

# **HIOKI**

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Instruction Manual

**MR8847-01**

**MR8847-02**

**MR8847-03**

**MEMORY HiCORDER**

**HIOKI E. E. CORPORATION**

March 2014 Revised edition 3 MR8847A981-03 14-03H



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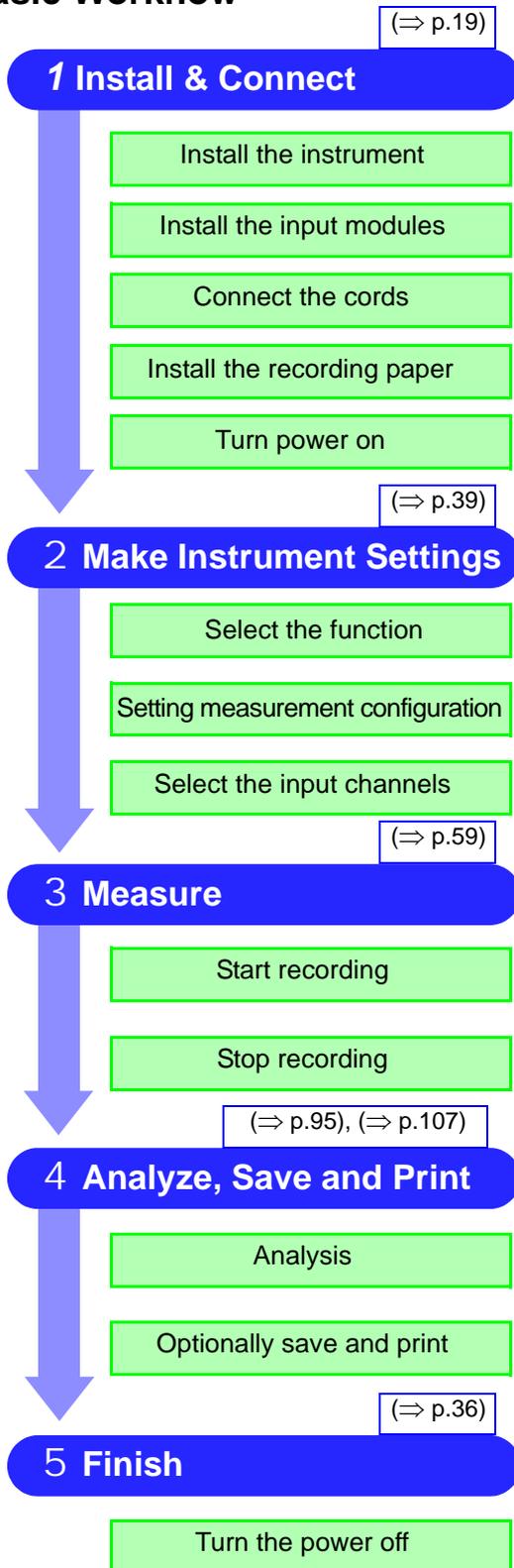
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# Usage Index

## Basic Workflow



- Viewing Input Signals (⇒ p.61)
- Catching Changes in Input Signals (⇒ p.157)
- Applying a Manual Trigger (⇒ p.171)
- Adding Comments (⇒ p.124)
- Freely Setting the Waveform Display (⇒ p.52)
- Converting Input Values (⇒ p.134)
- Copying Settings to Other Channels (⇒ p.145)
- Suppressing Noise (Low-pass filter) (⇒ p.57)
- Composing X-Y Waveforms (⇒ p.114)
- Locking the Keys (KEY LOCK) (⇒ p.11)
- Initializing a CF card (⇒ p.32)
- Scaling During Measurement Using a Current Clamp (⇒ p.136)



## Introduction

Thank you for purchasing the HIOKI "Model MR8847 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 <b>Measurement Guide</b>	<b>Read first.</b> Offers an introduction to the Memory HiCorder's basic measuring method for first time users.
2 <b>Instruction Manual (This document)</b>	Contains explanation and instructions regarding the instrument's operating method and functions.

Registered trademarks

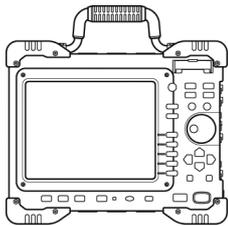
- Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.
- CompactFlash is a registered trademark of Sandisk Corporation (USA).

## Confirming Package Contents

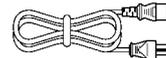
When you receive the instrument, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

### Confirm that these contents are provided. (One each)

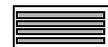
MR8847 Memory HiCorder



Power Cord



Input Cable Labels



USB Cable

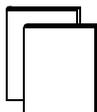


9231 Recording Paper



### Accessories

Instruction Manual



Paper Roll Axle



Measurement Guide



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



Application CD (⇒ p.299)

The latest version can be downloaded from our web site.

Other options specified when ordered

See: Options List (⇒ p. A12)

### **NOTE**

If the 8967 TEMP Unit is installed in the MR8847, two ferrite clamp-on chokes (small) will be supplied per unit.

## Safety Information



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.
	Indicates a burn hazard if touched directly.

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

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

## Symbols for Various Standards



WEEE marking:

This symbol indicates that the electrical and electronic appliance is put on the EU market after August 13, 2005, and producers of the Member States are required to display it on the appliance under Article 11.2 of Directive 2002/96/EC (WEEE).



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

## 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

## Measurement categories

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

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

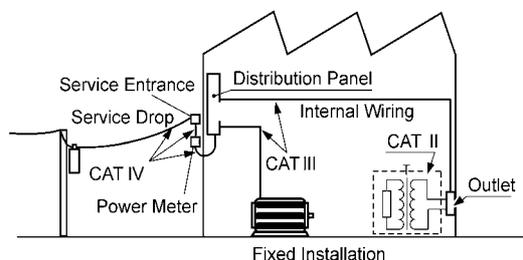
CAT II covers directly measuring electrical outlet receptacles.

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

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

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

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



### **NOTE**

The applicable measurement category is determined by the input module being used. Refer to "18.6 Input Modules Specifications" (⇒ p.331).

## Operating Precautions



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

### Before Use

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



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:  $23 \pm 5^\circ\text{C}$ , 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 water, oil, other chemicals, or solvents. Exposed to high humidity or condensation



Exposed to strong electromagnetic fields  
Near electromagnetic radiators



Exposed to high levels of particulate dust

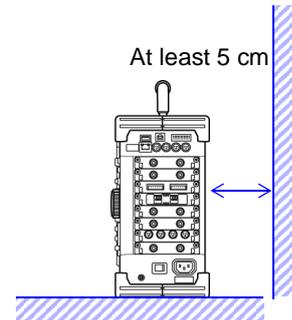
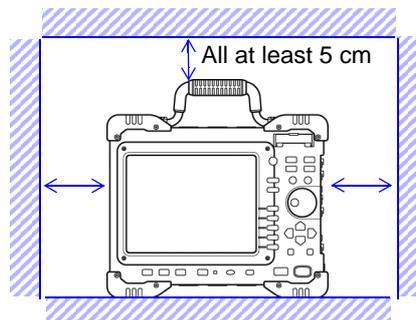


Subject to vibration

### 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.

### **NOTE**

This instrument may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

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



# Overview

# Chapter 1

1

Chapter 1 Overview

## 1.1 Product Overview

The Memory HiCorder MR8847 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 \*

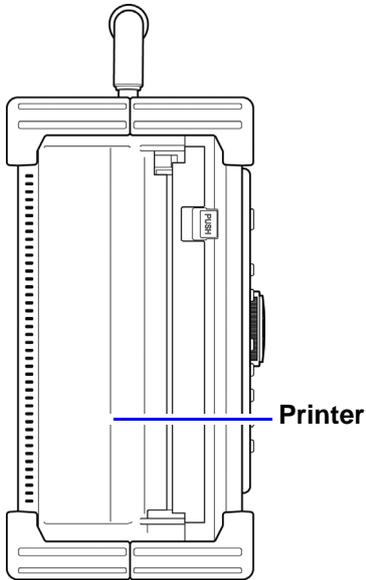
### High-speed sampling: 20 Ms/s

Enables responsive evaluation and analysis.

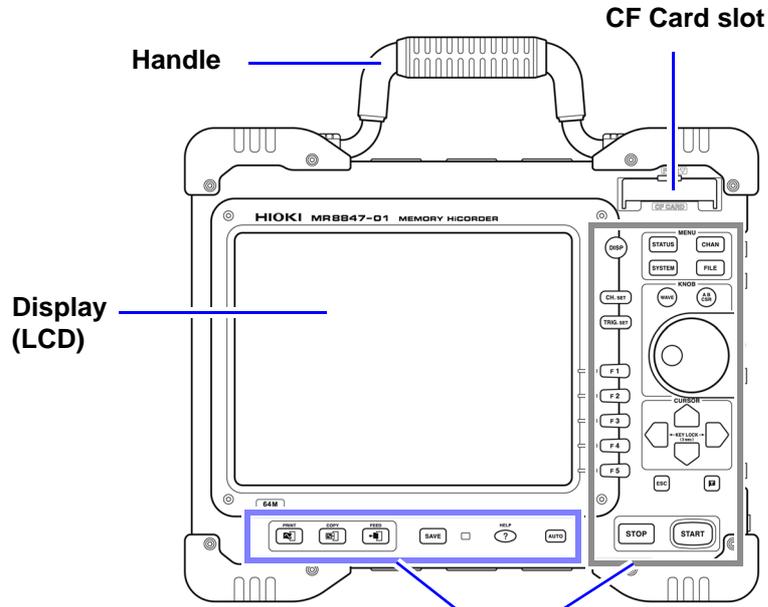
\* For best measurement precision, a warm-up period of about 30 minutes after power-on is recommended, to allow the internal temperature of the input modules to stabilize. Then perform zero-adjust and start the measurement.

# 1.2 Names and Functions of Parts

### Left Side



### Front Panel



### Right Side

#### USB Connector (Type B)

Connect a USB cable here.  
(⇒ p.300)

#### USB Connector (Type A)

Connect a USB memory stick here.  
(⇒ p.30)

#### 100BASE-TX Connector

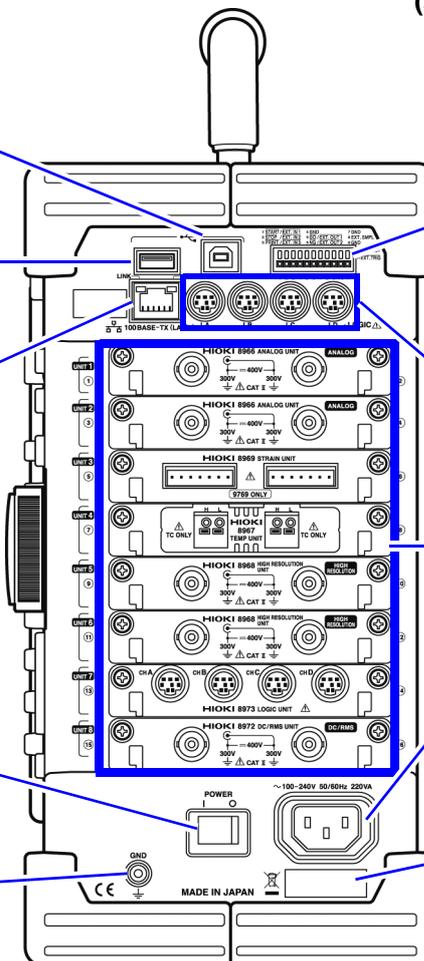
Connect a LAN cable here.  
(⇒ p.281)

#### POWER Switch

Turns the instrument on and off.  
 | : Power On  
 ○ : Power Off (⇒ p.36)

#### GND Terminal (Functional Earth)

Connect to Earth ground.(⇒ p.35)



#### External control terminals

An external sampling signal can be connected here. (⇒ p.313)  
Allows control of the instrument.

#### Standard LOGIC terminals

Input connectors for proprietary logic probes. (⇒ p.22)

#### Various Input Modules

(⇒ p.20), (⇒ p.22)  
(For details, see the documentation of the respective input module.)

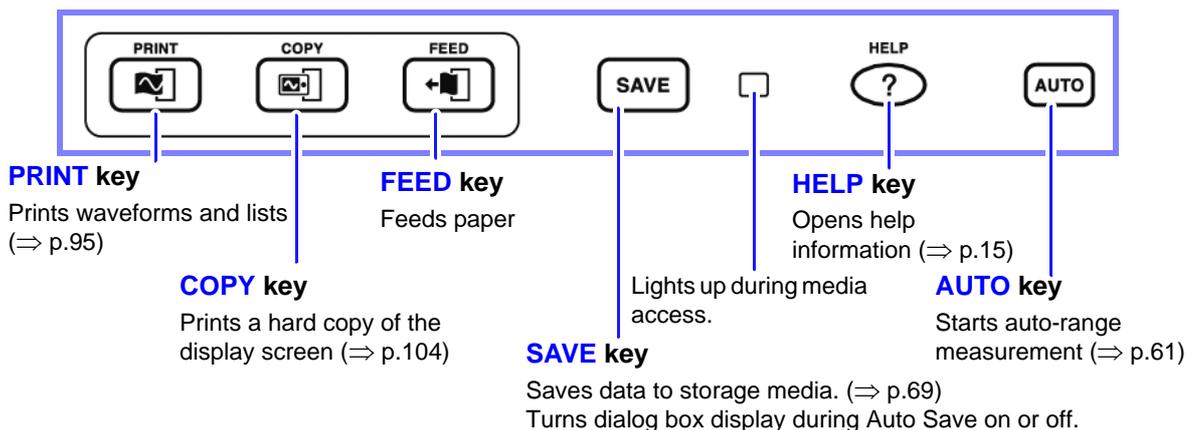
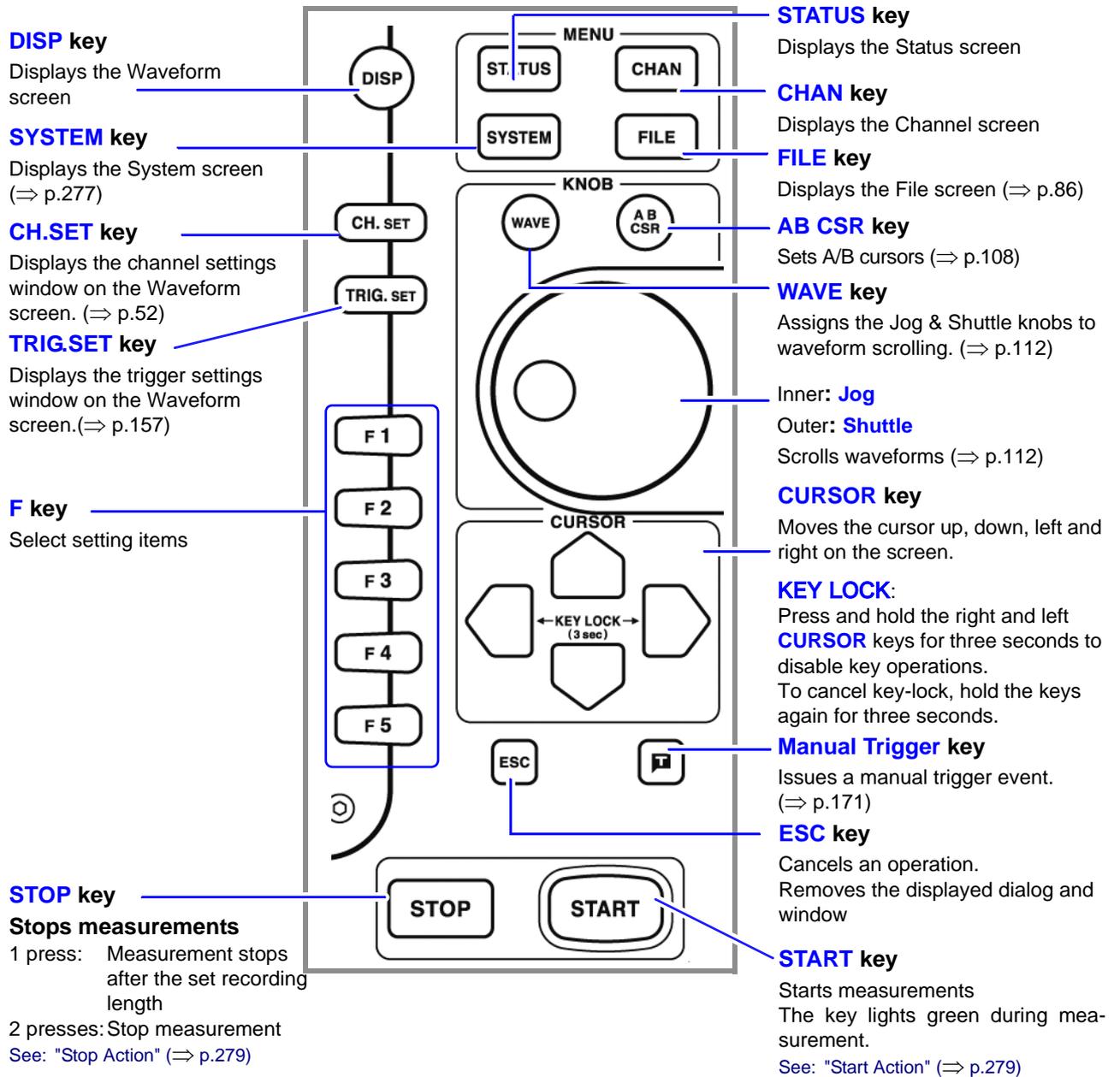
#### Power Inlet

Connect the supplied power cord here.(⇒ p.35)

#### Manufacturer's Serial No.

Shows the serial number. Do not remove this label, as it is required for product support.

**Operating Keys**



## 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



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

### Trigger settings window/Channel settings window



Shows details about the trigger settings.



Shows details about the analog channel and logic channel settings.

### Status Screen



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



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



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



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.124)

Trigger time

Shows the date and time of the last trigger event. (⇒ p.157)

Media icon

Shows the media status. (⇒ p.30)

Current date and time

Shows the date and time as set for the internal clock. (⇒ p.37)

Trigger symbol

Shows the point where the trigger event occurred. (⇒ p.157)

Storage counter

Shows how many trigger events occurred. (⇒ p.60)

Logic waveform (⇒ p.58)

Analog waveform (⇒ p.55)

Upper and lower limit

The upper and lower limit values for each channel are shown here. (⇒ p.120)

Vertical axis display

Shows the value per increment for each channel. This is linked to the range setting. (⇒ p.55)

Scroll bar

The stored waveform is indicated by a red bar, and the displayed waveform by a blue frame. (⇒ p.112)

**MEMORY**  
**Settings cursor**  
The current cursor location is indicated by flashing.

**Settings window**  
Measurement parameters are set here. (⇒ p.43)

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.

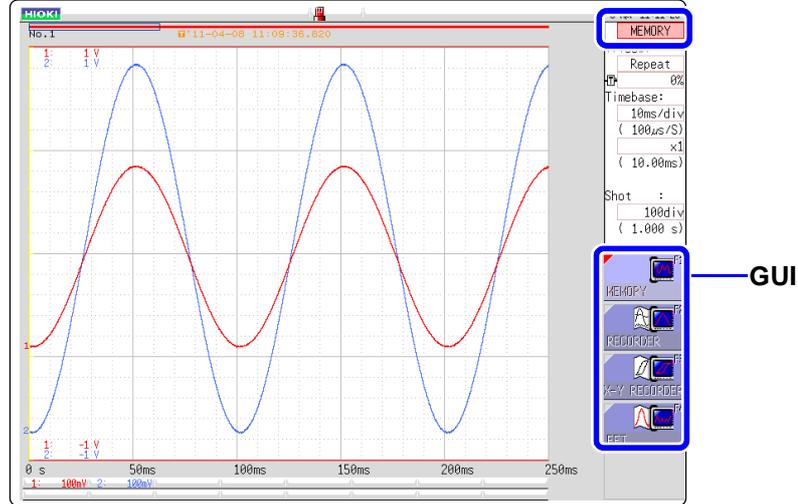
Hint

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.

**Next Page**  
This is shown if there are more than six setting items.  
Selecting this button brings up other items.

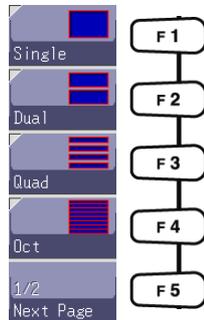
### 1.4 Basic Key Operations

- 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.

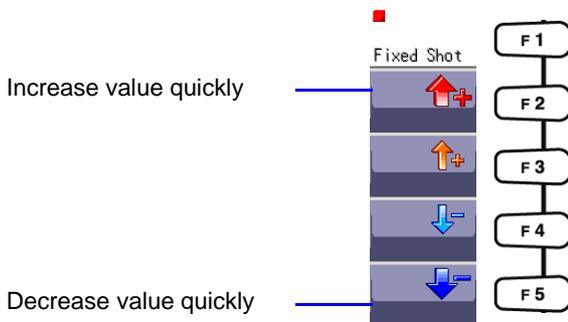
#### Selecting a setting item



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.127)

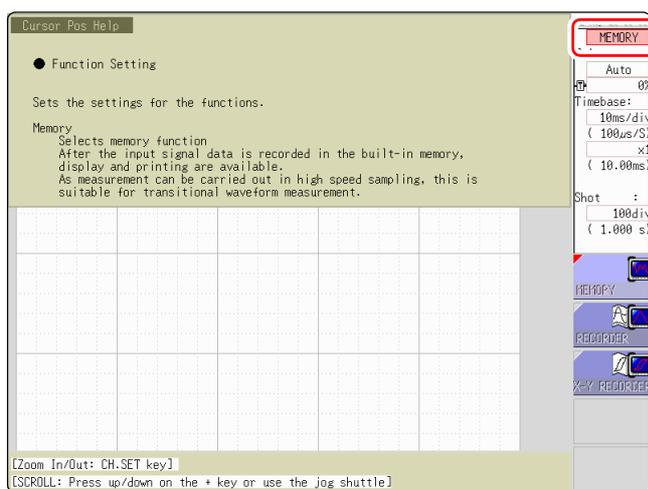
## 1.4.1 Example for Using the HELP Key

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.



- 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.

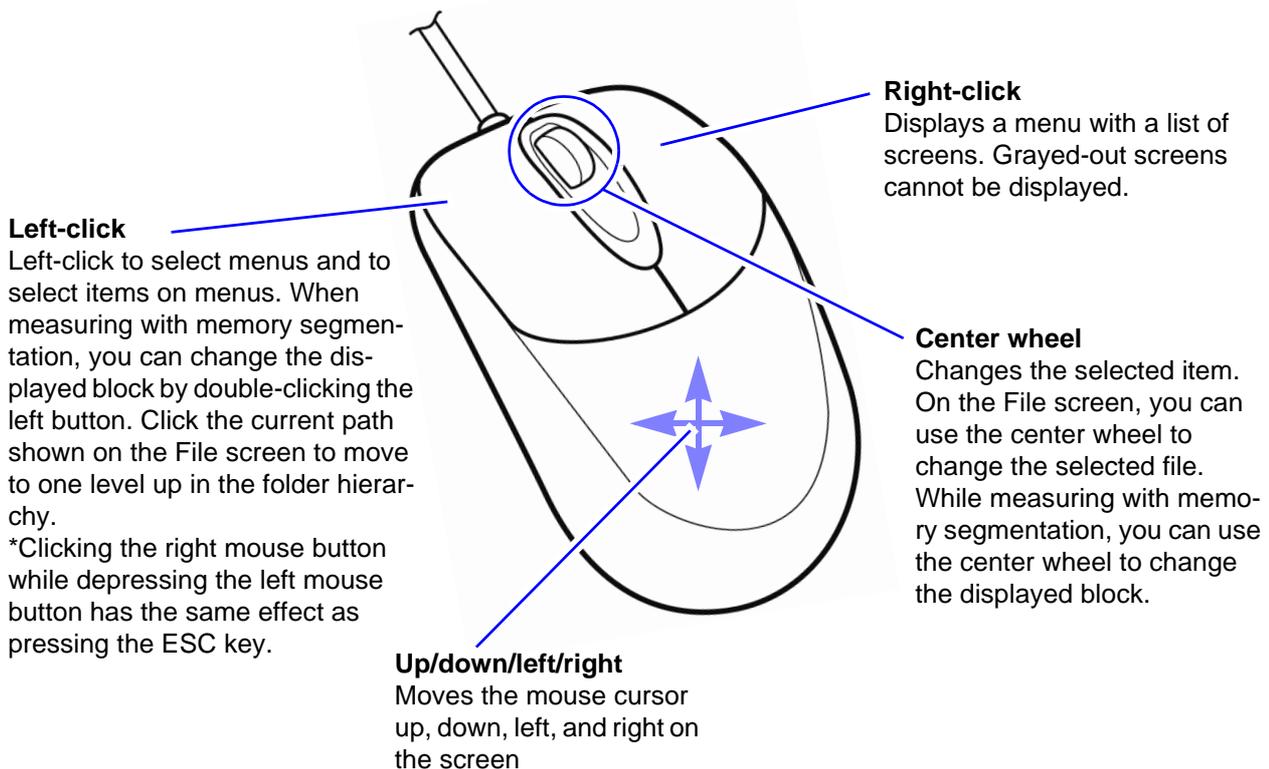
## 1.4.2 Using a Mouse to Perform Key Operations

You can use a commercially available USB mouse to perform the same operations as with the keys on the MR8847.

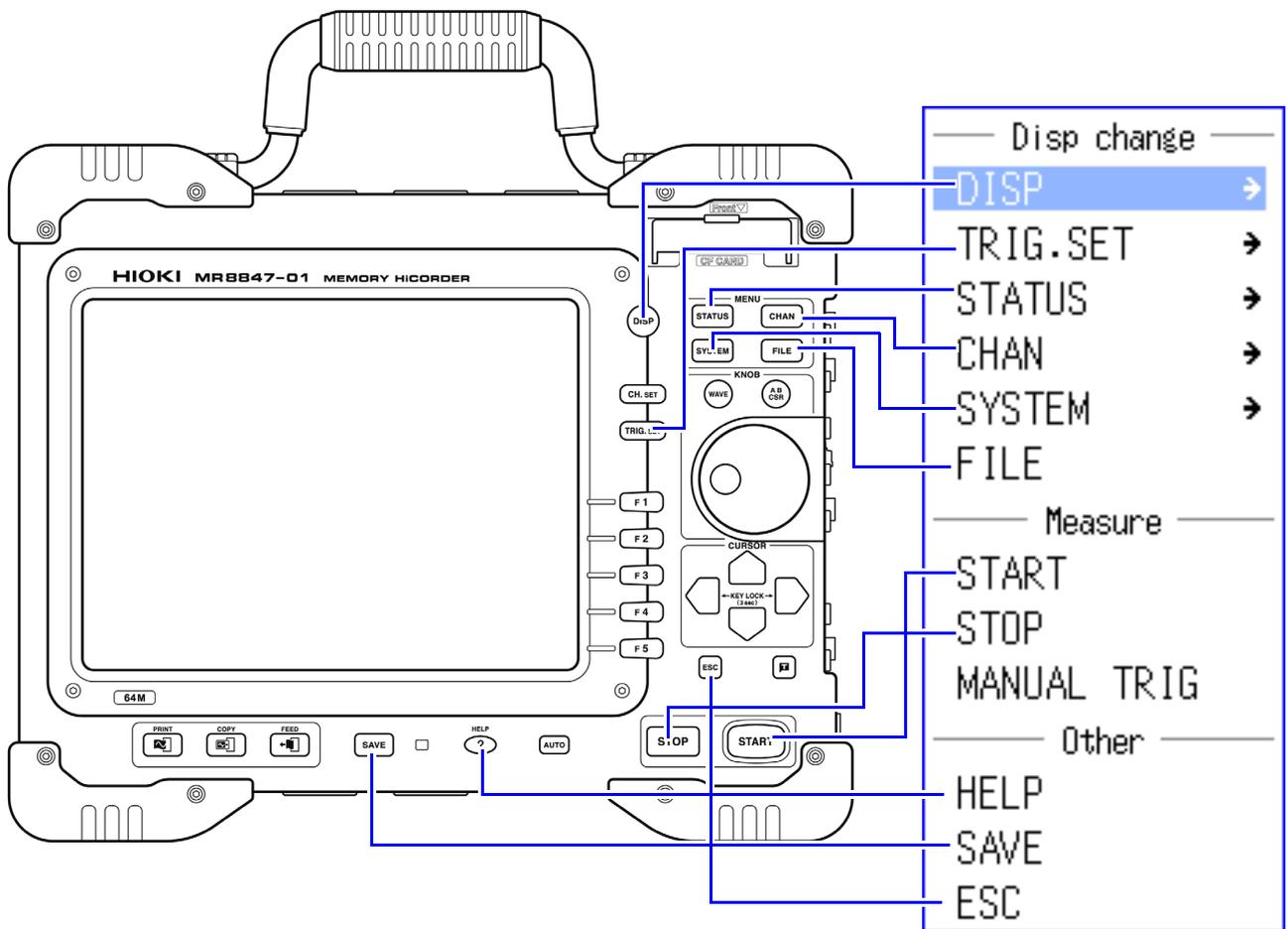
### **NOTE**

- There are a variety of mice available, and not all devices will work with the instrument. If you find that your mouse isn't working properly, try a different model.
- The instrument's USB ports are designed exclusively for use with mice and USB memory sticks. Do not connect any other type of device.
- When operating the instrument with the mouse, some screens may not display properly.
- When using a mouse, do not change the interface on the System screen to anything other than "LAN." You may not be able to use the mouse while USB communications are in progress.
- External interference may cause the mouse to malfunction. Keep the mouse and mouse cable as far away as possible from sources of interference.

The following diagram describes how to operate the instrument with a mouse:



The operation keys of the MR8847 Memory HiCorder and the menu displayed when you right-click the mouse are related as follows:



To operate and carry out settings for CH.SET, WAVE, and AB CSR click the icon in the display shown when the mouse is connected. The relationships between the operation keys and icons when the mouse is connected are as follows.

	CH.SET key
	WAVE key
	AB SCR key



# Measurement Preparations

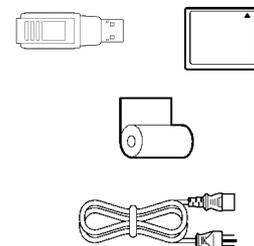
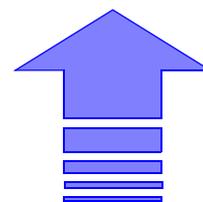
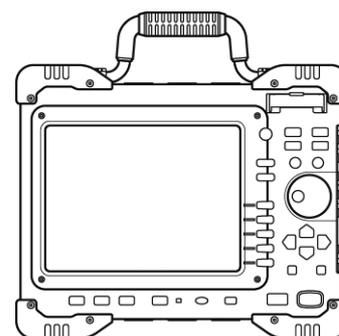
## Chapter 2

2

Chapter 2 Measurement Preparations

### Work Flow

- 1** Install this instrument (⇒ p.6)
- 2** Install an input module (Adding or replacing an input module) (⇒ p.20)
- 3** Connect a logic probe to the Standard LOGIC terminals (When measuring logic signals) (⇒ p.22)
- 4** Connect the input cable(s) to the input module (When measuring analog signals) (⇒ p.22)  
Probes and cables will differ depending on the measurement purpose.
- 5** Insert media (CF Card, USB memory stick) (⇒ p.30)
- 6** Load recording paper (⇒ p.33)
- 7** Connect the power cord (⇒ p.35)
- 8** Ground the Functional Earth of this instrument (⇒ p.35)  
(For measurement in noise-prone environments)
- 9** Turn the power on (⇒ p.36)
- 10** Setting the clock (⇒ p.37)
- 11** Perform zero-adjust (⇒ p.38)



**When preparations are complete, let's start a measurement (⇒ p.39)**



#### Using communication functions

See: "Chapter 16 Connection to a Computer" (⇒ p.281)

#### Using external control functions

See: "Chapter 17 External Control" (⇒ p.313)

## 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**

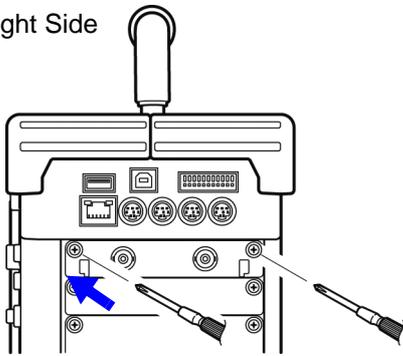
- To avoid damaging input modules, do not touch the input module connectors on this instrument.
- Measurements made without a blank panel installed may fail to meet specifications because of temperature instability within the instrument.

### **NOTE**

For information on analog channel accuracy when using logic channels, see "8.10 Making Detailed Settings for Input Modules" (⇒ p.146).

### Installing an input module

Right Side

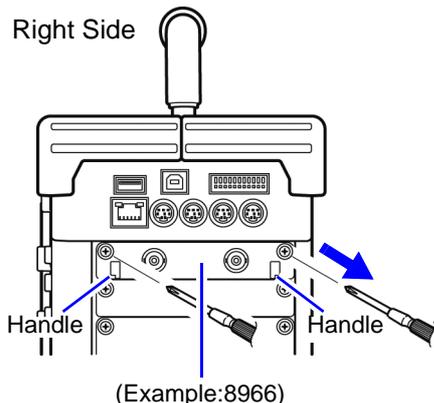


Required item: One Phillips-head screwdriver

- 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

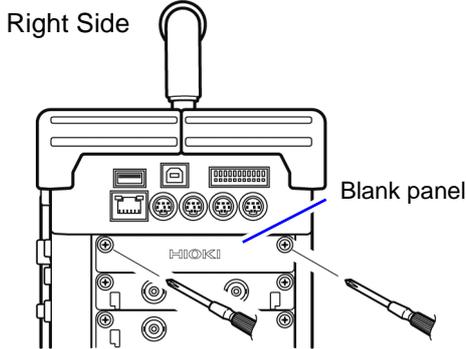
Right Side



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**



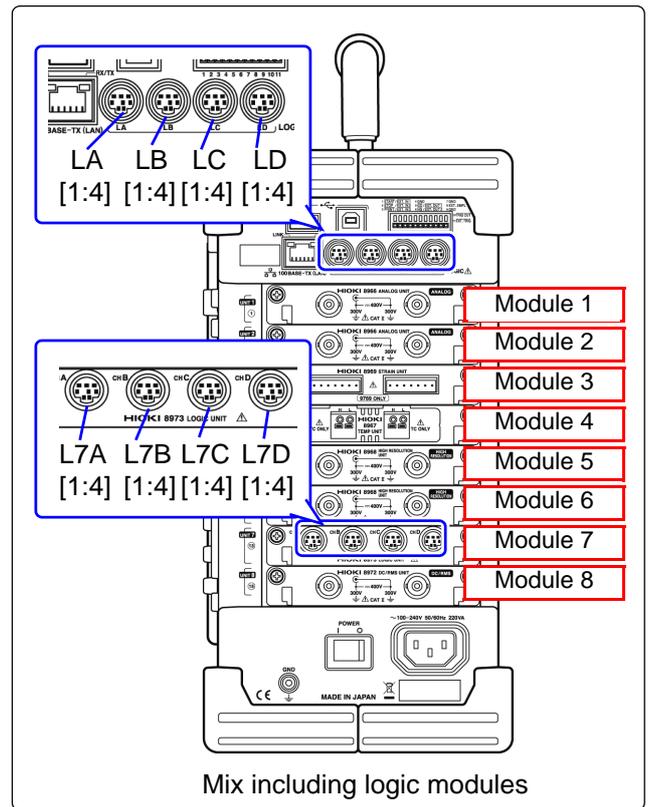
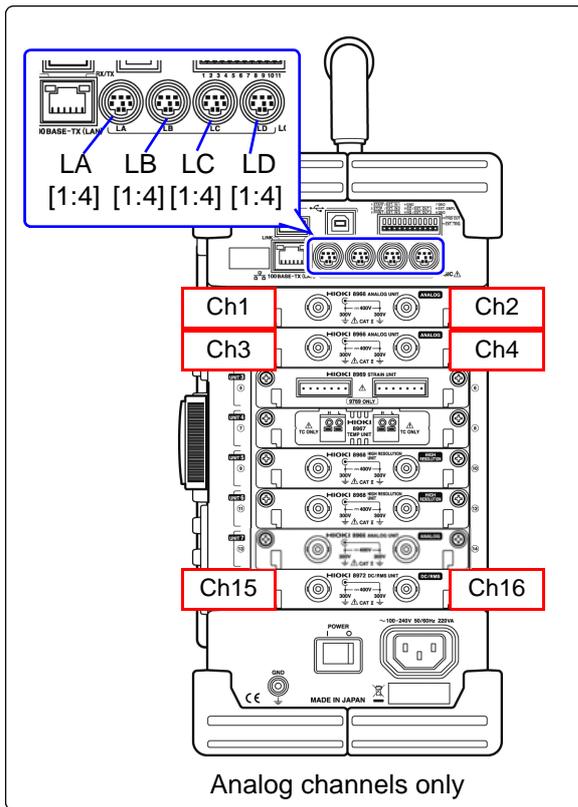
Using the Phillips screwdriver, tighten the two mounting screws.

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 [\[System Information\]](#).



## 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.



#### 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.



#### 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



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.



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



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

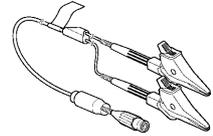
- 8966 Analog Unit
- 8968 High Resolution Unit
- 8972 DC/RMS Unit

Connect to the BNC jack on an input module.

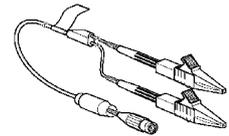
\*: A power cord option or AC adapter may be required, depending on the input module used.

### Use to connect: Connection cords

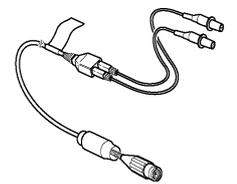
- L9197 Connection Cord (Maximum input voltage: 600 V) Large alligator clip type



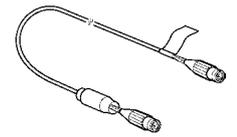
- 9197 Connection Cord (Maximum input voltage: 600 V) Large alligator clip type



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

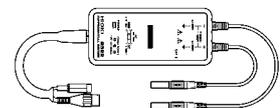


- L9217 Connection Cord (Maximum input voltage: 300 V) For measuring BNC output



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

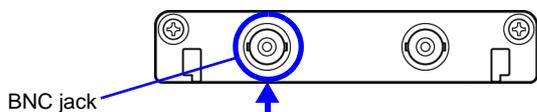
- 9322 Differential Probe\*
- 9665 10:1 Probe
- 9666 100:1 Probe



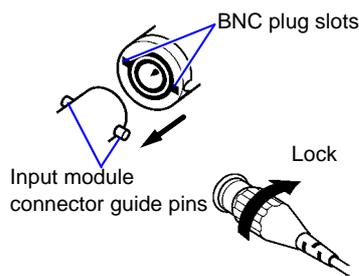
Example: 9322 Differential Probe

### Connect to BNC jack

Example: 8966 Analog Unit



#### Connecting the cable



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

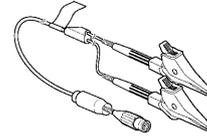
- 8970 Freq Unit

Connect to the BNC jack on an input module.

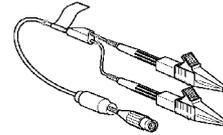
\* A power cord option or AC adapter may be required.

Use to connect: Connection cords

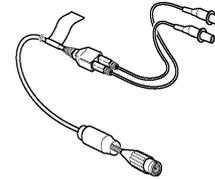
- L9197 Connection Cord (Maximum input voltage: 600 V) Large alligator clip type



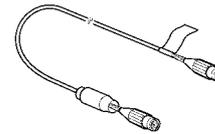
- 9197 Connection Cord (Maximum input voltage: 600 V) Large alligator clip type



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

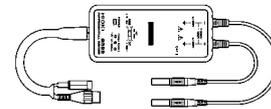


- L9217 Connection Cord (Maximum input voltage: 300 V) For measuring BNC output



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.23 for details for how to connect to a BNC terminal.

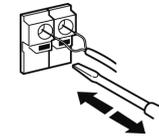
Measuring Temperature

Applicable Input Modules  
 • 8967 TEMP Unit

Connect to the terminal block on the input module.

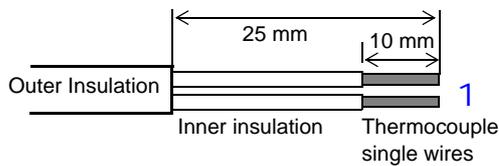
Use to connect: Thermocouple

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



Connect to terminal block

Insert to terminal block

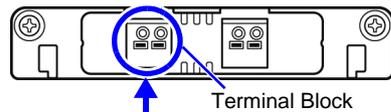


Required item:

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



**Inserting a Thermocouple**

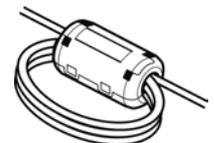
Connection Holes

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.

**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).



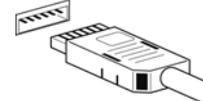
### Using a Strain Gauge to Measure Vibration or Displacement (Strain)

Applicable Input Modules  
 • 8969 Strain Unit

Connect Model 9769 Conversion Cable to the input module jack.

Use to connect: Sensor

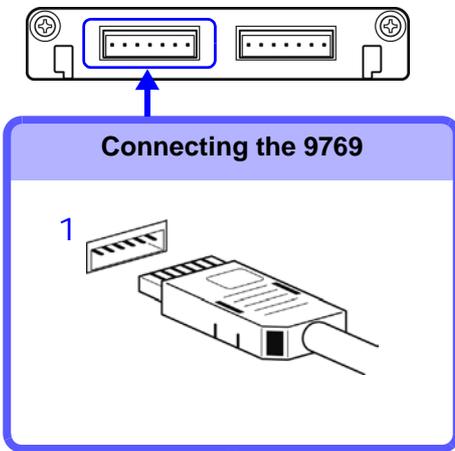
- Strain Gauge Transducer (Not available from Hioki)
- 9769 Conversion Cable



Connecting using a 9769 Conversion Cable

#### Connect to input module's terminal

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



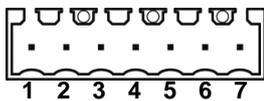
Connecting the 9769

- 1 Connect to the Strain Gauge Converter
- 2 Connect to the Strain Gauge Converter
- 3 Attach to the measurement object

Required item:  
 9769 Conversion Cable, Strain Gauge Converter

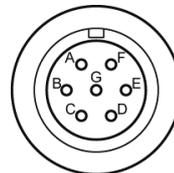
- 1 Connect the 9769 to a terminal on the input module.  
 The orange section of the 9769 must face up.
- 2 Connect the strain gauge transducer to the conversion cable.
- 3 Attach to the measurement object.

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.

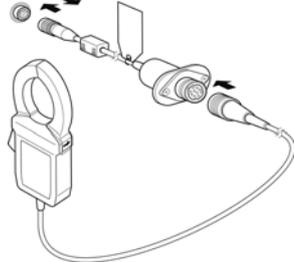
**Measuring Current**

Applicable Input Modules  
 • 8971 Current Unit

Connect Model 9318 Conversion Cable to the input module jack.

Use to connect: Clamps

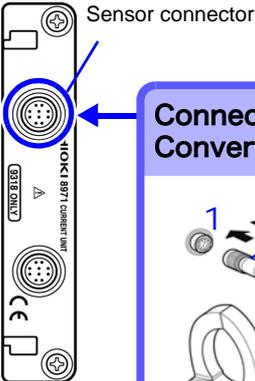
- Clamp-On Sensor 9272-10
- Universal Clamp-On CTs 9277, 9278, 9279
- AC/DC Current Sensors 9709, CT6862, CT6863



Example:  
9272-10+9318

**Connect to input module's terminal**

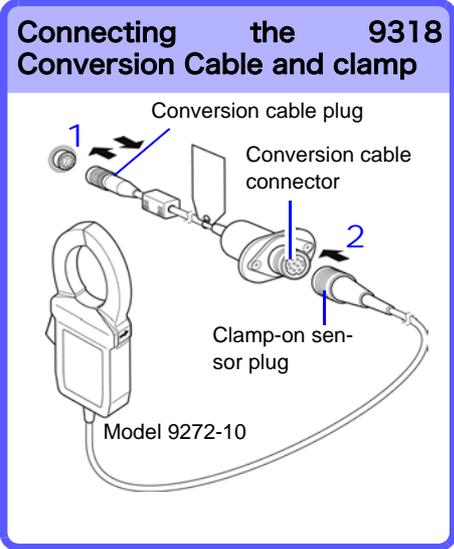
Example: When connecting the 9272-10 Clamp-On Sensor



Sensor connector

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

**Connecting the 9318 Conversion Cable and clamp**



Conversion cable plug

Conversion cable connector

Clamp-on sensor plug

Model 9272-10

- 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.

**3 Attach to the measurement object**

When measuring current with a 9018-50 Clamp On Probe  
 You can use a voltage measurement unit such as the 8966 Analog Unit to make measurements. For more information about how to configure the instrument for use in this type of application, see the example settings in "8.5.1 Scaling Setting Examples" (⇒ p.136).

Measuring Logic Signals

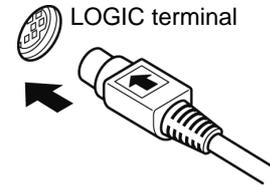
Applicable Input Modules  
 • 8973 Logic Unit

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



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

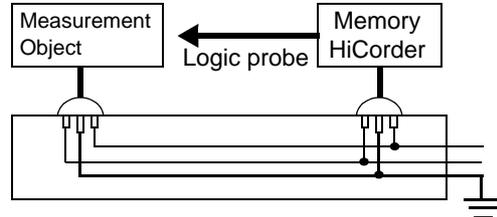
- The ground pin in the LOGIC connector (plug) of the Model 9320-01 and 9327 Logic Probes (and legacy Models 9306 and 9320) is not isolated from this instrument's ground (common ground).

Use grounding-type polarized power cords for the measurement object and this instrument, and obtain power from the same mains circuit.

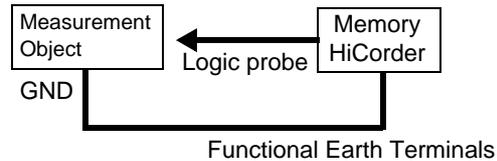
Connecting to different mains circuits or using a non-grounding power cord may cause damage to the measurement object or this instrument because of current flow through the logic probes resulting from potential difference between the grounds of the different wiring systems.

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.



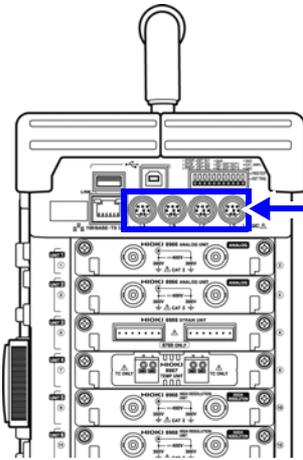
For more information about logic probe specifications, see the instruction manual that came with the logic probe you plan to use.

### Connect to LOGIC Terminals

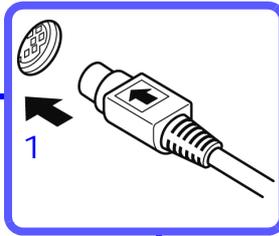
Example: Connecting the 9327 Logic Probe

Right Side

Required item: 9327 Logic Probe



LOGIC terminals



2 Connect to the measurement object

- 1 Connect the logic probe by aligning the grooves 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.
- Peculiar USB memory requiring fingerprint authentication or password cannot be used.

#### **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, USB memory stick and CF Card media.
- Data can also be saved to a USB flash drive in real time, but from the perspective of data protection, we recommend using Hioki's optional CF card.

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#### **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

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Media icons

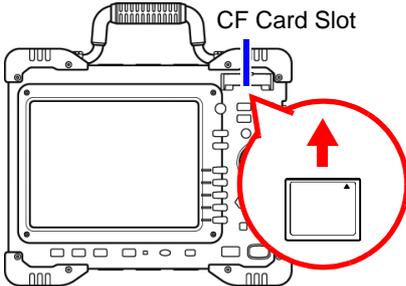
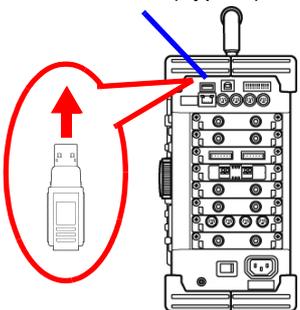
Icons indicating the status of storage media are always shown at the top of the screen.



: 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
<p>CF Card</p> 	<p><b>Inserting a CF Card</b> 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.</p> <p><b>Removing a CF Card</b> Press the Eject button. When the button pops out, press it again to eject the CF Card.</p> 
<p>HDD (Hard disk)</p> 	<p>9664 HD Unit (capacity: 80 GB 1GB=1,000,000,000 bytes)</p> <p>The optional 9664 HD Unit (factory option) is required. The hard disk is formatted at the factory.</p>
<p>RAM (Internal memory)</p> 	<ul style="list-style-type: none"> <li>• Memory integrated in the unit is used. Only settings can be stored.</li> <li>• Automatic saving of data is not possible.</li> </ul>
<p>USB memory stick</p> 	<ul style="list-style-type: none"> <li>• Do not connect any devices other than USB memory stick.</li> <li>• Not all commonly available USB memory sticks are supported.</li> <li>• To use a USB memory stick, suitable unit settings must be made, as USB Connector (Type A) described below.</li> </ul> <p><b>Inserting a USB memory stick</b> Ensure correct orientation of the USB memory stick and push it all the way into the connector.</p> <p><b>Remove a USB memory stick</b> 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.)</p> 

## 2.3 Recording Media Preparation

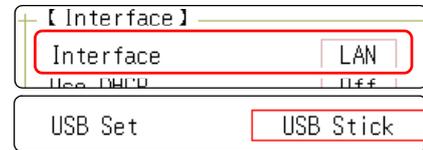
Depending on the intended use of the USB memory stick, connector types and settings at the instrument will differ, as listed in the table below.

USB use	Connector	MR8847 setting		Reference information
		Interface	USB setting	
As USB memory stick	Type A	LAN	USB Stick	Reference procedure
To retrieve CF card or hard disk files from a computer (using a USB cable)	Type B	LAN	Mass StorageHDD, mass storage CF	"16.4" (⇒ p.298)
For communication with PC (using a USB cable)	Type B	USB	Interface	"16.6.1" (⇒ p.300)

### Procedure

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

- 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.

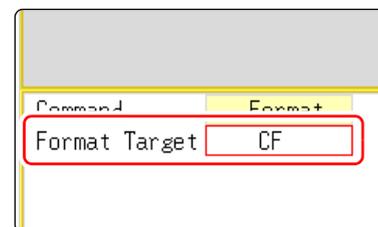
### **NOTE**

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**

- 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**

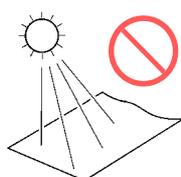
Be careful not to cut yourself with the paper cutter.

### **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

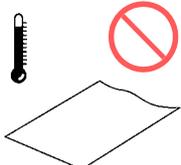
The recording paper is thermally and chemically sensitized. Observe the following precautions to avoid paper discoloration and fading.



Avoid exposure to direct sunlight.



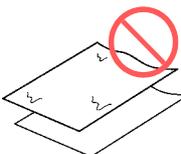
Avoid exposure to volatile organic solvents like alcohol, ethers and ketones.



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



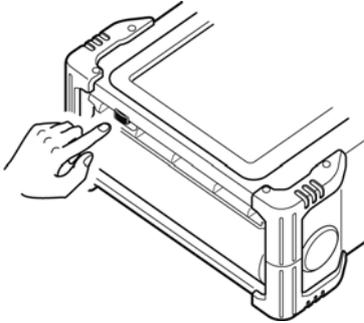
Avoid contact with adhesive tapes like soft vinyl chloride and cellophane tape.



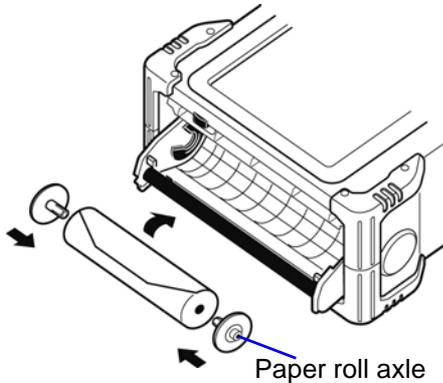
Avoid stacking with wet Diazo copy paper.

### Procedure

Required item: MR9231 Recording Paper,  
Paper roll axle (Supplied with the instrument)

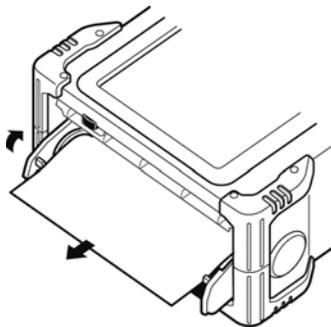


1. Press the Eject button to open the printer cover.



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 MR8847 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)
- Use only the designated power cord with this instrument. Use of other power cords may cause fire.

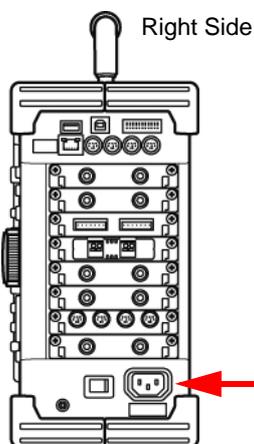
#### **CAUTION**

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

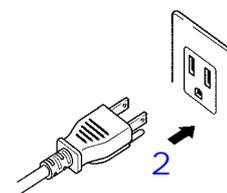
#### **NOTE**

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.



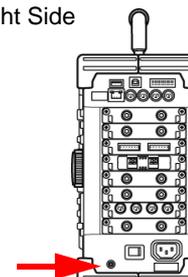
### 2.5.2 Grounding the Instrument's Functional Earth

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.

Right Side



## 2.5.3 Turning the Power On and Off

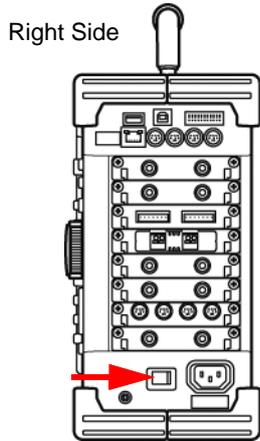
This section explains the correct procedure for powering the unit up or down.



**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.69)

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.85)

## 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.

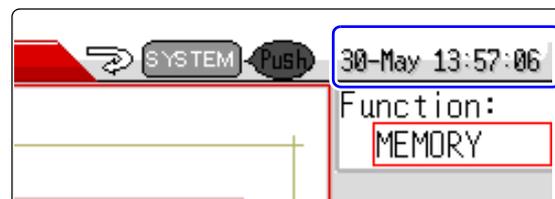
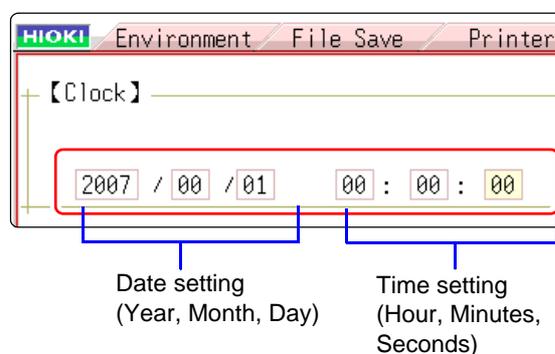
- Measurement with timer-based trigger
- Printout of data including count of trigger events
- Saving measurement data

### 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.

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



### 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 procedure is performed for all channels and ranges.

### 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.)

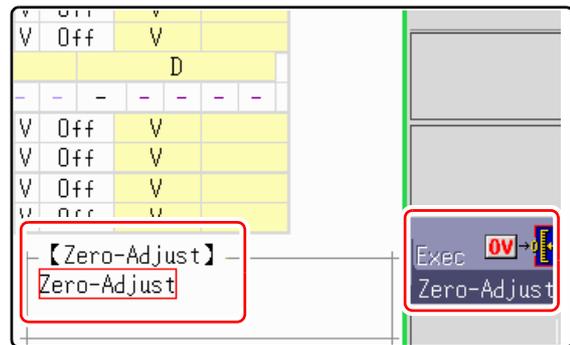
### Procedure

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.150))

#### 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 amplifier. 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

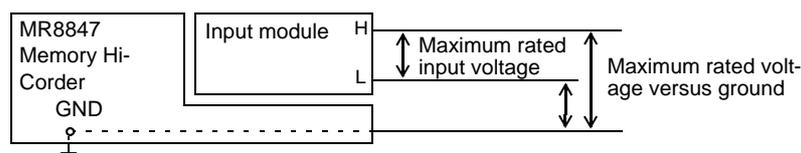
Be sure to observe the following points, to ensure safe measurement.



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
L9197 Connection Cord	600 VAC/DC	600 VAC/DC (CAT III)
9197 Connection Cord		300 VAC/DC (CAT IV)
L9198 Connection Cord	300 VAC/DC	600 VAC/DC



## 3.2 Measurement Workflow

### 1 Pre-Measurement Inspection

See:

"3.3 Pre-Measurement Inspection" (⇒ p.42)

### 2 Make basic settings for measurement

Select suitable recording method for measurement target

See:

"3.4.1 Measurement Function" (⇒ p.43)

Set data acquisition speed

"3.4.2 Time Axis Range and Sampling Rate" (⇒ p.45)

Set waveform length

"3.4.3 Recording Length (number of divisions)" (⇒ p.48)

Set waveform display format and printing format

"3.4.4 Screen Layout" (⇒ p.51)

#### Application examples

See:

"7.4 Performing Waveform X-Y Synthesis" (⇒ p.114)

"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.130)

"8.3 Displaying New Waveforms Over Past Waveforms (Overlay)" (⇒ p.131)

"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.133)

"Chapter 10 Numerical Calculation Functions" (⇒ p.179)

### 3 Input Channel Settings

Make analog channel settings

See:

"3.5.2 Analog Channel" (⇒ p.55)

Make logic channel settings

"3.5.3 Logic Channel" (⇒ p.58)

#### Application examples

See:

"8.1 Adding Comments" (⇒ p.124)

"8.5 Converting Input Values (Scaling Function)" (⇒ p.134)

"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)

"8.7 Fine Adjustment of Input Values (Vernier Function)" (⇒ p.143)

### 4 Make trigger settings

See:

"Chapter 9 Trigger Settings" (⇒ p.157)

## 5 Starting Measurement

See:

- "3.6 Starting and Stopping Measurement" (⇒ p.59)
- "Chapter 5 Saving/Loading Data & Managing Files" (⇒ p.69)
- "Chapter 6 Printing" (⇒ p.95)
- "7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.108)
- "7.3.2 Scrolling With Jog and Shuttle Knobs (Scroll)" (⇒ p.112)
- "7.5 Magnifying and Compressing Waveforms" (⇒ p.116)

## 6 Stopping Measurement

See:

- "3.6 Starting and Stopping Measurement" (⇒ p.59)



### 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.61)



### 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.82)



### 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.85)

#### 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: "19.2 Initializing the Instrument" (⇒ p.342)

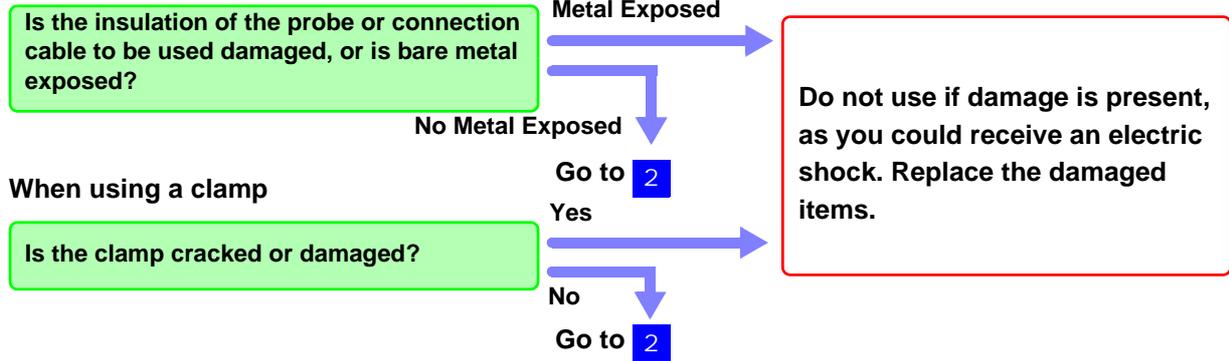
# 3.3 Pre-Measurement Inspection

The following steps should be performed before measurement.

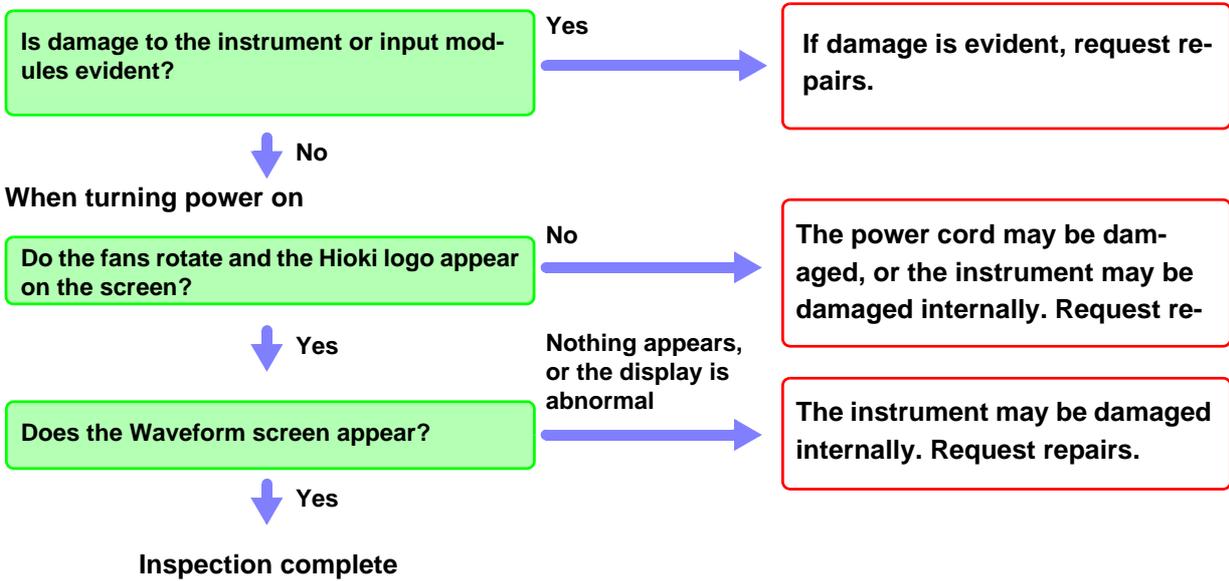
Before using the instrument the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

## 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

MEMORY (⇒ p.43)

Timebase setting (Sampling rate) (⇒ p.45)

Recording Length (Number of divisions) (⇒ p.48)

---Measure---

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

0ns 5ms 10ms 15ms 20ms 25ms

1-200mV 2-200mV

### 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



**This function is most suitable for oscilloscope-type measurements, such as instantaneous waveforms and transient phenomena.**

Trigger functions and calculation functions can be used.



**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.**

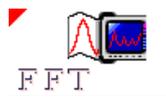
Real-time printing of data is possible.



**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.63)



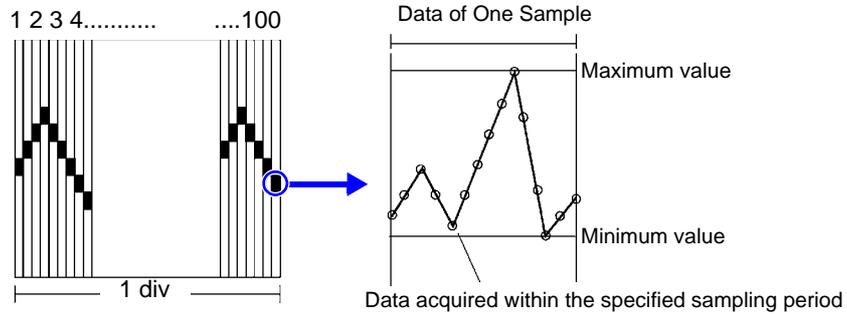
**Analyze the frequency.**

**Various types of spectrum and octave analysis can be performed.**

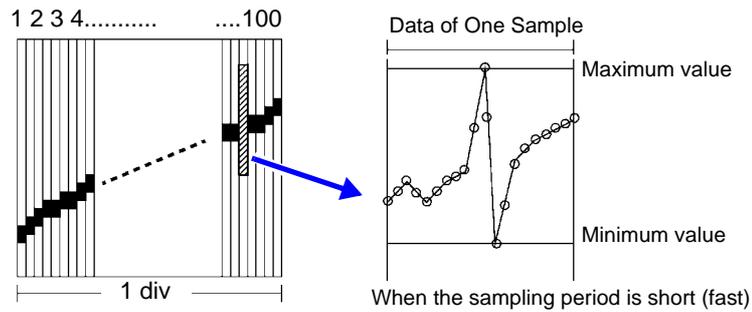
See: "Chapter 13 FFT Function" (⇒ p.215)

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  
( 10 $\mu$ s/S)

3

### 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  $\mu$ s/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: "17.2.3 External Sampling (EXT.SMPL)" ( $\Rightarrow$  p.318)

### 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  $\mu$ s  
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**

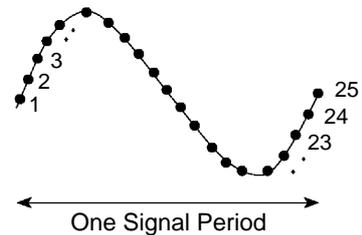
Refer to the table below when setting the time axis range. For example, to measure a 100 kHz waveform, the maximum display frequency setting range according to the table is 200 kHz - 800 kHz. If the maximum display frequency is set to 400 kHz, setting the time axis range to 10  $\mu$ s/div is recommended.

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



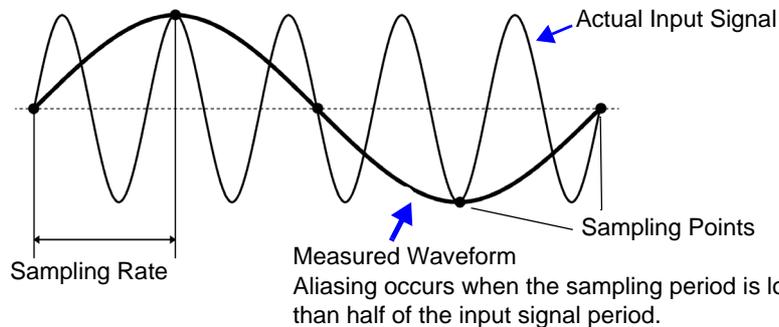
**What is the maximum display frequency?**

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.



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 ( $\Rightarrow$  p.61) 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.61)

**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.55).

**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 $\mu$ s/div	50 ns (20 MS/s)	-
8967	Dependent on data refresh setting	Dependent on data refresh setting	See: "8.10.5"(⇒ p.151)
8968	100 $\mu$ s/div	1 $\mu$ s (1 MS/s)	-
8969	500 $\mu$ s/div	5 $\mu$ s (500 ks/s)	-
8970	Dependent on setting	Dependent on setting	See: "8.10.5"(⇒ p.151)
8971	100 $\mu$ s/div	1 $\mu$ s (1 MS/s)	See: "8.10.6"(⇒ p.154)
8972	Dependent on response setting	Dependent on response setting	See: "8.10.7"(⇒ p.155)
8973	5 $\mu$ s/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)

MR8847-01

25, 50, 100, 200, 500, 1,000, 2000, 5000, 10000, 20000 DIV  
50000 DIV (2, 4,8 channel mode)  
100000 DIV (2, 4 channel mode)  
200000 DIV (2 channel mode)

MR8847-02

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000,  
100000 DIV  
200000 DIV (2, 4, 8 channel mode)  
500000 DIV (2, 4 channel mode)  
1000000 DIV (2 channel mode)

MR8847-03

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000,  
100000, 200000 DIV  
500000 DIV (2, 4, 8 channel mode)  
1000000 DIV (2, 4 channel mode)  
2000000 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. Data from the point at which measurement was stopped to the maximum recording length can be saved or printed again.

**MR8847-01**

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 div

**MR8847-02**

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000 div

**MR8847-03**

25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000 div

(User Shot)

**MR8847-01** 1 to 20,000 div

**MR8847-02** 1 to 80,000 div

**MR8847-03** 1 to 160,000 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.133)

**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.  
The instrument stores the maximum recording length of data back from the point at which measurement was stopped in its internal memory (20,000 divisions for the MR8847-01, 80,000 divisions for the MR8847-02, and 160,000 divisions for the MR8847-03).
- 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.99)
- 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.114)

#### 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.
Hex	Display and record using 16 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.
Hex	Display and record using 16 graphs.

### Analog Channel Assignment

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

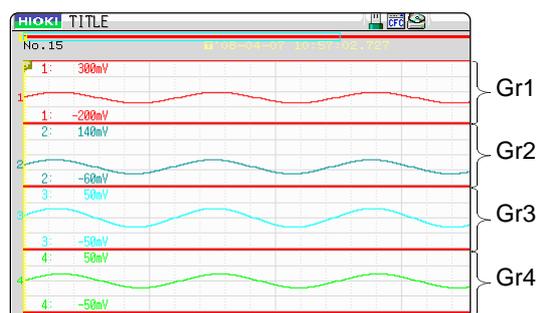
#### Procedure

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>

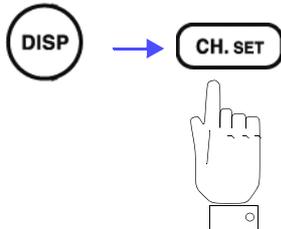


## 3.5 Input Channel Setting

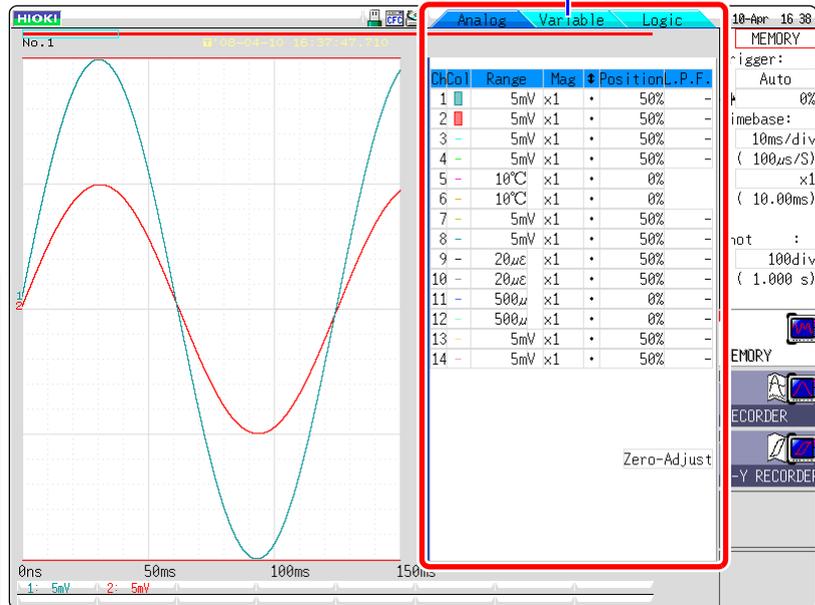
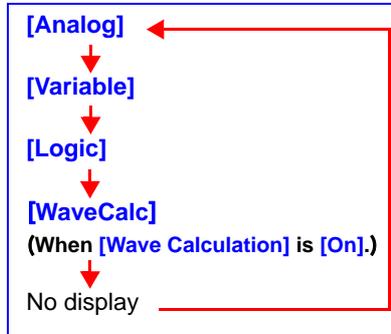
Set the analog channel and logic channel.

### Opening the Channel settings window

See: "Displaying All Channels for Making the Variable Function Setting" (⇒ p.141)



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



#### To perform waveform interpolation

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

See: "1. Waveform Display Color" (⇒ p.55)



#### 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.133)



#### To copy the settings of one channel to another

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

## 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.133)

### 2 Make input and screen display related settings

Select input coupling	See: "3. Coupling" (⇒ p.55)
Match range to measurement target input value (as necessary)	"2. Vertical axis (Voltage axis) Range" (⇒ p.55)
Convert input value (as necessary)	"8.5 Converting Input Values (Scaling Function)" (⇒ p.134)
Make filter settings (if noise occurs)	"7. Low-pass filtering" (⇒ p.57)
Fine-tune waveform amplitude (as necessary)	"5. Vernier" (⇒ p.56)
Set zoom on vertical axis (voltage axis) direction (as necessary)	"4. Vertical axis (Voltage axis) Zoom" (⇒ p.56)

### 3 Make trigger settings (as necessary)

See:

"Chapter 9 Trigger Settings" (⇒ p.157)

### 4 Make display color and display position settings

Set waveform display color	See: "1. Waveform Display Color" (⇒ p.55)
Set display position and scaling (as necessary)	"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)

### 4 Make graph display settings

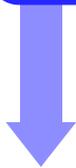
For 1, 2, 4, 8 screens	See: "Analog Channel Assignment" (⇒ p.51)
For X-Y1, X-Y4 screens	Procedures "4" and "5" of "7.4 Performing Waveform X-Y Synthesis" (⇒ p.115)

### **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.58)

### 2 Make display color and display position settings

Set waveform display position

See:  
"2. Waveform Display Position" (⇒ p.58)

Set waveform display color

"3. Waveform Display Color" (⇒ p.58)

### **NOTE**

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

## 3.5.2 Analog Channel

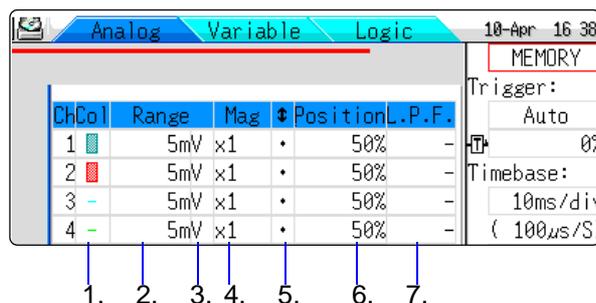
Set the analog channel.

For information on specific settings for 8967 TEMP Unit, 8969 Strain Unit, and 8972 DC/RMS Unit, see "8.10" (⇒ p.146).

### 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.



### To copy the settings of one channel to another

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

### 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

<b>Off</b>	The waveform is not displayed. If the Auto Save setting for <b>[Save Channel]</b> is <b>[Disp Ch]</b> , data for the channel will also not be saved. See: "Select the channel to save." (⇒ p.76)
<b>On</b>	The waveform is displayed. Select the color with the <b>F</b> keys <b>[↑]</b> and <b>[↓]</b> .
<b>All On-Off</b>	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.56).

When the Variable function is on but Variable Auto Adjustment is off, the size of the waveform on the screen will not change even if the vertical axis (voltage) 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

<b>DC (V)</b>	Both DC components and AC components of the input signal will be measured. (default setting)
<b>AC (V̂)</b>	Only AC components of the input signal will be measured. DC components are blocked.
<b>GND (⏏)</b>	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.118)

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.140)  
 "8.8 Inverting the Waveform (Invert Function)" (⇒ p.144)

### 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.143)

### 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.38)

#### 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

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

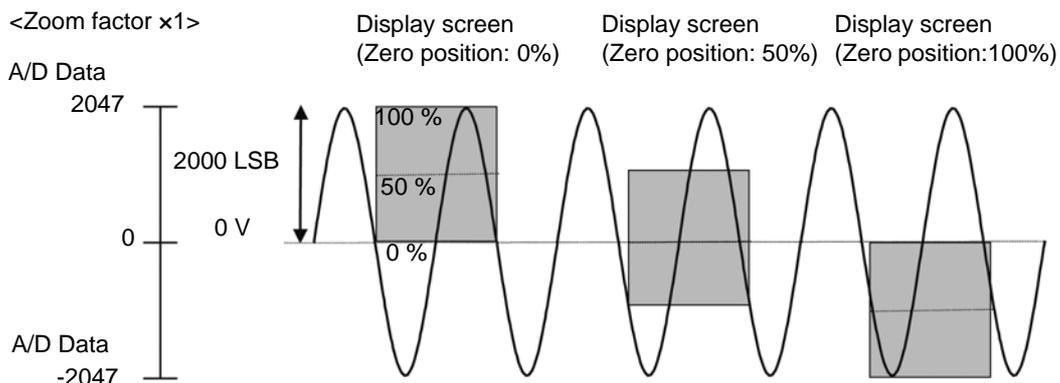
If the zero position of the 8969 Strain Unit is out of alignment, perform auto balance.

**See:** "8.10.4 Settings for the 8969 Strain Unit" (⇒ p.150)

#### 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									
	x1/10	x1/5	x1/2	x1	x2	x5	x10	x20	x50	x100
8966 (Analog) 8971 (Current) 8972 (DC/RMS)	20000 (4000)	10000 (4000)	4000	2000	1000	400	200	100	40	20
8967 (Temperature)*	200000	100000	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.

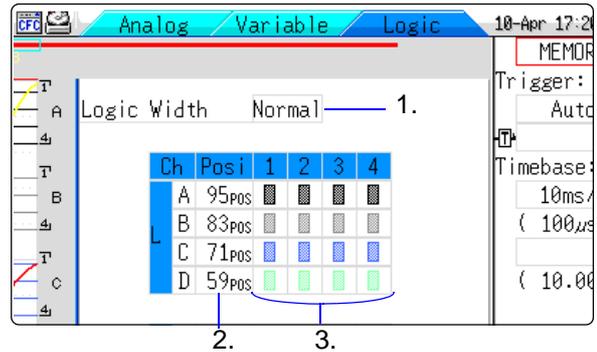
### 3.5.3 Logic Channel

Make settings for the logic channels. The channel settings window (Logic sheet) is shown when the display format is 1, 2, 4, 8 or 16 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.



**To copy the settings of one channel to another**

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

**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

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

**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

<b>Off</b>	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.74)
<b>On</b>	The waveform is displayed. Select the color with the <b>F</b> keys.
<b>Probe On-Off</b>	Switches the waveform display of the same probes to all ON or all OFF.
<b>All On-Off</b>	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 17 External Control" (⇒ p.313)



#### 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.279)

#### To automatically save data during measurement

See: "5.2.2 Automatically Saving Waveforms" (⇒ p.74)

#### To print the waveform

See: "Chapter 6 Printing" (⇒ p.95)

### Stopping Measurement

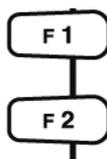
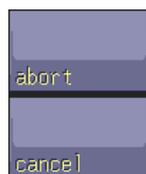
Press the **STOP** key once, recording stops at the end of the specified recording length.

Press the **STOP** key again, recording stops immediately.

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

See: "Chapter 15 System Environment Settings" (⇒ p.277)

**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.

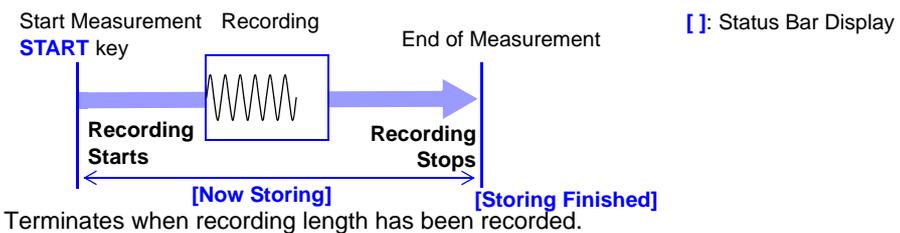
**Measurement and Internal Operations**

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.159)
- Enable pre-triggering if you want **to capture data measured prior to trigger events**. (⇒ p.172)

**Normal Measurement**

**Without triggering**

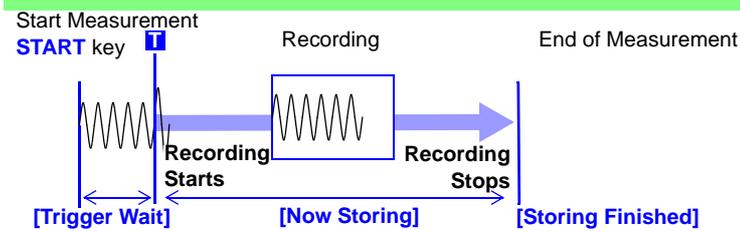


Terminates when recording length has been recorded.

**Trigger Measurement**

**Single triggering**

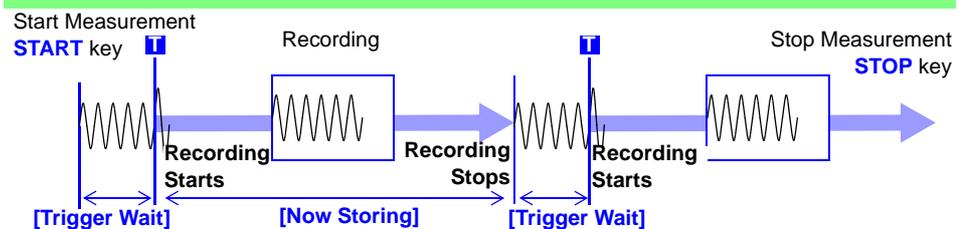
Trigger mode: **[Single]**  
Pre-triggering not enabled



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

**Repeated triggering**

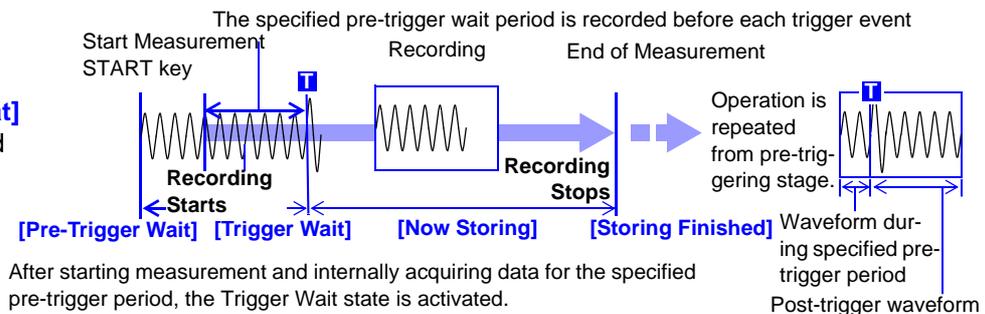
Trigger mode: **[Repeat]**  
Pre-triggering not enabled



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

**Repeated triggering and recording of phenomena before each event**

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



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 - <b>[Status]</b> 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

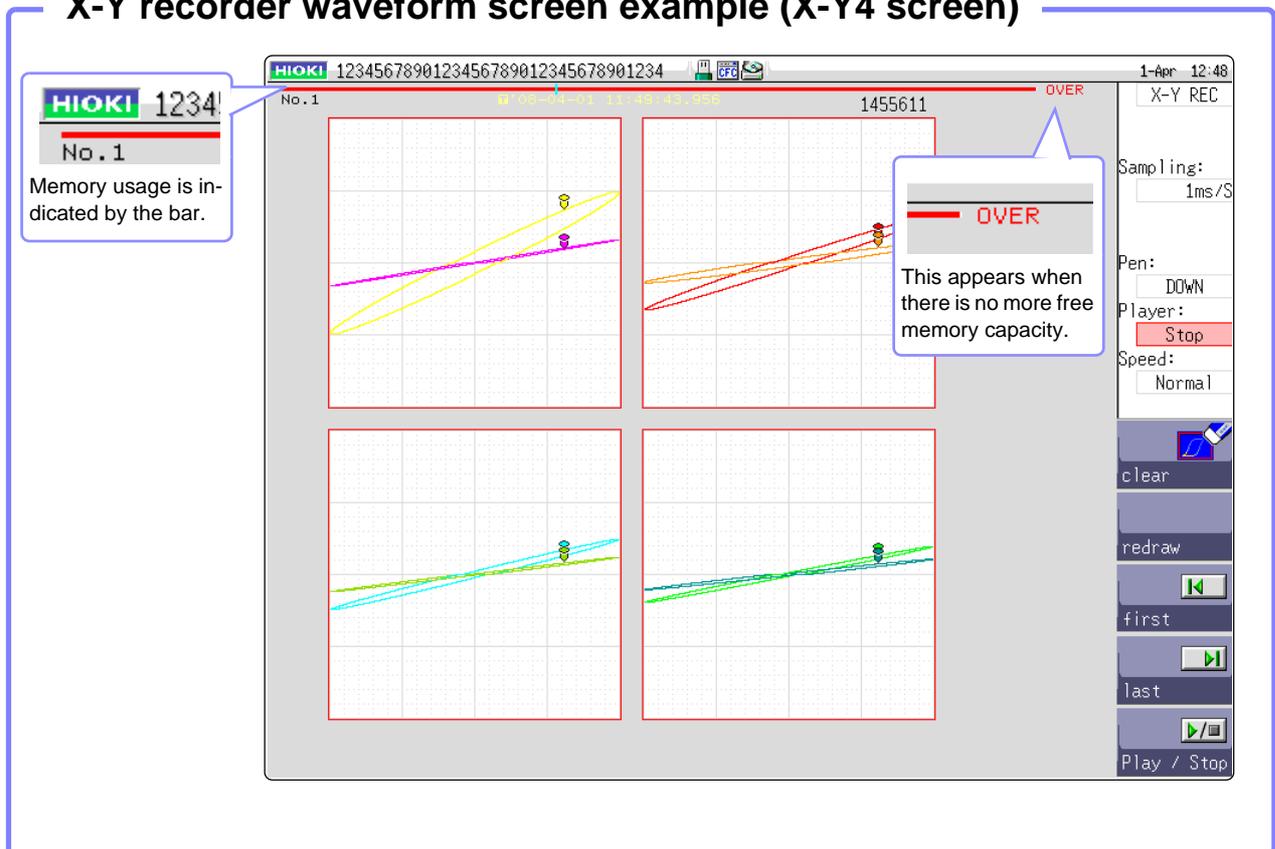
## Chapter 4

- 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.

4

Chapter 4 X-Y Recorder Function

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



## 4.1 Measurement Workflow

### 1 Pre-Measurement Inspection

See:

"3.3 Pre-Measurement Inspection" (⇒ p.42)

### 2 Make basic settings for measurement

Select X-Y recorder as measurement function

See:

"Function" (⇒ p.65)

Set sampling rate

"Sampling" (⇒ p.65)

Determine screen layout format

"Format" (⇒ p.65)

Determine whether to perform waveform interpolation

"Dots-Line (interpolation)" (⇒ p.65)

Determine whether to clear previous waveform data

"Disp Clear" (⇒ p.65)

### 3 Input Channel Settings

Make analog channel settings

See:

"3.5.2 Analog Channel" (⇒ p.55)

Logic channels cannot be used.

#### Application examples

See:

"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)

"8.7 Fine Adjustment of Input Values (Vernier Function)" (⇒ p.143)

"8.1 Adding Comments" (⇒ p.124)

"8.5 Converting Input Values (Scaling Function)" (⇒ p.134)

### 4 Starting Measurement

See:

"4.3 Starting and Stopping Measurement" (⇒ p.66)

"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.108)

### 5 Stopping Measurement

See:

"4.3 Starting and Stopping Measurement" (⇒ p.66)

"4. Redrawing Waveforms" (⇒ p.66)

"5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)

"6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.99)

### **NOTE**

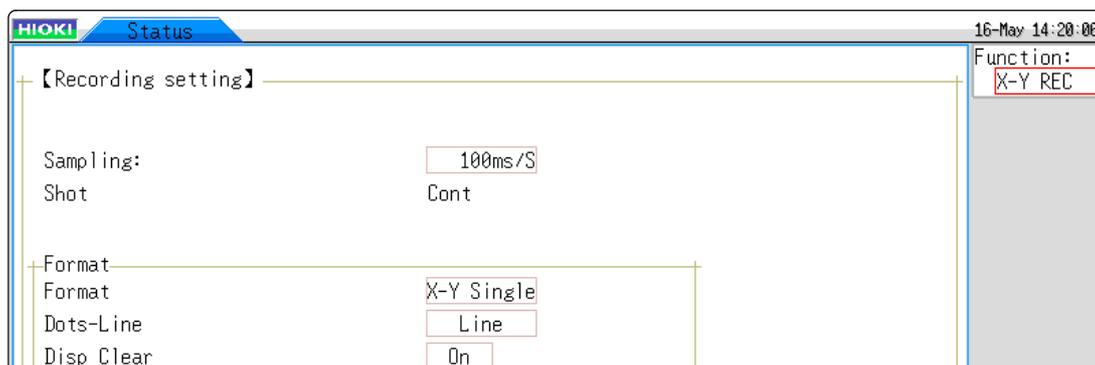
With the X-Y recorder function, the following operations are not available.

- 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** 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.

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

<b>Dots</b>	Display and print sampling data as dots.
<b>Line</b>	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.

<b>Off</b>	Overlay on existing waveforms
<b>On</b>	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.55)



### To set the channels for X-Y synthesis

See: "7.4 Performing Waveform X-Y Synthesis" (⇒ p.114)

## 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

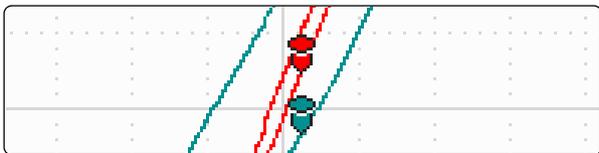
Make this setting either during or before measurement. When the pen is set to Down, the waveform is being drawn. When the pen is set to Up, the waveform is not drawn. This setting applies to all channels.

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

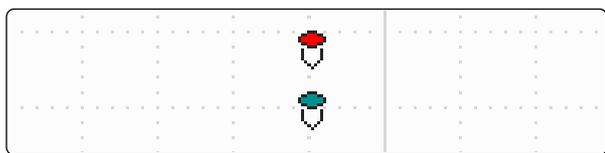
Select

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 played back on the screen and will not affect the printout data. To print the same waveforms as shown on the screen, use hard copy (⇒ p.104).

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.315)

## 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.104).

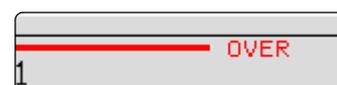
## 4.4 Waveform Observation

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.108)

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.79)

### 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.99)



# 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.

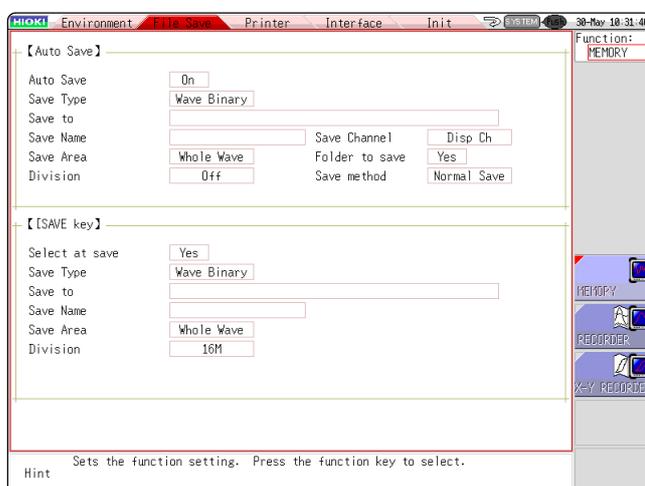
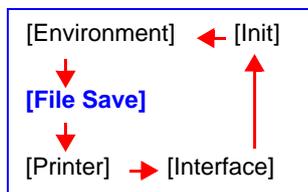
Load data and manage files from the File screen.

## Opening the **[File Save]** sheet

SYSTEM



Pressing this key repeatedly displays the various sheets.



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

### Saving Data (⇒ p.73)

#### Save Method

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

#### Save Types

- |                 |                                               |
|-----------------|-----------------------------------------------|
| (Auto Save)     | (Manual save by pressing the <b>SAVE</b> key) |
| • Waveform data | • Settings data                               |
|                 | • Waveform data                               |
|                 | • Display screens                             |
|                 | • Waveform screen                             |
|                 | • Numerical calculation results (⇒ p.189)     |
|                 | • Waveform evaluation area                    |

### Saving an Auto Settings file (⇒ p.85)

## Opening the File screen

**FILE**

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 re-naming such files is not possible.

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.

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

### To change the media

- 1** Verify that a storage media is inserted.  
See: "2.3 Recording Media Preparation" (⇒ p.30)
- 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 HDD]** and **[Mass storage CF]**.

## Operations available from the File screen

**Formatting Storage Media** (⇒ p.32)

**Loading Data** (⇒ p.82)

**Saving/loading an Auto Settings file**  
(⇒ p.85)

**Managing Files** (⇒ p.73)

- Saving data(⇒ p.87)
- Creating new folders (⇒ p.89)
- Copying files (⇒ p.92)
- Sorting files (⇒ p.91)
- Deleting files (⇒ p.90)
- Renaming files (⇒ p.91)
- Printing the File List(⇒ p.93)

## 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		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		MEM Memory Function waveform data	O	O	O	- *4
			REC Recorder Function waveform data	O	O	O	- *4
			XYC X-Y Recorder Function waveform data	-	O	O	-
			FFT FFT Function data	O	O	O	-
	Text		CSV Text Data	O	O	-	O
Waveform Management Data *3 (Divided Saving)	(Index file)		IDX Index data for divided saving	O	O	O	-
			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
Waveform evaluation settings Data	Binary		ARE Settings data (measurement conditions + waveform evaluation areas)	-	O	O	-
Waveform evaluation area	BMP		BMP Waveform evaluation area image data	-	O	O	O

\*1: Multiple data can be saved in the instrument, and loaded selectively. Automatic loading at power-on is also possible. (⇒ p.85)

\*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.73)

When saving a section of a waveform, use the A and B cursors to set the section. (⇒ p.108), (⇒ p.111)

\*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 MR8847.

### NOTE

Files larger than 2 GB cannot be saved.

### **Data Not Loadable on the Instrument**

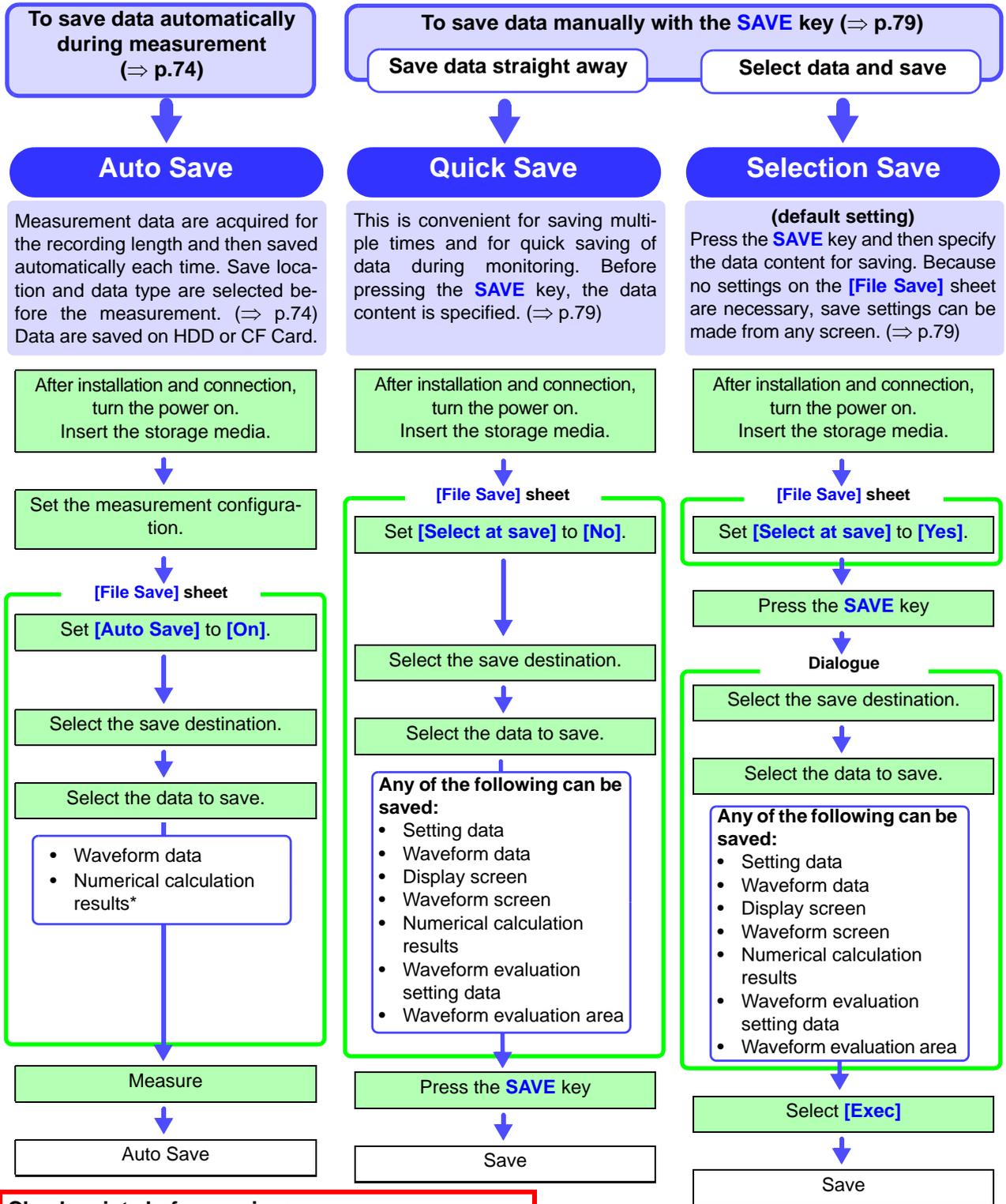
---

- Data saved on devices other than the MR8847 Memory HiCorder and 8847 Memory HiCorder.
- Image files other than waveform evaluation areas ()
-  file

## 5.2 Saving Data

### 5.2.1 Save Types and Workflow

There are basically three types of save operations.



- Check points before saving:**
- Media inserted and initialized? (⇒ p.30), (⇒ p.32)
  - 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.189)

## 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

- 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

<b>Wave Binary</b>	Save the waveform data in binary format. (Data saved in binary format can only be loaded to this instrument.)
<b>Wave Text</b>	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.)

- 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]**.

Select

<b>HDD</b>	Automatically save the waveform data on the HDD. (For the instrument with Model 9664 HD Unit installed)
<b>CF</b>	Automatically save the waveform data in the CF card.
<b>USB1</b>	Automatically save the waveform data on the USB memory stick.
<b>LAN</b>	Automatically save the waveform data on the PC connected via LAN. Model 9333 LAN Communicator is required to be installed.

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]**.

When **[LAN]** is set as the save destination, **[New Folder]** setting is ignored and the folder named with the current date is created.

- 4 Set the file name.**  
Move the cursor to the **[Save Name]**, and enter the save name.

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

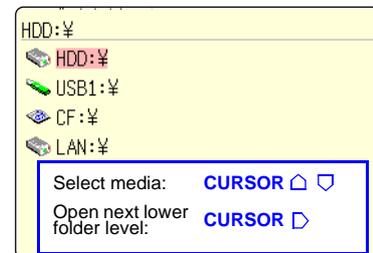
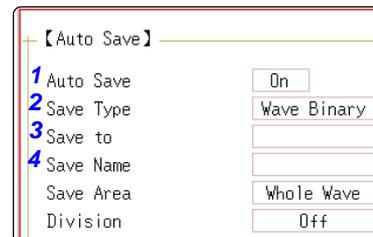
When **[LAN]** is set as the save destination, **[Save Name]** setting is ignored and the files to be saved are named in the previously-determined format.

See: "Save Operations (When setting the save destination to [LAN])" (⇒ p.78)

### 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.



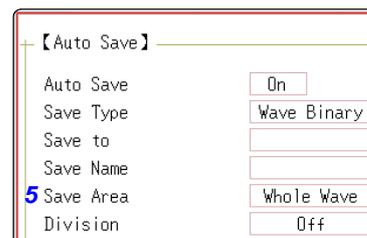
- \*
  - To save the waveform data in the PC connected via LAN **Model 9333 LAN Communicator is required to be installed on the PC on which the data is to be saved. For more information about how to operate and configure Model 9333 LAN Communicator, in addition to install it on the PC, see the instruction manual of Model 9333 LAN Communicator.**
  - When setting the save destination to **[LAN]** **The IP addresses of the MR8847 and the PC connected via LAN are required to be set. For more information about how to set the IP addresses, see (⇒ p.282).**

**5 Select the save area.**

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

Select

<b>Whole Wave</b>	Save all recorded data. (default setting)
<b>A-B Wave</b>	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.108)

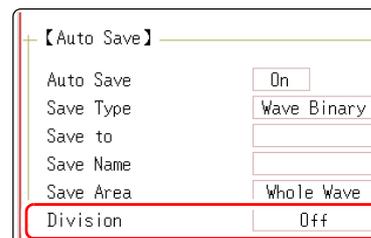
**6 (When [Wave Binary] is the selected save type)**

**Select whether to save divided files**

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

Select

<b>Off</b>	Files are not divided when saved.
<b>16M, 32M 64M</b>	Select the size for divided save.



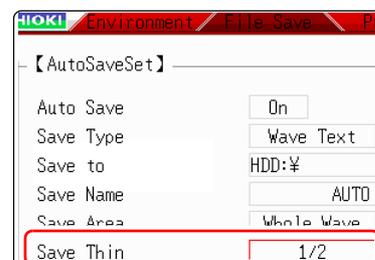
**(When [Wave Text] is selected as the save type)**

**Set the data thinning number.**

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

Select

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

**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.83)

"Chapter 12 Memory Division Function" (⇒ p.209)

**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.

**Automatic Saving**

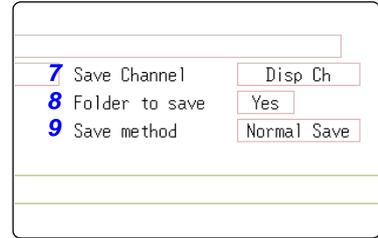
Data can also be saved to a USB flash drive in real time, but from the perspective of data protection, we recommend using Hioki's optional CF card.

### 7 Select the channel to save.

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

Select

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



### 8 Set whether to create folders.

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

Select

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

When **[LAN]** is set as the save destination, **[New Folder]** setting is ignored and the folder named with the current date is created.

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

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

Select

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

When **[LAN]** is set as the save destination, **[Save Name]** setting is ignored and the files to be saved are named in the previously-determined format.

See: "Save Operations (When setting the save destination to **[LAN]**)" (⇒ p.78)

### 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: "Save Operations (When setting the save destination to **[LAN]**)" (⇒ p.78)

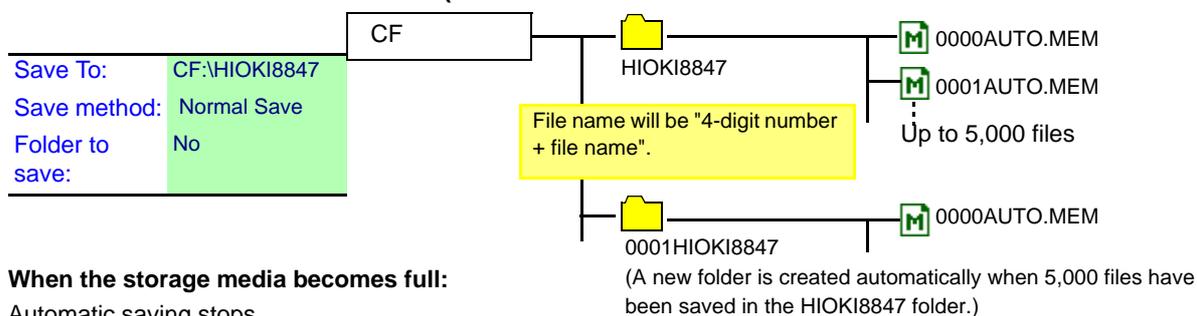


#### To clear the Auto Save dialog box

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

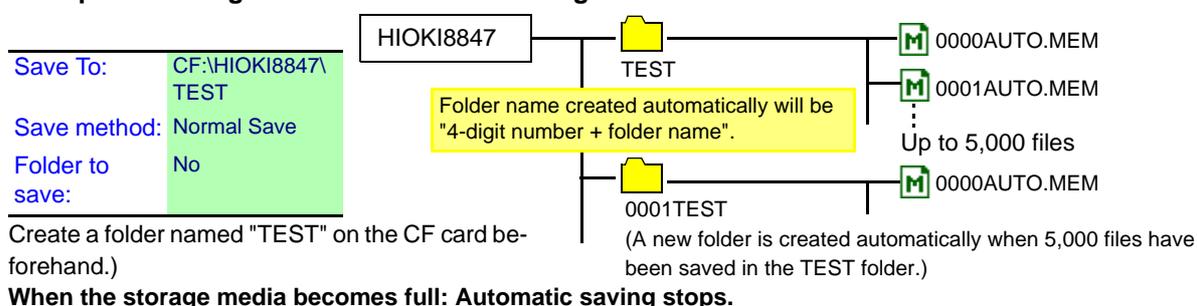
## Auto Save Operations (When setting the save destination to the recording media)

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



**When the storage media becomes full:**  
Automatic saving stops.

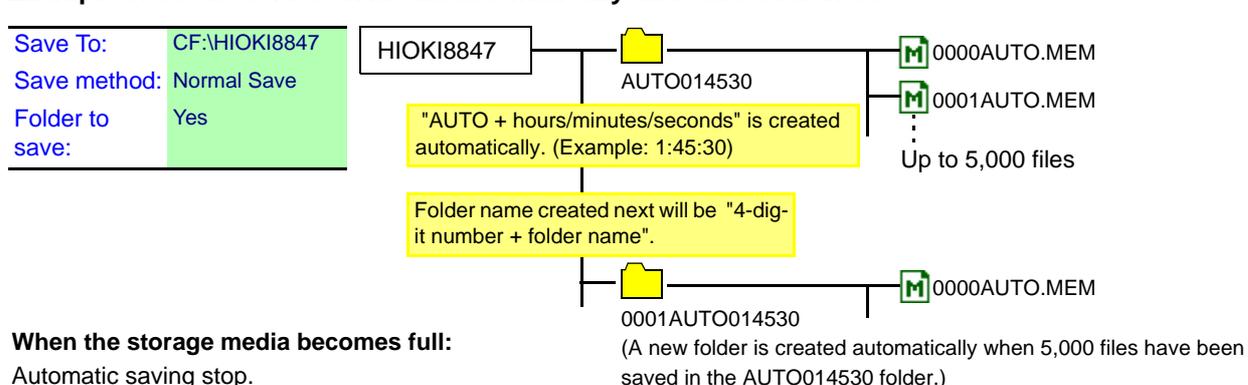
### Example 2: Saving Files to a Folder on Storage Media



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

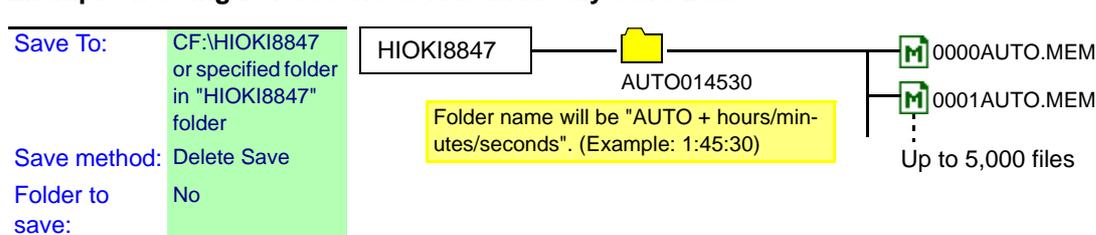
**When the storage media becomes full: Automatic saving stops.**

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



**When the storage media becomes full:**  
Automatic saving stop.

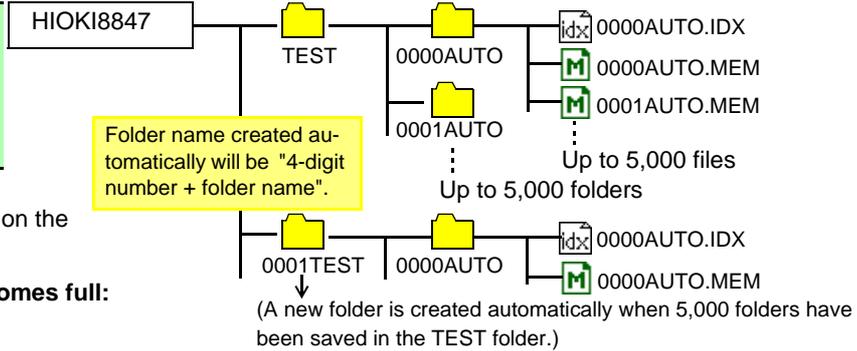
### Example 4: Using Delete/Save to Automatically Save Data



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

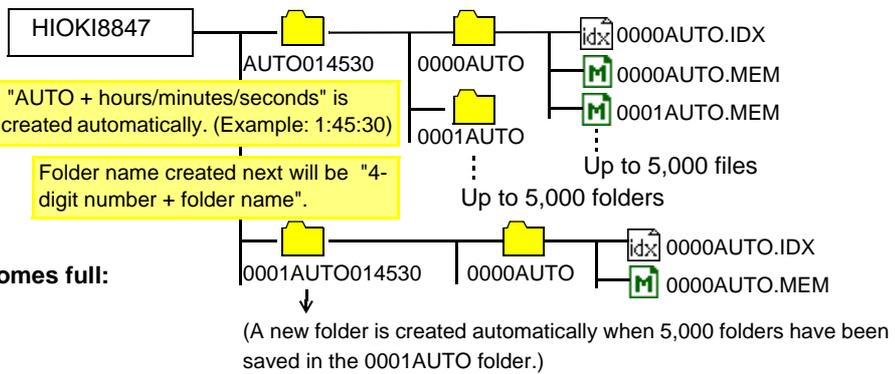


Create a folder named "TEST" on the CF card beforehand.)

**When the storage media becomes full: Automatic saving stops.**

**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



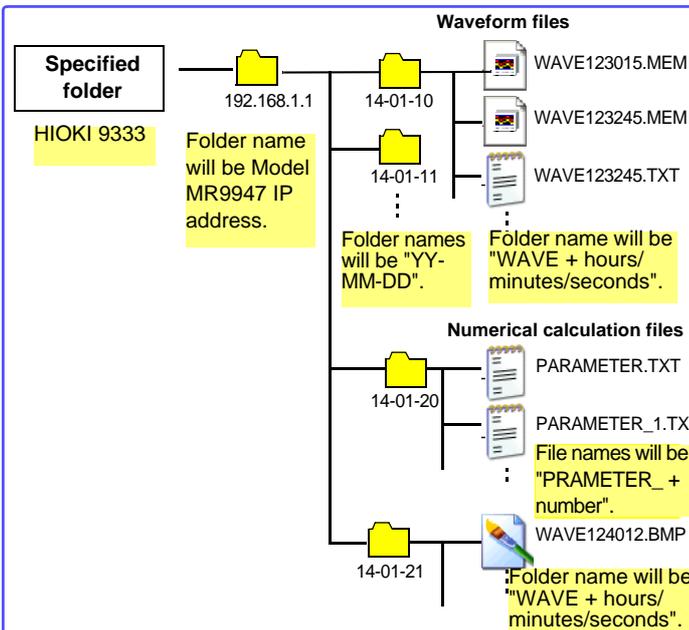
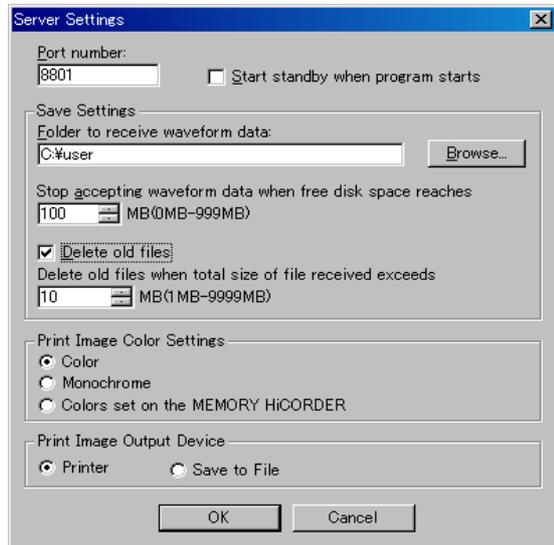
**When the storage media becomes full: Automatic saving stop.**

**Save Operations (When setting the save destination to [LAN])**

The file is saved according to the method (on the right figure) specified under [Save Settings] by using Model 9333 LAN Communicator.

For more information about how to configure the save settings, see the instruction manual of Model 9333 LAN Communicator.

The destination folders and files are named in the previously-determined formats as follows:



## 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

<b>Yes</b>	After pressing the <b>SAVE</b> key, set the data to save in the dialog box, then save the data. (default setting) See: "Selection Save" (⇒ p.73)
<b>No</b>	The preset data is saved upon pressing the <b>SAVE</b> key. See: "Quick Save" (⇒ p.73)

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.

#### 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]**.

Select

<b>HDD</b>	Automatically save the waveform data on the HDD. (For the instrument with Model 9664 HD Unit installed)
<b>CF</b>	Automatically save the waveform data in the CF card.
<b>USB1</b>	Automatically save the waveform data on the USB memory stick.
<b>LAN</b>	Automatically save the waveform data on the PC connected via LAN. Model 9333 LAN Communicator is required to be installed.

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]**. When **[LAN]** is set as the save destination, **[New Folder]** setting is ignored and the folder named with the current date is created.

#### 3 Set the file name.

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

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

When **[LAN]** is set as the save destination, **[Save Name]** setting is ignored and the files to be saved are named in the previously-determined format.

See: "Save Operations (When setting the save destination to [LAN])" (⇒ p.78)

### NOTE

#### File Name

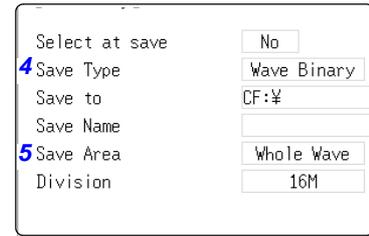
The maximum number of characters for the **[Save Name]** string is 123. The maximum path length including file name is 255 characters.

### 4 Set the data to save.

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

Select

<b>Set</b>	Save the settings data.
<b>Wave Binary</b>	Save waveform data in binary format. Select this to reload the waveform into the instrument.
<b>Wave Text</b>	Save waveform data in text format. Select this to use the waveform in a PC. (Memory/Recorder/FFT Function only)
<b>ALL-Wave Bin</b>	Data of all blocks is saved in binary format. (Only when the memory division setting is On.)
<b>ALL-Wave Txt</b>	Data of all blocks is saved in text format. (When the memory division setting is On)
<b>Screen Copy</b>	Save screen display data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
<b>Wave Image</b>	Save printer output data as a BMP file. Data saved in BMP format can be displayed on a PC with image viewing software.
<b>Calc Result</b>	Save the numerical calculation results. (Memory Function only)
<b>Waveform evaluation setting</b>	Save settings data and waveform evaluation areas.
<b>Waveform evaluation area</b>	Save evaluation areas created with the waveform evaluation function as black-and-white BMP files. Saved data can be edited on a computer and loaded back into the instrument. Edit images in black and white only.



### 5 (When Wave Binary or Wave Text was selected)

**Set the save area.**

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

Select

<b>Whole Wave</b>	Save all recorded data.(default setting)
<b>A-B Wave</b>	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.111))

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
<b>Setting</b>	-	-
<b>Wave Binary</b>	<b>Division</b> (Off, 16 M, 32 M, 64 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.
<b>Wave Text</b>	<b>Save Thin</b> (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.
<b>Screen Copy (Hard copy of the display)</b>	<b>Image Color</b> (Color, Gray, Mono, Mono (Rev))	Specifies the color for the created image file.
	<b>Image size</b> (UnCompressed, Compressed)	Determines whether the image file is compressed.
	<b>Save GUI</b> (Yes, No)	Determines whether the GUI section is also saved.
<b>Wave Image (Print Image)</b>	<b>Output File</b> (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)
	<b>Wave Image Shot</b> (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)
<b>Calc Result</b>	<b>Folder to save</b> (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.

## 7 (For memory function)

When using the memory division function

Select the blocks to be saved

Move the cursor to the [Save Block].

Select

<b>All Blks</b>	Blocks with waveforms are all saved.
<b>Start-End</b>	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.

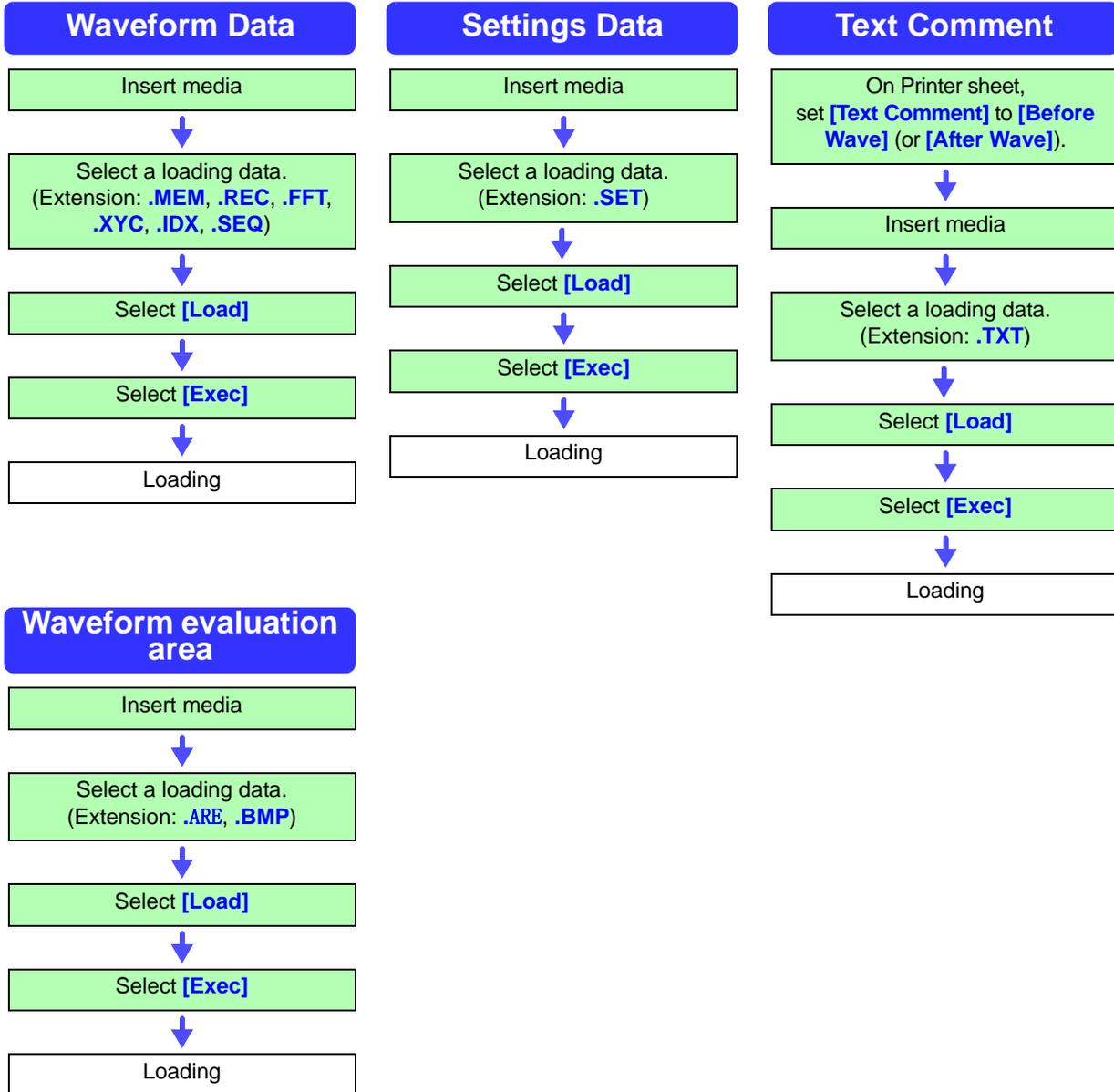
## 5.3 Loading Data

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.



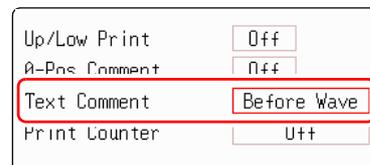
## Procedure

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.

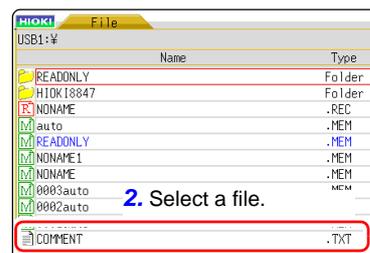
Move the cursor to the **[Text Comment]**, and select **[Before Wave]** (or **[After Wave]**).



### 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.



### 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 Memory HiCorders other than the MR8847 and 8847 cannot be loaded into the MR8847.
- 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.342) 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
<b>IDX</b>	Divided files are loaded together. (To create index files: Use <b>[Division]</b> at the <b>[File Save]</b> sheet of the System screen to set the dividing size and then save. Note: If <b>[Save type]</b> is not <b>[Wave Binary]</b> , index files are not created) See: "5.2.2 Automatically Saving Waveforms" (⇒ p.74) "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)
<b>SEQ</b>	(When using the memory division function of the memory function) Waveform data of all blocks is loaded together. (To create index files: At the <b>[Memory Div]</b> sheet of the Status Screen, set <b>[Memory Div]</b> to <b>[On]</b> . At the <b>[File Save]</b> sheet of the System Screen, set <b>[Save Type]</b> to <b>[ALL-Wave Bin]</b> .) See: "12.1 Recording Settings" (⇒ p.211) "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)

**Loading a waveform evaluation area**

Files with the following two extensions can be loaded:

Extension	Explanation
<b>ARE</b>	<b>Loads waveform evaluation areas and settings data (files saved by selecting "Area settings" when saving the data).</b>
<b>BMP</b>	<b>Loads waveform evaluation areas. (Files saved by selecting "Area image" when saving the data can be edited on a computer and then loaded back into the instrument.)</b>

## 5.4 Automatically Loading Settings (Auto Setup Function)

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

### **NOTE**

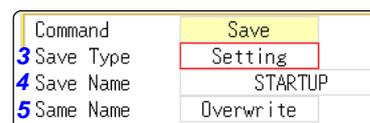
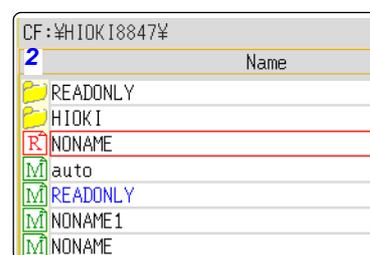
The Auto setup function is compatible with CF cards only. If the STARTUP file is on the HDD, USB memory stick, or RAM (internal memory), it is not referenced. Always create the STARTUP file on a CF card.

### Procedure

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

To change the media: (⇒ p.70)

- 1 Select **[Change Media]** and specify CF Card.
- 2 If a folder named "**HIOKI8847**" exists in the root directory (top-most 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.127)
- 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
<b>CH.SET</b>	<b>Media Change</b>	Change media.	(⇒ p.70)
<b>F1</b>	<b>Save</b>	Select channels and save settings data and waveform data as files.	(⇒ p.87)
	<b>Sort</b>	Sort files on file list in selected order.	(⇒ p.91)
<b>F2</b>	<b>Open Folder</b>	Open the selected folder.	(⇒ p.89)
	<b>Load</b>	Load settings data or waveform data from a file.	(⇒ p.82)
	<b>Copy</b>	Copy a file to a specified folder. If selected item is a folder, move to that folder.	(⇒ p.92)
<b>F3</b>	<b>New Folder</b>	Create a new folder.	(⇒ p.89)
	<b>Rename</b>	Change a file name or folder name.	(⇒ p.91)
<b>F4</b>	<b>Delete</b>	Delete a file or folder.	(⇒ p.90)
	<b>Format</b>	Format selected storage media.	(⇒ p.32)
<b>F5</b>	<b>Next Page</b>	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

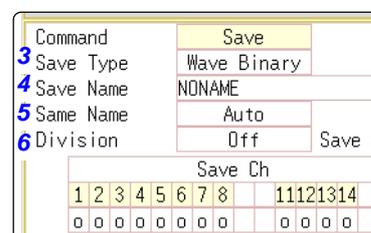
To open the screen: Press the **FILE** key → File screen

To change the media: (⇒ p.70)

- 1 **Select storage media for saving.**  
See: "To change the media" (⇒ p.70)
- 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/FFT Function)
Numeric value calculation results	Numeric value calculation results (Text)
Waveform evaluation settings	Settings data and evaluation area
Waveform evaluation area	Evaluation area



- 4 **Set the file name.**  
Move the cursor to the [**Save Name**] item.  
Enter the save name.  
See: "8.1.3 Alphanumeric Input" (⇒ p.127)
- 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.

- The "Text" option is only for loading the data to a PC. Data saved with this option cannot be loaded back into the MR8847. To reload the data later into the MR8847, use the "Binary" option.
- When [**Memory (Int)**] is selected as storage media, only settings data can be saved.
- The waveform evaluation area you have created can be saved as a black-and-white BMP file. Saved data can be edited on a computer and loaded back into the instrument. Edit images in black and white only.

**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, 64M	Select the size for Divided Save.

See: "About divided saving" (⇒ p.88)

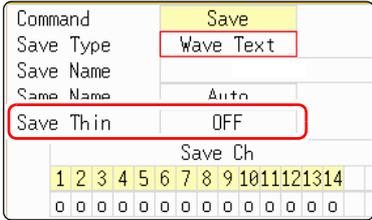
**(When [Text] is the selected save type)**

Set the data thinning number.

Move the cursor to the [Save Thin] item.

Select

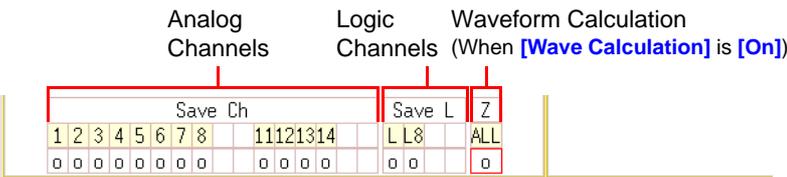
Off	Data thinning (sub-sampling) is not carried out.
1/2 to 1/1000	Set the thinning number (out of how many data items to leave one data item remaining).



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.85)

**7 Select the channels to save.**

Move the cursor to the save channel item.



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.83)

**Other limitations**

Text format data cannot be loaded into the MR8847.

## 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.70)

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



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

## 5.5.3 Creating New Folders

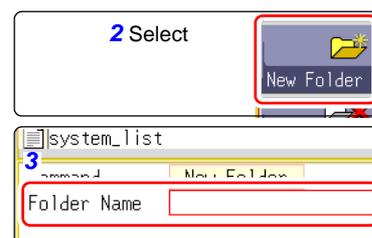
You can create a new folder in the currently displayed folder level.

### Procedure

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

To change the media: (⇒ p.70)

- 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.124)
- 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.70)

**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.

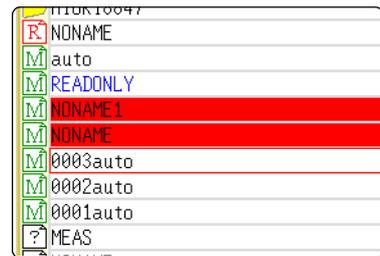
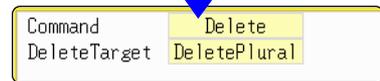
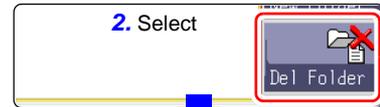
Select

<b>Slct/Deslct</b>	Select the individual file or folder at the cursor. If something is currently selected, the selection is cleared.
<b>Slct/Deslct All</b>	Select all files or folders. If something is currently selected, the selection is cleared.
<b>Rev Slct</b>	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).

**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.70)

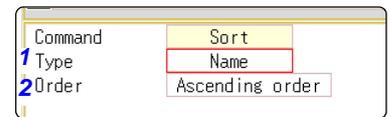
- 1 Select **[Sort]**, and select **[Type]**.

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



- 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  $\Delta$ : Ascending order  $\nabla$ : 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.70)

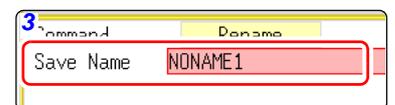
- 1 Select the file or folder you want to rename.



2. Select

- 2 Select **[Rename]**.

- 3 Select **[Enter Char]**, and enter **[Save Name]**.  
See: "8.1 Adding Comments" (⇒ p.124)



- 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.70)

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

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

**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]**.

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

Select

<b>Slct/Deslct</b>	Select the individual file or folder at the cursor. If something is currently selected, the selection is cleared.
<b>Slct/Deslct All</b>	Select all files or folders. If something is currently selected, the selection is cleared.
<b>Rev Slct</b>	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).

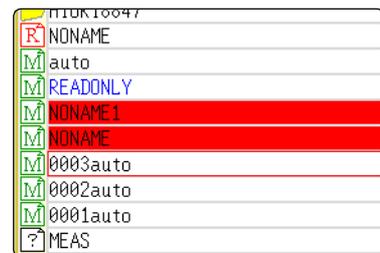
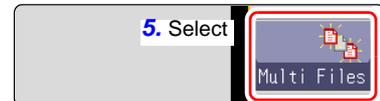
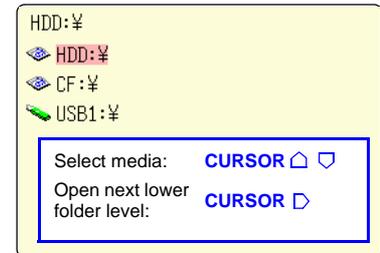
Select **[Select End]**.

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

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



**2.** Select



## 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.33)

### Procedure

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

To change the media: (⇒ p.70)

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

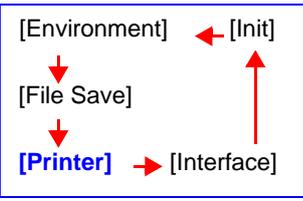
# Chapter 6

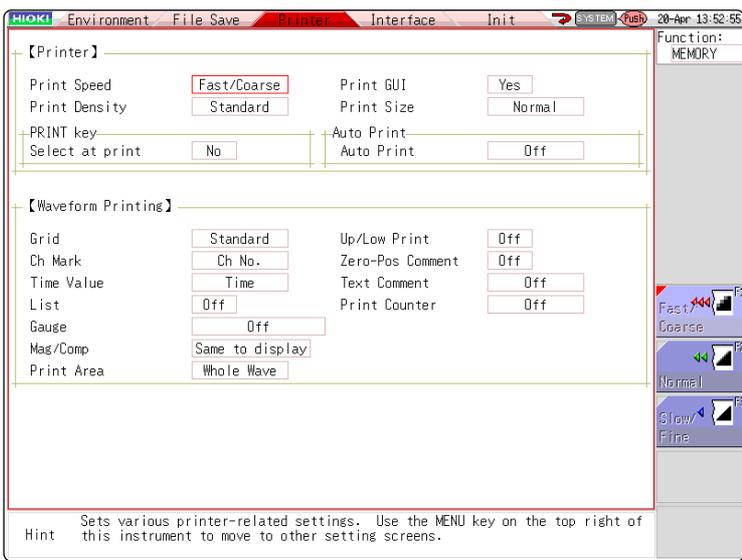
The **[Printer]** sheet lets you specify the print method and make other printing related settings.

## Opening the **[Printer]** sheet



Pressing this key repeatedly displays the various sheets.





## Operations available from the **[Printer]** sheet

### Selecting the print method

See: "6.1 Printing Type and Workflow" (⇒ p.96)

- Auto Print (⇒ p.97)
- Manual Print (⇒ p.99)

See: "6.6.1 Screen Hard Copy" (⇒ p.104)

See: "6.6.2 Report Print (A4 Size Print)" (⇒ p.104)

See: "6.6.3 List Print" (⇒ p.105)

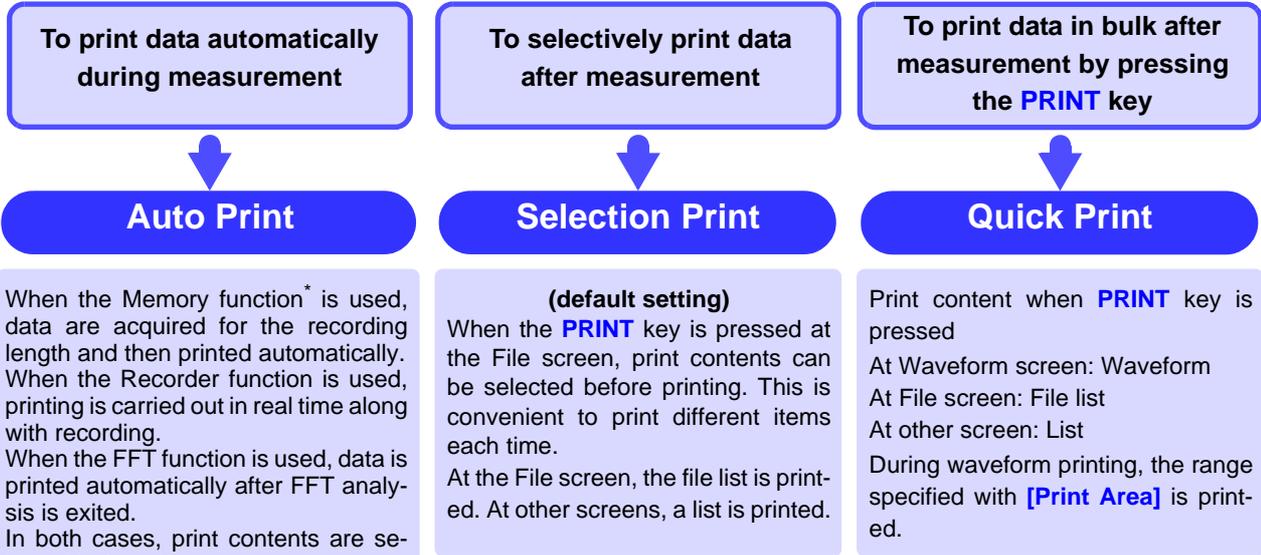
See: "6.6.4 Text Comment Printing" (⇒ p.105)

### Making printer settings

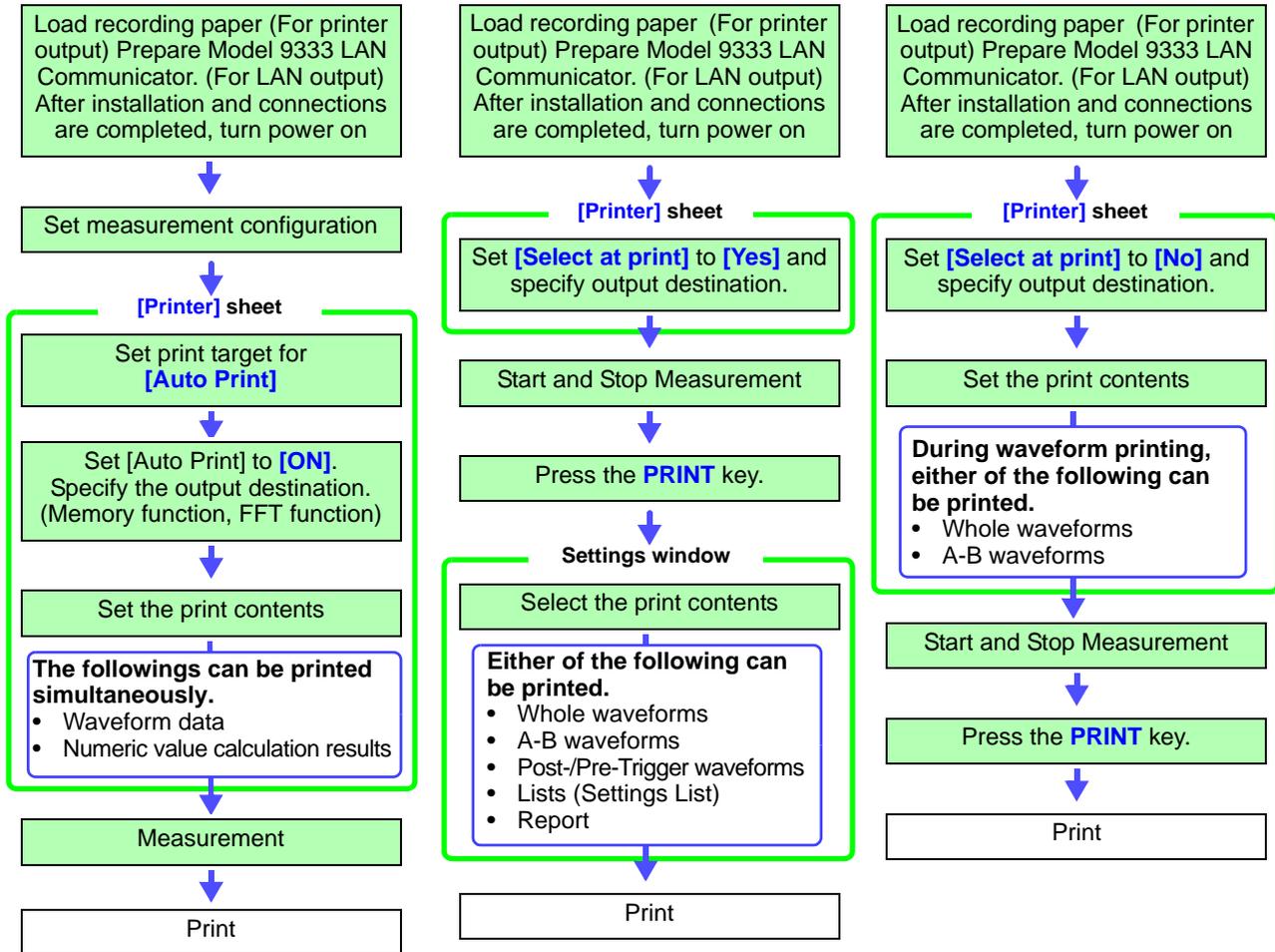
- Print Speed (⇒ p.101)
- Grid Type (⇒ p.101)
- Channel Marker Type (⇒ p.101)
- List (⇒ p.102)
- Gauge (⇒ p.102)
- Printer Density (⇒ p.101)
- Horizontal axis (Time axis) Zoom (Mag/Comp) (⇒ p.102)
- Print size (⇒ p.101)
- Upper/Lower Limit Print (⇒ p.103)
- Zero Position Comment Print (⇒ p.103)
- Print Counter (⇒ p.103)

# 6.1 Printing Type and Workflow

There are basically three types of printing operations.



\*: 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.)



**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. For printer output, make sure that the recording paper is loaded correctly. For LAN output, make sure that the PC connected via LAN is prepared.

### Procedure

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

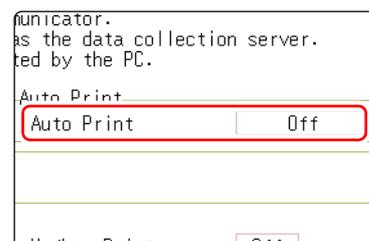
#### 1 Enable Auto Print.

**(Memory Function, FFT Function case:)**

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

Select **[On]**.

Default setting: Off (Auto Print is not carried out)



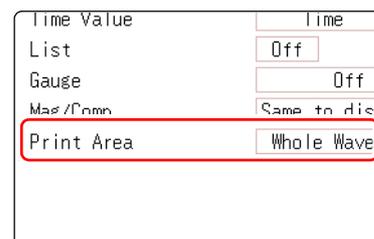
#### 2 (Memory Function, FFT Function case:)

**Specify the output destination.**

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

Printer: The data are automatically printed by using the internal printer.

LAN : The data are automatically transferred to the PC connected via LAN. Model 9333 LAN Communicator is required.



#### 3 (Memory Function case:)

**Make print area settings as required.**

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

Select

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

#### 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.

FFT Function case:

Data is printed automatically after FFT analysis is exited.

#### • To output the waveform data to the PC connected via LAN

Model 9333 LAN Communicator is required to be installed on the PC to which the data is to be output. For more information about how to operate and configure Model 9333 LAN Communicator, in addition to install it on the PC, see the instruction manual of Model 9333 LAN Communicator.

#### • When setting the output destination to **[LAN]**

The IP addresses of the MR8847 and the PC connected via LAN are required to be set. For more information about how to set the IP addresses, see (⇒ p.282).

### 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	

When performing waveform evaluation, the evaluation area will be printed at the same time. To disable printing of the evaluation area, set waveform evaluation to **[OFF]**. (⇒ p.268)

If **[Output]** is set to **[LAN]**, measurement data are automatically printed after the data are acquired for the recording length regardless of the time axis range setting.

### 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.190)

## 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

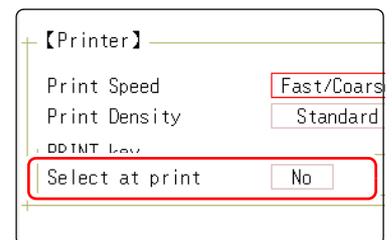
Move the cursor to the **[Select at print]** item.  
Select **[Yes]**.

#### 2 Specify the output destination.

##### 2 Move the cursor to the **[Output]** item.

**Printer**: The data are automatically printed by using the internal printer.

**LAN**: The data are automatically output to the PC connected via LAN. Model 9333 LAN Communicator is required.



### 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

<b>Whole Wave</b>	Print all waveform data in internal memory of instrument. (default setting)
<b>A-B Wave</b>	Print only A/B cursor defined range of waveform data in internal memory of instrument. (Memory Function and Recorder Function only)
<b>About Trig</b>	Print waveform data for 10 divisions before and after trigger position. (Memory Function only)
<b>List</b>	Print main settings.
<b>Report</b>	Print the report. See: "6.6.2 Report Print (A4 Size Print)" (⇒ p.104)

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

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



#### • To output the waveform data to the PC connected via LAN

Model 9333 LAN Communicator is required to be installed on the PC to which the data is to be output. For more information about how to operate and configure Model 9333 LAN Communicator, in addition to install it on the PC, see the instruction manual of Model 9333 LAN Communicator.

#### • When setting the output destination to **[LAN]**

The IP addresses of the MR8847 and the PC connected via LAN are required to be set. For more information about how to set the IP addresses, see (⇒ p.282).

# 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	Zo
HIGH RES	1		voltage	5mV	
	2		voltage	5mV	
FREQ	3		Freq	1Hz	
	4		Freq	1Hz	
ANALOG	5		voltage	5mV	
	6		voltage	5mV	
STRAIN	7			20μV	

[Unit List] sheet

Coupling	DC	
LPF	Off	Pr
【Disp】		
Wave_Disp		Gr
Variable	Off	Zo
Range(/div)	200mV	Up
Zero pos %	50%	Lo

[Each Ch] sheet

Move the cursor to the **[Wave]**, or **[Wave\_Dis]**.

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	Fast/Coarse	Print GUI	Yes	(⇒ p.104)
2	Print Density	Standard	3	Print Size	Normal
	PRINT key		Auto Print		
	Select at print	No	Auto Print	Off	
【Waveform Printing】					
4	Grid	Standard	Up/Low Print	Off	
5	Ch Mark	Ch No.	Zero-Pos Comment	Off	
	Time Value	Time	Text Comment	Off	(⇒ p.105)
	List	Off	Print Counter	Off	
	Gauge	Off			
	Mag/Comp	Same to display			
	Print Area	Whole Wave			

#### 1 Select the print speed (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

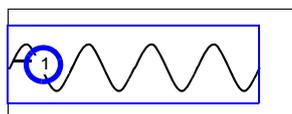
Off, Standard (default setting), Fine, Std Dark, Fine Dark

#### 5 Select the channel marker type.

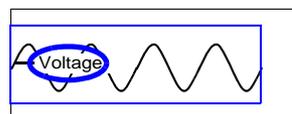
Move the cursor to the **[Ch Mark]** item.

Select

<Print Example>



Channel number.



Comment

Off	Do not print the channel number or comments.
Ch No.	Print the channel number. (default setting)
Comment	Print the comments entered in the Channel Settings screen over the waveform. A comment setting must have been made. See: "8.1 Adding Comments" (⇒ p.124)

### NOTE

#### Grid Type

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

#### Print Speed

While **[USB Set]** is set to **[Mass Storage HDD]**, or **[Mass Storage CF]** printing speed is always Slow/Fine.

When the instrument is configured to automatically save data to the USB memory, automatic printing will be performed at standard speed, even if the print speed has been set to fast.

### Printer settings

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

Print Speed	Fast/Coarse	Print GUI	Yes	(⇒ p.104)
Print Density	Standard	Print Size	Normal	
PRINT key		Auto Print		
Select at print	No	Auto Print	Off	
【Waveform Printing】				
Grid	Standard	10 Up/Low Print	Off	
Ch Mark	Ch No.	11 Zero-Pos Comment	Off	
6 Time Value	Time	12 Text Comment	Off	(⇒ p.105)
7 List	Off	12 Print Counter	Off	
8 Gauge	Off			
9 Mag/Comp	Same to display			
Print Area	Whole Wave			

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

Move the cursor to the [Time Value] item.

<Print Example>

-2.000000 s	5	500
Time	div	Sample Num
1m40 s	'04-10-30 10:20:30	
Time (60)	Date	

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 Select

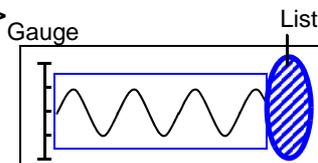
Move the cursor to the [List] item.

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

### 8 Select the type of gauge. Select

Move the cursor to the [Gauge] item.

<Print Example>



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. Select

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

Select

x10 to x1/200000 (Memory Function case)	Print using the magnification or compression ratio set here.
x1 to x1/50000 (Recorder Function case)	
Same to display	Print using the magnification or compression ratio set for the waveform screen. (default setting)

### NOTE

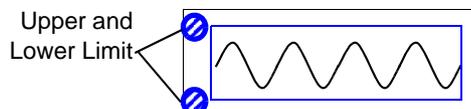
#### Horizontal axis (Time axis) zoom

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**

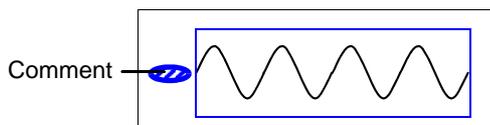
Move the cursor to the **[Up/Low Print]** item.

<Print Example>

**11 Set the zero-position comment**

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

<Print Example>

**12 Select the counter print.**

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

(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.127)

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)

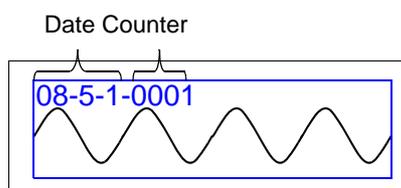
(When **[Name]** is selected)

**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.127)

<Print Example of Data and Counter>



Select

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

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.124)

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)

## 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

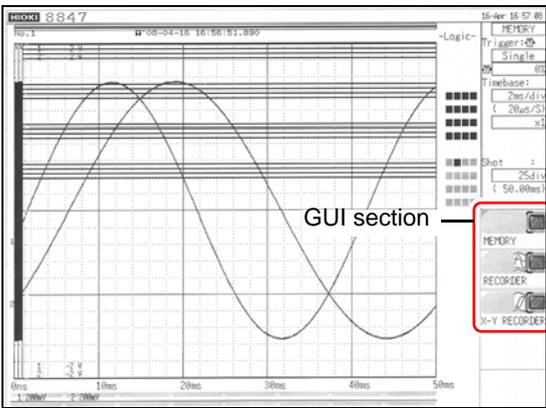
Press **COPY** key while the screen to print is displayed. The printer will produce a hard copy of the screen contents. The GUI section can also be printed.

#### GUI print setting

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

<Print Example>

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.

### 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.124) )

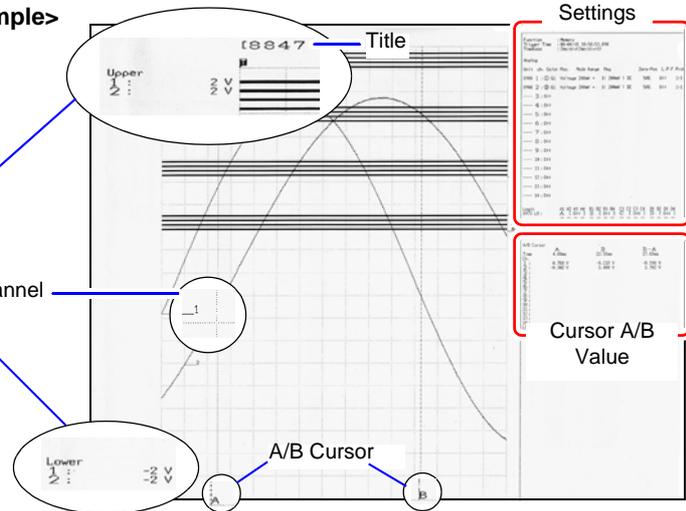
#### Procedure

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

<Print Example>

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

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



Upper and Lower Limit Value

Channel

A/B Cursor

Settings

Cursor A/B Value

### 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.102)

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 MR8847 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.

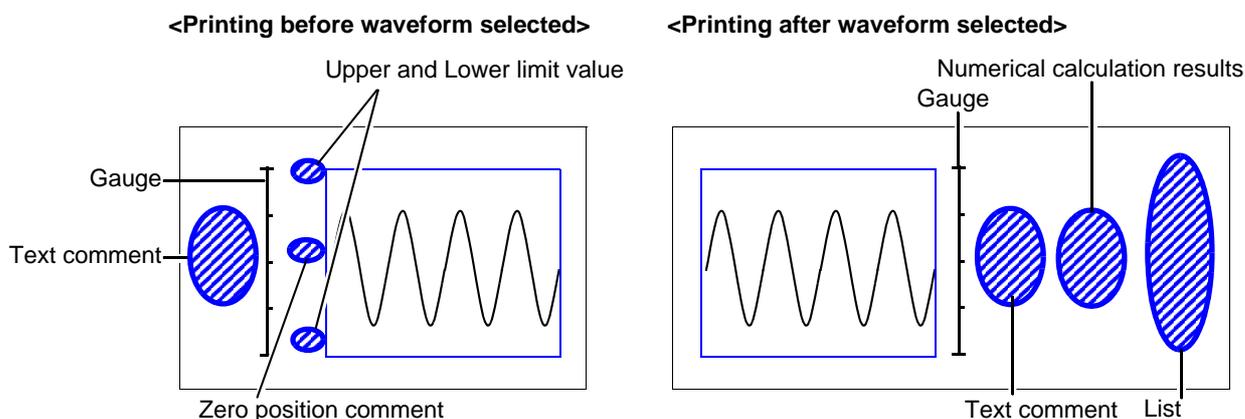
After Wave Text comment is printed after waveform.

3. Press the **FILE** key and use the File screen to import the text file created on the PC into the MR8847.

See: "5.3 Loading Data" (⇒ p.82)

The text file content will be printed along with the waveform when printing.

Print Example \_ Positioning with regard to other print items





# 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

The screenshot shows a HIOKI oscilloscope interface with the following elements:

- DISP** button: A circular button with a hand icon pointing to it, labeled "Press this key." (⇒ p.120)
- A cursor** and **B cursor**: Vertical dashed lines on the waveform, labeled "A cursor (⇒ p.108)" and "B cursor (⇒ p.108)".
- Scroll bar**: A horizontal bar at the bottom of the waveform, labeled "Scroll bar (⇒ p.112)".
- Upper Limit Value**: A horizontal line at the top of the waveform, labeled "Upper Limit Value (⇒ p.120)".
- Level Monitor**: A horizontal line in the middle of the waveform, labeled "Level Monitor (⇒ p.119)".
- Lower Limit Value**: A horizontal line at the bottom of the waveform, labeled "Lower Limit Value (⇒ p.120)".
- Time Value**: A vertical line at the bottom of the waveform, labeled "Time Value (⇒ p.278)".
- Waveform Data Table**: A table showing measurement values for various parameters:
 

Parameter	Value 1	Value 2	Value 3
t	50.00ms	100.00ms	50.00ms
1	-429.0mV	415.5mV	844.5mV
2	-0.818 V	0.906 V	1.724 V
5	1.45mV	1.33mV	-2.30mV
6	-1.60mV	0.65mV	2.25mV
- Settings Panel**: Includes "MEMORY", "Trigger" (Repeat, 0%), "Timebase" (10ms/div, 100us/S, x1, 10.00ms), "Shot" (100div, 1.000 s), and function buttons: MEMORY, REORDER, X-Y REORDER, FFT.

### Operations available from the Waveform screen

#### A/B Cursor

- Read measurement value (⇒ p.108)
- Specifying a Waveform Range (⇒ p.111)

#### Moving the Waveform Display Position

- Using the Jog & Shuttle knobs (⇒ p.112)
- Moving the position (⇒ p.113)

#### Performing X-Y Synthesis (⇒ p.114)

#### Magnifying and Compressing Waveforms

- Magnifying and Compressing Horizontal Axis (Time Axis) (⇒ p.116)
- Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis) ) (⇒ p.117)
- Magnifying and Compressing Vertical Axis (Voltage Axis) (⇒ p.118)

#### Monitoring Input Levels (⇒ p.119)

#### Switching the Waveform Screen (⇒ p.120)

- 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 <b>[Trace]</b> or <b>[Range]</b> )
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.120)

**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.112)

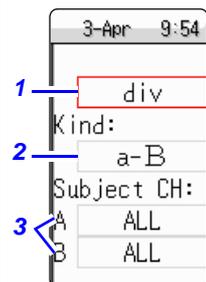
Turning the Jog & Shuttle knobs will show the respective cursor on the screen.

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.

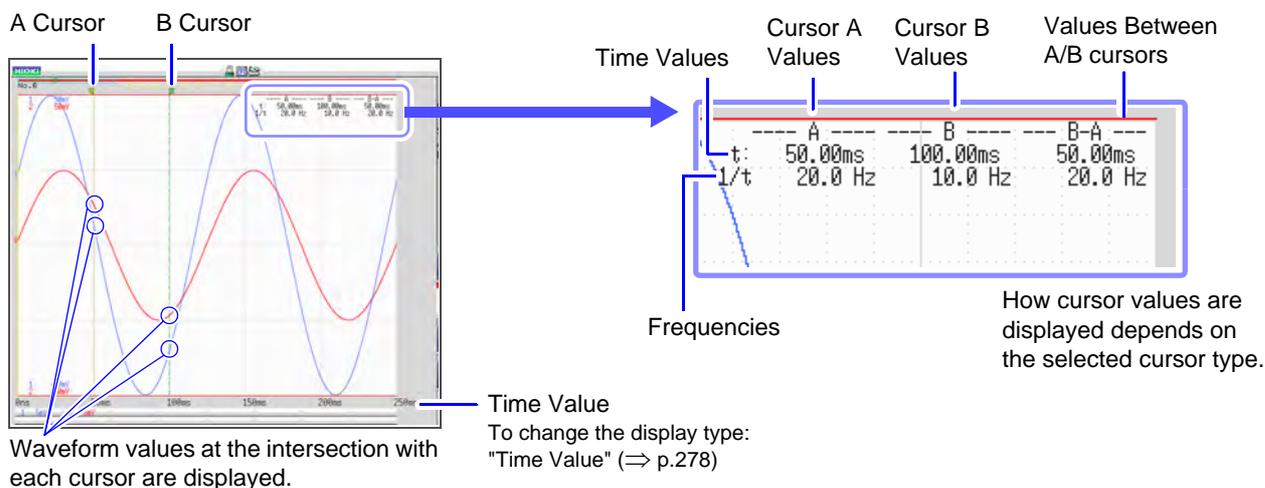
**See:** "7.3.3 Moving the Position (Jump Function)" (⇒ p.113)



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)>



<Cursor Value>

Cursor Type	Cursor Value	Cursor Value Display Example (with two cursors)
<b>div</b> (Time Value and Frequency)	<p>t: A, B each cursor value: Time from trigger point or recording start B-A value: Time difference between A/B cursors</p> <p>1/t: Frequency for which t is 1 cycle</p>	See "Screen display" above
<b>Range</b> (Measurement Values)	<p>A, B each cursor value: Measured value of channel B-A value: Difference between measured values at A/B cursors</p>	
<b>Trace</b> (Time and Measurement Values)	<p>Time Values A, B each cursor value: Time from trigger point or recording start B-A value: Time difference between A/B cursors</p> <p><b>Measurement Values</b> 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</p>	<p>Time Values</p> <p>Measurement Values</p>

You can press the **DISP** key to display the waveform and cursor values separately.  
See: "7.7.3 Switching the Waveform Display Width" (⇒ p.120)

**NOTE**

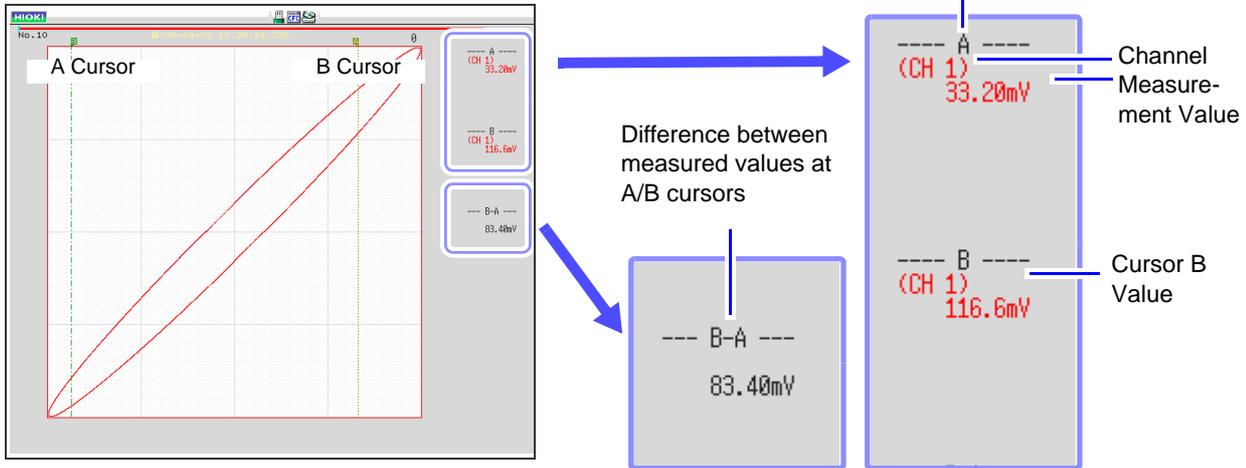
- When Using External Sampling: Value t is the number of samples.
- When the voltage range is changed during measurement by the recorder function or X-Y recorder function: Trace measurement values are acquired at the range settings when measurement was stopped.

### 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



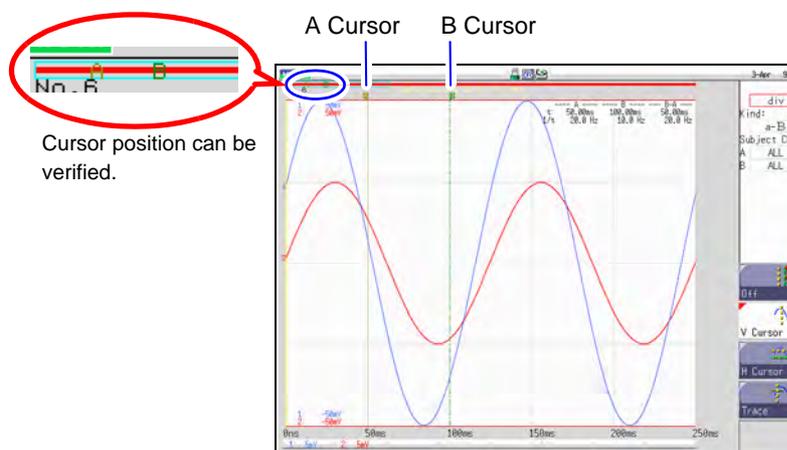
#### <Cursor Value>

Cursor Type	Cursor Value	Cursor Value Display Example (with two cursors)
<b>X</b> (X axis measurement value)		See "Screen display" above
<b>Y</b> (Y axis measurement value)		<p><b>(Y axis channels)</b></p> <ul style="list-style-type: none"> <li>Cursor A measurement value: 16.60mV (CH 2)</li> <li>Cursor B measurement value: 58.30mV (CH 2)</li> <li>Difference between measured values at A/B cursors: 41.70mV (B-A)</li> </ul>
<b>Trace</b> (Time and X axis, Y axis measurement value)		<p><b>(X axis and Y axis channels)</b></p> <ul style="list-style-type: none"> <li>Cursor A time and measurement value: t: 50.00ms, X: CH1 6.620V, Y: CH2 3.952V</li> <li>Cursor B time and measurement value: t: 100.00ms, X: CH1 -14.02V, Y: CH2 -11.83V</li> <li>Time and measurement value differential between cursor A and B: t: 50.00ms, X: -20.64V, Y: -15.78V (B-A)</li> </ul>

## 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.108)
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.74)  
"5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)
  - **For printing:**  
System screen - **[Printer]** sheet - **[Slect Print Area]** item: Select **[A-B Wave]**.  
See: "6.2 Making Auto Print Settings" (⇒ p.97)  
"6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.99)
  - **For X-Y synthesis:**  
Status screen - **[Status]** sheet - **[Combo Area]** item: Select **[A-B Wave]**.  
See: "7.4 Performing Waveform X-Y Synthesis" (⇒ p.114)
  - **For numerical calculation:**  
Status screen - **[Num Calc]** sheet - **[Calc Area]** item: Select **[A-B Wave]**.  
See: "6.2 Making Auto Print Settings" (⇒ p.97)

### NOTE

#### About reading measurement values and cursor types:

See: "7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.108)

#### Available range for A/B cursor

The available range depends on the function.

- Memory function: Recorded measurement data for one measurement
- Recorder function: Up to the range of measurement data recorded during one measurement, or up to the range of measurement data that can be recorded internally, starting at the point at which measurement ended and going backwards in time.

The following measurement data can be recorded internally:

MR8847-01	max. 20,000div
MR8847-02	max. 80,000div
MR8847-03	max. 160,000div

## 7.3 Moving the Waveform Display Position

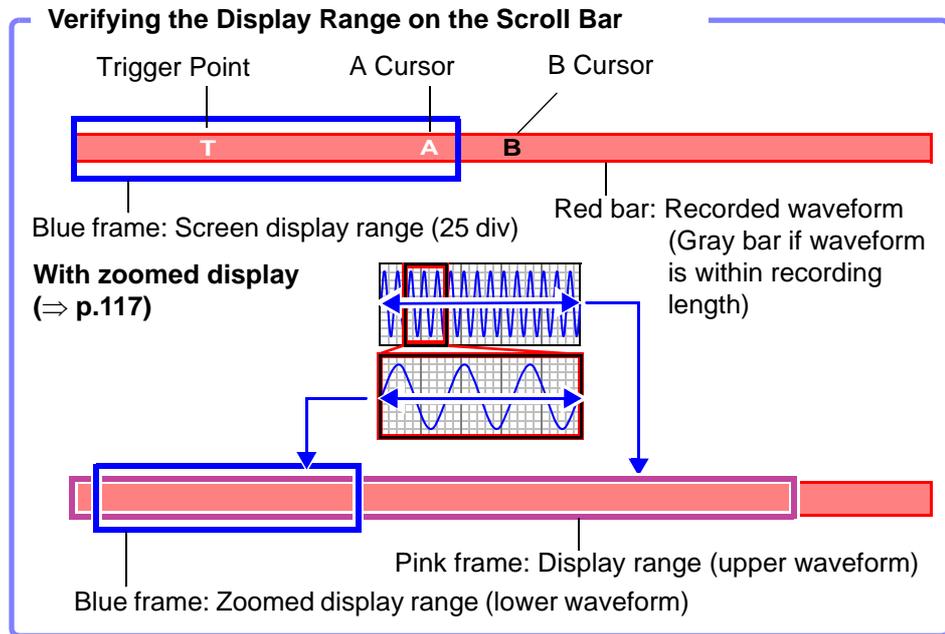
MEM REC

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.

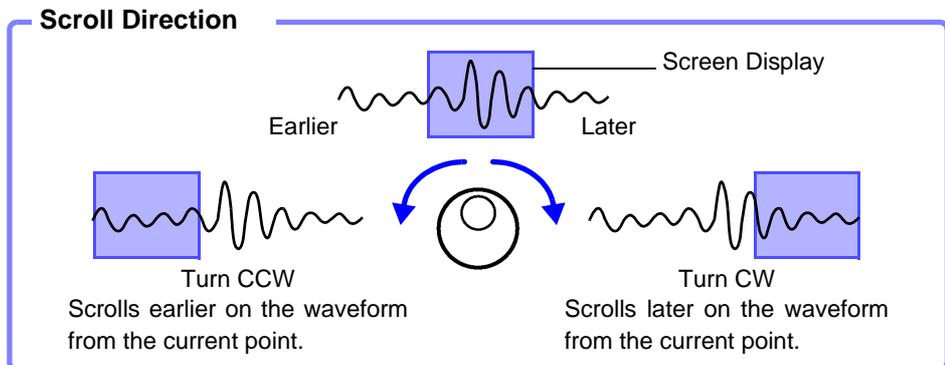
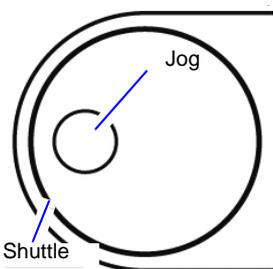
Trigger time, trigger position and A/B cursor positions (when using voltage axis cursor or trace cursors) are also displayed.



### 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.)



**To see past waveforms in Roll Mode**

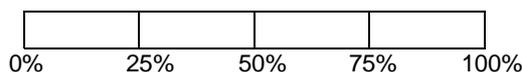
The Jog & Shuttle knobs can be used to view past waveforms during measurement. To redisplay a waveform, select **[Scroll]**.

### 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

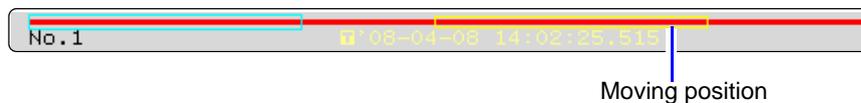
To open the screen: Press the **DISP** key → Waveform screen → Press the **WAVE** key → WAVE settings GUI is shown

- 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.121))

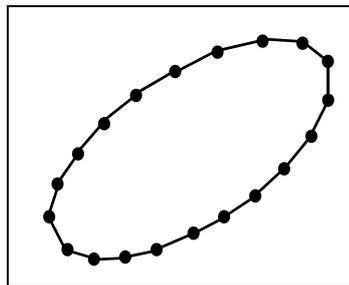
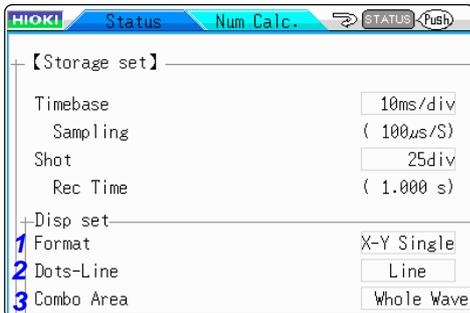
### 7.4 Performing Waveform X-Y Synthesis MEM X-Y

This applies to the Memory function and X-Y recorder function.

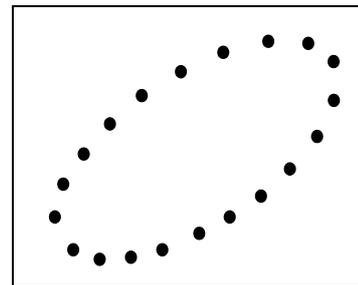
- To perform **waveform X-Y synthesis**, go to the Status screen, select the **[Status]** sheet, and set **[Format]** to X-Y1 screen or X-Y4 screen. By assigning any analog channel to the X axis and Y axis, up to 8 X-Y combo displays can be generated.
- Vertical axis (voltage axis) zoom also applies to X-Y synthesis.

#### Procedure

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



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.

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.

See: "7.2 Specifying a Waveform Range (A/B Cursor)"  
(⇒ p.111)



#### 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.76)
On	Waveform is displayed. Select the display color with the <b>F</b> 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, 8 or 16 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.108), (⇒ p.111)
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**

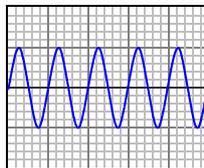
This applies to the Memory function and Recorder function. (However, with the Recorder function, waveform magnification is not available.)

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.

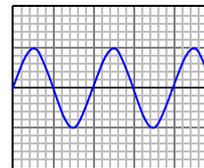
On-screen magnification and compression is based on the left edge of the screen. However, when A/B cursor appears on the screen, use the cursor as the standard to expand or compress.

The amount of magnification/compression can be changed after measurement.

Normal Display



Magnified Display (x2)



#### 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, x1/200000

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.117)

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, x1/50000



**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.102)

When a waveform loaded from media is displayed at a high compression ratio, the display may be slow to update.

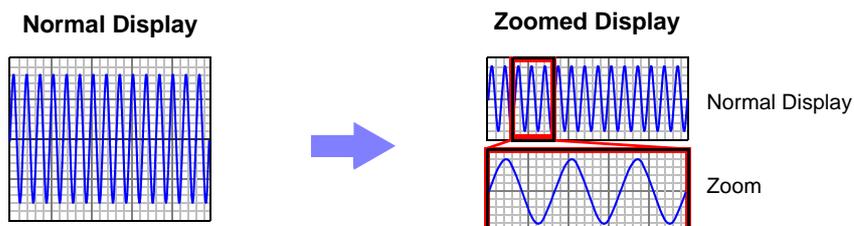
## 7.5.2 Zoom Function (Magnifying a Section of the Horizontal Axis (Time Axis))

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.

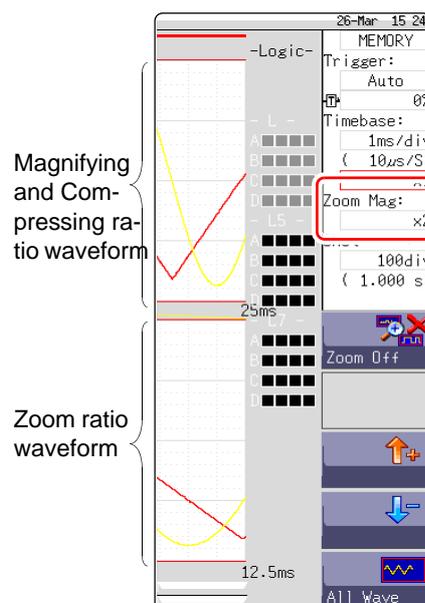
**4** Scrolls the zoomed section of the waveform.

See: "7.3.2 Scrolling With Jog and Shuttle Knobs (Scroll)" (⇒ p.112)

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)**

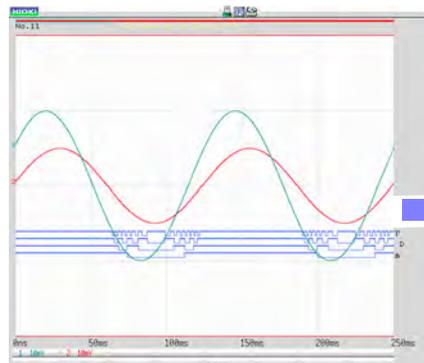
Move the cursor to the ratio item in the settings window and select **[All Wave]**. The waveform information for the entire recording length is displayed.

**Description About logic waveform display**

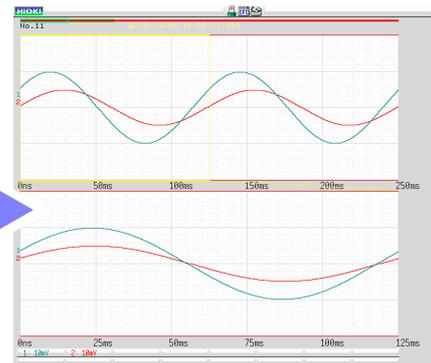
When the Zoom function is enabled, and the logic waveform display position is at less than **[50pos]**, the logic waveform will not be displayed.

Example: Display position **[30pos]**

Normal Display



Zoomed Display



**7.5.3 Magnifying and Compressing Vertical Axis (Voltage Axis)**

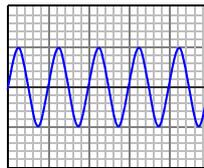
**MEM REC**

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

Selecting **[Invert]** will invert plus and minus in the waveform.

See: "8.8 Inverting the Waveform (Invert Function)" (⇒ p.144)

Ch	Col	Range	Mag	Position	L.P.F.
1	█	5mV	x1	•	50%
2	█	5mV	x1	•	50%
3	█	5mV	x1	•	50%
4	█	5mV	x1	•	50%



**To display at an arbitrary ratio**

See: "8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)

## 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

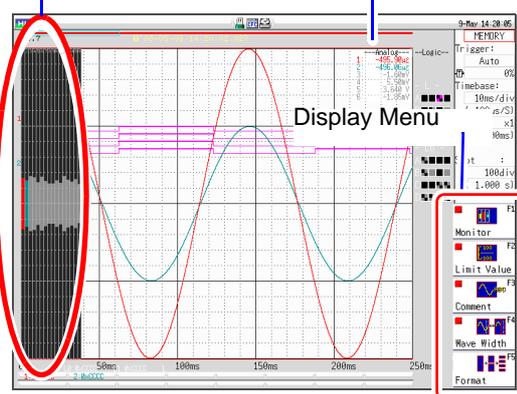
To open the Menu: Press the **DISP** key → Display Menu

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.

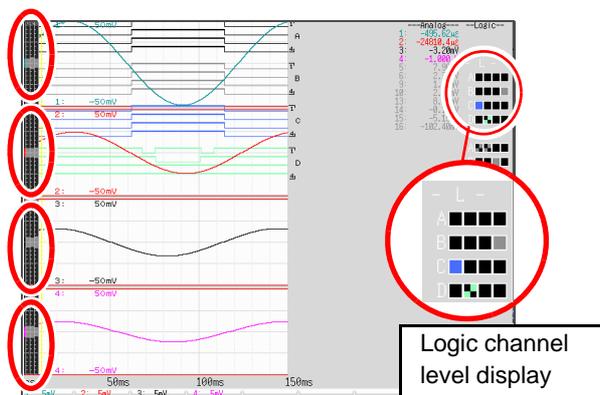
Analog channel level display      Monitor values of analog and logic channels



Display format 2 - 16 screens (⇒ p.51)  
Level monitors are displayed for each graph.

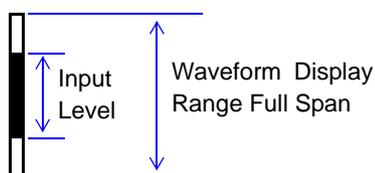
Upper and lower limit indication is combined with level monitor.

See: "7.7.1 Showing Upper/Lower Limit On Waveform Screen" (⇒ p.120)

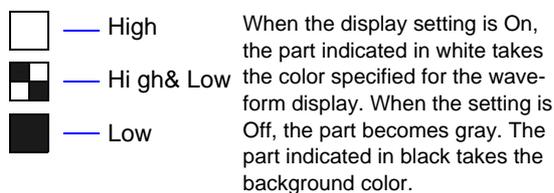


### How to View a Level Monitor

#### Level display of an analog channel



#### Level display of logic channels



### 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.)

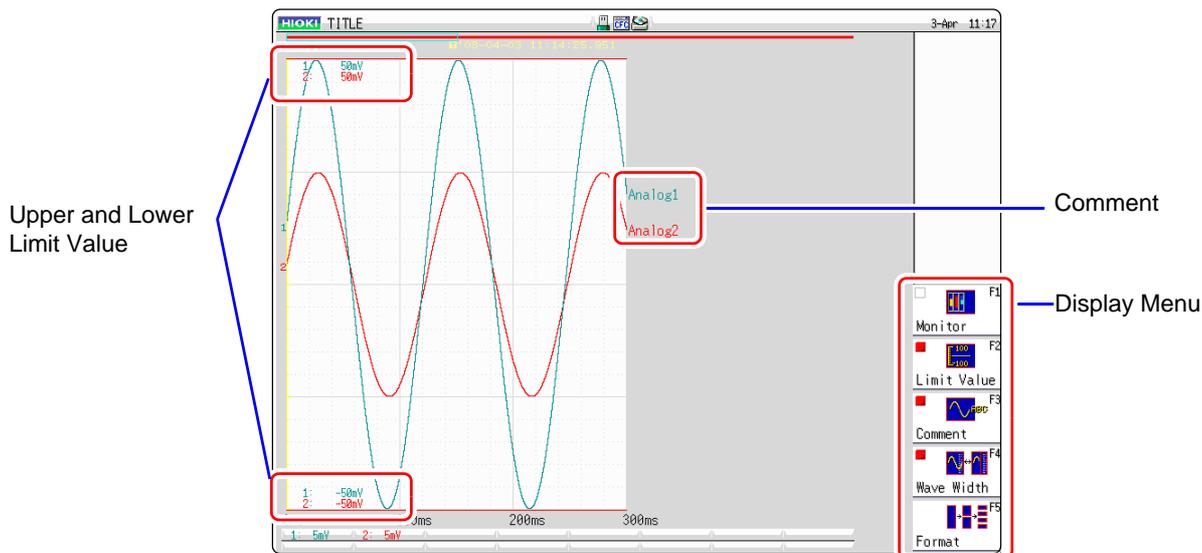
## 7.7 Switching the Waveform Screen Display (Display Menu)

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.119)

### 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.124)
- 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.

## 7.7.4 Switching the Format

The screen changes each time you press the **[Format]** key.

## 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.112)

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.212)



# Utility Functions Chapter 8

Various utility functions are described in the section.

## Utility Functions

**Adding Comments** (⇒ p.124)

**Setting the channels to use  
(Making recording length longer)** (⇒ p.133)

**Converting input values (Scaling)** (⇒ p.134)

**Setting the waveform display freely**(⇒ p.140)

**Fine Adjustment of Input Values** (⇒ p.143)

**Inverting a waveform** (⇒ p.144)

**Copying a setting to another channel**(⇒ p.145)

### Applicable measurements and settings

- Displaying Waveforms During Recording (⇒ p.130)
- Overlaying with past recorded waveforms (⇒ p.131)

### Detailed input module settings (⇒ p.146)

- 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.

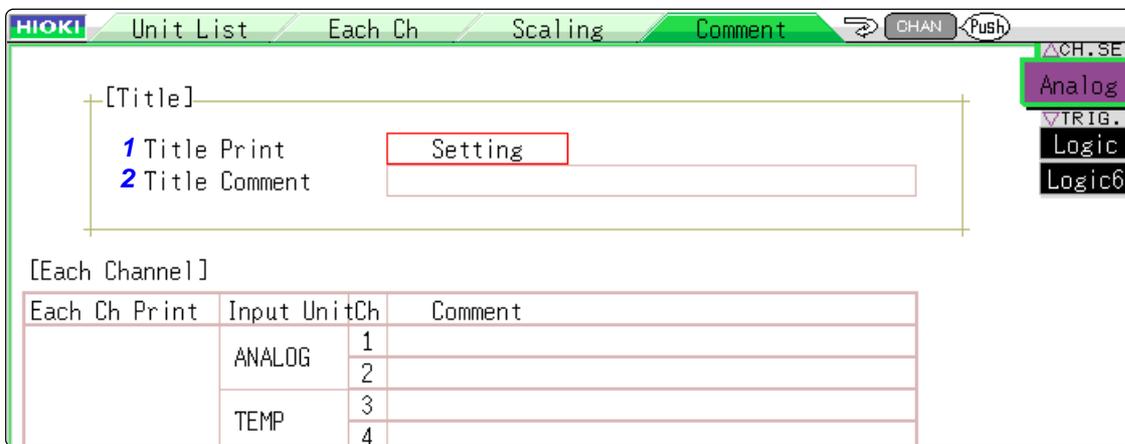
#### 8.1.1 Adding a Title Comment

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.104)

#### Procedure

To open the screen: Press the **CHAN** key → **[Comment]** sheet



#### 1 Set the print title content

Move the cursor to the **[Title Print]** item for the title.

Select

<b>Off</b>	Title comment is not printed.
<b>Setting</b>	Equipment settings are printed.
<b>Comment</b>	Title is printed.
<b>Set&amp;Com</b>	Both equipment settings and title are printed.

#### 2 Enter a title comment.

Move the cursor to the **[Title Comment]** item.

Select

<b>Input</b>	Enter comment text. See: "Entering Text" (⇒ p.127)
<b>Clear</b>	Clear entered information
<b>Undo</b>	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.128)

## 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.145)

### Procedure

To open the screen: Press the **CHAN** key → **[Comment]** sheet

[Each Channel]			
Each Ch Print	Input UnitCh	2	Comment
	ANALOG	1	
		2	
	TEMP	3	
		4	
	DC/RMS	5	
		6	
1	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

<b>Off</b>	No channel comment is printed.
<b>Setting</b>	Settings for each channel are printed. (Not displayed on screen)
<b>Comment</b>	Comments for each channel are printed.
<b>Set&amp;Com</b>	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

<b>Input</b>	Enter comment text. See: "Entering Text" (⇒ p.127)
<b>Clear</b>	Clear entered information
<b>Undo</b>	Return to condition of preceding step

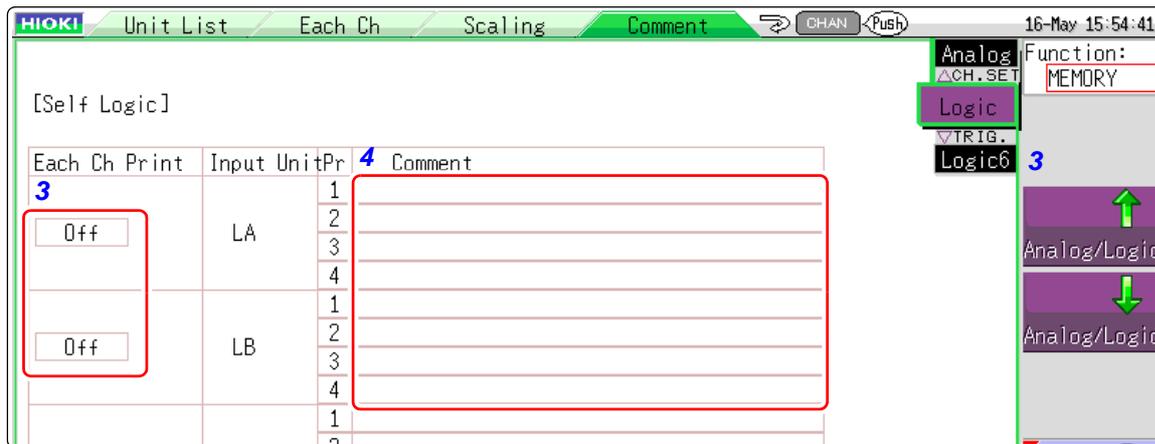


### To select from preset terms

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.128)



### 3 Select the print content for each logic channel. Select

Select **[Analog/Logic]** to display logic channel page.

Move the cursor to the **[Each Ch Print]** item.

<b>Off</b>	Comments are not printed.
<b>Comment</b>	Comments are printed.

### 4 Enter the comment for each logic channel. Select

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

<b>Input</b>	Enter comment text. See: "Entering Text" (⇒ p.127)
<b>Clear</b>	Clear entered information
<b>Undo</b>	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).

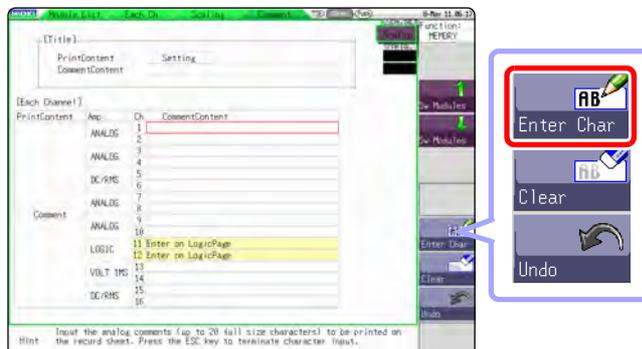
See: "Entering Text From a Term List Or History List" (⇒ p.128)

## 8.1.3 Alphanumeric Input

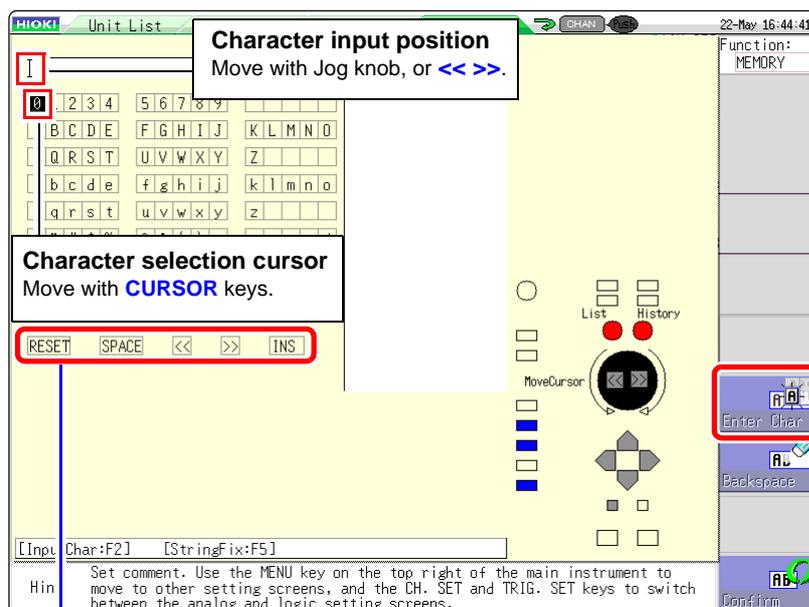
Move the cursor to the setting item for which to make the input, and choose the content with the **F** keys.

### Entering Text

1. Move the cursor to the comment field and select **[Enter Char]**.  
A virtual keyboard appears.



2. Select a character with the **CURSOR** key from the virtual keyboard, and select **[Enter Char]** to enter it.



**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)

$2 \rightarrow \wedge 2$ ,  $3 \rightarrow \wedge 3$ ,  $\mu \rightarrow \sim u$ ,  $\Omega \rightarrow \sim o$ ,  $\varepsilon \rightarrow \sim e$ ,  $^\circ \rightarrow \sim c$ ,

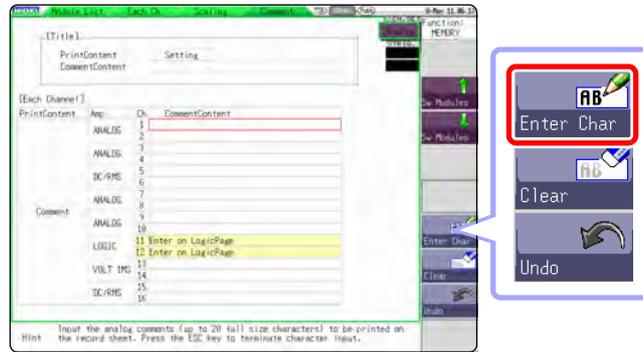
$\pm \rightarrow \sim +$ ,  $\mu\text{E}$  (display only)  $\rightarrow uE$ ,  $^\circ\text{C}$  (display only)  $\rightarrow C$

Characters not allowed in the file name have been detected. (Please use only uppercase letters.)

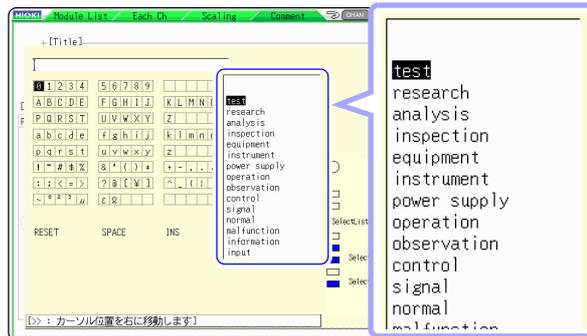
## Entering Text From a Term List Or History List

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.

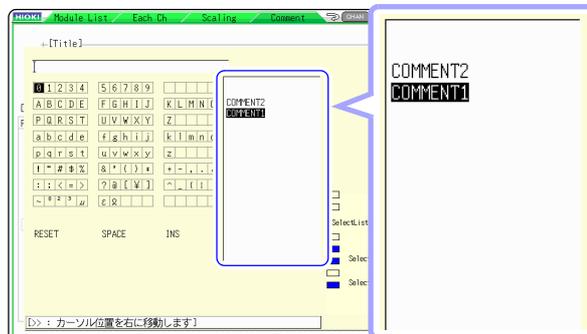
1. Move the cursor to the comment field and select **[Enter Char]**. The virtual keyboard appears.



2. (To select from preset terms)  
Press the **WAVE** key.  
A list of preset terms appears.



- (To select from past input)  
Press the **AB CSR** key.  
A History list appears.

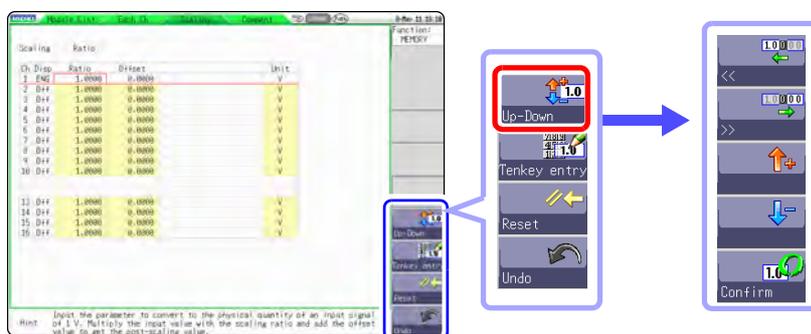


Press the **ESC** key to cancel selection from the history list.

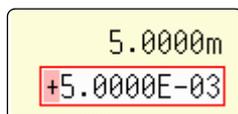
3. Use the **CURSOR** keys or the Jog knob to select a term from the list, and select **[Enter Char]**.
4. Select **[Confirm]** to accept the entry. The virtual keyboard disappears. To return the edited field to the original condition, select **[Undo]**.

## 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.



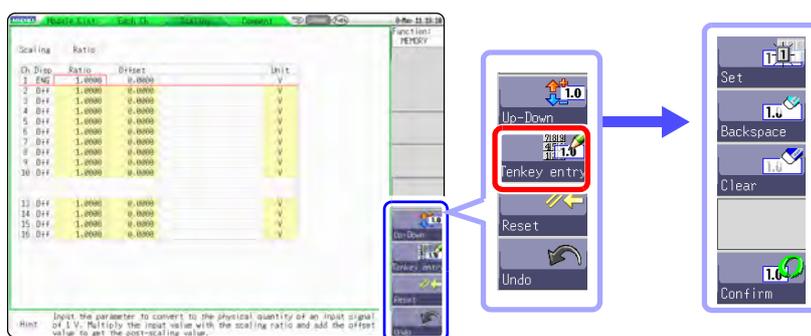
2. Use the virtual keyboard to enter the numerals.  
(Use **F1** and **F2** to move digit position, and use **F3** and **F4** to increase or decrease the value.)



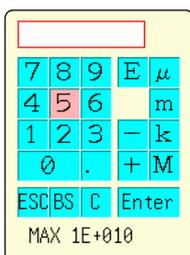
3. Select **[Confirm]** to accept the entry.  
Press the **ESC** key to cancel the input.

## 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.



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.97)

- 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.

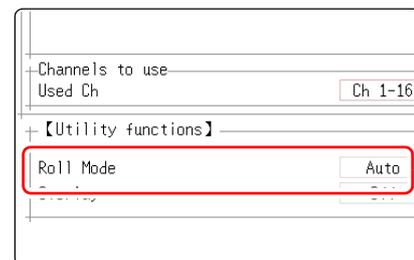
### Procedure

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, when the waveform is displayed using a time axis slower than 100 ms per division, or when the time axis range is 5 μs/div, the waveform will be displayed after it has been captured.



### 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.131)
- 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.97) 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

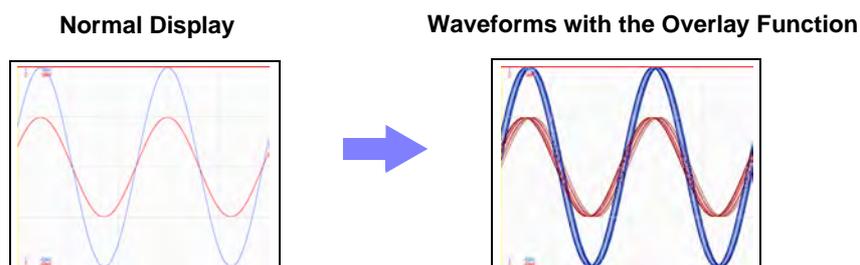
Waveforms are displayed after the data has been acquired for the entire recording length, so with slow sampling there may be a long wait after starting measurement before the waveform is displayed.

## 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.159)
- There are two overlay methods: automatic overlay during measurement and manual overlay.



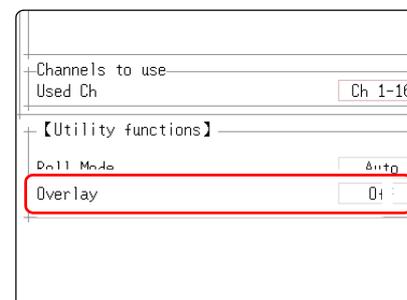
### Procedure

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

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

Select

<b>Off</b>	Overlay disabled.(default setting)
<b>Auto</b>	Each time a waveform is acquired, it is automatically displayed as an overlay. When the trigger mode is <b>[Cont.]</b> or <b>[Auto]</b> , waveforms will be overlaid from start until stop.
<b>Manual</b>	Overlay waveforms on the screen manually. Regardless of the trigger mode, the waveform is left on the screen. (⇒ p.131)



This mode cannot be used simultaneously with the Roll Mode.

"When the Overlay function is enabled ([Auto] or [Manual])." (⇒ p.132)

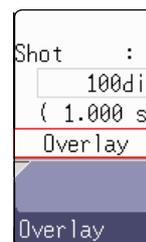
### Manual Overlay (Any waveform can be retained on-screen)

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

Move the cursor to the **[Overlay]**.

Select

<b>Overlay (F1 key)</b>	Pressing <b>F1</b> key <b>[Overlay]</b> leaves the loaded waveform on the screen. The overlay is displayed until the waveform is cleared.
<b>Clear (F5 key)</b>	Clears the screen of all overlaid waveforms. Cleared waveforms cannot be displayed again.



- Description** When the Overlay function is enabled (**[Auto]** or **[Manual]**).
- The Roll Mode function (⇒ p.130) and Overlay functions (⇒ p.131) 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 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

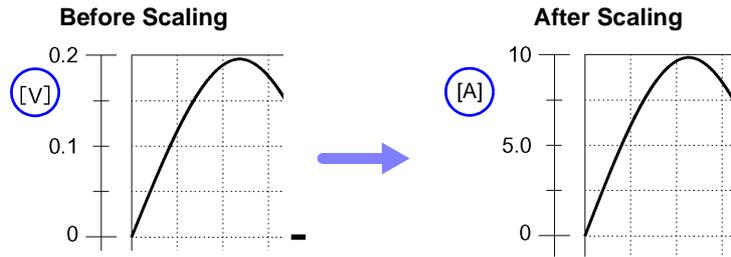
Note that the maximum number of logic modules that can be used is three.

# 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.



### Scaling Setting Example

See: When using a clamp sensor (⇒ p.136) (Example: Converting [ V ] → [ A ])   
 When using the Strain Unit (⇒ p.137) (Example: Converting [  $\mu\epsilon$  ] → [ G ])

## Scaling Methods

Two scaling methods are available:

- Conversion Ratio Setting
- Two-Point Setting

(:Example: Converting [V] → [A])

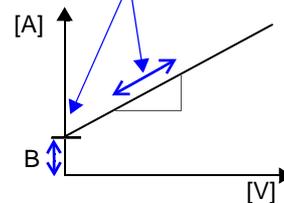
### Conversion Ratio Setting

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

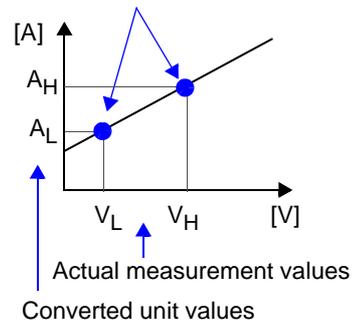
Set the voltage values of two points of the input signal, the converted unit value of these two points and the name of the converted measurement units, so measurement values acquired as voltage are converted to the specified units.

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

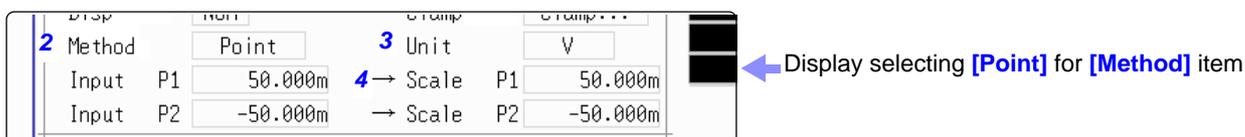
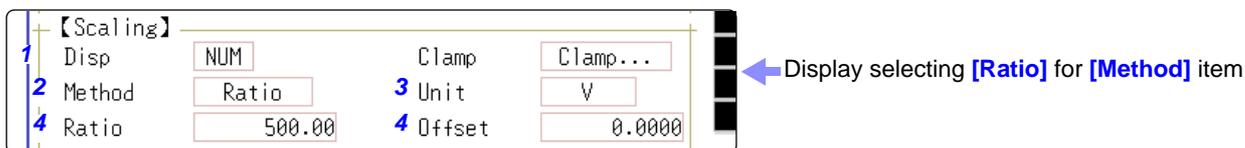
Unit name: A

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



### 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.127)

**Input example:**

Decimal 1.2345 mV  
 Exponent 1.2345E-03V

### 4 Enter the numerical values for conversion.

**When you have selected [Ratio] (set conversion ratio and offset)**

Enter numerical values in each field.

Move the cursor to the [Ratio] and [Offset] items.

-9.9999E+9 to 9.9999E+9

**When you have selected [2-Point] (set input values for two points and the values after conversion)**

Enter numerical values in each field.

Move the cursor to the [Input P1], [Scale P1], [Input P2], and [Scale P2].

-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. (MR8847 display → saved string)
- $^2 \rightarrow \wedge 2$ ,  $^3 \rightarrow \wedge 3$ ,  $\mu \rightarrow \sim u$ ,  $\Omega \rightarrow \sim o$ ,  $\varepsilon \rightarrow \sim e$ ,  $^\circ \rightarrow \sim c$ ,  $\pm \rightarrow \sim +$ ,  $\mu\varepsilon$  (display only)  $\rightarrow uE$ ,  $^\circ C$  (display only)  $\rightarrow C$



To enter the current input value as is for P1 or P2  
 Select [Monitor Val].



### To reset Scaling settings:

Move the cursor to the **[Setting]**, 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.145)

### Using the Scaling and Variable functions (⇒ p.140) in combination:

The full span of output from a sensor can be displayed. (⇒ p.142)

## NOTE

At factory shipping, automatic correction of the variable function (⇒ p.279) 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).

Setting Items	Setting Choice
Disp	NUM or SCI
Clamp	9018-50
Unit*	A
Method*	Ratio
Ratio*	50.000

\*: Set automatically when clamp is selected.

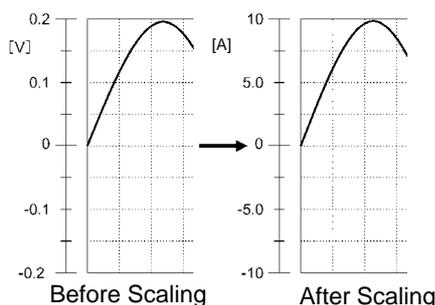
### Selecting a Clamp Type

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.

8.5 Converting Input Values (Scaling Function)

However, you may need to switch the vertical axis (voltage axis) range to suit actual input values.

For example, to display  $\pm 0.2$  V at full scale, set the vertical display to 20 mV per division (the instrument's 20 mV/div range)



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: ( $\Rightarrow$  p.102)

Cursor A/B value: ( $\Rightarrow$  p.97)

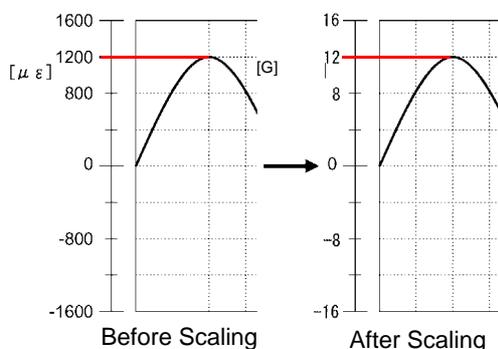
Using Model 8969 Strain Unit

Example 2 Using the 20 G rated capacity and a sensor with 1000  $\mu$ V/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	$\mu$ V/V

Setting Items	Setting Choice
Disp	NUM
Unit	G
Rated Cap	20 [G]
(Rated capacity)	
Rated Output	1k



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: ( $\Rightarrow$  p.102)

Cursor A/B value: ( $\Rightarrow$  p.97)

**NOTE**

Set the rated capacity (2 x rated output) to be less than  $\pm 9.9999 \pm 9$ .

### When a calibration factor is stated in the sensor's inspection records \_\_

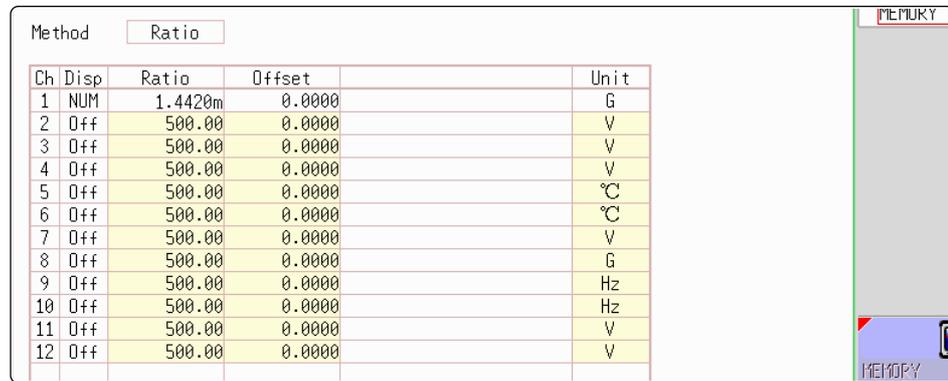
Set the [Method] item on the [Scaling] sheet to [Ratio].

**Example 3 Measure using a sensor with a calibration factor of 0.001442 G / 1 x 10<sup>-6</sup> 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<sup>-6</sup> strain =  $\mu\epsilon$ )

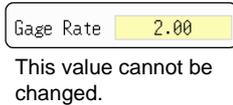
Move the cursor to the channel to set, and making settings as follows.

Setting Items	Setting Choice
Disp	NUM
Unit	G
Ratio	0.001442 [G]
(Conversion ratio)	(displays as 1.4420m)



### 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).



**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\*

$$\text{Conversion Ratio} = 0.952 \times 0.001442 = 0.0013728$$

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.A11)

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  1

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

MEMURY

10.000  
40 60  
dB Scaling

Up-Down 1.0

Tenkey ent 1.0

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.127)

Method

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

MEMURY

Verify Input

Input 1.0000 V 10.000 V

dB value input 40.000 dB 60.000 dB

Up-Down 1.0

Tenkey ent 1.0

1.0 Confirm

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

Ch	Set	Ratio	Offset	Unit
1	NUM	10.000	0.0000	V
2	Off	1.0000	0.0000	V

MEMURY

## 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).

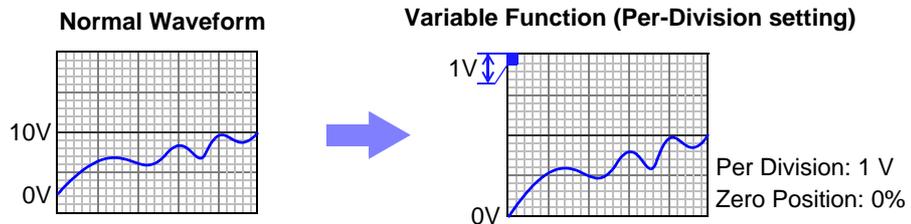
### **NOTE**

#### Precautions for using the Variable Function

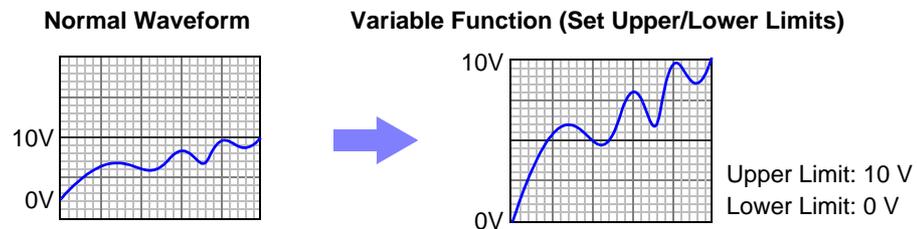
- Verify that the vertical axis (voltage axis) range is set properly for the input signal.
- The vertical axis (voltage axis) range is unaffected by changes to the upper and lower limits made by the Variable setting.

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).



- 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.



Settings for the Variable function can be made for each individual channel, using the **[Each Ch]** sheet accessed from the Channel screen ( $\Rightarrow$  p.141), or for all channels using the Display range window ( $\Rightarrow$  p.141).

## Make the Variable Function Setting per channel

### Procedure

To open the screen: Press the **CHAN** key → [Each Ch] sheet

#### 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.)

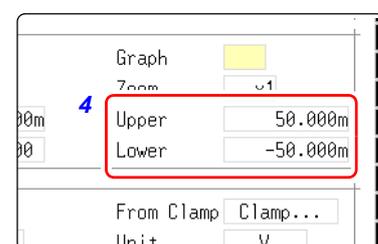
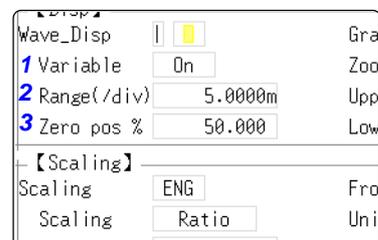
#### 4 (When setting upper and lower values)

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.

### NOTE

- For information on numeric input, see "8.1.3 Alphanumeric Input" (⇒ p.127).
- 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.142)
- 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.



#### To reset the settings

Select **[Reset]** to return the settings to the default values.

## 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

#### 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.

Ch	Variable	Lower	Upper
1	On	-50.000m	50.000m
2	-	-50m	50m
3	-	-50m	50m
4	-	-50m	50m
5	-	-50m	50m

**Description** When setting combined use of the Scaling and Variable functions

**When Auto-Correction of the Variable function is enabled (On, default setting) (⇒ p.279)**

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:

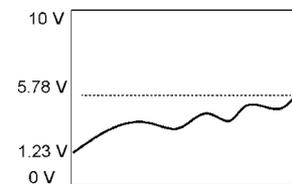
Set Scaling as follows:

Scaling: Decimal or exponent, Two-Point Setting

Units: A

Sensor Output (Input 1): 1.23 [V]→(Scale 1): 0 [A]

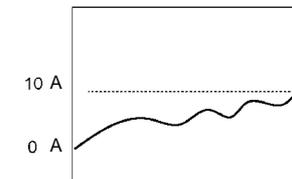
Sensor Output (Input 2): 5.78 [V]→(Scale 2):10 [A]



(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).

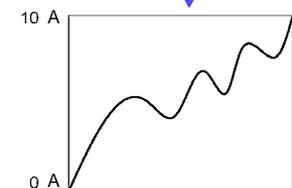


The Variable function is set as follows:

Variable: On, Set Upper/Lower Limits

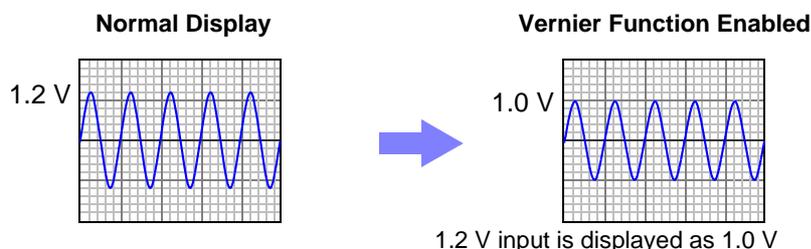
Lower Limit: 0 [A] Upper Limit: 10 [A]

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.



### 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 **[↕]** vernier setting item of the channel to adjust.
- 2 Make the adjustment with the **F** keys while watching the waveform.

Analog Variable Logic					
Ch	Col	Range	Mag	Position	L.P.F.
1		5mV ×1		50%	-
2		5mV ×1	•	50%	-
3		5mV ×1		50%	-
4		5mV ×1		50%	-

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.

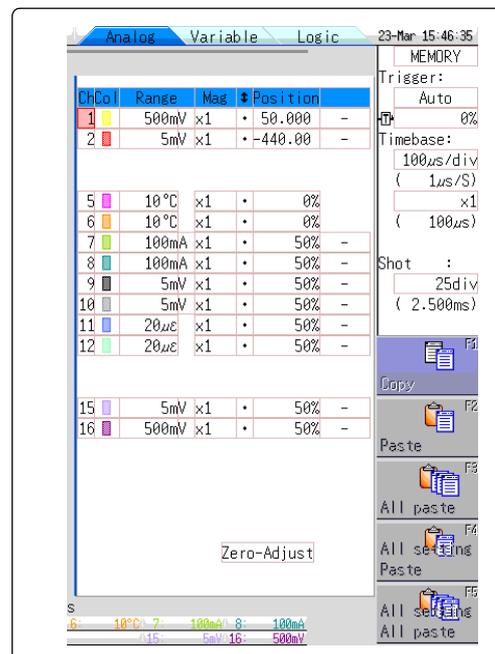
### Procedure

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.



### 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

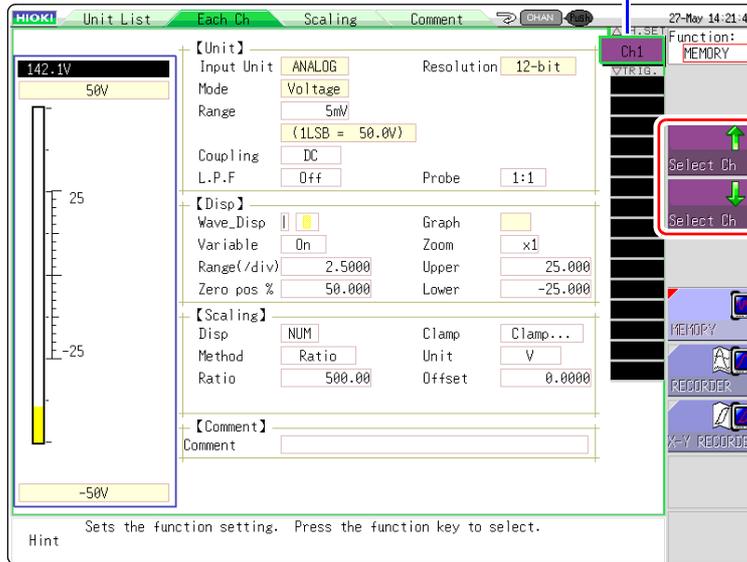
Using the **[Each Ch]** sheet accessed from the Channel screen, you can make detailed settings.

## Opening the **[Each Ch]** sheet, Making a Channel Selection

**CHAN**



Press this key.



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.146)

【Unit】			
InputUnit	HIGH RES		
Mode	Voltage	A.A.F	Off
Range	5mV		

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.146)

Range	5mV		
Resolution	3.125 $\mu$ V	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 L9197, 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.146)

InputUnit	TEMP	RJC	INT
Mode	Temp-K	Burn Out	Off
Range	10 °C	Renew Data	Normal
Resolution	0.01 °C (16-bit)		

#### 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 <a href="#">[Burn Out]</a> to <a href="#">[Off]</a> 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
<b>Fast</b>	Data are updated approximately every 1.2 ms.
<b>Normal</b>	Data are updated approximately every 100 ms. (default setting)
<b>Slow</b>	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.146)

InputUnit	STRAIN
Range	20 $\mu$ E
Resolution	0.0160 $\mu$ E (16-bit)
Gauge Rate	2.00

Setting Item: [\[Range\]](#)

Selections	Description
<b>Auto Bal All Chs</b>	Auto Balance is executed for all channels where the 8969 Strain Unit is installed.
<b>Auto Bal Ch 1</b>	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.55)

#### 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.146)

【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

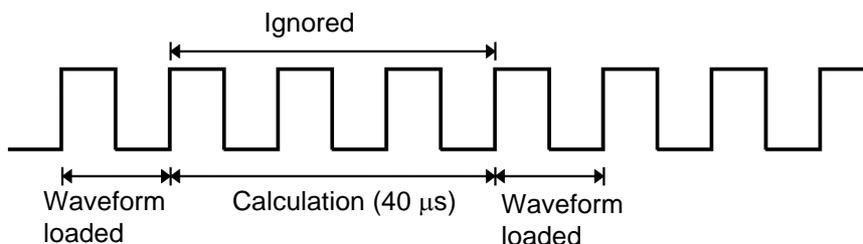
Changes the measurement mode.

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 <b>START</b> 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 50000) the count value returns to 0.

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.146)

InputUnit	FREQ	VRange	±10V
Mode	Duty	Threshold	+2.5V
Range	5%		
Resolution	0.01% (16-bit)		
Coupling	DC	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
<b>High</b>	Measures above the threshold value. (default setting)
<b>Low</b>	Measures below the threshold value.

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.146)

InputUnit	FREQ	VRange	±10V
Mode	Freq	Threshold	+2.5V
Range	1kHz	Smoothing	Off
Resolution	2.00 Hz (16-bit)	Hold	Off(0.5Hz)

## Smoothing

This is enabled only when **[Mode]** is **[Frequency]** or **[RPM]**.

Set smoothing.

Select

Selections	Description
<b>Off</b>	The measured data is recorded as is. (A step waveform.) (default setting)
<b>On</b>	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
<b>Off</b> <b>(1Hz/0.5Hz/ 0.2Hz/0.1Hz)</b>	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)
<b>On</b>	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.146)

【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
<b>20A/2V</b>	Set when a 9272-10 (20 A range) or 9277 Clamp Sensor is connected. (default setting)
<b>200A/2V</b>	Set when a 9272-10 (200 A range), 9277, or CT6863 Clamp Sensor is connected.
<b>50A/2V</b>	Set when a CT6862 Clamp Sensor is connected.
<b>500A/2V</b>	Set when a 9279 or 9209 Clamp Sensor is connected.

## 8.10.7 Settings for the 8972 DC/RMS Unit

See: Opening the **[Each Ch]** sheet, Making a Channel Selection (⇒ p.146)

InputUnit	DC/RMS		
Mode	DC	Response	Normal
Range	5mV		

### Mode

Switches between voltage measurement and RMS measurement.

Select

Selections	Description
<b>DC</b>	Voltage measurement (default setting)
<b>RMS</b>	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
<b>Fast</b>	Sets the response time to about 100 ms. (default setting)
<b>Normal</b>	Sets the response time to about 800 ms.
<b>Slow</b>	Sets the response time to about 5 s.



# Trigger Settings Chapter 9

9

Chapter 9 Trigger Settings

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 the Trigger settings window

Pressing [TRIG.SET] key repeatedly displays the various sheets.

[Analog Trig]  
↓  
[Logic Trig]  
↓  
No display

## Operations available from the Trigger settings window

### Trigger Settings

- Trigger mode setting (⇒ p.159)
- Combining logic (AND/OR) for multiple trigger sources (⇒ p.176)
- Pre-trigger settings (⇒ p.172)
- Trigger timing settings (⇒ p.175)

### Trigger Source Settings

#### Analog Trigger Settings (⇒ p.160)

- Level trigger
- Window trigger
- Period trigger
- Glitch trigger
- Slope trigger

#### Timer Trigger Settings (⇒ p.168)

#### External Trigger Settings (⇒ p.171)

#### Manual Trigger Settings (⇒ p.171)

#### Logic Trigger Settings (⇒ p.166)

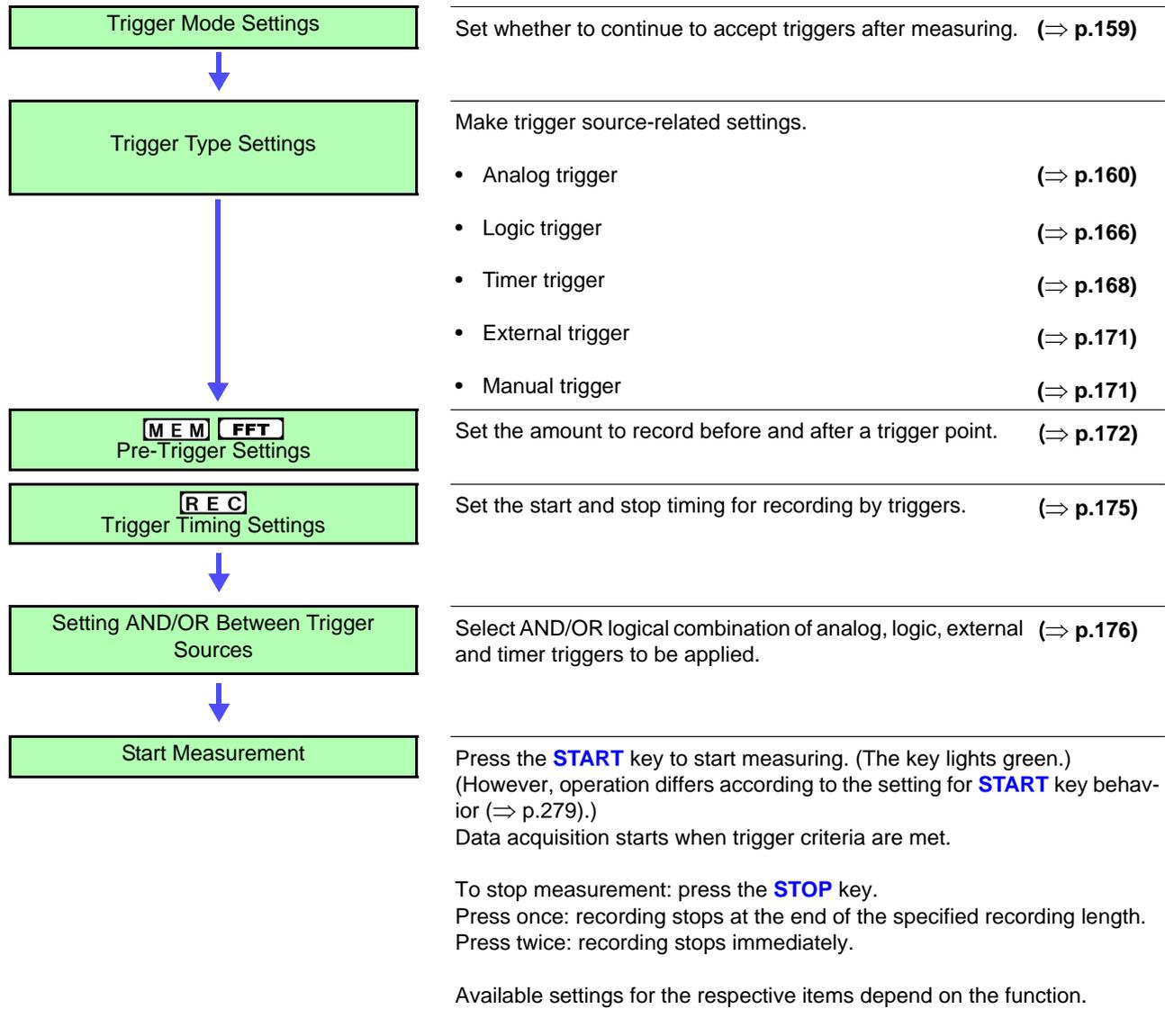
- Setting combining logic for logic triggers
- Trigger filter settings
- Trigger pattern settings

#### Trigger Output (⇒ p.319)

#### Searching for trigger positions (⇒ p.177)

## 9.1 Setting Workflow

The procedure for making trigger settings is as follows.



### NOTE

- Except for manual trigger, triggering is based on the AND/OR combination of trigger sources. (⇒ p.176)
- When triggering occurs, the TRIG OUT terminal for control of external devices carries an output signal. (⇒ p.319)

## 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).

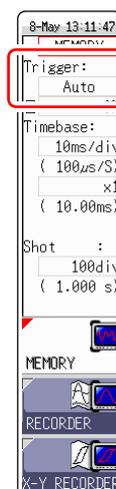
### Procedure

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

- 1 Move the cursor to the **[Trigger]** item.
- 2 Select the trigger mode.

Select

<b>Single</b>	Only one trigger is recognized. After pressing the <b>START</b> key, once a trigger is applied, a waveform is recorded for the specified recording length, and measurement then stops.
<b>Repeat</b>	Triggers are accepted continuously. When no trigger is applied, the instrument enters the Trigger Wait state. Press the <b>STOP</b> key to stop measuring. (See below)
<b>Auto</b>	<div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">MEM</div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">FFT</div> 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 <b>STOP</b> key to stop measuring.



**Description** Available selections depend on the function.

Trigger Mode	Function	
	<div style="border: 1px solid black; padding: 2px;">MEM</div> <div style="border: 1px solid black; padding: 2px;">FFT</div>	<div style="border: 1px solid black; padding: 2px;">REC</div>
<b>Single</b>	○	○ (default setting)
<b>Repeat</b>	○	○
<b>Auto</b>	○ (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 Trigger (⇒ p.161)	1	Level	L	0.000 V	S↑	Event 1	F 0.1di
2. In-Window Trigger	2	In	Lower	-2.000mV	Upper	2.000mV	F 0.2di
Out-of-Window Trigger (⇒ p.161)	3	Out	Lower	-2.000mV	Upper	2.000mV	F 0.5di
3. Voltage Sag Trigger (⇒ p.162)	4	VDrop	L	254.4 V	f= 50Hz	RMS: 179.9 V	
4. In-Period Trigger	5	Per.	IL	0.000 V	S↑ P↓	5.00μs↑ 10.00μsF	-
Out-of-Period Trigger (⇒ p.163)	6	Per.	OL	0.000 V	S↑ P↓	5.00μs↑ 10.00μsF	-
5. Glitch Trigger (⇒ p.163)	7	Glitch	L	0.000 V	S↑	Event 1	Width 100ns

- 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 ([\[Analog Trg.\]](#) sheet) can be used to copy a setting.

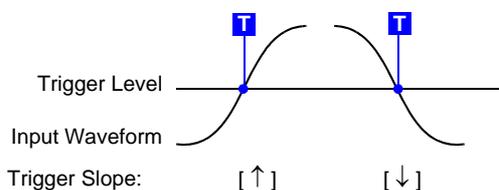
See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

#### **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).



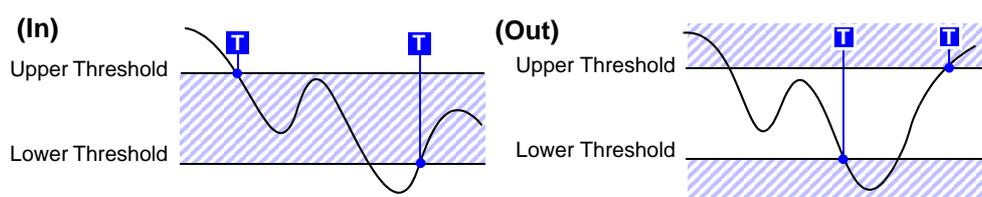
### **NOTE**

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

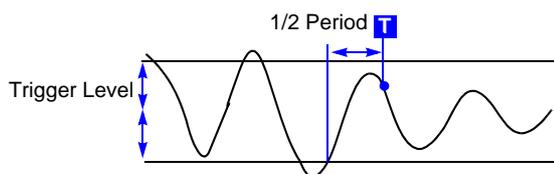
To open the screen: Press the **DISP** key → Waveform screen → Press the **TRIG.SET** key → Trigger settings window (**[Analog Trg.]** sheet)

	Ch	Type	Parameter				
1. Level Trigger (⇒ p.161)	1	Level	L	0.000 V	S↑	Event 1	F 0.1d
2. In-Window Trigger	2	In	Lower	-2.000mV	Upper	2.000mV	F 0.2d
Out-of-Window Trigger (⇒ p.161)	3	Out	Lower	-2.000mV	Upper	2.000mV	F 0.5d
3. Voltage Sag Trigger (⇒ p.162)	4	VDrop	L	254.4 V	f= 50Hz	RMS: 179.9 V	
4. In-Period Trigger	5	Per.	IL	0.000 V	S↑	P↓	5.00μs↑ 10.00μsF -
Out-of-Period Trigger (⇒ p.163)	6	Per.	OL	0.000 V	S↑	P↓	5.00μs↑ 10.00μsF -
5. Glitch Trigger (⇒ p.163)	7	Glit.	L	0.000 V	S↑	Event 1	Width 100ns

- 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.

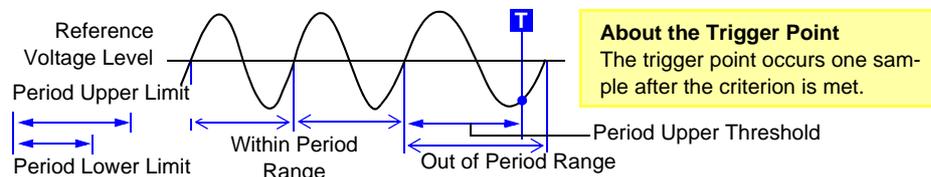


Type	Parameters	
<b>[VDrop]</b>	<b>[L]</b> (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	<b>[f=]</b> (Frequency)	Select 50 or 60 Hz.
	RMS: (actual value)	It is an aim of the actual value. Changes in sync with the level setting.

## 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.165)

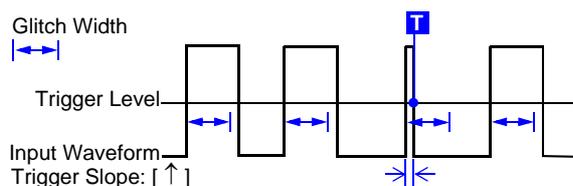


Type	Parameters	
[Per.] or [Per.O]	[L] (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the upslope (rising edge) or on the downslope (falling edge). (↑, ↓)
	[P ↓] (Period lower limit) <sup>*1</sup>	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) <sup>*1</sup>	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.



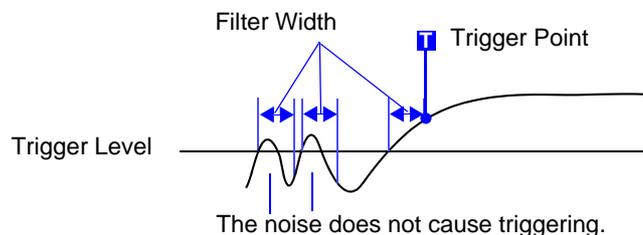
Type	Parameters	
[Grit.]	[L] (Level)	Sets the level (voltage value) for the trigger. (The setting can be made in 1/50 increments.)
	[S] (Slope)	Determines whether triggering occurs when the signal crosses the threshold (trigger level) on the upslope (rising edge) or on the downslope (falling edge). (↑, ↓)
	[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

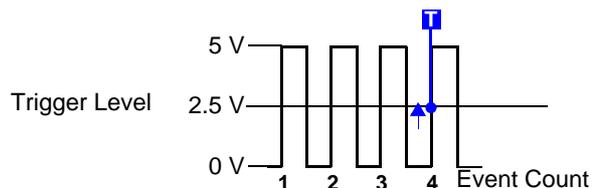
By setting the filter width to prevent triggering on noise, triggering occurs only when the trigger criteria continue to be met for at least the specified width (interval).



#### Method 2: Setting an Event Count

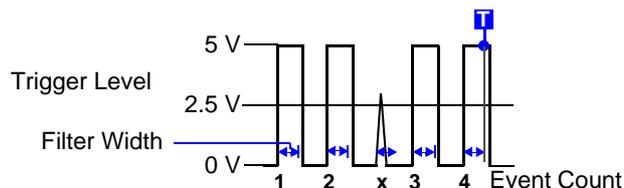
If triggering occurs too frequently, an event count can be specified so that a trigger is accepted only after the specified number of trigger events has occurred.

Example: When the event count is set to [4] (Slope:  $\uparrow$ )



### 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:

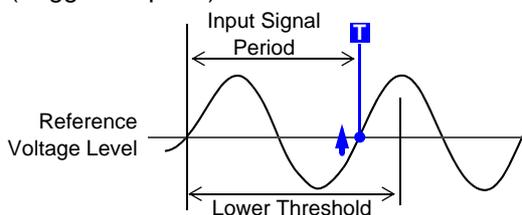
Set the period trigger type to **[Per.O]**, and the lower threshold to **[0]**. The lower threshold is ignored, and triggering occurs when the frequency drops below that corresponding to the upper threshold.

**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.

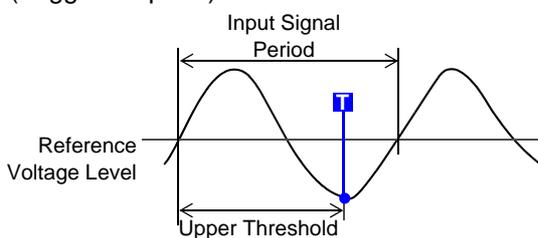
The point at which triggering occurs depends on the specified period range and the period of the measured signal.

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.

Logic Channels		1.	2.	3.		
Ch	Terms	Filter	1	2	3	4
L	A Or	-	x	x	x	x
	B And	-	x	x	x	x
	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.164)

Select

<b>M E M</b> 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.
<b>R E C</b> 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.145)

## Setting Example

**Example 1: Trigger when the input signal matches any of the following criteria:**

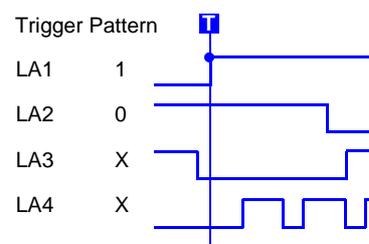
Channel 1 (LA1): HIGH level

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:**

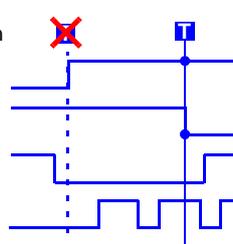
Trigger Pattern

LA1 1

LA2 0

LA3 X

LA4 X



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.37)

### 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.

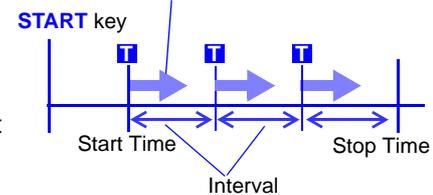
Select

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
  
```

Records the specified recording length



#### 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]**.

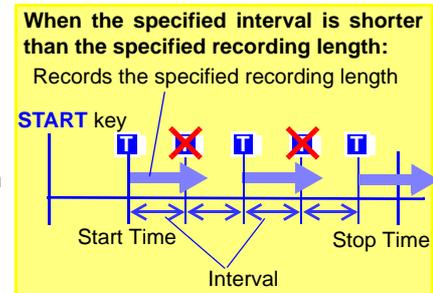
#### 3 (To apply a trigger through the specified interval, from Start to Stop) Set the Interval.

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 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.169)

**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.

### NOTE

The timer trigger time and the time at which the trigger is actually fired may differ by up to 3 sample 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.

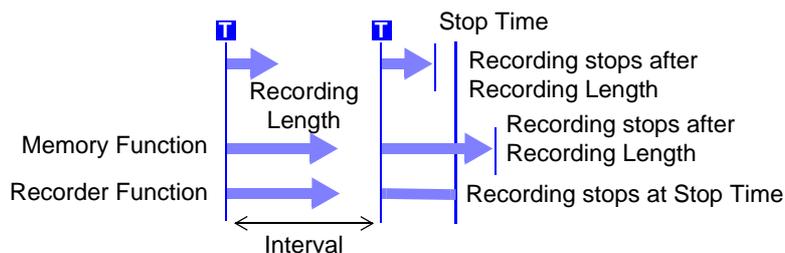
**About Stop Time and Recording Length**

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

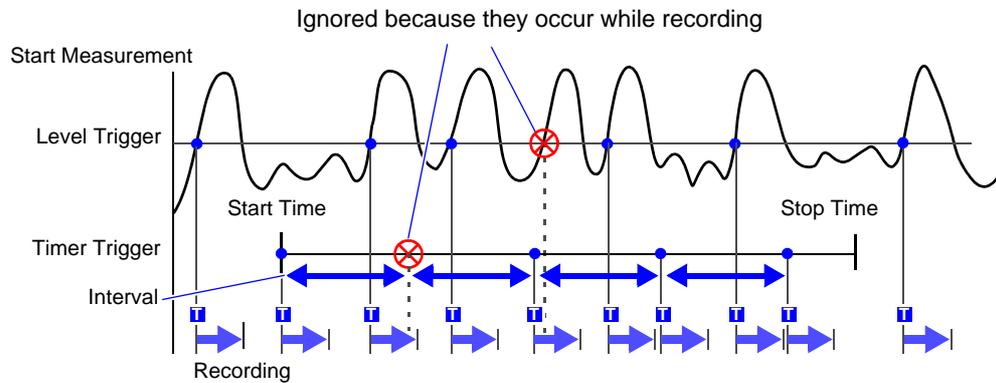
Trigger sources set to On are all enabled.

However, trigger timing depends on the trigger source settings.

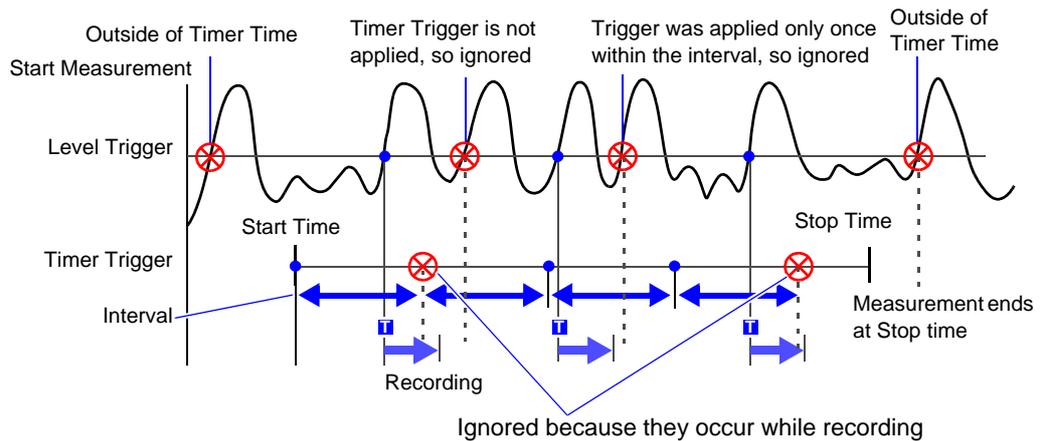
- When trigger criteria are ORed together (Trigger Source: OR)  
Depending on the other trigger sources, triggering can occur before the specified trigger Start time, after the specified Stop time, or outside of the specified Interval.
- When trigger criteria are ANDed together (Trigger Source: AND)  
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:  $\uparrow$ ) 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.

Select

Off	Disables external triggering.(default setting)
On	Enables external triggering.

Trig Prio	-	Timer
Trig Src	OR	Start
Ext Trig	On	Stop
		Inter

#### 2 Apply the input signal to the external trigger (EXT.TRIG) terminal.

See: "17.2.5 External Trigger terminal (EXT.TRIG)" (⇒ p.320)

## 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.174)

## 9.8 Pre-Trigger Settings

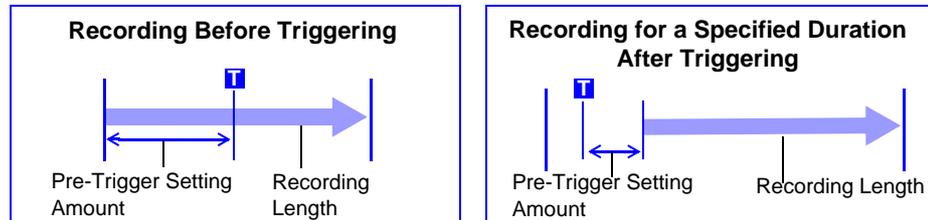
MEM

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.



### 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

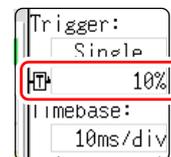
To open the screen: Press the **DISP** key → Waveform screen

#### 1 Select the unit to set the pre-trigger.

Move the cursor to the Pre-trigger.

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.

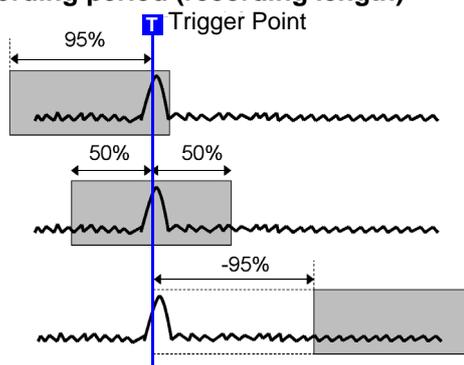
Select

-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.174)

### 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.60)

## 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

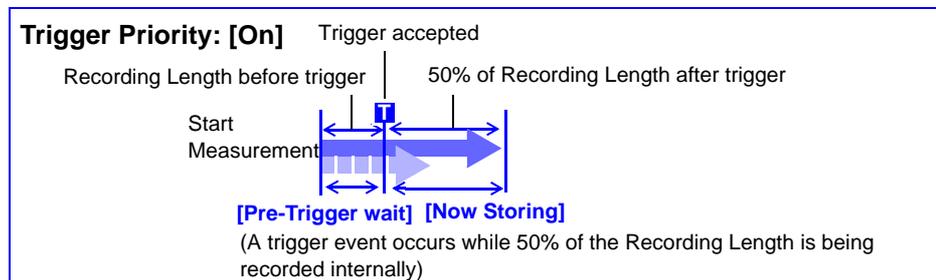
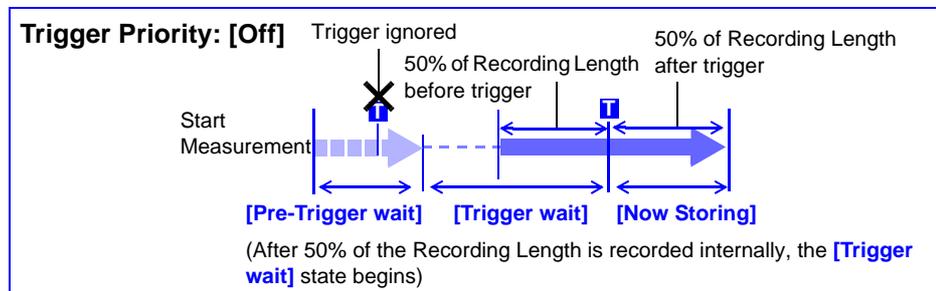
Move the cursor to the **[Trig Prio]** item.

Select	
Off	Trigger events are ignored during <b>[Pre-Trigger wait]</b> (default setting)
On	Trigger events are recognized (accepted) during <b>[Pre-Trigger wait]</b> .



### Description When trigger criteria are met during **[Pre-Trigger wait]**

Example: When the pre-trigger period is set to 50%



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

9

This applies to the Memory function only.  
Set waveform recording operation when a trigger event occurs.

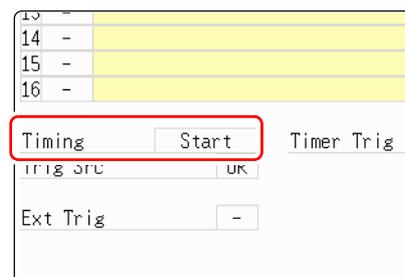
## Procedure

To open the screen: Press the **DISP** key → Waveform screen → Press the **TRIG.SET** key → Trigger settings window

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

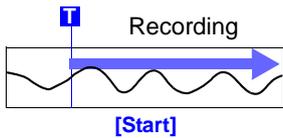
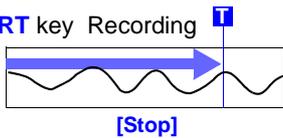
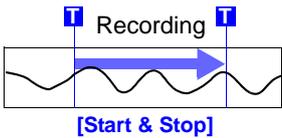
Select

<b>Start</b>	Start recording when a trigger event occurs, and stop after the specified recording length.(default setting)
<b>Stop</b>	Start recording when the <b>START</b> key is pressed, and stop when a trigger event occurs.
<b>Start &amp; Stop</b>	Record the interval from one trigger event until the next trigger event.



## Description About trigger timing

The selected trigger mode determines how recording stops.

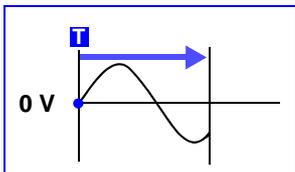
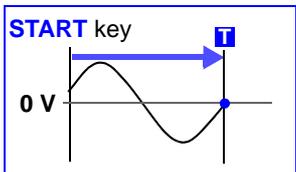
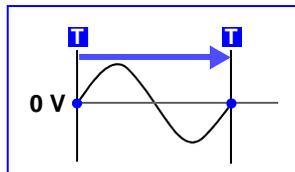
			
Recording Starts	Recording starts when a trigger event occurs	Recording starts when you press the <b>START</b> key	Recording starts when a Start trigger event occurs
Recording Stops	Recording stops after data has been acquired for the specified recording length	Recording stops when a trigger event occurs	Recording stops when a Stop trigger event occurs
With <b>[Single]</b> trigger mode			
With <b>[Repeat]</b> 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]** or **[Start & Stop]**: Recording stops after data has been acquired for the specified recording length

**If no trigger event occurs before the specified recording length elapses:**  
**[Start]** : 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]**

<b>[Start]</b>	<b>[Stop]</b>	<b>[Start &amp; Stop]</b>
		
Records for specified recording length	Press <b>START</b> key to record. Records until a trigger occurs	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

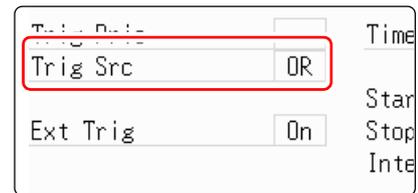
Analog, logic, external and timer trigger criteria can be combined by AND/OR logic to define complex trigger criteria.

## 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	
<b>OR</b>	Triggering occurs when any one of the specified trigger source criteria is met. (default setting)
<b>AND</b>	Triggering occurs only when all of the specified trigger source criteria are met.



(Memory Function case)

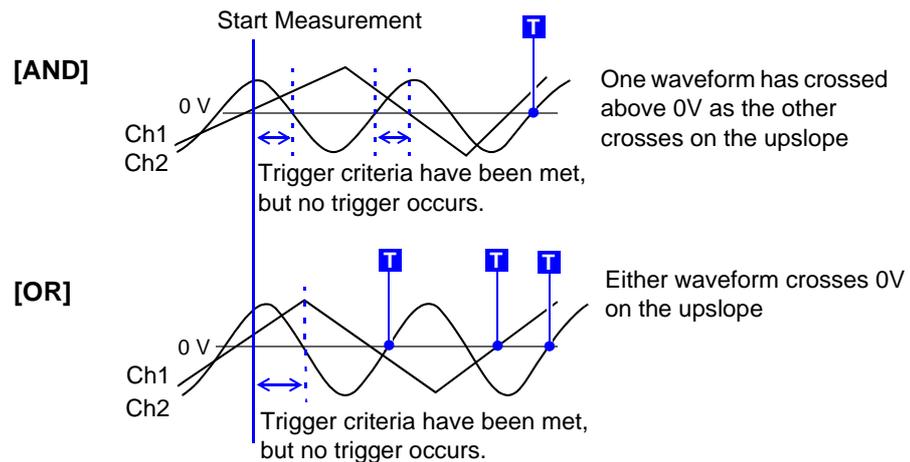
## Description When the trigger combining logic (Source (AND/OR)) is set to [AND]

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



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

MEM

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.160) and "9.4 Triggering by Logic Signals (Logic Trigger)" (⇒ p.166).

#### 2 Specify the search range.

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

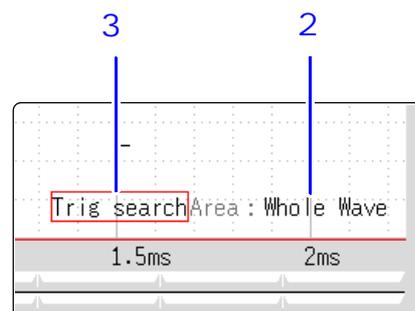
Select

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.

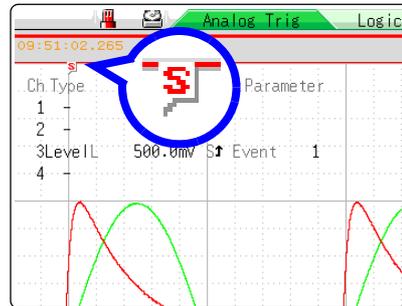
Select

Execute search	Start the search from the beginning of the measurement data.
Search next	Searches for the next search condition at the most recent search 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.

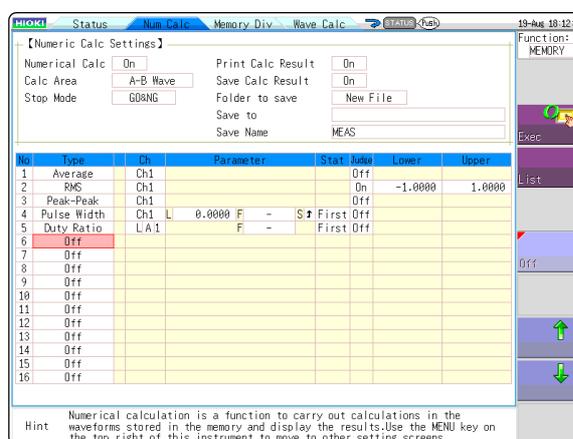
### Opening the **[Num Calc]** sheet

STATUS



Pressing this key repeatedly displays the various sheets.

[Status] ← [Wave Calc]  
 ↓                    ↑  
**[Num Calc]** → [Memory Div]



### 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.191)

#### Numerical Calculation Judgment (⇒ p.186)

The result of a numerical calculation can be compared to a preset reference range, for GO/NG (Pass/Fail) evaluation.

There are a total of 24 types of numerical calculations, 16 of which can be performed simultaneously.

#### Save/Print Numerical Calculation Results

- Auto Save numerical calculation results
- Save specified existing numerical calculation result
- See: "10.4 Saving Numerical Calculation Results" (⇒ p.189)
- Auto Print
- Arbitrary printing
- See: "10.5 Printing Numerical Calculation Results" (⇒ p.190)

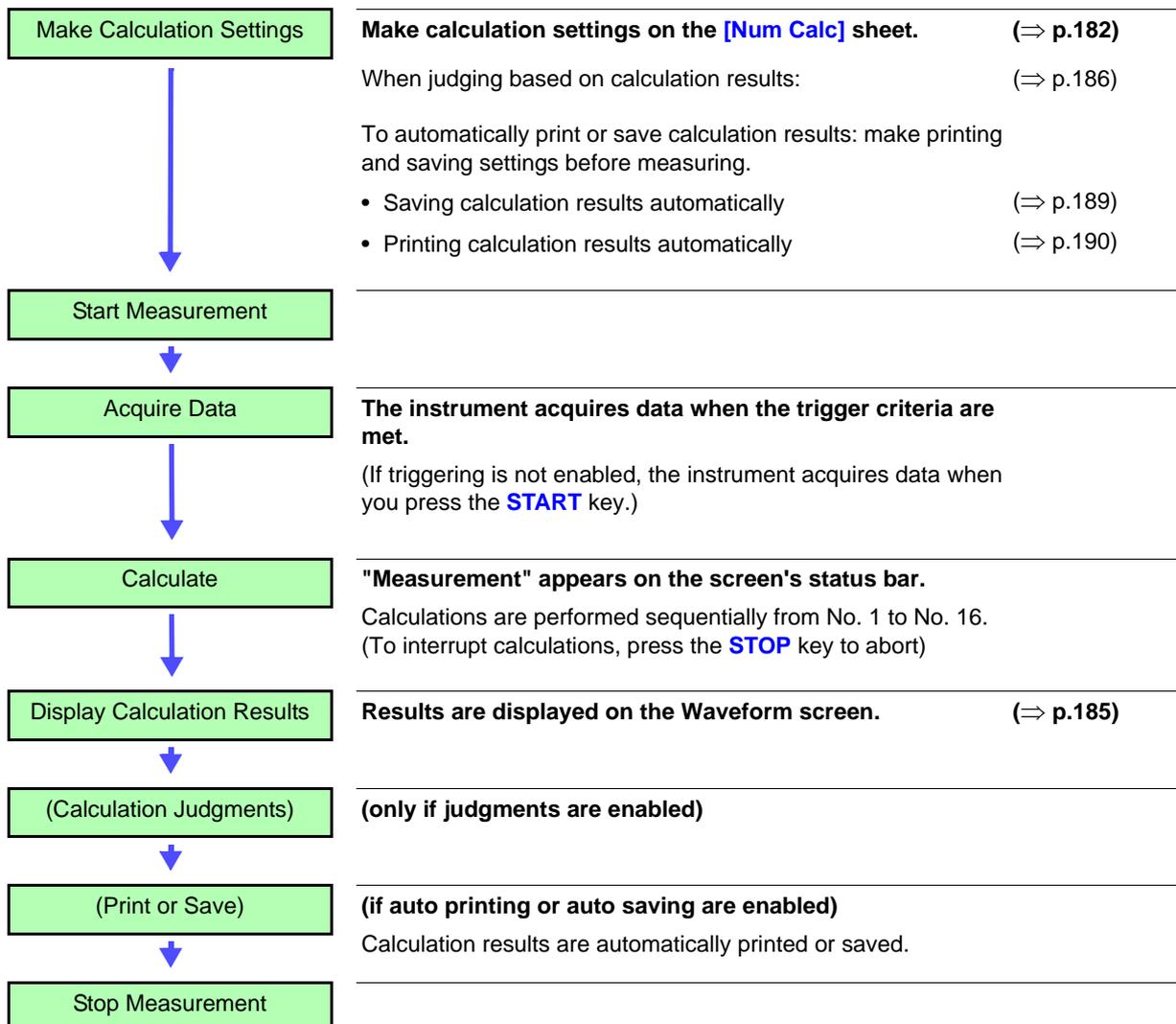
When the Scaling function is used, numerical calculation is performed on the scaled value.

## 10.1 Numerical Calculation Workflow

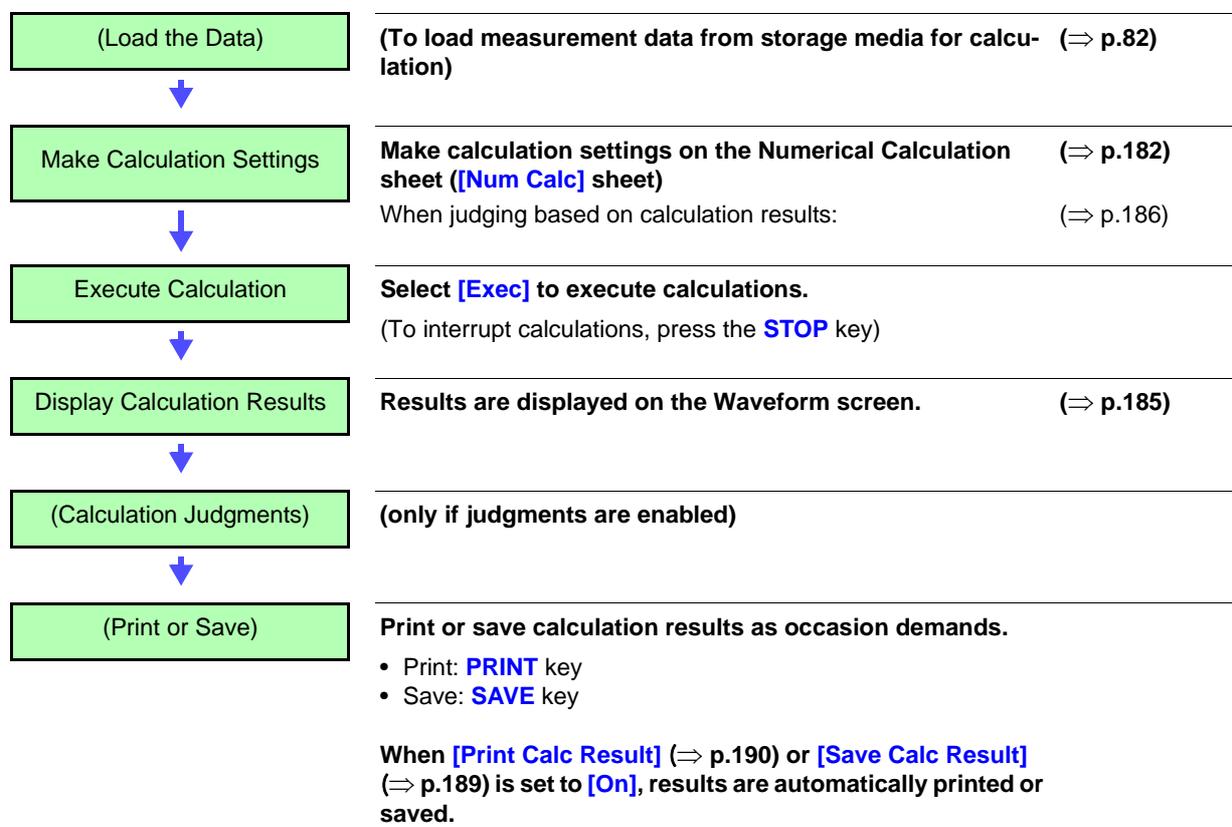
There are two different ways of performing calculation.

- 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



## Applying Calculations to Existing Data



### 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.111)  
"10.2 Settings for Numerical Value Calculation" (⇒ p.182)

# 10.2 Settings for Numerical Value Calculation

## Procedure

To open the screen: Press the **STATUS** key → **[Num Calc]** sheet

**1 Enable the Numerical Calculation function.**

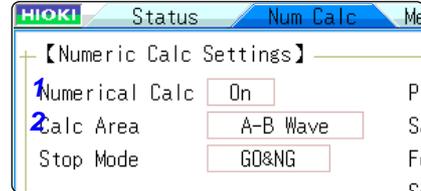
Move the cursor to the **[Numerical Calc]** item.  
Select **[On]**.

**2 Specify the Numerical Calculation range.**

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

Select

<b>WholeWave</b>	Applies calculations to the whole waveform. (default setting)
<b>A-B Wave</b>	Applies calculations to the data between A/B cursors.
<b>After Trigger</b>	Applies calculations to the waveform after trigger.



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.

See: "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.111)

**3 Perform calculation settings.**

Calculation 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 0.1divS↑ First	Off			

(1) Calculation Type    (2) Channel for Calculation    (3) Parameters\*    (4) Statistical calculation    \*: 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.

Also select **[Judge]** if you require judgment of calculation results.(⇒ p.186)

(When you select **[List]** a list of calculation types appears. To clear the display, press the **TRIG.SET** key once more.)

<b>Off</b>	No calculation. (default setting)	<b>X-Y Area</b>	Area of X-Y composite waveform
<b>Average</b>	Average value of waveform data	<b>Time to Lev*</b>	Time from trigger to specified level
<b>Rms</b>	RMS value of waveform data	<b>Lev-time</b>	Measurement value at a specified time point after triggering
<b>Peak-Peak</b>	Peak-to-peak value of waveform data	<b>Pulse Width*</b>	Pulse width of waveform data
<b>Maximum</b>	Maximum value of waveform data	<b>Duty Ratio*</b>	Duty of waveform data
<b>Max-Time</b>	Time from trigger to maximum value	<b>Pulses*</b>	Pulse count of waveform data
<b>Minimum</b>	Minimum value of waveform data	<b>Calculation</b>	Four arithmetic operations on numerical calculation results
<b>Min-Time</b>	Time from trigger to minimum value	<b>Time Diff*</b>	Time difference between phenomenon A and B.
<b>Period*</b>	Period of signal waveform	<b>Phase Diff*</b>	Time difference between phenomenon A and B displayed as a phase contrast.
<b>Frequency*</b>	Frequency of signal waveform	<b>High Level</b>	High level value for waveform data
<b>RiseTime</b>	Rise time of waveform data	<b>Low Level</b>	Low level value for waveform data
<b>FallTime</b>	Fall time of waveform data		
<b>Std Dev</b>	Standard deviation of waveform data		
<b>Area</b>	Area enclosed by zero position and signal waveform		

\*: 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, make settings for A and B channels.

Move the cursor to the parameter items, and make appropriate parameter settings.

See: "Parameter table" (⇒ p.184)

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

**(4) Set the statistical calculation.**

Move the cursor to the [Stat] column.

Select

<b>First</b>	Calculate at the first condition of the measurement data.
<b>Average</b>	Acquire the average value of the calculation result in the measurement data.
<b>Max</b>	Acquire the maximum value from the calculation result in the measurement data.
<b>Min</b>	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.186))**

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.189)

"10.5 Printing Numerical Calculation Results" (⇒ p.190)

**When printing or saving existing data**

Use **PRINT** key or **SAVE** key.

See: "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)

"6.3 Manual Printing With PRINT key (Selective Printing)" (⇒ p.99)

**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.145)

## Parameter table

Calculation Type	Parameter	Parameter description
<b>Period</b> <b>Frequency</b> <b>Pulse Width</b> <b>Pulses</b> <b>Duty Ratio*</b> <b>Time Diff</b> <b>Phase Diff</b>  *: Level and Filter only	<b>L (Level)</b>	Calculation is based on the interval (time) when this level is crossed.
	<b>F (Filter)</b>	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.
	<b>S (Slope(↑, ↓))</b>	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.
<b>Risetime</b> <b>Falltime</b>	<b>P (%)</b>	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.
<b>Time to Lev</b>	<b>L (Level)</b>	Calculates the time specified level is crossed.
	<b>F (Filter)</b>	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.
	<b>S (Slope(↑, ↓))</b>	Determines whether the time is calculated until the signal crosses the specified level on the upward slope or on the downward slope.
<b>Lev-Time</b>	<b>Time or Measure (Calculation results)</b>	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.
<b>Calculation</b>	<b>Numerical Calculation No.</b>	Sets the numerical calculation number.
	<b>+, -, ×, ÷</b>	Sets the operators for the four arithmetic operations.

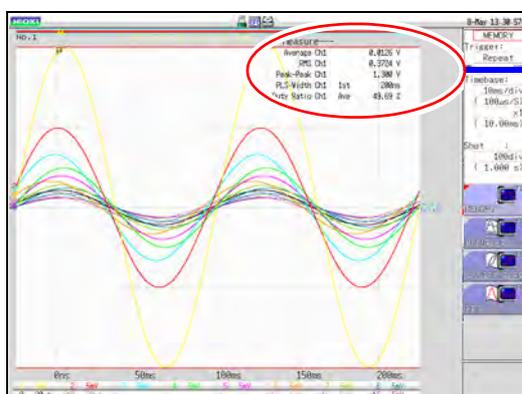
**NOTE**

- 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.

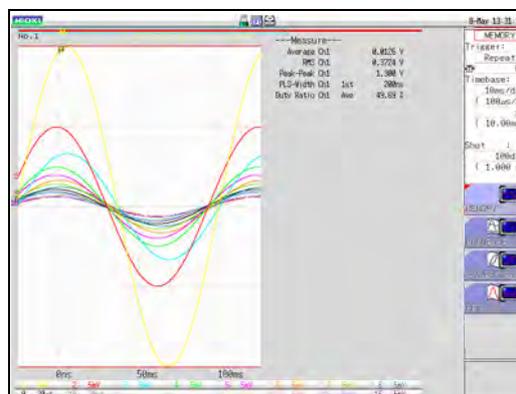
See: About Scaling: "8.5 Converting Input Values (Scaling Function)" (⇒ p.134)

## 10.2.1 Displaying Numerical Calculation Results

Numerical calculation results are displayed on the Waveform screen



Calculation Results



If the display is hard to view because of overlapping numerical values and waveforms

Press the **DISP** key.  
Numerical values and waveforms are displayed separately.

See: "7.7.3 Switching the Waveform Display Width"  
(⇒ p.120)



**To save calculation results after measuring:**

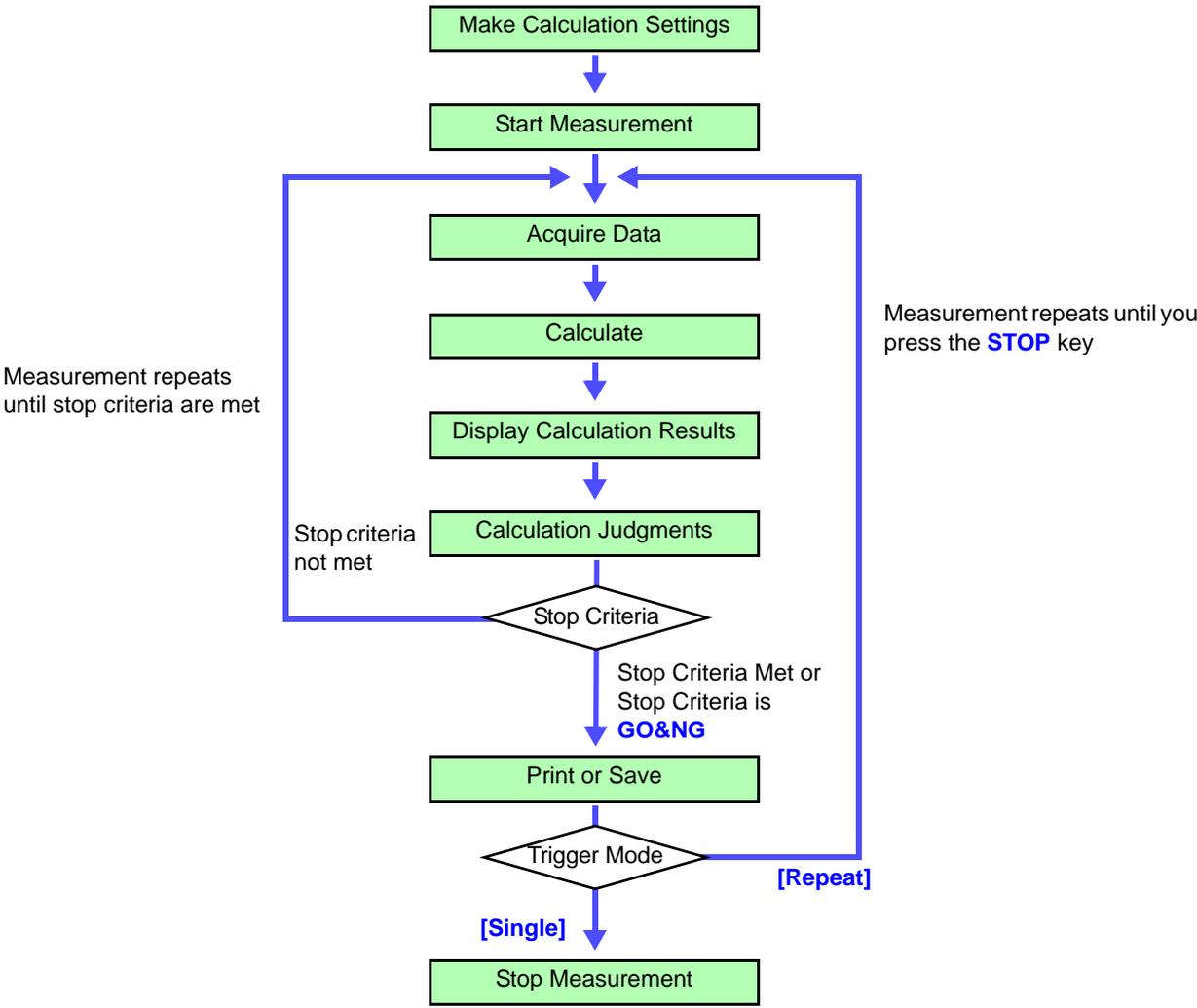
Set the **[Select at save]** item to **[Yes]**. When you press the **SAVE** key after measurement, you can select the content to be saved. (Select **[Calc Result]**.)

See: "5.2.3 Saving Data Selectively (SAVE Key)" (⇒ p.79)

# 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.182)

### 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.

Stat	Judge	Lower	Upper
2	Off		
	On	-1.0000	1.0000
S ↑	First Off		
	First Off	Lower limit value	Upper limit value

HIOKI	Status	Num Calc	Memory
+【Numeric Calc Settings】			
Numerical Calc	On		Print
Calc Area	A-B Wave		Save
4 top Mode	GO&NG		Folde
			Save

### 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.127)

### 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.186)



### 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)



When printing, judgment results for each parameter are also printed.

### When the judgment result is GO

- The GO signal is output at the GO/EXT.OUT.1 external I/O terminal.

### When the judgment result is NG

- The NG signal is output at the NG/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.



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

#### 1 Enable the saving of numerical calculation results.

Move the cursor to the [Save Calc Result] item.

Select [On]. (default setting: Off)

Print Calc Result	Off
1 Save Calc Result	On
2 Folder to save	New File
3 Save to	
4 Save Name	

#### 2 Select the file creation method.

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

Select

<b>New File</b>	Creates a new file for each measurement.
<b>Existing File</b>	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.

Select

<b>HDD</b>	Automatically save the waveform data on the HDD. (For the instrument with Model 9664 HD Unit installed)
<b>CF</b>	Automatically save the waveform data in the CF card.
<b>USB1</b>	Automatically save the waveform data on the USB memory stick.
<b>LAN</b>	Automatically save the waveform data on the PC connected via LAN. Model 9333 LAN Communicator is required to be installed.

Select a media: CURSOR ⬆ ⬇ ⬅

Open next lower folder level: CURSOR ⬇

To create a new folder to use as target, select [New Folder]. When [LAN] is set as the save destination, [New Folder] setting is ignored and the folder named with the current date is created.

#### 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.124)

When [LAN] is set as the save destination, [Save Name] setting is ignored and the files to be saved are named in the previously-determined format.

See: "Save Operations (When setting the save destination to [LAN])" (⇒ p.78)

**Confirm the measurement configuration and numerical calculation result settings, then start measurement (Press the **START** key).**

- 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
$\mu$	~u
$\Omega$	~o
e	~e
°	~c
$\pm$	~+
$\mu\text{E}$ (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

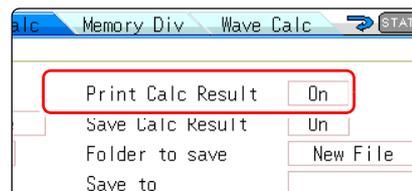
## 10.5 Printing Numerical Calculation Results

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]**.

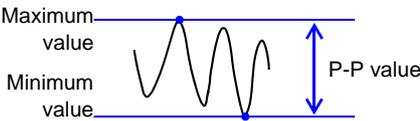
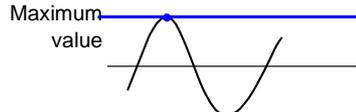
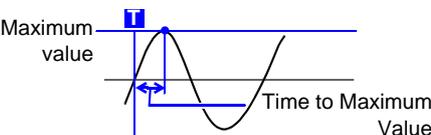
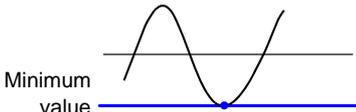
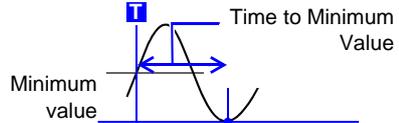
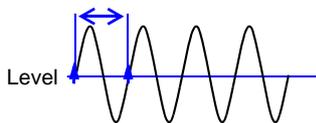


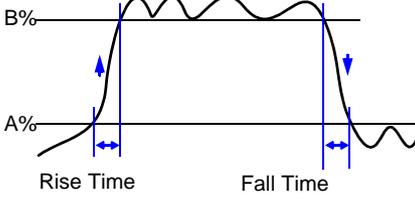
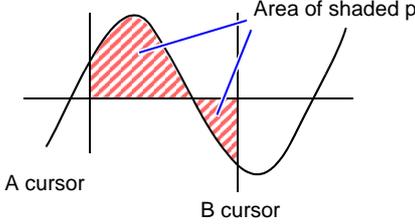
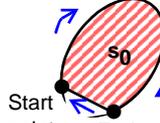
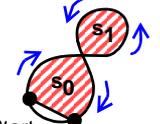
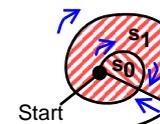
#### **NOTE**

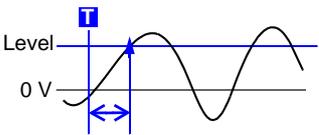
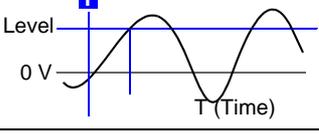
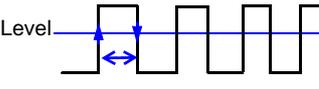
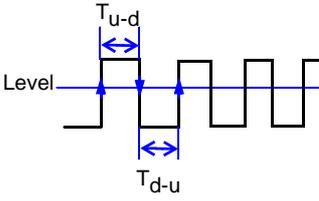
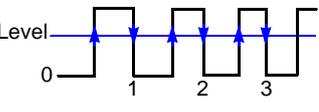
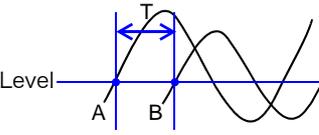
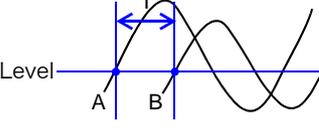
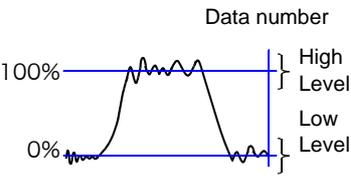
- Printing is also carried out when only calculation but no measurement was performed.
- Calculation results are output to the output destination specified in the **[Printer]** sheet.

See: "6.2 Making Auto Print Settings" (⇒ p.97)

## 10.6 Numerical Calculation Type and Description

Numerical Calculation Type	Description
<b>Average</b>	<p>Obtains the average value of waveform data.</p> $AVE = \frac{1}{n} \sum_{i=1}^n di$ <p>AVE: Average value n: Data count di: Data on channel number i</p>
<b>RMS (Root-Mean-Square) value (Rms)</b>	<p>Obtains the RMS value of waveform data. If Scaling is enabled, calculations are applied to the waveform after scaling.</p> $RMS = \sqrt{\frac{1}{n} \sum_{i=1}^n di^2}$ <p>RMS: RMS value n: Data count di: Data on channel number i</p>
<b>Peak-to-Peak value (Peak-Peak)</b>	<p>Obtains the value of the difference (peak-to-peak value) between maximum and minimum values of waveform data.</p>  <p>Maximum value Minimum value P-P value</p>
<b>Maximum Value (Maximum)</b>	<p>Obtains the maximum value of waveform data.</p>  <p>Maximum value</p>
<b>Time to Maximum Value (Max-Time)</b>	<p>Obtains the time (in seconds) from the last trigger point to the maximum value. If the maximum value occurs in two or more instances, the first instance is treated as the maximum value.</p>  <p>Maximum value Time to Maximum Value</p>
<b>Minimum Value (Minimum)</b>	<p>Obtains the minimum value of waveform data.</p>  <p>Minimum value</p>
<b>Time to Minimum Value (Min-Time)</b>	<p>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.</p>  <p>Minimum value Time to Minimum Value</p>
<b>Period/Frequency</b>	<p>Obtains the time (in seconds) from the last trigger point to the minimum value. If the minimum value occurs in two or more instances, the first instance is treated as the minimum value.</p>  <p>Level</p>

Numerical Calculation Type	Description
<p><b>Rise Time and Fall Time</b></p>	<p>The rise time of the acquired waveform from A% to B% (or fall time from B% to A%) is obtained by calculation using a histogram (frequency distribution) of the 0 and 100% levels of the acquired waveform.</p> <p>As waveform data is acquired, the rise time (or fall time) is obtained from the first rising (or falling) edge.</p> <p>When calculation of the range specified by the A/B cursors is selected, the obtained rise time (or fall time) is the first rising (or falling) edge between the cursors.</p>  <p>A: 5 to 30% B: 95 to 70%</p>
<p><b>Standard Deviation (Std Dev)</b></p>	<p>Obtains the standard deviation of the waveform data.</p> $\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (di - AVE)^2}$ <p>σ: Standard Deviation AVE: Average n: Data count di: Data on channel number i</p>
<p><b>Area</b></p>	<p>Obtains the area value (V•s) enclosed by the zero position (point of zero potential) and the signal waveform.</p> <p>When calculation of the range specified by the A/B cursors is selected, the calculated area is constrained to the waveform between the cursors.</p>  $S = \sum_{i=1}^n  di  \cdot h$ <p>S: Area n: Data count di: Data on channel number i h=Δt: Sampling rate</p>
<p><b>X-Y Area</b></p>	<p>Obtains the area (V<sup>2</sup>) of an X-Y composite waveform. In the following figures, the areas within the lines are calculated. The calculation is available even if the X-Y composite waveform is not intended for display.</p> <p>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.)</p> <p><a href="#">See: About A/B Cursor:"7.1 Reading Measurement Values (Using the A/B Cursors)"</a> (⇒ p.108)</p> <div style="display: flex; justify-content: space-around;"> <div> <p><b>When the trace consists of multiple loops</b></p>  <p><math>S = n \times s_0</math> S: Area n: Number of loops</p> <p>Start/end point</p> </div> <div> <p><b>When the trace is an open curve</b></p>  <p><math>S = s_0</math> S: Area (Area enclosed by the curve and line connecting start and end points)</p> <p>Start point End point</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div> <p><b>When the trace is a figure-8</b></p>  <p><math>S =  s_0 - s_1 </math> S: Area</p> <p>Start point End point</p> </div> <div> <p><b>When the trace is an open curve</b></p>  <p><math>S = s_0 \times 2 + s_1</math> S: Area (The number of overlapping regions increases with the number of loops)</p> <p>Start point End point</p> </div> </div> <p><b>Setting Choices: Set the X- and Y-axis channels.</b></p>

Numerical Calculation Type	Description	
<b>Time to Level (Time-Lev)</b>	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.	
<b>Specified Time Level (Lev-Time)</b>	Obtains the level at a specified time point after the trigger event. The time can also be specified using other calculation results obtained earlier.	
<b>Pulse Width</b>	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).	
<b>Duty Ratio (%)</b>	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. $\text{Duty (\%)} = \frac{T_{u-d}}{T_{u-d} + T_{d-u}} \times 100 (\%)$ $T_{u-d}$ : Time (seconds) after rising intersection to falling intersection $T_{d-u}$ : (s) Time (seconds) after falling intersection to the next rising intersection	
<b>Pulses</b>	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)	
<b>Four Arithmetic Operations (Calculation)</b>	Performs arithmetic operations (+, -, ×, ÷) upon arbitrarily selected results of numerical calculations.	
<b>Time difference calculation (Time Diff)</b>	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).	
<b>Phase contrast calculation (Phase Diff)</b>	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. $\text{Phase contrast} = \frac{\text{Time difference of A and B waveform [T]}}{\text{Cycle of A waveform}} \times 360^\circ$	
<b>High Level Low Level</b>	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.

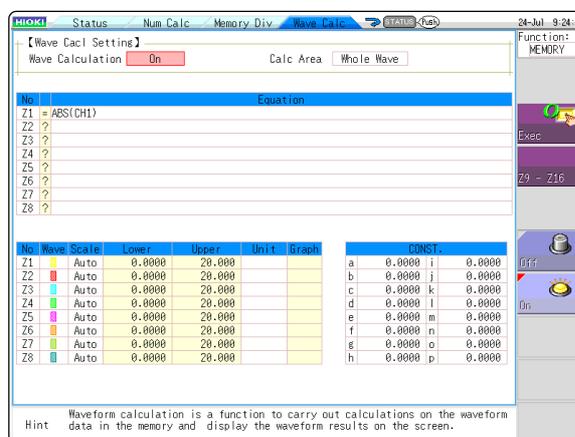
Waveform calculation settings are made on the Status screen - **[Wave Calc]** sheet.

## Opening the **[Wave Calc]** sheet

**STATUS**



Pressing this key repeatedly displays the various sheets.



## 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: 1<sup>st</sup> derivative (DIF), 2<sup>nd</sup> derivative (DIF2)
- Integral Calculus: 1<sup>st</sup> integral (INT), 2<sup>nd</sup> 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.205)

In addition to the four arithmetic operators, 10 types of functions can be used. It is possible to set up to 16 calculation formulas.

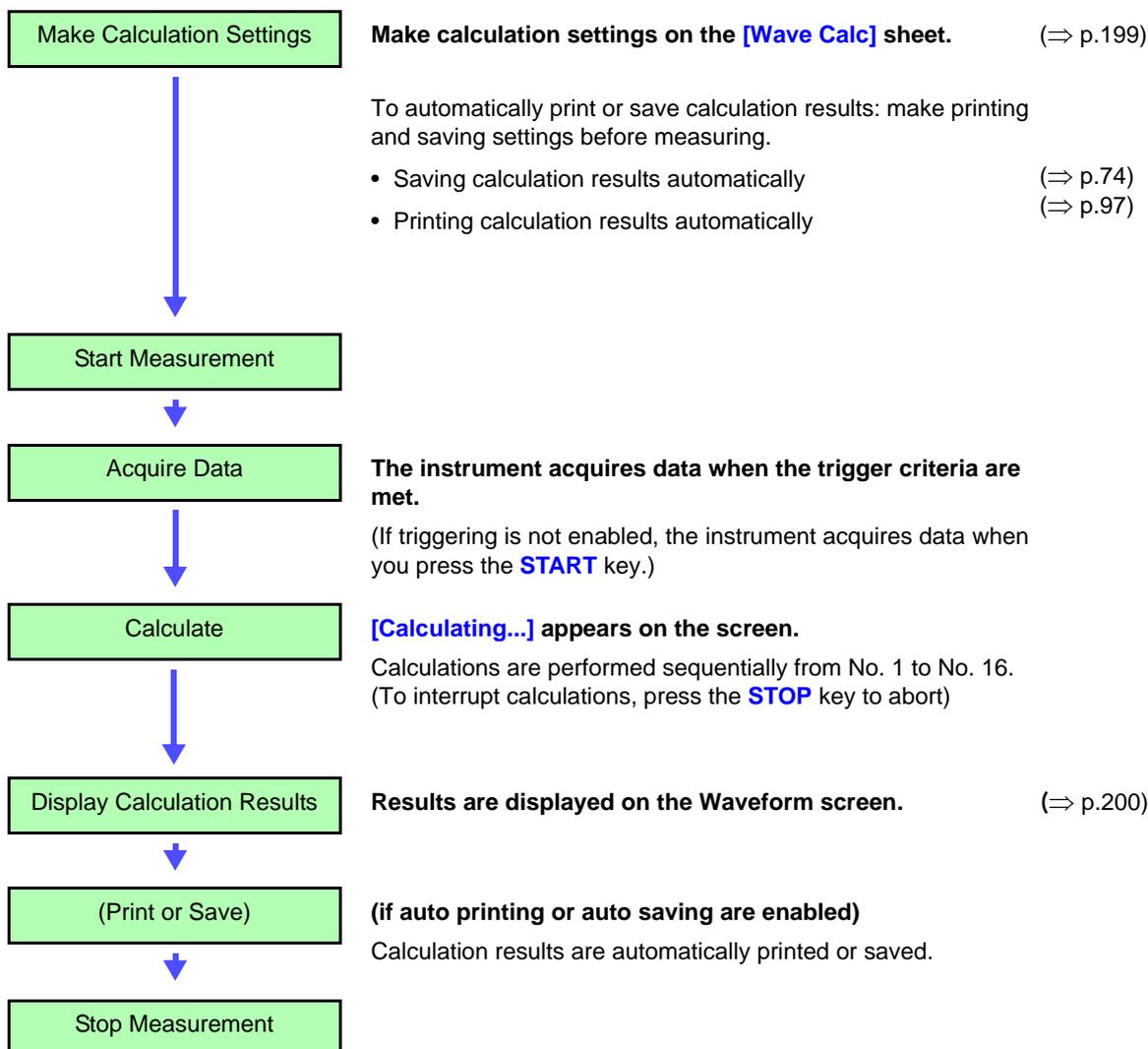
When Scaling is enabled, numerical calculations are performed on scaled values.

## 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.

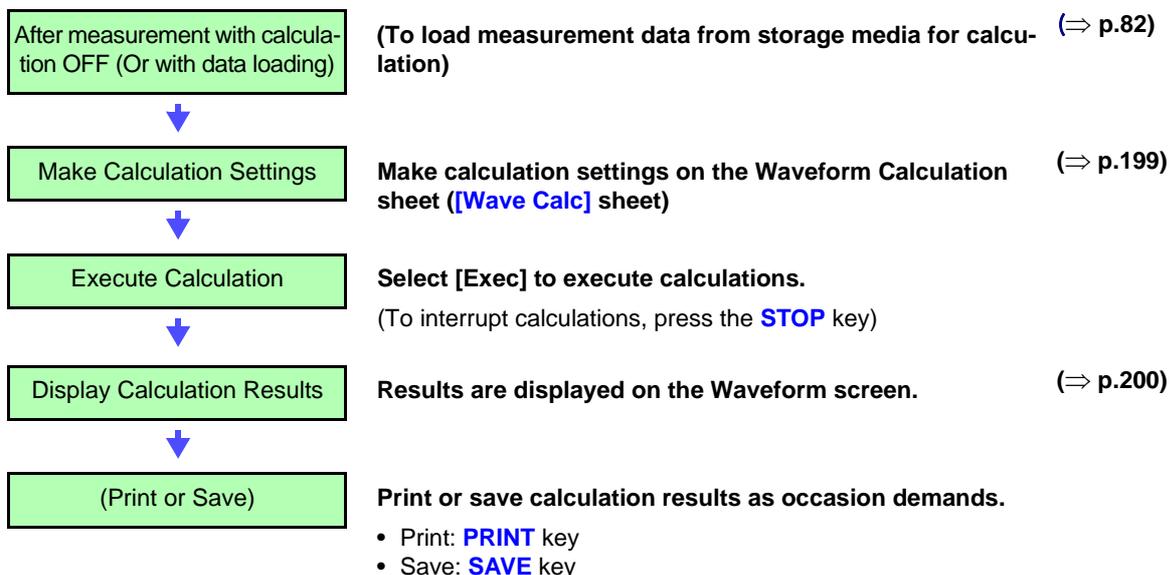
### Calculating While Measuring



### **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



### NOTE

- The maximum record length that can be calculated is as follows.

MR8847-01	10,000div
MR8847-02	40,000div
MR8847-03	80,000div

To perform calculation for waveforms measured at longer record lengths, save to files in sections at a range shorter than maximum record length, 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 maximum record length or more cannot be calculated, even if the range is specified by the A/B cursor.

Post-measurement waveform calculation cannot be performed for waveforms measured in excess of the maximum recording length, even if a range is specified with the A and B cursors. To perform waveform calculation for a waveform with a longer recording length, save a subset of the waveform that is shorter than the maximum recording length to a separate file, load that file back into the instrument, and then perform the calculation.

**See:** "7.2 Specifying a Waveform Range (A/B Cursor)" (⇒ p.111)

"11.2 Settings for Waveform Calculation" (⇒ p.199)

**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.199)

**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.203)

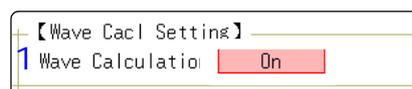
## 11.2 Settings for Waveform Calculation

### Procedure

To open the screen: Press the **STATUS** key → [Wave Calc] sheet

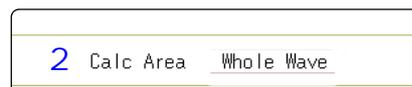
#### 1 Enable the Waveform Calculation function.

Move the cursor to the [Wave Calculation] item, and select [On].



#### 2 Specify the waveform calculation range.

Move the cursor to the [Calc Area] item.



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.111)

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.

No.	Equation
Z1 ?	
Z2 ?	
Z3 ?	

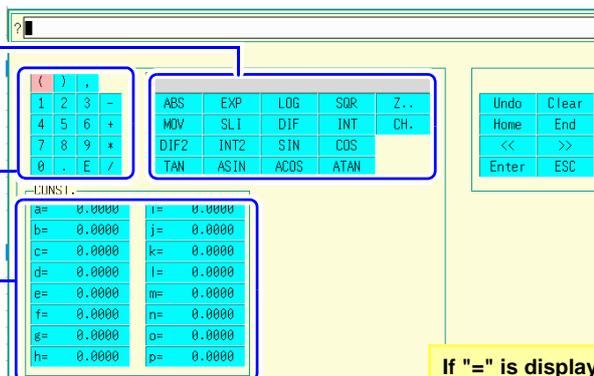


Enter calculation operators

Enter numerical values and symbols

Enter constants

Constants must have been previously entered on the [CONST.] (⇒ p.202)



#### 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.

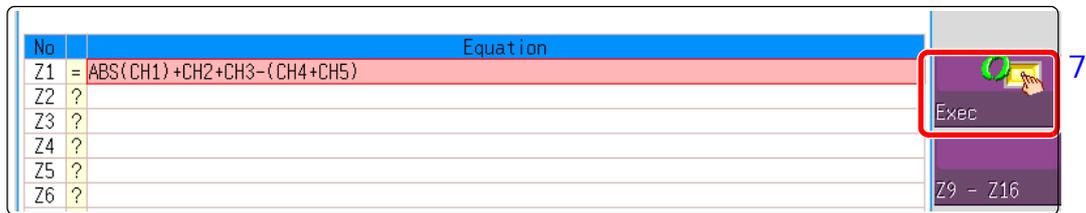
See: "Waveform Calculation Example" (⇒ p.204)

11.2 Settings for Waveform Calculation

- 5 When finished entry, select **[Confirm]**.  
The entered equation is displayed in the **[Equation]** field.  
The scale (maximum and minimum values) 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.203)
- 6 (As occasion demands)  
Set auto saving (⇒ p.74) and auto printing (⇒ p.97).
- 7 Execute the calculations.

Applying Calculations to Existing Data

At the **[Wave Calc]** sheet, select **[Exec]**.



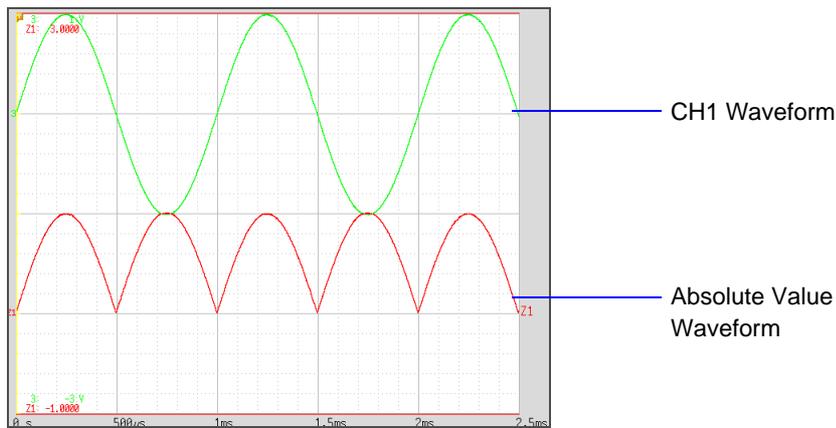
To calculate while measuring

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.145)



## 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:  $-9.9999\text{E}+29$  to  $+9.9999\text{E}+29$

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

Defined constants are shown in the constant display of the calculation equation setting dialog.

1

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

MEM

### Procedure

To open the screen: Press the **STATUS** key → **[Wave Calc]** sheet

Nr	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

Calculation No. ————

To copy settings between Calculation Nos.:  
Select F1 [Copy].

1 Waveform color  
2 Display range setting method  
3 Upper and lower limits  
4 Displayed measurement units  
6 Graph to display

### 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.127)

### 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.127)

### 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.

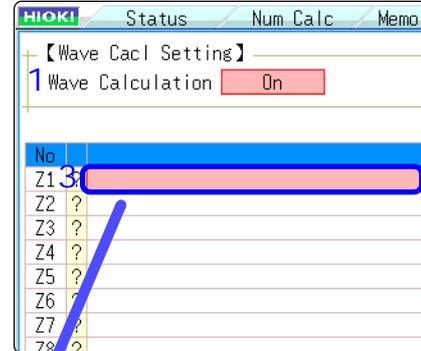
### Waveform Calculation Example

#### 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.

After selecting the channel number, select the **[Enter Char]** button.

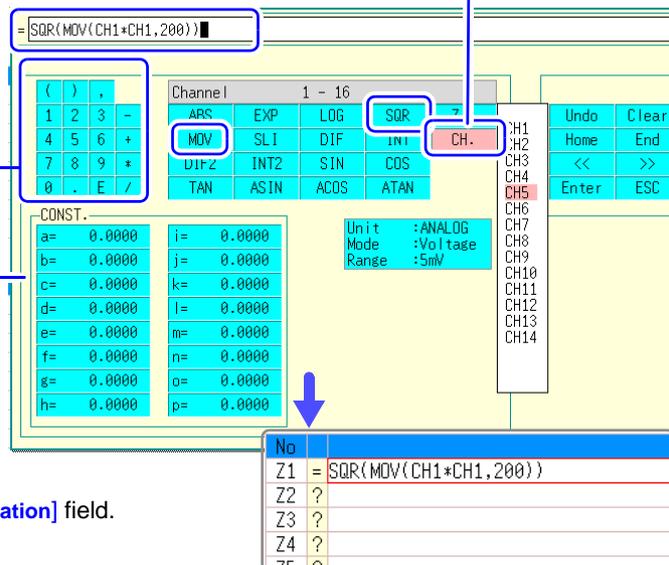
#### Entering the calculation equation

$SQR(MOV(CH1*CH1,200))$

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.]** ( $\Rightarrow$  p.202)



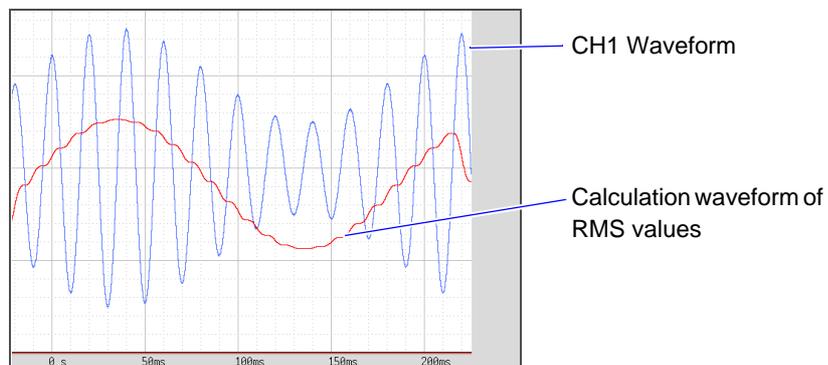
#### 4 When finished entry, select **[Confirm]**.

The entered equation is displayed in the **[Equation]** field.

#### 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

$b_i$ :  $i$ th member of calculation result data,  $d_i$ :  $i$ th member of source channel data

Waveform Calculation Type	Description
<b>Four Arithmetic Operators (+, -, *, /)</b>	Executes the corresponding arithmetic operation.
<b>Absolute Value (ABS)</b>	$b_i =  d_i $ ( $i = 1, 2, \dots, n$ )
<b>Exponent (EXP)</b>	$b_i = \exp(d_i)$ ( $i = 1, 2, \dots, n$ )
<b>Common Logarithm (LOG)</b>	<p>When <math>d_i &gt; 0</math>, <math>b_i = \log_{10} d_i</math>            When <math>d_i = 0</math>, <math>b_i = -\infty</math> (overflow value output)            When <math>d_i &lt; 0</math>, <math>b_i = \log_{10}  d_i </math> (<math>i = 1, 2, \dots, n</math>)            Note: Use the following equation to convert to natural logarithm calculations.  <math>\ln X = \log_e X = \log_{10} X / \log_{10} e</math>  <math>1 / \log_{10} e \approx 2.30</math></p>
<b>Square Root (SQR)</b>	<p>When <math>d_i \geq 0</math>, <math>b_i = \sqrt{d_i}</math>            When <math>d_i &lt; 0</math>, <math>b_i = -\sqrt{ d_i }</math> (<math>i = 1, 2, \dots, n</math>)</p>
<b>Moving Average (MOV)</b>	<p>When <math>k</math> is odd number: <math>b_i = \frac{1}{k} \sum_{t=i-\frac{k}{2}}^{i+\frac{k}{2}} dt</math> (<math>i = 1, 2, \dots, n</math>)            When <math>k</math> is even number: <math>b_i = \frac{1}{k} \sum_{t=i-\frac{k}{2}+1}^{i+\frac{k}{2}} dt</math> (<math>i = 1, 2, \dots, n</math>)</p> <p><math>dt</math>: <math>t^{\text{th}}</math> member of source channel data  <math>k</math>: number of points to move (1 to 5000)            1 div = 100 points.</p> <p><math>k</math> is specified after a comma.            (Ex.) To make Z1 the moving average of 100 points: MOV(Z1,100)</p>
<b>Slides waveform data along the time axis (SLI)</b>	<p>Moves along the time axis by the specified distance.  <math>b_i = d_i - k</math> (<math>i = 1, 2, \dots, n</math>)  <math>k</math>: number of points to move (-5000 to 5000)</p> <p><math>k</math> is specified after a comma.            (Ex.) To slide Z1 by 100 points along the time axis: SLI(Z1,100)            Note: When sliding a waveform, if there is no data at the beginning or end of the calculation result, the voltage value becomes zero. 1 div = 100 points.</p>
<b>Sine (SIN)</b>	<p><math>b_i = \sin(d_i)</math> (<math>i = 1, 2, \dots, n</math>)            Trigonometric functions employ radian (rad) units.</p>
<b>Cosine (COS)</b>	<p><math>b_i = \cos(d_i)</math> (<math>i = 1, 2, \dots, n</math>)            Trigonometric functions employ radian (rad) units.</p>
<b>Tangent (TAN)</b>	<p><math>b_i = \tan(d_i)</math> (<math>i = 1, 2, \dots, n</math>)            where <math>-10 \leq b_i \leq 10</math>            Trigonometric functions employ radian (rad) units.</p>
<b>Arcsine (ASIN)</b>	<p>When <math>d_i &gt; 1</math>, <math>b_i = \pi/2</math>            When <math>-1 \leq d_i \leq 1</math>, <math>b_i = \text{asin}(d_i)</math>            When <math>d_i &lt; -1</math>, <math>b_i = -\pi/2</math>            Trigonometric functions employ radian (rad) units.</p>

$b_i$ :  $i$ th member of calculation result data,  $d_i$ :  $i$ th member of source channel data

Waveform Calculation Type	Description
<b>Arccosine (ACOS)</b>	<p>When <math>d_i &gt; 1</math>, <math>b_i = 0</math>                      When <math>-1 \leq d_i \leq 1</math>, <math>b_i = \text{acos}(d_i)</math>                      When <math>d_i &lt; -1</math>, <math>b_i = \pi</math> (<math>i = 1, 2, \dots, n</math>)                      Trigonometric functions employ radian (rad) units.</p>
<b>Arctangent (ATAN)</b>	<p><math>b_i = \text{atan}(d_i)</math> (<math>i = 1, 2, \dots, n</math>)                      Trigonometric functions employ radian (rad) units.</p>
<b>First derivative (DIF) Second derivative (DIF2)</b>	<p>The first and second derivative calculations use a fifth-order Lagrange interpolation polynomial to obtain a point data value from five sequential points.  <math>d_1</math> to <math>d_n</math> are the derivatives calculated for sample times <math>t_1</math> to <math>t_n</math>.                      Note: Scattering of calculation results increases as input voltage level decreases. If scattering is excessive, apply the moving average (MOV).</p> <p><b>Calculation formulas for the first derivative</b>                      Point <math>t_1</math> <math>b_1 = (-25d_1 + 48d_2 - 36d_3 + 16d_4 - 3d_5)/12h</math>                      Point <math>t_2</math> <math>b_2 = (-3d_1 - 10d_2 + 18d_3 - 6d_4 + d_5)/12h</math>                      Point <math>t_3</math> <math>b_3 = (d_1 - 8d_2 + 8d_4 - d_5)/12h</math>                      ↓                      Point <math>t_i</math> <math>b_i = (d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2})/12h</math>                      ↓                      Point <math>t_{n-2}</math> <math>b_{n-2} = (d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n)/12h</math>                      Point <math>t_{n-1}</math> <math>b_{n-1} = (-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n)/12h</math>                      Point <math>t_n</math> <math>b_n = (3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n)/12h</math></p> <p><math>b_1</math> to <math>b_n</math>: calculation results  <math>h = \Delta t</math>: Sampling Period</p> <p><b>Calculation formulas for the second derivative</b>                      Point <math>t_1</math> <math>b_1 = (35d_1 - 104d_2 + 114d_3 - 56d_4 + 11d_5)/12h^2</math>                      Point <math>t_2</math> <math>b_2 = (11d_1 - 20d_2 + 6d_3 + 4d_4 - d_5)/12h^2</math>                      Point <math>t_3</math> <math>b_3 = (-d_1 + 16d_2 - 30d_3 + 16d_4 - d_5)/12h^2</math>                      ↓                      Point <math>t_i</math> <math>b_i = (-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - d_{i+2})/12h^2</math>                      ↓                      Point <math>t_{n-2}</math> <math>b_{n-2} = (-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n)/12h^2</math>                      Point <math>t_{n-1}</math> <math>b_{n-1} = (-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n)/12h^2</math>                      Point <math>t_n</math> <math>b_n = (11d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n)/12h^2</math></p>

$b_i$ :  $i$ th member of calculation result data,  $d_i$ :  $i$ th member of source channel data

Waveform Calculation Type	Description
First integral (INT) Second integral (INT2)	<p>First and second integrals are calculated using the trapezoidal rule.  <math>d_1</math> to <math>d_n</math> are the integrals calculated for sample times <math>t_1</math> to <math>t_n</math>.</p> <p>Calculation formulas for the first integral</p> <p>Point <math>t_1</math> <math>I_1 = 0</math></p> <p>Point <math>t_2</math> <math>I_2 = (d_1 + d_2)h/2</math></p> <p>Point <math>t_3</math> <math>I_3 = (d_1 + d_2)h/2 + (d_2 + d_3)h/2 = I_2 + (d_2 + d_3)h/2</math></p> <p>↓</p> <p>Point <math>t_n</math> <math>I_n = I_{n-1} + (d_{n-1} + d_n)h/2</math></p> <p><math>I_1</math> to <math>I_n</math>: calculation results  <math>h = \Delta t</math>: Sampling Period</p>
	<p>Calculation formulas for the second integral</p> <p>Point <math>t_1</math> <math>II_1 = 0</math></p> <p>Point <math>t_2</math> <math>II_2 = (I_1 + I_2)h/2</math></p> <p>Point <math>t_3</math> <math>II_3 = (I_1 + I_2)h/2 + (I_2 + I_3)h/2 = II_2 + (I_2 + I_3)h/2</math></p> <p>↓</p> <p>Point <math>t_n</math> <math>II_n = II_{n-1} + (I_{n-1} + I_n)h/2</math></p> <p><math>II_1</math> to <math>II_n</math>: calculation results</p>



# Memory Division Function **MEM** Chapter 12

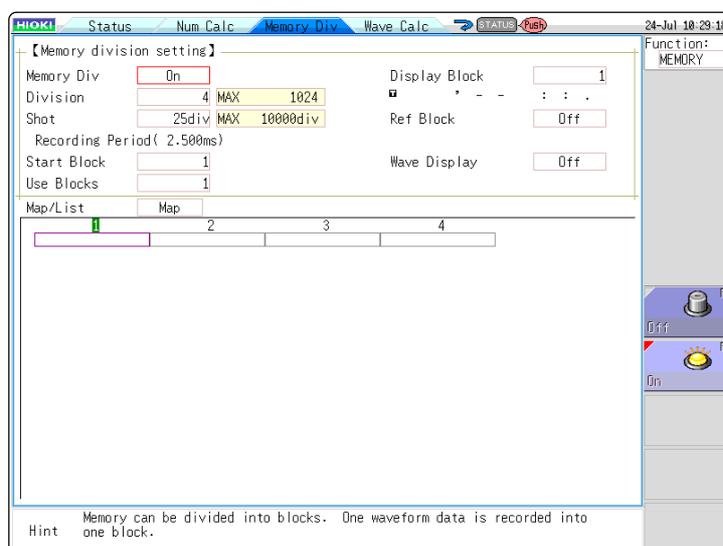
Memory division function can only be used with the Memory function.  
 Memory division settings are made on the Status screen - **[Memory Div]** sheet.  
 Blocks to be displayed can also be selected on the Waveform screen ( $\Rightarrow$  p.121).

## Opening the **[Memory Div]** sheet



Pressing this key repeatedly displays the various sheets.

[Status]	←	[Wave Calc]
↓		↑
[Num Calc]	→	<b>[Memory Div]</b>



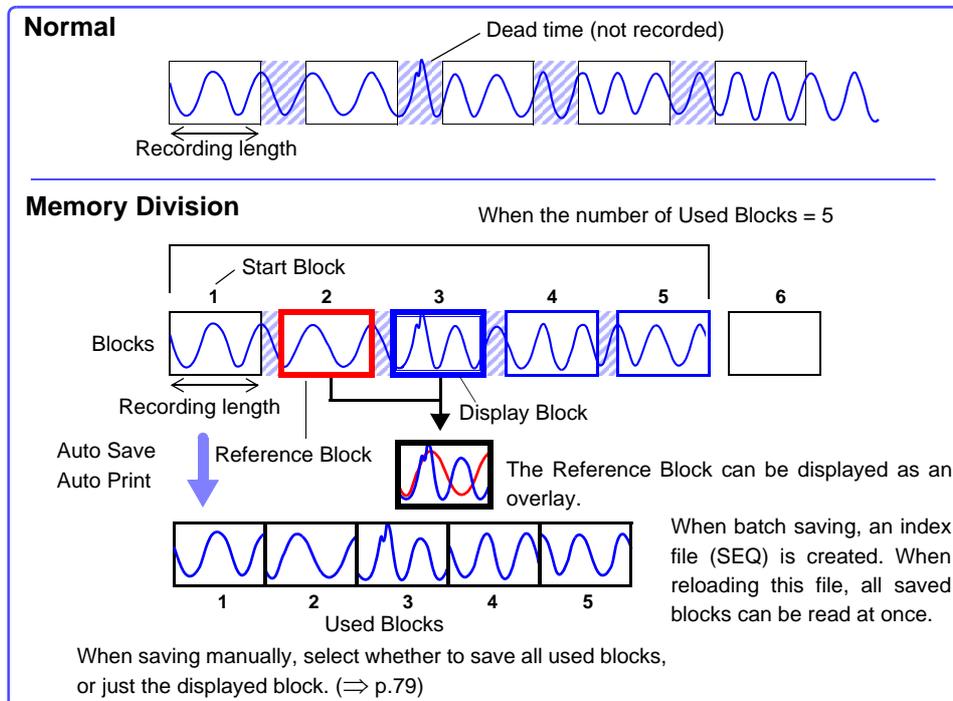
**NOTE** When using memory division, the trigger output (TRIG\_OUT terminal output) may output the Low level or output erratically in the following conditions.

- The time axis range is 5  $\mu$ s/div to 100  $\mu$ s/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.121)



## 12.1 Recording Settings

### Procedure

To open the screen: Press the **STATUS** key → **[Memory Div]** sheet

#### 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.A9)

#### 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.

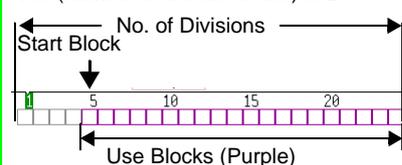
Default setting: 1

【Memory division setting】

1	Memory Div	On
2	Division	4
3	Shot	25div
	Recording Period	2.500ms
4	Start Block	1
5	Use Blocks	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.212).  
(This can also be set on the Waveform screen (⇒ p.121).)

#### To display overlaid waveforms:

Set the number of blocks for reference (⇒ p.212).

# 12.2 Display Settings

## Procedure

To open the screen: Press the **STATUS** key → [Memory Div] sheet

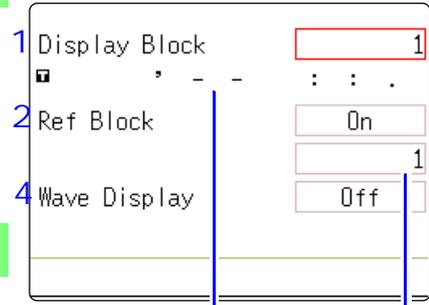
### 1 To display any block on the Waveform screen

#### Set the display blocks

Set after measurement is complete. (This can also be set on the Waveform screen (⇒ p.121).)

Move the cursor to the [Display Block] item.

Set the number of blocks to display on the Waveform screen.



Trigger time Reference Block No.

### 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.

### 3 (When Reference Blocks are enabled [On]) Select whether to reference every block

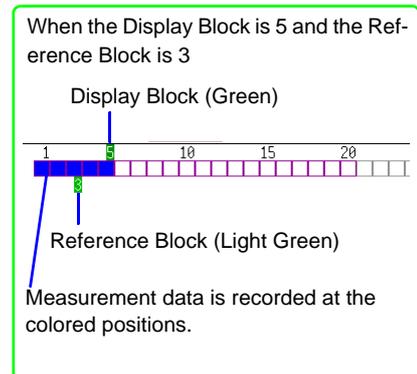
To overlay all waveforms, select [All Blks On].

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.213)

### 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.214)

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.121)



### 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]**.

Map/List		List					
No.	Trigger time	Source	Timebase	Data	Use Block	Ref Block	
1	09-06-23 16:40:33.093	Ch1	10 $\mu$ s/div	2501	<input type="radio"/>		
2	09-06-23 16:40:34.968	Ch1	10 $\mu$ s/div	2501	<input type="radio"/>		
3	09-06-23 16:40:36.023	Ch1	10 $\mu$ s/div	2501	<input type="radio"/>		

Block No.

A block can be selected by the  $\triangle$   $\square$  **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" ( $\Rightarrow$  p.121)

### 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.

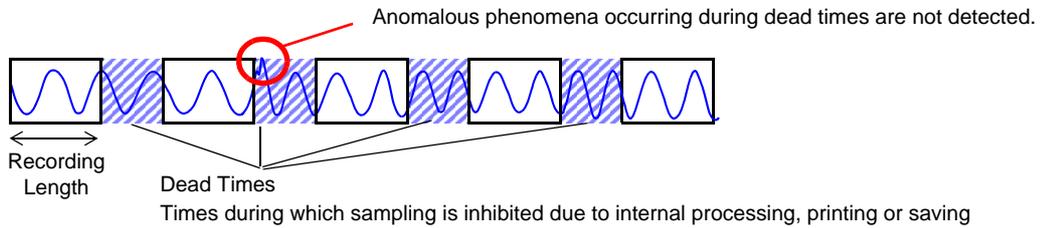
**Example:**  
The recording time is 1.25 ms and the trigger times of No. 3 and No. 4 blocks may be the same.

No.	Trigger time	Source	Timebase	Data	Use Block	Ref Block
1	09-06-23 16:40:33.093	Ch1	10 $\mu$ s		<input type="radio"/>	
2	09-06-23 16:40:34.968	Ch1	10 $\mu$ s		<input type="radio"/>	
3	09-06-23 16:40:36.023	Ch1	10 $\mu$ s		<input type="radio"/>	
4	09-06-23 16:40:36.023	Ch1	10 $\mu$ s/div	2501	<input type="radio"/>	
5	09-06-23 16:40:38.132	Ch1	10 $\mu$ s/div	2501	<input type="radio"/>	

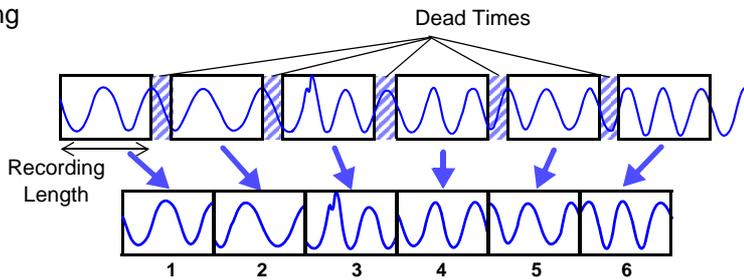
- If triggers occur continuously within an interval shorter than 500  $\mu$ s, the displayed trigger time may indicate a time slower than reality.

**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  $\mu$ s/div to 20  $\mu$ s/div: 1 to 8 samples  
 Time axis slower than 50  $\mu$ s/div: 1 samples  
 Note: Dead time lengthens during calculation of a number of values or when the time axis is 5 to 20  $\mu$ s/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 $\mu$ s/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 $\mu$ s/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.A17).

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.227)

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.234)

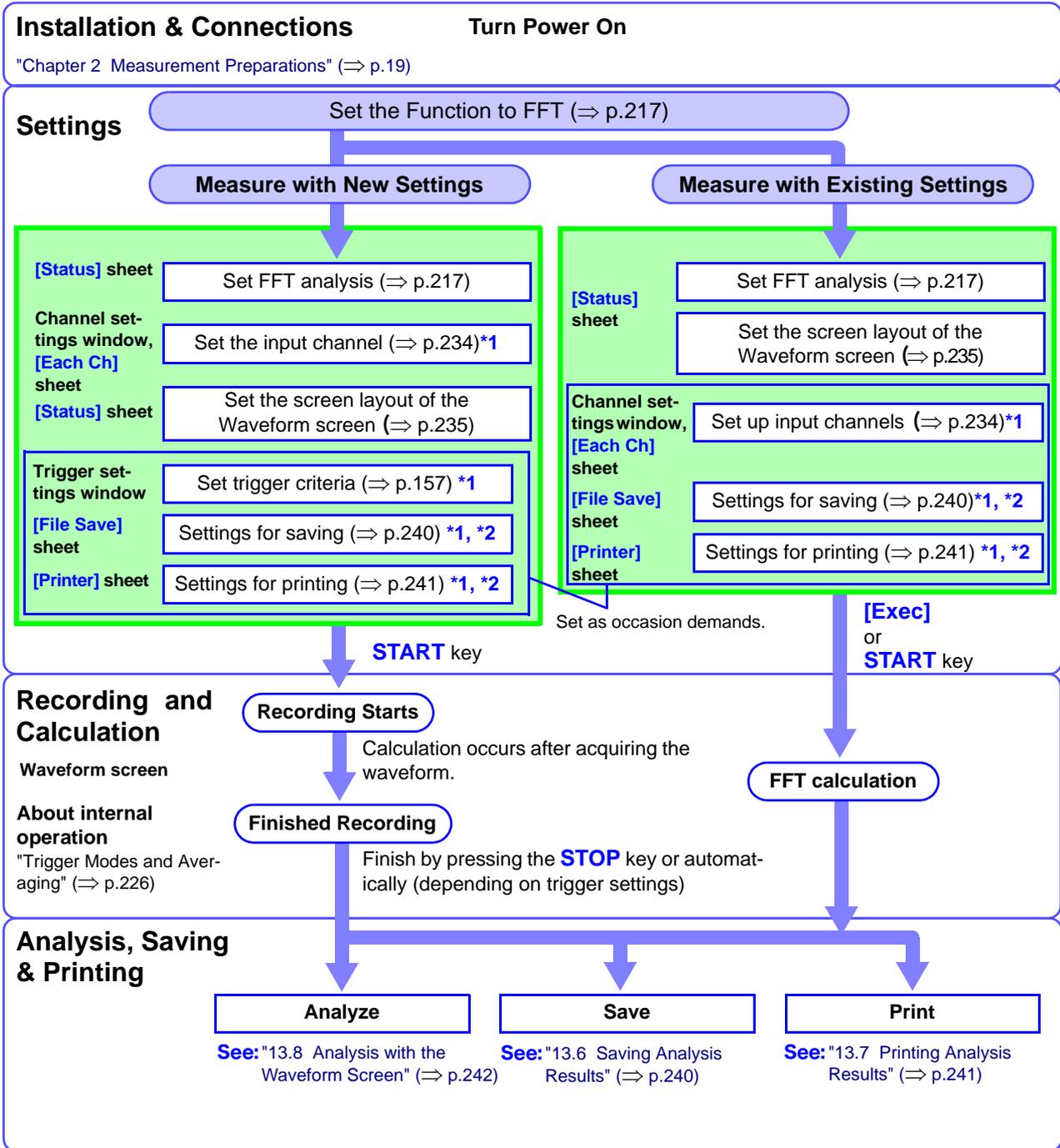
#### **NOTE** To suppress the effects of aliasing distortion

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.A17)

Refer to the "18.2.4 FFT Function" (⇒ p.325) for FFT function specifications.

# 13.2 Operation Workflow



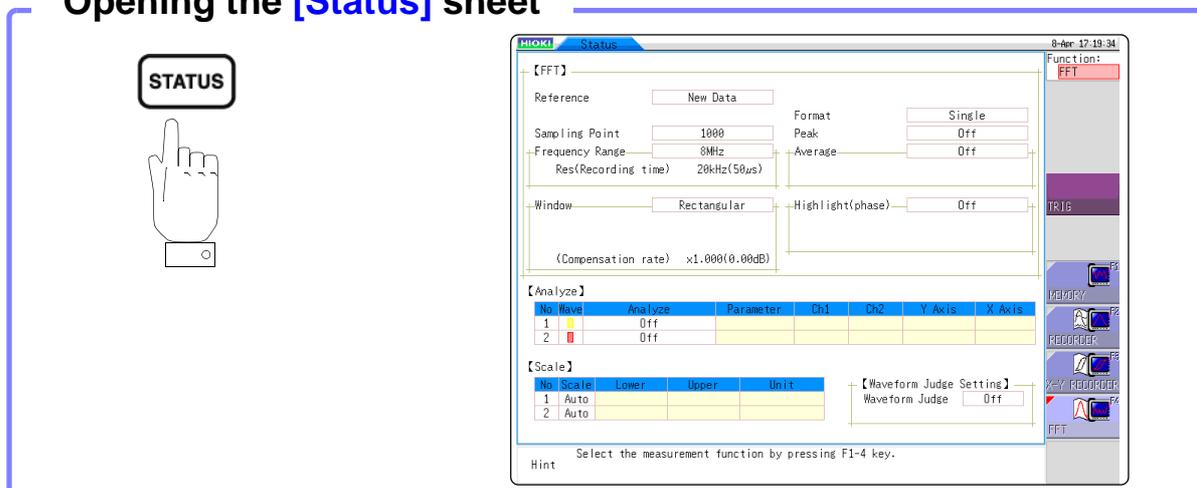
\*1: Settings are the same as for the Memory function.

\*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.233).

### Opening the [Status] sheet

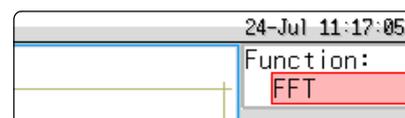


### 13.3.1 Selecting the FFT Function

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).
- 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.233)

#### 1 Select the input data source.

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

Select

<b>New Data</b>	Acquire a new waveform for analysis.
<b>From Memory</b>	Calculates data measured using the memory function.

1

【FFT】

Reference

Sampling Point

Frequency Range

#### 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) .

The analysis starting point can also be specified.

See: "13.8.1 Analyzing after Specifying an Analysis Starting Point" (⇒ p.242)

The frequency range is selected automatically.

See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.220)

#### 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.)

#### 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.220)

- 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.220)

- 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.A19)



#### 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.233)

#### 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.A19)

#### 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.220)

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

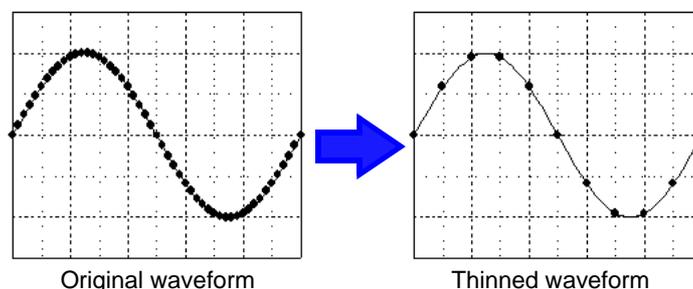
The cut-off frequency of the anti-aliasing filter is the same as the frequency range.

\*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.



#### Procedure

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

#### 1 Select the reference data.

Move the cursor to the **[Reference]** item, and select **[From Memory]**.

Reference	From Memory
Save Thin	OFF
Sampling Point	1000
Frequency Range	4MHz
Res(Recording time)	10kHz(100μs)

#### 2 Select the thinning amount.

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

Select

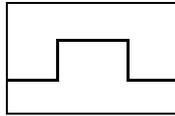
Off	Do not thin out.. (default setting)
1/10	Skip every 10 data points.
1/100	Skip every 100 data points.
1/1000	Skip every 1000 data points.

#### NOTE

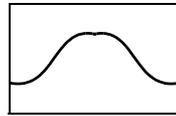
- The **[Save Thin]** setting can only be set when the **[Reference]** is set to **[From Memory]**.
- The range that can be set for thinning changes depending on the time axis range measured by the memory function.
- The frequency range is automatically determined. This setting cannot be changed.
- When 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

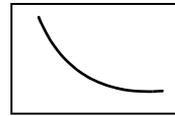
The window function defines the segment of the input signal to be analyzed. Use the window function to minimize leakage errors. There are three general types of window functions:



• 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.

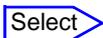
#### Procedure

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

See: To set from the Waveform screen (⇒ p.233)

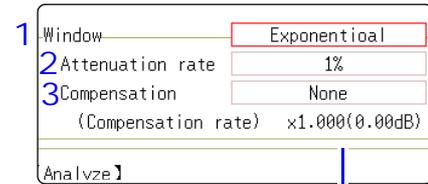
#### 1 Select the window function.

Move the cursor to the [Window] item.



Rectangular (default setting), Hanning, Hamming, Blackman, Blackman Harris, Flat-top, Exponential

See: "Window Function" (⇒ p.A24)



Correction value

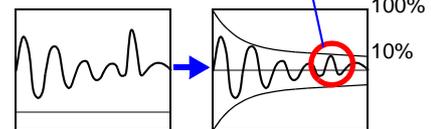
#### 2 If [Exponential] is the selected type

##### 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.



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

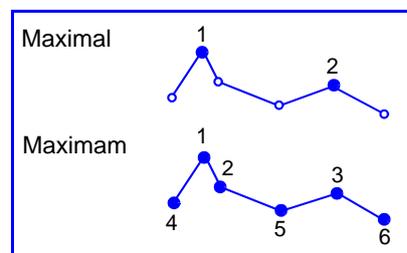
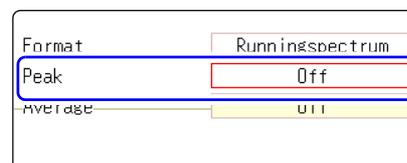
To open the screen: Press the **STATUS** key → [Status] sheet

#### Selecting peak value display.

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

Select

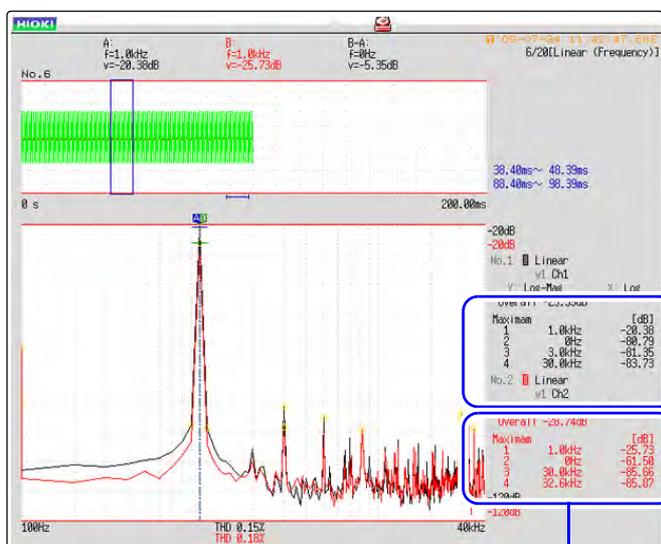
Off	Not displayed. (default setting)
Maximal	(local maxima) When the value of data at a point is greater than that of the adjacent points, that data is considered a local maxima. The ten largest local maxima are displayed.
Maximam	(global maxima) Among all data values, the ten points with the greatest 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]**



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.A23)

**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.226)

#### 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, ○: Partially settable

Analysis Mode	Averaging				
	Waveform Averaging		Spectrum Averaging		
	Simple	Exponential	Simple	Exponential	Peak Hold
OFF	✕	✕	✕	✕	✕
Storage Waveform	●	●	✕	✕	✕
Histogram	●	●	✕	✕	✕
Linear Spectrum	●	●	○*2	○*2	○*2
RMS Spectrum	●	●	○*2	○*2	○*2
Power Spectrum	●	●	●	●	●
Power Spectrum Density *1	●	●	●	●	●
LPC analysis(Power Spectrum Density) *1	●	●	✕	✕	✕
Transfer Function	●	●	○*2	○*2	○*2
Cross Power Spectrum	●	●	○*2	○*2	○*2
Impulse Response	●	●	●	●	●
Coherence Function	✕	✕	●	●	✕
Phase Spectrum	●	●	✕	✕	✕
Auto-correlation Function	●	●	●	●	●
Cross-correlation Function	●	●	●	●	●
1/1 Octave Analysis *1	●	●	●	●	●
1/3 Octave Analysis *1	●	●	●	●	●

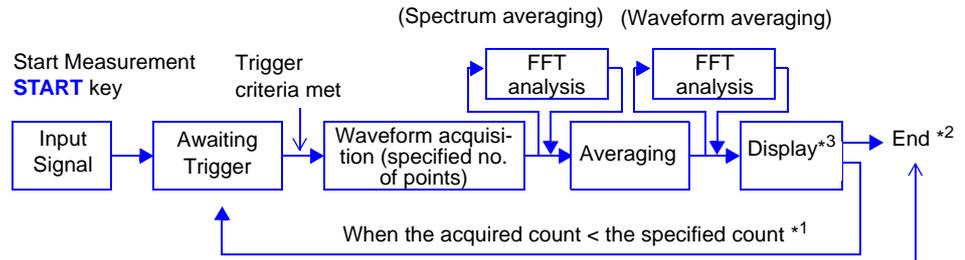
\*1. Not available for external sampling

\*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.

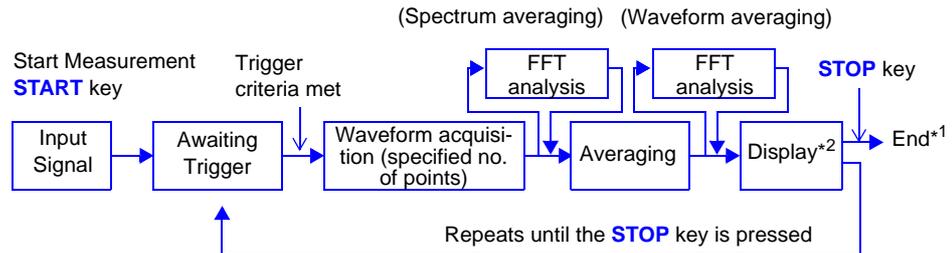


- \*1. Awaiting trigger continues until the specified count is reached.
- \*2. Measurement stops automatically when the specified count is reached. If measurement was interrupted by the **STOP** key, the averaging result up to that point is displayed.
- \*3 If **[Reference]** is **[New Data]** and the 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]**

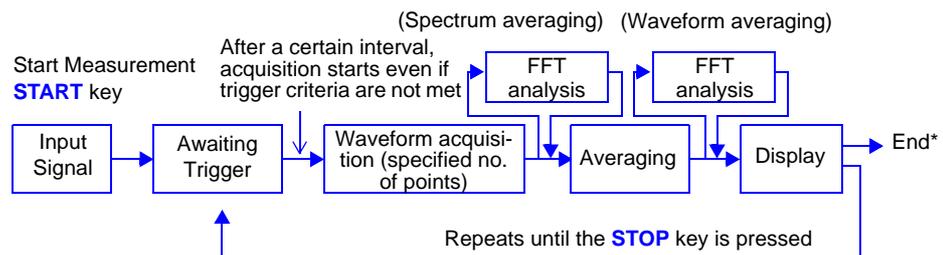
•For time-domain waveforms:

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.

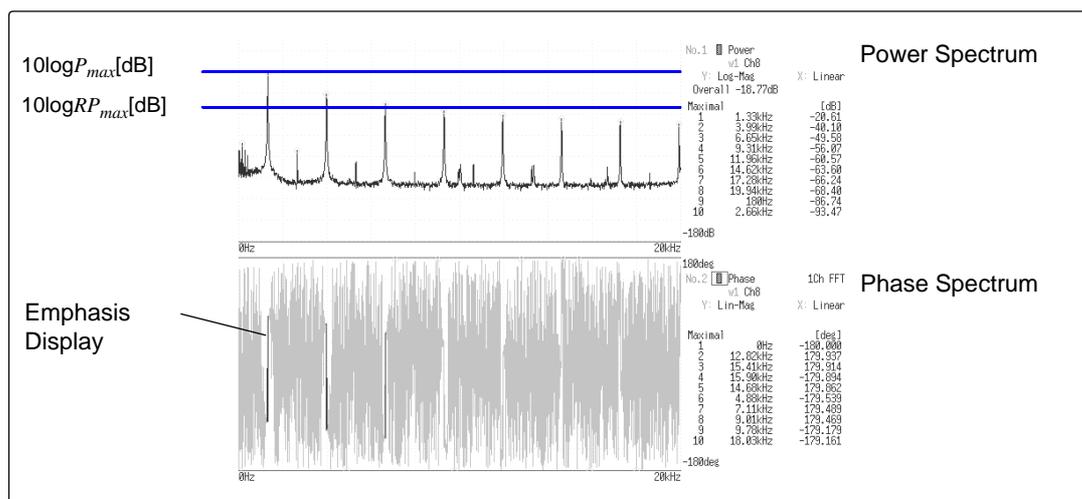


- \* When stopped before the specified count, the average up to that point is displayed.

## 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.



### Procedure

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

#### 1 Enable the highlighting function.

Move the cursor to the **[Highlight(phase)]** item.

Select

Off Emphasis display disabled. (default setting)

On Emphasis display enabled.

1	Highlight(phase)	On
2	Attenuation rate	1
3	(dB)	0dB

#### 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.127)

##### To set an attenuation value [dB]

Move the cursor to the **[(dB)]** item.

Enter the attenuation value.

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

##### Attenuation Rate and Value

Attenuation value: A [dB]

Attenuation rate: R

$$-A = 10\log_{10}R$$

$$1 \times 10^{-6} \leq R \leq 1$$

$$0 \leq A \leq 60$$

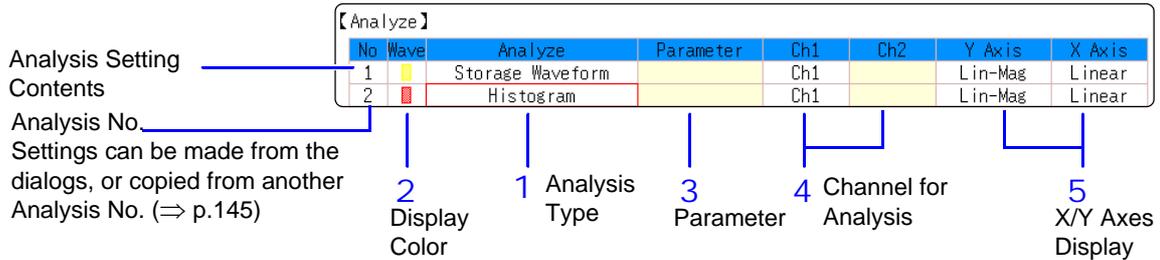
### 13.3.9 Analysis Mode Settings

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.233)



**1 Select the FFT analysis mode.**

Move the cursor to the [Analyze] column of the Analysis No. to set.

Select

<b>Off</b>	No analysis. (default setting)	<b>Transfer Function</b>	(⇒ p.251)
<b>Storage Waveform</b>	(⇒ p.244)	<b>Cross Power Spectrum</b>	(⇒ p.252)
<b>Histogram</b>	(⇒ p.244)	<b>Impulse Response</b>	(⇒ p.253)
<b>Linear Spectrum</b>	(⇒ p.245)	<b>Coherence Function</b>	(⇒ p.254)
<b>RMS Spectrum</b>	(⇒ p.246)	<b>Phase Spectrum</b>	(⇒ p.255)
<b>Powre Spectrum</b>	(⇒ p.248)	<b>Auto-Correlation</b>	(⇒ p.256)
<b>Powre Spectrum density*</b>	(⇒ p.249)	<b>Cross-correlation</b>	(⇒ p.257)
<b>LPC (density)*</b>	(⇒ p.250)	<b>1/1 Octave*</b>	(⇒ p.257)
		<b>1/3 Octave*</b>	(⇒ p.257)

\*Not available with external sampling enabled.

See: "13.9.2 Analysis Mode Functions" (⇒ p.262)

(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	<b>Filter: Normal</b>	enables the octave filter.
	<b>Filter: Sharp</b>	<b>See:</b> "Octave Filter Setting" (⇒ p.230)
Phase Spectrum	<b>1ch FFT</b>	Calculates the phase of [Ch1].
	<b>2ch FFT</b>	Calculates the phase difference between [Ch1] and [Ch2].
LPC (density)	<b>Order :2 to 64</b>	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.230)

#### Y-axis display

<b>Lin-Mag</b>	Analysis results are displayed as amplitude values.
<b>Log-Mag</b>	Analysis results are displayed as dB values. The dB reference is 1 eu. (As a voltage example, 1 V is 0 dB.)
<b>Lin-Real</b>	The real-number component of analysis results are displayed.
<b>Lin-Imag</b>	The imaginary component of analysis results are displayed.

#### X-axis display

<b>Linear</b>	Frequency-axis is displayed linearly.
<b>Log</b>	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.

#### 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)

#### To analyze using external sampling

The horizontal axis ( x-axis) displays the number of data points.

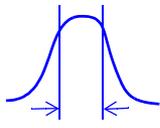
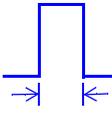


#### How do I copy settings to other calculation No.?

**See:** "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

■ Octave Filter Setting

Filter features are based on JIS C1513-2002 class 1, class 2 (IEC61260).

 <p>Normal</p> <p>Filter characteristics approximate those of an analog filter.</p>	 <p>Sharp</p> <p>Only those spectral component within the octave band are used for analysis. Spectral components outside of the octave band are totally ignored.</p>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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.A28)

■ Analysis Modes and X/Y Axis Display

●: Settable, x: Unsettable

Analysis Mode	X axis		Y axis				Nyquist display
	Linear	Log	Lin-Mag	Log-Mag	Lin-Real	Lin-Imag	
OFF	x	x	x	x	x	x	x
Storage Waveform	●	x	●	x	x	x	x
Histogram	●	x	●	x	x	x	x
Linear Spectrum	●	●	●	●	●	●	●
RMS Spectrum	●	●	●	●	●	●	x
Power Spectrum	●	●	●	●	x	x	x
Power Spectrum Density	●	●	●	●	x	x	x
LPC analysis (Power Spectrum Density)	●	●	●	●	x	x	x
Transfer Function	●	●	●	●	●	●	●
Cross Power Spectrum	●	●	●	●	●	●	●
Impulse Response	●	x	●	x	x	x	x
Coherence Function	●	●	●	x	x	x	x
Phase Spectrum	●	●	●	x	x	x	x
Auto-correlation Function	●	x	●	x	x	x	x
Cross-correlation Function	●	x	●	x	x	x	x
1/1 Octave	x	●	●	●	x	x	x
1/3 Octave	x	●	●	●	x	x	x

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.

$$\text{THD} = \sqrt{\frac{\sum(f_n)^2}{(f_0)^2}} \times 100 \quad [\%]$$

$f_0$  = 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 

<b>Auto</b>	Scaling of the vertical (y) axis is automatically set according to analysis results. (default setting)
<b>Manu- al</b>	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.

No	Scale	Lower	Upper
1	Manual	-1.0000	1.0000
2	Auto		

1 2

#### 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.127)



#### How do I copy settings to other calculation No.?

See: "8.9 Copying settings to other channels (calculation No.) (Copy function)" (⇒ p.145)

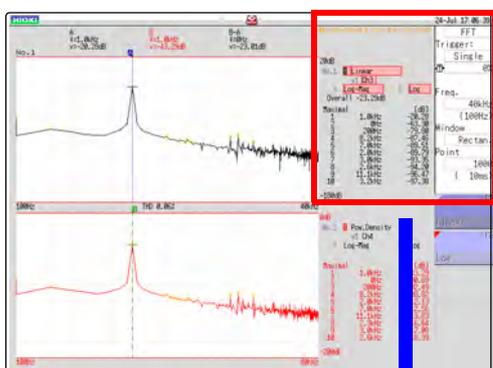
# 13.3.11 Setting and Changing Analysis Conditions on the Waveform Screen

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.160)  
(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 for the Memory function).

Trigger Mode: Single, Repeat, Auto  
Pre-trigger: Select from list

See: "9.2 Setting the Trigger Mode" (⇒ p.159)  
"9.8 Pre-Trigger Settings" (⇒ p.172)

**Analysis Mode**

**Analysis Number\***(⇒ p.228)

**Analysis Channel**

\*Coupled with the [Analysis] list at the [Status] sheet of the Status screen.

3	200Hz	-79.80
4	8.2kHz	-87.46
5	7.0kHz	-89.51
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

FFT	Trigger: Single	0%
Freq. 40kHz (100Hz)	Window Rectan.	Point 1000 (10ms)

Select the frequency range (133 mHz to 8 MHz). (⇒ p.219)

**Frequency Resolution (during acquisition)**

**FFT Window Function Type (⇒ p.222)**

**Number of Analysis Points (⇒ p.219)**  
(1000, 2000, 5000, 10000)

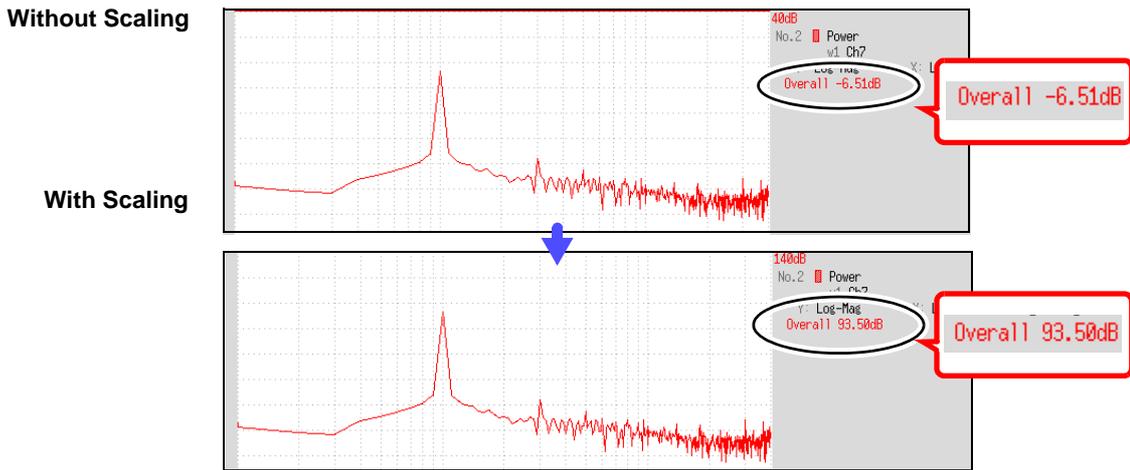
# 13.4 Selecting Channels

Channel selection is the same for all functions.

For the setting method, refer to "3.5 Input Channel Setting" (⇒ p.52) and "8.10 Making Detailed Settings for Input Modules" (⇒ p.146).

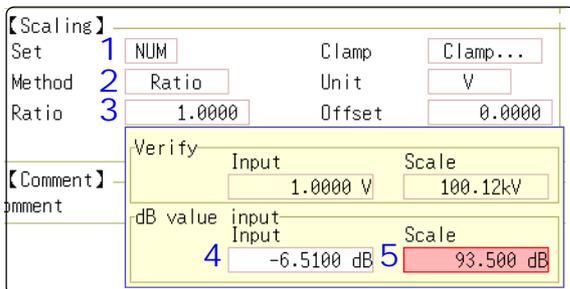
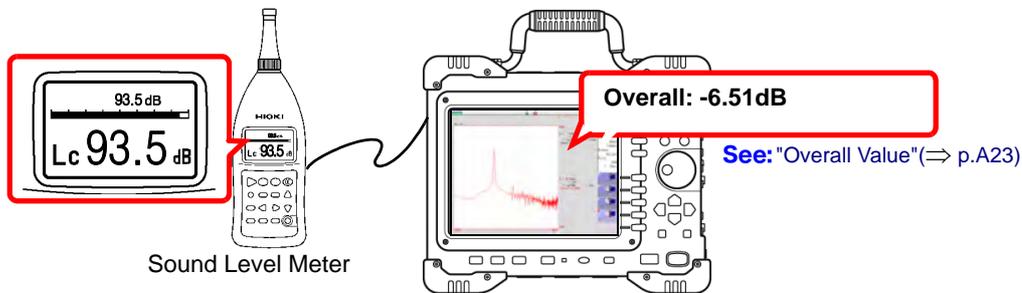
## ■ Scaling

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.



- 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.

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.

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.

Select the format of data to be displayed.

The display format depends on the input data selected for analysis.

<b>Single Standard</b>	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.
<b>Dual Standard</b>	The FFT calculation results are displayed in two screens. If the calculations have multiple settings, waveforms are displayed for each specified calculation.
<b>Single Nyquist</b>	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.
<b>Dual Nyquist</b>	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.
<b>Running spectrum</b>	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.

#### 2 Press the **DISP** key to display the Waveform screen.

1

Format	Single Standard
Peak	Off
Average	Linear (Time axis)
Number	2

#### 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.218)

#### 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.242)



**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.

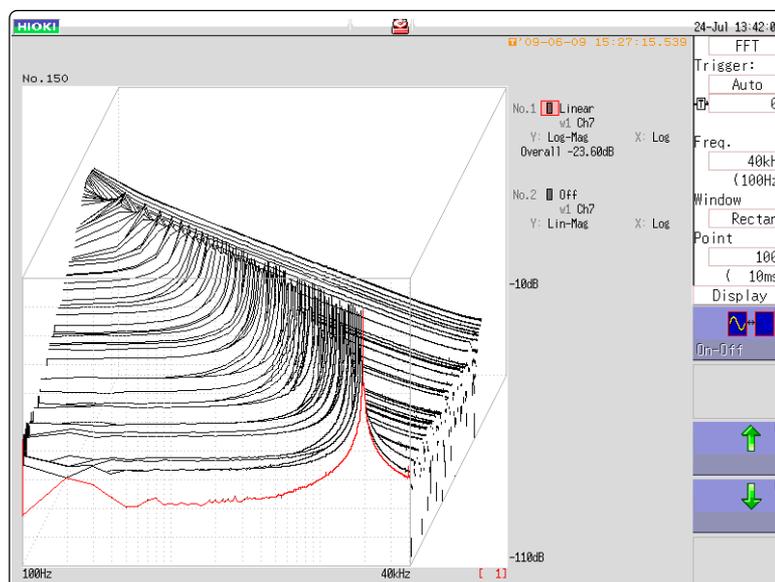
**■ Display Types and Split-Screen Settings**

Nine display arrangements are available.

	Standard		Nyquist		Running Spectrum
	Single Standard	Dual Standard	Single Nyquist	Dual Nyquist	Running spectrum
<b>[Reference] setting</b>	<b>[New Data]</b>	<b>[From Memory]</b>	<b>[New Data]</b>	<b>[From Memory]</b>	<b>[New Data]</b>
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].

Reference	<input type="button" value="New Data"/>
Sampling Point	<input type="text" value="1000"/>
Frequency Range	<input type="text" value="8MHz"/>
Res(Recording time)	<input type="text" value="20kHz(50μs)"/>

#### 2 Select the display format.

Move the cursor to the [Format], and select [Running spectrum].

Format	<input type="button" value="Runningspectrum"/>
Peak	<input type="button" value="Off"/>
Average	<input type="button" value="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

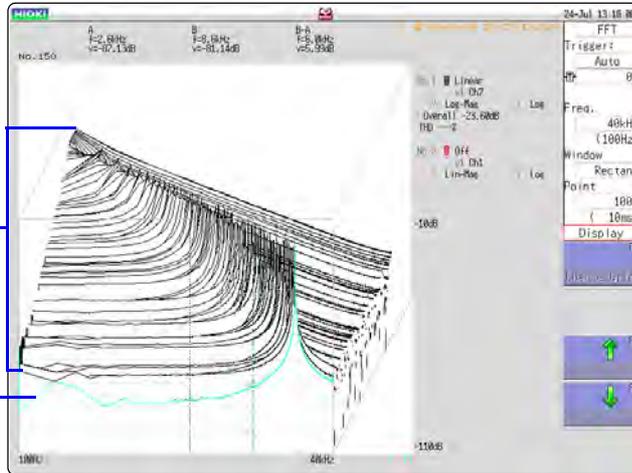
#### Stopping waveform movement during measurement

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

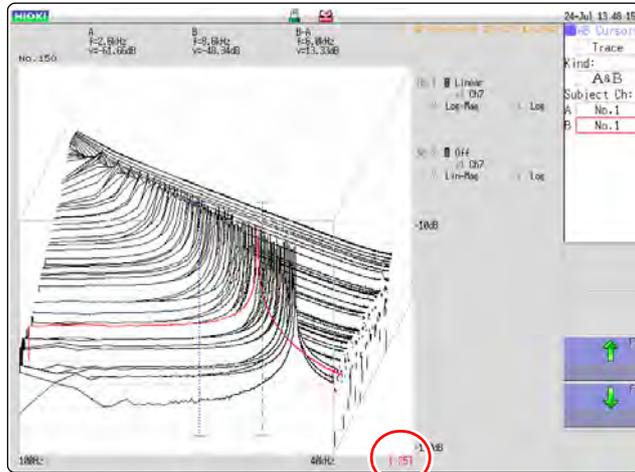
The latest waveform displayed during pausing of measurement



#### 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.

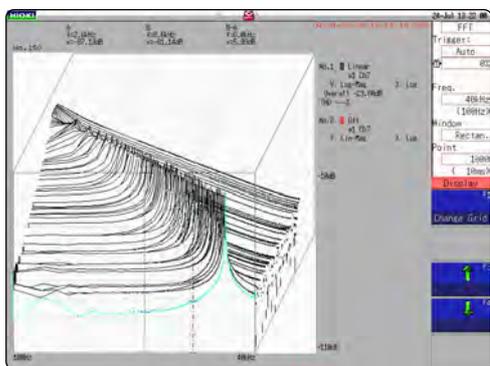


The older the waveform, the larger the number.

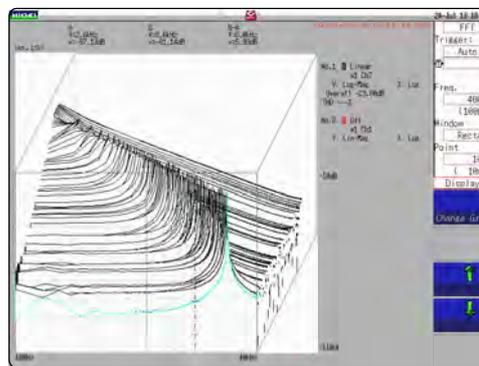
### Changing the grid display

The display format of the grid can be switched.

- 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

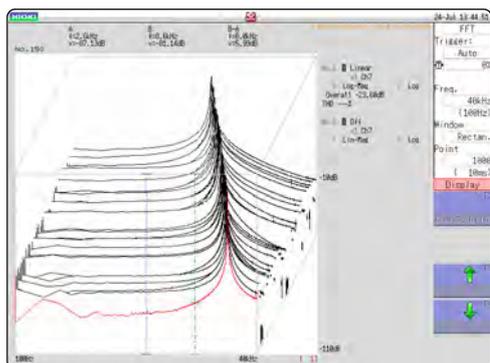


### Changing the number of waveforms to be displayed

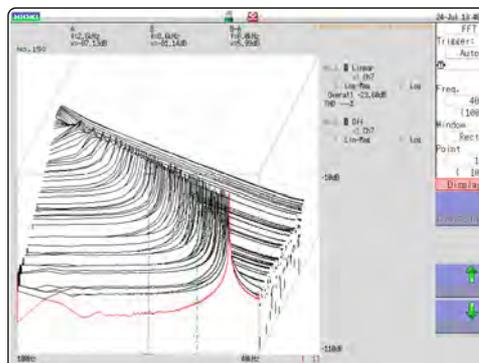
The number of waveforms to be displayed can be changed.

The following number of waveforms can be selected: 10, 20, 50, 100, and 200.

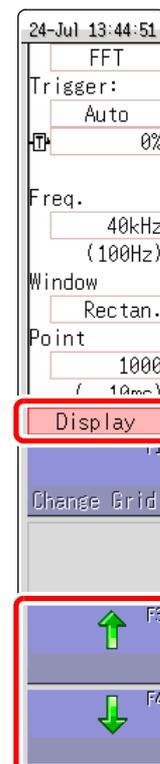
- 1** Press the **WAVE** key on the panel of the unit.
- 2** Move the cursor to the **[Display]**.
- 3** Change the number of waveforms to be displayed.  
Using either the **F3 [↑]** or **F4 [↓]** key, adjust the number of waveforms to be displayed.



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.69)

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

```

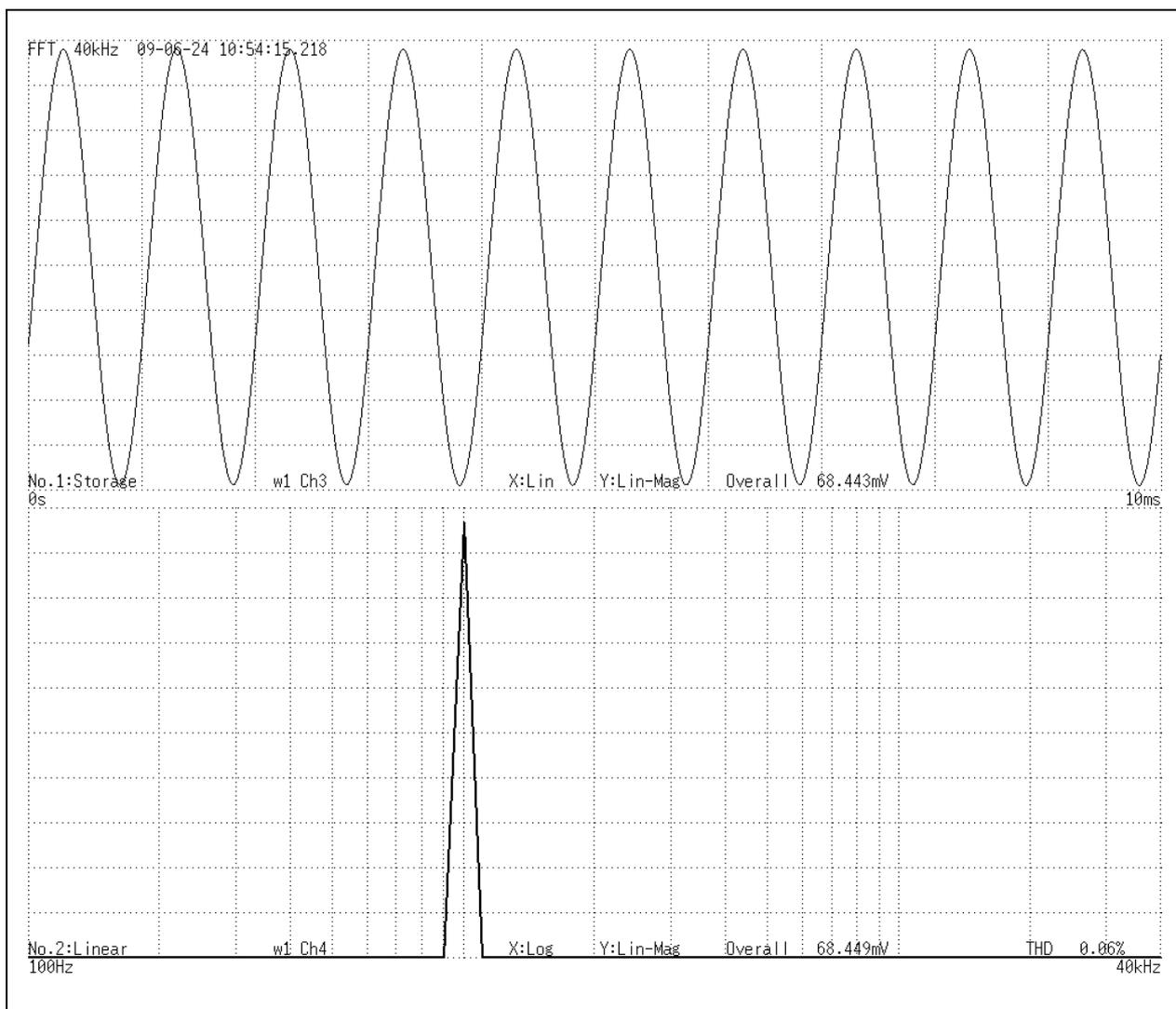
Line 1: Title comment  
Lines 2 to 3: Trigger Time  
Calculation information  
X-axis data    Y-axis data

## 13.7 Printing Analysis Results

The printing procedure is the same as for the Memory and Recorder functions.

See: "Chapter 6 Printing" ( $\Rightarrow$  p.95)

### 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.226)

•Calculation execution: **[Single]**

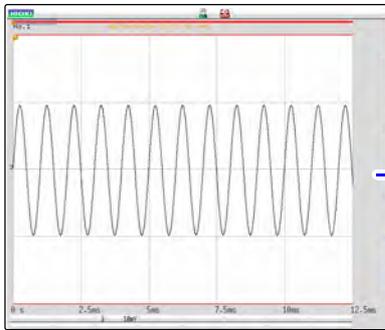
Analysis is performed once on the specified number of analysis points beginning with the specified starting point, and analysis results are displayed.

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.

No	Wave	Analyze	Parameter	Ch1	Ch2	Y Axis	X Axis
1	■	Off					
2	■	Off					

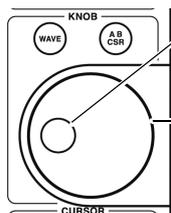
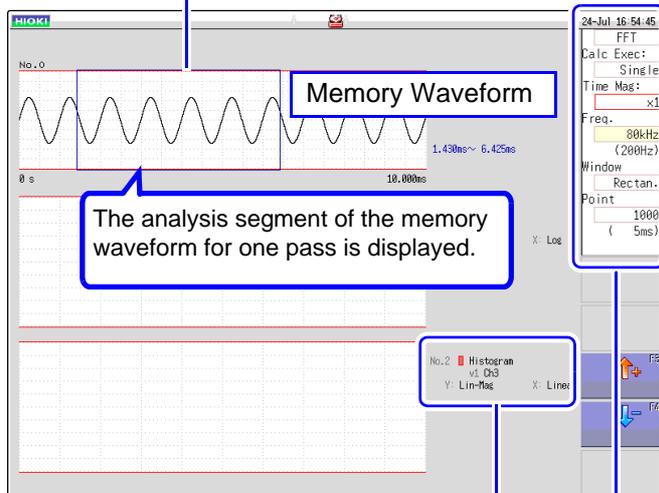
  

No	Scale	Lower	Upper	Unit
1	Auto			
2	Auto			

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.



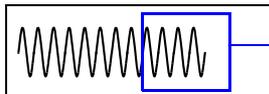
**Jog**  
Moves the analysis starting point.

**Shuttle**  
Scrolls the Memory waveform.

7 Select analysis conditions as occasion demands.

**To change the number of analysis points**

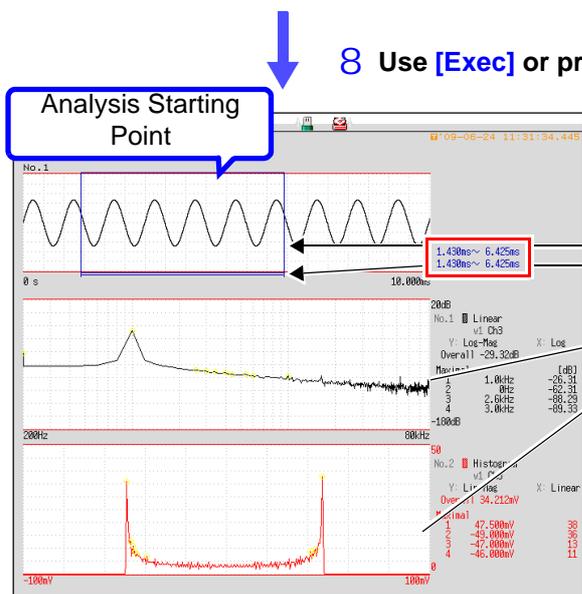
The setting can be changed at the top of the Waveform screen. The range is determined by the number of analysis points. If the analysis range (number of points) is larger than the memory waveform as shown below, analysis is not performed.



**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.



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.262).

### 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. <a href="#">See: "Relationship Between Frequency Range, Resolution and Number of Analysis Points" (⇒ p.220)</a>
Y axis	Lin-Mag	Displays the input module waveform

### Waveform Example



Window: Rectangular  
X axis: Linear  
Y axis: Lin-Mag

### Histogram

Acquires the amplitude distribution of the input signal.

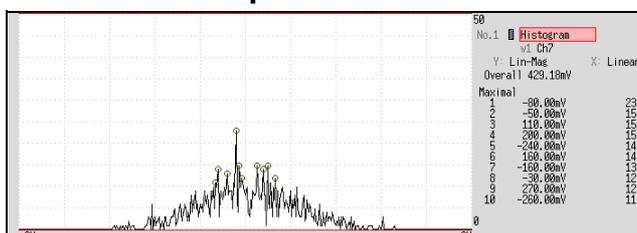
Main uses:

- 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" \(⇒ p.262\)](#)

Axis	Display Type	Description
X axis	Linear	Displays input level of the input signal.
Y axis	Lin-Mag	Displays analysis data distribution.

### Waveform Example



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.262)

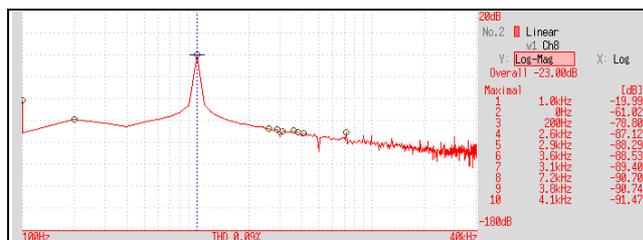
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
	Nyquist display	The real-number component of analysis values are displayed linearly.
Y axis	Lin-Mag	Analysis values are displayed linearly.
	Log-Mag	Analysis values are 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**



Normal display  
X axis: Log  
Y axis: Lin-Mag



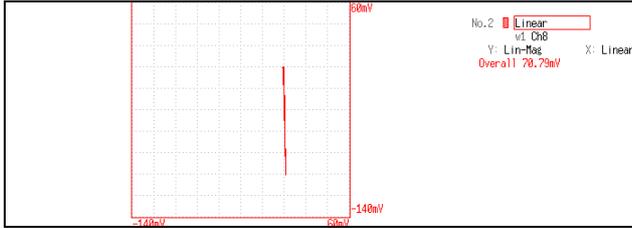
Normal display  
X axis: Log  
Y axis: Log-Mag



Normal display  
X axis: Log  
Y axis: Lin-Real



Normal display  
X axis: Log  
Y axis: Lin-Imag



**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 two cursors appear, A cursor is the fundamental wave. When results cannot be obtained, [---%] is displayed.
- When only sine waves are input, the level of this component becomes approximately 1.4 times (3 dB) larger than the overall value. To measure at a reference the same as the overall value, analyze using RMS spectrum or power spectrum.

See: RMS Spectrum (⇒ p.246), Power Spectrum (⇒ p.248)

### 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.262)

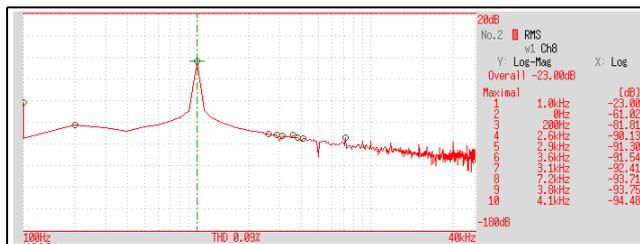
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis values are displayed linearly.
	Log-Mag	Analysis values are displayed as dB values. (0 dB reference value: 1 eu)*
	Lin-Real	The real-number component of analysis values are displayed.
	Lin-Imag	The imaginary component of analysis values are displayed.

\* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V)

### Waveform Example



**Normal display**  
X axis: Log  
Y axis: Lin-Mag



**Normal display**  
X axis: Log  
Y axis: Log-Mag



**Normal display**  
X axis: Log  
Y axis: Lin-Real



**Normal display**  
X axis: Log  
Y axis: Lin-Imag

**NOTE**

If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed.  
When two cursors appear, A cursor is the fundamental wave.  
When results cannot be obtained, [---%] is displayed.

### Power Spectrum

Displays input signal power as the amplitude component.

Main uses:

- To inspect the peak frequency contents of a waveform
- To inspect the power level at each frequency

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.262)

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 <sup>2</sup> )*

\* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V<sup>2</sup>)

### Waveform Example



**Normal display**

X axis: Log

Y axis: Lin-Mag



**Normal display**

X axis: Log

Y axis: Log-Mag

### NOTE

If the cursor is displayed, the total harmonic distortion (THD), which sets the fundamental wave as the cursor position, is displayed.

When two cursors appear, A cursor is the fundamental wave.

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.262)

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 <sup>2</sup> /Hz)*

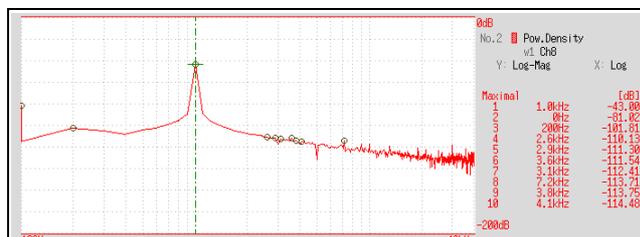
\* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts, 0 dB = 1 V<sup>2</sup>/Hz)

**Waveform Example**



**Normal display**

X axis: Log  
Y axis: Lin-Mag



**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.262)

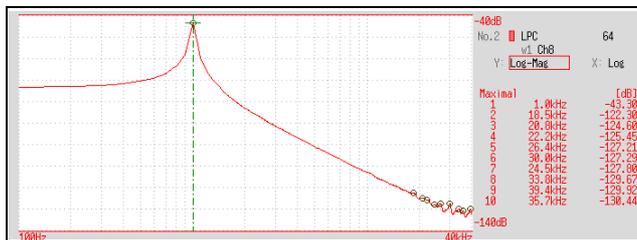
Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	The analysis data is displayed linearly.
	Log-Mag(logarithm)	Analysis values are displayed as dB values. (0 dB reference value: $1 \text{ eu}^2/\text{Hz}$ )*

\* eu: engineering units that are currently set are the standard (e.g., when the unit settings is volts,  $0 \text{ dB} = 1 \text{ V}^2/\text{Hz}$ )

### Waveform Example



X axis: Log  
Y axis: Lin-Mag



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.

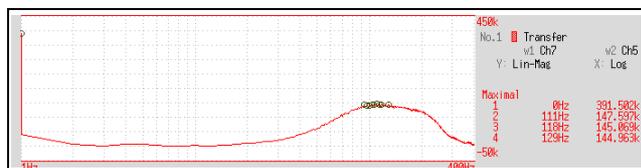
**Main uses:**

- 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

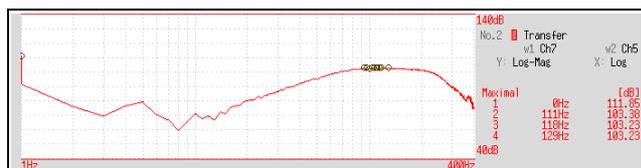
See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.262), "Linear Time-Invariant Systems"(⇒ p.A18)

Axis	Display Type	Description
<b>X axis</b>	<b>Linear</b>	Frequency is displayed with equal spacing
	<b>Log</b>	Frequency display of logarithm interval
	<b>Nyquist display</b>	Displays the real-number component of the input-output ratio.
<b>Y axis</b>	<b>Lin-Mag</b>	Displays the input-output ratio linearly (dimensionless units).
	<b>Log-Mag(logarithm)</b>	Displays the input-output ratio as dB values.
	<b>Lin-Real</b>	Displays the real-number component of the input-output ratio (dimensionless units).
	<b>Lin-Imag</b>	Displays the imaginary component of the input-output ratio (dimensionless units).
	<b>Nyquist display</b>	Displays the imaginary component of the input-output ratio.

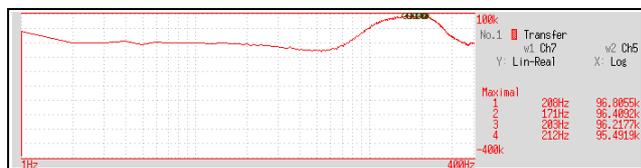
### Waveform Example



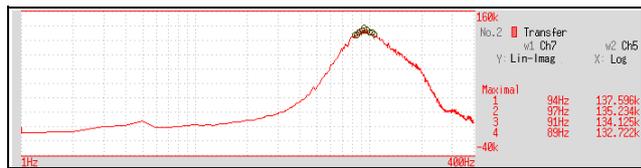
**Normal display**  
X axis: Log  
Y axis: Lin-Mag



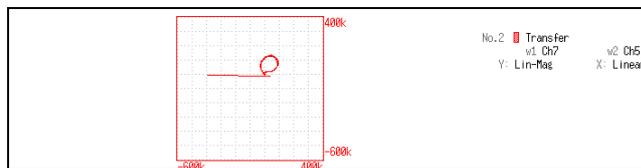
**Normal display**  
X axis: Log  
Y axis: Log-Mag



**Normal display**  
X axis: Log  
Y axis: Lin-Real



**Normal display**  
X axis: Log  
Y axis: Lin-Imag



**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.262)

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 <sup>2</sup> )*
	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<sup>2</sup>)

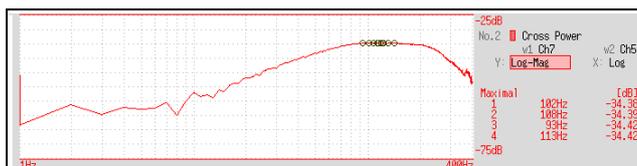
### Waveform Example



#### Normal display

X axis: Log

Y axis: Lin-Mag



#### Normal display

X axis: Log

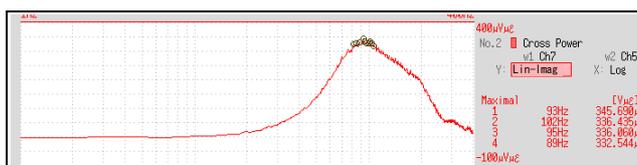
Y axis: Log-Mag



#### Normal display

X axis: Log

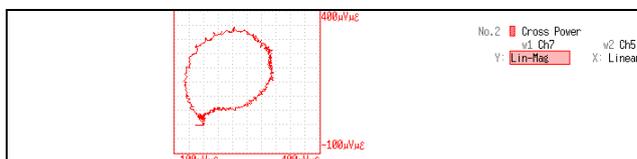
Y axis: Lin-Real



#### Normal display

X axis: Log

Y axis: Lin-Imag



#### 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.

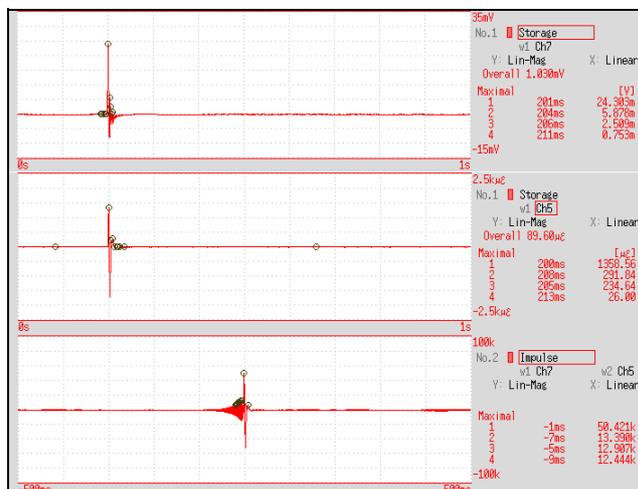
**Main uses:**

To inspect circuit time constants

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.262), "Linear Time-Invariant Systems"(⇒ p.A18)

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.

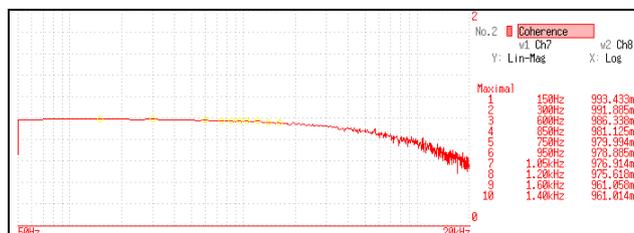
### Main uses:

- 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.262)

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Displays the causal relationship and degree of relationship between two input signals, as a value between 0 and 1 (dimensionless units).

### Waveform Example



Normal display

X axis: Log

Y axis: Lin-Mag

### **NOTE**

- With a single measurement, the coherence function gives a value of one for all frequencies. Spectrum (frequency-domain) averaging should always be performed before measurement (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.262).

## Phase Spectrum

Shows the phase characteristics of the input signal.

Main uses:

- To inspect the phase spectrum of channel 1. Displays the phase of a cosine waveform as a reference (0°).
- To inspect the phase difference between channels 1 and 2.

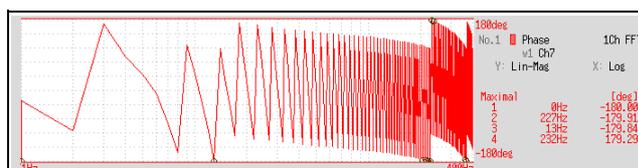
See: [About the Functions](#) "13.9.2 Analysis Mode Functions" (⇒ p.262)

1 Ch FFT: Displays the phase of the signal on channel 1. Displays the phase of a cosine waveform as a reference (0°). Unless the waveform is synchronous, phase values are unstable.

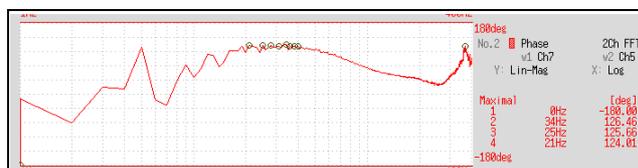
2 Ch FFT: Displays the phase difference between channels 1 and 2. Positive values indicate that the phase of channel 2 is leading.

Axis	Display Type	Description
X axis	Linear	Frequency is displayed with equal spacing
	Log	Frequency display of logarithm interval
Y axis	Lin-Mag	Analysis values are displayed linearly.

### Waveform Example



1chFFT  
X axis: Log  
Y axis: Lin-Mag



2chFFT  
X axis: Log  
Y axis: Lin-Mag

### ■ 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.227)

## Auto Correlation Function

Shows the correlation of two points on the input signal at time differential  $t$ .

**Main uses:**

- To detect periodicity 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" ( $\Rightarrow$  p.262)

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  $t$ .

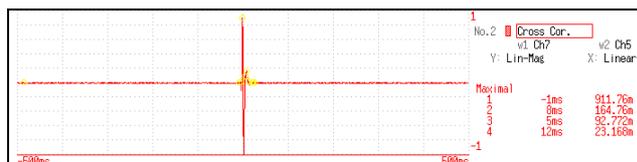
Main uses:

- 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.262)

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



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:

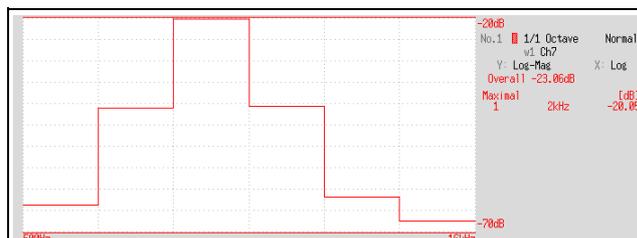
To analyze noise frequency

See: About the Functions"13.9.2 Analysis Mode Functions" (⇒ p.262), "Octave Filter Characteristics"(⇒ p.A28)

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



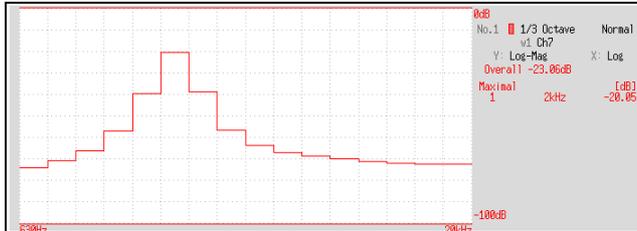
1/1 Octave  
X axis: Log  
Y axis: Log-Mag  
Filter: Normal

**1/1 Octave**

X axis: Log

Y axis: Log-Mag

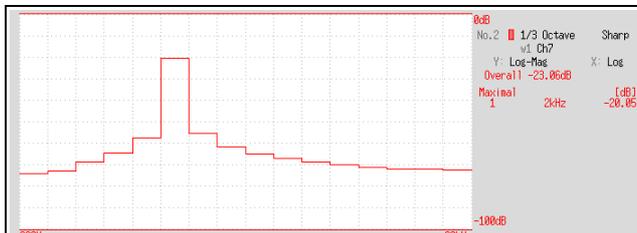
Filter: Sharp

**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.134)





(●: 1/1 OCT, ○: 1/3 OCT)

Timebase	5 μ	10 μ	20 μ	50 μ	100 μ	200 μ	500 μ	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	1 μ	2 μ	5 μ	10 μ	20 μ	50 μ	100 μ	200 μ	500 μ	1m	2m	5m	10m	20m	50m	100m	300m	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	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	667m	400m	333m	133m	
1/1 OCT	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
1/3 OCT																										
Center frequency [Hz]	3.15M	4M	5M	6.3M	8M	10M	12.5M																			
22	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
23	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
24	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

## 13.9.2 Analysis Mode Functions

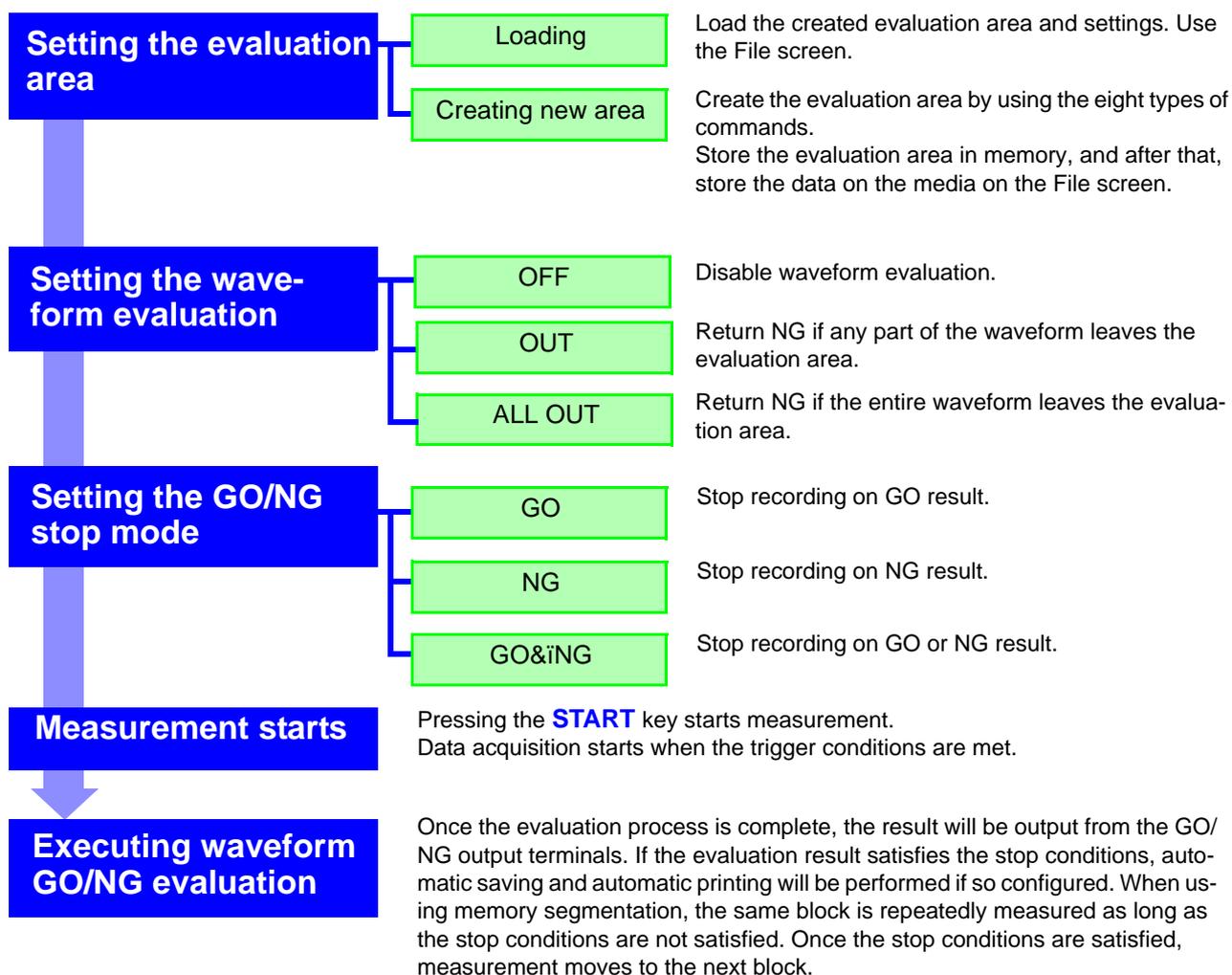
Analysis Mode	Internal analysis formula (linear, real, imag [imaginary], log [logarithm])
<b>OFF</b>	No analysis.
<b>Storage Waveform</b>	A waveform obtained by applying the window function to a time-domain waveform.
<b>Histogram</b>	Counts amplitude data.
<b>Linear Spectrum</b>	$X(k) = \sum_{n=0}^{N-1} x(n)W^{kn} \quad F(k) = CX(k) \quad C = \begin{cases} 1/N(DC) \\ 2/N(AC) \end{cases}$ $linear =  F(k)  \quad real = \text{Re}\{F(k)\} \quad imag = \text{Im}\{F(k)\} \quad log = 20 \log  F(k) $
<b>RMS Spectrum</b>	$F'(k) = C'F(k) \quad C' = \begin{cases} 1(DC) \\ 1/\sqrt{2}(AC) \end{cases}$ $linear =  F'(k)  \quad real = \text{Re}\{F'(k)\} \quad imag = \text{Im}\{F'(k)\} \quad log = 20 \log  F'(k) $
<b>Power Spectrum</b>	$P(k) = a F(k) ^2 \quad a = \begin{cases} 1(DC) \\ 1/2(AC) \end{cases}$ $linear = P(k) \quad log = 10 \log  P(k) $
<b>Power Spectrum Density</b>	$P'(k) = P(k) / \delta f \quad \delta f: \text{Frequency resolution}$ $linear = P'(k) \quad log = 10 \log  P'(k) $
<b>LPC analysis(Power Spectrum Density)</b>	(Abbr.) Spectrum approximation from Linear Predictive Coding. <b>See:</b> "Linear Predictive Coding (LPC)"(⇒ p.A29)
<b>Transfer Function</b>	$H(k) = Y(k) / X(k)$ $linear =  H(k)  \quad real = \text{Re}\{H(k)\} \quad imag = \text{Im}\{H(k)\} \quad log = 20 \log  H(k) $
<b>Cross Power Spectrum</b>	$S_{yx}(k) = X^*(k)Y(k) : \text{Cross Spectrum}$ $X_{power}(k) = AS_{yx}(k) \quad A = \begin{cases} 1/N^2 \\ 2/N^2 \end{cases}$ $linear =  X_{power}(k)  \quad real = \text{Re}\{X_{power}(k)\}$ $mag = \text{Im}\{X_{power}(k)\} \quad log = 10 \log  X_{power}(k) $
<b>Impulse Response</b>	$h(n) = \frac{1}{N} \sum_{k=0}^{N-1} \frac{Y(k)}{X(k)} W^{-kn}$
<b>Coherence Function</b>	$coh(k) = \sqrt{\frac{S_{yx}(k)S_{yx}^*(k)}{S_{xx}(k)S_{yy}(k)}}$
<b>Phase Spectrum</b>	$\theta(k) = 180/\pi \times \tan^{-1}(\text{Im}(F'(k)) / \text{Re}(F'(k)))$ $\theta(k) = 180/\pi \times \tan^{-1}(\text{Im}(S_{yx}(k)) / \text{Re}(S_{yx}(k)))$
<b>Auto-correlation Function</b>	$R_{xx}(n) = \frac{1}{N} \sum_{k=0}^{N-1}  X(k) ^2 W^{-kn} \quad (\text{recursive convolution})$
<b>Cross-correlation Function</b>	$R_{yx}(n) = \frac{1}{N} \sum_{k=0}^{N-1} S_{yx}(k) W^{-kn} \quad (\text{recursive convolution})$
<b>1/1 Ovtave Analysis</b>	(Abbr.)
<b>1/3 Ovtave Analysis</b>	(Abbr.)

# Waveform Evaluation Function

## Chapter 14

### 14.1 Waveform GO/NG Evaluation (MEM, FFT Function)

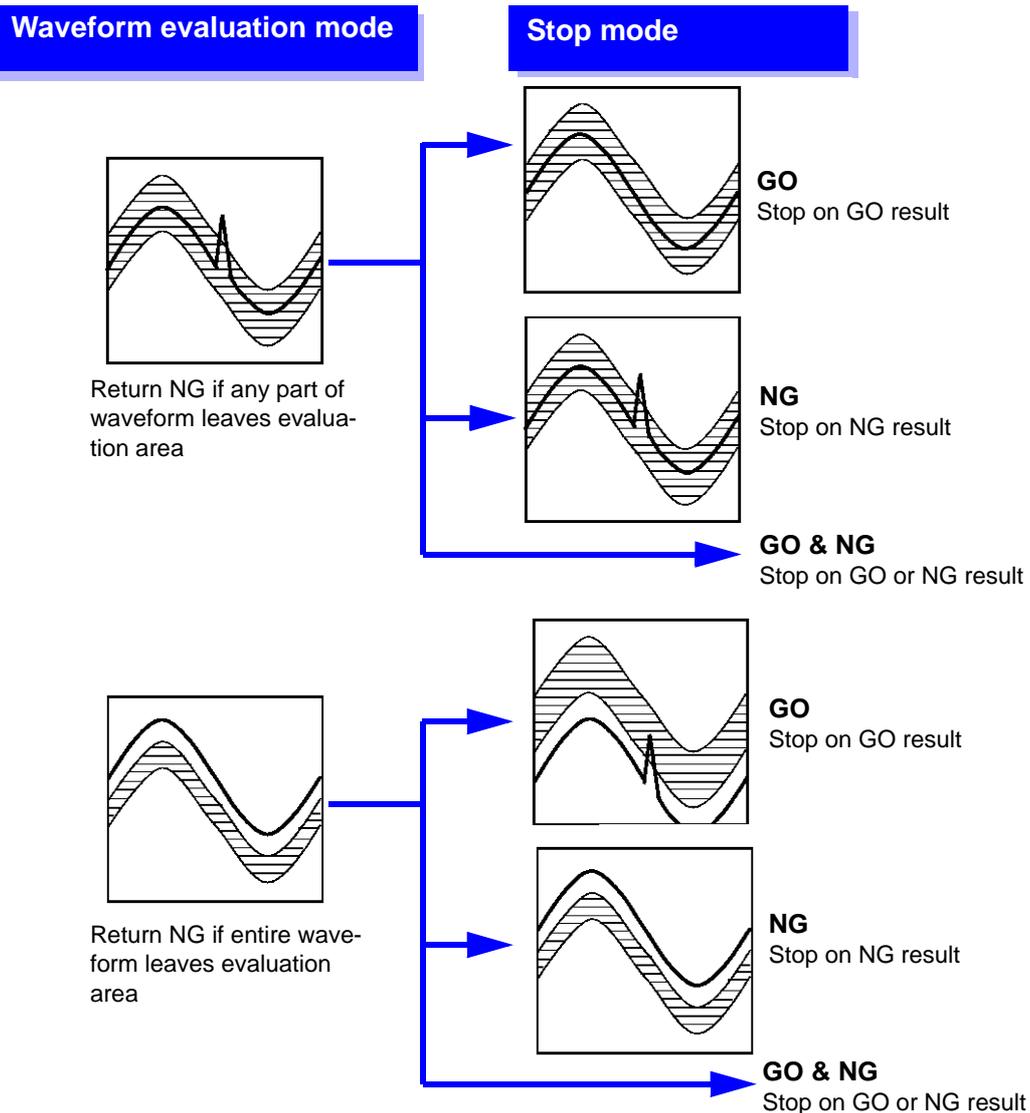
- The waveform evaluation function can be used from the Memory function (single screen, X-Y single screen), FFT function (1 screen standard, 1 screen Nyquist).
- GO (pass) or NG (fail) evaluation of the input signal waveform can be performed using an evaluation area specified by the user.
- This can serve to detect irregular waveforms.
- Depend on evaluation result, GO and NG terminal output the signal.
- Displaying all channels can be used for GO/NG evaluation.



**NOTE**

- Trigger mode: SINGLE Measurement continues until stop mode conditions are fulfilled and then stops.
- Trigger mode REPEAT, AUTO Recording and waveform evaluation is carried out continuously. Press the **STOP** key to terminate the measurement.
- When "auto print" is set to ON, the waveform is printed out when the stop conditions are satisfied.
- When "auto save" is set to ON, data are stored on media when the stop conditions are satisfied.
- When memory segmentation is ON, data is recorded to the memory block only when the stop conditions are satisfied.
- During waveform evaluation, evaluation is performed concurrently with measurement when the time axis range is 1 ms/div or less with the roll mode setting ON or during automatic operation with the display at 100 ms/div or less as a result of the time axis magnification factor. At all other times, evaluation is performed after measurement is complete.
- When performing evaluation after measurement is complete, this sequence of two alternating operations (capturing data and performing the evaluation) is performed repeatedly, so that data is not captured while the evaluation is in progress.
- Therefore data are not captured while the evaluation is in progress, which means that the input signal is not being continuously monitored. The time required for evaluation is on the order of 100 ms.
- When performing evaluation and measurement concurrently, the waveform is displayed and evaluated while measurement continues. However, please note that processing is not necessarily conducted in real time.
- If a high setting is chosen for recording length or if compression is used, the evaluation cycle becomes slower.
- Waveform scrolling is not available while waveform evaluation is ON. To use waveform scrolling, you should first turn waveform evaluation OFF.
- When memory function waveform evaluation is specified, one screen of display data (25 divisions) is printed out. When waveform data having a recording length of more than 25 divisions is to be printed out, the time axis should be compressed.
- Although the waveform display will change if you change display-related settings after measurement completes, the waveform evaluation results from when the measurement was made are retained. To repeat the evaluation process for the waveform after the new settings have been applied, perform waveform evaluation on the Status basic settings screen.  
[See: "7.5.1 Magnifying and Compressing Horizontal Axis \(Time Axis\)" \(⇒ p.116\)](#)
- When using the highlight function with the FFT function, only the highlighted data is evaluated.

## Waveform evaluation mode and stop mode



# 14.2 Setting the Waveform Area

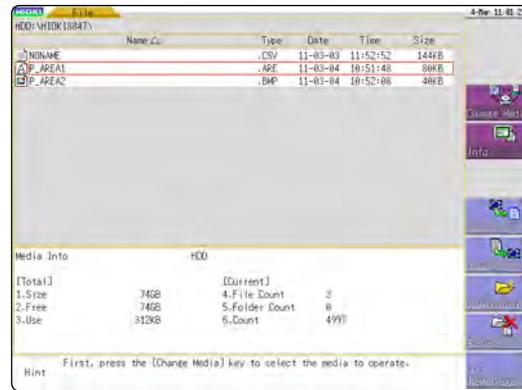
To evaluate the waveforms, a evaluation area is required. Two methods are available: one is to load the already created evaluation area and settings, and the other is to create a new evaluation area.

## Loading the already created evaluation area

### Setting method

#### Procedure Screen: FILE

- 1 Press the **FILE** key to call the File screen.
- 2 Select the media for loading.
- 3 Use the bar cursor to select the desired file.
- 4 Press the **[load]** function key.
- 5 Press the **[Exec]** key.
- 6 When no more changes need be made to the loaded settings, press the **DISP** key to make the Waveform display screen appear, and then press the **START** key to initiate measurement.  
 To change the settings, first change the contents, press the **DISP** key to make the Waveform display screen appear, and then press the **START** key to initiate measurement.  
 See: "5.3 Loading Data" (⇒ p.82)



### Requirements for loading waveform evaluation area BMP files

Observe the following requirements when creating waveform evaluation areas on a computer and when loading waveform evaluation areas created on other equipment:

item	Condition	Loading operation
Color	White and black	White pixels are treated as background, and black pixels are treated as the evaluation area.
Size	501 horizontal pixels × 626 vertical pixels	The file will be used as the evaluation area for the Memory Function 1 screen.
	501 horizontal pixels × 501 vertical pixels	When using the FFT function, the file will be used as the FFT evaluation area. When using other functionality, the file will be used as the memory function XY evaluation area.

Files that do not satisfy these requirements cannot be loaded properly.

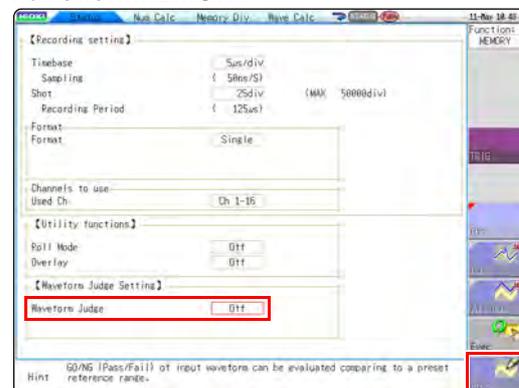
## Creating a new evaluation area

### Setting method

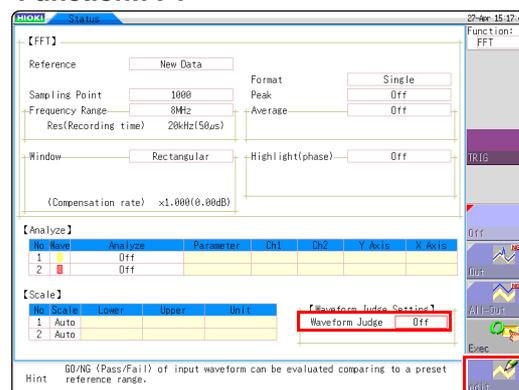
#### Procedure Screen: STATUS

- 1 Press the **STATUS** key to call the Status screen.
- 2 Move the flashing cursor to Waveform Judge.
- 3 Press the **[edit]** function key.
- 4 Make the new evaluation area.  
See: "14.5 Creating the Evaluation Area" (⇒ p.271)
- 5 Store the new evaluation area in the internal memory.
- 6 After setting the parameters for "Waveform Judge setting" and "Stop Mode," press the **DISP** key to make the Waveform display screen appear, and then press the **START** key to initiate measurement.
- 7 Save the evaluation area on the File screen, if it is necessary.  
See: "5.2 Saving Data" (⇒ p.73)

#### Function:MEMORY



#### Function:FFT



### NOTE

Only one waveform evaluation area is stored in internal memory. For example, when operation is changed from the Memory function screen to the X-Y screen and the X-Y screen waveform evaluation area is stored, the waveform evaluation area created for the Memory function is lost.

# 14.3 Setting the Waveform Evaluation Mode

## Setting method

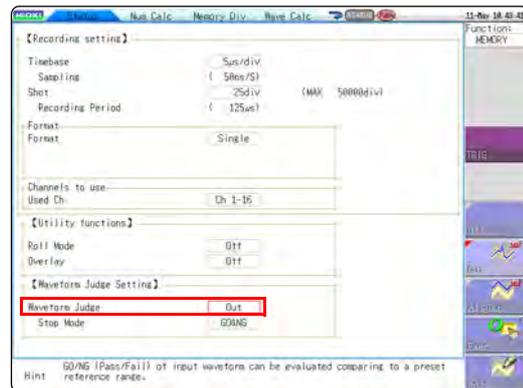
### Procedure Screen: STATUS

- 1 Move the flashing cursor to Waveform Judge.
- 2 Make the setting with the function keys.

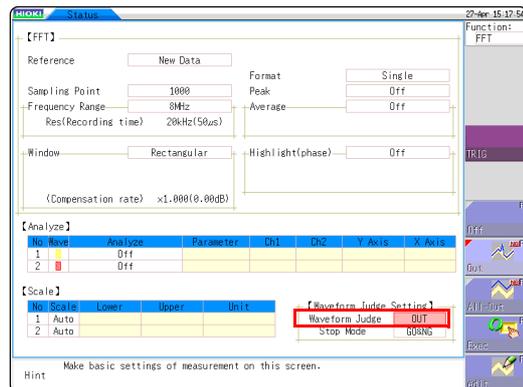
Select

Off	Disable waveform evaluation.
Out	Return NG if any part of the waveform leaves the evaluation area.
All out	Return NG if the entire waveform leaves the evaluation area.
exec	Enable waveform evaluation.
edit	Activate editor for setting up evaluation area.

### Function:MEMORY



### Function:FFT



## 14.4 Setting the GO/NG Stop Mode

When waveform evaluation is enabled (OUT or ALL OUT is selected), the "Stop mode" menu appears. Specify which evaluation option, GO or NG, should be used to stop the recording. The Auto Save and Auto Print functions are only executed when interruption conditions are satisfied.

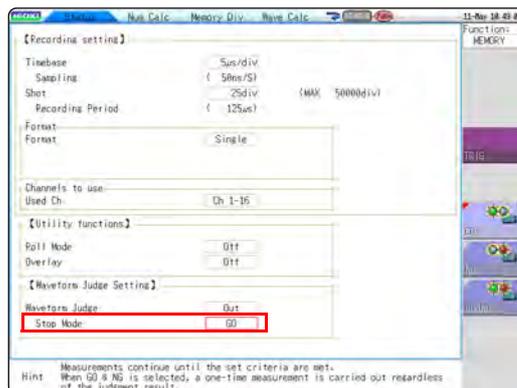
### Setting method

#### Procedure Screen: STATUS

- 1 Move the flashing cursor to the position Stop Mode.
- 2 Make the setting with the function keys.

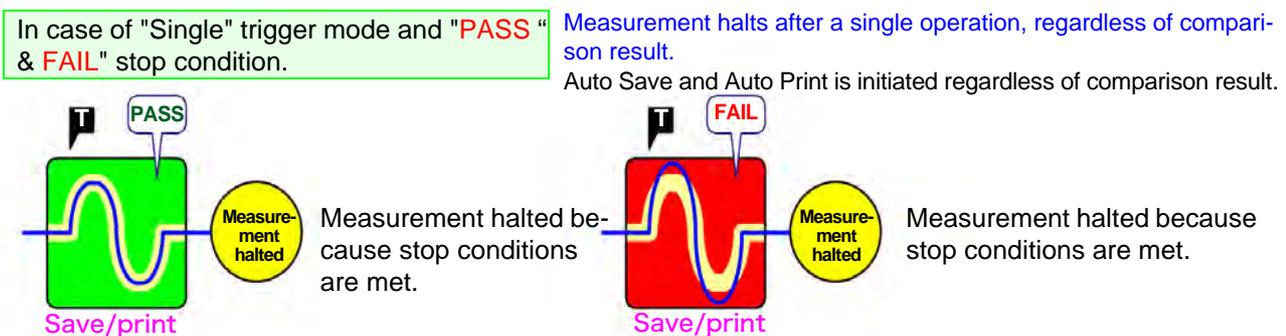
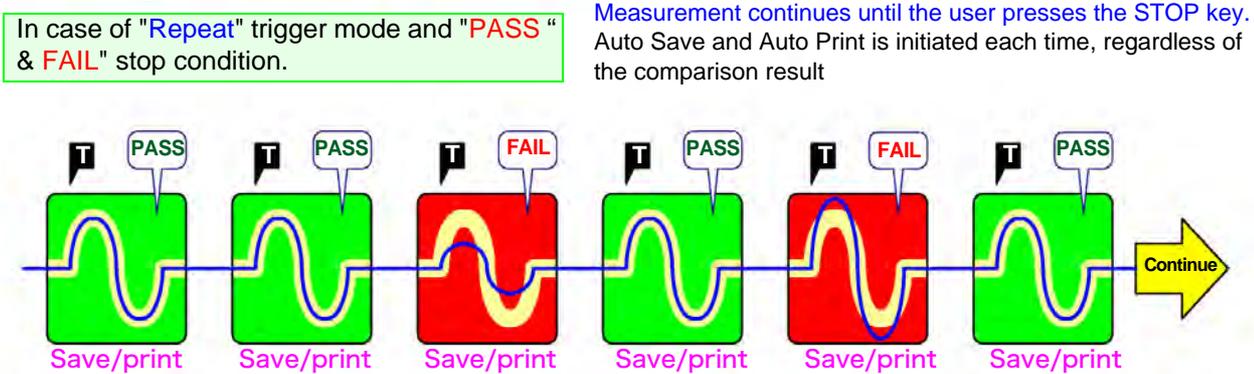
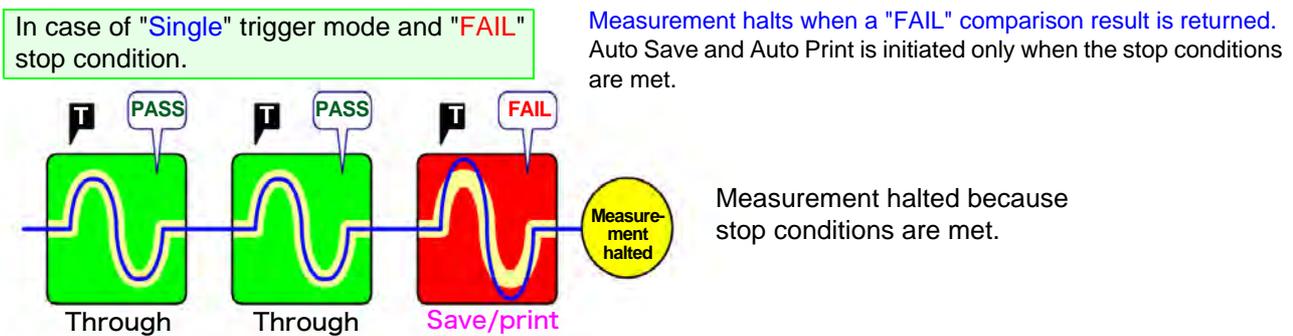
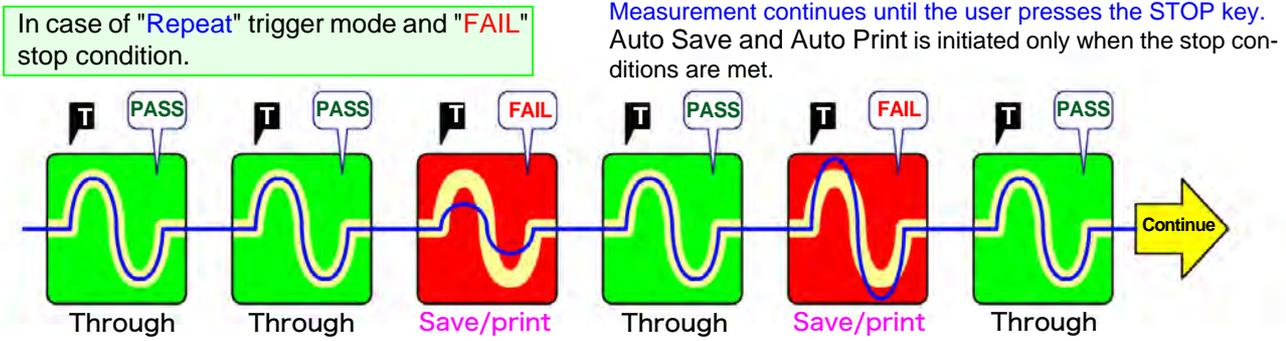
Select

GO	Stop recording on GO result.
NG	Stop recording on NG result.
GO or NG	Stop recording on GO or NG result.



**Relationship between stop conditions and the trigger mode**

- There are three trigger modes: Single, Repeat, and Auto.
- See: "9.2 Setting the Trigger Mode" (⇒ p.159)
- There are three stop conditions: PASS, FAIL, and PASS & FAIL.
- By combining a trigger mode and a stop condition, you can halt measurement when a desired comparison result is achieved. You can also automatically save, automatically print, or superimpose the waveform for the desired evaluation results. Automatic saving, automatic printing, and superimposition are performed when the stop conditions are met.



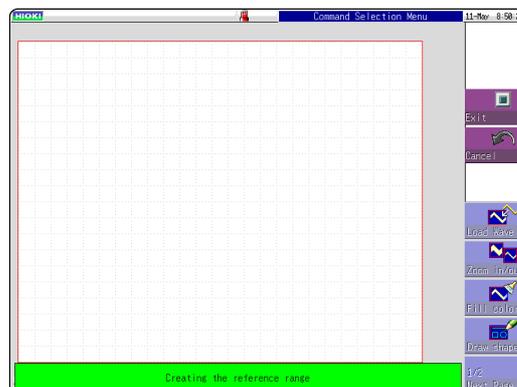
- conditions are met. Measurement continues until the stop conditions are met.
- When the "Repeat" or "Auto" trigger mode is set, measurement continues until the STOP key is pressed (or a STOP signal is input), whether or not the stop conditions are met.

## 14.5 Creating the Evaluation Area

### Setting method

#### Procedure Screen: Waveform display

- 1 Move the flashing cursor to the Waveform Judge item. Press the **[edit]** key.
- 2 Use these commands to create the evaluation area. You can also use the mouse to create an area.  
See: "1.4.2 Using a Mouse to Perform Key Operations" (⇒ p.16)
- 3 Select the **[Exit]** function key to terminate the editor.
- 4 Serves to store the created area in memory.



<b>Save and End</b>	Saves the created evaluation area in the instrument's internal memory and exits.
<b>Discard Changes and End</b>	Discards the created evaluation area and exits.

- 5 Save the evaluation area through the File screen or **SAVE** key, if necessary.  
See: "5.2 Saving Data" (⇒ p.73)

## 14.6 Editor Command Details



### Load Wave

The waveform shown on the Waveform screen is loaded into the editor and displayed.

#### Instructions

- 1 Press the **[Load Wave]** function key.
- 2 Select the type of waveform capture to perform. The waveform displayed on the Waveform screen will be loaded into the editor.

Select	
Waveform capture	Captures the storage waveform displayed on the Waveform screen.
Overlay capture	Captures overlay waveforms shown on the Waveform screen after connecting the uppermost and lowermost positions with the same display color and filling in the resulting enclosed space. When the waveforms are overlapping, undisplayed portions of the waveforms cannot be recognized. This option can be selected when an overlay has been drawn on the screen.
Memory segmentation reference waveform	Captures the memory segmentation reference waveform shown on the Waveform screen after connecting the uppermost and lowermost positions with the same display color and filling in the resulting enclosed space. When the waveforms are overlapping, undisplayed portions of the waveforms cannot be recognized. This option can be selected when an overlay has been drawn on the screen.

- 3 Press the **[Load Wave]** function key to exit waveform capture mode.



### Zoom in/out

Magnifies or compresses the waveform shown on the screen in the horizontal and vertical directions.

#### Instructions

- 1 Press the **[Zoom in/out]** function key.
- 2 Select whether to magnify or compress the waveform.
- 3 Set the amount of magnification or compression.
  - You can set values with the function keys, jog knob, or shuttle knob.
  - The amount of movement can be set in 0.04/div steps.

Execute	Performs magnification or compression processing based on the settings and creates an evaluation area.
Exit magnification/compression	Exits magnification/compression mode.



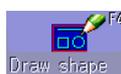
## Fill color

Fills in an enclosed area.

### Instructions

- 1 Press the **[Fill color]** function key.
- 2 Use the cursor keys to move the paintbrush mark  to the area to be filled in. Pressing speed up accelerates the movement of the mark. If the area is not completely enclosed, adjacent areas will also be filled in.

Execute	The area completely enclosed by lines is filled in.
Exit paint	Terminate the paint mode.



## Draw shape

Serves to draw a straight, square or a circle.

### Instructions

- 1 Press the **[Draw shape]** function key.
- 2 Select the figure you wish to draw.
- 3 Using the cursor keys, move the  mark to the origin of the figure. Pressing speed up accelerates the movement of the mark.
- 4 Pressing the **[Set]** function key sets the current position as the origin.
- 5 Moving the  mark draws a figure between the origin and the  mark.
- 6 Pressing **[Set]** again accepts the figure and causes its color to change. For straight lines, the origin is set at the accepted position. For other types of figure, accepting the figure has the same effect as pressing **[Cancel]**.
- 7 To draw another figure, press **[Select]** and select the figure type.
- 8 You can repeat steps (3) through (7) to draw figures as desired.
- 9 Press the **[Exit Draw shape]** key to exit figure mode.



## Eraser

Serves to erase unwanted sections.

Move the  mark with the cursor keys to erase parts of the image.

### Instructions

- 1 Press the **[Eraser]** function key.
- 2 Use the cursor keys to move the eraser mark  to the start point of the section to be erased.  
Pressing speed up accelerates the movement of the mark.
- 3 Pressing the **[Set]** function key allows you to erase figures while moving the eraser. Pressing **[Cancel]** allows you to move the eraser without erasing the figures.
- 4 Move the  mark in the **[Set]** state to erase the parts of figures you don't need.
- 5 Press the **[Exit Erase]** key to terminate the erase mode.



## Clear all

Clears the entire editor screen.

Press this key and clears the editor screen.



## Clear select area

Clears a specified rectangular area of the editor screen.

### Instructions

- 1 Press the **[Clear select area]** function key.
- 2 Using the cursor keys, move the  mark to the origin of the area to be erased.  
Pressing speed up accelerates the movement of the mark.
- 3 Pressing the **[Set]** function key sets the position as the origin.
- 4 Moving the  mark displays a rectangle drawn between the origin and the  mark.
- 5 Pressing **[Set]** again erases the area inside the rectangle.  
Pressing **[Cancel]** cancels the position of the origin.
- 6 Press the **[Exit Area Clear]** key to exit area clear mode.



## Invert colors

Reverses the colors of a filled-in area and the surrounding area.

Press this key. Displays filled in area in reverse.



## Cancel

Serves to undo the immediately preceding command.

It can be used with commands other than [Save and End] and [Discard and End].

Press this key and cancels the editor screen.



## Exit

Terminates the editor.

Press this key and select storing evaluation area in memory and quit editor or quitting editor without storing evaluation area in memory. If the **Exit** key is pressed without having done any editing or immediately after using the store command, the editor is terminated without confirmation.

**Note** :The waveform loaded into the editor will be displayed in a different color than was set with the original settings.

Save and End	Store evaluation area in memory and quit editor. <a href="#">See:"5.2 Saving Data" (⇒ p.73)</a>
Discard and End	Quit editor without storing evaluation area in memory. The created area is discarded.



# System Environment Settings

## Chapter 15

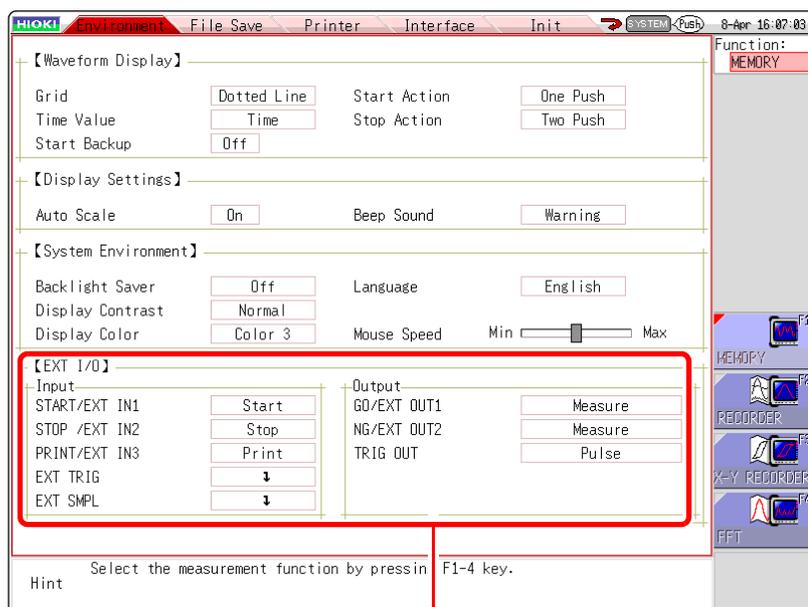
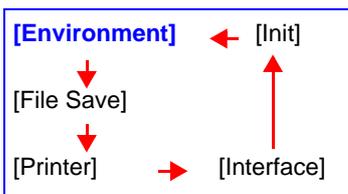
Use the System screen - **[Environment]** sheet to make system-related settings.

### Opening the **[Environment]** sheet

**SYSTEM**

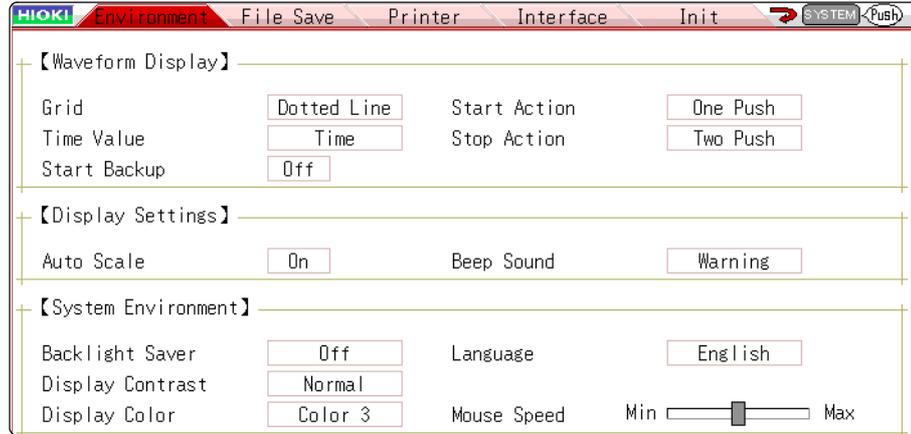


Pressing this key repeatedly displays the various sheets.



See: "Chapter 17 External Control" (=> p.313)

Setting Descriptions



**Grid** Select the grid (graticule) type for the waveform screen.

<b>Off</b>	No grid displayed.
<b>Dotted Line</b>	Display a dotted-line grid. (default setting)
<b>Solid Line</b>	Display a solid-line grid.

**Time Value** Display the time from the trigger point on the display.

<b>Time</b>	Display the time from the trigger point (fixed units). (default setting)
<b>Time (60)</b>	Display the time from the trigger point (sexagesimal (base-60) system).
<b>div</b>	Display the number of divisions (div) from the trigger point.
<b>Date</b>	Display time of waveform acquisition.
<b>Sample Num</b>	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 <b>[Color Edit]</b> change the <b>[R]</b> (red), <b>[G]</b> (green) and <b>[B]</b> (blue) values of each item to change its color. (⇒ p.280)						
<b>Color 1 / Color 2 / Color 3 / Color Edit</b>							
Beep Sound	This function audibly indicates warnings and operating conditions by beep sounds.						
<table border="1"> <tr> <td><b>Off</b></td> <td>Beep sounds are disabled.</td> </tr> <tr> <td><b>Warning</b></td> <td>Beeps sound for error messages (warning displays) and upon NG (fail) judgments. (default setting)</td> </tr> <tr> <td><b>Warn+Act</b></td> <td>In addition to the warning beeps above, beeps sound to indicate start, trigger, stop and auto-save-finish.</td> </tr> </table>		<b>Off</b>	Beep sounds are disabled.	<b>Warning</b>	Beeps sound for error messages (warning displays) and upon NG (fail) judgments. (default setting)	<b>Warn+Act</b>	In addition to the warning beeps above, beeps sound to indicate start, trigger, stop and auto-save-finish.
<b>Off</b>	Beep sounds are disabled.						
<b>Warning</b>	Beeps sound for error messages (warning displays) and upon NG (fail) judgments. (default setting)						
<b>Warn+Act</b>	In addition to the warning beeps above, beeps sound to indicate start, trigger, stop and auto-save-finish.						
Language	Selects the display language.						
<b>English (default setting) / Japanese / Korean / Chinese</b>							
Auto Scale	Variable values are automatically changed according to changes in scaling and voltage range. <b>See:</b> "8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)						
<b>Off / On (default setting)</b>							
Start Action	To prevent operating mistakes from unintentionally starting measurement, the <b>START</b> key operation method can be changed. This setting does not affect external control terminal functions.						
<table border="1"> <tr> <td><b>One Push</b></td> <td>Measurement starts by pressing once. (default setting)</td> </tr> <tr> <td><b>Two Push</b></td> <td>Measurement starts by pressing twice.</td> </tr> <tr> <td><b>Hold 2s*</b></td> <td>Measurement starts by pressing for two seconds.</td> </tr> </table>		<b>One Push</b>	Measurement starts by pressing once. (default setting)	<b>Two Push</b>	Measurement starts by pressing twice.	<b>Hold 2s*</b>	Measurement starts by pressing for two seconds.
<b>One Push</b>	Measurement starts by pressing once. (default setting)						
<b>Two Push</b>	Measurement starts by pressing twice.						
<b>Hold 2s*</b>	Measurement starts by pressing for two seconds.						
* When the <b>START</b> key is pressed, "Hold START key down." appears. After pressing for two seconds, the message disappears and measurement starts.							
Stop Action	Normally, pressing the <b>STOP</b> 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.						
<table border="1"> <tr> <td><b>Two Push</b></td> <td>Press the key twice to stop measurement. (default setting)</td> </tr> <tr> <td><b>One Push</b></td> <td>Press the key once to stop measurement.</td> </tr> </table>		<b>Two Push</b>	Press the key twice to stop measurement. (default setting)	<b>One Push</b>	Press the key once to stop measurement.		
<b>Two Push</b>	Press the key twice to stop measurement. (default setting)						
<b>One Push</b>	Press the key once to stop measurement.						
Mouse Speed	Sets the mouse movement speed. Use the mouse to move the square while holding down the left button. Moving it towards "Min" makes the mouse pointer move more slowly, while moving it towards "Max" makes the pointer move more quickly.						

## 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.127)

**[Custom Color]** screen

The screenshot shows the 'Custom Color' screen with a waveform display on the left and a list of color settings on the right. The waveform display shows two waves with peak values of 2.5400mV and 3.2800mV. The list of settings includes:

	R	G	B
Wave 1	7	0	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	5	5	5
Cursor A	0	0	5
Cursor B	0	4	0
Number	0	0	0
AllBack	6	6	6
WaveBack	7	7	7
SetBack	7	7	7
Waveform	3	6	6

Annotations on the right side of the screen indicate the following settings:

- Color setting for each waveform (points to the Wave 1-16 rows)
- Grid (graticule) color (points to the Grid row)
- Colors of cursor A and B lines (points to the Cursor A and B rows)
- Color of numerical values (points to the Number row)
- Background color (points to the AllBack row)
- Background color of the Waveform screen (points to the WaveBack row)
- Background color of the setting screen (points to the SetBack row)
- Evaluation area color (points to the Waveform row)

Select

Done

Applies the settings.

Reset

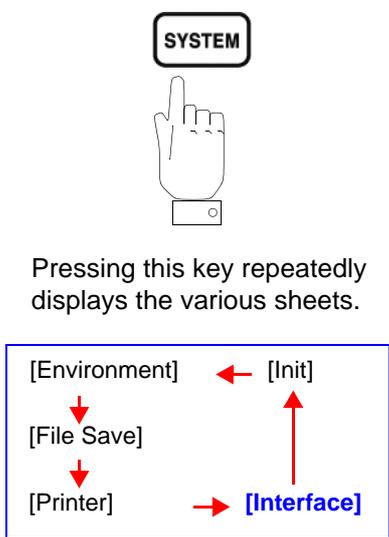
Reverts to the default settings.

# Connection to a Computer

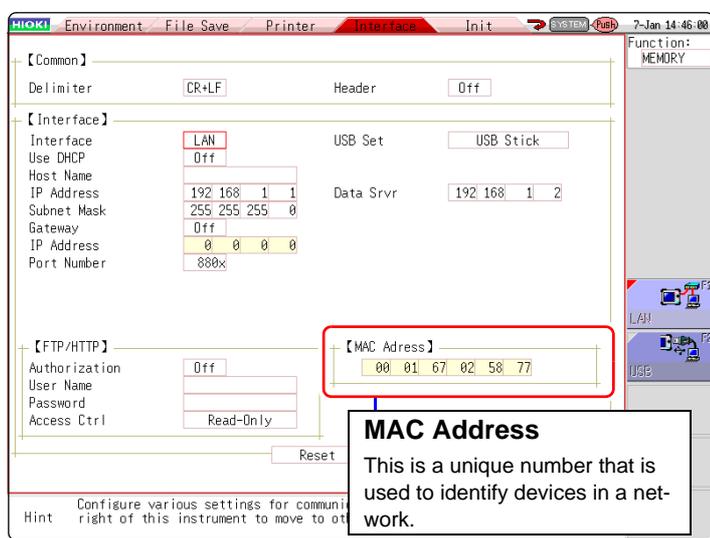
## Chapter 16

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.



**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.282)

- Connecting the instrument and a PC over a network
- Making 1:1 Connections between the instrument and a PC

**Accessing files on the instrument via FTP** (⇒ p.294)

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.

**Transfer data to a PC** (⇒ p.298)

**Controlling the instrument by command communications** (⇒ p.307)

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.

**USB connection and settings** (⇒ p.300)

**Remote control of the instrument using an Internet browser** (⇒ p.287)

**Operating the instrument remotely and acquiring data by using Model 9333 LAN Communicator** (⇒ p.311)

## 16.1 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.

### 16.1.1 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

<b>Interface</b>	Select LAN or USB.
<b>Use DHCP*</b> *: 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.
<b>Host Name</b>	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.
<b>IP Address</b>	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.
<b>Subnet Mask</b>	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.
<b>Gateway IP Address</b>	<b>For network connections:</b> When your PC (or the communicating device) is on another network than this instrument, set this to <b>[On]</b> 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.

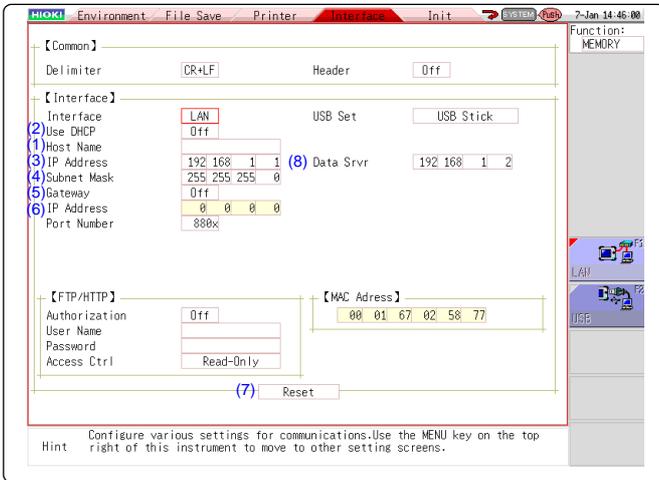
The "Password" item is displayed as "\*\*\*\*\*".

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.

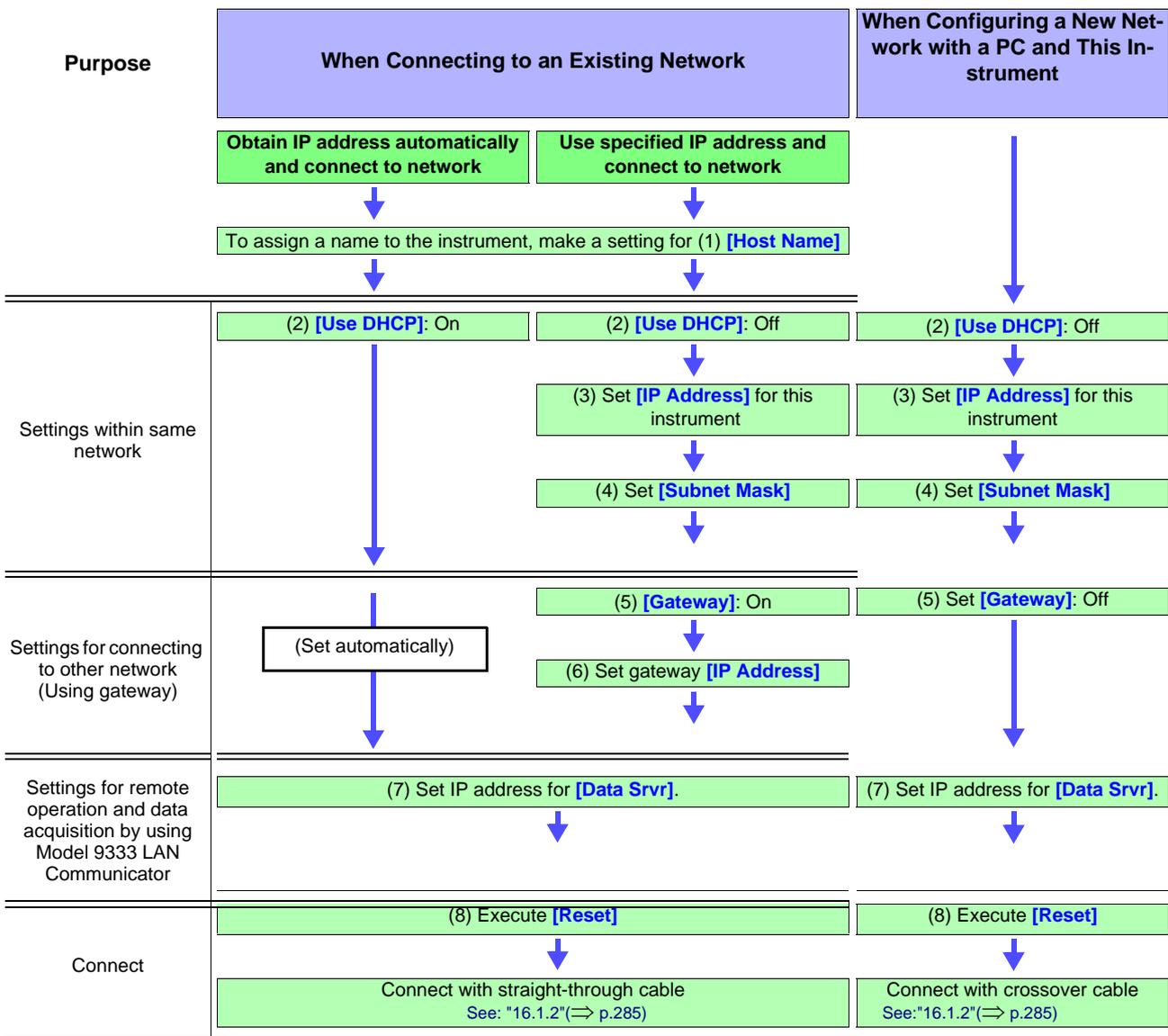


Use the **CURSOR** keys to move the settings cursor, and use the **F** keys to select a setting item.

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

For details on each setting, see "Setting Items" (⇒ p.283).

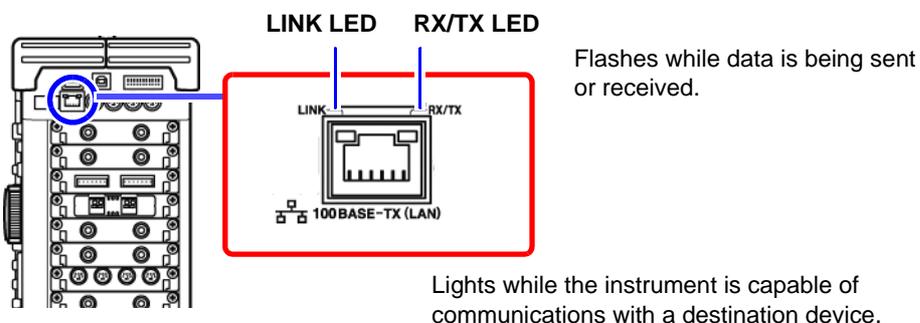
**About the network**  
For IP address information and other details about the network you are using, contact your network administrator.



## 16.1.2 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.



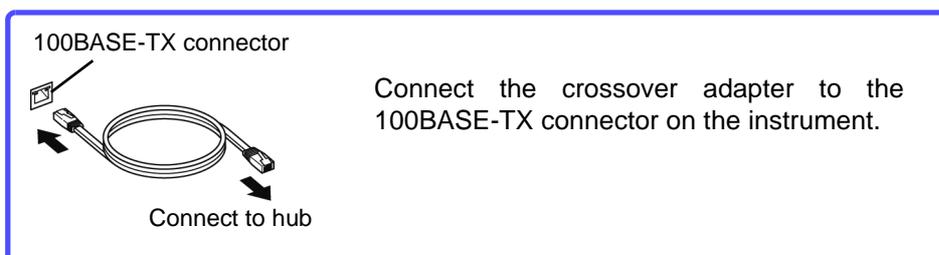
2. Connect the above LAN cable to the PC. There are two ways to do this.

### 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).

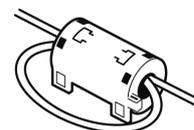
Connection cable: Use one of the following.

- 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)



### **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)

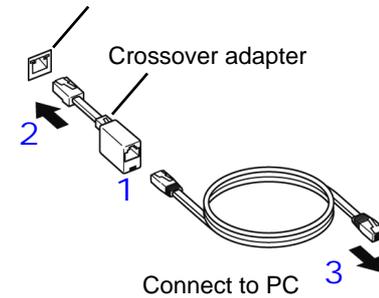
You can monitor and control the instrument from a PC by connecting the instrument to the PC with LAN cable (100BASE-TX cable)

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)

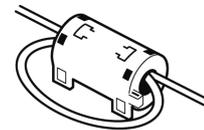
100BASE-TX connector



- 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: "16.2 Performing Remote Operations on the Instrument (Use an Internet Browser)" (⇒ p.287)

"16.3 Accessing the Files on the Instrument From a Computer (Using FTP)" (⇒ p.294)

"16.7 Controlling the Instrument with Command Communications (LAN/USB)" (⇒ p.307)

## 16.2 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.282), (⇒ p.285)**

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.

### 16.2.1 Making HTTP Settings on the Instrument

#### Procedure

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

#### 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.

The user name and password for authentication are used both for access via an Internet browser and FTP.

#### 2 (When **[On]** is selected) Set the user name and password for authentication.

Move the cursor to the **[User Name]** and **[Password]** items and enter suitable information.

See: "8.1.3 Alphanumeric Input" (⇒ p.127)

"Authorization User Name and Password" (⇒ p.283)

#### 3 Apply the setting.

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

Select **[Reflect Set]**.

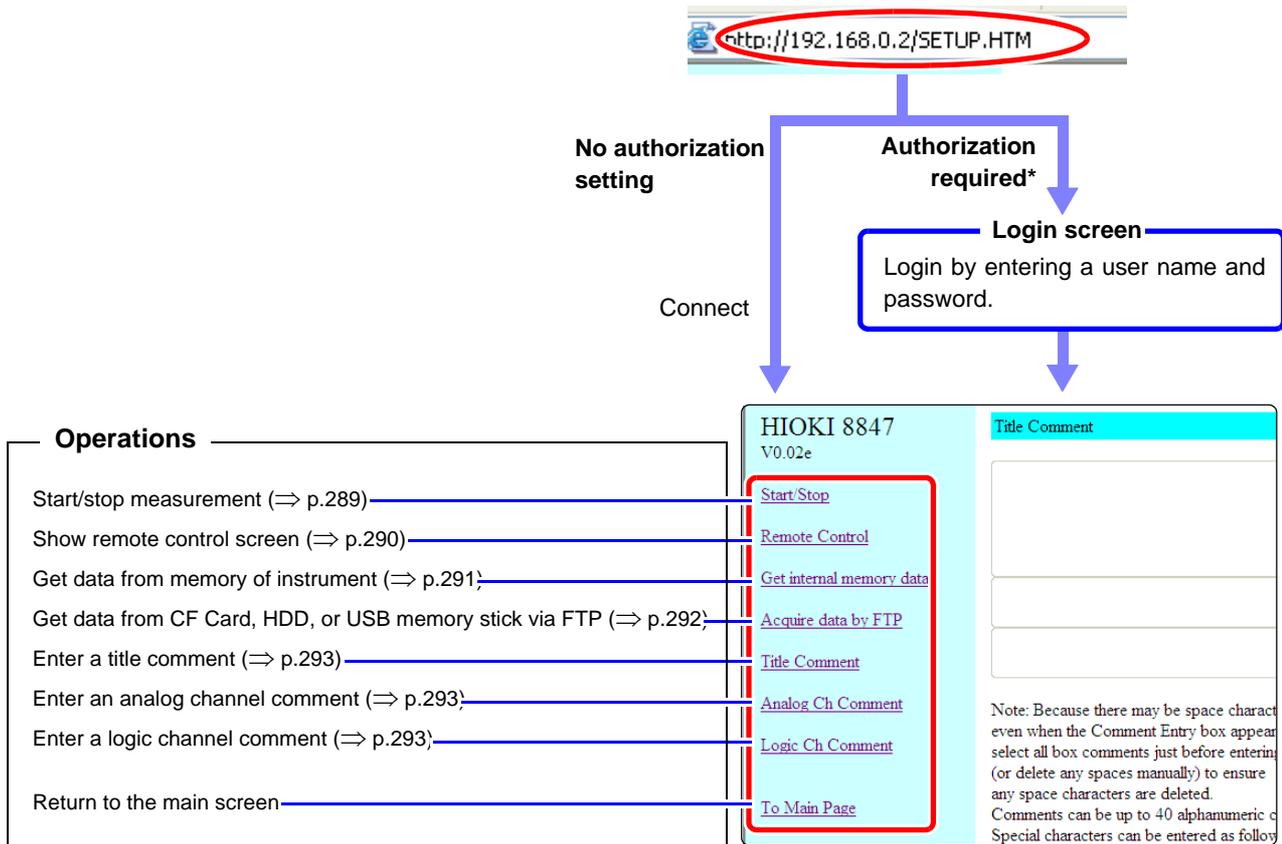
The indication "LAN was reconnected" appears at the bottom of the screen.

## 16.2.2 Connecting to the Instrument With an Internet Browser

The following example shows how to use the IE (Internet Explorer) browser on Windows 7.

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"



\*: When user name and password for authentication were set via System screen - **[Interface]** sheet  
 See: "16.2.1 Making HTTP Settings on the Instrument" (⇒ p.287)

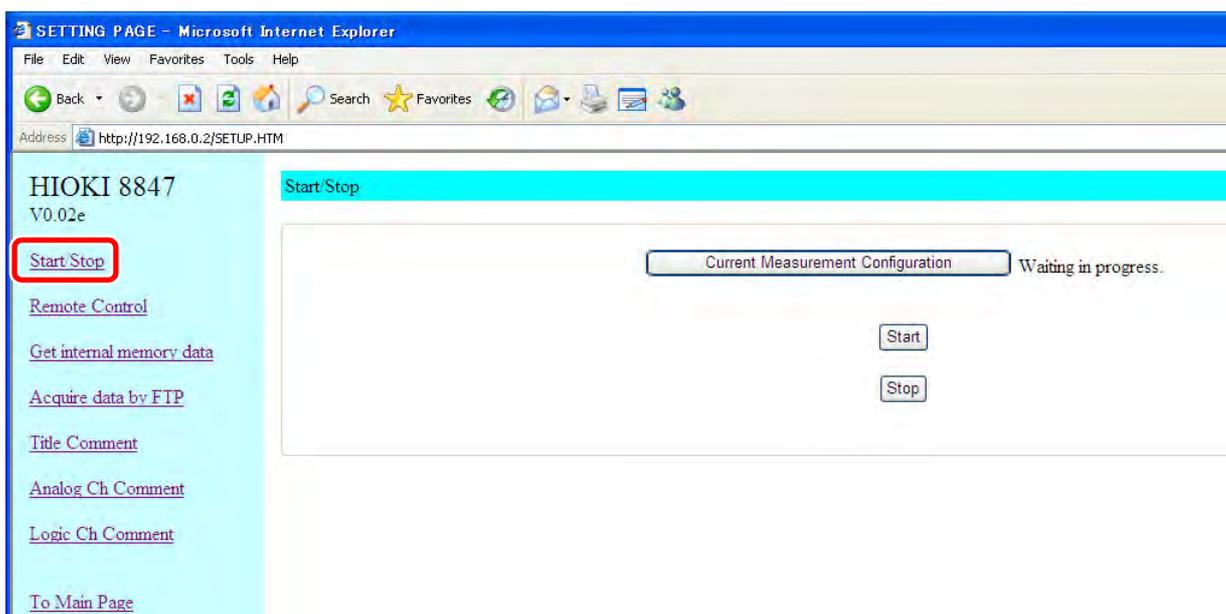
## 16.2.3 Operating the Instrument With an Internet Browser

### 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.



#### Procedure

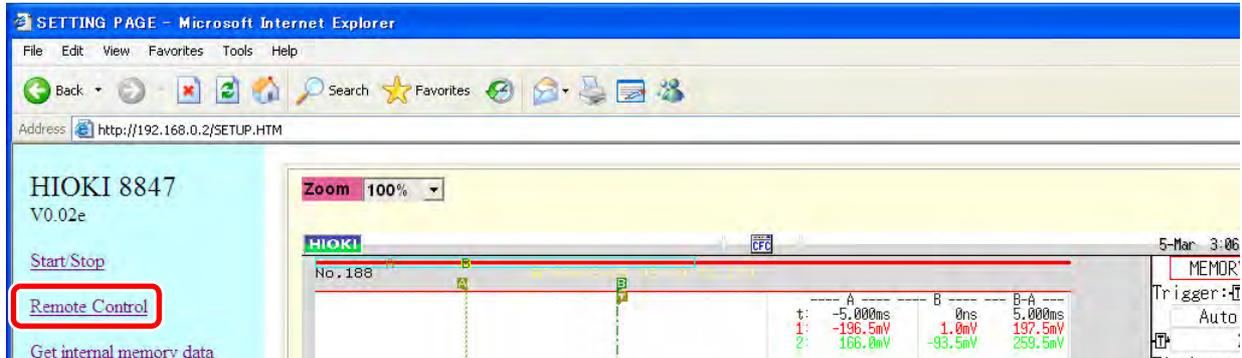
- Click **[Start]** to start the measurement.
- Click **[Stop]** to stop the measurement.
- Click **[Current Measurement Configuration]** to bring up information about the current measurement configuration on the screen.

### Remote Operation

The instrument can be controlled from a remote location.

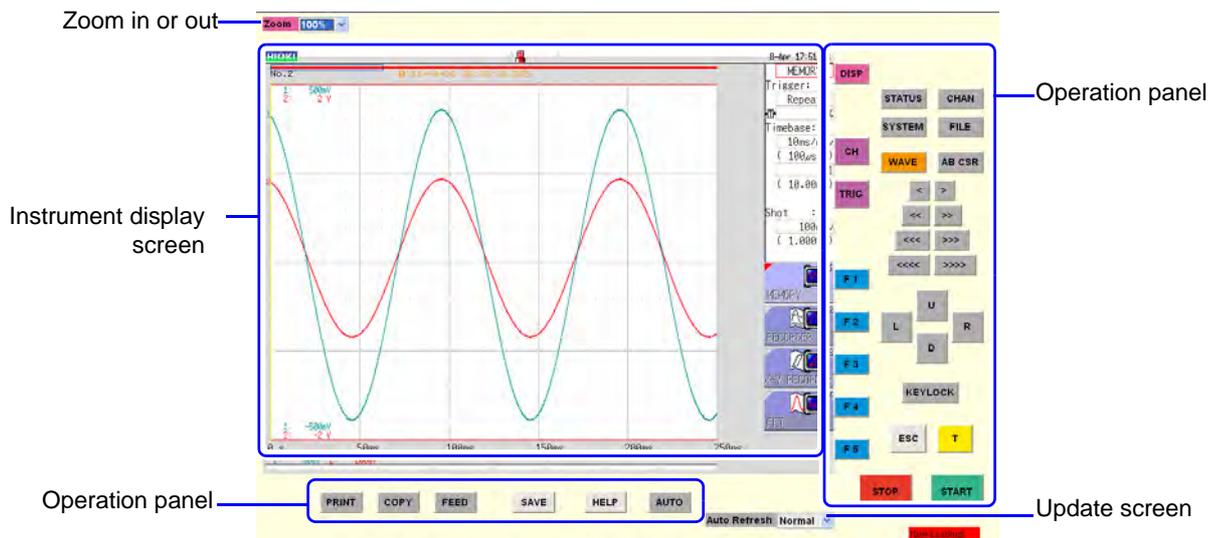
#### Remote Control Screen

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.

Zoom in or out



When Auto Update is enabled, screen information is sent from the instrument to the PC in regular intervals to keep the display updated.



#### Basic Operations

When you click a button on the operation panel, the instrument performs the same action as 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.287)
- The printing may be interrupted, if the printing has been made during the remote operation. Set display update speed to **[Slow]** or **[Very Slow]**.

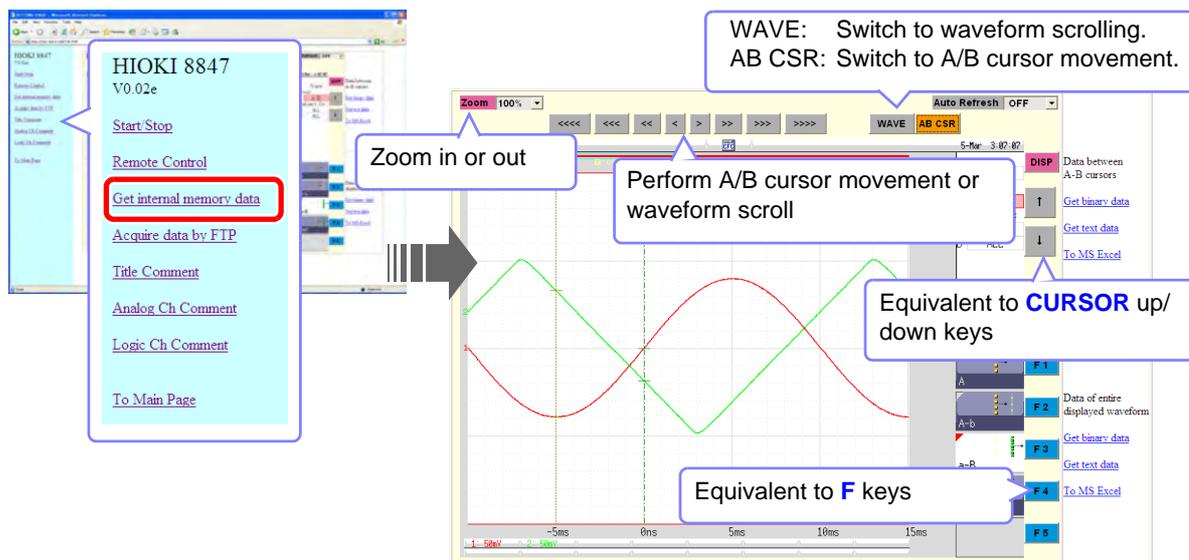
## Downloading Memory Data From Instrument

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



### 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.290)  
"7.1 Reading Measurement Values (Using the A/B Cursors)" (⇒ p.108)

- 2** Select one of the following choices for **[Data Select between A-B cursors]**.

<b>Get binary data</b>	Get binary data for range specified by A/B cursors.
<b>Get text data</b>	Get text data for range specified by A/B cursors.
<b>To MS Excel</b>	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 Select entire displayed waveform]**.

<b>Get binary data</b>	Get all data in binary format.
<b>Get text data</b>	Get all data in text format.
<b>To MS Excel</b>	Get all data in Excel format. (Data can be opened with Microsoft Excel)

### NOTE

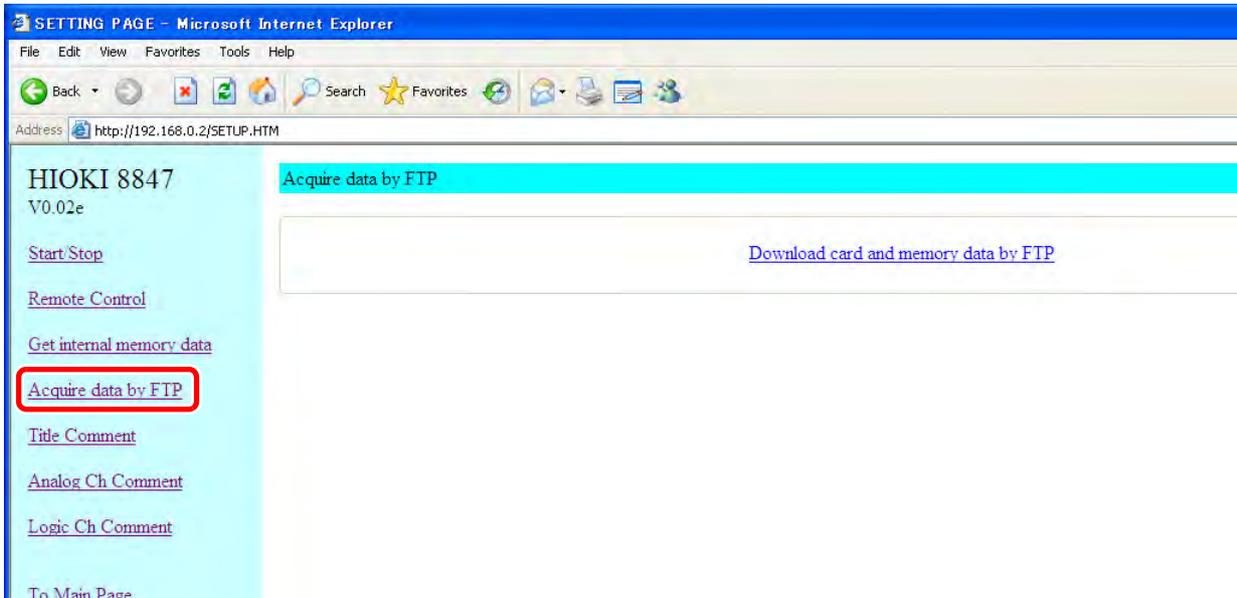
Getting data may not be possible when JRE has not been installed. (⇒ p.287)

## 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.



### Procedure

Click **[Download card and memory data by FTP]**.  
A list of folders is displayed.

For information on how to perform file operations, see "16.3.3 Using FTP for File Operations" (⇒ p.297).

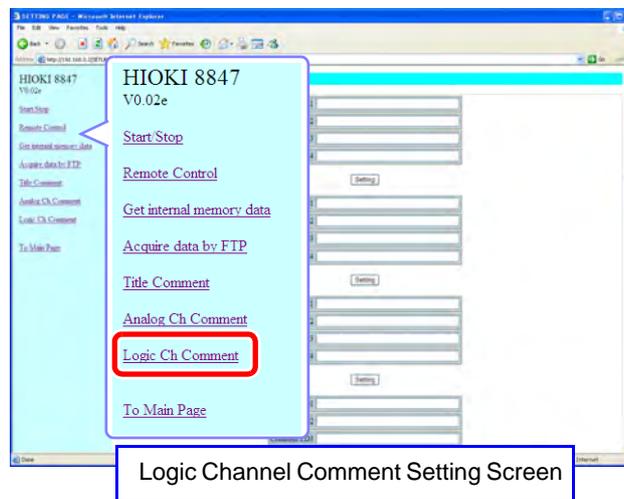
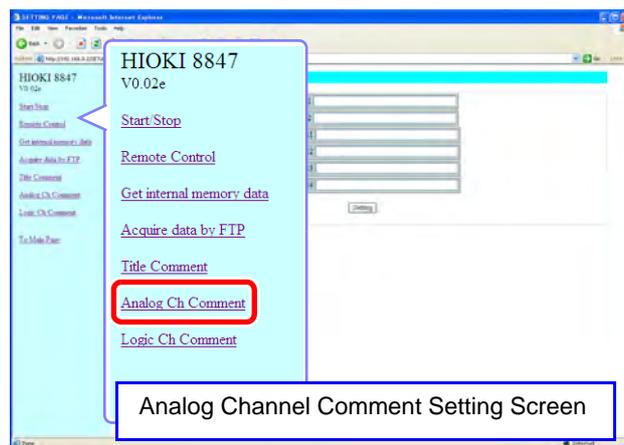
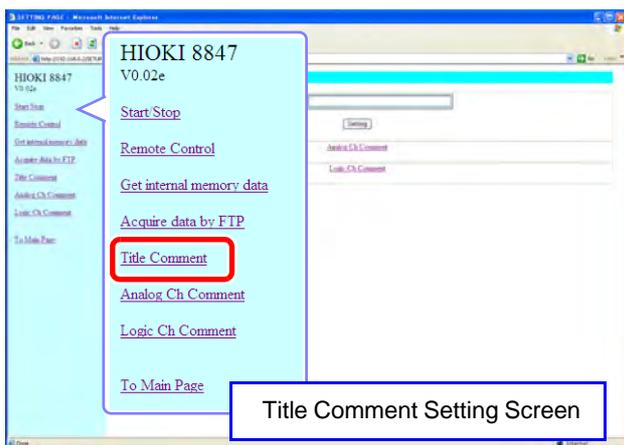
**Entering a Comment**

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.

Comment LC1

Comment LC2

Comment LC3

Comment LC4

Comment LD1

## 16.3 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: "16.1.1 Making LAN Settings at the Instrument" (⇒ p.282)  
 "16.1.2 Connecting Instrument and PC With LAN Cable" (⇒ p.285)

**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.

## 16.3.1 Making FTP Settings at the Instrument

### Procedure

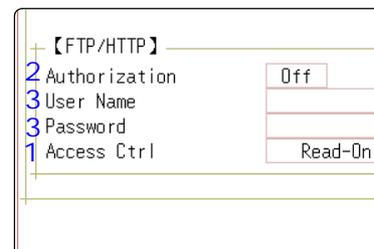
To open the screen: Press the **SYSTEM** key → **[Interface]** sheet

#### 1 Set the access restrictions.

Move the cursor to the **[Access Ctrl]** item.

Select

Read/Write	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.127)

"Authorization User Name and Password" (⇒ p.283)

#### 4 Apply the settings.

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

Select **[Reflect Set]**.

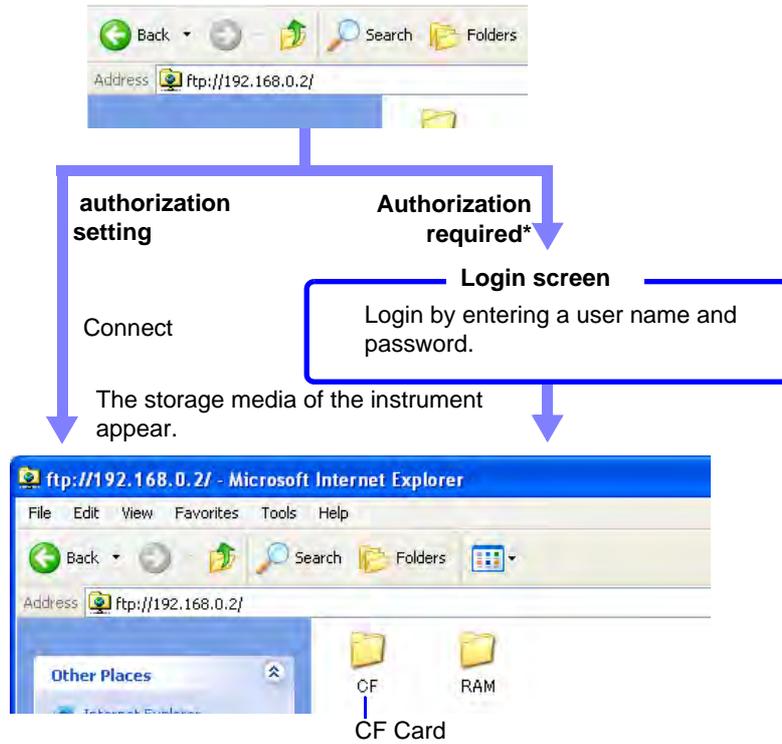
The indication "LAN was reconnected" appears at the bottom of the screen.

# 16.3.2 Using FTP to Connect to the Instrument

The following example shows how to use the IE (Internet Explorer) browser on Windows 7.

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":



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: "16.3.1 Making FTP Settings at the Instrument" (⇒ p.295)

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].



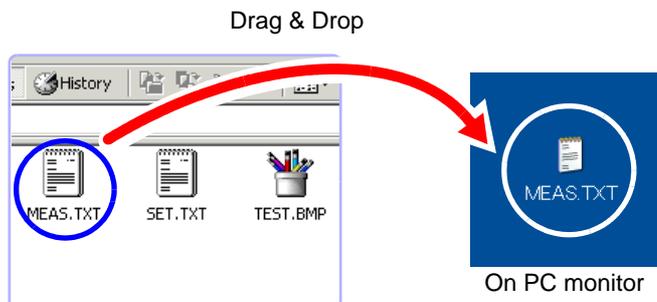
**If the connection fails**  
Check the communications settings of the instrument.  
See: " LAN Setup Workflow" (⇒ p.284)

## 16.3.3 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).

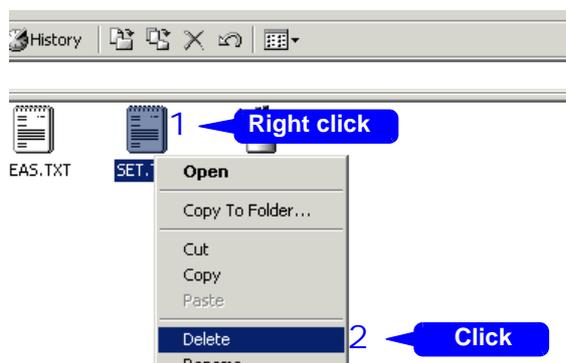
\*: Click the file and hold the button down. Move the mouse pointer to the target destination, and then release the button



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.



### **NOTE**

Files cannot be uploaded to the MR8847 from the computer. To copy a file to the MR8847's hard disk, use a USB memory stick or CF card.

## 16.4 Transferring Data to the PC

The supplied USB Cable can be used to transfer data from the HDD or CF card to a computer.

**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:"16.5"(⇒ p.299)

### Supported hardware

PC capable of running Windows XP, Vista 7 or 8.

### **CAUTION**

- During data transfer, do not disconnect the USB cable. Otherwise the transfer will not be completed normally.
- Ground the instrument and the computer at the same ground point. If the equipment is connected to different ground points, an electric potential will exist between the computer 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

- 2 Move the cursor to the **[USB Set]**, and select **[Mass storage HDD]** and **[Mass storage CF]**.

USB Set

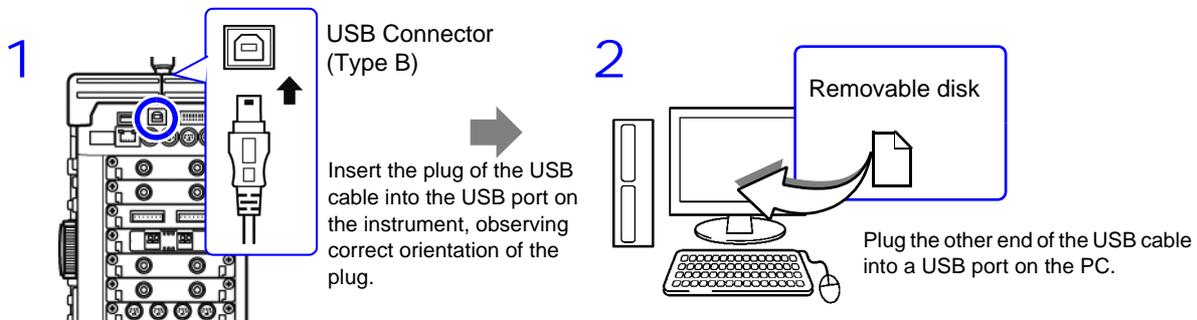
### **NOTE**

Operations to the USB memory stick, HDD or CF card 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.



When the connection is established, the computer will recognize the instrument as a removable disk. The computer can now access data on the HDD or CF card of the instrument.

## Disconnecting the USB Cable

To disconnect the USB Cable of the instrument from a computer that is currently running, use the "Safely Remove Hardware" icon and follow the prescribed steps.

## 16.5 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 XP, Windows Vista, Windows 7 or Windows 8.

### Installation (Windows 7)

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.

## 16.6 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.

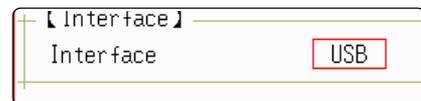
### 16.6.1 Making USB Settings at the Instrument

#### 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].



#### **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

### 16.6.2 Installing the USB Driver

Before connecting the instrument by USB, perform the following procedure to install the USB driver..

#### **NOTE**

Perform the installation with administrator privileges.

If you install the USB driver in Windows2000, the USB Drive Mode of the device will be disabled.

#### Installing the Driver

- 1 Run [HiokiUsbCdcDriver.msi] in the CD-R X:\Driver folder.  
([X] indicates the CD-ROM drive. The letter will differ depending on the computer.)

#### **NOTE**

Depending on the environment, the dialog box may take some time to appear so please wait till it does so.

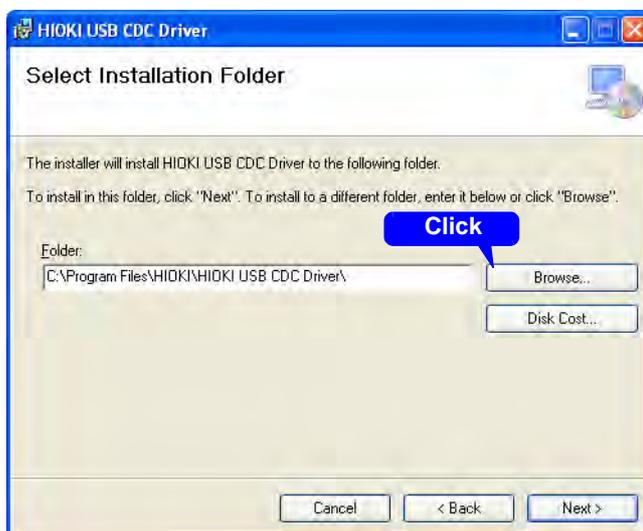
2 Click **[Next]**.



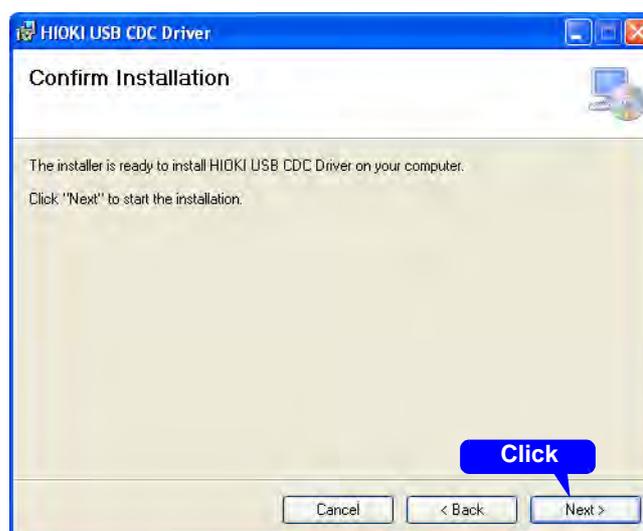
3 Click **[Next]**.

**When you want to change the installation destination.**

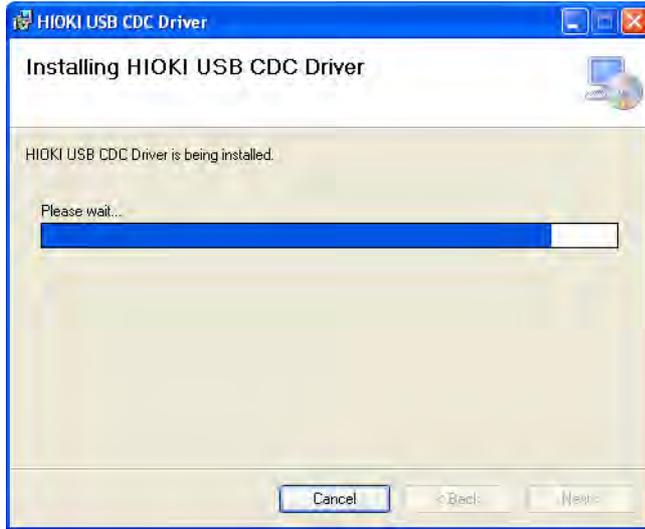
Click **[Browse...]** to change the folder to install into. Normally, there is no need to change.



4 Click **[Next]** to start installing.



Installing



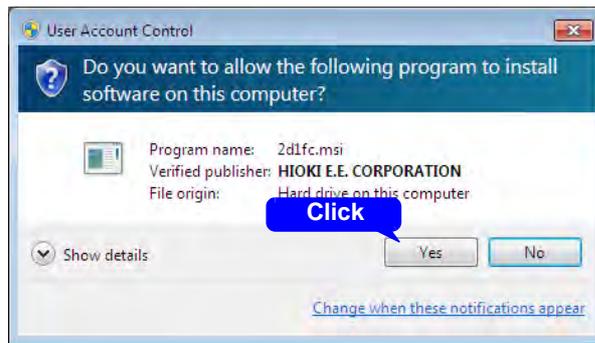
For WindowsXP

During the installation, a message saying that the software has not passed Windows Logo testing will appear a few times, click **[Continue Anyway]** to continue installing.



For WindowsVista/7/8

When a dialog box requesting your permission to continue the program appears, click **[Yes]**.

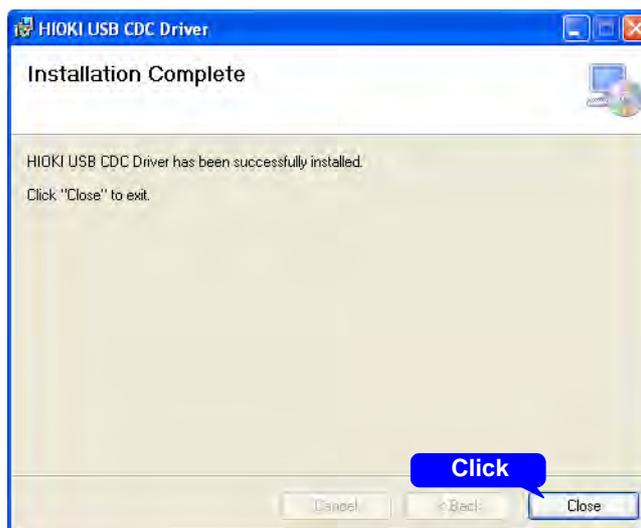


Sometimes another dialog box requesting your permission to install the software may appear. When it does, check **[Always trust software from "HIOKI E.E. CORPORATION"]** and click **[Install]** to continue.



- 5** When installation is completed and the dialog box appears, click **[Close]** to exit.

This completes the driver installation.



## Connecting the Instrument and Computer

Computer Requirements: A personal computer running Windows XP, Vista 7 or 8.

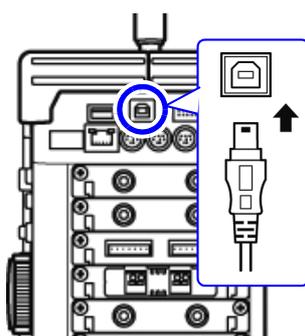
### **CAUTION**

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

### **NOTE**

If you connect the USB cable while both the instrument and the computer are off, be sure to turn on the computer first. If you turn them on in the wrong order, communication between the instrument and computer will not be possible.

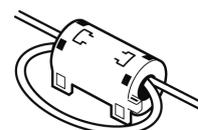
- 1** Connect the AC adapter to the instrument and turn the power on.



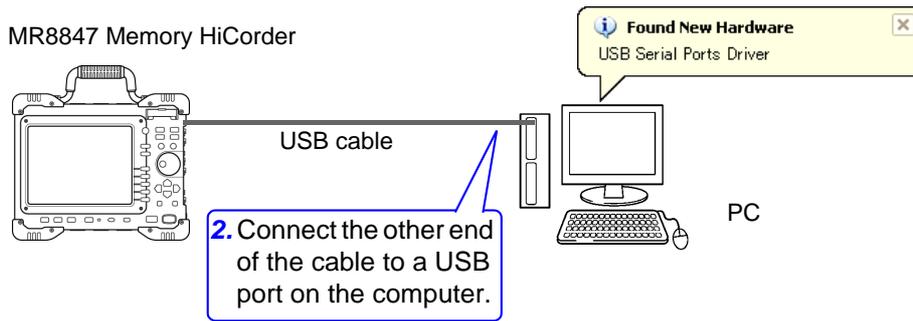
1. Plug the USB cable supplied with the instrument into the USB connector (Type B) on the right side of the instrument.
2. Connect the other end of the cable to the USB port on the PC.

### **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.



2



The first time you connect the instrument and computer, perform the following procedure to enable the computer to recognize the instrument.

**For Windows Vista/ 7/ 8**

The instrument is recognized automatically, and the preparation to use the device completes.

**For WindowsXP**

A [Found New Hardware Wizard] dialog box will appear and the new hardware detection wizard will begin.

- 1 Check [No, not this time] and click [Next].



- 2 Check [Install the software automatically (Recommended)] and click [Next].



Please wait while the driver is being installed.



### 3 Click **[Continue Anyway]**.

A message saying that the software has not passed Windows Logo testing will appear a few times, click **[Continue Anyway]** to continue installing.



### 4 When installation is completed and the dialog box appears, click **[Finish]** to exit.

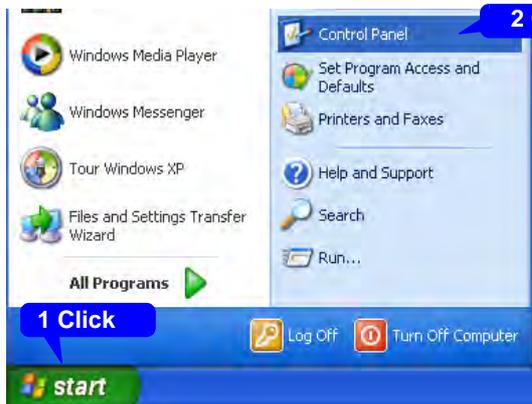
This completes the driver installation.



## Uninstalling the USB Driver

When the USB driver is no longer needed, uninstall it with the following procedure.

- 1 From the Windows Start menu, select the **[Control Panel]**, and double click **[Add or Remove Programs]**.



The **[Add or Remove Programs]** screen appears.

- 2 From the list of installed programs, select **[HIOKI USB CDC Driver]**, and remove it. You are returned to the **[Add or Remove Programs]** screen.

## 16.7 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"16.1"(⇒ p.282), USB"16.6"(⇒ p.300)



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

<b>Delimiter</b>	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.
<b>Header</b>	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.
<b>Command Port (Port number) (LAN only)</b>	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.

### 16.7.1 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.307)

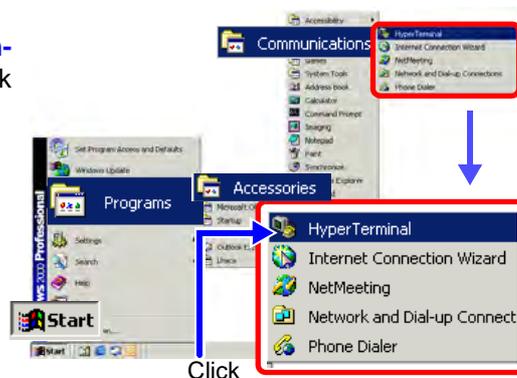
1 Delimiter	LF
2 Header	Off
3 Port Number	690x

## 16.7.2 Communication Command Setting

The following example shows how to make a connection using the telnet software (HyperTerminal) supplied with Windows XP.

### 1 Launch HyperTerminal.

Click **[Start]**, **[Programs]** - **[Accessories]** - **[Communications]** - **[HyperTerminal]**, and then click **[HyperTerminal]**.

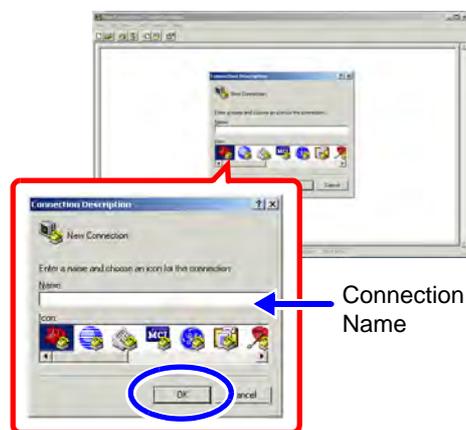


The HyperTerminal screen appears.

### 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.

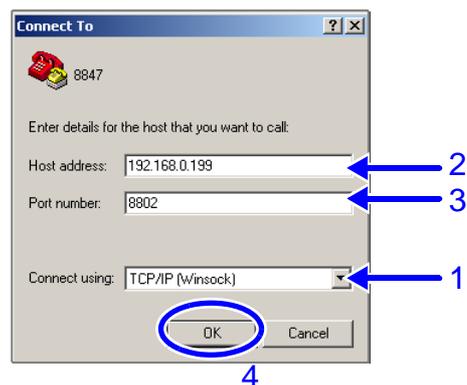
1. In **[Connect using]** select **[TCP/IP (Winsock)]**.
2. In **[Host address]**, enter the IP address of the instrument.
3. In **[Port number]**, enter the port number specified in the **[Interface]** sheet.

#### 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.307)

4. Click the **[OK]** button.

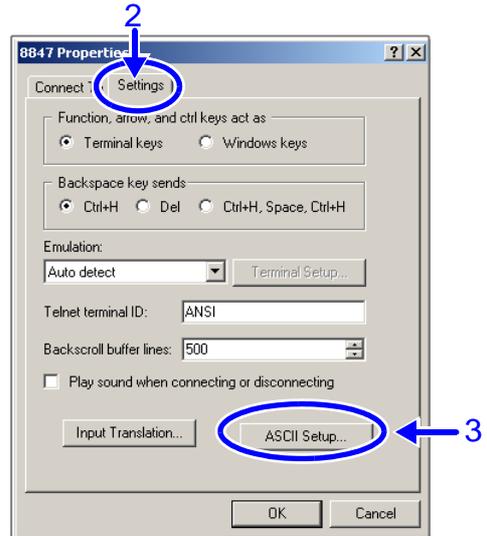


The connection is made.

### 4 Make detailed connection settings.

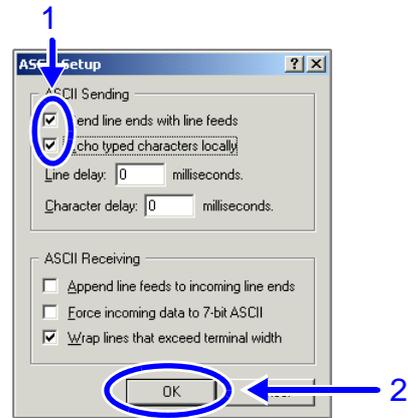
1. Select **[Properties]** in the **[File]** menu.  
The Properties dialog for the specified connection name appears.
2. Click the **[Settings]** tab.
3. Click the **[ASCII Setup...]** button.

The **[ASCII Setup]** dialog appears.



### 5 Make detailed settings

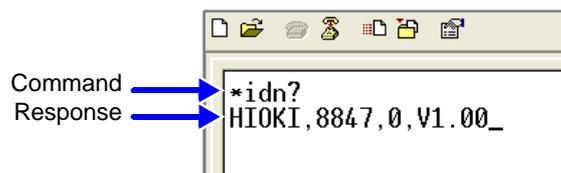
1. Check the **[Send line ends with line feeds]** and **[Echo typed characters locally]** check boxes.
2. Click the **[OK]** button to return to the Properties dialog.
3. Click the **[OK]** button to return to the HyperTerminal window.



### 6 Try sending a command.

Enter `"*idn?"` and press the Enter key.

A response is returned from the instrument.



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.

<b>Bits per second</b>	19200
<b>Data bit</b>	8
<b>Parity</b>	None
<b>Stop bit</b>	1
<b>Flow control</b>	None

## 16.8 Operating the instrument remotely and acquiring data by using Model 9333 LAN Communicator

Model 9333 LAN Communicator, which is the optional communication program for PCs, enables the PC to control the instrument remotely and to store data directly.

Additionally, Model 9333 enables waveforms to be printed from a printer connected to the PC.

### Procedure

#### 1 Setting the data collection server

Specify the IP address of the PC on which Model 9333 LAN Communicator is running to communicate with the instrument.

The IP address is required to acquire data by using Model 9333 LAN communicator.

As necessary, set "LAN:\\" as the save destination on the [\[File Save\]](#) sheet, and set "LAN" as the output destination of the Print Key operation and the Auto Print setting.



#### 2 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.



# External Control Chapter 17

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.



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



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.

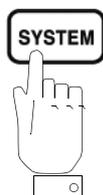


The ground pins of external control connectors are not isolated from the instrument's ground. Connect so that no potential difference arise between external control connector ground and the ground of the connection object. Failure to observe this precaution can result in damage to the connection object and the instrument.

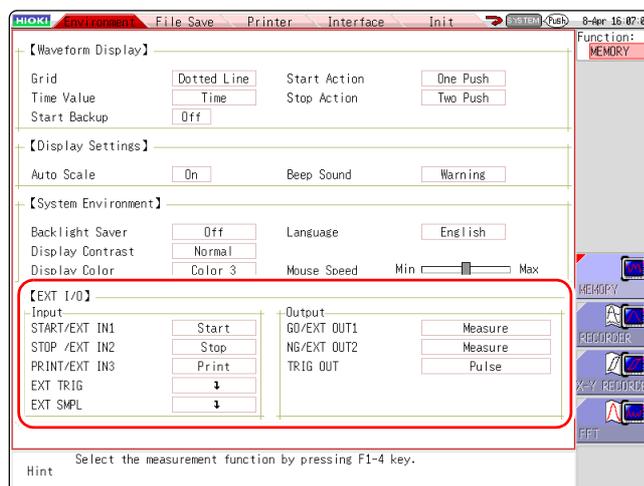
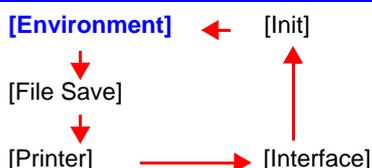


Signals input to the external control terminals take effect even when the operating keys are locked.

## Opening the [Environment] sheet



Pressing this key repeatedly displays the various sheets.

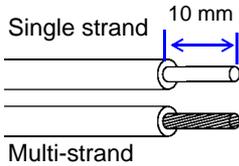


# 17.1 Connecting External Control Terminals

The method for connecting to the external control terminals is as follows.

## Connecting External I/O Terminals (Connector Blocks)

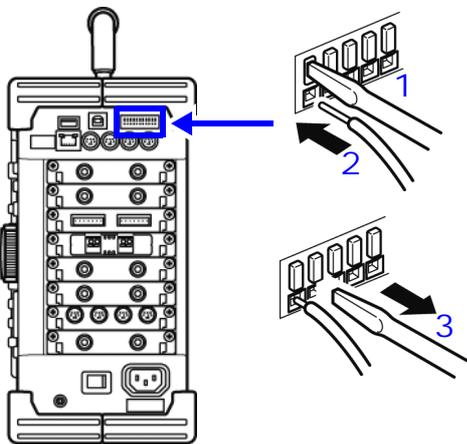
### Cables to connect



Recommended cables:  
 single strand diameter:  $\phi$  0.65 mm (AWG22)  
 multi-strand: 0.32 mm<sup>2</sup> (AWG22)

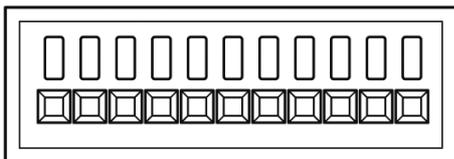
Usable cables:  
 Single strand diameter:  $\phi$  0.32 - 0.65 mm (AWG28 to 22)  
 Multi-strand: 0.08 - 0.32 mm<sup>2</sup> (AWG28 - 22)  
 Strand diameter:  $\phi$  0.12 mm or greater (per wire)  
 Standard insulation stripping length: 9 - 10 mm  
 Button operation specified tool: Flat-blade screwdriver ( $\phi$  3 mm shaft diameter, 2.6 mm tip width)

### 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.



1 2 3 4 5 6 7 8 9 10 11  
 START/EXT.IN1 STOP/EXT.IN2 PRINT/EXT.IN3  
 GND GO/EXT.OUT1 NG/EXT.OUT2  
 GND EXT.SMPL EXT.TRIG  
 TRIG OUT

Terminal No.	Operation
1	Input external signal and execute the following
2	
3	
4	-
5	Output instrument status as a signal
6	
7	-
8	Input external signal and set sampling rate
9	-
10	Output signal when triggering occurs

## 17.2 External I/O

### 17.2.1 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  $\overline{\text{START/EXT.IN1}}$ ,  $\overline{\text{STOP/EXT.IN2}}$ ,  $\overline{\text{PRINT/EXT.IN3}}$ , and GND terminals.  
See: "17.1 Connecting External Control Terminals" ( $\Rightarrow$  p.314)
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.

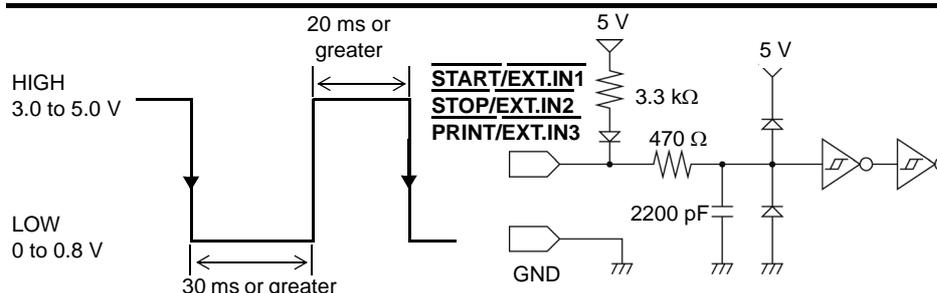
Select	
Start	Start measurement. (Is not affected by <b>[START Action]</b> ( $\Rightarrow$ p.279))
Stop	Stop measurement. (Operations after measurement, such as numerical calculations and automatic saving will be carried out)
Start/Stop	Start measurement on LOW level, and stop measurement on HIGH level.
Abort	Stop measurement immediately. (Operations after measurement, such as numerical calculations and automatic saving will not be carried out)
Print	Same operation as <b>PRINT</b> key (Not valid during Selective Printing ( $\Rightarrow$ p.99))
Save	Save to the media specified for the <b>SAVE</b> key, according to the specified conditions. (Not valid during Selective Saving ( $\Rightarrow$ p.79))
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]** ( $\Rightarrow$  p.279).
  - 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.

<b>Voltage range</b>	HIGH level: 3.0 to 5.0 V , LOW level: 0 to 0.8 V
<b>Pulse width</b>	HIGH level: 20 ms or greater, LOW level: 30 ms or greater
<b>Maximum input voltage</b>	-0.5 to 7 V



## 17.2.2 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  $\overline{\text{GO/EXT.OUT1}}$ ,  $\overline{\text{NG/EXT.OUT2}}$ , and GND terminals to the device(s) to be controlled by single wires.  
See: "17.1 Connecting External Control Terminals" ( $\Rightarrow$  p.314)
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 

<b>Measure</b>	A LOW signal is output when the judgment result is GO (pass).
<b>Waveform Evaluation</b>	A LOW signal is output when the waveform evaluation result is GO (pass).
<b>Value Evaluation or Waveform Evaluation</b>	A LOW signal is output when either the value calculation or waveform calculation evaluation result is GO (pass).
<b>Value Evaluation and Waveform Evaluation</b>	A LOW signal is output when both the value calculation and waveform evaluation result are GO (pass).
<b>Error</b>	Output a LOW level signal when an error occurs.
<b>Busy</b>	A LOW signal is output when external start operation is disabled, such as during startup, saving, and printing.
<b>Trigger</b>	Output a LOW level signal while instrument is waiting for a trigger.

GO evaluation result output (low level output) is held until the next measurement starts.

(when the **[NG/EXT OUT2]** item is selected)

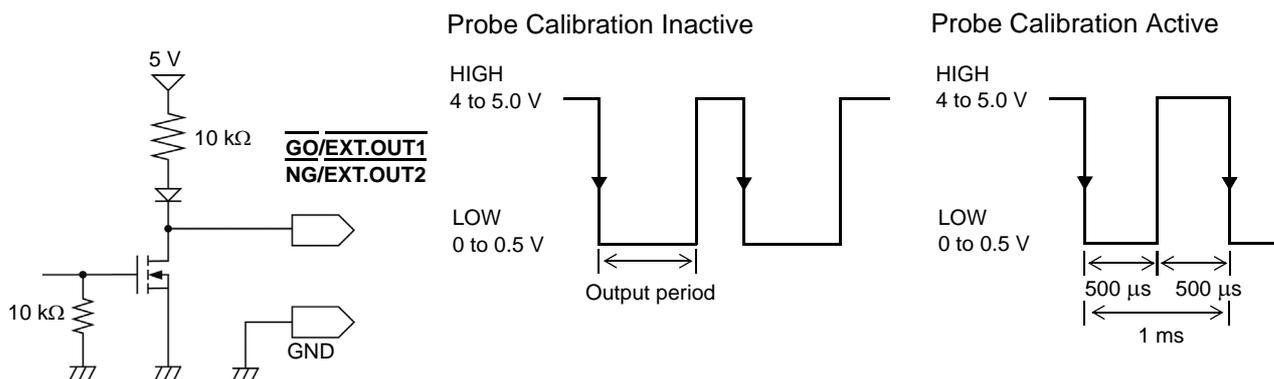
Select 

<b>Measure</b>	A LOW signal is output when the judgment result is NG (fail).
<b>Waveform Evaluation</b>	A LOW signal is output when the waveform evaluation result is NG (fail).
<b>Value Evaluation or Waveform Evaluation</b>	A LOW signal is output when either the value calculation or waveform calculation evaluation result is NG (fail).
<b>Value Evaluation and Waveform Evaluation</b>	A LOW signal is output when both the value calculation and waveform evaluation result are NG (fail).
<b>Error</b>	Output a LOW level signal when an error occurs.
<b>Busy</b>	A LOW signal is output during measurement, saving, and printing, and when it's finished, a HIGH signal is output.
<b>Trigger</b>	Output a LOW level signal while instrument is waiting for a trigger.
<b>Calibration</b>	1 kHz output for calibrating Model 9665 10:1 Probe and the 9666 100:1 Probe.

NG evaluation result output (low level output) is held until the next measurement starts.

**4.** The signal for the specified state is output.

<b>Output signal</b>	Open drain output (with voltage output) active LOW
<b>Output voltage range</b>	HIGH level: 4.0 to 5.0 V, LOW level: 0 to 0.5 V (current value: 15 mA)
<b>Maximum input voltage</b>	50 VDC, 50 mA, 200 mW



## 17.2.3 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.

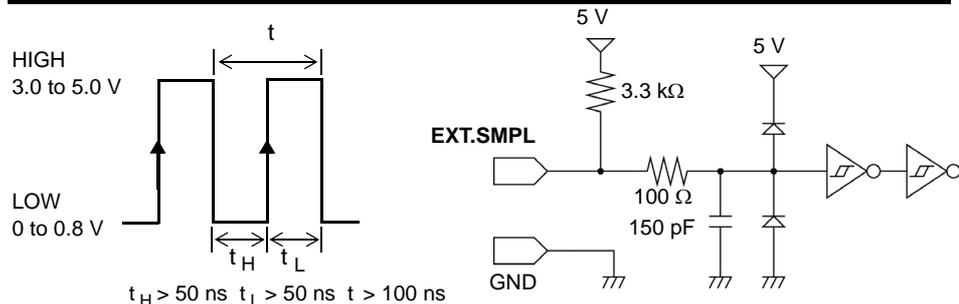
### Signal Input Procedure

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 <b>[On]</b>			When the Roll Mode is set to <b>[Off]</b>		
	$t_H$	$t_L$	t	$t_H$	$t_L$	t
↑	> 5 $\mu$ s	> 5 $\mu$ s	> 10 $\mu$ s	> 50 ns	> 50 ns	> 100 ns
↓	> 5 $\mu$ s	> 5 $\mu$ s	> 10 $\mu$ s	> 50 ns	> 50 ns	> 100 ns

<b>Voltage range</b>	HIGH level: 3.0 to 5.0 V, LOW level: 0 to 0.8 V
<b>Pulse width</b>	HIGH, LOW level: 50 ns or greater
<b>Response frequency</b>	10 MHz or lower
<b>Maximum input voltage</b>	-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  $\mu$ s to 200  $\mu$ s after the first sampling clock has been entered, and
  - (2) Clock 2 when no signals are detected in the period (1) above.

## 17.2.4 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  $\overline{\text{TRIG OUT}}$  and GND terminals.  
See: "17.1 Connecting External Control Terminals" ( $\Rightarrow$  p.314)
2. Press the **SYSTEM** key to open the **[Environment]** sheet, and move the cursor to **[TRIG OUT]**.
3. Select the output signal type for the trigger output terminal.

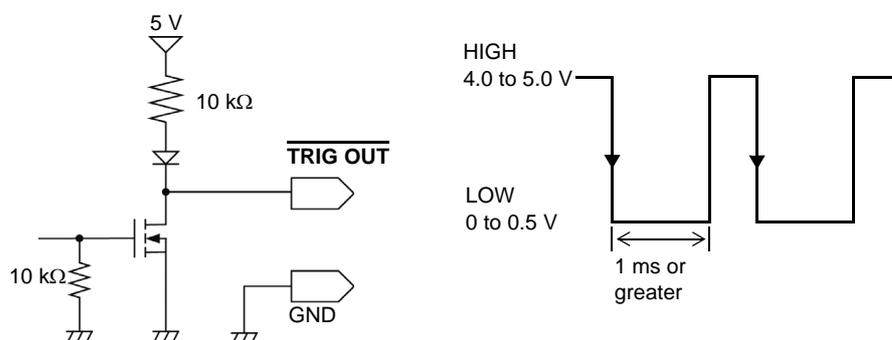
Select 

<b>Pulse</b>	After LOW level output, the signal goes HIGH after a specified interval.
<b>Level</b>	After the trigger is established, a LOW level signal will be outputted during the waveform retrieval.

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  $\overline{\text{TRIG OUT}}$  terminal.

<b>Output signal</b>	Open drain output (with voltage output), active LOW*
<b>Output voltage range</b>	HIGH level: 4.0 to 5.0 V, LOW level: 0 to 0.5 V (current value:15 mA)
<b>Pulse width</b>	Pulse width at pulse setting time : 2 ms $\pm$ 1 ms Pulse width at level setting time: (sampling rate $\times$ no. of data points after trigger) or more
<b>Maximum input voltage</b>	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  $\mu\text{s}/\text{div}$  to 100  $\mu\text{s}/\text{div}$
  - The record (measurement) time is 5 ms or less
  - Tracking wave display is [OFF].

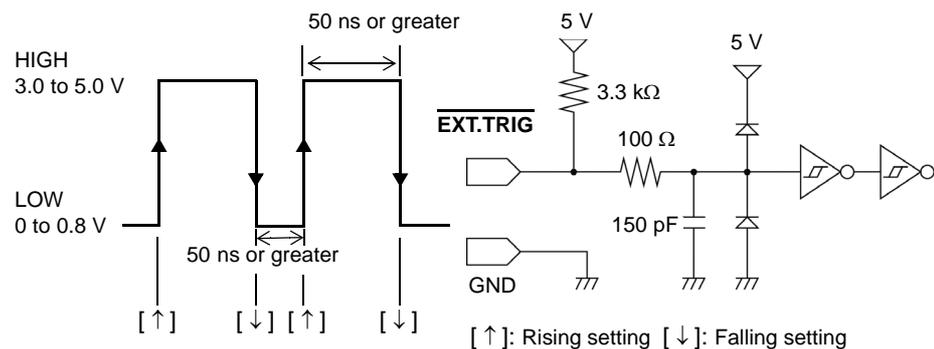
## 17.2.5 External Trigger terminal (EXT.TRIG)

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  $\overline{\text{EXT.TRIG}}$  and GND terminals.  
See: "17.1 Connecting External Control Terminals" ( $\Rightarrow$  p.314)
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 ( $\uparrow$ ) of the waveform or the falling edge ( $\downarrow$ ).
5. Short-circuit the  $\overline{\text{EXT.TRIG}}$  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  $\overline{\text{EXT.TRIG}}$  terminal.  
A trigger event occurs on the rising or falling edge of the input waveform.

<b>Output signal</b>	HIGH level: 3.0 to 5.0 V, LOW level: 0 to 0.8 V
<b>Pulse width</b>	HIGH level: 50 ns or greater, LOW level: 50 ns or greater
<b>Maximum input voltage</b>	-0.5 to 7 V



# Specifications Chapter 18

## 18.1 General Specifications

### Basic Specifications

<b>Measurement functions</b>	<ul style="list-style-type: none"> <li>• Memory Function (high-speed data saving)</li> <li>• Recorder Function (real time recording)</li> <li>• X-Y Recorder Function</li> <li>• FFT Function</li> </ul>
<b>No. of channels (max.)</b>	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)
<b>Memory capacity</b>	<p><b>MR8847-01 (Total memory 64MW)</b>            16 channels : 4 MW /channel, 8 channels: 8MW /channel, 4 channels: 16MW /channel,            2 channels : 32MW /channel</p> <p><b>MR8847-02 (Total memory 256MW)</b>            16 channels : 16MW /channel, 8 channels: 32MW /channel, 4 channels: 64MW /channel,            2 channels : 128MW /channel</p> <p><b>MR8847-03 (Total memory 512MW)</b>            16 channels : 32MW /channel, 8 channels: 64MW /channel, 4 channels: 128MW /channel,            2 channels : 256MW /channel</p>
<b>Maximum sampling rate</b>	20 MS / s (All channels simultaneously)
<b>Timebase accuracy</b>	± 0.01% (Relative grid timing error)
<b>External control terminals</b>	External Trigger Input, Trigger Output, External Sampling Input, GND, External Output 2 terminals (GO, NG), External Input 3 terminals (START, STOP, PRINT)
<b>Clock functions</b>	Auto calendar, auto leap year judgment, 24-hour timer Accuracy: ±100 ppm (within the operating temperature range) Reference value: ± 10 ppm (25°C)
<b>Backup battery life</b>	Approx. Ten years for clock and settings (@25°C, 77°F)
<b>Operating environment</b>	Indoors, Pollution degree 2, up to 2000 m (6562-ft.) ASL
<b>Operating temperature and humidity</b>	-10 to 40°C (14 to 104°F), 20 to 80%RH (non-condensation) <ul style="list-style-type: none"> <li>• When using the printer: 0 to 40°C (32 to 104°F), 20 to 80%RH (non-condensation)</li> <li>• When using the 9664 HD Unit: 5 to 40°C (41 to 104°F), 20 to 80%RH (non-condensation)</li> </ul>
<b>Temperature and humidity range for guaranteed accuracy</b>	23 ± 5°C (73.4 ± 41°F), 20 to 80%RH (non-condensation)
<b>Period of guaranteed accuracy</b>	1 year
<b>Storage temperature and humidity</b>	-20 to 50°C (-4 to 422°F), 90%RH or less (non-condensation)
<b>Isolation resistance and withstand voltage</b>	Between chassis and power line: 1.69 kVAC for 1 min at least 100 MΩ at 500 VDC Between input module and chassis: 3 kVAC for 1 min at least 100 MΩ at 500 VDC
<b>Power source</b>	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)
<b>Maximum rated power</b>	130 VA max. / When using the printer: 220 VA max.
<b>Dimensions</b>	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)
<b>Mass</b>	Approx. 7.6 kg (268.1oz) (Instrument)
<b>Applicable standards</b>	Safety EN61010 EMC EN61326 Class A, EN61000-3-2, EN61000-3-3

### Recording Section

<b>Recording system</b>	Thermosensitive recording system using thermal line head
<b>Recording paper</b>	Approx. 216 mm × 30 m (8.50" × 98.43-ft) roll-type thermosensitive paper (9231 Recording Paper)
<b>Recording width</b>	Overall recording width Approx. 208 mm ±1mm (8.19"±0.04"), Waveform portion Approx. 200 mm ±1 mm (7.87"±0.04")
<b>Recording speed</b>	Maximum 50 mm/s
<b>Paper feeding accuracy</b>	± 1% (25°C (77°F), 60%RH)
<b>Recording paper loading</b>	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), Waveform evaluation conditions (evaluation area + setting conditions)

### 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), Waveform evaluation conditions (evaluation area + setting conditions)

### 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), Mouse
Function	Connector: Series-B receptacle Connecting device: PC Functions: mass storage device (for file transfer from internal hard drive or CF card 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%)

<b>Zero adjust</b>	All channels and ranges together
<b>Waveform display magnification</b>	Horizontal axis (Time axis): $\times 10$ , $\times 5$ , $\times 2$ , $\times 1$ , $\times 1/2$ , $\times 1/5$ , $\times 1/10$ , $\times 1/20$ , $\times 1/50$ , $\times 1/100$ , $\times 1/200$ , $\times 1/500$ , $\times 1/1000$ , $\times 1/2000$ , $\times 1/5000$ , $\times 1/10000$ , $\times 1/20000$ , $\times 1/50000$ , $\times 1/100000$ , $\times 1/200000$ (expansion only with Memory function) Vertical axis (Voltage axis): $\times 100$ , $\times 50$ , $\times 20$ , $\times 10$ , $\times 5$ , $\times 2$ , $\times 1$ , $\times 1/2$ , $\times 1/5$ , $\times 1/10$
<b>Variable display function</b>	Included (Upper and lower display limits, or specified vertical divisions)
<b>Scaling</b>	Automatic scrolling (10:1, 100:1, 1000:1, selectable for different attenuating probes) Manual scrolling (conversion ratio setting, two-point setting and unit settings)
<b>Invert function</b>	Included (Polarity reversal)
<b>Vernier function</b>	Included
<b>Commenting</b>	Alphanumeric and Japanese characters (title and comments for each analog and logic channel)
<b>Comment entry method</b>	Single character, stored string and historical string entry (pre-stored and previously used strings can be recalled, inserted and edited)
<b>Copy channel settings</b>	Included
<b>Logic setting</b>	Included
<b>Recording printout width</b>	Selectable from three types
<b>Display position</b>	Freely settable in 1% steps
<b>Display bits</b>	Off, or select from 16 colors
<b>Zoom function</b>	Included (The waveform screen is divided two. Upper displays normal waveforms, Lower displays zoomed waveforms)

## Accessories/Options

<b>Accessories</b>	Instruction Manual and Measurement Guide..... Each one
<b>For information about options:</b> (⇒ p. A12)	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

## 18.2 Measurement Specifications

### 18.2.1 Memory Function

<b>Timebase</b>	5, 10, 20, 50, 100, 200, 500 $\mu$ s/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)
<b>Time axis resolution</b>	100 points/div
<b>Sampling period</b>	1/100th of timebase
<b>Recording length</b>	<b>MR8847-01</b> Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000DIV, 50000DIV (2, 4, or 8 channel mode), 100000DIV (2 or 4 channel mode), 200000DIV (2 channel mode) Adjustable recording length: Can be set in units of divisions (up to 320,000DIV) <b>MR8847-02</b> Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000DIV (2, 4, 8 or 16 channel mode), 200000DIV (2, 4, or 8 channel mode), 500000DIV (2 or 4 channel mode), 1000000DIV (2 channel mode) Adjustable recording length: Can be set in units of divisions (up to 1,280,000DIV) <b>MR8847-03</b> Fixed recording length: 25, 50, 100, 200, 500, 1,000, 2000, 5000, 10000, 20000, 50000, 100000, 200000DIV (2, 4, 8 or 16 channel mode), 500000DIV (2, 4, or 8 channel mode), 1000000DIV (2 or 4 channel mode), 2000000DIV (2 channel mode) Adjustable recording length: Can be set in units of divisions (up to 2560000DIV)
<b>Screen and Printing Settings</b>	1, 2, 4, 8, 16 or X-Y (1 or 4) screens
<b>Interpolation function</b>	Line (exc. X-Y), dot or line (with X-Y)
<b>Waveform scrolling</b>	Left-right scrolling by Jog and Shuttle knobs, Backward scrolling is available during Roll Mode display
<b>Overlay function</b>	Auto: Always overdraws when starting, and clears by restarting Manual: Overdraws waveforms only when necessary, and clears as needed
<b>Automatic saving</b>	Automatically saves data on CF card or hard disk after measuring (binary or text) When sampling is slow, saving starts during recording.
<b>Auto Print</b>	Automatically prints recording waveforms after the measurement (When slow sampling is used, printing is available even while recording.)
<b>Manual Print</b>	By the <b>PRINT</b> key (prints up to 50 mm/s, depending on print coverage)
<b>Selection printing</b>	Included Prints the waveform between A/B cursors (Print All and Print Selection)
<b>Report printing</b>	Included
<b>Channel modes</b>	Selectable 2, 4, 8 or 16 channel modes

### 18.2.2 Recorder Function

<b>Timebase</b>	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
<b>Time axis resolution</b>	100 points/div
<b>Sampling period</b>	1, 10, 100 $\mu$ s 1, 10, 100 ms (not more than 1/100th of the selected timebase)
<b>Recording length</b>	<b>MR8847-01</b> 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 <b>MR8847-02</b> Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000 DIV Adjustable recording length: Can be set in units of divisions (up to 20,000 DIV) Continuous <b>MR8847-03</b> Fixed recording length: 25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000, 100000 DIV Adjustable recording length: Can be set in units of divisions (up to 160,000 DIV) Continuous
<b>Screen and Printing Settings</b>	1, 2, 4 or 8 screens
<b>Waveform Storage</b>	MR8847-01: The most recent 20,000 divisions of measurement data is retained in internal memory MR8847-02: The most recent 80,000 divisions of measurement data is retained in internal memory MR8847-03: The most recent 160,000 divisions of measurement data is retained in internal memory
<b>Waveform Scrolling</b>	Left-right scrolling by Jog and Shuttle knobs. Including backward scrolling during measurement

<b>Automatic saving</b>	Automatically saves data on CF card or hard disk after measuring (binary or text) When sampling is slow, saving starts during recording.
<b>Realtime printing</b>	Available with 500 ms/div and slower recording (start and stop printing by <b>F</b> 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
<b>Manual Print</b>	By the <b>PRINT</b> key (prints up to 50 mm/s, depending on print coverage)
<b>Selection printing</b>	Included Prints the waveform between A/B cursors (Print All and Print Selection)
<b>Logging recording</b>	None
<b>Report printing</b>	Included

### 18.2.3 X-Y Recording

<b>Sampling period</b>	1, 10, 100 ms
<b>Recording length</b>	Continuous
<b>Screen and Printing Settings</b>	X-Y 1 screen, X-Y 4 screens
<b>No. of X-Y display</b>	Up to 8 phenomena
<b>X-Y setting</b>	Select 8 channels out of 16 for X axis and Y axis
<b>Interpolation function</b>	Dot/Line (smooth trace)
<b>Waveform Clear</b>	On/Off
<b>Waveform Storage</b>	The most recent 4000000 samples of measurement data is retained in internal memory
<b>Pen Up/Down</b>	Included (all phenomena simultaneously)
<b>External Pen Control</b>	Controllable by external control terminals (all phenomena simultaneously Up/Down)
<b>Auto Print</b>	None
<b>Manual Print</b>	By the <b>PRINT</b> key (prints up to 50 mm/s, depending on print coverage)
<b>Automatic saving</b>	None

### 18.2.4 FFT Function

<b>Frequency range</b>	133 mHz to 8 MHz, external
<b>Dynamic range</b>	72 dB(Theoretical value ), 96dB (Theoretical value)(When the 8968 High Resolution Unit is used)
<b>Number of sampling points</b>	1000 points, 2000 points, 5000 points, 10000 points
<b>Frequency resolution</b>	1/400, 1/800, 1/2000, 1/4000
<b>Anti-aliasing filter</b>	Coupled with the frequency range, the cutoff frequency is automatically set.
<b>Analysis channel setting</b>	Can be selected from desired channels
<b>FFT analysis modes</b>	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
<b>Display formats</b>	Single , Dual, Nyquist display, running spectrum display
<b>Window</b>	Rectangular window, Hanning, Hamming, Blackman, Blackman Harris, Flat top, Exponential
<b>Display scale</b>	Linear
<b>Print Function</b>	Based on the memory function. Note: Sectional printing is not possible.
<b>Averaging</b>	Time axis, simple average of frequency axis, indexed average, peak hold (frequency axis), number of times (2 to 10,000)

## 18.3 Trigger Section

<b>Trigger method</b>	Digital comparison
<b>Trigger modes</b>	<ul style="list-style-type: none"> <li>• Memory Function, FFT Function: Single, Repeat, or Automatic</li> <li>• Recorder Function: Single or Repeat</li> </ul>
<b>Trigger source</b>	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.
<b>Manual trigger</b>	Included
<b>Trigger criteria</b>	AND or OR of each trigger source
<b>Trigger types (analog)</b>	<ul style="list-style-type: none"> <li>• Level Trigger Set digitally as a voltage value below full-scale</li> <li>• Voltage Sag Trigger (Drop) Triggering occurs when peak voltage falls below the specified level (for commercial power). (for 50/60 Hz commercial power)</li> <li>• Window Trigger Upper and lower trigger threshold levels are specified Triggering occurs when the signal enters or exits the defined threshold range.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> </ul>
<b>Trigger types (logic)</b>	Pattern (mask) trigger by 1, 0, or x (x: don't care)
<b>Trigger filter</b>	<ul style="list-style-type: none"> <li>• Memory Function, FFT Function : Off, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 2.5, 5.0, 10.0 div</li> <li>• Recorder Function : Off/On (10 ms fixed)</li> </ul>
<b>Trigger types (external trigger)</b>	External signal is used as trigger.
<b>Trigger types (timer trigger)</b>	Triggering occurs at a preset time.
<b>Trigger level resolution</b>	0.1% f.s. (f.s. = 20 div)
<b>Pre-trigger</b>	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
<b>Trigger priority</b>	Off/On
<b>Trigger timing</b>	Start, Stop and Start & Stop (Recorder Function)
<b>Trigger output</b>	Open-collector output (with 5 V voltage output, active low, low output level of 0 to 0.5 V, current value of 15 mA) 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
<b>Trigger input and output terminals</b>	Terminal Block
<b>Level display function</b>	Included
<b>Trigger marker</b>	Trigger marks indicate positions of trigger events
<b>Trigger search function</b>	Searches for positions that meet trigger criteria

## 18.4 File Specifications

### Data Saving

<b>Supported storage media</b>	CF Card, HDD, USB memory stick, Internal RAM
<b>Saved data</b>	Setting data, Measurement data, Analysis data, Screen image, Print image, Waveform evaluation conditions
<b>Saving types</b>	<ul style="list-style-type: none"> <li>Setting data (.SET) Setting configurations can only be saved to internal RAM</li> <li>Measurement data Binary format (.MEM, .REC, FFT., .XYC), Text format (.TXT)</li> <li>Index , Memory division (.SEQ), division save (.IDX)</li> <li>Screen image (.BMP)</li> <li>Print image (.BMP)</li> <li>Startup (STRATUP.SET)</li> <li>Waveform evaluation conditions (.ARE) *Evaluation area + Saving settings</li> <li>Waveform evaluation area (.BMP) *Saving of evaluation area</li> </ul>
<b>File name entry</b>	Alphanumerics and Japanese
<b>Saving range</b>	Whole range, or between A/B cursors
<b>Data thinning save</b>	Included (Text only) Off, 1/2, 1/5, 1/10, 1/20, 1/50, 1/100, 1/200, 1/500, 1/1000
<b>Division save</b>	Included (Text only) 16 MB, 32 MB, 64 MB
<b>Duplicate file name handling</b>	Auto: Auto-saves with appended serial numbering Overwriting: Overwriting save Error: Reports an error
<b>Selection of blocks to be saved</b>	Included (for memory division only)
<b>Selection of channels to be saved</b>	Included (Select channels to be saved)

### Data Loading

<b>Supported storage media</b>	CF Card, HDD, USB memory stick, Internal RAM
<b>Loadable data types</b>	Setting data, Measurement data, Analysis data, Text comments, Waveform evaluation conditions, Waveform evaluation area
<b>Loadable data formats</b>	<ul style="list-style-type: none"> <li>Setting data (.SET) Setting configurations can only be saved to internal RAM</li> <li>Measurement data Text comments(.TXT) Binary format (.MEM, .REC, FFT., .XYC)</li> <li>Index memory division (.SEQ), division save (.IDX)</li> <li>Waveform evaluation conditions (.ARE) Evaluation area + Loading a setting configurations</li> <li>Evaluation area (.BMP) Loading a evaluation area</li> </ul>
<b>Loading method</b>	New
<b>Loadable communication settings</b>	None

### Others

<b>File information display</b>	Included
<b>Data deletion</b>	Single or multiple file selections
<b>File sorting</b>	By name, date, size or extension, in ascending or descending order
<b>File renaming</b>	Included
<b>Folders</b>	Create, rename and delete
<b>Copy file</b>	Included
<b>Print file list</b>	Included
<b>One-Touch saving</b>	Included (By <b>SAVE</b> key) The save method can be selected beforehand for one-touch saving with the <b>SAVE</b> key.
<b>Bundled application program</b>	"Wv" Wave Viewer

## 18.5 Built-In Functions

### Calculation-related functions

<b>Calculation functions</b>	Memory Function supported
<b>Number of calculations</b>	Up to 16 calculations can be applied to any channel
<b>Calculation range</b>	Whole range, or between A/B cursors
<b>Calculation types</b>	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
<b>Print calculation results</b>	Included
<b>Auto-save calculation results</b>	After measuring, automatically saves to CF card or hard disk (text format)
<b>Judgment of calculation results</b>	GO, NG, GO&NG stop according to max/min value of calculation result
<b>Judgment output</b>	GO, NG signal at open-collector output from external control terminal (with 5 V voltage output, active low, low output level of 0 to 0.5 V, current value of 15 mA), Pulse width: at least 1.8 ms

### Waveform calculation function

<b>Calculation support function</b>	Memory Function
<b>Number of calculations</b>	Up to a maximum of 16 calculations for desired channels
<b>Calculation range</b>	All range, between A/B cursor selections
<b>Calculation record length</b>	Up to 1/4 maximum memory capacity
<b>Operators</b>	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
<b>Printing of calculation results</b>	Included
<b>Automatic saving of calculation results</b>	After measurement, automatic saving to CF card or HDD (binary, .txt file)

### Memory division function

<b>Division support function</b>	Memory Function
<b>Number of memory divisions</b>	2 to 1024
<b>Divided record length</b>	Can be set as desired (but depends on the number of divisions)
<b>Sequential saving</b>	Possible by specifying start and end blocks
<b>Sequential saving dead time</b>	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)
<b>Multi-block saving</b>	Saving of waveforms is possible by specifying the desired blocks of divisions
<b>Block display</b>	Display can be set to ON or OFF
<b>Block overlaying</b>	Desired blocks or all blocks
<b>Automatic saving of calculation results</b>	After measurement, automatic batch saving to CF card or HDD (binary, .txt file)

### Cursor measurement functions

<b>Cursor Functions</b>	All functions supported
<b>Number of cursors</b>	Two (Cursors A and B)
<b>Cursor types</b>	Line (vertical or horizontal) and Trace
<b>Cursor movements</b>	A Cursor, B Cursor, A&B Cursors
<b>Measurement function</b>	A Cursor : Amplitude at each cursor, time from trigger event AB Cursor: Time, amplitude and frequency (period) differences between cursors
<b>Cursor-supported channels</b>	All channels (default), or any specified channel
<b>Included functions</b>	Partial printout, partial saving (specified time span)

### Monitor functions

<b>Level monitor display</b>	Press the <b>DISP</b> key and select Level Monitor from the Switching window
<b>Numerical value display</b>	Instantaneous value display
<b>Sampling rate</b>	10 kS/s (fixed)
<b>Refresh rate</b>	Instantaneous value display 0.5 s

## Position Display (VIEW) Functions

<b>Display function</b>	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)
<b>Relative position display</b>	Displays the relative position of the currently displayed waveform within the overall recording length, and locations of cursors and trigger events
<b>Block display</b>	Block usage status (when memory division is ON) or past waveform history status (when memory division is OFF) Displayed block position
<b>Jump function</b>	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

## Waveform Evaluation Function

<b>Waveform evaluation functionality</b>	Compares memory (Y-T waveform, X-Y waveform) and FFT-created waveform area with captured waveforms and determines whether the captured waveform falls inside or outside the corresponding area.
<b>Evaluation modes</b>	Out: NG (fail) if any part of the waveform falls outside the area. All out: NG (fail) if the entire waveform falls outside the area.
<b>Evaluation stop conditions</b>	GO, NG, GO&NG Printer output can be generated or the waveform can be saved when evaluation stops.
<b>Evaluation output</b>	GO/NG evaluation output from terminal block: Open collector output (with 5 V voltage output, active low, low output level of 0 to 0.5 V, current value of 15 mA)
<b>Waveform evaluation time</b>	Evaluation time: 100 ms or less; evaluation period: 250 ms or less* *1 channel, time axis of 5 $\mu$ s/div, recording length of 25 div, magnification factor of 1, 2 input waveform periods
<b>Graphic editor</b>	Instrument: Includes an editor for creating waveform evaluation reference areas. External: Waveform evaluation reference areas (BMP data) created with third-party software on a computer can be loaded into the instrument.
<b>Editor commands</b>	Waveform capture, magnify/compress, paint, draw, erase, all clear, clear, reverse, undo, end

## Others

<b>On-line help function</b>	Pressing the <b>HELP</b> 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)
<b>Grid types</b>	Display: Off, normal or normal (dark) Printouts: Off, normal, fine, normal (dark) or fine (dark)
<b>Comment display</b>	Comments are displayed with channel numbers on the screen and in printouts (channel markers)
<b>Time scale display</b>	Time (seconds, base-60), divisions, Date, sample number (screen and printouts)
<b>Variable auto-compensation</b>	Included
<b>Start backup function</b>	Included
<b>Backlight Saver</b>	Off, or 1 to 30 min
<b>Display color</b>	Color 1 to 3, or user-defined
<b>Beep sound</b>	Off, warnings, or warnings and operations
<b>Language</b>	Japanese/English/Korean/Chinese
<b>Start key function</b>	Press once, twice or hold for two seconds
<b>Stop key function</b>	Press once, or twice
<b>External I/O terminals</b>	Trigger I/O terminals (EXT_TRIG, TRIG_OUT), External sampling input terminal (EXT_SAMP) Remote control input terminal (START, STOP, PRINT)* <sup>1</sup> , Judgment output terminals can be set to generate value judgment (GO/NG) or waveform evaluation output. * <sup>2</sup> *1: User selectable *2: Select from value, waveform, value OR waveform, and value AND waveform.
<b>Remote control</b>	Select external I/O terminals for remote control (Start, Stop, Abort, Start&Stop, Pen_Up, Pen_Down, Print, Save)
<b>Internal status output</b>	For the GO/NG terminals, select (Error, Busy, Awaiting Trigger or Numerical Judgment)
<b>Probe calibration output</b>	Output from NG/EXT OUT2 terminal
<b>Keylock function</b>	Included
<b>Recording printout content</b>	Waveform
<b>Printout magnification</b>	Prints waveforms magnified or compressed on the time axis, regardless of Waveform screen display
<b>Print size</b>	Standard (A4) or Reduced (A6)
<b>Print density</b>	5 levels
<b>Print Speed</b>	Fast/Coarse, Normal or Slow/Fine
<b>Upper/lower limit printing</b>	Off / On
<b>Zero-position comments</b>	Off/On But not overlaid
<b>Text comment printing</b>	Load text file and print at printing start time.

<b>Counter printing</b>	Off, date or counter name and count value
<b>GUI partial printing/saving</b>	Off / On
<b>List</b>	Prints a list of settings
<b>Gauge</b>	Prints gauges for measurement channels (the same range is displayed on the same gauge) Gauges can be displayed
<b>Waveform backup function</b>	None
<b>Auto setup function</b>	When switched on, settings are automatically loaded from a file on the CF card, hard disk or internal memory.
<b>Auto measurement function</b>	Automatically selects the optimal timebase and voltage range for the input waveform
<b>Backlight brightness</b>	Selectable from 3 levels
<b>Time setting</b>	Included
<b>Initialization</b>	System reset, or clear waveform only
<b>Self-Test function</b>	ROM/RAM, Printer, Display, Key

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## 18.6 Input Modules Specifications

### 18.6.1 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 With-stand voltage	3 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 radio-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

## 18.6.2 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) ± 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	-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	
		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								
	<table border="1"> <thead> <tr> <th>Selection</th> <th>Fast</th> <th>Normal</th> <th>Slow</th> </tr> </thead> <tbody> <tr> <td>Data Refresh Rate</td> <td>1.2 ms</td> <td>100 ms</td> <td>500 ms</td> </tr> </tbody> </table>	Selection	Fast	Normal	Slow	Data Refresh Rate	1.2 ms	100 ms	500 ms
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)								
Dielectric strength	3 kVAC for 1 minute (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 radio-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								

## 18.6.3 8968 High Resolution Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9°F), 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 kHz -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	3 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 radio-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

## 18.6.4 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) (anticipated transient overvoltage 330 V)	
Dielectric 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 radio-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

## 18.6.5 8970 Freq Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9°F), 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	DC3 kVAC for 1 minute (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
<b>Frequency mode</b>	
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)
<b>Rotation speed mode</b>	
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)
<b>Power frequency mode</b>	
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)
<b>Integral values mode</b>	
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)
<b>Pulse duty ratio mode</b>	
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)
<b>Pulse width mode</b>	
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

## 18.6 Input Modules Specifications

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.)

### 18.6.6 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 HiCorder	Max. 4 unit (for Model MR8847)

\*: During current measurement, add the accuracy and characteristic of clamp sensor using with Model 8971.

## 18.6.7 8972 DC/RMS Unit

Temperature and humidity range for guaranteed accuracy	23 ± 5°C (73 ± 9°F), 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 to 90% 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	3 kVAC for 1 minute, (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 radio-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, with 1 VDC input)	
Applicable standards	Safety	EN61010
	EMC	EN61326 Class A

## 18.6.8 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 19

### 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.



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
<b>Fan Motor</b>	Approx. 4 years	<b>9664 HD Unit</b>	Approx. 20,000 hours
<b>Printer</b>	After using approx. 1,000 rolls of the recording paper	<b>LCD</b>	Approx. 74,000 hours
<b>Backlight (to half brightness)</b>	Approx. 50,000 hours		
<b>Electrolytic Capacitors</b>	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.)		
<b>Lithium Battery</b>	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.

# 19.1 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. <b>"2.5 Supplying Power" (⇒ p.35)</b>
Keys do not work.	<ul style="list-style-type: none"> <li>Is any key being held down?</li> <li>Is the key-lock state active (Key-Lock message displayed)?</li> </ul>	<ul style="list-style-type: none"> <li>Verify key operation.</li> <li>Deactivate the key-lock state. (Hold the   <b>CURSOR</b> keys for three seconds)</li> </ul>

### 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 <b>START</b> key.	<ul style="list-style-type: none"> <li>Is the "Pre-Trigger wait" message displayed?</li> <li>Is the "Trigger wait" message displayed?</li> </ul>	When pre-triggering is enabled, triggering is ignored until the pre-trigger portion of the waveform has been acquired. Recording starts when a trigger occurs.
No changes occur in the displayed waveform.	<ul style="list-style-type: none"> <li>Is the clamp sensor or connection cable connected correctly?</li> <li>Is the vertical axis (voltage axis) range set properly?</li> <li>Is the low-pass filter enabled?</li> </ul>	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. <b>"3.4.2 Time Axis Range and Sampling Rate" (⇒ p.45)</b>
Some channels are unusable.	Is the channel enabled for use?	<b>"8.4 Setting Channels to Use (Extending the Recording Length)" (⇒ p.133)</b>
The displayed waveform size does not change when the input range is changed.	Is the Variable function enabled?	Turn the Variable function off. <b>"8.6 Variable Function (Setting the Waveform Display Freely)" (⇒ p.140)</b>

## 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.33)
Printout is too light.	<ul style="list-style-type: none"> <li>Is the specified recording paper being used?</li> <li>Is the print density setting correct?</li> <li>Is the print head dirty?</li> </ul>	Try changing the print density setting. "6.5 Making Printer Settings" (⇒ p.101) Clean the print head. "Print Head Cleaning" (⇒ p.349)
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.55)
Recording traces are doubled.	Is the waveform printing density set to <b>[Light]</b> ? 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 <b>[Light]</b> . ([Printer] sheet) "6.5 Making Printer Settings" (⇒ p.101)

## If Saving is Not Possible

Symptom	Check Item, or Cause	Remedy and Reference
If saving is not possible to the storage media.	<ul style="list-style-type: none"> <li>Is your CF card Hioki certified?</li> <li>Is the storage media inserted properly?</li> <li>Is the storage media formatted?</li> <li>Is the remaining capacity of the storage media too low?</li> <li>Has the number of files in the folder reached the limit?</li> </ul>	"2.3 Recording Media Preparation" (⇒ p.30)  "Media information"(⇒ p.70)
Cannot use USB memory stick	Have settings for using USB memory stick been made?	"USB use"(⇒ p.32)

## Others

Symptom	Check Item, or Cause	Remedy and Reference
Cannot use USB communications	Have USB communication settings been made?	"16.6.1 Making USB Settings at the Instrument" (⇒ p.300)
Cannot install USB driver	<ul style="list-style-type: none"> <li>Is the <b>[Interface]</b> item set to <b>[USB]</b>?</li> <li>Has driver installation failed?</li> </ul>	<ul style="list-style-type: none"> <li>Set <b>[Interface]</b> item to <b>[USB]</b>.</li> </ul> "16.6.1 Making USB Settings at the Instrument" (⇒ p.300) <ul style="list-style-type: none"> <li>Access the <b>[device manager]</b> on the PC and delete <b>[Other Devices]</b>. Then reconnect the USB cable.</li> </ul>
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: "19.2 Initializing the Instrument" (⇒ p.342)

## 19.2 Initializing the Instrument

### 19.2.1 Initializing System Settings (System Reset)

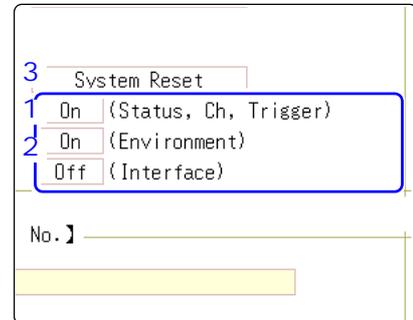
Select groups of settings currently in force on the instrument, and initialize the settings. Initialization returns the instrument to the factory default state. By default, the setting of [Setting (Stat, Ch, Trig)] and [Setting (Env)] are selected for initialization in this screen.

#### 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.

<b>(Status, Ch, Trigger)</b>	Current settings in Status screen, Channel screen, and Trigger setting window (Default setting: On)
<b>(Environment)</b>	Current settings in the Environment sheet, File Save sheet, and Printer sheet (Default setting: On)
<b>(Interface)</b>	Current settings in the Interface sheet (Default setting: Off)



- 3 Move the cursor to the **[System Reset]**.

- 4 Select **[Exec]**.

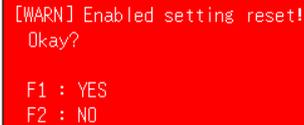
A confirmation dialog box appears.

- 5 Select **[Yes]**.

To cancel initializing:

Select **[No]**.

Initialization is complete when "System initialized" appears.



### 19.2.2 Initializing Waveform Data

Discard the waveform data saved in memory and initialize the data.

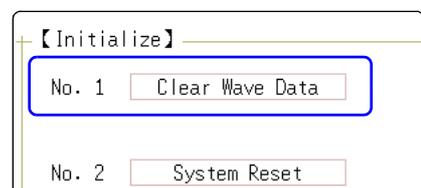
#### Procedure

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

- 1 Move the cursor to the **[Clear Wave Data]**.

- 2 Select **[Exec]**.

Initialization is complete when "Waveform data erased." appears.



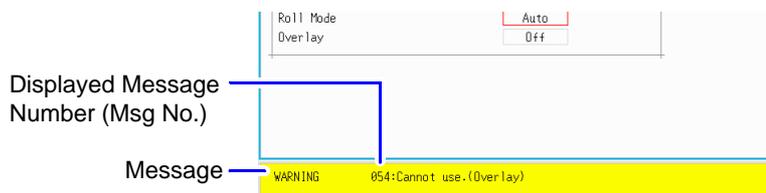
## 19.3 Error Messages

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 15 System Environment Settings" (⇒ p.277)

### Warning Display



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.33)
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.48)
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.30)
11	Illegal format.	Wrong recording format. Reformat the media.	"2.3.2 Formatting Storage Media" (⇒ p.32)
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.90)
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.91)
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.179)
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.79)
28	Pressed key invalid (waveform evaluation).	Unable to perform operation because waveform evaluation is enabled. Turn off waveform evaluation.	"14.3 Setting the Waveform Evaluation Mode" (⇒ p.268)
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.61)
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.111)
32	Zero-adjustment needed.	Perform zero-adjustment.	"2.7 Adjusting the Zero Position (Zero-Adjust)" (⇒ p.38)
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.131)
36	No trigger has been set.	Set trigger criteria.	"Chapter 9 Trigger Settings" (⇒ p.157)
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.146)
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.150)
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.160)
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.133)
42	There is not enough data in the memory.	Measure the data portion required for calculation.	"11.1 Waveform Calculation Workflow" (⇒ p.196)
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.58)
47	:This unit cannot be used because it is not AAF aligned.	Press the SYSTEM key to display the [Init] sheet.	
48	There are units on which AAF cannot be set to On because of lack of adjustment.	Execute the [System Information] and check the software items. If [Not AAF aligned] is displayed, send the unit for repairs.	-
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.130)
51	Cannot use. (Pre Trigger)	The pre-trigger function is not available when using external sampling.	"Chapter 17 External Control" (⇒ p.313)
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.196)

## Displayed Warnings

Msg No.	Message	Remedial Action	Reference
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.130)
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.131)
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.130)
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.48) "6.2 Making Auto Print Settings" (⇒ p.97)
57	Cannot set.(External sampling)	Cannot use roll mode when using external sampling.	"8.2 Displaying Waveforms During Recording (Roll Mode)" (⇒ p.130)
58	Rated capacity/rated output error.	Rated capacity/Rated output has exceeded selected range. Input correct value.	Note (⇒ p.137)
59	Cannot use. (Roll Mode, Wave Calculation)	If the memory division function is used, these functions cannot be used.	"12.1 Recording Settings" (⇒ p.211)
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.65)
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.48)
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.	"16.1 LAN Settings and Connection (Before Using FTP/Internet Browser/Command Communications)" (⇒ p.282)
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.45)
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.	"9.11 Using trigger settings to search measurement data" (⇒ p.177)
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.177)
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 search target.	-
105	There is a block with no data in the search target channel.	Select blocks with measurement data in the search target.	
106	Some blocks are different in measurement mode of unit from the others.	Blocks different in measurement mode cannot be searched.	
108	Some blocks are different in measurement mode of unit from the others.	Set the search range within the display blocks.	"9.11 Using trigger settings to search measurement data" (⇒ p.177)

### 19.4 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.346)
No. 2	Printer Check	Check printing by the printer and clean print heads. (⇒ p.349)
No. 3	Display Check	Check the screen display (color check, gradation check). (⇒ p.347)
No. 4	Key Check	Check whether instrument keys are functioning correctly. (⇒ p.347)
No. 5	System Information	Check the system configuration. (⇒ p.348)

#### 19.4.1 ROM/RAM Check

This check tests the instrument's internal memory (ROM and RAM).

- 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.

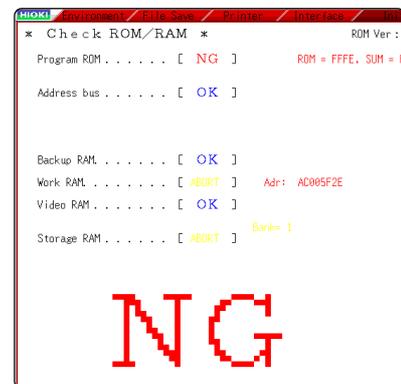
**OK:** Normal

**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



#### **NOTE**

Performing a ROM/RAM check will cause measurement data to be erased. Save the measurement data to other media before performing the ROM/RAM check.

### Procedure (Common for Printer Check, Display Check, Key Check, System Configuration Check)

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

## 19.4.2 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.349)

Print quality (print speed) and print density settings will be reflected in the test printout.

## 19.4.3 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 cancel 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.

## 19.4.4 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.

### 19.4.5 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  
[MR8847 MEMORY HiCORDER]

Ch	Model	Name	Resolution	Sampling	Firmware
Ch1	8966	ANALOG	12-bit	20MS/s	
Ch2	8966	ANALOG	12-bit	20MS/s	
Ch3	8966	ANALOG	12-bit	20MS/s	
Ch4	8966	ANALOG	12-bit	20MS/s	
Ch5	8967	TEMP	16-bit		EC.EB
Ch6	8967	TEMP	16-bit		ED.14
Ch7	8967	TEMP	16-bit		EC.EB
Ch8	8967	TEMP	16-bit		ED.14
Ch9	8969	STRAIN	16-bit	200kS/s	
Ch10	8969	STRAIN	16-bit	200kS/s	
Ch11					
Ch12					
Ch13					
Ch14					
Ch15	8973	LOGIC			
Ch16	8973	LOGIC			

Storage RAM: : 512MWord

Printer : Exists

HDD : Equipped

[Communication]

Interface : LAN

Firmware Version : V3.00

Board Revision: 0002

[FPGA Version]

Storage Version: 0300:0102

IO Version: 0103

LCDC Version: 0103

PUSH ANY KEY

Model number, name, resolution and sampling rate of each installed input module (unit)

Currently selected interface

Internal memory capacity

Firmware version no.

Board revision no.

FPGA version no.

## 19.5 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

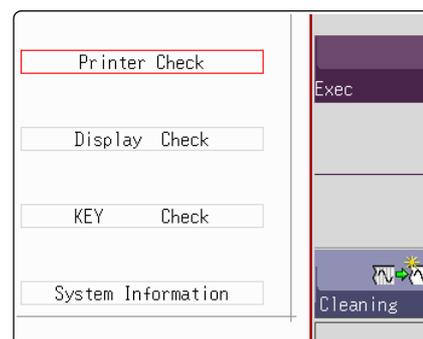
##### Before Cleaning

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].

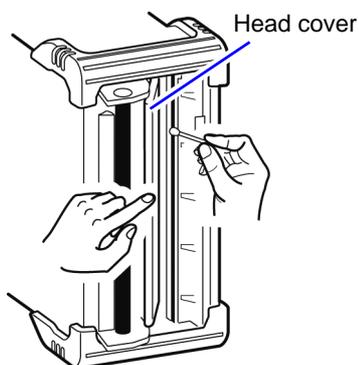
The paper should print solid (100%) black.

If sufficient improvement is not obtained even after cleaning several times, wash the print head (⇒ p.349).



#### 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.

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## 19.6 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

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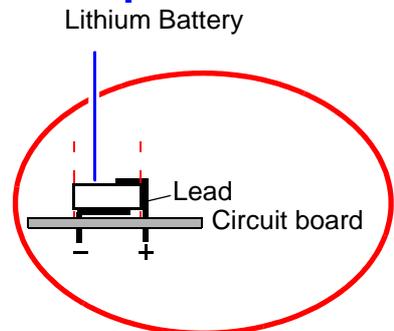
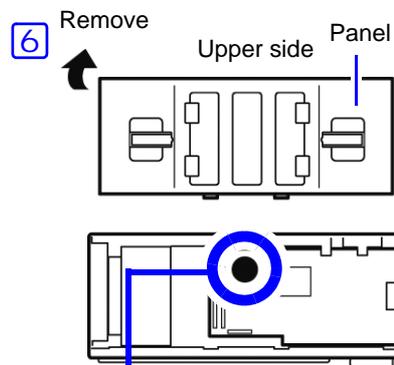
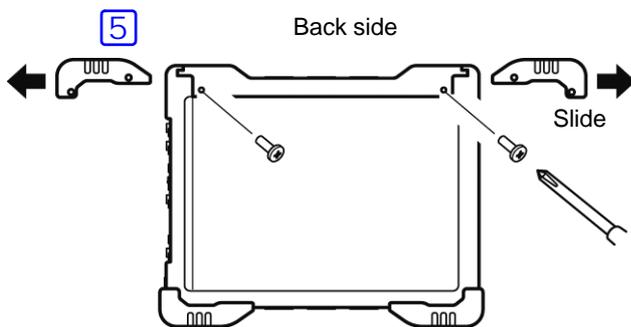
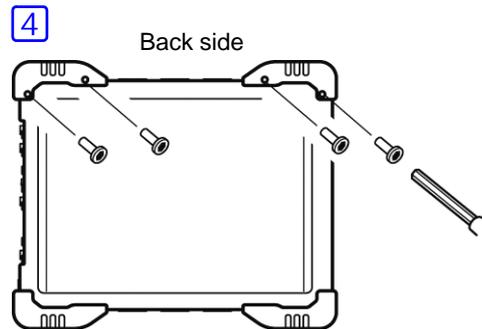
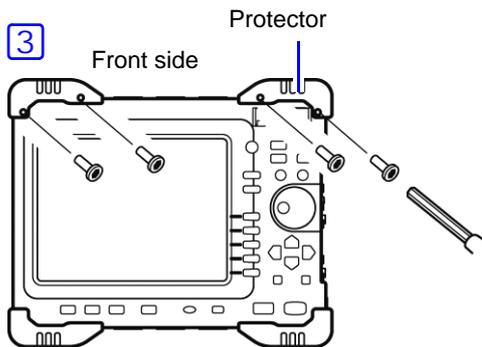
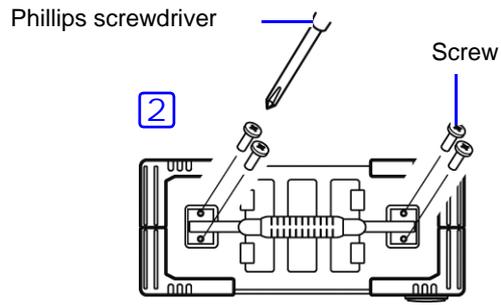
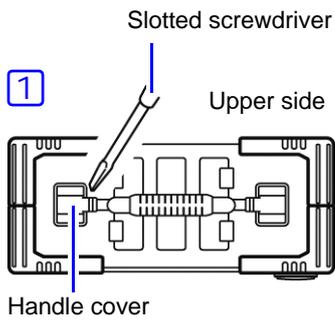
Required tools:

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 $\mu$ s/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	152 MB	305 MB
1,000,000	100,000,001	190 MB	381MB	762 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
100,000	10,000,001	38 MB	76 MB	152 MB	305 MB	610 MB

### 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	1.1 GB	2.1 GB
1,000,000	100,000,001	3.1 GB	4.4 GB	7.1 GB	-	-

### CSV (Text) File Size (Recorder Function)

**Note:**

When saving, CSV (text) files longer than 2 GB are segmented into files of 2 GB each.

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
100,000	10,000,001	391 MB	619 MB	1.1 GB	1.9 GB	3.7 GB

### Waveform File Size Calculation Method

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#### MEM File

**File size (bytes) = setting size<sup>\*1</sup> + data size<sup>\*2</sup>**

\*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 x Number of waveform calculation channels) x number of data

#### REC File

**File size (bytes) = setting size<sup>\*1</sup> + data size<sup>\*2</sup>**

\*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<sup>\*1</sup> + the size of the time axis data<sup>\*2</sup> + the size of the mid-term data<sup>\*3</sup>**

\*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 x Number 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<sup>\*1</sup> + data size<sup>\*2</sup>**

\*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<sup>\*1</sup> + data size<sup>\*2</sup>**

\*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<sup>\*1</sup> + data size<sup>\*2</sup>**

\*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.

$$\text{Recordable Time} = \text{Timebase} \times \text{Recording Length}$$

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/div	MR8847-01 Maximum Recording Length : 20,000 div	MR8847-02 Maximum Recording Length : 80,000 div	MR8847-03 Maximum Recording Length : 160,000 div
10 ms	3 min 20 s	13 min 20 s	26 min 40 s
20 ms	6 min 40 s	26 min 40 s	53 min 20 s
50 ms	16 min 40 s	1 h 6 min 40 s	2 h 13 min 20 s
100 ms	33 min 20 s	2 h 13 min 20 s	4 h 26 min 40 s
200 ms	1 h 6 min 40 s	4 h 26 min 40 s	8 h 53 min 20 s
500 ms	2 h 46 min 40 s	11 h 6 min 40 s	22 h 13 min 20 s
1 s	5 h 33 min 20 s	22 h 13 min 20 s	1 d 20 h 26 min 40 s
2 s	11 h 6 min 40 s	1 d 20 h 26 min 40 s	3 d 16 h 53 min 20 s
5 s	1 d 3 h 46 min 40 s	4 d 15 h 6 min 40 s	9 d 6 h 13 min 20 s
10 s	2 d 7 h 33 min 20 s	9 d 6 h 13 min 20 s	18 d 12 h 26 min 40 s
30 s	6 d 22 h 40 min 0 s	27 d 18 h 40 min 0 s	55 d 13 h 20 min 0 s
50 s	11 d 13 h 46 min 40 s	46 d 7 h 6 min 40 s	92 d 14 h 13 min 20 s
1 min	13 d 21 h 20 min 0 s	55 d 13 h 20 min 0 s	111 d 2 h 40 min 0 s
100 s	23 d 3 h 33 min 20 s	92 d 14 h 13 min 20 s	185 d 4 h 26 min 40 s
2 min	27 d 18 h 40 min 0 s	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s
5 min	69 d 10 h 40 min 0 s	277 d 18 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 as follows.

MR8847-01: 20,000div

MR8847-02: 80,000div

MR8847-03: 160,000div

**Memory Function**

MR8847-01 (Total memory: 64 MW)

Timebase (Time/div)	Sampling Speed	Channels used / Maximum Recording Length			
		16 channels	8 channels	4 channels	2 channels
		40,000 div	80,000 div	160,000 div	320,000 div
5 µs	50 ns	0.2 s	0.4 s	0.8 s	1.6 s
10 µs	100 ns	0.4 s	0.8 s	1.6 s	3.2 s
20 µs	200 ns	0.8 s	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	
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)

MR8847-02 (Total memory: 256 MW)

Timebase (Time/div)	Sampling Speed	Channels used / Maximum Recording Length			
		16 channels	8 channels	4 channels	2 channels
		160,000 div	320,000 div	640,000 div	1,280,000 div
5 µs	50 ns	0.8 s	1.6 s	3.2 s	6.4 s
10 µs	100 ns	1.6 s	3.2 s	6.4 s	12.8 s
20 µs	200 ns	3.2 s	6.4 s	12.8 s	25.6 s
50 µs	500 ns	8 s	16 s	32 s	1 min 4 s
100 µs	1 µs	16 s	32 s	1 min 4 s	2 min 8 s
200 µs	2 µs	32 s	1 min 4 s	2 min 8 s	4 min 16 s
500 µs	5 µs	1 min 20 s	2 min 40 s	5 min 20 s	10 min 40 s
1 ms	10 µs	2 min 40 s	5 min 20 s	10 min 40 s	21 min 20 s
2 ms	20 µs	5 min 20 s	10 min 40 s	21 min 20 s	42 min 40 s
5 ms	50 µs	13 min 20 s	26 min 40 s	53 min 20 s	1 h 46 min 40 s
10 ms	100 µs	26 min 40 s	53 min 20 s	1 h 46 min 40 s	3 h 33 min 20 s
20 ms	200 µs	53 min 20 s	1 h 46 min 40 s	3 h 33 min 20 s	7h 6 min 40 s
50 ms	500 µs	2 h 13 min 20 s	4 h 26 min 40 s	8 h 53 min 20 s	17 h 46 min 40 s
100 ms	1 ms	4 h 26 min 40 s	8 h 53 min 20 s	17 h 46 min 40 s	1 d 11 h 33 min 20 s
200 ms	2 ms	8 h 53 min 20 s	17 h 46 min 40 s	1d 33 h 33 min 20 s	2 d 23 h 6 min 40 s
500 ms	5 ms	22 h 13 min 20 s	1 d 20 h 26 min 40 s	1d 16 h 53 min 20 s	7 d 9 h 46 min 40 s
1 s	10 ms	1 d 20 h 26 min 40 s	3 d 16 h 53 min 20 s	7 d 9 h 46 min 40 s	14 d 19 h 33 min 20 s
2 s	20 ms	32 d 16 h 53 min 20 s	7 d 9 h 46 min 40 s	14 d 19 h 33 min 20 s	29 d 15 h 6 min 40 s
5 s	50 ms	9 d 6 h 13 min 20 s	18 d 12 h 26 min 40 s	37 d 0 h 53 min 20 s	74 d 1 h 46 min 40 s
10 s	100 ms	18 d 12 h 26 min 40 s	37 d 0 h 53 min 20 s	74 d 1 h 46 min 40 s	148 d 3 h 33 min 20 s
30 s	300 ms	55 d 13 h 20 min 0 s	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s	
50 s	500 ms	92 d 14 h 13 min 20 s	185 d 4 h 26 min 40 s		
1 min	600 ms	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s		
100 s	1 s	185 d 4 h 26 min 40 s			
2 min	1.2 s	222 d 5 h 20 min 0 s			
5 min	3 s				

(d: days/ h: hours/ min: minutes/ s: seconds)

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## Appendix 2 Reference

MR8847-03 (Total memory: 512 MW)

Timebase (Time/div)	Sampling Speed	Channels used			
		Maximum Recording Length			
		16 channels 320,000 div	8 channels 640,000 div	4 channels 1,280,000 div	2 channels 2,560,000 div
5 µs	50 ns	1.6 s	3.2 s	6.4 s	12.8 s
10 µs	100 ns	3.2 s	6.4 s	12.8 s	25.6 s
20 µs	200 ns	6.4 s	12.8 s	25.6 s	51.2 s
50 µs	500 ns	16 s	32 s	1 min 4 s	2 min 8 s
100 µs	1 µs	32 s	1 min 4 s	2 min 8 s	4 min 16 s
200 µs	2 µs	1 min 4 s	2 min 8 s	4 min 16 s	8 min 32 s
500 µs	5 µs	2 min 40 s	5 min 20 s	10 min 40 s	21 min 20 s
1 ms	10 µs	5 min 20 s	10 min 40 s	21 min 20 s	42 min 40 s
2 ms	20 µs	10 min 40 s	21 min 20 s	42 min 40 s	1 h 25 min 20 s
5 ms	50 µs	26 min 40 s	53 min 20 s	1 h 46 min 40 s	3 h 33 min 20 s
10 ms	100 µs	53 min 20 s	1 h 46 min 40 s	3 h 33 min 20 s	7h 6 min 40 s
20 ms	200 µs	1 h 46 min 40 s	3 h 33 min 20 s	7 h 6 min 40 s	14 h 13 min 20 s
50 ms	500 µs	4 h 26 min 40 s	8 h 53 min 20 s	17 h 46 min 40 s	35 h 33 min 20 s
100 ms	1 ms	8 h 53 min 20 s	17 h 46 min 40 s	35 h 33 min 20 s	2 d 23 h 6 min 40 s
200 ms	2 ms	17 h 46 min 40 s	35 h 33 min 20 s	71 h 6 min 40 s	5 d 22 h 13 min 20 s
500 ms	5 ms	44 h 26 min 40 s	3 d 16 h 53 min 20 s	177 h 46 min 40 s	14 d 19 h 33 min 20 s
1 s	10 ms	3 d 16 h 53 min 20 s	7 d 9 h 46 min 40 s	14 d 19 h 33 min 20 s	29 d 15 h 6 min 40 s
2 s	20 ms	7 d 9 h 46 min 40 s	14 d 19 h 33 min 20 s	29 d 15 h 6 min 40 s	59 d 6 h 13 min 20 s
5 s	50 ms	18 d 12 h 26 min 40 s	37 d 0 h 53 min 20 s	74 d 1 h 46 min 40 s	148 d 3 h 33 min 20 s
10 s	100 ms	37 d 0 h 53 min 20 s	74 d 1 h 46 min 40 s	148 d 3 h 33 min 20 s	296 d 7 h 6 min 40 s
30 s	300 ms	111 d 2 h 40 min 0 s	222 d 5 h 20 min 0 s		
50 s	500 ms	185 d 4 h 26 min 40 s			
1 min	600 ms	222 d 5 h 20 min 0 s			
100 s	1 s				
2 min	1.2 s				
5 min	3 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

MR8847-01 (Total memory: 64 MW)

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

MR8847-02 (Total memory: 256 MW)

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	640,000	320,000	160,000	80,000
4	320,000	160,000	80,000	40,000
8	160,000	80,000	40,000	20,000
16	80,000	40,000	20,000	10,000
32	40,000	20,000	10,000	5,000
64	20,000	10,000	5,000	2,500
128	10,000	5,000	2,500	1,200
256	5,000	2,500	1,200	600
512	2,500	1,200	600	300
1024	1,200	600	300	150

MR8847-03 (Total memory: 512 MW)

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	1,280,000	640,000	320,000	160,000
4	640,000	320,000	160,000	80,000
8	320,000	160,000	80,000	40,000
16	160,000	80,000	40,000	20,000
32	80,000	40,000	20,000	10,000
64	40,000	20,000	10,000	5,000
128	20,000	10,000	5,000	2,500
256	10,000	5,000	2,500	1,200
512	5,000	2,500	1,200	600
1024	2,500	1,200	600	300

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## Appendix 2 Reference

### Fixed record length

MR8847-01 (Total memory: 64 MW)

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

MR8847-02 (Total memory: 256 MW)

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	500,000	200,000	100,000	50,000
4	200,000	100,000	50,000	20,000
8	100,000	50,000	20,000	20,000
16	50,000	20,000	20,000	10,000
32	20,000	20,000	10,000	5,000
64	20,000	10,000	5,000	2,000
128	10,000	5,000	2,000	1,000
256	5,000	2,000	1,000	500
512	2,000	1,000	500	200
1024	1,000	500	200	100

MR8847-03 (Total memory: 512 MW)

The number of divisions (blocks)	Channels used			
	1-2 channels	1-4 channels	1-8 channels	1-16 channels
	Maximum record length (div)			
2	1,000,000	500,000	200,000	100,000
4	500,000	200,000	100,000	50,000
8	200,000	100,000	50,000	20,000
16	100,000	50,000	20,000	20,000
32	50,000	20,000	20,000	10,000
64	20,000	20,000	10,000	5,000
128	20,000	10,000	5,000	2,000
256	10,000	5,000	2,000	1,000
512	5,000	2,000	1,000	500
1024	2,000	1,000	500	200

## 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,  $\nu$ : Poisson ratio,  $\varepsilon$ : Distortion measurement value

Tensile and Compressive Stress Measurement: Stress ( $\sigma$ ) = E  $\times$   $\varepsilon$

For temperature compensation with two or four gauges, position the gauges perpendicularly.

Stress ( $\sigma$ ) is obtained by  $1 / (1 + \nu)$  for two gauges, and by  $1 / \{2 (1 + \nu)\}$  for four gauges.

Bending Stress Measurement: Stress ( $\sigma$ ) = E  $\times$   $\varepsilon$

For temperature compensation with two or four gauges, stress ( $\sigma$ ) is obtained as a multiple of  $1/2$  or  $1/4$ , respectively.

Torsional Stress Measurement: Stress ( $\sigma$ ) = 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,

$$\begin{aligned} \sigma &= 73 \times 10^9 \times \text{Measurement Value (in } \mu\varepsilon \text{ units)} \times 10^{-6} \text{ (in } \mu\varepsilon \text{ units)} \\ &= 73 \times \text{Measurement Value (in kPa units)} \\ &= 7.44^* \times \text{Measurement Value (in gf/mm}^2 \text{ units)} \\ &^*: 1 \text{ Pa} = 1.01971621 \times 10^{-7} \text{ kgf/mm}^2 \end{aligned}$$

Unit: gf/mm<sup>2</sup>, Conversion Ratio = 7.44 gf/mm<sup>2</sup>

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)	$\nu$
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)" ( $\Rightarrow$  p.134)

### 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: "18.6 Input Modules Specifications" (⇒ p.331)

##### Measurement probes, cords, and clamps

			Maximum input voltage
For Voltage Measurement	L9197 Connection Cord	For high voltage	600 V
	9197 Connection Cord	For high voltage	600 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 module requires 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	

## Measurement probes, cords, and clamps

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 <sup>(1),(2)</sup>	20 A, DC to 100 kHz
	9278 Universal Clamp-On CT <sup>(1),(2)</sup>	200 A, DC to 100 kHz
	9279 Universal Clamp-On CT <sup>*(1),(2)</sup>	500 A, DC to 20 kHz
	9709 AC/DC Current Sensor <sup>(1),(2)</sup>	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.	9272-10 Clamp-On Sensor* <sup>(1),(2)</sup>	20/200 A, 1 Hz to 100 kHz
For AC	9018-50 Clamp-On Probe	10 to 500 A, 40 Hz to 3 kHz
	9132-50 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) 9555-10 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
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\* : 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	9333 LAN Communicator 9335 Wave Processor	
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## 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

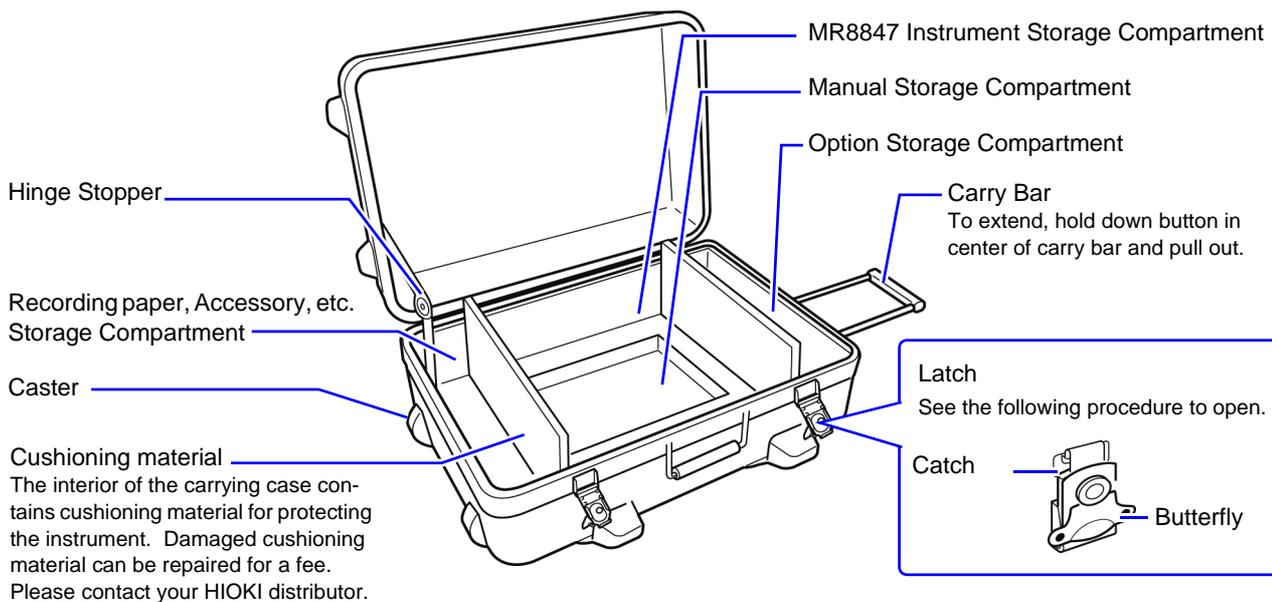
#### **! WARNING**

- 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**

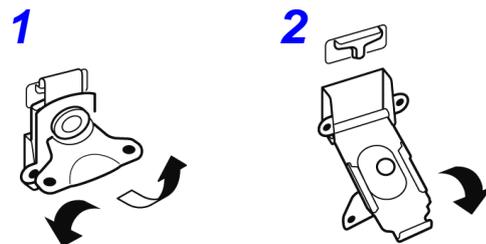
- Observe the following precautions to avoid damage to the case.
  - Do not exceed the load limit of 15 kg (33 lb).
  - Do not open or close the case in the upright position.
- The case includes flammable materials, so do not place it near open flame or any object hotter than 100°C, as the case could catch fire.

#### Parts Names



#### 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  $\pm 10\%$  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  $23\pm 5^\circ\text{C}$  and 20 to 80% RH, 30 minutes after power on

<b>Rated input voltage</b>	12 VDC
<b>Input voltage range</b>	10 to 28 VDC
<b>Maximum rated power</b>	200 VA
<b>Operating temperature and humidity</b>	Same as MR8847
<b>Storage temperature and humidity</b>	Same as MR8847
<b>Operating environment</b>	Same as MR8847
<b>Withstand voltage</b>	700 V DC for 1 min. (between input and output, and between input and instrument chassis)
<b>Isolation voltage</b>	100 M $\Omega$ or more @ 500 V DC (between input and output, and between input and instrument chassis)
<b>Dimensions</b>	Adds approx. 29 mm (D) (1.14"D) to dimensions of Models MR8847
<b>Mass</b>	Adds approx. 1.20 kg (42.3 oz.) to the weight of Models MR8847

# A16

## Appendix 4 If the Model 9784 DC Power Unit is Installed

### 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.

Turn the power switch on.

Positive terminal on the 9784

Negative terminal on the 9784

1 Power Switch OFF

2

3 DC source

Rear

DC Power Unit

### 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.

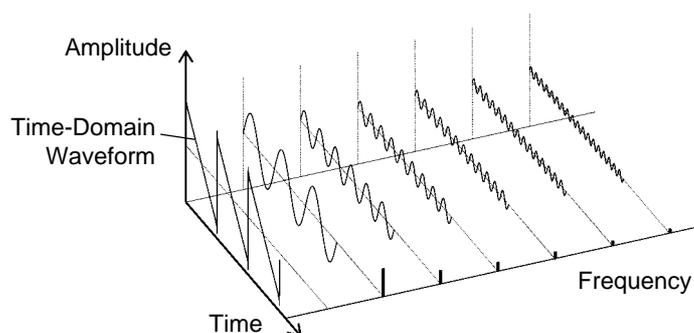
## Appendix 5 FFT Definitions

### 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:

$$X(k) = DFT\{x(n)\} = \sum_{n=0}^{N-1} x(n)W_N^{kn} \quad \dots \dots \dots (1)$$

$$x(n) = IDFT\{X(k)\} = \frac{1}{N} \sum_{k=0}^{N-1} X(k)W_N^{-kn} \quad \dots \dots \dots (2)$$

$$W_N = \exp\left(-j\frac{2\pi}{N}\right) \quad \dots \dots \dots (3)$$

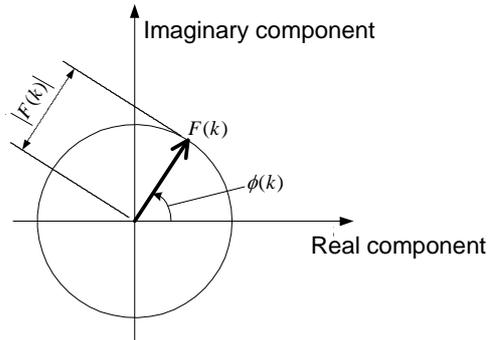
$X(k)$  is typically a complex number, so expression (1) can be transformed again and written as follows:

$$F(k) = |F(k)|\exp\{j\phi(k)\} = |F(k)|\angle\phi(k) \quad \dots \dots \dots (4)$$

$$\phi(k) = \tan^{-1} \frac{\text{Im}\{X(k)\}}{\text{Re}\{X(k)\}} \quad \dots \dots \dots (5)$$

$|F(k)|$  : Amplitude spectrum,  $\phi(k)$  : Phase spectrum

Representing the above relationship on a complex flat surface produces the following figure.



## Linear Time-Invariant Systems

Consider a linear time-invariant (LTI) system  $y(n)$  that is a response to discrete time-domain signal  $x(n)$ .

In such an LTI system, the following expression applies to any integer  $A_i$  when the response to  $x_i(n)$  is  $y_i(n) = L[x_i(n)]$ .

$$L[A_1x_1(n) + A_2x_2(n)] = A_1y_1(n) + A_2y_2(n) \dots \dots \dots (6)$$

If the system function of an LTI system is  $h(n)$ , the input/output relationship can be obtained by the next expression.

$$y(n) = \sum_{m=0}^{\infty} h(n)x(n-m) = \sum_{m=-\infty}^{\infty} h(n-m)x(m) \dots \dots \dots (7)$$

Therefore, when a unit impulse  $\delta(n)$  (which is 1 when  $n = 0$ , and 0 when  $n \neq 0$ ) is applied to  $x(n)$ , the input/output relationship is:

$$y(n) = h(n) \dots \dots \dots (8)$$

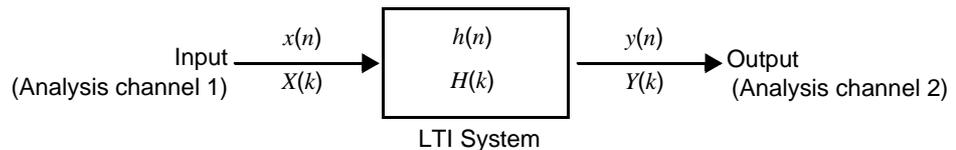
This means that when the input signal is given as a unit impulse, the output is the LTI system characteristic itself.

The response waveform of a system to a unit impulse is called the **impulse response**.

On the other hand, when the discrete Fourier transforms of  $x(n)$ ,  $y(n)$  and  $h(n)$  are  $X(k)$ ,  $Y(k)$  and  $H(k)$ , respectively, expression (7) gives the following:

$$Y(k) = X(k)H(k) \dots \dots \dots (9)$$

$H(k)$  is also called the transfer function, calculated from  $X(k)$  and  $Y(k)$ . Also, the inverse discrete Fourier transform function of  $H(k)$  is the unit impulse response  $h(n)$  of the LTI system. The impulse response and transfer function of this instrument are calculated using the relationships of expression (9).



## Number of Analysis Points

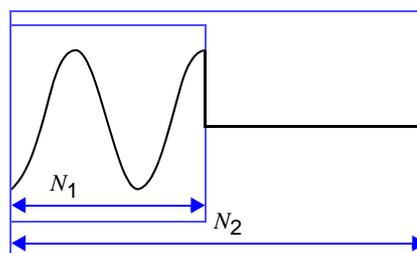
The FFT functions of this instrument can perform frequency analysis of time-domain waveforms consisting of 1000, 2000, 5000, or 10,000 points. However, when the following conditions are satisfied, previously analyzed data can be reanalyzed with a different number of analysis points.

- 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.

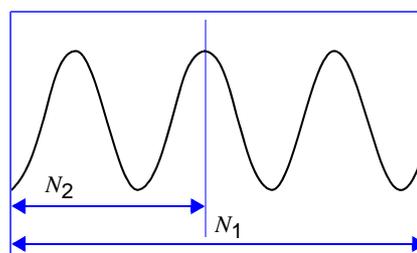
### (1) When $N_1 < N_2$

- 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

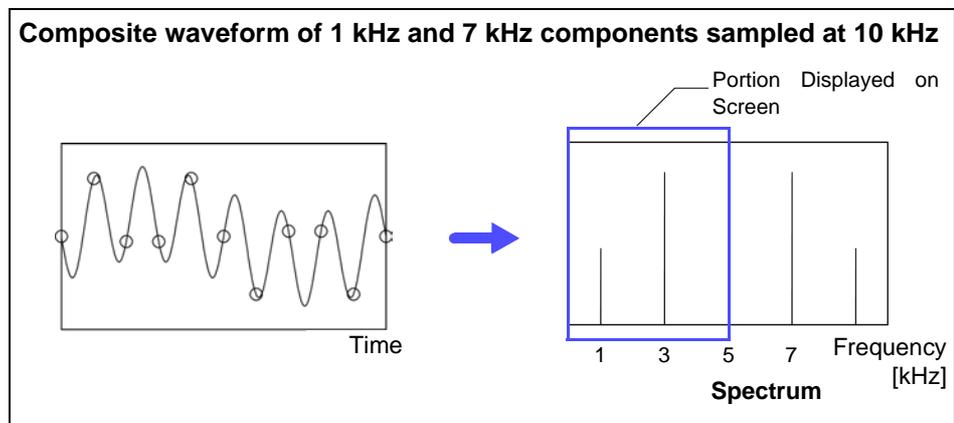
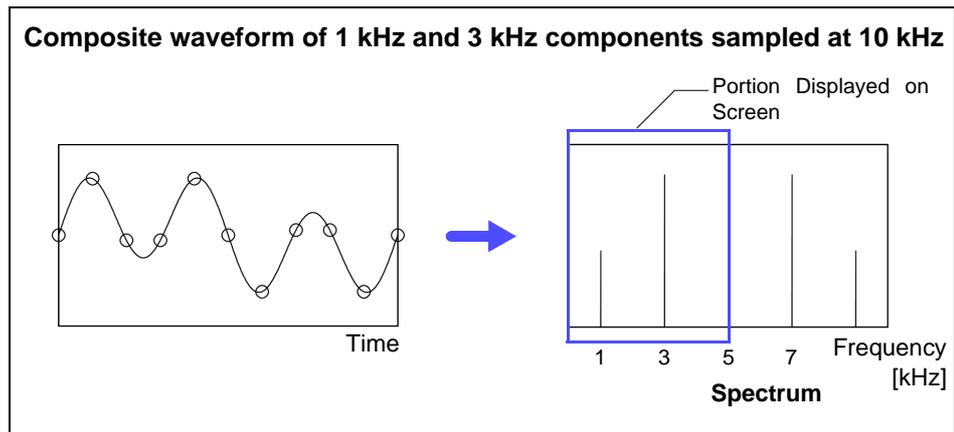
When the frequency of a signal to be measured is higher than the sampling rate, the observed frequency is lower than that of the actual signal, with certain frequency limitations. This phenomena occurs when sampling occurs at a lower frequency than that defined by the Nyquist-Shannon sampling theorem, 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:

$$f_s = 2f_{\max} \dots \dots \dots (10)$$

Therefore, if the input includes a frequency component higher than  $f_s/2$ , it is observed as a lower frequency (alias) that does not really exist.

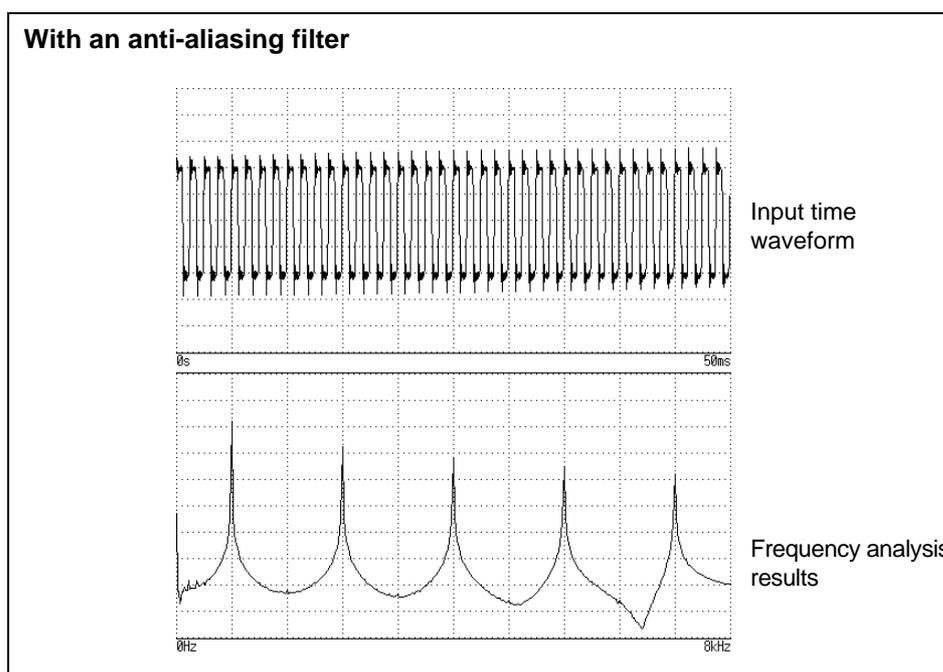
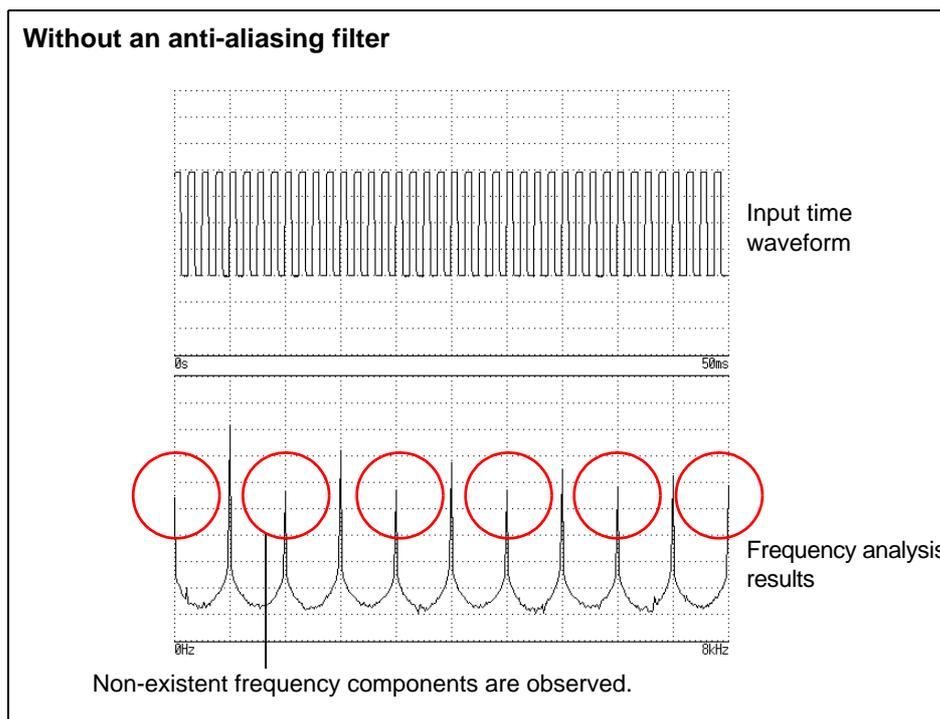
The following diagrams show the results of spectrum analysis of composite waveforms having components of 1 kHz and 3 kHz, and of 1 kHz and 7 kHz. If sampling frequency  $f_s$  is 10 kHz, the spectral component of an input frequency above 5 kHz (in this case, 7 kHz) is observed as an alias at 5 kHz or below. In this example the difference between the 3 and 7 kHz components is indiscernible.



## Anti-Aliasing Filters

When the maximum frequency component of the input signal is higher than one-half of the sampling frequency, aliasing distortion occurs. To eliminate aliasing distortion, a low-pass filter can be used that cuts frequencies higher than one-half of the sampling frequency. Such a low-pass filter is called an anti-aliasing filter.

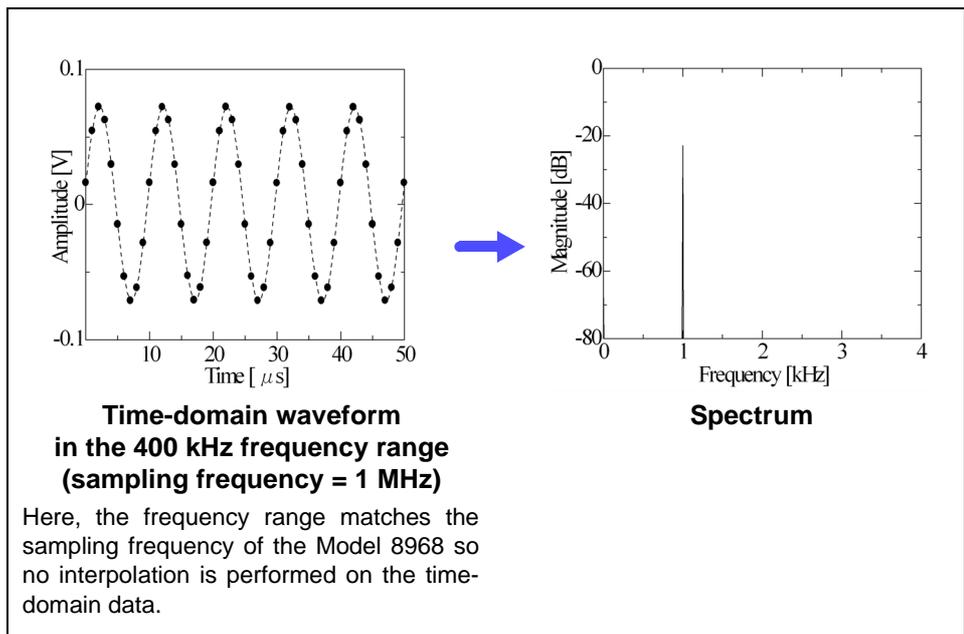
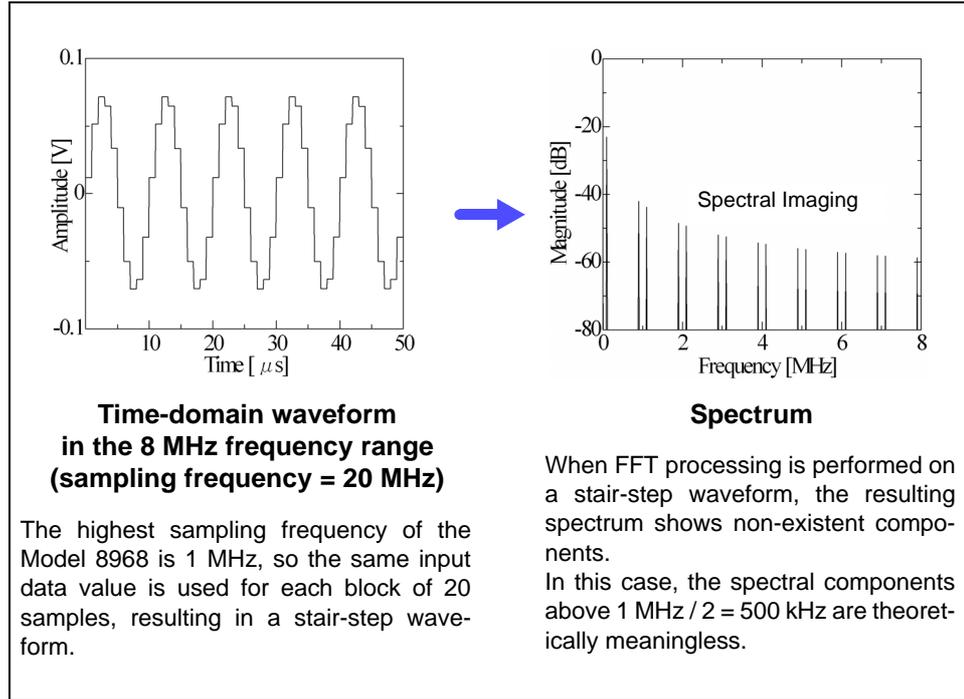
The following figures show the effect of application of an anti-aliasing filter on a square wave input waveform.



### 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.



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.

$$A_n = \frac{(n-1)A_{n-1} + Z_n}{n} \dots \dots \dots (11)$$

$n$ : count of measurements to average

$A_n$ : averaging results of  $n$  counts

$Z_n$ : measurement data of  $n$  counts

### 2. Exponential Averaging (Time and Frequency Domains)

Before averaging, newer data is given exponentially greater significance than older data.

$$A_n = \frac{(N-1)A_{n-1} + Z_n}{N} \dots \dots \dots (12)$$

$N$ : Specified number of counts to average

$n$ : count of measurements to average

$A_n$ : averaging results of  $n$  counts

$Z_n$ : measurement data of  $n$  counts

## Overall Value

---

The overall value is the sum of the power spectrum at each frequency. This value is equal to the positive sum of the squares of the (RMS) input signals, except when frequency averaging is performed. The FFT function of this instrument calculates and displays the RMS values for stored waveforms and the overall value from the sum of the power spectrum for the frequency domain.

$$(Over\ all) = \sum_{i=0} P_i \dots \dots \dots (13)$$

$P_i$ : power spectrum of value  $i$

## Total harmonic distortion (THD)

---

Total harmonic distortion (THD) indicates the proportion of the higher harmonics to the fundamental harmonic

This means that the larger the value, the more distorted the waveform.

$$THD = \sqrt{\frac{\sum (f_n)^2}{(f_0)^2}} \times 100 \text{ [%]}$$

$f_0$  = fundamental wave

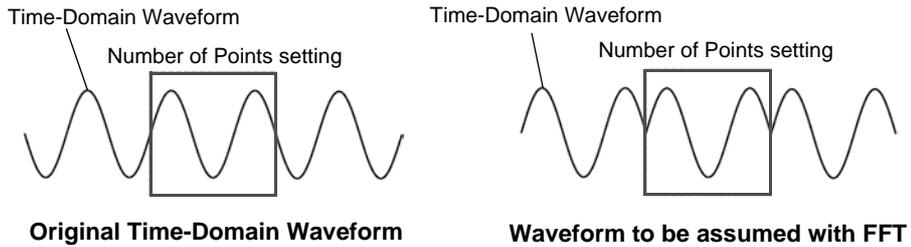
$f_n$  =  $n$  next higher harmonic

### Window Function

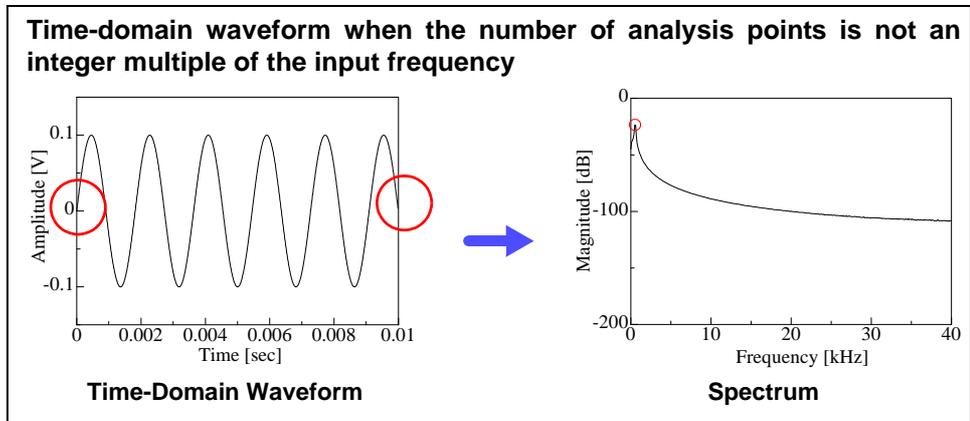
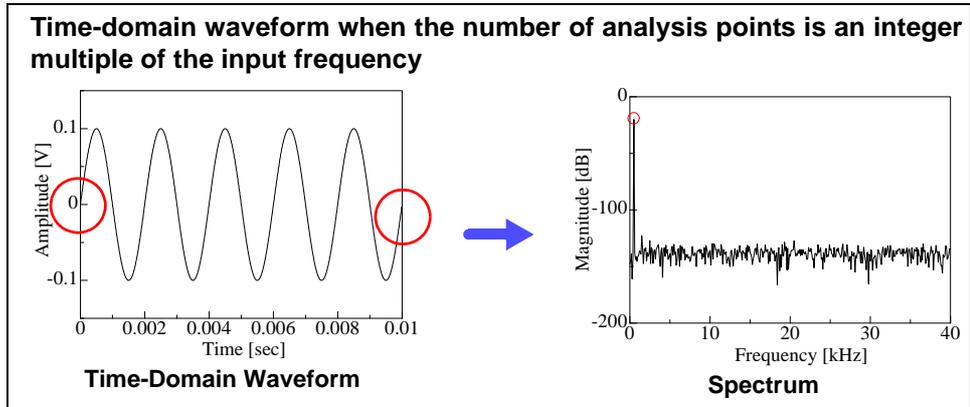
The Fourier transform of a continuous system is defined by the integral Calculus in expression (14) for the time range from minus infinity to plus infinity.

$$X(f) = \int_{-\infty}^{\infty} x(t)\varepsilon^{-2\pi ft} dt \dots\dots\dots (14)$$

However, because expression (14) cannot be calculated with actual measurements, the Analysis is performed on a segment between finite limits. Processing the waveform segment within these limits is called window processing. For FFT analysis, the waveform segment within these limits is assumed to repeat periodically (as shown below).

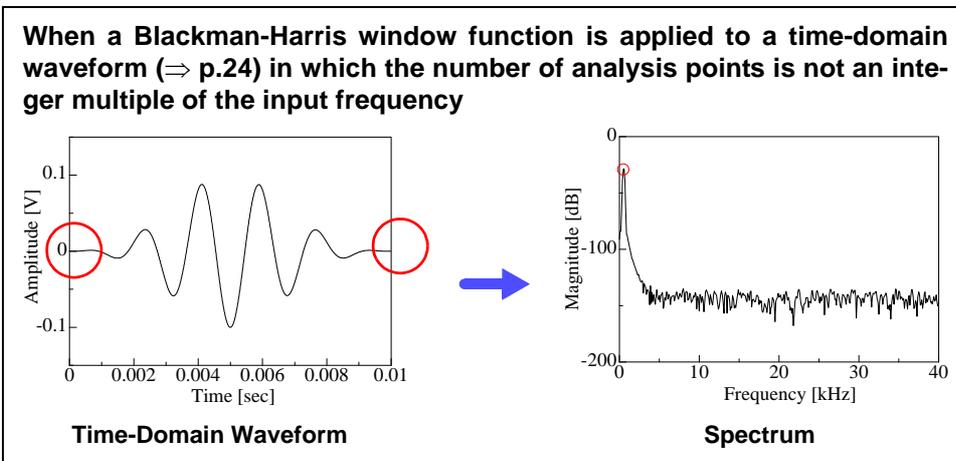


When the number of points for FFT analysis is an integer multiple of the input signal frequency, a single-line spectrum is obtained. However, if it is not an integer multiple of the frequency (when the waveform assumed with FFT includes discontinuous points), the spectrum is scattered, and a line spectrum cannot be obtained. This phenomena is called leakage error (as shown below).



The window function was created to suppress such leakage errors. The window function smoothly connects each end of the time-domain waveform where it is cut off.

The following figure presents an example of spectral analysis by applying a window function to a time-domain waveform. Using the window function, discontinuous points on the time-domain waveform are eliminated, so the wave shape approaches a line spectrum.



The following figure shows the time-domain waveform of the window function and its spectrum.

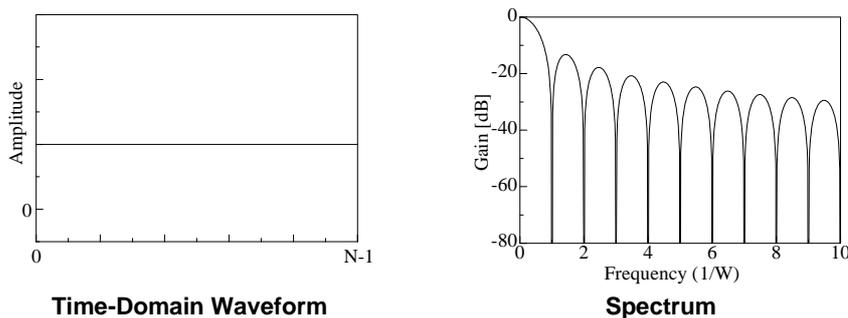
Each spectrum shows a large peak at a low frequency, and many smaller peaks at higher frequencies. The largest peak is called the **main lobe**, and the smaller peaks are the **side lobes**.

The most accurate results of the FFT 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.

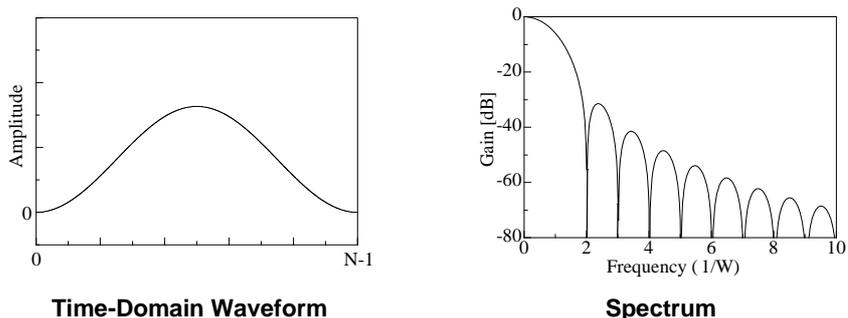
Therefore, a window function having a wide main lobe is used when amplitude values are important, while a window function having a small main lobe is used to observe fine spectral details, and a window function having small side lobe amplitudes is used to exclude the effects of the surrounding spectrum.

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.

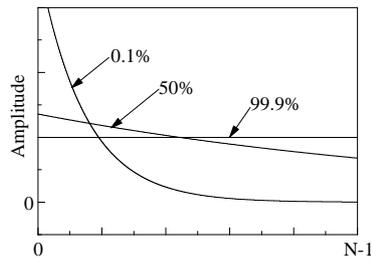
**Rectangular window**



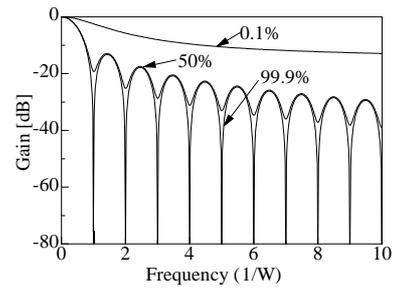
**Hann window**



### Exponential window

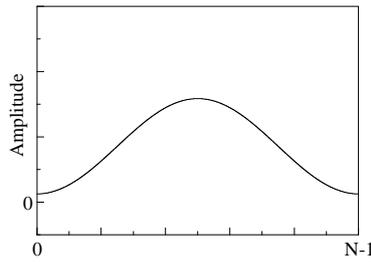


Time-Domain Waveform

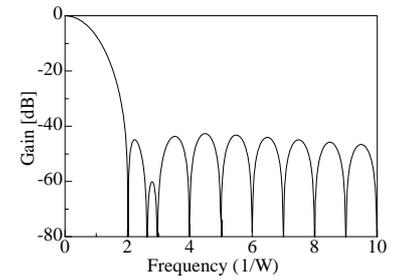


Spectrum

### Hamming window

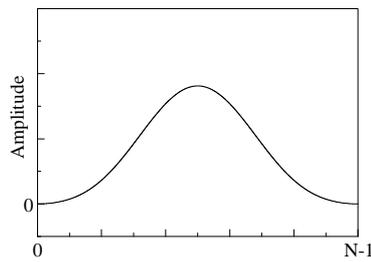


Time-Domain Waveform

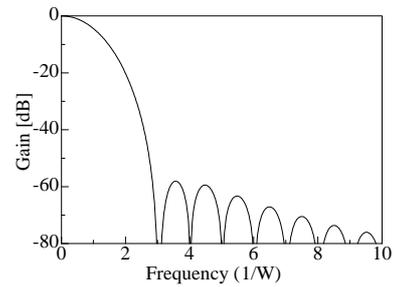


Spectrum

### Blackman window

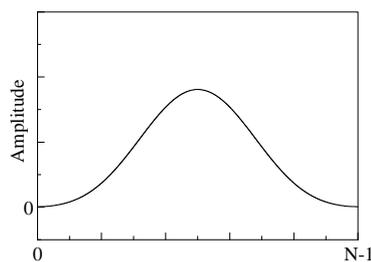


Time-Domain Waveform

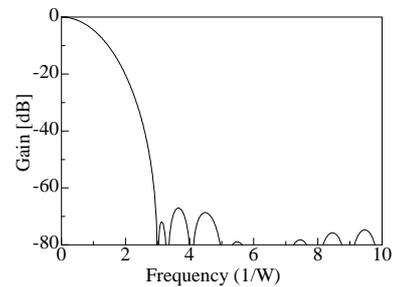


Spectrum

### Blackman-Harris window

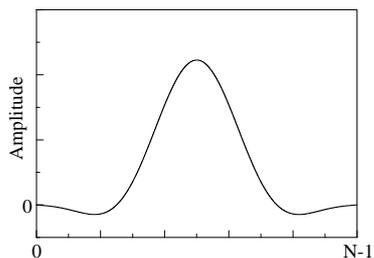


Time-Domain Waveform

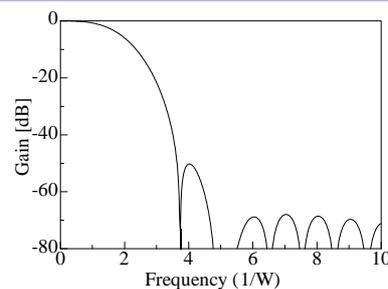


Spectrum

### Flat top window

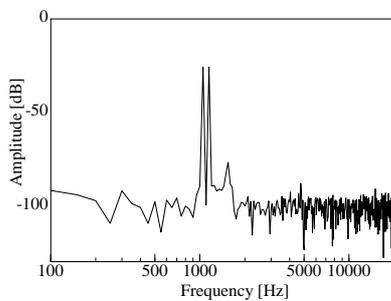


**Time-Domain Waveform**

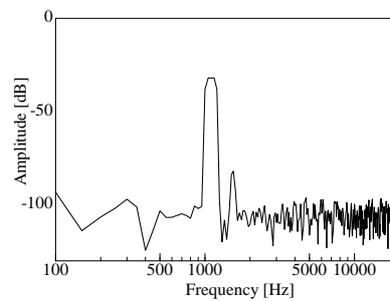


**Spectrum**

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**

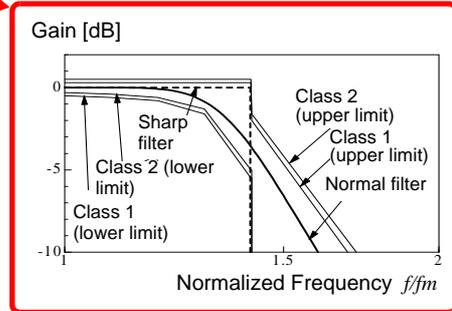
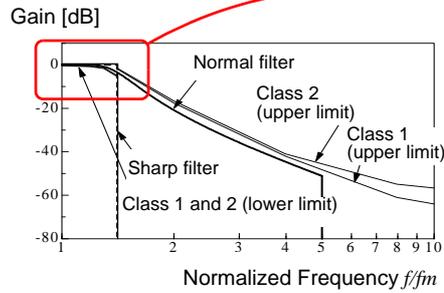


**Analysis Using a Hann Window**

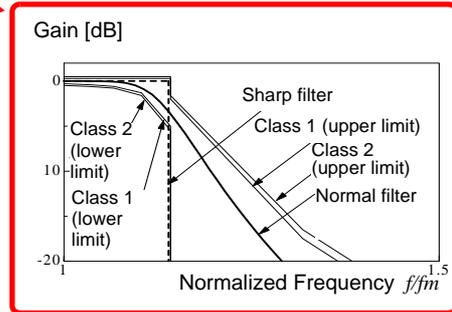
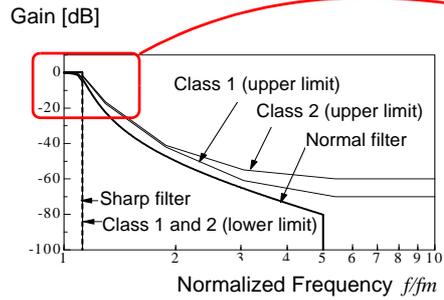
### Octave Filter Characteristics

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

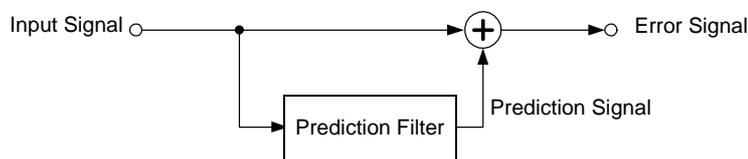


#### 1/3 Octave Filter Characteristic



## 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  $\Delta T$ , LPC analysis presumes the following relationship between current sample value  $x_t$  and the value of previous sample  $p$ .

$$x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \dots + \alpha_p x_{t-p} = \varepsilon_t \quad \text{----- (15)}$$

However,  $\{\varepsilon_t\}$  is an uncorrelated random variable with average value 0 and the dispersion  $\sigma^2$ .

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.

$$x_t = \hat{x}_t + \varepsilon_t = -\sum_{i=1}^p \alpha_i x_{t-i} + \varepsilon_t \quad \text{----- (16)}$$

Here,  $\alpha_i$  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.

# A30

## *Appendix 5 FFT Definitions*

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