HIOKI

8850

MEMORY Hi CORDER

INSTRUCTION MANUAL

HIOKI E.E. CORPORATION

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Introduction

Thank you for choosing the HIOKI 8850 Memory Hi-Corder. To maximize the performance and life of the HIOKI 8850 Memory Hi-Corder, please read the instruction manual carefully before using it.

Notes concerning for use

To insure full performance and safe operation, please observe the following instructions:

Inspection

When you receive the Hi-Corder check for any damage that may have occurred during transportation. Make sure you check all switches and terminals on the panel. If any damage should have occurred, or the machine does not work according to specifications, please contact your nearest dealer for service.

Before Turning Power On

Make sure that your power supply fits the rating of the Hi-Corder and that a correct fuse is installed in the Hi-Corder.

Protective Ground Terminal

Make sure your Hi-Corder is properly grounded. The Protective Earth Terminal must be connected to a ground. If your power source is a three-pole plug socket and you are using a three-pronged plug, proper grounding is completed.

Recording Paper

The Hi-Corder uses the thermal recording method. Special thermally sensitive recording paper is required for optimum performance. Please use the recording paper designated by us.

Storage

When leaving your Hi-Corder idle for long periods of time, raise the printing head to protect the head and prevent deformation of the rubber roller.

Transportation

When transporting the Hi-Corder, use the packaging materials provided. If you do not have the packaging materials designated by Hioki, use the following packaging procedure:

(1) Wrap the Hi-Corder in vinyl.

(2) Use a box with a thickness of over 7mm. Find some packaging material and pack the inside of the box to a thickness of over 100mm.

(3) Wrap the Hi-Corder in the packaging material and place it with its accessories into the box. Place more packaging material on the top, close the box, and tape it securely. Wrap the outside of the box with a cord if necessary.

Contents

This instruction manual has two parts. The first part describes the measurement functions, and the second, its affiliated functions. For instructions on how to use the GP-IB interface, please refer to a separate manual, the 8850 Memory Hi-Corder GP-IB Interface Instruction Manual.

How To Use This Manual

Each measurement function is explained separately. For basic operating procedure, read the section in Chapter 3 and 4 on the measurement function to be used.

Part names and functions

① Power Switch
Turns power on and off.

② START (Start Key)
Starts measurement and analysis. The upper LED is lit during measurement and analysis.

③ STOP (Stop Key)
Stops the machine.

④ TIME/DIV (Time/Division Key)
Sets the time-axis of the machine. During FFT operation, it sets the frequency range.

⑤ CH3 RANGE (CH3 Range Key)
Changes the CH3 measurement range.

⑥ CH2 Range (CH2 Range Key)
Changes the CH2 measurement range.

⑦ CH1 RANGE (CH1 Range Key)
Changes the CH1 measurement range.

⑧ CURSOR (Cursor Key)
Moves the blinking square (cursor) on the CRT screen up, down, and to the right and left.

⑨ Function select key
Selects the item to be displayed on the lowest line of the CRT screen.

⑩ KNOB (Rotary Knob)
When the right LED reads SCROLL, the Rotary Knob scrolls the wave pattern and moves the A and B cursors. When the LED reads VALUE, the Rotary Knob changes the digit indicated by the cursor.

⑪ STATUS (Status Key)
Changes the CRT screen to the measurement setting screen (Status Screen).

⑫ TRIG (Trigger Key)
Changes the CRT screen to the trigger setting screen (Trigger Screen).

⑬ DISPLAY (Display Key)
Changes the CRT screen to the wave pattern display screen (Display Screen).

⑭ MANU TRIG (Manual Trigger Key)
When the trigger source is set to MANU, this key activates the trigger.

⑮ HELP (Help Key)
Displays how much wave pattern memory is being used during Memory Recorder function. Displays information on the X and Y axes during FFT operation.

⑯ SCROLL/VALUE (Scroll/Value Key)
Selects the function of the Rotary Knob as either SCROLL or VALUE.

⑰ PRINT (Print Key)
Prints the contents of the memory during Memory Recorder function. Turns the printer on or off during the Recorder function. Prints the X-Y recorded wave pattern during the X-Y Recorder function. Prints the FFT wave pattern during FFT operation.

⑱ CRT COPY (CRT Copy Key)
Prints a copy of the screen being displayed.

⑲ FEED (Feed Key)
Feeds recording paper while the key is pressed.

⑳ IC CARD (IC Card Key)
Sets IC cards. When an IC card is being used, the upper LED is lit.

㉑ KEY LOCK (Key Lock Key)
When the Key Lock key is pressed, the upper LED is lit and all functions will be locked. No key will have any effect except the Key Lock key. Keys can also be locked by using the GP-IB command.

㉒ IC Card Slot

㉓ CRT Display
Sets conditions and monitors wave pattern.

㉔ Memory Back-Up Terminal
Connects batteries for backing up the wave pattern data memory. (2.7 to 5.0 V)

㉕ GO/NG Output Terminal
Outputs the result of wave pattern judgment. (Active Low)

㉖ Remote Input Terminal
Controls Start and Stop functions externally. (Active Low or Terminal Short)

㉗ EXT TRIG (External Trigger Input Terminal)
Allows input when trigger source is set on EXT. (Active Low or Terminal Short)

㉘ TRIG OUT (Trigger Output Terminal)
Outputs a signal when trigger is applied.

㉙ CAL 1kHz (Output Terminal for Calibration)
Outputs analog probe calibration (square wave of 1kHz approx. 5Vp-p).

㉚ CRT Intensity (CRT Intensity Control Knob)
Adjusts the brightness of the CRT display screen.

㉛ GP-IB Connector
Connects the GP-IB cable.

㉜ Fuse Holder

㉝ Power Connector
Connects the accessory power cord.

㉞ Earth Terminal
Grounds the case. Make sure to connect it to a proper ground to insure safe and stable operation.

㉟ Printing Density Control Volume
Controls the density of chart printing. A standard screwdriver is needed to make any adjustments.

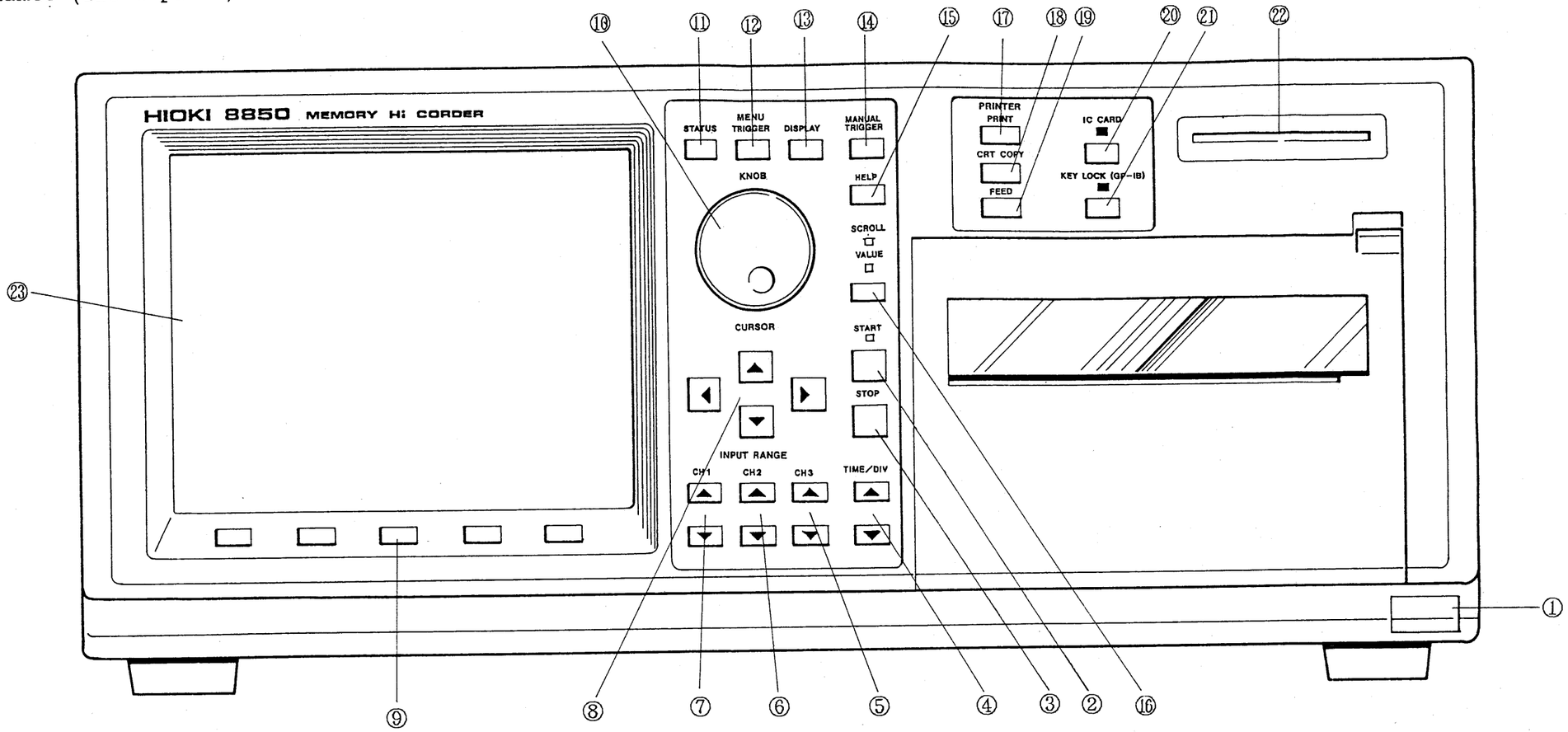
㊱ Analog Input Terminal (8941)
An input terminal of the analog unit used for unbalanced input. A BNC plug is used.

㊲ Analog Input Terminal (8942)
An input terminal of the analog unit used for unbalanced input. A banana plug is used.

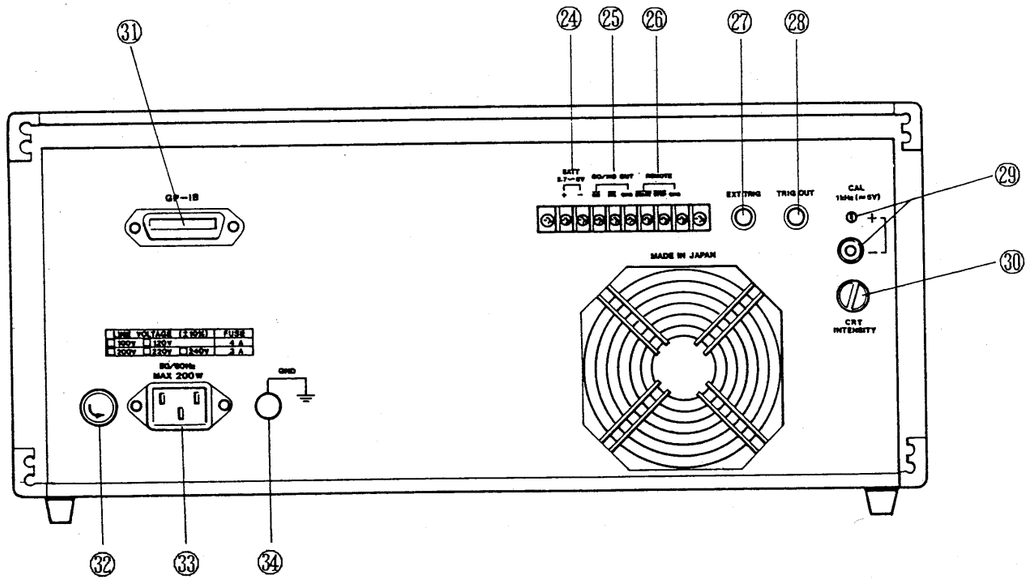
㊳ Gain Control Knob (Variable)
Adjusts input sensitivity.

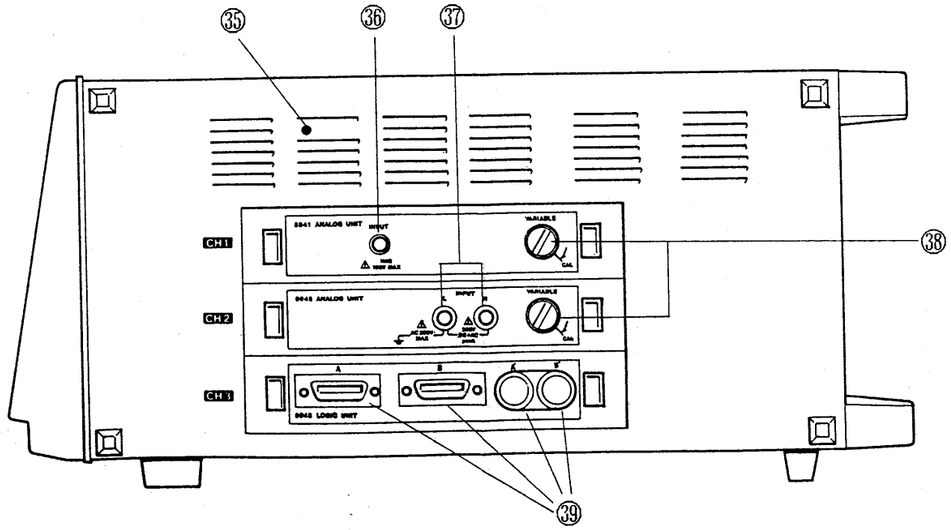
㊴ Logic Input Terminal
An input terminal of the logic unit used exclusively by the optional logic probe.

Part names (front panel)



Part names and functions





CHAPTER 1

OUTLINE

1.1 Product outline

The 8850 waveform recorder is a new type of waveform recorder that integrates observation and recording functions. There are two input systems, logic and analog, making it applicable to a wide range of phenomena from low-speed to high-speed.

Major features of the 8850

(1) Enhanced waveform acquisition capability
The large-capacity memory (maximum 20MS/s, 64k words/channel) can capture even transient phenomena accurately.

(2) Easy to read waveform detection and observation
The two-tone CRT display, together with waveform compression, enlargement and scroll functions, allows you to easily extract the portion of the waveform you need for detailed observation.

(3) Record the required portions when needed
The high-resolution thermal printer allows you to make recordings of the portions you need, and a CRT copy can be output any time.

(4) Select the input unit to match your needs
The three-channel plug-in input unit design lets you freely select analog and logic input units.

(5) Recorder, XY recorder and logic recorder functions
A single unit handles the full range from low-speed to high-speed phenomena, and can also handle XY recording and logic recording applications.

(6) Powerful trigger functions
A digital trigger circuit is provided for each channel, allowing the trigger level to be specified in 1% steps, and a handy selection of other settings such as trigger filter, timer trigger and logic pattern trigger are possible.

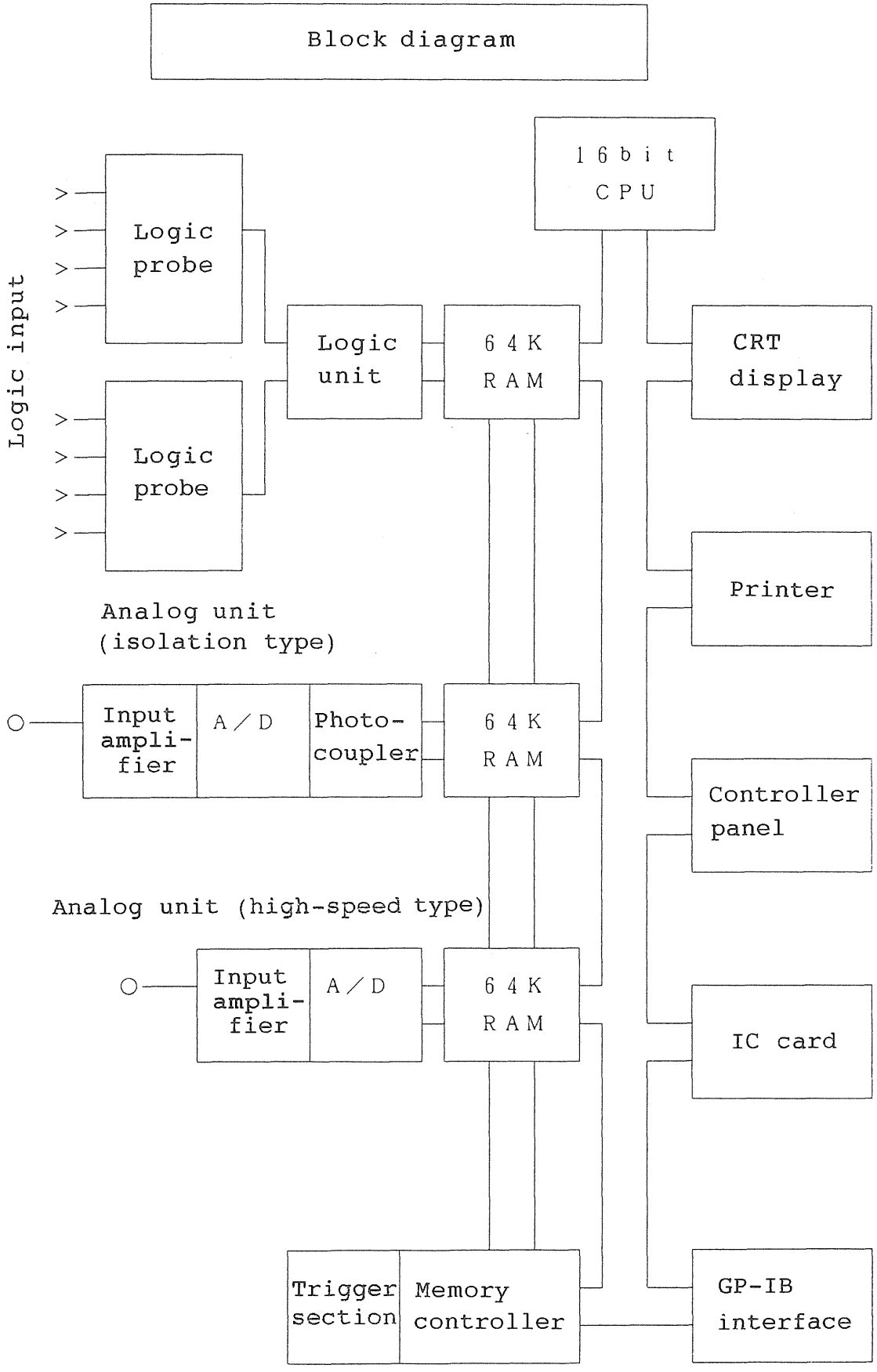
(7) Automatic judgment through waveform judgment function
The system automatically judges if the waveform is inside the specified region or not and outputs a GO/NG signal. Judgment is possible for memory waveforms, XY waveforms and FFT analysis results, and a graphics editor is provided to simplify region specification.

(8) IC card storage
Handy IC cards can be used as external storage media for waveforms and system measurement parameters.

(9) Intelligent controller
High-level accessory functions supported include memory partitioning, cursor measurement, FFT analysis and arithmetic operations.

(10) GP-IB interface
The GP-IB interface is provided as standard equipment, supporting data I/O through a rich array of commands and making possible remote operation.

Fig. 1-1 8850 Block Diagram



1.2 System operation

The following description is based on the block diagram given in Fig. 1-1.

* The 8850 has an internal 16-bit microcomputer (CPU) which controls the entire system. This CPU also handles FFT analysis.

* The analog input unit mounts an 8-bit high-speed A/D converter, and the isolation type is linked to the 8850 through a photo-coupler. Each channel is equipped with an independent power supply, electrically insulating the isolation type from the 8850 main unit.

* The A/D converted (or latched) data is written to 64KB RAM (64KB per channel) for storage.

* The 8850 uses a digital trigger circuit. When internal triggering is used, the A/D converted signal is compared to the preset digital value, and the trigger signal output accordingly.

* Measurement data stored to memory is processed by the CPU, displayed on the CRT, and output to the graphic printer. Data output to the IC card or GP-IB interface is also possible.

CHAPTER 2

SPECIFICATIONS

2.1 General specifications

[Basic specifications]

Max. sampling speed:	20MS/s (isolation type analog unit 5MS/s)
Time axis accuracy:	Relative accuracy between scale and time)
Memory capacity:	8-bit x 64k words/channel
Input:	plug-in input units
Channels (maximum):	three analog channels, or two analog channels and 8 logic channels, or one analog channel and 16 logic channels.
	Note: An analog unit must be installed in CH1. The system will not operate with CH1 empty, or with a logic unit in CH1.
Measurement functions:	Recorder (realtime recording) Memory recorder (high-speed recording) XY recorder (continuous XY recording) FFT analysis (high-speed Fourier transformation)
External control terminals:	External trigger input, trigger output, START/STOP input, GO/NG output, measurement data backup battery input
Calibration voltage:	1kHz 5V±10% square wave
Operation environment:	Temperature 0°C to 40°C, humidity 35% to 80% (no condensation)
Accuracy assurance environment:	Temperature 23±5°C, humidity 35% to 80% (no condensation)
Storage environment:	Temperature -10°C to 50°C, humidity 5% to 90% (no condensation)
Insulation resistance and dielectric strength:	100 megaohms minimum/DC500V, AC1.5kV/one minute (between case and power supply)
Power supply:	AC 100V ±10% 50/60 Hz (...specified at order)
Power consumption:	200W (about 70W during normal recording operation)
Dimensions:	Approx. 180H x 430W x 390D (mm) (not including protrusions)
Weight:	Approx. 12.6 kg (main unit only)

[Recorder section]

Printing method:	Thermal recording with thermal line head
Recording paper:	114 mm x 30 m Roll type thermal recording paper
Recording width:	105.6 mm total recording width (640 dots) Waveform recording section: 82.5mm f.s., 1DIV=8.25mm
Chart speed:	Max. 2 cm/sec
Paper feed accuracy:	±2% (25°C, 60%RH)

[Display section]

Display method: 7-inch CRT raster scan (two-tone display)

Display resolution: Waveform section 751 x 256 dots, text display 48 characters x 29 lines.

[Other]

Accessories:
- power cord: 1,
- recording paper (roll paper): 1,
- roll paper attachments: 2,
- spare fuse: 1
  (power supply 100/120V: 4A/250V.
  ϕ 6.4 x 30 mm)
  (power supply 200/220/240V: 3A/250V,
  ϕ 6.4 x 30 mm)
- instruction manual: 2
  (main unit and GP-IB interface)

Options:
- 8941 Analog unit (high-speed type)
- 8942 Analog unit (isolation type)
- 8943 Logic unit

Optional accessories (sold separately)
- 9228 Recording paper (30 meter roll, 10 rolls)
- 9526 IC card (64KB)
- 9151-01 GP-IB (1m) cable
- 9151-02 GP-IB (2m) cable
- 9151-03 GP-IB (4m) cable
- 9165 Input cord (BNC-BNC)
- 220H Chart take-up reel
- 9352 ROM card
  Function provided
  - Linear differentiation
  - Linear integration
  - Moving average(2 to 100 samples)
  - Arithmetic
  - Data transfer between channels
  - Maximum and minimum values
  - Peak value
  - RMS calculation
  - Area calculation
  - Period
  - Frequency
  - Waveform rise time (10 to 90% rising)
  - Waveform fall time (90 to 10% falling)
  - Average

2.2 Option specifications (accuracy at 23±5°C), accuracy assurance period six months

(1) 8941 analog unit (high-speed type)

Measurement ranges:	5mV/DIV to 5V/DIV 10 ranges in 1, 2, and 5 steps.
Gain adjustment:	Continuously variable from approx. 50-100% (with the gain adjustment knob)
DC amplitude accuracy:	±1%f.s
Offset adjustment:	continuously variable from -100 to +100% in 1% steps, with zero adjust function.
Offset accuracy:	±0.8%f.s.
Frequency response:	DC to 7MHz ±3dB (when DC coupled) Approx. 7Hz - 7MHz ±3dB (when AC coupled)
Rise time:	Approx. 50ns (analog amplifier section)
Low pass filter:	Cutoff frequency 5Hz, on/off switch
Input waveform:	Unbalanced (one end grounded)
Input RC:	Direct 1 megaohm ±1% Approx. 50pF (at 100kHz) 9162 (10:1 probe), in use: 10 megohms ±3% max. 23pF
Input coupling:	AC, GND, DC
Permissible input voltage:	Direct 150V (DC + AC peak)
9162 (10:1 probe), in use:	250V (DC + AC peak)
A/D conversion:	8-bit parallel approximation
High-speed sampling speed:	20MS/s
Input terminal:	BNC connector
Dimensions and weight:	Approx. 170H x 35W x 200D (mm), approx. 600g (excluding projections)
Accessories:	9166 Input cord (BNC-clip)
Optional accessories:	9162 Input probe (10:1 probe)

(2) 8942 analog unit (isolation type)

Measurement ranges:	5mV/DIV to 20V/DIV 12 ranges in 1, 2, and 5 steps.
Gain adjustment:	Continuously variable from about 50-100% (with the gain adjustment knob)
DC amplitude accuracy:	±1%f.s.
Offset adjustment:	continuously variable from -100 to +100% in 1% steps, with zero adjust function.
Offset accuracy:	±0.8%f.s
Frequency response:	DC to 2 megaohm ±3dB (when DC coupled) Approx. 7Hz to 2 megaohm ±3dB (when AC coupled)
Rise time:	Approx. 150ns (analog amplifier section)
Low pass filter:	Cutoff frequency 5Hz, on/off switch
Input waveform:	Unbalanced (input/output insulated)
Input RC:	Direct 1 megaohm ±1% approx. 50pF (at 100kHz)
Input coupling:	AC, GND, DC
Permissible input voltage:	Direct 200V (DC + AC peak)
Max. floating voltage:	(between input unit and case)
Insulation and dielectric strength:	Min. 100 megaohm/DC 500V, AC 1.5kV/one minute (between input unit and case, at 100kHz) Min. 100 megaohm/DC 500V, AC 1.5V/one minute (between units)
Insulation charge capacity:	Max. 1000pF (ref.) Max. 1000pF (between units, 100KHz) (between input unit and case, at 100kHz)
Common mode masking ratio:	80dB min. (at 50 or 60Hz, signal source resistance 100 ohms max.)
A/D conversion:	8-bit parallel approximation
High-speed sampling speed:	5MS/s
Input terminal:	Two (banana plugs)
Dimensions and weight:	Approx. 170H x 35W x 200D (mm) (excluding protrusions), approx. 600g
Accessories:	9163 Input cord (banana clip)

(3) 8943 logic unit

Input channels:	eight (two 4-channel logic probes can be connected)
Input:	logic probe (4-channel), common ground
High-speed sampling speed:	20MS/s
Compatible logic probe:	9306, 9307, 9308 or dedicated 9310 logic probe (9308 can be used with 8942 analog unit)
Dimensions and weight:	Approx. 170H x 35W x 200D (mm) (excluding projections), approx. 600g
Optional accessories:	9310 high-speed logic probe 9306 logic probe 9307 line logic probe 9308 line dip detector

2.3 Trigger section

Triggering method:	Digital comparison
Trigger mode:	Memory recorder, FFT analysis - single repeat, auto Recorder - single, repeat XY recorder - single
Trigger source:	CH1, CH2, CH3, EXT, MANU, and TIME sources can be turned on and off individually. When all are off the system is free running. The TIME trigger can be used with settings for start time, stop time, and interval time.
Trigger conditions:	OR between triggers
Trigger slope:	Analog input - rise, fall Logic input - condition match, mismatch EXT - fall
Trigger level:	Analog input 0-100% set digitally. Step width is variable through hysteresis width (min. 0.4%). TTL level for EXT (active low), or terminal short.
Hysteresis width:	1, 2, 4, 8, 16 dots

Level-setting accuracy (max.): ±0.2%f.s. (f.s.=100%)

Logic input conditions:	1, 0, X (don't care) pattern specification. AND and OR between A and B channels.
Pre-trigger:	0, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100, -100% (memory recorder and FFT analysis)
Trigger timing:	Start, stop (recorder, XY recorder), start and stop (recorder, XY recorder)
Trigger filter:	3, 4, 6, 10, 18, 34, 66, 130 samples OFF (CH1 to CH3)
Trigger output:	TTL level (active low), pulse width, approx. 50usec.
Trigger I/O terminal:	BNC terminals

2.4 Memory recorder function

Time axis:	20 ranges in 1, 2.5, and 5 steps (10usec/DIV to 5sec/DIV when using isolation type analog input unit).
Time axis resolution:	50 dots/DIV
Sampling rate:	Automatically set from time axis range (1/50th of time axis)
Recording length (shot length):	15, 20, 40, 80, 160, 300, 600, 1200 DIV
Format:	Normal, dual, XY
Interpolation function:	provided, dot/line indication

Overwrite function:	provided
Waveform enlargement and compression rates (time axis direction):	1/100, 1/50, 1/20, 1/10, 1/5, 1/2, x1, x2, x5, x10
Waveform scroll:	Left-right scroll provided
Grid:	on/off
Auto-print:	Automatic printout of stored waveform
Manual print:	supported
CRT copy:	supported
Partial print:	Prints portion between A and B cursors
Smooth print:	Smooth print specification causes density in the time axis direction to be doubled for smoother waveforms.

2.5 Recorder function

Time axis:	400, 500
(TIME/DIV)	1, 2, 5, 10, 20 (sec/DIV) 1, 2, 5, 10, 20 (min/DIV) 1 (hour/DIV)
Time axis resolution:	400 mse, 500 mse 50 dots/DIV, others are 100 dots/DIV
Sampling rate:	Fixed regardless of time axis (high-speed sampling)
Dot display, line display	1CH - 125 usec 200 usec 2CH - 200 usec 250 usec 3CH - 500 usec 500 usec
Recording length (shot length):	15, 20, 40, 80, 160, 300, 600DIV, CONT
Format:	normal, dual
Interpolation function:	Provided, dot/line
CRT display:	Supported for all except 400msec and 500msec ranges. Simultaneous display with printout supported.
Waveform storage:	last 95DIV stored to memory. Observation with reverse scroll possible (only CRT printout supported)
Print functions:	On, off and CRT copy

2.6 X-Y recorder function

X-channel:	CH1
Y-channel:	CH2, CH3 (only for analog input unit)
Effective recording dimensions:	82.5mm x 82.5mm (10DIV x 10DIV)

XY axis resolution:	25 dots/DIV
Sampling rate:	dot display line display 1CH 125usec 125 usec to 12.5 msec 2CH 125usec 125 usec to 25 msec (varies with amplitude)
Recording time:	infinite
Interpolation function:	provided, dot/line
Monitor function:	CRT realtime display
Print function:	manual print, CRT copy

2.7 FFT analysis function

Analysis mode:	One channel FFT (CH1 or CH2) 1) Time axis waveform 2) Linear spectrum 3) Power spectrum 4) Histogram Two-channel FFT (input waveform CH1, output waveform CH2) 5) Transfer function 6) Coherence
Calculation time:	one-channel FFT analysis approx. 1.5 seconds, two-channel FFT approx. 3 seconds (calculation only, data input and display times not included).
Frequency range:	3.90Hz to 7.90MHz (3.90Hz to 1.95MHz for isolation type analog unit).
Frequency resolution:	1/400
Frequency accuracy:	±0.02%
Sampling points:	1024
Dynamic range:	48dB (theoretical)
Input data:	Portion of waveform from memory recorder memory, or newly input waveform (selectable)
Window:	Rectangular or Hanning
Display scale:	Linear, log, phase, Nyquist
Format:	normal, dual
Print function:	as per memory recorder, excluding partial print

2.8 Accessory functions

Averaging function:	2, 4, 8 to 256 times (memory recorder, FFT analysis functions)
Memory partition function:	In memory recorder function memory capacity for each channel can be partitioned (maximum 16 divisions). 1) Memory partition use (multi-block memory) 2) Sequential save
Waveform judgment function:	Waveform judgment (GO/NG) to a reference area for time axis waveforms

	in the memory recorder function, XY waveforms, and FFT analysis.
Judgment mode:	1 - GO if entire waveform in area 2 - GO if any of waveform in area 3 - GO is entire waveform outside area 4 - GO if any of waveform outside area
Stop mode:	GO stop, NG stop, GO and NG stop
Judgment output:	External output of judgment result (TTL level, active low)
Judgment time:	Approx. 150msec (judgment only, excluding data input and display times)
Graphic editor:	Editor provided to define reference area to cover any portion of waveform
Editor commands:	line (dotted line), paint, parallel (parallel movement and paint), all clr (clear screen), quit and end
Calculation functions:	+, -, x and / between CH1 and CH2. (memory recorder) True rms value calculation between A and B cursors.
Cursor measurement functions:	Time difference, potential difference and frequency between A and B cursors. Potential and elapsed time from trigger for A cursor
Clock function:	auto calendar, automatic leap year recognition, 24-hour clock
Clock accuracy:	100ppm (25°C)
Back-up battery life:	Min. one month for clock and set parameters (from full charge)
Waveform data back-up:	External battery back-up possible (2.7 to 5.0V)
Waveform data current consumption: (Reference:)	Approx. 1mA at 5.0V (max.), approx. 350uA at 3.0V (max.) (service life of three size AA (SUM-3) batteries external cells is about one month)
IC card:	External storage for set parameters, measured data and waveform judgment area definition.
Commands:	LOAD, SAVE, INIT, KILL, COPY, TEST. Partial save for section between A and B cursors also possible.
Capacity:	8k bytes to 256k bytes
List print:	Waveform data print followed by set parameter output (on/off select)
Remote control:	start, stop input terminals (TTL level, active low, or terminal short)
GP-IB:	Electrically and mechanically compatible with IEEE 488-1978. Remote control possible for entire system including input unit (excluding gain adjustment and CRT intensity adjustment)
Help function:	Display of location of current screen within entire memory when in memory

recorder function.
During memory partition, use status for each block can be displayed. In FFT analysis function, calculation result scale can be displayed.

Key lock: Disables all keys except itself.

2.9 Appendix

Memory recorder and FFT analysis function

TIME/DIV	Sampling rate	Maximum recording time	FFT analysis frequency range	FFT analysis maximum recording time
2.5 μsec/DIV	50 nsec	3 msec	7.79 MHz	51 μsec
5	100	6	3.90	102
10	200	12	1.95	205
25	500	30	779 KHz	510
50	1 μsec	60	390	1.0 msec
100	2	120	195	2.0
250	5	300	77.9	5.1
500	10	600	39.0	10
1 msec/DIV	20	1.2 sec	19.5	20
2.5	50	3	7.79	51
5	100	6	3.90	102
10	200	12	1.95	205
25	500	30	779 Hz	510
50	1 msec	1 min	390	1.0 sec
100	2	2	195	2.0
250	5	5	77.9	5.1
500	10	10	39.0	10
1 sec/DIV	20	20	19.5	20
2.5	50	50	7.79	51
5	100	100	3.90	102

Time axis resolution 1/50 (per DIV)

Recorder function

TIME/DIV	Chart speed	Time axis resolution (per DIV)
400 msec/DIV	20.6 mm/sec	1/50
500	16.5	
1 sec/DIV	495 mm/min	
2	247.5	
5	99	
10	49.5	
20	24.8	
1 min/DIV	495 mm/hour	1/100
2	247.5	
5	99	
10	49.5	
20	24.8	
1 hour/DIV	8.3	

Recorder sampling rate

Channels used	dot	line
1	8 kHz (125μsec)	5 kHz (200μsec)
2	5 kHz (200μsec)	4 kHz (250μsec)
3	2 kHz (500μsec)	2 kHz (500μsec)

XY recorder sampling rate

Channels used	dot	line
1	8 kHz (125μsec)	80Hz (12.5 msec)
2	8 kHz (125μsec)	40Hz (25 msec)

CHAPTER 3

INSTALLATION AND PREPARATION

3.1 Notes on installation

(1) Supply voltage and fuse
The supply voltages on which the Memory Hi-Corder can operate are marked on the back panel. Check the supply voltage of the power source in your area. The fuse ratings are also marked on the back panel. Be sure to use a fuse having the specified current rating.

LINE VOLTAGE (±10%)			FUSE	Size
☐ 100V	☐ 120V		4 A	φ 6.4×30mm
☐ 200V	☐ 220V	☐ 240V	3 A	φ 6.4×30mm

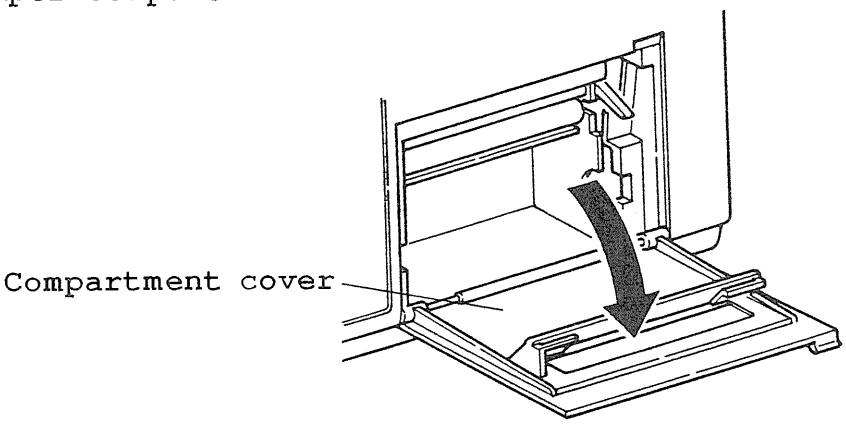
(2) Power cable
Be sure to use the included power cable.

(3) Ground terminal
If a grounded power outlet is not available at the installation site, be sure to connect the ground terminal to a good ground potential.

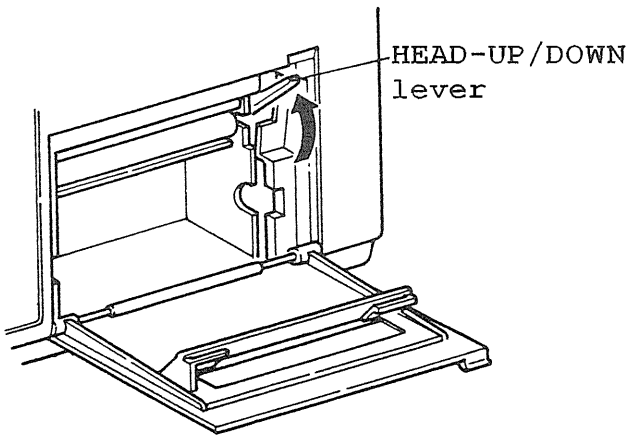
(4) Operating environment
Use the Memory Hi-Corder at a temperature of 0 to 40$^{C}_{o}$ and a humidity of 35 to 80%RH. Avoid locations that are subject to direct sunlight, high dust levels, or corrosive gases.

3-2 Installing paper

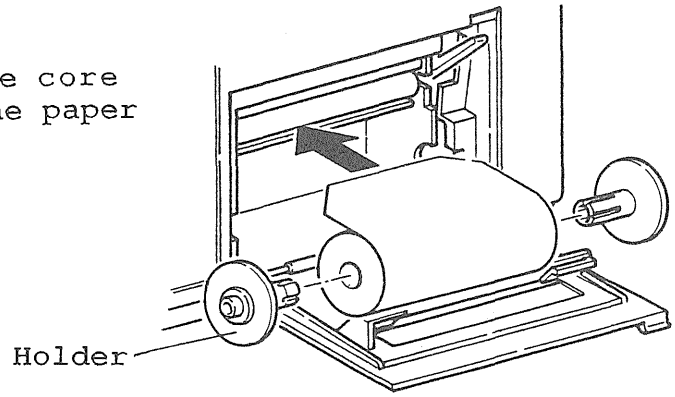
(1) Open up the paper compartment cover.



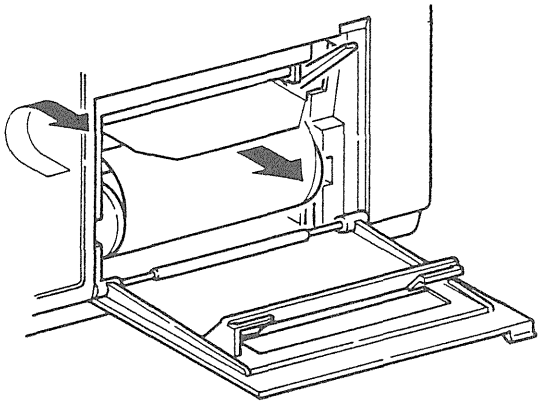
(2) Move the HEAD-UP/DOWN level to the UP position.



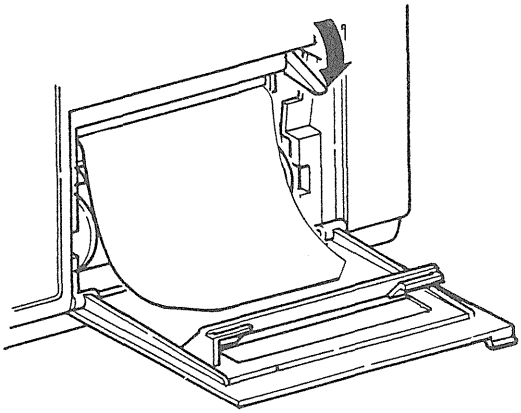
(3) Attach the holders to the core of the paper roll, and set the paper into the rail in the paper compartment.



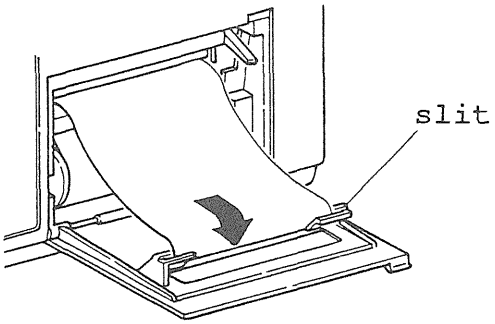
(4) Insert the loose end of the paper into the gap in the printer platen and pull the paper out.



(5) When the loose end of the paper comes out, pull it out 5cm or more. Straighten the paper. Then move the HEAD-UP/DOWN level to the DOWN position.
Unless the paper is at right angles to the printer plate, the paper may jam.



(6) Thread the paper through the slit in the paper compartment cover, and then close the paper compartment cover.



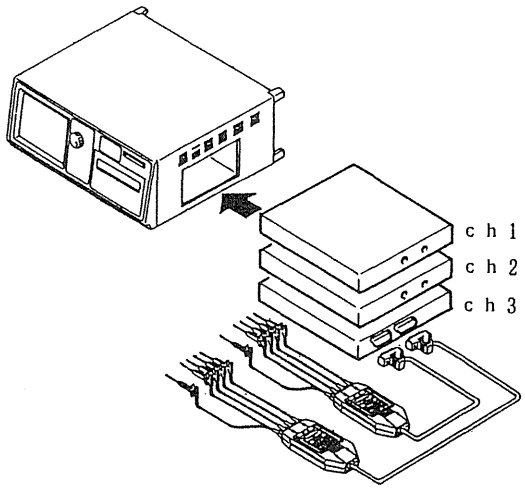
Note: If the paper is inserted backwards, the waveform will not be drawn.

3.3 Unit assembly

This system can combine freely a number of different units to suit specific applications, in what is called the plug-in unit design.

Up to three input units can be mounted, and the maximum input channel configuration is as given in Fig. 3-7.

These are numbered from the top as channel 1 (CH1), channel 2 (CH2) and channel 3 (CH3). Note that CH1 is always analog, regardless of overall system configuration.



3.4 Notes on measurement

WARNING

* The 8941 analog unit (high-speed type) and 8943 logic unit are not insulated from the main unit. The GND line for each is common with the GND of the main unit.

* The maximum permissible input voltage for the input terminals of the 8941 analog unit (high-speed type) is 150V (AC+DC peak), and 250V (AC+DC peak) when the 9162 (10:1) probe is used. Take care to avoid input voltage levels over these limits.

* The 8942 analog unit (isolation type) is insulated from the main unit, but the following cautions must be observed:

  . The maximum input terminal floating voltage is 250VAC, or 350VDC. Take care to avoid input of voltages over these limits between the channels, or between a channel and the main unit.

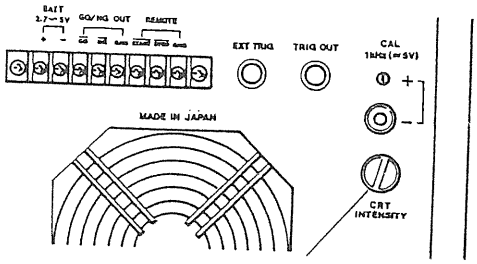
  . The maximum permissible input voltage for the input terminals is 200V (AC+DC peak). Take care to avoid input voltage levels over this limit.

3.5 CRT intensity adjustment

. The CRT is capable of displaying in two intensities (tones). Adjust the intensity so that the display is easiest to read.

. Rotate the CRT INTENSITY knob located on the rear panel to adjust intensity.

. The optimum intensity adjustment is where the retrace line (horizontal line) cannot be seen. Excessive display intensity will shorten CRT service life.



CRT INTENSITY knob.

3.6 Handling recording paper

* Usualy, storage conditions do not affect thermal paper rolls. However, if paper is to be stored for a long time, do so at a temperature of 40°C or lower. The paper is not adversely affected as long as it is stored at a low temperature.

* If the paper is exposed to strong light, it may discolor. Do not expose the paper to strong light for long periods of time.

Data storage
Since the paper is heat-sensitive, pay attention to the following points when handling paper on which data has been recorded:

* Do not expose paper to direct sunlight.

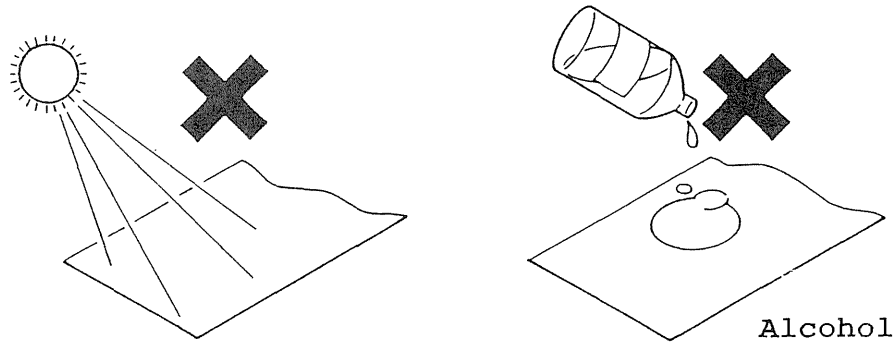
* Store the paper at a maximum temperature of 40°C and a maximum humidity of 90%.

* It is recommended that copies of the recorded data be made for storage.

* The thermal paper may be discolored when it is subjected to volatile organic solvents such as those based on alcohol, ether or ketone.

* When the thermal paper has absorbed organic solvents such as those based on alcohol, ether or ketone, it may lose its color, resulting in the data fading away. Soft vinyl chloride films and adhesive tapes such as cellophane tape contain these organic solvents.

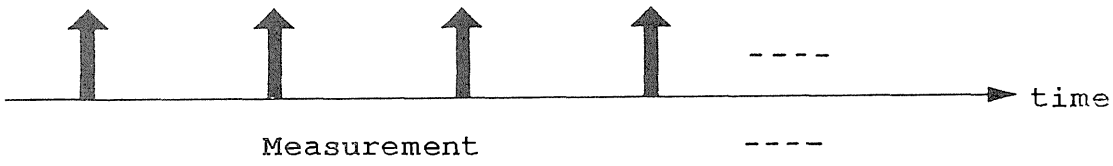
* Do not place the thermal paper on wet diazo copy paper.



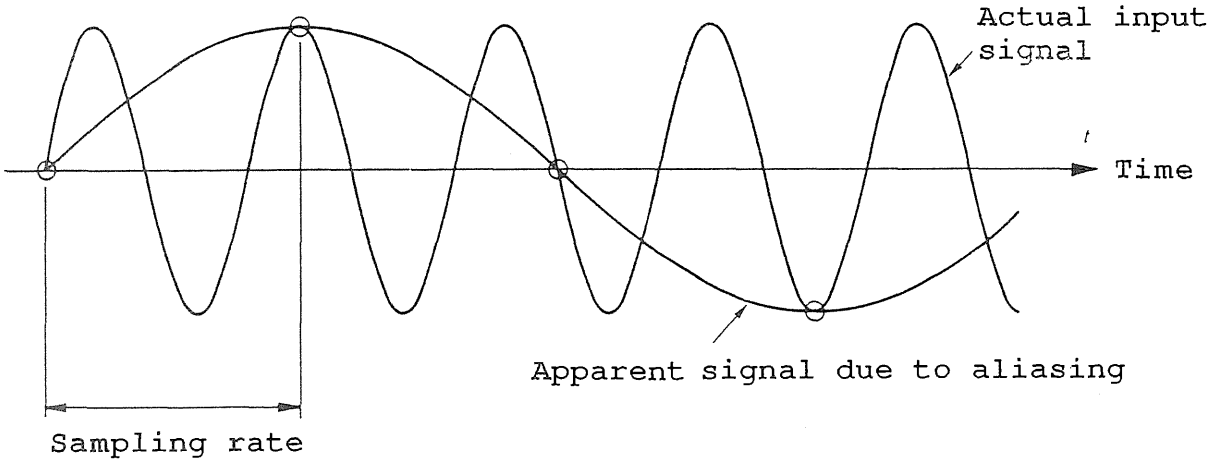
3.7 Aliasing distortion

* In the 8850 all input signals are converted from analog to digital, and all internal processing is handled with digital signals. This A/D conversion process is referred to as sampling.

* Sampling consists of measuring the height of the input signal waveform at predetermined intervals.



* If the variation in the signal being measured is extremely rapid compared to the sampling interval (sampling rate), a waveform will be recorded which does not accurately express the input waveform. This phenomenon is called "aliasing", to signify the creation of an unreal waveform.



* For measurement where the sampling rate can vary over a wide range with the time axis, such as in the memory recorder function, it is effectively impossible to avoid aliasing distortion.

During memory recorder function use the limiting measurement frequency is defined by the time axis range selected, and so measurement should be performed from a range with as high a speed as possible to minimize this distortion.

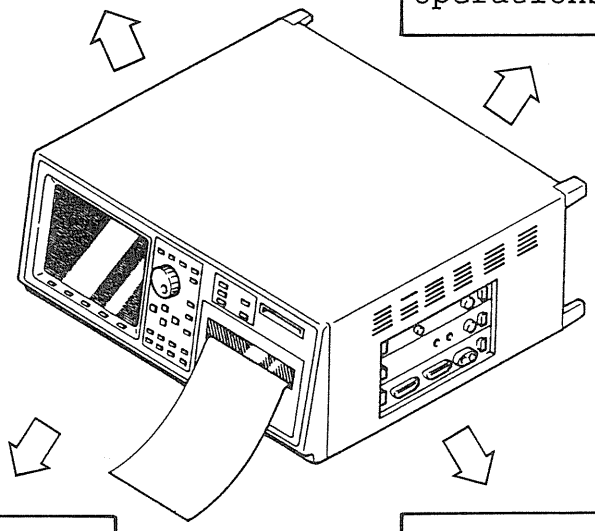
CHAPTER 4

OPERATIONS

Measurement function selection guide

Recorder
Continuous realtime recording possible. Chart speed variable from 400 msec/DIV to 1 hour/DIV. Waveform scroll with rotary knob. High-speed sampling allows peak capture for even rapidly fluctuating waveforms.

Memory recorder
Recording executed after input signal stored to memory. Time axis variable from 2.5 usec/DIV to 5 sec/DIV. Trigger function captures transient phenomena waveforms accurately. Memory partitioning supported. Waveform judgment supported. Waveform operations supported.



XY recorder
Continuous recording of XY waveforms for two signals. High-speed sampling tracks even rapidly fluctuating signals.

FFT analysis
Calculates and displays spectrum while inputting waveform. FFT analysis supported for waveforms stored through the memory recorder function. Transfer function calculation between two signals. Spectrum waveform judgment supported.

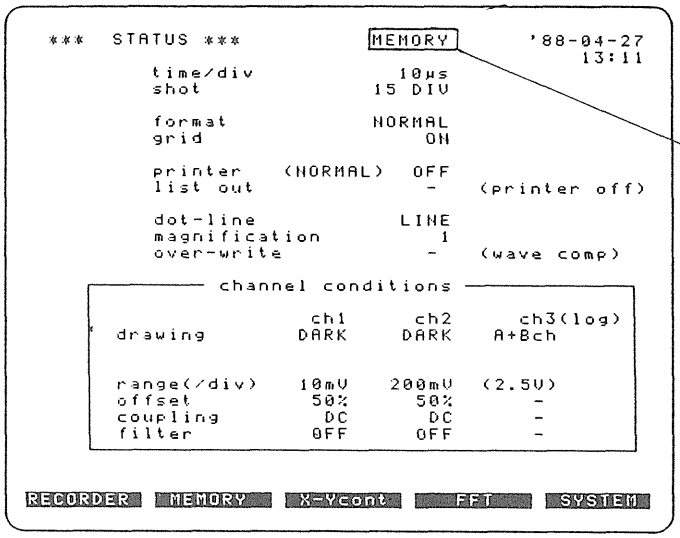
SYSTEM (8850 system setup)
Clock setup. Variety of self-diagnosis functions. GP-IB setup.

Transition between measurement functions

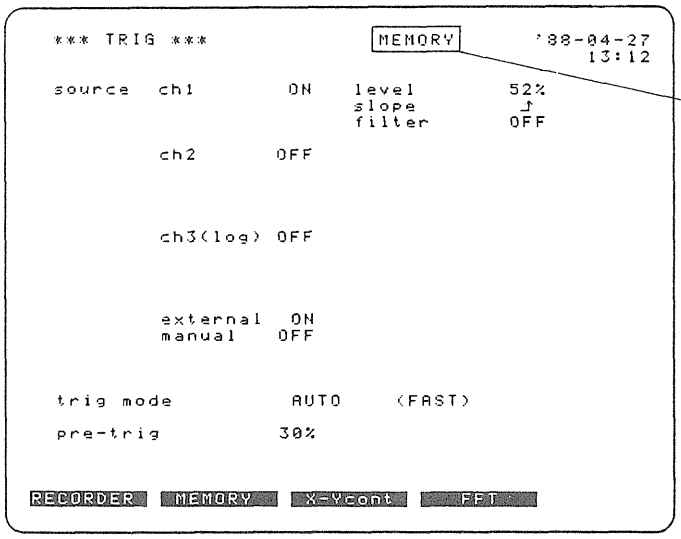
* Each measurement function has a status screen, a trigger screen, and a display screen, and the system can be shifted to a different function from any of them.

* Move the cursor to the function name and select the function with the function select keys.
  Example: Memory recorder function

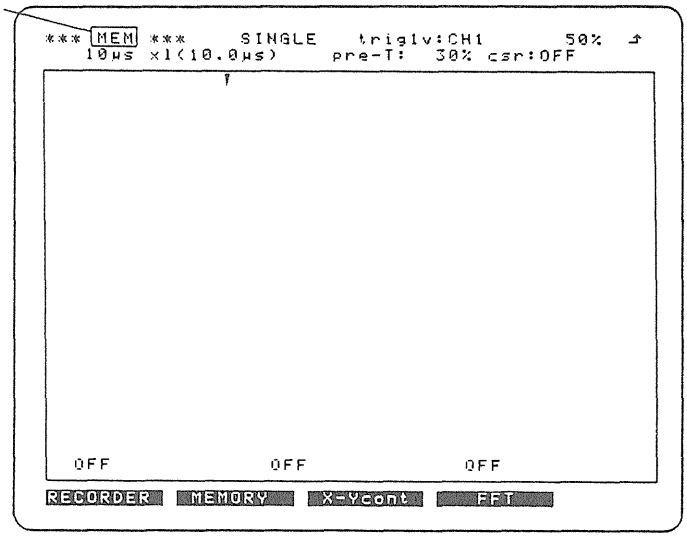
Status screen



Trigger screen



Display screen



4.1 Power on (reset)

(1) When the power switch is turned on the CRT will display the current settings, and the 8850 will enter the operational state.

(2) The settings are stored to memory, and the 8850 will automatically restore the settings it had when the power was turned off.

Note: If the 8850 is not used for long periods of time, these settings may vanish, in which case new parameters must be set.

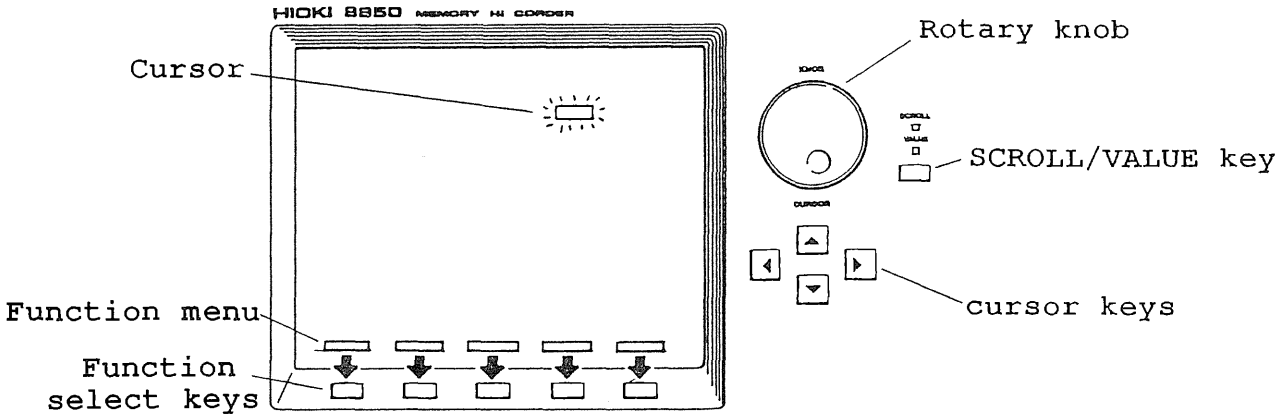
System reset
If the STOP key is depressed and the power turned off, all stored set parameter information will be cleared and the 8850 will return to the factory-shipment state.

4.2 Display screens and the function select keys

(1) Setting through the screen
Use the following procedure to specify system settings through the CRT screen.

1) Use the cursor keys to move the cursor (the blinking portion of the screen) to the item to be changed.

2) Press the function select key corresponding to the desired item indicated by the function menu, and alter the item displayed on the screen.



(2) The rotary knob is used for two purposes.
1) When SCROLL/VALUE key is set to SCROLL
a. In the status screen the screen scrolls vertically, and the cursor moves vertically.

Clockwise rotation - Screen moves up (same as down cursor key)
Counter-clockwise direction - Screen moves down (same as up cursor key)

b. In the display screen the waveform scrolls horizontally, and the A and B cursors move.
Clockwise rotation - Waveform moves right, or A and B cursors move up or to the right.
Counter-clockwise rotation - Waveform moves left, or A and B cursors move down or to the left.

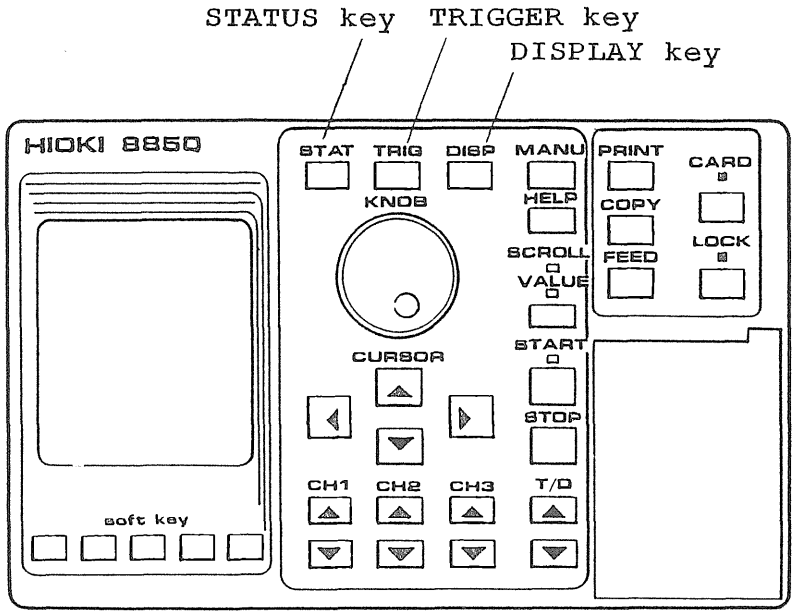
2) When SCROLL/VALUE key is set to VALUE
When function menu is vertical arrows, this knob can be used to set a value instead of the function select keys.
Clockwise rotation - Same as up arrow.
Counter-clockwise - Same as down arrow.

(3) Types of screens
Screens come in three major types: status, trigger and display. These are selected by pressing the STATUS, TRIGGER and DISPLAY keys respectively.

1) Status screen
Sets all parameters except for the function trigger conditions.

2) Trigger screen
Sets the trigger conditions for each function.

3) Display screen
Used to display the measurement results for measurement in various functions. Major parameters can also be set in this screen.



4.3 Memory recorder function and operation
4.3.1 Memory recorder function

(1) Displays and records input signals after storing them to memory once.

(2) Records all channels on the same time axis. Signals

can be drawn overlapped to clarify the relation between them.

(3) The time axis can be set to any of 20 steps from 2.5 usec/DIV to 5 sec/DIV for logic units (high-speed type), or 18 steps from 10 usec/DIV to 5 sec/DIV for analog units (isolation type).

(4) Storage capacity is a maximum of 60 words/channel continuous (about 1.200 DIV). With memory partition the total is 64k words/channel.

(5) The pretrigger function allows the signal present before the trigger to be observed.

(6) Enlarged and compressed display and recording
Enlargement 2, 5 or 10 times normal, compression 1/2, 1/5, 1/10, 1/20, 1/50 or 1/100 times normal.

(7) Three display formats
Time axis normal display, time axis dual display, and XY display

(8) High-quality (smooth) print
Smooth print function generates a high-quality waveform image that closely approximates the analog input.

(9) Partial print function
The desired portion of a stored waveform can be selectively printed out.

(10) Reprint function
A stored waveform can be printed out any number of times.

(11) Memory partition supported
To minimize dead time for continuous recording of transient phenomena, a maximum of 16 blocks (about 80DIV each) can be assigned to each channel for waveform storage.

(12) Waveform judgment function
Comparison of a user-defined area and the waveform can be used to detect abnormal waveforms automatically.

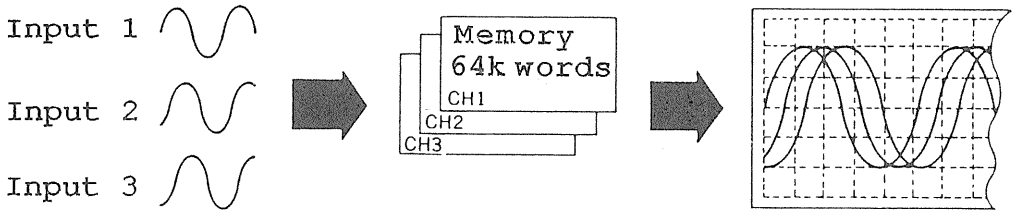
(13) Waveform operations
Cursor read-out of vertical and horizontal axes, true rms value, and the four basic arithmetic operations.

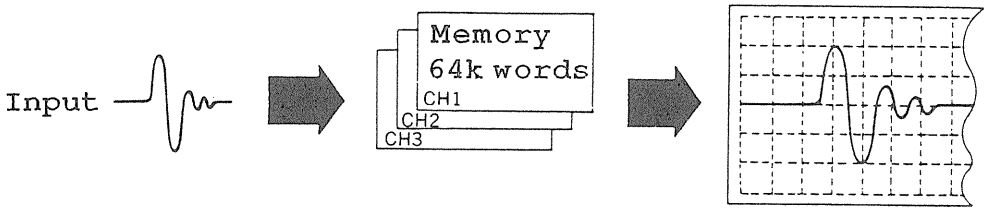
(14) Averaging supported
Cumulative averaging allows you to eliminate spurious components and observe only the signal components.

(15) Waveform scroll supported
Rotary knob can scroll waveform horizontally for easy search of critical waveform portions.

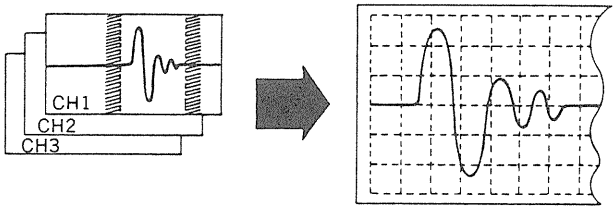
Fig p38: Input 1, Input 2, Input 3; Memory 64k words; Simultaneous three-channel recording

Simultaneous three-channel recording

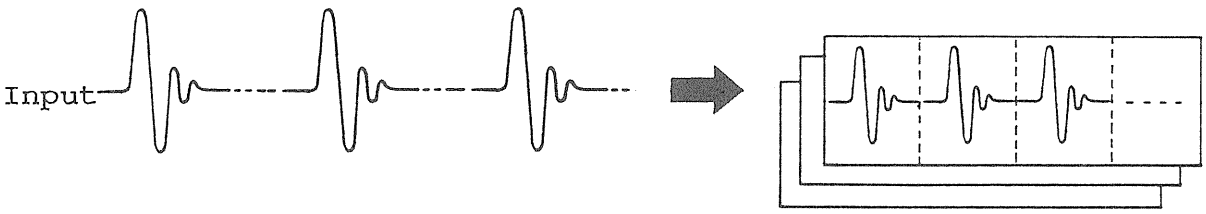




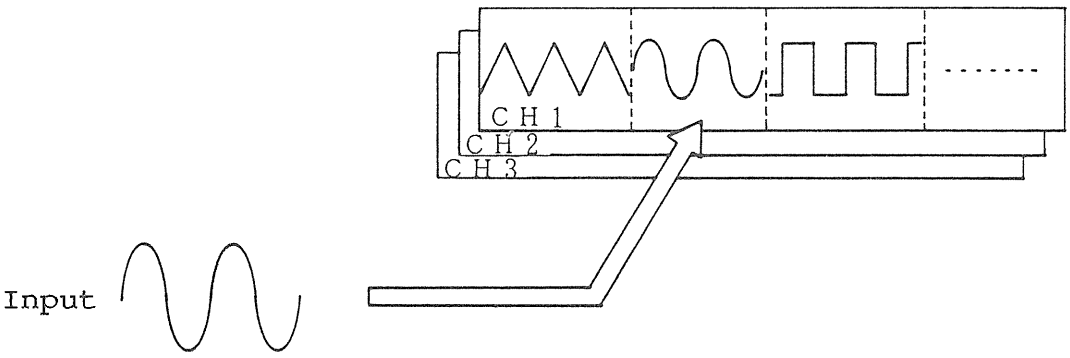
Observation of waveform
prior to triggering with pretrigger function



Partial print of memory data

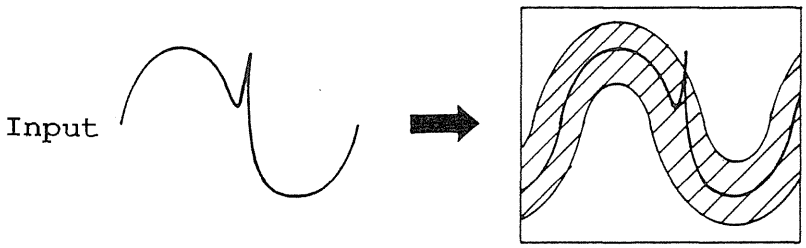


Minimal dead time through memory partition function



Waveform data storage through memory partition function

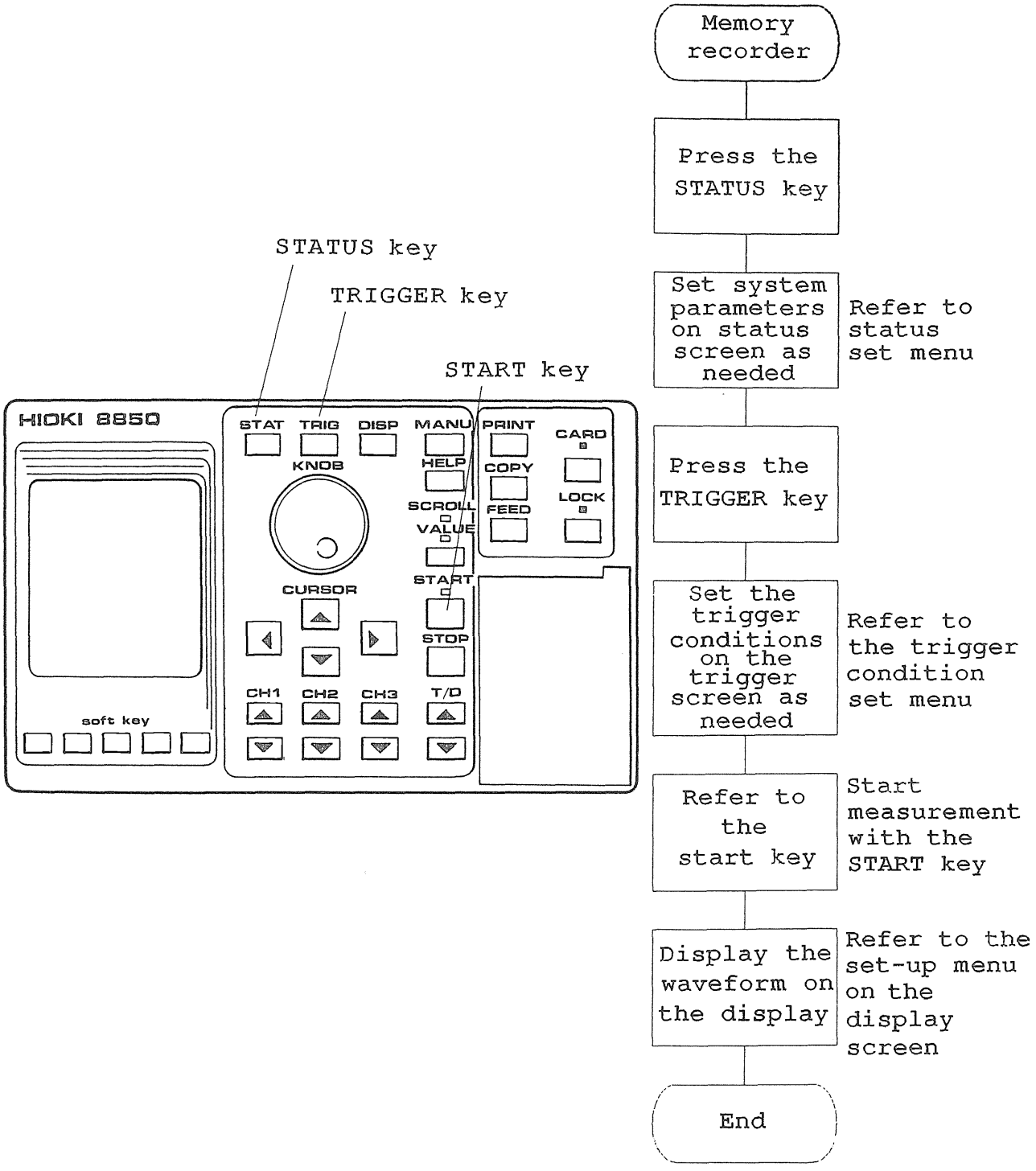
MEM



Abnormal waveform detection through
waveform judgment function

4.3.2 Outline of memory recorder operation

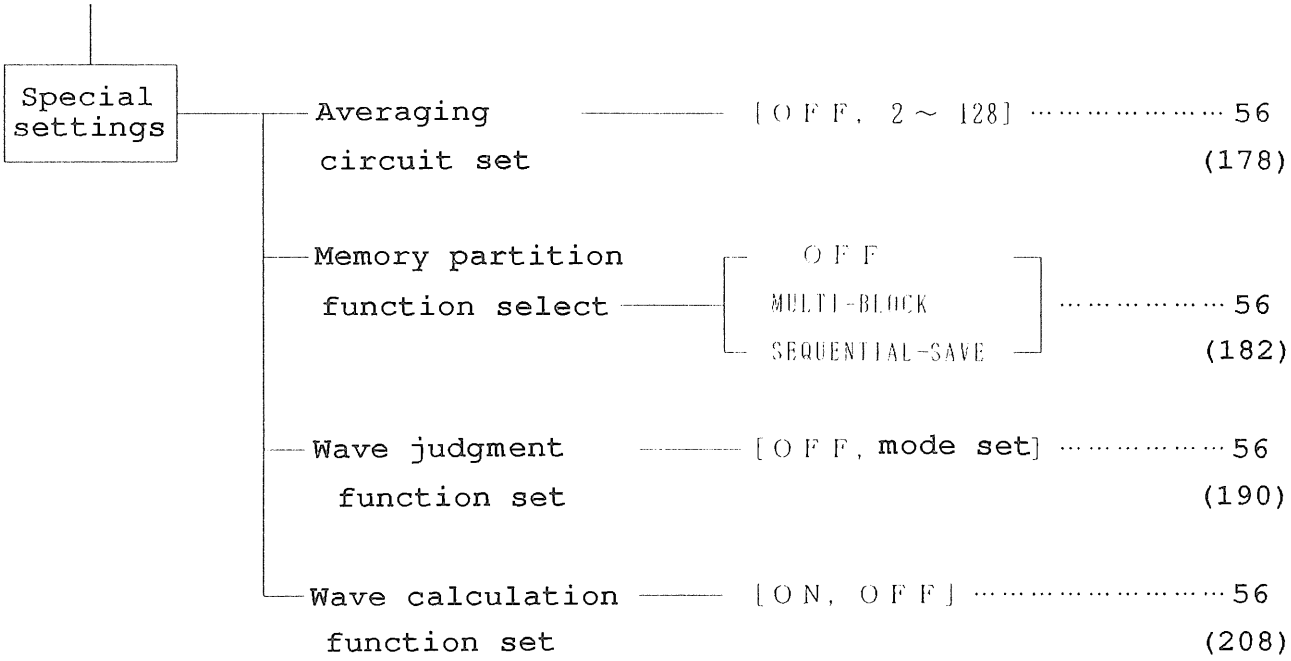
(1) Basic operation
The flowchart for the basic operation is indicated below.



Basic Operation Flowchart

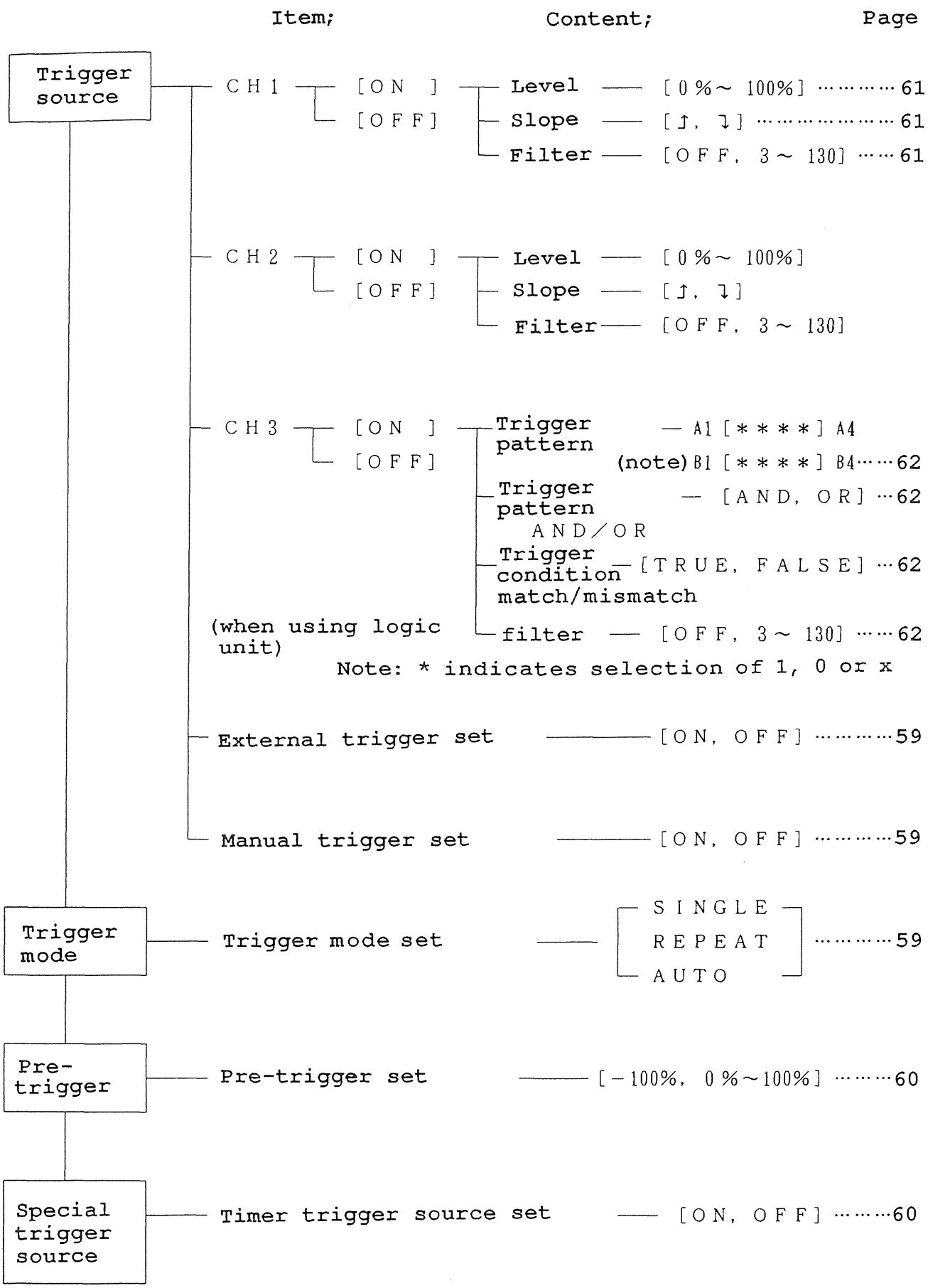
(2) Status set-up menu

Item		Content	Page
Basic settings	Function set	[MEMORY]	48
	Time axis (time/div) set	[2.5μs～5 s]	48
	Recording length (shot length) set	[15DIV～1200DIV]	48
	Display format set	[NORMAL, DUAL, X－Y]	48
	Grid set	[ON, OFF]	50
	Line interpolation (dot/line) set	[DOT, LINE]	50
	Printer set	[ON, OFF]	50
	List out set	[ON, OFF]	50
	Magnification (enlargement/compression) set	[×10～× 1/100]	50
	Over-write set	[ON, OFF]	51
Input unit settings	Drawing set	[OFF, DARK, LIGHT]	52
	Measurement range (range/div) set	[5mV～20V]	54
	Offset set	[－100%～100%]	55
	Coupling set	[GND, AC, DC]	55
	Input filter set	[ON, OFF]	55

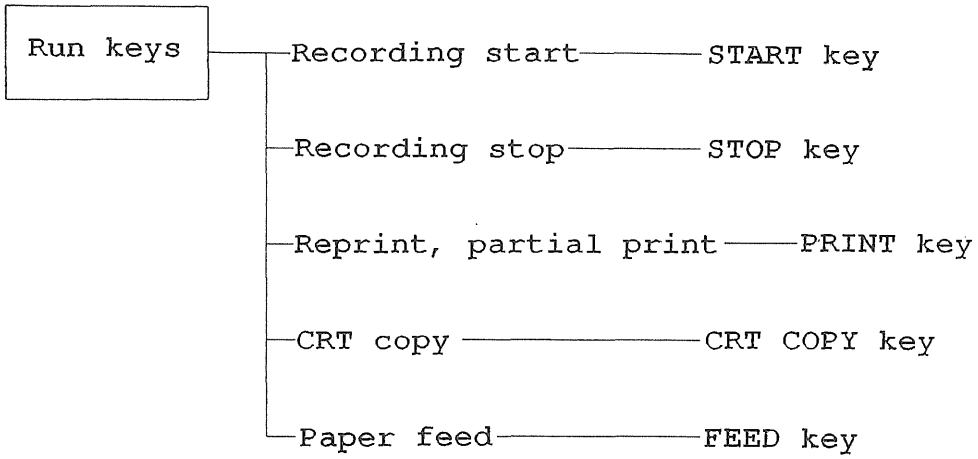


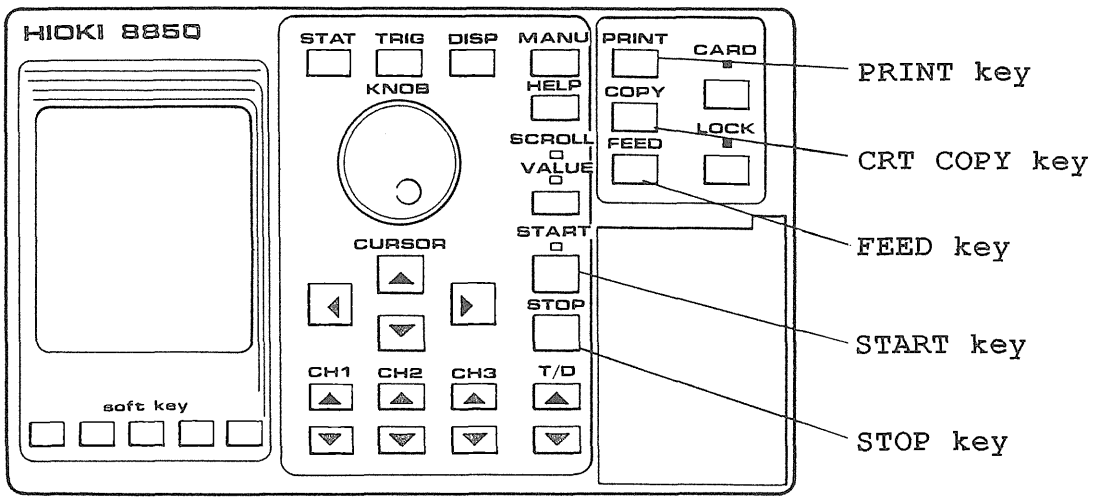
Note: Special settings are detailed in sections 4-3, and 4-10 through 4-14. The listed page numbers above refer to sections 4-10 through 4-14.

(3) Trigger condition set-up menu

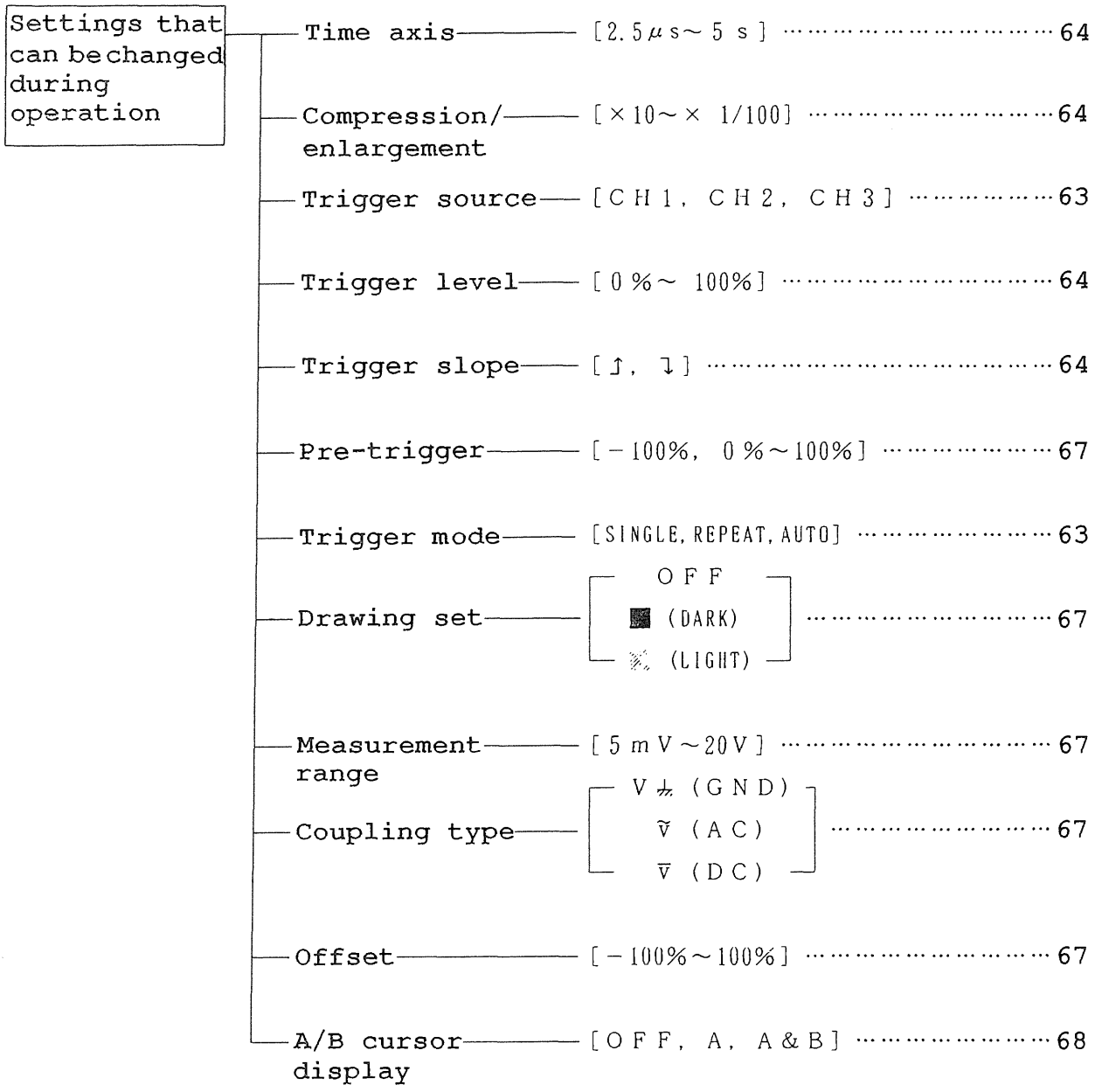


(4) Run keys


Run keys
Recording start
START key
Recording stop
STOP key
Reprint, partial print
PRINT key
CRT copy
CRT COPY key
Paper feed
FEED key


HIOKI 8850
STAT
TRIG
DISP
MANU
KNOB
HELP
SCROLL
VALUE
CURSOR
START
STOP
CH1
CH2
CH3
T/D
PRINT
CARD
COPY
LOCK
FEED
soft key
PRINT key
CRT COPY key
FEED key
START key
STOP key

(5) Display screen set-up menu

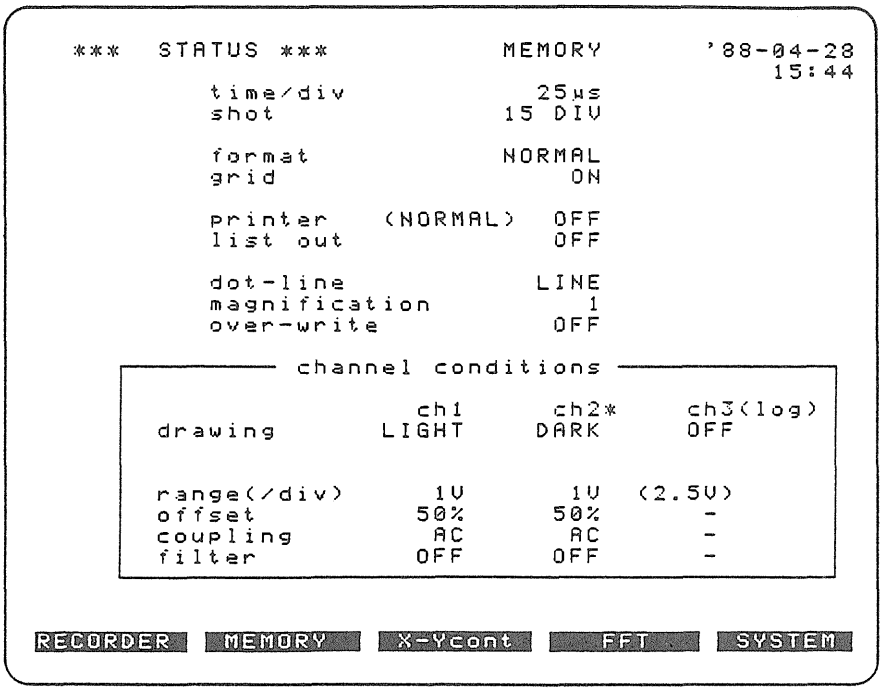


4.3.3 Memory recorder parameters and operation

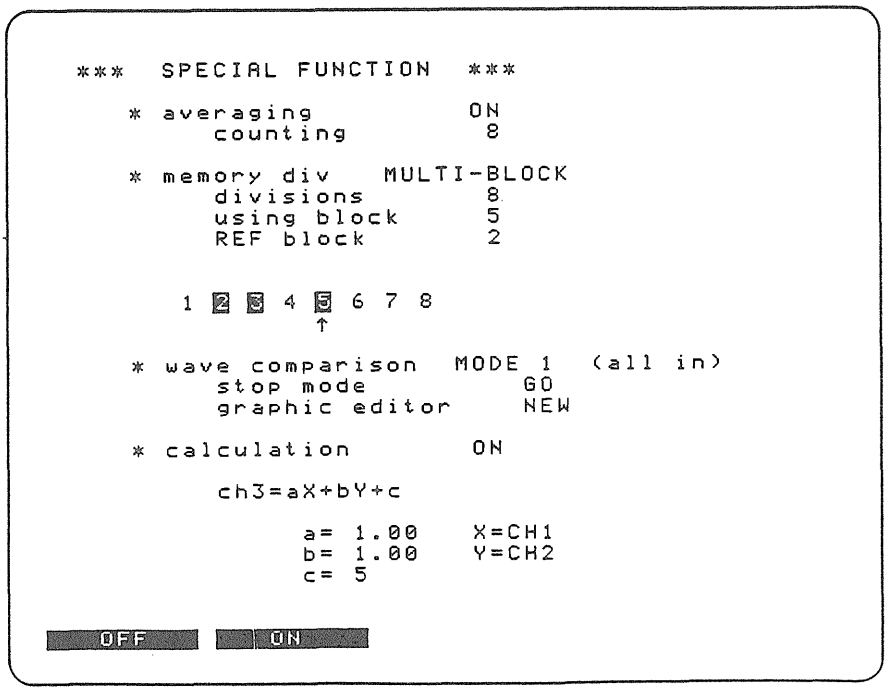
(1) Status screen

Pressing the STATUS key causes the status screen to appear. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys. Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special function screen is displayed by scrolling the screen, or by holding down the down cursor key.



Status screen



Special function screen

* Basic settings

o [MEMORY] - Sets the measurement function, and shifts to status screens of other functions. (This can be used to set RECORDER, MEMORY, XYcont, FFT, and SYSTEM).

o time/div - Sets the speed with which the input signal waveform is read in, expressed as the time required by a single division.

When the analog unit (high-speed type) or logic unit is used, setting is possible from 2.5usec/DIV to 5sec/DIV. When the analog unit (isolation type) is used, setting is possible from 10usec/DIV to 5sec/DIV.

This setting may be accomplished with the function elect keys or the IME/DIV key.

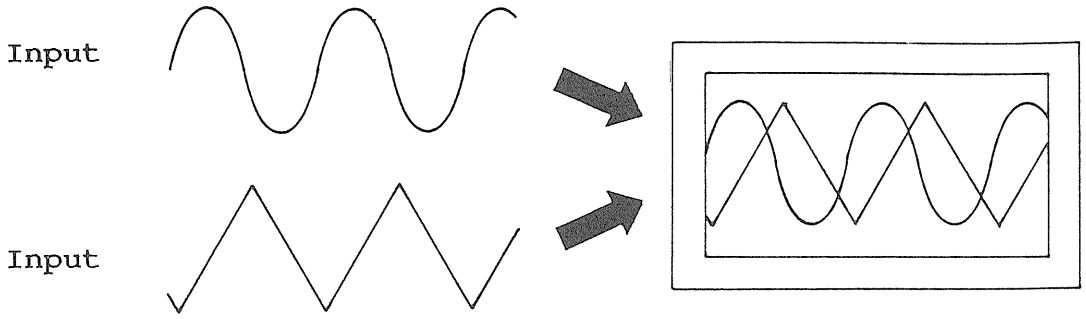
⚠ CAUTION

For 2.5usec/DIV and 5us/DIV settings, the analog unit (isolation type) is assumed to not be mounted in the main unit.

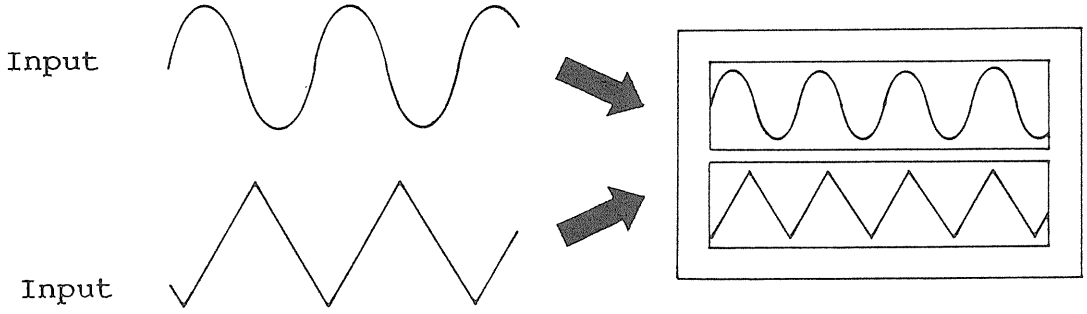
o shot - Sets the recording length of a single operation. (15 DIV - 1200 DIV)

o format - Sets the display format for the input signal waveform.

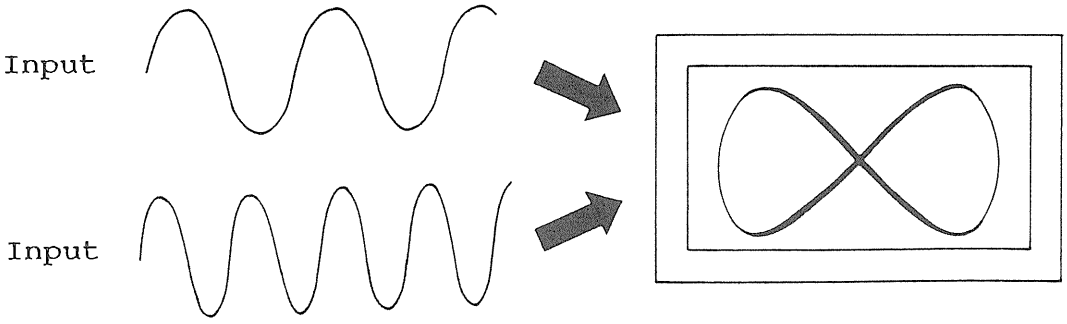
[NORMAL] - Displays the waveform on a single screen. Overlap display is possible for multiple waveforms.
[DUAL] - Divides the screen into upper and lower screens for waveform display. Waveforms from multiple channels can be displayed individually.
[XY] - The waveform is XY synthesized and displayed.



NORMAL display



DUAL display



XY display

o grid - Determines grid display.
[ON]: Displays grid
[OFF]: Does not display grid

o printer - Determines printer use during operation.
[ON]: Printer is used. Input waveform is read, and printed out.
[OFF]: Printer is not used.
[(NORMAL)]: Normal printout quality.
[(SMOOTH)]: Printout is smoothed out to approximate analog waveform.

Note: XY display printouts will always be in NORMAL mode regardless of setting.

o list out - Determines print out of setting parameters
[ON]: Prints out the setting parameter list after the waveform.
[OFF]: No printout of parameters.

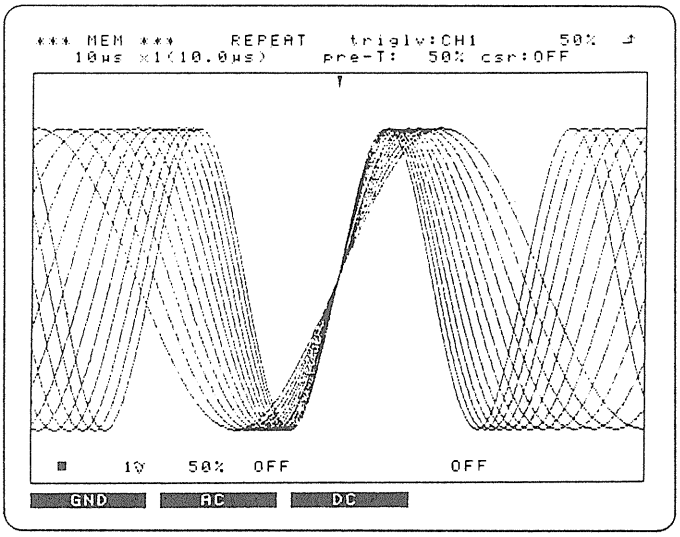
o dot-line - Sets the line interpolation for the measurement signal points.
[ON]: Line interpolation for an easy-to-read display.
[OFF]: No line interpolation for a display the accurately reproduces sampled data.

o magnification - Sets the enlargement/compression ratio for the time axis of the displayed waveform.
[x2]: Doubles waveform size
(x10, x5, x2, x1, x1/2, x15, x1/10, x1/20, x150, x1/100)

Note: If over-write is ON, the magnification setting cannot be altered.

o over-write - Overwrites without clearing the display.
[ON]: Overwrites, allowing comparison of multiple waveforms.
[OFF]: No overwriting (display is cleared)

Over-write example



MEM

CAUTION

Over-write setting is not possible if the printer is ON, or if the wave judgment function is ON.

* Input unit setting (channel conditions)

channel conditions

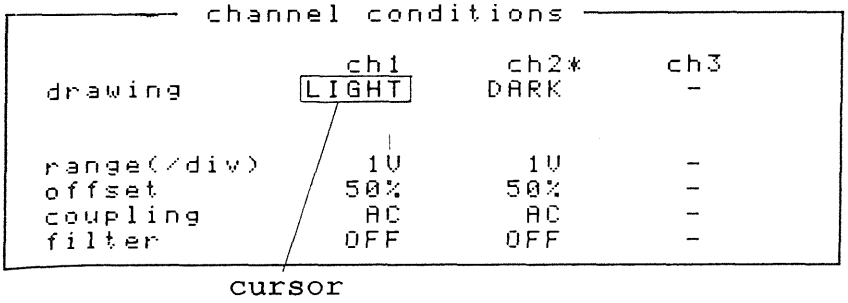
	ch1	ch2*	ch3(log)
drawing	LIGHT	DARK	OFF
range(/div)	1V	1V	(2.5V)
offset	50%	50%	-
coupling	AC	AC	-
filter	OFF	OFF	-

Settings for CH1

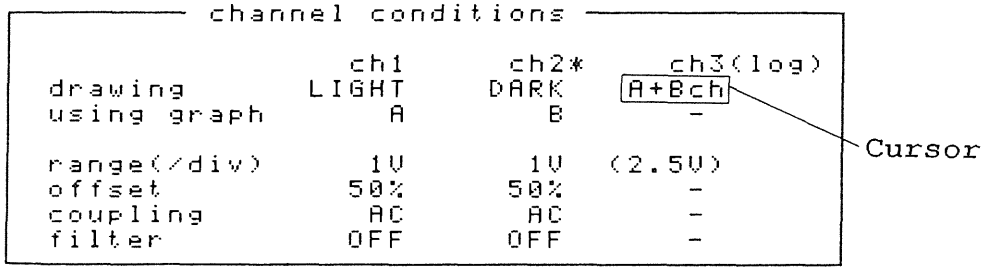
Note: * indicates an analog unit (isolation type), and (log) a logic unit.

o drawing - Sets the display of the input signal waveform.

When an analog unit is used and format is NORMAL:
[OFF]: No waveform display
[DARK]: Waveform displayed dark
[LIGHT]: Waveform displayed light



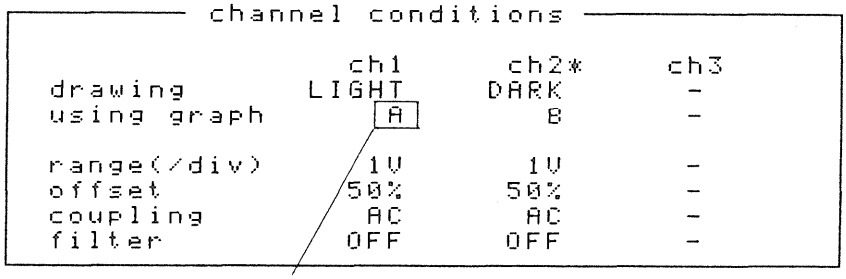
When a logic unit is used the setting is handled for each four logic waveform channels.
[OFF]: No logic waveform display
[Ach]: Displays the 4-channel logic waveform for logic probe A.
[Bch]: Displays the 4-channel logic waveform for logic probe B.
[A+Bch]: Displays total of eight logic channel waveforms, composed of logic probes A and B.



Note: When using a logic probe, the logic waveform will not be displayed if the format is set to [XY].

. When using an analog unit and format is DUAL, the drawing setting and the using graph setting are both required.

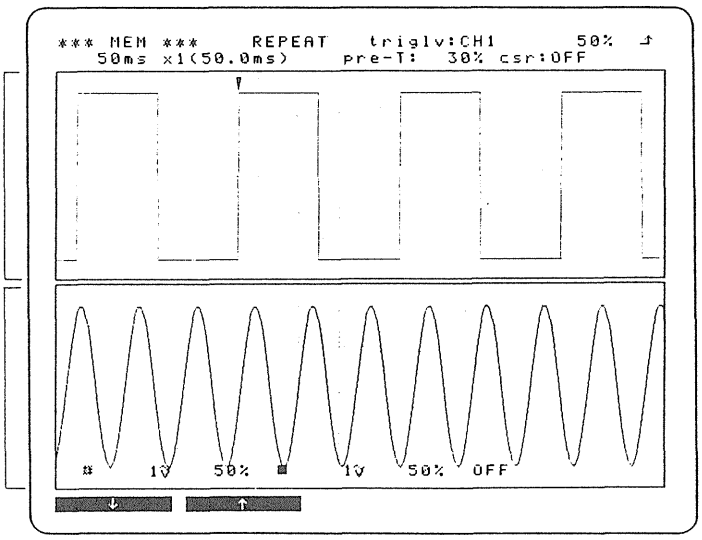
o using graph - Sets whether the input signal waveform is displayed on the upper or lower screen.
[A]: Displayed on the A (upper) screen
[B]: Displayed on the B (lower) screen



Display screen setting

A screen

B screen



MEM

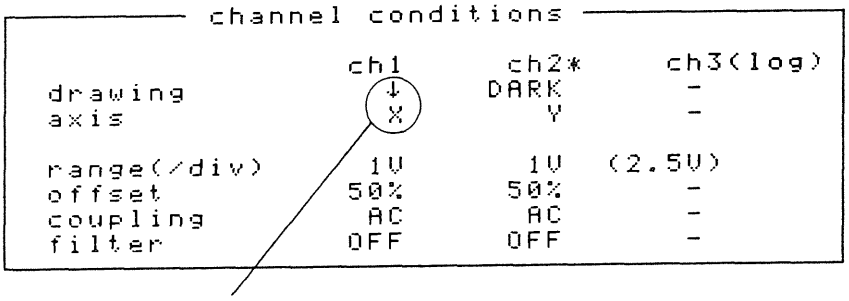
CAUTION

When the display mode is set to DUAL, there is no difference between DARK and LIGHT displays.

. When using an analog unit and format is XY, the drawing setting and the axis setting are both required.

o axis - Sets the x axis of the XY synthesis for the input signal waveform. The X axis can be set to any single input channel, and the remaining channel will be used as the Y axis.

Note: The arrow pointing down for drawing indicates the channel is the X axis.
Setting for OFF, DARK and LIGHT is made on the Y-axis channel.



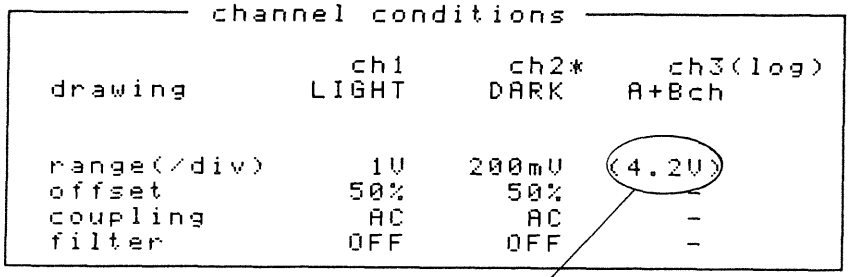
Channel 1 is the X axis.

. range (/div) - Sets the measurement range. This can be set with the function select key and the RANGE key for each channel.

. When using an analog unit
Sets one division on the vertical axis to 1V.

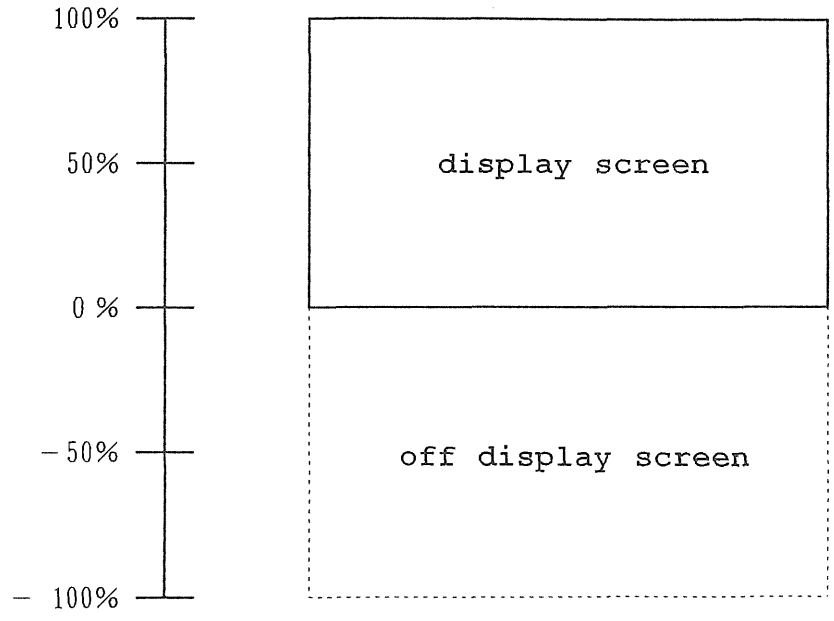
Note: The range for the analog unit (high-speed type) is 5mV to 5V, and for the analog unit (isolation type) is 5mV to 20V. When the gain adjustment knob is moved the "<" symbol will appear, as: <5mV

Sets the threshold to discriminate between input logic signal HI and LO at 4.2V. The usable range is -6.3V to +6.3V, in 0.1V steps.



Logic signal threshold value

o offset - Sets the input signal zero position
[10%]: The input signal zero position is set to 10% of the displayed portion. The usable range is 0 to 100%, in 1% steps.
[-10%]: The input signal zero position is set to -10% of the displayed portion. The usable range is 0 to -100%, in 1% steps.



o coupling - Sets the input coupling
[GND]: No input signal connected. Zero position can be checked.
[AC]: Capacitor coupled in series. DC component of input signal cut, and only AC component measured.
[DC]: input terminal directly connected to amplifier for measurement of DC component.

filter - Input unit internal low-pass filter set.
[ON]: Low-pass filter used (cutoff frequency is about 5Hz).
[OFF]: Low-pass filter is not used.

* Special settings (special function screen)

Refer to Sections 4-10 through 4-14 for descriptions of functions and function operation.

o averaging - Sets cumulative average.
  [OFF]: No cumulative average.
  [ON]: Cumulative average.
  counting: Sets averaging count from 2 to 256 times.

o memory div - Sets memory division (partition)
  1) [OFF]: No memory partition.
  2) [SEQUENTIAL SAVE]: Memory is partitioned, and used to capture sequential triggers.
     divisions - Sets the number of blocks.
     using block: Sets the number of the memory block to be displayed on the CRT.

  3) [MULTI BLOCK]: Partitions memory and uses user-specified block.
     divisions - Sets the number of blocks.
     using block: Sets the number of the memory block to store the input waveform.
     REF block: Sets the memory block holding the reference input signal waveform.

waveform judgment - Compares the input waveform with a user-defined judgment area to detect abnormal waveforms.
  [OFF]: No waveform judgment
  [MODE 1]: Sets the waveform judgment mode (modes 1, 2, 3 and 4 are available).
  stop mode: Sets stop to activate on GO or NG output.
  graphic editor: Used to define judgment area.

  Note: The waveform judgment function cannot be used with averaging or sequential save functions.

o calculation - Operates the four basic arithmetic operations for the input signals from CH1 and CH2, and input the result into CH3.

  [OFF]: No operations.
  [ON]: Sets operators 1) and 2), channels X and Y to be operated on, and coefficients a, b and c.

Note: Operations are performed on the display screen (refer to Section 4-14). Calculation results are output as analog waveforms in the DARK mode. LIGHT display is not possible.

⚠ CAUTION

When calculation is on, it is impossible to input and display a signal waveform on channel 3. To observe an input signal waveform on channel 3, turn calculation off.

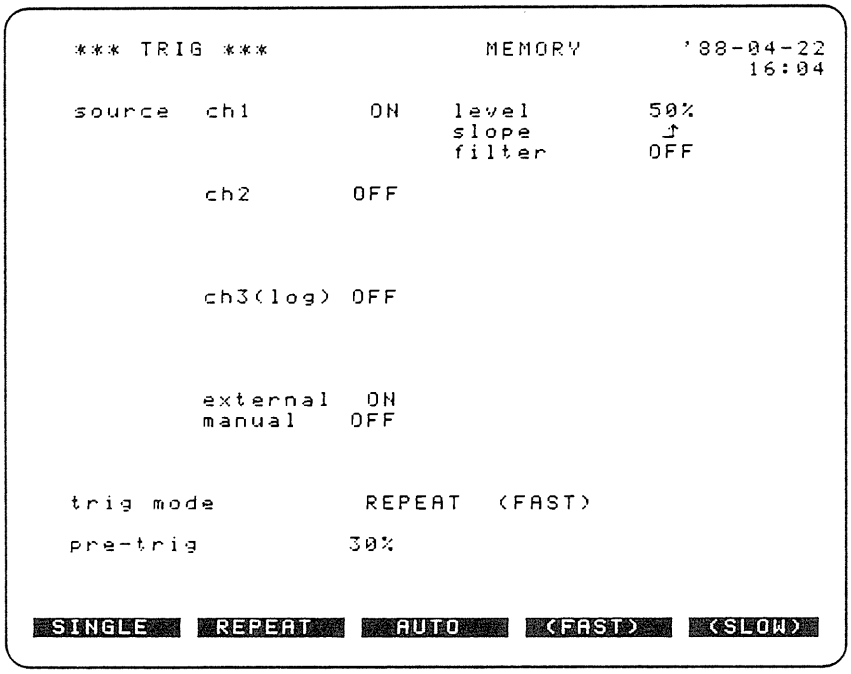
It is impossible to input a signal waveform, perform arithmetic operations and display the result.

Operations on logic waveforms are not possible.

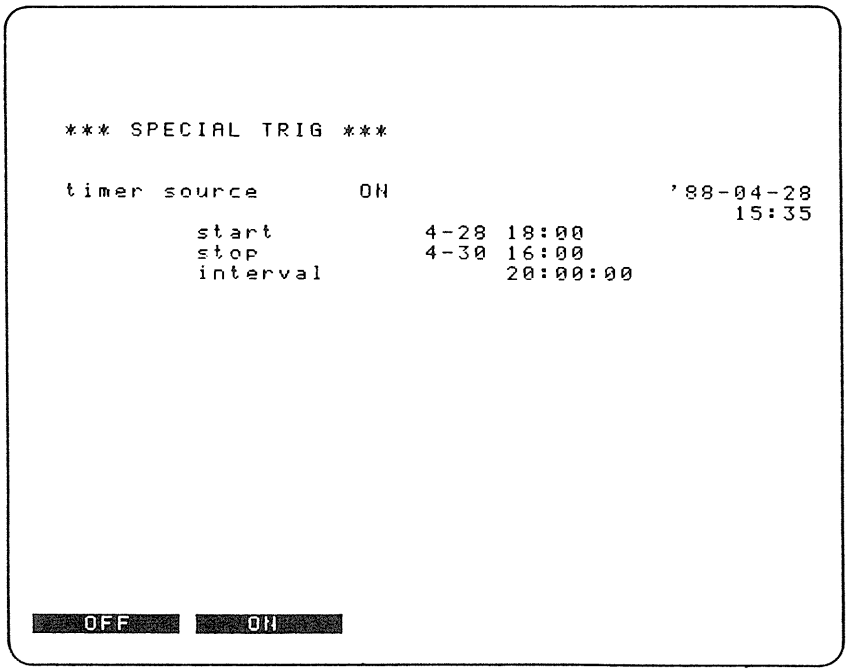
(2) Trigger screen

Pressing the TRIGGER key switches to the trigger set screen. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys . Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special trigger screen is displayed by scrolling the screen, or by holding down the down cursor key.



Trigger screen



Special trigger screen

o [MEMORY] - Sets the measurement function, and switches to other function trigger screens (setting possible for RECORDER, MEMORY, XYcont, and FFT).

o source - Sets trigger to input signal from channel 1-3, respectively. These trigger sources are referred to as the internal trigger(s), and should be turned ON to use.

external - Trigger set to signal from external trigger input terminal. Turn ON to use.

manual - Activates the trigger when the MANU key is pressed. Turn ON to use.

Note: When multiple trigger sources are on the trigger will be activated by any of them. If all trigger sources are off, the trigger will be activated by pressing the START key.

o trig mode - Sets the trigger mode.
[SINGLE]: Only the first trigger after the START key is pressed is enabled.
[REPEAT]: System will be activated by every trigger.
[AUTO]: System will be activated by every trigger, and if no trigger is received by a set time limit the system will automatically generate one (Note: this time limit is the time axis times the recording length. For example, at 2.5usec/DIV 80DIV, the time limit would be 200usec. However, the maximum is 2 seconds).

[(FAST)]: Sets the update rate for the screen to fast.
[(SLOW)]: Sets the update rate for the screen to slow.

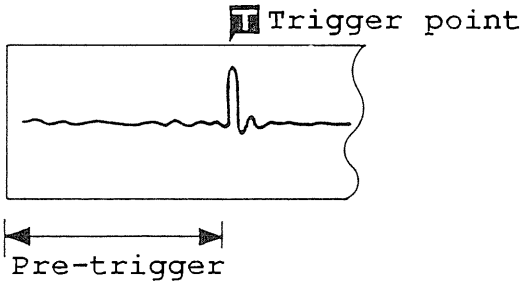
When screen update rate is set to fast:
A single screen takes two cycles, and when a 90% span sin wave is input:

DOT grid off - about 0.15 sec.
LINE grid on - about 0.20 sec.
(Time axis, recording length, trigger, pre-trigger, trigger level)

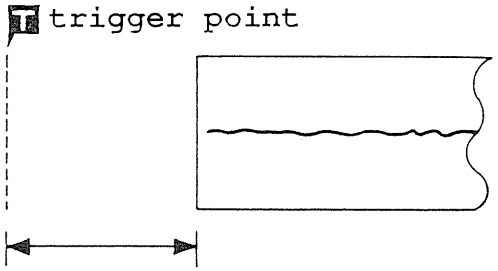
The above values are reference values only. The slower the time axis or the longer the recording length the slower the update time.

o pre-trig - Sets the pre-trigger.
[2%]: Starts recording from 2% before the recording length after a trigger is received.
(2, 5, 10, 20, 30, 40, 50, 60, 80, 90, 95, 100%)
[-100%]: Begins recording 100% of the recording length after a trigger is received.
[0%]: Begins recording when trigger is received.

Fig: Trigger point, Pre-trigger; (2% to 100% of set recording length); trigger point; minus pre-trigger portion



(2% to 100% of set recording length)



minus pre-trigger portion (-100%)

⚠ CAUTION

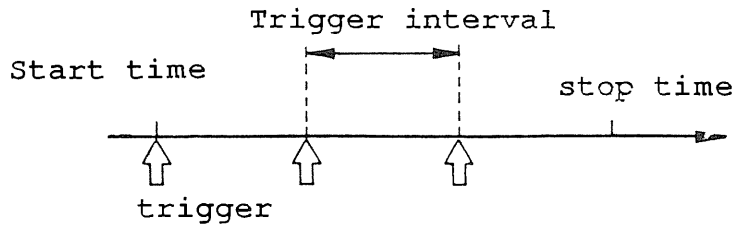
A trigger will not be activated while a pre-trigger portion signal is being input, or during printout.

o timer source - Sets the timer trigger.
[ON]: Trigger is set to on from the specified start time through the specified stop time, at the specified interval.

When the interval is "00:00:00", the trigger will activate only one time, at the start time.

[OFF]: Timer trigger does not activate.

```
timer source        ON

        start           5-06  12:00
        stop            5-10  12:00
        interval            06:00:00
```



Note: Start time and stop time are only valid if specified for times after the point the START key is pressed.

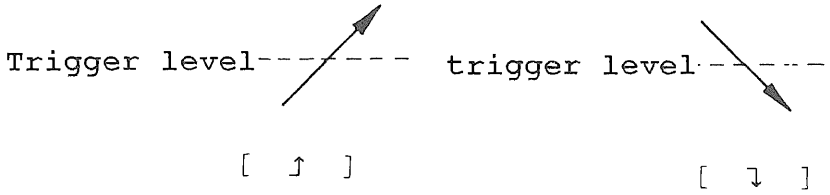
When the trigger mode is SINGLE, recording will only occur when the start time is reached, regardless of the set interval.

*Internal trigger setting when analog unit used

ch1	ON	level	54%
		slope	↴
		filter	18

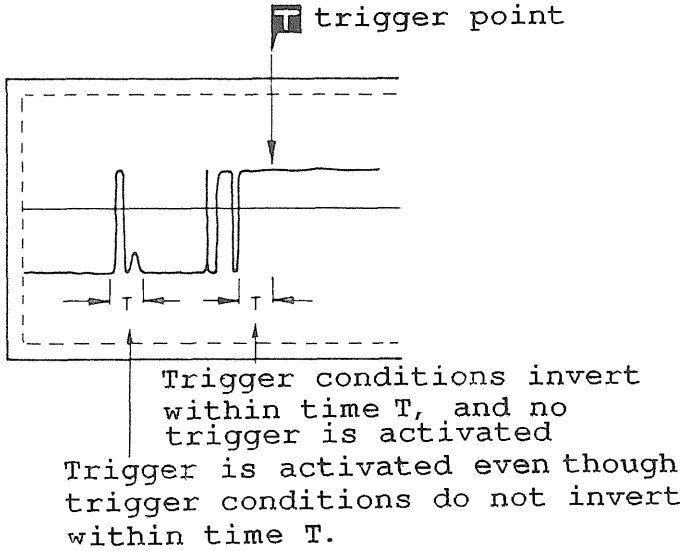
o level - Sets the trigger level.
[54%]: This threshold value is compared to the input value, expressed as a percent of the full scale recording width, which is taken as 100%. Settings from 0% to 100% are possible.

o slope: Sets trigger slope.
[>]: Trigger is activated when input signal passes the threshold value as a positive edge.
[<]: Trigger is activated when input signal passes the threshold value as a negative edge.



o filter - Sets the trigger filter.
[OFF]: No filter operation.
[18]: Sets the sampling value (3, 4, 6, 10, 18, 34, 66, 130) to x. If the trigger conditions are inverted within the set time atrigger will be activated.

Example: When the trigger is set to the input signal, this function prevents triggering due to excessive noise.



*Internal trigger set for logic unit

```
ch3(log)   ON    A1 [xxxx]A4  B1 [xxxx]B4
                 AND/OR         AND
                 filter           4
                 trigT/F      TRUE
```

o Trigger pattern
[A1] [XX01] A4 B1[x11 x] B4: The logic pattern compared to the input logic single is expressed with 1, 0 and X. 1 indicates HI, 0 indicates LO, and X indicates don't care.

Discrimination between 1 and 0 is handled by the signal detection logic probe. HI/LO level threshold values are set with respect to the status screen input unit.

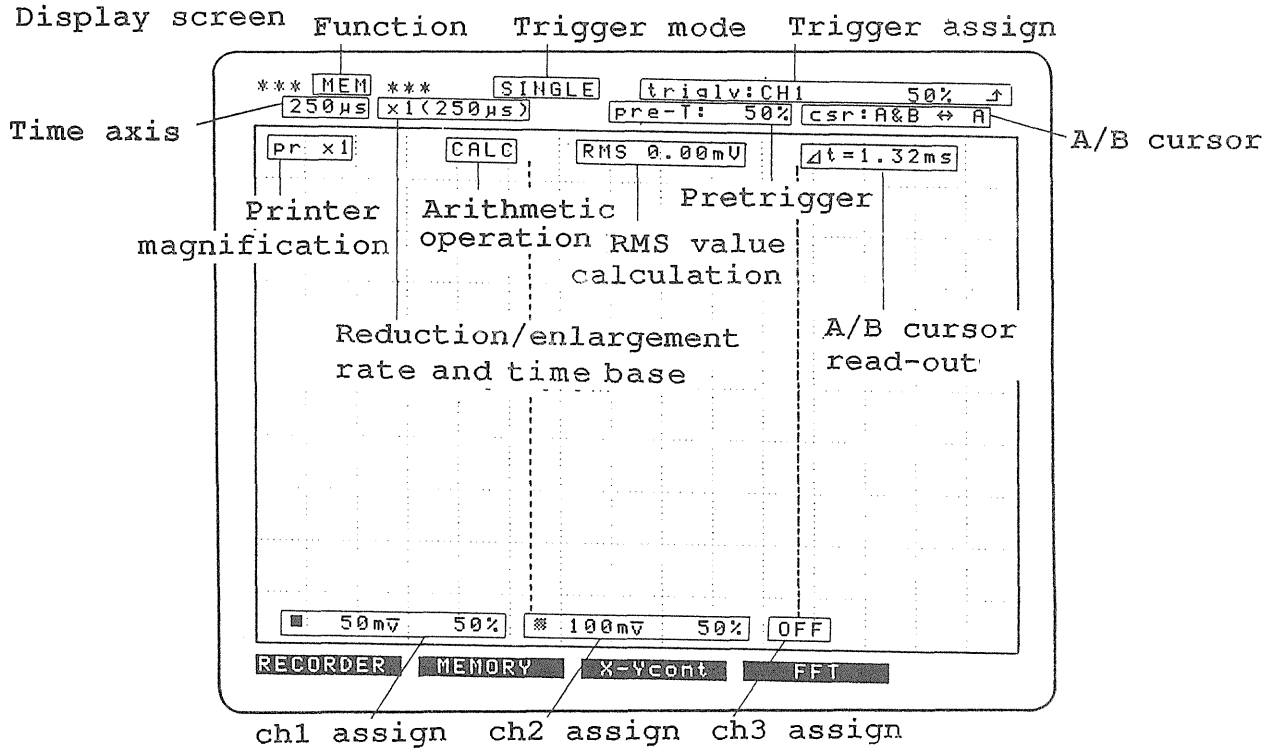
o AND/OR: Sets trigger pattern AND and OR
[AND]: Trigger activated when all specified trigger patterns match.
[OR]: Trigger activated if even one specific trigger pattern matches.

o filter: Sets the trigger filter. Setting is the same as for the analog unit.

o trig T/F: Sets logic trigger condition match/mismatch.
[TRUE]: Trigger activated when trigger pattern and AND/OR trigger conditions met.
[FALSE]: Trigger activated when trigger pattern and AND/OR trigger conditions not met.

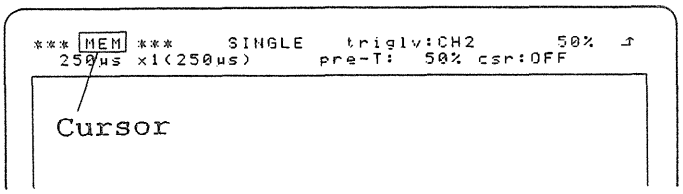
(3) Display screen
The display screen appears when the DISPLAY key is pressed.

* Display screen

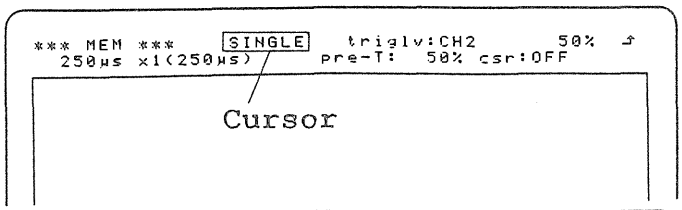


Certain items of the status screen and trigger screen settings can be set from the display screen.
For details, refer to the status screen and trigger screen.

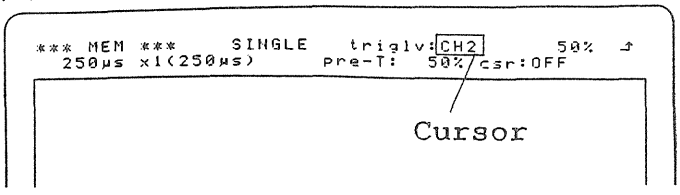
o [MEM]:Sets the measurement function (to RECORDER, MEMORY, X-Y cont, or FFT). Can be switched to another function display.



o [SINGLE]: Sets the trigger mode (to SINGLE, REPEAT or AUTO).



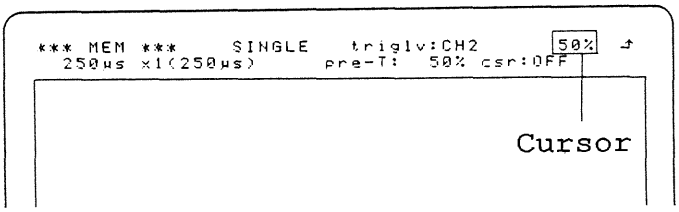
o [CH2]: Selects a trigger source from ch1, ch2 and ch3.



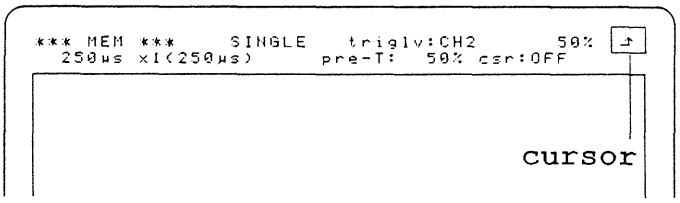
Note: It is impossible to select a channel which has been turned off as a trigger source on the trigger screen.

MEM

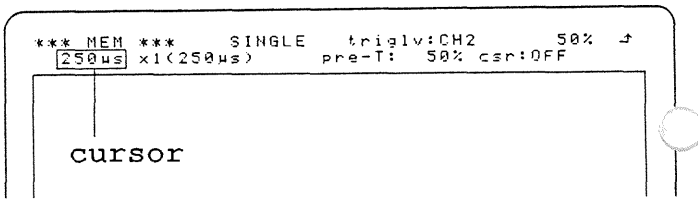
o [50%]: Sets selected trigger source trigger level from 0% to 100%.



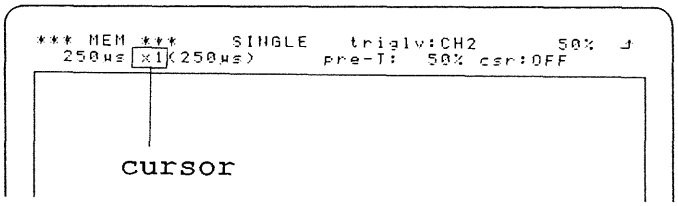
o [⊥↑]: Sets slope for selected trigger source, either positive or negative.



o [250usec]: Sets input speed (time/div) for input signal waveform.



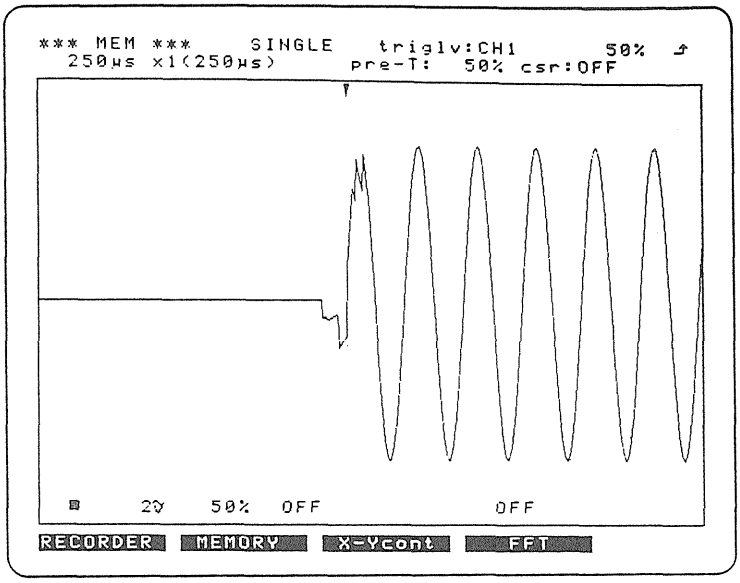
o [x1]: Sets magnification (enlargement/compression) of display waveform time axis.



Note: When over-write is on, magnification cannot be changed.

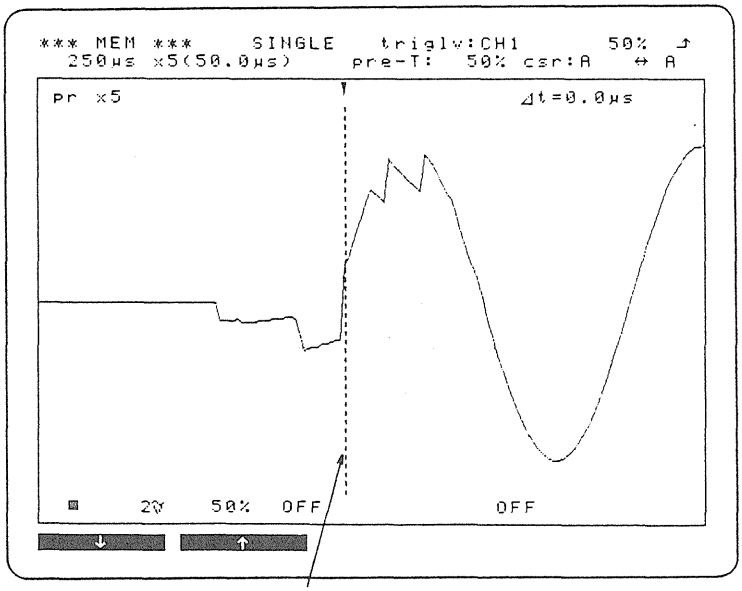
Magnification is handled with the position of the A cursor as the center. If the A cursor is not present, then the center of the display is used.

The A cursor display is set with "csr".



x1 display

Enlargement



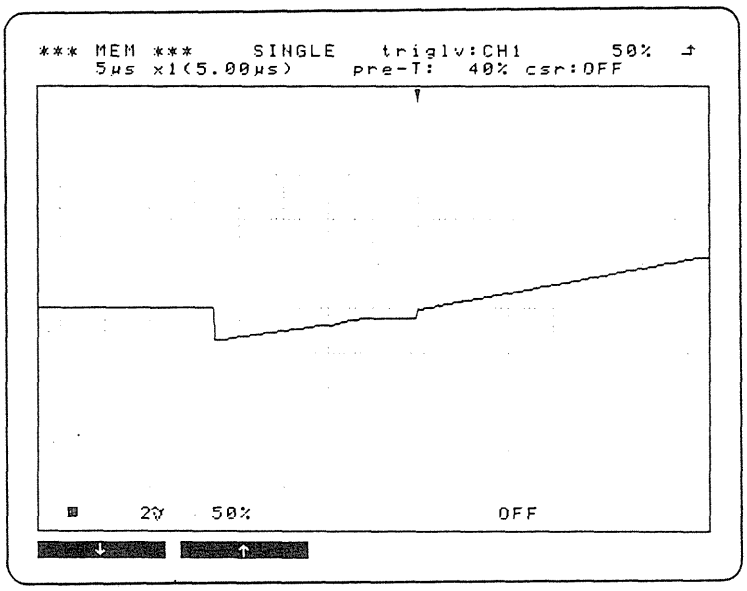
A cursor

x5 display

MEM

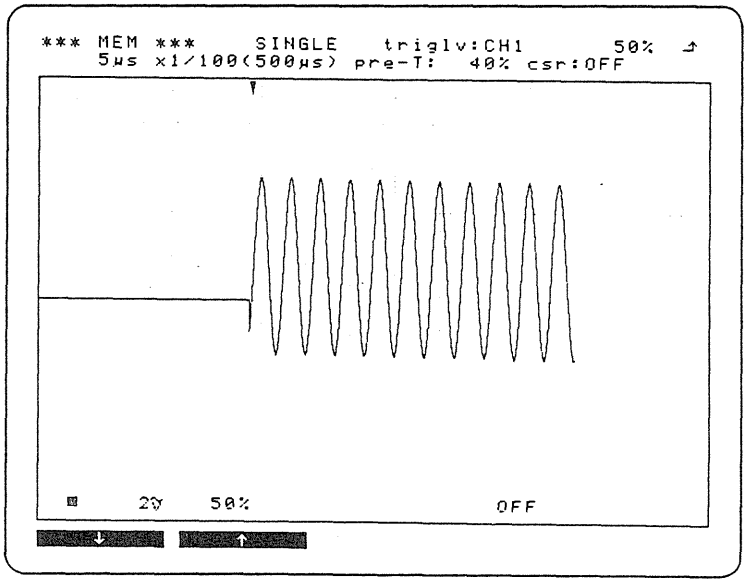
Compression allows the entire input signal waveform to the seen.

Compression allows even the longest recording length (1200 divisions) to be seen on a single screen.



1200DIV x1 display

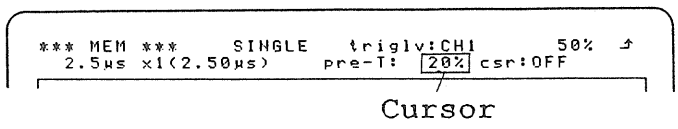
Compression



1200DIV x1/100
compressed display

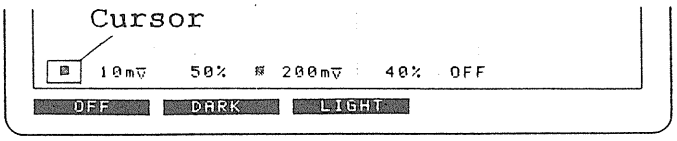
[20%]: Sets the pre-trigger from -100% to 100%.

Note: The trigger mark willchange to a[▼] on the display.



* For analog units:

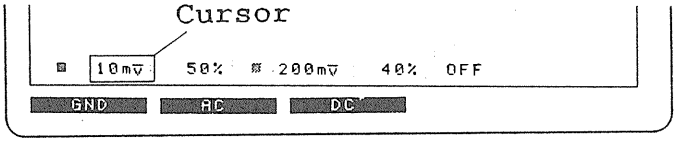
o [■]: Sets the input signal waveform display to OFF, ■ or ▨



Note: ■ is DARK, ▨ is LIGHT.

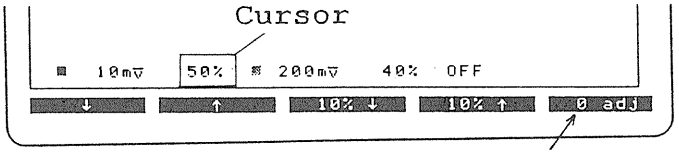
o [10mV]: Sets the measurement range and input junction.

[V ⏚] indicates [GND]
[Ṽ] indicates [AC]
[V̄] indicates DC.



o [50%]: Sets the offset for the input signal from -100% to 100%. Pressing the [0adj] function select key executes calibration to the offset value.

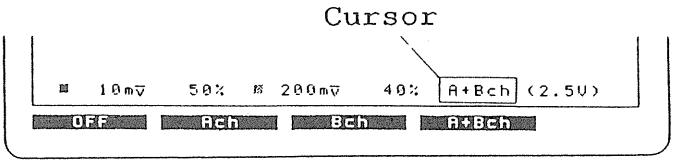
Note: Zero adjust processing will erase stored waveforms. Execute zero adjustment in the [AUTO] trigger mode, during operation.



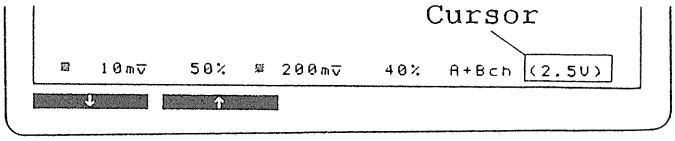
Executes zero adjust processing

* When logic unit is used

o [A+Bch] Sets the display for four logic waveform channels at a time. Possible settings are OFF, Ach, Bch, and A+Bch.



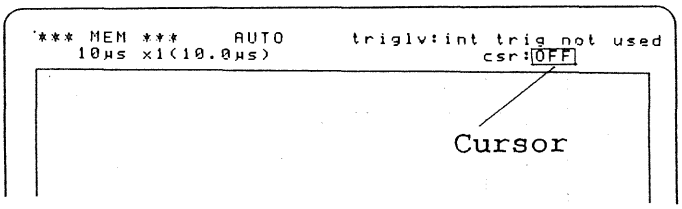
(2.5V) Sets thresholds for input signal HI and LO levels. Settings are possible from -6.3V to 6.3V.



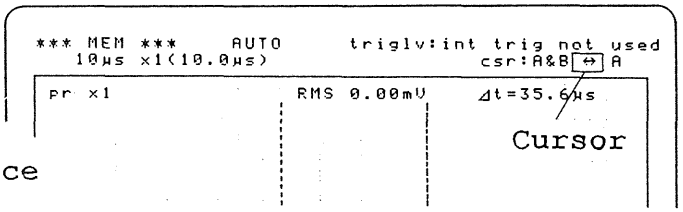
MEM

o csr - Displays both A and B cursors on the display screen.
Note: When using the rotary knob, be sure to set the SCROLL/VALUE key to SCROLL.

1) [OFF] - no cursor display
[A&B] - Displays both A and B cursors.
[A] - Displays only A cursor.



2) [↕]: Sets the horizontal display cursor. Voltage difference (delta V) will be determined.
[↔ Δ t]: Sets the vertical display cursor. Time difference (delta t) will be determined.
[↔ Δ f]: Sets the vertical display cursor. Frequency (delta f) will be determined. (delta f) is determined as (1/delta t).

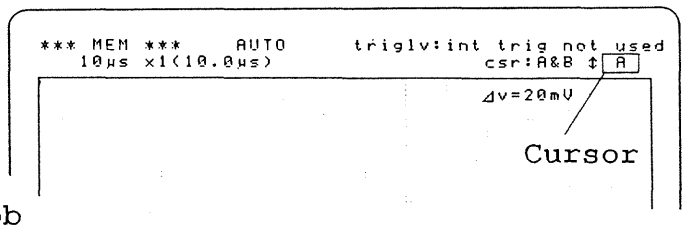


3) [A]: Turning the rotary knob will move the A cursor.

[B]: Turning the rotary knob will move the B cursor.

[A&B]: Turning the rotary knob will move both A and B cursors at once.

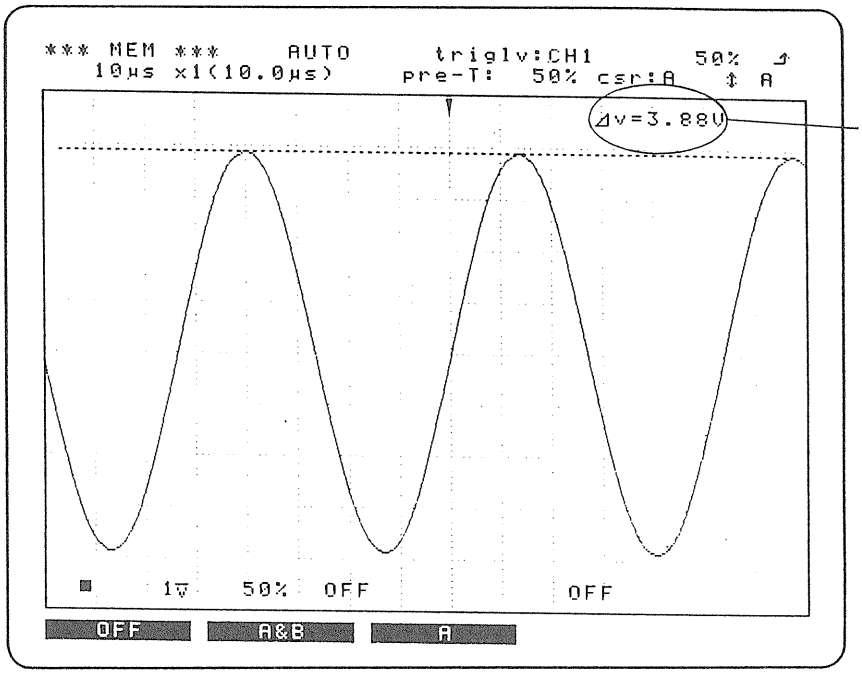
[WAVE]: Turning the rotary knob will scroll the input signal waveform horizontally.



Note: When the waveform fills the screen, over-write is on, or waveform judgment function is on, the waveform cannot be horizontally scrolled.

Example of cursor calculation

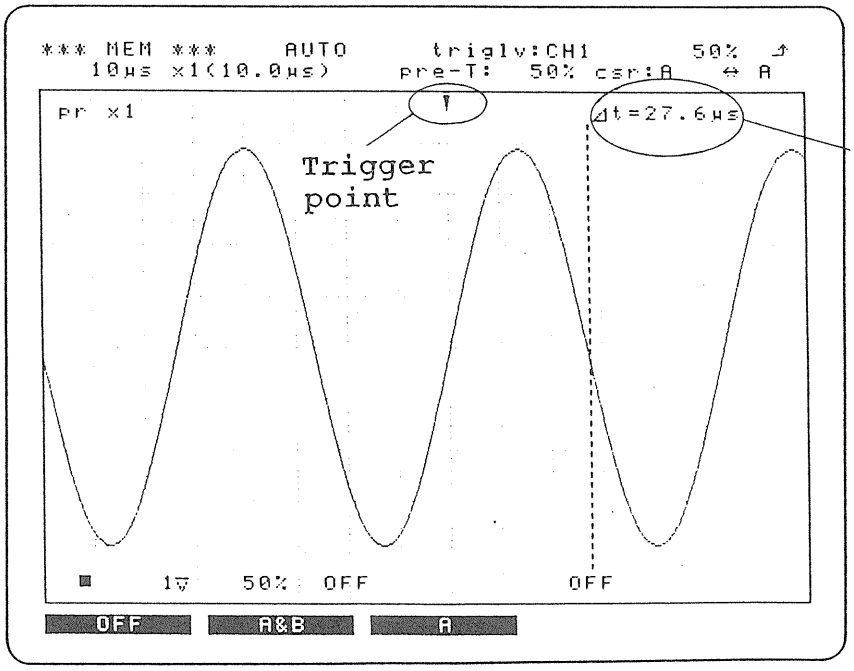
1) In csr:A↕, the voltage potential (ΔV) from the input signal zero position (offset) is determined, and in csr:A&B the voltage difference (ΔV) between cursors A and B is determined.



determines voltage potential from zero position

Input signal offset ▶

2) In csr:A⇔ the time difference (Δt) or frequency (Δf) from the trigger point to the A cursor is determined, and in csr:A&B⇔ the time difference (Δt) or frequency difference (Δf) between the A and B cursors is determined.



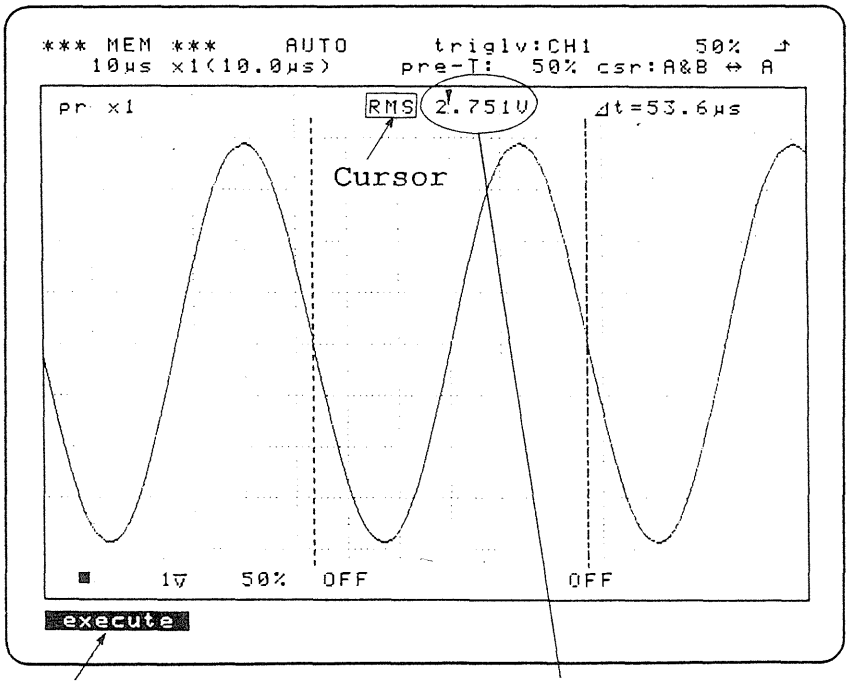
Time (frequency) difference from trigger point.

MEM

* RMS calculation

When the A and B cursors are displayed on the screen it is possible to determine the true rms value for the section of input signal waveform displayed between the A and B cursors.

RMS is displayed when the A and B cursors are displayed. Move the cursor to the RMS position, and press the "execute" function select key to perform rms calculation.



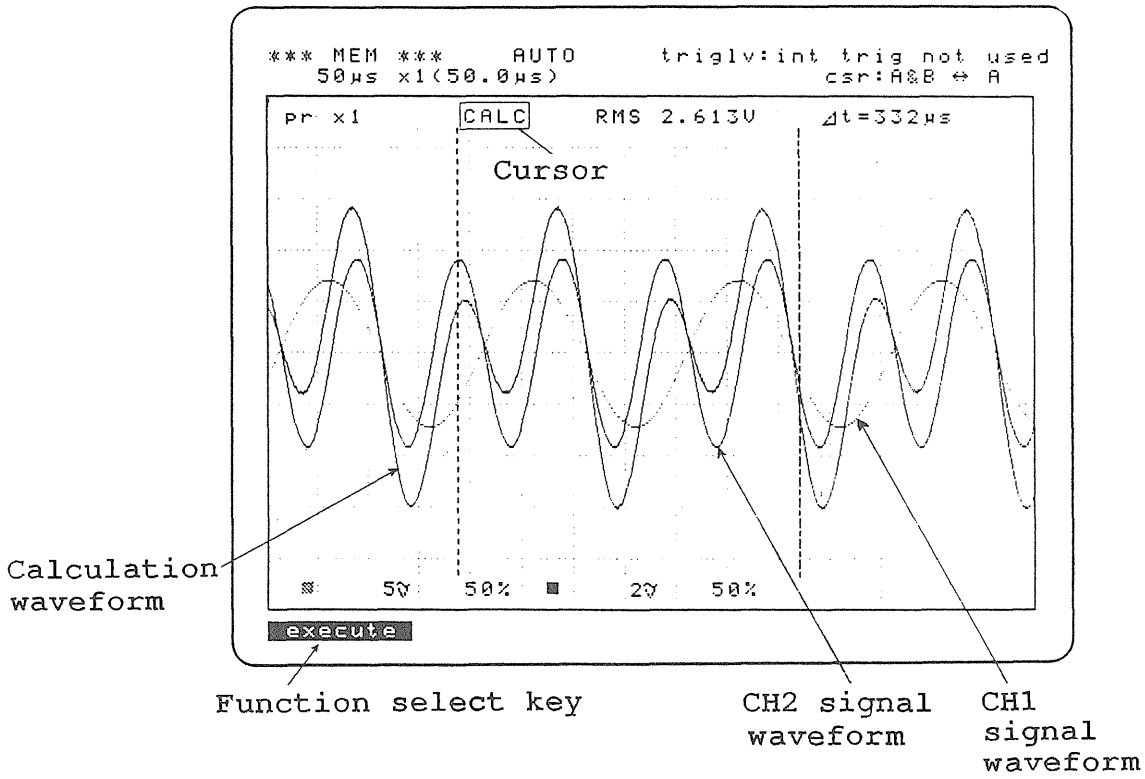
Notes:

- If signal waveforms for multiple channels are displayed on the screen, rms calculation will be done for the signal with the lowest channel number.
- When the potential or rms value is calculated, the result may reflect the input unit offset error (max. ±0.8%).
- With cursor read-out and rms calculation, calculations are performed based on the input range that is currently displayed.

* Input signal waveform arithmetic calculations
When calculation is on the status screen it is possible to perform arithmetic calculations between input signals for channels 1 and 2, with the output stored to channel 3 memory.

When calculation is set to on, CALC is displayed. Move the cursor to the CALC position, and press the "execute" function select key to perform rms calculation.

Arithmetic calculation example



Note: Calculation is performed each time the "execute" function select key is pressed. Calculation is not possible during operation, so the system must be stopped for calculation.

4.3.4 Printer operation

o Reprint function
By pressing the PRINT key it is possible to print any number of copies of a waveform from memory.

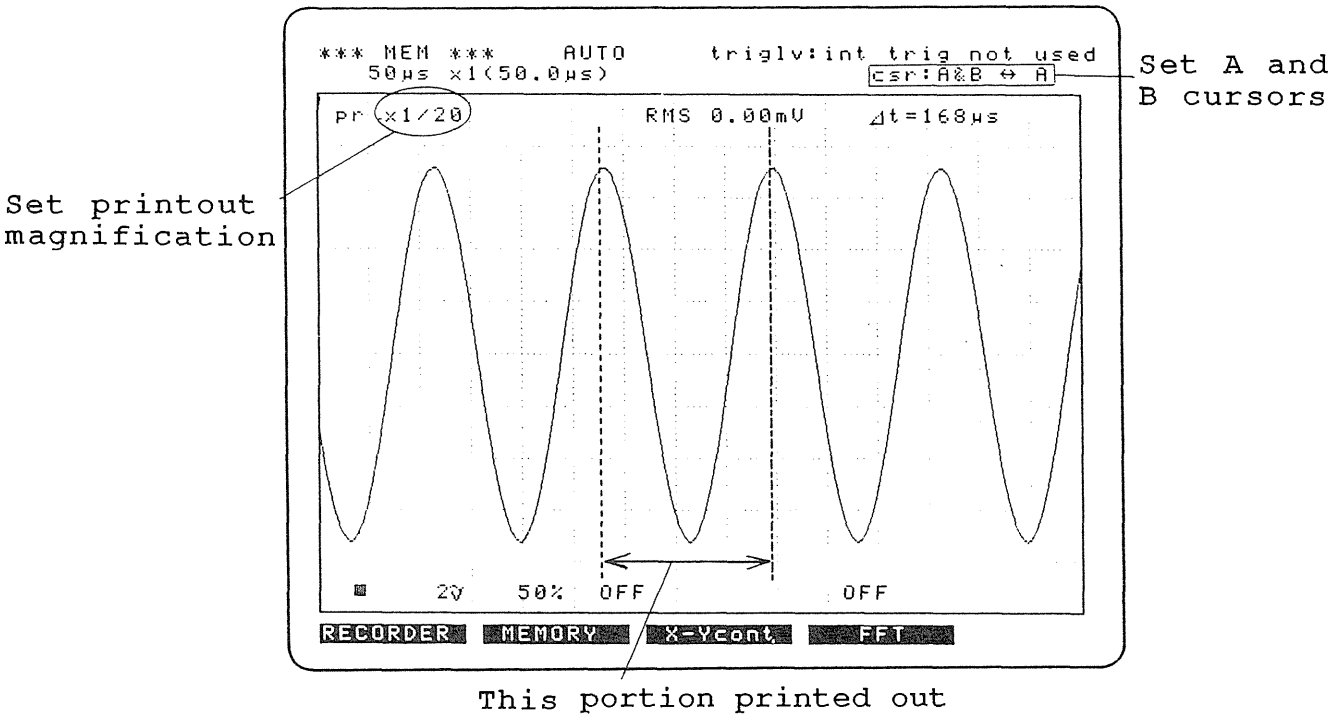
Note: The trigger mark is printed out as [▼].

o Partial print function
It is also possible to print out a selected portion of a waveform.

Operation
1) When A or A and B cursors are displayed
When the A cursor is displayed, the section of waveform from the A cursor to the end will be printed out.
When A and B cursors are displayed, the section of waveform between them will be printed out.
A and B cursor display positions are set with the display screen csr.

2) Set print magnification (enlargement and compression). Move the cursor to the pr position and set the magnification.

3) Press the PRINT key.

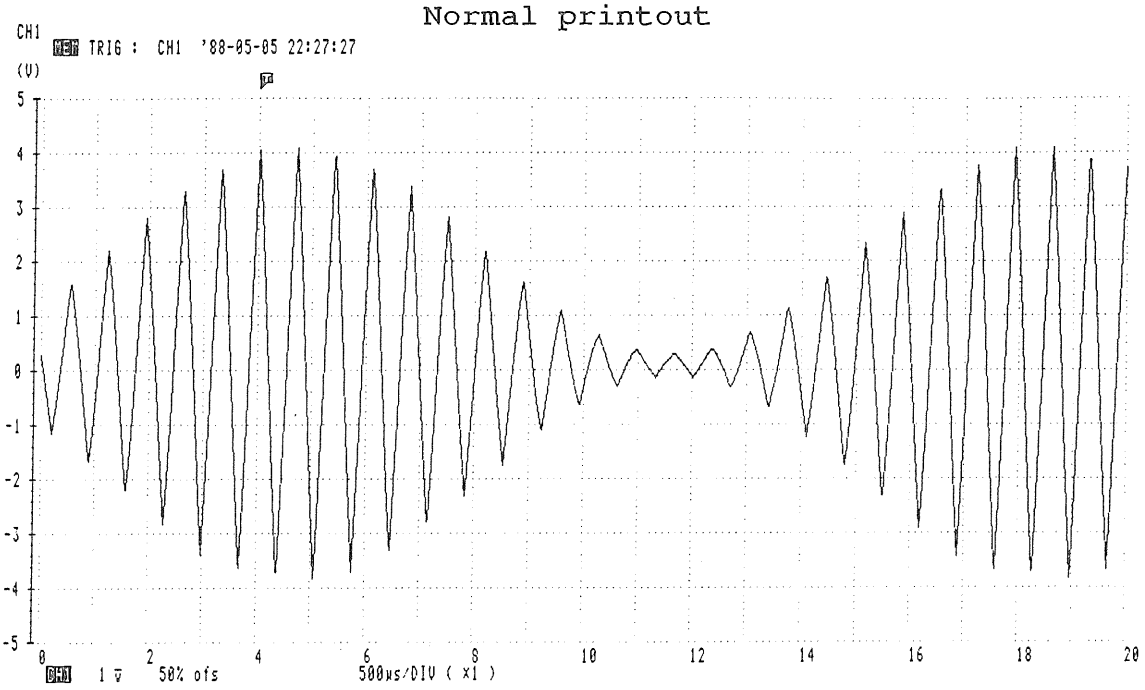


o Smooth print
By setting smooth print the printout will approximate an analog waveform.

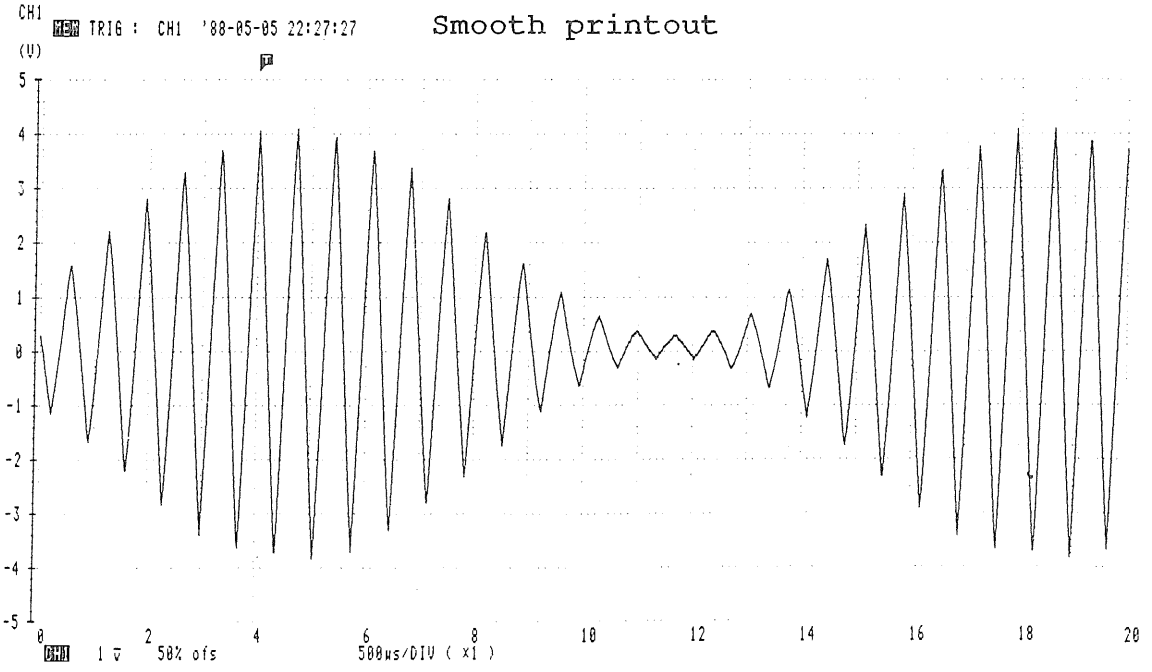
The smooth print selection is made by pressing the SMOOTH function select key on the status screen printer item.

Note: Smooth printouts take longer than normal printouts.

Normal printout



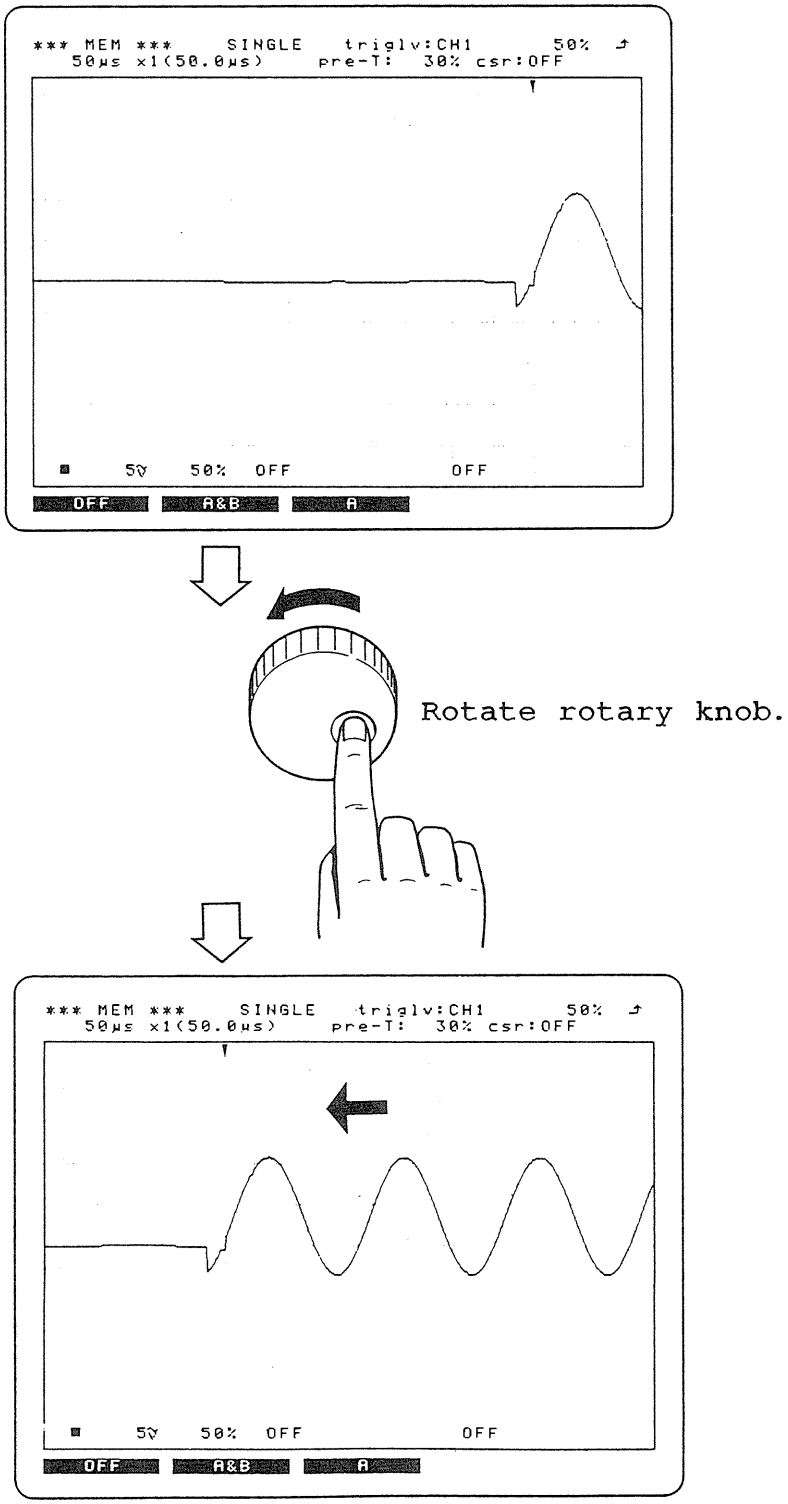
Smooth printout



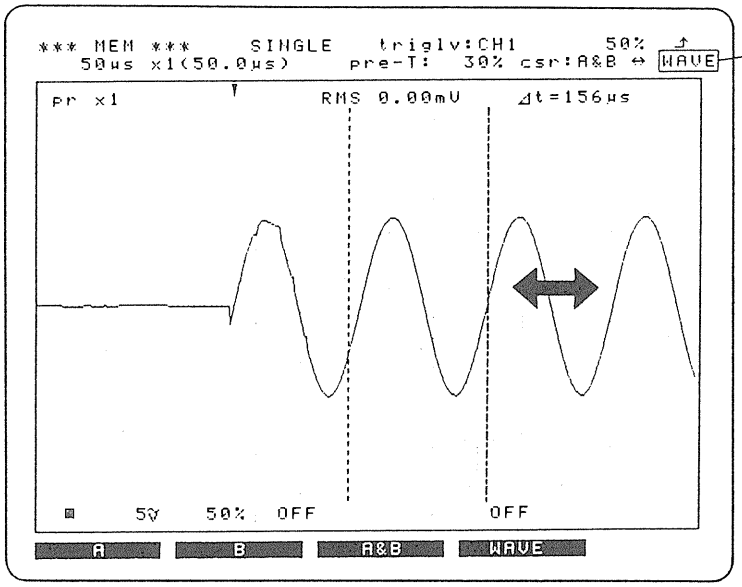
4.3.5 Waveform scroll function

Turning the rotary knob lets you scroll the waveform on-screen (after setting the SCROLL/VALUE key to SCROLL). Turning the knob rapidly activates the Auto scroll mode to automatically scroll the waveform.

Waveform scroll example
(1) Without A/B cursors
Rotating the rotary knob scrolls the waveform.



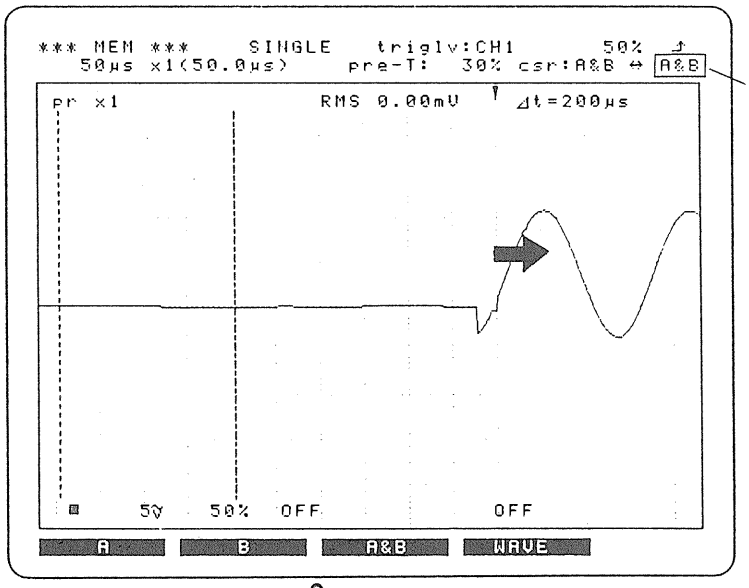
(2) With A/B cursors
Setting the system to WAVE allows waveform scroll.



Set to [WAVE]

Rotary knob scrolls waveform

(3) With A/B cursors (vertical cursor only)
For [A], [B] or [A and B] cursors, the rotary knob will move the cursors. When the cursors reach the edge of the display, the waveform will scroll.



Other than [WAVE]

When cursors reach edge of screen waveform scrolls.

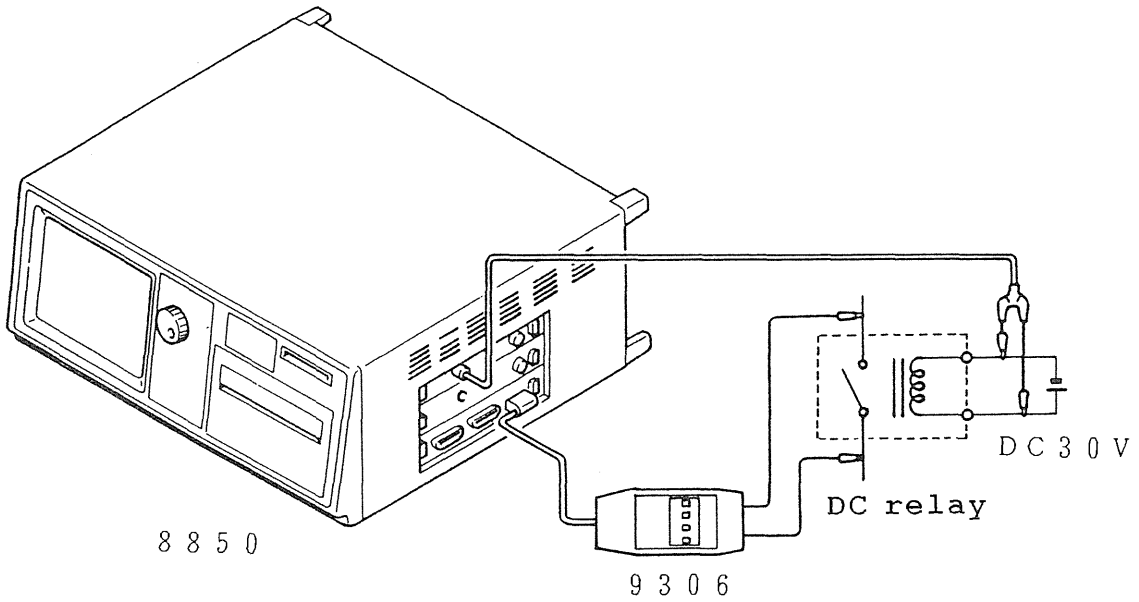
CAUTION

If waveform fits inside screen, if over-write is on, or if the waveform judgment function is on, waveform scroll is not possible.

MEM

4.3.6 Memory recorder operation examples

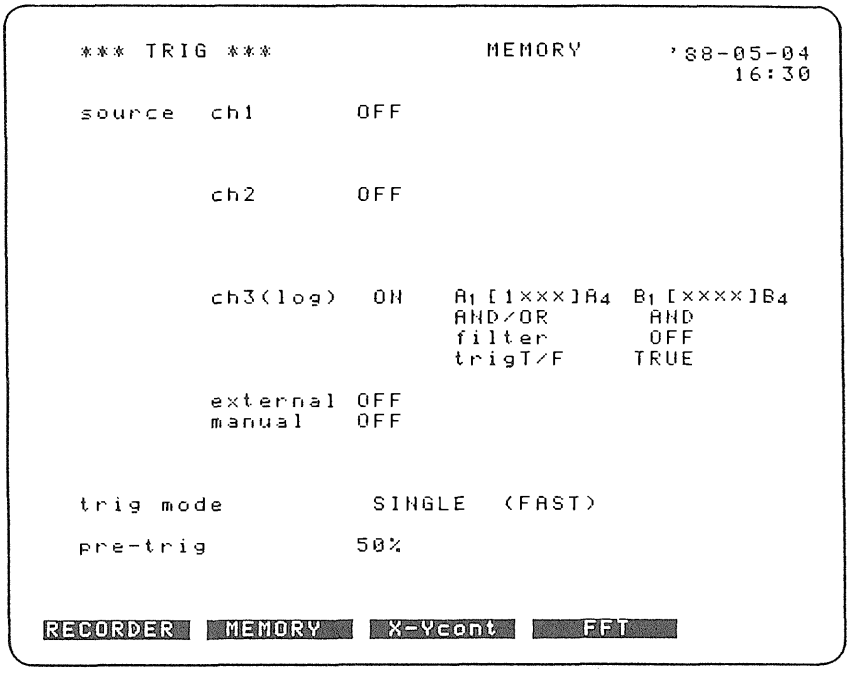
DC relay drive voltage and relay contact operation timing measurement.



1) Press the STATUS key, and set the measurement parameters on the STATUS screen as indicated below (all special functions are off).

```
***  STATUS ***              MEMORY        '88-04-28
                                              15:41
        time/div                2.5ms
        shot                   20 DIV

        format                 NORMAL
        grid                      ON

        printer    (NORMAL)       OFF
        list out                  OFF

        dot-line                LINE
        magnification              1
        over-write                OFF

              channel conditions
                    ch1       ch2*      ch3(log)
drawing             DARK      DARK        Ach

range(/div)          5V      200mV     (2.5V)
offset              10%        50%        -
coupling             DC         DC        -
filter              OFF        OFF        -

RECORDER  MEMORY  X-Ycont  FFT  SYSTEM
```

2) Press the TRIGGER key, and set trigger conditions as indicated below.
The trigger is activated when the 9306 logic probe 1CH (A-1) contact closes (change from 0 to 1).



3) Connect the 9306 logic probe CH1 to the contact side, the logic unit A' to the connector, and CH1 to the relay output.

4) Press the START key to enter the trigger wait state. When the relay goes on the waveform will be input and displayed.

. Try waveform enlargement, compression and scroll.

. Press the PRINT key to print out the full waveform.

. Use the cursors to measure the response time.

4.4 Recorder function and operation

4.4.1 Recorder function

(1) Realtime continuous recording possible.

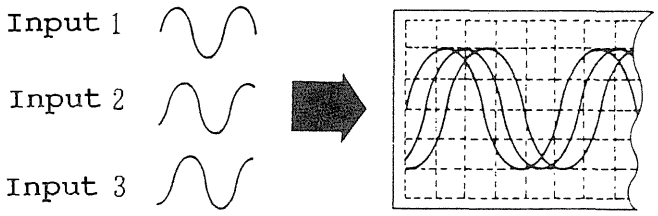
(2) Records all channels on the same time axis. Signals can be drawn overlapped to clarify the relation between them.

(3) Chart speed can be set to any of 13 steps from 400 msec/DIV to 1 hour/DIV. Speeds of 400 and 500 msec/DIV are printer output only, without screen monitoring.

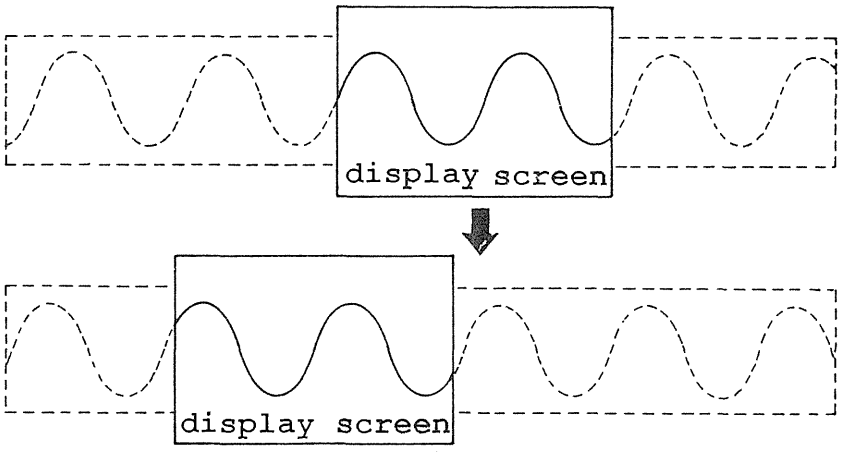
(4) High-speed sampling
High-speed sampling maximum if 8kHz, and the minimum 2kHz, to measure complete envelopes.

(5) Waveform scroll
Along with realtime continuous recording, the memory allows you to scroll back up to 95 divisions, including the current one.

(6) High-quality (smooth) print
Smooth print function generates a high-quality waveform image that closely approximates the analog input for chart speeds of 1 sec/DIV through 1 hour/DIV.



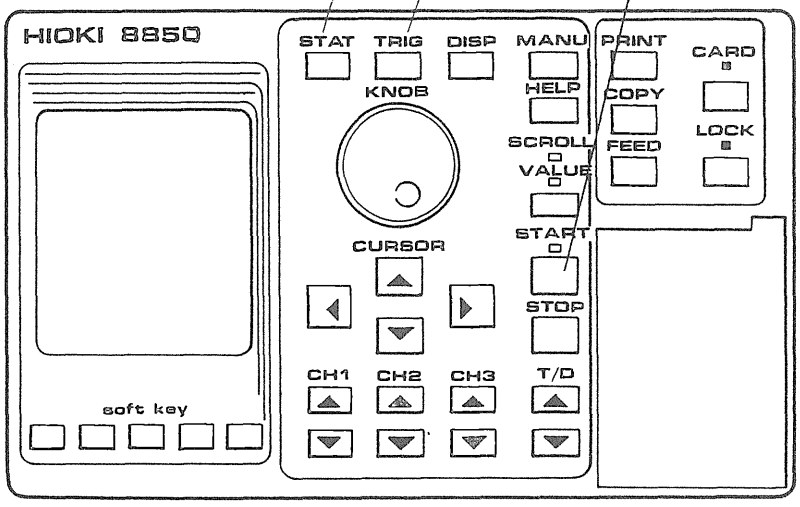
3-channel simultaneous recording

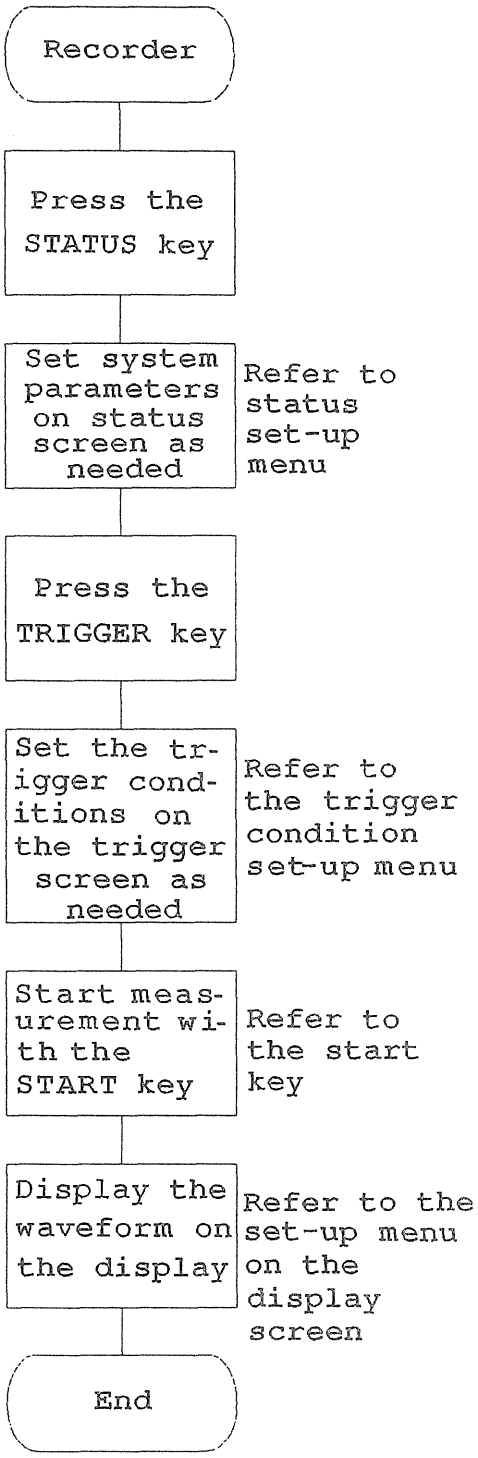


waveform scroll

4.4.2 Outline of recorder operation

(1) Basic operation
The flowchart for the basic operation is indicated below.

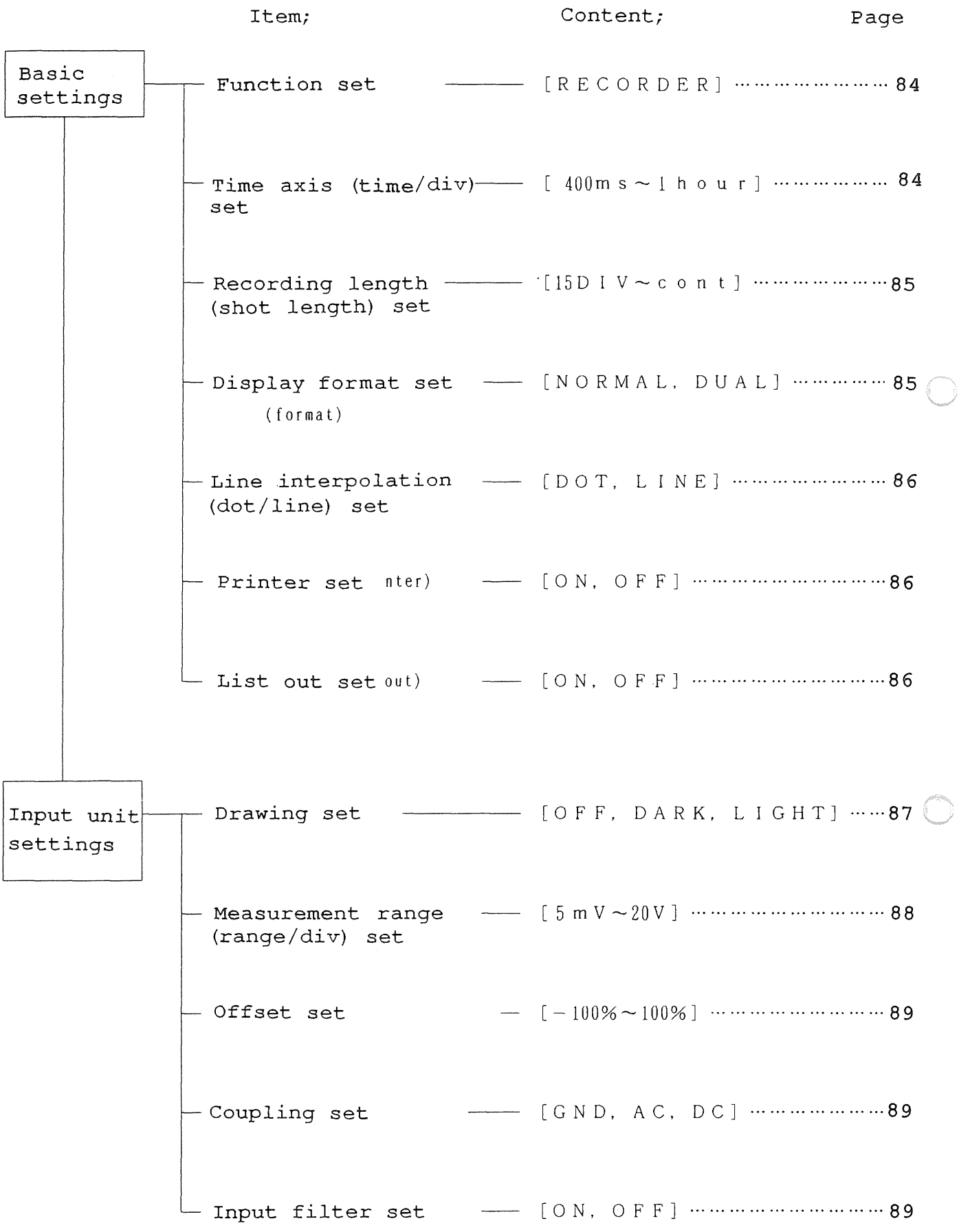




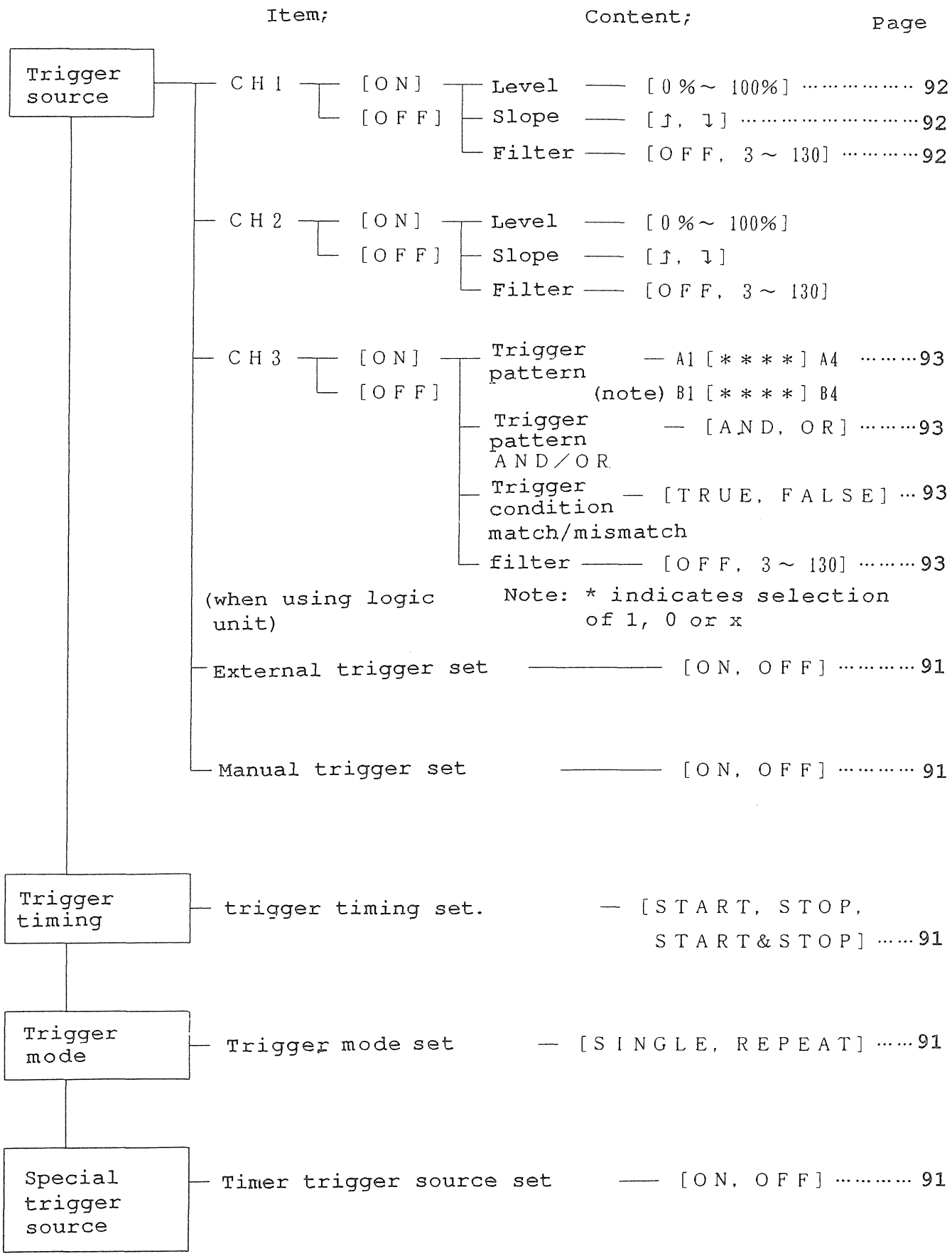
Basic Operation Flowchart

REC

(2) Status set-up menu

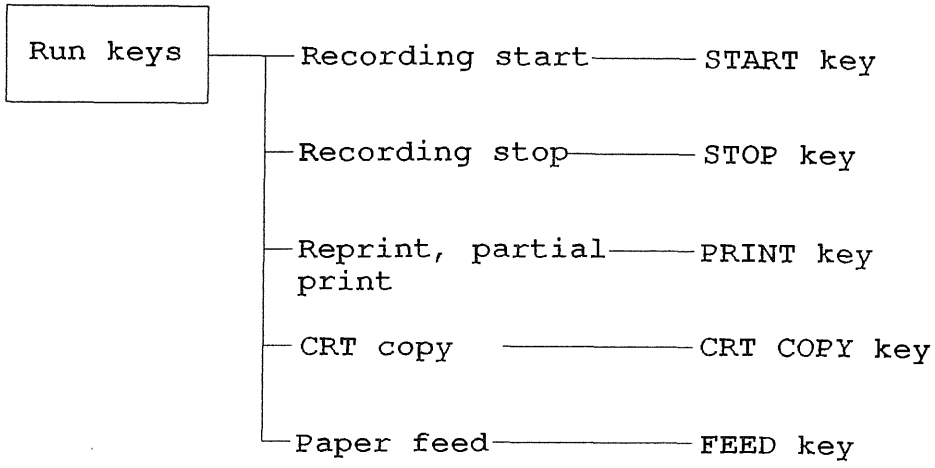


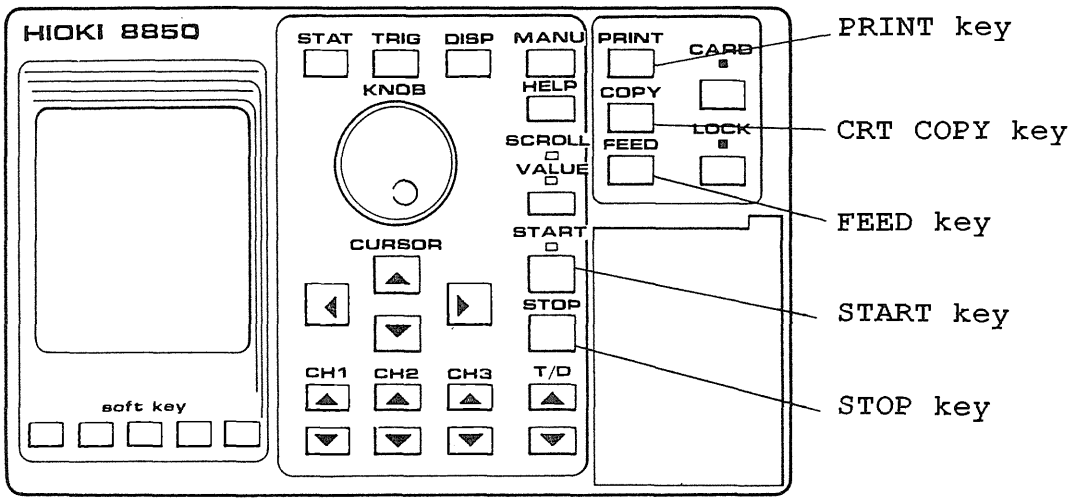
(3) Trigger condition set-up menu



REC

(4) Run keys


Run keys
Recording start
START key
Recording stop
STOP key
Reprint, partial print
PRINT key
CRT copy
CRT COPY key
Paper feed
FEED key


HIOKI 8850
STAT
TRIG
DISP
MANU
KNOB
HELP
SCROLL
VALUE
CURSOR
START
STOP
CH1
CH2
CH3
T/D
soft key
PRINT
CARB
COPY
LOCK
FEED
PRINT key
CRT COPY key
FEED key
START key
STOP key

(5) Display screen set-up menu

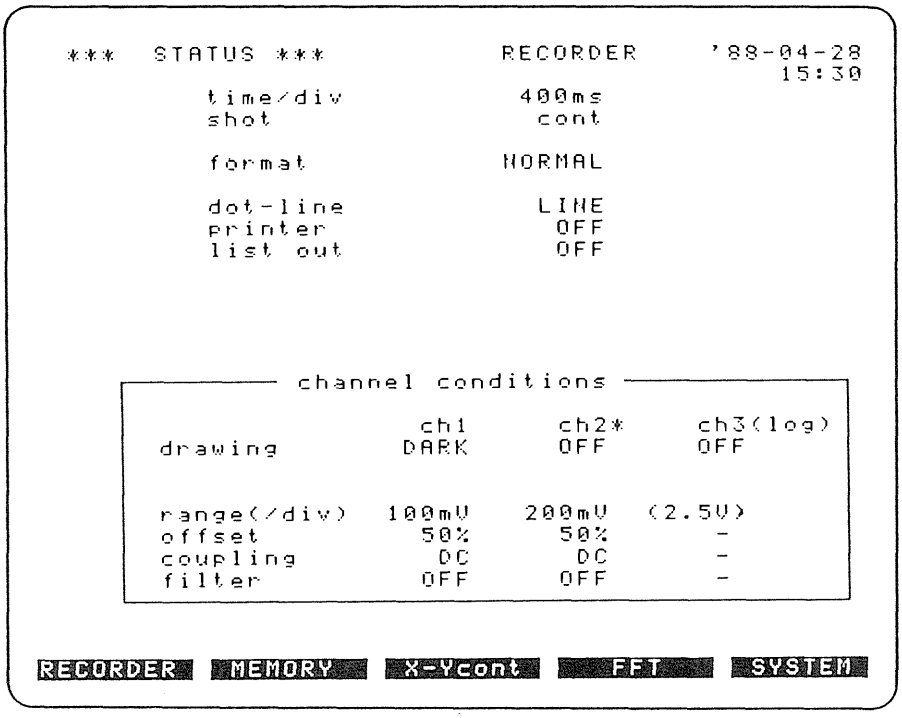
Settings that can be changed during operation	Item;	Content;	Page
	Time axis	[400ms～1hour]	95
	Trigger source	[CH1, CH2, CH3]	94
	Trigger level	[0%～ 100%]	95
	Trigger slope	[↑, ↓]	95
	Trigger mode	[SINGLE, REPEAT]	94
	Printer operation	[ON, OFF]	95
	Drawing set	OFF ■ (DARK) ▨ (LIGHT)	98
	Measurement range	[5mV～20V]	98
	Coupling type	V⏚ (GND) Ṽ (AC) V̄ (DC)	98
	Offset	[－100 %～ 100%]	98
	A/B cursor display	[OFF, A, A&B]	96

REC

4.4.3 Recorder parameters and operation

(1) Status screen

Pressing the STATUS key causes the status screen to appear. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys. Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).



Status screen

* Basic settings

- o [RECORDER] - Sets the measurement function, and shifts to status screens of other functions. (This can be used to set RECORDER, MEMORY, XYcont, FFT, and SYSTEM).

- o [time/div] - Sets the speed with which the input signal waveform is read in, expressed as the time required by a single division.

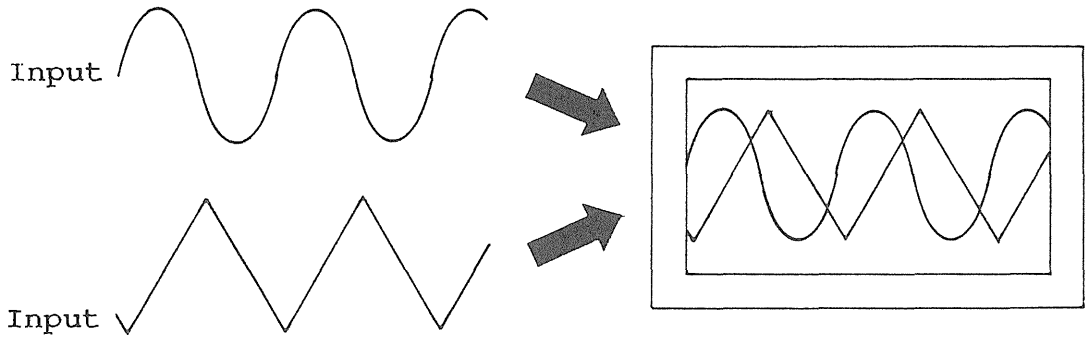
> ⚠CAUTION:
> Settings of 400 or 500 msec/DIV will be printed out only, without CRT monitor display.

o shot - Sets the recording length of a single operation.
(15 DIV - 600 DIV, cont)
o cont - Recording will be continued until the [STOP] key is pressed.
o format - Sets the display format for the input signal waveform.

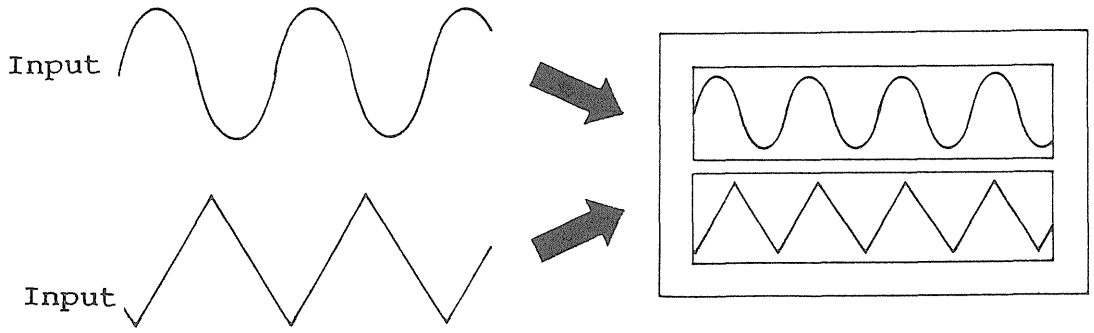
[NORMAL] - Displays the waveform on a single screen. Overlap display is possible for multiple waveforms.

[DUAL] - Divides the screen into upper and lower screens for waveform display. Waveforms from multiple channels can be displayed individually.

Input NORMAL display
Input DUAL display



NORMAL display



DUAL display

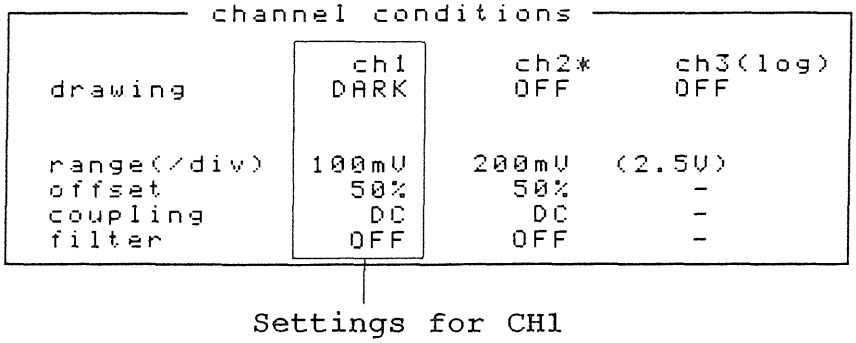
REC

o dot-line - Sets the line interpolation for the measurement signal points.
    ON: Line interpolation for an easy-to-read display.
    OFF: No line interpolation for a display the accurately reproduces sampled data.

o printer - Determines printer use during operation.
    ON: Printer is used. Input waveform is read, and printed out.
    OFF: Printer is not used.

o list out - Determines print out of setting parameters
    ON: Prints out the setting parameter list after the waveform.
    OFF: No printout of parameters.

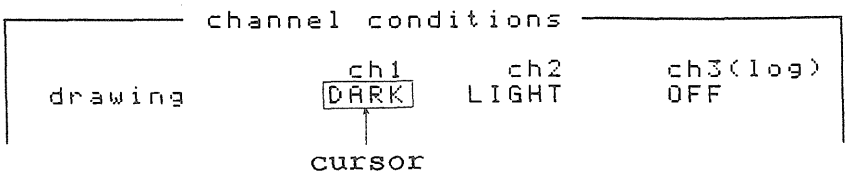
* Input unit setting (channel conditions)



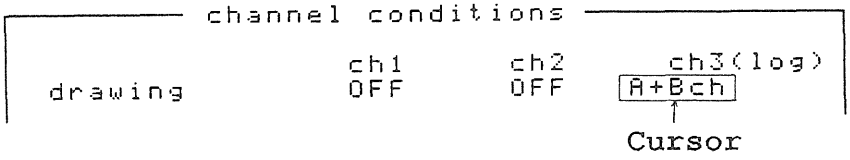
Note: * indicates an analog unit (isolation type), and (log) a logic unit.

o drawing - Sets the display of the input signal waveform.

. When an analog unit is used and format is NORMAL:
[OFF]: No waveform display
[DARK]: Waveform displayed dark
[LIGHT]: Waveform displayed light



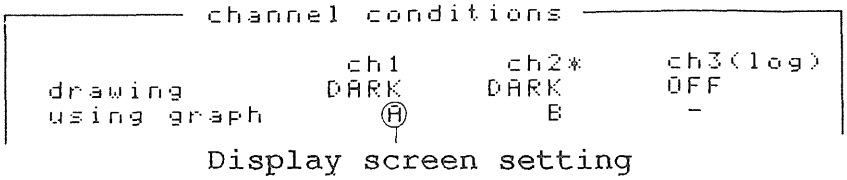
. When a logic unit is used the setting is handled for each four logic waveform channels.
[OFF]: No logic waveform display
[Ach]: Displays the 4-channel logic waveform for logic probe A.
[Bch]: Displays the 4-channel logic waveform for logic probe B.
[A+Bch]: Displays total of eight logic channel waveforms, composed of logic probes A and B.

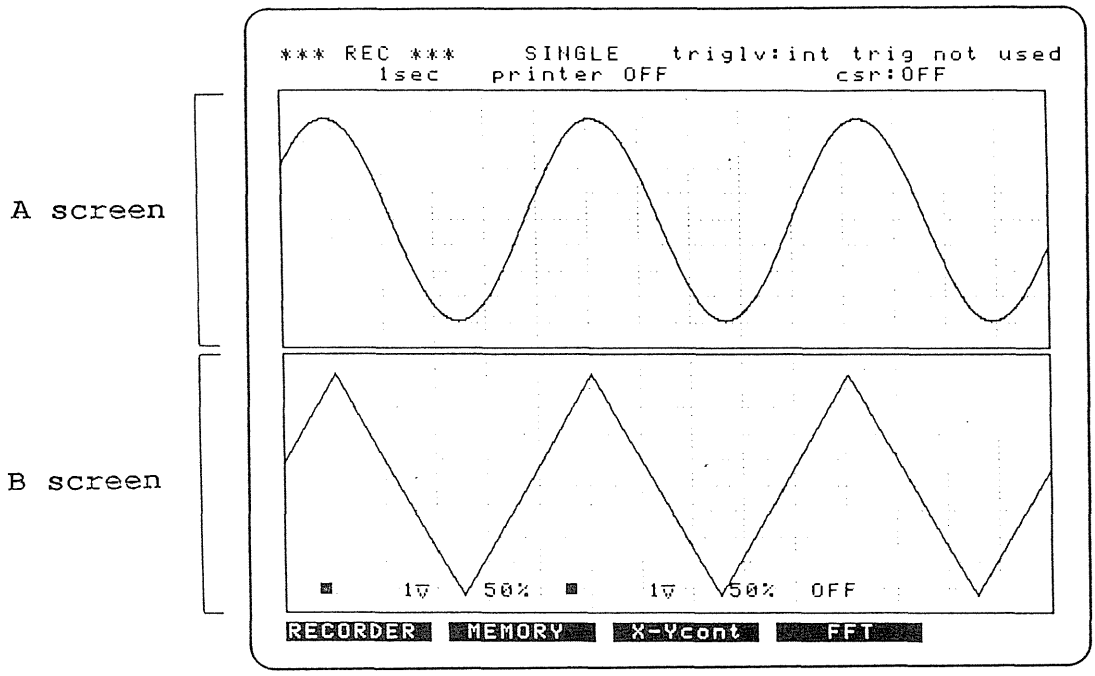


Note: When using an analog unit and format is DUAL, the drawing setting and the using graph setting are both required.

o using graph - Sets whether the input signal waveform is displayed on the upper or lower screen.
[A]: Displayed on the A (upper) screen
[B]: Displayed on the B (lower) screen

CAUTION:
When the display mode is set to DUAL, there is no difference between DARK and LIGHT displays.





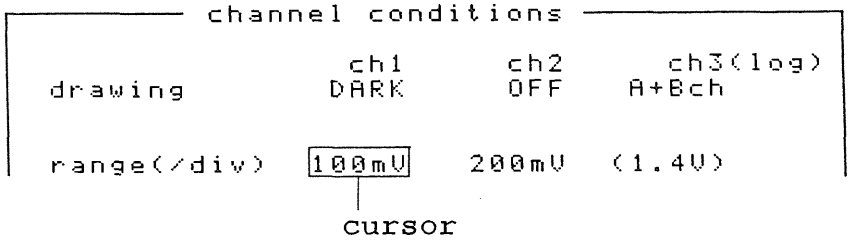
o range (/div) - Sets the measurement range. This can be set with the function select key and the RANGE key for each channel.

Sets one division on the vertical axis to 100mV.

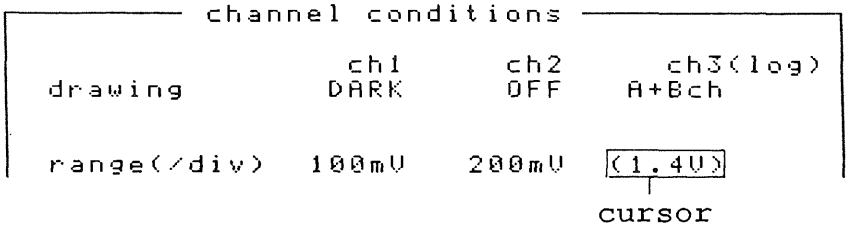
Note: The range for the analog unit (high-speed type) is 5mV to 5V, and for the analog unit (isolation type) is 5mV to 20V. When the gain adjustment knob is moved the "<" symbol will appear, as: <5mV.

Sets the threshold to discriminate between input logic signal HI and LO at 1.4V. The usable range is -6.3V to +6.3V, in 0.1V steps.

Analog unit



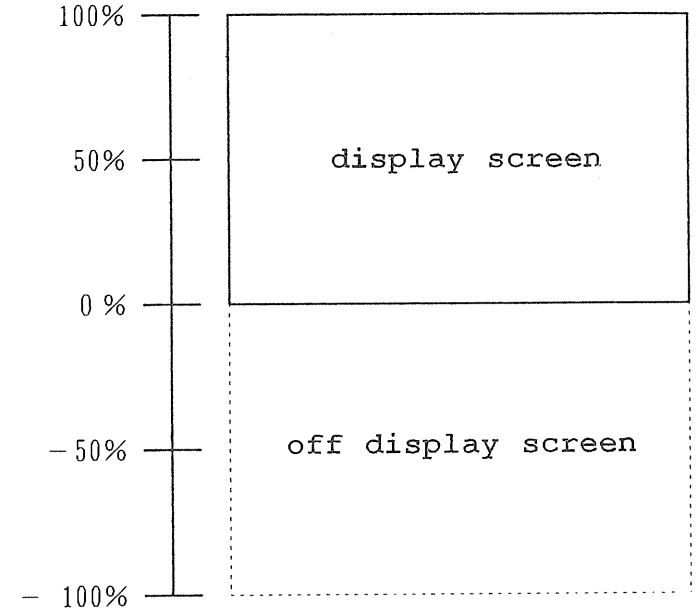
logic unit



o offset - Sets the input signal zero position

[10%]: The input signal zero position is set to 10% of the displayed portion. The usable range is 0 to 100%, in 1% steps.

[-10%]: The input signal zero position is set to -10% of the displayed portion. The usable range is 0 to -100%, in 1% steps.



(zero position)

o coupling - Sets the input coupling

[GND]: No input signal connected. Zero position can be checked.

[AC]: Capacitor coupled in series. DC component of input signal cut, and only AC component measured.

[DC]:: input terminal directly connected to amplifier for measurement of DC component.

o filter - Input unit internal low-pass filter set.

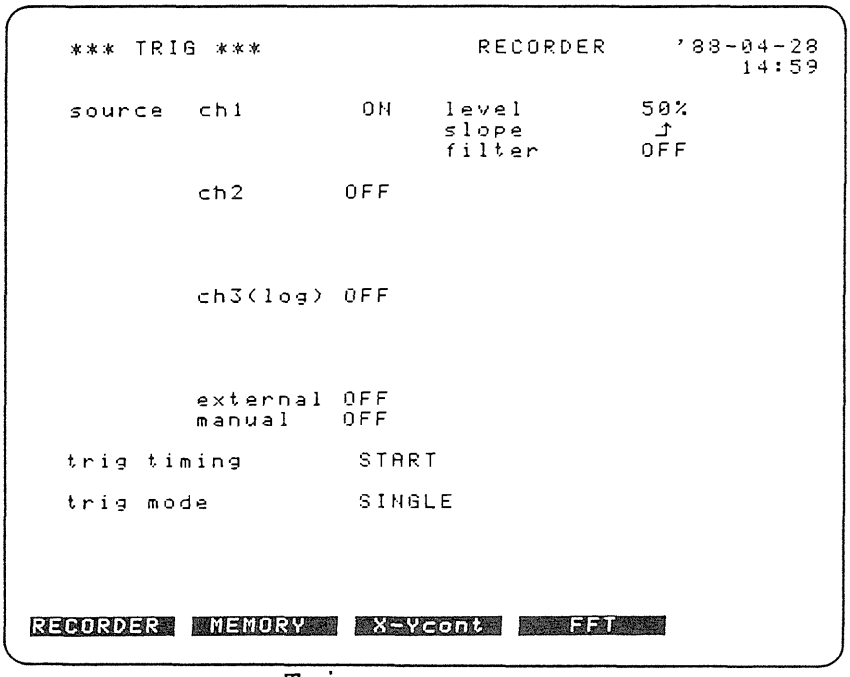
[ON]: Low-pass filter used (cutoff frequency is about 5Hz).

[OFF]: Low-pass filter is not used.

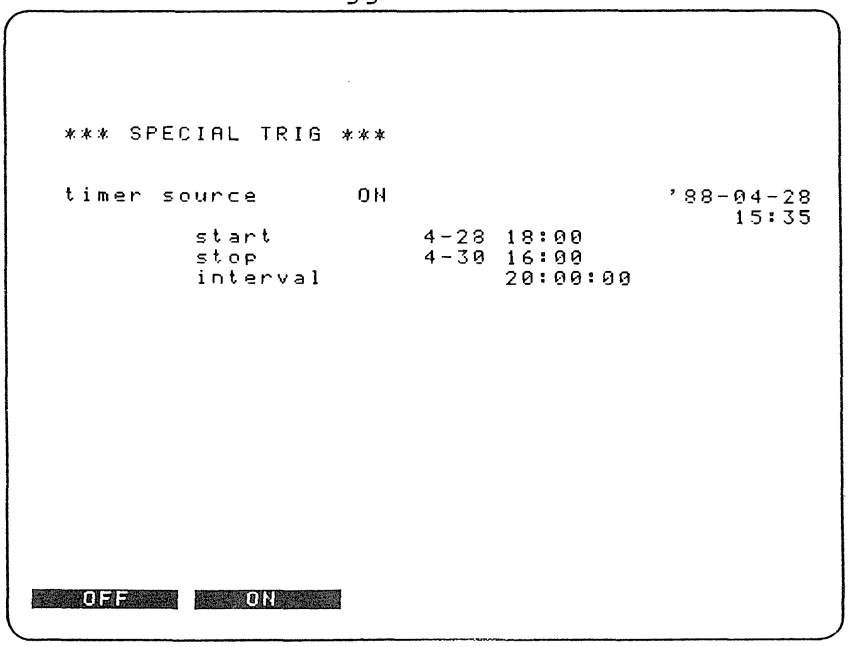
(2) Trigger screen

Pressing the TRIGGER key switches to the trigger set screen. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys . Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special trigger screen is displayed by scrolling the screen, or by holding down the down cursor key.



Trigger screen



Special trigger screen

o RECORDER - Sets the measurement function, and switches to other function trigger screens (setting possible for RECORDER, MEMORY, XYcont, and FFT).

o source [CH1], [CH2], [CH3] - Sets trigger to input signal from channel 1~3 respectively. Set to on to use.

[external] - Trigger set to signal from external trigger input terminal. Turn ON to use.

[manual] - Activates the trigger when the MANU key is pressed. Turn ON to use.

Note: When multiple trigger sources are on the trigger will be activated by any of them.

If all trigger sources are off, the trigger will be activated by pressing the START key.

o trig mode - Sets the trigger mode.
[SINGLE]: Only the first trigger after the START key is pressed is enabled.
[REPEAT]: System will be activated by every trigger.

Note: If recording length is set to cont, REPEAT has no significance.

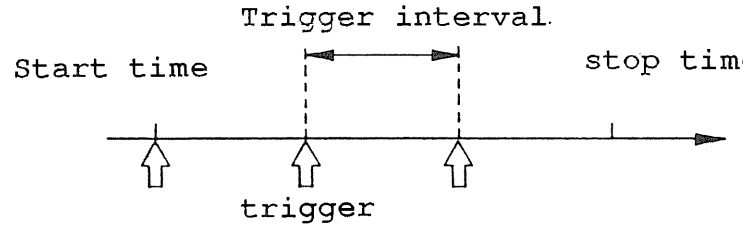
o trig timing - Sets trigger timing.
[START]: Starts recording from the point the trigger is activated.
[STOP]: Starts recording from the point the START key is pressed, and stops it when the trigger is activated.
[START&STOP]: Records when trigger conditions are met (trigger is active).

o timer source - Sets the timer trigger.
[ON]: Trigger is set to on from the specified start time through the specified stop time, at the specified interval.

When the interval is "00:00:00", the trigger will activate only one time, at the start time.

[OFF]: Timer trigger does not activate.

```
timer source        ON

        start           4-27  12:45
        stop            4-27  13:45
        interval              00:01:15
```



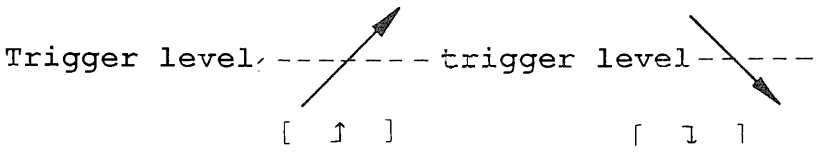
Note: Start time and stop time are only valid if specified for times after the point the START key is pressed. When the trigger mode is SINGLE, recording will only occur when the start time is reached, regardless of the set interval.

* Internal trigger setting when analog unit used

```
source  ch1         ON    level         50%
                          slope          ⤴
                          filter        OFF
```

o level - Sets the trigger level.
[50%]: This threshold value is compared to the input value, expressed as a percent of the full scale recording width, which is taken as 100%. Settings from 0% to 100% are possible.

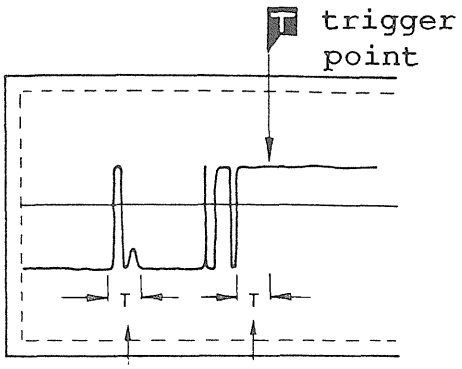
o slope: Sets trigger slope.
[⤴]: Trigger is activated when input signal passes the threshold value as a positive edge.
[⤵]: Trigger is activated when input signal passes the threshold value as a negative edge.



o filter - Sets the trigger filter.
[OFF]: No filter operation.
[3]: Sets the sampling value (3, 4, 6, 10, 18, 34, 66, 130) to x. If the trigger conditions are inverted within the set time a trigger will be activated.

Note: Sampling rate is 125 usec to 500 usec.

Example: When the trigger is set to the input signal, this function prevents triggering due to excessive noise.



Trigger conditions invert within time T, and no trigger is activated

Trigger is activated even though trigger conditions do not invert within time T.

* Internal trigger set for logic unit

```
ch3(log)   ON    A1 [xxxx]A4  B1 [xxxx]B4
                 AND/OR         AND
                 filter         OFF
                 trigT/F      TRUE
```

Set for channels 2 and 3, which support logic units.

o Trigger pattern
  A1 [xx01] A4 B1 [x11x] B4:
  The logic pattern compared to the input logic single is expressed with 1, 0 and X. 1 indicates HI, 0 indicates LO, and X indicates don't care.

  Discrimination between 1 and 0 is handled by the signal detection logic probe. HI/LO level threshold values are set with respect to the status screen input unit.

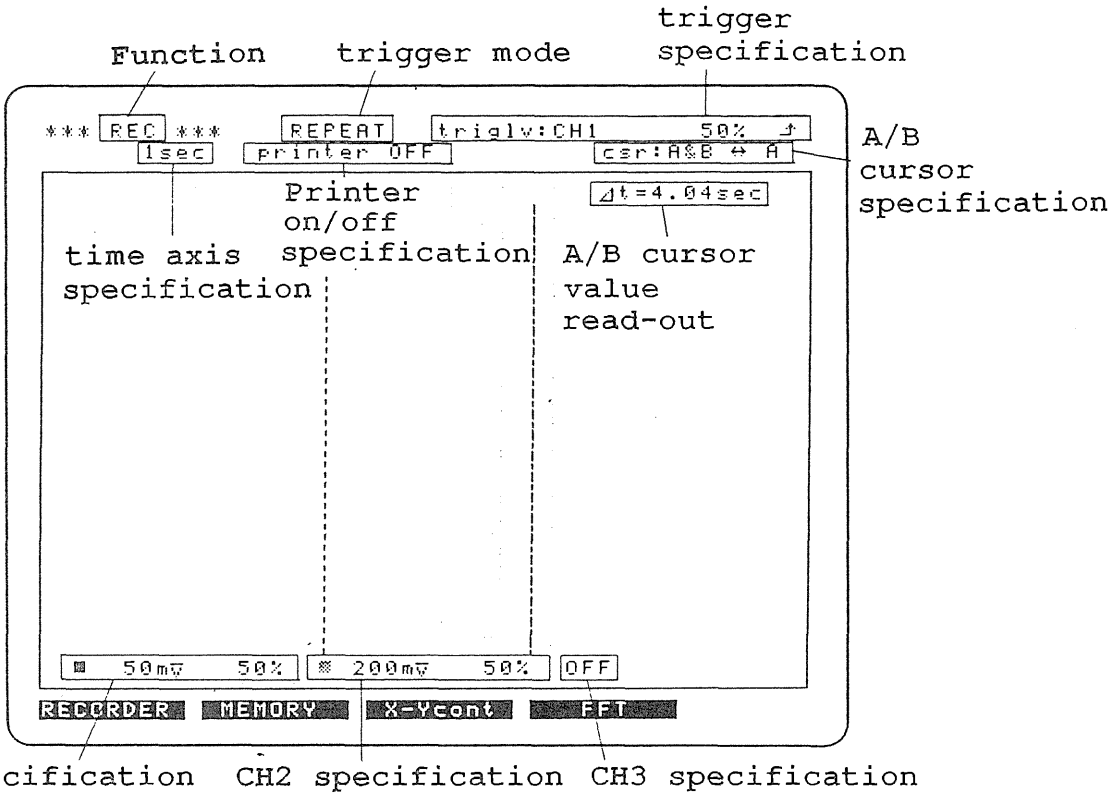
o AND/OR: Sets trigger pattern AND and OR
  [AND]: Trigger activated when all specified trigger patterns match.
  [OR]: Trigger activated if even one specific trigger pattern matches.

o trig T/F: Sets logic trigger condition match/mismatch.
  [TRUE]: Trigger activated when trigger pattern and AND/OR trigger conditions met.
  [FALSE]: Trigger activated when trigger pattern and AND/OR trigger conditions not met.

o filter: Sets the trigger filter. Setting is the same as for the analog unit.

(3) Display screen

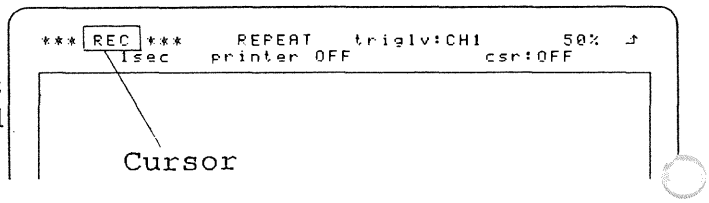
Display screen information



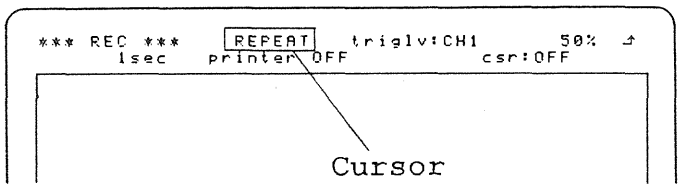
Critical settings for the trigger screen can also be handled through the status screen.

Refer to the sections on the status and trigger screens for details.

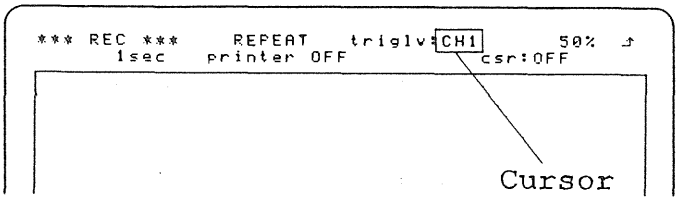
o [REC]: Selects the function. Can also switch to other function's status screen. (possible settings are RECORDER, MEMORY, XYcont, and FFT).



o [REPEAT]: Sets the trigger mode (possible settings are single, repeat).

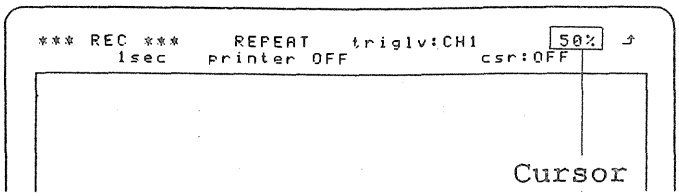


o [CH1]: Selects the trigger source as CH1, CH2 or CH3 (can be set to CH1, CH2, or CH3).

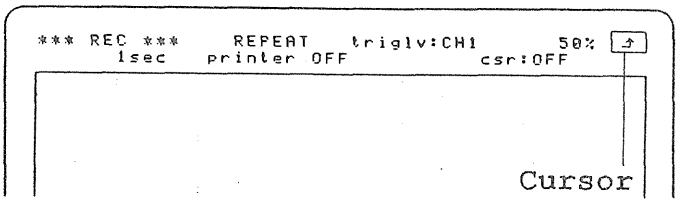


Note: Channel selection is not possible if a channel has been turned off as a trigger source on the trigger screen.

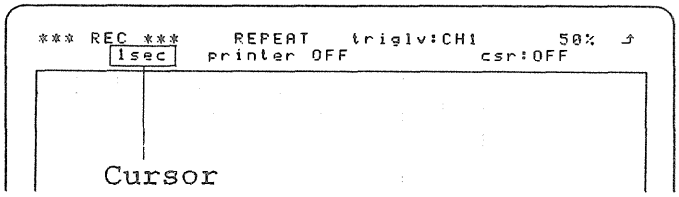
o [50%]: Sets selected trigger source trigger level from 0% to 100%.



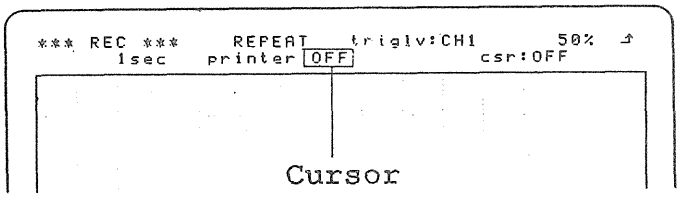
o [↑]: Sets slope for selected trigger source, either positive or negative.



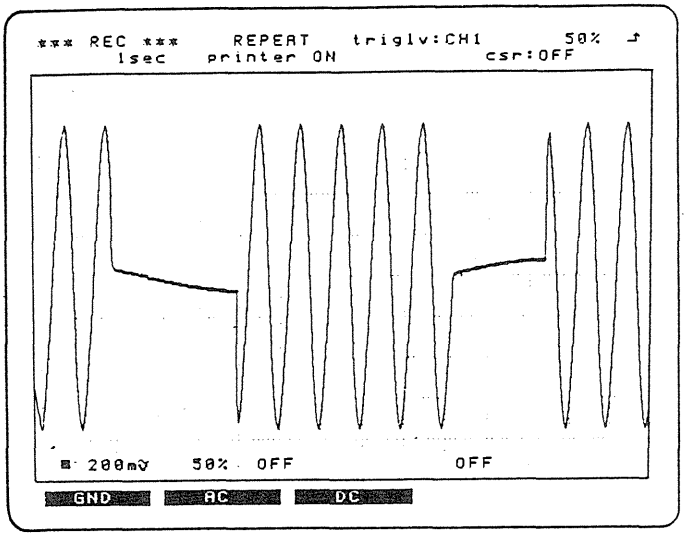
o [1sec]: Sets input speed (time/div) for input signal waveform from 400 msec to 1 hour.



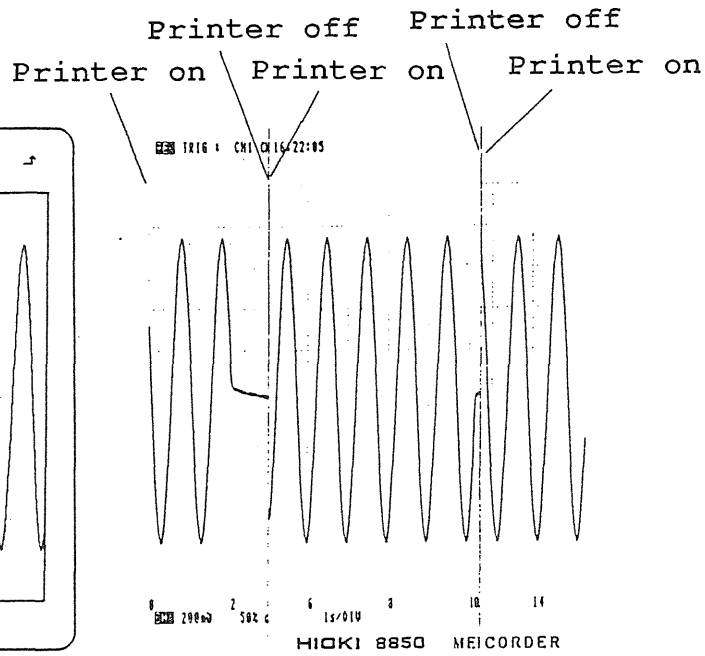
o Printer - Sets printer on/off. When the printer is on during operation, the recorded waveform will be printed out from the time waveform input starts.



It is also possible to monitor the waveform on the CRT screen, and print out essential portions. The printer can be turned on and off at any time with the PRINT key.



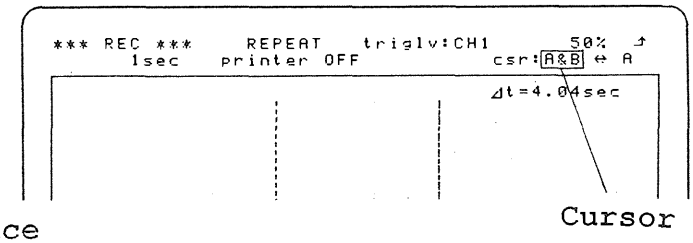
display screen



printer output

csr - Displays both A and B cursors on the display screen.
Can be used to determine voltage potential or time difference between input signal waveforms.

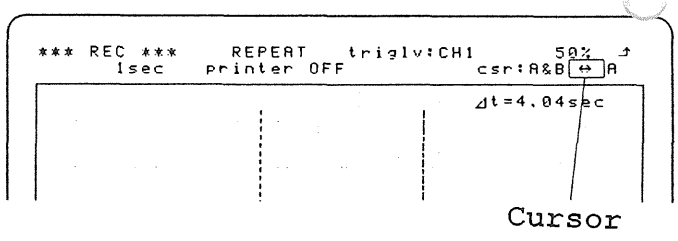
1) [OFF] - no cursor display
[A&B] - Displays both A and B cursors.
[A] - Displays only A cursor.



2) [↕]: Sets the horizontal display cursor. Voltage difference (Δ V) will be determined.

[↔ Δt]: Sets the vertical display cursor. Time difference (Δ t) will be determined.

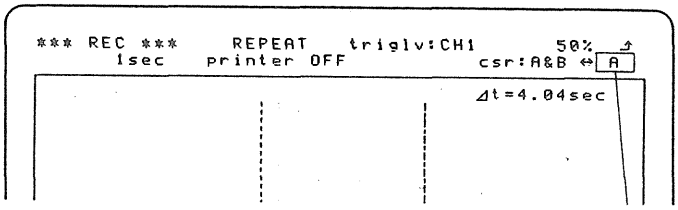
[↔ Δf]: Sets the vertical display cursor. Frequency (Δ f) will be determined. (Δ f) is determined as (1/ Δ t).



⚠ CAUTION:

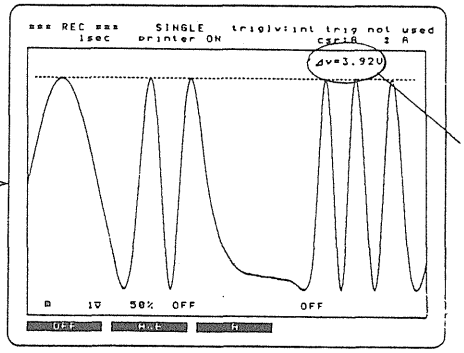
For vertical display [↔], the A cursor alone cannot be displayed.

3) [A]: Turning the rotary knob will move the A cursor.
[B]: Turning the rotary knob will move the B cursor.
[A&B]: Turning the rotary knob will move both A and B cursors at once.
[WAVE]: Turning the rotary knob will scroll the input signal waveform horizontally.

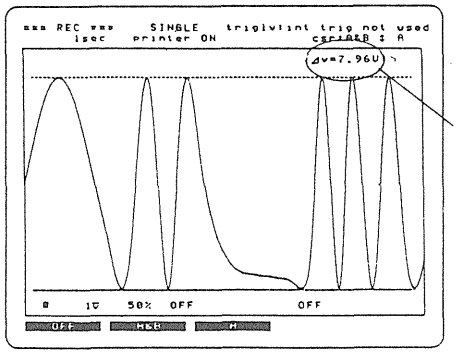


Note: Set the SCROLL/VALUE key to SCROLL when using the rotary knob.

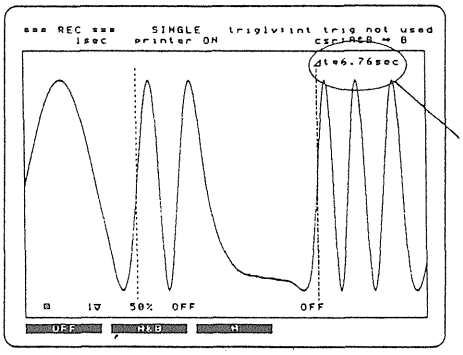
Example of cursor calculation
1) In csr:A↕, the voltage potential (Δ V) from the input signal zero position is determined.



2) In csr:A&B↕ the time difference (Δ t) between the A and B cursors is determined.



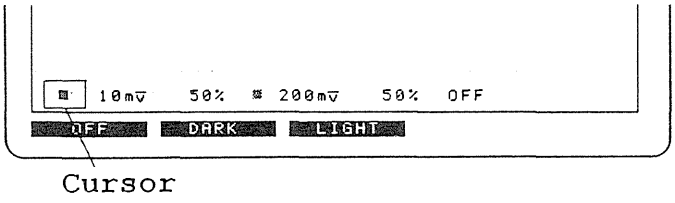
3) In csr:A&B[↔], the time difference (Δ t) or frequency difference (Δ f) between the two cursors is determined.



REC

* For analog units:

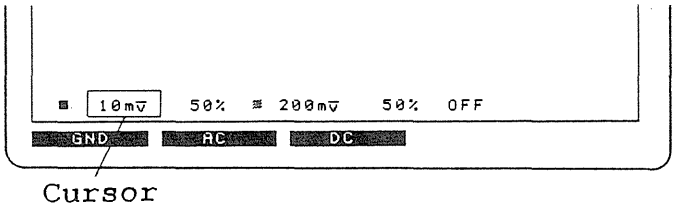
o [■]: Sets the input signal waveform display to OFF, ■ or ▨.



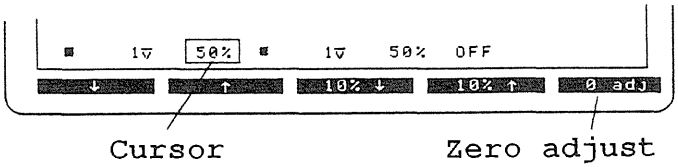
Note: [■] is DARK, [▨] is LIGHT.

o [10mV̄]: Sets the measurement range and input junction.
V indicates DC.

[V ⏚] indicates [GND]
[Ṽ] indicates [AC]
[V̄] indicates [DC]



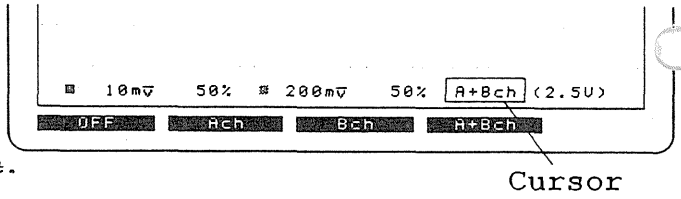
o [50%]: Sets the offset for the input signal from -100% to 100%.



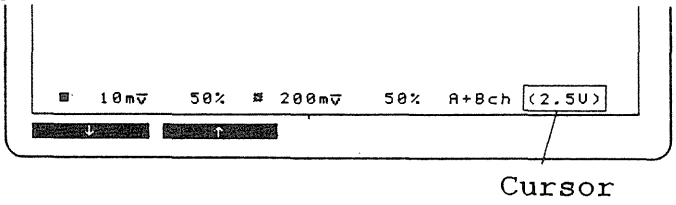
Pressing the [0adj] function select key executes calibration to the offset value.

* When logic unit is used

o [A+Bch] Sets the display for four logic waveform channels at a time. Possible settings are OFF, Ach, Bch, and A+Bch.



o [(2.5V)] Sets thresholds for input signal HI and LO levels. Settings are possible from -6.3V to 6.3V.



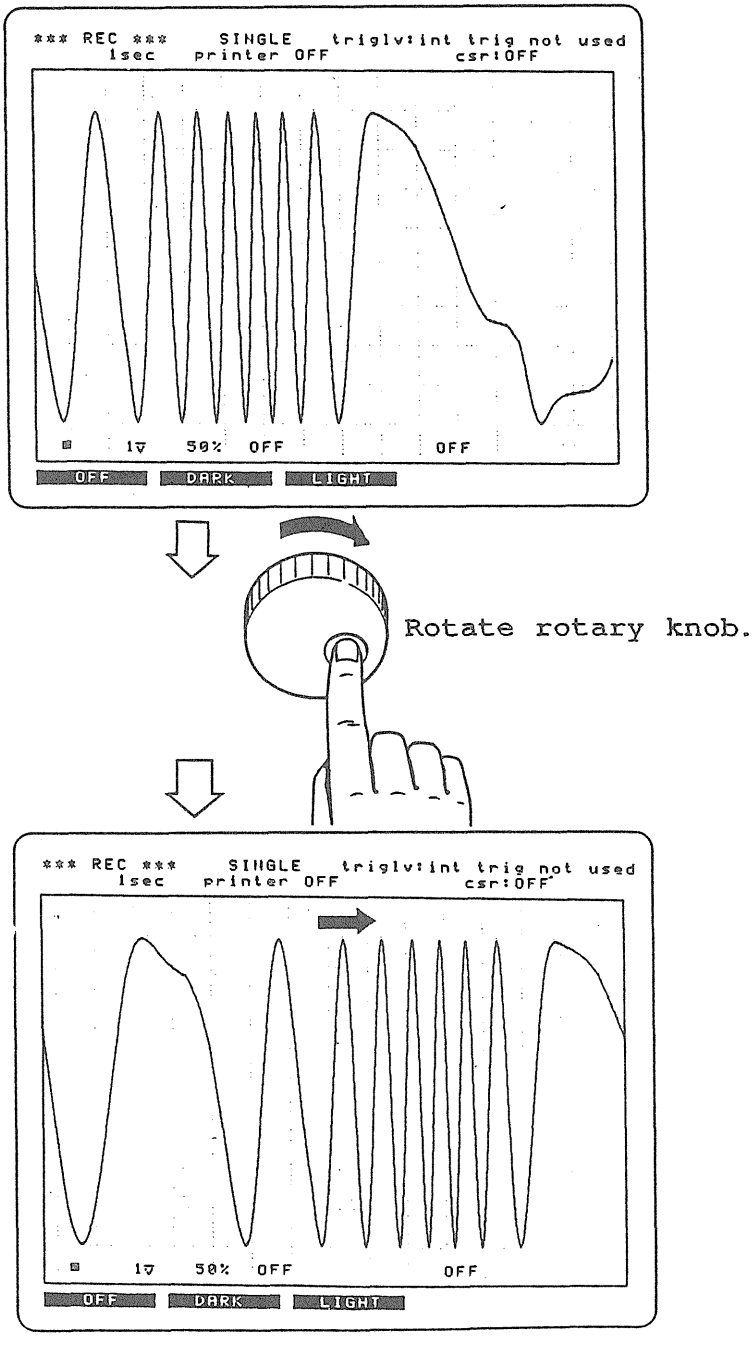
4.4.4 Reverse scroll function

Along with continuous realtime recording functions, the 8850 can also store up to 95 divisions before the current one. This means that the signal waveform can be scrolled over this entire 95-division length.

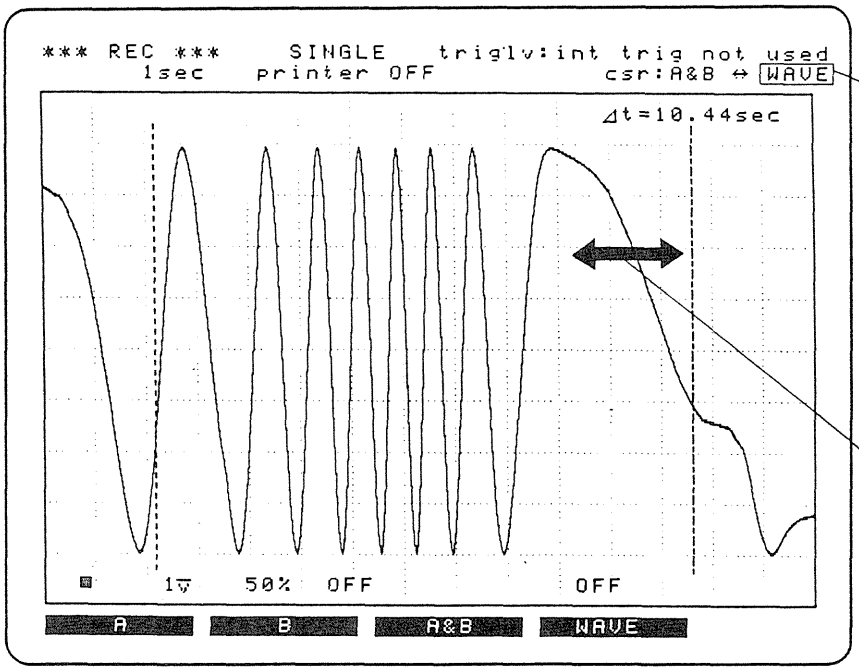
Turning the rotary knob lets you scroll the waveform on-screen (after setting the SCROLL/VALUE key to SCROLL). Turning the knob rapidly activates the Auto scroll mode to automatically scroll the waveform.

Waveform scroll example

(1) Without A/B cursors
Rotating the rotary knob scrolls the waveform.



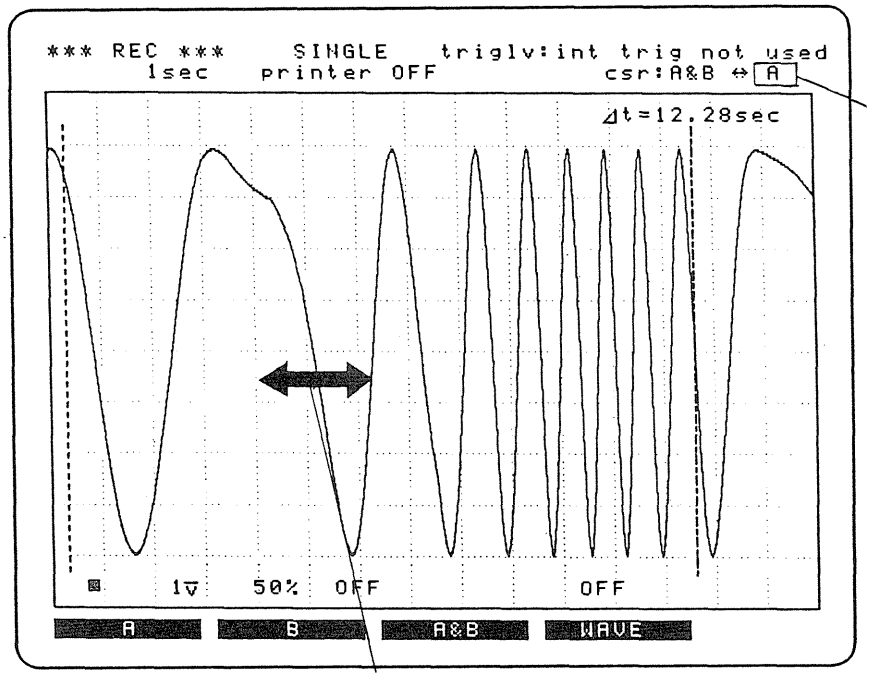
(2) With A/B cursors
Setting the system to [WAVE] allows waveform scroll.



Set to [WAVE]

Rotary knob scrolls waveform

(3) With A/B cursors (vertical cursor only)
For A, B or A and B cursors, the rotary knob will move the cursors. When the cursors reach the edge of the display, the waveform will scroll.

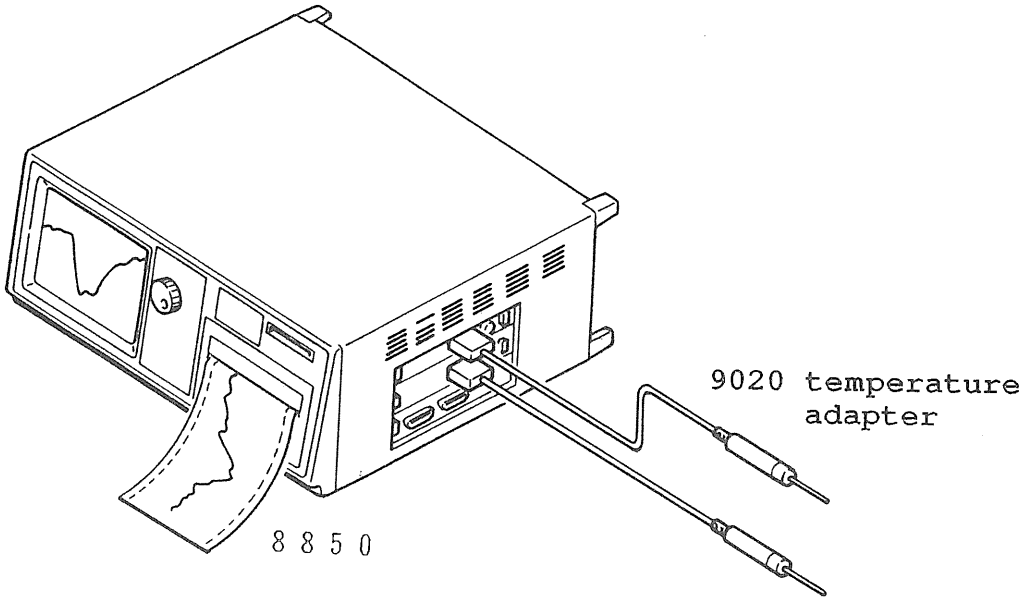


Other than [WAVE]

When cursors reach edge of screen waveform scrolls.

4.4.5 Recorder operation examples

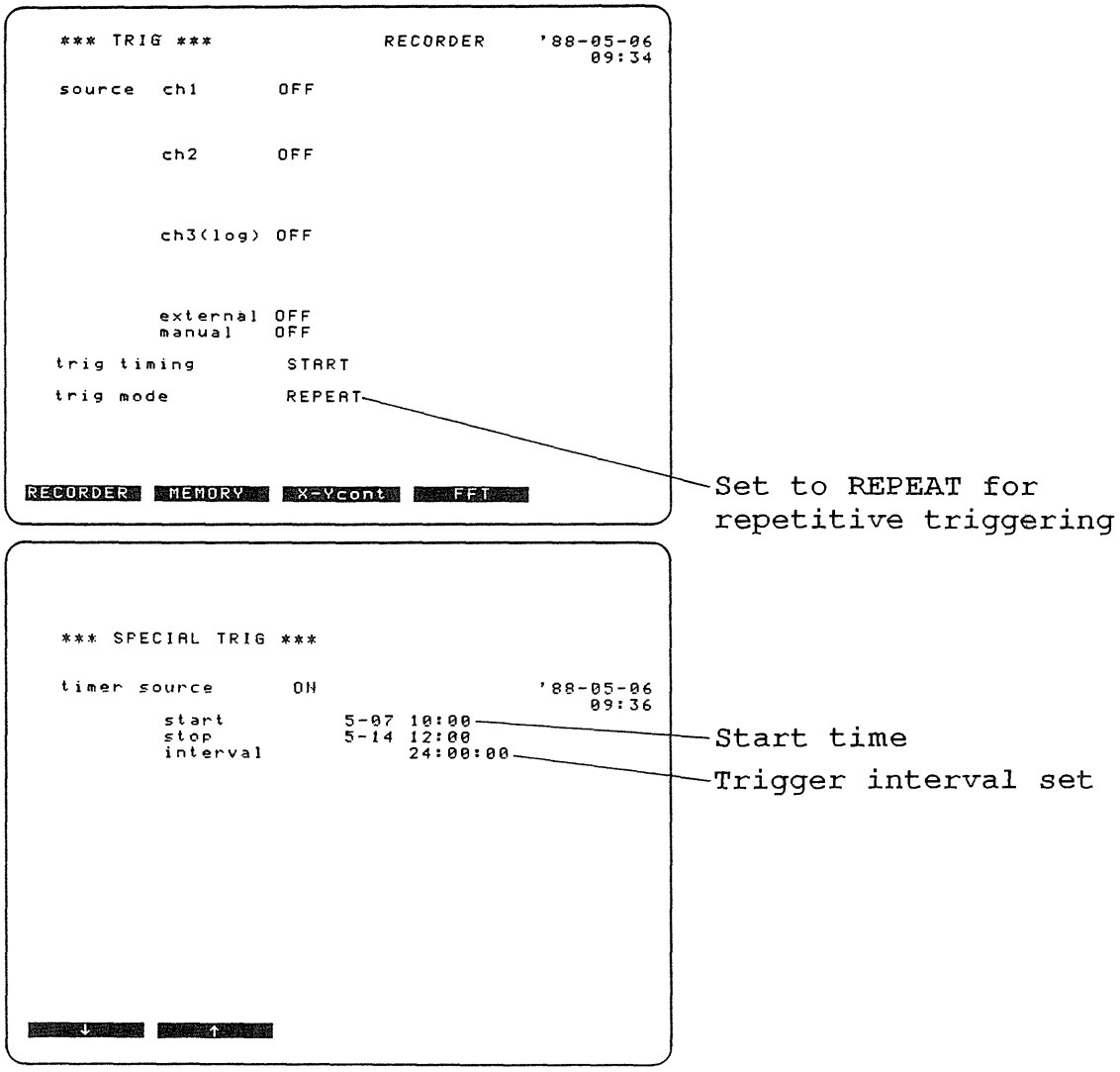
o Using a temperature adapter, record the temperature change each day for a fixed period of time starting at 10:00.



1) Press the STATUS key, and set the measurement parameters on the STATUS screen as indicated below. The 5-hour recording is handled at (1 min/DIV x 300 divisions).

```
***  STATUS ***              RECORDER      '88-05-06
                                            09:34
        time/div                1min
        shot                 300 DIV

        format               NORMAL

        dot-line               LINE
        printer                  ON
        list out                 OFF


        channel conditions
                        ch1*      ch2*      ch3(log)
        drawing         DARK      DARK        OFF

        range(/div)     20mV      20mV    (2.5V)
        offset           50%       50%       -
        coupling          DC        DC       -
        filter            ON        ON       -

   OFF        ON
```

2) Press the TRIGGER key, and set trigger conditions as indicated below. The start time is 10:00 each day.



3) Press the START key to start recording. Temperature variation for a five hour period every day from 10:00 will be recorded.

4.5 X-Y recorder function and operation

4.5.1 X-Y recorder function

(1) XY synthesis for pairs of channels just as with conventional XY recorders.

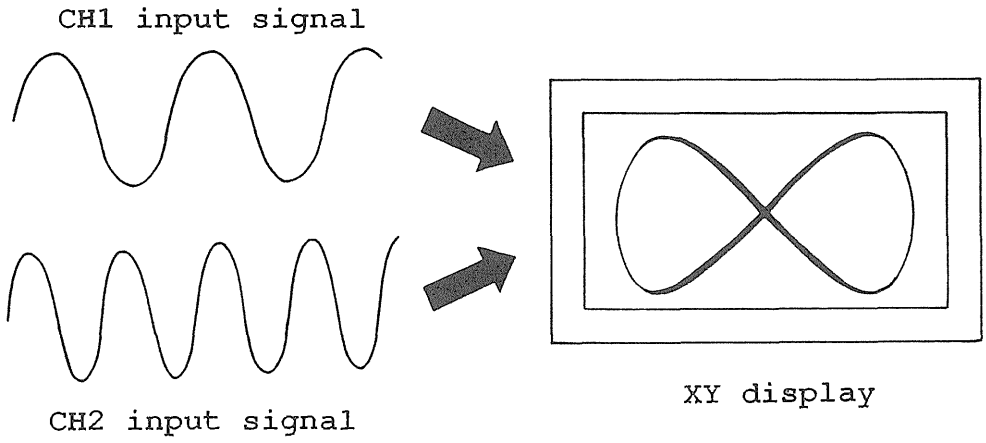
(2) Unlike the memory recorder XY function, the time axis waveforms of each channel are not stored.

(3) XY synthesis waveforms are stored.

(4) CH1 is X, and CH2 and CH3 are Y.

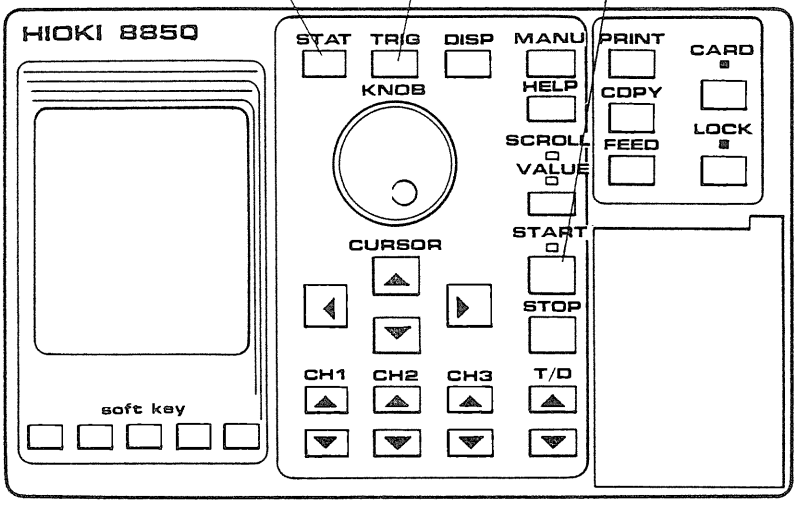
(5) Maximum recording speed is 8.0kHz for dot and line, and minimum is 80Hz.

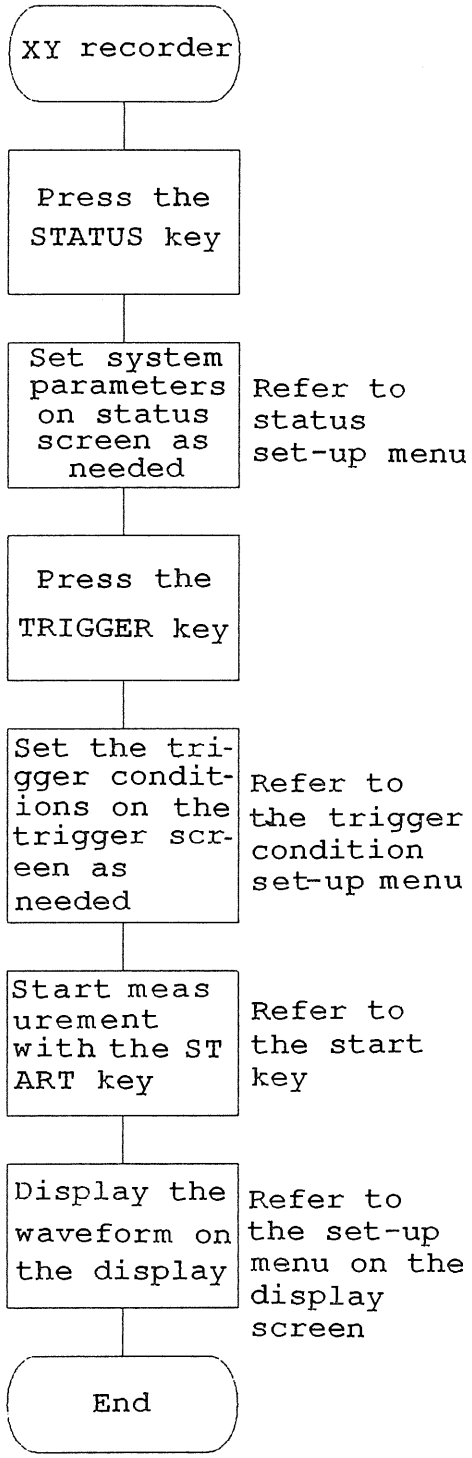
(6) Infinite recording time
Infinite recording is possible, just like conventional XY recorders.



4.5.2 Outline of X-Y recorder operation

(1) Basic operation
The flowchart for the basic operation is indicated below.



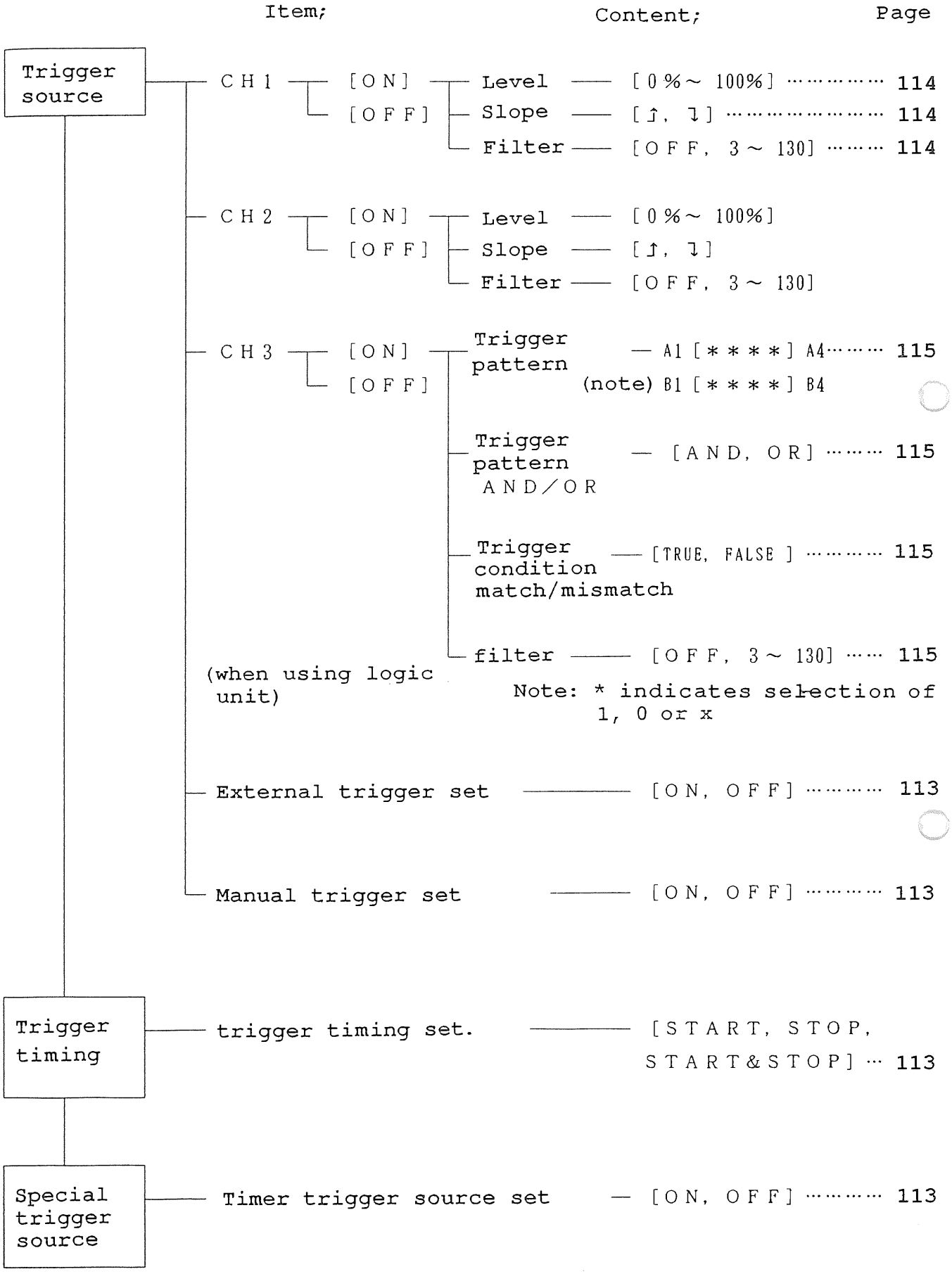


Basic Operation Flowchart

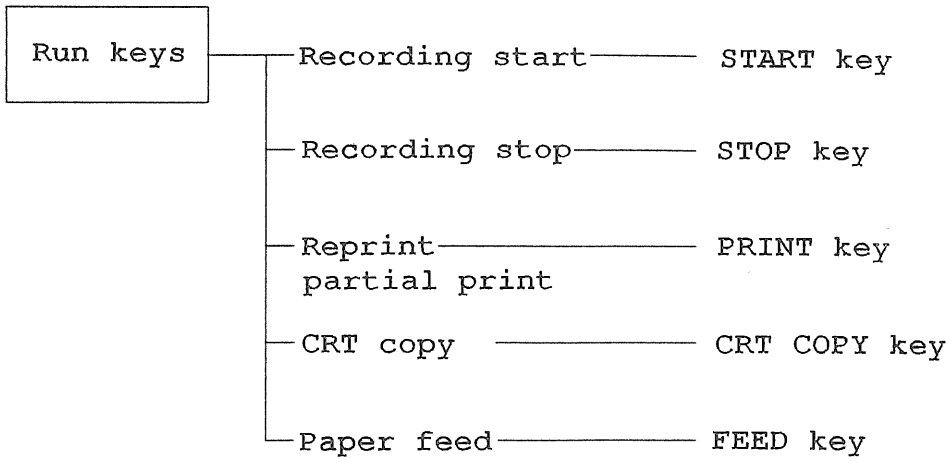
(2) Status set-up menu

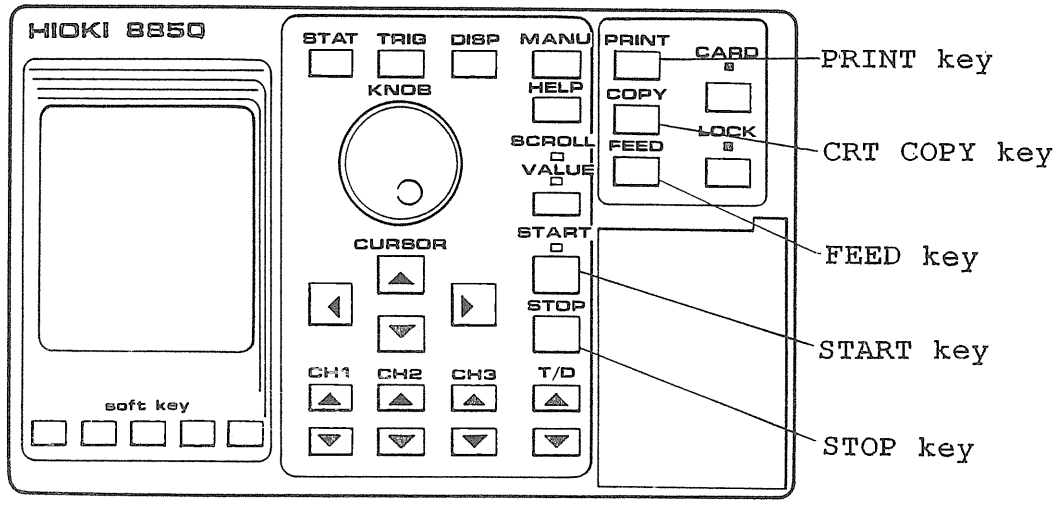
Outline	Item	Content	Page
Basic settings	Function set	[X-Y cont]	109
	Line interpolation (dot/line) set	[DOT, LINE]	109
	Display clear	[ON, OFF]	109
Input unit settings	Drawing set	[OFF, DARK, LIGHT]	110
	Measurement range (range/div) set	analog unit [5mV~20V]	110
		logic unit [-6.3V~6.3V]	110
	Offset set	[-100%~100%]	111
	Coupling set	[GND, AC, DC]	111
	Input filter set	[ON, OFF]	111

(3) Trigger condition set-up menu

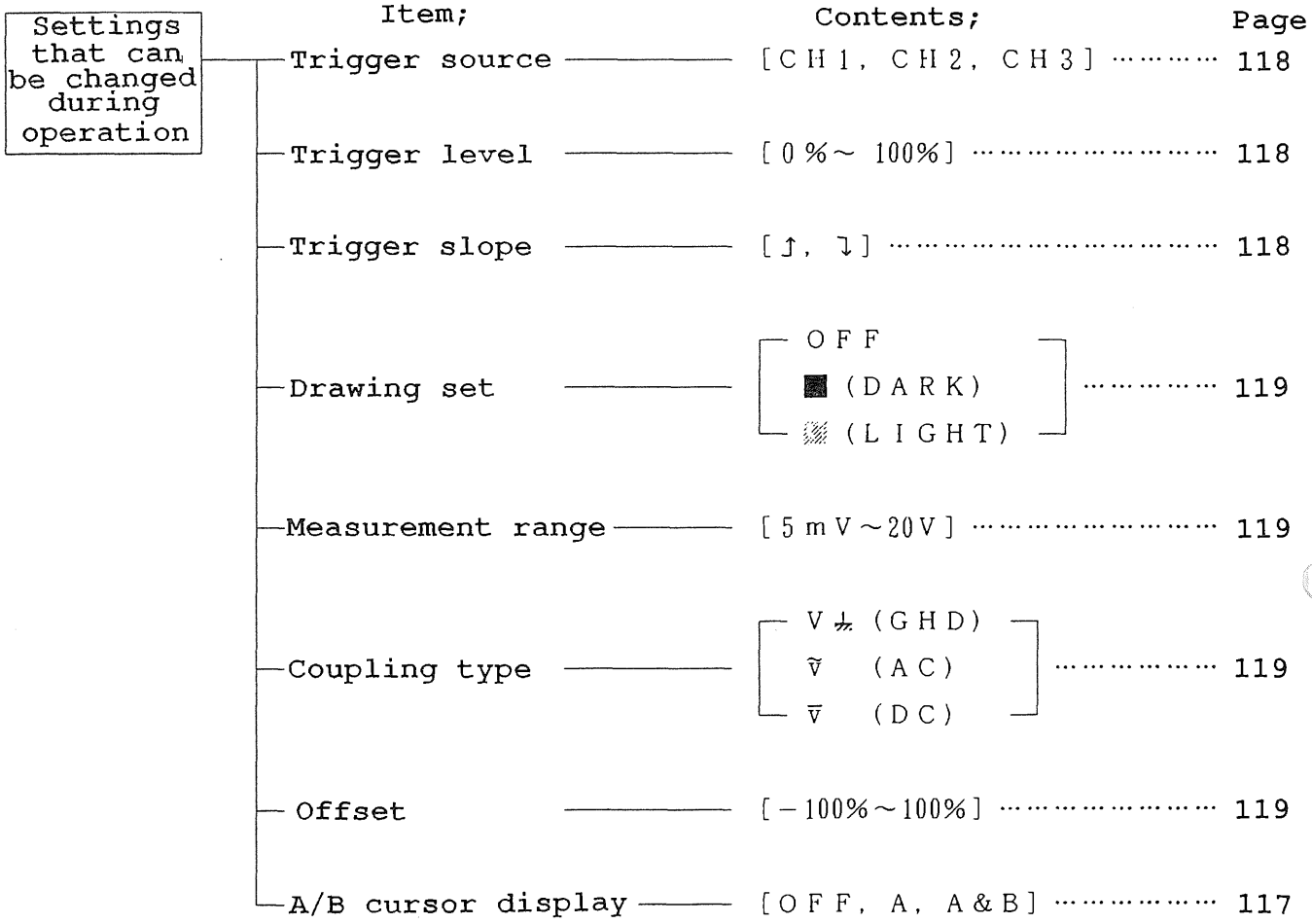


(4) Run keys


Run keys
Recording start
START key
Recording stop
STOP key
Reprint
partial print
PRINT key
CRT copy
CRT COPY key
Paper feed
FEED key


HIOKI 8850
STAT
TRIG
DISP
MANU
KNOB
HELP
SCROLL
VALUE
CURSOR
START
STOP
CH1
CH2
CH3
T/D
soft key
PRINT
CARD
COPY
LOCK
FEED
PRINT key
CRT COPY key
FEED key
START key
STOP key

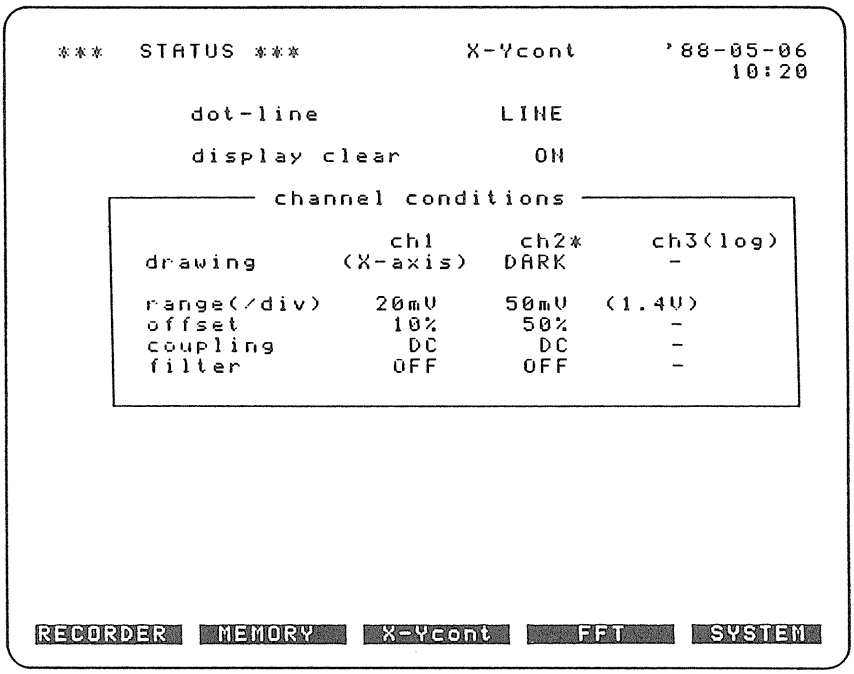
(5) Display screen set-up menu



4.5.3 XY recorder parameters and operation

(1) Status screen

Pressing the STATUS key causes the status screen to appear. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys. Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).



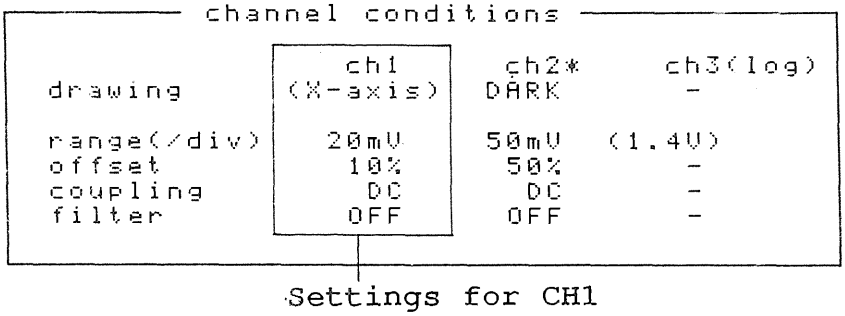
* Basic settings

o [XYcont] - Sets the measurement function, and shifts to status screens of other functions. (This can be used to set RECORDER, MEMORY, XYcont, FFT, and SYSTEM).

o [dot-line] - Sets the line interpolation for the measurement signal points.
  [LINE]: Line interpolation for an easy-to-read display.
  [DOT]: No line interpolation for a display the accurately reproduces sampled data.

o [display clear] - Sets the display clear.
  [ON]: Display is cleared when START key pressed.
  [OFF]: DIsplay is not cleared when START key pressed. FOllowing waveforms are displayed over-lapped.

* Input unit setting (channel conditions)



Note: * indicates an analog unit (isolation type), and (log) a logic unit.

o drawing - Sets the display of the input signal waveform. X axis is fixed to CH1.

[OFF]: No waveform display
[DARK]: Waveform displayed dark
[LIGHT]: Waveform displayed light

⚠ CAUTION:

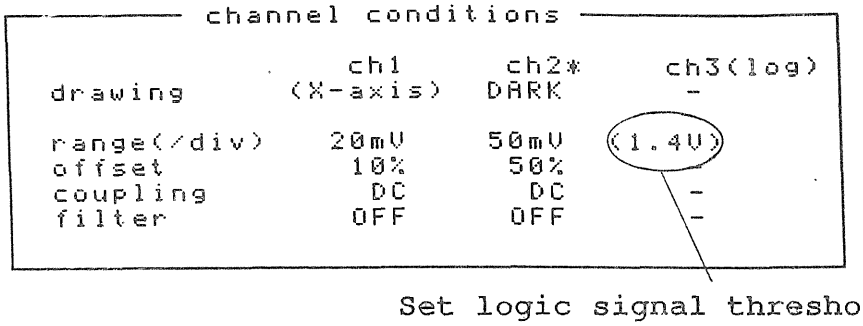
The drawing setting is not used when a logic unit is used. The logic unit can only be used as a trigger source.

o range (/div) - Sets the measurement range.

. When using an analog unit
Sets one division on the vertical axis to 20mV.

Note: The range for the analog unit (high-speed type) is 5mV to 5V, and for the analog unit (isolation type) is 5mV to 20V. When the gain adjustment knob is moved the "<" symbol will appear, as:

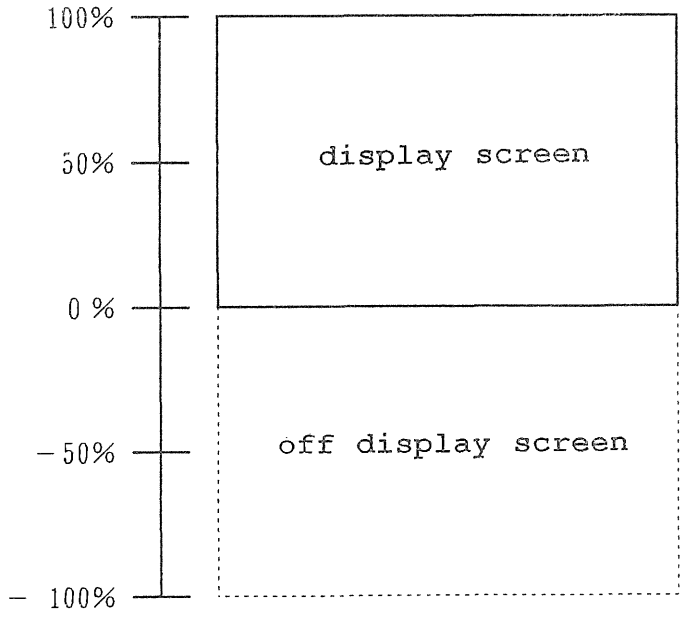
. When using a logic unit
Sets the threshold to discriminate between input logic signal HI and LO at 1.4V. The usable range is -6.3V to +6.3V, in 0.1V steps.



o offset - Sets the input signal zero position

[10%]: The input signal zero position is set to 10% of the displayed portion. The usable range is 0 to 100%, in 1% steps.

[-10%]: The input signal zero position is set to -10% of the displayed portion. The usable range is 0 to -100%, in 1% steps.



o coupling - Sets the input coupling

[GND]: No input signal connected. Zero position can be checked.

[AC]: Capacitor coupled in series. DC component of input signal cut, and only AC component measured.

[DC]: input terminal directly connected to amplifier for measurement of DC component.

o filter - Input unit internal low-pass filter set.

[ON]: Low-pass filter used (cutoff frequency is about 5Hz).

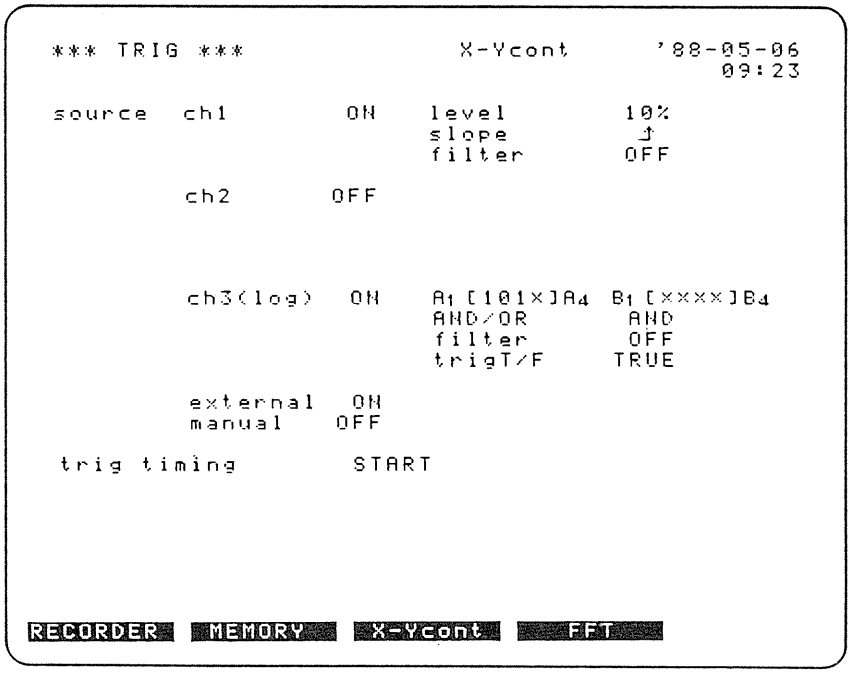
[OFF]: Low-pass filter is not used.

(2) Trigger screen

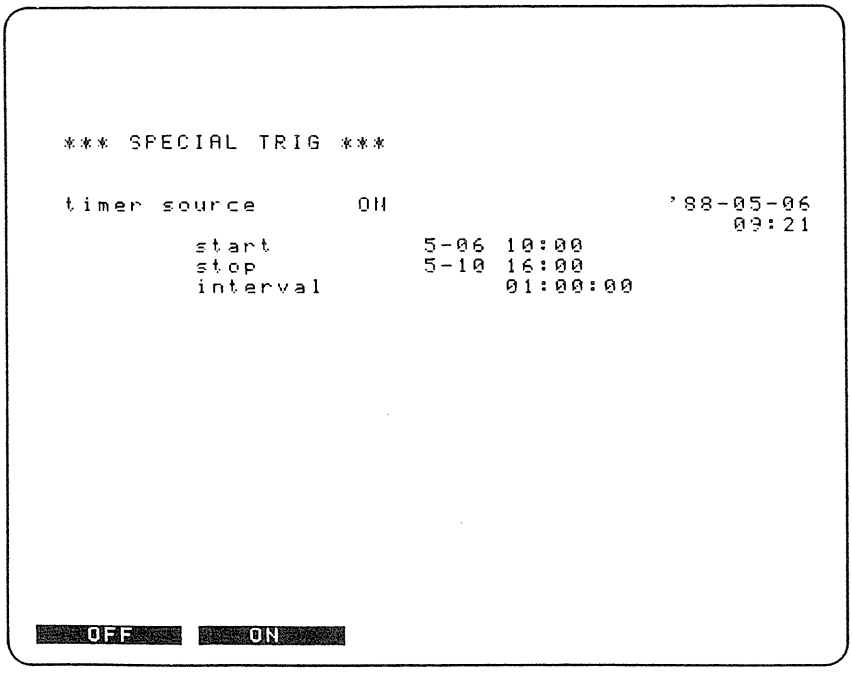
Pressing the TRIGGER key switches to the trigger set

screen. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys . Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special trigger screen is displayed by scrolling the screen, or by holding down the down cursor key.



Trigger screen



Special trigger screen

o [XYcont] - Sets the measurement function, and switches to other function trigger screens (setting possible for RECORDER, MEMORY, XYcont, and FFT).

o source - Sets trigger to input signal from channel 1~3, respectively. Set to on to use.

. external - Trigger set to signal from external trigger input terminal. Turn ON to use.

. manual - Activates the trigger when the MANU key is pressed. Turn ON to use.

Note: When multiple trigger sources are on the trigger will be activated by any of them.

If all trigger sources are off, the trigger will be activated by pressing the START key.

o trig timing - Sets trigger timing.
[START]: Starts recording from the point the trigger is activated.
[STOP]: Starts recording from the point the START key is pressed, and stops it when the trigger is activated.
[START&STOP]: Records when trigger conditions are met (trigger is active).

o timer source - Sets the timer trigger.
[ON]: Trigger is set to on from the specified start time through the specified stop time, at the specified interval.

When the interval is "00:00:00", the trigger will activate only one time, at the start time.

[OFF]: Timer trigger does not activate.

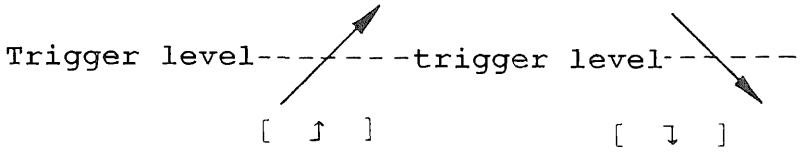
Note: When trigger timing is set to START or STOP, recording will be started or stopped regardless of interval setting.

* Internal trigger setting when analog unit used

source	ch1	ON	level	10%
			slope	↑
			filter	OFF

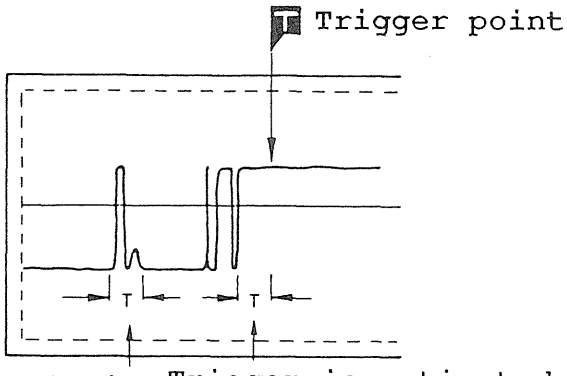
o level - Sets the trigger level.
[10%]: This threshold value is compared to the input value, expressed as a percent of the full scale recording width, which is taken as 100%. Settings from 0% to 100% are possible.

o slope: Sets trigger slope.
[>]: Trigger is activated when input signal passes the threshold value as a positive edge.
[<]: Trigger is activated when input signal passes the threshold value as a negative edge.



o filter - Sets the trigger filter.
[OFF]: No filter operation.
[3]: Sets the sampling value (3, 4, 6, 10, 18, 34, 66, 130). If the trigger conditions are inverted within the set time a trigger will be activated.

Example: When the trigger is set to 11 the input signal, this function prevents triggering due to excessive noise.



Trigger conditions invert within time T, and no trigger is activated

Trigger is activated even though trigger conditions do not invert within time T.

Note: Sampling rate for trigger detection in the XY recorder mode is 125 usec, regardless of line interpolation.

* Internal trigger set for logic unit
(Set for channels 2 and 3, which support logic units.)

o Trigger pattern
A1[101x] A4 B1 [xxxx] B4 : The logic pattern compared to the input logic singleis expressed with 1, 0 and X. 1 indicates HI, 0 indicates LO, and X indicates don't care.

Discrimination between 1 and 0 is handled by the signal detection logic probe. HI/LO level threshold values are set with respect to the status screen input unit.

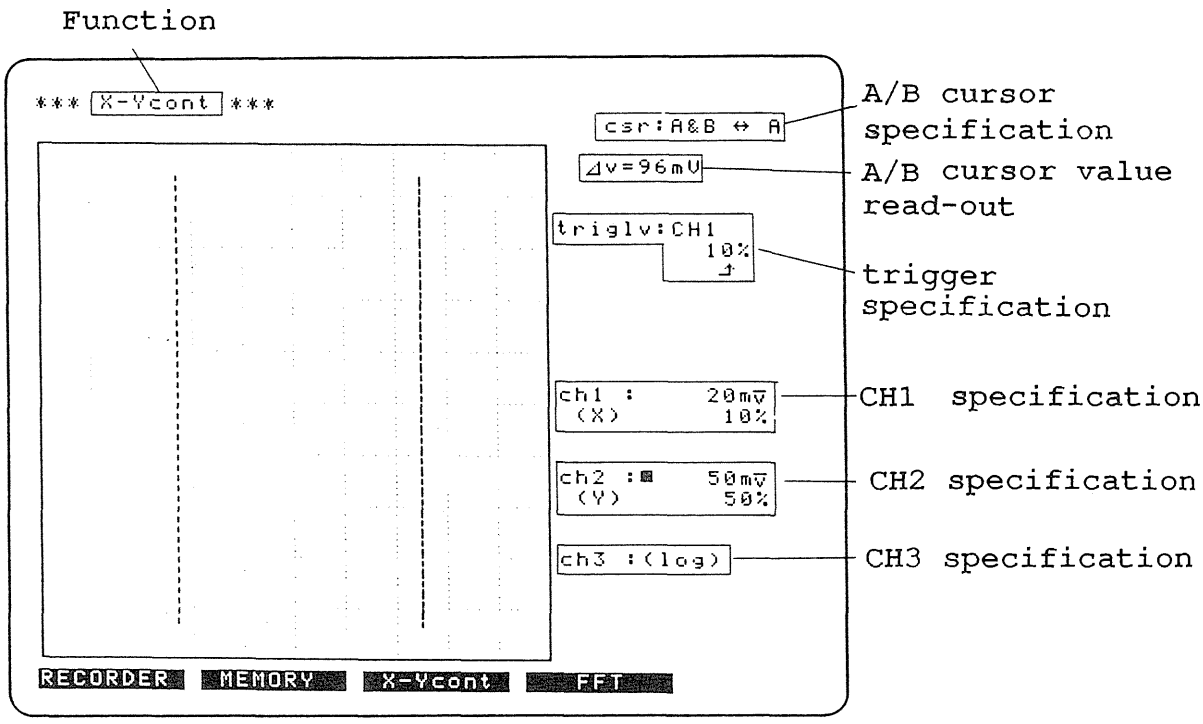
o AND/OR: Sets trigger pattern AND and OR
[AND]: Trigger activated when all specified trigger patterns match.
[OR]: Trigger activated if even one specific trigger pattern matches.

o trig T/F: Sets logic trigger condition match/mismatch.
[TRUE]: Trigger activated when trigger pattern and AND/OR trigger conditions met.
[FALSE]: Trigger activated when trigger pattern and AND/OR trigger conditions not met.

o filter: Sets the trigger filter. Setting is the same as for the analog unit.

(3) Display screen
Press the DISPLAY key to switch to the DISPLAY screen.

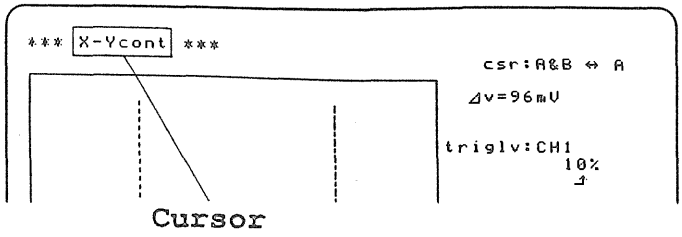
* Display screen information



Critical settings for the trigger screen can also be handled through the display screen.

Refer to the sections on the status and trigger screens for details.

o [XYcont]: Selects the function. Can also switch to other function's status screen.



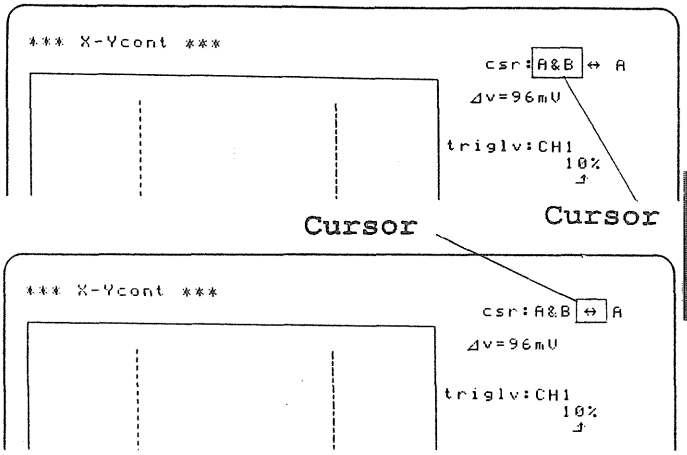
(possible settings are RECORDER, MEMORY, XYcont, and FFT).

o csr - Displays both A and B cursors on the display screen.
Can be used to determine voltage potential or time difference between input signal waveforms.

1) OFF - no cursor display
[A] - Displays only A cursor.
[A&B] - Displays both A and B cursors.

2) [↕]: Sets the vertical display cursor.

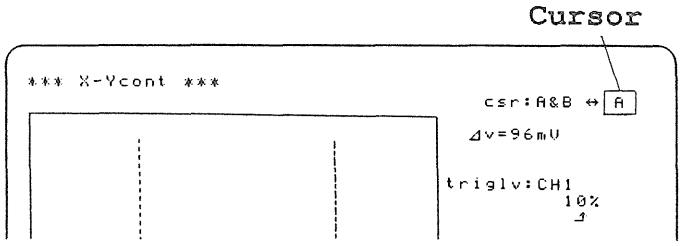
[↔]: Sets the horizontal display cursor.



3) A: Turning the rotary knob will move the A cursor.

[B]: Turning the rotary knob will move the B cursor.

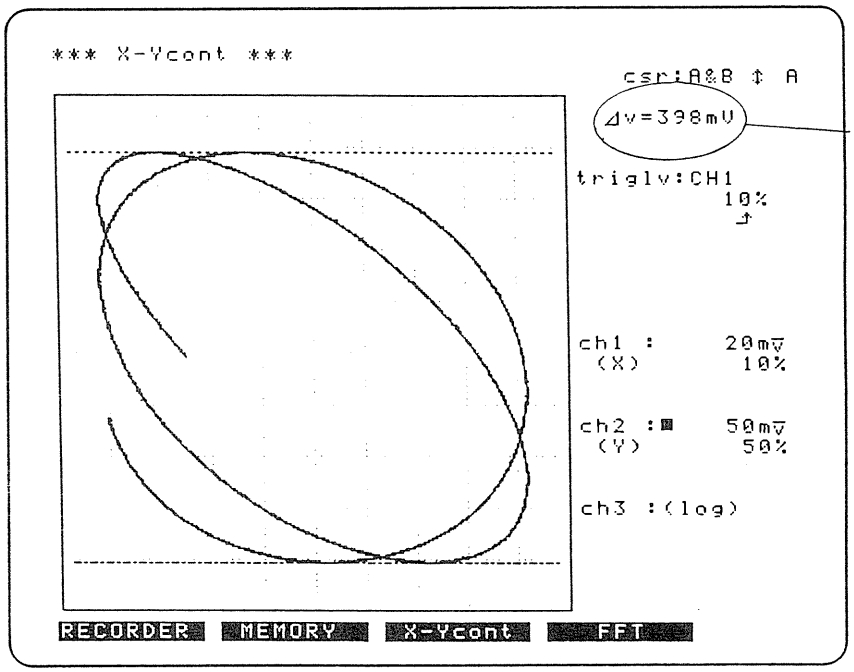
[A&B]: Turning the rotary knob will move both A and B cursors at once.



Note: For potential calculation, the result may reflect the input unit offset error (max. ±0.8%).

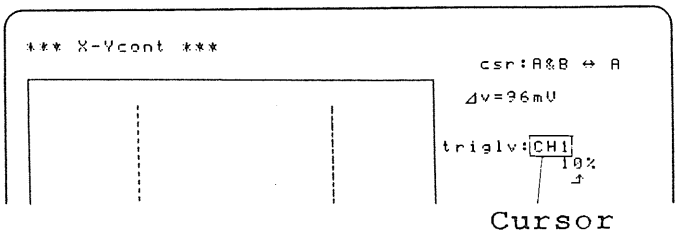
Example of cursor calculation with A and B cursors

. csr:A&B ↕



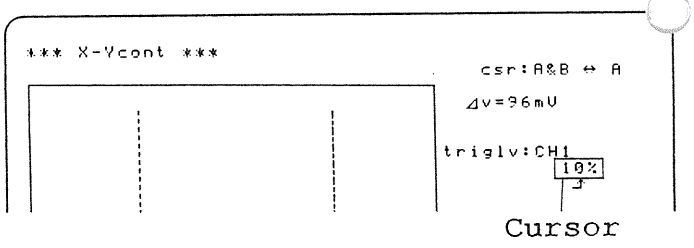
Voltage difference can be determined.

o CH1 - Selects CH1, CH2 or CH3 as the trigger source(s). Possible settings are CH1, CH2 and CH3.

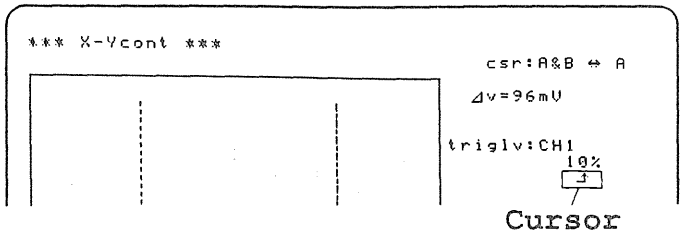


Note: If a trigger source is off on the trigger screen, that channel cannot be selected.

o 10% - Sets the trigger level for the selected trigger source (range from 0% to 100%).



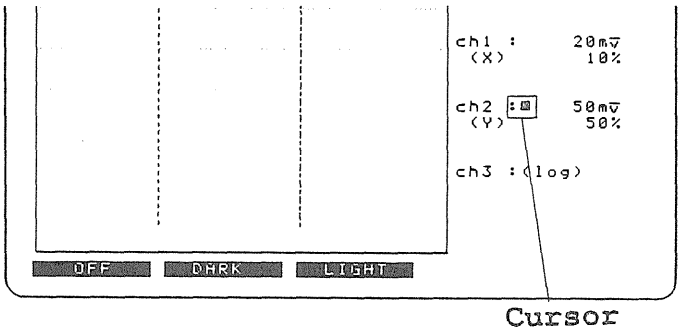
o [↕]: Sets the slope of the selected trigger source (may be positive edge or negative edge).



. For analog units:

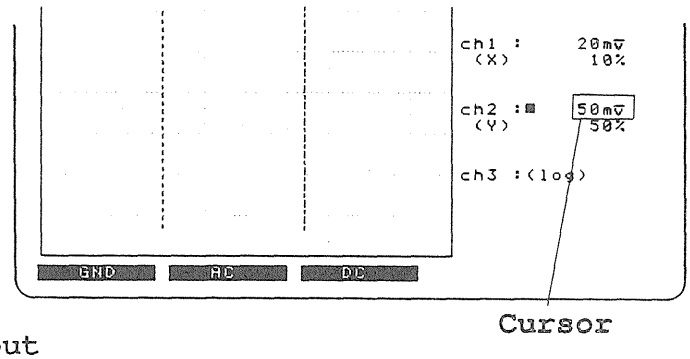
o [■]: Sets the input signal waveform display to OFF, ■ or ▨.

Note: ■ is DARK, ▨ is LIGHT.



o [50mV̄]: Sets the measurement range and input junction.

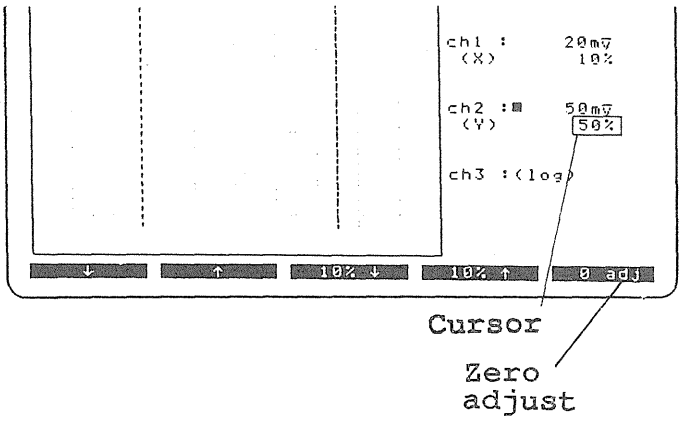
[V ⏚] indicates [GND]
[Ṽ] indicates [AC]
[V̄] indicates [DC].



o [50%]: Sets the offset for the input signal from -100% to +100%.

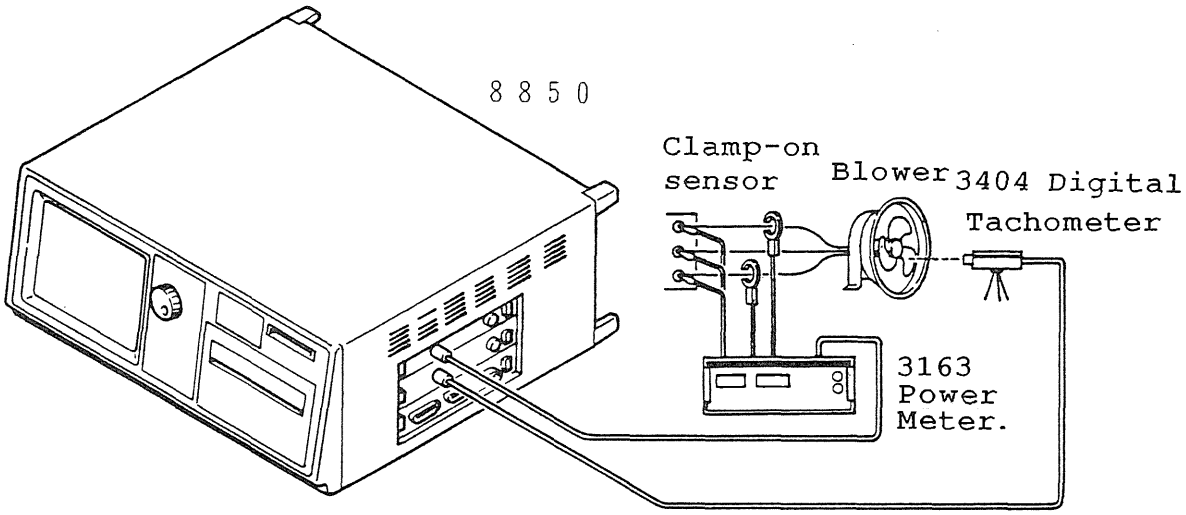
Pressing the [0adj] function select key executes calibration to the offset value.

. This setting is not possible on logic units.

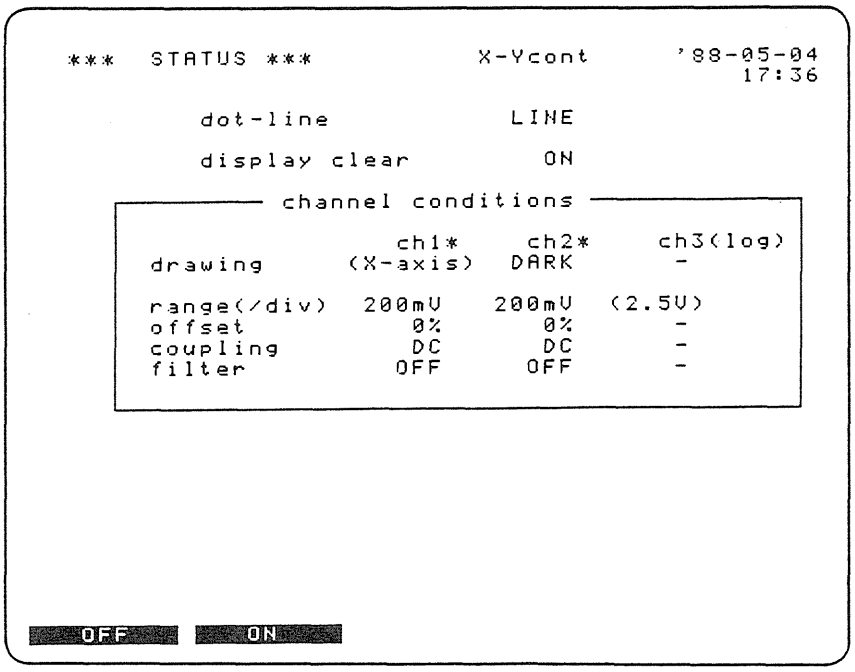


4.5.4 X-Y recorder operation

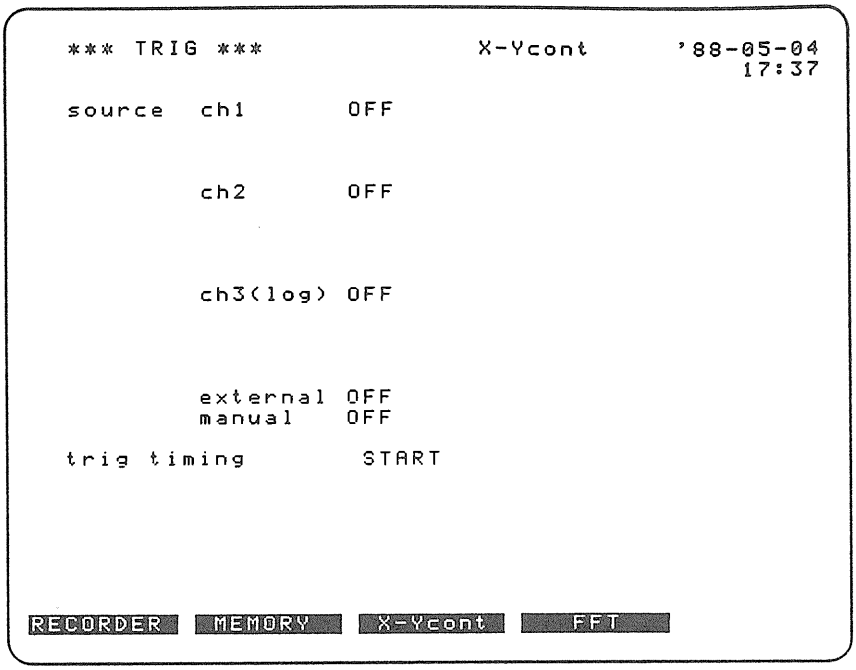
Record the rpm and power consumption of an inverter-controlled blower.



1) Press the STATUS key, and set the measurement parameters on the STATUS screen as indicated below.



2) Press the TRIGGER key, and set trigger conditions as indicated below. As the trigger is not used, all trigger sources are set to OFF.



3) Press the START key to start recording.
The CRT will monitor power and rpm in realtime.

4.6 FFT analysis function and operation

4.6.1 FFT analysis function

(1) A captured time region signal can be analyzed in the frequency and amplitude regions as well with this function.

(2) Analysis is possible in the following modes:

* [STR] - Time axis waveform (storage)
  The time region waveform of the input signal.

* [LIN] - Linear spectrum
  The frequency region waveform of the input signal, including amplitude and phase information.

  Major applications include:
  . Determining the peak of waveform frequency component
  . Determining the level of high and low harmonics

* [PSP]- Power spectrum
  The energy spectrum of the input signal, including only amplitude information.

  Major applications include:
  . Determining the peak of waveform frequency component
  . Determining the energy levels of high and low harmonics

* [HIS] - Histogram
  The frequency of sampling points can be determined for the amplitude region.

  Major applications include:
  . Determining waveform imbalance
  . Determining whether a waveform is artificial or natural from waveform distribution (most natural waveforms are regular sine waves).

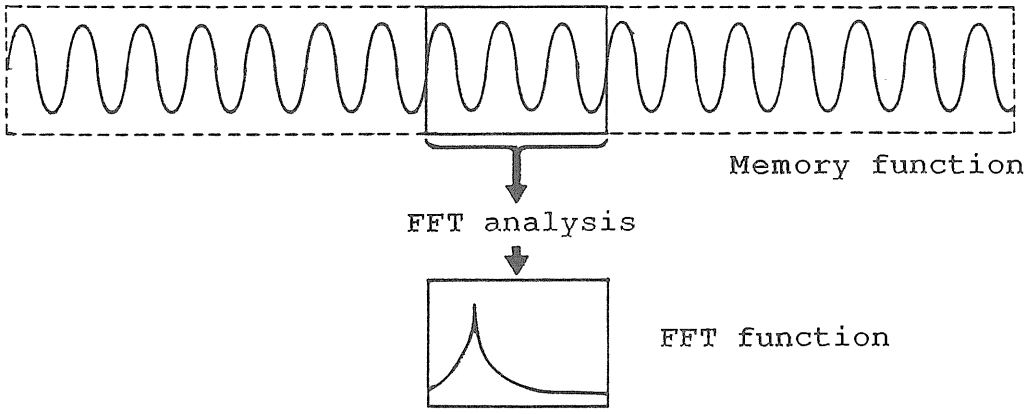
* [TRF] - Transfer function
  The transfer function (frequency response) of the measurement system can be determined from system I/O signals. Nyquist diagrams are possible, including amplitude and phase information.

  Major applications include:
  . Determining filter frequency response.
  . Determining feedback control system stability through Nyquist diagrams.
  . Determining physical resonance frequency with an impulse hammer and pick-up sensor.

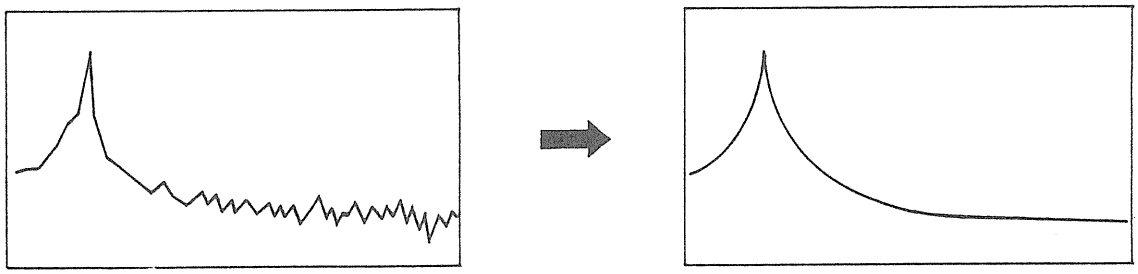
* [COH] - Coherence function
  Determines the output signal component that is coherent (interference possible) to the input signal, yielding a value from 0 to 1.

  Major applications include:
  . Evaluation of transfer functions.
  . Contribution of single input lines to output in multi-input systems.

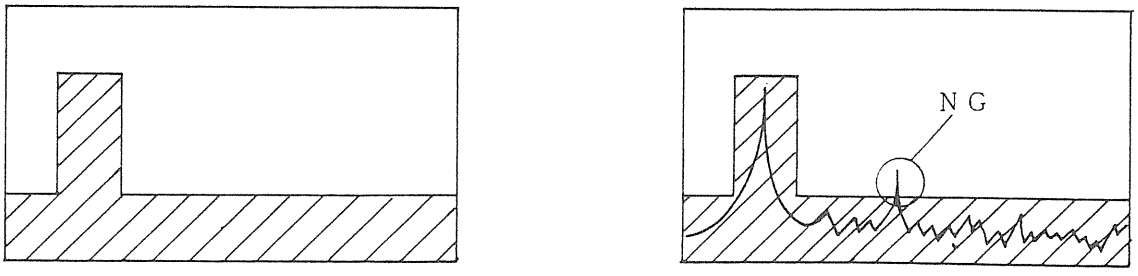
(3) FFT analysis of waveforms stored to memory through the memory function is also possible.



(4) Averaging possible up to 256 times.



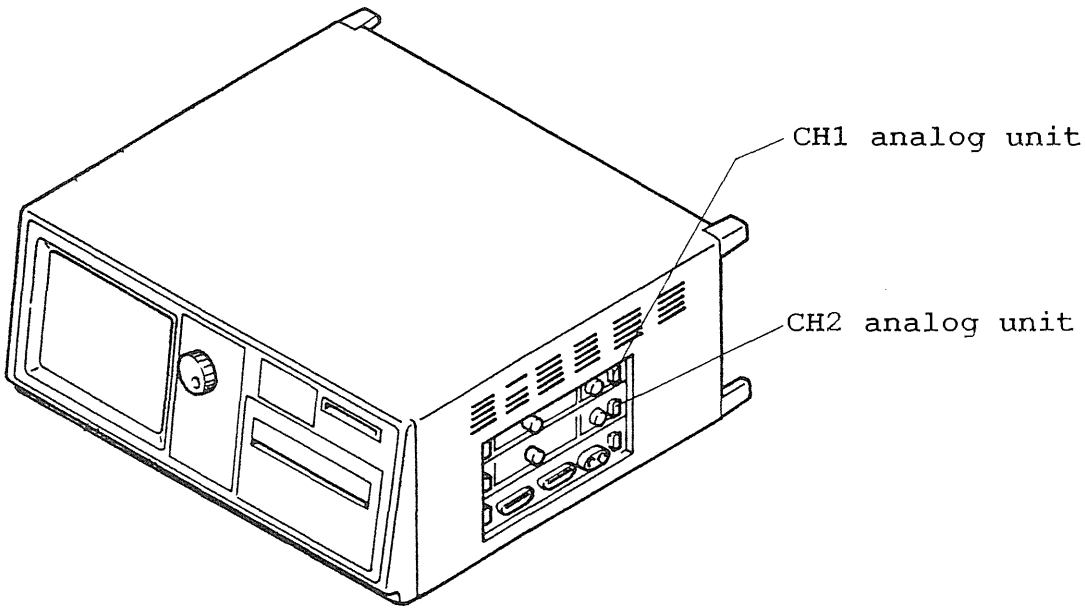
(5) Waveform judgment function used in the memory function can also be used in the frequency region.



4.6.2 Outline of FFT analysis operation

(1) Before starting FFT analysis

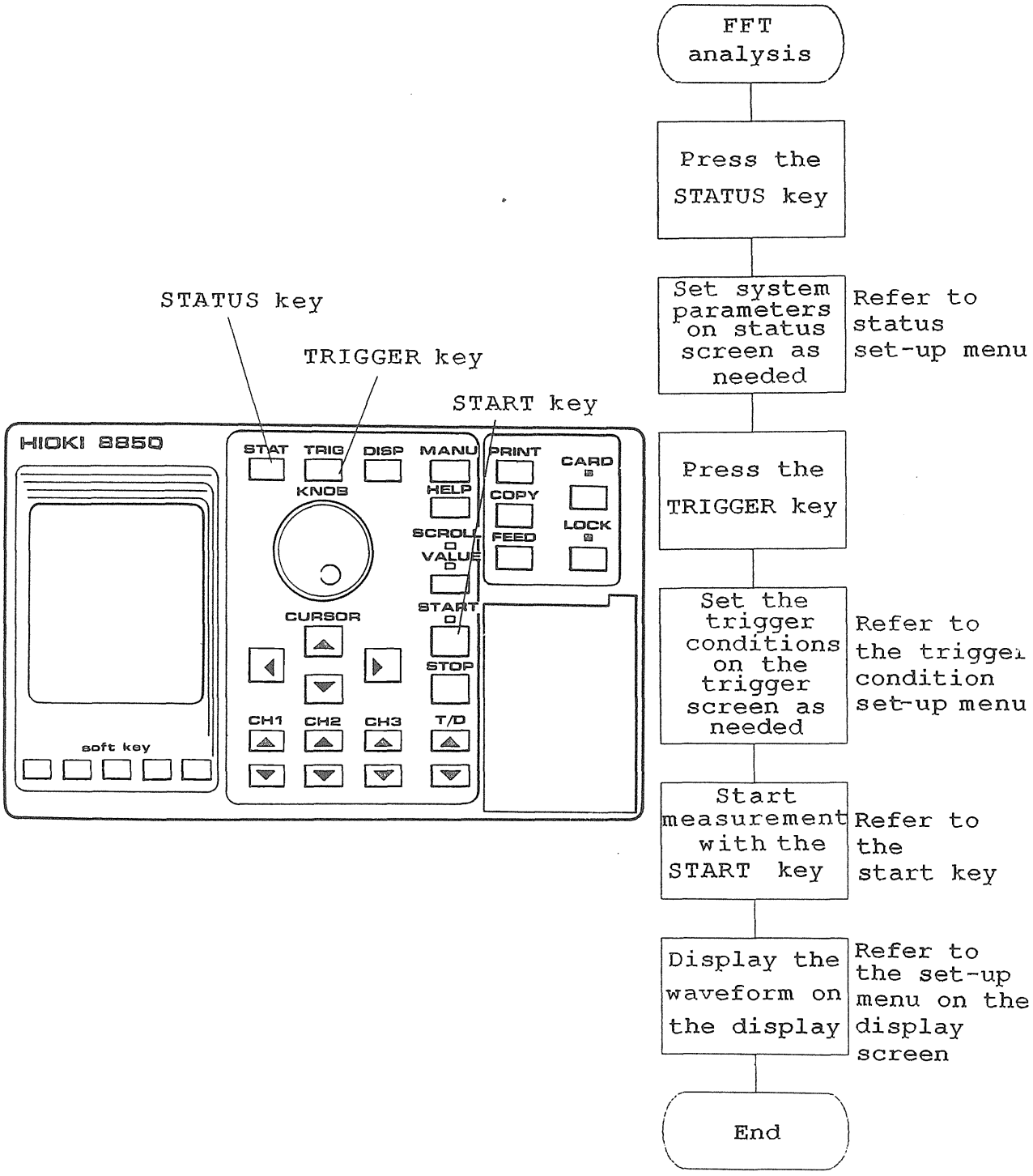
The FFT analysis function can only handle FFT analysis for input waveforms on CH1 and CH2, in principal. For this reason, please connect analog units (8941, 8942) to CH1 and CH2. However, even if there is no analog unit connected to CH2, CH1 analysis is possible in the 1CH FFT mode.



Waveform analysis is discussed in Chapter 6, and a brief description of the physical significance of Fourier transformations is given in Appendix 2.

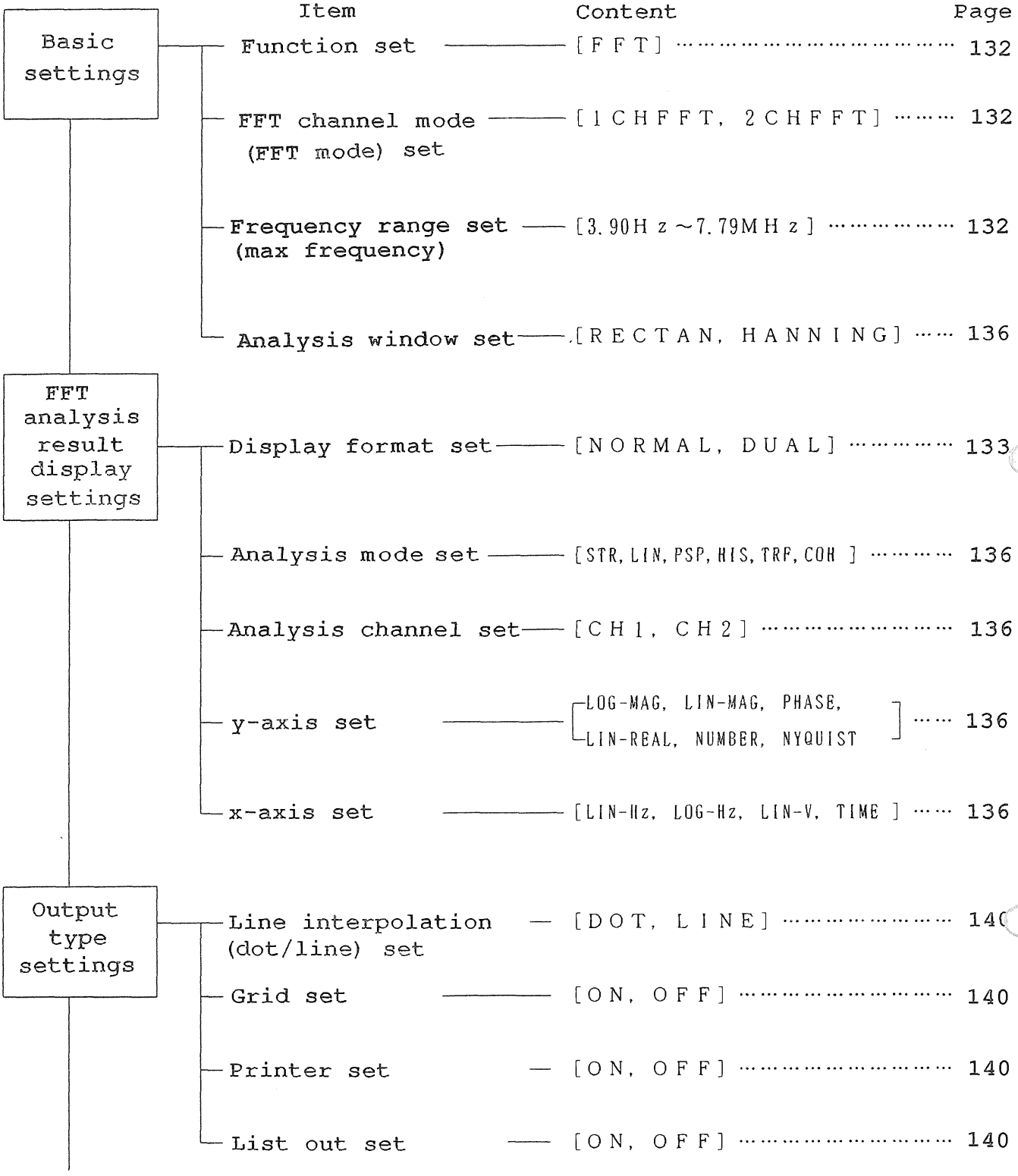
(2) Basic operation

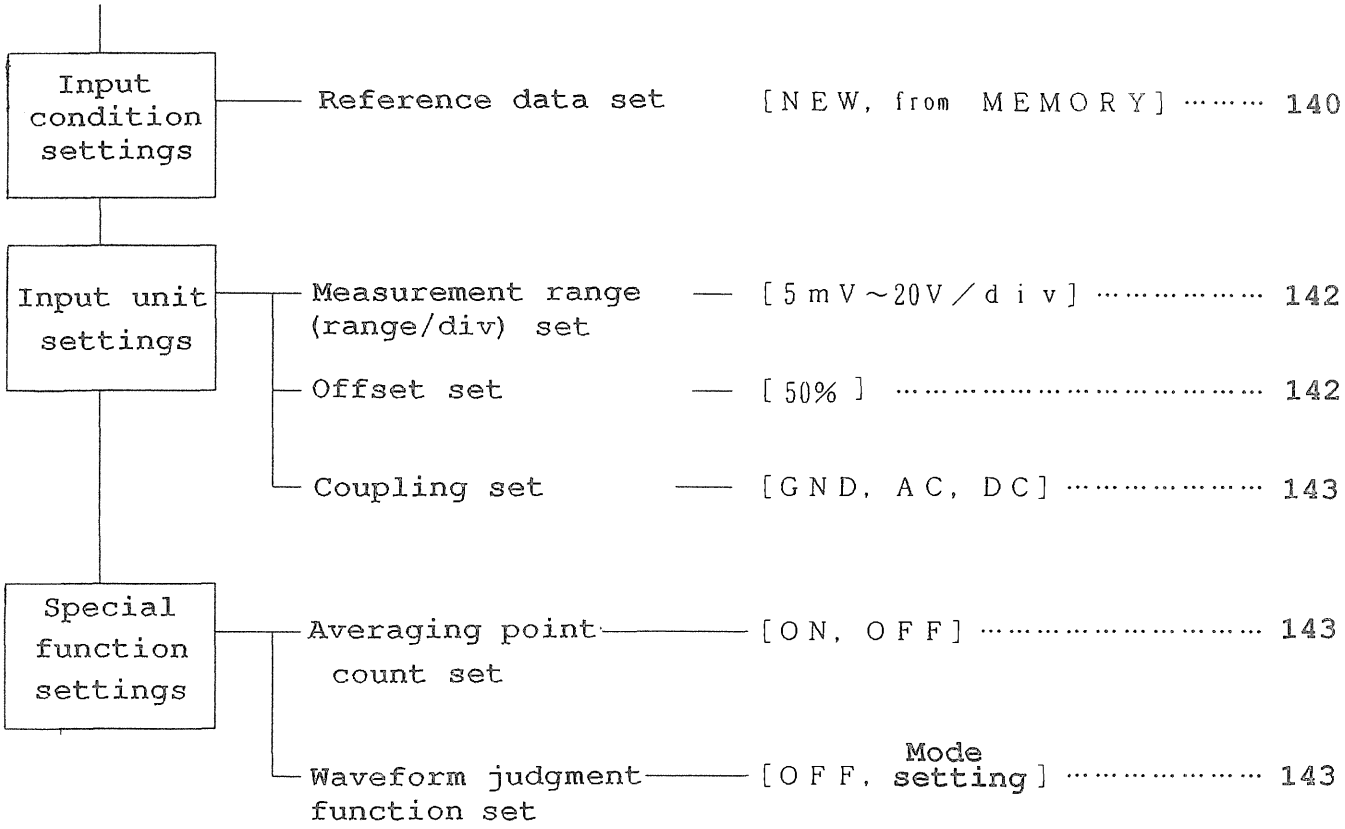
The flowchart for the basic operation is indicated below.



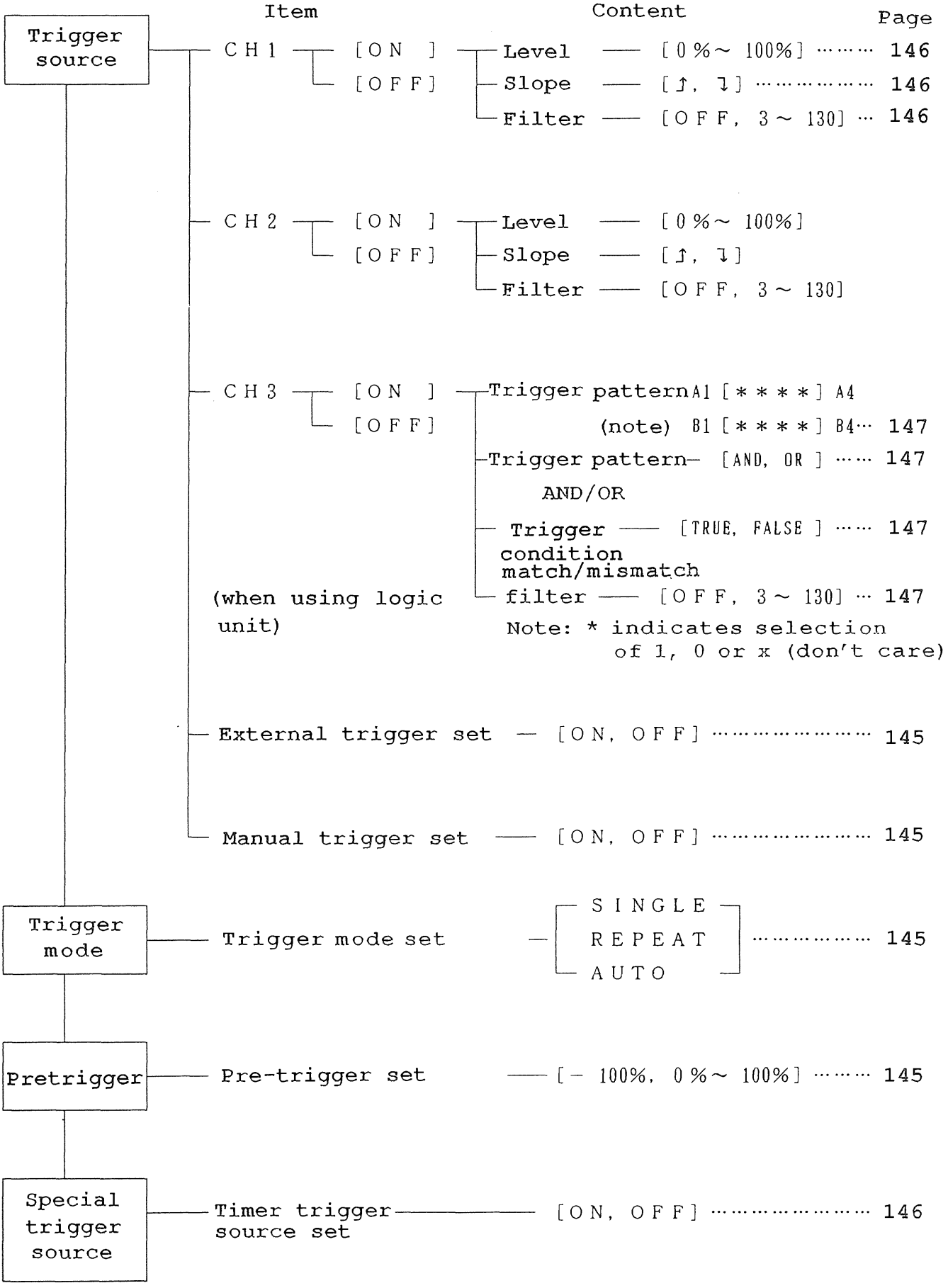
Basic Operation Flowchart

(3) Status set-up menu

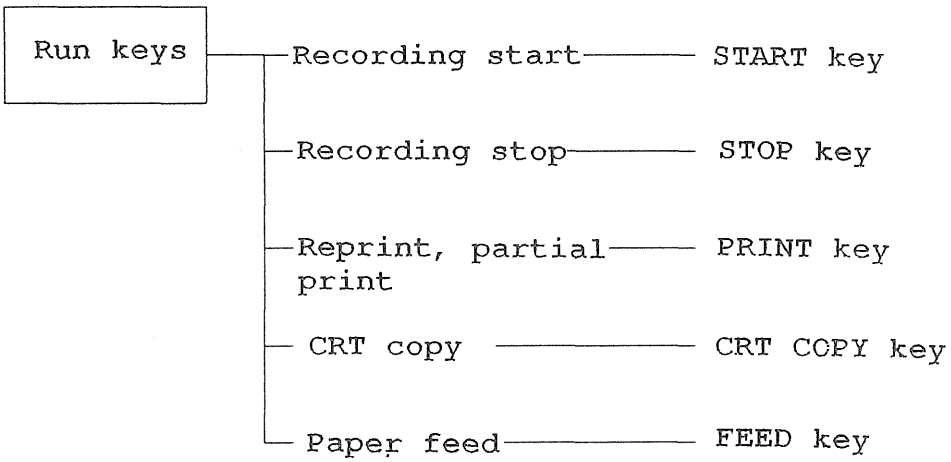


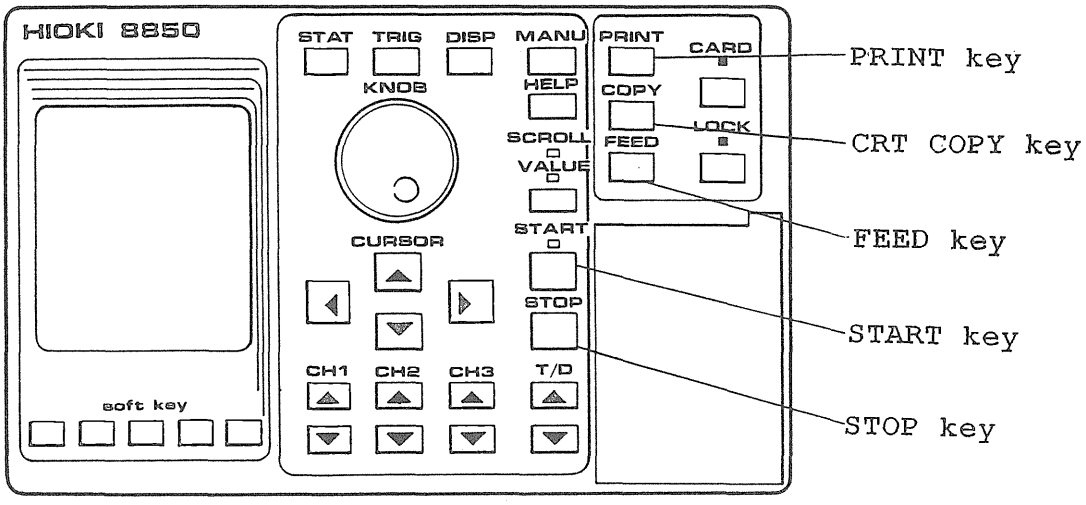

Input condition settings
Reference data set [NEW, from MEMORY] …… 140
Input unit settings
Measurement range (range/div) set — [5mV～20V／div] …… 142
Offset set — [50%] …… 142
Coupling set — [GND, AC, DC] …… 143
Special function settings
Averaging point count set — [ON, OFF] …… 143
Waveform judgment function set — [OFF, Mode setting] …… 143

(4) Trigger condition set-up menu

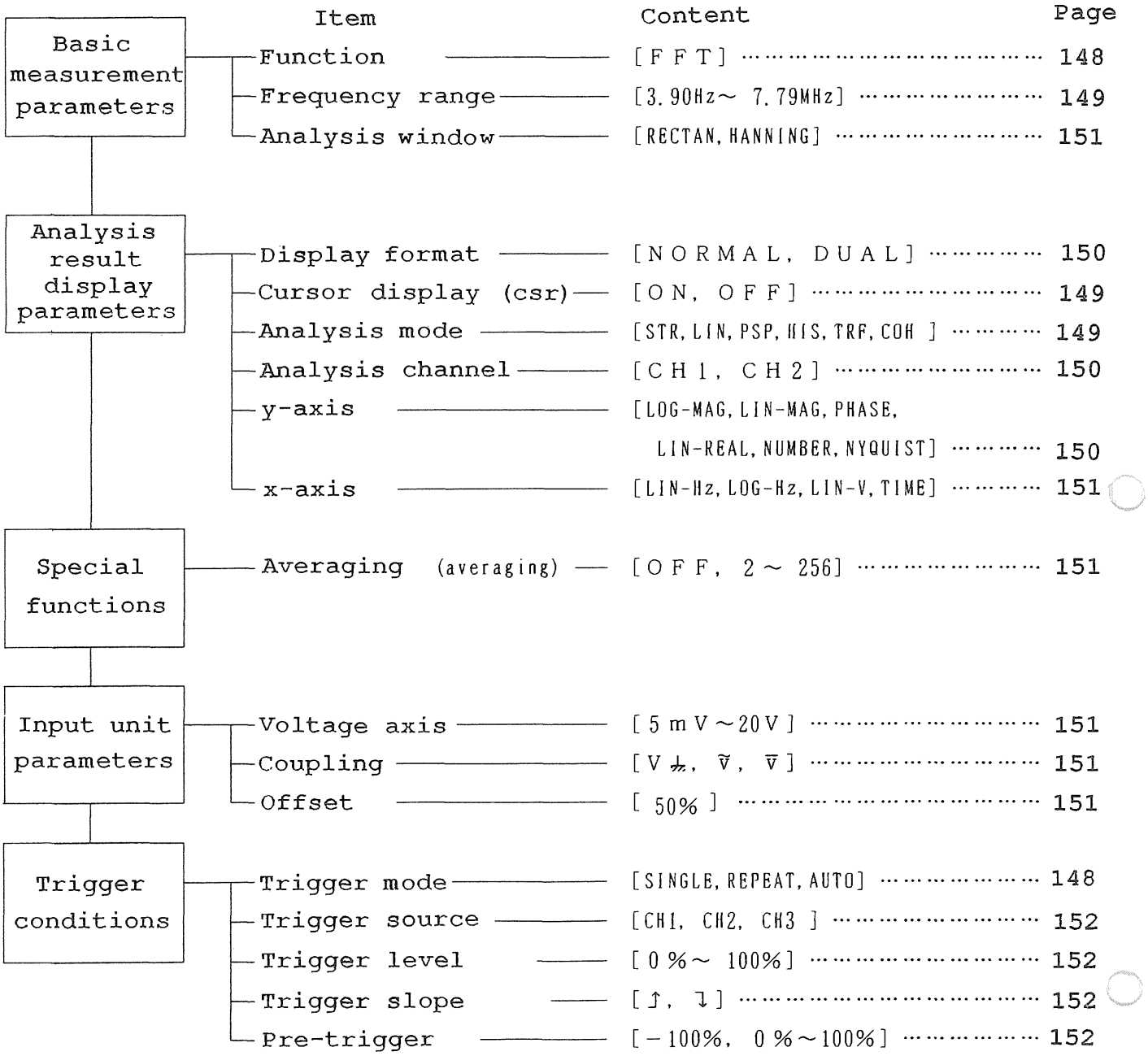


(5) Run keys


Run keys
Recording start
START key
Recording stop
STOP key
Reprint, partial print
PRINT key
CRT copy
CRT COPY key
Paper feed
FEED key


HIOKI 8850
STAT
TRIG
DISP
MANU
KNOB
HELP
SCROLL
VALUE
CURSOR
START
STOP
CH1
CH2
CH3
T/D
soft key
PRINT
CARD
COPY
LOCK
FEED
PRINT key
CRT COPY key
FEED key
START key
STOP key

(6) Display screen set-up menu

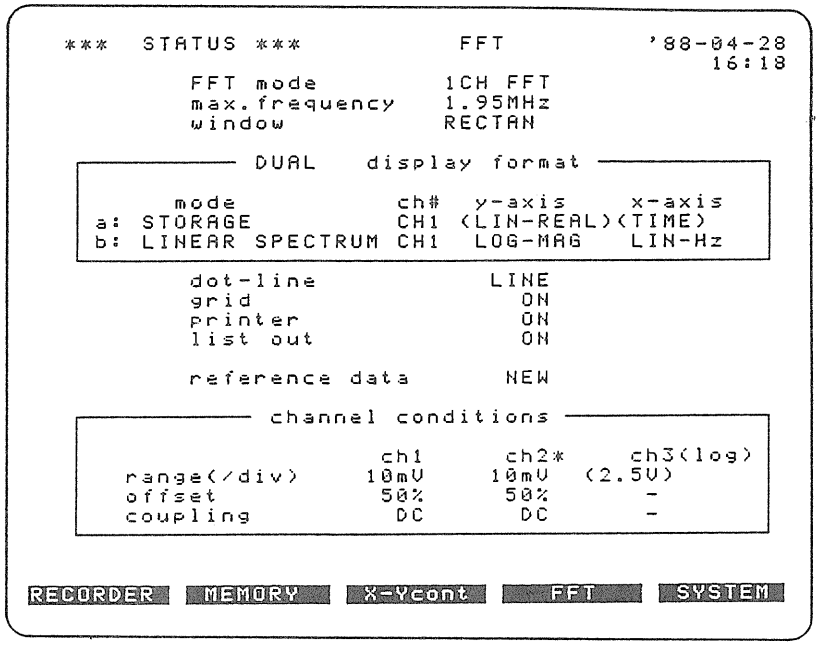


4.6.3 FFT analysis parameters and operation

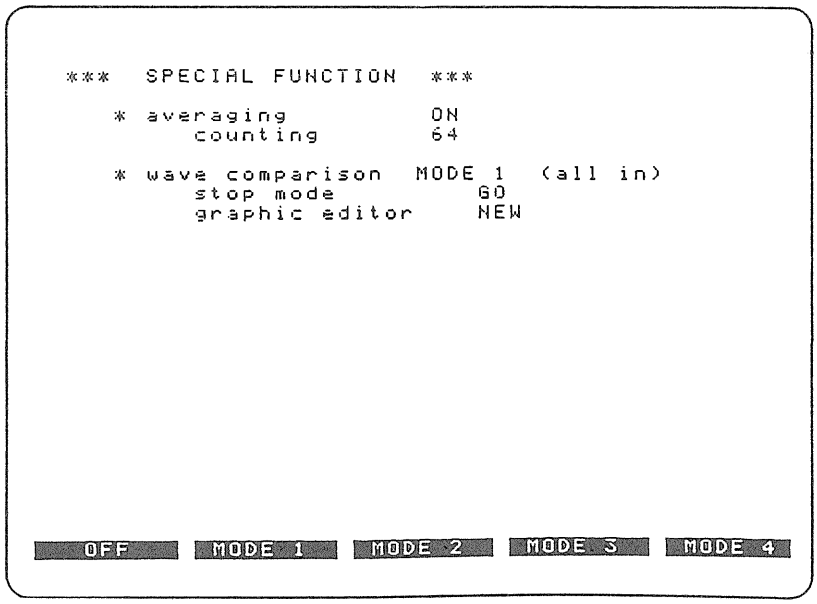
(1) Status screen

Pressing the STATUS key causes the status screen to appear. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys, and then select the desired setting with the function select keys. Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special function screen is selected by either scrolling the screen or holding down the down cursor key.



STATUS screen



Special function screen

o [FFT] - Sets the measurement function, and shifts to status screens of other functions. (This can be used to set RECORDER, MEMORY, XYcont, FFT, and SYSTEM).

o FFTmode - Sets the FFT analysis channel mode.

[1CHFFT]: Used for FFT analysis of signals from one chan nel. Analysis time will be faster than 2CHFFT analysis.

[2CHFFT]: Used for simultaneous FFT analysis of two channels.

Table 1 - Supported FFT Modes

FFT analysis mode	1CHFFT	2CHFFT
Storage waveform (STR)	o	o
Linear spectrum (LIN)	o	o
power spectrumg (PSP)	o	o
Histogram (HIS)	o	x
Transfer function (TRS)	x	o
Coherence function (COH)	x	o

A circle indicates supported FFT analysis modes.
An X shows FFT analysis modes that are not supported.

. 1CHFFT analysis is faster than 2CHFFT analysis.

⚠ CAUTION:

. Transfer function analysis in 2CHFFT requires CH1 be used as input, and CH2 as output.

. In 1CHFFT CH1 must be an analog unit (8941, 8942). In CH2FFT, both CH1 and CH2 must be analog units.

. It is impossible to analyze a waveform input in 1CHFFT mode in the 2CHFFT mode, or vice-versa.

Note: 2CHFFT is not possible unless analog units are connected to both CH1 and CH2.

o max.frequency - Sets the frequency range.
Frequency ranges as indicated in Table 2 are available, and may be set with the function select keys or the TIME/DIV key.

. In the 1CH FFT mode, when an analog unit (isolation unit) is installed in the specified channel, the maximum freqency range will be 1.95KHz. The same maximum applies in 2CHFFT mode when either or both channels is an analog (isolation type) unit.

. The 8850 is not equipped with an anti-aliasing function. Refer to Appendix 2 for a description of digital signal characteristics.

Table 2 - Frequency Ranges

Frequency range [Hz]	Maximum frequency [Hz]	Frequency resolution [Hz]	Correspondence to memory recorder function time/div (see note) [/div]
7.79 M	7.792 M	19.5 k	2.5μ sec
3.90 M	3.896 M	9.77 k	5 μ sec
1.95 M	1.948 M	4.88 k	10 μ sec
779 k	779.2 k	1.95 k	25 μ sec
390 k	389.6 k	977	50 μ sec
195 k	194.8 k	488	100 μ sec
77.9 k	77.92 k	195	250 μ sec
39.0 k	38.96 k	97.7	500 μ sec
19.5 k	19.48 k	48.8	1 m sec
7.79 k	7.792 k	19.5	2.5m sec
3.90 k	3.896 k	9.77	5 m sec
1.95 k	1.948 k	4.88	10 m sec
779	779.2	1.95	25 m sec
390	389.6	977 m	50 m sec
195	194.8	488 m	100 m sec
77.9	77.92	195 m	250 m sec
39.0	38.96	97.7 m	500 m sec
19.5	19.48	48.8 m	1 sec
7.79	7.792	19.5 m	2.5 sec
3.90	3.896	9.77 m	5 sec

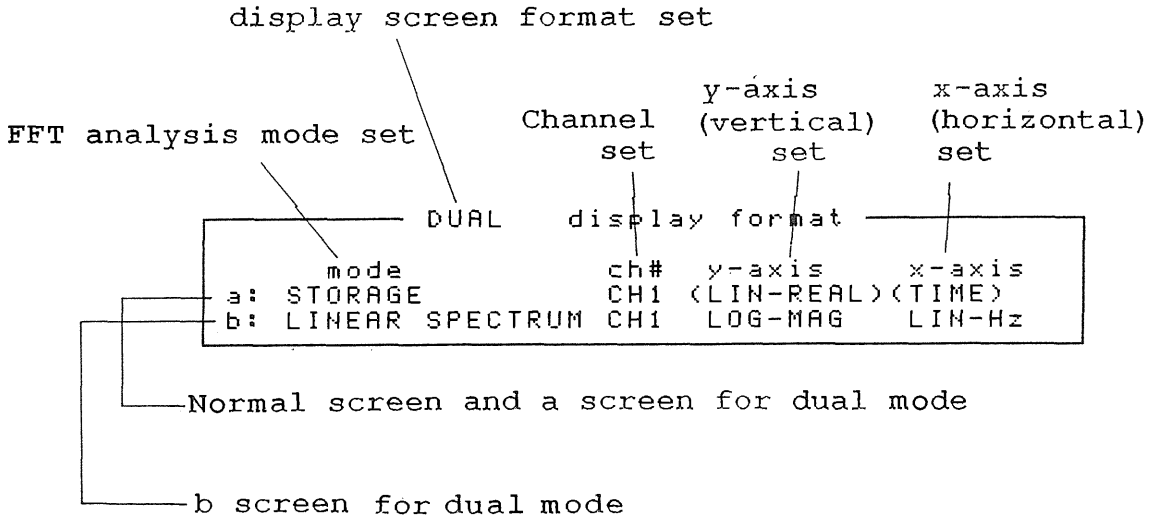
Note: The storage display time/div for the FFT analysis function is twice that shown.

o window - Sets the analysis window.

[RECTAN] - Rectangular function, effective on discrete waveforms.
[HANNING] - Hanning function, effective on continuous waveforms.

. Refer to Appendix 2 for a description of windows.

* FFT analysis results display parameters

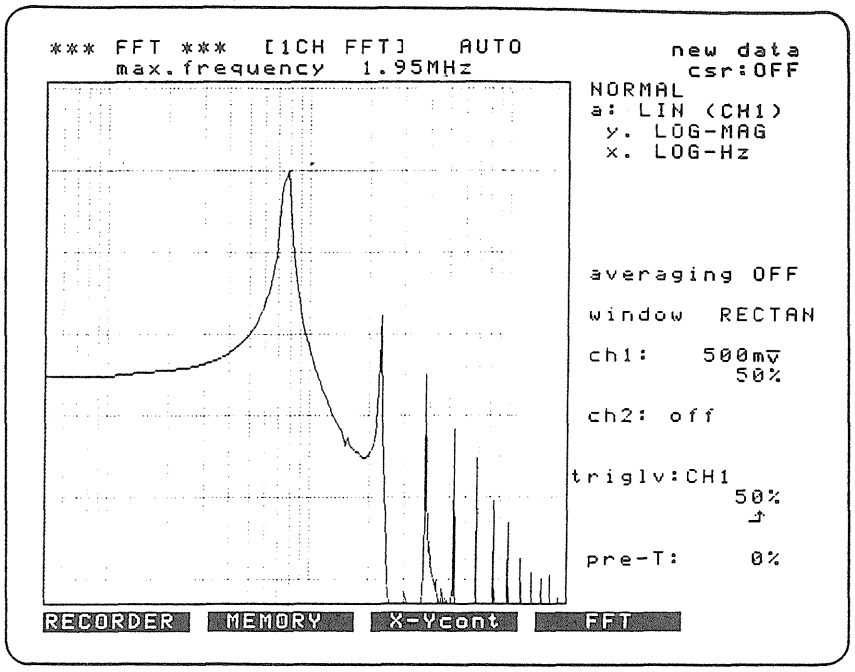


o display format - Sets the display format for the analysis results.

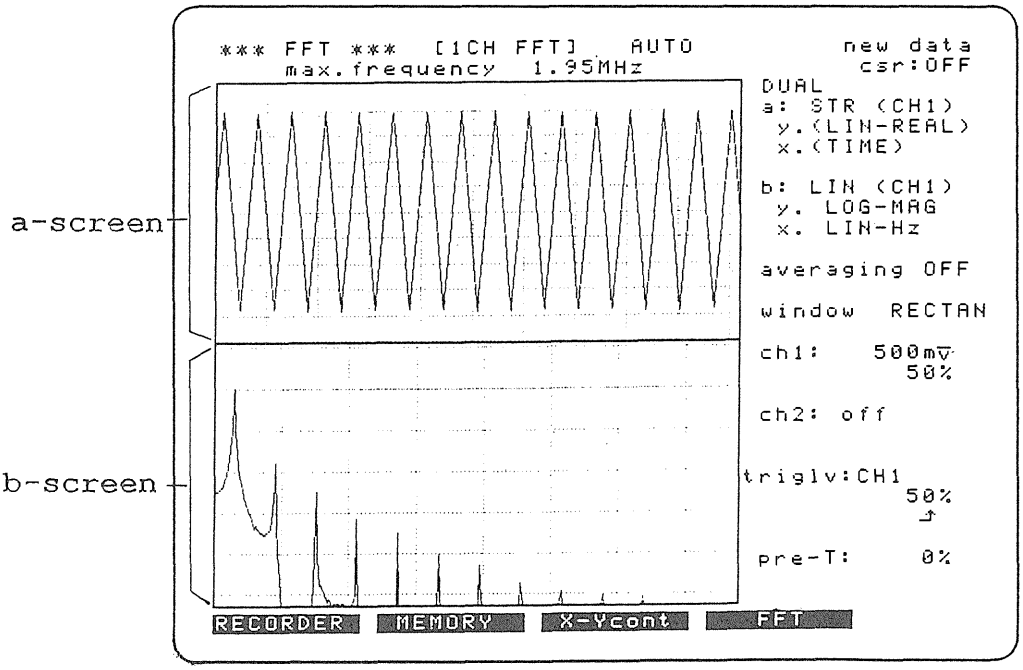
[NORMAL] - Displays the waveform on a single screen.

[DUAL] - Divides the screen into upper and lower screens for waveform display. Multiple results can be displayed individually.

NORMAL display example



DUAL display example; a-screen; b-screen



Note: For Nyquist diagram display of FFT mode transfer functions the format is fixed to NORMAL.

o mode - Sets the FFT analysis mode.

Sets the FFT analysis mode. Note that not all options can be selected for both CH1FFT and CH2FFT modes.

[STR] - Time axis waveform storage
[LIN] - Linear spectrum
[PSP] - Power spectrum
[HIS] - Histogram
[TRF] - Transfer function
[COH] - Coherence function

Note: HIS is only possible in 1CHFFT. TRF and COH are only possible in 2CHFFT.

. Analysis time is about 1.5 seconds for 1CHFFT mode, and about 3 seconds for 2CHFFT. In addition to this analysis time, display processing time is also required. When the REPEAT option is used data read time is also needed.

Example: At LIN 195kHz with a 20kHz sine wave input and REPEAT active, the screen update interval will be about 2.3 seconds.

o ch# - Sets the channel number.
[CH1] - Displays CH1 data.
[CH2] - Displays CH2 data.

Note: For tRF and COH analysis, channel 1 is fixed as input, and channel 2 as output.

o y-axis - Sets the y-axis
x-axis - Sets the x-axis

These settings vary with the FFT analysis mode selected, as indicated in Table 3. Entries in parens are fixed.

Table 3

FFT analysis mode	y-axis (vertical)	x-axis (horizontal)
[STR] Time axis waveform storage	(LIN-REAL)	(TIME)
[LIN] Linear spectrum	LOG-MAG	LIN-Hz or LOG-Hz
	LIN-MAG	LIN-Hz or LOG-Hz
	PHASE	LIN-Hz or LOG-Hz
[PSP] Power spectrum	LOG-MAG	LIN-Hz or LOG-Hz
	LIN-MAG	LIN-Hz or LOG-Hz
[HIS] Histogram	(NUMBER)	(LIN-V)
[TRF] Transfer function	LOG-MAG	LIN-Hz or LOG-Hz
	LIN-MAG	LIN-Hz or LOG-Hz
	PHASE	LIN-Hz or LOG-Hz
	NYQUIST	x-axis cannot be selected when Nyquist has been selected.
[COH] Coherence function	(LIN-REAL)	LIN-Hz or LOG-Hz

1) STR (time axis waveform storage)

. y-axis
[(LIN-REAL)] - The value is as per the input unit measurement range (units volts).
. x-axis
[(TIME)] - Time axis display. The value is double the memory recorder function TIME/DIV range (units seconds).

1024 data points used for FFT analysis are displayed.

Note: Time axis waveforms are not averaged. When averaging is on the last waveform input is displayed.

2) LIN - Linear spectrum

. y-axis
[LOG-MAG]: Setting the peak as 0dB, the ratio to the peak value is displayed digitally.
[LIN-MAG]: Absolute data values displayed as voltage.
[PHASE]: Angle between data real and imaginary components given as an angle (from -180 to +180 degrees).

. x-axis
[LIN-Hz]: Displays frequency at fixed interval across a range from DC through the maximum frequency value.
[LOG-Hz]: Logarithmic frequency display, across a range from 1/400th of the maximum frequency to the maximum frequency.

3) PSP - Power spectrum

. y-axis
[LOG-MAG]: Setting the peak as 0dB, the ratio to the peak value is displayed digitally.
[LIN-MAG]: Absolute data values displayed as voltage.

. x-axis
[LIN-Hz]: Displays frequency at fixed interval across a range from DC through the maximum frequency value.
[LOG-Hz]: Logarithmic frequency display, across a range from 1/400th of the maximum frequency to the maximum frequency.

4) HIS - Histogram

. y-axis
[(NUMBER)]: Gives the number of sampling points for the time axis data (total 1024).

. x-axis
[(LIN)]: Gives voltage as per input unit measurement range.

5) TRF - Transfer function

. y-axis
[LOG-MAG]: Gives the digital ratio of input (CH1) to output (CH2). Non-unit, indicating amplitude component.
[LIN-MAG]: Gives the ratio of input (CH1) to output (CH2). Non-unit, indicating amplitude component.
[PHASE]: Gives the angle between the real and imaginary terms of the ratio of input (CH1) to output (CH2) as an angle. Indicates phase component.
[NYQUIST]: Displays the ratio of input (CH1) to output (CH2) with the imaginaries on the x-axis and the reals on the y-axis.

> Note: When DUAL screen is selected Nyquist cannot be selected. To display Nyquist, switch the screen display to normal first. When Nyquist is selected, no further change in screen format or x-axis is possible.

. x-axis
[LIN-Hz]: Displays frequency at fixed interval, across a range of DC through the maximum frequency.
[LOG-Hz]: Logarithmic display of frequency, across a range from 1/400th of maximum frequency to maximum frequency.

6) COH - Coherence function selection

. y-axis
[(LIN-REAL)] - Express correspondence between two input signals (CH1 and CH2) as a value between 0 and 1. No units.

. x-axis
[LIN-Hz]: Displays frequency at fixed interval, across a range of DC through the maximum frequency.
[LOG-Hz]: Logarithmic display of frequency, across a range from 1/400th of maximum frequency to maximum frequency.

* Output type condition settings

o dot-line - Sets the line interpolation for the measurement signal points.
[LINE]: Line interpolation for an easy-to-read display.
[DOT]: No line interpolation for a display the accurately reproduces sampled data.

o grid - Displays grid.
[ON]: Grid displayed.
[OFF]: No grid displayed.

o printer - Determines printer use during operation.
[ON]: Printer is used. Input waveform is read, and printed out.
[OFF]: Printer is not used.

o list out - Determines print out of setting parameters
[ON]: Prints out the setting parameter list after the waveform.
[OFF]: No printout of parameters.

* Input parameter settings

o reference data - Selects data to be FFT analyzed
[NEW]: Reads in a new input waveform for analysis.
[from MEMORY]: Analyzes a waveform read in through the memory recorder function. Note that FFT analysis of stored waveforms is not possible in the following cases:

1) Data point count of stored waveform is less than 1024 points.

. The waveform was stored with a shot length of 20DIV or less.

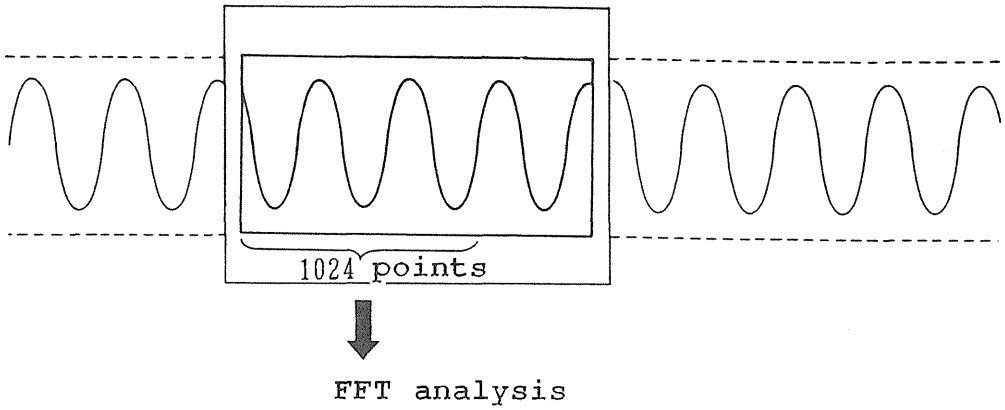
. When the analysis start point was set with the cursor, the defined point count was less than 1024.

2) Waveforms not read in through the memory recorder function.

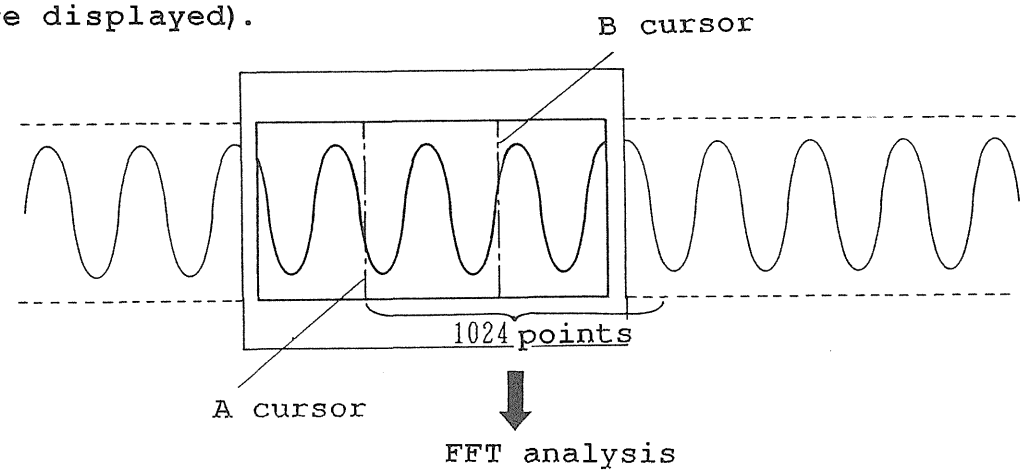
3) When the XY format is specified in the memory recorder function.

* Relation of FFT analysis data and memory recorder function waveform when from MEMORY selected:

1) If the memory recorder function cursor is off, or horizontal cursor, then the 1024 points of data from the left edge of the screen are analyzed.



2) If the memory recorder function vertical cursor is on, the 1024 points of data will be analyzed starting from the A cursor (if the A cursor only is displayed) or from the left-most cursor (if the A and B cursors are displayed).



3) Range and other restrictions

. The frequency range is restricted by the memory recorder function time/div. Refer to Table 2 for the relation between the two.

. The averaging function is automatically turned off. It is not related to memory recorder function averaging.

. The trigger mode is automatically set to SINGLE.

* Input unit setting (channel conditions)

channel conditions

	ch1	ch2	ch3(log)
range(/div)	20mV	20mV	(1.4V)
offset	50%	50%	-
coupling	DC	AC	-

o range (/div) - Sets the measurement range.

. When using an analog unit
Sets one division on the vertical axis to 20mV.

Note: The range for the analog unit (high-speed type) is 5mV to 5V, and for the analog unit (isolation type) is 5mV to 20V. When the gain adjustment knob is moved the "<" symbol will appear, as: <5mV

. When using a logic unit
Sets the threshold to discriminate between input logic signal HI and LO at 1.4V. The usable range is -6.3V to +6.3V, in 0.1V steps.

o offset - Sets the input signal zero position (Normally set to 50%)
[10%]: The input signal zero position is set to 10% of the displayed portion. The usable range is 0 to 100%, in 1% steps.

[-10%]: The input signal zero position is set to -10% of the displayed portion. The usable range is 0 to -100%, in 1% steps.

⚠ CAUTION:
For displays of FFT analysis function waveform caluculations and cursor values, 50% is the zero point. Setting the zero values will allow DC compornent to be cancelled out. Note in this case caluculation results and DC component indicated for cursor position will diffr from true values.

o coupling - Sets the input coupling
[GND]: No input signal connected. Zero position can be checked.
[AC]: Capacitor coupled in series. DC component of input signal cut, and only AC component measured.
[DC]: input terminal directly connected to amplifier for measurement of DC component.

Note: The FFT function automatically turns off the low-pass filter.

* Special function parameter settings
For details of the functions and their operation, refer to Sections 4-10 and 4-13.

o averaging - Sets averaging.
[OFF]: No averaging operation.
[ON]: Averaging executed.
counting: Sets the number of points to be averaged, from 2 through 256.

Note: When [STR] time axis waveform storage is selected the time axis waveform is not averaged. The only waveform displayed will be that input last.

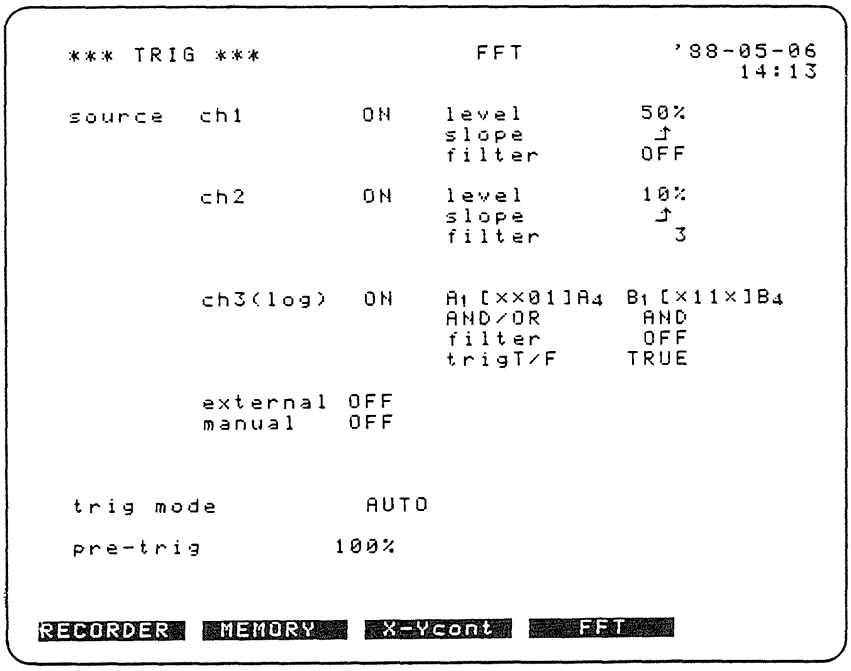
o wave judgment - Compares a user-defined profile area and the FFT analysis results.
[OFF]: No waveform judgment
[MODE1]: Sets the judgment mode (may be set to MODE1, MODE2, MODE3 or MODE4.
. stop mode: Sets whether stop activated by GO or NG results
. graphic editor: Used to define the judgment profile.

Note: Waveform judgment is only possible for a NORMAL display.

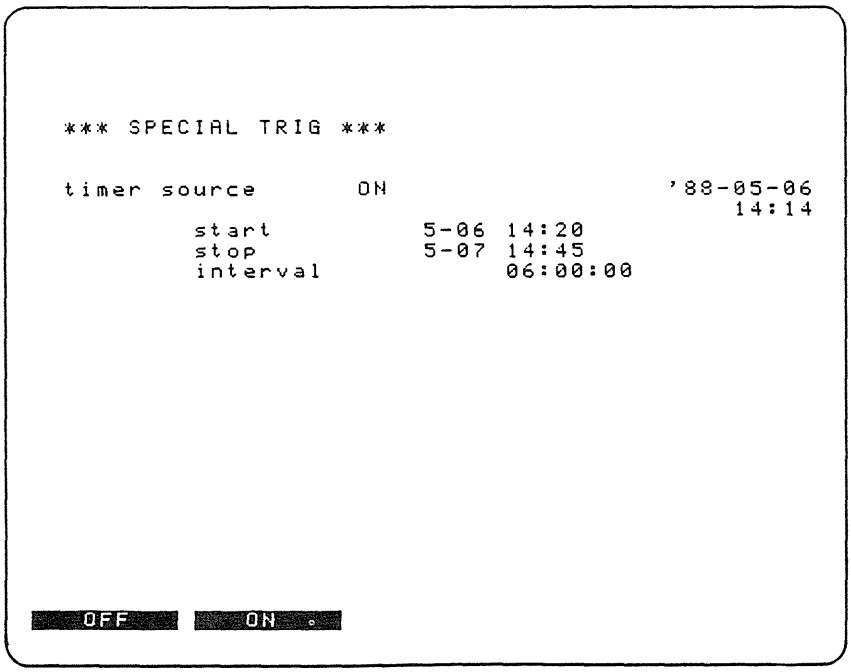
(2) Trigger screen

Pressing the TRIGGER key switches to the trigger set screen. To change the indicated (current) settings, move the flashing spot on the screen with the cursor keys and then select the desired setting with the function select keys Values are input with the vertical arrow function select keys, or with the rotary knob (set the SCROLL/VALUE key to VALUE).

The special trigger screen is displayed by scrolling the screen, or by holding down the down cursor key.



Trigger screen



Special trigger screen

o [FFT] - Sets the measurement function, and switches to other function trigger screens (setting possible for RECORDER, MEMORY, XYcont, and FFT).

o source - Sets trigger to input signal from channel 1~3, respectively. Set to on to use.

. external - Trigger set to signal from external trigger input terminal. Turn ON to use.

. manual - Activates the trigger when the MANU key is pressed. Turn ON to use.

Note: When multiple trigger sources are on the trigger will be activated by any of them.

If all trigger sources are off, the trigger will be activated by pressing the START key.

o trig mode - Sets the trigger mode.
[SINGLE]: Only the first trigger after the START key is pressed is enabled.
[REPEAT]: System will be activated by every trigger.
[AUTO]: Trigger continuously on. If a certain period of time passes without a trigger input, the system will automatically activate the trigger. This period of time is the measurement range (time axis used in memory function) times 20DIV. 7.79MHz, for example, would be 50 usec. Note that the maximum is 2 seconds.

o pre-trig- Sets the pretrigger timing.
[2%]: Starts recording the specified time before the trigger time.
(2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 100%)
[100%]: Starts recording 100% of th record length after the trigger time.
[0%]: Starts recording at the trigger time.

. With the FFT function, the record length is always 1024 points (approx. 10.5 DIV)

⚠ CAUTION

The trigger signal is not accepted while the signal to be recorded is input or the record is printed.

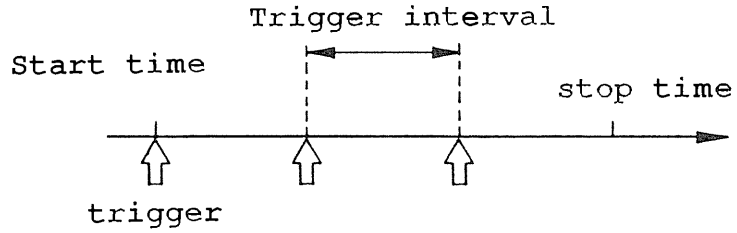
o timer source - Sets the timer trigger.

[ON]: Trigger is set to on from the specified start time through the specified stop time, at the specified interval.

When the interval is "00:00:00", the trigger will activate only one time, at the start time.

[OFF]: Timer trigger does not activate.

```
timer source        ON

        start           5-06  12:00
        stop            5-10  12:00
        interval              06:00:00
```



Note: Start time and stop time are only valid if specified for times after the point the START key is pressed. When the trigger mode is [SINGLE], recording will only occur when the start time is reached, regardless of the set interval.

*Internal trigger setting when analog unit used

```
ch2         ON    level       10%
                  slope        ⮥
                  filter        3
```

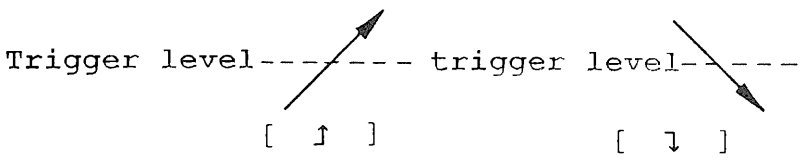
o level - Sets the trigger level.

[10%]: This threshold value is compared to the input value, expressed as a percent of the full scale recording width, which is taken as 100%. Settings from 0% to 100% are possible.

o slope - Sets trigger slope.

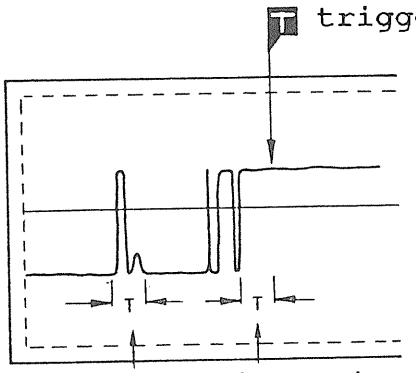
[⮥]: Trigger is activated when input signal passes the threshold value as a positive edge.

[⮧]: Trigger is activated when input signal passes the threshold value as a negative edge.



o filter - Sets the trigger filter.
[OFF]: No filter operation.
[3]: Sets the sampling value (3, 4, 6, 10, 18, 34, 66, 130). If the trigger conditions are inverted within the set time a trigger will be activated.

Example: When the trigger is set to the input signal, this function prevents triggering due to excessive noise.



Trigger conditions invert within time T, and no trigger is activated

Trigger is activated even though trigger conditions do not invert within time T.

* Internal trigger set for logic unit

ch3(log)	ON	A_1 [××××] A_4	B_1 [××××] B_4
		AND/OR	AND
		filter	OFF
		trigT/F	TRUE

o Trigger pattern
A1 [XX0101] A4, B1 [X11X] B4
The logic pattern compared to the input logic single is expressed with 1, 0 and X. 1 indicates HI, 0 indicates LO, and X indicates don't care.

Discrimination between 1 and 0 is handled by the signal detection logic probe. HI/LO level threshold values are set with respect to the status screen input unit.

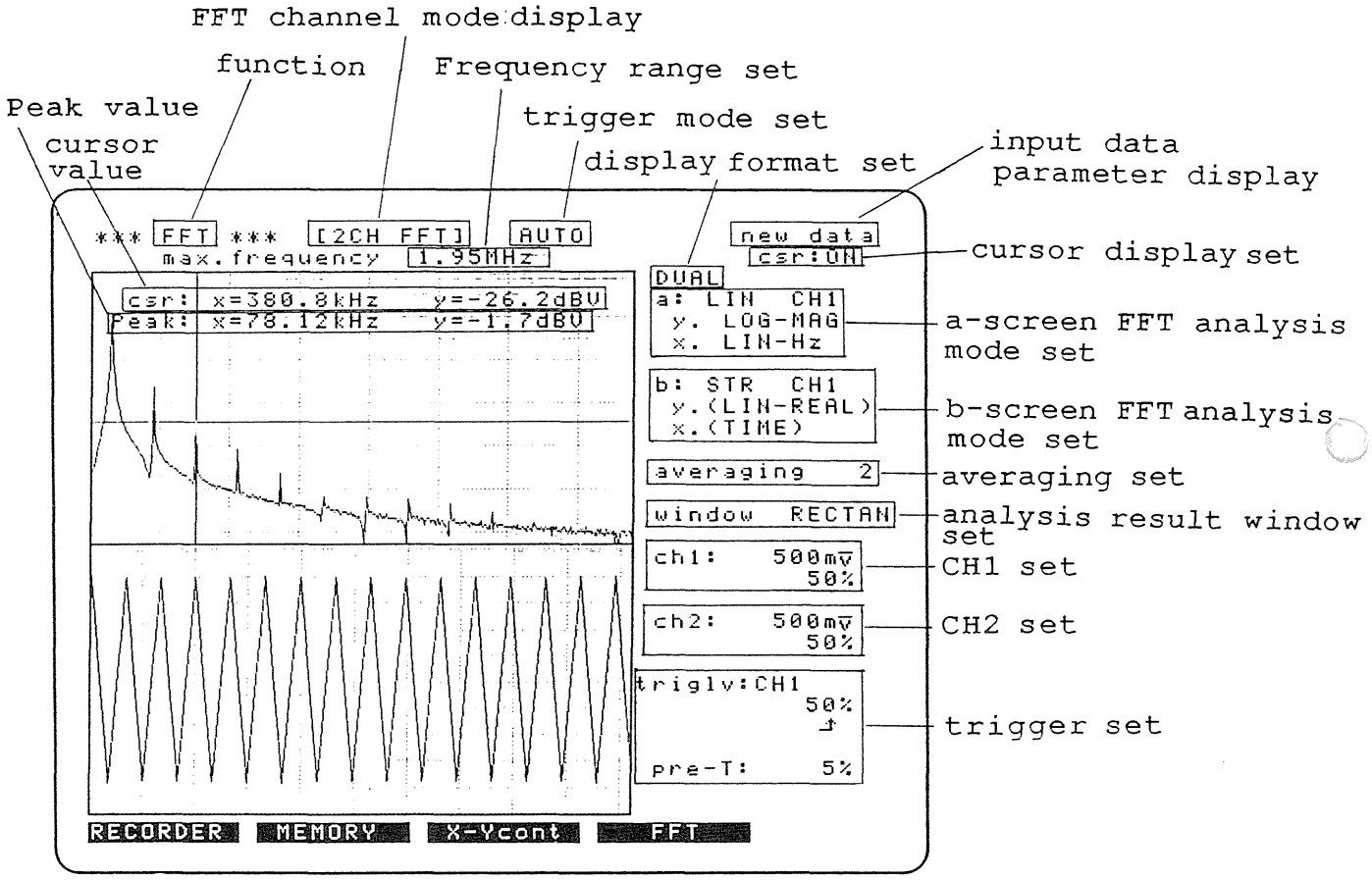
[AND/OR]: Sets trigger pattern AND and OR
[AND]: Trigger activated when all specified trigger patterns match.
[OR]: Trigger activated if even one specific trigger pattern matches.

o filter: Sets the trigger filter. Setting is the same as for the analog unit.

o trig T/F: Sets logic trigger condition match/mismatch.
[TRUE]: Trigger activated when trigger pattern and AND/OR trigger conditions met.
[FALSE]: Trigger activated when trigger pattern and AND/OR trigger conditions not met.

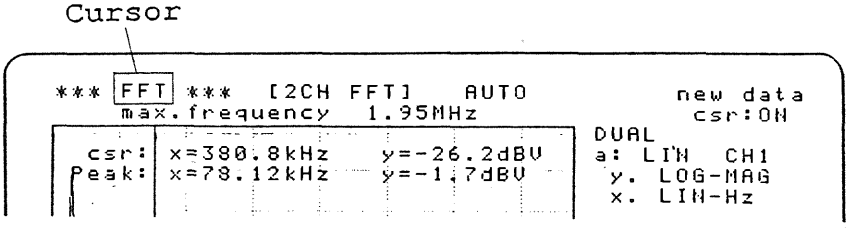
(3) Display screen
Press the DISPLAY key to switch to the display screen.

* Display screen information

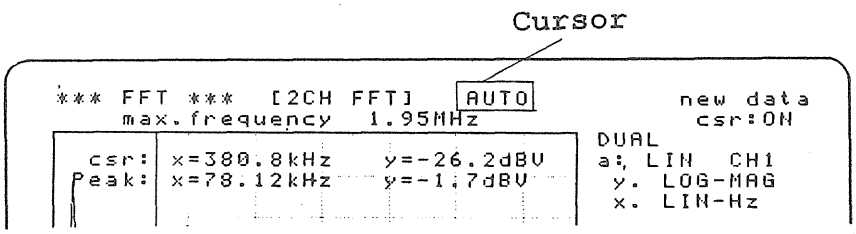


Critical settings for the status and trigger screens can also be handled through the display screen. Refer to the sections on the status and trigger screens for details.

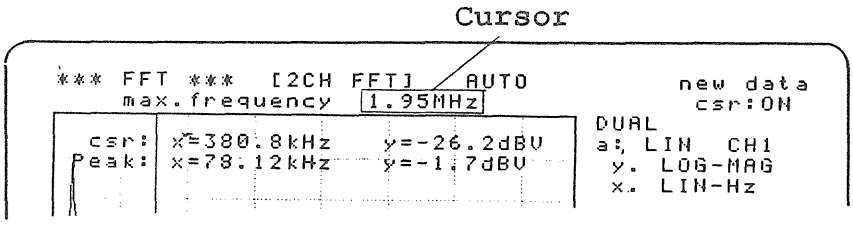
o [FFT]: Selects the function. Can also switch to other function's status screen. (possible settings are RECORDER, MEMORY, XYcont, and FFT).



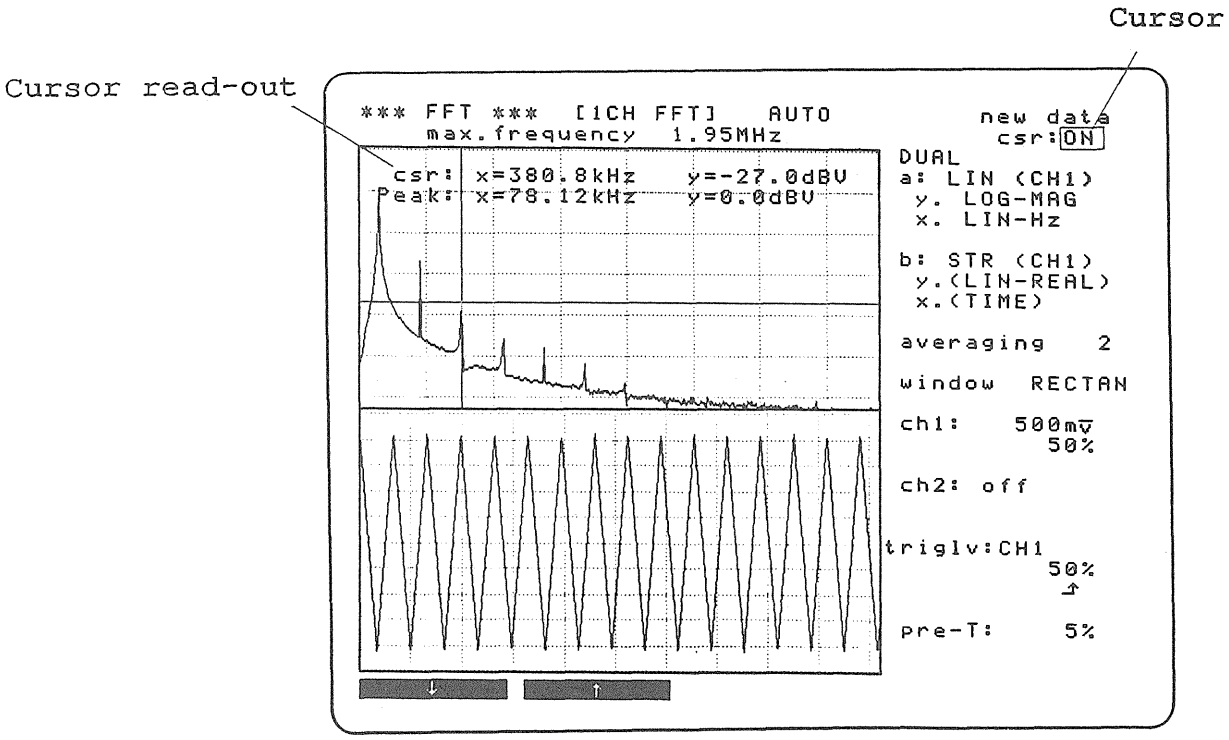
o AUTO: Sets the trigger mode (possible settings are single, repeat and auto).



o max. - Sets the frequency range.
[1.95MHz]: Sets the frequency range to 1.95MHz (possible values are 3.90Hz to 7.79Mhz).



o csr - Sets cursor display to on or off. In Nyquist display the cursor function is disabled.



X-axis and y-axis data indicated by the cursor is displayed with the cursor read-out function (set SCROLL/VALUE key to SCROLL).

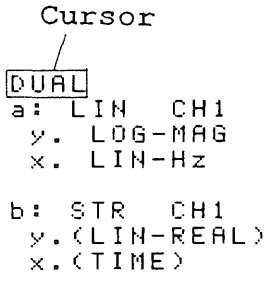
When analyzing linear spectrum or power spectrum, peak x-axis and y-axis values will also be displayed.

Note: Refer to page 242 (Decibel/voltage conversion)

⚠ CAUTION

- When trigger mode set to REPEAT or AUTO, cursors will not move after START pressed even if rotary knob is turned.
- When the offset value is 50%, DC component value on the cursor read-out display differs from the calculated value.
- The cursor read-out value is calculated based on the time base and voltage that are currently displayed.

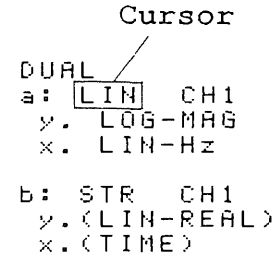
* FFT analysis result display parameter setting



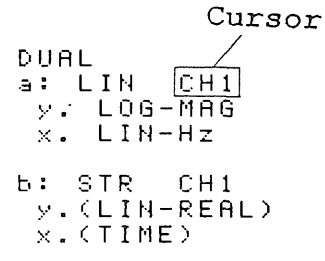
o [DUAL]: Sets the display format for the analysis results to either DUAL or NORMAL.
When waveform judgment is on, DUAL cannot be selected.
Alteration is not possible during START or when Nyquist is selected.

o [LIN]: Sets the FFT analysis mode (for both a and b screens).

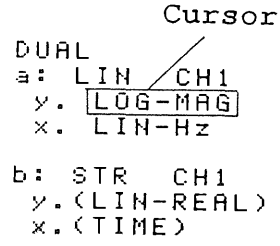
[STR] - Time axis waveform storage
[LIN] - Linear spectrum
[PSP] - Power spectrum
[HIS] - Histogram
Note: Only in 1CHFFT
[TRF] - Transfer function - x-axis cannot be selected when Nyquist has been selected.
Note: Only in 2CHFFT.
[COH] - Coherence function
Note: Only in 2CHFFT.



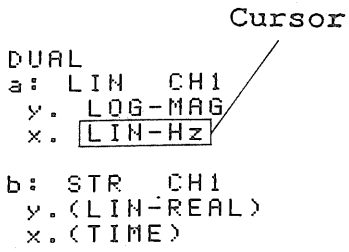
o CH1: Sets the channel (common to a and b screens).
In 1CHFFT mode, CH1 or CH2 is displayed, and channel setting cannot be changed.
In TRF or COH the display is a dash, and channel setting is not possible.



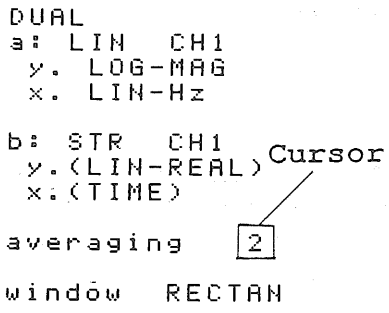
o LOG-MAG: Sets the y-axis (common to a and b screens). When displayed inside parens it indicates the setting cannot be changed. Possible settings are log-mag, lin-mag, phase, lin-real, number, and Nyquist.



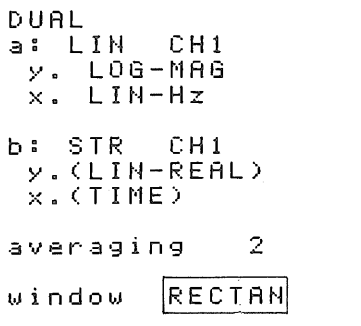
o [LIN-Hz]: Sets the x-axis (common to a and b screens). When displayed in parens it indicates the setting cannot be changed.
When Nyquist is selected for the y-axis, the x-axis will be displayed with a dash, and cannot be selected.
Possible settings are LIN-Hz, LOG-Hz, LIN-V, and TIME.



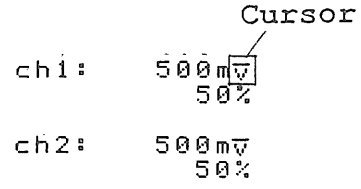
o Averaging: Sets the number of points to be averaged.
[2]: Sets the count to two points (possible settings are off, and 2 through 256 points).



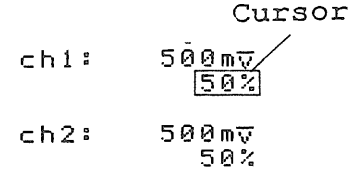
o window: Sets the analysis window.
[RECTAN]: Rectangular window.
[HANNING]: Hanning window
Even if the window setting is altered during analysis, the window selected at the time the START key was pressed will be used.
If the window is changed during repeat, the new window will be used from the next analysis started after the window is changed.



o [500m$\bar{v}$]: Sets measurement range and coupling.
measurement range: 5mV ~ 20V
input coupling
Note: V$\pm$ is GND, $\tilde{v}$ is AC coupling, and $\bar{v}$ is DC coupling.

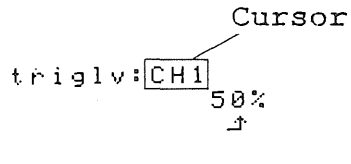


o [50%]: Sets the offset value from -100% to 100%. For FFT caluculation, 50% level is set as zero position (with no DC component included).

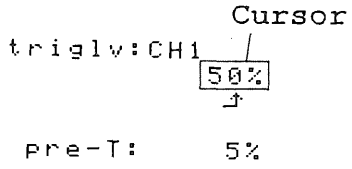


o [CH1]: Selects the trigger source with variable trigger level to one of CH1, CH2 or CH3.

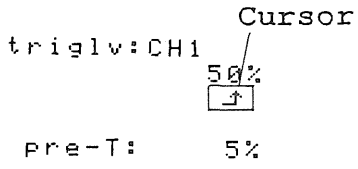
Note: Channels cannot be selected if they have been turned off as trigger sources.



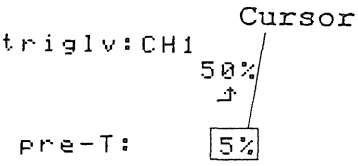
o [50%]: Sets the trigger level for the selected source, from 0% to 100%.



o [⤴]: Sets the slope of the selected trigger source to up or down.

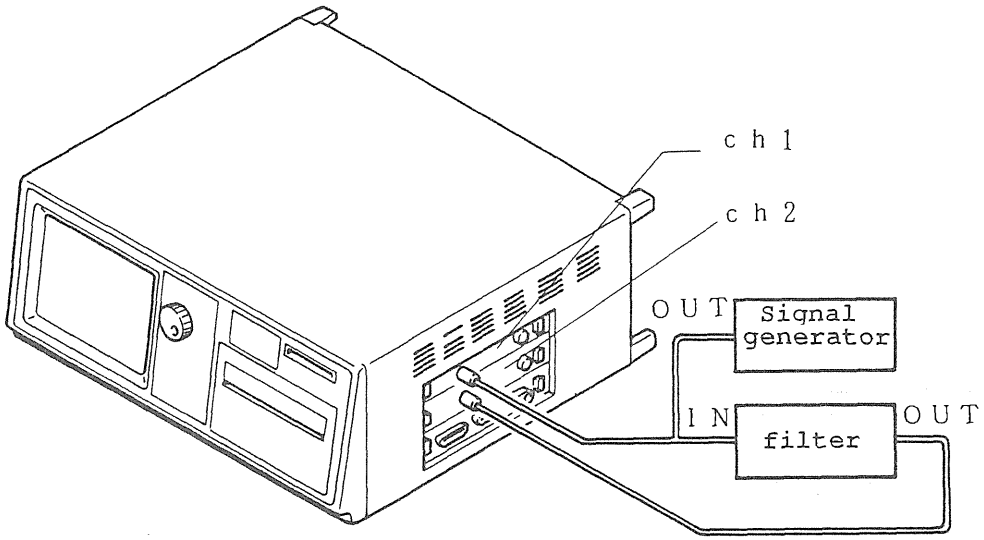


o [5%]: Sets the pre-trigger to -100%, or 0% through 100%.



4.6.4 FFT analysis operation examples

(1) Measurement of frequency response of a filter.



Note: The signal generator output signal may be impulse or sweep.

* Press the STATUS key.

```
***  STATUS ***              FFT            '88-04-27
                                                19:22
        FFT mode             2CH FFT
        max.frequency        3.90kHz
        window               RECTAN
      ---------- DUAL   display format ----------
          mode            ch#  y-axis    x-axis
    a: TRANSFER FUNC       -    LOG-MAG   LOG-Hz
    b: STORAGE             CH1  (LIN-REAL)(TIME)
        dot-line                LINE
        grid                     ON
        printer                  ON
        list out                 ON
        reference data          NEW
      ---------- channel conditions ----------
                          ch1      ch2      ch3*
    range(/div)         200mV    200mV      2V
    offset                50%      49%      50%
    coupling               DC       DC       DC
 RECORDER | MEMORY | X-Ycont | FFT | SYSTEM
```

Use the 2CHFFT mode.

Set the measurement frequency range.

Use the rectangular window.

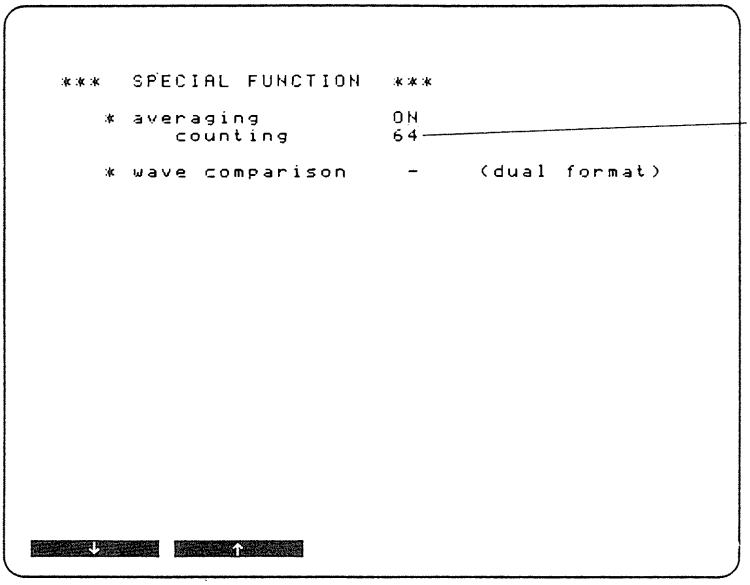
Set the display desired.

Set NEW.

Set the range to match the signal.

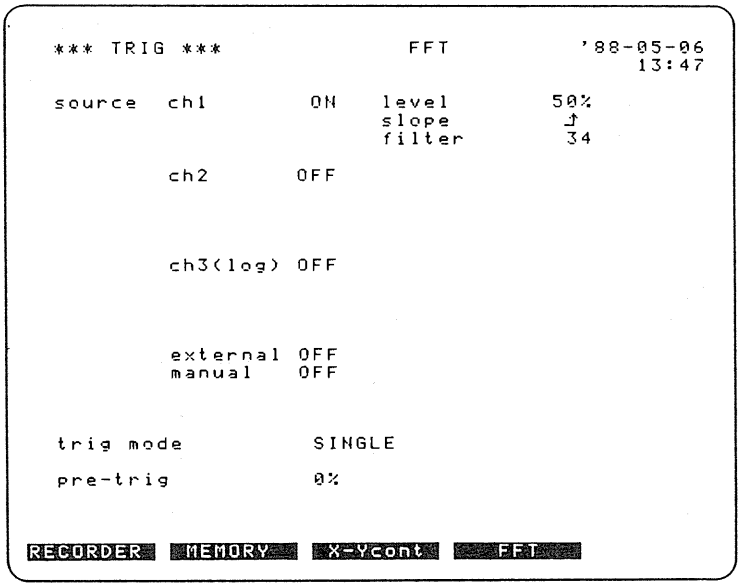
Set to about 50% to cancel out DC component.

Set to DC.



Set averaging count to about 64 points.

* Press the TRIGGER key.



Set the trigger to the input waveform (CH1).

Set the special trigger off.

* Press the START key to start measurement.
The transfer function and input waveforms will be displayed on the screen.
Change the FFT analysis mode, x-axis and y-axis settings to observe Nyquist diagrams, etc.
Refer to the sample outputs given in Chapter 6.

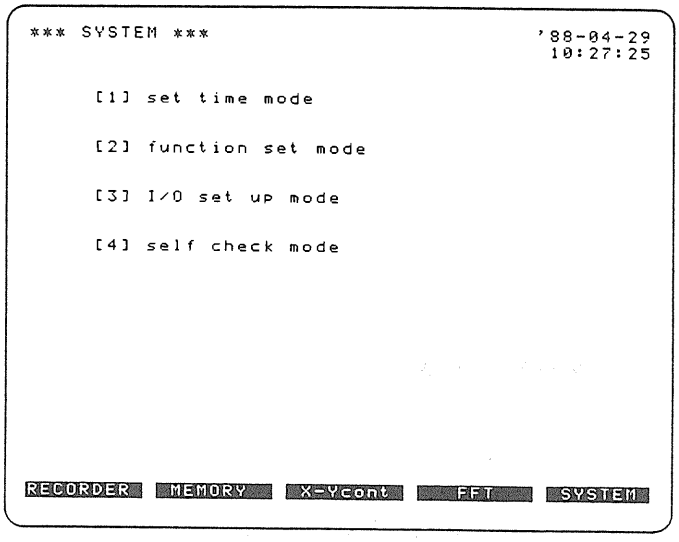
4.7 Using the system set-up screen

The system set-up screen can be used to set the clock, set operation parameters common to all functions, define interface parameters, and execute self-diagnosis.

Operation

1) Press the STATUS key twice, and then select the SYSTEM function select key to switch to the system set-up screen.

2) Move the cursor to the desired menu entry, and press the EXECUTE function select key to select that item.



System set-up screen

Each mode is described below. Refer to Chapter 7 for details on the self-diagnosis mode.

4.7.1 Clock function and setting

- Internal clock has auto-calendar, automatic leap year adjustment, and 24-hour clock.
- Status and trigger screens display year, month, date, hour and minute. The system set-up screen also displays second.
- Time and date are used in the timer source function as the trigger, and to mark the start of recording printed on recording charts.
- The clock will continue operation for about a month after power is turned off, when the internal battery is fully charged.

Note: Leaving the power on for about 50 hours consecutively will fully charge the battery. Operating the system about 1.5 hours a day will maintain the battery at full charge.

peration

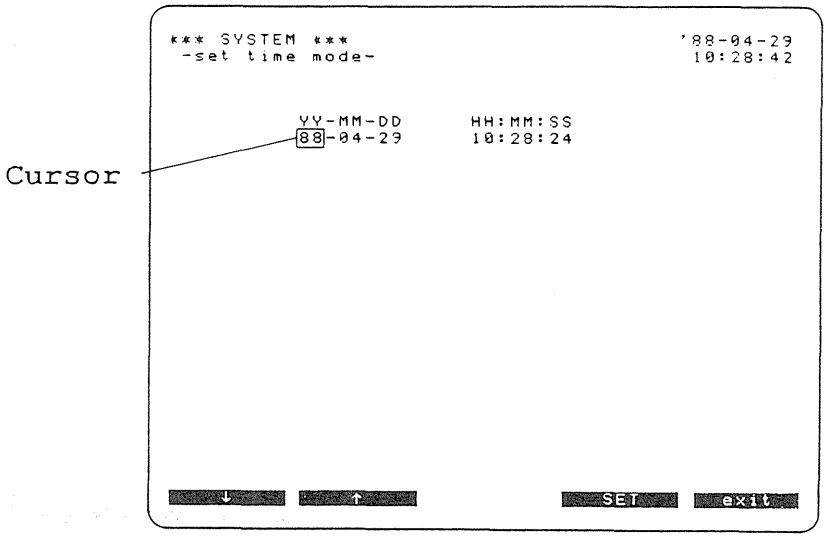
1) Move the cursor on the system set-up screen to [1] set time mode, and press the EXECUTE function select key to display the set time mode screen.

2) Use the cursor keys to move the cursor to the item to be changed, and then the up and down arrow function select keys to select the correct entry.

3) Once date and time are updated, press the [SET] function select key. Unless this key is pressed the new

values will not be stored into the system.

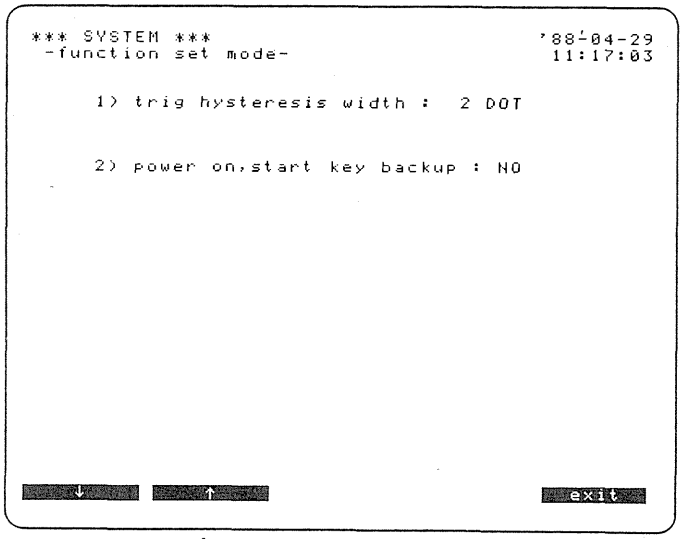
4) Press the [EXIT] function select key to return to the system set-up menu.



Set Time Mode Screen

4.7.2 Operating state setting - trigger hysteresis and back-up state

- Move the cursor on the system set-up screen to [2] function set mode, and press the EXECUTE function select key to display the function set mode screen.
- On the function set mode screen set the trigger hysteresis width and back-up status.
- After setting is complete, press EXIT to return to the system set-up screen.



Function Set Mode Screen

(1) Hysteresis

When an analog unit is used as the trigger source, accidental triggering due to noise can be prevented by creating an insensitive band in the trigger level

(hysteresis).

. Hysteresis widths may be set to 1, 2, 4, 8 or 16. Hysteresis width 1 is equal to 0.4% of the trigger level.

. When the hysteresis width is changed, the trigger level setting step size may change from 1%. For details, refer to Section 4-15.

Setting

. Move the cursor on the system set-up screen to dot count specification region of [3] trig hysteresis width, and press the EXECUTE function select key to display the trigger hysteresis width set screen.

(2) Back-up state

. The stored state is that existing when the power is turned off.

. If the system is turned off during recording, either of the following states may be selected when power is turned back on:
  A. Continue recording
  B. Stop recording, and enter stand-by as if the STOP key had been pushed.

Operation

On the function select mode screen move the cursor to 2) power on, start key back-up, and press function select keys YES or NO accordingly.

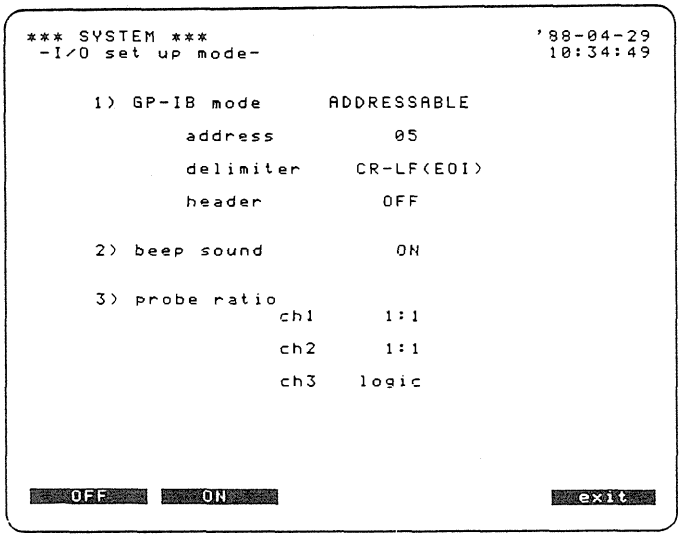
4.7.3 Interface parameters (GP-IB, beep, probe attenuation)

. On the system set-up screen move the cursor to [3] I/O set-up mode, and press the EXECUTE function select key to enter the I/O set-up mode screen.

. In this screen it is possible to set parameters for the GP-IB interface, the beep sound, and the attenuation ratio for analog input probes.

  For settings dealing with GP-IB, refer to Section 3.1.1 of the 8850 GP-IB Interface Manual.

. After set-up is complete, press the EXIT function select key to return to the system set-up screen.



I/O set-up mode screen

(1) Beeper

. The beeper can be set to sound when an error is generated, a warning message displayed, or a waveform judgment has in an NG result.

Operation

. On the I/O set-up mode screen, move the cursor to 2) beep sound, and select either ON or OFF accordingly.

(2) Input probe attenuation ratio

. The attenuation ratio for analog input channels can be set individually to 1:1 or 10:1.

. This attenuation ratio is used in the input unit measurement range, and therefore must be matched to the input probe used.

Note: If the settings of the input probe and the attenuation ratio do not match, the values generated for A and B cursor calculation of voltage display (delta V), true rms value and voltage values printed on the chart will be incorrect.

Operation

. On the I/O set-up mode screen, move the cursor to 3) probe ratio, and select either 1:1 or 10:1 for each channel accordingly.

4.8 Printer operation

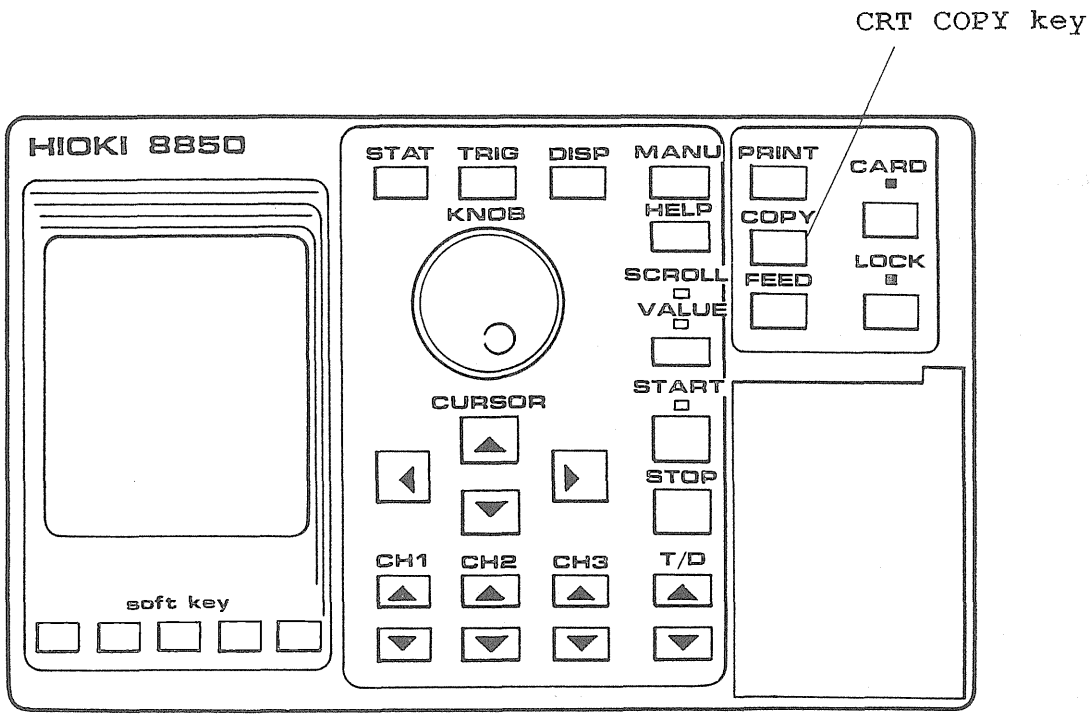
4.8.1 Head raise and paper end

. Printout is not possible with the printing head in the raised position. The following error message will be displayed:

. If there is no recording paper present in the printer printout is not possible. Refer to Section 3.2 and load new recording paper. The following error message will be displayed:

4.8.2 CRT copy function

Except during measurement pressing the CRT COPY key will allow you to make a printout of the screen at any time.



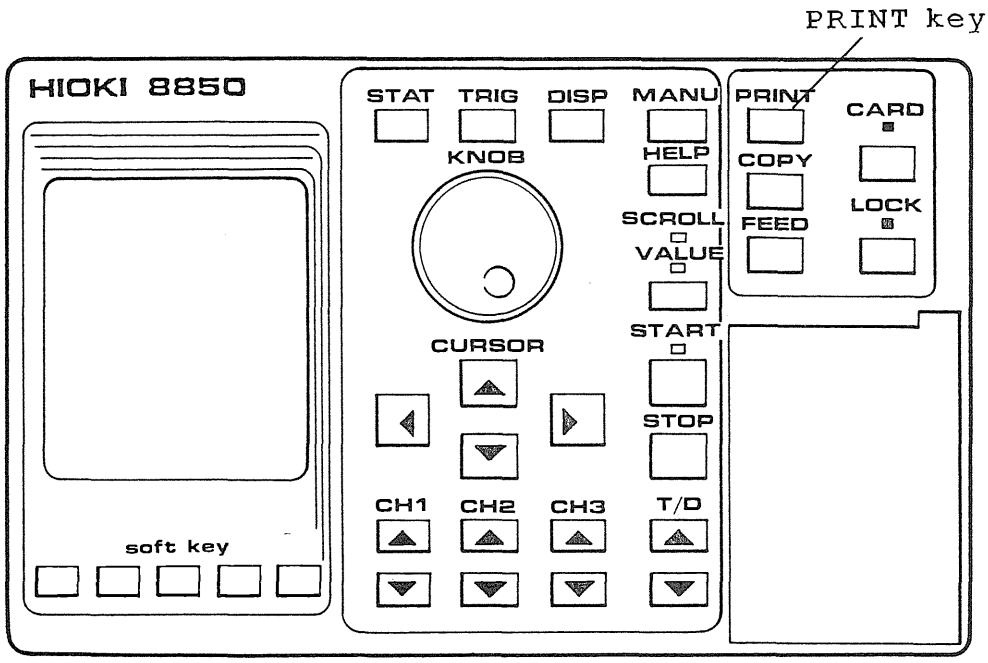
4.8.3 Manual print function

Except in the recorder function, stored waveform data can be printed out any number of times by pressing the PRINT key.

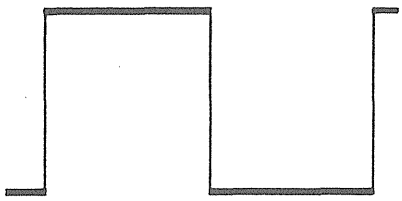
When list out has been set to on in the status screen, the parameter list will also be printed out.

When the printer has been set to smooth for the memory recorder function, the printout will approximate an analog signal.

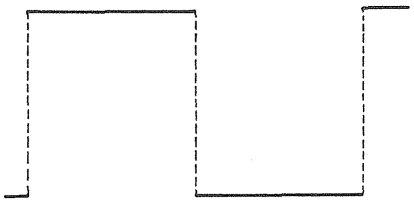
> ⚠ CAUTION
>
> The PRINT key turns the printer on and off in the recorder function.



4.8.4 DARK and LIGHT indicators
When the display format is NORMAL and drawing is DARK, interpolation is drawn with lines, but when drawing is LIGHT interpolation is handled with dotted lines. For this reason, when a fixed-level input signal is displayed (especially in the recorder function), the LIGHT specification may be drawn as parallel lines due to input signal fluctuation (see diagram below).



[DARK] display



[LIGHT] display

[DARK] fixed level display
(enlarged view)

[LIGHT] fixed level display
(enlarged view)

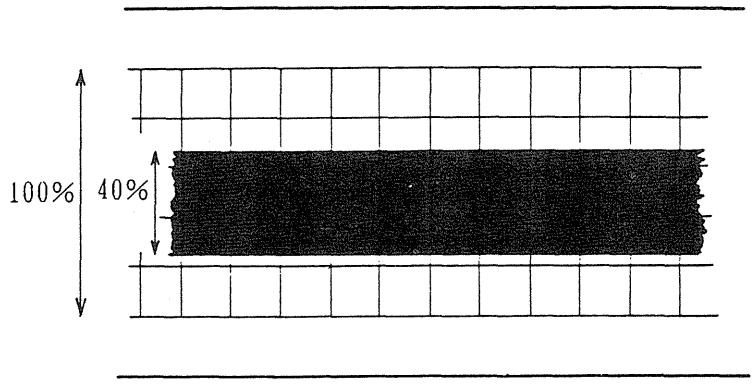
4.8.5 Maintaining head temperature

This printer is equipped with a circuit to maintain the optimum printing head temperature. If thermal head temperature rises above a threshold level, this function cuts out printing. During this period the printout will be temporarily disabled, and the recording paper remain blank.

Head temperature rise becomes a problem as the amount of black per unit area rises, and as paper feed speed rises. For example, note that the printout will be cut out in several minutes for a printout in recorder function of the painted area shown in Fig. 4-8-4 An excessively high ambient temperature may cause the same problem to occur.

If the protective circuit operates and halts printing, printing will be restarted once the printing head temperature drops back below the threshold. Once printing is restarted, either adjust the input amplifier range to minimize the black area, or set the recording line to LIGHT.

TIME/DIV	Ratio of black
400m s	35%
500m s	40%
1 s e c	35%
2 s e c	60%
5 s e c	100%



Printout example

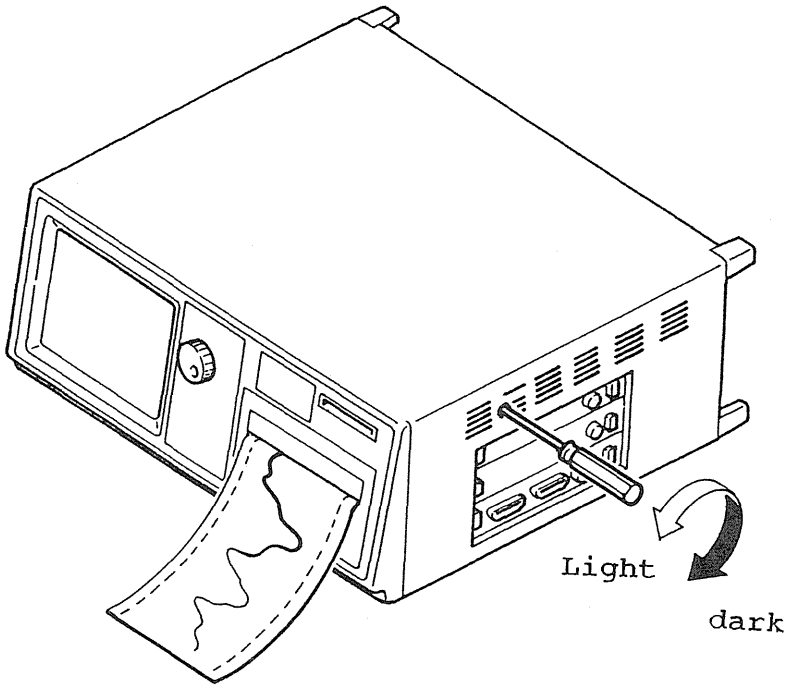
Note: These values are only to be taken as guidelines. Actual values will vary with use conditions.

Fig. 4-8-4 - Black areas that can be printed out continuously (recorder function, ambient temperature 23°C).

4.8.6 Adjusting print density

Chart print density can be adjusted with a blade screwdriver as indicated below.

Do not set the print density any darker than necessary.



Adjustment of print density

4.9 IC card functions and operation

4.9.1 IC card functions

(1) Two types of IC cards are available: RAM cards and ROM cards.

(2) RAM cards are used by selecting commands from the screen.

(3) RAM cards can be used to store set-up parameters, measurement data, and waveform judgment profiles.

(4) RAM cards make it possible to assure that the 8850 is always used with the same parameter set-up for a given process.

(5) Maximum IC card size is 256KB.

(6) The 9352 ROM card (optional) provides various calculations, such as differentiation, integration, averaging and area calculation.

⚠ CAUTION

* Only use Hioki IC cards. The manufacturer cannot accept responsibility for problems arising from the use of other cards.

* If the IC card is forcibly inserted upside down, the IC card or the system itself may be damaged.

* Battery replacement is handled by first inserting an IC card into the system, and then changing batteries with the power on. If the battery is removed from the IC card without external power supply back-up, stored data will be lost.
* RAM card batteries are replaced by first inserting an RAM card into the system, then changing the battery with the power on. If the battery is removed from the card without providing an external power supply, stored data will be lost.

* When using a new RAM card, be sure to format it first. Remove the battery and destroy all data that may be stored in the chip.

* Never pull out IC cards during command execution.

Note: The following descriptions are for RAM cards. For ROM cards, read the ROM card instruction manual. In the following, the term "IC cards" refers to RAM cards.

4.9.2 List of commands

[INIT]: IC card initialization
[SAVE]: Store data to IC card
[LOAD]: Upload data from IC card
[KILL]: Delete data from IC card
[COPY]: Copy IC card data to another IC card
[TEST]: Check IC card internal RAM

4.9.3 Storable items and capacity

(1) Set-up parameters

1) IC cards can store set-up parameters for recorder, memory recorder, XY recorder and FFT analysis functions.

2) When these stored parameters are uploaded to the 8850 it will be automatically set to match them.

Storage capacity per function: Recorder 97 bytes
Memory recorder 126 bytes
XY recorder 89 bytes
FFT analysis 114 bytes

(2) Measurement data

1) IC cards can store measurement data for memory recorder, XY recorder and FFT analysis functions.

2) When memory recorder function stored data is uploaded to the 8850 the waveform data is stored in the input channel memory.

3) When XY recorder function data is uploaded to the 8850 it is displayed on the CRT.

4) When FFT analysis function data is uploaded to the 8850 it is stored to 8850 system memory, and FFT analysis is possible.

5) The system parameters are stored along with the measurement data, and when data is uploaded the system is automatically reset to the state it was in when the data was recorded.

Storage capacity per function:
Memory recorder recording length (DIV) x 50 + 63 bytes
XY recorder 32863 bytes
FFT analysis 16004 bytes

(3) Waveform judgment profile

1) The waveform judgment profile can be stored for memory recorder and FFT analysis functions.

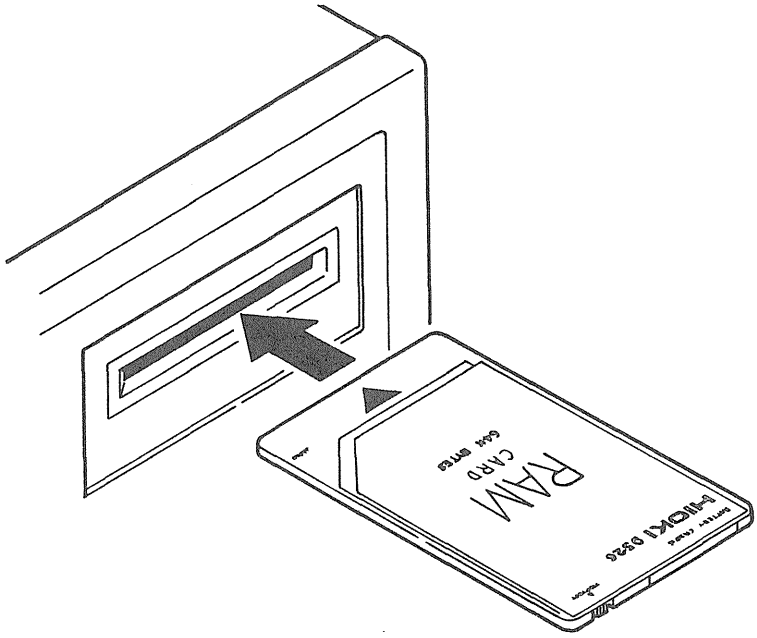
2) Set-up parameters are not stored.

Storage capacity per function:
Memory recorder (normal display) 24604 bytes
Memory recorder (XY display) 16412 bytes
FFT analysis 16412 bytes

4.9.4 IC card usage

IC card insertion

Turn the IC card so that the printed side is up, and insert it gently but firmly until it stops.

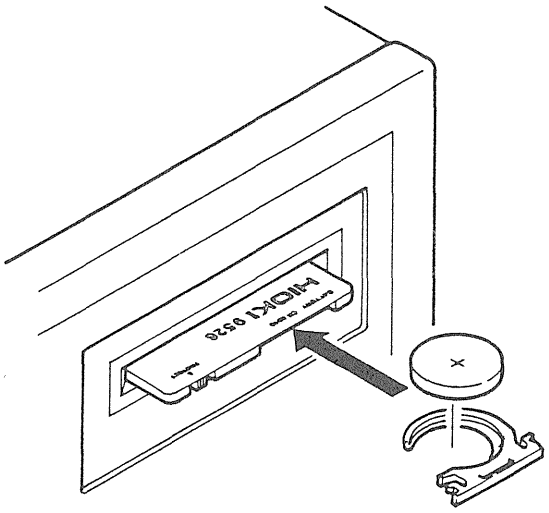


IC card battery replacement

1) Insert the IC card into the 8850, and turn on the 8850 power. Pull out the IC card battery holder.

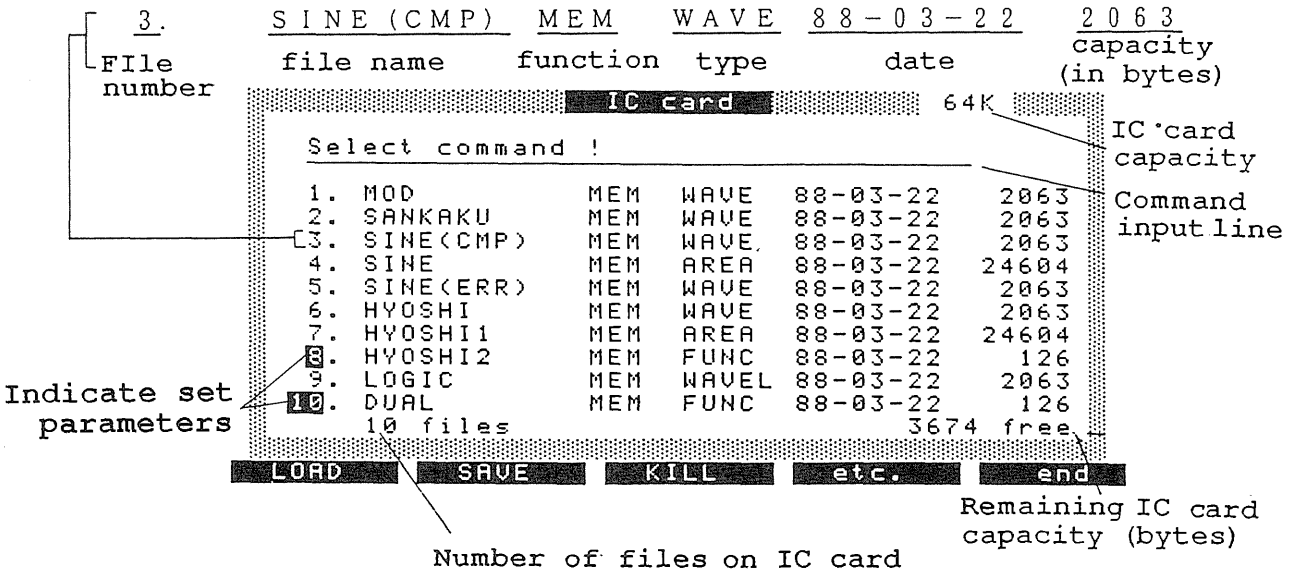
2) Turn the battery so that the + side faces up, insert it into the battery holder, and insert the battery holder into the IC card package.

3) Make sure the battery holder is securely installed in the IC card package.



(1) Transferring commands to the IC card

1) Pressing the IC CARD key (except when in the system set-up screen) will switch to the IC card command selection screen, and the files on the IC card will be displayed. If a new IC card or an IC card with corrupt files is used, the command will automatically be set to INIT (refer to the description of INIT below).



. Functions will be displayed as below, depending on the function stored:
  REC = recorder
  MEM = memory recorder
  XY = XY recorder
  FFT = FFT analysis

. The type displayed also depends on the type stored:
  FUNC = Set-up parameters
  WAVE = Waveform (analog for memory recorder)
  WAVEL = Logic waveform (memory recorder only)
  AREA = Waveform judgment profile (excluding XY display on memory recorder)
  ARXY = Waveform judgment profile (memory recorder XY display)

2) If there are 10 or more files on the IC card, turning the rotary knob will scroll the file list vertically one file name at a time. The rotary knob SCROLL/VALUE select function is disabled at this time.

3) The function select keys are used to select commands. Pressing the "etc" key will cause the function menu to switch between LOAD, SAVE and KILL and COPY, INIT and TEST.

4) Move the cursor to the item to be altered, and set the new value with the software function keys.

Note: Asterisks (*) may be displayed after the file numbers. This indicates that the contents of the file are

corrupted, and that the file cannot be uploaded.

(2) Automatic parameter set from IC card at boot

. If the IC card is inserted and then the system power turned on, and an automatic parameter set file is stored on the IC card, the data will be uploaded automatically and the 8850 system parameters set to match.

. Automatic setting is possible for the run parameters for each function, and for the judgment profile.

. Automatic parameter set files must be saved under the name STARTUP, and judgment profiles under the name STARTUPa.

. When set-up is handled from the IC card, the CRT screen will display the following message:

"Load STARTUP....complete!"

Command descriptions

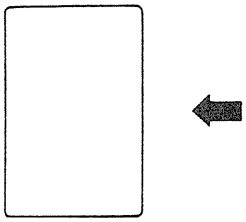
[INIT] - Initializes the IC card.

Command input line display　　procedure

1) [_Select command]:
Cursor　　On the command selection screen, press INIT.

2) [_Initialize]:Are you sure ?(no/yes):
Cursor　　Pressing YES will start the initialization program, and pressing NO will return to the command selection screen without initialization.

Pressing YES will initialize the IC card.
Pressing NO will return to the command selection.



Initialize -

data clear

IC card

[SAVE] - Transfers system set-up parameters, measurement waveforms or waveform judgment profiles to the IC card for storage.

Command input line display　　procedure

1) [_Select command]:
Cursor　　On the command selection screen, press [SAVE].

The parameters for the function currently being used will be downloaded.
Press [EXIT] to cancel the save command, and return to the command selection screen.

(1) Recorder function (only set-up parameters can be saved)

2) [save FUNC to file[_]]:
Cursor　　Input the file name and press [EXECUTE] to transfer the data to the IC card. Specification of file names is detailed below.

(2) XY recorder function (set-up parameters and measurement waveforms can be saved)

Command input line display	procedure
2) [save FUNC]: Cursor	Press [FUNC] to save the set-up parameters only, or press [WAVE] to save the set-up parameters together with the measurement waveform.
3) [save (FUNC) to file[_]]: (WAVE) Cursor	Input the file name and press EXCUTE to transfer the data to the IC card. Specification of file names is detailed below.

(3) FFT analysis function (set-up parameters, judgment waveforms and measurement waves can be saved)

2) [save FUNC]: Cursor	Press [FUNC] to save the set-up parameters only, press [WAVE] to save the set-up parameters together with the measurement waveform, or press [AREA] to save the set-up parameters, the measurement waveform and the judgment profile.
3) [save (FUNC) to file_]: (WAVE) (AREA) Cursor	Input the file name and press EXECUTE to transfer the data to the IC card. Specification of file names is detailed below.

(4) Memory recorder function: (set-up parameters, judgment waveforms and measurement waves can be saved for each channel)

2) [save FUNC]: Cursor	Press FUNC to save the set-up parameters only, press WAVE to save the set-up parameters together with the measurement waveform, press AREA to save the judgment profile, or press ARXY to save the judgment profile for XY function.

For Wave: Select the channel to be saved as CH1, CH2 or CH3.
[SAVE WAVE CH1]
Cursor

3) [save(FUNC)to file[_]]: Input the file name and press
(WAVE CH1) Cursor EXECUTE to transfer the data
(AREA) to the IC card.

* Partial save of measurement waveform (memory recorder function)
By using the A and B cursors it is possible to save a portion of the measurement waveform.
1) Set the cursors on the display screen to A&B.
2) Set the direction for the A and B cursors to horizontal.
3) Use both cursors to bracket the portion of the waveform to be saved.
4) Press the IC card key, and save the data with the SAVE command. The procedure for the save is the same as outlined above for memory recorder waveforms.

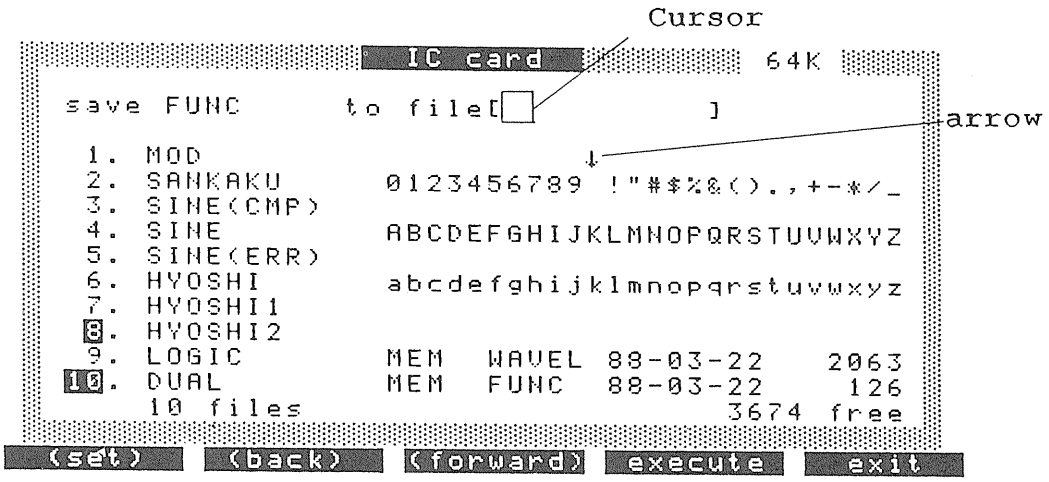
Note: . The recording length of a waveform stored with partial save is the shortest recording length including the specified range, with the remainder filled with 0 (0 represents a value below the lowest waveform value).
. If the system is set to A&B cursor type and horizontal direction, it will automatically be set to partial save. If the entire measurement waveform is to be saved, set the A and B cursors to "off".

Note: The saved waveform length will be the smallest possible length that incorporates the specified length, with the remainder filled with "0" data.
When the cursors are set to horizontal A and B cursors partial save is automatically assumed by the system. To save the entire waveform, turn off the A and B cursors.

. In the XY format there is no partial save function.

. In partial save the word "part" is displayed under the word "WAVE", as shown below.

* File name input



File name input screen

1) Using the four cursor keys move the arrow to the desired character.

2) Press the (set) key to input the selected character into the cursor position, and advance the cursor one column to the right.

By repeating steps (1) and (2) up to 10 characters can be input. To correct an input file name, use the function select keys marked back and forward. Pressing back will move the cursor one column to the left, and forward will move it one space to the right. Move the cursor to the column with the character to be corrected, and repeat steps (1) and (2) to correct it.

* Automatic file name assignment function

If execute is pressed without inputting a file name, the system will generate one, consisting of four letters indicating the file type and a sequential 3-digit number. File types can be FUNC (set-up parameters), WAVE (measurement waveform) or AREA (judgment profile).

The 3-digit number is a sequential number from 001 to 999.

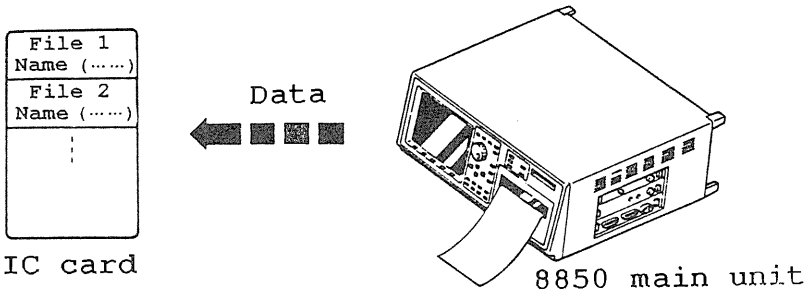
Example: WAVE001

* Saving file names that already exist on that IC card

If a file name that already exists is selected, the system will ask for verification first by displaying the following message:

If YES is pressed the previous file will be deleted and the new one saved.

If NO is pressed, the screen will return to the state it is in before EXECUTE is pressed.



[LOAD]: Uploads data from the IC card to the 8850

Command input line display	procedure
1) [_select command]: Cursor	Press LOAD on the command selection screen.
2) [load file NO.1]: Cursor	Pressing [↑] will cause the file number to increment, and pressing [↓] will cause it to decrement. Pressing execute will upload the specified file. After the data transfer is complete, the screen will change to the IC card screen. Pressing exit will return to the command selection screen without executing upload.

* When file is memory recorder waveform

[load life NO.1 to CH1]: Move cursor to CH1, and set the
Cursor Channel to be loaded to.

In this case the following restrictions apply:

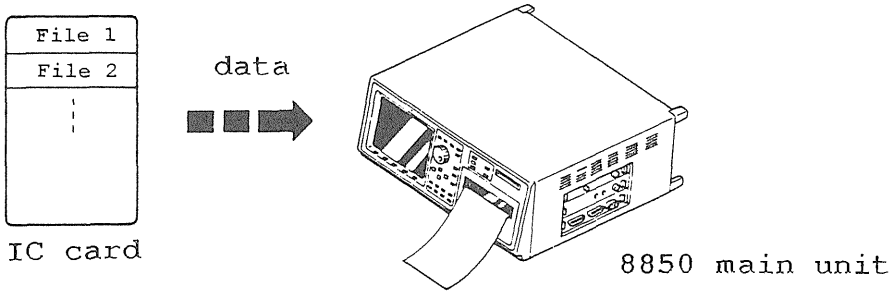
1) Set-up parameters for channel settings (input unit and trigger parameters) and the sampling speed are changed to match IC card data.
2) If the current recording length is equal to or greater than the file recording length, the file will be loaded and the remaining space filled with "0".
3) If the current recording length is less than the file

recording length, load is not possible and the recording length must be changed.

Note: If there is no waveform data in memory, the recording length can also be uploaded (in certain cases).

⚠ CAUTION

Make sure the channel used for uploading is the same type as that used for saving. There is no meaning if the upload is made to an input unit of a different type.



[KILL] - Delete a file from the IC card

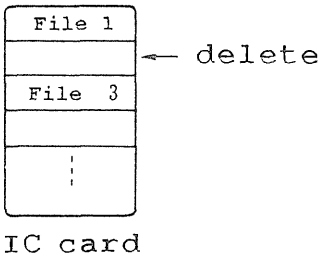
Command input line display

1) [_ select command]:
Cursor

2) [kill file NO.1]:
Cursor

procedure
Press [KILL] on the command selection Cursor screen.

Pressing [↑] will cause the file number to increment, and pressing [↓] will cause it to decrement. Pressing execute will delete the specified file. Pressing exit will return to the command selection screen without executing upload.

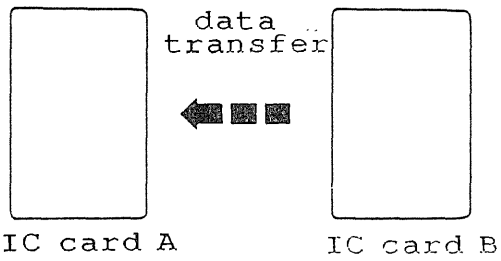


[COPY]: Copy all data from one IC card to another

Command input line display	procedure
1) [_ select command]: Cursor	Press [COPY] on the command selection screen.
2) [_ Storage data will lost OK?(no/yes)]: Cursor	Pressing [NO] will return to the command selection screen. Pressing [YES] will transfer all IC card data to the 8850 memory. If there is waveform data present in the 8850 memory, it will be deleted.
3) [_ Change IC card!]: Cursor	Remove the source IC card. Pressing [exit] will return to the command selection screen.
4) [_ Please set IC card!]: Cursor	Insert the destination IC card. Be sure that the IC card write protect is not enabled. Pressing exit will cause the IC card screen to vanish, and return to the function screen present before the IC CARD key was pressed.
5) [_ Copy Start OK?(no/yes)]: Cursor	Pressing NO will return to the command selection screen. Pressing YES will transfer data from the 8850 memory to the new IC card. After transfer is complete the system will return to the command selection screen.

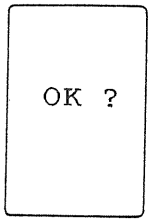
Note: When an IC card of different capacity is used, be sure the destination card's capacity is larger than the source card's, or copy may be impossible.

All data present on the destination IC card will be deleted.



[TEST]: Performs test to check IC card data integrity

Command input line display	procedure
1) [_ select command]: Cursor	Press TEST on the command selection screen. Either OK or an error message will be displayed. IC card contents will not be affected.
2) [Now testing IC card]:	Test program is running. Please wait for several seconds.
3) [OK, this IC card is good]:	(result shows good card)
4) [Sorry, this IC card is broken]:	(result shows card is damaged). Press any key to return to the command selection screen.



IC card

4.9.5 IC card operation examples

It is possible to store the waveform data from channel 1 to an IC card, and then display it together with a new waveform for comparison.

1) Record an input signal in the memory recorder function with the following CH1 parameters:
   [time/div]:100 μsec
   [shot]: 15 DIV

2) Insert an IC card into the 8850.

3) Press IC CARD.
. For a new IC card, initialization is required.
   [ERROR:bad IC card (end or init?)]:
   Press function select key [INIT]
   [Initialize:Are you sure?(no/yes)]:
   Press function select key [YES]

4) Store waveform data to IC card
   [_ Select command!]: Press function select key SAVE
   [save FUNC]:Press function select key WAVE
   [save WAVE CH1]: Press function select key CH1

Note: Underlined terms inside the parens indicate the flashing cursor locations.

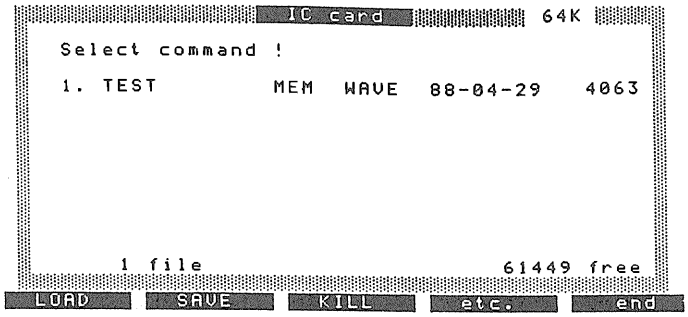
5) Specify the file name as TEST using the cursor keys, and the [(set)] key as described above.

6) Execute save
Press the execute function select key to execute the save command.

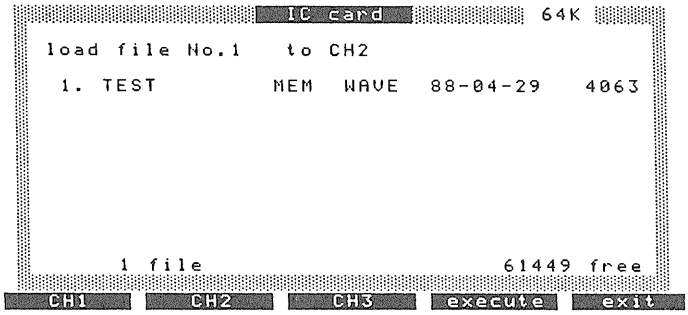
7) Record a new waveform on the memory recorder under the same measurement parameters.

Use the simultaneous print function to print out the new waveform and the stored waveform overlapped.

8) Press the IC CARD key



9) Load the IC card file named TEST to CH2 of the 8850.
[_Select command!]: Press function select key LOAD
[load file No.1 to CH1]: Use the vertical arrow keys to select the file number. Use the horizontal arrow to set the channel.
[load file No.1 to CH1]: Press function select key CH2.



10) Execute the load
Run the load command with the execute function select key. After the load is complete the IC card screen will vanish.

11) On the display screen, setting the CH2 display to DARK or LIGHT will allow simultaneous overlapping display of the CH1 new waveform and the CH2 waveform from the IC card.

Pressing the print key will print out both waveforms, allowing detailed comparison.

In this way it is possible to compare the waveform stord in the IC card currently displayed waveform.

4.10 Averaging function

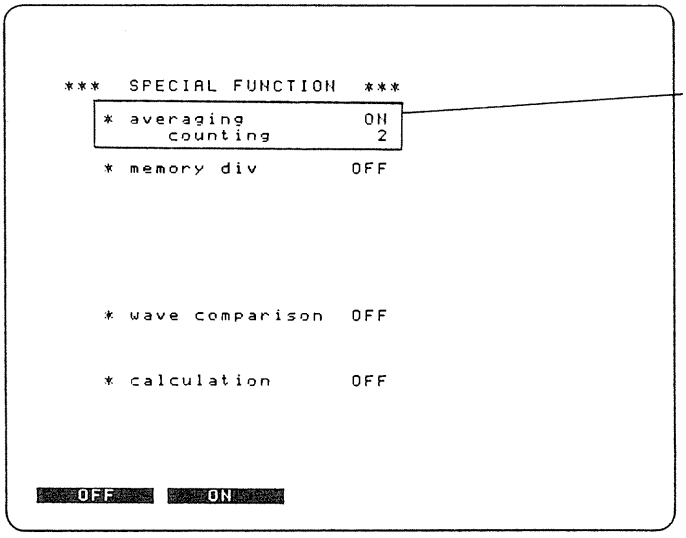
4.10.1 Memory recorder function averaging

Averages the input signal waveform, making it possible to observe waveform components without the effects of noise component weighting.

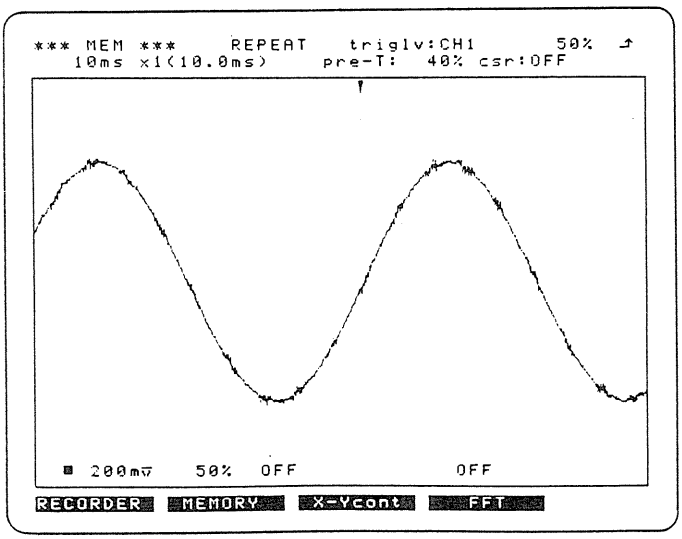
Settings are handled with the status screen special functions.

o averaging: Averages the input signal waveform.
[OFF]: No averaging performed.
[ON]: Averaging performed.
. counting: The number of points that are averaged.

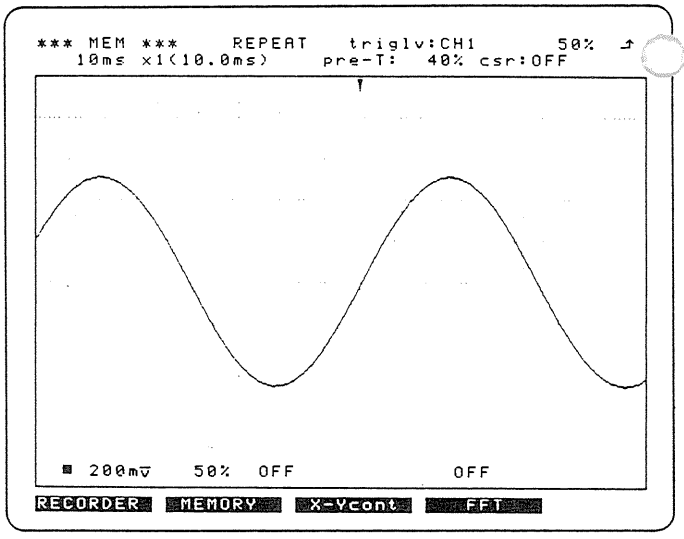
(number of points averaged can be set to 2, 4, 8, 16, 32, 64, 128, 256)



special function screen



no averaging



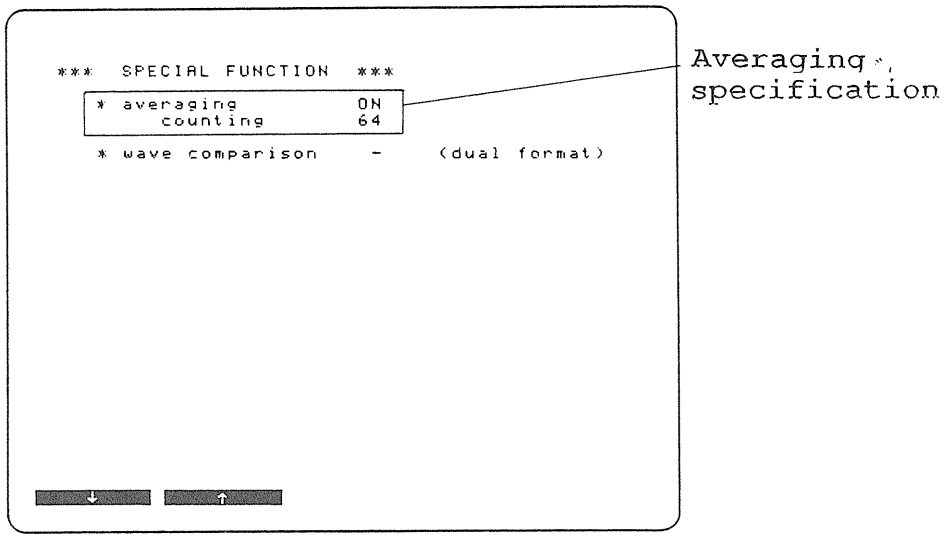
with averaging (64回)

4.10.2 FFT analysis function averaging

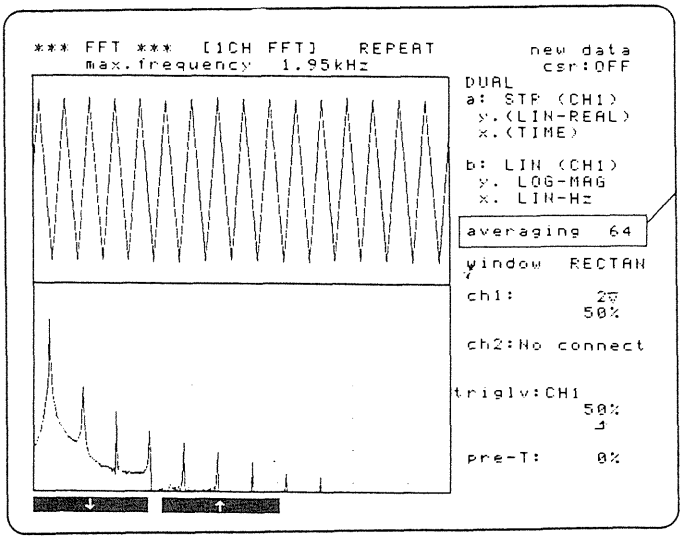
The FFT analysis function performs averaging for the time axis. By using the trigger function to average waveforms with the same phase, it is possible to cancel out noise components. The resultant waveforms will display only the periodic components.

Setting is handled on the status screen special function and the display screen.

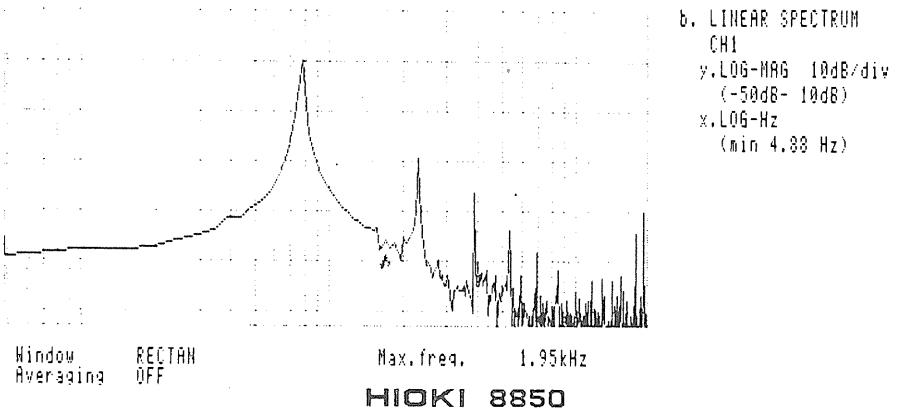
o averaging: Averages the input signal waveform.
[OFF]: No averaging performed.
[ON]: Averaging performed.
[counting]: The number of points that are averaged. (number of points averaged can be set to 2, 4, 8, 16, 32, 64, 128, 256)



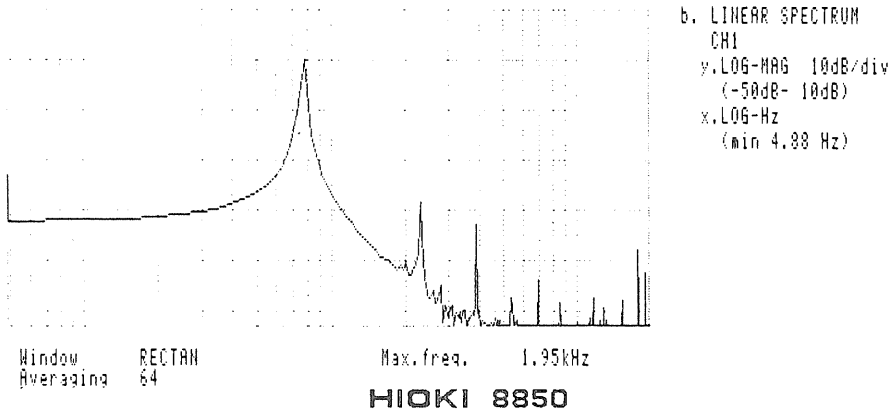
special function screen



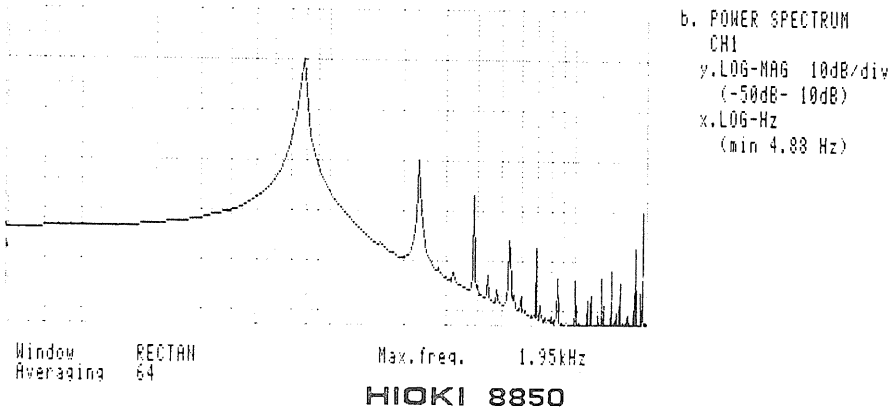
display screen



[Linear spectrum, no averaging]



[Linear spectrum, 64 point averaging]



[Power spectrum, 64 point averaging]

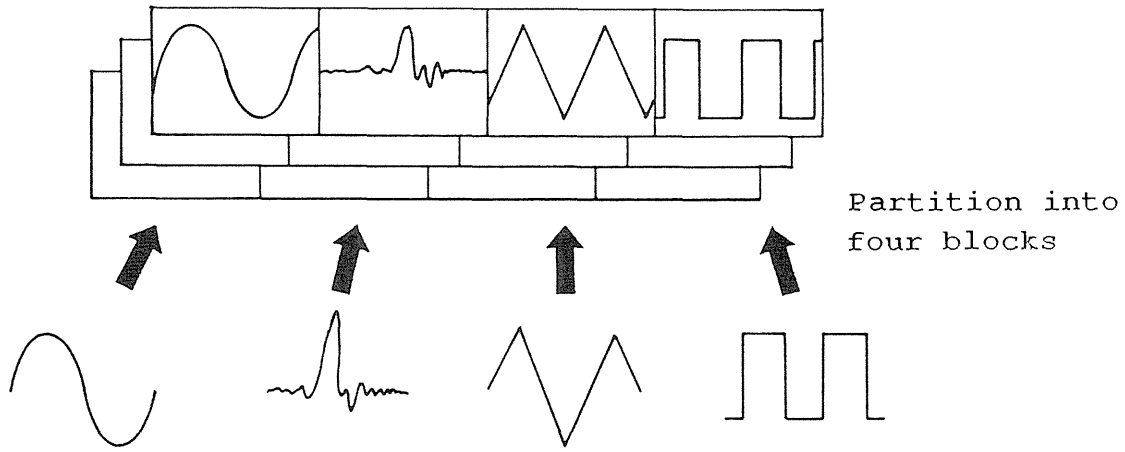
Note: Power spectrum averaging cannot cancel out the noise component.

4.11 Memory partition function and operation (memory recorder function)

Memory can be partitioned and used in blocks. There are two memory partition functions: the multi-block function and the sequential save function.

4.11.1 Multi-block function

The memory capacity is divided into a number of blocks, and any memory block can be used independently. This partition makes it possible to store up to 16 data segments (for three channel configuration). By establishing a reference block it is possible to over-write waveforms from two blocks.



4.11.2 Multi-block function operation

Setting is handled on the status screen special function.

```
* memory div    MULTI-BLOCK
     divisions          8
     using block        2
     REF block          1

   1 2 3 4 5 6 7 8
     ↑
```

[MULTI BLOCK]: Use of the multi-block function.

- divisions: Sets the number of blocks the memory capacity is to be divided into.
  [8] - Memory is divided into eight blocks (possible specifications are 2, 4, 8 and 16).

- using block - Defines which partitioned memory block is to receive the input waveform recording when the START

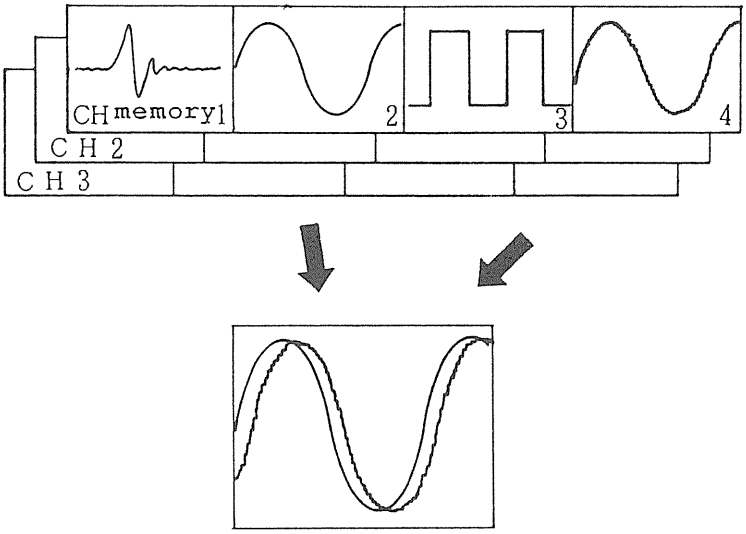
key is pressed. The memory block to be displayed on the CRT is also defined.

[2] - Sets the second memory block (possible settings are from 1 through the number of blocks declared above)

REF block - Defines the memory block holding the input signal waveform that will be used as the reference.

By over-writing this reference waveform with the memory block waveform defined in using block, comparison between the two is possible.

[1]: Defines the first block as the reference block (possible settings from one through the number of partitions).



[Sets the second block as the reference waveform, and the fourth block as the using block.]

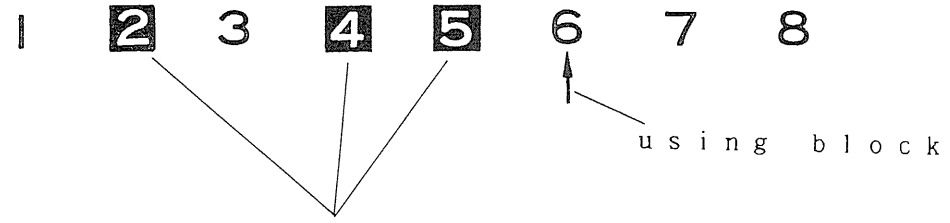
The relation between the memory capacity partitions and the recording length (shot) is:

Memory partitions	2	4	8	16
recording length (DIV)	~ 600	~ 300	~ 160	~ 80

⚠ CAUTION

When the recording length is 1200DIV memory partition is not possible.

The memory map will provide information on the status of memory blocks (whether they currently hold waveforms or not). This is displayed with the status screen memory partition specification key, or the HELP key from the display screen.



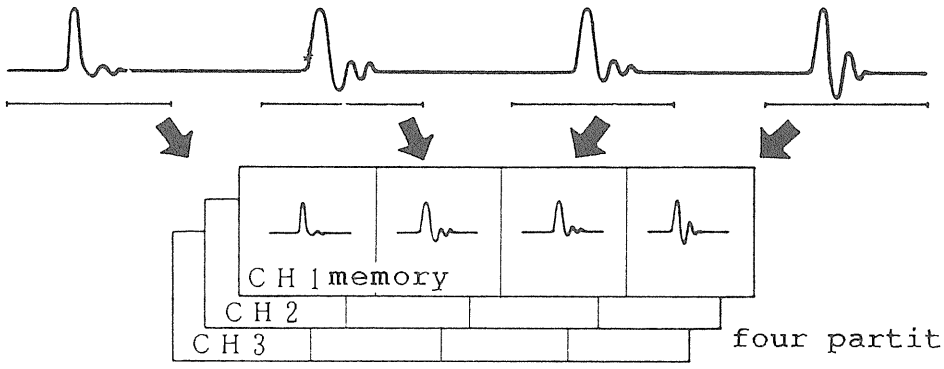
⚠ CAUTION

* When the trigger mode is set to repeat or auto, and operation is stopped with the stop key, there are occasions where no input signal has been acquired. This is because operation was stopped while the input signal was being read into memory. The frequency of such problems will drop if the screen update speed is set to SLOW.

* If the number of memory partitions is changed, current waveform data will be deleted.

4.11.3 Sequential save function

The memory capacity is divided into a number of blocks, and the input signal is saved continuously without display or recording operations. After recording is completed the first memory block is displayed. This sequence is designed to minimize system overhead normally created by display and recording tasks.



four partitions.

4.11.4 Sequential save function operation examples

Set-up parameters are defined with the status screen special function. The trigger mode is SINGLE, and input is saved to all blocks.

```
* memory div    SEQUENTIAL SAVE
     divisions          8
     using block        2


  1  2  3  4  5  6  7  8
     ↑
```

[SEQUENTIAL SAVE]: Sets the sequential save function.

divisions: Sets the number of blocks the memory capacity is to be divided into.
[8]- Memory is divided into eight blocks (possible specifications are 2, 4, 8 and 16).

using block - Defines which partitioned memory block is to be displayed on the CRT.
[2] - Sets the second memory block (possible settings are from 1 through the number of blocks declared above).

⚠ CAUTION

If the number of memory partitions is changed, current waveform data will be deleted.

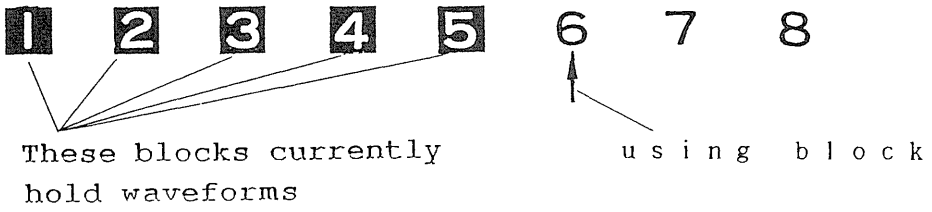
Note 1 - The relation between the memory capacity partitions and the recording length (shot) is:

Memory partitions	2	4	8	16
recording length (DIV)	~ 600	~ 300	~ 160	~ 80

CAUTION

When the recording length is 1200DIV memory partition is not possible.

Note 2 - The memory map will provide information on the status of memory blocks (whether they currently hold waveforms or not).



Note 3 - When the trigger mode is repeat, save to all blocks is repeated.

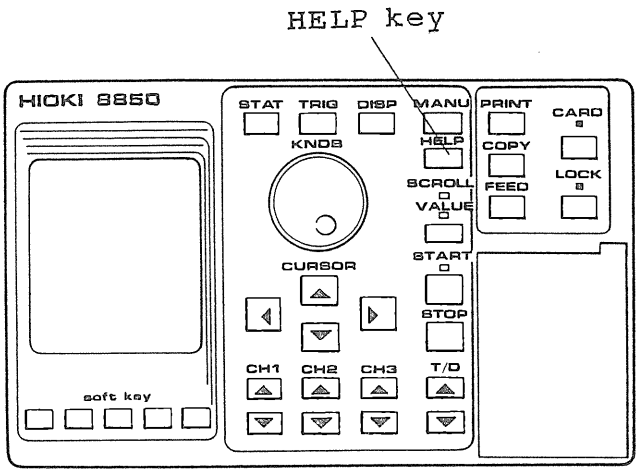
Note 4 - When the printer is set to on and after all blocks have been saved, the blocks are printed out sequentially one block at a time.

4.12 Help function

4.12.1 Help function notes

The help function can be used:
from the display screen in the memory recorder function
from the display screen in the FFT function.

Pressing the HELP key will cause the help screen to appear in the top portion of the display screen.

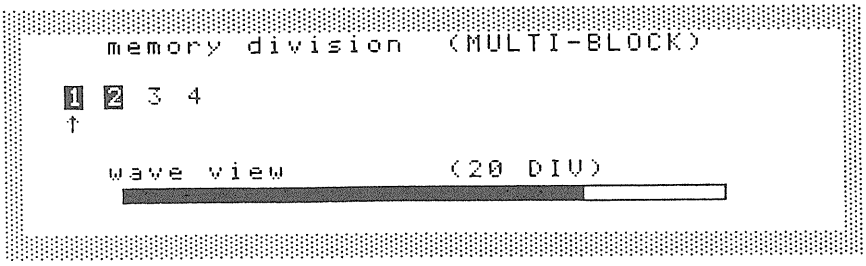


4.12.2 Memory recorder function help function

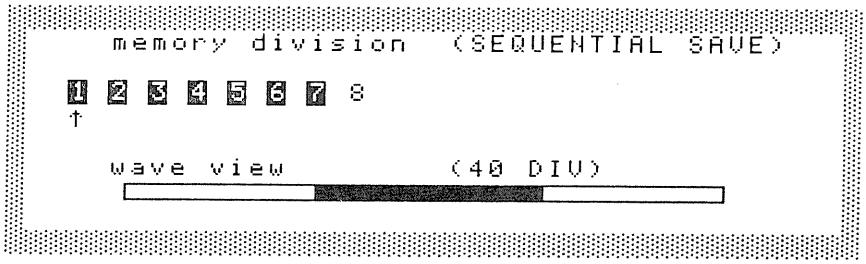
The HELP key can be used to display the memory partition status and measurement waveform in the memory recorder function.

1) Memory partition status
Displays the current memory partition status (off, sequential save, multi-block), and the memory use status (memory map).

2) Measurement waveform display
The location of the currently displayed waveform is indicated within the total waveform.



- Memory partition is multi-block, four partitions. Blocks 1 and 2 already hold data, and block 1 is currently displayed.
- The measurement waveform has a recording length of 20DIV, and accounts for about the first 75% of the total waveform.

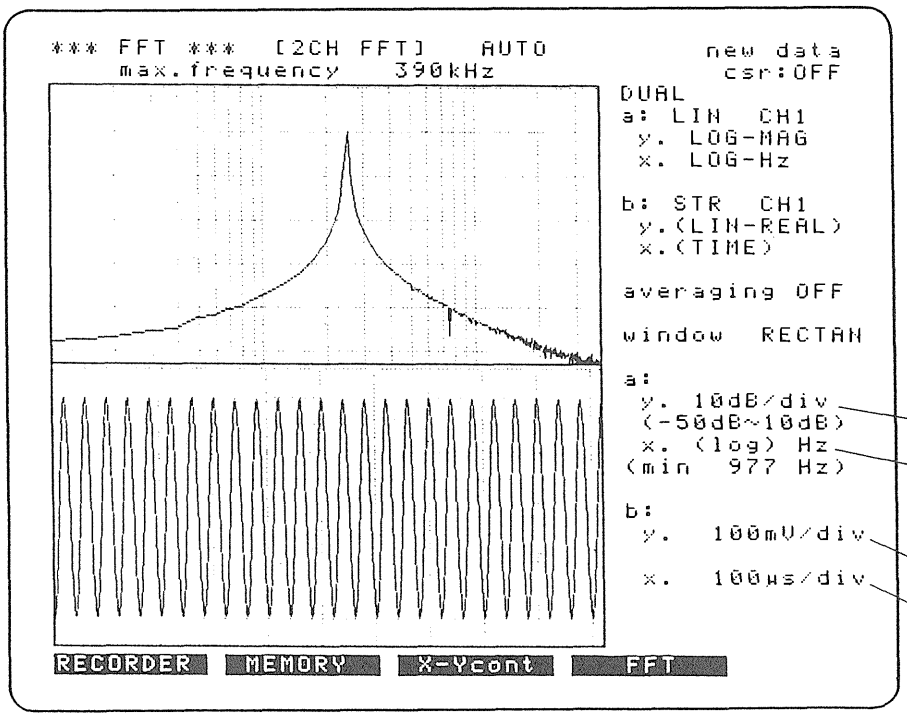


. Memory partition is sequential save, and there are eight partitions. Blocks 1-7 already hold waveforms, and block 1 is currently displayed.

. The measurement waveform recording length is 40DIV, and the central section of the total waveform is being displayed.

4.12.3 FFT analysis function help function

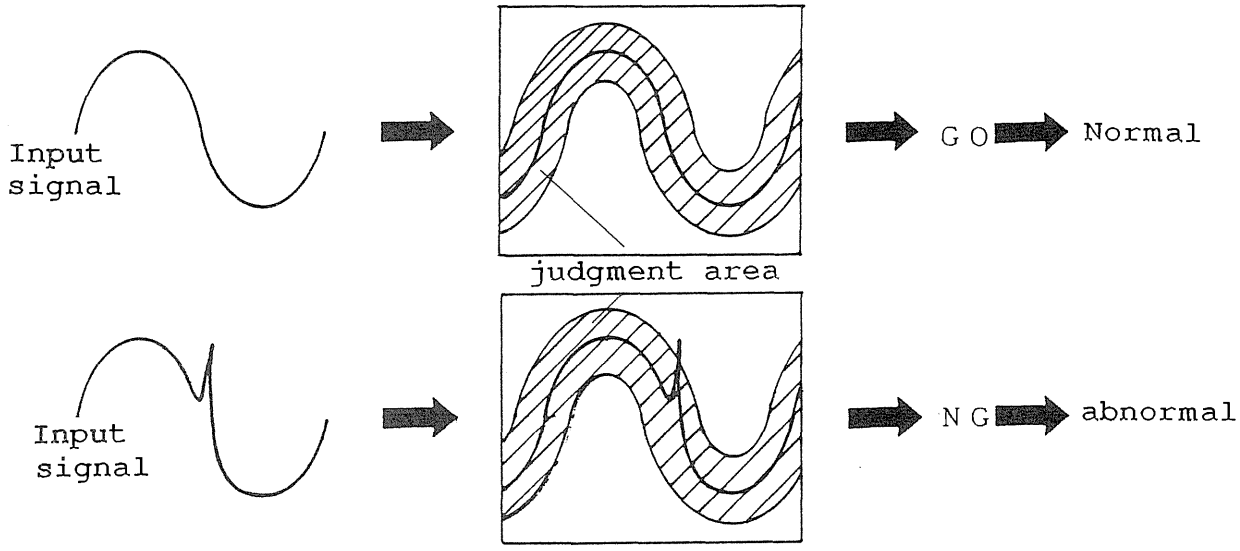
On the FFT analysis display screen pressing the HELP key will display the scale of the currently displayed waveform.



4.13 Waveform judgment function and operation

4.13.1 Waveform judgment function

- The input signal waveform can be compared to a user-defined judgment profile (template), yielding a match (GO) or mismatch (NG) result.
- This feature is handy for detection of abnormal waveforms. Judgment results are output from the rear panel, making production line applications possible.
- The waveform judgment function can be used in NORMAL and XY display modes for the memory recorder function, and in NORMAL display mode for the FFT analysis function.



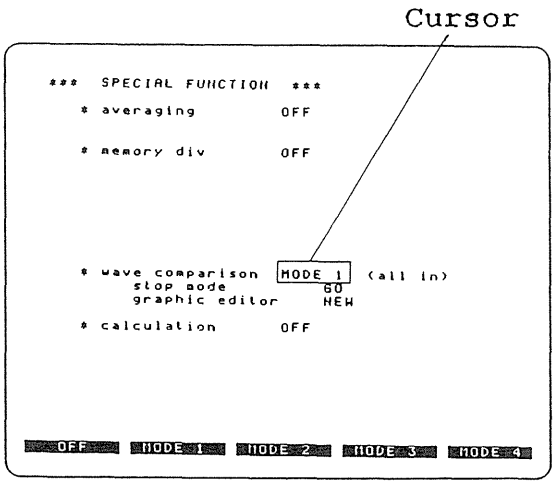
Waveform judgment example

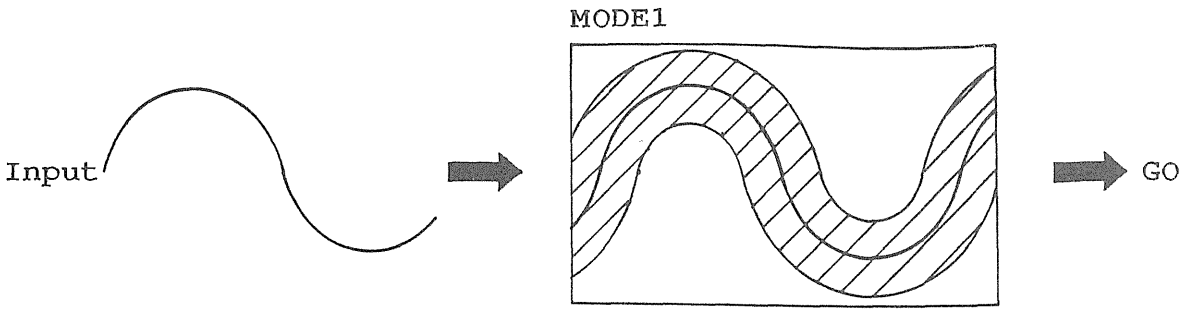
4.13.2 Waveform judgment function operation

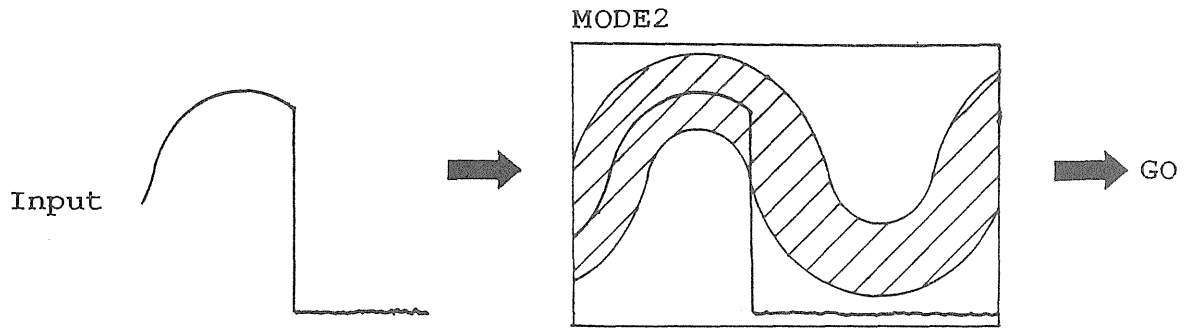
Sets measurement judgment mode and stop mode.

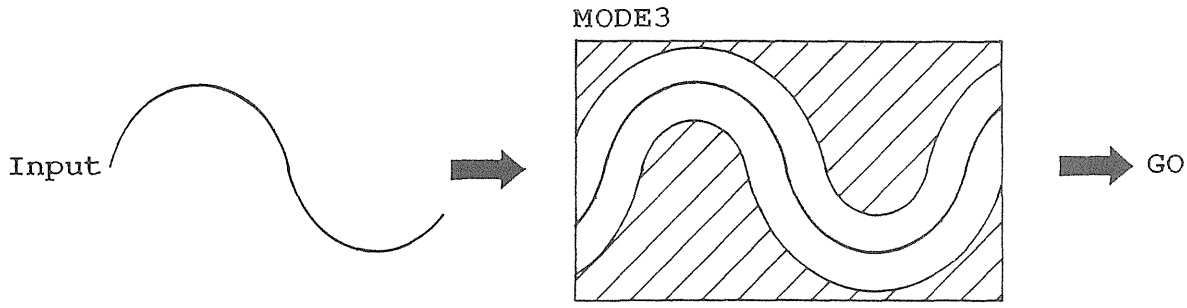
* Sets waveform judgment mode to one of the following four modes:

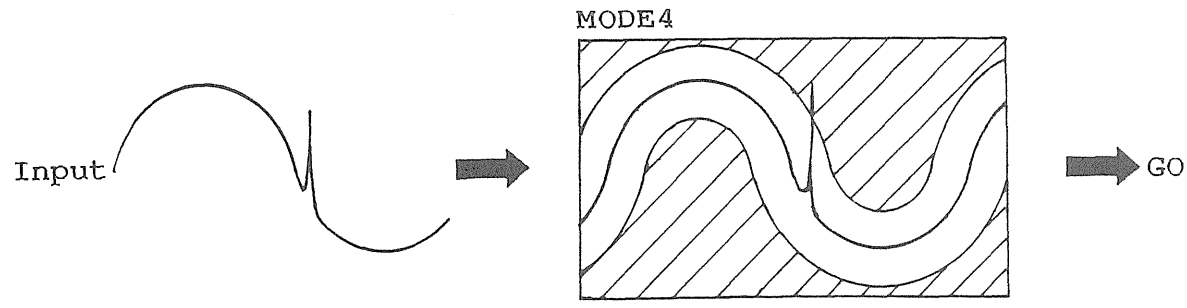
MODE1	If entire waveform is within judgment profile result is GO.
MODE2	If any portion of waveform is within judgment profile, result is GO.
MODE3	If entire waveform is outside judgment profile result is GO.
MODE4	If any portion of waveform is outside judgment profile result is GO.




MODE1
Input
GO


MODE2
Input
GO


MODE3
Input
GO


MODE4
Input
GO

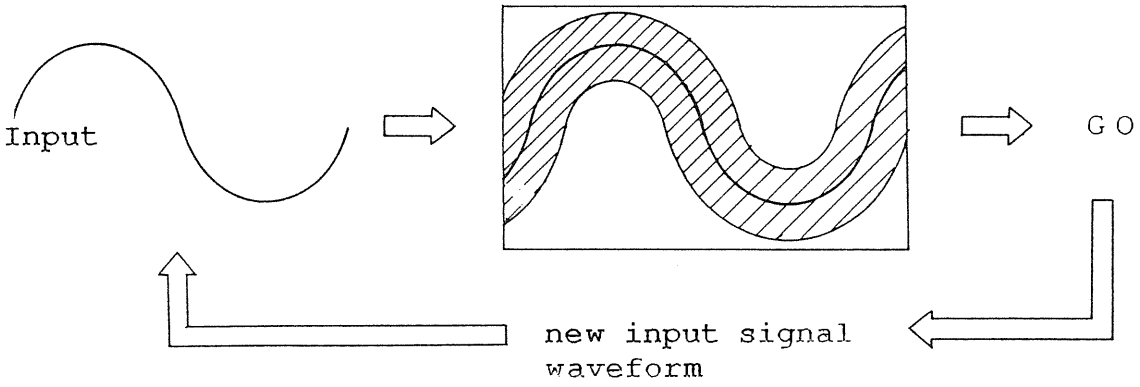
* Stop mode set
The system can be set to stop on a GO and/or a NG result.

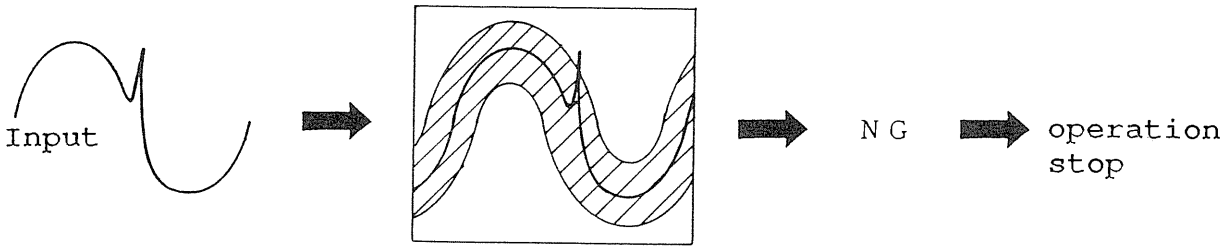
```
* wave comparison  MODE 1  (all in)
    stop mode          GO
    graphic editor     NEW
                       ↑
                     Cursor
```

[GO] - Operation stops if a GO result generated.
[NG] - Operation stops if a NG result generated.
[GO&NG] - Operations stops for either GO or NG result.

Note: If the printer is on, the waveform will be printed out even when sywtem operation is stopped.

Example: When trigger mode is SINGLE, judgment mode is MODE1 and stop mode is NG, input signal waveforms will be input until a NG result is generated.





⚠ CAUTION

When trigger is set to REPEAT or AUTO, the above sequences will be repeated.

4.13.3 Graphic editor

- The graphic editor is used to define the judgment area (template).
- By using the editor the judgment area can be easily generated on the screen, just like drawing a picture.
- The graphic editor can be used in NORMAL and XY display modes for the memory recorder function, and in NORMAL display mode for the FFT analysis function.

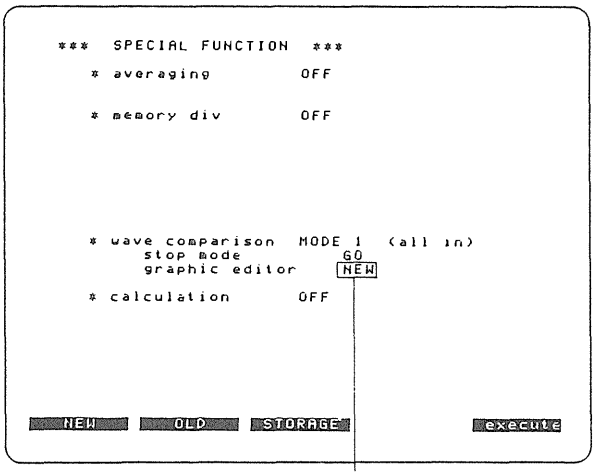
4.13.4 Graphic editor commands and usage

Once the waveform judgment mode is set, the graphic editor can be used. Move the cursor to the position indicated in the diagram for graphic editor settings.

[NEW] - Use this specification to create a new judgment profile. Press the execute key to enter the graphic editor function.

[OLD] - Use this specification to call up an existing judgment profile and revise it. Press the execute key to enter the graphic editor function.

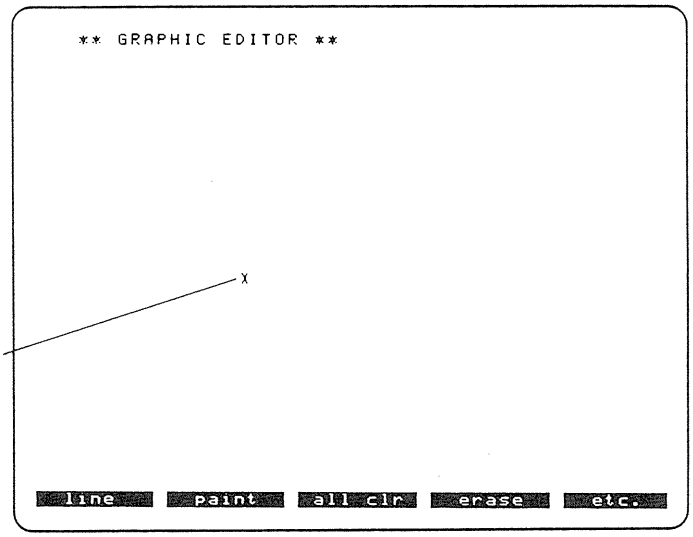
[STORAGE] - Use this specification to define a user area to suit a specific input waveform. Press the execute key to enter the graphic editor function.



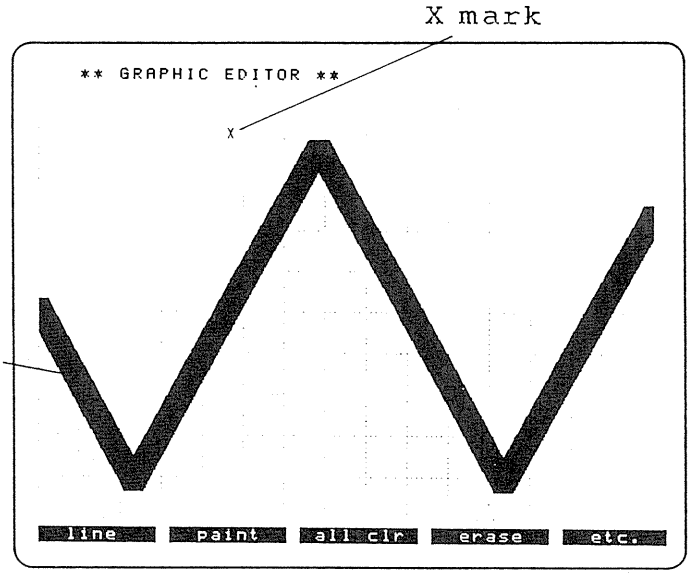
Cursor

COMP.

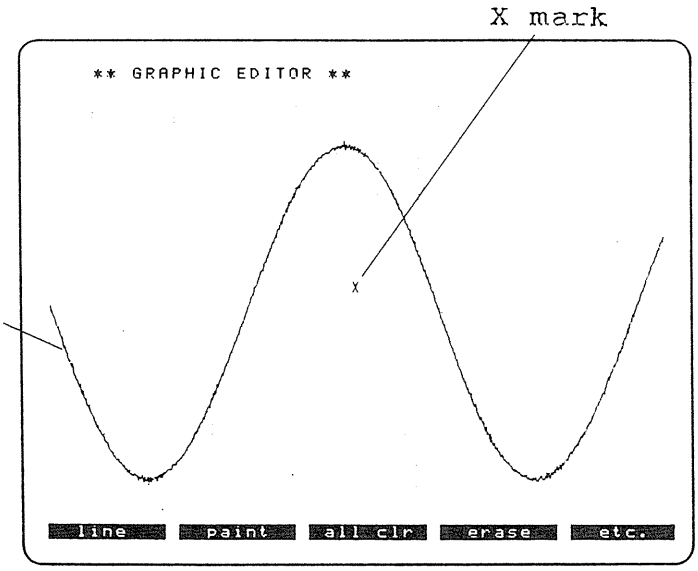
Graphic editor in NEW mode



Graphic editor in OLD mode



Graphic editor in STORAGE mode



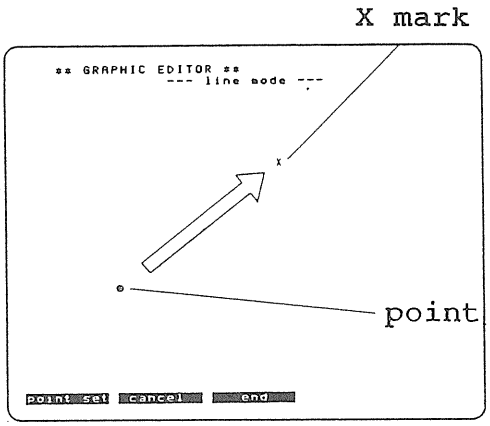
* Graphic editor commands

(1) [line] - Draws lines
(2) [paint] - Paints closed areas
(3) [all clr] - Clears the screen
(4) [erase] - Eraser function for partial erasure
(5) [parallel] - Extend screen image in parallel
(6) [QUIT] - Cancels editor without saving screen image to memory
(7) [end] - Saves generated profile to memory, and terminates graphic editor function.

[line] - Draws lines

Move the X-mark with the cursor keys to connect two points with a line.
Press the line key to enter the line mode.

. Press point set to draw the line.

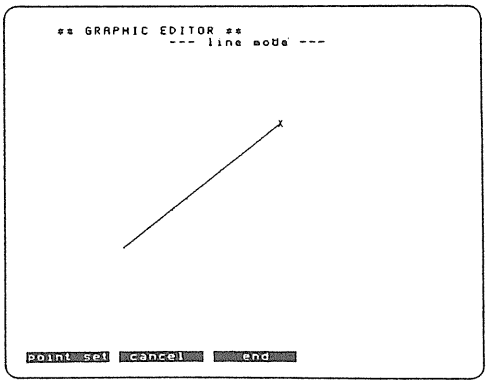


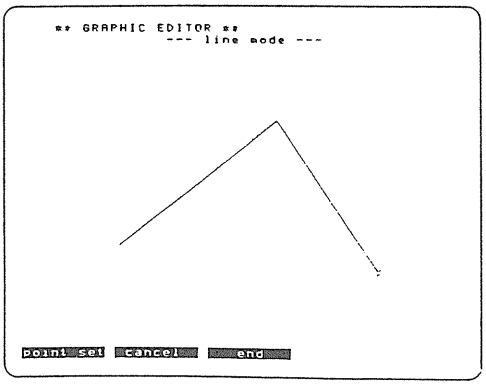
Operation

1) Press point set to mark a point at the location of the X-mark.

2) Use the cursor keys to move the X-mark.

3) Press point set again to mark a second point, again at the location of the X-mark, and connect it to the previous one with a line.





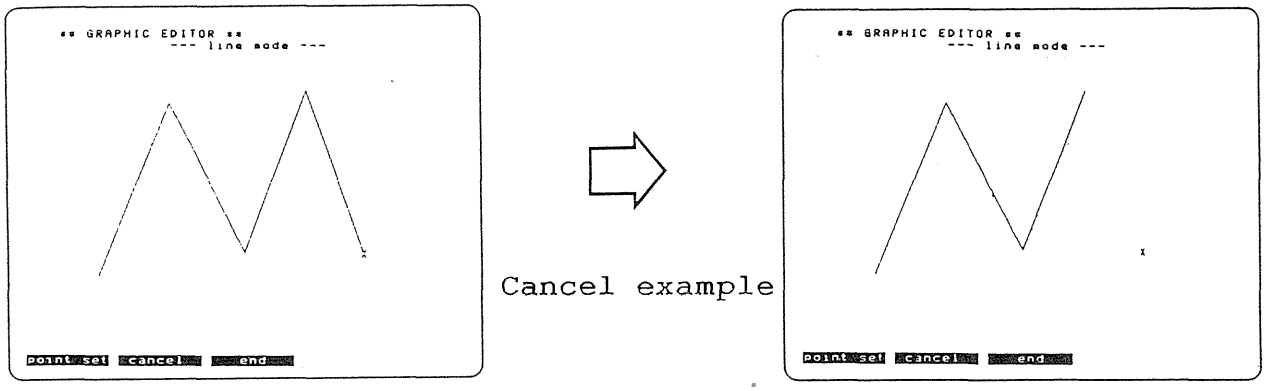
4) Move the X-mark with the cursor keys.

5) Press point set to create a new point, and connect it to the previous one with a line.

. [cancel] - Erases drawn lines
Lines drawn with [point set] are erased one at a time,

starting from the most recent.

Note: Only the most recent 10 lines can be erased with the cancel function.

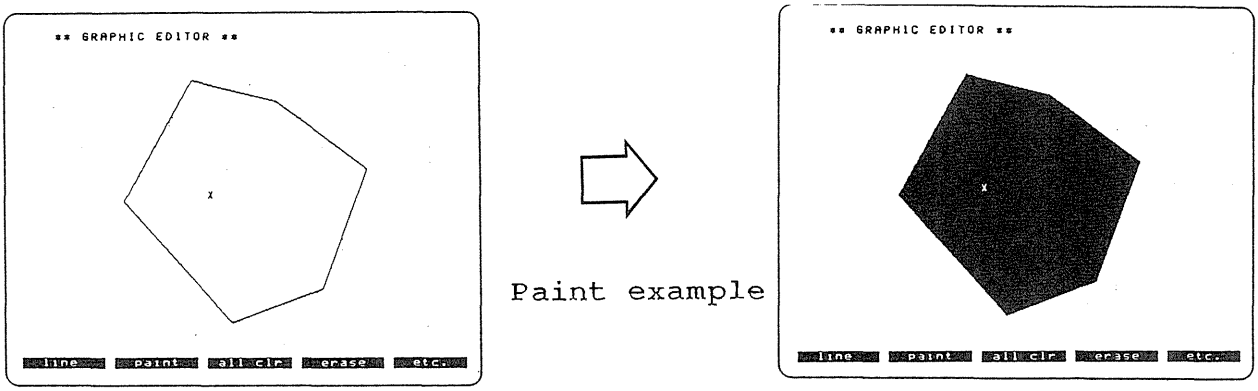


Cancel example

[end] - Terminates the line function.

[paint] - Paints is a closed area defined by X-mark points.

Pressing [paint] executes the paint command.



Paint example

Note: Unless the area is closed, the paint will extend outside the defined area, and may paint the entire screen.

[all clr] - Clears the display screen.

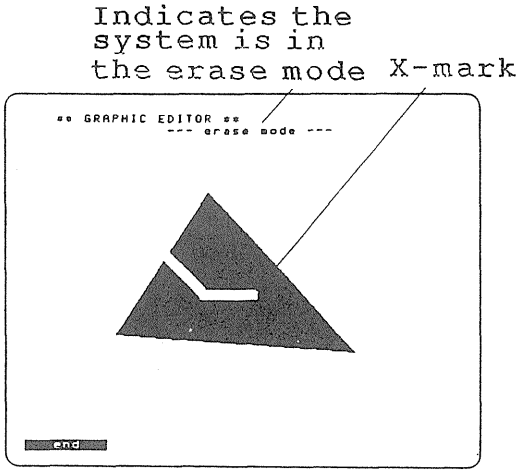
Press [all clr] to execute.

[erase] - Eraser function. Move the x-mark with the cursor keys to erase.

Pressing the erase key enters the erase mode.

Operation

1) Use the cursor keys to move the X-mark to the location to be erased.
2) The erase mode can be terminated with the end key.



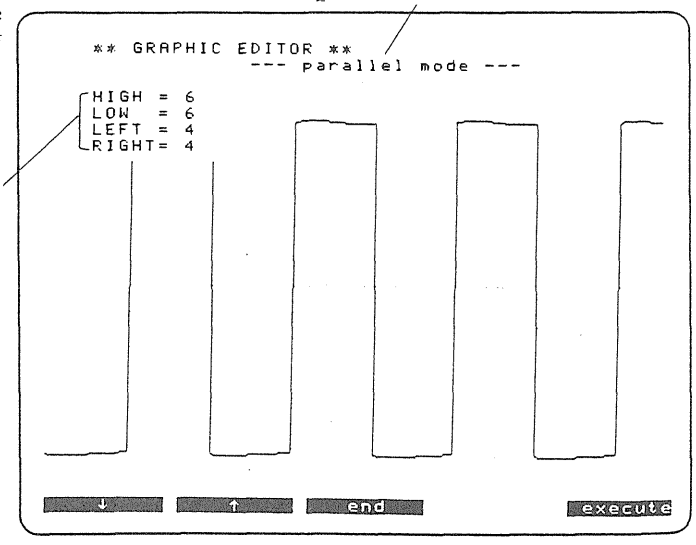
[parallel] - Defines the judgment profile by duplicating the waveform on the screen in parallel.

Press the parallel key to enter the parallel mode.

Operation

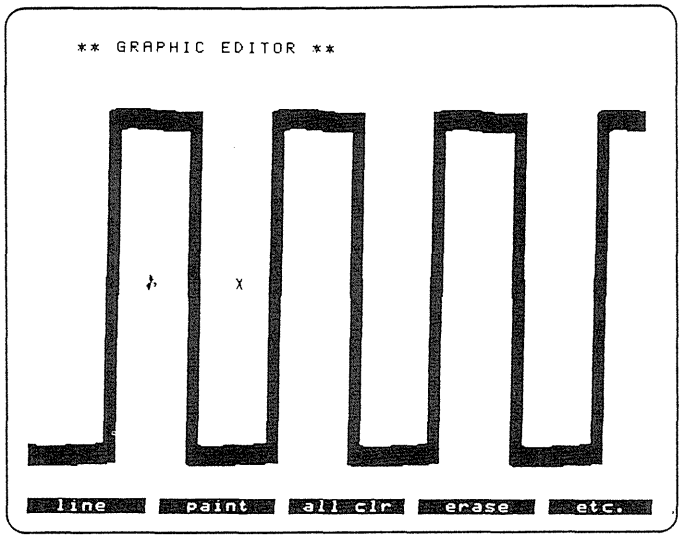
1) Set the parallel movement distance. Set the values with the [↑] and [↓] arrows. Move the cursor with the cursor keys. A movement value of 25 is equivalent to a single division.

HIGH is up,
LOW is down,
RIGHT is right,
and LEFT is left.



2) Pressing execute will generate the judgment profile through parallel movement. Once parallel movement is completed, the system will automatically terminate the parallel mode.

Example after execution of parallel movement



3) Pressing the end key will terminate the parallel mode without executing parallel movement.

[QUIT] - Terminates the editor without saving the screen image to memory.

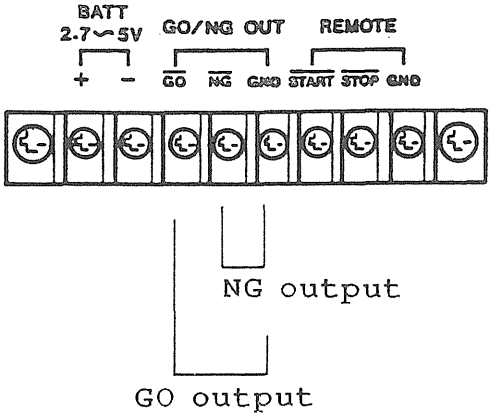
The generated judgment profile will be discarded if QUIT is pressed.

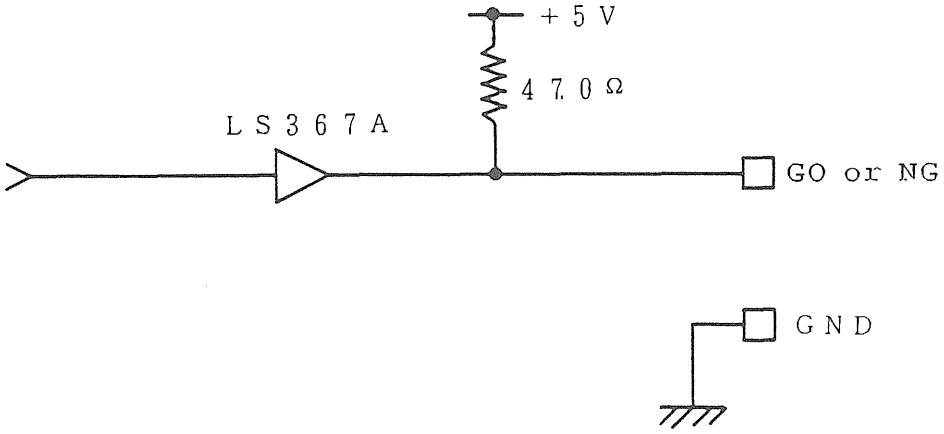
[end]- Saves the generated image to memory, and terminates the graphic editor.

The generated image can be used as a waveform judgment profile.

4.13.5 GO/NG judgment output usage

* Waveform judgment results are output through the rear panel terminals.
  GO output can be picked up through the GO-GND terminals (TTL level, active LOW), and NG output through the NG-GND terminals (TTL level, active LOW).
  The output circuit is indicated below.

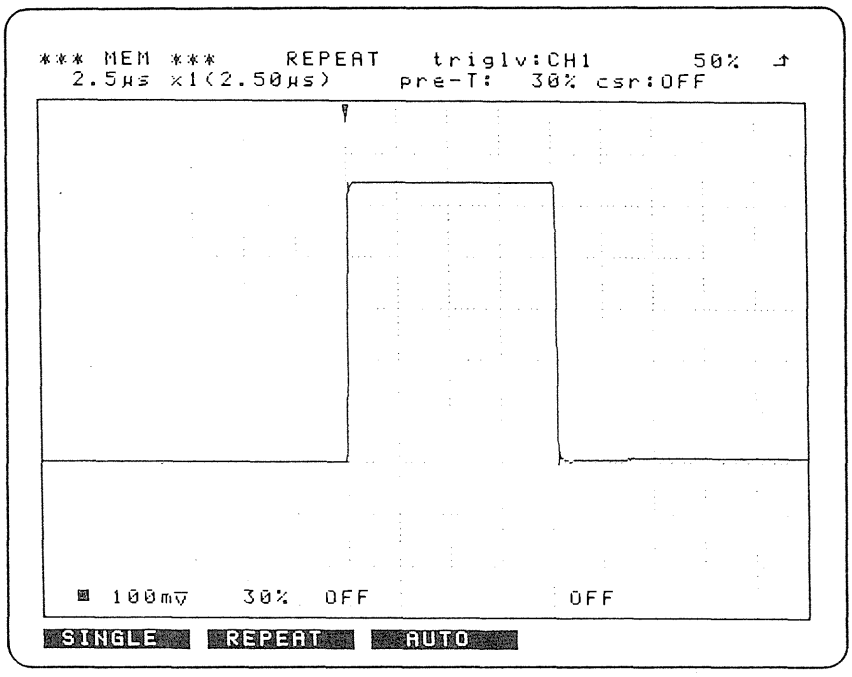




4.13.6 Waveform judgment function operation examples

o Input the positive edge, negative edge operation cycle of a logic IC, and generate a judgment profile based on that shape. Use this profile to judge IC output waveforms for undershoot and overshoot.

(1) Read in the waveform to be used as reference. Use the trigger to capture the waveform to assure that the waveforms captured are under identical parameters, and display it in DARK mode.



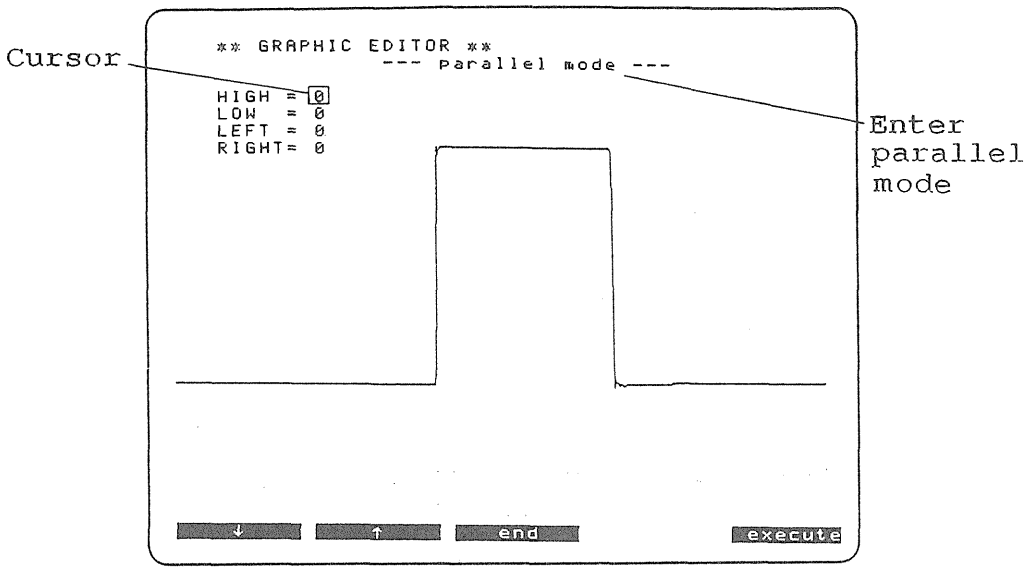
Input reference waveform

(2) Generate the judgment profile based on the reference waveform.

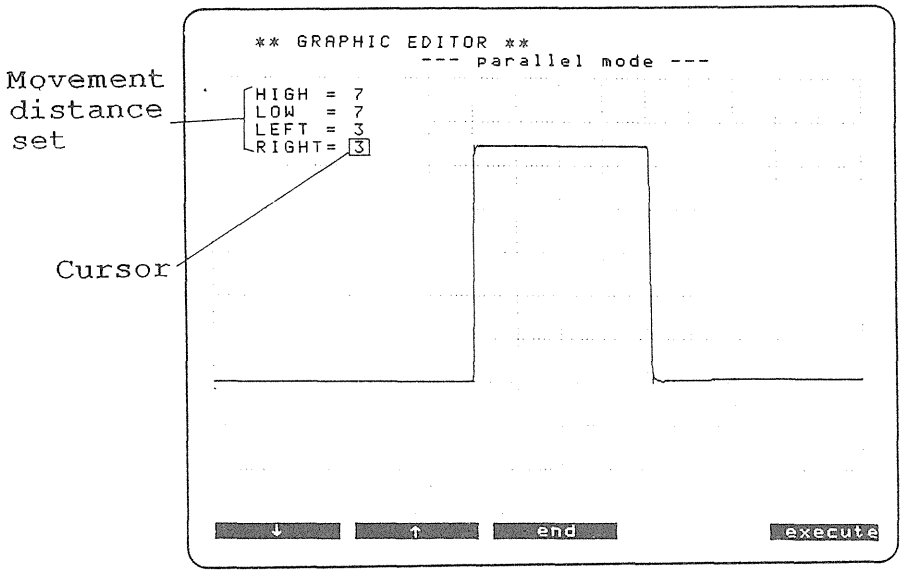
1) Using the status screen waveform judgment key, set the system to stop when the waveform is partially outside the judgment profile.

```
* wave comparison   MODE 1   (all in)
      stop mode          NG
      graphic editor     STORAGE.WAVE

* calculation        OFF
```

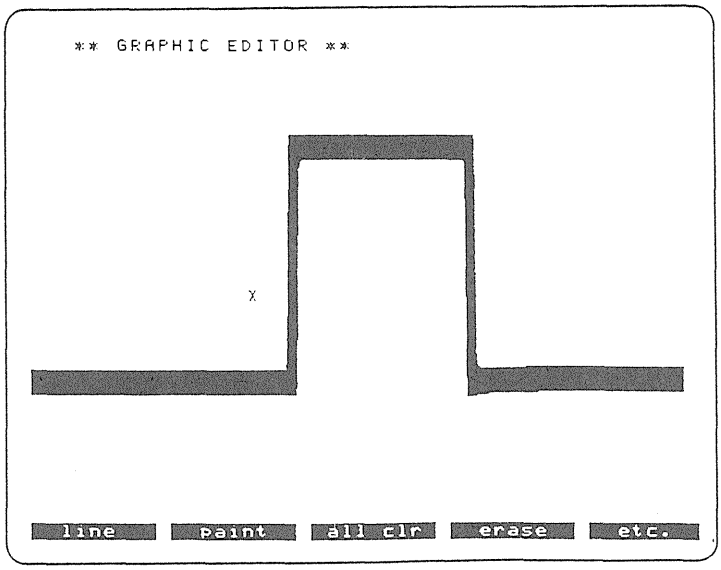
2) Move the cursor to the graphic editor mode, and press the execute key to enter the graphic editor.
3) Press the etc function select key, and then the parallel key.



4) Use the ↑↓ function keys and the cursor keys to set the parallel movement distance.



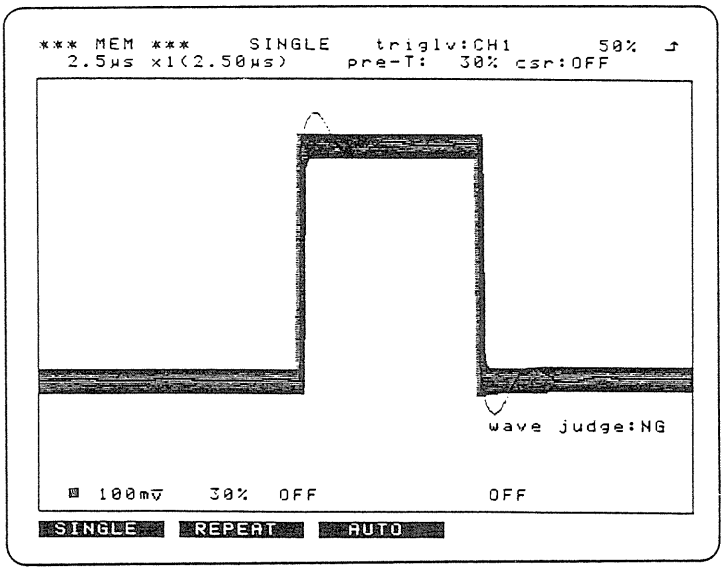
5) Press the execute function key to execute parallel movement, and return to the graphic editor screen.



6) Press the etc function key, and then terminate the graphic editor with the end key.

(3) Set the trigger mode to SINGLE, for a single judgment operation on a continuous waveform.

(4) Press the START key and begin waveform measurement.



Waveform example of NG result

CAUTION

The waveform judgment function (1) inputs the waveform, and (2) compares it. These two steps are repeated alternately, and during waveform judgment no waveforms are input. For this reason, the signal is not being monitored continuously. The time required for judgment is about 0.15 seconds (sine wave, one cycle per screen), not including data input time.

4.14 Mathematical functions and operation

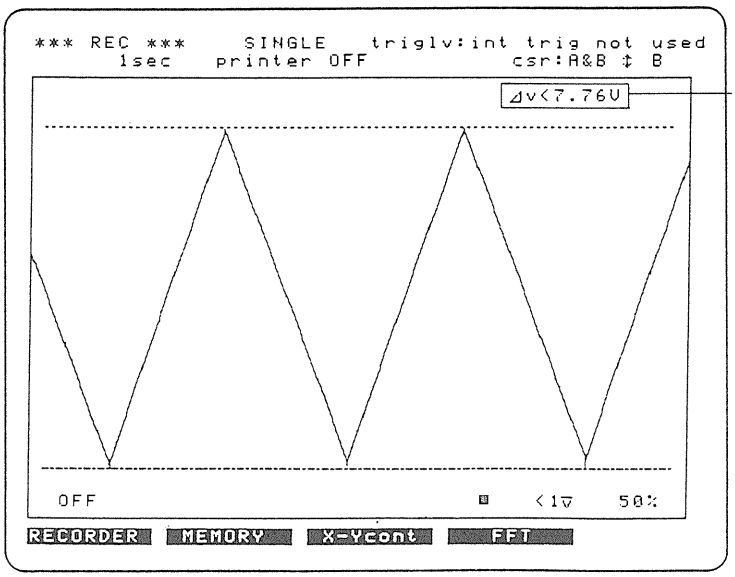
- Using the A and B cursors it is possible to determine measurement waveform voltage, period and frequency.
- For frequency analysis, the value for the data where the vertical and horizontal cursors cross can be determined (FFT analysis function).
- The true rms value for the portion of the waveform between the A and B cursors can be determined (memory recorder function).
- The four basic operations are possible between waveforms on different channels, with the results expressed as a waveform (memory recorder function).

4.14.1 A/B cursor-defined operations

Cursor functions for recorder, memory recorder and XY recorder

- In the display screen setting the csr item to "A&B" allows determination of potential difference (△V), time difference (△t) and frequency (△f) between cursor A and cursor B. By setting the csr item to "A", the potential of the A cursor to a reference point can be determined, and time difference and frequency can be calculated.
- Values for range, offset, TIME/DIV and pre-trigger will be those set at the time of the calculation. For this reason, if range or other parameters are changed after the waveform is stored, the calculation results will not match the displayed waveform.
- For potential difference (△V) display where the gain adjustment knob is set to other than CAL, printouts with values under that will use the "<" symbol instead of the "=" symbol.

Example △V< 1.456V



Calculation results display position

CALC

Calculation items

Function and display format differ with the calculation item (see the following chart).

Function	format	csr	ΔV	Δt	Δf (note)
recorder	NORMAL	A&B	○	○	○
		A	○	×	×
	DUAL	A&B	×	○	○
		A	×	×	×
memory recorder	NORMAL	A&B	○	○	○
		A	○	○	○
	DUAL	A&B	×	○	○
		A	×	○	○
	X−Y	A&B	○	×	×
		A	○	×	×
XY recorder	X−Y	A&B	○	×	×
		A	○	×	×

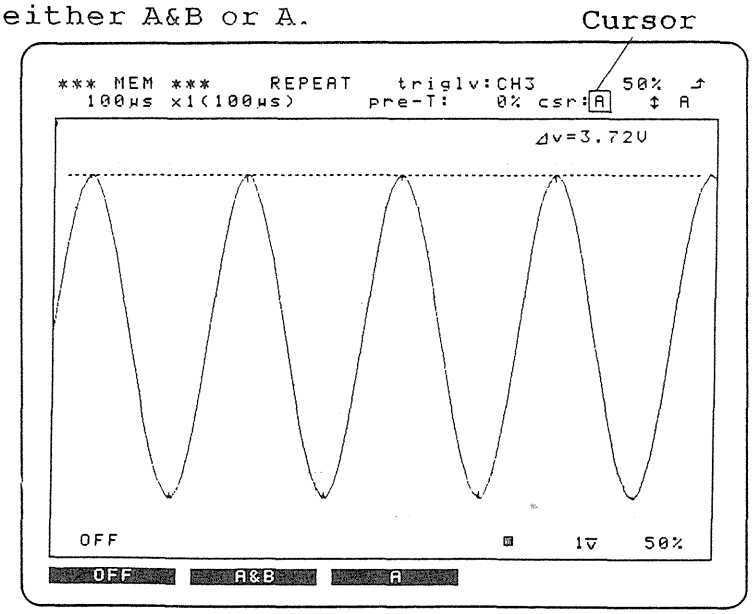
Note: delta f is calculated as 1/delta t. (Circle is possible, x is not possible)

A cursor reference position

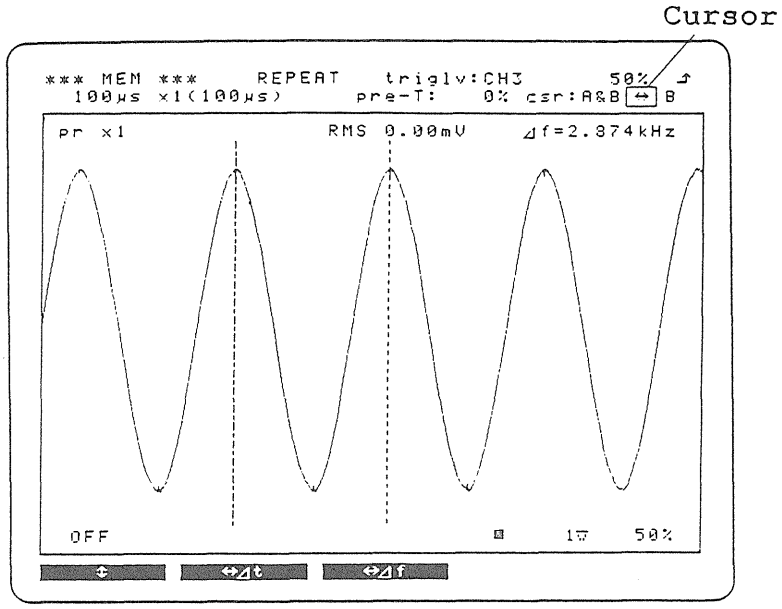
- For potential (△V) calculation, the analog unit offset position is used as the reference (potential is determined).
- Time difference (△t) and frequency (△f) in the memory recorder function use the trigger point as the reference position.

Set-up (set SCROLL/VALUE key to SCROLL)

1) On the display screen move the cursor to the csr item, and select either A&B or A.

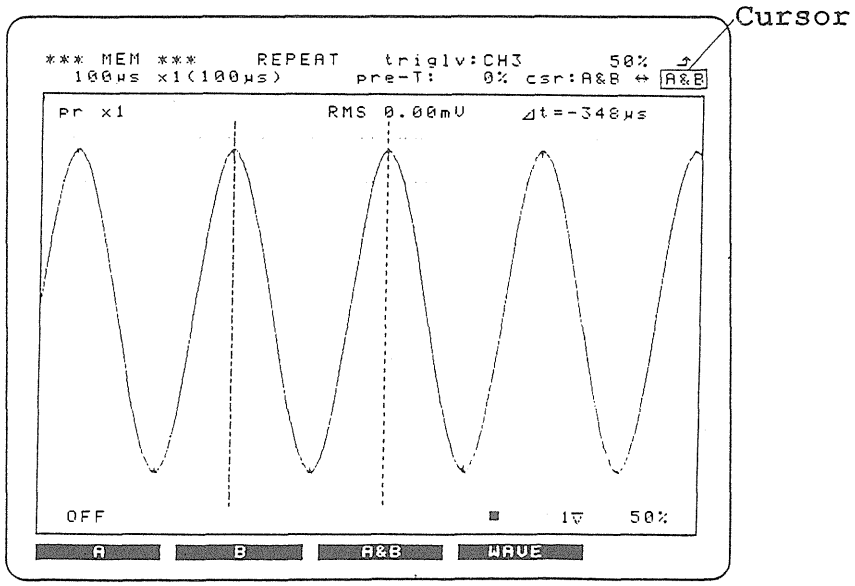


2) Move the cursor to the right to select [↕] for potential difference calculation, [↔Δt] for time difference calculation, or [↔Δf]for frequency calculation.



3) Move the cursor to the right, and select one of [A], [B], [A&B] or [WAVE]. Turning the rotary knob will have the following effects.

[A] - Moves the A cursor
[B] - Moves the B cursor
[A&B] - Moves both cursors, maintaining the same distance between them
[WAVE]: Scrolls the displayed waveform



Note: For A/B cursor movement or waveform scroll, be sure to set the SCROLL/VALUE key to SCROLL.

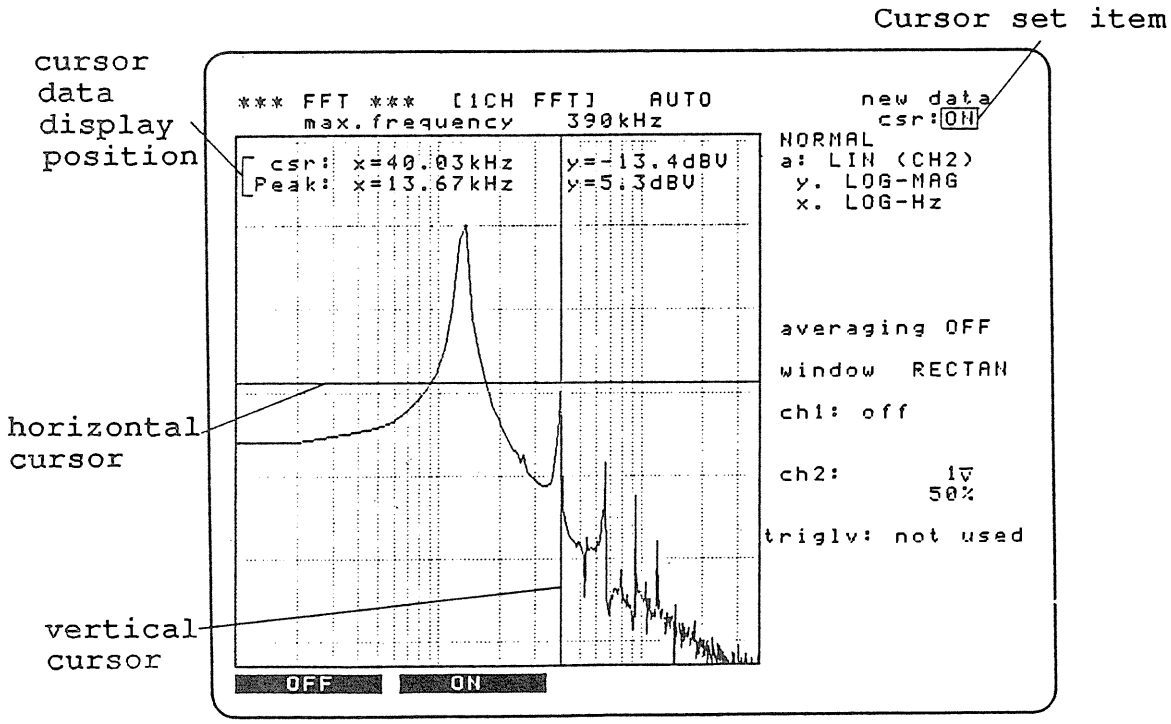
FFT analysis function cursor function

- The cursor in the FFT analysis function is equipped with a readout function. The horizontal cursor indicates the intersection between the vertical cursor and the waveform.
- The data at the intersection point of the vertical and horizontal cursors is displayed at the top of the screen.

Operation

- The cursor function is selected by turning it on with the csr function.

  Note: To move the cursor, set the SCROLL/VALUE key to SCROLL.



4.14.2 True rms calculation function (memory recorder function)

. When the A and B cursors are displayed on the screen, the true rms value of the input waveform displayed between them can be determined.

. The expression used is:

$$RMS = \sqrt{\frac{\sum_{i=1}^{n} X i^2}{n}}$$

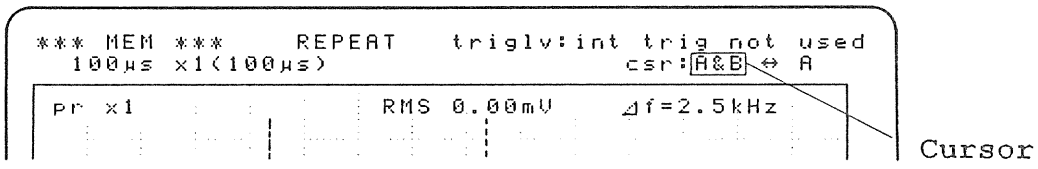
n = the number of data points between cursor A and cursor B, and Xi is the ith data value counting cursor A data as data point 1.

Note: When there are multiple channel waveforms displayed on the screen, the rms calculation will be made for the channel with the lowest channel number.

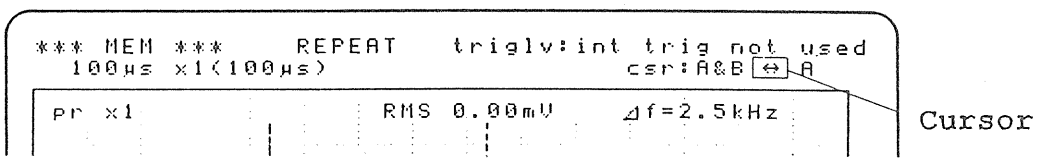
Note: For A/B cursor movement be sure to set the SCROLL/VALUE key to SCROLL.

Operation

1) On the display screen move the cursor to csr, and select A&B cursors.



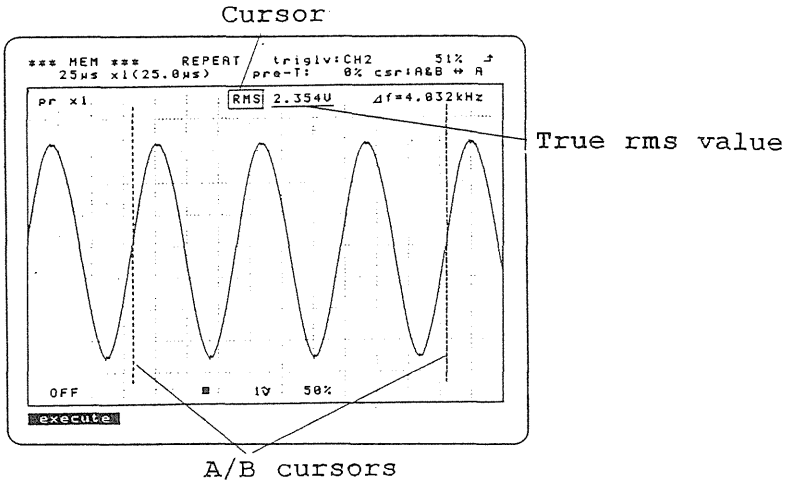
2) Move the cursor to the right to select (↔Δt) or (↔Δf). The rms value [RMS 0.00mV] will be displayed in the center of the screen at the top.



3) Using A and B cursors define the portion of waveform to be measured.

CALC

4) Move the cursor flashing over the RMS item, and press the [execute] function key The rms value will be determined and displayed on the CRT screen



4.14.3 Arithmetic operations for inter-channel relations (memory recorder function)

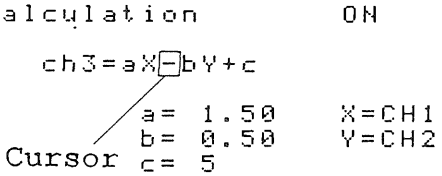
- The four basic mathematical operations can be performed between waveforms on two channels, and the results displayed as a waveform.
- The result waveform can be handled as a normal waveform, including enlargement/compression, scroll, and printout.
- The result waveform generated by these operations is automatically stored to channel 3, so it cannot be used to store a different waveform. Channel 3, however, can be set as a trigger source.
- Amplifier range has no effect on calculation at all, because calculation is carried out on the displayed waveform size (GND level is 0, DIV size is 1).
- Operations are carried out even if there is no input unit connected to CH3.

Note: Operation time is proportional to recording length. Operation time is especially long for division (max. 50 seconds for 1200DIV division operation).

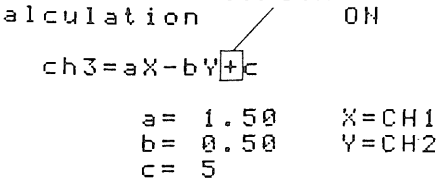
Operation

1) Switch calculation on in the status screen of the memory recorder function.

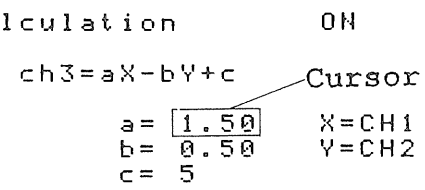
2) Set the operation.
[-]: Define the operator (possible operators are +, −, × and ÷).



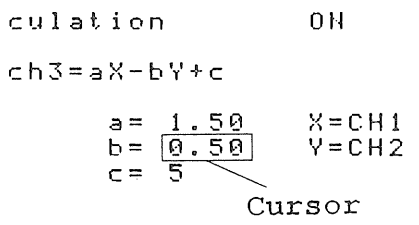
[+]: Define the operator (possible operators are + and −).



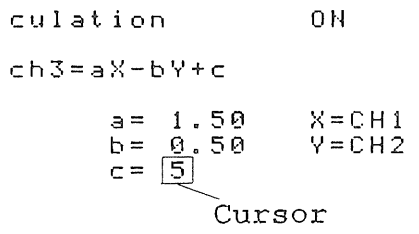
[a]: Define the coefficient. Sets the size of a DIV to 1.00 (possible values are -9.99 to +9.99).



[b]: Define the coefficient. Sets the size of a DIV to 1.00 (possible values are -9.99 to +9.99).

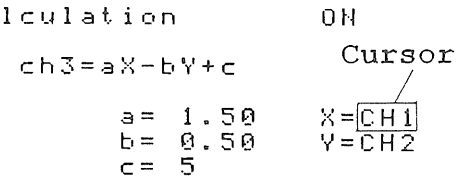


[c]: Define the offset value. Sets the size of a DIV to 1.00. Possible values are 0-10.

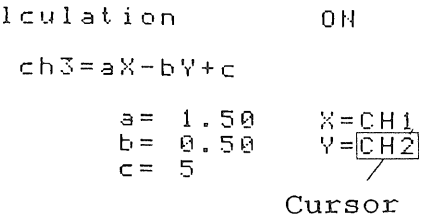


Note: Set the offset to 5 to take the center of the screen as the zero position.

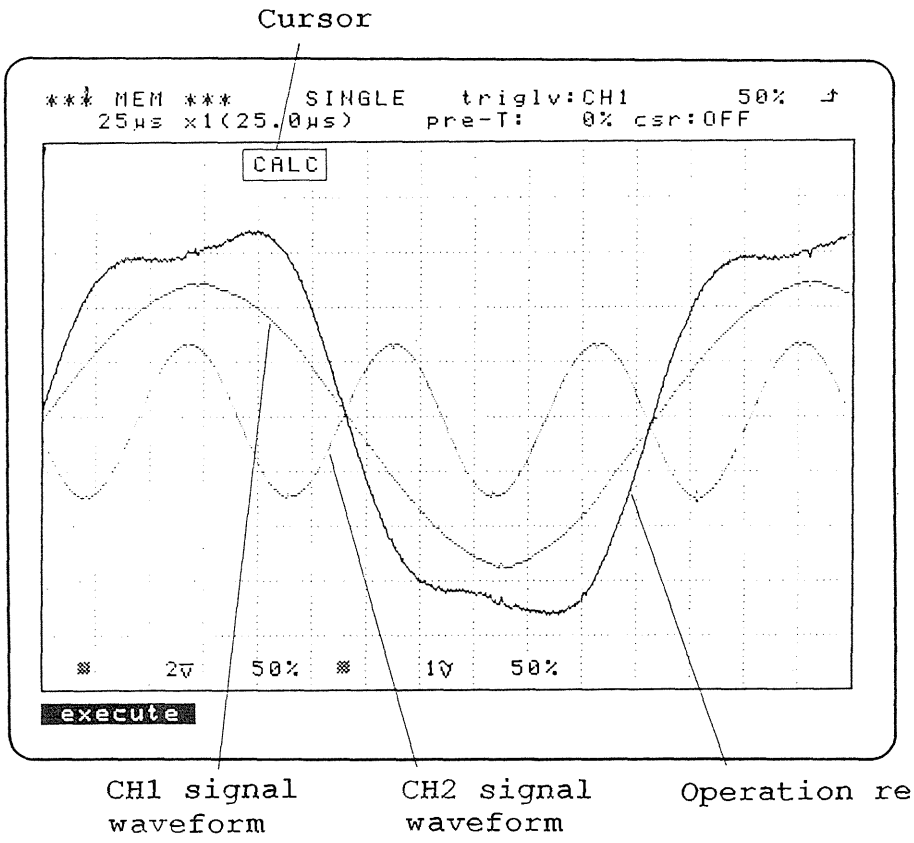
[X]: Sets the channel to be operated on (possible settings are CH1 and CH2).



[Y]: Sets the channel to be operated on (possible settings are CH1 and CH2).



3) Read in the input waveforms.
4) On the display screen move the cursor to CALC, and press the execute function key to run the operation and display the results. The operation result waveform will always be displayed as an analog waveform in DARK mode.



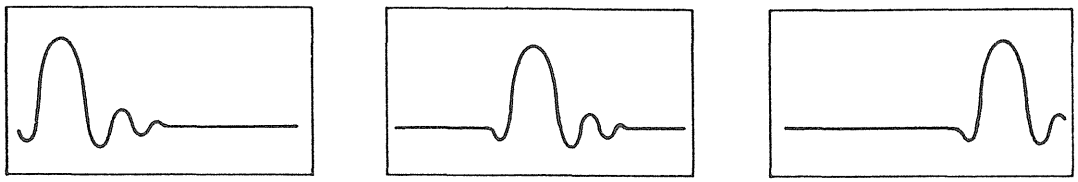
⚠ CAUTION

* During operation no other mathematical operations can be performed (press STOP first).

* The operation will be run each time the [execute] key is pressed. Unless [execute] is pressed after cursor movement the results of the previous operation will remain displayed.

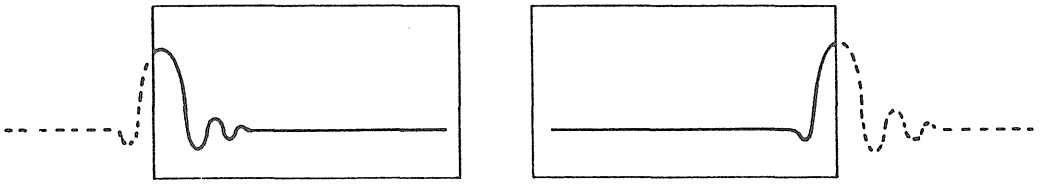
4.15 Trigger function

The 8850 is equipped with a wide variety of trigger functions. Each function has its own operation method, described below. The basic concepts of operation are covered below.



Pre-trigger 5% 50% 95%

Memory recorder function



Trigger start Trigger stop

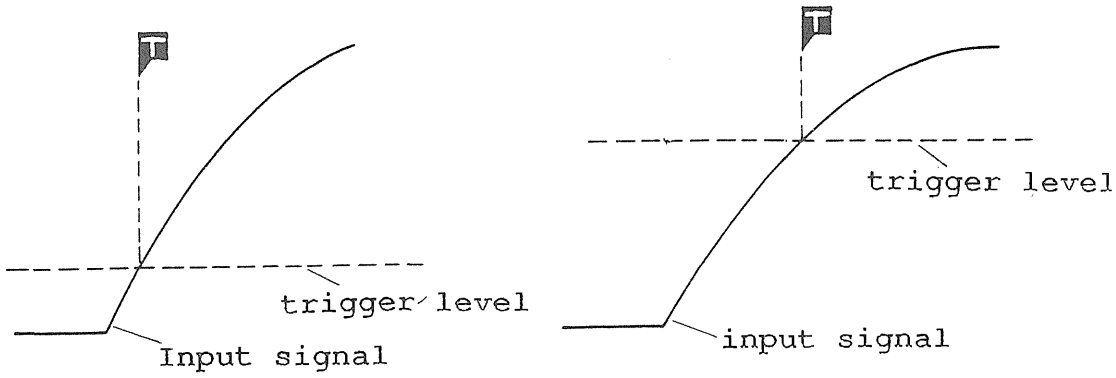
Recorder function

Difference in recorded waveform due to pre-trigger function

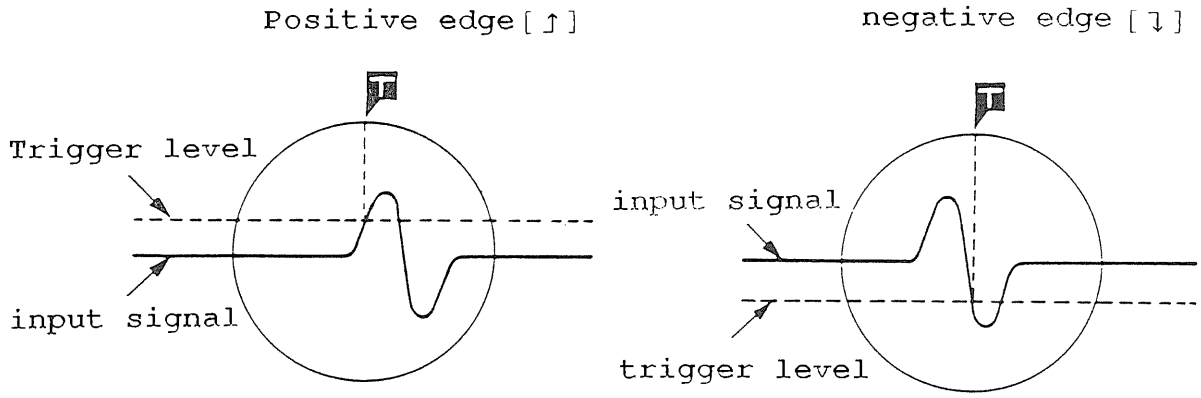
4.15.1 Trigger functions for individual channels

When a channel is assigned as a trigger source, the following two types of parameters must be set to each input channel.

* Trigger level [0 - 100%]

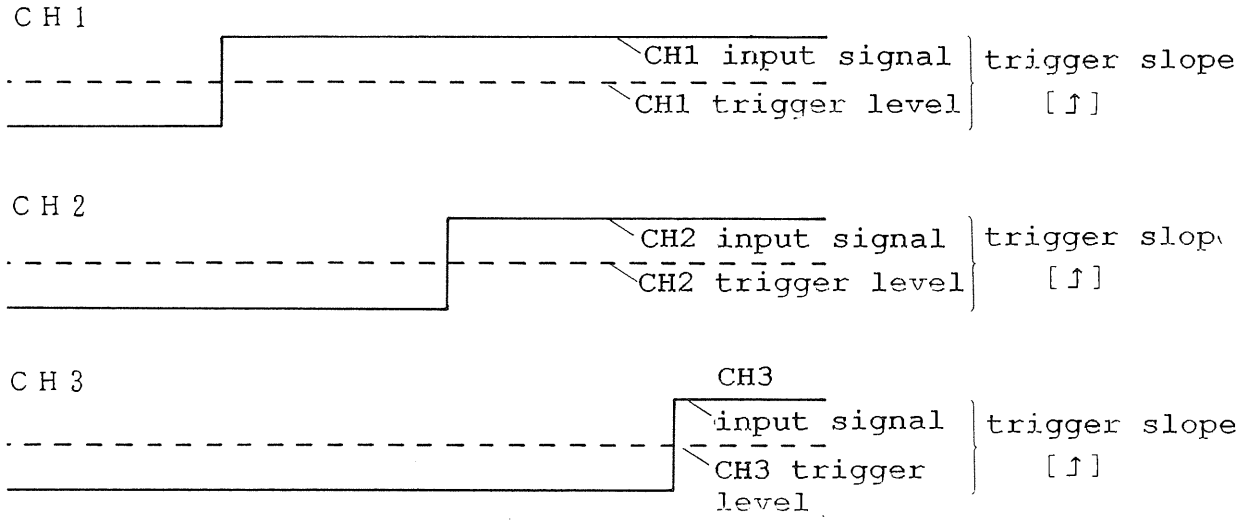


* Trigger slope

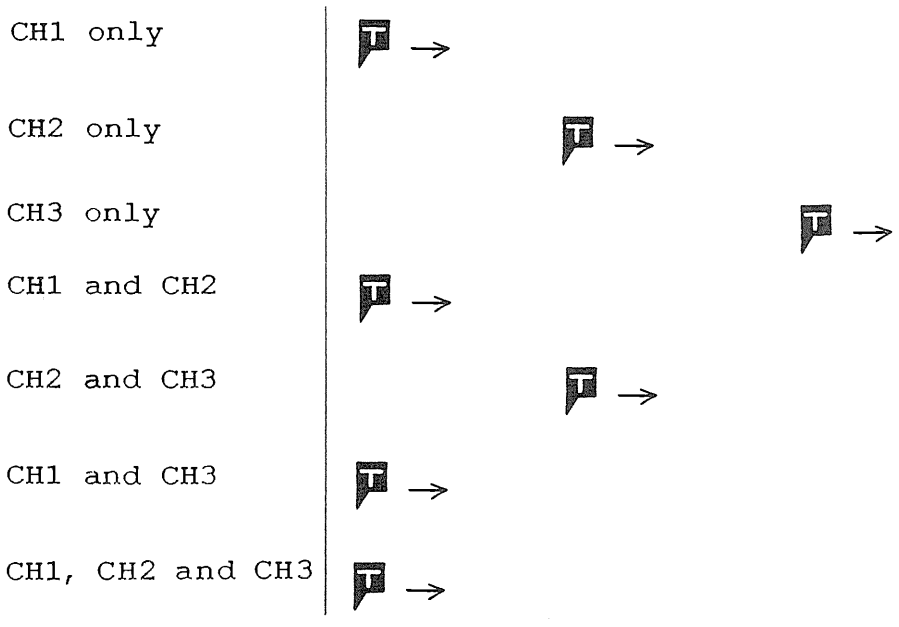


4.15.2 Trigger-source trigger conditions

The trigger will be activated is any one of the specified trigger sources fulfills its conditions.



Trigger source specification, trigger point



4.15.3 Trigger conditions for logic units

For channels using logic units the following three types of trigger conditions may be set.

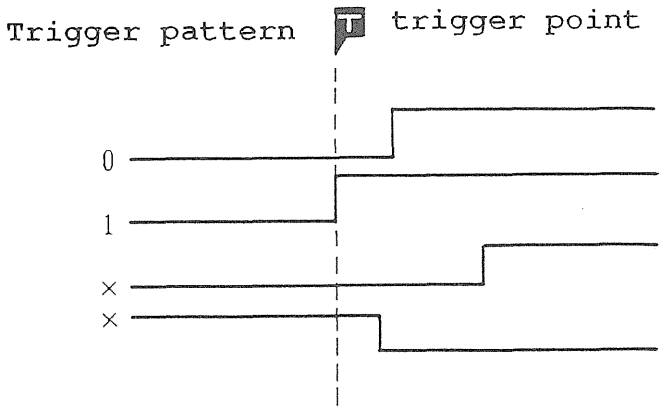
* Trigger pattern [1, 0, X]
There are three pattern settings:
[1] - HI level
[0] - LO level
[X] - don't care

Note: The threshold level discriminating HI from LO is set in the status screen for each function.

* Trigger pattern AND/OR
[AND] - Triggered when all logic input signals trigger patterns are matched.
[OR] - Triggered when at least one of the logic input signal levels changes to match the trigger pattern after none of them match the pattern.

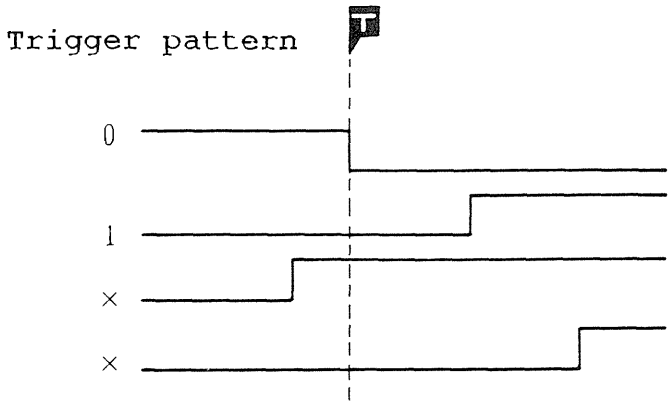
* Trigger condition match/mismatch (true/false)
[TRUE] - When the logic input signal matches the trigger pattern and the AND/OR conditions, the trigger is activated.
[FALSE] - When the logic input signal does not match the trigger pattern or the AND/OR conditions, the trigger is activated.

(1) Trigger pattern [01XX], conditions AND TRUE



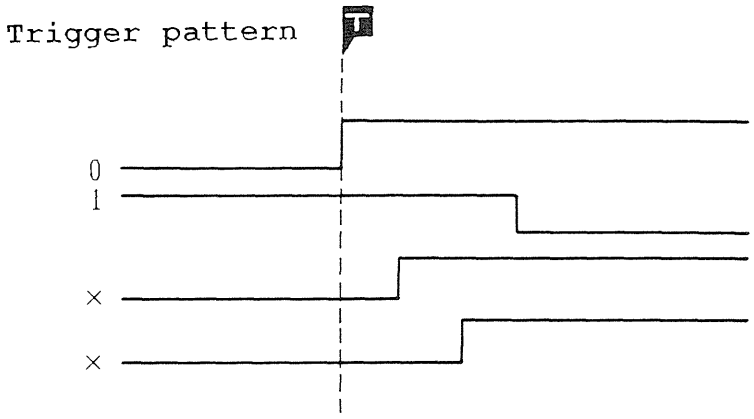
Triggered when all trigger pattern conditions met.

(2) Trigger pattern [01XX], conditions OR TRUE



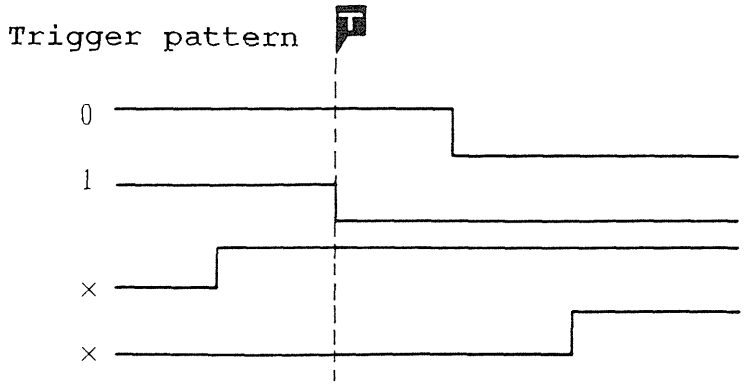
Triggered when at least one trigger pattern condition met.

(3) Trigger pattern [01XX] conditions AND FALSE



Triggered when no trigger patterns are met any more.

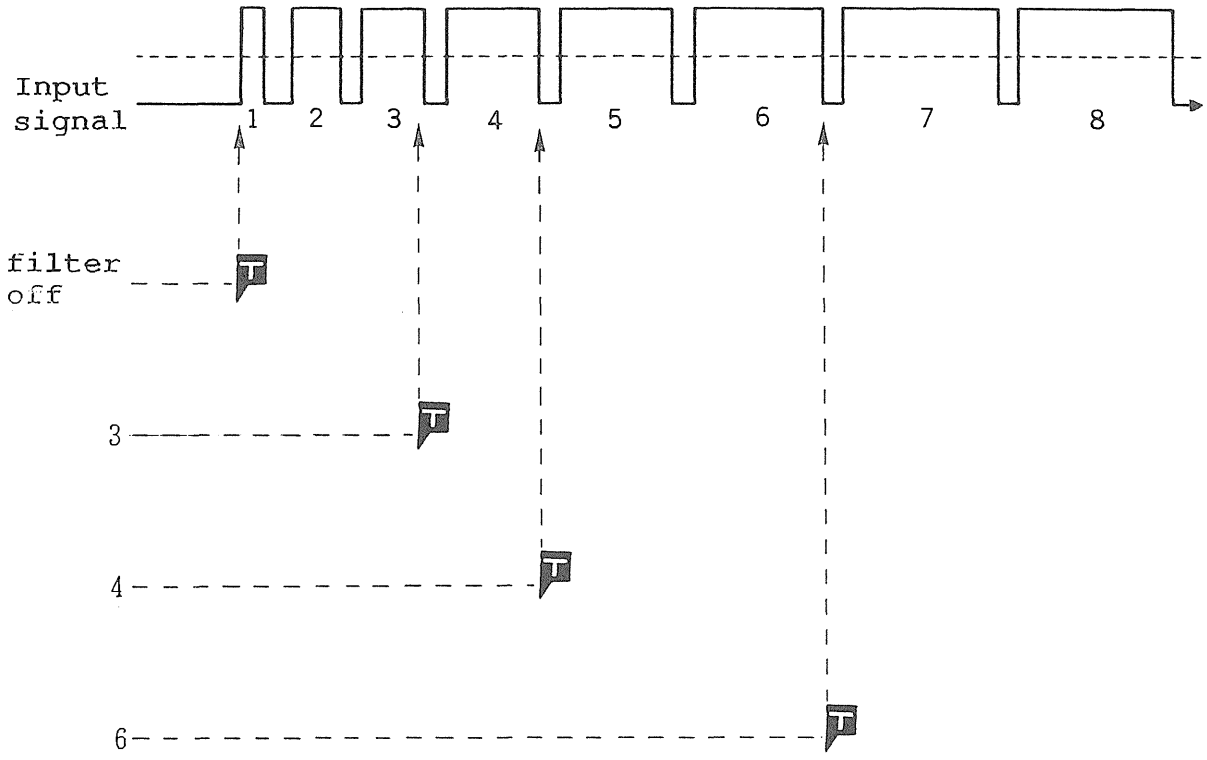
(4) Trigger pattern [01XX], conditions OR FALSE



Triggered when any trigger pattern is not met any more.

4.15.4 Trigger filter

- When the internal trigger is used the trigger filter can be used as well.
- The trigger filter masks triggers that do not match its setting for sample count.
- Filter counts can be set to 3, 4, 6, 10, 18, 34, 66 and 130 samples.

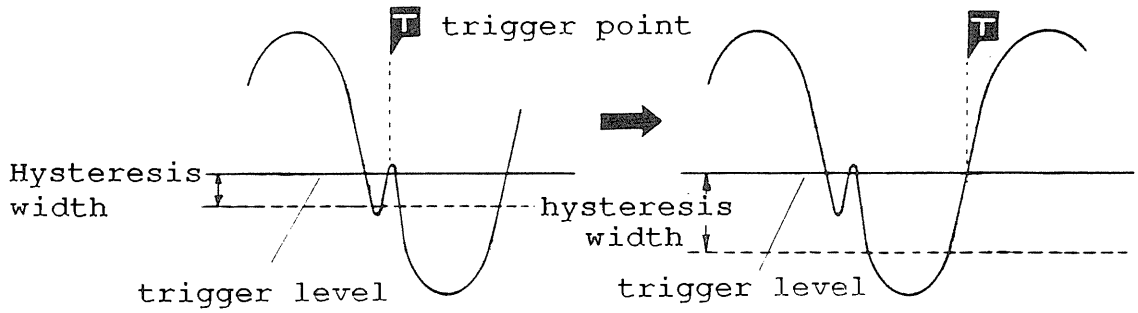


4.15.5 Trigger level width (hysteresis, used for analog units)

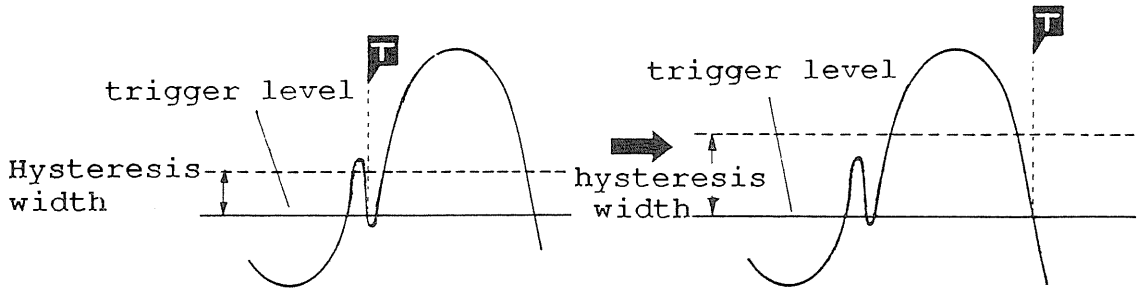
- By providing a trigger level with hysteresis (an insensitive band), it is possible to reduce accidental triggering due to noise.
- Trigger hysteresis widths can be set to 1, 2, 4, 8 or 16 (the hysteresis width of 1 is about 0.4% of the trigger level).
- The trigger hysteresis width setting is handled on the system set-up screen (see Section 4.7.2).

The relation between the trigger level and the hysteresis width is given below.

(1) Trigger slope [⤴]



(2) Trigger slope [⤵]



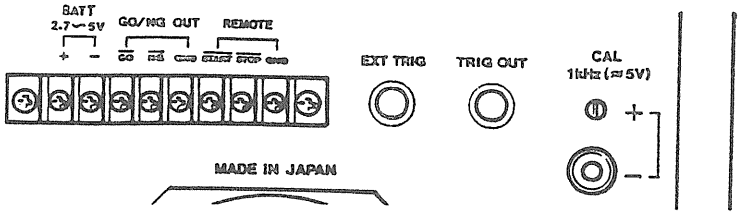
Differences in trigger points due to hysteresis width

4.15.6 Using the external trigger I/O terminal

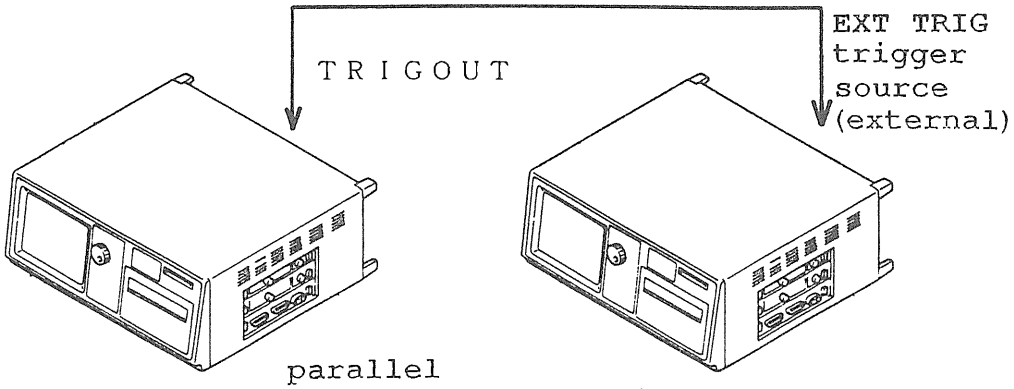
When the trigger source is set to EXT an external trigger can be applied through the EXT TRIG terminal.

The TRIG OUT terminal will output a trigger signal when the trigger is activated.

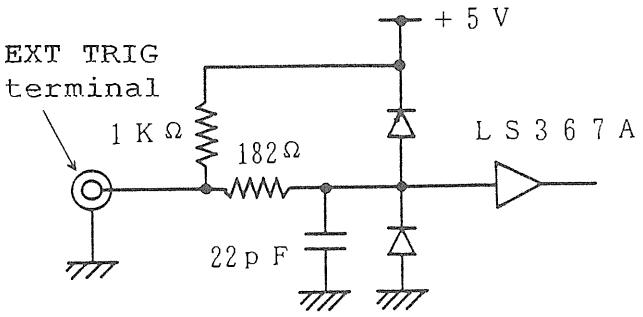
[EXT TRIG]: Triggered at TTL level signal low, or terminal short.
[TRIG OUT]: TTL level output, low active.



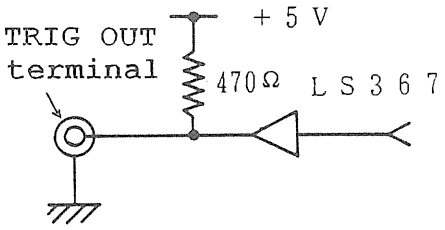
When multiple 8850 units are used parallel synchronized operation is possible.



parallel
synchronous operation



EXT TRIG circuit diagram



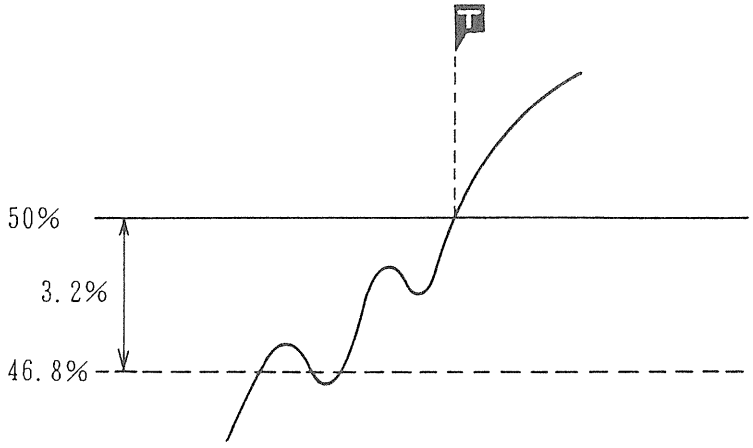
TRIG OUT circuit
diagram

4.15.7 Trigger application example

Application of analog unit trigger

Example: Trigger level: [50]%
Trigger slope: [↑]
Trigger hysteresis: [8]

The hysteresis width is 8x0.4% of the trigger level, or 3.2%.

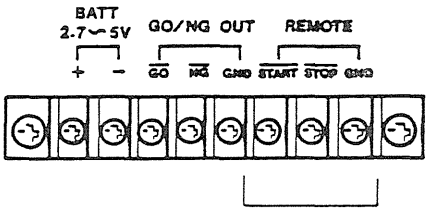


4.16 External start/stop input terminal usage

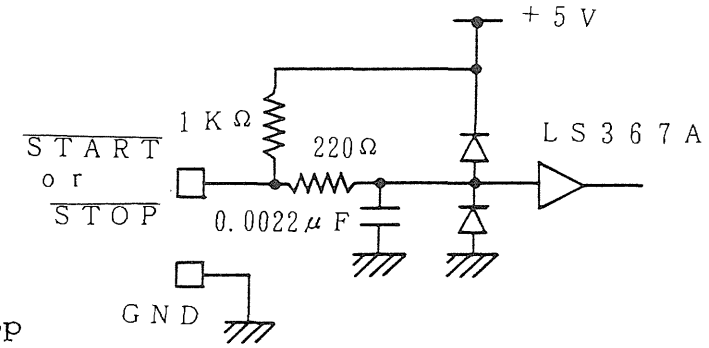
. Using the rear panel external terminals it is possible to start and stop recording in all measurement functions.

[START]: Input low TTL level signal between START and GND terminals, or short them out.

[STOP]: Input low TTL level signal between STOP and GND terminals, or short them out.



External Start/Stop input terminals



Input circuit diagram

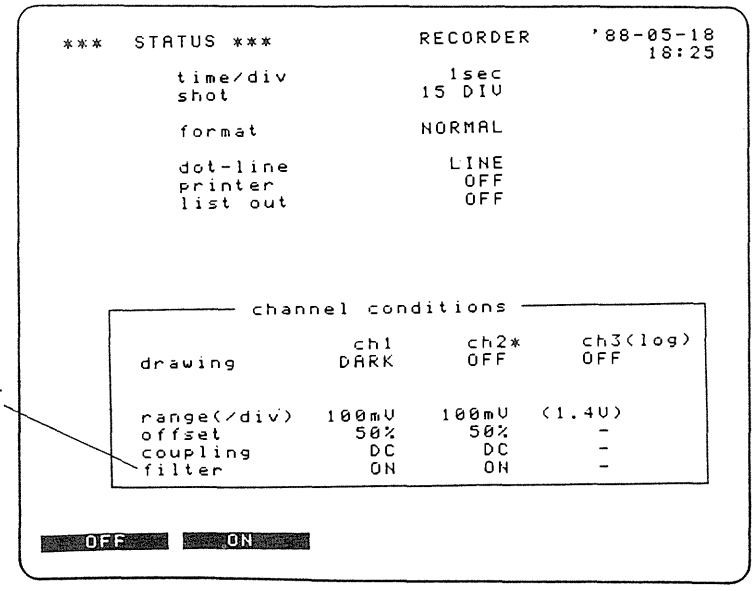
4.17 Input signal ripple filtering

. For recorder analog recording, high-speed sampling and a high-bandwidth input amplifier can reflect signal ripple component and generate artifacts.

. Many transducer outputs have a ripple component, leading to recordings that are thicker than normal.

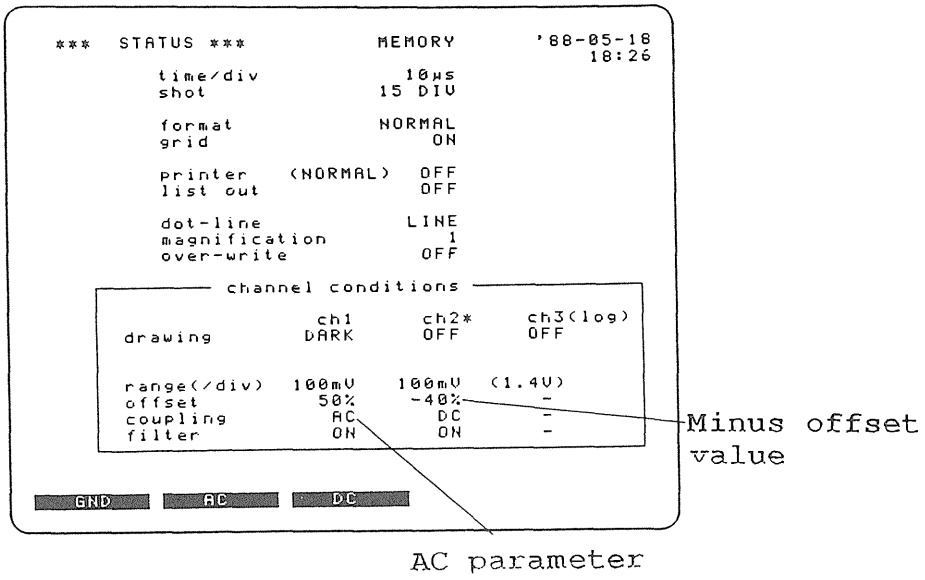
. By turning on the filter parameter for the input unit a low-pass filter can be switched into circuit to eliminate these phenomena (cut-off frequency about 5Hz).

Low-pass filter setting



4.18 Input signals with DC component weighting

- When measuring an AC signal with DC weighting, raising the input amplifier sensitivity will lead to the waveform peaks exceeding the full scale value.
- In this case, either change the input coupling to AC (C coupling), or adjust the offset to a minus value.

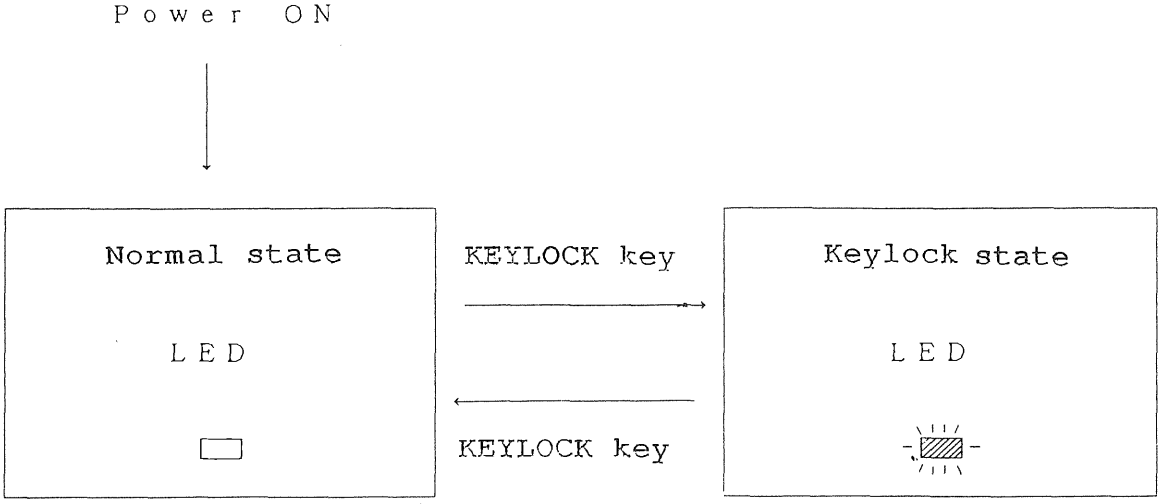


4.19 Key lock

(1) Pressing the KEYLOCK key can lock all keys on the 8850 with the exception of itself. In this state, the KEYLOCK (GP-IB) LED will light and all other keys will be disabled.

This is designed to prevent accidental alteration of system parameters during measurement.

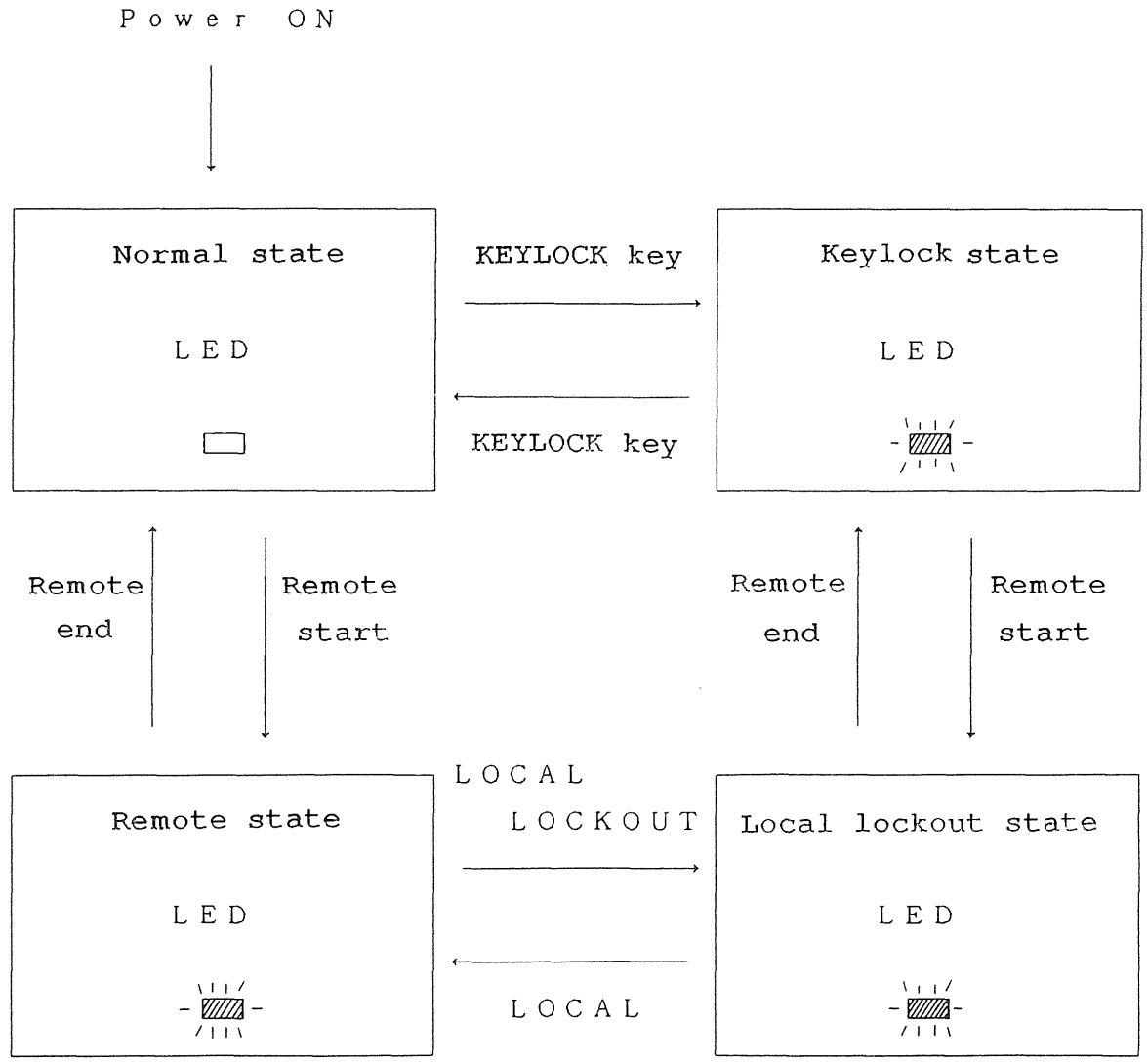
(2) The Keylock state will be cleared when the KEYLOCK key is pressed a second time.



GP-IB and keylock state

(1) Regardless of the keylock key setting, when the 8850 is controlled remotely through the GP-IB interface the KEYLOCK (GP-IB) LED will light, and all keys (including the KEYLOCK key) will be disabled.

(2) When the external remote control is terminated, the 8850 will return to its former state.



[Normal state]: All keys are enabled
[Keylock state]: KEYLOCK key only enabled
[Remote state]:----------┐
[local lockout state]:---┘---- All keys are disabled

4.20 Battery back up

o 8850 internal battery

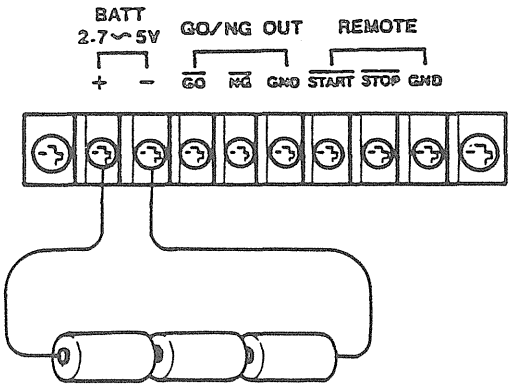
. Parameters are backed up by the internal battery. These parameters will be stored for about a month when power is turned off (when battery is at full charge).

Note: Leaving the 8850 on for about 50 hours will recharge the battery completely. Running the 8850 for about 1.5 hours per day fill maintain the battery at full charge.

o External battery

. Waveform data input in the memory recorder function is not backed up by the internal battery, but can be backed up by connection of an external battery to the BATT terminals on the back panel.

. The BATT terminal is designed to handle voltages from 2.7V to 5.0V. Power consumption is 1.0mA max. at 5.0V, and 350uA max. at 3.0V.



Reference: Three AAA batteries will back up the 8850 for about one month.

Note: If the external voltage exceeds 5.0V the protective circuit will operate and current consumption will rise rapidly. For this reason, do not use power supply voltages over 5.0V.

If the backup power fails or is too low to maintain the memory, stored waveform data will be initialized when the system power is turned on.

CHAPTER 5

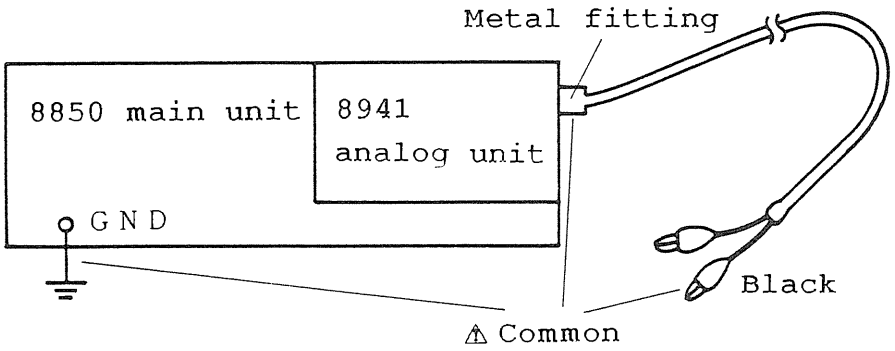
INPUT UNIT OPERATING

5.1 8941 analog unit (high-speed type) operation

⚠ CAUTION

* The 8941 GND terminal is common with the 8850 chassis CND.

* The 8941 input connector is a BNC connector. The connector metal forms the minus side (common with 8850 chassis GND). This is common with the black clip of the 9166 input cord and the 9162 input probe, so care is required to prevent shocks.



* The maximum permissible input for the 8941 is 150V (DC + AC peak). Never input a signal above this limit.

* When an input exceeds the full scale value of that range, the waveform may not be displayed accurately (because the pre-amplifier may be saturated due to input size). Resolution is 8 bits (using 250 of 256 dots), so if the input signal is excessively small compared to the full scale value resolution will drop.

* Always be sure to tighten the mounting screws when installing an input unit, and be sure to turn off the power first before removal or installation.

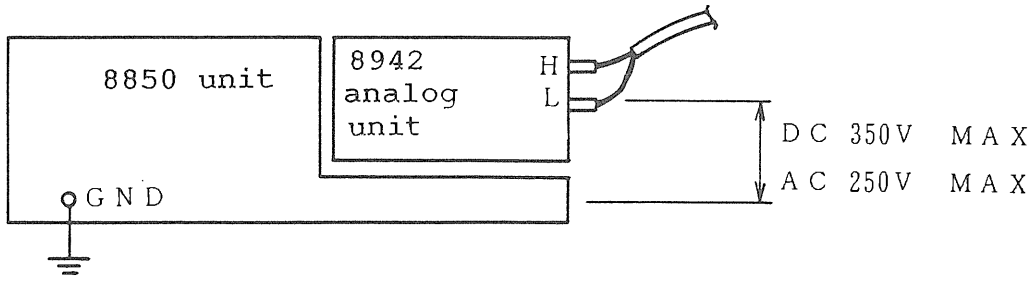
. Gain adjustment
By rotating the VARIABLE control (gain adjustment) on the unit panel, gain can be varied over a range of about 50% to 100%. Normally leave it in the CAL position.

5.2 8942 analog unit (isolation type) operation

⚠ CAUTION

* The 8942 input is isolated from input and output.

* The maximum floating voltage between the 8850 case and input, or between other analog units and input, is AC250V, DC350V. Never apply a voltage over this limit.



Maximum floating voltage

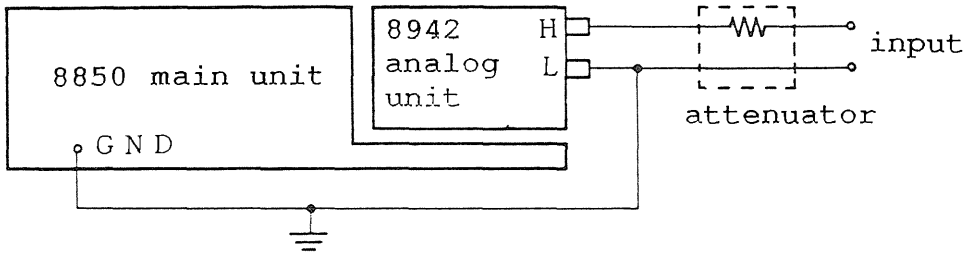
* The maximum permissible input for the 8942 is 200V (DC + AC peak). Never input a signal above this limit.

* When an input exceeds the full scale value of that range, the waveform may not be displayed accurately (because the pre-amplifier may be saturated due to input size). Resolution is 8 bits (using 250 of 256 dots), so if the input signal is excessively small compared to the full scale value resolution will drop.

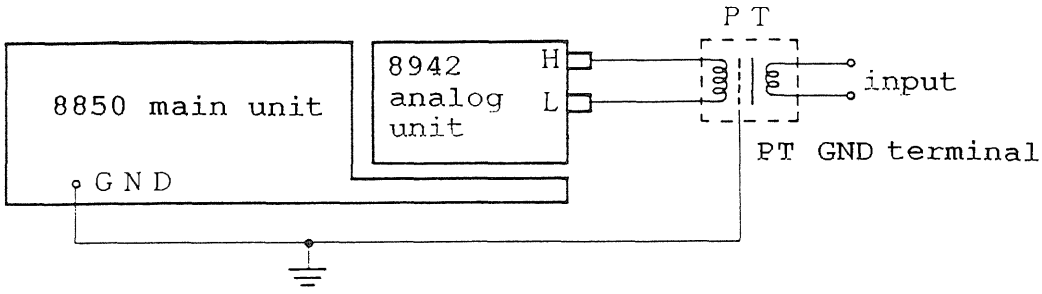
* Always be sure to tighten the mounting screws when installing an input unit, and be sure to turn off the power first before removal or installation.

. Gain adjustment
By rotating the VARIABLE control (gain adjustment) on the unit panel, gain can be varied over a range of about 50% to 100%. Normally leave it in the CAL position.

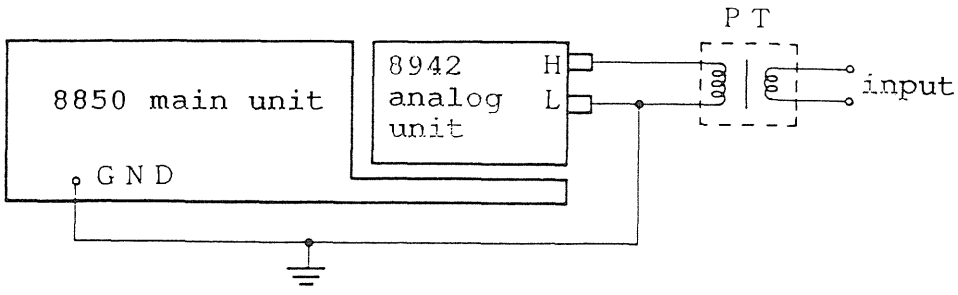
* Maximum floating voltage does not change even when an attenuator is used in the input. For this reason, always ground the input side as well for measurement over DC350V (AC250V).



When a PT is used for measurement of AC power lines, for example, be sure to ground it.



(a) When PT fitted with GND terminal

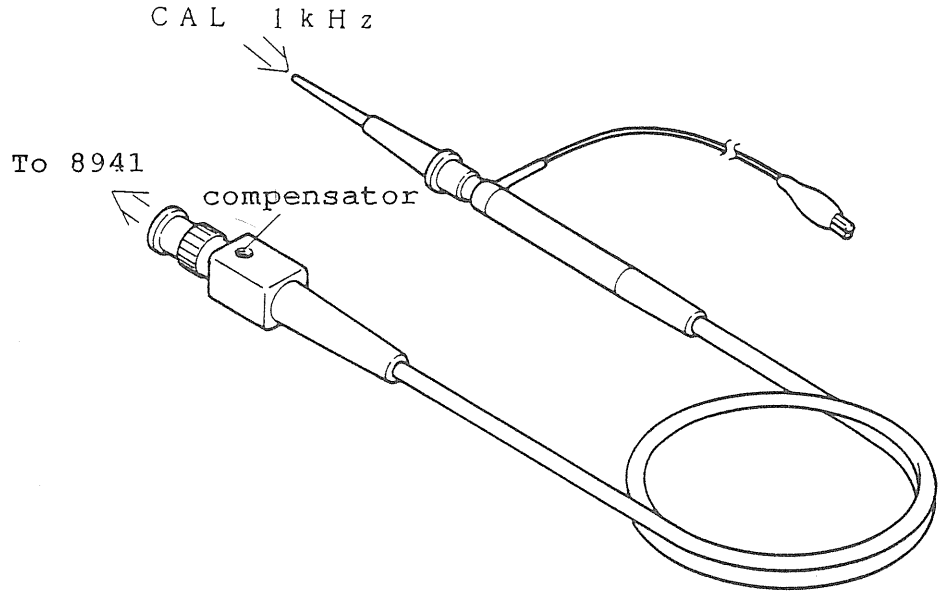


(b) When PT not fitted with GND terminal

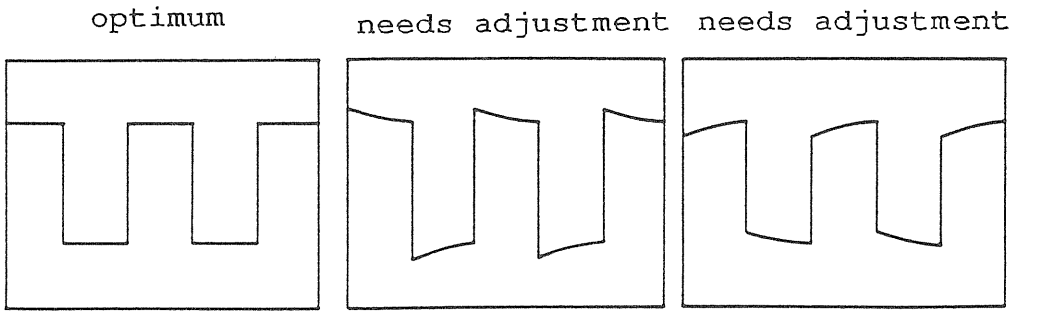
5.3 9162 input probe (10:1) usage

The 9162 input probe is composed of a wide bandwidth attenuator, but unless phase compensation is correct the displayed waveform will be erroneous. Be sure that the probe is calibrated correctly before use.

Calibration is handled with the calibration output terminal (CAL 1kHz) on the rear panel. This terminal outputs a 1kHz (about 5V) signal for connection to the probe tip. Adjust the 8850 so that the entire waveform is displayed on the CRT, and adjust the compensator with an insulated screwdriver as indicated below.



9162 input probe calibration



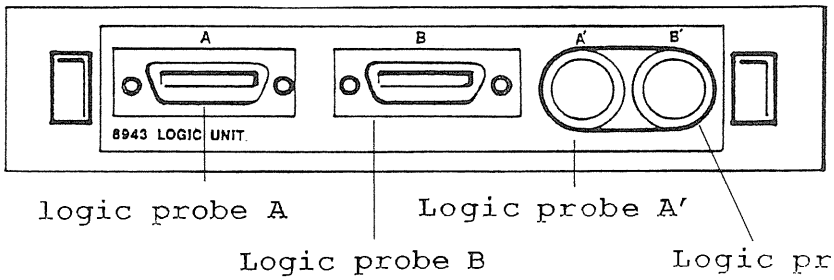
5.4 8943 logic unit operation

> ⚠ CAUTION
>
> * A logic unit can only be connected to a maximum of two probes (total eight channels).
>
> * The probe GND terminal is common with the 8850 chassis GND (except for the 9307).

(1) Set the display channel, trigger conditions and threshold voltage as per normal function procedure.

(2) The logic unit requires the dedicated logic probe (sold separately). Select the input terminal to be used for that probe.

Logic probe input terminals



logic probe A
Logic probe A'
Logic probe B
Logic probe B'

o Compatible probes
Logic probes A and B 9310 high-speed logic probe
Logic probes A' and B' 9306, 9307, 9308 probes

(3) Input signal selection
. If probes are connected to both sets of terminals, A (B) is given priority, and that input signal will be received.

If A'(B') are to be used, disconnect the probe from the A(B) terminals.

5.5 Logic probes

Logic probe	9306	9307	9308	9310
application	digital signals and contact signals	AC/DC voltage detection	transient voltage drop detection	high-speed digital signals

types of logic probes

(1) 9310 high-speed logic probe
Response time is 50nsec, and the variable threshold level make this probe suitable to high-speed signal measurement across a wide range.

⚠ CAUTION

- A single logic unit can handle two 9310 probes.
- GND is common with the 8850 GND.
- Read the 9310 manual thoroughly before use.

(2) 9306 logic probe
Select switch provided for selection of digital input or contact input for each channel, making it perfect for a wide range of applications from electronic circuits to relay operation timing.

⚠ CAUTION

- Check the selection switch setting before starting measurement.
- GND is common with the 8850 GND.
  Read the 9306 manual thoroughly before use.

(3) 9307 line logic probe
Capable of detecting AC line voltage on/off. Can handle high voltage (up through 250V), for measurement of relay sequence timing.

⚠ CAUTION

- Input channels are insulated from each other, as are input and output. Do not input floating voltage above the specified limit.
- Read the 9307 manual thoroughly before use.

(4) 9308 line dip detector

Line dip detector for detection of transient drops in commercial line (AC100V, 120V). Dip level can be set to either 80% or 90%.

⚠ CAUTION

- The low clip (black) is common with the input clip (black).
- The 8942 input unit is required.
- Read the 9308 manual thoroughly before use.

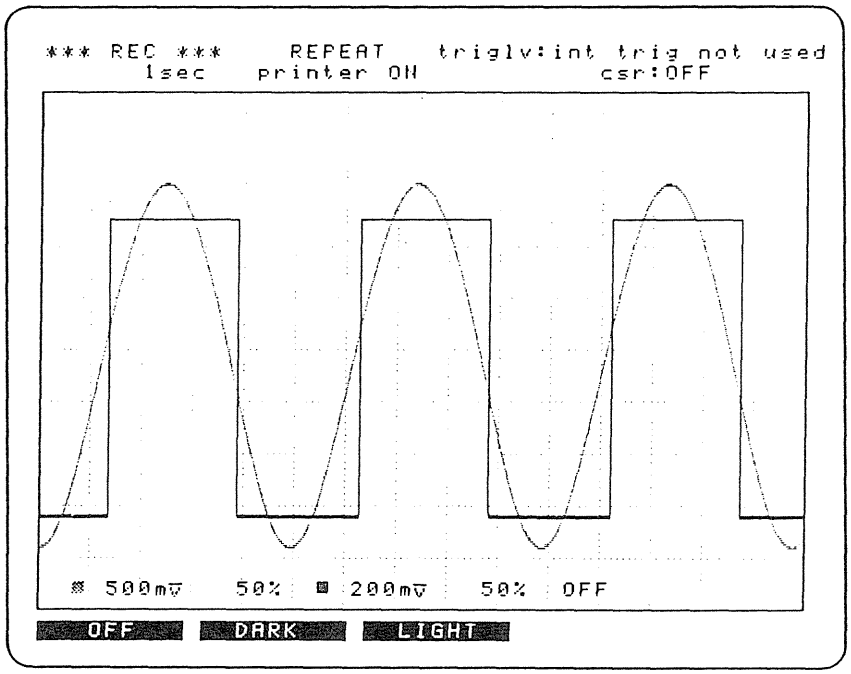
CHAPTER 6

READING SCREENS AND CHARTS

6.1 Recorder function

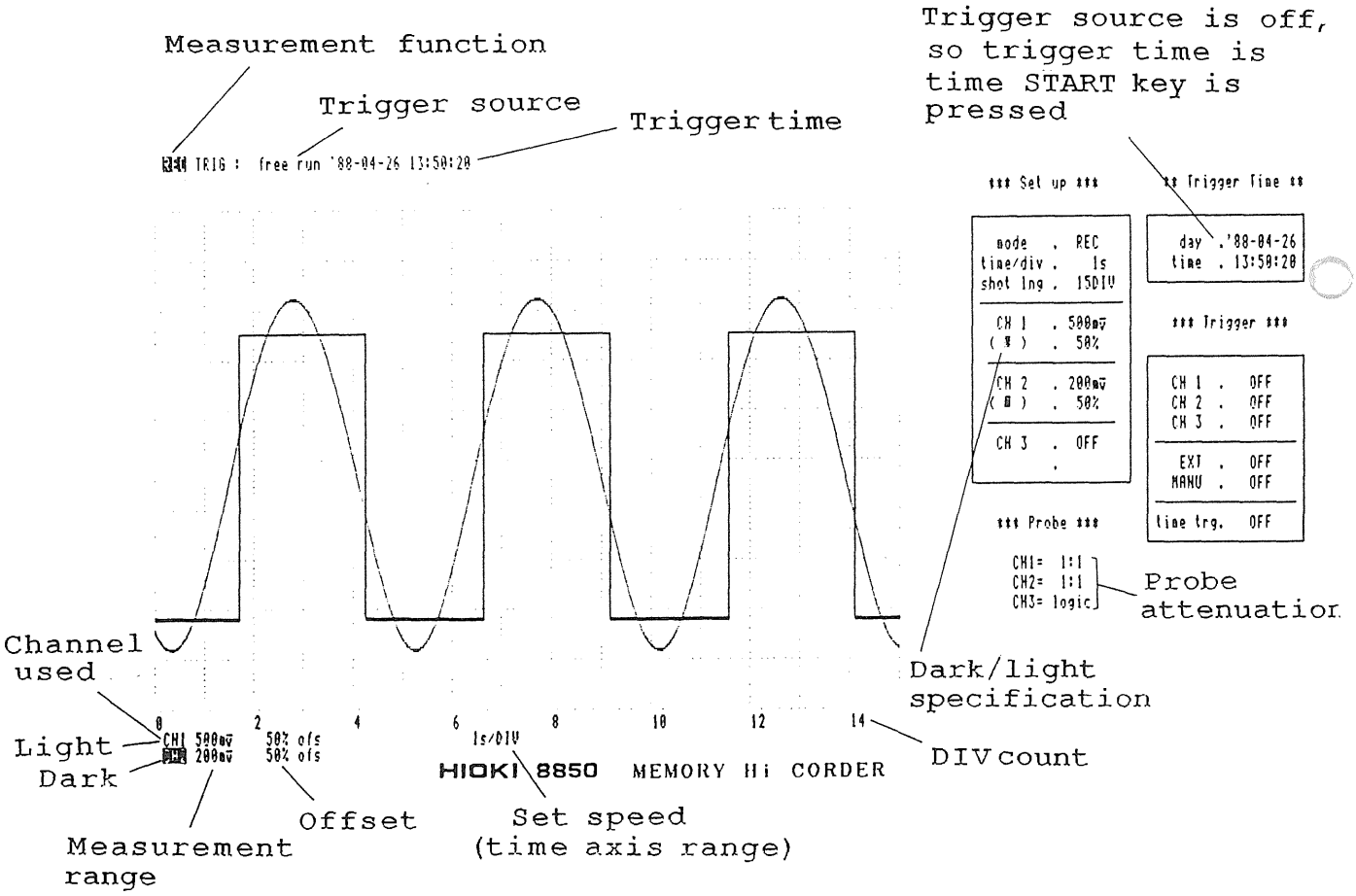
* NORMAL format

. Display screen



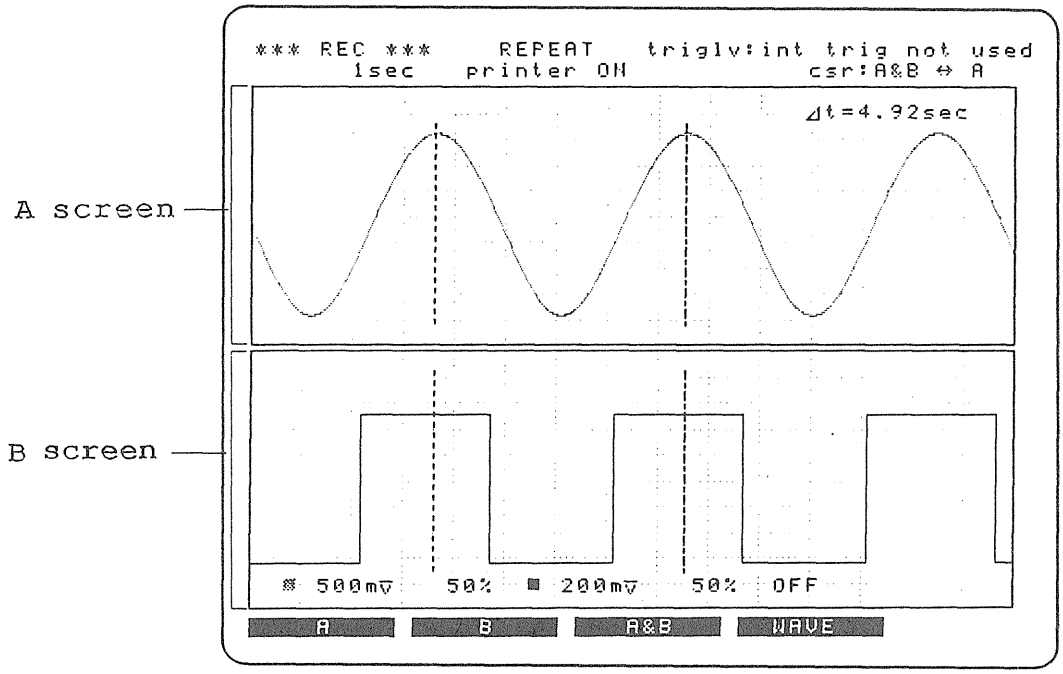
· Chart

· List



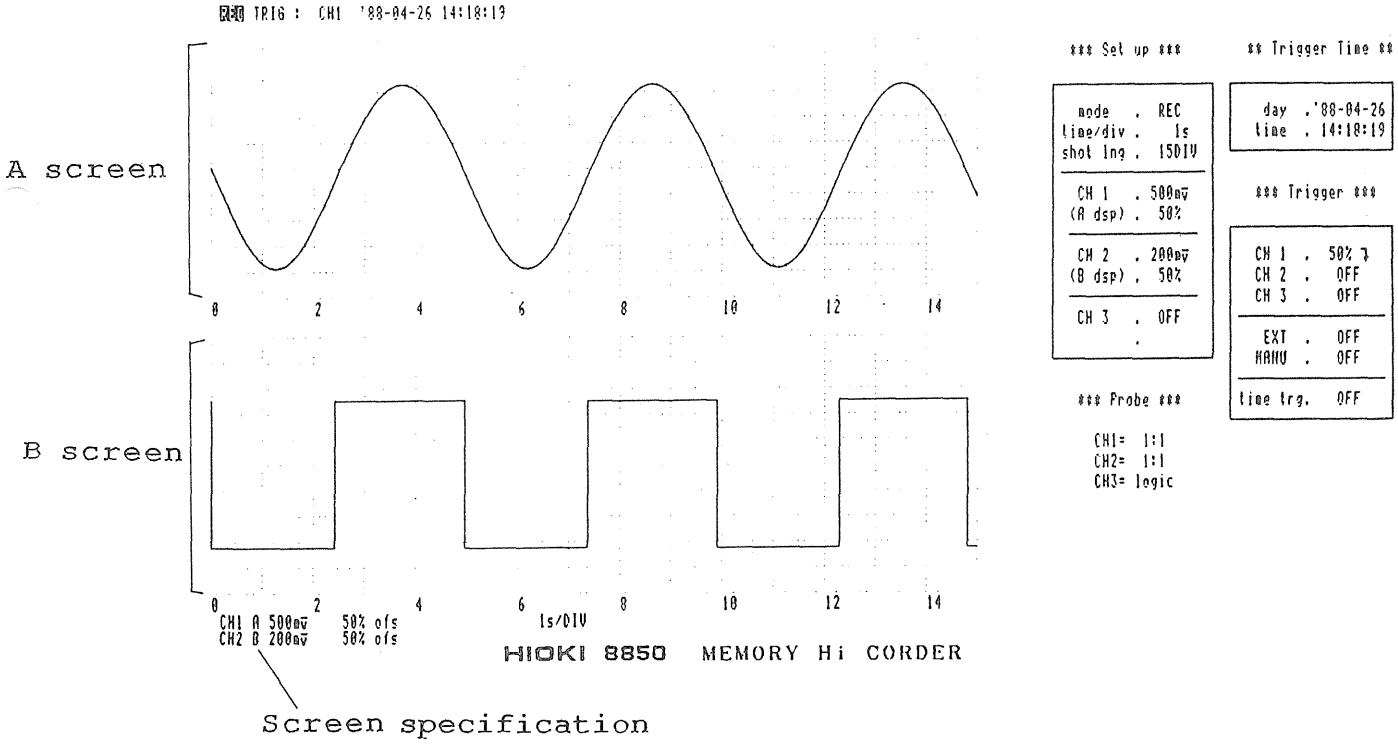
* DUAL format

· Display screen



. Chart

· List

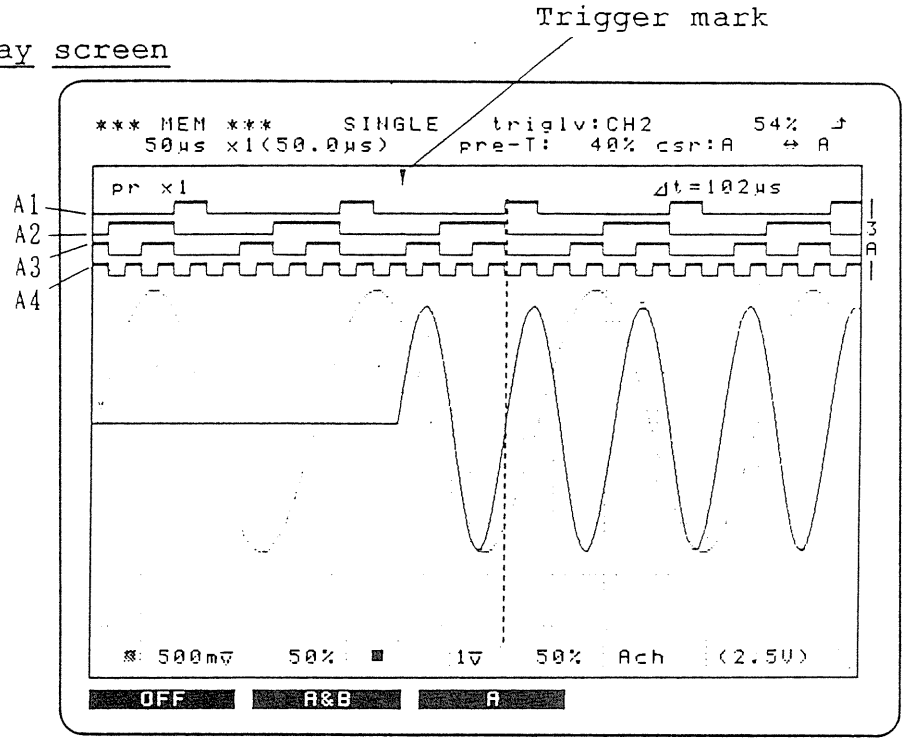


Screen specification

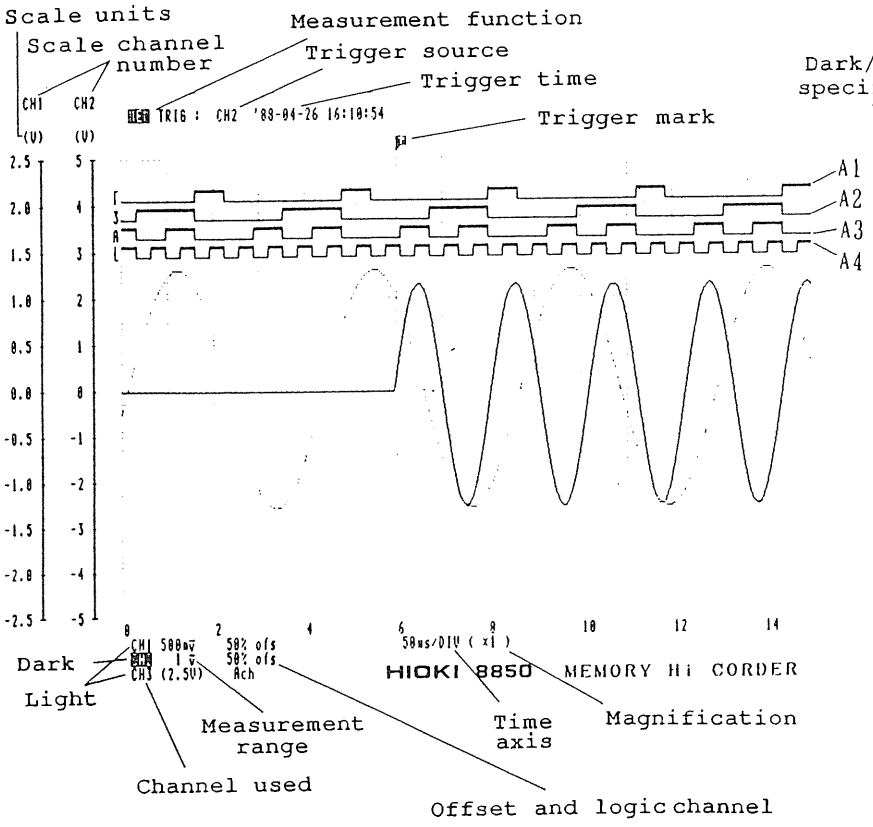
6.2 Memory recorder function (Scales are printed on the chart.)

* NORMAL format

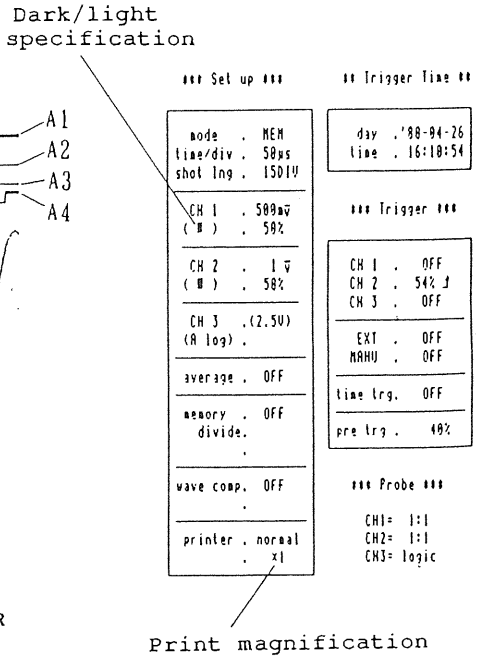
Display screen



· Chart

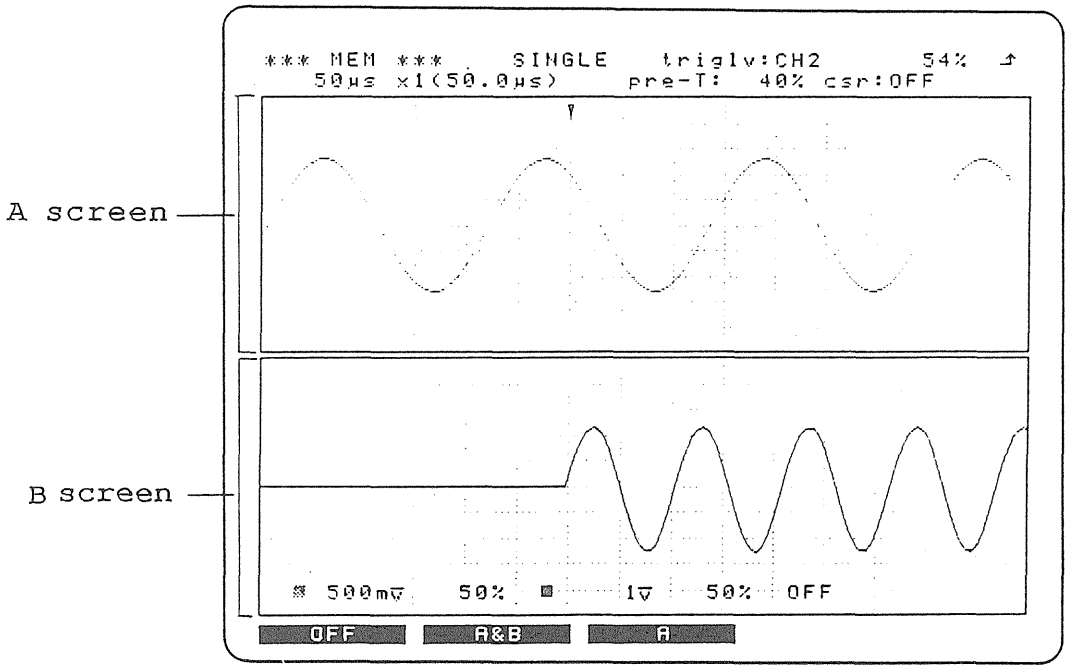


List

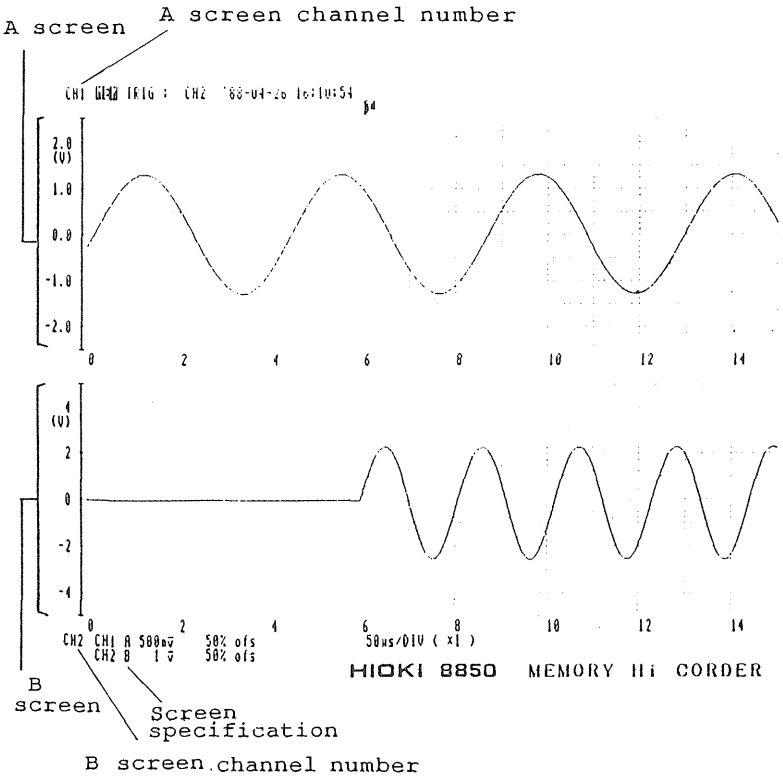


* DUAL format

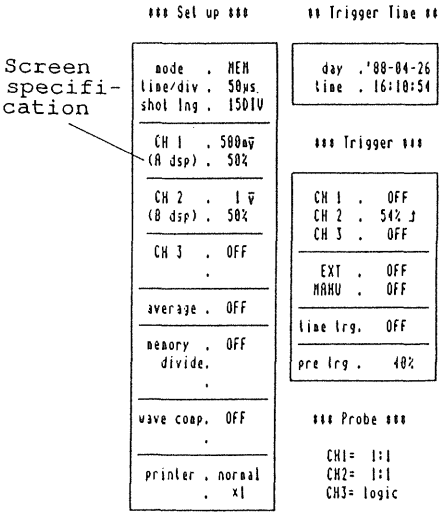
· Display screen



· Chart

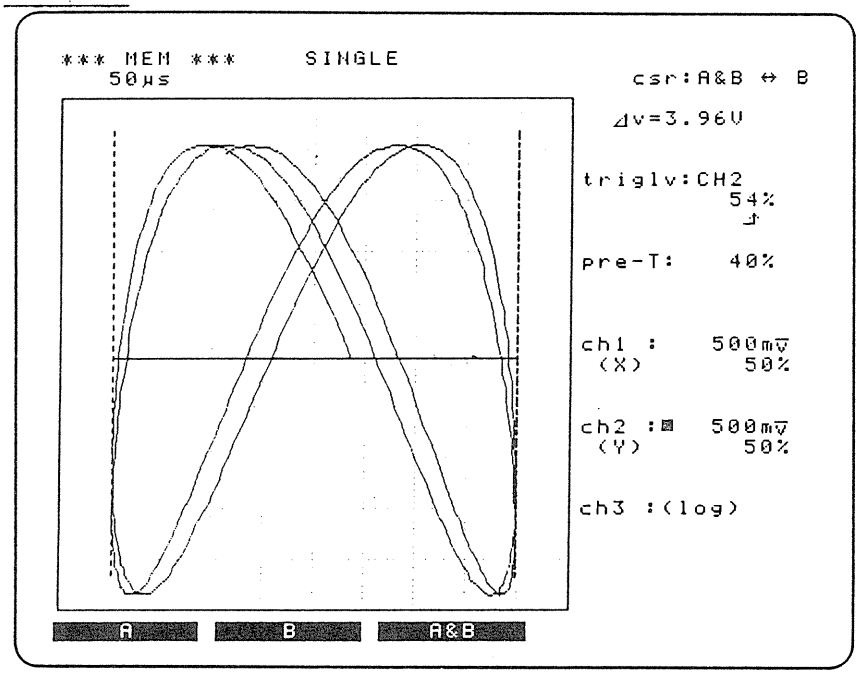


· List

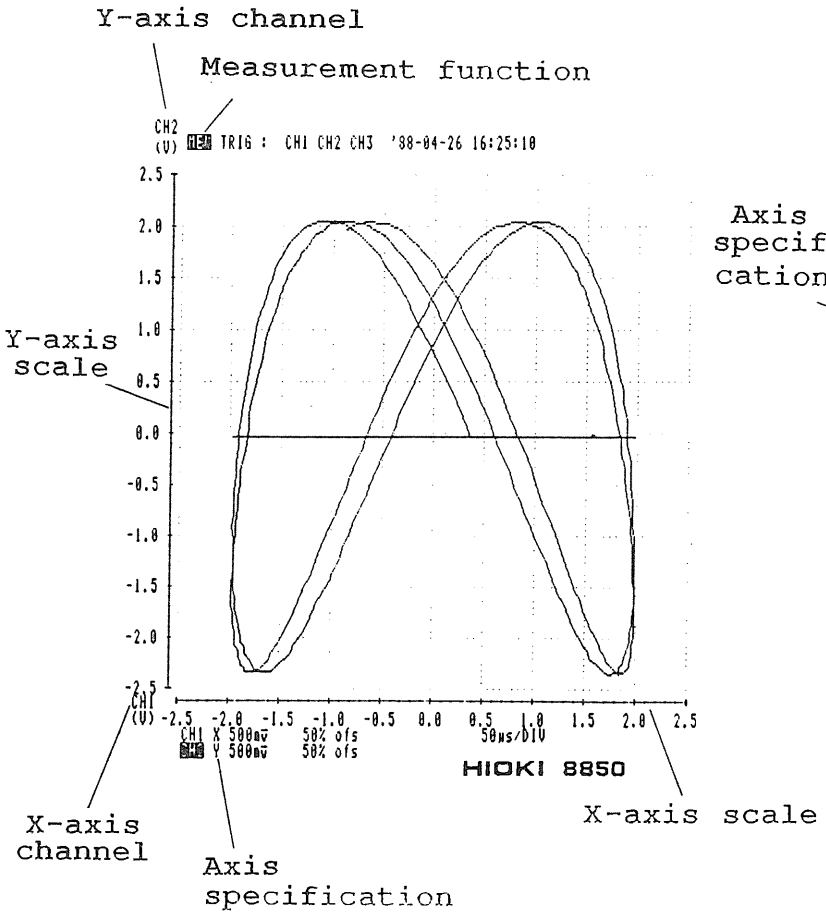


* XY format

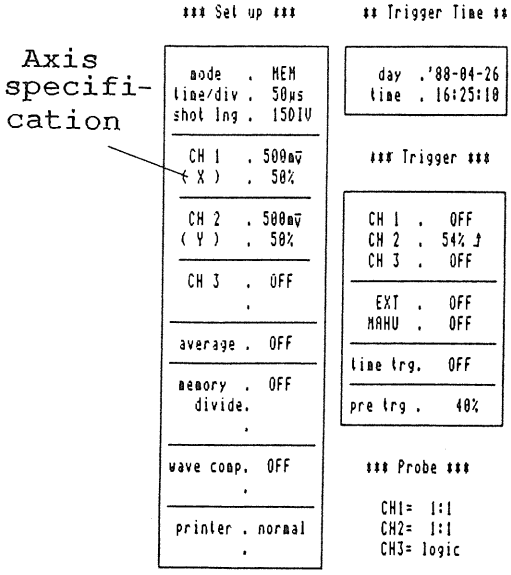
· Display screen



· Chart

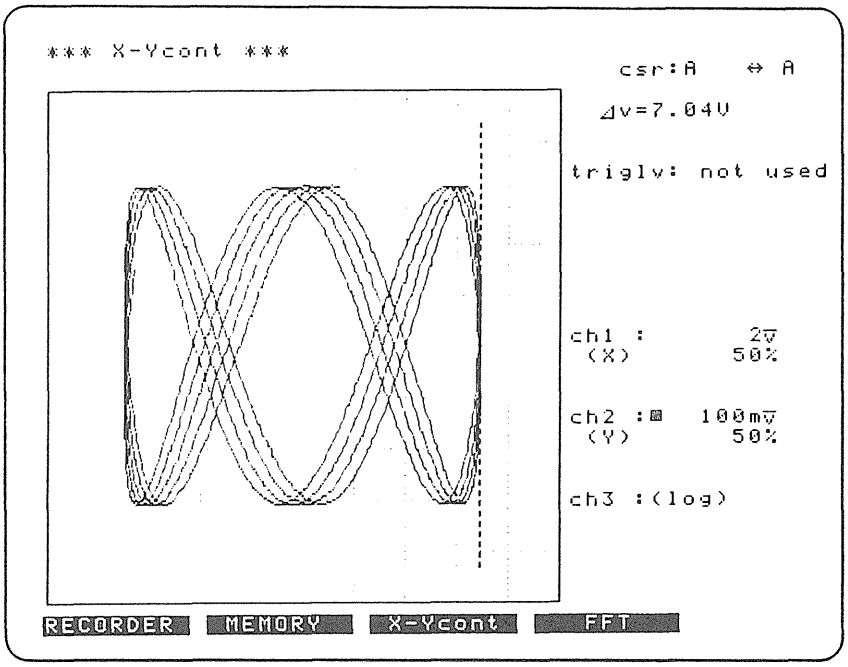


· List

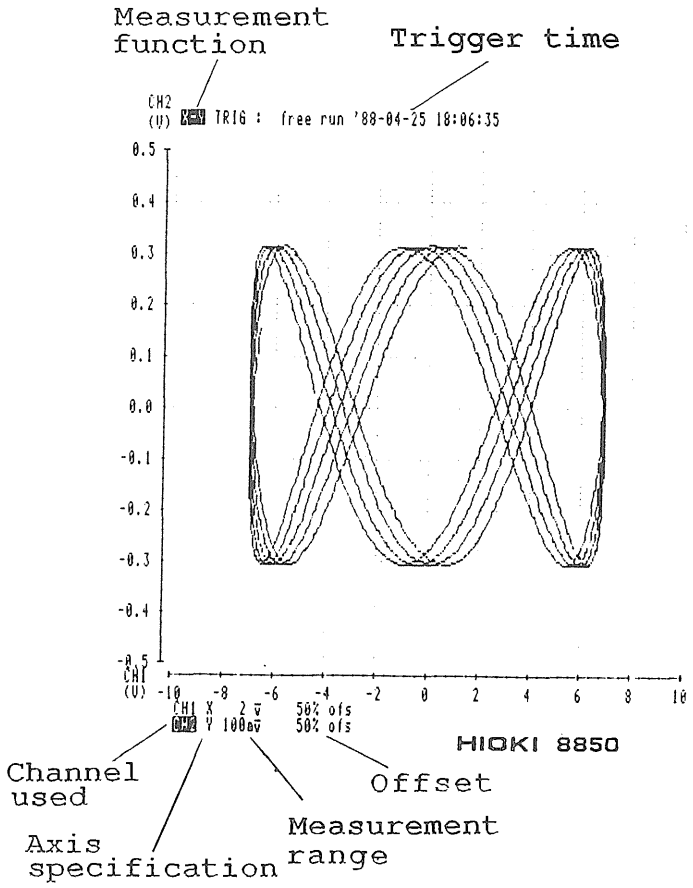


6.3 XY recorder function (Scales are printed on the chart.)

·Display screen



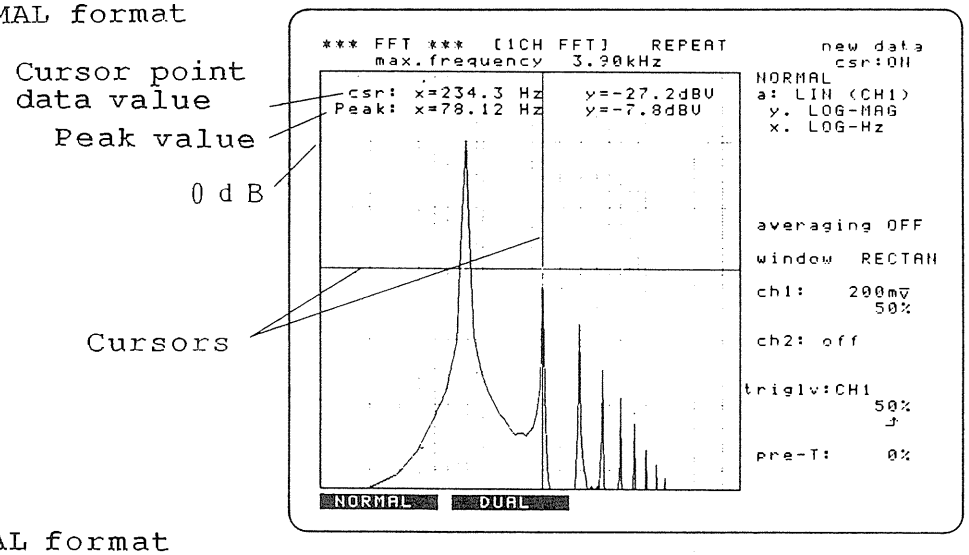
· Chart



6.4 FFT analysis function

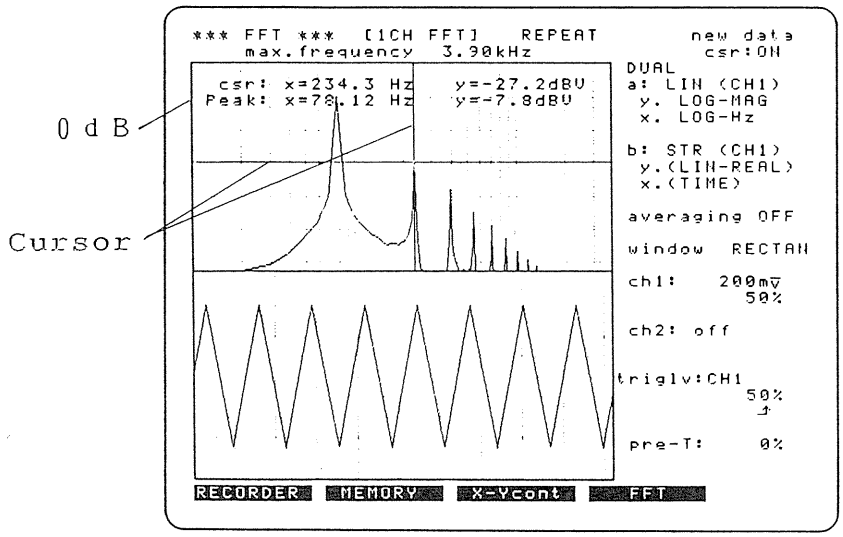
Display screen

* NORMAL format



* DUAL format

Cursor on A screen only used



* Nyquist display screen

Cursors not used

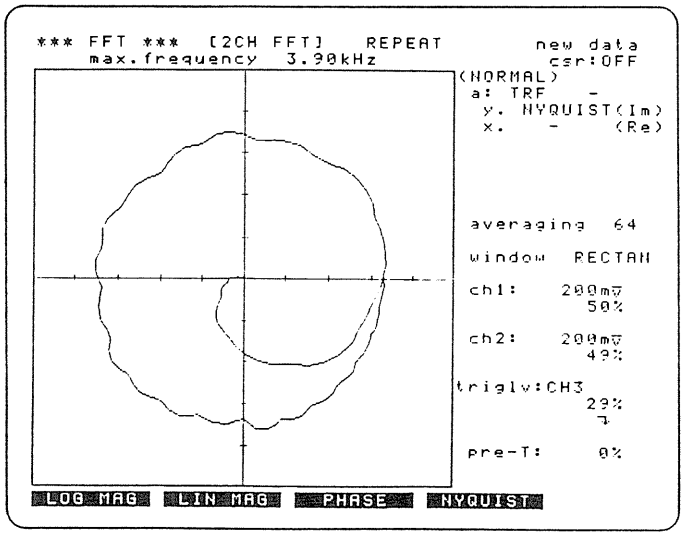
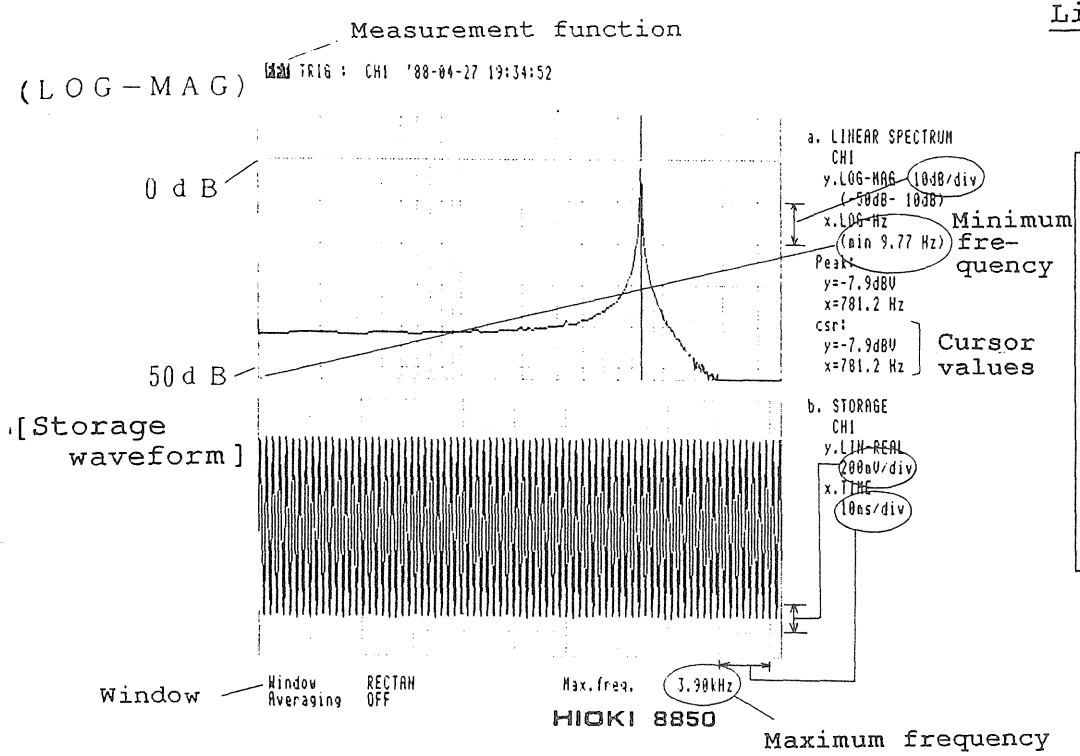


Chart (dual format other than Nyquist)

[Linear spectrum]



List

*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV 50%
CH 2	OFF
CH 3	OFF
average	OFF
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	19:34:52

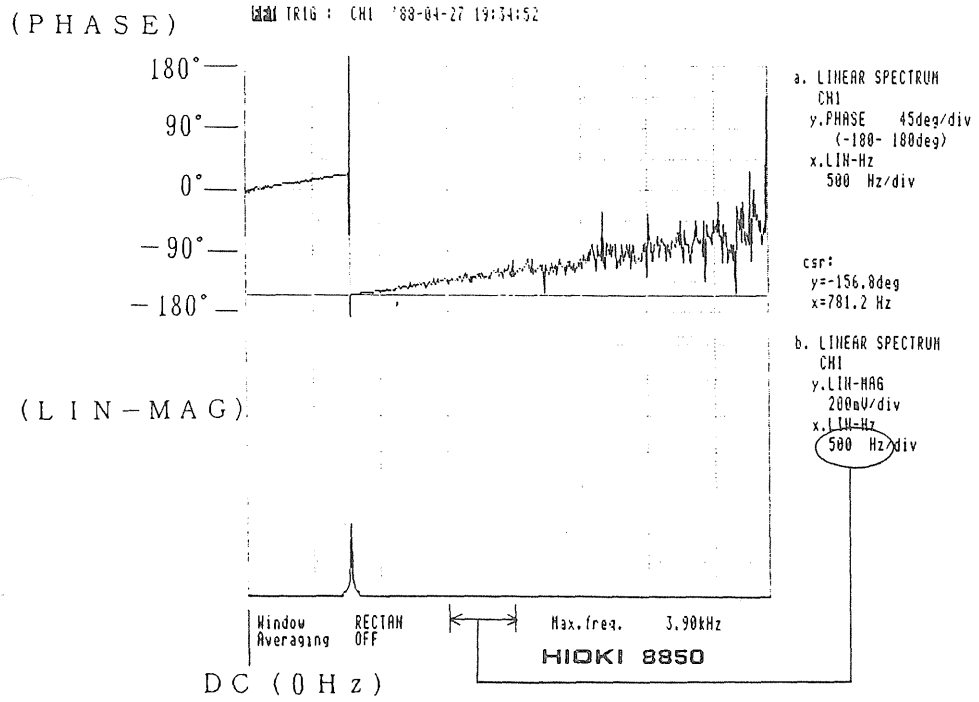
*** Trigger ***

CH 1	50% ↓
CH 2	OFF
CH 3	OFF
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

[Linear spectrum]



*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV 50%
CH 2	OFF
CH 3	OFF
average	OFF
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	19:34:52

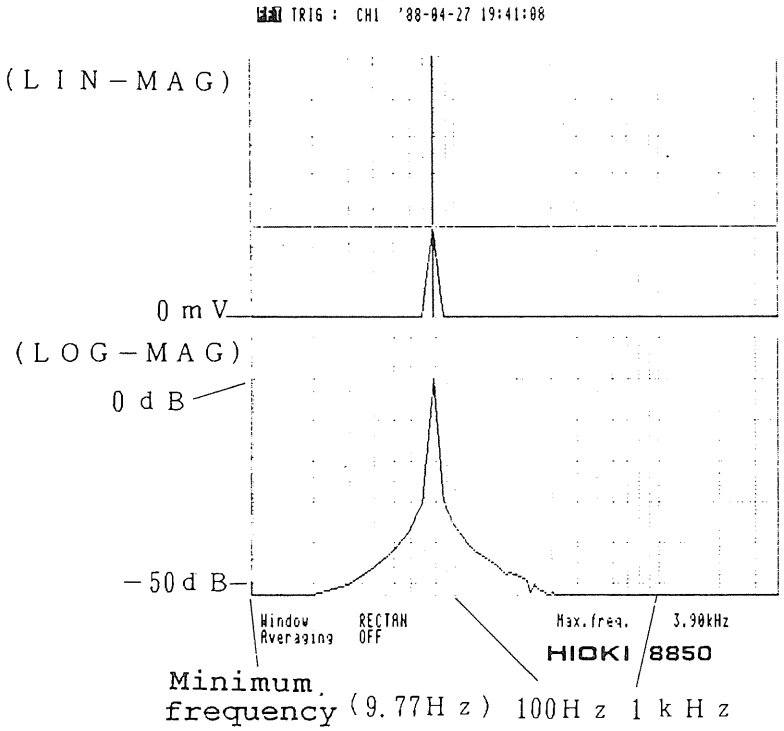
*** Trigger ***

CH 1	50% ↓
CH 2	OFF
CH 3	OFF
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

[Power spectrum]



a. POWER SPECTRUM
CH1
y.LIN-MAG
200mV/div
x.LOG-Hz
(min 9.77 Hz)
Peak:
y=-6.0dBV
x=78.12 Hz
csr:
y=-6.0dBV
x=78.12 Hz

b. POWER SPECTRUM
CH1
y.LOG-MAG 10dB/div
(-50dB- 10dB)
x.LOG-Hz
(min 9.77 Hz)

*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV 50%
CH 2	OFF
CH 3	OFF
average	OFF
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	19:41:08

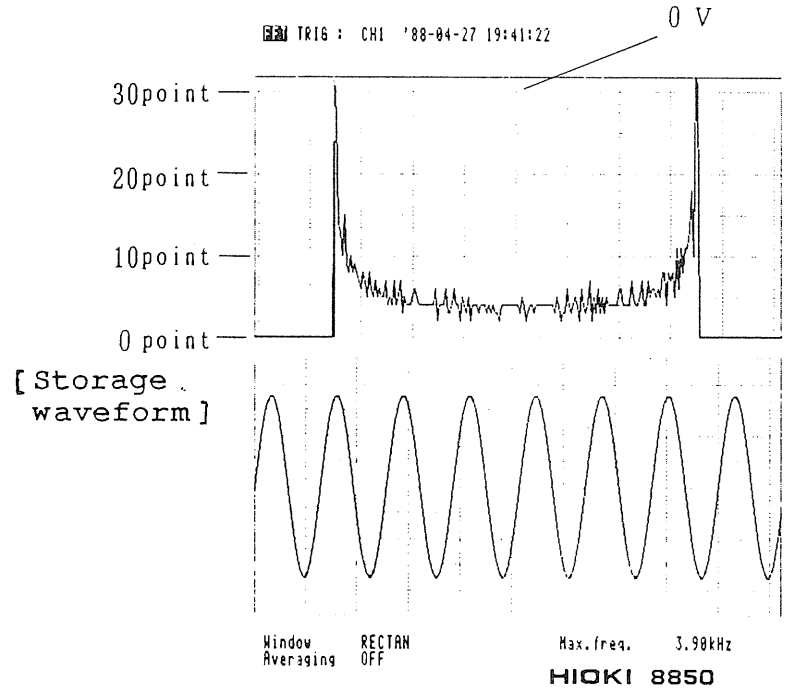
*** Trigger ***

CH 1	50% ↑
CH 2	OFF
CH 3	OFF
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

[Histogram]



a. HISTOGRAM
CH1
y.NUMBER
5point/div
x.LIN-V
200mV /div

csr:
y=38
x=-794mV

b. STORAGE
CH1
y.LIN-REAL
200mV/div
x.TIME
10ms/div

*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV 50%
CH 2	OFF
CH 3	OFF
average	OFF
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	19:41:22

*** Trigger ***

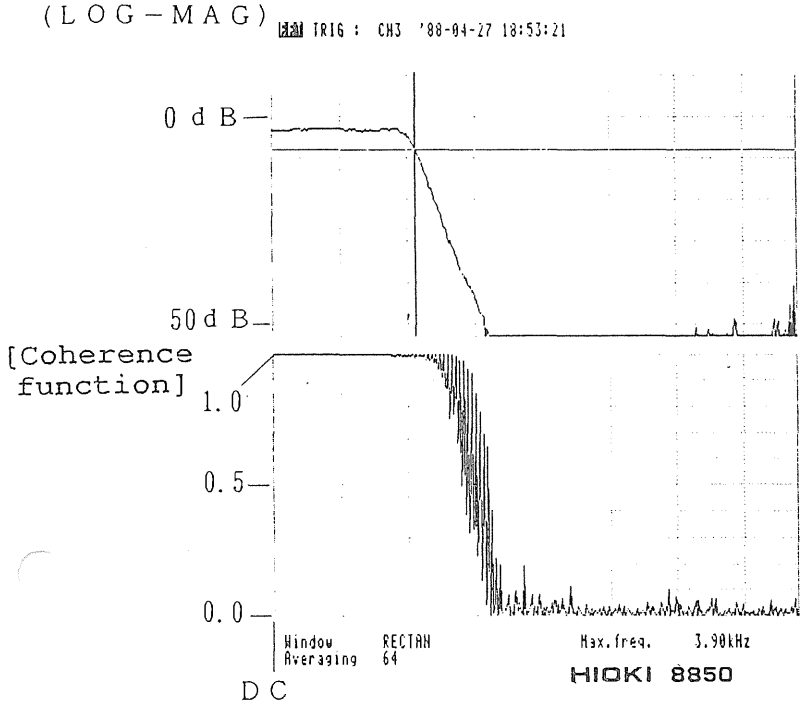
CH 1	50% ↑
CH 2	OFF
CH 3	OFF
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

[Transfer function]

(L O G − M A G)



a. TRANSFER FUNC
y.LOG-MAG 10dB/div
(-50dB- 10dB)
x.LIN-Hz
500 Hz/div

csr:
y=-8.10dB
x=1.064kHz

b. COHERENCE
y.LIN-REAL 0.1/div
(0.0- 1.0)
x.LIN-Hz
500 Hz/div

*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV
	50%
CH 2	200mV
	49%
CH 3	OFF
average	64
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	18:53:21

*** Trigger ***

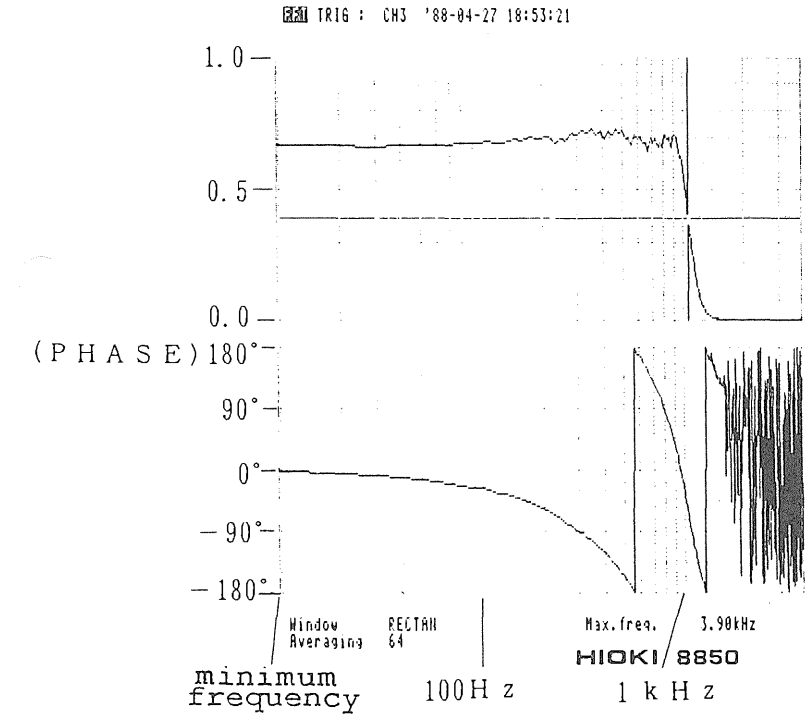
CH 1	OFF
CH 2	OFF
CH 3	29% ↘
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg.	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

[Transfer function]

(L I N − M A G)



a. TRANSFER FUNC
y.LIN-MAG 0.1/div
(0.0- 1.0)
x.LOG-Hz
(min 9.77 Hz)

csr:
y=-8.10dB
x=1.064kHz

b. TRANSFER FUNC
y.PHASE 45deg/div
(-180- 180deg)
x.LOG-Hz
(min 9.77 Hz)

*** Set up ***

mode	FFT
Max.freq	3.90kHz
window	RECTAN
CH 1	200mV
	50%
CH 2	200mV
	49%
CH 3	OFF
average	64
wave comp.	OFF
ref data	NEW

** Trigger Time **

day	'88-04-27
time	18:53:21

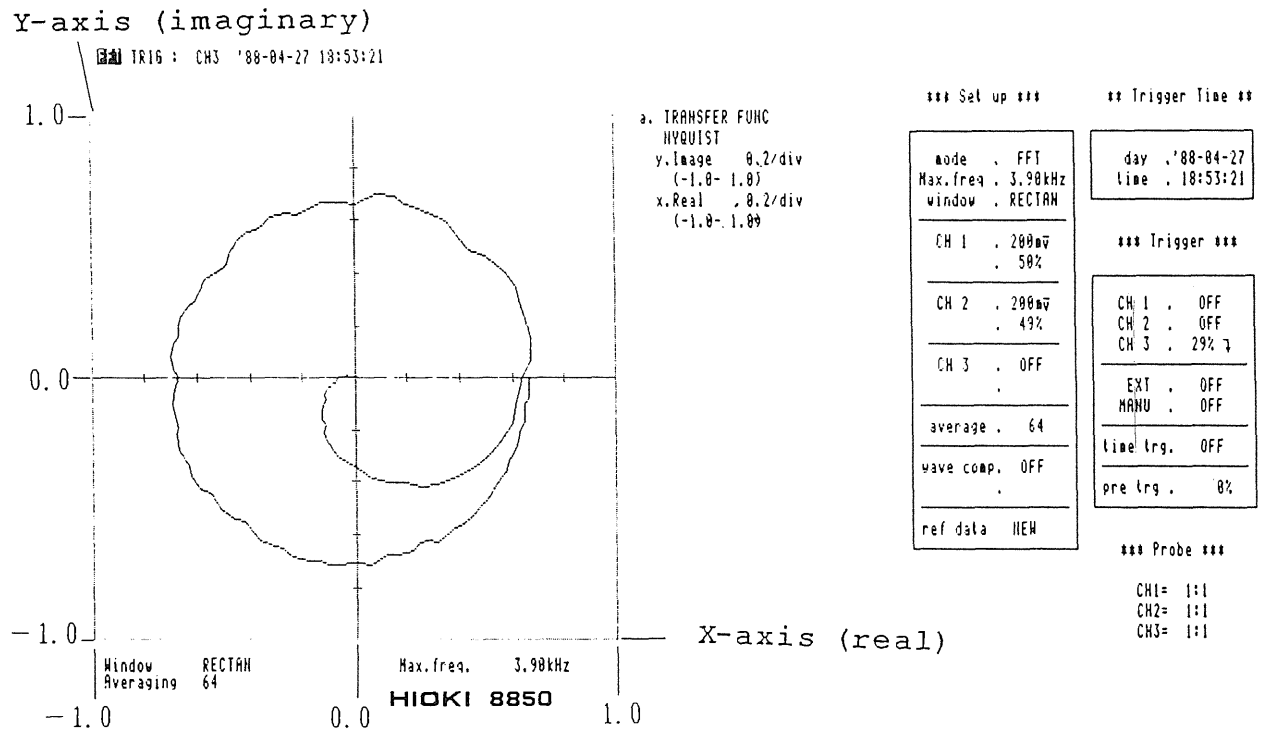
*** Trigger ***

CH 1	OFF
CH 2	OFF
CH 3	29% ↘
EXT	OFF
MANU	OFF
time trg.	OFF
pre trg.	0%

*** Probe ***

CH1= 1:1
CH2= 1:1
CH3= 1:1

(N Y Q U I S T)



Decibel / voltage conversion

① [dBV] used on the chart and the measurement voltage [V] can be converted using the following formula.

$$dBV = 20 \cdot \mathrm{Log}_{10}(V)$$

$$V = 10^{\frac{dBV}{20}}$$

〈EXAMPLE〉

Peak value of -14.0 dB can be converted to a voltage value as follows:

$$V = 10^{\frac{-14.0}{20}}$$

$$= 0.200V$$

$$= 200mV \text{ (RMS value)}$$

② [dB] used on the chart indicates the ratio between two channels.

$$dB = 20 \cdot \mathrm{Log}_{10} \frac{\text{CH2 voltage}}{\text{CH1 voltage}}$$

$$\frac{dBV}{20} \quad \frac{-14.0}{20}$$

CHAPTER 7

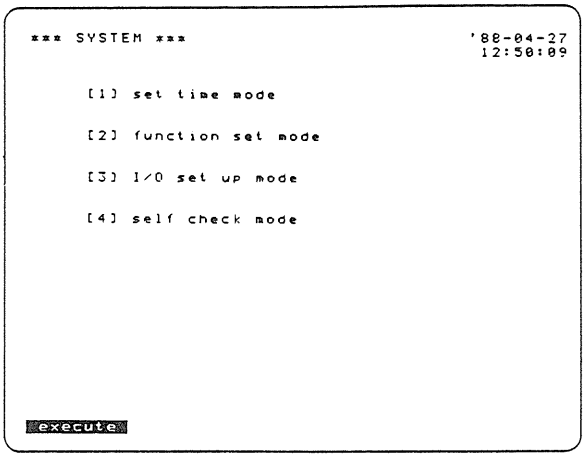
SELF-DIAGNOSIS FUNCTION

Self-diagnosis function

The 8850 will enter the self-diagnosis mode when [4] self-check mode is selected on the system set-up screen. This self-diagnosis mode is described below.

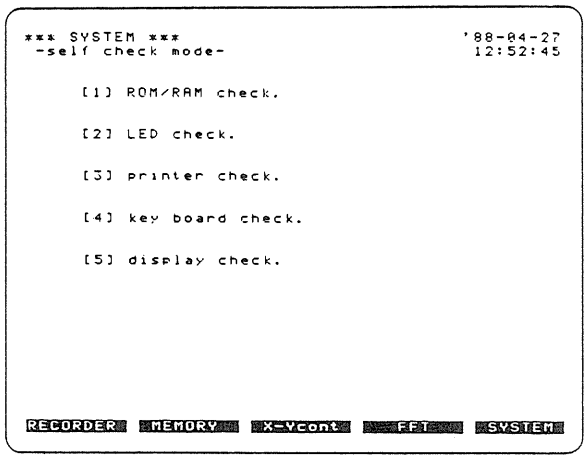
Operation

1) Press the STATUS key twice, and then press function key SYSTEM to enter the system set-up screen.



System set-up screen

2) Move the cursor to [4] Self check mode, and press the execute function key.
Separate checks can be performed by moving the cursor to the desired menu item and pressing the execute key.



Self-check mode screen

7.1 ROM and RAM check

CHeck 8850 internal ROM and RAM memory. The results are displayed on the CRT screen, as either OK or NG. Note that RAM content will not be affected by this check.

Operation

. On the self-check mode screen, move the cursor to [1] ROM/RAM check, and press the execute function key.

. To terminate the check, press any key.

ROM and RAM normal

```
*** ROM/RAM check ***  V0.00                    '88-04-27
                                                 14:05:01

--- ROM check ... OK ---
--- RAM check ... OK ---
```

ROM abnormal

```
*** ROM/RAM check ***  V0.00                    '88-04-27
                                                 14:08:48

### ROM check ... NG ###     ROM:2E93    Sum:2E92
--- RAM check ... OK ---
```

RAM abnormal

```
*** ROM/RAM check ***  V0.00                    '88-04-27
                                                 14:02:05

--- ROM check ... OK ---
### RAM check ... NG ###
#### Error address. ####
 220001   220007   220009   22000F   220011   220017
 220019   22001F   220021   220027   220029   22002F
 220031   220037   220039   22003F   220041   220047
 220049   22004F   220051   220057   220059   22005F
 220061   220067   220069   22006F   220071   220077
 220079   22007F   220081   220087   220089   22008F
 220
```

7.2 LED check

Check the LED indicator lamps. All LED will flash in synchronization.

Operation

. On the self-check mode screen, move the cursor to [2] LED check, and press the execute function key.

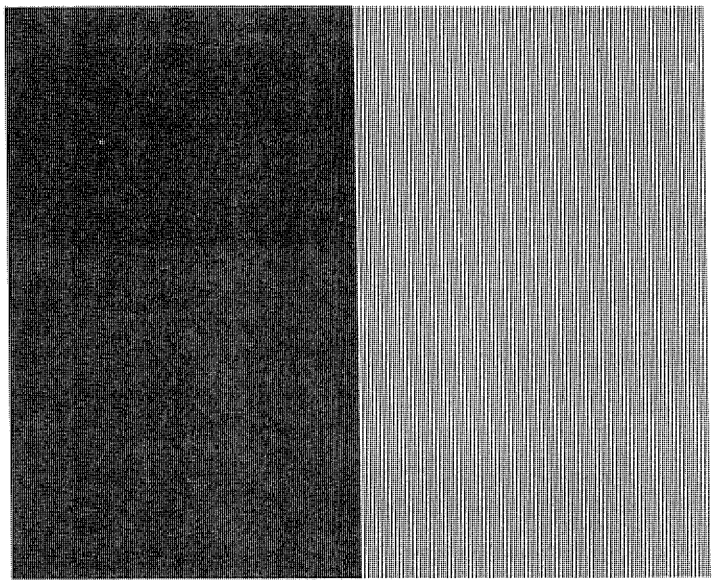
. To terminate the check, press any key.

7.3 Printer check

. The printer performance is verified with the test pattern indicated below in Fig. 7-3.

peration

. On the self-check mode screen, move the cursor to [3] printer check, and press the execute function key.
. To terminate the check, press the STOP key.



Test pattern

7.4 Keyboard check

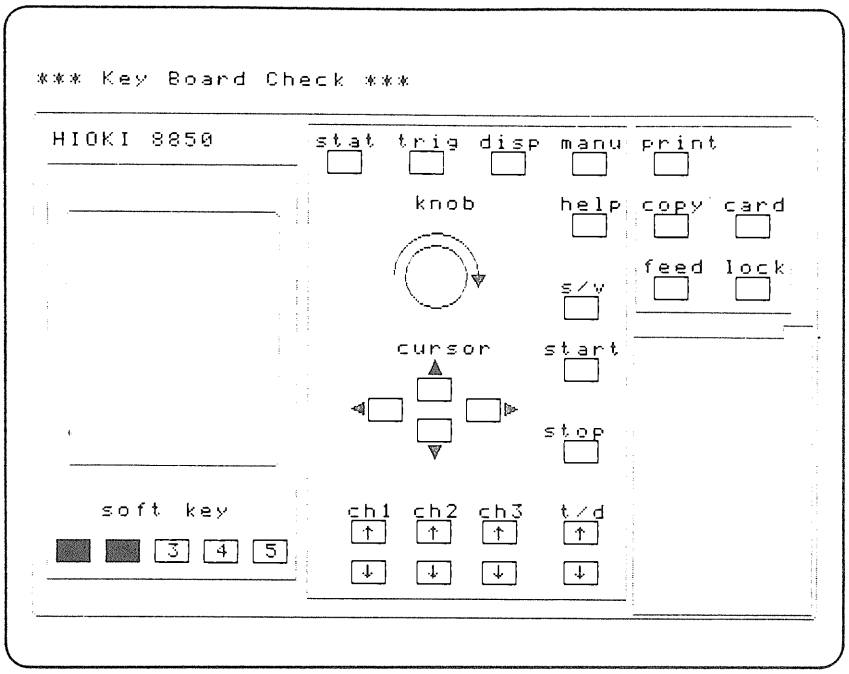
Checks if key entry is normal or not.

Operation

(1) On the self-check mode screen, move the cursor to [4] key board check, and press the [execute] function key to enter the keyboard check screen.

(2) Pressing a key will cause the corresponding input code to be blacked out on the screen display. By turning the rotary knob an arrow will be displayed indicating the direction of rotation.

Note: All keys will be blacked out on the display by pressing them once (but not the rotary knob). The arrow display for the rotary knob will vanish when the knob stops.



(display example) function keys 1 and 2 have been pressed, and the rotary knob is being rotated clockwise.

(3) Rotate the rotary knob at least one full rotation in each direction, and press all keys once to terminate the test and return to the self-check screen.

If there is a keyboard error and a key cannot be recognized by the system the keyboard check cannot be terminated. In this case, turn the power off and return to the system set-up screen.

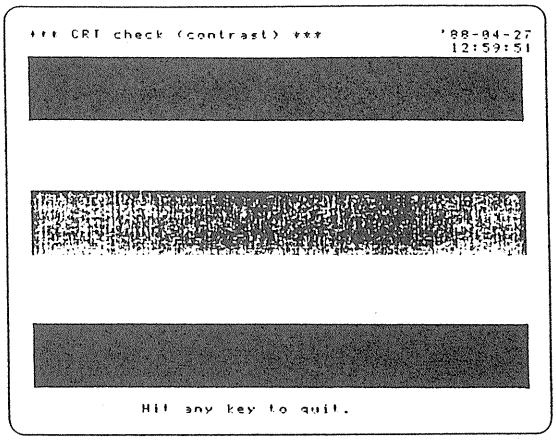
7.5 Display screen check

This test checks the condition of the display screen.

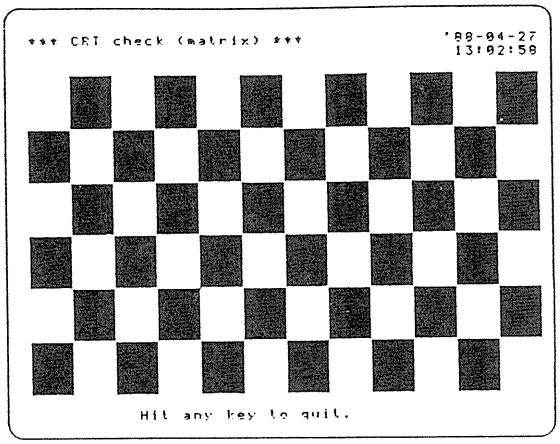
Operation

- On the self-check mode screen, move the cursor to [5] display check, and press the execute function key.
- To terminate the check, press any key.

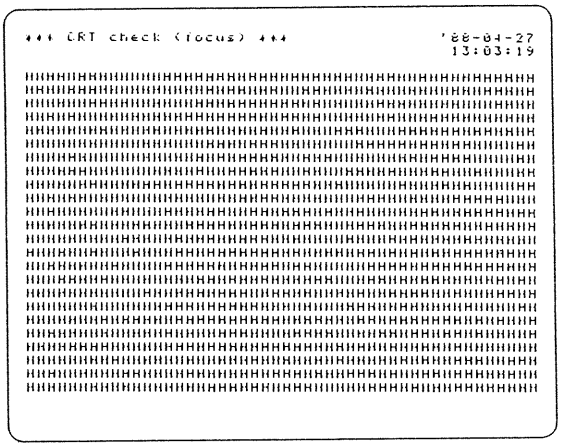
1) Contrast check
Checks darkness contrast. From the top, the bars should be dark, light and dark again.



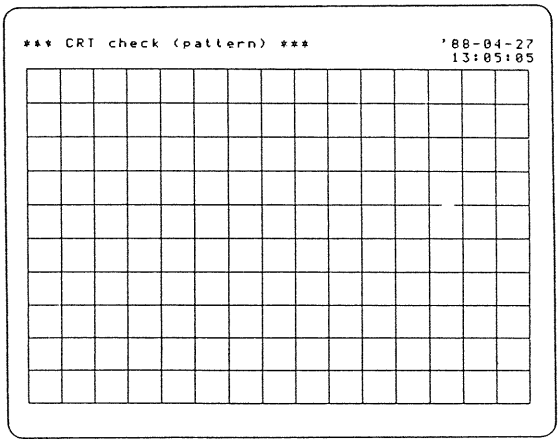
2) Matrix check
Displays a matrix



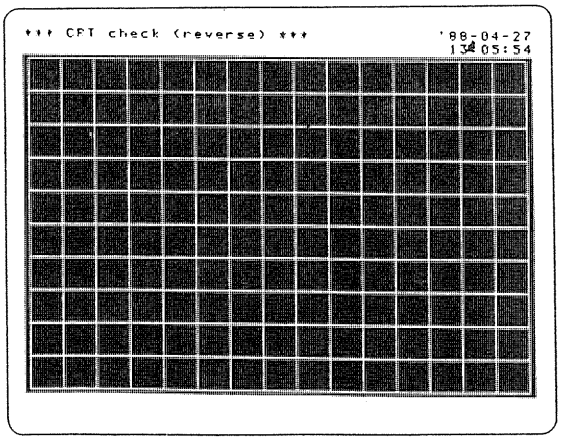
3) Focus check
Check the focus. Also checks that flashing screen sections are really flashing.



4) Pattern check
Displays a 10x15 mesh pattern to check for screen distortion.

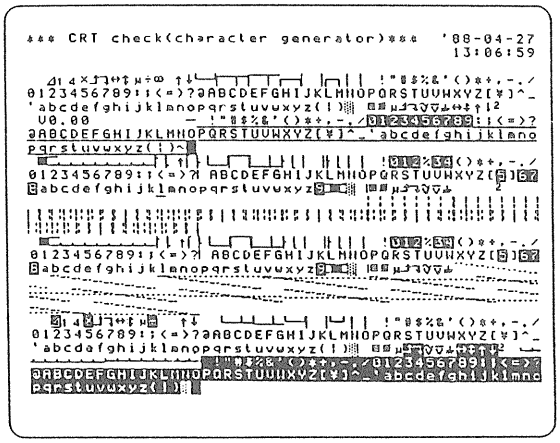


5) Reverse check
Displays the same 10x15 pattern inverted.



6) Character generator check
The CRT character generator content is displayed. Pressing the CRT COPY key will output the same content, using the printer character generator, and make a comparison of the two easy.

Note: Your display may not be identical to the picture at the right.



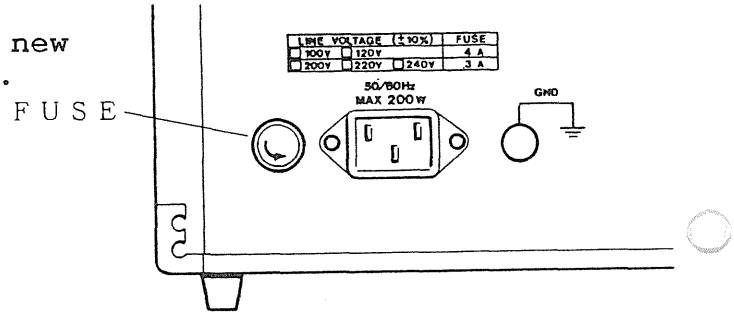
CHAPTER 8

MAINTENANCE AND SERVICES

8.1 Fuse replacement

> ⚠ CAUTION
>
> * If a fuse blows, determine and fix the cause before replacing it.
>
> * Before replacing a fuse, remove the power cord from the socket, and the input cord from the terminal.
>
> * Always check the rating of the new fuse. The correct fuse rating is given on the fuse holder.

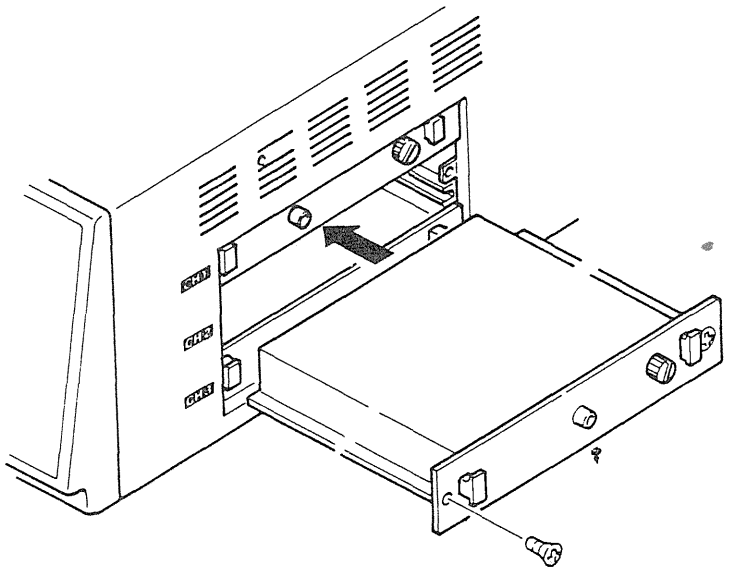
1) Turn the power switch off.
2) Remove the power cord.
3) Replace the old fuse with a new one of the specified rating.
4) Reconnect the power cord.



8.2 Input unit installation

Insert the unit along the guide rails. The top unit will be channel 1, the next channel 2, and the bottom channel 3. Be sure to tighten the mounting screws securely after insertion.

Note: Unless the mounting screws are tight, there may be trouble with noise.



CAUTION

* Always turn off the power before installing or removing an input unit.

* Input units are securely fastened to the main unit. Be sure to remove the mounting screws before trying to remove a unit.

8.3 Printer head cleaning

The printer normally does not require maintenance. Depending on use conditions, however, particles and paper fragments may build up on the thermal head after long period of use. This will cause print to become lighter, and must be cleaned off through one of the following methods:

(1) Make a recording in the recorder function at a high-speed range of at least 1 sec/DIV. Add input noise, and print out 100% black for at least 10 seconds. If this does not improve printing quality sufficiently, continue with step 2 below.

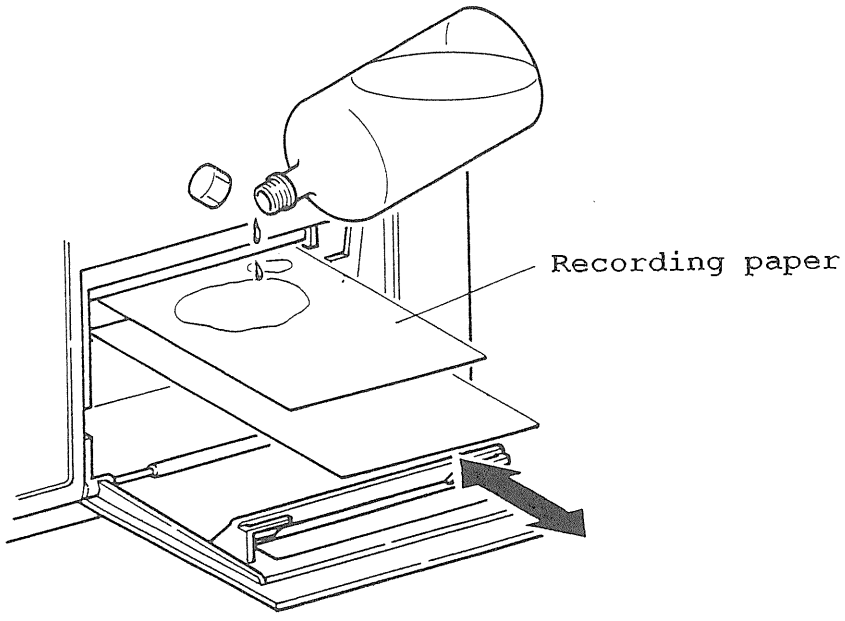
(2) Pour anhydrous alcohol, freon or normal hexane onto the recording paper, lower the head-up lever, and wash the heads manually by sliding the recording paper back and forth under them.

Alcohol will discolor recording paper, so it should be turned back-side up first.

⚠ CAUTION

* Never use thinner or benzene.

* After using a solvent for cleaning, dry the printer thoroughly before use.



Printer head cleaning

8.4 Trouble-shooting

If the 8850 does not operate normally, check the following items yourself before calling for service.

CRT or LED does not light even when power switched on	* Is power cord normally connected ? * Is the fuse blown ? * Is the CRT intensity adjustment correct ?
No CRT waveform drawn even when START key pressed	* Is the pre-trig wait message displayed ? Memory recording before the trigger will cause the trigger reception to be delayed by the length of the recording. * No waveform will be displayed on the CRT for recorder function operation at 400 msec or 500 msec/DIV. * Is wait for trig message being displayed ? Check your trigger settings. * Are all channels set to OFF ?
Display waveform does not change	* Is measurement range correct ? * Is coupling set to GND ? * Is low-pass filter ON ?
Recording is very faint, or missing	* Is recording paper right-side up ? * Is recording paper compatible with the 8850 ? * Try turning the density adjustment with a screwdriver.
In memory recorder operation a frequency much lower than the actualfrequency is displayed.	* This is probably an aliasing error. Try setting the TIME/DIV to a faster setting. Refer to Section 3.7 for details.
Recorded line in recorder mode is thick	* Ripple component is being drawn. Set the filter to on with the input unit parameters.
Amplifier is connected but the system says it is not	* Is the range set to 2.5usec or 5usec/DIV ? When high-speed and floating types are mixed, the floating type will appear as being unconnected in these ranges.

Display wavers	* Is there a strong electromagnetic field nearby ? * Is power supply voltage fluctuating or too low ?
Key input not accepted	* Is the unit in the key lock state? (Is the KEY LOCK LED lit?) Clear the key lock state by pressing the KEY LOCK key. * Is the recorder being remotely controlled through the GP-IB interface.

APPENDIXES

1. Error messages and actions

There are two types of error messages: ERROR displays and WARNING displays.

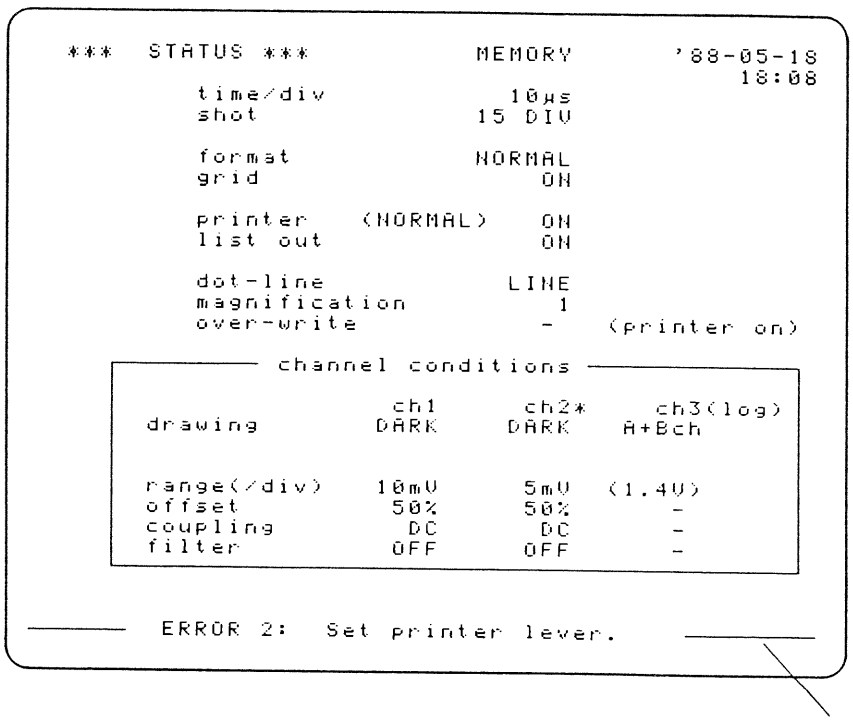
ERROR displays

(1) The error message is displayed on the lowest CRT line, and remains until the error condition is fixed or a key pressed.
(2) Execution commands (START, PRINT, CRT COPY, etc.) are disabled while an error message is displayed.
(3) When the I/O set-up mode screen beep sound parameter is set to ON, the beeper will sound intermittently as long as the error message is displayed.

WARNING displays

(1) When a warning is generated the warning display will be displayed once.
(2) Execution processing will be run normally.
(3) The warning message will be erased by pressing any key.
(4) When the I/O set-up mode screen beep sound parameter is set to ON, the beeper will sound intermittently as long as the warning message is displayed.

Fig: Message display position



1.1 Meanings of error messages and actions to take

ERROR 1: Set printer paper.	Recording paper is empty. Load new recording paper.
ERROR 2: Set printer lever.	Head up lever is in the up position. Lower it.
ERROR 3: No storage data.	There is no data in storage. Execute START to acquire data.
ERROR 4: Bad A&B cursor position	For partial print execution the position of the A and B cursors is not appropriate. Check and adjust their positions.
ERROR 5: Wave Com is impossible	Averaging is on, or imposibble. sequential save is on, making waveform judgment processing impossible. Change your settings as needed.
ERROR 6: Set CH1 analog unit.	CH1 is not fitted with an analog unit. Install an analog unit to CH1.
ERROR 7: Set CH2 analog unit.	CH2 is not fitted with an analog unit. Install an analog unit to CH2 (for FFT analysis only).
ERROR 8: Insufficient storage	In the FFT analysis function data. storage data point count is less than 1024 points. Change the shot length in the memory recorder function and run storage again.
ERROR 9: Set [printer ON].	In the recorder function when time/div is set to 400 or 500 msec, no CRT waveform will be displayed. Set the printer to on to output the waveform to the recording paper.
ERROR 11: Set IC card.	No IC card is detected. Insert an IC card.
ERROR 12: File is not found.	Specified file was not located, so LOAD or KILL command cannot be executed.
ERROR 13: Card meory is full.	IC card memory is full. Insert a new IC card.

ERROR 14: Card is write-protected.	Card is write protected, so SAVE or other command cannot be processed. Release the write protect.
ERROR 15: Card size is unmatched.	COPY command cannot be run because IC card capacity does not match setting. Use a card of the correct capacity.
ERROR 16: Card data is defective.	IC card memory data is corrupt. Reformat it.
ERROR 17: Amplifier is not set.	No input unit is installed on the specified channel. Use another channel.
ERROR 18: No WAVE data	No storage data present. Restore data.
ERROR 19: NO AREA data	No judgment profile present. Define a judgment profile.
ERROR 20: No CALC data	No post-calculation data. Execute CALC command.
ERROR 21: Shot (cord)=300 div	Shot length for loaded data does not match system. Reset shot length.
ERROR 22: Cannot copy this card.	This IC card cannot be copied. Use another IC card.

1.2 Meanings of warning messages and actions to take

WARNING 31: Amp filter is "ON"	In the memory recorder function the analog input filter was left ON and storage processing run. Turn OFF the filter.
WARNING 32: No REF data	No data is present in the block defined as reference waveform data. Change the reference block specification.
WARNING 33: REF block= using block	The block defined as the reference block was also defined as a using block. Change the reference block specification.
WARNING 34: REF shot=300 div	Reference block shot length is longer that shot length being stored. Change the shot length.
WARNING 35: No FFT data	FFT analysis data not found, so waveform cannot be displayed on CRT. Run START processing.
WARNING 36: No storage data	In memory recorder function the MAG setting was changed, but there is no stored data and so no waveform can be displayed.
WARNING 37: Change time/div.	The specified time/div setting cannot be used with an isolation type analog unit. Change the setting.
WARNING 41: Invarid key (START)	Pressed key was ignored because the system is executing START processing.
WARNING 42: Invarid key (function)	Key is not supported in this function, and is ignored.
WARNING 43: Invarid key (CRT mode)	Function is not supported in this CRT function, and is ignored.
WARNING 44: Invarid key (IC card)	Function is not supported in this IC card mode, and is ignored.

WARNING 45: Invarid key (Graphic)	Function is not supported in this graphic editor mode, and is ignored.
WARNING 46: Cannot scroll. (START)	Waveform scroll is not possible because system is executing START processing (recorder function).
WARNING 47: Invarid key (TRIG off)	In memory recorder or FFT analysis function all triggers are off, so pre-trigger setting is not possible.
WARNING 48: Invarid (Wave Com ON)	Waveform judgment is ON, so format cannot be set to dual.
WARNING 49: Invarid (over-write)	Over-write is on, so MAG cannot be changed.

2. Notes on FFT analysis

2.1 Introduction

FFT stands for Fast Fourier Transformation, and is a technique for dividing the time axis waveform into frequency components.

System operation is the same as memory recorder function, and the input data is FFT analyzed. The results are output as a graph.

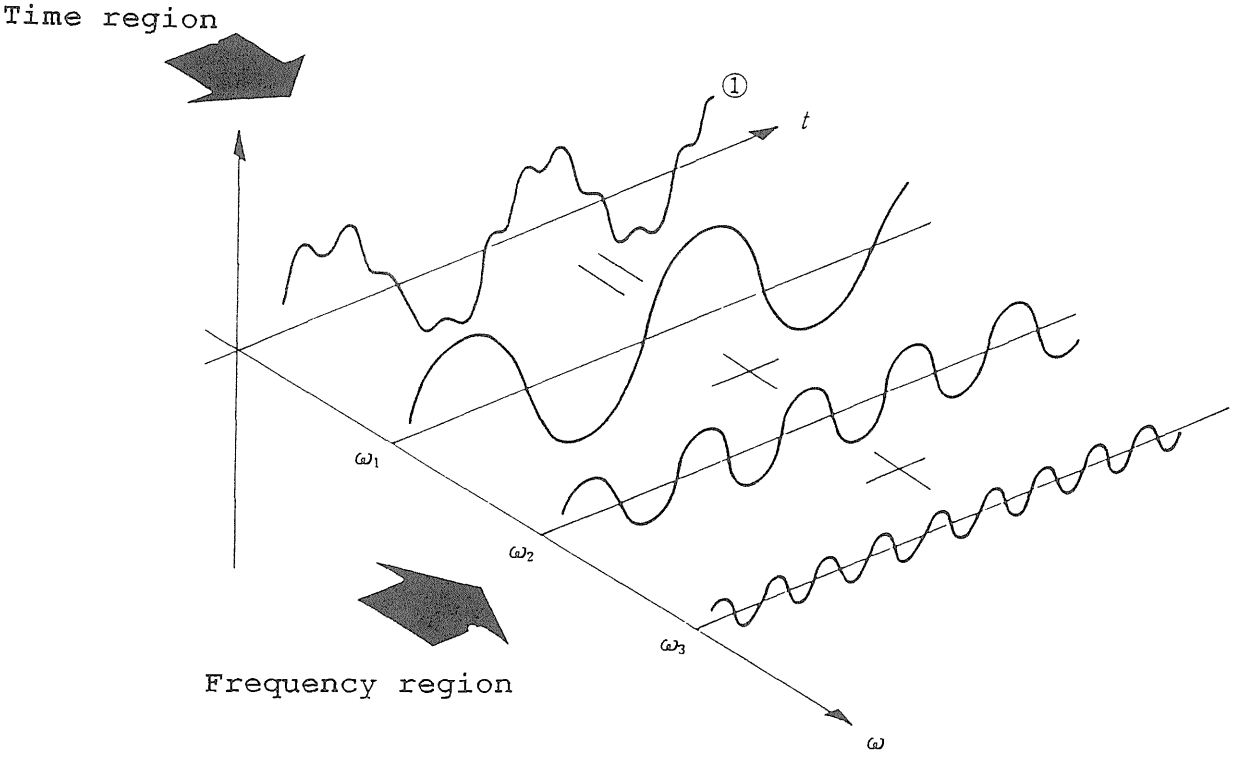
2.2 Basic concepts of analysis functions

(1) Time and frequency regions

The signal being measured by the memory recorder is given below as waveform ①. It can be considered a function of time, which is the time region concept.

This signal is in fact the synthesis of a number of sine waves of various frequencies. The raw signal ① waveform can be expressed as a function of frequency, which is the frequency region concept.

Even signals that are extremely difficult to analyze in the time region can be measured with relative ease in the frequency region.



(2) FFT analyzers and spectrum analyzers

There are currently two types of equipment used to analyze frequency regions. The first is generally called a spectrum analyzer, and the other is the FFT analyzer. The spectrum analyzer uses many filters to measure the spectrum through hardware. The FFT analyzer measures the spectrum through mathematical operations.

Each has its own strong and weak points. The FFT analyzer can use the DC component, while the spectrum analyzer can not. On the other hand, the spectrum analyzer can handle high frequency ranges that the FFT analyzer can not.

While the spectrum analyzer merely generates data on spectrum, the FFT analyzer data includes an imaginary component which can make many types of operations possible, such as spectral energy analysis (power spectrum) and division (transfer function).

(3) Physical significance of the Fourier transformation

The mathematical significance of the Fourier and reverse Fourier transformations are given below.

$$F(\omega) = \mathcal{F}[f(t)] = \int_{-\infty}^{+\infty} f(t) \cdot \exp(-j\omega t)\, dt \qquad (2.1)$$

$$f(t) = \mathcal{F}^{-1}[F(\omega)] = \frac{1}{2\pi}\int_{-\infty}^{+\infty} F(\omega) \cdot \exp(j\omega t)\, d\omega \qquad (2.2)$$

(2.1)
(2.2)
(where ω is 2 π f, j is imaginary units, f(t) is asynchronous function, F is Fourier transformation, and exp is natural logarithm.

Function $F(\omega)$ is generally a multi-term expression:

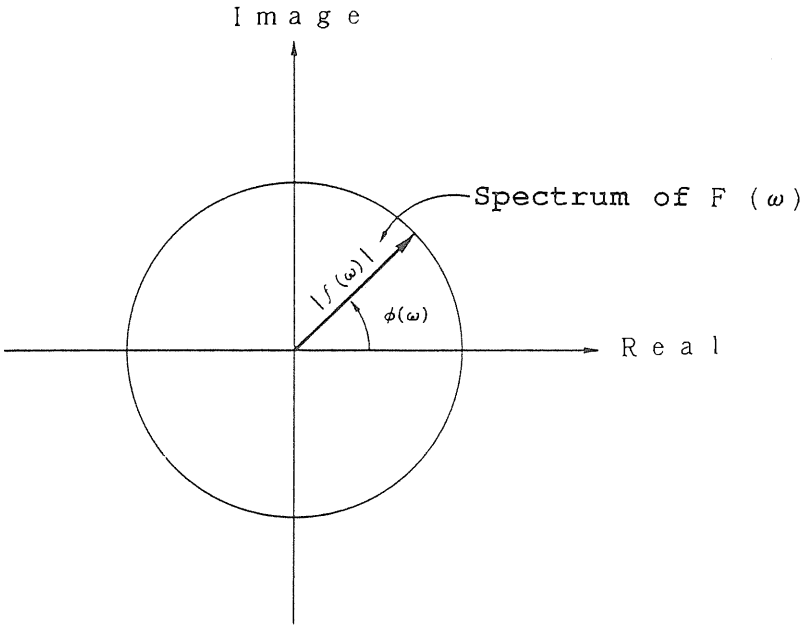
$$F(\omega) = |F(\omega)| \cdot \exp(j\phi(\omega)) = |F(\omega)| L\phi(\omega) \qquad (2.3)$$

$$\mathcal{F}[f(t)] = F(\omega) = F(j\omega) \qquad (2.4)$$

(2.3)
(2.4)

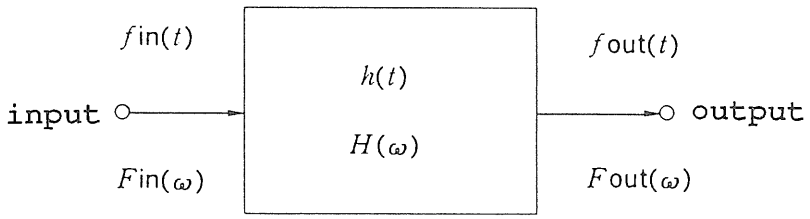
$|F(\omega)|$: Absolute spectrum of f(t)
$|\phi(\omega)|$: Phase unit spectrum of f(t)

The transformation from the time region to the frequency region yields the amplitude and phase information clearly, as indicated in expression (2.3). In the diagram below, F(ω) is expressed as a spectrum.



(4) Fourier transformation applications
Fourier transformation can be used in the consideration of linear systems:

Fig: input, output, linear system



linear system

In the time region, fin (t) is input time (origin function), fout (t) is the output time function (response function), h (t) the linear system unit impulse response, and t, τ represent time.

The I/O relation can be expressed as follows:

$$f\,out\,(t) = \int_{-\infty}^{+\infty} f\,in\,(\tau) \cdot h\,(t-\tau)\,d\tau \qquad (2.5)$$

This indicates that the linear system response can be expressed through the system unit impulse response h(t). Next let us turn to the I/O relation in the frequency region:

In the frequency region, $F_{in}(\omega)$ is the Fourier transformation of fin (t) (frequency function), $F_{out}(\omega)$ the Fourier transformation of $f_{out}(t)$ (frequency function), $H(\omega)$ the Fourier transformation of h(t) (called the transfer function in frequency function), and ω is frequency.

The I/O relation can be expressed as follows:

$$F_{out}(\omega) = F_{in}(\omega) \cdot H(\omega) \tag{2.6}$$

Therefore by measuring fin (t) and fout (t) and running an FFT analysis, system transfer function $H(\omega)$ can be determined.

2.3 Definition and meaning of analysis functions

(1) [STR] - Time axis waveform storage

Function (CH1): fa

Meaning - Time region waveform of CH1 input signal. Is 1k words of data after A/D conversion.

Function (CH2): fb

Meaning - Time region waveform of CH2 input signal. Is 1k words of data after A/D conversion.

(2) [LIN] - Linear spectrum

Function: $Fa=F(fa)$

$=|Fa| \cdot \exp(ja)$

$=|Fa| \cdot (\cos \angle a + j \sin \angle a)$

Meaning - Spectrum of waveform stored to CH1. Includes amplitude and phase information.

Major applications include
- . Determining peak of waveform frequency component
- . Determining harmonic levels
- . Using impulse signals to determine filter frequency response

(3) [PSP] - Power spectrum

Function: $Ga\ a=Fa \cdot Fa^*$

$=Re^2(Fa) + 1\ m^2\ (Fa)$

$=|Fa|^2$

Meaning - Fa* is the multi-term Fa
Energy spectrum of waveform stored to CH1. Includes amplitude information.

The display value is determined through $\sqrt{Gaa}$

Major applications include
- . Determining the peak of waveform frequency components.
- . Determining energy levels of high and low harmonics.

(4) [HIS] - Histogram

Function: Pa

Meaning - The frequency of sampling points can be determined for the amplitude region.

Major applications include
- Determining waveform deflection on the amplitude axis
- Determining whether a waveform is artificial or natural from waveform distribution (most natural waveforms are regular sine waves).

(5) [TRF]- Transfer function

Function: $Hab=Fb/Fa$

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

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

Meaning - The transfer function (frequency response) of the measurement system can be determined from system I/O signals. Nyquist diagrams are possible, including amplitude and phase information.

Major applications include
- Determining filter frequency response
- Determining physical resonance frequency with an impulse hammer and pick-up sensor.

(6) [COH]- Coherence function

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

Meaning - Expresses the correspondence between input and output as a value from 0 to 1. When measurement system is non-linear or there are multiple input signals (including noise), the true transfer function cannot be determined.

If the coherence value is 1 for a system, output is totally generated by input, and if the value is 0 output has no relation to input. Intermediate values represent the degree of relation.

Major application include
- Evaluation of transfer function
- Determining the degree of contribution of a signal input to output for a multi-input system

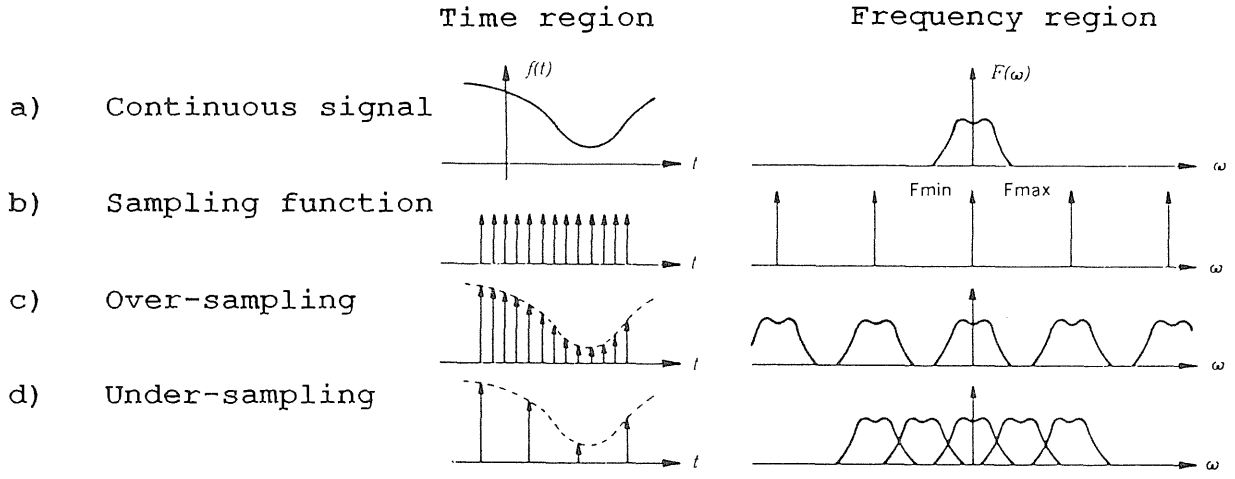
2.4 Aliasing distortion

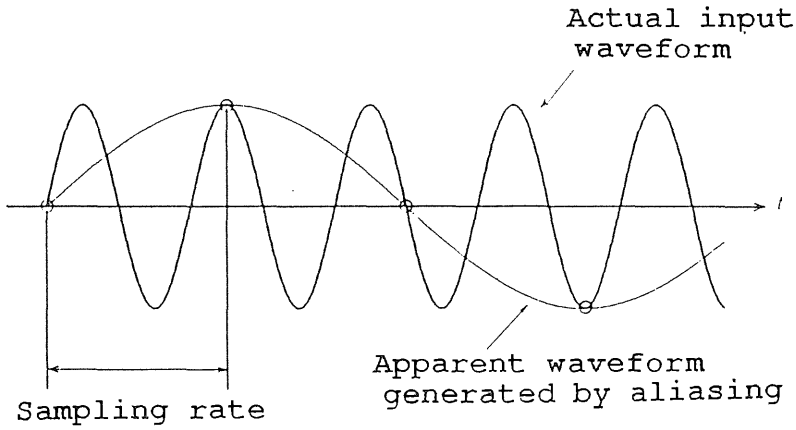
(1) A/D conversion

- The 8850 converts input signals from analog to digital values, and all downstream internal processing is handled digitally. This process of A/D conversion is called sampling.
- The sampling process can be viewed mathematically as multiplication between unit impulse matrix linear function and continuous signal.
- When signal input period, i.e. sampling rate, is increased above a certain level, erroneous data will be generated.
- As indicated in the diagram below, the A/D converted signal spectrums of several frequencies can overlap. This is called aliasing.
- The sampling frequency used when frequencies overlap in this way is also called the Nyquist frequency.

$Fs=2 \cdot Fmax$ Fmax: Maximum analysis frequency
Fs: Nyquist frequency

- If the sampling frequency used is lower than the Nyquist frequency determined by this theory, the generated data may indicate the existence of a frequency that is not actually present.

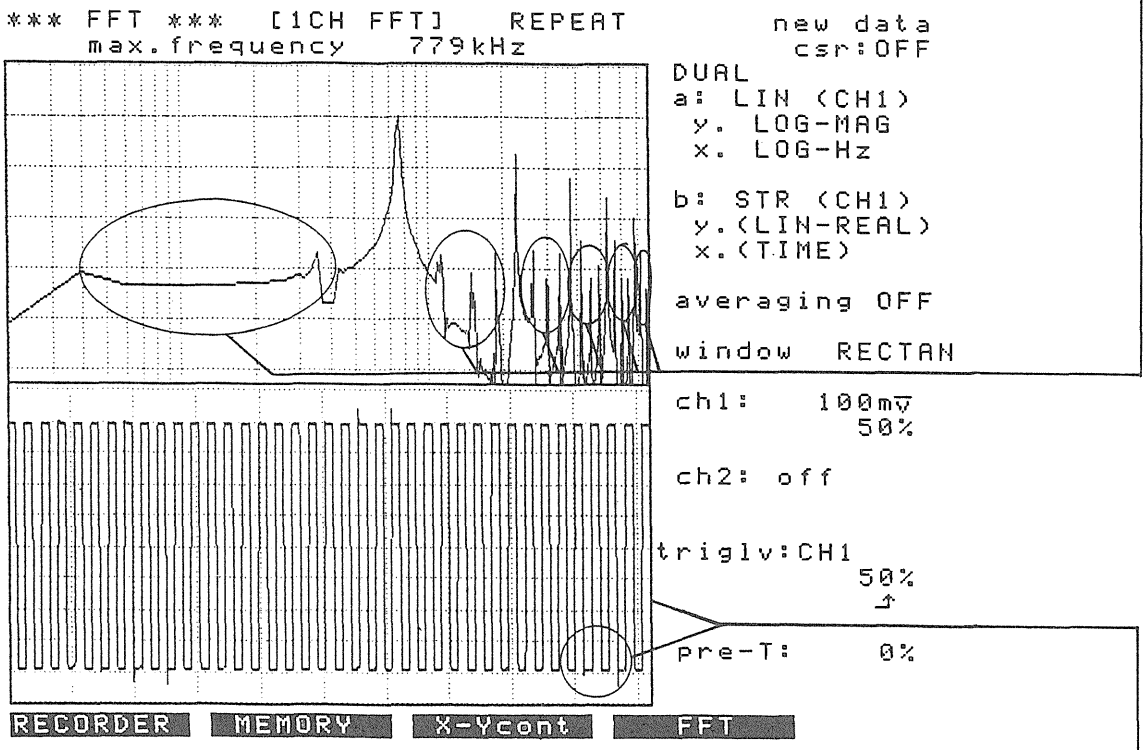




(2) Anti-aliasing filter

- The 8850 determines the sampling frequency from the time axis range setting, and so there will be occasions where the high frequency component of the input signal will exceed the Nyquist frequency.
- This error is reflected in FFT analysis, and a number of non-existent frequencies may therefore be generated.
- To prevent this phenomenon, a low-pass filter with a cut-off frequency half of the sampling frequency is placed in circuit before sampling. This low-pass filter is called the anti-aliasing filter.
- In the 8850 there is no anti-aliasing filter function. Be sure you understand the characteristics of the digital signal being handled.

For a spectrum where there is aliasing distortion generated by a high-frequency component relatively high in relation to the A/D converter sampling rate, measurement will often indicate a non-existent frequency.



Since there is no anti-aliasing filter, clean square waves can be attained through a high-bandwidth amplifier. The corners of the square waves include the high-frequency component.

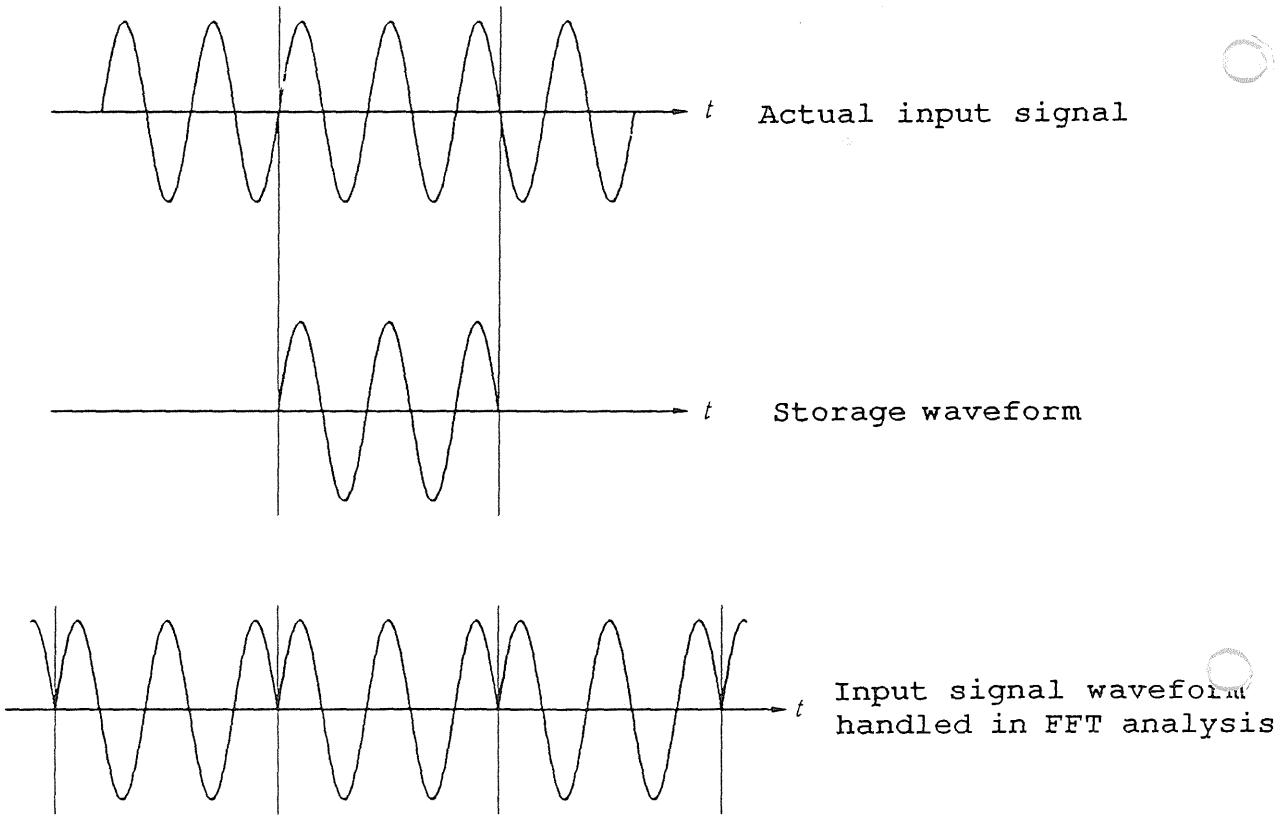
2.5 Windows and leakage

(1) Window processing

. The theory of Fourier transformation is defined as integration from minus infinity to plus infinity, but this is of course impossible in actual measurement. For this reason, a finite portion of the signal is extracted and processed with what is called a window.

. In other words, the frequency spectrum is determined for the data within a specific time frame (window).

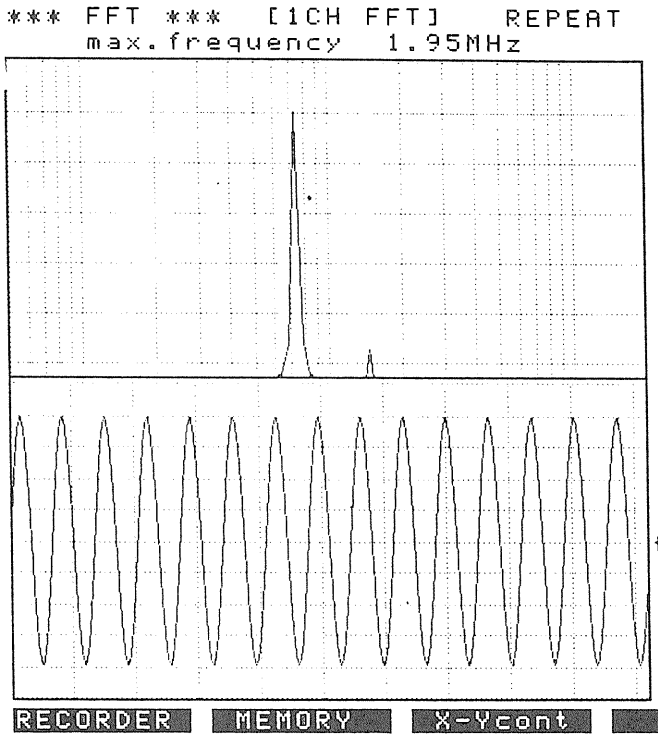
. The FFT algorithm is calculated on the assumption that the input signal is a cyclic function. To rephrase, it assumes that the signal segment within the window repeats.



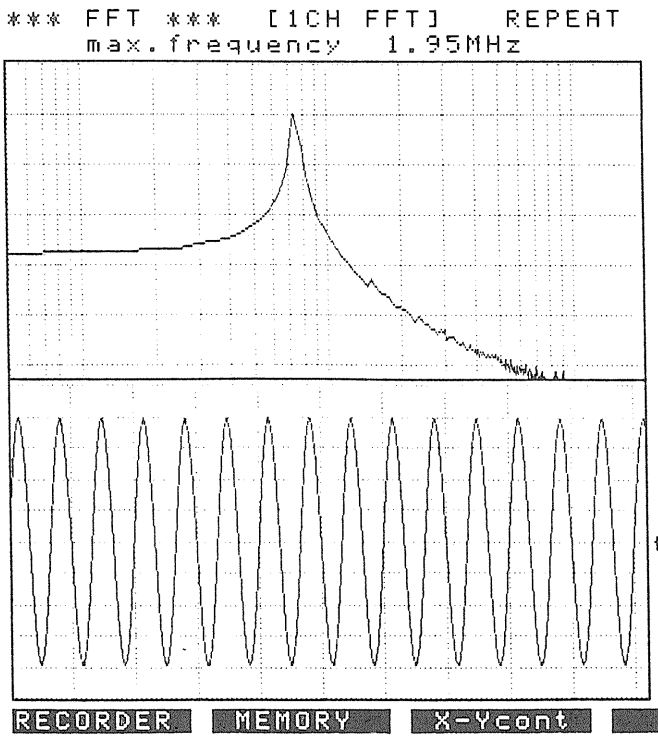
The phases at the start and end points of the storage waveform will in fact be different between the actual input signal and that used in FFT analysis.

(2) Leakage error

. Where the signal waveform assumed to exist by the FFT algorithm is different from the actual waveform, the error will increase in the results. This is called leakage.
. The leakage error is generated by the fact that the values for the start and end of the finite data segment differ.



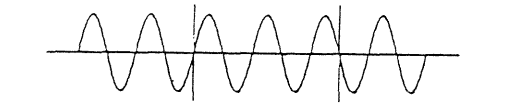
Low leakage, fine spectrum width



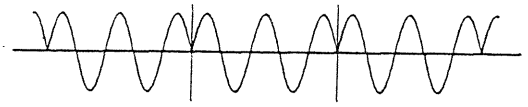
High leakage, Spectrum width spreads over frequency

(3) Window function

. When the input signal is input for a finite time, there is a method by which is can be processed to minimize leakage error.
. For example, as indicated below, FFT analysis of only the central portion of the input waveform will minimize leakage in the generated spectrum.
. For this reason the function that defines a small segment of the input signal is called the window function.
. Window functions such as Hanning, rectangular, flat top, minimum, Foss, and exponential exist to minimize leakage error, and the 8850 is equipped with Hanning and rectangular windows.
. Transient waveforms are best handled with the rectangular window, and continuous waveforms with the Hanning.

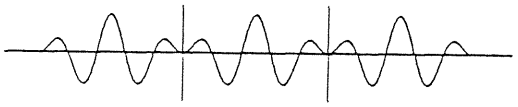


Input signal



Input waveform assumed by FFT analyzer

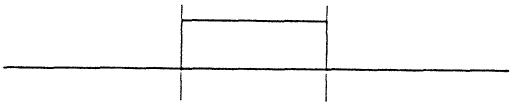
Hanning window function



Window-processed input waveform

Input signal

Input waveform assumed by FFT analyzer



Rectangular window function

Window-processed input waveform

3. Terminology

Aliasing error - Aliasing distortion. Overlapped signal spectrum.

Analog - Continuous physical amount.

Analyzer - Device used for analysis.

Attenuator - Potentiometer used to reduce signal level.

Bit - A single character, either 0 or 1. Decimal value will be (number of bits)th power of 2.

Byte - A group of binary numbers. A byte is 8 bits.

Channel - Input path. Channel 1 is expressed as CH1.

Chart - Recorded waveform. Analyzed waveform.

Dynamic range - Range of amplitude that a device can express.

Editor - Editing function.

Envelope - Locus of a signal drawn on the chart.

File - A set of data stored on the IC card.

Format - Style used for display or printout

Function - Function

Image - Image

Impulse - Mathematically referred to as delta function. A single signal whose width is infinitely close to 0, height is infinite, and area is 1.

Isolation - The circuit is electrically independent for any other, and is insulated from them.

Leakage - FOr FFT, level leakage to the frequency axis due to error generated in operation.

LED - Light Emitting Diode

Memory - Location to which the signal is stored.

Mode - Mode. For FFT, type of operation.

Nyquist diagram - Vector locus of complex number in which the real number term is expressed on the horizontal axis, and the imaginary number part on the vertical axis.

Pre-trigger - A time before the trigger is activated.

Sampling - Sampling.

Shot length - For the 8850, the number of matrix divisions.

Trigger - Trigger used to start operation. Recorded is started and ended with reference to this signal.

Unbalanced input - Inputting a signal through two terminals, with one used as the reference.

Window - Window function. When a signal is input for FFT analysis, this function processes data.

Word - Data expressed in digital form. Input signal converted to a digital data by one sampling is referred to as one word.

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HIOKI E.E. CORPORATION

81 Koizumi, Ueda, Nagano 386-11, Japan

TEL:0268-28-0562 FAX:0268-28-0568

TLX:3327508 HIOKI J CABLE: HEWLOV, Ueda

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