MR8847A

MR8847-51
MR8847-52
MR8847-53

HIOKI

Measurement Guide

MEMORY HiCORDER

Read first.

Offers an introduction to the Memory HiCorder's basic measuring method for first time users.

EN

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Introduction

Thank you for purchasing the Hioki MR8847A Memory HiCorder (MR8847-51, MR8847-52, MR8847-53).
This Measurement Guide consists of several basic application examples. Before using the instrument, be sure to read the Instruction Manual carefully.
The following documents are provided with this instrument. Refer to them as appropriate for your application.

Instruction manuals		Description
1	**Measurement Guide (This document)**	**Read first.** Offers an introduction to the instrument's basic measuring method for first time users.
2	**Instruction Manual (book)**	Contains explanations and instructions regarding the instrument's operating methods and functions.
3	**Communication Command Instruction Manual (PDF file)**	Contains lists of the communication commands to control the instrument with a computer and explanations regarding the commands.
4	**U8793, MR8790, MR8791 Instruction Manual (PDF file)**	Contains explanations and instructions regarding the operating method as well as functions of the following models: U8793 Arbitrary Waveform Generator Unit, MR8790 Waveform Generator Unit, MR8791 Pulse Generator Unit, and SF8000 Waveform Maker

Contents

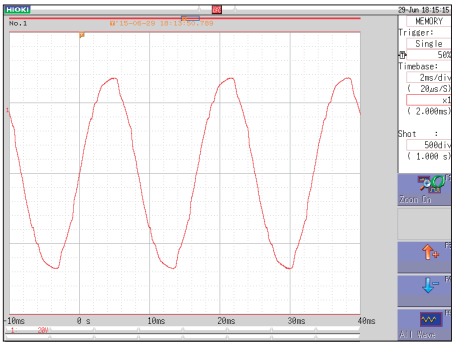
Screen structure and operation overview

Screen structure

For screens with sheet tabs displayed, the sheets can be switched every time a key is pressed.

Waveform screen

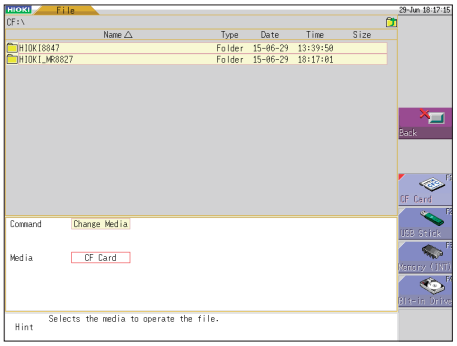
DISP



The screen to observe waveforms

File screen

FILE



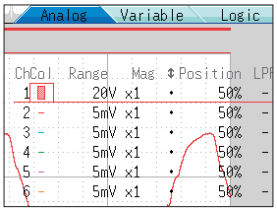
The screen to view data files in a storage media (CF card, built-in drive, USB flash memory, internal memory).

Settings window

CH. SET TRIG. SET

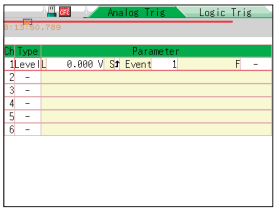
Displayable on the waveform screen.

Channel settings window



The window to set details for analog or logic channels

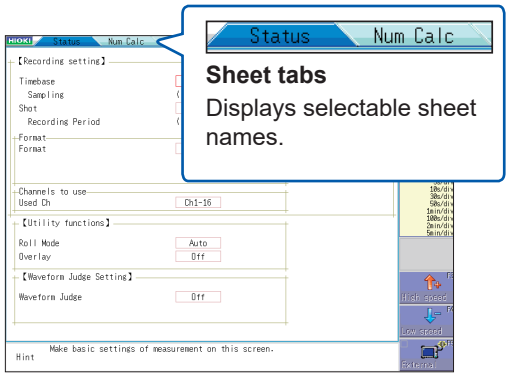
Trigger settings window



The window to set details for triggers

Status screen

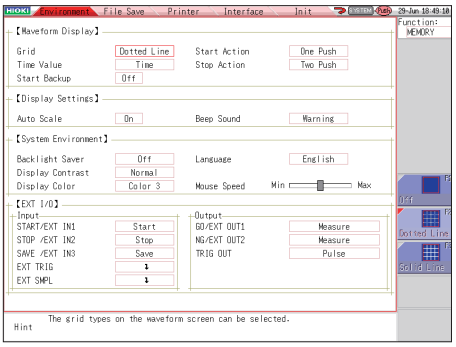
STATUS



The screen to set measuring methods and waveform calculations

System screen

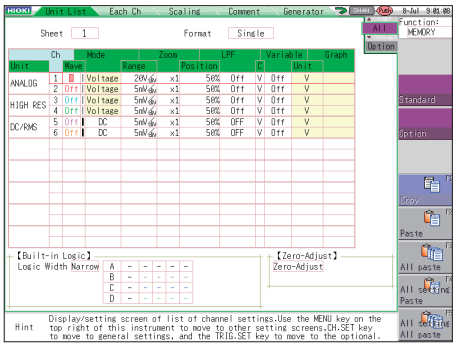
SYSTEM



The screen to set environment, file saving, printing, and communication, as well as initialize data

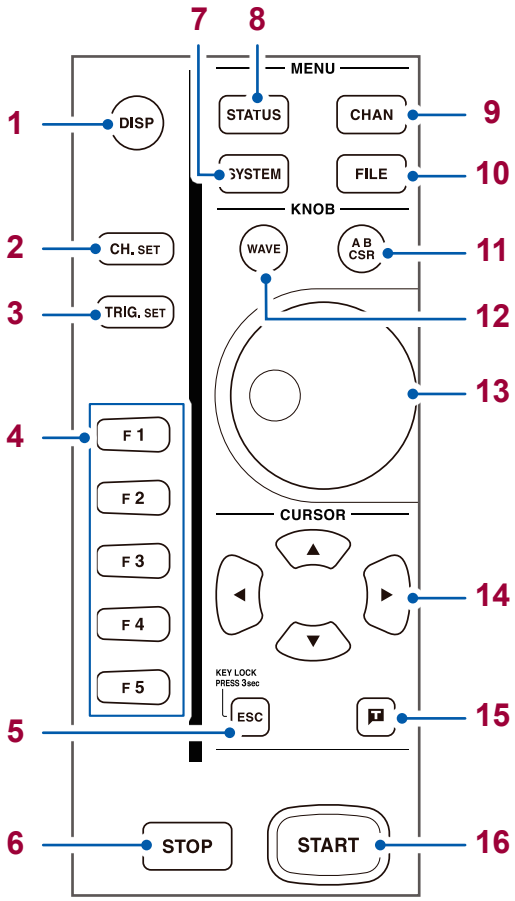
Channel screen

CHAN

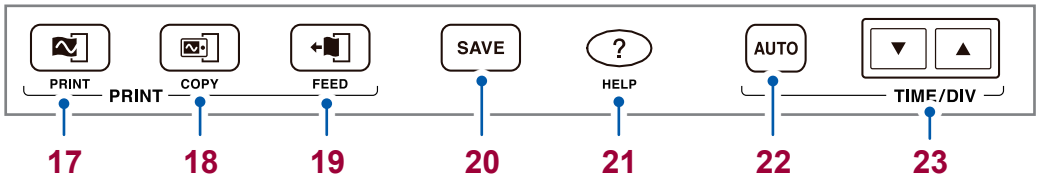


The screen to set the each channel, scaling, and comment

Operating Keys

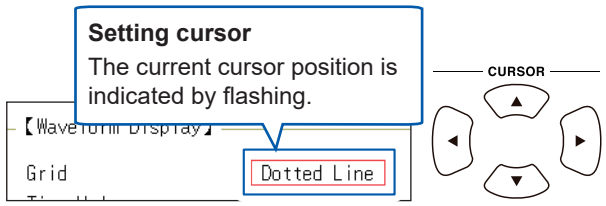


1	**DISP key** Displays the waveform screen.	8	**STATUS key** Displays the status screen.
2	**CH.SET key** Displays the channel settings window in the waveform screen.	9	**CHAN key** Displays the channel screen.
3	**TRIG.SET key** Displays the trigger settings window in the waveform screen.	10	**FILE key** Displays the file screen.
4	**F key** Select items to be set.	11	**AB CSR key** (Lit in red while selected) Displays the A/B cursor settings window.
5	**ESC key** Cancels the running operation. Closes the displayed dialog and the window. **KEY LOCK:** Press and hold **ESC** key for 3 s to disable key operations. Press and hold it for 3 s enable key operations.	12	**WAVE key** (Lit in red while selected) Assigns the waveform scrolling to the jog and shuttle knobs.
		13	**Inner: Jog** **Outer: Shuttle** Scrolls through waveforms.
6	**STOP key** Stops the running measurement. 1 press: Measurement stops after the set recording length. 2 presses: It stops immediately.	14	**CURSOR keys** Moves the cursor displayed on the screen.
		15	**Manual trigger key** Issues a manual trigger event.
7	**SYSTEM key** Displays the system screen.	16	**START key** Starts a measurement. (Lit in green during measurement operations)

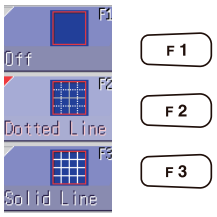


17	**PRINT key** Prints waveforms and others.	21	**HELP key** Opens the help information.
18	**COPY key** Prints a screen shot.	22	**AUTO key** Starts auto-range measurement.
19	**FEED key** Feeds the recording paper.	23	**TIME/DIV key** Configures the time axis setting.
20	**SAVE key** (Lit in blue while accessing a recording medium) Saves data (a dialog can be switched between visible and invisible during an auto-saving).		

To change the setting content



1 **Move the setting cursor to an item to be set.**



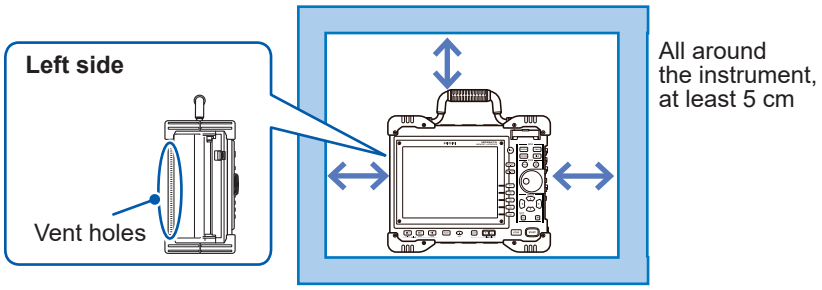
2 **Select an option**

Preparations for Measurement

Before using the instrument, refer to “Operating Precautions” in the Instruction Manual.

Install the instrument

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



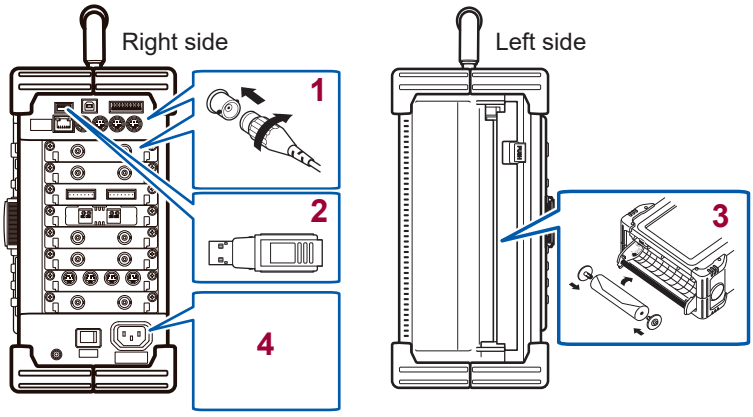
Set the items necessary to the instrument

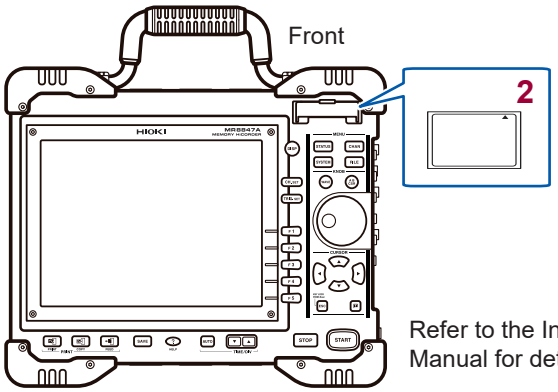
1 Connect the probes and cords.

2 Insert the USB flash memory or CF card.

3 Set the recording paper.

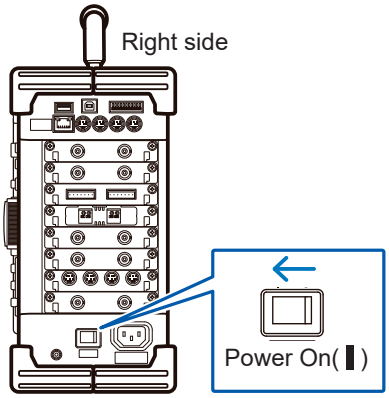
4 Connect the power cord.





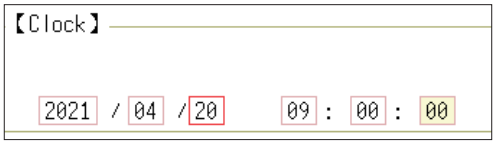
Refer to the Instruction Manual for details.

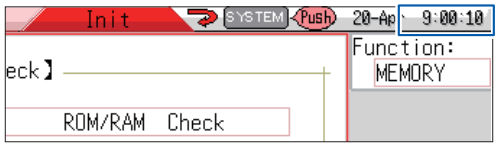
Turn on the instrument



Set the clock

SYSTEM





Set the clock on the **[Init]** sheet.

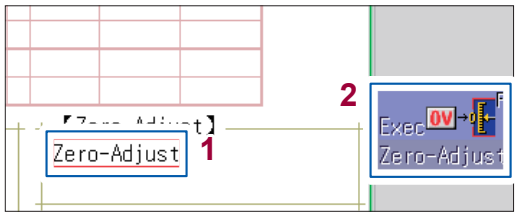
The date and time indication is shown at the upper right of the screen.

Execute the zero-adjustment

This procedure compensates for input module differences and sets the reference potential of the instrument to 0 V.

To ensure precise measurements, perform zero-adjustment after 30-minute warm-up.

CHAN



F3

Configure the setting on the **[Unit List]** sheet.

1. **Move the cursor to this position.**
2. **Select [Exec Zero-Adjust].**

Tip **[Exec Zero-Adjust]** can also be selected on the channel settings window (**[Analog]** sheet).
(On the waveform screen, press the **DISP** key, and then, on the channel settings window, press the **CH.SET** key)

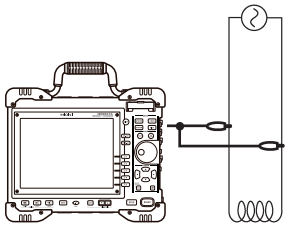
Measurement Procedure

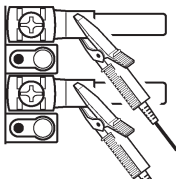
Before perform measurement, please read “Operating Precautions” in the Instruction Manual.

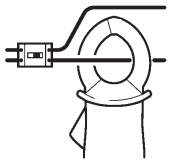
Inspect the instrument before measurement

Please read “Pre-Measurement Inspection” in the Instruction Manual.

Connect the leads or clamp sensor to the measurement point







Set the measurement conditions

DISP

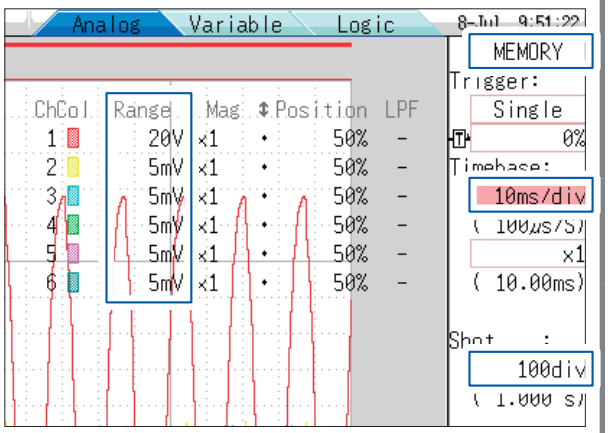
Configure the setting on the waveform screen.

- Measurement function
- Timebase (horizontal axis)
- Recording length

CH. SET

On the Channel settings window of the **[Analog]** sheet, configure the settings.

- Voltage (vertical) axis range



Configure other settings if necessary.

Start and stop the measurement

START

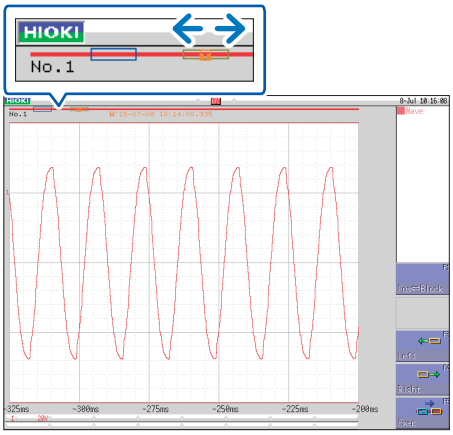
Start the measurement

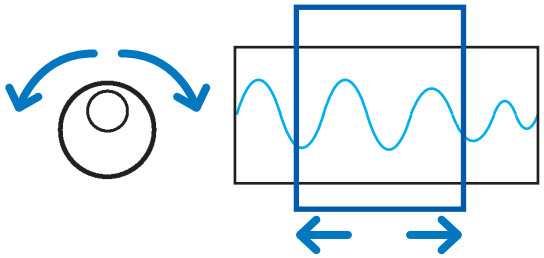
STOP

Stop the measurement

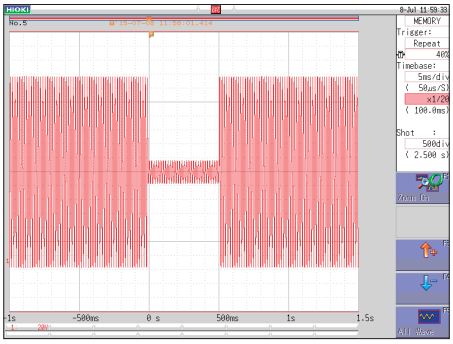
Analyze, save, and print the data

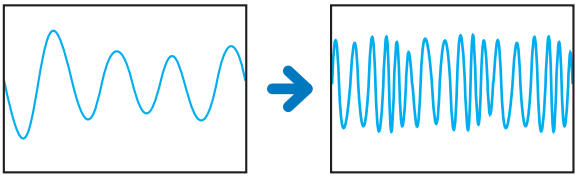
Analysis





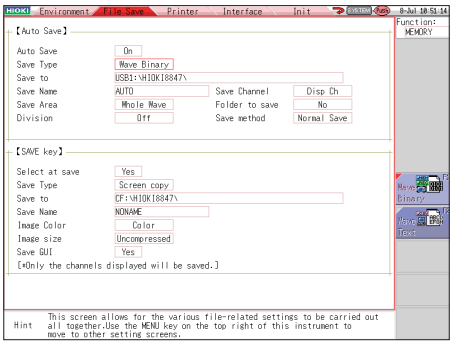
Scroll through the waveforms to observe them.

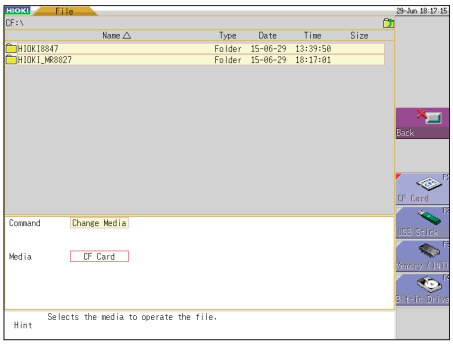




The displayed waveforms can be changed.
(It can be stretched or compressed.)

Save



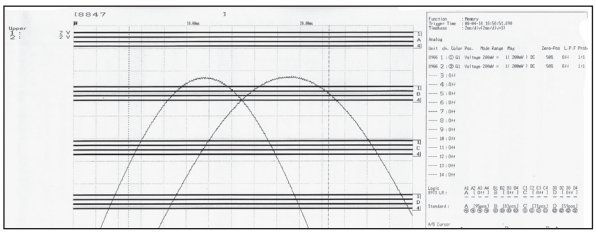


Save the data.
The data can be also automatically saved under the pre-configured saving conditions.

Observe the saved data.
The data can be loaded, and files can be deleted and copied.

Print

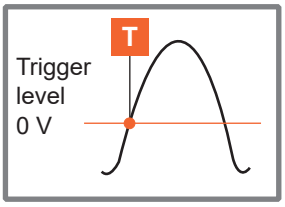
<Example of print>



Print the recorded waveforms.

Measure the commercial power supply

The following explains the method of recording a voltage waveform for the commercial power supply of 200 V AC (50 Hz /60 Hz), including the method of saving the data after measurement. For one instance, the level trigger is used to measure waveforms.
To measure repetitive waveforms such as the commercial power supply, setting the standard level trigger level as the measurement start point will make it easier to observe the waveforms.

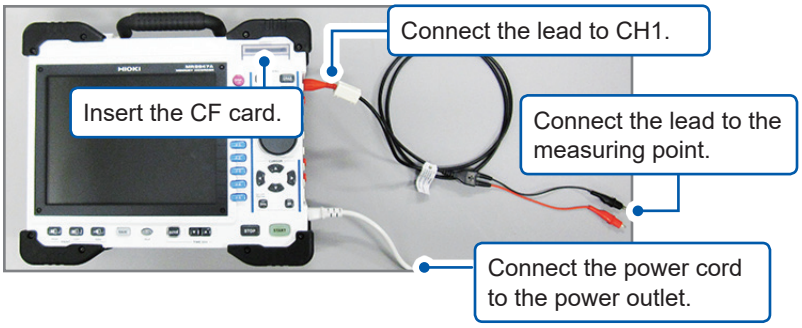


1 Prepare for measurement

Required items:

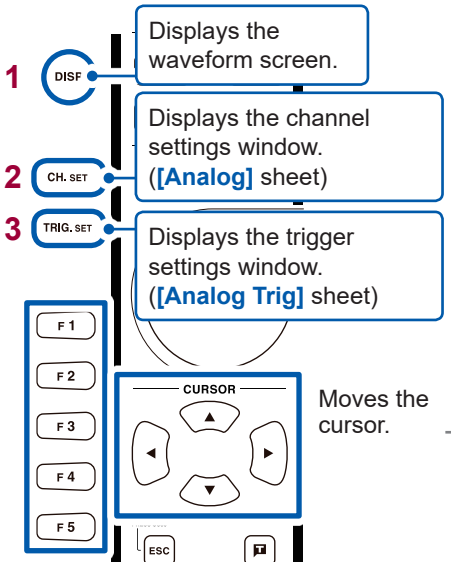
- ☐ MR8847A Memory HiCorder
- ☐ 8966 Analog Unit
- ☐ L9198 Connection Cord
- ☐ CF card

Refer to “Preparations for Measurement” (p. 5)

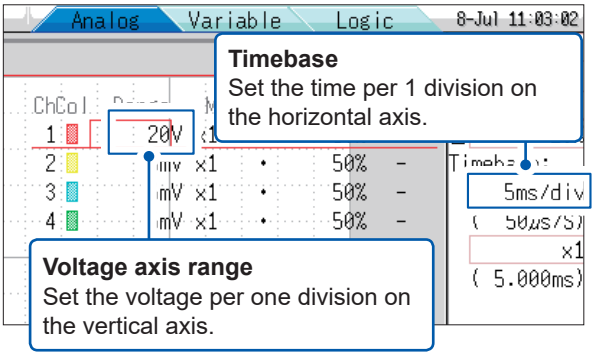


2 Set the measurement conditions and trigger conditions

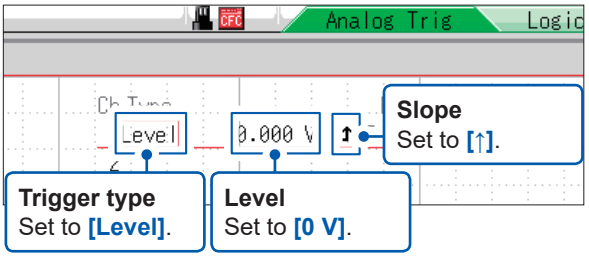
Configure the settings on the waveform screen described as follows.



1 Set the measurement conditions.



3 Set the trigger conditions.



Deciding on the horizontal axis (time axis) range

The horizontal axis (time axis) range is calculated from the frequency and cycle.

f [Hz] = 1/t [s] (f: frequency; t: cycle)

Example: When the measurement frequency is 50 Hz.

1 cycle is t = 1/50 [s], i.e. 20 ms.

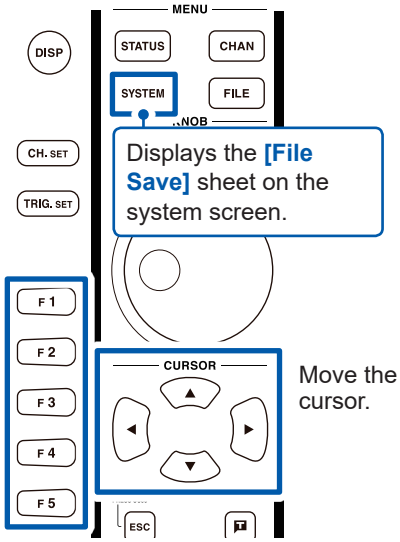
When the horizontal axis (time axis) is set to 20 ms/div, exactly 1 cycle will be displayed in 1 division (1 square).

Vertical axis (Voltage axis) range

If you change the range during a measurement, the measurement will restart.

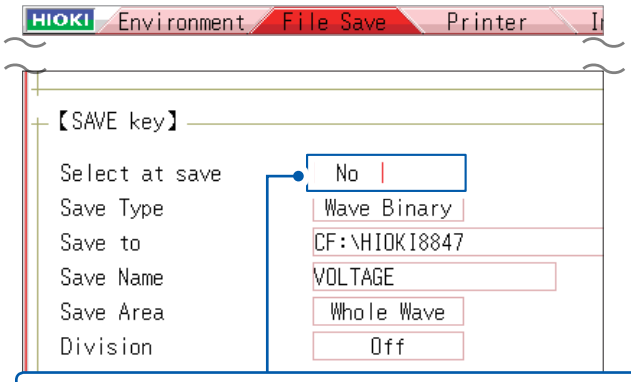
3 Set the saving conditions

Configure the settings on the system screen described as follows.



Select the items to be set.

Set the saving conditions



Select at save (Selection Save)

[No] Pressing the **SAVE** key allows saving measured data under the configured saving conditions immediately.

[Yes] Pressing the **SAVE** key each time allows saving measured data after the operator checks and configures the saving conditions.

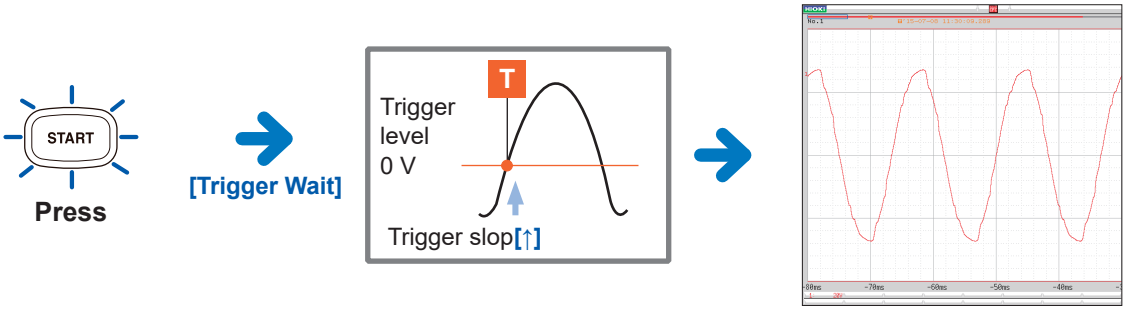
For example, the saving conditions listed below will be displayed on the screen as shown above.

Save Type: Wave Binary	Save to: CF Card
Save Name: Voltage	Save Area: Whole Wave

Tip

To observe waveforms on the instrument, set the **[Save Type]** to **[Wave Binary]**. To observe them on a computer, set it to **[Text]**. Data saved in the text format cannot be observed on the instrument.

4 From Starting Measurement to Stop It



When the trigger conditions are met, the trigger is issued and the waveforms with a length equivalent to the preset record length will be recorded. Measurement data will be recorded until the **STOP** key is pressed.

5 Save the data

SAVE

Press SAVE key.

Data will be saved under the pre-set saving conditions.

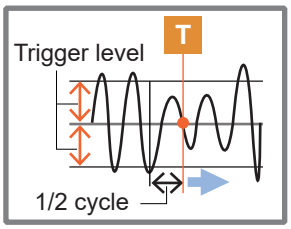
Tip

Press **FILE** key to observe the saved data on the file screen. Refer to “Access the storage medium” (p. 19).

Refer to”Analyze data” (p. 14) for the analyzing method.

Monitor abnormal occurrences

The following explains the recording method to record a voltage drop including a voltage interruption.
Keep monitoring and save the measurement data automatically.
In this section, a voltage dip trigger is used to measure waveforms. The following explains how to issue the trigger when an input signal from a 50-Hz commercial power falls from approximately 200 V rms (282.8 V peak) to below 180 V rms (254.4 V peak).

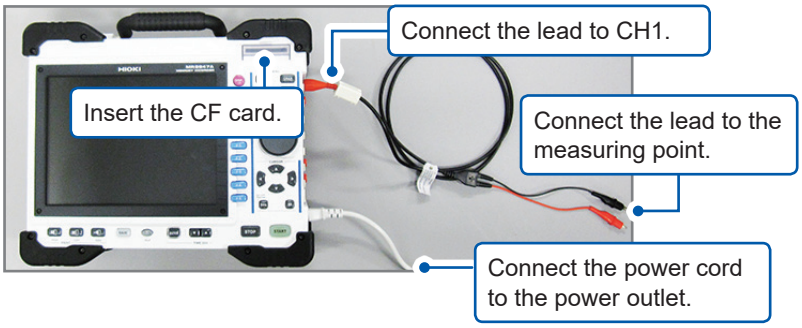


1 Prepare for measurement

Required items:

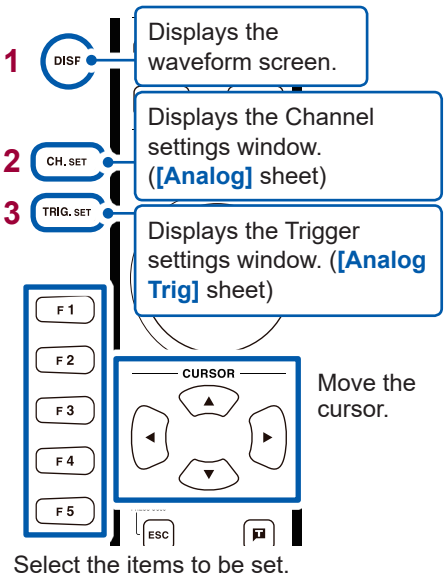
- ☐ MR8847A Memory HiCorder
- ☐ 8966 Analog Unit
- ☐ L9198 Connection Cord
- ☐ CF card

Refer to “Preparations for Measurement” (p. 5)



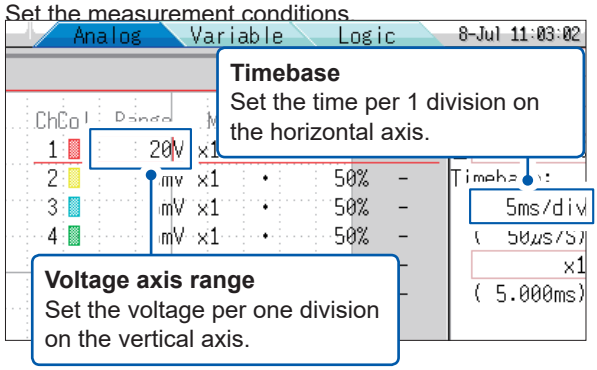
2 Set the measurement conditions and trigger conditions

Configure the setting on the waveform screen as follows.

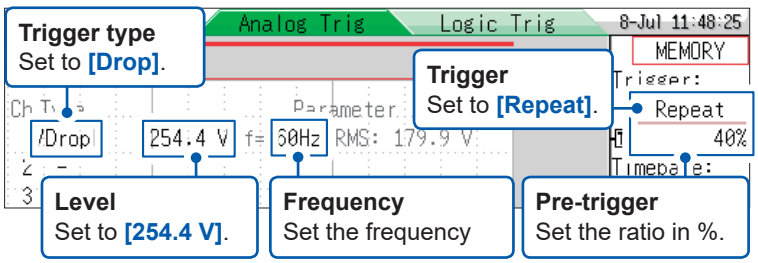


Select the items to be set.

1 **2** Set the measurement conditions.



3 **Set the trigger conditions.**

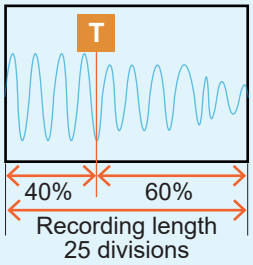


Pre-trigger

To record waveforms that exist before any abnormal occurrence, such as an instantaneous power failure, set the pre-trigger, which sets where the trigger (trigger point) is issued on the recording length of the waveform.

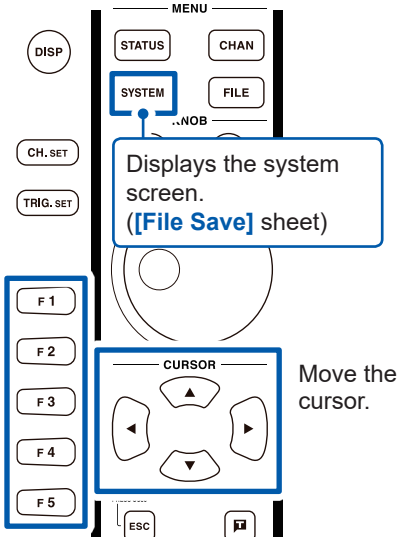
E.g. To record the waveform with a length of 10 divisions that exist before an instantaneous power failure for the recording length setting of 25 divisions, set the pre-trigger to 40%. (Calculation method: 10 [div] / 25 [div] × 100%)

Refer to “What is a pre-trigger?” (p. 25).

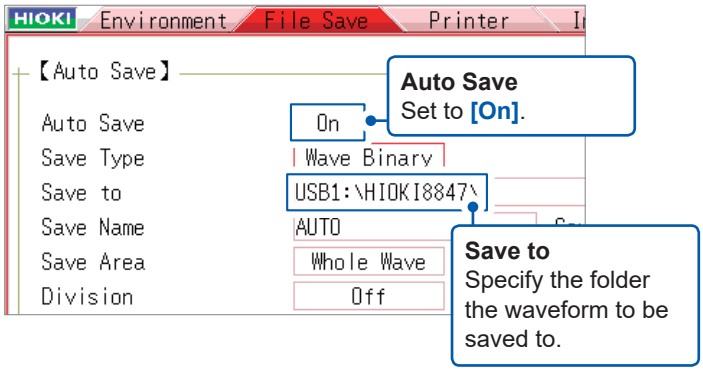


3 Set automatic saving

Configure the setting on the system screen as follows.



Select the items to be set.

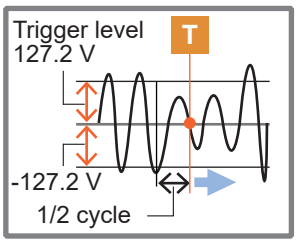


For automatic saving, the built-in drive, a USB flash memory, and a CF card are available.
When saving waveforms to the CF card, please check that there is enough capacity and the card is properly inserted.

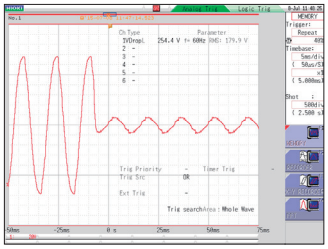
4 Start and Stop Measurement

Press

→ [Trigger waiting]



→



[Trigger waiting] will be displayed until the commercial power voltage satisfies the trigger conditions (in this case, until an instantaneous power failure occurs).

When the trigger conditions are met, the trigger is issued and measurement will start.
Measurement data will be recorded until the **STOP** key is pressed.
Data will be saved automatically to the CF card and wait the next instantaneous power failure after the measurement completes.

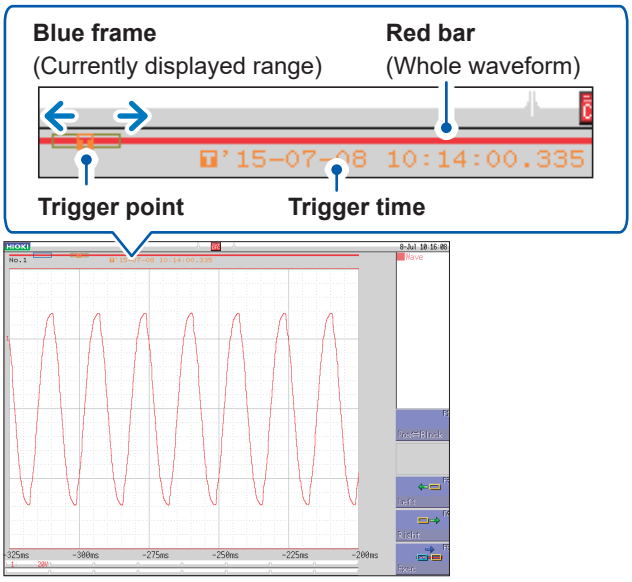
Refer to “Analyze data” (p. 14) for analysis method.

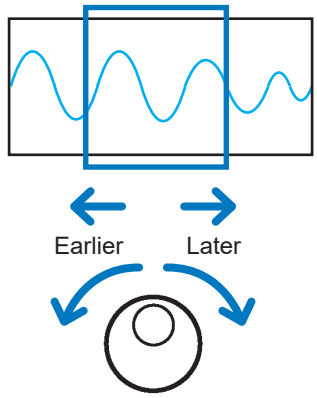
Analyze data

Observe the measured waveform

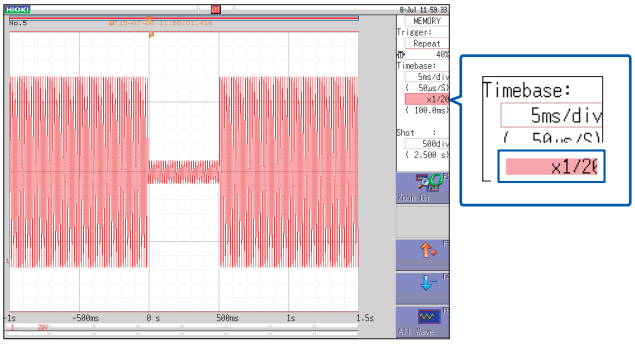
Scroll through the waveform

The position of the waveform currently displayed on the display is indicated on the scroll bar.

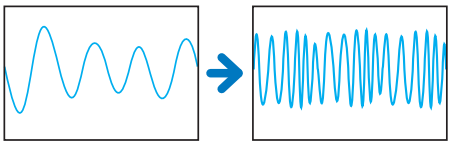




Stretch or compress the waveform

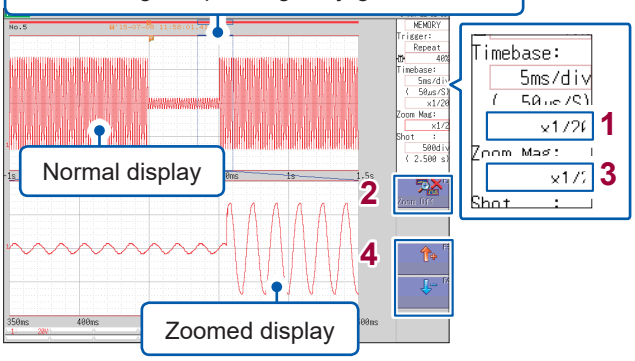


Change the magnification.
When the A and B cursors appear on the screen, use the cursors as the standard to stretch or compress.



Zoom in and observe the waveform

The waveform in the blue frame is zoomed up.
Scroll through it operating the jog shuttle.

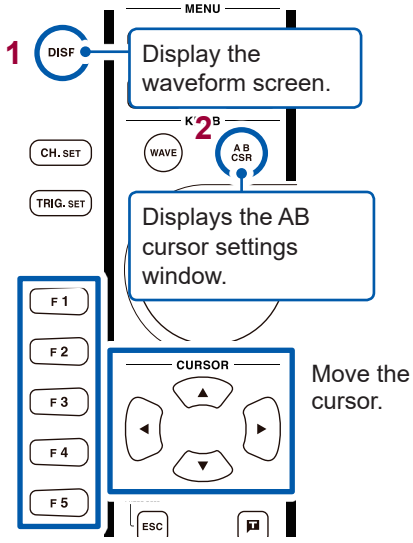


1. **Move the cursor to the magnification.**
2. **Press [ZOOM On].**
   The icon is changed to **[ZOOM Off]**, and the screen is divided vertically into two.
3. **Move the cursor to [Zoom Mag].**
4. **Change the magnification.**

Read measured value

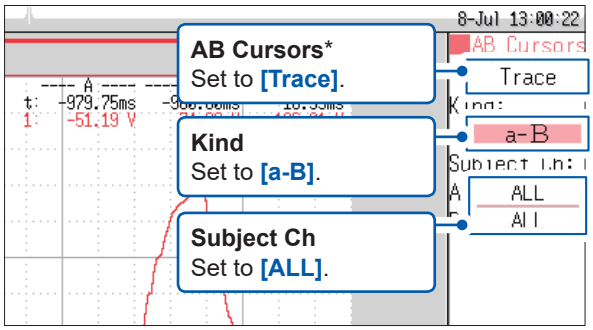
1. Set the A and B cursors.

Configure the setting on the waveform screen as follows.



Move the cursor.

Select the items to be set.

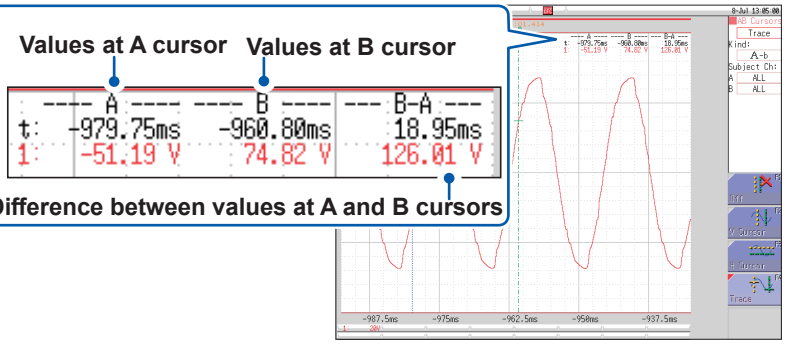


*The value to be displayed can be switched.

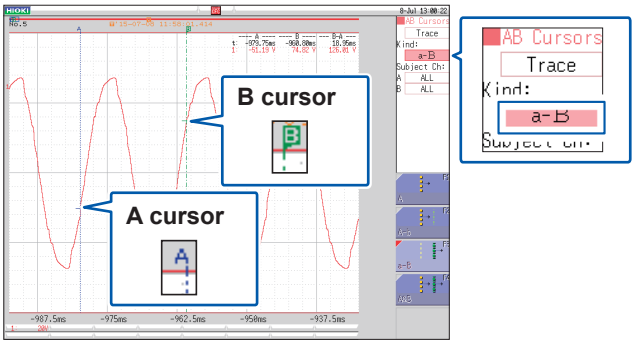
[Trace]	Time value and measured value
[V Csr]	Time value and frequency
[H Csr]	Measured value

Example

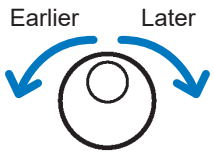
Time
Measured value of CH 1



2. Move the A and B cursors to the point you wish to observe.



Move the cursor to the point of the measured value on the waveform you wish to observe operating the jog shuttle.



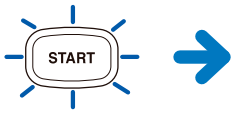
To change the cursor to be moved

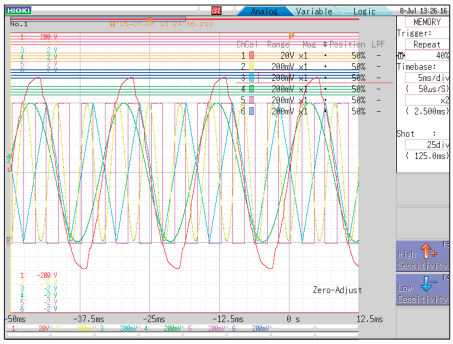
Switch the **[Kind]** among the following:

[A]	Use and move A cursor only (default).
[A-b]	Use the A and B cursors. Move the A cursor only.
[a-B]	Use the A and B cursors. Move the B cursor only.
[A&B]	Use the A and B cursors. Move the both simultaneously.

Display the waveforms eliminating overlap each other

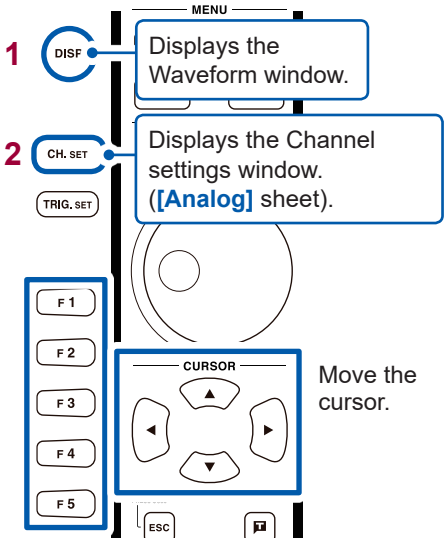
When multi phenomenon are measured, the waveforms may overlap each other and become difficult to observe.
When this happens, change the positions of the waveforms or the magnifications on the vertical axes on the display to recognize the waveforms easily.





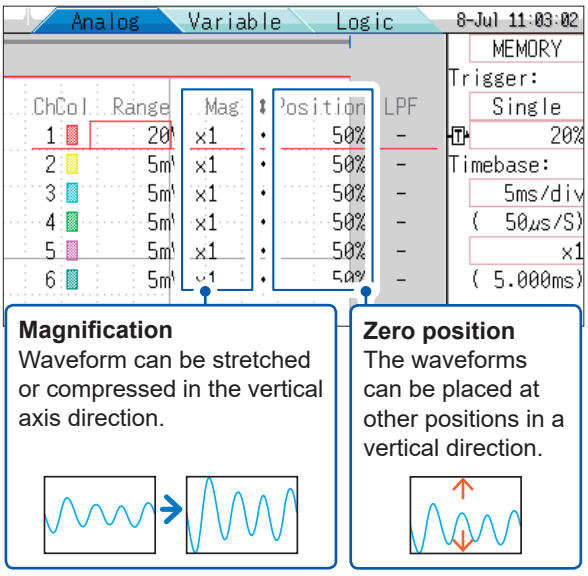
The **START** key is pressed and measurement has started but the waveforms overlap each other and cannot be recognized easily.

Configure the setting on the waveform screen as follows.

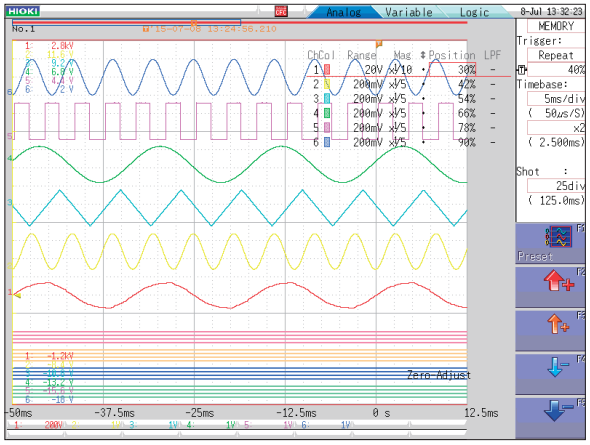


1 **Configure the magnification and zero position each channel.**

2



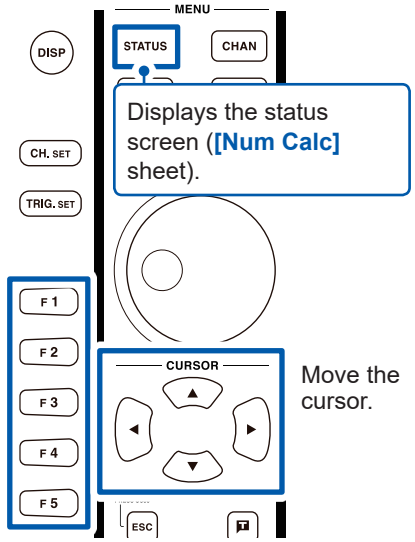
- Can be changed even during measurement.
- Positions of logic waveforms can also be changed arbitrary. ([Logic] sheet)



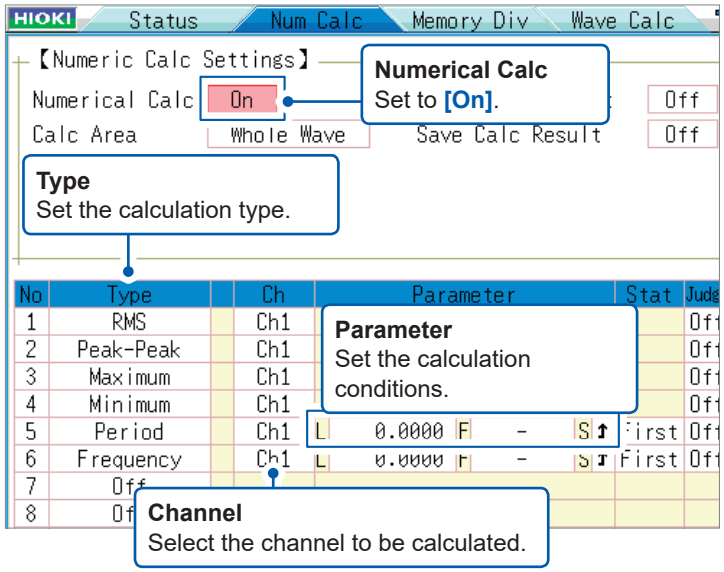
If direct current components are superposed on the waveform, the waveform appears to fluctuate when the magnification is changed. This is because magnification applied to the direct current component as well.

Calculate the measurement data

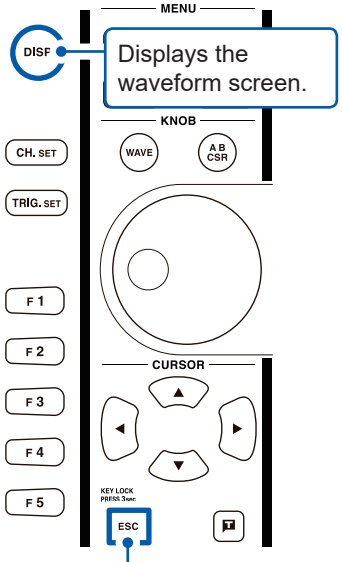
Up to 16 items can be calculated at once.
The 24 calculations are provided include average value, effective value, peak value, maximum value, minimum value, cycle, and frequency.
The following describes the calculation method for the measured data.
Configure the settings on the status screen described as follows.

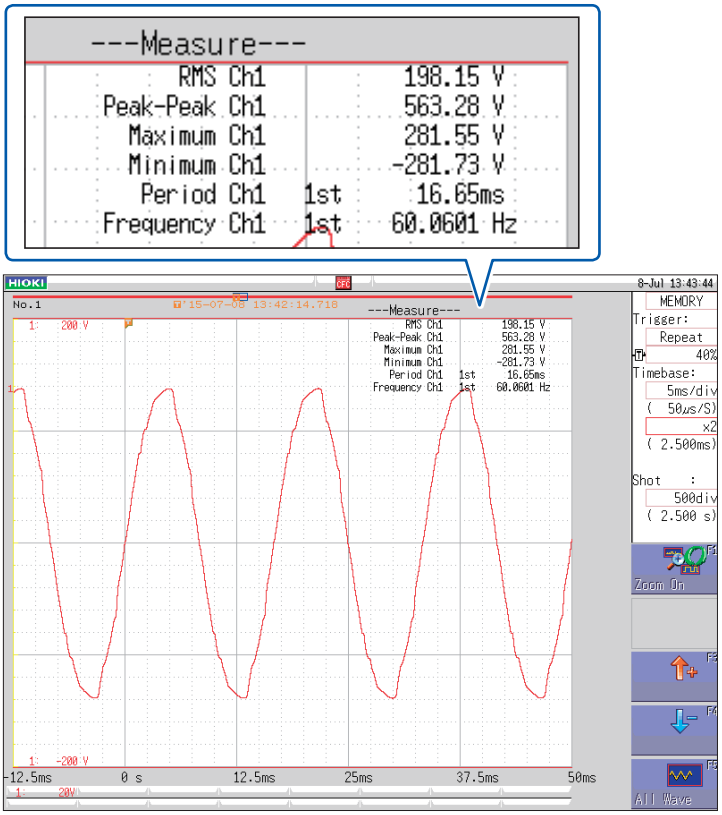


Select the items to be set.



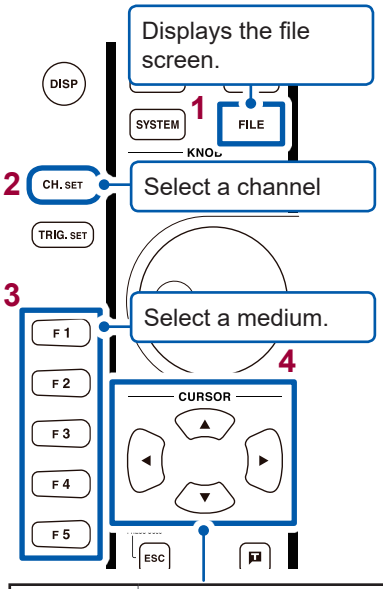
Once measurement is completed, calculation automatically starts. The calculation result will be displayed at the upper right side of the waveform screen.
(In consecutive trigger mode, the next measurement will take place after the calculation has been executed.)





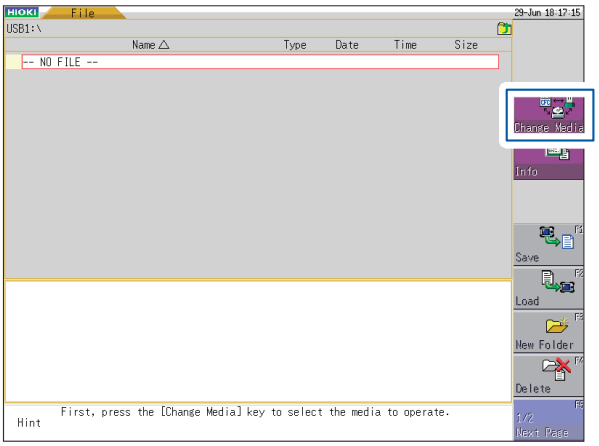
Access the storage medium

Data saved with the instrument can be observed on the file screen

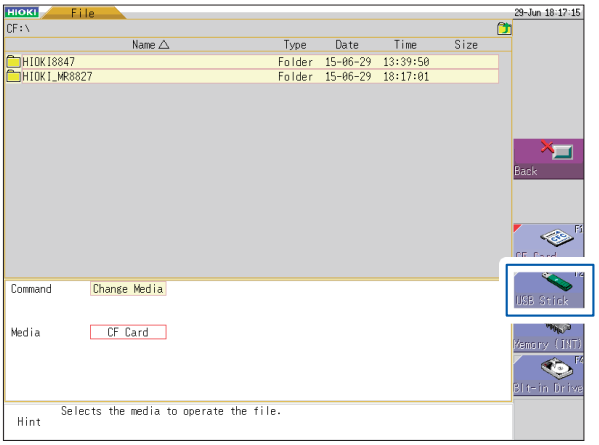


Up/Down	Select a file or folder.
Left	Move to the superior folder.
Right	Move to a subordinate folder.

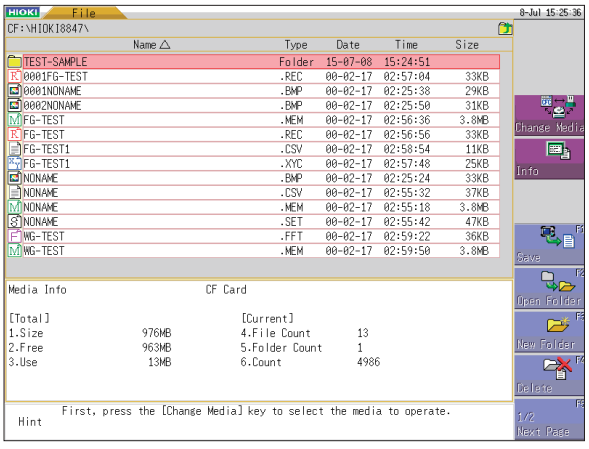
1 2 Select [Change Media].



3 Select a recording medium.



4 Select a file or folder.



The file is saved in the folder “HIOKI8847.”

The types of data the instrument can save and load

File type	File format	File extension and description		
Setting data*1	Binary	SET	S, L*2	Settings data (Measurement conditions)
Waveform data	Binary	MEM	S, L	Memory function waveform data
		REC	S, L	Recorder function waveform data
		XYC	S, L	X-Y recorder function waveform data*1
		FFT	S, L	FFT function data
	Text	CSV	S	Text data
Waveform management data (Memory division/Divided saving)	(Index file)	IDX	S, L	Index data for divided saving
		SQR	S, L	Index data for memory division (automatically created during batch saving)
Displayed image*1, Waveform image*1	Bitmap	BMP	S	Image data
Numerical calculation result	Text	CSV	S	Text data
Comment for printing	Text	TXT	L	Text data
Waveform evaluation setting data	Binary	ARE	S, L	Waveform evaluation areas settings data
Waveform evaluation area	Bitmap	BMP	S, L	Image data

*1: Cannot be saved automatically (only manually).
*2: S: Savable; L: Loadable

Setting data
Multiple setting data can be saved in the instrument, and loaded selectively.
When a setting data is saved with a name of “STARTUP” in the [HIOKI8847] folder in the CF card, it is automatically loaded when the instrument is turned on.

Waveform data
- To load data with the instrument, save them in the binary format.
- To load data with computers, save them in the text format.

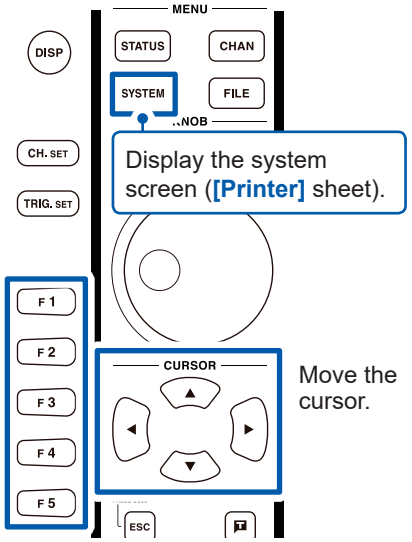
Arbitrary waveform generation data
The instrument can load waveform data for Model U8793 Arbitrary Waveform Generator Unit.

Print the data

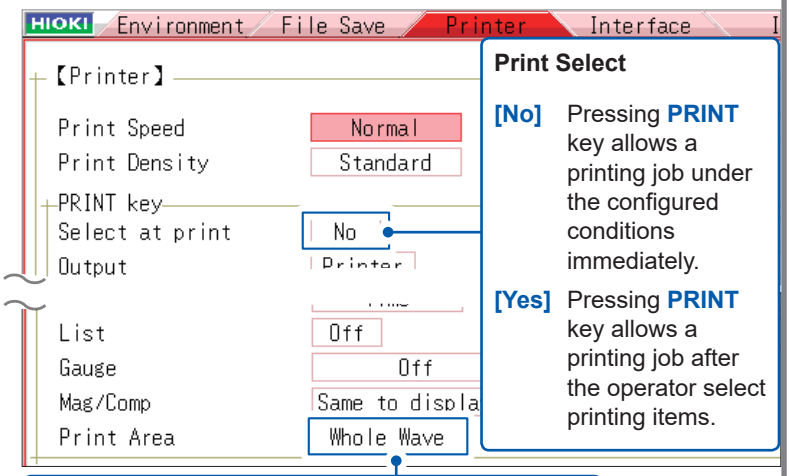
Print the measurement results.

1. Configure the print setting

Print the measurement results according to the conditions set on the **[Printer]** sheet on the system screen. Use this sheet to set other detailed settings related to the printer, such as the print density. The setting does not have to be configured every time.



Select the items to be set.



Print Select

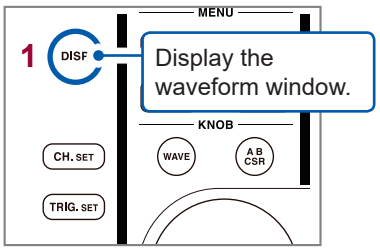
[No] Pressing **PRINT** key allows a printing job under the configured conditions immediately.

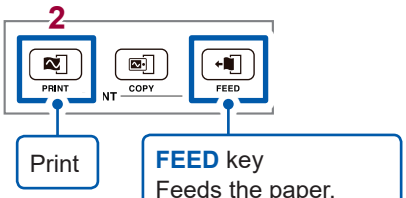
[Yes] Pressing **PRINT** key allows a printing job after the operator select printing items.

Print Area
[Whole Wave] or **[A-B Wave]**.

2. Print the data

Configure the settings on the waveform screen described as follows.

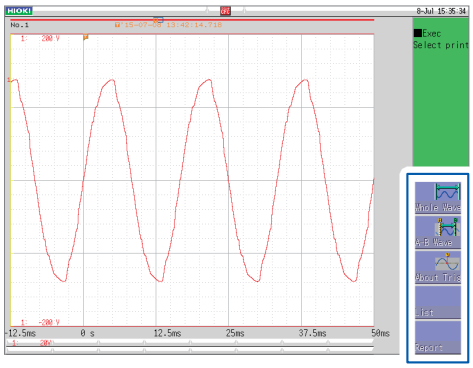




Press the **STOP** key to stop the current print job.

If Print Select is set to [Yes]

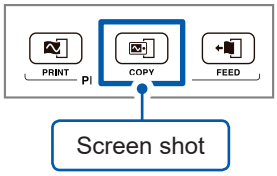
3 Select the items to be printed.



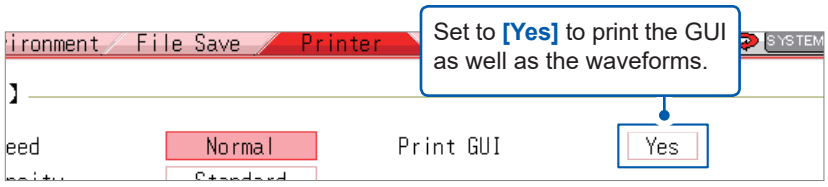
[Whole Wave]	Print the waveform data in the whole range (default).
[A-B Wave]	Print the waveform data in the range specified by the A and B cursors (the A and B cursors will not be printed).
[About Trig]	Print the waveform data corresponding to 10 divisions each on the both sides of the trigger point.
[List]	Print the major setting items.
[Report]	Print the report.(p.23)

Screen shot

Press the **COPY** key to take the screen shot. The display screen will be printed as it is.

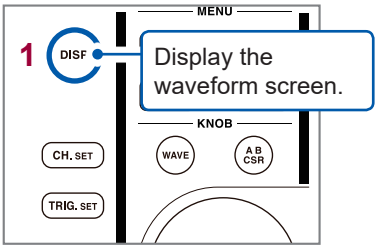


Printing the waveform display only is also possible.
Press the **[SYSTEM]** key to display the **[Printer]** sheet and configure the setting for it.

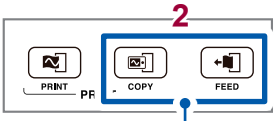


Report printing

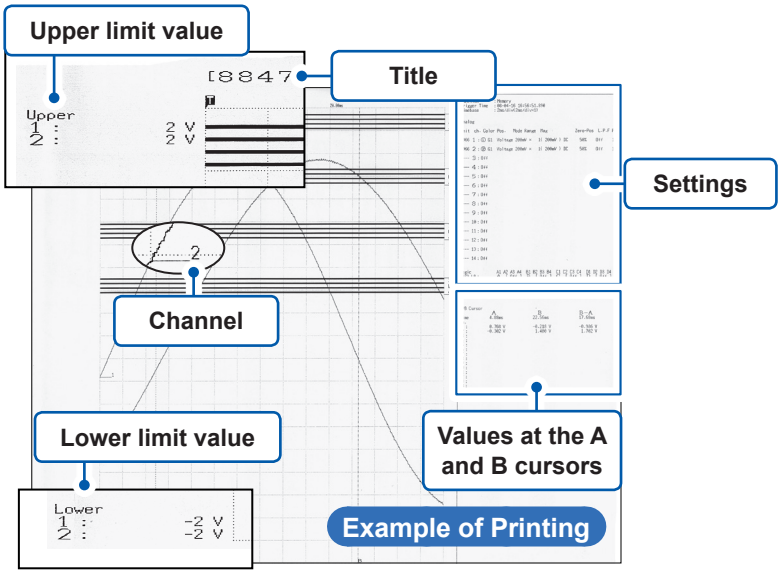
Function to print the waveform appearing on the screen not as a screen shot, but as the waveform printing together with the setting information.



Display the waveform screen.

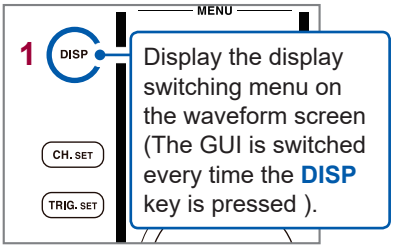


Press them almost simultaneously (Press the **FEED** key a little earlier).

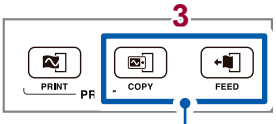


A4-size printing

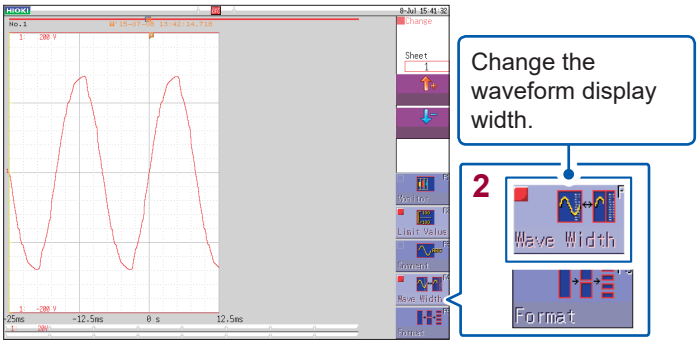
The A4-size printing is possible, with the same operation as for the report printing, by changing the waveform display width.



Display the display switching menu on the waveform screen (The GUI is switched every time the **DISP** key is pressed).



Press them simultaneously (Press the **FEED** key a little earlier).



Convenient functions

This section introduces the convenient functions.

Auto-range function

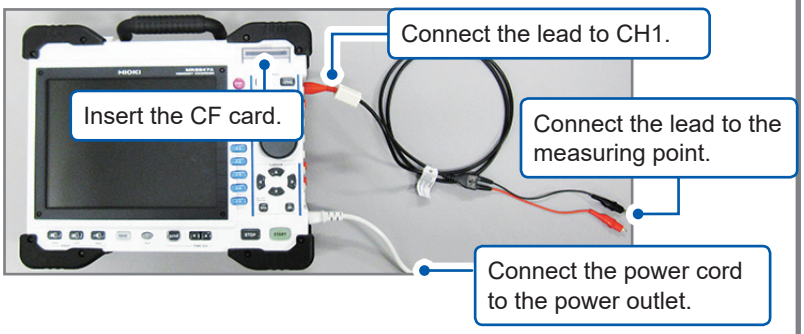
Start the measurement by pressing the **AUTO** key to automatically set the time axis range, voltage axis range, and zero position.

1. Prepare for measurement

Required items:

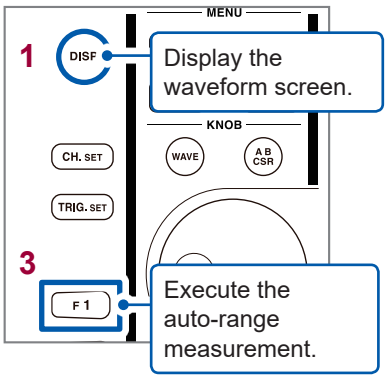
- ☐ MR8847A Memory HiCorder
- ☐ 8966 Analog Unit
- ☐ L9198 Connection Cord
- ☐ CF card

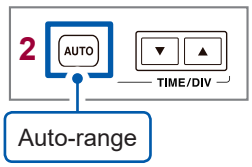
Refer to “Preparations for Measurement” (p. 5).

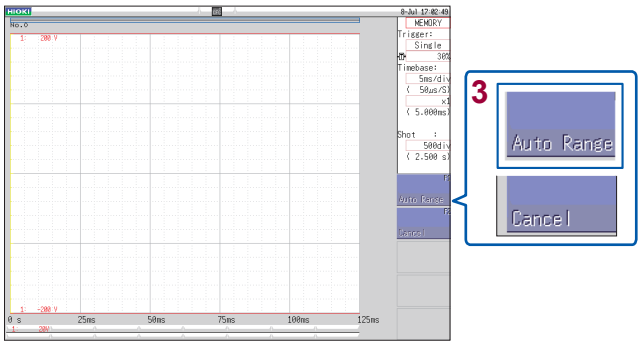


2. Measure the waveform by the auto-range

Configure the settings on the waveform screen described as follows.

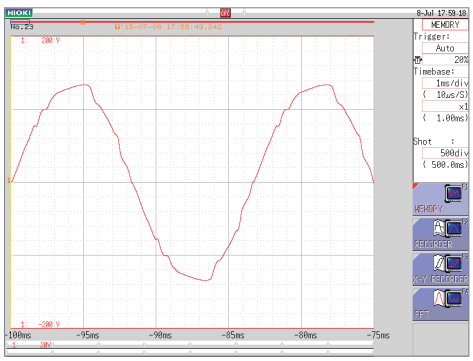






Example

Measurement of 200 V, 60 Hz commercial power using the auto-range function, inputting it to the Analog Unit



What is a pre-trigger?

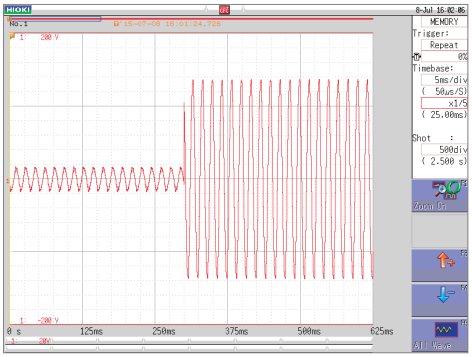
It is a function that allows recording of waveforms before trigger points.

Merit

Useful to detect signs before abnormal occurrences happen because parts before the trigger point are recorded.

If the pre-trigger is not used...

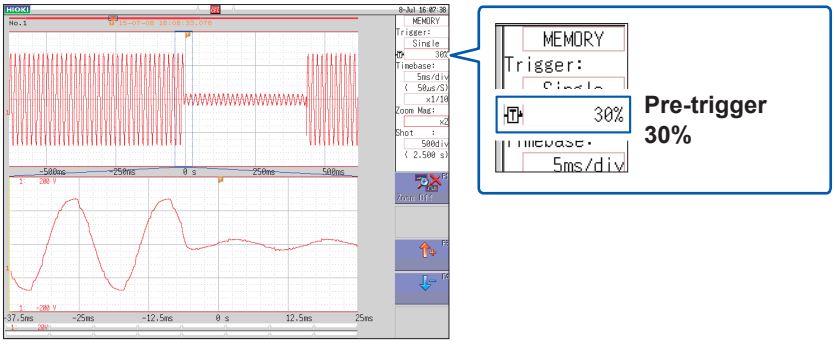
If the pre-trigger is not used, only the parts after the trigger point are recorded. You will be able to observe the abnormal occurrence but will not be able to detect any signs before that.



Waveforms without the pre-trigger function activated

Using the pre-trigger allows you to observe the part before the abnormal occurrence.

If the pre-trigger is used, waveforms including portions of those existing before the trigger point are recorded, allowing you to detect signs before the abnormal occurrences happen.

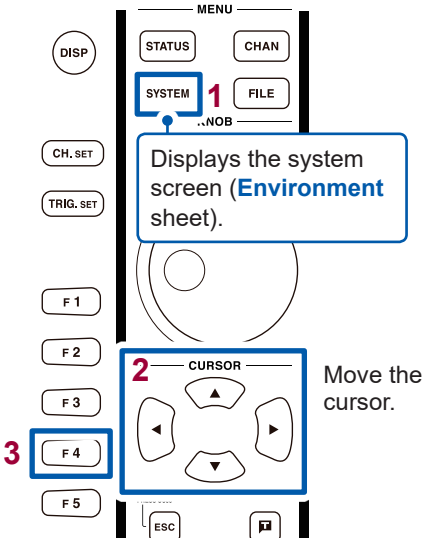


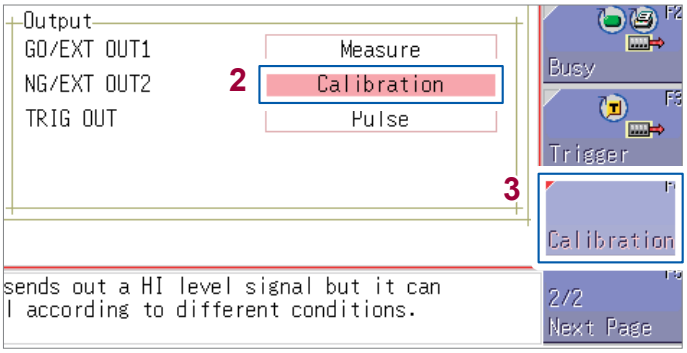
Waveforms with 30% of the pre-trigger setting activated

Signs will appear before any abnormal occurrence or distortion happens.
Using the pre-trigger of the Memory HiCorder, you can observe the parts of the waveforms existing before any abnormal occurrences, and find out which type of waveforms caused accidents and production installation faults .
It is recommended using the trigger function to prevent accidents and faults, as well as losses due to such occurrences.

Probe compensation

Probe compensation can be carried out by using Model 9665 10:1 Probe or Model 9666 100:1 Probe.



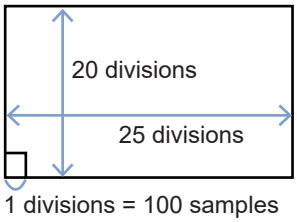


A 1-kHz 5-V square wave is output from the external output terminal (NG/EXT.OUT2 Terminal). The probe compensation can be carried out by using this signal.

Others

Screen

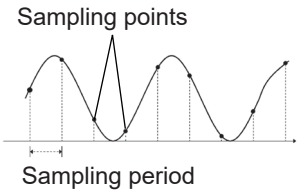
The instrument LCD provides SVGA resolution (800 × 600). The waveform display area consists of 625 horizontal dots and 500 vertical dots.
The waveform display area has 25 divisions horizontally and 20 divisions vertically, with each division composed of 25 dots horizontally and vertically.
Each data frame (one division) represents 100 samples horizontally and 100 to 50000 least significant bits (LSBs) vertically (depending on the input module).
Each displayed data frame (one division) changes in accordance with expansion and compression of the time and voltage axes.



Timebase and Sampling

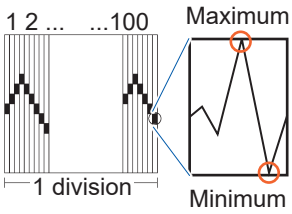
For the memory function (Sampling point recording)

The sampling period is 1/100 of the timebase. When the timebase is set to 100 ms/div, the sampling period is 1 ms. Changing the timebase setting also changes the sampling period accordingly.



For the recorder function (Envelope recording)

In every one data point, which is 1/100 of the timebase, two values are recorded: the maximum and minimum values obtained during the specified sampling period.
With 10 ms/div of the timebase setting, one data point is 100 µs. When the sampling period is set to 1 ms, one data point consists of 100 samples. The two values, the maximum and minimum values obtained during 100 samples are recorded each data point, .



Recording Length Setting

Set the time length (the number of divisions) during which data are recorded for one data recording event.
Each division of the recording length consists of 100 data points. The number of data during the whole recording length is calculated from the following formula:

The specified recording length (number of divisions) × 100 + 1

Example: The number of data for the specified recording length of 50 divisions

50 divisions × 100 + 1 = 5001

Voltage axis and resolution

The resolution differs depending on input modules.
The following table shows the full scale resolution for all the modules.
The minimum resolution can be calculated from the screen full scale value and the full scale resolution shown in the table below.

Example: Measurement with Model 8966 Analog Unit

If the power voltage is measured with 20 V/div of the vertical axis range and ×1 of the vertical axis magnification settings, the minimum resolution is calculated as follows:
Screen full scale: 20 V/div × 20 div = **400 V**
Full scale resolution at ×1 of the vertical axis magnification: **2000**
Minimum resolution: **400 V / 2000 = 0.2 V**

Full-scale resolution for input modules at each vertical axis magnification (LSB)

Input module	Magnification									
	×1/10	×1/5	×1/2	×1	×2	×5	×10	×20	×50	×100
8966 (Analog) 8971 (Current) 8972 (DC/RMS)	20000 (4000)	10000 (4000)	4000	2000	1000	400	200	100	40	20
8967 (Temperature)*	200000	100000	40000	20000	10000	4000	2000	1000	400	200
8968 (High resolution) U8974 (High voltage) U8975 (4ch analog) U8978 (4CH analog) U8977 (3CH current)	320000 (64000)	160000 (64000)	64000	32000	16000	6400	3200	1600	640	320
8969, U8969 (Strain) U8979 (Charge)	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 (Integration)	400000	200000	80000	40000	20000	8000	4000	2000	800	400
8970 (Excluding power frequency and integration)	100000	50000	20000	10000	5000	2000	1000	500	200	100
MR8990 (DVM)	1200000	1200000	1200000	1000000	500000	200000	100000	50000	20000	10000

The figures enclosed in parentheses indicate valid data range.
*: For Model 8967 Temp Unit, the valid ranges differ depending on types of thermocouple. For information on the minimum resolution, see the specifications of Model 8967 Temp Unit in the instruction manual.

Data Saving Speed

The table lists the speeds of saving binary data (values used as a reference) using different media and interfaces. Note that the data saving speed varies depending on the saving conditions, device manufacturer, device capacity, communication conditions, and others.

Storage media	Saving speed (As a reference)
CF card	800 kB/s
Built-in drive (SSD)	800 kB/s
USB flash drive	800 kB/s
Computer via LAN	1 MB/s

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