HIOKI

INSTRUCTION MANUAL

8835 MEMORY HiCORDER

9540

FUNCTION UP DISK

HIOKI E.E. CORPORATION

Contents

Request for Return of User Registration Card

The 9540 FUNCTION UP DISK is provided with a software license agreement.

You may only use this product if you agree to be bound by the terms and conditions of this agreement. Please read the following software license agreement and return the user registration card to HIOKI. As a licensed registered owner of this product, you are entitled to receive software support and upgrade notices. Even if you do not return the registration card, by opening the package, you are consenting to be bound by the software license agreement.

The user registration card is not valid for products sold by distributors outside of Japan. Users outside of Japan should refer to the distributor from whom they purchased the product for product support.

Software License Agreement

(1) Applicability

The following terms and conditions apply to the 9540 FUNCTION UP DISK you purchased from HIOKI.

(2) Consent of use

1. The 9540 may only be used under the supervision of a registered owner of this product.
2. The product may only be used on a single computer at one time.
3. The product may not be transferred, sold or leased under any circumstances.
4. The product may be copied onto a program disk solely for back-up purpose provided HIOKI's copyright notice is also reproduced.
5. Production, transfer, sale or lease of copyrighted material produced using the 9540 without written permission from HIOKI is prohibited.
6. Quotations from the 9540 may not be published without prior consent from HIOKI. Use of the trademark "HIOKI" is prohibited.
7. This agreement does not authorize the use of any software made by other companies. Authorization for use of each company's software must be obtained separately.

(3) Limited Warranty

1. Specifications of this product are subject to change without notice. Information on revisions to the 9540 is provided to licensed registered users for one year from the date of registration.
2. In no event will HIOKI be responsible for any outcome resulting from the use of this software.
3. HIOKI will provide a replacement for this product in the event that it cannot be used due to a serious physical defect, such as erasure or physical damage. This is the full extent of HIOKI's warranty regarding the product.

(4) Term of Agreement

This agreement is effective from the date of purchase. (The date of purchase is indicated on the user registration card.)

Introduction

Thank you for purchasing this HIOKI "FUNCTION UP DISK."
To get the maximum performance from the unit, please read this manual first, and keep this at hand.

Inspection

- When the unit is delivered, check and make sure that it has not been damaged in transit. In particular, check the accessories, panel switches, and connectors.
- If the unit is damaged, or fails to operate according to the specifications, contact your dealer or HIOKI representative.

Accessories

UPGRADE DISK	1
FUNCTION UP DISK	2
Instruction Manual	1
User registration card	1

Safety Notes

This Instruction Manual provides information and warnings essential for operating this equipment in a safe manner and for maintaining it in safe operating condition. Before using this equipment, be sure to carefully read the following safety notes.

⚠ DANGER

This equipment is designed according to IEC 61010-1 Safety Standards, and has been tested for safety prior to shipment. During high voltage measurement, incorrect measurement procedures could result in injury or death, as well as damage to the equipment. Please read this manual carefully and be sure that you understand its contents before using the equipment. The manufacturer disclaims all responsibility for any accident or injury except that resulting due to defect in its product.

Safety symbols

	• This symbol is affixed to locations on the equipment where the operator should consult corresponding topics in this manual (which are also marked with the ⚠ symbol) before using relevant functions of the equipment. • In the manual, this mark indicates explanations which it is particularly important that the user read before using the equipment.
	Indicates a grounding terminal.
	Indicates AC (Alternating Current).
	Indicates DC (Direct Current).
	Indicates both DC (Direct Current) and AC (Alternating Current).

Conventions used in this manual

The following symbols are used in this Instruction Manual to indicate the relative importance of cautions and warnings.

⚠ DANGER	Indicates that incorrect operation presents extreme danger of accident resulting in death or serious injury to the user.
⚠ WARNING	Indicates that incorrect operation presents significant danger of accident resulting in death or serious injury to the user.
⚠ CAUTION	Indicates that incorrect operation presents possibility of injury to the user or damage to the equipment.
NOTE	Denotes items of advice related to performance of the equipment or to its correct operation.

Notes on Use

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.

(1) Installation environment

⚠ WARNING **The unit should always be operated in a range from 5℃ to 40℃ and 35% to 80% RH or less. Do not use the unit in direct sunlight, dusty conditions, or in the presence of corrosive gases.**

(2) Power supply connections

⚠ DANGER

- **Before connecting the unit, make sure that the power supply voltage matches the rated power supply voltage of the 8835**
- **Before connecting the unit to a battery or other DC source, make sure that the switch is set to OFF. If the switch is ON, there is a risk of sparks.**

(3) Grounding the unit

- When the AC outlet is of the grounded three-pin type, use the grounded three-core power cord supplied.
- When the AC outlet is not of the grounded three-pin type, use the ground adapter supplied, and be absolutely sure to connect the green ground wire which protrudes from the adapter to a ground line (see Section 2.2 in the 8835 instruction manual).

(4) Before powering on

- Check that the power supply is correct for the rating of the unit. (The AC fuse is integrated in the unit.)
- The AC power power switch on 8835 is for AC power. If DC power is being supplied and the switch on DC power adapter is set to ON, the 8835 will operate also if the power switch is set to OFF.

(5) Probe Connection, Measurement Voltage Input

⚠ DANGER

- **Maximum input voltage ratings for the 8936 ANALOG UNIT, the 8937 VOLTAGE/TEMPERATURE UNIT, the 8938 FFT ANALOG UNIT, the 8939 STRAIN UNIT and the input terminals of the 8835 are shown below. To avoid the risk of electric shock and damage to the unit, take care not to exceed these ratings.**
- **The maximum rated voltage to earth of the 8936, 8937, 8938 and 8939 (voltage between input terminals and 8835 frame ground, and between inputs of other units) is shown below. To avoid the risk of electric shock and damage to the unit, take care that voltage between channels and between a channel and ground does not exceed these ratings.**
- **The maximum rated voltage to earth rating applies also if an input attenuator or similar is used. Ensure that voltage does not exceed these ratings.**
- **When measuring power line voltages with the 8936 or 8938, always connect the probe to the secondary side of the circuit breaker. Connection to the primary side involves the risk of electric shock and damage to the unit.**
- **Always use the optional connection cables. Any exposed metal sections in a connection cable consist a risk of electric shock.**

Input/output terminal	Maximum input voltage	Maximum rated voltage to earth
8936 inputs	400 VDC max.	400 V AC/DC
8937 inputs	30 V rms or 60 VDC	30 V rms or 60 VDC
8938 inputs	400 VDC max.	400 V AC/DC
8939 inputs	10 VDC max.	40 VDC
EXT TRIG	-5 to +10 VDC	Not insulated
START · STOP		
PRINT		
EXT SMPL		
TRIG OUT	-20 V to +30 VDC 500 mA max. 200 mW max.	
GO		
NG		

⚠ WARNING **The logic units all have and the 8835 have a common ground.**

(6) Replacing the input units

⚠ DANGER

- **In order to avoid accidents from electric shock, before removing or replacing an input unit, check that the connection cables are disconnected, turn off the power, and remove the power cable.**
- **Normally keep all two input units installed permanently. If a unit is not fitted, it must be replaced by a blanking panel. If the unit is operated with an input unit not in place it poses a shock hazard.**

Chapter Summary

Chapter 1
Product Overview

1.1 Outline

The 9540 FUNCTION UP DISK is provided exclusively for use in updating the 8835 MEMORY HiCORDER.
Installation is easy using the provided floppy.

1.2 Functions Added by the 9540 FUNCTION UP DISK

Functions added by the 9540 FUNCTION UP DISK are as follows.

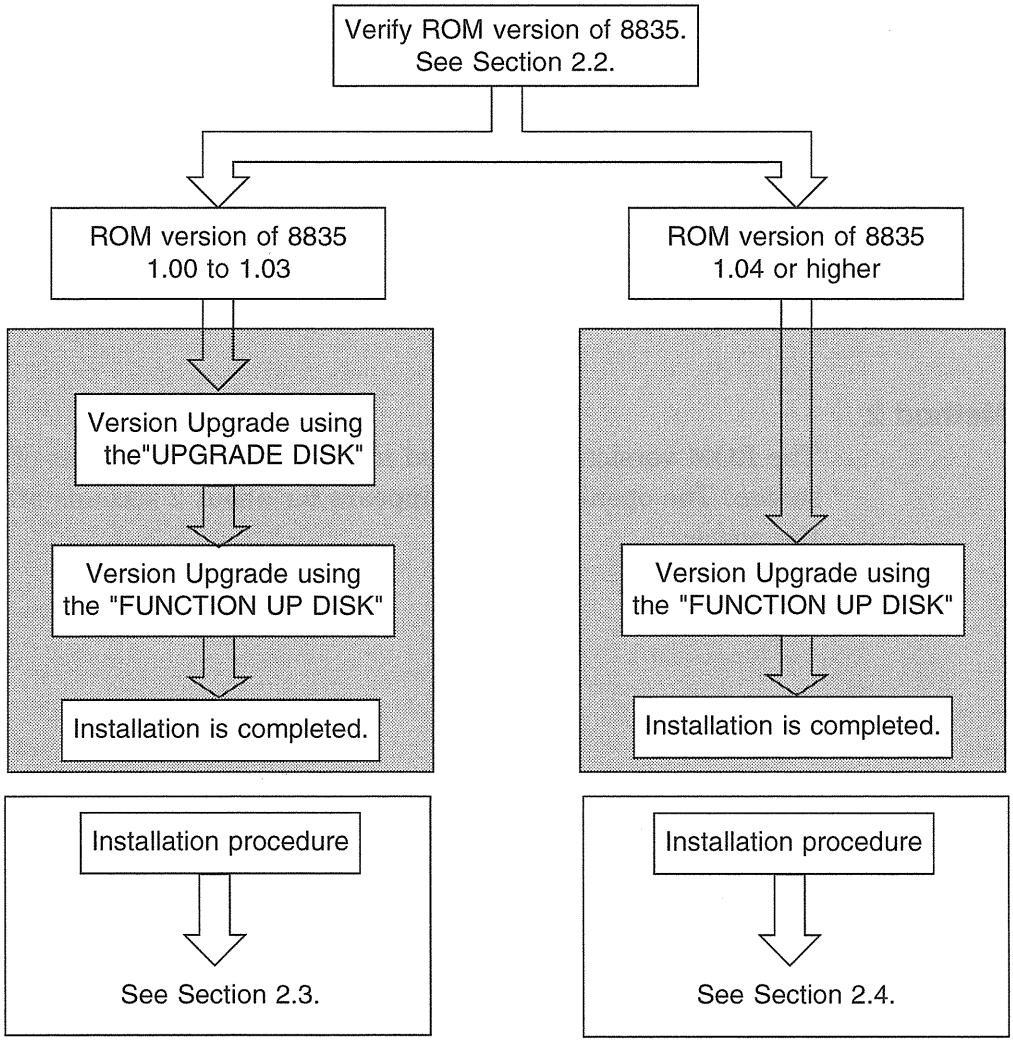
Measurement functions	Recorder and memory function FFT function
Computation functions	Waveform processing calculation Averaging function
Waveform decision functions	Waveform area decision Waveform parameter decision
Memory segmentation functions	Sequential save function Multi-block function

These topics are explained in later chapters.

Chapter 2 Installation Procedures

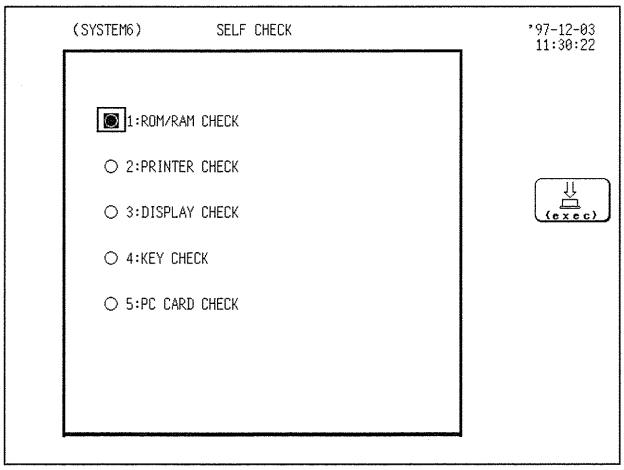
2.1 Preparations

- Procedures for installing the 9540 FUNCTION UP DISK are explained in flowchart form.
- The installation procedure varies depending on the ROM version of 8835.

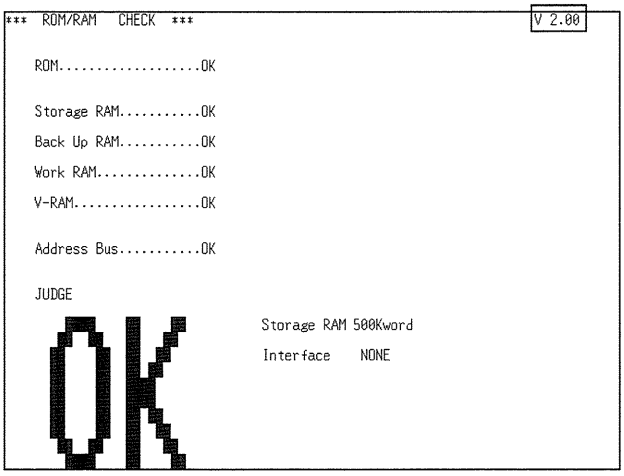


2.2 Verifying ROM Version of 8835

Method 1



1. Press the SYSTEM key to call up the SELF CHECK screen.
2. Move the flashing cursor to the position shown in the figure on the left and check the ROM and RAM.



3. The result of ROM/RAM check is displayed. The ROM version of 8835 is displayed in the position shown in the figure on the left.

Method 2

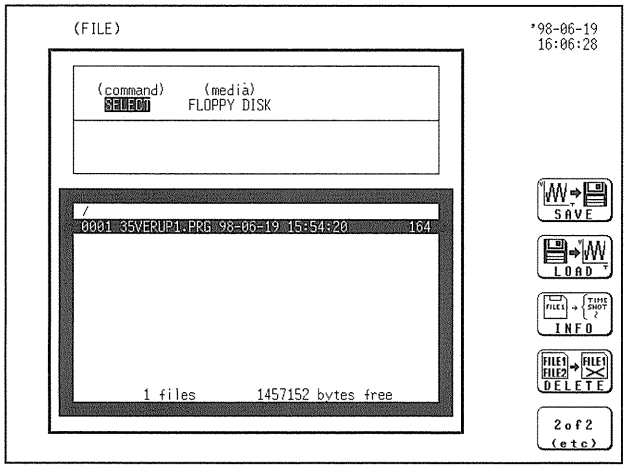
The ROM version is displayed in the upper right corner of the opening screen. The opening screen appears for about 2 seconds after turning on the power.

2.3 Installation Procedure (v1.00 to v1.03)

If the 8835 is equipped with ROM version v1.00 to 1.02, the version must be upgraded using the version upgrade disk.

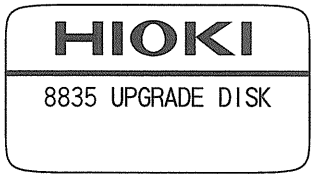
NOTE Never turn off the power during upgrade of the ROM version; the program may become unusable.

2.3.1 Version Upgrade



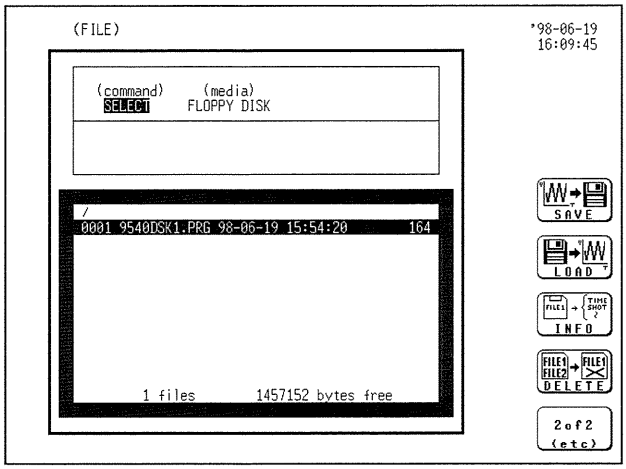
1. Insert the UPGRADE DISK.
2. Press the [FILE] key to call up the FILE screen.
3. Select "FD" as the media type.
4. Load the file named "35VERUP1.PRG".
5. Version upgrade is completed when the message "Version upgrade completed" appears.

Version upgrade floppy disk



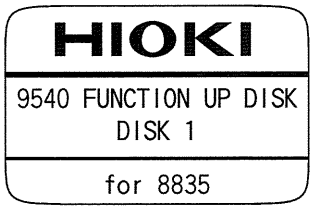
NOTE Remove write protection from the version upgrade disk before using it to upgrade the ROM version. Version upgrade is not possible if the disk is write protected. Since operation requires removal of write protection, be sure to handle the disk carefully.

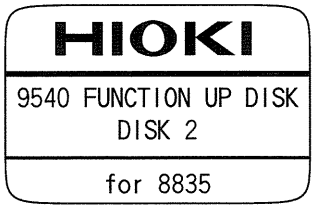
2.3.2 Functional Update



1. Insert the FUNCTION UP DISK1.
2. Press the [FILE] key to call up the FILE screen.
3. Select "FD" as the media type.
4. Load the file named "9540DSK1.PRG".
5. When "Insert Disk 2 and press any key" appears, insert "FUNCTION UP DISK2" and press any key.
6. The messages "FINISH" and "Turn off the power" appear.
7. Turn off the power, then turn it back on again. The message "Version has changed" appears, and installation is completed.

Functional update floppy disks



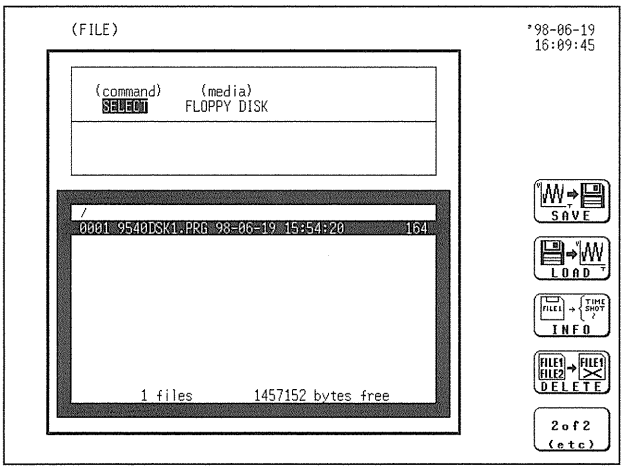


2.4 Installation Procedure (v1.04 or Higher)

If the 8835 is equipped with ROM version v1.04 or higher, functional update can be accomplished using just the functional update disk (the version upgrade disk is not used).

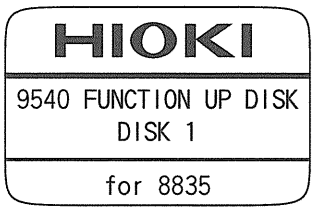
NOTE

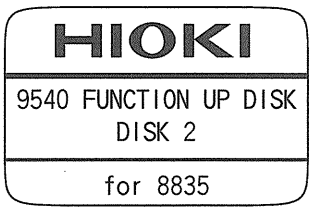
Never turn off the power during upgrade of the ROM version; the program may become unusable.



1. Insert the FUNCTION UP DISK1.
2. Press the [FILE] key to call up the FILE screen.
3. Select "FD" as the media type.
4. Load the file named "9540DSK1.PRG".
5. When "Insert Disk 2 and press any key" appears, insert "FUNCTION UP DISK2" and press any key.
6. The messages "FINISH" and "Turn off the power" appear.
7. Turn off the power, then turn it back on again. The message "Version has changed" appears, and installation is completed.

Functional update floppy disks





Chapter 3 Recorder and Memory Function

3.1 Outline

3.1.1 Outline of the Recorder and Memory Function

The recorder and memory function has the following features.

(1) While recording is in progress, recording by the memory recorder can be initiated by trigger.

(2) All input channel data are recorded on the same time axis.

Since data for all channels can be superimposed, the relative relationship between input signals can be observed visually.

(3) Time axis setting

- 10 ms/DIV to 1 h/DIV (recorder)
- 100 μ ms/DIV to 5 min/DIV (memory recorder)

(4) Time axis resolution 100 points/DIV

(5)Sampling period

For both recorder and memory recorder functions, 1/100 of the memory recorder time axis range setting

(6) Waveform magnification/compression display and printout

- Time axis direction: $\times$10 to $\times$1/2000 (memory recorder)
  : $\times$1 to $\times$1/50 (recorder)
- Voltage axis direction: $\times$10 to $\times$1/2
  With the variable function

(7) Display format

Time axis waveform: single, dual, quad screen display

(8) Scrollable display

- The data for the specified recording length are stored in memory.
- It is possible to scroll back for easy review.

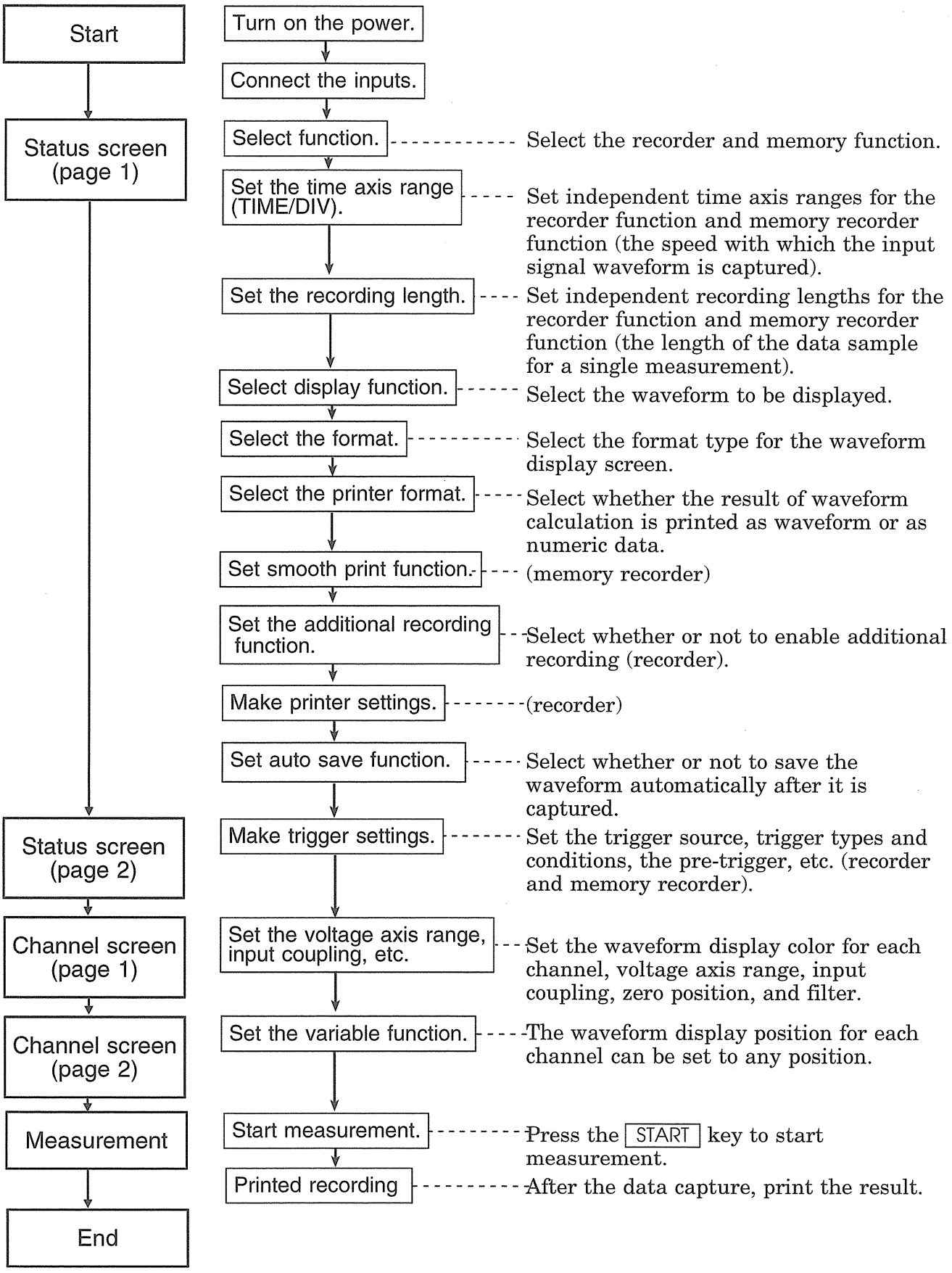
(9) Additional recording function

(10) Print output

Printed output of displayed recorder waveforms or memory recorder waveforms

3.1.2 Operation Sequence

The flowchart below illustrates the sequence of operations involved in using the recorder and memory function.

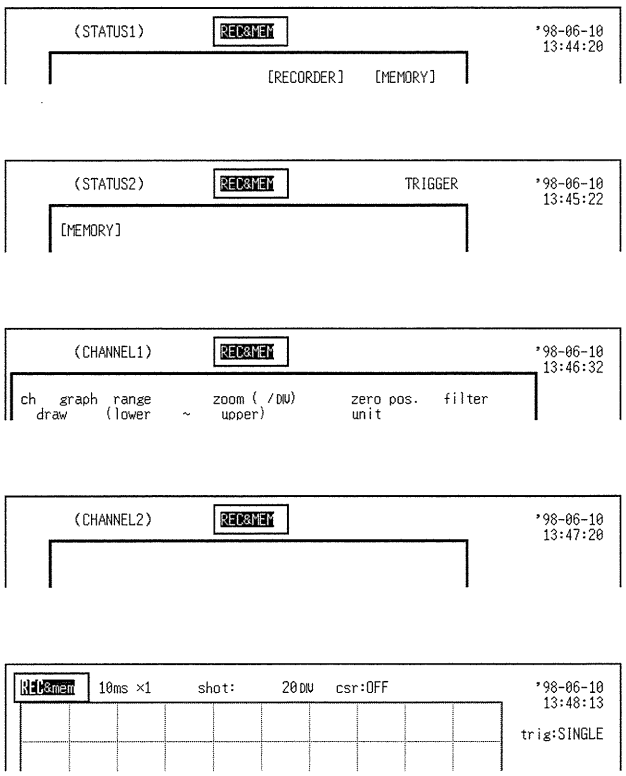


3.2 Making Settings

3.2.1 Setting the Function Mode

Select the recorder and memory function.

Method Screen: STATUS, CHANNEL, DISPLAY



1. Call up the STATUS, CHANNEL or DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
3. Press F4 [REC&MEM].

: Memory recorder function

: Recorder function

: RMS recorder function

: Recorder and memory function

: FFT function

NOTE

On the Display screen, the display position in the figure is different from that on other screens.

Recorder and memory function

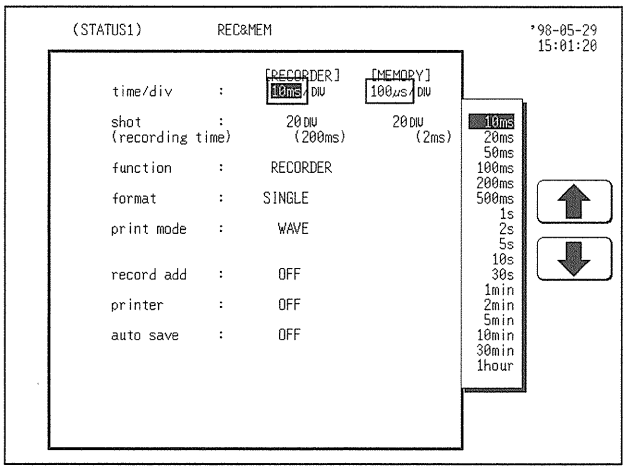
During real-time recording of a signal in the recorder function, if a fault is captured by a trigger, the relevant part of the signal is captured in parallel by the memory recorder at a high sampling rate. Thus the recorder operation is not interrupted by the memory recorder operation, and the normal recording is available in addition to the fault recording.

The memory recorder function can capture a maximum of 15 phenomena by memory segmentation (63 phenomena with 2M words of memory).

3.2.2 Setting the Time Axis Range

- For both recorder and memory recorder functions, set the speed for inputting and storing the waveform of the input signal.
- Time axis range setting expresses the time for 1 DIV.
- The sampling interval is 1/100 of the memory recorder time axis range setting (100 samples/DIV).

Method 1 Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the **time/div** item, as shown in the figure on the left.
3. Use the JOG control or the function keys to make the selection.

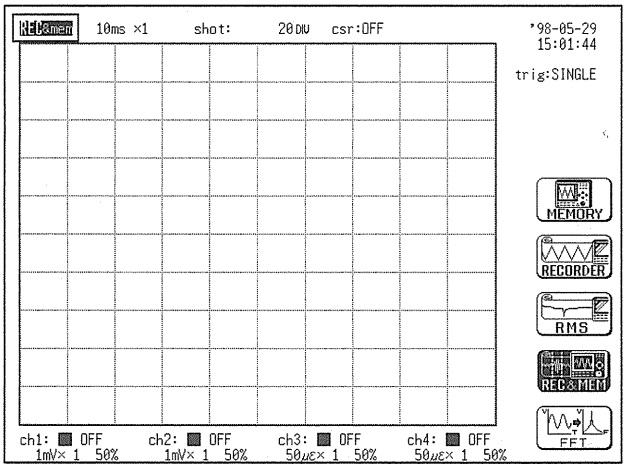
: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

NOTE

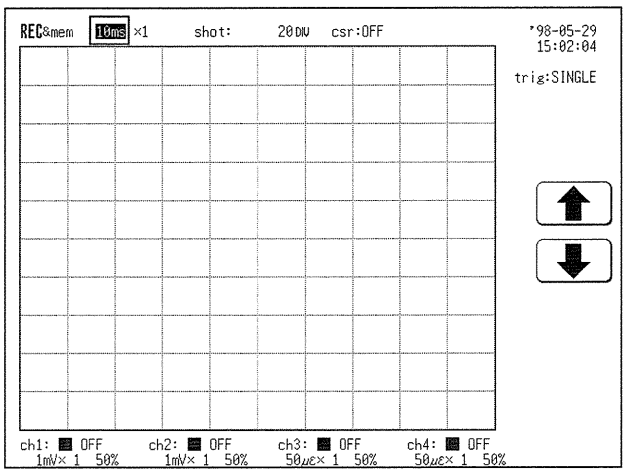
On the DISPLAY screen, the selection window is not displayed.

Method 2 Screen: DISPLAY



1. Call up the DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
   Select the time axis range function that you want to set.
   Upon pressing the "Recorder & Memory" function key, the display changes where indicated in the figure, and you can set the waveform to be displayed.

REC&mem: Recorder
rec&MEM: Memory



3. Move the flashing cursor to the position shown in the figure on the left, and use the function keys to set the time axis range.

NOTE

- On the DISPLAY screen, the selection window is not displayed.
- In the time axis range setting of 10 to 200 ms, the printer cannot be set ON.

⚠ CAUTION The recorder sampling interval is determined by the sampling interval set in memory. However, some sampling intervals that can be set as a recorder time axis. See the table below for details.

Combinations of recorder and memory time axis ranges

Vertical axis: Time axis (/DIV) of memory waveform

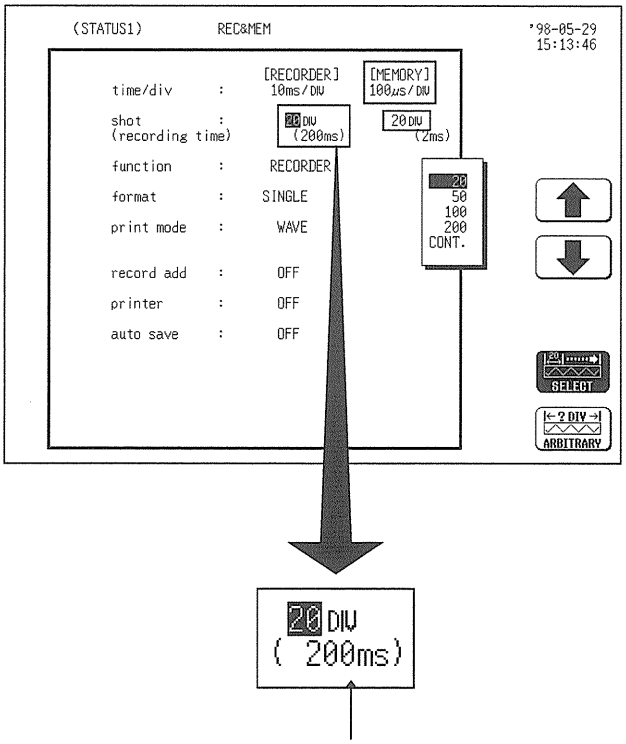
Horizontal axis: Time axis (/DIV) of recorder waveform

	20ms	50ms	100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	30 s	1 min	2 min	5min	10 min	30 min	1 hour
100 μs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
200 μs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
500 μs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1 ms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2 ms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5 ms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10 ms	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20 ms	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
50 ms	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
100 ms	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
200 ms	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
500 ms	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1 s	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2 s	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5 s	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10 s	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
30 s	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
1 min	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
2 min	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
5 min	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes

3.2.3 Setting the Recording Length

- For both recorder and memory recorder functions, the length of recording for one measurement operation (number of DIV) can be set.
- Two types of recording length can be set.
  Fixed recording length mode:
  Any recording length mode: Any recording length can be selected by the user.

Method 1 (Fixed recording length mode)
Screen: STATUS (page 1), DISPLAY



Shows the measurement time in the set time axis range and recording length.

1. Call up the STATUS (page 1) or DISPLAY screen.
2. Move the flashing cursor to the **shot** item, as shown in the figure on the left.
3. Use the JOG control or the function keys to make the selection.

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

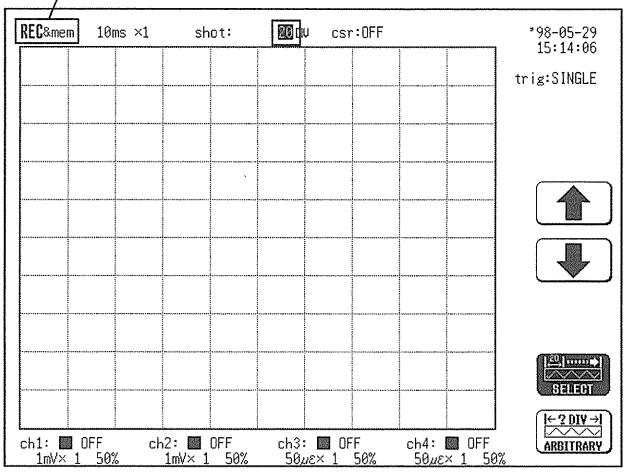
: Set the fixed recording length mode.

: Set the any recording length mode.

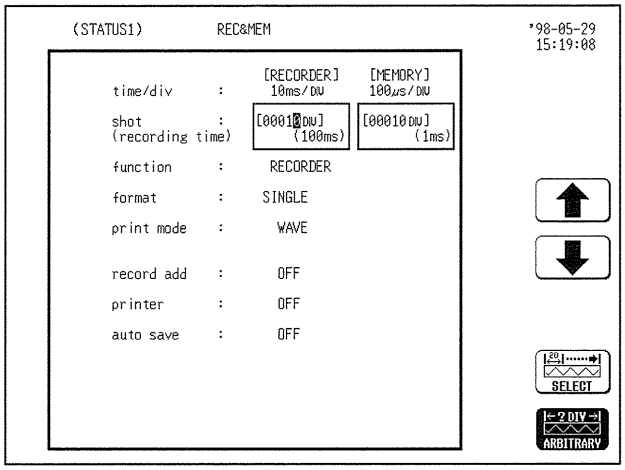
NOTE

- On the DISPLAY screen, the selection window is not displayed.
- The setting on the DISPLAY screen is the same as in Section 3.2.2.

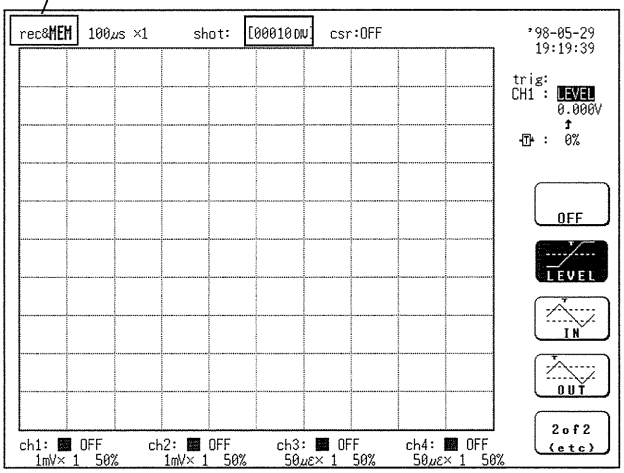
Display function



Method 2 (Any recording length mode)
Screen: STATUS (page 1), DISPLAY



Display function



1. Call up the STATUS (page 1) or DISPLAY screen.
2. Move the flashing cursor to the **shot** item, as shown in the figure on the left.
3. Set the any recording length mode.
4. Use the JOG control or the function keys to make the selection. Use the cursor keys to change the column.

: Value up

: Value down

: Set the fixed recording length mode.

: Set the any recording length mode.

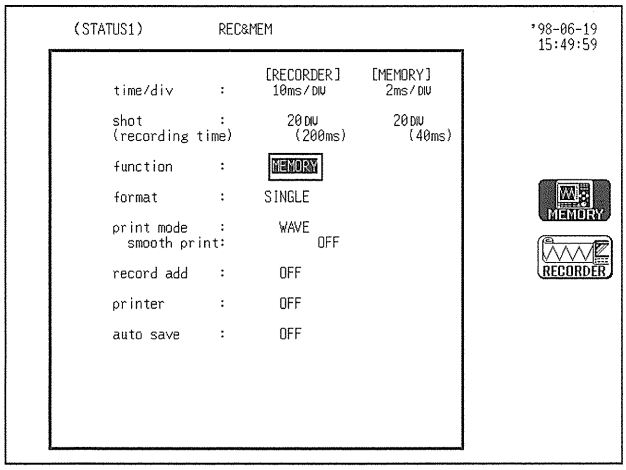
NOTE

- On the DISPLAY screen, the setting cannot be made with the JOG control.
- The setting on the DISPLAY screen is the same as in Section 3.2.2.

3.2.4 Setting the Display Function

- Select the waveform function to be used for display.
- During measurement, the display shows the recorder waveform.
- Function switching is used with display screen settings and displayed waveforms.

Method 1 Screen: STATUS (page 1)

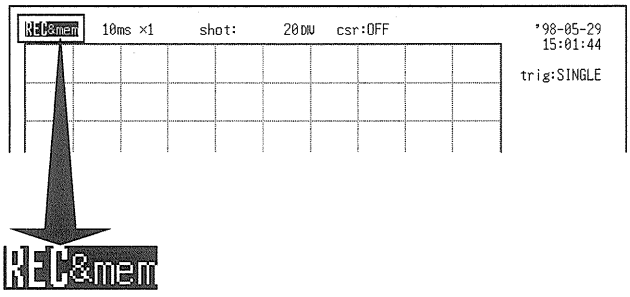


1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

: Memory recorder function

: Recorder function

Method 2 Screen: DISPLAY



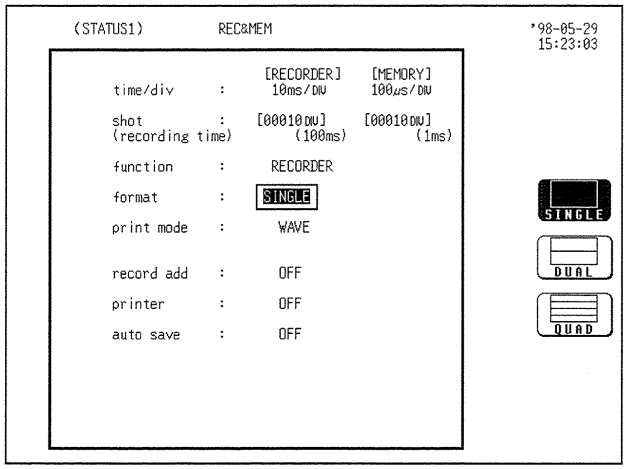
1. Call up the DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
3. Upon pressing the "Recorder & Memory" function key, you can switch the display function

REC&mem: Recorder
rec&MEM: Memory

3.2.5 Setting the Format

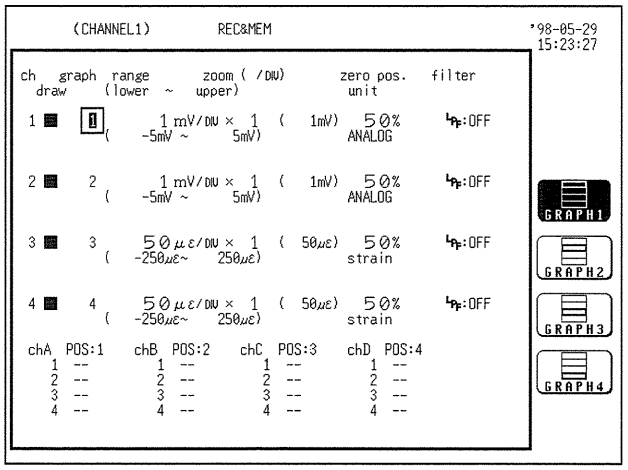
- The style can be set for showing input signals on the screen display and recording them on the printer.
- The styles single, dual, and quad are available.

Method Screen: STATUS (page 1)



1. Press the [STATUS] key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **format** item, as shown in the figure on the left.
3. Use the function keys to select the display format.

SINGLE: Single
DUAL: Dual
QUAD: Quad



4. If dual or quad screen display was chosen in step 3, determine which input channel to display on which graph. This setting is made with the CHANNEL screen (page 1).

① Press the [CHAN] key to call up the CHANNEL screen (page 1).

② Move the flashing cursor to the point shown in the illustration at left.
- The illustration shows the setting for CH1.
- Settings for CH2 - CH4 should be made in the same way.

③ Use the function keys to select the graph.

GRAPH 1: Display the waveform on graph 1.
GRAPH 2: Display the waveform on graph 2.
GRAPH 3: Display the waveform on graph 3. (*)
GRAPH 4: Display the waveform on graph 4. (*)

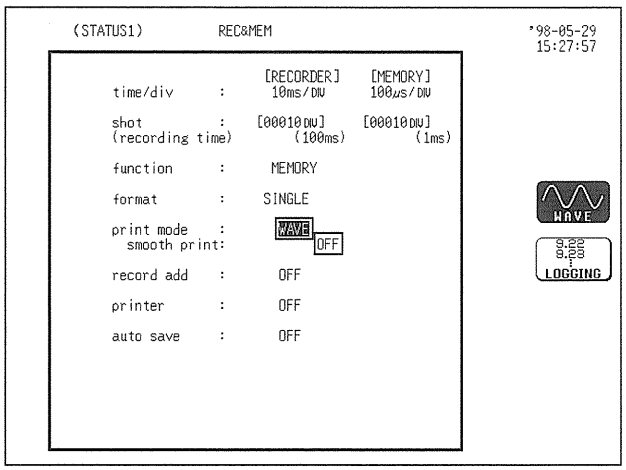
*: when the quad screen display is selected

3.2.6 Setting the Printer Format

· Selects whether waveform data are printed as waveform or as numeric data.
· When numeric data are selected, the data spacing interval also must be set.

Printing as a waveform

Method



1. Press the [STATUS] key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **print mode** item, as shown in the figure on the left.
3. Use the function keys to make the selection.

   [WAVE]: Waveform data are printed as a waveform.

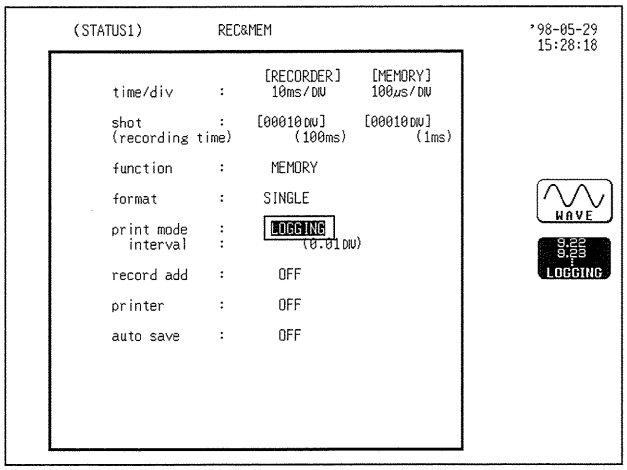
   [LOGGING]: Waveform data are printed as numeric data.

4. Set the smooth print function (when the display function is Memory).

NOTE When the display function is Recorder, the "smooth print" item is not displayed.

Printing as numeric data

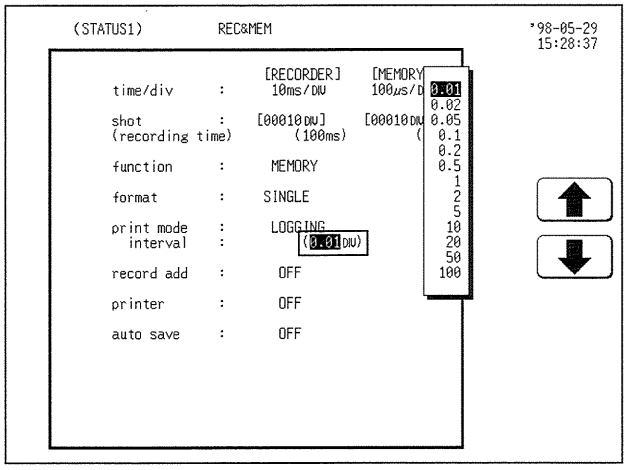
Method



1. Press the STATUS key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **print mode** item, as shown in the figure on the left
3. Use the function keys to select **numeric data.**

WAVE: Waveform data are printed as a waveform.

LOGGING: Waveform data are printed as numeric data.



4. Move the flashing cursor to the **print interval** item.
5. Use the JOG control or the function keys to select the print interval.

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

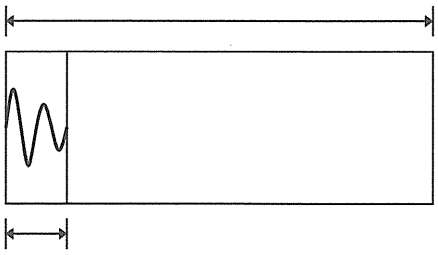
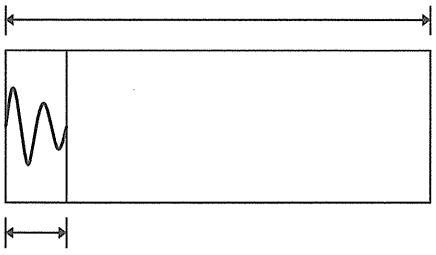
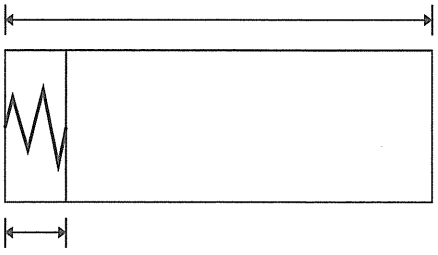
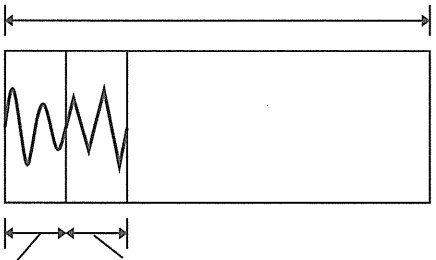
NOTE

- When the print interval longer than the recording length is set, only the first dot is printed.
- In the recorder function, the maximum and minimum values are printed.
- In the recorder function, the print intervals of 0.01 to 0.5 DIV can be selected only when there are wavefom data present.

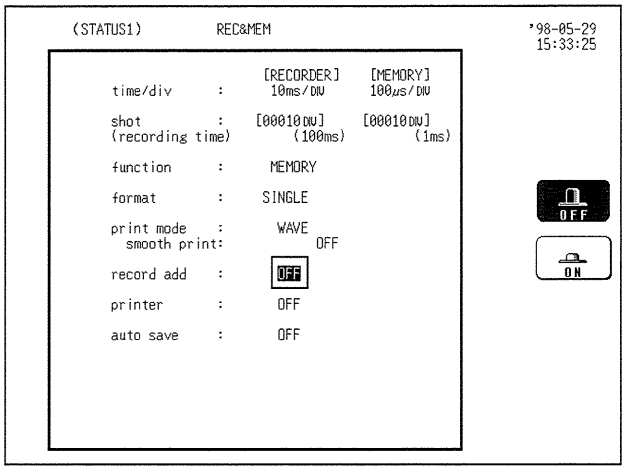
3.2.7 Setting the Additional Recording Function (Recorder Waveform Only)

- This records, regarding the memory as though it were recording paper.
- Without expansion memory, the last 500 divisions of waveform can be held in memory.
- The waveform can be scrolled and printed out.

Switching the additional recording on and off affects the use of memory as shown below.

Additional recording OFF	Additional recording ON
1. Recording 20 divisions of waveform 200divisions (No memory expansion)  20 divisions	1. Recording 20 divisions of waveform 200divisions (No memory expansion)  20 divisions
2. Recording another 20 divisions of waveform The first set of measurement data is discarded, and recording of the second set of measurement data starts again from the beginning of memory.  20 divisions	2. Recording another 20 divisions of waveform The first set of measurement data is preserved, and recording of the second set of measurement data starts after the first set.  20 divisions 20 divisions The first and seconfd sets of waveforms can be observed by scrolling or printing the waveform.

Method



1. Press the STATUS key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **additional recording** item, as shown in the figure on the left.
3. Use the function keys to make the selection.

OFF : Additional recording is disabled.

ON : Additional recording is enabled.

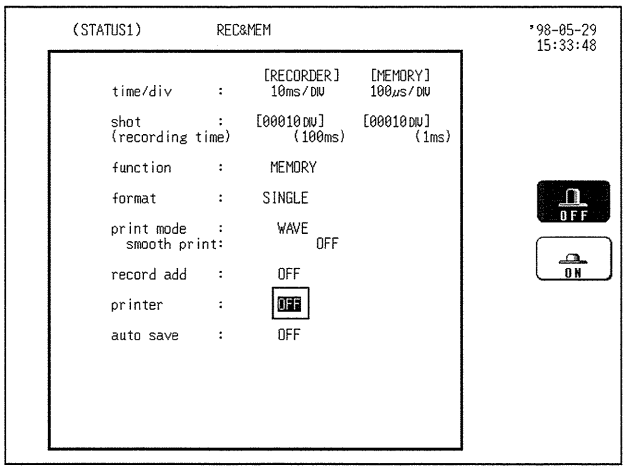
NOTE

- Time values output to the printer and displayed on the screen with the additional recording function enabled are equal to those of the most recently acquired waveforms. Therefore, when measuring waveforms in a different time axis range, always take that difference into consideration.
- The voltage axis range is determined by the most recently acquired waveforms.

3.2.8 Setting the Printer Function (Recorder Waveform Only)

The input waveform is continuously printed in real time.

Method



1. Press the STATUS key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **printer** item, as shown in the figure on the left.
3. Use the function keys to make the selection.

OFF : Printing is disabled.

ON : Printing is enabled.

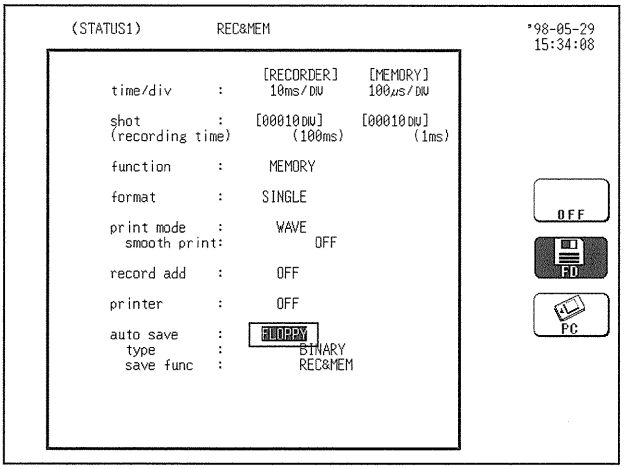
NOTE

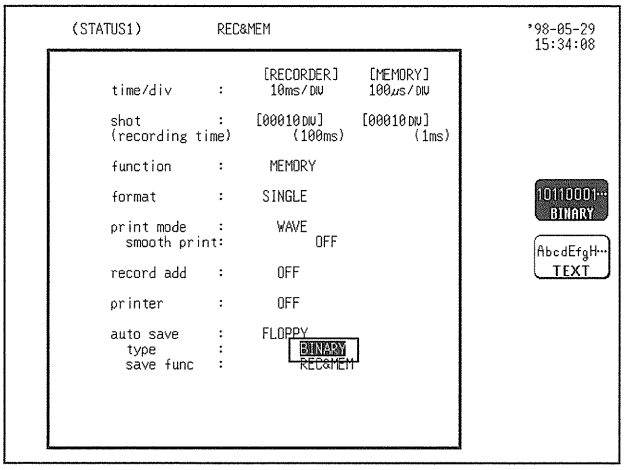
- See Section 10.7.3. in the 8835 instruction manual.
- In the recorder time axis range setting of 10 to 200 ms, the printer cannot be set ON.

3.2.9 Setting the Auto Save Function

When the function is enabled, waveform data are automatically stored on a floppy disk or PC card after they are captured.

Method





1. Press the [STATUS] key to call up the STATUS screen (page 1).
2. Move the flashing cursor to the **auto save** item, as shown in the figure on the left.
3. Use the function keys to make the selection.

   OFF : Auto save is disabled.

   FD : Waveform data are automatically stored on floppy disk

   PC : Waveform data are automatically stored on PC card.

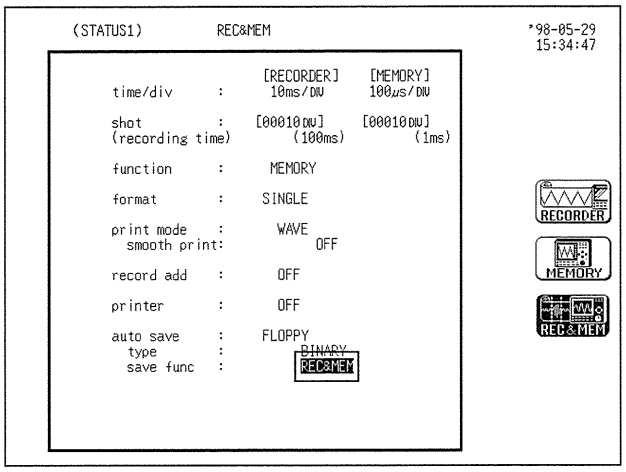
4. Use the function keys to select the data store principle.

   10110001··· BINARY : Data are stored as binary data.

   AbcdEfgH··· TEXT : Data are stored as text data.

NOTE

- When the recording length is "continuous", the auto save function is disabled
- For the curtailed interval at which the waveform data is saved in text format, refer to the settings used in saving the file screen data.
- A file is stored in the directory currently selected on the file screen.
- A file stored in the text format is not readable by the 8835.



5. Select the function to be stored.

: Memory waveforms are stored.

: Recorder waveforms are stored.

: Both memory waveforms and recorder waveforms are stored.

NOTE

- When batch saving with the Recorder & Memory, the measurement data (with REC, MEM extensions) are created together with an index file (R_M). When only the measurement data are read, these are read to the respective functions. To read to the Recorder & Memory, read the index file (R_M).
- Do not change or delete the name of a file to be batch read (R_M). The batch reading may not be executed correctly.
- When the auto save function is used while the additional recording function is ON, only newly acquired waveform data is stored. (In this case, the A/B cursors are set OFF.)
- All the displayed channels are stored.

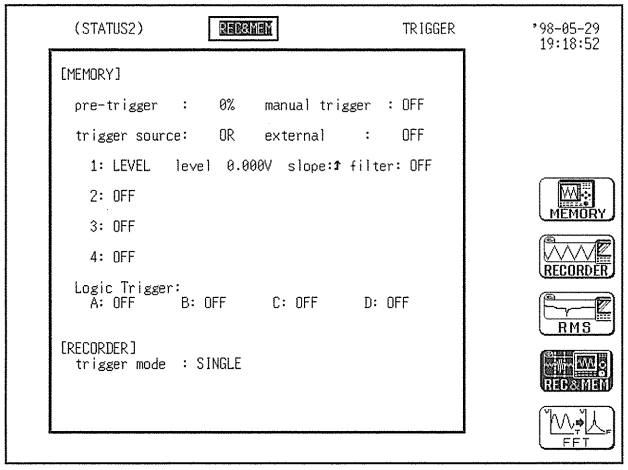
3.3 Setting the Trigger

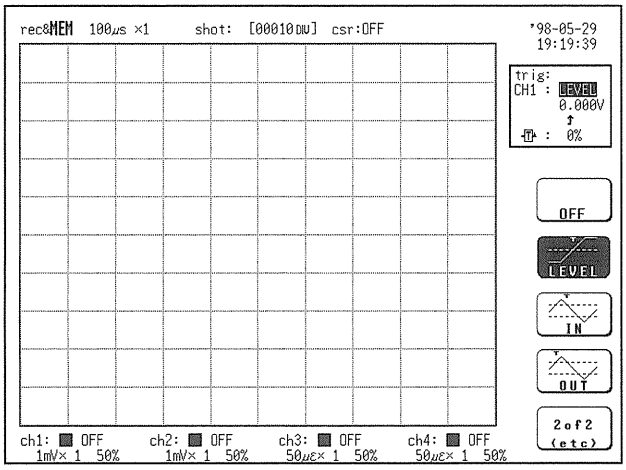
Set the trigger for both the recorder waveform and memory recorder waveform.

3.3.1 Setting the Trigger for the Memory Recorder Waveform

Set the trigger for the memory recorder waveform.

Method



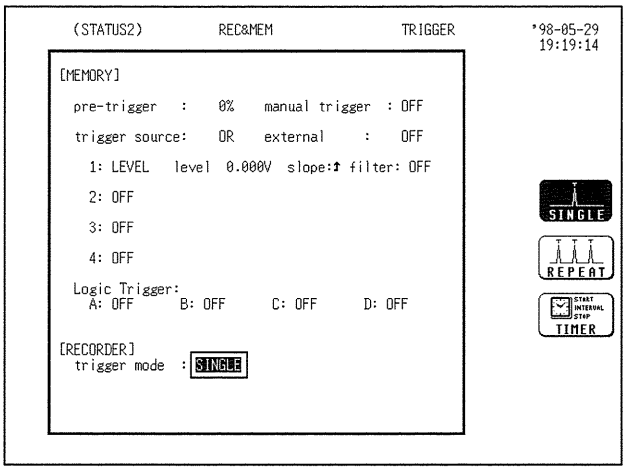


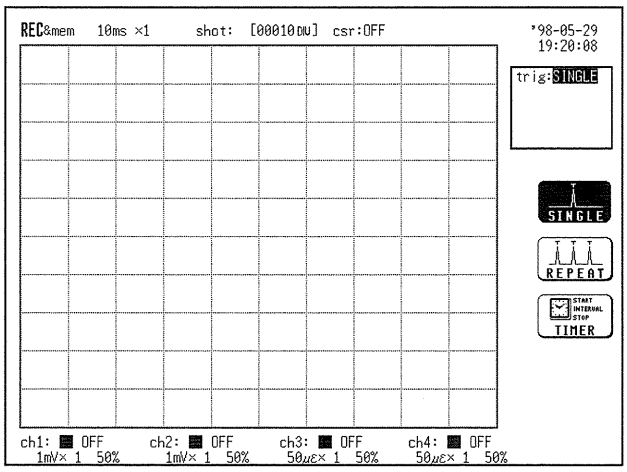
1. Press the STATUS key to call up the STATUS (page 2) or DISPLAY screen.
2. Same as the normal trigger setting.

3.3.2 Setting the Trigger for the Recorder Waveform

Set the trigger for the memory recorder waveform.

Method





1. Press the [STATUS] key to call up the STATUS (page 2) or DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left, and use the function keys to make the selection.

SINGLE : Setting starts when the [START] key is pressed, and one measurement is taken.

REPEAT : Setting starts when the [START] key is pressed, and measuremens are taken repeatedly

TIMER : Activate recording at preset times. Triggering can be performed at constant intervals within a preset start time and end time.

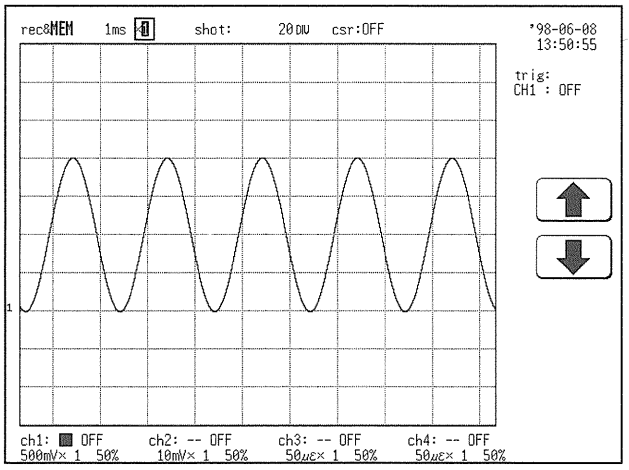
3.4 Settings on the Display Screen

Explains the setting items on the Display screen.

3.4.1 Setting Magnification/Compression Along the Time Axis

- The magnification/compression ratio along the time axis can be set.
- By magnifying the waveform, detailed observations can be made. By compressing the waveform, an entire change can be promptly apprehended.
- Magnification/compression of the screen uses the left edge as reference, regardless of the status of the A/B cursor.

Method



1. Move the flashing cursor to the position shown in the figure on the left.
2. Use the function keys to select the magnification/compression ratio.

[↑]: Ratio up

[↓]: Ratio down

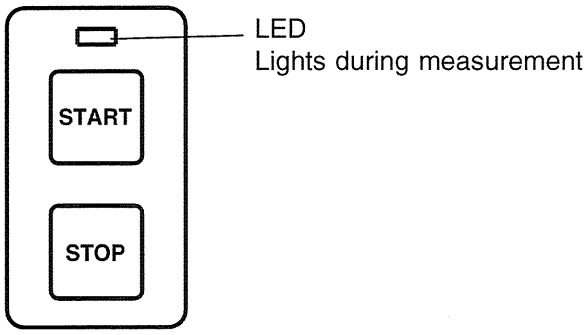
NOTE The magnification/compression factor can be changed also after measurement is completed.

Reference The [HELP] key can be used to check which position within the entire recording length is occupied by the currently shown waveform (see [VIEW] key in Section 3.1.7 in the 8835 instruction manual).

3.5 Start and Stop Measurement Operation

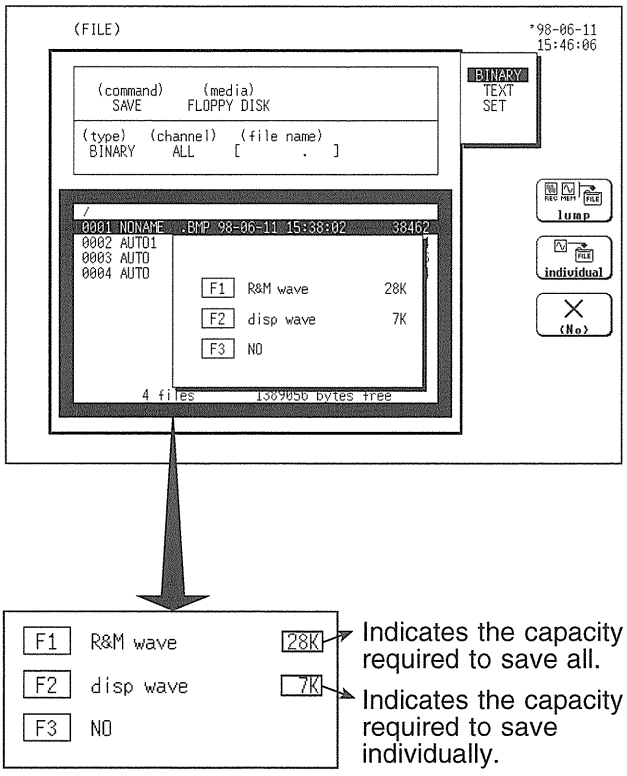
Method

1. Press the [START] key to initiate measurement or set the unit to trigger standby.
2. Press the [STOP] key during measurement to stop the measurement.



3.6 Procedures for Saving Data

- This section explains how to save data in binary or text form without using the auto-save function.
- Settings file considerations are the same as with other functions.
- With the recorder and memory functions, data cannot be loaded over existing data when a file is loaded.



1. Press the FILE key to call up the FILE screen.
2. Select the "Save" command; the display changes as shown below.
3. Use the function keys to make the selection.

SINGLE: Save all (The measurement data (with REC, MEM extensions) are created together with an index file (R_M).)

REPEAT: Save individually (Saves the display function data.)

TIMER: Cancel (Do not save)

⚠ CAUTION Since only a limited number of files (including directories) can be created in the directory, directories should be created to enable the creation of multiple files.

Chapter 4
FFT Function

4.1 Outline

4.1.1 Outline of the FFT Function

The recorder and memory function has the following features.

(1) FFT (Fast Fourier Transform) processing can be performed on input signal data for frequency analysis.

(2) Frequency range

133 mHz to 400 kHz, 20 steps

(3) Frequency resolution

1/400 of frequency range

(4) 12 types of analysis functions

Storage waveform, linear spectrum, RMS spectrum, power spectrum, auto-correlation function, histogram, transfer function, cross-power spectrum, cross-correlation function, unit-impulse response, coherence function, octave analysis

(5) Analysis modes

1-channel FFT, 2-channel FFT

(6) Analysis of data stored with memory recorder function possible

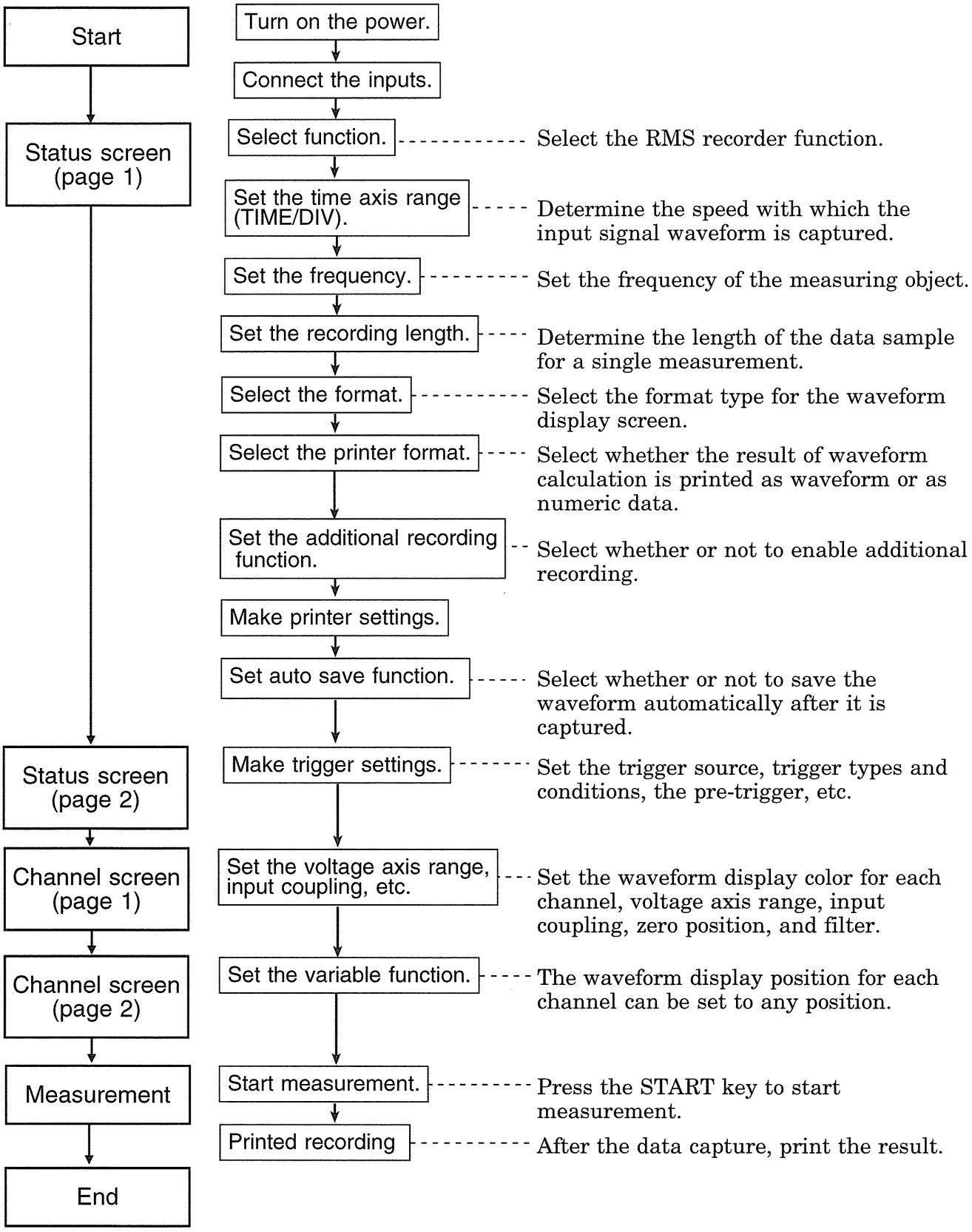
(7) Switchable antialiasing filter

Automatic selection of cutoff frequency to match frequency range (8938 FFT unit)

(8) Waveform evaluation function using evaluation area

4.1.2 Operation Sequence

The flowchart below illustrates the sequence of operations involved in using the FFT function.

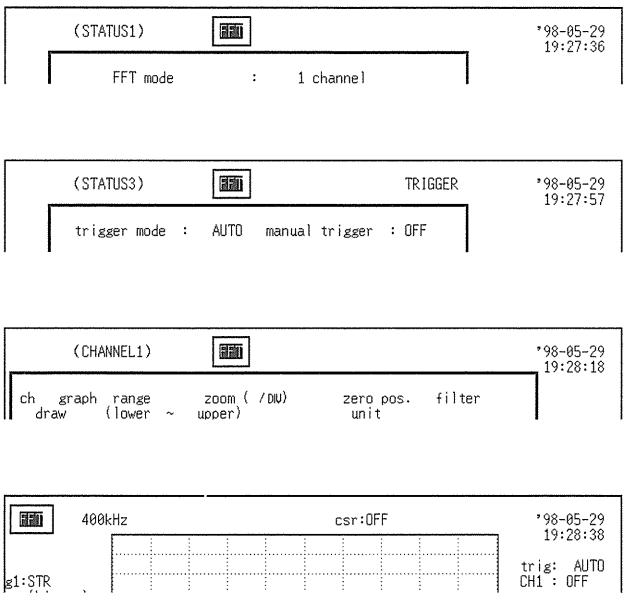


4.2 Making Settings

4.2.1 Setting the Function Mode

Select the FFT function.

Method Screen: STATUS, CHANNEL, DISPLAY



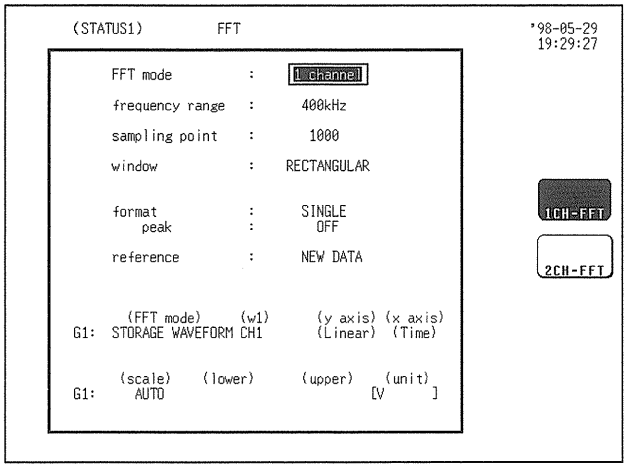
1. Call up the STATUS, CHANNEL or DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
3. Press F5 [FFT].

MEMORY : Memory recorder function
RECORDER : Recorder function
RMS : RMS recorder function
REC&MEM : Recorder and memory function
FFT : FFT function

4.2.2 Setting the FFT Channel Mode

- This setting determines whether only one channel (1ch-FFT) or two channels (2ch-FFT) are used for FFT processing.
- When "1ch-FFT" is selected, certain FFT analysis modes will not be available.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
2. Use the function keys to make the selection.

1ch-FFT : 1ch-FFT
2ch-FFT : 2ch-FFT

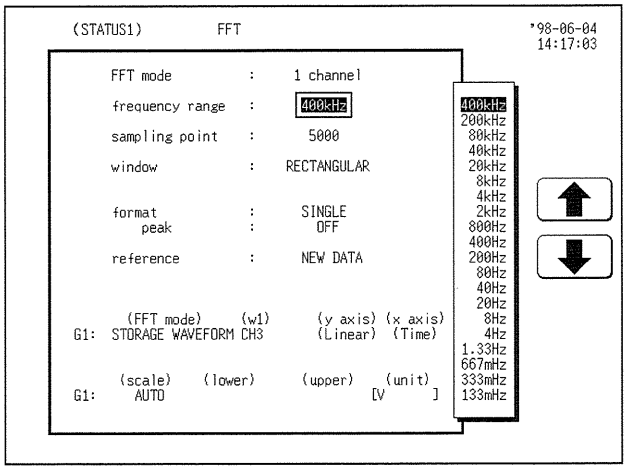
NOTE

The following analysis functions are not possible in 1-channel FFT mode: Transfer function (TRF), cross-power spectrum (CSP), cross-correlation function (CCR), impulse response (IMP), coherence function (COH)

4.2.3 Setting the Frequency Range

- The frequency range (frequency axis maximum value) can be set as follows.
- The frequency range corresponds to the time axis range (TIME/DIV) setting of the memory function.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the JOG control or the function keys to make the selection.

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

NOTE The antialiasing filter (8938 FFT unit) cutoff frequency is the same as the selected frequency range.

Frequency Range, Frequency Resolution, Window Width, Corresponding Time Axis Range (Number of FFT points: 1000)

Frequency range [Hz]		Frequency resolution [Hz]	Window width	Time axis [/DIV]
400 k	*1	1 k	1 ms	100 μs
200 k	*1	500	2 ms	200 μs
80 k	*1	200	5 ms	500 μs
40 k		100	10 ms	1 ms
20 k		50	20 ms	2 ms
8 k		20	50 ms	5 ms
4 k		10	100 ms	10 ms
2 k		5	200 ms	20 ms
800		2	500 ms	50 ms
400		1	1 s	100 ms
200		500 m	2 s	200 ms
80		200 m	5 s	500 ms
40		100 m	10 s	1 s
20		50 m	20 s	2 s
8	*2	20 m	50 s	5 s
4	*2	10 m	100 s	10 s
1.33	*2	3.3 m	5 min	30 s
667 m	*2	1.67 m	10 min	1 min
333 m	*2	0.83 m	20 min	2 min
133 m	*2	0.33 m	50 min	5 min

The cutoff frequency of the antialiasing filter is the same as the selected frequency range, except for the cases listed below.

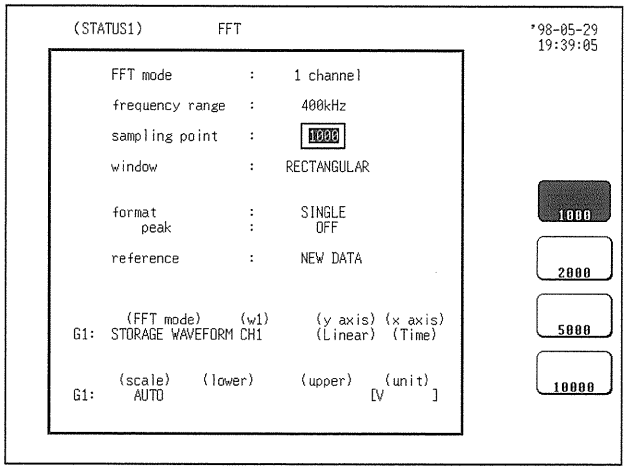
*1: Antialiasing filter is OFF.

*2: Cutoff frequency is 20 Hz.

4.2.4 Setting the Number of FFT Points

Set the number of sampling points.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

1000 : Set the number of sampling points to 1000.

2000 : Set the number of sampling points to 2000.

5000 : Set the number of sampling points to 5000.

10000 : Set the number of sampling points to 10000.

4.2.5 Setting the Peak Display

- From the sampling points and FFT processing results, the 10 peak values or maximum values can be shown.
- This setting is available only in single-screen mode.

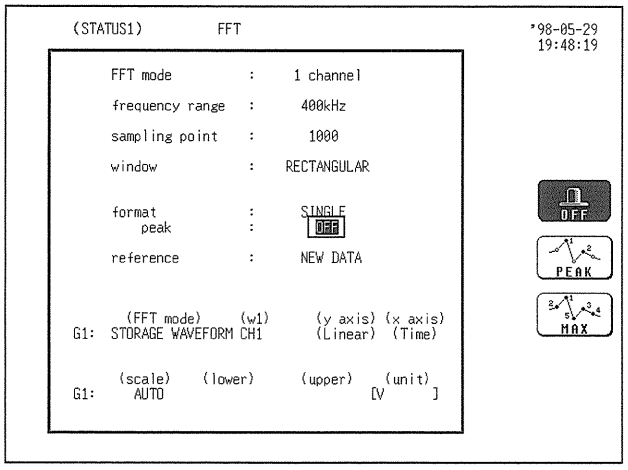
Peak value

- When data at one point are higher than data within the vicinity, the point is a peak.
- The 10 highest peaks are shown.

Maximum value

Points with the 10 highest values are shown.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

OFF : Normal display

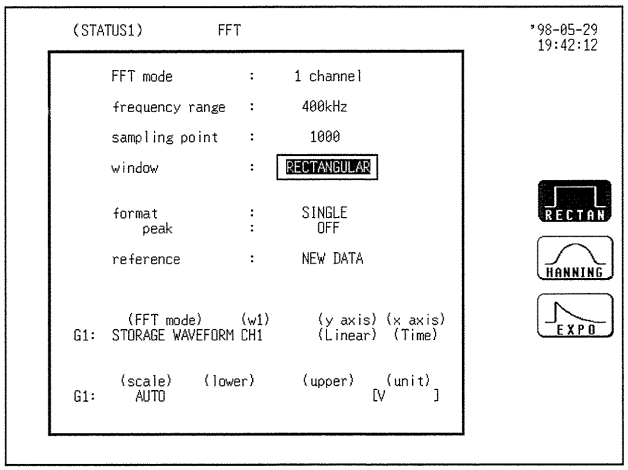
PEAK : Peak display

MAX : Maximum value display

4.2.6 Setting the Window Function

- The window function defines the segment of the input signal that will be processed.
- Window processing can be used to minimize leakage error.
  Rectangular (rectangular window function): effective on discrete waveforms.
  Hanning (hanning window function): effective on continuous waveforms.
  Exponential (exponential window function): effective on decaying waveforms.

Method Screen: STATUS (page 1)

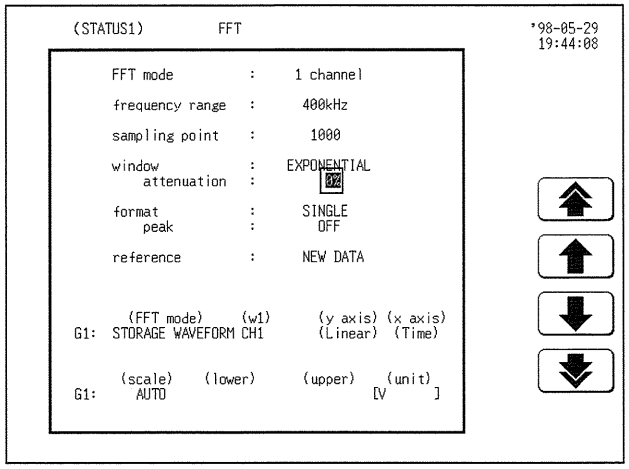


1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

RECTAN : Rectangular

HANNING : Hanning

EXPO : Exponential



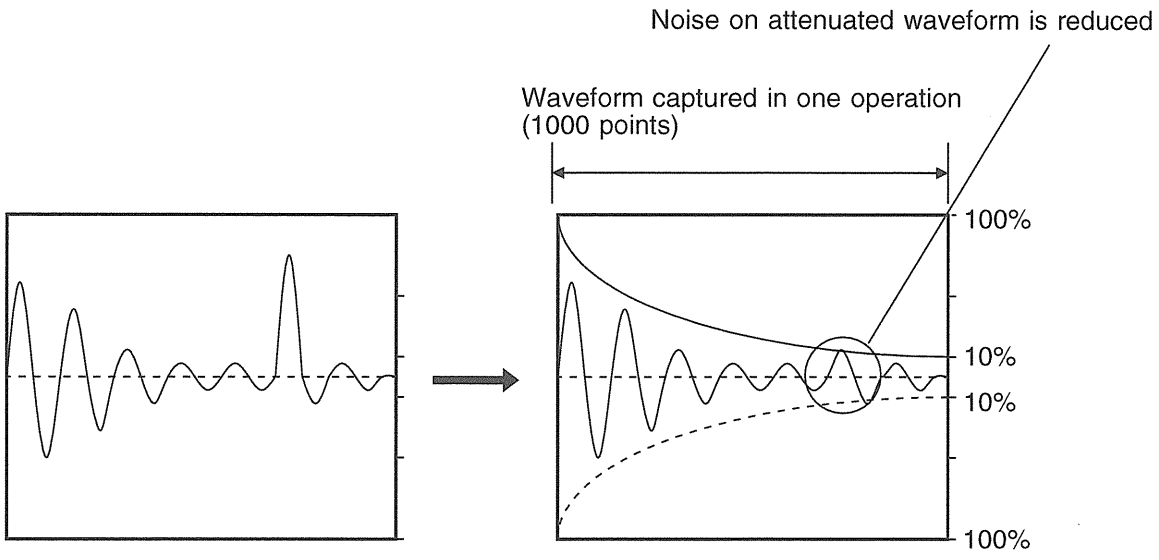
3. If **EXPO** was selected, the **coefficient** item is displayed. Select the attenuation ratio in percent, using the function keys or the JOG control.

: Value up, large step

: Value up, small step

: Value down, small step

: Value down, large step



Setting: Exponential window function
Attenuation ratio 10%

> ⚠ CAUTION
>
> - If **coefficient** (attenuation ratio) is set to 0%, processing will be carried out as 0.1%.
> - When measurements are taken using the Hanning window or exponential window, note that the calculation results in the display of a value that is lower than the amplitude obtained when using a rectangular window.

4.2.7 Setting the Display Format

- You can set the format for displaying input signal waveforms on the screen and recording them on the printer.
- The SINGLE, DUAL, and NYQUIST formats are available.

(1) Single

Displays the waveform on a single screen.

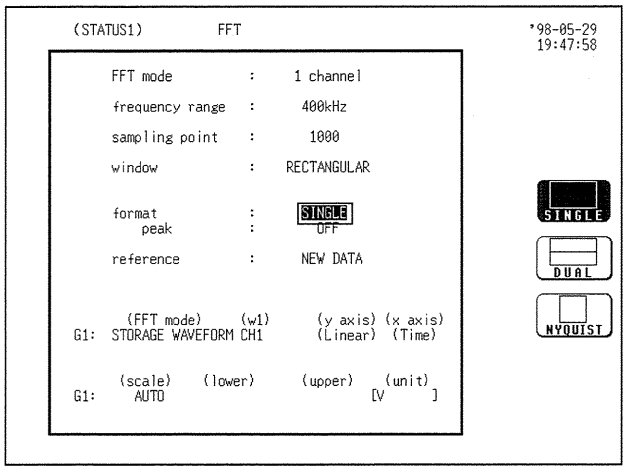
(2) Dual

Divides the waveform display screen into upper and lower screens.

(3) Nyquist

For the linear spectrum, cross power spectrum, and transfer function, displays the real-number portion of the data for the FFT calculation result on the X-axis, and the imaginary number portion of the data on the Y-axis.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection. .

SINGLE: Single
DUAL: Dual
NYQUIST: Nyquist

4.2.8 Selecting Reference Data

Select data to be used for FFT processing.

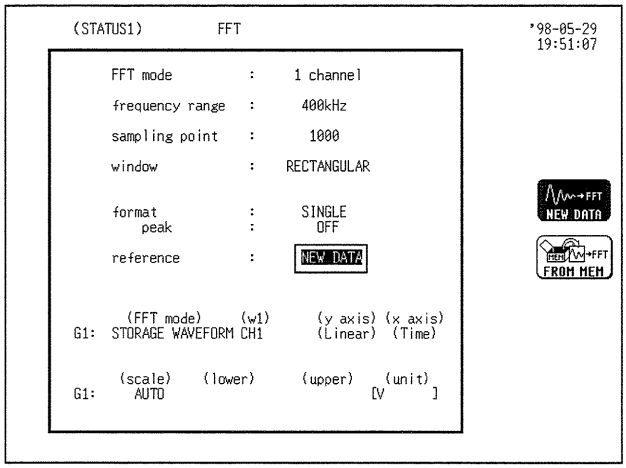
New data

When [START] key is pressed, data for 1000 points are captured and used for FFT processing.

Memory waveform

- When [START] key is pressed, FFT processing is carried out using data stored in memory with the memory function.
- Processing start point can be specified on the memory recorder display, using the A/B cursors.
- When the A/B cursors are used, data for 1000 points from the first cursor are used for FFT processing.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.

NEW DATA: Capture new waveform data for FFT processing
FROM MEM: Use stored waveform data for FFT processing

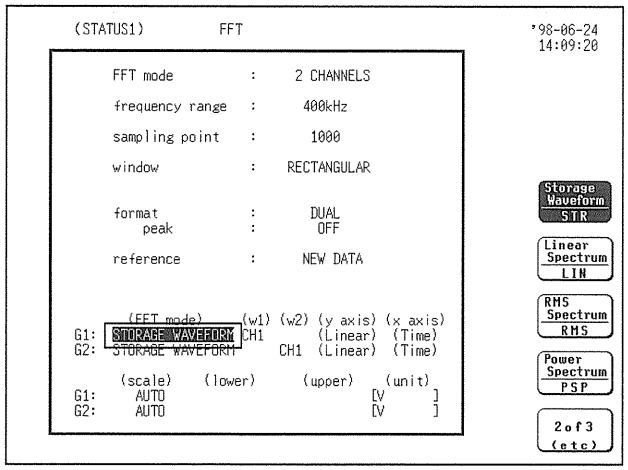
NOTE

When stored waveform data are used, the trigger setting is not required. But the trigger mode is active, and when REPEAT, AUTO, or AUTO STOP is selected, FFT analysis is performed continuously for the specified number of data at a time, until the end of data. (Calculation is not performed if less than the specified number of points.

4.2.9 Setting the FFT Analysis Mode

Used to select the FFT calculation method.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

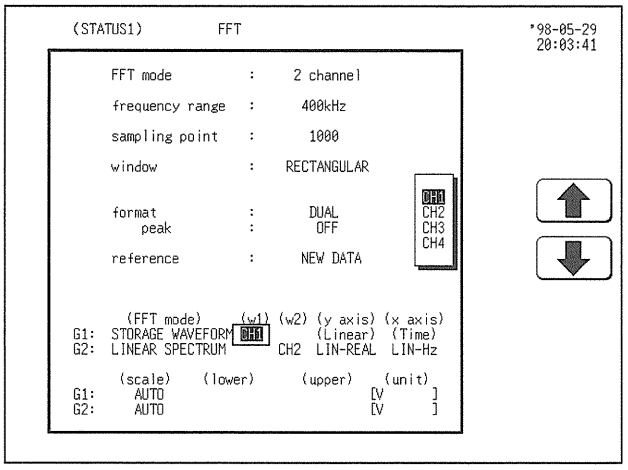
Storage STR : Stored waveform
Linear Spectrum LIN : Linear spectrum
RMS Spectrum RMS : RMS spectrum
Power Spectrum PSP : Power spectrum
Auto Correlation ACR : Auto correlation function
Histogram HIS : Histogram
Transfer TRF : Transfer function
Cross Power CSP : Cross power spectrum
Cross Correlation CCR : Cross correlation function
Impulse Response IMP : Impulse response
Coherense COH : Coherence function
Octave OCT : Octave analysis

NOTE The transfer, cross-power spectrum, cross-correlation, unit-impulse response, and coherence functions use 2 channels.

4.2.10 Setting the Analysis Channel

Select the channel for FFT analysis.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the JOG control or the function keys to to make the selection.

: Move the cursor up in the selection window.
: Move the cursor down in the selection window.

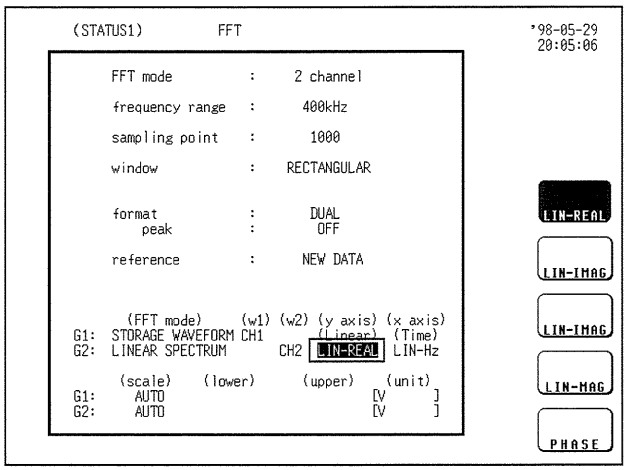
NOTE

- For the transfer function and impulse response, calculation is performed from "(w2)/(w1)".
- To prevent distortion due to sampling aliasing from affecting analysis, it is recommended that the 8938 FFT ANALOG UNIT be used for channel input with FFT analysis.

4.2.11 Setting the X-axis and Y-axis Displays

- Set the X and Y axis for display of FFT calculation results.
- Different units can be selected for the X and Y axis.
- With some FFT analysis modes, one of the axis cannot be set.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

· Y-axis

LIN-REAL : Real number part (linear display)

LIN-IMAG :Imaginary number part (linear display)

LIN-MAG : Amplitude (linear display)

LOG-MAG :Amplitude (decibel display)

PHASE :Phase (degree display)

· X-axis.

LIN-Hz : Frequency (linear display)

LOG-Hz : Frequency (logalism display)

· Octave analysis

1/3 OCT : 1/3 octave

1/1 OCT : 1/1 octave

X and Y Axis Settings Available with each FFT Analysis Mode

FFT analysis mode		X-axis (horizontal axis)	Y-axis (vertical axis)
STR	Storage Waveform	(Time)	(Linear)
LIN	Linear Spectrum	LIN-Hz LOG-Hz	LIN-REAL LIN-IMAG LIN-MAG LOG-MAG PHASE
RMS	RMS Spectrum	LIN-Hz LOG-Hz	LIN-REAL LIN-IMAG LIN-MAG LOG-MAG PHASE
PSP	Power Spectrum	LIN-Hz LOG-Hz	LIN-MAG LOG-MAG
ACR	Auto Correlation Function	(Time)	(Linear)
HIS	Histogram	(Volt)	(Linear)
TRF	Transfer Function	LIN-Hz LOG-Hz	LIN-REAL LIN-IMAG LIN-MAG LOG-MAG PHASE
CSP	Cross Power Spectrum	LIN-Hz LOG-Hz	LIN-REAL LIN-IMAG LIN-MAG LOG-MAG PHASE
CCR	Cross Correlation Function	(Time)	(Linear)
IMP	Unit Impulse Response	(Time)	(Linear)
COH	Coherence Function	LIN-Hz LOG-Hz	(Linear)
OCT	Octave Analysis	1/3 OCT 1/1 OCT	LIN-MAG LOG-MAG

Parens surrounding an item indicate that those items are fixed.

⚠ CAUTION When external sampling is used, the X-axis (horizontal axis) expresses the data count.

4.2.12 Setting the Display Scale

The display scale for showing the FFT processing result can either be set manually or automatically.

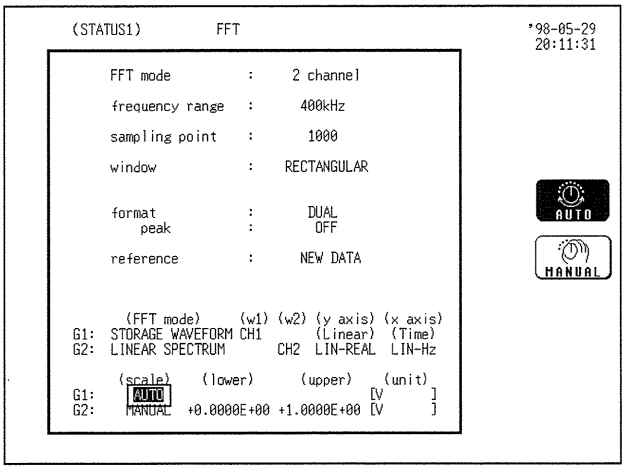
AUTO

The vertical axis (Y-axis) scale is set automatically, depending on the processing result.

MANUAL

The vertical axis (Y-axis) scale can be set as desired, to match the purpose of the measurement.
This is useful for enlarging or reducing the amplitude and for shifting the waveform up or down.

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

AUTO :Scale set automatically.

MANUAL : Scale set manually.

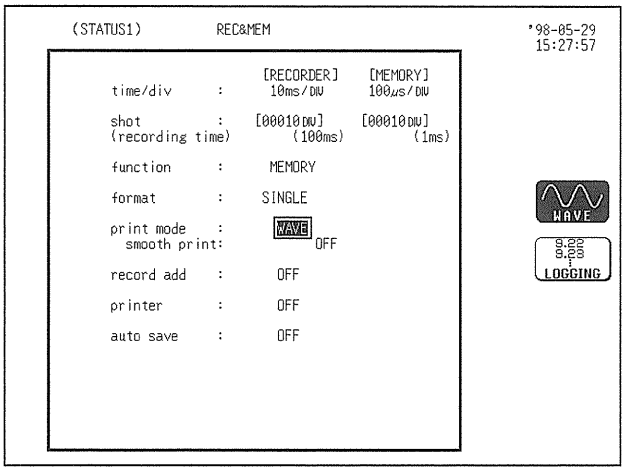
(1) When **AUTO** is selected

Upper and lower limits are set automatically, according to the processing result.

(2) When **MANUAL** is selected

- The upper and lower limits for the display scale can be set by the user.
- Setting range is -9.9999E+29 to 9.9999E+29. (exponent is E-29 to E+29).

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys etc. to enter the value.

: Value up

: Value down

TEN-KEY INPUT

Displaying the display scale units

- The selected unit is displayed with "scaling" in the system screen.
- When scaling is turned OFF, V (volts) or ℃ is displayed.

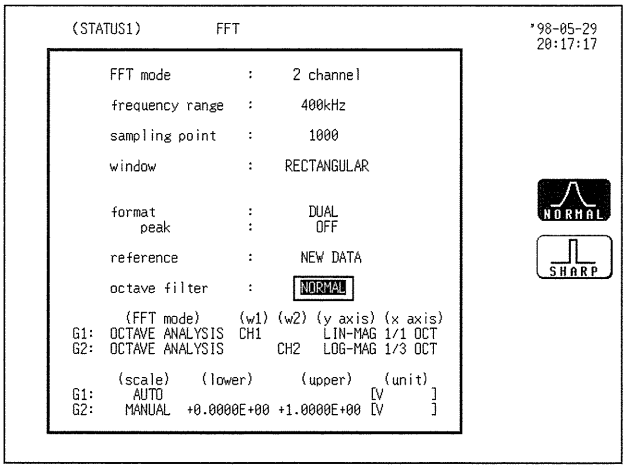
> **⚠ CAUTION** The X-axis setting for the histogram can be changed on the channel setting page (page 1) of the CHANNEL screen.

4.2.13 Octave Filter Setting

When octave analysis has been selected, two different filter types can be chosen.

- Normal
  Filter characteristics approximate the characteristics used for conventional octave analyzers with analog filters.
- Sharp
  Spectrum components outside the octave band are excluded totally and only the spectrum in the octave band is bundled and used for analysis.
  (The characteristics of both filter types are within ANSI CLASS 3 tolerance limits.)

Method Screen: STATUS (page 1)



1. Call up the STATUS screen (page 1).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

NORMAL : Normal filter characteristics

SHARP : Sharp filter characteristics

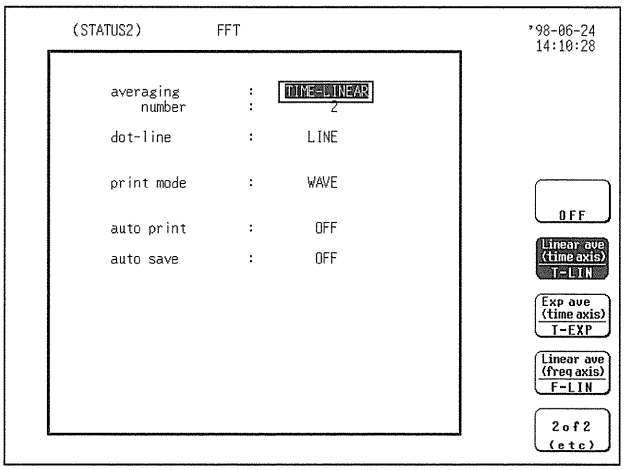
NOTE

This unit does not use analog filters. It first determines the entire power spectrum and then uses weighting by bundling the spectrum to achieve the desired filter characteristics.

4.2.14 Setting the Averaging Function

- The averaging function allows capturing several instances of a waveform and determining the average.
- This makes it possible to eliminate noise and irregular signal components.
- Time axis waveform averaging
  Frequency axis waveform averaging

Method Screen: STATUS (page 2)



1. Call up the STATUS screen (page 2).
2. Move the flashing cursor to the **average** item as shown in the figure on the left.
3. Use the function keys to select the type of averaging.

   OFF : Disable averaging
   Linear ave (time axis) T-LIN : Perform time axis waveform summing averaging
   Exp ave (time axis) T-EXP : Perform time axis waveform exponential averaging
   Linear ave (freq axis) F-LIN : Perform frequency axis waveform summing averaging
   Exp ave (freq axis) F-EXP : Perform frequency axis waveform exponential averaging
   Peak Hold (freq axis) F-PEAK : Frequency axis waveform peak hold

4. Move the flashing cursor to the count item, and use the function keys or the JOG control to set the averaging count.

   ↑ : Move the cursor up in the selection window.
   ↓ : Move the cursor down in the selection window.

⚠ CAUTION

- When averaging is used together with the waveform evaluation function, waveform evaluation is carried out after the specified averaging count is completed.
- After averaging was carried out, the scaling setting cannot be changed.
- After averaging, recalculation does not take place even if the analysis channel is changed.
- Averaging data is lost when the power is turned off. Save important data to floppy disk belore turning off the power.

FFT analysis mode and averaging

●: Setting is valid
−: Setting is invalid (has no effect)

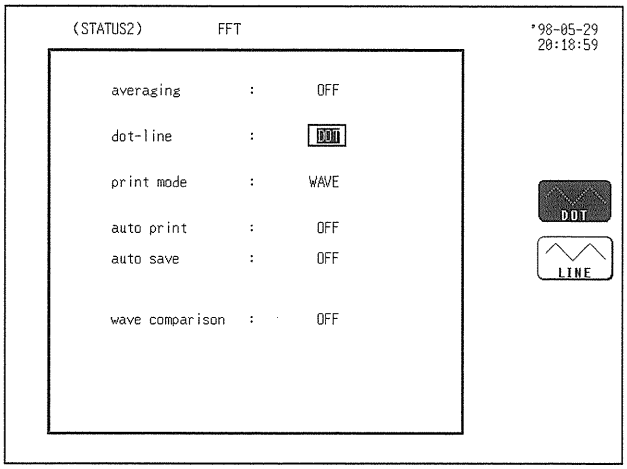
FFT analysis mode	Y-axis	Time axis averaging	Frequency axis averaging	Peak hold
Storage waveform	(Linear)	●	●	−
Linear spectrum	LIN-REAL	●	●	−
	LIN-IMAG	●	●	−
	LIN-MAG	●	●	●
	LOG-MAG	●	●	●
	PHASE	●	−	−
RMS spectrum	LIN-REAL	●	●	−
	LIN-IMAG	●	●	−
	LIN-MAG	●	●	●
	LOG-MAG	●	●	●
	PHASE	●	−	−
Power spectrum	LIN-MAG	●	●	●
	LOG-MAG	●	●	●
Auto correlation function	(Linear)	●	●	●
Histogram	(Linear)	●	−	−
Transfer function	LIN-REAL	●	−	−
	LIN-IMAG	●	−	−
	LIN-MAG	●	●	●
	LOG-MAG	●	●	●
	PHASE	●	−	−
Cross power spectrum	LIN-REAL	●	●	−
	LIN-IMAG	●	●	−
	LIN-MAG	●	●	●
	LOG-MAG	●	●	●
	PHASE	●	−	−
Cross correlation function	(Linear)	●	●	●
Unit impulse response	(Linear)	●	●	●
Coherence function	(Linear)	●	●	●
Octave analysis	LIN-MAG	●	●	●
	LOG-MAG	●	●	●

* Same for linear spectrum, and cross-power spectrum with Nyquist display.

4.2.15 Setting the Interpolation Function

The input signal (sampled data) and FFT waveform can be displayed and recorded as is, or after linear interpolation.

Method Screen: STATUS (page 2)



1. Call up the STATUS screen (page 2).
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to make the selection.

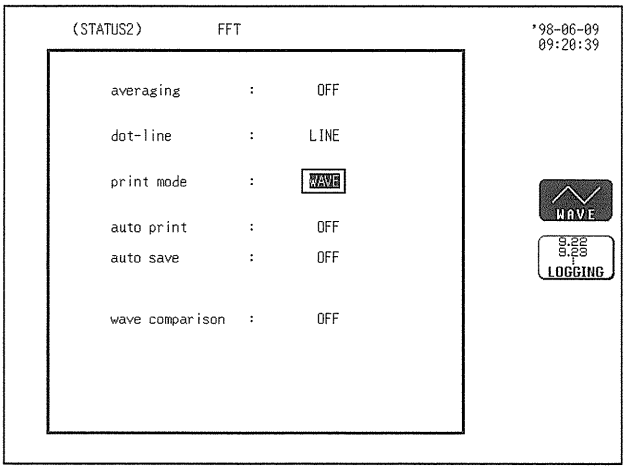
DOT :Linear interpolation is not performed.

LINE :Linear interpolation is performed.

4.2.16 Setting the Printer Format

· Selects whether the result of FFT calculation is printed as waveform or as numeric data.

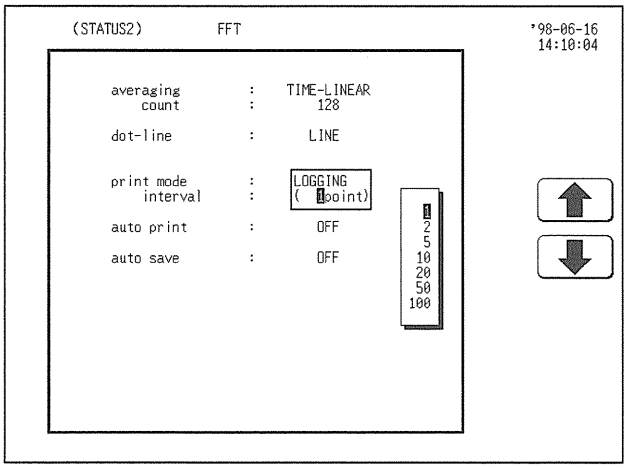
Method Screen: STATUS (page 2)



1. Press the STATUS key to call up the STATUS screen (page 2).
2. Move the flashing cursor to the **print mode** item, as shown in the figure on the left
3. Use the function keys to select **waveform**.

WAVE : The result of FFT calculation is printed as a waveform.

LOGGING : The result of FFT calculation is printed as numeric data.



4. Move the flashing cursor to the **print interval** item.
5. Use the function keys to make the selection.

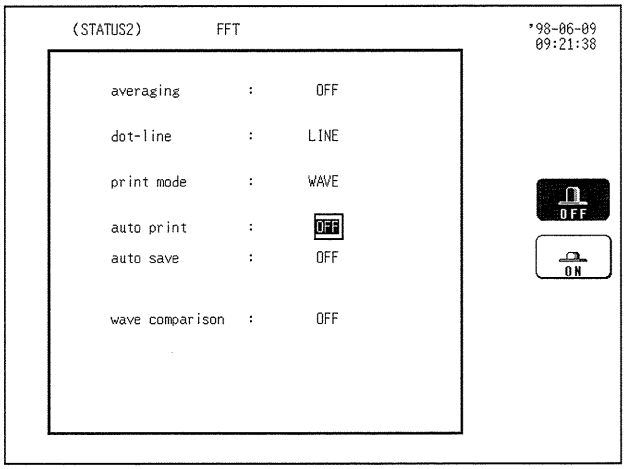
: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

4.2.17 Setting the Auto Print Function

When the function is enabled, printout is carried out automatically after a waveform is captured.

Method Screen: STATUS (page 2)



1. Press the [STATUS] key to call up the STATUS screen (page 2).
2. Move the flashing cursor to the **auto print** item, as shown in the figure on the left
3. Use the function keys to make the selection.

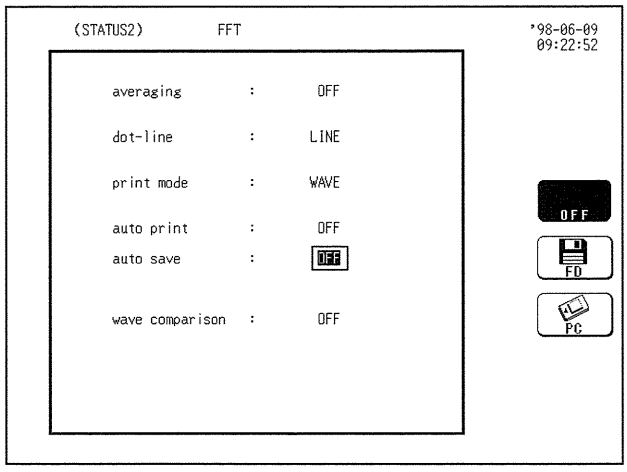
[OFF]: Auto print is disabled.

[ON]: Auto print is enabled.

4.2.18 Setting the Auto Save Function

When the function is enabled, waveform data are automatically stored on a floppy disk or PC card after they are captured.

Method Screen: STATUS (page 2)



1. Press the [STATUS] key to call up the STATUS screen (page 2).
2. Move the flashing cursor to the **auto save** item, as shown in the figure on the left
3. Use the function keys to make the selection.

[OFF]: Auto save is disabled.

[FD]: Waveform data are automatically stored on floppy disk

[PC]: Waveform data are automatically stored on PC card.

4. Use the function keys to select the data store principle.
   : Data are stored as binary data.
   : Data are stored as text data.

NOTE A file stored in the text format is not readable by the 8835.

4.3 Analysis Function

4.3.1 Storage Waveform [STR]

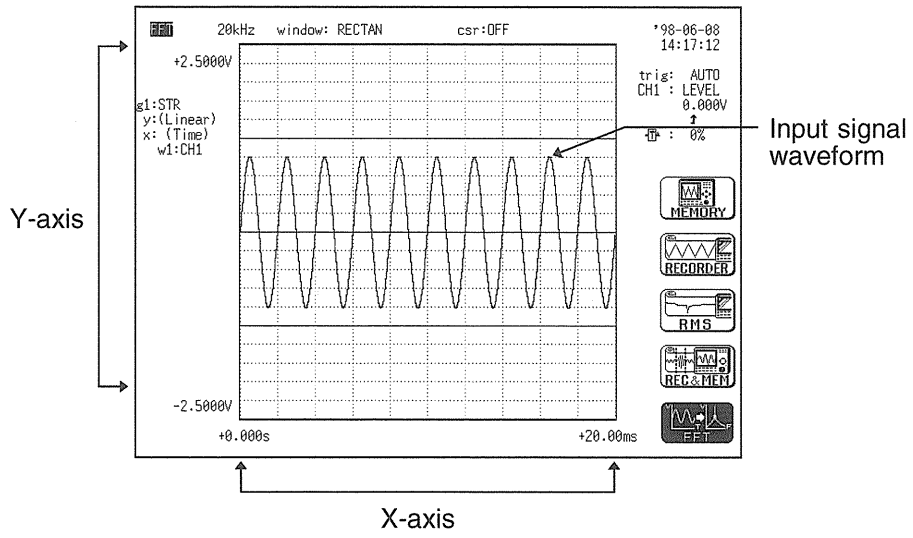
Displays the time domain waveform of the input signal. Displays the time domain waveform of the input signal.

Function fa

Horizontal cursor	Time	Time axis display Indicates the value of the specified TIME/DIV frequency range. (Refer to the table of the frequency range and time axis in Section 8.2.3.)
Vertical cursor	Linear	Indicates the value of the measurement range of the input unit in voltage units.

Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	fa
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Stored waveform



4.3.2 Linear Spectrum [LIN]

- The frequency domain waveform of the input signal, including magnitude and phase information.
- Major applications include:
  - Determining the peaks of waveform frequency components
  - Determining the levels of high and low harmonics

Function

$$Fa = \Im(fa)$$
$$= |Fa| \exp(j\theta a)$$
$$= |Fa|(\cos \angle\theta a + j \sin \angle\theta a)$$

Horizontal cursor

LIN-Hz — Frequency spectrum display as linear units.
The range is from DC to the maximum frequency range value.

LOG Hz — Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Real — Linear display of real-number part of the data as voltage (Nyquist mode)

Vertical cursor

LIN-REAL — Linear display of real-number part of the data as voltage

LIN-IMAG — Linear display of imaginary-number part of the data as voltage

LIN-MAG — Linear display of analysis data as voltage

LOG-MAG — Logarithmic display of analysis data as dB
(0dB reference value: 1 V peak= α V p-p)

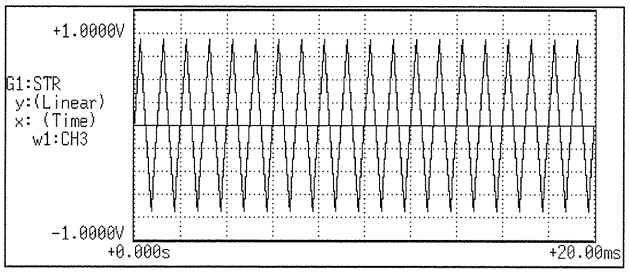
PHASE — Degrees (deg) display of phase component of data

Imag — Linear display of imaginary-number part of the data as voltage (Nyquist mode)

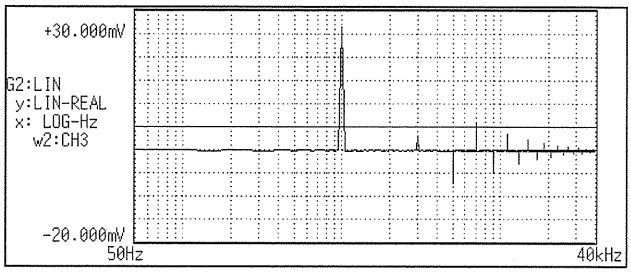
Vertical axis	Display
LIN-REAL (real-number part)	|Fa|·cos ∠ θ a
LIN-IMAG (imaginary-number part)	|Fa|· sin ∠ θ a
LIN-MAG (amplitude)	|Fa|
LOG-MAG (logarithmic amplitude)	20·log |Fa|
PHASE (phase)	∠ θ a

Examples Linear spectra waveforms

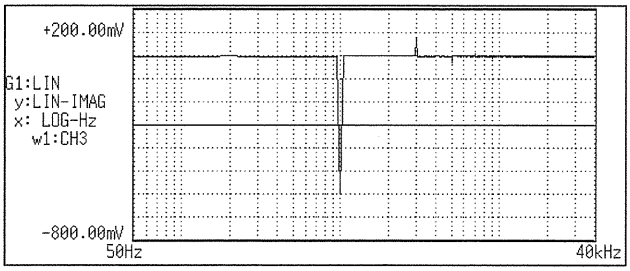
Stored waveform



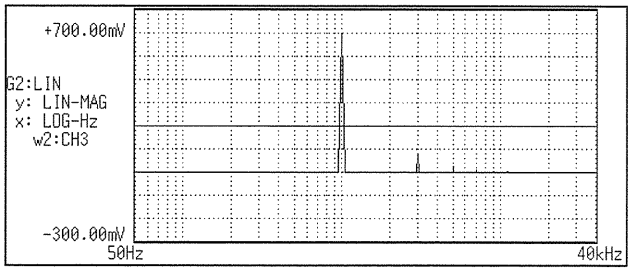
Y-axis: LIN-REAL (X-axis: LOG-Hz)



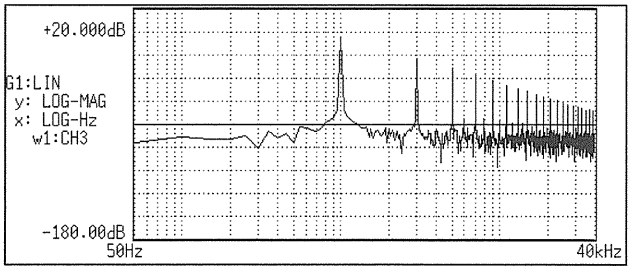
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



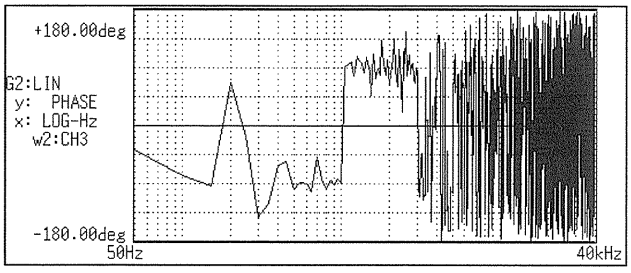
Y-axis: LIN-MAG (X-axis: LOG-Hz)



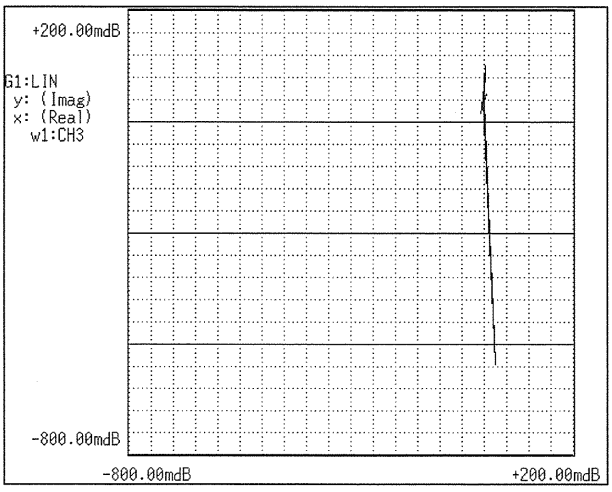
Y-axis: LOG-MAG (X-axis: LOG-Hz)



Y-axis: PHASE (X-axis: LOG-Hz)



Nyquist



4.3.3 RMS Spectrum [RMS]

- Displays the frequency domain waveform of the input signal, including magnitude (effective value) and phase information.
- Major applications include:
  - Determining the peaks of waveform frequency components.
  - Determining the effective values of frequency components.

Function

$$Ra = \frac{1}{\sqrt{2}} Fa$$
$$= |Ra| \exp(j\theta a)$$
$$= |Ra|(\cos \angle \theta a + j \sin \angle \theta a)$$

DC components: Ra = Fa

Horizontal cursor

LIN-Hz: Frequency spectrum display as linear units. The range is from DC to the maximum frequency range value.

LOG-Hz: Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Vertical cursor

LIN-REAL: Linear display of real-number part of the data as voltage

LIN-IMAG: Linear display of imaginary-number part of the data as voltage

LIN-MAG: Linear display of analysis data as voltage

LOG-MAG: Logarithmic display of analysis data as dB (0dB reference value: 1 Vrms)

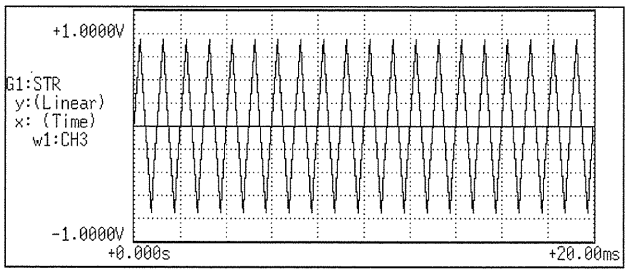
PHASE: Degrees (deg) display of phase component of data

Vertical axis	Display
LIN-REAL (real-number part)	|Ra|·cos ∠ θa
LIN-IMAG (imaginary-number part)	|Ra|·sin ∠ θa
LIN-MAG (amplitude)	|Ra|
LOG-MAG (logarithmic amplitude)	20·log |Ra|
PHASE (phase)	∠ θa

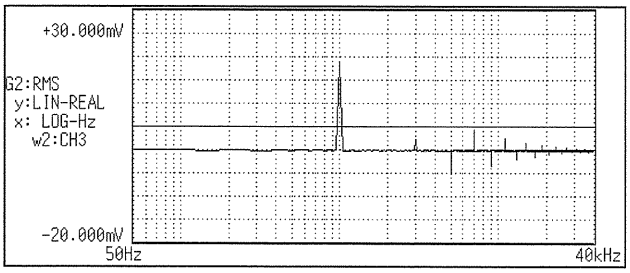
NOTE The RMS spectrum display and the LOG-MAG display express the same processing result.

Example RMS spectra waveform

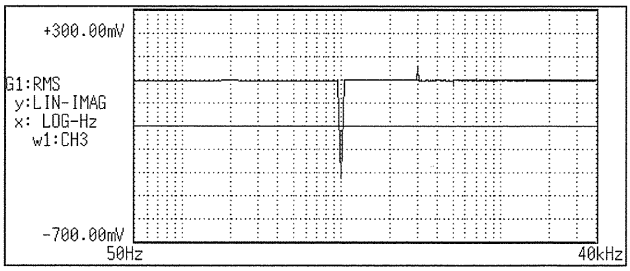
Stored waveform



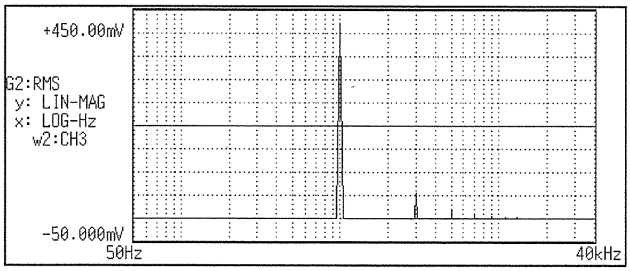
Y-axis: LIN-REAL (X-axis: LOG-Hz)



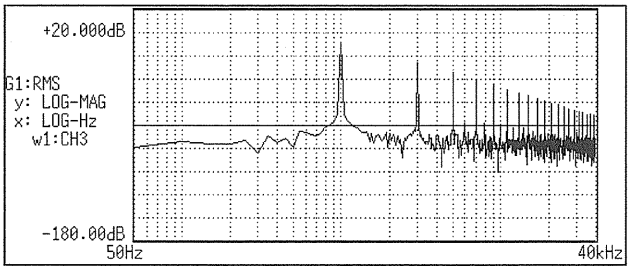
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



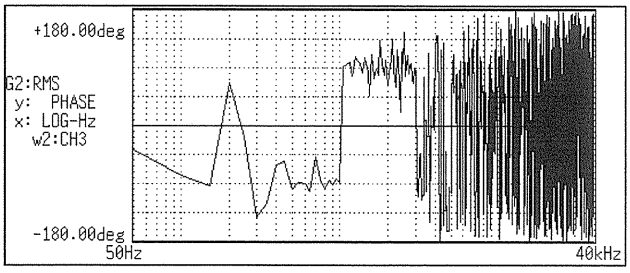
Y-axis: LIN-MAG (X-axis: LOG-Hz)



Y-axis: LOG-MAG (X-axis: LOG-Hz)



Y-axis: PHASE (X-axis: LOG-Hz)



4.3.4 Power Spectrum [PSP]

- Displays the energy spectrum of the input signal, consisting of only magnitude information.
- Major applications include:

· Determining the peaks of waveform frequency components
· Determining the energy levels of high and low harmonics

Function

$$Gaa = \frac{1}{2} Fa^* \cdot Fa$$
$$= \frac{1}{2}\{Re^2(Fa) + Im^2(Fa)\}$$
$$= \frac{1}{2}|Fa|^2$$

DC component:

$$Gaa = Fa^* \cdot Fa$$
$$= \{Re^2(Fa) + Im^2(Fa)\}$$
$$= |Fa|^2$$

Horizontal cursor

LIN-Hz — Frequency spectrum display as linear units. The range is from DC to the maximum frequency range value.

LOG Hz — Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Vertical cursor

LIN-MAG — Linear display of analysis data as binary exponential voltage
This expresses the energy component.

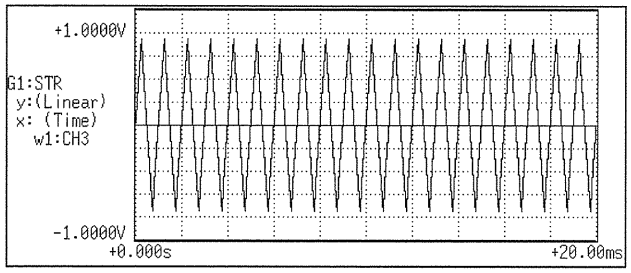
LOG-MAG — Logarithmic display of analysis data as dB
(0dB reference value: 1 V^2 rms)

Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	Gaa
LOG-MAG (logarithmic amplitude)	10 log |Gaa|
PHASE (phase)	—

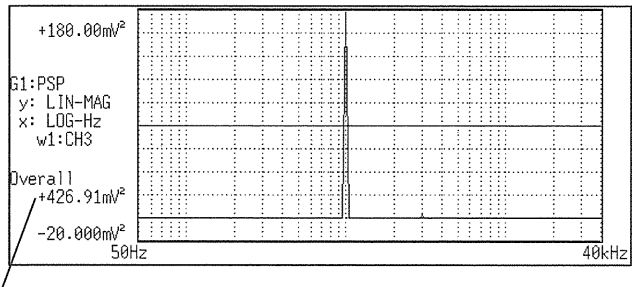
NOTE The LOG-MAG display and the RMS spectrum display express the same processing result.

Example Power spectra waveforms

Stored waveform

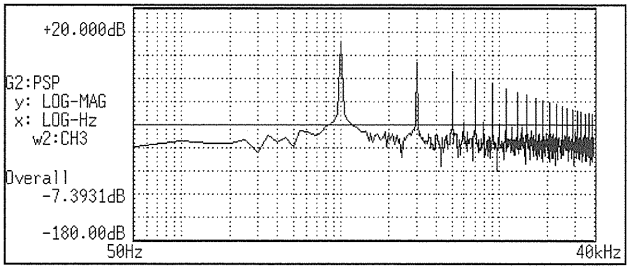


Y-axis: LIN-MAG (X-axis: LOG-Hz)



Overall value

Y-axis: LOG-MAG (X-axis: LOG-Hz)



Overall value

The overall value is the total effective value obtained from the frequency spectrum contained in the input signal. It is obtained by taking the square root of the total of power spectra for all frequencies.

(Overall value) $\sqrt{PSPo + \sum_{i=1} PSPi}$ (Vrms)

PSPo DC component
PSPi ith AC component

NOTE

Compensation is applied to data captured before starting FFT processing, to achieve the same overall value, also when a window function other than rectangular window is used.

Window compensation value: γ

Square wave: $\gamma = 1$

Hanning: $\gamma = \sqrt{\frac{8}{3}}$

Exponential: $\gamma = \sqrt{\frac{2\log(\alpha/100)}{(\alpha/100)^2 - 1}}$

(α is a percentage with a range of $0 \leqq \alpha < 100$.)
If α is set to 0 with the exponential window function, processing will be carried with $\alpha = 0.1$.

4.3.5 Auto Correlation [ACR]

- Displays the degree of similarity between two points in the input signal separated by time difference (τ).
- Major applications:
  - Detecting a periodic signal contained in a noisy signal with an improvement in signal-to-noise ratio.
  - Checking the periodic signal components contained in a noisy waveform, and periodic noise.

Function

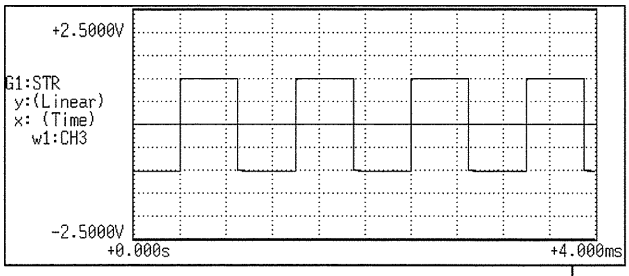
$$Raa(\tau) = \Im^{-1}(Gaa)$$
$$= \frac{1}{2\pi}\int_{-\infty}^{+\infty} Gaa(\omega)\exp(j\omega\tau)d\omega$$

Horizontal cursor	Time	Time display. The center indicates the reference (τ =0), the right side indicates time lag (+ τ), and the left side indicates time lead (- τ).
Vertical cursor	Linear	Readings are between +1 and -1 (without units). +1: the highest similarity for time differential τ 0: the lowest similarity, -1: the polarity is completely opposite. Due to the characteristics of the function, τ =0 always results in +1.

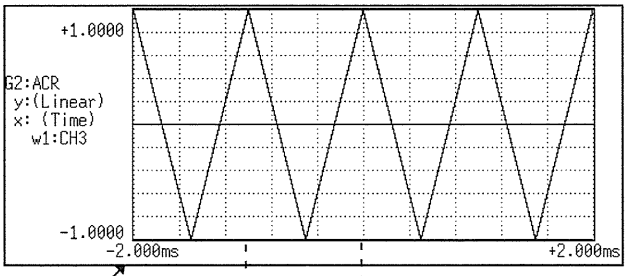
Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	Raa
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Auto correlation function waveforms

Stored waveform



Auto correlation function



Because the input waveform is the frequency waveform, peaks are repeated at regular intervals.

0 The time until the first peak is the input signal period.

4.3.6 Histogram [HIS]

- Displays the frequencies of the magnitudes of sampled points.
- Major applications include:
  - Determining waveform imbalance
  - Determining whether a waveform is artificial or natural from the waveform distribution (most natural waveforms are regular sine waves).

Function Pa

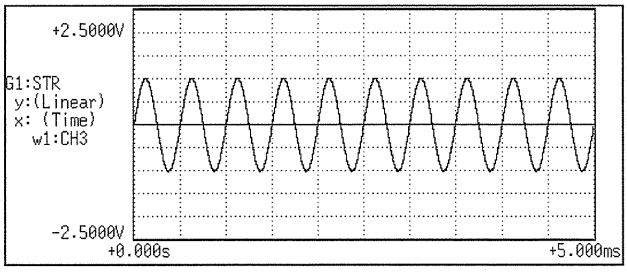
Horizontal cursor	Volt	Linear display of the measurement range of the input unit.
Vertical cursor	Linear	Number of sample points for the time axis data (total: 1000, 2000, 5000 or 10000 points).

Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	Pa
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

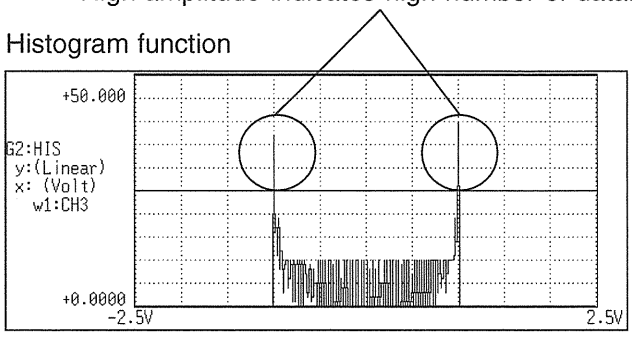
Example Histogram function waveforms

High amplitude indicates high number of data.

Stored waveform



Histogram function



4.3.7 Transfer Function [TRF]

- Displays the transfer function (frequency characteristics) of the system being measured calculated from input and output signals.
- Nyquist diagrams can also be displayed, including magnitude and phase information.
- Major applications include:
  - Determining filter frequency characteristics.
  - Determining feedback control system stability through Nyquist diagrams.
  - Determining the physical resonant frequency using an impulse hammer and pick-up sensor.

Function

$$Hab = \frac{Fb}{Fa} = \frac{Fb \cdot Fa^*}{Fa \cdot Fa^*} = \frac{Gab}{Gaa}$$

$$= \frac{|Gab|}{|Gaa|}\{\cos(\angle\theta b - \angle\theta a) + j\sin(\angle\theta b - \angle\theta a)\}$$

a: input

b: output

Horizontal cursor

LIN-Hz — Frequency spectrum display as linear units. The range is from DC to the maximum frequency range value.

LOG-Hz — Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Real — Linear display of the real-number part of the input-to-output ratio (Nyquist mode)

Vertical cursor

RIN-REAL — Linear display of the real-number part of the input-to-output ratio (no units).

LIN-IMAG — Linear display of the imaginary-number part of the input-to-output ratio (no units).

LIN-MAG — Linear display of input-to-output ratio (no units)
This expresses the amplitude component.

LOG-MAG — Logarithmic display of input-to-output ratio as dB (no units)
This expresses the amplitude component.

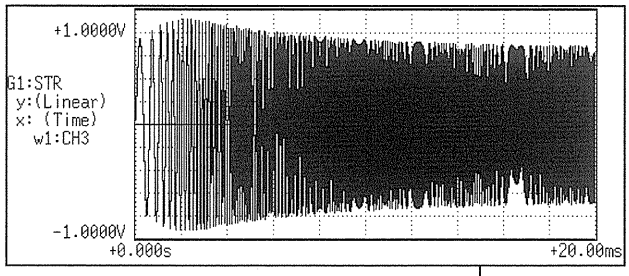
PHASE — Degrees (deg) display of phase component of data of input-to-output ratio

Imag — Linear display of the imaginary-number part of the input-to-output ratio (Nyquist mode).

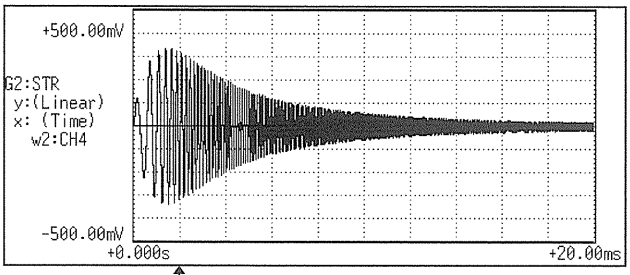
Vertical axis	Display
LIN-REAL (real-number part)	|Hab|·cos ∠θb−∠θa
LIN-IMAG (imaginary-number part)	|Hab|·sin ∠θb−∠θa
LIN-MAG (amplitude)	|Hab|
LOG-MAG (logarithmic amplitude)	20 log |Hab|
PHASE (phase)	∠θb−∠θa

Example Transfer function spectra waveform

Stored waveform (input signal)

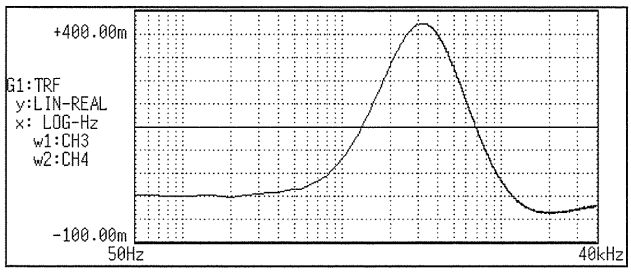


Stored waveform (output signal)

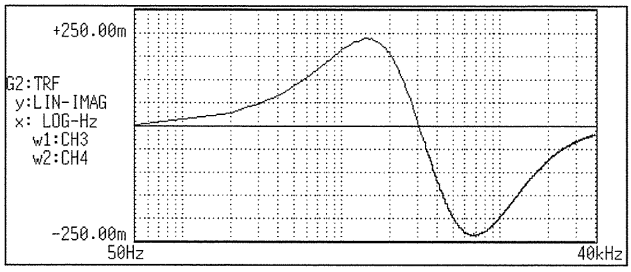


After bandpass filter

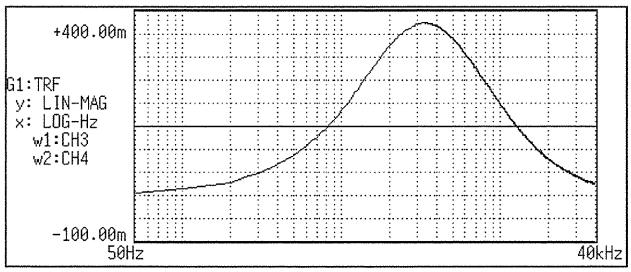
Y-axis: LIN-REAL (X-axis: LOG-Hz)



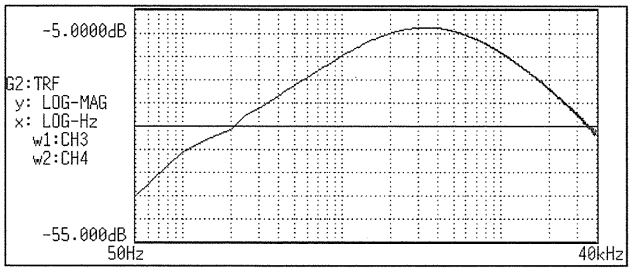
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



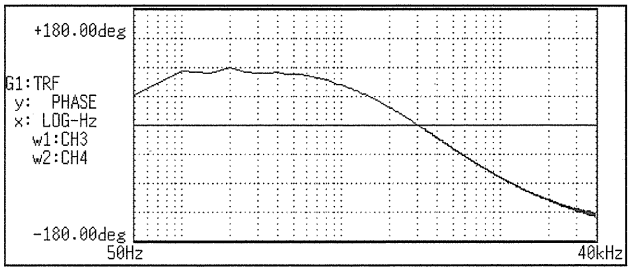
Y-axis: LIN-MAG (X-axis: LOG-Hz)



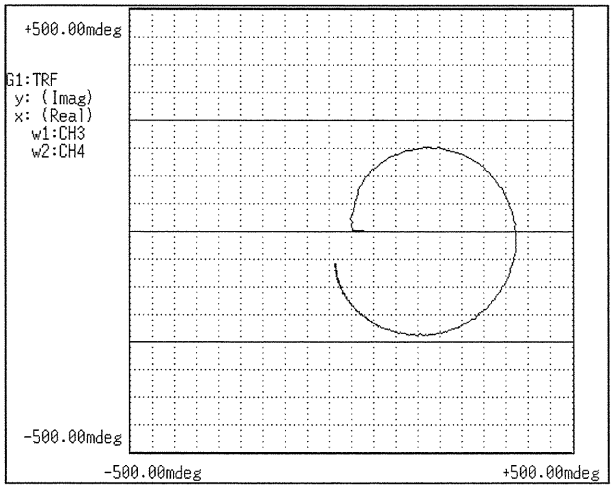
Y-axis: LOG-MAG (X-axis: LOG-Hz)



Y-axis: PHASE (X-axis: LOG-Hz)



Nyquist



4.3.8 Cross Power Spectrum [CSP]

- Displays the product of the spectra of two input signals.
- The magnitude and phase information of the frequency components that are common to both signals can be displayed.
- Major applications:
  Obtaining frequency components common to two signals.

Function

$$Gab = \frac{1}{2} Fa^* \cdot Fb$$

$$= \frac{1}{2} |Fa| \cdot |Fb| \{\cos(\angle\theta b - \angle\theta a) + j \sin(\angle\theta b - \angle\theta a)\}$$

Horizontal cursor

LIN-Hz — Frequency spectrum display as linear units. The range is from DC to the maximum frequency range value.

LOG Hz — Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Real — Linear display of real-number part of the data as voltage (Nyquist mode).

Vertical cursor

LIN-REAL — Linear display of real-number part of the data as binary exponential voltage

LIN-IMAG — Linear display of imaginary-number part of the data as binary exponential voltage

LIN-MAG — Linear display of amplitude component as binary exponential voltage

LOG-MAG — Logarithmic display of the amplitude component as dB (0dB reference value; $1V^2$rms.)

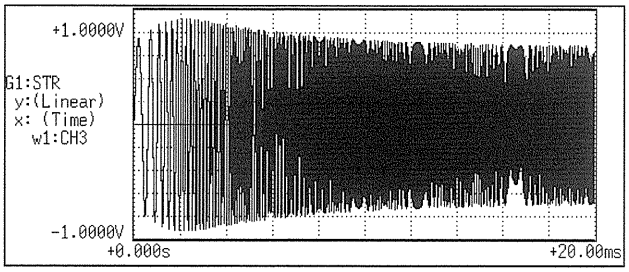
PHASE — Degrees (deg) display of phase component of data

Imag — Linear display of imaginary-number part of the data as binary exponential voltage (Nyquist mode)

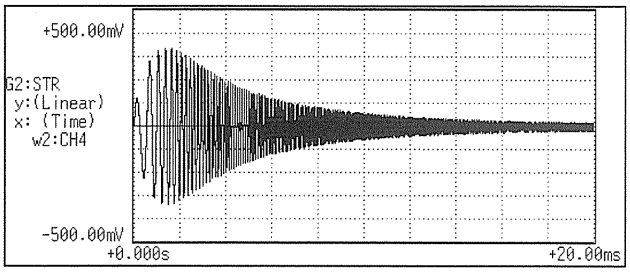
Vertical axis	Display
LIN-REAL (real-number part)	|Gab|·cos ∠θb−∠θa
LIN-IMAG (imaginary-number part)	|Gab|·sin ∠θb−∠θa
LIN-MAG (amplitude)	|Gab|
LOG-MAG (logarithmic amplitude)	10 log |Gab|
PHASE (phase)	∠θb−∠θa

Example Cross power spectra waveforms

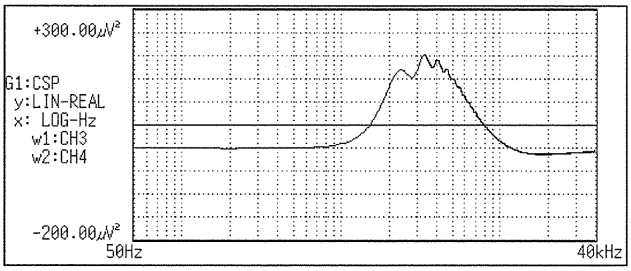
Stored waveform 1



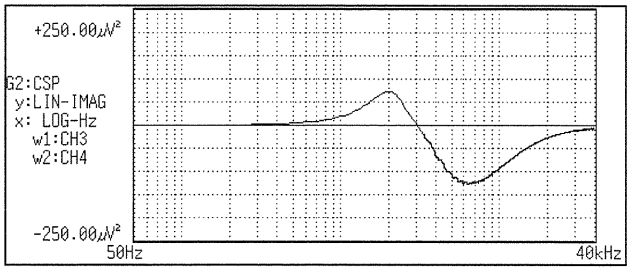
Stored waveform 2



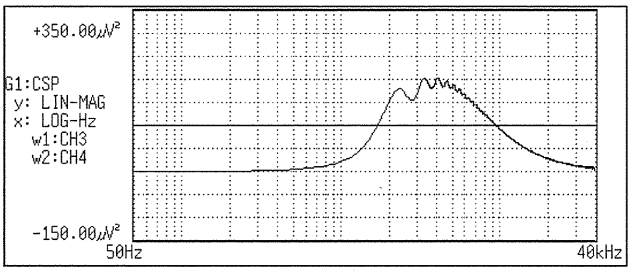
Y-axis: LIN-REAL (X-axis: LOG-Hz)



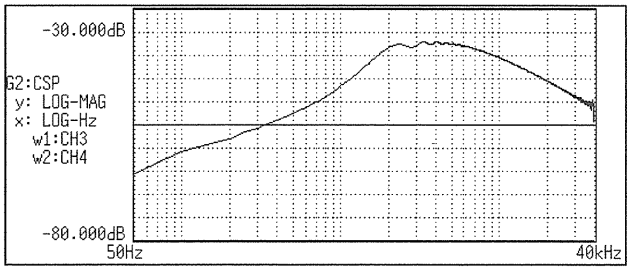
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



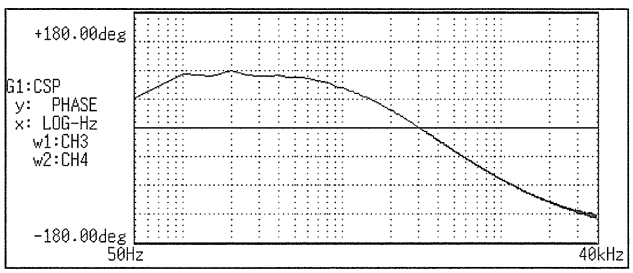
Y-axis: LIN-MAG (X-axis: LOG-Hz)



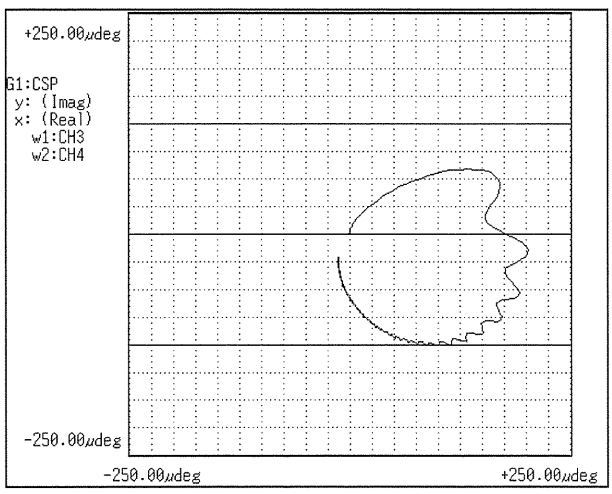
Y-axis: LOG-MAG (X-axis: LOG-Hz)



Y-axis: PHASE (X-axis: LOG-Hz)



Nyquist



4.3.9 Cross Correlation [CCR]

- Displays the degree of similarity between two points separated by a time difference (τ) on two signals.
- The degree of similarity is expressed as a function of the time difference (τ).
- Major applications:

· Obtaining the phase difference between two signals in time units.
· Obtaining a speed or distance by measuring the time delay.

Function $Rab(\tau) = \Im^{-1}(Gab)$

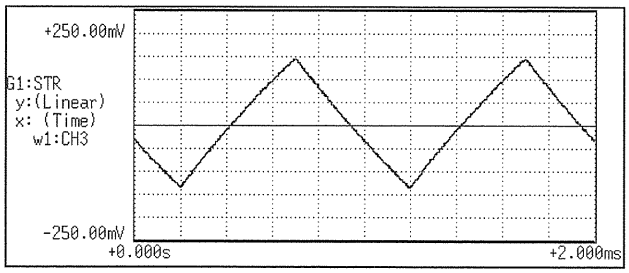
$$= \frac{1}{2\pi} \int_{-\infty}^{+\infty} Gab(\omega) \cdot \exp(j\omega\tau) d\omega$$

Horizontal cursor	Time	Time display. The center indicates the reference (τ =0), the right side indicates time lag (+ τ), and the left side indicates time lead (- τ).
Vertical cursor	Linear	Readings are from +1 to -1 (no units). +1: the highest similarity between the input and output signals for time differential τ , 0: the lowest similarity, -1: the polarity is completely opposite

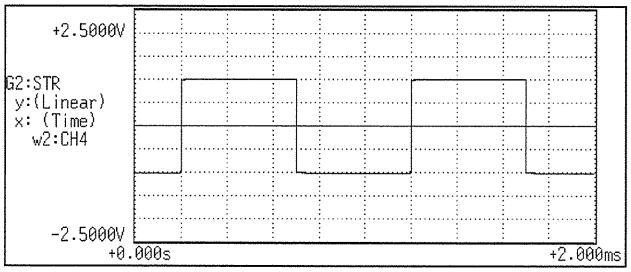
Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	Rab
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Cross correlation function waveforms

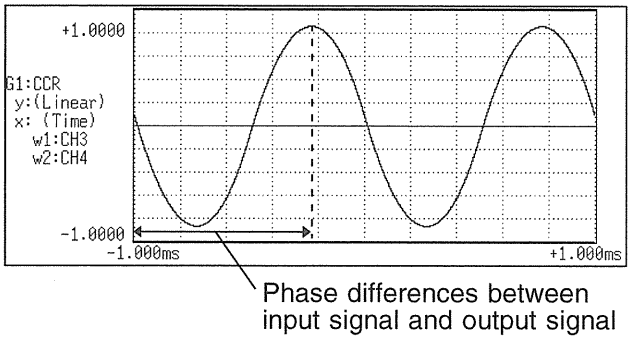
Stored waveform (input waveform)



Stored waveform (output waveform)



Cross correlation function



4.3.10 Unit Impulse Response [IMP]

- Displays the frequency response of a system in the time domain.
- A response waveform equivalent to the unit impulse function is obtained by analyzing the input and output signals of the system being measured.
- Major applications
  Checking circuit time constants.

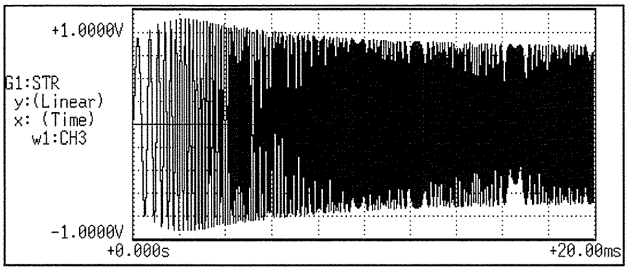
Function $IMP = \Im^{-1}(Hab)$

Horizontal cursor	Time	Time display. The center indicates the reference (τ =0), the right side indicates time lag (+ τ), and the left side indicates time lead (- τ).
Vertical cursor	Linear	Inverse Fourier conversion value of the transfer function (Hab) (no units).

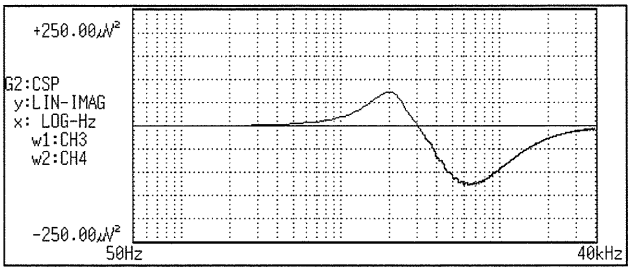
Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	IMP
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Unit impulse response waveforms

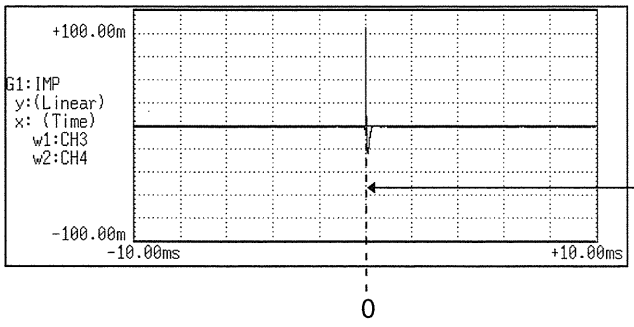
Stored waveform (input signal)



Stored waveform (output signal)



Unit impulse response



Input point of impulse signal

4.3.11 Coherence [COH]

- Displays the output signal component that is coherent (interference possible) to the input signal, yielding a value from 0 to 1.
- Major applications include:
  - Evaluation of transfer functions.
  - Determining the contribution of individual input lines to the output of multi-input systems.

Function $COH = \dfrac{Gab^* \cdot Gab}{Gaa \cdot Gbb}$

Horizontal cursor

LIN-Hz — Frequency spectrum display as linear units. The range is from DC to the maximum frequency range value.

LOG-Hz — Frequency spectrum display as logarithmic units.
The number of FFT points and the range are as follows.

Number of FFT points	Rrange
1000	1/400 the maximum frequency range value to the maximum frequency range value
2000	1/800 the maximum frequency range value to the maximum frequency range value
5000	1/2000 the maximum frequency range value to the maximum frequency range value
10000	1/4000 the maximum frequency range value to the maximum frequency range value

Vertical cursor

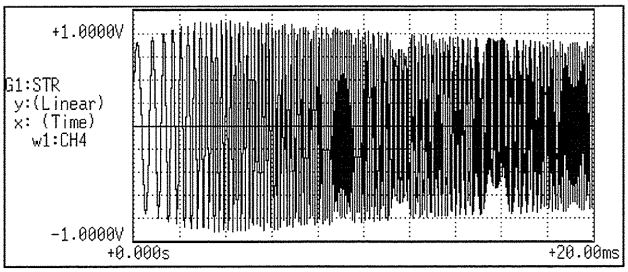
Linear — The relationship between the two input signals. The degree of relationship is indicated from 0 to 1 on a linear scale (no units).

Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	COH
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

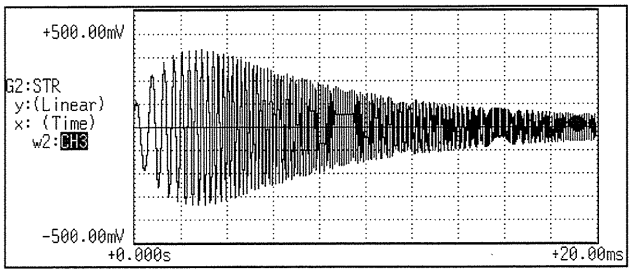
NOTE For a single measurement, the coherence function returns 1 for all frequencies. When measuring, be sure to use frequency averaging.

Example Coherence function waveforms

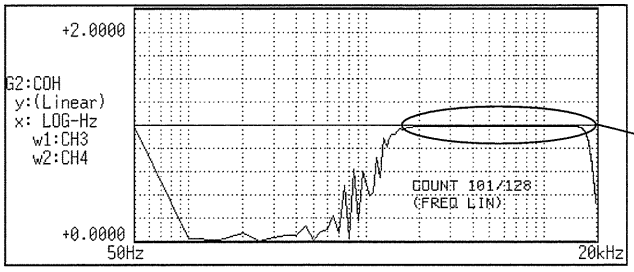
Stored waveform (input signal)



Stored waveform (output signal)



Coherence



Frequencies in this range have high coherence.

4.3.12 Octave Analysis [OCT]

- This function displays the spectrum of a noise signal or other signal, using 1/1-octave or 1/3-octave band filters with fixed ratio.
- Main uses
  Frequency analysis of noise

Function OCT

Horizontal cursor
- 1/1 OCT 1/1-octave band filtering
- 1/3 OCT 1/3-octave band filtering

Vertical cursor
- LIN-MAG Linear display of octave analysis value as voltage
- LOG-MAG Logarithmic display of octave analysis value as dB

Vertical axis	Display
LIN-REAL (real number)	—
LIN-IMAG (imaginary number)	—
LIN-MAG (amplitude)	OCT
LOG-MAG (logarithmic amplitude)	10log (OCT)
PHASE	—

· For frequency analysis of a noise signal or similar, the signal is passed through fixed-ratio band filters with 1/1-octave or 1/3-octave bandwidth.

· As opposed to the power spectrum function, where the signal is divided into bands of identical width and the power in each band is displayed, octave analysis divides the frequency axis evenly on a logarithmic scale and expresses the level as a bar for each band.

· In analog octave analysis, the octave band center frequencies and filter characteristics are determined according to the ANSI CLASS 3 standard. In the 8835, the power spectrum is measured first and bundling is then used to perform 1/1-octave or 1/3-octave analysis. This allows the following analysis functions:

  5-band 1/1-octave analysis
  15-band 1/3-octave analysis

· 15-band 1/3-octave analysis and filter characteristics of the 8835 correspond to the ANSI CLASS 3 standard. However, in the upper bands of frequency analysis, there are no leak components from higher frequencies.

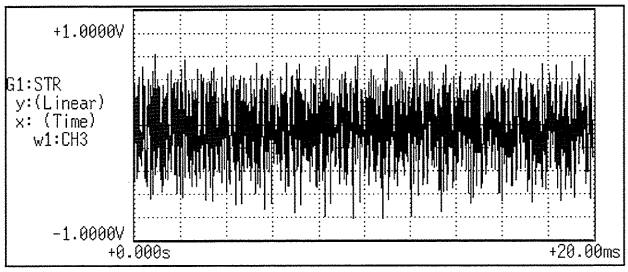
  For example, the 20 kHz band contains no leak components from the 25 kHz band or other bands.

· 15-band 1/3-octave analysis
  In this mode, the 400 spectrum lines of regular frequency analysis are bundled into 1/3 octave bands and shown as a bar graph.

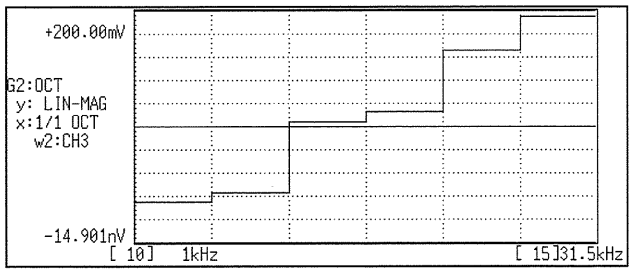
· 5-band 1/1-octave analysis
In this mode, the 400 spectrum lines of regular frequency analysis are bundled into 1/1 octave bands and shown as a bar graph.

Example Octave analysis waveforms

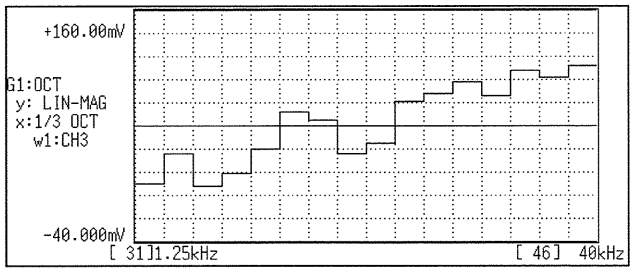
Stored waveform



1/1 octave analysis



1/3 octave analysis

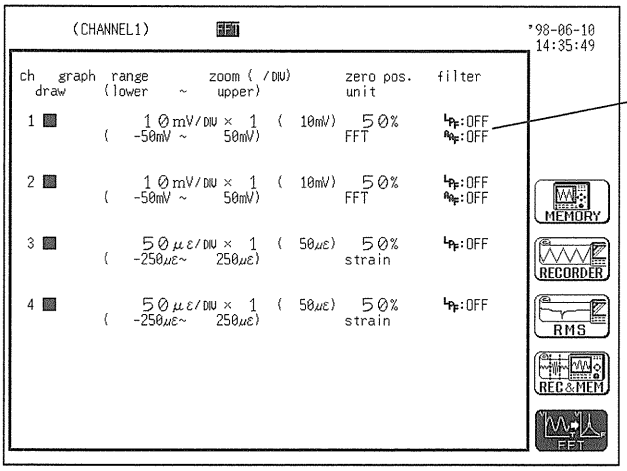


Frequency ranges and measurable range widths (0: 1/3 OCT, X: 1/1 OCT)

Band No.		Center frequency (Hz)	Frequency ranges (Hz)																			
1/1	1/3		133 m	333 m	667 m	2	4	8	20	40	80	200	400	800	2 k	4 k	8 k	16 k	20 k	32 k	40 k	80 k
-8	-24 -23	4 m 5 m	X 0X																			
-7	-22 -21 -20	6.3 m 8 m 10 m	0X 0X 0X	 X 0X																		
-6	-19 -18 -17	12.5 m 16 m 20 m	0X 0X 0X	0X 0X 0X	 X 0X																	
-5	-16 -15 -14	25 m 31.5 m 40 m	0X 0X 0X	0X 0X 0X	0X 0X 0X																	
-4	-13 -12 -11	50 m 63 m 80 m	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X																
-3	-10 -9 -8	100 m 125 m 160 m	0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X															
-2	-7 -6 -5	200 m 250 m 315 m		0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X														
-1	-4 -3 -2	400 m 500 m 630 m			0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	X 0X													
0	-1 0 1	800 m 1 1.25				0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	X 0X												
1	2 3 4	1.6 2 2.5				0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	X 0X											
2	5 6 7	3.15 4 5					0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X											
3	8 9 10	6.3 8 10						0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0 0X 0X										
4	11 12 13	12.5 16 20							0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	0 0X 0X									
5	14 15 16	25 31.5 40								0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	0 0X 0X								
6	17 18 19	50 63 80									0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X							
7	20 21 22	100 125 160										0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X						
8	23 24 25	200 250 315										0X X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X					
9	26 27 28	400 500 630											0X X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X	X 0X			

Band No.		Center frequency (Hz)	Frequency ranges (Hz)																		
1/1	1/3		133 m	333 m	667 m	2	4	8	20	40	80	200	400	800	2 k	4 k	8 k	16 k	20 k	32 k	40 k	80 k
10	29 30 31	800 1 k 1.25 k												0X X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	 0X 0X	 X 0X	
11	32 33 34	1.6 k 2 k 2.5 k													0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	 X 0X
12	35 36 37	3.15 k 4 k 5 k														0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X
13	38 39 40	6.3 k 8 k 10 k															0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X	0X 0X 0X
14	41 42 43	12.5 k 16 k 20 k																0X 0X	0X 0X 0	0X 0X 0X	0X 0X 0X	0X 0X 0X
15	44 45 46	25 k 31.5 k 40 k																		0X 0X	0X 0X 0	0X 0X 0X
16	47 48 49	50 k 63 k 80 k																				0X 0X 0

4.4 Making the Settings of the 8938 FFT ANALOG UNIT



Displays the type of the installed unit

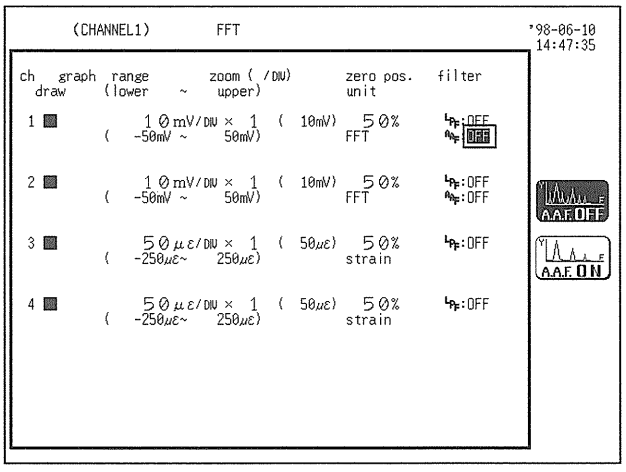
4.4.1 Settings

The settings of the waveform display color, waveform display graph type, voltage axis range, input coupling, magnification/compression ratio along the voltage axis, zero position, zero adjustment and low-pass filter are the same as in the 8936 ANALOG UNIT.
For the settings, see Section 7.3 of the 8835 Instruction Manual.

4.4.2 Setting the Anti-aliasing Filter

The 8938 FFT ANALOG UNIT incorporates an antialiasing filter designed to prevent aliasing distortion. The filter can be set to ON or OFF. The cutoff frequency of the filter is set automatically, according to the frequency range setting.

Method Screen: CHANNEL (page 1)



1. Press the CHAN key to call up the CHANNEL screen (page 1).
2. Move the flashing cursor to the point shown in the figure on the left, and use the function keys to make the selection.

AAF OFF: Anti-aliasing filter is disabled.

AAF ON: Anti-aliasing filter is enabled.

Chapter 5
Other Functions

5.1 Outline

The following five functions are added by the 9540 FUNCTION UP DISK.

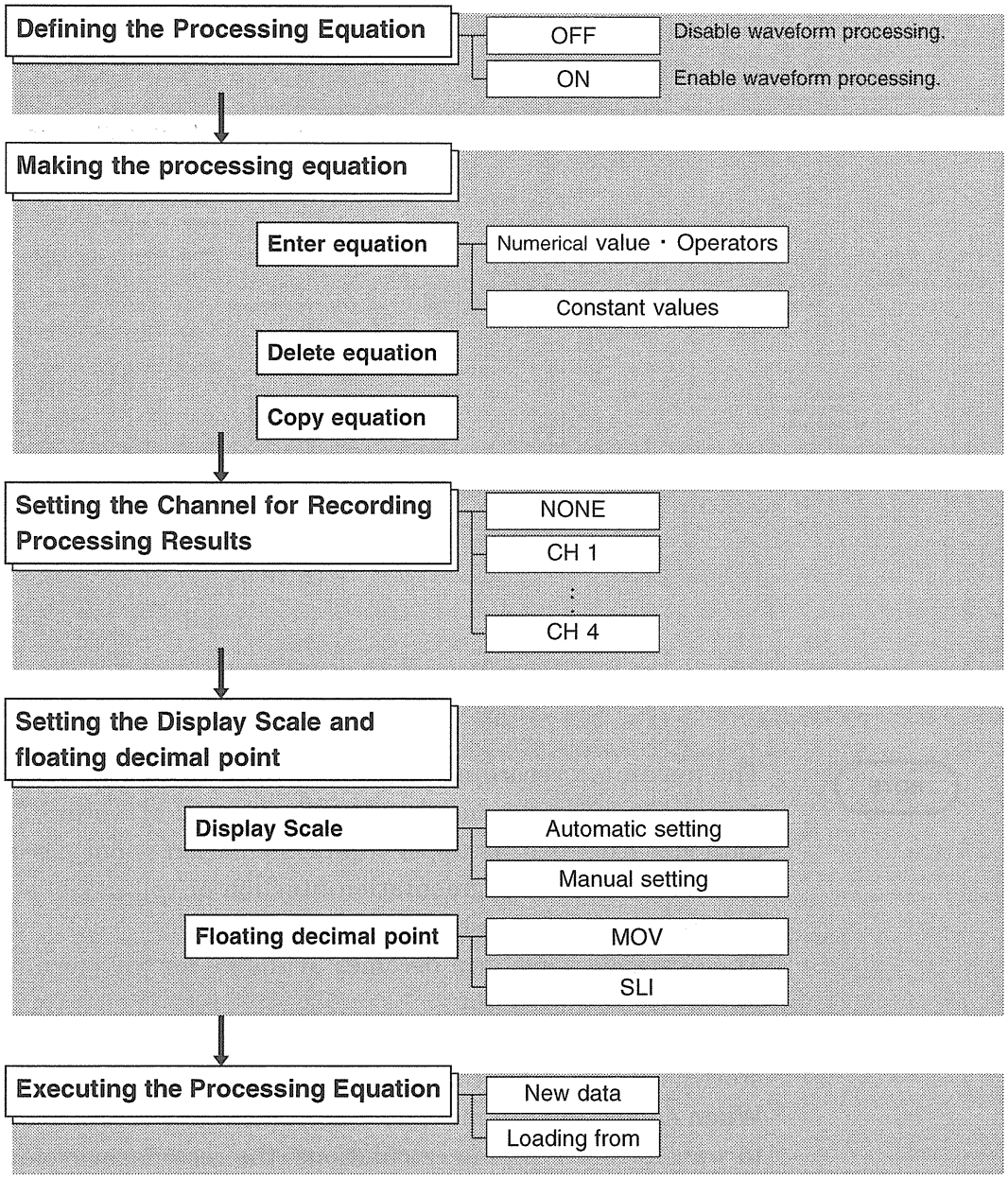
- Waveform processing calculation
- Waveform parameter decision
- Waveform area decision
- Memory segmentation functions
- Averaging function

5.2 Calculating Waveform Data

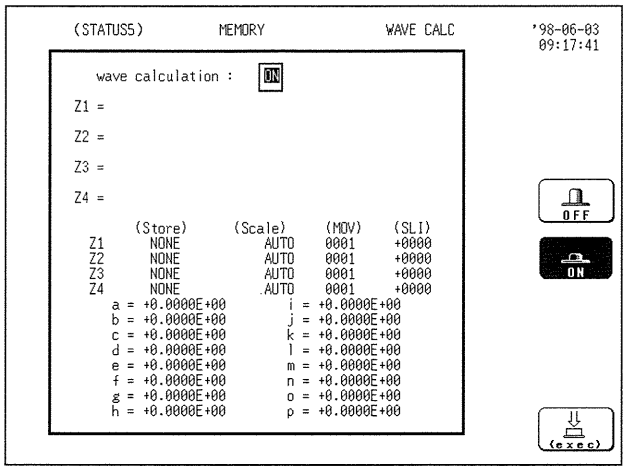
- Waveform processing is possible only for the memory recorder function.
- Processing results are displayed as a waveform.
- Processing is only possible for waveforms for which the recording length was set at 200 divisions (1000 divisions for 2 M words) or less.
- Use the A/B cursors (vertical or trace cursor) to specify the processing range for the waveform data.

The following operators can be used to define processing equations.
(1) Arithmetic operators (+, -, *, /)
(2) Absolute value (ABS)
(3) Exponent (EXP)
(4) Logarithm (LOG)
(5) Square root (SQR)
(6) Displacement average (MOV)
(7) Parallel displacement on time axis (SLI)
(8) 1st and 2nd differential (DIF, DIF2)
(9) 1st and 2nd integral (INT, INT2)
(10) Trigonometric functions (SIN, COS, TAN)
(11) Reverse trigonometric functions (ASIN, ACOS, ATAN)

Waveform Processing procedure



5.2.1 Preparing for Waveform Processing



Method

Screen: STATUS (page 5) (MEM)

① Press the [STATUS] key to call up the STATUS screen (page 5).
② Move the flashing cursor to the position shown in the figure on the left.
③ Make the setting with the function keys.

Selection

OFF : Disable waveform processing.

ON : Enable waveform processing. The various setting items are displayed.

(exec) : Execute waveform processing.

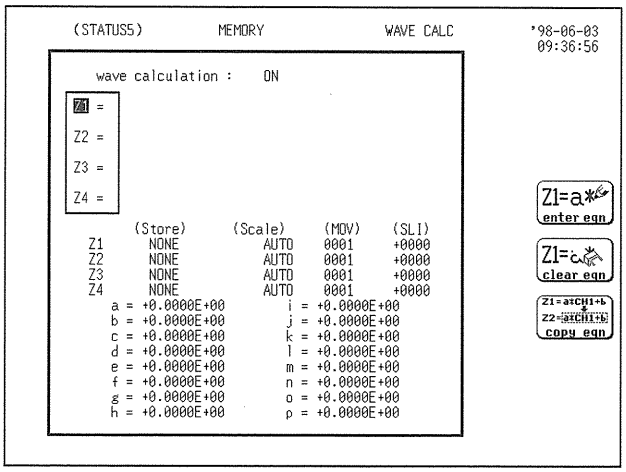
NOTE

- The maximum recording length at which waveform processing calculation is possible is 200 divisions (1000 divisions for 2 M words). If the waveform data size exceeds this upper limit, calculation is not possible.
- When the memory segmentation function or roll mode is used, waveform processing is not possible.
- The averaged waveform becomes available for waveform processing following measurement.
- When scaling is set for the channel in which the processing result is to be stored, scaling is not carried out and only the unit is valid.
- When subjecting the memory waveform of the recorder and memory function to waveform processing calculations, the recorder waveform data will be destroyed.

5.2.2 Defining the Processing Equation

Four processing equations (Z1 - Z4) can be defined.

Making the processing equation



Method

Screen: STATUS4 (MEM)

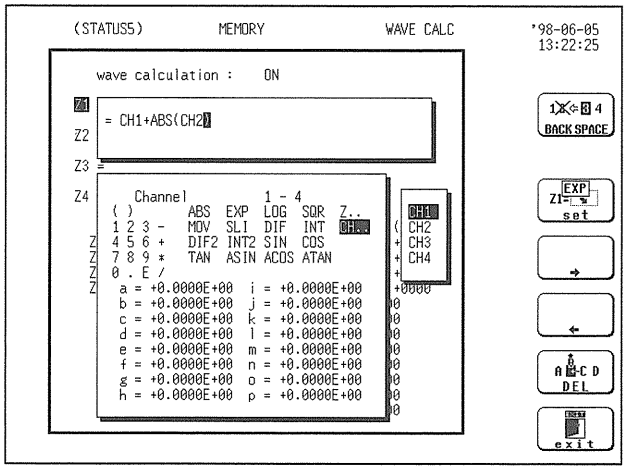
① Press the STATUS key to call up the STATUS4 screen.
② Move the flashing cursor to " **Z1** to **Z4**".
③ Use the function keys to select the "**enter equ**".

Selection

Z1=a*CH1+b enter equ : Enter equation.

Z1=a*CH1+b clear equ : Delete equation.

Z1=a*CH1+b & Z2=a*CH1+b copy equ : Copy equation.



④ Move the flashing cursor to the desired item with the JOG control or the CURSOR key, use the function keys to select the **set**. Use the function key to move the flashing cursor within the equation.

Selection

EXP set : Enter the item into selected equation.

: Move the equation cursor right.

: Move the equation cursor left.

A B C D DEL : Delete character under cursor in equation.

exit : Terminate equation input.

⑤ When the equations have been input, press the F5 [exit] key. If there are any syntax errors in the equations (incomplete bracketing, missing "*", more than eight MOV, SLI, DIF, DIF2, INT, INT2 operators, etc.), a "**?**" is displayed, and the cursor rests on the error, so that the problem can be corrected. When there are no syntax errors, a "=" is displayed.
⑥ Make settings for Z2 to Z4 as for Z1.

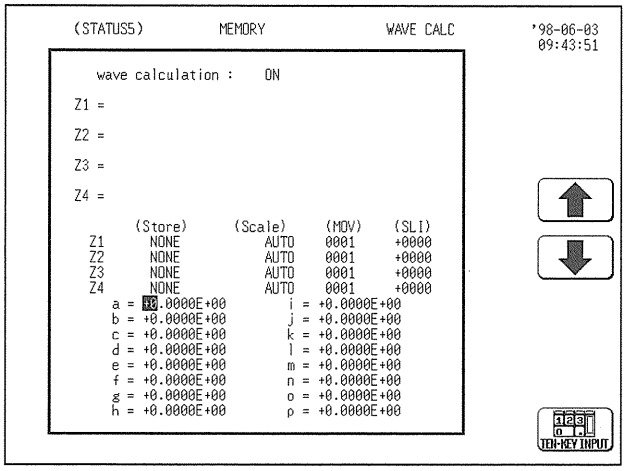
Operators (For details, see Section 19.3.9.)

ABS	Absolute value	DIF2	2nd differential
EXP	Exponential	INT2	2nd integral
LOG	Logarithm	SIN	Sine
SQR	Square root	COS	Cosine
MOV	Displacement average	TAN	Tangent
SLI	Parallel displacement on time axis	ASIN	Arc-sine
DIF	1st differential	ACOS	Arc-cosine
INT	1st integral	ATAN	Arc-tangent

NOTE

- For multiplication, always use the "*" sign.
- Out of the MOV, SLI, DIF, DIF2, INT, and INT2 operators, up to eight can be used in the same equation (for example eight MOV operators or five MOV and three SLI operator, etc.).
- The maximum number of digits for a constant is 30.
- If division by 0 is specified (1/0), an overflow value is output.
- Equations are calculated in ascending order, from Z1 to Z4.
- The data that can be used in an operational equation (channel data and results of operation) must be smaller than in the preset operation numbers (for example, Z3 and Z4 cannot be used on Z2).
- Up to eighty characters can be entered in an operational equation. However, only the first line of the expression is displayed on the waveform operation screen.

Entering the constant values



Method

Screen: STATUS (page 5) (MEM)

① Move the flashing cursor to the position shown in the figure on the left.

② Use the function keys to select the **enter**. The setting range is -9.9999E+29 to +9.9999E+29 (exponent: -29 to +29).

Selection

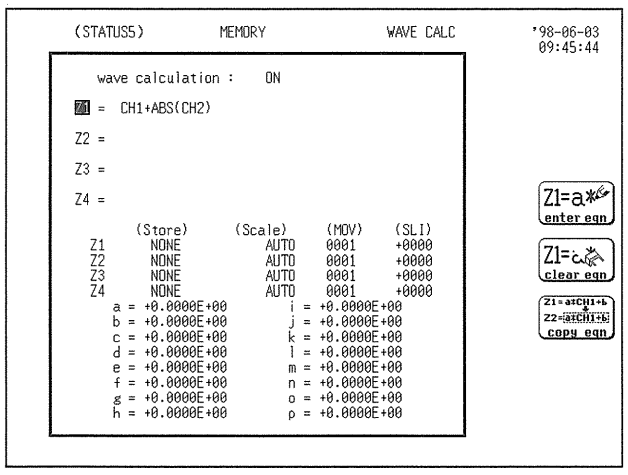
: Value up

: Value down

TEN-KEY INPUT

③ Move the flashing cursor to the desired item with the CURSOR key, enter the constant value with the function key or the JOG control.

Deleting an Equation



Method

Screen: STATUS (page 5) (MEM)

① Move the flashing cursor to one of the Z1 - Z4 items.

② Press the F2 [clear eqn].

③ Make the setting with the function keys.

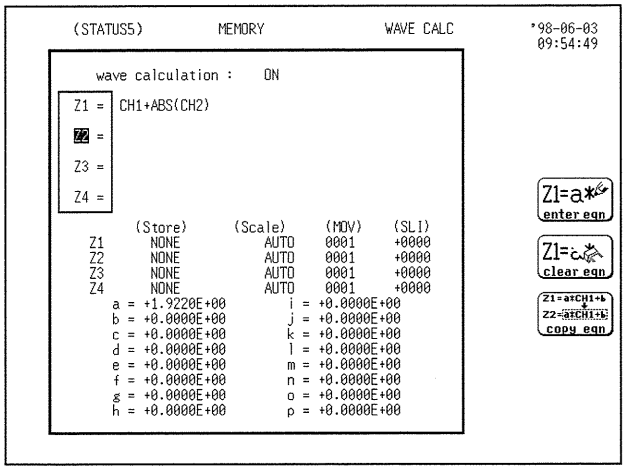
Selection

○ (Yes) : Clear equation

× (No) : Do not clear equation

5.2.3 Copying an Equation

An equation to which an equation number has been assigned (copy source) can be copied to another equation number (copy target).



Method

Screen: STATUS (page 5) (MEM)

① Move the flashing cursor to one of the Z1 - Z4 items.
② Press the F3 [copy eqn].
③ Use the function keys or the JOG control to specify the number of the equation to be copied.

Selection

: Increase equation number.

: Decrease equation number.

: Execute copy.

: Quit copy mode.

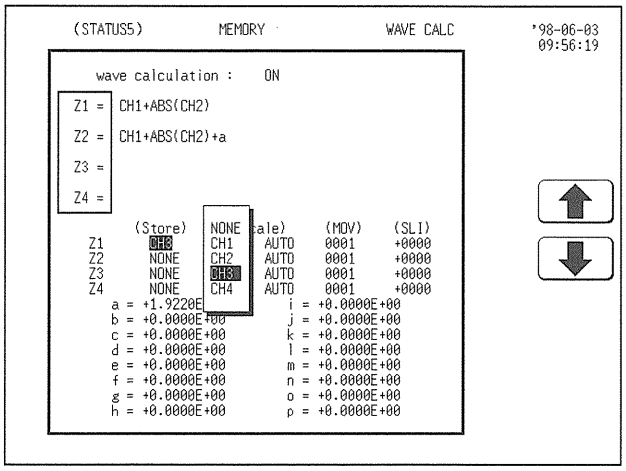
④ Press the F4 [exec] key. The copy source equation is copied to the copy target.

NOTE

The calculation result output destination and calculation formula settings (display scale and number of moved points) are not copied.

5.2.4 Setting the Channel for Recording Processing Results

- The calculation result of equations Z1 - Z4 can be recorded and displayed in a specified channel.
- Processing results can be recorded also in channels where no input unit is installed (but the range of the "number of channels in use" setting cannot be exceeded).



Method

Screen: STATUS (page 5) (MEM)

① Move the flashing cursor to one of the Z1 - Z4 items.
② Move the flashing cursor to the position shown in the figure on the left.
③ Use the function keys or the JOG control to specify the number of the equation to be copied.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

Equations not to be used should be set to **NONE** (calculation result is not recorded).

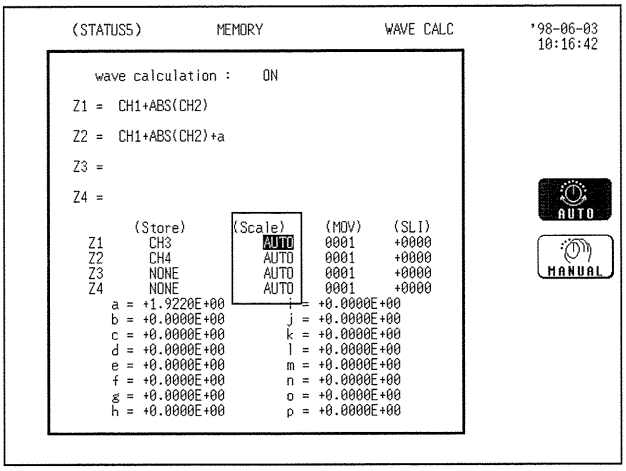
NOTE

- If the same channel is selected as source in the equation and as target for recording, the waveform data in the source channel are overwritten by the equation calculation result.
- In the following cases, the calculation result is displayed with in the same color set as the channel number for the first processing run:
  ① If results are recorded in a channel where no input unit is installed.
  ② If the display color for the channel selected for recording is set to OFF.
  When wishing to change the display color set, perform calculation once and then use the CHANNEL1 screen or DISPLAY screen to make the setting.
- The channel selected for recording is automatically set to variable display.

5.2.5 Setting the Display Scale and Floating Decimal Point

Set the scale and floating decimal point.

- Display scale can be set automatically or manually.
- The channel selected for recording is automatically set to variable display.



Method

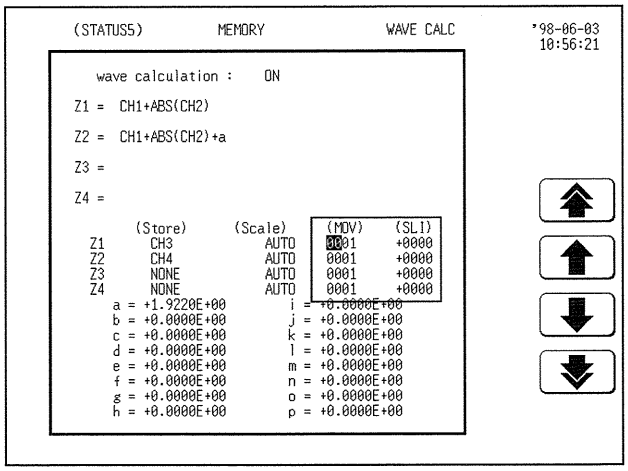
Screen: STATUS (page 5) (MEM)

① Move the flashing cursor to the position shown in the figure on the left.
② Make the setting with the function keys.

Selection

AUTO : Set display scale automatically.

MANUAL : Set display scale manually.



③ If MOV or SLI was used, the floating decimal point must be specified.
Move the flashing cursor to the various digits and make the setting with the function keys or the JOG control.
For MOV (moving average): 1 to 4000
For SLI (parallel displacement): -4000 to +4000

Selection

: Value up, large step

: Value up, small step

: Value down, small step

: Value down, large step

• Automatic setting

After calculation, the upper and lower limit is determined from the result, and the variable display settings are made accordingly.
Depending on the type of calculation, automatically display scale setting may not be satisfactory. In such a case, use the manual setting procedure.

• Manual setting

Use the variable display setting function on the CHANNEL2 screen to set the upper and lower limit.

• Calculation result with overflows

The values shown using cursors A and B and the printed values obtained when the printer recording type is set to "numerical value" are not accurate.
If the display scale is set to "**AUTO**," the waveform is shown at the top or bottom of the screen. This indicates that the calculation result has overflowed.

5.2.6 Performing Waveform Processing

Waveform processing while capturing the waveform

Measurement Start

- Press the **START** key and LED light.
- When the pre-trigger is set, the trigger will not be registered for a certain period after the start of measurement. (During this interval, **Pre-trigger standby** is shown on the display.)
- When the trigger can be registered, the indication **Waiting for trigger** is shown on the display.

↓

Meeting the trigger condition

- Data recording starts when trigger condition are met.
- When trigger mode selected AUTO, unit waits for about 1 second for trigger conditions to be met. After this interval, data recording starts, regardless of trigger state.

↓

Storing measurement data

- Displays "**Storing**".
  Waveform displays after data corresponding to recording length have been stored in memory.
- When the **STOP** key is pressed twice during measurement, the 8835 is forcibly stopped. (Waveform calculation is not executed.)

↓

Waveform calculation

- Displays "**Waveform calculating**".

Displaying calculation result

- Displays waveform calculation result on the screen.

↓

Operating the result

- Auto print : ON →Prints the measurement data.
- Auto save : ON →Saves the measurement data.

↓

Measurement end

Trigger mode:SINGLE

- End of measurement.

Trigger mode:REPEAT AUTO

- Each time when trigger conditions are met, data are recorded and memory contents are overwritten.

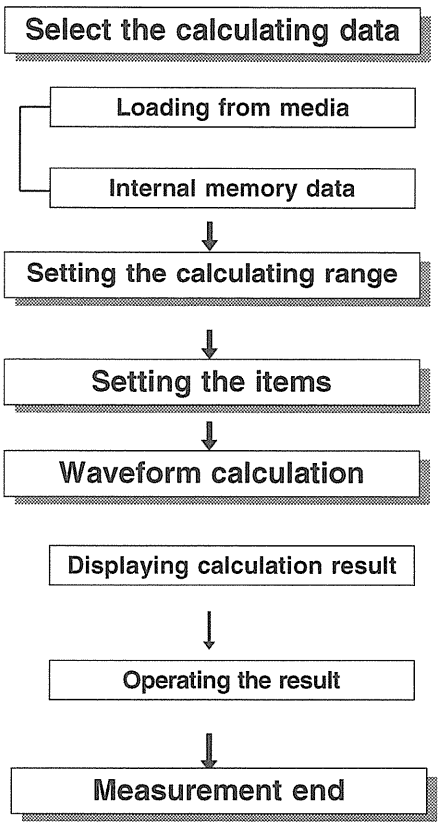
[End of measurement in REPEAT and AUTO trigger modes]

- When the **STOP** key is pressed once during measurement, the 8835 acquires measurement data in an amount corresponding to the set recording length, and the measurement is stopped. (Waveform display, Waveform calculation is executed.)

NOTE

The maximum recording length allowing waveform processing calculation is 200 divisions (1000 divisions for 2 M words).

Waveform processing of data in internal memory or media



- Press the **FILE** key to call up the FILE screen.
- Waveform calculation execute the stored measurement data.
- This setting calculates the measurement data between A and B cursors.
  When there is no A and B cursors, calculates all data.
- Press the **STATUS** key to call up the STATUS4 screen.
- Move the flashing cursor to **wave calculation**. And use the function key to select "**exec**".
- Displays "**Waveform calculating**".
- Displays waveform calculation result on the screen.
- Printout can be carried out.
- Saving can be carried out.

Recorder and memory waveform processing calculations

After measuring with the recorder and memory function and switching to the memory recorder function, the memory waveform data are transferred to the memory recorder function. (Following this, the process is the same as processing in the case of the internal memory.)
However, when subjecting the memory waveform of the recorder and memory function to waveform processing calculations, the recorder waveform data will be destroyed.

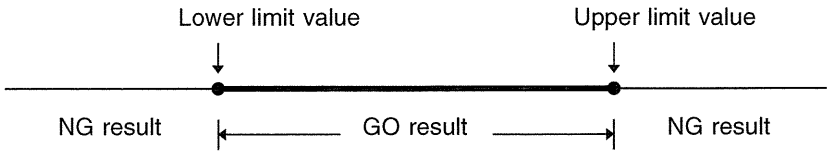
NOTE

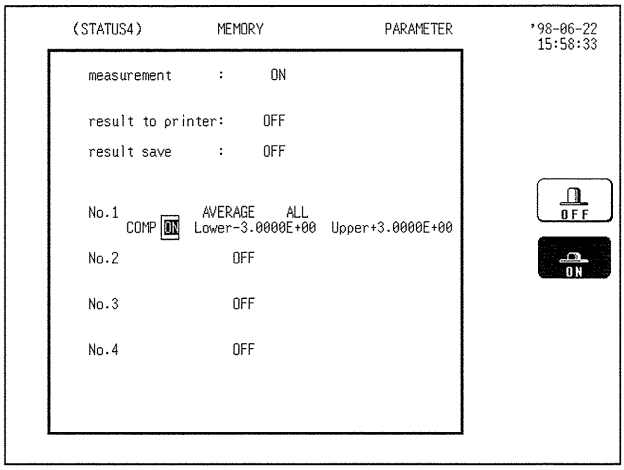
- The maximum recording length allowing waveform processing calculation is 200 divisions (1000 divisions for 2 M words).
- When using the trace cursor, the trace point value is displayed as processed value.
- When the cursors overlap, processing is carried out for that point.
- The line cursor (horizontal) cannot be used to specify the processing range.
- When only the cursor A is used, the waveform data from the position of cursor A to the end of the data is calculated.
- The result can be recalculated by altering the calculation process.

5.3 Waveform Parameter Evaluation

5.3.1 Making Settings for Waveform Parameter Evaluation

- Depending on the results of the waveform parameter calculation, a GO (pass) or NG (fail) result is returned.
- Evaluation criteria can be set independently for each of the calculation sets No. 1 - No. 4.





Method

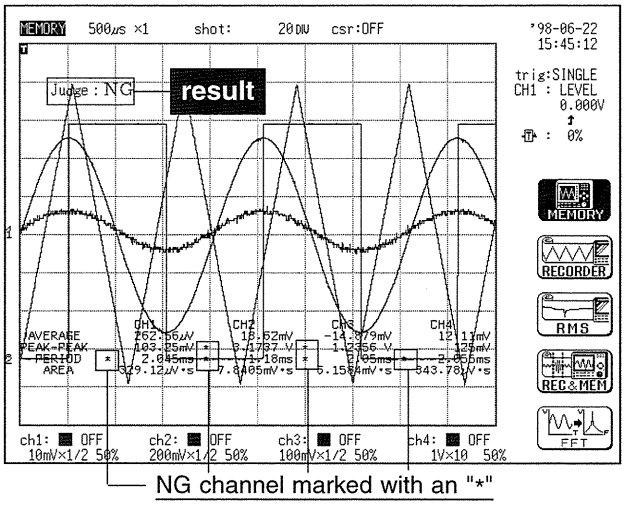
Screen: STATUS (page 4) (MEM)

① Make the settings for waveform parameter calculation.
② Move the flashing cursor to the **COMP** item. And use the function key to select.

Selection

OFF : Disable evaluation function.

ON : Return NG if result is outside specified range.



③ Set the upper and lower limits.

The setting range is -9.9999E+29 to +9.9999E+29 (exponent: -29 to +29).

Move the flashing cursor to the various digits and make the setting with the function keys or the JOG control.

The upper limits must not be smaller than the lower limits, or the lower limits must not be larger than the upper limits.

NOTE

- When waveform parameter measurement and waveform evaluation are carried out simultaneously, the screen displayed waveform evaluation results. Check the results of parameter evaluation using "*" (NG decision) accompanying the figure. Alternatively, a beeping sound can be used for the evaluation instead of the "*" mark; the machine beeps if the result of either parameter or waveform evaluation is NG.
- When the evaluation result is NG, the calculation value for that channel is marked with an "*" (on the display and the printout).
  The result of the evaluation is NG if any of the values is NG.
- While all evaluation results appear on the display screen, the evaluation results are printed out for each parameters in the print mode.
- When the evaluation result is NG, an NG output signal can be obtained between the NG terminal and the GND terminal.

5.3.2 Executing Waveform Parameter Calculation

- Calculation is carried out in the order No.1 through No.4.
- Also for channels where no input unit is installed, parameter calculation is carried out if waveform processing results or data loaded from media are stored in the channel.
- The scaling setting has effect. (RMS value and area value are calculated after scaling.)
- When **measurement** is set to **ON**, waveform data after waveform processing are used for parameter calculation.

Parameter calculation while capturing the waveform

Measurement Start

- Press the **START** key and LED light.
- When the pre-trigger is set, the trigger will not be registered for a certain period after the start of measurement. (During this interval, **Pre-trigger standby** is shown on the display.)
- When the trigger can be registered, the indication **Waiting for trigger** is shown on the display.

↓

Meeting the trigger condition

- Data recording starts when trigger condition are met.
- When trigger mode selected AUTO, unit waits for about 1 second for trigger conditions to be met. After this interval, data recording starts, regardless of trigger state.

↓

Storing measurement data

- Displays "**Storing**".
  Waveform displays after data corresponding to recording length have been stored in memory.
- When the **STOP** key is pressed twice during measurement, the 8835 is forcibly stopped. (Parameter calculation is not executed.)

↓

Parameter calculation

- Displays "**Calculating**".

Displaying calculation result

- Displays parameter calculation result on the screen.

↓

Parameter evaluation

(When COMP setting: ON)

- Depending on the results of the waveform parameter calculation, a GO (pass) or NG (fail) result is returned.

[When the evaluation result is GO]
- Outputs GO signal.
- Continue measurements, until NG result appeared.

[When the evaluation result is NG]
- Outputs NG signal.
- The calculation value for that channel is marked with an "*" (on the display and the printout).

↓

Operating the evaluation result

- Result to printer : ON →Prints the evaluation results.
- Result save : ON →Saves the evaluation results.
- Auto print : ON →Prints the measurement data.
- Auto save : ON →Saves the measurement data.

↓

Measurement end

Trigger mode:SINGLE

- End of measurement.

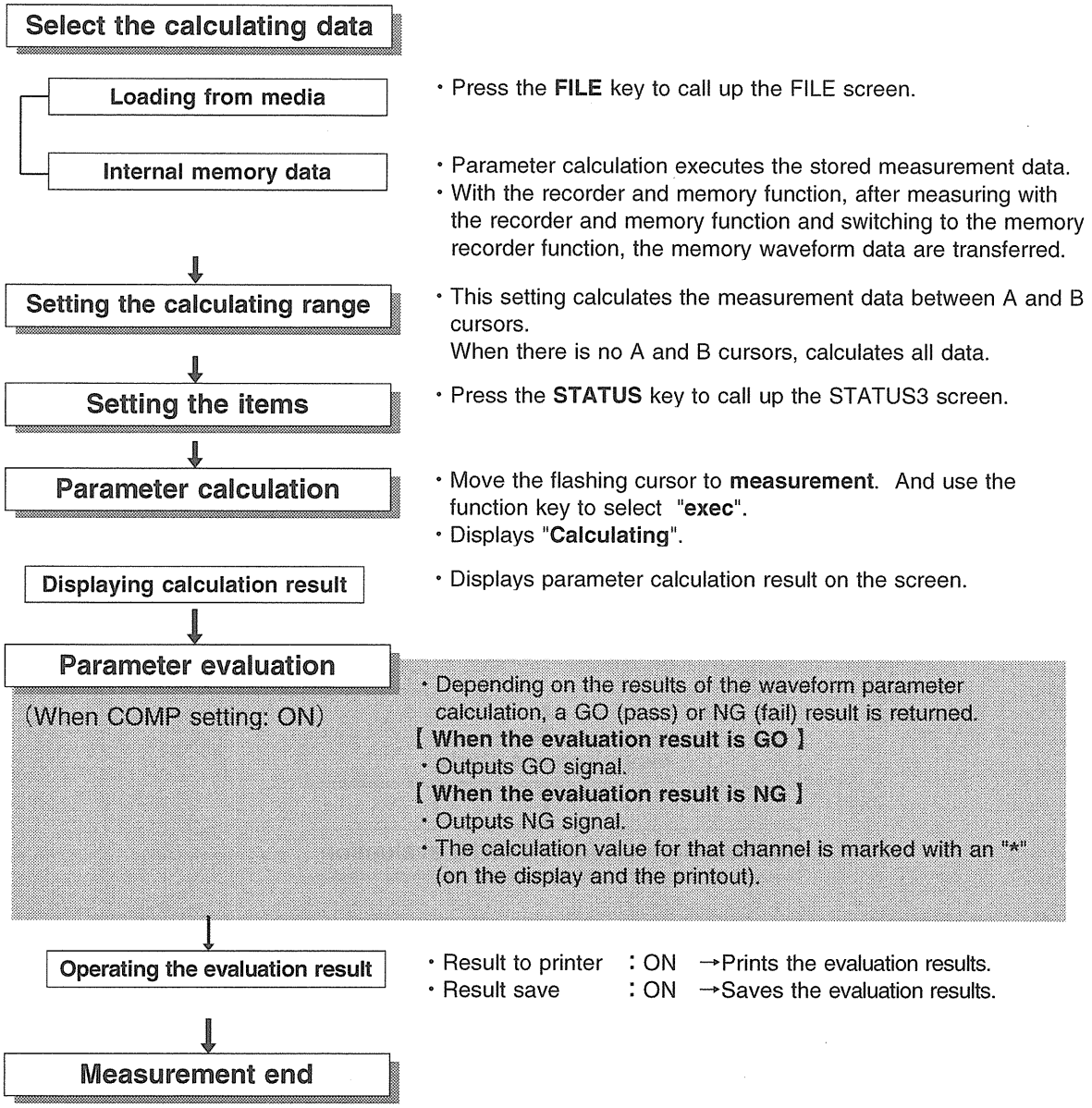
Trigger mode:REPEAT
AUTO

- Each time when trigger conditions are met, data are recorded and memory contents are overwritten.

[End of measurement in REPEAT and AUTO trigger modes]
- When the **STOP** key is pressed once during measurement, the 8835 acquires measurement data in an amount corresponding to the set recording length, and the measurement is stopped. (Waveform display and parameter calculation are executed.)

NOTE When waveform parameter measurement and waveform evaluation are carried out simultaneously, the waveform evaluation stop mode is given priority.

Parameter calculation of measurement data loaded from media

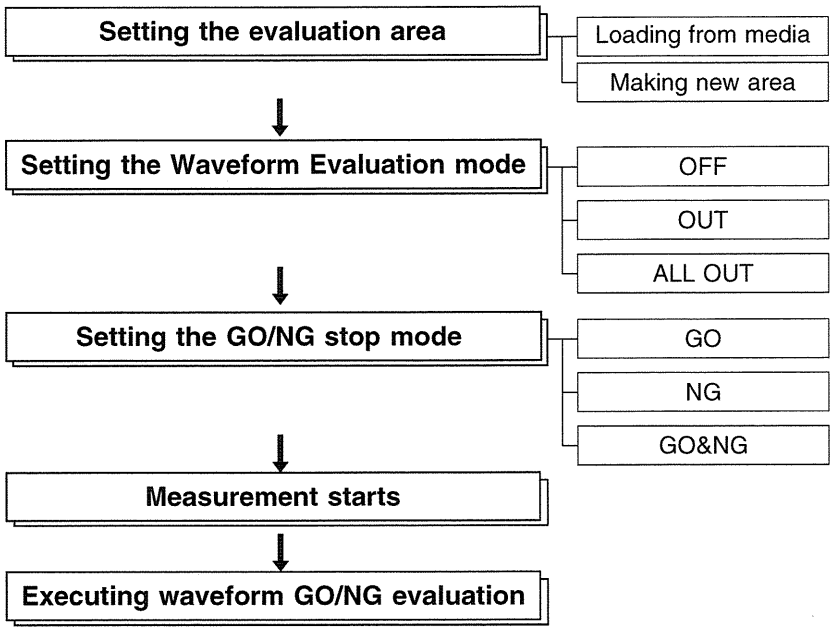


NOTE

- The line cursor (horizontal) cannot be used to specify the processing range.
- When only the cursor A is used, the waveform data from the position of cursor A to the end of the data is calculated.
- The result can be recalculated by altering the calculation process.

5.4 Waveform Area Evaluation

- The waveform evaluation function can be used from the Memory recorder (single screen, X-Y single screen).
- 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.

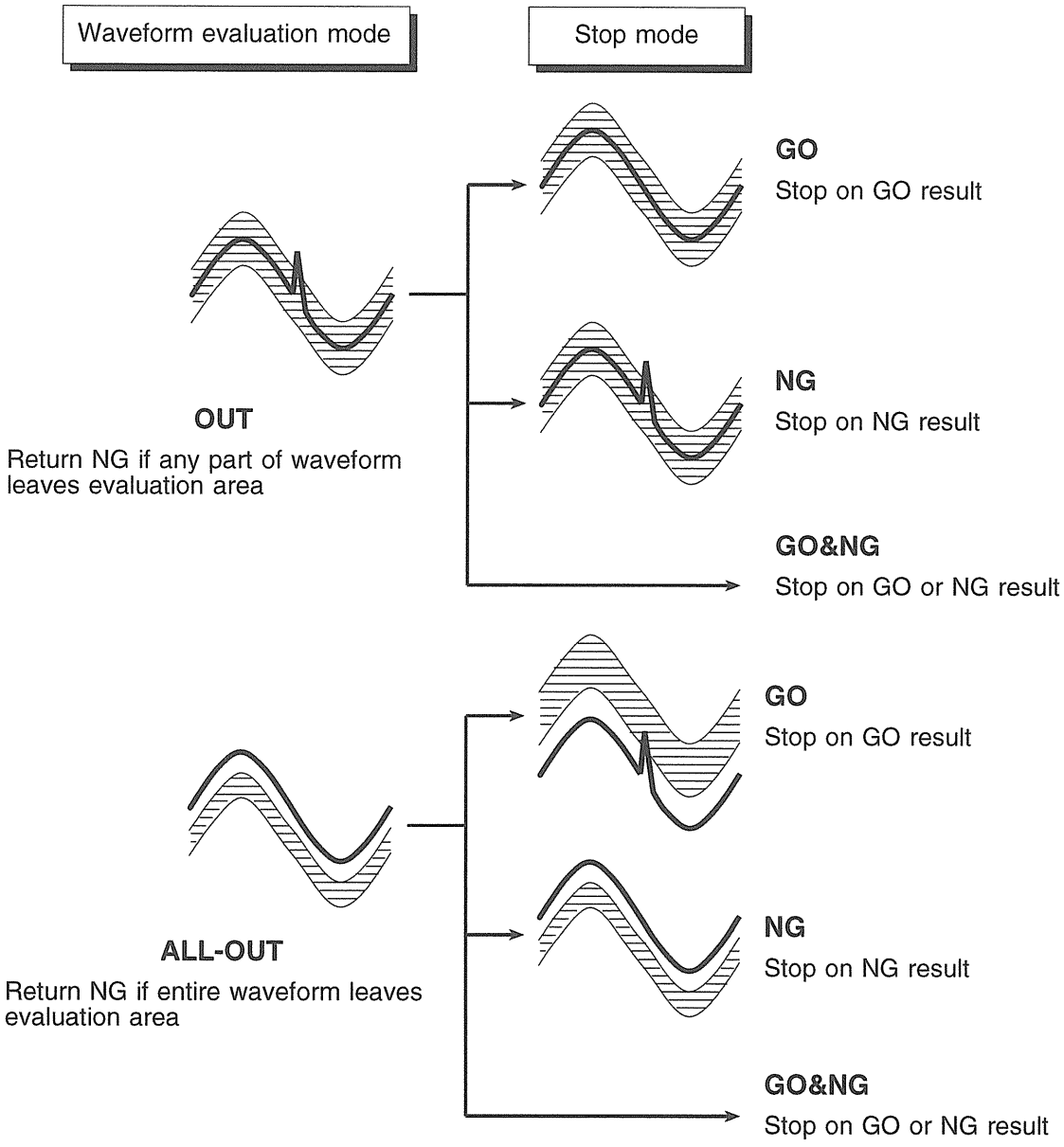


NOTE

- 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 operation stops.
- When **auto save** is set to **ON**, data are stored on media when operation stops.
- When memory segmentation (sequential save) is ON, data are stored in the memory block only when operation stops.
- Waveform evaluation consists of two actions, namely capturing data and performing the evaluation. These two actions are carried out in sequence, not simultaneously. 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 20 ms.
- If a high setting is chosen for recording length or if compression is used, the evaluation cycle becomes slower.
- Waveform area made by other than the 8835 cannot be used.
- On the waveform evaluation screen, A/B cursors can be used, but a partial printout cannot be made.

· When the waveform evaluation is specified, data equivalent to one screen (10 divisions) is printed out. When waveform data having a recording length of more than 10 divisions is to be printed out, the time axis should be compressed.

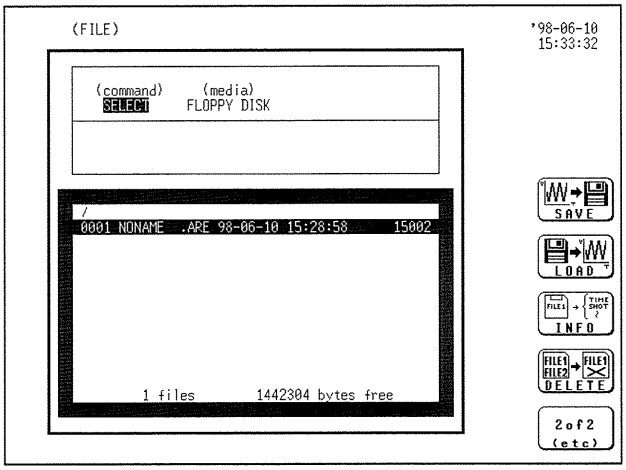
Waveform evaluation mode and stop mode



5.4.1 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

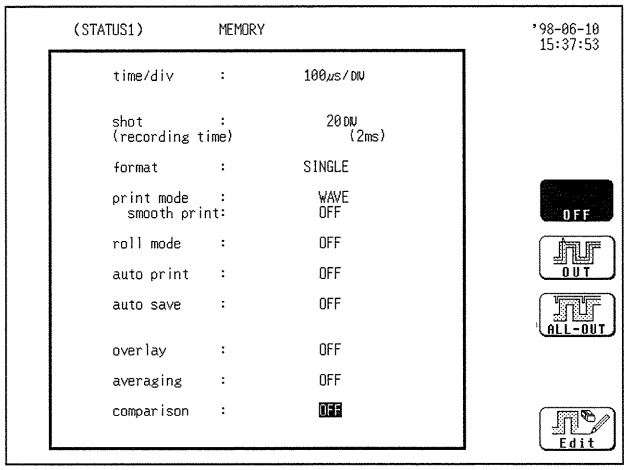


Method

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 Use the function key to select the **LOAD**.
⑤ Use the function key to select the **exec**.
⑥ When no more changes need be made to the loaded settings, press the [DISP] key to make the 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 display screen appear, and then press the [START] key to initiate measurement.

Creating a new evaluation area

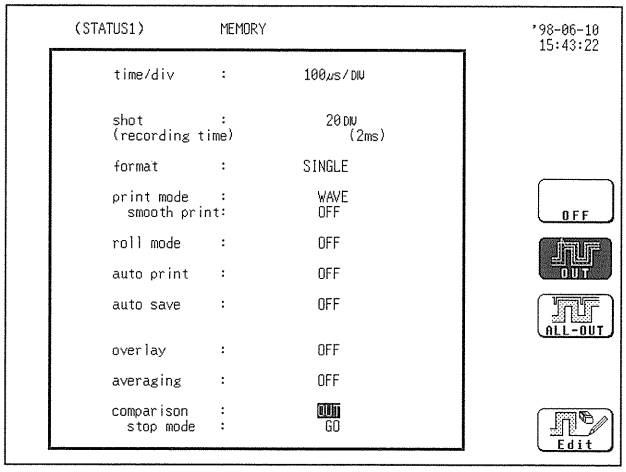


Method

Screen: SUTATUS1 (MEM)

① Press the [STATUS] key to call the STATUS1 screen.
② Move the flashing cursor to the position shown in the figure on the left.
③ Use the function key to select the **Edit**.
④ Make the new evaluation area.
⑤ Store the new evaluation area in the internal memory.
⑥ After setting the parameters for "**comparison**" and "**stop mode**," press the [DISP] key to make the 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.

5.4.2 Setting the Waveform Evaluation Mode



Method

Screen: STATUS1 (MEM)

① Move the flashing cursor to the position shown in the figure on the left.
② Make the setting with the function keys.

Selection

OFF : Disable waveform evaluation.

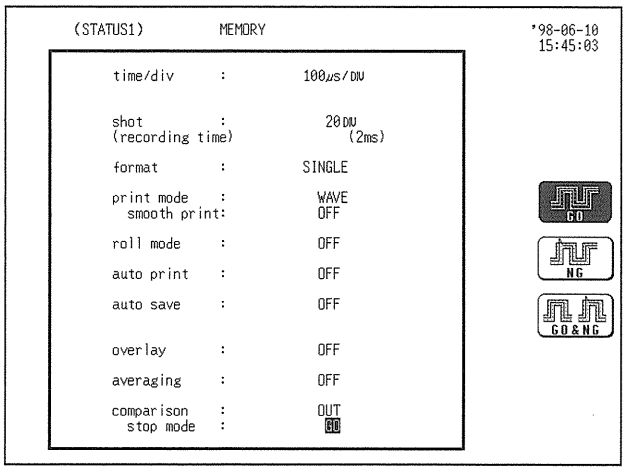
OUT : Return NG if any part of the waveform leaves the evaluation area.

ALL-OUT : Return NG if the entire waveform leaves the evaluation area.

Edit : Activate editor for setting up evaluation area.

5.4.3 Setting the GO/NG stop mode

When waveform evaluation is enabled (OUT or ALL OUT is selected), the "Stop Conditions" menu appears. Specify which evaluation option, GO or NG, should be used to stop the recording.



Method

Screen: STATUS1 (MEM)

① Move the flashing cursor to the position shown in the figure on the left.
② Make the setting with the function keys.

Selection

GO : Stop recording on GO result.

NG : Stop recording on NG result.

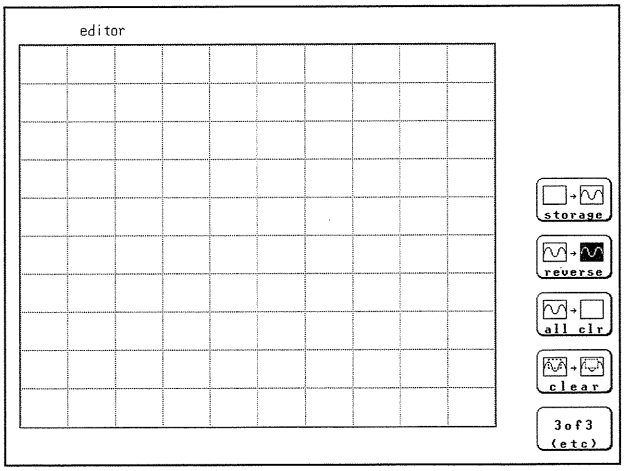
GO&NG : Stop recording on GO or NG result.

NOTE

When waveform parameter measurement and waveform evaluation are carried out simultaneously, the screen displayed waveform evaluation results. Check the results of parameter evaluation using "*" (NG decision) accompanying the figure. Alternatively, a beeping sound can be used for the evaluation instead of the "*" mark; the machine beeps if the result of either parameter or waveform evaluation is NG.

5.4.4 Creating the Evaluation Area

· The graphics editor serves to create the waveform evaluation area.
· The area is created by drawing it on screen.



Method

Screen: STATUS1 (MEM)

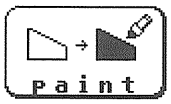
① Move the flashing cursor to the **comparison** item. Press the F5 [Edit].
② Use these commands to create the evaluation area.
③ When the area has been stored in memory, it can be used for waveform evaluation.
④ Press the F4 [end] function key to terminate the editor.
⑤ Serves to store the created area in memory.
⑥ Save the evaluation area through the file screen, if necessary.

Editor commands

When the editor is active, the following commands are assigned to the function keys.

paint	Fill in a closed area	all clr	Clear screen
paral	Parallel shift	clear	Clear area
line	Draw a straight line	(exec) undo	Undo immediately preceding command
erase	Erase	save	Store area in memory
storage	Import waveform into editor	edit end	Quit editor
reverse	Display filled-in area in reverse		

5.4.5 Editor Command Details

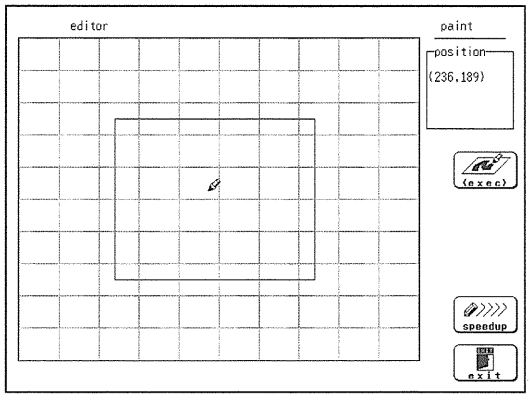


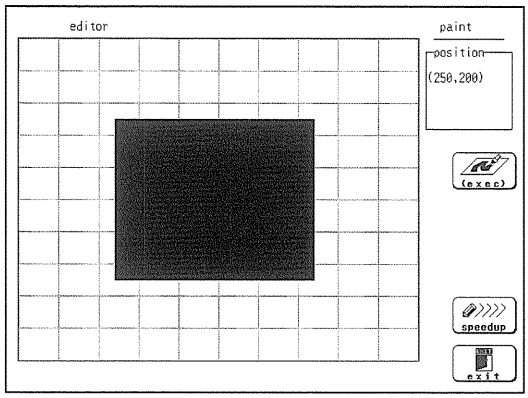
paint Function key display: 1/3
: Fills in an enclosed area.

① Press the F1 [paint].
② Use the CURSOR keys to move the mark to the area to be filled in. Pressing speedup accelerates the movement of the mark.
If the area is not completely enclosed, adjacent areas will also be filled in.

③ Press the F1 [exec] key. The area completely enclosed by lines is filled in.

④ Press the F5 [exit] key to terminate the paint mode.





parallel Function key display: 1/3
: Shifts the line pattern in parallel direction, to create an area.

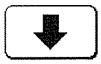
① Press the F2 [parallel].
② Set the amount of shift.
- Use the function keys or the JOG control to set the value.
- Use the F3 [move csr] key (or the CURSOR keys) to set the shift amount in the up/down/right/left directions.

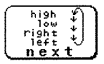
③ Press the F4 [exec] key. The parallel shift is carried, thereby creating the evaluation area.

④ Press the F5 [exit] key to terminate the parallel shift mode.

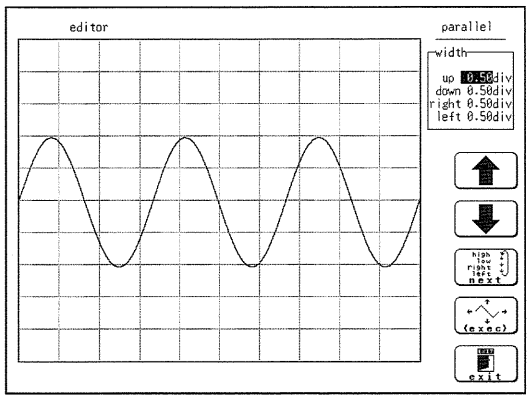
Selection

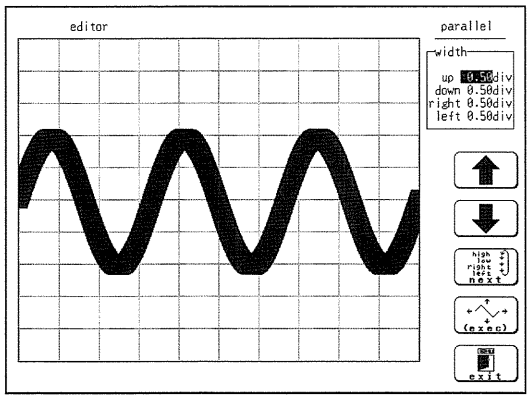
 : Increase shift amount

 : Decrease shift amount



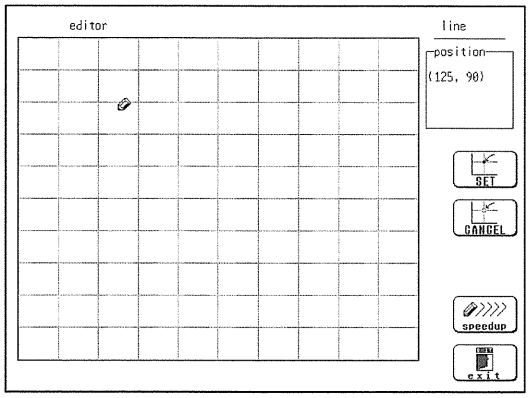
: Cycle the cursor through up/down/right/left

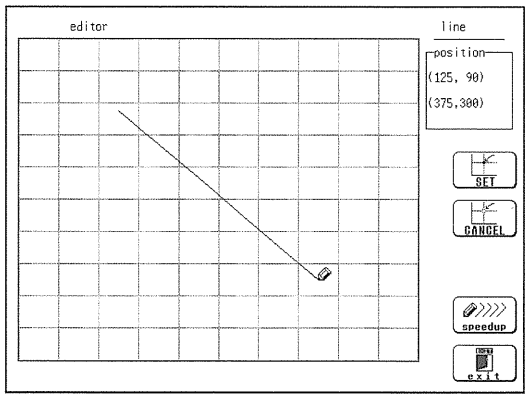




line Function key display: 1/3
: Serves to draw a straight or polygonal line.

① Press the F3 [line].
② Use the CURSOR keys to move the ✎ mark to the start point of the line.
Pressing speedup accelerates the movement of the mark.
If the area is not completely enclosed, adjacent areas will also be filled in.
③ Press the F1 [set] key.
④ Move the ✎ mark. A line is drawn between the set point and the ✎ mark.
⑤ Press the F1 [set] key again. The color of the line changes, and it is fixed.
Press the F2 [cancel] key. Cancel the immediately preceding set point.
⑥ Repeat steps ④ and ⑤ when wishing to draw a polygonal line.
⑦ Press the F5 [exit] key to terminate the line mode.

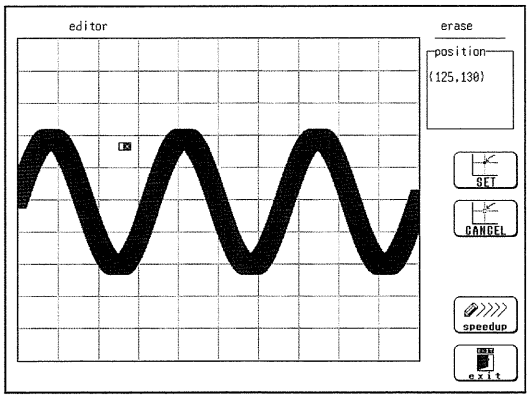


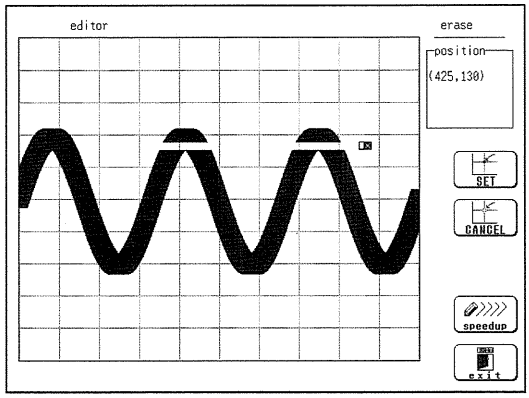


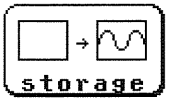
erase Function key display: 1/3
: Serves to erase unwanted sections.

① Press the F4 [erase].
② Use the CURSOR keys to move the ◪ mark to the start point of the section to be erased.
Pressing speedup accelerates the movement of the mark.

③ Press the F1 [set] key.
Press the F2 [cancel] key. Cancel the immediately preceding set point.
④ Move the ◪ mark to erase the unwanted section.
⑤ Press the F5 [exit] key to terminate the erase mode.

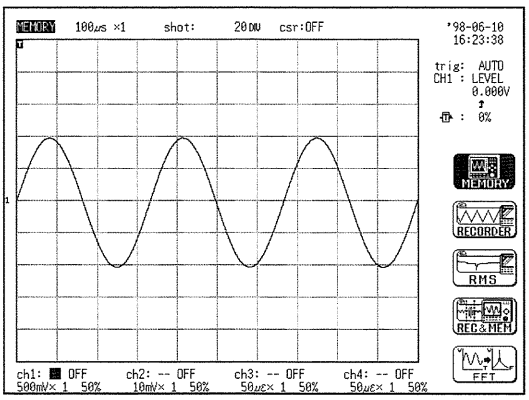


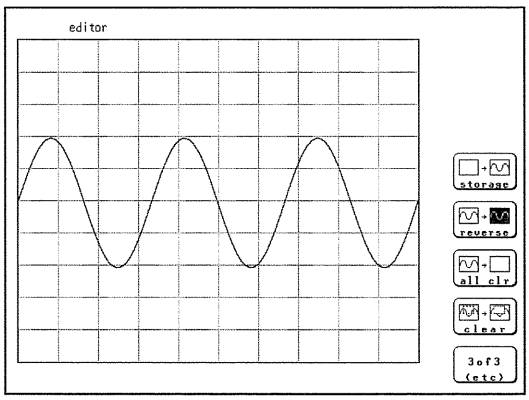


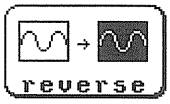


storage Function key display: 2/3
: Loads a waveform already stored in memory into the editor.

① Press the F1 [storage].
The waveform that was displayed on the screen is loaded into the editor.
The imported waveform is shown in a different color from the original setting.

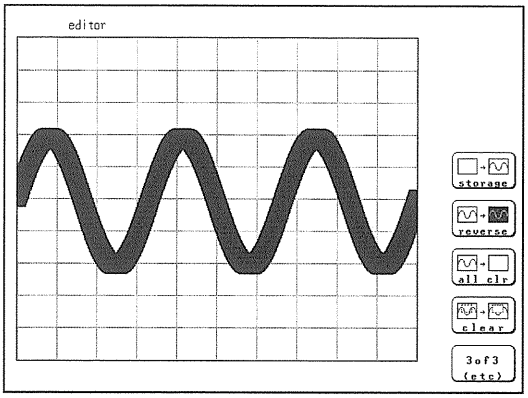


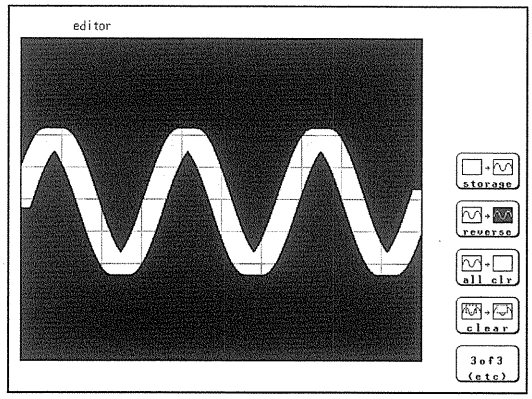


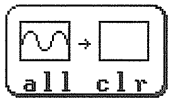


reverse Function key display: 2/3
: Reverses the colors of a filled-in area and the surrounding area.

① Press the F2 [reverse].
Displays filled in area in reverse.

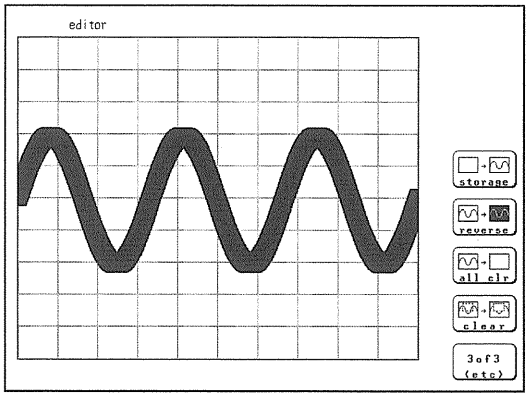


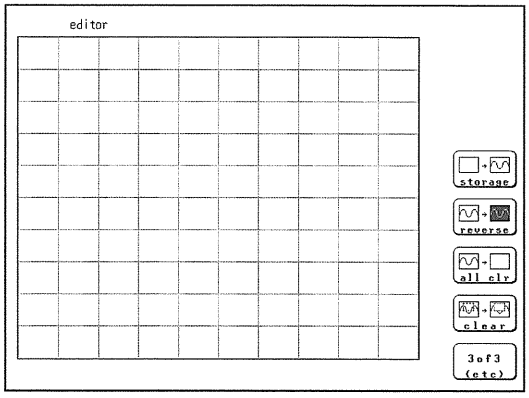


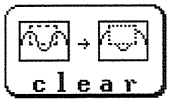


all clr Function key display: 2/3
: Clears the entire editor screen.

① Press the F3 [all clear].

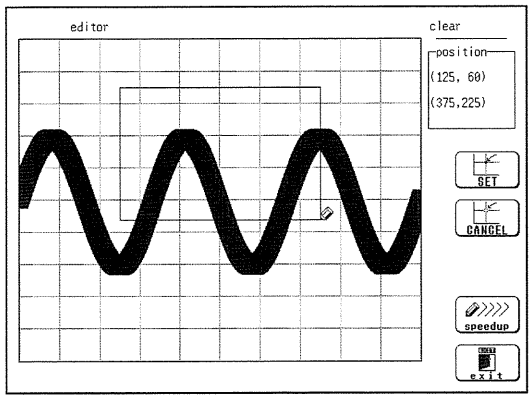


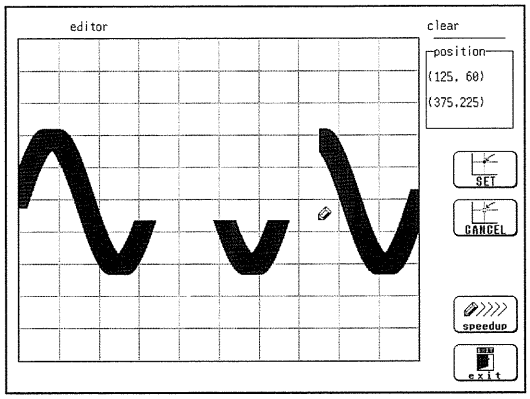




clear Function key display: 2/3
: Clears a specified rectangular area of the editor screen.

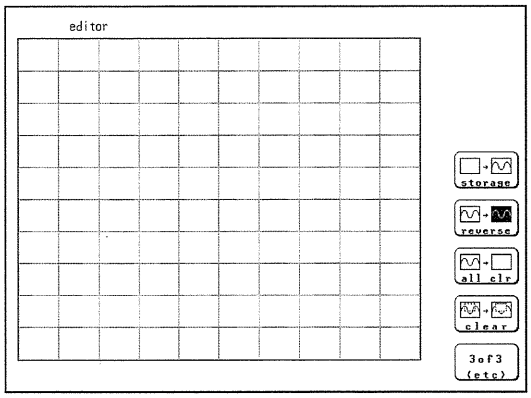
① Press the F4 [clear].
② Use the CURSOR keys to move the mark to the start corner of the area to be erased. Pressing speedup accelerates the movement of the mark.
③ Press the F1 [set].
④ Move the mark to the end corner of the area to be erased.
⑤ Press the F1 [set] key again. The rectangular area is cleared.
Press the F2 [cancel] key. Cancel the immediately preceding set point.
⑥ Press the F5 [exit] key to terminate the clear area mode.



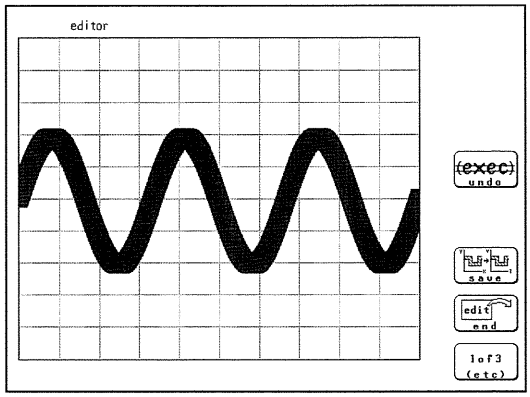


undo Function key display: 3/3
: Serves to undo the immediately preceding command.
Undo is applicable to all commands except **save** and **end**.

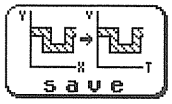
① Press the F1 [undo].



Clears the editor screen

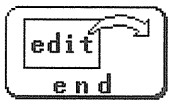


Screen before "clear screen" is restored.



save function key display: 3/3
: Serves to store the created area in memory.
After an area has been stored, it can be used for waveform evaluation.

① Press the F3 [save] key.



end function key display: 3/3
: Terminates the editor.

(1) Store evaluation area in memory and quit editor
- Press the F4 [end] key and then the F3 [save] key.
- The stored area can be used for waveform evaluation.

(2) Quit editor without storing evaluation area in memory
- Press the F4 [end] key and then the F5 [kill area] function key.
- The created area will be discarded.

NOTE

If the F4 [end] key is pressed without having done any editing or immediately after using the store command, the editor is terminated without confirmation.

5.5 Memory Segmentation Function

- This function divides the memory into separate blocks, each of which can be used for waveform recording.
- The memory segmentation function has two modes: sequential save and multi-block.

Sequential save function

- The recording length (DIV) has priority over the number of memory blocks.
- Input signal capture is carried out continuously using the trigger, storing waveform data successively in each block.
- During recording, no display or printout is carried out.
- This reduces dead time (non-sensitivity periods due to display and printing delays).

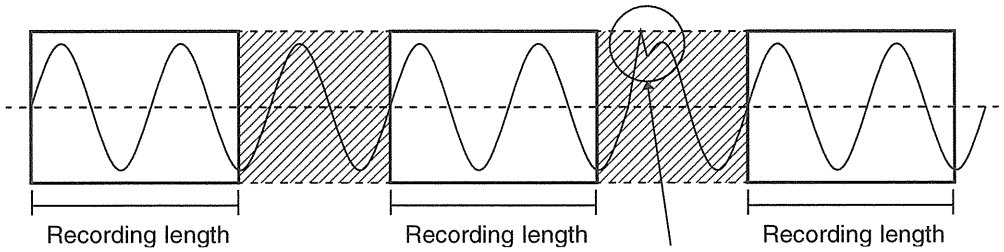
Multi-block function

- The number of memory blocks has priority over the recording length (DIV).
- Waveform data can be stored in a selected block.
- Data from two different blocks can be overlayed on screen for easy comparison. (it can be printed out)

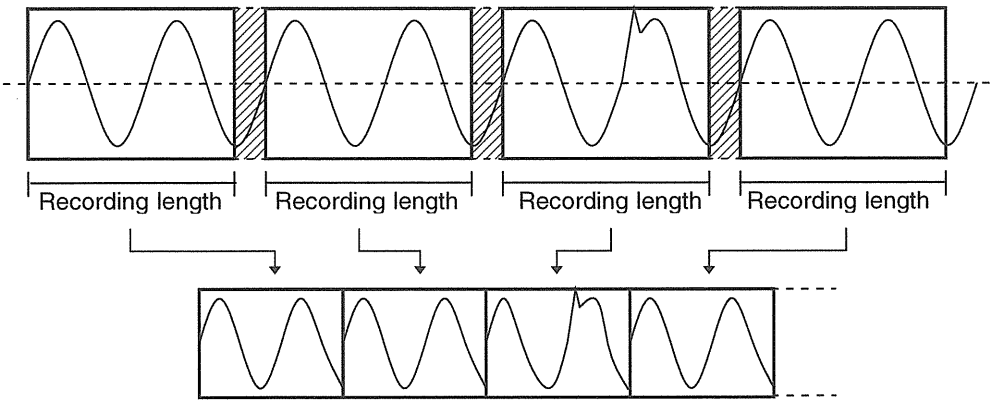
5.5.1 Using the Sequential Save Function

- Input signal capture is carried out continuously using the trigger, storing waveform data successively in each block.
- Any block in which an input signal is recorded can be called up on the display. During measurement, the display, print and save functions are disabled until data have been recorded in all blocks.

■ When continuous print (auto print) is being performed in REPEAT trigger mode



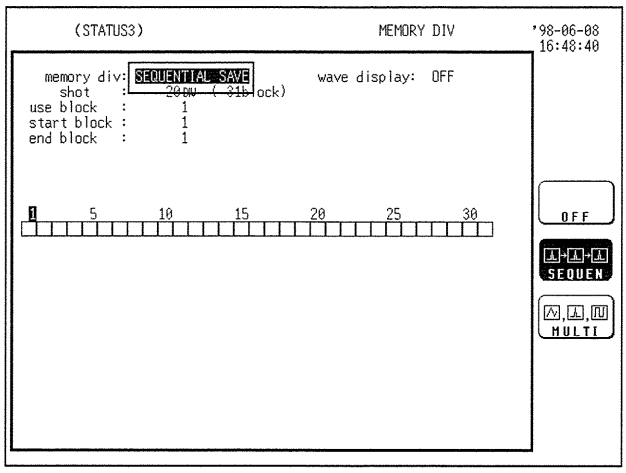
■ Using sequential save



··· Dead time (interval in which no sampling occurs due to display and print processing)

NOTE

- With the memory recorder function, dead time (interval in which no sampling occurs due to display and print processing after data is recorded in one block) is approximately 5 ms when no blocks are displayed, and approximately 15 ms when the blocks are displayed.
  With the recorder and memory function, maximum dead time is equivalent to the recorder sampling time.
- While the sequential save function is being used, the waveform processing calculation and averaging functions are disabled.
- While the roll mode is being used, the sequential save function in the status is disabled.



Method

Screen: STATUS (page 3) (MEM, R&M)

(1) Select the Memory Segmentation

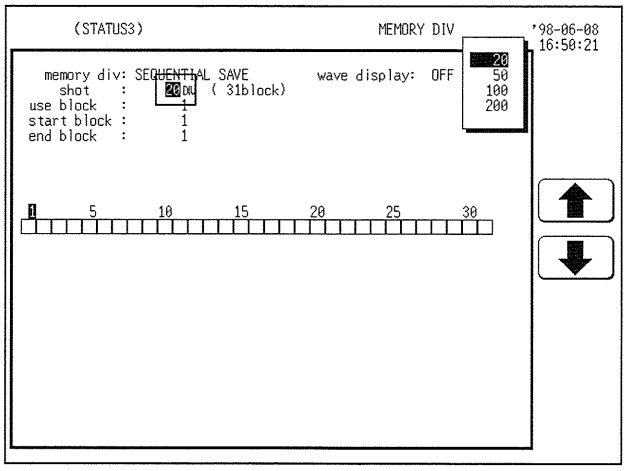
① Press the [STATUS] key to call up the STATUS screen (page 3).
② Move the flashing cursor to the position shown in the figure on the left.
③ Press the [F2] [SEQUEN].

Selection

[OFF] : Disable memory segmentation.

[SEQUEN] : Enable sequential save function.

[MULTI] : Enable multi-block function.



(2) Setting the Recording Length

① Move the flashing cursor to the **shot** item, as shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

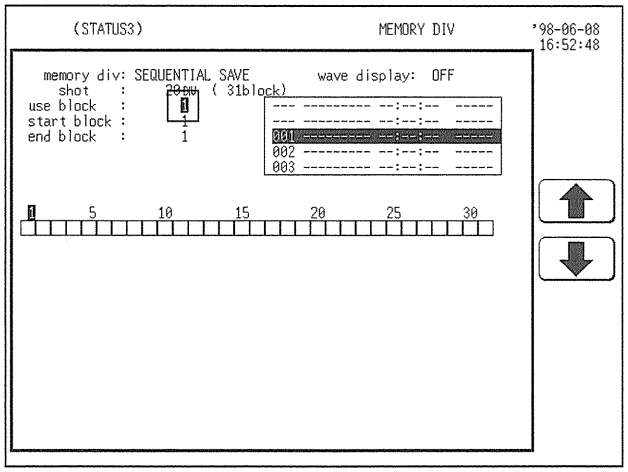
Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

When the recording length is set to the arbitrary recording-length mode, recording-length setting cannot be performed on the memory segmentation screen.
When the recording length is changed to one for which memory segmentation is not permitted on the STATUS1 or the DISPLAY screen, sequential saving is automatically set to OFF.

■ The recording length and maximum number of divisions are automatically determined according to the set memory capacity and number of available channels.



(3) Display block setting

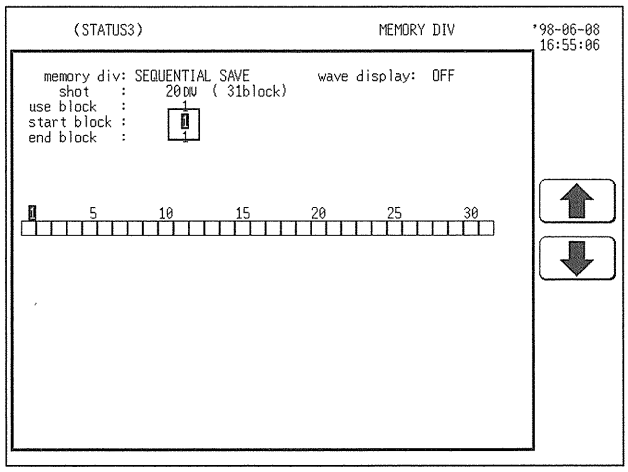
① Move the flashing cursor to the **use block** item, as shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

After measurement starts, the displayed block is updated by the recorded block.
When measurement is completed, the most recently recorded block is displayed.



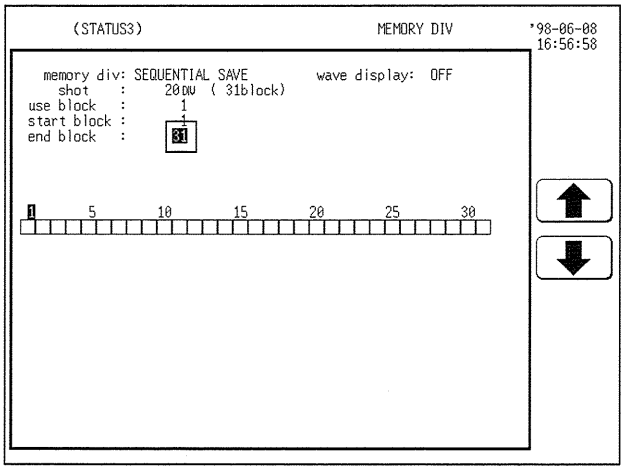
(4) Start block setting

① Move the flashing cursor to the **start block** item, as shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.



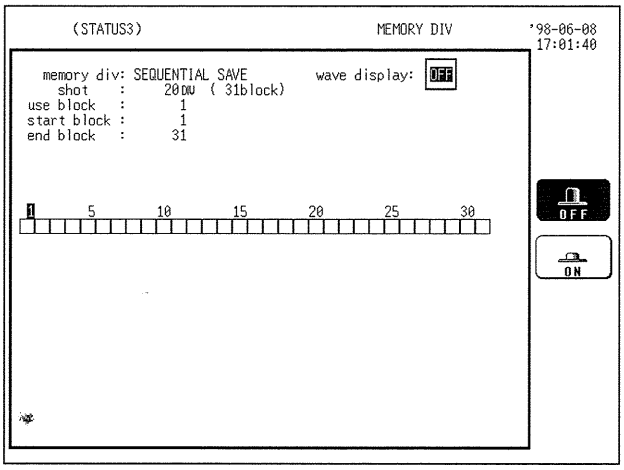
(5) End block setting

① Move the flashing cursor to the **end block** item, as shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.



(6) Setting the follow-up waveform display

Waveforms acquired for each block by triggering during the sequential saving process are displayed one by one.
(As a result, the dead time is increased.)

① Move the flashing cursor to the **wave display** item, as shown in the figure on the left.
② Use the the function keys to make the selection.

Selection

: After all blocks are recorded, the waveform of the last block only is displayed.

: Each block is recorded and displayed.

NOTE

- The colored blocks indicate that measured data has been saved to the blocks.
- The displayed block settings and block status are shown on the display screen.

Relation between trigger mode and sequential save function

Measurement Start

- Press the **START** key and LED light.
  Data recording starts when trigger condition are met.

start block

- Start block is stored.
  wave display O N: start block waveform is displayed.
  wave display OFF: waveform is not displayed.

↓

end block

- End block is stored.
  wave display O N: end block waveform is displayed.
  wave display OFF: waveform is not displayed.

↓

Measurement end

- Displays end block waveform.

Auto print

- When auto printing is enabled, all blocks are printed from the start block while individual blocks are displayed.

Auto save

- When auto saving is enabled, waveforms in all blocks are saved in a batch.

↓

Recording end

Trigger mode:SINGLE

- End of measurement
  When the **STOP** key is pressed twice during measurement, the 8835 is forcibly stopped. (Auto printout and auto save are not executed.)

Trigger mode: REPEAT
AUTO

- Each time when trigger conditions are met, data are recorded and memory contents are overwritten.

【 End of measurement in REPEAT and AUTO trigger modes 】

- When the **STOP** key is pressed once during measurement, the 8835 acquires measurement data in an amount corresponding to the set recording length, and the measurement is stopped. (Waveform display, auto printout, and auto save are executed.)
- When the **STOP** key is pressed twice during measurement, the 8835 is forcibly stopped.(Auto printout and auto save are not executed.)

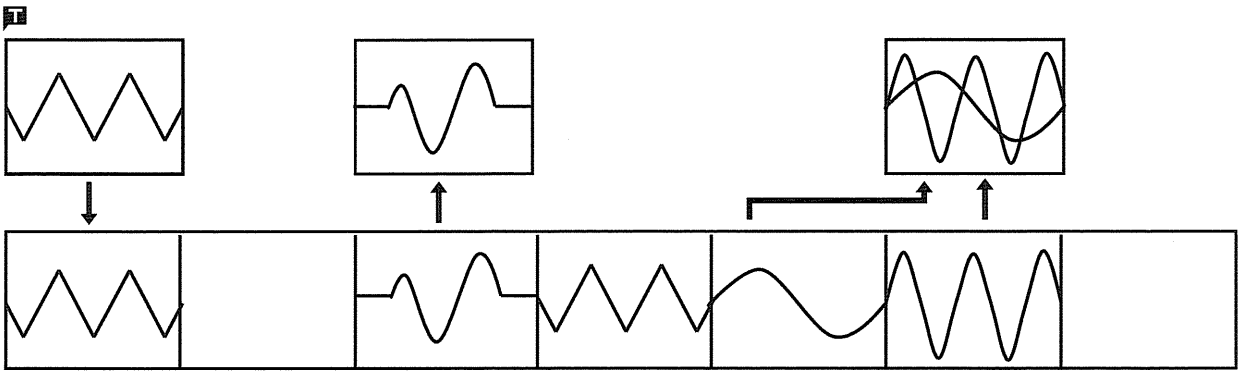
5.5.2 Using the Multi-Block Function

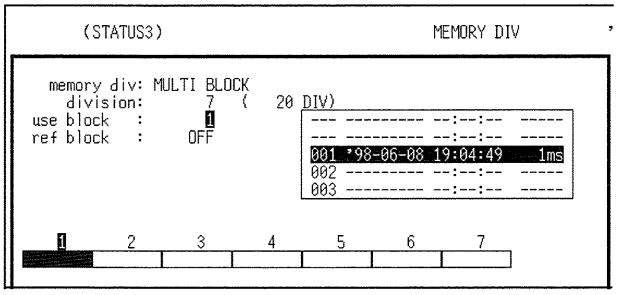
- Memory is divided into blocks which can be freely selected by the user for storing measurement data.
- Data stored in any block can be called up on the display.
- Data from two different blocks can be overlayed on screen for easy comparison. (it can be printed out)

(1) Store in memory

(2) Any block can be called up on display

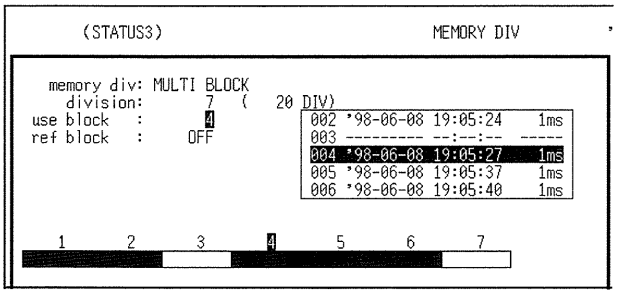
(3) Overlayed display of data from 2 blocks





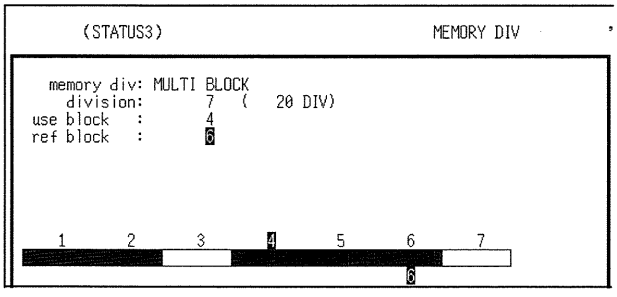
(1) Recording the waveform data in an arbitrary block

① Set the number of memory divisions.
② Select the block to be used for saving the waveform data, from among the divided blocks on the "use block" menu.
③ Press the **START** key to conduct measurement and save waveform data to the specified block.



(2) Displaying an arbitrary block

Select the block to be used to display the waveform data, from among the recorded blocks on the "use block" menu.

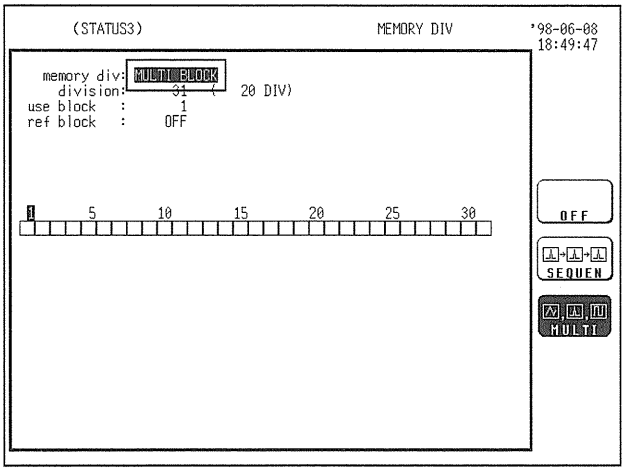


(3) Displaying two arbitrary blocks in duplicate

① Save at least two waveform data items.
② Select the block to be used to display waveform data, from among the recorded blocks on the "use block" menu.
③ Select the block to be to displayed in duplicate on the "ref block" menu.
④ Display the block selected from the "use block" menu and the block selected from the "ref block" menu, in duplicate.
Note that waveform data cannot be saved while blocks are overlapping.

NOTE

- While the multi-block function is being used, the waveform processing calculation and averaging functions are disabled.
- If the blocks have different recording lengths, the overlap block display is disabled.
- The **VIEW** key can be used to change the displayed memory block or to call up information about the usage status of memory blocks.



Method

Screen: STATUS (page 3) (MEM, REC&MEM)

(1) Select the Memory Segmentation

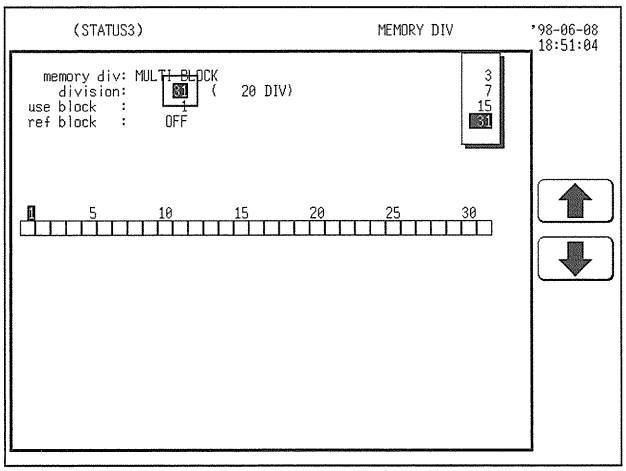
① Press the **STATUS** key to call up the STATUS2 screen.
② Move the flashing cursor to the position shown in the figure on the left.
③ Press the F3 [MULTI].

Selection

OFF : Disable memory segmentation.

SEQUEN : Enable sequential save function.

MULTI : Enable multi-block function.



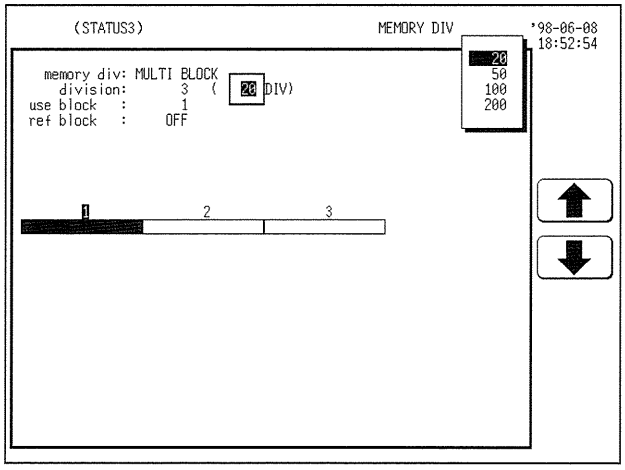
(2) Set the number of memory block

① Move the flashing cursor to the **division** item, as shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.



(3) Setting the Recording Length

① Move the flashing cursor to the position shown in the figure on the left.
② Use the JOG control or the function keys to make the selection.

Selection

: Move the cursor up in the selection window.

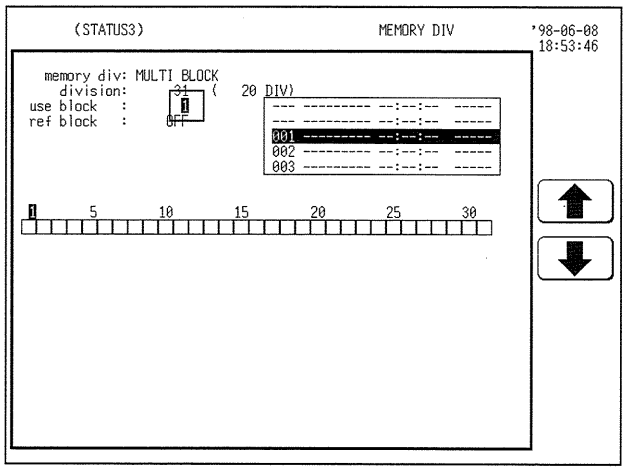
: Move the cursor down in the selection window.

When the recording length is set to the arbitrary recording-length mode, recording-length setting cannot be performed on the memory segmentation screen.
When the recording length is changed to one for which memory segmentation is not permitted on the STATUS1 or the DISPLAY screen, multi-block saving is automatically set to OFF.

■ The maximum number of divisions and the maximum recording length are automatically determined according to the set memory capacity and number of available channels.

NOTE

When using the multi-block function, the number of memory blocks has priority over the recording length (DIV). When the number of memory blocks is changed, the recording length may automatically be adjusted.



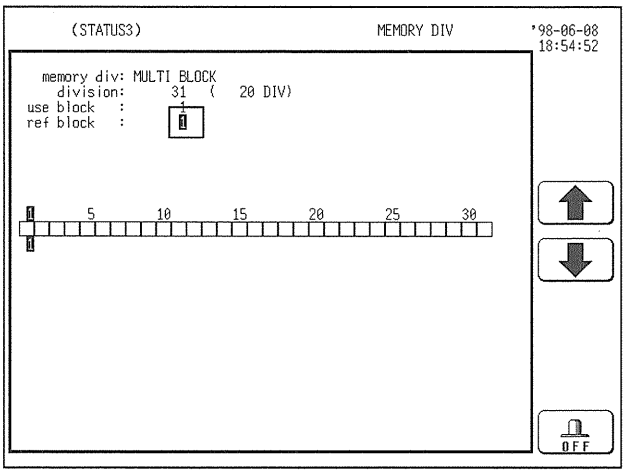
(4) Setting the using block

· Select the number of the memory block for display and recording of the input signal waveform.
① Move the flashing cursor to the **use block** item, as shown in the figure on the left.
② Use the JOG/SHUTTLE control or the function keys to make the selection.

Selection

: Value up.

: Value down.



(5) Setting the ref block

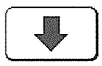
· Select a memory block whose waveform data are to be overlayed on screen with the memory block selected for display.

① Move the flashing cursor to the **ref block** item, as shown in the figure on the left.

② Use the JOG/SHUTTLE control or the function keys to make the selection.

Selection

 : Value up.

 : Value down.

: Disable ref block

5.5.3 SAVE

What Can Be Recorded And How Much

Memory block (SEQ: sequential, MUL: multiblock)

① Using the memory segmentation function, the recorded waveform data can be saved to the memory block.

② Batch saving of all blocks can be selected.

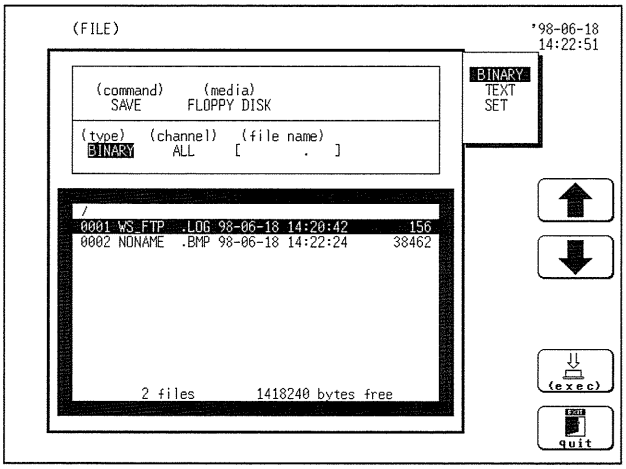
Evaluation area (AREA)

① The area created using the waveform evaluation editor can be saved.

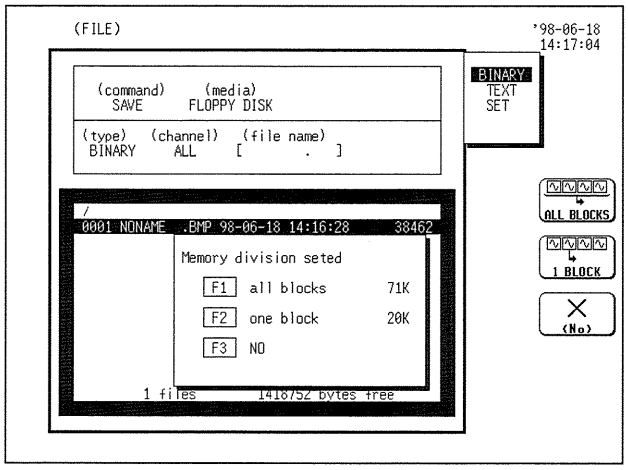
② The setup conditions are saved together with the evaluation area.

③ The recording capacity varies depending on the evaluation area. (2 KB to 66 KB)

Executing the saving



① Use the function key to select the **exec**.



② When the waveform data is selected and the memory segmentation function is used, select block saving.

Selection

R&M wave : In sequential saving, all data, from the starting block through the ending block, is saved.

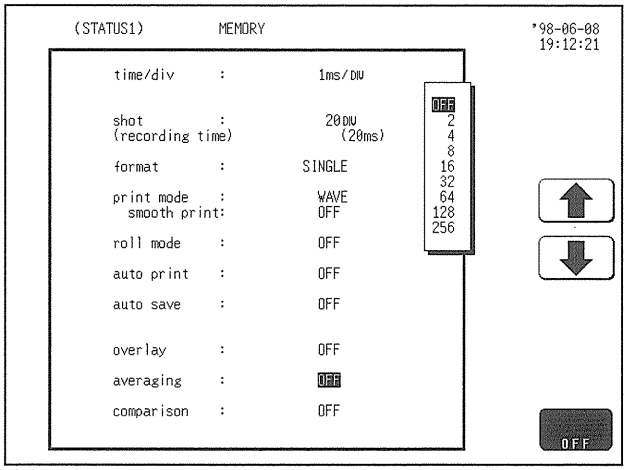
disp wave : Save the waveform data on the selected blocks (displayed block, use block)

NOTE

- When "**ALL BLOCKS**" is selected, files for all blocks as well as a index file for reading the data in one operation are created.
- Since only a limited number of files (including directories) can be created in the directory, directories should be created to enable the creation of multiple files.

5.6 Setting the Averaging Function

- The averaging function allows capturing several instances of a waveform and determining the average.
- This makes it possible to eliminate noise and irregular signal components.
- The higher the number of averaging instances, the more effectively will noise be suppressed.



Method

Screen: STATUS1

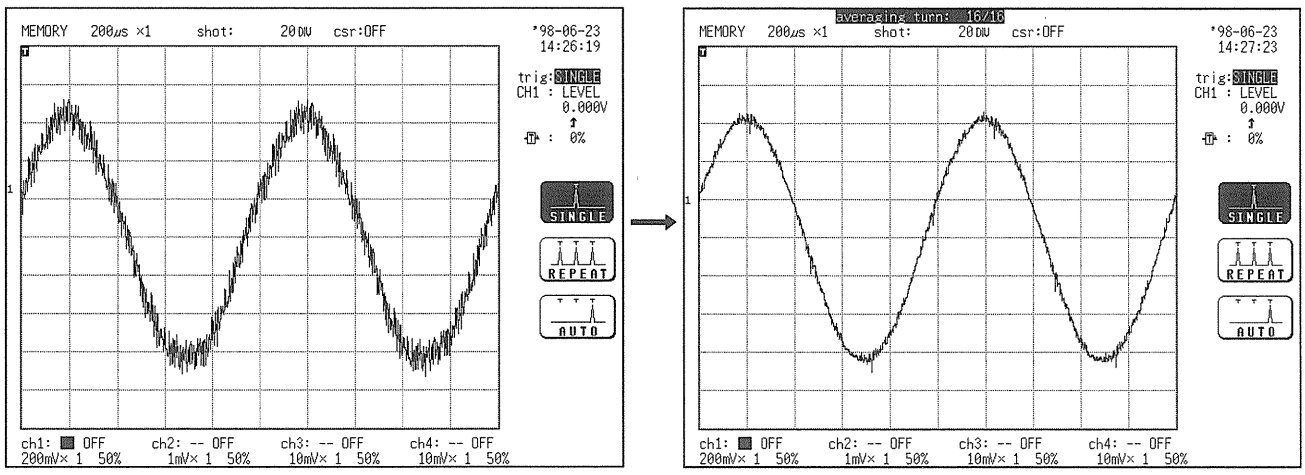
① Press the **STATUS** key to call up the STATUS1 screen.
② Move the flashing cursor to the **averaging** item, as shown in the figure on the left.
③ Use the JOG control or the function keys to set the averaging count.

Selection

: Move the cursor up in the selection window.

: Move the cursor down in the selection window.

After starting the measurement, the averaging count and the current waveform data count are shown on the screen.



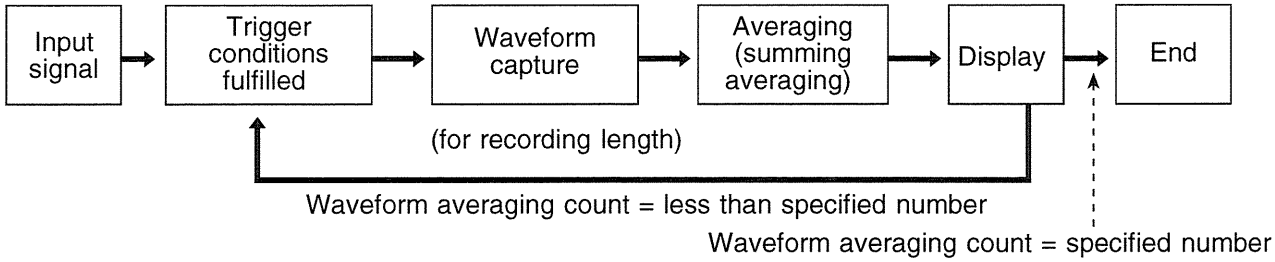
NOTE

- When the averaging function is used, logic waveform is not displayed.
- When the memory segmentation function is used, averaging is not available.
- Averaging and waveform processing cannot be carried out simultaneously.
- The averaged waveform becomes available for waveform processing when the averaging setting is turned OFF following measurement.
- When the averaging function is used, the maximum recording length is reduced to 25% of the normal value.

Averaging and trigger mode (Memory recorder function)

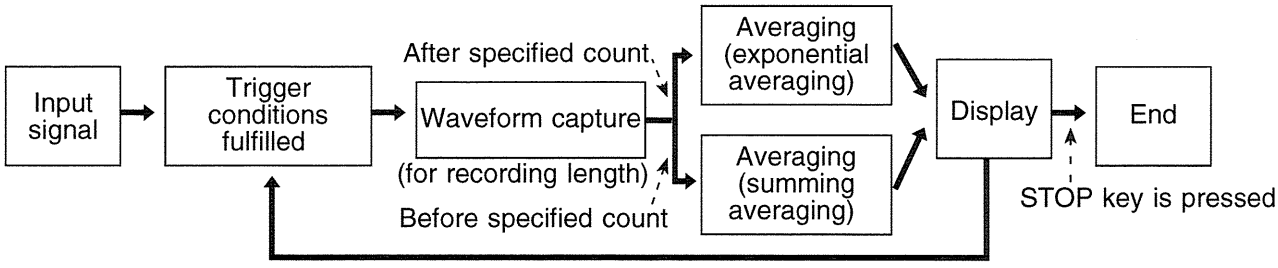
Trigger mode: SINGLE

(1) After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and summing averaging is carried out.
(2) When the specified number of data has been captured, measurement stops automatically.
(3) If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.



Trigger mode: REPEAT

(1) After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and summing averaging is carried out until the specified averaging count. The averaging result is shown on the display.
(2) After the specified averaging count was reached, exponential averaging is carried out whenever data are captured, and the averaging result is shown on the display.
(3) If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.



Trigger mode: AUTO and AUTO STOP

When the START key is pressed, data are captured even if trigger conditions are not fulfilled after a certain interval. If averaging is applied to unsynchronized input signals, the result will be meaningless.

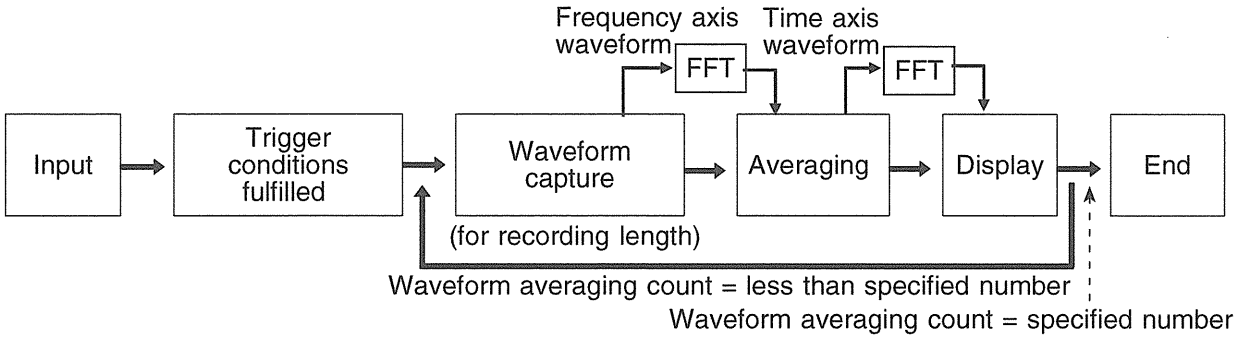
(FFT function)

Trigger mode: SINGLE

(1) After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, averaging is carried out, and then the waveform is displayed.
Collected waveform data is averaged with the FFT time axis waveform and FFT processing is performed. FFT processing is performed on the frequency axis and the calculated result is averaged.

(2) Trigger occurs when the trigger conditions are fulfilled again.

(3) When the specified number of data has been captured, measurement stops automatically. If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.

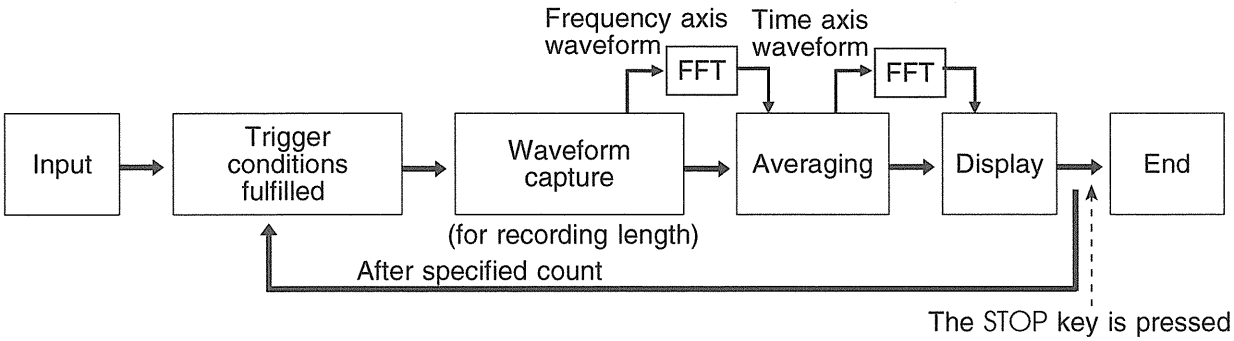


Trigger mode: REPEAT

(1) After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and averaging is carried out until the specified averaging count. The averaging result is shown on the display.

(2) Trigger occurs when the trigger conditions are fulfilled again.

(3) When the specified averaging count is reached, data up to that point are discarded, and new data are captured for averaging. If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.



Trigger mode: AUTO

(Time axis waveform)

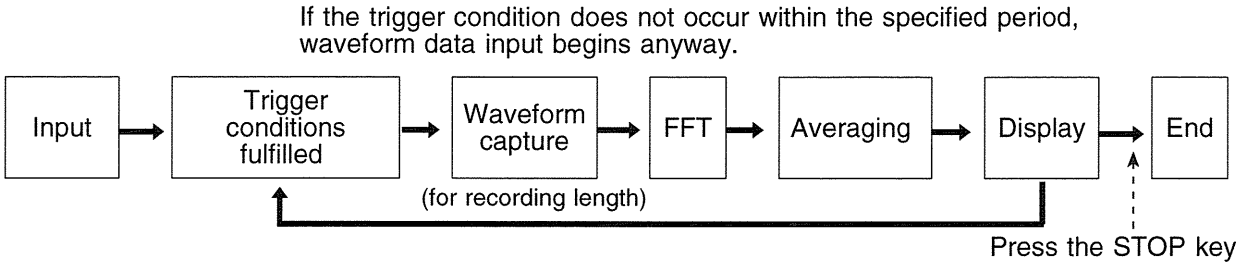
When the START key is pressed, data are captured even if trigger conditions are not fulfilled after a certain interval. If averaging is applied to unsynchronized input signals, the result will be meaningless.

(Frequency axis waveform)

(1) After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and averaging is carried out until the specified averaging count. The averaging result is shown on the display.

(2) When the specified number of data has been captured, measurement stops automatically.

(3) If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.



Chapter 6 Interface

6.1 Commands

① CONFigure command (Setting and querying the time axis range, the recording length, etc.)

:CONFigure

Command	Data (for a query, response data)	Explanation	Function	Ref page
:TDIV *A, B*	*A*: TIME/DIV for REC, *B*: TIME/DIV for MEM	Sets the time axis ranges.	R&M	127
:TDIV?	*A, B* <NR3> (unit seconds)	Queries the time axis ranges.		
:SHOT *A, B*	*A*: REC recording length *B*: MEM recording length	Sets the recording lengths.	R&M	127
:SHOT?	*A, B* <NR1> (unit DIV)	Queries the recording lengths.		
:AVERage *A*	*A*: 0, 2, 4, 8, 16, 32, 64, 128, 256 (0: OFF)	Sets the count for averaging.	MEM	128
:AVERage?	*A* <NR1>	Queries the count for averaging.		
:WVCOmp *A$*	*A$*: OFF, OUT, ALLOut	Sets the waveform decision mode.	MEM FFT	128
:WVCOmp?	*A$*	Queries the waveform decision mode.		
:CMPStop *A$*	*A$*: GO, NG, G-N	Sets the waveform decision stop mode.	MEM FFT	128
:CMPStop?	*A$*	Queries the waveform decision stop mode.		
:MEMDiv *A$*	*A$*: OFF, SEQ, MULTI (MULTI: MEM only)	Sets memory segmentation.	MEM R&M	129
:MEMDiv?	*A$*	Queries memory segmentation.		
:USEBlock *A*	*A*: 1 to number of segmentations (63 max.)	Sets the memory block used.	MEM R&M	129
:USEBlock?	*A* <NR1>	Queries the memory block used.		

Command	Data (for a query, response data)	Explanation	Function	Ref page
:STTBlock *A*	*A*: 1 to number of blocks	Sets the start block (during sequential save).	MEM R&M	130
:STTBlock?	*A* <NR1>	Queries the start block.		
:ENDBlock *A*	*A*: 1 to number of blocks	Sets the end block (during sequential save).	MEM R&M	130
:ENDBlock?	*A* <NR1>	Queries the end block.		
:SEQDisp *A$*	*A$*: OFF, ON	Sets the follow-up waveform display (during sequential save).	MEM	130
:SEQDisp?	*A$*	Queries the follow-up waveform display.		
:MAXBlock *A*	*A*: 3, 7, 15, 31, 63, 127, 255	Sets the number of memory blocks (during multi-block).	MEM	131
:MAXBlock?	*A* <NR1>	Queries the number of memory blocks.		
:REFBlock *A*	*A*: 0, 1 to number of memory segmentations (0: OFF)	Sets the reference block (during multi-block).	MEM	131
:REFBlock?	*A* <NR1>	Queries the reference block.		
:FFTAVERage *A*	*A*: 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096	Sets the count for averaging in the FFT function.	FFT	131
:FFTAVERage?	*A* <NR1>	Queries the current setting of the count for averaging in the FFT function.		
:FFTAVKind *A$*	*A$*: OFF, T_EXP, F_EXP, T_LIN, F_LIN, F_PEAK	Sets the averaging method.	FFT	132
:FFTAVKind?	*A$*	Queries the currently set averaging method.		
:FFTMode *A, ch1$, (,ch2$)*	*A*: 1, 2 *ch1$, ch2$*: CH1 to CH4	Sets the FFT channel mode.	FFT	132
:FFTMode?	*A* <NR1>, *ch1$, ch2$*	Queries the current FFT channel mode.		
:FFTWind *A$ (,B)*	*A$*: RECTan, HANNing, EXPOnential *B*: 0 to 99 (%)	Sets the window function.	FFT	133
:FFTWind?	*A$, B* <NR1>	Queries the current window function.		
:FFTFunction *A$, B$*	*A$*: G1, G2 *B$*: STR, LIN, RMS, PSP, ACR, HIS, TRF, CSP, CCR, IMP, COH, OCT	Sets the FFT analysis mode.	FFT	133
:FFTFunction? *A$*	*A$, B$*	Queries the current FFT analysis mode.		

Command	Data (for a query, response data)	Explanation	Function	Ref page
:FFTRef *A$*	*A$*: NEW, MEM	Designates the source for FFT analysis data.	FFT	134
:FFTRef?	*A$*	Queries the current FFT analysis data source.		
:FFTSCale *A$, B$*	*A$*: G1, G2 *B$*: AUTO, MANUal	Sets the display scaling method for a graph.	FFT	135
:FFTSCale? *A$, B$*	*A$, B$*	Queries the current display scaling method for a graph.		
:FFTUp *A$, B*	*A$*: G1, G2 *B$*: -9.9999E+29 to +9.9999E+29	Sets the vertical axis upper limit for a graph.	FFT	135
:FFTUp? *A$*	*A$, B* <NR3>	Queries the current vertical axis upper limit for a graph.		
:FFTLow *A$, A*	*A$*: G1, G2 *B$*: -9.9999E+29 to +9.9999E+29	Sets the vertical axis lower limit for a graph.	FFT	136
:FFTLow? *A$*	*A$, B* <NR3>	Queries the current vertical axis lower limit for a graph.		
:FFTXaxis *A$, B$*	*A$*: G1, G2 *B$*: 1_1oct, 1_3oct (octave analysis) LINhz, LOGhz (otherwise)	Sets the x-axis.	FFT	136
:FFTXaxis? *A$*	*A$, B$*	Queries the current x-axis setting.		
:FFTYaxis *A$, B$*	*A$*: G1, G2 *B$*: LINMAg, LINREal, LINIMag, LOGMAg, PHASE	Sets the y-axis.	FFT	137
:FFTYaxis? *A$*	*A$, B$*	Queries the current y-axis setting.		
:FREQ *A*	*A*: 400000, 200000, 80000, 40000, 20000, 8000, 4000, 2000, 800, 400, 200, 80, 40, 20, 8, 4, 1.33, 0.667, 0.333, 0.133	Sets the frequency range.	FFT	138
:FREQ?	*A* <NR3>	Queries the currently set frequency range.		
:OCTFilter *A$*	*A$*: NORMal, SHARp	Sets the type of octave filter.	FFT	139
:OCTFilter?	*A$*	Queries the currently set type of octave filter.		
:PEAK *A$*	*A$*: OFF, PEAK, MAX	Sets the peak value display.	FFT	139
:PEAK?	*A$*	Queries the currently set peak value display.		
:FFTSAmple *A*	*A*: 1000, 2000, 5000, 10000	Sets the number of FFT points.	FFT	139
:FFTSAmple?	*A* <NR1>	Queries the number of FFT points.		

② TRIGger command (Setting and querying trigger.)

:TRIGger

Command	Data (for a query, response data)	Explanation	Function	Ref page
:MODE *A$*	*A$*: SINGle, REPEat, AUTO (MEM, FFT) SINGle, REPEat (REC, RMS) SINGle, REPEat, TIMEr (R&M)	Sets trigger mode.	All	140
:MODE?	*A$*	Queries trigger mode.		

③ DISPlay command (Setting and querying changeover of the screen mode, waveform display, etc.)

:DISPlay

Command	Data (for a query, response data)	Explanation	Function	Ref page
:RMDIsplay *A$*	*A$*: REC, MEM	Sets the CRT display waveform in the R&M function.	R&M	140
:RMDIsplay?	*A$*	Queries the CRT display waveform in the R&M function.		

④ CURSor command (Cursor setting and reading)

:CURSor

Command	Data (for a query, response data)	Explanation	Function	Ref page
:ABCHAnnel *A$*	*A$*: G1, G2	Sets the graph for the A and B cursors.	FFT	141
:ABCHAnnel?	*A$*	Queries the graph setting for the A and B cursors.		
:DFREad? *A$*	*B$, C$* *A$*: A, B, B_A *B$*: readout position for x-axis data *C$*: readout position for y-axis data	Queries the current cursor readout position.	FFT	141

⑤ MEMory command (Setting and querying input and output, etc., from the memory)

:MEMory

Command	Data (for a query, response data)	Explanation	Function	Ref page
:FFTPOint A$, B	*A$*: G1, G2 *B*: 0 to 9999 (STR, ACR, CCR, IMP) 0 to 4000 (LIN, RMS, PSP, TRF, COH, CSP) 0 to 400 (HIS, OCT)	Sets the output point for FFT data.	FFT	142
:FFTPOint?	*A$, B* <NR3>	Queries the current output point for FFT data.		
:FFTData?	*A* unit, *B* unit *A*: X-axis data <NR3> *B*: Y-axis data <NR3>	Output FFT data.	FFT	142

⑥ CALCulate command (Calculation setting and querying)

:CALCulate

Command	Data (for a query, response data)	Explanation	Function	Ref page
:COMP *NO$, A$*	*NO$*: NO1 to NO4 *A$*: ON, OFF	Enables and disables decision for waveform parameter calculation.	MEM	143
:COMP? *NO$*	*A$*	Queries enablement of decision for waveform parameter calculation.		
:COMPArea *NO$, upper, lower*	*NO$*: NO1 to NO4 *upper, lower*: -9.9999E+29 to +9.9999E+29	Sets upper and lower limits for decision for waveform parameter calculation.	MEM	143
:COMPArea? *NO$*	*upper* <NR3>, *lower* <NR3>	Queries upper and lower limits for decision for waveform parameter calculation.		
:WVCALc *A$*	*A$*: ON, OFF, EXEC (execute)	Sets waveform processing calculation.	MEM	144
:WVCALc?	*A$*	Queries waveform processing calculation.		
:Z *Z$, "A$"*	*Z$*: Z1 to Z16 *A$*: calculation equation	Sets the waveform processing calculation equation.	MEM	144
:Z? *Z$*	*A$*	Queries the waveform processing calculation equation.		
:FACTor *A$, B*	*A$*: A to P *B*: -9.9999E+29 to +9.9999E+29	Sets coefficients a to p.	MEM	145
:FACTor? *A$*	*B* <NR3>	Queries coefficients a to p.		

Command	Data (for a query, response data)	Explanation	Function	Ref page
:ZDIsplay *Z$, ch$, A$*	*ch$*: NONE, CH1 to CH32 *Z$*: Z1 to Z16 *A$*: AUTO, MANUal	Sets the display channel for the calculated result.	MEM	145
:ZDIsplay? *Z$*	*ch$, A$*	Queries the display channel for the calculated result.		
:MOVE *Z$, A*	*Z$*: Z1 to Z16 *A*: 0 to 4000 <NR1>	Sets the moving averaging.	MEM	146
:MOVE? *Z$*	*A*	Queries the moving averaging.		
:SLIDe *Z$, A*	*Z$*: Z1 to Z16 *A*: -4000 to 4000 <NR1>	Sets the parallel movement.	MEM	146
:SLIDe? *Z$*	*A*	Queries the parallel movement.		

⑦ FDISK command (Setting and querying file operation)

:FDISK

Command	Data (for a query, response data)	Explanation	Function	Ref page
:SAVE *'NAME1$. NAME2$', A$, B$ (C$)*	*NAME1$*: file name (up to 8 characters) *NAME2$*: file extension (up to 3 characters) *A$*: type of file Bin: binary data Text: text data Set: settings Area: waveform decision area *A$*: type of file (During memory segmentation or in R&M) BAll: binary data (All blocks are saved.) BOne: binary data (One block is saved.) TAll: text data (All blocks are saved.) TOne: text data (One block is saved.) *B$*: channels to save ALL, CH1 to CH4, LOGIC *C$*: spacing OFF, 1_2 to 1_1000	Saves a file.	All	147

⑧ GRAPh command (Commands relating to graphics editor)

:GRAPh

Command	Data (for a query, response data)	Explanation	Function	Ref page
:EDIT *A$*	*A$*: OFF, ON	Enables and disables the editor.	MEM FFT	148
:EDIT?	*A$*	Queries editor enablement.		
:PAINT *X, Y*	*X*: x-coordinate *Y*: y-coordinat	Begins solid fill from the point specified by (X, Y).	MEM FFT	148
:PARAllel *high, low, right, left*	*high, low, right, left*: 0 to 10 (div)	Carries out a parallel movement of the drawing.	MEM FFT	148
:LINE *X1, Y1, X2, Y2*	*X1, X2*: x-coordinates *Y1, Y2*: y-coordinates	Draws a line from (*X1, Y1*) to (*X2, Y2*).	MEM FFT	149
:ERASe *X1, Y1, X2, Y2*	*X1, X2*: x-coordinates *Y1, Y2*: y-coordinates	Erases the line from (*X1, Y1*) to (*X2, Y2*).	MEM FFT	149
:STORage		Loads a waveform into the editor.	MEM FFT	149
:REVErse		Reverses the video of the drawing.	MEM FFT	149
:ALLClear		Clears the entire drawing.	MEM FFT	150
:CLEAr *X1, Y1, X2, Y2*	*X1, X2*: x-coordinates *Y1, Y2*: y-coordinates	Clears the rectangle with the points (*X1, Y1*) and (*X2, Y2*) at diagonally opposite corners.	MEM FFT	150
:UNDO		Reverses the effect of the immediately previous editor command.	MEM FFT	150
:SAVE		Saves the decision area created with the editor.	MEM FFT	150

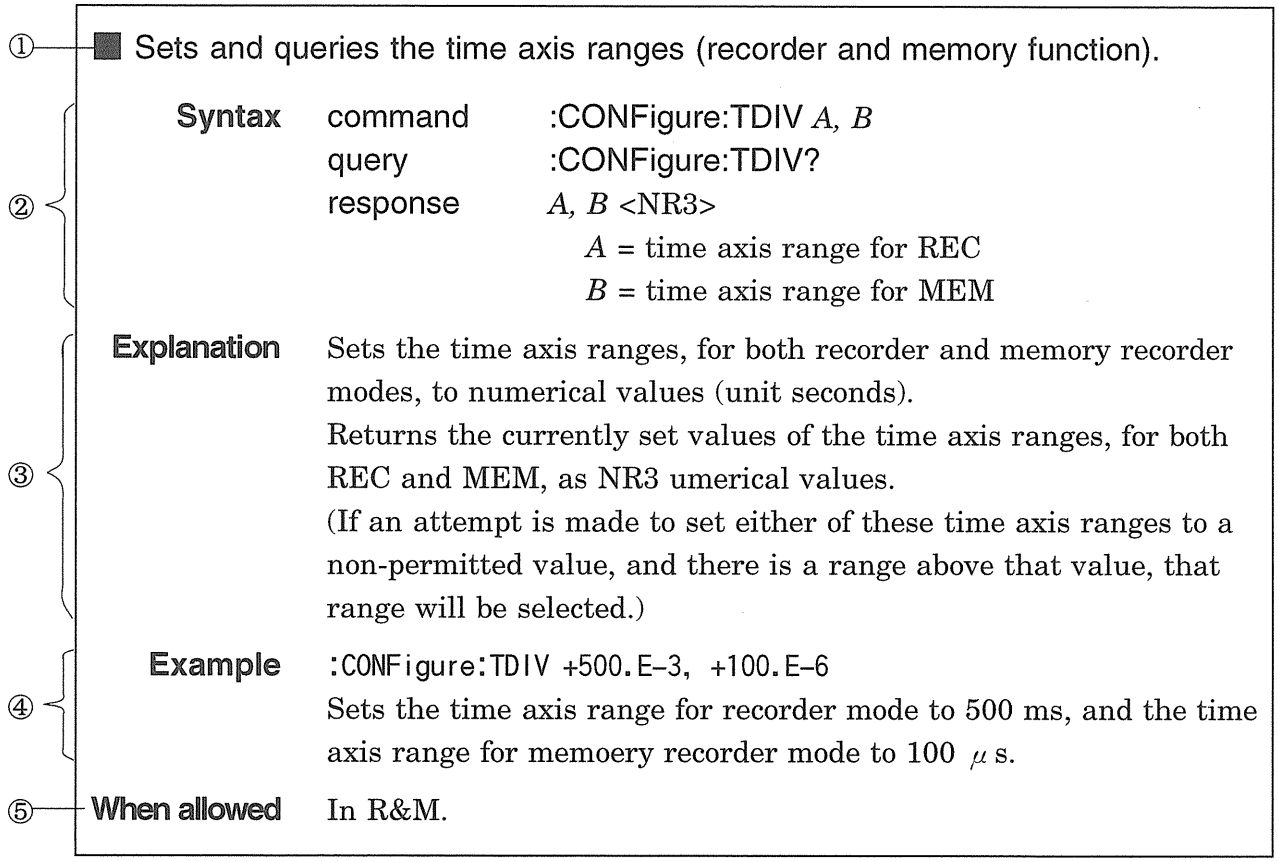
MEM: memory recorder function REC: recorder function
RMS: RMS recorder function R&M: recorder and memory function
FFT: FFT function
All: all MEM, REC, RMS, R&M and FFT functions

6.2 Detailed Explanation of the Commands

6.2.1 Explanation

The following sections describe the format and functions of individual commands.
The following is an example of how the descriptions are organized.

Example



① Command function

② Command syntax

command gives the syntax of a command program message,
query the syntax of a query program message, and
response the format of the response message.

The parameters, referred to as data, are shown as follows:

A, B, C,... Numerical data (e.g. 1.5, 10E-3)
A$, B$,... Character data (e.g. A, B1, GND, OFF)
"*A*", "*A$*",... Character string data (e.g. "1.5", "mA")
(Single quotation marks (') can be used instead of double quotation marks (").)

The format of numerical data follows the formats <NR1>, <NR2>, and <NR3>.

Example

A <NR1> Numerical parameter in NR1 format
B <NR2> Numerical parameter in NR2 format
C <NR3> Numerical parameter in NR3 format

NOTE If no format is mentioned, <NR1> format is accepted.

NR1 format	integer data
NR2 format	fixed point numbers
NR3 format	floating point numbers

The term "NRf format" includes all these three formats.

When the unit is receiving a command or query program message, it accepts format, but when it is sending it utilizes whichever one of the formats <NR1> to <NR3> is indicated in the particular command.

Response messages may or may not have headers prefixed.

③ Explanation of the command function.

④ Example of command use.

⑤ This lists the functions in which the command may be used.

MEM memory recorder function
REC recorder function
RMS RMS recorder function
R&M recorder and memory function
FFT FFT function

Execution of commands

- Commands are input into the input buffer and are executed in order.
- However the :ABORT command is executed immediately, even if commands are waiting in the input buffer - more precisely, at the instant its terminator is received.
- Commands other than those which can be handled by the 8835 in its current state are not executed but generate execution errors. This happens, for example, when in memory recorder function it is attempted to execute a recorder mode setting.
- Further, almost all commands cannot be executed during measurement operation.

6.2.2 Specific Commands

1. CONFigure command (Sets and queries time axis range, recording length, etc.)

:CONFigure

■ Sets and queries the time axis ranges (recorder and memory function).

Syntax

command	:CONFigure:TDIV *A, B*
query	:CONFigure:TDIV?
response	*A, B* <NR3>
	A = time axis range for REC
	B = time axis range for MEM

Explanation Sets the time axis ranges, for both recorder and memory recorder modes, to numerical values (unit seconds).
Returns the currently set values of the time axis ranges, for both REC and MEM, as NR3 umerical values.
(If an attempt is made to set either of these time axis ranges to a non-permitted value, and there is a range above that value, that range will be selected.)

Example
```
:CONFigure:TDIV +500.E-3, +100.E-6
```
Sets the time axis range for recorder mode to 500 ms, and the time axis range for memoery recorder mode to 100 μs.

When allowed In R&M.

■ Sets and queries the recording length (recorder and memory function).

Syntax

command	:CONFigure:SHOT *A, B*
query	:CONFigure:SHOT?
response	*A, B* <NR1>
	A = recording length for REC (0: continuous)
	B = recording length for MEM

Explanation Sets the numerical value of the recording lengths (unit divisions).
Returns the currently set values of the recording lengths as NR1 numerical values.

Example
```
:CONFigure:SHOT 0, 20
```
Sets the recording length for recorder mode to continuous, and the recording length for memoery recorder mode to 20 divisions.

When allowed In R&M.

■ Sets and queries the count for averaging.

Syntax

command :CONFigure:AVERage *A*
query :CONFigure:AVERage?
response *A* <NR1>
A = 0: OFF
2, 4, 8, 16, 32, 64, 128, 256

Explanation Sets the count for averaging.
Returns the current setting of the count for averaging as NR1 numerical value.

Example

```
:CONFigure:AVERage 32
```

Sets the count for averaging to 32.

When allowed In MEM.

■ Sets and queries the waveform decision mode.

Syntax

command :CONFigure:WVCOmp *A$*
query :CONFigure:WVCOmp?
response *A$*
A$ = OFF, OUT, ALLOut

Explanation Sets the waveform decision mode.
Returns the current waveform decision mode as character data.

Example

```
:CONFigure:WVCOmp OUT
```

Sets the waveform decision mode to OUT.

When allowed In MEM and FFT.

■ Sets and queries the waveform decision stop mode.

Syntax

command :CONFigure:CMPStop *A$*
query :CONFigure:CMPStop?
response *A$*
A$ = GO, NG, G-N

Explanation Sets the stop mode during waveform decision.
Returns the current stop mode as character data.

Example

```
:CONFigure:CMPStop GO
```

Sets the stop mode during waveform decision to GO.

When allowed In MEM and FFT.

■ Sets and queries memory segmentation.

Syntax

command	:CONFigure:MEMDiv *A$*
query	:CONFigure:MEMDiv?
response	*A$*

(MEM)
A$ = OFF
SEQ : sequential save
MULTI : multi-block
(R&M)
A$ = OFF, SEQ

Explanation Sets the method of memory segmentation recording.
Returns the current setting for method of memory segmentation recording as character data.

Example `:CONFigure:MEMDiv SEQ`

Sets the method of memory segmentation recording to sequential save.

When allowed In MEM and R&M.

■ Sets and queries the memory block used.

Syntax

command	:CONFigure:USEBlock *A*
query	:CONFigure:USEBlock?
response	*A* <NR1>

A = 1 to number of segmentations

Explanation During memory segmentation, sets the memory block used ("using block").
Returns the currently used memory block as an NR1 numerical value.

Example `:CONFigure:USEBlock 15`

Sets the block used to 15.

When allowed In MEM and R&M, when the memory segmentation function is in use.

■ Sets and queries the start block.

Syntax

command	:CONFigure:STTBlock *A*
query	:CONFigure:STTBlock?
response	*A* <NR1>

Explanation Sets the start block.
Returns the current start block as an NR1 numerical value.

Example

```
:CONFigure:STTBlock 5
```

Sets the start block to 5.

When allowed In MEM and R&M, when the sequential save function is in use.

■ Sets and queries the end block.

Syntax

command	:CONFigure:ENDBlock *A*
query	:CONFigure:ENDBlock?
response	*A* <NR1>

Explanation Sets the end block.
Returns the current end block as an NR1 numerical value.

Example

```
:CONFigure:ENDBlock 63
```

Sets the end block to 63.

When allowed In MEM and R&M, when the sequential save function is in use.

■ Sets and queries the follow-up waveform display.

Syntax

command	:CONFigure:SEQDisp *A$*
query	:CONFigure:SEQDisp?
response	*A$*

A$ = OFF, ON

Explanation Sets whether or not the data are displayed on the screen after they are saved to the blocks.
Returns the current setting of the follow-up waveform display as character data.

Example

```
:CONFigure:SEQDisp ON
```

Displays the data on the screen after they are saved to the blocks.

When allowed In MEM, when the sequential save function is in use.

■ Sets and queries the number of memory blocks.

Syntax

command	:CONFigure:MAXBlock *A*
query	:CONFigure:MAXBlock?
response	*A* <NR1>
	A = 3, 7, 15, 31, 63, 127, 255

Explanation Sets the number of memory blocks for the multi-block function.
Returns the current number of memory blocks as an NR1 numerical value.

Example

```
:CONFigure:MAXBlock 15
```

Sets the number of memory blocks to 15.

Note Set the recording length during sequential save using the :CONFigure:SHOT command (see "Sets and queries the recording length").

When allowed In MEM, when the multi-block function is in use.

■ Sets and queries the reference block.

Syntax

command	:CONFigure:REFBlock *A*
query	:CONFigure:REFBlock?
response	*A* <NR1>
	A = 0 : OFF
	1 to number of memory segmentations

Explanation Sets the reference block during multi-block.
Returns the current reference block as an NR1 numerical value.

Example

```
:CONFigure:REFBlock 15
```

Sets the reference block to 15.

When allowed In MEM, when the multi-block function is in use.

■ Sets and queries the count for averaging in the FFT function.

Syntax

command	:CONFigure:FFTAVERage *A*
query	:CONFigure:FFTAVERage?
response	*A* <NR1>
	A = 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096

Explanation Sets the count for averaging in the FFT function.
Returns the current setting of the count for averaging in the FFT function as NR1 numerical values.

Example

```
:CONFigure:FFTAVERage 2048
```

Sets the count for averaging to 2048.

When allowed In FFT.

■ Sets and queries the type of averaging in the FFT function.

Syntax

command :CONFigure:FFTAVKind *A$*
query :CONFigure:FFTAVKind?
response *A$*

A$ = OFF
T_LIN: simple time axis averaging
T_EXP: exponential time axis averaging
F_LIN: simple frequency axis averaging
F_EXP: exponential frequency axis averaging
F_PEAK: frequency axis peak hold

Explanation Sets the averaging method designated by *A$*.
Returns the currently set averaging method as character data.

Example

```
:CONFigure:FFTAVKind T_EXP
```

Sets time axis exponential averaging.

When allowed In FFT.

■ Sets and queries the FFT channel mode.

Syntax

command :CONFigure:FFTMode *A, ch1$ (,ch2$)*
query :CONFigure:FFTMode?
response *A* <NR1>*, ch1$, ch2$*

A$ = 1: one-channel FFT mode
2: two-channel FFT mode
ch1$ = CH1 to CH4: analysis channel W1
ch2$ = CH1 to CH4: analysis channel W2

Explanation Sets the FFT channel mode. I.e., designates the object channel or channels for FFT channel mode and the number thereof. In the one-channel FFT mode (only) the specification of channel 2 can be omitted, and if it is provided it is ignored. Transfer function, coherence function, cross power spectrum, cross correlation function and impulse response are only effective in the two-channel FFT mode.
Returns the current FFT channel mode as a numerical value in NR1 format, and the analysis channel as character data.

Example

```
:CONFigure:FFTMode 2, CH1, CH2
```

The channel mode is set to the two-channel FFT mode, and the object channels for FFT mode are set to be channel 1 and channel 2.

When allowed In FFT.

■ Sets and queries the FFT window function.

Syntax

command	:CONFigure:FFTWind *A$* (,*B*)
query	:CONFigure:FFTWind?
response	*A$*, *B* <NR1>

A$ = RECTan: rectangular window
HANNing: Hanning window
EXPOnential: exponential function window

B = 0 to 99 (units %): coefficient for the exponential function

Explanation

Sets the window function as indicated by *A$*. If the exponential window function is designated by *A$*, its exponential function coefficient can be set by using *B*.
Returns the current window function as character data, and the current exponential function coefficient as a numerical value in NR1 format.

Example

```
:CONFigure:FFTWind HANN
```

The window function is set to Hanning window.

When allowed

In FFT.

■ Sets and queries the FFT analysis mode.

Syntax

command	:CONFigure:FFTFunction *A$, B$*
query	:CONFigure:FFTFunction? *A$*
response	*A$, B$*

A$ = G1, G2:graph number

B$ = STR: stored waveform
LIN: linear spectrum
RMS: RMS spectrum
PSP: power spectrum
ACR: auto-correlation function
HIS: histogram
TRF: transfer function (*)
CSP: cross power spectrum (*)
CCR: cross correlation function (*)
IMP: impulse response (*)
COH: coherence function (*)
OCT: octave analysis
(*) can only be used when the two-channel FFT mode is set.

Explanation Sets the FFT analysis mode.
The FFT analysis mode can be set to transfer function, coherence function, cross power spectrum, cross correlation function, or impulse response only in the two-channel FFT mode (FFTMODE 2, *ch1$*, *ch2$*). In this case, the corresponding function is calculated from channel 1 and channel 2. The result of the calculation is displayed on the graph designated by *A$*. G2 can be designated even if the display format is SINGLE, but this does not affect the display.
Returns the current FFT analysis mode as character data.

Example
```
:CONFigure:FORMat DUAL
:CONFigure:FFTMode 2, CH1, CH3
:CONFigure:FFTFUNCTION G1, IMP
:CONFigure:FFTFUNCTION G2, TRF
```
The impulse response calculated from channel 1 and channel 3 is displayed on G1, and the transfer function calculated from these channels is displayed on G2.

When allowed In FFT.

■ Sets and queries the FFT data source.

Syntax

command	:CONFigure:FFTRef *A$*
query	:CONFigure:FFTRef?
response	*A$*

A$ = NEW: new data
MEM: data stored in the memory

Explanation Designates the source for FFT data as specified by *A$*.
Returns the current FFT data source as character data.

Example
```
:CONFigure:FFTRef NEW
```
New data is used as FFT data.

When allowed In FFT.

■ Sets and queries the FFT display scaling method.

Syntax

command	:CONFigure:FFTSCale *A$, B$*
query	:CONFigure:FFTSCale?
response	*A$, B$*
	A$ = G1, G2
	B$ = AUTO, MANUal

Explanation Sets the display scaling method for the graph number designated by *A$*.
Returns the current display scaling method for the graph number designated by *A$* as character data.

Example

```
:CONFigure:FFTSCale G1,AUTO
```

The scaling method for graph number 1 is set to automatic.

When allowed In FFT.

■ Sets and queries the FFT display scale vertical axis upper limit.

Syntax

command	:CONFigure:FFTUp *A$, B*
query	:CONFigure:FFTUp? *A$*
response	*A$, B* <NR3>
	A$ = G1, G2
	B = -9.9999E+29 to +9.9999E+29

Explanation Sets the FFT display scale vertical axis upper limit for the graph number designated by *A$* to the value designated by *B*.
Returns the current FFT display scale vertical axis upper limit for the graph number designated by *A$* as a numerical value in NR3 format.

Example

```
:CONFigure:FFTUp G2,100
```

The FFT display scale vertical axis upper limit for graph 2 is set to 100.

When allowed In FFT.

■ Sets and queries the FFT display scale vertical axis lower limit.

Syntax

command :CONFigure:FFTLow *A$, B*
query :CONFigure:FFTLow? *A$*
response *A$, B* <NR3>
A$ = G1, G2
B = -9.9999E+29 to +9.9999E+29

Explanation Sets the FFT display scale vertical axis lower limit for the graph number designated by *A$* to the value designated by *B*.
Returns the current FFT display scale vertical axis lower limit for the graph number designated by *A$* as a numerical value in NR3 format.

Example

```
:CONFigure:FFTLow G2,100
```

The FFT display scale vertical axis lower limit for display graph 2 is set to 100.

When allowed In FFT.

■ Sets and queries the FFT x-axis.

Syntax

command :CONFigure:FFTXaxis *A$, B$*
query :CONFigure:FFTXaxis? *A$*
response *A$, B$*
A$ = G1, G2
B$ = 1_1oct, 1_3oct: during octave analysis
LINhz, LOGhz: otherwise

Explanation Sets the x-axis of the graph number designated by *A$*. When the analysis mode is octave analysis, 1_1oct or 1_3oct can be set; otherwise, LINhz or LOGhz can be set. Some settings are not available for some analysis modes. If a setting is not available, an execution error is generated (see the table on the next page.)
Returns the current x-axis setting as character data.

Example

```
:CONFigure:FFTXaxis G1, LINHZ
```

The setting for the x-axis of graph 1 is set to LINHZ.

When allowed In FFT.

■ Sets and queries the FFT y-axis.

Syntax

command :CONFigure:FFTYaxis *A$, B$*
query :CONFigure:FFTYaxis? *A$*
response *A$, B$*
A$ = G1, G2
B$ = LINMAg: linear magnitude
LINREal: linear real axis magnitude
LINIMag: linear imaginary axis magnitude
LOGMAg: logarithmic magnitude
PHASE

Explanation

Sets the y-axis of the graph number designated by *A$*. Some settings are not available for some analysis modes. If a setting is not available, an execution error is generated (see the table on the next page.)
Returns the current y-axis setting as character data.

Example

```
:CONFigure:FFTYaxis G1,LINMAG
```

The setting for the y-axis of graph 1 is set to LINMAG.

When allowed

In FFT.

Display settings available on the x-axis

Analysis mode	X-axis				
	Linear-Hz	Log-Hz	1/1 octave	1/3 octave	Fixed scale
STR					TIME
LIN	●	●			
RMS	●	●			
PSP	●	●			
ACR					TIME
HIS					VOLT
TRF	●	●			
CSP	●	●			
CCR					TIME
IMP					TIME
COH	●	●			
OCT			●	●	

Display settings available on the y-axis

Analysis mode	Y-axis					
	Linear-real	Linear-imaginary	Linear-magnitude	Log-magnitude	Phase	Fixed scale
STR						LINEAR
LIN	●	●	●	●	●	
RMS	●	●	●	●	●	
PSP			●	●		
ACR						LINEAR
HIS						LINEAR
TRF	●	●	●	●	●	
CSP	●	●	●	●	●	
CCR						LINEAR
IMP						LINEAR
COH						LINEAR
OCT			●	●		

■ Sets and queries the FFT frequency range.

Syntax

command :CONFigure:FREQ *A*
query :CONFigure:FREQ?
response *A* <NR3>
A = 400000, 200000, 80000, 40000, 20000, 8000, 4000, 2000, 800, 400, 200, 80, 40, 20, 8, 4, 1.33, 0.667, 0.333, 0.133

Explanation

Sets the frequency range. If an attempt is made to set an unacceptable value, i.e. a value which is not one of the above, then the frequency range is set to the next higher one of the above values.
Returns the currently set frequency range as a numerical value in NR3 format.

Example

```
:CONFigure:FREQ 80
```

The frequency range is set to 80 Hz.

When allowed

In FFT.

■ Sets and queries octave filter type.

Syntax

command	:CONFigure:OCTFilter *A$*
query	:CONFigure:OCTFilter?
response	*A$*

A$ = NORMal, SHARp

Explanation Sets the type of octave filter.
Returns the currently set type of octave filter as character data.

Example

```
:CONFigure:OCTFilter NORMal
```

Sets the octave filter type to NORMAL.

When allowed In FFT.

■ Sets and queries peak value display.

Syntax

command	:CONFigure:PEAK *A$*
query	:CONFigure:PEAK?
response	*A$*

A$ = OFF, PEAK, MAX

Explanation Sets the peak value display.
Returns the currently set peak value display as character data.

Example

```
:CONFigure:PEAK PEAK
```

Sets the peak value display to PEAK.

When allowed In FFT.

■ Sets and queries the number of FFT points.

Syntax

command	:CONFigure:FFTSAmple *A*
query	:CONFigure:FFTSAmple?
response	*A* <NR1>

A = 1000, 2000, 5000, 10000

Explanation Sets the number of FFT points.
Returns the currently set number of FFT points as a numerical value in NR1 format.

Example

```
:CONFigure:FFTSAmple 2000
```

Sets the number of FFT points to 2000.

When allowed In FFT.

2. TRIGger command (Sets and queries trigger.)

:TRIGger

■ Sets and queries trigger mode.

Syntax

command	:TRIGger:MODE *A$*
query	:TRIGger:MODE?
response	*A$*

A$ = SINGle, REPEat, AUTO : MEM, FFT
SINGle, REPEat : REC, RMS
SINGle, REPEat, TIMEr : R&M

Explanation Sets the trigger mode.
Returns the current trigger mode as character data.

Example `:TRIGger:MODE REPEat`
Sets the trigger mode to repeat.

When allowed In all functions.

3. DISPlay command (Sets and queries changeover of the screen mode and waveform display.)

:DISPlay

■ Sets and queries the CRT display waveform for the recorder and memory function.

Syntax

command	:DISPlay:RMDIsplay *A$*
query	:DISPlay:RMDIsplay?
response	*A$*

A$ = REC, MEM

Explanation Sets the waveform shown on the screen, in the recorder and memory function, according to the character data.
Returns the waveform shown on the screen, in the recorder and memory function, as character data.

Example `:DISPlay:RMDIsplay MEM`
Sets the waveform shown in the recorder and memory function to the memory recorder waveform.

When allowed In MEM, REC, RMS and R&M.

4. CURSor command (Cursor setting and reading)

:CURSor

■ Sets and queries the graph for the A and B cursors.

Syntax

command	:CURSor:ABCHAnnel *A$*
query	:CURSor:ABCHAnnel?
response	*A$*

A$ = G1, G2

Explanation Sets the graph for the A and B cursors when the display format is DUAL. If the display format is SINGle or NYQuist, the cursor is displayed on graph 1, whatever setting is made with this command.
Returns the current graph setting for the A and B cursors as character data.

Example

```
:CONFigure:FORMat DUAL
:CURSor:ABCHAnnel G1
:CURSor:MODE TRACEe
```

The A and B cursors are displayed on graph 1.

When allowed In FFT.

■ Queries the cursor readout position for FFT data.

Syntax

query	:CURSor:DFREAd? *A$*
response	*B$*, *C$*

A$ = A, B, B_A
B$ = readout position for x-axis data
C$ = readout position for y-axis data

Explanation Returns the current cursor readout position for FFT data as character data.

Example

```
:CURSor:DFREAd? A
```

The A cursor readout position is returned as character data.

When allowed In FFT.

5. MEMory command (Sets and queries input and output, etc., from the memory.)

:MEMory

■ Sets and queries the output point for FFT data.

Syntax

command	:MEMory:FFTPOint *A$, B*
query	:MEMory:FFTPOint?
response	*A$, B*<NR1>

A$ = G1, G2

B = 0 to 9999 : in analysis mode STR, ACR, CCR, or IMP (maximum value: number of FFT points - 1)

0 to 4000 : in analysis mode LIN, RMS, PSP, TRF, COH, or CSP (maximum value: number of FFT points × 0.4)

0 to 400 : HIS or OCT

Explanation Sets the output point for FFT data on the graph number designated by *A$*. Returns the current output point as an NR1 format.

Example

```
:MEMory:FFTPOint G1,100
```

Sets the output point for FFT data on the graph 1 to 100.

When allowed In FFT.

■ Queries the FFT data at the output point.

Syntax

query only	:MEMory:FFTData?
response	*A* unit, *B* unit

A = x-axis data (in <NR3> numerical format)

B = y-axis data (in <NR3> numerical format)

Explanation Returns the x-axis and y-axis FFT data at the output point specified by the instruction :MEMORY:FFTPOint in <NR3> numerical format.
When this command is executed, only one output point is calculated, and then the specified output point is increased by one. By executing this command repeatedly, a continuous set of data can be obtained.

Example

```
:MEMory:FFTPOint G1,100
:MEMory:FFTData?
```

Returns the x-axis and y-axis FFT data at points of 100 on graph 1.

When allowed In FFT.

6. CALCulate command (Calculation setting and querying)

:CALCulate

■ Enables and disables, and queries decision for waveform parameter calculation.

Syntax

command	:CALCulate:COMP *NO$, A$*
query	:CALCulate:COMP? *NO$*
response	*NO$, A$*
	NO$ = NO1 to NO4
	A$ = OFF, ON

Explanation Enables and disables the decision for the waveform parameter calculation.
Returns, as character data, the current enablement state of the decision for the waveform parameter calculation.

Example

```
:CALCulate:COMP NO1, ON
```

Sets the decision of the calculation result of NO1 to ON.

When allowed In MEM.

■ Sets and queries upper and lower limits for decision for waveform parameter calculation.

Syntax

command	:CALCulate:COMPArea *NO$, upper, lower*
query	:CALCulate:COMPArea? *NO$*
response	*NO$, upper* <NR3>, *lower* <NR3>
	NO$ = NO1 to NO4
	upper, lower = -9.9999E+29 to +9.9999E+29

Explanation Sets the upper limit and the lower limit for the decision for the waveform parameter calculation designated by *NO$*.
Returns the settings of the upper limit and the lower limit for the decision for the waveform parameter calculation designated by *NO$* as NR3 numerical values.

Example

```
:CALCulate:COMPArea NO1, +1.000E+0, -1.000E+0
```

Sets the decision value for the waveform parameter calculation NO1 to be in the range -1.000E+0 < NO1 < +1.000E+0

When allowed In MEM.

■ Sets and queries waveform processing calculation.

Syntax

command	:CALCulate:WVCALc *A$*
query	:CALCulate:WVCALc?
response	*A$*

A$ = OFF, ON, EXEC (execute)

Explanation Sets the waveform processing calculation.
Returns the current setting of the waveform processing calculation as character data.
Only valid when execution (EXEC) is enabled.

Example

```
:CALCulate:WVCALc ON
```

Sets the waveform processing calculation to ON.

When allowed In MEM.

■ Sets and queries the waveform processing calculation equation.

Syntax

command	:CALCulate:Z *Z$, "A$"*
query	:CALCulate:Z? *Z$*
response	*Z$, "A$"*

Z$ = Z1 to Z16
A$ = calculation equation (up to 80 characters, alphabets in small letter, operator in capital letter)

Explanation Sets the waveform processing calculation equation.
Single quotation marks(') can be used instead of double quotation marks (").
Returns the setting of the waveform processing calculation equation as character data.

Example

```
:CALCulate:Z Z1 'a+b+ABS(CH1)'
```

Sets up the calculation equation for Z1 to be Z1 = a+b+ABC(CH1)

When allowed In MEM.

■ Sets and queries coefficients a to p.

Syntax

command	:CALCulate:FACTor *A$, B*
query	:CALCulate:FACTor? *A$*
response	*A$, B* <NR3>
	A$ = A to P
	B = -9.9999E+29 to +9.9999E+29

Explanation Sets the one of the coefficients which is designated by *A$*.
Returns as an NR3 numerical value the current setting of that one of the coefficients which is designated by *A$*.

Example

```
:CALCulate:FACTor A, +1.234E+1
```

Sets the coefficient a to be equal to +1.234E+1

When allowed In MEM.

■ Sets and queries the display channel for the calculated result.

Syntax

command	:CALCulate:ZDIsplay *Z$, ch$, A$*
query	:CALCulate:ZDIsplay? *Z$*
response	*Z$, ch$ (,A$)*
	Z$ = Z1 to Z4
	ch$ = CH1 to CH4, NONE
	A$* = MANUal, AUTO (when *ch$ is set to CH1 to CH32)

Explanation Displays the calculated result of the calculation equation for *Z$* on the channel designated by *ch$*.
When *A$* is MANUal, displays within upper and lower limits on the variable screen. (When scaling, displays in its unit.)
Returns the currently set display channel of the calculated result of the calculation equation for *Z$* .

Example

```
:CALCulate:ZDIsplay Z1, ch1, MANUal
```

Displays the calculated result of the waveform processing calculation equation for Z1 on channel 1. Displays the range between upper and lower limits for the channel 1 on the variable screen.

When allowed In MEM.

■ Sets the moving averaging.

Syntax

command	:CALCulate:MOVE *Z$*, *A*
query	:CALCulate:MOVE? *Z$*
response	*Z$*, *A* <NR1>
	Z$ = Z1 to Z16
	A = 0 to 4000 <NR1>

Explanation Sets the moving averaging for the calculation designated by *Z$*.
Returns as an <NR1> numerical value the current setting of the value of the moving averaging for the calculation designated by *Z$*.

Example

```
:CALCulate:MOVE Z1, 200
```

Sets the moving averaging of Z1 equation to 200.

When allowed In MEM.

■ Sets the parallel movement.

Syntax

command	:CALCulate:SLIDe *Z$*, *A*
query	:CALCulate:SLIDe? *Z$*
response	*Z$*, *A* <NR1>
	Z$ = Z1 to Z16
	A = -4000 to 4000 <NR1>

Explanation Sets the parallel movement for the calculation designated by *Z$*.
Returns as an <NR1> numerical value the current setting of the value of the parallel movement for the calculation designated by *Z$*.

Example

```
:CALCulate:SLIDe Z1, 200
```

Sets the parallel movement of Z1 equation to 200.

When allowed In MEM.

7. FDISK command (Setting and querying relating to the file)

:FDISK

■ Saves a file.

Syntax command :FDISK:SAVE '*NAME1$. NAME2$*', *A$*, *B$ (,C$)*
:FDISK:SAVE '*NAME1$. NAME2$*', *A$* (when *A$* = Set, Area or in the FFT function)

NAME1$ = file name (8 characters)
NAME2$ = extension (3 characters)
A$ = type of file
Bin: binary data
Text: text data
Set: settings
Area: waveform decision area
A$ = type of file (During memory segmentation or in the R&M function)
BAll: binary data (All blocks (all waveforms) are saved.)
BOne: binary data (One block (the displayed waveform) is saved.)
TAll: text data (All blocks (all waveforms) are saved.)
TOne: text data (One block (the displayed waveform) is saved.)
* In the R&M function
BAll, TAll: Both the MEM and REC waveforms are saved simultaneously.
BOne, TOne: Only the waveform in the display function is saved.
B$ = saved channels
ALL, CH1 to CH4, LOGIC
C$ = spacing (text only)
OFF, 1_2 to 1_1000

Explanation Saves the information specified by *A$*. If an attempt is made to save to a filename that already exists, an execution error is generated.
Double quotation marks (") can be used instead of single quotation marks (').

Example `:FDISK:SAVE 'TEST. DAT', Bin, ALL`
Saves all channels of measurement data under the file name 'TEST. DAT'.

When allowed Providing that measurement operation is not taking place.

8. GRAPh Command (Commands relating to graphics editor)

:GRAPh

■ Enables and disables, and queries the enablement of the graphics editor.

Syntax

command :GRAPh:EDIT *A$*
query :GRAPh:EDIT?
response *A$*
A$ = OFF, ON

Explanation Enables and disables the graphic editor mode.
Returns whether or not the graphic editor mode is enabled as character data.

Example

```
:GRAPh:EDIT ON
```

Sets the graphic editor mode to ON.

When allowed In MEM in SINGLE, XY format and in FFT in SINGLE, Nyquist format.

■ Paints the drawing.

Syntax

command :GRAPh:PAINT *X, Y*
X = x-coordinate
Y = y-coordinate

Explanation Begins solid fill from the point specified by (X, Y).
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed In MEM and FFT, when in the editor mode.

■ Parallel movement

Syntax

command :GRAPh: PARAllel *high, low, right, left*
high, low, right, left = 0 to 10.00 (div)

Explanation Carries out a parallel movement of the drawing.
The *high* and *low* parameters and the *right* and *left* parameters are set in units of 0.05 steps.

When allowed In MEM and FFT, when in the editor mode.

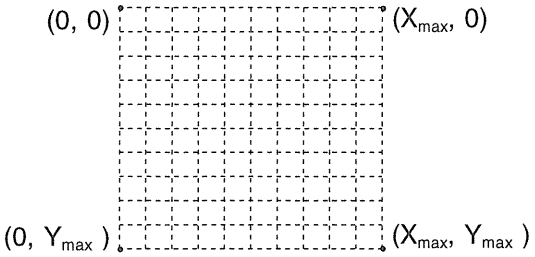
■ Draws a line.

Syntax command :GRAPh: LINE *X1, Y1, X2, Y2*

X1, *X2* = x-coordinates

Y1, *Y2* = y-coordinates

Explanation Draws a line from (*X1*, *Y1*) to (*X2*, *Y2*).



Display format	X_{max}	Y_{max}
MEM (SINGLE)	500	400
MEM (XY)	400	400
FFT	400	400

Example :GRAPH:LINE 10,20,100,200

Draws a line from (10, 20) to (100, 200).

When allowed In MEM and FFT, when in the editor mode.

■ Erases the line.

Syntax command :GRAPh:ERASe *X1, Y1, X2, Y2*

X1, X2 = x-coordinates

Y1, Y2 = y-coordinates

Explanation Erases the line from (*X1*, *Y1*) to (*X2*, *Y2*).
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed In MEM and FFT, when in the editor mode.

■ Loads a waveform into the editor.

Syntax command :GRAPh:STORage

Explanation Loads a waveform into the editor.

When allowed In MEM and FFT, when in the editor mode.

■ Reverses the video of the drawing.

Syntax command :GRAPh:REVErse

Explanation Reverses the video of the drawing.

When allowed In MEM and FFT, when in the editor mode.

■ Clears all drawing.

Syntax command :GRAPh:ALLClear

Explanation Clears the entire drawing.

When allowed In MEM and FFT, when in the editor mode.

■ Clears drawing.

Syntax command :GRAPh: CLEAr *X1, Y1, X2, Y2*

X1, *X2* = x-coordinates

Y1, *Y2* = y-coordinates

Explanation Clears the rectangle with the points (*X1*, *Y1*) and (*X2*, *Y2*) at diagonally opposite corners.
Refer to the :GRAPh:LINE command for details of X and Y.

When allowed In MEM and FFT, when in the editor mode.

■ Undoes the drawing.

Syntax command :GRAPh:UNDO

Explanation Reverses the effect of the immediately previous editor command.

When allowed In MEM and FFT, when in the editor mode.

■ Saves the drawing (decision area).

Syntax command :GRAPh:SAVE

Explanation Saves the decision area created with the editor in the internal memory.

When allowed In MEM and FFT, when in the editor mode.

Chapter 7
8835 Specifications

7.1 General Specifications

7.1.1 Basic specifications

Measurement functions	<table><tr><th>Measurement function</th><th>Feature</th><th>Version</th></tr><tr><td>Memory recorder</td><td>High-speed data saving</td><td rowspan="3">Basic version</td></tr><tr><td>Recorder</td><td>Real time recording</td></tr><tr><td>RMS recorder</td><td>For commercial power supplies</td></tr><tr><td>Recorder & Memory</td><td>Real time recording & High-speed data saving</td><td rowspan="2">Advanced version</td></tr><tr><td>FFT</td><td>Frequency analysis</td></tr></table>
Number of channels (maximum)	4 analog channels + 16 logic channels (The logic channels are standard equipment for the 8835, common ground with main unit)
Memory capacity	500 K words When 1 channel is in use: 12 bits × 500 K words /channel When 2 channels are in use: 12 bits × 200 K words /channel When 4 channels are in use: 12 bits × 100 K words /channel Memory expansion possible with SRAM PC cards (see Appendix)
Maximum sampling period	1 μs (all channels simultaneously) (Maximum sampling speed: 1 MS/s, all channels simultaneously)
Time axis accuracy	±0.01% (difference between grid and actual time)
Input method	Plug-in 2-ch analog units
External control connections	External trigger input, trigger output, GO/NG output, external start/stop, print input
Time measurement functions	Auto calendar with automatic leap year, 24 hour clock
Backup battery and lifetime	Used for clock and to preserve waveforms and settings, at least 10 years (reference value at 25℃)
Operational ranges for temperature and humidity	Temperature: 5℃ to 40℃ Relative humidity: 10% to 90% RH (with no condensation)

Operating place	Max. 2000 m height, indoors
Temperature and humidity ranges for assured accuracy	Temperature: 23±5℃ Relative humidity: 10% to 90% RH (with no condensation)
Temperature and humidity ranges for storage	Temperature: -10℃ to 50℃ Relative humidity: 20% to 90% RH (with no condensation)
Insulation resistance	At least 100 MΩ/500 VDC
Dielectric strength	One minute at 1.35 kVAC between the main unit and the power supply One minute at 3.7 kVAC between the input units and the main unit, and between the input units
Power supply	Rated power voltage 100 to 120 VAC, 200 to 240 VAC (auto-switching) Rated power frequency 50/60 Hz 10 to 28 VDC (the optional DC power adapter is used) (Voltage fluctuations of 10% from the rated supply voltage are taken into account.)
Maximum rated power	AC: 180 VA (65 W) (when 2 8936 analog units are installed) DC: 80 VA (80 W) (when 2 8936 analog units are installed)
Dimensions	285 (W) × 220 (H) × 132 (D) mm (excluding projections)
Mass	Approx. 4.5 kg
Standards applying	EMC EN55011:1991+A1:1997+A2:1996, Group 1, Class A EN50082-1:1992 EN61000-3-2:1995+A3:1997 EN61000-3-3:1995 Safety EN61010-1:1993+A2:1995 Voltage input: Pollution Degree 2, Overvoltage Category II (anticipated transient overvoltage: 4000 V) Power supply: Pollution Degree 2, Overvoltage Category II (anticipated transient overvoltage 2500 V)

7.1.2 Recorder

Method of recording	Thermosensitive recording method using a thermal line head
Recording paper	Roll type thermosensitive paper, 110 mm × 30 m (long)
Width of recording	Total recording width: 104 mm±0.3 mm (832 dots) Waveform portion: 100 mm±0.3 mm f.s. (1 DIV=10 mm)
Recording speed	Approx. 25 mm/s max.
Paper feed accuracy	±1% (25℃, 60% RH)

7.1.3 Display

Display language	Japanese/English (selectable)
Screen	6.4 inch TFT color LCD display (640 × 480 dots)
Display resolution	In the memory recorder, recorder and RMS recorder functions (1 DIV= 50 (horizontally) × 46 (vertically) dots) · Waveform: 10 DIV × 10 DIV f.s. · Text: 40 characters × 30 lines In the X-Y CONT recorder function · Waveform: 10 DIV × 10 DIV f.s. · Text: 40 characters × 30 lines
Dots spacing	0.214 (H) × 0.202 (V) mm
Backlight lifetime	20000 hours

7.1.4 External Data Storage

(1) Floppy disk

Device	3.5-inch floppy disk drive
Capacity	· 1.44 MB (2HD) (IBM PC/AT compatible or NEC PC-9801 series with 3-mode drive) · 1.2 MB (2HD) (NEC PC-9801 series) · 720 KB (2DD) (IBM PC/AT compatible)
Data format	MS-DOS format*1
Data stored	Settings, measurement data, waveform decision area (advanced version), screen data (Measurement data can be saved between cursors A and B.)

(2) PC card

Expansion slot	· PC card standard (1 slot) · Accepts TYPE I, II, III PC cards
Card types	SRAM card, flash ATA card, hard disk drive card (HDD)
Card capacity	32 MB max. (SRAM), 528 MB max. (flash, HDD)
Data format	MS-DOS format*1
Data stored	Settings, measurement data, waveform decision area (advanced version), screen data (Measurement data can be saved between cursors A and B.)

*1: MS-DOS is the registered trademark of Microsoft Corporation.

7.1.5 Memory Expansion

Memory capacity after expansion	1 M words · When 1 channel is in use: 12 bits × 1 M words /channel · When 2 channels are in use: 12 bits × 500 K words /channel · When 4 channels are in use: 12 bits × 200 K words /channel 2 M words · When 1 channel is in use: 12 bits × 2 M words /channel · When 2 channels are in use: 12 bits × 1 M words /channel · When 4 channels are in use: 12 bits × 500 K words /channel
Installation method	Memory can be expanded by inserting a PC card into the slot behind the cover on the bottom of the unit.
PC card type	SRAM PC card (PC card standard)
PC card capacity	1 MB min. (expanded to 1 M words) 4 MB min. (expanded to 2 M words)
PC card speed rating	Within 200 ns

7.1.6 Interface

GP-IB	· Complies with IEEE 488.1-1987 · Remote control including input unit is possible. · The optional 9558 GP-IB CARD is used.
RS-232C	· Complies with EIA RS-232C · Remote control including input unit is possible. · The optional 9557 RS-232C CARD is used.

7.1.7 Others

Accessories	Grounded three-core power cord	1
	Ground adapter	1
	Recording paper	1
	Protective cover	1
	Roll paper attachment	2
	PC card protector	1
	Instruction Manual	1

Options

9540 FUNCTION UP DISK
8936 ANALOG UNIT
8937 VOLTAGE/TEMPERATURE UNIT
8939 STRAIN UNIT
9439 DC POWER ADAPTER
9221 RECORDING PAPER (10 rolls)
9557 RS-232C CARD
9558 GP-IB CARD
9528 RAM CARD (512 KB)
9596 RAM CARD (1 MB)
9597 RAM CARD (4 MB)
9388 CARRYING CASE
9320 LOGIC PROBE
9321 LOGIC PROBE
9303 PT *
9197 CONNECTION CABLE (for high voltage, maximum input voltage 500 V)
9198 CONNECTION CABLE (for low voltage, maximum input voltage 300 V)
9199 BNC TO BANANA CONNECTOR
9305 TRIGGER CORD
220H PAPER WINDER
9018 CLAMP ON PROBE (10 to 500 A, 40 Hz to 3 kHz)
9132 CLAMP ON PROBE * (20 to 1000 A, 40 Hz to 1 kHz)
9270 CLAMP ON SENSOR * (20 A, 5 Hz to 5 kHz)
9271 CLAMP ON SENSOR * (200 A, 5 Hz to 50 kHz)
9272 CLAMP ON SENSOR * (20/200 A, 5 Hz to 10 kHz)
9277 UNIVERSAL CLAMP ON CT * (20 A, DC to 100 kHz)
9278 UNIVERSAL CLAMP ON CT * (200 A, DC to 100 kHz)
9279 UNIVERSAL CLAMP ON CT * (500 A, DC to 20 kHz)
9555 SENSOR UNIT * (used with the 9270 to 9272, and the 9277 to 9279)

*: Not complied with the CE marking

7.2 Trigger Unit

Trigger Method

Digital comparison

Trigger modes

Function	Available trigger modes	Version
Memory recorder	Single, repeat, auto	Basic version
Recorder	Single, repeat	
RMS recorder	Single, repeat	
Recorder & Memory	Single, repeat	Advanced version
FFT	Single, repeat, auto	

Trigger source

CH1 to CH4, logic CHA to CHD
- External trigger
- Manual trigger
- Timer trigger

Sources can be set on or off. When all sources are off, the unit is in the free-run state.

Trigger conditions can be set for each channel individually.

With an external trigger, the triggering occurs on a falling edge of 2.5 V, or when the terminals are shorted together.

Trigger conditions

Logical AND or OR of any trigger sources

Trigger types (analog)

(1) Level trigger
- Digital setting of voltage values for full scale
- Triggering occurs at rising edge (falling edge) of set value.

(2) Window-in, window-out trigger
- Upper and lower trigger levels can be set.
- Triggering occurs when the waveform enters or leaves the defined area.

(3) Voltage drop trigger
Triggering occurs when the peak of the voltage falls lower than the setting level (for commercial power supplies).

(4) RMS level trigger
Digital setting of rms values
Triggering occurs at rising edge (falling edge) of set value (for commercial power supplies and DC).

(5) Period trigger
The period trigger setting determines the period reference voltage and period range beyond which the measured rise (or fall) of the set voltage results in tripping of the period trigger.

Trigger type (logic)

Pattern trigger specified by 1, 0, and ×
(× means that either 1 or 0 is fine.)

Trigger filter

- Memory recorder and recorder & memory functions
  OFF, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, 2.5, 5.0, 10.0 DIV
- Recorder and X-Y CONT recorder functions (advanced version)
  ON, OFF

Trigger level resolution

0.25 % f.s. (f.s. = 10 DIV)

Pre-trigger

Memory recorder function, recorder & memory function (advanced version)
0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, -95 %
RMS recorder function
0, 5, 10 DIV

Trigger timing	Start, stop, start and stop (recorder function)
Trigger output	· Open collector output (with 5 V output voltage, active low) · Pulse width 10 ms min.
Trigger input and output connectors	Mini-jack (3.5 mm dia.)

7.3 Memory Recorder Function

Time axis	100, 200, 500 μs/DIV 1, 2, 5, 10, 20, 50, 100, 200, 500 ms/DIV 1, 2, 5, 10, 30 s/DIV 1, 2, 5 min/DIV
Time axis resolution	100 points/DIV
Sampling period	1/100 of the time axis
Recording length	Any setting(*1) or preset setting (see below) · No memory expansion 20, 50, 100, 200, 500, 1000, 2000(*2, *3), 5000(*3) DIV · Expanded to 1 M words 20, 50, 100, 200, 500, 1000, 2000, 5000(*2, *3), 10000(*3) DIV · Expanded to 2 M words 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000(*2, *3), 20000(*3) DIV
Screen · print format	Single, dual, quad screen display, X-Y (dot), X-Y (line)
Recording line display	12-color
Superimposition function	Provided
Waveform magnification/ compression	· Time axis ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, ×1/500, ×1/1000, ×1/2000 · Voltage axis ×10, ×5, ×2, ×1, ×1/2
Waveform scrolling	Available in the left/right directions
Auto-print	ON/OFF switchable. Automatically prints the memorized waveform
Manual print	Available
Partial print	Prints between the A and the B cursors
Print smoothing function	When set, a smoothed waveform is printed, with twice the density in the time axis direction.
Logging function	Records measured data as digital values
Variable function	Provided

*1: Set from 1 division to the maximum number of divisions at 1-division intervals

*2: When 2 channels are in use

*3: When 1 channel is in use

7.4 Recorder Function

Time axis	10(*1), 20(*1), 50(*1), 100(*1), 200(*1), 500 ms/DIV 1, 2, 5, 10, 30 s/DIV 1, 2, 5, 10, 30 min/DIV 1 h/DIV
Time axis resolution	100 points/DIV (with the printer)
Sampling period	1, 10, 100 μs, 1, 10, 100 ms (Can be selected, from 1/100 of the time axis setting)
Recording length	Any setting (*2) or preset setting (see below) · No memory expansion 20, 50, 100, 200, 500 DIV, continuous(*3) · Expanded to 1 M words 20, 50, 100, 200, 500, 1000 DIV, continuous(*3) · Expanded to 2 M words 20, 50, 100, 200, 500, 1000, 2000 DIV, continuous(*3)
Screen · print format	Single, dual, quad screen display
Recording line display	12-color
Waveform magnification/ compression	· Time axis ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50 · Voltage axis ×10, ×5, ×2, ×1, ×1/2
Waveform storage	Last 500 divisions of data saved in memory (*4) Can be checked by reverse scrolling and reprinted
Print function	Can be set to ON, OFF, or reprint. (*4)
Additional recording function	ON/OFF (*5)
Logging function	Records measured data as digital values
Variable function	Provided
Virtual record function	Provided (*6)

*1: Display shows real-time recording data, but printer output is at 20 mm/s.

*2: Set from 1 division to the maximum number of divisions at 1-division intervals

*3: With time axis 10 to 200 ms/DIV, "continuous" is not possible with printer ON.

*4: · No memory expansion: 500 DIV
· Expanded to 1 M words : 1000 DIV
· Expanded to 2 M words: 2000 DIV

*5: Additional recording function (recording data without paper)
· When enabled, the memory is regarded as printer paper. Recording starts at the end of previous data, without erasing them. When the recording length*4 has been reached, old data will be overwritten.
· When OFF, previous data will be erased. Set to ON if erasing is not desired.

*6: Virtual record function

Although real-time recording to the recording paper is not possible in the high-speed range (10 to 200 ms/DIV), the waveforms are stored to the memory and can therefore be monitored on the screen. The last 500 divisions of each waveform(*4) are retained in memory before the measurement is complete. If the recording length is not set to "continuous," the printer can also be operated, enabling the waveforms to be printed out later.

7.5 RMS Recorder Function

Time axis	5, 10, 30 s/DIV 1, 2, 5, 10, 30 min/DIV 1 h/DIV
Time axis resolution	100 lines/DIV (with the printer)
Sampling period	20 rms data/s (200 μ s fixed)
RMS accuracy	±3% f.s. (at 50/60 Hz±2 Hz, DC) (f.s.=10 DIV)
Measuring object	Commercial power supplies (50/60 Hz), DC
Recording length	Any setting (*1) or preset setting (see below) · No memory expansion 20, 50, 100, 200, 500 DIV, continuous · Expanded to 1 M words 20, 50, 100, 200, 500, 1000 DIV, continuous · Expanded to 2 M words 20, 50, 100, 200, 500, 1000, 2000 DIV, continuous
Screen · print format	Single, dual, quad screen display
Recording line display	12-color
Waveform magnification/ compression	· Time axis ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50 · Voltage axis ×10, ×5, ×2, ×1, ×1/2
Waveform storage	Last 500 divisions of data saved in memory (*2) Can be checked by reverse scrolling and reprinted
Print function	Can be set to ON, OFF, or reprint. (*2)
Additional recording function	ON/OFF (*3)
Logging function	Records measured data as digital values

*1: Set from 1 division to the maximum number of divisions at 1-division intervals

*2: · No memory expansion: 500 DIV
· Expanded to 1 M words: 1000 DIV
· Expanded to 2 M words: 2000 DIV

*3: Additional recording function (recording data without paper)
When enabled, the memory is regarded as printer paper. Recording starts at the end of previous data, without erasing them. When the recording length (500 DIV)*3 has been reached, old data will be overwritten.

7.6 X-Y CONT Recorder Function

X channel	Any of CH 1 to 4
Y channel	Any of CH 1 to 4 except X channel (up to 3 combinations)
Effective recording dimensions	100 mm × 100 mm (10 DIV × 10 DIV)
Spatial resolution	25 dots/DIV (with the display) 100 dots/DIV (horizontally), 80 dots/DIV (vertically) (with the printer)
Sampling period	Dot display: 300 μs fixed Line display: 300 μs (min.), 25 ms (max.)
Recording time	No limit
Interpolation function	dot, line
Monitoring function	Real time display on screen
Print function	Manual print, hard copy
Variable function	Provided
Vernier function	Provided

7.7 Recorder & Memory Function (Advanced Version)

Time axis	· Recorder 500 ms/DIV 1, 2, 5, 10, 30 s/DIV 1, 2, 5, 10, 30 min/DIV 1 h/DIV · Memory recorder 100, 200, 500 μs/DIV 1, 2, 5, 10, 20, 50, 100, 200, 500 ms/DIV 1, 2, 5, 10, 30 s/DIV 1, 2, 5 min/DIV
Time axis resolution	100 points/DIV
Sampling period	1, 10, 100 μs, 1, 10, 100 ms (Can be selected, from 1/100 of the time axis setting).....recorder 1/100 of the time axis.....memory recorder
Recording length	Any recording length (*1) or preset setting (see below) · No memory expansion · No memory expansion 20, 50, 100, 200 DIV, continuous (recorder) 20, 50, 100, 200, 500 DIV (memory recorder) · Expanded to 1 M words 20, 50, 100, 200, 500 DIV, continuous (recorder) 20, 50, 100, 200, 500, 1000 DIV (memory recorder) · Expanded to 2 M words 20, 50, 100, 200, 500, 1000 DIV, continuous (recorder) 20, 50, 100, 200, 500, 1000, 2000 DIV (memory recorder)
Screen · print format	Single, dual, quad screen display
Display	Switchable between recorder and memory recorder waveforms
Printer output	During measurement operation, recorder waveform only. After data capture, printout of recorder waveform as on display or memory recorder waveform.
Waveform storage (recorder)	Last 200 divisions of data saved in memory (*2) Can be checked by reverse scrolling and reprinted
Additional recording function	ON/OFF (*3)
Trigger source	Timer trigger or off (recorder) CH1 to CH4, CHA to CHD and external trigger (memory recorder)
Ancillary function	Superimposition, sequential save

*1: Set from 1 division to the maximum number of divisions at 1-division intervals

*2: · Expanded to 1 M words: 500 DIV
· Expanded to 2 M words: 1000 DIV

*3: Additional recording function (recording data without paper)

7.8 FFT Function (Advanced Version)

FFT channel mode	1 channel FFT, 2 channel FFT
FFT range setting	133 mHz to 400 kHz
Dynamic range	72 dB (logical value)
Number of sampling points	1000
Frequency resolution	1/400
Antialiasing filter	Automatic cutoff frequency selection linked to frequency range
Analysis channel setting	1 channel FFT, 2 channel FFT for any channel
FFT analysis mode setting	Storage waveform, linear spectrum, RMS spectrum, power spectrum, cross-power spectrum, auto-correlation function, histogram, transfer function, cross-correlation function, unit-impulse response, coherence function, octave analysis
Display format setting	Single, dual screen display, Nyquist display
Windows	Rectangular, hanning, exponential
Display scale	Linear scale, log scale, phase
Print function	As per the memory recorder function, excluding partial print function
Averaging function	Additive average of time and frequency domains (2, 4, 8 to 256 samples)

7.9 Advanced Version

It is possible to upgrade the basic version to the advanced version, using the feature upgrade disk available as an option.

Measurement functions	Recorder & Memory (real time recording & high-speed data saving FFT (frequency analysis)

Computation functions (memory recorder function)	
Waveform processing calculations	Arithmetic operations, absolute value, exponents, common logarithms, square roots, moving average, 1st and 2nd derivatives, 1st and 2nd integrals, time axis parallel shift
Averaging function	Additive averaging, exponential averaging (2, 4, 8 to 256 samples)

Waveform decision (memory recorder function)	
① Waveform area decision	Waveform decision based on reference area for Y-T waveform, X-Y waveform, or FFT results
Decision modes	Out: fail if any part of waveform is outside reference area All out: fail if whole of waveform is outside reference area
Stop modes	GO (pass) stop, NG (fail) stop, GO & NG stop Printer output or waveform save at stop
Decision output	GO and NG outputs on rear panel: open collector outputs (with 5 V output, active low, pulse width 10 ms min.)
② Waveform parameter decision	Decision based on setting minimum and maximum values for waveform parameter calculation results
Graphics editor	Provided, used for defining an arbitrary reference area for waveform decisions
Editor commands	Line (straight line segment), paint (filling in), storage (waveform input), erase (eraser), parallel (parallel displacement), reverse (reverse video), clear (partial deletion), all clr (screen deletion), undo, save, end

Memory segmentation	
Memory segmentation function	Memory can be segmented among channels.
Numberof segments	Maximum 256 Multi-block Sequential saving

7.10 Auxiliary Function

Waveform parameter calculations	Average value, effective value, peak-to-peak value, maximum value, time to maximum value, minimum value, time to minimum value, period, frequency, rise time, fall time, area value, XY area value, standard deviation

7.11 Others

Comment printing	Function, channel, input range, zero position, trigger time, DIV and other information can be printed.
Cursor measurement function	Time difference, voltage difference or number of cycles between cursors A and B, voltage at each cursor, time from trigger
Scaling function	Specifiable for each channel
Comment input function	Provided
Display copy function	Provided
List · gauge functions	ON, OFF
Waveform backup function	Provided
Starting status backup function	Provided
Auo setup function	When the power is turned on, settings and a waveform decision area stored on a floppy disk can be automatically loaded. (waveform decision area: advanced version)
Auto save function	Provided
Remote control	Start, stop and print control terminals (threshold value: 2.5 V ±1 V, active low, or terminal short)
Auto-range function	Provided, selects optimum time axis and voltage axis for input waveform
VIEW function	· In memory recorder and recorder functions, shows relative positions of displayed data within recording length and to full-scale point. · In memory recorder function, when memory segmentation is used, usage condition of each block is shown (advanced version).
On-line help	Pressing the HELP key brings up a brief explanation of procedures for using the current function or feature.
GP-IB	· Complies with IEEE 488.1-1987 · Remote control including input unit is possible. · The optional 9558 GP-IB CARD is used.
RS-232C	· Complies with EIA RS-232C · Remote control including input unit is possible. · The optional 9557 RS-232C CARD is used.
Key lock function	Locks all keys except the KEY LOCK key
LCD back lighting	ON, OFF (with the auto OFF function)
List print function	· Settings output after waveform data print (selectable on/off) · Output by pressing PRINT key other than on display screen

7.12 DC Power Adapter (9439) Specifications

- Used for operating the unit on DC power.
- Connect DC power adapter output to 8835, and connect DC source (battery etc.) to adapter input.
- Accuracy at 23℃±5℃, 35% to 80% RH after 30-minute warming-up time
- Accuracy guaranteed for 1 year

Input voltage range	10 to 28 VDC
Rated output voltage	24 VDC
Output voltage accuracy	24±1 VDC
Rated output current	2.2 A
Efficiency	70% min. (under rated output conditions)
Output over-current protection	Detected at 110%+15% or -5% of rated output current (output shutoff)
Output over-voltage protection	Detected at 115%±5% of rated output voltage (output shutoff)
Maximum rated power	80 VA
Operational ranges for temperature and humidity	Same as the 8835 MEMORY HiCORDER
Temperature and humidity ranges for storage	-10℃ to 50℃, 20% to 90% RH (with no condensation)
Operating place	Same as the 8835 MEMORY HiCORDER
Output indication	Output indicated by the red LED
When used together with AC power supply	When both AC power and the 9439 DC power adapter are connected to the 8835, AC power has priority. When AC power shuts off, the 8835 switches to DC.
Dielectric strength	One minute at 700 VDC (between the input and the output, and between the input and the main unit)
Insulation resistance	100 MΩ/500 VDC
Dimensions	152 (W) × 92 (H) × 54 (D) mm Input cable: 2000 mm±100 mm Output cable: 300 mm±30 mm
Mass	Approx. 770 g
Accessories	None

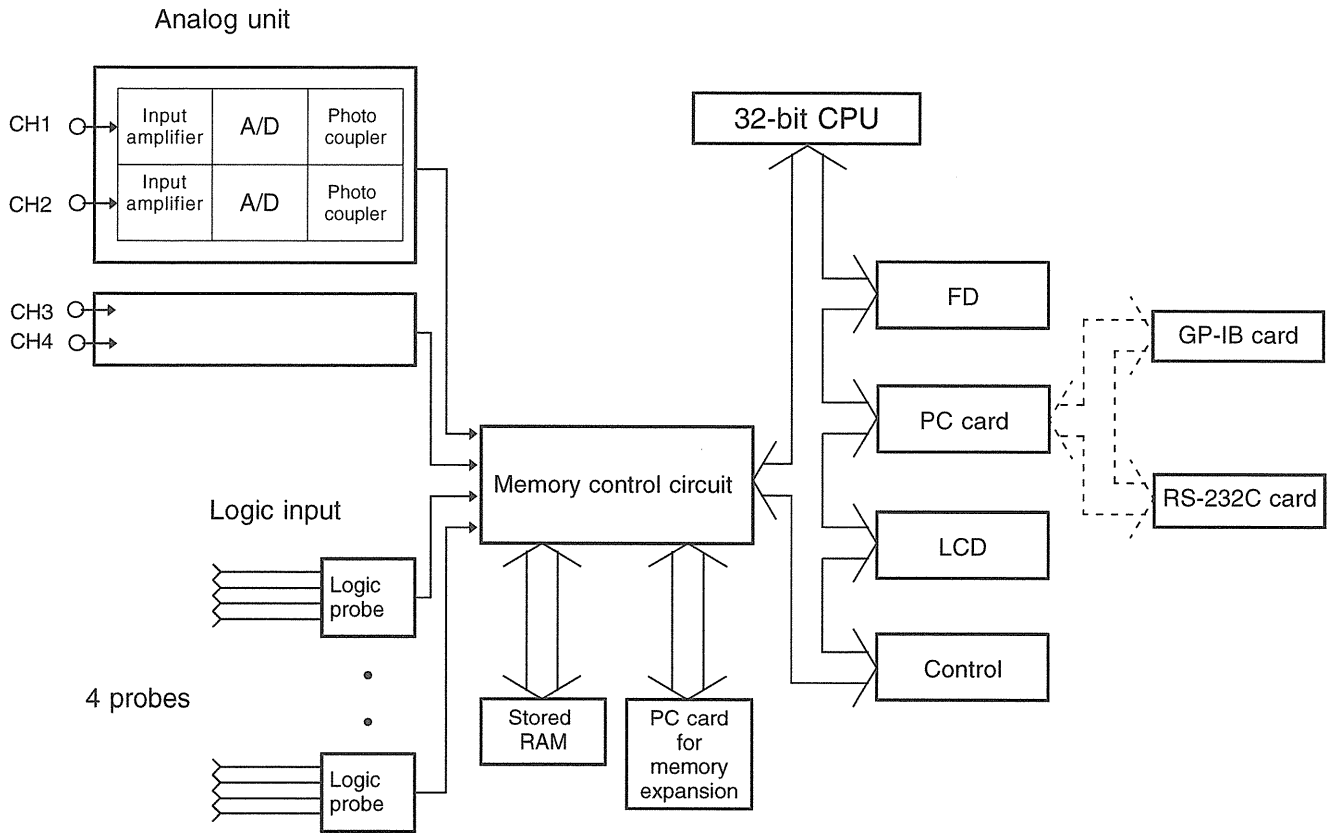
7.13 System Operation

System operation is explained according to the block diagram.

(1) All system operations are controlled by a 32-bit RISC CPU.

(2) The input unit 8936 incorporates high-speed 12-bit A/D converters which are connected to the main unit via a photocoupler integrated in each input unit. Each channel has its own power supply, to assure electrical isolation from the main unit.

(3) Measurement data stored in memory are processed by the CPU, displayed on the LCD screen, and output to the printer. Output to floppy disk, the SRAM card, flash ATA card, GP-IB card or RS-232C card is also provided.



Block Diagram

Table 1 (1/2)
Sampling period and maximum recording length for various time axis settings

1. Memory recorder function

Time axis range	Sampling period	Max. recording length (*1)		
		5000 DIV	10000 DIV (*2)	20000 DIV (*2)
100 μs/DIV	1.00 μs	500 ms	1 s	2 s
200 μs/DIV	2.00 μs	1 s	2 s	4 s
500 μs/DIV	5.00 μs	2.5 s	5 s	10 s
1 ms/DIV	10.0 μs	5 s	10 s	20 s
2 ms/DIV	20.0 μs	10 s	20 s	40 s
5 ms/DIV	50.0 μs	25 s	50 s	1 min 40 s
10 ms/DIV	100 μs	50 s	1 min 40 s	3 min 20 s
20 ms/DIV	200 μs	1 min 40 s	3 min 20 s	6 min 40 s
50 ms/DIV	500 μs	4 min 10 s	8 min 20 s	16 min 40 s
100 ms/DIV	1.00 ms	8 min 20 s	16 min 40 s	33 min 20 s
200 ms/DIV	2.00 ms	16 min 40 s	33 min 20 s	1 h 6 min 40 s
500 ms/DIV	5.00 ms	41 min 40 s	1 h 23 min 20 s	2 h 46 min 40 s
1 s/DIV	10.0 ms	1 h 23 min 20 s	2 h 46 min 40 s	5 h 33 min 20 s
2 s/DIV	20.0 ms	2 h 46 min 40 s	5 h 33 min 20 s	11 h 6 min 40 s
5 s/DIV	50.0 ms	6 h 56 min 40 s	13 h 53 min 20 s	1 d 3 h 46 min 40 s
10 s/DIV	100 ms	13 h 53 min 20 s	1 d 3 h 46 min 40 s	2 d 7 h 33 min 20 s
30 s/DIV	300 ms	1 d 17 h 40 min 0 s	3 d 11 h 20 min 0 s	6 d 22 h 40 min 0 s
1 min/DIV	600 ms	3 d 11 h 20 min 0 s	6 d 22 h 40 min 0 s	13 d 21 h 20 min 0 s
2 min/DIV	1.20 s	6 d 22 h 40 min 0 s	13 d 21 h 20 min 0 s	27 d 18 h 40 min 0 s
5 min/DIV	3.00 s	17 d 8 h 40 min 0 s	34 d 17 h 20 min 0 s	69 d 10 h 40 min 0 s

Time axis resolution: 100 points/DIV
(*1): When using one channel only
(*2): When expanded with SRAM PC card

Table 1 (2/2)
Time axis resolution and maximum recording length for various time axis settings

2. Recorder function

Time axis range	Chart speed	Approximate recording time on one roll (30 m) of recording paper	Time axis resolution
10 ms/DIV	20 mm/s (*1)	30 s	100 points/DIV
20 ms/DIV	20 mm/s (*1)	1 min	
50 ms/DIV	20 mm/s (*1)	2.5 min	
100 ms/DIV	20 mm/s (*1)	5 min	
200 ms/DIV	20 mm/s (*1)	10 min	
500 ms/DIV	20 mm/s	25 min	
1 s/DIV	10 mm/s	50 min	
2 s/DIV	5 mm/s	1 h 40 min	
5 s/DIV	2 mm/s	4 h 10 min	
10 s/DIV	1 mm/s	8 h 20 min	
30 s/DIV	20 mm/min	1 d 1 h	
1 min/DIV	10 mm/min	2 d 2 h	
2 min/DIV	5 mm/min	4 d 4 h	
5 min/DIV	2 mm/min	10 d 10 h	
10 min/DIV	1 mm/min	20 d 20 h	
30 min/DIV	20 mm/h	62 d 12 h	
1 h/DIV	10 mm/h	125 d	

(*1): Virtual record

Table 2
Memory capacity and recording length after memory expansion with SRAM PC card

1. Memory recorder function

Card capacity	Memory capacity after expansion	Number of divisions per channel		
		When 1 channel is in use	When 2 channels are in use	When 4 channels are in use
1 MB	1 M words	10000	5000	2000
4 MB	2 M words	20000	10000	5000

2. Recorder and RMS recorder functions

Card capacity	Number of divisions
1 MB	2000
4 MB	5000

Chapter 8
8938 FFT ANALOG UNIT Specifications

8.1 Specifications

Accuracy at 23℃±5℃ (73°F±9°F), 35% to 80% RH after zero adjustment after 60-minute warming-up time
Accuracy guaranteed for 1 year.

Number of input channels	2
Measurement ranges	10, 20, 50, 100, 200, 500 mV/DIV 1, 2, 5, 10, 20, 50 V/DIV
DC amplitude accuracy	±0.4% f.s.
Zero position accuracy	±0.1% f.s. (after zero adjustment)
Temperature characteristic	Gain: ±0.025%f.s./℃ Zero position: ±0.02%f.s./℃ (after zero adjustment)
Frequency characteristic	DC to 400 kHz ±3 dB (DC coupling) 7 Hz to 400 kHz ±3 dB (AC coupling, low cut-off frequency: 7 Hz±20%)
Noise	500 μVp-p typical, 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, 500, 5 k, 100 k ±50% (Hz) -3 dB
Anti-aliasing filter	Cutoff frequency (fc) of 20, 40, 80, 200, 400, 800, 2 k, 4 k, 8 k, 20 k, 40 kHz (selected automatically with anti-aliasing filter ON) Attenuation is -66 dB min. at 1.5 fc.
Input type	Unbalanced (floating)
Input resistance	1 MΩ±1%
Input capacitance	30 pF±10 pF (at 100 kHz)
Input coupling	DC, GND, AC
A/D resolution	12 bits
Maximum sampling speed	1 MS/s (sampling period: 1 μs)
Input terminals	Insulated BNC terminal

Maximum input voltage	400 V DC max.
Insulation resistance / Dielectric strength	One minute at 3.7 kVAC between the input units and the main unit, and between the input units At least 100 MΩ/500 VDC
Maximum rated voltage to earth	400 V AC/DC (between each input channel and main unit, and between input channels)
Operational ranges for temperature and humidity	Same as the MEMORY HiCORDER in which the 8938 is installed
Operating place	Same as the MEMORY HiCORDER in which the 8938 is installed
Temperature and humidity ranges for storage	Temperature: -10℃ to 50℃ (14°F to 122°F) Relative humidity: 80% RH maximum (with no condensation)
Influence of the radiation field	±2% f.s. at 3 V/m
Dimensions	170 (W) × 20 (H) × 148.5 (D) mm (6.69" (W) × 0.79" (H) × 5.85" (D))
Mass	Approx. 290 g (10.2 oz.)
Standards applying	EMC EN55011:1991+A1:1997+A2:1996, Group 1, Class A EN50082-1:1992 Safety EN61010-1:1993+A2:1995 Pollution Degree 2, Overvoltage Category II (anticipated transient overvoltage: 4000 V)

8.2 Safety Requirements

⚠ DANGER

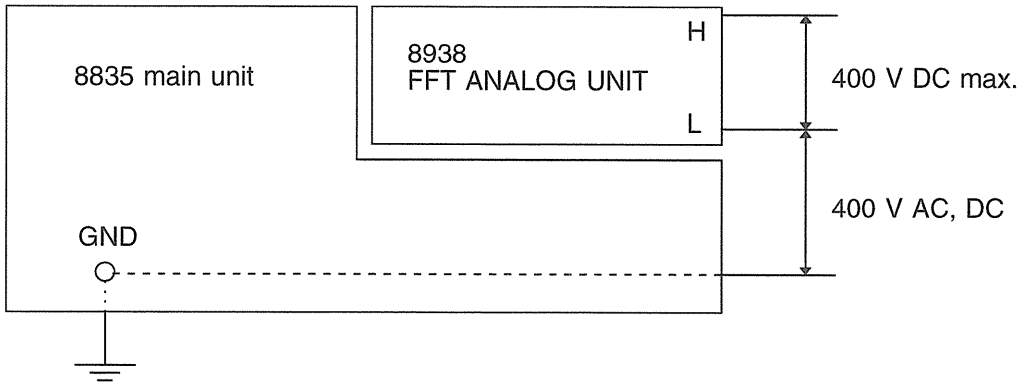
- **The maximum rated voltage to earth (voltage between 8938 input and 8835 frame, and between inputs of other analog units) is 400 V AC/DC. To avoid the risk of electric shock and damage to the unit, take care that voltage between 8938 input and 8835 frame, and between inputs of other analog units does not exceed these ratings.**
- **The maximum input voltage to the 8938 is 400 V DC max. To avoid the danger of electric shock or damage to the equipment, ensure that the applied voltage never exceeds this level.**

⚠ WARNING

- **The maximum rated voltage to earth rating applies also if an input attenuator or similar is used.**
- **When measuring voltages in power lines with high current capability, always connect the probe to the secondary side of the circuit breaker, to avoid the risk of electric shock and damage to the unit.**

⚠ CAUTION

- For safety reasons, only use the specified 9197 or 9198 INPUT CABLE for measurement.
- Before using the unit, make sure that the sheathing on the input cables is not damaged and that no bare wire is exposed. If there is damage, using the unit could cause electric shock. Replace with the specified 9197 or 9198 INPUT CABLE.

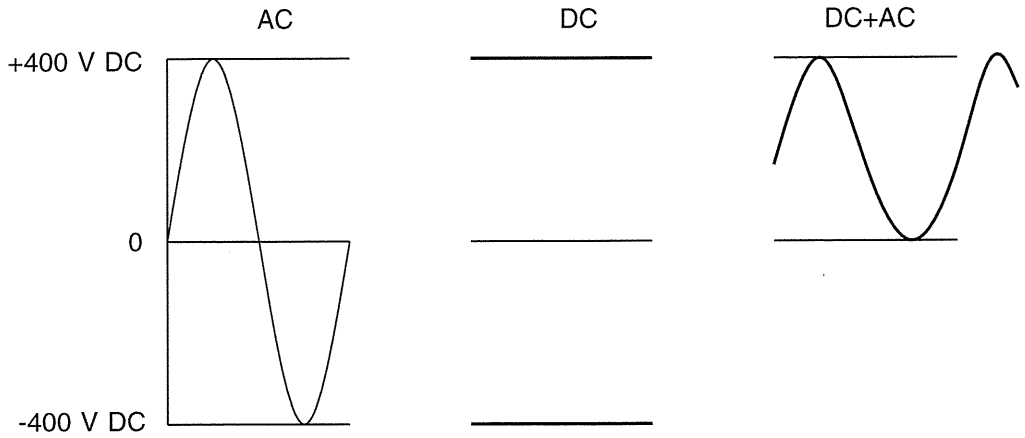


Difference between "400 V AC, DC" and "400 V DC max." indication

400 V AC, DC: Rms value is displayed.

400 V DC max.: Instantaneous value is displayed.

The maximum input voltage is defined as the superposition of DC component and AC peak.



Chapter 9
Appendix

9.1 Error and Warning Messages

The unit produces two levels of message to indicate problems. These are distinguished as follows.

Error messages

(1) The "ERROR" indication appears at the bottom of the screen, followed by the message. This remains until the cause of the error is removed, or the STOP key is pressed.

(2) If the "beep sound" item on the system screen is set to ON, then the beeper sounds intermittently while the message is displayed.

Warning messages

(1) The "WARNING" indication is displayed on the bottom line of the screen, followed by the message, but disappears after a few seconds.

(2) Warning messages also disappear if any key is pressed.

(3) If the "beep sound" item on the system screen is set to ON, then the beeper sounds once only when the message is displayed.

9.1.1 Error Messages

ERROR 1: Set printer paper.	Printer paper has run out. Reload.
ERROR 2: Set printer lever.	The head up/down lever has been left in the up position. Lower it.
ERROR 11: Waint printer initiarize.	Make sure that the external printer is ready to print.
ERROR 12: Set printer power on	Make sure that the external printer is connected or the unit is powered on.
ERROR 13: Paper End	Printer paper has run out. Reload.
ERROR 14: Printer Error.	This indicates an internal printer error.

9.1.2 Warning Messages

WARNING 70: Insert Floppy disk.	No disk is present in the floppy disk drive. Insert one.
WARNING 71: Cannot load. (not 8835 data)	Data cannot be loaded, because it is not a set of data created by the 8835.
WARNING 72: Illegal format.	The floppy disk is not a correctly formatted MS-DOS disk, or is a 2DD, 640 KB format disk.
WARNING 73: Write Protected.	The floppy disk is write-protected. Change the write-protect setting or use a different disk.
WARNING 74: Disk full.	There is insufficient space remaining on the floppy disk.
WARNING 75: File is read only.	File cannot be written or deleted, because it is read-only.
WARNING 76: General failure.	Access to disk is not possible because of some low-level error, such as in formatting or file saving.
WARNING 80: Insert PC card.	No card is present in the PC card slot. Insert one.
WARNING 81: Cannot load. (not 8835 data)	Data cannot be loaded, because it is not a set of data created by the 8835.
WARNING 82: Illegal format.	The PC card is not a correctly formatted MS-DOS disk.
WARNING 83: Write Protected.	The PC card is write-protected. Change the write-protect setting or use a different card.
WARNING 84: Disk full.	There is insufficient space remaining on the PC card.
WARNING 85: File is read only.	File cannot be written or deleted, because it is read-only.
WARNING 86: General failure.	Access to card is not possible because of some low-level error, such as in formatting or file saving.
WARNING 90: File already exists.	File cannot be saved because a file of the same name already exists. Change the file name.

WARNING 91: Directory full	Only a limited number of files and directories can be created in the root directory.
WARNING 92: Directory not empty	The directory is not empty. Delete files in it.
WARNING 93: Disk full	Delete files or use a different media.
WARNING 94: Path name error.	Make sure that the path name does not exceed 127 characters.
WARNING 95: Empty directory name.	Specify a directory name.
WARNING 96: Directory already exists.	A directory of the same name already exists. Change the directory name.
WARNING 97: 2DD type FD.	The floppy disk is a 2DD media. Select the appropriate disk format.
WARNING 98: 2HD type FD.	The floppy disk is a 2HD media. Select the appropriate disk format.
WARNING 99: Conditions for OVERWRITE are not satisfied.	Set the instrument's measurement data, file function, and time axis range settings.
WARNING 201: Set printer paper.	Printer paper has run out. Reload.
WARNING 202: Set printer lever.	The head up/down lever has been left in the up position.
WARNING 205: Invalid. (START)	The key pressed is not valid, because measurement operation is in progress.
WARNING 207: AUTO RANGE failure	The auto ranging function has failed. Check the input signal.
WARNING 208: Cannot SAVE. (Write Protected)	Move the write-protect tab to the unset position.
WARNING 209: Cannot SAVE. (Disk Full)	Delete files or use a different media.
WARNING 213: Invalid. (MEASUREMENT)	Pressed key is invalid, because parameter processing is ON.
WARNING 214: Invalid. (Pre Trigger)	The pre-trigger cannot be set, because the additional recording function is set.
WARNING 300: Cannot START.	Cannot start measurement from SYSTEM screen.
WARNING 301: Invalid (SYSTEM)	The key pressed is not valid on the system screen.
WARNING 324: Ignore in running. (AVERAGE)	Because averaging is used, waveform processing is not carried out during the start operation.
WARNING 325: Ignore in running. (WAVE CALC.)	Because a waveform processing calculation is carried out, vernier adjustment cannot be carried out.
WARNING 327: Invalid. (COMPARISON)	Pressed key is invalid, when waveform evaluation is being carried out.
WARNING 328: Invalid. (OVER LAY)	Operation is not possible, since the overlay function is enabled.
WARNING 329: Wrong format for Comparison	Since the format is not SINGLE or XYsing, a waveform decision is not possible.
WARNING 330: Cannot set. (SHOT too long)	The recording length is too long for the memory segmentation function or a waveform processing calculation to be carried out.
WARNING 334: Cannot set. (AVERAGE)	The memory segmentation function cannot be set together with the averaging function.

WARNING 335: Cannot set. (SEQUENTIAL)	Waveform processing cannot be carried out, because memory segmentation function is active.
WARNING 336: Cannot set. (MULTI BLOCK)	Waveform processing cannot be carried out, because memory segmentation function is active.
WARNING 337: Cannot set. (ROLL MODE)	Superimpose and waveform decision cannot be carried out, because roll mode is active.
WARNING 338: Cannot set. (OVER LAY)	Waveform processing cannot be carried out, because overlay function is active.
WARNING 339: Invalid. (STATUS)	On the status screen, the key pressed is invalid.
WARNING 345: Cannot set. (AND logic trigger)	'AND' cannot be set between the trigger sources using the logic trigger and the RMS level trigger
WARNING 346: Cannot set. (AND rms level)	'AND' cannot be set between the trigger sources using the RMS level trigger and the logic trigger.
WARNING 347: Invalid. (Pre Trigger)	When the trigger is not set, the pre-trigger is invalid.
WARNING 348: Invalid. (V-drop Trigger)	In the time axis range of 100 ms to 5 min, the voltage drop trigger is invalid.
WARNING 351: Cannot set. (Free run)	The pre-trigger setting cannot be made, since all trigger sources are switched off (free run).
WARNING 352: Invalid. (CHAN)	On the CHANNEL screen, the key pressed is invalid.
WARNING 353: Cannot set. (time/div:100ms-5min)	The time axis range whithin which the voltage drop trigger can be used is 100 μs to 50 ms/DIV.
WARNING 380: No data in Ref. Block	When using the memory segmentation function (multi-block), there is no data in the reference block.
WARNING 381: Ref. block = Using block	When using the memory segmentation function (multi-block), the reference block and the block specified by the "using block" item are the same.
WARNING 382: No waveform data.	Because there is no waveform data present, it cannot be displayed. Start measurement operation to capture data.
WARNING 384: Different Ref. shot.	The recording lengths are different for the reference block and the block specified by the "using block" item. Capture data with the recording lengths set the same.
WARNING 386: Invalid. (RECORDER)	In the recorder function, the key pressed is invalid.
WARNING 387: Invalid. (X-Ycont)	In the X-Y recorder function, the key pressed is invalid.
WARNING 388: No comparison AREA	No waveform evaluation area. Create waveform evaluation area.
WARNING 389: Cannot use Printer.	The printer cannot be used when the time axis range is 10 ms to 200 ms/DIV, and the recording length is "continuous."
WARNING 390: Cannot set over up level.	Setting cannot be higher than upper limit.
WARNING 391: Cannot set under low level.	Setting cannot be lower than lower limit.
WARNING 392: Cannot set. (Using unit 2ch)	Recording length cannot be set to higher value because 2 channels are being used. Reduce number of channels.

WARNING 396: Out of range. (variable)	The settable range for the variable function (captured voltage range full-scale value×±500) was exceeded. When this warning appears, the upper and lower value setting is automatically changed to be within range.
WARNING 397: Out of range. (scaling)	POINT was set for scaling and the settable range (shown on Section 9.4.2) was exceeded.
WARNING 398: A/B cursor positions invalid.	Move A/B cursors to appropriate position.
WARNING 421: Equation contains a syntax error.	Correct equation.
WARNING 422: Cannot copy the equation. (Zxx)	Copy function cannot be carried out, because the copy source equation contains a Z number higher than the copy target equation.
WARNING 423: Upper value has to be bigger than lower value.	Upper limit must be higher than lower limit.
WARNING 610: No interface card.	Insert the interface card (PC card).
WARNING 799: Invalid. (shot:CONT.)	Operation is not possible, because the recording length is set to continuous.

9.2 Glossary

A/D	Conversion of an analog quantity into a digital quantity
Aliasing	Phantom signal components; a phenomenon that occurs if sampling frequency is low in relation to the frequency of the sampled signal (see Section 17.3.2).
Analog	Continuous physical quantity such as voltage or current
Attenuator	Device for reducing the level of a signal
Bit	Smallest unit of binary information
Byte	Unit of information. 1 byte is made up of 8 bits.
Channel (CH)	Input signal route
Chart	Printout of recorded waveform
Chart speed	Paper feed rate at which the chart was created
Chassis	Metal frame of the unit
Comment	A string input by the user. Also measurement conditions and other information printed for all functions.
Common mode	Voltage between ground and measurement input line
Cutoff frequency	Point where the filter output amplitude is $1/\sqrt{2}$ of the input.
Digital	Discrete physical quantity
DIV (division)	Increment on display or printout
Dynamic range	Ratio of maximum vs. minimum amplitude that can be displayed
File	A collection of data on a medium such as tape
LED	Abbreviation of "light-emitting diode"
Logic-level	Waveform expressed as High and Low level
Low-pass filter	Filter that passes through only signals below a certain frequency
Memory	A device for storing digital data
MS-DOS	Personal computer operating system. MS-DOS is a registered trademark of Microsoft Corporation.
Offset	Amount of shift in relation to 0 V when scaling is used
Position	When referring to the position of the waveform along the voltage axis on the display, this refers more precisely to the origin, that is the position corresponding to 0 V.
Pre-trigger	The condition of the signal before triggering occurred
Probe	Signal line for supplying the signal to the input
PT	Abbreviation of (voltage) "potential transformer"
Recording length	Total amount of sampling data expressed as number of increments
Ripple component	AC component of noise

Sampling	Measuring an analog waveform at regular intervals (☞ Appendix 2.1)
Sampling rate	Rate at which sampling carried out; sampling frequency
Scaling	Conversion of voltage value into a specified unit
Storage	Storing measurement data in the internal memory
Thermal head	Print head of thermal printer
Threshold value	When turning an analog signal into a logic signal, the level at which the measured value is divided between High and Low.
Trigger	An event that causes a certain action (such as starting or stopping a measurement) to happen.
Unbalanced input	Using a two-pole input in such a way that one pole carries the signal referenced to the other pole
Word	A unit for expressing digital data. The digital data for one input signal point after conversion.

9.3 Reference

9.3.1 Averaging Equations

For time axis averaging, summing averaging is synchronized by the trigger. If trigger synchronization is not performed, the results will be meaningless. Unlike time axis averaging, results are valid also if no trigger synchronization is used. But if the characteristics of the input waveform allow triggering, using the trigger for synchronization is recommended.

■ Summing averaging

Captured data are added sequentially and the sum is divided by the number of samples.

Equation: $A_n = \{ (n - 1)A_{n-1} + Z_n \} / n$

n : *Averaging count*
A_n : *Result of n times averaging*
Z_n : *n-th measurement data*

■ Exponential averaging

Most recent data are given greatest weighting, and the weighting of older data is reduced with an exponential function.

Equation $A_n = \{ (N - 1)A_{n-1} + Z_n \} / N$

N : *Specified averaging count*
n : *Averaging count*
A_n : *Result of n times averaging*
Z_n : *n-th measurement data*

■ Peak hold (frequency axis: FFT)

The specified number of samples are captured, and the peak value is held (stored) for each frequency.

9.3.2 "2-point Method" Scaling Equation

$$Y = \{ (SC_H - SC_L) / (V_H - V_L) \} X + \{ (V_H \times SC_L - V_L \times SC_H) / (V_H - V_L) \}$$

V_H : *Voltage high point* SC_H : *Scaling high point*

V_L : *Voltage low point* SC_L : *Scaling low point*

The ranges for the parts enclosed in dotted lines are as follows.

-9.9999E+9 ≦ { } value of enclosed part ≦ -1.0000E-9

{ } value of enclosed part = 0

+1.0000E-9 ≦ { } value of enclosed part ≦ +9.9999E+9

- When a setting outside of the above range is attempted, a warning indication is given and the setting becomes "converted value" = "voltage value" (no scaling).
- For channels in which waveform processing result data are recorded, only the unit is valid (scaling is invalid).
- The scaling value is used for the gauge scale, upper and lower display limits, and for A/B cursor readings.

9.3.3 Details on Operators

This section describes the operators used in waveform operation. The parameter "b_i" shows the operational result, and "d_i" shows the source channel, respectively, in which "i" indicates the serial number of data.

(1) The four arithmetical operations (+, −, *, /)

According to the operators set, the four arithmetical operations are performed.

(2) Absolute value (ABS)

【 *Equation* 】

$b_i = | d_i |$ $(i = 1, 2, ... n)$

(3) Exponential (EXP)

【 *Equation* 】

$b_i = exp(d_i)$ $(i = 1, 2, ... n)$

(4) Common logarithm (LOG)

【 *Equation* 】

When $d_i > 0$, $b_i = log_{10} d_i$

When $d_i = 0$, $b_i = -\infty$ *(overflow value is output)*

When $d_i < 0$, $b_i = log_{10} | d_i |$ $(i = 1, 2, ... n)$

【*Reference*】 Use the following equation to convert to natural logarithm:

$LnX = logeX = log10X \ / \ log10e$

$1 \ / \ log10e \fallingdotseq 2.33E + 0$

(5) Square root (SQR)

【 *Equation* 】

When $d_i \geqq 0$, $b_i = \sqrt{\ } d_i$

When $d_i < 0$, $b_i = -\sqrt{\ } | d_i |$ $(i = 1, 2, ... n)$

(6) Moving average (MOV)

【 *Equation* 】

$$b_i = 1/k \sum_{t=i-k/2}^{i+k/2} dt \quad (i = 1, 2, ... n)$$

dt : *t-th data of source channel*

k : *number of points for averaging (1 to 4000)*

【*Reference*】 1 DIV = 100 points

(7) Parallel displacement on time axis (SLI)

Shifts the value on the time axis by a certain number of points.

【 *Equation* 】

$b_i = d_{i-k}$ $(i = 1, 2, ... n)$

k : *number of points for averaging (-4000 to 4000)*

【*Reference*】 After shifting the waveform, the part right or left without source channel data becomes 0 V. 1 DIV = 100 points

(8) Differentiation once (DIF)

(9) Differentiation twice (DIF2)

- 1st and 2nd differential are calculated using the 5th-order Lagrange interpolation equation, whereby data from a range of five surrounding points are used to determine the value of the current point.
- Data corresponding to sample time t_1 - t_n are taken as d_1 - d_n and used for calculating the differential.

【*Reference*】 When the input voltage becomes small, processing results will show little variation. In such a case, apply the MOV operator.

【 *Equation for 1st differential* 】

$$\text{Point } t_1\ b_1 = (-25d_1 + 48d_2 - 36d_3 + 16d_4 - 3d_5)/12h$$
$$\text{Point } t_2\ b_2 = (-3d_1 - 10d_2 + 18d_3 - 6d_4 + d_5)/12h$$
$$\text{Point } t_3\ b_3 = (d_1 - 8d_2 + 8d_4 - d_5)/12h$$
$$\downarrow$$
$$\text{Point } t_i\ b_i = (d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2})/12h$$
$$\downarrow$$
$$\text{Point } t_{n-2}\ b_{n-2} = (d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n)/12h$$
$$\text{Point } t_{n-1}\ b_{n-1} = (-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n)/12h$$
$$\text{Point } t_n\ b_n = (3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n)/12h$$

b_1 *to* b_n : *data of calculation result*

$h = \Delta t$: *sampling period*

【 *Equation for 2st differential* 】

$$\text{Point } t_1\ b_1 = (35d_1 - 104d_2 + 114d_3 - 56d_4 + 11d_5)/12h^2$$
$$\text{Point } t_2\ b_2 = (11d_1 - 20d_2 + 6d_3 + 4d_4 - d_5)/12h^2$$
$$\text{Point } t_3\ b_3 = (-d_1 + 16d_2 - 30d_3 + 16d_4 - d_5)/12h^2$$
$$\downarrow$$
$$\text{Point } t_i\ b_i = (-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - d_{i+2})/12h^2$$
$$\downarrow$$
$$\text{Point } t_{n-2}\ b_{n-2} = (-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n)/12h^2$$
$$\text{Point } t_{n-1}\ b_{n-1} = (-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n)/12h^2$$
$$\text{Point } t_n\ b_n = (11d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n)/12h^2$$

(10) 1st integral (INT)

(11) 2nd integral (INT2)

- The 1st and 2nd integral calculation uses the trapezoidal rule.
- Data corresponding to sample time t_1 - t_n are taken as d_1 - d_n and used for calculating the integral.

【*Equation for 1st integral*】

$$\text{Point } t_1\ I_1 = 0$$
$$\text{Point } t_2\ I_2 = (d_1 + d_2)h/2$$
$$\text{Point } t_3\ I_3 = (d_1 + d_2)h/2 + (d_2 + d_3)h/2 = I_2 + (d_2 + d_3)h/2$$
$$\downarrow$$
$$\text{Point } t_n\ I_n = I_{n-1} + (d_{n-1} + d_n)h/2$$

I_1 *to* I_n : *processing result data*

$h = \Delta t$: *sampling period*

【*Equation for 2st integral*】

Point t_1 $II_1 = 0$

Point t_2 $II_2 = (I_1 + I_2)h/2$

Point t_3 $II_3 = (I_1 + I_2)h/2 + (I_2 + I_3)h/2 = II_2 + (I_2 + I_3)h/2$

↓

Point t_n $II_n = II_{n-1} + (I_{n-1} + I_n)h/2$

II_1 *to* II_n : *processing result data*

(12) Sine (SIN)

【 *Equation* 】

$b_i = sin(d_i)$ $(i = 1, 2, ... n)$

(13) Cosine (COS)

【 *Equation* 】

$b_i = cos(d_i)$ $(i = 1, 2, ... n)$

(14) Tangent (TAN)

【 *Equation* 】

$b_i = tan(d_i)$ $(i = 1, 2, ... n)$

$-10 \leqq b_i \leqq 10$

(15) Arc-sine (ASIN)

【 *Equation* 】

$b_i = \pi / 2$ $\quad d_i > 1$

$b_i = asin(di)$ $\quad -1 \leqq d_i \leqq 1$

$b_i = -\pi / 2$ $\quad d_i < 1$

(16) Arc-cosine (ACOS)

【 *Equation* 】

$b_i = 0$ $\quad d_i > 1$

$b_i = acos(di)$ $\quad -1 \leqq d_i \leqq 1$

$b_i = \pi$ $\quad d_i < -1$ $(i = 1, 2, ... n)$

(17) Arc-tangent (ATAN)

【 *Equation* 】

$b_i = atan(di)$ $(i = 1, 2, ... n)$

【*Reference*】 The unit for the Trigonometric and inverse trigonometric functions (12) - (17) is rad (radian).

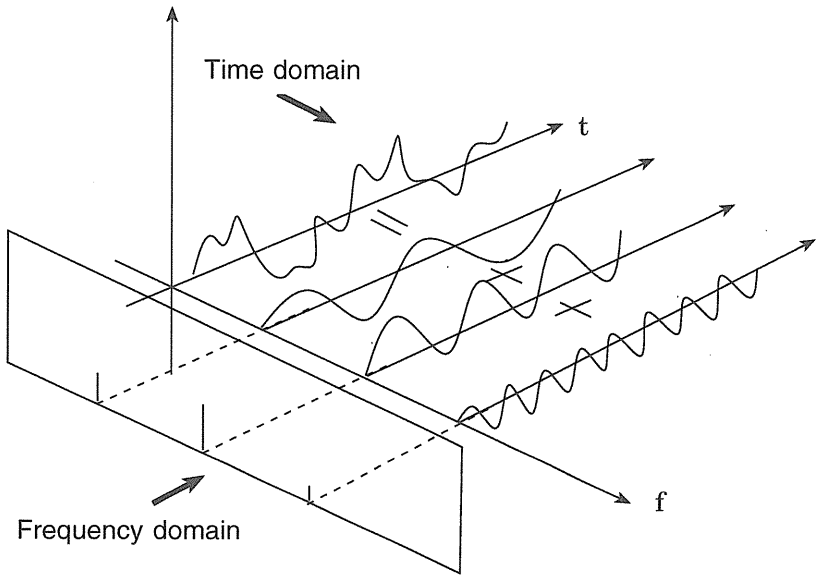
9.3.4 FFT

FFT stands for Fast Fourier Transformation, which is a calculation method used to decompose a time-domain waveform into frequency components. By performing FFT calculation, various calculations can be performed.

• Concept of time domain and frequency domain

The signals measured by this memory recorder have values which correspond to time, that is the signals are functions of time.

Waveform in the figure below is an example of such a signal.
Signals which are expressed as a function of time are called time domain signals.
In reality, a signal consists of a number of sine-waves of different frequencies, called frequency components, which combine to create the final shape of the waveform. Expressing waveform the source signal, as a function of its frequency components yields a frequency domain representation.
Often, the characteristics of a signal which cannot be easily analyzed in the time domain, can be clearly revealed by the frequency domain representation.



• Fourier transformation and the Inverse Fourier transformation

The following equations define the Fourier transformation and the Inverse Fourier transformation.

$$F(\omega) = \Im[f(t)] = \int_{-\infty}^{+\infty} f(t) \cdot \exp(-j\omega t)dt \qquad ②$$

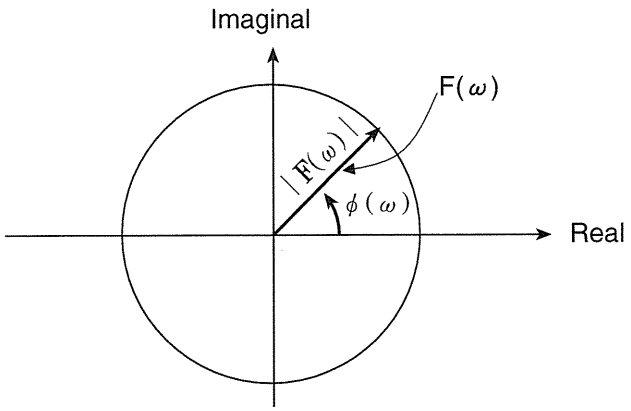
$$f(t) = \Im^{-1}[F(\omega)] = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(\omega) \cdot \exp(j\omega t)d\omega \qquad ③$$

The function $F(\omega)$generally results in a complex number, and can be expressed as follows.

$$F(\omega) = |F(\omega)| \cdot \exp(j\phi(\omega)) = |F(\omega)|\angle\phi(\omega) \qquad ④$$

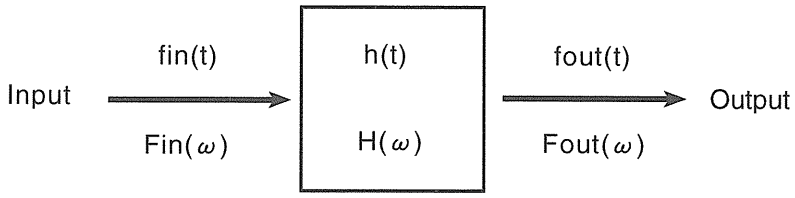
$|F(\omega)|$: Absolute value spectrum of f(t)
$\phi(\omega)$: Unit spectrum of the phase of f(t)

When conversion is made from the time domain to the frequency domain, the magnitude information and phase information are clearly expressed as indicated in equation (④). The figure below shows $F(\omega)$ in vector form.



• Application of Fourier transform (transfer function, unit-impulse response)

As an application of Fourier transform, this section describes a steady-state response in a static linear system.



Stationary Linear System

fin(t): time function of input (source signal)
fout(t): time function of output (response function)
h(t): unit impulse response of linear system
t , τ : time

$$fout(t) = \int_{-\infty}^{\infty} fin(\tau) \cdot h(t-\tau) d\tau \quad ⑤$$

The relationship between the input and output is expressed as follows: This indicates that the response of the linear system can be determined just by knowing the unit impulse response h(t) of the system.

In the frequency domain, Fin(ω), Fout(ω), H(ω), and ω are defined as follows
Fin(ω): Fourier transformation of fin(t)
Fout(ω): Fourier transformation of fout(t)
H(ω): Fourier transformation of h(t)
ω : Angular frequency
Fout (ω) = Fin(ω)·H(ω) ⑥

Therefore, when fin(t) and fout(t) are measured, the system transfer function H (ω) and the unit impulse response h(t) can be obtained by performing an FFT operation and an inverse FFT operation.

• Aliasing

When the frequency of the signal to be measured approaches the sampling frequency, beyond a certain point the measured signal frequency will be lower than the actual signal frequency. In such a case, frequency components that do not exist will appear in the waveform along the frequency axis. This phenomenon is called aliasing, and it occurs if sampling is carried out at a frequency lower than the so-called Nyquist frequency determined by Nyquist's sampling theorem.

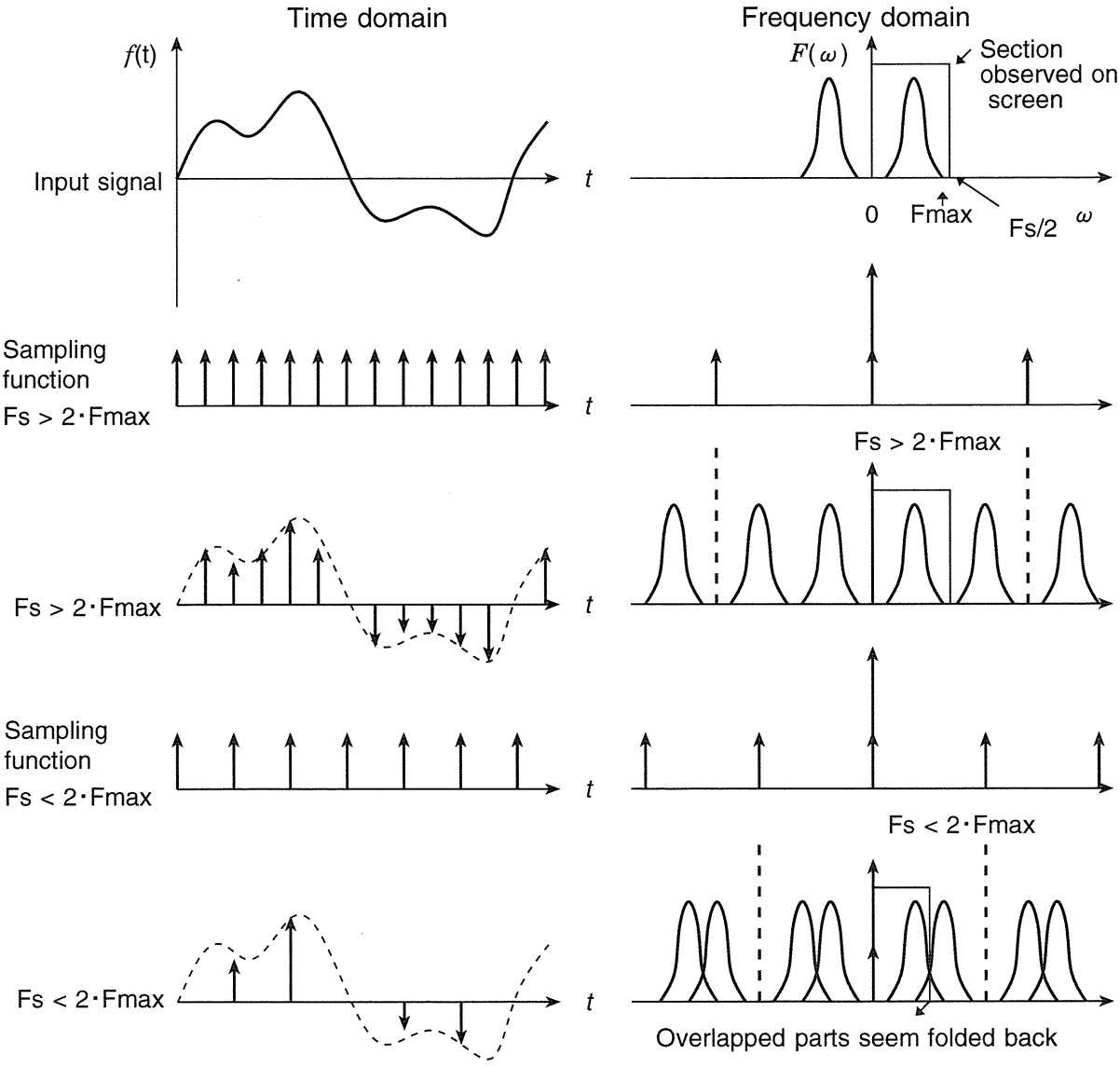
Sampling theorem

Fs = 2·Fmax ①

Fmax: Highest frequency component to be measured

Fs: Sampling frequency (Nyquist frequency)

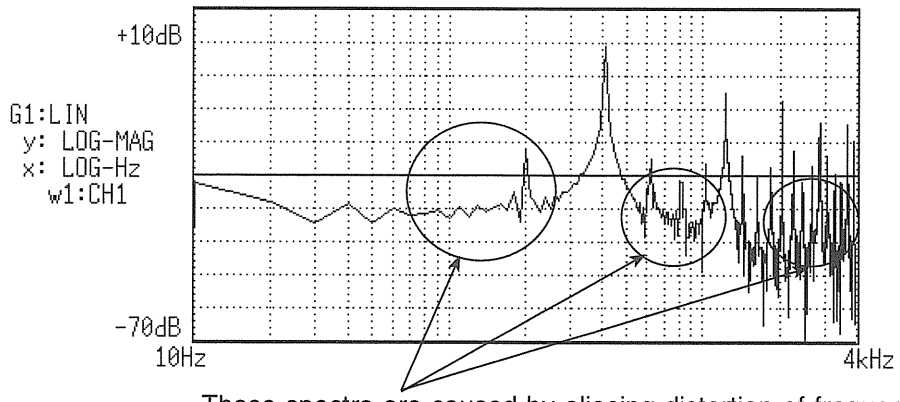
- In order to be able to restore the original waveform from the sampling data, the sampling frequency must be at least twice as high as the signal frequency.
- If sampling is carried out at a frequency lower than the Nyquist frequency, frequency components above 1/2 of the sampling frequency will be aliased to lower frequencies, and the measured signal will appear to contain frequency components that actually do not exist.



• Anti-aliasing filter (A.A. Filter)

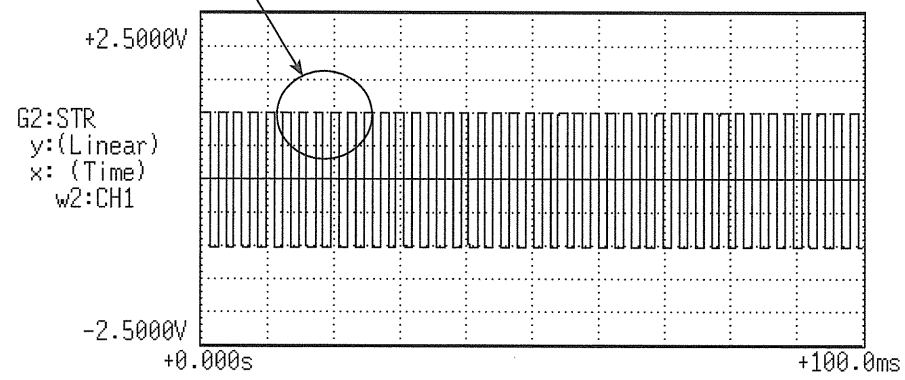
- If the input signal is regarded as having an unlimited bandwidth, aliasing distortion is an unavoidable consequence of sampling.
- For an FFT operation, a consequence of aliasing distortion is that a number of frequency spectra appear that do not actually exist in the original input signal.
- This problem can be solved by passing the input signal through a low-pass filter whose cut-off frequency is one-half the sampling frequency before sampling. This filter is referred to as an anti-aliasing filter.
- The 8938 FFT ANALOG UNIT available for the 8835 has such an anti-aliasing filter.

When an anti-aliasing filter is not used



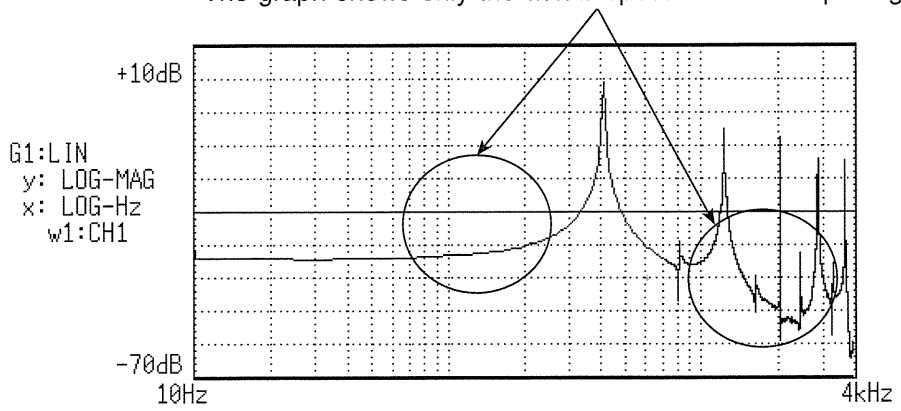
These spectra are caused by aliasing distortion of frequency components which are higher than half the sampling frequency of the A/D converter. They do not exist in the original input signal, yet they appear in the spectrum.

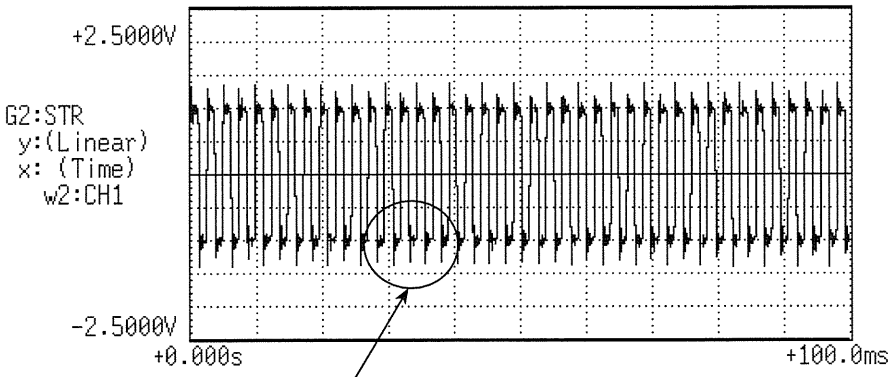
Since an anti-aliasing filter is not used for this square wave, a sharp edge is observed through a wide-band amplifier. The edge of the square wave contains very high-frequency components.



When an anti-aliasing filter is used

Spectra caused by aliasing distortion are clearly eliminated.
The graph shows only the actual spectrum of the input signal.



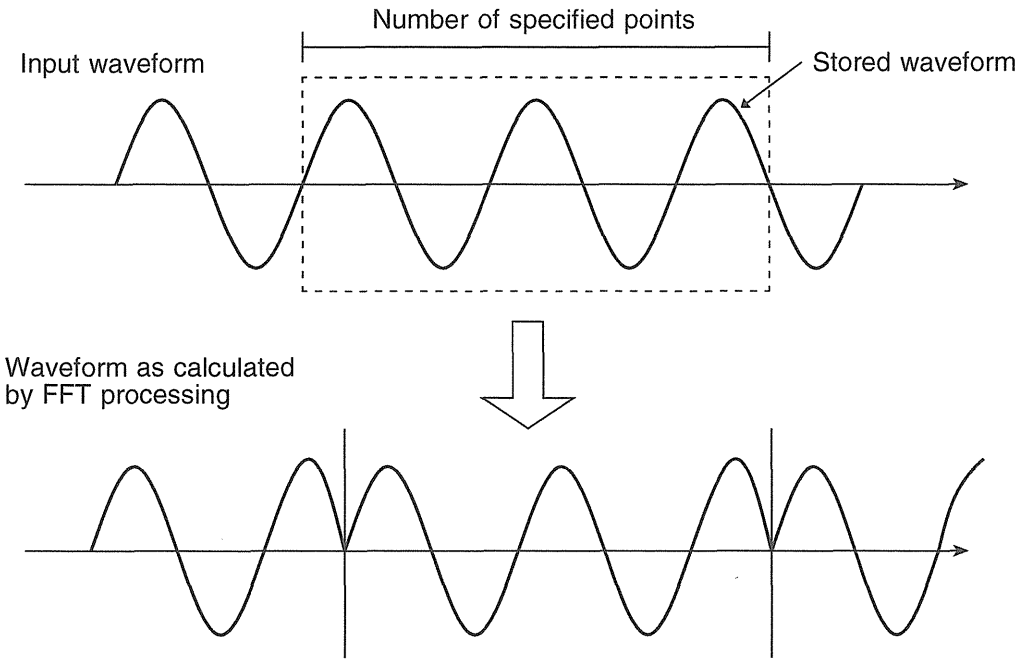


Due to the sharp cut-off characteristic of the anti-aliasing filter,
the edge of the square wave contains a ripple.

• Window processing

Fourier transform is defined as the integration from negative infinity to positive infinity, but in actual measurement this calculation is not possible. Therefore only a limited segment of the continuous signal is taken for processing. This is called window processing.

The FFT algorithm assumes that the data of that limited segment are repeated and defines the input signal using a periodic function for determining the frequency spectrum.
Depending on the phase at the start and end of the stored waveform, there may be a difference between the waveform as calculated by FFT processing and the actual input waveform.



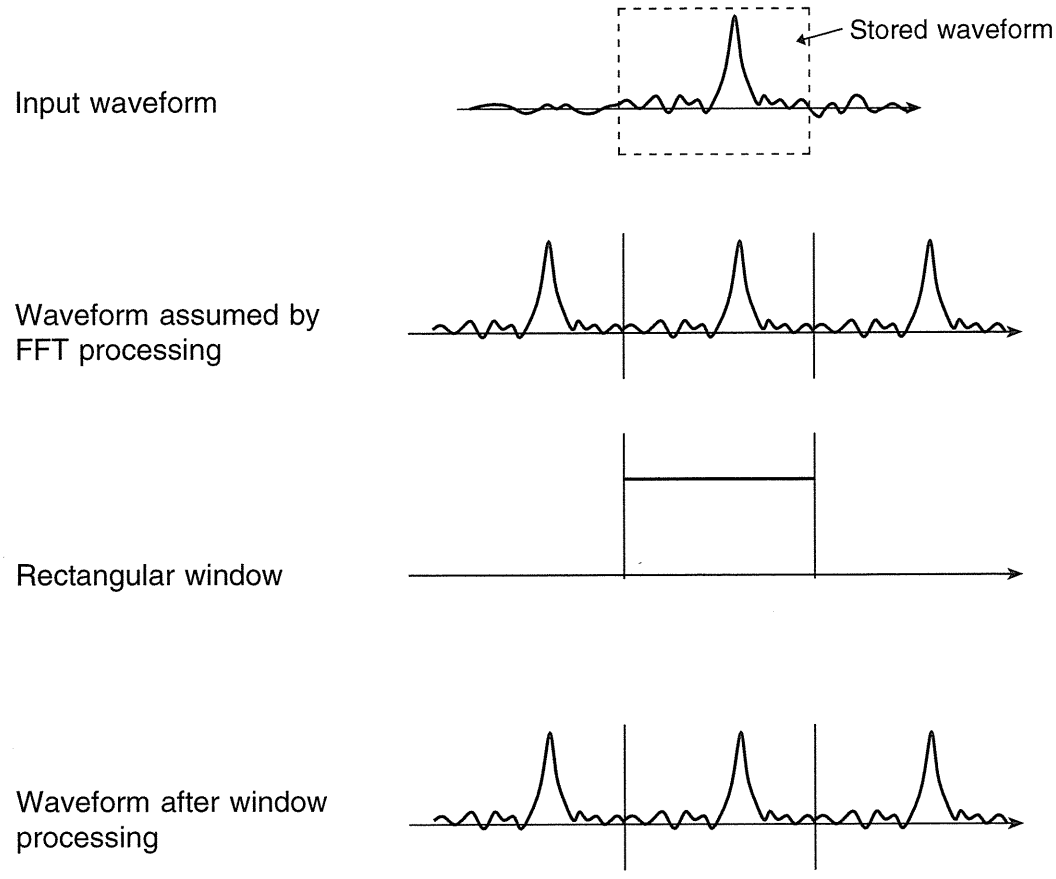
Leakage error

When the signal waveform as assumed by the FFT algorithm and the actual waveform are different, the processing result will contain an error. This error is called the leakage error.

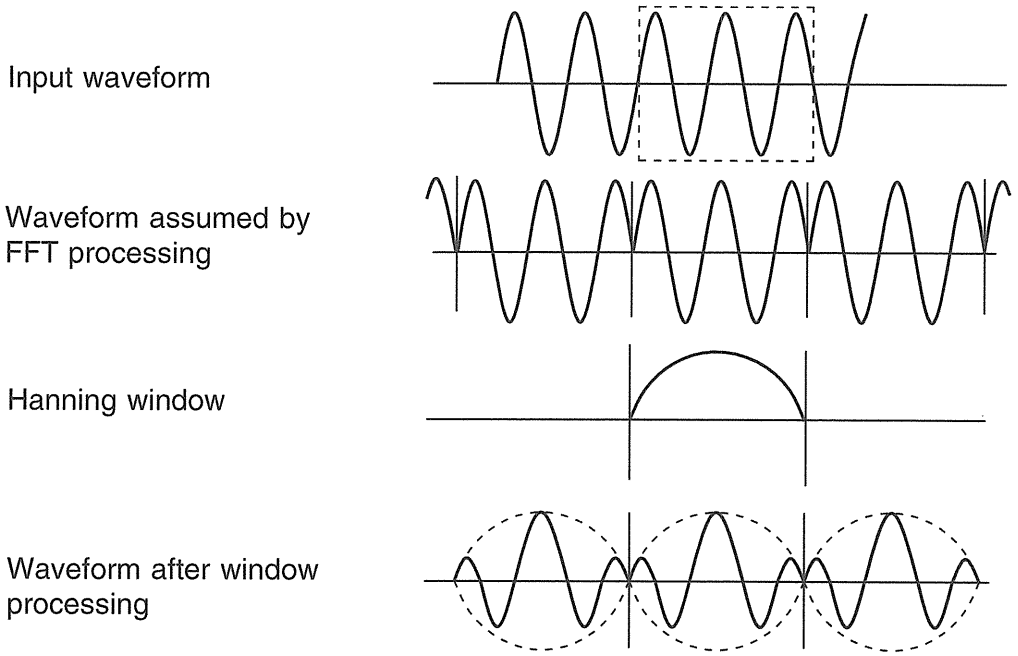
Window function

- When a limited segment of the input signal is captured, a function can be applied to reduce the leakage error.
- This function is called the window function.
- To minimize the leakage error, a suitable window should be chosen which matches the type of input signal.
- Possible window types include rectangular, Hanning, exponential, flat-top, minimum, force, etc. In the 8835, three window functions (rectangular, Hanning, exponential) are available.
- Generally, the rectangular window function is most useful for single waveforms, the Hanning window function for continuous waveforms, and the exponential window function for attenuated waveforms.

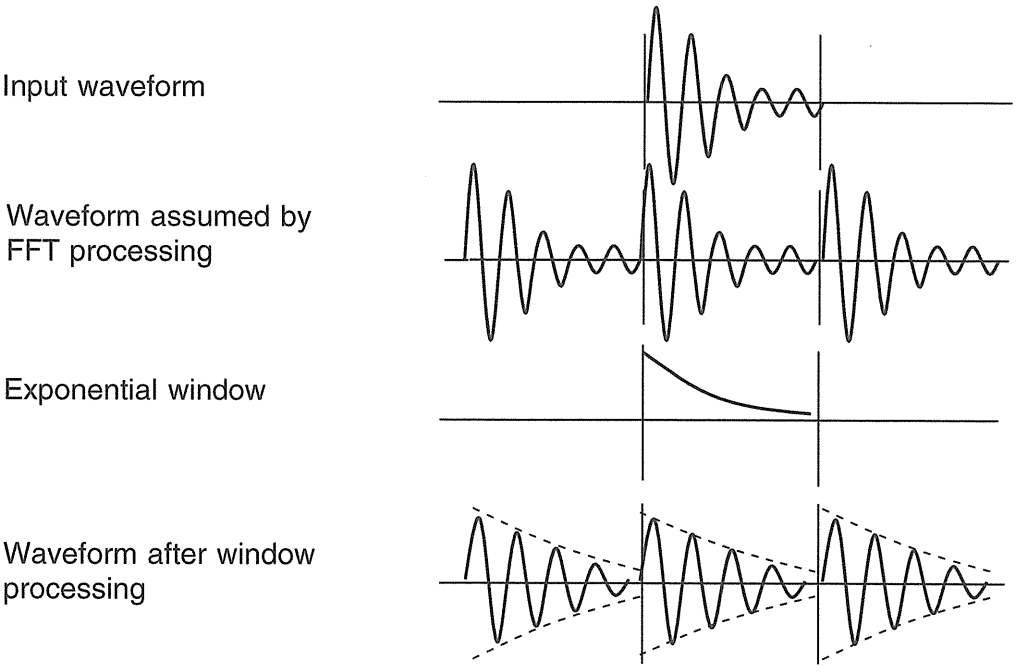
- **Rectangular window**



- **Hanning window**



- **Exponential window**



9.4 To Users of 8835 ROM Version Earlier Than 2.00

The following functions are added to the 8835 equipped with ROM version earlier than 2.00 after the 9540 FUNCTION UP DISK is installed.

- Zoom function
- Vernier function
- Continuous X-Y plot
- Display colors setting
- External printer

9.4.1 Zoom Function

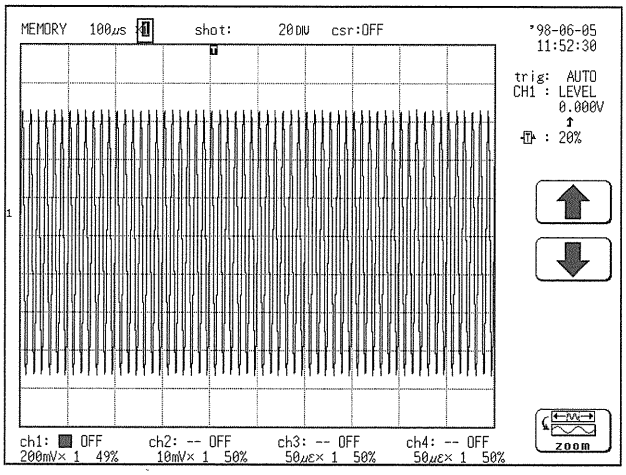
(Memory Waveform Only in the Memory Recorder Function and the Recorder and Memory Function)

This function divides the display screen into two screens (upper and lower), and allows the waveform on the upper screen to be magnified along the time axis and displayed on the lower screen.

In the recorder and memory function*, the following operations are required.

1. Capture the waveform in the recorder and memory function.
2. Change the function to the memory recorder function.
3. The memory waveform is continuously relayed.
4. Zooming affects this waveform.

Method Screen: DISPLAY



1. Press the DISP key to call up the DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to select **zoom**.

   : Time axis direction magnification up

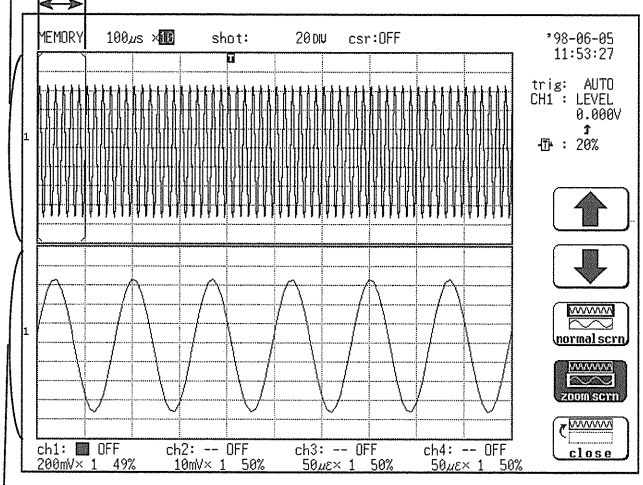
   : Time axis direction magnification down

   : Zoom function is used.

   When the zoom function is selected, the display is split into two horizontally tiled screens.
   The waveform before the zoom mode was activated is displayed on the upper screen (standard screen). The lower screen shows the zoomed waveform (zoom screen).
4. Use the JOG control or the function keys to set the magnification ratio.
   The lower screen's display magnification is always larger than the upper screen's display magnification.
   { } brackets on the upper screen indicate the waveform range displayed on the lower screen.

Standard screen

Magnified range



Zoom screen


: Time axis direction magnification up


: Time axis direction magnification down

: Enables operations on the standard screen

: Enables operations on the zoom screen

: Terminates the zoom function

5. To terminates the zoom function, press the function key [close].

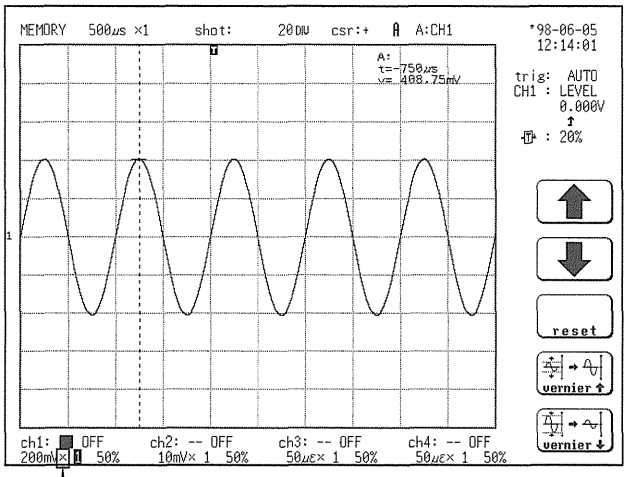
NOTE

- The A/B cursors can be used only for the waveform on the lower screen.
- During the zoom function, pressing the PRINT key prints the waveform on the lower screen. (The waveform becomes that of the one screen display. If the A/B cursors are used, partial print is applied.)
- The time axis direction magnification indicates the magnification in relation to the original waveform both in the case of the standard display and the in the case of the zoom display.
- The display magnification of the lower display can only be set at a value that exceeds the magnification of the upper display. (E.g., if the upper magnification is ×1, the lower can only be set to ×2, 5 or 10. If the upper is ×10, this should be decreased to ×5 and the lower set to ×10.)
- Scrolling the waveform with the jog button is executed on the lower display. When the lower waveform is scrolled, the brackets indicating the range of the upper display also move.
  (When the lower waveform is scrolled beyond the range indicated at the top, redisplay the upper waveform. Display it so that the range displayed at the bottom is at the center of the screen.)
- When the zoom function is used, the logic waveform display positions are indicated on the screen provided they are 1 to 4. If 5 to 8, the positions are not indicated.

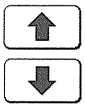
9.4.2 Vernier Function

- Using fine adjustment, the input voltage can be matched to a desired reading.
- For example, an actual input voltage of 1.8 V can be converted to a 2.0 V reading.

Method Screen: DISPLAY



1. Press the DISP key to call up the DISPLAY screen.
2. Move the flashing cursor to the position shown in the figure on the left.
3. Use the function keys to select the vernier function.
   Use ⩓ to magnify and ⩔ to compress. The adjustment range is from 1/2 to 2 times of the original waveform.



RESET : Cancels the vernier function. (The original waveform returns.)

vernier ↑ : Magnifies the waveform.

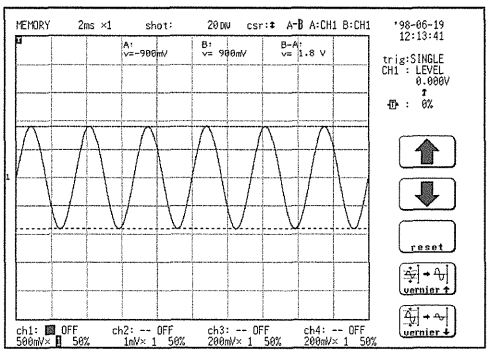
vernier ↓ : Compresses the waveform.

⩓	Displays the magnified waveform.
×	Displays the waveform with no vernier scaling.
⩔	Displays the compressed waveform.

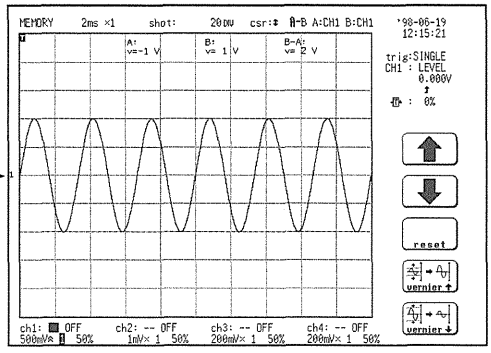
NOTE The vernier function is not applicable to a waveform after waveform processing*.
*: Advanced version

Example: Changing a 1.8 Vp-p waveform to a 2.0 Vp-p waveform

The actual captured waveform

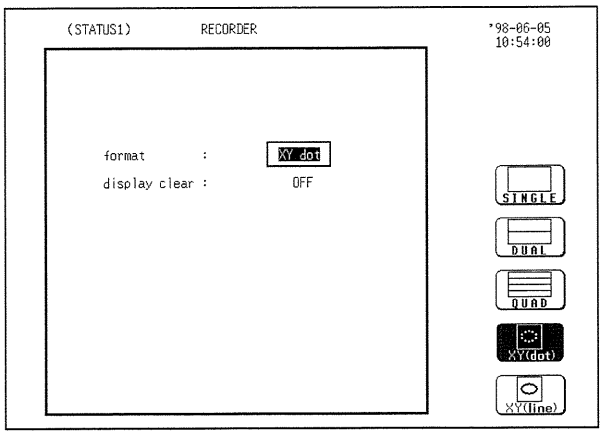


Adjusted to 2 Vp-p using the vernier function.



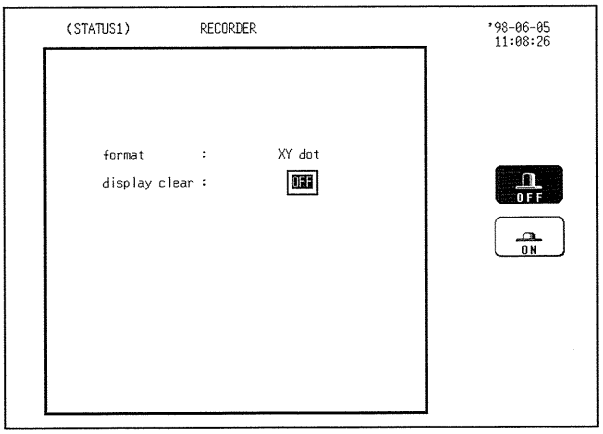
9.4.3 Continuous X-Y Plot

- Setting the display format to X-Y allows X-Y waveforms to be combined continuously.
- Selecting the X-Y display format changes the setting screen as shown in the figure below.



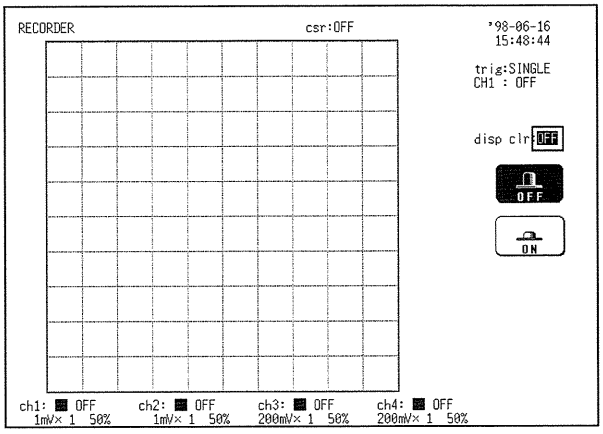
1. Use the function keys to select the display format.

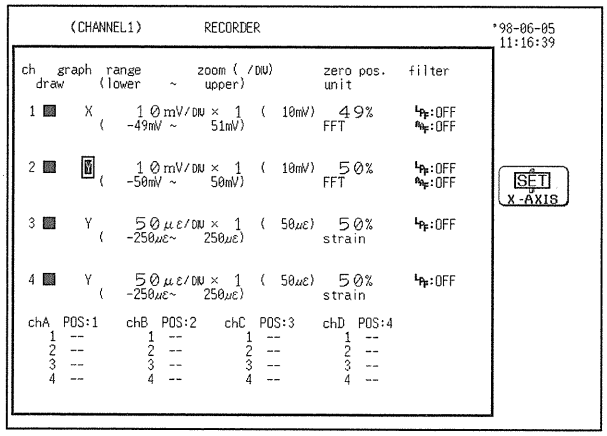
SINGLE : Single
DUAL : Dual
QUAD : Quad
XY(dot) : XY (dot)
XY(line) : XY (line)



2. Select whether or not to clear any existing X-Y plot.

OFF : Do not clear the display window. The new recording is overlayed the existing one.
ON : Clear the display window.





3. Press the CHAN key to call up the CHANNEL screen (page 1).

4. Specify the X-axis channel.

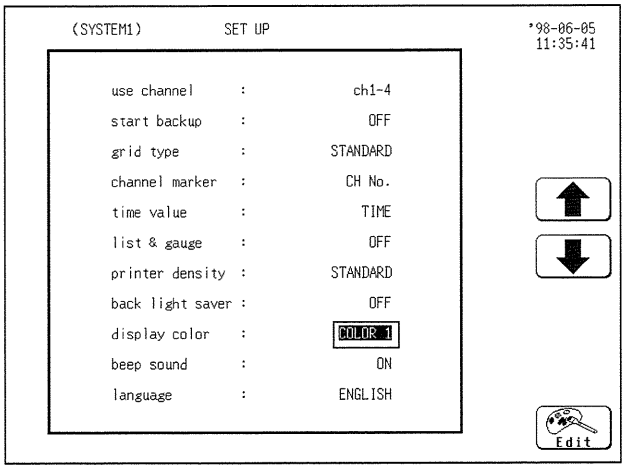
① Move the cursor to the channel to be used as X axis, as shown at left.

② Use the function keys to select X axis.

9.4.4 Setting the Display Colors

- Serves to set the display color.
- The display color can be selected from among the display colors 1 to 8 and the customer color 9 which can be set as desired.

Method Screen: SYSTEM (SETUP)

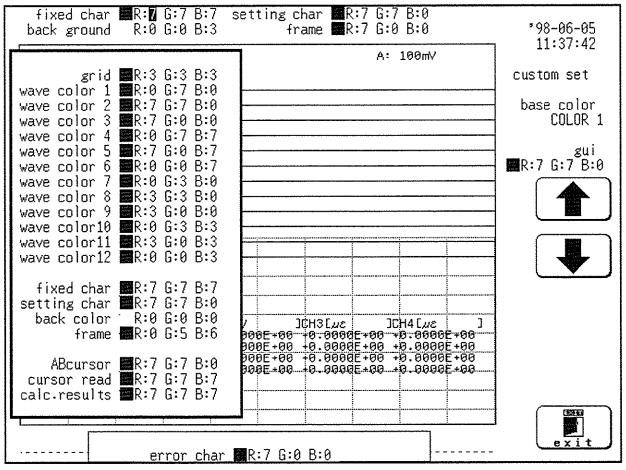


: Display color number up

: Display color number down

: Call up the custom setting screen

Custom setting (setting the color as desired)



1. Change the R.G.B. setting values of each item on the screen.
2. Move the flashing cursor to the item for which you want to change the setting values, and use the JOG control or the function keys to make the settings.
3. The setting values inside the window applies to the colors of the particular window. When a value is changed, the color of the area corresponding to this item changes.

: Value up

: Value down

: Exit from the custom setting screen

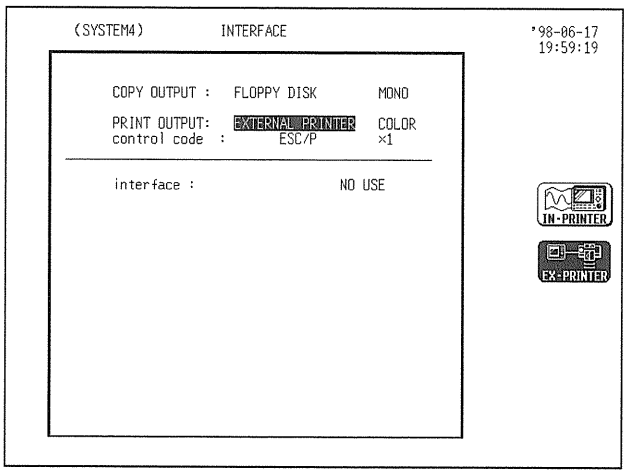
NOTE

- When system reset is executed, set colors are initialized and become the same color as that of display color 1.
- Only one customer color type can be set as desired.

9.4.5 External Printer

- It is possible to output to the external printer by setting the output destination to the external printer.
- The optional 9559 PRINTER CARD is used.

Method Screen: SYSTEM (INTERFACE)



IN-PRINTER: Output to internal printer.

EX-PRINTER: Output to external printer.

When the external printer is the output destination, select the control code.

ESC/P: Uses ESC/P as the control code.

ESC/P RASTER: Uses ESC/P raster as the control code.

When the external printer is the output destination, select the color of the output destination.

COLOR: Output color data.

MONO: Output monochrome data.

Select the printing size.

X1: Print normal size.

X1.5: Print at 1.5 times magnification.

NOTE

Even if the information that has been input using the PRINT key is to be output to the external printer, automatic printing or real-time printing is performed on the internal printer rather than the external printer.

9.5 Size of a Waveform File

9.5.1 Binary Data

In the memory recorder function (*.MEM)

Size of a file = 512 (4 + number of analog channles + number of logic probes) + (2 × (number of analog channels + (number of logic probes + 1) / 2)) × recording length × 100

	Number of logic probes				
	0				
	Number of analog channels				
Recording length	0	1	2	3	4
20		7,074	11,588	16,102	20,616
50		13,074	23,588	34,102	44,616
100		23,074	43,588	64,102	84,616
200		43,074	83,588	124,102	164,616
500		103,074	203,588	304,102	404,616
1000		203,074	403,588	604,102	804,616
2000		403,074	803,588	1,204,102	1,604,616
5000		1,003,074	2,003,588	3,004,102	4,004,616
10000		2,003,074	4,003,588		
20000		4,003,074			

	Number of logic probes				
	1				
	Number of analog channels				
Recording length	0	1	2	3	4
20	5,073	9,587	14,101	18,615	23,129
50	8,073	18,587	29,101	39,615	50,129
100	13,073	33,587	54,101	74,615	95,129
200	23,073	63,587	104,101	144,615	185,129
500	53,073	153,587	254,101	354,615	455,129
1000	103,073	303,587	504,101	704,615	905,129
2000	203,073	603,587	1,004,101	1,404,615	1,805,129
5000	503,073	1,503,587	2,504,101	3,504,615	4,505,129
10000	1,003,073	3,003,587	5,004,101		
20000	2,003,073	6,003,587			

	Number of logic probes				
	2				
	Number of analog channels				
Recording length	0	1	2	3	4
20	5,585	10,099	14,613	19,127	23,641
50	8,585	19,099	29,613	40,127	50,641
100	13,585	34,099	54,613	75,127	95,641
200	23,585	64,099	104,613	145,127	185,641
500	53,585	154,099	254,613	355,127	455,641
1000	103,585	304,099	504,613	705,127	905,641
2000	203,585	604,099	1,004,613	1,405,127	1,805,641
5000	503,585	1,504,099	2,504,613	3,505,127	4,505,641
10000	1,003,585	3,004,099	5,004,613		
20000	2,003,585	6,004,099			

	Number of logic probes				
	3				
	Number of analog channels				
Recording length	0	1	2	3	4
20	8,098	12,612	17,126	21,640	26,154
50	14,098	24,612	35,126	45,640	56,154
100	24,098	44,612	65,126	85,640	106,154
200	44,098	84,612	125,126	165,640	206,154
500	104,098	204,612	305,126	405,640	506,154
1000	204,098	404,612	605,126	805,640	1,006,154
2000	404,098	804,612	1,205,126	1,605,640	2,006,154
5000	1,004,098	2,004,612	3,005,126	4,005,640	5,006,154
10000	2,004,098	4,004,612	6,005,126		
20000	4,004,098	8,004,612			

	Number of logic probes				
	4				
	Number of analog channels				
Recording length	0	1	2	3	4
20	8,610	13,124	17,638	22,152	26,666
50	14,610	25,124	35,638	46,152	56,666
100	24,610	45,124	65,638	86,152	106,666
200	44,610	85,124	125,638	166,152	206,666
500	104,610	205,124	305,638	406,152	506,666
1000	204,610	405,124	605,638	806,152	1,006,666
2000	404,610	805,124	1,205,638	1,606,152	2,006,666
5000	1,004,610	2,005,124	3,005,638	4,006,152	5,006,666
10000	2,004,610	4,005,124	6,005,638		
20000	4,004,610	8,005,124			

Normal
Memory expanded to 1 M words
Memory expanded to 2 M words

Note: Four logic channels are assigned to each probe.
Unit: byte

In the recorder and RMS recorder functions (∗.REC, ∗.RMS)

Size of a file = 512 (4 + number of analog channles + number of logic probes) + (4 × (number of analog channels + (number of logic probes) × recording length × 100

	Number of logic probes				
	0				
	Number of analog channels				
Recording length	0	1	2	3	4
20		11,076	19,592	28,108	36,624
50		23,076	43,592	64,108	84,624
100		43,076	83,592	124,108	164,624
200		83,076	163,592	244,108	324,624
500		203,076	403,592	604,108	804,624
1000		403,076	803,592	1,204,108	1,604,624
2000		803,076	1,603,592	2,404,108	3,204,624

	Number of logic probes				
	1				
	Number of analog channels				
Recording length	0	1	2	3	4
20	5,073	13,589	22,105	30,621	39,137
50	8,073	28,589	49,105	69,621	90,137
100	13,073	53,589	94,105	134,621	175,137
200	23,073	103,589	184,105	264,621	345,137
500	53,073	253,589	454,105	654,621	855,137
1000	103,073	503,589	904,105	1,304,621	1,705,137
2000	203,073	1,003,589	1,804,105	2,604,621	3,405,137

	Number of logic probes				
	2				
	Number of analog channels				
Recording length	0	1	2	3	4
20	7,586	16,102	24,618	33,134	41,650
50	13,586	34,102	54,618	75,134	95,650
100	23,586	64,102	104,618	145,134	185,650
200	43,586	124,102	204,618	285,134	365,650
500	103,586	304,102	504,618	705,134	905,650
1000	203,586	604,102	1,004,618	1,405,134	1,805,650
2000	403,586	1,204,102	2,004,618	2,805,134	3,605,650

	Number of logic probes				
	3				
	Number of analog channels				
Recording length	0	1	2	3	4
20	10,099	18,615	27,131	35,647	44,163
50	19,099	39,615	60,131	80,647	101,163
100	34,099	74,615	115,131	155,647	196,163
200	64,099	144,615	225,131	305,647	386,163
500	154,099	354,615	555,131	755,647	956,163
1000	304,099	704,615	1,105,131	1,505,647	1,906,163
2000	604,099	1,404,615	2,205,131	3,005,647	3,806,163

	Number of logic probes				
	4				
	Number of analog channels				
Recording length	0	1	2	3	4
20	12,612	21,128	29,644	38,160	46,676
50	24,612	45,128	65,644	86,160	106,676
100	44,612	85,128	125,644	168,160	206,676
200	84,612	165,128	245,644	326,160	406,676
500	204,612	405,128	605,644	806,160	1,006,676
1000	404,612	805,128	1,205,644	1,606,160	2,006,676
2000	804,612	1,605,128	2,405,644	3,206,160	4,006,676

Normal
Memory expanded to 1 M words
Memory expanded to 2 M words

Note: Four logic channels are assigned to each probe.
Unit: byte

9.5.2 Text File

In the memory recorder function (*.TXT) (Reference values)

Size of a file = header portion + data portion

Size of a header portion = 170 + 27 × number of analog save channles + 64 × number of logic save units

Size of a data portion = (14 + 13 × number of analog save channles + 9 × number of logic save units) × (recording length × 100 + 1)

	Number of logic probes				
	0				
	Number of analog channels				
Recording length	0	1	2	3	4
20		54,224	80,264	106,304	132,344
50		135,224	200,264	265,304	330,344
100		270,224	400,264	530,304	650,344
200		540,224	800,264	1,060,304	1,320,344
500		1,350,224	2,000,264	2,650,304	3,300,344
1000		2,700,224	4,000,264	5,300,304	6,600,344
2000		5,400,224	8,000,264	10,600,304	13,200,344
5000		13,500,224	20,000,264	26,500,304	33,000,344
10000		27,000,224	40,000,264		
20000		54,000,224			

	Number of logic probes				
	1				
	Number of analog channels				
Recording length	0	1	2	3	4
20	46,257	72,297	98,337	124,377	150,417
50	115,257	180,297	245,337	310,377	375,417
100	230,257	360,297	490,337	620,377	750,417
200	460,257	720,297	980,337	1,240,377	1,500,417
500	1,150,257	1,800,297	2,450,337	3,100,377	3,750,417
1000	2,300,257	3,600,297	4,900,337	6,200,377	7,500,417
2000	4,600,257	7,200,297	9,800,337	12,400,377	15,000,417
5000	11,500,257	18,000,297	24,500,337	31,000,377	37,500,417
10000	23,000,257	36,000,297	49,000,337		
20000	46,000,257	72,000,297			

	Number of logic probes				
	2				
	Number of analog channels				
Recording length	0	1	2	3	4
20	64,330	90,370	116,410	142,450	168,490
50	160,330	225,370	290,410	355,450	420,490
100	320,330	450,370	580,410	710,450	840,490
200	640,330	900,370	1,160,410	1,420,450	1,680,490
500	1,600,330	2,250,370	2,900,410	3,550,450	4,200,490
1000	3,200,330	4,500,370	5,800,410	7,100,450	8,400,490
2000	6,400,330	9,000,370	11,600,410	14,200,450	16,800,490
5000	16,000,330	22,500,370	29,000,410	35,500,450	42,000,490
10000	32,000,330	45,000,370	58,000,410		
20000	64,000,330	90,000,370			

	Number of logic probes				
	3				
	Number of analog channels				
Recording length	0	1	2	3	4
20	82,403	108,443	134,483	160,523	186,563
50	205,403	270,443	335,483	400,523	465,563
100	410,403	540,443	670,483	800,523	930,563
200	820,403	1,080,443	1,340,483	1,600,523	1,860,563
500	2,050,403	2,700,443	3,350,483	4,000,523	4,650,563
1000	4,100,403	5,400,443	6,700,483	8,000,523	9,300,563
2000	8,200,403	10,800,443	13,400,483	16,000,523	18,600,563
5000	20,500,403	27,000,443	33,500,483	40,000,523	46,500,563
10000	41,000,403	54,000,443	67,000,483		
20000	82,000,403	108,000,443			

	Number of logic probes				
	4				
	Number of analog channels				
Recording length	0	1	2	3	4
20	100,476	126,516	152,556	178,596	204,636
50	250,476	315,516	380,556	445,596	510,636
100	500,476	630,516	760,556	890,596	1,020,636
200	1,000,476	1,260,516	1,520,556	1,780,596	2,040,636
500	2,500,476	3,150,516	3,800,556	4,450,596	5,100,636
1000	5,000,476	6,300,516	7,600,556	8,900,596	10,200,636
2000	10,000,476	12,600,516	15,200,556	17,800,596	20,400,636
5000	25,000,476	31,500,516	38,000,556	44,500,596	51,000,636
10000	50,000,476	63,000,516	76,000,556		
20000	100,000,476	126,000,516			

Normal
Memory expanded to 1 M words
Memory expanded to 2 M words

Note: Four logic channels are assigned to each probe.
Unit: byte

In the recorder and RMS recorder functions (*.TXT) (Reference values)

Size of a file = header portion + data portion

Size of a header portion = 170 + 64 × number of analog save channles + 165 × number of logic save units

Size of a data portion = (14 + 26 × number of analog save channles + 18 × number of logic save units) × (recording length × 100 + 1)

	Number of logic probes				
	0				
	Number of analog channels				
Recording length	0	1	2	3	4
20		80,274	132,364	184,454	236,544
50		200,274	330,364	460,454	590,544
100		400,274	660,364	920,454	1,180,544
200		800,274	1,320,364	1,840,454	2,360,544
500		2,000,274	3,300,364	4,600,454	5,900,544
1000		4,000,274	6,600,364	9,200,454	11,800,544
2000		8,000,274	13,200,364	18,400,454	23,600,544

	Number of logic probes				
	1				
	Number of analog channels				
Recording length	0	1	2	3	4
20	64,367	116,457	168,547	220,637	272,727
50	160,367	290,457	420,547	550,637	680,727
100	320,367	580,457	840,547	1,100,637	1,360,727
200	640,367	1,160,457	1,680,547	2,200,637	2,720,727
500	1,600,367	2,900,457	4,200,547	5,500,637	6,800,727
1000	3,200,367	5,800,457	8,400,547	11,000,637	13,600,727
2000	6,400,367	11,600,457	16,800,547	22,000,637	27,200,727

	Number of logic probes				
	2				
	Number of analog channels				
Recording length	0	1	2	3	4
20	100,550	152,640	204,730	256,820	308,910
50	250,550	380,640	510,730	640,820	770,910
100	500,550	760,640	1,020,730	1,280,820	1,540,910
200	1,000,550	1,520,640	2,040,730	2,560,820	3,080,910
500	2,500,550	3,800,640	5,100,730	6,400,820	7,700,910
1000	5,000,550	7,600,640	10,200,730	12,800,820	15,400,910
2000	10,000,550	15,200,640	20,400,730	25,600,820	30,800,910

	Number of logic probes				
	3				
	Number of analog channels				
Recording length	0	1	2	3	4
20	136,733	188,823	240,913	293,003	345,093
50	340,733	470,823	600,913	731,003	861,093
100	680,733	940,823	1,200,913	1,461,003	1,721,093
200	1,360,733	1,880,823	2,400,913	2,921,003	3,441,093
500	3,400,733	4,700,823	6,000,913	7,301,003	8,601,093
1000	6,800,733	9,400,823	12,000,913	14,601,003	17,201,093
2000	13,600,733	18,800,823	24,000,913	29,201,003	34,401,093

	Number of logic probes				
	4				
	Number of analog channels				
Recording length	0	1	2	3	4
20	172,916	225,006	277,096	329,186	381,276
50	430,916	561,006	691,096	821,186	951,276
100	860,916	1,121,006	1,381,096	1,641,186	1,901,276
200	1,720,916	2,241,006	2,761,096	3,281,186	3,801,276
500	4,300,916	5,601,006	6,901,096	8,201,186	9,501,276
1000	8,600,916	11,201,006	13,801,096	16,401,186	19,001,276
2000	17,200,916	22,401,006	27,601,096	32,801,186	38,001,276

Normal
Memory expanded to 1 M words
Memory expanded to 2 M words

Note: Four logic channels are assigned to each probe.
Unit: byte

Index

- A -

- B -

- C -

- D -

- E -

- F -

- H -

- I -

- L -

- M -

- N -

- O -

- P -

- R -

- S -

- T -

- U -

- V -

- W -

- X -

- Z -

HIOKI 9540 FUNCTION UP DISK

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Technical Sales Support Section

All inquiries to Sales and Marketing International Department
81 Koizumi, Ueda, Nagano, 386-1192, Japan
FAX: +81-268-28-0568 TEL: +81-268-28-0562
E-mail: os-com@hioki.co.jp
URL http://www.hioki.co.jp/

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HIOKI

HIOKI E. E. CORPORATION

HEAD OFFICE

81 Koizumi, Ueda, Nagano 386-1192, Japan
TEL +81-268-28-0562 / FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp

HIOKI USA CORPORATION

6 Corporate Drive, Cranbury, NJ 08512, USA
TEL +1-609-409-9109 / FAX +1-609-409-9108

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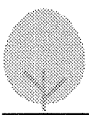

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