
9666 100:1PROBE
9769 CONVERSION CABLE

The above mentioned products conform to the following product specifications:

Safety:

EN61010-1:2001
EN61010-031:2002+A1:2008

EMC:

EN61326-1:2006
Class A equipment
Basic Immunity test requirement
EN61000-3-2:2006
EN61000-3-3:2008

Supplementary Information:

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

HIOKI E.E. CORPORATION

4 October 2010

Atsushi Mizuno

Atsushi Mizuno
Director of Quality Assurance

8847A999-02

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