HIOKI

INSTRUCTION MANUAL

8846

MEMORY HiCORDER

HIOKI E. E. CORPORATION

Contents

Chapter 4 Installation and Preparation 41

Chapter 5 Basic Operation and Measurement 59

Chapter 6 Memory Recorder Function ········ 81

Chapter 7 Recorder Function ········ 105

Chapter 11 SYSTEM Screen Settings 219

11
12
13

16
17
18
19
20
21
22
23
24
14
15
APP
IND

Introduction

Thank you for purchasing this HIOKI "8846 MEMORY HiCORDER."
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

☐ Power cord	1
☐ DC power cord	1
☐ Recording paper (roll paper)	1
☐ Spare fuse (DC supply 10 - 30 V: class A melting fuse (NM) 12 A/250 V, 6.4 dia.×31.8 mm)	1
☐ Instruction Manual	1
☐ Protect cover	1
☐ MO disk (230MB)	1
☐ Recording paper attachment	2
☐ Eject pin	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

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 a grounding terminal for measurement.
⏛	Indicates a fuse.
∿	Indicates AC (Alternating Current).
⎓	Indicates DC (Direct Current).
≂	Indicates both DC (Direct Current) and AC (Alternating Current).
PEAK	Indicates a peak value.

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.

Symbols used for setting and operating steps

Method **Operation** **Step**	Indicates a setting or operating procedure. Follow the numbered sequence and perform the indicated steps.
Reference	Additional information about setting and operating procedures.
Example	Indicate practical examples for setting and operating procedures.

	Example	
(Bold character) --------	Set to **FFT**	Indicates display items or selection items.
☞ ----------	(☞ Section ..)	Indicates sections for reference.
☐ ----------	F1	Indicates operation keys.
[ ] ----------	[FFT]	Indicates function key displays.

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 8846 (☞ Section 4.2, "Power Supply and Ground Connection".**
- **Before connecting the unit to a battery or other DC source, make sure that the intermediate switch is set to OFF. If the switch is ON, there is a risk of sparks.**

(3) Protective grounding

- Be sure to connect the ground terminal to a good ground (☞ Section 4.2, "Power Supply and Ground Connection"). If the AC outlet is grounded, using the supplied power cord with 3-prong plug will establish the ground connection.
- Also when powering the unit from a battery or other DC source, connect the ground terminal to a good ground.

(4) Before powering on

- Check that the power supply is correct for the rating of the unit. Also check that the correct fuse is fitted. (☞ Section 4.2, "Power Supply and Ground Connection". (The AC fuse is integrated in the unit.)
- The power switches of this unit are separate for AC power (power switch on 8846) and DC power (intermediate switch on DC power supply cable). If DC power is being supplied and the intermediate switch is set to ON, the 8846 will operate also if the power switch is set to OFF.

(5) Probe Connection, Measurement Voltage Input

⚠ DANGER

- **Maximum input ratings for the analog units 8916 - 8919, 8927, and 8928 and the input terminals of the 8846 are shown below. To avoid the risk of electric shock and damage to the unit, take care not to exceed these ratings.**
- **The 8918 TEMPERATURE UNIT is designed specifically for thermocouples. Do not use it with any other components. (Circuit protection is provided for up to 100 V DC or AC, but any voltage above this value will destroy the unit.)**
- **The maximum floating voltage of 8916 to 8919, 8928 (voltage between input and 8846 frame ground, and between inputs of other analog 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 floating voltage rating applies also if an input attenuator or similar is used.**
- **The 8927 ANALOG UNIT is not isolated from the ground of the 8846 (common ground). To avoid the risk of electric shock and damage to the unit, make sure that the ground connection and input connections are correctly established. (☞ Section 4.4)**
- **When measuring power line voltages with the 8916, 8917, or 8919, 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 supplied input cables (units 8916, 8917, and 8919 use the input cable 9574, and unit 8927 uses the connecting cable 9437). Any exposed metal sections in an input cable consist a risk of electric shock.**

Input/output terminal	Maximum input rating	Maximum floating voltage
8916 inputs 8917 inputs 8919 inputs	500 V DC+AC peak	450 V AC/DC
8918 inputs	100 V AC/DC	250 V AC/DC
8927 inputs	50 V DC+AC peak	No floating
8928 inputs	10 V DC+AC peak	40 V DC+AC peak
EXT TRIG START STOP PRINT EXT SMPL	-5 V to 10 V	No floating
MIC	0 V to 5 V DC+AC peak	No floating
TRIG OUT NG	-20 V to +30 V 500 mA max 200 mW max	No floating

⚠ WARNING **The logic units all have and the 8846 have a common ground.**

(6) Replacing the fuse and input units

⚠ DANGER

- **Use a DC power supply fuse of the proper rating (12 A/250 V).**
- **In order to avoid accidents from electric shock, before removing or replacing an input unit or changing a fuse, check that the input cables are disconnected, turn off the power, and remove the power cable.**
- **Normally keep all eight 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.**

(7) Recording paper

⚠ CAUTION

- This unit uses a thermal printer. The recording paper supplied has characteristics finely tuned for use with the printer.
  Using recording paper of a different specification may not only result in impaired printing quality, but even prevent the printer from operating. Always use the HIOKI specified product.
- Insert the paper with correct orientation (☞ Section 4.6, "Loading Recording Paper").

(8) Using a printer

⚠ CAUTION Using the printer in a high-temperature or high-humidity environment should be avoided at all costs. This can seriously reduce the printer life.

(9) Storing

NOTE When the unit is not to be used for an extended period, set the head up/down lever to the "head up" position. This will protect the printer head and prevent deformation of the rubber roller.

(10) Shipping

⚠ CAUTION

Remove the printer paper from the unit. If the paper is left in the unit, paper support parts may be damaged due to vibrations.
Remove the tape from the unit.

NOTE

If reshipping the unit, preferable use the original packing.

(11) Others

NOTE

- In the event of problems with operation, first refer to Section 23.4, "Trouble shooting".
- Carefully read and observe all precautions in this manual.

Chapter Summary

Chapter 1 Product Overview

Contains an overview of the unit and its features.

Chapter 2 Specifications

Contains general specifications and detailed function specifications.

Chapter 3 Logic Input Section and Analog Input Unit

Contains specifications and precautions for logic input section and input amplifier units.

Chapter 4 Setup and Preparations

Explains how to set the unit up for measurement.

Chapter 5 Operation Steps for Basic Measurement

Explains how to operate the keys and JOG/SHUTTLE control for carrying out basic measurement functions.

Chapter 6 Memory Recorder Function Settings

Explains how to use the memory recorder functions of the unit.

Chapter 7 Recorder Function Settings

Explains how to use the recorder functions of the unit.

Chapter 8 FFT Function Settings

Explains how to use the FFT analysis functions of the unit.

Chapter 9 Input Channel Settings

Explains how to make settings using the channel setting screen.

Chapter 10 Trigger Functions

Explains how to use the trigger functions of the unit.

Chapter 11 System Screen Settings

Explains how to make settings using the system setting screen.

Chapter 12 Printout of Waveform Data and Processing Data

Explains how to print out data and how to read printed charts.

Chapter 13 Storing Data On MO Disk

Explains how to store data on MO disk and how to read stored data.

Chapter 14 Calculating Waveform Data

Explains the waveform processing functions of the unit and how to input processing equations.

Chapter 15 Determining Waveform Parameters / Evaluating Parameter Values

Explains waveform parameter processing functions and waveform parameter evaluation. 14 parameters of the input waveform are determined and used for GO/NG evaluation.

Chapter 16 Waveform GO/NG Evaluation

Explains the waveform evaluation function which uses an evaluation area created by the user for GO/NG evaluation.

Chapter 17 Memory Segmentation Function

Explains the memory segmentation function which splits the internal memory into blocks for storing waveform data.

Chapter 18 Waveform Averaging

Explains the waveform averaging function which serves to remove noise components from the waveform.

Chapter 19 Using the A/B Cursors / Waveform Scrolling

Explains how to use the A/B cursors and how to perform waveform scrolling.

Chapter 20 LEVEL MON. Key, CH.SET Key, HELP Key

Explains how to use the LEVEL MON., CH.SET, and HELP keys.

Chapter 21 External Input/Output Connectors / Key Lock Function

Gives specifications and usage details of the external input/output connectors.

Chapter 22 Using the D/A Output Unit 9539 (Option)

Gives specifications and usage details of the optional D/A output unit 9539.

Chapter 23 Maintenance

Describes maintenance and fuse replacement procedures.

Chapter 24 Error and Warning Messages

Describes error and warning messages and lists reference sections in the manual.

Appendix

Contains a glossary of terms used in this manual and gives some basic reference information.

Chapter 1
Product Overview

1.1 Major Features

(1) Storage capability using MO disk

Waveform data and parameter information can be recorded on MO disk.

(2) Easy to read, large color display

The 9.5-inch TFT color screen with a resolution of 640 × 480 dots shows all information at a glance.

(3) Built-in thermal printer for A4-size printouts

- The built-in printer delivers waveform printouts on the spot.
- The printer can also be used to print screen shots and parameter information.

(4) 16-channel, 14-bit high-resolution recording capability

Using the analog unit 8927 (designed specifically for the 8845 and 8846, not isolated from ground), waveform recording can be performed in up to 16 channels with 14-bit resolution.

(5) Expansion units designed for 8840 can be used

- The 8916 ANALOG UNIT, 8917 DC/RMS UNIT, 8918 TEMPERATURE UNIT, and 8919 FFT UNIT can be used in the 8846.
- Units designed for 8840 are connected in a floating configuration (isolated from ground).

(6) Playback of recorded waveform data

The optional 9539 D/A OUTPUT UNIT allows output of recorded waveform data (2 channels) as an analog waveform with a +6.4 to -6.4 V range.

(7) Voice memo capability

Simply by connecting a microphone to the unit, the user can record a voice memo along with waveform data.

(8) Simple function key interface

Thanks to its GUI-inspired design using large function key graphics, the unit is easy to set up and operate.

(9) 3 incorporated functions

- Memory recorder with up to 200 kS/s and 2 M word capacity (using 1 unit/1 channel); X-Y plotting also possible.
- Continuous real-time recording capability to tape or paper in recorder function
- FFT function with 12 analysis patterns

(10) Trigger function

- Digital trigger circuit
- 4 trigger types: level trigger, window-in trigger, window-out trigger, logic trigger

(11) Waveform data processing

Absolute waveform values, integral values, and differential values can be calculated, and arithmetic processing of multiple waveform data is also possible.

(12) Waveform parameter calculation

14 waveform values including maximum, minimum, and effective values can be determined.

(13) Waveform evaluation

A good/no-good decision (GO/NG) can be performed depending on whether the waveform is in a standard area or not. The standard area can be easily set up using the graphics editor.

(14) Scaling function

By setting the physical amount and the unit to be used for 1 V input, the measurement result can be converted into any desired scale.

(15) Strain gauge adapter

The measurement with a strain gauge adapter is possible by using the 8928 STRAIN UNIT.

(16) GP-IB interface

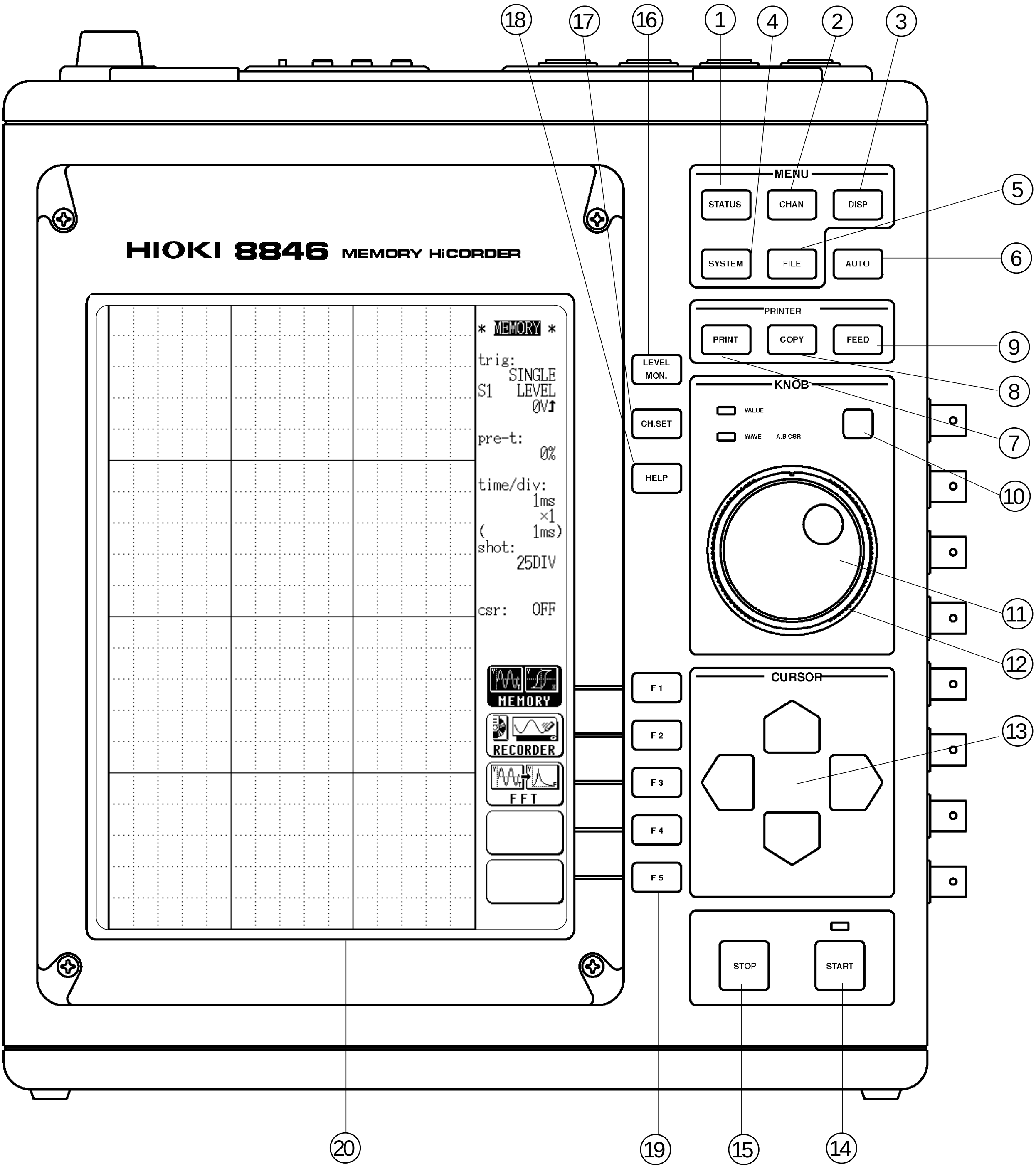
The optional 9537 GP-IB INTERFACE applied to IEEE-488.2 can be used.
It is possible to input and output data and remotely control.

(17) SCSI interface

The optional 9538 SCSI INTERFACE applied to ANSI-X3.131-1986, JIS-X6051 can be used. The waveform data recorded on a MO disk can be transferred to a personal computer with using the 9606 DATA CONVERSION UTILITY.

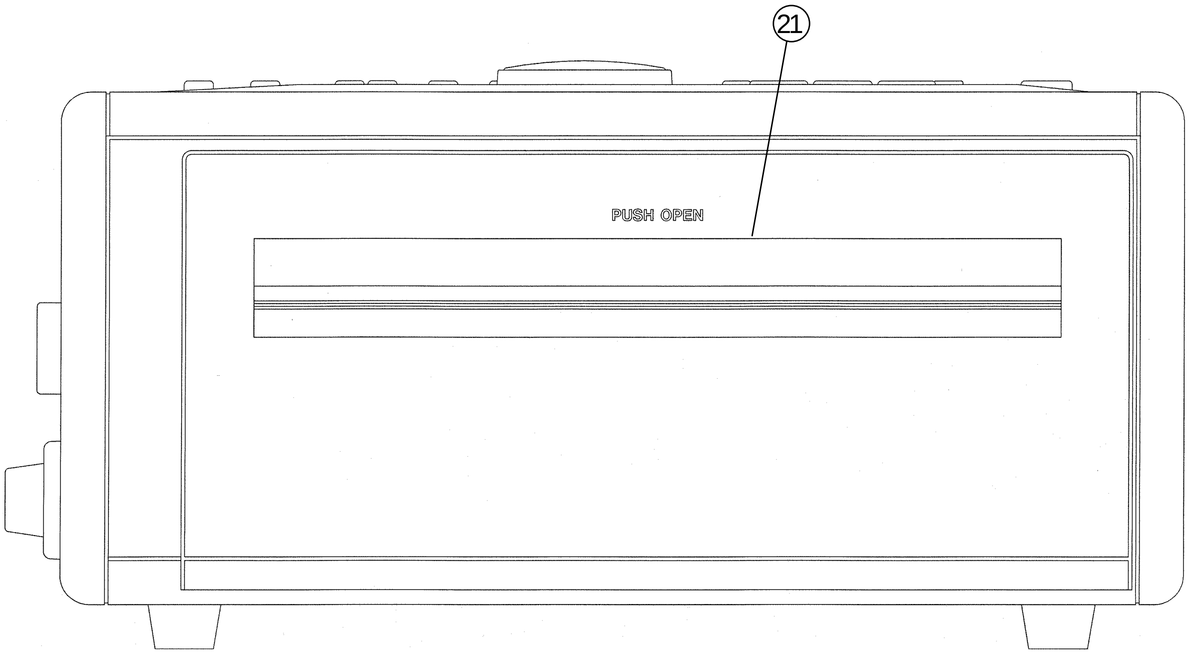
1.2 Identification of Controls and Indicators

Controls and indicators of the unit are listed on the following pages, along with a simple explanation of their function.

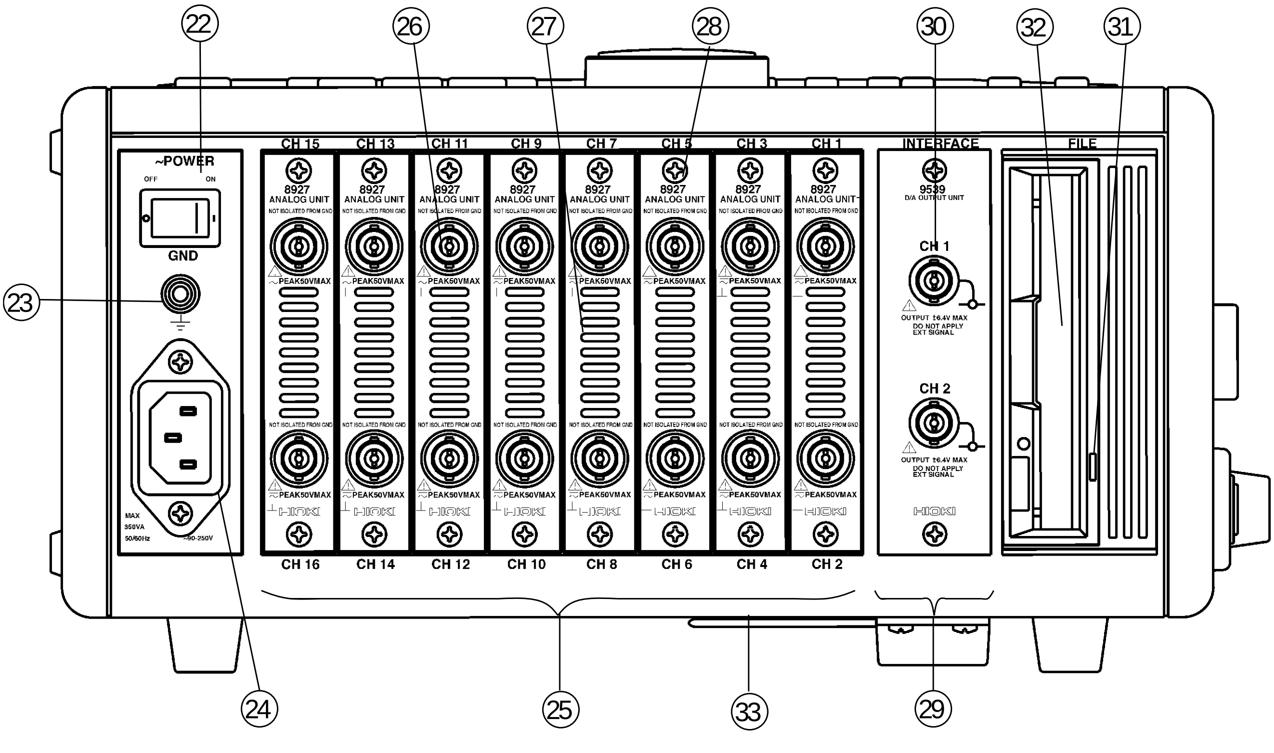

⑱
⑰
⑯
①
④
②
③
⑤
⑥
⑨
⑧
⑦
⑩
⑪
⑫
⑬
⑳
⑲
⑮
⑭
HIOKI 8846 MEMORY HiCORDER
MENU
STATUS
CHAN
DISP
SYSTEM
FILE
AUTO
PRINTER
PRINT
COPY
FEED
KNOB
VALUE
WAVE
A.B CSR
CURSOR
LEVEL MON.
CH.SET
HELP
F1
F2
F3
F4
F5
STOP
START
* MEMORY *
trig: SINGLE
S1 LEVEL 0V
pre-t: 0%
time/div: 1ms ×1 (1ms)
shot: 25DIV
csr: OFF
MEMORY
RECORDER
FFT

Front Panel

① STATUS key	Causes the display to show the STATUS screen which serves for setting most measurement parameters.
② CHAN key	Causes the display to show the CHANNEL screen which serves for making input channel settings.
③ DISP key	Causes the display to show measurement and analysis results.
④ SYSTEM key	Causes the display to show the SYSTEM screen which serves for making system-wide settings such as for the scaling function (☞ Chapter 11).
⑤ FILE key	Causes the display to show the MO screen which serves for making MO disk settings (☞ Chapter 13).
⑥ AUTO key	Pressing this key activates automatic setting of X and Y axis range values for easy reading (☞ Sections 6.3, 7.3).
⑦ PRINT key	Serves to print out stored waveforms (☞ Chapter 12).
⑧ COPY key	Serves to print out a hard copy of the current screen display (☞ Chapter 12).
⑨ FEED key	Causes the printer paper to advance for as long as the key is pressed (☞ Chapter 12).
⑩ Select key	Selects the function that is controlled by the JOG/SHUTTLE knob. With each push of the key, the functions is toggled between VALUE and WAVE A B CSR. The respective LED lights up (☞ Chapter 19).
⑪ JOG key	Rotary control knob that serves to change values, move the A/B cursors, and scroll the waveform.
⑫ SHUTTLE key	Concentric ring that serves to move the flashing cursor, A/B cursors, and to scroll the waveform. The speed of movement is proportional to the rotation angle (☞ Chapter 19).
⑬ CURSOR keys	These keys serve to move the flashing cursor in the four directions.
⑭ START key	Initiates the measurement and analysis. During measurement, the LED above the key is lit.
⑮ STOP key	Stops measurement and analysis.
⑯ LEVEL MON. key	Serves to check the input signal level (☞ Chapter 20).
⑰ CH. SET key	Serves to display and change measurement parameters for the various channels (☞ Chapter 20).
⑱ HELP key	Serves to indicate the position of the currently displayed screen information in relation to the entire recording length (☞ Chapter 20).
⑲ F1 - F5 keys	Serve to select setting items.
⑳ LCD screen	

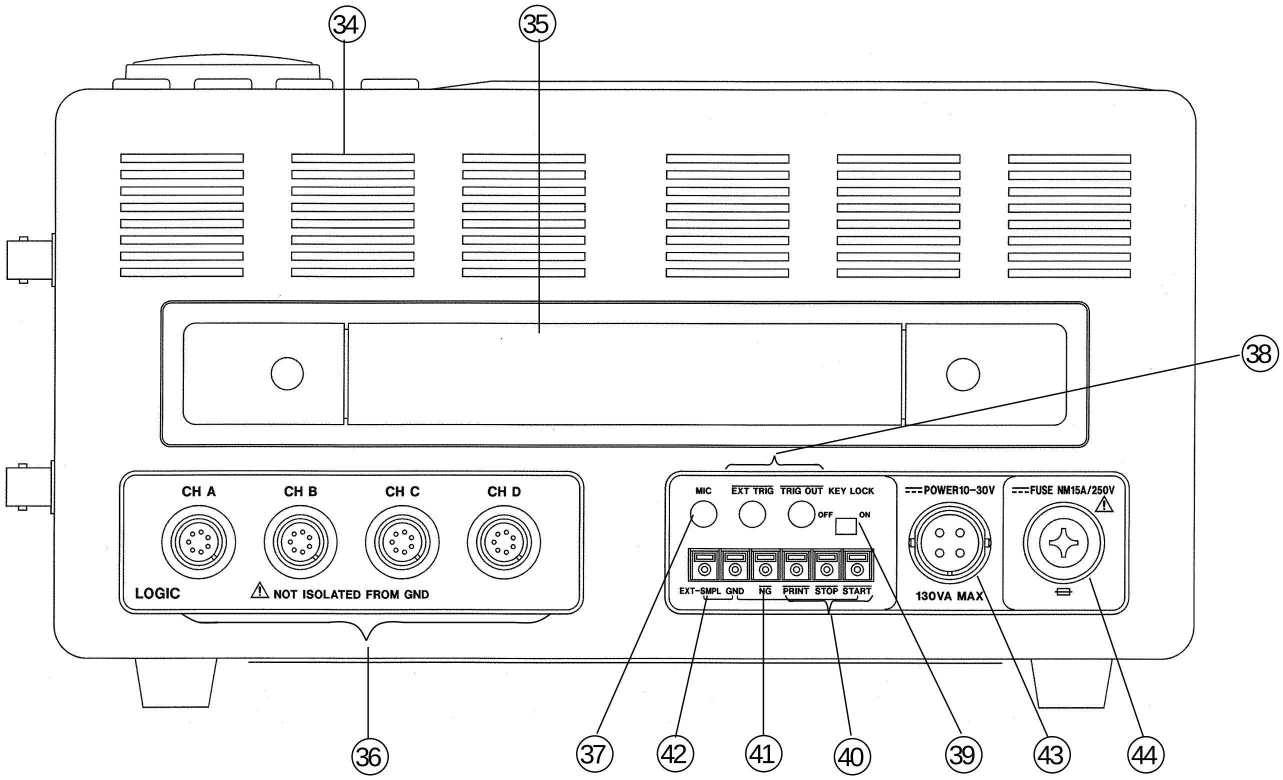


Left Side View

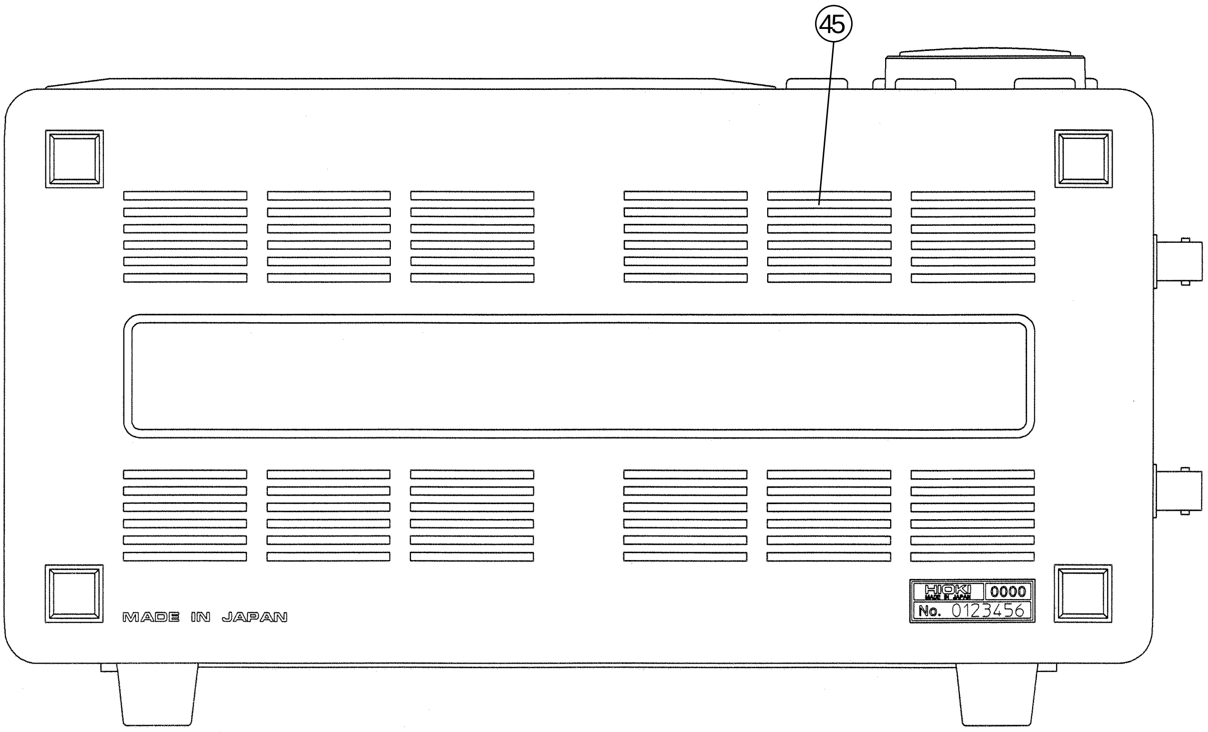


Right Side View

㉑	Printer	
㉒	AC POWER switch	Serves to turn the unit on and off.
㉓	Protective ground terminal (GND)	
㉔	AC connector	The supplied power cord must be plugged in here.
㉕	Input unit slots	These slots accept various input units, such as the 8916 ANALOG UNIT, 8917 DC/RMS UNIT, 8918 TEMPERATURE UNIT, 8919 FFT ANALOG UNIT, 8927 ANALOG UNIT, and 8928 STRAIN UNIT.
㉖	Analog input connector (on 8927 ANALOG UNIT)	Unbalanced analog input
㉗	Ventilation slots	
㉘	Fastening screw	Secures the plug-in unit.
㉙	Expansion slot	Accepts the optional unit. The 9537 GP-IB INTERFACE, 9538 SCSI INTERFACE, and 9539 D/A OUTPUT UNIT can be used.
㉚	Analog output connector (of the 9539 D/A OUTPUT UNIT)	
㉛	BUSY lamp	MO drive activity indicator. Indicates during drive operation.
㉜	Disk insertion slot	The MO disk is inserted here.
㉝	Tilt support	Serves to tilt the unit upwards.



Top View



Bottom View

㉞ Ventilation slots	
㉟ Handle	Serves for transporting the 8846.
㊱ Logic probe connectors	Input connector for the logic input section, designed for the dedicate logic probes (CH A, CH B, CH C, CH D) (☞ Chapter 3).
㊲ MIC (microphone) connector	For connection of a microphone (☞ Chapter 21).
㊳ Trigger connectors	Can be used to synchronize multiple units, using the EXT TRIG input and TRIG OUT output (☞ Chapter 21).
㊴ KEY LOCK switch	When this switch is set to ON, all keys of the 8846 are inactive. The key lock condition is maintained also when the power is switched off and on again (☞ Chapter 21).
㊵ Remote terminals	Start, stop, and print operation can be controlled via external signals (☞ Chapter 21).
㊶ NG evaluation output terminal	When the waveform evaluation based on waveform parameters has resulted in NG, a signal is output from this terminal (☞ Chapter 21).
㊷ External sampling terminal	Allows input of an external sampling signal (☞ Chapter 21).
㊸ DC power supply connector	Allows use of an external DC source to power the unit (with dedicated DC cable).
㊹ Fuse holder	Contains a DC power supply fuse.
㊺ Ventilation slots	

Chapter 2
Specifications

2.1 General Specifications

■ Basic specifications

Number of units (maximum)	Analog 8 units 8 channels when using with only the 8916, 8917, 8918, 8919, 8928 16 channels when using with only the 8927 (The logic channels are standard equipment for the 8846, common ground with main unit)	
Memory capacity	2 M words 8916, 8917, 8918, 8919, 8928	8927
When 1 unit is in use	12 bits×2 M words /channel	14 bits×1 M words /channel
When 2 units are in use	12 bits×1 M words /channel	14 bits×500 K words /channel
When 4 units are in use	12 bits×500 K words /channel	14 bits×200 K words /channel
When 8 units are in use	12 bits×200 K words /channel	14 bits×100 K words /channel
	one unit of the 8928 equals two units of the 8916 to 8919	
Maximum sampling speed	Memory recorder, FFT	200 kS/s (8927 is not in use) 100 kS/s (8927 is in use)
	Recorder	80 kS/s
Input method	Plug-in analog input units floating input 8916, 8917, 8918, 8919, 8928 no floating 8927	
Time measurement functions	Auto calendar with automatic leap year, 24 hour clock	
Time measurement precision (maximum)	20 ppm (25℃)	
Backup battery and lifetime	Used for clock and to preserve settings, 8 years (reference value at 25℃)	
Operational ranges for temperature and humidity	Temperature: 5℃ to 40℃ Relative humidity: 35% to 80% RH (with no condensation)	
Temperature and humidity ranges for assured accuracy	Temperature: 23℃±5℃ Relative humidity: 35% to 80% RH (with no condensation)	
Temperature and humidity ranges for storage	Temperature: -10℃±50℃ Relative humidity: 35% to 80% RH (with no condensation)	

Insulation resistance and dielectric strength	At least 10 MΩ/500 VDC, one minute at 1.5 kVAC (between the frame and the AC power supply) At least 10 MΩ/500 VDC, one minute at 700 VDC (between the frame and the DC power supply) At least 100 MΩ/500 VDC, one minute at 2 kVAC (between the input units (excluding 8918, 8927, 8928) and the frame) At least 100 MΩ/500 VDC, one minute at 1.5 kVAC (between the input unit (8918) and the frame) At least 100 MΩ/500 VDC, one minute at 500 VAC (between the input unit (8928) and the frame) At least 100 MΩ/500 VDC, one minute at 2 kVAC (between the input units (excluding 8918, 8927, 8928)) At least 100 MΩ/500 VDC, one minute at 500 VAC (between the input units (8928))
Power supply	90 to 250 VAC (50/60 Hz) 10 to 30 VDC
Fuse	10 to 30 VDC class A melting fuse (NM) 12 A/250 V 6.4 dia.×31.8 mm (DC power supply)
Maximum rated power	AC: 350 VA (when printer off, 130 VA) DC: 130 VA (when printer off, 70 VA)
Dimensions	Approx. 280 (W)×306 (H)×140 (D) mm (excluding projections)
Mass	Approx. 7 kg

■ Display

Screen	9.5 inch LCD display (TFT color LCD, 640×480 dots)
Display resolution	Waveform: 20 DIV f.s. × 15 DIV f.s. Text: 60 characters × 40 characters (1 DIV= 32 dots (vertically) × 32 dots (horizontally)
Dots spacing	0.30 mm × 0.30 mm
Maximum display defect ratio	Always-on dots + always-off dots = max. 15

■ Recorder

Method of recording	Thermosensitive recording method using a thermal line head
Recording paper	Roll type thermosensitive recording paper, 216 mm × 30 m (long)
Width of recording	Total recording width: 212 mm±1mm (1696 dots) Waveform portion: 200 mm±1mm f.s. (1 DIV=10 mm)
Recording speed	Approx. 25 mm/s max
Paper feed accuracy	±1% (25℃, 60% RH)

■ External data storage

Device	3.5-inch MO drive
Capacity	640 MB (540, 230, 128 MB)
Data format	Accordance with ISO standard , overwrite object supported
Recorded data	Binary format and text format of the waveform data (memory recorder, recorder, FFT), settings, waveform decision area, screen copy (BMP file)

■ External input /output terminals

START STOP PRINT	Input signal	active LOW			
		HIGH level	2.5 to 5.0 V	LOW level	0 to 1.0 V
	Pulse width	HIGH level	20 ms at least	LOW level	10 ms at least
	Maximum allowable input		-5 to 10 V		
EXT TRIG	Input signal	active LOW			
		HIGH level	2.5 to 5.0 V	LOW level	0 to 1.0 V
	Pulse width	LOW level	5 μs at least		
	Maximum allowable input		-5 to 10 V		
	Input terminal	mini-jack connector, 3.5 mm diameter			
EXT SMPL	Input signal	active LOW			
		HIGH level	2.5 to 5.0 V	LOW level	0 to 1.0 V
	Pulse width	LOW level	1 μs at least		
	Frequency	180 kHz max (90 kHz max when using the 8927)			
	Maximum allowable input		-5 to 10 V		
MIC	Maximum allowable input		0 to 5.0 V DC+AC peak		
	Input terminal	mini-jack connector, 3.5 mm diameter			
TRIG OUT	Output signal	active LOW			
		HIGH level	4.5 to 5.0 V	LOW level	0 to 0.5 V
	Pulse width	LOW level	1.5±0.5 ms		
	Maximum allowable input		-20 to 30 V, 500 mA max, 200 mW max		
	Output terminal	mini-jack connector, 3.5 mm diameter			
NG	Output signal	active LOW			
		HIGH level	4.5 to 5.0 V	LOW level	0 to 0.5 V
	Pulse width	HIGH level	20 ms at least	LOW level	70 ms approx.
	Maximum allowable input		-20 to 30 V, 500 mA max, 200 mW max		

2.2 Trigger Unit Specifications

Trigger Method	Digital comparison
Trigger modes	Memory recorder, FFT functions: Single, repeat, auto, auto-stop Recorder function: Single repeat
Trigger source	CH1 - CH16: Analog waveform to input for each channel CHA - CHD: Logic waveform to input for each channel External trigger: Input signal to EXT TRIG terminal Timer trigger: Start, stop, interval selectable 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 source individually.
Analog trigger	Uses analog input waveform (channel 1 - 16) as trigger source. Level trigger: Trigger level is set as voltage. Triggering occurs when the signal passes the trigger level with the selected slope (rising edge, falling edge). Window-in trigger: Upper and lower trigger levels can be set. Triggering occurs when the waveform enters the defined area. Window-out trigger: Upper and lower trigger levels can be set. Triggering occurs when the waveform leaves the defined area.
Logic trigger	Uses the logic input waveform (CH A - CH D) as trigger source. Triggering occurs when the set pattern is matched.
Trigger source AND, OR	AND, OR logic can be used to link trigger sources. AND: Triggering occurs when all sources have been triggered. OR: Triggering occurs when one trigger source has been triggered.
Trigger filter	Trigger width can be set by number of sampling points. OFF, 10, 20, 50, 100, 150, 200, 250, 500, 1000
Trigger level resolution	0.25 % f.s. (f.s. = 20 DIV)
Pre-trigger	0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, -95 % (in the memory recorder function,) unsettable at external sampling
Trigger output	Signal is output from TRIG OUT terminal when triggering occurs.

2.3 Memory Recorder Function Specifications

Time axis	500 μs/DIV (not available when 8927 is used) 1, 1.25, 2, 2.5, 5, 10, 20, 50, 100, 200, 500 ms/DIV 1, 2, 5, 10, 20 s/DIV 1, 2, 5 min/DIV
Time axis resolution	100 points/DIV (time axis magnification × 1)
Time axis precision	±0.001% (relative scale vs. time error)
Sampling period	1/100 of the time axis
Recording length	25, 50, 100, 200, 500, 1000(*1), 2000(*2), 5000(*3), 10000(*4), 20000(*5) DIV *1: when 16 channels are in use *2: when 8 channels are in use *3: when 4 channels are in use *4: when 2 channels are in use *5: when 1 channel is in use (when using the 8927, not selectable)
Display format	Single, dual, quad, oct screen display, X-Y single, X-Y dual display
Recording line display	16-color (LCD) dark, medium dark, normal, light (printer)
Interpolation function	dot (no interpolation), line (linear interpolation)
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 Voltage axis ×20, ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10
Variable display function	① Settable upper and lower limit (-9.9999E+29 to 9.9999E+29) ② 0 V (position) fixed; magnification/compression from 0.0001E-29V/DIV to 9.9999E+28V/DIV
Automatic store function	ON/OFF switchable. Automatic recording of waveform data on MO disk after completion of measurement.
Auto-print	ON/OFF switchable. Automatically prints the memorized waveform
Manual print	Prints by pressing the PRINT key
Partial print	Prints between the A and the B cursors
Print smoothing function	ON/OFF switchable. Doubles density along time axis for smooth printout (at lower speed).
Logging function	Numeric printout of waveform data
Memory segmentation function	Memory area of each channel can be divided into max. 63 blocks. ① Multi-block memory (memory segmentation) ② Sequential save
Superimposition function	ON/OFF switchable
Waveform scrolling	Available in both the left/right and the up/down directions

2.4 Recorder Function Specifications

Time axis	(*1)1.25, 2, (*2)2.5, (*3)5, (*4)10, (*5)20, 50, 100, 200, 500 ms/DIV 1, 2, 5, 10, 20 s/DIV 1, 2, 5, 10, 20 min/DIV 1 h/DIV *1: when 1 channel is in use *2: when 2 channels are in use *3: when 4 channels are in use *4: when 8 channels are in use *5: when 16 channels are in use
Time axis resolution	100 points/DIV (time axis magnification × 1)
Time axis precision	±0.001% (relative scale vs. time error)
Recording time	Continuous or settable from 1 second to 366 days 23 h 59 min 59 s in 1-second intervals
Display format	Single, dual, quad, oct screen display
Recording line display	16-color (LCD) dark, medium dark, normal, light (printer)
Interpolation function	dot (no interpolation), line (linear interpolation) line only when measurement
Waveform magnification/ compression	Time axis ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, ×1/400, ×1/500, ×1/800, ×1/1000, ×1/2000, ×1/5000, ×1/10000, ×1/20000, ×1/50000, ×1/100000 Voltage axis ×20, ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10
Variable display function	① Settable upper and lower limit (-9.9999E+29 to 9.9999E+29) ② 0 V (position) fixed; magnification/compression from 0.0001E-29 V/DIV to 9.9999E+28 V/DIV
Data storage medium	OFF, printer, MO
Data transferring	Transfer the recorded data in memory recorder function to memory recorder function.
Manual printing	Activated by pressing the PRINT key Printout of data in memory at completion of recording Printout of all recording data when data are read
Partial print	Prints between the A and the B cursors
Waveform scrolling	Available in both the left/right and the up/down directions
Logging function	Numeric printout of waveform data

2.5 FFT Function Specifications

FFT range setting	133, 333, 667 mHz 2, 4, 8, 20, 40, 80, 200, 400, 800 Hz 2, 4, 8, 16, 20, 32, 40, 80* kHz (*:not available when 8927 is used)
Frequency resolution	1/400
Number of sampling points	1000 (storage waveform)
Dynamic range	72 dB (logical value for 8916, 8917, 8918, 8919, 8928) 84 dB (logical value for 8927)
Antialiasing filter	ON/OFF switchable. Automatic cutoff frequency selection linked to frequency range (for channels using 8919 FFT unit)
Window functions	Rectangular, Hanning, Exponential
FFT analysis modes	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
X-axis setting	Time, frequency (linear, logarithmic), real-number voltage (Nyquist only)
Y-axis setting	Voltage (real-number, imaginary number, absolute value, logarithmic)
FFT channel mode	1 channel FFT, 2 channel FFT
Analysis channels	2 channels selectable from all analog channels
Reference data	Newly read waveform, waveform stored with memory recorder function
Display format	Single, dual screen display, Nyquist display
Recording line display	Identical fixed color for g1, g2 (display), Dark (printer)
Interpolation function	dot (no interpolation), line (linear interpolation)
Waveform magnification/ compression	Selectable upper and lower limit (only voltage values set with STATUS screen; settings made with CHANNEL screen are valid only for histogram of X-axis)
Automatic store function	ON/OFF switchable. Automatic recording of waveform data on MO disk after completion of measurement.
Auto-print	ON/OFF switchable. Automatically prints the memorized waveform
Manual print	Prints by pressing the PRINT key
Logging function	Numeric printout of waveform data

2.6 Auxiliary Functions Specifications

■ Averaging function

Memory recorder	Averaging count (OFF, 2 - 256, summing averaging up to specified count, then exponent averaging)
FFT	Averaging count (OFF, 2 - 4096) Selectable functions: summing averaging, exponent averaging (each on time axis or frequency axis), peak hold (frequency axis)

■ Waveform decision function

Waveform area evaluation	Comparison to reference area Memory recorder (single, X-Y single display) FFT (single, Nyquist display)
Decision modes	Out NG (fail) if any part of the waveform goes out of the decision area. All out NG (fail) if the waveform is entirely outside the decision area.
Stop modes	Go stop, NGstop, GO&NG stop On stop, printer output and waveform save can be selected.
Decision time	20 ms approx.
Decision period	1.75 s approx. (1 ch, 1 mS/DIV, 25 DIV, ×1, line display during compressed display or when the recoding length is long, this becomes slower.
Reference area editor	Graphic editor
Editor commands	Line (dotted line), Paint, Read Waveform, Erase, Parallel Move (with overwrite), Reverse, Clear (partial deletion), All Clear (screen deletion), Undo, Save
Waveform parameter evaluation (memory recorder, recorder)	Upper and lower trigger limits for waveform parameter processing can be set
Evaluation modes	Out NG when parameter leaves specified range In NG when parameter enters specified range
Evaluation output	Signal is output from NG terminal when NG occurs.

■ Calculation processing

Waveform processing (Memory recorder)	Arithmetic calculation, absolute value, exponent, common logarithm, square root, displacement average, 1st and 2nd differential, 1st and 2nd integral, parallel displacement on time axis, trigonometric functions (sin, cos, tan), reverse trigonometric functions (asin, acos, atan)
Waveform parameter (Memory recorder, recorder)	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, standard deviation, area value, XY area value,

■ Other function

(1) System screen

Start condition backup	ON/OFF switchable. (Retains measurement status.)
Grid settings	OFF, standard, fine, standard (dark), fine (dark), standard (shaded), fine (shaded) (only OFF and standard for display)
Channel marker	ON/OFF switchable. Waveform numbered with channel number. Always used (regardless of ON/OFF setting) for logic waveforms. Not valid for FFT.
List/gauge print function	ON/OFF switchable. Together with measurement waveform, measurement settings (list) and Y-axis scale (gauge) information is printed.
LCD backlight saver function	ON/OFF switchable. Turns LCD backlight off automatically after 10 minutes of key inactivity.
Comment input function	Input and printout of comments possible.
Scaling function	ON/OFF switchable. Converts voltage values into any unit. Can be set separately for each channel.
Subsampling print function	ON/OFF switchable. Omits interpolation in envelope display.

(2) Key operation

A4 print function	Activated by pressing FEED key and COPY key simultaneously. Displayed waveform is printed out in A4 size.
Display copy function	Activated by pressing COPY key. Produces a hard copy of display contents.
List print function	Activated by pressing PRINT key when display shows setting information. Produces a list of parameter settings.
Auto-range function	Activated by pressing AUTO key (not valid in FFT mode). Selects optimum time axis and voltage axis for input waveform.
Level monitor function	Activated by pressing LEVEL MON. key. Serves to verify voltage range position for input waveform in each channel.
Help function	Activated by pressing HELP key. Shows relative position of displayed data within entire recorded data. When voltage axis is enlarged, relative position of displayed data to full-scale point for each channel is shown (memory recorder, recorder). When memory segmentation is used, usage condition of each block is shown (memory recorder).

(3) External terminal and switches

Remote control	Measurement start, stop, and print control via rear- panel connectors.
External sampling	Signal input to EXT SMPL connector (max. 180 kHz) can be used for sampling (limited by number of recording channels and input units).
Voice memo function	Microphone connected to MIC connector can be used to record a voice memo for any unit.
Key lock	ON/OFF switchable

(4) Others

Comment printing	Function, channel, input range, 0 V position, trigger time, DIV and other information can be printed.
Cursor measurement function	Time, potential, temperature, frequency difference between A and B cursor can be measured. Potential, time from trigger, frequency at A or B cursor can be measured.

2.7 Accessories and Options

Accessories

Power cord	1	
Cord for DC power supply	1	
Recording paper (roll)	1	
Recording paper attachment	2	
Instruction Manual	1	
Protect cover	1	
Spare fuse	1	(DC power supply 10 to 30 V: class A melting fuse (NM) , 12 A/250 V, 6.4 dia. ×31.8 mm)
MO disk (230 MB)	1	
Eject pin	1	

Options

8916	ANALOG UNIT
8917	DC/RMS UNIT
8918	TEMPERATURE UNIT
8919	FFT ANALOG UNIT
8927	ANALOG UNIT (2 channel/one unit)
8928	STRAIN UNIT
9537	GP-IB INTERFACE
9538	SCSI INTERFACE
9539	D/A OUTPUT UNIT (for output of data recorded with recorder function)
9606	DATA CONVERSION UTILITY

Optional accessories

9231	RECORDING PAPER (6 rolls)
9303	PT
9305	TRIGGER CORD
9306	LOGIC PROBE
9307	LINE LOGIC PROBE
9308	LINE DIP DETECTOR??
9369	CARRYING CASE
9370	CARRYING CASE
220H	PAPER WINDER

2.8 System Operation

System operation is explained according to the block diagram.

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

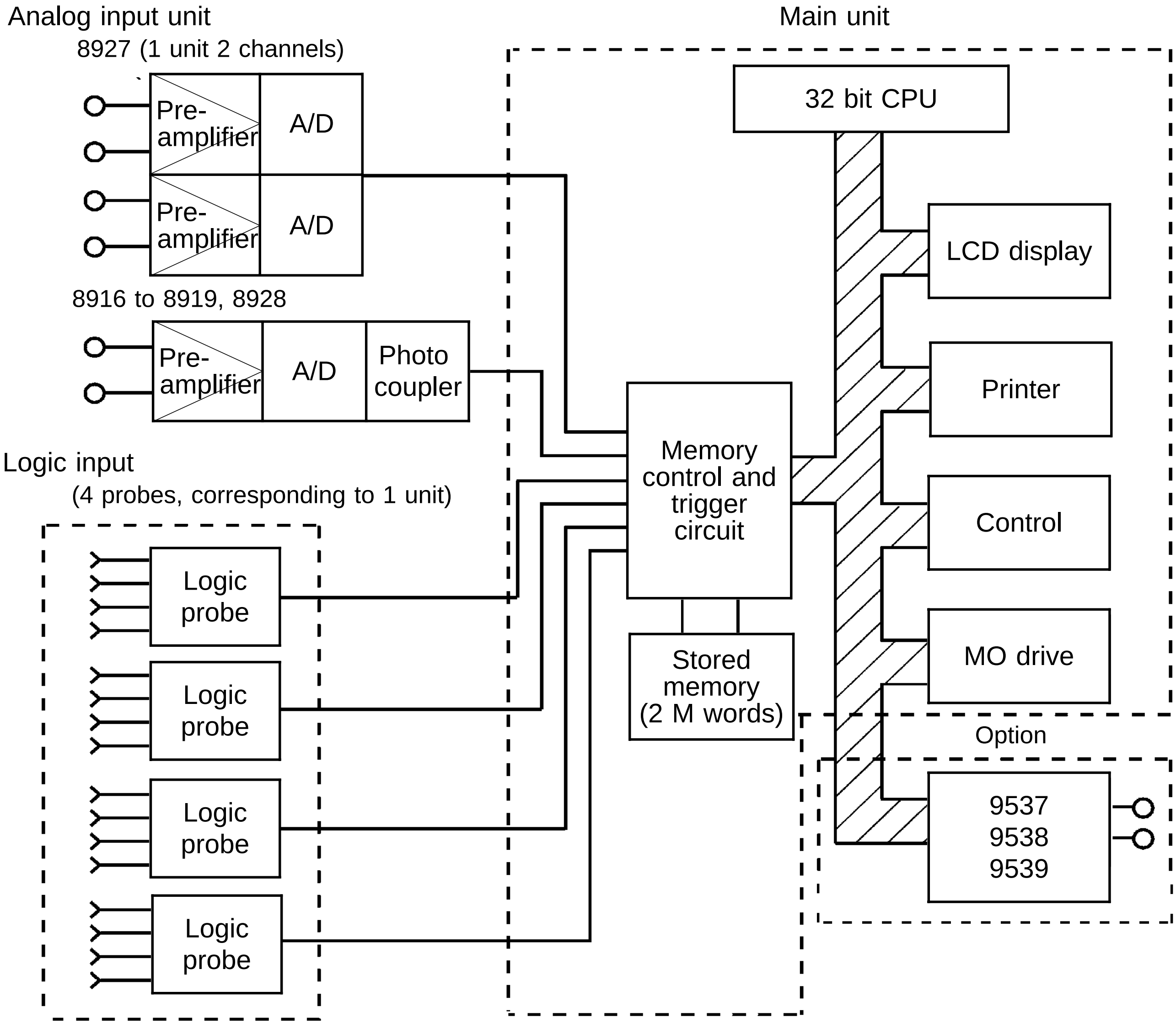
(2) The input units 8916, 8917, 8918, and 8919 incorporate high-speed 12-bit A/D converters which are connected to the main unit via a photocoupler integrated in each input unit. Each channel has its own power supply, to assure electrical isolation from the main unit.

(3) The analog unit 8927 incorporates a 14-bit A/D converter and uses a common ground with the main unit.

(4) The input signals for each channel are converted into digital form by the A/D converter, and the resulting data are stored in the memory by the memory control circuit.

(5) Measurement data stored in memory are processed by the CPU and displayed on the LCD screen. The waveform displayed on the screen can be printed out.

(6) Waveforms can be recorded on MO disk and redisplayed using the D/A output unit (option).



Block Diagram

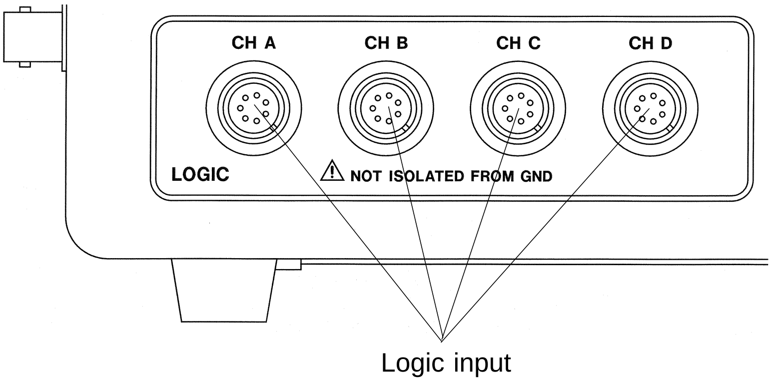
Chapter 3
Logic and Analog Inputs

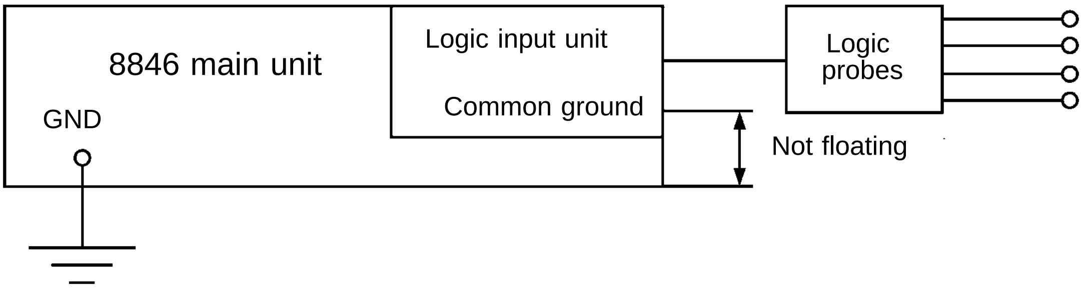
3.1 Logic Inputs

- The logic input is located on the top side of the unit. Up to four probes can be connected.
- Since one logic probe can record 4 channels, the combined maximum recording capability for logic waveforms is 16 channels.

⚠ **WARNING**

- **The 8846 has separate inputs for four probes, but the ground lines of these inputs are not isolated from each other and from the frame ground of the unit (common ground).**
- **Do not connect logic probes other than supplied by HIOKI to the logic inputs.**





NOTE If no logic probe is connected, the corresponding logic waveform is displayed on the screen ad high level.

3.1.1 Logic Probes

NOTE Carefully read the documentation supplied with the probe.

■ 9306 LOGIC PROBE

Input can be switched between voltage input and contact input. Suitable for a wide range of applications, from checking electronic circuits to measuring relay timing.

⚠ DANGER

The 8846 has separate inputs for four probes, but the ground lines of these inputs are not isolated from each other and from the frame ground of the unit (common ground). If voltages with different ground levels are input, probe short-circuiting may occur and lead to accidents.

■ 9307 LINE LOGIC PROBE

- Can be used to detect the on/off status of AC line voltage. Maximum input voltage is 250 V. The probe is suitable for timing measurements of relay sequencers or similar.
- The probe provides internal isolation between channels and between input and output.

⚠ DANGER

The maximum floating (insulation) voltage between channels and between input and output is 250 V AC. To avoid the risk of electric shock and damage to the unit, make sure that the voltage in each channel and between input and output does not exceed this value.

■ 9308 LINE DIP DETECTOR

- Serves to detect momentary voltage drops in commercial power supply lines (100, 120 V AC).
- Dip level switchable between 80% and 90%.
- Requires 8916 ANALOG UNIT, 8917 DC/RMS UNIT or 8919 FFT UNIT .

⚠ DANGER

The banana plug on the LOW side (black) is directly connected to the input clip (black). Take suitable precautions against the risk of electric shock.

3.2 8916 ANALOG UNIT

- The 8916 is the analog unit for the 8840 and 8846 MEMORY HiCORDER.
- Follow carefully the advice of Section 3.2.2, "Safety Requirements."

3.2.1 Specifications

Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV/DIV 1, 2, 5, 10, 20 V/DIV
DC amplitude accuracy	±0.25% f.s.
Zero position accuracy	±0.1% f.s.(after zero adjustment)
Temperature characteristic	Gain: ±0.02%f.s./℃ Zero position: ±0.015%f.s./℃
Frequency characteristic	DC to 100 kHz, -3 dB
Noise	180 μVp-p (typical) maximum sensitivity range, with input shorted
Common mode rejection ratio	100 dB minimum (at 50/60 Hz and with signal source resistance 100 Ω maximum)
Low-pass filter	Cutoff frequency 5, 50, 500 Hz, 5 kHz approx. Can be turned on and off
Input type	Unbalanced (floating)
Input resistance and capacitance	1 MΩ±1% (at power supply off, 500 kΩ) approx. 20 pF (at 100 kHz)
A/D resolution	12 bits
Maximum sampling speed	200 kS/s
Input terminals	2 terminals (for banana plugs)
Maximum allowable input voltage	500 V (DC+AC peak)
Maximum floating voltage	450 V AC/DC (between input unit and frame, and between input units)
Dimensions and mass	110 (W) × 20 (H) × 88 (D) mm (excluding projections), 110 g approx.
Accessories	9574 INPUT CABLE (1)

3.2.2 Safety Requirements

⚠ DANGER

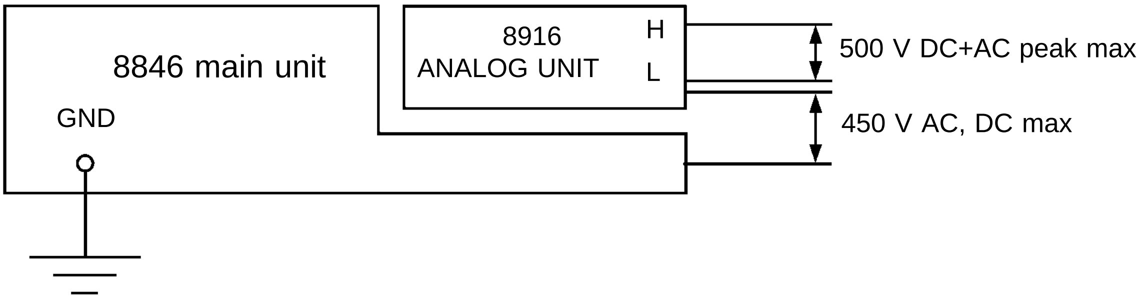
- **The maximum floating voltage (voltage between 8916 input and 8846 frame, and between inputs of other analog units) is 450 V AC/DC. To avoid the risk of electric shock and damage to the unit, take care that voltage between 8916 input and 8846 frame, and between inputs of other analog units does not exceed these ratings.**
- **The maximum allowable input to the 8916 is 500 V (DC+AC peak). To avoid the danger of electric shock or damage to the equipment, ensure that the applied voltage never exceeds this level.**

⚠ WARNING

- **The maximum floating voltage 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 9574 INPUT CABLE provided with the unit 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 9574 INPUT CABLE.



3.3 8917 DC/RMS UNIT

- The 8917 DC/RMS UNIT is the analog unit for the 8840, 8845, and 8846 MEMORY HiCORDERs.
- Records the voltage level converted into RMS values.
- Follow carefully the advice of Section 3.3.2, Safety Requirements."

3.3.1 Specifications

Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV/DIV 1, 2, 5, 10, 20 V/DIV
DC amplitude accuracy	±0.3% f.s.
Zero position accuracy	±0.1% f.s. (after zero adjustment)
RMS accuracy	±1% f.s. (DC, 40 to 1 kHz), ±8% f.s. (1 to 100 kHz),
Temperature characteristic	Gain: ±0.02%f.s./℃ Zero position: ±0.05%f.s./℃
Frequency characteristic	DC to 100 kHz, -3dB
RMS response rate	100 ms typical (0→90%f.s.) 200 ms typical (100→10%f.s.)
Crest factor	2
Noise	250 μVp-p (typical) maximum sensitivity range, with input shorted
Common mode rejection ratio	100 dB minimum (at 50/60 Hz and with signal source resistance 100 Ω maximum)
Low-pass filter	Cutoff frequency 5, 500 Hz, approx. Can be turned on and off
Input type	Unbalanced (floating)
Input resistance and capacitance	1 MΩ±1% (at power supply off, 500 kΩ) approx. 20 pF (at 100 kHz)
A/D resolution	12 bits
Maximum sampling speed	200 kS/s
Input terminals	2 terminals (for banana plugs)
Maximum allowable input voltage	500 V (DC+AC peak)
Maximum floating voltage	450 V AC/DC (between input unit and frame, and between input units)
Dimensions and mass	110 (W) × 20 (H) × 88 (D) mm (excluding projections), 110 g approx.
Accessories	9574 INPUT CABLE (1)

3.3.2 Safety Requirements

⚠ DANGER

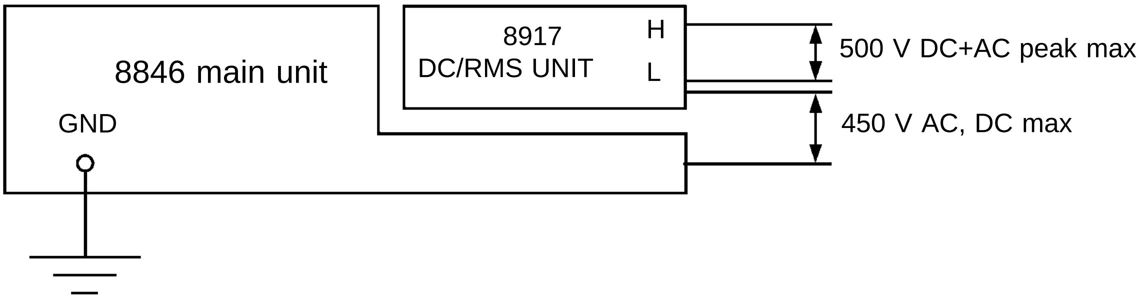
- **The maximum floating voltage (voltage between 8917 input and 8846 frame, and between inputs of other analog units) is 450 V AC/DC.**
  To avoid the risk of electric shock and damage to the unit, take care that voltage between 8917 input and 8846 frame, and between inputs of other analog units does not exceed these ratings.
- **The maximum allowable input voltage to the 8917 is 500 V (DC+AC peak). To avoid the danger of electric shock or damage to the equipment, ensure that the applied voltage never exceeds this level.**

⚠ WARNING

- **The maximum floating voltage 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 9574 INPUT CABLE provided with the unit 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 9574 INPUT CABLE.



3.4 8918 TEMPERATURE UNIT

- The 8918 TEMPERATURE UNIT is a thermocouple unit that is used the 8840, 8845, and 8846 MEMORY HiCORDERs for measuring temperature.
- Using the 8918, temperature can be measured by any of three types of thermocouples: K, J, T.
- Follow carefully the advice of Section 3.4.2, Safety Requirements."

3.4.1 Specifications

Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	10 (0.125), 20 (0.25), 50 (0.625)℃/DIV ( ): minimum resolution
Measurement input range	K (CA) -90 to 1200℃ J (IC) -90 to 800℃ T (CC) -90 to 400℃
Zero position	-110 to 110% of recording width in 1% steps (no zero adjustment)
Reference contact compensation	Automatic compensation
Accuracy	±0.25%f.s.±2℃
Temperature characteristic	±0.05%f.s./℃
Frequency characteristic	DC to 500 Hz, -3dB typical
Response time	1 ms typical (0→90%f.s.), (100→10%f.s.) Low-pass filter 5 Hz ON 100 ms typical (0→90%f.s.) 100 ms typical (100→10%f.s.) Low-pass filter 1.5 Hz ON 300 ms typical (0→90%f.s.) 300 ms typical (100→10%f.s.)
Normal mode rejection ratio	50 dB typical (at 50/60 Hz with 1.5 Hz low-pass filter ON)
Common mode rejection ratio	100 dB minimum (at 50/60 Hz and with signal source resistance 100 Ω maximum)
Low-pass filter	Cutoff frequency 1.5, 5 Hz approx. Can be turned on and off
Input resistance	5 MΩ approx.
A/D resolution	12 bits
Maximum sampling speed	50 kS/s
Input terminals	Press-screw type terminal board
Maximum allowable input voltage	100 V rms
Maximum floating voltage	250 V AC/DC (between input unit and frame, and between input units)
Dimensions and mass	110 (W) × 20 (H) × 88 (D) mm (excluding projections), 110 g approx.
Accessories	Flat blade screwdriver (1)

3.4.2 Safety Requirements

⚠ DANGER

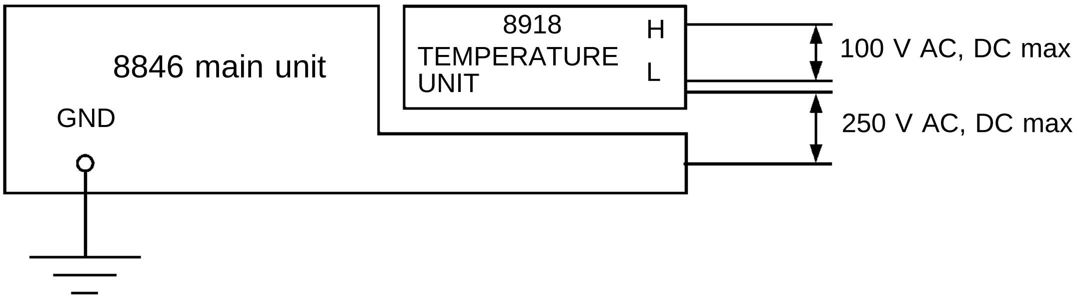
- **The maximum floating voltage (voltage between 8918 input and 8846 frame, and between inputs of other analog units) is 250 V AC/DC. To avoid the risk of electric shock and damage to the unit, take care that voltage between 8918 input and 8846 frame, and between inputs of other analog units does not exceed these ratings.**
- **The maximum permitted input to the 8918 is 100 V rms. To avoid the danger of electric shock or damage to the equipment, ensure that the applied voltage never exceeds this level.**

⚠ WARNING

When using an non-insulated thermocouple to measure temperature in a place where voltage is present, be careful to avoid touching the terminals, since voltage may be present.

⚠ CAUTION

The 8918 TEMPERATURE UNIT input terminal is only for connection to a thermocouple. Never apply any input other than that from a thermocouple to this input terminal.

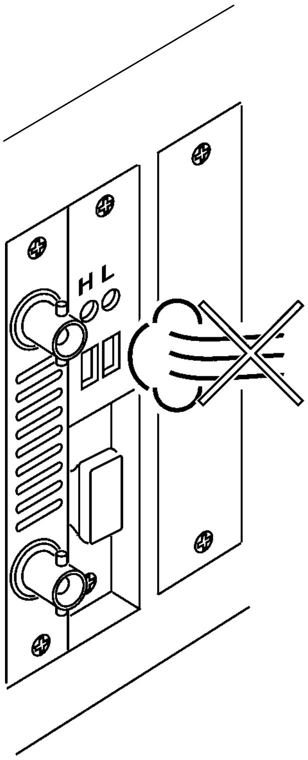


NOTE

The 8918 input and the 8846 frame are insulated.

3.4.3 Notes on Installation Site

- Strong wind striking the input terminal can disrupt the thermal balance of the input circuit, resulting in incorrect readings. When taking measurements in windy environments, arrange the equipment to prevent wind from directly striking the input terminal.
- Abrupt changes on ambient temperature can also disrupt the thermal balance of the input circuit. To prevent measurement error, allow the unit to adjust to the new temperature for about 30 minutes before starting measurement.



3.5 8919 FFT ANALOG UNIT

- The 8919 FFT ANALOG UNIT is used for the 8840, 8845, and 8846 MEMORY HiCORDER.
- The 8919 is equipped with a builed-in anti-aliasing filter to suppress aliasing.
- The anti-aliasing filter's cutoff frequency is automatically set according to the setting of the frequency axis (or time axis) range.
- The anti-aliasing filter can be turned on or off using the Memory recorder or FFT function.
- Follow carefully the advice of Section 3.5.2, "Safety Requirements."

3.5.1 Specifications

Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	5, 10, 20, 50, 100, 200, 500 mV/DIV 1, 2, 5, 10, 20 V/DIV
DC amplitude accuracy	±0.25% f.s.
Zero position accuracy	±0.1% f.s. (after zero adjustment)
Temperature characteristic	Gain: ±0.02%f.s./℃ Zero position: ±0.015%f.s./℃
Frequency characteristic	DC to 100 kHz, -3dB
Noise	180 μVp-p (typical) maximum sensitivity range, with input shorted
Common mode rejection ratio	100 dB minimum (at 50/60 Hz and with signal source resistance 100 Ω maximum)
Low-pass filter	Cutoff frequency 5, 500 Hz approx., can be turned on and off Attenuation is -6 dB/OCT
Anti-aliasing filter	Cutoff frequency (fc) of 20, 40, 80, 200, 400, 800 Hz, 2, 4, 8, 20, 40 kHz
Input type	Unbalanced (floating)
Input resistance and capacitance	1 MΩ±1%, approx. 27 pF (at 100 kHz)
A/D resolution	12 bits
Maximum sampling speed	200 kS/s
Input terminals	2 terminals (for banana plugs)
Maximum allowable input voltage	500 V (DC+AC peak)
Maximum floating voltage	450 V AC/DC (between input unit and frame, and between input units)
Dimensions and mass	110 (W) × 20 (H) × 88 (D) mm (excluding projections), 110 g approx.
Accessories	9574 INPUT CABLE (1)

3.5.2 Safety Requirements

⚠ DANGER

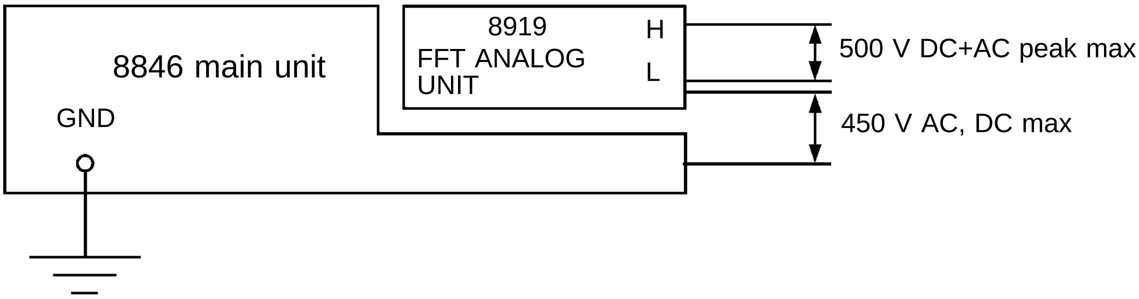
- **The maximum floating voltage (voltage between 8919 input and 8846 frame, and between inputs of other analog units) is 450 V AC/DC.** **To avoid the risk of electric shock and damage to the unit, take care that voltage between 8919 input and 8846 frame, and between inputs of other analog units does not exceed these ratings.**
- **The maximum permitted input to the 8919 is 500 V (DC+AC peak).** **To avoid the danger of electric shock or damage to the equipment, ensure that the applied voltage never exceeds this level.**

⚠ WARNING

- **The maximum floating voltage 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 9574 INPUT CABLE provided with the unit 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 9574 INPUT CABLE.



3.6 8927 ANALOG UNIT

- The 8927 is the analog unit for the 8846 MEMORY HiCORDER. It cannot be used for the 8845 and 8846 MEMORY HiCORDERs.
- One unit has input facilities for 2 channels with 14- bit resolution, allowing detailed waveform recording.
- Follow carefully the advice of Section 3.6.2, "Safety Requirements."

3.6.1 Specifications

Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	20, 50, 100, 200, 500 mV/DIV 1 V/DIV
DC amplitude accuracy	±0.25% f.s.
Zero position accuracy	±0.2% f.s.(after zero adjustment)
Temperature characteristic	Gain: ±0.02%f.s./℃ Zero position: ±0.025%f.s./℃
Frequency characteristic	DC to 50 kHz, -3dB
Noise	375 μVp-p typical, 625 μVp-p maximum (sensitivity range, with input shorted)
Crosstalk between channels	-56 dB max. (same range, 50/60 Hz at full-span voltage input)
Low-pass filter	Cutoff frequency 5, 50, 500 Hz, 5 kHz approx. Can be turned on and off
Input type	Unbalanced (one side grounded; input ground connected directly to unit ground)
Input resistance and capacitance	1 MΩ±1% (at power supply off, 700 kΩ) approx. 20 pF (at 50 kHz)
A/D resolution	14 bits
Maximum sampling speed	100 kS/s
Input terminals	BNC connector
Maximum allowable input voltage	50 V (DC+AC peak)
Dimensions and mass	110 (W) × 20 (H) × 88 (D) mm (excluding projections), 125 g approx.
Accessories	9437 CONNECTION CABLE (between BNC and clip, cable contains fuses×2 Spare fuse F0.5 A/250 V rating (spark killer)×2

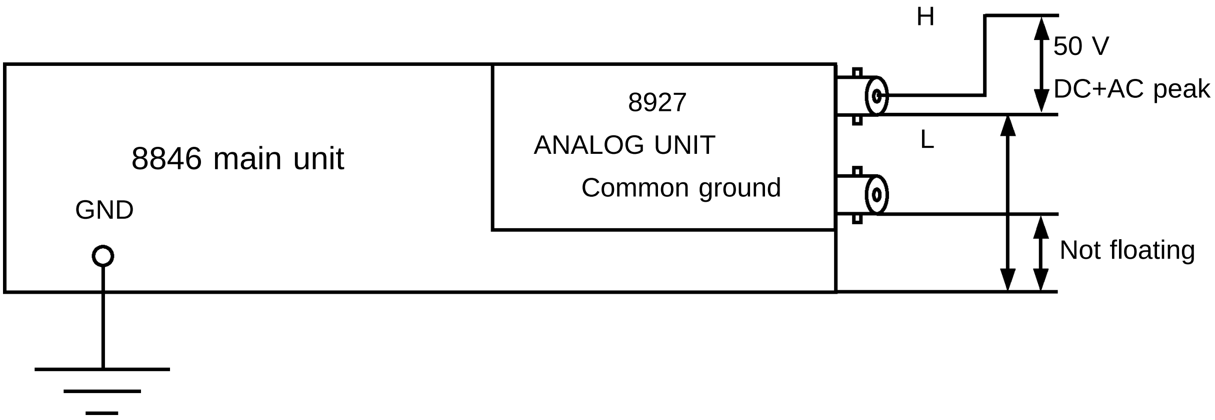
3.6.2 Safety Requirements

⚠ DANGER

- **The input ground lines of the analog units 8927 are not isolated against each other and against the frame ground of the 8846. In particular, input GND and frame GND are connected directly. Therefore it is essential to connect the protective ground terminal of the 8846 to a good ground. Otherwise, a potential may exist between the input of the 8927 ANALOG UNIT and exposed metal parts of the 8846.**
- **The input ground lines of the 8927 ANALOG UNIT channels are directly linked. Be sure to connect all input GND (black) leads to the measurement object ground and make sure that all connections are correctly established. Otherwise the 8846 and/or the measurement object may be damaged, or short-circuiting may occur which can lead to accidents. (☞ Section 4.4)**
- **Never use the 8927 ANALOG UNIT for power line measurements, to avoid the risk of electric shock and damage to the unit.**
- **The maximum allowable voltage for the 8927 is 50 V (DC + AC peak). Make sure that this rating is not exceeded, to avoid the risk of electric shock and damage to the unit.**

⚠ CAUTION

For safety reasons, only use the 9437 CONNECTION CABLE provided with the unit for measurement.



3.7 8928 STRAIN UNIT

- The 8928 STRAIN UNIT is an option for the 8840, 8845, and 8846 MEMORY HiCORDERs.
- This unit for measurement with a strain gauge adapter.
- Follow carefully the advice of Section 3.7.2, "Safety Requirements."

3.7.1 Specifications

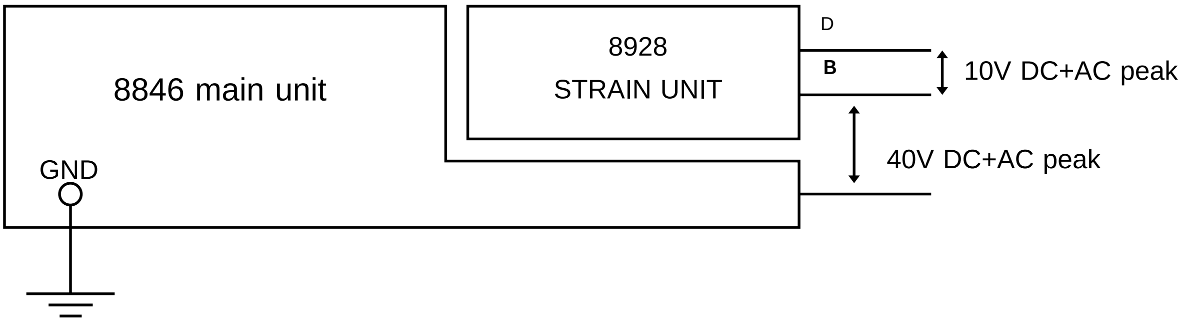
Accuracy at 23℃±5℃, after 1 hour warming-up time
Accuracy guaranteed for six months.

Measurement ranges	20, 50, 100, 200, 500, 1000 με/DIV
DC amplitude accuracy	± (0.5% f.s. + 2 με) (after auto-balancing)
Zero position accuracy	±0.5%f.s. (after auto-balancing)
Temperature characteristic	Gain: ±0.05%f.s./℃ max (after auto-balancing) Zero position: ±2 με/℃ max (20, 50 με/DIV ranges), ±0.1%f.s./℃ max (100, 200, 500, 1000 με/DIV)
Frequency characteristic	DC to 16 kHz $^{+1}_{-3}$ dB
Appropriate adapter	Strain gauge adapter Bridge resistance: 120 Ω to 1 kΩ
Gauge ratio	2.00 (fixed)
Bridge voltage	3±0.05 V
Balancing	Electronic auto-balancing
Balance adjustment range	±10000 με max
Low-pass filter	Cutoff frequency OFF, 10 Hz, 30 Hz, 300 Hz, 3 kHz ±30%
Number of input channels	2
A/D resolution	12 bits
Maximum sampling speed	200 kS/s
Input terminals	TAJIMI PRC03-23A10-7F
Maximum allowable input voltage	10 V (DC+AC peak)
Maximum floating voltage	40V（DC＋ACpeak）
Dimensions and mass	110(W)×40(H)×88(D)mm (not including projection), 245 g approx.
Standards applying	Safety: Pollution Degree 2 Overvoltage Category Ⅰ(anticipated transient overvoltage 330 V)

3.7.2 Safety Requirements

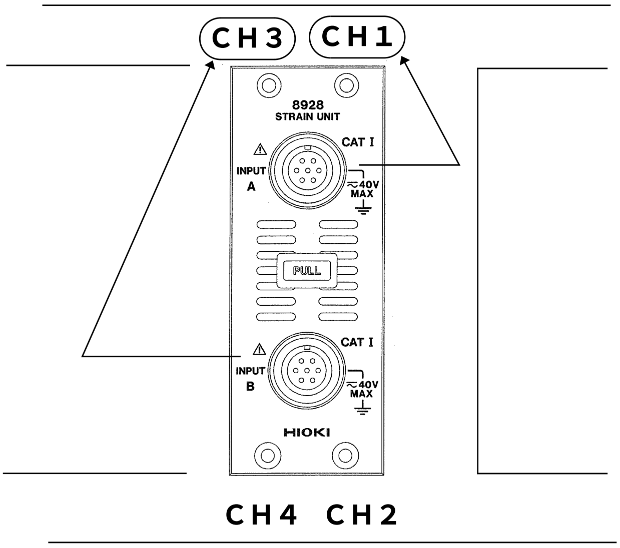
⚠ DANGER

- **The maximum floating voltage is 40 V (DC+ACpeak). To avoid the risk of electric shock and damage to the unit, take care that voltage between 8928 input and 8840, 8846 frames, and between inputs of other analog units does not exceed these ratings.**
- **The maximum permitted input (between BD terminals) to the 8928 is 10 V (DC+ACpeak).**
  To avoid the damage to the equipment, ensure that the applied voltage never exceeds this level.



3.7.3 Strain Unit Settings

- The upper input on the unit is the lower-numbered channel, and the lower input is the higher-numbered channel.
- When the unit is inserted in the slot shown, the channel assignments are as in the figure below.



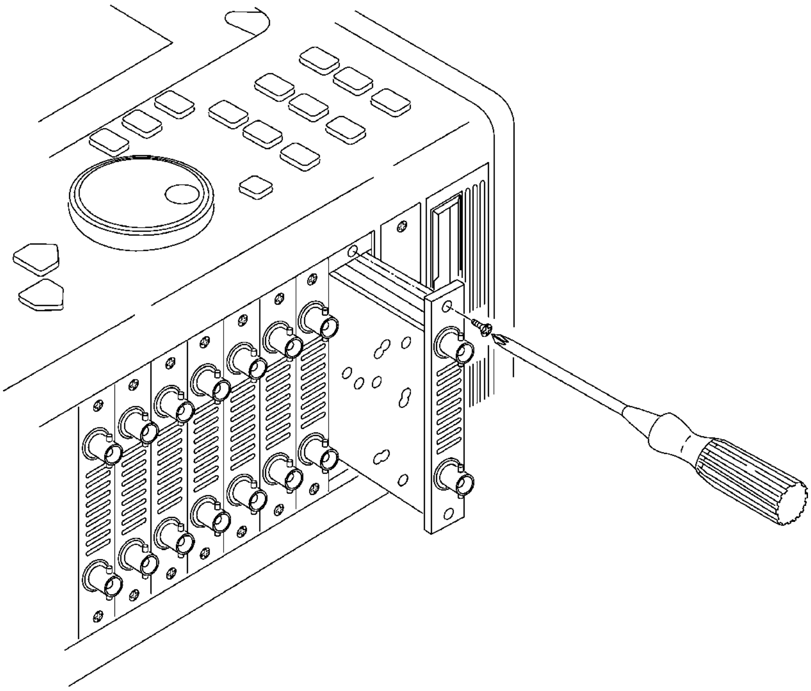
3.8 Replacement Procedure

- This section describes how to replace the input units; 8916, 8917, 8918, 8919, 8927, and 8928.
- The following procedure describes how to remove the input unit.
- Install the units by reversing the procedure for removal.

⚠ **WARNING**

- **To avoid the danger of electric shock, never operate the unit with an input unit removed. If you should wish to use the unit after removing an input unit, fit a blank panel over the opening of the removed unit.**
- **To prevent electrical shock, before adding or replacing the input unit, check that the power for the unit is off and the power cord and input cables are disconnected. The fixing screws must be firmly tightened or the input unit may not function up to specification, or may even fail.**

1. Remove the input cables and thermocouples from all input units.
2. Power off the 8846 main unit, and disconnect the power cord.
3. Remove the two or four fixing screws with a Phillips screwdriver, as shown in the figure below.
4. Grasp the handle on 8916 - 8919, 8928 units or the BNC connector on 8927 unit and pull the unit out, as shown in the illustration.

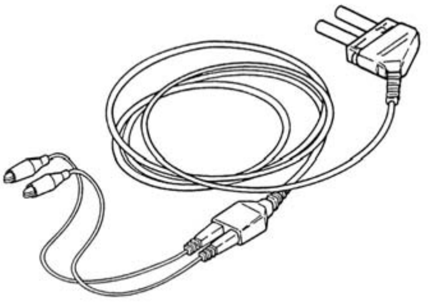


3.9 Input Cables

■ 9574 INPUT CABLE (8916, 8917, 8919)

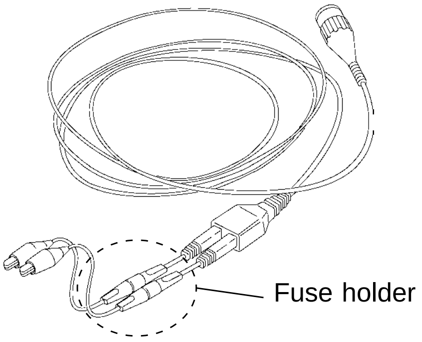
- Only use the special-purpose 9574 INPUT CABLE for connection to the 8916 ANALOG UNIT, 8917 DC/RMS UNIT, and 8919 FFT ANALOG UNIT.
- A plastic cover on the unit connector serves as protection against electric shock.

Operating temperature and humidity range	0 to 40℃, 80%RH max (with no condensation)
Dimensions	Approx. 1.7 m
Mass	Approx. 100 g

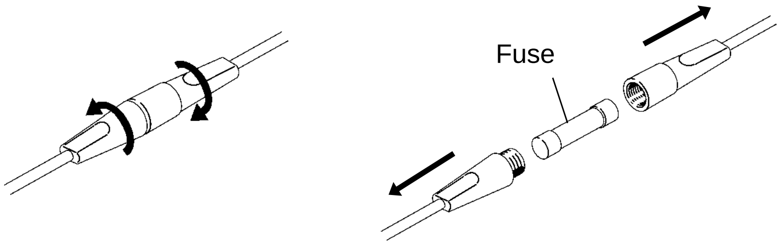


■ 9437 CONNECTION CABLE

Operating temperature and humidity range	5 to 40℃, 20 to 80%RH max (with no condensation)
Dimensions	Approx. 1.7 m
Mass	Approx. 90 g
Fuse	Fast-blow, high-insulation type fuse (0.5 A/250 V) with spark killer 5.2 mm dia×20 mm



To remove the fuse



3.10 Measurement Errors Caused by Signal Source Internal Resistance

If the signal source impedance is higher than the input impedance of the unit, a measurement error will occur.

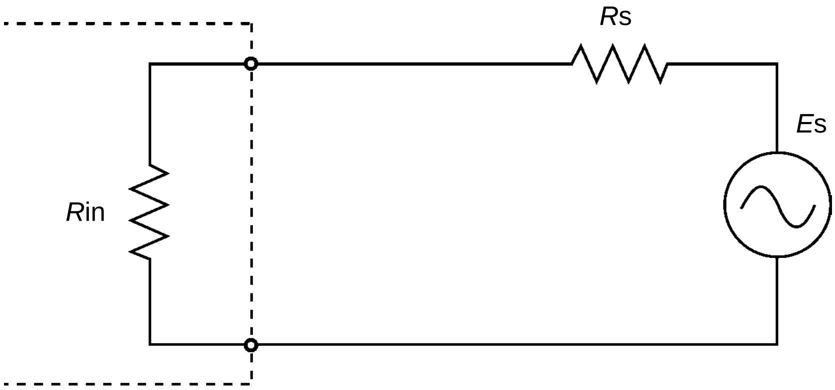
Example The input impedance of the 8916 ANALOG UNIT is 1 MΩ. If the signal source impedance is 1 kΩ, an error of about 0.1% will occur.

$$\text{Measurement errors} = \text{Es}\left(1 - \frac{R\text{in}}{R\text{s} + R\text{in}}\right)[\text{V}]$$

*E*s:Signal voltage

*R*s: Signal source resistance

*R*in: Input resistance

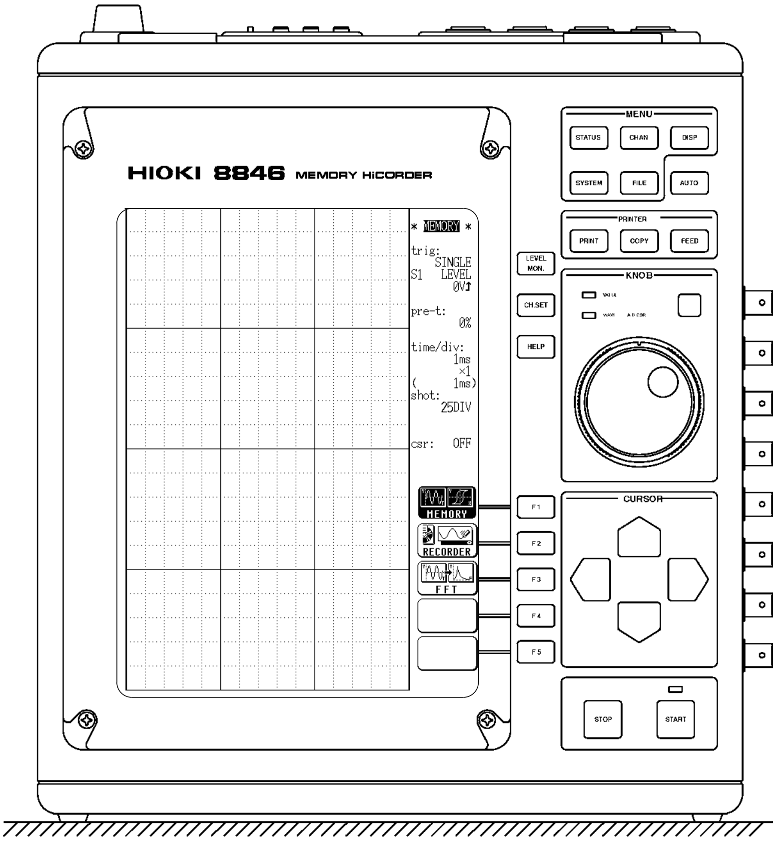


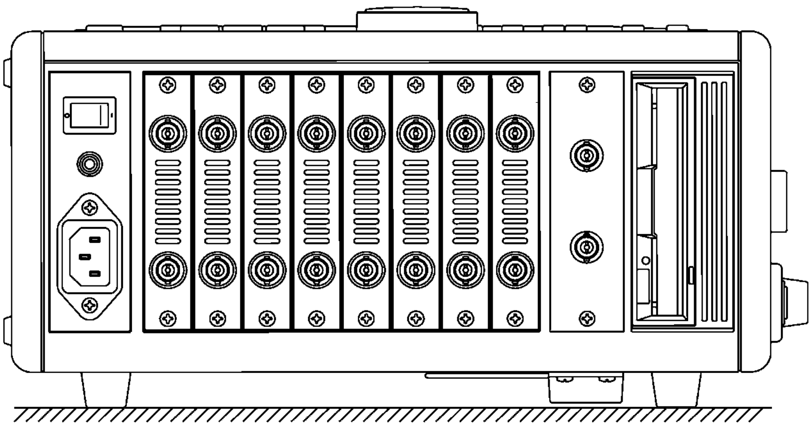
Chapter 4
Installation and Preparation

4.1 Installation of the Unit

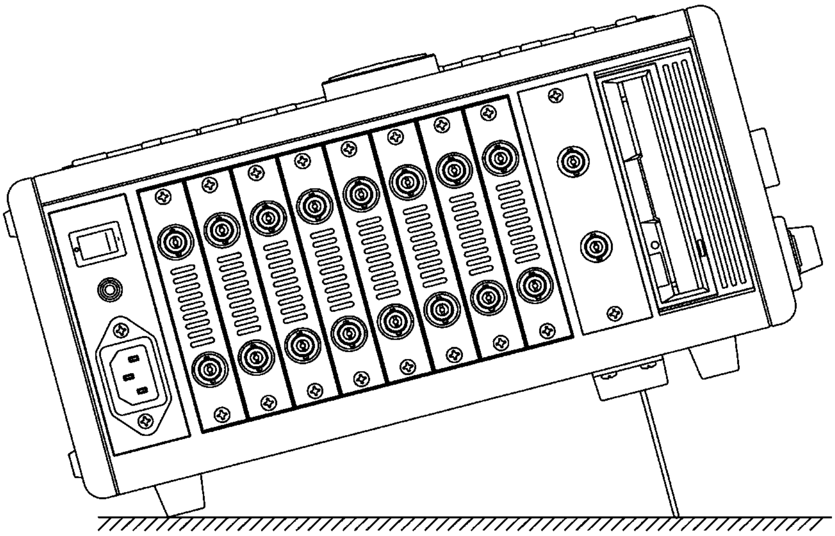
Installation orientation

Install the unit on a flat, level surface.





The unit can also be propped up at an angle, using the stand.

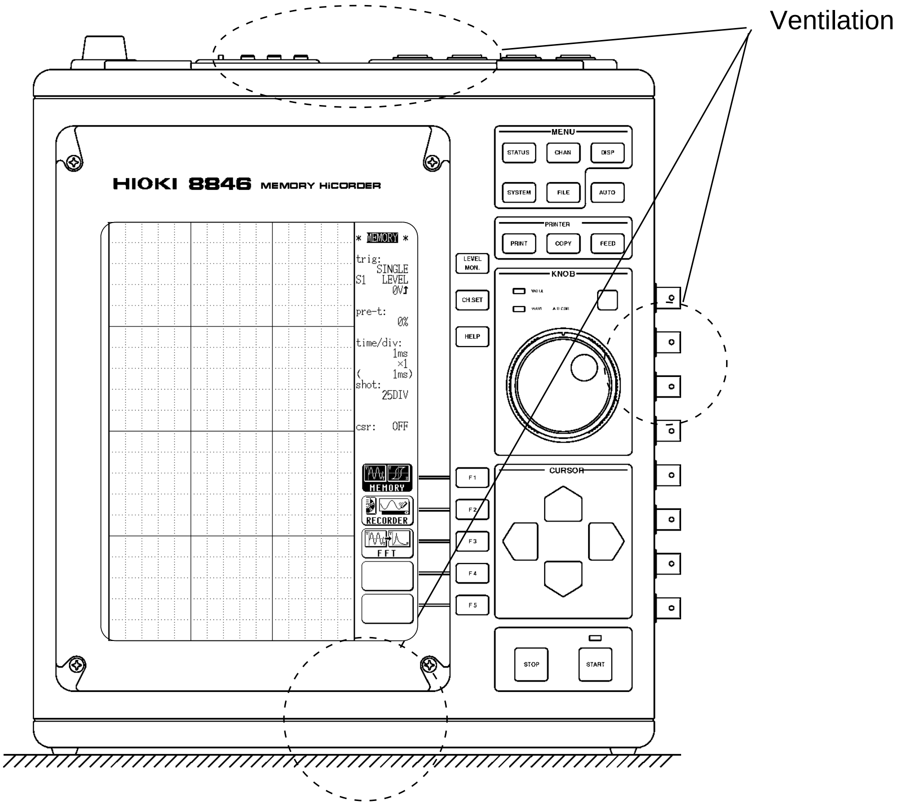


Ambient conditions

Temperature	5 to 40°C, 23±5°C recommended for high-precision measurements
Humidity	35 - 80% RH (no condensation); 50±10% RH (no condensation) recommended for high-precision measurements
Ventilation	Take care not to block the ventilation openings and assure proper ventilation. When using the unit in an upright position, take care not to block the openings on the bottom.

NOTE

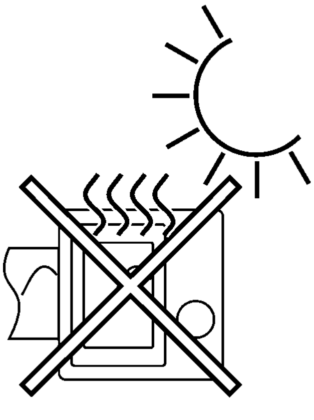
Avoid operation at above 37°C as far as possible. (If operated at above 37°C, the disk protection function is activated, and it is not possible to save or read data.)

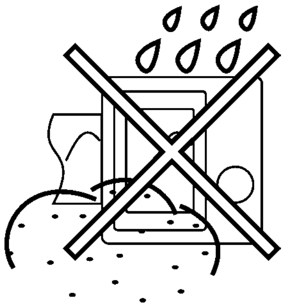


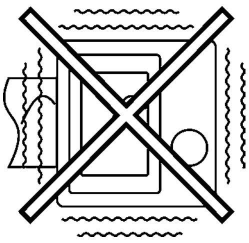
NOTE

Avoid the following locations:

- Subject to direct sunlight
- Subject to high levels of dust, steam, or corrosive gases
- Subject to vibrations
- In the vicinity of equipment generating strong electromagnetic fields







4.2 Power Supply and Ground Connection

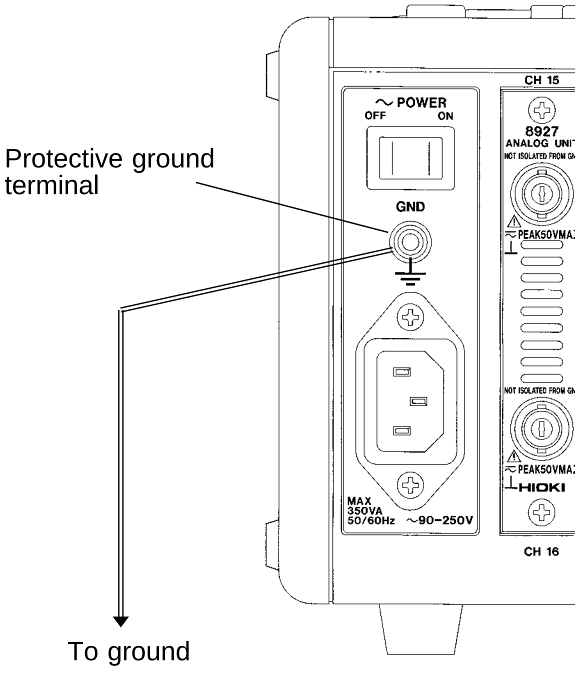
⚠ WARNING **Take care never to exceed the power supply ratings given below, to avoid the risk of electric shock and damage to the unit.**

• Power supply, fuse

Rated power supply voltage		90 - 250 V AC 10 - 30 V DC
Rated AC power supply frequency		50/60 Hz
Fuses	AC	incorporated in power supply (not user- replaceable)
	DC	class A melting fuse (NM) 12 A/250 V, 6.4 dia. × 31.8 mm

• Grounding

- To ensure safety during operation, always ground the unit.
- Connect the GND terminal on the side of the unit to a good ground.



• Check the following points before connecting the unit to a power supply:

- The power supply matches the ratings shown above.
- The AC power switch of the 8846 and the intermediate switch in the DC cable are set to OFF.
- The ground connection is established.
- Use only the supplied AC power cord or DC power supply cable.

• Connecting the unit to a power supply:

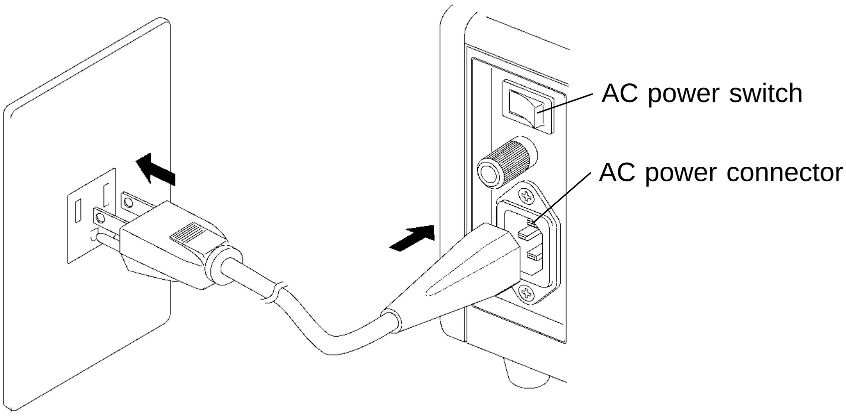
(1) AC power supply

⚠ WARNING **Make sure that the AC power switch of the 8846 is set to OFF.**

1. Verify that the AC power switch of the 8846 is set to OFF.
2. Plug the supplied AC power cord into the AC power connector on the side of the 8846.
3. Plug the power cord into an AC outlet corresponding to the rating of the 8846.

Rated voltage:
90 - 250 V AC

Rated line frequency:
50/60 Hz



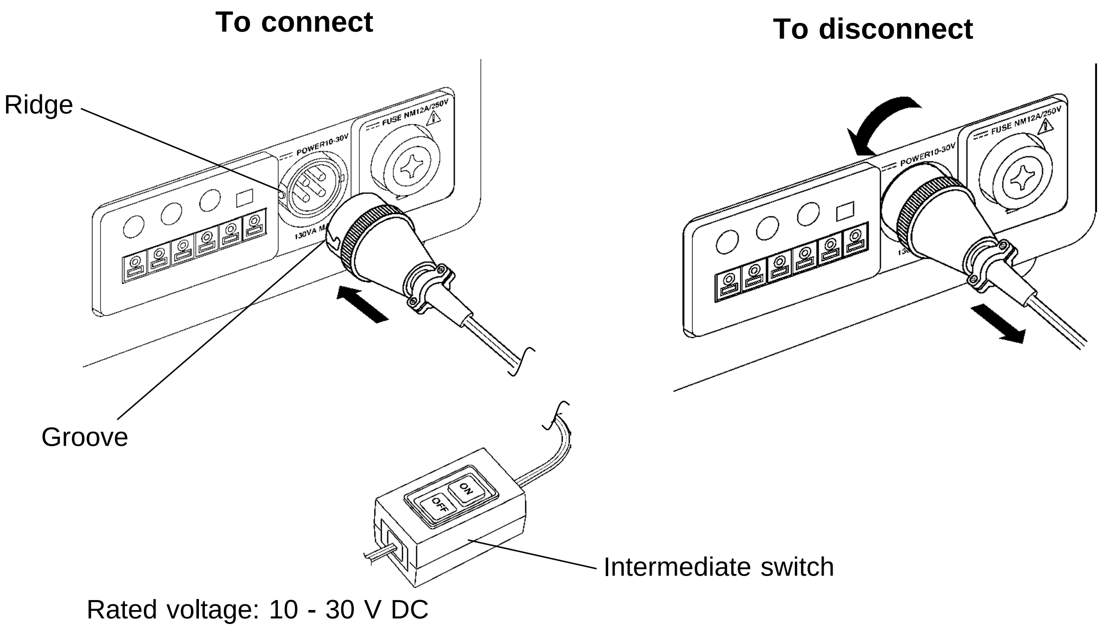
(2) DC power supply

⚠ DANGER **Before connecting the unit to a battery or other DC source, make sure that the intermediate switch is set to OFF. If the switch is ON, there is a risk of sparks.**

⚠ WARNING

- **When connecting the DC cable, take care not to mix up the red (+) and black (-) leads. If polarity is reversed, the 8846 may be damaged.**
- **When wishing to extend DC cable, use a cable of identical or better rating as the supplied cable.**

1. Verify that the intermediate switch in the DC cable is set to OFF.
2. Align the ridge of the connector on the unit with the groove in the plug and insert the plug fully.
3. Connect the red alligator clip to the positive side (+) and the black alligator clip to the negative side (-) of the power supply.
4. To remove the plug of the DC cable, rotate it as shown in the illustration.



• Estimated battery operation hours (at room temperature)

Battery type: 12 V, 38 Ah, fully charged
8846: channels 8927 installed in channels 1 - 16, GP-IB not installed

Operation condition	Running time
Printer not used (trigger waiting)	Approx. 5 h 30 min
Printer used Recorder function 500 ms/DIV, all store	Approx. 3 h 30 min

- Actual running time may differ, depending on battery age, charge condition, ambient temperature, and other factors.
- Running time is approximately proportional to battery capacity. Increasing battery voltage to 24 V will extend running time by a factor of about 1.5 for identical capacity.

NOTE

- This unit is not equipped to charge an external battery.
- When using a battery, take care not to deplete it completely.

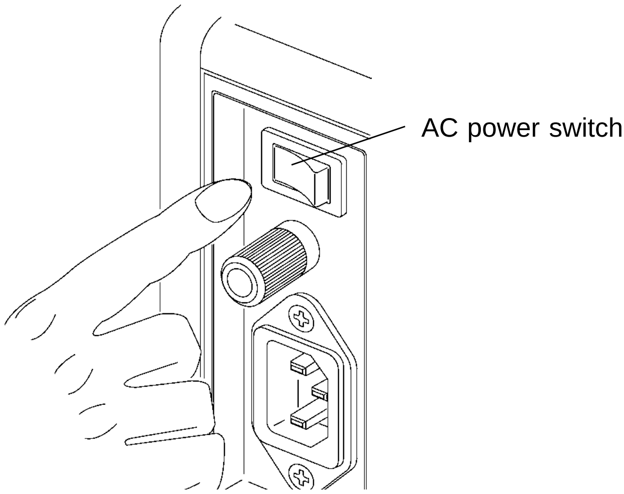
4.3 Power On/Off

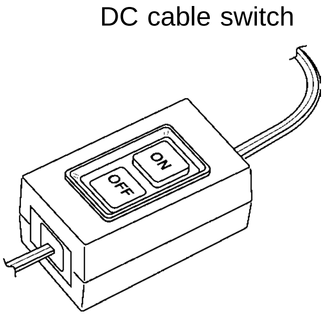
(1) Check before power-on

- Unit is correctly installed (☞ Section 4.1).
- Power cord is correctly connected and unit is properly grounded (☞ Section 4.2).

(2) Power switch on/off

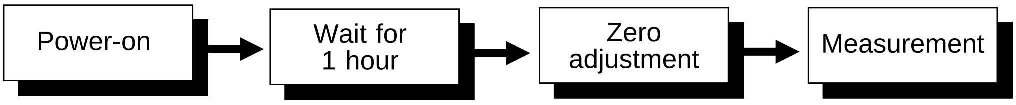
- There is no need for the user to manually select AC or DC power.
- When both AC and DC power are connected, AC power has priority.
- When AC power is disconnected (or falls under 90 V), the 8846 automatically switches to DC (if both the AC power switch of the 8846 and the intermediate switch of the DC cable are set to ON).
- If a DC power source is connected and the intermediate switch of the DC cable is set to ON, the 8846 will be operative even if the AC power switch on the unit is set to OFF.





(3) To assure high measurement precision

Turn the unit on and let it warm up for about one hour, to allow internal temperature to fully stabilize. Then carry out zero adjustment and start the measurement.



(☞ Section 9.6.6)

(4) Power-off

When the unit is turned off, it memorizes the currently used settings and reestablishes the same settings the next time the unit is turned on again.

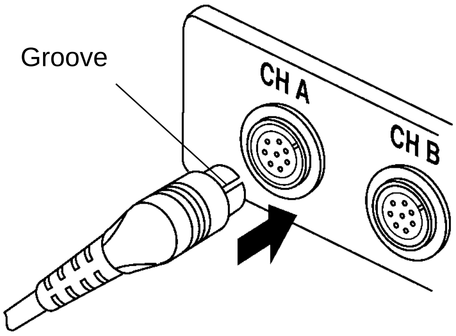
4.4 Probe and Thermocouple Connection

Logic probe connection

⚠ WARNING

The 8846 has separate inputs for four probes, but the ground lines of these inputs are not isolated from each other and from the frame ground of the unit (common ground).

If voltages with different ground levels are input, probe short-circuiting may occur and lead to accidents.



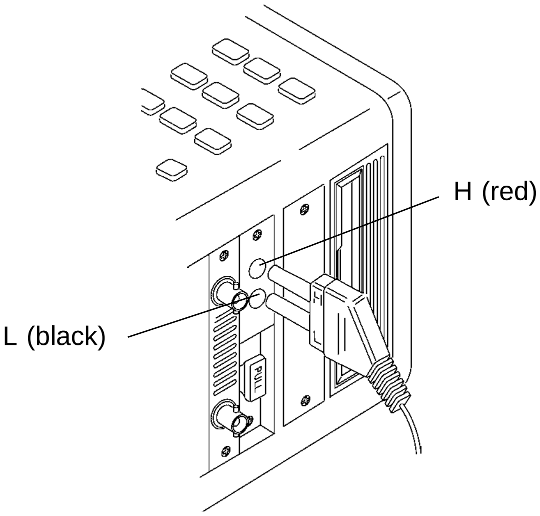
Connect the probe by aligning the groove on the plug with the ridge on the connector.

Connection cable (☞ Section 3.9)

⚠ WARNING

Never connect the probe to the 8846 while the probe is already connected to the measurement object. Otherwise there is a risk of electric shock.

(1) 9574 INPUT CABLE (8916, 8917, 8919)



Connect the cable so that H and L of the cable match H (red) and L (black) on the unit.

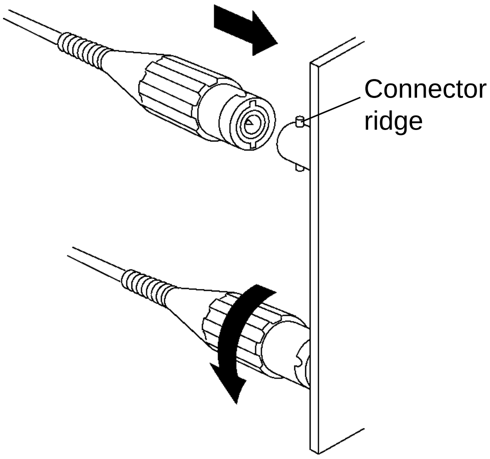
(2) 9437 CONNECTION CABLE (8927)

⚠ DANGER

- **Use only the specified type of fuse. (☞ Section 3.9, "Input Cables")**
- **The input ground line is directly connected to the frame ground of the unit. Be sure to connect the reference connector of the probe (black) and the ground pin of the input BNC connector to the ground potential of the measurement object.**
- **Before measurement, connect the protective ground terminal of the 8846 to a good ground.**
- **Never use the cable for a power line connection.**

⚠ CAUTION

When disconnecting a BNC connector, be sure to release the lock first, then hold the connector and pull carefully. Using force to pull the connector without releasing the lock, or pulling on the cable instead of the connector may damage the connector.



1. The 9437 CONNECTION CABLE is equipped with a protective fuse. Before starting the measurement, verify that the fuse has not blown.

2. Match the grooves on the plug with the ridges on the connector when inserting the plug.

NOTE

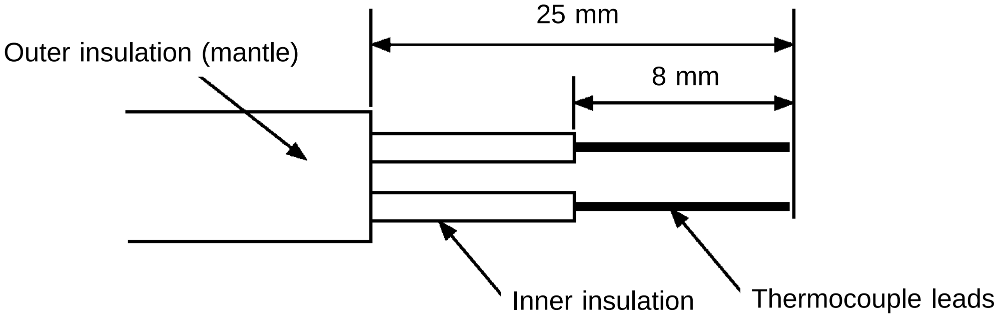
Before using the 8927 ANALOG UNIT to measure, be sure to read the following notes.

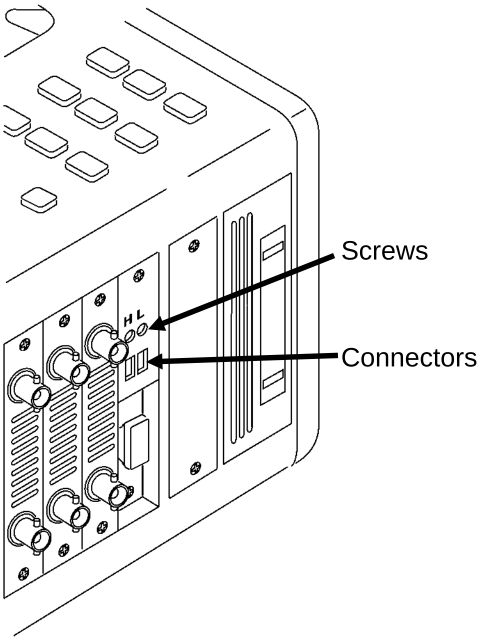
- With some measurement objects (equipment), a noise current may flow in the ground line, leading to a degradation of S/N ratio. This is especially apparent at high sensitivity range settings.
- Do not connect any unnecessary input cables. For minimum noise, the use of BNC-BNC cables is recommended.

Thermocouple connection (8918)

⚠ DANGER **When an uninsulated thermocouple is used to measure temperature at a point carrying electric potential, take care not to touch the terminals and connector screws. Otherwise there is a risk of electric shock.**

1. Strip off the insulation as shown in the illustration.





2. Loosen the connector screws on the unit with a flat blade screwdriver.

3. Connect the thermocouple + and - leads to the H (+) and L (-) connectors on the unit, taking care to observe correct polarity.

4. Tighten the screws.

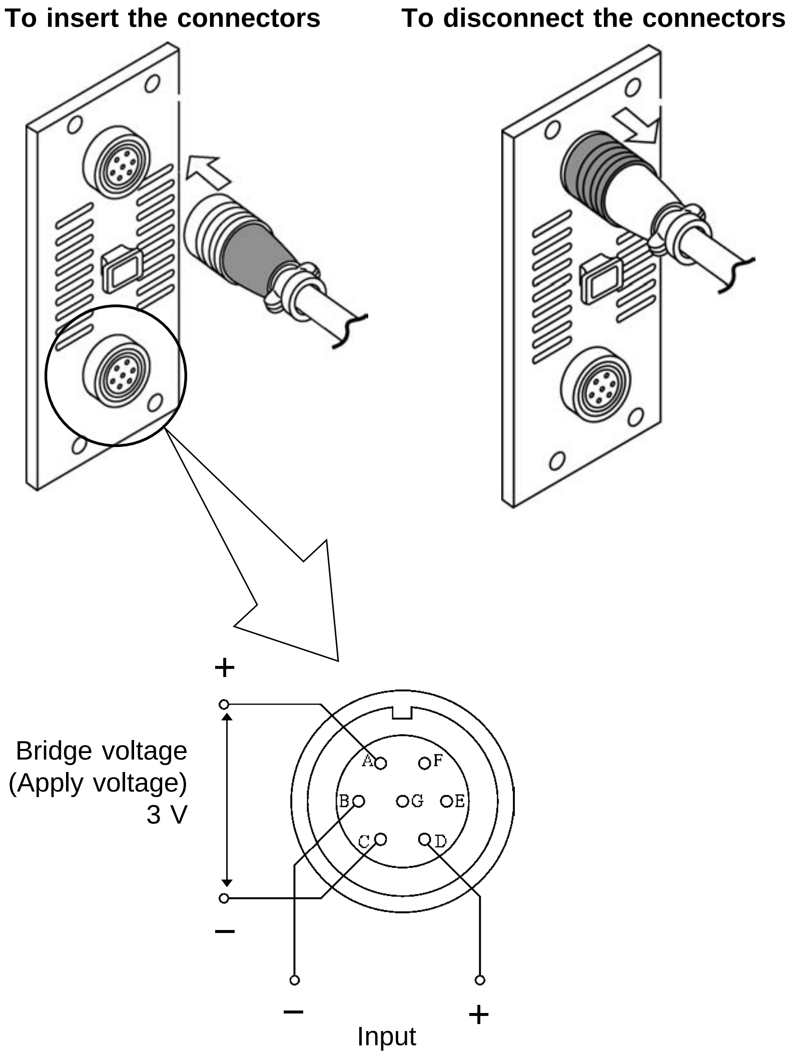
NOTE

- Do not use thermocouples other than the specified types (K, J, T).
- If the thermocouple is connected in reverse, the temperature reading will not be correct.

4.5 Connection to a Strain Gauge Adapter

This section describes connection to a strain gauge adapter.

1. Align the projecting portion of the connector on the main unit with the cutout portion of the connector, and plug it in. (Hold the portion colored in the illustration.)
2. When removing the connector, hold the connector (the portion colored in the illustration), and pull it toward you and out.



To insert the connectors

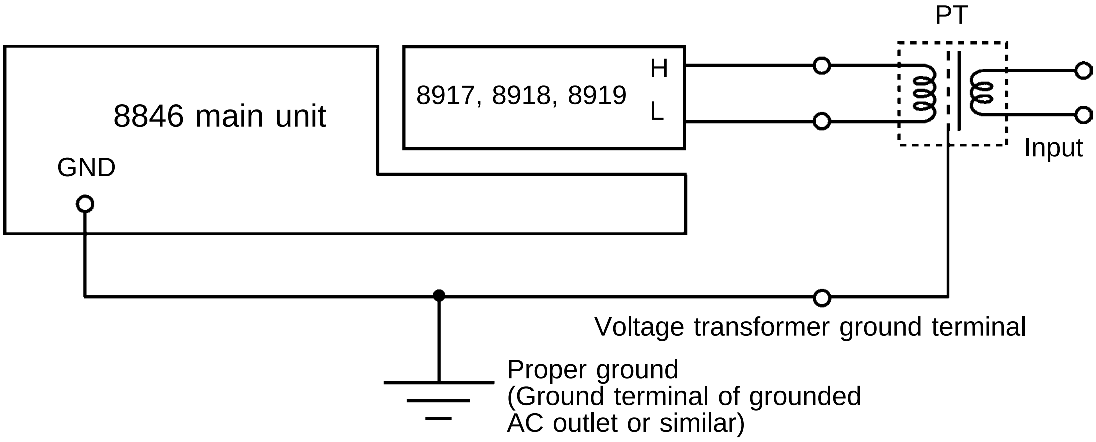
To disconnect the connectors

4.6 Connecting the Voltage Transformer

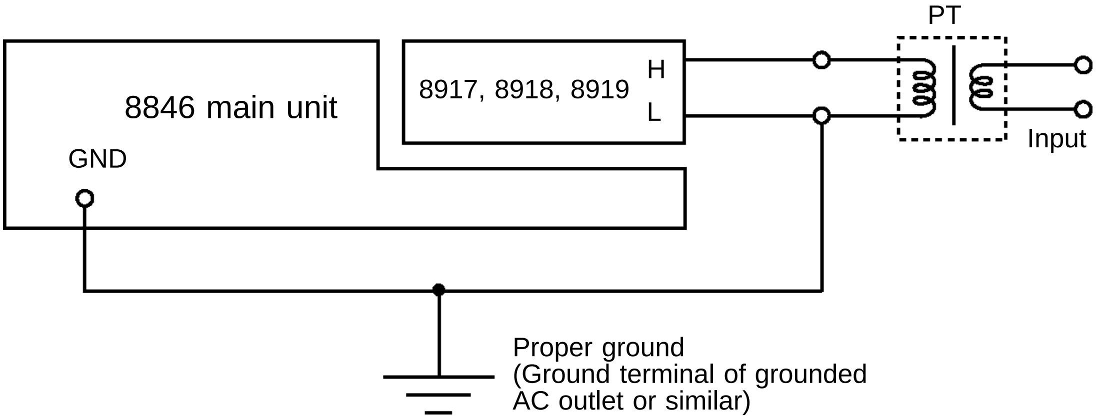
Explains how to connect the 8916, 8917, 8919, or 8927 and PT (voltage transformer)

8916, 8917, 8919

① When the voltage transformer has a ground terminal



② When the voltage transformer has no ground terminal

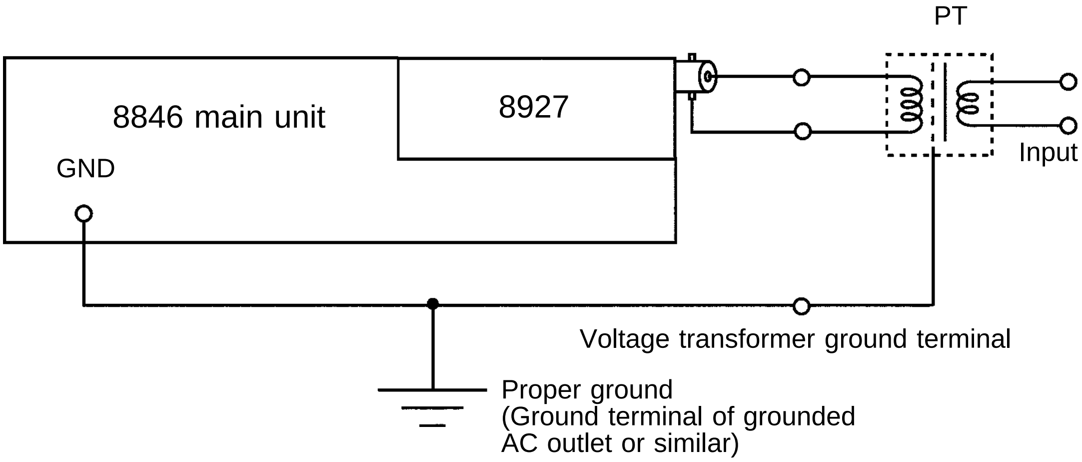


NOTE

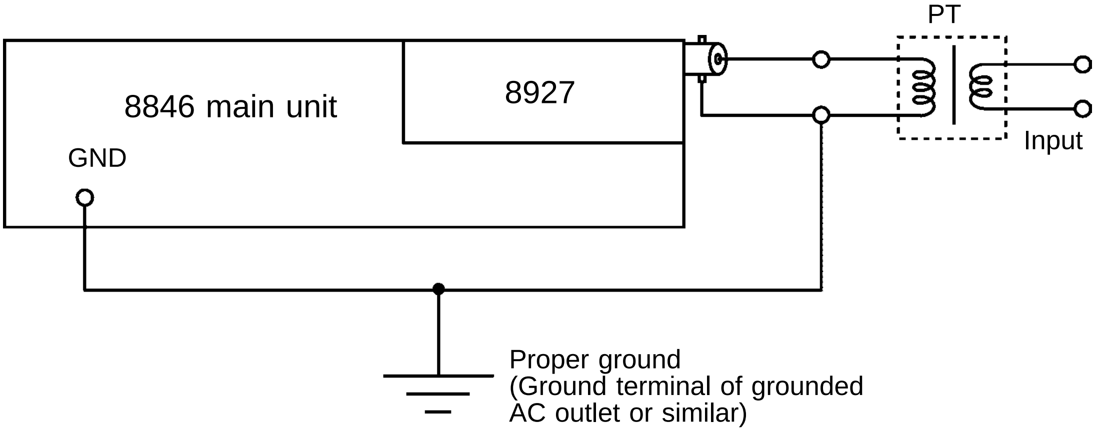
- The 8916, 8917, 8919 input and the 8846 frame are insulated.
- When making measurements on as AC power line for example, using a voltage transformer, be sure to connect the transformer input to the secondary side of the breaker.
- Be sure to connect the protective ground terminal to ground.

8927

① When the voltage transformer has a ground terminal (9303)



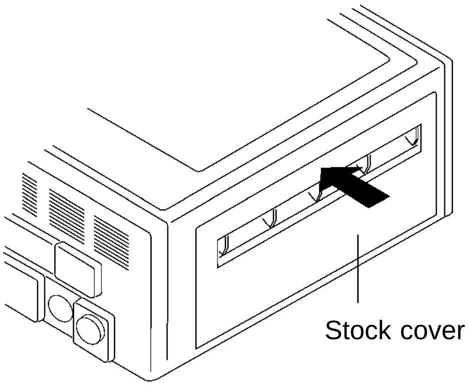
② When the voltage transformer has no ground terminal



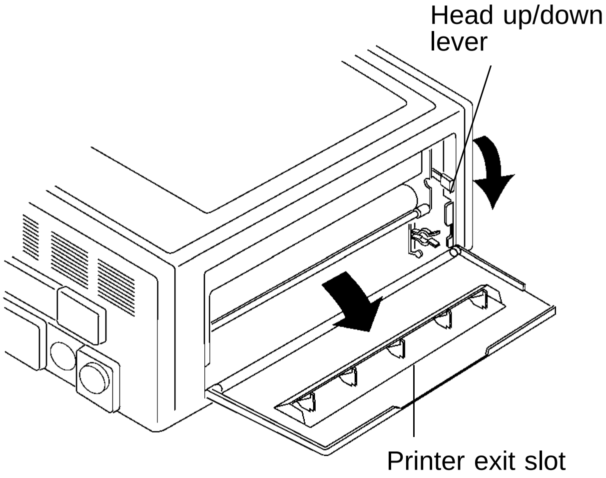
NOTE

- The 8927 input and the 8846 have a common ground.
- When making measurements on as AC power line for example, using a voltage transformer, be sure to connect the transformer input to the secondary side of the breaker.
- Be sure to connect the protective ground terminal to ground.
- When using the cable supplied with the 9303, use a commercially available BNC-to-banana-plug adapter.

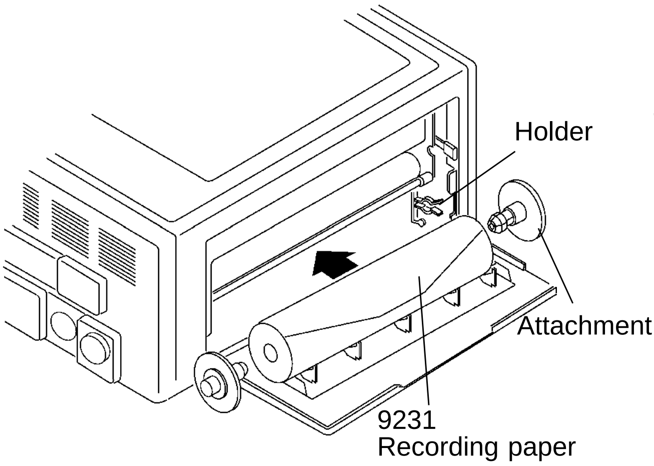
4.7 Loading Recoding Paper



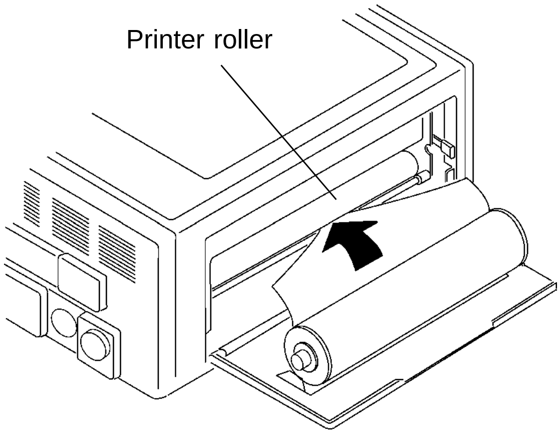
1. Press the stock cover and open it.



2. Raise the had up/down lever.



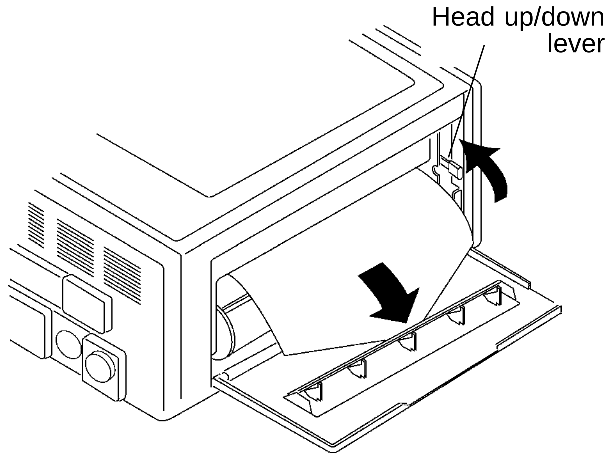
3. Insert the attachments into the ends of the roll of recording paper and set the paper into its holder.



4. Insert the leading edge of the recording paper from above into the gap behind the printer roller, and pull it out to the other side.

NOTE

Do not insert it into the gap between the roller and the black sheet metal portion.

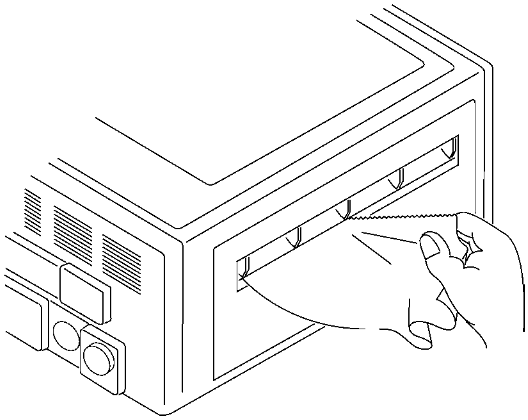


5. Pull the end of the recording paper out at least 10 cm, and make sure that it is positioned quite straight.

NOTE

Do this very carefully, because if the recording paper is slanted with respect to the roller there is a danger that later a paper jam will occur.

6. Put down the head up/down lever.
7. Pull the recording paper to the outside through the printer exit slot in the stock cover.
8. Close the stock cover, and finish by tearing off the recording paper against the edge of the printer exit slot.



⚠ CAUTION Before shipping, remove the printer paper from the unit. If the paper is left in the unit, paper support parts may be damaged due to vibrations.

NOTE

- Always put the unit in the head up condition when it is to be transported or if it is to be stored for a long period of time. If the unit is left to lie in the state where the roller is being subjected to pressure by the head, then the roller may become deformed or the characters may become uneven.
- Particularly care should be taken not to put the recording paper in back to front by mistake, because if this happens the waveform cannot be drawn.

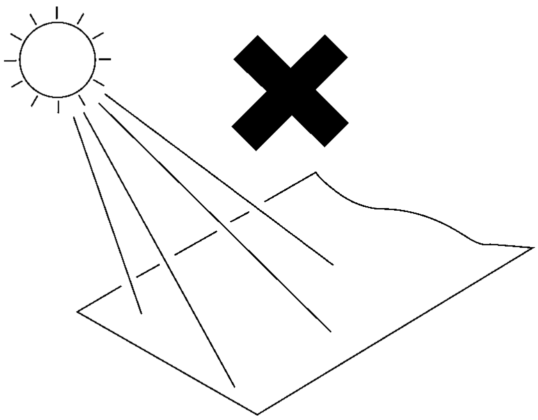
4.8 Storage and Handling Precautions

- While unopened, thermal paper will not be affected by the environment, provided that ambient temperature and humidity do not exceed normal levels. For long-term storage, temperature should be lower than 40. Low temperatures cause no problem.
- After opening, protect the paper from strong light, to prevent discoloration.

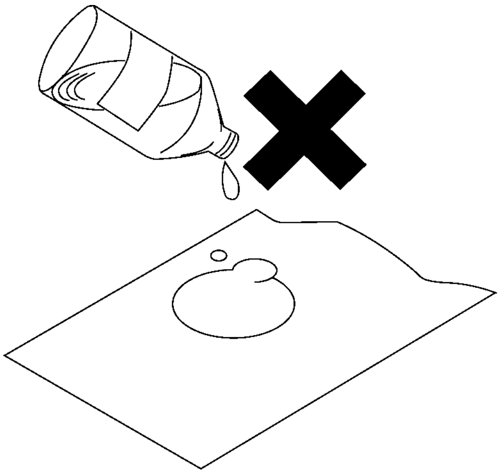
Storing recordings

The recording paper uses a thermochemical reaction. Note the following points:

- To avoid discoloration, do not leave recording paper in direct sunlight.
- Store at not more than 40℃ and 90% RH.
- To keep definitive data, make photocopies of the recordings.
- Thermal paper will blacken when brought into contact with alcohol, ester, ketone, or other volatile organic substances.
- If the thermal paper absorbs an organic solvent such as alcohols or ketones it may no longer develop properly, and recorded information may fade. Soft PVC film and transparent contact adhesive tape contain such solvents, so avoid using them with recordings.
- Avoid interleaving the thermal recordings with damp diazo copies.



Direct sunlight



Organic solvent

4.9 Notes on Measurement

⚠ DANGER

- **Maximum input ratings for the analog units 8916 - 8919, 8927, and 8928 and the input terminals of the 8846 are shown below. To avoid the risk of electric shock and damage to the unit, take care not to exceed these ratings.**
- **The 8918 TEMPERATURE UNIT is designed specifically for thermocouples. Do not use it with any other components. (Circuit protection is provided for up to 100 V DC or AC, but any voltage above this value will destroy the unit.)**
- **The maximum floating voltage of 8916 to 8919, 8928 (voltage between input and 8846 frame ground, and between inputs of other analog 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 8927 ANALOG UNIT is not isolated from the ground of the 8846 (common with ground). To avoid the risk of electric shock and damage to the unit, make sure that the ground connection and input connections are correctly established. (☞ Section 4.4, "Probe and Thermocouple Connection")**

Input/output terminal	Maximum allowable input rating	Maximum floating voltage
8916 inputs 8917 inputs 8919 inputs	500 V DC+AC peak	450 V AC/DC
8918 inputs	100 V AC/DC	250 V AC/DC
8927 inputs	50 V DC+AC peak	No floating
8928 inputs	10 V DC+AC peak	40 V DC + AC peak
EXT TRIG START STOP PRINT EXT SMPL	-5 V to 10 V	No floating
MIC	0 V to 5 V DC+AC peak	No floating
TRIG OUT NG	-20 V to +30 V 500 mA max 200 mW max	No floating

⚠ WARNING

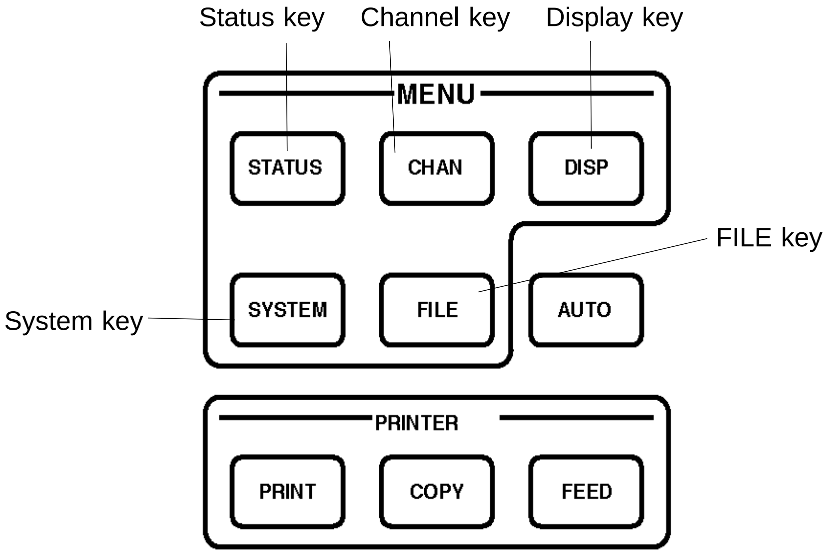
The logic units all have and the 8846 have a common ground.

Chapter 5
Basic Operation and Measurement

5.1 Basic Operation

This section explains basic steps and settings for measurement.

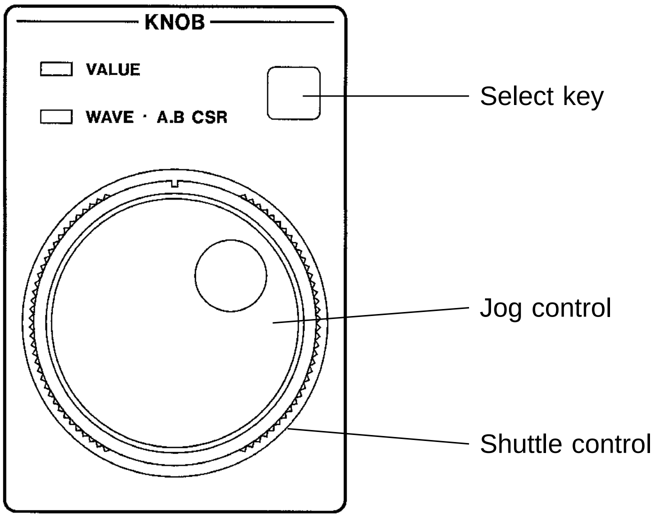
5.1.1 Basic Display Operation



STATUS key	Calls up the STATUS screen. Serves to switch pages. Serves to make main settings for various functions.
CHAN key	Calls up the CHANNEL screen. Serves to switch pages. Serves to set voltage range, position, etc. for input channels.
DISP key	Calls up the display screen. Serves to display and observe waveforms.

SYSTEM key	Calls up the SYSTEM screen. Serves to switch pages. Serves to make common settings for all functions (clock setting, comment input, etc.).
FILE key	Calls up the MO screen. Serves to display, store, read, and delete files.

5.1.2 JOG/SHUTTLE Control and Select Key



Entering numbers and setting items

Function key display	Meaning
+	: Item up, value up
−	: Item down, value down

Function key display	Meaning
⬆	: Value up, large step
↑	: Value up, small step
↓	: Value down, small step
⬇	: Value down, large step

Function key display	Meaning
10 ↑	Value up, 10-units
1 ↑	Value up, 1-units
1 ↓	Value down, 1-units
10 ↓	Value down, 10-units

Function key display	Meaning
CH ↑	Channel number up
CH ↓	Channel number down

Function key display	Meaning
Z ↑	Function number up
Z ↓	Function number down

Scroll waveform, move A/B cursors

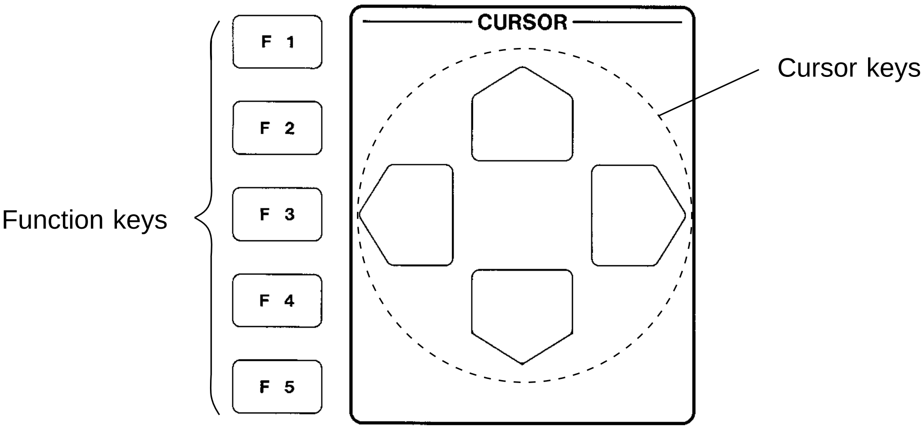
JOG/SHUTTLE control can be used to scroll the waveform and to move the A and B cursors (☞ Chapter 19).

Switch between numeric input and waveform scroll/cursor movement

Use the select key when the screen is in measurement display mode.

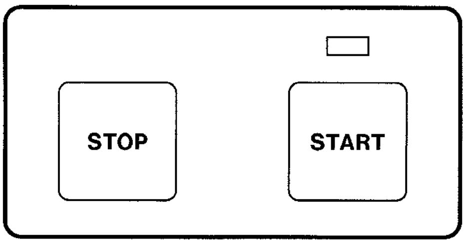
LED	JOG/SHUTTLE control function
VALUE	Numeric input of values
WAVE･A.B CSR	Waveform scrolling, movement of A/B cursors

5.1.3 Setting Items



CURSOR keys	Serve to move the flashing cursor.
F1 to F5 (Function key)	Select items. The respective items are shown in the function key display.

5.1.4 Measurement Start and End



Start measurement

Press the START key and the LED lights.

Stop measurement

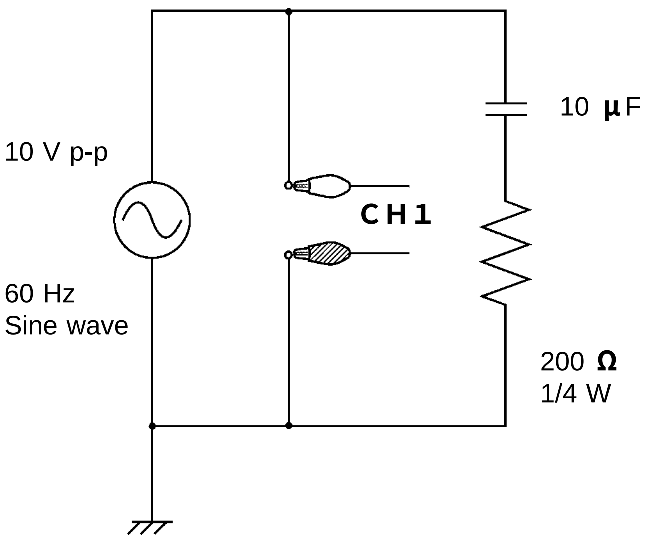
Press the STOP key.

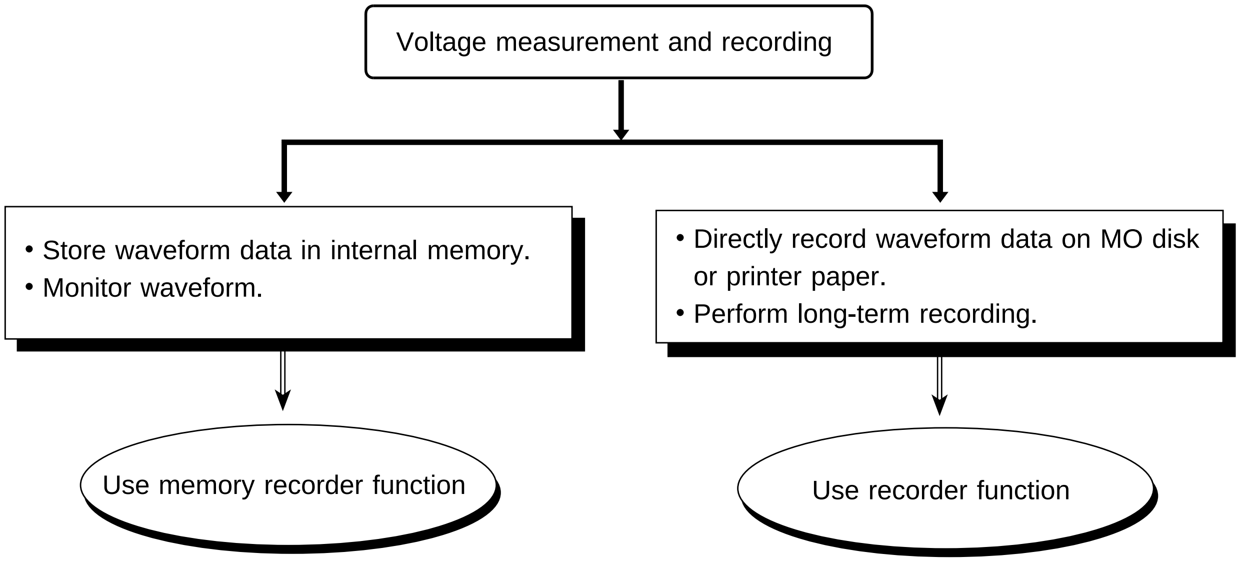
5.2 Basic Measurement and Setting Procedures

This section uses some representative examples to describe basic measurement steps and settings.

5.2.1 Measuring and Recording a Voltage (Memory Recorder, Recorder)

Example Monitor and record a power supply voltage, as shown in the illustration.

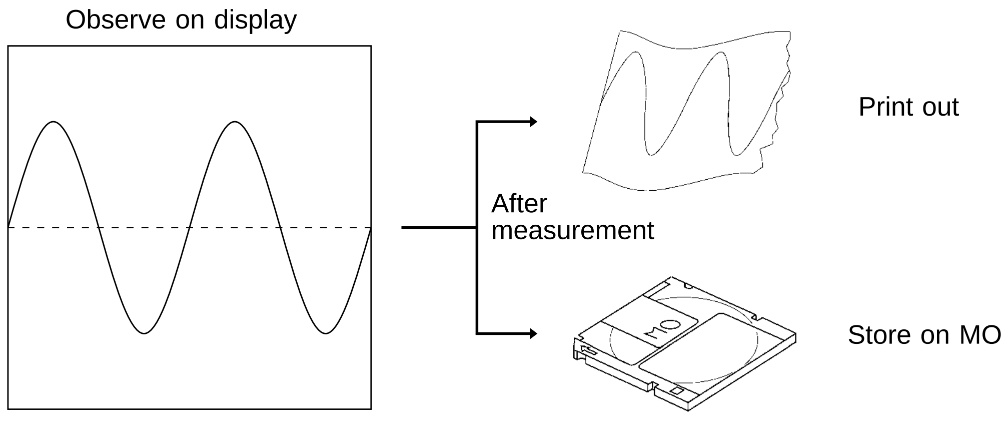




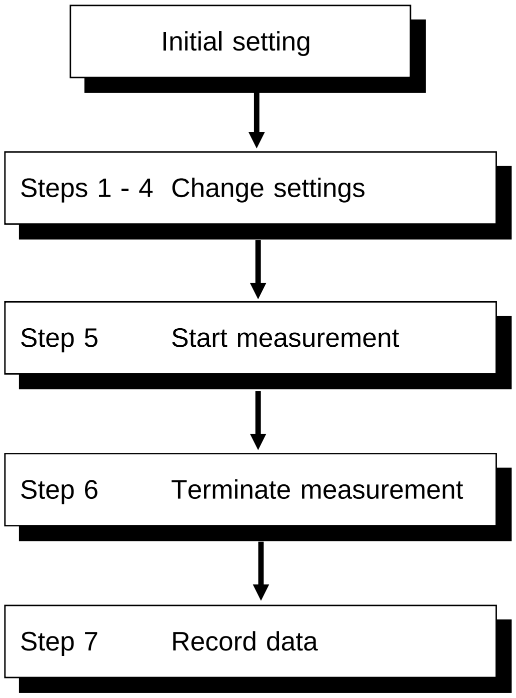
Measuring voltage with memory recorder function

The following measurement is carried out:

- Monitor input waveform on one screen.
- Print waveform or record on tape after measurement is completed.



Only steps which require changing from factory default condition are described.

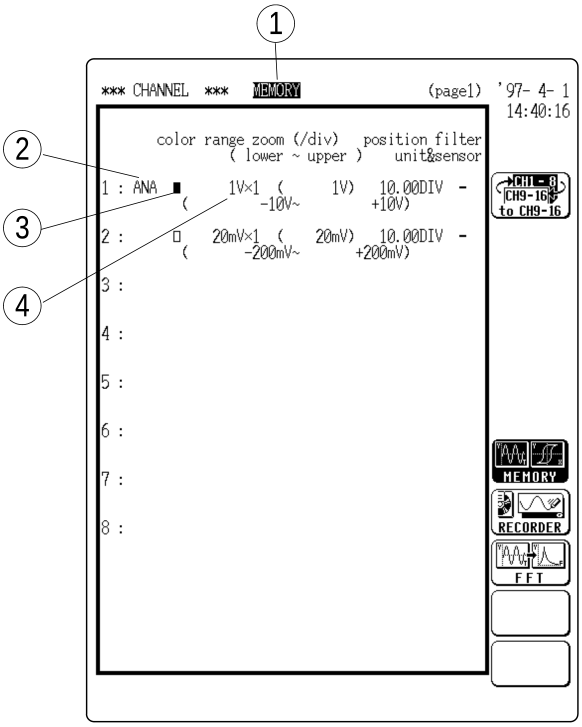


Step 1 Setup and measurement preparations (☞ Chapter 4)

- Install the 8846 in a proper location.
- Install analog units 8927 in the CH1 and CH2 slots.
- Connect the power cord and turn the unit on.
- Use the connecting cable to connect the input connectors to the measurement object.

Step 2 CHANNEL screen settings (page 1) (☞ Chapter 9)

- Press the CHAN key to call up the CHANNEL screen (page 1).
- Press the CH. SET key to select the screen for CH1 - CH8 or CH9 - CH16.



```
*** CHANNEL  ***   MEMORY               (page1)  '97- 4- 1
                                                  14:40:16
        color range zoom (/div)   position filter
                   ( lower ~ upper )    unit&sensor
1 : ANA  ■      1V×1  (      1V)   10.00DIV  -
         (         -10V~          +10V)
2 :      □    20mV×1  (    20mV)   10.00DIV  -
         (        -200mV~        +200mV)
3 :
4 :
5 :
6 :
7 :
8 :
```

① Set function to **MEMORY** (Memory recorder).

1. Move the flashing cursor to the function item.
2. Press F1 [MEMORY].

② Set CH1 to analog input.

Move the flashing cursor to the graph for CH1 and press F1 [ANALOG].

③ Set CH1 waveform to be shown on display with color 1 (printout: dark).

1. Move the flashing cursor to the **color** item.
2. Press F2 [# 1 (dark)]. (Set CH2 to OFF.)

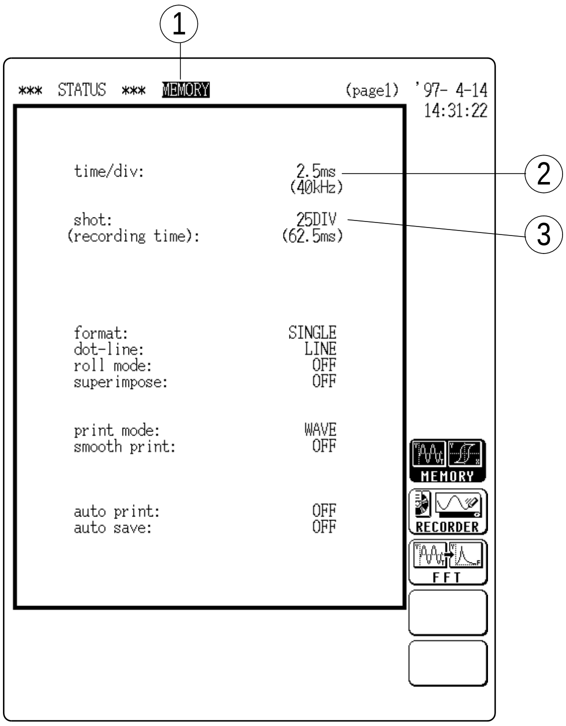
④ Select suitable voltage range for input.

- Since input voltage in this example is 10 Vp-p, select **1V/DIV**.
- Automatic setting by pressing the AUTO key is also possible (☞ Section 6.3.3).

1. Move the flashing cursor to the **range** item.
2. Use the JOG control or the function keys F1 [+] and F2 [−] to select the **1V/DIV** range.

Step 3 STATUS screen settings (page 1) (☞ Chapter 6)

Press the STATUS key to call up the STATUS screen (page 1).



*** STATUS *** MEMORY (page1) '97- 4-14
14:31:22

time/div: 2.5ms (40kHz)

shot: 25DIV
(recording time): (62.5ms)

format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

① Set function to **MEMORY** (Memory recorder).

1. Move the flashing cursor to the function item.
2. Press F1 [MEMORY].

② Set time axis range.

- Since the frequency in this example is 60 Hz, one cycle is
  1/60 16.67 ms.
  To observe two cycles on the display (15 DIV), the time axis should be
  16.67 ms × 2/15 DIV = 2.22 ms/DIV.
  Therefore the setting **2.5 ms/DIV** should be selected.
- If the frequency is unknown, search for a suitable range, starting with high sampling frequencies.
- Automatic setting by pressing the AUTO key is also possible (☞ Section 6.3.3).

1. Move the flashing cursor to the **time/div** item.
2. Use the JOG control or the function keys F1 [+] and F2 [−] to select the **2.5ms/DIV** range.

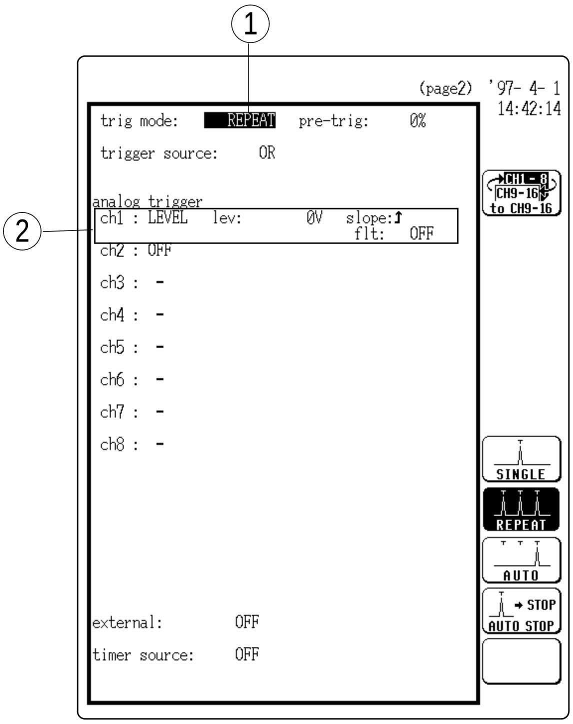
③ Set recording length (recording time)

- Recording time = time axis range (s/DIV) × recording length (DIV)
- If recording length is to be 25 DIV, the recording time is
  2.5 ms/DIV × 25 DIV = 62.5 ms.

1. Move the flashing cursor to the **shot** item.
2. Use the JOG control or the function keys F1 [+] and F2 [−] to select **25DIV**.

Step 4 Trigger settings (☞ Chapter 10)

Press the STATUS key to call up the STATUS screen (page 2).



```
                                    (page2)  '97- 4- 1
                                              14:42:14
trig mode:      REPEAT   pre-trig:     0%

trigger source:     OR

analog trigger
ch1 : LEVEL    lev:         0V   slope:↑
                                  flt:   OFF
ch2 : OFF
ch3 :  -
ch4 :  -
ch5 :  -
ch6 :  -
ch7 :  -
ch8 :  -

external:          OFF
timer source:      OFF
```

① Set the trigger mode.

- Determine whether triggering is to be used continuously.
- Four trigger types are available: **SINGLE**, **REPEAT**, **AUTO**, and **AUTO STOP**.
- For continuous trigger-activated waveform sampling and recording, choose **REPEAT**.
- For automatic setup, choose **AUTO**.

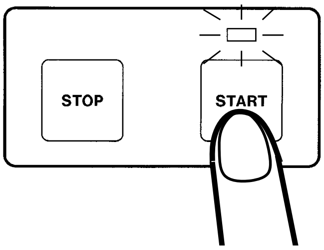
1. Move the flashing cursor to the **trig mode** item.
2. Press F2 [REPEAT].

② Select input waveform of CH 1 as trigger source.

- Waveform data recording starts when the input waveform crosses the 0 V level from below (rising edge).
- When the AUTO key was used, the setting becomes **LEVEL**.

1. Move the flashing cursor to the CH 1 position.
2. Press F2 [LEVEL].
3. Use the JOG control or function keys F1 - F4 to set the voltage level to **0V**.
4. Select F1 [UP] for **slope**.

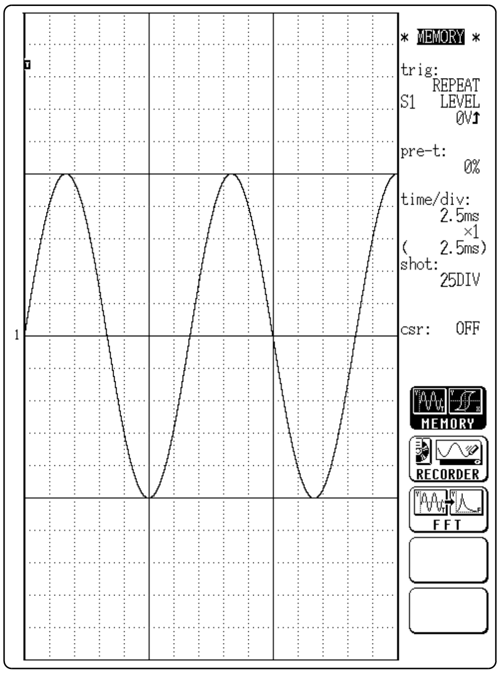
Step 5 Measurement start



Press the START key. The LED above the key lights up and measurement starts.

Step 6 Measurement end

Since trigger mode is set to **REPEAT**, measurement continues until the STOP key is pressed. Press the STOP key to terminate the measurement.



* MEMORY *

trig: REPEAT
S1 LEVEL 0V↑

pre-t: 0%

time/div: 2.5ms ×1
(2.5ms)

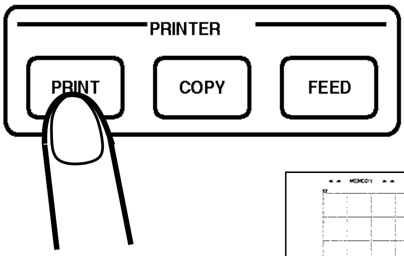
shot: 25DIV

csr: OFF

Step 7 Recording waveform data

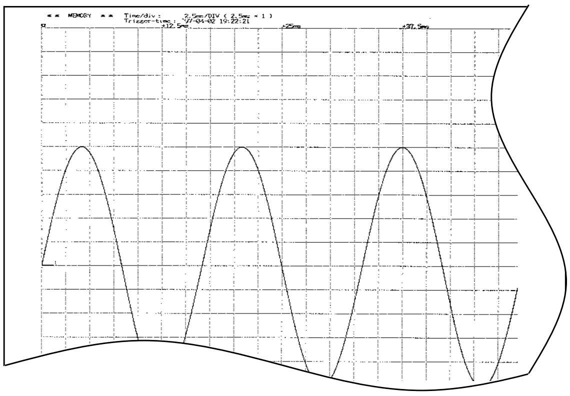
The most recently acquired waveform data can be printed out or stored on tape.

(1) Printing the waveform

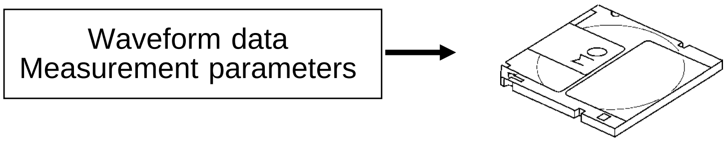


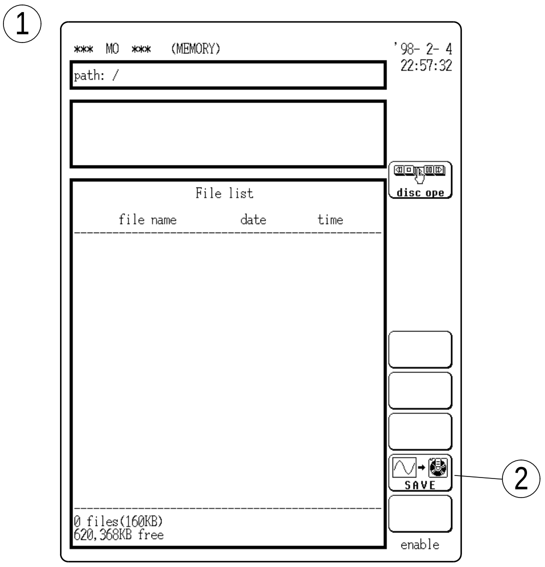
Press the PRINT key.

The waveform data stored most recently in memory are printed out.



(2) Storing waveform data on MO (Storing in binary format)




*** MO *** (MEMORY) '98- 2- 4 22:57:32

path: /

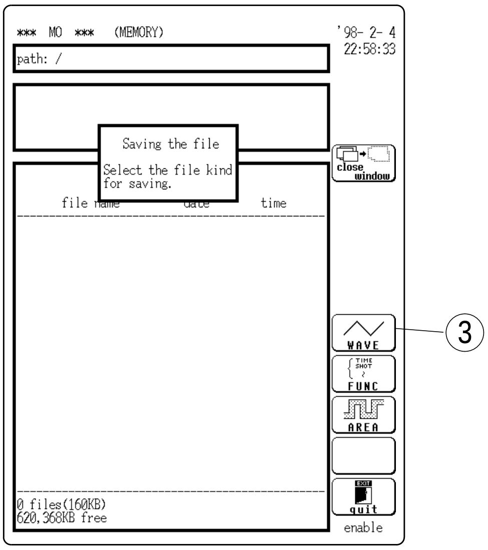
File list

file name date time

0 files(160KB)
620,368KB free

① Press the FILE key to call up the MO screen.

② Make a displaying of the directory in which the data is stored, and press the function key F4 [SAVE].


*** MO *** (MEMORY) '98- 2- 4 22:58:33

path: /

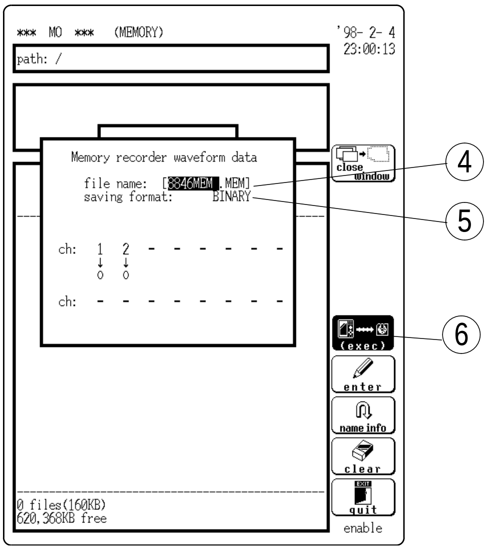
Saving the file

Select the file kind for saving.

file name date time

0 files(160KB)
620,368KB free

③ Since waveform data are to be stored, select F1 [WAVE].


*** MO *** (MEMORY) '98- 2- 4 23:00:13

path: /

Memory recorder waveform data

file name: [8846MEM .MEM]
saving format: BINARY

ch: 1 2 - - - - - -
↓ ↓
0 0

ch: - - - - - - - -

0 files(160KB)
620,368KB free

④ Move the flashing cursor to the file name item and input the file name (☞ Section 11.6.1).

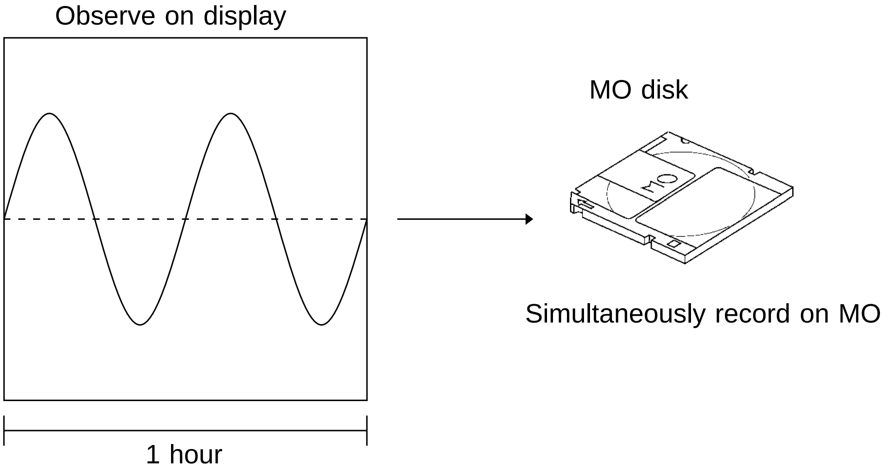
⑤ Press F2 [binary] to set the storing type.

⑥ Press F1 [exec].

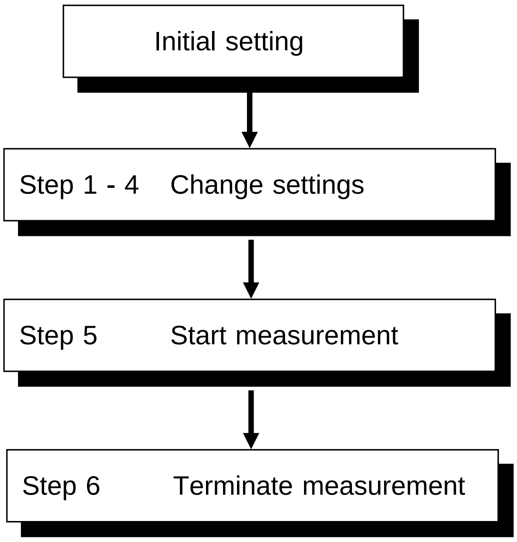
Measuring voltage with recorder function

The following measurement is carried out:

- Monitor input waveform on one screen.
- Record waveform on disk for one hour.



Only steps which require changing from factory default condition are described.

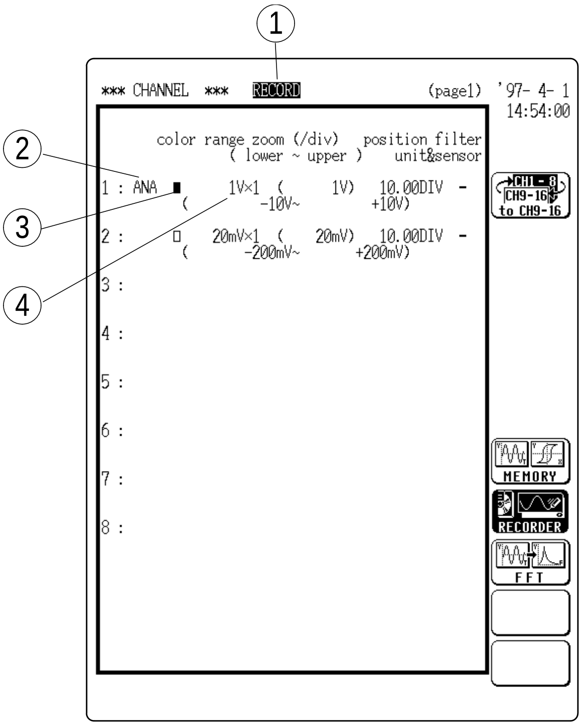


Step 1 Setup and measurement preparations (☞ Chapter 4)

- Install the 8846 in a proper location.
- Install 8927 ANALOG UNIT in the CH1 and CH2 slots.
- Connect the power cord and turn the unit on.
- Use the connecting cable to connect the input connectors to the measurement object.

Step 2 CHANNEL screen settings (page 1) (☞ Chapter 9)

- Press the CHAN key to call up the CHANNEL screen (page 1).
- Press the CH. SET key to select the screen for CH1 - CH8 or CH9 - CH16.



```
*** CHANNEL  ***   RECORD                       (page1)  '97- 4- 1
                                                          14:54:00
       color range zoom (/div)   position filter
              ( lower ~ upper )     unit&sensor
1 : ANA ■       1V×1  (       1V)   10.00DIV  -
          (        -10V~          +10V)
2 :     □    20mV×1  (     20mV)   10.00DIV  -
          (       -200mV~       +200mV)
3 :
4 :
5 :
6 :
7 :
8 :
```

① Set function to **RECORDER** (Recorder).

1. Move the flashing cursor to the function item.
2. Press F2 [RECORDER]. (Set CH2 to OFF.)

② Set CH1 to analog input.

Move the flashing cursor to the graph for CH1 and press F1 [ANALOG].

③ Set CH1 waveform to be shown on display with color 1 (printout: dark).

1. Move the flashing cursor to the **color** item.
2. Press F2 [# 1 (dark)].

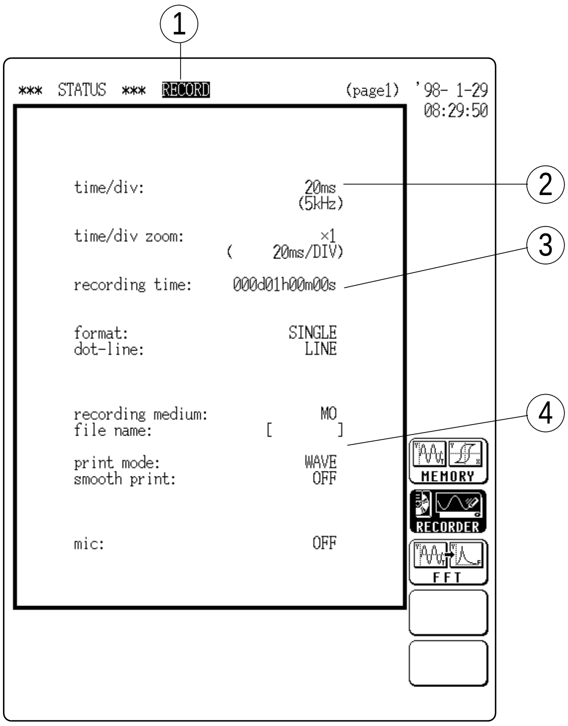
④ Select suitable voltage range for input.

- Since input voltage in this example is 10 Vp-p, select **1V/DIV**.
- Automatic setting by pressing the AUTO key is also possible (☞ Section 7.3.3).

1. Move the flashing cursor to the **range** item.
2. Use the JOG control or the function keys F1 [+] and F2 [-] to select the **1V/DIV** range.

Step 3 STATUS screen settings (page 1) (☞ Chapter 7)

Press the STATUS key to call up the STATUS screen (page 1).



```
*** STATUS *** RECORD                     (page1) '98- 1-29
                                                   08:29:50

     time/div:                          20ms
                                       (5kHz)
     time/div zoom:                       ×1
                               (     20ms/DIV)
     recording time:       000d01h00m00s

     format:                          SINGLE
     dot-line:                          LINE

     recording medium:                    MO
     file name:                  [          ]
     print mode:                        WAVE
     smooth print:                       OFF

     mic:                                OFF
```

① Set function to **RECORDER**.

1. Move the flashing cursor to the function item.
2. Press F2 [RECORDER].

② Set time axis range.

Since the frequency in this example is 60 Hz, one cycle is
1/60 = 16.67 ms.
The setting **20 ms/DIV** should be selected.

1. Move the flashing cursor to the **time/div** item.
2. Use the JOG control or the function keys F1 [+] and F2 [**-**] to select the **20ms/DIV** range.

③ Set recording time

Set recording time to 1 hour.

1. Move the flashing cursor to the **recording time** item.
2. Use the JOG control or function keys F1 - F4 to set the recording time to **1h**.

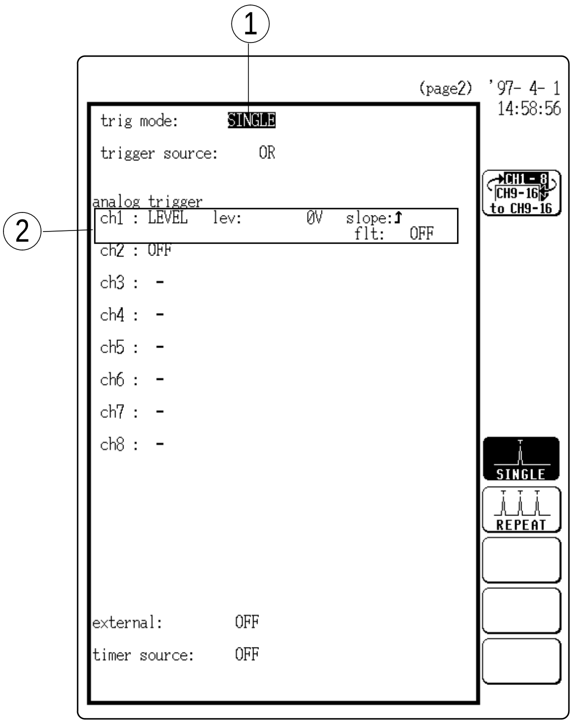
④ Choose recording medium.

1. Move the flashing cursor to the **recording medium** item and select F3 [MO].
2. Move the flashing cursor to the **file name** item to enter the file name.

(☞ Section 11.6.1, "Comment and File Name Entry Procedure")

Step 4 Trigger settings (☞ Chapter 10)

Press the STATUS key to call up the STATUS screen (page 2).



(page2) '97- 4- 1 14:58:56

trig mode: SINGLE

trigger source: OR

analog trigger

ch1 : LEVEL lev: 0V slope:↑ flt: OFF

ch2 : OFF

ch3 : -

ch4 : -

ch5 : -

ch6 : -

ch7 : -

ch8 : -

external: OFF

timer source: OFF

① Set the trigger mode.

- Determine whether triggering is to be used continuously.
- Four trigger types are available: **SINGLE**, **REPEAT**.
- For stop recording after 1 hour, choose **SINGLE**.
- For automatic setup, choose **SINGLE**.

1. Move the flashing cursor to the **trig mode** item.
2. Press F1 [SINGLE].

② Select input waveform of CH 1 as trigger source.

- Waveform data recording starts when the input waveform crosses the 0 V level from below (rising edge).
- When the AUTO key was used, the setting becomes **LEVEL**.

1. Move the flashing cursor to the CH 1 position.
2. Press F2 [LEVEL].
3. Use the JOG control or function keys F1 - F4 to set the voltage level to **0V**.
4. Select F1 [UP] for **slope**.

Step 5 Measurement start

Press the START key. The LED above the key lights up and measurement starts.

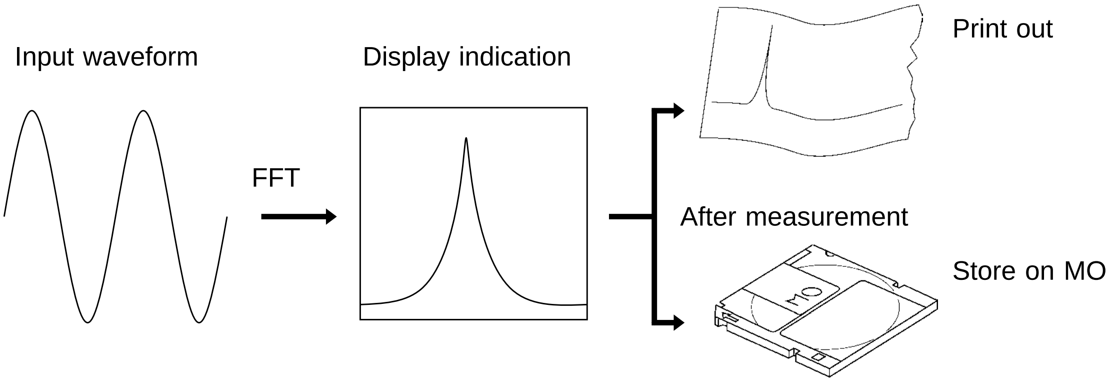
Step 6 Measurement end

After recording the waveform data for 1 hour, the measurement is terminated.

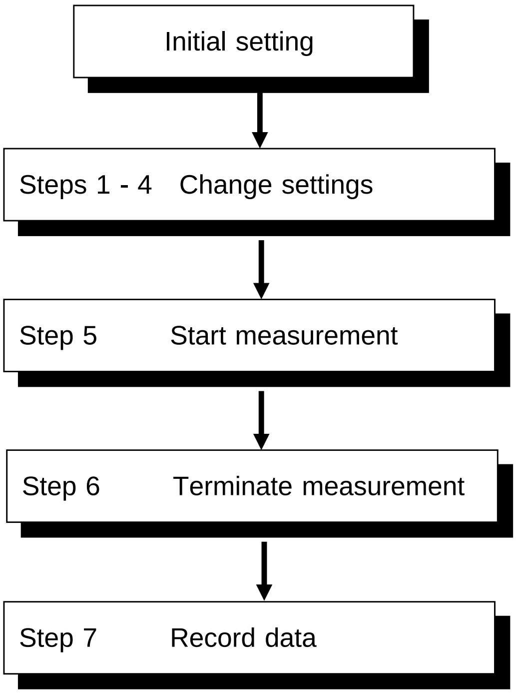
5.2.2 Frequency Analysis of Measured Voltage (FFT)

Example Monitor and record a power supply voltage, as shown in the illustration in Section 5.2.1, and analyze the frequency content of the measured voltage, using FFT (Fast Fourier Transform).

The following measurement is carried out:
- Analyze the linear spectrum.
- Display the analysis result on one screen.
- Print out the waveform or record data on MO disk after measurement is completed.



Only steps which require changing from factory default condition are described.

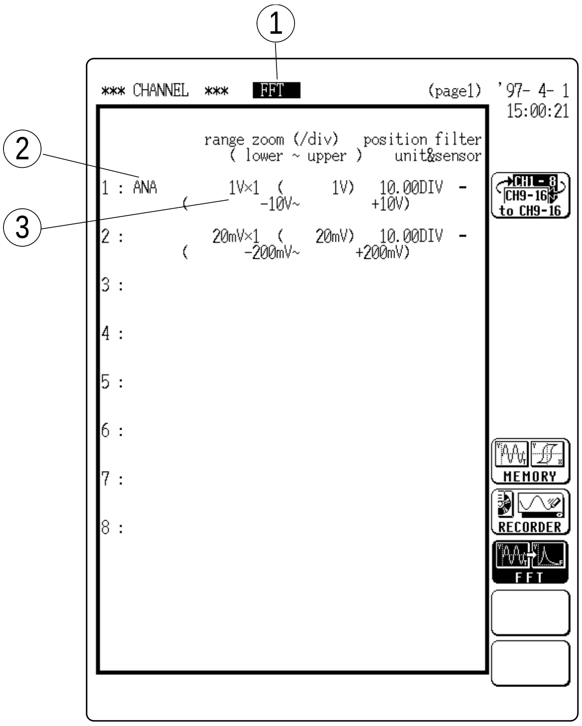


Step 1 Setup and measurement preparations (☞ Chapter 4)

- Install the 8846 in a proper location.
- Install 8927 ANALOG UNIT in the CH1 and CH2 slots.
- Connect the power cord and turn the unit on.
- Use the connecting cable to connect the input connectors to the measurement object.

Step 2 CHANNEL screen settings (page 1) (☞ Chapter 9)

- Press the CHAN key to call up the CHANNEL screen (page 1).
- Press the CH. SET key to select the screen for CH1 - CH8 or CH9 - CH16.



```
*** CHANNEL  ***  FFT                    (page1) '97- 4- 1
                                                  15:00:21
              range zoom (/div)   position filter
                ( lower ~ upper )    unit&sensor
1 : ANA       1V×1  (      1V)  10.00DIV  -
         (        -10V~          +10V)
2 :          20mV×1  (    20mV)  10.00DIV  -
         (      -200mV~        +200mV)
3 :
4 :
5 :
6 :
7 :
8 :
```

① Set function to **FFT**.

1. Move the flashing cursor to the function item.
2. Press F3 [FFT].

② Set CH1 to analog input.

Move the flashing cursor to the graph for CH1 and press F1 [ANALOG].

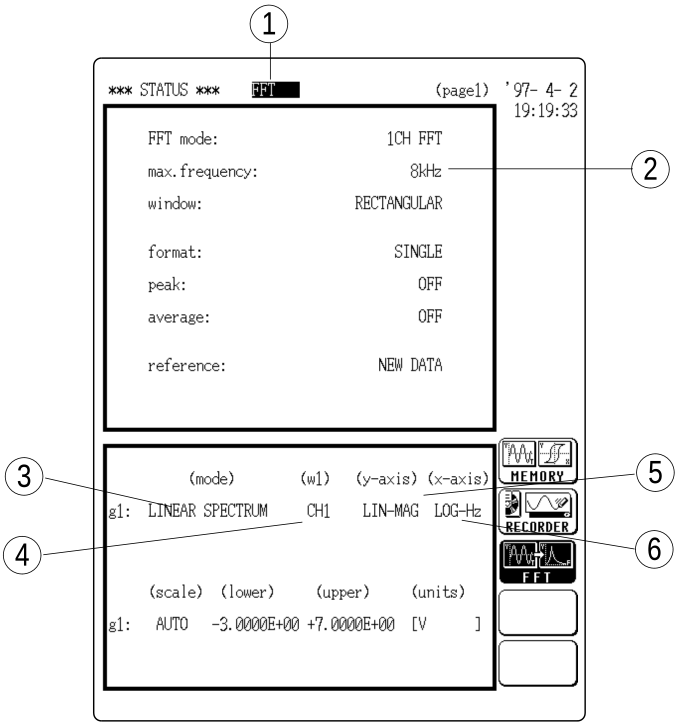
③ Select suitable voltage range for input.

Since input voltage in this example is 10 Vp-p, select **1V/DIV**.

1. Move the flashing cursor to the **range** item.
2. Use the JOG control or the function keys F1 [+] and F2 [-] to select the **1V/DIV** range.

Step 3 STATUS screen settings (page 1) (☞ Chapter 8)

Press the STATUS key to call up the STATUS screen (page 1).



```
*** STATUS ***  FFT                     (page1)  '97- 4- 2
                                                  19:19:33
    FFT mode:                      1CH FFT
    max.frequency:                 8kHz
    window:                        RECTANGULAR

    format:                        SINGLE
    peak:                          OFF
    average:                       OFF

    reference:                     NEW DATA

          (mode)         (w1)   (y-axis) (x-axis)
g1:  LINEAR SPECTRUM     CH1    LIN-MAG  LOG-Hz

     (scale)  (lower)     (upper)      (units)
g1:   AUTO   -3.0000E+00 +7.0000E+00  [V      ]
```

① Set function to **FFT**.

1. Move the flashing cursor to the function item.
2. Press F3 [FFT].

② Set the frequency range.

Since frequencies up to 8 kHz are to be observed, set the range to **8kHz**.

1. Move the flashing cursor to the **max. frequency** item.
2. Use the JOG control or the function keys F1 [+] and F2 [-] to select **8kHz**.

③ Set the analysis mode.

- 12 different analysis settings are available.
- Select the linear spectrum in this example.

1. Move the flashing cursor to the **mode** item of g1.
2. Select F2 [LIN].

④ Set the analysis channel.

1. Move the flashing cursor to the **w1** item.
2. Use the JOG control or the function keys F1 [+] and F2 [-] to select **CH1**.

⑤ Set the Y-axis (vertical axis).

- The setting differs, depending on the analysis mode.
- In this example, the magnitude of the frequency components is to be observed. The setting therefore should be linear amplitude.

1. Move the flashing cursor to the **y-axis** item.
2. Select F3 [LIN-MAG] (linear amplitude).

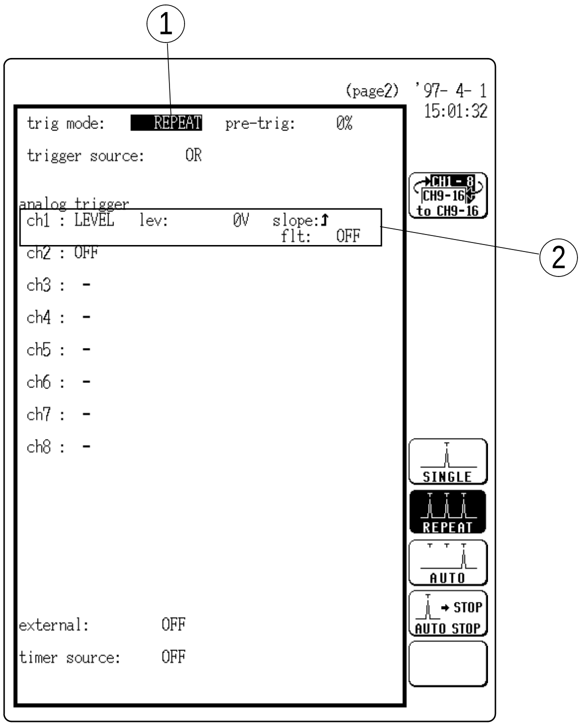
⑥ Set the X-axis (horizontal axis).

- The setting differs, depending on the analysis mode.
- In this example, the frequency is to be observed on a logarithmic scale. The setting therefore should be logarithmic frequency.

1. Move the flashing cursor to the **x-axis** item.
2. Select F2 [LOG-Hz] (logarithmic frequency).

Step 4 Trigger settings (☞ Chapter 10)

Press the STATUS key to call up the STATUS screen (page 2).



```
                                  (page2)  '97- 4- 1
                                            15:01:32
trig mode:       REPEAT   pre-trig:      0%
trigger source:      OR

analog trigger
ch1 : LEVEL    lev:         0V   slope:↑
                                   flt:   OFF
ch2 : OFF
ch3 :  -
ch4 :  -
ch5 :  -
ch6 :  -
ch7 :  -
ch8 :  -

external:           OFF
timer source:       OFF
```

① Set the trigger mode.

- Determine whether triggering is to be used continuously.
- Four trigger types are available: **SINGLE**, **REPEAT**, **AUTO**, and **AUTO STOP**.
- For continuous trigger-activated waveform sampling and recording, choose **REPEAT**.
- For automatic setup, choose **AUTO**.

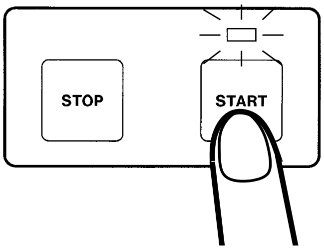
1. Move the flashing cursor to the **trig mode** item.
2. Press F2 [REPEAT].

② Select input waveform of channel 1 (ch1) as trigger source.

- Waveform data recording starts when the input waveform crosses the 0 V level from below (rising edge).
- When the AUTO key was used, the setting becomes **LEVEL**.

1. Move the flashing cursor to the **ch1** position.
2. Press F2 [LEVEL].
3. Use the JOG control or function keys F1 - F4 to set the voltage level to **0V**.
4. Select F1 [UP] for **slope**.

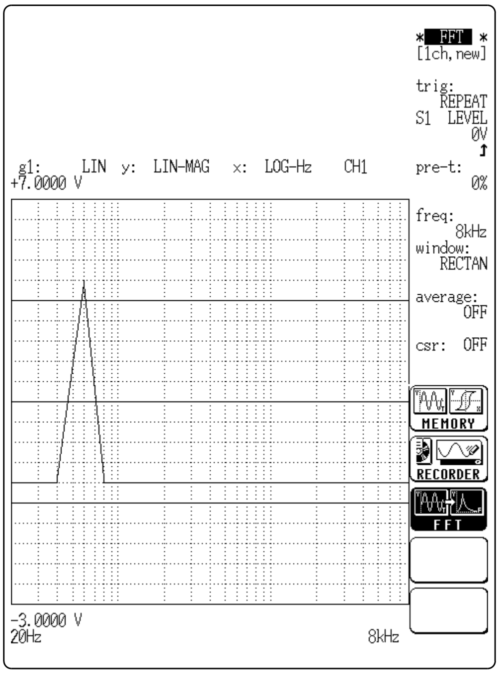
Step 5 Measurement start



Press the START key. The LED above the key lights up and measurement starts.

Step 6 Measurement end

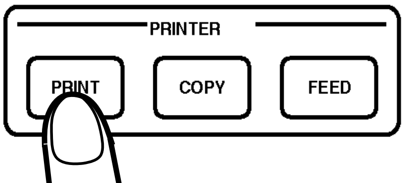
Since trigger mode is set to **REPEAT**, measurement continues until the STOP key is pressed. Press the STOP key to terminate the measurement.


* FFT *
[1ch, new]
trig: REPEAT
S1 LEVEL
0V
↑
g1: LIN y: LIN-MAG x: LOG-Hz CH1
+7.0000 V
pre-t: 0%
freq: 8kHz
window: RECTAN
average: OFF
csr: OFF
-3.0000 V
20Hz 8kHz

Step 7 Recording waveform data

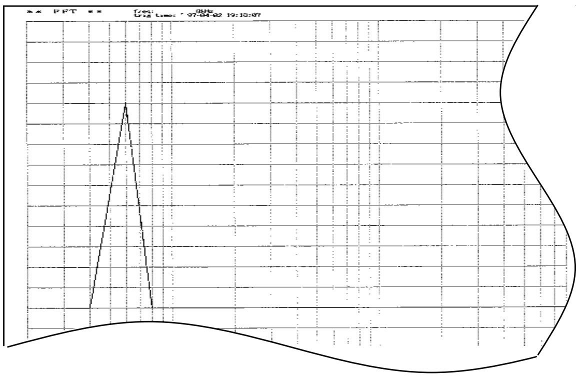
The most recently acquired waveform data can be printed out or stored on tape.

(1) Printing the waveform

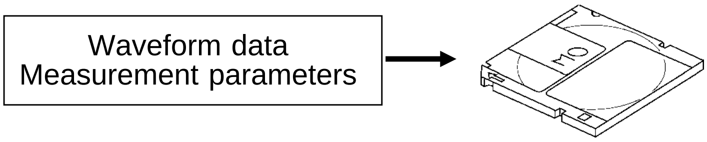


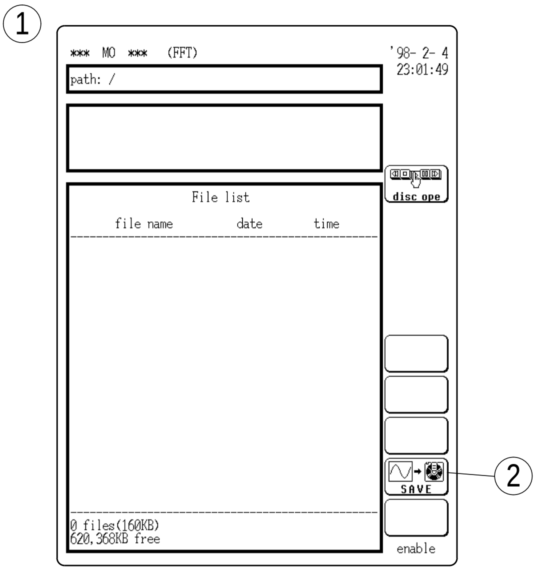
Press the PRINT key.

The waveform data stored most recently in memory are printed out.



(2) Storing waveform data on MO (Storing in binary format)

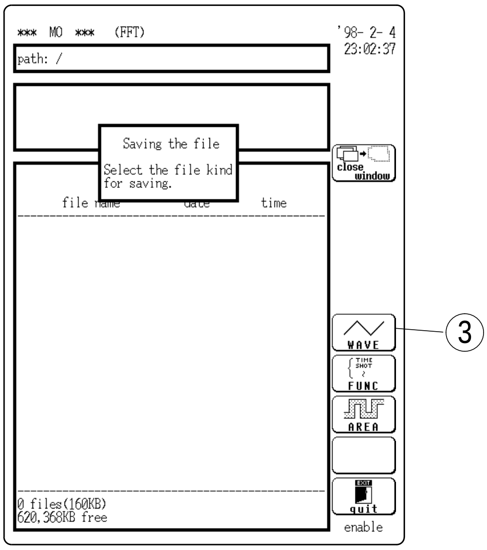




```
*** MO ***   (FFT)                    '98- 2- 4
path: /                               23:01:49
                 File list
      file name          date        time
0 files(160KB)
620,368KB free
```

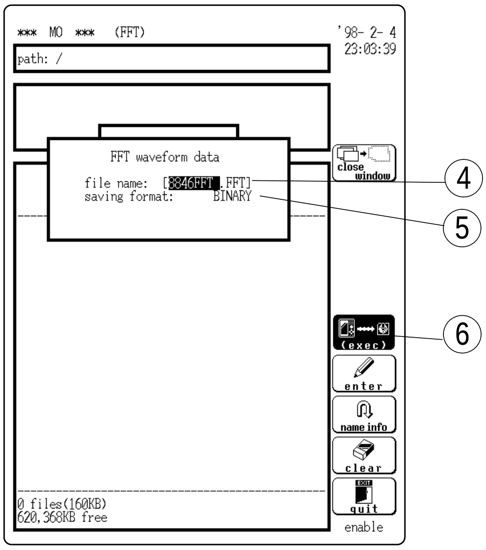
① Press the FILE key to call up the MO screen.

② Make a displaying of the directory in which the data is stored, and press the function key F4 [SAVE].



```
*** MO ***   (FFT)                    '98- 2- 4
path: /                               23:02:37
          Saving the file
          Select the file kind
          for saving.
0 files(160KB)
620,368KB free
```

③ Since waveform data are to be stored, select F1 [WAVE].



```
*** MO ***   (FFT)                    '98- 2- 4
path: /                               23:03:39
          FFT waveform data
     file name:     [8846FFT .FFT]
     saving format:       BINARY
0 files(160KB)
620,368KB free
```

④ Move the flashing cursor to the file name item and input the file name (☞ Section 11.6.1).

⑤ Press F2 [binary] to set the storing type.

⑥ Press F1 [exec].

Chapter 6
Memory Recorder Function

6.1 Outline

(1) After being stored in the internal memory, input signal data can be displayed and printed.

(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

Up to 20 steps: 500 μs/DIV (8927 not installed), 1 ms/DIV - 5 min/DIV.

(4) Time axis resolution 100 points/DIV

(5) Storage capacity

2 M words (8916 - 8919 one unit or 8928 one channel: 20,000 DIV; 8927 one unit: 10,000 DIV)

(6) Waveform magnification/compression display and print

- Time axis direction: ×10 to ×1/1000
- Voltage axis direction: user-variable display range

(7) Voltage axis resolution

320 dots/DIV (8927), 80 dots/DIV (8916 - 8919, 8928) (magnification factor ×1)

(8) Display format

- Time axis waveform: single, dual, quad, oct screen display
- X-Y waveform: X-Y single, X-Y dual display

(9) Printing

Normal print, A4 print, partial print, screen hard copy. Multiple printing possible.

(10) High-quality print

Smooth print function approximates analog waveform.

(11) Logging function

Numeric printout of waveform data

(12) Pretrigger function

Allows monitoring of signal also before triggering.

(13) Memory segmentation function

Helps to reduce dead time. Up to 63 waveforms corresponding to 25 DIV can be stored per channel.

(14) Waveform evaluation function detects abnormal waveforms

(15) Processing functions

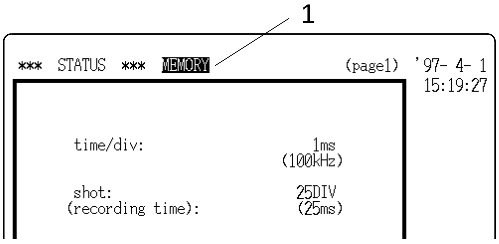
Waveform processing (arithmetic processing, differential processing etc.)
Waveform parameter processing (frequency measurement, rms measurement etc.)

6.2 Making Settings

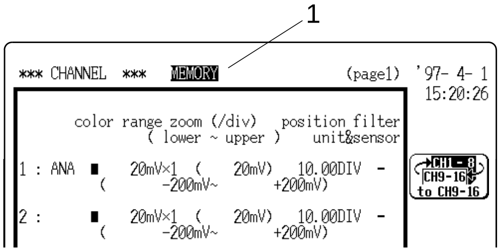
6.2.1 Setting the Function Mode

- The 8846 has three function modes: the memory recorder function mode, the recorder function mode, and the FFT function mode
- Select the memory recorder function.

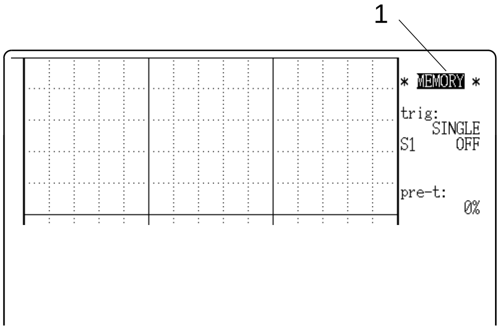
Method Screen: STATUS (page 1), CHANNEL(page1), DISPLAY



```
*** STATUS *** MEMORY                    (page1) '97- 4- 1
                                                 15:19:27

    time/div:                    1ms
                              (100kHz)

    shot:                      25DIV
   (recording time):           (25ms)
```



```
*** CHANNEL ***  MEMORY                  (page1) '97- 4- 1
                                                 15:20:26
      color range zoom (/div)   position filter
              ( lower ~ upper )    unit&sensor
1 : ANA  ▮   20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~      +200mV)
2 :      ▮   20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~      +200mV)
```



```
* MEMORY *
trig:
     SINGLE
S1      OFF

pre-t:
         0%
```

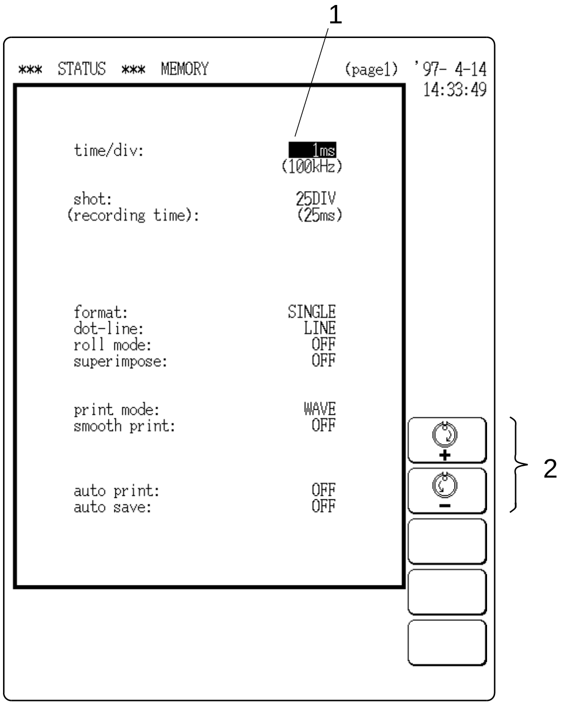
1. Move the flashing cursor to the position shown in the figure on the left.
2. Press F1 [MEMORY].

Function key display	Meaning
MEMORY	: Memory recorder function
RECORDER	: Recorder function
FFT	: FFT function

6.2.2 Setting the Time Axis Range

- 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 period is 1/100th of the set value for the time axis range. (100 samples/DIV)

Method Screen: STATUS (page 1), DISPLAY



*** STATUS *** MEMORY (page1) '97- 4-14 14:33:49

time/div: 1ms (100kHz)

shot: (recording time): 25DIV (25ms)

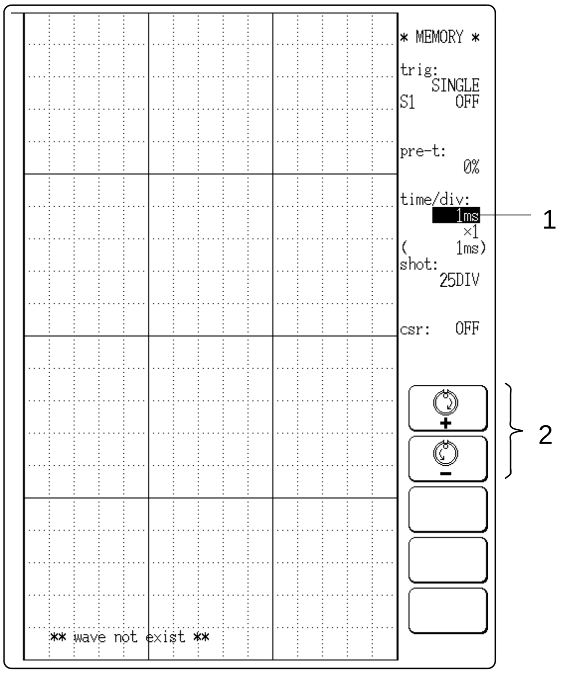
format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

1. Move the flashing cursor to the **time/div** item.
2. Use the JOG control or the function keys to make the selection.

Function key display	Meaning
+ −	500 µs (not selectable when 8927 is use.) 1, 1.25, 2, 2.5, 5, 10, 20, 50, 100, 200, 500 ms, 1, 2, 5, 10, 20 s 1, 2,5 min, EXT (external)



* MEMORY *

trig: SINGLE
S1 OFF

pre-t: 0%

time/div: 1ms
×1
(1ms)

shot: 25DIV

csr: OFF

** wave not exist **

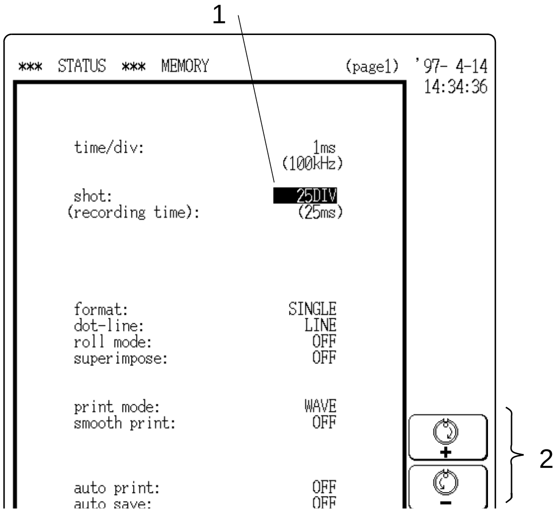
NOTE

- When analog unit 8927 is used, 500 µs/DIV cannot be selected.
- Sampling rate is shown below time axis range.
- When time axis range is changed during measurement, measurement starts again with the new setting.
- When using the external sampling,: ☞ Section 21.5

6.2.3 Setting the Recording Length

The length of recording for one measurement operation (number of DIV) can be set.

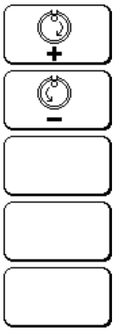
Method Screen: STATUS (page 1), DISPLAY



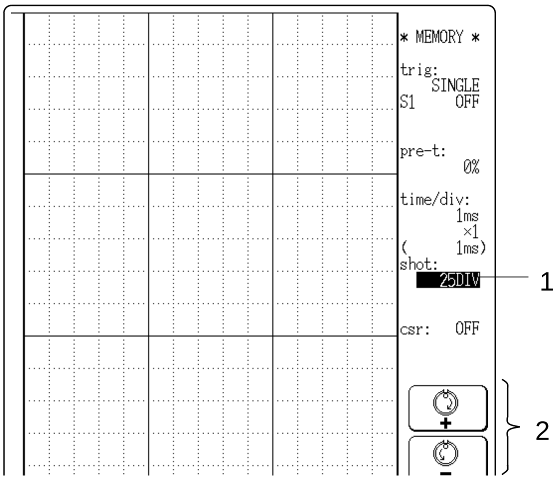
```
*** STATUS *** MEMORY                 (page1)  '97- 4-14
                                                14:34:36
time/div:                     1ms
                           (100kHz)
shot:                       25DIV
(recording time):          (25ms)

format:                    SINGLE
dot-line:                    LINE
roll mode:                    OFF
superimpose:                  OFF

print mode:                  WAVE
smooth print:                 OFF

auto print:                   OFF
auto save:                    OFF
```

1. Move the flashing cursor to the **shot** item.
2. Use the JOG control or the function keys to make the selection.

Function key display Meaning



25, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 DIV
(when 1 unit is used, excluding 8927)



```
* MEMORY *
trig:
   SINGLE
S1    OFF
pre-t:
       0%
time/div:
      1ms
       ×1
(     1ms)
shot:
    25DIV
csr:  OFF
```

NOTE

- Depending on the number and types of units, the recording length is limited as shown in the table below.
- When recording length is changed during measurement, measurement starts again with the new setting.

Number of Units and Maximum Recording Length

Number of units	1		2		4		8	
	1ch	2ch	1ch	2ch	1ch	2ch	1ch	2ch
Maximum recording length DIV	20000	10000		5000		2000		1000

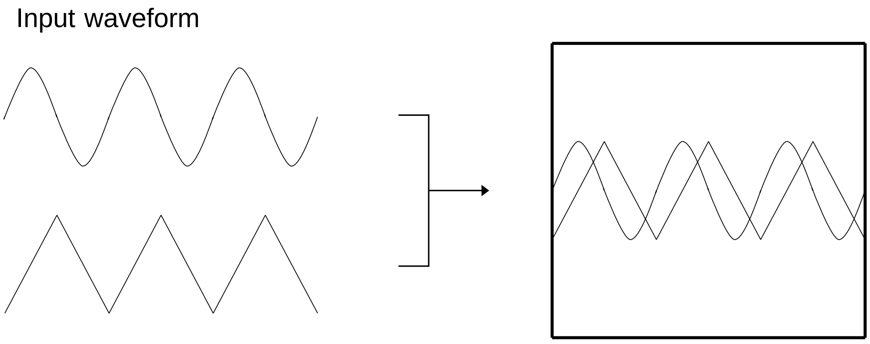
1ch: Only 8916 - 8919, 8928 can be used.
2ch: 8916 - 8919, 8927, 8928 can coexist, or 8927 can be used exclusively. (For the 8928, one channel corresponds to one unit.)

6.2.4 Setting the Format

- The style can be set for showing input signal waveforms on the screen display and recording them on the printer.
- The styles single, dual, quad, oct, X-Y single, and X-Y dual are available. (For X-Y single and X-Y dual: ☞ Section 6.2.5, "Using the X-Y Waveform Plots")

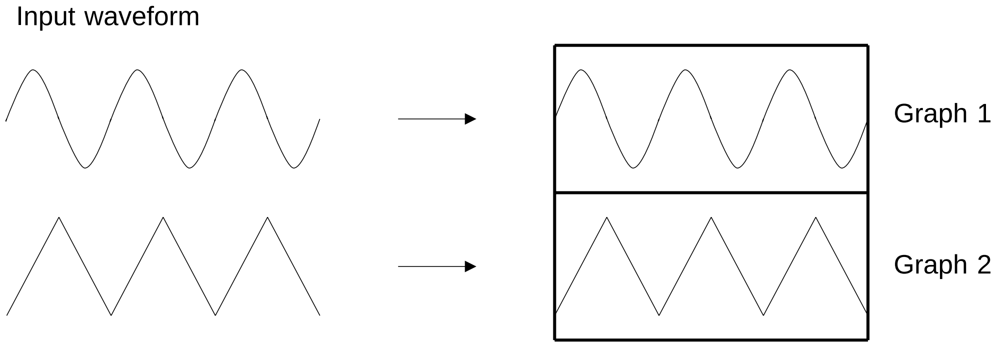
(1) Single

Display and record as one graph. (At the most, 16 analog signals and 14 analog + 16 logic signals)



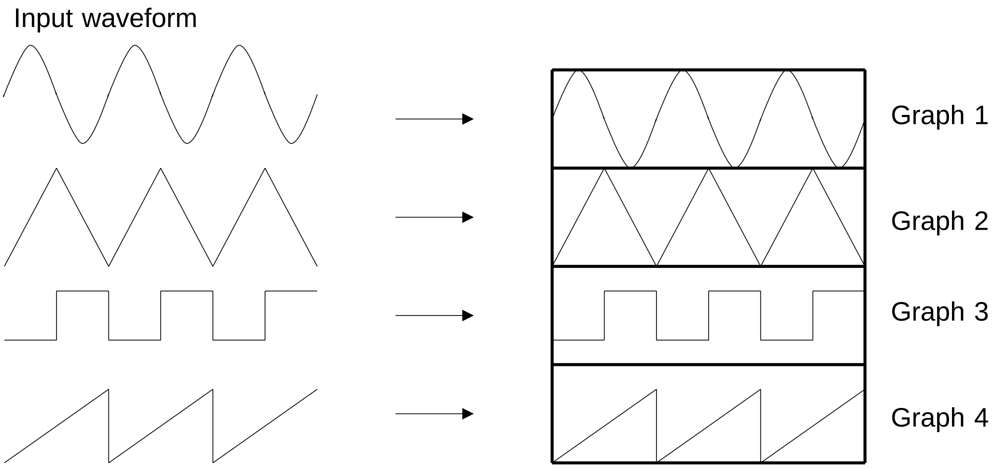
(2) Dual

- Display and record as two graphs. (On each graph, at most, 16 analog signals and 14 analog + 16 logic signals)
- Specify which input channel to use for waveform graph display and recording.



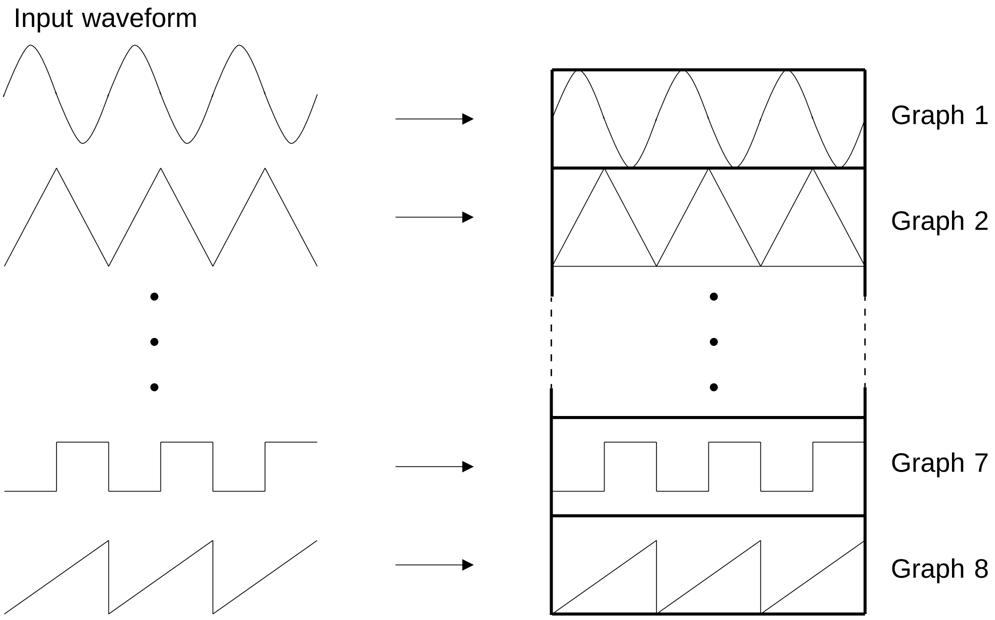
(3) Quad

- Display and record as four graphs. (On each graph, at most, 16 analog signals and 14 analog + 8 logic signals)
- Specify which input channel to use for waveform graph display and recording.

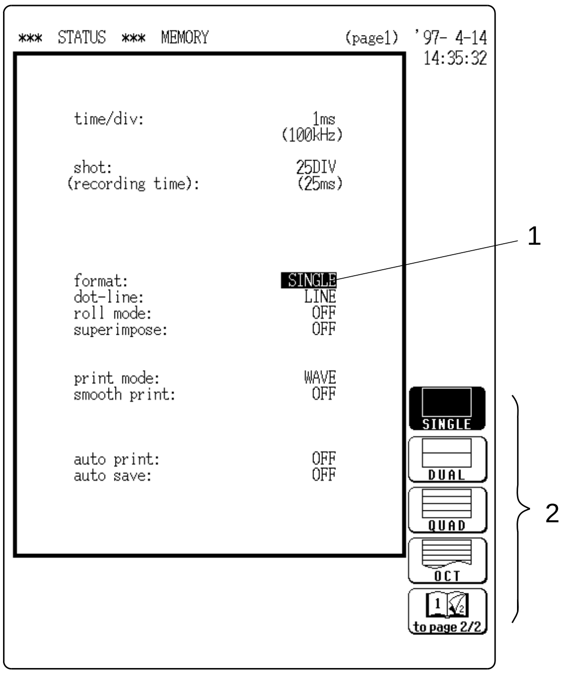


(4) Oct

- Display and record as eight graphs. (On each graph, at most, 16 analog signals and 14 analog + 4 logic signals)
- Specify which input channel to use for waveform graph display and recording.



Method Screen: STATUS (page 1)



```
*** STATUS  ***  MEMORY                    (page1)  '97- 4-14
                                                     14:35:32

   time/div:                         1ms
                                  (100kHz)

   shot:                            25DIV
  (recording time):                 (25ms)

   format:                         SINGLE
   dot-line:                         LINE
   roll mode:                         OFF
   superimpose:                       OFF

   print mode:                       WAVE
   smooth print:                      OFF

   auto print:                        OFF
   auto save:                         OFF
```

1. Move the flashing cursor to the **format** item.
2. Use the function keys to select the display format.

・**1/2**

Function key display	Meaning
SINGLE	: Single (one division only)
DUAL	: Dual (divided into two)
QUAD	: Quad (divided into four)
OCT	: Oct (print only divided into eight)
to page 2/2	: Switch to 2/2

・**2/2**

Function key display	Meaning
X-Y single	: X-Y single (☞ Section 6.2.5)
X-Y dual	: X-Y dual (☞ Section 6.2.5)
to page 1/2	: Switch to 1/2

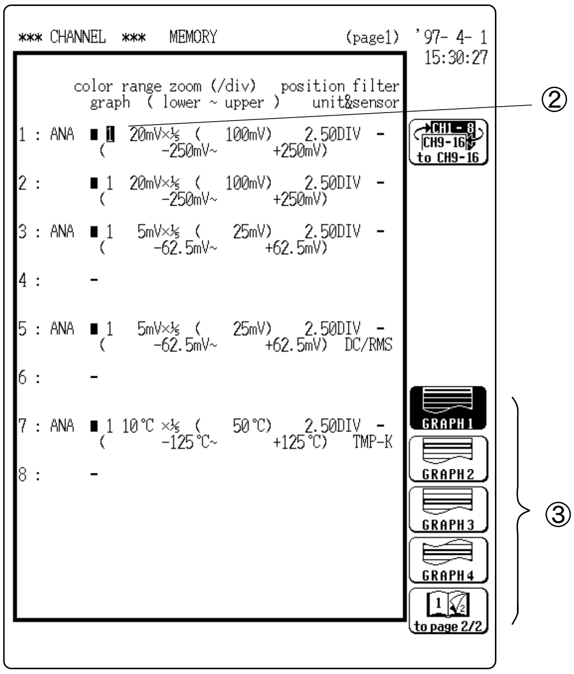
3. If dual, quad, or octo screen display was chosen in step 2, determine which input channel to display on which graph. This setting is made with the CHANNEL screen.

① Press the CHAN key to call up the CHANNEL screen.

② Move the flashing cursor to the point shown in the illustration at left.

- The illustration shows the setting for CH1.
- Settings for CH2 - CH16 should be made in the same way.

③ Use the function keys to select the graph.



```
*** CHANNEL  ***   MEMORY                 (page1)  '97- 4- 1
                                                    15:30:27
     color range zoom (/div)   position filter
       graph  ( lower ~ upper )    unit&sensor
1 : ANA  ■ 1  20mV×⅕  (   100mV)    2.50DIV  -
            (       -250mV~        +250mV)
2 :      ■ 1  20mV×⅕  (   100mV)    2.50DIV  -
            (       -250mV~        +250mV)
3 : ANA  ■ 1   5mV×⅕  (    25mV)    2.50DIV  -
            (      -62.5mV~       +62.5mV)
4 :      -
5 : ANA  ■ 1   5mV×⅕  (    25mV)    2.50DIV  -
            (      -62.5mV~       +62.5mV)  DC/RMS
6 :      -
7 : ANA  ■ 1 10℃ ×⅕  (    50℃)    2.50DIV  -
            (       -125℃~        +125℃)   TMP-K
8 :      -
```

- **1/2**

Function key display	Meaning
GRAPH1	: Graph 1
GRAPH2	: Graph 2
GRAPH3	: Graph 3 (*1)
GRAPH4	: Graph 4 (*1)
1 2 to page 2/2	: Switch to 2/2

- **2/2**

Function key display	Meaning
GRAPH5	: Graph 5 (*2)
GRAPH6	: Graph 6 (*2)
GRAPH7	: Graph 7 (*2)
GRAPH8	: Graph 8 (*2)
1 2 to page 1/2	: Switch to 1/2

*1: displays when the quad or oct screen display is selected

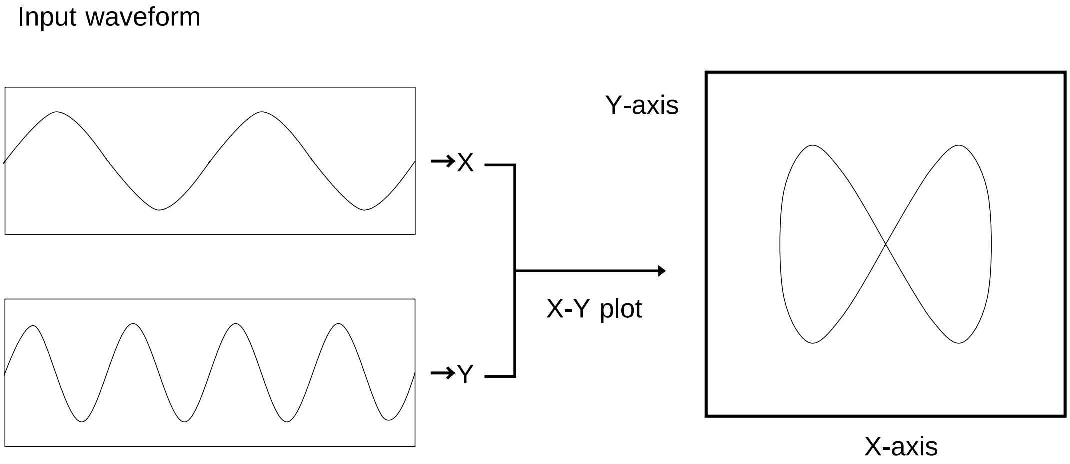
*2: displays when the oct screen display is selected

6.2.5 Using the X-Y Waveform Plots

- Setting the display format to X-Y single or X-Y dual allows up to four X-Y waveforms to be combined.
- Assign any analog channel to the X axis and Y axis to form the combined plot.
- Voltage axis magnification/compression is active also when using X-Y combined plotting.
- Using the A/B cursors, it is possible to specify the data between the cursors for partial plotting.

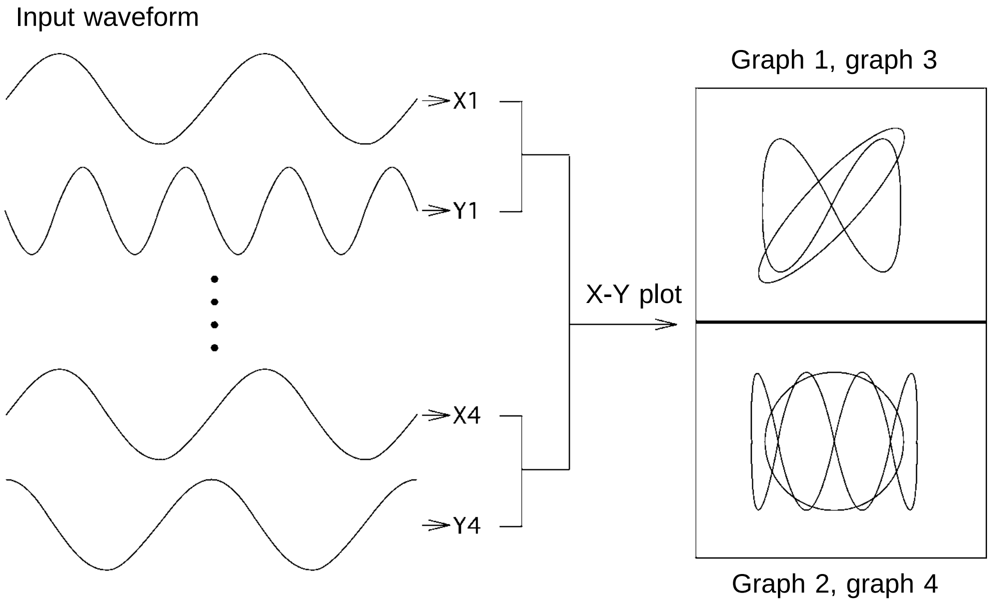
(1) X-Y single screen

- Display and recording is carried out using only one X-Y graph.
- The X-Y waveforms of graph 1 - graph 4 are shown on one screen.



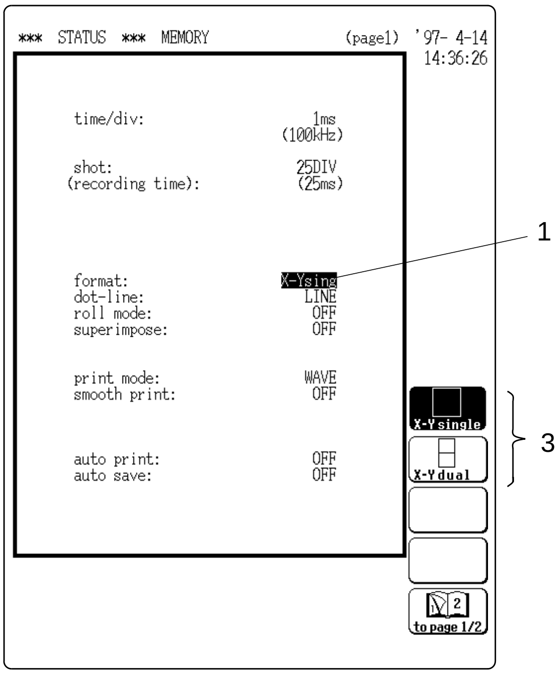
(2) X-Y dual screen

- Display and recording is carried out using only two X-Y graphs.
- The X-Y waveforms of graph 1 - graph 4 use superimposition of graph 1 and 3 and graph 2 and 4, respectively.



Method

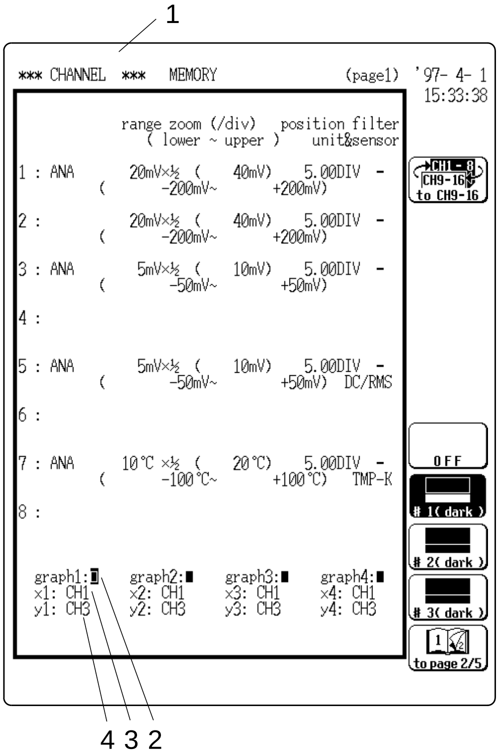
(1) STATUS screen settings



```
*** STATUS *** MEMORY                         (page1) '97- 4-14
                                                      14:36:26

    time/div:                      1ms
                               (100kHz)

    shot:                        25DIV
   (recording time):            (25ms)


    format:                    X-Ysing
    dot-line:                     LINE
    roll mode:                     OFF
    superimpose:                   OFF

    print mode:                   WAVE
    smooth print:                  OFF

    auto print:                    OFF
    auto save:                     OFF
```

1. Move the flashing cursor to the **format** item.
2. Use the function key to call up page 2/2.
3. Select F1 [X-Y single] or F2 [X-Y dual] using the function keys.

(2) CHANNEL screen settings



```
*** CHANNEL  ***   MEMORY                     (page1) '97- 4- 1
                                                      15:33:38
              range zoom (/div)   position filter
                ( lower ~ upper )    unit&sensor
1 : ANA      20mV×½  (    40mV)    5.00DIV  -
         (        -200mV~       +200mV)
2 :          20mV×½  (    40mV)    5.00DIV  -
         (        -200mV~       +200mV)
3 : ANA       5mV×½  (    10mV)    5.00DIV  -
         (         -50mV~        +50mV)
4 :

5 : ANA       5mV×½  (    10mV)    5.00DIV  -
         (         -50mV~        +50mV)  DC/RMS
6 :

7 : ANA      10℃ ×½  (    20℃)    5.00DIV  -
         (        -100℃~       +100℃)   TMP-K
8 :

  graph1:█     graph2:█     graph3:█     graph4:█
  x1: CH1      x2: CH1      x3: CH1      x4: CH1
  y1: CH3      y2: CH3      y3: CH3      y4: CH3
```

1. Press the CHAN key to call up the CHANNEL screen.

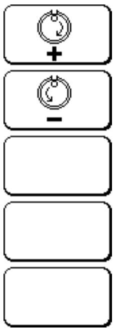
   If **X-Y single** or **X-Y dual** was selected with the STATUS screen, the graph items are shown, as follows.

   Graph 1: x1 and y1 combined plot
   Graph 2: x2 and y2 combined plot
   Graph 3: x3 and y3 combined plot
   Graph 4: x4 and y4 combined plot

2. Move the flashing cursor to the point shown in the illustration and use the function keys to specify display OFF and waveform color.

   OFF, color 1 - color 16

3. Set the X-axis channel.

Function key display	Meaning
	CH1 to CH16

4. Set the Y-axis channel in the same way as the X-axis channel.
5. Make the same setting for graphs 2 - 4.

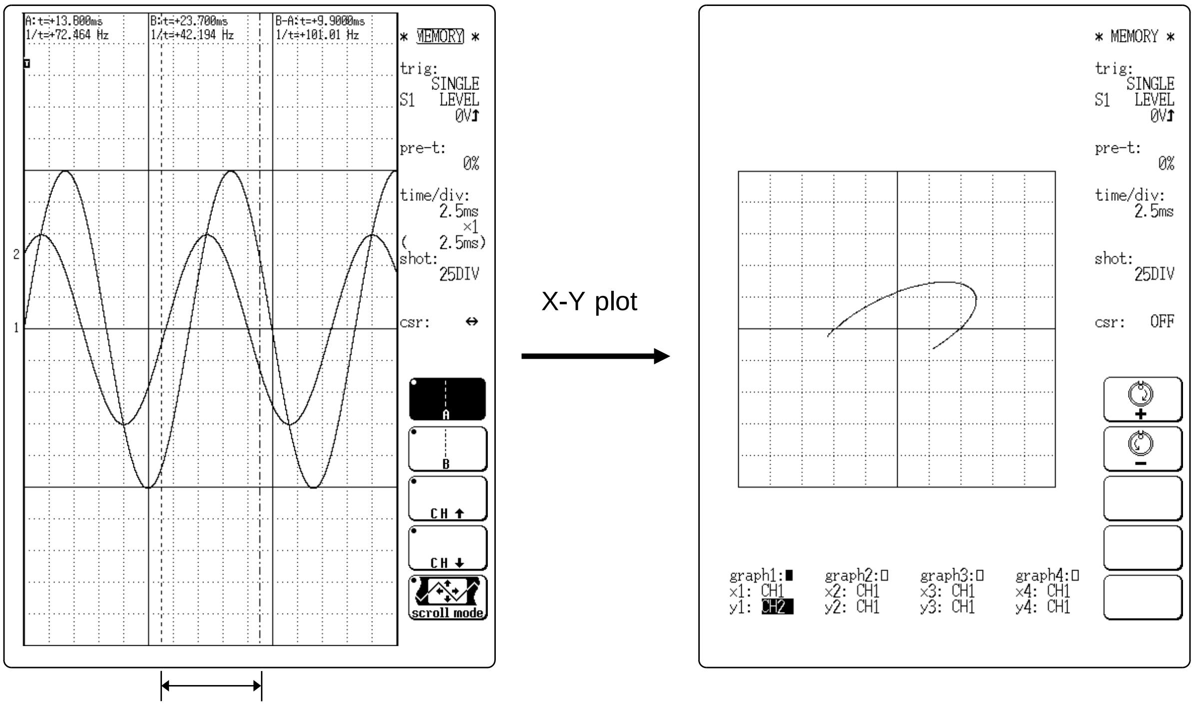
Reference The graph setting can also be carried out with the CH. SET key while the screen is in measurement display mode (☞ Section 20.3).

Partial X-Y plot

Using the A/B cursors, it is possible to specify a range for partial X-Y plotting. (Normal X-Y plotting covers all data of the recording length.)

Method

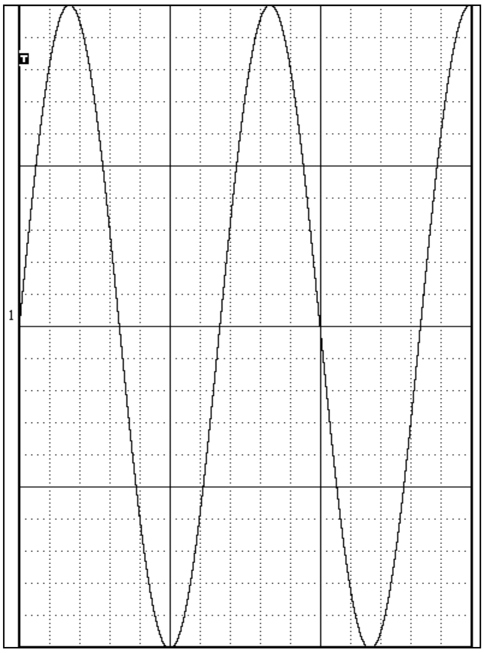
1. Display the captured waveform data, using a format other than X-Y single or X-Y dual.
2. Use the A/B cursors to specify the desired portion for plotting (☞ Section 19.2).
3. Press the STATUS key to call up the STATUS screen.
4. Carry out combined plotting as described above.



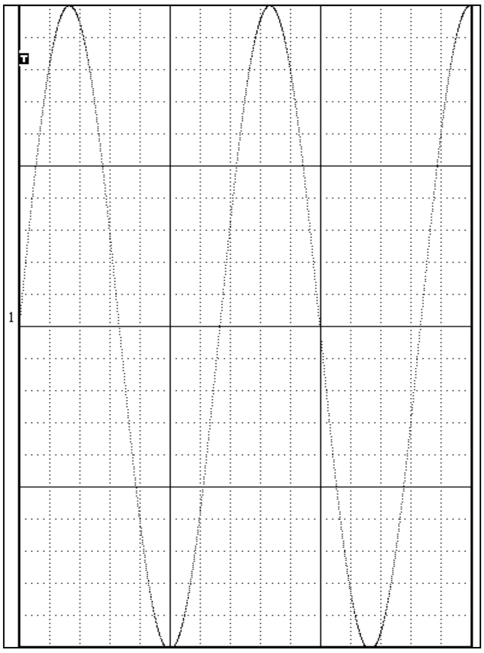
Specified portion for X-Y plotting

6.2.6 Setting the Interpolation Function

This setting determines whether the input waveform (sampling data) is to be displayed and printed as a series of dots or a line using linear interpolation.

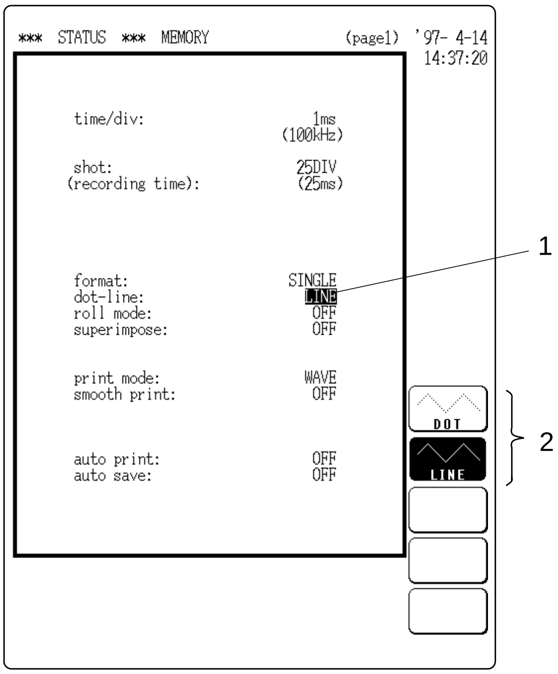


Line Display (with interpolation)



Dot Display

Method Screen: STATUS (page 1)



```
*** STATUS *** MEMORY                  (page1) '97- 4-14
                                                14:37:20

  time/div:                          1ms
                                  (100kHz)

  shot:                            25DIV
 (recording time):                 (25ms)

  format:                         SINGLE
  dot-line:                         LINE
  roll mode:                         OFF
  superimpose:                       OFF

  print mode:                       WAVE
  smooth print:                      OFF

  auto print:                        OFF
  auto save:                         OFF
```

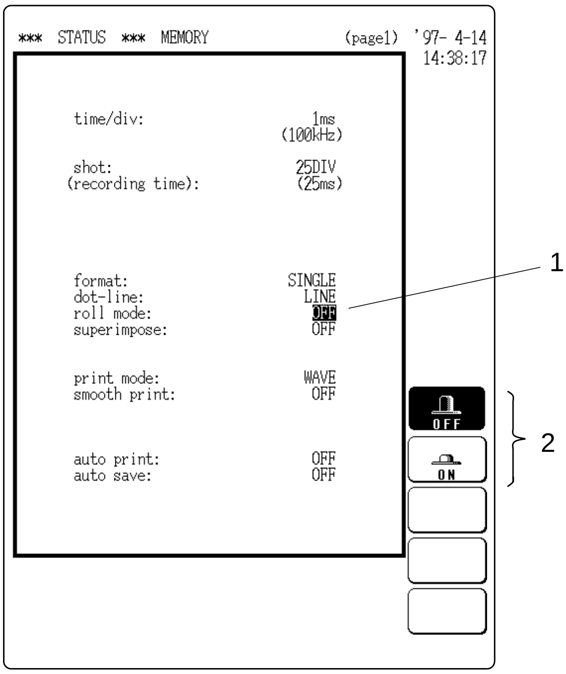
1. Move the flashing cursor to the **dot-line** item.
2. Use the function keys to make the selection.

Function key display	Meaning
DOT	: Linear interpolation is not performed. The sampled data is displayed just as it comes.
LINE	: Linear interpolation is performed. The display is easier on the eye. High speed display is available when compression is being performed.

6.2.7 Setting the Roll Mode

- This mode can be used at a time axis range setting of 20 ms/DIV or slower.
- In normal recording, the waveform is displayed only after all data of the recording length have been captured. At low sampling speed settings, this will cause a considerable delay between the start of measurement and the appearance of the waveform on the display.
- When local mode is set to ON, the waveform is displayed immediately at the start of recording (the screen scrolls).

Method Screen: STATUS (page 1)



```
*** STATUS *** MEMORY                (page1) '97- 4-14
                                              14:38:17

  time/div:                      1ms
                               (100kHz)

  shot:                         25DIV
 (recording time):              (25ms)


  format:                       SINGLE
  dot-line:                       LINE
  roll mode:                       OFF
  superimpose:                     OFF

  print mode:                     WAVE
  smooth print:                    OFF

  auto print:                      OFF
  auto save:                       OFF
```

1. Move the flashing cursor to the **roll mode** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: Roll mode off
ON	: Roll mode on

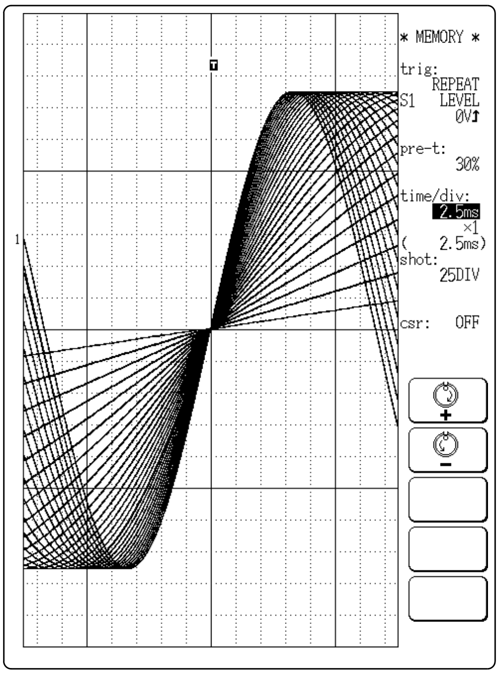
NOTE

- When the roll mode function is ON, the superimposition function and averaging function can not be used.
- Local mode is not available when an external sampling signal is used.
- When the roll mode function is on and then the numerical output is carried out with normal print (auto), the maximum output interval for the time axis magnification is as shown in the left table. It is not possible to print more than these output intervals.

Time axis magnification	Logging interval
×10	100
×5	100
×2	100
×1	100
×1/2	50
×1/5	100
×1/10	50
×1/20	5
×1/50	5
×1/100	5
×1/200	1
×1/500	5
×1/1000	1

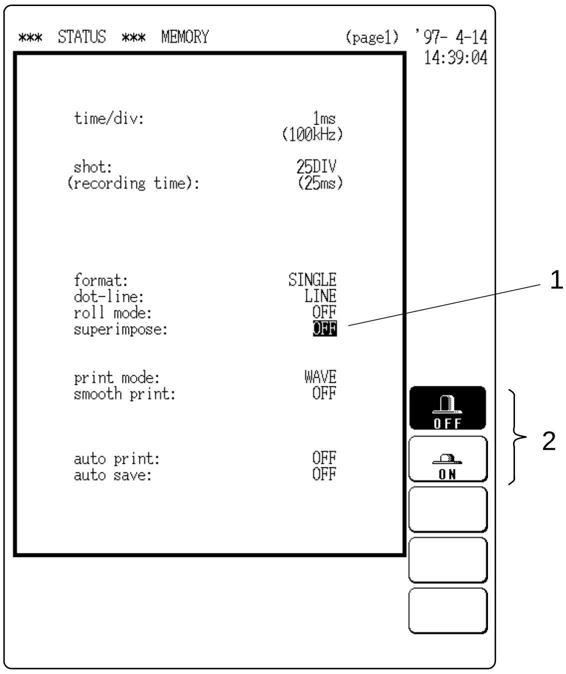
6.2.8 Superimpose

- Overlay is performed without clearing the currently displayed waveform (if trigger mode is **REPEAT**, **AUTO**, or **AUTO STOP**).
- This allows comparison to the immediately preceding waveform.



* MEMORY *
trig: REPEAT
S1 LEVEL 0V↑
pre-t: 30%
time/div: 2.5ms
×1
(2.5ms)
shot: 25DIV
csr: OFF

Method Screen: STATUS (page 1)



*** STATUS *** MEMORY (page1) '97- 4-14 14:39:04

time/div: 1ms (100kHz)
shot: (recording time): 25DIV (25ms)
format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF
print mode: WAVE
smooth print: OFF
auto print: OFF
auto save: OFF

1. Move the flashing cursor to the **superimpose** item.
2. Use the function keys to make the selection.

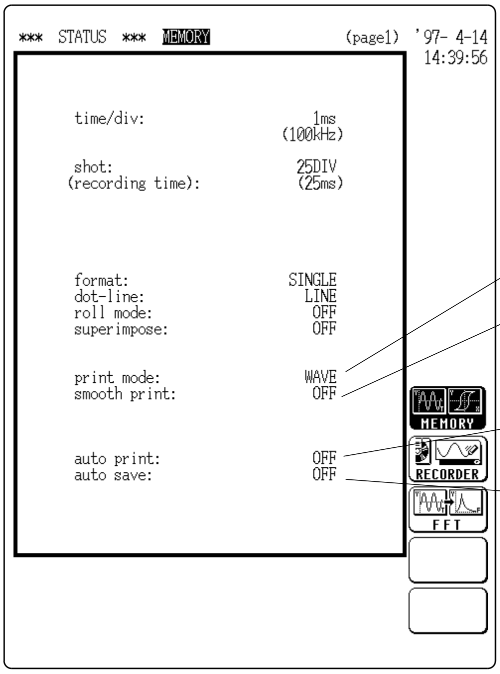
Function key display	Meaning
OFF	: Not perform superimpose
ON	: Perform superimpose

NOTE

- If trigger mode is **SINGLE**, measurement terminates after one set of data has been collected. Therefore the overlay setting is invalid.
- While the overlay function is being used, waveform scrolling and waveform evaluation cannot be carried out.
- When normal printing (☞ Section 19.2.1) is carried out, only the last waveform will be printed.
- If one of the following settings is changed, the overlay waveform display terminates and only the last waveform is shown:
  ① Screen zoom ratio (along time axis or voltage axis)
  ② Display format
  ③ Waveform interpolation
  ④ Waveform display or store channel
  ⑤ X axis or Y axis during X-Y display
- When the START key is pressed again during recording, all overlaid waveforms are erased (including the last waveform).

6.2.9 Other Settings (STATUS Screen)

For details, refer to the following sections.



*** STATUS *** MEMORY (page1) '97- 4-14
14:39:56

time/div: 1ms (100kHz)
shot: 25DIV
(recording time): (25ms)

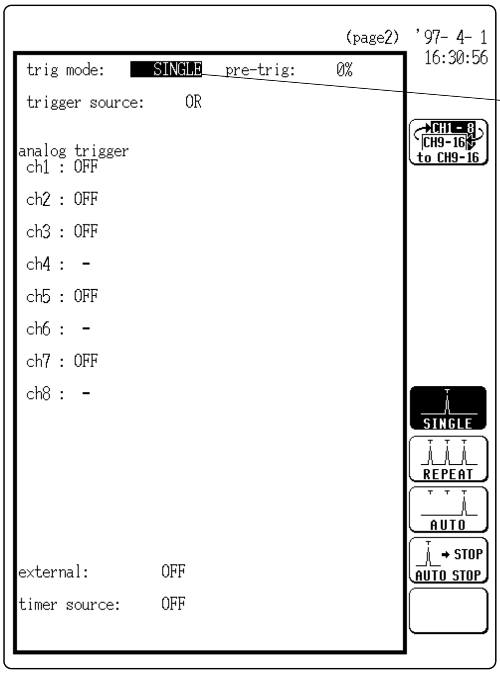
format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

☞ Section 12.2
☞ Section 12.3
☞ Section 12.5.2
☞ Section 13.5.1 (2)

Status Screen (page 1)



(page2) '97- 4- 1
16:30:56

trig mode: SINGLE pre-trig: 0%

trigger source: OR

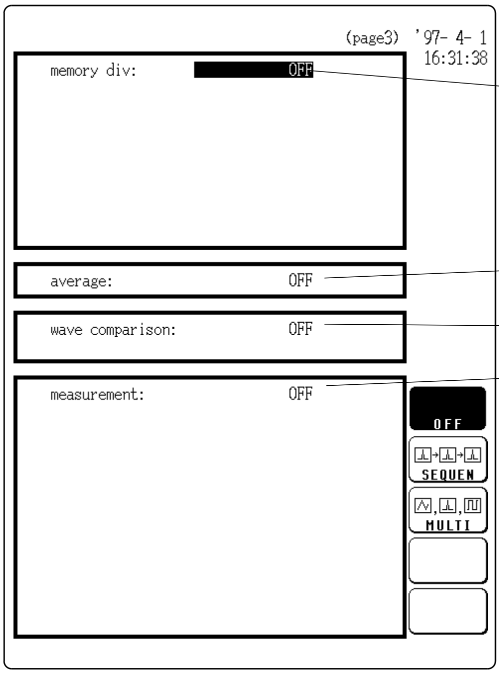
analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 : -
ch5 : OFF
ch6 : -
ch7 : OFF
ch8 : -

external: OFF

timer source: OFF

☞ Chapter 10

Status Screen (page 2)



(page3) '97- 4- 1
16:31:38

memory div: OFF

average: OFF

wave comparison: OFF

measurement: OFF

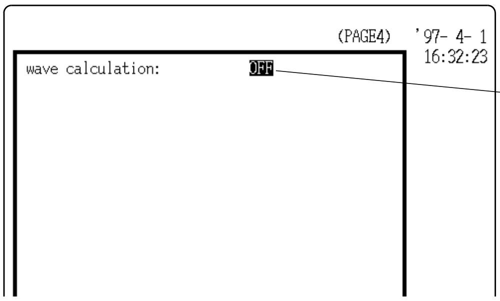
☞ Chapter 17

☞ Chapter 18

☞ Chapter 16

☞ Chapter 15

Status Screen (page 3)



(PAGE4) '97- 4- 1
16:32:23

wave calculation: OFF

☞ Chapter 14

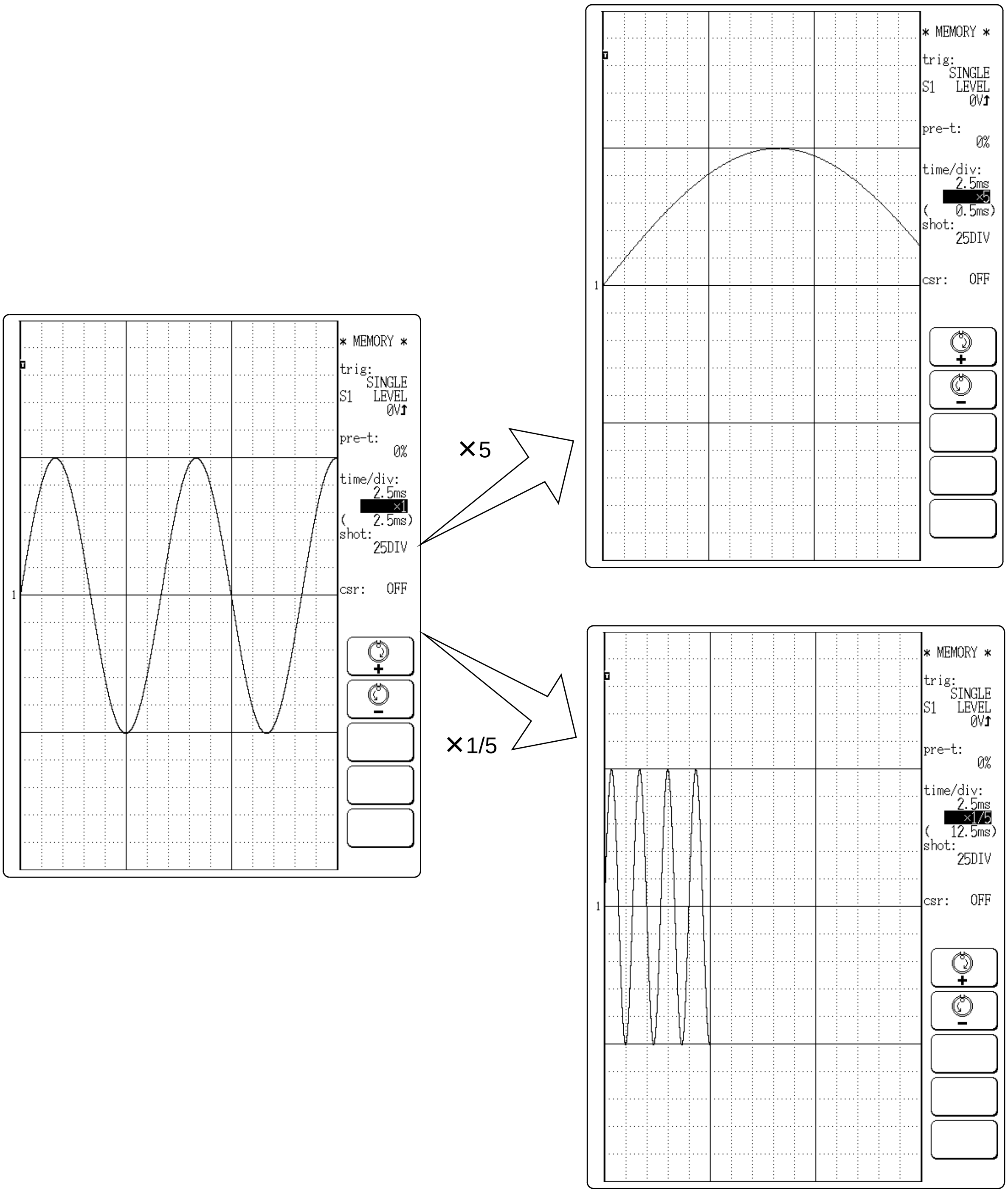
Status Screen (page 4)

6.3 Settings on the Display Screen and Auto Settings

Explains the setting items on the Display screen and the auto-setting of the voltage axis and time axis.

6.3.1 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.

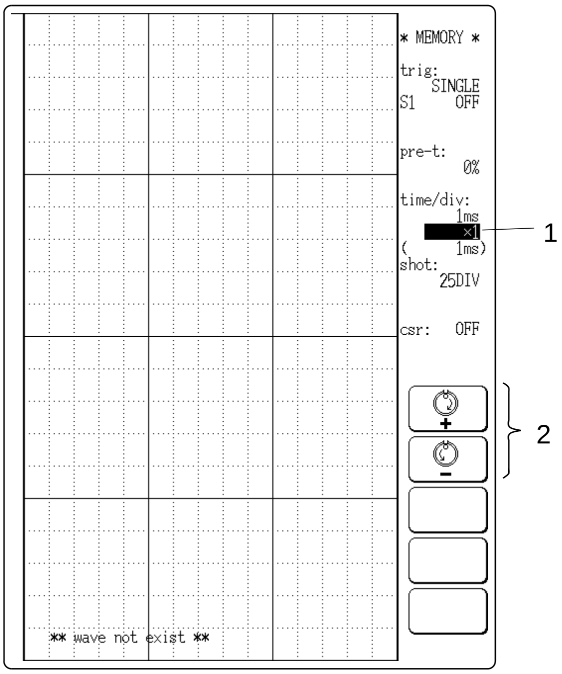


* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF

* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×5 (0.5ms)
shot: 25DIV
csr: OFF

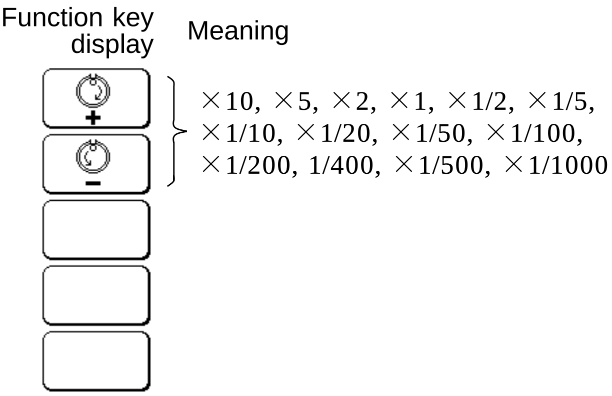
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1/5 (12.5ms)
shot: 25DIV
csr: OFF

Method Screen: DISPLAY



* MEMORY *
trig: SINGLE
S1 OFF
pre-t: 0%
time/div: 1ms
×1
(1ms)
shot: 25DIV
csr: OFF
** wave not exist **

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 select the magnification/compression ratio.



×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, 1/400, ×1/500, ×1/1000

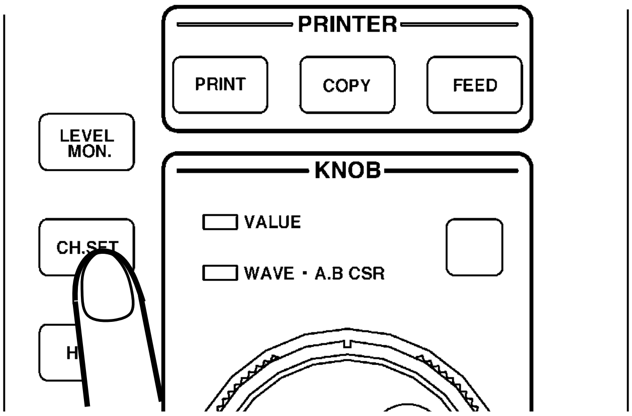
NOTE

- The magnification/compression factor can be changed also after measurement is completed.
- To display the long recording length with compressed when the interpolation function is set to dot, it takes about maximum 80 seconds.

Reference The HELP key can be used to check which position within the entire recording length is occupied by the currently shown waveform (☞ Section 20.4).

6.3.2 Making Channel Settings

While the screen is in measurement display mode, the CH. SET key can be used to make settings for the various channels (☞ Section 20.3).



CH. SET key:

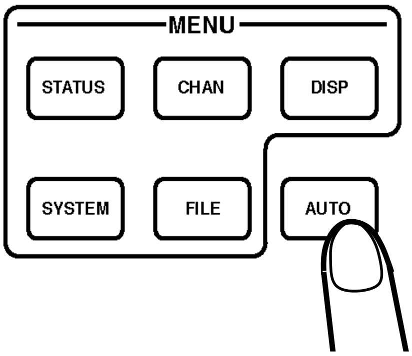
Serves to make channel settings in measurement display mode.

6.3.3 Automatic Setting of Time Axis and Voltage Axis

(Auto Range Function)

This function automatically selects the time axis range (TIME/DIV), voltage axis range (V/DIV) and zero position.

Method 1. Press the AUTO key.



2. Use the function keys to make the selection.

Function key display	Meaning
Auto Range	: Auto range (only display)
(exec)	: Enable auto range function
cancel	: Disable auto range function

3. Press F2 [exec]. The automatic range setting is made and measurement starts.

When the auto range function is used to start the measurement, the following items are changed.

(1) Channel settings

• Range and position	Automatically set
• Low-pass filter	OFF (all channels)
• Input coupling	DC

(2) Trigger parameters

• Trigger source AND/OR	OR
• Internal trigger	Only channel with lowest number of all active display channels is set to ON, other channels are OFF (if difference between maximum and minimum value is large).
• Trigger type	Level trigger: trigger level automatically set (only 1 channel)
• Trigger mode	Auto
• Trigger filter	OFF
• Pretrigger	20%
• External trigger, timer trigger	OFF

(3) STATUS settings

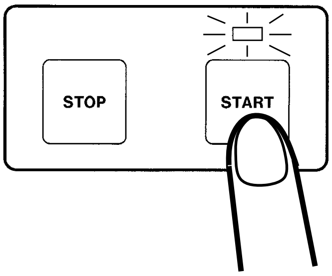
• Time axis range (TIME/DIV)	Automatically set
• Time axis magnification/compression, voltage axis magnification	×1
• Memory segmentation	OFF

NOTE

- The time axis range is set using the channel with lowest number of all active display channels. (The setting is made so that out of 25 DIV units, a cycle of 1 - 2.5 is recorded.)
- If the channel for which the time axis range has been set is at the maximum sensitivity range (8916, 8917, 8919: 5 mV/DIV, 8918: 10℃/DIV, 8927: 20 mV/DIV, 8928: 20 $\mu\varepsilon$) and the difference between the maximum and minimum input signal level is 1 DIV or less, the next higher channel is used for time axis range setting.
- If range setting cannot be performed for all active channels, the measurement is terminated with a warning message.
- When the WAVE•A.B CSR LED is lit on the DISPLAY screen, the AUTO key is invalid.

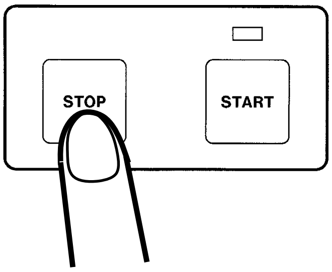
6.4 Start and Stop Measurement Operation

Method



To start the measurement:

Press the START key and the LED lights



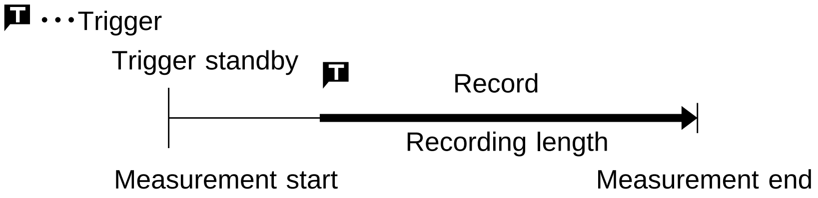
To stop the measurement:

Press the STOP key.

Trigger mode and measurement operation

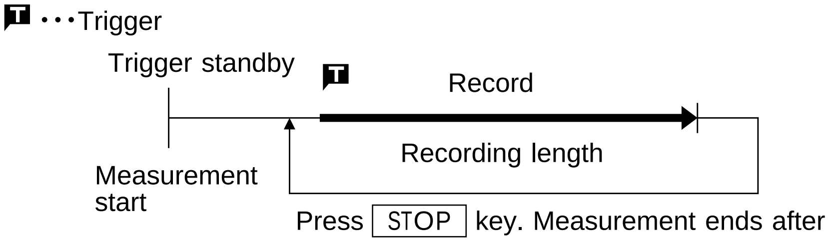
(1) When trigger mode is **SINGLE**

- After START key has been pressed, data recording starts when trigger conditions are met.
- When data corresponding to recording length have been stored in memory, measurement stops also without pressing the STOP key.



(2) When trigger mode is **REPEAT**

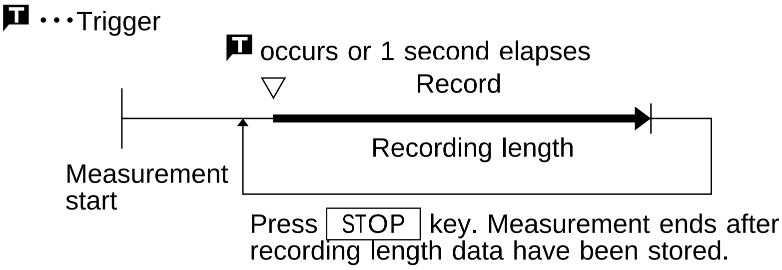
- After START key has been pressed, data recording starts when trigger conditions are met.
- Each time when trigger conditions are met, data are recorded and memory contents are overwritten.
- When STOP key is pressed, measurement stops after data corresponding to recording length have been stored in memory.



Press STOP key. Measurement ends after recording length data have been stored.

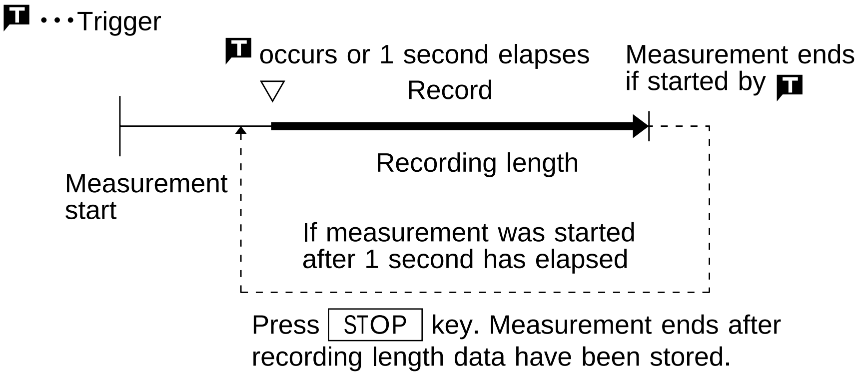
(3) When trigger mode is **AUTO**

- When START key is pressed, unit waits for about 1 second for trigger conditions to be met. After this interval, data recording starts, regardless of trigger state.
- Data are recorded repeatedly and memory contents are overwritten.
- When STOP key is pressed, measurement stops after data corresponding to recording length have been stored in memory.

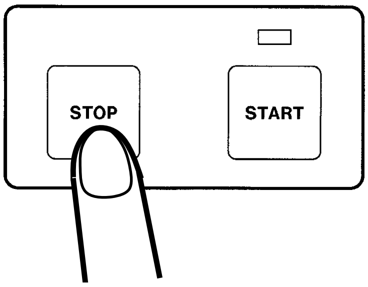


(4) When trigger mode is **AUTO STOP**

- When START key was pressed and trigger conditions are met, data recording starts and continues until data corresponding to recording length have been stored in memory.
- Unit waits for about 1 second. If trigger conditions are not met, data recording starts and continues until data corresponding to recording length have been stored in memory. This process is repeated until trigger conditions are met.
- When STOP key is pressed in trigger standby condition, measurement stops after data corresponding to recording length have been stored in memory.



Stopping measurement



① Press STOP key once to terminate measurement after recording length data are stored.

② Press STOP key twice to terminate measurement immediately.

① Pressing STOP key once

- When STOP key is pressed once, data recording continues until data corresponding to recording length have been stored in memory. (LED above START key is lit.)
- If START key is pressed after STOP key was pressed once and before waveform data recording is completed, the measurement is restarted.

② Pressing STOP key twice

- When STOP key is pressed twice, waveform recording is stopped immediately.
- If trigger mode is **SINGLE**, or if recording length is maximum length, the waveform is not displayed.
- If trigger mode is **REPEAT**, **AUTO**, or **AUTO STOP** and if recording length is below maximum length, the previously stored waveform is displayed.
- If time axis range is 20 ms/DIV or slower, the waveform up to the current point is displayed.

Chapter 7
Recorder Function

7.1 Outline

(1) Real-time recording of input signal data on MO or printer paper

(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

Up to 21 steps: 1.25 ms//DIV - 1 h/DIV.

(4) Time axis resolution 100 points/DIV

(5) Waveform magnification/compression display and printout

- Time axis direction: ×10 to ×1/1000
- Voltage axis direction: variable display range up to 10 µV/DIV - 100 V/DIV, 10 µV steps

(6) Voltage axis resolution

320 dots/DIV (8927), 80 dots/DIV (8916 - 8919, 8928) (magnification factor ×1)

(7) Display format

Time axis waveform: single, dual, quad, octo screen display

(8) High-quality print

Smooth print function approximates analog waveform.

(9) Logging function

Numeric printout of waveform data

(10) Waveform parameter processing (frequency measurement, rms measurement etc.)

(11) Voice memo function using a microphone (using a MO disk)

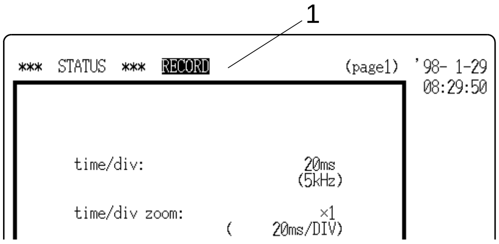
(12) Recorded waveform data can be transferred to memory recorder function

7.2 Making Settings

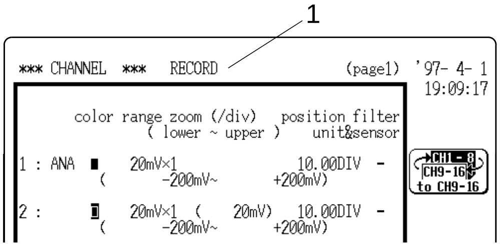
7.2.1 Setting the Function Mode

- The 8846 has three function modes: the memory recorder function mode, the recorder function mode, and the FFT function mode
- Select the recorder function.

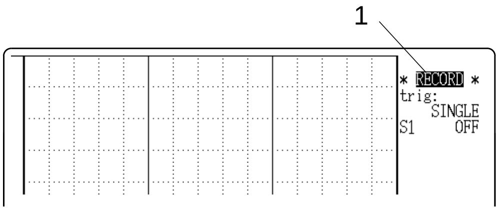
Method Screen: STATUS (page 1), CHANNEL(page1), DISPLAY



```
*** STATUS *** RECORD                   (page1) '98- 1-29
                                                08:29:50

     time/div:                     20ms
                                  (5kHz)

     time/div zoom:                 ×1
                             (    20ms/DIV)
```



```
*** CHANNEL  ***   RECORD               (page1) '97- 4- 1
                                                19:09:17
     color range zoom (/div)   position filter
              ( lower ~ upper )     unit&sensor
1 : ANA ■    20mV×1               10.00DIV  -
       (          -200mV~      +200mV)
2 :     ▮    20mV×1  (    20mV)   10.00DIV  -
       (          -200mV~      +200mV)
```



```
* RECORD *
trig:
     SINGLE
S1     OFF
```

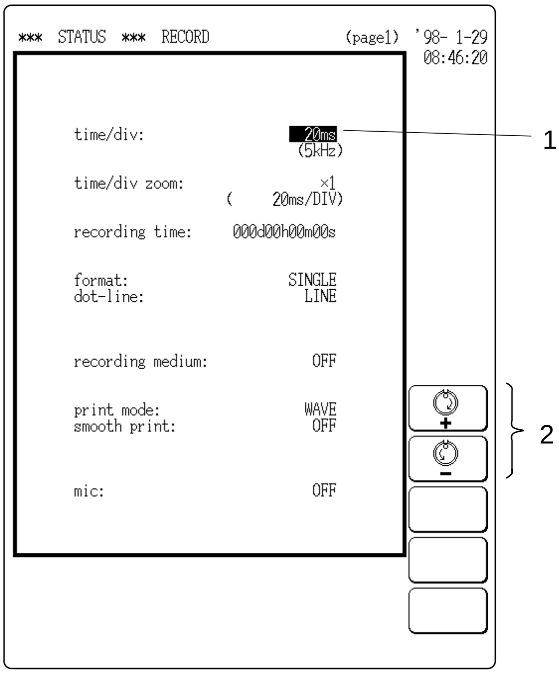
1. Move the flashing cursor to the position shown in the figure on the left.
2. Press F2 [RECORDER].

Function key display	Meaning
MEMORY	: Memory recorder function
RECORDER	: Recorder function
FFT	: FFT function

7.2.2 Setting the Time Axis Range

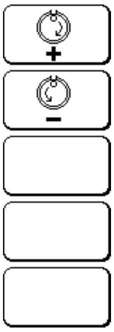
- Set the speed for inputting and storing the waveform of the input signal.
- Time axis range setting expresses the time for 1 DIV.
- The sampling period is 1/100th of the set value for the time axis range.

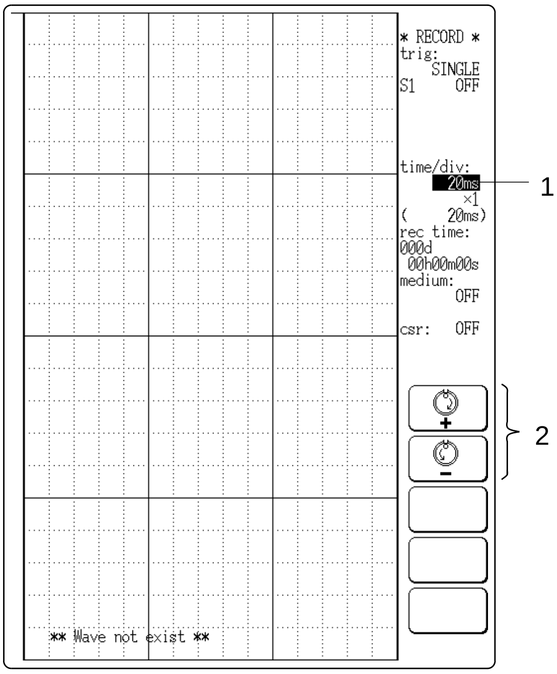
Method Screen: STATUS (page 1), DISPLAY



```
***  STATUS  ***  RECORD              (page1)  '98- 1-29
                                                08:46:20

  time/div:                        20ms
                                  (5kHz)

  time/div zoom:                     ×1
                         (      20ms/DIV)

  recording time:        000d00h00m00s

  format:                        SINGLE
  dot-line:                        LINE

  recording medium:                 OFF

  print mode:                      WAVE
  smooth print:                     OFF

  mic:                              OFF
```

1. Move the flashing cursor to the **time/div** item.
2. Use the JOG control or the function keys to make the selection.

Function key display	Meaning
	1.25, 2, 2.5, 5, 10, 20, 50, 100, 200, 500 ms, 1, 2, 5, 10, 20 s, 1, 2,5, 10, 20 min, 1 h EXT (external)



```
* RECORD *
trig:
     SINGLE
S1      OFF

time/div:
       20ms
         ×1
(      20ms)
rec time:
000d
 00h00m00s
medium:
        OFF

csr:    OFF

** Wave not exist **
```

NOTE

- Time axis range settings depend on the number and type of installed units.

Time Axis Range and Number of Units

Number of units	1		2		4		8	
	1ch	2ch*	1ch	2ch	1ch	2ch	1ch	2ch
Upper time axis range limit ms/DIV	1.25	2.5		5		10		20

1ch: (1 channel) Only 8916 - 8919, 8928 can be used.

2ch: (2 channels) 8916 - 8919, 8927, 8928 can coexist, or 8927 can be used exclusively.

(For the 8928, one channel corresponds to one unit.)

* When using only one 8927 unit, range selection up to 1.25 mV/DIV is possible, but only 1 channel can be used.

- When using external sampling for the recorder, data dropouts may occur at sampling frequencies above 80 kHz.
- When time axis range is changed during measurement, measurement starts again with the new setting.

- The magnification ratio of the screen display using external sampling depend on the number of installed units.

Magnification Ratio and Number of Units (at external sampling)

Number of units	1		2		4		8	
	1ch	2ch	1ch	2ch	1ch	2ch	1ch	2ch
Magnification ratio (maximum value)	1/800	1/400		1/200		1/100		1/50

1ch: Only 8916 - 8919, 8928 can be used.

2ch: 8916 - 8919, 8927, 8928 can coexist, or 8927 can be used exclusively.

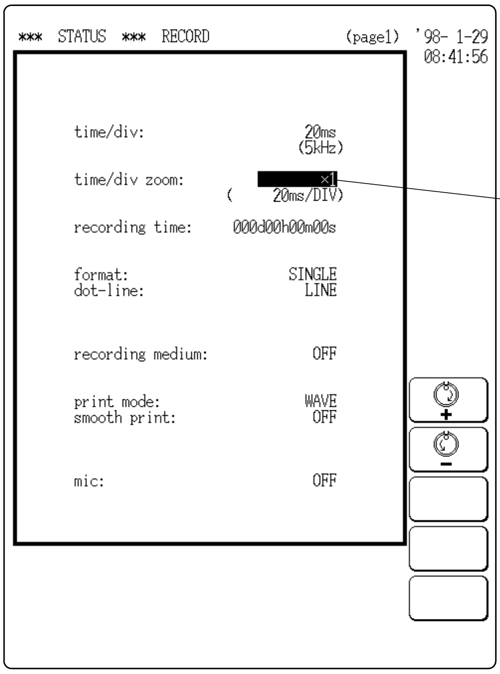
(For the 8928, one channel corresponds to one unit.)

- When carrying out measurement with a fast time axis range, use an MO disk which has been newly formatted by the 8846. For details, see Section 13.10.4. (If the MO disk has had frequent file additions and deletions made, the resulting fragmentation may cause recording to be lost, and the measurement to stop.)

7.2.3 Setting the Magnification Along the Time Axis

- The magnification ratio along the time axis can be set and changed.
- By magnifying the waveform, detailed observations can be made. By compressing the waveform, an entire change can be promptly apprehended.

Method Screen: STATUS (page 1), DISPLAY


*** STATUS *** RECORD (page1) '98- 1-29 08:41:56

time/div: 20ms (5kHz)

time/div zoom: ×1 (20ms/DIV)

recording time: 000d00h00m00s

format: SINGLE

dot-line: LINE

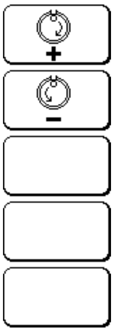
recording medium: OFF

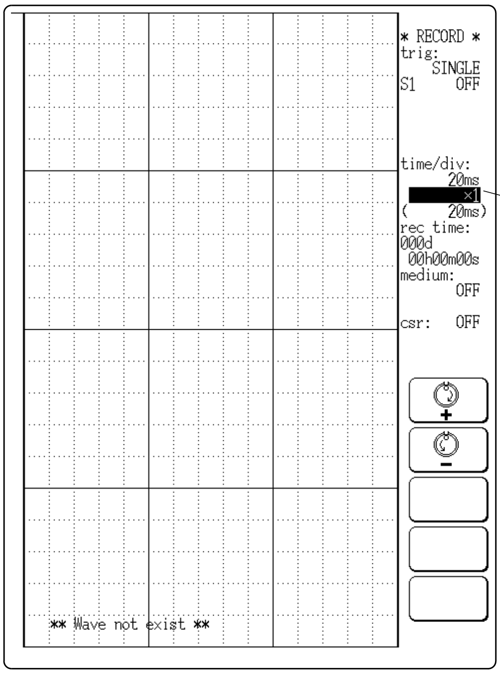
print mode: WAVE

smooth print: OFF

mic: OFF

1. Move the flashing cursor to the **time/div zoom** item.
2. Use the JOG control or the function keys to set the the magnification ratio.

Function key display	Meaning
	×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10, ×1/20, ×1/50, ×1/100, ×1/200, 1/400, ×1/500, ×1/1000, ×1/20000, ×1/50000, ×1/100000


* RECORD *

trig: SINGLE

S1 OFF

time/div: 20ms ×1 (20ms)

rec time: 000d 00h00m00s

medium: OFF

csr: OFF

** Wave not exist **

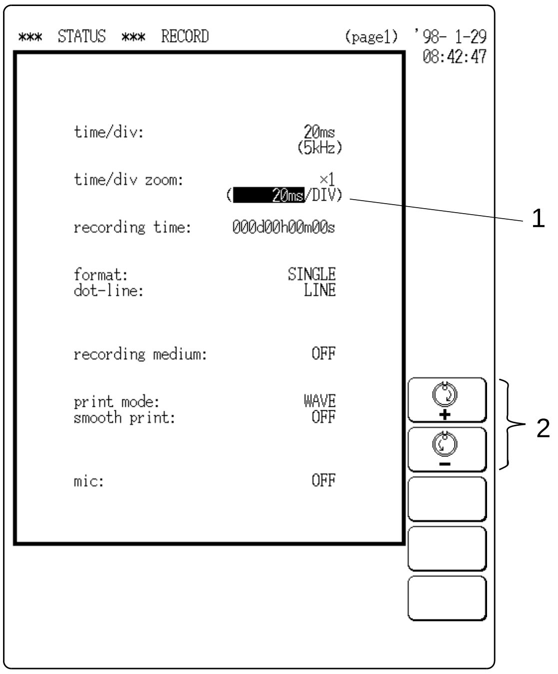
NOTE

- Compression of a waveform takes longer than magnification. The higher the compression factor, the more time will be required until the display appears.
- The magnification ratio during measurement depend on the time axis (☞ Section 12.5.3)

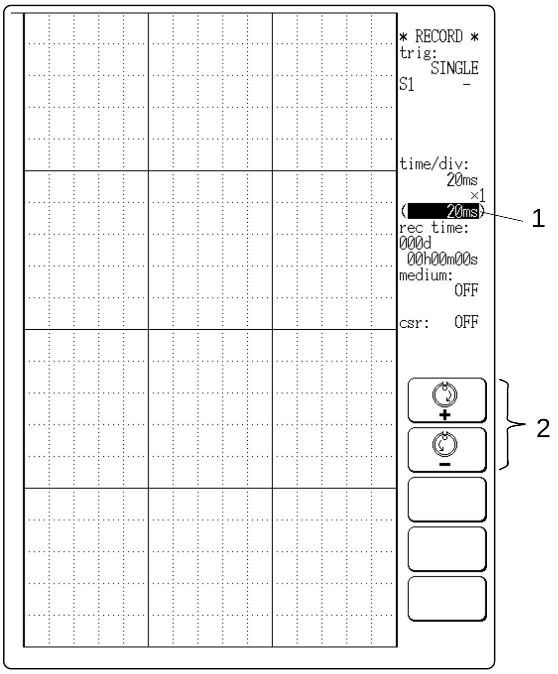
For higher-resolution time axis compression

By choosing a different ratio setting, you can increase the detail resolution of time axis compression.

Method Screen: STATUS (page 1), DISPLAY

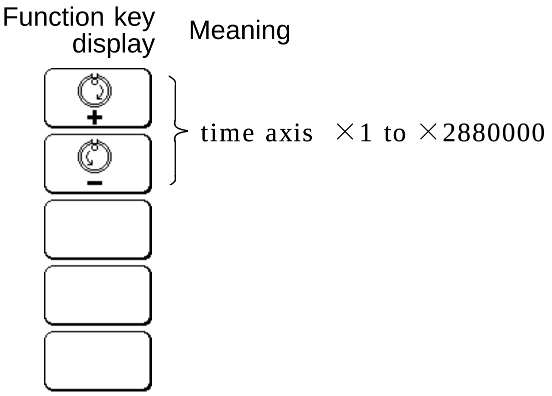


```
*** STATUS *** RECORD                (page1)  '98- 1-29
                                               08:42:47

time/div:                     20ms
                             (5kHz)
time/div zoom:                  ×1
                      (   20ms/DIV)
recording time:    000d00h00m00s

format:                     SINGLE
dot-line:                     LINE

recording medium:              OFF

print mode:                   WAVE
smooth print:                  OFF

mic:                           OFF
```



```
* RECORD *
trig:
    SINGLE
S1      -

time/div:
      20ms
        ×1
(     20ms)
rec time:
000d
 00h00m00s
medium:
       OFF

csr:   OFF
```

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 change the time for one division.



time axis ×1 to ×2880000

NOTE The setting values are shown in the table below.

Time axis (TIME/DIV) and compression ratio (reciprocal for magnification ratio)

time axis (TIME/DIV)	time axis display																				
	1.25 ms	2 ms	2.5 ms	5 ms	10 ms	20 ms	50 ms	100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	1 min	2 min	5 min	10 min	20 min	1 h
1.25 ms	1	–	2	4	8	16	40	80	160	400	800	1.6k	4k	8k	16k	48k	96k	240k	480k	960k	2880k
2 ms	–	1	–	–	5	10	25	50	100	250	500	1k	2.5k	5k	10k	30k	60k	150k	300k	600k	1800k
2.5 ms	–	–	1	2	4	8	20	40	80	200	400	800	2k	4k	8k	24k	48k	120k	240k	480k	1440k
5 ms	–	–	–	1	2	4	10	20	40	100	200	400	1k	2k	4k	12k	24k	60k	120k	240k	720k
10 ms	–	–	–	–	1	2	5	10	20	50	100	200	500	1k	2k	6k	12k	30k	60k	120k	360k
20 ms	–	–	–	–	–	1	–	5	10	25	50	100	250	500	1k	3k	6k	15k	30k	60k	180k
50 ms	–	–	–	–	–	–	1	2	4	10	20	40	100	200	400	1.2k	2.4k	6k	12k	24k	72k
100 ms	–	–	–	–	–	–	–	1	2	5	10	20	50	100	200	600	1.2k	3k	6k	12k	36k
200 ms	–	–	–	–	–	–	–	–	1	–	5	10	25	50	100	300	600	1.5k	3k	6k	18k
500 ms	–	–	–	–	–	–	–	–	–	1	2	4	10	20	40	120	240	600	1.2k	2.4k	7.2k
1 s	–	–	–	–	–	–	–	–	–	–	1	2	5	10	20	60	120	300	600	1.2k	3.6k
2 s	–	–	–	–	–	–	–	–	–	–	–	1	–	5	10	30	60	150	300	600	1.8k
5 s	–	–	–	–	–	–	–	–	–	–	–	–	1	2	4	12	24	60	120	240	720
10 s	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	6	12	30	60	120	360
20 s	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	3	6	15	30	60	180
1 min	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	5	10	20	60
2 min	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	5	10	30
5 min	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	4	12
10 min	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	6
20 min	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	3
1 h	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1

– : cannot be set

Time axis settings depend on the number of installed units.

Time Axis Range and Number of Units

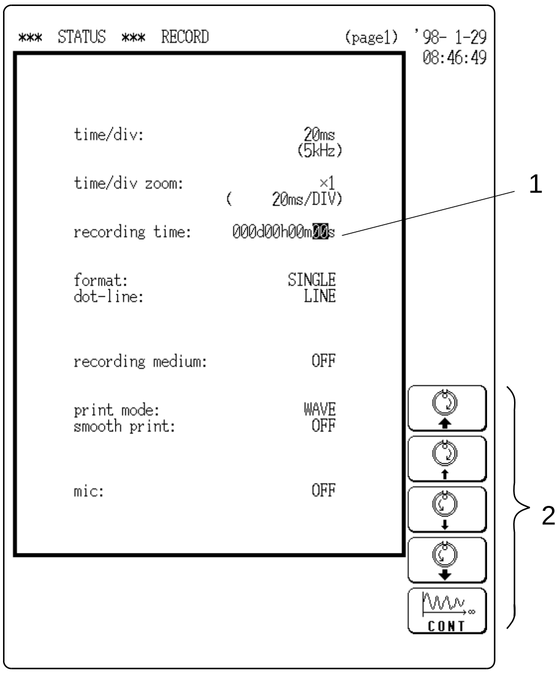
Number of units	1	2	4	8	16
Magnification ratio	to 960 k	to 480 k	to 280 k	to 120 k	to 60 k

Reference The HELP key can be used to check which position within the entire recording length is occupied by the currently shown waveform (☞ Section 20.4).

7.2.4 Setting the Recording Time

This setting determines for how long the input signal will be recorded.

Method Screen: STATUS (page 1), DISPLAY

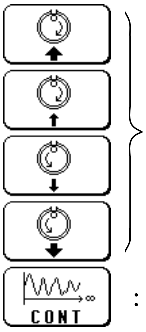


```
***  STATUS  ***  RECORD                (page1)  '98- 1-29
                                                  08:46:49
   time/div:                     20ms
                                (5kHz)
   time/div zoom:                  ×1
                          (    20ms/DIV)
   recording time:       000d00h00m00s

   format:                      SINGLE
   dot-line:                      LINE

   recording medium:               OFF

   print mode:                    WAVE
   smooth print:                   OFF

   mic:                            OFF
```

1. Move the flashing cursor to the **recording time** item.
2. Use the JOG control or the function keys to select the recording time.

・When time setting is enabled

Function key display Meaning

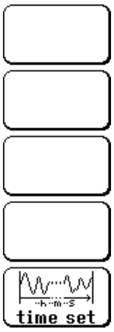


1 second - 366 days 23 h 59 min 59 s

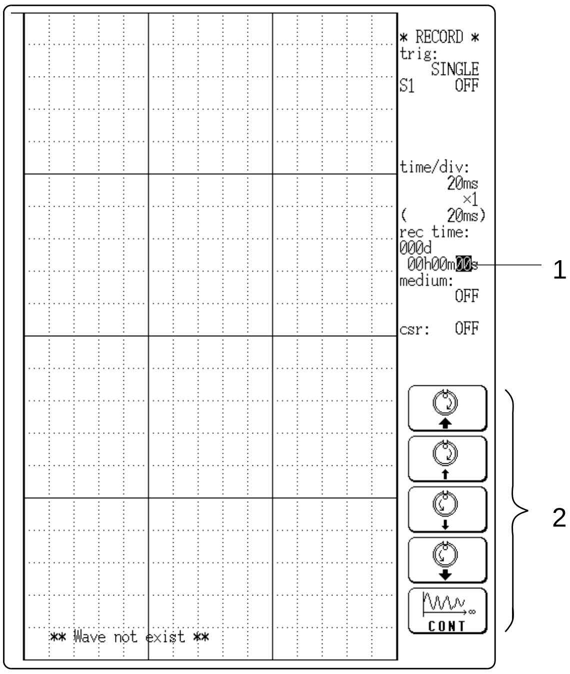
: Continuous recording (until STOP key is pressed or printer paper runs out)

• When continuous recording is enabled

Function key display Meaning



: Switch to time setting



```
* RECORD *
trig:
    SINGLE
S1     OFF

time/div:
      20ms
        ×1
(     20ms)
rec time:
000d
 00h00m00s
medium:
       OFF

csr:   OFF

** Wave not exist **
```

NOTE

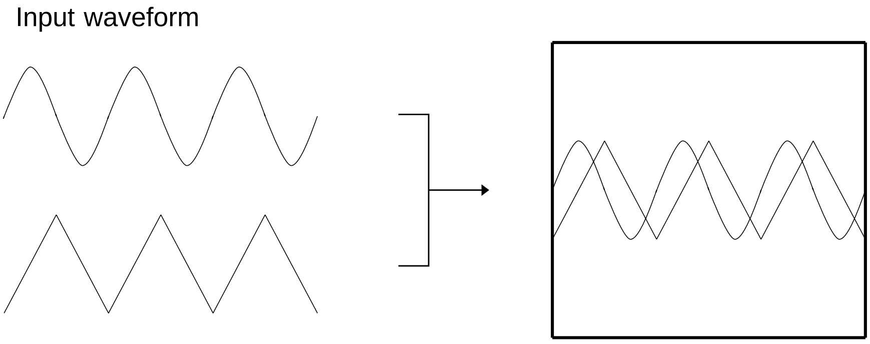
- When recording length is changed during measurement, measurement starts again with the new setting.
- Data immediately preceding the recording stop operation are stored in internal memory. For the length of the stored data, see NOTE in Section 7.2.6," Setting the Recording Medium".

7.2.5 Setting the Format

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

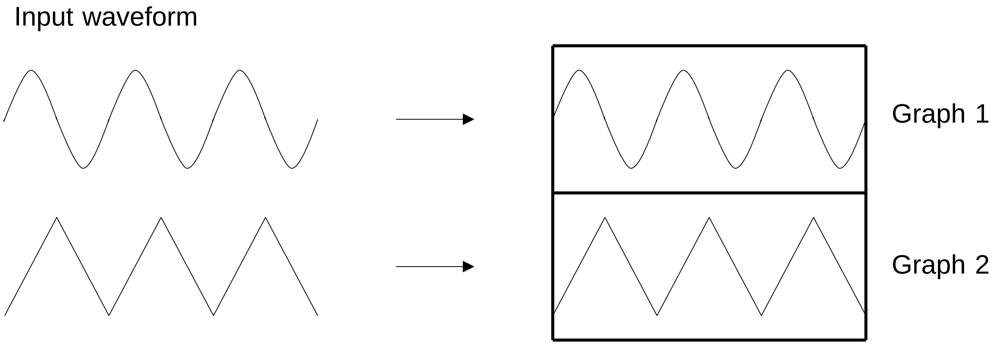
(1) Single

Display and record as one graph. (At the most, 16 analog signals and 14 analog + 16 logic signals)



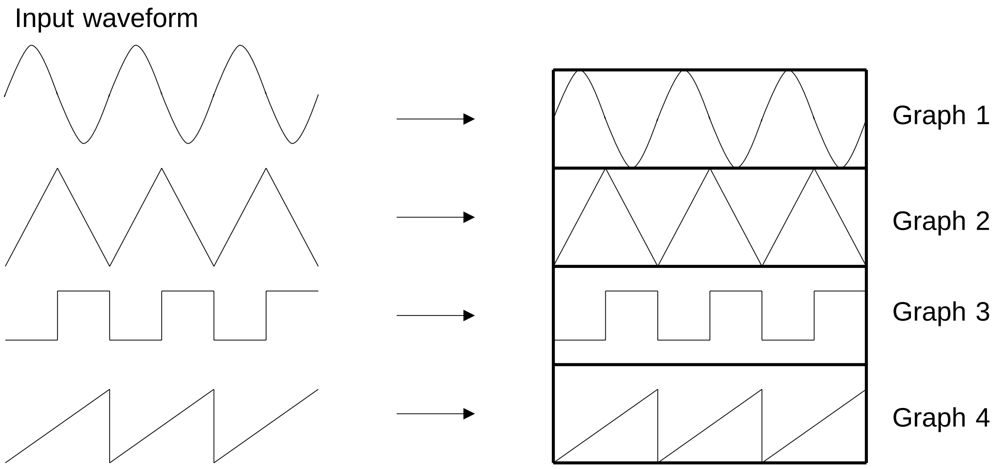
(2) Dual

- Display and record as two graphs. (On each graph, at most, 16 analog signals and 14 analog + 16 logic signals)
- Specify which input channel to use for waveform graph display and recording.



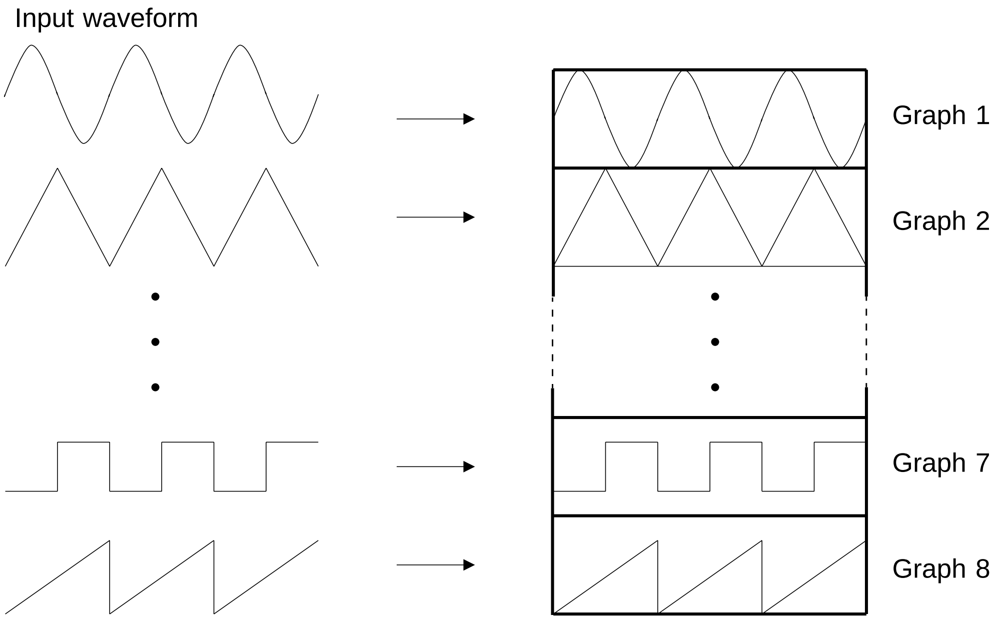
(3) Quad

- Display and record as four graphs. (On each graph, at most, 16 analog signals and 14 analog + 16 logic signals)
- Specify which input channel to use for waveform graph display and recording.

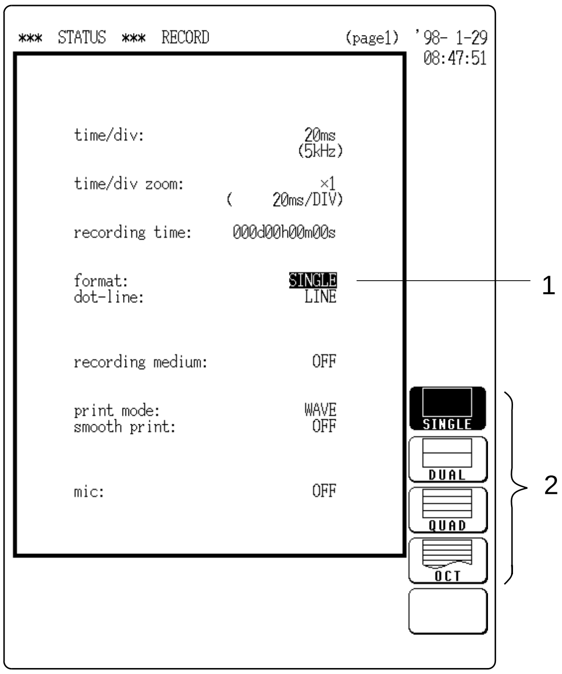


(4) Oct

- Display and record as eight graphs. (On each graph, at most, 16 analog signals and 14 analog + 16 logic signals)
- Specify which input channel to use for waveform graph display and recording.



Method Screen: STATUS (page 1)



```
*** STATUS ***  RECORD              (page1) '98- 1-29
                                             08:47:51

  time/div:                     20ms
                               (5kHz)
  time/div zoom:                 ×1
                          (   20ms/DIV)
  recording time:      000d00h00m00s

  format:                     SINGLE
  dot-line:                     LINE

  recording medium:              OFF

  print mode:                   WAVE
  smooth print:                  OFF

  mic:                           OFF
```

1. Move the flashing cursor to the **format** item.
2. Use the function keys to select the format.

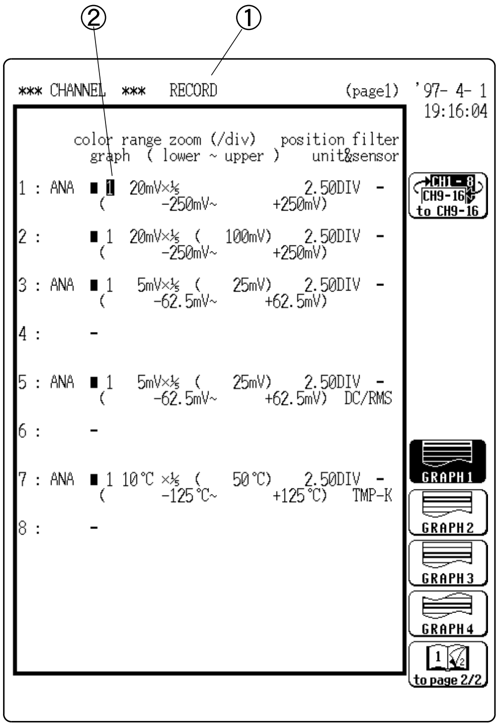
Function key display	Meaning
SINGLE	: Single (one division only)
DUAL	: Dual (divided into two)
QUAD	: Quad (divided into four)
OCT	: Oct (print only divided into eight)

3. If dual, quad, or octo screen display was chosen in step 2, determine which input channel to display on which graph. This setting is made with the CHANNEL screen.

① Press the CHAN key to call up the CHANNEL screen.

② Move the flashing cursor to the point shown in the illustration at left.

- The illustration shows the setting for CH1.
- Settings for CH2 - CH16 should be made in the same way.
- Use the function keys to select the graph.



```
*** CHANNEL  ***   RECORD              (page1) '97- 4- 1
                                                19:16:04
      color range zoom (/div)   position filter
        graph  ( lower ~ upper )   unit&sensor
1 : ANA  ■ 1  20mV×⅕                  2.50DIV  -
           (      -250mV~       +250mV)
2 :      ■ 1  20mV×⅕  (   100mV)     2.50DIV  -
           (      -250mV~       +250mV)
3 : ANA  ■ 1   5mV×⅕  (    25mV)     2.50DIV  -
           (     -62.5mV~      +62.5mV)
4 :      -

5 : ANA  ■ 1   5mV×⅕  (    25mV)     2.50DIV  -
           (     -62.5mV~      +62.5mV)  DC/RMS
6 :      -

7 : ANA  ■ 1 10℃ ×⅕  (    50℃)     2.50DIV  -
           (      -125℃~       +125℃)   TMP-K
8 :      -
```

- **1/2**

Function key display	Meaning
GRAPH1	: Graph 1
GRAPH2	: Graph 2
GRAPH3	: Graph 3 (*1)
GRAPH4	: Graph 4 (*1)
1 2 to page 2/2	: Switch to page 2/2

- **2/2**

Function key display	Meaning
GRAPH5	: Graph 5 (*2)
GRAPH6	: Graph 6 (*2)
GRAPH7	: Graph 7 (*2)
GRAPH8	: Graph 8 (*2)
1 2 to page 1/2	: Switch to page 1/2

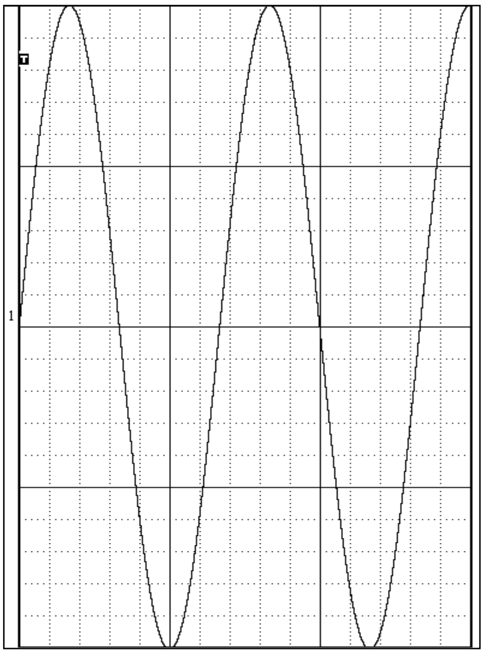
*1: displays when the quad or oct screen is selected

*2: displays when the oct screen is selected

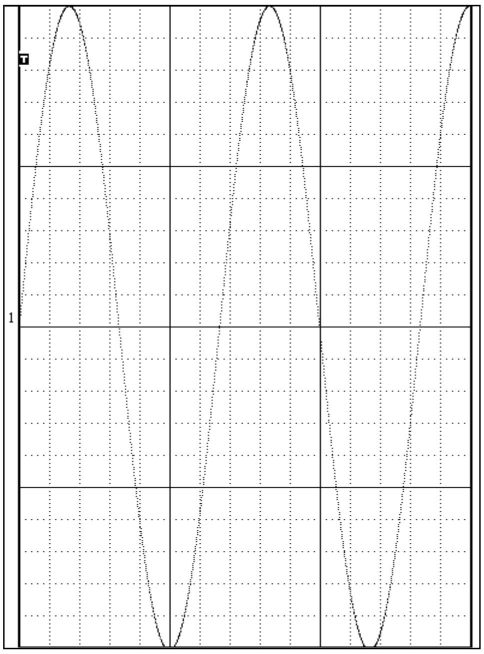
7.2.6 Setting the Interpolation Function

Set the input waveform (sampling data) to display or print as dot or linear interpolation.

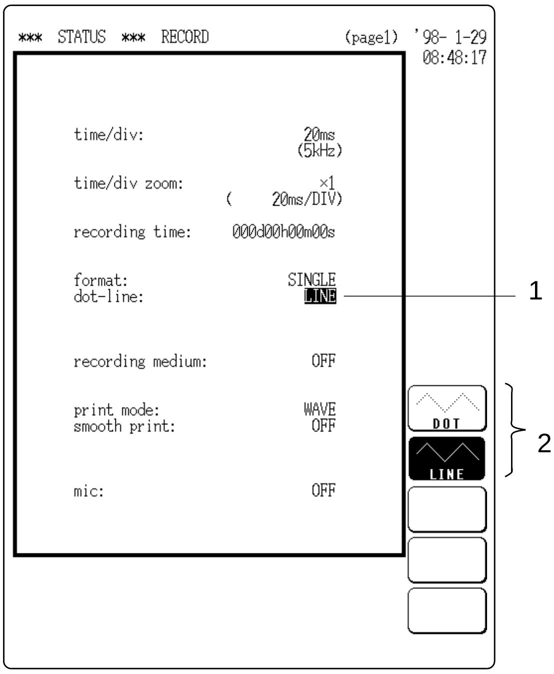
Line（linear interpolation）



Dot

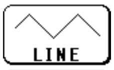


Method Screen: STATUS (page 1)



```
*** STATUS *** RECORD            (page1) '98- 1-29
                                          08:48:17

time/div:                  20ms
                          (5kHz)
time/div zoom:               ×1
                    (   20ms/DIV)
recording time:     000d00h00m00s

format:                  SINGLE
dot-line:                  LINE

recording medium:           OFF

print mode:                WAVE
smooth print:               OFF

mic:                        OFF
```

1. Move the flashing cursor to the **dot-line** item.
2. Use the function keys to make the selection.

Function key display		Meaning
	:	Linear interpolation is not performed. The sampled data is displayed just as it comes.
	:	Linear interpolation is performed. The display is easier on the eye. High speed display is available when compression is being performed.

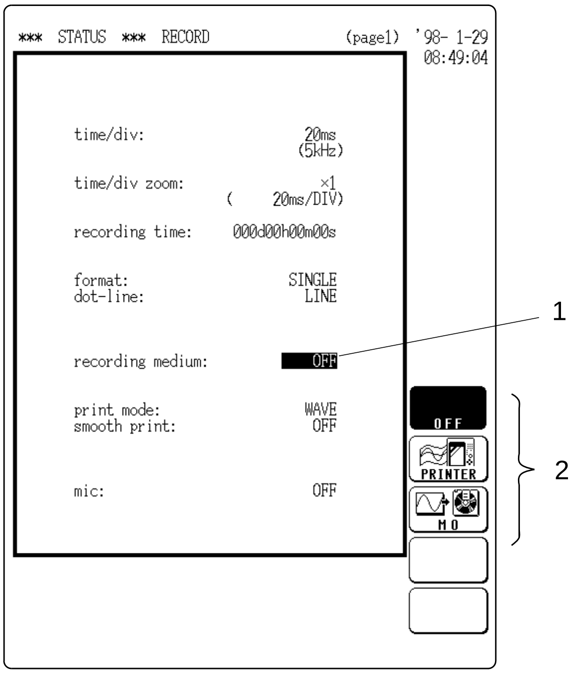
NOTE

When carrying out real-time printing (waveform is printed as it is being captured (☞ Section 12.9.3), the display is a line also when **DOT** is selected.

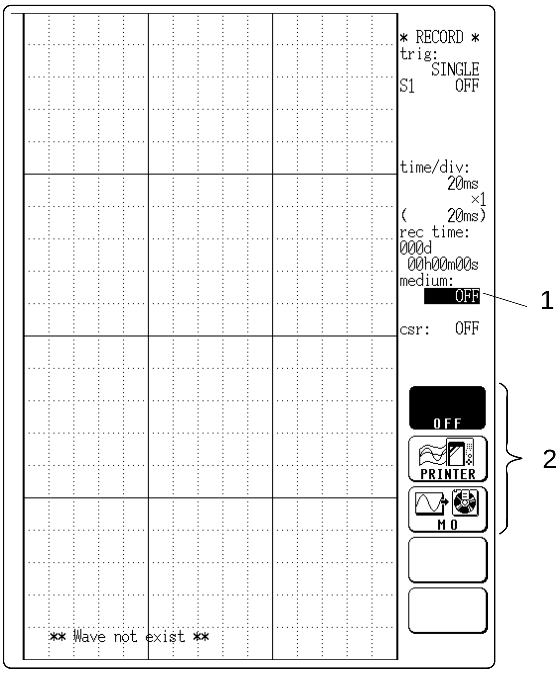
7.2.7 Setting the Recording Medium

This setting determines whether the measurement data are printed out in real time, recorded on MO, or not recorded (recorded in the internal memory).

Method Screen: STATUS (page 1), DISPLAY



```
*** STATUS *** RECORD                  (page1) '98- 1-29
                                               08:49:04

time/div:                     20ms
                             (5kHz)

time/div zoom:                  ×1
                     (    20ms/DIV)

recording time:    000d00h00m00s

format:                     SINGLE
dot-line:                     LINE

recording medium:              OFF

print mode:                   WAVE
smooth print:                  OFF

mic:                           OFF
```



```
* RECORD *
trig:
    SINGLE
S1     OFF

time/div:
      20ms
        ×1
(     20ms)
rec time:
000d
 00h00m00s
medium:
       OFF
csr:   OFF

** Wave not exist **
```

1. Move the flashing cursor to the **recording medium** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: No recording (display only)
PRINTER	: Print data on printer (☞ Section 12.5.3)
MO	: Record data on MO (☞ Section 13.5.2)

NOTE

Also when **recording medium** is OFF, data immediately preceding the recording stop operation are stored in internal memory. The length of the stored data is determined by the following equations (1 M = 10^6).

- Only 8916 - 8919, 8928 can be used

$$\text{Recording time (s)} = \frac{\text{Time axis range(s/DIV)} \times 1.8\ \text{M}}{\text{Number of units} \times 100}$$

- 8927 one unit can be used

$$\text{Recording time (s)} = \frac{\text{Time axis range(s/DIV)} \times 1.8\ \text{M}}{\text{Number of channels} \times 100}$$

- 8916 - 8919, 8927, and 8928 can coexist, or 8927 can be used exclusively

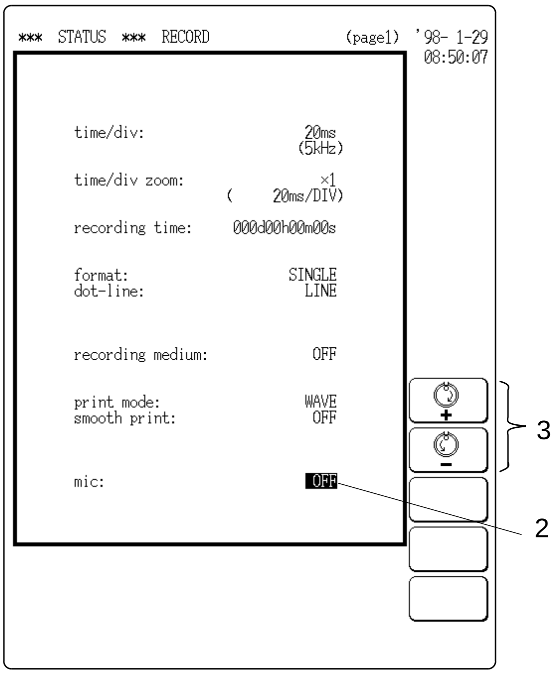
$$\text{Recording time (s)} = \frac{\text{Time axis range(s/DIV)} \times 1.8\ \text{M}}{\text{Number of units} \times 200}$$

(For the 8928, one channel corresponds to one unit.)

7.2.8 Recording a Voice Memo

- When **MO** is selected as a recording medium, a voice memo can be recorded along with the waveform data.
- During playback, the voice memo is reproduced along with the monitored output (☞ Section 13.6.2).

Method Screen: STATUS (page 1)



```
***  STATUS  ***  RECORD                (page1)  '98- 1-29
                                                  08:50:07

  time/div:                        20ms
                                  (5kHz)
  time/div zoom:                     ×1
                             (    20ms/DIV)
  recording time:        000d00h00m00s

  format:                        SINGLE
  dot-line:                        LINE

  recording medium:                 OFF

  print mode:                      WAVE
  smooth print:                     OFF

  mic:                              OFF
```

1. Set the items **time/div** and **recording medium** on the STATUS screen (page 1) as follows.

- **time/div**

  Choose a setting between 1.25 ms/DIV and 10 ms/DIV
- **recording medium**

  MO

NOTE

When time axis sampling is set to a slow setting such as 20 ms/DIV or more, the voice memo will become garbled.

2. Move the flashing cursor to the **mic** item.
3. Use the JOG control or the function keys to make the setting.

Function key display	Meaning
+	: Increase channel number
−	: Decrease channel number

NOTE

When the microphone is used, one channel will become unavailable. (On the CHANNEL screen, **mic** is displayed.

4. Connect the microphone to the MIC jack.

NOTE

For information on microphone types and connection: ☞ Section 21.7.

5. Press the START key to start the measurement. When trigger has occurred and the waveform is being recorded, voice memo recording is possible.

   Speak into the microphone from a distance of about 10 to 20 cm, to prevent distortion.

7.2.9 Transferring Data to the Memory Recorder Function

The waveform data stored in recorder function can be transferred to memory recorder function.

Data which can be transferred

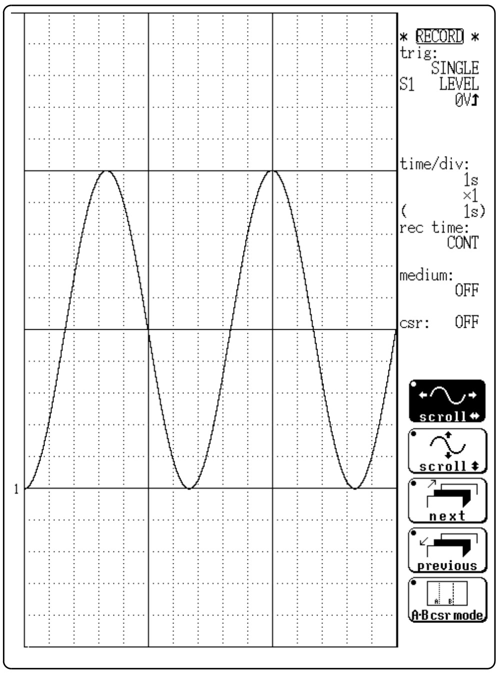
- Waveform data stored in memory immediately before stopping recording operation.
- Waveform data recorded on a MO disk. (REC file)

Data length transferred

The waveform of the following data length is transferred from the left end of the display screen.

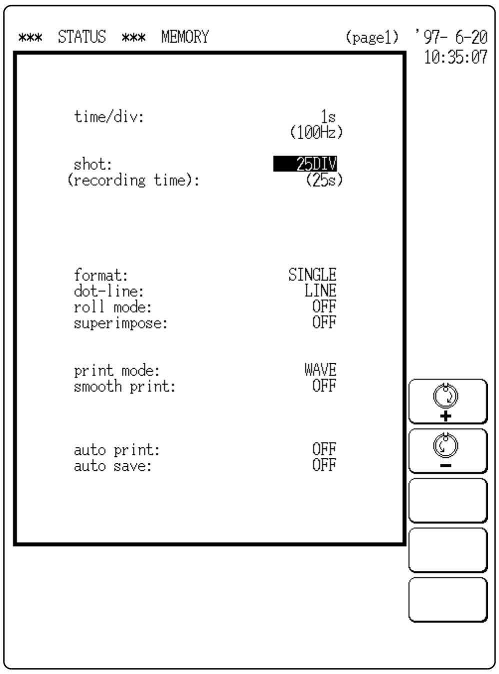
Data length transferred (s) = time axis (s/DIV) when recording × recording length in memory recorder function which is set before transferring.

Method Screen: DISPLAY (recorder) → STATUS, DISPLAY (memory recorder) → STATUS (recorder)



* RECORD *
trig: SINGLE
S1 LEVEL 0V↑
time/div: 1s ×1 (1s)
rec time: CONT
medium: OFF
csr: OFF

1. Record the data in recorder function, or load the waveform data from a MO disk.
2. Scroll the waveform on the display screen and specify the start position (left end of the screen) to transfer data.



*** STATUS *** MEMORY (page1) '97- 6-20 10:35:07

time/div: 1s (100Hz)

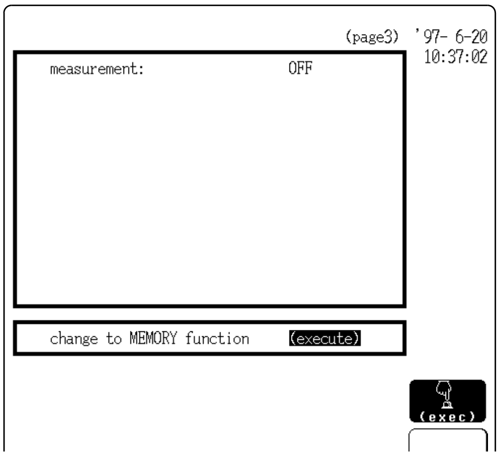
shot: 25DIV
(recording time): (25s)

format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

3. Set the item **shot** on the STATUS screen (page 1) or display screen in memory recorder function. (☞ Section 6.2.3)

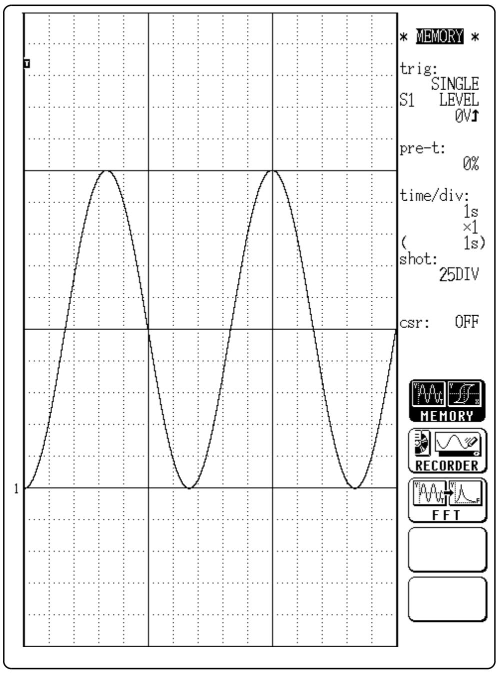


(page3) '97- 6-20 10:37:02

measurement: OFF

change to MEMORY function (execute)

4. Move the flashing cursor to the **change to MEMORY function** item on the STATUS screen in recorder function (page 3), and press the F1 [exec] key.



* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 1s ×1 (1s)
shot: 25DIV
csr: OFF

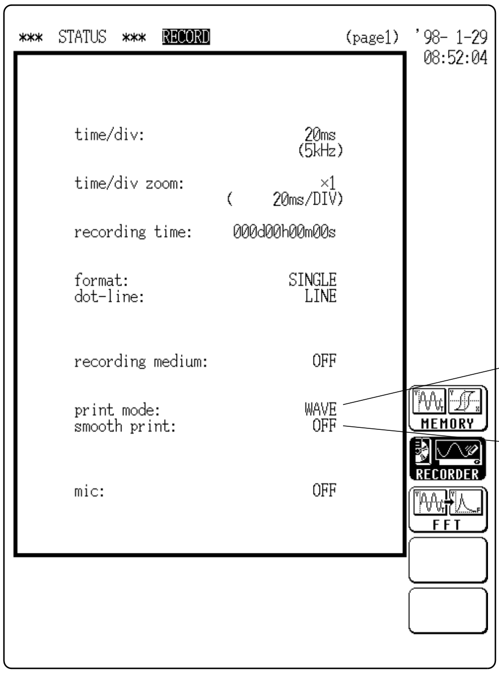
5. The data is transferred and the waveform is displayed on the display screen in memory recorder function.

NOTE

- If the recording length in memory recorder function is set to maximum recording length, the data can not be transferred. (☞ Section 6.2.3)
- The waveform data which is measured by using the 8927 unit, with 1.25 or 2ms/DIV time axis range cannot be transferred.
- When measuring with time axis range (10, 20 min, or 1h/DIV) in recorder function only, the waveform data can be transferred.

7.2.10 Other Settings

For details, refer to the following sections.



*** STATUS *** RECORD (page1) '98- 1-29 08:52:04

time/div: 20ms (5kHz)

time/div zoom: ×1 (20ms/DIV)

recording time: 000d00h00m00s

format: SINGLE
dot-line: LINE

recording medium: OFF

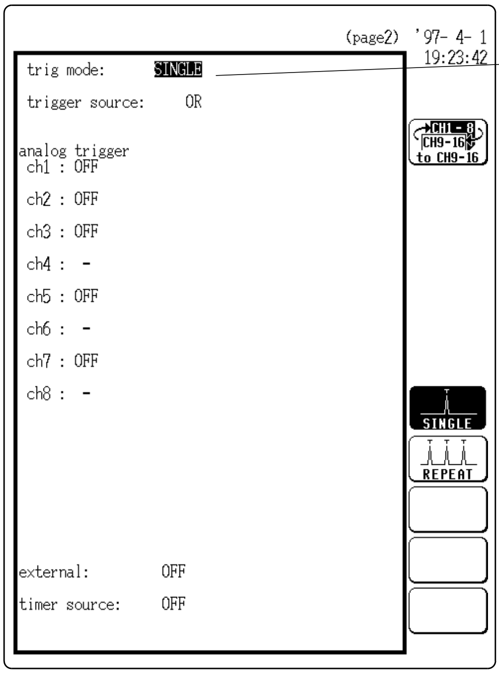
print mode: WAVE
smooth print: OFF

mic: OFF

☞ Section 12.2

☞ Section 12.3

Status Screen (page 1)



(page2) '97- 4- 1 19:23:42

trig mode: SINGLE

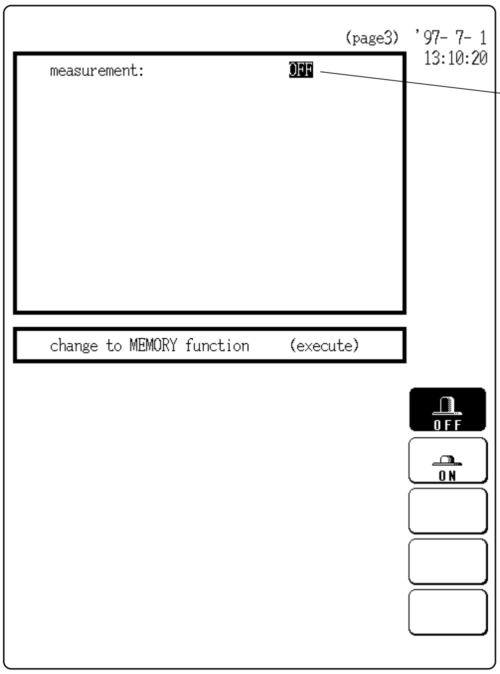
trigger source: OR

analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 : -
ch5 : OFF
ch6 : -
ch7 : OFF
ch8 : -

external: OFF
timer source: OFF

☞ Chapter 10

Status Screen (page 2)



(page3) '97- 7- 1
13:10:20

measurement: OFF

change to MEMORY function (execute)

☞ Chapter 15

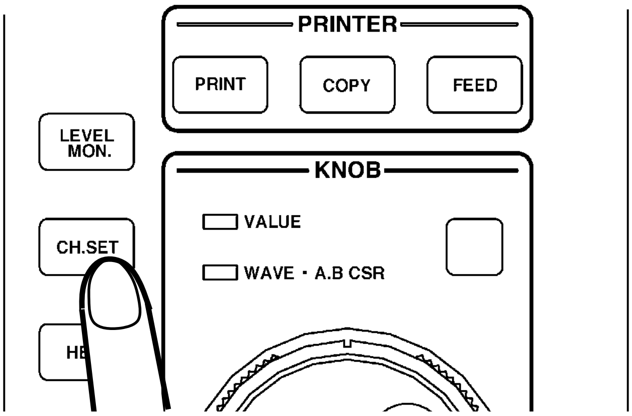
Status Screen (page 3)

7.3 Settings on the Display Screen and Auto Settings

Explains the setting items on the Display screen and the auto-setting of the voltage axis and time axis.

7.3.1 Making Channel Settings

While the screen is in measurement display mode, the CH. SET key can be used to make settings for the various channels (☞ Section 20.3).



CH. SET key:

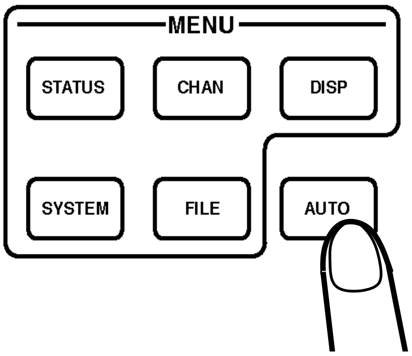
Serves to make channel settings in measurement display mode.

7.3.2 Automatic Setting of Time Axis and Voltage Axis

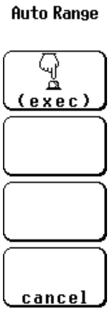
(Auto Range Function)

This function automatically selects the time axis range (TIME/DIV), voltage axis range (V/DIV) and zero position.

Method 1. Press the AUTO key.



2. Use the function keys to make the selection.



Function key display	Meaning
Auto Range	Auto range (only display)
(exec)	Enable auto range function
cancel	Disable auto range function

3. Press F2 [exec]. The automatic range setting is made and measurement starts.

When the auto range function is used to start the measurement, the following items are changed.

(1) Channel settings

• Range and position	Automatically set
• Low-pass filter	OFF (all channels)
• Input coupling	DC

(2) Trigger parameters

• Trigger source AND/OR	OR
• Internal trigger	Only channel with lowest number of all active display channels is set to ON, other channels are OFF (if difference between maximum and minimum value is large).
• Trigger type	Level trigger: trigger level automatically set (only 1 channel)
• Trigger mode	Auto
• Trigger filter	OFF
• External trigger, timer trigger	OFF

(3) STATUS settings

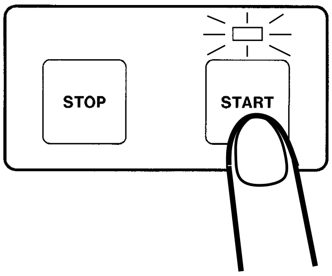
• Time axis range (TIME/DIV)	Automatically set
• Time axis magnification/compression, voltage axis magnification	×1

NOTE

- The time axis range is set using the channel with lowest number of all active display channels. (The setting is made so that out of 25 DIV units, a cycle of 1 - 2.5 is recorded.)
- If the channel for which the time axis range has been set is at the maximum sensitivity range (8916, 8917, 8919: 5 mV/DIV, 8918: 10℃/DIV, 8927: 20 mV/DIV, 8928: 20 με) and the difference between the maximum and minimum input signal level is 1 DIV or less, the next higher channel is used for time axis range setting.
- If range setting cannot be performed for all active channels, the measurement is terminated with a warning message.

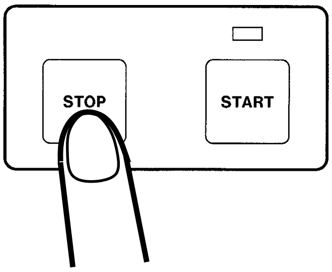
7.4 Start and Stop Measurement Operation

Method



To start the measurement:

Press the START key and the LED lights



To stop the measurement:

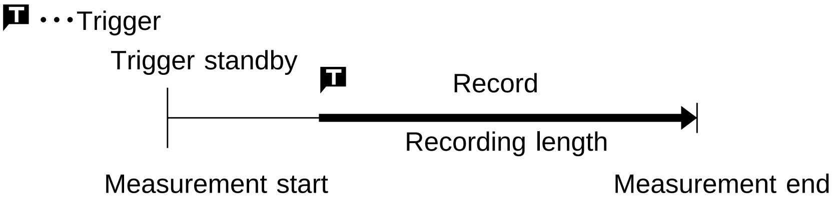
Press the STOP key.

Recording length, trigger mode and measurement operation

(1) When time setting is enabled:

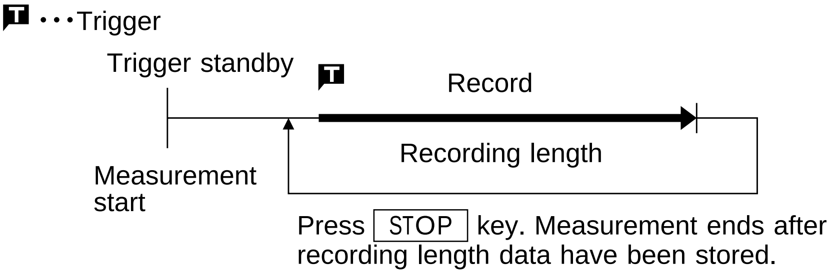
① Trigger mode: **SINGLE**

- After START key has been pressed, data recording starts when trigger conditions are met.
- When data corresponding to recording length have been stored in memory, measurement stops also without pressing the STOP key.



② Trigger mode: **REPEAT**

- After START key has been pressed, data recording starts when trigger conditions are met.
- Each time when trigger conditions are met, data are recorded and memory contents are overwritten.
- When STOP key is pressed, measurement stops after data corresponding to recording length have been stored in memory.

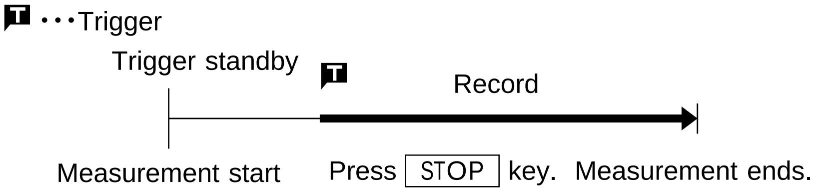


Press STOP key. Measurement ends after recording length data have been stored.

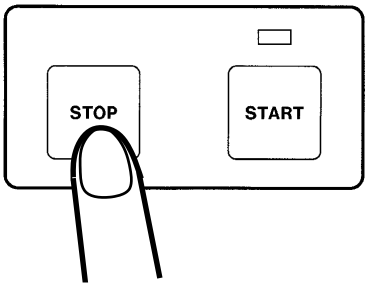
(2) When continuous recording is enabled

Trigger mode: **SINGLE** or **REPEAT**

- After START key has been pressed, data recording starts when trigger conditions are met.
- When STOP key is pressed twice, measurement stops.



Stopping measurement



① To terminate measurement after recording length data are stored:
Press STOP key once.

② To terminate measurement immediately:
Press STOP key twice.

(1) Pressing STOP key once

- When STOP key is pressed once, data recording continues until data corresponding to recording length have been stored in memory. (LED above START key is lit.)
- If START key is pressed after STOP key was pressed once and before waveform data recording is completed, the measurement is restarted.

(2) Pressing STOP key twice

- When STOP key is pressed twice, waveform recording is stopped immediately.
- The waveform until the current point is displayed.

Chapter 8
FFT Function

8.1 Outline

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

(2) Frequency range

133 mHz to 40 kHz or 80 kHz (when 8927 is not used), 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 (8919 FFT unit)

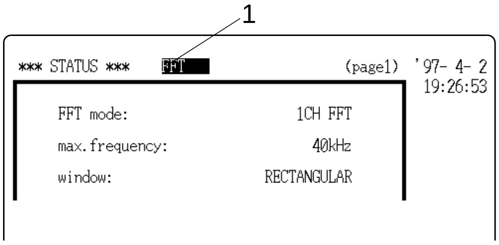
(8) Waveform evaluation function using evaluation area

8.2 Item Settings

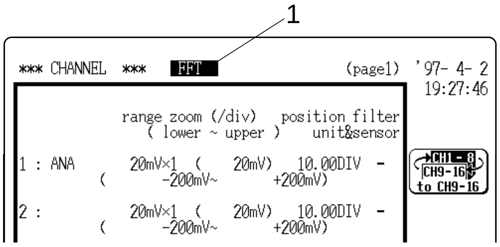
8.2.1 Setting the FFT Function

- The 8846 has three function modes; the memory recorder function, the recorder function, the FFT function.
- Select the FFT function for performing FFT analysis.

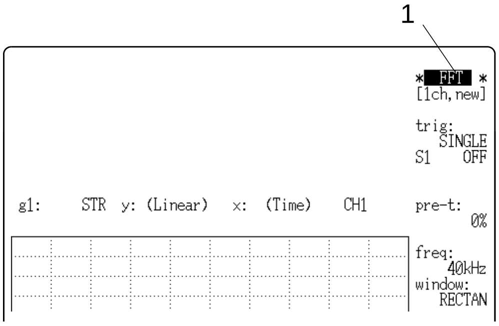
Method Screen: STATUS (page 1), CHANNEL(page1), DISPLAY



```
*** STATUS ***   FFT              (page1) '97- 4- 2
                                          19:26:53
    FFT mode:                1CH FFT
    max.frequency:             40kHz
    window:              RECTANGULAR
```



```
*** CHANNEL  ***  FFT             (page1) '97- 4- 2
                                          19:27:46
              range zoom (/div)   position filter
                ( lower ~ upper )    unit&sensor
1 : ANA      20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~         +200mV)
2 :          20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~         +200mV)
```



```
                                                  * FFT *
                                                  [1ch,new]
                                                  trig:
                                                    SINGLE
                                                  S1    OFF
g1:    STR  y: (Linear)   x:  (Time)    CH1       pre-t:
                                                        0%
                                                  freq:
                                                     40kHz
                                                  window:
                                                    RECTAN
```

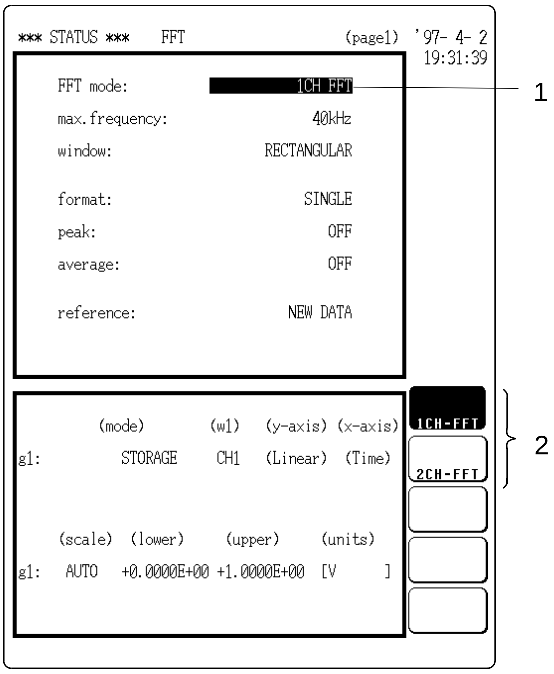
1. Move the flashing cursor to the position shown in the figure on the left.
2. Press F3 [FFT].

Function key display	Meaning
MEMORY	: Memory recorder function
RECORDER	: Recorder function
FFT	: FFT function

8.2.2 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)



```
*** STATUS ***    FFT                (page1)  '97- 4- 2
                                               19:31:39
   FFT mode:                      1CH FFT
   max.frequency:                   40kHz
   window:                    RECTANGULAR

   format:                         SINGLE
   peak:                              OFF
   average:                           OFF

   reference:                    NEW DATA

         (mode)       (w1)   (y-axis) (x-axis)
g1:         STORAGE     CH1   (Linear)  (Time)

     (scale)  (lower)      (upper)      (units)
g1:   AUTO    +0.0000E+00 +1.0000E+00  [V       ]
```

1. Move the flashing cursor to the **FFT mode** item.
2. Use the function key to make the selection.

Function key display	Meaning
1CH-FFT	: Used for FFT analysis of signals from one channel.
2CH-FFT	: Used for simultaneous FFT analysis of two channels.

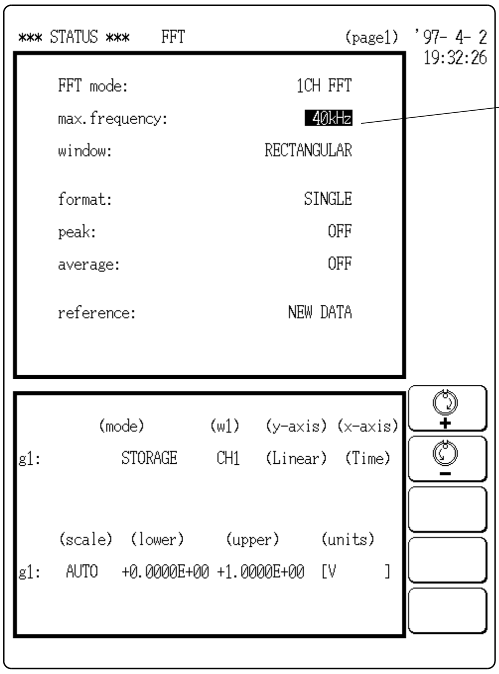
NOTE The following analysis functions are not possible in 1-channel FFT mode:

Transfer function (TRF), cross-power spectrum (CSP), cross-correlation function (CCR), impulse response (IMP), coherence function (COH)

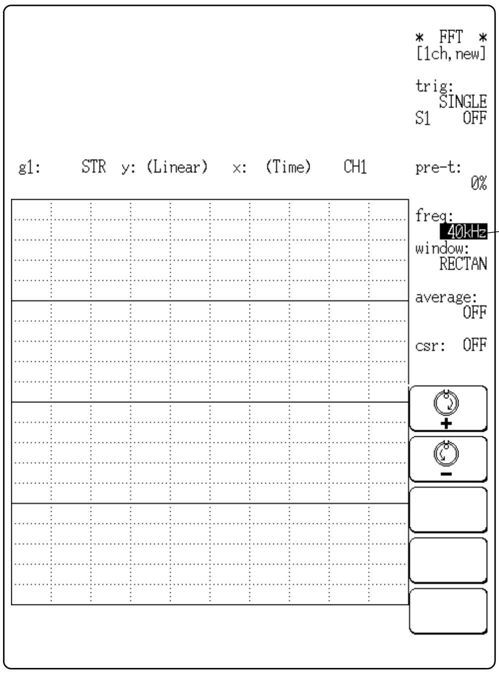
8.2.3 Setting the Frequency Range

- 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), DISPLAY



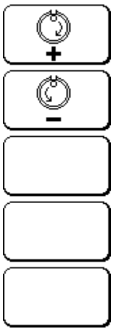
```
*** STATUS ***    FFT                 (page1)  '97- 4- 2
                                               19:32:26
     FFT mode:                     1CH FFT
     max.frequency:                  40kHz
     window:                   RECTANGULAR

     format:                        SINGLE
     peak:                             OFF
     average:                          OFF

     reference:                   NEW DATA

           (mode)        (w1)   (y-axis)  (x-axis)
g1:         STORAGE      CH1    (Linear)  (Time)

     (scale)  (lower)      (upper)      (units)
g1:   AUTO   +0.0000E+00  +1.0000E+00   [V      ]
```



```
                                                 *  FFT  *
                                                 [1ch, new]
                                                 trig:
                                                    SINGLE
                                                 S1    OFF
g1:   STR  y: (Linear)  x:  (Time)    CH1        pre-t:
                                                        0%
                                                 freq:
                                                     40kHz
                                                 window:
                                                    RECTAN
                                                 average:
                                                       OFF
                                                 csr:  OFF
```

1. Move the flashing cursor to the **max. frequency** item on the STATUS screen or the **freq** item on the DISPLAY screen.
2. Use the JOG control or the function keys to make the selection.

Function key display | Meaning



133, 333, 667 mHz
2, 4, 8, 20, 40, 80, 200, 400, 800 Hz
2, 4, 8, 16, 20, 32, 40, 80 kHz
EXT (external)

NOTE

- When the analog unit 8927 is used, the 80 kHz range cannot be selected (maximum setting 40 kHz).
- The antialiasing filter (8919 FFT unit) cutoff frequency is the same as the selected frequency range.
- When **EXT** was selected, octave analysis cannot be carried out.
- To use external sampling: ☞ Section 21.5

Frequency Range, Frequency Resolution, Window Width, Corresponding Time Axis Range

Frequency range [Hz]		Frequency resolution [Hz]	Window width	Time axis [/DIV]
80 k	*1	200	5 ms	500 μs
40 k		100	10 ms	1 ms
32 k	*2	80	12.5 ms	1.25 ms
20 k		50	20 ms	2 ms
16 k	*3	40	25 ms	2.5 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	*4	20 m	50 s	5 s
4	*4	10 m	100 s	10 s
2	*4	5 m	200 s	20 s
667 m	*4	1.67 m	10 min	1 min
333 m	*4	0.83 m	20 min	2 min
133 m	*4	0.33 m	50 min	5 min
(67 m)	*4	0.17 m	100 min	10 min
(33 m)	*4	0.08 m	200 min	20 min
(11 m)	*4	0.03 m	10 hour	1 hour

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 40 kHz.

*3: Cutoff frequency is 20 kHz.

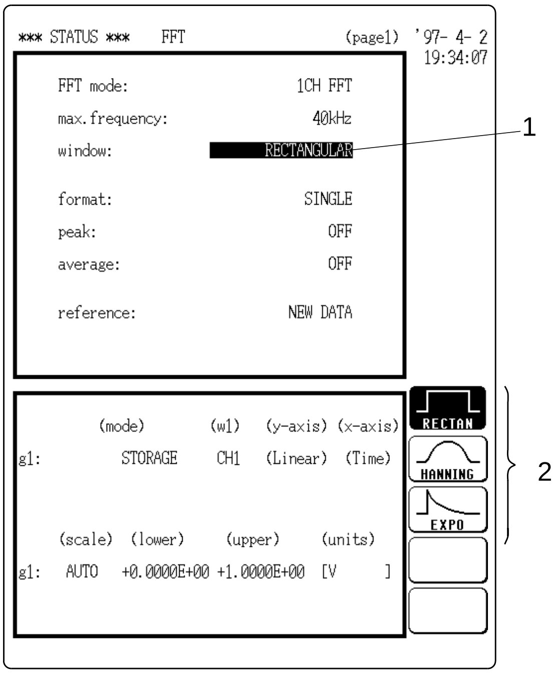
*4: Cutoff frequency is 20 Hz.

( ) indicates range for FILEtoFFT mode. Normally it can not be used.

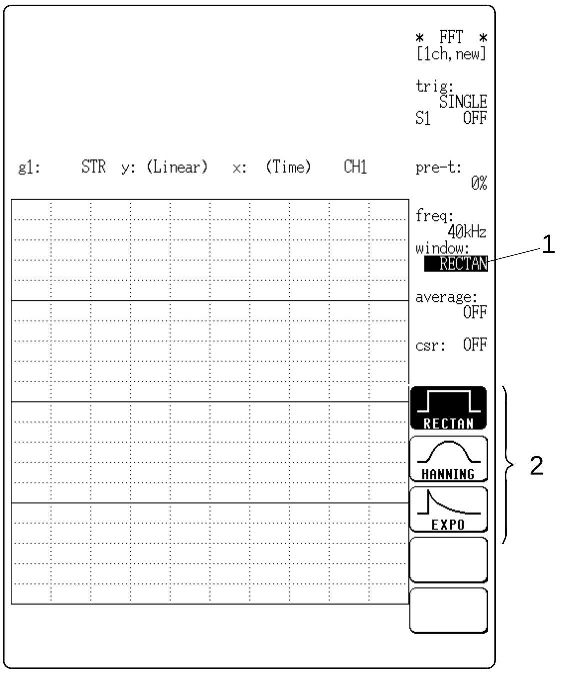
8.2.4 Setting the Window Function

- 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), DISPLAY



```
*** STATUS ***    FFT                (page1)  '97- 4- 2
                                               19:34:07
   FFT mode:                    1CH FFT
   max.frequency:                 40kHz
   window:                  RECTANGULAR

   format:                       SINGLE
   peak:                            OFF
   average:                         OFF

   reference:                  NEW DATA

          (mode)       (w1)   (y-axis) (x-axis)
g1:          STORAGE      CH1    (Linear)  (Time)

    (scale)  (lower)      (upper)      (units)
g1:   AUTO    +0.0000E+00 +1.0000E+00  [V      ]
```



```
                                                *  FFT  *
                                                [1ch,new]
                                                trig:
                                                   SINGLE
                                                S1    OFF
g1:    STR  y: (Linear)   x:  (Time)    CH1     pre-t:
                                                       0%
                                                freq:
                                                    40kHz
                                                window:
                                                   RECTAN
                                                average:
                                                      OFF
                                                csr:  OFF
```

1. Move the flashing cursor to the **window** item.
2. Use the function keys to make the selection.

Function key display	Meaning
RECTAN	: Rectangular
HANNING	: Hanning
EXPO	: Exponential

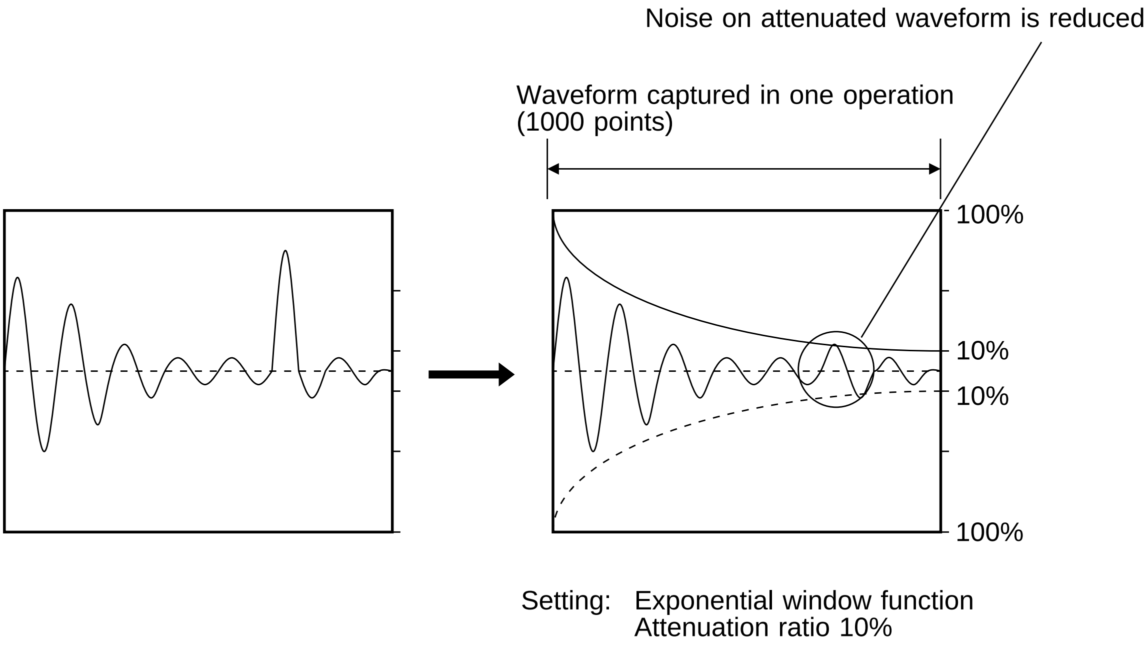
3. If **EXPO** was selected in step 2, the **coefficient** item is displayed. Select the attenuation ratio in percent, using the function keys or the JOG control.

Function key display	Meaning
+	0 to 99%
−	

NOTE

If **coefficient** (attenuation ratio) is set to 0%, processing will be carried out as 0.1%.

Example Attenuation ratio set to 10%



Setting: Exponential window function
Attenuation ratio 10%

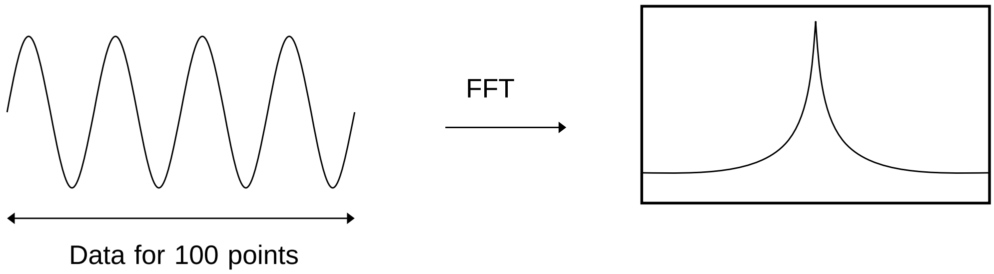
NOTE When measurements are taken using the Hanning window or exponential window, note that the calculation results in the display of a value that is lower than the amplitude obtained when using a rectangular window.

8.2.5 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

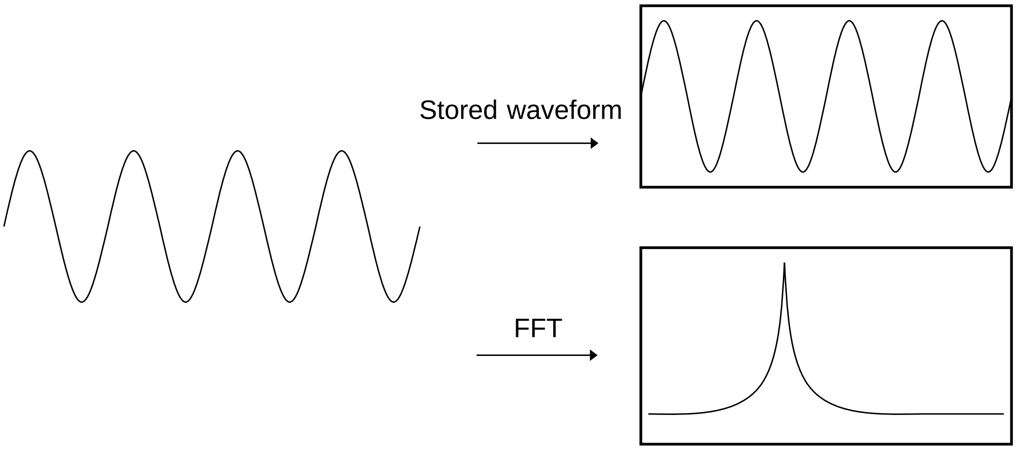
Displays the waveform on a single screen.



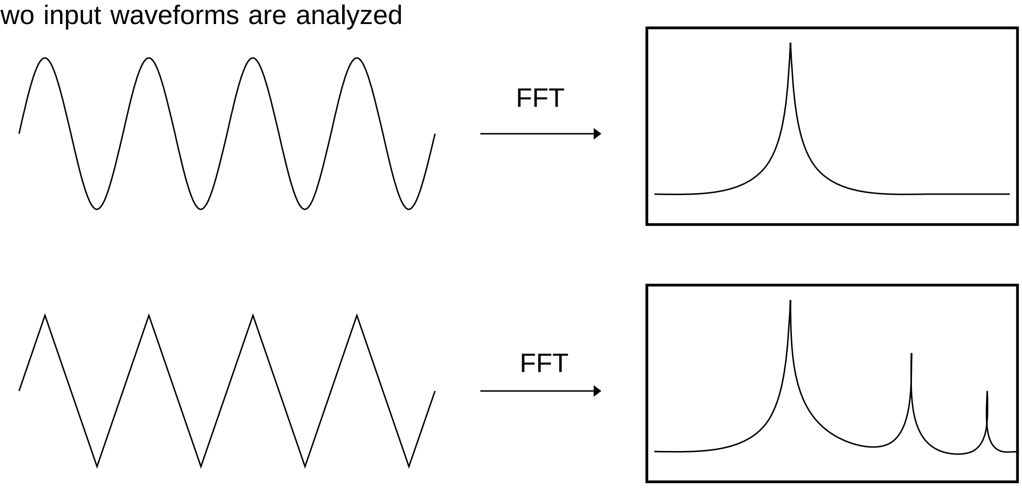
(2) Dual

Divides the waveform display screen into upper and lower screens.

A input waveform is analyzed in two ways

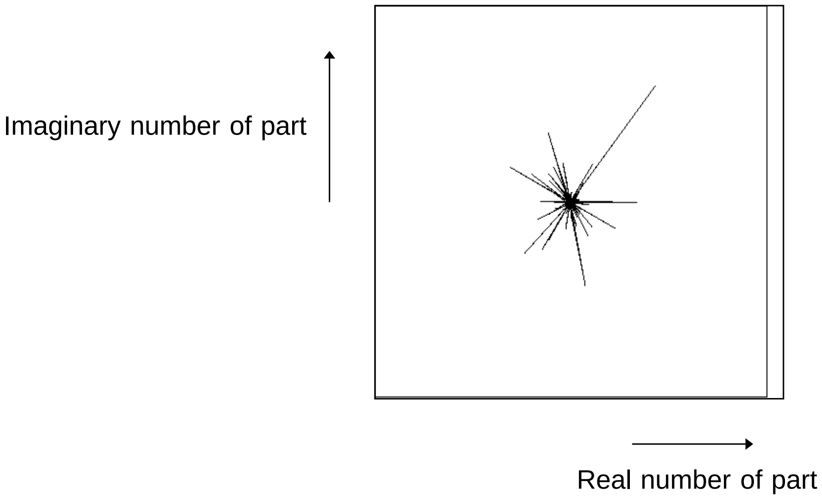


Two input waveforms are analyzed

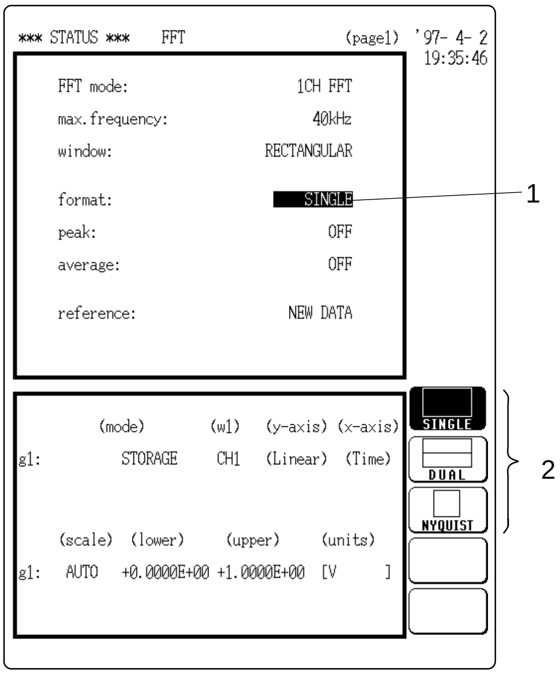


(3) Nyquist

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)



```
*** STATUS ***    FFT                    (page1)  '97- 4- 2
                                                   19:35:46
    FFT mode:                     1CH FFT
    max.frequency:                40kHz
    window:                       RECTANGULAR

    format:                       SINGLE
    peak:                         OFF
    average:                      OFF

    reference:                    NEW DATA

          (mode)       (w1)   (y-axis) (x-axis)
g1:        STORAGE      CH1   (Linear)  (Time)

     (scale)  (lower)     (upper)      (units)
g1:  AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```

1. Move the flashing cursor to the **format** item.
2. Use the function keys to make the selection.

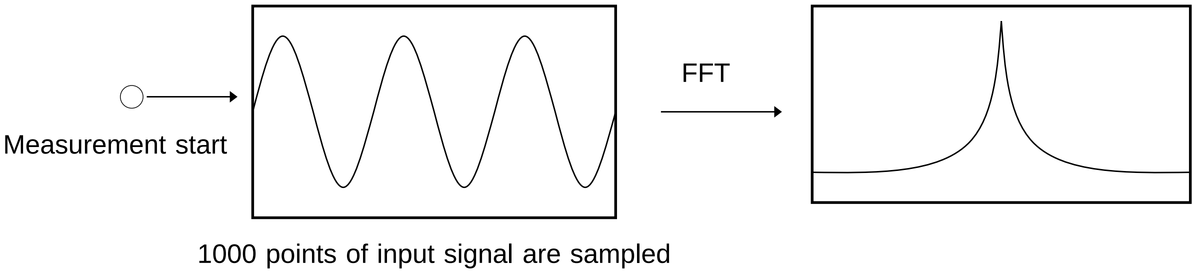
Function key display	Meaning
SINGLE	: Single
DUAL	: Dual
NYQUIST	: Nyquist

8.2.6 Selecting Reference Data

Select data to be used for FFT processing.

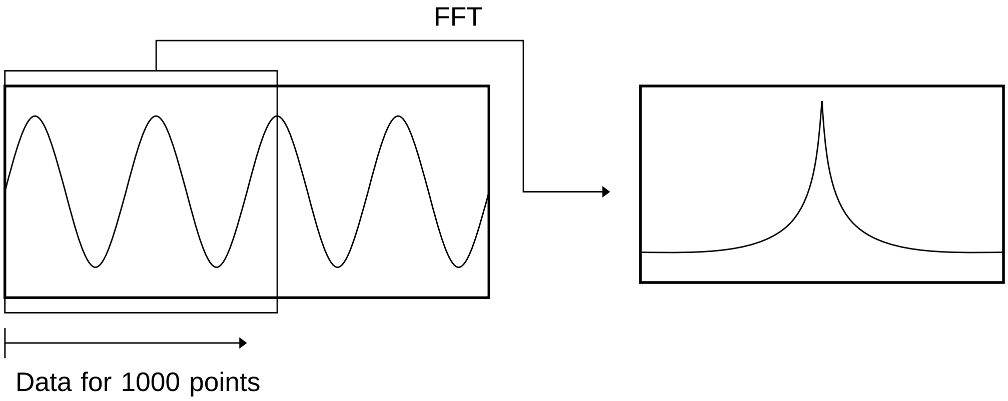
New data

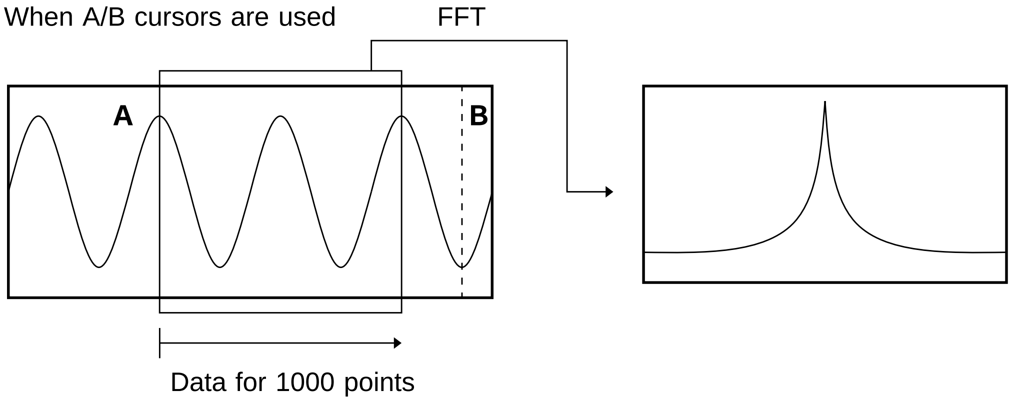
When START key is pressed, data for 1000 points are captured and used for FFT processing.



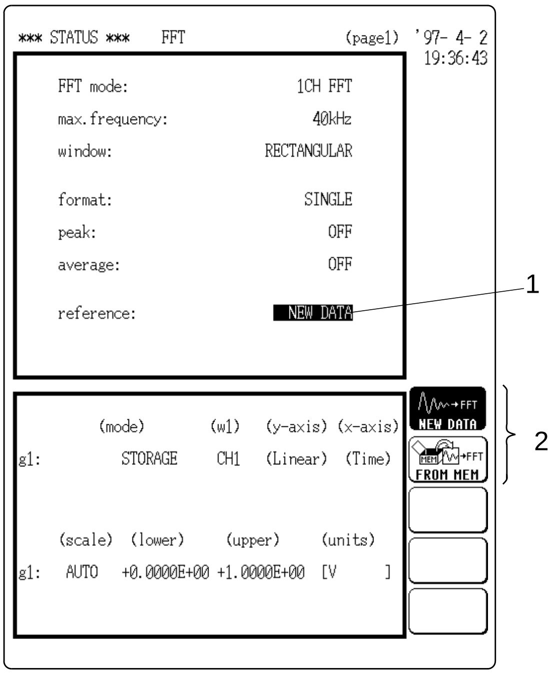
Memory waveform

- 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)



```
*** STATUS ***    FFT                     (page1) '97- 4- 2
                                                  19:36:43
    FFT mode:                     1CH FFT
    max.frequency:                  40kHz
    window:                   RECTANGULAR

    format:                        SINGLE
    peak:                             OFF
    average:                          OFF

    reference:                   NEW DATA

          (mode)      (w1)   (y-axis) (x-axis)
g1:       STORAGE     CH1    (Linear)  (Time)


     (scale)  (lower)      (upper)      (units)
g1:   AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```

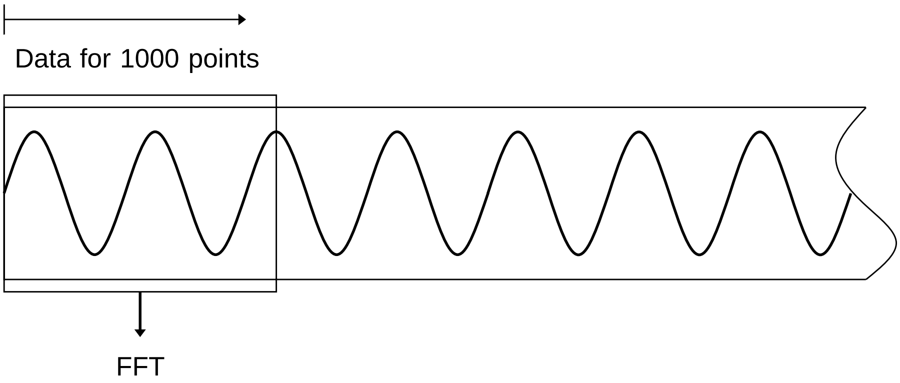
1. Move the flashing cursor to the **reference** item.
2. Use the function keys to select the data.

Function key display	Meaning
NEW DATA	: Capture new waveform data for FFT processing
FROM MEM	: Use stored waveform data for FFT processing

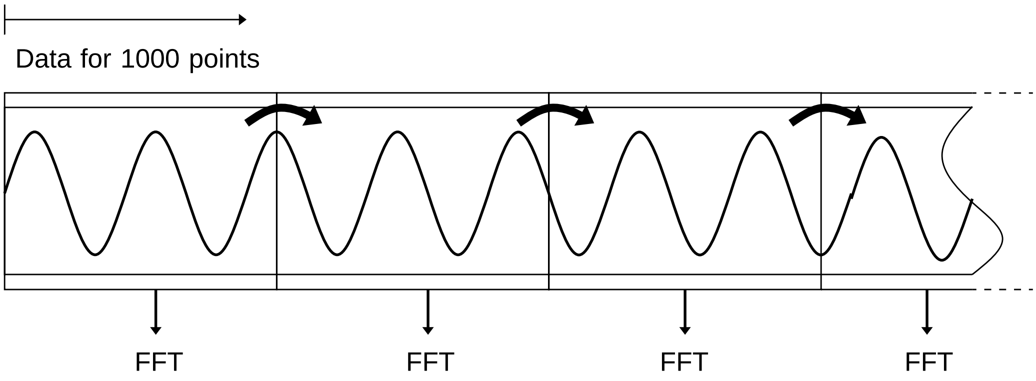
NOTE

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 1000-point data at a time, until the end of data. (Calculation is not performed if less than 1000 points.)

- Trigger mode set to SINGLE



- Trigger mode set to REPEAT, AUTO, AUTO STOP

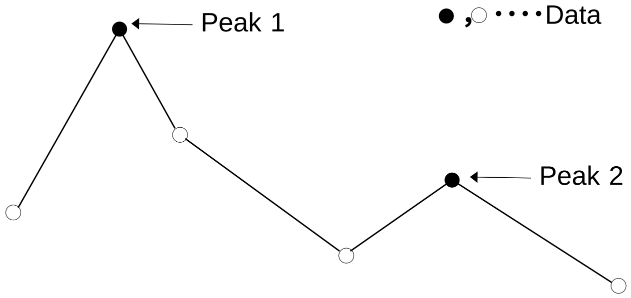


8.2.7 Setting the Peak Display

- 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.

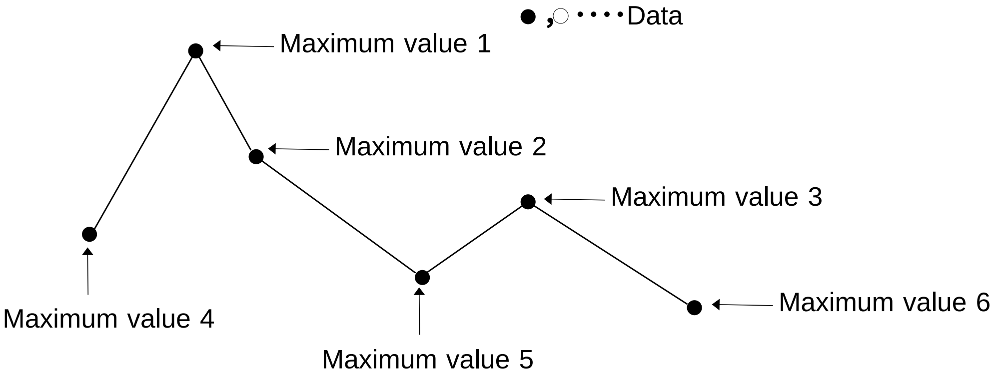
Peak value

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

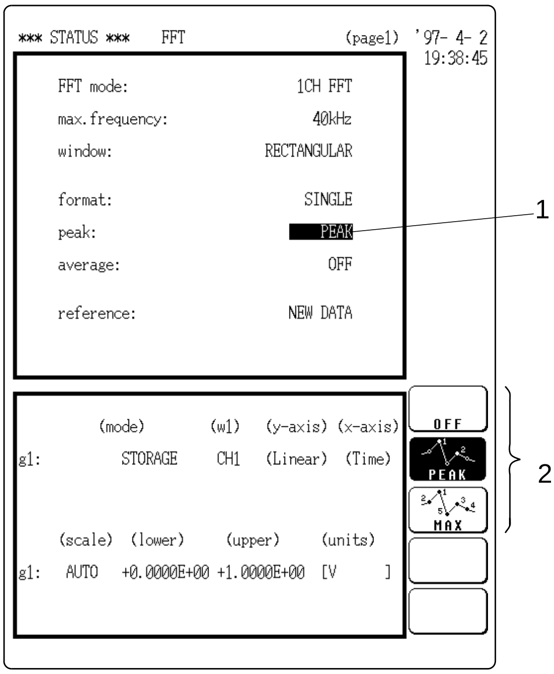


Maximum value

Points with the 10 highest values are shown.



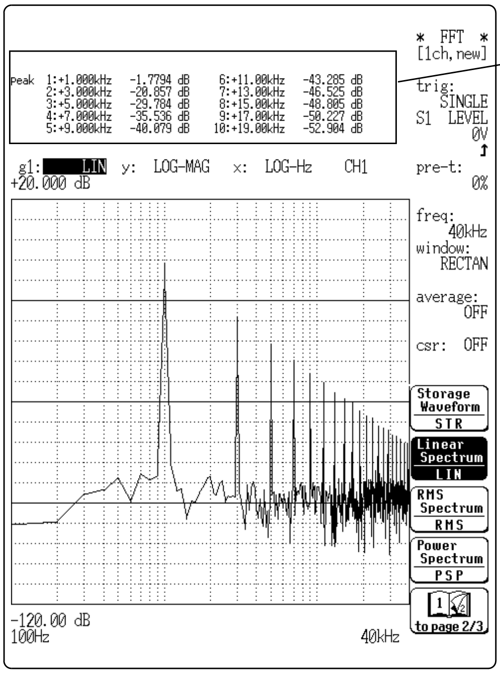
Method Screen: STATUS (page 1)



```
*** STATUS ***    FFT                 (page1) '97- 4- 2
                                               19:38:45
FFT mode:                   1CH FFT
max.frequency:                40kHz
window:                 RECTANGULAR

format:                      SINGLE
peak:                          PEAK
average:                        OFF

reference:                 NEW DATA

        (mode)       (w1)  (y-axis) (x-axis)
g1:      STORAGE     CH1   (Linear)  (Time)

   (scale)  (lower)      (upper)     (units)
g1:  AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```

1. Move the flashing cursor to the **peak** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: OFF
PEAK	: Shows the 10 peak values
MAX	: Shows the 10 highest peaks

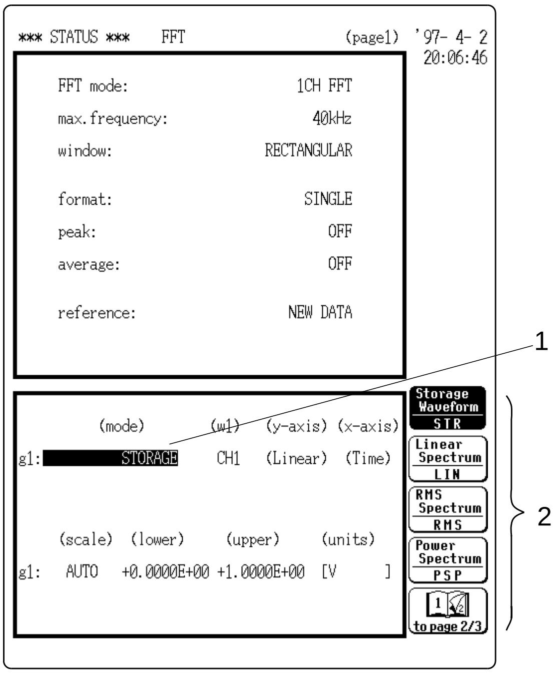


```
                                                        * FFT *
                                                        [1ch,new]
Peak 1:+1.000kHz  -1.7794 dB   6:+11.00kHz  -43.285 dB  trig:
     2:+3.000kHz  -20.857 dB   7:+13.00kHz  -46.525 dB     SINGLE
     3:+5.000kHz  -29.784 dB   8:+15.00kHz  -48.805 dB  S1  LEVEL
     4:+7.000kHz  -35.536 dB   9:+17.00kHz  -50.227 dB         0V
     5:+9.000kHz  -40.079 dB  10:+19.00kHz  -52.904 dB

 g1:     LIN  y:  LOG-MAG   x:  LOG-Hz    CH1           pre-t:
+20.000 dB                                                  0%

                                                        freq:
                                                           40kHz
                                                        window:
                                                          RECTAN

                                                        average:
                                                             OFF

                                                        csr:  OFF

-120.00 dB
100Hz                                        40kHz
```

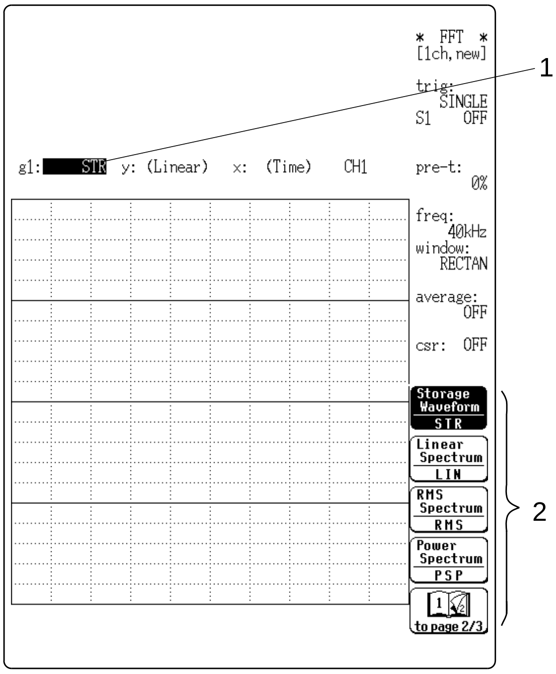
8.2.8 Setting the FFT Analysis Mode

Used to select the FFT calculation method.

Method Screen: STATUS (page 1), DISPLAY



```
*** STATUS ***    FFT                    (page1)  '97- 4- 2
                                                   20:06:46
  FFT mode:                     1CH FFT
  max.frequency:                40kHz
  window:                       RECTANGULAR

  format:                       SINGLE
  peak:                         OFF
  average:                      OFF

  reference:                    NEW DATA

          (mode)       (w1)   (y-axis)  (x-axis)
g1:           STORAGE  CH1    (Linear)  (Time)

      (scale)  (lower)      (upper)      (units)
g1:   AUTO     +0.0000E+00  +1.0000E+00  [V      ]
```



```
                                              * FFT *
                                              [1ch,new]
                                              trig:
                                                 SINGLE
                                              S1    OFF
g1:    STR  y: (Linear)   x:  (Time)   CH1    pre-t:
                                                    0%
                                              freq:
                                                 40kHz
                                              window:
                                                RECTAN
                                              average:
                                                   OFF
                                              csr:  OFF
```

1. Move the flashing cursor to the **mode** item.
2. Use the function keys to select the FFT calculation.

- **1/3**

Function key display	Meaning
Storage Waveform STR	: Stored waveform (☞ Section 8.3.1)
Linear Spectrum LIN	: Linear spectrum (☞ Section 8.3.2)
RMS Spectrum RMS	: RMS spectrum (☞Section 8.3.3)
Power Spectrum PSP	: Power spectrum (☞ Section 8.3.4)
1 2 to page 2/3	: Switch to page 2/3

- **2/3**

Function key display	Meaning
Auto Correlation ACR	: Auto correlation function (☞ Section 8.3.5)
Histogram HIS	: Histogram (☞ Section 8.3.6)
Transfer TRF	: Transfer function (☞ Section 8.3.7)
Cross Power Spectrum CSP	: Cross power spectrum (☞ Section 8.3.8)
2 3 to page 3/3	: Switch to page 3/3

- **3/3**

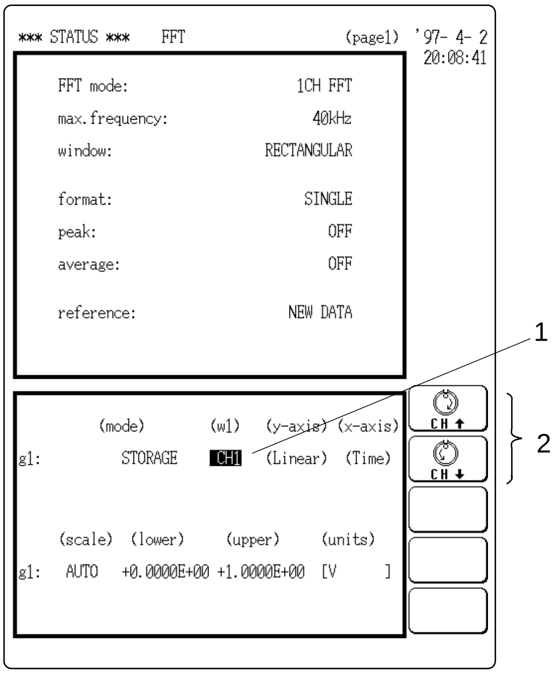
Function key display	Meaning
Cross Correlation CCR	: Cross correlation function (☞ Section 8.3.9)
Impulse Response IMP	: Impulse response (☞ Section 8.3.10)
Coherence COH	: Coherence function (☞ Section 8.3.11)
Octave OCT	: Octave analysis (☞ Section 8.3.12)
1 3 to page 1/3	: Switch to page 1/3

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

8.2.9 Setting the Analysis Channel

Select the channel for FFT analysis.

Method Screen: STATUS (page 1), DISPLAY

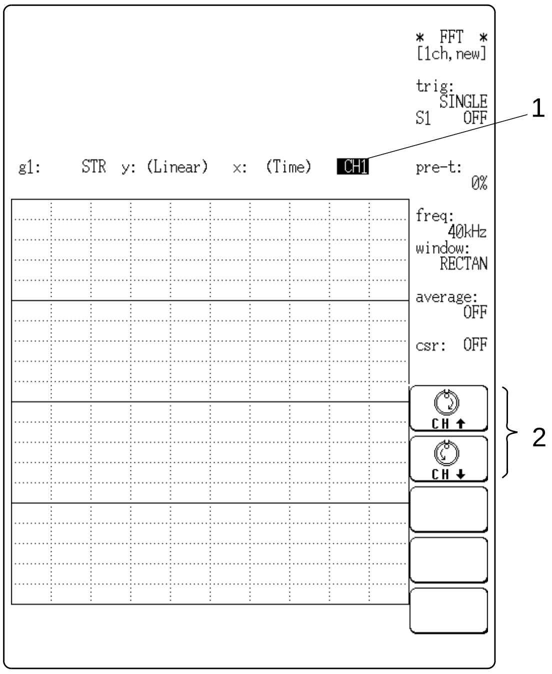


*** STATUS *** FFT (page1) '97- 4- 2 20:08:41

FFT mode: 1CH FFT
max.frequency: 40kHz
window: RECTANGULAR
format: SINGLE
peak: OFF
average: OFF
reference: NEW DATA

(mode) (w1) (y-axis) (x-axis)
g1: STORAGE CH1 (Linear) (Time)

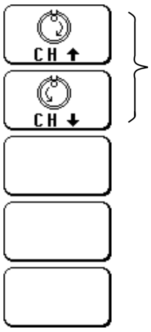
(scale) (lower) (upper) (units)
g1: AUTO +0.0000E+00 +1.0000E+00 [V]



* FFT * [1ch,new]
trig: SINGLE
S1 OFF
g1: STR y: (Linear) x: (Time) CH1
pre-t: 0%
freq: 40kHz
window: RECTAN
average: OFF
csr: OFF

1. Move the flashing cursor to the **w1** item.
2. Use the JOG control or the function keys to select the channel.
3. When **2CH-FFT** was selected, the **w2** item is displayed. Select the channel in the same way as for **w1**.

Function key display Meaning



CH1 to CH16

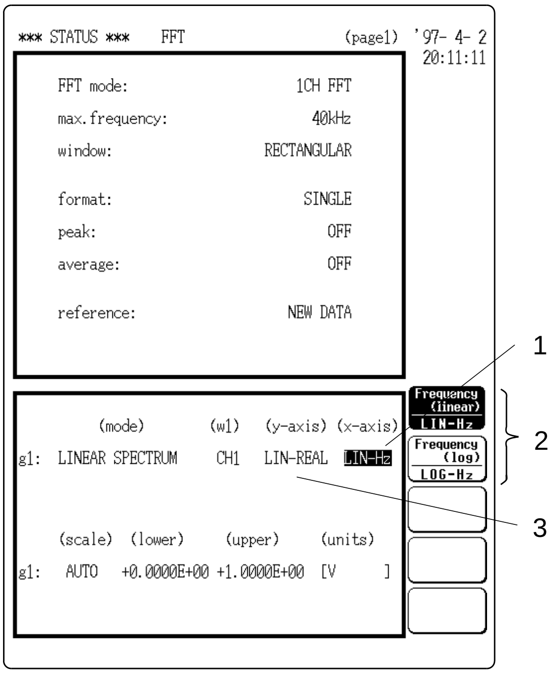
NOTE

For the transfer function and impulse response, calculation is performed from "(w2)/(w1)".

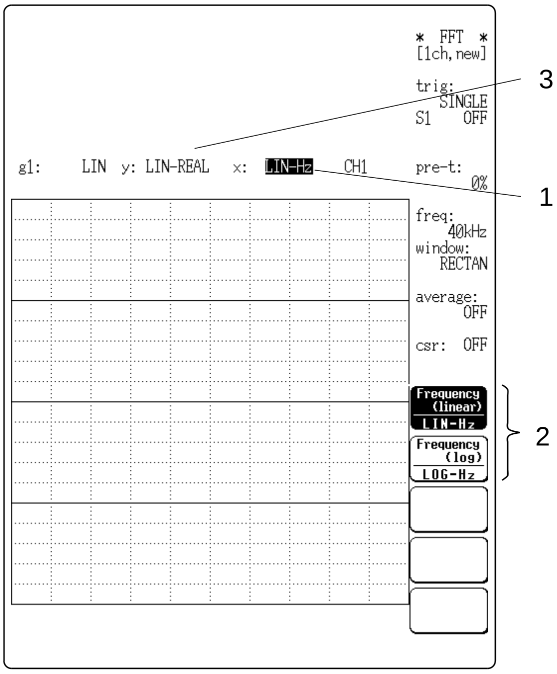
8.2.10 Setting the X-axis and Y-axis Displays

- 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), DISPLAY



```
*** STATUS ***    FFT                      (page1)  '97- 4- 2
                                                     20:11:11
    FFT mode:                       1CH FFT
    max.frequency:                    40kHz
    window:                     RECTANGULAR

    format:                          SINGLE
    peak:                               OFF
    average:                            OFF

    reference:                     NEW DATA

         (mode)          (w1)   (y-axis)  (x-axis)
g1:  LINEAR SPECTRUM      CH1    LIN-REAL   LIN-Hz

     (scale)  (lower)      (upper)      (units)
g1:   AUTO   +0.0000E+00  +1.0000E+00   [V       ]
```



```
                                              *  FFT  *
                                              [1ch,new]
                                              trig:
                                                 SINGLE
                                              S1    OFF
g1:    LIN  y: LIN-REAL   x: LIN-Hz   CH1     pre-t:
                                                     0%
                                              freq:
                                                  40kHz
                                              window:
                                                 RECTAN
                                              average:
                                                    OFF
                                              csr:  OFF
```

1. Move the flashing cursor to the **x-axis** item.
2. Use the function keys to make the selection.
3. For the y-axis, select in the same way as for x-axis.

- **X-axis**

Function key display	Meaning
Frequency (linear) LIN-Hz	: Frequency (linear display)
Frequency (log) LOG-Hz	: Frequency (logalism display)

(when octave analysis)

Function key display	Meaning
1/3 OCT	: 1/3 octave
1/1 OCT	: 1/1 octave

- **Y-axis**

Function key display	Meaning
Real part LIN-REAL	: Real number part (linear display)
Imaginary part LIN-IMAG	: Imaginary number part (linear display)
Magnitude (linear) LIN-MAG	: Amplitude (linear display)
Magnitude (dB) LOG-MAG	: Amplitude (decibel display)
Phase (deg) PHASE	: Phase (degree display)

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

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

8.2.11 Setting the Display Scale

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

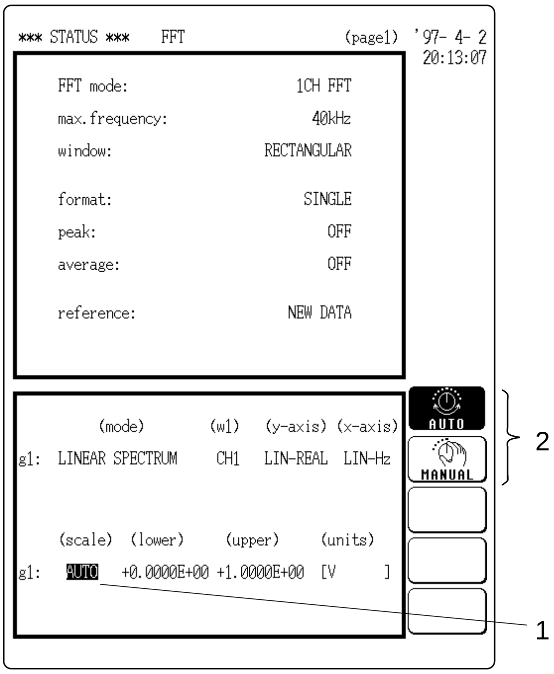
AUTO

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))



```
*** STATUS ***    FFT                    (page1)  '97- 4- 2
                                                  20:13:07
     FFT mode:                        1CH FFT
     max.frequency:                      40kHz
     window:                      RECTANGULAR

     format:                           SINGLE
     peak:                                OFF
     average:                             OFF

     reference:                      NEW DATA

          (mode)          (w1)   (y-axis) (x-axis)
g1:  LINEAR SPECTRUM       CH1    LIN-REAL  LIN-Hz

     (scale)  (lower)      (upper)      (units)
g1:  AUTO     +0.0000E+00  +1.0000E+00  [V       ]
```

1. Move the flashing cursor to the **scale** item.
2. Use the function keys to make the selection.

Function key display	Meaning
	: Scale set automatically.
	: Scale set manually

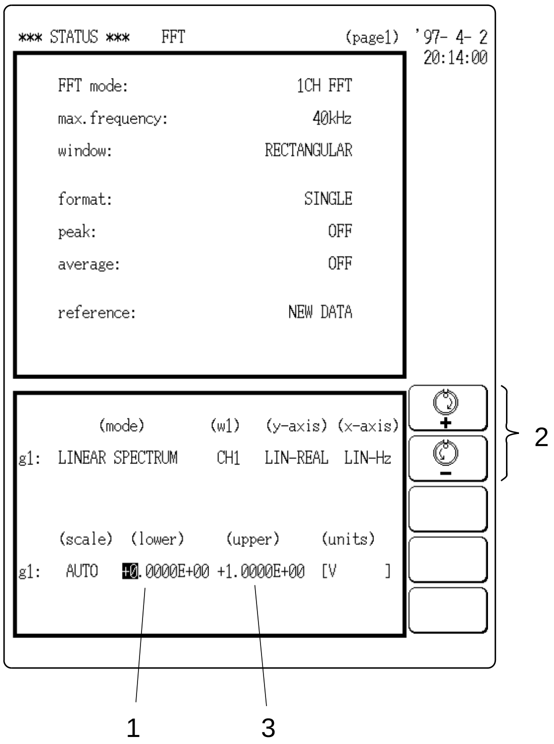
(1) When **AUTO** is selected

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

(2) When **MANUAL** is selected

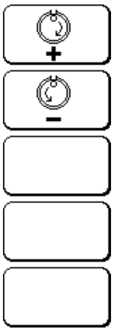
- The upper and lower limits for the display scale can be set by the user.
- Make settings to match processing results.
- Setting range is -9.9999E+29 to 9.9999E+29. (exponent is E-29 to E+29).

Method Screen: STATUS (page 1)



```
*** STATUS ***    FFT                    (page1)  '97- 4- 2
                                                   20:14:00
   FFT mode:                        1CH FFT
   max.frequency:                      40kHz
   window:                       RECTANGULAR

   format:                            SINGLE
   peak:                                 OFF
   average:                              OFF

   reference:                       NEW DATA

        (mode)          (w1)   (y-axis) (x-axis)
g1:  LINEAR SPECTRUM     CH1    LIN-REAL  LIN-Hz

     (scale)  (lower)      (upper)      (units)
g1:   AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```

1. Move the flashing cursor to the **lower** item.
2. Use the JOG control or the function keys to select the lower limit for each digits.
3. Set the upper limit in the same manner.

Function key display	Meaning
	0 to 9 (-9 to +9 for the most significant digit, -29 to +29 for exponent.)

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.

NOTE

The X-axis setting for the histogram can be changed on the channel setting page (page 1) or the variable setting page (page 2) of the CHANNEL screen.

8.2.12 Octave Filter Setting

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

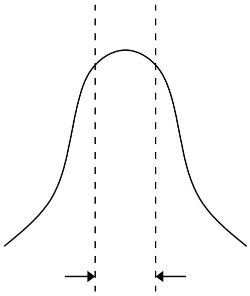
- Normal

  Filter characteristics approximate the characteristics used for conventional octave analyzers with analog filters.

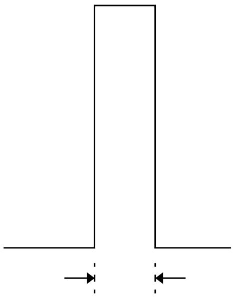
- Sharp

  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.)

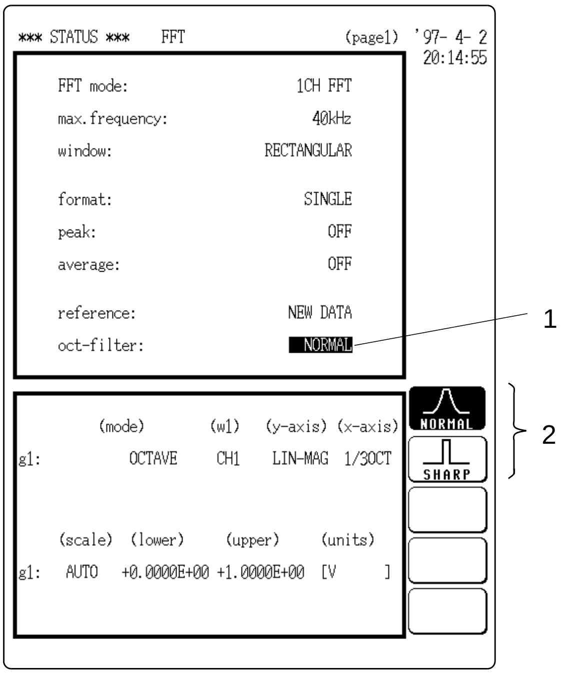


1/1-octave (1/3-octave)
normal filter characteristics



1/1-octave (1/3-octave)
sharp filter characteristics

Method Screen: STATUS (page 1)



```
*** STATUS ***    FFT                              (page1)  '97- 4- 2
                                                            20:14:55
    FFT mode:                          1CH FFT
    max.frequency:                     40kHz
    window:                            RECTANGULAR

    format:                            SINGLE
    peak:                              OFF
    average:                           OFF

    reference:                         NEW DATA
    oct-filter:                        NORMAL

          (mode)       (w1)   (y-axis) (x-axis)
g1:         OCTAVE      CH1    LIN-MAG  1/3OCT

     (scale) (lower)     (upper)      (units)
g1:   AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```

1. When the octave analysis is selected in analysis mode, the **oct-filter** item is shown.
2. Move the flashing cursor to the **oct-filter** item.
3. The function key display appears, allowing you to make the selection.

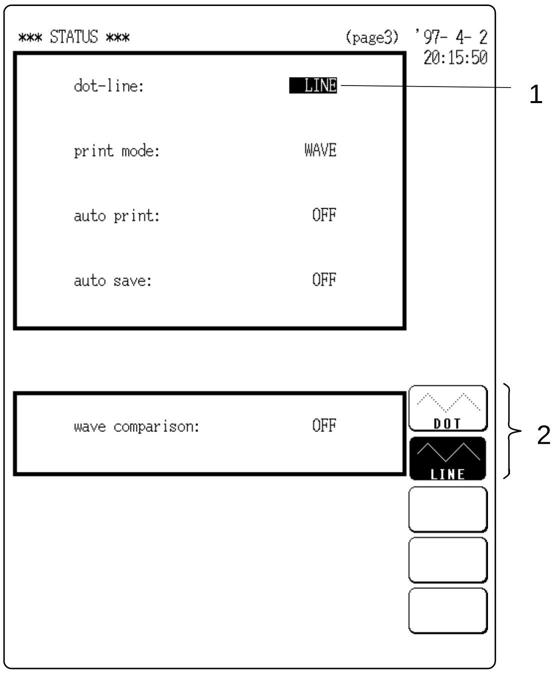
Function key display	Meaning
NORMAL	: Normal filter characteristics
SHARP	: Sharp filter characteristics

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.

8.2.13 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 3)



*** STATUS *** (page3) '97- 4- 2 20:15:50

dot-line: LINE

print mode: WAVE

auto print: OFF

auto save: OFF

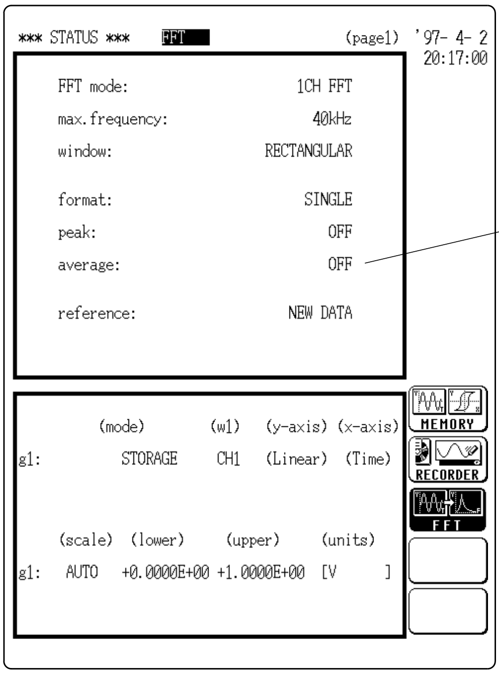
wave comparison: OFF

1. Move the flashing cursor to the **dot-line** item.
2. Use the function keys to make the selection.

Function key display	Meaning
DOT	: Linear interpolation is not performed. The sampled data is displayed just as it comes.
LINE	: Linear interpolation is performed. The display is easier on the eye.

8.2.14 Other Settings

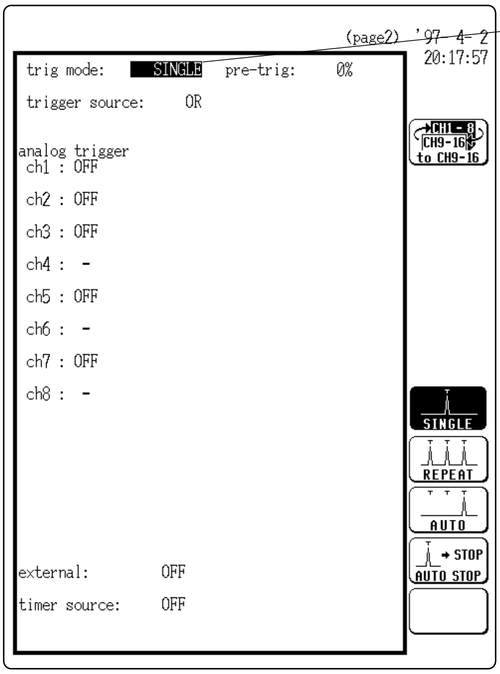
For details, refer to the following sections.



```
*** STATUS ***   FFT                      (page1)  '97- 4- 2
                                                   20:17:00
    FFT mode:                       1CH FFT
    max.frequency:                  40kHz
    window:                         RECTANGULAR

    format:                         SINGLE
    peak:                           OFF
    average:                        OFF

    reference:                      NEW DATA

           (mode)        (w1)   (y-axis)  (x-axis)
g1:        STORAGE       CH1    (Linear)  (Time)


    (scale)  (lower)      (upper)      (units)
g1:  AUTO    +0.0000E+00  +1.0000E+00  [V      ]
```

☞ Chapter 18

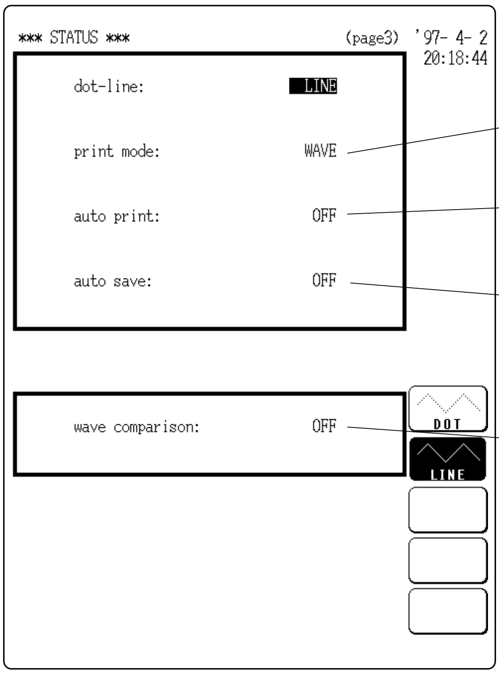
Status Screen (page 1)



```
                                          (page2)  '97- 4- 2
                                                   20:17:57
 trig mode:      SINGLE    pre-trig:      0%
 trigger source:     OR

analog trigger
 ch1 : OFF
 ch2 : OFF
 ch3 : OFF
 ch4 :  -
 ch5 : OFF
 ch6 :  -
 ch7 : OFF
 ch8 :  -



external:         OFF
timer source:     OFF
```

☞ Chapter 10

Status Screen (page 2)



*** STATUS ***
(page3) '97- 4- 2
20:18:44

dot-line: LINE

print mode: WAVE

auto print: OFF

auto save: OFF

wave comparison: OFF

☞ Section 12.2

☞ Section 12.5.2

☞ Section 13.5.1 (2)

Chapter 16

Status Screen (page 3)

8.3 Analysis Function

The following waveform data can be analyzed.

Storage waveform	STR
Linear spectrum	LIN
RMS spectrum	RMS
Power spectrum	PSP
Auto correlation function	ACR
Histogram	HIS
Transfer function	TRF
Cross power spectrum	CSP
Cross correlation function	CCR
Unit impulse response	IMP
Coherence function	COH
Octave analysis	OCT

8.3.1 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

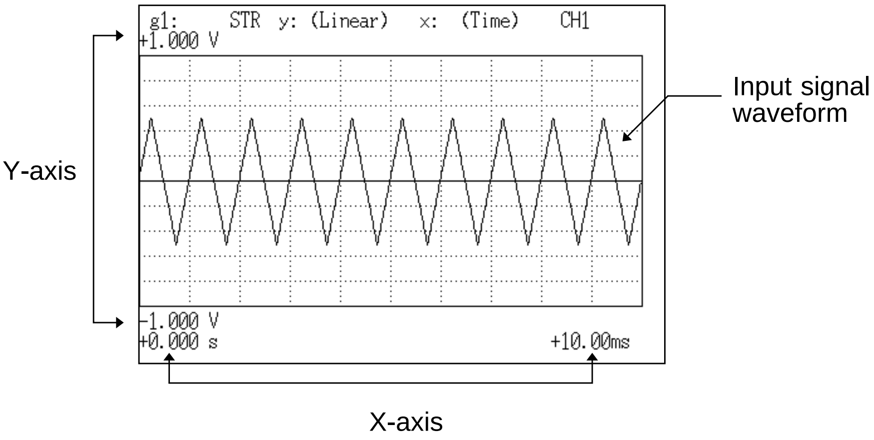
Indicates the value of the specified TIME/DIV frequency range. (Refer to the table of the frequency range and time axis in Section 8.2.3.)

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



8.3.2 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

$$\begin{aligned} Fa &= \Im(fa) \\ &= |Fa|\exp(j\theta a) \\ &= |Fa|\exp(\cos\angle\theta a + j\sin\angle\theta a) \end{aligned}$$

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 range is from 1/400 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)

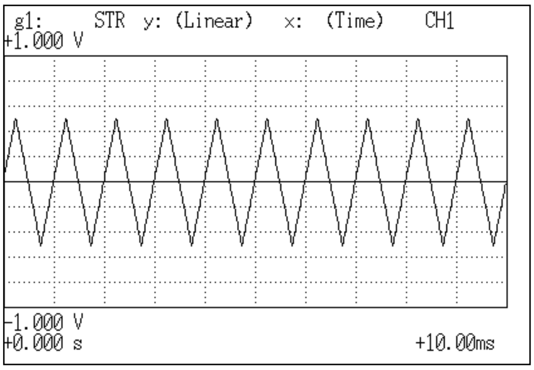
Vertical cursor

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)

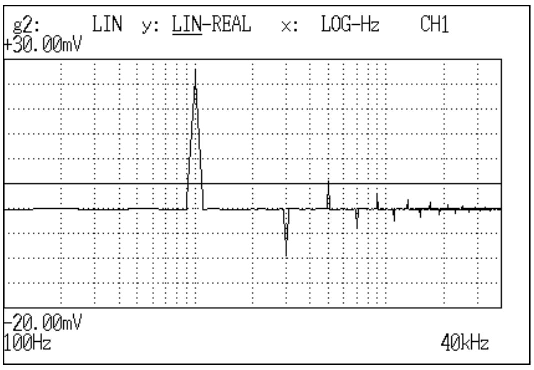
Vertical axis	Display
LIN-REAL (real-number part)	$\lvert Fa\rvert \cdot \cos\angle\theta a$
LIN-IMAG (imaginary-number part)	$\lvert Fa\rvert \cdot \sin\angle\theta a$
LIN-MAG (amplitude)	$\lvert Fa\rvert$
LOG-MAG (logarithmic amplitude)	$20 \cdot \log \lvert Fa\rvert$
PHASE (phase)	$\angle\theta a$

Examples Linear spectra waveforms

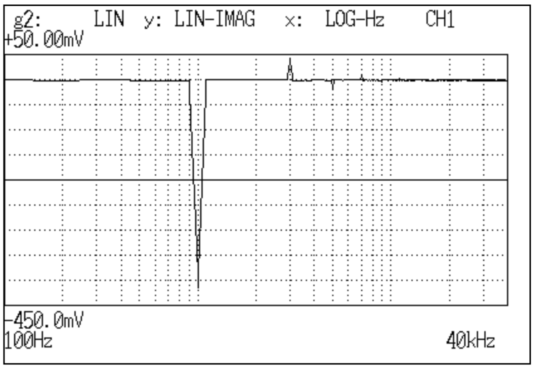
Stored waveform



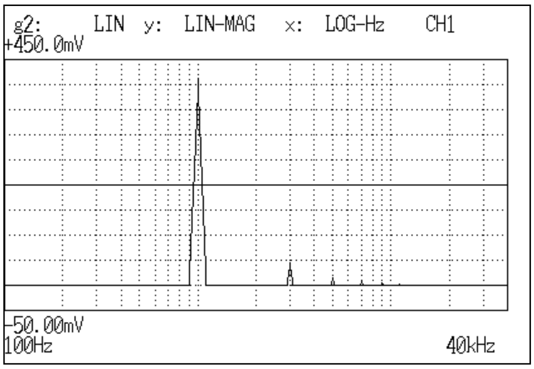
Y-axis: LIN-REAL (X-axis: LOG-Hz)



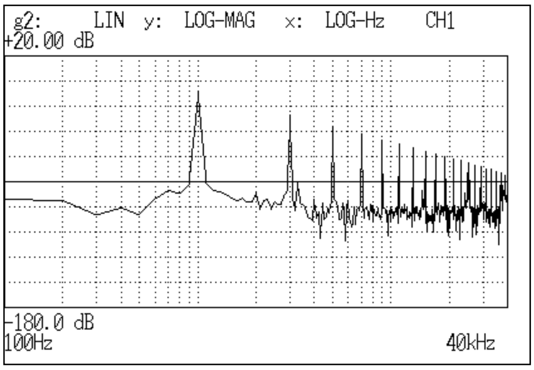
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



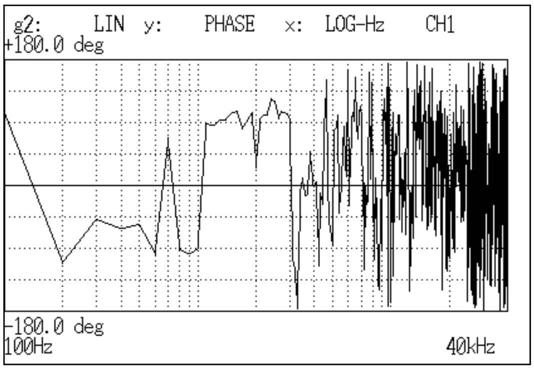
Y-axis: LIN-MAG (X-axis: LOG-Hz)



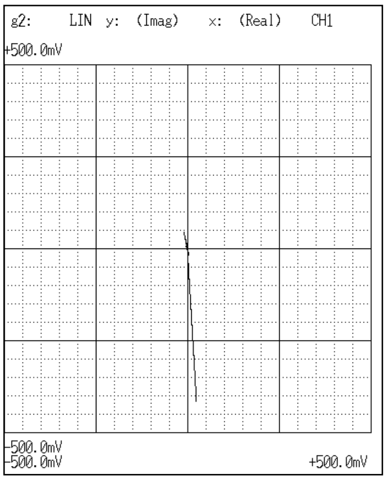
Y-axis: LOG-MAG (X-axis: LOG-Hz)



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



Nyquist



8.3.3 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

$$Ra = \frac{1}{\sqrt{2}} Fa \qquad \text{DC components: } Ra = Fa$$

$$= |Ra| \exp(j\theta a)$$

$$= |Ra| (\cos \angle \theta a + j\sin \angle \theta a)$$

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 range is from 1/400 the maximum frequency range value to the maximum frequency range value.

Vertical cursor

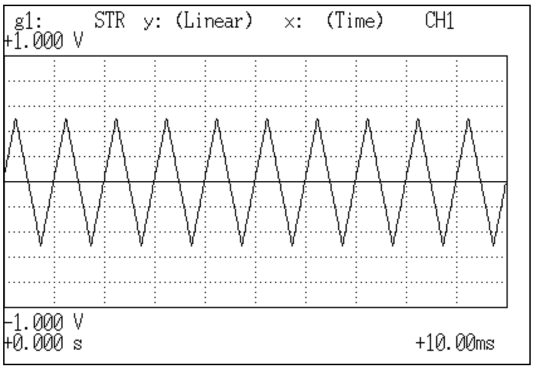
LIN-REAL	Linear display of real-number part of the data as voltage
LIN-IMAG	Linear display of imaginary-number part of the data as voltage
LIN-MAG	Linear display of analysis data as voltage
LOG-MAG	Logarithmic display of analysis data as dB (0dB reference value: 1 Vrms)
PHASE	Degrees (deg) display of phase component of data

Vertical axis	Display
LIN-REAL (real-number part)	$|Ra| \cdot \cos \angle \theta a$
LIN-IMAG (imaginary-number part)	$|Ra| \cdot \sin \angle \theta a$
LIN-MAG (amplitude)	$|Ra|$
LOG-MAG (logarithmic amplitude)	$20 \cdot \log |Ra|$
PHASE (phase)	$\angle \theta a$

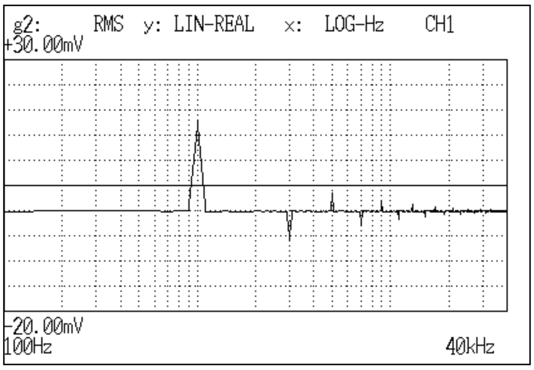
NOTE The RMS spectrum display and the LOG-MAG display express the same processing result.

Example RMS spectra waveform

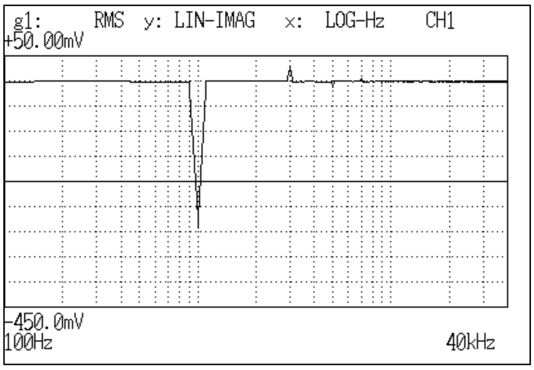
Stored waveform



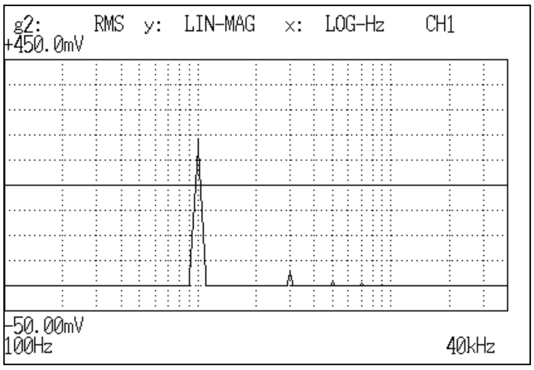
Y-axis: LIN-REAL (X-axis: LOG-Hz)



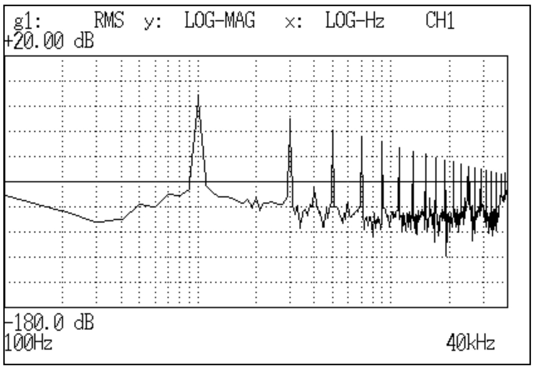
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



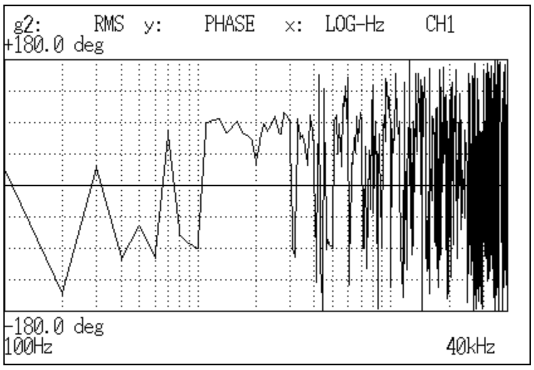
Y-axis: LIN-MAG (X-axis: LOG-Hz)



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



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



8.3.4 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

$$\begin{aligned} Gaa &= \frac{1}{2}\ Fa^{*}\cdot Fa \\ &= \frac{1}{2}\left\{Re^{2}(Fa) + Im^{2}(Fa)\right\} \\ &= \frac{1}{2}\ |Fa| \end{aligned}$$

Fa^{*} : complex conjugate of Fa
Re（Fa）: real number component of Fa
Im（Fa）: imaginary number component of Fa

Dc component:

$$\begin{aligned} Gaa &= Fa^{*}\cdot Fa \\ &= \left\{Re^{2}(Fa) + Im^{2}(Fa)\right\} \\ &= |Fa|^{2} \end{aligned}$$

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 range is from 1/400 the maximum frequency range value to the maximum frequency range value.

Vertical cursor

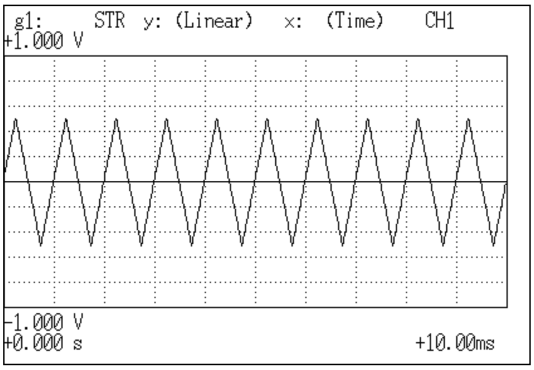
LIN-MAG	Linear display of analysis data as binary exponential voltage This expresses the energy component.
LOG-MAG	Logarithmic display of analysis data as dB (0dB reference value: 1 V^{2} rms)

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)	–

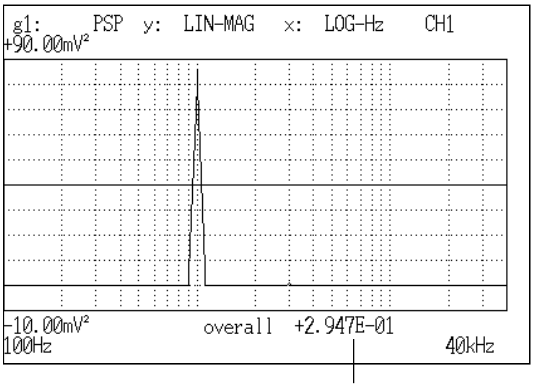
NOTE The LOG-MAG display and the RMS spectrum display express the same processing result.

Example Power spectra waveforms

Stored waveform

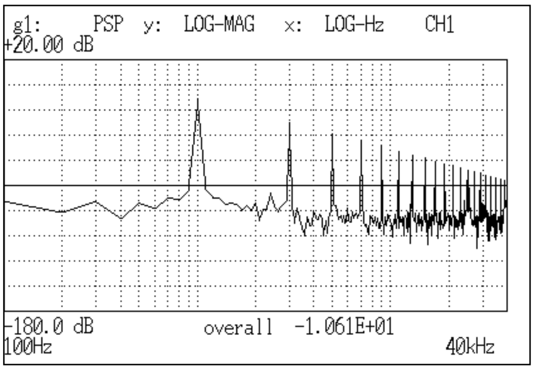


Y-axis: LIN-MAG (X-axis: LOG-Hz)



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 for 1000 points 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 $\alpha = 0.1$.

8.3.5 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 $\mathrm{Raa}(\tau) = \Im^{-1}(\mathrm{Gaa})$

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

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

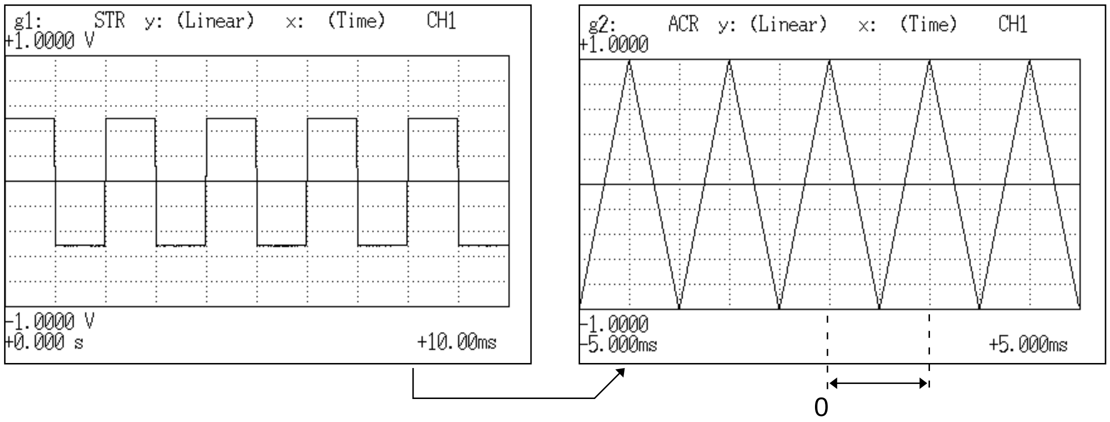
Readings are between +1 and -1 (without units).
+1: the highest similarity for time differential τ
0: the lowest similarity, -1: the polarity is completely opposite.
Due to the characteristics of the function, τ =0 always results in +1.

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.

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

8.3.6 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

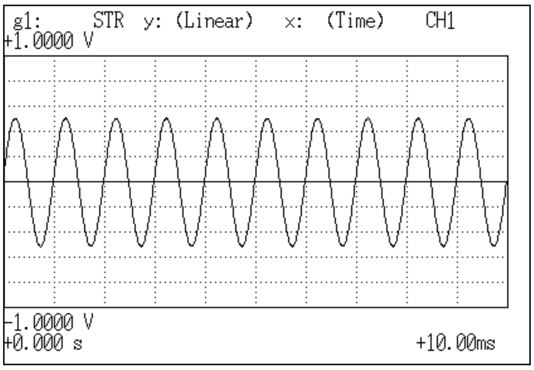
Horizontal cursor Volt — Linear display of the measurement range of the input unit.

Vertical cursor Linear — Number of sample points for the time axis data (total: 1000 points).

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

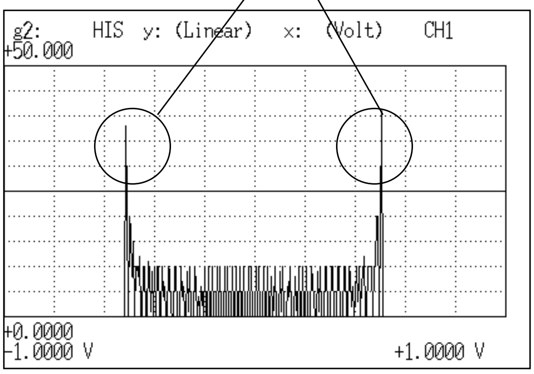
Example Histogram function waveforms

Stored waveform



High amplitude indicates high number of data

Histogram function



8.3.7 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

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

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

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 range is from 1/400 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)

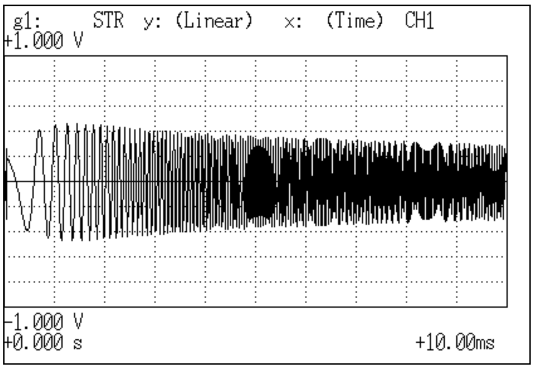
Vertical cursor

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).

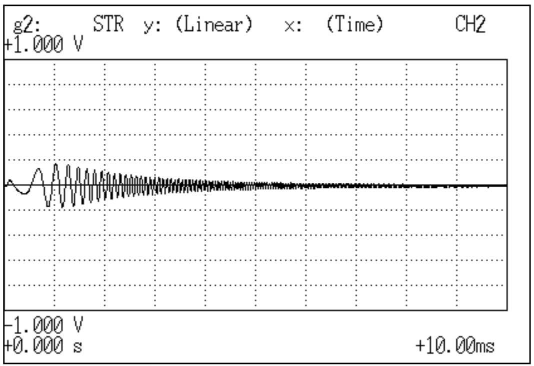
Vertical axis	Display
LIN-REAL (real-number part)	$\|Hab\| \cdot \cos \angle\theta b - \angle\theta a$
LIN-IMAG (imaginary-number part)	$\|Hab\| \cdot \sin \angle\theta b - \angle\theta a$
LIN-MAG (amplitude)	$\|Hab\|$
LOG-MAG (logarithmic amplitude)	$20 \log \|Hab\|$
PHASE (phase)	$\angle\theta b - \angle\theta a$

Example Transfer function spectra waveform

Stored waveform (input signal)

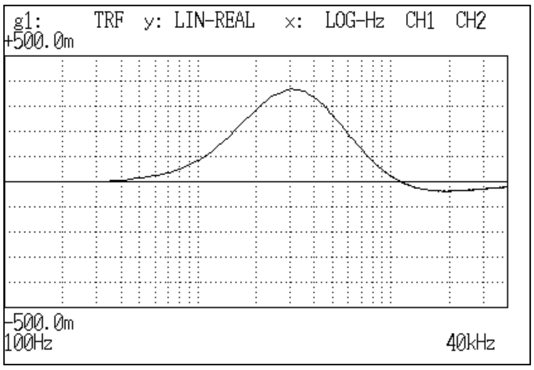


Stored waveform (output signal)

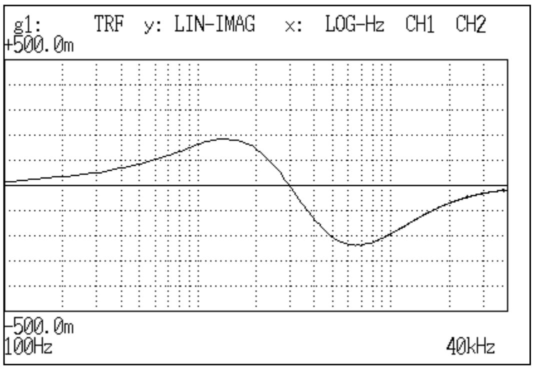


After bandpass filter

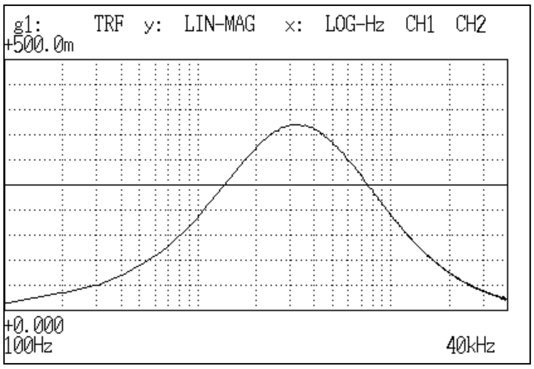
Y-axis: LIN-REAL (X-axis: LOG-Hz)



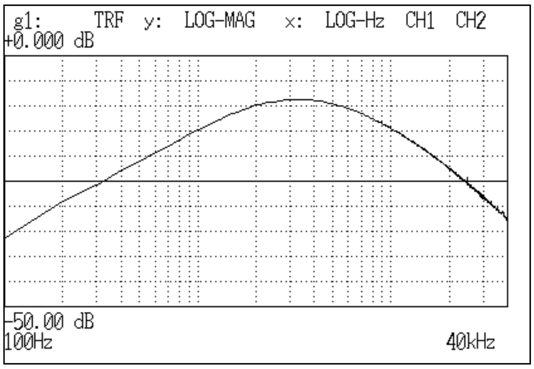
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



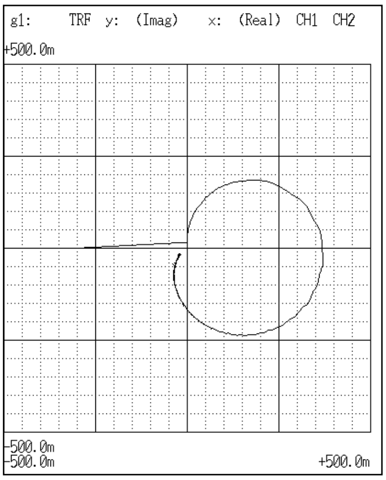
Y-axis: LIN-MAG (X-axis: LOG-Hz)



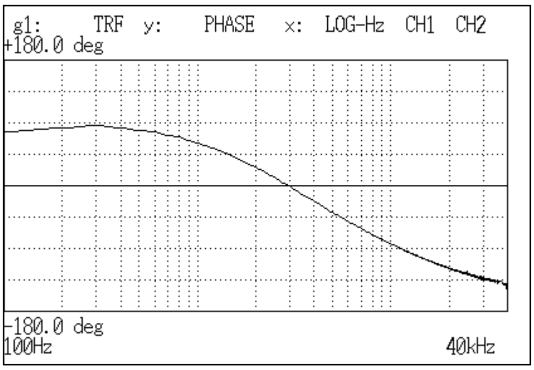
Y-axis: LOG-MAG (X-axis: LOG-Hz)



Nyquist



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



8.3.8 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 range is from 1/400 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).

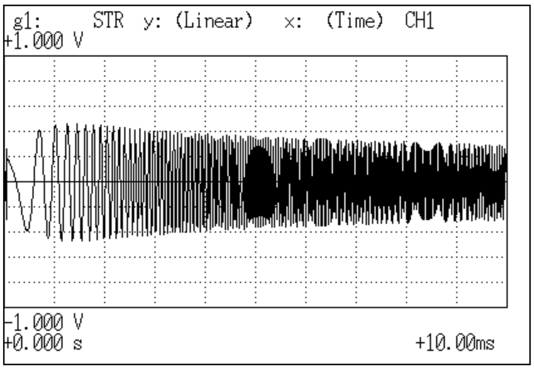
Vertical cursor

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)

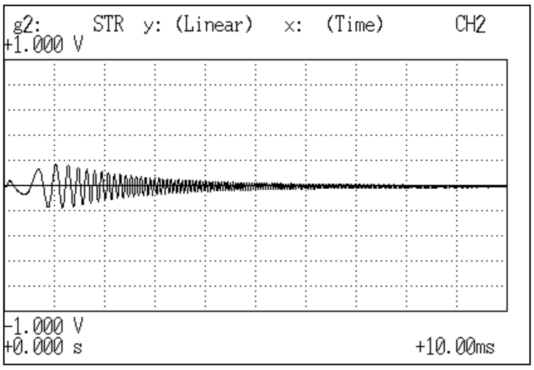
Vertical axis	Display
LIN-REAL (real-number part)	$|Gab| \cdot \cos \angle \theta b - \angle \theta a$
LIN-IMAG (imaginary-number part)	$|Gab| \cdot \sin \angle \theta b - \angle \theta a$
LIN-MAG (amplitude)	$|Gab|$
LOG-MAG (logarithmic amplitude)	$10 \log |Gab|$
PHASE (phase)	$\angle \theta b - \angle \theta a$

Example Cross power spectra waveforms

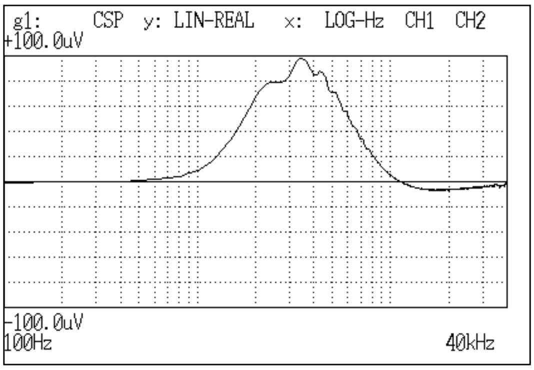
Stored waveform 1



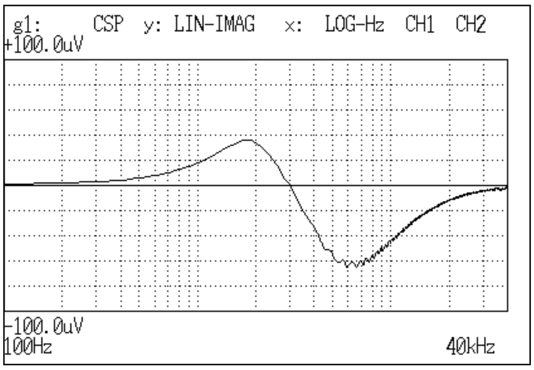
Stored waveform 2



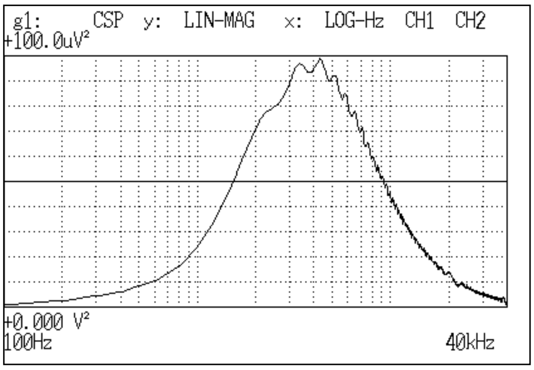
Y-axis: LIN-REAL (X-axis: LOG-Hz)



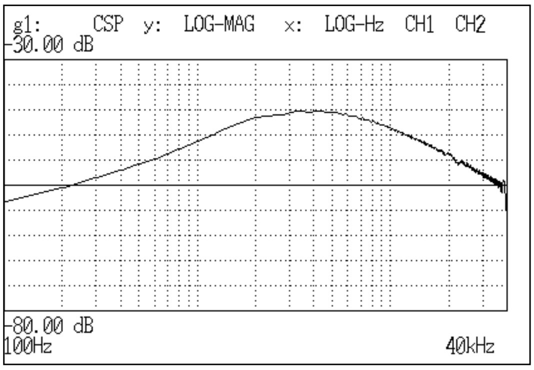
Y-axis: LIN-IMAG (X-axis: LOG-Hz)



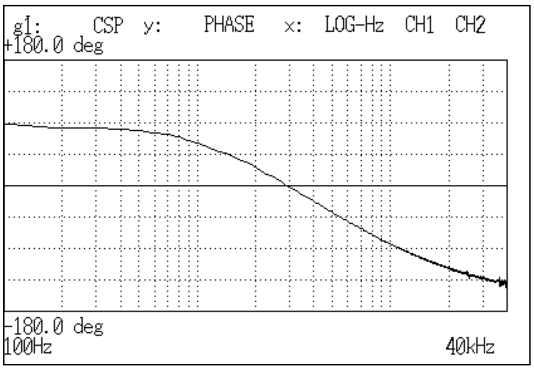
Y-axis: LIN-MAG (X-axis: LOG-Hz)



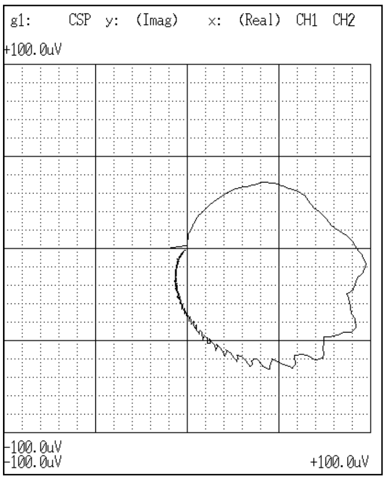
Y-axis: LOG-MAG (X-axis: LOG-Hz)



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



Nyquist



8.3.9 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

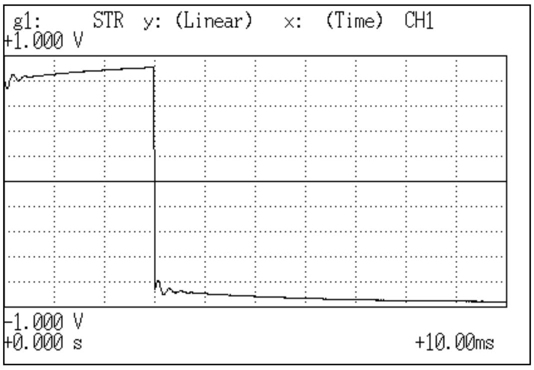
$$\mathrm{Rab}(\tau) = \Im^{-1}(\mathrm{Gab}) = \frac{1}{2\pi}\int_{-\infty}^{+\infty} \mathrm{Gab}(\omega)\exp(j\omega\tau)d\omega$$

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 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

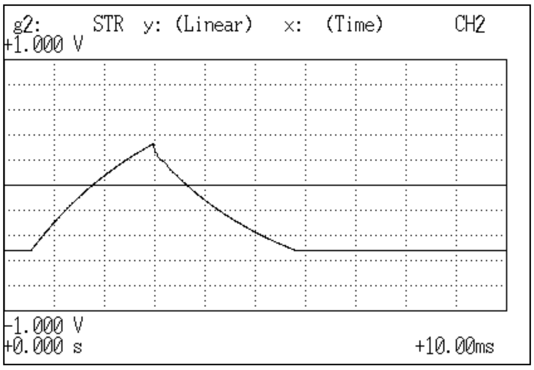
Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	Rab
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Cross correlation function waveforms

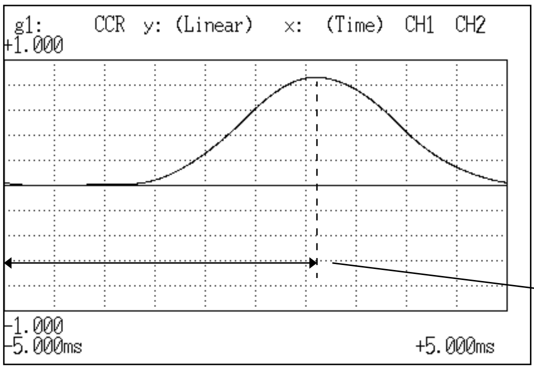
Stored waveform (input waveform)



Stored waveform (output waveform)



Cross correlation function



Phase differences between input signal and output signal

8.3.10 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.

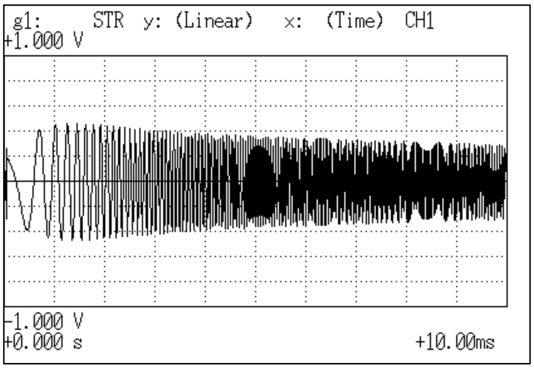
Function IMP = $\Im^{-1}$ (Hab)

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).

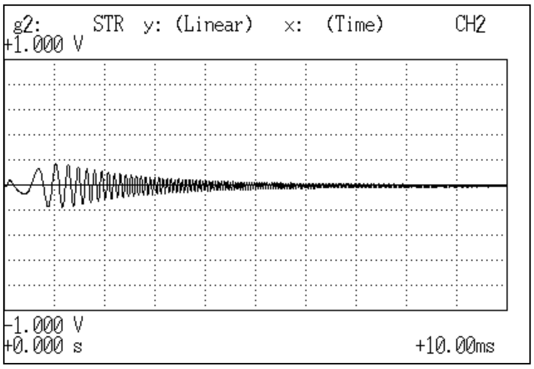
Vertical axis	Display
LIN-REAL (real-number part)	—
LIN-IMAG (imaginary-number part)	—
LIN-MAG (amplitude)	IMP
LOG-MAG (logarithmic amplitude)	—
PHASE (phase)	—

Example Unit impulse response waveforms

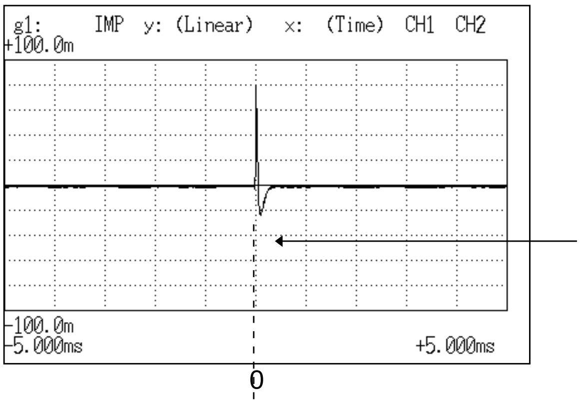
Stored waveform (input signal)



Stored waveform (output signal)



Unit impulse response



Input point of impulse signal

8.3.11 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

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

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 range is from 1/400 the maximum frequency range value to the maximum frequency range value.

Vertical cursor

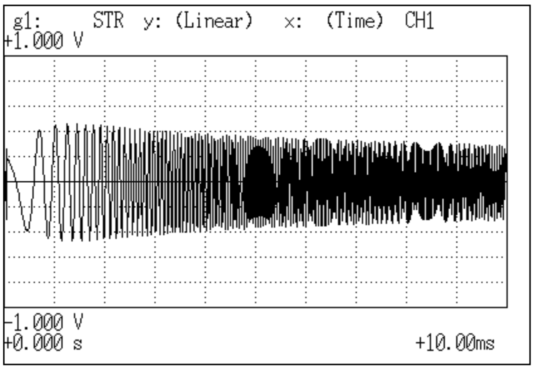
Linear	The relationship between the two input signals. The degree of relationship is indicated from 0 to 1 on a linear scale (no units).

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

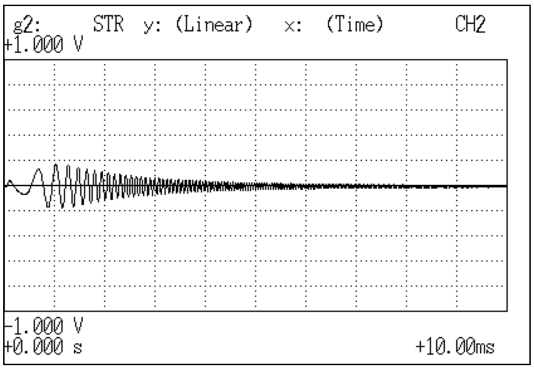
NOTE For a single measurement, the coherence function returns 1 for all frequencies. When measuring, be sure to use frequency averaging.

Example Coherence function waveforms

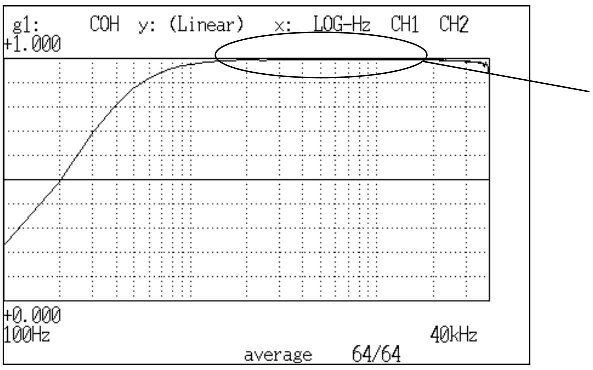
Stored waveform (input signal)



Stored waveform (output signal)



Coherence



Frequencies in this range have high coherence.

8.3.12 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	−

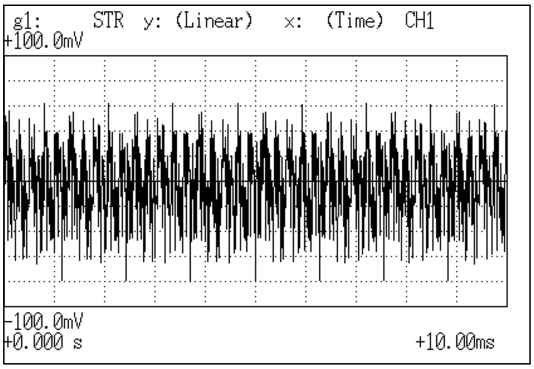
- For frequency analysis of a noise signal or similar, the signal is passed through fixed-ratio band filters with 1/1-octave or 1/3-octave bandwidth.
- As opposed to the power spectrum function, where the signal is divided into bands of identical width and the power in each band is displayed, octave 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 8846, 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 8846 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.

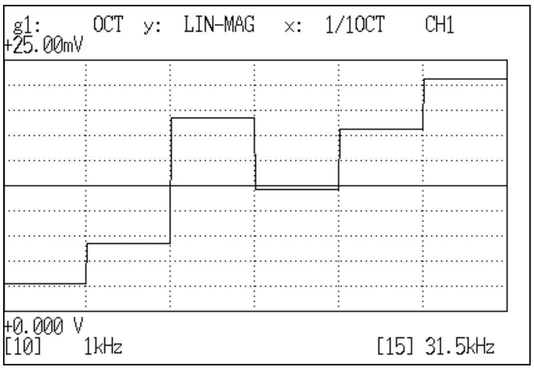
- 5-band 1/1-octave analysis
  In this mode, the 400 spectrum lines of regular frequency analysis are bundled into 1/1 octave bands and shown as a bar graph.

Example Octave analysis waveforms

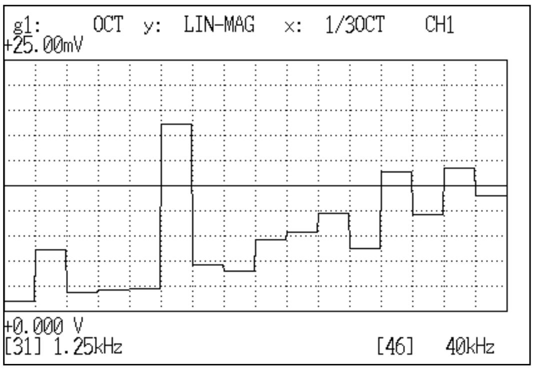
Stored waveform



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	4 m	X																			
	-23	5 m	0X																			
-7	-22	6.3 m	0X																			
	-21	8 m	0X	X																		
	-20	10 m	0X	0X																		
-6	-19	12.5 m	0X	0X																		
	-18	16 m	0X	0X	X																	
	-17	20 m	0X	0X	0X																	
-5	-16	25 m	0X	0X	0X																	
	-15	31.5 m	0X	0X	0X																	
	-14	40 m	0X	0X	0X																	
-4	-13	50 m	0X	0X	0X																	
	-12	63 m	0X	0X	0X	0X																
	-11	80 m	0X	0X	0X	0X																
-3	-10	100 m	0X	0X	0X	0X																
	-9	125 m	0X	0X	0X	0X	0X															
	-8	160 m	0	0X	0X	0X	0X															
-2	-7	200 m		0X	0X	0X	0X															
	-6	250 m		0X	0X	0X	0X	0X														
	-5	315 m		0	0X	0X	0X	0X														
-1	-4	400 m			0X	0X	0X	0X														
	-3	500 m			0X	0X	0X	0X	X													
	-2	630 m			0	0X	0X	0X	0X													
0	-1	800 m				0X	0X	0X	0X													
	0	1				0X	0X	0X	0X	X												
	1	1.25				0X	0X	0X	0X	0X												
1	2	1.6				0X	0X	0X	0X	0X												
	3	2				0X	0X	0X	0X	0X	X											
	4	2.5					0X	0X	0X	0X	0X											
2	5	3.15					0X	0X	0X	0X	0X											
	6	4					0X	0X	0X	0X	0X											
	7	5						0X	0X	0X	0X											
3	8	6.3						0X	0X	0X	0X	0										
	9	8						0X	0X	0X	0X	0X										
	10	10							0X	0X	0X	0X										
4	11	12.5							0X	0X	0X	0X	0									
	12	16							0X	0X	0X	0X	0X									
	13	20							0	0X	0X	0X	0X									
5	14	25								0X	0X	0X	0X	0								
	15	31.5								0X	0X	0X	0X	0X								
	16	40								0	0X	0X	0X	0X								
6	17	50									0X	0X	0X	0X								
	18	63									0X	0X	0X	0X	0X							
	19	80									0	0X	0X	0X	0X							
7	20	100										0X	0X	0X	0X							
	21	125										0X	0X	0X	0X	0X						
	22	160										0X	0X	0X	0X	0X						
8	23	200										0X	0X	0X	0X	0X						
	24	250										X	0X	0X	0X	0X	0X					
	25	315											0X	0X	0X	0X	0X					
9	26	400											0X	0X	0X	0X	0X					
	27	500											X	0X	0X	0X	0X	0X	X			
	28	630												0X	0X	0X	0X	0X	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	800												0X	0X	0X	0X	0X	0X			
	30	1 k												X	0X	0X	0X	0X	0X	0X	X	
	31	1.25 k													0X	0X	0X	0X	0X	0X	0X	
11	32	1.6 k													0X	0X	0X	0X	0X	0X	0X	
	33	2 k													0X	0X	0X	0X	0X	0X	0X	X
	34	2.5 k														0X	0X	0X	0X	0X	0X	0X
12	35	3.15 k														0X	0X	0X	0X	0X	0X	0X
	36	4 k														0X	0X	0X	0X	0X	0X	0X
	37	5 k															0X	0X	0X	0X	0X	0X
13	38	6.3 k															0X	0X	0X	0X	0X	0X
	39	8 k															0X	0X	0X	0X	0X	0X
	40	10 k																0X	0X	0X	0X	0X
14	41	12.5 k																0X	0X	0X	0X	0X
	42	16 k																0X	0X	0X	0X	0X
	43	20 k																	0	0X	0X	0X
15	44	25 k																		0X	0X	0X
	45	31.5 k																		0X	0X	0X
	46	40 k																			0	0X
16	47	50 k																				0X
	48	63 k																				0X
	49	80 k																				0

Chapter 9
Input Channel Settings

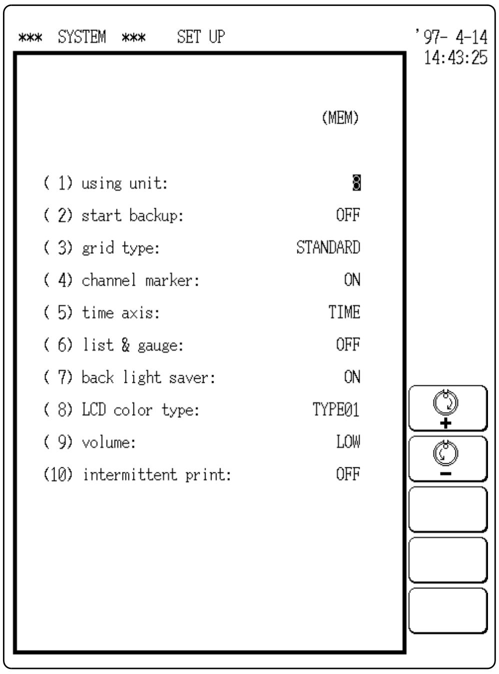
(For all functions)

9.1 Overview

- Input channel settings are made with the CHANNEL screen of each function.
- The 8846 can use up to 16 analog channels or 14 analog and 16 logic channels.
- Settings are made separately for one analog channel or four logic channels (1 probe).
- Using the CH. SET key, channel settings can also be made from the display screen. (☞ Section 20.3).
- Before making input channel settings, use the SYSTEM screen to select the units to be used.

9.2 Selecting Units (SYSTEM Screen)

- Perform this setting before making the input channel settings.
- This setting on the SYSTEM screen determines the number of units in use.
- Use the menu items **SETUP** and **(1) using unit**.
- For details, see Section 11.4.1.



```
***  SYSTEM  ***    SET UP                      '97- 4-14
                                                14:43:25

                                        (MEM)

( 1) using unit:                            8
( 2) start backup:                        OFF
( 3) grid type:                      STANDARD
( 4) channel marker:                       ON
( 5) time axis:                          TIME
( 6) list & gauge:                        OFF
( 7) back light saver:                     ON
( 8) LCD color type:                   TYPE01
( 9) volume:                              LOW
(10) intermittent print:                  OFF
```

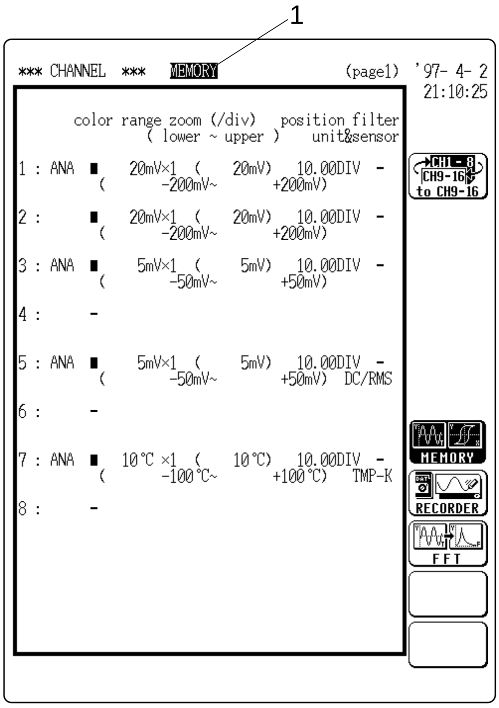
NOTE

- Depending on the number of units in use, the recording length of the memory recorder function differs (☞ Section 6.2.3).
- Depending on the number of units in use, the time axis of the recorder function differs (☞ Section 7.2.3).

9.3 Selecting Functions

- Press the CHAN key to call up the CHANNEL screen.
- Select the function.

Method



```
*** CHANNEL  ***   MEMORY                    (page1)  '97- 4- 2
                                                       21:10:25
       color range zoom (/div)   position filter
                 ( lower ~ upper )    unit&sensor
1 : ANA  ■    20mV×1   (    20mV)   10.00DIV  -
         (        -200mV~        +200mV)
2 :      ■    20mV×1   (    20mV)   10.00DIV  -
         (        -200mV~        +200mV)
3 : ANA  ■     5mV×1   (     5mV)   10.00DIV  -
         (         -50mV~         +50mV)
4 :      -
5 : ANA  ■     5mV×1   (     5mV)   10.00DIV  -
         (         -50mV~         +50mV)  DC/RMS
6 :      -
7 : ANA  ■   10℃ ×1   (    10℃)   10.00DIV  -
         (        -100℃~        +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the position shown in the figure.
2. Use the function keys to make the selection.

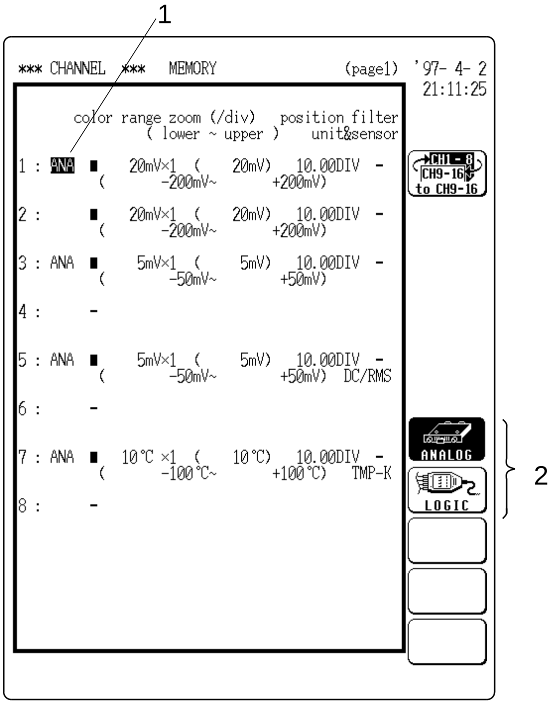
Function key display	Meaning
MEMORY	: Memory recorder function
RECORDER	: Recorder function
FFT	: FFT function

9

9.4 Selecting the Input Type

Specifies whether analog input or logic input is used for each channel.

Method Screen: STATUS (page 1), CHANNEL (page 1), DISPLAY)



```
*** CHANNEL  ***   MEMORY                    (page1)  '97- 4- 2
                                                       21:11:25
     color range zoom (/div)    position filter
              ( lower ~ upper )     unit&sensor
1 : ANA  ■   20mV×1   (    20mV)   10.00DIV  -
         (       -200mV~         +200mV)
2 :      ■   20mV×1   (    20mV)   10.00DIV  -
         (       -200mV~         +200mV)
3 : ANA  ■    5mV×1   (     5mV)   10.00DIV  -
         (        -50mV~          +50mV)
4 :      -
5 : ANA  ■    5mV×1   (     5mV)   10.00DIV  -
         (        -50mV~          +50mV)   DC/RMS
6 :      -
7 : ANA  ■   10℃ ×1   (    10℃)   10.00DIV  -
         (       -100℃~          +100℃)    TMP-K
8 :      -
```

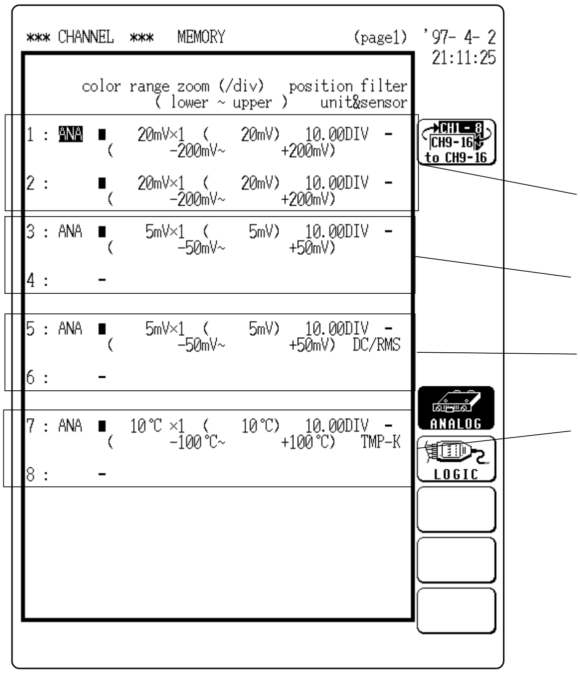
1. Move the flashing cursor to a channel with an odd number, as shown in the illustration.
2. Use the function keys to make the selection.

- If a unit is installed in specified channel

Function key display		Meaning
ANALOG	:	Select analog input
LOGIC	:	Select logic input

- If no unit is installed in specified channel

Function key display		Meaning
--- NO USE	:	Set channel to non-use
LOGIC	:	Select logic input



```
*** CHANNEL  ***   MEMORY                    (page1)  '97- 4- 2
                                                       21:11:25
     color range zoom (/div)    position filter
              ( lower ~ upper )     unit&sensor
1 : ANA  ■   20mV×1   (    20mV)   10.00DIV  -
         (       -200mV~         +200mV)
2 :      ■   20mV×1   (    20mV)   10.00DIV  -
         (       -200mV~         +200mV)
3 : ANA  ■    5mV×1   (     5mV)   10.00DIV  -
         (        -50mV~          +50mV)
4 :      -
5 : ANA  ■    5mV×1   (     5mV)   10.00DIV  -
         (        -50mV~          +50mV)   DC/RMS
6 :      -
7 : ANA  ■   10℃ ×1   (    10℃)   10.00DIV  -
         (       -100℃~          +100℃)    TMP-K
8 :      -
```

Channel where 8927 is installed

Channel where 8916 is installed

Channel where 8917 is installed

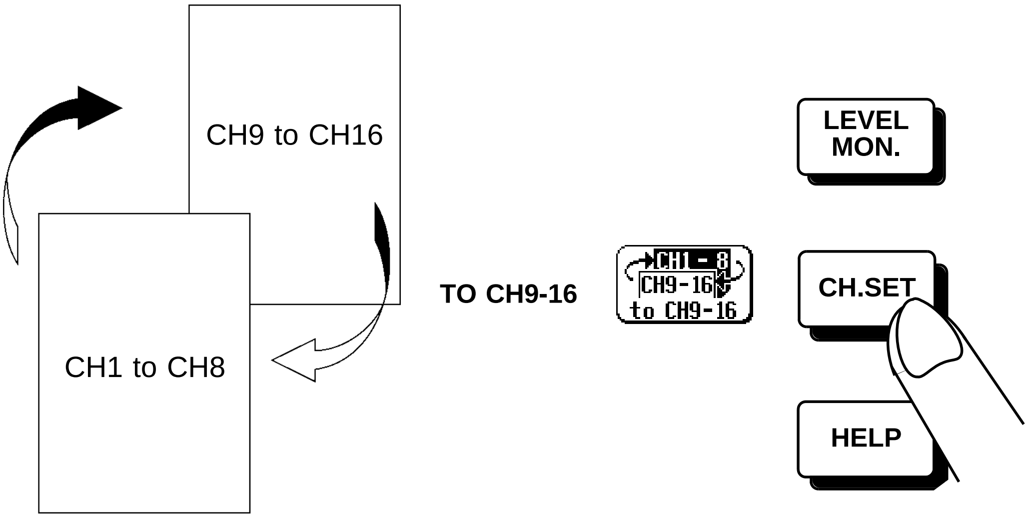
Channel where 8918 is installed

NOTE

- When the units 8916 - 8919 are installed, even channel numbers cannot be used. (Example: If an 8916 unit is installed in CH1/CH2, CH2 cannot be used.)
- When a logic input has been assigned to an odd channel number, the next even channel number cannot be used. (Example: If CH3 has been set to logic input, CH4 cannot be used.)
- If an odd channel number has been assigned to "Microphone" in the recorder function, the next even channel number cannot be used. (Microphone setting: ☞ Section 7.2.8)
- One unit of the 8928 corresponds to two units of the 8916 to 8919.

Switching the setting screen between CH1-CH8 and CH9- CH16

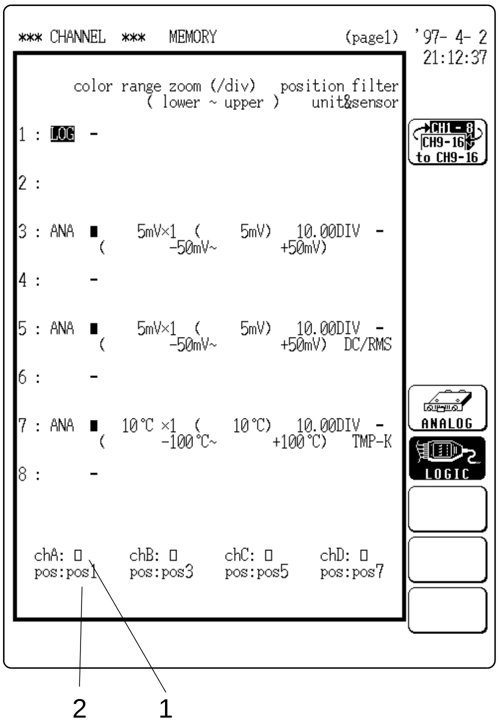
While the CHANNEL screen is displayed, use the CH. SET key to switch the display between CH1-CH8 and CH9- CH16.



9.5 Making Logic Input Settings (FFT Excluded)

- When a channel has been set to logic input as described in Section 9.4, the logic channel setting items are displayed.
- Select the display positions for CH A - CH D (1 probe).

Method



```
*** CHANNEL  ***   MEMORY                 (page1)  '97- 4- 2
                                                    21:12:37
      color range zoom (/div)   position filter
              ( lower ~ upper )    unit&sensor
1 : LOG  -

2 :

3 : ANA ■    5mV×1  (     5mV)   10.00DIV  -
         (        -50mV~        +50mV)

4 :      -

5 : ANA ■    5mV×1  (     5mV)   10.00DIV  -
         (        -50mV~        +50mV)  DC/RMS

6 :      -

7 : ANA ■  10℃ ×1  (    10℃)   10.00DIV  -
         (        -100℃~      +100℃)   TMP-K

8 :      -


  chA: □        chB: □        chC: □        chD: □
  pos:pos1      pos:pos3      pos:pos5      pos:pos7
```

1. Specify the display colors for each channel (☞ Section 9.6.1).
2. Specify the display position for the logic waveform.

Function key display		Meaning
POSITION 1	:	Position 1
POSITION 2	:	Position 2
POSITION 3	:	Position 3
POSITION 4	:	Position 4
to page 2/2	:	Switch to page 2/2

Function key display		Meaning
POSITION 5	:	Position 5
POSITION 6	:	Position 6
POSITION 7	:	Position 7
POSITION 8	:	Position 8
to page 1/2	:	Switch to page 1/2

NOTE For channels where a logic waveform is recorded, the indication **logic** is shown at the (/div) location.

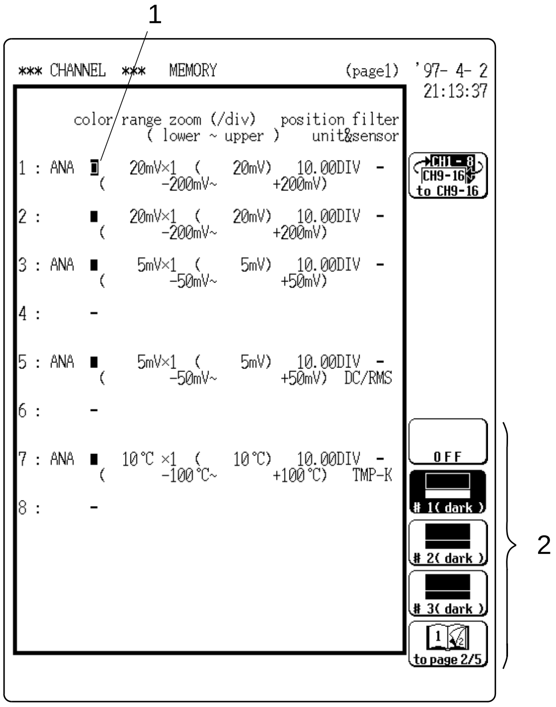
9.6 Making Analog Input Settings

9.6.1 Waveform Display Color (FFT Excluded)

Set the display color for the waveform.

Method

1. Move the flashing cursor to the point shown in the illustration.
2. Use the function keys to make the selection.
   The indication in brackets refers to the printout color (dark, medium dark, normal, light).



```
*** CHANNEL  ***   MEMORY                 (page1)  '97- 4- 2
                                                    21:13:37
      color range zoom (/div)    position filter
              ( lower ~ upper )     unit&sensor
1 : ANA ■    20mV×1  (     20mV)   10.00DIV  -
         (        -200mV~      +200mV)
2 :     ■    20mV×1  (     20mV)   10.00DIV  -
         (        -200mV~      +200mV)
3 : ANA ■     5mV×1  (      5mV)   10.00DIV  -
         (         -50mV~       +50mV)
4 :     -
5 : ANA ■     5mV×1  (      5mV)   10.00DIV  -
         (         -50mV~       +50mV)  DC/RMS
6 :     -
7 : ANA ■   10℃ ×1  (     10℃)   10.00DIV  -
         (        -100℃~      +100℃)   TMP-K
8 :     -
```

- **1/5**

Function key display	Meaning
OFF	No waveform display
# 1(dark)	Color 1 (dark)
# 2(dark)	Color 2 (dark)
# 3(dark)	Color 3 (dark)
to page 2/5	Switch to page 2/5

- **2/5**

Function key display	Meaning
# 4(dark)	Color 4 (dark)
# 5(M-dark)	Color 5 (medium dark)
# 6(M-dark)	Color 6 (medium dark)
# 7(M-dark)	Color 7 (medium dark)
to page 3/5	Switch to page 3/5

- **3/5**

Function key display	Meaning
# 8(M-dark)	Color 8 (medium dark)
# 9(norm)	Color 9 (normal)
#10(norm)	Color 10 (normal)
#11(norm)	Color 11 (normal)
to page 4/5	Switch to page 4/5

- **4/5**

Function key display	Meaning
#12(norm)	: Color 12 (normal)
#13(light)	: Color 13 (light)
#14(light)	: Color 14 (light)
#15(light)	: Color 15 (light)
to page 5/5	: Switch to page 5/5

- **4/5**

Function key display	Meaning
#16(light)	: Color 16 (light)
to page 1/5	: Switch to page 1/5

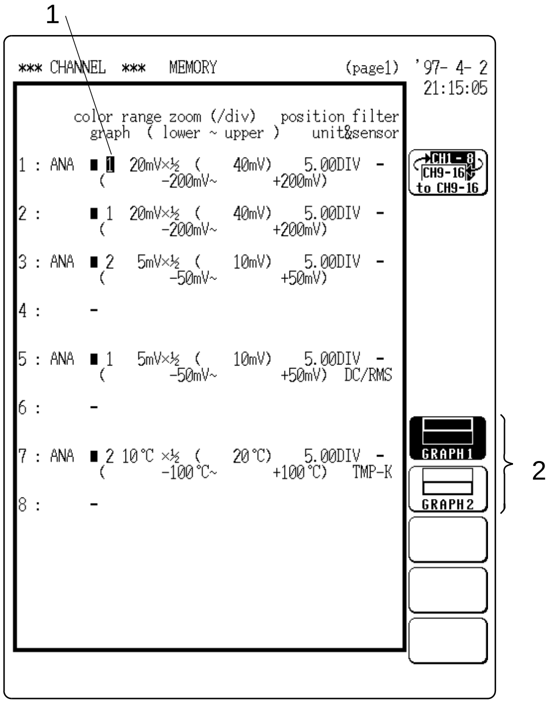
NOTE

- When the display color is changed using the **SETUP** item on the SYSTEM screen, the waveform display color also changes.
- When the copy function was used to copy settings between the temperature unit (8918) and other units (8916, 8917, 8919, 8927, 8928) (☞ Section 9.6.11), only the waveform display color and the display graph type are copied.
- The FFT waveform display color is fixed to color 1.

9.6.2 Display Graph Type (FFT Excluded)

- Specify which graph type to use when display format has been set to DUAL, QUAD, or OCT screen display on the STATUS screen.
- When the display format has been set to SINGLE, this item is not available.
- When the display format has been set to XY SINGLE or XY DUAL display, refer to Section 6.2.5.

Method



```
*** CHANNEL  ***   MEMORY                (page1) '97- 4- 2
                                                 21:15:05
      color range zoom (/div)   position filter
        graph  ( lower ~ upper )    unit&sensor
1 : ANA  ■ 1  20mV×½  (    40mV)    5.00DIV  -
          (        -200mV~       +200mV)
2 :      ■ 1  20mV×½  (    40mV)    5.00DIV  -
          (        -200mV~       +200mV)
3 : ANA  ■ 2   5mV×½  (    10mV)    5.00DIV  -
          (         -50mV~        +50mV)
4 :      -
5 : ANA  ■ 1   5mV×½  (    10mV)    5.00DIV  -
          (         -50mV~        +50mV)  DC/RMS
6 :      -
7 : ANA  ■ 2 10℃ ×½  (    20℃)    5.00DIV  -
          (        -100℃~       +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the position shown in the figure.
2. Use the function keys to make the selection.

- **1/2**

Function key display	Meaning
GRAPH1	: Graph 1
GRAPH2	: Graph 2
GRAPH3	: Graph 3 (*1)
GRAPH4	: Graph 4 (*1)
1 2 to page 2/2	: Switch to page 2/2 (*2)

- **2/2**

Function key display	Meaning
GRAPH5	: Graph 5 (*2)
GRAPH6	: Graph 6 (*2)
GRAPH7	: Graph 7 (*2)
GRAPH8	: Graph 8 (*2)
1 2 to page 1/2	: Switch to page 1/2. (*2)

(*1): Setting available when "quad" or "octo" screen display has been selected.
(*2): Setting only available when "octo" screen display has been selected.

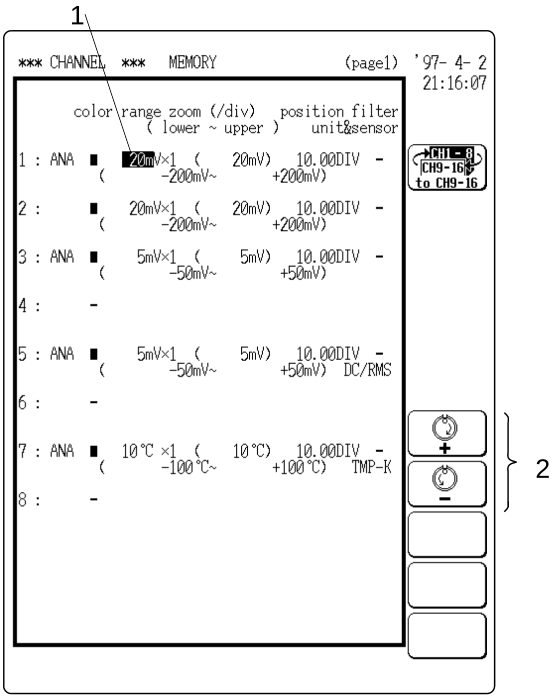
NOTE

When the copy function was used to copy settings between the temperature unit (8918) and other units (8916, 8917, 8919, 8927, 8928) (☞ Section 9.6.11), only the waveform display color and the display graph type are copied.

9.6.3 Setting the Voltage Axis, Temperature Axis, Strain Axis Ranges

- Set the voltage axis range for each channel.
- The voltage axis range is the voltage unit per 1 DIV on the vertical axis (when magnification/compression is set to 1).
- The available settings depend on the type of unit that is installed.
- When histogram analysis of the FFT function is used, the range setting affects the X-axis.

Method



```
*** CHANNEL  ***   MEMORY                (page1) '97- 4- 2
                                                  21:16:07
      color range zoom (/div)   position filter
               ( lower ~ upper )   unit&sensor
1 : ANA  ■   20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~       +200mV)
2 :      ■   20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~       +200mV)
3 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
          (        -50mV~        +50mV)
4 :      -
5 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
          (        -50mV~        +50mV)  DC/RMS
6 :      -
7 : ANA  ■  10℃ ×1  (    10℃)   10.00DIV  -
          (       -100℃~        +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the **range** item.
2. Use the JOG control or the function keys to select the range.

Function key display	Meaning
+	(When using the 8916, 8917, 8919) 5, 10, 20, 50, 100, 200, 500 mV 1, 2, 5, 10, 20 V
−	
	(When using the 8927) 20, 50, 100, 200, 500 mV, 1 V
	(When using the 8918) 10, 20, 50℃
+	(When using the 8928) 20, 50, 100, 200, 500, 1000 με
−	
auto balance THIS·CH	: Carries out auto-balancing for the selected channel only.
auto balance ALL·CH	: Carries out auto-balancing for all of the strain unit channels.

NOTE When the histogram analysis of the FFT function is used, the change in voltage axis (X axis) only becomes active after a restart.

Auto-balancing

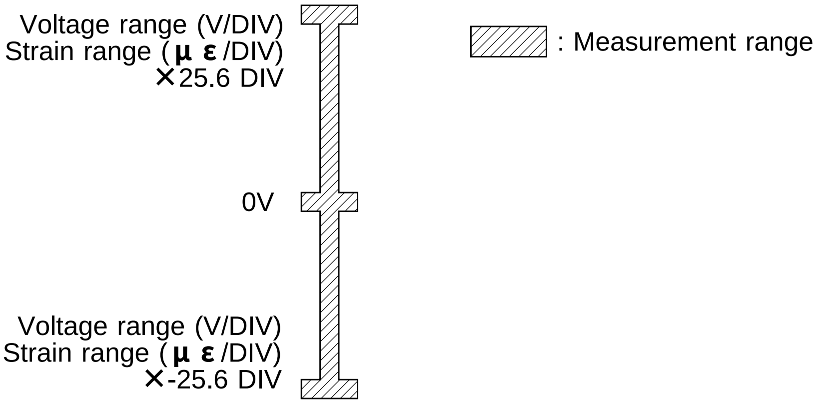
Align the reference output level of the adapter with the specified origin position. (Zero position ☞ Section 9.6.6)

NOTE

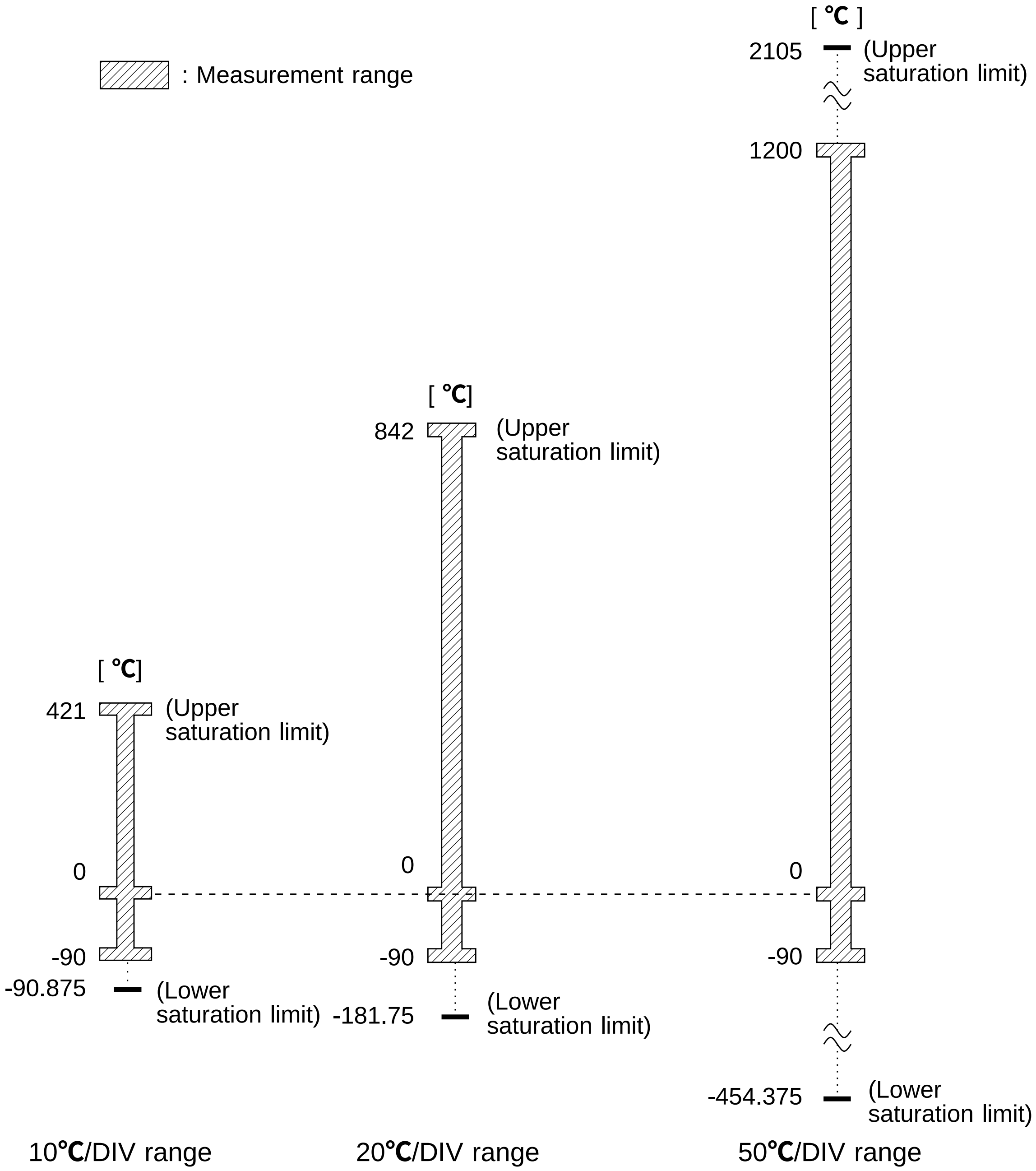
- Auto-balancing is carried out for the strain units only. It is not carried out for other input units (8916, 8917, 8918, 8919, and 8927).
- When the next setting or change is made, carry out auto-balancing again. Changing the setting range, changing the strain gauge adapter, change of reference state, powering on, or unit replacement

Measurement voltage range

With 8916, 8917, 8919, 8927, 8928:



With 8918:



NOTE

- When the input has exceeded the lower measurement limit of the thermocouple, the display extends fully to the lower saturation level.
- When the input has exceeded the upper measurement limit of the thermocouple, or if burnout has occurred, the display extends fully to the upper saturation level.

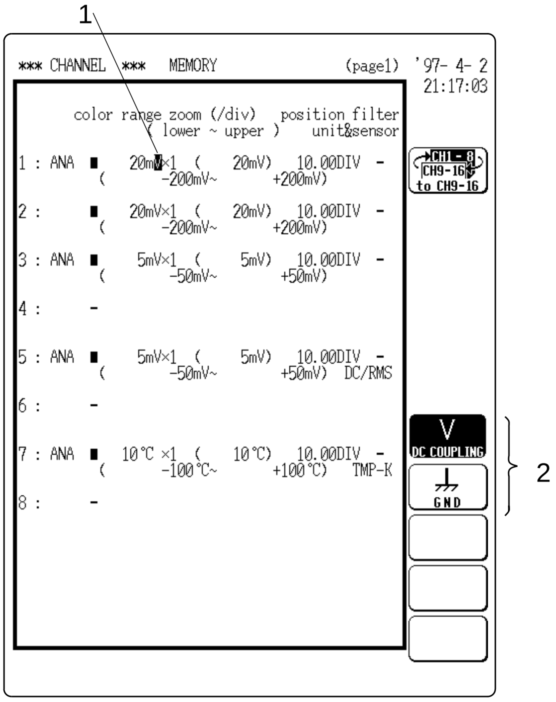
Thermocouple types and measurement range

K(CA)	-90 to 1200℃
J(IC)	-90 to 800℃
T(CC)	-90 to 400℃

9.6.4 Setting the Input Coupling (Not Required for 8918, 8928)

- For the 8917 DC/RMS unit, two types of input coupling (DC or RMS conversion) can be selected.
- The ground level can be checked.
- This item does not appear for channels set to the 8918 TEMPERATURE UNIT.

Method



```
*** CHANNEL  ***    MEMORY                     (page1)  '97- 4- 2
                                                         21:17:03
         color range zoom (/div)    position filter
                     ( lower ~ upper )    unit&sensor
1 : ANA  ■     20mV×1   (     20mV)   10.00DIV  -
          (        -200mV~         +200mV)
2 :      ■     20mV×1   (     20mV)   10.00DIV  -
          (        -200mV~         +200mV)
3 : ANA  ■      5mV×1   (      5mV)   10.00DIV  -
          (         -50mV~          +50mV)
4 :      -
5 : ANA  ■      5mV×1   (      5mV)   10.00DIV  -
          (         -50mV~          +50mV)  DC/RMS
6 :      -
7 : ANA  ■    10℃ ×1   (     10℃)   10.00DIV  -
          (        -100℃~         +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the position as shown in the figure.
2. Use the function keys to select the input coupling.

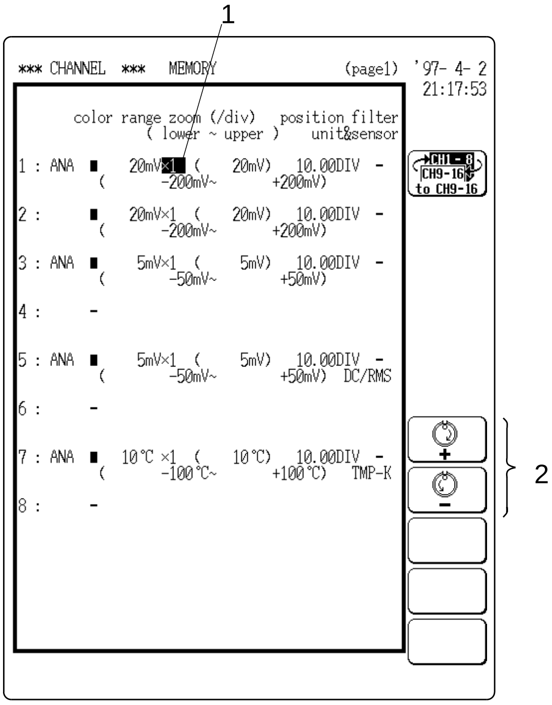
Function key display	Meaning
V DC COUPLING	: The input signal is directly connected to the amplifier. This allows a DC component to be measured.
GND	: The input signal is not connected. This allows the zero position to be checked.
V RMS	: The input signal is converted to a real effective value (8917 only).
RMS-GND	: The ground in RMS mode is displayed. (8917 only).

NOTE When one channel of the 8927 analog unit has been set to **GND**, the setting for the other channel automatically also becomes **GND**.

9.6.5 Setting Voltage Axis, Temperature Axis, and Strain Axis Magnification/ Compression

- Set the magnification/compression ratio for each channel.
- Magnification/compression can be used to make the waveform easy to read.
- When histogram analysis of the FFT function is used, the magnification/compression setting affects the X axis.
- When wishing to set the voltage axis to an arbitrary magnification/ compression value, refer to Section 9.6.10.

Method

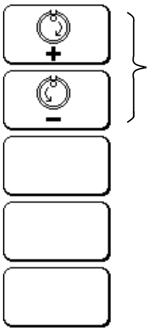


```
*** CHANNEL  ***   MEMORY                  (page1)  '97- 4- 2
                                                     21:17:53
      color range zoom (/div)   position filter
               ( lower ~ upper )    unit&sensor
1 : ANA  ■   20mV×1  (    20mV)   10.00DIV  -
         (       -200mV~       +200mV)
2 :      ■   20mV×1  (    20mV)   10.00DIV  -
         (       -200mV~       +200mV)
3 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
         (        -50mV~        +50mV)
4 :      -
5 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
         (        -50mV~        +50mV)  DC/RMS
6 :      -
7 : ANA  ■  10℃ ×1  (    10℃)   10.00DIV  -
         (       -100℃~       +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the position as shown in the figure.
2. Use the function keys to make the selection.

Function key display

Meaning



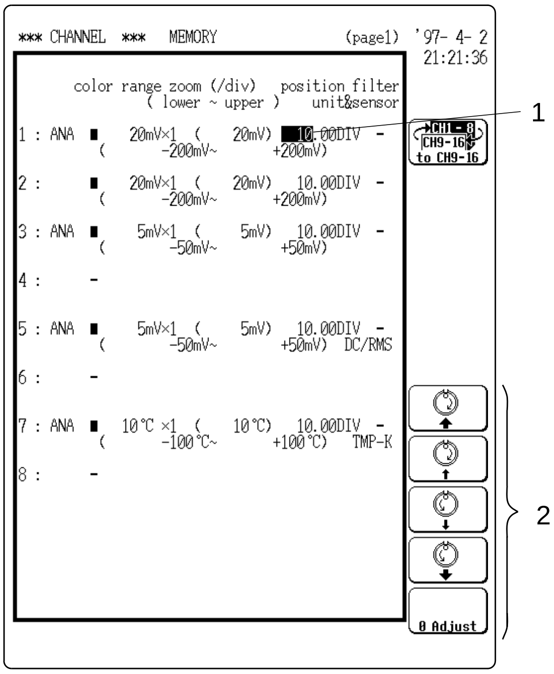
×20, ×10, ×5, ×2, ×1, ×1/2, ×1/5, ×1/10

NOTE Based on the voltage axis range and the magnification/compression, the display range (/div) is determined.

9.6.6 Setting the Zero Position

- This setting determines the DIV position at which the 0 V, 0 ℃, or 0 μ ε is located for each channel.
- The available setting range depends on the magnification/compression setting.
- When histogram analysis of the FFT function is used, the setting affects the X axis.

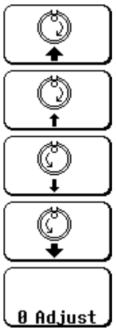
Method



```
*** CHANNEL  ***   MEMORY               (page1) '97- 4- 2
                                                 21:21:36
      color range zoom (/div)   position filter
               ( lower ~ upper )    unit&sensor
1 : ANA  ■   20mV×1  (    20mV)  10.00DIV  -
          (       -200mV~       +200mV)
2 :      ■   20mV×1  (    20mV)  10.00DIV  -
          (       -200mV~       +200mV)
3 : ANA  ■    5mV×1  (     5mV)  10.00DIV  -
          (        -50mV~        +50mV)
4 :      -

5 : ANA  ■    5mV×1  (     5mV)  10.00DIV  -
          (        -50mV~        +50mV)  DC/RMS
6 :      -

7 : ANA  ■  10℃ ×1  (    10℃)  10.00DIV  -
          (       -100℃~       +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the **position** item.
2. Use the JOG control or the function keys to make the selection.

Function key display　Meaning

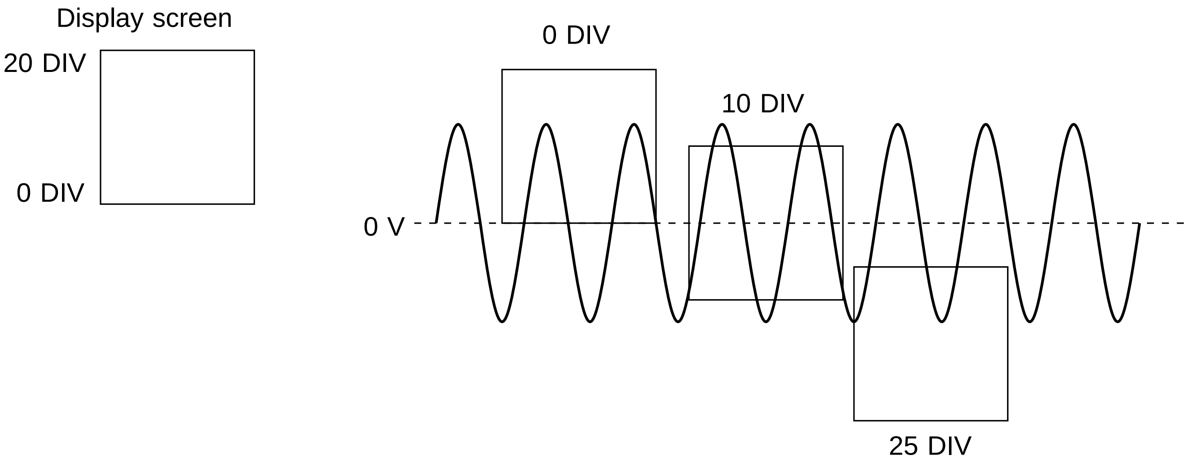


When the magnification ratio is 1:
-15.6 to 35.6 DIV

: Zero adjustment is performed.
(☞ Section 9.6.6)
not displayed with the 8928

Magnification ratio	Setting range (units: DIV)
×20	-502.0 to 522.0
×10	-246.0 to 266.0
×5	-118.0 to 138.0
×2	-41.2 to 61.2
×1	-15.6 to 35.6
×1/2	-2.8 to 22.8
×1/5	0.0 to 20.0
×1/10	0.0 to 20.0

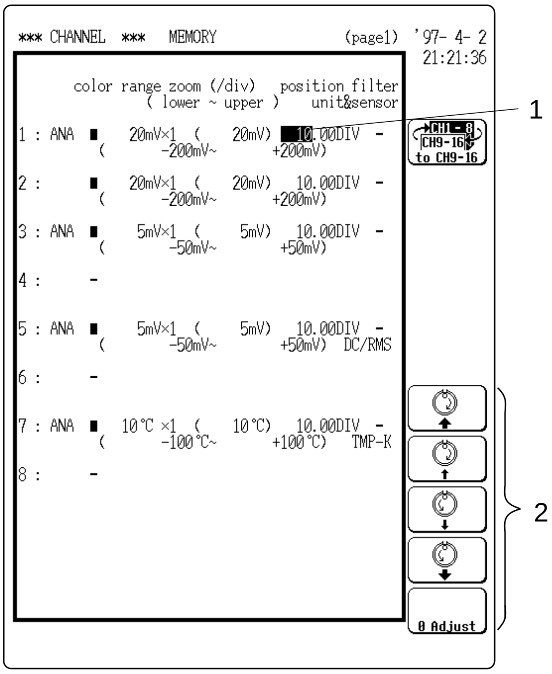
NOTE The zero position is as follows:



Zero adjustment

This function calibrates the 0 V position (ground position) to the selected zero position. Use it to assure precise results.

Method



```
*** CHANNEL  ***   MEMORY                (page1) '97- 4- 2
                                                  21:21:36
      color range zoom (/div)   position filter
               ( lower ~ upper )    unit&sensor
1 : ANA  ■    20mV×1  (    20mV)  10.00DIV  -
          (        -200mV~      +200mV)
2 :      ■    20mV×1  (    20mV)  10.00DIV  -
          (        -200mV~      +200mV)
3 : ANA  ■     5mV×1  (     5mV)  10.00DIV  -
          (         -50mV~       +50mV)
4 :      -
5 : ANA  ■     5mV×1  (     5mV)  10.00DIV  -
          (         -50mV~       +50mV)  DC/RMS
6 :      -
7 : ANA  ■   10℃ ×1  (    10℃)   10.00DIV  -
          (        -100℃~       +100℃)   TMP-K
8 :      -
```

- Allow the unit to warm up for at least 1 hour to ensure that the internal temperature of the input units has stabilized.
- Compensation for the voltage axis range or frequency axis range (8919 FFT unit) is performed.

1. Move the flashing cursor to the **position** item.
2. Press F5 [0 Adjust]. All channels (all units installed) will be calibrated together.

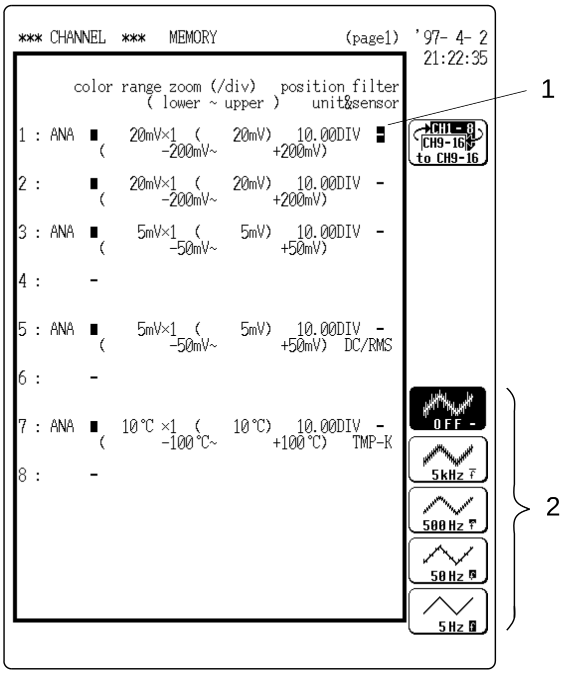
NOTE

- Zero adjustment cannot be performed during measurement.
- Repeat the zero adjustment when the input unit was changed, when the power is on/off, or when the system is set to reset.
- The 8918 TEMPERATURE UNIT does not have a zero adjustment function. The function applies only to other input units.
- For the 8928 STRAIN UNIT, the zero adjustment is not also carried out.
- When there is a sudden change in ambient temperature, the zero position may drift. To assure continued measurement precision, perform the zero adjustment again.
- Zero adjustment may take up to 80 seconds. During this time, the keys are inactive.

9.6.7 Setting the Low-Pass Filter

- Set the cutoff frequency for the low-pass filter, which limits the frequency bandwidth.
- When the observed waveform has high ripple content or noise, causing the recording line to become thick, or if pulse type noise is present, the low-pass filter should be enabled.

Method



```
*** CHANNEL  ***   MEMORY                   (page1) '97- 4- 2
                                                    21:22:35
      color range zoom (/div)   position filter
               ( lower ~ upper )    unit&sensor
1 : ANA  ■   20mV×1  (    20mV)   10.00DIV  ▪
          (       -200mV~        +200mV)
2 :      ■   20mV×1  (    20mV)   10.00DIV  -
          (       -200mV~        +200mV)
3 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
          (        -50mV~         +50mV)
4 :      -
5 : ANA  ■    5mV×1  (     5mV)   10.00DIV  -
          (        -50mV~         +50mV)  DC/RMS
6 :      -
7 : ANA  ■  10℃ ×1  (    10℃)   10.00DIV  -
          (       -100℃~        +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the position shown in the figure.
2. Use the JOG control or the function keys to make the selection. Available setting items depend on the type of input unit.

- 8916, 8927 Analog units

Function key display		Meaning
OFF -	:	No low pass filter is used.
5kHz	:	A filter with 5 kHz cutoff is used.
500Hz	:	A filter with 500 Hz cutoff is used.
50Hz	:	A filter with 50 Hz cutoff is used.
5Hz	:	A filter with 5 Hz cutoff is used.

- 8917 DC/RMS, 8919 FFT units

Function key display		Meaning
OFF -	:	No low pass filter is used.
500Hz	:	A filter with 500 Hz cutoff is used.
5Hz	:	A filter with 5 Hz cutoff is used.

- 8918 Temperature unit

Function key display		Meaning
OFF -	:	No low pass filter is used.
5Hz	:	A filter with 5 Hz cutoff is used.
1.5Hz	:	A filter with 1.5 Hz cutoff is used.

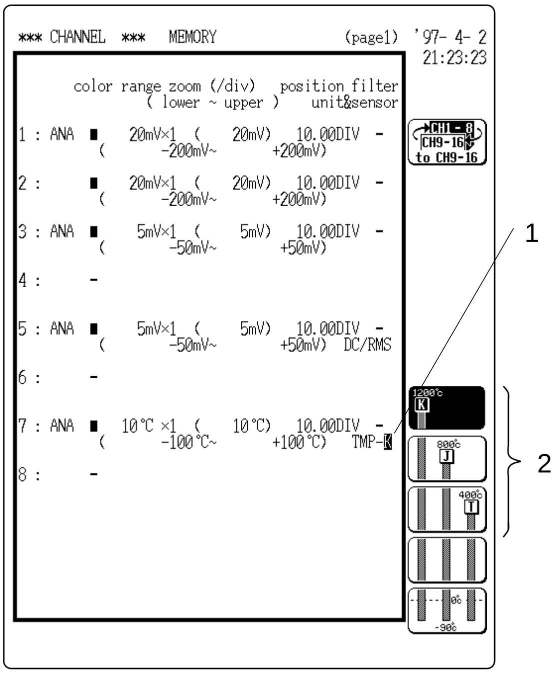
- 8928 Strain unit

Function key display		Meaning
OFF -	:	OFF (cutoff 20 kHz)
3kHz	:	3 kHz Cutoff filter
300Hz	:	300 Hz Cutoff filter
30Hz	:	30 Hz Cutoff filter
10Hz	:	10 Hz Cutoff filter

9.6.8 Setting the Thermocouple Type (8918 Only)

The temperature unit 8918 can use three types of thermocouples. Choose the correct setting for the thermocouple in use.

Method



```
*** CHANNEL  ***   MEMORY                (page1) '97- 4- 2
                                                 21:23:23
      color range zoom (/div)   position filter
              ( lower ~ upper )    unit&sensor
1 : ANA ■   20mV×1  (    20mV)   10.00DIV  -
        (       -200mV~      +200mV)
2 :     ■   20mV×1  (    20mV)   10.00DIV  -
        (       -200mV~      +200mV)
3 : ANA ■    5mV×1  (     5mV)   10.00DIV  -
        (        -50mV~       +50mV)
4 :     -
5 : ANA ■    5mV×1  (     5mV)   10.00DIV  -
        (        -50mV~       +50mV)  DC/RMS
6 :     -
7 : ANA ■  10℃ ×1  (    10℃)   10.00DIV  -
        (       -100℃~      +100℃)   TMP-K
8 :     -
```

1. Move the flashing cursor to the point shown in the figure. (This item is not displayed for channels where the temperature unit 8918 is not installed.)
2. Use the function keys to make the selection.

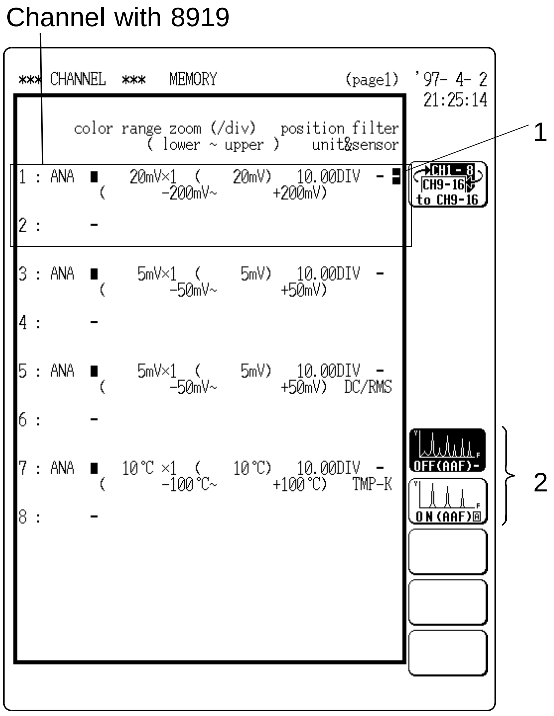
Function key display	Meaning
1200℃ K	: K (CA) thermocouple
800℃ J	: J (IC) thermocouple
400℃ T	: T (CC) thermocouple
0℃ -90℃	

NOTE If the setting and the actually used thermocouple are different, the measurement reading will be wrong.

9.6.9 Setting the Antialiasing Filter (8919 Only)

- The FFT unit 8919 incorporates an antialiasing filter designed to prevent aliasing distortion (☞ Appendix 2). The filter can be set to ON or OFF. The cutoff frequency of the filter is set automatically, according to the frequency range and time axis setting.
- This item is only available when the FFT unit 8919 is installed.

Method

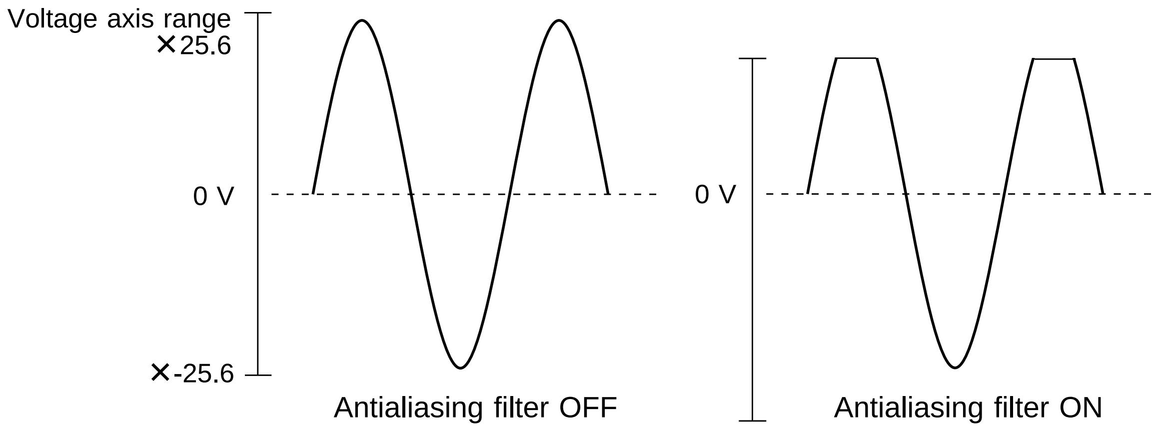


```
*** CHANNEL  ***   MEMORY                (page1)  '97- 4- 2
                                                   21:25:14
        color range zoom (/div)   position filter
                  ( lower ~ upper )    unit&sensor
1 : ANA  ■    20mV×1  (    20mV)   10.00DIV  - ■
         (        -200mV~        +200mV)
2 :      -

3 : ANA  ■     5mV×1  (     5mV)   10.00DIV  -
         (         -50mV~         +50mV)
4 :      -

5 : ANA  ■     5mV×1  (     5mV)   10.00DIV  -
         (         -50mV~         +50mV)  DC/RMS
6 :      -

7 : ANA  ■   10℃ ×1  (    10℃)   10.00DIV  -
         (        -100℃~         +100℃)   TMP-K
8 :      -
```

1. Move the flashing cursor to the point shown in the figure. (This item is not displayed for channels where the FFT unit 8919 is not installed.)
2. Use the function keys to make the selection.

Function key display	Meaning
OFF(AAF)-	: Antialiasing filter disabled
ON(AAF)	: Antialiasing filter enabled

NOTE When the antialiasing filter is set to ON, the measurement is slightly shifted.



Antialiasing filter OFF

Antialiasing filter ON

- Antialiasing filter cutoff frequency and range settings for each function

The cutoff frequency is the same value as the frequency range (except when a different value is specified in brackets).

Frequency range FFT function [Hz]	Time axis range Memory recorder, recorder function [/DIV]
80 k (OFF)	500 μs *
40 k	1 ms *
32 k (40 k)	1.25 ms
20 k	2 ms
16 k (20 k)	2.5 ms
8 k	5 ms
4 k	10 ms
2 k	20 ms
800	50 ms
400	100 ms
200	200 ms
80	500 ms
40	1 s
20	2 s
8 (20)	5 s
4 (20)	10 s
2 (20)	20 s
667 m (20)	1 min
333 m (20)	2 min
133 m (20)	5 min

Ranges marked with an asterisk (*) are available only for the memory recorder function.

9.6.10 Arbitrary Setting if Voltage Axis Magnification/ Compression and Display Range

(Variable Display Function) (FFT Excluded)

- This function allows setting the 1 DIV value on the voltage axis or the display range in voltage axis direction to any setting.

(1) Voltage axis magnification/compression

- Set the value which should correspond to 1 DIV on the voltage axis.
- Set the zero position to any position.

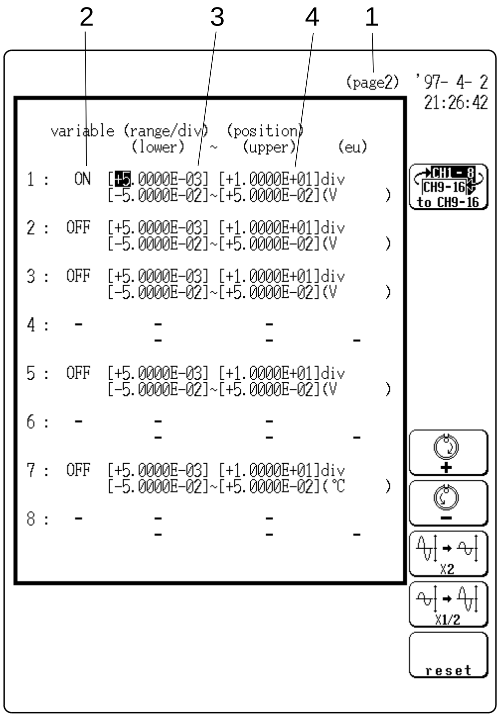
(2) Display range in voltage axis direction

- Set the lower and upper limit of the display to any desired setting.

- The variable function can be set to ON or OFF for each channel individually.

(1) Setting the 1 DIV value and zero position for the voltage axis

Method Screen: CHANNEL (page 2)



```
                                    (page2) '97- 4- 2
                                            21:26:42
   variable (range/div)  (position)
              (lower)   ~   (upper)      (eu)
1 :   ON  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
2 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
3 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
4 :   -          -             -
                 -             -         -
5 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
6 :   -          -             -
                 -             -         -
7 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](℃       )
8 :   -          -             -
                 -             -         -
```

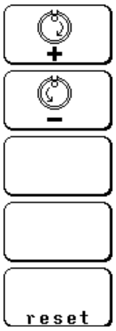
Move the flashing cursor in the order shown below to make the setting.

1. Use the CHAN key to call up the CHANNEL screen (page 2).
2. Set the variable function for the desired channels to ON.
3. Set the voltage axis range (Display range/div).
   - The zero position is fixed, and the voltage axis 1 DIV value changes.
   - Setting range: +0.0001E-29 to +9.9999E+28

Function key display	Meaning
+ −	0 to 9 (-9 to +9 for the most significant digit, -29 to +28 for exponent.)
X2	: Changes display range by a factor of 2
X1/2	: Changes display range by a factor of 1/2
reset	: Reset

4. Set the **position** item.
   (Same as in step 3.)

Function key display   Meaning



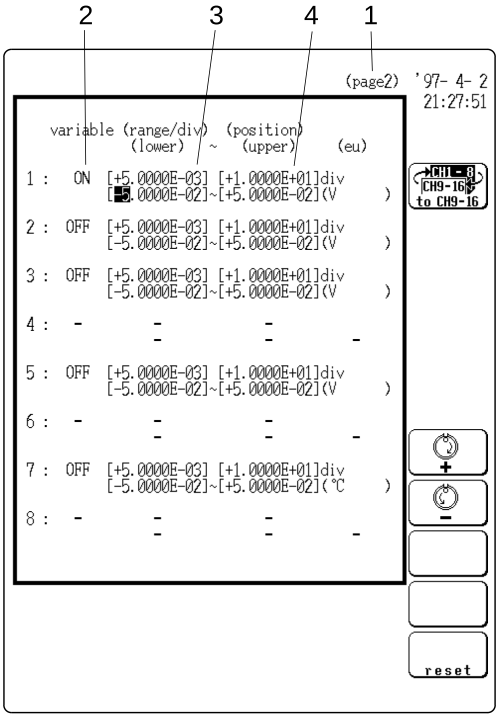
0 to 9
(-9 to +9 for the most significant digit, -29 to +29 for exponent.)

: Reset

NOTE When voltage axis range or zero position are changed, the upper limit and lower limit values also change.

(2) Setting the upper and lower display limit

Method Screen: CHANNEL (page 1)



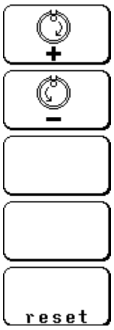
```
                                              (page2)  '97- 4- 2
                                                        21:27:51
   variable (range/div)  (position)
               (lower)   ~   (upper)      (eu)
1 :   ON  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
2 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
3 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
4 :   -         -             -
                -             -        -
5 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](V       )
6 :   -         -             -
                -             -        -
7 :  OFF  [+5.0000E-03] [+1.0000E+01]div
          [-5.0000E-02]~[+5.0000E-02](℃       )
8 :   -         -             -
                -             -        -
```

Move the flashing cursor in the order shown below to make the setting.

1. Use the CHAN key to call up the CHANNEL screen (page 2).
2. Set the variable function for the desired channels to ON.
3. Set the **lower** and **upper** items.

- Setting range: +0.0001E-29 to +9.9999E+29
- The setting must be (lower limit) ≧ (upper limit)
- Move the flashing cursor to the respective digits to make the setting.

Function key display   Meaning



0 to 9
(-9 to +9 for the most significant digit, -29 to +29 for exponent)

: Reset

NOTE When the upper limit and lower limit values are changed, the voltage axis range or zero position also change.

Reset

When the flashing cursor is on the items **range/div**, **position**, **lower**, or **upper**, pressing this key causes the upper and lower limit values to be calculated from the voltage axis range setting and zero position setting (page 1). The calculated values are automatically inserted in the respective positions.

NOTE

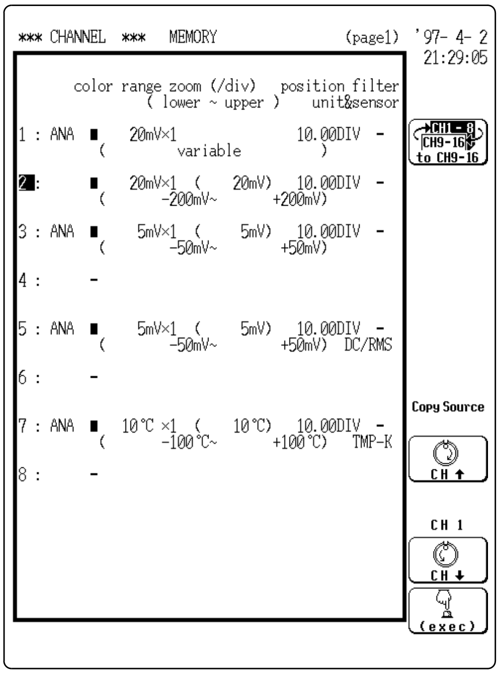
- If no input unit is installed, "--" is displayed and the item cannot be set.
- Channels for which the variable function has been set to ON are denoted by the indication **variable** below the **lower - upper** indication on page 1 of the CHANNEL screen.

Reference The settings for one channel can be copied to another channel (☞ Section 9.6.11).

9.6.11 Copying Channel Settings

- While using the CHANNEL screen, settings made for one channel can be copied to another channel.
- The **copy source** is the channel whose settings are being copied to the "copy target" channel.

Method



```
*** CHANNEL  ***   MEMORY                (page1)  '97- 4- 2
                                                  21:29:05
       color range zoom (/div)   position filter
                ( lower ~ upper )    unit&sensor
1 : ANA  ■    20mV×1                 10.00DIV  -
          (           variable            )
2:       ■    20mV×1  (    20mV)    10.00DIV  -
          (        -200mV~        +200mV)
3 : ANA  ■     5mV×1  (     5mV)    10.00DIV  -
          (         -50mV~         +50mV)
4 :      -

5 : ANA  ■     5mV×1  (     5mV)    10.00DIV  -
          (         -50mV~         +50mV)   DC/RMS
6 :      -

7 : ANA  ■   10℃ ×1  (    10℃)    10.00DIV  -
          (        -100℃~        +100℃)    TMP-K
8 :      -
```

1. Move the flashing cursor to the number of the channel to be used as copy source.
2. Use the function keys or the JOG control to specify the copy target channel.

Function key display	Meaning
Copy Source	: (display only)
CH ↑	: Increase channel number
CH 1	: Copy source is shown (display only)
CH ↓	: Decrease channel number
(exec)	: Execute copy

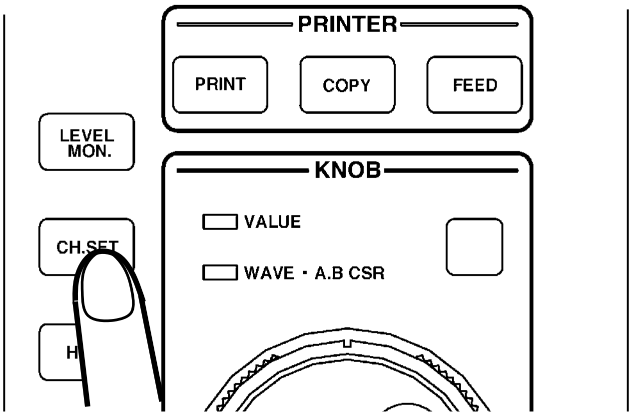
3. When F5 [exec] is pressed, the settings of the copy source channel are copied to the copy target channel.

NOTE

- When making a copy settings for channel between temperature unit and other units (8916, 8917, 8919, 8927, 8928), only display color of the waveform and graph display can be copied.
- In case of copying between strain unit (8928) and voltage unit (8916, 8917, 8919, 8927), the settings for range and lowpass filter cannot be copied.

9.6.12 Making Channel Settings on Display Screen

- With the CH. SET key, individual channel setting items and the variable function setting can be superimposed on the current display screen. The item is switched with each push of the button.
- Move the flashing cursor to the item and make the setting in the same way as described for the CHANNEL screen. Results can be judged immediately by observing the waveform.
- For details, see Section 20.3.



Chapter 10
Trigger Functions

(For all functions)

10.1 Overview

- The term "trigger" refers to a signal which is used to control the timing for recording start or stop.
- The term "triggering has occurred" refers to the state when such a signal has activated recording start or stop.
- Trigger parameters for the various functions are set using the STATUS screen (page 2).
- There are four types of signals which can be used for triggering (as trigger source).

① Analog trigger

- The input signal to analog units (CH1 - CH16) is used as trigger source.
- The input signal is constantly monitored, and triggering occurs when the preset trigger conditions are met.

② Logic trigger

- The input signal to logic channels (CH A - CH D) is used as trigger source.
- The input signal is constantly monitored, and triggering occurs when the preset trigger conditions are met.

③ External trigger

- Triggering occurs when the EXT TRIG connector is shorted or when a high-level signal (2.5-5.0 V) at this connector changes to low-level (0-1.0 V).
- External triggering is used for example when several Memory HiCorder units are connected in parallel for synchronized operation.

④ Timer trigger

- Triggering occurs from a preset start time to a preset stop time.
- Serves for real-time recording.

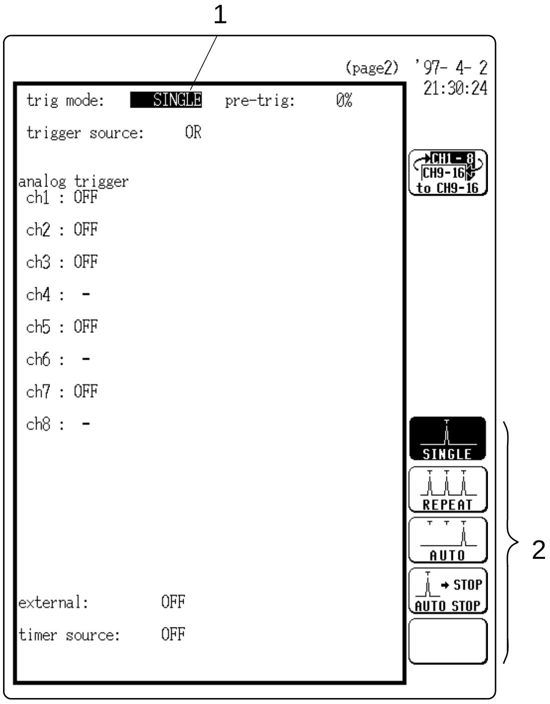
- The above trigger sources can be combined with AND/OR.
- The trigger mode setting determines whether repeated triggering is used.
- The pretrigger setting can be used to record the waveform not only after but also before triggering has occurred (memory recorder, FFT).

NOTE If the trigger settings (trigger source AND, OR, trigger source parameters, pretrigger) are changed during recording, the measurement is restarted, using the new settings.

10.2 Setting the Trigger Mode

- The trigger mode determines the way triggering is used to control operation of the 8846.
- When all trigger sources are OFF, the waveform is recorded continuously in the interval between pressing the START key and the STOP key (free-run operation).

Method Screen: STATUS (page 2), DISPLAY



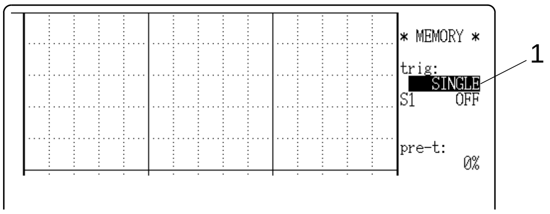
(page2) '97- 4- 2 21:30:24

trig mode: SINGLE pre-trig: 0%

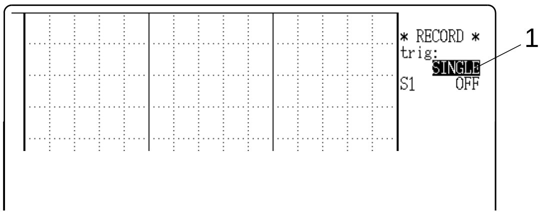
trigger source: OR

analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 : -
ch5 : OFF
ch6 : -
ch7 : OFF
ch8 : -

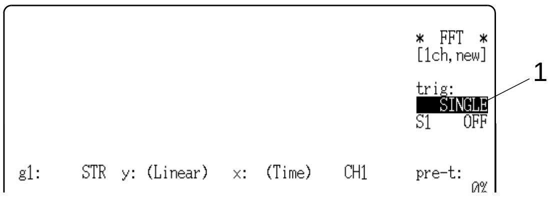
external: OFF
timer source: OFF



* MEMORY *
trig: SINGLE
S1 OFF
pre-t: 0%



* RECORD *
trig: SINGLE
S1 OFF



* FFT *
[1ch, new]
trig: SINGLE
S1 OFF

g1: STR y: (Linear) x: (Time) CH1 pre-t: 0%

1. Move the flashing cursor to the **trig mode** item.
2. Use the function keys to make the selection.

Function key display	Meaning
SINGLE	: ① See below.
REPEAT	: ②
AUTO	: ③
→ STOP AUTO STOP	: ④

① Trigger is registered only once. After START key was pressed, unit starts waveform recording when triggering occurs and continues for preset recording length. Measurement then ends automatically.

② Trigger is registered continuously. Unit is in trigger standby condition when trigger conditions are not met. Measurement ends when STOP key is pressed.

③ Trigger is registered continuously. If trigger conditions are not met within 1 second, waveform recording starts automatically and continues for preset recording length. Measurement ends when STOP key is pressed (memory recorder, FFT).

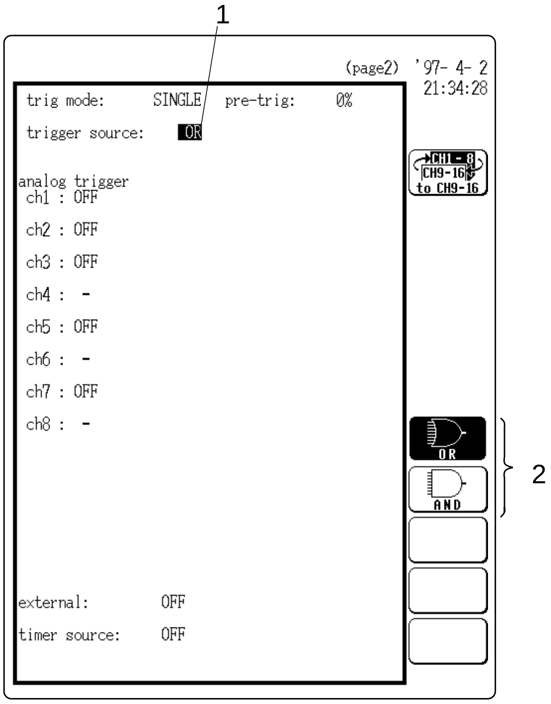
④ When triggering occurs, waveform recording is carried out for preset recording length. If trigger conditions are not met within 1 second, waveform recording starts automatically and continues for preset recording length (memory recorder, FFT).

10.3 Setting Trigger Source AND/OR Linking

The analog trigger, logic trigger, and timer trigger can be linked with the AND/OR logical operators.
AND: Triggering occurs when conditions for all triggers are met.
OR: Triggering occurs when conditions for one trigger are met.

NOTE The external trigger cannot be AND/OR linked with other trigger sources.

Method Screen: STATUS (page 2)



(page2) '97- 4- 2
21:34:28

trig mode: SINGLE pre-trig: 0%
trigger source: OR

analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 : -
ch5 : OFF
ch6 : -
ch7 : OFF
ch8 : -

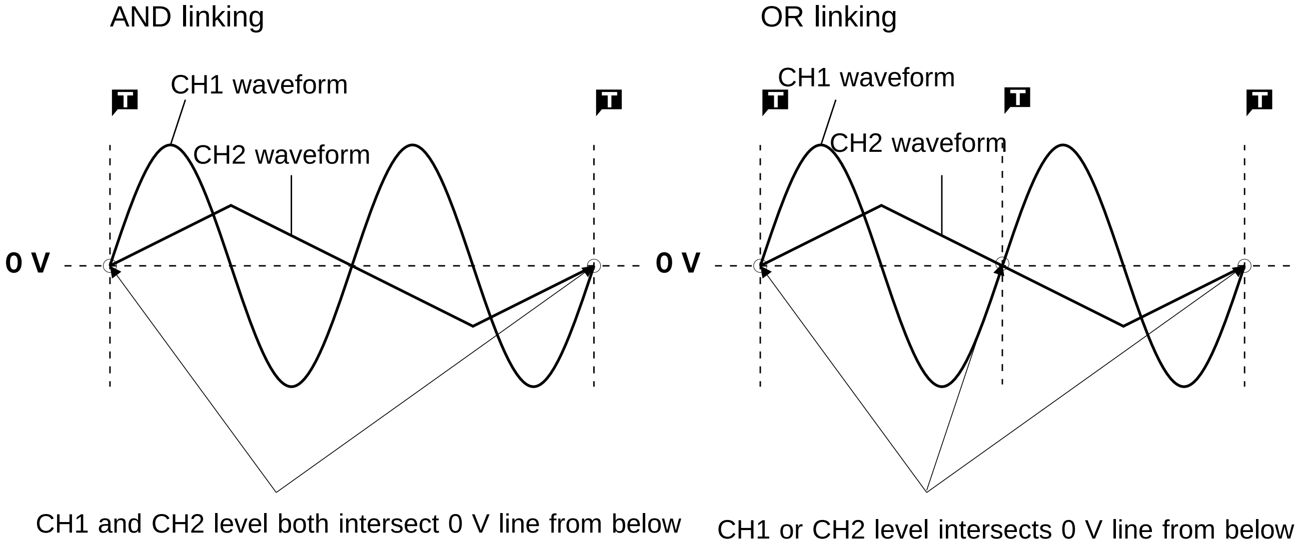
external: OFF
timer source: OFF

1. Move the flashing cursor to the **trigger source** item.
2. Use the function keys to select the AND or OR.

Function key display	Meaning
OR	: Link trigger sources with logical operator OR.
AND	: Link trigger sources with logical operator AND.

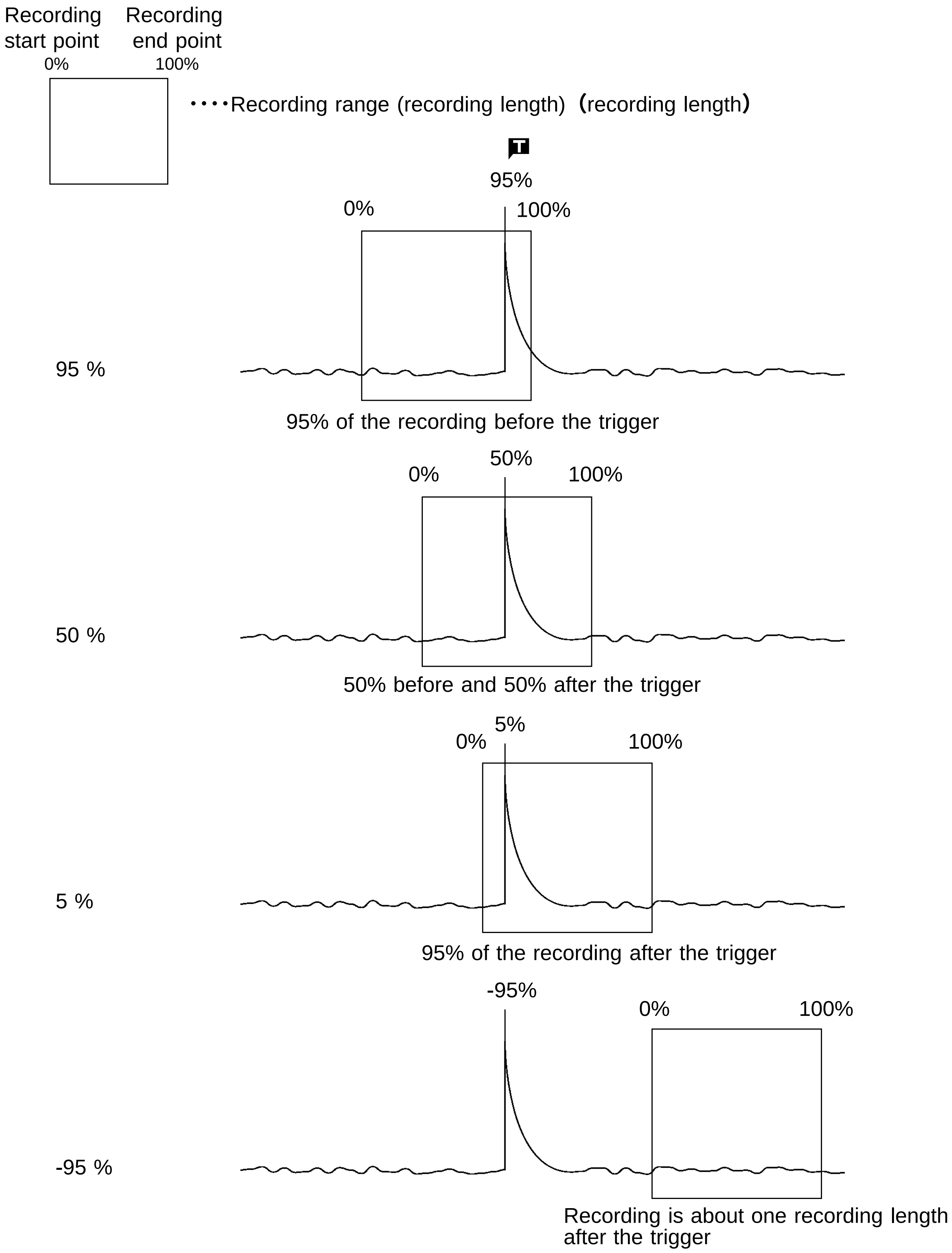
Example The figures below show the effect of AND/OR linking.

CH1: level trigger; level 0.00 V, slope ↑ ; filter OFF
CH2: level trigger; level 0.00 V, slope ↑ ; filter OFF

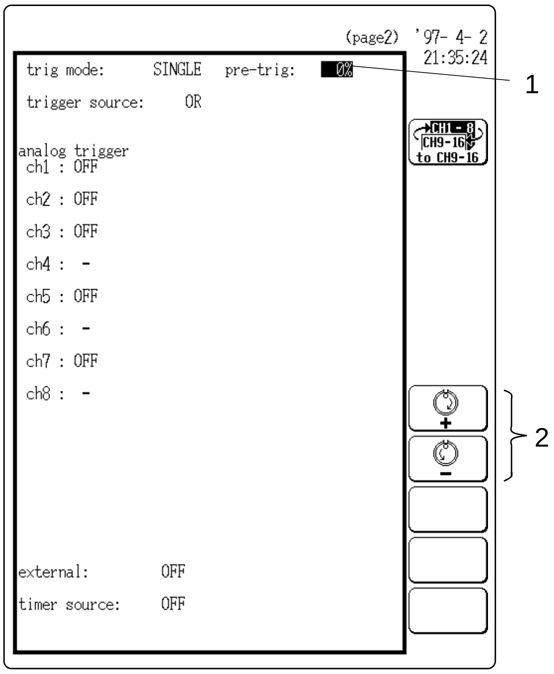


10.4 Setting the Pretrigger (Memory recorder, FFT)

- The pretrigger function serves to record the waveform not only after but also before triggering has occurred.
- Using the recording start point as 0% and the recording end point as 100%, the trigger point can be specified in percent.
- When all trigger sources are set to OFF, pretrigger cannot be set.



Method Screen: STATUS (page 1), CHANNEL (page 1), DISPLAY



(page2) '97- 4- 2 21:35:24

trig mode: SINGLE pre-trig: 0%

trigger source: OR

analog trigger

ch1 : OFF

ch2 : OFF

ch3 : OFF

ch4 : -

ch5 : OFF

ch6 : -

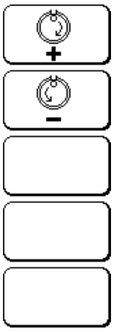
ch7 : OFF

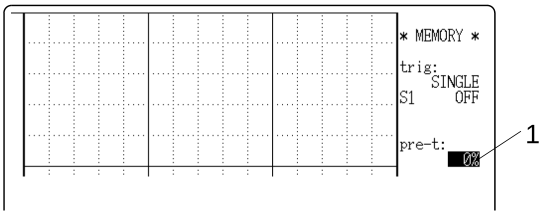
ch8 : -

external: OFF

timer source: OFF

1. Move the flashing cursor to the **pre-trig** item.
2. Use the JOG control or the function keys to make the selection.

Function key display	Meaning
	0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, -95%

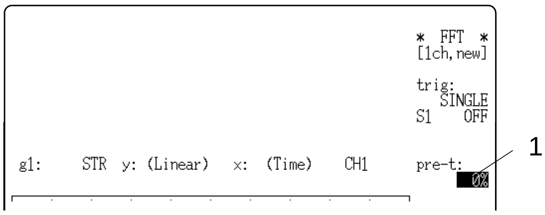


* MEMORY *

trig: SINGLE

S1 OFF

pre-t: 0%



* FFT *
[1ch, new]

trig: SINGLE

S1 OFF

g1: STR y: (Linear) x: (Time) CH1

pre-t: 0%

NOTE

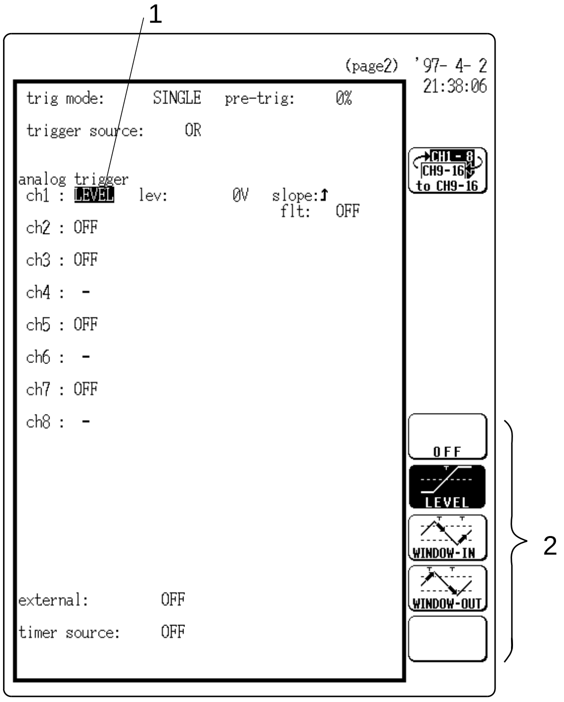
- When the pretrigger is set (memory recorder or FFT: 2 - 100%), the trigger will not be registered for a certain period after the start of measurement. (During this interval, **Pretrigger standby** is shown on the display.)
- When the trigger can be registered, the indication **Waiting for trigger** is shown on the display.

10.5 Using the Analog Trigger Function

The analog signal input channels (CH1 - CH16) can be used as trigger source.

Method Screen: STATUS (page 2)

(1) While STATUS (page 2) screen is shown



(page2) '97- 4- 2 21:38:06

trig mode: SINGLE pre-trig: 0%

trigger source: OR

analog trigger

ch1 : LEVEL lev: 0V slope:↑ flt: OFF

ch2 : OFF

ch3 : OFF

ch4 : -

ch5 : OFF

ch6 : -

ch7 : OFF

ch8 : -

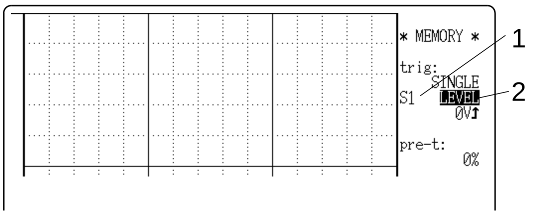
external: OFF

timer source: OFF

1. Move the flashing cursor to the point shown in the figure.
2. Use the function keys to select the trigger type.

Function key display	Meaning
OFF	: Trigger not used
LEVEL	: Level trigger (☞ 10.5.1)
WINDOW-IN	: Window-in trigger (☞ 10.5.2)
WINDOW-OUT	: Window-out trigger (☞ 10.5.2)

(2) While display screen is shown

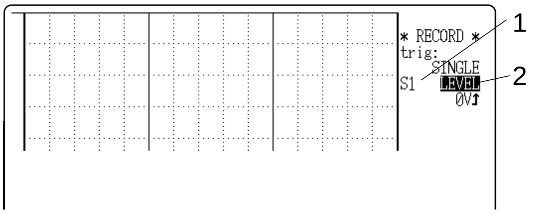


* MEMORY *

trig: SINGLE

S1 LEVEL 0V↑

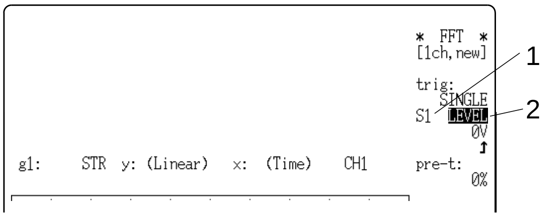
pre-t: 0%



* RECORD *

trig: SINGLE

S1 LEVEL 0V↑



* FFT *

[1ch, new]

trig: SINGLE

S1 LEVEL 0V ↑

g1: STR y: (Linear) x: (Time) CH1

pre-t: 0%

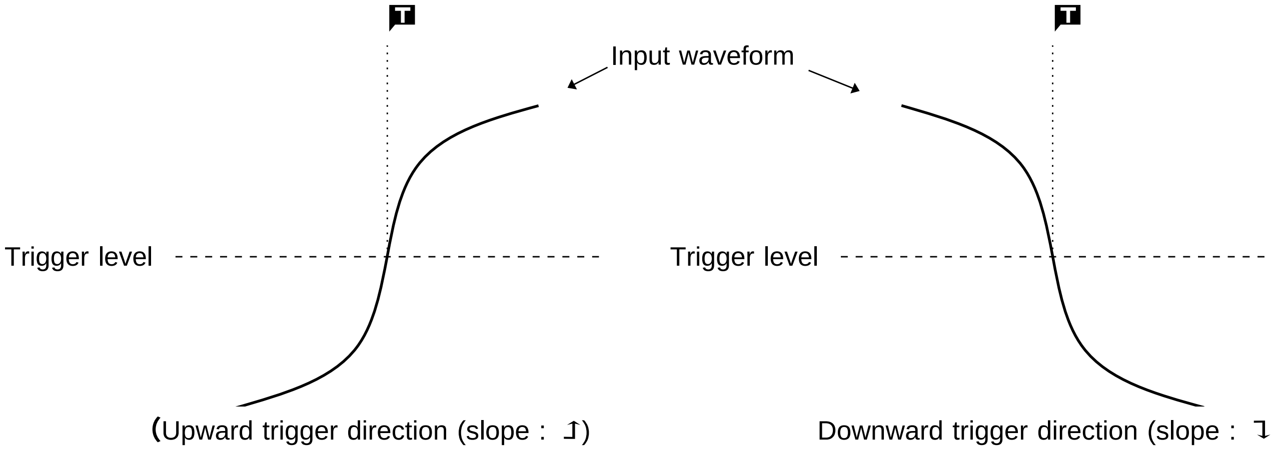
1. Move the flashing cursor to the point shown in the illustration, and use the function keys or the JOG control to specify the source channel.

Function key display	Meaning
+	S1 to S16
−	

2. When the source channel has been specified, move the flashing cursor to the right and specify the trigger source in the same way as on the STATUS screen.

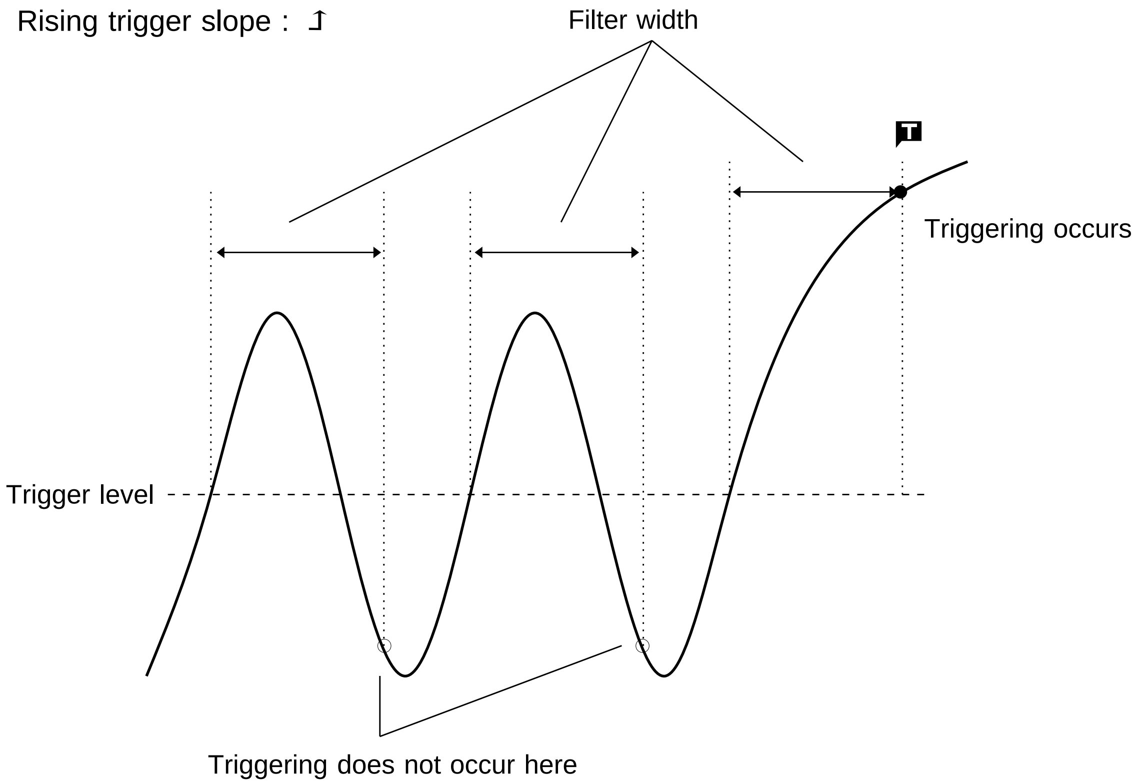
10.5.1 Level Trigger

- Triggering occurs when the input signal crosses the preset trigger level (voltage) with the preset trigger slope (↥, ↧).
- When a trigger filter is used, triggering occurs only within the filter width. This is useful to exclude noise.



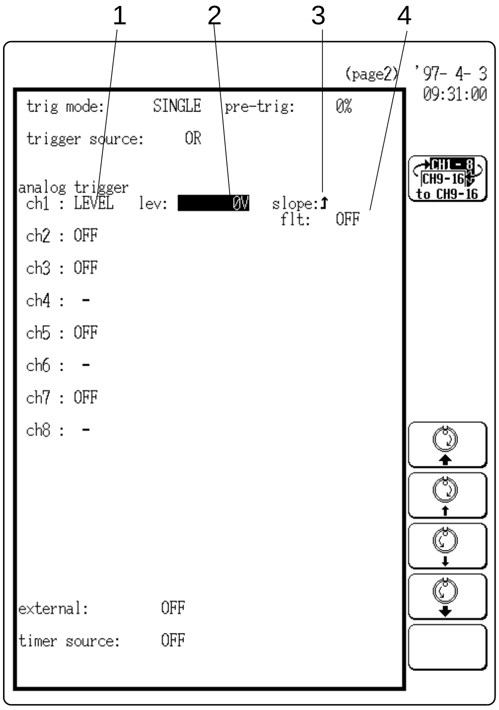
Trigger filter

- Triggering occurs when the trigger conditions are met within the filter width.
- This is useful to prevent spurious triggering by noise.
- The filter width is specified by number of sampling points.

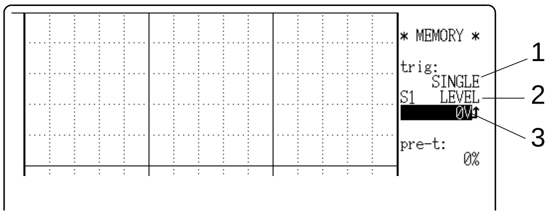


Method Screen: STATUS (page 2), DISPLAY

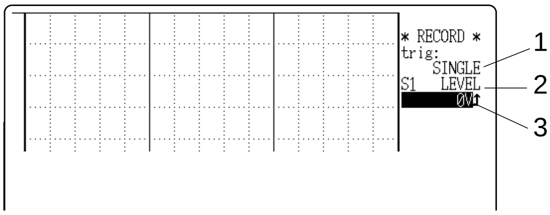
Can be used when the specified channel is an analog input channel.



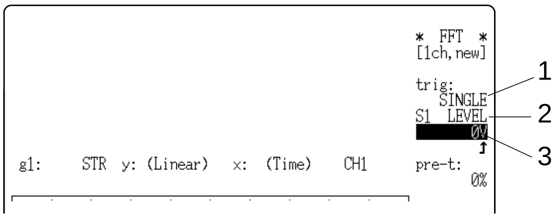
```
                                   (page2)  '97- 4- 3
                                            09:31:00
trig mode:      SINGLE  pre-trig:    0%
trigger source:     OR

analog trigger
ch1 : LEVEL   lev:       0V   slope:↑
                                flt:   OFF
ch2 : OFF
ch3 : OFF
ch4 :  -
ch5 : OFF
ch6 :  -
ch7 : OFF
ch8 :  -

external:        OFF
timer source:    OFF
```



```
* MEMORY *
trig:
     SINGLE
S1   LEVEL
         0V↑
pre-t:
          0%
```



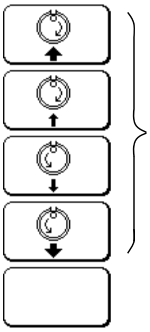
```
* RECORD *
trig:
     SINGLE
S1   LEVEL
         0V↑
```



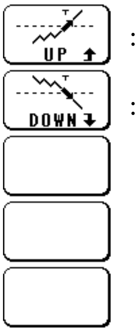
```
                                                * FFT *
                                                [1ch,new]

                                                trig:
                                                  SINGLE
                                                S1  LEVEL
                                                         0V
                                                          ↑
g1:   STR  y: (Linear)   x:  (Time)    CH1      pre-t:
                                                         0%
```

1. Move the flashing cursor to the position as shown in the figure, and press F2 [LEVEL].

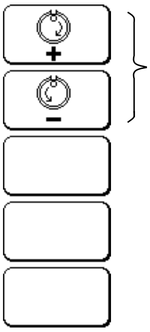
2. Set the trigger level.
   Use the JOG control or the function keys to make the selection.

Function key display	Meaning
	Trigger voltage level

3. Select the trigger direction (slope).
   Use the function keys to make the selection.

Function key display	Meaning
	: Trigger will occur when the input signal crossed the trigger level from below going upwards. : Trigger will occur when the input signal crossed the trigger level from below going downwards.

4. Set the trigger filter
   - This setting cannot be made from the display screen.
   - Use the function keys or the JOG control to make the setting.
   - Filter width is specified using sampling points.

Function key display	Meaning
	OFF, 10, 20, 50, 100, 150, 200, 250, 500, 1000

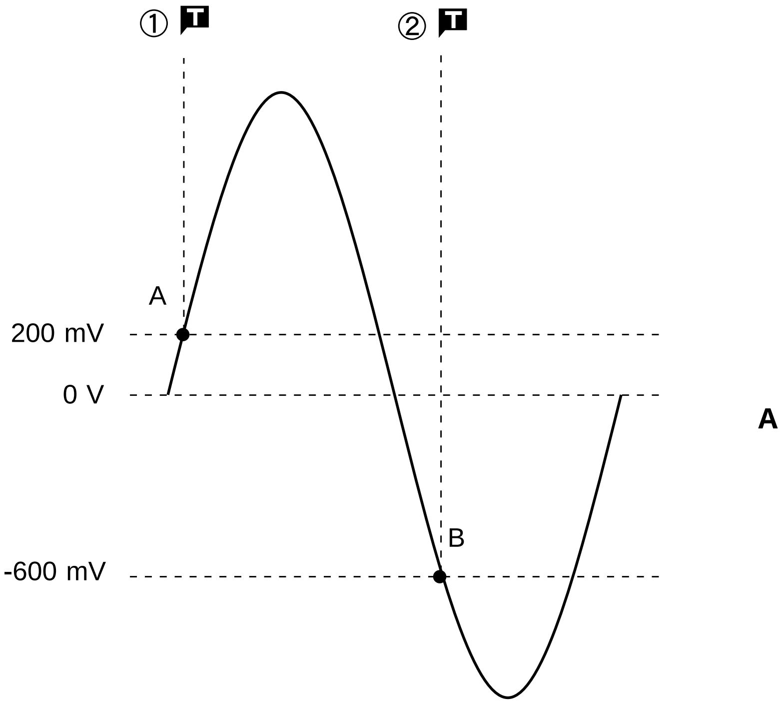
NOTE

- To cause triggering at point A or point B with the sine wave shown below, make the following settings.
- When using the recorder function, the filter width is limited by the time axis range setting.

Time axis range (/DIV)	Filter width (maximum value)
1.25 ms - 200 ms	all settable
500 ms	250
1 s	200
2 s	100
5 s	20
10 s	20
20 s	10
1 min -	all unsettable

Example

① Point A trigger level: 200 mV, trigger direction (slope): rising (↥)
② Point B trigger level: -600 mV, trigger direction (slope): falling (↧)



10.5.2 Window-In, Window-Out Trigger

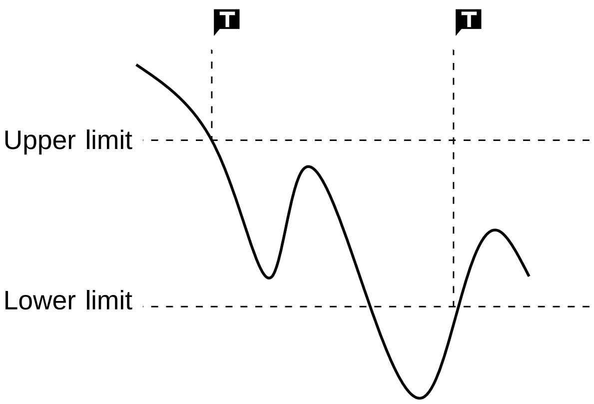
Window-in trigger

Set upper limit level and lower limit level and activated when the input signal enters the range between these limits.

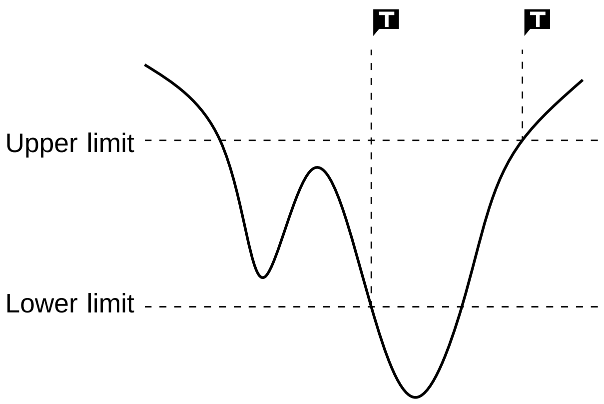
Window-out trigger

Set upper limit level and lower limit level and activated when the input signal leaves this range.

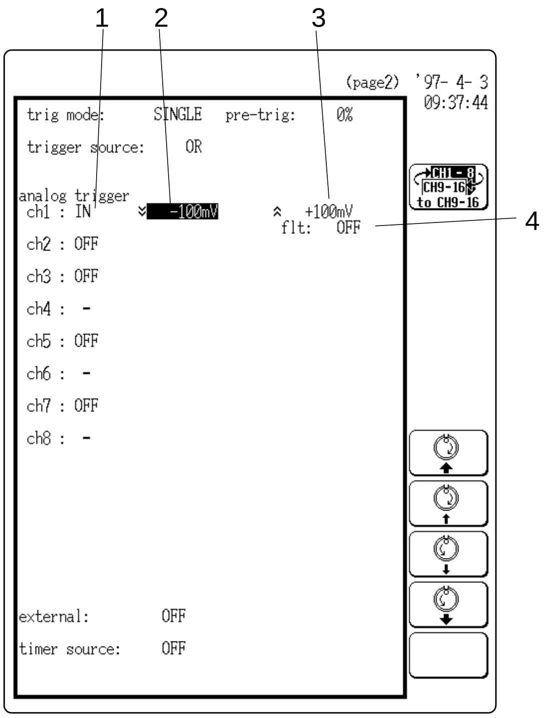
Window-in-trigger



Window-out-trigger



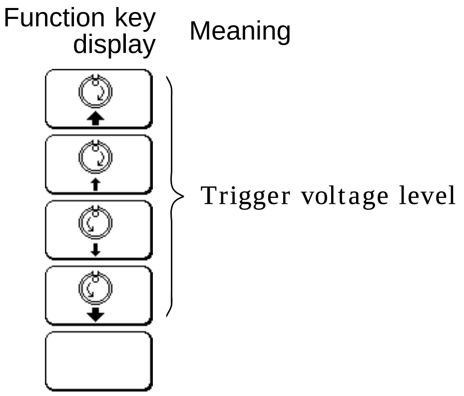
Method Screen: STATUS (page 2), DISPLAY



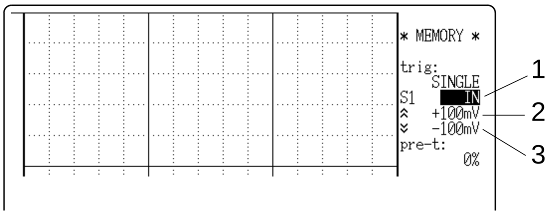
```
                                  (page2) '97- 4- 3
                                           09:37:44
 trig mode:      SINGLE   pre-trig:     0%
 trigger source:     OR

analog trigger
 ch1 : IN       ≚   -100mV        ≙   +100mV
                                  flt:   OFF
 ch2 : OFF
 ch3 : OFF
 ch4 :  -
 ch5 : OFF
 ch6 :  -
 ch7 : OFF
 ch8 :  -

external:        OFF
timer source:    OFF
```

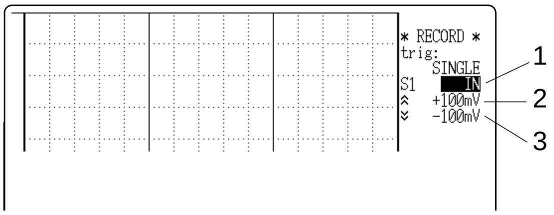
Can be used when the specified channel is an analog input channel.

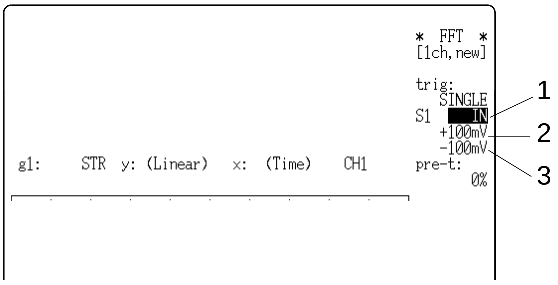
1. Move the flashing cursor to the point shown in the figure.
   Press F3 [WINDOW-IN] or F4 [WINDOW-OUT].
2. Set the lower trigger level.
   Use the JOG control or the function keys to make the selection.



- The value must be larger than the upper trigger level.


* MEMORY *
trig:
SINGLE
S1 IN
+100mV
-100mV
pre-t:
0%


* RECORD *
trig:
SINGLE
S1 IN
+100mV
-100mV


* FFT *
[1ch, new]
trig:
SINGLE
S1 IN
+100mV
-100mV
pre-t:
0%
g1: STR y: (Linear) x: (Time) CH1

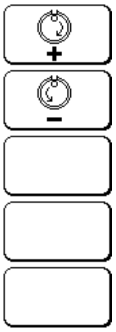
3. Set the upper trigger level

- Make the setting as in step 2.
- The value must be smaller than the lower trigger level.

4. Set the trigger filter

- This setting cannot be made from the display screen.
- Use the function keys or the JOG control to make the setting.
- Filter width is specified using sampling points.

Function key display   Meaning

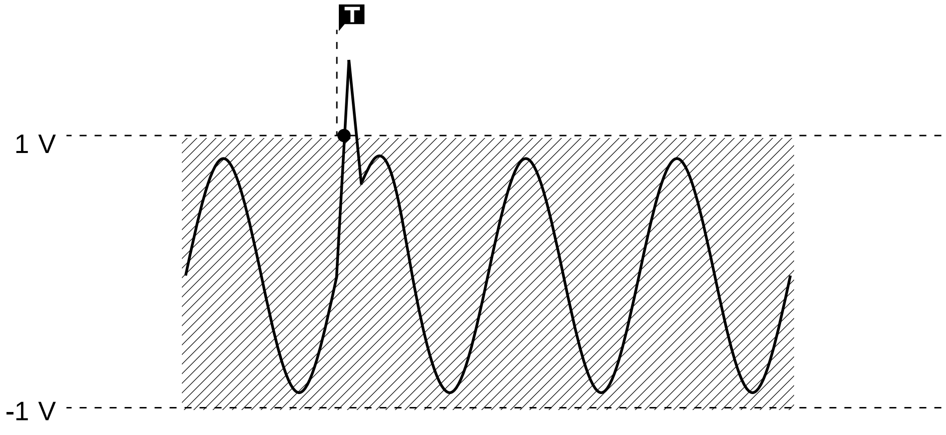


OFF, 10, 20, 50, 100, 150, 200, 250, 500, 1000

Setting example of the window trigger

In order to cause triggering when the signal as shown in the figure below leaves the hatched area, the following settings are made:

Window-out trigger   Upper limit : 1 V, lower limit: -1 V



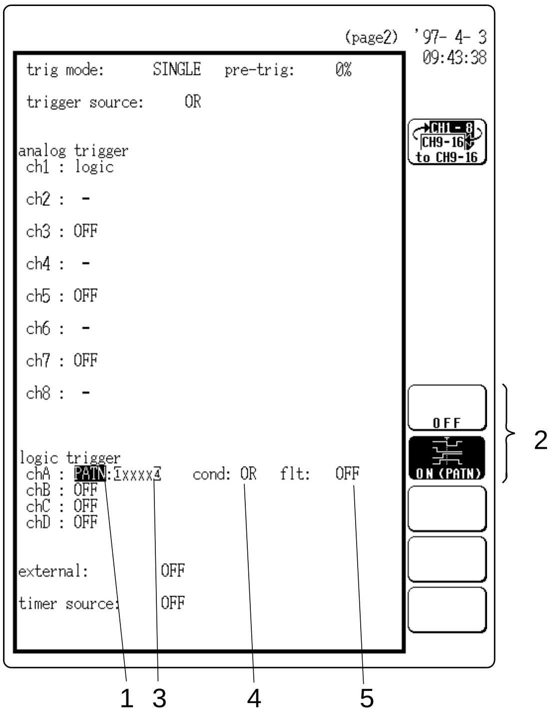
10.6 Using the Logic Trigger Function

- The signal of a logic channel can be used as trigger source.
- The channel must be set to **LOGIC** on the CHANNEL screen (☞ Section 9.4).
- A trigger pattern and logical operator (AND/OR) are specified, and triggering occurs when the trigger conditions are met.
- A trigger filter can be specified, so that triggering occurs only when the trigger conditions are met within the filter width.

NOTE If no channel has been set to **LOGIC** on the CHANNEL screen, the logic trigger cannot be set.

Method Screen: STATUS (page 2), DISPLAY

(1) While STATUS (page 2) screen is shown



```
                                  (page2)  '97- 4- 3
                                            09:43:38
 trig mode:      SINGLE   pre-trig:     0%
 trigger source:     OR

analog trigger
 ch1 : logic
 ch2 :  -
 ch3 : OFF
 ch4 :  -
 ch5 : OFF
 ch6 :  -
 ch7 : OFF
 ch8 :  -

logic trigger
 chA : PATN:1xxxx4    cond: OR   flt:    OFF
 chB : OFF
 chC : OFF
 chD : OFF

external:            OFF
timer source:        OFF
```

1. Move the flashing cursor to the position as shown in the figure.
2. Press F2 [ON (PATN)].

Function key display	Meaning
OFF	: Logic trigger is not used.
ON (PATN)	: Logic trigger is used.

3. Set the trigger pattern

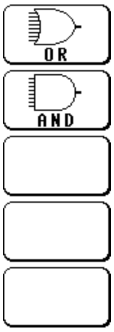
- When "CH A" is selected, the setting is for logic input CH A1 - CH A4 from left to right.
- Make the setting with the function keys.

Function key display	Meaning
X	: Signal disregarded
0	: Low level signal
1	: High level signal

4. Set the AND/OR operator.

Determine whether to use the AND or OR logical operator.

Function key display Meaning



: Triggering occurs if any one of the logic input signals conforms to the trigger pattern.

: Triggering only occurs if all of the logic input signals conforms to the trigger pattern.

NOTE

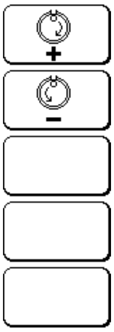
If the conditions are met already when measurement is started (AND: all trigger patterns are met, OR: one trigger pattern is met), triggering does not occur at this slope. Triggering only occurs if the conditions are removed and then met again.

5. Set the trigger filter.

・Use the function keys or the JOG control to make the setting.

・Filter width is specified using sampling points.

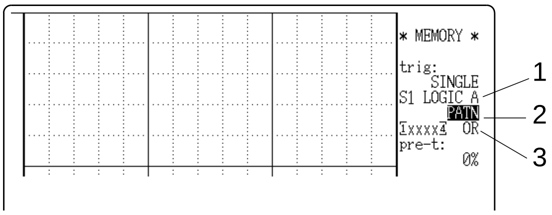
Function key display Meaning



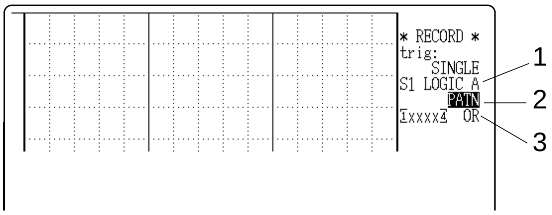
OFF, 10, 20, 50, 100, 150, 200, 250, 500, 1000

(2) While display screen is shown

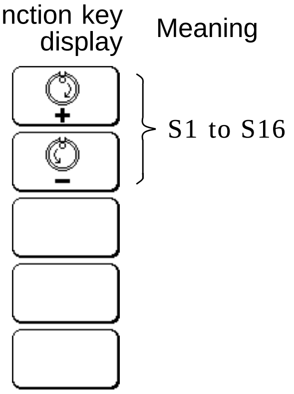
1. Move the flashing cursor to the point shown in the illustration, and select a channel that is set to logic input.



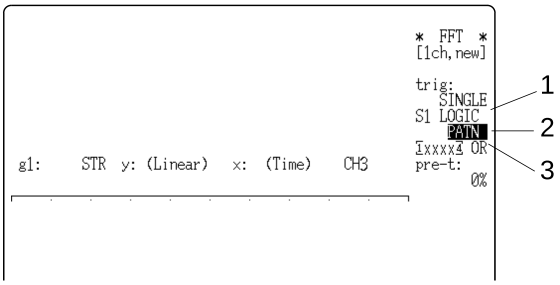
* MEMORY *
trig: SINGLE
S1 LOGIC A
PATN
1xxxx4 OR
pre-t: 0%



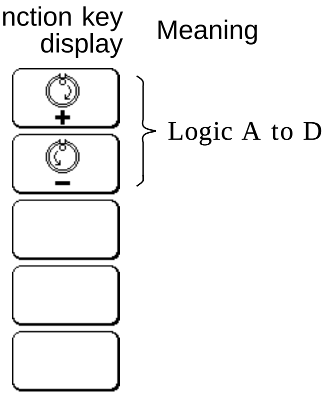
* RECORD *
trig: SINGLE
S1 LOGIC A
PATN
1xxxx4 OR



2. Move the flashing cursor to the point shown in the illustration, and select a logic channel.



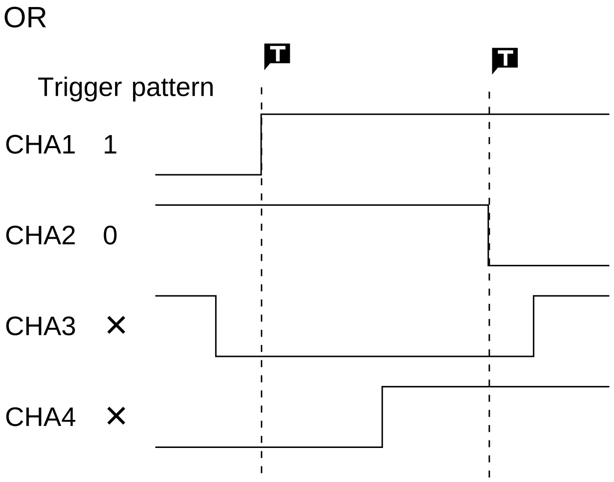
* FFT *
[1ch, new]
trig: SINGLE
S1 LOGIC
PATN
1xxxx4 OR
pre-t: 0%
g1: STR y: (Linear) x: (Time) CH3



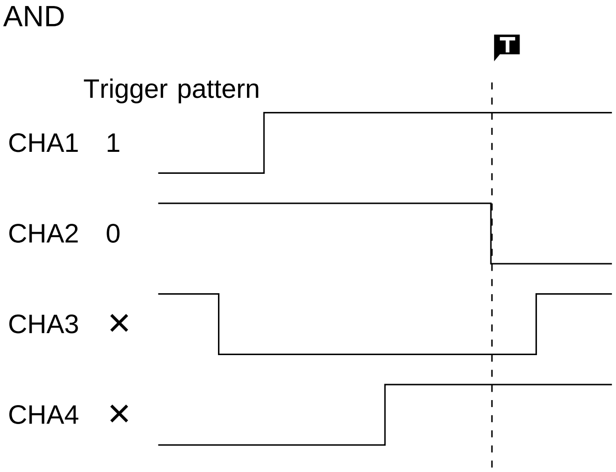
3. Set the logic trigger conditions (same as steps 1 to 4 when using the STATUS screen).

Setting example of the logic trigger

(1) If the trigger pattern has been set to "10××" with the operator OR, then triggering occurs as shown in the figure below.

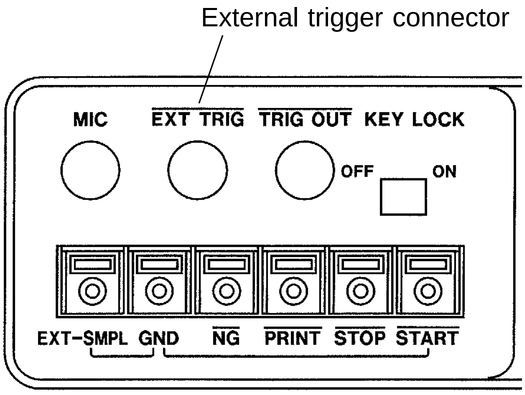


(2) If the trigger pattern has been set to "10××" with the operator AND, then triggering occurs as shown in the figure above.

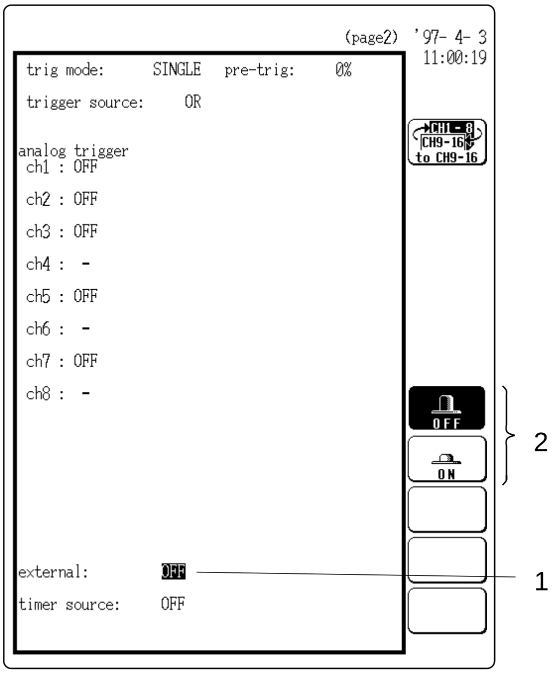


10.7 Using the External Trigger Function

- An external signal can be used as trigger source.
- The EXT TRIG connector is used for this purpose.
- For details, refer to Section 21.3.



Method Screen: STATUS (page 2)



(page2) '97- 4- 3 11:00:19

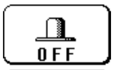
trig mode: SINGLE pre-trig: 0%

trigger source: OR

analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 : -
ch5 : OFF
ch6 : -
ch7 : OFF
ch8 : -

external: OFF
timer source: OFF

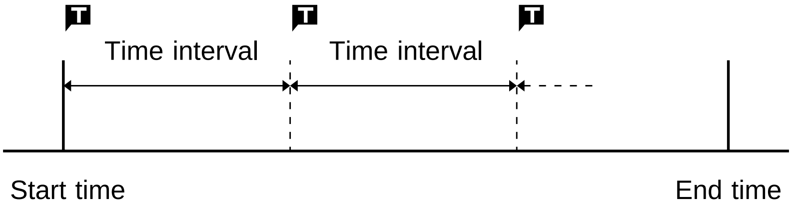
1. Move the flashing cursor to the **external** item.
2. Press F2 [ON].

Function key display	Meaning
 OFF	: External trigger is not used.
 ON	: External trigger is used.

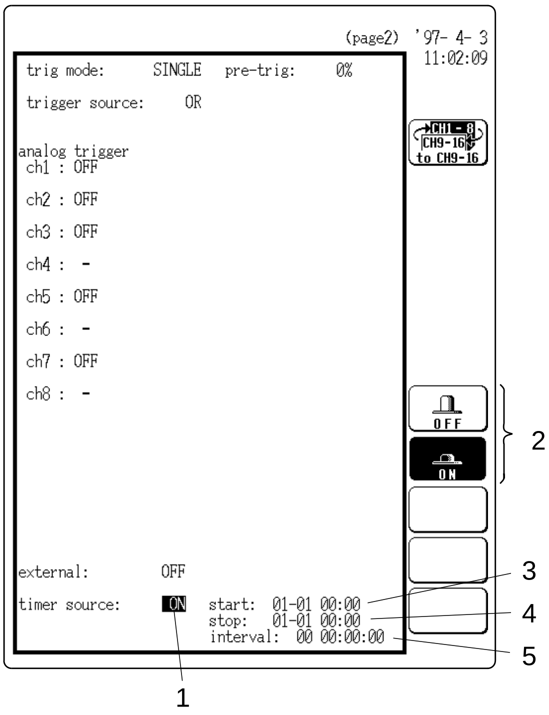
NOTE The external trigger cannot be linked to other trigger sources with the logical AND operator.

10.8 Using the Timer Trigger Function

- This function serves to activate recording at preset times.
- Triggering can be performed at constant intervals within a preset start time and end time.



Method Screen: STATUS (page 2)



```
                    (page2)  '97- 4- 3
                             11:02:09
trig mode:     SINGLE   pre-trig:    0%
trigger source:    OR

analog trigger
ch1 : OFF
ch2 : OFF
ch3 : OFF
ch4 :  -
ch5 : OFF
ch6 :  -
ch7 : OFF
ch8 :  -

external:       OFF
timer source:   ON    start:  01-01 00:00
                      stop:   01-01 00:00
                      interval:  00 00:00:00
```

1. Move the flashing cursor to the **timer source** item.
2. Press F2 [ON].

Function key display	Meaning
OFF	: Timer trigger is not used.
ON	: Timer trigger is used.

3. Set the start time (month, day, hour, minute).

① Move the flashing cursor to the **start** item.
② Use the function keys or the JOG control to make the setting.

Function key display	Meaning
10 ↑ 1 ↑ 1 ↓ 10 ↓	Set numerals for month, day, hour, minute
date·time	: Use current time as start time or end time

4. Set the end time (month, day, hour, minute).

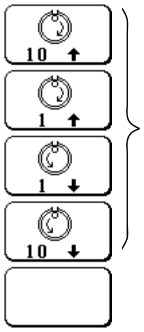
① Move the flashing cursor to the **stop** item.
② Use the function keys or the JOG control to make the setting.

5. Set the trigger interval (day, hour, minute, second).

- The setting range is 0 s to 10 d 23 h 59 m 59 s.

① Move the flashing cursor to the **interval** item.
② Use the function keys or the JOG control to make the setting.

Function key display Meaning



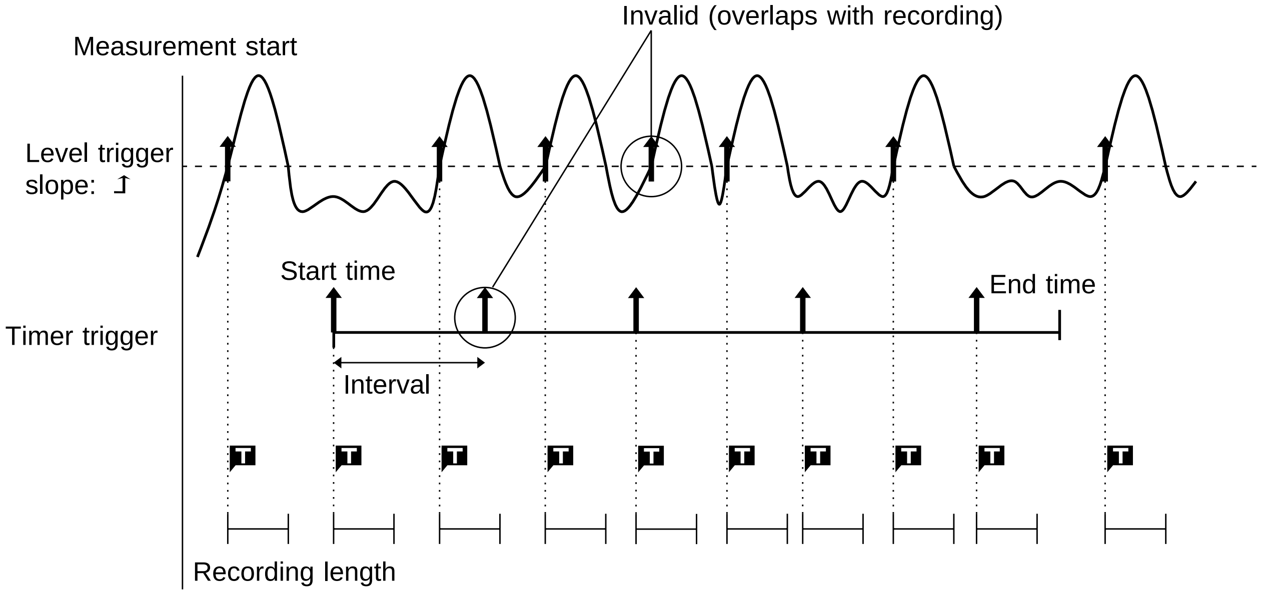
Set numerals for month, day, hour, minute

NOTE Set the start time and end time to a point after the pressing of the START key.

Relation between timer trigger and AND/OR linking

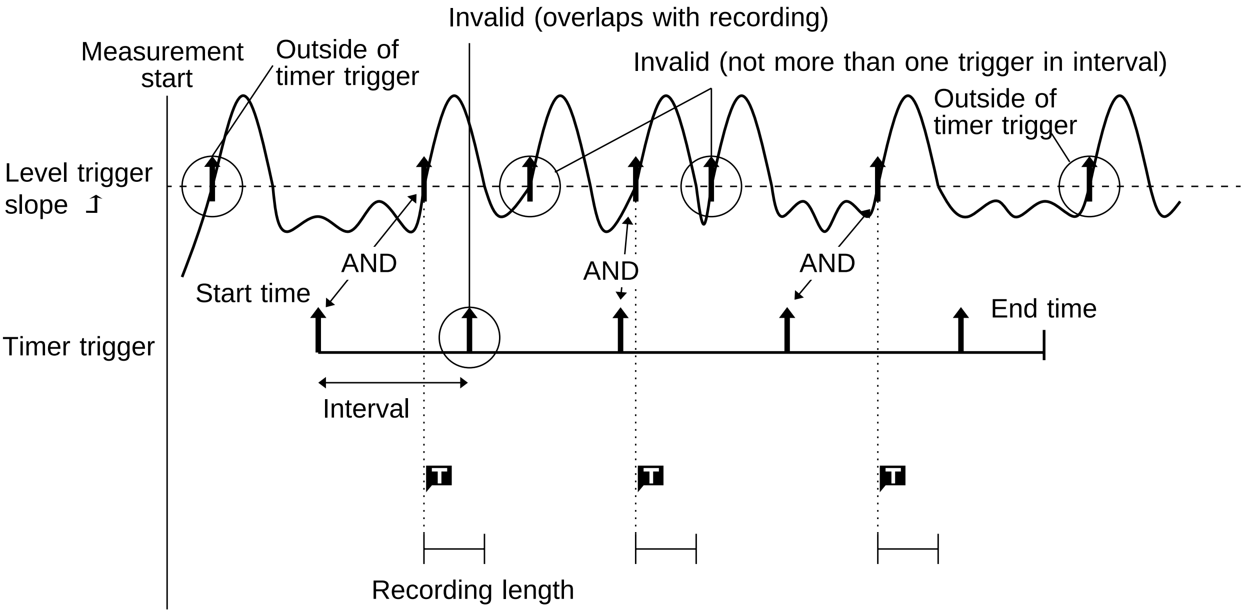
(1) When trigger sources are set to OR

All trigger sources are valid. If other trigger sources have been set, triggering can also occur before the start time or after the end time.



(2) When trigger sources are set to AND

- Measurement is carried out from the start time to the end time. Triggering occurs at the preset intervals if the conditions for the other trigger sources are also met at these points.
- If the interval has been set to 0s, triggering occurs at any point between the start and end time, if if the conditions for the other trigger sources are met.



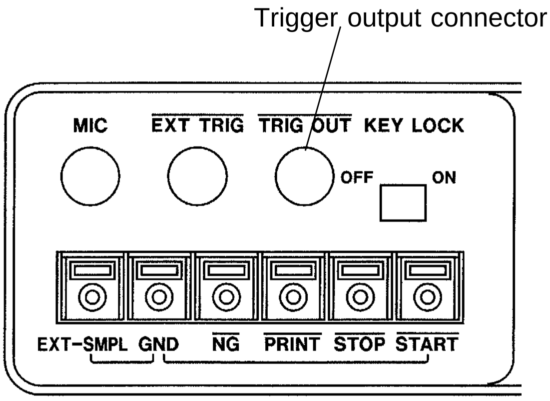
NOTE

- When the trigger mode has been set to **SINGLE**, only one triggering action occurs after the measurement was started.
- To perform recording at regular intervals, establish the following settings.

  Trigger mode: continuous
  Trigger source linking: AND or OR
  Other trigger sources: all OFF

10.9 Trigger Output Connector

- When triggering occurs, a signal is output from the TRIG OUT connector.
- This can be used to synchronize several 8846 units.
- For details, refer to Section 21.4.



Chapter 11
SYSTEM Screen Settings

(For all functions)

11.1 Overview

The SYSTEM screen serves to set the following items which are common to all functions.

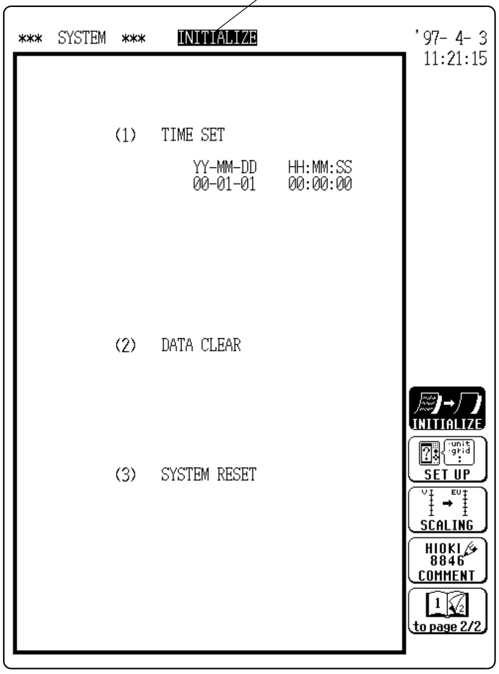
(Refer to the following Sections)

11.2 How to Use the SYSTEM Screen

- Press the SYSTEM key to call up the SYSTEM screen.
- On the SYSTEM screen, items common to all functions are displayed.
- Use the function keys to select the item you wish to set and then make the setting. (Press the SYSTEM key to switch items.)
- When the flashing cursor is at the point shown in the illustration, the function keys have the following assignments.

Method

Flashing cursor



*** SYSTEM *** INITIALIZE

'97- 4- 3
11:21:15

(1) TIME SET

YY-MM-DD HH:MM:SS
00-01-01 00:00:00

(2) DATA CLEAR

(3) SYSTEM RESET

- **1/2**

Function key display	Meaning
INITIALIZE	Set clock / clear waveform data / system reset (☞ Section 11.3)
SET UP	Channel selection and other functions (☞ Section 11.4)
SCALING	Scaling function (☞ Section 11.5)
HIOKI 8846 COMMENT	Input titles and comments (☞ Section 11.6)
to page 2/2	Switch to page 2/2

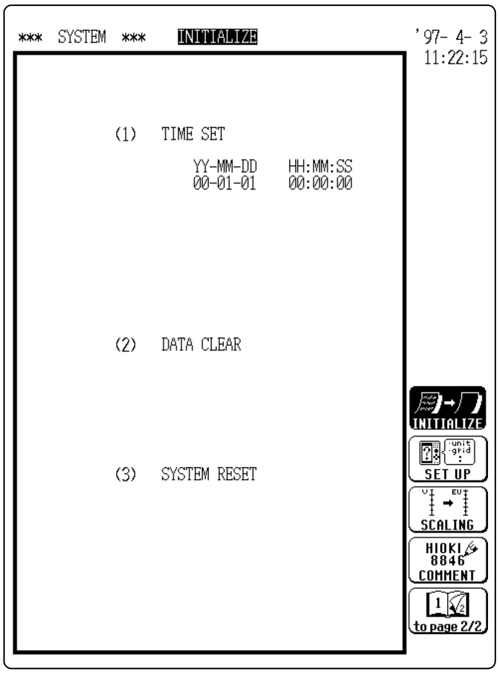
- **2/2**

Function key display	Meaning
SELF CHECK	Perform self-test (☞ Section 11.7)
INTERFACE	Make interface settings (☞ Section 11.8)
to page 1/2	Switch to page 1/2

11.3 Initialization [INITIALIZE]

Setting the clock (TIME SET), clearing waveform data (DATA CLEAR), and initialization of setting items (SYSTEM RESET) are available.

Method Screen: SYSTEM (INITIALIZE)


*** SYSTEM *** INITIALIZE '97- 4- 3 11:22:15

(1) TIME SET
YY-MM-DD HH:MM:SS
00-01-01 00:00:00

(2) DATA CLEAR

(3) SYSTEM RESET

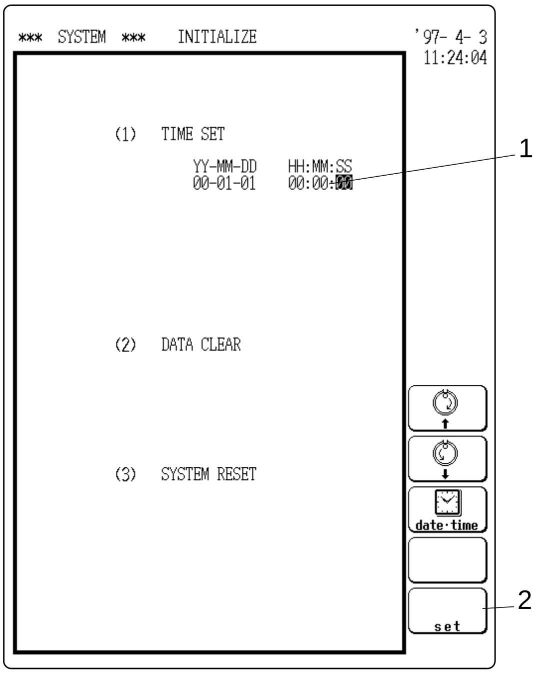
1. Press F1 [INITIALIZE].
2. Move the flashing cursor to the setting item, and press the function key to make the selection.

For details on settings, see Sections 11.3.1 to 11.3.3.

11.3.1 Setting the Clock [TIME SET]

- This unit incorporates a calendar with automatic leap year compensation and 24-hour clock.
- The clock is used for the following functions:
  - Display of year/month/day/hour/minutes/seconds on STATUS, CHANNEL, and SYSTEM screens
  - Timer trigger function
  - Trigger time list printout
  - Date/time printout at every 5 DIV when time axis is set to **DATE**

Method Screen: SYSTEM (INITIALIZE)



*** SYSTEM *** INITIALIZE '97- 4- 3 11:24:04

(1) TIME SET
YY-MM-DD HH:MM:SS
00-01-01 00:00:00

(2) DATA CLEAR

(3) SYSTEM RESET

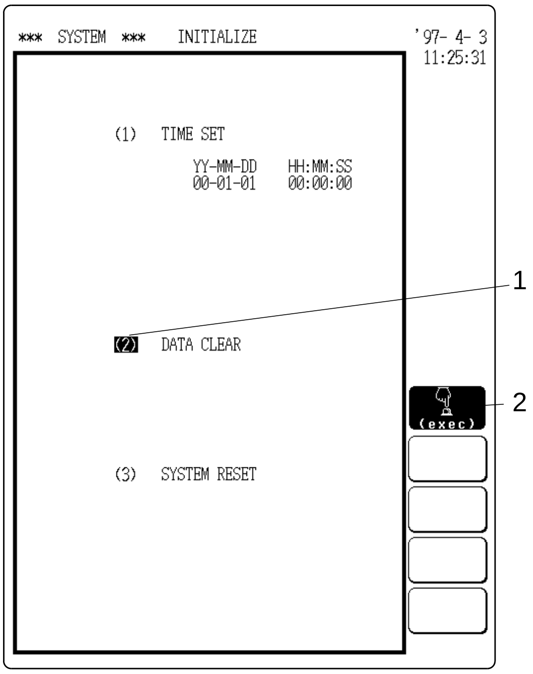
1. Move the flashing cursor to the year, month, day, hour, minute, second items of **(1) TIME SET** and make the settings.
2. Press F5 [set] to start the clock.

Function key display	Meaning
↑	Set numerals for year, month, day, hour, minute, second
↓	
date·time	: Insert current date and time in respective fields
set	: Start clock

11.3.2 Clear Waveform Data [DATA CLEAR]

Clears waveform data stored in memory.

Method Screen: SYSTEM (INITIALIZE)



*** SYSTEM *** INITIALIZE '97- 4- 3 11:25:31

(1) TIME SET
YY-MM-DD HH:MM:SS
00-01-01 00:00:00

(2) DATA CLEAR

(3) SYSTEM RESET

1. Move the flashing cursor to **(2) DATA CLEAR**.
2. Press F1 [exec].

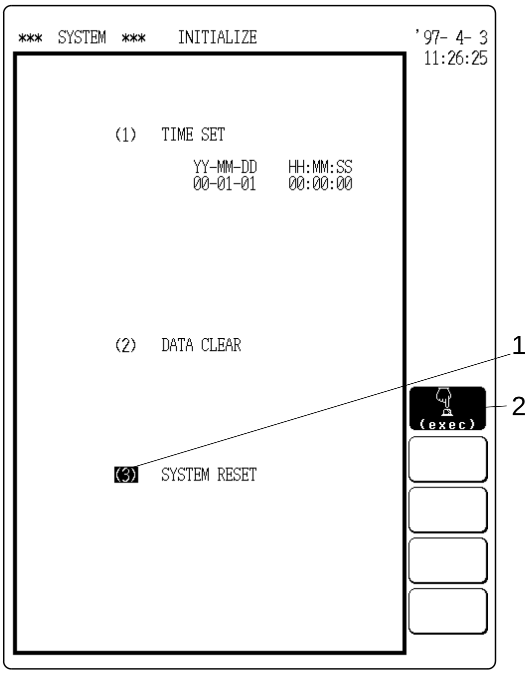
Function key display	Meaning
(exec)	: Clear waveform data

NOTE When memory segmentation (☞ Chapter 17) is used, data in all blocks are cleared.

11.3.3 System Reset [SYSTEM RESET]

- Resets all settings to the factory default values.
- The same effect can be achieved by turning power to the unit on while holding down the STOP key (☞ Section 23.5).

Method Screen: SYSTEM (INITIALIZE)



*** SYSTEM *** INITIALIZE '97- 4- 3 11:26:25

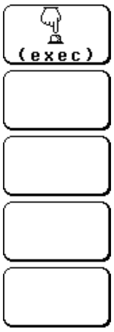
(1) TIME SET
YY-MM-DD HH:MM:SS
00-01-01 00:00:00

(2) DATA CLEAR

(3) SYSTEM RESET

1. Move the flashing cursor to the **(3) SYSTEM RESET** item.
2. Press F1 [exec].

Function key display Meaning



: Reset all system items

System reset list

(1) STATUS screen

Memory recorder function

Settings	Display items	Initial settings
Time axis range	**time/div**	500 µs/DIV (8927 not installed), 1 ms/DIV
Recording length	**shot**	25 DIV
Display format	**format**	SINGLE
Interpolation	**dot-line**	LINE
Superimpose	**superimpose**	OFF
Printer recording format	**print mode**	WAVEFORM
Smooth print Auto print Auto save	**smooth print** **auto print** **auto save**	OFF
Trigger mode	**trig mode**	SINGLE
Pretrigger	**pre-trig**	0%
Trigger source AND/OR	**trigger source**	OR
Trigger source	**analog trigger**	all OFF
Memory segmentation Averaging Waveform decision Waveform parameter calculation Waveform processing	**memory div** **averaging** **wave comparison** **measurement** **wave calculation**	OFF

Recorder function

Settings	Display items	Initial settings
TIme axis range	**time/div**	10 ms/DIV (8927 not installed), 20 ms/DIV
Time axis magnification	**time/div zoom**	×1
Recording time	**recording time**	0 s
Display format	**format**	SINGLE
Interpolation	**dot-line**	LINE
Recording medium	**recording medium**	OFF
Printer recording format	**print mode**	WAVEFORM
Smooth print Microphone	**smooth print** **mic**	OFF
Trigger mode	**trig mode**	SINGLE
Trigger source AND/OR linking	**trigger source**	OR
Trigger source	**analog trigger**	all OFF
Waveform parameter calculation	**measurement**	OFF

FFT function

Settings	Display items	Initial settings
FFT mode	**FFT mode**	1CH FFT
Frequency range	**max.frequency**	80 kHz(8927 not installed), 40 kHz
Window function	**window**	RECTAN
Display format	**format**	SINGLE
Peak value display Averaging	**peak** **average**	OFF
Reference data	**reference**	NEW DATA
Mode	**(mode)**	STRAGE
w1	**(w1)**	CH1
Scale	**(scale)**	AUTO
Trigger mode	**trig mode**	SINGLE
Pretrigger	**pre-trig**	0%
Trigger source AND/OR	**trigger source**	OR
Trigger source	**analog trigger**	all OFF
Interpolation	**dot-line**	LINE
Printer recording format	**print mode**	WAVEFORM
Auto print Auto save Waveform evaluation	**auto print** **auto save** **wave comparison**	OFF

(2) Channel screen

Setting displays	Initial settings
Input type	ANALOG
Waveform display color	Same color as channel number (not in FFT)
Voltage axis range	Minimum range of installed amplifier
Zooming	×1
Zero position	10 DIV
Filter	OFF

(3) System screen

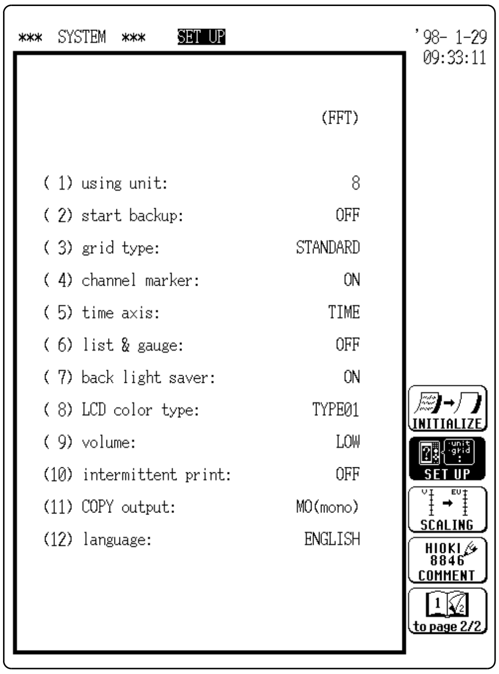
Display items	Initial settings
(1) using unit	8
(2) start backup	OFF
(3) grid type	STANDARD
(4) channel marker	ON
(5) time axis	TIME
(6) list&gauge	OFF
(7) backlight saver	ON
(8) LCD color type	TYPE 1
(9) volume	LOW
(10) intermittent print	OFF
(11) COPY output	PRINTER
scaling	all OFF
Comment	OFF
title	SETTING
channel	OFF

11.4 Special Function Settings [SETUP]

The following 10 functions are available.

(1) Channel selection (☞ 11.4.1)
(2) Start key backup (☞ 11.4.2)
(3) Setting the grid (☞ 11.4.3)
(4) Channel marker function (☞ 11.4.4)
(5) Time axis display (☞ 11.4.5)
(6) List and gauge functions (☞ 11.4.6)
(7) Backlight saver function (☞ 11.4.7)
(8) Setting screen colors (☞ 11.4.8)
(9) Setting the volume (☞ 11.4.9)
(10) Intermittent printing (☞ 11.4.10)
(11) Setting the screen hard copy destination (11.4.11)
(12) Setting the display language (☞ 11.4.12)

Method Screen: SYSTEM (SETUP)



*** SYSTEM *** SET UP '98- 1-29 09:33:11

(FFT)

(1) using unit: 8
(2) start backup: OFF
(3) grid type: STANDARD
(4) channel marker: ON
(5) time axis: TIME
(6) list & gauge: OFF
(7) back light saver: ON
(8) LCD color type: TYPE01
(9) volume: LOW
(10) intermittent print: OFF
(11) COPY output: MO(mono)
(12) language: ENGLISH

1. Press F2 [SETUP].
2. Move the flashing cursor to the various items and use the function keys to make the selection.

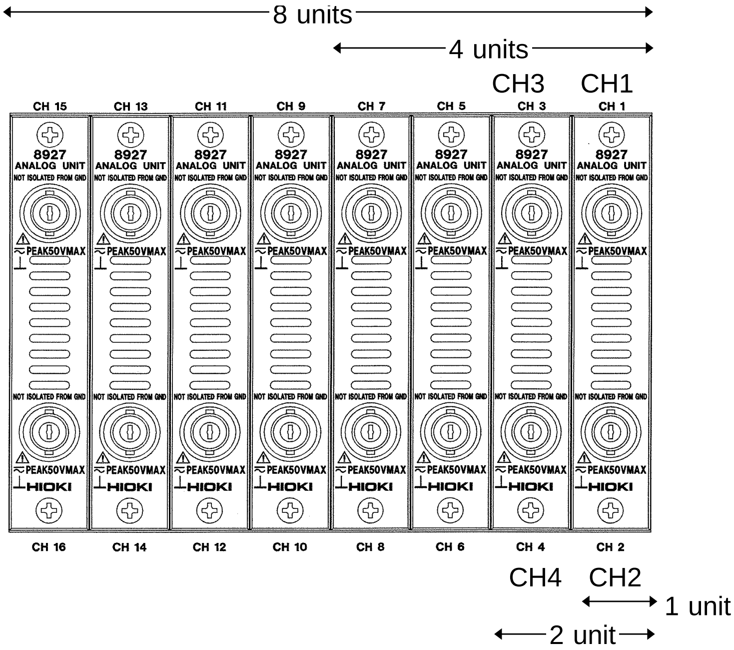
For details, see Sections 11.4.1 - 11.4.11.

11.4.1 Channel Selection [using unit]

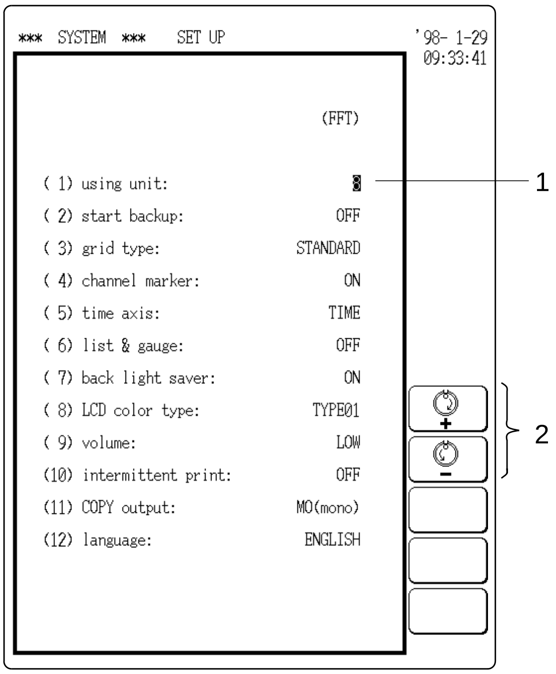
- This function allows limiting the number of units to be used.
- Be sure to make this setting before measurement.
- Units in use are assigned to channels in ascending order.

NOTE

- When using the memory recorder function, the number of units determines the available recording length (☞ Section 6.2.3).
- When using the recorder function, the number of units determines the available time axis range (☞ Section 7.2.2).



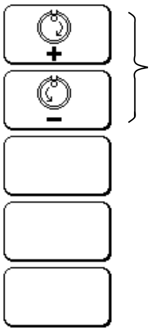
Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***    SET UP                '98- 1-29
                                         09:33:41

                              (FFT)

( 1) using unit:                  8
( 2) start backup:              OFF
( 3) grid type:            STANDARD
( 4) channel marker:             ON
( 5) time axis:                TIME
( 6) list & gauge:              OFF
( 7) back light saver:           ON
( 8) LCD color type:         TYPE01
( 9) volume:                    LOW
(10) intermittent print:        OFF
(11) COPY output:          MO(mono)
(12) language:              ENGLISH
```

1. Move the flashing cursor to the **(1) using unit** item.
2. Use the JOG control or the function keys to make the selection.

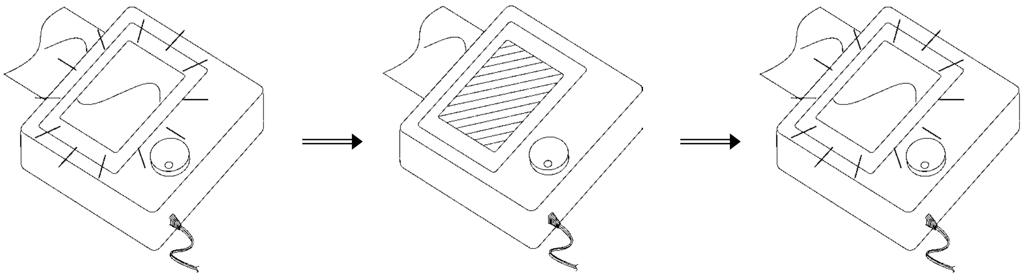
Function key display Meaning



1, 2, 4, 8 (unit)

11.4.2 Start Key Backup [start backup]

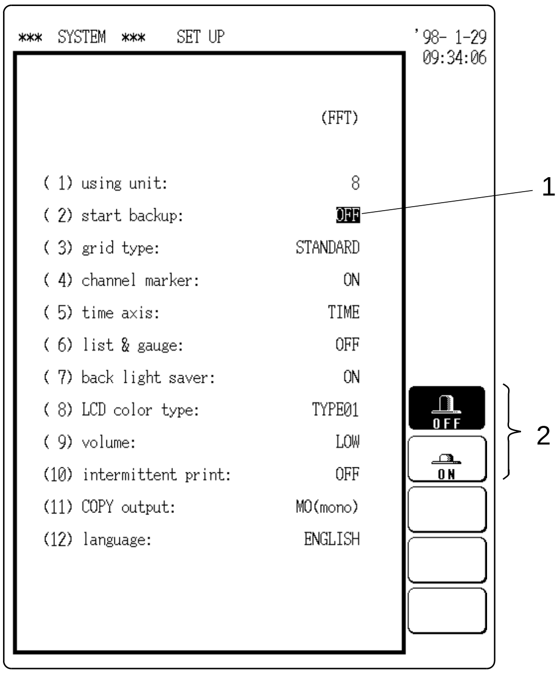
When this function is enabled, the unit will operate as follows: If the power supply is interrupted during measurement (while the START key LED is lit), recording is restarted immediately as soon as the power is restored. If the trigger function is used, the unit goes into trigger standby mode.



If power fails during recording...

...recording is restarted when power is restored.

Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***   SET UP                    '98- 1-29
                                            09:34:06

                              (FFT)

( 1) using unit:                  8
( 2) start backup:              OFF
( 3) grid type:            STANDARD
( 4) channel marker:             ON
( 5) time axis:                TIME
( 6) list & gauge:              OFF
( 7) back light saver:           ON
( 8) LCD color type:         TYPE01
( 9) volume:                    LOW
(10) intermittent print:        OFF
(11) COPY output:          MO(mono)
(12) language:              ENGLISH
```

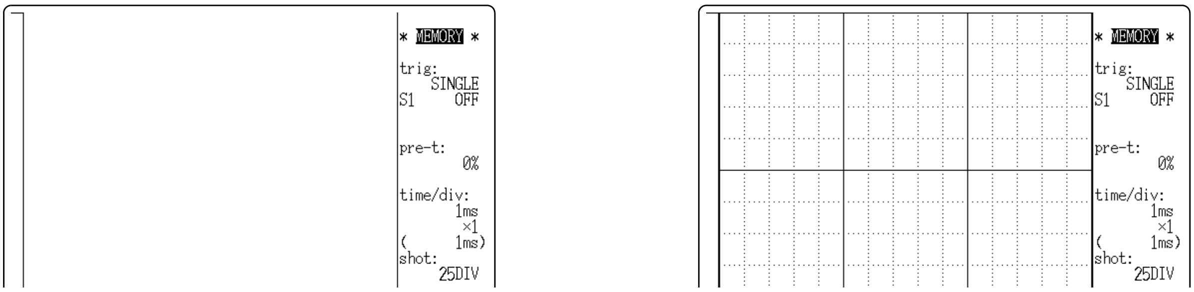
1. Move the flashing cursor to **(2) start backup** item.
2. Press the function key to make the settings.

Function key display	Meaning
OFF	: Start key backup is not enabled.
ON	: Start key backup is enabled.

11.4.3 Setting the Grid [grid type]

- Sets the type of grid to be used for printout.
- The following seven settings are available: OFF (no grid), standard, fine, standard (dark), fine (dark), standard (shaded), fine (shaded).
- Only OFF and standard (used at any other setting) are available for the display.

The DISPLAY screen

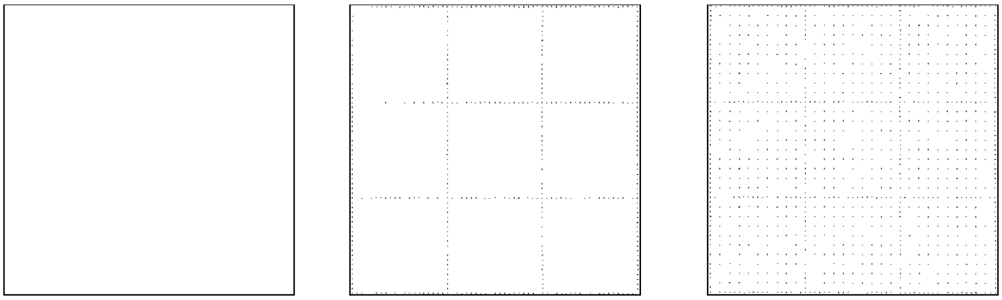


* MEMORY *
trig: SINGLE
S1 OFF
pre-t: 0%
time/div: 1ms ×1 (1ms)
shot: 25DIV

Grid: OFF

Grid: ON
(excluding the OFF setting)

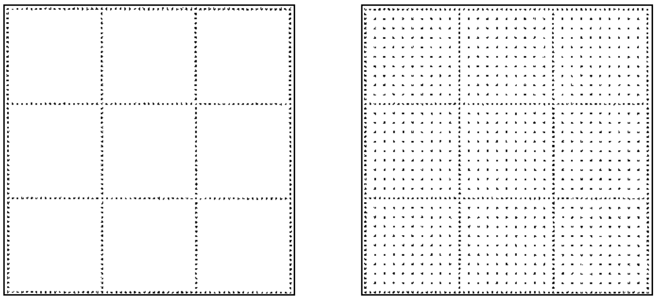
Printed recordings



OFF

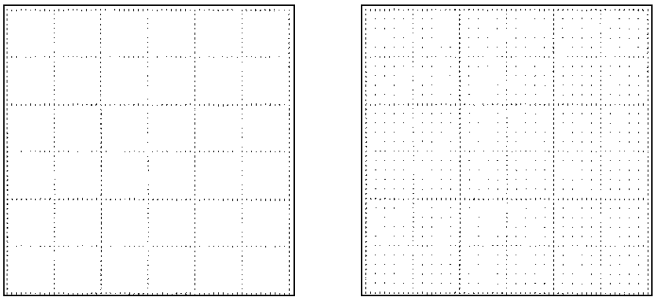
Standard

Fine



Standard (dark)

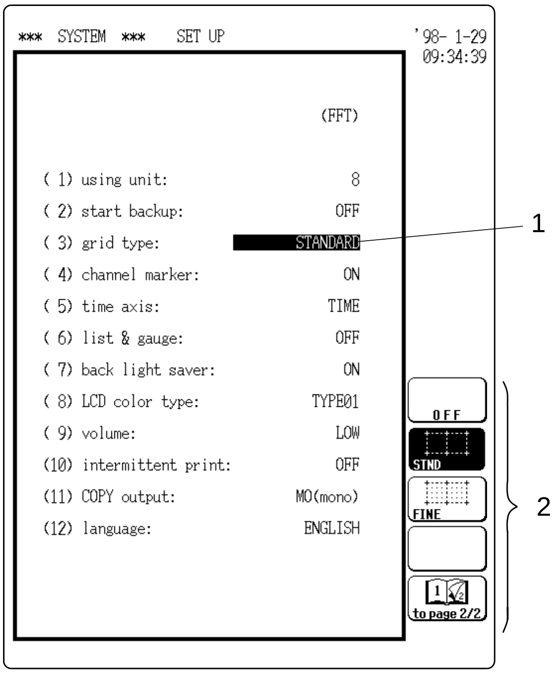
Fine (dark)



Standard (shaded)

Fine (shaded)

Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***    SET UP                    '98- 1-29
                                             09:34:39
                                  (FFT)

( 1) using unit:                      8
( 2) start backup:                  OFF
( 3) grid type:                STANDARD
( 4) channel marker:                 ON
( 5) time axis:                    TIME
( 6) list & gauge:                  OFF
( 7) back light saver:               ON
( 8) LCD color type:             TYPE01
( 9) volume:                        LOW
(10) intermittent print:            OFF
(11) COPY output:              MO(mono)
(12) language:                  ENGLISH
```

1. Move the flashing cursor to **(3) grid type** item.

2. Press the function key to make the settings.

- **1/2**

Function key display	Meaning
OFF	: Off
STND	: Standard
FINE	: Fine
to page 2/2	: Switch to page 2/2

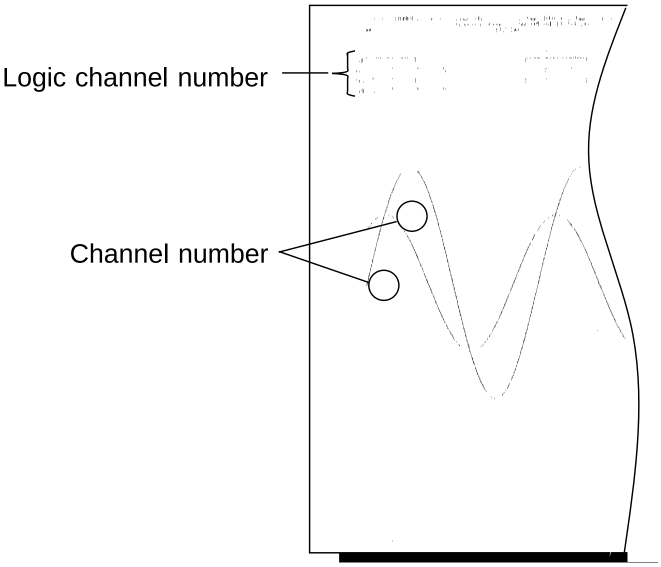
- **2/2**

Function key display	Meaning
STND(dark)	: Standard (dark)
FINE(dark)	: Fine (dark)
STND(shad)	: Standard (shaded)
FINE(shad)	: Fine (shaded)
to page 1/2	: Switch to page 1/2

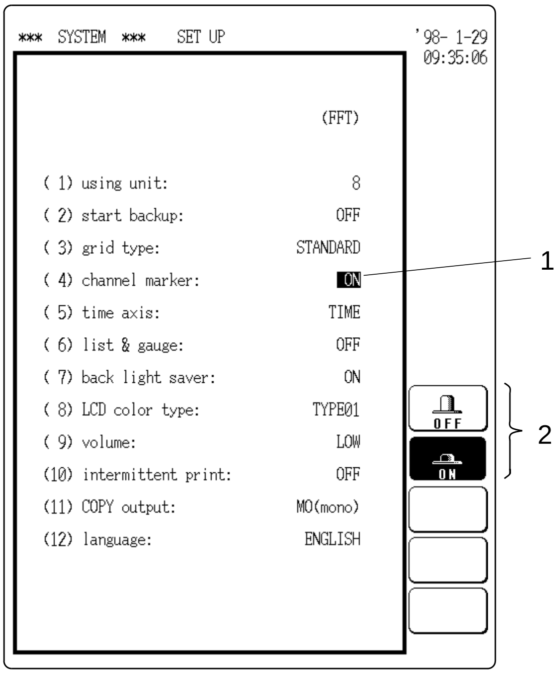
NOTE For the FFT function, the settings are "Standard (shaded)" → "Standard (dark)", "Fine (shaded)" → "Fine (dark)".

11.4.4 Channel Marker Function [channel marker]

This function adds channel numbers to the waveforms on the printout.



Method Screen: SYSTEM (SETUP)



*** SYSTEM *** SET UP '98- 1-29 09:35:06

(FFT)

(1) using unit: 8
(2) start backup: OFF
(3) grid type: STANDARD
(4) channel marker: ON
(5) time axis: TIME
(6) list & gauge: OFF
(7) back light saver: ON
(8) LCD color type: TYPE01
(9) volume: LOW
(10) intermittent print: OFF
(11) COPY output: MO(mono)
(12) language: ENGLISH

1. Move the flashing cursor to the **(4) channel marker** item.
2. Press the function keys to make the selection.

Function key display	Meaning
OFF	: Channel numbers will not be printed.
ON	: Channel numbers will be printed.

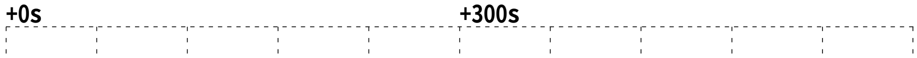
NOTE

- When using the X-Y screen of the memory recorder function or the FFT function, channel numbers are not printed.
- Logic channel numbers are printed regardless of the channel marker setting.

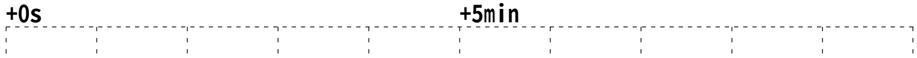
11.4.5 Time Axis Display [time axis]

Determines the way the time from the trigger point is printed out.

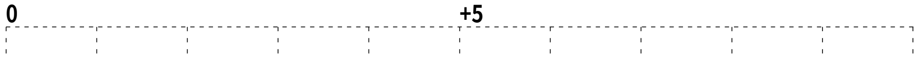
Time



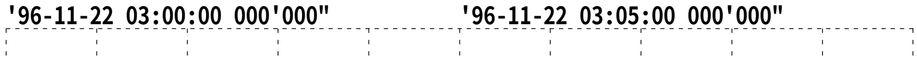
Time (base 60)



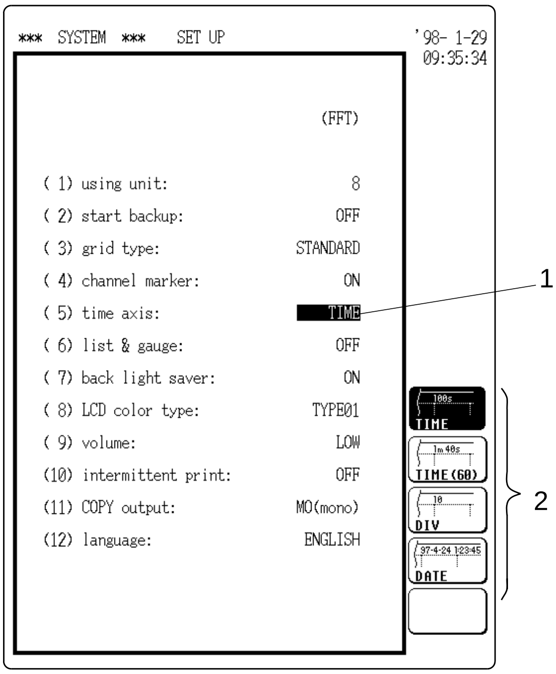
Scale



Date



Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***   SET UP                '98- 1-29
                                        09:35:34

                                 (FFT)

( 1) using unit:                     8
( 2) start backup:                 OFF
( 3) grid type:               STANDARD
( 4) channel marker:                ON
( 5) time axis:                   TIME
( 6) list & gauge:                 OFF
( 7) back light saver:              ON
( 8) LCD color type:            TYPE01
( 9) volume:                       LOW
(10) intermittent print:           OFF
(11) COPY output:             MO(mono)
(12) language:                 ENGLISH
```

1. Move the flashing cursor to the **(5) time axis** item.
2. Use the function keys to make the selection.

Function key display	Meaning
TIME	: Displays the time from the trigger point (unit: fixed).
TIME(60)	: Displays the time from the trigger point (unit: base 60).
DIV	: Displays the number of DIV from trigger point.
DATE	: Print date and time every 5 DIV

NOTE

- When using the FFT function, **DIV** and **DATE** are identical to **TIME**.
- When external sampling is used, the following applies.

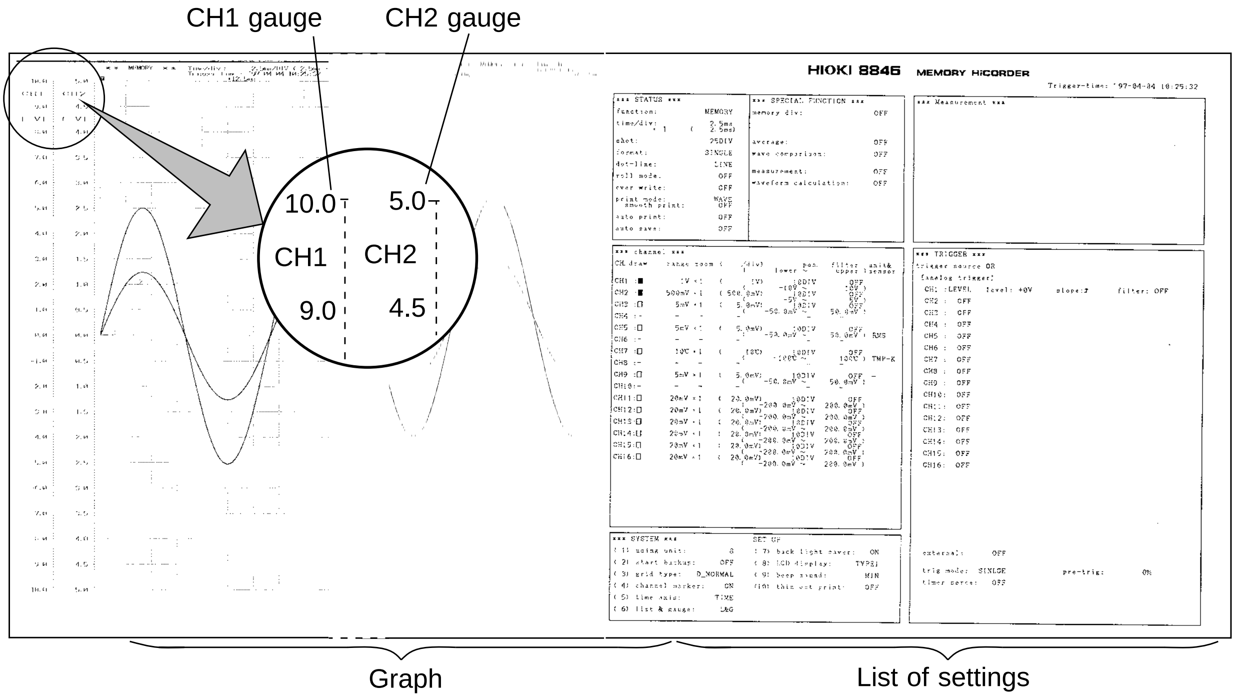
(1) If printer format is set to **WAVE**, the "Scale" setting is used in any case.

(2) If printer format is set to **LOGGING**, the setting except "Scale" is the sampling count.

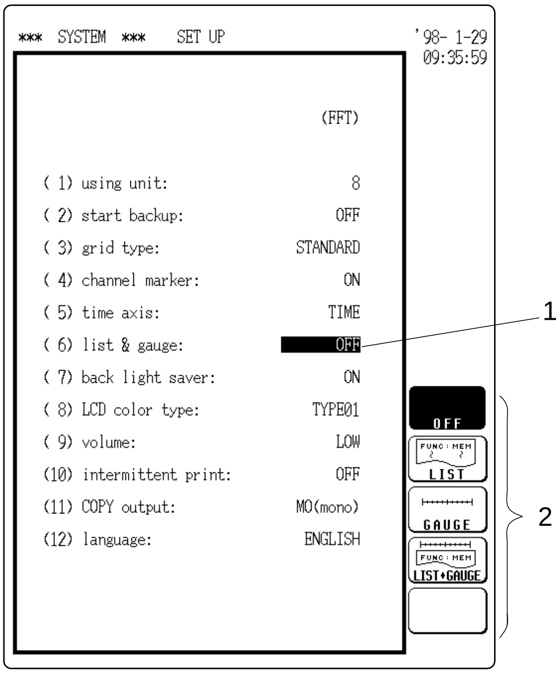
If printer format is set to **LOGGING** and "Date" is used, μs and lower values are discarded.

11.4.6 List and Gauge Functions [list & gauge]

When a waveform is being printed (except for screen hard copies), a gauge (vertical scale) and list of setting items can be added.



Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***   SET UP                '98- 1-29
                                        09:35:59

                               (FFT)

 ( 1) using unit:                  8
 ( 2) start backup:              OFF
 ( 3) grid type:            STANDARD
 ( 4) channel marker:             ON
 ( 5) time axis:                TIME
 ( 6) list & gauge:              OFF
 ( 7) back light saver:           ON
 ( 8) LCD color type:         TYPE01
 ( 9) volume:                    LOW
 (10) intermittent print:        OFF
 (11) COPY output:          MO(mono)
 (12) language:              ENGLISH
```

1. Move the flashing cursor to **(6) list & gauge** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: No gauges or listing
FUNC : MEM LIST	: Print listing only
GAUGE	: Print gauges only
FUNC : MEM LIST+GAUGE	: Print both gauges and listing

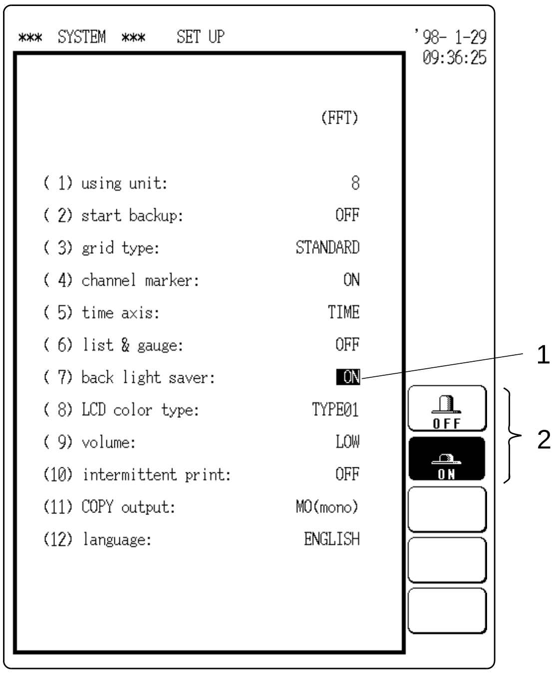
NOTE

- The gauge is only printed for channels for which the waveform is being displayed.
- When the X-Y plot of the memory recorder function is used, the number of gauges for the X axis is restricted to 2.
- When single screen display is used, channels using the same voltage range, magnification/compression factor, zero position, variable setting, and scaling setting are displayed with the same gauge.

11.4.7 Backlight Saver Function [backlight saver]

- When this function is enabled, LCD backlighting is turned off automatically if no key is pressed for about 10 minutes.
- Pressing any key will turn the backlight on again.
- This increases the service life of the backlight.

Method Screen: SYSTEM (SETUP)



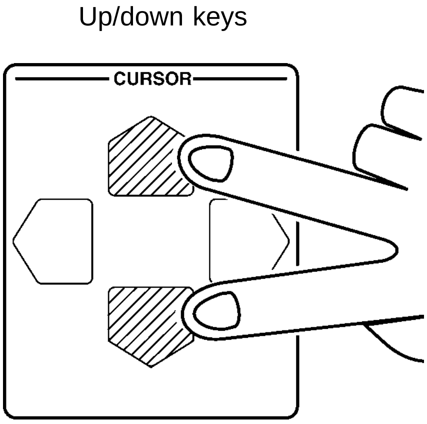
```
*** SYSTEM ***    SET UP                         '98- 1-29
                                                  09:36:25

                                        (FFT)

( 1) using unit:                            8
( 2) start backup:                        OFF
( 3) grid type:                      STANDARD
( 4) channel marker:                       ON
( 5) time axis:                          TIME
( 6) list & gauge:                        OFF
( 7) back light saver:                     ON
( 8) LCD color type:                   TYPE01
( 9) volume:                              LOW
(10) intermittent print:                  OFF
(11) COPY output:                    MO(mono)
(12) language:                        ENGLISH
```

1. Move the flashing cursor to the **(7) backlight saver** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: Backlight is always on
ON	: Backlight is turned off automatically

LCD backlight ON/OFF

- To turn the LCD backlight off:
  press the up and down cursor keys simultaneously.
- To turn the LCD backlight on:
  press any key.

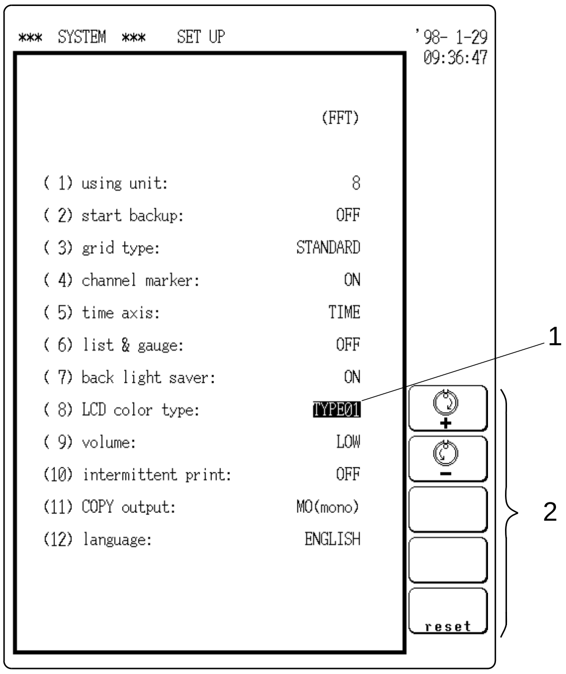


Turning the LCD backlight off

11.4.8 Setting Screen Colors [LCD color type]

The user can choose between various color patterns for the display.

Method Screen: SYSTEM (SETUP)



```
***  SYSTEM  ***   SET UP                    '98- 1-29
                                              09:36:47

                          (FFT)

( 1) using unit:                8
( 2) start backup:              OFF
( 3) grid type:                 STANDARD
( 4) channel marker:            ON
( 5) time axis:                 TIME
( 6) list & gauge:              OFF
( 7) back light saver:          ON
( 8) LCD color type:            TYPE01
( 9) volume:                    LOW
(10) intermittent print:        OFF
(11) COPY output:               MO(mono)
(12) language:                  ENGLISH
```

1. Move the flashing cursor to the **(8) LCD color type** item.
2. Use the function keys to make the selection.

Function key display	Meaning
+	: Switch to the next higher pattern
−	: Switch to the next lower pattern
reset	: Reset to type 1

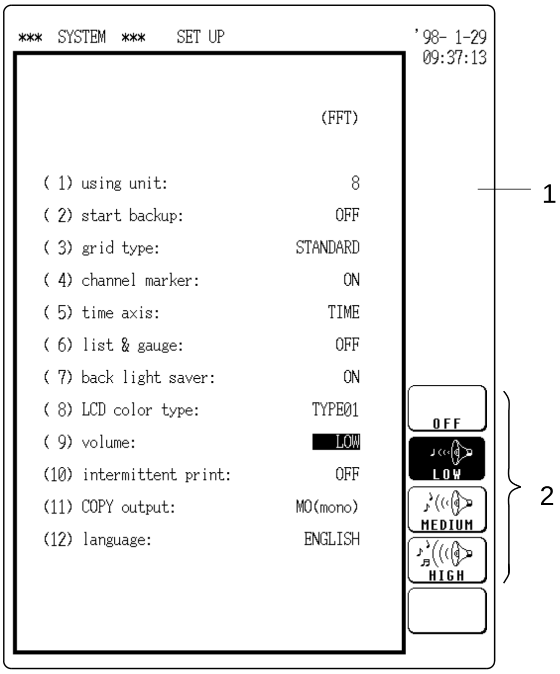
NOTE

Changing the display color has no effect on the printout (normal printing, screen hard copy, A4 print).

11.4.9 Setting the Volume [volume]

- This setting controls the volume of the error and warning beep that is also produced when a waveform decision result is NG, and when stop mode is entered.
- The setting also affects the volume with which a voice memo is played back when using the recorder function.

Method Screen: SYSTEM (SETUP)



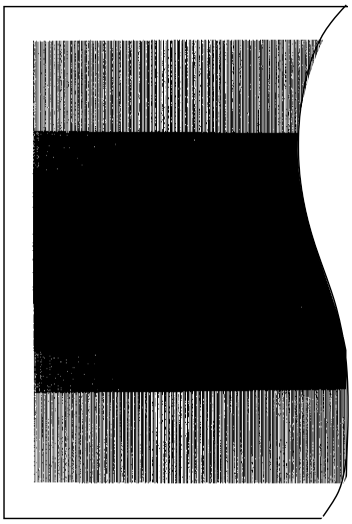
```
*** SYSTEM ***   SET UP                         '98- 1-29
                                                 09:37:13
                                   (FFT)

 ( 1) using unit:                      8
 ( 2) start backup:                  OFF
 ( 3) grid type:                STANDARD
 ( 4) channel marker:                 ON
 ( 5) time axis:                    TIME
 ( 6) list & gauge:                  OFF
 ( 7) back light saver:               ON
 ( 8) LCD color type:             TYPE01
 ( 9) volume:                        LOW
 (10) intermittent print:            OFF
 (11) COPY output:              MO(mono)
 (12) language:                  ENGLISH
```

1. Move the flashing cursor to the **(9) volume** item.
2. Use the function keys to make the selection.

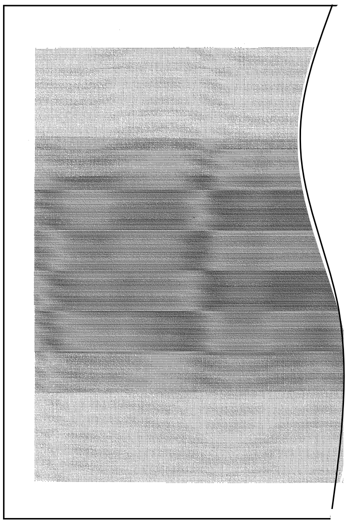
Function key display	Meaning
OFF	: No sound from speaker
LOW	: Volume low
MEDIUM	: Volume medium
HIGH	: Volume high

11.4.10 Intermittent Printing [intermittent print]

- When the interpolation function is set to ON and the envelope waveform exceeds 0.5 DIV, printout is carried out with reduced frequency.
- When operating the unit on DC, this can help to conserve power.
- The intermittent printing setting can be chosen also when operating the unit on AC.
- Print speed will differ depending on the density of the screen display.
- Real-time printing when the unit is operated from a DC source is intermittent, also when the setting is OFF.

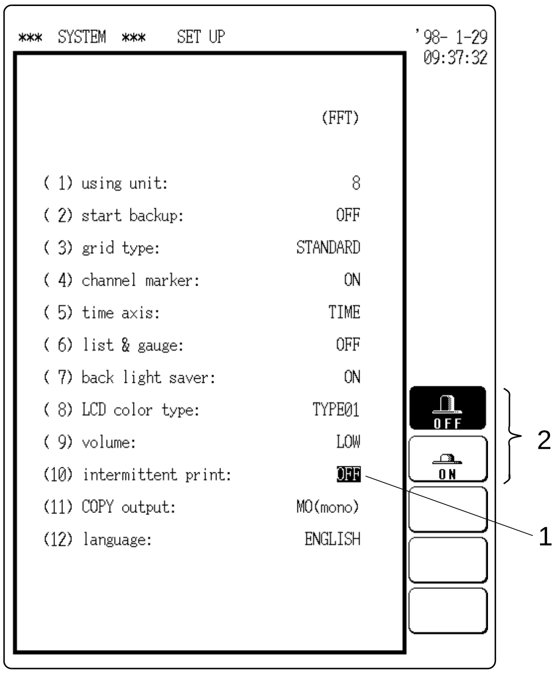


Intermittent printing OFF



Intermittent printing ON

Method Screen: SYSTEM (SETUP)



*** SYSTEM *** SET UP '98- 1-29 09:37:32

(FFT)

(1) using unit: 8
(2) start backup: OFF
(3) grid type: STANDARD
(4) channel marker: ON
(5) time axis: TIME
(6) list & gauge: OFF
(7) back light saver: ON
(8) LCD color type: TYPE01
(9) volume: LOW
(10) intermittent print: OFF
(11) COPY output: MO(mono)
(12) language: ENGLISH

1. Move the flashing cursor to the **(10) intermittent print** item.
2. Use the function keys to make the selection.

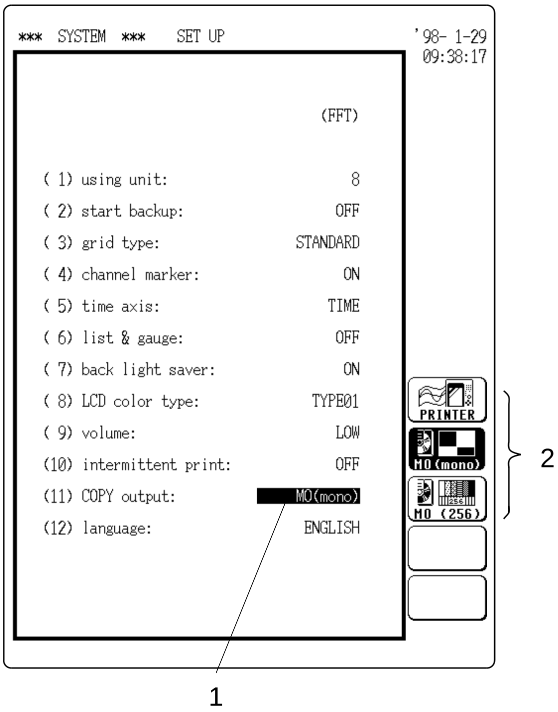
Function key display	Meaning
OFF	: Intermittent printing is disabled.
ON	: Intermittent printing is enabled.

NOTE

- In dot display mode the intermittent printing function has no effect.
- In FFT mode the intermittent printing function has no effect.

11.4.11 Selecting the Hard Copy Destination

Method Screen: SYSTEM (SETUP)



```
*** SYSTEM ***   SET UP                    '98- 1-29
                                            09:38:17

                                  (FFT)

( 1) using unit:                      8
( 2) start backup:                  OFF
( 3) grid type:                STANDARD
( 4) channel marker:                 ON
( 5) time axis:                    TIME
( 6) list & gauge:                  OFF
( 7) back light saver:               ON
( 8) LCD color type:             TYPE01
( 9) volume:                        LOW
(10) intermittent print:            OFF
(11) COPY output:              MO(mono)
(12) language:                  ENGLISH
```

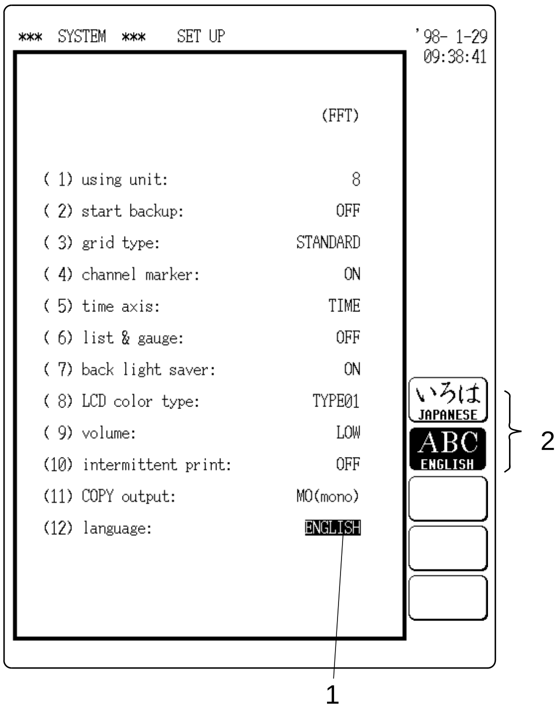
1. Move the flashing cursor to the **(11) COPY output** item.
2. Use the function keys to make the selection.

Function key display		Meaning
PRINTER	:	Output to printer.
MO(mono)	:	Save bitmap file to MO disk (monochrome).
MO (256)	:	Save bitmap file to MO disk (256 colors).

11.4.12 Setting the Display Language

The display languages can be switched between Japanese and English.

Method Screen: SYSTEM (SETUP)



```
***  SYSTEM  ***    SET UP                '98- 1-29
                                           09:38:41

                                 (FFT)

( 1) using unit:                     8
( 2) start backup:                 OFF
( 3) grid type:               STANDARD
( 4) channel marker:                ON
( 5) time axis:                   TIME
( 6) list & gauge:                 OFF
( 7) back light saver:              ON
( 8) LCD color type:            TYPE01
( 9) volume:                       LOW
(10) intermittent print:           OFF
(11) COPY output:             MO(mono)
(12) language:                 ENGLISH
```

1. Move the flashing cursor to the **(12) language** item.
2. Use the function keys to make the selection.

Function key display	Meaning
いろは JAPANESE	: Display in Japanese.
ABC ENGLISH	: Display in English

NOTE

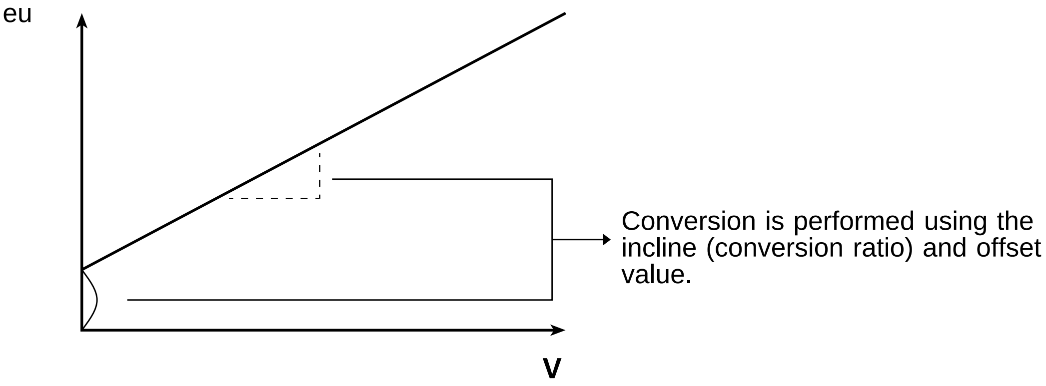
A system reset does not change the language setting.

11.5 Scaling Function [SCALING]

- The scaling function can be used to convert an output voltage from a sensor or similar into a physical quantity.
- Two types of scaling functions are available.

Method 1 (conversion ratio method)

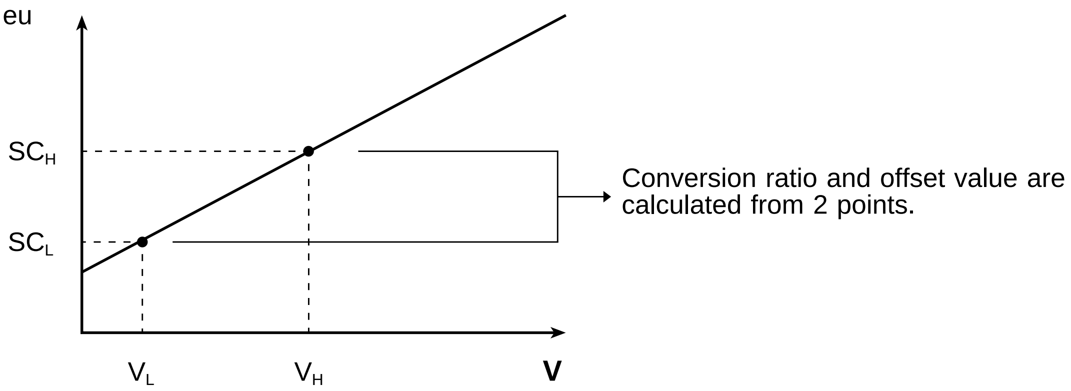
Scaling is performed by specifying a physical quantity to correspond to a 1V input signal (conversion ratio: eu/v), an offset value, and the unit (eu: engineering units). This will cause the measurement voltage to be converted into the selected units.



Conversion is performed using the incline (conversion ratio) and offset value.

Method 2 (2-point method)

Scaling is performed by specifying two input signal points (voltage values) and the conversion values for these two points in engineering units (eu). This will cause the measurement voltage to be converted into the selected units.

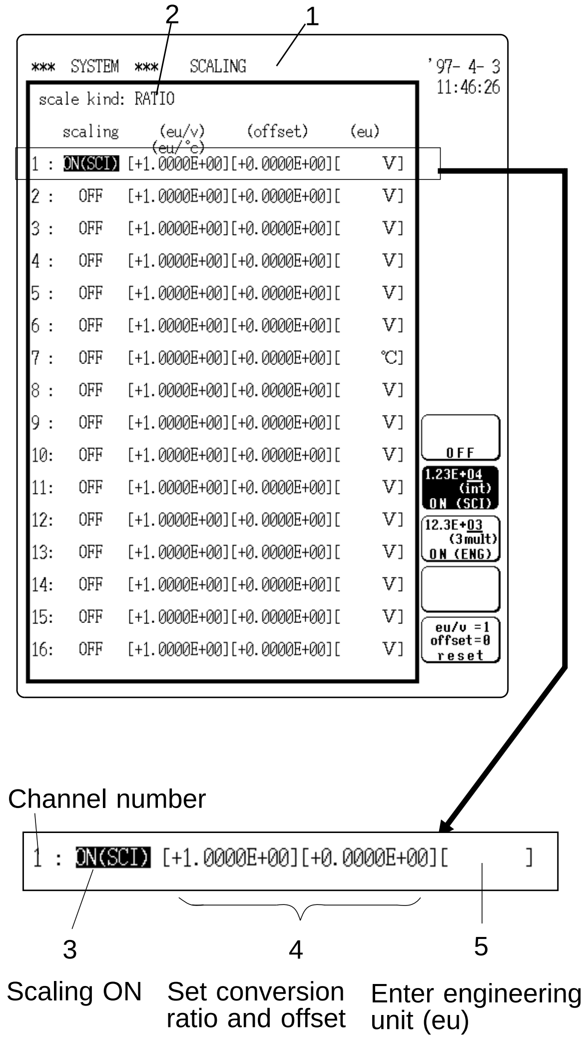


Conversion ratio and offset value are calculated from 2 points.

- The gauge scale (maximum and minimum values of horizontal axis) and A/B cursor measurement values are displayed in the scaled units.
- Scaling can be performed for every channel.

11.5.1 Conversion Ratio Scaling

Method Screen: SYSTEM (SCALING)



```
***  SYSTEM  ***   SCALING                       '97- 4- 3
                                                  11:46:26
scale kind: RATIO
   scaling     (eu/v)      (offset)      (eu)
              (eu/°c)
1 :  ON(SCI)  [+1.0000E+00][+0.0000E+00][     V]
2 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
3 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
4 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
5 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
6 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
7 :   OFF     [+1.0000E+00][+0.0000E+00][    ℃]
8 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
9 :   OFF     [+1.0000E+00][+0.0000E+00][     V]
10:   OFF     [+1.0000E+00][+0.0000E+00][     V]
11:   OFF     [+1.0000E+00][+0.0000E+00][     V]
12:   OFF     [+1.0000E+00][+0.0000E+00][     V]
13:   OFF     [+1.0000E+00][+0.0000E+00][     V]
14:   OFF     [+1.0000E+00][+0.0000E+00][     V]
15:   OFF     [+1.0000E+00][+0.0000E+00][     V]
16:   OFF     [+1.0000E+00][+0.0000E+00][     V]
```

```
1 : ON(SCI) [+1.0000E+00][+0.0000E+00][        ]
```

1. Press F3 [SCALING] to call up the scaling screen.
2. Move the flashing cursor to **scale kind** and select **RATIO**.

Function key display	Meaning
RATIO	: Use conversion ratio method
POINT	: Use 2-point method

3. Move the flashing cursor to the channel for which you want to perform scaling and change the setting to ON.

Function key display	Meaning
OFF	: Scaling not used
1.23E+04 (int) ON (SCI)	: Scaling used (specify exponent as integer)
12.3E+03 (3mult) ON (ENG)	: Scaling used (specify exponent as multiple of 3)
eu/v =1 offset=0 reset	: Conversion ratio = +1.0000E+0, offset = +0.0000E+0

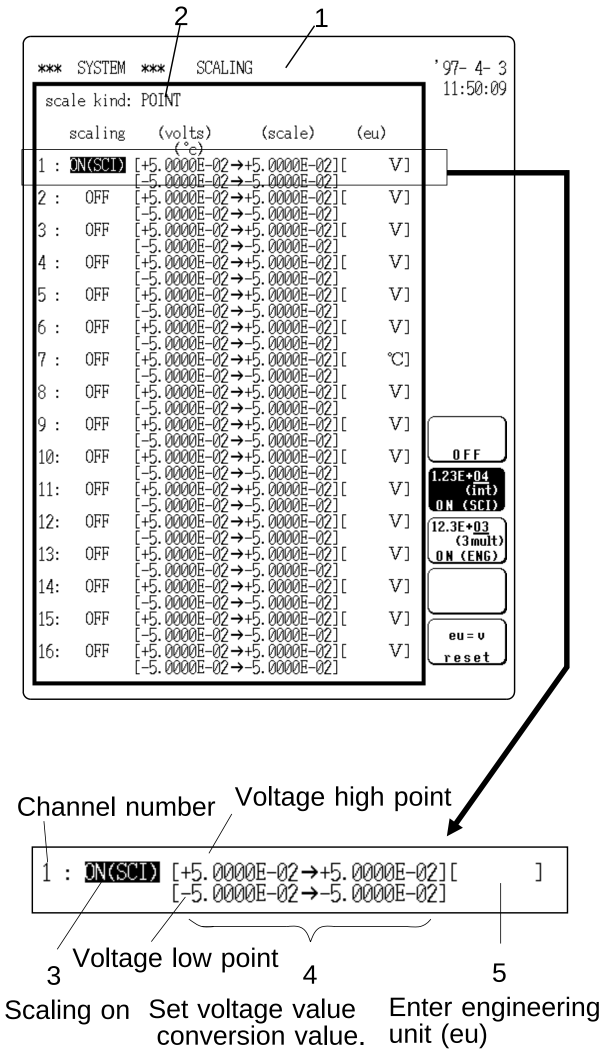
4. Enter the "Conversion ratio: eu/V" and "Offset".
   - The setting range for both these items is -9.9999E+9 to +9.9999E+9 (exponent E-9 to E+9).
   - Move the flashing cursor to each item and make the setting.

Function key display	Meaning
+	0 to 9 (the most significant digit and the exponent, from -9 to +9
−	

5. Enter the "Unit name: eu".
- The unit name can be up to 7 characters long.
- When the flashing cursor is moved within the [ ] brackets, the function key display for comment input appears.
- For details on how to enter the unit name, refer to Section 11.6.1

11.5.2 2-Point Scaling

Method Screen: SYSTEM (SCALING)



```
*** SYSTEM ***   SCALING                        '97- 4- 3
                                                 11:50:09
 scale kind: POINT
   scaling    (volts)       (scale)       (eu)
                (°c)
1 : ON(SCI)  [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
2 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
3 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
4 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
5 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
6 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
7 :   OFF    [+5.0000E-02→+5.0000E-02][    ℃]
             [-5.0000E-02→-5.0000E-02]
8 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
9 :   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
10:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
11:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
12:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
13:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
14:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
15:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
16:   OFF    [+5.0000E-02→+5.0000E-02][    V]
             [-5.0000E-02→-5.0000E-02]
```

1. Press F3 [SCALING] to call up the scaling screen.
2. Move the flashing cursor to **scale kind** and select **POINT**.

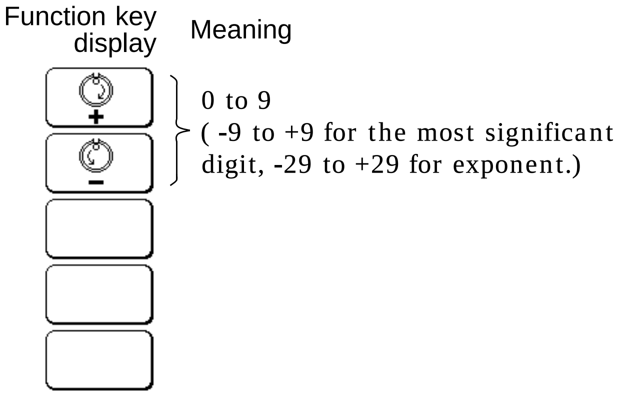
Function key display	Meaning
RATIO	: Use conversion ratio method
POINT	: Use 2-point method

3. Move the flashing cursor to the channel for which you want to perform scaling and change the setting to ON.

Function key display	Meaning
OFF	: Scaling not used
1.23E+04 (int) ON (SCI)	: Scaling used (specify exponent as integer)
12.3E+03 (3mult) ON (ENG)	: Scaling used (specify exponent as multiple of 3)
eu=v reset	: Enter the voltage upper and lower limits of screen

4. Enter the two points.
- Enter the voltage value on the left and the corresponding converted value on the right.
- Enter the higher voltage value in the top row and the lower voltage value in the bottom row.
- The setting range is -9.9999E+29 to +9.9999E+29.

- Move the flashing cursor to each item and make the setting.



0 to 9
(-9 to +9 for the most significant digit, -29 to +29 for exponent.)

5. Enter the "Unit name: eu".

- The unit name can be up to 7 characters long.
- When the flashing cursor is moved within the [ ] brackets, the function key display for comment input appears.
- For details on how to enter the unit name, refer to Section 11.6.1

NOTE

- When the 2-point method is used, scaling is performed using the following equation.

$$Y = \boxed{\frac{SC_H - SC_L}{V_H - V_L}} X + \boxed{\frac{V_H \times SC_L - V_L \times SC_H}{V_H - V_L}}$$

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.

Reference The settings for one channel can be copied to another channel (☞ Section 9.6.10).

Relationship between scaling function and variable function

When both the scaling and variable functions are to be used, the setting procedure differs, depending on the order the functions are enabled.

Method 1 Scaling setting → Variable setting

1. Make the settings for the scaling function (conversion ratio method or 2-point method).
2. Call up the CHANNEL screen (page 2) with the setting item for the variable function.
3. Make the variable setting to be used after conversion to a physical quantity.

Method 2 Variable setting → Scaling setting

1. Call up the CHANNEL screen (page 2) with the setting item for the variable function.
2. Set the input voltage range to be displayed or the voltage value for 1 DIV.
3. Make the settings for the scaling function.

NOTE

- When using both the scaling and variable functions, the upper and lower limits for the variable display after scaling are as follows.

  -9.9999E＋29 ≦setting value ≦ -1.0000E - 29

  Setting value = 0

  +1.0000E-29 ≦ setting value ≦ +9.9999E+29

- When a setting outside of the above range is attempted, a warning indication is given and the setting for the upper and lower limit becomes as follows.

  When setting value ＜ -9.9999E+29: -1.0000E+29

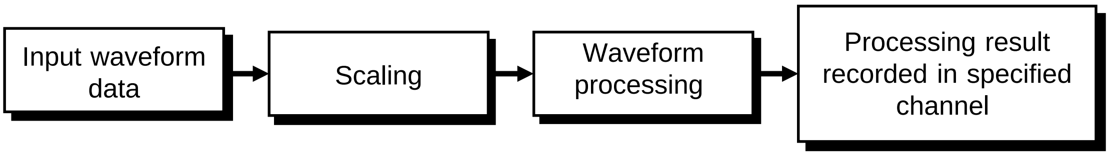
  When -1.0000E-29 ＜ setting value ＜ 0.0000E＋00: -1.0000E-29

  When 0.0000E＋00 ＜ setting value ＜ +1.0000E-29: +1.000E-29

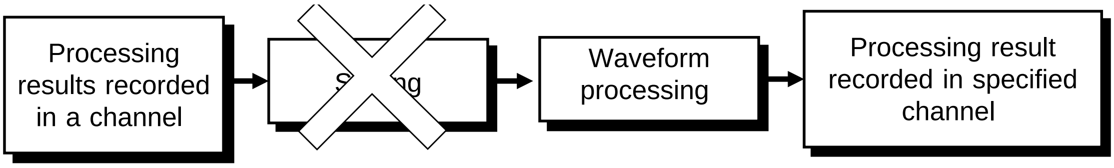
  When +9.9999E＋29＜ setting value: +1.0000E＋29

Relationship between scaling function and waveform processing functions

When both the scaling and waveform processing functions are to be used, the operation sequence becomes as follows.

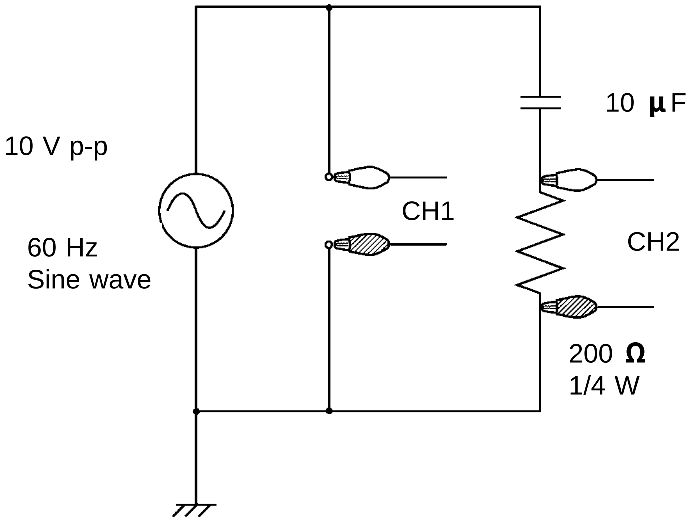


Scaling is not applied to processing results recorded in a channel



11.5.3 Scaling Setting Example

Example In a circuit as shown below, the measure voltage in CH2 is to be converted into current.

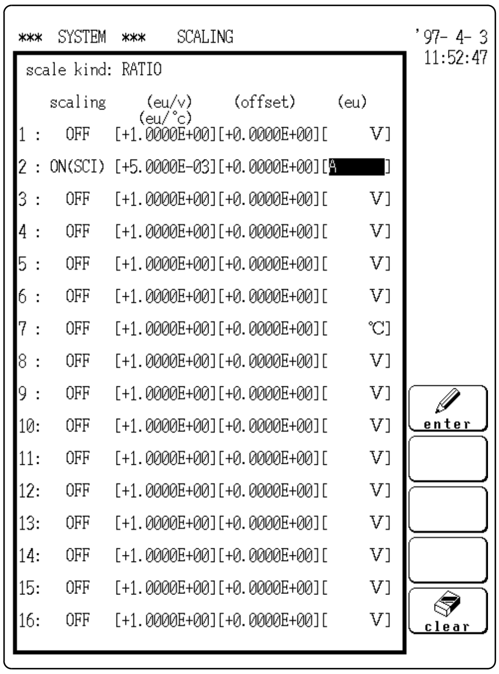


To determine current from voltage, Ohm’s law is applied as follows.

Y = 200X ··················· (1)

X: Current flowing in resistor (A)
Y: Voltage between resistor terminals (V)

Method 1 (conversion ratio method)



```
***  SYSTEM  ***    SCALING                            '97- 4- 3
                                                        11:52:47
 scale kind: RATIO

    scaling     (eu/v)      (offset)      (eu)
               (eu/°c)
1 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
2 : ON(SCI)  [+5.0000E-03][+0.0000E+00][A      ]
3 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
4 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
5 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
6 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
7 :   OFF    [+1.0000E+00][+0.0000E+00][     ℃]
8 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
9 :   OFF    [+1.0000E+00][+0.0000E+00][      V]
10:   OFF    [+1.0000E+00][+0.0000E+00][      V]
11:   OFF    [+1.0000E+00][+0.0000E+00][      V]
12:   OFF    [+1.0000E+00][+0.0000E+00][      V]
13:   OFF    [+1.0000E+00][+0.0000E+00][      V]
14:   OFF    [+1.0000E+00][+0.0000E+00][      V]
15:   OFF    [+1.0000E+00][+0.0000E+00][      V]
16:   OFF    [+1.0000E+00][+0.0000E+00][      V]
```

Equation (1) is transformed into

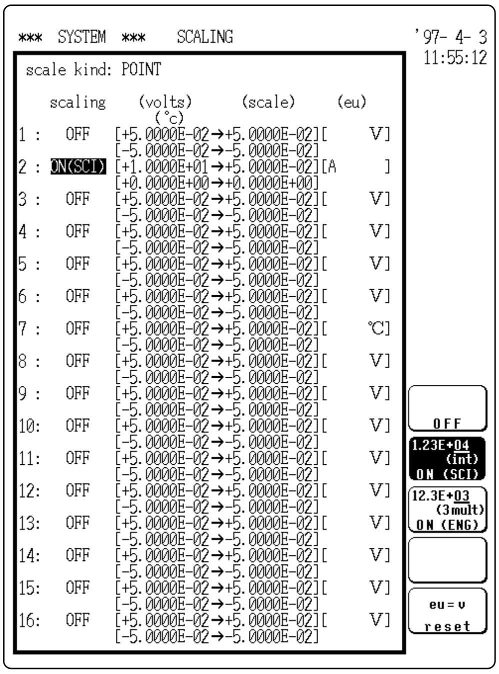
X = 0.005Y ·············· (2)

From equation (2), the settings for "Conversion ratio (eu/V)" and "Offset" are as follows.

Conversion ratio (eu/V) = 5.0000E-3
Offset = 0.0000E+0
Unit : A

Use these value to make the setting. This will cause the voltage measured in CH2 to be converted into current (A) for observation.

Method 2 (2-point method)



```
***  SYSTEM  ***    SCALING                              '97- 4- 3
                                                          11:55:12
 scale kind: POINT

    scaling    (volts)      (scale)      (eu)
                 (°c)
1 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
2 : ON(SCI)  [+1.0000E+01→+5.0000E-02][A       ]
             [+0.0000E+00→+0.0000E+00]
3 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
4 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
5 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
6 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
7 :   OFF    [+5.0000E-02→+5.0000E-02][       ℃]
             [-5.0000E-02→-5.0000E-02]
8 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
9 :   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
10:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
11:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
12:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
13:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
14:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
15:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
16:   OFF    [+5.0000E-02→+5.0000E-02][       V]
             [-5.0000E-02→-5.0000E-02]
```

Equation (1) is transformed into

$$X=0.005Y \cdots\cdots (2)$$

From equation (2), two points are chosen.

Point A:
When voltage Y=0 (V), then current X=0 (A)

Point B:
When voltage Y=10 (V), then current X=0.05 (A)

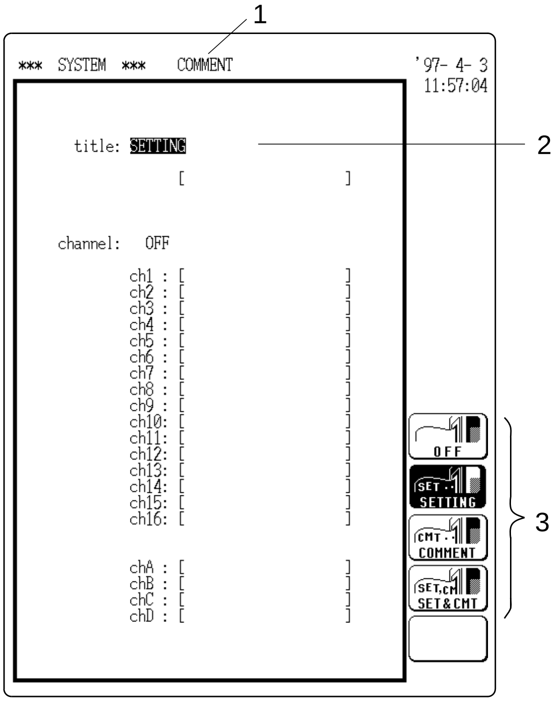
These two points are converted.
A: (0.0000E+0 → 0.0000E+0)
B: (1.0000E+1 → 5.0000E-2)
Unit: A

This will cause the voltage measured in CH2 to be converted into current (A) for observation.

11.6 Adding Comments to a Graph [COMMENT]

Comments for titles or each channel can be added. The maximum length for a comment is 20 characters in normal print (see Section 12.5).

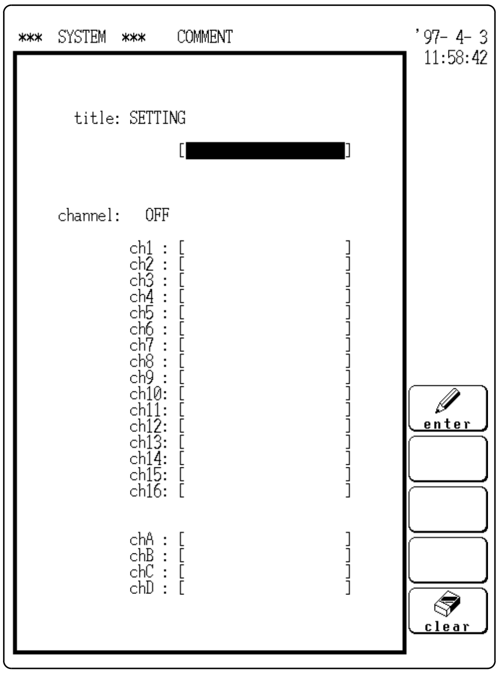
Method Screen: SYSTEM (COMMENT)



```
***  SYSTEM  ***     COMMENT                 '97- 4- 3
                                              11:57:04

      title: SETTING
                  [                    ]

    channel:   OFF

          ch1 : [                    ]
          ch2 : [                    ]
          ch3 : [                    ]
          ch4 : [                    ]
          ch5 : [                    ]
          ch6 : [                    ]
          ch7 : [                    ]
          ch8 : [                    ]
          ch9 : [                    ]
          ch10: [                    ]
          ch11: [                    ]
          ch12: [                    ]
          ch13: [                    ]
          ch14: [                    ]
          ch15: [                    ]
          ch16: [                    ]

          chA : [                    ]
          chB : [                    ]
          chC : [                    ]
          chD : [                    ]
```

1. Press the F3 [COMMENT] key to call up the comment setting screen.
2. Move the flashing cursor to **title** item.
3. Use the function key to select the item to be printed.

Function key display	Meaning
OFF	: Off
SET · SETTING	: Setting item is printed.
CMT · COMMENT	: Comment is printed.
SET,CM SET&CMT	: Both item and comment are printed.



```
***  SYSTEM  ***     COMMENT                 '97- 4- 3
                                              11:58:42

      title: SETTING
                  [████████████████████]

    channel:   OFF

          ch1 : [                    ]
          ch2 : [                    ]
          ch3 : [                    ]
          ch4 : [                    ]
          ch5 : [                    ]
          ch6 : [                    ]
          ch7 : [                    ]
          ch8 : [                    ]
          ch9 : [                    ]
          ch10: [                    ]
          ch11: [                    ]
          ch12: [                    ]
          ch13: [                    ]
          ch14: [                    ]
          ch15: [                    ]
          ch16: [                    ]

          chA : [                    ]
          chB : [                    ]
          chC : [                    ]
          chD : [                    ]
```

4. When [COMMENT] or [SET&CMT] is selected, enter the comment.

- When the flashing cursor is moved with the CURSOR keys, the following function key indication appears.
- For details on comment input refer to Section 11.6.1.

Function key display	Meaning
enter	: Enter comment input mode
clear	: Clear the comment.

5. Move the flashing cursor to the **channel** item and select the item to be printed, using the function keys. (The function key indication is the same as for step 3.)

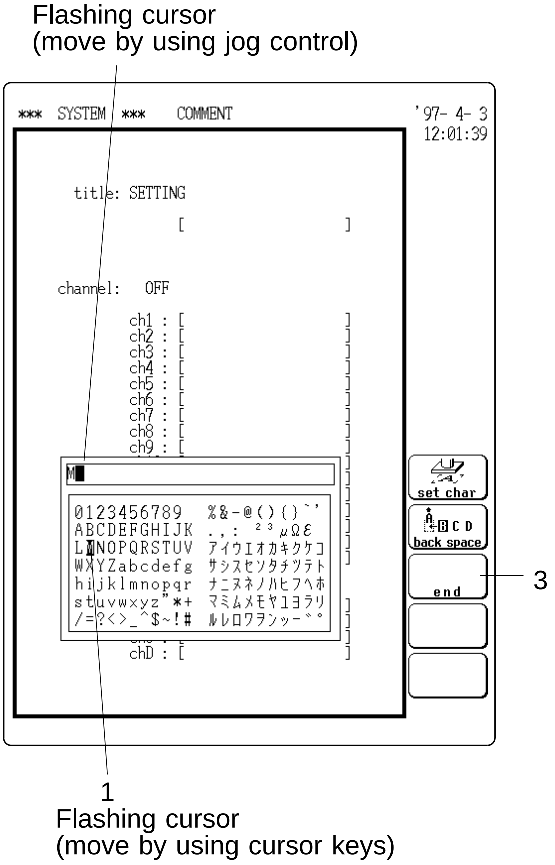
6. If **comment** or **SET & CMT** was selected, enter the comment for each channel.

Reference The settings entered for one channel can be copied to another channel. (☞ Section 9.6.11)

11.6.1 Comment and File Name Entry Procedure

When the mode for input of a comment, file name, or unit is activated, the display changes as follows.

Method



```
***  SYSTEM  ***    COMMENT                         '97- 4- 3
                                                     12:01:39
      title: SETTING
                    [                        ]

    channel:   OFF
                ch1 : [                        ]
                ch2 : [                        ]
                ch3 : [                        ]
                ch4 : [                        ]
                ch5 : [                        ]
                ch6 : [                        ]
                ch7 : [                        ]
                ch8 : [                        ]
                ch9 : [                        ]
        M█
        0123456789   %&-@(){}`'
        ABCDEFGHIJK  .,: ²³μΩε
        LMNOPQRSTUV  アイウエオカキクケコ
        WXYZabcdefg  サシスセソタチツテト
        hijklmnopqr  ナニヌネノハヒフヘホ
        stuvwxyz"*+  マミムメモヤユヨラリ
        /=?<>_^$~!#  ルレロワヲンッー゛゜
                chD : [                        ]
```

1. Move the cursor to select a character.
2. Press F1 [set char].
3. After input characters, press F3 [end].

Function key display	Meaning
set char	: Enter selected character
back space	: Delete character left of cursor (backspace key)
end	: Confirm entry and terminate input mode

NOTE

・When the file name is input (inputting, changing, or searching of the directory name and file name), the following characters cannot be used.
", *, +, /, =, ?, <, >, ., :, ³
・The small letters are changed to capital letters during file input.

11.7 Self Check

The following tests can be carried out.

(1) ROM/RAM check (☞ 11.7.1)

(2) LED check (☞ 11.7.2)

(3) Printer check (☞ 11.7.3)

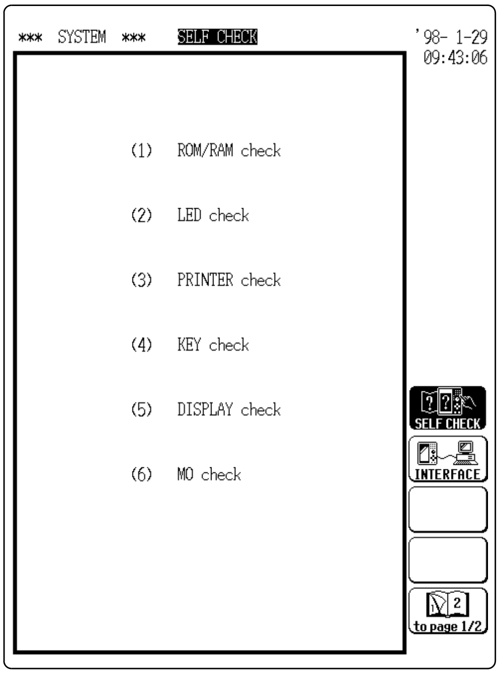
(4) Key check (☞ 11.7.4)

(5) Display check (☞ 11.7.5)

(6) MO check (☞ 11.7.6)

(7) D/A unit output check (when D/A output unit 9539 is installed) (☞ 11.7.7)

Method Screen: SYSTEM (SELF-TEST)



*** SYSTEM *** SELF CHECK '98- 1-29 09:43:06

(1) ROM/RAM check

(2) LED check

(3) PRINTER check

(4) KEY check

(5) DISPLAY check

(6) MO check

1. Press the 2/2 function key and then the F1 [SELF CHECK] key.
2. Move the flashing cursor to the various items and use the [exec] function key to start the test.

For details on the various tests, refer to Sections 11.7.1 - 11.7.7.

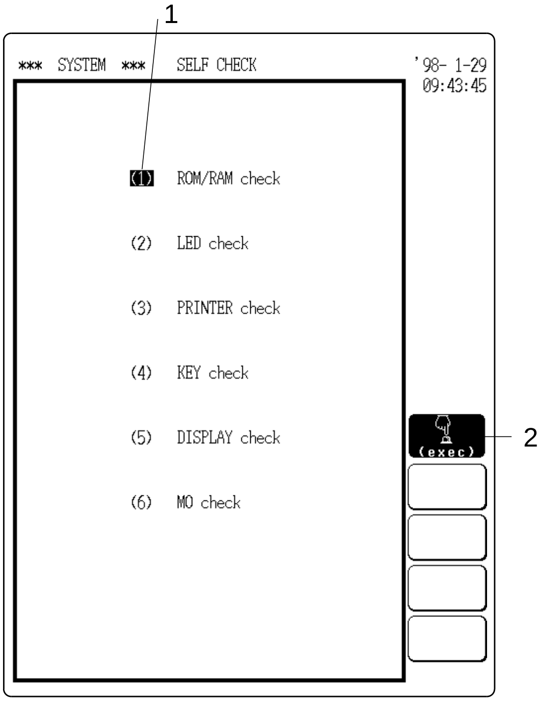
NOTE

When the result of a self-test is "NG", or if another problem is observed during the test, the unit should be returned for servicing.

11.7.1 ROM/RAM Check

- This test checks the internal memory (ROM and RAM) of the 8846.
- The test is non-destructive; it does not affect the contents of RAM.
- The result is displayed as follows. OK: Passed, NG: Failed

Method Screen: SYSTEM (SELF-TEST)

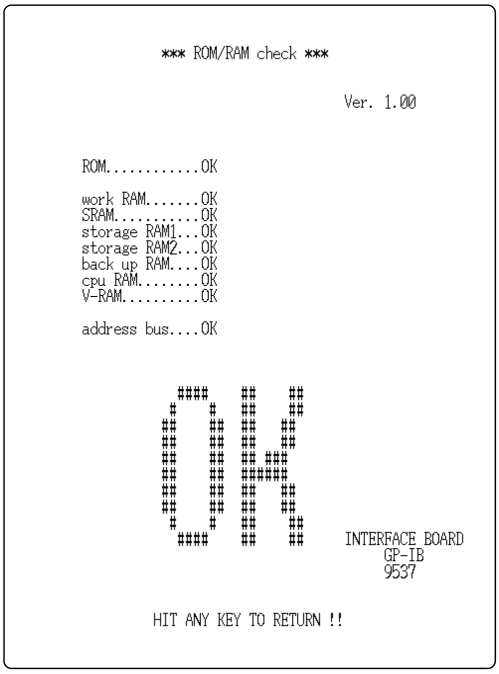


1. Move the flashing cursor to the **(1) ROM/RAM check** item.
2. Press F1 [exec] to start the test. .

NOTE

- During the test, all keys are disabled.
- When "OK" appears, the test result was normal.

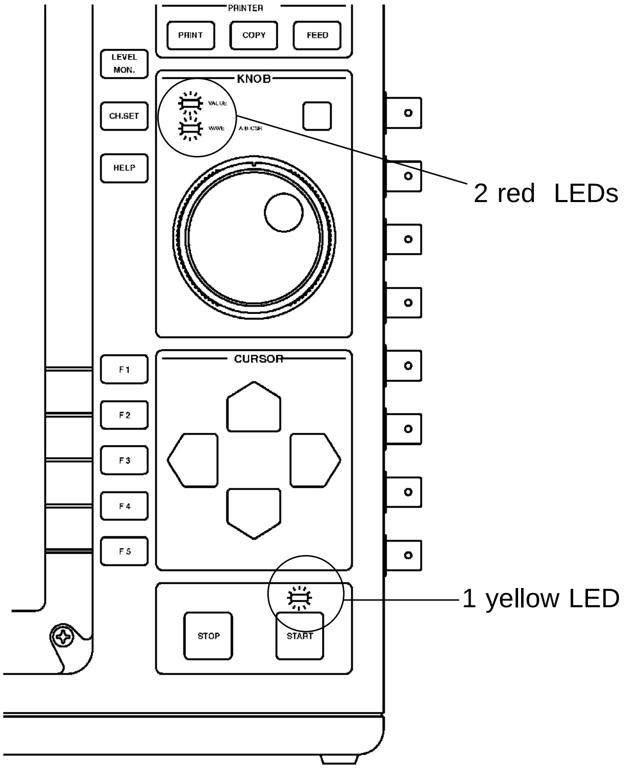
3. When the test is completed, press any key to return to the self-test setting screen.



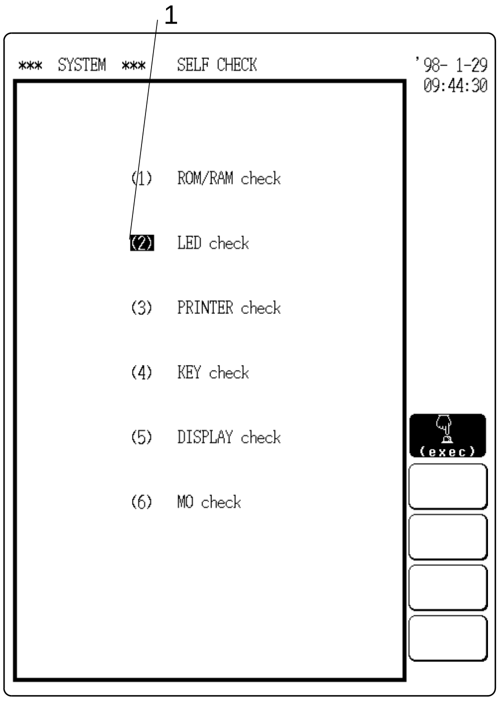
```
*** ROM/RAM check ***

Ver. 1.00

ROM............OK

work RAM.......OK
SRAM...........OK
storage RAM1...OK
storage RAM2...OK
back up RAM....OK
cpu RAM........OK
V-RAM..........OK

address bus....OK

  ####    ##     ##
 #    #   ##     ##
##    ##  ##    ##
##    ##  ##    ##
##    ##  ## ###
##    ##  ######
##    ##  ##    ##
##    ##  ##    ##
 #    #   ##     ##
  ####    ##     ##     INTERFACE BOARD
                             GP-IB
                             9537

HIT ANY KEY TO RETURN !!
```

11.7.2 LED Check

- This test checks the LED indicators.
- The three LED indicators on the front panel (START key, VALUE, WAVE･A.B CURSOR) flash simultaneously, and a beep should be heard from the speaker.



Method Screen: SYSTEM (SELF CHECK)



*** SYSTEM *** SELF CHECK '98- 1-29 09:44:30

(1) ROM/RAM check

(2) LED check

(3) PRINTER check

(4) KEY check

(5) DISPLAY check

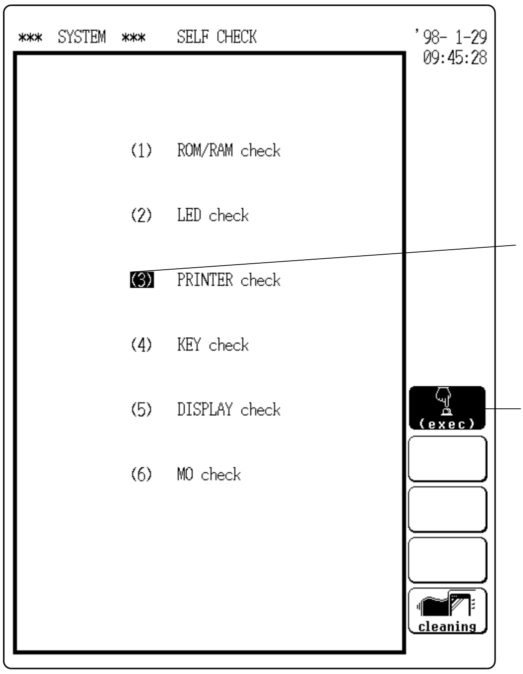
(6) MO check

1. Move the flashing cursor to the **(2) LED check** item.
2. Press F1 [exec] to start the test.
3. When the test is completed, press any key to return to the self-test setting screen.

11.7.3 Printer Check

This test checks the printer operation.

Method Screen: SYSTEM (SELF CHECK)



*** SYSTEM *** SELF CHECK

'98- 1-29
09:45:28

(1) ROM/RAM check

(2) LED check

(3) PRINTER check

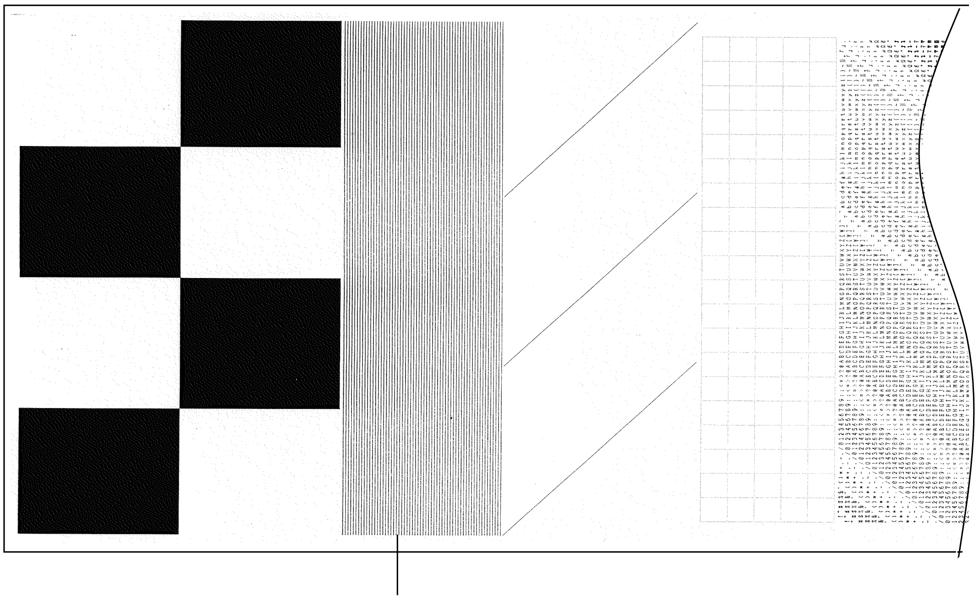
(4) KEY check

(5) DISPLAY check

(6) MO check

1. Move the flashing cursor to the **(3) PRINTER check** item.
2. Press F1 [exec] to start the test.

   To cancel the test pattern printout, press the STOP key.



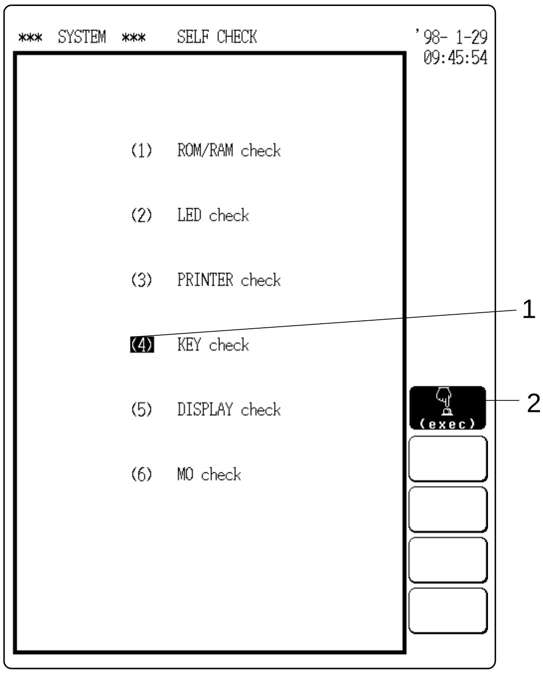
Printer test pattern

NOTE When operated from a DC source, the black sections are printed using intermittent printing.

11.7.4 Key Check

This test checks the key operation.

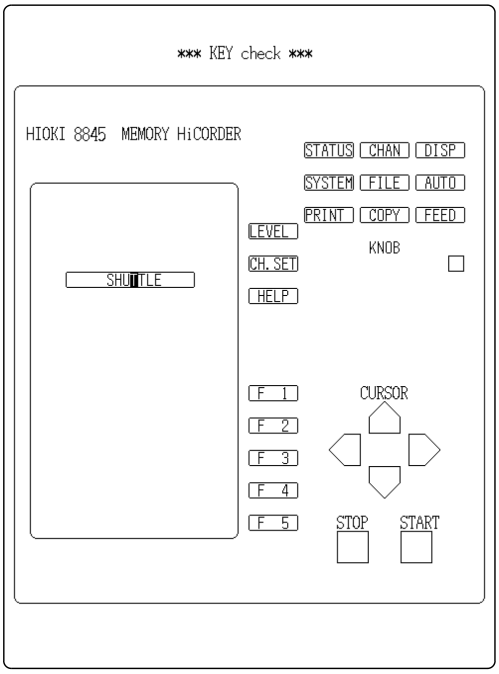
Method Screen: SYSTEM (SELF CHECK)



1. Move the flashing cursor to the **(4) KEY check** item.
2. Press F1 [exec]. The key test screen appears.
3. Press any key on the front panel. If the corresponding field on the display changes to reverse, the key is operating normally.
4. Turn the JOG and SHUTTLE controls at least one turn fully clockwise and counterclockwise. When all key fields on the screen are shown in reverse, the test is completed.

NOTE

Rotate the SHUTTLE control slowly and with care.



5. Press any key to return to the self-test setting screen.

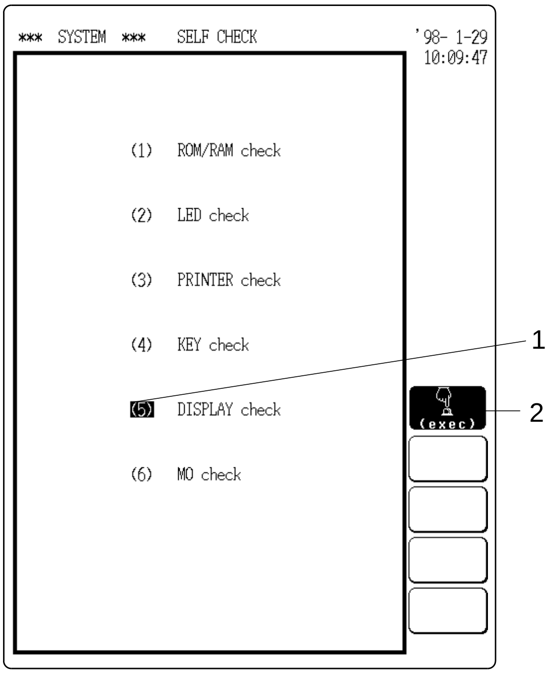
NOTE

- If any key is defective, the key test cannot not be completed normally.
- In this case, press the START key while holding down the STOP key to return to the self-test setting screen.

11.7.5 Display Check

This test checks the display.

Method Screen: SYSTEM (SELF CHECK)



*** SYSTEM *** SELF CHECK '98- 1-29 10:09:47

(1) ROM/RAM check

(2) LED check

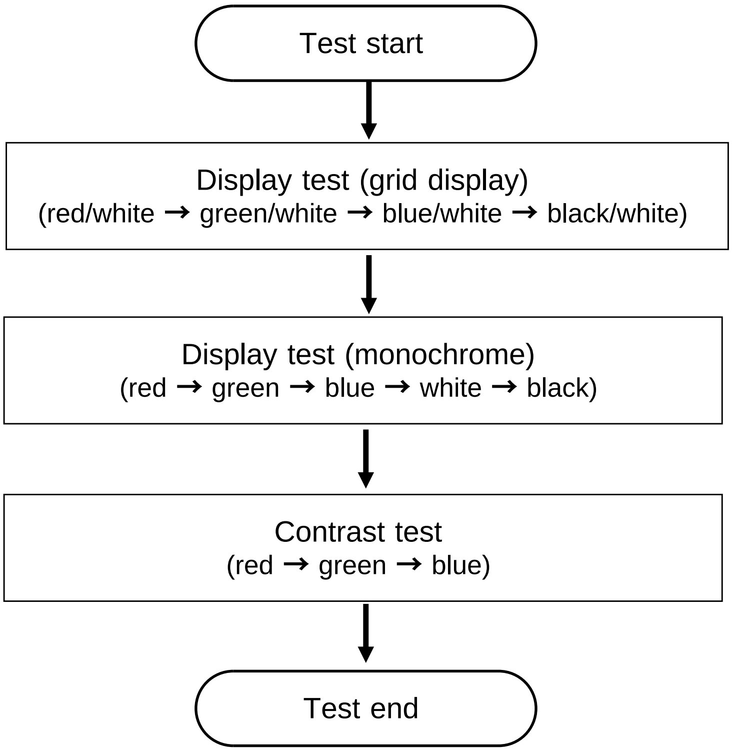
(3) PRINTER check

(4) KEY check

(5) DISPLAY check

(6) MO check

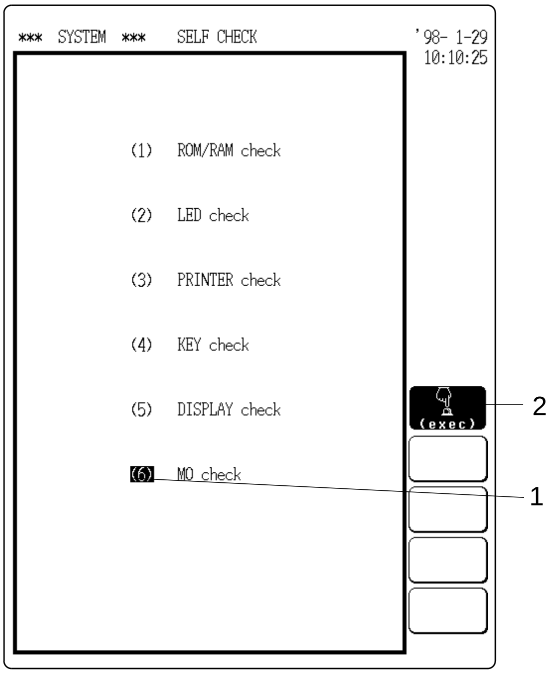
1. Move the flashing cursor to the **(5) DISPLAY check** item.
2. Press F1 [exec] to start the test.
3. When the test is completed, press any key to return to the self-test setting screen.



11.7.6 MO Check

- This test checks whether the DAT drive and the 8846 main unit are communicating properly.
- The result is displayed as follows.（OK: Passed, NG: Failed)

Method Screen: SYSTEM (SELF CHECK)

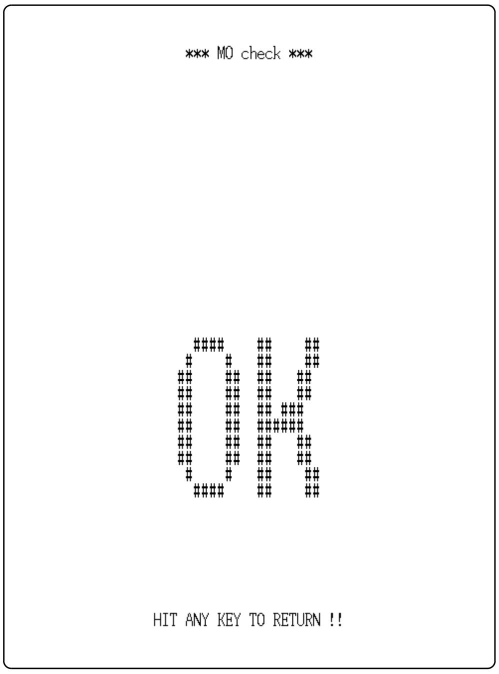


1. Move the flashing cursor to the **(6) MO check** item.
2. Press F1 [exec] to start the test.

NOTE

During the test, all keys are disabled.

3. When the test is completed, press any key to return to the self-test setting screen.



*** MO check ***

OK

HIT ANY KEY TO RETURN !!

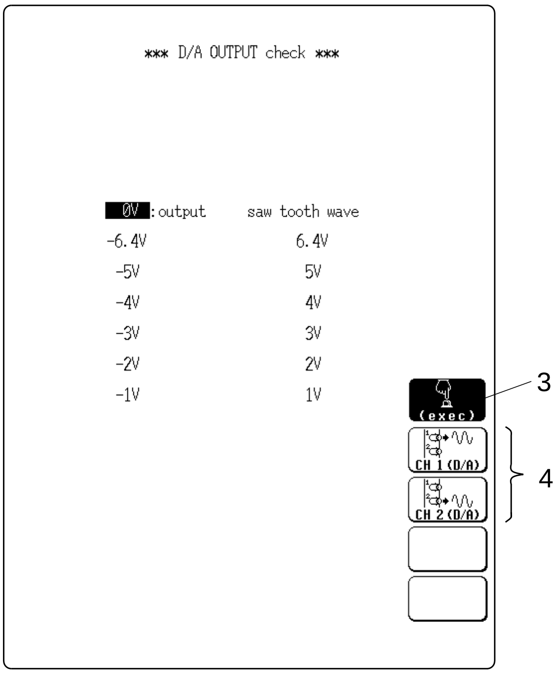
11.7.7 D/A Unit Output Check

- This item is available when the 9539 D/A OUTPUT UNIT is installed in the expansion slot.
- Use an oscilloscope or similar to check the waveform.

Method Screen: SYSTEM (SELF-TEST)

1. Move the flashing cursor to the **(7) D/A OUTPUT check** item.
2. Press the F1 [exec] key to start the test.
3. Items for 0 V to ±6.4 V DC and sawtooth waveform (12.8 Vp-p, approx. 0.3 Hz) are displayed.

   Move the flashing cursor to the respective item and press F1 [exec].
4. The indication **Output active** appears. When the function key for channel 1 (F2) or channel 2 (F3) is pressed, the display appears in reverse and the waveform is output.
5. Press the STOP key to terminate the self test.

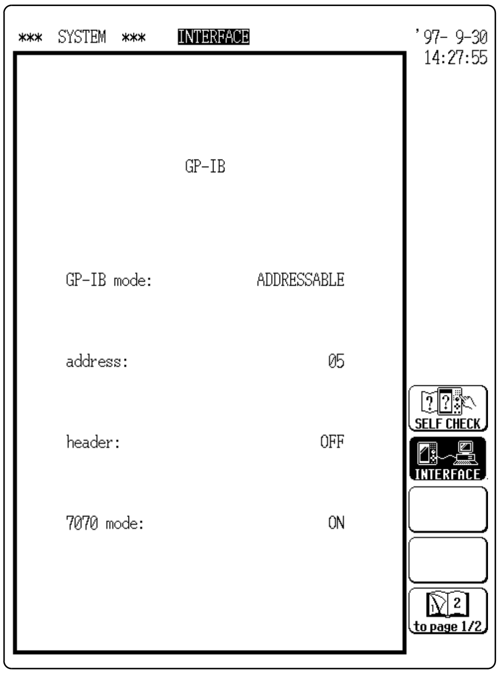


*** D/A OUTPUT check ***

0V :output	saw tooth wave
-6.4V	6.4V
-5V	5V
-4V	4V
-3V	3V
-2V	2V
-1V	1V

11.8 Interface Settings

- Serves to set up the optional GP-IB interface and SCSI interface.
- This item is available when the 9537 GP-IB INTERFACE or 9538 SCSI INTERFACE is installed in the expansion slot.
- For details on setting method, refer to the Instruction Manual of each optional units.



GP-IB

GP-IB mode: ADDRESSABLE

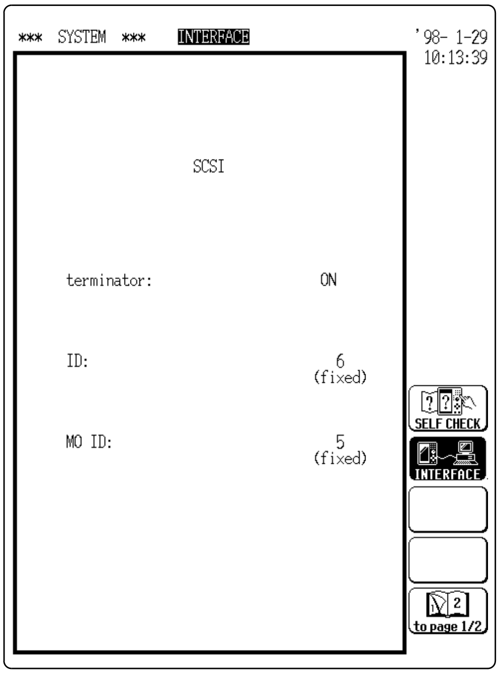
address: 05

header: OFF

7070 mode: ON

GP-IB Setting Screen

7070 mode:
By connecting the HIOKI 7070 WAVEFORM GENERATOR and the 8846 using the GP-IB interface, the waveform data of the 8846 can be transferred to the 7070.
The HIOKI 7070 WAVEFORM GENERATOR can be purchased in Japan only.



SCSI

terminator: ON

ID: 6 (fixed)

MO ID: 5 (fixed)

SCSI Setting Screen

Chapter 12
Printout of Waveform Data and Processing Data

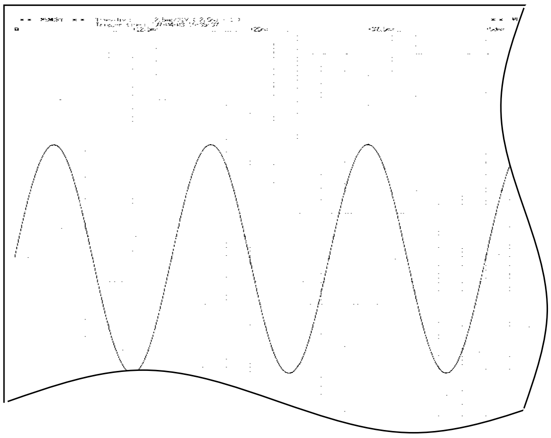
(For all functions)

12.1 Overview

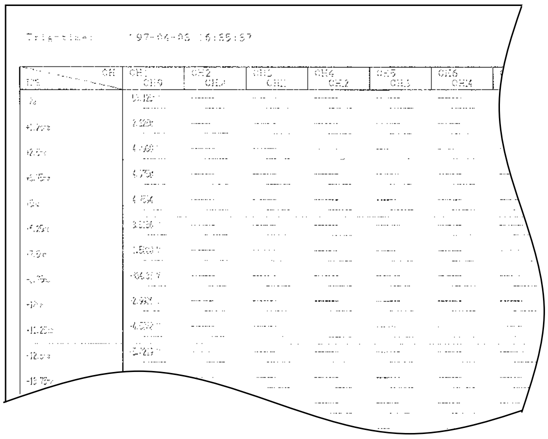
- Waveform data can be printed out in two formats: waveform or numeric.
- A smooth print function is available for waveform printout.
- The following seven printing modes are available:
    - Normal print (manual)
    - Normal print (auto)
    - Real-time print
    - Partial print
    - Screen hard copy
    - A4 print
    - List print

12.2 Selecting Waveform or Numeric Print

- This item lets the user select waveform or numeric print.
- Making this setting is required for normal print, real-time print, and partial print.

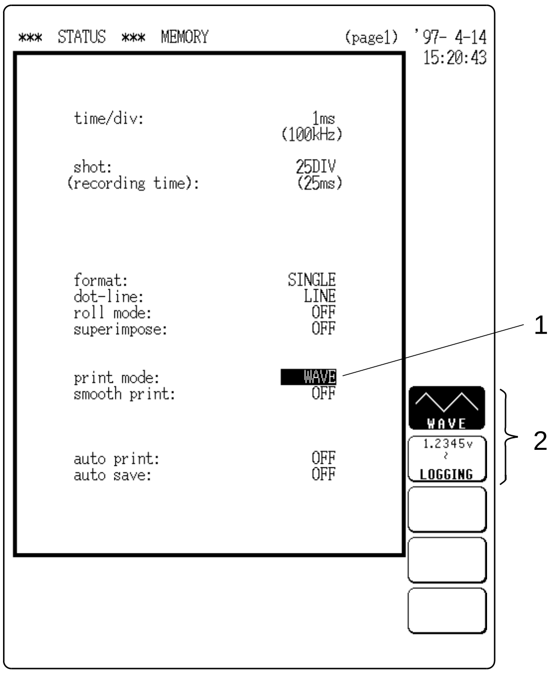


Waveform



Numeric

Method Screen: STATUS (page 1) in the memory recorder and recorder functions, STATUS (page 3) in the FFT function



*** STATUS *** MEMORY (page1) '97- 4-14 15:20:43

time/div: 1ms (100kHz)

shot: 25DIV
(recording time): (25ms)

format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

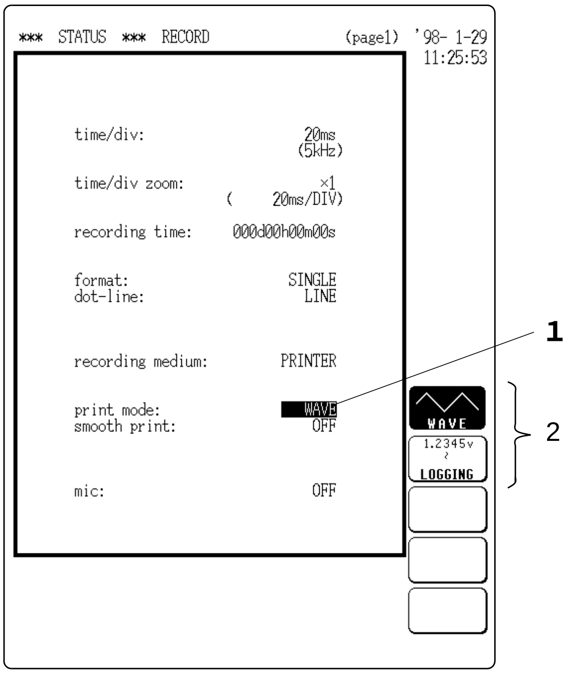
print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

Memory Recorder Function

1. Move the flashing cursor to the **print mode** item.
2. Use the function keys to make the selection.

Function key display	Meaning
WAVE	: Perform waveform print
1.2345v ≀ LOGGING	: Perform numeric print


*** STATUS *** RECORD (page1) '98- 1-29 11:25:53

time/div: 20ms (5kHz)

time/div zoom: ×1 (20ms/DIV)

recording time: 000d00h00m00s

format: SINGLE

dot-line: LINE

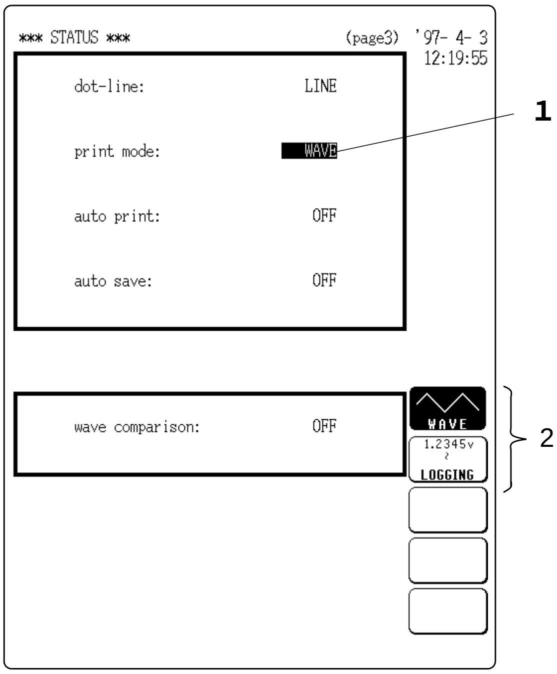
recording medium: PRINTER

print mode: WAVE

smooth print: OFF

mic: OFF

Recorder Function


*** STATUS *** (page3) '97- 4- 3 12:19:55

dot-line: LINE

print mode: WAVE

auto print: OFF

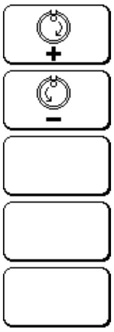
auto save: OFF

wave comparison: OFF

FFT Function

3. When numeric was selected in step 2, specify the data sample interval to be used.

Function key display | Meaning



1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000

NOTE

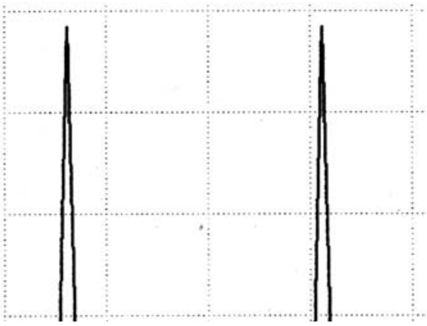
When numeric is selected in FFT mode, the number of output data is fixed and depends on the analysis type.

Item		Data
Storage waveform Auto correlation function Cross-correlation function Impulse response		1000
Octave analysis	1/1 octave	6
	1/3 octave	16
Other functions		401

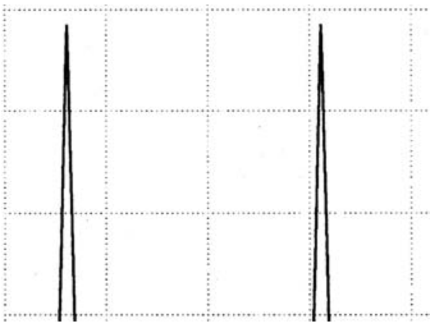
12.3 Using the Smooth Print Function

- When waveform print is selected, the smooth print function can be used.
- When smooth print is enabled, dot density along the time axis increases by a factor of 2, to achieve a smooth waveform shape. Print speed will decrease.
- This option can be selected when using the memory recorder or recorder function.

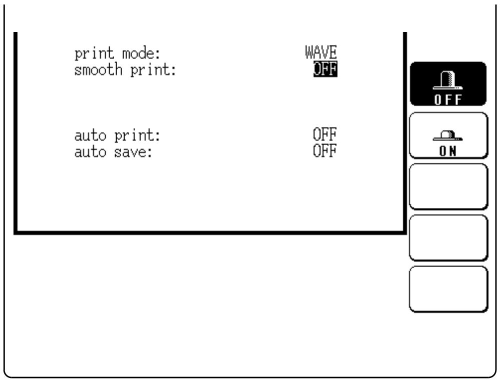
Smooth print OFF



Smooth print ON



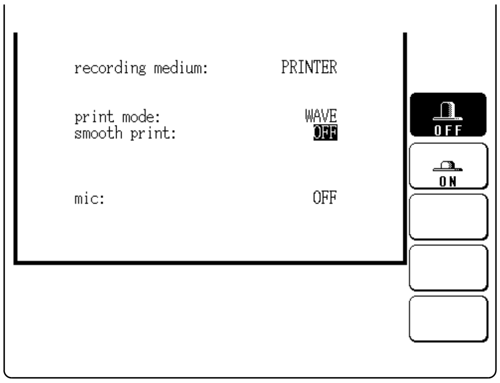
Method Screen: STATUS (page 1) in the memory recorder and recorder functions



print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

Memory Recorder Function



recording medium: PRINTER

print mode: WAVE
smooth print: OFF

mic: OFF

Recorder Function

1. Move the flashing cursor to the **smooth print** item.
2. Use the function key to make selection.

Function key display	Meaning
OFF	: Smooth print OFF
ON	: Smooth print ON

NOTE

During real-time printing, the smooth print setting has no effect.

12.4 Print Settings on SYSTEM Screen

- Set time axis display (☞ Section 11.4.5)

  The time display as incremented from the trigger point can be changed.

- Set grid display (☞ Section 11.4.3)

  The type of grid to be used for printout can be changed.

- Assign channel number to waveform for printout (☞ Section 11.4.4)

  Waveforms can be printed out with channel markers.

- Intermittent printing (☞ Section 11.4.10)

  When interpolation is set to "line, intermittent printing can be carried out.

- Add comment to printout (☞ Section 11.6)

  Titles and channel comments can be appended to the printout.

12.5 Printing Procedure

The following seven printing modes are available:

(1) Normal print (manual) (PRINT key, DISPLAY screen)

(2) Normal print (auto) (set with STATUS screen)

(3) Real-time print (set with STATUS screen)

(4) Partial print (A/B cursors, PRINT key, display screen)

(5) Screen hard copy (COPY key)

(6) A4 print (FEED key + COPY key)

(7) List print (PRINT key, any screen except display screen)

12.5.1 Normal Print (Manual) (All Functions)

- This mode serves to print waveform data from the internal memory or stored on MO disk, or processing results.

- Memory recorder

Measurement data from one measurement (entire recording length) are printed.

- Recorder

If recording on tape MO disk was carried out:
Data read from tape (entire recording length) are printed.

If recording on tape MO disk was not carried out:
Last data set stored in memory before the end of measurement is printed.

- FFT

Processing results for one processing run are printed.

- SYSTEM screen "Setup" can be used to set:

- Time axis display (☞ Section 11.4.5)
- Grid (☞ Section 11.4.3)
- Channel number for waveform (☞ Section 11.4.4)
- Intermittent print (☞ Section 11.4.10)
- Comment (☞ Section 11.6)

Method Screen: DISPLAY

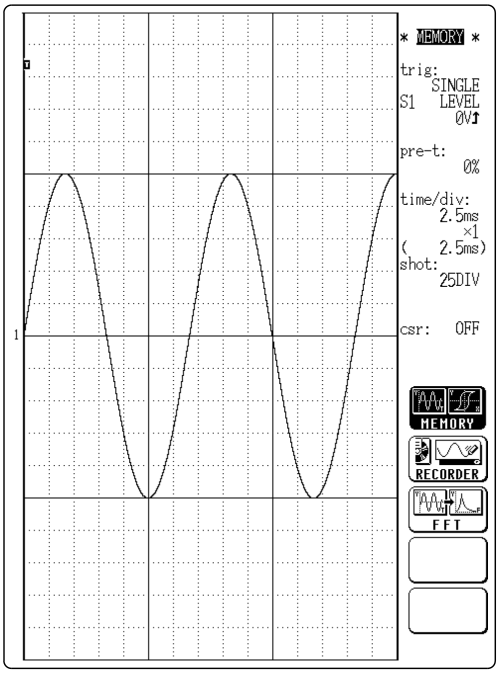
- After the measurement is completed, press the PRINT key.

Memory, FFT	Data for one measurement are printed.
Recorder	Last data in memory before end of measurement are printed.

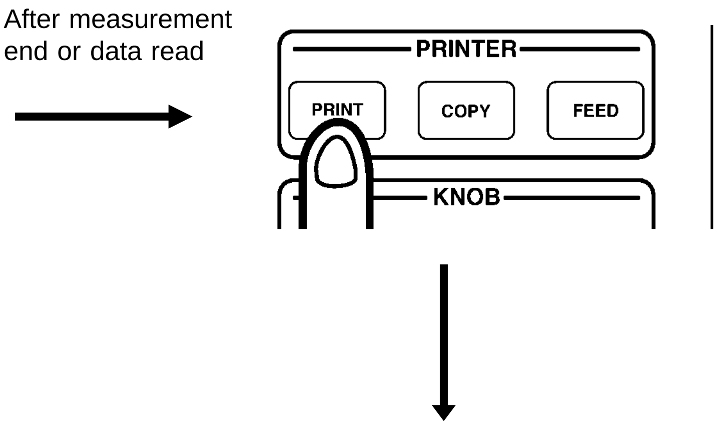
- After measurement data have been read from tape, press the PRINT key at the display screen.

Memory, FFT	Measurement results, processing results stored on tape are printed.
Recorder	Measurement data (entire recording length) stored on tape are printed.

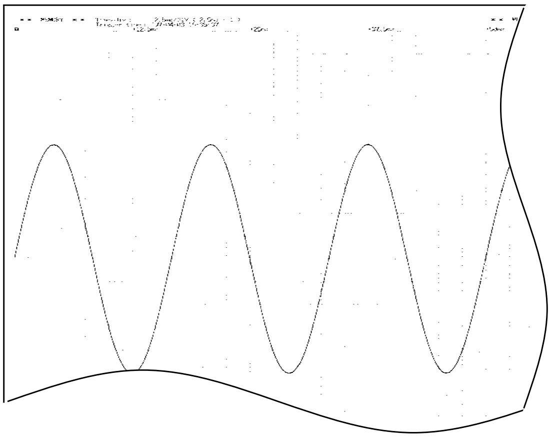
- Since data are stored, they can be printed as often as desired.
- When magnification/compression was used, the printout reflects this condition.



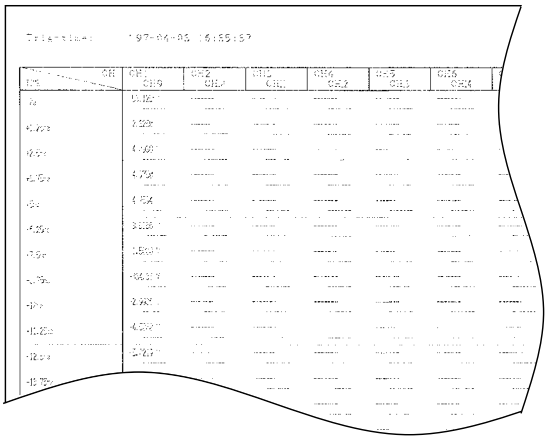
* MEMORY *
trig:
SINGLE
S1 LEVEL
0V↑
pre-t:
0%
time/div:
2.5ms
×1
(2.5ms)
shot:
25DIV
csr: OFF



Print example



Waveform



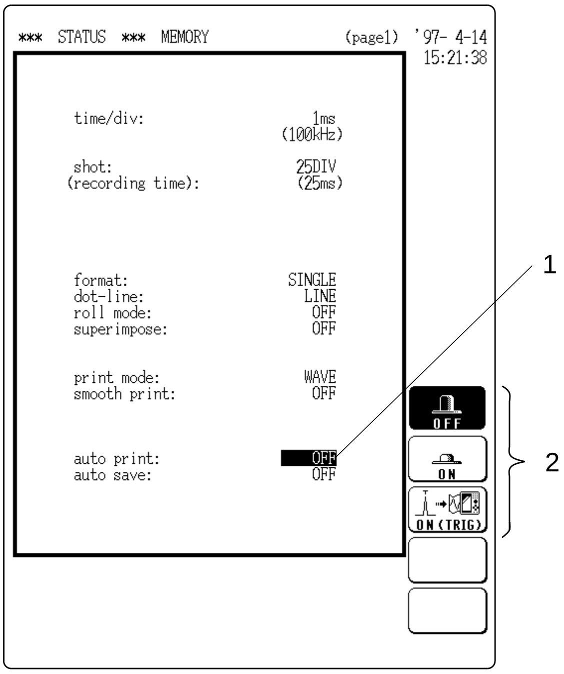
Numeric

NOTE If gauge print was selected at the SYSTEM screen, the number of gauges for the X axis of the X-Y plot is restricted to 2 channels.

12.5.2 Normal Print (Auto) (Memory Recorder, FFT)

Printing is carried out automatically when a measured waveform is displayed on the screen.

Method Screen: STATUS



*** STATUS *** MEMORY (page1) '97- 4-14 15:21:38

time/div: 1ms (100kHz)

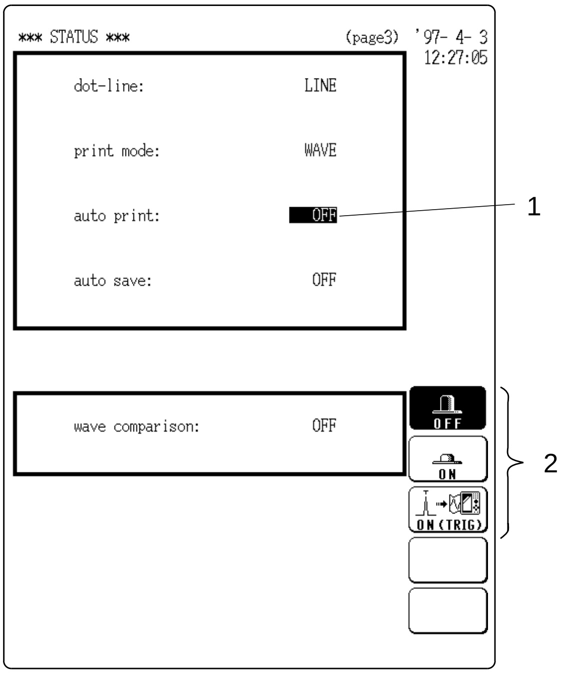
shot: 25DIV
(recording time): (25ms)

format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF

Memory Recorder Function



*** STATUS *** (page3) '97- 4- 3 12:27:05

dot-line: LINE

print mode: WAVE

auto print: OFF

auto save: OFF

wave comparison: OFF

FFT Function

1. Move the flashing cursor to the **auto print** item.
2. Use the function keys to make the selection.

Function key display	Meaning
OFF	: Disable auto print
ON	: Enable auto print
ON (TRIG)	: When trigger mode is AUTO or AUTO STOP, printing is carried out only if recording was started through triggering. (In trigger modes SINGLE and REPEAT, function is same as regular auto print.)

3. Press the DISP key to call up the display screen.
4. Press the START key to start the measurement.

   Printout starts when waveform is displayed on screen.

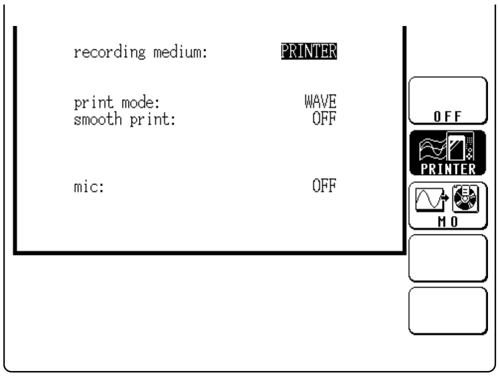
NOTE

If gauge print was selected at the SYSTEM screen, the number of gauges for the X axis of the X-Y plot is restricted to 2 channels.

12.5.3 Real-Time Print (Recorder Function)

The input waveform is printed out continuously in real time.

Method Screen: STATUS, DISPLAY


recording medium: PRINTER

print mode: WAVE
smooth print: OFF

mic: OFF

1. Move the flashing cursor to the **recording medium** item.
2. Press F2 [PRINTER] for the recording target.

Function key display	Meaning
OFF	: Disable store (screen display only)
PRINTER	: Print data on paper
MO	: Record data on MO disk

3. When measurement starts, waveform appears on screen and printout starts.

NOTE

● Printer recording format: **WAVE**

- When real-time printing is used, magnification on the time axis is fixed, as shown below.
- When a larger value is set, the setting is automatically corrected at the start of measurement, according to the values shown below.

Time Axis Magnification for Real-time Print

Time axis range (/DIV)	Magnification of the time axis (maximum value)
1.25 ms	1/800
2 ms	1/500
2.5 ms	1/400 (unsettable for 1/500)
5 ms	1/200
10 ms	1/100
20 ms	1/50
50 ms	1/20
100 ms	1/10
200 ms	1/5
500 ms	1
1 s	1
2 s	1
5 s	1
10 s	1
20 s	1
1 min	1
2 min	1
5 min	1
10 min	1
20 min	1
1 h	1

- The waveform color for real-time printing can be normal or light only. (Dark becomes normal, and medium dark become light.)
- During real-time printing, the smooth print function has no effect.
- During real-time printing, setting interpolation to **DOT** has no effect (**LINE** will be used).

● Printer recording format: **LOGGING** (numerical value)

- When magnification/compression is set to 1/2 or lower, the output value is the envelope maximum value, not the instantaneous value.
- During real-time printing, the magnification/compression and output increment (minimum value) are limited by the time axis setting, as shown below. (If a smaller value is set, the setting is automatically corrected at the start of measurement, according to the values shown below.)
- The output interval is for time axis/magnification ratio.

Time Axis Magnification, Output Interval (minimum value) for Real-time Print

Magnification	Time axis range (/DIV)															
	1.25 ms	2 ms	2.5 ms	5 ms	10 ms	20 ms	50 ms	100 ms	200 ms	500 ms	1 s	2 s	5 s	10 s	20 s	1 min or more
×1	—	—	—	—	—	—	—	—	—	100	100	50	20	10	5	1
×1/2	—	—	—	—	—	—	—	—	—	100	50	25	10	5	2	1
×1/5	—	—	—	—	—	—	—	—	100	25	20	10	2	2	1	1
×1/10	—	—	—	—	—	—	—	100	50	20	10	5	2	1	1	1
×1/20	—	—	—	—	—	—	100	50	25	10	5	2	1	1	1	1
×1/50	—	—	—	—	—	100	25	20	10	2	1	1	1	1	1	1
×1/100	—	—	—	—	100	50	20	10	5	2	1	1	1	1	1	1
×1/200	—	—	—	100	50	25	10	5	2	1	1	1	1	1	1	1
×1/400	—	—	100	50	25	10	5	2	1	1	1	1	1	1	1	1
×1/500	—	100	—	25	20	10	2	1	1	1	1	1	1	1	1	1
×1/800	100	50	50	25	10	5	2	1	1	1	1	1	1	1	1	1
×1/1000	25	50	25	20	10	5	2	1	1	1	1	1	1	1	1	1
×1/2000	25	25	20	10	5	2	1	1	1	1	1	1	1	1	1	1
×1/5000	10	10	5	2	2	1	1	1	1	1	1	1	1	1	1	1
×1/10000	5	5	2	2	1	1	1	1	1	1	1	1	1	1	1	1
×1/20000	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
×1/50000-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Example
When 20 ms/DIV, ×1/100:
Because of 50 sampling interval; 20 ms÷1/100 = 2 s/DIV (1 DIV = 100 sampling), the data of 1 second interval is output.

12.5.4 Partial Print (Memory Recorder, Recorder)

- This function prints the waveform between the A and B cursors (vertical or trace cursors).

・Memory recorder

Specified range (out of entire data recorded from a measurement) is printed.

・Recorder

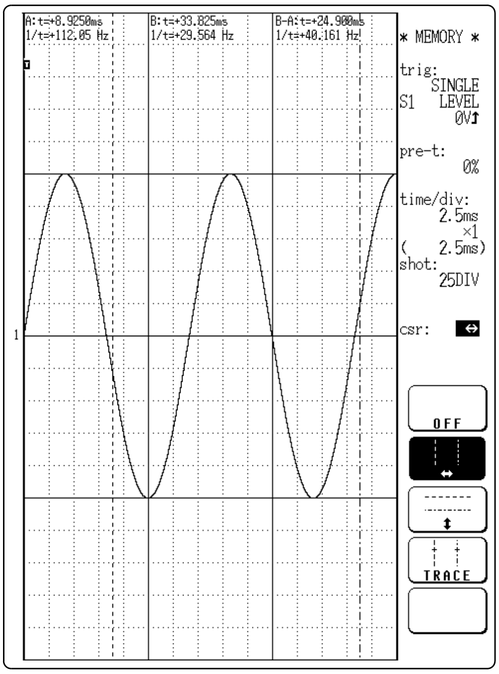
If recording on MO was carried out:
Specified range (out of entire data read from tape MO) is printed.

If recording on MO was not carried out:
Specified range (out of last set of data in memory) is printed.

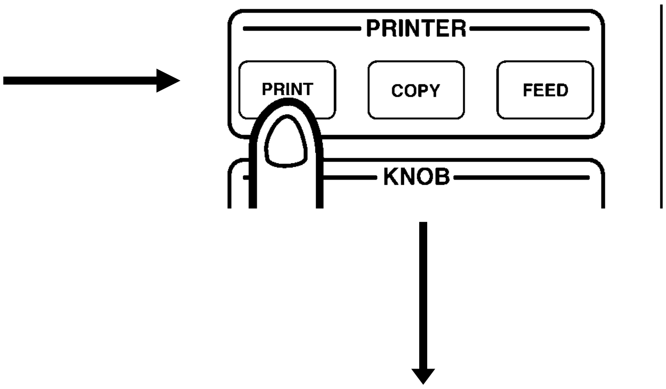
- The function is available also when the A/B cursors are currently outside the range displayed on screen.
- For details regarding the use of the A/B cursors, refer to section 19.2.
- Printing is possible also when the print format is currently set to "numeric".
- If data were stored on MO disk, data are read from MO disk(☞ Section 13.6).

Method Screen: DISPLAY

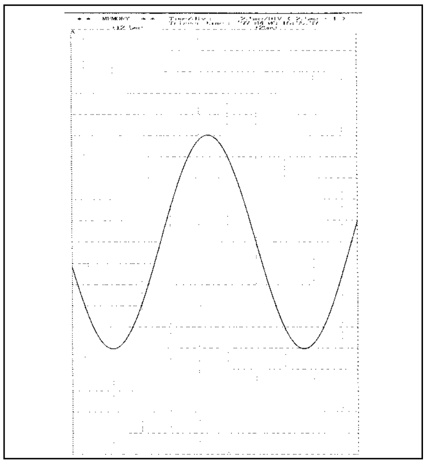
1. Position cursor A at the start point of the range to be printed.
2. Move cursor B to the right. When the cursor is at the rightmost edge of the screen, the waveform scrolls to the left, and cursor B scrolls with it.
3. Specify the end point of the range with cursor B. Then press the PRINT key. The specified range is printed, also if cursor A is currently off screen.

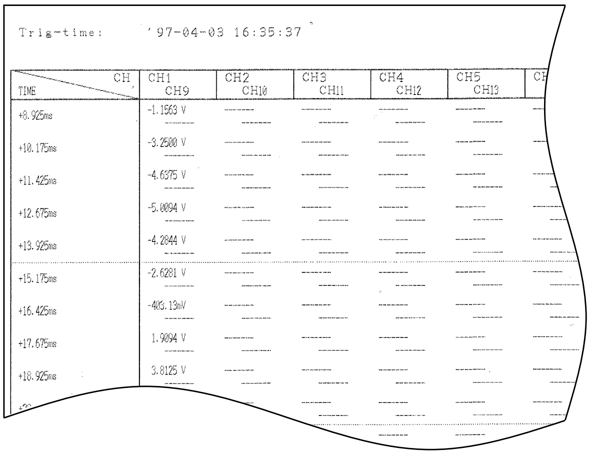

A:t=+8.9250ms 1/t=+112.05 Hz
B:t=+33.825ms 1/t=+29.564 Hz
B-A:t=+24.900ms 1/t=+40.161 Hz

* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ⇔



Print example


Waveform


Trig-time: '97-04-03 16:35:37

CH TIME	CH1 CH9	CH2 CH10	CH3 CH11	CH4 CH12	CH5 CH13
+8.925ms	-1.1563 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+10.175ms	-3.2500 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+11.425ms	-4.6375 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+12.675ms	-5.0094 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+13.925ms	-4.2844 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+15.175ms	-2.6281 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+16.425ms	-403.13mV --------	-------- --------	-------- --------	-------- --------	-------- --------
+17.675ms	1.9094 V --------	-------- --------	-------- --------	-------- --------	-------- --------
+18.925ms	3.8125 V --------	-------- --------	-------- --------	-------- --------	-------- --------

Numerical Value

NOTE

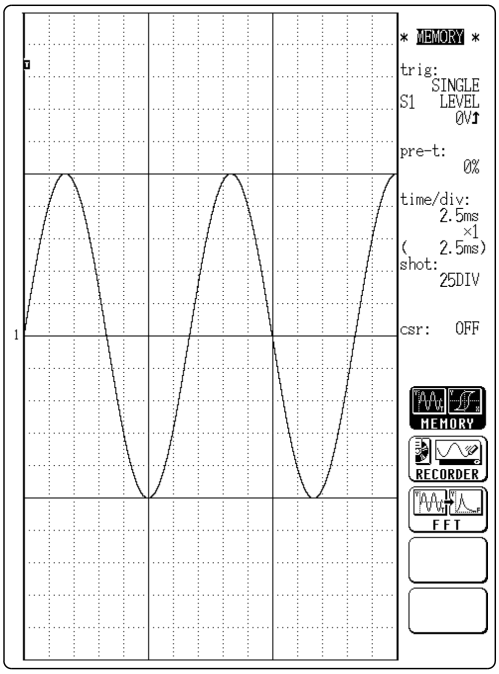
- If gauge print was selected at the SYSTEM screen, the number of gauges for the X axis of the X-Y plot is restricted to 2 channels.
- The range is printed also if the positions of cursor A and cursor B are reversed.
- If the horizontal cursor is selected, it is printed along with the waveform. (Partial print is not carried out.)
- When real-time printing is carried out, the waveform is printed together with the cursor. (Partial print is not carried out.)

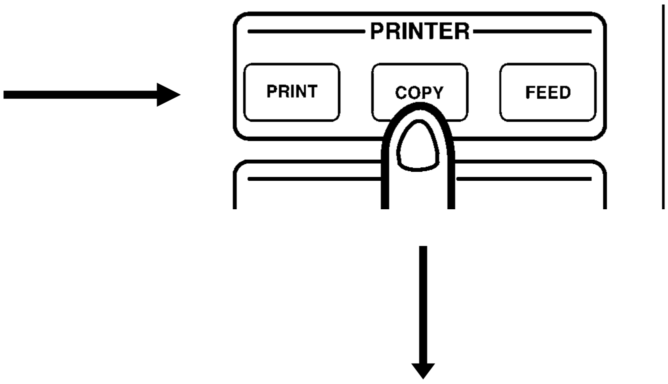
12.5.5 Screen Hard Copy (All Functions)

- The display contents of the STATUS screen, CHANNEL screen, display screen, SYSTEM screen, and MO control screen can be printed out as is.
- The output destination of screen hard copy is set to printer. (☞ Section 11.4.11)

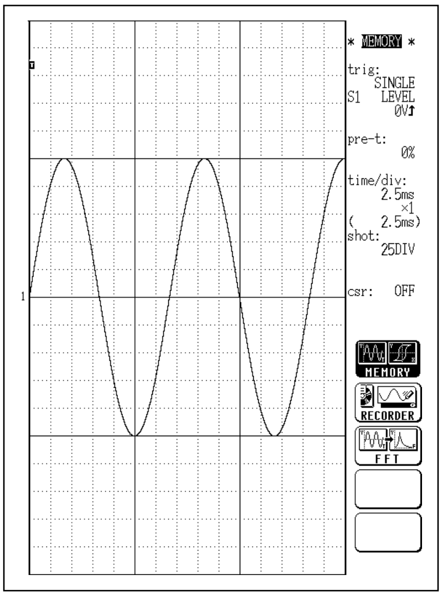
Method 1. Call up the desired screen.

2. Press the COPY key.


* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF



Print example


* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF

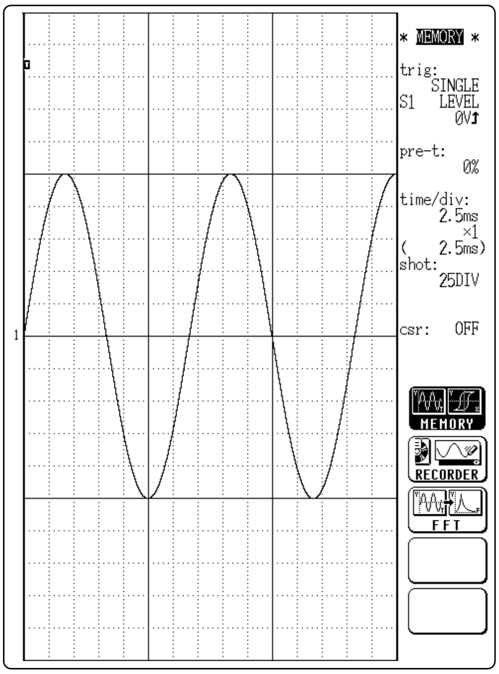
NOTE The screen hard copy function is not available during measurement or during playback of data from MO.

12.5.6 A4 Print (Memory Recorder, Recorder)

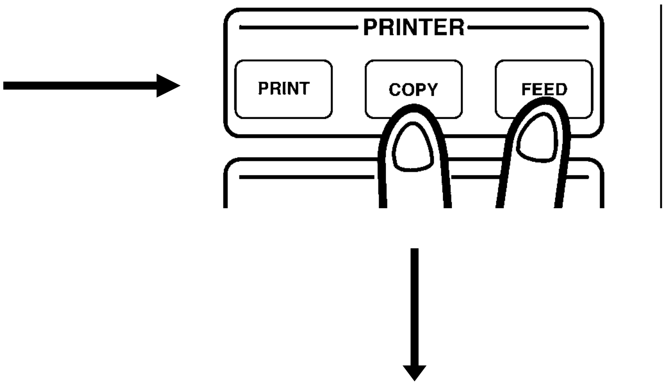
- This function prints the waveform range shown on the display, along with the active settings, on an A4 size (210 × 297 mm, 8.27 × 11.69 in.) printout.
- If the A and B cursors are displayed on the screen, they are also printed.

Method Screen: DISPLAY

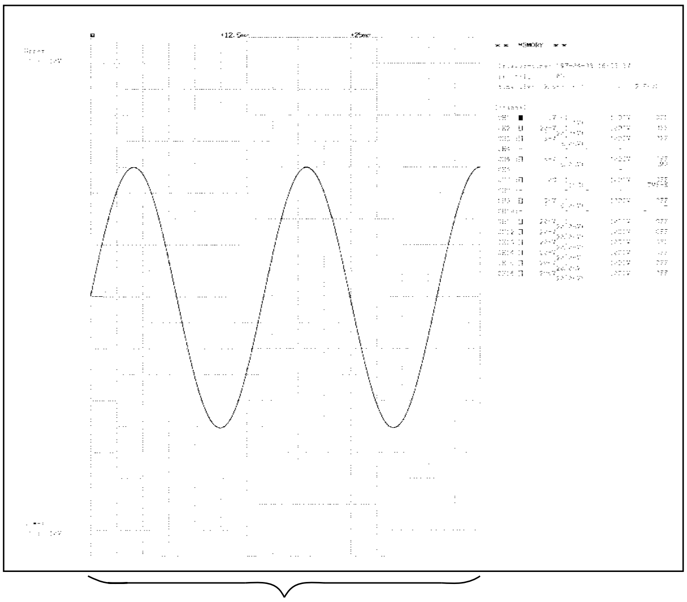
Call up the desired display screen and press the FEED key and COPY key simultaneously. (Press and hold the FEED key and then press the COPY key.)



* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1
(2.5ms)
shot: 25DIV
csr: OFF



Print example



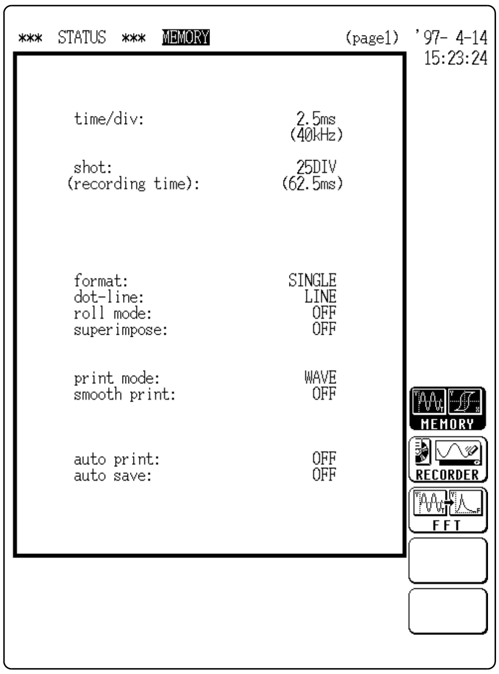
A 15 DIV segment of the waveform shown on the display is printed.

12.5.7 List Print (All Functions)

The settings for the various functions made with the STATUS screen, CHANNEL screen etc. can be printed out in list format.

Method Screen: Respective function setting screen, except DISPLAY Screen

While the setting screen (STATUS, CHANNEL, SYSTEM, DAT) is displayed, press the PRINT key.



*** STATUS *** MEMORY (page1) '97- 4-14 15:23:24

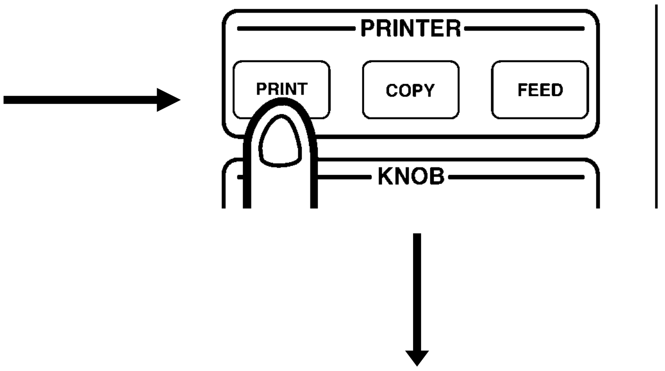
time/div: 2.5ms (40kHz)

shot: 25DIV
(recording time): (62.5ms)

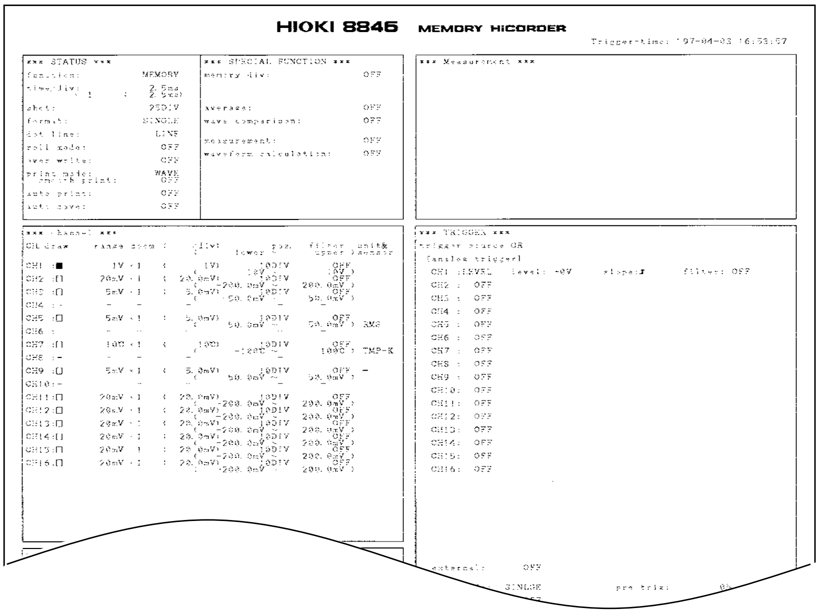
format: SINGLE
dot-line: LINE
roll mode: OFF
superimpose: OFF

print mode: WAVE
smooth print: OFF

auto print: OFF
auto save: OFF



Print example

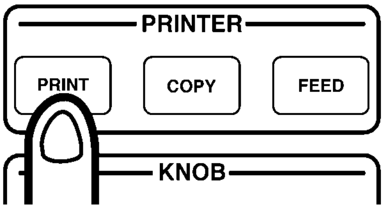


```
Trigger-time: '97-04-03 16:53:57

*** STATUS ***
function:            MEMORY
time/div:            2.5ms
shot:                25DIV
format:              SINGLE
dot line:            LINE
roll mode:           OFF
over write:          OFF
print mode:          WAVE
  smooth print:      OFF
auto print:          OFF
auto save:           OFF

*** SPECIAL FUNCTION ***
memory div:                OFF
average:                   OFF
wave comparison:           OFF
measurement:               OFF
waveform calculation:      OFF

*** Measurement ***

*** Channel ***
CH draw   range zoom (   /DIV)      pos.     filter   unit&
                       (lower  ~    upper )  sensor
CH1  :■    1V ×1  (    1V)         10DIV     OFF
                        (    -8V ~      8V )
CH2  :□   20mV ×1  ( 20.0mV)       10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH3  :□    5mV ×1  (  5.0mV)       10DIV     OFF
                        (   -50.0mV ~   50.0mV )
CH4  :-
CH5  :□    5mV ×1  (  5.0mV)       10DIV     OFF
                        (    50.0mV ~   50.0mV )  RMS
CH6  :
CH7  :□   10C ×1   (   10C)        10DIV     OFF
                        (   -100C ~    100C )  TMP-K
CH8  :-
CH9  :□    5mV ×1  (  5.0mV)       10DIV     OFF   -
                        (    50.0mV ~   50.0mV )
CH10:-
CH11:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH12:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH13:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH14:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH15:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )
CH16:□   20mV ×1  ( 20.0mV)        10DIV     OFF
                        (  -200.0mV ~  200.0mV )

*** TRIGGER ***
trigger source OR
 [analog trigger]
  CH1 :LEVEL   level: +0V     slope:↑      filter: OFF
  CH2 :  OFF
  CH3 :  OFF
  CH4 :  OFF
  CH5 :  OFF
  CH6 :  OFF
  CH7 :  OFF
  CH8 :  OFF
  CH9 :  OFF
  CH10:  OFF
  CH11:  OFF
  CH12:  OFF
  CH13:  OFF
  CH14:  OFF
  CH15:  OFF
  CH16:  OFF

  external:      OFF
           SINGLE          pre trig:        0%
```

12.5.8 Paper Change During Printing

If the paper runs out during printing, or if the printer lever is raised, the following action should be performed.

Method



1. Insert new printer paper and raise the printer lever (☞ Section 4.6)
2. Press the PRINT key.

NOTE

- During normal print (manual), partial print, screen hard copy, A4 print, and list print, printing resumes from the point where it was stopped.
- During real-time printing, the data that were captured during the time when the printer is stopped are not printed.
- During normal print (auto) with trigger mode set to **REPEAT**, no data recording is carried out during the time when the printer is stopped. After paper has been inserted and the PRINT key pressed, the rest of the data is printed, and then the measurement resumes.

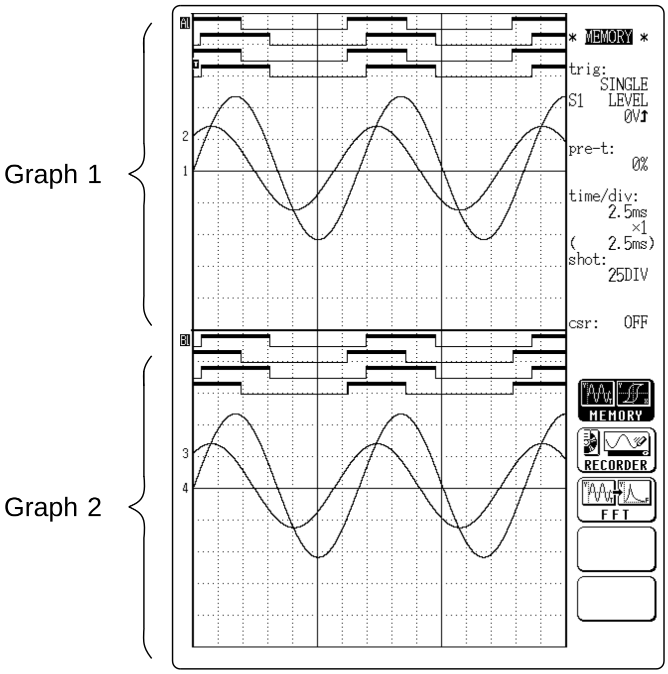
12.6 Reading the Display and Printout

The relationship between the display indication and printout for the various functions is shown in this section.

Memory recorder function

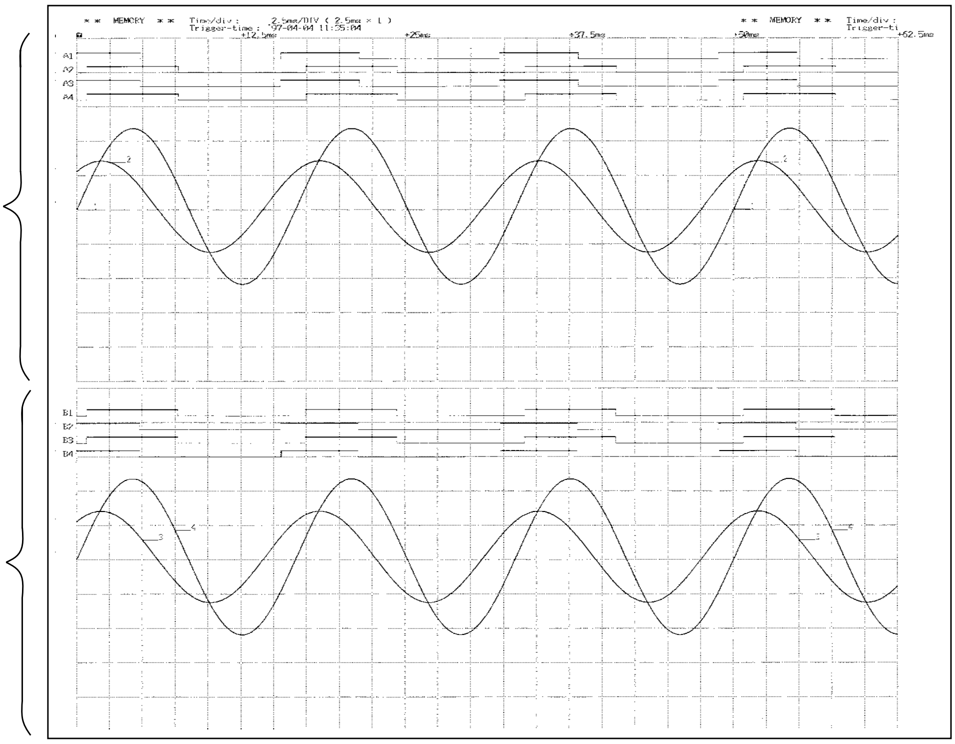
(1) Y-T screen (dual in this example)

- Display



* MEMORY *
trig:
SINGLE
S1 LEVEL
0V↑
pre-t:
0%
time/div:
2.5ms
×1
(2.5ms)
shot:
25DIV
csr: OFF

- Normal print

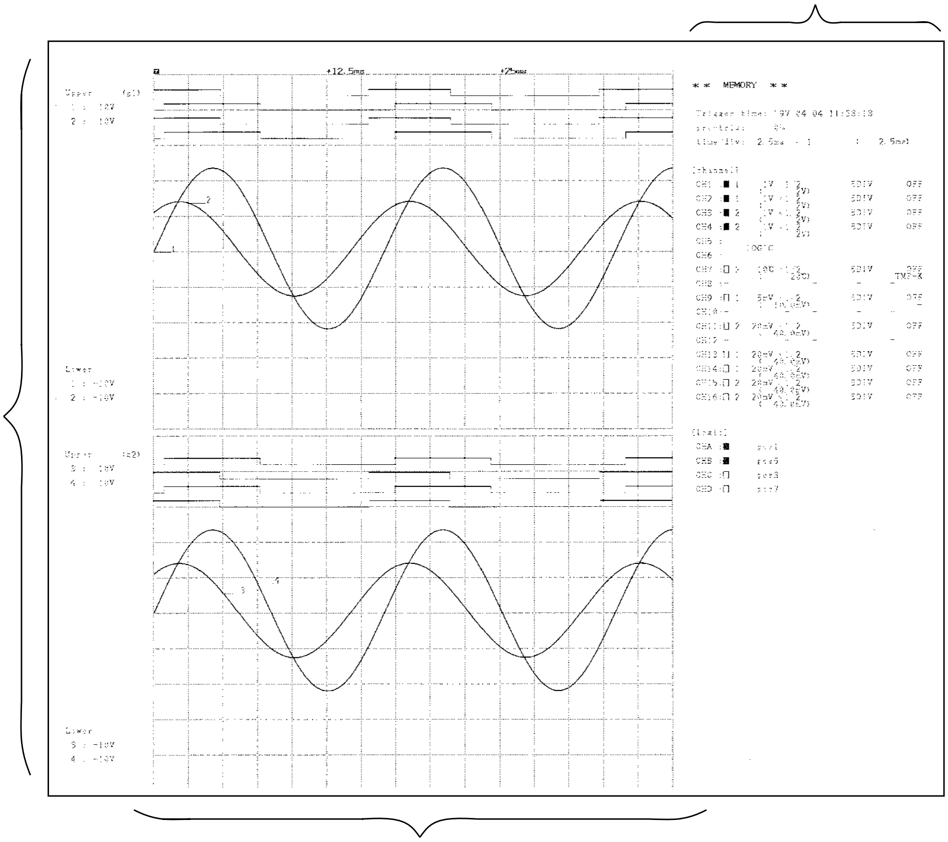


Graph 1

Graph 2

- A4 print

Input channel settings

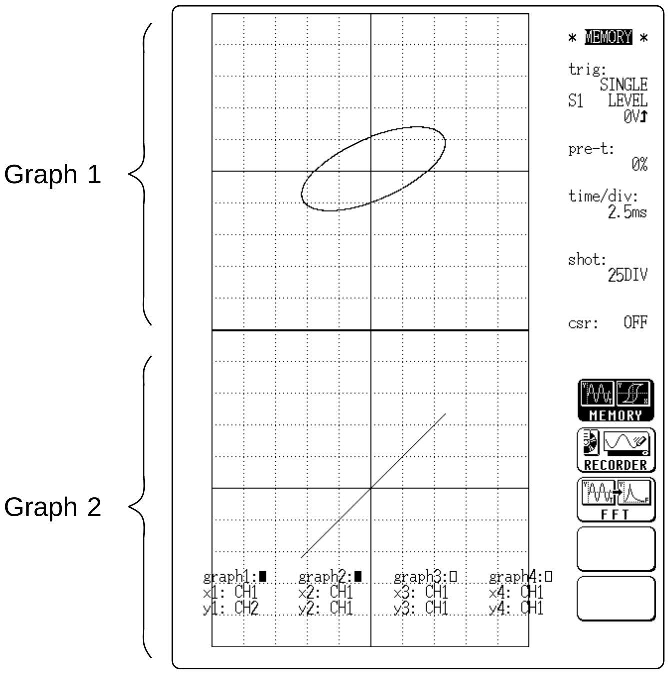


Indicates upper and lower limit of waveform

15 DIV segment (same as on display) is printed.

(2) X-Y screen (X-Y dual)

- Display



* MEMORY *

trig:
SINGLE
S1 LEVEL
0V↑

pre-t:
0%

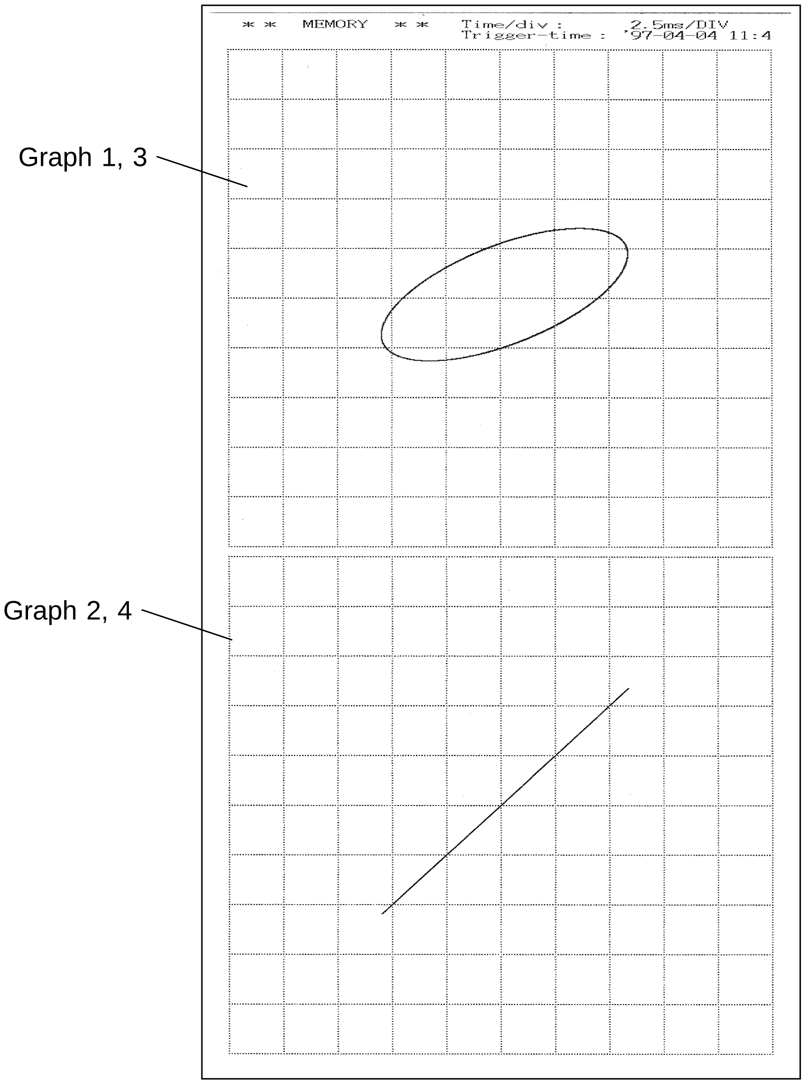
time/div:
2.5ms

shot:
25DIV

csr: OFF

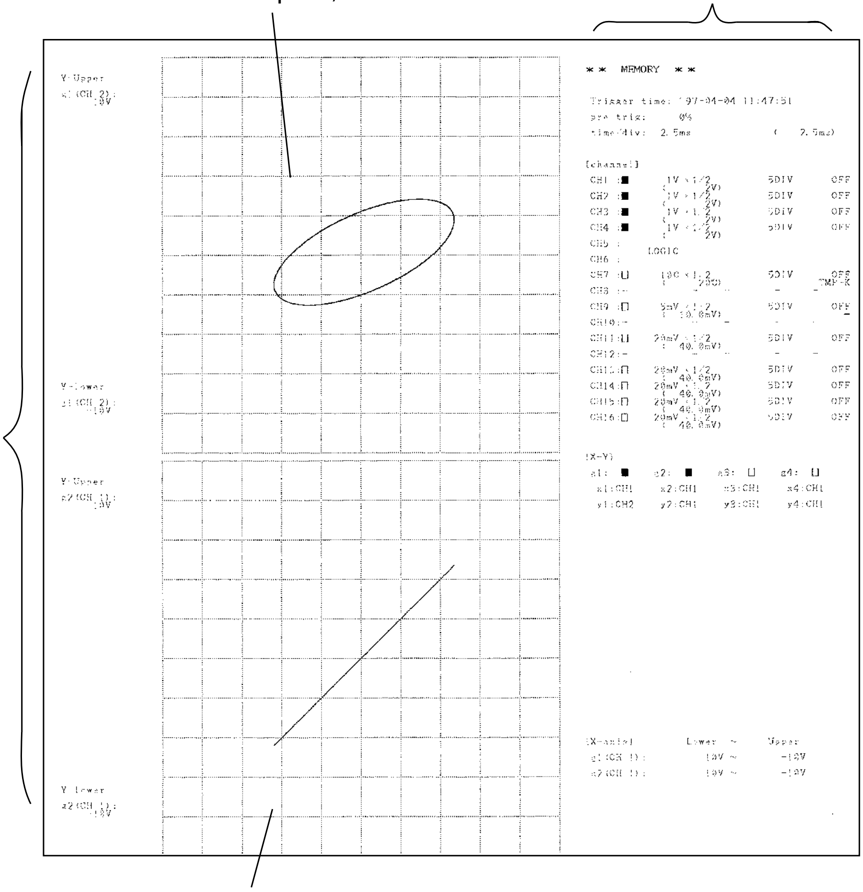
graph1:■ graph2:■ graph3:□ graph4:□
x1: CH1 x2: CH1 x3: CH1 x4: CH1
y1: CH2 y2: CH1 y3: CH1 y4: CH1

- Normal print



* * MEMORY * * Time/div : 2.5ms/DIV
Trigger-time : '97-04-04 11:4

- A4 print



Graph 1, 3

Input channel settings

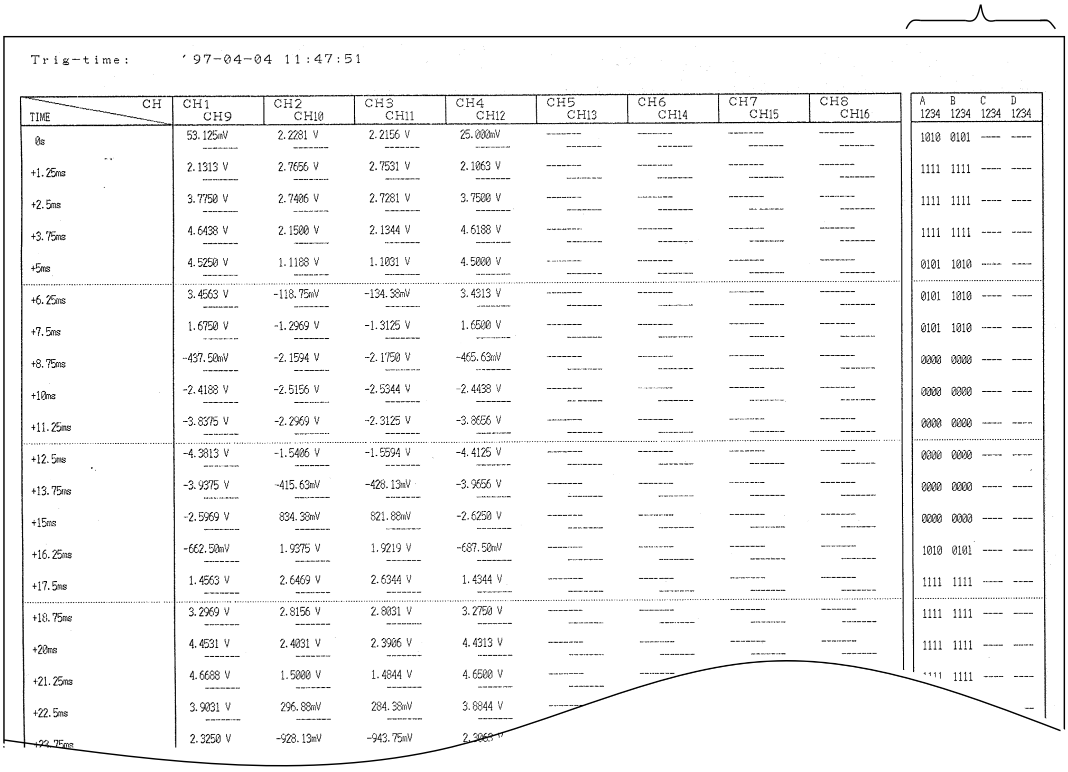
Indicates upper and lower limit of waveform

Graph 2, 4

```
Y-Upper
a1(CH 2):
      10V

Y-Lower
a1(CH 2):
     -10V

Y-Upper
a2(CH 1):
      10V

Y-Lower
a2(CH 1):
     -10V
```

```
** MEMORY **

Trigger time: '97-04-04 11:47:51
pre trig:      0%
time/div:   2.5ms                  (    2.5ms)

[channel]
CH1  :■      1V ×1/2              5DIV      OFF
            (    2V)
CH2  :■      1V ×1/2              5DIV      OFF
            (    2V)
CH3  :■      1V ×1/2              5DIV      OFF
            (    2V)
CH4  :■      1V ×1/2              5DIV      OFF
            (    2V)
CH5  :
          LOGIC
CH6  :
CH7  :□     10C ×1/2              5DIV      OFF
            (   20C)                      TMP-K
CH8  :-                            -         -
CH9  :□     5mV ×1/2              5DIV      OFF
            (  10.0mV)
CH10 :-
CH11 :□    20mV ×1/2              5DIV      OFF
            (  40.0mV)
CH12 :-                            -         -
CH13 :□    20mV ×1/2              5DIV      OFF
            (  40.0mV)
CH14 :□    20mV ×1/2              5DIV      OFF
            (  40.0mV)
CH15 :□    20mV ×1/2              5DIV      OFF
            (  40.0mV)
CH16 :□    20mV ×1/2              5DIV      OFF
            (  40.0mV)

[X-Y]
 g1:  ■      g2:  ■      g3:  □      g4:  □
  x1:CH1      x2:CH1      x3:CH1      x4:CH1
  y1:CH2      y2:CH1      y3:CH1      y4:CH1

[X-axis]              Lower  ~     Upper
 g1(CH 1):             10V  ~      -10V
 g2(CH 1):             10V  ~      -10V
```

(3) Numeric printout



Logic

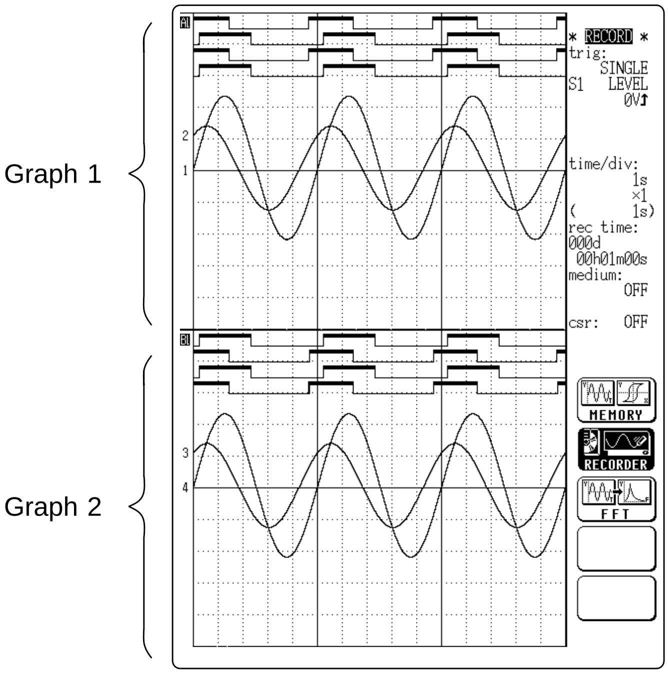
Trig-time: '97-04-04 11:47:51

TIME \ CH	CH1 CH9	CH2 CH10	CH3 CH11	CH4 CH12	CH5 CH13	CH6 CH14	CH7 CH15	CH8 CH16	A 1234	B 1234	C 1234	D 1234
0s	53.125mV --------	2.2281 V --------	2.2156 V --------	25.000mV --------	-------- --------	-------- --------	-------- --------	-------- --------	1010	0101	----	----
+1.25ms	2.1313 V --------	2.7656 V --------	2.7531 V --------	2.1063 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+2.5ms	3.7750 V --------	2.7406 V --------	2.7281 V --------	3.7500 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+3.75ms	4.6438 V --------	2.1500 V --------	2.1344 V --------	4.6188 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+5ms	4.5250 V --------	1.1188 V --------	1.1031 V --------	4.5000 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+6.25ms	3.4563 V --------	-118.75mV --------	-134.38mV --------	3.4313 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+7.5ms	1.6750 V --------	-1.2969 V --------	-1.3125 V --------	1.6500 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+8.75ms	-437.50mV --------	-2.1594 V --------	-2.1750 V --------	-465.63mV --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+10ms	-2.4188 V --------	-2.5156 V --------	-2.5344 V --------	-2.4438 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+11.25ms	-3.8375 V --------	-2.2969 V --------	-2.3125 V --------	-3.8656 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+12.5ms	-4.3813 V --------	-1.5406 V --------	-1.5594 V --------	-4.4125 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+13.75ms	-3.9375 V --------	-415.63mV --------	-428.13mV --------	-3.9656 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+15ms	-2.5969 V --------	834.38mV --------	821.88mV --------	-2.6250 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+16.25ms	-662.50mV --------	1.9375 V --------	1.9219 V --------	-687.50mV --------	-------- --------	-------- --------	-------- --------	-------- --------	1010	0101	----	----
+17.5ms	1.4563 V --------	2.6469 V --------	2.6344 V --------	1.4344 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+18.75ms	3.2969 V --------	2.8156 V --------	2.8031 V --------	3.2750 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+20ms	4.4531 V --------	2.4031 V --------	2.3906 V --------	4.4313 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+21.25ms	4.6688 V --------	1.5000 V --------	1.4844 V --------	4.6500 V --------	-------- --------	--------			1111	1111	----	----
+22.5ms	3.9031 V --------	296.88mV --------	284.38mV --------	3.8844 V --------	--------							--
+23.75ms	2.3250 V	-928.13mV	-943.75mV	2.3063 V								

Recorder function

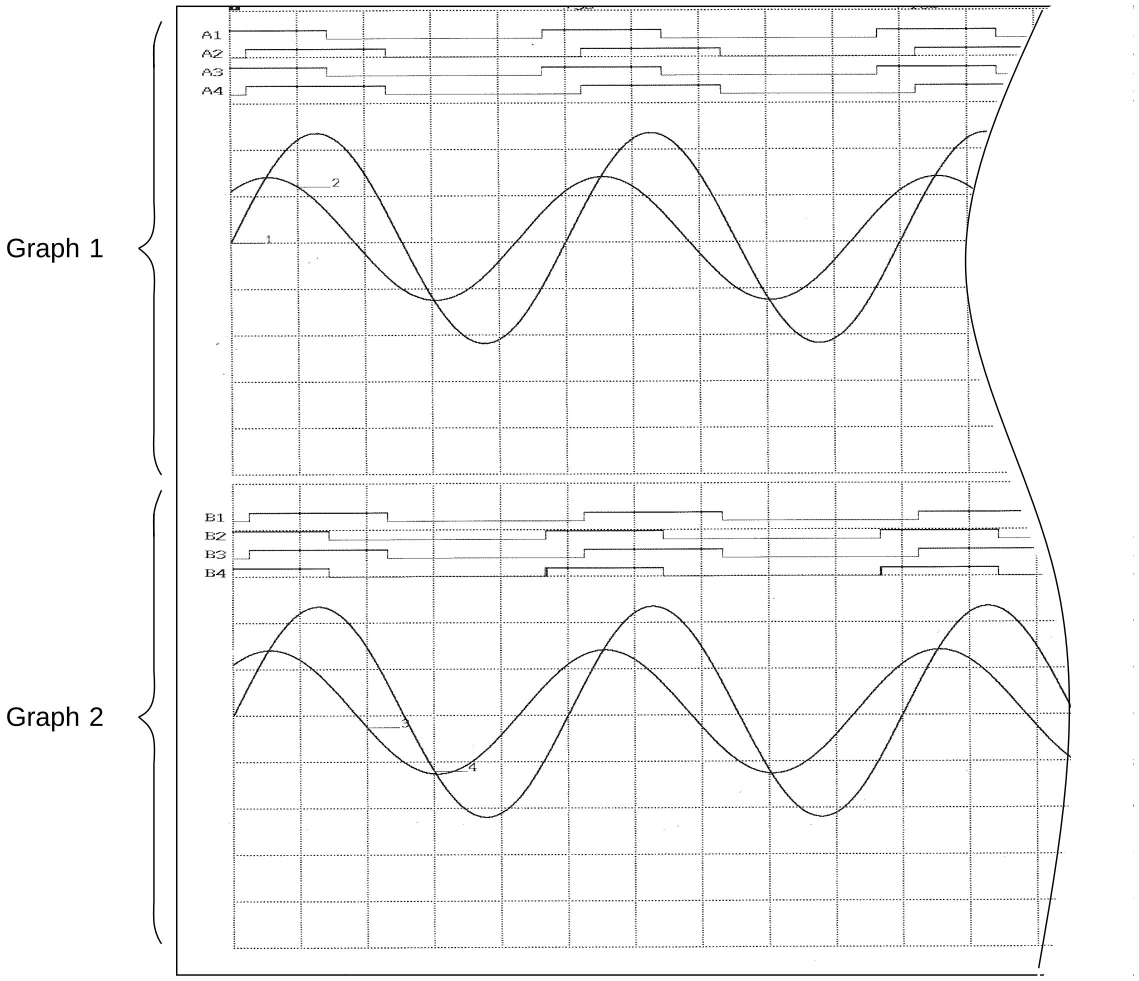
(1) Y-T screen (dual in this example)

- Display



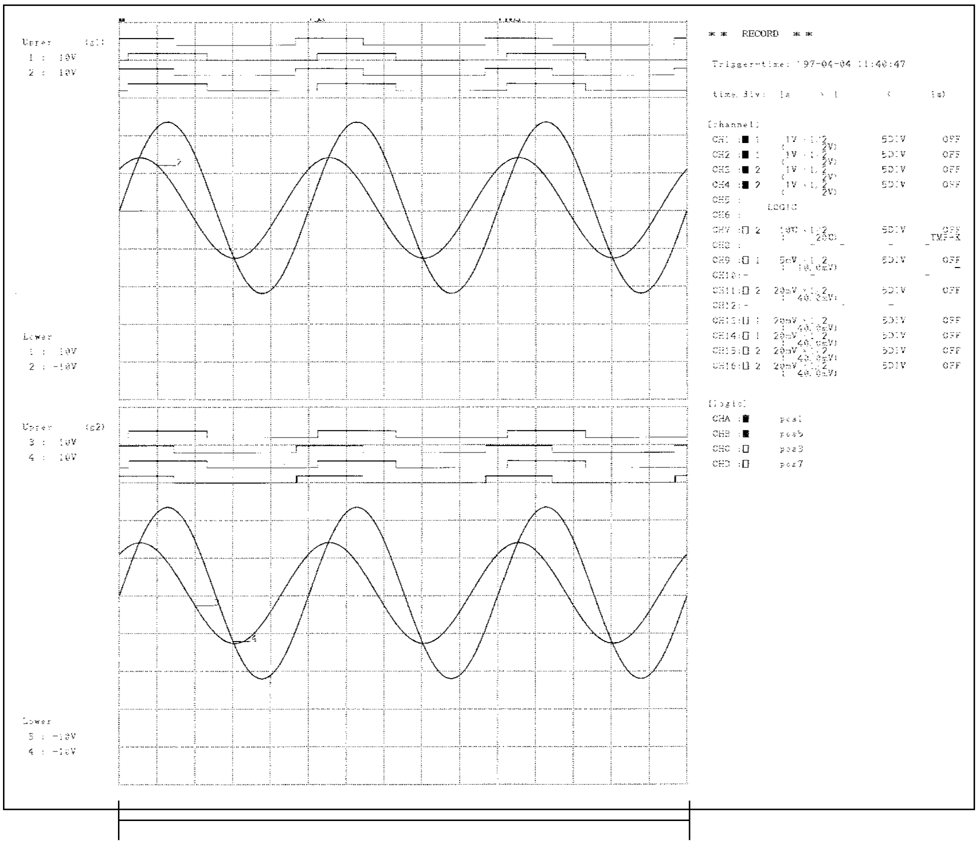
* RECORD *
trig:
SINGLE
S1 LEVEL
0V↑
time/div:
1s
×1
(1s)
rec time:
000d
00h01m00s
medium:
OFF
csr: OFF

- Normal print, real time print



- A4 print

Input channel settings

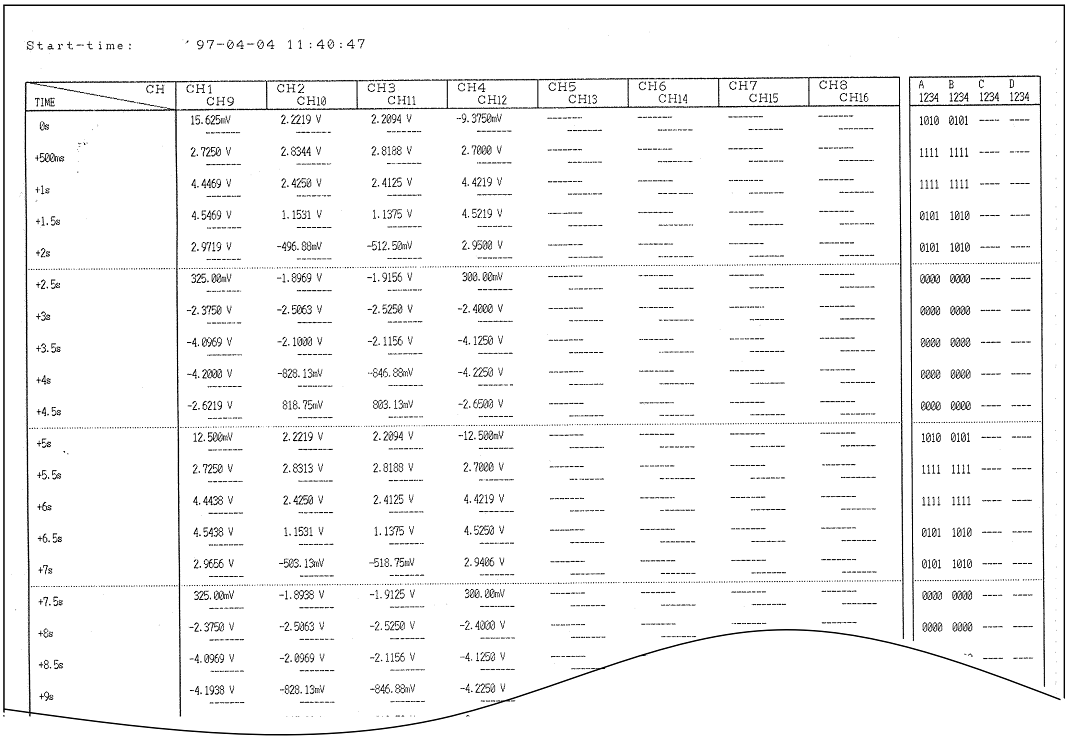


Indicates upper and lower limit of waveform

15 DIV segment (same as on display) is printed.

(2) Numerical recording

Logic

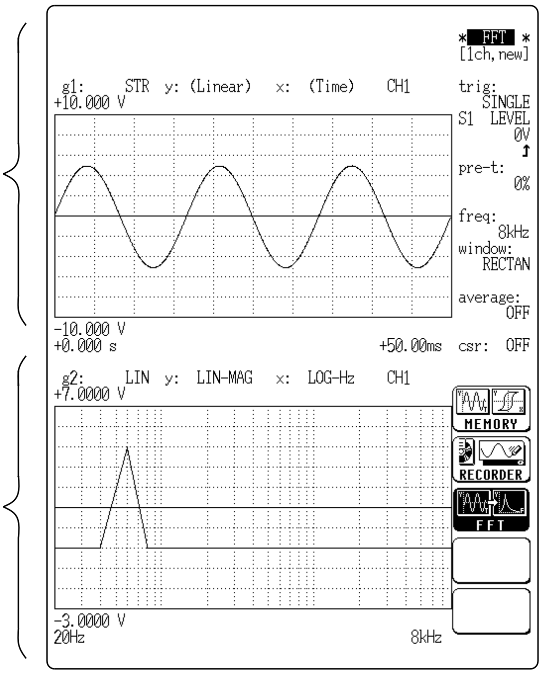


Start-time: '97-04-04 11:40:47

TIME \ CH	CH1 CH9	CH2 CH10	CH3 CH11	CH4 CH12	CH5 CH13	CH6 CH14	CH7 CH15	CH8 CH16	A 1234	B 1234	C 1234	D 1234
0s	15.625mV --------	2.2219 V --------	2.2094 V --------	-9.3750mV --------	-------- --------	-------- --------	-------- --------	-------- --------	1010	0101	----	----
+500ms	2.7250 V --------	2.8344 V --------	2.8188 V --------	2.7000 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+1s	4.4469 V --------	2.4250 V --------	2.4125 V --------	4.4219 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+1.5s	4.5469 V --------	1.1531 V --------	1.1375 V --------	4.5219 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+2s	2.9719 V --------	-496.88mV --------	-512.50mV --------	2.9500 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+2.5s	325.00mV --------	-1.8969 V --------	-1.9156 V --------	300.00mV --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+3s	-2.3750 V --------	-2.5063 V --------	-2.5250 V --------	-2.4000 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+3.5s	-4.0969 V --------	-2.1000 V --------	-2.1156 V --------	-4.1250 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+4s	-4.2000 V --------	-828.13mV --------	-846.88mV --------	-4.2250 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+4.5s	-2.6219 V --------	818.75mV --------	803.13mV --------	-2.6500 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+5s	12.500mV --------	2.2219 V --------	2.2094 V --------	-12.500mV --------	-------- --------	-------- --------	-------- --------	-------- --------	1010	0101	----	----
+5.5s	2.7250 V --------	2.8313 V --------	2.8188 V --------	2.7000 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+6s	4.4438 V --------	2.4250 V --------	2.4125 V --------	4.4219 V --------	-------- --------	-------- --------	-------- --------	-------- --------	1111	1111	----	----
+6.5s	4.5438 V --------	1.1531 V --------	1.1375 V --------	4.5250 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+7s	2.9656 V --------	-503.13mV --------	-518.75mV --------	2.9406 V --------	-------- --------	-------- --------	-------- --------	-------- --------	0101	1010	----	----
+7.5s	325.00mV --------	-1.8938 V --------	-1.9125 V --------	300.00mV --------	-------- --------	-------- --------	-------- --------	-------- --------	0000	0000	----	----
+8s	-2.3750 V --------	-2.5063 V --------	-2.5250 V --------	-2.4000 V --------	-------- --------	-------- --------	--------	--------	0000	0000	----	----
+8.5s	-4.0969 V --------	-2.0969 V --------	-2.1156 V --------	-4.1250 V --------	-------- --------						----	----
+9s	-4.1938 V --------	-828.13mV --------	-846.88mV --------	-4.2250 V --------								

FFT function

- Display



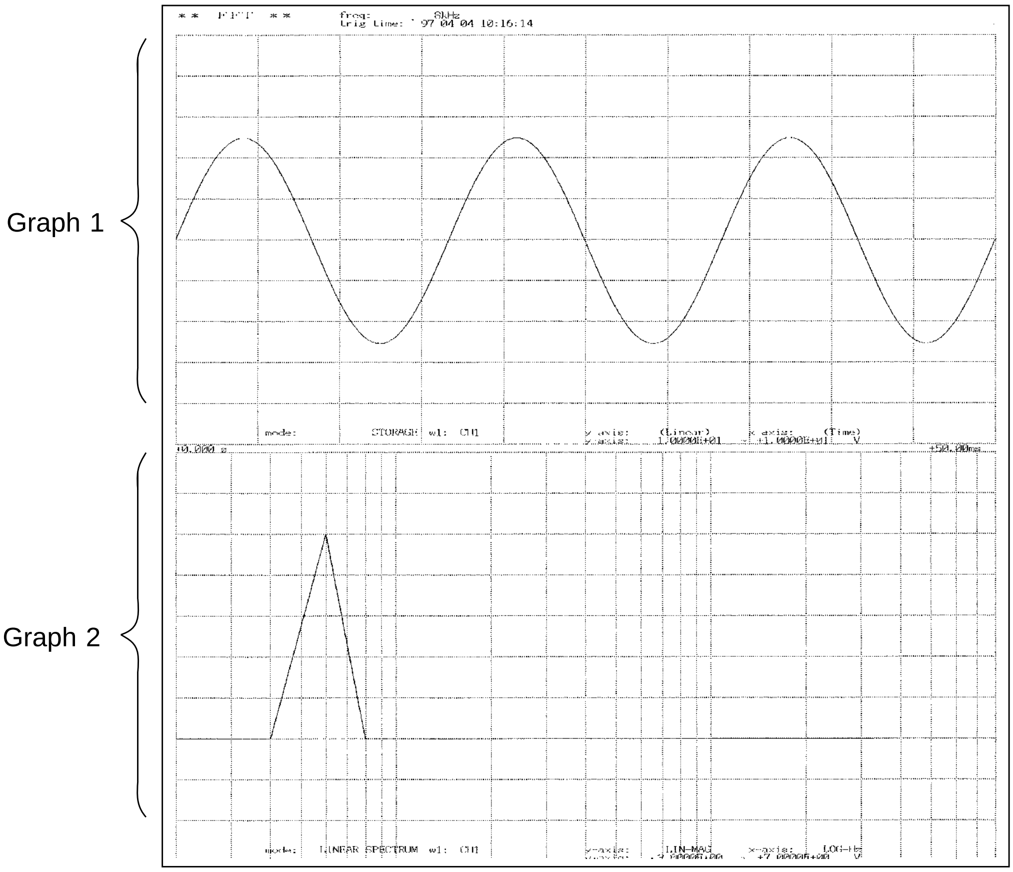
* FFT *
[1ch, new]

g1: STR y: (Linear) x: (Time) CH1
+10.000 V
-10.000 V
+0.000 s
+50.00ms

trig: SINGLE
S1 LEVEL 0V
pre-t: 0%
freq: 8kHz
window: RECTAN
average: OFF
csr: OFF

g2: LIN y: LIN-MAG x: LOG-Hz CH1
+7.0000 V
-3.0000 V
20Hz
8kHz

- Normal print

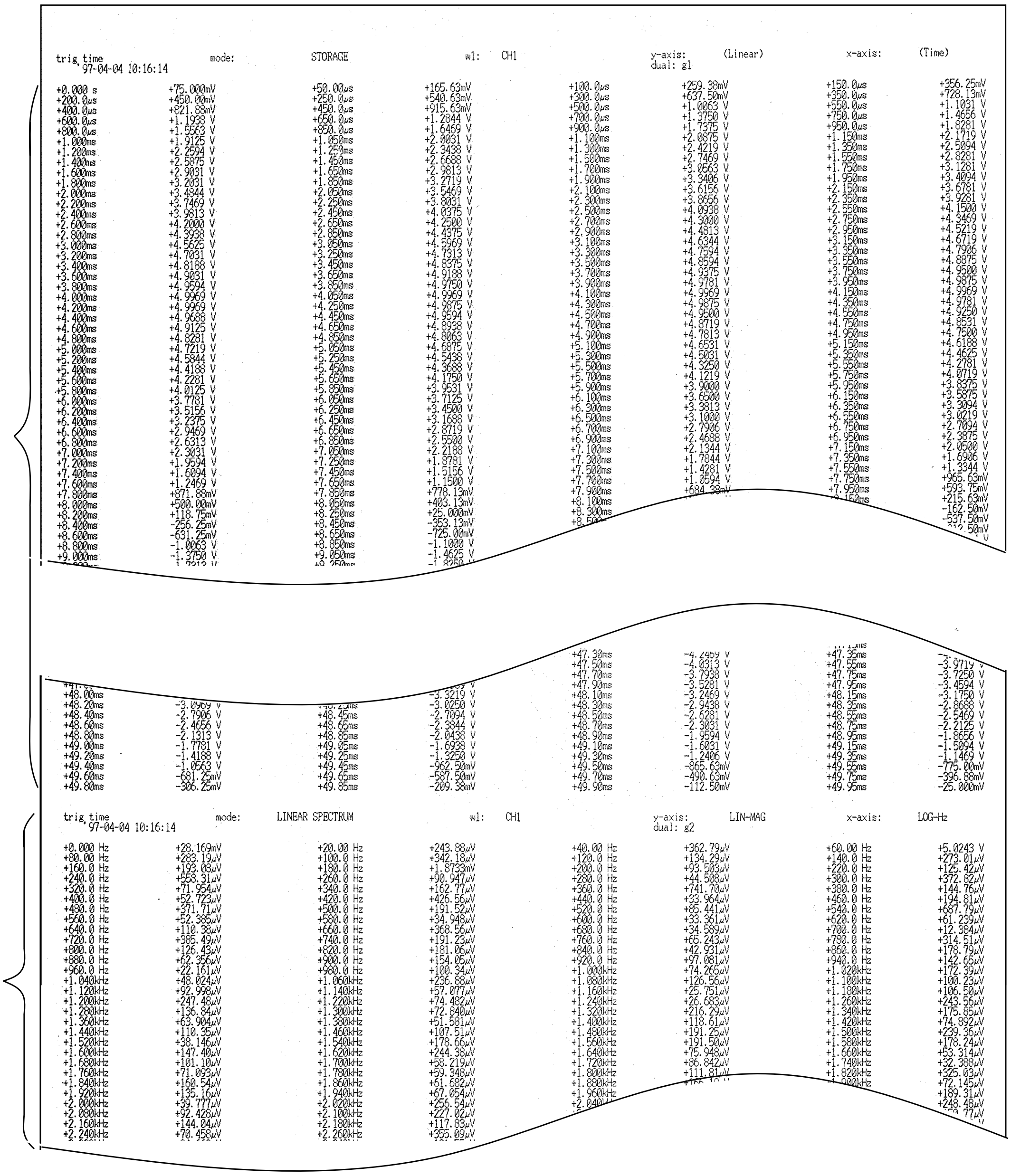


* * FFT * *
freq: 8kHz
trig time: ' 97 04 04 10:16:14

mode: STORAGE w1: CH1
y axis: (Linear) x axis: (Time)
y-axis: 1.0000E+01 ~ +1.0000E+01 V
+0.000 s
+50.00ms

mode: LINEAR SPECTRUM w1: CH1
y-axis: LIN-MAG x-axis: LOG-Hz
y-axis: -3.0000E+00 ~ +7.0000E+00 V

- Numeric printout



```
trig time              mode:       STORAGE             w1:   CH1                     y-axis:     (Linear)            x-axis:     (Time)
   97-04-04 10:16:14                                                                  dual: g1

+0.000 s    +75.000mV     +50.00µs    +165.63mV     +100.0µs    +259.38mV     +150.0µs    +356.25mV
+200.0µs    +450.00mV     +250.0µs    +540.63mV     +300.0µs    +637.50mV     +350.0µs    +728.13mV
+400.0µs    +821.88mV     +450.0µs    +915.63mV     +500.0µs    +1.0063 V     +550.0µs    +1.1031 V
+600.0µs    +1.1938 V     +650.0µs    +1.2844 V     +700.0µs    +1.3750 V     +750.0µs    +1.4656 V
+800.0µs    +1.5563 V     +850.0µs    +1.6469 V     +900.0µs    +1.7375 V     +950.0µs    +1.8281 V
+1.000ms    +1.9125 V     +1.050ms    +2.0031 V     +1.100ms    +2.0875 V     +1.150ms    +2.1719 V
+1.200ms    +2.2594 V     +1.250ms    +2.3438 V     +1.300ms    +2.4219 V     +1.350ms    +2.5094 V
+1.400ms    +2.5875 V     +1.450ms    +2.6688 V     +1.500ms    +2.7469 V     +1.550ms    +2.8281 V
+1.600ms    +2.9031 V     +1.650ms    +2.9813 V     +1.700ms    +3.0563 V     +1.750ms    +3.1281 V
+1.800ms    +3.2031 V     +1.850ms    +3.2719 V     +1.900ms    +3.3406 V     +1.950ms    +3.4094 V
+2.000ms    +3.4844 V     +2.050ms    +3.5469 V     +2.100ms    +3.6156 V     +2.150ms    +3.6781 V
+2.200ms    +3.7469 V     +2.250ms    +3.8031 V     +2.300ms    +3.8656 V     +2.350ms    +3.9281 V
+2.400ms    +3.9813 V     +2.450ms    +4.0375 V     +2.500ms    +4.0938 V     +2.550ms    +4.1500 V
+2.600ms    +4.2000 V     +2.650ms    +4.2500 V     +2.700ms    +4.3000 V     +2.750ms    +4.3469 V
+2.800ms    +4.3938 V     +2.850ms    +4.4375 V     +2.900ms    +4.4813 V     +2.950ms    +4.5219 V
+3.000ms    +4.5625 V     +3.050ms    +4.5969 V     +3.100ms    +4.6344 V     +3.150ms    +4.6719 V
+3.200ms    +4.7031 V     +3.250ms    +4.7313 V     +3.300ms    +4.7594 V     +3.350ms    +4.7906 V
+3.400ms    +4.8188 V     +3.450ms    +4.8375 V     +3.500ms    +4.8594 V     +3.550ms    +4.8875 V
+3.600ms    +4.9031 V     +3.650ms    +4.9188 V     +3.700ms    +4.9375 V     +3.750ms    +4.9500 V
+3.800ms    +4.9594 V     +3.850ms    +4.9750 V     +3.900ms    +4.9781 V     +3.950ms    +4.9875 V
+4.000ms    +4.9969 V     +4.050ms    +4.9969 V     +4.100ms    +4.9969 V     +4.150ms    +4.9969 V
+4.200ms    +4.9969 V     +4.250ms    +4.9875 V     +4.300ms    +4.9875 V     +4.350ms    +4.9781 V
+4.400ms    +4.9688 V     +4.450ms    +4.9594 V     +4.500ms    +4.9500 V     +4.550ms    +4.9250 V
+4.600ms    +4.9125 V     +4.650ms    +4.8938 V     +4.700ms    +4.8719 V     +4.750ms    +4.8531 V
+4.800ms    +4.8281 V     +4.850ms    +4.8063 V     +4.900ms    +4.7813 V     +4.950ms    +4.7500 V
+5.000ms    +4.7219 V     +5.050ms    +4.6875 V     +5.100ms    +4.6531 V     +5.150ms    +4.6188 V
+5.200ms    +4.5844 V     +5.250ms    +4.5438 V     +5.300ms    +4.5031 V     +5.350ms    +4.4625 V
+5.400ms    +4.4188 V     +5.450ms    +4.3688 V     +5.500ms    +4.3250 V     +5.550ms    +4.2781 V
+5.600ms    +4.2281 V     +5.650ms    +4.1750 V     +5.700ms    +4.1219 V     +5.750ms    +4.0719 V
+5.800ms    +4.0125 V     +5.850ms    +3.9531 V     +5.900ms    +3.9000 V     +5.950ms    +3.8375 V
+6.000ms    +3.7781 V     +6.050ms    +3.7125 V     +6.100ms    +3.6500 V     +6.150ms    +3.5875 V
+6.200ms    +3.5156 V     +6.250ms    +3.4500 V     +6.300ms    +3.3813 V     +6.350ms    +3.3094 V
+6.400ms    +3.2375 V     +6.450ms    +3.1688 V     +6.500ms    +3.1000 V     +6.550ms    +3.0219 V
+6.600ms    +2.9469 V     +6.650ms    +2.8719 V     +6.700ms    +2.7906 V     +6.750ms    +2.7094 V
+6.800ms    +2.6313 V     +6.850ms    +2.5500 V     +6.900ms    +2.4688 V     +6.950ms    +2.3875 V
+7.000ms    +2.3031 V     +7.050ms    +2.2188 V     +7.100ms    +2.1344 V     +7.150ms    +2.0500 V
+7.200ms    +1.9594 V     +7.250ms    +1.8781 V     +7.300ms    +1.7844 V     +7.350ms    +1.6906 V
+7.400ms    +1.6094 V     +7.450ms    +1.5156 V     +7.500ms    +1.4281 V     +7.550ms    +1.3344 V
+7.600ms    +1.2469 V     +7.650ms    +1.1500 V     +7.700ms    +1.0594 V     +7.750ms    +965.63mV
+7.800ms    +871.88mV     +7.850ms    +778.13mV     +7.900ms    +684.38mV     +7.950ms    +593.75mV
+8.000ms    +500.00mV     +8.050ms    +403.13mV     +8.100ms                              +215.63mV
+8.200ms    +118.75mV     +8.250ms    +25.000mV     +8.300ms                              -162.50mV
+8.400ms    -256.25mV     +8.450ms    -353.13mV                                           -537.50mV
+8.600ms    -631.25mV     +8.650ms    -725.00mV
+8.800ms    -1.0063 V     +8.850ms    -1.1000 V
+9.000ms    -1.3750 V     +9.050ms    -1.4625 V
```

```
                                                      +47.30ms    -4.2469 V     +47.35ms
                                                      +47.50ms    -4.0313 V     +47.55ms    -3.9719 V
                                                      +47.70ms    -3.7938 V     +47.75ms    -3.7250 V
                                                      +47.90ms    -3.5281 V     +47.95ms    -3.4594 V
+48.00ms                                -3.3219 V     +48.10ms    -3.2469 V     +48.15ms    -3.1750 V
+48.20ms    -3.0969 V                   -3.0250 V     +48.30ms    -2.9438 V     +48.35ms    -2.8688 V
+48.40ms    -2.7906 V     +48.45ms      -2.7094 V     +48.50ms    -2.6281 V     +48.55ms    -2.5469 V
+48.60ms    -2.4656 V     +48.65ms      -2.3844 V     +48.70ms    -2.3031 V     +48.75ms    -2.2125 V
+48.80ms    -2.1313 V     +48.85ms      -2.0438 V     +48.90ms    -1.9594 V     +48.95ms    -1.8656 V
+49.00ms    -1.7781 V     +49.05ms      -1.6938 V     +49.10ms    -1.6031 V     +49.15ms    -1.5094 V
+49.20ms    -1.4188 V     +49.25ms      -1.3250 V     +49.30ms    -1.2406 V     +49.35ms    -1.1469 V
+49.40ms    -1.0563 V     +49.45ms      -962.50mV     +49.50ms    -865.63mV     +49.55ms    -775.00mV
+49.60ms    -681.25mV     +49.65ms      -587.50mV     +49.70ms    -490.63mV     +49.75ms    -396.88mV
+49.80ms    -306.25mV     +49.85ms      -209.38mV     +49.90ms    -112.50mV     +49.95ms    -25.000mV
```

```
trig time              mode:    LINEAR SPECTRUM        w1:   CH1                     y-axis:     LIN-MAG             x-axis:     LOG-Hz
   97-04-04 10:16:14                                                                  dual: g2

+0.000 Hz   +28.169mV     +20.00 Hz   +243.88µV     +40.00 Hz   +362.79µV     +60.00 Hz   +5.0243 V
+80.00 Hz   +283.19µV     +100.0 Hz   +342.18µV     +120.0 Hz   +134.29µV     +140.0 Hz   +273.01µV
+160.0 Hz   +193.08µV     +180.0 Hz   +1.8733mV     +200.0 Hz   +93.503µV     +220.0 Hz   +125.42µV
+240.0 Hz   +558.31µV     +260.0 Hz   +90.947µV     +280.0 Hz   +44.508µV     +300.0 Hz   +372.82µV
+320.0 Hz   +71.954µV     +340.0 Hz   +162.77µV     +360.0 Hz   +741.70µV     +380.0 Hz   +144.76µV
+400.0 Hz   +52.723µV     +420.0 Hz   +426.56µV     +440.0 Hz   +33.964µV     +460.0 Hz   +194.81µV
+480.0 Hz   +371.71µV     +500.0 Hz   +191.52µV     +520.0 Hz   +85.441µV     +540.0 Hz   +687.79µV
+560.0 Hz   +52.385µV     +580.0 Hz   +34.948µV     +600.0 Hz   +33.361µV     +620.0 Hz   +61.239µV
+640.0 Hz   +110.38µV     +660.0 Hz   +368.56µV     +680.0 Hz   +34.589µV     +700.0 Hz   +12.384µV
+720.0 Hz   +385.49µV     +740.0 Hz   +191.23µV     +760.0 Hz   +65.243µV     +780.0 Hz   +314.51µV
+800.0 Hz   +126.43µV     +820.0 Hz   +181.06µV     +840.0 Hz   +42.931µV     +860.0 Hz   +178.79µV
+880.0 Hz   +62.356µV     +900.0 Hz   +154.05µV     +920.0 Hz   +97.081µV     +940.0 Hz   +142.65µV
+960.0 Hz   +22.161µV     +980.0 Hz   +100.34µV     +1.000kHz   +74.265µV     +1.020kHz   +172.39µV
+1.040kHz   +48.024µV     +1.060kHz   +236.88µV     +1.080kHz   +126.56µV     +1.100kHz   +100.23µV
+1.120kHz   +92.998µV     +1.140kHz   +57.077µV     +1.160kHz   +25.751µV     +1.180kHz   +106.50µV
+1.200kHz   +247.48µV     +1.220kHz   +74.482µV     +1.240kHz   +26.683µV     +1.260kHz   +243.56µV
+1.280kHz   +136.84µV     +1.300kHz   +72.840µV     +1.320kHz   +216.29µV     +1.340kHz   +175.85µV
+1.360kHz   +63.904µV     +1.380kHz   +51.581µV     +1.400kHz   +118.61µV     +1.420kHz   +74.892µV
+1.440kHz   +110.35µV     +1.460kHz   +107.51µV     +1.480kHz   +191.25µV     +1.500kHz   +239.36µV
+1.520kHz   +38.146µV     +1.540kHz   +178.66µV     +1.560kHz   +191.50µV     +1.580kHz   +178.24µV
+1.600kHz   +147.40µV     +1.620kHz   +244.38µV     +1.640kHz   +75.948µV     +1.660kHz   +53.314µV
+1.680kHz   +101.10µV     +1.700kHz   +58.219µV     +1.720kHz   +86.842µV     +1.740kHz   +32.388µV
+1.760kHz   +71.093µV     +1.780kHz   +59.348µV     +1.800kHz   +111.81µV     +1.820kHz   +325.03µV
+1.840kHz   +160.54µV     +1.860kHz   +61.682µV     +1.880kHz                              +72.145µV
+1.920kHz   +135.16µV     +1.940kHz   +67.054µV     +1.960kHz                              +189.31µV
+2.000kHz   +39.777µV     +2.020kHz   +256.54µV                                           +248.48µV
+2.080kHz   +92.428µV     +2.100kHz   +227.02µV
+2.160kHz   +144.04µV     +2.180kHz   +117.83µV
+2.240kHz   +70.458µV     +2.260kHz   +355.09µV
```

Chapter 13
Storing Data on MO/ Reading Data From MO

13.1 Overview

- Data can be stored on magneto optical disk (MO).
- Waveform data, measurement setting data, and waveform parameter evaluation data can be stored in separate files.
- There are two formats for storing waveform data: binary format and text format.
- Stored data can be used in two ways: "data read" or "playback".

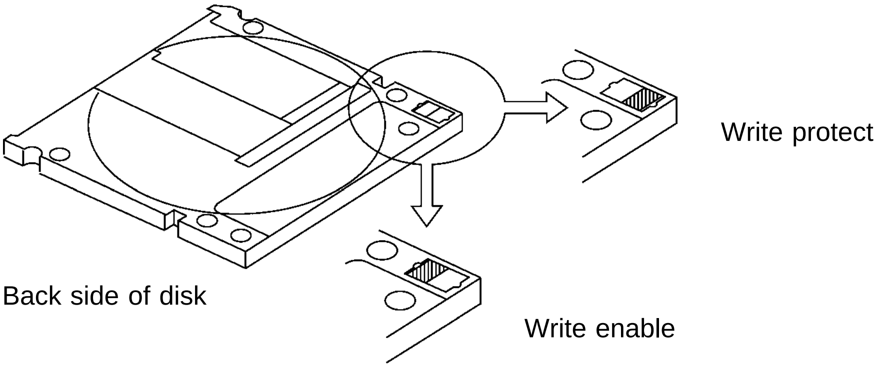
13.2 About the MO Disk

MO type

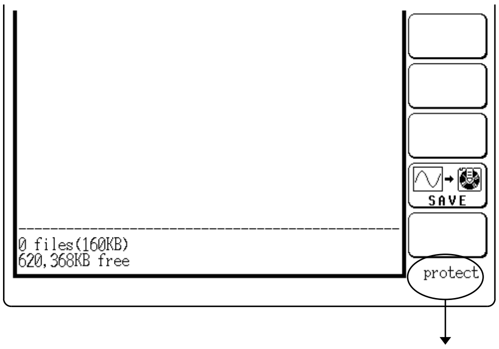
- Use only commercially 3.5-inch MO disks (128, 230, 540, 640 MB: rewritable) with this unit.

Write protection

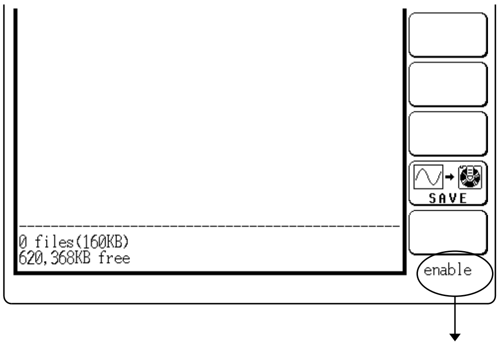
- The DDS tapes have a provision for write protection which serves to prevent accidental erasure or overwriting of data.
- When wishing to record or erase data, the tab on the tape must be set to write enable first.



The write protect or write enable status of the tape is shown on the MO screen, below the function key display.



```
0 files(160KB)
620,368KB free
```



```
0 files(160KB)
620,368KB free
```

Format

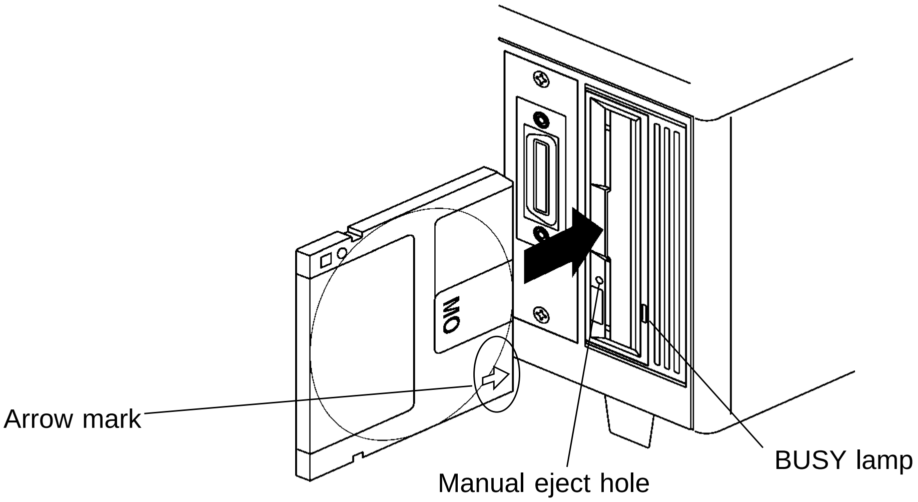
Before use the MO disk to record the data with the unit, always format using the 8846.

For details on formatting, see Section 13.10.4, "Formatting the MO Disk".

13.3 MO Drive Operation

Inserting the MO disk

Insert the MO disk into the disk slot with the arrow mark facing to the right, as shown in the illustration.



NOTE The lid to the disk slot has a two-layer construction. Note that it is not possible to insert a disk when the outer panel is closed.

Removing the MO disk

Method (MO screen)

1. Press the FILE key to call up the MO screen.
2. Press the [disk ope] function key (**HELP** key) for tape operation.
3. Press the [eject] function key.

NOTE

- Even if the eject button of the MO drive is pressed, the disk is not ejected.
- Do not turn the unit off during the BUSY lamp is lit. The disk may be damaged or data may be cleared.
- If for any reason it should be impossible to remove the disk by the above method, power off the unit and insert a pin of diameter approximately 1 mm into the manual eject hole of the MO drive, to eject the disk.

Drive head cleaning

Use a commercially available cleaning disk. For details, see Section 23.1 (3) "MO drive head".

Power failure backup function

- This function protects files on the MO disk as far as possible against the possibility of a power failure occurring while recording on the MO disk.
- To use this function, note the following:

(1) Use a disk formatted on the 8846 itself (normal format).

(2) On an MO disk to be used on the 8846, do not add, delete, or rename files using a separate computer.

(File operations on the disk using a personal computer invalidate the backup function.)

NOTE

- The backup data is written to the disk at regular intervals, so in the recorder function the screen display may stop operating during the recording.
- If a power failure occurs immediately after measurement starts, in some cases it may not be possible to restore saved data.
- Using Scandisk on the MO disk in either Windows 95 or Windows NT disables the backup function.
- When reading the file in Windows 95 or Windows NT, make the disk write-protected. Reading a file in while the disk is not write-protected again disables the backup function.
- Do not write to or amend the backup data (in hidden files).
- If a disk on which the power failure backup function cannot be used is inserted in the drive, a message to that effect appears just once in the recorder function display. (But is not displayed if the disk is write-protected.)

Initial operation after powering on

- Immediately after power on, the MO drive carries out a self-diagnosis. The BUSY indicator lights for about 8 seconds during the self-diagnosis operation, and goes off when the operation ends. If a fault is found, the BUSY indicator flashes.
- If a fault appears, refer to your retail service representative.

System position during MO drive operation

During an MO drive operation (when saving or reading data), do not tilt the system more than 10 degrees from its horizontal or vertical position. (Do not use the stand located at the rear of the system.)

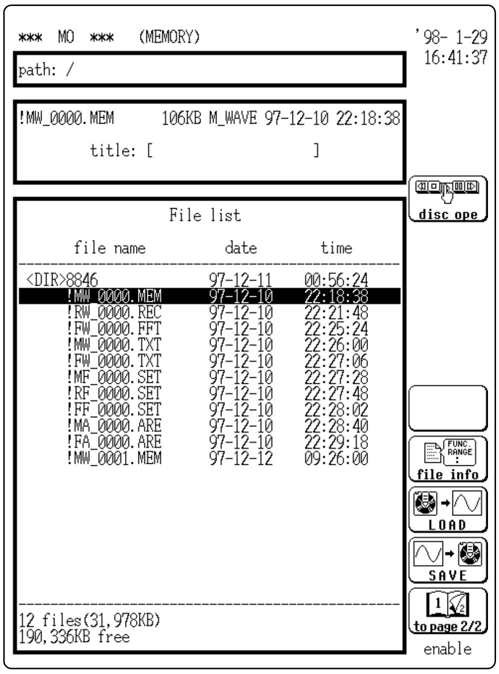
13.4 Displaying File List and File Information

- You can display a list of files contained on a MO disk.
- You can check the contents of stored files.

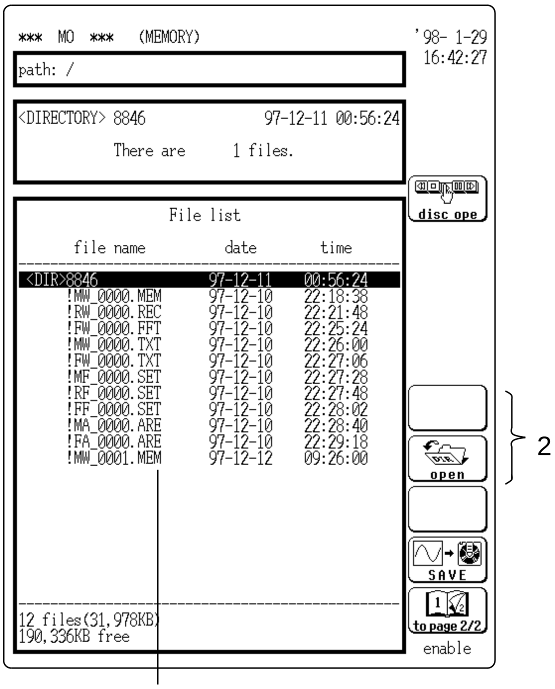
13.4.1 Displaying a File List

File name, the date and time are displayed when the data is stored in a file.

Method Screen: MO



```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           16:41:37

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                  File list
        file name           date        time
----------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
      !MW_0000.MEM        97-12-10    22:18:38
      !RW_0000.REC        97-12-10    22:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00
----------------------------------------------------
12 files(31,978KB)
190,336KB free
```



```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           16:42:27

<DIRECTORY> 8846              97-12-11 00:56:24
           There are      1 files.

                  File list
        file name           date        time
----------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
      !MW_0000.MEM        97-12-10    22:18:38
      !RW_0000.REC        97-12-10    22:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00
----------------------------------------------------
12 files(31,978KB)
190,336KB free
```

File type

1. Press the FILE key to call up the MO screen.
2. Insert a disk.
   The data stored on MO disk is automatically listed.

NOTE

Up to 1000 files can be displayed in a single directory.

● File type (mode) display

- Waveform data, measurement settings
  XXX.MEM (memory recorder, binary format)
  XXX.REC(recorder, binary format)
  XXX.FFT(FFT, binary format)
  XXX.TXT(text format)
  XXX.SEQ (sequential save file)
  XXX.MUL (multiblock file)
- Measurement settings
  XXX.SET
- Evaluation area
  XXX.ARE

Opening and closing directories

1. Move the flashing cursor to the <DIR> file.
2. Press the F1 and F2 key to open or close the directory.

Function key display		Meaning
DIR close	:	Close the current directory and display the above directory
open	:	Display the files in directory

13.4.2 Displaying File Information

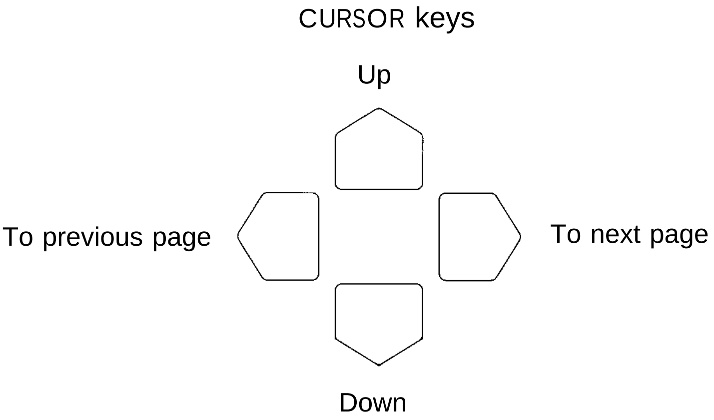
The measurement settings that were used to store the file and title comments can be displayed.

Method Screen: MO

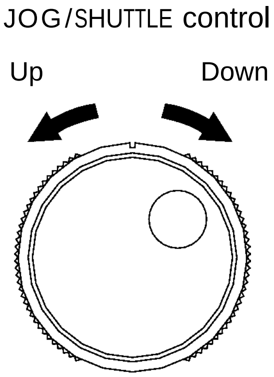
1. Display the file list (☞ Section 13.4.1).
2. Move the flashing cursor to the desired file, and press F1 [file info].

Moving the flashing cursor

CURSOR keys

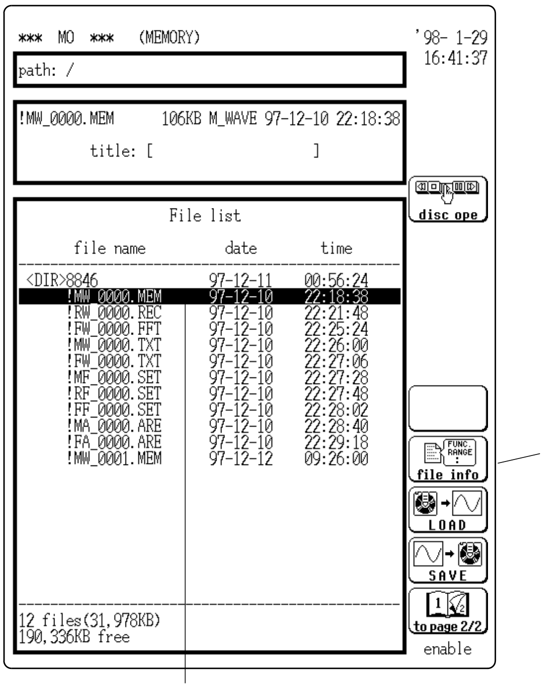


JOG/SHUTTLE control



STOP key: To first file

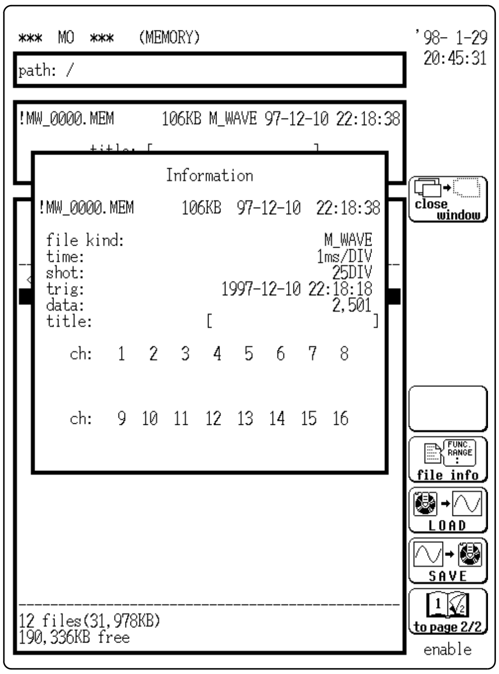
START key: To last file



```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           16:41:37

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                  File list
     file name              date        time
----------------------------------------------
 <DIR>8846                 97-12-11    00:56:24
      !MW_0000.MEM         97-12-10    22:18:38
      !RW_0000.REC         97-12-10    22:21:48
      !FW_0000.FFT         97-12-10    22:25:24
      !MW_0000.TXT         97-12-10    22:26:00
      !FW_0000.TXT         97-12-10    22:27:06
      !MF_0000.SET         97-12-10    22:27:28
      !RF_0000.SET         97-12-10    22:27:48
      !FF_0000.SET         97-12-10    22:28:02
      !MA_0000.ARE         97-12-10    22:28:40
      !FA_0000.ARE         97-12-10    22:29:18
      !MW_0001.MEM         97-12-12    09:26:00
----------------------------------------------
12 files(31,978KB)
190,336KB free
```

2

Flashing cursor



```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           20:45:31

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

                 Information
!MW_0000.MEM      106KB   97-12-10   22:18:38

 file kind:                        M_WAVE
 time:                             1ms/DIV
 shot:                               25DIV
 trig:                 1997-12-10 22:18:18
 data:                               2,501
 title:              [                    ]

    ch:   1   2   3   4   5   6   7   8

    ch:   9  10  11  12  13  14  15  16

12 files(31,978KB)
190,336KB free
```

NOTE Depending on the usage condition of the tape, up to 3 minutes may elapse before the information is displayed.

13.5 Storing Data on a MO Disk

13.5.1 Storing Memory Recorder and FFT Data

The following three store types are available.

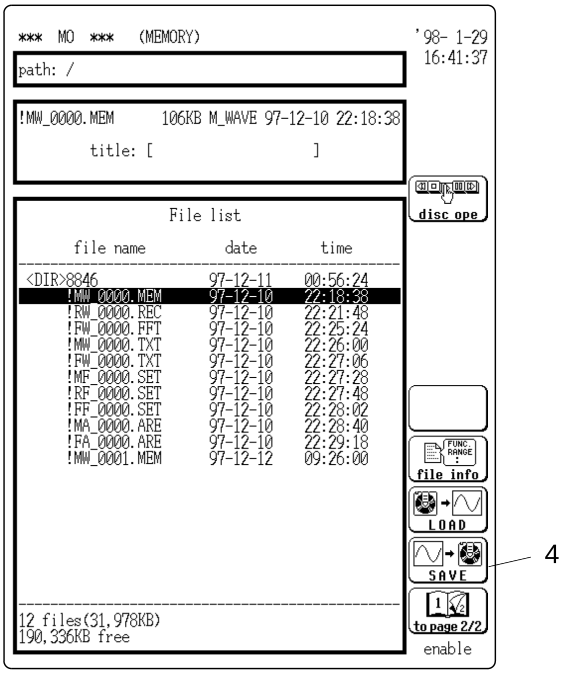
- Storing data on MO disk after measurement is completed.
- Storing data automatically during measurement (auto store).
- Storing data between cursors after measurement is completed (memory recorder function only)

NOTE There is a limit of 10,000 on the number of files that can be stored in a single directory Automatic saving, however, continues as long as there is space on the disk (512 files in the root directory, including hidden files).

(1) Storing data on MO disk after measurement is completed

- Waveform data gained with the memory recorder or FFT function are stored on MO disk .
- Measurement setting data and evaluation area data are stored in separate files.

Method Screen: Memory recorder or FFT→MO

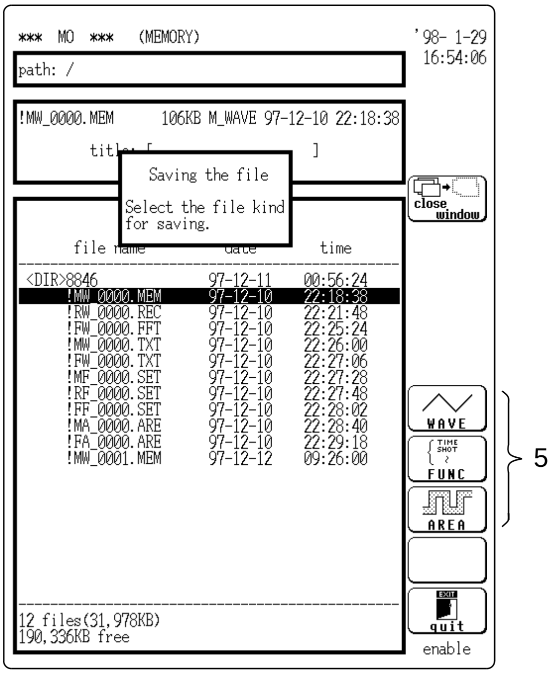


```
***  MO  ***   (MEMORY)                           '98- 1-29
                                                   16:41:37
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                  File list
      file name            date        time
--------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
      !MW_0000.MEM        97-12-10    22:18:38
      !RW_0000.REC        97-12-10    22:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00
--------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Record the waveform with the memory recorder or FFT function.
2. Insert a MO disk in the unit.
3. Without changing the measurement function, press the FILE key.
4. When the directory in which the data is stored is displayed, press F3 [SAVE].

- **1/2 (or 1/3)**

Function key display	Meaning
file info	: Display file information (☞ 13.4.2)
LOAD	: Read data (☞ 13.6)
SAVE	: Store data
to page 2/2	: Switch to 2/2



```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  16:54:06
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                      ]

            Saving the file

            Select the file kind
            for saving.

    file name            date        time
-----------------------------------------------
 <DIR>8846               97-12-11    00:56:24
     !MW_0000.MEM        97-12-10    22:18:38
     !RW_0000.REC        97-12-10    22:21:48
     !FW_0000.FFT        97-12-10    22:25:24
     !MW_0000.TXT        97-12-10    22:26:00
     !FW_0000.TXT        97-12-10    22:27:06
     !MF_0000.SET        97-12-10    22:27:28
     !RF_0000.SET        97-12-10    22:27:48
     !FF_0000.SET        97-12-10    22:28:02
     !MA_0000.ARE        97-12-10    22:28:40
     !FA_0000.ARE        97-12-10    22:29:18
     !MW_0001.MEM        97-12-12    09:26:00

-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

5. Select the file type with the function keys.

Function key display	Meaning
WAVE	: Store recorded waveform data and some measurement settings (.MEM, FFT, or .TXT file)
FUNC	: Store current settings (.SET file)
AREA	: Store only evaluation area recorded in memory (.ARE file)
quit	: Return to the previous setting item.

NOTE

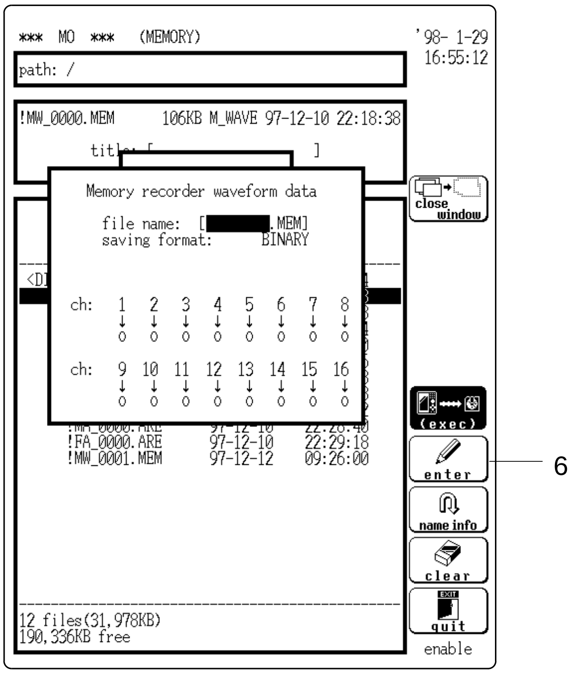
- The waveform data, settings, and evaluation area are stored only for the currently selected function.
- The stored data content depends on the file type (☞ Section 13.5.4).

- When the memory is segmented in the memory recorder function.

  Press F1 [WAVE] to select the type of save.

Function key display	Meaning
1 BLOCK	: Store only waveform data selected.
ALL BLOCKS	: Store all waveform data recorded in each blocks.

When F2 [all blocks] is selected, files for all blocks as well as a file for reading the data in one operation (.SEQ for sequential save and .MUL for multi-block save) are created.

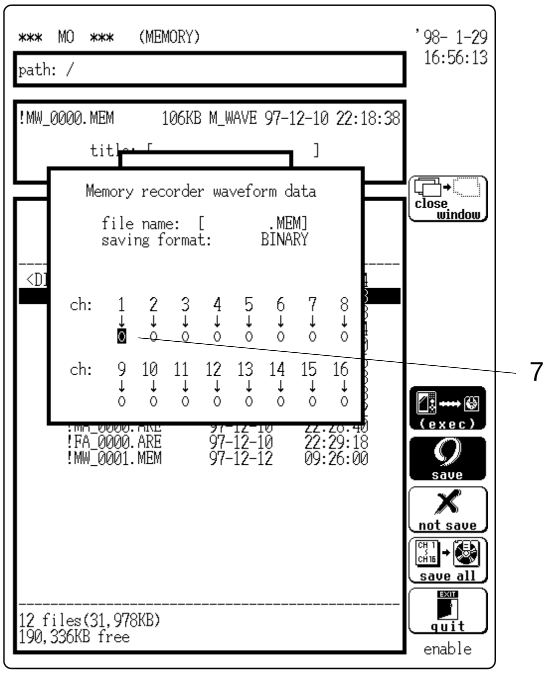


```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  16:55:12
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                      ]

      Memory recorder waveform data

        file name:    [        .MEM]
        saving format:        BINARY

    ch:   1   2   3   4   5   6   7   8
          ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
          0   0   0   0   0   0   0   0

    ch:   9  10  11  12  13  14  15  16
          ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
          0   0   0   0   0   0   0   0

     !FA_0000.ARE        97-12-10    22:29:18
     !MW_0001.MEM        97-12-12    09:26:00

-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

6. Enter the file name.

- Move the flashing cursor to the **file name** item (☞ Section 11.6.1).
- The file name can be entered up to 8 characters.
- If no file name is entered, a file name is assigned automatically (☞ Section 13.5.3). Input the file name.

Function key display	Meaning
(exec)	: Store data
enter	: Activate file name input mode
name info	: Recall up to the last ten file names confirmed or deleted.
clear	: Delete a file name
quit	: Return to the previous setting item



```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  16:56:13
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

        Memory recorder waveform data

          file name:  [          .MEM]
          saving format:       BINARY

     ch:   1   2   3   4   5   6   7   8
           ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
           0   0   0   0   0   0   0   0

     ch:   9  10  11  12  13  14  15  16
           ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
           0   0   0   0   0   0   0   0

   !FA_0000.ARE       97-12-10     22:29:18
   !MW_0001.MEM       97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

7. When "waveform data" was selected, select the type of storing data.

Data in binary format is not directly accessible on a personal computer, but is much more compact. Text data can be read directly into spreadsheet or other software on the computer.

Function key display	Meaning
(exec)	: Execute the store data
BINARY	: Save in binary format
TXT	: Save in text format

- When the text format is selected:

① When the header presence or absence selection is made

The header includes the date and time of saving, the channels saved, and other information.

Function key display	Meaning
(exec)	: Execute the store data
OFF	: Do not store header
ON (STND)	: Store header data (for Excel)
ON (DADiSP)	: Store header data (for DADiSP)

② Select the data intermittent.

Function key display	Meaning
(exec)	: Execute the store data
+	OFF, 1/2, 1/5, 1/10, 1/20, 1/50, 1/100, 1/200, 1/500 1/10000
−	

NOTE The setting cannot be made in FFT function.

8. When "waveform data" was selected, move the flashing cursor to the channel item and select the channel whose data are to be stored.
   ○: store, ×: not store

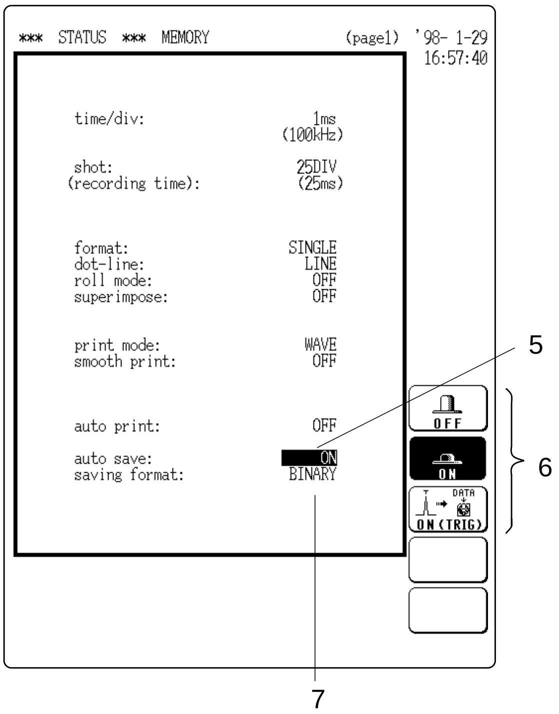
Function key display	Meaning
(exec)	: Execute the store process
save	: Store data for selected channel
not save	: Do not store data for selected channel
save all	: Store data for all channels
quit	: Return to file list screen

9. Press the F1 [exec] to store the data on the MO.

(2) Storing data automatically on MO disk during measurement

- After storing the input waveform in memory and displaying it on the screen, it is stored automatically on MO disk (data are stored each time when a waveform is captured).
- Waveform data (all data in all units in use) and measurement settings (.MEM, .FFT, .TXT file) are stored.

Method Screen: STATUS in Memory recorder (page 1), FFT (page 3)



```
*** STATUS *** MEMORY                (page1) '98- 1-29
                                              16:57:40

  time/div:                     1ms
                             (100kHz)

  shot:                       25DIV
 (recording time):            (25ms)

  format:                    SINGLE
  dot-line:                    LINE
  roll mode:                    OFF
  superimpose:                  OFF

  print mode:                  WAVE
  smooth print:                 OFF

  auto print:                   OFF

  auto save:                     ON
  saving format:             BINARY
```

1. Insert the MO disk into the unit.
2. Press the FILE key to display the MO screen.
3. Make a display of directory in which the data is stored.
4. Press the STATUS key to select the function.
5. Move the flashing cursor to the **auto save** item on the STATUS screen.
6. Use the function keys to make the selection.

Function key display	Meaning
OFF	: Disable auto store
ON	: Store memory data on MO
ON (TRIG)	: Store only data recorded after triggering on MO

7. Move the flashing cursor to **saving format** item to select the type of storing.

Function key display	Meaning
BINARY	: Save in binary format.
TXT	: Save in text format.

- When the text format is selected:

① When the header presence or absence selection is made
The header includes the date and time of saving, the channels saved, and other information.

Function key display	Meaning
OFF	: Do not store header
ON (STND)	: Store header data (for Excel)
ON (DADiSP)	: Store header data (for DADiSP)

② Select the data intermittent.

Function key display	Meaning
+	OFF, 1/2, 1/5, 1/10, 1/20, 1/50, 1/100, 1/200, 1/500 1/10000
−	

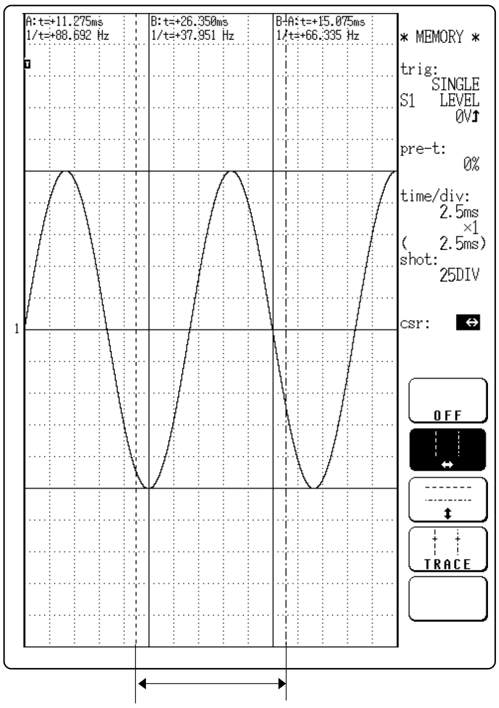
8. Start the measurement. Waveform data are recorded in memory, displayed on screen, and then stored automatically on MO disk.

NOTE The file name is assigned automatically. (☞ Section 13.5.3)

(3) Select the data between cursors. (memory recorder function)

- After recording the waveform data in memory recorder function, the data to be stored is specified by the A and B cursors.
- Using the vertical cursor or trace cursor specified range.

Method Screen: Memory recorder → MO screen)


A:t=+11.275ms
1/t=+88.692 Hz
B:t=+26.350ms
1/t=+37.951 Hz
B-A:t=+15.075ms
1/t=+66.335 Hz
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ⇔

The data between A and B cursors is stored

1. Records the waveform data in memory recorder function.
2. Specify the range to be stored using the A and B cursors (vertical or trace cursors).
3. Store data reffering to the step 3 to 8 in Section 13.5.1 (1).

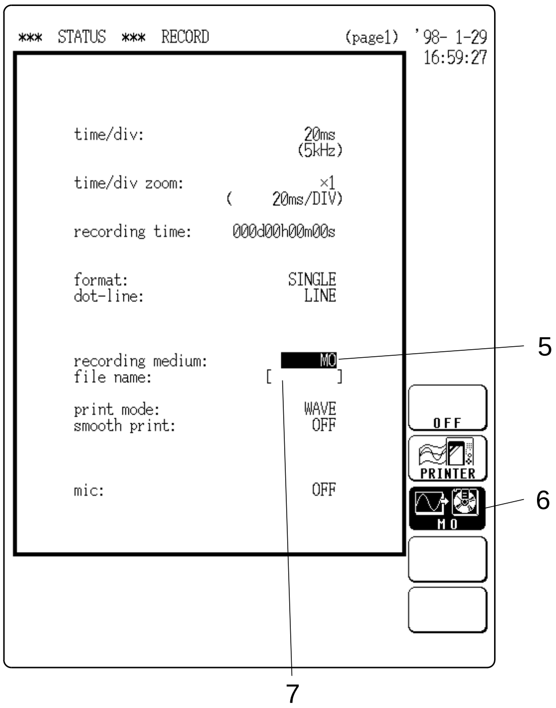
13.5.2 Storing Recorder Data

There are following two methods of storing
(1) Storing waveform data and measurement settings in real time
(2) Storing settings only

(1) Storing waveform data and measurement settings

- Waveform data are stored on MO disk at the same time as being displayed on the screen.
- Waveform data and measurement settings are stored (.REC file: binary format only).
- Up to 1000 files can be displayed in a single directory.

Method Screen: STATUS (page 1)



```
*** STATUS *** RECORD                (page1) '98- 1-29
                                              16:59:27

time/div:                       20ms
                               (5kHz)
time/div zoom:                    ×1
                         (    20ms/DIV)
recording time:        000d00h00m00s

format:                       SINGLE
dot-line:                       LINE

recording medium:                 MO
file name:             [            ]
print mode:                     WAVE
smooth print:                    OFF

mic:                             OFF
```

1. Insert the MO disk into the unit.
2. Press the FILE key to display the MO screen.
3. Make a display of directory in which the data is stored.
4. Press the STATUS key to select the recorder function.
5. Move the flashing cursor to the **recording medium** item.
6. Press F3 [MO].

Function key display	Meaning
OFF	: Disable data recording
PRINTER	: Print waveform data
MO	: Store waveform data on MO

7. Move the flashing cursor to the **file name** item to enter the file name. (☞ 11.6.1 "Comment and File Name Entry Procedure")
   - The file name can be entered up to 8 characters.
   - If no file name is entered, a file name is assigned automatically (☞ Section 13.5.3). Input the file name.

Function key display	Meaning
enter	: Enter the file name input mode
name info	: Recall up to the last ten file names confirmed or deleted.
clear	: Delete a file name

8. Start the measurement. Waveform data are displayed on screen and simultaneously stored on MO disk.

NOTE

- It is not possible to store only waveform data recorded in memory after the measurement is completed.
- The backup data is written to the disk at regular intervals, so in the recorder function the screen display may stop operating during the recording.
- When carrying out measurement with a fast time axis range, use an MO disk which has been newly formatted by the 8846. (If the MO disk has had frequent file additions and deletions made, the resulting fragmentation may cause recording to be lost, and the measurement to stop. ☞ Appendix 3)
- The MO disk defect may also cause recording to be lost, and the measurement to stop.

Event mark

- So-called "event marks" can be placed in the file, denoting the date and time and the elapsed time since the start of recording.
- When playing back a waveform, playback can be started or stopped at these points.
- It is useful to search the display position after loading a waveform. (☞ Section 20.4)
- The event marks can be used up to 1000.

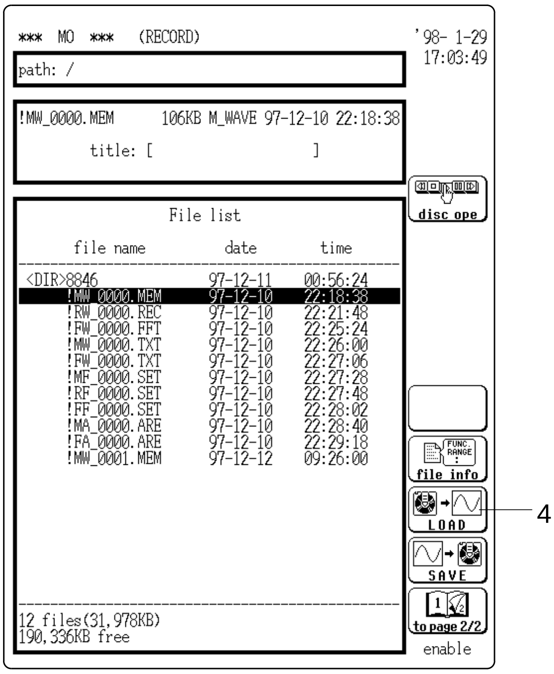
Method 1 During recording (while START key LED is lit), press the START key.

Method 2 Apply a signal to the START connector (☞ Section 21.2).

(2) Storing measurement settings only

Only the settings at the current point are stored on MO disk (.SET file).

Method Screen: MO (recorder function)

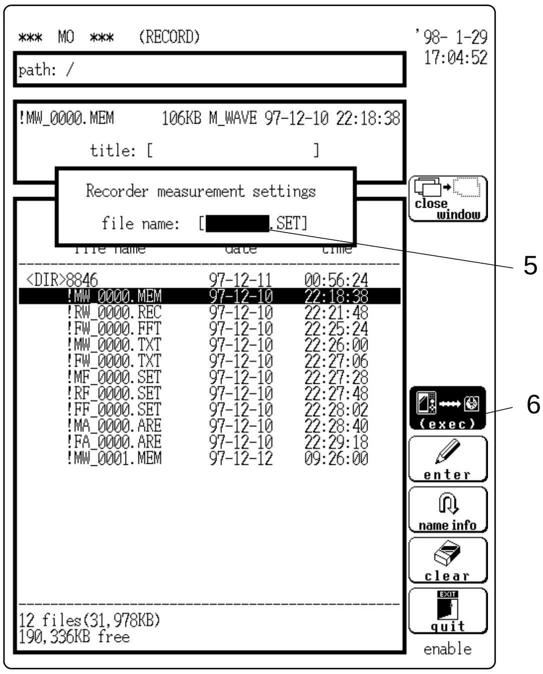


```
***  MO  ***   (RECORD)                         '98- 1-29
path: /                                          17:03:49

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                    File list
        file name            date        time
---------------------------------------------------
 <DIR>8846                 97-12-11    00:56:24
      !MW_0000.MEM         97-12-10    22:18:38
      !RW_0000.REC         97-12-10    22:21:48
      !FW_0000.FFT         97-12-10    22:25:24
      !MW_0000.TXT         97-12-10    22:26:00
      !FW_0000.TXT         97-12-10    22:27:06
      !MF_0000.SET         97-12-10    22:27:28
      !RF_0000.SET         97-12-10    22:27:48
      !FF_0000.SET         97-12-10    22:28:02
      !MA_0000.ARE         97-12-10    22:28:40
      !FA_0000.ARE         97-12-10    22:29:18
      !MW_0001.MEM         97-12-12    09:26:00
---------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Make the settings for the recorder function.
2. Insert a tape into the MO drive.
3. Press the FILE key.
4. When the directory in which the data is stored is displayed, press F4 [SAVE].

- **1/2 (or 1/3)**

Function key display	Meaning
file info	: Display file information
LOAD	: Read data
SAVE	: Store data
to page 2/2	: Switch to page 2/2



```
***  MO  ***   (RECORD)                               '98- 1-29
                                                       17:04:52
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                        ]

     Recorder measurement settings
       file name:  [        .SET]

 <DIR>8846                97-12-11     00:56:24
       !MW_0000.MEM       97-12-10     22:18:38
       !RW_0000.REC       97-12-10     22:21:48
       !FW_0000.FFT       97-12-10     22:25:24
       !MW_0000.TXT       97-12-10     22:26:00
       !FW_0000.TXT       97-12-10     22:27:06
       !MF_0000.SET       97-12-10     22:27:28
       !RF_0000.SET       97-12-10     22:27:48
       !FF_0000.SET       97-12-10     22:28:02
       !MA_0000.ARE       97-12-10     22:28:40
       !FA_0000.ARE       97-12-10     22:29:18
       !MW_0001.MEM       97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

5. Enter the file name (☞ Section 11.6.1).

   If no file name is entered, a file name is assigned automatically (☞ Section 13.5.3).

6. Press the F1 [exec] key to store the current settings on MO disk.

13.5.3 Automatic File Name Assignment

If no file name is input when storing data, the file name is assigned automatically, as follows.

! (Function) (File type) – (File number)

M (Memory recorder) R (Recorder) F (FFT)	W (Waveform data) F (Setting conditions) A (Evaluation area)	Number from the first of the same file 1 0000 to 9999

13.5.4 File Contents and Size

- The contents of a file depend on the file type (WAV, SET, or ARE) and the function of the 8846.
- The size of a file can be roughly calculated, using the equations shown in this Section.

(1) File contents

● : Items stored in the file are marked with a circle

① STATUS screen settings

Memory recorder

Setting item \ Mode		WAVE	FUNC	AREA
Function		●	●	●
Time axis range		●	●	
Recording length		●	●	
Display format		●	●	
Interpolation			●	
Roll mode			●	
Superimpose			●	
Printout format			●	
Logging cycle			●	
Smooth print			●	
Auto print			●	
Auto save			●	
Trigger setting		●	●	
Memory segmentation	Sequential	●	●	
	Multi-block	●	●	
Averaging			●	
Waveform evaluation	Setting	●	●	
	Evaluation area			●
Waveform parameter	Calculation		●	
	Evaluation		●	
Waveform processing			●	

Recorder

Setting item Mode	WAVE	FUNC
Function	●	●
Time axis range	●	●
Recording time	●	●
Display format		●
Interpolation		●
Recording target DAT		●
Printout format		●
Logging cycle		●
Microphone channel	●	●
Trigger setting	●	●
Waveform parameter Calculation		●
Evaluation		●

FFT

Setting item Mode	WAVE	FUNC	AREA
Function	●	●	●
FFT channel mode	●	●	
Frequency range	●	●	
Window function	●	●	
Display format	●	●	
Averaging	●	●	
Reference data	●	●	
Peak display		●	
FFT analysis mode	●	●	
Analysis channel	●	●	
X-axis, Y-axis	●	●	
Display scale	●	●	
Octave filter	●	●	
Trigger setting	●	●	
Interpolation		●	
Printout format		●	
Auto print		●	
Auto store		●	
Waveform evaluation Setting	●	●	
Evaluation area			●

② Display screen settings

Function Setting item	Memory recorder			Recorder	
	WAVE	FUNC	AREA	WAVE	FUNC
Time axis magnification/ compression		●			●

③ CHANNEL screen settings

Function Setting item	Memory recorder			Recorder		FFT		
	WAVE	FUNC	AREA	WAVE	FUNC	WAVE	FUNC	AREA
Input format	●	●		●	●	●	●	
Display color	●	●		●	●	—	—	—
Display position	●	●		●	●	—	—	—
Voltage range	●	●		●	●	●	●	
Input coupling	●	●		●	●	●	●	
Range magnification/ compression	●	●		●	●	●	●	
Zero position	●	●		●	●	●	●	
Variable setting	●	●		●	●	●	●	
Filter	●	●		●	●	●	●	
Thermocouple type	●	●		●	●	●	●	
Vernier function	●	●		●	●	●	●	

④ SYSTEM screen settings

Function Setting item	Memory recorder			Recorder		FFT		
	WAVE	FUNC	AREA	WAVE	FUNC	WAVE	FUNC	AREA
Number of units in use	●	●		●	●	●	●	
Start backup		●			●		●	
Grid		●			●		●	
Channel marker		●			●			
Time axis display		●			●		●	
List and gauge		●			●		●	
Backlight saver		●			●		●	
Display color pattern		●			●		●	
Volume		●			●		●	
Intermittent print		●			●		●	
Scaling	●	●		●	●	●	●	
Comment Setting	●	●		●	●	●	●	
Characters	●	●		●	●	●	●	
Interface		●			●		●	

(2) File size calculation

- The approximate file size can be calculated as follows.
- The "file number" is the number of the stored file or the file to be stored, as counted from the first file.

NOTE When the remaining space on the disk drops to about 1 M bytes in recorder function, new data cannot be stored.

WAVE (waveform) file

- Memory recorder function

Binary format

File size (bytes) = number of channels in use×recording length (DIV)×200+28k

Text format

File size (bytes) = (number of channels in use × 16 + 16)×recording length (DIV)×100+header length

(When using logic)

File size (bytes) = (number of channels in use × 16 + 48)×recording length (DIV)×100+header length

Header length no headers: 0 byte, headers on: less than 1 kbytes

- Recorder function

Binary format

(when using the 128 MB, 230 MB MO disk)

File size (bytes) = number of units in use ×2N×recording time (s)/time axis (s/DIV) ×100+36k

(when using the 540 MB MO disk)

File size (bytes) = number of units in use ×2N×recording time (s)/time axis (s/DIV) ×100+40k

(when using the 640 MB MO disk)

File size (bytes) = number of units in use ×2N×recording time (s)/time axis (s/DIV) ×100+48k

When only 8916 - 8919 units are used, or when one 8927 unit is used in one channel: N=1

When only 8916 - 8919 units and 8927 units are used together, or only 8927 units are used: N=2

- FFT function

Binary format: 48.9 KB

Text format: 14 KB approx.

Func (setting) file

Memory recorder: 25.5 KB

Recorder: 23.5 KB

FFT:23KB

AREA (evaluation area) file

Memory recorder: 32.7 KB

FFT: 32.7 KB

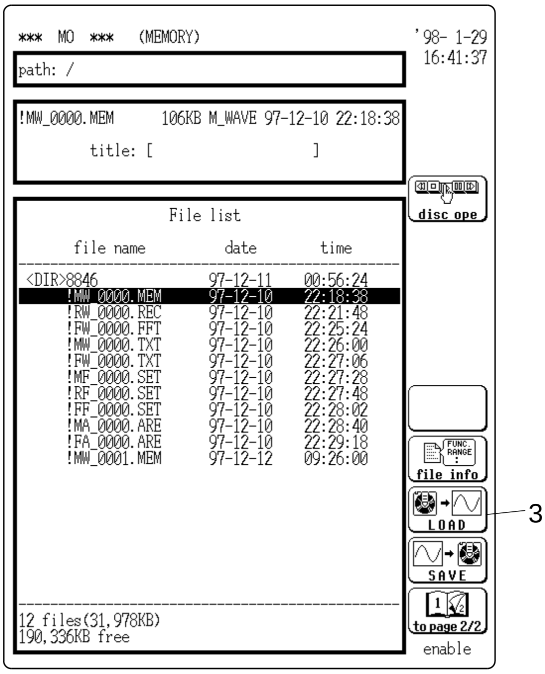
NOTE The above figures may change slightly when new versions are introduced.

13.6 Reading Data From MO Disk

13.6.1 Reading Stored Data

This procedure reads data that were stored with the memory recorder, recorder, or FFT function.

Method Screen: MO



```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  16:41:37
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                  File list
        file name          date        time
--------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
      !MW_0000.MEM        97-12-10    22:18:38
      !RW_0000.REC        97-12-10    22:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00

--------------------------------------------------
12 files(31,978KB)
190,336KB free
```

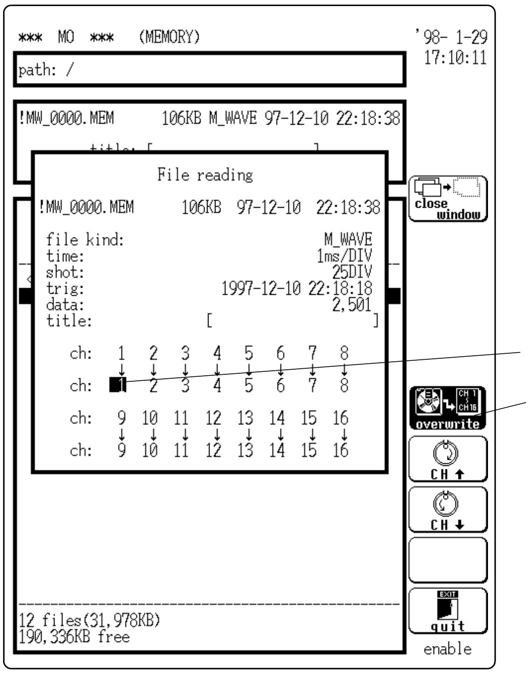
1. Insert the disk with the desired files into the MO drive.
2. Press the FILE key.
3. Select the file to read and press the F2 [LOAD] key.

- **1/2 (or 1/3)**

Function key display	Meaning
file info	: Display file information (13.4.2)
LOAD	: Read data
SAVE	: Store data (13.5)
to page 2/2	: Switch to page 2/2

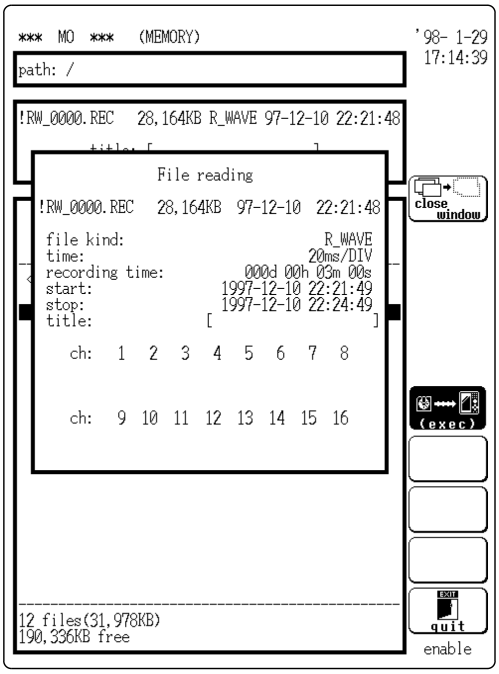
4. The file information is displayed.

When .MEM



```
***  MO  ***   (MEMORY)                              '98- 1-29
                                                      17:10:11
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

                 File reading
!MW_0000.MEM      106KB  97-12-10  22:18:38
 file kind:                              M_WAVE
 time:                                  1ms/DIV
 shot:                                    25DIV
 trig:                      1997-12-10 22:18:18
 data:                                    2,501
 title:               [                        ]

    ch:  1   2   3   4   5   6   7   8
         ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
    ch:  1   2   3   4   5   6   7   8

    ch:  9  10  11  12  13  14  15  16
         ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
    ch:  9  10  11  12  13  14  15  16

12 files(31,978KB)
190,336KB free
```

When other than .MEM
(Example: REC file)



```
***  MO  ***   (MEMORY)                              '98- 1-29
                                                      17:14:39
path: /

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48

                 File reading
!RW_0000.REC   28,164KB  97-12-10  22:21:48
 file kind:                              R_WAVE
 time:                                 20ms/DIV
 recording time:                000d 00h 03m 00s
 start:                     1997-12-10 22:21:49
 stop:                      1997-12-10 22:24:49
 title:               [                        ]

    ch:  1   2   3   4   5   6   7   8


    ch:  9  10  11  12  13  14  15  16

12 files(31,978KB)
190,336KB free
```

● .MEM file

(1) Select either (exec) or overwrite

(exec)	The saved data, time axis, and record length are read. (The data saved in memory is discarded.)
overwrite	Data saved in memory is overwritten with the new data being read. (Data is read using the most-recently set time axis and record length.)

Function key display	Meaning
(exec)	: Normal reading is performed.
overwrite	: The screen for overwrite and reading settings appears.

(2) When "overwrite" is selected

Move the flashing cursor to select the channel into which to read the data.

If reading is not performed, decrease the channel number and display **X**.

Function key display	Meaning
overwrite	: Execute the overwrite process
CH ↑	: Increase channel number
CH ↓	: Decrease channel number
EXIT quit	: Return to file list screen

(3) After specifying the channel, press the F1 [overwrite] key to read.

NOTE

- If the same number channel was selected, data in channels with lower numbers are overwritten. (If CH1 → 1, CH2 → 1 was selected, CH1 data are overwritten by CH2 data.)

● Files other than .MEM files

Press the F1 [exec] key.

5. When read-in is completed, the respective function display appears on the screen.

13.6.2 Playback of Stored Data

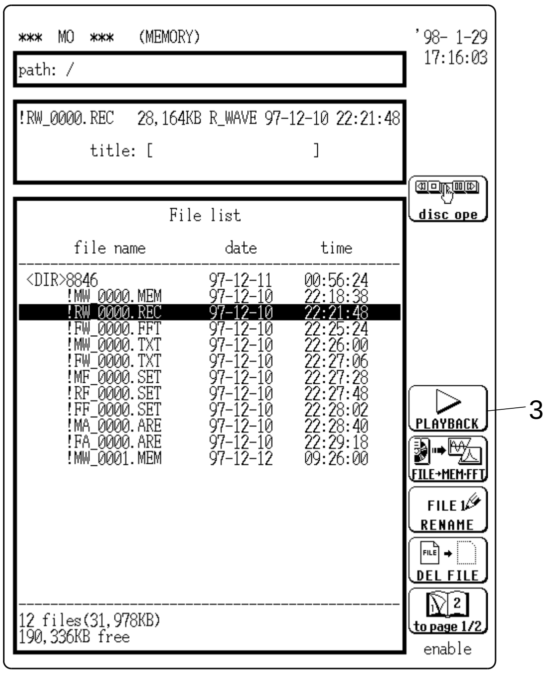
- Playback the waveform data (.REC file) stored in recorder function.
- If the D/A output unit 9539 is installed, the analog waveform can be displayed in real time (☞ Chapter 22).

NOTE

The following data cannot be played back:
1. Waveform data recorded with external sampling
2. Waveform data recorded with a sampling frequency of 40 kHz or above (2.5 ms/DIV)

During playback, the waveform is not displayed.

Method (MO screen)

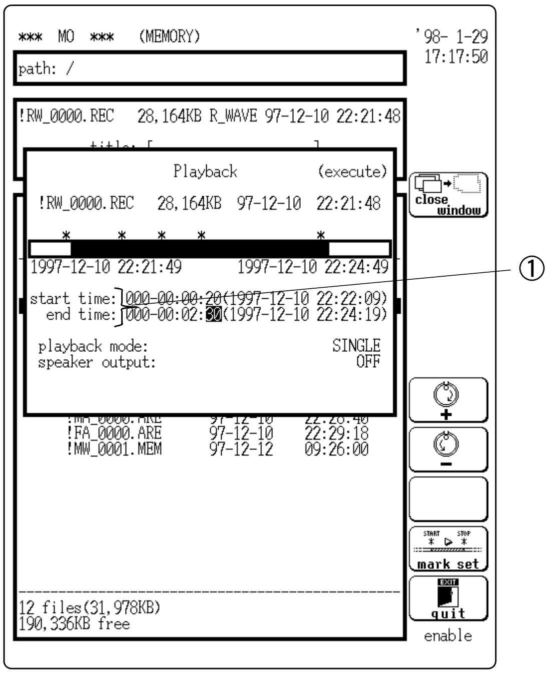


```
***  MO  ***   (MEMORY)                                  '98- 1-29
path: /                                                   17:16:03

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
        title: [                    ]

                    File list
        file name          date         time
------------------------------------------------
 <DIR>8846                97-12-11     00:56:24
      !MW_0000.MEM        97-12-10     22:18:38
      !RW_0000.REC        97-12-10     22:21:48
      !FW_0000.FFT        97-12-10     22:25:24
      !MW_0000.TXT        97-12-10     22:26:00
      !FW_0000.TXT        97-12-10     22:27:06
      !MF_0000.SET        97-12-10     22:27:28
      !RF_0000.SET        97-12-10     22:27:48
      !FF_0000.SET        97-12-10     22:28:02
      !MA_0000.ARE        97-12-10     22:28:40
      !FA_0000.ARE        97-12-10     22:29:18
      !MW_0001.MEM        97-12-12     09:26:00
------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Insert the MO disk with the desired files into the MO drive.
2. Press the FILE key.
3. Select **.REC** file and press the F2 [PLAYBACK] key (3/3).

- **2/2**

Function key display	Meaning
PLAYBACK	: Play back data
FILE→MEM·FFT	: Record data stored on a MO in the memory recorder function, FFT function. (13.7)
FILE RENAME	: Change the file name (13.9)
DEL FILE	: Delete the file (13.8)
to page 1/2	: Switch to page 1/2



```
***  MO  ***   (MEMORY)                              '98- 1-29
                                                      17:17:50
path: /

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48

                    Playback               (execute)
  !RW_0000.REC   28,164KB  97-12-10   22:21:48
       *       *     *     *              *
 1997-12-10 22:21:49        1997-12-10 22:24:49

 start time: 000-00:00:20(1997-12-10 22:22:09)
   end time: 000-00:02:30(1997-12-10 22:24:19)

  playback mode:                          SINGLE
  speaker output:                            OFF

         !FA_0000.ARE        97-12-10     22:29:18
         !MW_0001.MEM        97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

4. Make the settings on the playback command screen.

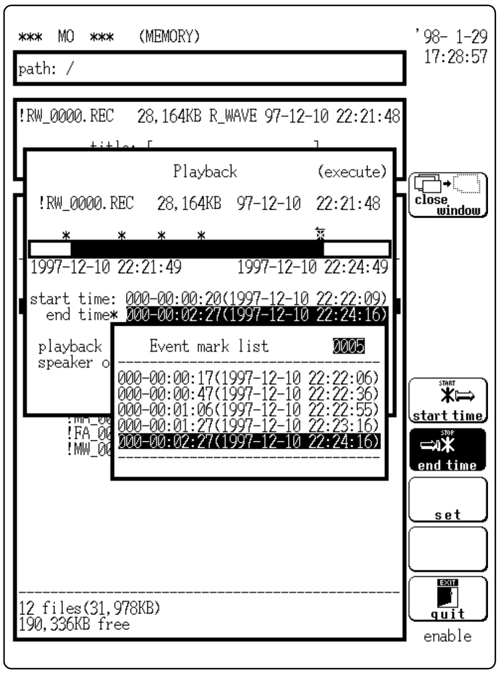
Move the flashing cursor to the respective items and make the settings with the function keys or the JOG control.

① Set **start time** and **end time**.

- Time setting (from 00:00:00 at beginning of file)

Move the flashing cursor to the **start time** and **end time** items and make the settings with the function keys or the JOG control.

Function key display	Meaning
+	: Increase time
−	: Decrease time
START STOP mark set	: Switch to event mark setting
EXIT quit	: Return to file list screen



```
***  MO  ***   (MEMORY)                              '98- 1-29
                                                      17:28:57
path: /

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48

                    Playback               (execute)
  !RW_0000.REC   28,164KB  97-12-10   22:21:48
       *       *     *     *              *
 1997-12-10 22:21:49        1997-12-10 22:24:49

 start time: 000-00:00:20(1997-12-10 22:22:09)
   end time* 000-00:02:27(1997-12-10 22:24:16)

  playback      Event mark list            0005
  speaker o  ----------------------------------
             000-00:00:17(1997-12-10 22:22:06)
             000-00:00:47(1997-12-10 22:22:36)
             000-00:01:06(1997-12-10 22:22:55)
             000-00:01:27(1997-12-10 22:23:16)
             000-00:02:27(1997-12-10 22:24:16)
             ----------------------------------

12 files(31,978KB)
190,336KB free
```

- Event mark setting (making time setting using event marks (*) registered during recording) (☞ Section 13.5.2)

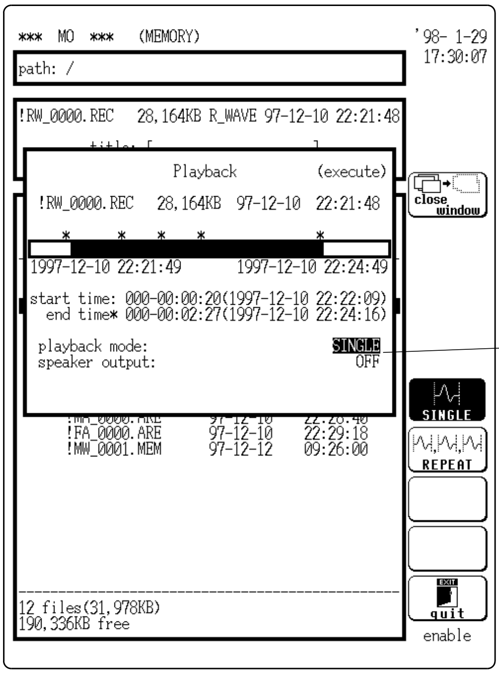
・**start time** and **end time** items can be entered using the event mark time.

・Press the F1 [start time] or F2 [end time] key to activate the input mode for the respective item. Select the event mark with the JOG/SHUTTLE control and the CURSOR keys and make the entry by pressing F3 [set].

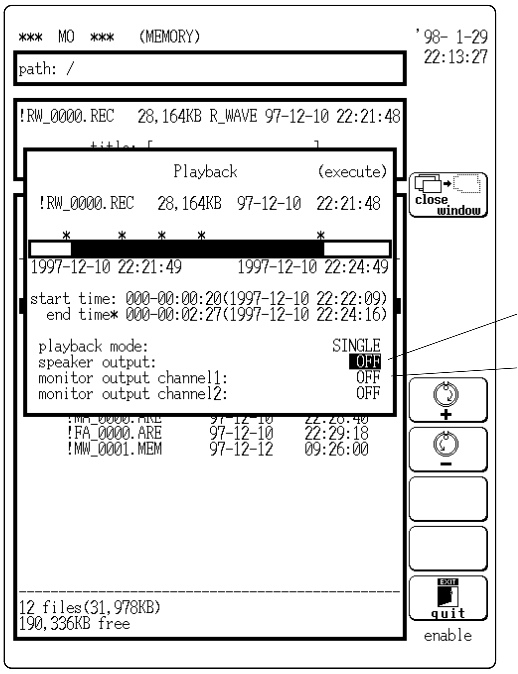
Function key display	Meaning
START start time	: Activate start time input mode
STOP end time	: Activate end time input mode
set	: Enter specified event mark time into start time or end time fields
EXIT quit	: Switch to time setting

NOTE

When "*" is displayed to the left of **start time** or **end time**, a more detailed time value than the displayed value (ms, µs) is available.



```
***  MO  ***   (MEMORY)                               '98- 1-29
                                                        17:30:07
path: /
!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
          Playback              (execute)
 !RW_0000.REC    28,164KB   97-12-10   22:21:48
1997-12-10 22:21:49        1997-12-10 22:24:49
start time: 000-00:00:20(1997-12-10 22:22:09)
  end time* 000-00:02:27(1997-12-10 22:24:16)
 playback mode:                          SINGLE
 speaker output:                            OFF
        !FA_0000.ARE      97-12-10      22:29:18
        !MW_0001.MEM      97-12-12      09:26:00
12 files(31,978KB)
190,336KB free
```



```
***  MO  ***   (MEMORY)                               '98- 1-29
                                                        22:13:27
path: /
!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
          Playback              (execute)
 !RW_0000.REC    28,164KB   97-12-10   22:21:48
1997-12-10 22:21:49        1997-12-10 22:24:49
start time: 000-00:00:20(1997-12-10 22:22:09)
  end time* 000-00:02:27(1997-12-10 22:24:16)
 playback mode:                          SINGLE
 speaker output:                            OFF
 monitor output channel1:                   OFF
 monitor output channel2:                   OFF
        !FA_0000.ARE      97-12-10      22:29:18
        !MW_0001.MEM      97-12-12      09:26:00
12 files(31,978KB)
190,336KB free
```

② Make "Playback mode" settings.

Function key display	Meaning
SINGLE	: Play back specified range once
REPEAT	: Play back specified range repeatedly
EXIT quit	: Return to file list screen

③ Set speaker output.

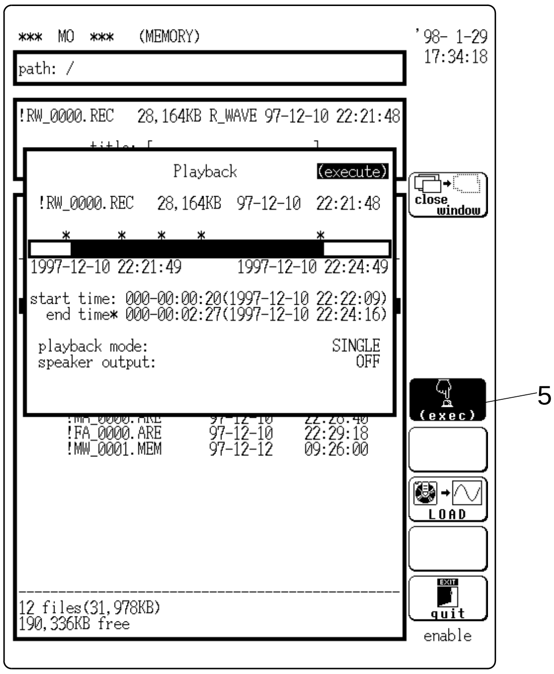
- Select the channel data which are to be output from the speaker.
- Channels for which a voice memo is recorded are marked with microphone.
- The volume can be set using the volume option under "SETUP" on the SYSTEM screen (☞ Section 11.4.9).

Function key display	Meaning
+	: Increase channel number
−	: Decrease channel number
EXIT quit	: Return to file list screen

④ Set monitor output (monitor output channel 1, 2)

- This option appears when the D/A output unit 9539 is installed.
- The maximum waveform output from the output channel is ±6.4 V.
- The setting determines whether the data are output from channel 1 or channel 2 of the D/A output unit.

Function key display	Meaning
+	: Increase channel number
−	: Decrease channel number
EXIT quit	: Return to the previous setting item



```
***  MO  ***   (MEMORY)                        '98- 1-29
                                                17:34:18
path: /
!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
                   Playback               (execute)
  !RW_0000.REC   28,164KB   97-12-10   22:21:48
      *      *    *    *              *
 1997-12-10 22:21:49          1997-12-10 22:24:49
start time: 000-00:00:20(1997-12-10 22:22:09)
  end time* 000-00:02:27(1997-12-10 22:24:16)

 playback mode:                             SINGLE
 speaker output:                               OFF

     !FA_0000.ARE        97-12-10     22:29:18
     !MW_0001.MEM        97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

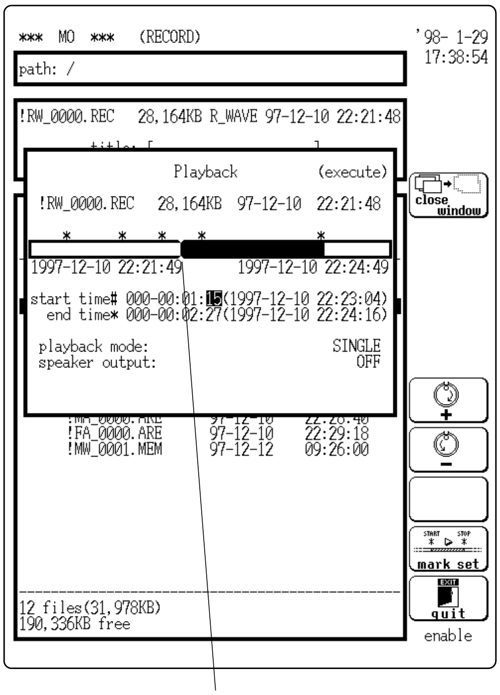
5. Move the flashing cursor to the **execute** position and press the F1 [exec] key.
   The voice is played back and then waveform is output from the D/A output unit without changing the screen.
6. When **playback mode** is set to **REPEAT**, press the STOP key when you wish to stop playback.

NOTE

When playing back waveform data as sound from the speaker, the waveform will not be recreated faithfully, due to limitations such as D/A resolution (8 bit), post- filtering (cutoff frequency   8 kHz, -48 dB/oct), and characteristics of the built-in power amplifier and speaker.

- Set the point to interrupt playback to start and stop times

Playback and the point to interrupt playback can be set to start and stop times.



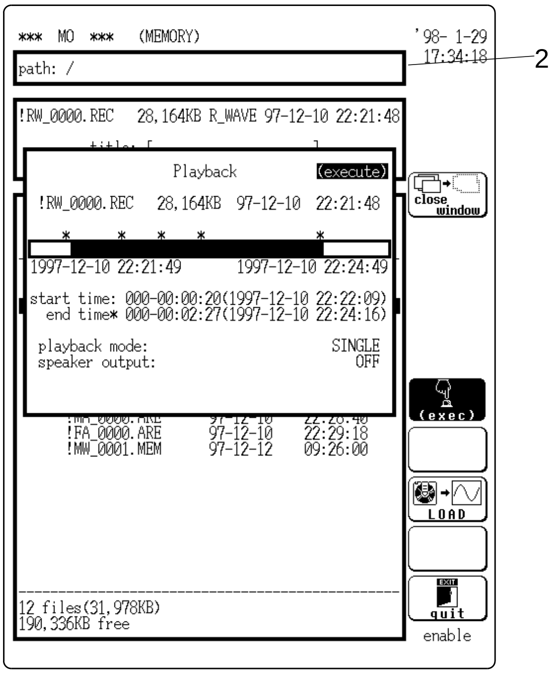
```
***  MO  ***   (RECORD)                        '98- 1-29
                                                17:38:54
path: /
!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
                   Playback               (execute)
  !RW_0000.REC   28,164KB   97-12-10   22:21:48
      *      *    *    *              *
 1997-12-10 22:21:49          1997-12-10 22:24:49
start time# 000-00:01:15(1997-12-10 22:23:04)
  end time* 000-00:02:27(1997-12-10 22:24:16)

 playback mode:                             SINGLE
 speaker output:                               OFF

     !FA_0000.ARE        97-12-10     22:29:18
     !MW_0001.MEM        97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

Point to interrupt playback

1. Follow the steps 1 to 4 in Section 13.6.2, "Playback of Stored Data."
2. Move the flashing cursor to the **execute** position and press the F1 [exec] key.
3. After playback has started, press the STOP key at a desired point to interrupt playback.
   A mark is placed at that point.
4. Move the flashing cursor to the start and stop time items.
5. Pressing the [to pause] key changes the start and stop time to the point to interrupt playback.

- Read data from playback screen
  - Select the point for reading data.
  - Set the point for reading data as start time.
  - Carry out playback. The data of point where playback is interrupted can be read.

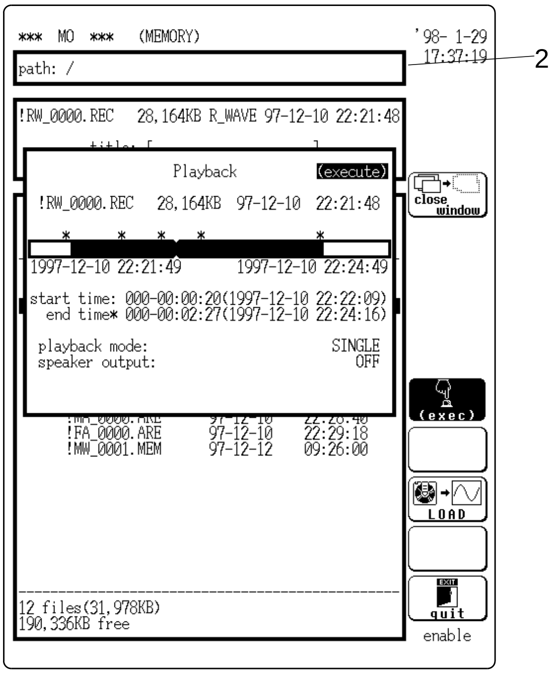
Method 1 Read data of point where start time is set ..



```
*** MO ***  (MEMORY)                          '98- 1-29
                                               17:34:18
path: /
!RW_0000.REC  28,164KB R_WAVE 97-12-10 22:21:48
            Playback                   (execute)
 !RW_0000.REC   28,164KB  97-12-10   22:21:48
1997-12-10 22:21:49         1997-12-10 22:24:49
start time: 000-00:00:20(1997-12-10 22:22:09)
  end time* 000-00:02:27(1997-12-10 22:24:16)
 playback mode:                          SINGLE
 speaker output:                            OFF
      !FA_0000.ARE     97-12-10     22:29:18
      !MW_0001.MEM     97-12-12     09:26:00
12 files(31,978KB)
190,336KB free
```

1. Follow the steps 1 to 4 in Section 13.6.2, "Playback of Stored Data." (The stop time setting is not necessary.)
2. Move the flashing cursor to the **execute** position and press the F3 [LOAD] key. The data of point as start time setting is read.

Method 2 Playback and read data point to interrupt playback.



```
*** MO ***  (MEMORY)                          '98- 1-29
                                               17:37:19
path: /
!RW_0000.REC  28,164KB R_WAVE 97-12-10 22:21:48
            Playback                   (execute)
 !RW_0000.REC   28,164KB  97-12-10   22:21:48
1997-12-10 22:21:49         1997-12-10 22:24:49
start time: 000-00:00:20(1997-12-10 22:22:09)
  end time* 000-00:02:27(1997-12-10 22:24:16)
 playback mode:                          SINGLE
 speaker output:                            OFF
      !FA_0000.ARE     97-12-10     22:29:18
      !MW_0001.MEM     97-12-12     09:26:00
12 files(31,978KB)
190,336KB free
```

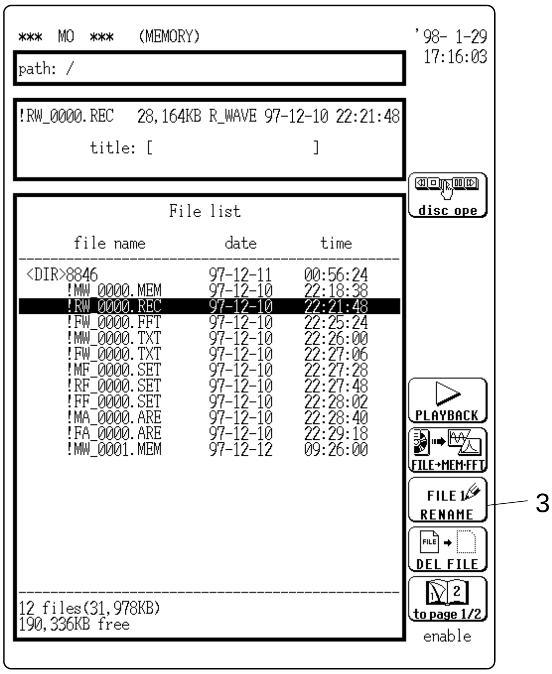
1. Follow the steps 1 to 4 in Section 13.6.2, "Playback of Stored Data."
2. Move the flashing cursor to the **execute** position and press the F1 [exec] key.
3. After playback has started, press the STOP key at a desired point to interrupt playback. A mark is placed at that point.
4. Move the flashing cursor to the **execute** position and press the F3 [LOAD] key.

13.7 Recording the Recorder Waveform Data Stored on MO in Memory Recorder Function/FFT Function

(FILEtoMEM/FFTT)

Recorder waveform data stored on MO disk (.REC file) are recorded using the memory recorder function or FFT function.

Method (MO→ Memory recorder function or FFT function)



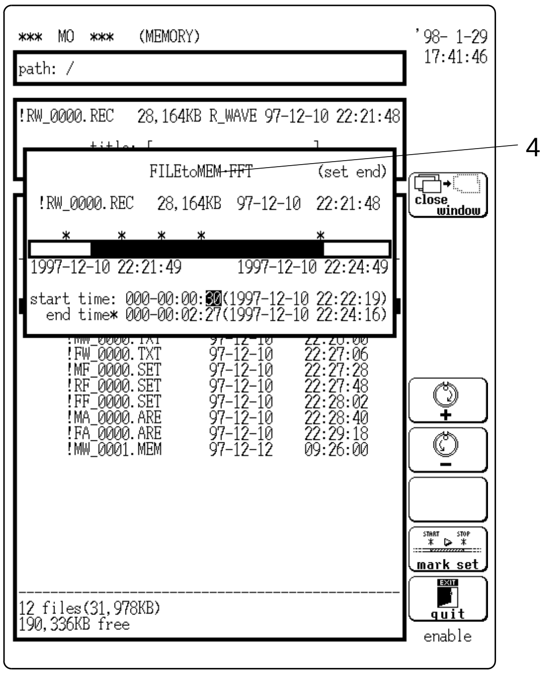
```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           17:16:03

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48
        title: [                    ]

                  File list
       file name          date        time
------------------------------------------------
 <DIR>8846               97-12-11    00:56:24
      !MW_0000.MEM       97-12-10    22:18:38
      !RW_0000.REC       97-12-10    22:21:48
      !FW_0000.FFT       97-12-10    22:25:24
      !MW_0000.TXT       97-12-10    22:26:00
      !FW_0000.TXT       97-12-10    22:27:06
      !MF_0000.SET       97-12-10    22:27:28
      !RF_0000.SET       97-12-10    22:27:48
      !FF_0000.SET       97-12-10    22:28:02
      !MA_0000.ARE       97-12-10    22:28:40
      !FA_0000.ARE       97-12-10    22:29:18
      !MW_0001.MEM       97-12-12    09:26:00
------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Insert a MO disk into the unit.
2. Press the FILE key.
3. Select ".REC " file item using the cursor keys, and press the F3 [FIILE → MEM・FFT] key (2/2).

・**2/2)**

Function key display	Meaning
PLAYBACK	Playback data (13.6.2)
FILE→MEM·FFT	Record a data stored on MO disk in memory recorder function or FFT function.
FILE RENAME	Change the file name (13.9)
DEL FILE	Delete the file (13.8)
to page 1/2	Switch to 1/2

4. Set on the FILEtoMEM・FFT command screen. Set the start time and stop time.



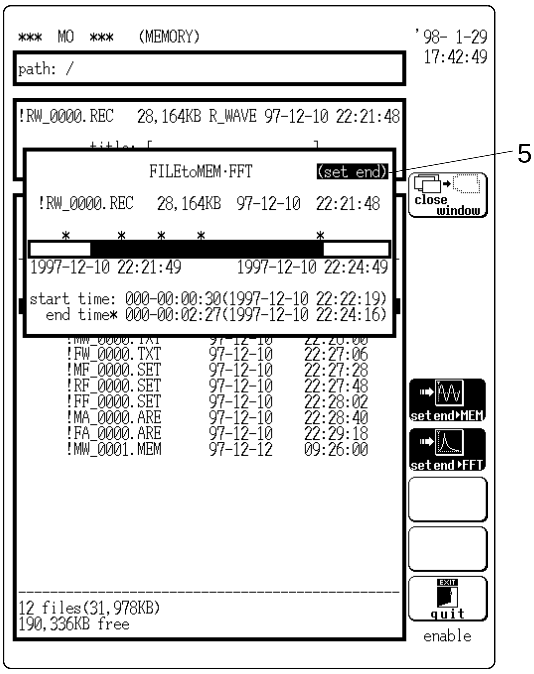
```
***  MO  ***   (MEMORY)                          '98- 1-29
path: /                                           17:41:46

!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48

          FILEtoMEM-FFT              (set end)
 !RW_0000.REC   28,164KB  97-12-10   22:21:48
    *      *    *    *             *
1997-12-10 22:21:49        1997-12-10 22:24:49
start time: 000-00:00:30(1997-12-10 22:22:19)
  end time* 000-00:02:27(1997-12-10 22:24:16)

      !FW_0000.TXT       97-12-10    22:27:06
      !MF_0000.SET       97-12-10    22:27:28
      !RF_0000.SET       97-12-10    22:27:48
      !FF_0000.SET       97-12-10    22:28:02
      !MA_0000.ARE       97-12-10    22:28:40
      !FA_0000.ARE       97-12-10    22:29:18
      !MW_0001.MEM       97-12-12    09:26:00
------------------------------------------------
12 files(31,978KB)
190,336KB free
```

Time setting

(Specify the start of the file as the time point 00:00:00.)

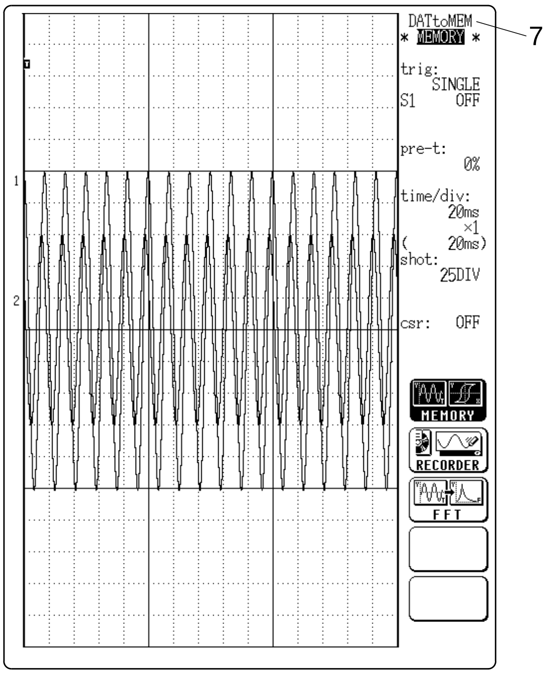
Move the flashing cursor to the start time or stop time item to set using the jog control or function keys.

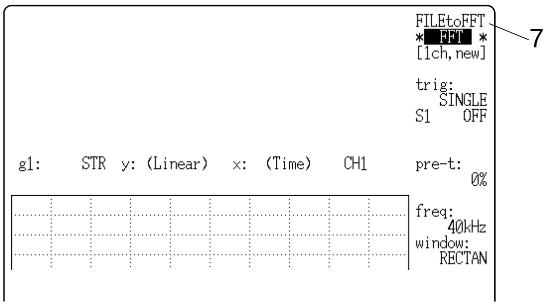
Function key display	Meaning
+	Increase the time
−	Decrease the time
mark set	Switch to the event mark setting
quit	Return to the file list screen



```
*** MO ***  (MEMORY)                                  '98- 1-29
                                                       17:42:49
path: /
!RW_0000.REC   28,164KB R_WAVE 97-12-10 22:21:48

            FILEtoMEM·FFT              (set end)
 !RW_0000.REC   28,164KB   97-12-10   22:21:48
 1997-12-10 22:21:49          1997-12-10 22:24:49
start time: 000-00:00:30(1997-12-10 22:22:19)
  end time* 000-00:02:27(1997-12-10 22:24:16)

 !FW_0000.TXT      97-12-10     22:27:06
 !MF_0000.SET      97-12-10     22:27:28
 !RF_0000.SET      97-12-10     22:27:48
 !FF_0000.SET      97-12-10     22:28:02
 !MA_0000.ARE      97-12-10     22:28:40
 !FA_0000.ARE      97-12-10     22:29:18
 !MW_0001.MEM      97-12-12     09:26:00

12 files(31,978KB)
190,336KB free
```

6





Event mark setting

Set the time where an event mark (*) was placed during recording. (See Section 13.5.2)

- "Start time" and "Stop time" use the time where an event mark was placed.
- Press the "Start time" or "Stop time" function key to activate the respective input mode, select the event mark with the jog control or CURSOR keys, and enter the time by pressing F3 [set].

Function key display	Meaning
start time	: Enter the start time input mode
end time	: Enter the stop time input mode
set	: "Start time" and "Stop time" use the time where an event mark was placed.
quit	: Switch to the time setting

NOTE

An asterisk to the left of the "Start time" or "Stop time" indicates that the actual time point is specified to a higher resolution (ms, μs) than the displayed value.

5. Select the function to be recorded. Move the flashing cursor to the **set end** item and press the F1 [set end → MEM] [set end → FFT] key to enter the specified function.
6. Press the START key to start measurement. Data are read from MO and recorded by the specified function.
7. To release the FILEtoMEM/FFT function, move the flashing cursor to the **FILEtoMEM** or **FILEtoFFT** and then press the F1 [OFF] key.

NOTE

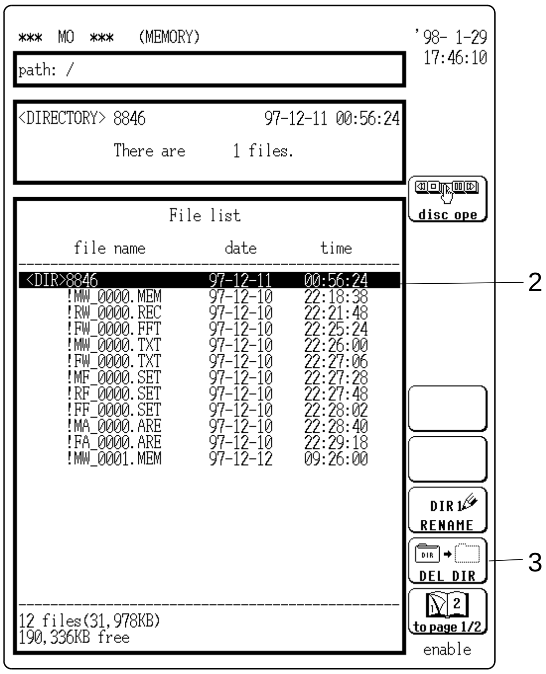
- The sampling cycle for the memory recorder function becomes the same as for the data recorded on MO. (Time axis setting is not possible.)
- The frequency range in FFT function corresponds with the time axis range of data recorded on MO. (Section 8.2.3, "Setting the Frequency Range")
- When using the FILE to MEM/FFT function, operation is always "Continuous", also when the trigger is set to "Auto".

13.8 Deleting Stored Data (directory and file deleting)

- This function erases all file data stored on a MO disk.
- Deleting a directory deletes the directory and all files that it contains.
- Deleting a file deletes only the data of the specified file.

• Deleting a directory

Method (MO screen)



```
***  MO  ***   (MEMORY)                      '98- 1-29
                                              17:46:10
path: /

<DIRECTORY> 8846             97-12-11 00:56:24
          There are      1 files.

                 File list
      file name          date        time
-----------------------------------------------
<DIR>8846               97-12-11    00:56:24
      !MW_0000.MEM      97-12-10    22:18:38
      !RW_0000.REC      97-12-10    22:21:48
      !FW_0000.FFT      97-12-10    22:25:24
      !MW_0000.TXT      97-12-10    22:26:00
      !FW_0000.TXT      97-12-10    22:27:06
      !MF_0000.SET      97-12-10    22:27:28
      !RF_0000.SET      97-12-10    22:27:48
      !FF_0000.SET      97-12-10    22:28:02
      !MA_0000.ARE      97-12-10    22:28:40
      !FA_0000.ARE      97-12-10    22:29:18
      !MW_0001.MEM      97-12-12    09:26:00
-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list..
2. Move the flashing cursor to the DIR directory to be deleted.
3. Call up screen 2/2 with the function keys, and then press the F4 [DEL DIR] key.

・2/2

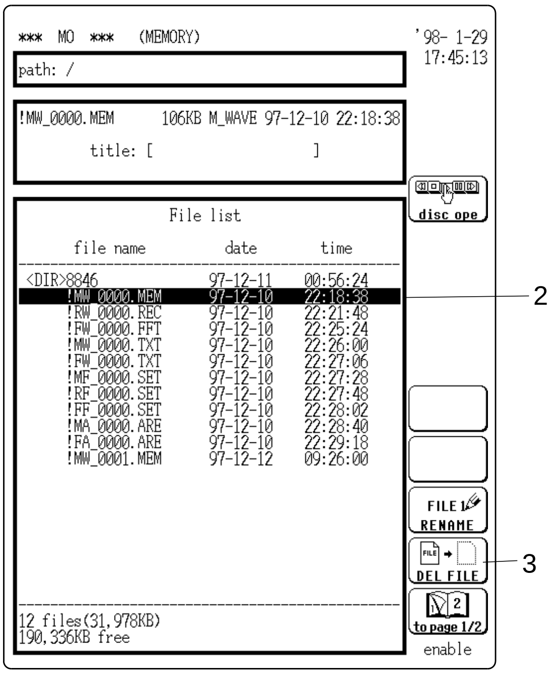
Function key display	Meaning
DIR RENAME	: Change the file name (13.9)
DEL DIR	: Delete the directory
to page 1/2	: Switch to 1/2

4. Press the F1 [exec] key. Press this key again to delete a directory and all files which belongs to the directory.

NOTE If the directory contains a large number of files, deletion may take some time (about 12 minutes for 1000 files).

• Deleting a file

Method (MO screen)



```
***  MO  ***   (MEMORY)                           '98- 1-29
                                                   17:45:13
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title: [                    ]

                   File list
      file name             date        time
--------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
       !MW_0000.MEM       97-12-10    22:18:38
       !RW_0000.REC       97-12-10    22:21:48
       !FW_0000.FFT       97-12-10    22:25:24
       !MW_0000.TXT       97-12-10    22:26:00
       !FW_0000.TXT       97-12-10    22:27:06
       !MF_0000.SET       97-12-10    22:27:28
       !RF_0000.SET       97-12-10    22:27:48
       !FF_0000.SET       97-12-10    22:28:02
       !MA_0000.ARE       97-12-10    22:28:40
       !FA_0000.ARE       97-12-10    22:29:18
       !MW_0001.MEM       97-12-12    09:26:00
--------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Move the flashing cursor to the file to be deleted.
3. Call up screen 2/2 with the function keys, and then press the F4 [DEL FILE] key.

・**2/2 (or 2/3)**

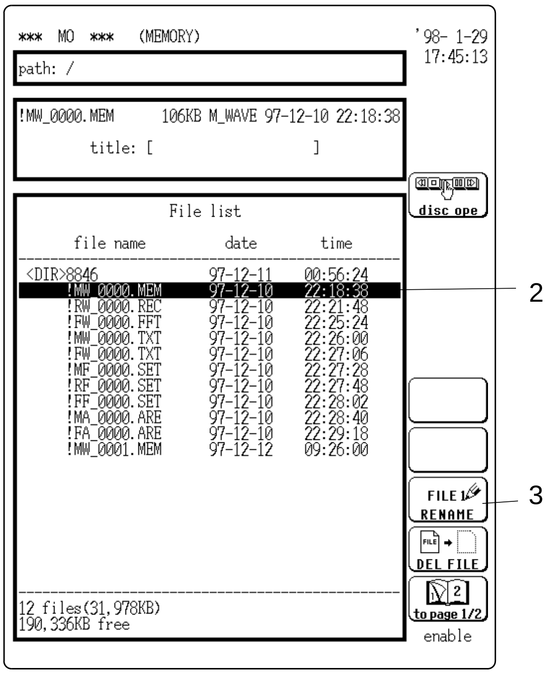
Function key display	Meaning
FILE RENAME	: Change the file name (13.9)
FILE DEL FILE	: Delete the file
1 2 to page 1/2	: Switch to 1/2

4. Press the F1 [exec] key. Press this key again to delete a file.

13.9 Renaming File (file name and directory name)

Renames the directory name and file name.

Method (MO screen)



```
*** MO *** (MEMORY)                                '98- 1-29
path: /                                             17:45:13

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38
       title: [                    ]

                    File list
     file name         date       time
-------------------------------------------------
 <DIR>8846          97-12-11    00:56:24
      !MW_0000.MEM  97-12-10    22:18:38
      !RW_0000.REC  97-12-10    22:21:48
      !FW_0000.FFT  97-12-10    22:25:24
      !MW_0000.TXT  97-12-10    22:26:00
      !FW_0000.TXT  97-12-10    22:27:06
      !MF_0000.SET  97-12-10    22:27:28
      !RF_0000.SET  97-12-10    22:27:48
      !FF_0000.SET  97-12-10    22:28:02
      !MA_0000.ARE  97-12-10    22:28:40
      !FA_0000.ARE  97-12-10    22:29:18
      !MW_0001.MEM  97-12-12    09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Display the file list on the MO screen.
2. Move the flashing cursor to the directory or file to rename.
3. Press the F3 [RENAME] key on the function indication 2/2.

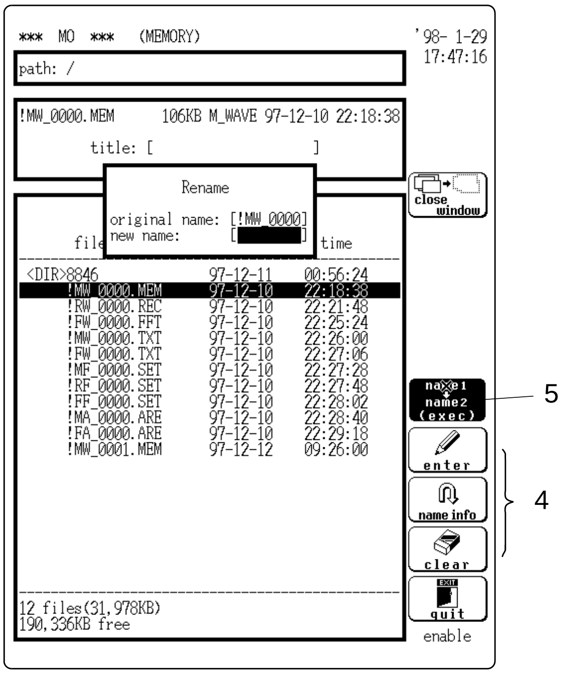
When the flashing cursor is on the directory name.

Function key display	Meaning
DIR RENAME	: Rename the directory name
DEL DIR	: Delete the directory (13.8)
to page 1/2	: Switch to 1/2

When the flashing cursor is on the file name.

・**2/2**

Function key display	Meaning
FILE RENAME	: Rename the file
DEL FILE	: Delete the file (13.8)
to page 1/2	: Switch to 1/2



```
*** MO *** (MEMORY)                                '98- 1-29
path: /                                             17:47:16

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38
       title: [                    ]

                 Rename
         original name: [!MW_0000]
         new name:      [        ]
     fil                                  time
-------------------------------------------------
 <DIR>8846          97-12-11    00:56:24
      !MW_0000.MEM  97-12-10    22:18:38
      !RW_0000.REC  97-12-10    22:21:48
      !FW_0000.FFT  97-12-10    22:25:24
      !MW_0000.TXT  97-12-10    22:26:00
      !FW_0000.TXT  97-12-10    22:27:06
      !MF_0000.SET  97-12-10    22:27:28
      !RF_0000.SET  97-12-10    22:27:48
      !FF_0000.SET  97-12-10    22:28:02
      !MA_0000.ARE  97-12-10    22:28:40
      !FA_0000.ARE  97-12-10    22:29:18
      !MW_0001.MEM  97-12-12    09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

4. Press F2 [enter] key to input a new file name. (See Section 11.6.1, "Comment and File Name Entry Procedure")

Function key display	Meaning
name1 name2 (exec)	: Rename the file or directory
enter	: Enter character input mode
name info	: Recall up to the last ten file names confirmed or deleted.
clear	: Delete characters
quit	: Returns to file list screen

5. Press F1 [exec] key to rename the directory or file.

13.10 Operating the Disk/ Deleting the Window (HELP key)

Disk operation

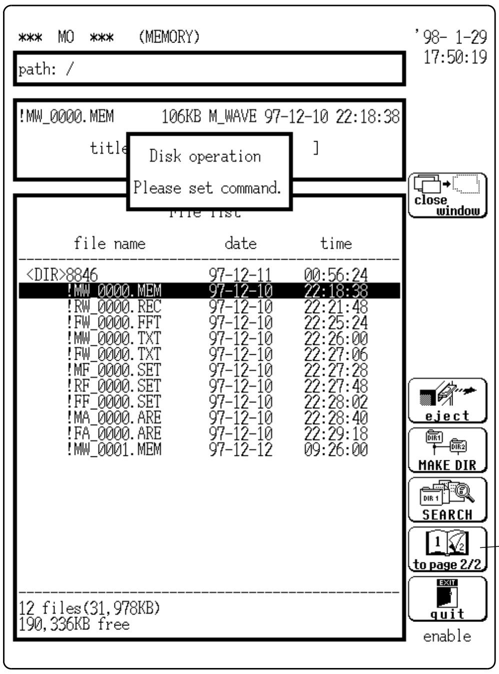
Formats the MO disk, makes a directory, and searches and sorts files.

Deleting windows

It is possible to delete all windows opened in the file list display in a single operation.

• Disk operation

Method (MO screen)



```
***  MO  ***   (MEMORY)                                  '98- 1-29
                                                          17:50:19
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title [                         ]

                 Disk operation
                 Please set command.

                    File list
       file name            date          time
-----------------------------------------------------
 <DIR>8846                97-12-11      00:56:24
      !MW_0000.MEM        97-12-10      22:18:38
      !RW_0000.REC        97-12-10      22:21:48
      !FW_0000.FFT        97-12-10      22:25:24
      !MW_0000.TXT        97-12-10      22:26:00
      !FW_0000.TXT        97-12-10      22:27:06
      !MF_0000.SET        97-12-10      22:27:28
      !RF_0000.SET        97-12-10      22:27:48
      !FF_0000.SET        97-12-10      22:28:02
      !MA_0000.ARE        97-12-10      22:28:40
      !FA_0000.ARE        97-12-10      22:29:18
      !MW_0001.MEM        97-12-12      09:26:00
-----------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key.

・**1/2**

Function key display	Meaning
eject	: Eject a disk (13.3)
MAKE DIR	: Make a directory (13.10.1)
SEARCH	: Search data (13.10.2)
to page 2/2	: Switch to 2/2
EXIT quit	: Return to the file list screen

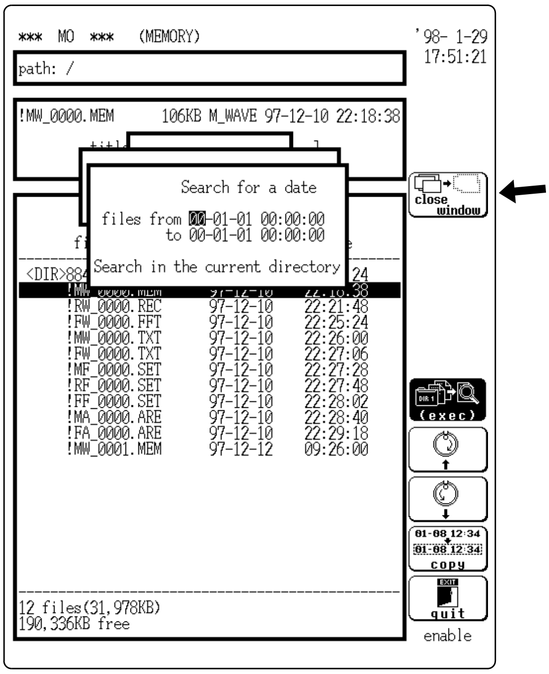
・**2/2**

Function key display	Meaning
SORT	: Sort a file (13.10.3)
FORMAT	: Format a file (13.10.4)
FORMAT(phy)	: Format a MO disk physically (13.10.5)
to page 1/2	: Switch to 1/2
EXIT quit	: Return to the file list screen

3. Select the each item.

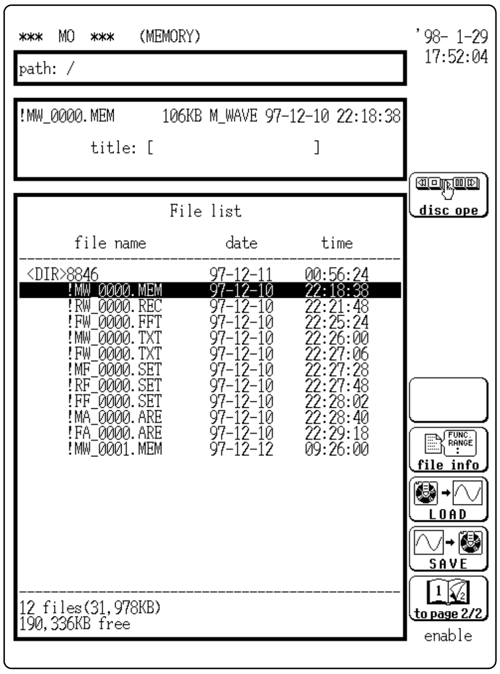
• Deleting a window

When a window is open in the file list display, press the HELP [close windows] key to delete all the windows in a single operation.



```
*** MO *** (MEMORY)                           '98- 1-29
                                                17:51:21
path: /

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38

            Search for a date

  files from 00-01-01 00:00:00
          to 00-01-01 00:00:00

Search in the current directory
<DIR>884                                   24
      !RW_0000.REC     97-12-10      22:21:48
      !FW_0000.FFT     97-12-10      22:25:24
      !MW_0000.TXT     97-12-10      22:26:00
      !FW_0000.TXT     97-12-10      22:27:06
      !MF_0000.SET     97-12-10      22:27:28
      !RF_0000.SET     97-12-10      22:27:48
      !FF_0000.SET     97-12-10      22:28:02
      !MA_0000.ARE     97-12-10      22:28:40
      !FA_0000.ARE     97-12-10      22:29:18
      !MW_0001.MEM     97-12-12      09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

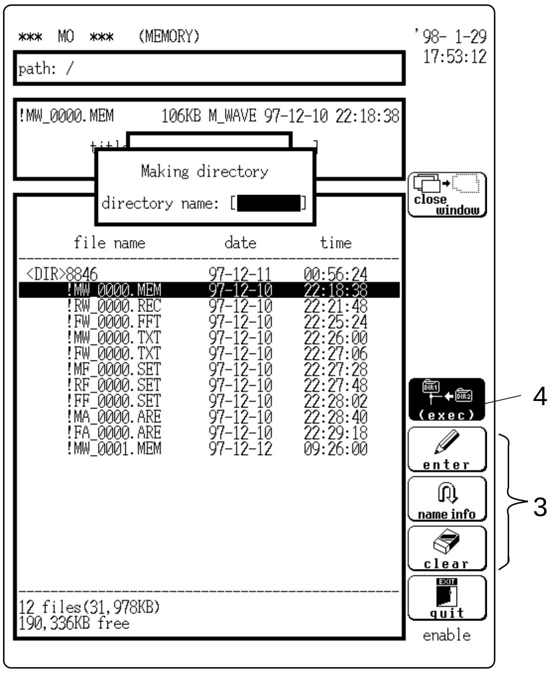
Deletes all the windows in a single operation



```
*** MO *** (MEMORY)                           '98- 1-29
                                                17:52:04
path: /

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38

        title: [                      ]

                  File list

      file name           date         time
-------------------------------------------------
<DIR>8846              97-12-11      00:56:24
      !MW_0000.MEM     97-12-10      22:18:38
      !RW_0000.REC     97-12-10      22:21:48
      !FW_0000.FFT     97-12-10      22:25:24
      !MW_0000.TXT     97-12-10      22:26:00
      !FW_0000.TXT     97-12-10      22:27:06
      !MF_0000.SET     97-12-10      22:27:28
      !RF_0000.SET     97-12-10      22:27:48
      !FF_0000.SET     97-12-10      22:28:02
      !MA_0000.ARE     97-12-10      22:28:40
      !FA_0000.ARE     97-12-10      22:29:18
      !MW_0001.MEM     97-12-12      09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

13.10.1 Creating a Directory

Method (MO screen)



```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  17:53:12
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

        Making directory
   directory name: [        ]

      file name            date          time
-------------------------------------------------
 <DIR>8846               97-12-11      00:56:24
       !MW_0000.MEM      97-12-10      22:18:38
       !RW_0000.REC      97-12-10      22:21:48
       !FW_0000.FFT      97-12-10      22:25:24
       !MW_0000.TXT      97-12-10      22:26:00
       !FW_0000.TXT      97-12-10      22:27:06
       !MF_0000.SET      97-12-10      22:27:28
       !RF_0000.SET      97-12-10      22:27:48
       !FF_0000.SET      97-12-10      22:28:02
       !MA_0000.ARE      97-12-10      22:28:40
       !FA_0000.ARE      97-12-10      22:29:18
       !MW_0001.MEM      97-12-12      09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key and then press the F2 [MAKE DIR] key.

・**1/2**

Function key display		Meaning
eject	:	Eject a disk
MAKE DIR	:	Make a directory
SEARCH	:	Search a file (13.10.2)
to page 2/2	:	Switch to 2/2
quit	:	Return to the file list screen

3. Input the directory name. (☞ Section 11.6.1) Upto 8 characters can be input.

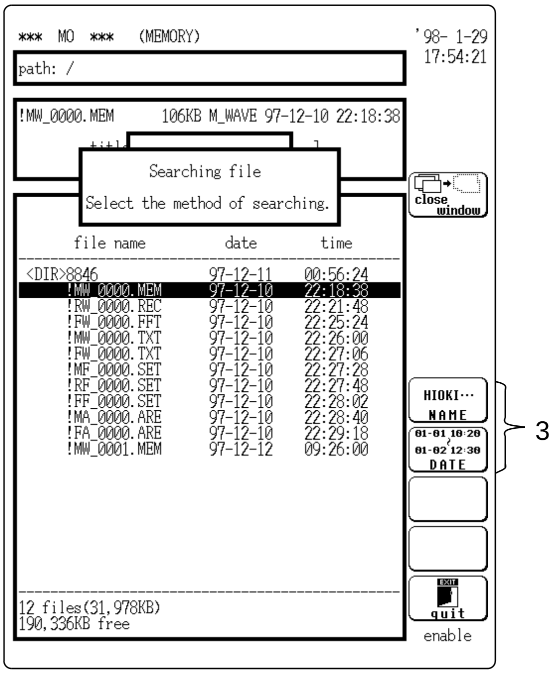
Function key display		Meaning
(exec)	:	Make a directory
enter	:	Enter character input mode
name info	:	Recall up to the last ten file names confirmed or deleted.
clear	:	Delete a file name
quit	:	Return to the previous setting item

4. Press the F1 [exec] key.

13.10.2 Searching file

Searches directory or file.

Method (MO screen)



```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  17:54:21
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

            Searching file
     Select the method of searching.

      file name          date          time
------------------------------------------------
 <DIR>8846              97-12-11      00:56:24
      !MW_0000.MEM      97-12-10      22:18:38
      !RW_0000.REC      97-12-10      22:21:48
      !FW_0000.FFT      97-12-10      22:25:24
      !MW_0000.TXT      97-12-10      22:26:00
      !FW_0000.TXT      97-12-10      22:27:06
      !MF_0000.SET      97-12-10      22:27:28
      !RF_0000.SET      97-12-10      22:27:48
      !FF_0000.SET      97-12-10      22:28:02
      !MA_0000.ARE      97-12-10      22:28:40
      !FA_0000.ARE      97-12-10      22:29:18
      !MW_0001.MEM      97-12-12      09:26:00
------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key and then press the F3 [SEARCH] key on the function indication.

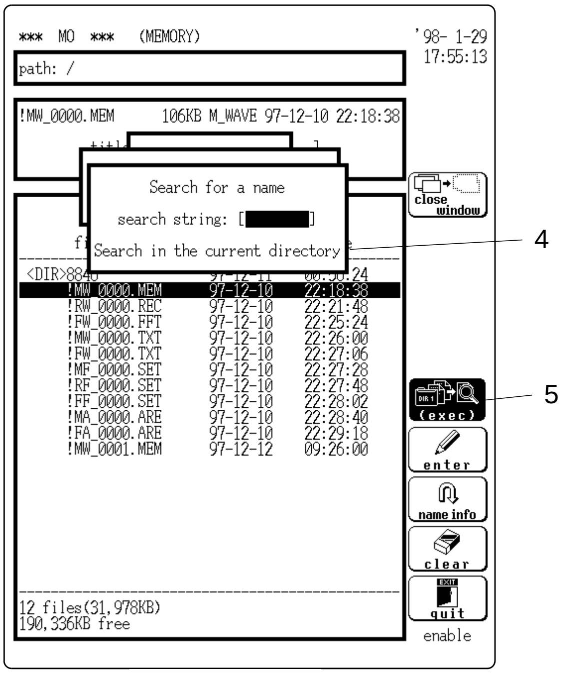
・**1/2**

Function key display	Meaning
eject	: Eject a disk
MAKE DIR	: Make a directory (13.10.1)
SEARCH	: Search data
to page 2/2	: Switch to 2/2
quit	: Return to the file list screen

3. Select the method of searching

Function key display	Meaning
NAME	: Search directory or file name
DATE	: Search for a file creation date
quit	: Return to the previous setting item

When searching for a name



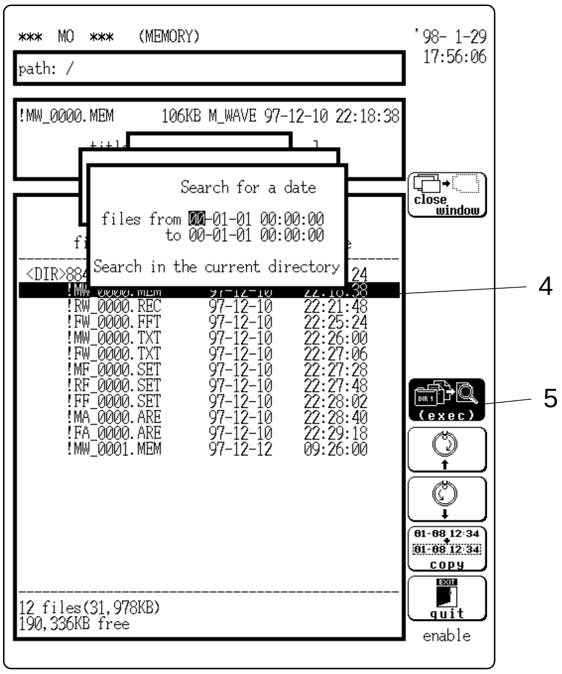
```
***  MO  ***   (MEMORY)                          '98- 1-29
                                                  17:55:13
path: /

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

            Search for a name
       search string: [        ]
     Search in the current directory
------------------------------------------------
 <DIR>8846              97-12-11      00:56:24
      !MW_0000.MEM      97-12-10      22:18:38
      !RW_0000.REC      97-12-10      22:21:48
      !FW_0000.FFT      97-12-10      22:25:24
      !MW_0000.TXT      97-12-10      22:26:00
      !FW_0000.TXT      97-12-10      22:27:06
      !MF_0000.SET      97-12-10      22:27:28
      !RF_0000.SET      97-12-10      22:27:48
      !FF_0000.SET      97-12-10      22:28:02
      !MA_0000.ARE      97-12-10      22:28:40
      !FA_0000.ARE      97-12-10      22:29:18
      !MW_0001.MEM      97-12-12      09:26:00
------------------------------------------------
12 files(31,978KB)
190,336KB free
```

① When the [NAME] is selected:

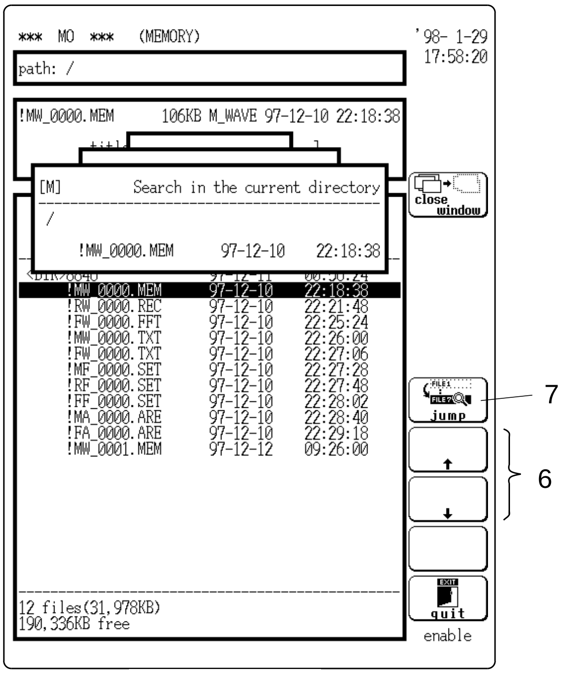
- Press the F2 [enter] key to input the character to search. (☞ Section 11.6.1)
- Up to 8 characters can be used.

Function key display	Meaning
(exec)	: Search a file.
enter	: Enter character input mode
name info	: Recall up to the last ten file names confirmed or deleted.
clear	: Delete the input character
quit	: Return to the previous setting

When searching for a date



```
***  MO  ***   (MEMORY)                    '98- 1-29
                                            17:56:06
path: /
!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
              Search for a date
   files from 00-01-01 00:00:00
           to 00-01-01 00:00:00
  Search in the current directory
        !RW_0000.REC    97-12-10    22:21:48
        !FW_0000.FFT    97-12-10    22:25:24
        !MW_0000.TXT    97-12-10    22:26:00
        !FW_0000.TXT    97-12-10    22:27:06
        !MF_0000.SET    97-12-10    22:27:28
        !RF_0000.SET    97-12-10    22:27:48
        !FF_0000.SET    97-12-10    22:28:02
        !MA_0000.ARE    97-12-10    22:28:40
        !FA_0000.ARE    97-12-10    22:29:18
        !MW_0001.MEM    97-12-12    09:26:00

12 files(31,978KB)
190,336KB free
```



```
***  MO  ***   (MEMORY)                    '98- 1-29
                                            17:58:20
path: /
!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
[M]         Search in the current directory
 /
     !MW_0000.MEM      97-12-10     22:18:38
        !MW_0000.MEM    97-12-10    22:18:38
        !RW_0000.REC    97-12-10    22:21:48
        !FW_0000.FFT    97-12-10    22:25:24
        !MW_0000.TXT    97-12-10    22:26:00
        !FW_0000.TXT    97-12-10    22:27:06
        !MF_0000.SET    97-12-10    22:27:28
        !RF_0000.SET    97-12-10    22:27:48
        !FF_0000.SET    97-12-10    22:28:02
        !MA_0000.ARE    97-12-10    22:28:40
        !FA_0000.ARE    97-12-10    22:29:18
        !MW_0001.MEM    97-12-12    09:26:00

12 files(31,978KB)
190,336KB free
```

② When [DATE] is selected:
Specify the date and time when the directory or file is made.
Move the flashing cursor and set.

Function key display	Meaning
exec	: Search a file.
↑	: Increase the numerical value.
↓	: Decrease the numerical value.
copy	: Copy the date and time where the flashing cursor is not present.
quit	: Return to the previous setting item.

NOTE

Enter the older date and time values above and the newer values below.
If the order is reversed, both upper and lower items will be set to the new date and time.

4. Select the range to search.
   Move the flashing cursor to select.

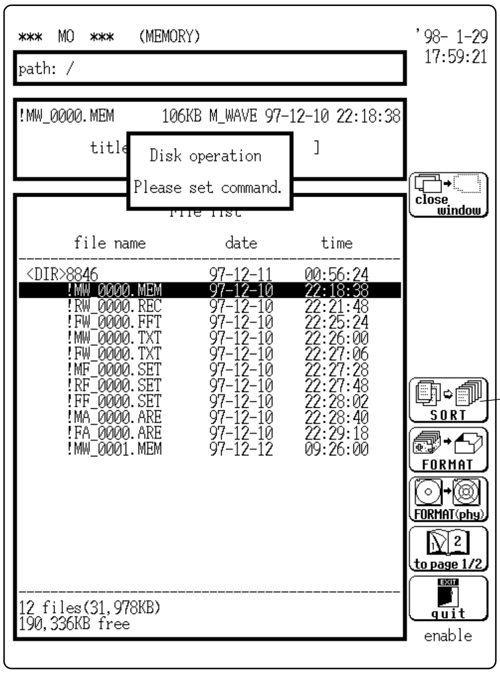
Function key display	Meaning
exec	: Search a file.
CURRENT DIR	: Search in the currently displayed directory.
+SUBDIR	: Search in the currently displayed directory and recursively in all subdirectories.

5. Pressing the F1 [exec] key carries out the search, and displays, starting from the older files.
6. Pressing the F2 [↑] or F3 [↓] key displays the files found by the search in order.
7. Pressing the F1 [jump] key moves the flashing cursor to the displaying file.
8. To stop searching file, press the **STOP** key.

13.10.3 Sorting files

This sorts the files in a directory according to their type.

Method (MO screen)



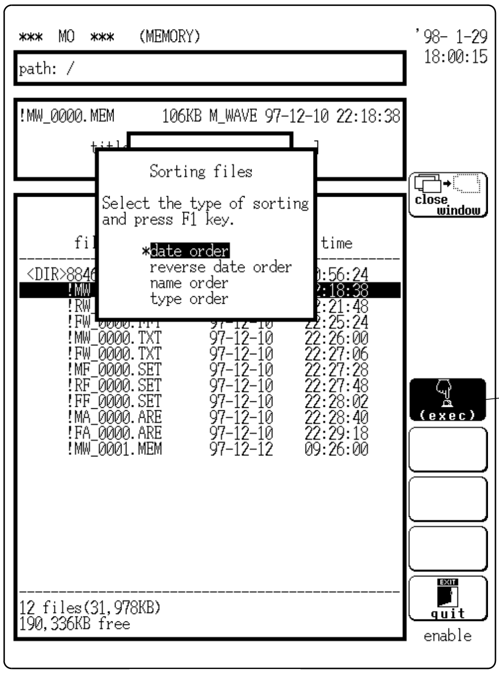
```
***  MO  ***   (MEMORY)                                   '98- 1-29
path: /                                                   17:59:21

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title[ Disk operation  ]
              Please set command.

      file name             date        time
-------------------------------------------------
 <DIR>8846                97-12-11    00:56:24
      !MW_0000.MEM        97-12-10    22:18:38
      !RW_0000.REC        97-12-10    22:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key.
3. Call up screen 2/2 with the function keys, and then press the F1 [SORT] key.

・**2/2**

Function key display		Meaning
SORT	:	Sort a file
FORMAT	:	Format a file (13.10.4)
FORMAT(phy)	:	Format a MO disk physically (13.10.5)
to page 1/2	:	Switch to 1/2
EXIT quit	:	Return to the file list screen

4. Select the type of sorting using the cursor keys. Pressing the F1 [exec] key sorts the files.

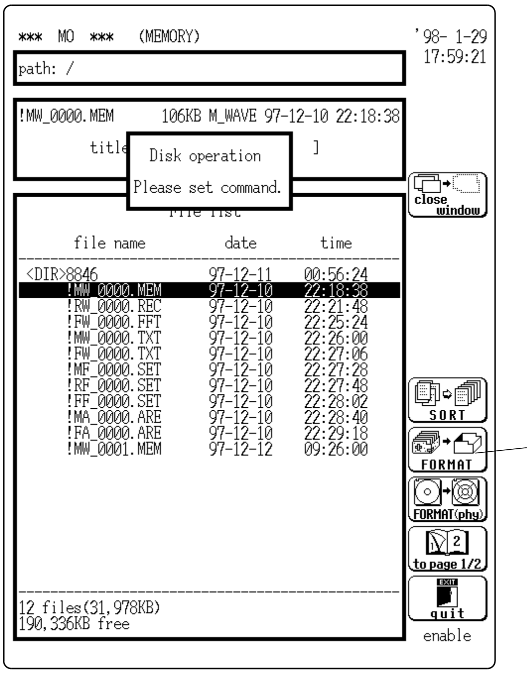


```
***  MO  ***   (MEMORY)                                   '98- 1-29
path: /                                                   18:00:15

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38

          Sorting files

     Select the type of sorting
     and press F1 key.

          *date order
           reverse date order
           name order
           type order

 <DIR>8846                                    0:56:24
      !MW                                     2:18:38
      !RW                                     2:21:48
      !FW_0000.FFT        97-12-10    22:25:24
      !MW_0000.TXT        97-12-10    22:26:00
      !FW_0000.TXT        97-12-10    22:27:06
      !MF_0000.SET        97-12-10    22:27:28
      !RF_0000.SET        97-12-10    22:27:48
      !FF_0000.SET        97-12-10    22:28:02
      !MA_0000.ARE        97-12-10    22:28:40
      !FA_0000.ARE        97-12-10    22:29:18
      !MW_0001.MEM        97-12-12    09:26:00
-------------------------------------------------
12 files(31,978KB)
190,336KB free
```

13.10.4 Formatting a MO Disk

Delete all file data and reformat a MO disk.
Before recording data with the 8846, always format a MO disk.

Method (MO screen)



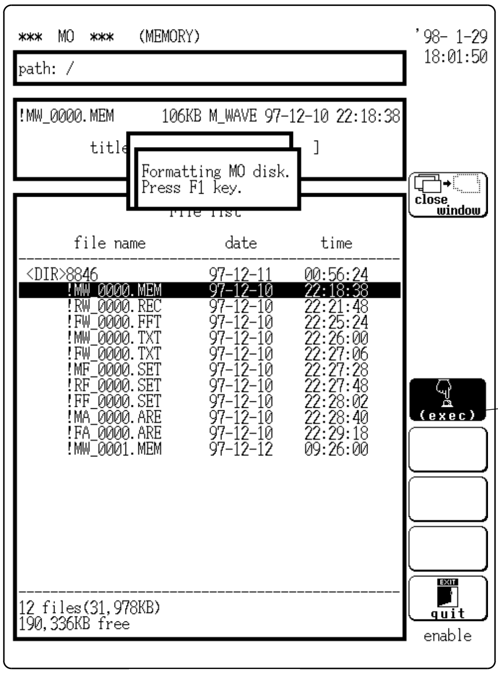
```
***  MO  ***   (MEMORY)                       '98- 1-29
path: /                                        17:59:21

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38
       title   Disk operation     ]
               Please set command.
                 File list
      file name            date         time
-----------------------------------------------
<DIR>8846               97-12-11     00:56:24
       !MW_0000.MEM     97-12-10     22:18:38
       !RW_0000.REC     97-12-10     22:21:48
       !FW_0000.FFT     97-12-10     22:25:24
       !MW_0000.TXT     97-12-10     22:26:00
       !FW_0000.TXT     97-12-10     22:27:06
       !MF_0000.SET     97-12-10     22:27:28
       !RF_0000.SET     97-12-10     22:27:48
       !FF_0000.SET     97-12-10     22:28:02
       !MA_0000.ARE     97-12-10     22:28:40
       !FA_0000.ARE     97-12-10     22:29:18
       !MW_0001.MEM     97-12-12     09:26:00
-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key.
3. Call up screen 2/2 with the function keys, and then press the F2 [FORMAT] key.

・**2/2**

Function key display	Meaning
SORT	: Sort file (13.10.3)
FORMAT	: Format a MO disk
FORMAT(phy)	: Format a MO disk physically
to page 1/2	: Switch to 1/2
EXIT quit	: Return to file list screen.

4. Press the F1 [exec] key. Pressing this key again formats a disk.



```
***  MO  ***   (MEMORY)                       '98- 1-29
path: /                                        18:01:50

!MW_0000.MEM     106KB M_WAVE 97-12-10 22:18:38
       title                      ]
            Formatting MO disk.
            Press F1 key.
                 File list
      file name            date         time
-----------------------------------------------
<DIR>8846               97-12-11     00:56:24
       !MW_0000.MEM     97-12-10     22:18:38
       !RW_0000.REC     97-12-10     22:21:48
       !FW_0000.FFT     97-12-10     22:25:24
       !MW_0000.TXT     97-12-10     22:26:00
       !FW_0000.TXT     97-12-10     22:27:06
       !MF_0000.SET     97-12-10     22:27:28
       !RF_0000.SET     97-12-10     22:27:48
       !FF_0000.SET     97-12-10     22:28:02
       !MA_0000.ARE     97-12-10     22:28:40
       !FA_0000.ARE     97-12-10     22:29:18
       !MW_0001.MEM     97-12-12     09:26:00
-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

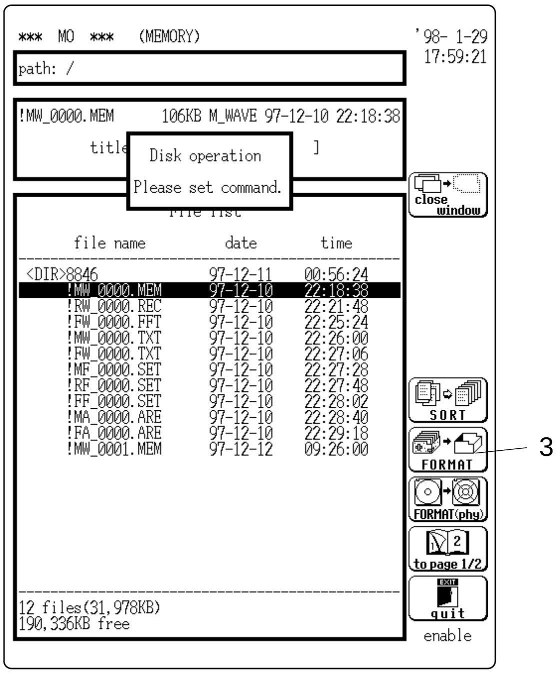
NOTE

The format on this unit complies with "Super Floppy Format".

13.10.5 Formatting a MO Disk Physically (Physical Format)

Format a disk which cannot be read by the 8846.
Under normal circumstances, do not physically format a MO disk.

Method (MO screen)



```
*** MO ***  (MEMORY)                              '98- 1-29
path: /                                            17:59:21

!MW_0000.MEM      106KB M_WAVE 97-12-10 22:18:38
        title     Disk operation          ]
                  Please set command.
                  File list
      file name          date        time
-----------------------------------------------
 <DIR>8846              97-12-11    00:56:24
     !MW_0000.MEM       97-12-10    22:18:38
     !RW_0000.REC       97-12-10    22:21:48
     !FW_0000.FFT       97-12-10    22:25:24
     !MW_0000.TXT       97-12-10    22:26:00
     !FW_0000.TXT       97-12-10    22:27:06
     !MF_0000.SET       97-12-10    22:27:28
     !RF_0000.SET       97-12-10    22:27:48
     !FF_0000.SET       97-12-10    22:28:02
     !MA_0000.ARE       97-12-10    22:28:40
     !FA_0000.ARE       97-12-10    22:29:18
     !MW_0001.MEM       97-12-12    09:26:00

-----------------------------------------------
12 files(31,978KB)
190,336KB free
```

1. Press the FILE key to display the file list.
2. Press the HELP [disk ope] key.
3. Call up screen 2/2 with the function keys, and then press the F2 [FORMAT (phy)] key.

・**2/2**

Function key display	Meaning
SORT	: Sort file (13.10.3)
FORMAT	: Format a MO disk (13.10.4)
FORMAT(phy)	: Format a MO disk physically
to page 1/2	: Switch to 1/2
EXIT quit	: Return to file list screen.

4. Press the F1 [exec] key. Pressing this key again formats a disk.

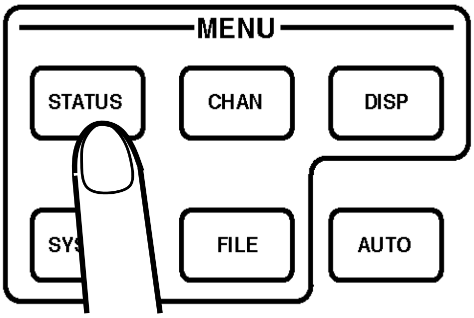
Chapter 14
Calculating Waveform Data

14.1 Overview

- Waveform processing is possible only for the memory recorder function.
- The following operators can be used to define processing equations.
  - Arithmetic operators (+, -, *, /)
  - Absolute value (ABS)
  - Exponent (EXP)
  - Logarithm (LOG)
  - Square root (SQR)
  - Displacement average (MOV)
  - Parallel displacement on time axis (SLI)
  - 1st and 2nd differential (DIF, DIF2)
  - 1st and 2nd integral (INT, INT2)
  - Trigonometric functions (SIN, COS, TAN)
  - Reverse trigonometric functions (ASIN, ACOS, ATAN)
- Processing results are displayed as a waveform.
- Vertical display scale can be set manually or automatically.

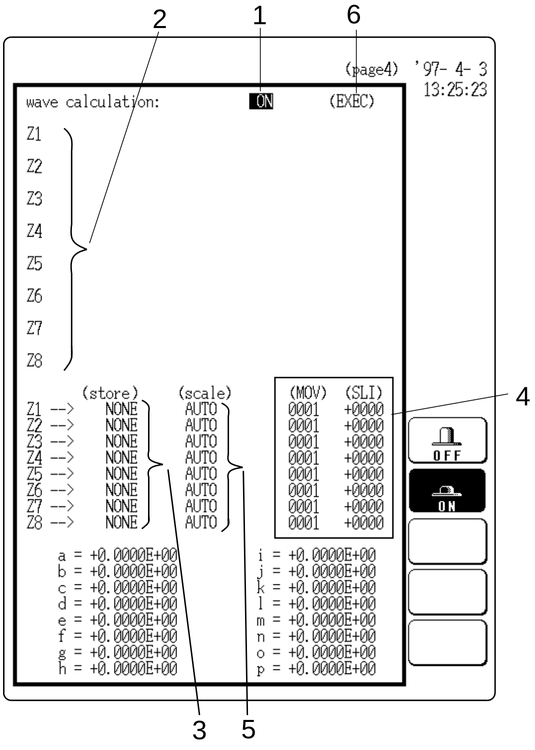
14.2 Preparing for Waveform Processing

- The settings are available on the STATUS screen (page 4), only when using the memory recorder function.
- Press the STATUS key to call up the STATUS screen (page 4).



Press STATUS key to call up STATUS screen

Method Screen: STATUS (page 4)



```
                                   (page4)  '97- 4- 3
                                              13:25:23
wave calculation:          ON       (EXEC)
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
          (store)      (scale)      (MOV)   (SLI)
Z1 -->      NONE        AUTO         0001    +0000
Z2 -->      NONE        AUTO         0001    +0000
Z3 -->      NONE        AUTO         0001    +0000
Z4 -->      NONE        AUTO         0001    +0000
Z5 -->      NONE        AUTO         0001    +0000
Z6 -->      NONE        AUTO         0001    +0000
Z7 -->      NONE        AUTO         0001    +0000
Z8 -->      NONE        AUTO         0001    +0000
    a = +0.0000E+00          i = +0.0000E+00
    b = +0.0000E+00          j = +0.0000E+00
    c = +0.0000E+00          k = +0.0000E+00
    d = +0.0000E+00          l = +0.0000E+00
    e = +0.0000E+00          m = +0.0000E+00
    f = +0.0000E+00          n = +0.0000E+00
    g = +0.0000E+00          o = +0.0000E+00
    h = +0.0000E+00          p = +0.0000E+00
```

1. Move the flashing cursor to the **wave calculation** item and select ON.
   The various setting items are displayed.

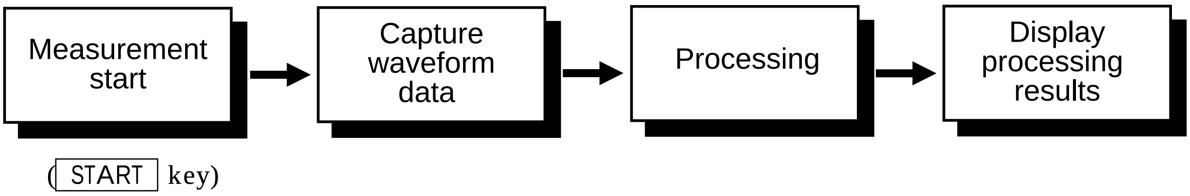
Function key display	Meaning
OFF	: Disable waveform processing
ON	: Enable waveform processing

2. Select the processing equation (☞ Section 14.3).
   Eight processing equations (Z1 - Z8) can be set.
3. Determine in which channel (CH1 - CH16) to display the processing results (Z1 - Z8) (☞ Section 14.4).
4. If the function "MOV" or "SLI" was selected in step 2, set the number of moving points (☞ Section 14.3.1).
5. Set the vertical axis display scale (☞ Section 14.5).
   The setting can be made automatically or by manual input.

6. Perform waveform processing.
   There are two methods for starting waveform processing

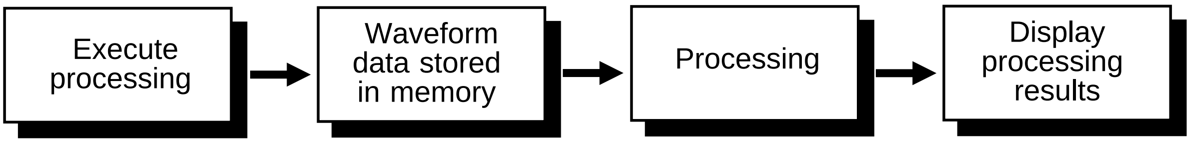
   ① Waveform processing while capturing the waveform

   1. Set **wave calculation** to **ON** and make the required settings.
   2. Press the START key.
   3. Processing is carried out on the captured waveform, and the result is displayed on the screen.
   4. When **auto print** is set to **ON,** the processing results are printed out.



   ② Waveform processing of data in internal memory (loaded from MO or already captured with memory recorder function)

   1. Set **wave calculation** to **ON** and make the required settings.
   2. Move the flashing cursor to the **execute** position at the top right of the screen and press the F1 [**exec**] key.
   3. Processing is carried on the data stored in memory, and the result is displayed on the screen.



NOTE

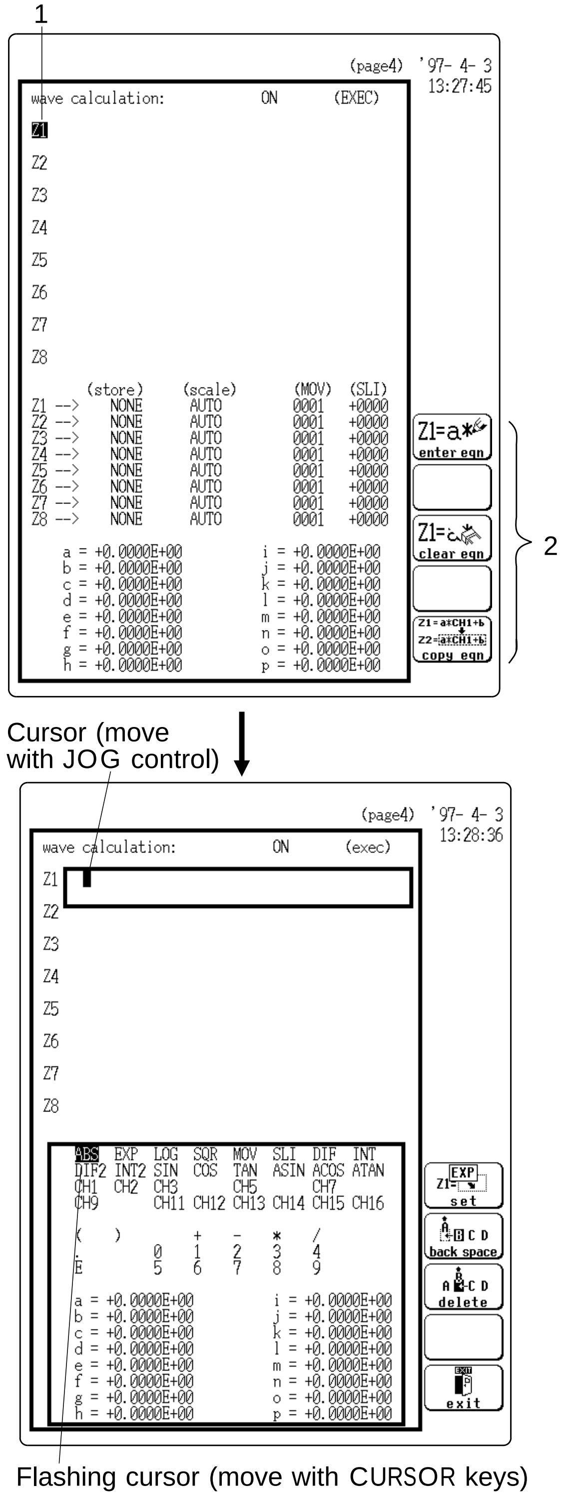
- When recording length is more than 1000 DIV, waveform processing is not possible.
- When the memory segmentation function is used, waveform processing is not possible.
- When scaling is set for the channel in which the processing result is to be stored, scaling is not carried out and only the unit is valid.

14.3 Defining the Processing Equation

- Set **wave calculation** to **ON**.
- Eight equations (Z1 - Z8) can be defined.

14.3.1 Entering the Equation

Method



```
                                        (page4)  '97- 4- 3
                                                  13:27:45
wave calculation:            ON        (EXEC)
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)    (scale)       (MOV)   (SLI)
Z1 -->    NONE      AUTO         0001    +0000
Z2 -->    NONE      AUTO         0001    +0000
Z3 -->    NONE      AUTO         0001    +0000
Z4 -->    NONE      AUTO         0001    +0000
Z5 -->    NONE      AUTO         0001    +0000
Z6 -->    NONE      AUTO         0001    +0000
Z7 -->    NONE      AUTO         0001    +0000
Z8 -->    NONE      AUTO         0001    +0000

    a = +0.0000E+00           i = +0.0000E+00
    b = +0.0000E+00           j = +0.0000E+00
    c = +0.0000E+00           k = +0.0000E+00
    d = +0.0000E+00           l = +0.0000E+00
    e = +0.0000E+00           m = +0.0000E+00
    f = +0.0000E+00           n = +0.0000E+00
    g = +0.0000E+00           o = +0.0000E+00
    h = +0.0000E+00           p = +0.0000E+00
```

```
                                        (page4)  '97- 4- 3
                                                  13:28:36
wave calculation:            ON        (exec)
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
   ABS  EXP  LOG  SQR  MOV  SLI  DIF  INT
   DIF2 INT2 SIN  COS  TAN  ASIN ACOS ATAN
   CH1  CH2  CH3       CH5       CH7
   CH9       CH11 CH12 CH13 CH14 CH15 CH16

   (    )         +    -    *    /
   .         0    1    2    3    4
   E         5    6    7    8    9

   a = +0.0000E+00           i = +0.0000E+00
   b = +0.0000E+00           j = +0.0000E+00
   c = +0.0000E+00           k = +0.0000E+00
   d = +0.0000E+00           l = +0.0000E+00
   e = +0.0000E+00           m = +0.0000E+00
   f = +0.0000E+00           n = +0.0000E+00
   g = +0.0000E+00           o = +0.0000E+00
   h = +0.0000E+00           p = +0.0000E+00
```

1. Move the flashing cursor to **Z1** to **Z8**.
2. Press F1 [enter eqn] for equation entry.

Function key display	Meaning
Z1=a* enter eqn	: Enter equation
Z1= clear eqn	: Delete equation (☞ Section 14.3.2)
Z1=a*CH1+b Z2=a*CH1+b copy eqn	: Copy equation (☞ Section 14.3.3)

3. Move the flashing cursor to the operator (ABS, EXP,...), channel (CH1 - CH16), equation (Z1 - Z7), constant (a - p), value (0 - 9, E: exponent) and make the entry with the F1 [set] key.
- The movement range of the flashing cursor is indicated by a border.
- Use the JOG control to move the cursor within the equation.

Function key display	Meaning
Z1= EXP set	: Enter channel (CH1 - Ch16), equation (Z1 - Z7), constant (a - p), value (0 - 9, E) into selected equation.
A B C D back space	: Delete character to left of cursor in equation (backspace key)
A B C D delete	: Delete character under cursor in equation (delete key)
EXIT exit	: Terminate equation input

Operators

For details, see Section 14.8, (2) to (17).

ABS	Absolute value	(2)
EXP	Exponential	(3)
LOG	Logarithm	(4)
SQR	Square root	(5)
MOV	Displacement average	(6)
SLI	Parallel displacement on time axis	(7)
DIF	1st differential	(8)
INT	1st integral	(9)
DIF2	2nd differential	(10)
INT2	2nd integral	(11)
SIN	Sine	(12)
COS	Cosine	(13)
TAN	Tangent	(14)
ASIN	Arc-sine	(15)
ACOS	Arc-cosine	(16)
ATAN	Arc-tangent	(17)

NOTE

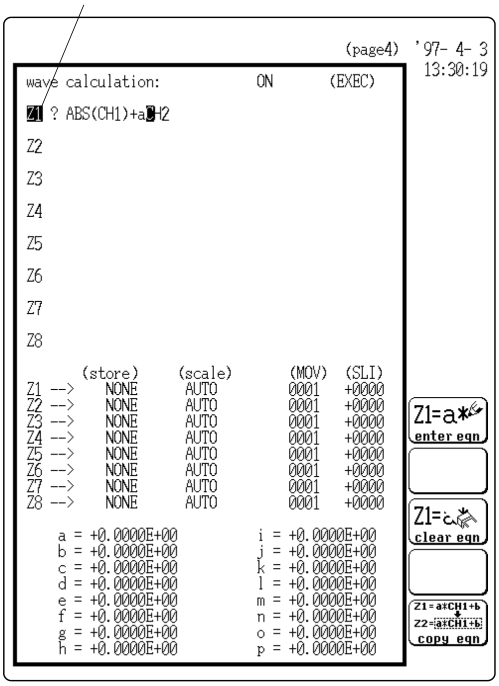
- For multiplication, always use the "*" sign.
- Out of the MOV, SLI, DIF, DIF2, INT, and INT2 operators, up to two can be used in the same equation (for example two MOV operators or one MOV and one SLI operator, etc.).
- The maximum number of digits for a constant is 30.
- If division by 0 is specified (1/0), an overflow value is output.
- Equations are calculated in ascending order, from Z1 to Z8.
- The following data (channel data, equation calculation results) can be used in equations (when 8 units, 16 channels are used).

Z1	CH1 - CH16
Z2	CH1 - CH16, Z1
Z3	CH1 - CH16, Z1, Z2
Z4	CH1 - CH16, Z1 - Z3
Z5	CH1 - CH16, Z1 - Z4
Z6	CH1 - CH16, Z1 - Z5
Z7	CH1 - CH16, Z1 - Z6
Z8	CH1 - CH16, Z1 - Z7

4. 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 two 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.

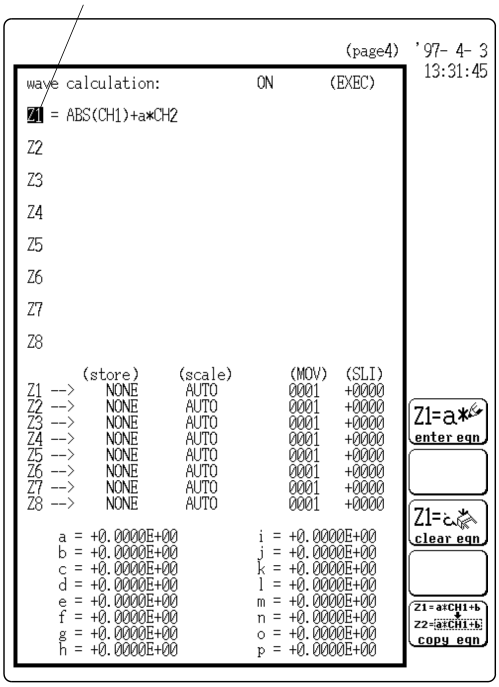
Syntax error is present



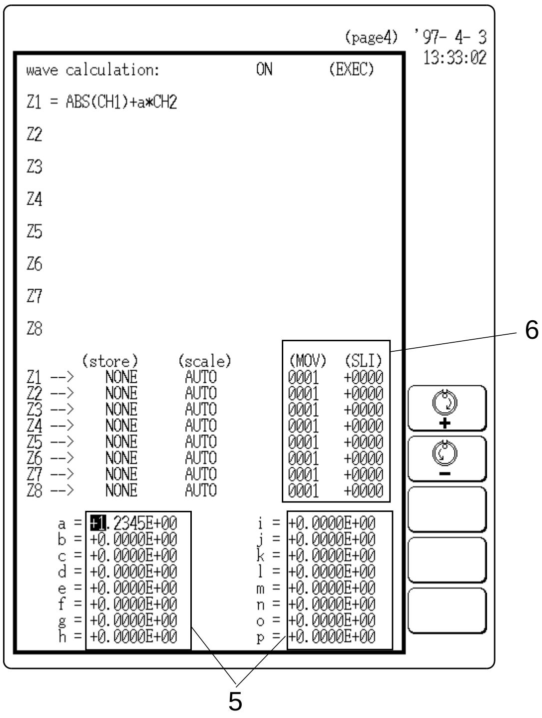
```
                                        (page4)  '97- 4- 3
                                                  13:30:19
wave calculation:              ON        (EXEC)
Z1 ? ABS(CH1)+aCH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)         (MOV)   (SLI)
Z1 -->    NONE       AUTO            0001    +0000
Z2 -->    NONE       AUTO            0001    +0000
Z3 -->    NONE       AUTO            0001    +0000
Z4 -->    NONE       AUTO            0001    +0000
Z5 -->    NONE       AUTO            0001    +0000
Z6 -->    NONE       AUTO            0001    +0000
Z7 -->    NONE       AUTO            0001    +0000
Z8 -->    NONE       AUTO            0001    +0000

    a = +0.0000E+00          i = +0.0000E+00
    b = +0.0000E+00          j = +0.0000E+00
    c = +0.0000E+00          k = +0.0000E+00
    d = +0.0000E+00          l = +0.0000E+00
    e = +0.0000E+00          m = +0.0000E+00
    f = +0.0000E+00          n = +0.0000E+00
    g = +0.0000E+00          o = +0.0000E+00
    h = +0.0000E+00          p = +0.0000E+00
```

Correct error

No syntax error is present

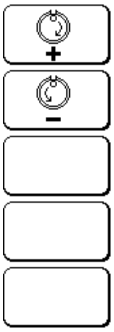


```
                                        (page4)  '97- 4- 3
                                                  13:31:45
wave calculation:              ON        (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)         (MOV)   (SLI)
Z1 -->    NONE       AUTO            0001    +0000
Z2 -->    NONE       AUTO            0001    +0000
Z3 -->    NONE       AUTO            0001    +0000
Z4 -->    NONE       AUTO            0001    +0000
Z5 -->    NONE       AUTO            0001    +0000
Z6 -->    NONE       AUTO            0001    +0000
Z7 -->    NONE       AUTO            0001    +0000
Z8 -->    NONE       AUTO            0001    +0000

    a = +0.0000E+00          i = +0.0000E+00
    b = +0.0000E+00          j = +0.0000E+00
    c = +0.0000E+00          k = +0.0000E+00
    d = +0.0000E+00          l = +0.0000E+00
    e = +0.0000E+00          m = +0.0000E+00
    f = +0.0000E+00          n = +0.0000E+00
    g = +0.0000E+00          o = +0.0000E+00
    h = +0.0000E+00          p = +0.0000E+00
```



```
                                        (page4)  '97- 4- 3
                                                  13:33:02
wave calculation:              ON        (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)         (MOV)   (SLI)
Z1 -->    NONE       AUTO            0001    +0000
Z2 -->    NONE       AUTO            0001    +0000
Z3 -->    NONE       AUTO            0001    +0000
Z4 -->    NONE       AUTO            0001    +0000
Z5 -->    NONE       AUTO            0001    +0000
Z6 -->    NONE       AUTO            0001    +0000
Z7 -->    NONE       AUTO            0001    +0000
Z8 -->    NONE       AUTO            0001    +0000

    a = +1.2345E+00          i = +0.0000E+00
    b = +0.0000E+00          j = +0.0000E+00
    c = +0.0000E+00          k = +0.0000E+00
    d = +0.0000E+00          l = +0.0000E+00
    e = +0.0000E+00          m = +0.0000E+00
    f = +0.0000E+00          n = +0.0000E+00
    g = +0.0000E+00          o = +0.0000E+00
    h = +0.0000E+00          p = +0.0000E+00
```

5. Enter the constant values.
   - Select the equation with the CURSOR keys, move the flashing cursor to the desired digit, and use the function keys or the JOG control to enter the value.
   - The setting range is -9.9999E+29 to +9.9999E+29 (exponent: -29 to +29).

Function key display	Meaning
	0 to 9 (-9 to +9 for the most significant digit, -29 to +29 for exponent.)

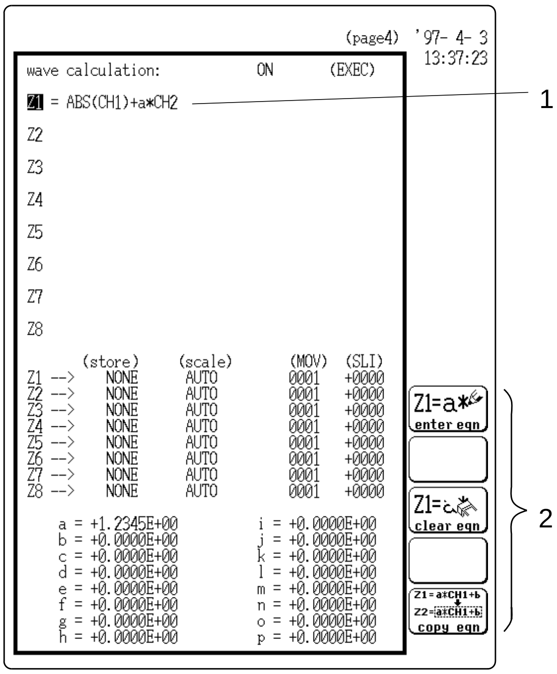
6. Specify the floating decimal point.

   If MOV or SLI was used in step 3, the floating decimal point must be specified (☞ Section 14.8.(6), (7)).

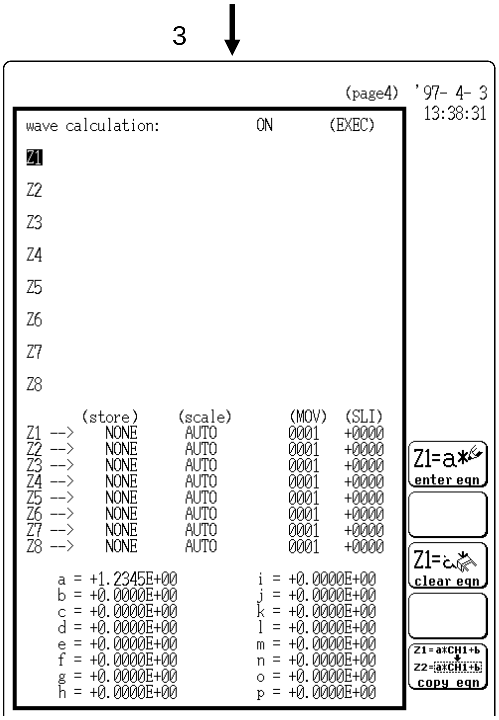
Function key display	Meaning
10 ↑	: For MOV (moving average): 1 to 4000
1 ↑	: For SLI (parallel displacement): -4000 to +4000
1 ↓	
10 ↓	

14.3.2 Deleting an Equation

Method



```
                                   (page4)  '97- 4- 3
                                             13:37:23
wave calculation:            ON       (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)        (MOV)  (SLI)
Z1 -->    NONE       AUTO           0001   +0000
Z2 -->    NONE       AUTO           0001   +0000
Z3 -->    NONE       AUTO           0001   +0000
Z4 -->    NONE       AUTO           0001   +0000
Z5 -->    NONE       AUTO           0001   +0000
Z6 -->    NONE       AUTO           0001   +0000
Z7 -->    NONE       AUTO           0001   +0000
Z8 -->    NONE       AUTO           0001   +0000

    a = +1.2345E+00            i = +0.0000E+00
    b = +0.0000E+00            j = +0.0000E+00
    c = +0.0000E+00            k = +0.0000E+00
    d = +0.0000E+00            l = +0.0000E+00
    e = +0.0000E+00            m = +0.0000E+00
    f = +0.0000E+00            n = +0.0000E+00
    g = +0.0000E+00            o = +0.0000E+00
    h = +0.0000E+00            p = +0.0000E+00
```



```
                                   (page4)  '97- 4- 3
                                             13:38:31
wave calculation:            ON       (EXEC)
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)        (MOV)  (SLI)
Z1 -->    NONE       AUTO           0001   +0000
Z2 -->    NONE       AUTO           0001   +0000
Z3 -->    NONE       AUTO           0001   +0000
Z4 -->    NONE       AUTO           0001   +0000
Z5 -->    NONE       AUTO           0001   +0000
Z6 -->    NONE       AUTO           0001   +0000
Z7 -->    NONE       AUTO           0001   +0000
Z8 -->    NONE       AUTO           0001   +0000

    a = +1.2345E+00            i = +0.0000E+00
    b = +0.0000E+00            j = +0.0000E+00
    c = +0.0000E+00            k = +0.0000E+00
    d = +0.0000E+00            l = +0.0000E+00
    e = +0.0000E+00            m = +0.0000E+00
    f = +0.0000E+00            n = +0.0000E+00
    g = +0.0000E+00            o = +0.0000E+00
    h = +0.0000E+00            p = +0.0000E+00
```

1. Move the flashing cursor to one of the Z1 - Z8 items.
2. Press P3 [clear eqn].

Function key display	Meaning
Z1=a* enter eqn	: Enter equation (14.3.1)
Z1= clear eqn	: Delete equation
Z1=a*CH1+b Z2=a*CH1+b copy eqn	: Copy equation (14.3.3)

3. The equation can be deleted.

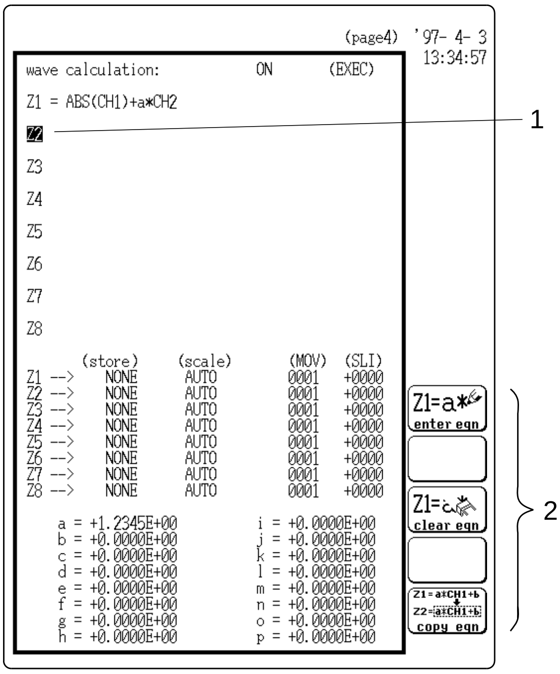
Function key display	Meaning
clear	: Clear equation
not clear	: Do not clear equation

14

14.3.3 Copying an Equation

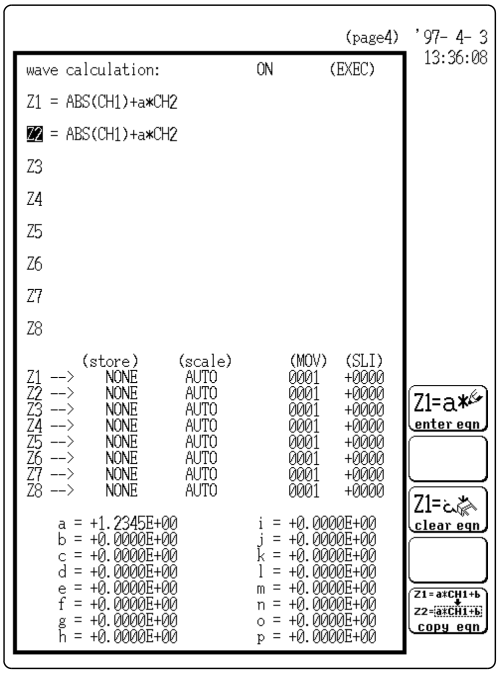
An equation to which an equation number has been assigned (copy source) can be copied to another equation number (copy target).

Method



```
                              (page4)  '97- 4- 3
                                        13:34:57
wave calculation:           ON      (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
       (store)    (scale)        (MOV)   (SLI)
Z1 -->   NONE      AUTO          0001    +0000
Z2 -->   NONE      AUTO          0001    +0000
Z3 -->   NONE      AUTO          0001    +0000
Z4 -->   NONE      AUTO          0001    +0000
Z5 -->   NONE      AUTO          0001    +0000
Z6 -->   NONE      AUTO          0001    +0000
Z7 -->   NONE      AUTO          0001    +0000
Z8 -->   NONE      AUTO          0001    +0000

  a = +1.2345E+00          i = +0.0000E+00
  b = +0.0000E+00          j = +0.0000E+00
  c = +0.0000E+00          k = +0.0000E+00
  d = +0.0000E+00          l = +0.0000E+00
  e = +0.0000E+00          m = +0.0000E+00
  f = +0.0000E+00          n = +0.0000E+00
  g = +0.0000E+00          o = +0.0000E+00
  h = +0.0000E+00          p = +0.0000E+00
```

3



```
                              (page4)  '97- 4- 3
                                        13:36:08
wave calculation:           ON      (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2 = ABS(CH1)+a*CH2
Z3
Z4
Z5
Z6
Z7
Z8
       (store)    (scale)        (MOV)   (SLI)
Z1 -->   NONE      AUTO          0001    +0000
Z2 -->   NONE      AUTO          0001    +0000
Z3 -->   NONE      AUTO          0001    +0000
Z4 -->   NONE      AUTO          0001    +0000
Z5 -->   NONE      AUTO          0001    +0000
Z6 -->   NONE      AUTO          0001    +0000
Z7 -->   NONE      AUTO          0001    +0000
Z8 -->   NONE      AUTO          0001    +0000

  a = +1.2345E+00          i = +0.0000E+00
  b = +0.0000E+00          j = +0.0000E+00
  c = +0.0000E+00          k = +0.0000E+00
  d = +0.0000E+00          l = +0.0000E+00
  e = +0.0000E+00          m = +0.0000E+00
  f = +0.0000E+00          n = +0.0000E+00
  g = +0.0000E+00          o = +0.0000E+00
  h = +0.0000E+00          p = +0.0000E+00
```

1. Move the flashing cursor to one of the Z1 - Z8 items.
2. Press F5 [copy eqn].

Function key display	Meaning
Z1=a* enter eqn	: Enter equation (14.3.1)
Z1= clear eqn	: Delete equation (14.3.2)
Z1=a*CH1+b Z2=a*CH1+b copy eqn	: Copy equation

3. Use the function keys or the JOG control to specify the number of the equation to be copied.

Function key display	Meaning
Copy Source Z 1	: Display copy source (display only)
Z ↑	: Increase equation number
Z ↓	: Decrease equation number
cancel	: Quit copy mode
(exec)	: Execute copy

4. Press the F5 [exec] key. The copy source equation is copied to the copy target.

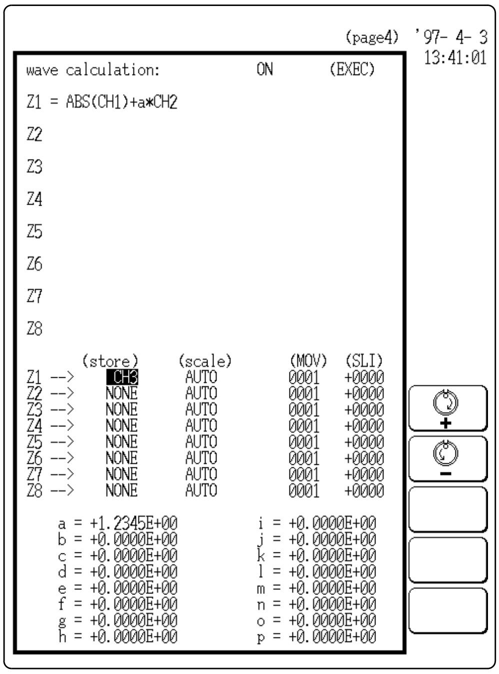
NOTE

When the equation in the copy source contains a calculation number that is higher than in the copy target, the copy function is not carried out.

14.4 Setting the Channel for Recording Processing Results

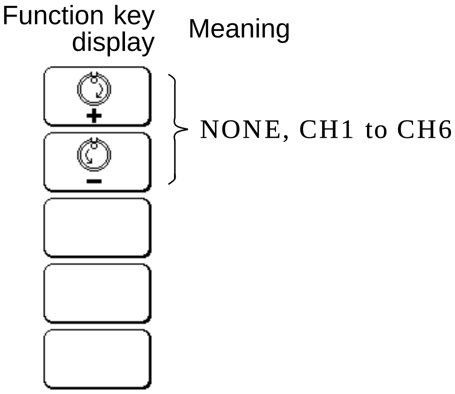
- The calculation result of equations Z1 - Z8 can be recorded and displayed in a specified channel.
- Processing results can be recorded also in channels where no input unit is installed (but the range of the "number of units in use" setting cannot be exceeded).

Method



```
                                   (page4)  '97- 4- 3
                                             13:41:01
wave calculation:          ON       (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
      (store)      (scale)      (MOV)   (SLI)
Z1 -->    CH3        AUTO        0001    +0000
Z2 -->   NONE        AUTO        0001    +0000
Z3 -->   NONE        AUTO        0001    +0000
Z4 -->   NONE        AUTO        0001    +0000
Z5 -->   NONE        AUTO        0001    +0000
Z6 -->   NONE        AUTO        0001    +0000
Z7 -->   NONE        AUTO        0001    +0000
Z8 -->   NONE        AUTO        0001    +0000

   a = +1.2345E+00         i = +0.0000E+00
   b = +0.0000E+00         j = +0.0000E+00
   c = +0.0000E+00         k = +0.0000E+00
   d = +0.0000E+00         l = +0.0000E+00
   e = +0.0000E+00         m = +0.0000E+00
   f = +0.0000E+00         n = +0.0000E+00
   g = +0.0000E+00         o = +0.0000E+00
   h = +0.0000E+00         p = +0.0000E+00
```

Move the flashing cursor to the position shown in the illustration and make the setting with the function keys or the JOG control.



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:

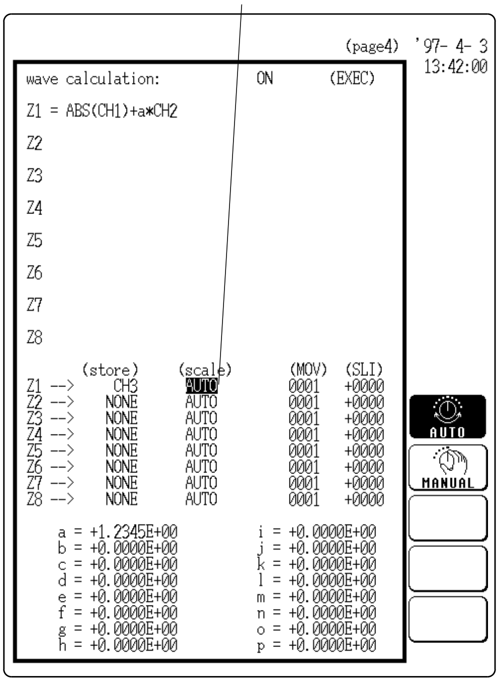
  ① If results are recorded in a channel where no input unit is installed.
  ② If the display color for the channel selected for recording is set to OFF.

  When wishing to change the display color set, perform calculation once and then use the CHANNEL screen to make the setting.

14.5 Setting the Display Scale

- Display scale can be set automatically or manually.
- The channel selected for recording is automatically set to variable display (☞ Section 9.6.10).

Method



```
                                   (page4)  '97- 4- 3
                                            13:42:00
wave calculation:              ON       (EXEC)
Z1 = ABS(CH1)+a*CH2
Z2
Z3
Z4
Z5
Z6
Z7
Z8
        (store)     (scale)        (MOV)  (SLI)
Z1 -->     CH3       AUTO          0001   +0000
Z2 -->    NONE       AUTO          0001   +0000
Z3 -->    NONE       AUTO          0001   +0000
Z4 -->    NONE       AUTO          0001   +0000
Z5 -->    NONE       AUTO          0001   +0000
Z6 -->    NONE       AUTO          0001   +0000
Z7 -->    NONE       AUTO          0001   +0000
Z8 -->    NONE       AUTO          0001   +0000

    a = +1.2345E+00         i = +0.0000E+00
    b = +0.0000E+00         j = +0.0000E+00
    c = +0.0000E+00         k = +0.0000E+00
    d = +0.0000E+00         l = +0.0000E+00
    e = +0.0000E+00         m = +0.0000E+00
    f = +0.0000E+00         n = +0.0000E+00
    g = +0.0000E+00         o = +0.0000E+00
    h = +0.0000E+00         p = +0.0000E+00
```

Move the flashing cursor to the position shown in the illustration and make the setting with the function keys.

Function key display	Meaning
AUTO	: Set display scale manually
MANUAL	: Set display scale automatically

• Automatic setting

After calculation, the upper and lower limit is determined from the result, and the variable display settings are made accordingly.

NOTE 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

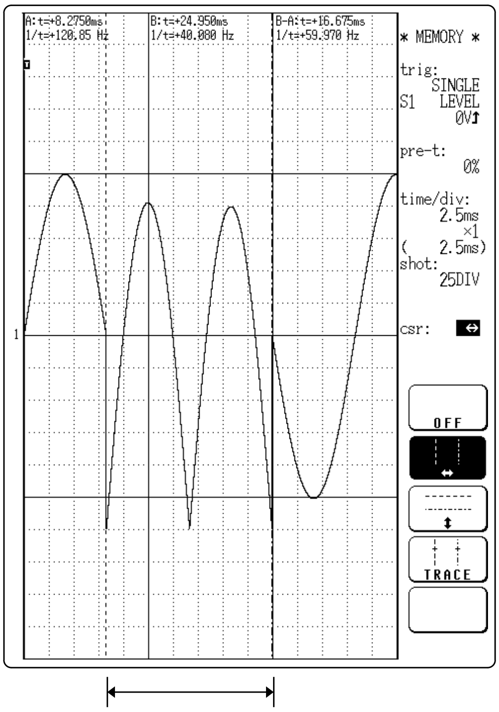
Use the variable display setting function on the CHANNEL screen (page 2) to set the upper and lower limit (☞ Section 9.6.10).

14.6 Specifying the Waveform Processing Range

- Use the A/B cursors (or trace cursor) to specify the processing range for the waveform data.
- Processing is carried out only for data between the A/B cursors.
- If the A/B cursors are turned off, or if a horizontal cursor is used, processing is carried out for all data. (Waveform processing is not possible if recording length is more than 1000 DIV.)

NOTE

- 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.
- When the A/B cursors are used, data outside of that range are considered invalid.



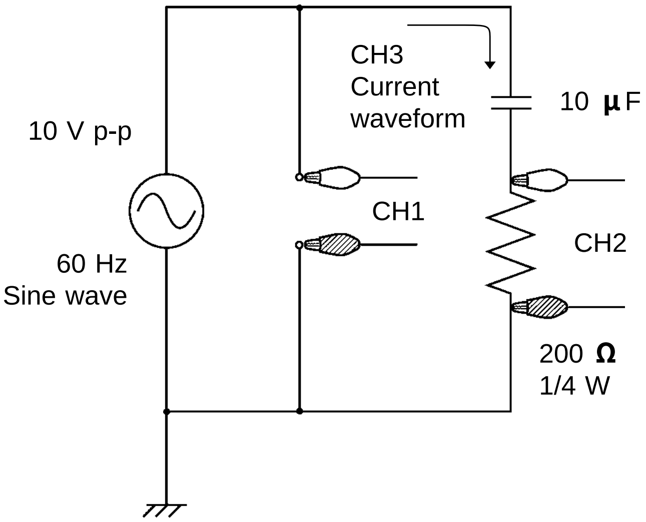
A:t=+8.2750ms 1/t=+120.85 Hz
B:t=+24.950ms 1/t=+40.080 Hz
B-A:t=+16.675ms 1/t=+59.970 Hz

* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ⇔

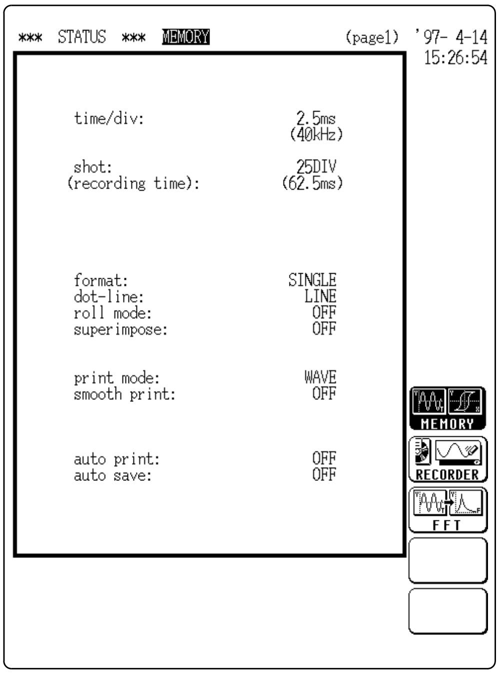
Processing is carried out for this range

14.7 Setting Example for Waveform Processing

Example Using the circuit shown in the illustration, the voltage applied to the load is measured in CH1, the voltage at the resistor in CH2, the waveform of the current flowing through the load in CH3, and instant power waveform data for the load are determined and recorded in CH4.

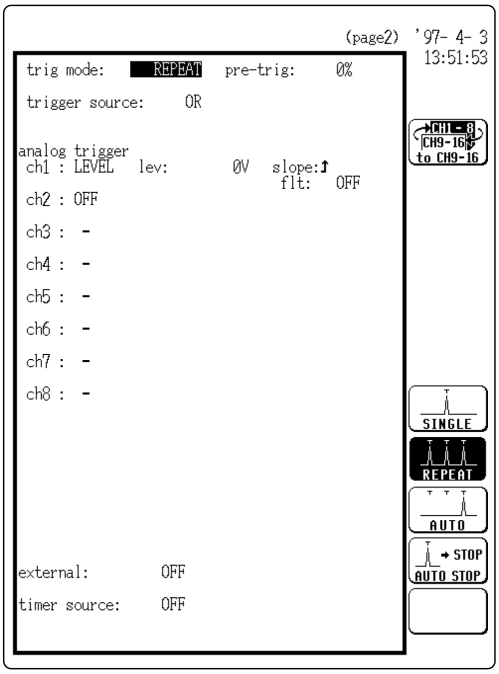


Setting Make settings on the memory recorder STATUS screen as shown below (☞ Section 5.2.1).



```
***  STATUS  ***  MEMORY                   (page1)  '97- 4-14
                                                     15:26:54

   time/div:                   2.5ms
                              (40kHz)

   shot:                       25DIV
  (recording time):          (62.5ms)

   format:                    SINGLE
   dot-line:                    LINE
   roll mode:                    OFF
   superimpose:                  OFF

   print mode:                  WAVE
   smooth print:                 OFF

   auto print:                   OFF
   auto save:                    OFF
```

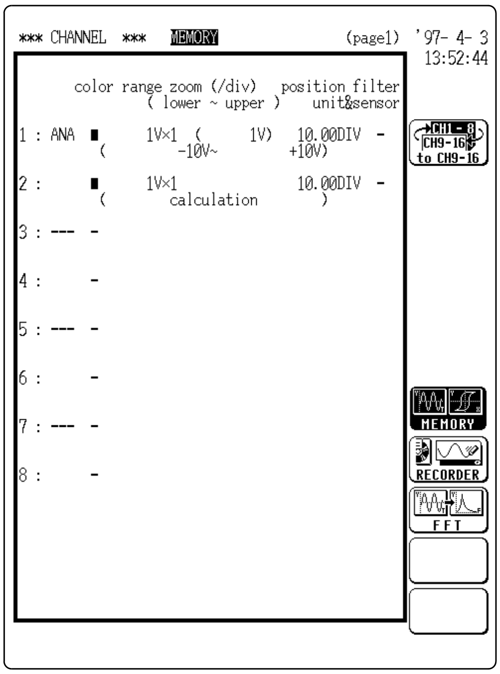
Status Screen (page 1)



```
                                    (page2)  '97- 4- 3
                                               13:51:53
 trig mode:      REPEAT   pre-trig:     0%

 trigger source:     OR

analog trigger
 ch1 : LEVEL   lev:          0V   slope:↑
                                    flt:   OFF
 ch2 : OFF

 ch3 :  -

 ch4 :  -

 ch5 :  -

 ch6 :  -

 ch7 :  -

 ch8 :  -

external:         OFF

timer source:     OFF
```

Status Screen (page 2)

Status screen (page 3): all settings OFF

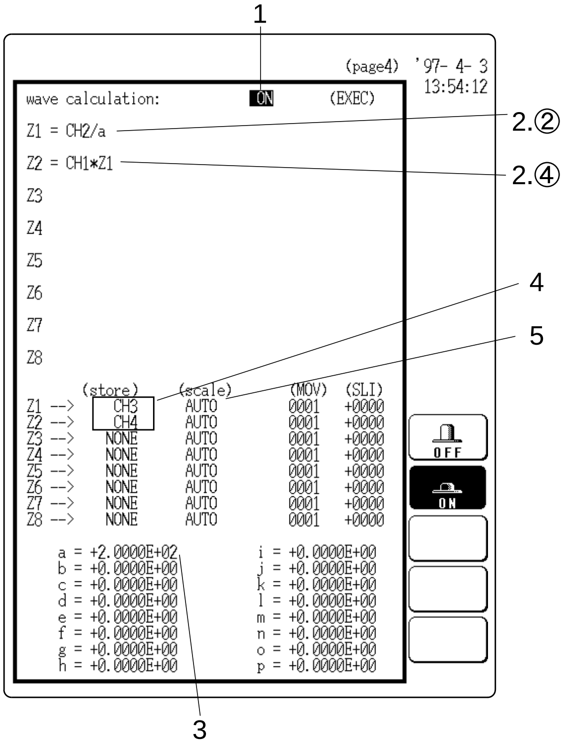


```
*** CHANNEL  ***   MEMORY                        (page1)  '97- 4- 3
                                                           13:52:44
        color range zoom (/div)   position filter
                 ( lower ~ upper )    unit&sensor
1 : ANA ■      1V×1  (       1V)   10.00DIV  -
          (         -10V~          +10V)
2 :     ■      1V×1                10.00DIV  -
          (        calculation          )
3 : ---  -
4 :      -
5 : ---  -
6 :      -
7 : ---  -
8 :      -
```

CHANNEL screen

Make settings for CH2 as for CH1.

Method



```
                                            (page4)  '97- 4- 3
                                                      13:54:12
wave calculation:            ON         (EXEC)
Z1 = CH2/a
Z2 = CH1*Z1
Z3
Z4
Z5
Z6
Z7
Z8
        (store)    (scale)        (MOV)   (SLI)
Z1 -->    CH3       AUTO           0001    +0000
Z2 -->    CH4       AUTO           0001    +0000
Z3 -->   NONE       AUTO           0001    +0000
Z4 -->   NONE       AUTO           0001    +0000
Z5 -->   NONE       AUTO           0001    +0000
Z6 -->   NONE       AUTO           0001    +0000
Z7 -->   NONE       AUTO           0001    +0000
Z8 -->   NONE       AUTO           0001    +0000

    a = +2.0000E+02          i = +0.0000E+00
    b = +0.0000E+00          j = +0.0000E+00
    c = +0.0000E+00          k = +0.0000E+00
    d = +0.0000E+00          l = +0.0000E+00
    e = +0.0000E+00          m = +0.0000E+00
    f = +0.0000E+00          n = +0.0000E+00
    g = +0.0000E+00          o = +0.0000E+00
    h = +0.0000E+00          p = +0.0000E+00
```

1. Set **wave calculation** on STATUS screen (page 4) to **ON**.

2. Enter the processing equation.

① Move the flashing cursor to **Z1** and press the F1 [enter] key.

② Enter the following equation:

Z1=CH2/a

③ Press the F5 [exit] key.

④ Move the flashing cursor to **Z2** and enter the following equation in the same way as for Z1:

Z2=CH1∗Z1

3. Move the flashing cursor to the constant a and enter the resistance value.

a=+2.0000E+02

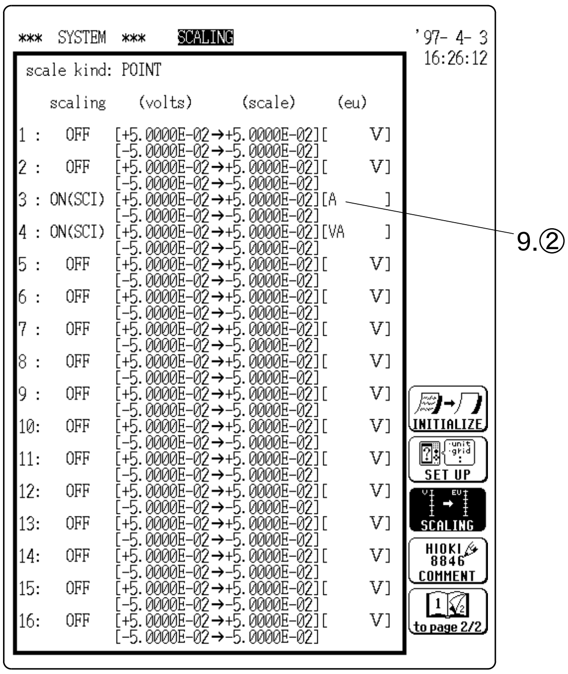
4. Set the result of Z1 to be recorded in channel 3 and the result of Z2 in channel 4.

・Set Z3 - Z8 to **NONE**.

5. Set the upper and lower limit to **AUTO**.
(The variable display setting for CH3 and CH4 becomes ON. When wishing to make the setting manually, use the CHANNEL screen (page 2).

6. Press the DISP key to activate the display screen.
7. Press the START key to start processing.
8. Press the STOP key to interrupt the measurement.

   The processing results of CH3 and CH4 are shown with color set 3 for CH3 and color set 4 for CH4. When wishing to change the color, make the setting from the CHANNEL screen (page 1).



```
***  SYSTEM  ***   SCALING                                   '97- 4- 3
                                                              16:26:12
 scale kind: POINT

   scaling    (volts)       (scale)      (eu)

1 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
2 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
3 : ON(SCI)  [+5.0000E-02→+5.0000E-02][A      ]
             [-5.0000E-02→-5.0000E-02]
4 : ON(SCI)  [+5.0000E-02→+5.0000E-02][VA     ]
             [-5.0000E-02→-5.0000E-02]
5 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
6 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
7 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
8 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
9 :   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
10:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
11:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
12:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
13:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
14:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
15:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
16:   OFF    [+5.0000E-02→+5.0000E-02][      V]
             [-5.0000E-02→-5.0000E-02]
```

9. Set the display unit for CH3 to **A** (ampere) and for CH4 to **VA** (volt-ampere).

   ① Press the SYSTEM key to call up the SYSTEM screen and press the F3 [SCALING] function key.

   ② Move the flashing cursor to the **eu** (unit name) item for CH3 and CH4 on the scaling setting screen and enter **A** and **VA** respectively (☞ Section 11.6.1).

10. Press the DISP key again to activate the display screen and press the START key to start the measurement.
11. Press the STOP key when wishing to terminate the measurement.

14.8 Details on Operators

(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)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(3) Exponential (EXP)

Equation:

$b_i = \exp(d_i)$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(4) Common logarithm (LOG)

Equation:

$b_i = \log_{10} di$ when $d_i > 0$
$b_i = -\infty$ when $d_i = 0$ (overflow value is output)
$b_i = \log_{10}|d_i|$ when $d_i < 0$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(Reference)
Use the following equation to convert to natural logarithm:

$$\mathrm{In}X = \mathrm{log}eX = \frac{\log_{10}X}{\log_{10}e} \qquad \frac{1}{\log_{10}e} \qquad 2.33\mathrm{E} + 0$$

(5) Square root (SQR)

Equation:

$b_i = \sqrt{di}$ when $d_i \geqq 0$
$b_i = \sqrt{|di|}$ when $d_i < 0$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(6) Moving average (MOV)

Equation:

$$b_i = \frac{1}{k}\sum_{t=i-k/2}^{i+k/2} d_i \quad (i = 1, 2, ..., n)$$

b_i : i-th data of calculation result
d_i : i-th data of source channel
k : number of points for averaging (1 to 4000)

NOTE 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:

$$b_i = d_{i-k} \qquad (i = 1, 2, ..., n)$$

b_i : i-th data of calculation result
d_i : i-th data of source channel
k : number of points for averaging (-4000 to 4000)

NOTE

- 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.

NOTE When the input voltage becomes small, processing results will show little variation. In such a case, apply the MOV operator.

- Equation for 1st differential:

Point t_1 $\quad b_1 = \frac{1}{12h}[-25d_1 + 48d_2 - 36d_3 + 16d_4 - 3d_5]$

Point t_2 $\quad b_2 = \frac{1}{12h}[-3d_1 - 10d_2 + 18d_3 - 6d_4 + d_5]$

Point t_3 $\quad b_3 = \frac{1}{12h}[d_1 - 8d_2 + 8d_4 - d_5]$

:

Point t_i $\quad b_i = \frac{1}{12h}[d_{i-2} - 8d_{i-1} + 8d_{i+1} - d_{i+2}]$

:

Point t_{n-2} $\quad b_{n-2} = \frac{1}{12h}[d_{n-4} - 8d_{n-3} + 8d_{n-1} - d_n]$

:

Point t_{n-1} $\quad b_{n-1} = \frac{1}{12h}[-d_{n-4} + 6d_{n-3} - 18d_{n-2} + 10d_{n-1} + 3d_n]$

Point t_n $\quad b_n = \frac{1}{12h}[3d_{n-4} - 16d_{n-3} + 36d_{n-2} - 48d_{n-1} + 25d_n]$

b_i to b_n: data of calculation result
$h = \Delta t$: sampling period (☞ Appendix 2.1)

- Equation for 2nd differential:

Point t_1 $\quad b_1 = \frac{1}{12h^2}[35d_1 - 104d_2 + 114d_3 - 56d_4 + 11d_5]$

Point t_2 $\quad b_2 = \frac{1}{12h^2}[11d_1 - 20d_2 + 6d_3 + 4d_4 - d_5]$

Point t_3 $\quad b_3 = \frac{1}{12h^2}[-d_1 + 16d_2 - 30d_3 + 16d_4 - d_5]$

:

Point t_i $\quad b_i = \frac{1}{12h^2}[-d_{i-2} + 16d_{i-1} - 30d_i + 16d_{i+1} - d_{i+2}]$

:

Point t_{n-2} $\quad b_{n-2} = \frac{1}{12h^2}[-d_{n-4} + 16d_{n-3} - 30d_{n-2} + 16d_{n-1} - d_n]$

:

Point t_{n-1} $\quad b_{n-1} = \frac{1}{12h^2}[-d_{n-4} + 4d_{n-3} + 6d_{n-2} - 20d_{n-1} + 11d_n]$

Point t_n $\quad b_n = \frac{1}{12h^2}[11d_{n-4} - 56d_{n-3} + 114d_{n-2} - 104d_{n-1} + 35d_n]$

(10) 1st integral (INT)

(11) 2nd integral (INT2)

- The 1st and 2nd integral calculation uses the trapezoidal rule.
- Data corresponding to sample time t1 - tn are taken as d1 - dn and used for calculating the integral.

- Equation for 1st integral:

Point t_1 $I_1 = 0$

Point t_2 $I_2 = \frac{1}{2}(d_1 + d_2)h$

Point t_3 $I_3 = \frac{1}{2}(d_1 + d_2)h + \frac{1}{2}(d_2 + d_3)h = I_2 + \frac{1}{2}(d_2 + d_3)h$

•

Point t_n $I_n = I_{n-1} + \frac{1}{2}(d_{n-1} + d_n)h$

I_1 - I_n : processing result data
h = Δt: sampling cycle (☞ Appendix 2.1)

- Equation for 2nd integral:

Point t_1 $II_1 = 0$

Point t_2 $II_2 = \frac{1}{2}(I_1 + I_2)h$

Point t_3 $II_3 = \frac{1}{2}(I_1 + I_2)h + \frac{1}{2}(I_2 + I_3)h = II_2 + \frac{1}{2}(I_2 + I_3)h$

•

Point t_n $II_n = II_{n-1} + \frac{1}{2}(I_{n-1} + I_n)h$

II_1 - II_n: processing result data

(12) Sine (SIN)

Equation:

$b_i = \sin(d_i)$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(13) Cosine (SOS)

Equation:

b_i = cos (d_i) (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(14) Tangent (TAN)

Equation:

b_i = tan (d_i), and $-10 \leqq bi \leqq 10$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(15) Arc-sine (ASIN)

Equation:

$b_i = \frac{\pi}{2}$ when $d_i > 1$
$b_i = \mathrm{asin}(d_i)$ when $-1 \leqq d_i \leqq 1$
$b_i = - \frac{\pi}{2}$ when $d_i < -1$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

(16) Arc-cosine (ACOS)

Equation:

$b_i = 0$ when $d_i > 1$
$b_i = \mathrm{acos}(d_i)$ when $-1 \leqq d_i \leqq 1$
$b_i = \pi$ when $d_i < -1$ (i = 1, 2, ..., n)

bi: i-th data of calculation result
di: i-th data of source channel

(17) Arc-tangent (ATAN)

Equation:

$b_i = \mathrm{atan}(d_i)$ (i = 1, 2, ..., n)

b_i : i-th data of calculation result
d_i : i-th data of source channel

NOTE

The unit for the Trigonometric and inverse trigonometric functions (12) - (17) is rad (radian).

Chapter 15
Determining Waveform Parameters / Evaluating Parameter Values

15.1 Overview

Waveform parameter calculation

- Available for memory recorder and recorder functions.
- Parameters that were used for captured waveform data and for data after waveform processing can be determined. The result is shown in numeric form.
- The following 14 types of calculations are possible:
  Average value, RMS value, peak-to-peak value
  Maximum value, time to reach maximum, minimum value,
  time to reach minimum, period, frequency, rise time, fall time,
  standard deviation, area, X-Y area
- The A/B cursors (vertical, trace) can be used to determine the parameters of a certain range.

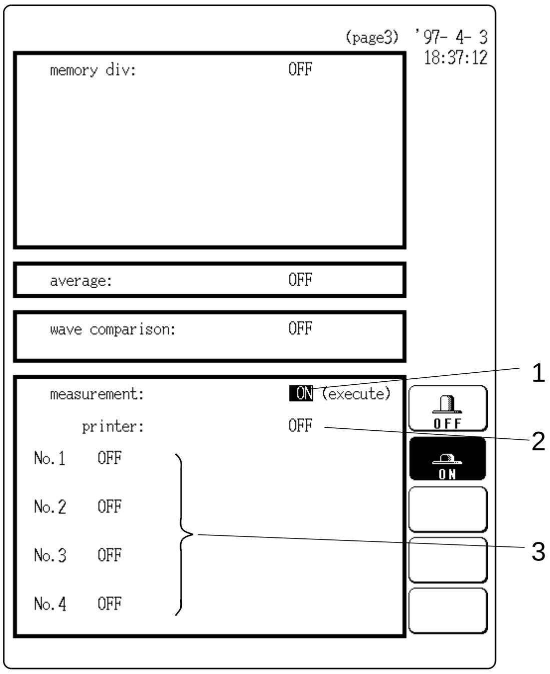
Waveform parameter evaluation

- Available for memory recorder and recorder functions.
- The result of waveform parameter calculation is compared to a reference range, for GO/NG evaluation.

15.2 Making Settings for Waveform Parameter Calculation

- Settings for waveform parameter calculation are made with the STATUS screen (page 3).
- Press the STATUS key to call up the STATUS screen (page 3).

Method Screen: STATUS (page 3)



(page3) '97- 4- 3 18:37:12

memory div: OFF

average: OFF

wave comparison: OFF

measurement: ON (execute)

printer: OFF

No.1 OFF

No.2 OFF

No.3 OFF

No.4 OFF

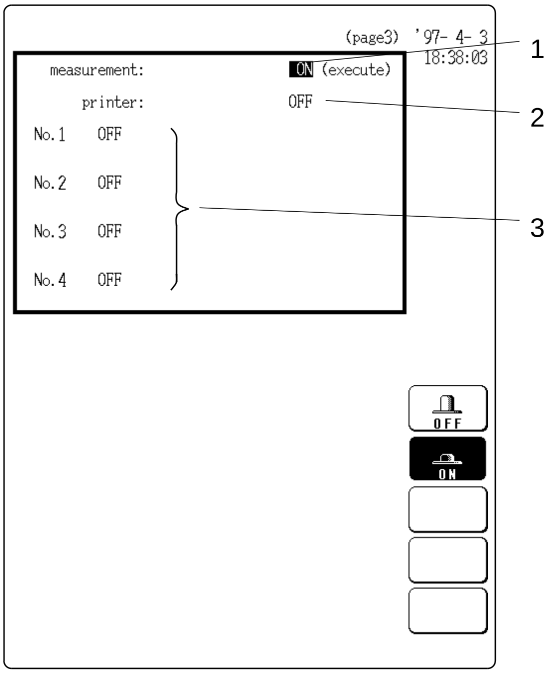
Move the flashing cursor to the items in the order as shown in the illustration.

1. Move the flashing cursor to the **measurement** item and press F2 [ON].

   The various setting items are displayed.

2. Choose the setting for parameter calculation result printout (☞ Section 15.6).

Function key display	Meaning
OFF	: Disable printout of parameter calculation results
ON	: Enable printout of parameter calculation results



(page3) '97- 4- 3 18:38:03

measurement: ON (execute)

printer: OFF

No.1 OFF

No.2 OFF

No.3 OFF

No.4 OFF

3. Parameter calculation settings
- Up to four parameter calculations (no. 1 - 4) can be set simultaneously.
- Make the settings with the function keys.

- **1/4**

Function key display	Meaning
OFF	: Disable calculation
AVERAGE	: Average value (☞ Section 15.8 (1))
RMS	: RMS value (☞ Section 15.8 (2))
PEAK-PEAK	: Peak-to-peak value (☞ Section 15.8 (3))
1 ½ to page 2/4	: Switch to 2/4

- **2/4**

Function key display	Meaning
MAXIMUM	Maximum value (☞ Section 15.8 (4))
MAX-TIME	Time to maximum value(☞ Section 15.8 (5))
MINIMUM	Minimum value (☞ Section 15.8 (6))
MIN-TIME	Time to minimum value (☞ Section 15.8 (7))
to page 3/4	Switch to 3/4

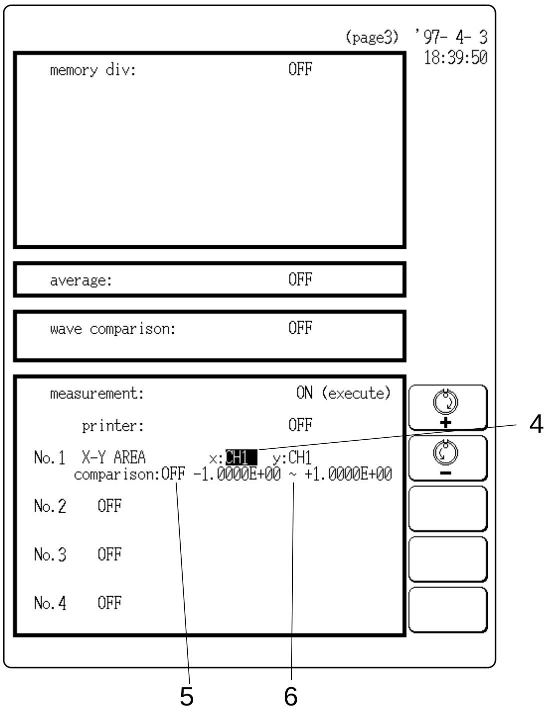
- **3/4**

Function key display	Meaning
PERIOD	Period (☞ Section 15.8 (8))
FREQUENCY	Frequency (☞ Section 15.8 (9))
RISE-TIME	Rise time (☞ Section 15.8 (10))
FALL-TIME	Fall time (☞ Section 15.8 (11))
to page 4/4	Switch to 4/4

- **3/4**

Function key display	Meaning
DEVIATION	Standard deviation (☞ Section 15.8 (12))
AREA	Area (☞ Section 15.8 (13))
X-Y AREA	X-Y area (☞ Section 15.8 (14))
to page 1/4	Switch to 1/4

For details on the various calculation functions, refer to Section 15.8.



(page3) '97- 4- 3
18:39:50

memory div: OFF

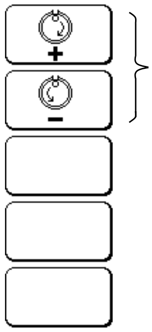
average: OFF

wave comparison: OFF

measurement: ON (execute)
printer: OFF
No.1 X-Y AREA x:CH1 y:CH1
comparison:OFF -1.0000E+00 ~ +1.0000E+00
No.2 OFF
No.3 OFF
No.4 OFF

4. Calculation channel settings

Function key display Meaning



ALL, CH1 to CH16
(ALL: Call channels, CH1 to CH16)

NOTE

Also when ALL is selected, channels where no units are installed and channels for which display/record is set to OFF will not be calculated.

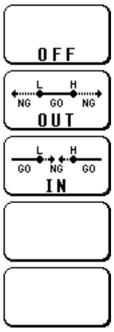
● When "X-Y area" was selected

- Move the flashing cursor to the point shown in the illustration and specify the channel for the X-axis and Y- axis.
- Use the function keys or the JOG control to make the setting.

5. Waveform parameter evaluation settings

For details, see Section 15.3.

Function key display Meaning



: Disable waveform parameter evaluation

: Return NG when result is outside of specified range

: Return NG when result is inside specified range (excluding upper and lower limit)

6. Waveform parameter evaluation range (upper and lower limit) setting

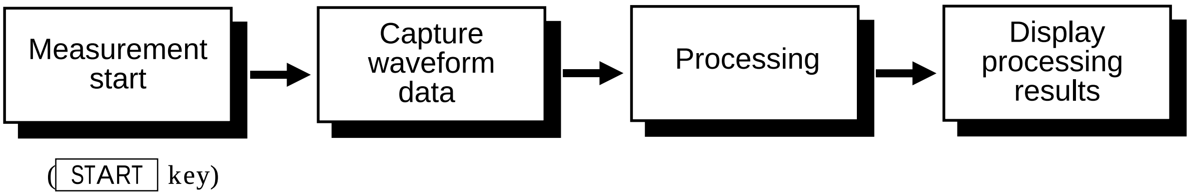
For details, see Section 15.3.

7. Executing waveform parameter calculation

- There are two methods for starting parameter calculation.

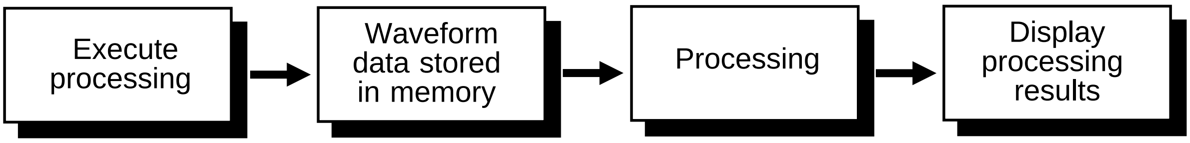
① Parameter calculation while capturing the waveform

1. Set **measurement** to **ON** and make the required settings.
2. Press the DISP key to activate the display screen, and then press the START key.
3. Calculation is performed using the captured waveform data, and the calculation results are displayed.
4. If **printer** was set to **ON**, the calculation results are printed out.



② Parameter calculation of measurement data loaded from MO disk or already present in internal memory

1. Set **measurement** to **ON** and make the required settings.
2. Move the flashing cursor to the **execute** position at the top right of the screen and press the F1 [exec] key.
3. Calculation is carried on the data stored in memory, and the result is displayed on the screen.
4. If **printer** was set to **ON**, the calculation results are printed out.



NOTE

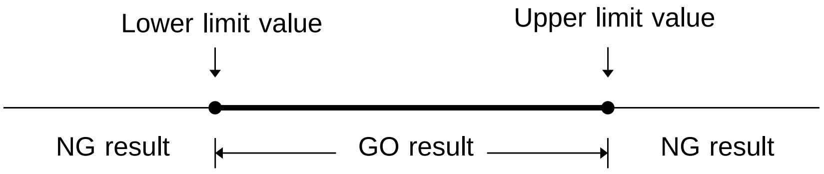
- Calculation is carried out in the order no. 1 through no. 4.
- Also for channels where no input unit is installed, parameter calculation is carried out if waveform processing results or data loaded from MO disk are stored in the channel.
- The scaling setting has no effect. (RMS value and area value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

15.3 Making Settings for Waveform Parameter Evaluation

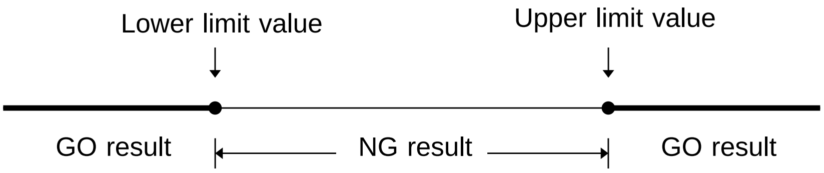
Depending on the results of the waveform parameter calculation, a GO (pass) or NG (fail) result is returned.

Out	NG is returned when result is outside of specified range.
In	NG is returned when result is inside specified range (excluding upper and lower limit).

Out

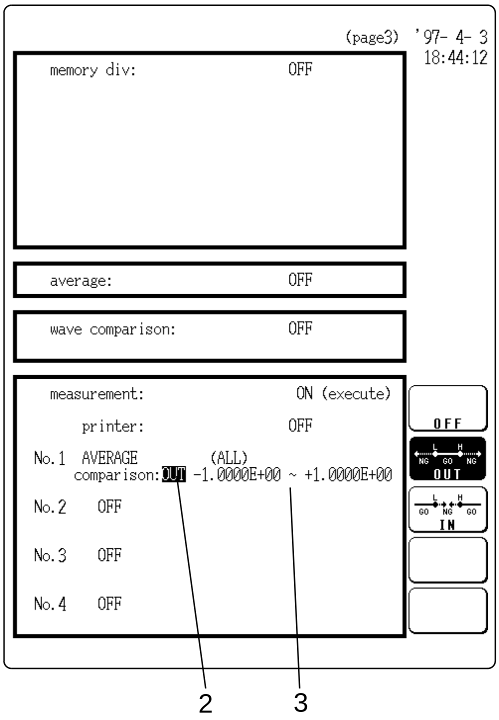


In



Evaluation criteria can be set independently for each of the calculation sets no. 1 - no. 4.

Method Screen: STATUS (page 1)



(page3) '97- 4- 3
18:44:12

memory div: OFF

average: OFF

wave comparison: OFF

measurement: ON (execute)

printer: OFF

No.1 AVERAGE (ALL)
comparison:OUT -1.0000E+00 ~ +1.0000E+00

No.2 OFF

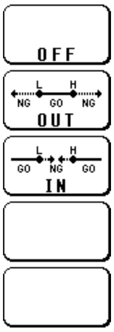
No.3 OFF

No.4 OFF

Move the flashing cursor to the items in the order as shown in the illustration.

1. Make the settings for waveform parameter calculation (☞ Section 15.2).
2. Move the flashing cursor to the **comparison** item and select **OUT** or **IN**.

Function key display Meaning



: Disable evaluation function

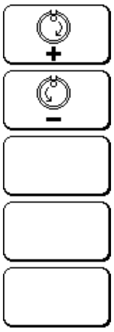
: Return NG if result is outside specified range

: Return NG if result is inside 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.

Function key display Meaning



0 to 9
(-29 to +29 for the most significant digit and exponent.)

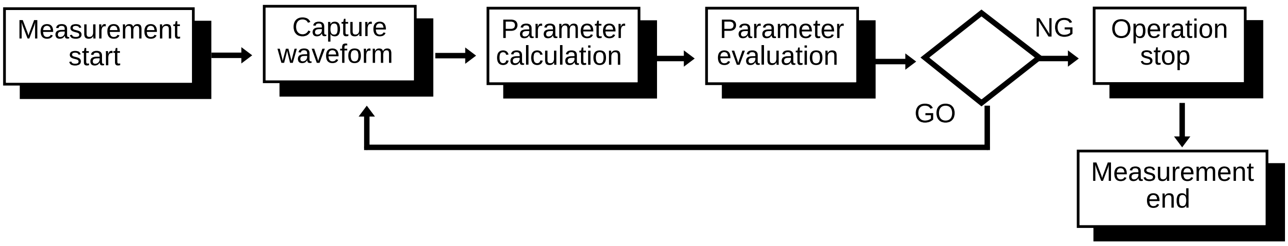
NOTE

- If the setting was made so that lower limit ≧ upper limit, the evaluation result is always NG for the **OUT** setting and always GO for the **IN** setting.
- When the evaluation result is NG, the calculation value for that channel is marked with an "*" (on the display and the printout).

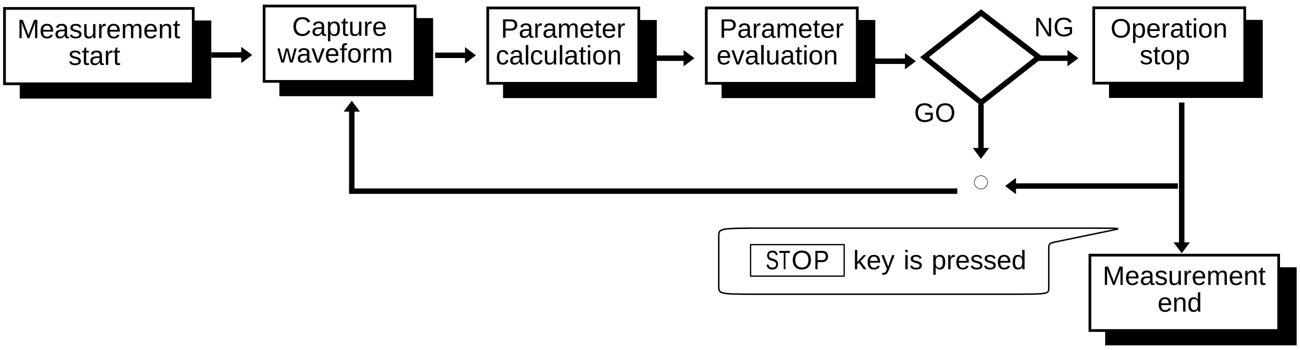
Stop mode and trigger mode

- When waveform parameter evaluation has been set to **OUT** or **IN**, and the START key is pressed to start the measurement, operation will stop when the evaluation result is NG.
- 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 MO disk when operation stops.
- When memory segmentation (sequential save) is ON, data are stored in the memory block only when operation stops.

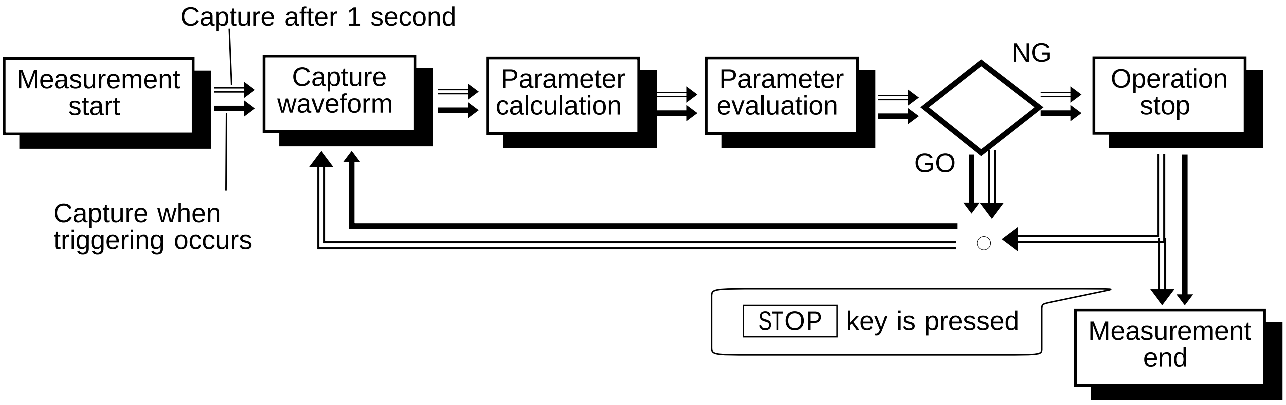
• Trigger mode: SINGLE



• Trigger mode: REPEAT, AUTO



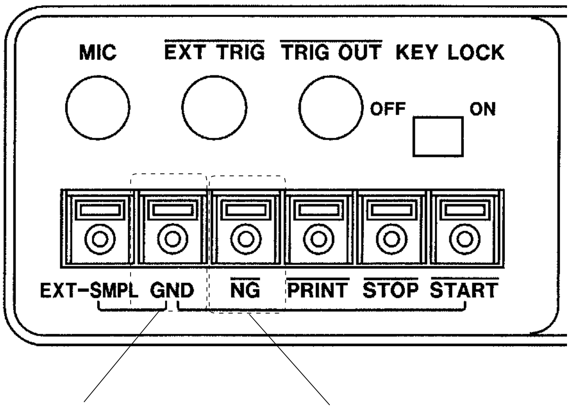
• Trigger mode: AUTO STOP



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

15.4 Using the NG Output

- When the evaluation result is NG, an NG output signal can be obtained between the NG terminal and the GND terminal.
- For details, please refer to the Section 21.6.

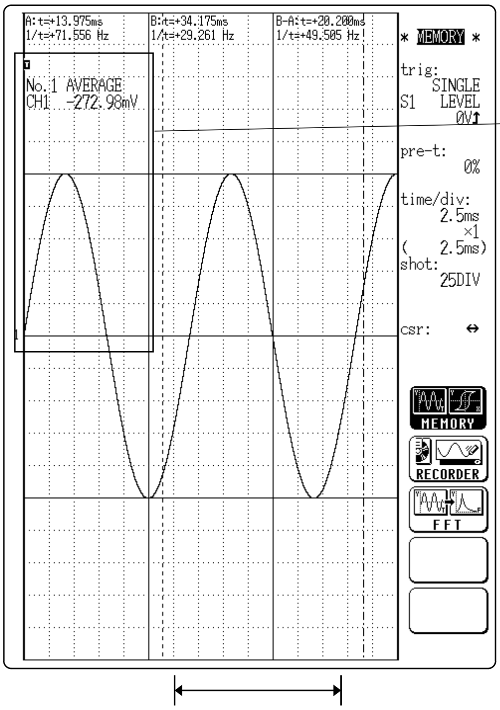


GND terminal NG output terminal

15.5 Specifying a Range for Waveform Parameter Calculation

- The A/B cursors (vertical, trace) can be used to specify a range of waveform data for processing.
- When a range is specified, waveform parameters are calculated only for the data between the A/B cursors.
- When not using the A/B cursors, or when using the horizontal cursor, waveform parameter calculation is carried out for all data.

NOTE When the cursors overlap, calculation is carried out for that point.



```
A:t=+13.975ms      B:t=+34.175ms      B-A:t=+20.200ms
1/t=+71.556 Hz     1/t=+29.261 Hz     1/t=+49.505 Hz

No.1  AVERAGE
CH1   -272.98mV

* MEMORY *
trig:
    SINGLE
S1   LEVEL
       0V↑
pre-t:
        0%
time/div:
     2.5ms
        ×1
(    2.5ms)
shot:
     25DIV
csr:      ↔
```

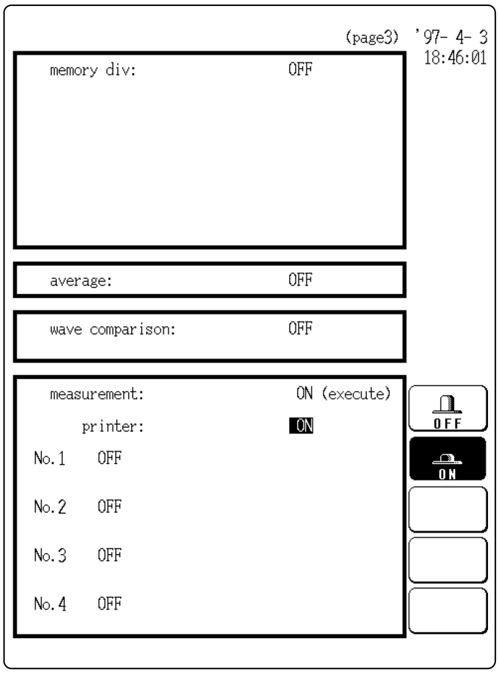
Calculation result for data between cursors is shown

Calculation range

15.6 Printing Out Waveform Parameter Calculation Results

Calculation results can be printed out.

Method Screen: STATUS (page 3)



(page3) '97- 4- 3
18:46:01

memory div: OFF

average: OFF

wave comparison: OFF

measurement: ON (execute)

printer: ON

No.1 OFF

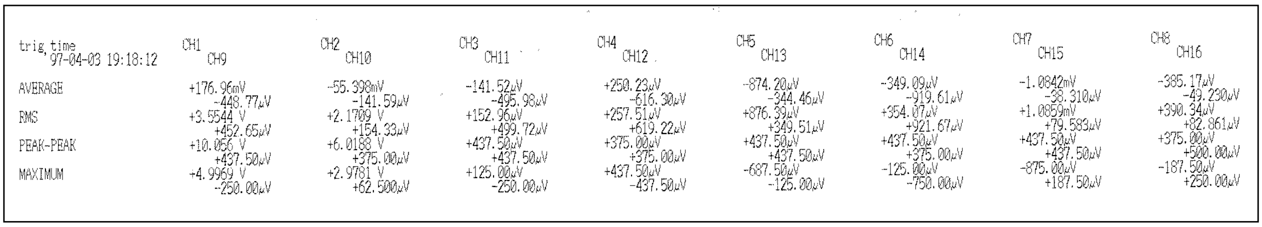
No.2 OFF

No.3 OFF

No.4 OFF

Move the flashing cursor to the **printer** item and set it to **ON**.

Function key display	Meaning
OFF	: Disable printout of parameter calculation results
ON	: Enable printout of parameter calculation results



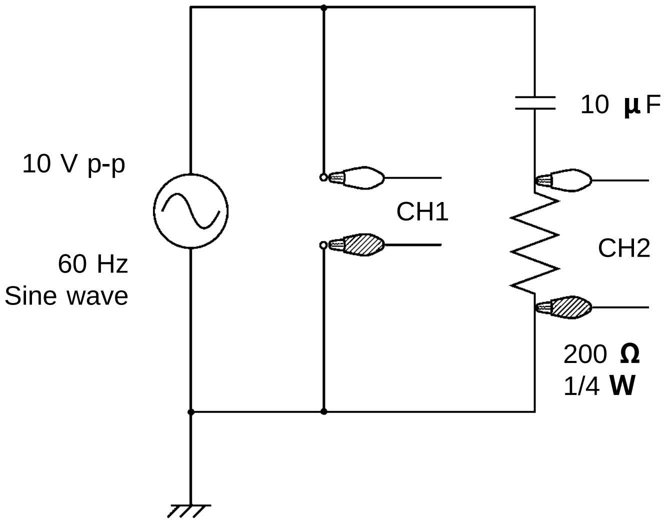
```
trig time     CH1           CH2           CH3           CH4           CH5           CH6           CH7           CH8
  97-04-03 19:18:12  CH9         CH10          CH11          CH12          CH13          CH14          CH15          CH16

AVERAGE       +176.96mV     -55.398mV     -141.52μV     +250.23μV     -874.20μV     -349.09μV     -1.0842mV     -385.17μV
                 -448.77μV     -141.59μV     -495.98μV     -616.30μV     -344.46μV     -919.61μV     -38.310μV     -49.230μV
RMS           +3.5544 V     +2.1709 V     +152.96μV     +257.51μV     +876.39μV     +354.07μV     +1.0859mV     +390.34μV
                 +452.65μV     +154.33μV     +499.72μV     +619.22μV     +349.51μV     +921.67μV     +79.583μV     +82.861μV
PEAK-PEAK     +10.056 V     +6.0188 V     +437.50μV     +375.00μV     +437.50μV     +437.50μV     +437.50μV     +375.00μV
                 +437.50μV     +375.00μV     +437.50μV     +375.00μV     +437.50μV     +375.00μV     +437.50μV     +500.00μV
MAXIMUM       +4.9969 V     +2.9781 V     +125.00μV     +437.50μV     -687.50μV     -125.00μV     -875.00μV     -187.50μV
                 -250.00μV     +62.500μV     -250.00μV     -437.50μV     -125.00μV     -750.00μV     +187.50μV     +250.00μV
```

Print Example

15.7 Waveform Parameter Calculation and Waveform Parameter Evaluation Examples

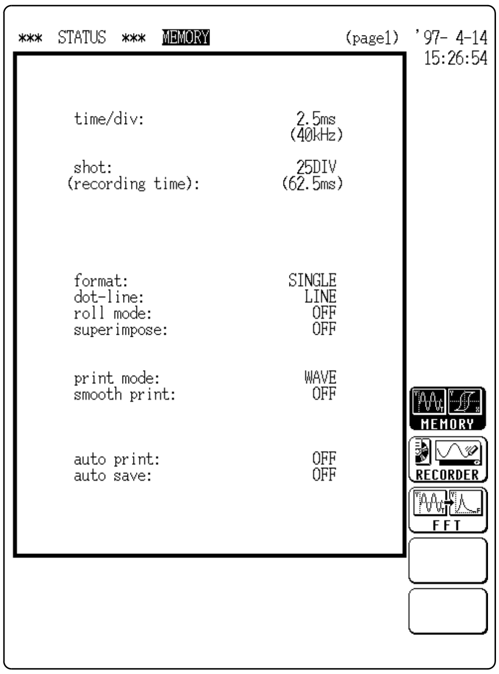
Example

- Using the circuit shown in the illustration, the voltage at the resistor is measured in CH2, and the RMS (effective) voltage is determined.
- Waveform parameter evaluation is carried out to determine whether the RMS voltage is within the permissible range that can be applied to the resistor (1/4 W).
- When the waveform parameter evaluation result is NG, the measurement is terminated.
- The memory recorder function is used.



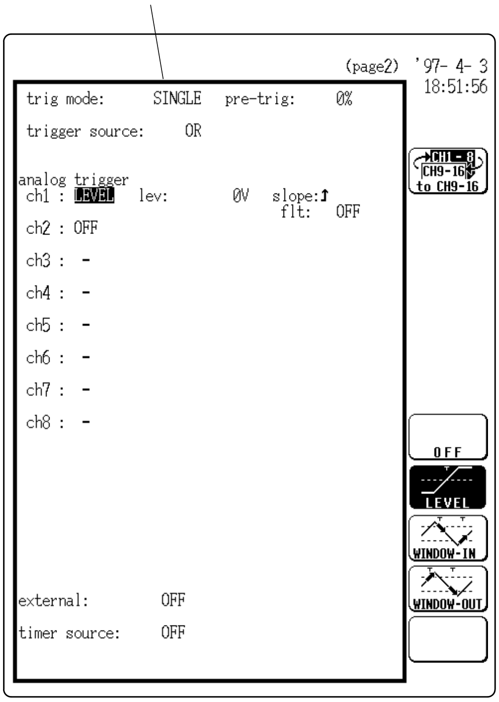
Setting Make the settings on the STATUS screen and the CHANNEL screen of the memory recorder function as follows (☞ Section 5.2.1).

Change the trigger mode to SINGLE so that measurement stops when the evaluation result is NG.



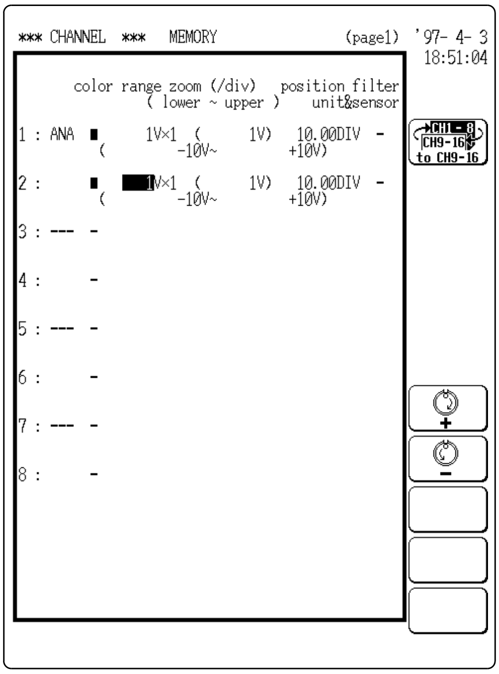
```
*** STATUS *** MEMORY                    (page1) '97- 4-14
                                                  15:26:54

    time/div:                      2.5ms
                                  (40kHz)

    shot:                          25DIV
   (recording time):             (62.5ms)

    format:                       SINGLE
    dot-line:                       LINE
    roll mode:                       OFF
    superimpose:                     OFF

    print mode:                     WAVE
    smooth print:                    OFF

    auto print:                      OFF
    auto save:                       OFF
```

Status Screen (page 1)



```
                                        (page2) '97- 4- 3
                                                 18:51:56
 trig mode:      SINGLE   pre-trig:     0%
 trigger source:    OR

analog trigger
 ch1 : LEVEL    lev:        0V   slope:↑
                                  flt:   OFF
 ch2 : OFF
 ch3 :  -
 ch4 :  -
 ch5 :  -
 ch6 :  -
 ch7 :  -
 ch8 :  -

external:        OFF
timer source:    OFF
```

Status Screen (page 2)

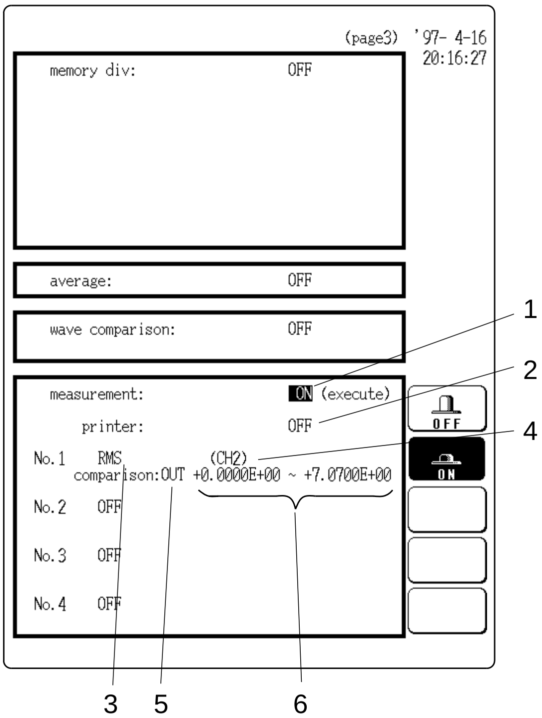


```
*** CHANNEL  ***   MEMORY                (page1) '97- 4- 3
                                                  18:51:04
       color range zoom (/div)   position filter
                ( lower ~ upper )    unit&sensor
1 : ANA  ■      1V×1  (      1V)   10.00DIV  -
          (          -10V~         +10V)
2 :      ■      1V×1  (      1V)   10.00DIV  -
          (          -10V~         +10V)
3 : ---  -
4 :      -
5 : ---  -
6 :      -
7 : ---  -
8 :      -
```

Channel Screen (page 1)

Make settings for CH1 in the same way as for CH1.

Method



(page3) '97- 4-16 20:16:27

memory div: OFF

average: OFF

wave comparison: OFF

measurement: ON (execute)

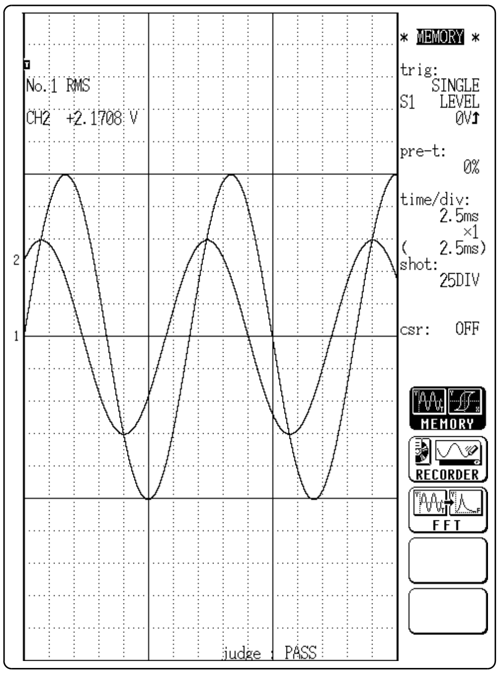
printer: OFF

No.1 RMS (CH2)
comparison:OUT +0.0000E+00 ~ +7.0700E+00

No.2 OFF

No.3 OFF

No.4 OFF



* MEMORY *

trig: SINGLE
S1 LEVEL 0V↑

pre-t: 0%

time/div: 2.5ms ×1 (2.5ms)

shot: 25DIV

csr: OFF

No.1 RMS
CH2 +2.1708 V

judge : PASS

1. Set "Waveform parameter calculation" on the STATUS screen (page 3) to **ON** by pressing the F2.
2. Set the printer to **OFF**.
3. Move the flashing cursor to the No. 1 item and select F3 [RMS].
4. Set the channel to **CH2**.
5. Select F2 [OUT] for waveform parameter evaluation.
6. Since the maximum RMS voltage that can be applied to the 1/4 W 200 Ω resistor is 7.07 V, set the evaluation range as follows.

   0.0000E+0 - 7.0700E+0
7. Press the DISP key to activate the display screen.
8. Press the START key to start the measurement. When an NG result occurs, the measurement is terminated.

When wishing to terminate the measurement beforehand, press the STOP key.

15.8 Parameter Calculation Details

(1) Average value

- Calculates the average value (V) of the waveform data.
- Equation:

$$AVE = \frac{1}{n}\sum_{i=1}^{n} di$$

AVE: average value
n: number of data samples
d_i : i-th data of the source channel

(2) RMS value

- Calculates the RMS (effective) value (V) of the waveform data.
- When scaling is used, the value is calculated after scaling
- Equation:

$$RMS = \sqrt{\frac{\sum_{i=1}^{n} di^2}{n}}$$

RMS: effective value
n: number of data samples
d_i : i-th data of the source channel

(3) Peak-to-peak value

Calculates the peak-to-peak (maximum-minimum) value of the waveform data.

(4) Maximum value

Calculates the maximum value of the waveform.

(5) Time to maximum value

- Calculates the time interval from the triggering point to the maximum value of the waveform (in seconds).
- If there are two maximum value points, the time to the point nearest the trigger point is calculated.

(6) Minimum value

Calculates the minimum value of the waveform.

(7) Time to minimum value

- Calculates the time interval from the triggering point to the minimum value of the waveform (in seconds).
- If there are two minimum value points, the time to the point nearest the trigger point is calculated.

(8) Period

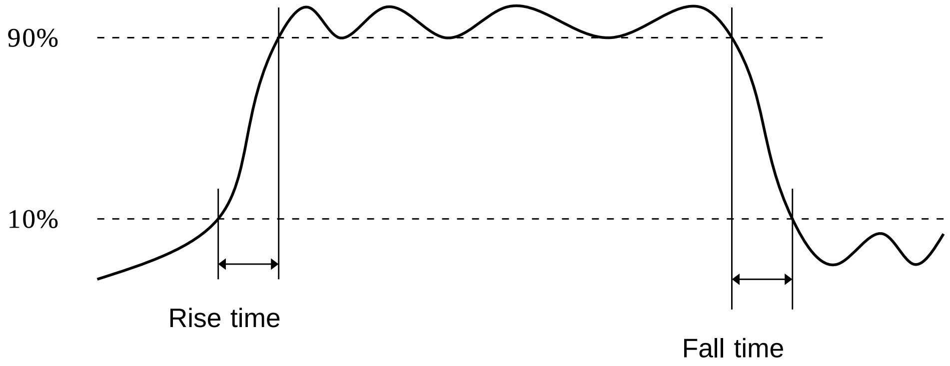
(9) Frequency

- Displays the period (s) and frequency (Hz) of the signal waveform.
- The calculation is performed by determining the middle point of the signal amplitude and then measuring the interval from the point when that level is crossed (in rising or falling direction) to the point when it is next crossed.

(10) Rise time

(11) Fall time

- From the captured waveform data, the 0% and 100% level is determined, and the rise time (s) is taken as the time required to go from 10% to 90% (fall time: from 90% to 10%).
- In the captured waveform data, the first rising slope (or falling slope) is used to make the calculation.
- If the A/B cursors (vertical, trace) are used, the first rising slope (or falling slope) within the range defined by the cursors is used.



(12) Standard deviation

- Calculates the standard deviation (V) of the waveform data.
- Equation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(di - AVE)^2}{n}}$$

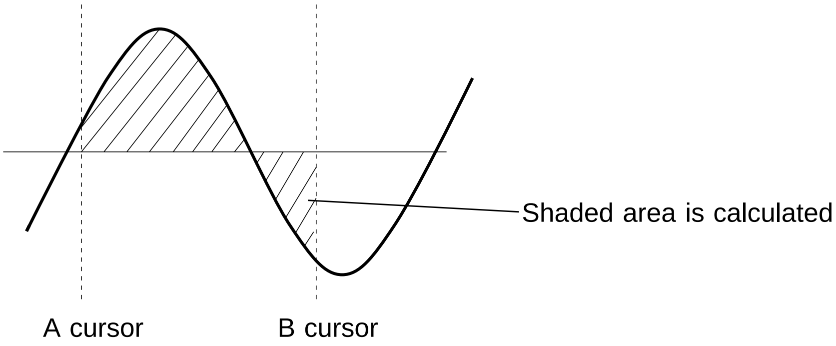
σ: standard deviation
AVE: average value
n : number of data samples
d_i : i-th data of the source channel

(13) Area value

- Calculates the area bordered by the signal waveform and the zero position (potential 0 V).
- If the A/B cursors (vertical, trace) are used, the area between the cursors is calculated.
- Equation:

$$S = \sum_{i=1}^{n}|di| \cdot h$$

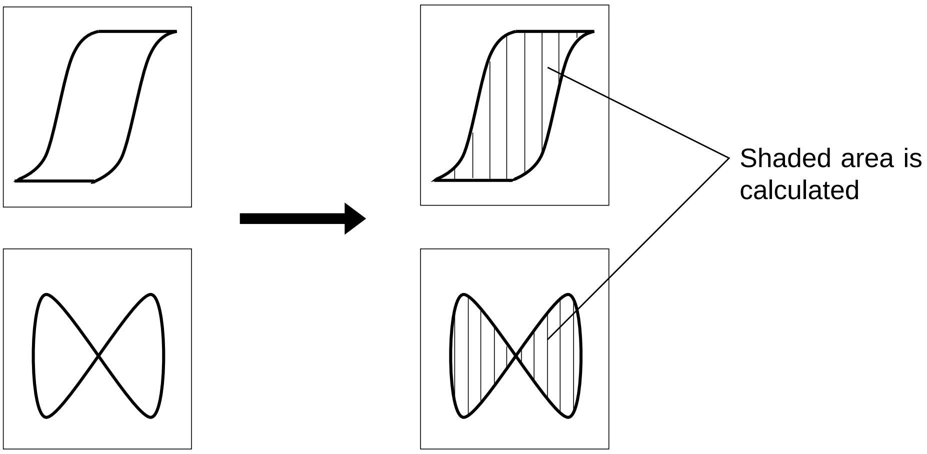
S : Area value
n : number of data samples
d_i : i-th data of the source channel
h = Δt : sampling period



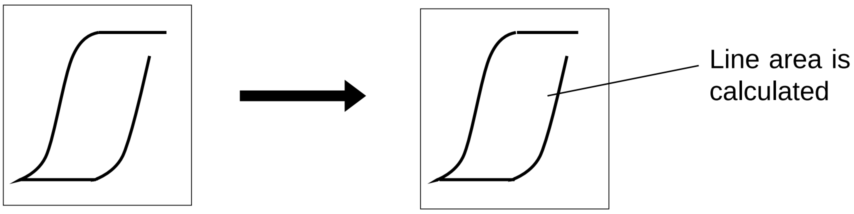
(14) X-Y area value

- Calculates the area (V^2) after X-Y plotting.
- The waveform is plotted on the X-Y screen, and the area enclosed by the plot lines is calculated.
- In single, dual, quad, or octo screen, the A/B cursors (vertical, trace) can be used to specify the range (see Section on cursor use) for X-Y plotting and area calculation.
- On the X-Y screen of the memory recorder function, it is not possible to specify the range with the A/B cursors.

X-Y waveform



X-Y waveform (no enclosed range)



NOTE

- Depending on the signal waveform, values for parameters (8), (9), (10), and (11) may not be displayed.
- When the scaling function is used, scaling is first applied to waveform data, and then the parameters are calculated. The parameter unit is determined by the scaling unit (☞ Section 11.5).

Chapter 16
Waveform GO/NG Evaluation

16.1 Overview

- 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.
- When the evaluation result is NG, an NG signal is output from the NG terminal.
- The waveform evaluation function can be used from the following screens:

  Memory recorder (single screen, X-Y single screen)
  FFT (single screen, Nyquist screen)

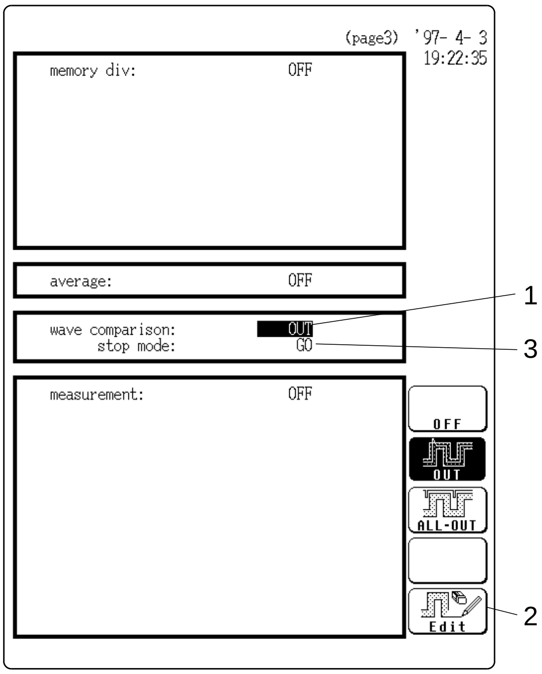
16.2 Waveform Evaluation Settings

The waveform evaluation function can be used from the following functions and screens:

- Memory recorder function (single screen, X-Y single screen)
- FFT (single screen, Nyquist screen)

Method Screen: STATUS (page 3) in the memory recorder and FFT functions

Display the respective page of the STATUS screen and move the flashing cursor to the **wave comparison** item.


(page3) '97- 4- 3 19:22:35

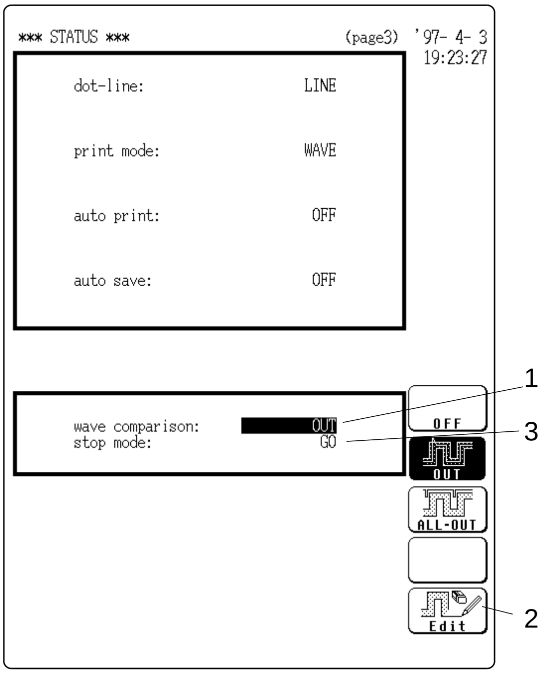
memory div: OFF

average: OFF

wave comparison: OUT
stop mode: GO

measurement: OFF

Memory recorder function


*** STATUS *** (page3) '97- 4- 3 19:23:27

dot-line: LINE

print mode: WAVE

auto print: OFF

auto save: OFF

wave comparison: OUT
stop mode: GO

FFT function

1. Waveform evaluation mode setting (wave comparison)

Select the waveform evaluation conditions (Out, All- Out).

Function key display		Meaning
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

2. Setting up the waveform evaluation area (☞ Section 16.3)

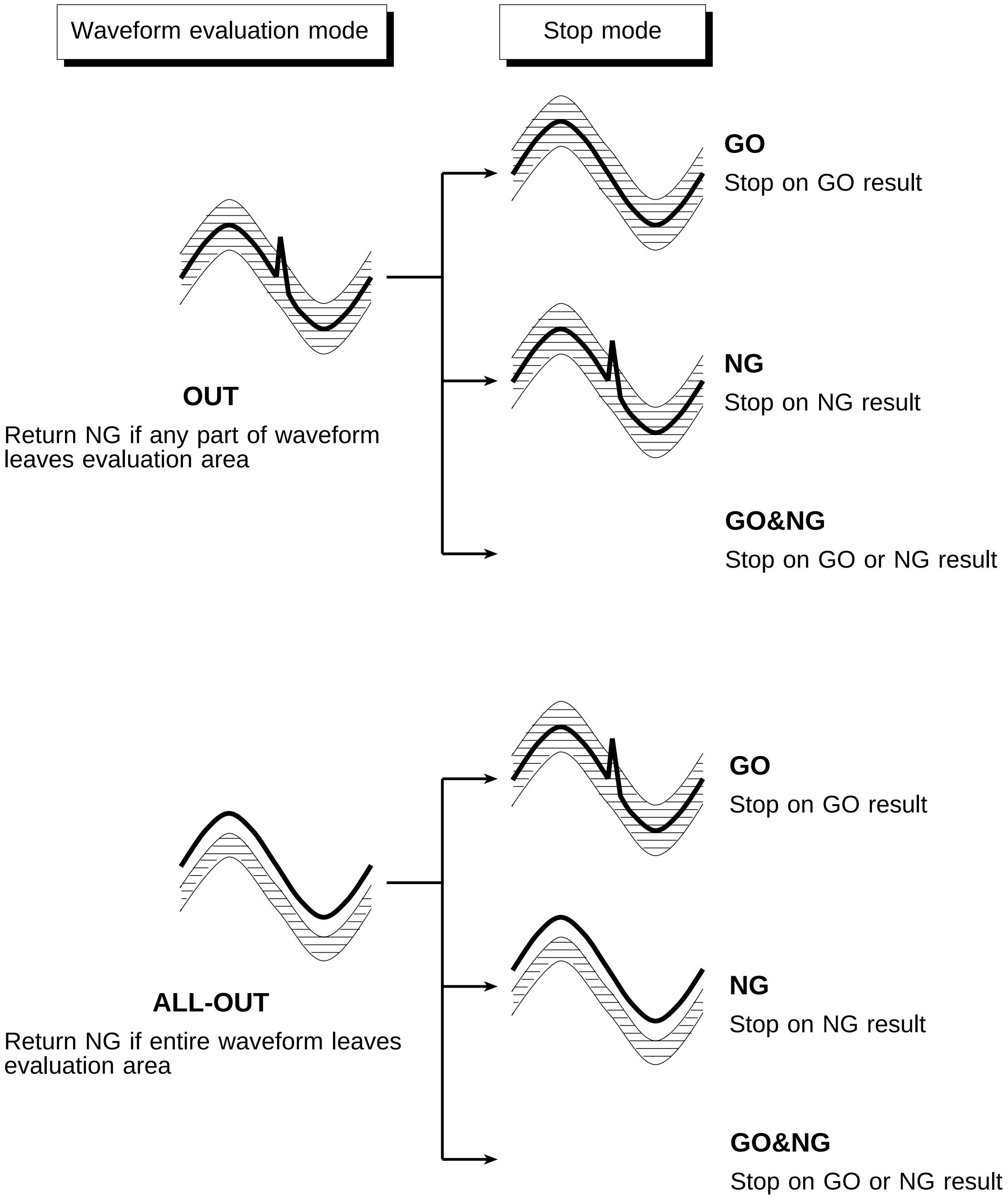
- Define the area to be used as reference for waveform evaluation.
- Press the F5 [Edit] key to activate the editor and create the area.

3. Setting the GO/NG stop mode

- When waveform evaluation is activated (Out or All-Out setting is selected), the **stop mode** item appears.
- This setting determines whether operation is stopped on the GO or NG result.

Function key display		Meaning
GO	:	Stop recording on GO result
NG	:	Stop recording on NG result
GO&NG	:	Stop recording on GO or NG result

Waveform evaluation mode and stop mode



OUT

Return NG if any part of waveform leaves evaluation area

GO

Stop on GO result

NG

Stop on NG result

GO&NG

Stop on GO or NG result

ALL-OUT

Return NG if entire waveform leaves evaluation area

GO

Stop on GO result

NG

Stop on NG result

GO&NG

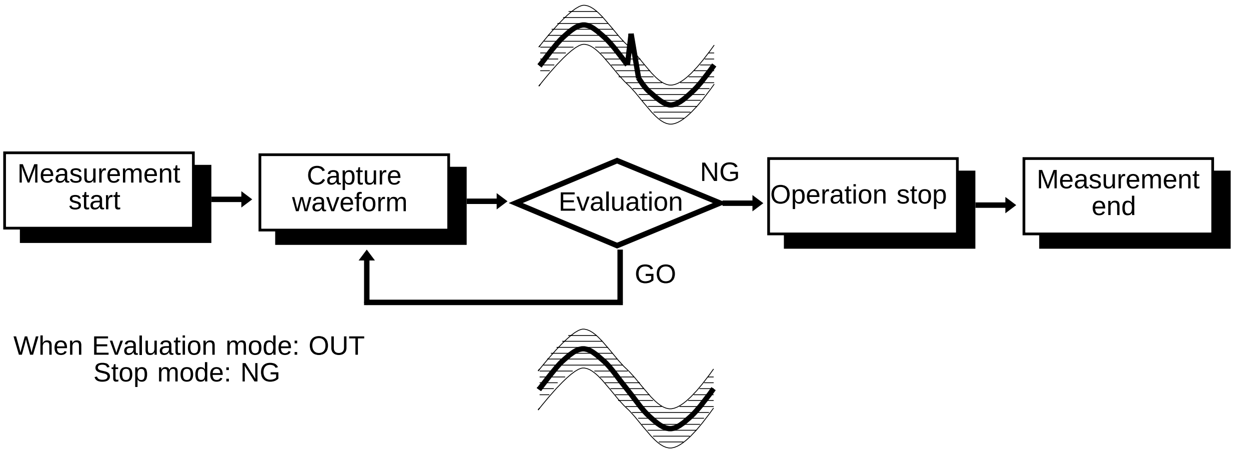
Stop on GO or NG result

Stop mode and trigger mode

- When the evaluation mode and stop mode conditions are fulfilled, measurement operation stops.
- When **auto print** is set to **ON**, the waveform is printed out when operation stops.
- When **auto store** is set to **ON**, data are stored on MO disk when operation stops.
- When memory segmentation (sequential save) is ON, data are stored in the memory block only when operation stops.

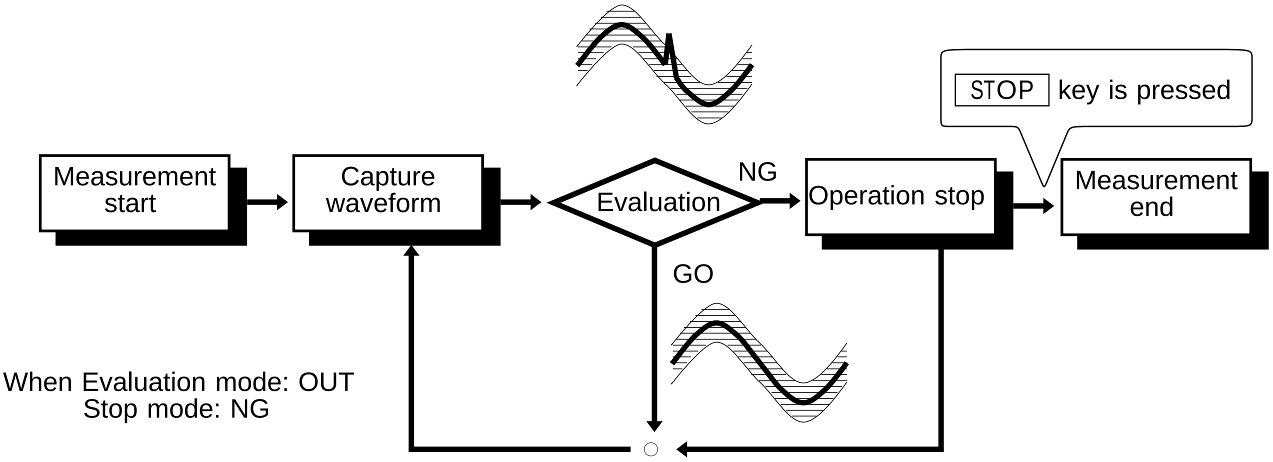
① Trigger mode: SINGLE

Measurement continues until stop mode conditions are fulfilled and then stops.



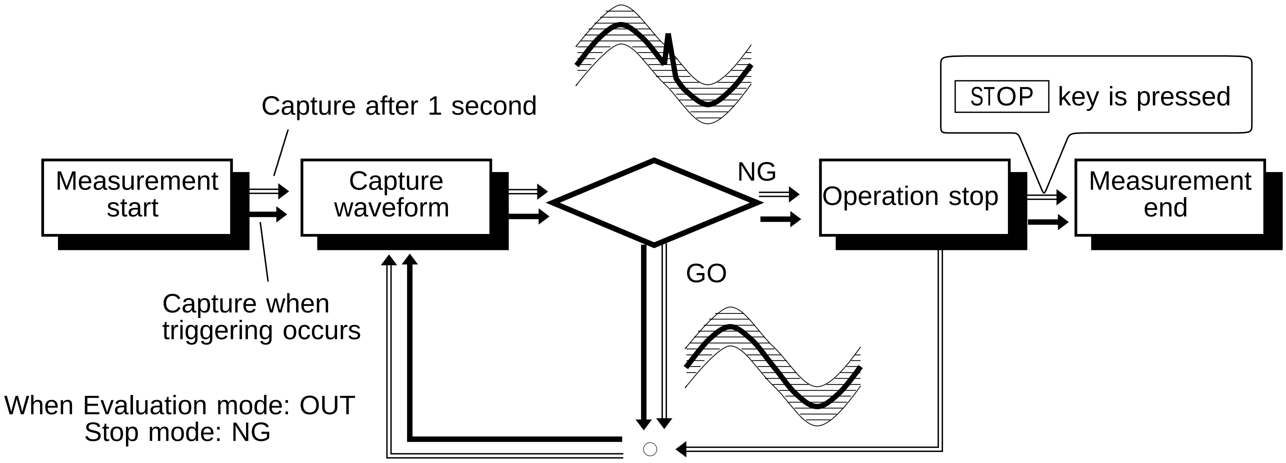
② Trigger mode REPEAT, AUTO

- Recording and waveform evaluation is carried out continuously.
- Press the STOP key to terminate the measurement.



③ Trigger mode: AUTO STOP

Measurement stops when trigger mode conditions are fulfilled and triggering occurs.



NOTE

- 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.
- For reference, the table below shows the evaluation period when evaluating about two cycles of a sine wave on one screen.

(Input waveform so that result is always GO in evaluation mode OUT)

Number of evaluation channels	Time axis (ms/DIV)	Recording length (DIV)	Magnification/compression	Dot/line indication	Evaluation period (s)
1	1	25	×1	Dot	Approx. 1.83
1	1	25	×1	Line	Approx. 1.75
2	1	25	×1	Line	Approx. 1.78

- If a high setting is chosen for recording length or if compression is used, the evaluation cycle becomes slower.
- When waveform parameter measurement and waveform evaluation are carried out simultaneously, the waveform evaluation stop mode is given priority.

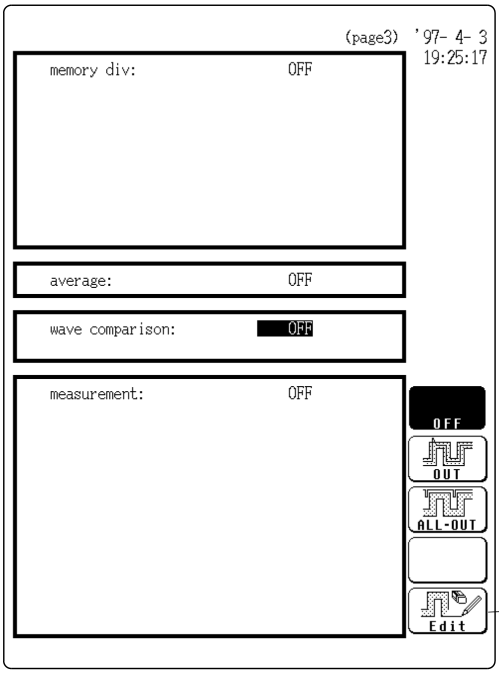
16.3 Creating the Evaluation Area

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

Method Screen: STATUS (page 3) in the memory recorder and FFT functions

1. Activating the editor

- Move the flashing cursor to the **wave comparison** item.
- Press F5 [Edit].



(page3) '97- 4- 3 19:25:17

memory div: OFF

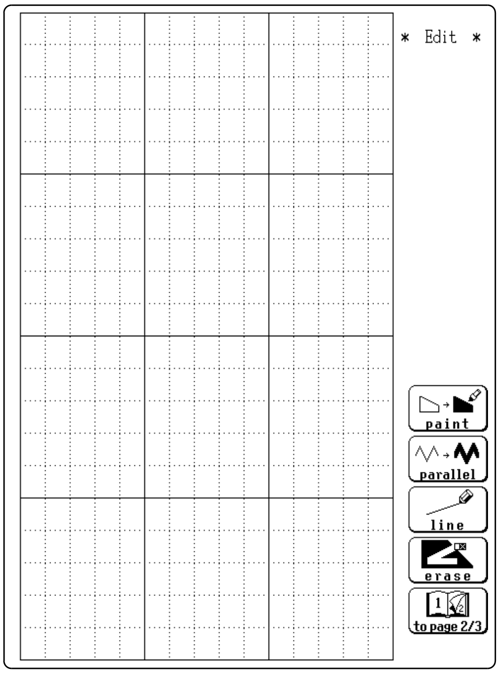
average: OFF

wave comparison: OFF

measurement: OFF

2. Editor commands

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



- **1/3**

Function key display	Meaning
paint	: Fill in a closed area
parallel	: Parallel shift
line	: Draw a straight line
erase	: Erase
to page 2/3	: Switch to 2/3

- **2/3**

Function key display	Meaning
storage	: Import waveform into editor
reverse	: Display filled-in area in reverse
all clear	: Clear screen
clear area	: Clear area
to page 3/3	: Switch to 3/3

- **3/3**

Function key display	Meaning
~~(exec)~~ undo	Undo immediately preceding command
save area	Store area in memory
Edit end	Quit editor
3 to page 1/3	Switch to 1/3

For details see Section 16.4.

3. Use these commands to create the evaluation area.
4. When the area has been stored in memory, it can be used for waveform evaluation.
5. Press the F4 [end] function key to terminate the editor.

NOTE

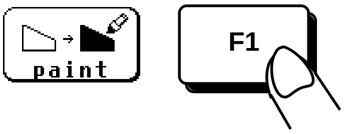
When the message "printing" or a warning message is displayed on the screen, the immediately preceding command is canceled (same as the undo command).

16.4 Editor Command Details

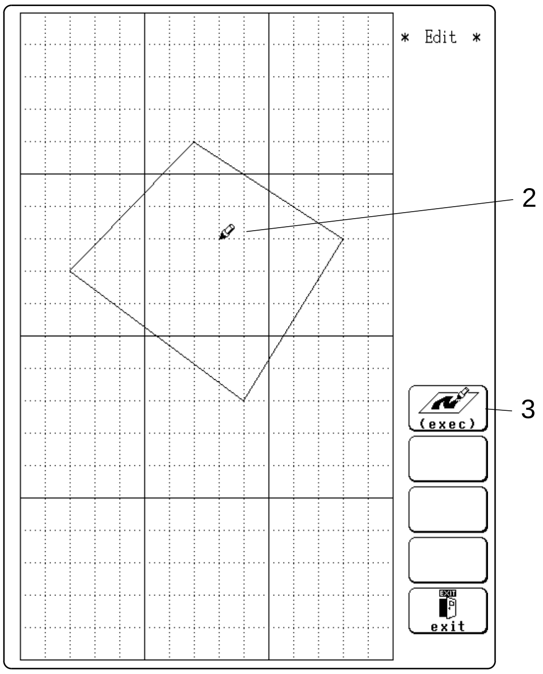
■ Paint .... Function key display: 1/3

Fills in an enclosed area.

Method

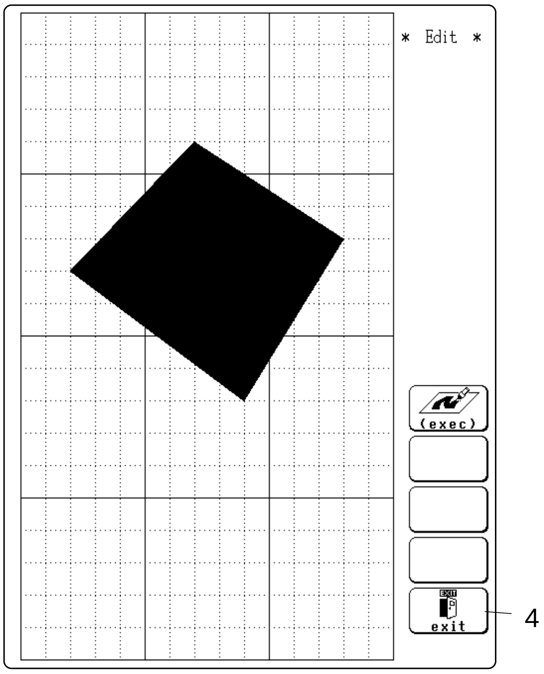


1. Press F1 [paint].



2. Use the CURSOR keys to move the ✎ mark to the area to be filled in.
3. Press the F1 [exec] key. The area completely enclosed by lines is filled in.

Function key display	Meaning
(exec)	: Execute paint
exit	: Terminate paint mode



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

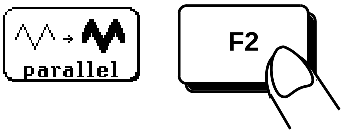
NOTE

If the area is not completely enclosed, adjacent areas will also be filled in.

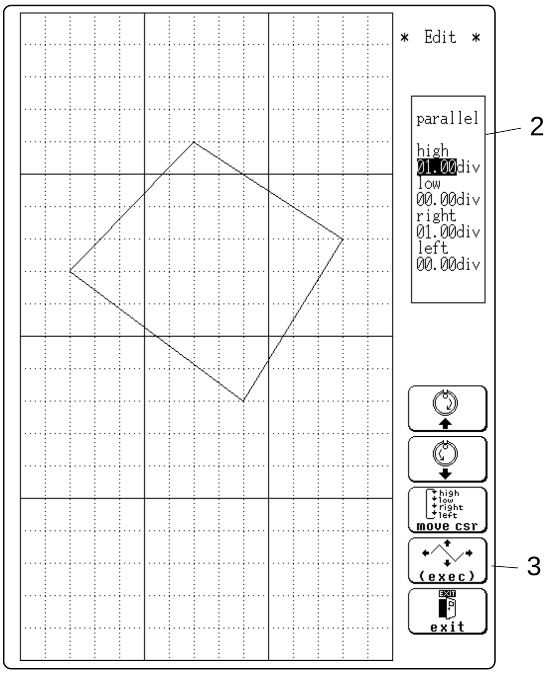
■ Parallel shift .... Function key display: 1/3

Shifts the line pattern in parallel direction, to create an area.

Method



1. Press F2 [parallel].



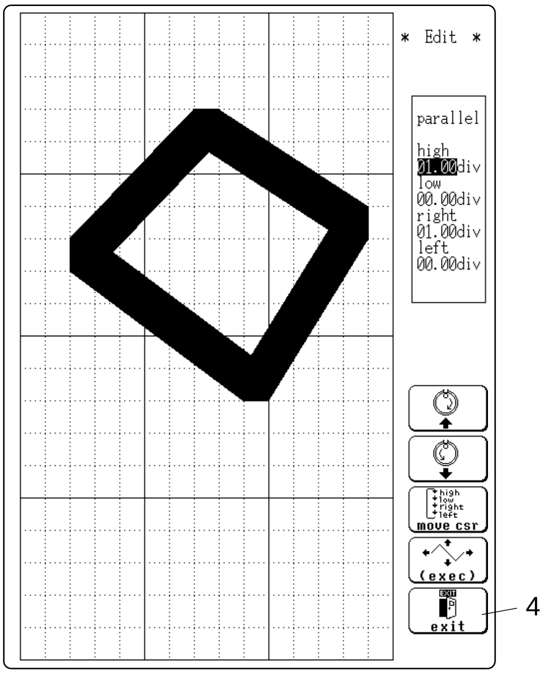
parallel
high
01.00div
low
00.00div
right
01.00div
left
00.00div

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.
- Minimum shift increments are shown in the following table.

Function	Screen	Movement
Memory recorder	Single	0.04
	X-Y single	
FFT	Single	0.05
	Nyquist	

Function key display	Meaning
↑	: Increase shift amount
↓	: Decrease shift amount
high low right left move csr	: Cycle the cursor through up/down/right/left
(exec)	: Execute parallel shift
EXIT exit	: Terminate parallel shift mode



parallel
high
01.00div
low
00.00div
right
01.00div
left
00.00div

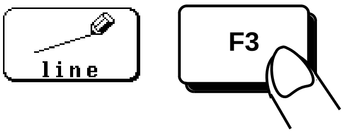
3. Press the F4 [exec] key. The parallel shift is carried, thereby creating the evaluation area.

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

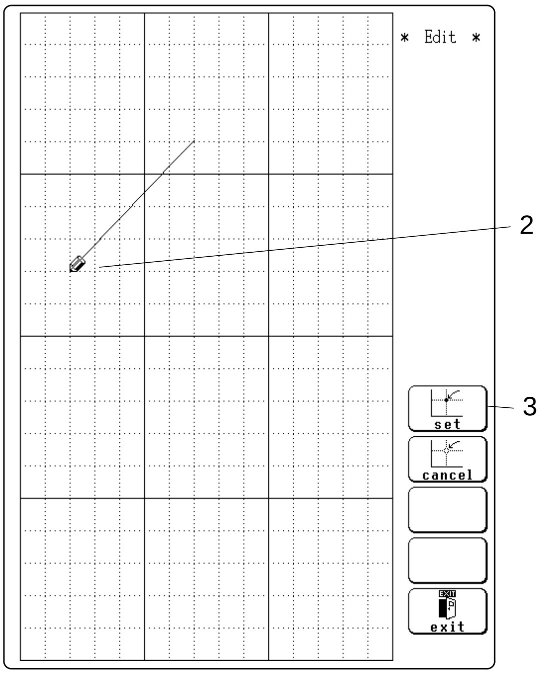
■ Line .... Function key display: 1/3

Serves to draw a straight or polygonal line.

Method

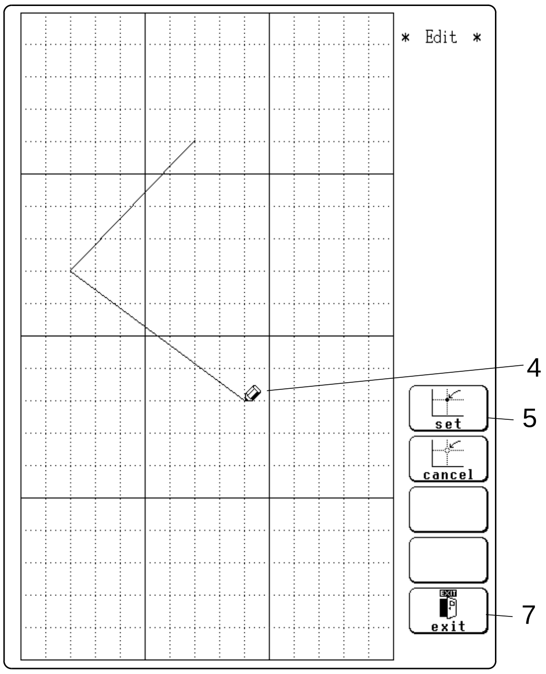


1. Press F3 [line].



2. Use the CURSOR keys to move the ✎ mark to the start point of the line.
3. Press F1 [set].

Function key display		Meaning
set	:	Set the point under the ✎ mark as start/end point
cancel	:	Cancel the immediately preceding set point
exit	:	Terminate line mode

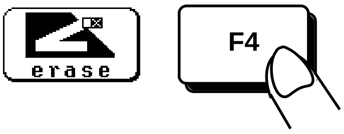


4. Move the ✎ mark. A line is drawn between the set point and the ✎ mark.
5. Press the F1 [set] key again. The color of the line changes, and it is fixed.
6. Repeat steps 4 and 5 when wishing to draw a polygonal line.
7. Press the F5 [exit] key to terminate the line mode.

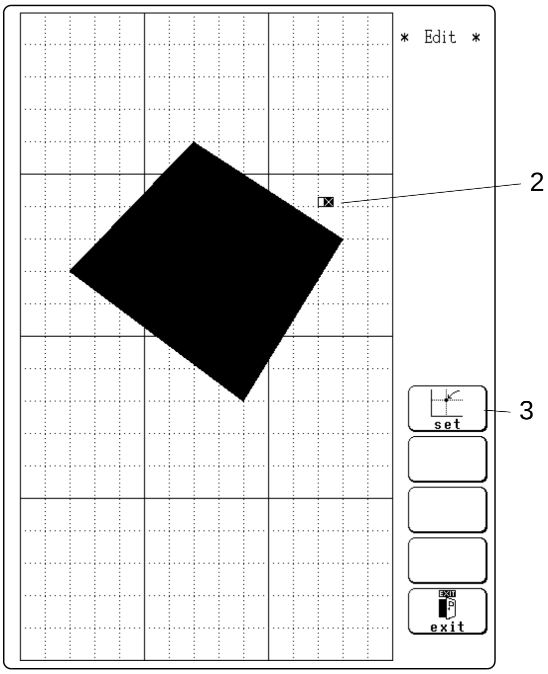
■ Erase .... Function key display: 1/3

Serves to erase unwanted sections.

Method

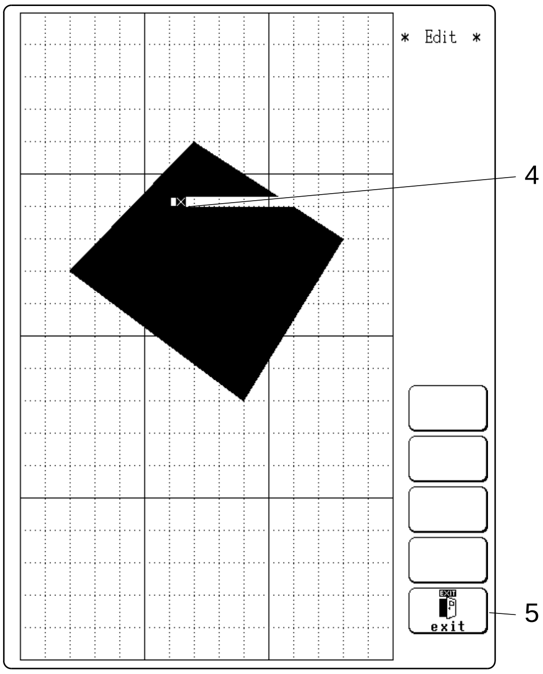


1. Press F4 [erase].



2. Use the CURSOR keys to move the ☒ mark to the start point of the section to be erased.
3. Press F1 [set].

Function key display	Meaning
set	: Set the eraser
exit	: Terminate erase mode

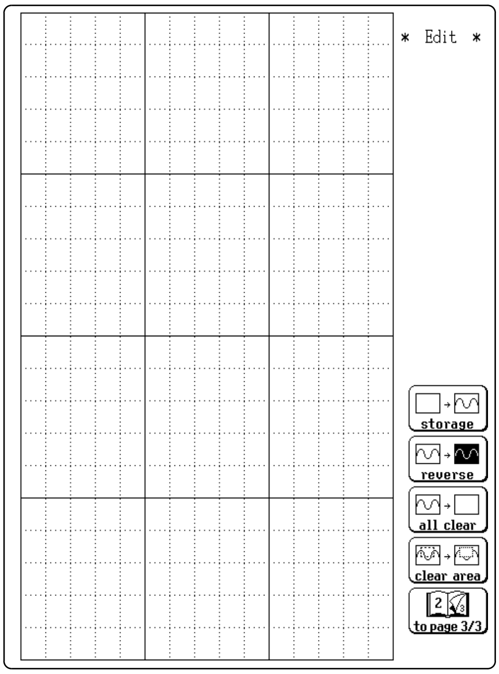


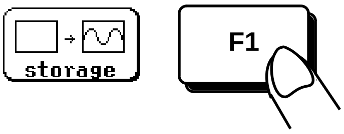
4. Move the ☒ mark to erase the unwanted section.
5. Press the F5 [exit] key to terminate the erase mode.

■ Import waveform .... Function key display: 2/3

Loads a waveform already stored in memory into the editor.

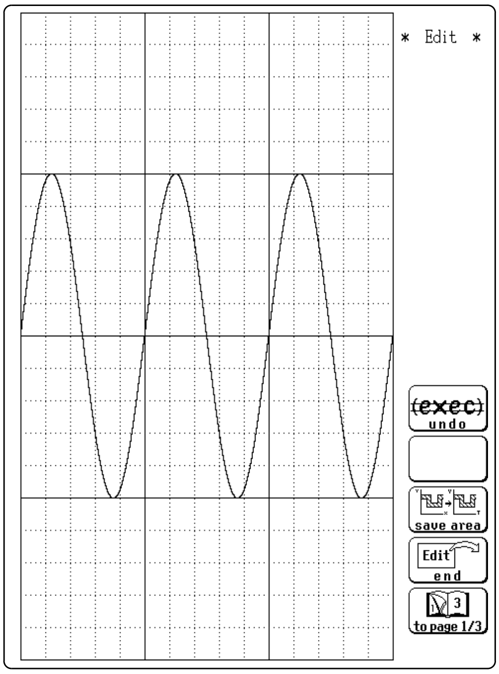
Method





Press F1 [storage].

The waveform that was displayed on the screen is loaded into the editor.



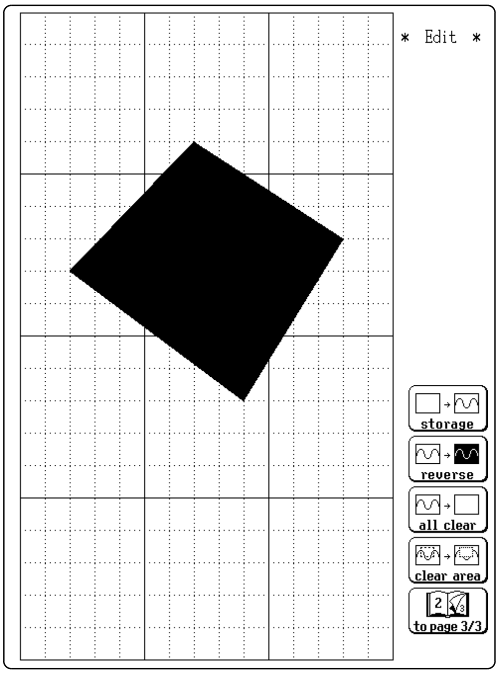
NOTE

The imported waveform is shown in a different color from the original setting.

■ **Reverse** .... Function key display: 2/3

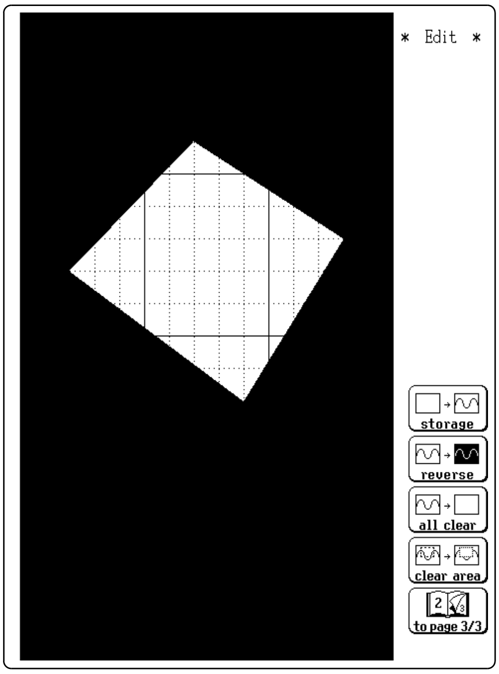
Reverses the colors of a filled-in area and the surrounding area.

Method



Press F2 [reverse].

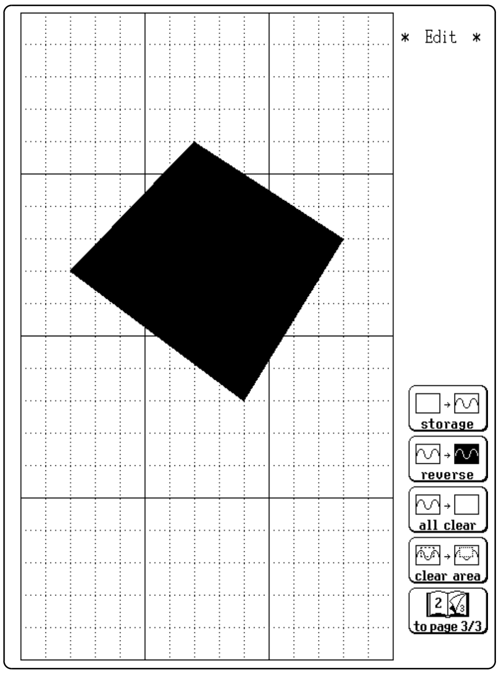
Displays filled in area in reverse.

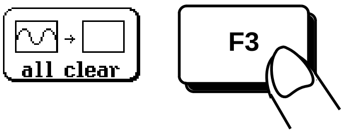


■ Clear screen .... Function key display: 2/3

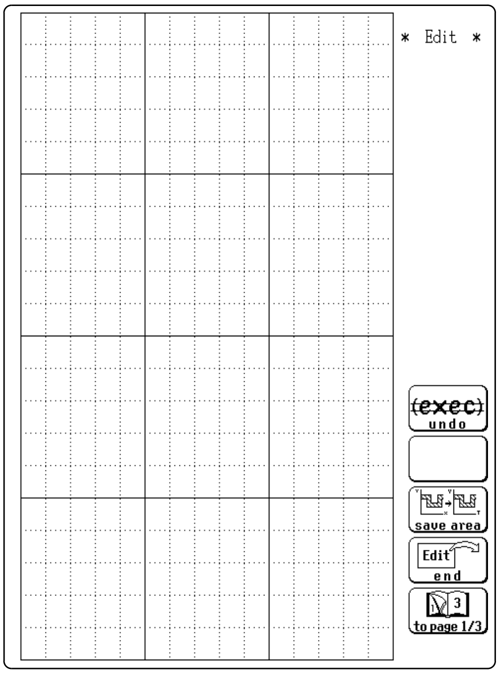
Clears the entire editor screen.

Method





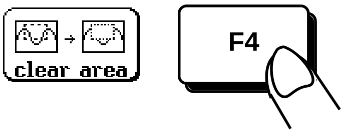
Press F3 [all clear].



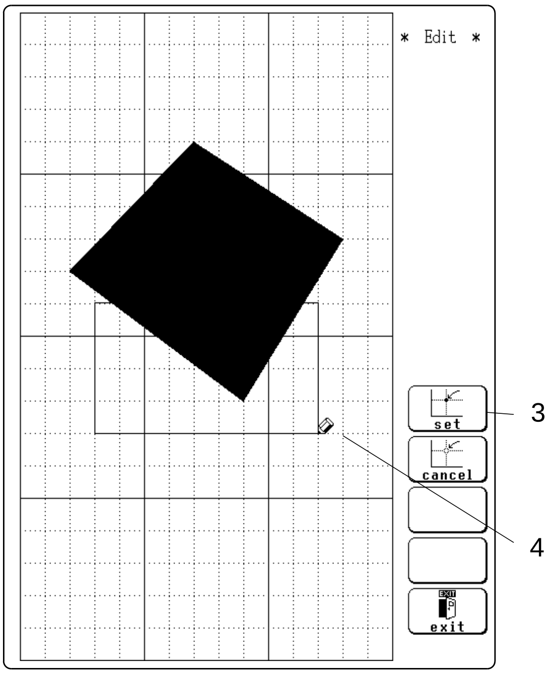
■ Clear area .... Function key display: 2/3

Clears a specified rectangular area of the editor screen.

Method



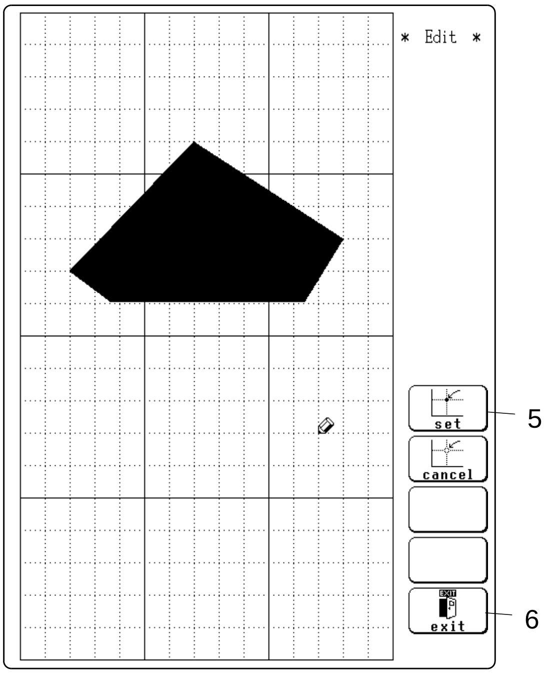
1. Press F4 [clear area].



2. Use the CURSOR keys to move the ✎ mark to the start corner of the area to be erased.
3. Press F1 [set].

Function key display		Meaning
set	:	Set start/end corner
exit	:	Terminate clear area mode

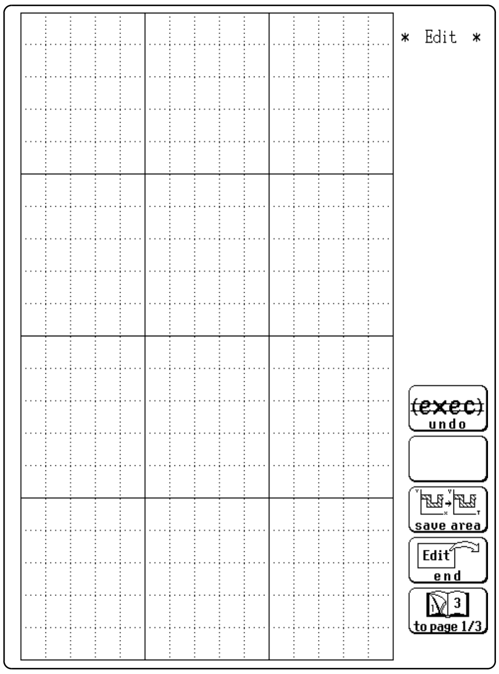
4. Move the ✎ mark to the end corner of the area to be erased.
5. Press the F1 [set] key again. The rectangular area is cleared.
6. Press the F5 [exit] key to terminate the clear area mode.



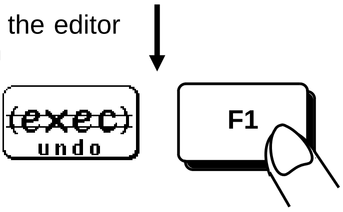
■ Undo .... Function key display: 3/3

- Serves to undo the immediately preceding command.
- Undo is applicable to all commands except **STORE** and **QUIT EDITOR**.

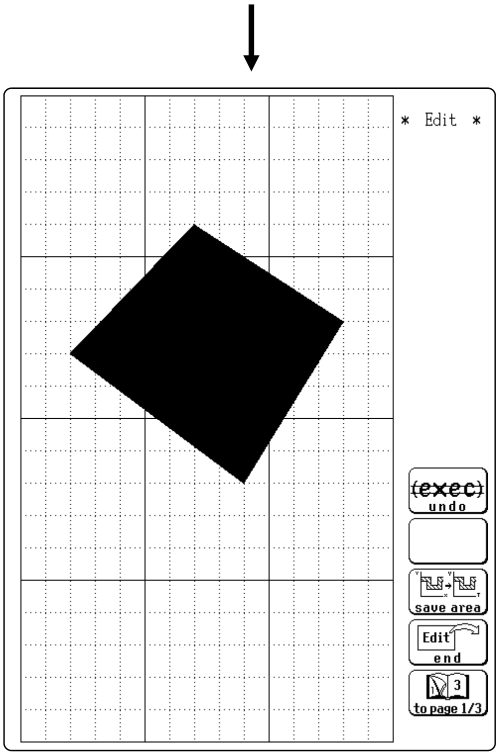
Method



Clears the editor screen



Press F1 [undo].

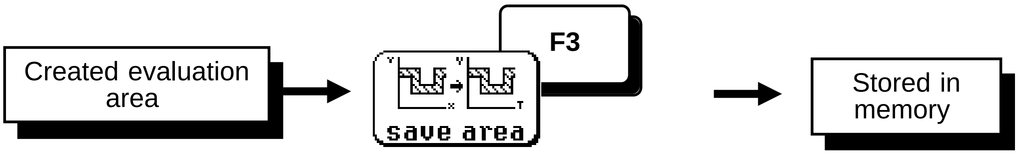


Screen before "clear screen" is restored.

Store area in memory (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.

Method Press the F3 [save area] key.



Quit editor (function key display: 3/3)

Terminates the editor.

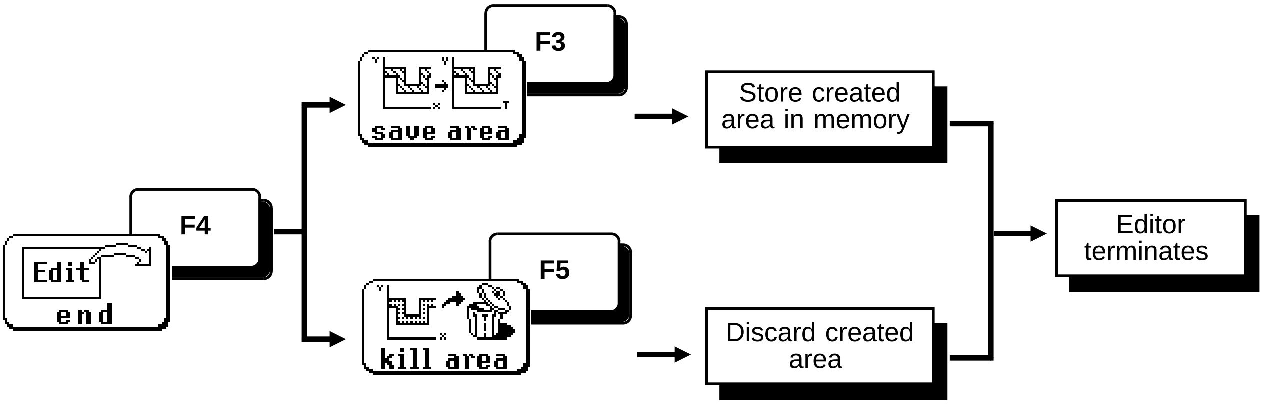
Method

① Store evaluation area in memory and quit editor

- Press the F4 [end] key and then the F3 [save area] key.
- The stored area can be used for waveform evaluation.

② Quit editor without storing evaluation area in memory

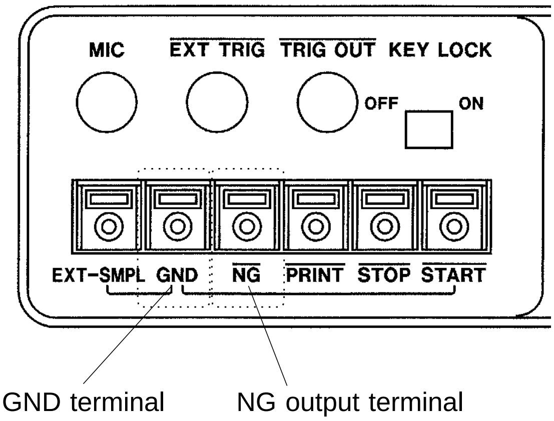
- Press the F4 [end] key and then the F5 [kill area] function key.
- The created area will be discarded. 1.



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.

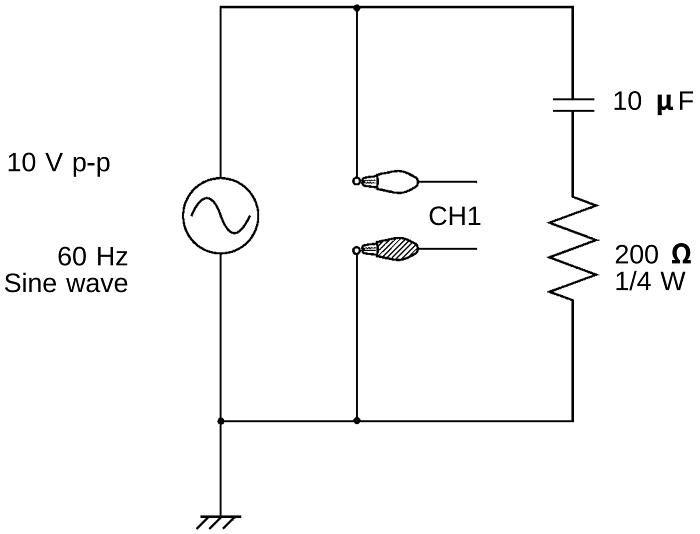
16.5 Using the NG Output

- When the waveform evaluation result is NG, an NG output signal can be obtained between the NG terminal and the GND terminal.
- For details, please refer to the Section 21.6.

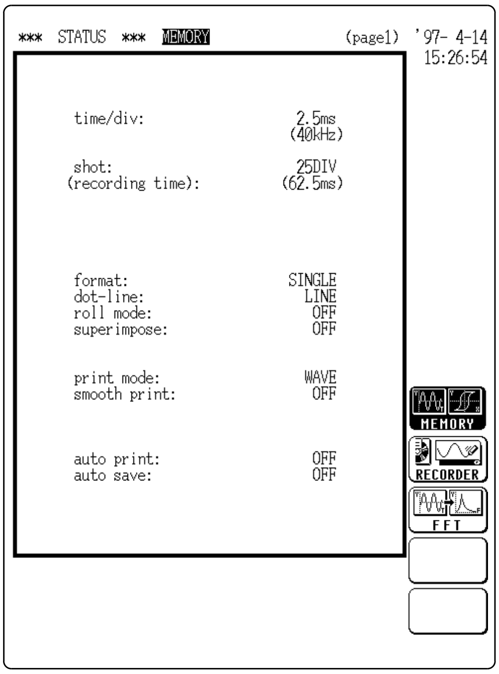


16.6 Setting Example for Waveform Evaluation

Example Using the circuit shown in the illustration, the power supply voltage is monitored in CH1, and the measurement is stopped if noise spikes cause the voltage to exceed the prescribed range.



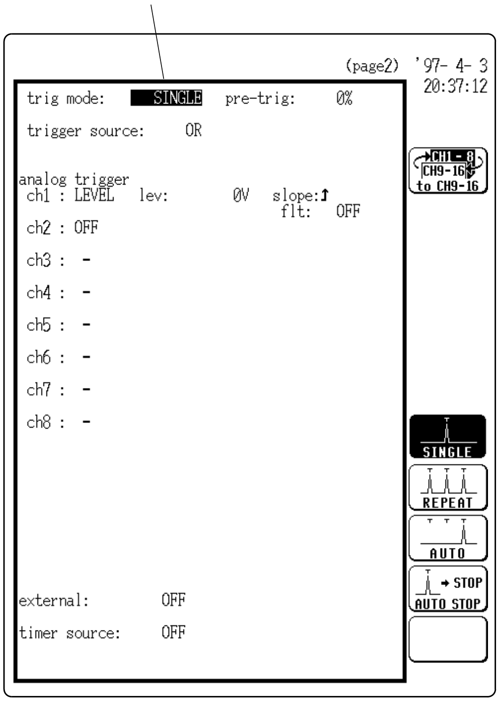
Setting Make settings on the memory recorder STATUS screen as shown below (☞ Section 5.2.1).



```
***  STATUS  ***  MEMORY                (page1)  '97- 4-14
                                                  15:26:54

   time/div:                      2.5ms
                                 (40kHz)

   shot:                          25DIV
  (recording time):             (62.5ms)


   format:                       SINGLE
   dot-line:                       LINE
   roll mode:                       OFF
   superimpose:                     OFF

   print mode:                     WAVE
   smooth print:                    OFF

   auto print:                      OFF
   auto save:                       OFF
```

Status Screen (page 1)

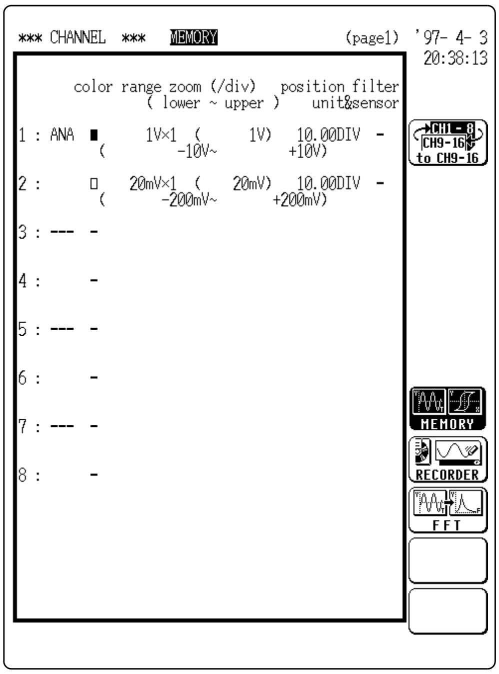
Change the trigger mode to SINGLE so that measurement stops when the evaluation result is NG.



```
                                        (page2)  '97- 4- 3
                                                  20:37:12
  trig mode:     SINGLE   pre-trig:     0%

  trigger source:    OR

 analog trigger
  ch1 : LEVEL   lev:       0V   slope:↑
                                 flt:   OFF
  ch2 : OFF

  ch3 :  -

  ch4 :  -

  ch5 :  -

  ch6 :  -

  ch7 :  -

  ch8 :  -


 external:        OFF

 timer source:    OFF
```

Status Screen (page 2)

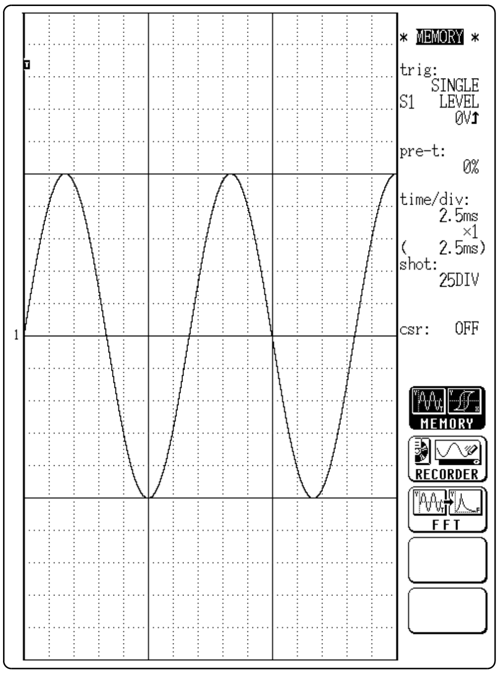
- Set all items on STATUS screen (page 3) to OFF. (Settings for waveform parameter calculation and evaluation are to be made later.)
- Set all items on STATUS screen (page 4) to OFF.



```
*** CHANNEL  ***   MEMORY                    (page1) '97- 4- 3
                                                     20:38:13
       color range zoom (/div)   position filter
                 ( lower ~ upper )    unit&sensor
1 : ANA  ■     1V×1  (      1V)   10.00DIV  -
          (          -10V~          +10V)
2 :      □   20mV×1  (    20mV)   10.00DIV  -
          (        -200mV~        +200mV)
3 : ---  -
4 :      -
5 : ---  -
6 :      -
7 : ---  -
8 :      -
```

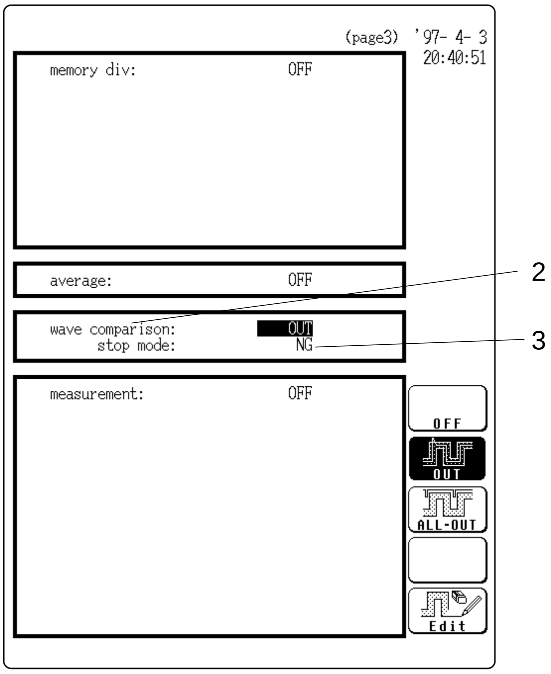
Channel Screen (page 1)

Method



```
* MEMORY *
trig:
     SINGLE
S1   LEVEL
        0V↑
pre-t:
         0%
time/div:
      2.5ms
         ×1
(     2.5ms)
shot:
      25DIV
csr:    OFF
```

1. After having established the settings described above, record the waveform to be used as reference.



memory div: OFF

average: OFF

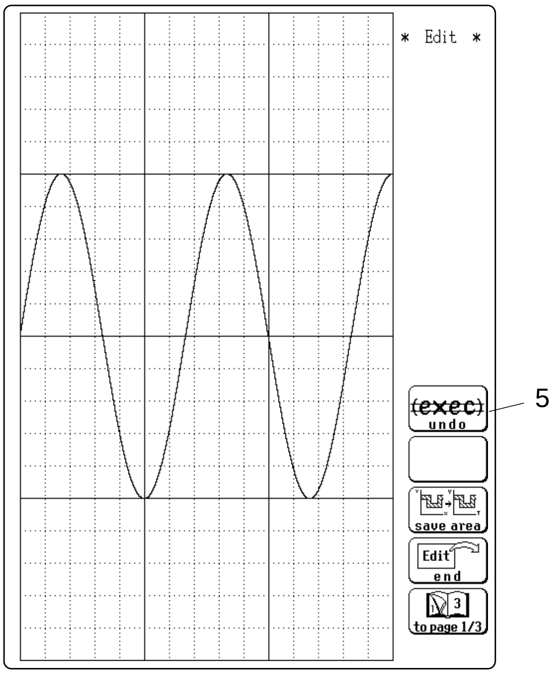
wave comparison: OUT
stop mode: NG

measurement: OFF

2. Move the flashing cursor to the **waveform comparison** item on the STATUS screen (page 3).

3. Set waveform evaluation to **OUT** (F2) and the stop mode to **NG** (F2).

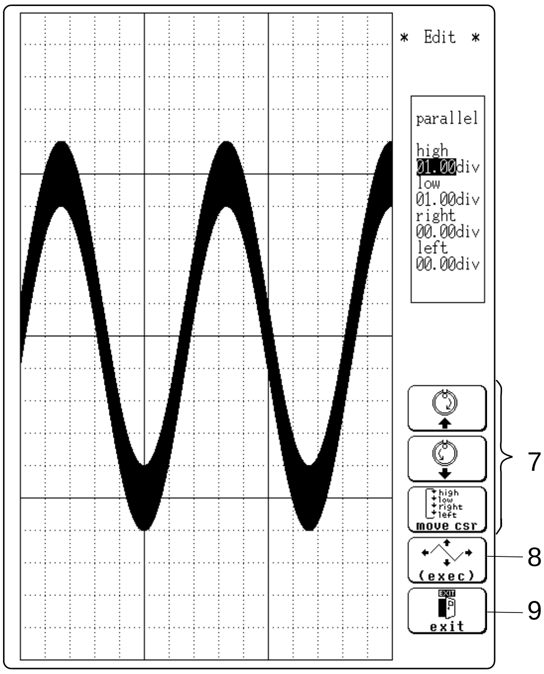
4. Move the flashing cursor to the **waveform comparison** item and press F5 [Edit].



5. Press F1 [storage] (2/3) to import the reference waveform into the editor.

6. Press F2 [parallel] (1/3).

・Shift the displayed waveform vertically and horizontally to create the evaluation area.



parallel
high 01.00div
low 01.00div
right 00.00div
left 00.00div

7. Use the F3 [move csr] key or the CURSOR keys to set the amount of up/down/right/left shift in DIV units.

- Since the scale is 1 V/DIV, make the following settings to obtain a 1.0 V range in the up/down directions.

  Up: 1.0
  Down: 1.0
  Left: 0
  Right: 0

8. Press F4 [exec] to carry out the parallel shift.

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

10. Press F4 [end] (3/3) and press F3 [save area] to quit the editor after storing the waveform.

11. Press the DISP key to activate the display screen.

12. Press the START key to start waveform evaluation (do not change the measurement parameters). If the input waveform leaves the evaluation area at any point, the measurement is terminated.

Chapter 17
Memory Segmentation Function

17.1 Overview

- 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

- Memory space is divided into 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

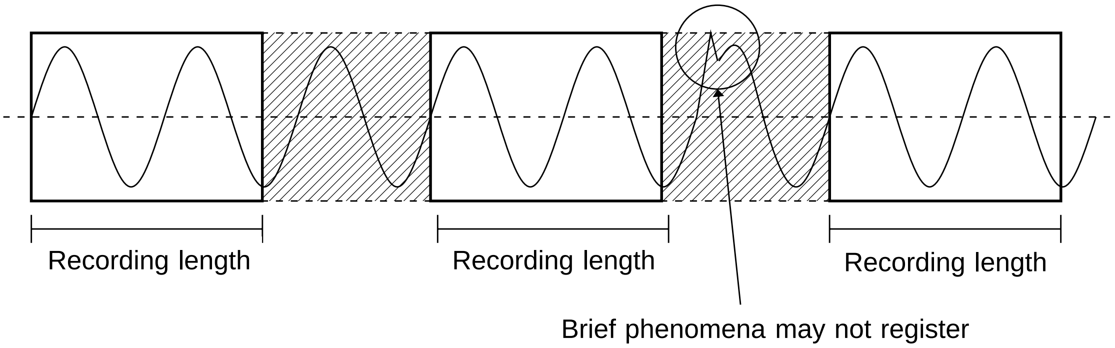
- Memory space is divided into blocks.
- Waveform data can be stored in a selected block.

17.2 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.

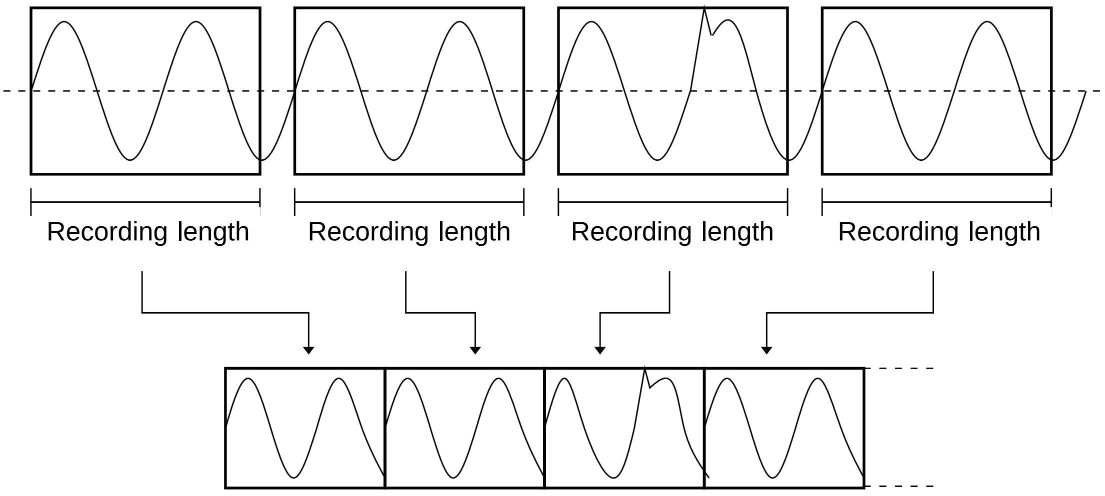
NOTE During measurement, the display and print functions are totally disabled until data have been recorded in all blocks.

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



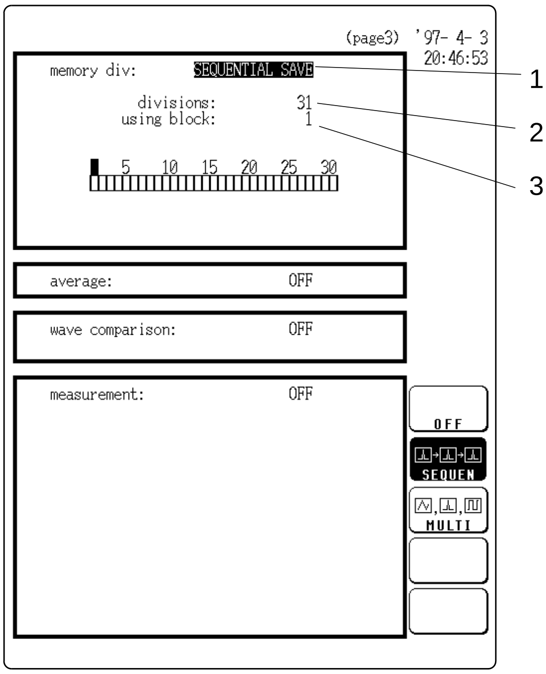
▨ •••Dead time (interval in which no sampling occurs due to display and print processing)

- Using sequential save



Data are divided into blocks and recorded in memory.

Method Screen: STATUS (page 3)



(page3) '97- 4- 3 20:46:53

memory div: SEQUENTIAL SAVE

divisions: 31

using block: 1

average: OFF

wave comparison: OFF

measurement: OFF

1. Memory segmentation settings

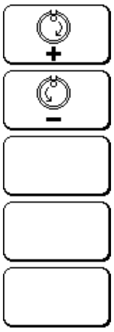
Select F2 [SEQUEN].

Function key display	Meaning
OFF	: Disable memory segmentation
SEQUEN	: Enable sequential save function
MULTI	: Enable multi-block function (☞ Section 17.3)

2. Number of memory blocks

- The number of available memory blocks (3, 7, 15, 31, 63) is automatically set, depending on the recording length and the number of units in use (see "Relation between recording length (DIV), number of units, and maximum number of memory blocks" on the next page).
- The user can select how many blocks to use out of the total available number.
- Use the function keys or the JOG control to make this setting.

Function key display Meaning



2 to maximum number of memory blocks

3. Display block setting

- Set the number of the memory block to display on screen.
- Make the setting in the same way as in step 2.

Relation between recording length (DIV), number of units, and maximum number of memory blocks

When using the sequential save function, recording length has priority over the number of memory blocks. When the recording length is changed, the number of memory blocks may automatically be adjusted.

<table>
<tr><th rowspan="2">Number of units
Recording length (DIV)</th><th colspan="2">1 unit</th><th colspan="2">2 units</th><th colspan="2">4 units</th><th colspan="2">8 units</th></tr>
<tr><th>1 ch</th><th>2 ch</th><th>1 ch</th><th>2 ch</th><th>1 ch</th><th>2 ch</th><th>1 ch</th><th>2 ch</th></tr>
<tr><td>20000</td><td>1</td><td colspan="2">—</td><td colspan="2">—</td><td colspan="2">—</td><td>—</td></tr>
<tr><td>10000</td><td>1</td><td colspan="2">1</td><td colspan="2">—</td><td colspan="2">—</td><td>—</td></tr>
<tr><td>5000</td><td>3</td><td colspan="2">1</td><td colspan="2">1</td><td colspan="2">—</td><td>—</td></tr>
<tr><td>2000</td><td>7</td><td colspan="2">3</td><td colspan="2">1</td><td colspan="2">1</td><td>—</td></tr>
<tr><td>1000</td><td>15</td><td colspan="2">7</td><td colspan="2">3</td><td colspan="2">1</td><td>1</td></tr>
<tr><td>500</td><td>31</td><td colspan="2">15</td><td colspan="2">7</td><td colspan="2">3</td><td>1</td></tr>
<tr><td>200</td><td>63</td><td colspan="2">31</td><td colspan="2">15</td><td colspan="2">7</td><td>3</td></tr>
<tr><td>100</td><td>63</td><td colspan="2">63</td><td colspan="2">31</td><td colspan="2">15</td><td>7</td></tr>
<tr><td>50</td><td>63</td><td colspan="2">63</td><td colspan="2">63</td><td colspan="2">31</td><td>15</td></tr>
<tr><td>25</td><td>63</td><td colspan="2">63</td><td colspan="2">63</td><td colspan="2">63</td><td>31</td></tr>
</table>

1 ch (one channel) : only 8916 - 8919, 8928

2 ch (two channels) : 8916 - 8919, 8927, and 8928 used together, or only 8927

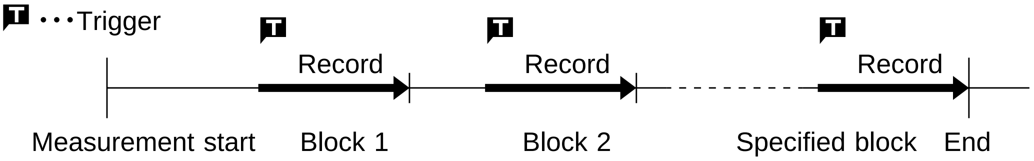
(For the 8928, one channel corresponds to one unit.)

Reference The HELP key can be used to change the displayed memory block or to call up information about the usage status of memory blocks (☞ Section 20.4).

Relation between trigger mode and sequential save

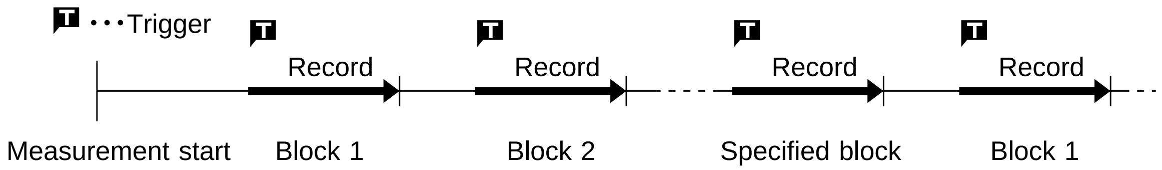
① Trigger mode SINGLE

- When the START key is pressed, waveform data are stored sequentially from block 1 onwards.
- When the specified number of memory blocks has been recorded, measurement stops.
- After measurement is completed, the waveform of the block selected for display is shown on the screen.



② Trigger mode REPEAT

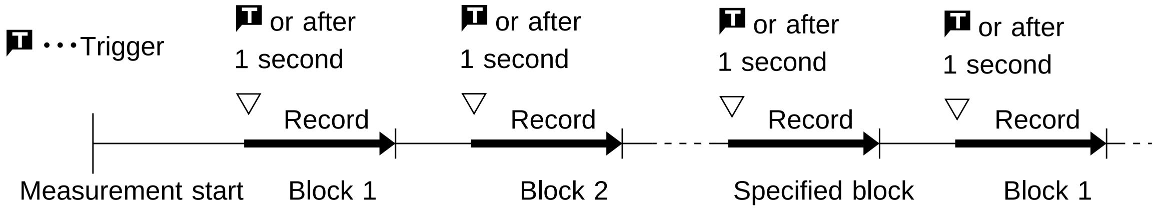
- When the START key is pressed, waveform data are stored sequentially from block 1 onwards.
- When the specified number of memory blocks has been recorded, storing of waveform data returns to block 1, and data continue to be recorded from block 1 onwards, overwriting the earlier data.
- After the specified number of memory blocks has been recorded, the waveform of the block selected for display is shown on the screen. (If auto print is ON, printing is carried out.)
- Pressing the STOP key once during measurement causes measurement to stop after the specified number memory blocks.
- Pressing the STOP key twice during measurement causes measurement to stop immediately.



Measurement ends at specified block when STOP key was pressed.

③ Trigger mode AUTO

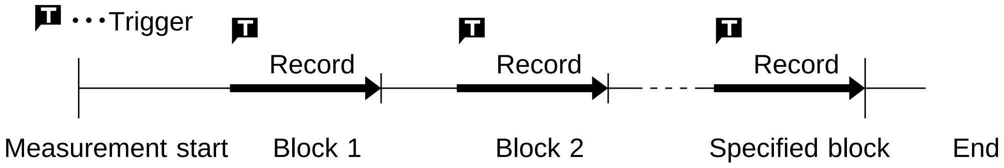
- When the START key is pressed, waveform data are stored sequentially from block 1 onwards, not only for waveforms captured by triggering but also waveforms captured at regular intervals.
- When the specified number of memory blocks has been recorded, storing of waveform data returns to block 1, and data continue to be recorded from block 1 onwards, overwriting the earlier data.
- After the specified number of memory blocks has been recorded, the waveform of the block selected for display is shown on the screen. (If auto print is ON, printing is carried out.)
- Pressing the STOP key once during measurement causes measurement to stop after the specified number memory blocks.
- Pressing the STOP key twice during measurement causes measurement to stop immediately.



Measurement ends at specified block when STOP key was pressed.

④ Trigger mode AUTO STOP

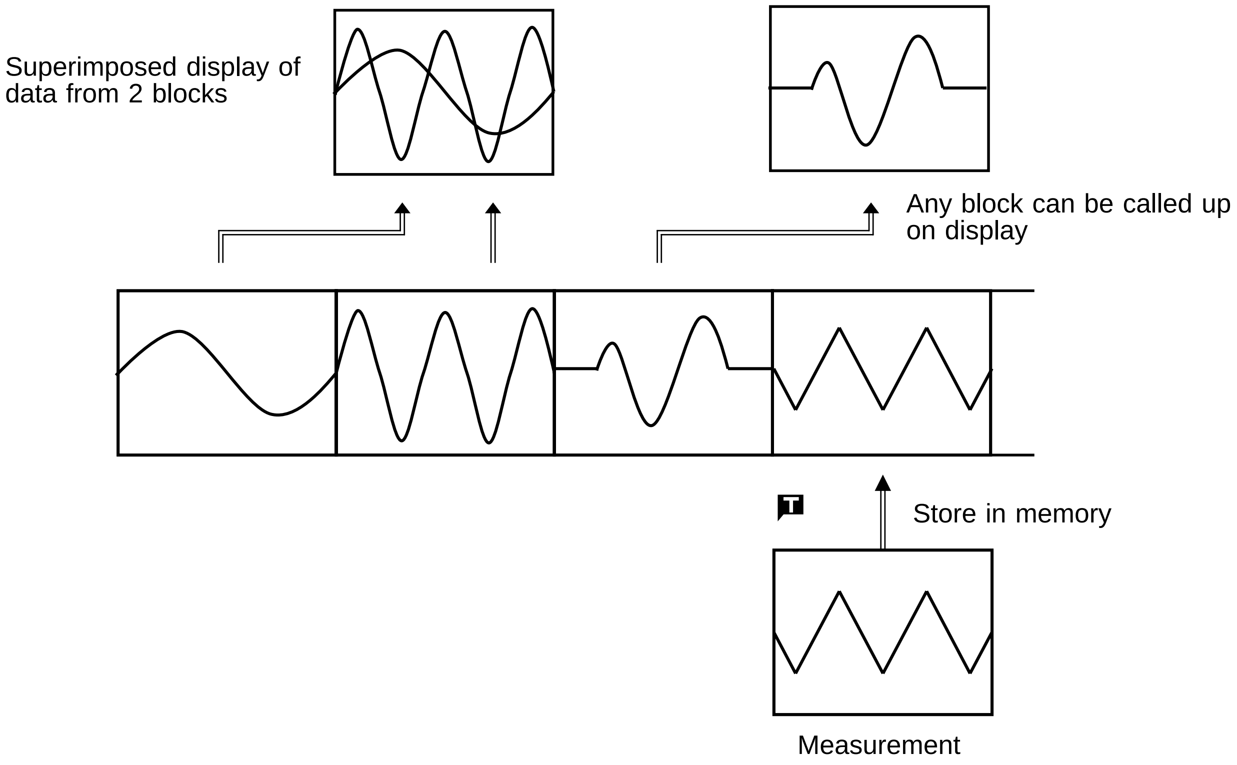
- When the START key is pressed, only waveform data which were captured by triggering are stored sequentially from block 1 onwards (not waveforms captured at regular intervals).
- When the specified number of memory blocks has been recorded, measurement stops.
- After measurement is completed, the waveform of the block selected for display is shown on the screen.



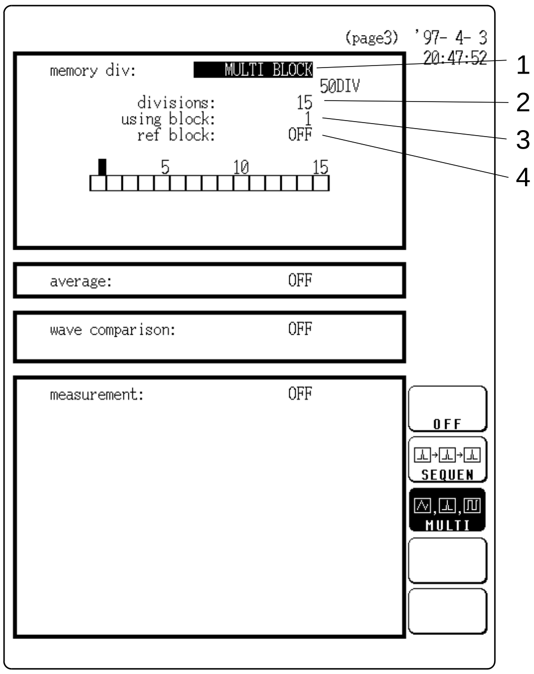
Measurement ends at specified block (waveform data captured after 1-second interval has elapsed are not recorded).

17.3 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 superimposed on screen for easy comparison. (it can be printed out)



Method Screen: STATUS (page 3)



(page3) '97- 4- 3
20:47:52

memory div: MULTI BLOCK
50DIV
divisions: 15
using block: 1
ref block: OFF

average: OFF

wave comparison: OFF

measurement: OFF

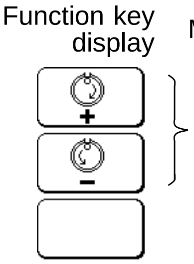
1. Memory segmentation setting

Select F3 [MULTI].

Function key display	Meaning
OFF	: Disable memory segmentation
SEQUEN	: Enable sequential save function (☞ Section 17.2)
MULTI	: Enable multi-block function

2. Number of memory blocks setting

- Determine into how many blocks the memory is to be divided.
- Use the function keys or the JOG control to make this setting.

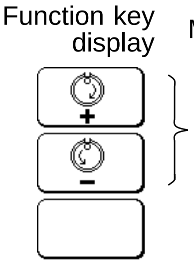


3, 7, 15, 31, 63

NOTE The recording length per block depends on the number of memory blocks and the number of units in use (see "Relation between number of memory blocks, number of units, and maximum recording length (DIV)" on the next page).

3. Number of memory block to use setting

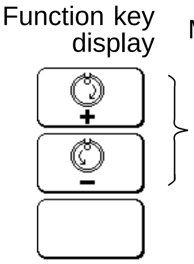
- Select the number of the memory block for display and recording of the input signal waveform..
- Use the function keys or the JOG control to make this setting.



1 to highest memory block number

4. Reference memory block

- Select a memory block whose waveform data are to be superimposed on screen with the memory block selected for display.
- Use the function keys or the JOG control to make this setting.



OFF, 1 to highest memory block number

Reference Scrolling can be carried out while the superimpose function is used (☞ Section 19.3).

NOTE It is not possible to superimpose two memory blocks of different recording length.

Relation between number of memory blocks, number of units, and maximum recording length (DIV)

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.

Number of units to be used Number of memory blocks	1		2		4		8	
	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch
3	5000	2000		1000		500		200
7	2000	1000		500		200		100
15	1000	500		200		100		50
31	500	200		100		50		25
63	200	100		50		25		−

1 ch (one channel) : only 8916 - 8919, 8928

2 ch (two channels) : 8916 - 8919, 8927, 8928 used together, or only 8927

(For the 8928, one channel corresponds to one unit.)

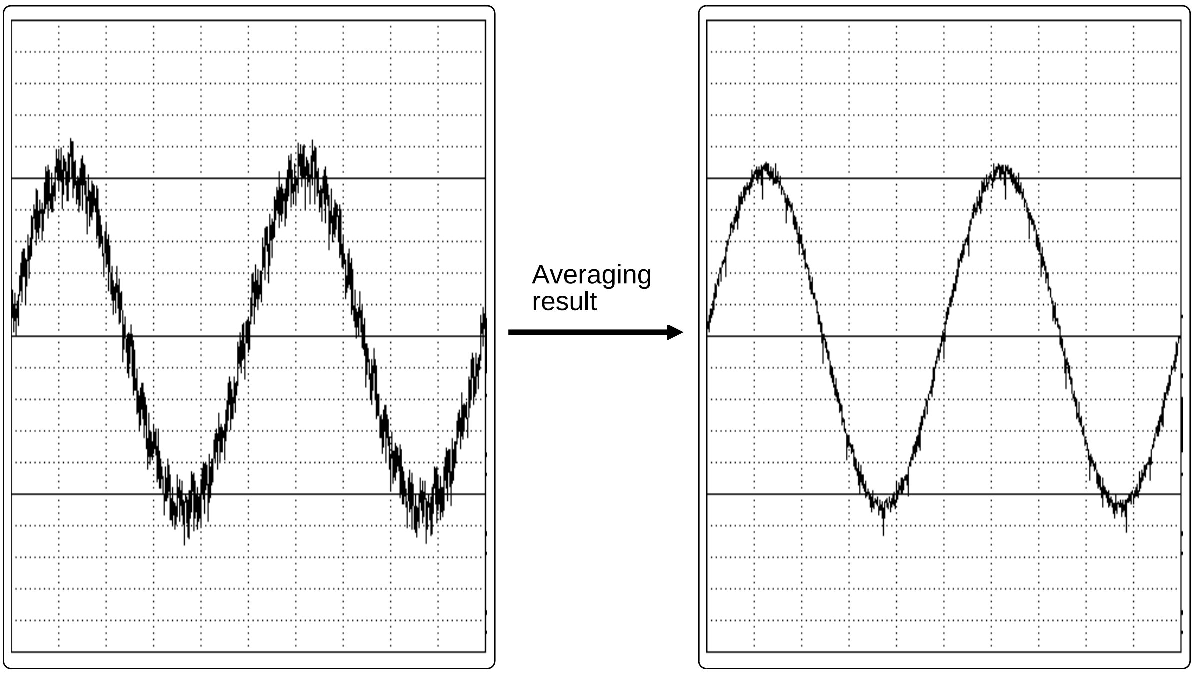
Reference The HELP key can be used to change the displayed memory block or to call up information about the usage status of memory blocks (☞ Section 20.4).

Chapter 18
Waveform Averaging

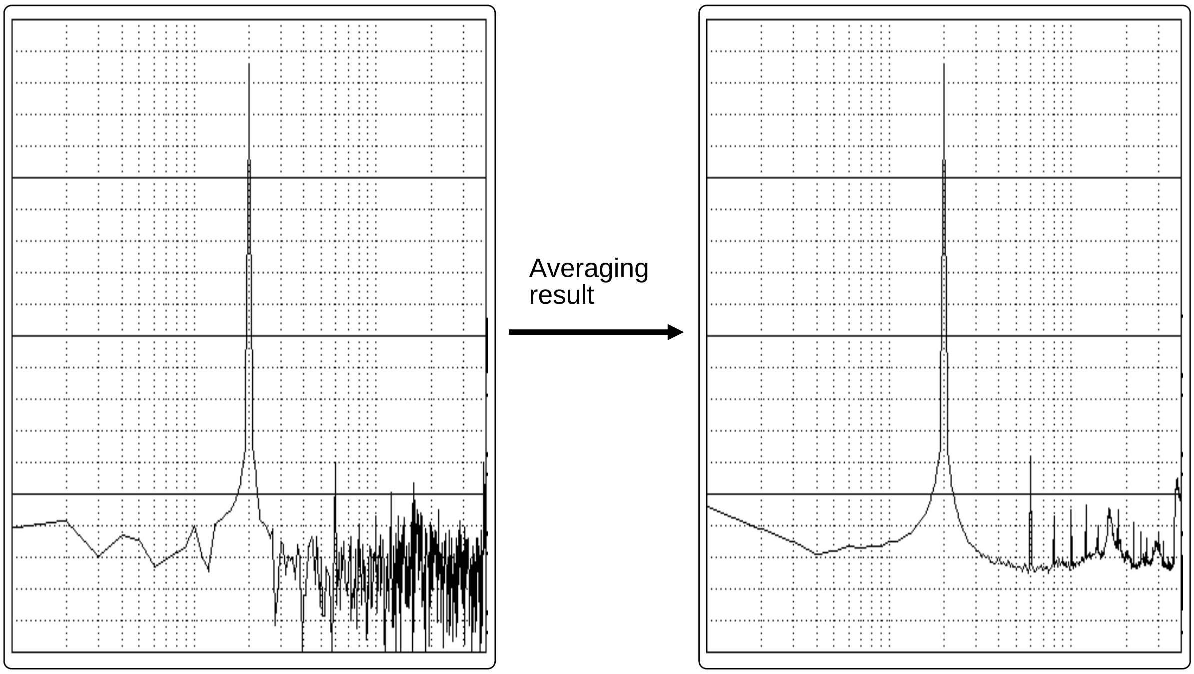
18.1 Overview

- 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.
- Averaging is available for the memory recorder and FFT functions.
- Time axis waveform averaging (memory recorder, FFT)
- Frequency axis waveform averaging (FFT)
- Frequency axis waveform peak hold (FFT)
- The higher the number of averaging instances, the more effectively will noise be suppressed.

Time axis waveform averaging



Frequency axis waveform averaging

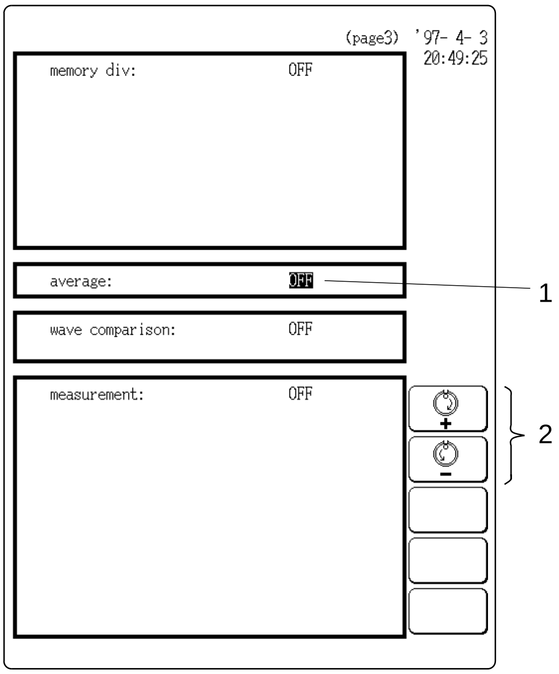


18.2 Setting the Averaging Function

18.2.1 When Using Memory Recorder Function

(1) Setting the averaging count

Method Screen: STATUS (page 3)



(page3) '97- 4- 3
20:49:25

memory div: OFF

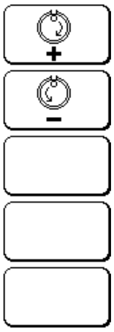
average: OFF

wave comparison: OFF

measurement: OFF

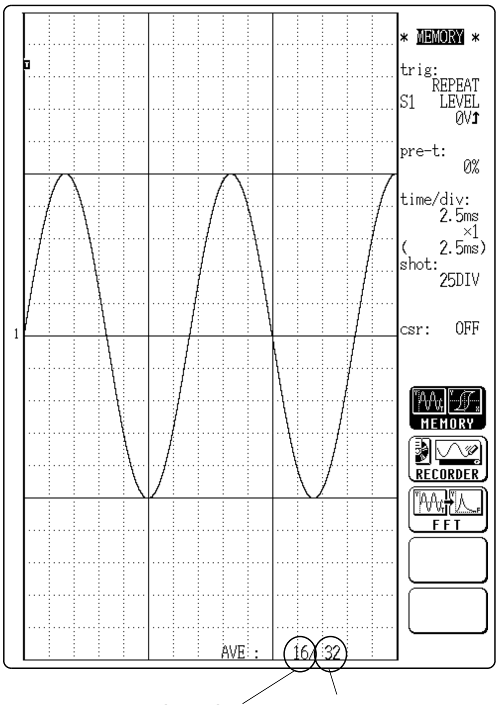
1. Move the flashing cursor to the **average** item.
2. Use the JOG control or the function keys to set the averaging count.

Function key display Meaning



OFF, 2, 4, 8, 16, 32, 64, 128, 256

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



* MEMORY *

trig: REPEAT
S1 LEVEL 0V↑

pre-t: 0%

time/div: 2.5ms ×1
(2.5ms)

shot: 25DIV

csr: OFF

AVE : 16/32

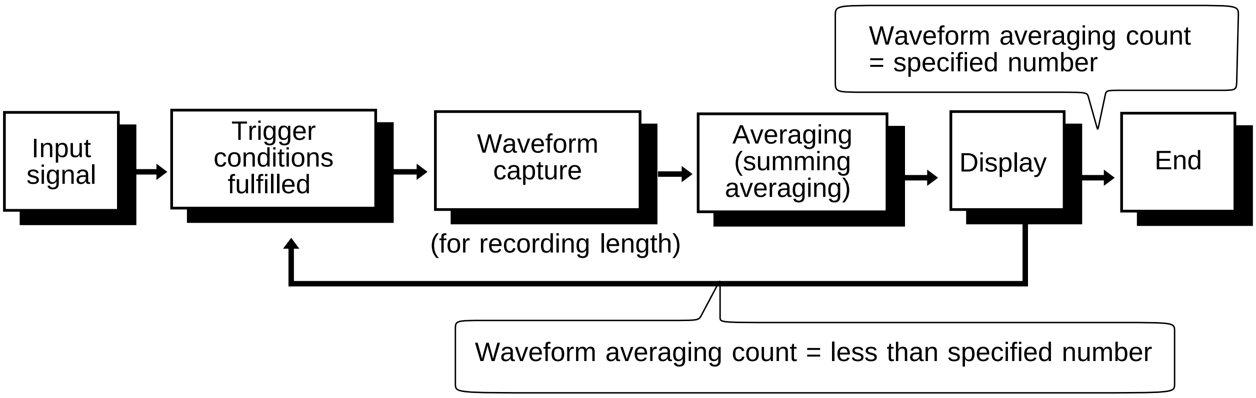
NOTE

- Averaging does not apply to logic input channels, which simply show the last captured value.
- When the memory segmentation function is used, averaging is not available.
- Averaging and waveform processing cannot be carried out simultaneously.
- Waveform processing can be carried out for an averaged waveform after measurement is completed.

Averaging and trigger mode

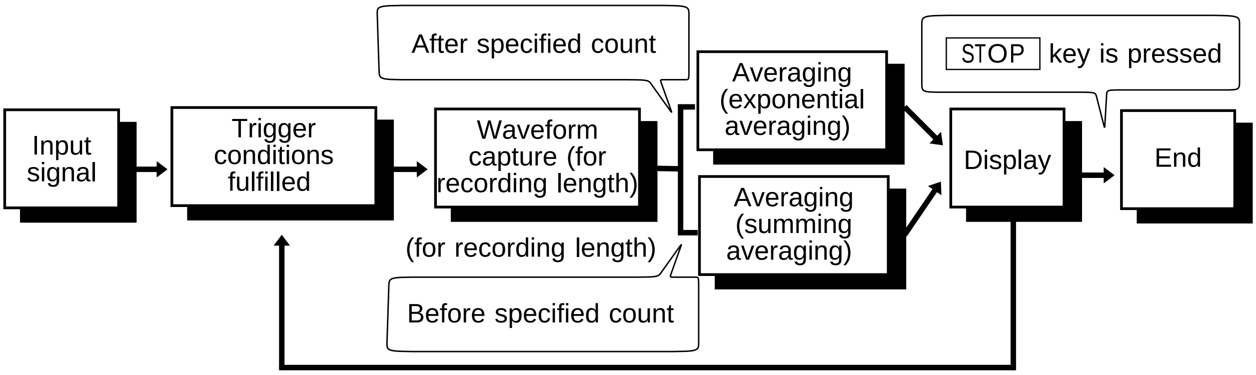
① Trigger mode: SINGLE

1. After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and summing averaging (*1) 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.



② Trigger mode: REPEAT

1. After the START key was pressed, data are captured whenever the trigger conditions are fulfilled, and summing averaging (*1) 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 (*2) 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.



③ 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.

NOTE For details on summing averaging (*1) and exponential averaging (*2), refer to Section 18.3.

Recording length limit

The maximum recording length that can be set for averaging depends on the number of units.

Number of units	1		2		4		8	
	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch
Maximum recording length (DIV)	5000	2000		1000		500		200

1ch: Only 8916 - 8919, 8928 can be used.

2ch: 8916 - 8919, 8927, and 8928 can coexist, or 8927 can be used exclusively.

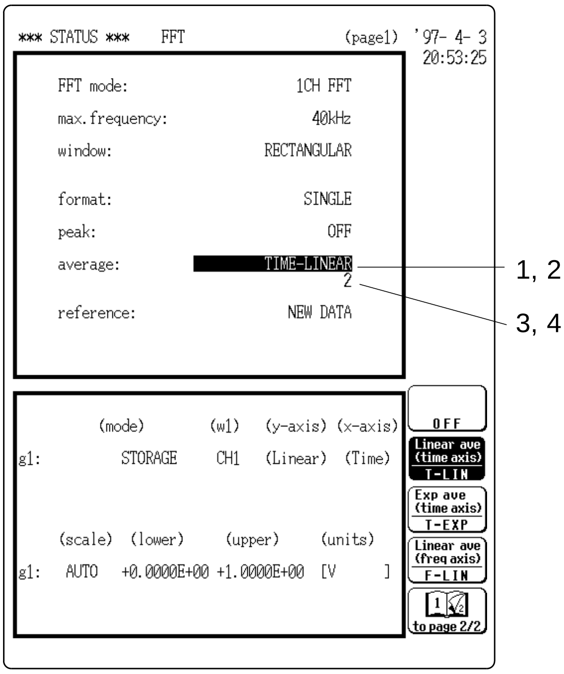
(For the 8928, one channel corresponds to one unit.)

18.2.2 When Using FFT Function

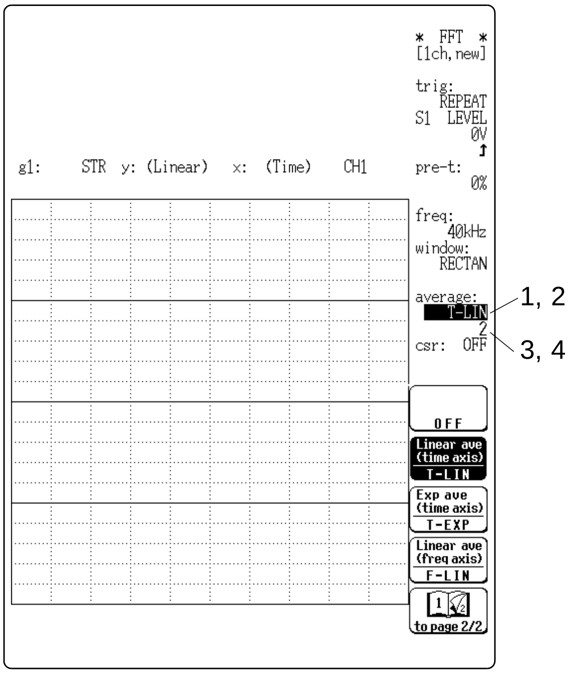
Select whether to use time axis waveform averaging or frequency axis waveform averaging and set the averaging count.

- Time axis waveform averaging
  Captured waveform data are averaged, and the averaged value is used for FFT processing.
- Frequency axis waveform averaging
  FFT processing is performed first, and the resulting data are averaged.

Method Screen: STATUS (page 1), DISPLAY



```
*** STATUS ***    FFT                         (page1)  '97- 4- 3
                                                        20:53:25
  FFT mode:                       1CH FFT
  max.frequency:                     40kHz
  window:                      RECTANGULAR

  format:                           SINGLE
  peak:                                OFF
  average:                     TIME-LINEAR
                                         2
  reference:                      NEW DATA

         (mode)        (w1)   (y-axis) (x-axis)
g1:       STORAGE       CH1    (Linear)  (Time)

    (scale)  (lower)      (upper)      (units)
g1:  AUTO   +0.0000E+00 +1.0000E+00  [V      ]
```



```
                                                  *  FFT  *
                                                  [1ch,new]
                                                  trig:
                                                      REPEAT
                                                  S1   LEVEL
                                                          0V
g1:    STR  y: (Linear)   x:  (Time)     CH1      pre-t:
                                                          0%
                                                  freq:
                                                       40kHz
                                                  window:
                                                      RECTAN
                                                  average:
                                                       T-LIN
                                                           2
                                                  csr:   OFF
```

1. Move the flashing cursor to the **average** item on the STATUS screen or the **average** item on the display screen.
2. Use the function keys to select the type of averaging.

- **1/2**

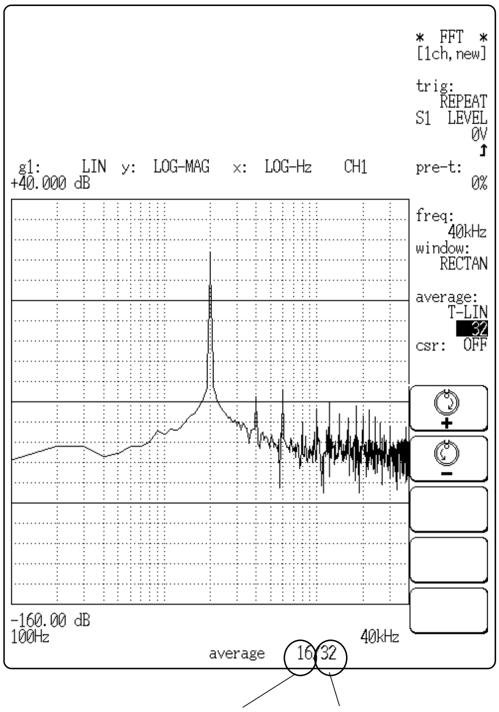
Function key display	Meaning
OFF	: Disable averaging
Linear ave (time axis) T-LIN	: Perform time axis waveform summing averaging
Exp ave (time axis) T-EXP	: Perform time axis waveform exponential averaging
Linear ave (freq axis) F-LIN	: Perform frequency axis waveform summing averaging (*3)
to page 2/2	: Switch to 2/2

- **2/2**

Function key display	Meaning
Exp ave (freq axis) F-EXP	: Perform frequency axis waveform exponential averaging (*4)
Peak Hold (freq axis) F-PEAK	: Frequency axis waveform peak hold (*5)
to page 1/2	: Switch to 1/2

NOTE

For details on frequency axis waveform summing averaging (*3), exponential averaging (*4), and peak hold (*5), refer to Section 18.3.



* FFT *
[1ch, new]
trig: REPEAT
S1 LEVEL 0V ↑
pre-t: 0%
g1: LIN y: LOG-MAG x: LOG-Hz CH1
+40.000 dB
freq: 40kHz
window: RECTAN
average: T-LIN 32
csr: OFF
-160.00 dB
100Hz 40kHz
average 16/32

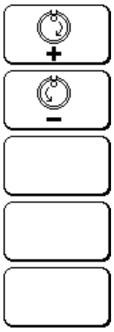
Averaging time

Specified number of times

3. After the settings of step 2 are completed, move the flashing cursor to the count item.
4. Use the function keys or the JOG control to set the averaging count.

Function key display

Meaning



2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096

NOTE

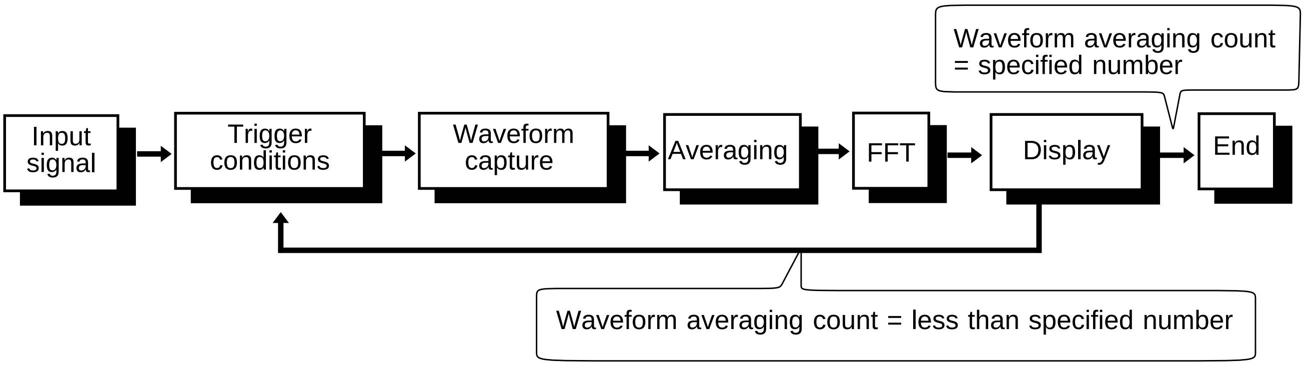
- When averaging is used together with the waveform evaluation function, waveform evaluation is carried out after the specified averaging count is completed. The same applies to the auto store and auto print functions.
- After averaging was carried out, the scaling setting cannot be changed.

Averaging and trigger mode

(1) Time axis waveform averaging

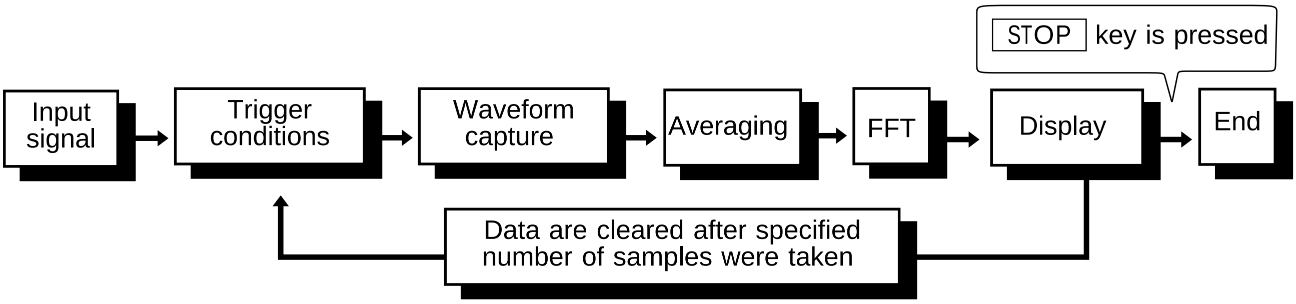
① Trigger mode: SINGLE

1. After the START key was pressed, data are captured whenever the trigger conditions are fulfilled. After averaging, FFT processing is performed and the result is displayed.
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.



② Trigger mode: REPEAT

1. After the START key was pressed, data are captured whenever the trigger conditions are fulfilled and averaging is carried out for the specified count. FFT processing is performed and the result is displayed.
2. When the specified averaging count is reached, data up to that point are discarded, and new data are captured for averaging.
3. If the measurement was stopped prematurely with the STOP key, the averaging result up to that point is displayed.



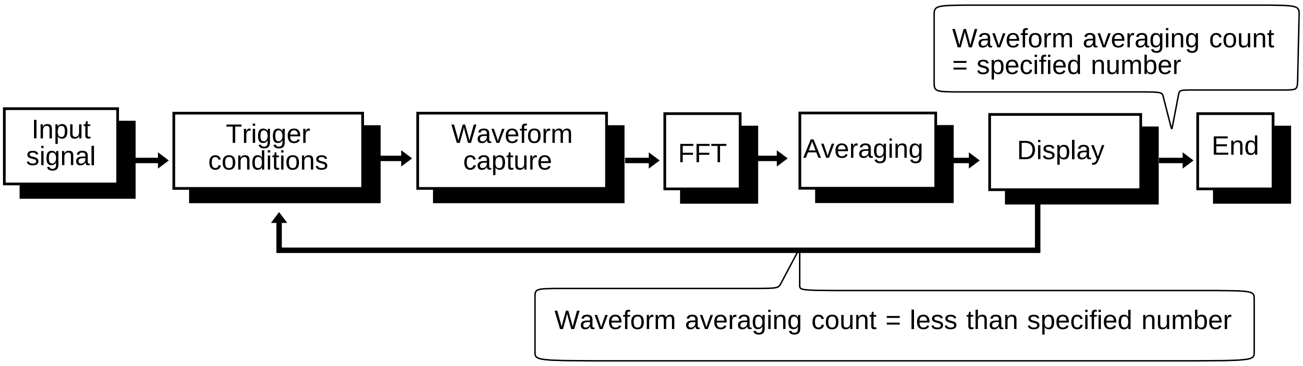
③ Trigger mode: AUTO and AUTO STOP

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.

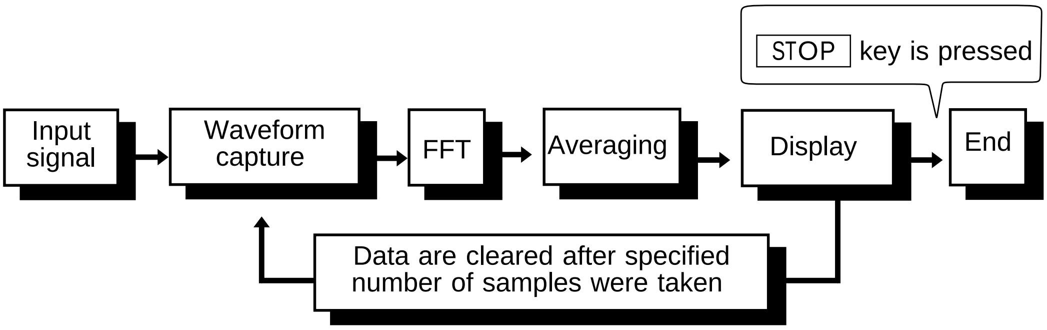
(2) Frequency axis waveform averaging

- Captured data first undergo FFT processing. Then averaging is performed and the result is displayed.
- Unlike time axis averaging, the 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.

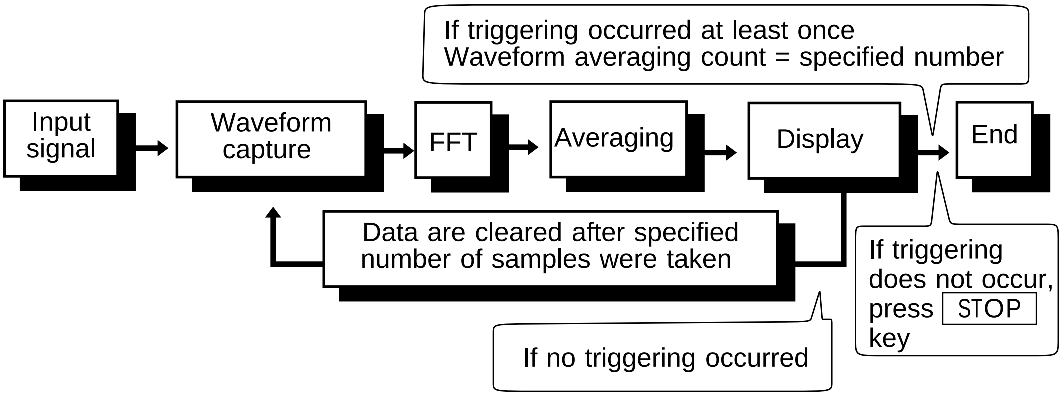
① Trigger mode: SINGLE



② Trigger mode: REPEAT or AUTO



③ Trigger mode: AUTO STOP



FFT analysis mode and averaging

Symbols in the table have the following meaning

●: 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.

18.3 Averaging Equations

Time axis waveform averaging (memory recorder, FFT)

For time axis averaging, summing averaging is synchronized by the trigger. If trigger synchronization is not performed, the results will be meaningless.

(*1) Summing averaging

Captured data are added sequentially and the sum is divided by the number of samples.

Equation:

$$A_n = \frac{(n-1)A_{n-1} + Z_n}{n}$$

n: Averaging count
A_n: Result of n times averaging
Z_n: nth measurement data

(*2) Exponential averaging

Most recent data are given greatest weighting, and the weighting of older data is reduced with an exponential function.

Equation

$$A_n = \frac{(N-1)A_{n-1} + Z_n}{N}$$

N: Specified averaging count
n: Averaging count
A_n: Result of n times averaging
Z_n: nth measurement data

Frequency axis waveform averaging (FFT)

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.

(*3) Summing averaging

Equation is the same as for time axis averaging.

(*4) Exponential averaging

Equation is the same as for time axis averaging.

(*5) Peak hold (frequency axis: FFT)

The specified number of samples are captured, and the peak value is held (stored) for each frequency.

Chapter 19

Using the A/B Cursors / Waveform Scrolling

19.1 Overview

- The following three types of A/B cursors are available:
  - Line cursor (vertical)
  - Line cursor (horizontal)
  - Trace cursor

  For FFT, only the trace cursor is available.

- The scroll function can be used to view a waveform (not available for FFT).

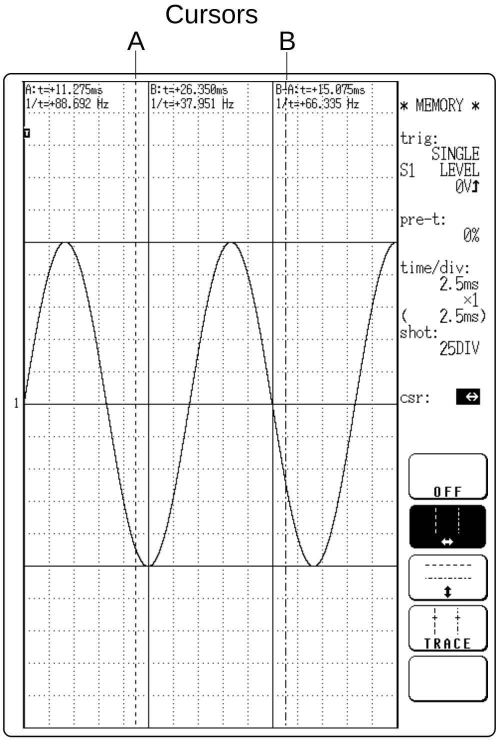
19.2 Using the A/B Cursors

- The A/B cursors can be used to read a time difference, frequency difference, potential difference, or temperature difference on screen. (When scaling is used, the difference is displayed in the scaling value. See the section on scaling.)
- The following three types of A/B cursors are available:
- Line cursor (vertical) (not available for FFT)
- Line cursor (horizontal) (not available for FFT)
- Trace cursor

(1) Line cursor (vertical, horizontal) (not available for FFT)

The value at cursor A and cursor B, and the value between the two cursors can be determined.

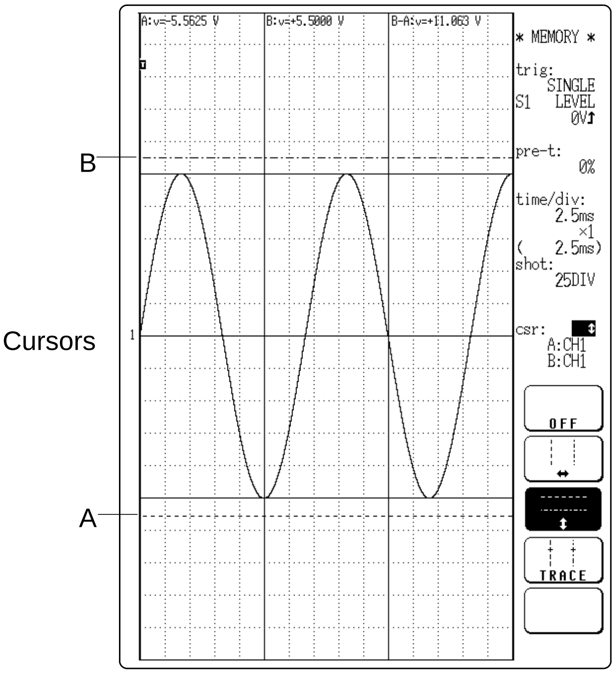
Value	Vertical cursor		Horizontal cursor	
A or B	t	time from the trigger point	v	voltage difference from 0 V or temperature difference from ℃
	1/t	frequency taking t as the period		
B - A	t	time interval between the A and B cursors	v	voltage difference or temperature difference between the A and B cursors.
	1/t	frequency taking t as the period		



A:t=+11.275ms
1/t=+88.692 Hz
B:t=+26.350ms
1/t=+37.951 Hz
B-A:t=+15.075ms
1/t=+66.335 Hz

* MEMORY *
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ↔

Line Cursors (vertical)



A:v=-5.5625 V
B:v=+5.5000 V
B-A:v=+11.063 V

* MEMORY *
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ↕
A:CH1
B:CH1

Line Cursors (horizontal)

(2) Trace cursor

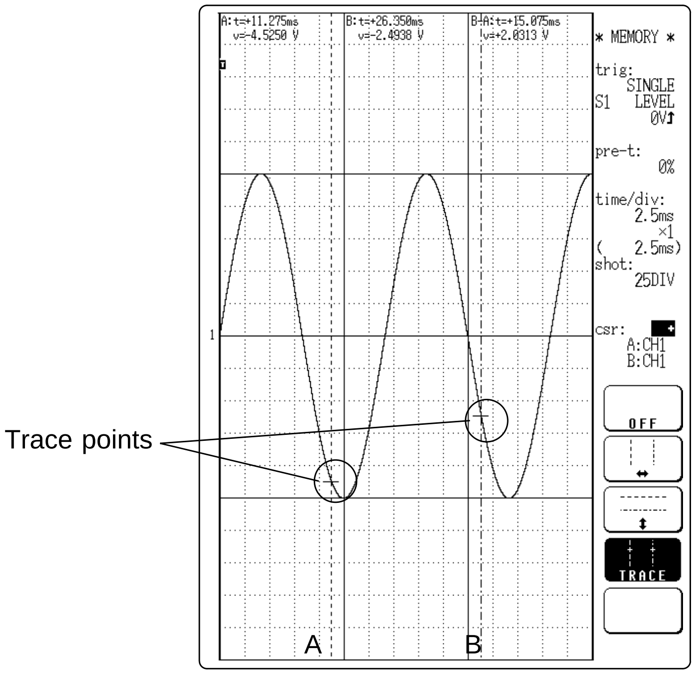
- The value at the point where the cursor crosses the waveform can be determined.
- The trace point moves on the waveform of the specified channel.

① A or B value

	Memory recorder, Recorder	FFT
t	Time from trigger point to trace point	Time from left edge of screen to trace point
v	Potential difference from 0 V (temperature difference from 0℃)	
f	――――――	Frequency

② B - A value

	Memory recorder, Recorder	FFT
t	Time difference between the trace points	
v	Potential difference between the trace points	
f	――――――	Frequency difference between the trace points



A:t=+11.275ms v=-4.5250 V
B:t=+26.350ms v=-2.4938 V
B-A:t=+15.075ms v=+2.0313 V

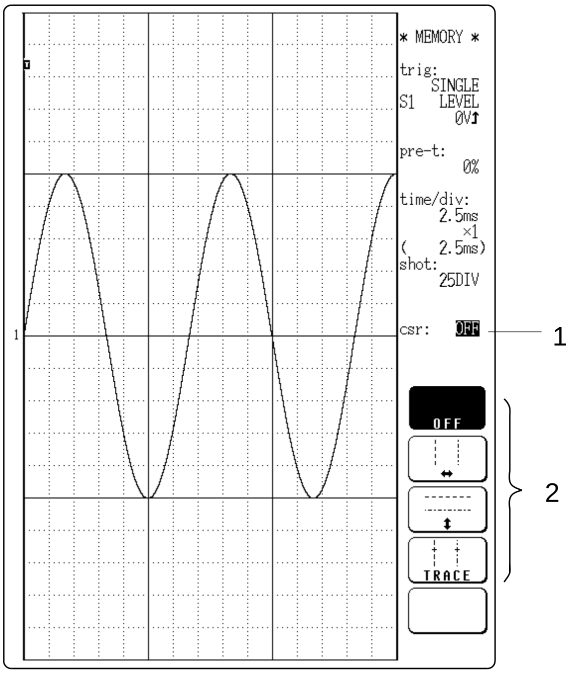
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: A:CH1 B:CH1

Trace Cursor

NOTE When using external sampling, the following value is displayed.

	A or B	B - A
t	Number of sampling point from the trigger point	Sampling points difference
v	Voltage difference from 0 V or temperature difference from ℃	Voltage difference
f	Number of data points from left side of graph	Data point difference
1/t	No display	

Method Screen: DISPLAY



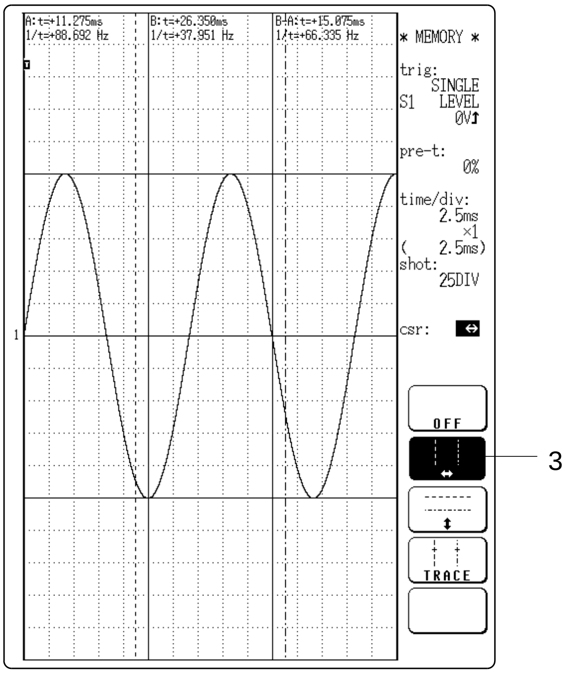
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF

1. Move the flashing cursor to the **csr** item.

2. The function key display changes as follows.

Function key display		Meaning
OFF	:	Disable A/B cursors
↔	:	Line cursor (vertical: t, 1/t) (not displayed for FFT)
↕	:	Line cursor (horizontal: v)
TRACE	:	Trace cursor (not displayed for recorder)

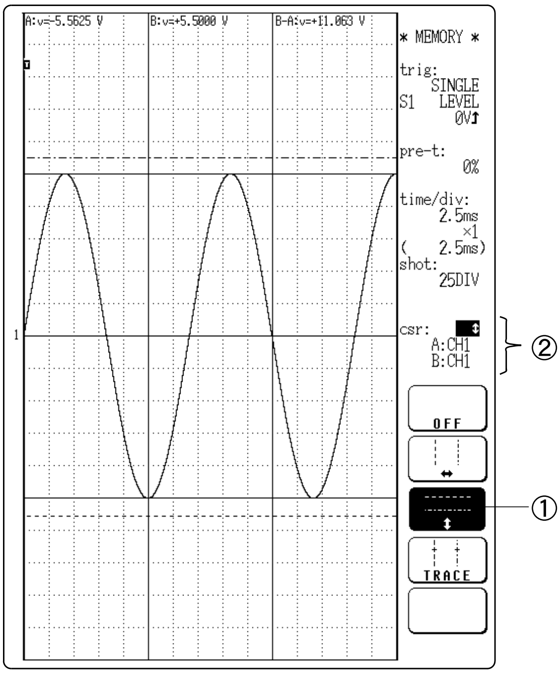
3. Specify the cursor shape.



A:t=+11.275ms 1/t=+88.692 Hz
B:t=+26.350ms 1/t=+37.951 Hz
B-A:t=+15.075ms 1/t=+66.335 Hz
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: ↔

- To use the line cursor (vertical)

Select F2 [↔] (Line cursor,vertical) key.



A:v=-5.5625 V
B:v=+5.5000 V
B-A:v=+11.063 V

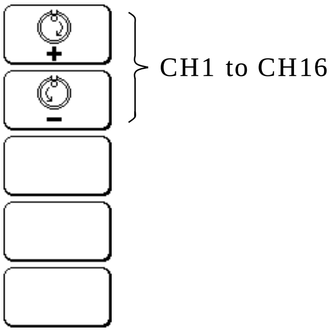
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: A:CH1 B:CH1

- To use the line cursor (horizontal)

① Select F3 [↕] (Line cursor, horizontal) key.

② The channel select option appears under the **csr** item. If 2 or more channels are being displayed, use the flashing cursor to select the channel for which you want to read the voltage (temperature) value with the A/B cursors.

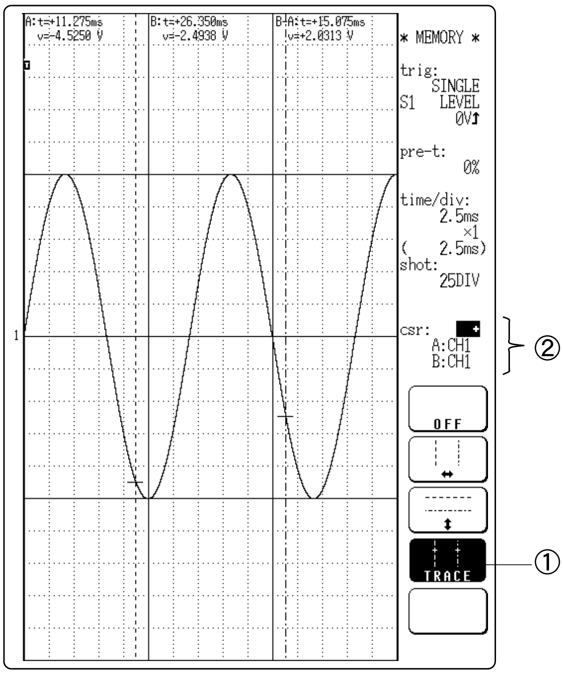
Function key display | Meaning



CH1 to CH16

NOTE

- This item does not appear when using the vertical line cursor.
- Only channels for which a waveform is being displayed can be specified.
- By specifying a different channel for the A and B cursors, a potential difference between the waveforms in the respective channels can be determined.



A:t=+11.275ms v=-4.5250 V
B:t=+26.350ms v=-2.4938 V
B-A:t=+15.075ms v=+2.0313 V

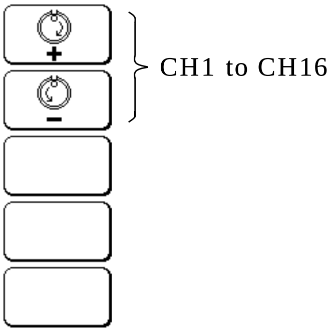
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↥
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: A:CH1 B:CH1

- To use the trace cursor

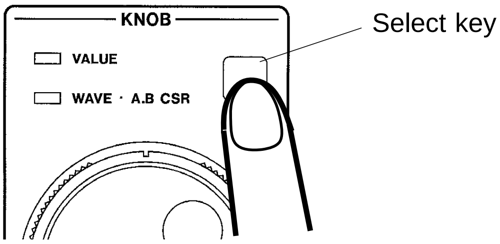
① Select F4 [TRACE].

② The channel select option appears under the **csr** item. Use the flashing cursor to select the channel for which you want to read the voltage (temperature) value with the A/B cursors. You can specify different channels for the two cursors.

Function key display | Meaning



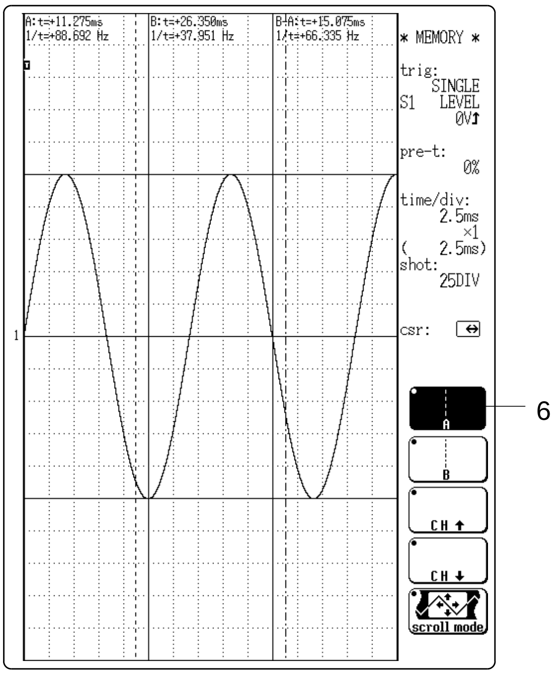
CH1 to CH16



4. Press the SELECT key so that the WAVE A.B CSR LED lights up. The JOG/SHUTTLE control now can be used for waveform scrolling and for operating the A/B cursors.

5. Each push of the function key F5 toggles between the waveform scroll mode and the A/B cursors mode. The display becomes as follows.

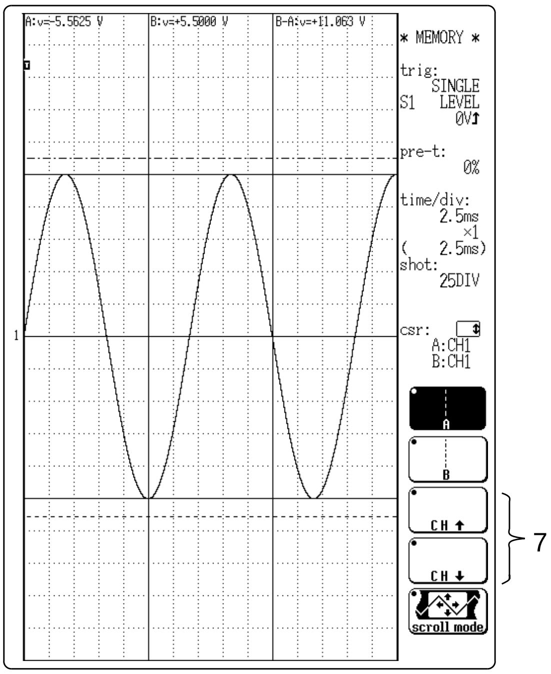
Function key display	Meaning
A	: Move cursor A
B	: Move cursor B
CH ↑	CH1 - CH16 (invalid with vertical cursor)
CH ↓	
scroll mode	: Switch to waveform scroll mode (☞ Section 19.3)



Cursor type shown in reverse will be moved

6. Use the function keys to select the cursor to be moved.

Press the desired function key, so that the display is shown in reverse. The respective cursor will be moved. Press the function key again to cancel.

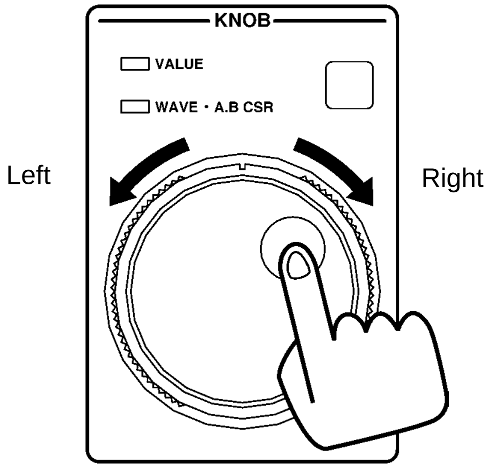


Channel of cursor shown in reverse can be selected

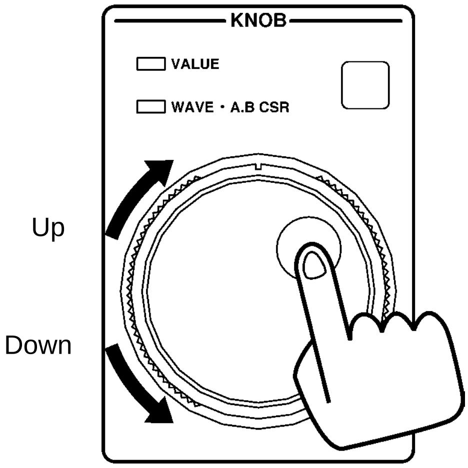
7. The channel for the current cursor (shown in reverse) can be changed with the function keys (for horizontal and trace cursor).

8. Rotate the JOG control to move the cursor.

- t, 1/t, v or f at the cursor position can be determined.
- When the vertical cursor or trace cursor is used, cursor measurements are possible also when one of the cursors is currently off screen.



Line cursor (vertical), Trace cursor



Line cursor (horizontal)

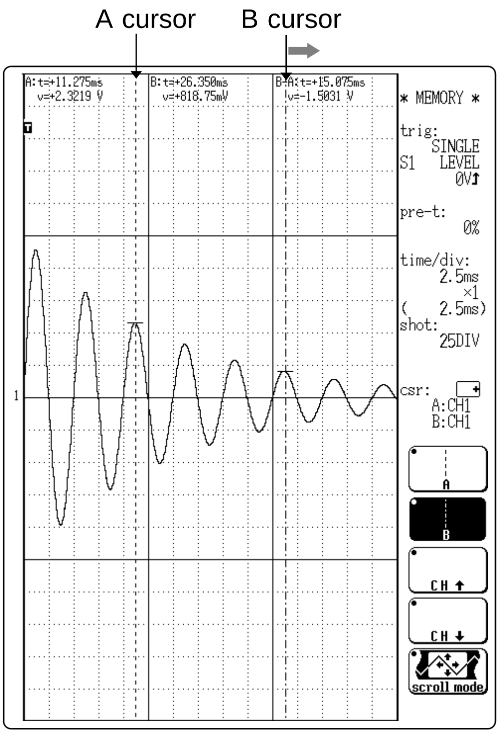
NOTE

Cursor movement and waveform scrolling

- Waveform scrolling behavior when the A/B cursors are moved differs, depending on whether the vertical/trace cursor or the horizontal cursor is used.
- The FFT screen does not allow scrolling.

① Vertical cursor or trace cursor (Example: trace cursor)
When cursor B is moved:

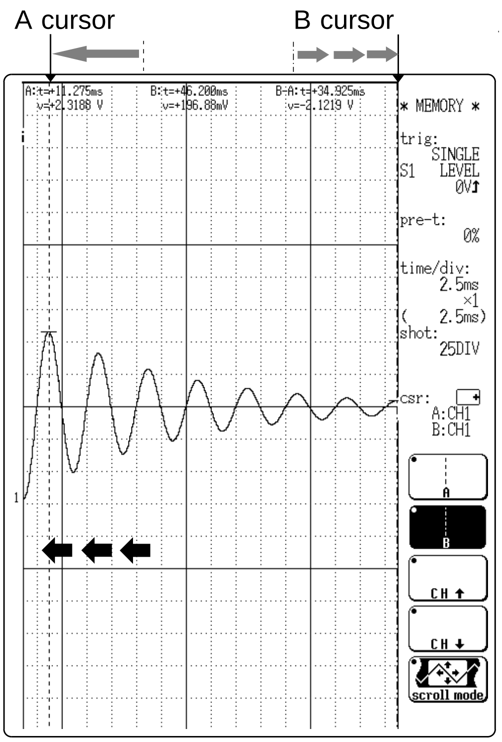
- When cursor B reaches the edge of the screen, the waveform scrolls to the left.
- Cursor A moves together with the waveform.



A:t=+11.275ms
v=+2.3219 V
B:t=+26.350ms
v=+818.75mV
B-A:t=+15.075ms
v=-1.5031 V

∗ MEMORY ∗
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr:
A:CH1
B:CH1

Cursor B is moved to the right



A:t=+11.275ms
v=+2.3188 V
B:t=+46.200ms
v=+196.88mV
B-A:t=+34.925ms
v=-2.1219 V

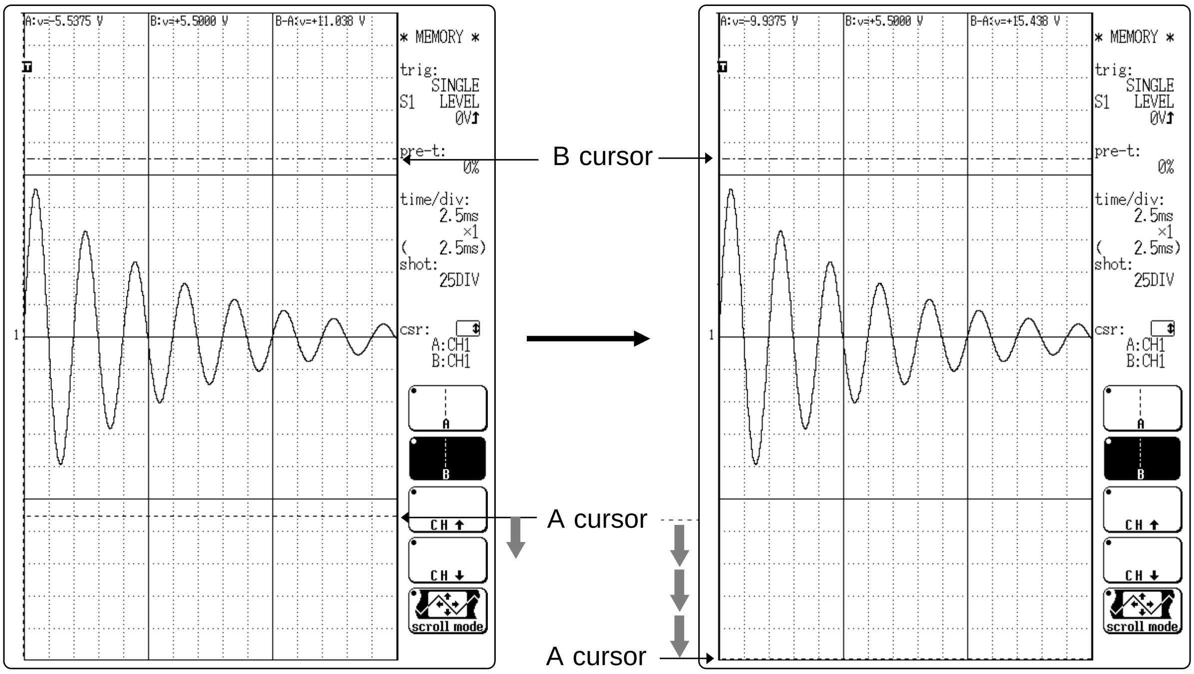
∗ MEMORY ∗
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr:
A:CH1
B:CH1

When cursor B is moved further, waveform scrolls to the left. Cursor A moves with waveform to the left.

② Horizontal cursor

When cursor A is moved:

When cursor A reaches the edge of the screen, the waveform does not scroll.



Cursor A is moved down

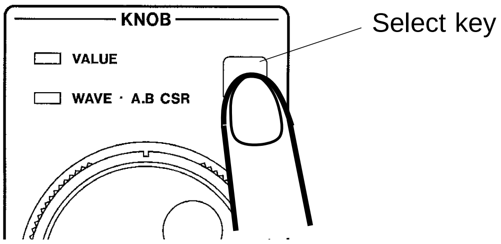
Waveform does not scroll also when attempting to move cursor A further

Reference When the vertical cursor or the trace cursor is off screen while using the memory recorder or recorder function, the HELP key can be used to check the cursor position within the total recording length (☞ Section 20.4).

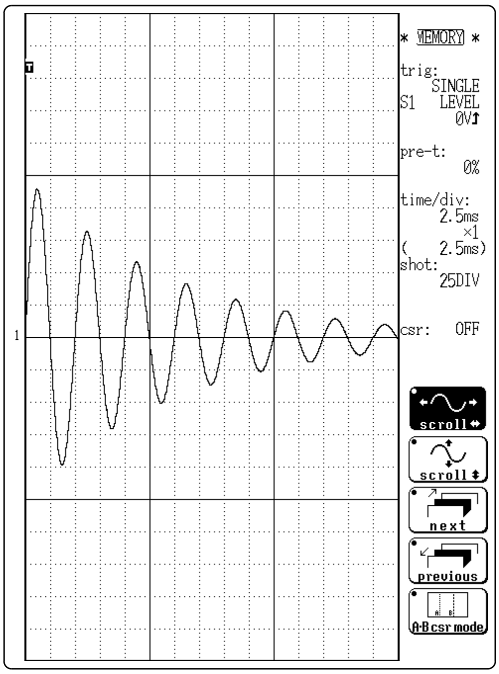
19.3 Scrolling the Waveform

- The waveform on the display can be scrolled horizontally and vertically.
- The FFT screen does not allow scrolling.

Method Screen: DISPLAY



1. Press the SELECT key so that the WAVE A.B CSR LED lights up. The JOG/SHUTTLE control now can be used for waveform scrolling and for operating the A/B cursors.
2. Each push of the function key F5 toggles between the waveform scroll mode and the A/B cursors mode. Set the display as follows to use the scroll mode.

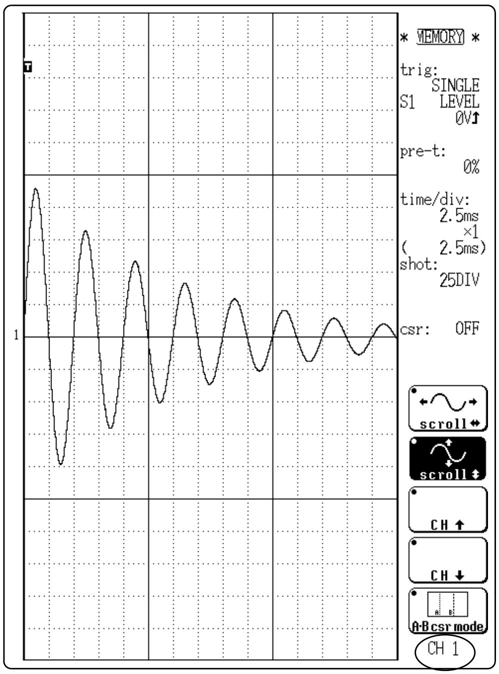


* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms
×1
(2.5ms)
shot: 25DIV
csr: OFF

Horizontal Scrolling

- When horizontal scrolling is selected

Function key display	Meaning
scroll↔	: Horizontal scroll
scroll↕	: Vertical scroll
next	: Show next screen (15 DIV). (Position of current screen within recording length is also shown.)
previous	: Show previous screen (15 DIV). (Position of current screen within recording length is also shown.)
A·B csr mode	: Switch to A/B cursor operation screen (☞ Section 19.2).



* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF
CH 1

Vertical Scrolling

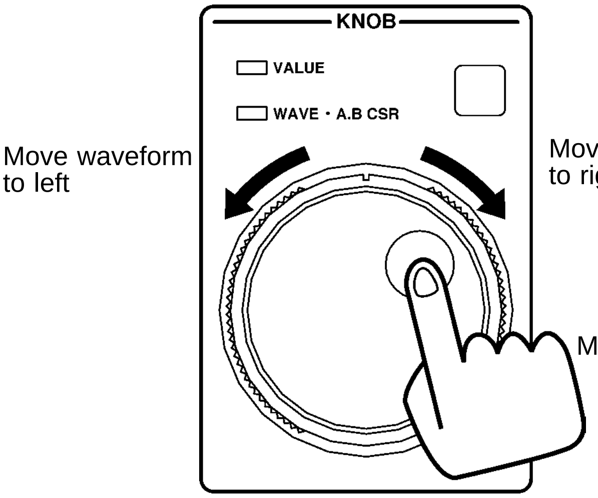
Channel of currently scrolled waveform is displayed

- When vertical scrolling is selected

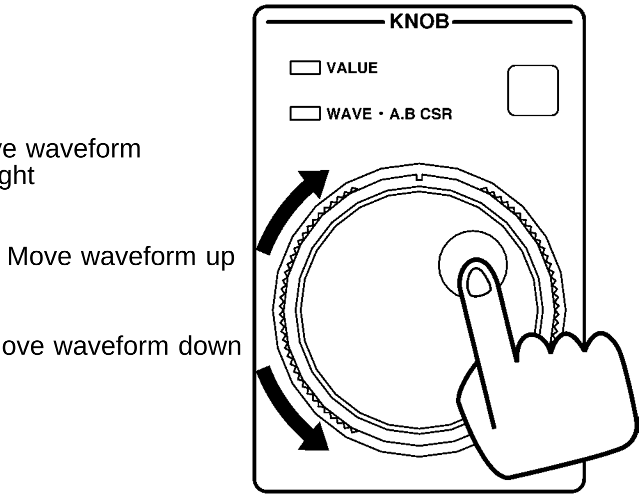
Function key display		Meaning
scroll ↔	:	Horizontal scroll
scroll ↕	:	Vertical scroll
CH ↑	:	Increase channel number
CH ↓	:	Decrease channel number
A·B csr mode	:	Switch to A/B cursor operation screen (☞ Section 19.2).

3. Use the function key display to select either vertical or horizontal scrolling. When vertical scrolling is selected, the channel of the scrolled waveform is shown.

4. Use the JOG/SHUTTLE control to scroll the waveform.



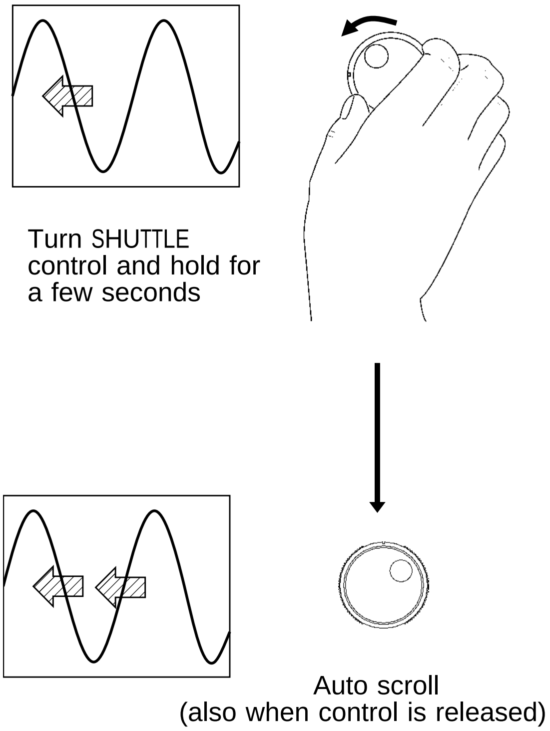
Horizontal Scrolling



Vertical Scrolling

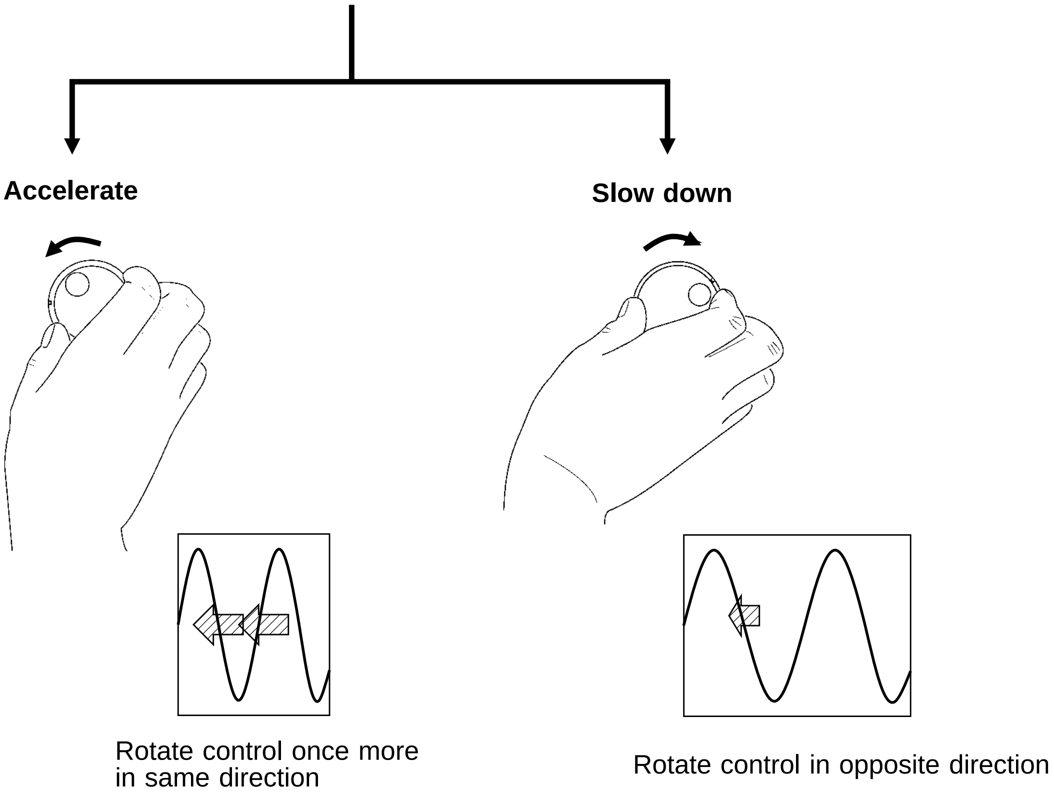
Auto scroll

Method (To scroll the waveform to the left)



1. Move the SHUTTLE control in the direction into which you want to scroll the waveform and hold the control for a few seconds.
2. When the indication **Auto scroll** appears on the function key display, release the SHUTTLE control. The waveform continues to scroll.
3. By turning the SHUTTLE control once more in the same direction, you can increase the speed of the scrolling process.

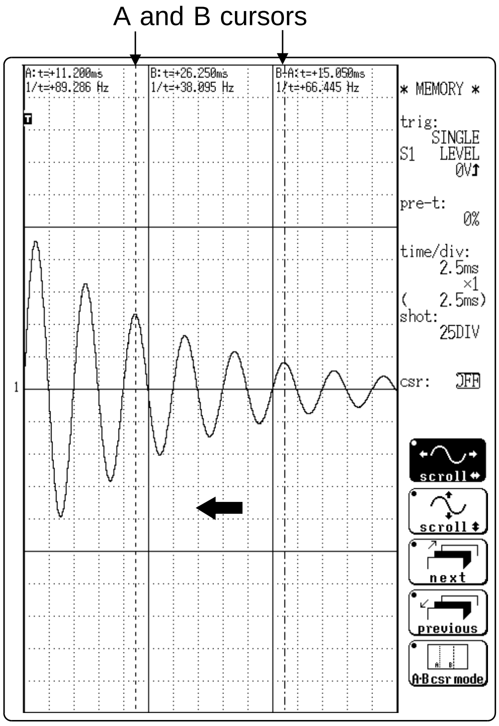
   Turning the control in the other direction reduces the scrolling speed. If you hold the control, the waveform will eventually scroll in the opposite direction.



NOTE The behavior of the A/B cursors during scrolling depends on whether the vertical/trace cursor or the horizontal cursor is used.

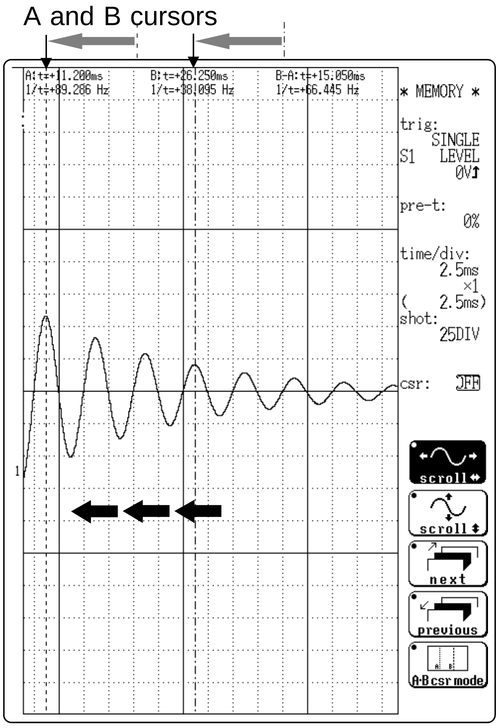
- When vertical or trace cursor is used (Example: vertical cursor)

When the waveform is scrolled, the cursor moves off screen together with the waveform.

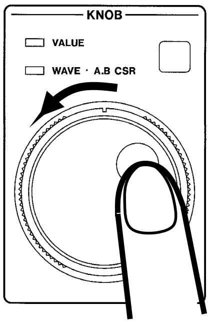


A:t=+11.200ms 1/t=+89.286 Hz
B:t=+26.250ms 1/t=+38.095 Hz
B-A:t=+15.050ms 1/t=+66.445 Hz
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF

Waveform is moved to the left



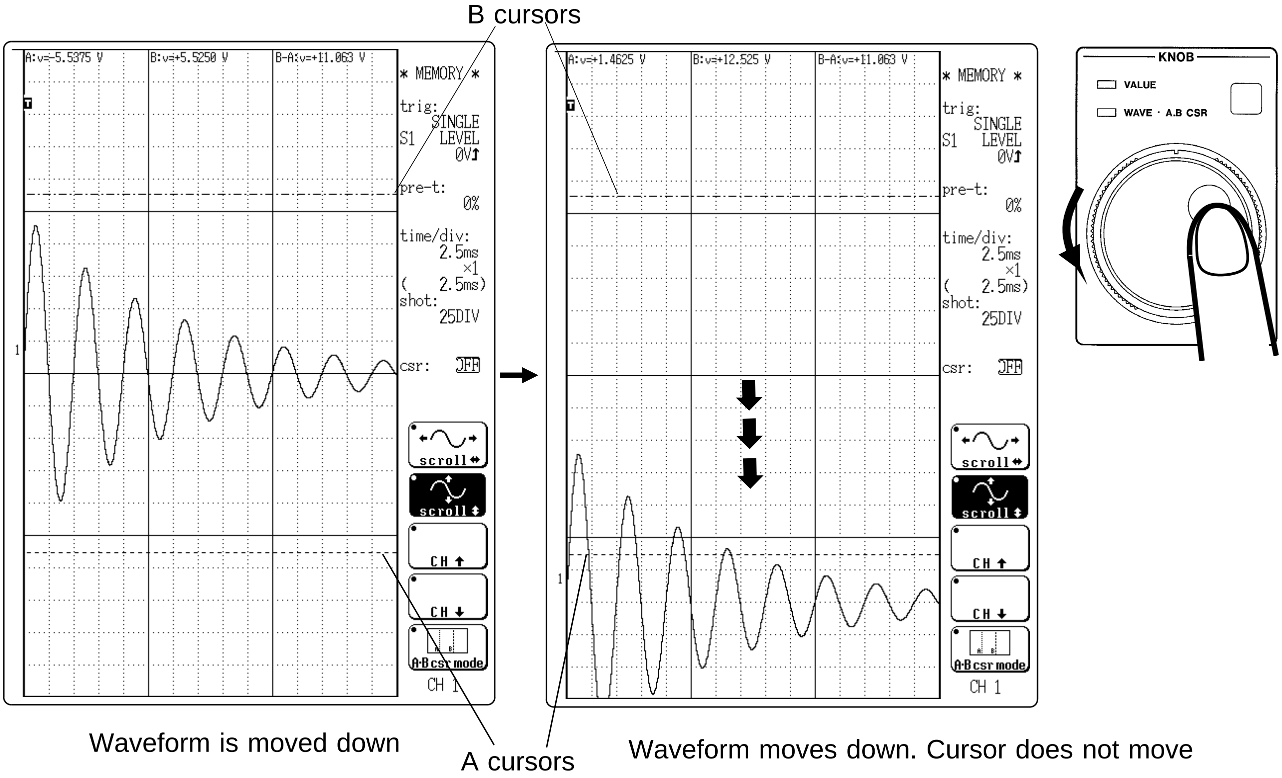
A:t=+11.200ms 1/t=+89.286 Hz
B:t=+26.250ms 1/t=+38.095 Hz
B-A:t=+15.050ms 1/t=+66.445 Hz
* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 25DIV
csr: OFF



Waveform moves to left. Cursor also moves to left.

- When horizontal cursor is used

Cursor position on screen does not change, also when waveform is scrolled.



Waveform is moved down

Waveform moves down. Cursor does not move

Chapter 20
LEVEL MON. / CH.SET / HELP Keys

20.1 Overview

This chapter explains the use of the following three keys:

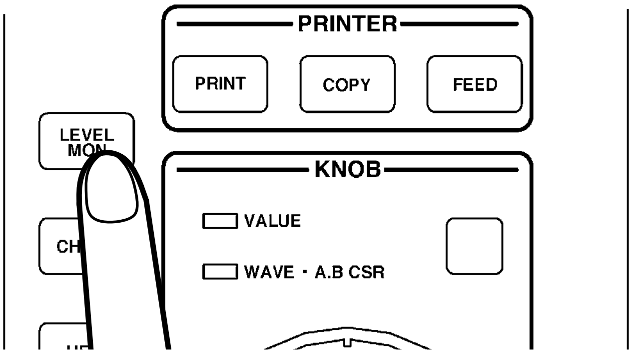
- LEVEL MON. key (input level check)
- CH.SET key (input channel setting)
- HELP key (waveform display position check)

20.2 Checking the Input Level (LEVEL MON. Key)

- The levels of all input waveforms can be monitored in real time.
- Levels are displayed separately for CH1 - CH16 and logical CH A - CH D.
- To select the input channel, use the CH.SET key. (☞ Section 20.3)
- This function is available in all modes.

Method 1. Press the LEVEL MON. key.

The level monitor function can be activated from any screen (STATUS, CHANNEL, display, SYSTEM, DAT, etc.).

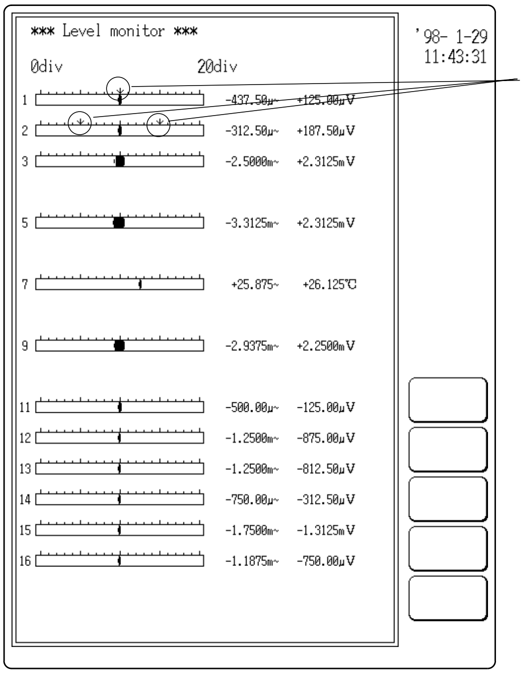


2. The CH.SET key can be used to select the input channel while using the level monitor function (☞ Section 20.3).
3. Press the LEVEL MON. key once more to terminate the function.

NOTE

For the following channels, analog input level is not displayed:

- Channels where no unit is installed
- Channels outside the "units in use" range
- Channels specified as logic input channels

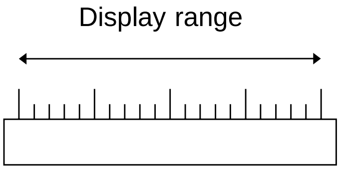


```
*** Level monitor ***                                    '98- 1-29
                                                          11:43:31
0div                  20div
1                          -437.50µ~   +125.00µV
2                          -312.50µ~   +187.50µV
3                          -2.5000m~   +2.3125mV

5                          -3.3125m~   +2.3125mV

7                           +25.875~    +26.125℃

9                          -2.9375m~   +2.2500mV

11                         -500.00µ~   -125.00µV
12                         -1.2500m~   -875.00µV
13                         -1.2500m~   -812.50µV
14                         -750.00µ~   -312.50µV
15                         -1.7500m~   -1.3125mV
16                         -1.1875m~   -750.00µV
```

Displays trigger level

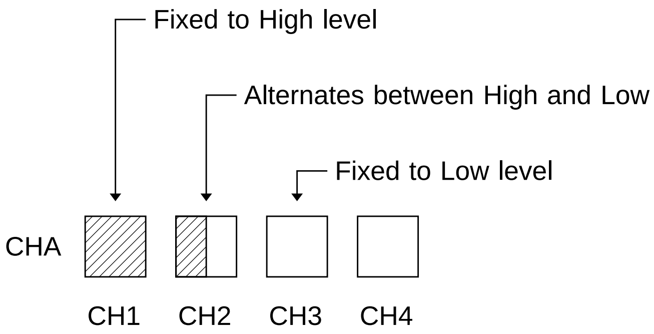
If the input waveform is out of the display screen, the color of the frame is changed.

Analog input display



Logic input level display

Logic inputs are displayed as follows.

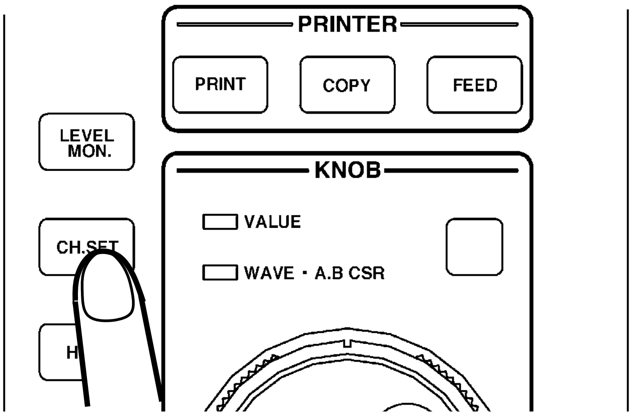


20.3 Selecting the Input Channel on the Display Screen and Level Monitor Screen (CH.SET Key)

Channel settings can be made while a waveform is displayed on screen.

Method Screen: DISPLAY

1. Press the CH.SET key while the display screen or level monitor screen is shown. The channel setting screen appears.
2. The display content changes with each push of the CH.SET key.

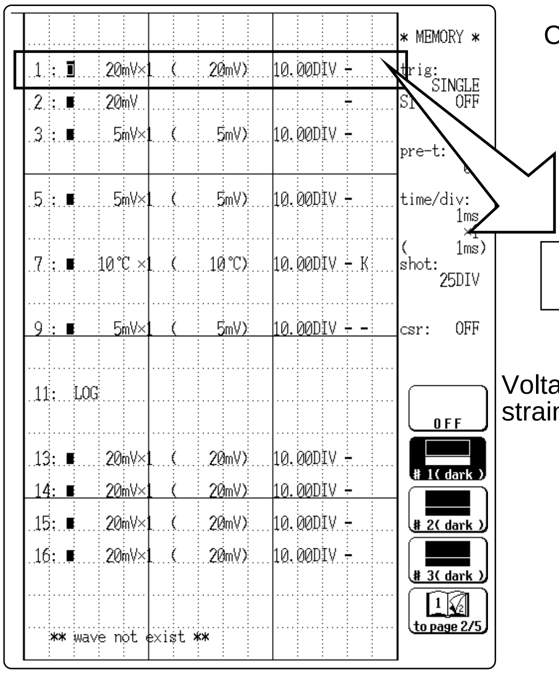


3. Move the flashing cursor to the item you want to change and make the setting.
   For details on settings, refer to Chapter 9.

NOTE

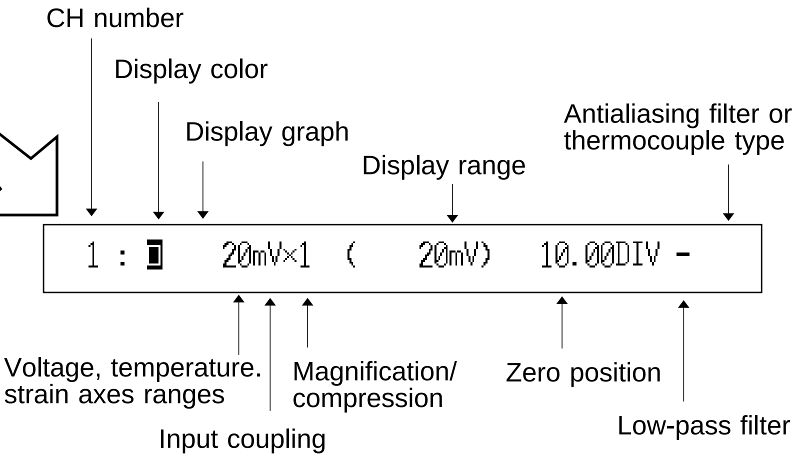
- During use of the FFT function, logic input settings cannot be made.
- During use of the STATUS screen (page 2) and the CHANNEL screen, the CH.SET key serves to switch the display between CH1 - CH8 and CH9 - CH16.
- When the input channel setting screen was called up with the CH.SET key, the following functions are not available:

(1) Copying channel settings
(2) Input waveform selection
(3) Switching the variable function on and off



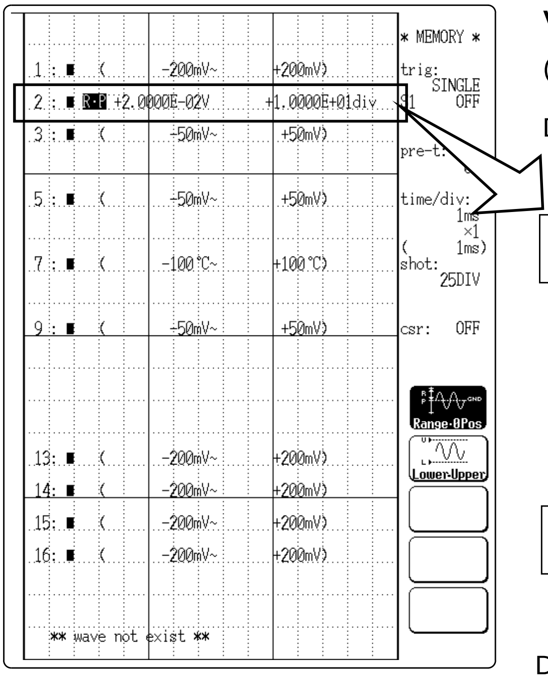
```
* MEMORY *
1 : ▮   20mV×1  (   20mV)  10.00DIV -
2 : ▮   20mV                        -
3 : ▮    5mV×1  (    5mV)  10.00DIV -
5 : ▮    5mV×1  (    5mV)  10.00DIV -
7 : ▮  10℃ ×1  (   10℃)  10.00DIV - K
9 : ▮    5mV×1  (    5mV)  10.00DIV - -
11:  LOG
13: ▮   20mV×1  (   20mV)  10.00DIV -
14: ▮   20mV×1  (   20mV)  10.00DIV -
15: ▮   20mV×1  (   20mV)  10.00DIV -
16: ▮   20mV×1  (   20mV)  10.00DIV -
  ** wave not exist **
trig:
   SINGLE
S1    OFF
pre-t:
time/div:
     1ms
(    1ms)
shot:
   25DIV
csr:  OFF
```

Analog input settings (☞ Section 9.6)



```
1 : ▮   20mV×1  (   20mV)  10.00DIV -
```

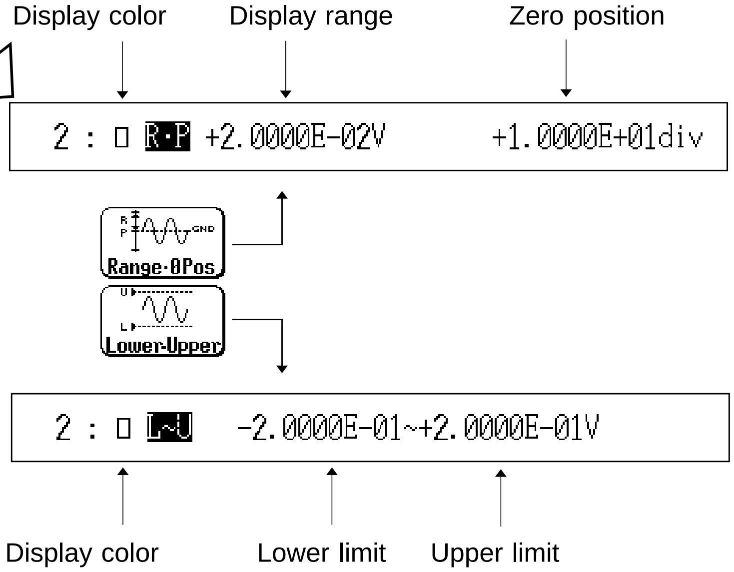
CH.SET key



```
* MEMORY *
1 : ▮ (       -200mV~      +200mV)
2 : ▮ R·P +2.0000E-02V    +1.0000E+01div
3 : ▮ (        -50mV~       +50mV)
5 : ▮ (        -50mV~       +50mV)
7 : ▮ (       -100℃~      +100℃)
9 : ▮ (        -50mV~       +50mV)
13: ▮ (       -200mV~      +200mV)
14: ▮ (       -200mV~      +200mV)
15: ▮ (       -200mV~      +200mV)
16: ▮ (       -200mV~      +200mV)
  ** wave not exist **
trig:
   SINGLE
S1    OFF
pre-t:
time/div:
     1ms
      ×1
(    1ms)
shot:
   25DIV
csr:  OFF
```

Variable function settings (☞ Section 9.6.10)

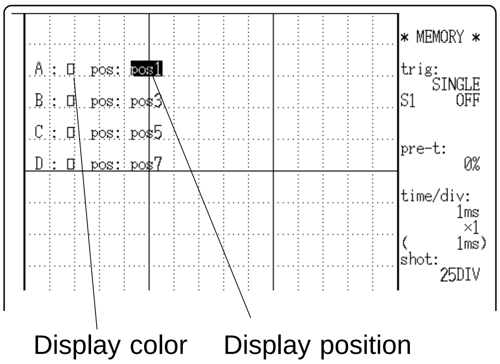
(Channels for which variable is set to ON)



```
2 : □ R·P +2.0000E-02V      +1.0000E+01div
```

```
2 : □ L~U  -2.0000E-01~+2.0000E-01V
```

CH.SET key



```
* MEMORY *
A : □  pos: pos1
B : □  pos: pos3
C : □  pos: pos5
D : □  pos: pos7
trig:
   SINGLE
S1    OFF
pre-t:
      0%
time/div:
     1ms
      ×1
(    1ms)
shot:
   25DIV
```

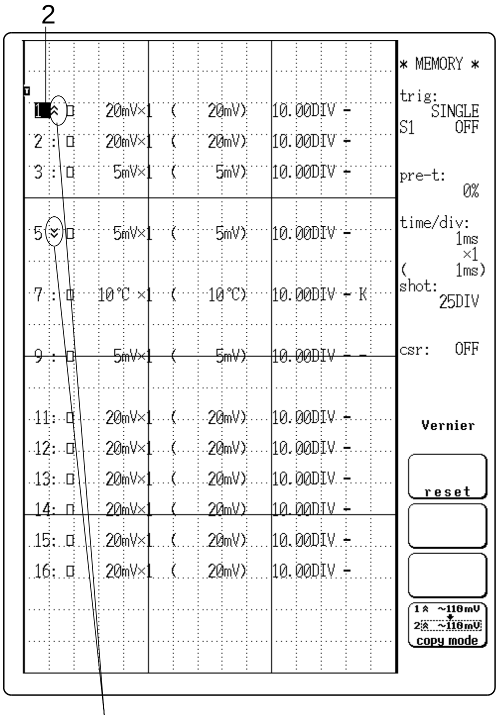
Logic input settings (☞ Section 9.5)

When the logic input is specified.

- Adjusting the input voltage to any desired voltage (Vernier function)

- Using fine adjustment, the input voltage can be matched to a desired reading.
- For example, an actual input voltage of 1.2 V can be converted to a 1.0 V reading.

Method Screen: DISPLAY, level monitor



```
* MEMORY *
1 ≈ □  20mV×1 (  20mV)  10.00DIV -      trig:  SINGLE
2 : □  20mV×1 (  20mV)  10.00DIV -      S1     OFF
3 : □   5mV×1 (   5mV)  10.00DIV -      pre-t:   0%
5 ≈ □   5mV×1 (   5mV)  10.00DIV -      time/div: 1ms
7 : □  10℃ ×1 (  10℃)   10.00DIV - K              ×1
9 : □   5mV×1 (   5mV)  10.00DIV - -    (       1ms)
11: □  20mV×1 (  20mV)  10.00DIV -      shot:  25DIV
12: □  20mV×1 (  20mV)  10.00DIV -      csr:   OFF
13: □  20mV×1 (  20mV)  10.00DIV -
14: □  20mV×1 (  20mV)  10.00DIV -      Vernier
15: □  20mV×1 (  20mV)  10.00DIV -      reset
16: □  20mV×1 (  20mV)  10.00DIV -
                                        1≈ ~110mV
                                        2≈ ~110mV
                                        copy mode
```

Channel for which the Vernier function is activated

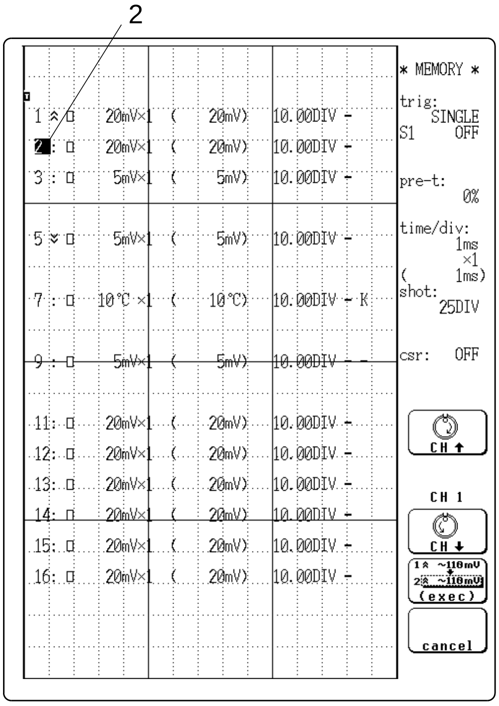
1. Press **CH.SET** key on the DISPLAY screen or the level monitor screen, to display the channel setting screen.
2. Move the flashing cursor to the channel number.
3. Adjust the channel by using the jog control.

NOTE

The Vernier function is not applicable to a waveform after waveform processing.

- Copying the Vernier setting

Method Screen: DISPLAY, level monitor



```
* MEMORY *
1 ≈ □  20mV×1 (  20mV)  10.00DIV -      trig:  SINGLE
2 : □  20mV×1 (  20mV)  10.00DIV -      S1     OFF
3 : □   5mV×1 (   5mV)  10.00DIV -      pre-t:   0%
5 ≈ □   5mV×1 (   5mV)  10.00DIV -      time/div: 1ms
7 : □  10℃ ×1 (  10℃)   10.00DIV - K              ×1
9 : □   5mV×1 (   5mV)  10.00DIV - -    (       1ms)
11: □  20mV×1 (  20mV)  10.00DIV -      shot:  25DIV
12: □  20mV×1 (  20mV)  10.00DIV -      csr:   OFF
13: □  20mV×1 (  20mV)  10.00DIV -      CH ↑
14: □  20mV×1 (  20mV)  10.00DIV -      CH 1
15: □  20mV×1 (  20mV)  10.00DIV -      CH ↓
16: □  20mV×1 (  20mV)  10.00DIV -      1≈ ~110mV
                                        2≈ ~110mV
                                        (exec)
                                        cancel
```

1. Move the flashing cursor to the channel number of the copy destination.
2. Press the F5 [copy mode] key.
3. Using the [CH↑] or [CH↓] jog control, select channel of the copy source.

Function key display	Meaning
CH ↑	: Increase the channel number
CH 3	: Copy source channel
CH ↓	: Decrease the channel number
1≈ ~110mV 2≈ ~110mV (exec)	: Copy
cancel	: Exit copy mode

4. Press the F4 [exec] key to copy the settings.

20.4 Checking the Waveform Display Position (HELP Key)

The HELP key serves to check the following items:

(1) Position display

Shows the position of the currently displayed waveform within the entire recording length (memory recorder, recorder).

(2) Bar graph

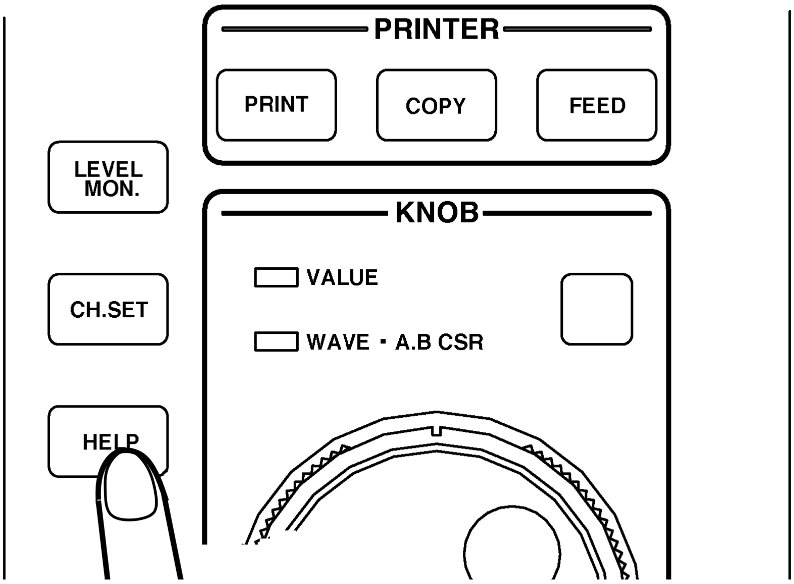
Shows the display position within the entire recorded waveform along the voltage axis (shown at the same time as the position display).

(3) Block display

Shows the memory segmentation status (memory recorder).

Method Screen: DISPLAY

1. Press the HELP key. The position display appears.

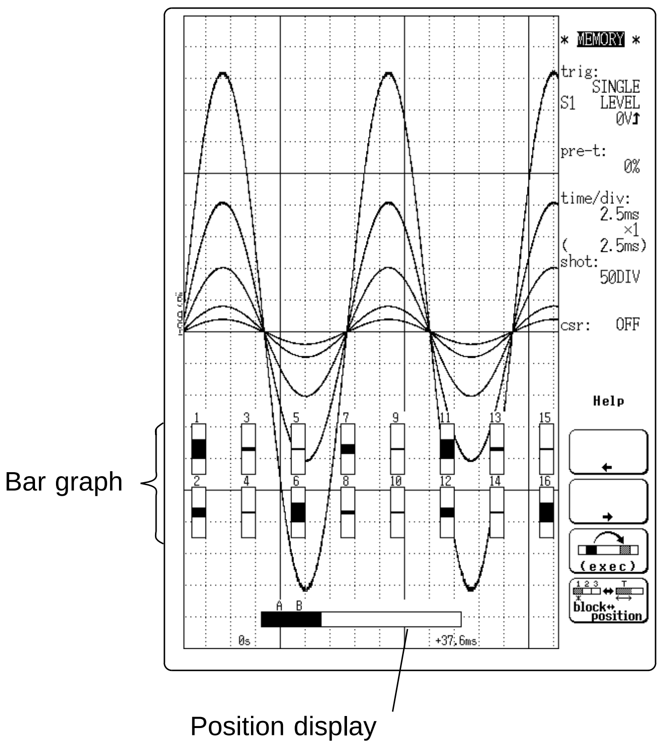


2. With each push of the F5 [block↔position] key, the display switches between the block display and the position display.

NOTE

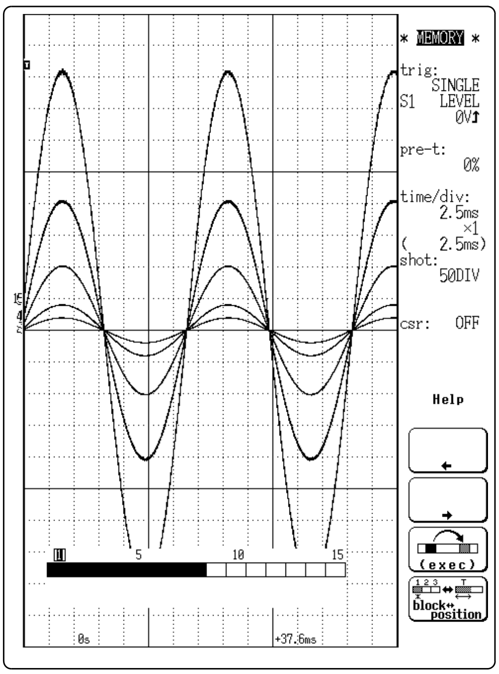
- The memory segmentation function can only be used with the memory recorder.
- When memory segmentation is disabled, the block display is not shown. (For details on memory segmentation, see Chapter 17.)

Position display



* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 50DIV
csr: OFF

Block display (Memory recorder only)

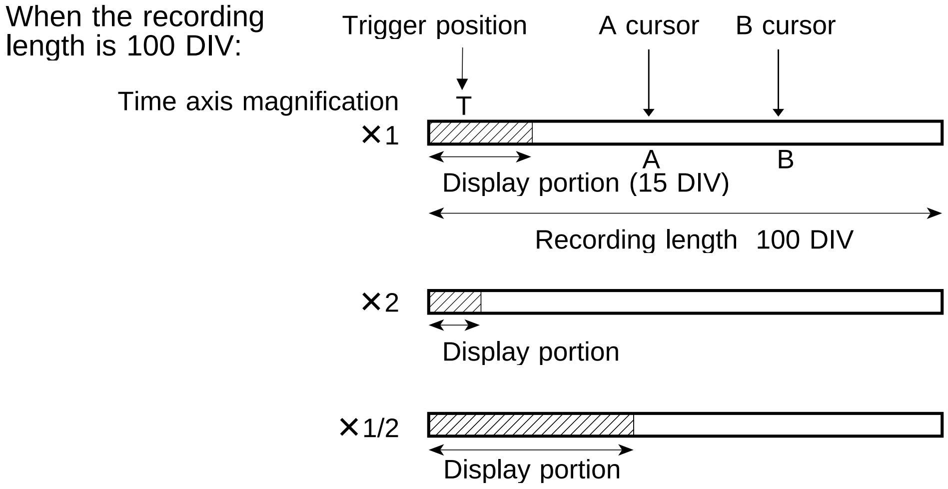


* MEMORY *
trig: SINGLE
S1 LEVEL 0V↑
pre-t: 0%
time/div: 2.5ms ×1 (2.5ms)
shot: 50DIV
csr: OFF

3. To terminate the position display mode or block display mode, press the HELP key once more.

① Position display

- Indicates the position of the currently displayed waveform within the entire recording length.
- When the trigger position and A/B cursors are used, their positions are also shown.
- The position display mode can be used to rapidly shift the displayed waveform.



Shifting the display position

The waveform display position can be specified in three ways.

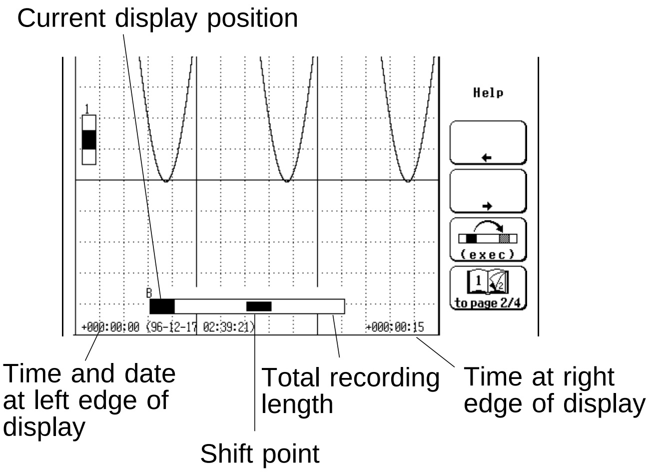
(1) Position
Specify the position of the shift point.

(2) Time
Specify the time (from recording start) of the shift point.

(3) Event mark
Specify the event mark of the shift point (For information on how to set event marks, refer to Section 13.5.2.)

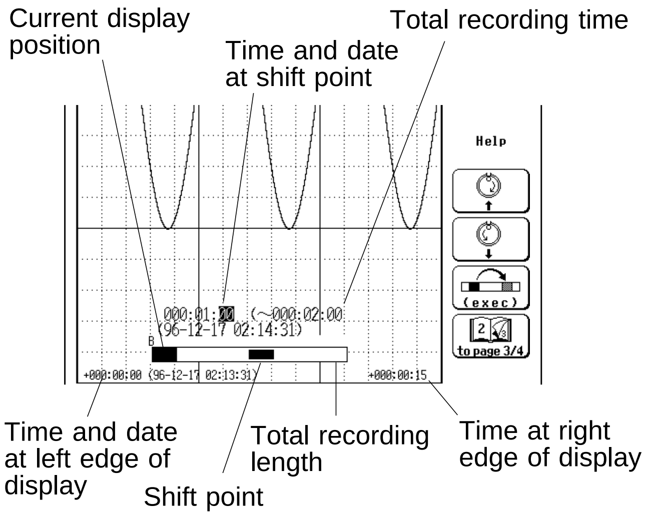
NOTE Methods (2) and (3) can be used only with the recorder function.

1. Record a waveform or read it from tape.
2. Press the HELP key.
3. Specify the part to be shown on the display. (The part is shown in detail.)



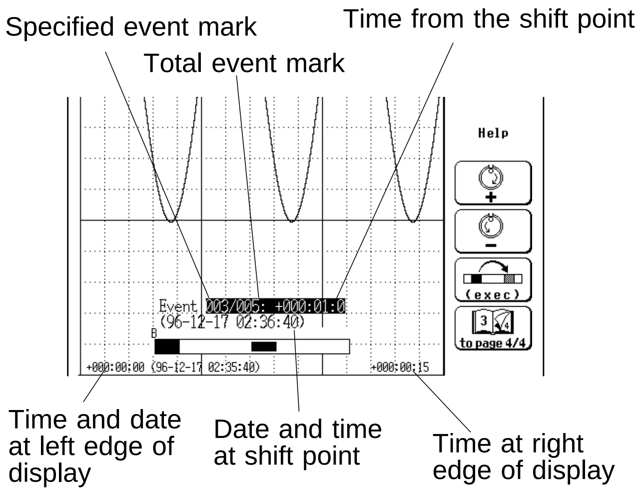
1/3 Position

Function key display	Meaning
Help	: (Display only)
← →	Specify shift position
(exec)	: Execute shift
to page 2/4	: Switch to page 2/4



2/3 Time (Recorder only)

Function key display	Meaning
Help	: (Display only)
↑ ↓	Specify time (h:min:s)
(exec)	: Execute shift
to page 3/4	: Switch to page 3/4



3/3 Event mark

Function key display	Meaning
Help	: (Display only)
+	Specify event mark
−	
(exec)	: Execute shift
to page 4/4	: Switch to page 3/4

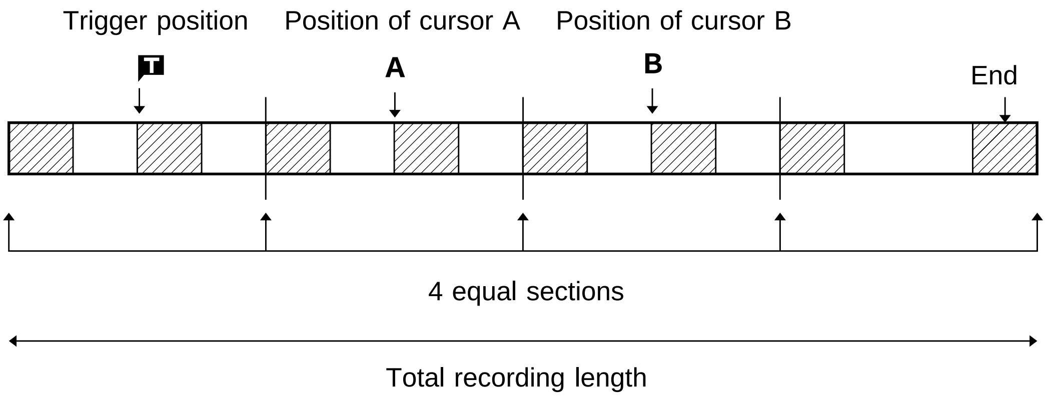
NOTE The event mark is displayed on the waveform screen.

4. When the F4 [exec] key is pressed, high-speed shift is carried out and the display position changes.

NOTE The display can be moved to the following 8 positions.

(1) The start of 4 equal sections into which the recording length is divided
(2) End of the recording length
(3) Position of the A/B cursors
(4) Trigger position

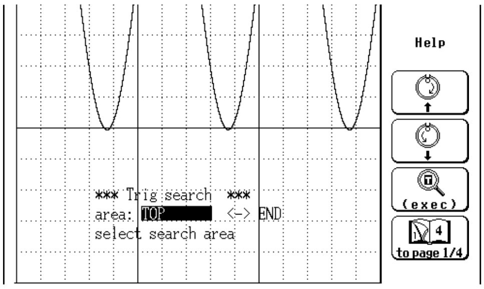
When the recording length is longer than four times the display screen range, the above may not apply.



Trigger searching

From waveforms recorded in memory or on MO disk, you can search for points which satisfy the current trigger conditions.

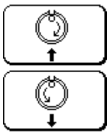
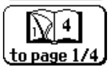
Method Screen: DISPLAY



*** Trig search ***
area: TOP <-> END
select search area

1. Record a waveform, or read it from MO disk.
2. Press the HELP key.
3. Switch to the function key indication 4/4.
4. Use the CURSOR keys to move the flashing cursor and select the range in which trigger searching is to be carried out.
   Use the jog control or function keys to specify the range, starting from the data start, cursor A position, cursor B position, left edge of current screen, or data end.

4/4

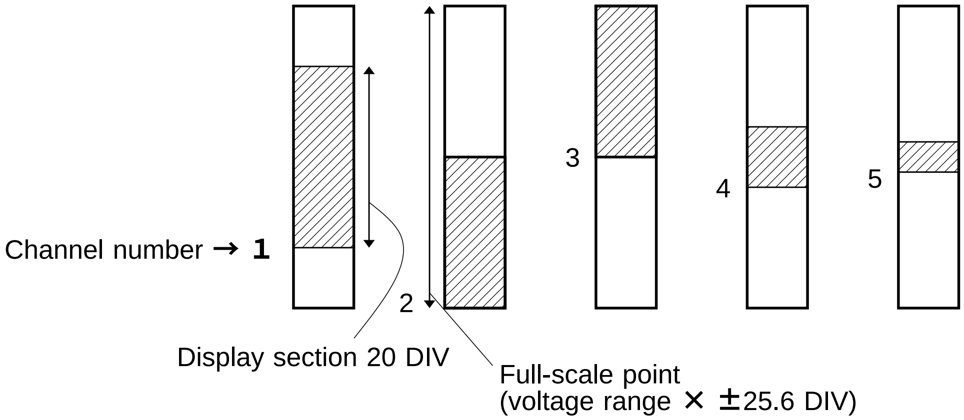
Function key display		Meaning
Help	:	(Display only)
		Specify shift position
	:	Search trigger
	:	Switch to page 1/4

5. Press the F4 [exec] key to start searching.

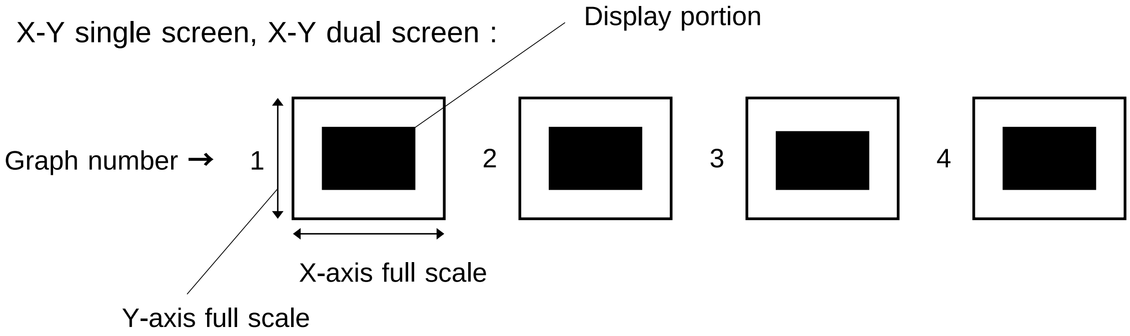
② Bar graph

- In position display mode, the bar graph indication is also shown.
- The bar graph indicates which part of the recorded waveform is currently being shown on the screen.
- For all displayed waveforms, the bar graph is shown with the channel number.

Single, dual, quad, oct screen :



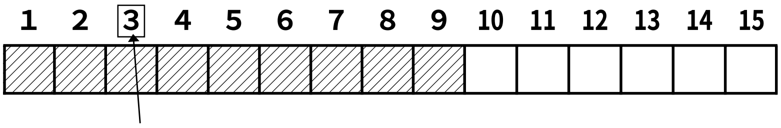
X-Y single screen, X-Y dual screen :



③ Block display (memory recorder function only)

- When memory segmentation is being used, the memory block status is shown.
- In block display mode, the memory block that is currently being shown on screen can be changed. (For details on memory segmentation, see Chapter 17.)
- Display shift can be carried out in the same way as in position display mode.

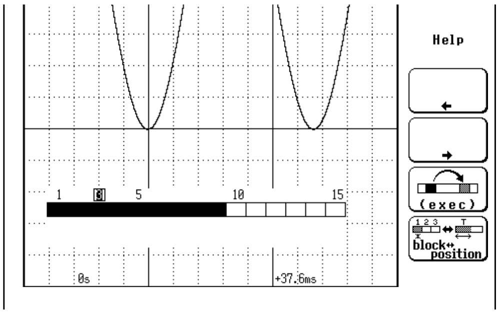
Memory segmentation, 15 blocks, 9 used



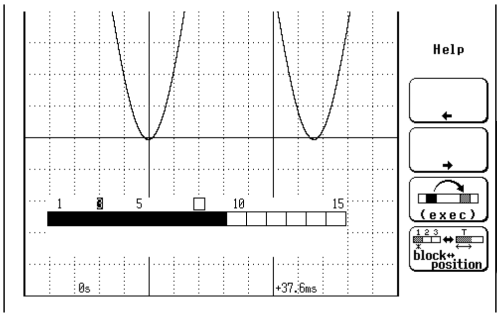
Indicates currently displayed memory block.

Changing the currently displayed memory block

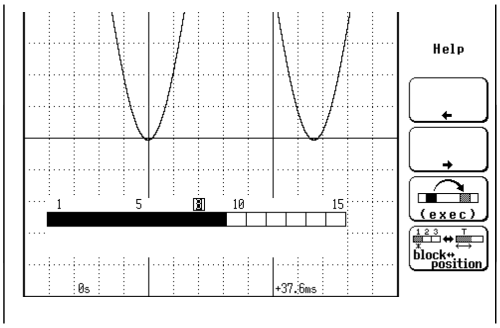
Method



1. When block display is selected, the currently displayed memory block is indicated.
2. Use the F2 [→] and F3 [←] keys to move the ☐ mark and specify the memory block you wish to display.



Function key display		Meaning
Help	:	(Display only)
←		Specify shift position
→		
(exec)	:	Execute shift
block↔position	:	Toggle position display and block display



3. Press the F4 [exec] key to shift the display to the selected memory block.

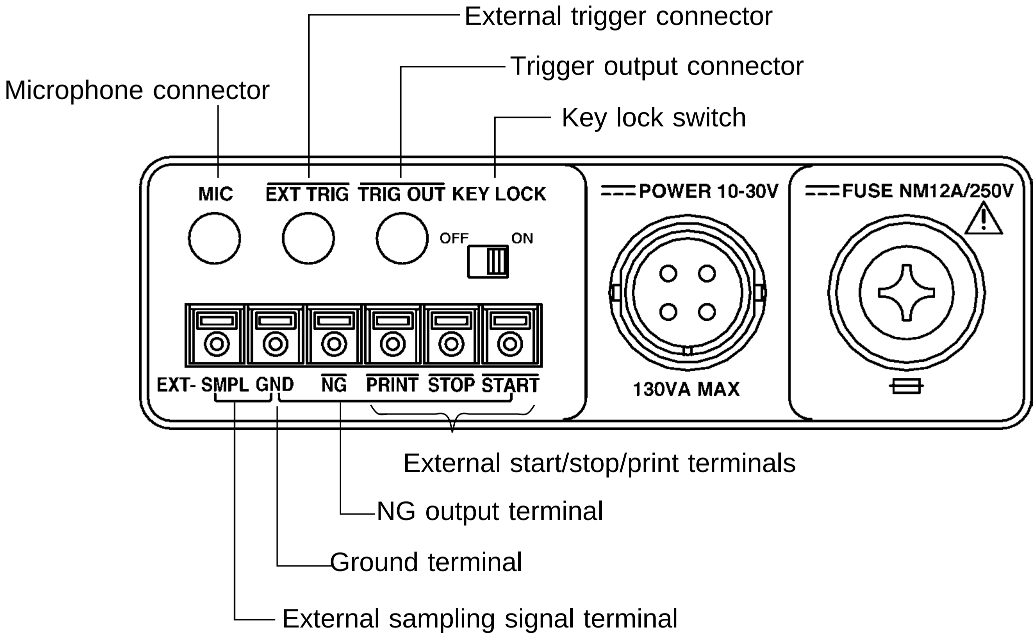
Chapter 21
External Input/Output Connectors / Key Lock Function

21.1 Overview

The input/output connectors of the 8846 serve the following functions:

- Measurement start/stop, printer output control
- Trigger signal input/output
- Sampling rate control via external signal
- Waveform evaluation NG output
- Microphone input

The KEY LOCK switch can be used to temporarily disable the other controls of the 8846.



21.2 Using the External Start, Stop, and Print Terminals

⚠ CAUTION To prevent damage to the unit, take care never to exceed the voltage rating of the inputs.

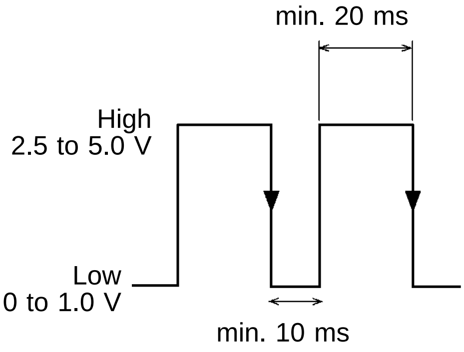
Using the external input terminals, recording start/stop and printer output can be controlled for all functions.

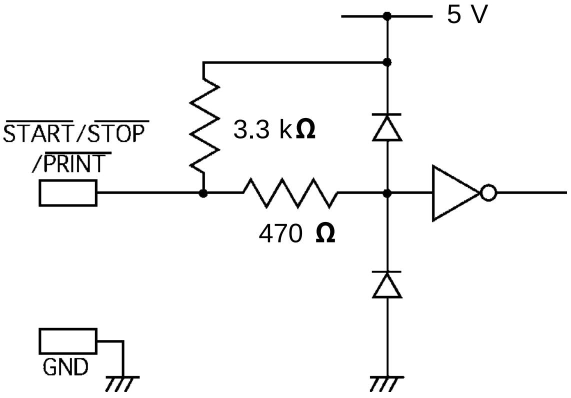
START terminal	Measurement starts when a signal is input here.
STOP terminal	Measurement stops when a signal is input here.
PRINT terminal	Printing starts when a signal is input here.

Signal input method

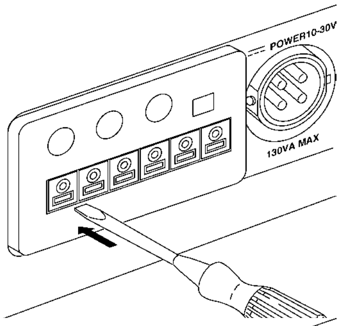
- Short the terminal to ground, or input a pulse signal (High level: 2.5 - 5.0 V, Low level: 0 - 1.0 V) or a square wave signal.
- Control is activated at the falling edge of the input waveform (active Low).

Voltage range	High level: 2.5 - 5.0 V Low level: 0 - 1.0 V
Pulse width	High level: min. 20 ms Low level: min. 10 ms
Maximum input rating	-5 to 10 V

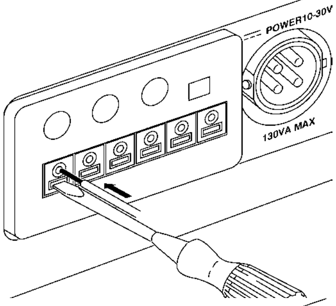




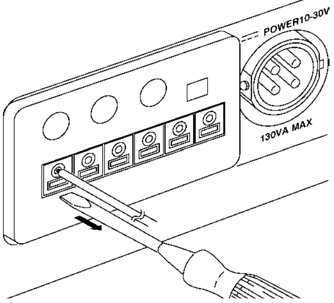
Using the terminals



1. Push the tab with a flatblade screwdriver or similar.

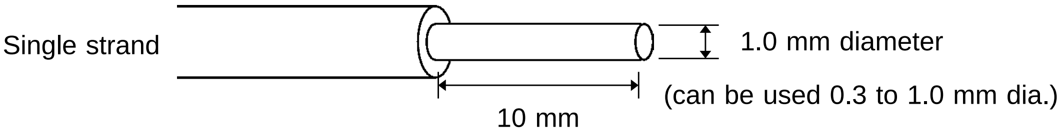


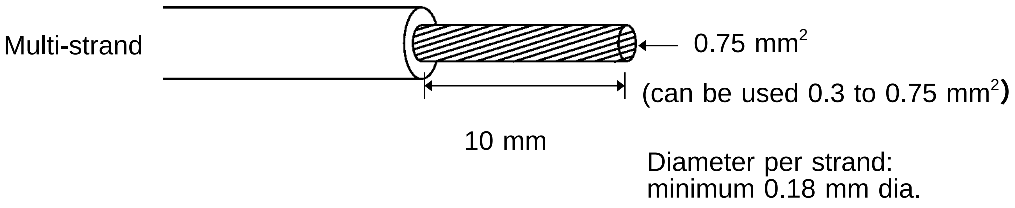
2. While keeping the tab depressed, insert a stripped wire into the connector opening.



3. Release the tab to lock the wire.

Recommended wire	Single strand: 1.0 mm dia. (AWG #18) Multi-strand: 0.75 mm^2
Usable limits	Single strand: 0.3 to 1.0 mm dia. (AWG #26 to #18) Multi-strand: 0.3 to 0.75 mm^2 (AWG #22 to #20) Strand diameter: minimum 0.18 mm
Standard insulation stripping length	10 mm





21.3 Using the External Trigger Input (EXT TRIG)

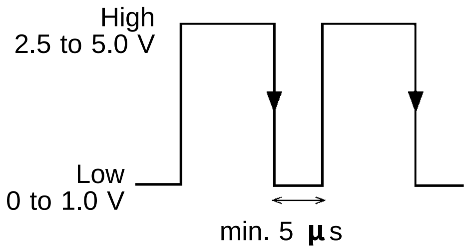
⚠ CAUTION To prevent damage to the unit, take care never to exceed the voltage rating of the EXT TRIG input.

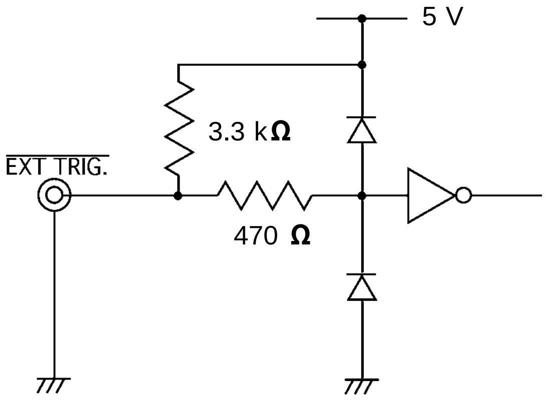
- An external signal can be used as trigger source.
- Several 8846 units can be synchronized for parallel operation.

Signal input method

- Short the terminal to ground, or input a pulse signal (High level: 2.5 - 5.0 V, Low level: 0 - 1.0 V) or a square wave signal.
- Triggering is activated at the falling edge of the input waveform (active Low).

Voltage range	High level: 2.5 - 5.0 V Low level: 0 - 1.0 V
Pulse width	Low level: min. 5 µs
Maximum input rating	-5 to 10 V
Connector type	miniature phone jack, 3.5 mm dia.





21.4 Using the External Trigger Output (TRIG OUT)

⚠ CAUTION To prevent damage to the unit, take care never to exceed the voltage rating of the TRIG OUT input.

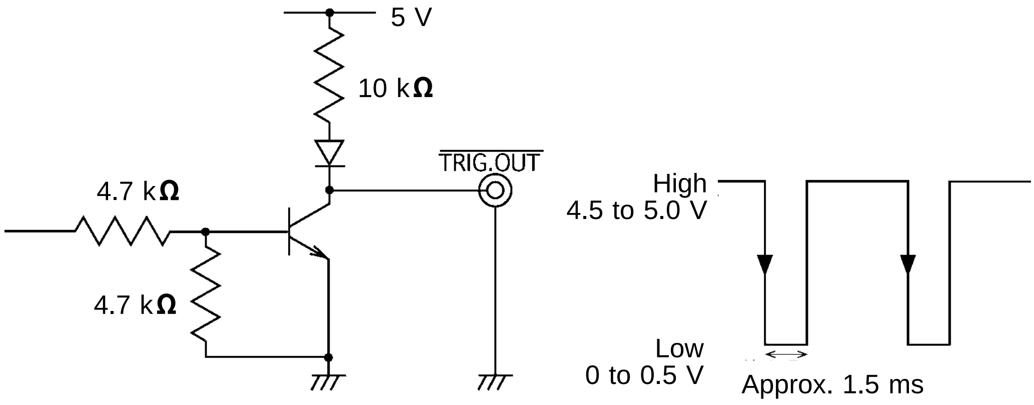
- When triggering occurs, a signal is output from this connector.
- Several 8846 units can be synchronized for parallel operation.

Trigger output signal

Signal type	open-collector signal, active Low
Output voltage range	High level: 4.5 - 5.0 V Low level: 0 - 0.5 V
Pulse width	approx. 1.5 ms
Maximum input rating	-20 to +30 V, max. 500 mA, max. 200 mW
Connector type	miniature phone jack, 3.5 mm dia.

NOTE

When the auto range function is activated by pressing the AUTO key, a trigger output signal is generated. This should be taken into consideration when using both the trigger output and the auto range function (memory recorder, recorder).



21.5 Using the External Sampling Input (EXT SMPL)

⚠ CAUTION To prevent damage to the unit, take care never to exceed the voltage rating of the EXT SMPL input.

An external signal can be used to set the sampling rate.

Signal input method

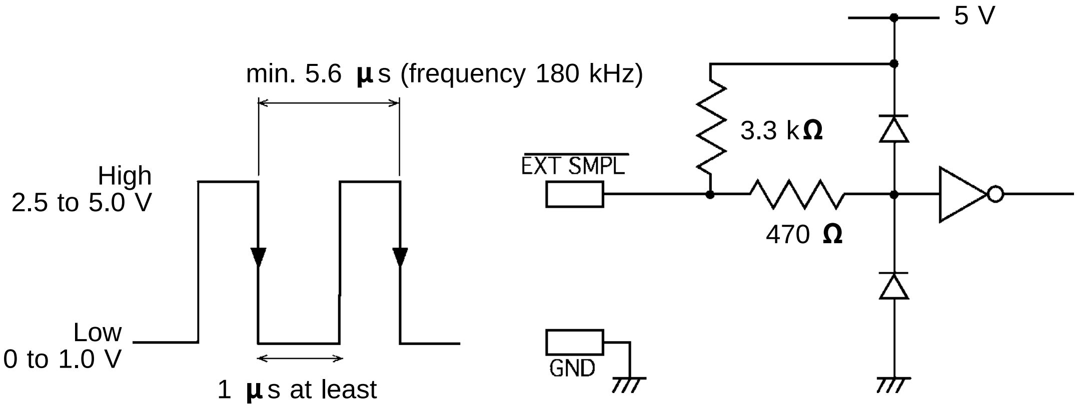
- Between the terminal and ground, input a pulse signal (High level: 2.5 - 5.0 V, Low level: 0 - 1.0 V) or a square wave signal.
- Sampling is activated at the falling edge of the input waveform (active Low).

Voltage range	High level: 2.5 - 5.0 V Low level: 0 - 1.0 V
Pulse width	Low level: min. 1 μs
Frequency	Memory recorder, FFT function max. 180 kHz max. 90 kHz (when 8927 is used) Recorder function

Number of units in use	1		2		4		8	
	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch	1 ch	2 ch
kHz max.	80	40		20		10		5

1ch: Only 8916 - 8919, 8928 can be used.
2ch: 8916 - 8919, 8927, 8928 can coexist, or 8927 can be used exclusively. (For the 8928, one channel corresponds to one unit.)

Maximum input rating -5 to 10 V



Connection method

Refer to Section 21.2.

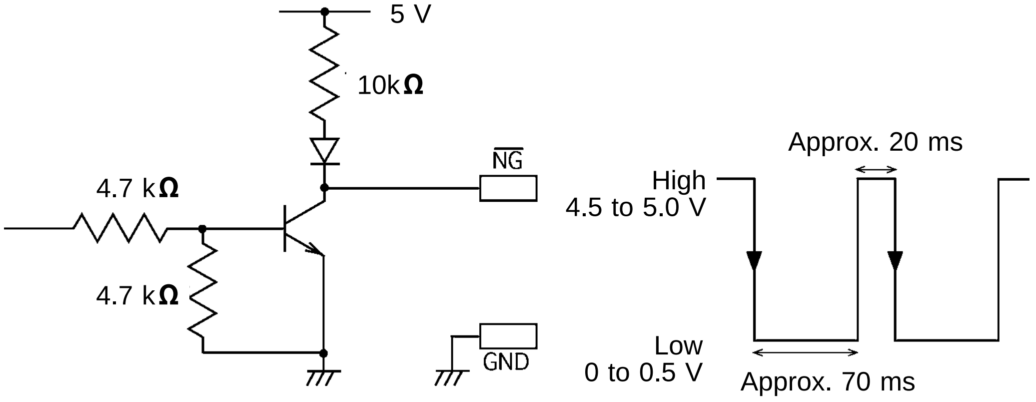
21.6 Using the NG Evaluation Output (NG)

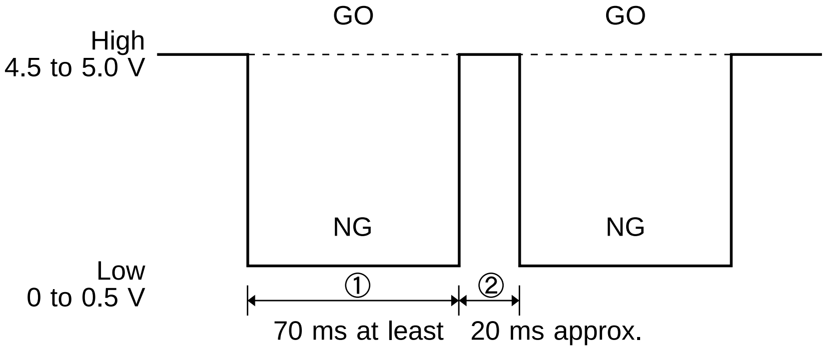
⚠ CAUTION To prevent damage to the unit, take care never to exceed the voltage rating of the NG output.

When waveform evaluation or waveform parameter evaluation is used, a signal is output from this connector when the result is NG (fail).

NG output signal

Signal type	open-collector signal, active Low
Output voltage range	High level: 4.5 - 5.0 V Low level: 0 - 0.5 V
Maximum input rating	-20 to +30 V, max. 500 mA, max. 200 mW





① Evaluation output interval (min. 70 ms)

When the evaluation result is GO (pass), the output is High level, and when the result is NG (fail), the output is Low level. Between these states, there is an interval during which the next data are read and waveform data are created. The duration of this interval is inversely proportional to the time axis and proportional to the recording length.

② Evaluation interval (approx. 20 ms)

The output is High level. Evaluation is carried out during this interval.

Connection method

Refer to section 21.2.

Setting the output to be active on GO result

(1) When waveform evaluation is used

1. Set the waveform evaluation mode to "All out".
2. Use the area editor to create the GO area.
3. Use the "reverse" command to reverse the evaluation area, so that the GO area is shown in white.

Now start the measurement. A signal will be output from the NG terminal when the waveform evaluation result is GO.

(2) When waveform parameter evaluation is used

1. Set the upper and lower limit.
2. When lower limit < GO range < upper limit, set the evaluation mode to "In". When GO range < lower limit, upper limit<GO range, set the evaluation mode to "Out".

Now start the measurement. A signal will be output from the NG terminal when the waveform parameter evaluation result is GO.

NOTE

If the result of either waveform evaluation or waveform parameter evaluation is NG, NG is output.

21.7 Using the Microphone Input (MIC)

⚠ CAUTION

- To prevent damage to the unit, take care never to exceed the voltage rating of the MIC output.
- Do not connect any other equipment besides a microphone to this jack.

- This input serves for recording a voice memo when using the recorder function.
- For details on how to record a voice memo, refer to Section 7.2.7.

Maximum input rating: 0 to 5.0 V DC + AC peak

Connector type: miniature phone jack, 3.5 mm dia.

Input configuration: mono

NOTE

- When using a stereo microphone, a stereo-to-mono adapter should be used.
- For microphones with standard-size phone plugs (6.3 mm dia.) or with other plugs, a suitable plug adapter should be used.
- The 8846 does not provide a microphone power supply.

Microphone types

The following microphone types can be used:

Dynamic microphone
Electret condenser microphone (with internal battery)

The following microphone models have been verified to work with the 8846.

- Dynamic microphones
  DM-H110 (Aiwa)
  AT-K40 (Audio Technica)
  F-V310 (Sony)
  MV-K2 (JVC)
  RP-VK2 (Matsushita)

- Electret condenser microphones
  AT9820 (Audio Technica)
  ECM-Z70 (Sony)
  ECM-T110 (Sony)
  RP-VC3 (Matsushita)

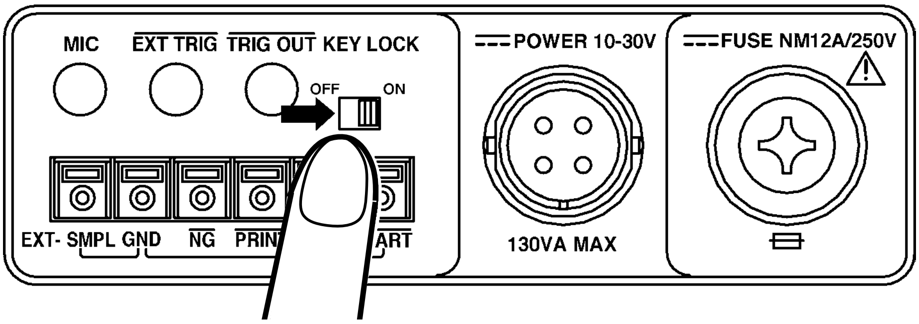
21.8 Using the Key Lock Function

- This function disables all front-panel controls of the 8846.
- The function serves to prevent unintended changes to settings during a measurement.

Method 1. Set the KEY LOCK switch to ON.

2. To cancel the function, set the KEY LOCK switch to OFF.
(The key lock function will not be canceled by turning the power off and on.)

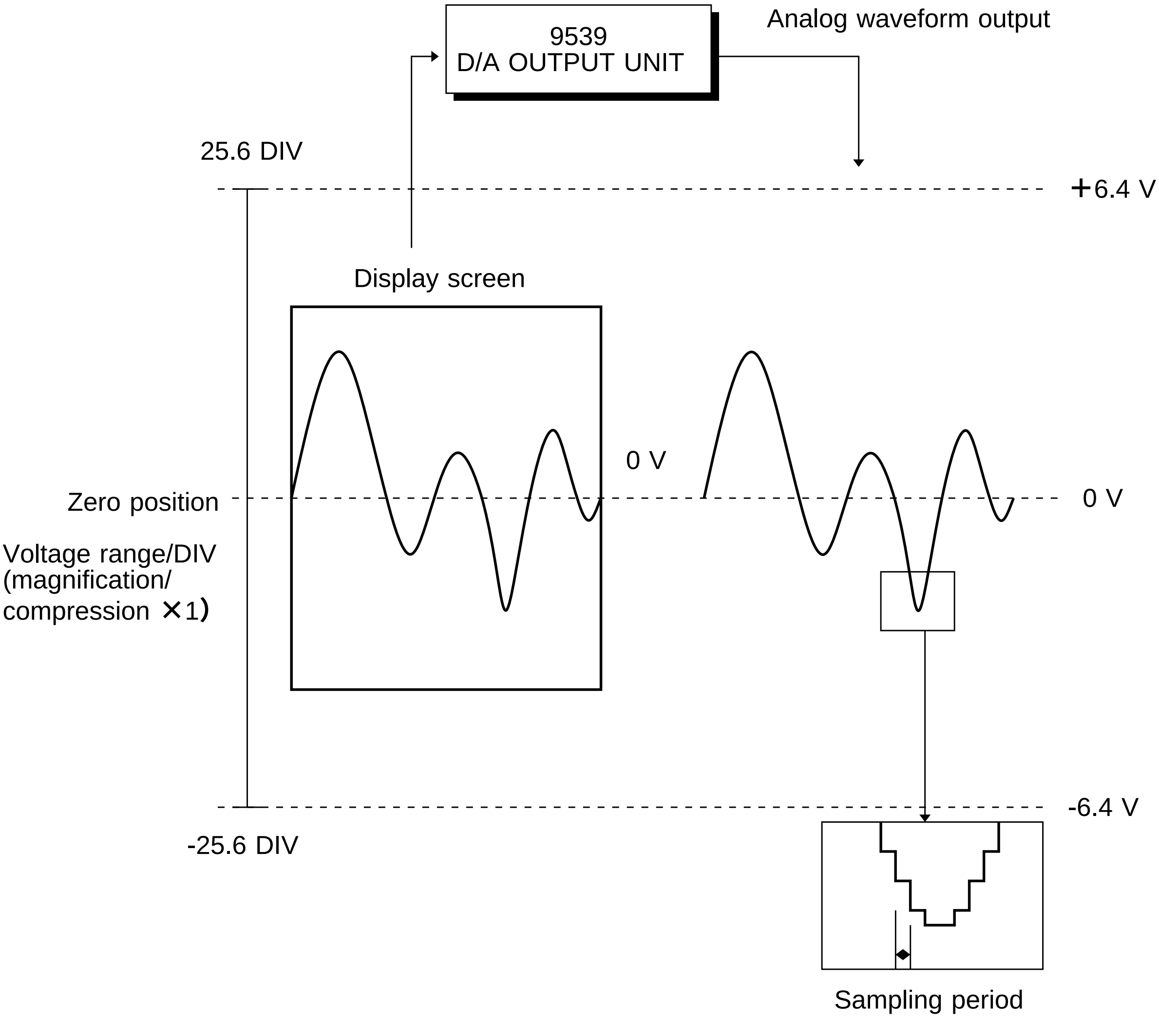
- When the key lock function is active, the indication "Key Lock" is shown on the display.
- If the backlight saver function is used and the display backlight turns off, it can be turned on again by touching any key. The function assigned to the key will not be activated.



Chapter 22
Using the D/A Output Unit 9539 (Option)

22.1 Overview

The D/A output unit 9539 can be used to convert the waveform data captured with the recorder function into an analog voltage waveform (step waveform) with a range of +6.4 V to -6.4 V.



22.2 Specifications

Specifications measured at 23℃±5℃, relative humidity 35% - 80%, one hour after power-on. Guarantee period is 6 months.

<table>
<tr><td>Output voltage</td><td>when measured with 8916, 8917, 8919, 8927, 8928 : ±6.4 V (250 mV/DIV)
when measured with 8918 : 125 mV/DIV
<table>
<tr><th>Temperature range (℃/DIV)</th><th>Recording range (℃)</th><th>Output voltage (V)</th></tr>
<tr><td>10
20
50</td><td>-90 to 421
-90 to 842
-90 to 1200</td><td>-1.1359 (*1), -1.125 to 5.2625 (*2)
-1.1359 (*1), -0.5625 to 5.2625 (*2)
-1.1359 (*1), -0.225 to 3, 5.2625 (*2)</td></tr>
</table>
*1: For recorded values lower than -90℃, -1.1359 V is output.
*2: In the following cases +5.2625 V (DC) is output:
・Recorded value exceeds the measurement range of the thermocouple.
・Recorded value exceeds the upper limit of the measurement range.
・Recorded value was taken in burnout condition of thermocouple.</td></tr>
<tr><td>Maximum output voltage</td><td>±6.4 V (open-load condition)</td></tr>
<tr><td>DC amplitude precision</td><td>±0.2%f.s. (open-load condition)</td></tr>
<tr><td>DC offset precision</td><td>±0.1%f.s. (open-load condition)</td></tr>
<tr><td>Temperature characteristics</td><td>DC amplitude: ±0.02% f.s./℃(typ.)
DC offset: ±0.02% f.s./℃(typ.)</td></tr>
<tr><td>Output format</td><td>Unbalanced output (one side grounded), output ground directly connected to frame ground</td></tr>
<tr><td>Output impedance</td><td>50 Ω±10% (DC)</td></tr>
<tr><td>Load impedance</td><td>1 kΩ or more (DC), 10000 pF or less (possible drive range)</td></tr>
<tr><td>Output waveform</td><td>Step waveform (no smoothing filter)</td></tr>
<tr><td>Output resolution</td><td>12 bit (for output of data measured with 8916, 8917, 8918, 8919, 8928)
14 bit (for output of data measured with 8927)</td></tr>
<tr><td>Update rate</td><td>20 kS/s(max.) (corresponding to sampling rate of recording function)</td></tr>
<tr><td>Number of output channels</td><td>2 channels</td></tr>
<tr><td>Output connector type</td><td>BNC</td></tr>
<tr><td>Dimensions and mass</td><td>29.8(W)×106.8(H)×108(D)mm (not including projection), 110g</td></tr>
</table>

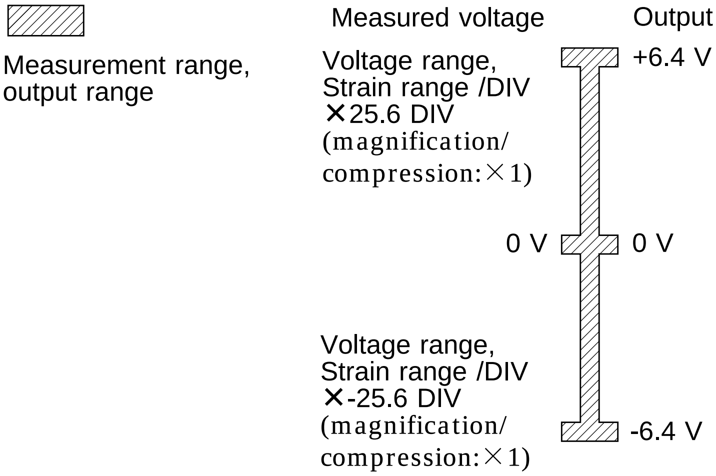
Output voltage

The relation between the measured voltage (temperature) and the output voltage is shown.

NOTE

- The output voltage of ±6.4 V (max.) applies to the open-load condition. Use the unit with load impedances of 1 kΩ or less. (At higher output impedances, the waveform will be distorted.)
- The output voltage can be checked (see system). (☞ Section 11.7.7)

● Using the 8916, 8917, 8919, 8927, 8928



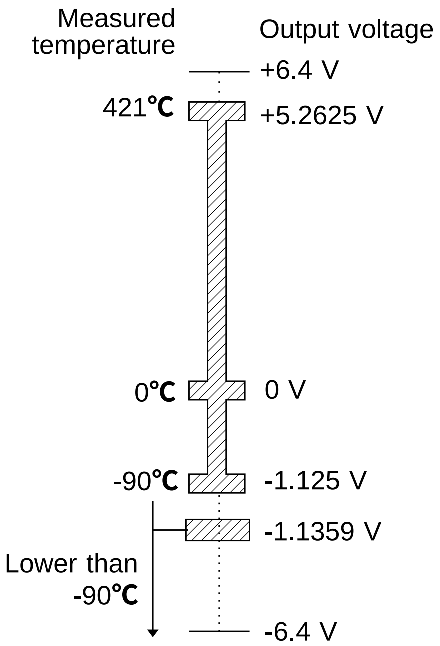
NOTE

When magnification/compression is ×1, the D/A output voltage per 1 DIV of measured voltage is 250 mV.

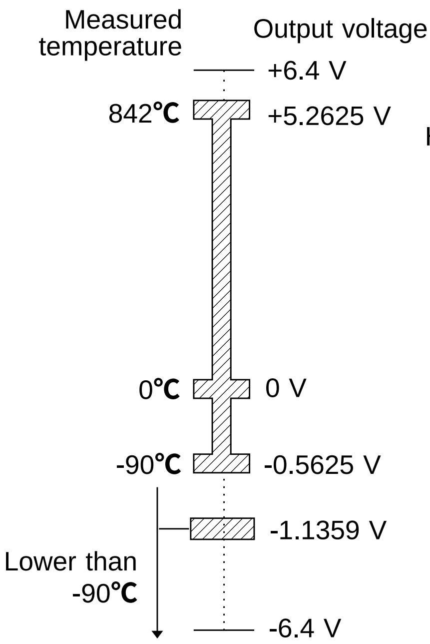
Example

When 20 mV DC was measured using the 20 mV/DIV range, the D/A output is 250 mV DC.

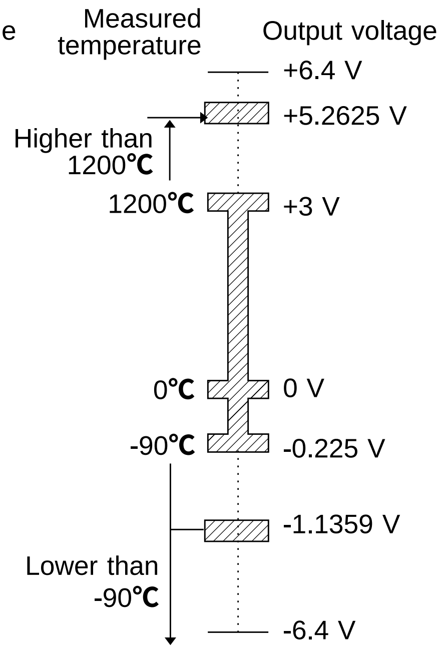
● Using the 8918



10℃/DIV range



20℃/DIV range



50℃/DIV range

NOTE

When magnification/compression is ×1, the D/A output voltage per 1 DIV of measured temperature is 125 mV.

Example

When 10℃ was measured using the 10℃/DIV range, the D/A output is 125 mV DC.

22.3 Usage Precautions

⚠ DANGER

- **The output connector ground of the D/A output unit 9539 is directly connected to the frame ground of the 8846. Therefore it is essential to connect the protective ground terminal of the 8846 to a good ground. Otherwise, a potential may exist between the output connector and exposed metal parts of the 8846.**
- **Do not apply an external voltage to the output connectors, to prevent the risk of electric shock and damage.**

⚠ WARNING

- **When power to the 8846 is turned on or off, voltage spikes may be present in the D/A output. Ensure that no equipment is connected to the D/A output unit 9539 when turning the 8846 on or off.**
- **For reference, the intensity of the voltage spikes is shown below.**

Power ON: approx. 6 Vp-p (approx. 100 ms)
Power OFF: approx. 4 Vp-p (approx. 100 ms)

⚠ CAUTION

The D/A output unit 9539 is designed only for use with the 8845 and 8846 MEMORY HiCORDERs. Do not use it for any other purpose.

NOTE

- When the D/A output is used, do not connect other equipment or measurement objects to the input of the 8927 unit. Otherwise noise currents flowing in the ground line may cause signal noise.
- To minimize susceptibility to external noise, use a BNC-BNC cable.

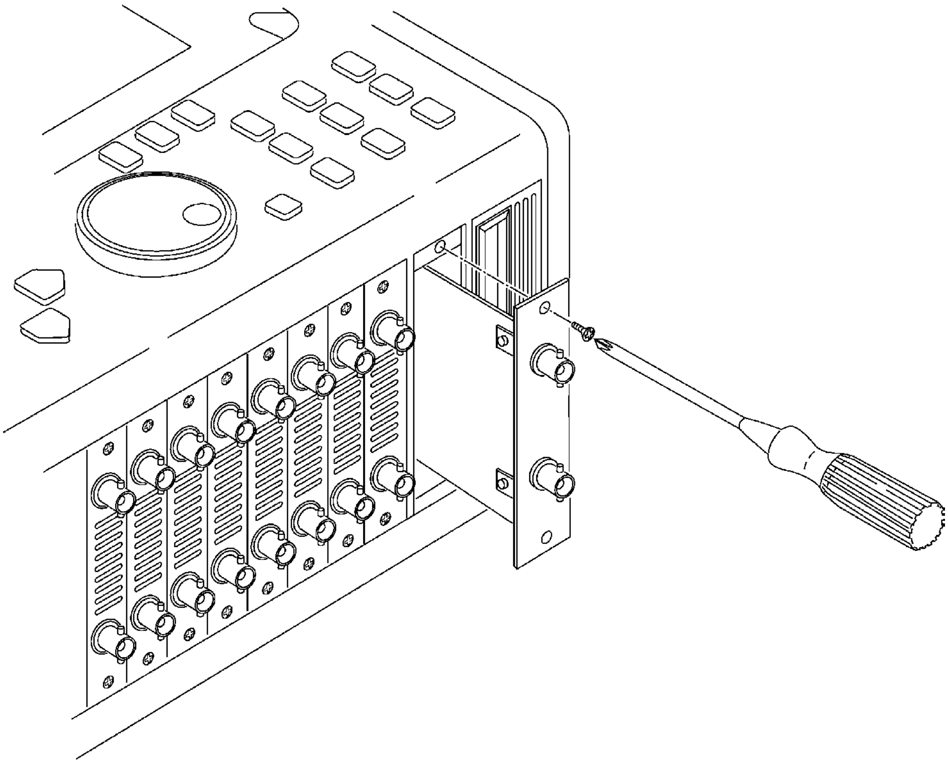
22.4 Replacing Units

⚠ **WARNING**

- **To prevent the risk of electric shock, be sure to turn the power to the 8846 OFF before inserting or removing the unit.**
- **Fasten the screw securely, to prevent the risk of performance degradation or damage.**

This section describes how to install the D/A output unit 9539. To remove the unit, reverse the procedure described below.

1. Disconnect all input cables and the thermocouple connection.
2. Turn power of the 8846 off and disconnect the power cord.
3. Grasp the BNC connectors on the D/A output unit and insert the unit into the expansion slot.
4. Secure the unit by fastening the screw with a Phillips screwdriver, as shown in the illustration.



22.5 Output of a Waveform Recorded With the Memory Recorder or Recorder Function

A waveform recorded can be output in two ways:

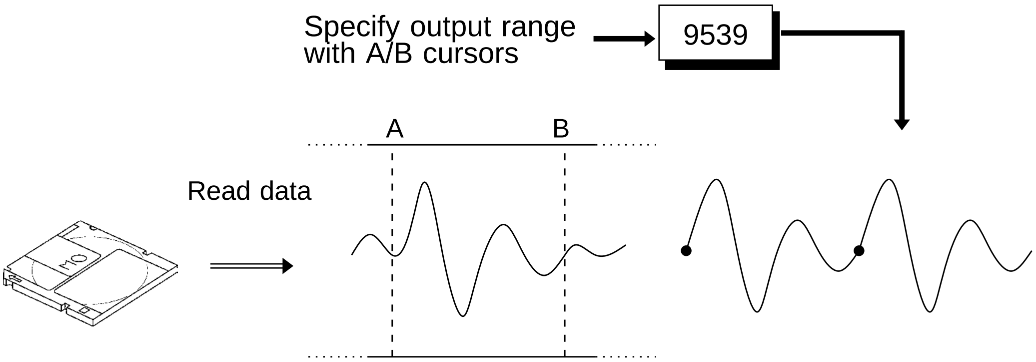
(1) Outputting data in memory on the unit or data read into the unit, specifying the range for output, using the A/B cursors (vertical or trace).

(2) Using the "playback" function and supplying the data side to the output. (Recorder function only)

NOTE

- Waveform data recorded with a sampling frequency of 40 kS/s (2.5 ms/DIV) or above for the time axis are output in intermittent form. (At 2.5 ms/DIV, 1 point is output for every 2 points, and at 2 ms/DIV and 1.25 ms/DIV 1 point for every 4 points.
- Waveform data gathered with external sampling cannot be output.
- The waveform data recorded with the maximum recording length in memory recorder function can not be replayed. (Section 6.2.3)
- For the waveform data measured by one channel, recording length of 10000 divisions, and range lower than 5mS/DIV time axis in memory recorder function, it is not replayed when the data between A and B cursors is more than 5000 divisions.

(1) Specifying output range with A/B cursors

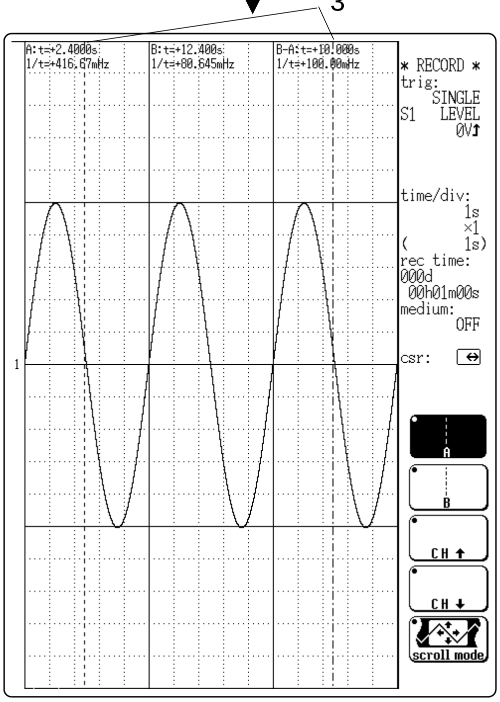


Method

Record the waveform in Memory recorder or Recorder function or read MEM, RECfile from MO

Display screen in Memory recorder or recorder function

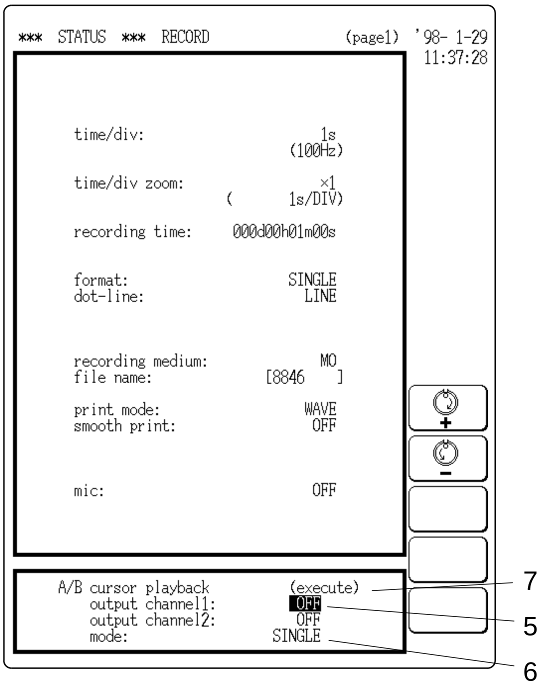
2



```
A:t=+2.4000s      B:t=+12.400s      B-A:t=+10.000s
1/t=+416.67mHz    1/t=+80.645mHz    1/t=+100.00mHz

* RECORD *
trig:
    SINGLE
S1   LEVEL
       0V↑

time/div:
        1s
        ×1
(       1s)
rec time:
000d
 00h01m00s
medium:
       OFF

csr:  ↔
```

Status screen in Memory recorder or recorder function

4



```
***  STATUS  ***  RECORD                    (page1)  '98- 1-29
                                                       11:37:28

     time/div:                           1s
                                      (100Hz)

     time/div zoom:                      ×1
                              (       1s/DIV)

     recording time:        000d00h01m00s

     format:                         SINGLE
     dot-line:                         LINE


     recording medium:                   MO
     file name:                 [8846     ]

     print mode:                       WAVE
     smooth print:                      OFF


     mic:                               OFF

   A/B cursor playback            (execute)
      output channel1:                  OFF
      output channel2:                  OFF
      mode:                          SINGLE
```

1. Record the waveform data in memory recorder or recorder function or read the data from MO disk. (.MEM, .REC file) (☞ Section 13.6).

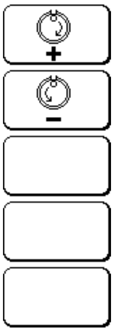
2. The data in the specified function are shown on the display when the data is read.

3. Scroll the waveform and use the A/B cursors (vertical or trace) to specify the range for output (☞ Section 19.2).

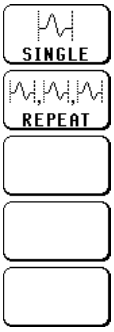
4. Press the STATUS key to activate the STATUS screen (memory or recorder).

- When the D/A output unit is installed, the setting item **A/B cursor playback** appears.

5. Move the flashing cursor to the **Output channel** item and specify the channel of the waveform to be output.

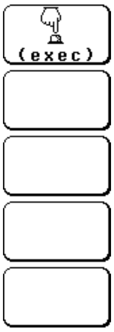
Function key display	Meaning
	OFF, CH1 to CH16 (channel where waveform data are recorded)

6. Move the flashing cursor to the **mode** item and select the output mode.

Function key display	Meaning
	SINGLE : Output cursor-specified range once REPEAT : Output cursor-specified range continuously

7. Move the flashing cursor to the **execute** item of "A/B cursor playback".

Function key display   Meaning



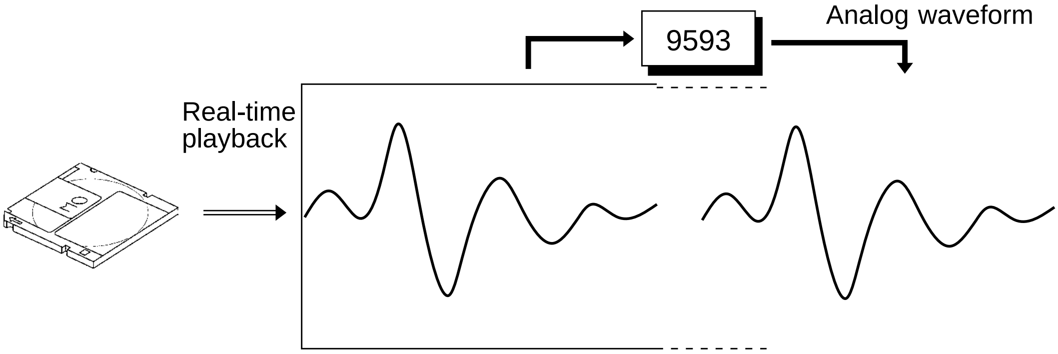
: Output cursor-specified range

8. Press the F1 [exec] key. The specified waveform range is output.
9. If "Output mode" is set to **REPEAT**, press the STOP key when wishing to stop the output.

(2) Using the "playback" function and supplying the data side to the output. (Recorder function only)

Output of data in real time from D/A output unit

For details on playback, refer to Section 13.6.2.



NOTE

If the STOP key was pressed to force measurement stop while the D/A output (A/B cursors, playback) is active, 0 V is output.

Chapter 23
Maintenance

23.1 Cleaning of the Unit and Parts

(1) Main unit

⚠ **CAUTION**	Gently wipe dirt from the surface of the unit with a soft cloth moistened with a small amount of water or mild detergent. Do not try to clean the unit using cleaners containing organic solvents such as benzine, alcohol, acetone, ether, ketones, thinners, or gasoline. They may cause discoloration or damage.

(2) Printer head

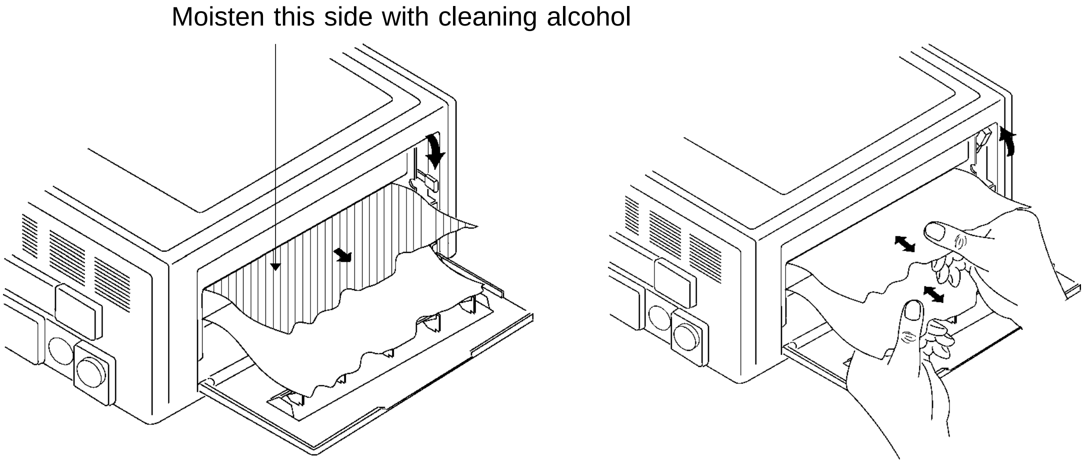
In normal use, the printer does not require periodic maintenance. However, depending on usage conditions, the thermal head may become contaminated by dust or paper scraps. If the print seems light or if there are dropped sections, clean the head as described below.

Method 1

1. Press the SYSTEM key to call up the SYSTEM screen.
2. Press the [SELF CHECK] function key.
3. Move the flashing cursor to the **Printer check** item.
4. Press the F5 [CLEANING] key for about 5 seconds. During this interval, the printer prints 100% black section.
5. If this method does not alleviate the problem, perform the steps of cleaning method 2 as described below.

Method 2

1. Moisten printer paper on the rear with dehydrated alcohol, and set the paper in the printer. (If the front side of the paper is moistened, discoloring will occur.)
2. Raise the head-up lever and move the printer paper back and forth to clean the head.



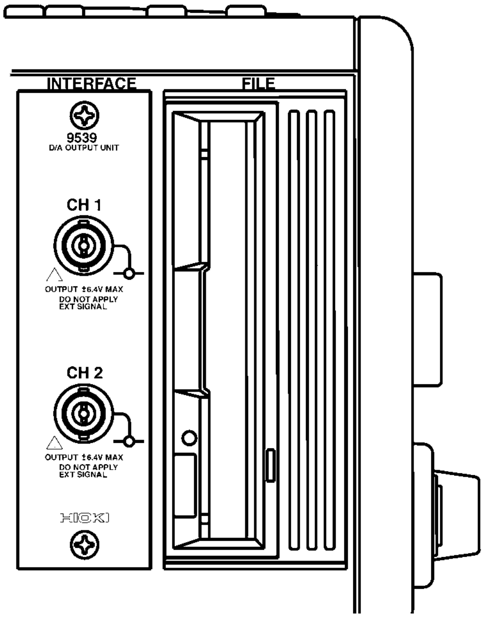
NOTE

- Do not use organic solvents such as thinners.
- After using alcohol, be sure that the printer is completely dry.
- After extended use, paper residue (visible as a white powder-like substance) may accumulate on the roller. While a small amount of residue has no adverse effect, the roller can be cleaned using a air-blow brush (such as sold as a camera accessory).
- Always use the paper cutter integrated in the printer cover to cut printer paper. If the paper is cut near the thermal head, a large amount of paper residue may accumulate on the roller.

(3) MO drive head

NOTE

- As a precautionary measure, the drive should be cleaned about every six months of use.
- Use the commercial MO drive head cleaner for cleaning.



Cleaning procedure

1. Turn the power of the unit off and insert the head cleaner disk into the disk slot.
2. The MO drive automatically recognizes the disk as a cleaning disk and cleans.
3. After 10 seconds, cleaning is completed and the disk is automatically ejected.

⚠ CAUTION

When disconnecting a BNC connector, be sure to release the lock first, then hold the connector and pull carefully. Using force to pull the connector without releasing the lock, or pulling on the cable instead of the connector may damage the connector.

⚠

23.2 Replacing the DC Power Supply Fuse

- When the unit is powered from a DC source, and the DC power supply fuse has blown, replace the fuse as described below.
- The fuse for the AC power supply is integrated in the unit and cannot be replaced by the user. When the unit does not operate normally using the AC power supply, contact a HIOKI service representative.

⚠ WARNING

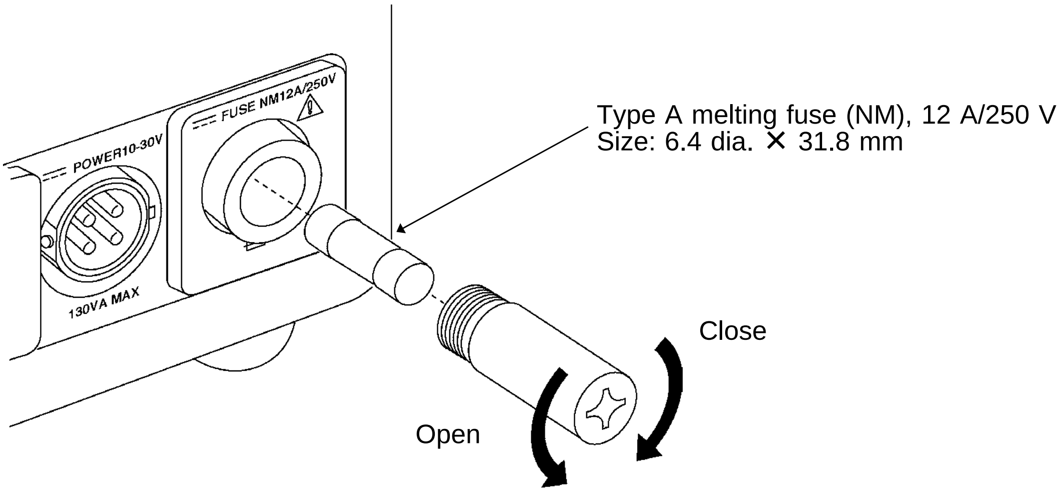
- **If the fuse has blown, an internal defect in the power supply section of the 8846 may be cause. Check for defects before replacing the fuse.**
- **To prevent the risk of electric shock when replacing the fuse, turn power to the 8846 OFF and disconnect the power cord from the AC outlet. Also disconnect any input cables from measurement objects.**
- **Use only a fuse of exactly the specified rating and type. Never use a different fuse or short-circuit the fuse holder, since this involves a severe risk of electric shock and injury.**

Type A melting fuse (NM), 12 A/250 V

Size: 6.4 dia. × 31.8 mm

Replacement procedure

1. Set the power switch of the 8846 and the intermediate switch on the DC power supply cable to OFF.
2. Disconnect the AC power cord and the DC power cord.
3. Remove the old fuse from the fuse holder.
4. Insert a new fuse.
5. Reconnect the power cord and other cables.



23.3 Removing the Battery Before Discarding the 8846

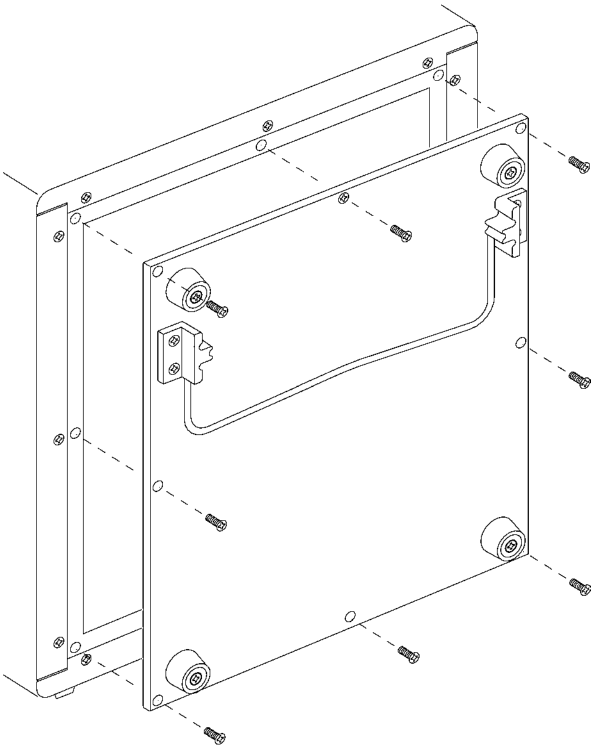
- The 8846 incorporates a lithium battery for memory backup.
- Before final disposal of the 8846, remove the battery as described below.

⚠ WARNING

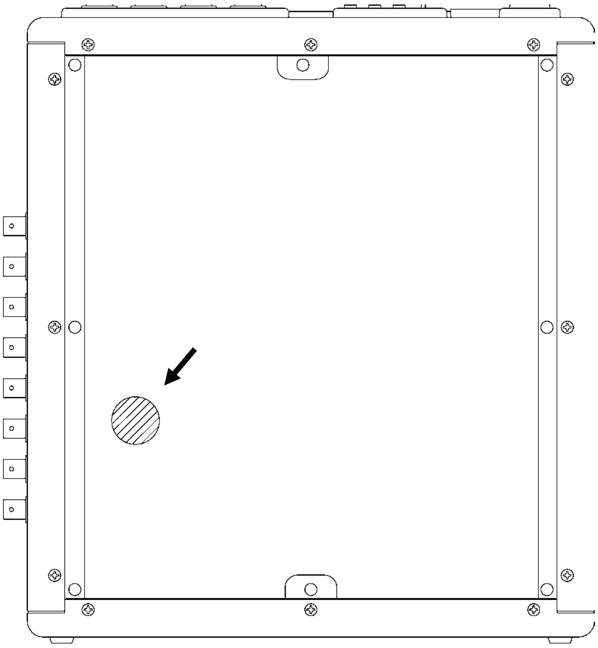
- **To avoid the risk of electric shock, be sure that all cables and the power cord are disconnected before removing the battery.**
- **Dispose of the battery as prescribed in your community.**

Removing the battery

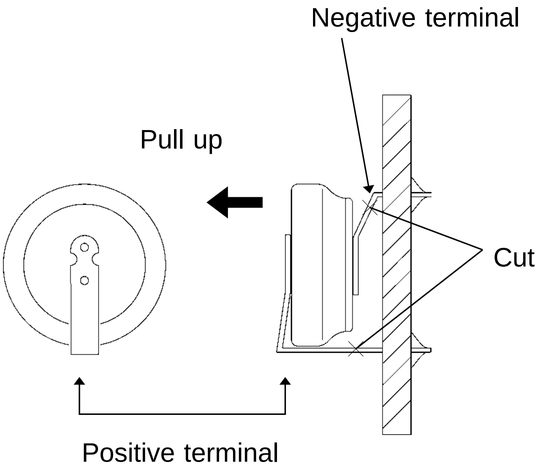
1. Verify that the power is switched OFF.
2. Disconnect all input cables and the power cord.
3. Remove the 8 screws which fasten the rear panel, using a Phillips screwdriver.



4. Remove the rear panel. The battery is located near the center of the PCB.



5. Pull the battery up and cut the positive terminal with a wire cutter.
6. Pull the battery further up.
7. Cut the negative terminal (under the battery) with a wire cutter.



23.4 Troubleshooting

If the unit does not seem to operate normally, check the following points before requesting service.

Problem	Check	Ref. page
LED does not light when the unit is turned on.	Is power cord connected properly?	45, 46
The screen and indicators do not light when using the DC power supply.	Has the fuse for the DC power supply blown?	454
There is absolutely no variation in the recorded waveform.	Is the "Pretrigger stanby" message displayed? (When pretriggering is activated, triggering does not occur until the current waveform is fully captured.)	202
	Has the "Waiting for trigger" message appeared? Check the trigger settings.	200
	Are all of the channels switched off on the display?	181
	Has the timer trigger been set?	215
There is absolutely no variation in the recorded waveform.	Is the measurement range setting appropriate?	184
	Has a low pass filter been set?	191, 193
The printed recording is non-existent.	Is the recording paper back to front?	54, 57
The printed recording is very faint	Are you using the correct (thermal) recording paper?	21, 57
During memory recorder operation, the apparent frequency of the recording is much lower than the expected frequency.	This is likely to be an aliasing error. Either switch to envelope mode, or make the time axis range setting faster.	84, 109, Appendix 6
Recording lines are dense or blurred.	Input signal contains ripple components. Make suitable filter settings at input unit.	191
The keys are dead and do not respond.	Has the unit been put into the key lock condition (message "KEY LOCK" appeared? Press the KEY LOCK key to clear the key lock condition.	442
	Is the unit being remotely controlled ("GP-IB REMOTE" is displayed), if the GP-IB interface is being used?	

If none of the above conditions apply, and the cause of the problem is not understood, try performing a SYSTEM RESET.
All the settings will revert to the factory settings.
Try the following operation, 1 or 2.

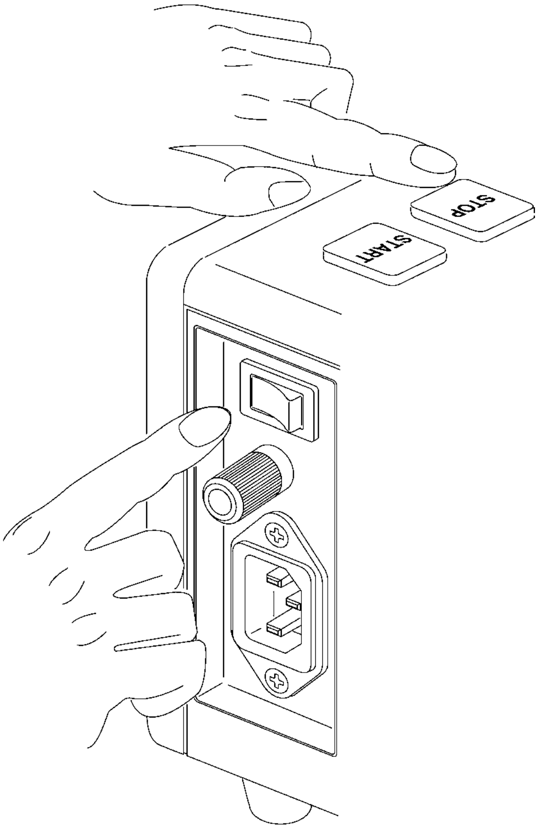
System reset

Method 1

1. Press the SYSTEM key to call up the SYSTEM screen, and select the **Initialize** item.
2. Move the flashing cursor to the **(3) Initialize settings** item and press the [exec] function key.

For details, refer to Section 11.3.3.

Method 2 Turn the unit on while holding down the STOP key.



Turn unit on while pressing STOP key.

Service

⚠ CAUTION If the unit is not functioning properly, check the "Troubleshooting" list. If a problem is found, contact your dealer or HIOKI representative. Pack the unit carefully so that it will not be damaged during transport, and write a detailed description of the problem. HIOKI cannot bear any responsibility for damage that occurs during shipment.

Chapter 24
Error and Warning Messages

24.1 Overview

Error messages

- Error messages are shown at the bottom of the screen.
- Error messages are displayed until the cause of the error is removed or a key is pressed (in some instances, only the STOP key can be used).
- If the volume setting is ON (High, Medium, Low), an intermittent beep sound is heard along with the error message.

Warning messages

- Warning messages are shown at the bottom of the screen.
- Warning messages are displayed only once when the cause occurs.
- Warning messages disappear when a key is pressed.
- If the volume setting is ON (High, Medium, Low), a single beep sound is heard along with the warning message.

24.2 Error Messages

Error no.	Message and explanation	Reference
1	Set printer paper Printer paper has run out. Load paper. Then keep the PRINT key depressed for a while.	54
2	Set printer lever Head up/down lever is raised. Lower the lever. Then keep the PRINT key depressed for a while.	54
3	No Waveform data There are no waveform data to be printed.	
41	Bad A/B cursor position Move A/B cursors to appropriate position.	406

24.3 Warning Messages

Warning no.	Message and explanation	Reference
201	Set printer paper Printer paper has run out. Load paper. Then keep the PRINT key depressed for a while.	54
202	Set printer lever Head up/down lever is raised. Lower the lever. Then keep the PRINT key depressed for a while.	54
205	Invalid key (measurement in progress) Pressed key is invalid, because measurement is being carried out.	
207	Auto setting failed Automatic range setting was not completed successfully.	100, 123
211	Auto store failed	
212	Bad A/B cursor position Move A/B cursors to appropriate position.	406
213	Invalid key (MEASUREMENT) Pressed key is invalid, because ’measurement’ is ON.	
300	Cannot start Cannot start measurement from SYSTEM screen.	
301	Invalid key (SYSTEM screen) Pressed key is invalid, because SYSTEM screen is being displayed.	
302	Invalid key (MO screen) Pressed key is invalid, because MO screen is being displayed.	
303	Invalid key (monitor screen) Pressed key is invalid, because monitor screen is being displayed.	
324	Waveform processing not possible (averaging) Waveform processing cannot be carried out, because averaging is being used.	
327	Invalid key (evaluation) Pressed key is invalid, because waveform evaluation is being carried out.	
328	Invalid key (superimpose) Pressed key is invalid, because superimpose function is active.	
329	Invalid key (display format) Waveform evaluation cannot be carried out, because display format is not single screen or X-Y single screen.	

Warning no.	Message and explanation	Reference
330	Invalid key (recording length) Memory segmentation and waveform processing cannot be carried out, because recording length is too long.	325, 386
331	Invalid key Recording length setting too high for averaging.	397
332	Invalid key (display format) Waveform evaluation cannot be carried out, because display format is not single screen or Nyquist display.	
335	Invalid key (sequential save) Waveform processing cannot be carried out, because sequential save is active.	
336	Invalid key (multi-block) Waveform processing cannot be carried out, because multi-block function is active.	
337	Invalid key (roll mode) Superimpose and waveform processing cannot be carried out, because roll mode is active.	
339	Invalid key (STATUS screen) Pressed key is invalid, because STATUS screen is being displayed.	
340	Invalid key Recording length not set.	
341	Invalid key (multi-block) Multi-block function is active. Number of units cannot be changed.	
342	Invalid key Recording length exceeds the remaining disk capacity. Use a recording length within the available capacity.	
351	Invalid key (trigger) Pretrigger setting cannot be made, because all trigger sources are OFF (free-run condition).	202
352	Invalid key (CHANNEL screen) Pressed key is invalid, because CHANNEL screen is being displayed.	
353	Invalid key (trigger) Pretrigger cannot be used with external sampling.	
361	Cannot print Choose a shorter logging cycle.	94, 268

Warning no.	Message and explanation	Reference
380	No data in reference memory block There are no data in the reference memory block for the multi-block function.	
381	Same setting for reference memory block and current block Reference memory block and currently used block are set to the same values.	
382	No waveform data Display screen cannot be used because there are no waveform data.	
383	No memory waveform data Record waveform data with FFT processing using memory function.	
384	Invalid reference memory block recording length The recording length of the reference memory block is different from the recording length of the current block. Record data with same recording length.	
385	Invalid key (FFT) Pressed key is invalid, because FFT function is being used.	
386	Invalid key (recorder) Pressed key is invalid, because recorder function is being used.	
388	No waveform evaluation area Create waveform evaluation area.	366
390	Invalid key (upper limit) Setting cannot be higher than upper limit.	
391	Invalid key (lower limit) Setting cannot be lower than lower limit.	
392	Invalid key (2 units use) Recording length cannot be set to higher value because 2 units are being used. Reduce number of units.	85
393	Invalid key (4 units use) Recording length cannot be set to higher value because 4 units are being used. Reduce number of units.	85
394	Invalid key (8units use) Recording length cannot be set to higher value because 8 units are being used. Reduce number of units.	85
396	Out of range Setting range of variable function is exceeded.	85
397	Out of range Setting range of scaling function is exceeded.	243
398	Out of range Setting range of variable function after scaling is exceeded.	244
405	File access error File access during store or format operation failed	
408	Cannot record A disk access could not be made rapidly enough. Either the files are excessively fragmented or there is another fault on the disk.	296

Warning no.	Message and explanation	Reference
418	Cannot playback (external sampling) Playback cannot be carried out, because waveform was recorded with external sampling.	
419	Cannot playback (not a loaded waveform)	
420	Invalid key (X-Y display) Pressed key is invalid,, because current display format is X-Y display.	
421	Syntax error Equation contains a syntax error. Correct equation.	327, 328
422	Cannot copy equation Copy function cannot be carried out, because the copy source equation contains a Z number higher than the copy target equation.	330
423	Halt the calculation. Pressing the stop key halts calculation.	
424	Octave processing error Octave processing cannot be carried out, because the frequency range uses external sampling.	
440	Invalid key Other unit set to logic input.	
445	Data with faster range than 5 ms/DIV cannot be played back.	
446	A trigger filter could not be set with current time axis range. The filter is invalid.	207
447	Data cannot be loaded In multi-block mode, waveform cannot be loaded into an empty block.	389
450	No waveform data Transfer could not be carried out, because there are no waveform data.	
451	Adjustment of auto-balance failed	
452	Cannot transfer. Too long recording length in memory recorder function. The waveform data is measured by time axis range; 1.25 or 2 ms/DIV, using the 8927 1 unit.	119
454	Invalid key The time axis cannot be set differently from the original recorder waveform.	
455	Cannot start. "FILEtoMEM" has already been executed up to the end.	

Warning no.	Message and explanation	Reference
500	Cannot read. (MO) There are more files than can be handled by the 8846, and therefore correct information cannot be displayed.	287
501	Cannot write (write protect) MO disk is write protected.	284
502	Cannot be created (path name) The directory cannot be created because the path name is too long.	
503	Cannot be created (no name) A directory cannot be created without a name. Enter name.	
504	Cannot be created (same file) The specified file already exists.	
505	Cannot be created (reserved device name) This file name is a reserved device name. Select another name.	
506	Cannot store (same name) The directory cannot be saved with an existing directory name.	
507	Cannot store (reserved device name) This file name is a reserved device name. Select another name.	
508	Cannot store (read only) The specified file is read only. Cannot overwrite.	
509	The file is read only. This command cannot be executed for the file or read only	
510	Cannot change (no name) Enter name	
511	Cannot change (same file) The specified file already exists	
512	Cannot change (reserved device name) This file name is a reserved device name. Select another name.	
513	Cannot read Cannot read this file data.	
514	Cannot read Cannot read the file information	
515	No waveform data Store could not be carried out, because there are no waveform data.	
516	No waveform evaluation area Store could not be carried out, because there is no waveform evaluation area.	
517	This medium is not supported.	
518	Cannot read this media This disk is not formatted, or has a format which cannot be read by the 8846.	320
519	File read error occurs The file may be corrupted.	

Warning no.	Message and explanation	Reference
520	Cannot make a file No more files can be created in the current directory.	289 295
521	Version mismatch This file was created on a later version of the 8846 and cannot be loaded.	
522	File error occurs This file format is different from the correct format.	
523	Cannot playback This file data is not recorder waveform data.	
524	A FILEtoMEM operation is not possible Because this file contains recorder function waveform data.	
525	Insufficient capacity of media No more recorder waveform data can be recorded, because there is not enough remaining capacity on the media.	301
526	Cannot playback (external sampling) Playback cannot be carried out, because waveform was recorded with external sampling.	304
527	Invalid key (start time) Start time cannot be later than end time.	
528	Invalid key (end time) End time cannot be earlier than start time.	
529	Cannot format The disk is write protected.	284
530	Cannot store (number of files) The number of files in the current directory exceeds 10,000.	
531	Cannot make (number of files) The number of files in the current directory exceeds 10,000.	
532	Saving is not possible. Either there is no disk in the drive, or the disk is not formatted correctly. A screen bitmap file cannot be saved.	
533	The MO disk is not installed. Insert the MO disk.	
534	MO disk drive error. An unrecoverable hardware error was detected on the MO drive.	
535	Completed successfully with retry The MO disk has defects, or the heads need cleaning.	453
536	Insufficient MO capacity Writing a file was abandoned. This file has not been saved correctly.	301
537	Cannot playback. Playback could not be carried out, because there are no waveform data.	
538	Cannot playback Recording length setting too high for playback.	448
539	Cannot start ’FILEtoFFT’ has already been, executed up to the end.	

Appendix

Appendix 1 Glossary

- % RH	Relative humidity (relative amount vs. saturation amount of moisture vapor in one cubic meter)

A

A/D	Conversion of an analog quantity into a digital quantity
A/D converter	Device for analog-to-digital conversion
AC	Abbreviation of "alternating current".
Active Low	An action is performed when the signal voltage state changes from High to Low.
Aliasing	Phantom signal components; a phenomenon that occurs if sampling frequency is low in relation to the frequency of the sampled signal (☞ Appendix 2.1, 2.2).
Analog	Continuous physical quantity such as voltage or current
ANSI	American National Standards Institute; also used for standards issued by this institute.
Attenuator	Device for reducing the level of a signal
Averaging	Determining the mean of a certain number of data.

B

Bit	Smallest unit of binary information
Byte	Unit of information. 1 byte is made up of 8 bits.

C

Channel (CH)	Input signal route
Channel crosstalk	Interference between signals in adjacent channels
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
CPU	Abbreviation of "central processing unit", the central component of a computer
Crest factor	Peak value/rms value
Cutoff frequency	Point where the filter output amplitude is $1/\sqrt{2}$ of the input.

D

D/A	Conversion of a digital quantity into an analog quantity
D/A converter	Device for digital-to-analog conversion
dB (decibel)	Unit for expressing the ratio of attenuation or gain, for voltage, current, power etc.
DC	Direct current
Digital	Discrete physical quantity
DIV (division)	Increment on display or printout
Dot	One display point on the LCD screen. Also, a point on a waveform without interpolation.
Dynamic range	Ratio of maximum vs. minimum amplitude that can be displayed

E

Envelope	A curve connecting the peaks of successive cycles of a signal

F

FFT	Abbreviation of "Fast Fourier Transform" (☞ Appendix 2.2)
File	A collection of data on a medium such as tape
Floating	Electrical circuits that are configured separately and kept apart
Full-span voltage	Voltage range that can be expressed by 20 DIV

G

Gain	Difference between output and input in decibel
GND	Ground, reference potential
GP-IB	Abbreviation of "general-protocol interface bus", an 8-bit bus standard used mainly for measuring equipment

I

Interface	Device for allowing data exchange between 8846 and a computer.
Isolation	Separation of electrical circuits from each other

L

LCD	Abbreviation of "liquid-crystal display"
LED	Abbreviation of "light-emitting diode"
Logging	Numeric expression of sampling data
Logic-level	Waveform expressed as High and Low level
Low-pass filter	Filter that passes through only signals below a certain frequency

M

Maximum allowable input	Maximum voltage that may be applied to the input terminals of the input unit.
Maximum floating voltage	Maximum voltage that may be applied between ground and an input unit.
Memory	A device for storing digital data

O

Offset	Amount of shift in relation to 0 V when scaling is used
Option	Non-standard accessory for the unit

P

Parameter	Signal waveform attributes such as maximum value, rms value, etc.
Peak hold	Retaining the maximum value at a frequency point
Pretrigger	The condition of the signal before triggering occurred
Probe	Signal line for supplying the signal to the input
PT	Abbreviation of (voltage) "potential transformer"

R

RAM	Abbreviation of "random access memory"
Recording length	Total amount of sampling data expressed as number of increments
Ripple component	AC component of noise
RMS (rms)	Abbreviation of "root mean square" value, also called effective value. For alternating current, the value identical to the direct current work.
ROM	Abbreviation of "read-only memory"

S

Sampling	Measuring an analog waveform at regular intervals (☞ Appendix 2.1)
Sampling data	Data gained by measuring an analog waveform at regular intervals and converting the results into digital data
Sampling rate	Rate at which sampling carried out; sampling frequency
Scaling	Conversion of voltage value into a specified unit
Scroll	Moving data shown on screen up/down or right/left
Slope	Slanted section of a rising or falling voltage
Storage	Storing measurement data in the internal memory

T

TFT	Abbreviation of "thin film transistor"
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.
Trigger source	Signal that serves as trigger

U

Unbalanced input	Using a two-pole input in such a way that one pole carries the signal referenced to the other pole

W

Word	A unit for expressing digital data. The digital data for one input signal point after conversion.

Z

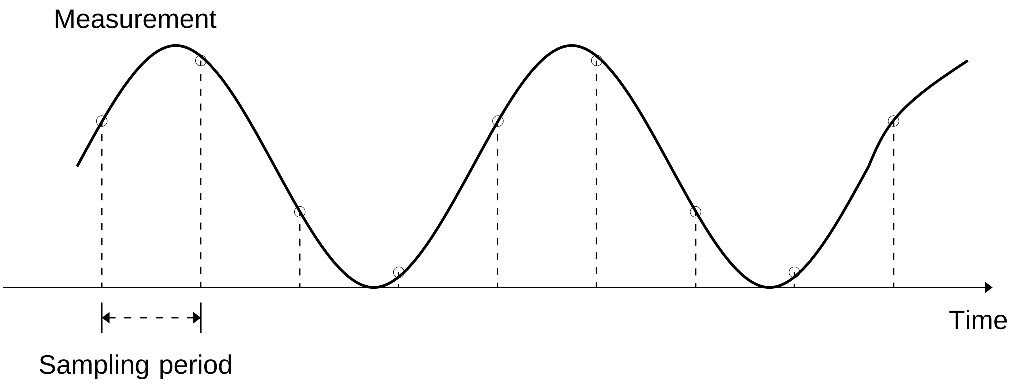
Zero adjust	Matching of zero position and actual ground level

Appendix 2 Reference

Appendix 2.1 Memory Recorder Function, Recorder Function

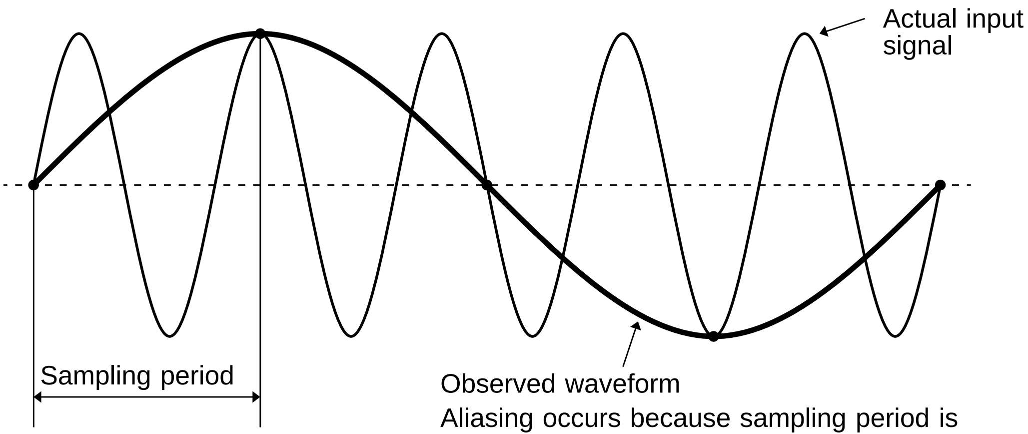
Sampling

- The 8846 converts the input signal (analog value) into digital form and performs all internal processing in the digital domain. The analog-to-digital conversion is achieved by sampling, that is measuring the signal level at regular intervals.
- The interval between the measurement instances is called the sampling cycle (unit: seconds).
- The number of measurement instances per second is called the sampling rate or sampling frequency. It is the reciprocal value of the sampling cycle (unit: samples per second, or Hz)



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.



Aliasing occurs because sampling period is longer than input signal period.

- 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

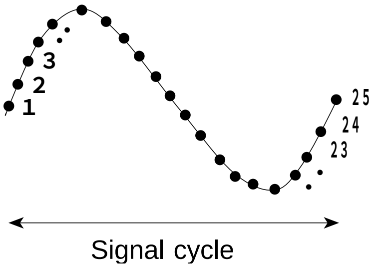
  Fs = 2•Fmax ………………………………………… ①

  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.

Measurement limit frequency

- The sampling theorem says that the sampling frequency must be twice as high as the signal frequency in order to be able to restore the original waveform.
- But in order to reproduce a sine waveform with peaks intact, about 25 sampling points per cycle are required.
- Because the time axis range setting determines the measurement limit frequency, this setting should be set as high as possible.



TIME/DIV (s/DIV)	Sampling period (s)	Measurement limit frequency (Hz)
500 μ	5 μ	8 k
1 m	10 μ	4 k
1.25 m	12.5 μ	3.2 k
2 m	20 μ	2 k
2.5 m	25 μ	1.6 k
5 m	50 μ	800
10 m	100 μ	400
20 m	200 μ	200
50 m	500 μ	80
100 m	1 m	40
200 m	2 m	20
500 m	5 m	8
1	10 m	4
2	20 m	2
5	50 m	0.8
10	100 m	0.4
20	200 m	0.2
50	500 m	0.08
60 (1min)	600 m	0.067
120 (2min)	1.2	0.033
300 (5min)	3	0.013
600 (10min)	6	0.007
1200 (20min)	12	0.003
3600 (1h)	36	0.001

Appendix 2.2 FFT Function

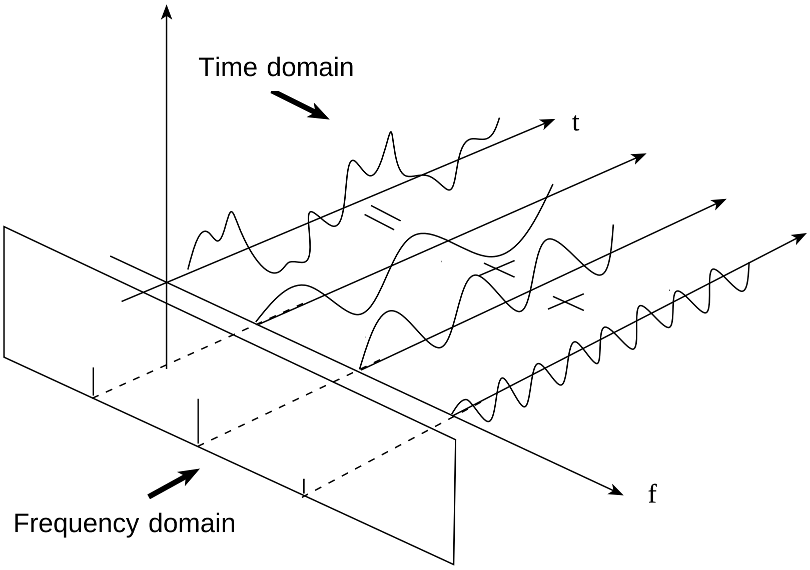
FFT

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.

$$F(\boldsymbol{\omega}) = \Im\,|f(t)| = \int_{-\infty}^{+\infty} f(t)\cdot\exp(-j\boldsymbol{\omega}t)dt \quad\cdots\cdots\cdots \text{②}$$

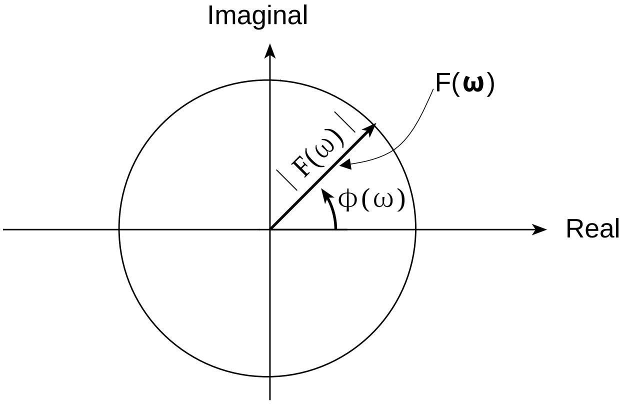
$$f(t) = \Im^{-1}\,|F(\boldsymbol{\omega})| = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(\boldsymbol{\omega})\cdot\exp(j\boldsymbol{\omega}t)d\boldsymbol{\omega} \quad\cdots \text{③}$$

The function $F(\omega)$generally results in a complex number, and can be expressed as follows.

$$F(\boldsymbol{\omega}) = |F(\boldsymbol{\omega})|\cdot\exp(j\boldsymbol{\phi}(\boldsymbol{\omega})) = |F(\boldsymbol{\omega})|\angle\boldsymbol{\phi}(\boldsymbol{\omega}) \cdots\cdots \text{④}$$

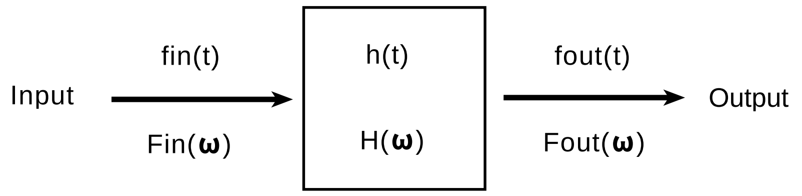
$|F(\boldsymbol{\omega})|$: Absolute value spectrum of f(t)
$\boldsymbol{\phi}(\boldsymbol{\omega})$: Unit spectrum of the phase of f(t)

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

$fout(t) = \int_{-\infty}^{+\infty} fin(\tau)\cdot h(t-\tau)d\tau$ ………… 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

$Fout(\omega) = Fin(\omega)\cdot H(\omega)$ ………… 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.

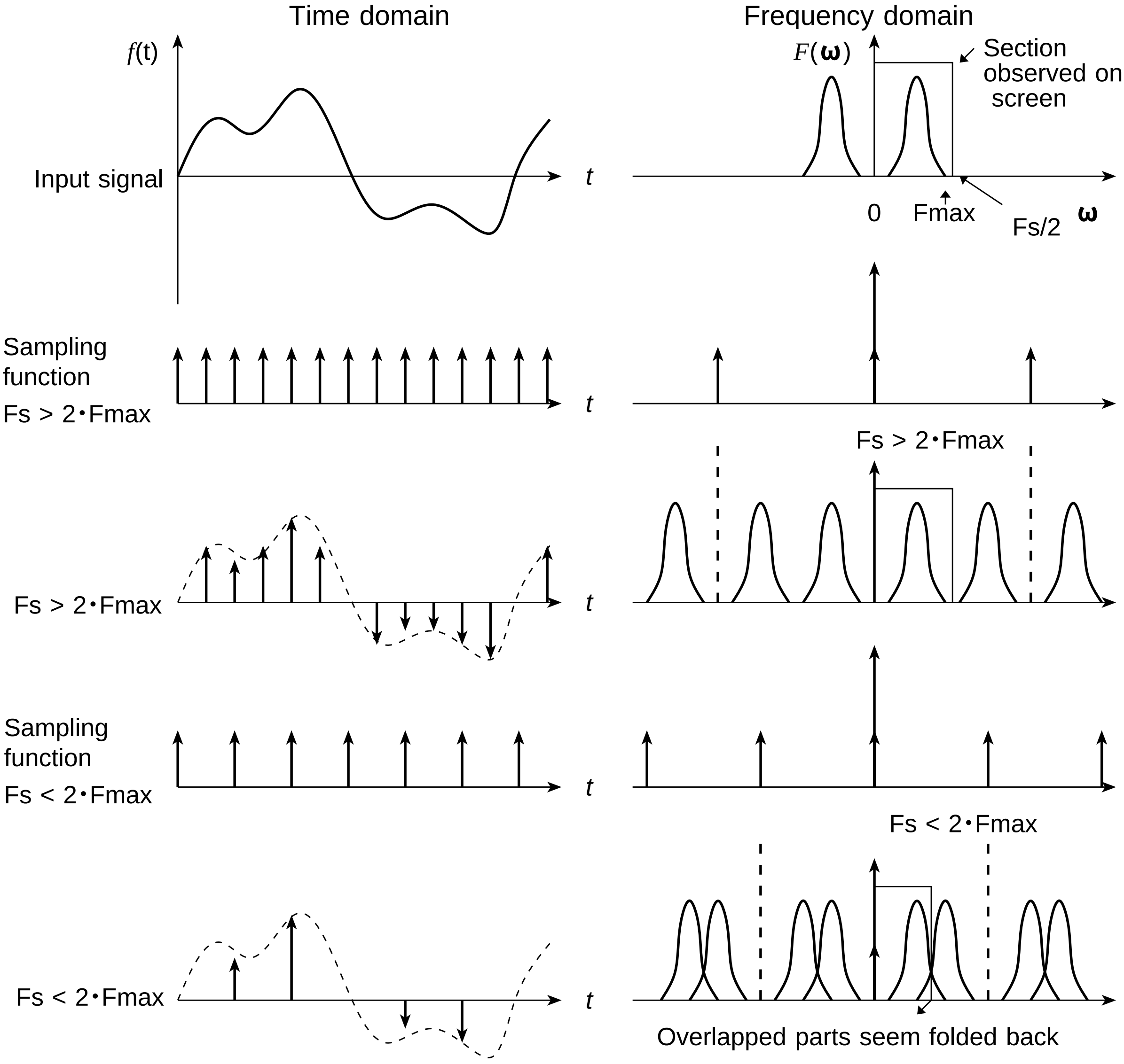
Sampling theorem

$Fs = 2 \cdot Fmax$ ①

Fmax: Highest frequency component to be measured

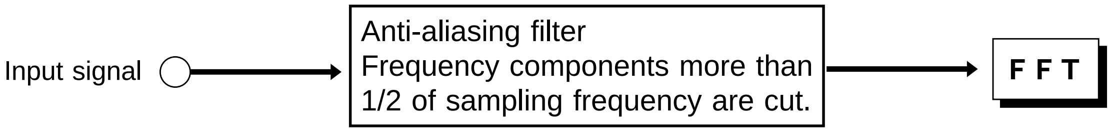
Fs: Sampling frequency (Nyquist frequency)

- 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.

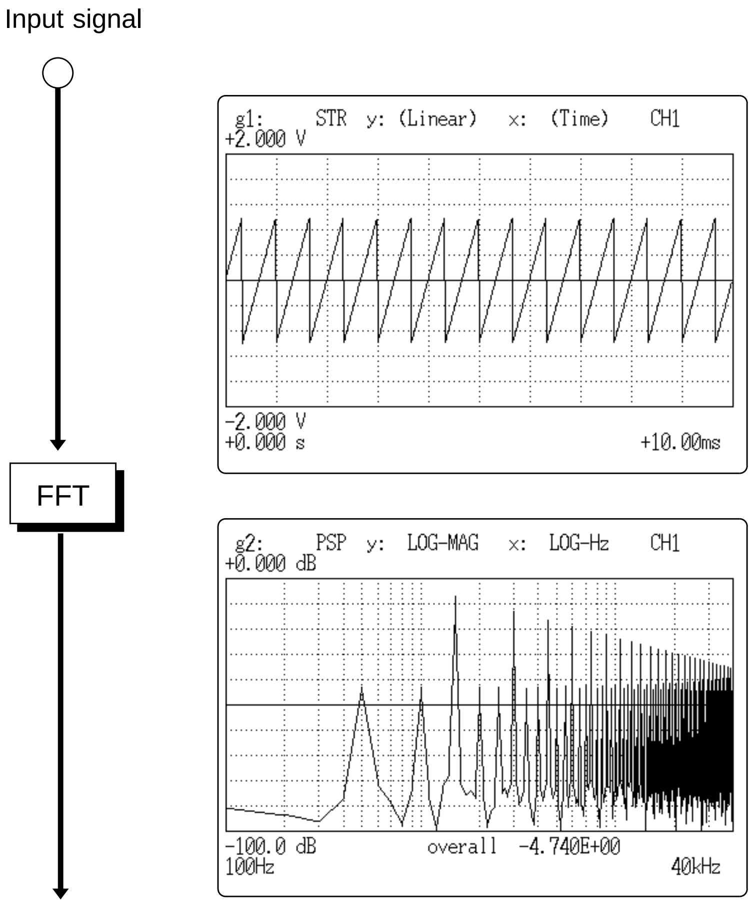


Anti-aliasing filter

- In FFT processing, when the frequency bandwidth of the input signal is unlimited, frequency spectrum components that do not exist will appear, due to aliasing. To prevent this, a low-pass filter is required which cuts off the input waveform at 1/2 of the sampling frequency. Such a low-pass filter is called an anti-aliasing filter.
- The 8919 FFT analog unit incorporates an anti- aliasing filter and therefore allows the 8846 to perform FFT analysis without being subject to aliasing.

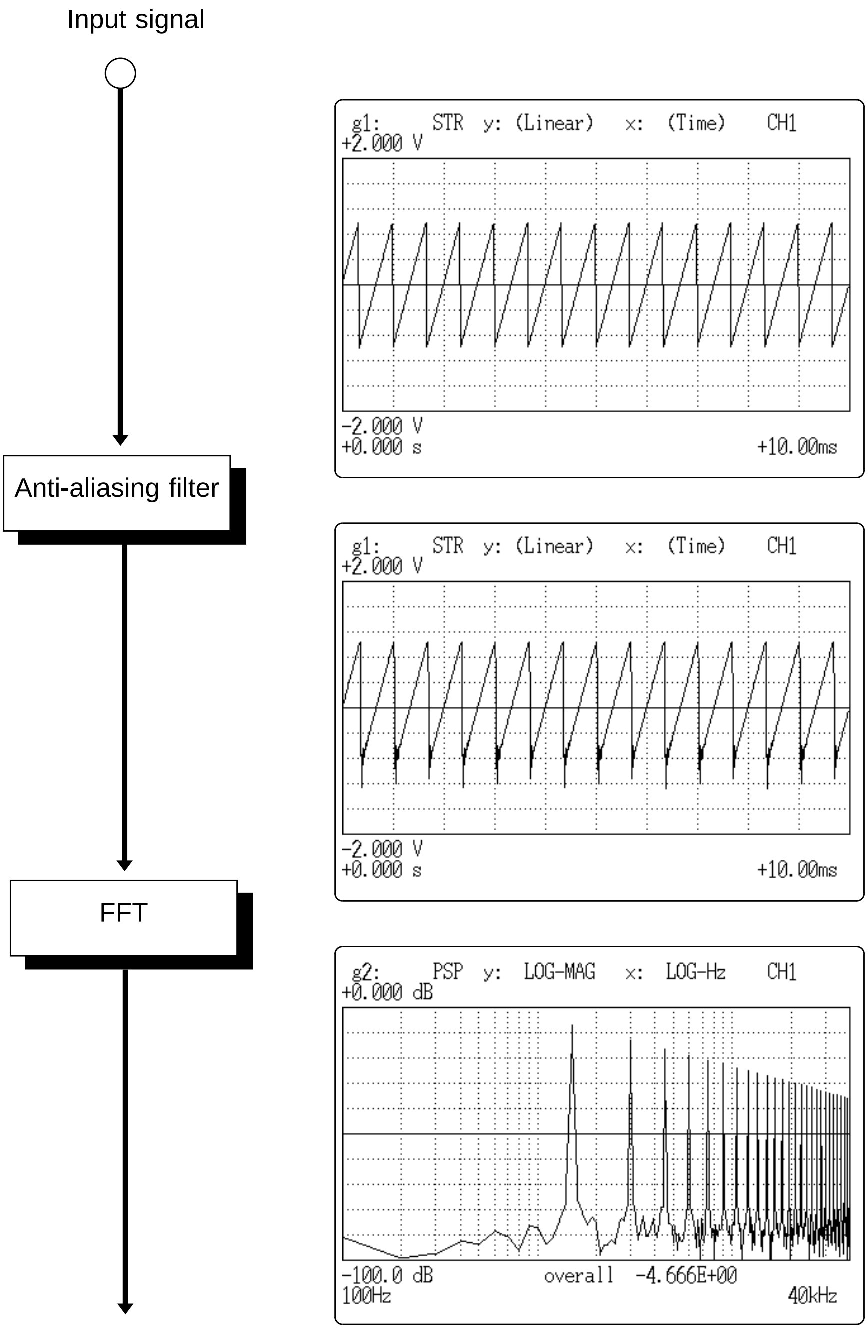


Example 1 When an anti-aliasing filter is not used.



Spectrum where frequency components higher than 1/2 of sampling frequency cause aliasing. Components that do not actually exist are observed.

Example 2 When an anti-aliasing filter is used.

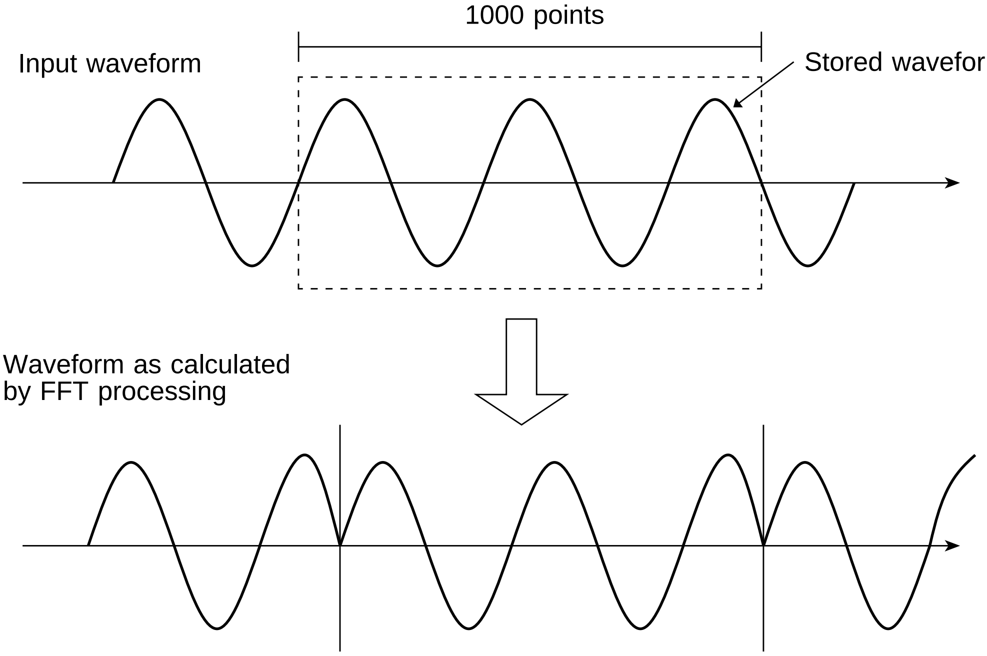


Aliasing spectrum components are effectively removed.

Window processing

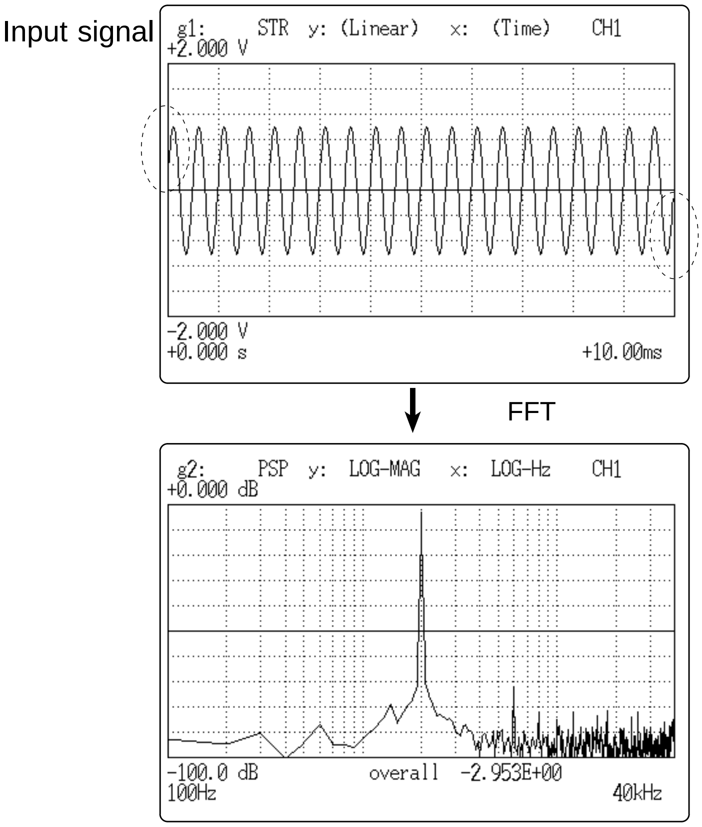
Fourier transform is defined as the integration from negative infinity to positive infinity, but in actual measurement this calculation is not possible. Therefore only a limited segment of the continuous signal is taken for processing. This is called window processing.

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.

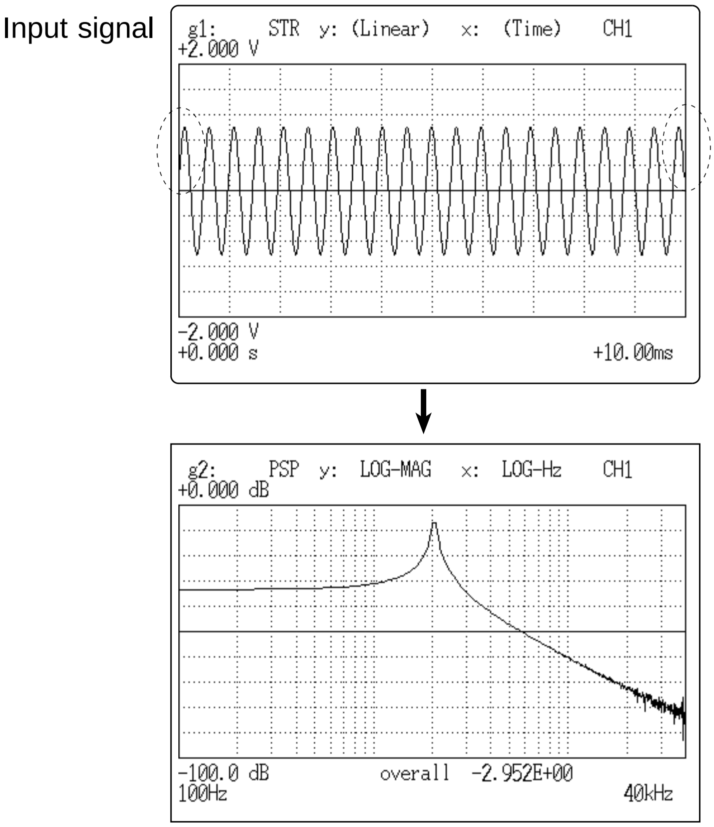


Leakage error

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.



Spectrum having small leakage

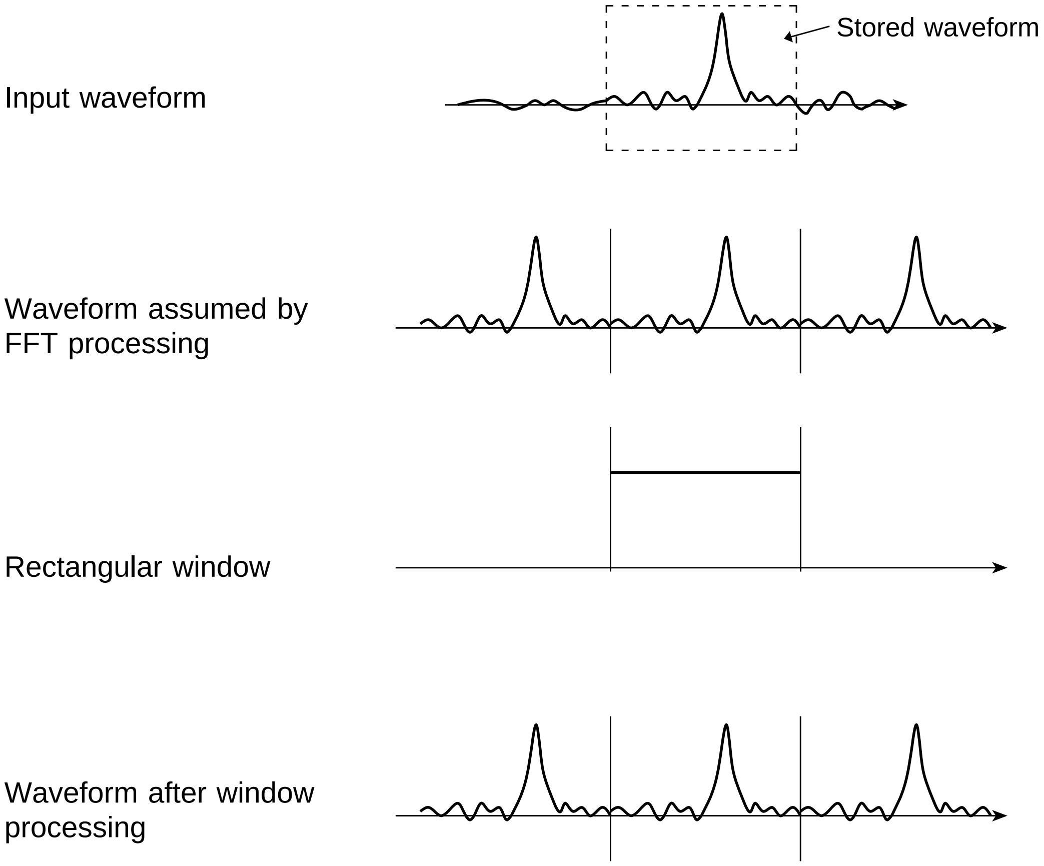


Spectrum having large leakage

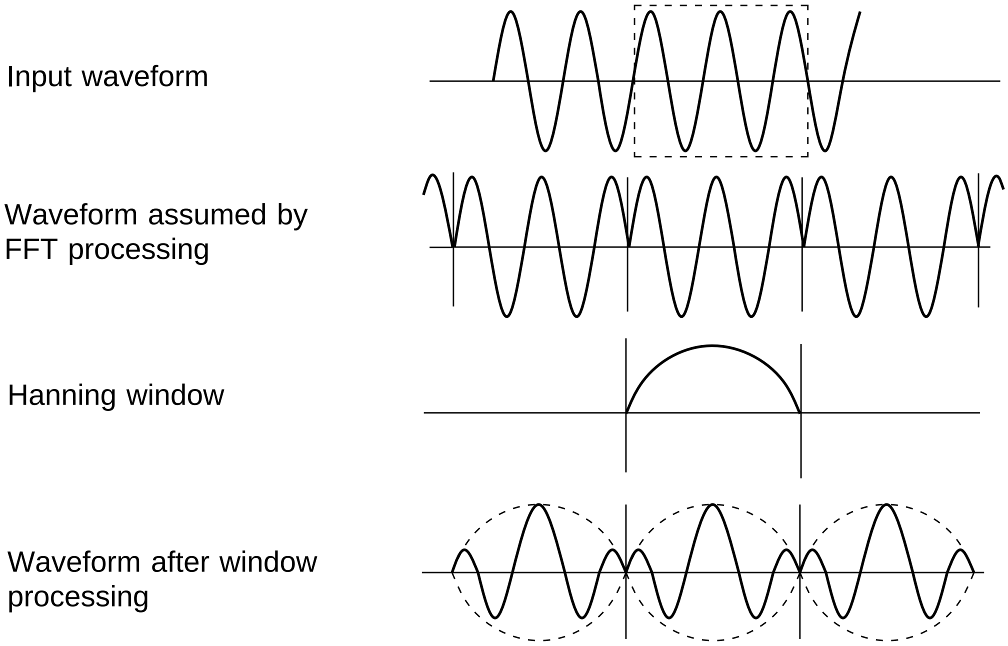
Window function

- 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 8846, 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.

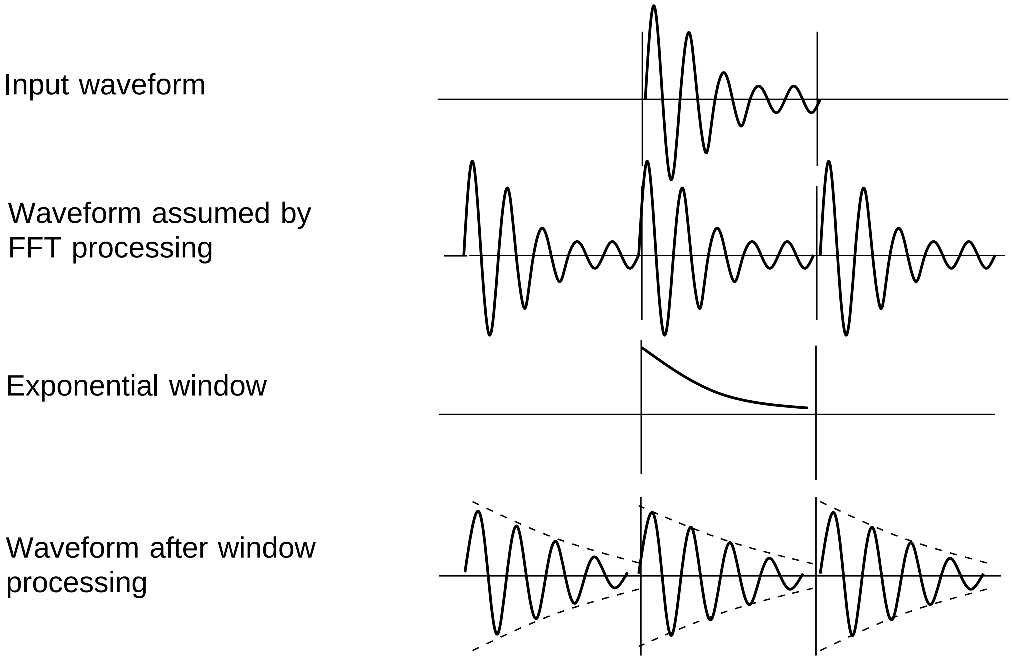
• Rectangular window



- **Hanning window**



- **Exponential window**



Appendix 3 Reference Table

When carrying out measurement with a time axis range faster than that of following table using the MO disk which has had frequent file additions and deletions made, the resulting fragmentation may cause recording to be lost, and the measurement to stop.

The fastest time axis range which the fragmented file does not cause recording to be lost.

(Unit: ms/DIV)

MO disk	The number of channels to be used				
	1 ch	2 ch	4 ch	8 ch	16 ch
128 M	20	50	100	200	500
230 M	10	20	50	100	200
540 M	5	10	20	50	100 (50)
640 M	2.5	5	10	50 (20)	100 (50)

( ): when overwriting

Index

HIOKI 8846 MEMORY HiCORDER
Instruction Manual

Publication date: November 1998 Revised edition 2

Edited and published by HIOKI E.E. CORPORATION
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

Printed in Japan 8846A981-02

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

8846A981-02 98-11-0001H

Printed on recycled paper