HIOKI

8815

MEMORY Hi CORDER

INSTRUCTION MANUAL

HIOKI E.E. CORPORATION

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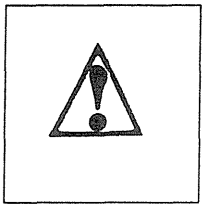


SAFETY PRECAUTIONS

●This manual contains information and precautions intended to ensure a safe operation of the unit and to keep it in a safe condition. Please read the following notes on safety before using the unit.

Safety Symbols

⚠	Refer to the related section(s) of the manual when handling a part of the unit bearing this symbol. When found in this manual, read the accompanying explanation.
⏚	Indicates a protective ground terminal.

DANGER

●To prevent electric shocks and unit damage, do not apply an AC or DC voltage over 250 V between an input unit and the main unit case or between input units. In particular, prevent voltage from large-current power lines from being applied. Otherwise, a short-circuit accident may occur.

●Do never connect the input terminal to an AC power line over 250 V or a ungrounded DC power line over 250 V.

●Be sure to insert the input plug completely to avoid the danger of an electric shock.

●Use the unit with all four input units installed. If measurement is performed with an input unit missing, you may suffer an electric shock.

●Two probes can be connected to a logic unit, but probes are not floating with respect to each other.

Notes

●To prevent unit damage, observe the ranges in the table at right for terminal inputs.

●Operating temperature and humidity ranges for this unit are 5℃ to 40℃ and 35% to 80%, respectively. Avoid using the unit in dusty places or where it would be exposed to direct sunlight or corrosive gas.

I/O Terminals	Maximum Allowance
8932 input	500 V DC + AC peak
TRIG IN	- 5 V to +10 V
TRIG OUT	-20 V to +30 V 300 mA max. 200 mW max.

INTRODUCTION

Thank you for choosing the HIOKI 8815 Memory Hi-Corder. To maximize the performance and life of the unit, please read this Instruction Manual thoroughly before use.

Notes on 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. Be sure to check all panel switches and terminals. If any damage should have occurred, or the machine does not work according to the specifications, please contact your nearest dealer.

Before Turning Power On

Confirm that you power supply matches the Hi-Corder rating and that the correct fuse is installed in the unit.

Protective Ground Terminal

Make sure the protective ground terminal is properly grounded. If your use a three-pronged plug inserted to a three-pole plug socket, however, no additional grounding is required.

Recording Paper

The Hi-Corder uses the thermal recording method. Special thermal paper is required for optimum performance. Please use the specified recording paper.

Storage

When not using the Hi-Corder for a long period, raise the head-up/down lever to protect the head and prevent deformation of the rubber roller.

Precaution on Measurement

The maximum floating voltage of the input unit is AC/DC 250 V. Always use a voltage converter when measuring power lines over 250 V.

Transportation

When transporting the Hi-Corder, use the packaging materials provided. If not available, proceed as follows:

(1) Wrap the unit in a vinyl plastic sheet.

(2) Pack the inside of a corrugated cardboard box more than 7-mm thick with packaging material to a thickness of over 100 mm.

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

Note: Set the head-up/down lever to the head-up position when shipping the Hi-Corder.

Others

Carefully read and observe all precautions in this manual.

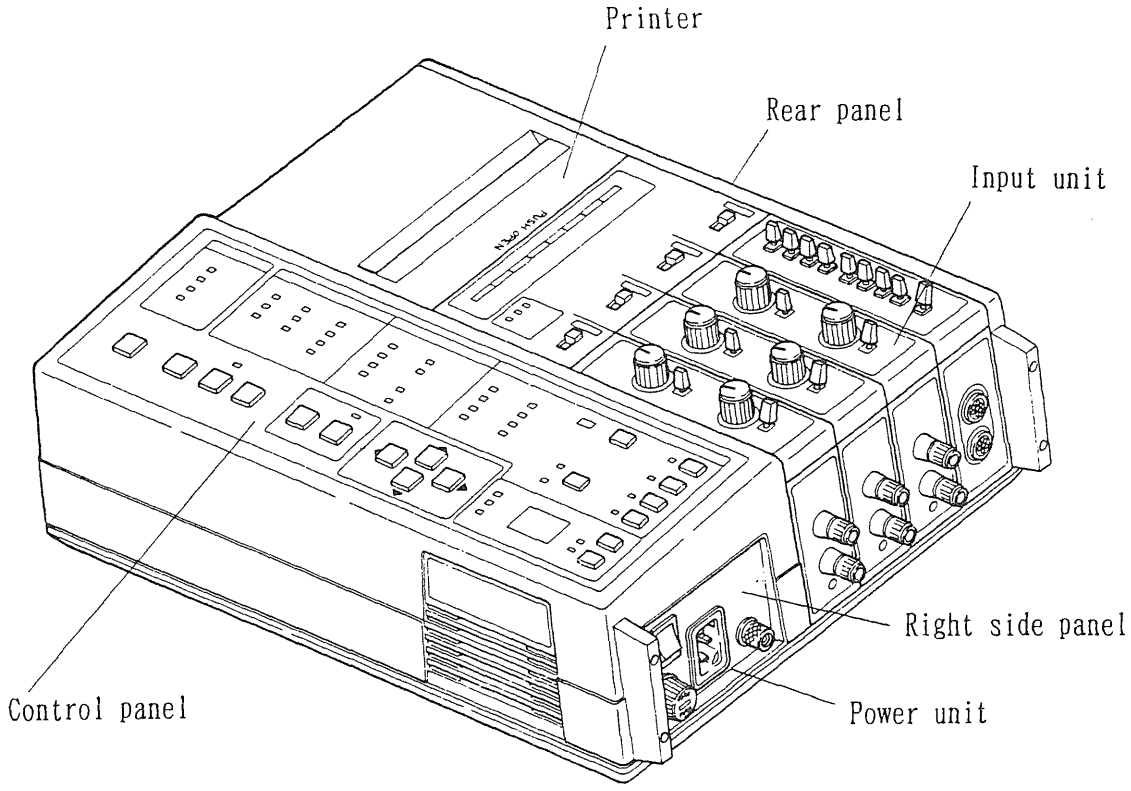
In the event of abnormal operation, please read 10-2 "In Case of Trouble and Before Sending for Repair."

How to Use this Instruction Manual

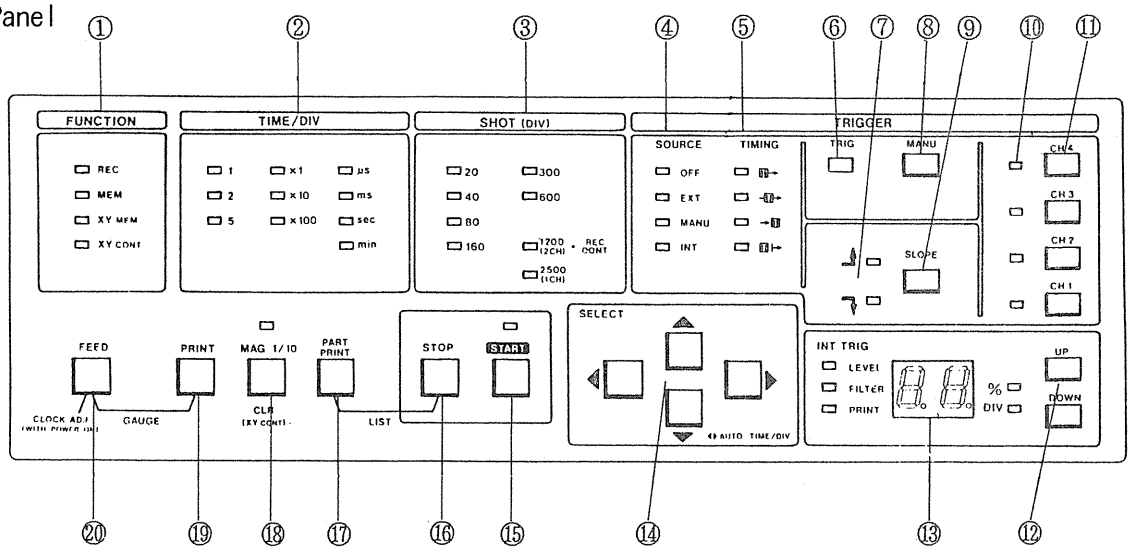
This Instruction Manual is divided into an operation section (Chapters 3 and 4) and a function explanation section (Chapters 5 through 11). When first using the unit, be sure to read Chapter 3. Then try operating the unit while reading Chapter 4. It is written so that you can master all basic operations. Chapters 5 through 11 contain detailed explanations on the particular functions. Refer to them when you have some problem operating the unit or you forgot the proper procedures.

Explanations are given for using input units other than the 8932 analog unit and the 8933 logic unit. To ensure safe operation, please read these explanations carefully before using option units.

PART NAMES AND FUNCTIONS



Control Panel



① FUNCTION Indicator : Shows the current recording mode.

② TIME/DIV Indicator : Shows the time axis setting.

③ SHOT Indicator : Shows the recording length setting.

④ SOURCE Indicator : Shows the trigger setting.

⑤ TIMING Indicator : Shows the trigger timing setting.

⑥ TRIGGER Lamp : This LED lights when triggering is applied.

⑦ SLOPE Indicator : Shows the trigger slope direction setting.

⑧ MANU Key : Triggering is applied. When pressed in the manual trigger mode.

⑨ SLOPE Key : Selects trigger slope direction.

⑩ Trigger Channel Indicator Lamps : Show to which channel is triggering applied in the internal trigger mode. Also indicate which channel is monitored by the level meter.

⑪ Trigger Channel Selector Keys : Select the channel to which triggering is to be applied. Also set the channel to be monitored by the level meter.

⑫ UP and DOWN Keys : Used to change display readings for trigger filter, trigger level, partial printing and time settings.

⑬ INT TRIG LEVEL/FILTER/PRINT Display : Shows trigger filter, trigger level and partial printing start point settings. Also used for error indications.

⑭ SELECT Keys : Used to set measurement conditions by moving the blinking LEDs on the respective indicators.

⑮ START Key : Starts measurement.

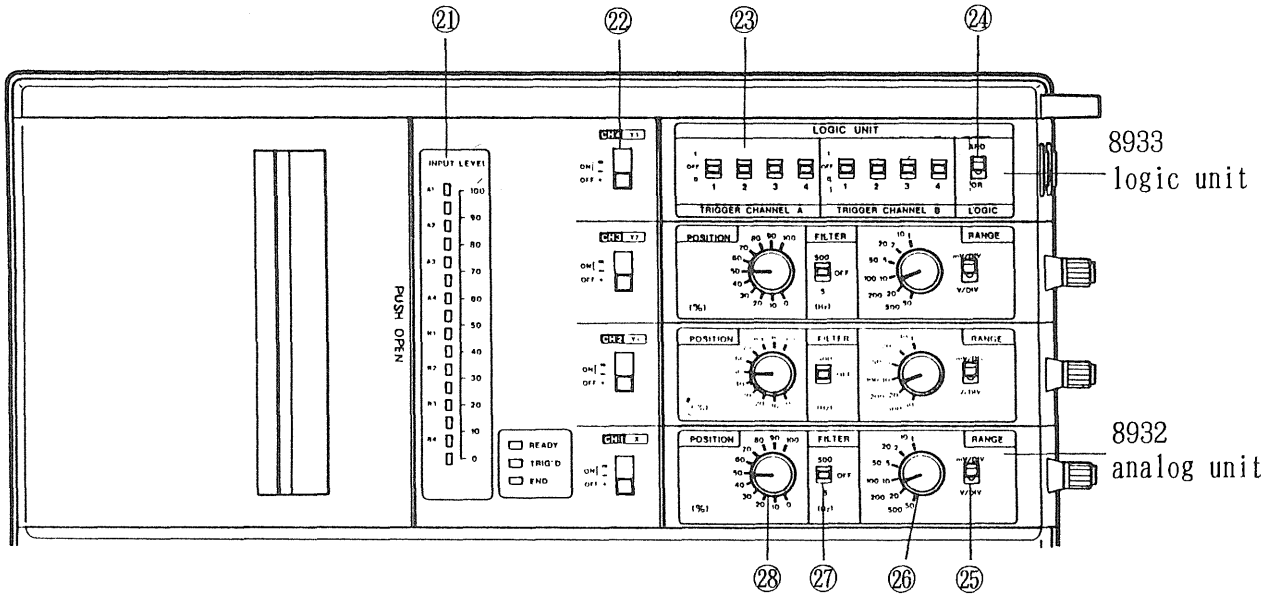
⑯ STOP Key : Stops measurement and printing.

⑰ PART PRINT Key : To print only a part of a waveform read in the MEM mode.

⑱ MAG 1/10, CLR Key : In the MEM mode, reduces the time axis to 1/10. In the XY_{CONT} mode, clears the memory.

⑲ PRINT Key : Prints out a waveform stored in memory.

⑳ FEED Key : Feeds recording paper into the unit as long as it is pressed down.



㉑ INPUT LEVEL Meter : Indicates the input level for the channel selected with the channel selector keys.

㉒ Printing Switches : Select whether the waveform for each channel is to be printed out. Also set recording line thickness.

㉓ TRIGGER CHANNEL A & B Switches: Select the logic signal trigger channels (8933 logic unit).

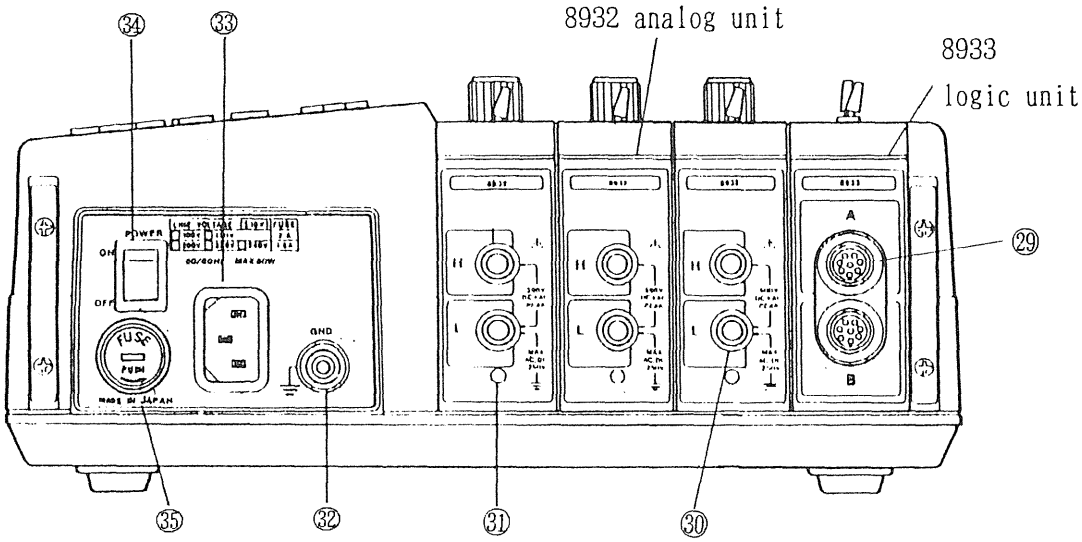
㉔ LOGIC AND & OR : Select the logic function (AND or OR) to be applied to the channels set with ㉓ (8933 logic unit).

㉕ Range Selectors : Select measurement range units between mV/DIV and V/DIV (8932 analog unit).

㉖ RANGE Knobs : Select the input unit measurement range among 12 settings. Use them in combination with ㉕ (8932 analog unit).

㉗ FILTER Switches : Make the input signal pass through a low-pass filter. Three settings are provided: 5 Hz, 500 Hz and OFF (8932 analog unit).

㉘ POSITION Knobs : Select the zero position among 11 settings, placed at 10% intervals (8932 analog unit).



㉙ Logic Probe Terminals : Logic unit input terminals for connecting the optional logic probes. Up to two probes can be connected (8933 logic unit).

㉚ Analog Input Terminals: Analog unit input terminals. Unbalanced (8932 analog unit).
H : High-level input
L : Low-level input

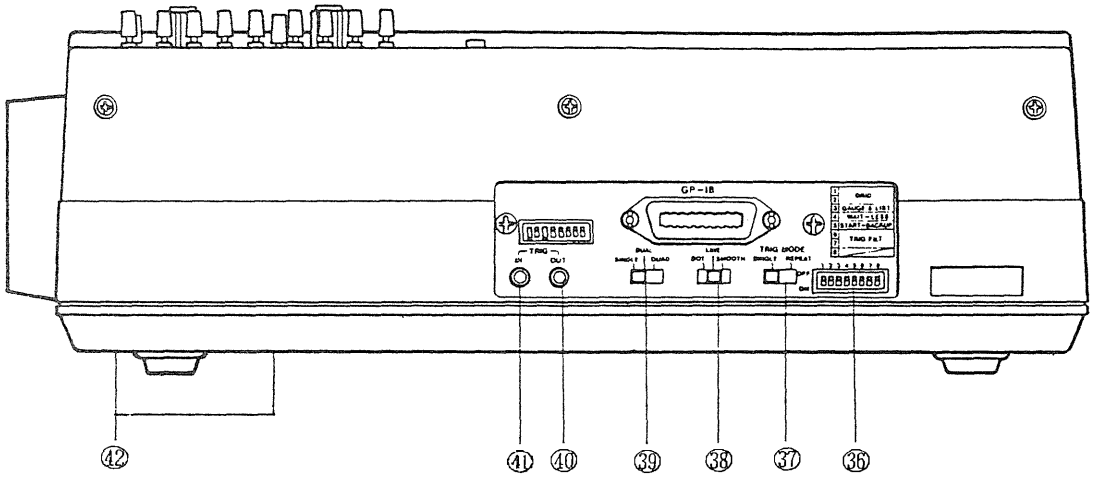
㉛ Zero Position Fine Adjustment Trimmer : Turn it using a small screwdriver (8932 analog unit).

㉜ Protective Ground Terminal (GND): Grounds the case. Make sure to connect it to a proper ground to ensure safe and stable operation.

㉝ AC power connector : Connect the provided AC power cord to this connector. This is a 3-terminal connector with ground.

㉞ POWER Switch : Turns power on and off.

㉟ Fuse holder : Holds the fuse.



㊱	DIP Switch	: Determines the default settings for analog unit trigger filter, start key backup, waitless mode, auto gauge, auto list, grid, etc.
㊲	TRIG MODE Switch	: Selects between the SINGLE and REPEAT trigger modes.
㊳	Interpolation Mode Switch	: Selects among the DOT, LINE and SMOOTH recording styles.
㊴	Recording Width Switch	: Selects recording width among the SINGLE, DUAL and QUAD settings.
㊵	TRIG OUT Jack	: Delivers a signal when the trigger is applied (active low, pulse width approx. 1.5 ms)
㊶	TRIG IN Jack	: Triggering is applied when the external trigger source is selected and this jack is short-circuited or it receives a falling signal of approx. 2.5 V (active low).
㊷	Fixing Screws	: Secure the input units.

CHAPTER 1

OUTLINE

1 — 1. Product Outline

The 8815 Memory Hi-Corder is a compact waveform recorder for the easy measurement of a wide range of phenomena from low to high speeds.

Major Features of the 8815

(1) Four functions to meet every measurement need
Recorder function for lengthy and continuous real-time recording, memory recorder function to securely catch transient and other high-speed phenomena, and high-speed XY recorder and continuous XY recorder functions for XY composition of the above phenomena.

(2) Powerful trigger functions
Digital trigger circuits are used, allowing trigger level to be specified in 1% steps. Trigger slope, trigger filter and other convenient functions are alsoprovided.

(3) High-speed sampling and large memory capacity
A maximum sampling speed of 500 kHz (500 ksample/s) and a maximum memory capacity of 125 kword (one channel), for securely capturing sporadic phenomena.

(4) Easy-to-use control panel
The number of switches has been reduced to a minimum. Settings can be easily done with the select keys while looking at the LED indicators.

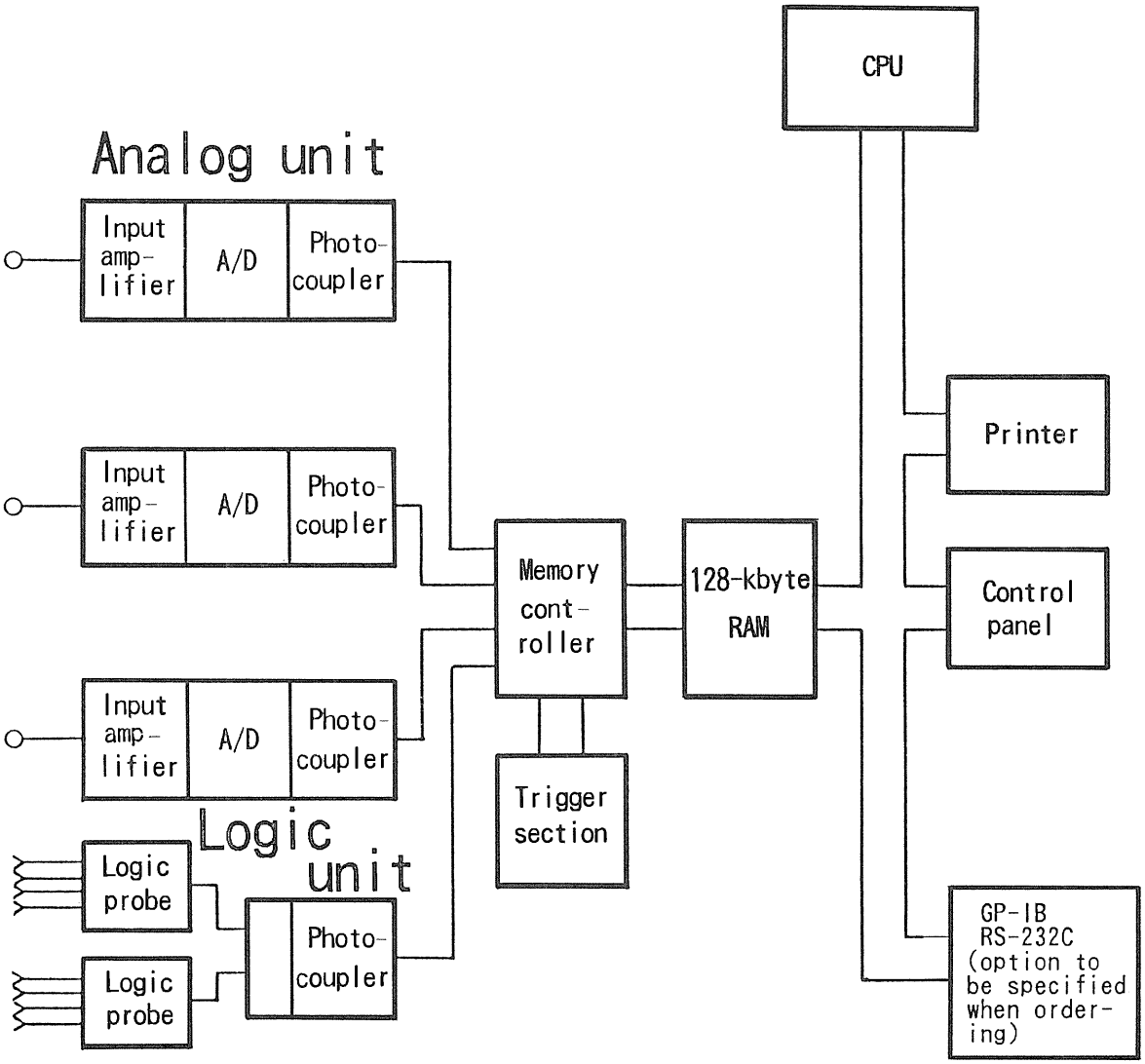
(5) Input units can be selected to match your needs
The 4-channel plug-in input unit system allows for free selection of analog orlogic units.

(6) Floating input units
Analog input units are floating, each connected to an independent potential point. Logic units are also isolated from the other input units.

(7) GP-IB, RS-232C interface (option to be specified when ordering)
A GP-IB, RS-232C interface can be installed as an option (to be specified when ordering). This makes data I/O and remote control through a computer possible.

1 — 2. System Operation

- This unit has a built-in 8-bit microprocessor which controls the whole system.
- Each input unit is provided with an 8-bit high-speed A/D converter, connected to the main unit through a photocoupler. A separate power source is used for each channel, ensuring total electrical insulation from the main unit.
- A/D converted data are stored in the 128-kword RAM by the memory controller.
- This unit uses digital trigger circuits. When internal triggering is used, the signal converted to digital is compared to the preset value and the trigger signal generated accordingly.
- Measurement data stored in the memory are processed by the CPU, then output to the graphics printer. Data can also be output to the GP-IB, RS-232C interface (option to be specified when ordering).



CHAPTER 2

SPECIFICATIONS

2－1. Main Unit General Specifications

Maximum sampling speed : 500 kS/s

Time axis accuracy : ±0.01% (relative error between readings and actual times)

Measurement functions : Recorder
Memory recorder
High-speed XY recorder
Continuous XY recorder

Maximum number of channels: 4 analog channels
3 analog channels and 8 logic channels
2 analog channels and 16 logic channels
1 analog channel and 24 logic channels
32 logic channels

Memory capacity : 8 bits × 25 kword/channel (when using one channel)
8 bits × 60 kword/channel (when using two channels)
8 bits × 30 kword/channel
(when using three or four channels)

Recording method : Thermal printing with thermal line head

Recording paper : 110 mm × 30 m roll type thermal recording paper

Recording width : (total) 104.2 mm (624 dots)
(waveform section) 83.8 mm f.s.

Scale : 1 DIV = 8.35 mm (50 dots)

Paper feed system : Stepping motor drive

Paper feed accuracy : ±3% (25℃, 60%)

Recording speed : 1.2 cm/s max.

Clock functions : Calendar with automatic adjustment for leap years
24-hour display clock

Maximum clock accuracy : 100 ppm (25℃)

Backup battery life : 10 years (reference value at 25 ℃). For the clock and unit settings

Operation environment : Temperature 5 ℃ to 40℃
Humidity 35% to 80% (no condensation)

Accuracy assurance environment: Temperature 23℃± 5 ℃
Humidity 35% to 80% (no condensation)

Storage environment : Temperature -10℃ to 50℃
Humidity 10% to 90% (no condensation)

Rated vibration resistance: Frequency-Sweep at the rate of about 1 octave/minute over the range from 10Hz to 55Hz and back again.
Amplitude-0.3mm for 30 minutes in each of X, Y, and Z directions (When not operating)

Shock resistance :30G in each of X, Y, and Z directions (when not operating)

Insulation resistance and
dielectric strength : 100 MΩ minimum/DC 500 V, AC 1.5 kV/1 minute
(between case and power supply)
100 MΩ minimum/DC 500 V, AC 1.5 kV/1 minute
(between input unit and case)
100 MΩ minimum/DC 500 V, AC 1.5 kV/1 minute
(between two input units)

Power Requirements : 8815: AC 100V ±10% 50/60 Hz (optionally 120, 200, 220 or 240V ±10% specified when ordering)

Power consumption : 8815: 60 W max. (approx. 20 W during normal recording)

Dimensions : Approx. 274 H × 340 W × 105 D (mm) (not including protrusions)

Weight : 8815: Approx. 4.5 kg (main unit only)

Standard accessories:

Power cord	1
Recording paper (roll type)	1
Protective cover	1
Roll paper holder	2
Spare fuse	1
8815: power supply 100/120V :2.0A/250V, 5.2mm dia. ×20mm power supply 200, 220, 240V:1.5A/250V, 5.2mm dia. ×20mm	
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Options : 8932 analog unit
8933 logic unit
8934 analog unit (DC/RMS type)
8935 temperature unit
9508 blank panel
9506 GP-IB interface (to be specified when ordering)
9507 RS-232C interface (to be specified when ordering)

Optional accessories:
9221 recording paper (in 10-roll sets)
9303 Voltage converter (PT)
9305 Trigger cord
9362 Transportation case
9084 Transportation case (for the accessories)
9151-02 GP-IB connector cable (2 m)
9151-04 GP-IB connector cable (4 m)
220H chart takeup reel

2－2. Input Unit Specifications

(1) 8932 Analog Unit (at 23℃± 5 ℃)

Accuracy assurance period : 6 months
Input method : Unbalanced input (input and output mutually insulated)
Measurement ranges : 10, 20, 50, 100, 200, 500 mV/DIV
1, 2, 5, 10, 20, 50 V/DIV
DC amplitude accuracy : ±1% f.s.
Zero position adjustment : 11 settings, placed at 10% intervals on the 100% recording width, and fine adjustment
Zero position accuracy : ±1% f.s.
Frequency characteristic : DC to 200 kHz (-3 dB)
Input RC : 1 MΩ ±1% (mV/DIV); approx. 30 pF (V/DIV; approx. 25 pF at 100 kHz
Low-pass filter : Cutoff frequency approx. 5 Hz, approx. 500 Hz, and OFF setting
A/D conversion resolution : 8 bits
Maximum sampling speed : 500kS/s (sampling interval 2μs)
Permissible input voltage : 500V (DC + AC peak)
Maximum floating voltage : AC/DC 250V
(between input unit and case, and between input units)
Insulation resistance and
dielectric strength : 100 MΩ minimum/DC 500 V, AC 1.5 kV/1 minute
(between input unit and case, and between input units)
Common-mode rejection ratio : 80 dB or more (at 50 or 60 Hz, source impedance 100Ω max.)
Temperature characteristic: ±0.1% f.s./℃
Input terminals : Two
Dimensions and weight : Approx. 34 H × 124 W × 82 D (mm) (excluding protrusions); approx. 220 g
Accessories : 9177 input cord
Fixing screws of input unit (2)

(2) 8933 Logic Unit

Number of input channels : 8 (4 channels× 2 logic probes)
Input method : Logic probes (4 channels). Independent floating for each unit
Maximum sampling speed : 500 kS/s (sampling interval 2 μs)
Maximum floating voltage : AC/DC 250 V (between input unit and case, and between input units)
Insulation resistance and
dielectric strength : 100 MΩ minimum/DC 500 V, AC 1.5 kV/1 minute
(between input unit and case, and between input units)
Dimensions and weight : Approx. 34 H× 124 W × 82 D (mm) (excluding protrusions); approx. 160 g

Optional accessories : 9306 logic probe
9307 line logic probe
9308 line dip detector
Standard accessories : Fixing screws of input unit (2)

2－3. Trigger Section

Triggering method : Digital comparison
Trigger modes : Memory recorder, high-speed XY recorder … Single, repeat
Continuous XY recorder… Single
Trigger source : OFF, EXT, MANU, INT (CH1, CH2, CH3 or CH4)
Trigger slope : Analog input…… rise, fall
Logic input …… condition match
EXT input …… fall
Trigger level : Analog input…digitally set between 0% and 99% (1% steps)
EXT ……approx. 2.5 V max, or terminal short-circuit
Trigger level setting accuracy: ±0.4% f.s. (f.s. = 100%)
Logic input conditions : 1, 0 and OFF pattern settings
AND/OR within the logic input (set at the input unit)
Trigger timing : Before the trigger point (95%), trigger stop (REC, XY_{CONT})
Around the trigger point (50%)
After the trigger point (5%), trigger start (REC, XY_{CONT})
At a point located 1 shot after the trigger point (-95%)
Trigger output : Open collector (with 5-V output; active low)
Pulse width approx. 1.5 ms
Trigger filter : OFF, 0.2, 0.6, 2.6 DIV (analog)
OFF, 0.1, 0.2, 0.3, 0.6, 1.3, 2.6 DIV (logic)
OFF, ON (REC, XY_{CONT})
Trigger I/O terminals : 3.5-mm-dia. minijacks
Waitless mode : Provided (memory recorder, high-speed XY recorder)

2－4. Recorder Function (REC)

Time axis : 1 s/DIV to 50 s/DIV and 1 min./DIV to 50 min./DIV, 12 ranges
Time axis resolution : 50 dots/DIV at 1 s/DIV; 100 dots/DIV at other settings
Sampling rate : Constant regardless of time axis (high-speed sampling)
1 channel …… 80 μs
2 channels…… 90 μs
3 channels…… 100 μs
4 channels…… 120 μs
(for both dot and line displays)
Recording length : 20, 40, 80, 160, 300, 600 DIV, CONT
Interpolation function : Provided, dot/line display
Printing format : SINGLE, DUAL, QUAD, gauge, setting lists

2－5. Memory Recorder Function (MEM)

Time axis : 100 μs/DIV to 5 s/DIV, 15 ranges
Time axis resolution : 50 dots/DIV
Sampling rate : 1/50 of time axis
Recording length : 20, 40, 80, 160, 300, 600, 1200 (2 channels),
2500 (1 channel) DIV
Interpolation function : Provided, dot/line/smooth display
Reduced output : 1/10 reduction on the time axis
Printing format : SINGLE, DUAL, QUAD, gauge, setting lists
Partial printing : Supported. The start point is specified in %.

2－6. High-speed XY Recorder Function (XY_{MEM})

No. of composed channels : 3 max.
X channel: Channel 1
Y channel: Channels 2 to 4 (only for analog input unit)
Effective recording area : 83.8 × 83.8 mm (10 DIV × 10 DIV)
X/Y axis resolution : 25 dots/DIV
Sampling rate : 2 μs to 100 ms (1/50 of time axis range)
Recording time : 2 ms to 100 min. (1 channel)
2 ms to 50 min. (2 or 3 channels)
Interpolation function : Provided, dot/line display
Line thickness selection : Thick (SLIM)/Thin (WIDE)

2－7. Continuous XY Recorder Function (XY_{CONT})

No. of channels : Same as XY_{MEM}
Effective recording area : Same as XY_{MEM}
X/Y axis resolution : 25 dots/DIV
Sampling rate :

	Dot display	Line display
1 channel	50 μs	180 μs to 8 ms
2 channels	60 μs	270 μs to 14 ms
3 channels	70 μs	360 μs to 19 ms

Recording time : Unlimited
Interpolation function : Provided, dot/line display
Line thickness selection : Thick (SLIM)/Thin (WIDE)
Superposed printing : Supported

2－8. Auxiliary Functions

Recording line designation: Independent for each channel
Analog recording…… WIDE, SLIM, OFF
Logic recording …… A + B (8 channels), A (4 channels), OFF
Input level meter : 16-segment LED
Binary value (1,0) for each channel indicated at logic input

Trigger condition indication : READY, TRIG'D and END LEDs
Comment printing : Function, channel(s) used, input range, zero position, trigger conditions, trigger time, No. of divs., etc.
Auto list/gauge printing : OFF, ON (always printed during waveform recording)
Grid designation : OFF, NORMAL, FINE
GP-IB (option to be specified when ordering): Electrical and mechanical specifications meet IEEE 488-1978 standards
RS-232C (option to be specified when ordering): Electrical specifications meet EIA RS-232C standard.
Supports waveform data read/write, input unit settings readout and main unit remote control

2－9. Additional Data

Memory Recorder and High-speed XY Recorder Functions (XY_{MEM} function between brackets)

Time/DIV	Sampling Interval	Maximum Recording Time		
		1 channel *1	2 channels *2 (Y axis 1 channel)	3-4 channels *3 (Y axis 2-3 channels)
100μs/DIV	2μs	250ms	120ms	60ms
200	4	500	240	120
500	10	1.25s	600	300
1ms/DIV	20	2.50	1.20s	600
2	40	5.00	2.40	1.20s
5	100	12.5	6.00	3.00
10	200	25.0	12.0	6.00
20	400	50.0	24.0	12.0
50	1ms	125	60.0	30.0
100	2	250	120	60.0
200	4	500	240	120
500	10	1250	600	300
1s/DIV	20	2500	1200	600
2	40	5000	2400	1200
5	100	12500	6000	3000

Time axis resolution is 1/50 (per DIV)
*1 Recording length 2500 DIV
*2 Recording length 1200 DIV
*3 Recording length 600 DIV

Recorder Function

Time/DIV	Chart Speed	Time Axis Resolution
1 s/DIV	501 mm/min	1／50DIV
2	250.5	1／100DIV
5	100.2	
10	50.1	
20	25.1	
50	10.0	
1 min/DIV	501 mm/h	
2	250.5	
5	100.2	
10	50.1	
20	25.1	
50	10.0	

Recorder Function Sampling Speed

No. of Channels Used	Sampling Speed	Sampling Interval
1	12.50 k S／s	80 μs
2	11.11 k S／s	90 μs
3	10.00 k S／s	100 μs
4	8.33 k S／s	120 μs

Continuous XY Recorder Function

	Dot		Line
No. of Channels	Sampling Speed	Sampling Interval	Sampling Interval Range
1	20.00 k S／s	50 μs	180 μs ～ 8 ms
2	16.67 k S／s	60 μs	270 μs ～ 14 ms
3	14.29 k S／s	70 μs	360 μs ～ 19 ms

Note: When line interpolation is used, the sampling interval is not constant.

CHAPTER 3

INSTALLATION AND PREPARATION

3－1 Notes on Installation

(1) Main Power Supply and Fuse

The type of power on which this unit can operate is indicated on the side panel. Be sure to check the power supply voltage. The fuse rating is also marked on the side panel. Be sure to use a fuse of the specified current rating.

① 8815

LINE VOLTAGE (±10%)	FUSE	SIZE
250V MAX 50/60Hz		
☐ 100V ☐ 120V	2.0A/250V	5.2(dia.)×20mm
☐ 200V ☐ 220V ☐ 240V	1.5A/250V	5.2(dia.)×20mm

Note: Specify the line voltage at time of order. Note that the maximum applicable voltage is 250V for the 240V type.

(2) Power cord

●Use only the power cord provided with the unit.

(3) Protective Grounding

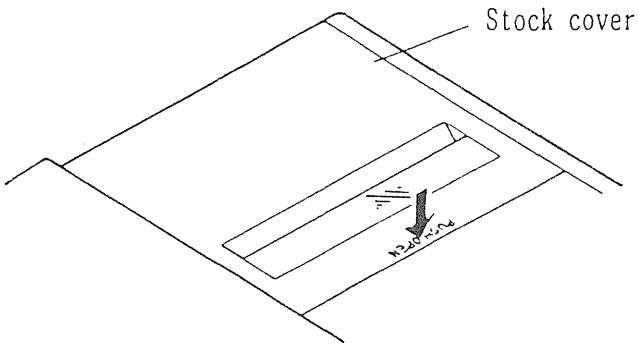
If a grounded power outlet is not available, be sure to ground the unit properly.

(4) Environmental Conditions

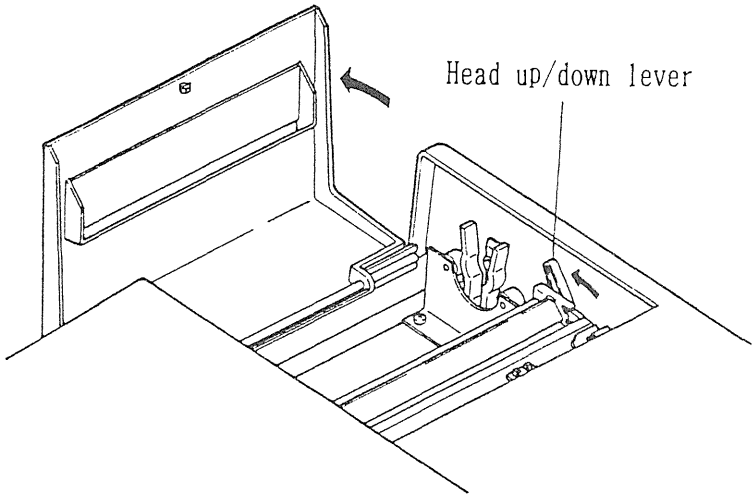
Temperature and humidity ranges for operation of this unit are 5℃ to 40℃ and 35% to 80%. Avoid locations exposed to direct sunlight, large amounts of dust, or corrosive gases.

3－2. Loading the Recording Paper

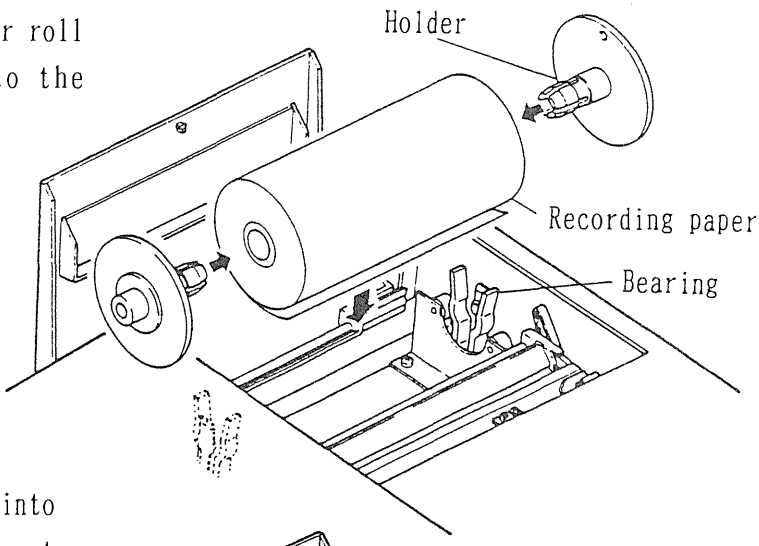
① Push the stock cover to open.



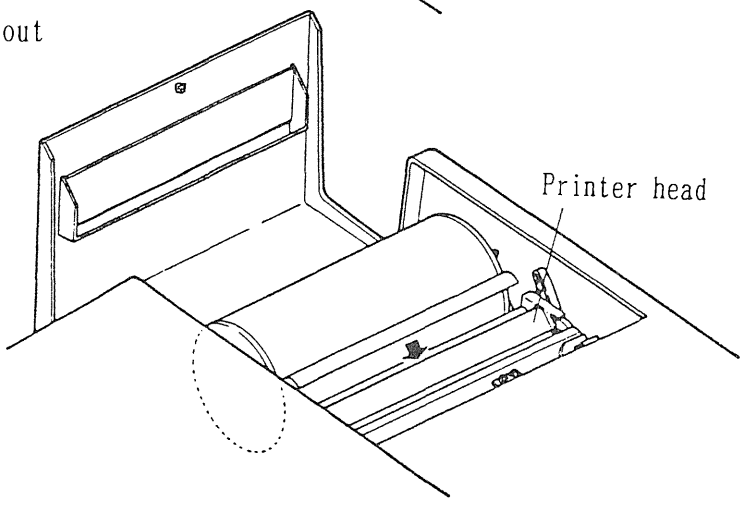
② Raise the head up/down lever.



③ Insert the holders into the paper roll core and place the paper onto the bearings.

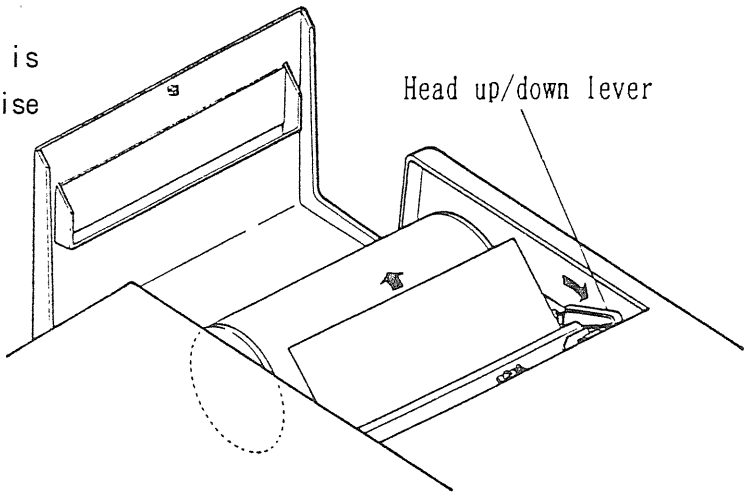


④ Insert the paper end from above into the printer slot, then pull it out from the other side.

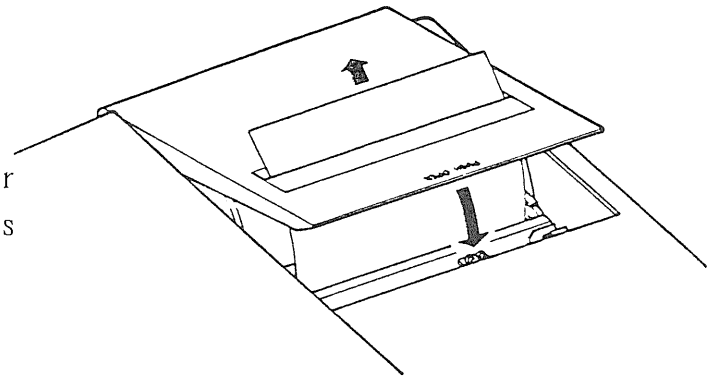


⑤ Pull the paper out 10 cm or more and straighten it. If the paper does not come out smoothly, push the head up/down lever down and press the FEED key to feed paper in.

Note: Make sure that the paper is aligned with the roller, otherwise a paper jam may occur.



⑥ Push the head up/down lever down.



⑦ Pull paper out of the stock cover slot and close the cover. This completes the procedure.

Note: ● Be sure to observe the proper paper position. Otherwise, no waveforms will be printed.

● When the device is transported or stored for a lengthy period, make sure that the paper roll is kept in the head-up position. The roller may deform if it is continuously pressed against the head causing irregular printing.

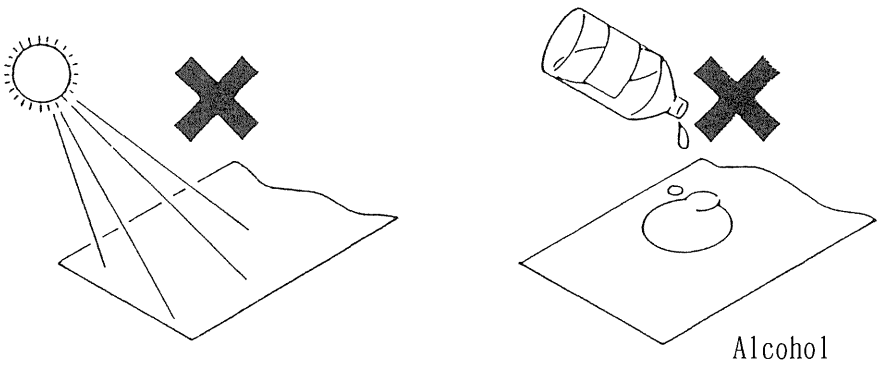
3 − 3. Recording Paper Handling

- Usually, storage conditions do not affect blank thermal paper rolls. However, if paper is to be stored for a long time, do so at temperature of 40 ℃ or lower. The paper is not adversely affected as long as it is stored at low temperature.
- If the paper is exposed to strong light for a long period, it may discolor. Therefore, do not expose the paper to a strong light with its wrapping removed.

Data Storage

Since recording paper is heat-sensitive, pay attention to the following when handling paper on which data have been recorded:

- Do not expose paper to direct sunlight.
- Store the paper at a maximum temperature of 40℃ and a maximum humidity of 90%.
- It is recommended that copies of important data be made for storage.
- The thermal paper may be discolored when put in contact to volatile organic solvents such as those based on alcohol, ether or ketone.
- When the thermal paper absorbs organic solvents such as those based on alcohol, ether or ketone, it may lose its color, resulting in the recorded 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 − 4. Notes on Measurement

⚠ WARNING

- The maximum permissible input voltage for the input terminals of the 8932 analog unit is 500 V (AC+DC peak). Take care to avoid voltage levels above this limit.
- The maximum input unit floating voltage is 250 V AC/DC. Avoid voltages over this limit between channels or between a channel and the main unit.
- Always use a voltage converter for measurement of AC power lines over 250 V.

CHAPTER 4

OPERATION

4 − 1. Hints on Reading this Chapter

Chapter 3 explained preparations before measurement, including some precautionary notes. In Chapter 4, unit setting and actual waveform recording will be explained for the first-time user. Each measurement function is described independently. You can refer just to the function you want to use. In the text you will find references to other sections you can read if more information on a particular setting is needed.

Please read the following while actually operating the unit.

- First, decide what kind of signal you will measure.

- Select the measurement function accordingly

4-1-1 Features of the Recorder Function
4-1-2 Features of the Memory Recorder Function
4-1-3 Features of the High-speed XY Recorder Function
4-1-4 Features of the Continuous XY Recorder Function

Read the section on the selected measurement function.

[REC]
4-2. Using the Recorder Function

[MEM]
4-3. Using the Memory Recorder Function

[XY_{MEM}]
4-4. Using the High-speed XY Recorder Function

[XY_{CONT}]
4-5. Using the Continuous XY Recorder Function

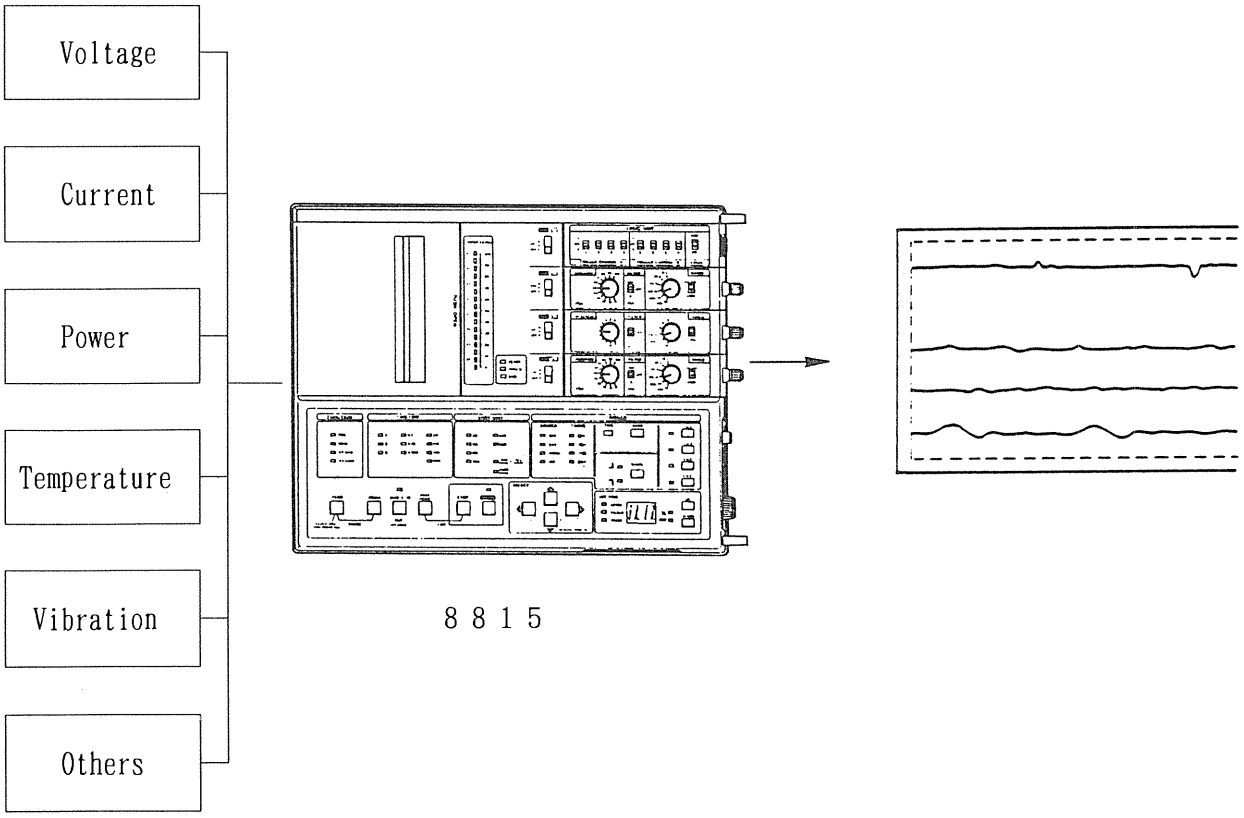
4－1－1. Features of the Recorder Function

(1) Continuous recording in real time.

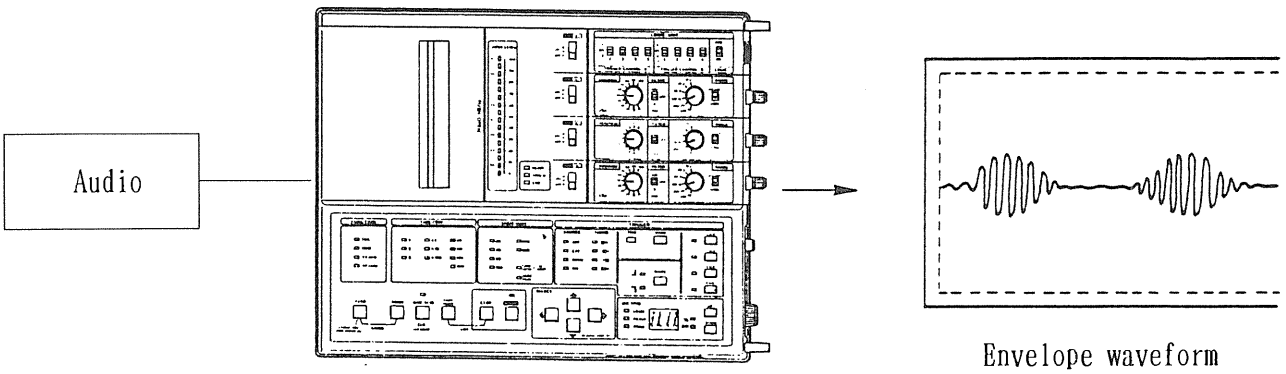
(2) Data from all input channels are recorded on the same time axis. Signals can be recorded overlapped, helping to observe their mutual relationship.

(3) Charting rate can be adjusted in 12 steps from 1 s/DIV to 50 min./DIV.

(4) High-speed sampling: Sampling is performed at a maximum 12.5 kHz, allowing for envelope observation.



Level Recording of Various Physical Quantities



4－1－2. Features of the Memory Recorder Function

(1) Input signals are first stored in memory, then displayed and recorded. High-speed phenomena can be captured.

(2) Data from all input channels are recorded on the same time axis. Signals can be recorded overlapped, helping to observe their mutual relationship.

(3) The time axis can be adjusted in 15 steps from 100 μs/DIV to 5 s/DIV.

(4) Maximum memory capacity (recording length) is 125 kword (equivalent to 2500 div.) when using 1 channel, 60 kword (equivalent to 1200 div.) when using 2 channels, and 30 kword (equivalent to 600 div.) when using 3 or 4 channels.

(5) The signal can be observed not only after, but also before the trigger point.

(6) 1/10 reduced printing for quickly getting a complete picture of the waveform.

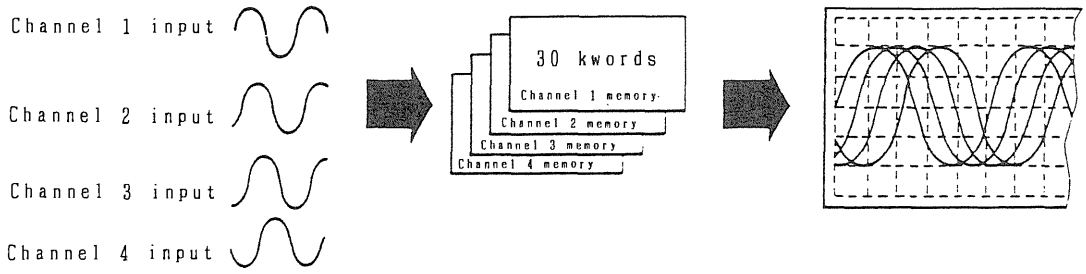
(7) Partial printing

The desired waveform section can be selected from stored data for printing.

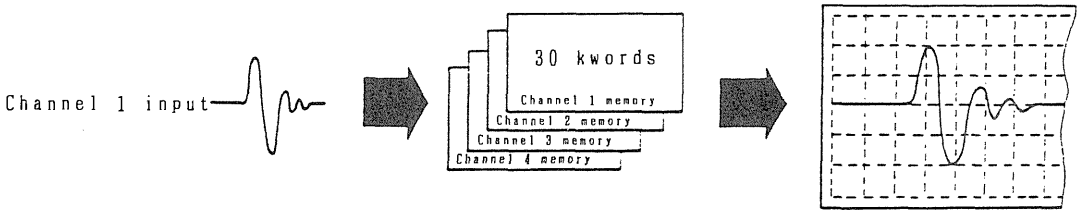
(8) Repeated printing

A stored waveform can be printed as many times as required.

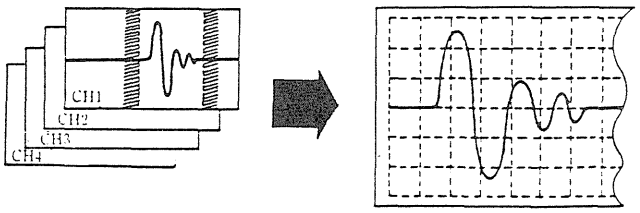
(9) Conversion to an XY composite waveform is possible.



Four-channel Simultaneous Recording



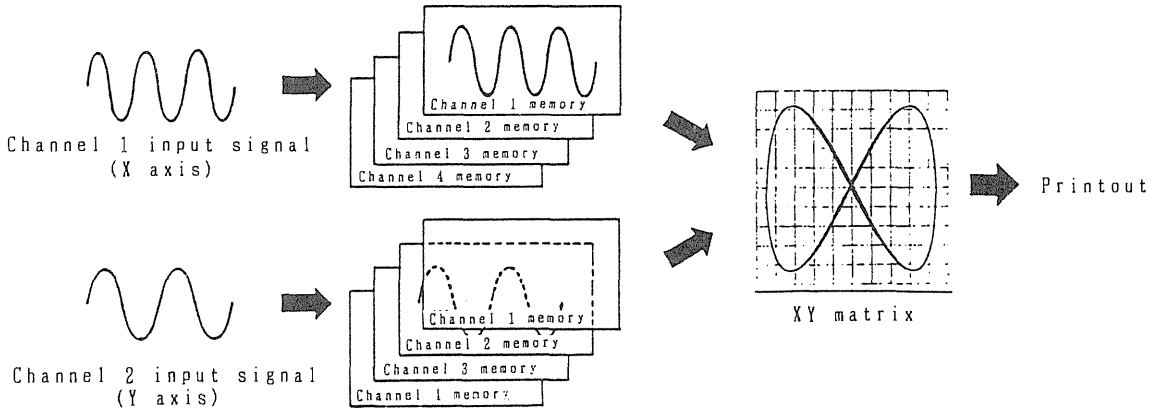
Pre-trigger Recording Using the Trigger Delay Function



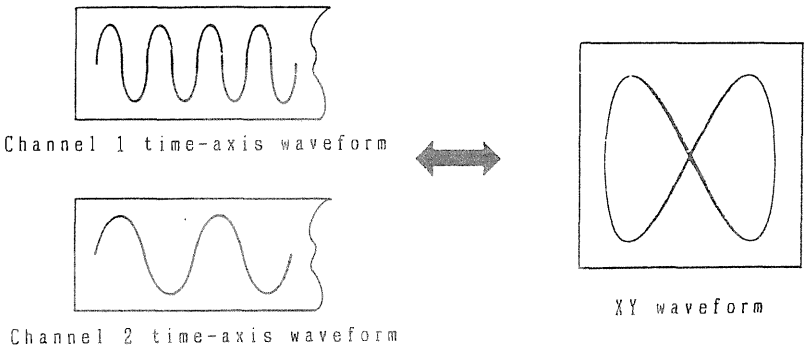
Partial Printing of Stored Data

4－1－3. Features of the High-speed XY Recorder

(1) Like with the memory recorder, input signals for each channel are stored in memory.
(2) The stored time-axis signals undergo XY combination.
(3) Channel 1 is assigned to the X axis, and any channel from 2 to 4 to the Y axis.
(4) Conversion to a time-axis waveform is possible.



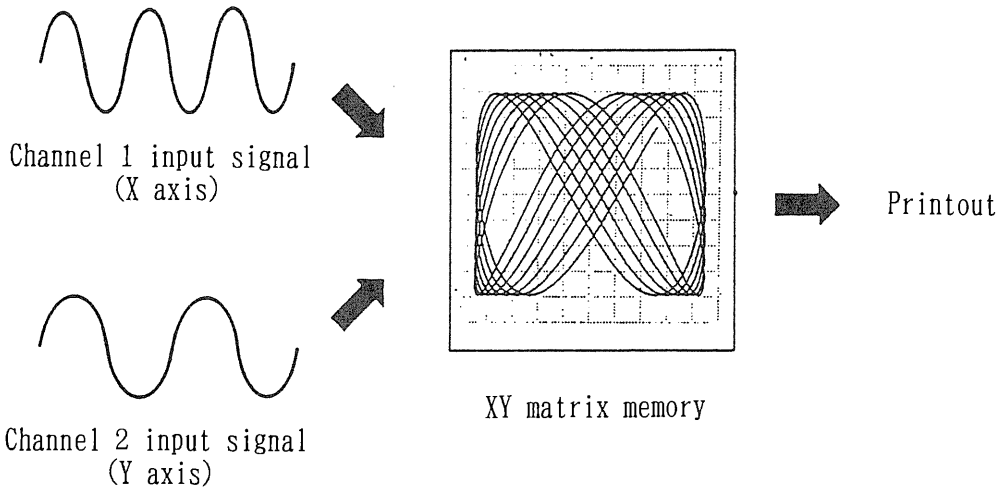
Operation Principle of the XY MEM Function



Output Format Conversion

4－1－4. Features of the Continuous XY Recorder Function

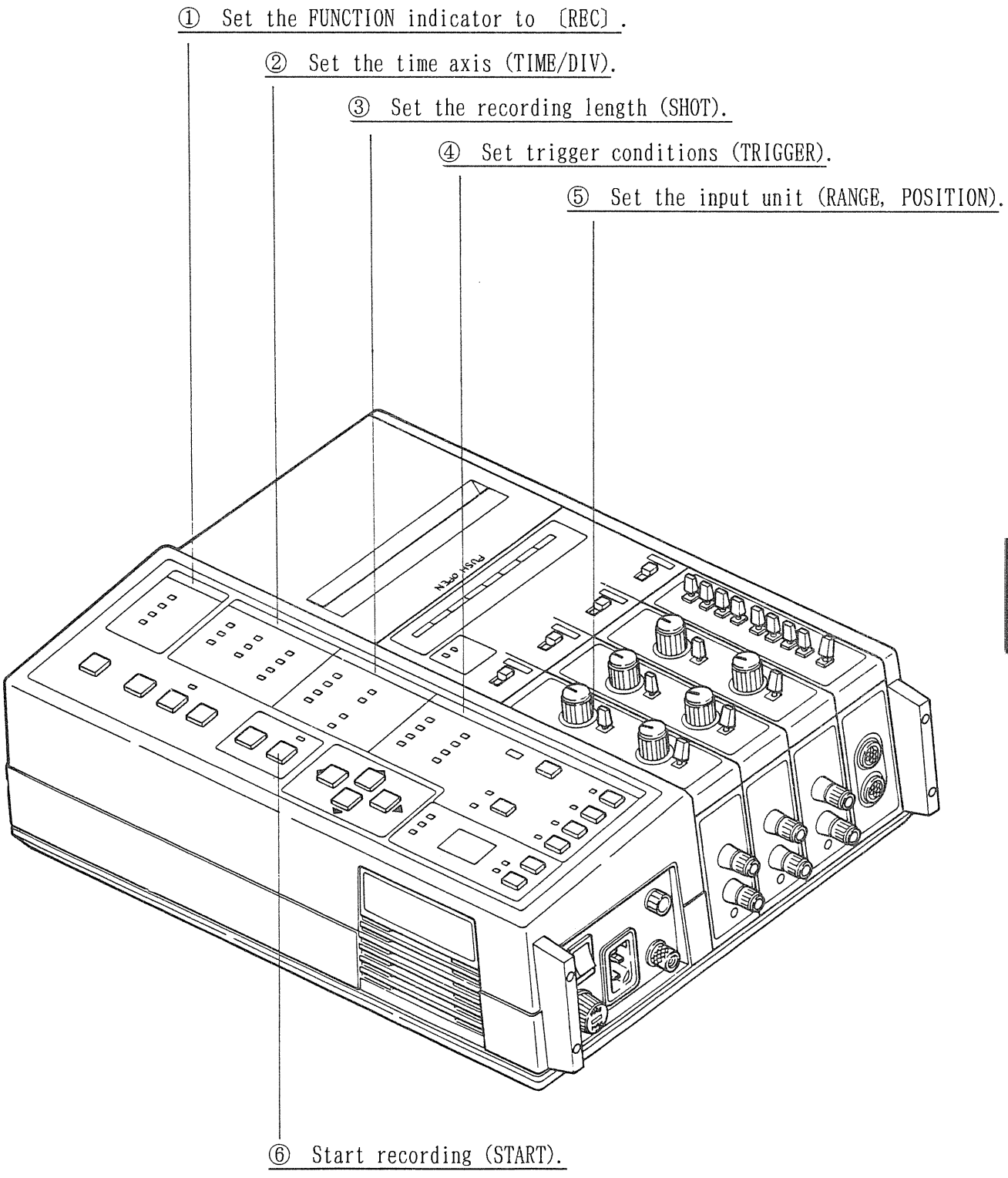
(1) XY combination of input channels is performed as in the normal XY recorder mode.
(2) Channel 1 is used for the X axis, and channels 2-4 for the Y axis.
(3) The XY composite signal is recorded. Unlike the high-speed recorder function, time-axis signals for each channel are not recorded.
(4) High-speed sampling
Recording is performed at a maximum speed of 20 kS/s.
(5) Unlimited recording time
Since operation is basically the same as in the normal XY recorder, recording can be continued as long as desired.
(6) Overlapped recording
Waveforms are not erased until the memory is cleared, and can be overlapped as desired.
(7) Repeated printing is possible.



4 − 2. Using the Recorder Function

4 − 2 − 1. Procedures

Basic operation of the recorder function is performed in the following order:

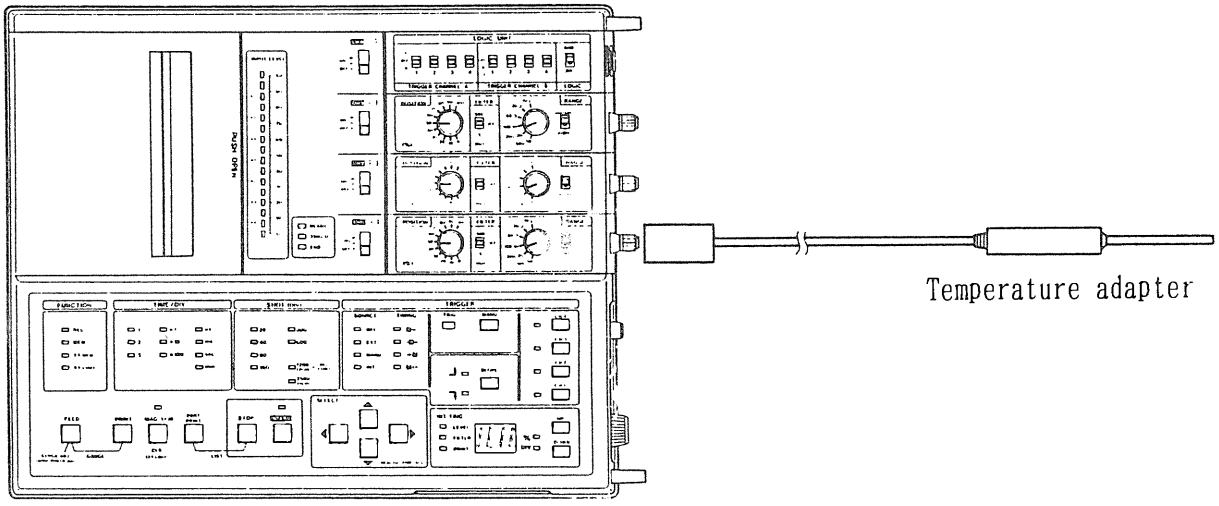


4－2－2. Recorder Operation Example

Recording temperature fluctuations using a temperature adapter.

(1) Preparations for Measurement

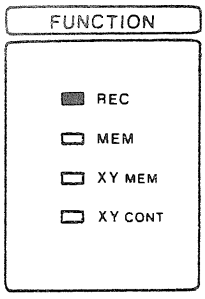
Connect the temperature adapter to the input terminal of the 8932 analog unit (channel 1) mounted into the 8815.



8 8 1 5

(2) 8815 Setting

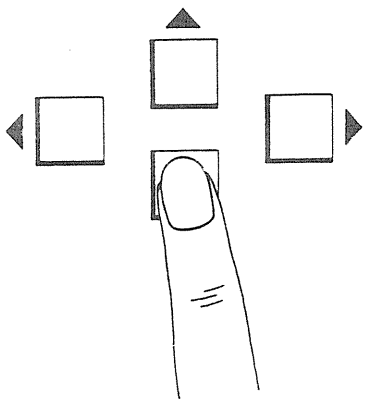
After turning the power on, set the LED indicators as follows.

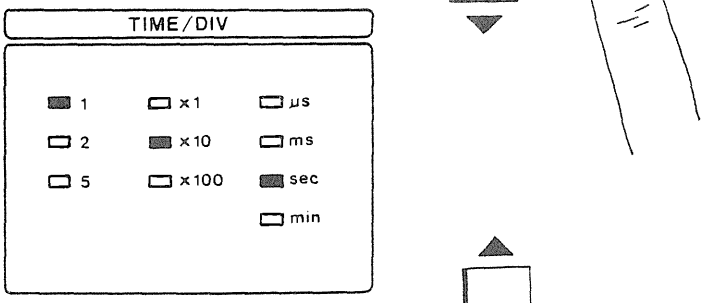


① FUNCTION Setting

Selects the function to be used.

First, press the ◁ or ▷ SELECT key until a FUNCTION lamp starts blinking. Then, use the △▽ SELECT keys to make the REC lamp blink.

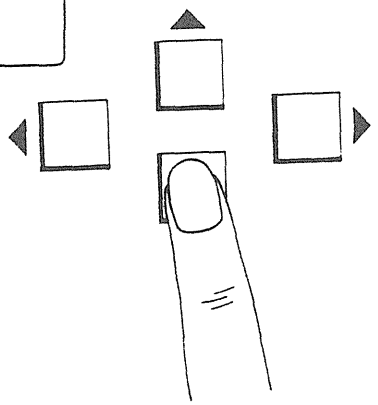




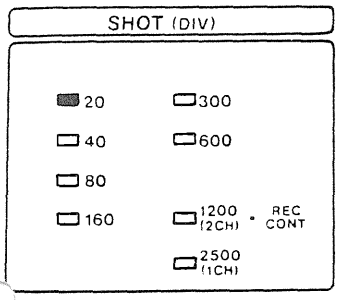
② TIME/DIV Setting

(see Chapter 6. TIME AXIS SETTING)

- This procedure sets the time corresponding to one square on the recording paper grid. Press the SELECT ▷ key once so that a TIME/DIV lamp starts blinking.
- The recorder function has two time axis setting ranges: 1 to 50 s/DIV and 1 to 50 min./DIV. Press the △ key to obtain a faster speed on the time axis, or the ▽ key to reduce speed.



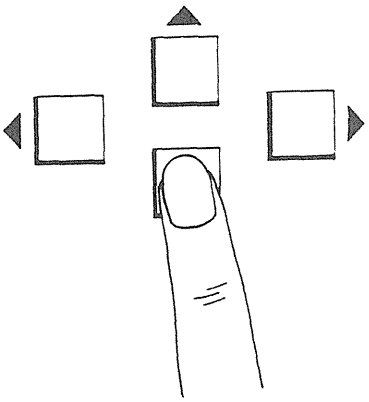
- In this example, let's choose the 10 s/DIV setting. If the LEDs indicate, for example, 2 min./DIV, press the △ key to light the 1 and × 10 LEDs. This sets the time axis to 10 s/DIV.

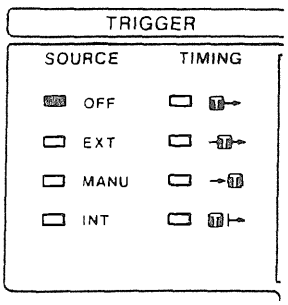


③ SHOT Setting

(see Chapter 7. RECORDING LENGTH SETTING)

- This sets the length of paper to be printed in one recording operation.
- Press the ▷ key so that a SHOT lamp starts blinking.
- Press the △ key to obtain a shorter recording length, or the ▽ key to make it longer.
- We will set it to 20 DIV here. Use the ▽△ keys so as to make the 20 LED blink.





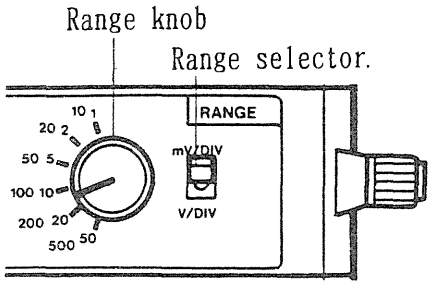
④ TRIGGER Setting

(see Chapter 8. USING THE TRIGGER FUNCTION)

- Trigger signal and recording operation timing is determined.
- Press the ▷ key once so that a SOURCE lamp in the TRIGGER section starts blinking. Since we will not use triggering in this example, make the OFF lamp blink.

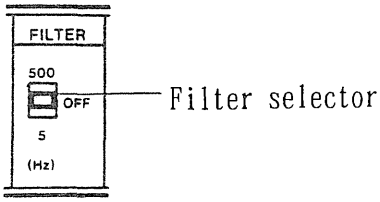
REC

Finally, set the input unit POSITION, RANGE and printing switches (see Chapter 5. USING THE INPUT UNIT).



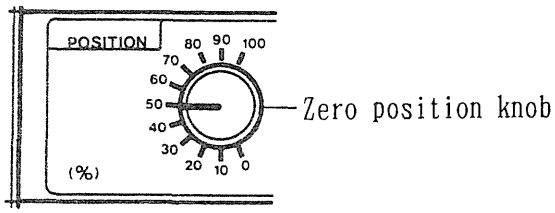
① RANGE Setting

- Set the range selector to the mV/DIV (green) position, and the range knob to the 50 (green) position.
- This sets a measurement range of 50 mV/DIV.



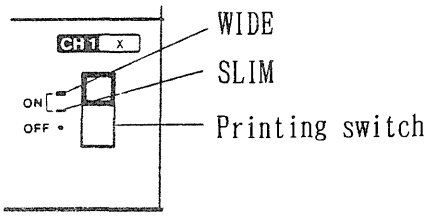
② FILTER Setting

- Set the FILTER switch to 5 Hz to pass the input signal through a low-pass filter.



③ POSITION Setting

- Set the Zero POSITION knob to 20%.

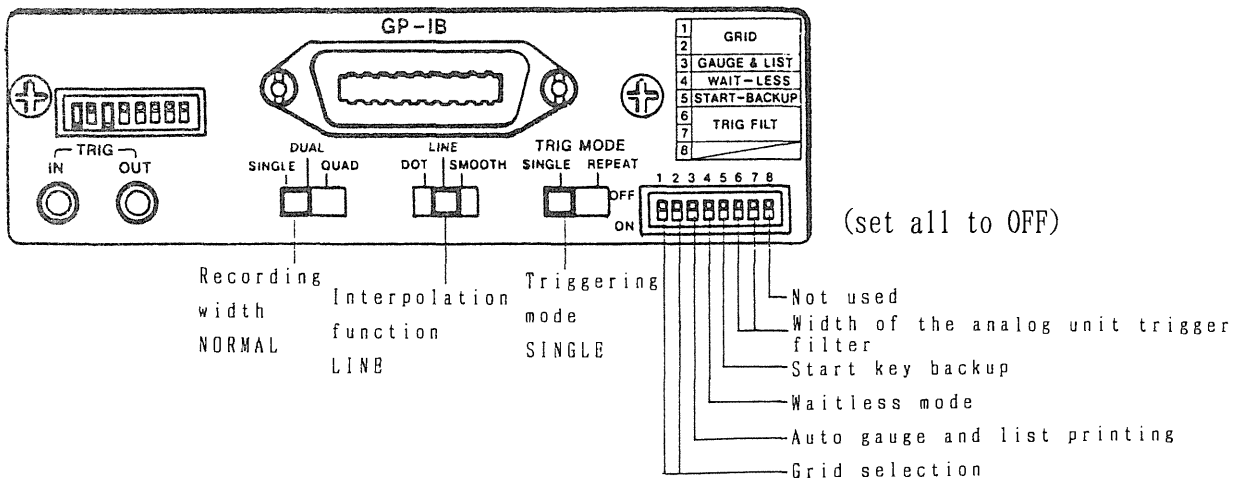


④ Printing Switch Setting

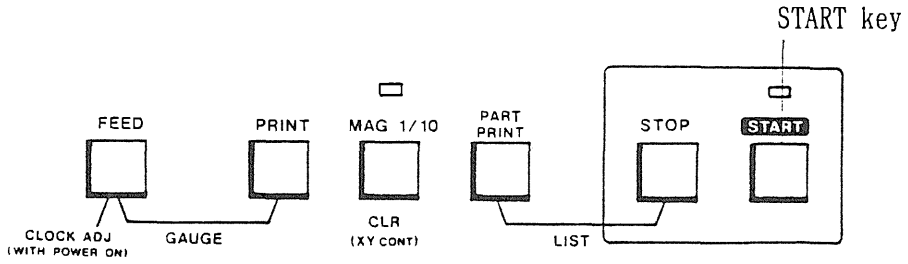
Set the channel 1 printing switch to the upper ON (WIDE) position. Set the printing switches for the other (unused) channels to OFF.

This completes the setting procedure.

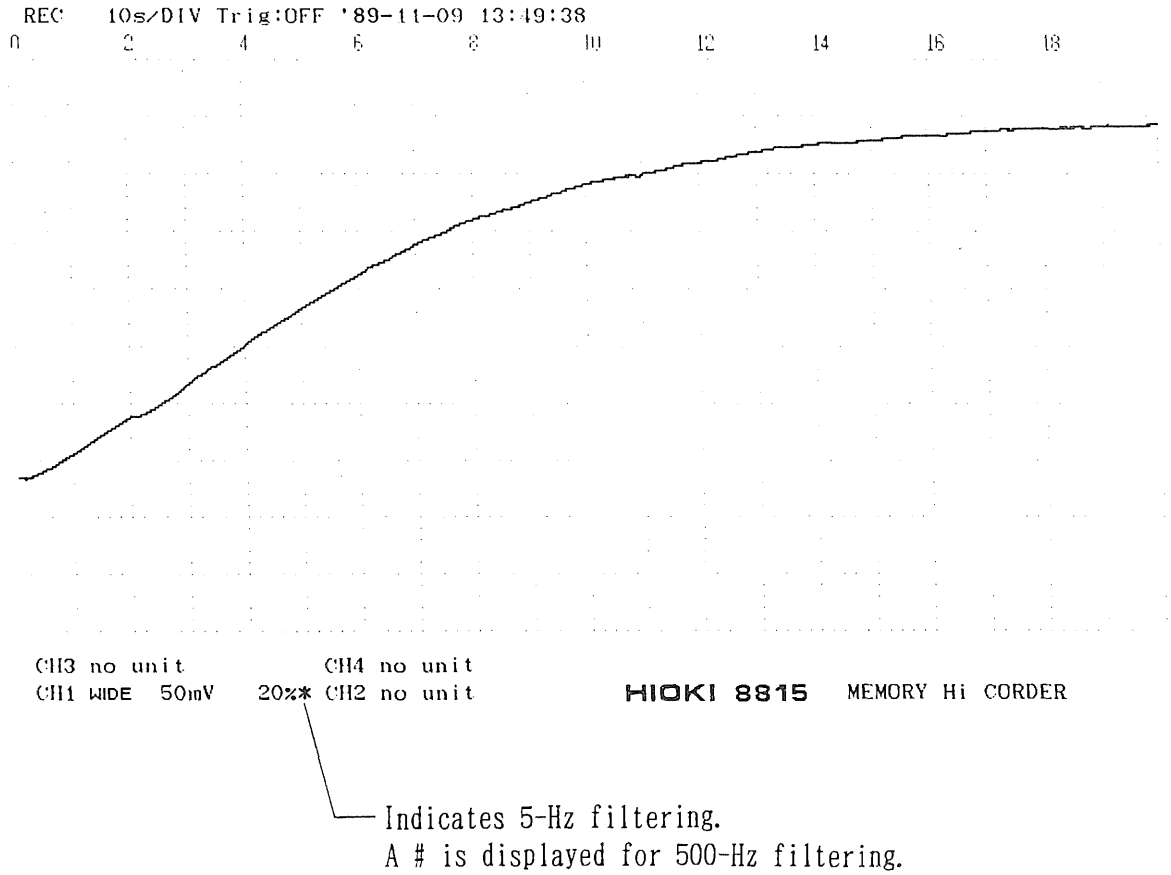
Note: Set the rear panel as shown below. For details, refer to Chapter 10. THE REAR PANEL.



Press the START key.



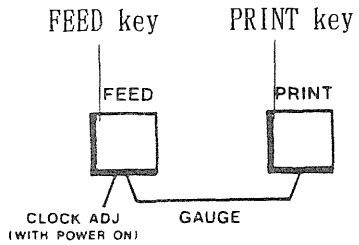
Confirm that recording starts, then try changing the temperature at the point of the temperature adapter. A waveform printout will be obtained as shown below.

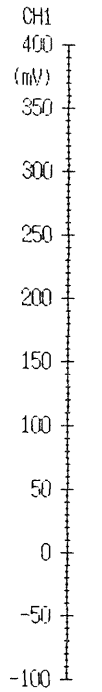


Note: In case no waveform is printed and the HU or PE indication blinks on the LED display, the printer is not properly set up. HU (Head Up) indicates that the head-up lever is in the up position, and PE (Paper Empty) that there is no paper loaded. Refer to 3-2. Loading the Recording Paper.

● Gauge Printing

To print the gauge, press the FEED and PRINT keys simultaneously.

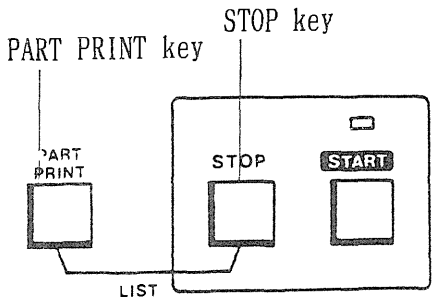




Gauge

● List Printing

To print the lists, press the PART PRINT and STOP keys simultaneously.



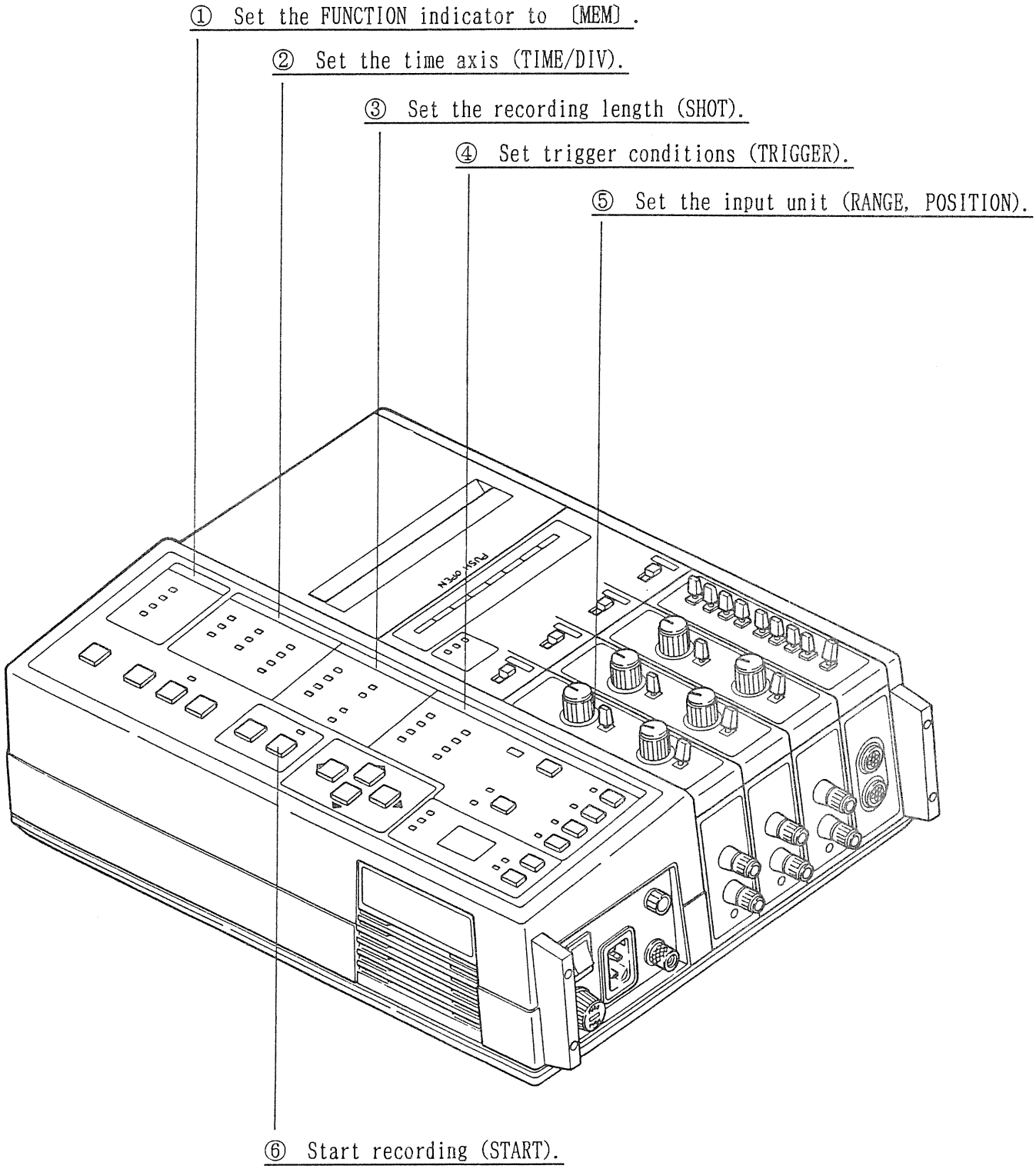

```
*** Set up ***
function.     REC          ← Time axis setting
time/DIV.     10s
shot lng.     20DIV        ← Recording length
-------------------------
 print   .    LINE         ← Interpolation function
         .
-------------------------
CH1 WIDE .    50mV         ← Measurement range
         .    20%          ← Zero position
 filter  .    500Hz        ← Filter
-------------------------
CH2 OFF  .    500mV
         .    50%
 filter  .    OFF
-------------------------
CH3 OFF  .    500mV
         .    60%
 filter  .    500Hz
-------------------------
CH4 OFF  .  (logic)
         .
         .
*** Trigger ***            ← Trigger conditions
-------------------------
  date   .'89-11-30
  time   .  10:37:34       ← Trigger time
-------------------------
source   .    OFF
timing   .    -
-------------------------
 level   .    -
 slope   .    -
 filter  .    -
-------------------------
waitless.     -
```

Lists

4 − 3. Using the Memory Recorder Function

4 − 3 − 1. Procedures

Basic operation of the memory recorder function is performed in the following order:



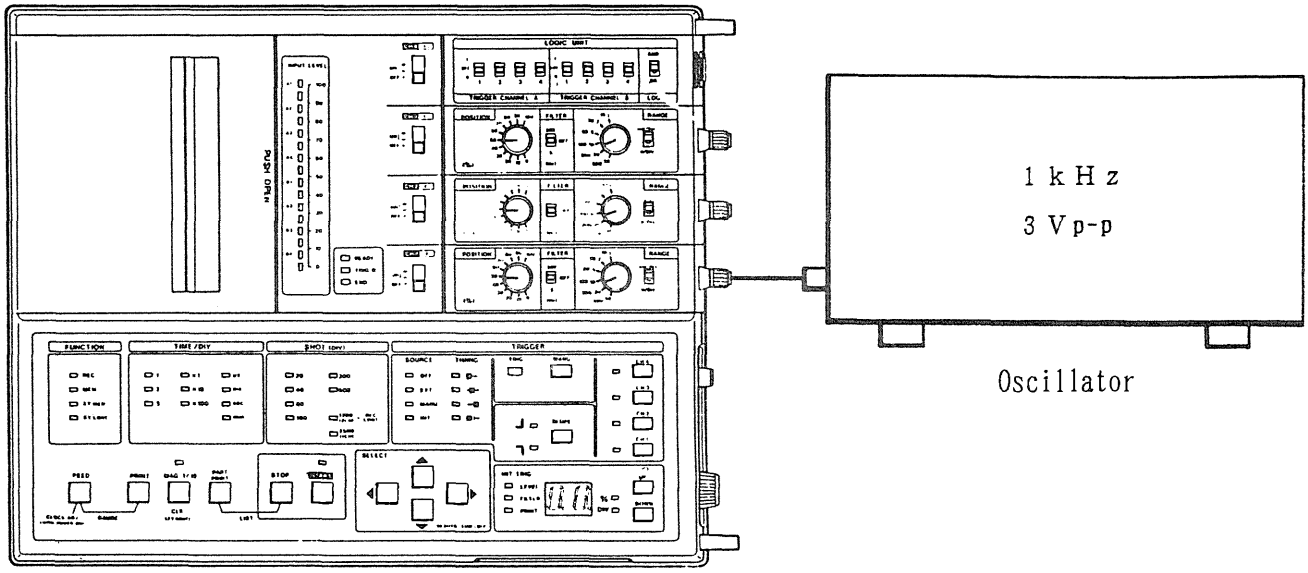
4－3－2. Memory Recorder Operation Example

Recording a 1-kHz sine wave input from an oscillator.

(1) Preparations for Measurement

Connect the oscillator to the 8815 channel 1 (analog unit) input terminal. Adjust the oscillator so as to generate a 1-kHz, 3-Vp-p sine wave.

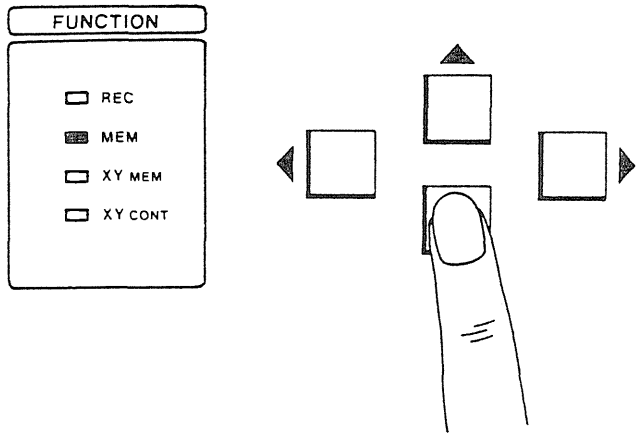
Note: Be sure to match the oscillator's and the analog unit's high and low sides.



8 8 1 5

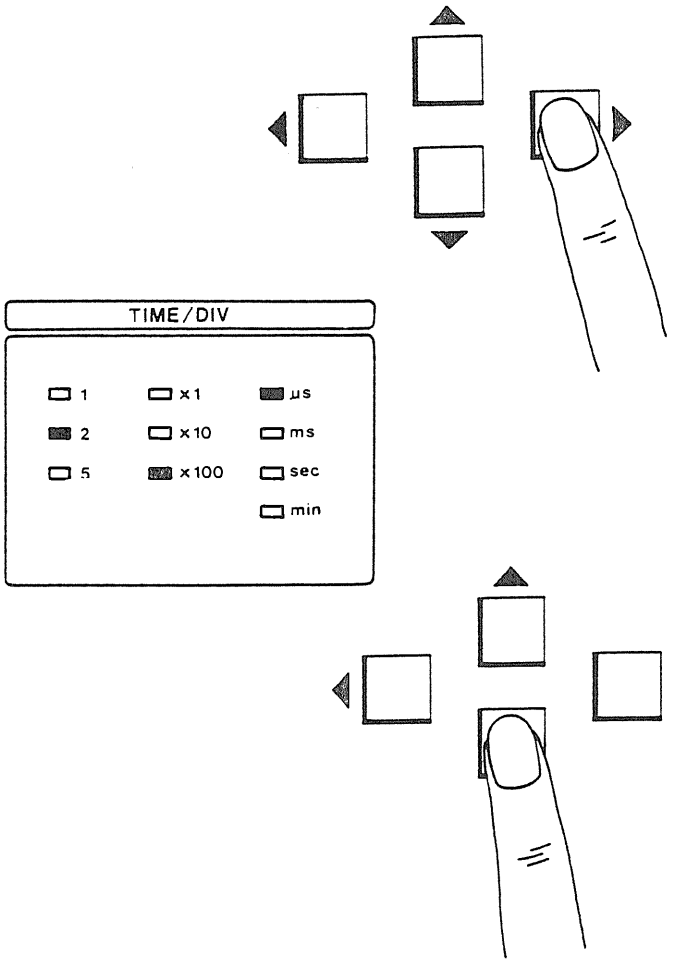
(2) 8815 Setting

After turning the power on, set the LED indicators as follows.



① FUNCTION Setting

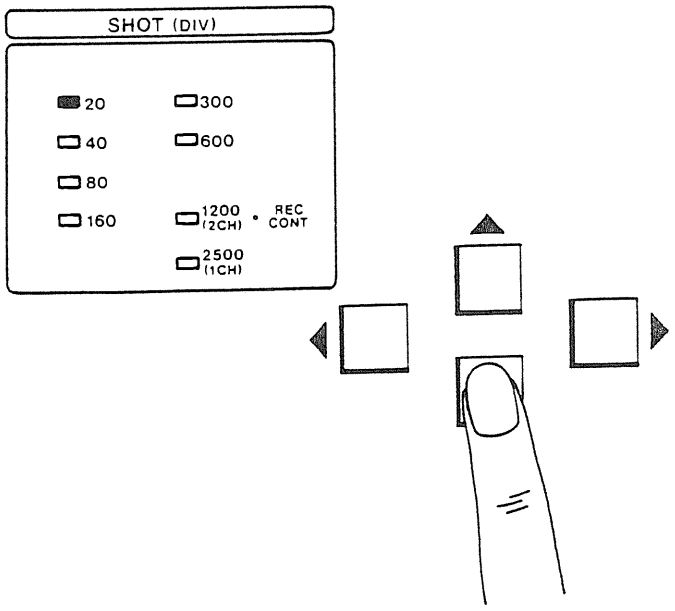
- Selects the function to be used.
- First, press the ◁ or ▷ SELECT key until a FUNCTION lamp starts blinking.
- Then, use the △▽ SELECT keys to make the MEM lamp blink.



② TIME/DIV Setting
(see Chapter 6. TIME AXIS SETTING)

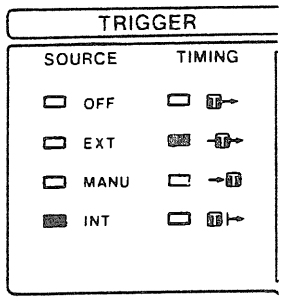
- This procedure sets the time corresponding to one square on the recording paper grid.
- Press the SELECT ▷ key once so that a TIME/DIV lamp starts blinking.
- With the memory recorder function, the time axis can be set within the 100 μs /DIV to 5 s/DIV range. Press the △ key to obtain a faster speed on the time axis, or the ▽ key to reduce speed.
- In this example, let's choose the 200 μs/DIV setting. If the LEDs indicate, for example, 20 ms/DIV, keep the △ key pressed until the 2, × 100 and μs LEDs light up. This sets the time axis to 200 μs/DIV.

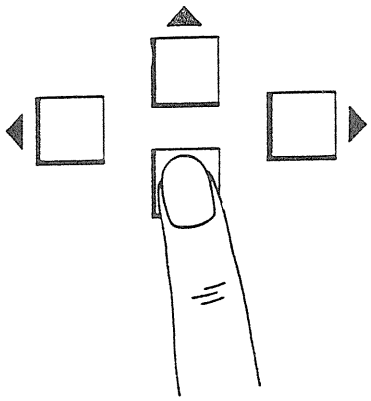
The time axis can also be automatically set by means of the trigger function. After setting the trigger, press the ◁ and ▷ SELECT keys simultaneously. The TIME/DIV indication will go out for an instant, and the time axis will be automatically set. For further details, see 6-1-2. Automatic Time Axis Setting.

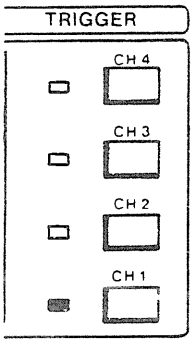


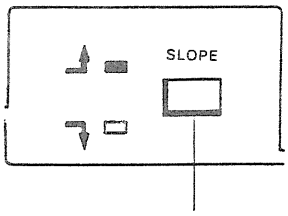
③ SHOT Setting
(see Chapter 7. RECORDING LENGTH SETTING)

- This sets the length of paper to be printed in one recording operation.
- Press the ▷ key so that a SHOT lamp starts blinking.
- We will set recording length to 20 DIV here. Use the △▽ keys so as to make the 20 LED blink.

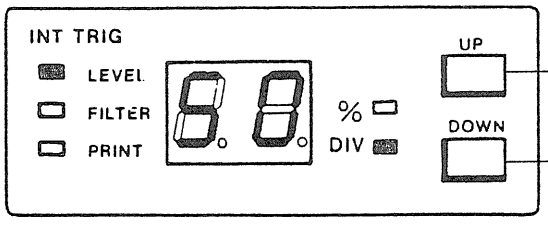








SLOPE key



UP key

DOWN key

④ TRIGGER Setting

(see Chapter 8. USING THE TRIGGER FUNCTION)

- This selects the kind of signal to be used for starting the recording operation, and which portion of the target waveform is to be recorded.
- Press the ▷ key once so that a SOURCE lamp in the TRIGGER section starts blinking.
- In this example we will use an internal trigger. Press the ▽ key to make the INT lamp blink.
- Press the ▷ key once so that a TIMING lamp starts blinking. This section sets the recording time before and after the trigger point.
- Let's record the waveform around the trigger point. Press the △ or ▽ key to make the →T← lamp blink.

⑤ Selecting the Trigger Channel Number

(see 8-4. INTernal Triggers)

- Press the key corresponding to the channel you want to use for triggering.
- Triggering will be applied with the signal input to channel 1, so press the CH1 key.

⑥ Setting Trigger Slope

(see 8-4. INTernal Triggers)

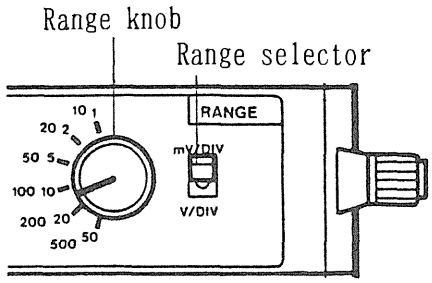
- This determines the direction in which the input signal has to cross the trigger level to trigger operation.
- Press the SLOPE key to toggle between the ↑ and ↓ settings. In this case, make the ↑ lamp blink.

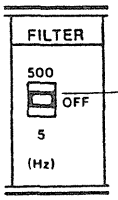
⑦ Setting Trigger Level

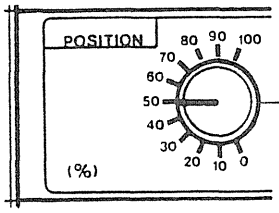
(see 8-4. INTernal Triggers)

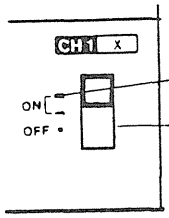
- Use the UP and DOWN keys to adjust the LED display reading to the desired level.
- Trigger level can be set between 0% and 99%.
- Set it to 50%.

Finally, set the input unit POSITION, RANGE and printing switches (see Chapter 5. USING THE INPUT UNIT).









This completes the setting procedure.

① RANGE Setting

- Set the range selector to the mV/DIV (green) position, and the range knob to the 500 (green) position.
- This sets a measurement range of 500 mV/DIV.

② FILTER Setting

- No filtering will be used, so set the FILTER switch to OFF.

③ POSITION Setting

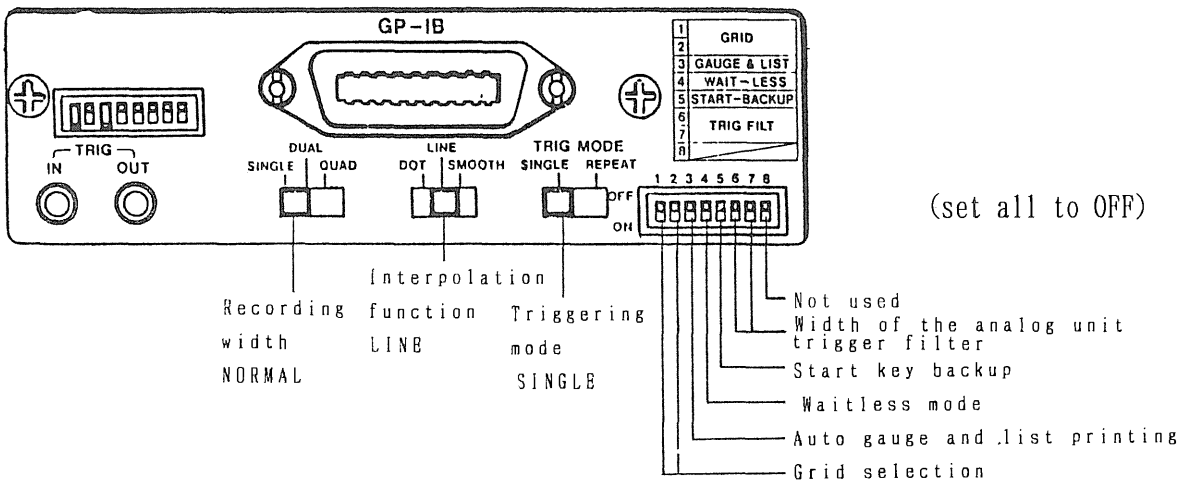
- Set the Zero POSITION knob to 50%.

④ Printing Switch Setting

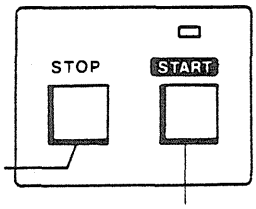
- Set the channel 1 printing switch to the upper ON (WIDE) position. Set the printing switches for the other (unused) channels to OFF.

MEM

Note: Set the rear panel as shown below. For details, refer to Chapter 10. THE REAR PANEL.



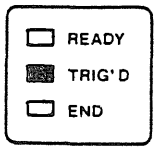
Press the START key.



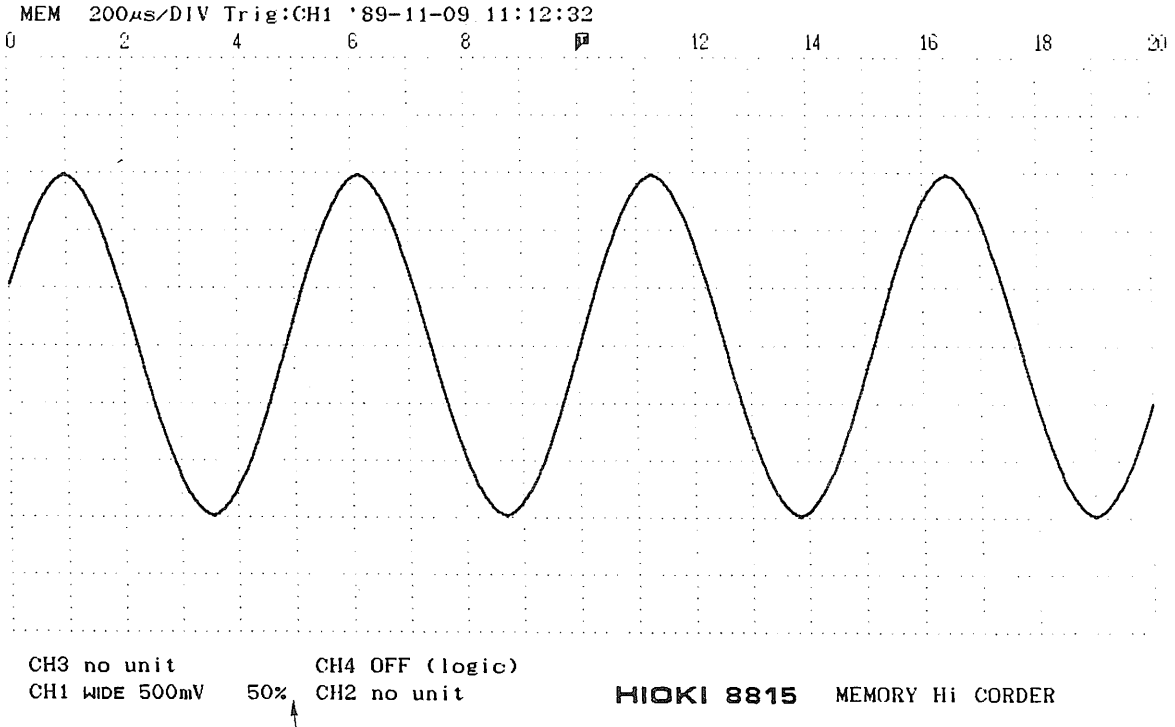
START key

The READY LED will light, remaining lit until triggering is applied.

The TRIG'D LED will be lit during waveform read-in.



When waveform read-in is completed, the END LED will light up. A waveform like the one shown below will be printed out.



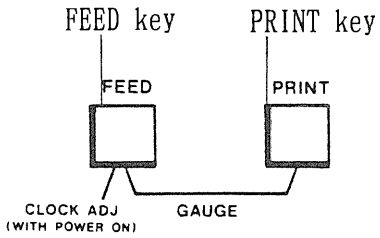
Indicates filter OFF. # is displayed for 500-Hz filtering, and * for 5-Hz filtering.

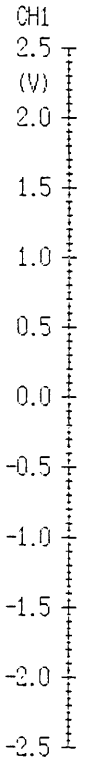
Repeated printing is possible while the END LED is lit.

Note: In case the HU or PE indication blinks on the LED display, the printer is not properly set up. HU (Head Up) indicates that the head-up lever is in the up position, and PE (Paper Empty) that there is no paper loaded. Refer to 3-2. Loading the Recording Paper.

●Gauge Printing

To print the gauge, press the FEED and PRINT keys simultaneously.

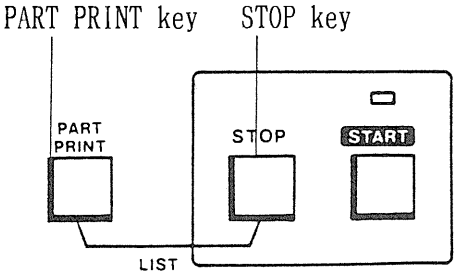




Gauge

●List Printing

To print the lists, press the PART PRINT and STOP keys simultaneously.



*** Set up ***

function.	MEM	Time axis setting
time/DIV.	200μs	
shot lng.	20DIV	Recording length
print .	LINE	Interpolation function
.	×1	Scaling
CH1 WIDE .	500mV	Measurement range
:	50%	Zero position
filter .	OFF	Filter
CH2 OFF .	(logic)	
CH3 OFF .	(logic)	
CH4 OFF .	(logic)	

*** Trigger *** — Trigger conditions

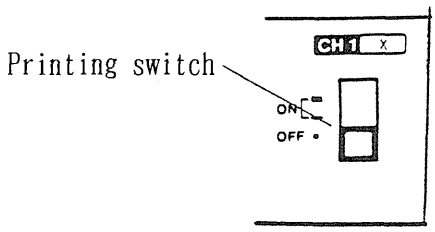
date	.'89-11-10	Trigger time
time	. 11:00:59	
source .	CH1	Trigger source
pre-trig.		Pre-trigger
level .	50%	Trigger level
slope .	↑	Trigger slope
filter .	OFF	Trigger filter
waitless.	OFF	Waitless mode

Lists

MEM

(3) Repeated Printing

A waveform read into the unit can be printed again as many times as desired by pressing the PRINT key. Also, channels to be printed out can be changed with the printing switches on the left side of input units (except in XY_{CONT} mode).

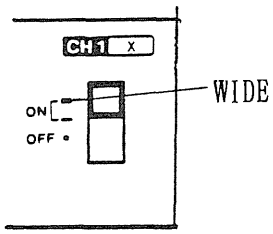


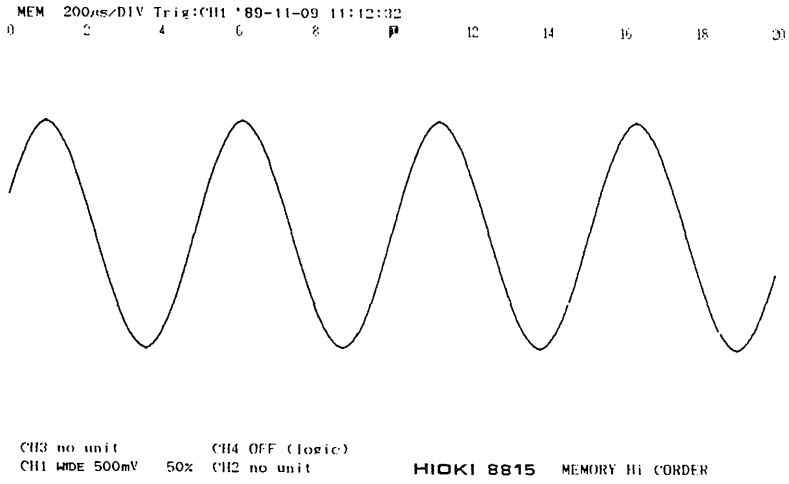
Notes : ● In the memory recorder mode, repeated printing is subjected to shot length limitations.

● Repeated printing is not possible in the XY_{MEM} and XY_{CONT} modes.

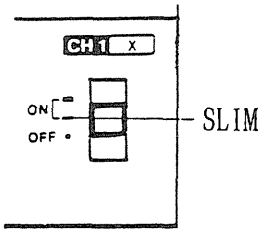
● Line Thickness Selection

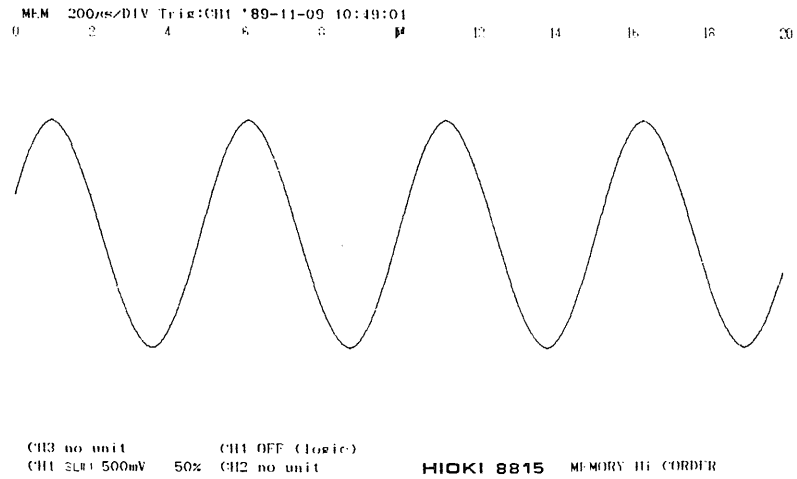
Set the printing switch to the upper (WIDE) position to print the waveform with a thick line.





Set it to the middle (SLIM) position to print the waveform with a thin line.

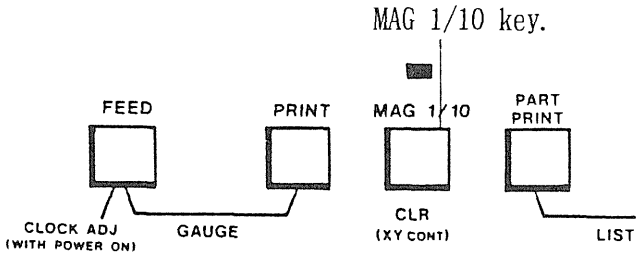




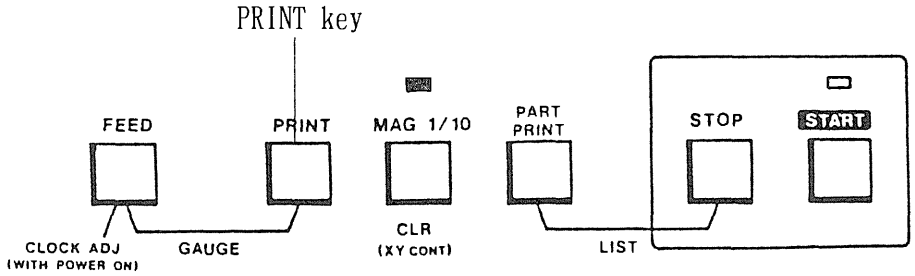
(4) Reduced Printing

Let's try printing the waveform at 1/10 size. This is useful to quickly get a complete picture of the waveform and to save recording paper.

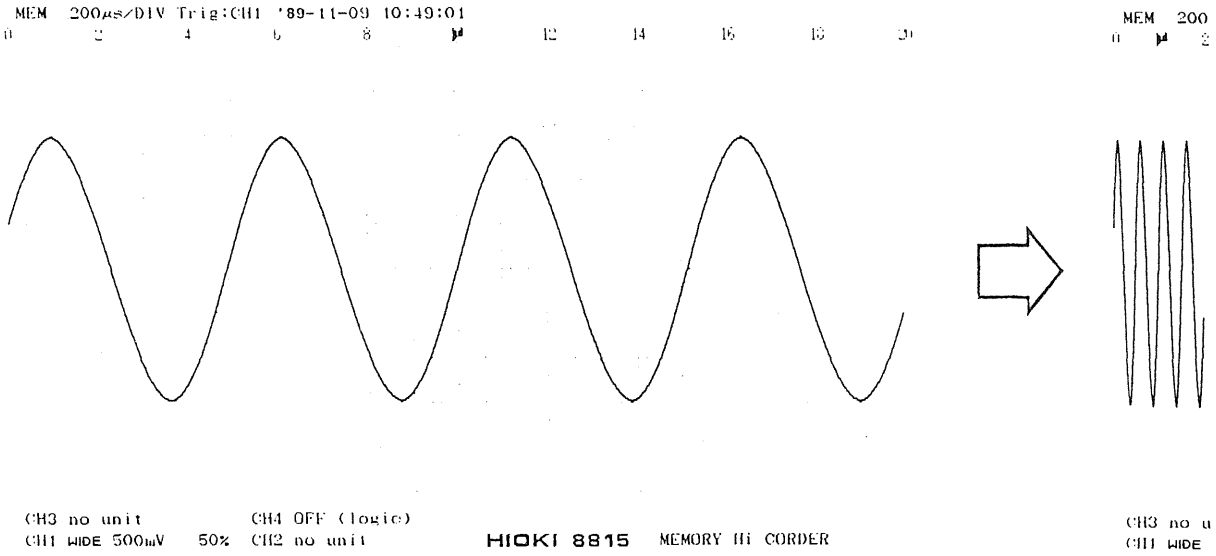
Press the MAG 1/10 key. The LED above the key will light.



Press the PRINT key.



The waveform will be printed out reduced as shown below.



× 1

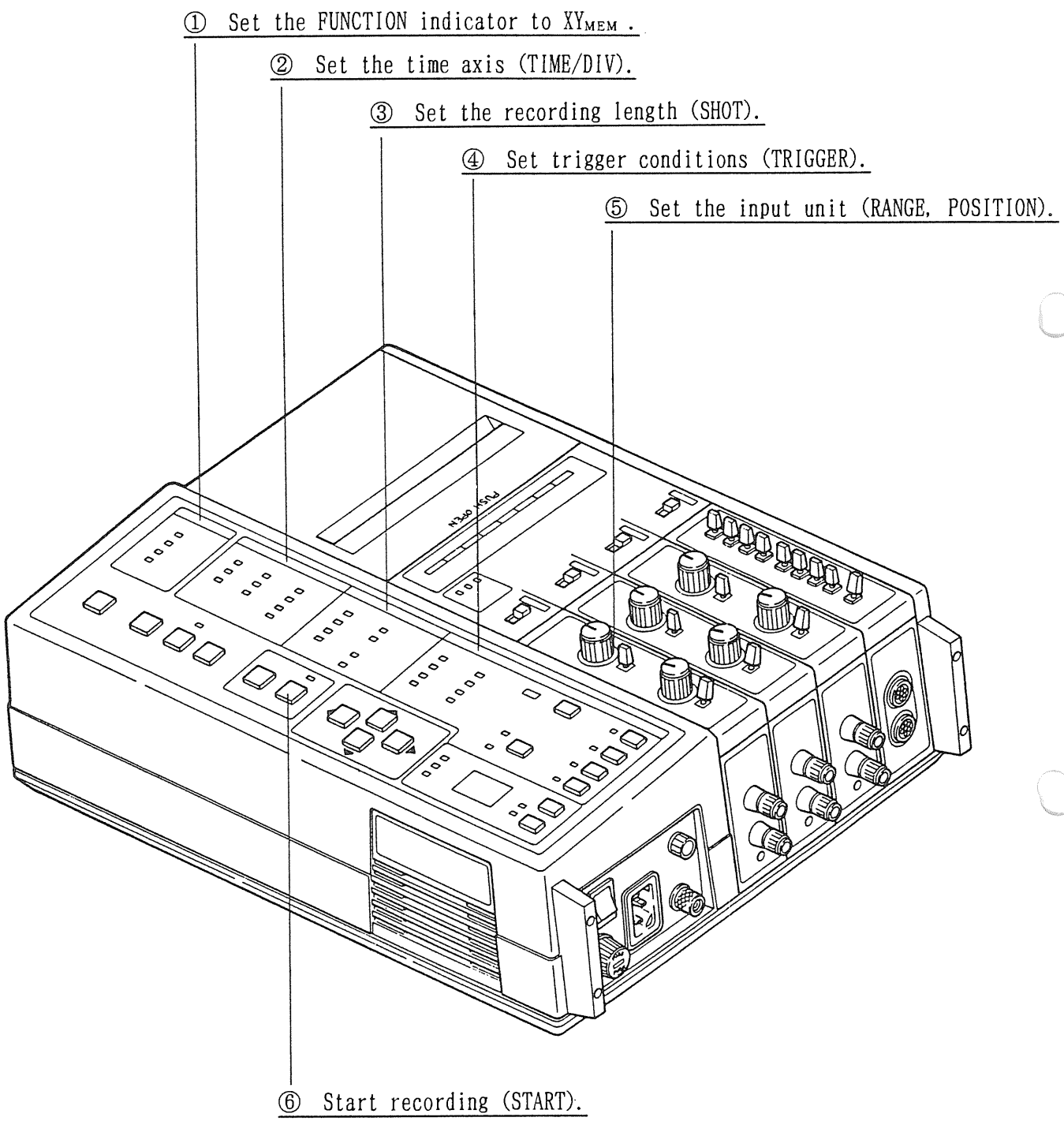
×1/10

MEM

4－4. Using the High-speed XY Recorder Function

4－4－1. Procedures

Basic operation of the high-speed XY recorder function is performed in the following order:



Note: XY composition is not possible unless an analog input unit is mounted for channel 1.

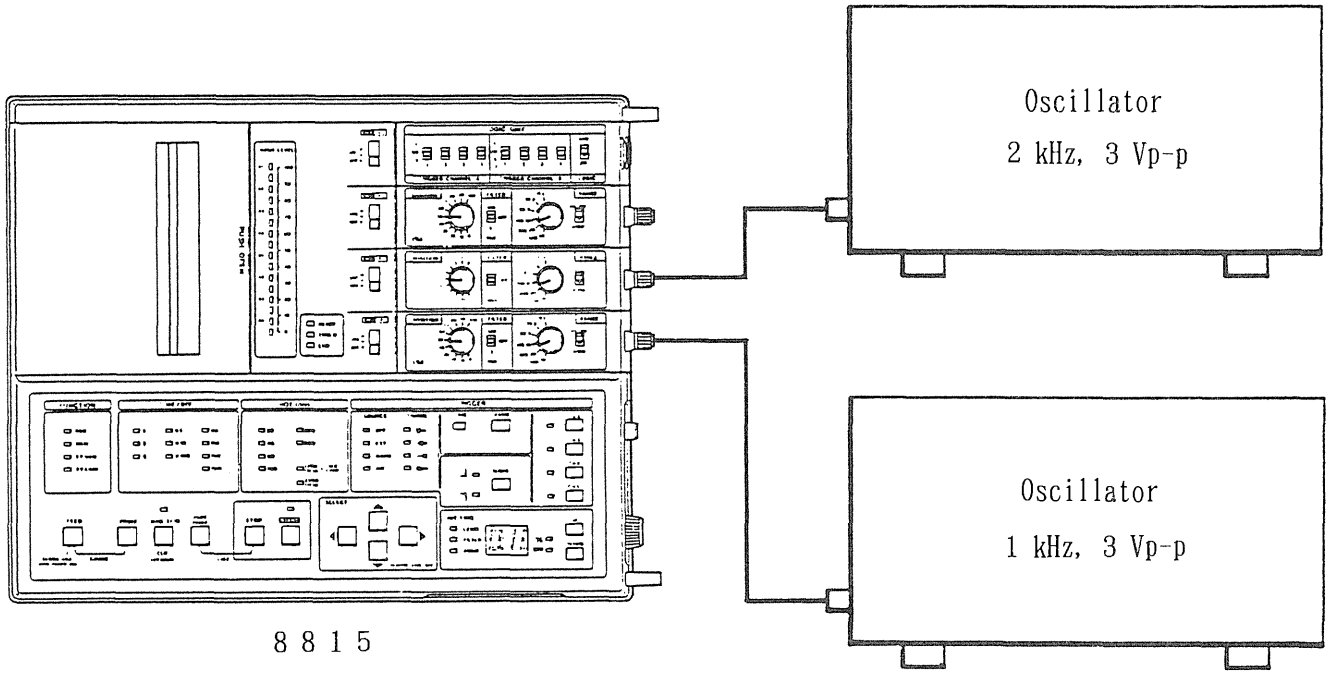
4 − 4 − 2. High-speed XY Recorder Operation Example

Let's apply XY composition to a 1-kHz signal and a 2-kHz signal from two oscillators.

(1) Preparations for Measurement

Connect the oscillators to channels 1 and 2 of the 8815. Adjust the oscillator connected to channel 1 to generate a 1-kHz sine wave, and that connected to channel 2 to generate a 2-kHz sine wave. Set output voltage to 3 Vp-p for both.

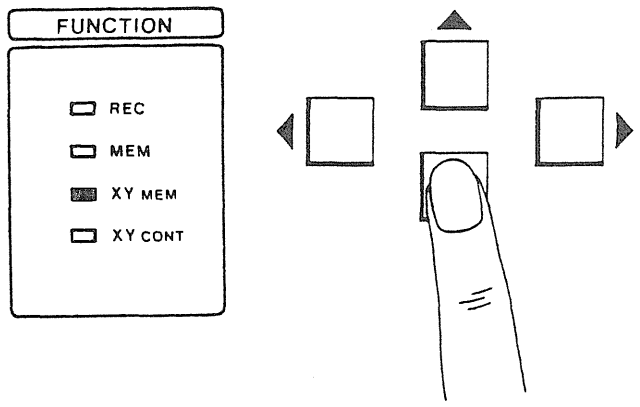
Note: Be sure to match the oscillators' and the analog unit's high and low sides.



8 8 1 5

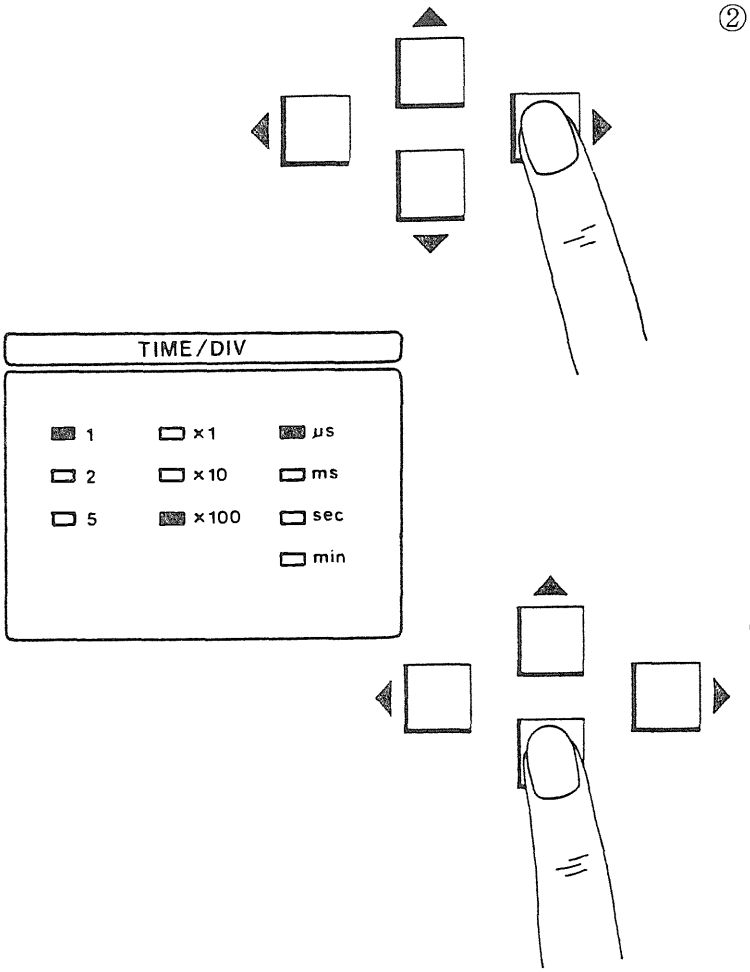
(2) 8815 Setting

After turning the power on, set the LED indicators as follows.



① FUNCTION Setting

- Selects the function to be used.
- First, press the ◁ or ▷ SELECT key until a FUNCTION lamp starts blinking.
- Then, use the △▽ SELECT keys to make the XY_{MEM} lamp blink.



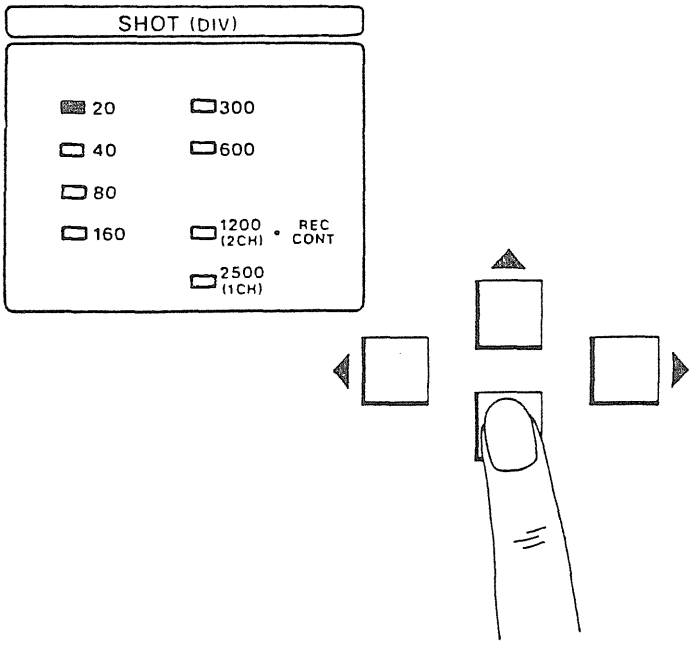
② TIME/DIV Setting

(see Chapter 6. TIME AXIS SETTING)

- This procedure sets the time corresponding to one square on the recording paper grid.
- Press the SELECT ▷ key once so that a TIME/DIV lamp starts blinking.
- With the high-speed XY recorder function, the time axis can be set within the 100 μs/DIV to 5 s/DIV range. Press the △ key to obtain a faster speed on the time axis, or the ▽ key to reduce speed.
- In this example, let's choose the 100 μs/DIV setting. If the LEDs indicate, for example, 20 ms/DIV, keep the △ key pressed until the 1, × 100 and μs LEDs light up. This sets the time axis to 100μs/DIV.

Automatic Time Axis Setting

The time axis can also be automatically set by means of the trigger function. After setting the trigger, press the ◁ and ▷ SELECT keys simultaneously. The TIME/DIV indication will go out for an instant, and the time axis will be automatically set. For further details, see 6-1-2 Automatic Time Axis Setting.

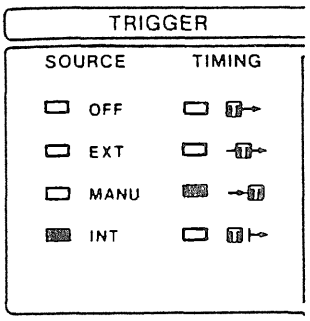


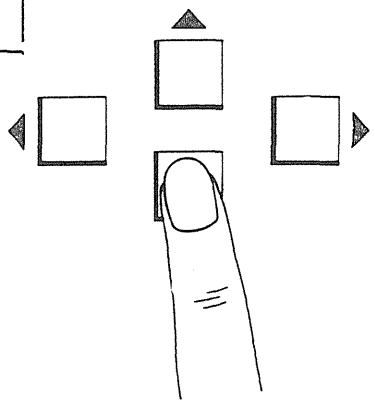
③ SHOT Setting

(see Chapter 7. RECORDING LENGTH SETTING)

- This sets the length of paper to be printed in one recording operation.
- Press the ▷ key so that a SHOT lamp starts blinking.
- We will set recording length to 20 DIV here. Use the △▽ keys so as to make the 20 LED blink.

Note: The 2500 DIV setting cannot be used in the XY_{MEM} mode.

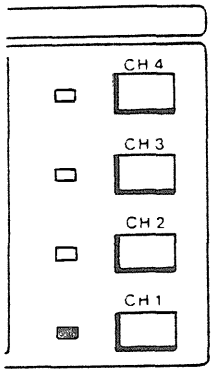




④ TRIGGER Setting

(see Chapter 8. USING THE TRIGGER FUNCTION)

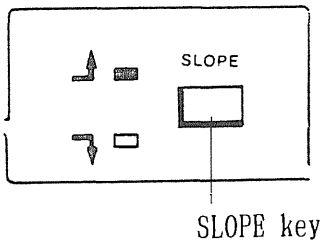
- This selects the kind of signal to be used for starting the recording operation, and which portion of the target waveform is to be recorded.
- Press the ▷ key once so that a SOURCE lamp in the TRIGGER section starts blinking.
- In this example we will use an internal trigger. Press the ▽ key to make the INT lamp blink.
- Press the ▷ key once so that a TIMING lamp starts blinking. This section sets the recording time before and after the trigger point.
- Let's record the waveform from a point prior to the trigger point. Press the △ or ▽ key to make the →T lamp blink.



⑤ Selecting the Trigger Channel Number

(see 8-4. INTernal Triggers)

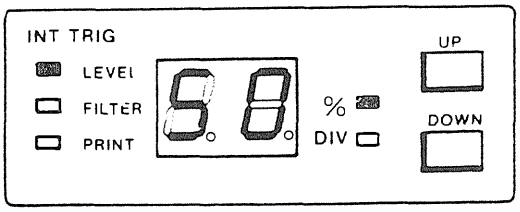
- Press the key corresponding to the channel you want to use for triggering.
- Triggering will be applied with the signal input to channel 2, so press the CH2 key.



⑥ Setting Trigger Slope

(see 8-4. INTernal Triggers)

- This determines the direction in which the input signal has to cross the trigger level to trigger operation.
- Press the SLOPE key to toggle between the ⤴ and ⤵ settings. In this case, make the ⤴ lamp blink.

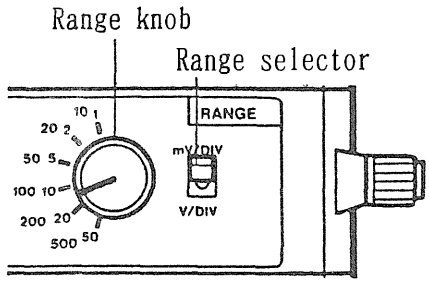


⑦ Setting Trigger Level

(see 8-4. INTernal Triggers)

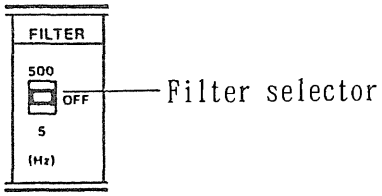
- Use the UP and DOWN keys to adjust the LED display reading to the desired level.
- Trigger level can be set between 0% and 99%.
- Set it to 50%.

Finally, set the input unit POSITION, RANGE and printing switches. Choose the same settings for both channels 1 and 2.



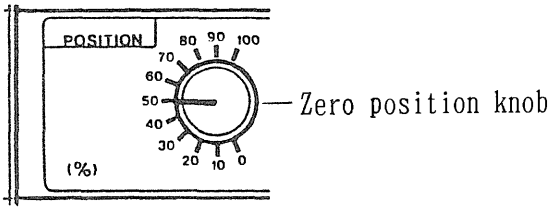
① RANGE Setting

- Set the range selector to the mV/DIV (green) position, and the range knob to the 500 (green) position.
- This sets a measurement range of 500 mV/DIV.



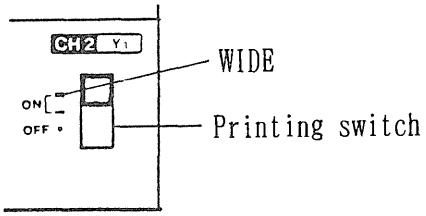
② FILTER Setting

- No filtering will be used, so set the FILTER switch to OFF.



③ POSITION Setting

- Set the Zero POSITION knob to 50%.

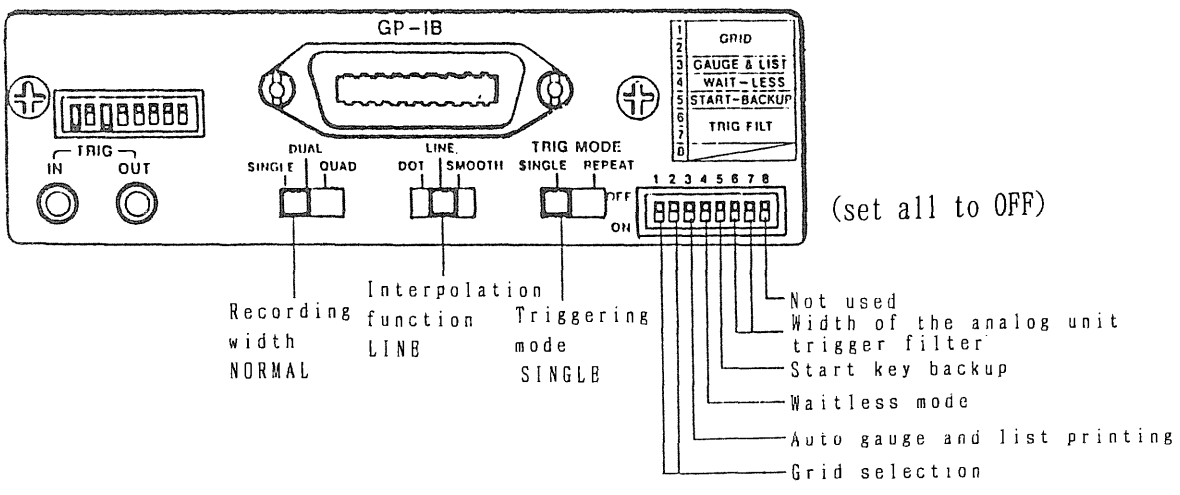


④ Printing Switch Setting

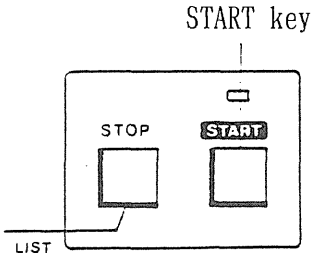
- Set the channel 2 printing switch to the upper ON (WIDE) position. Set the printing switches for the unused channels (3 and 4) to OFF. The position of the channel 1 printing switch is immaterial.

This completes the setting procedure.

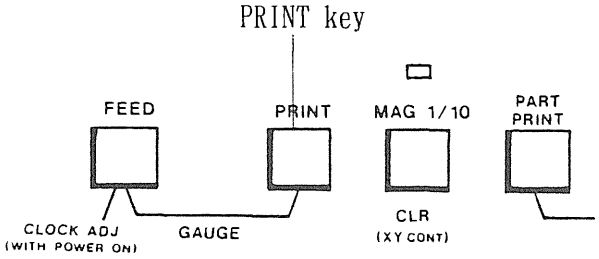
Note: Set the rear panel as shown below. For details, refer to Chapter 10. THE REAR PANEL.



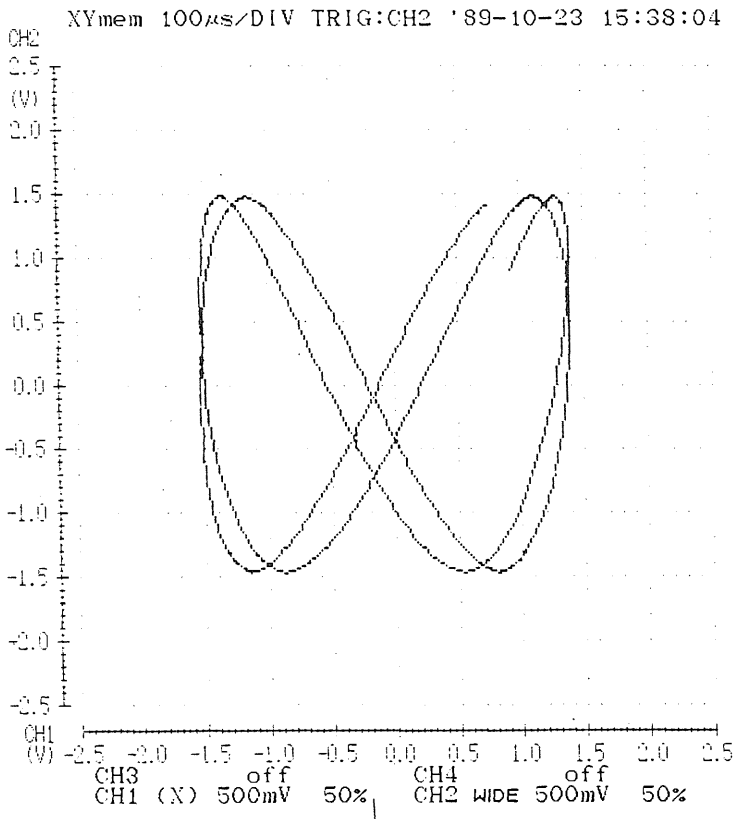
Press the START key.



Press the PRINT key.



A waveform like the one shown below will be printed out.

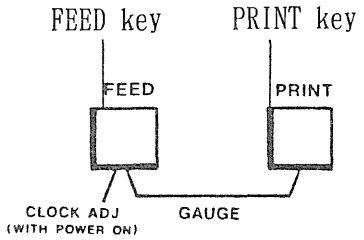


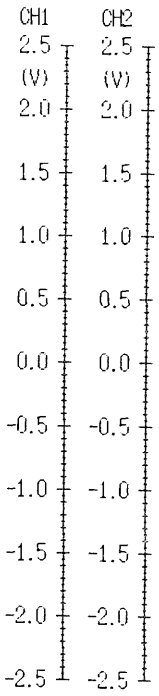
Indicates filter OFF. # is displayed for 500-Hz filtering, and * for 5-Hz filtering.

Note: In case the HU or PE indication blinks on the LED display, the printer is not properly set up. HU (Head Up) indicates that the head-up lever is in the up position, and PE (Paper Empty) that there is no paper loaded. Refer to 3-2. Loading the Recording Paper.

● Gauge Printing

To print the gauge, press the FEED and PRINT keys simultaneously.

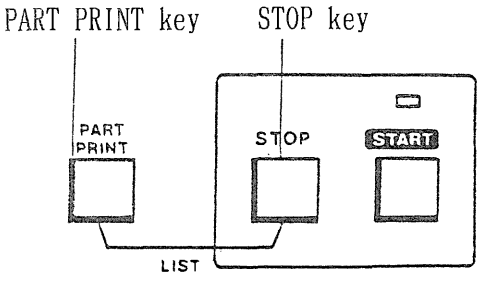


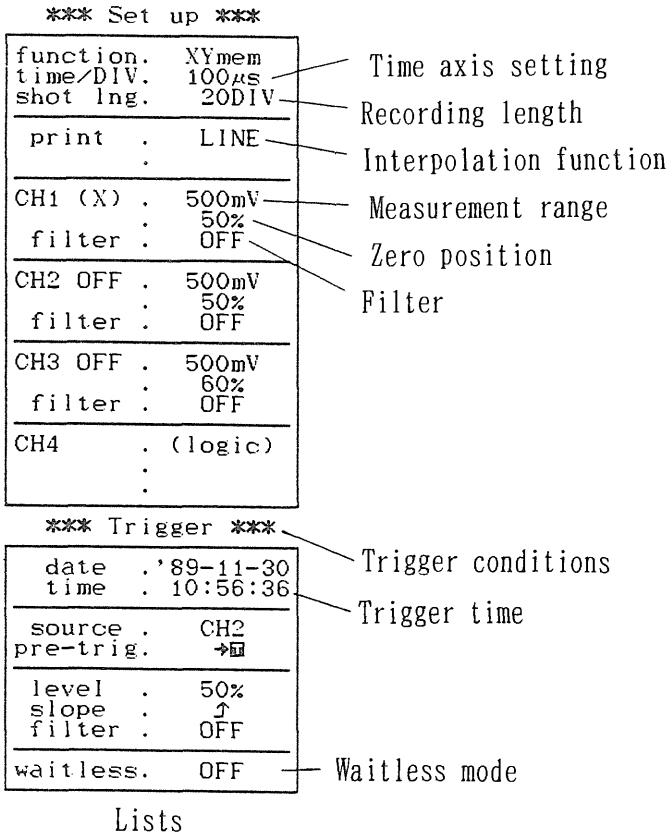


Gauge

● List Printing

To print the lists, press the PART PRINT and STOP keys simultaneously.



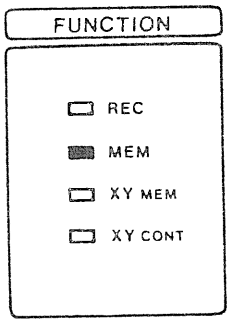


Lists

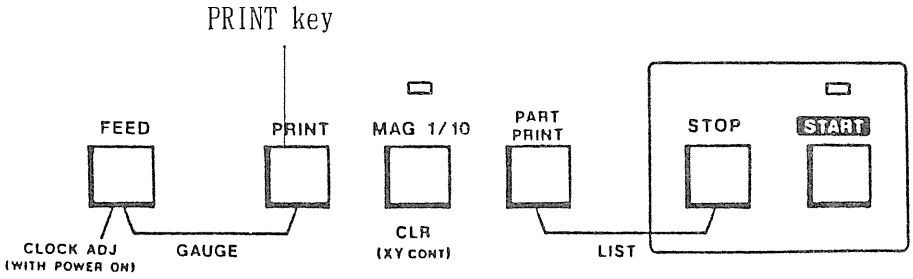
(3) Conversion into a Time-axis Waveform

Time-axis waveforms for each channel can be obtained by setting the memory recorder mode for printing.

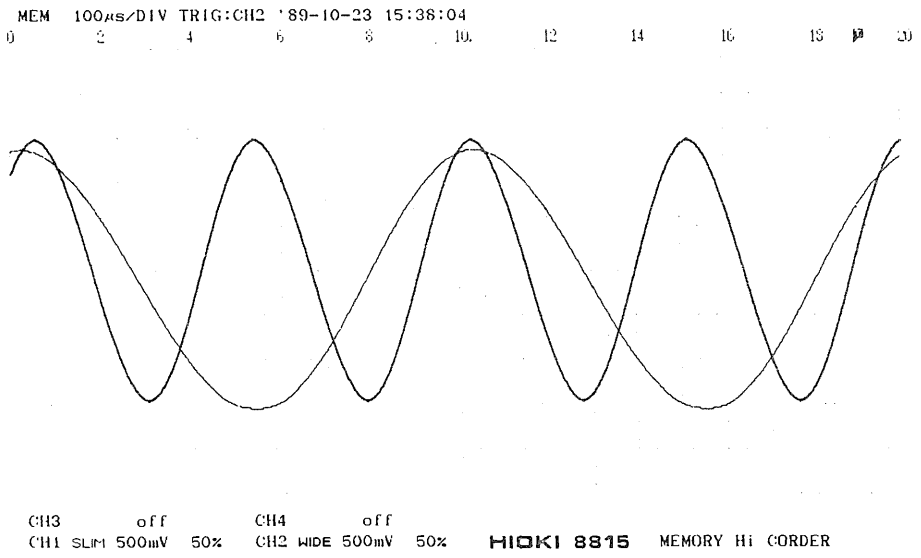
① Set the FUNCTION indicator to MEM.



② Press the PRINT key.



Time-axis waveforms will be printed as shown below.

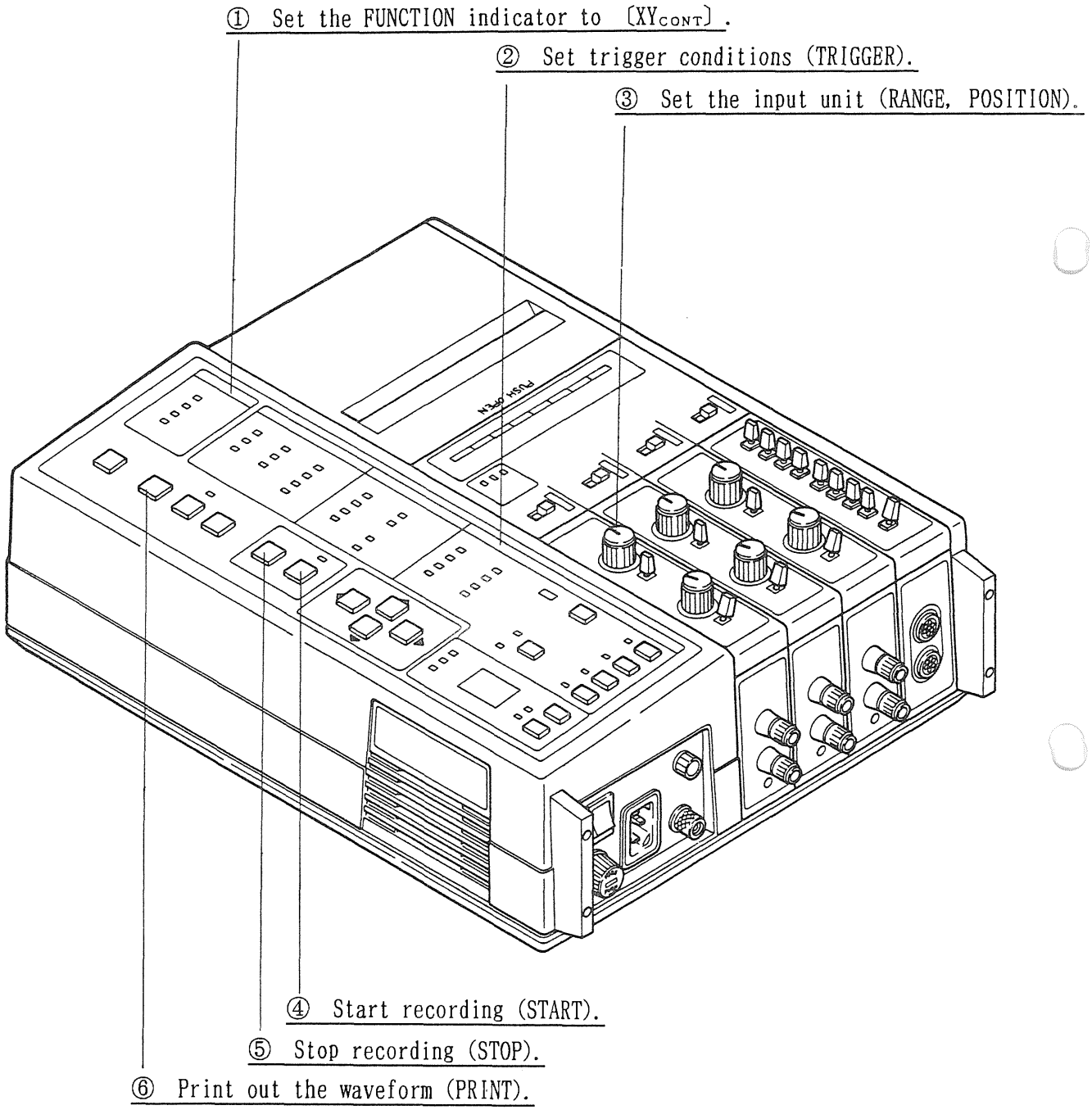


Note: Waveforms read in the MEM mode can also be turned into XY waveforms.

4－5. Using the Continuous X-Y Recorder Function

4－5－1. Procedures

Basic operation of the continuous XY recorder function is performed in the following order:



Note: XY composition is not possible unless an analog input unit is mounted for channel 1.

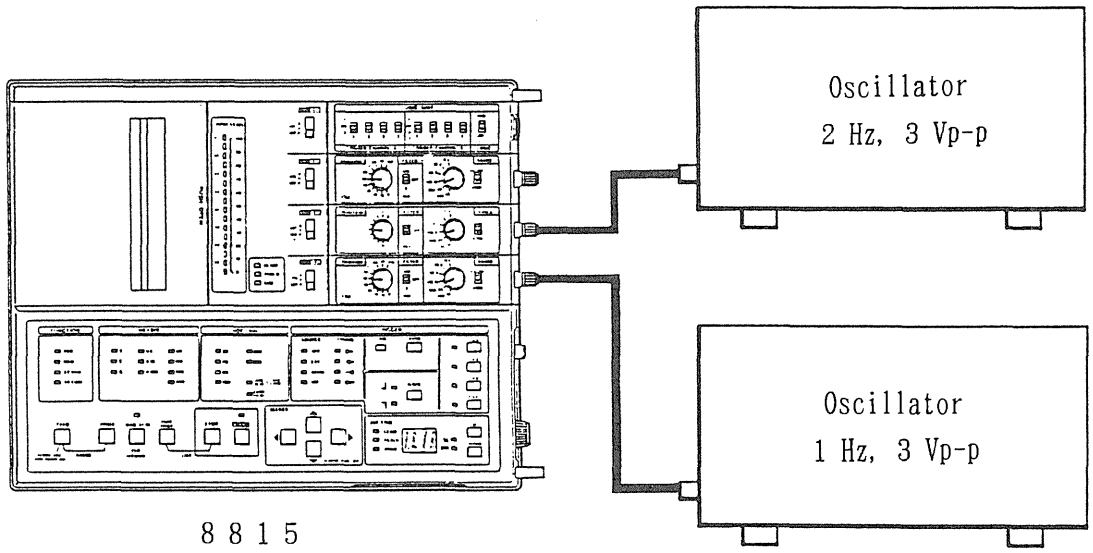
4－5－2. Continuous XY Recorder Operation Example

Let's apply XY composition to a 1-Hz signal and a 2-Hz signal from two oscillators.

(1) Preparations for Measurement

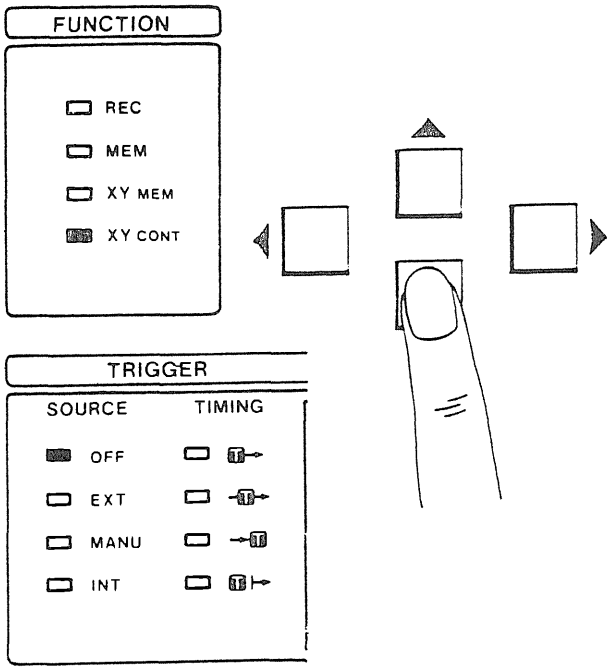
Connect the oscillators to channels 1 and 2 of the 8815. Adjust the oscillator connected to channel 1 to generate a 1-Hz sine wave, and that connected to channel 2 to generate a 2-Hz sine wave. Set output voltage to 3 Vp-p for both.

Note: Be sure to match the oscillators' and the analog unit's high and low sides.



(2) 8815 Setting

After turning the power on, set the LED indicators as follows.



① FUNCTION Setting

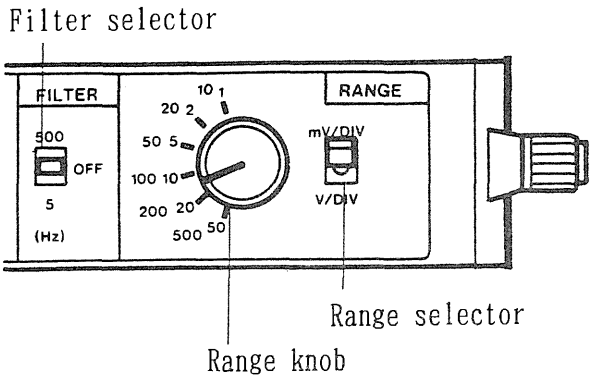
- Selects the function to be used.
- First, press the ◁ or ▷ SELECT key until a FUNCTION lamp starts blinking.
- Then, use the ▽ SELECT keys to make the XY_{CONT} lamp blink.

② TRIGGER Setting

- Press the ▷ key once so that a SOURCE lamp in the TRIGGER section starts blinking. No triggering will be applied in this example, so make the OFF lamp blink.

Note: With the XY_{CONT} function, there is no need to set the TIME/DIV and SHOT parameters. Therefore, the corresponding LEDs do not light.

Finally, set the input unit POSITION, RANGE and printing switches. Choose the same settings for both channels 1 and 2.

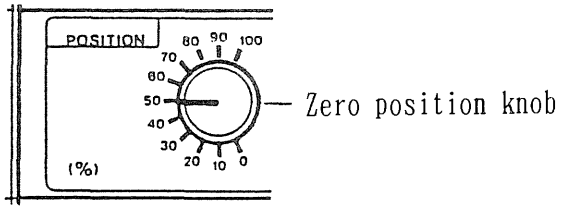


① RANGE Setting

- Set the range selector to the mV/DIV (green) position, and the range knob to the 500 (green) position.
- This sets a measurement range of 500 mV/DIV.

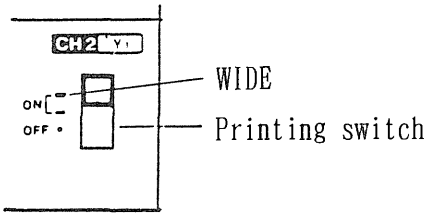
② FILTER Setting

- No filtering will be used, so set the FILTER switch to OFF.



③ POSITION Setting

- Set the Zero POSITION knob to 50%.

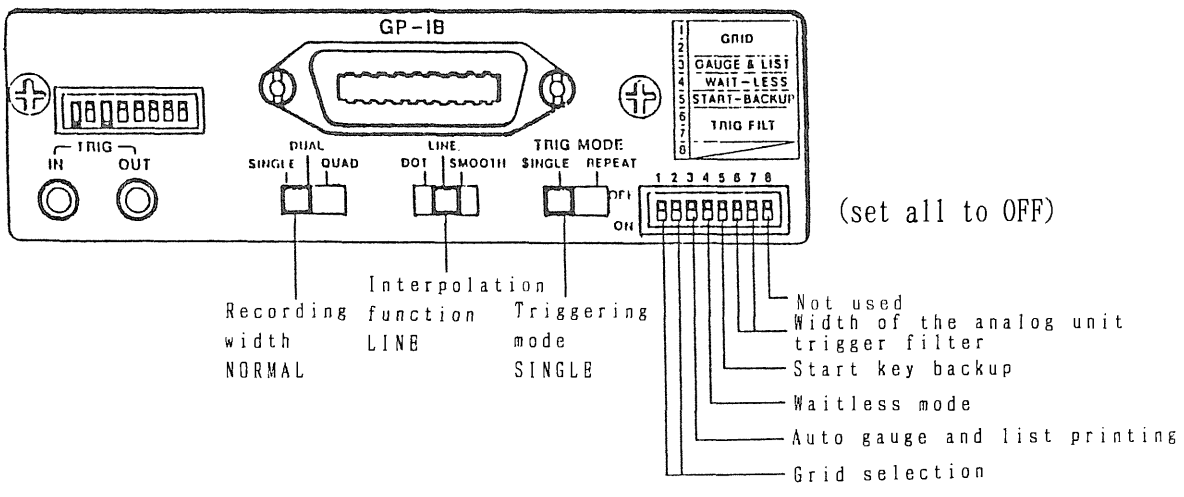


④ Printing Switch Setting

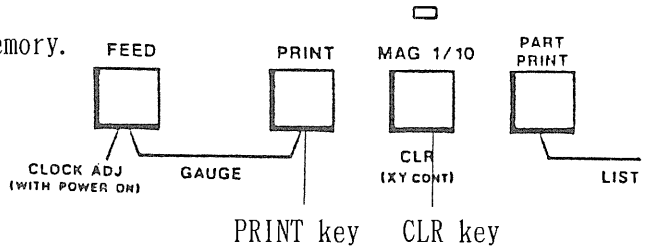
Set the channel 2 printing switch to the upper ON (WIDE) position. Set the printing switches for the unused channels (3 and 4) to OFF. The position of the channel 1 printing switch is immaterial.

This completes the setting procedure.

Note: Set the rear panel as shown below. For details, refer to Chapter 10. THE REAR PANEL.

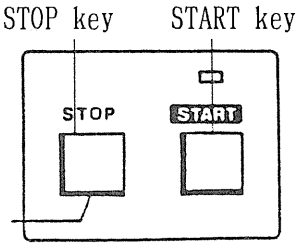


Press the CLR key to clear the memory.

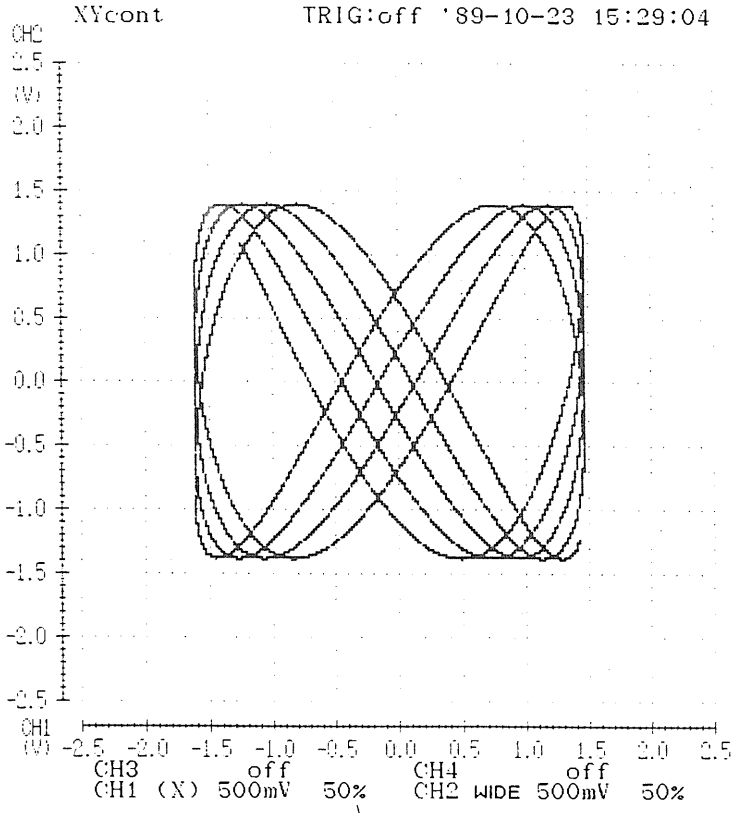


Press the START key to start recording.

Wait for about 3 seconds, then press the STOP key to stop recording.



Press the PRINT key, and a waveform like the one shown below will be printed out.

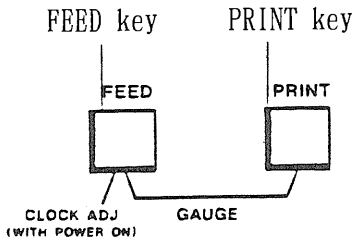


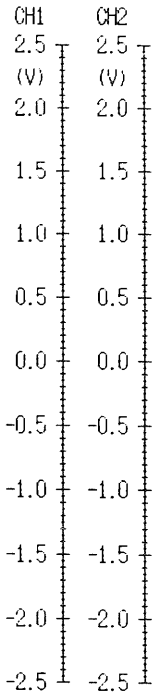
Indicates filter OFF. # is displayed for 500-Hz filtering, and * for 5-Hz filtering.

Note: In case the HU or PE indication blinks on the LED display, the printer is not properly set up. HU (Head Up) indicates that the head-up lever is in the up position, and PE (Paper Empty) that there is no paper loaded. Refer to 3-2. Loading the Recording Paper.

●Gauge Printing

To print the gauge, press the FEED and PRINT keys simultaneously.

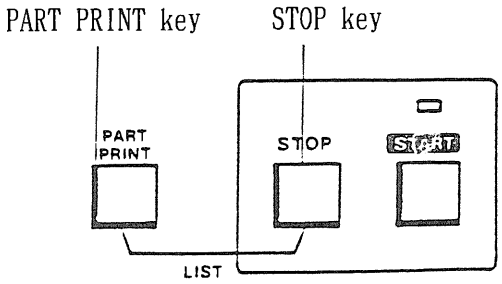




Gauge

●List Printing

To print the lists, press the PART PRINT and STOP keys simultaneously.




```
*** Set up ***
function.   XYcont
          .
          .
print     .   LINE
          .
CH1 (X)   .   500mV
          .    50%
filter    .   OFF
CH2 WIDE  .   500mV
          .    50%
filter    .   OFF
CH3 OFF   .   500mV
          .    60%
filter    .   OFF
CH4       .  (logic)
          .
          .
*** Trigger ***
date      .'89-11-30
time      .  11:00:19
source    .   OFF
timing    .    -
level     .    -
slope     .    -
filter    .    -
waitless.      -
```

Interpolation function
Measurement range
Zero position
Filter
Trigger conditions
Trigger time

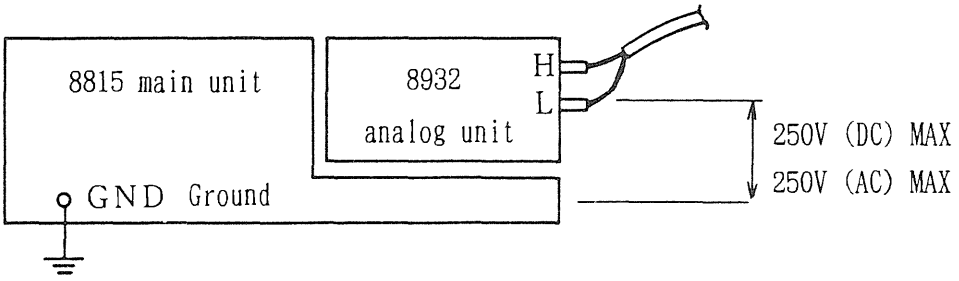
Lists

CHAPTER 5

USING THE INPUT UNIT

⚠ WARNING

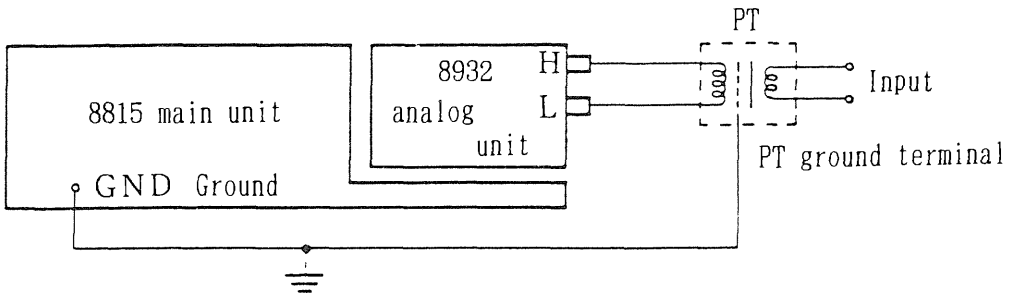
- Be sure to insert the input plug completely to avoid the danger of an electric shock.
- The 8932 input and output are mutually insulated.
- The maximum floating voltage between the input unit and the 8815 case, or between two analog units, is 250 V AC/DC. Take care to avoid voltages over this limit.
- The maximum floating voltage does not change even when an attenuator, etc. is used at the input.



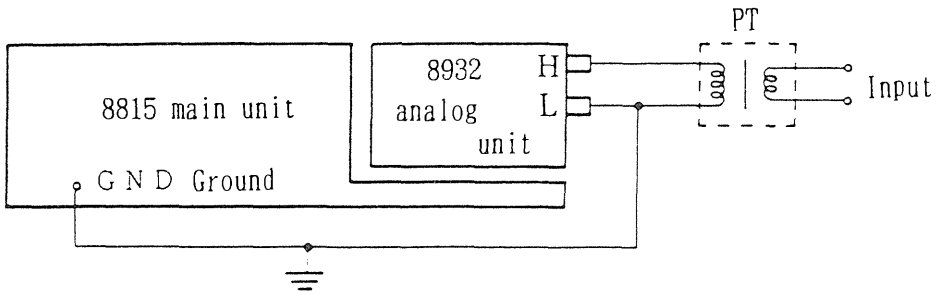
⚠ WARNING

- The maximum permissible input voltage for the 8932 is 500 V (AC+DC peak). Take care to avoid voltage levels above this limit.

- When using a PT for measurement of AC power lines, etc., be sure to ground it.

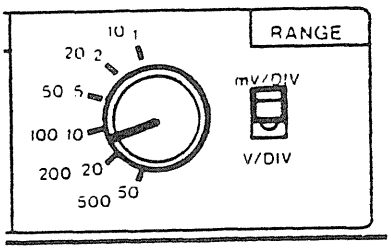


(a) PT with ground terminal



(b) PT without ground terminal

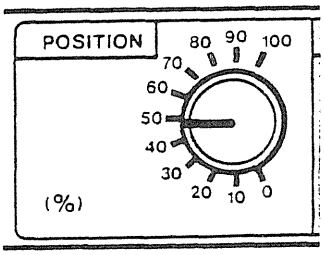
5 — 1 — 1. Measurement RANGE



Sets the voltage corresponding to one square (1 division) on the recording paper voltage axis. Since the voltage axis is ten-squares long, the maximum voltage that can be recorded is equal to ten times this setting (100 mV to 500 V).

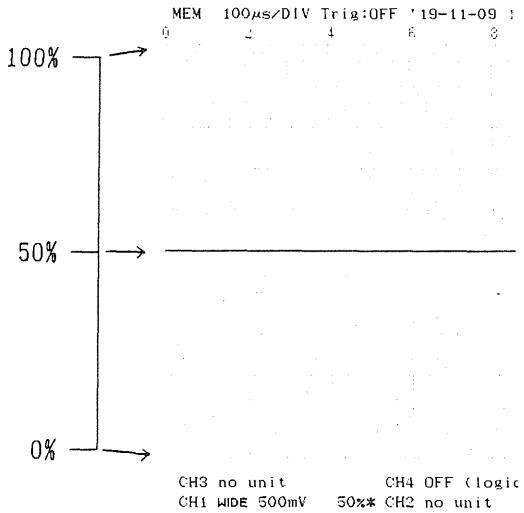
[Setting Range]
10 mV to 50 V (12 settings)

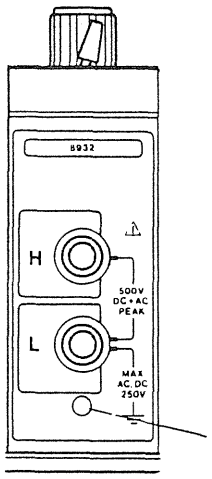
5 — 1 — 2. Zero POSITION



Selects the 0 V position on the recording paper among 11 settings on the paper dotted lines.

[Setting Range]
0% to 100% (11 settings)

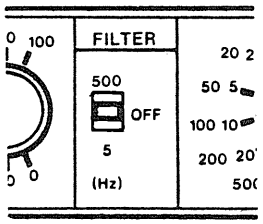




Zero position fine adjustment knob

In case the zero position does not coincide with any of the above settings, try correcting it with the fine adjustment knob. If this does not work, contact your dealer.

5－1－3. FILTER



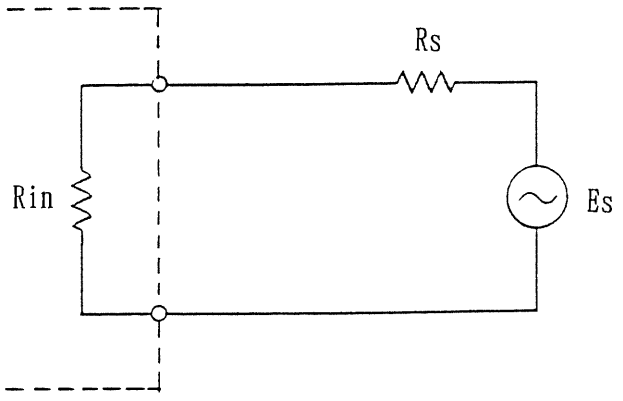
The frequency band is limited by the built-in low-pass filter .
Attenuation gradient: -6 dB/oct.
Cutoff frequency: Approx. 5 Hz/500 Hz

This filter is effective for preventing the following phenomena:

- Thickening of the recording line caused by signal ripple components and noise during level recording in the recorder mode, because of the use of high-speed sampling and a high-frequency amplifier.
- Thickening of the recording line due to ripple contained in the output from a transducer, etc.

5－1－4. Measurement Error Due to Source Impedance

- Source impedance is not a problem when sufficiently low compared to the unit's input impedance. It affects measurement, however, if it is above a certain level.



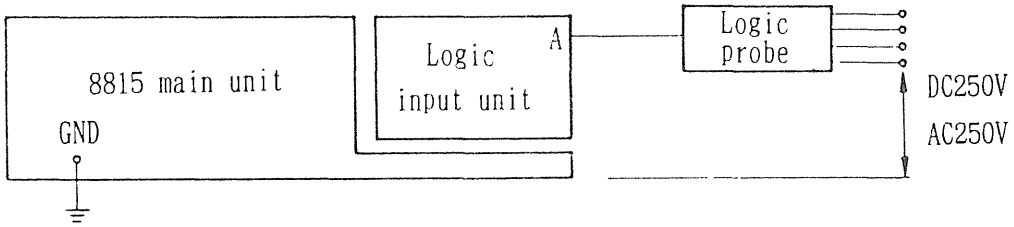
Es : Signal voltage
Rs : Source impedance
Rin : Input impedance

$$\text{Measurement error} = Es\left(1 - \frac{Rin}{Rs + Rin}\right)$$

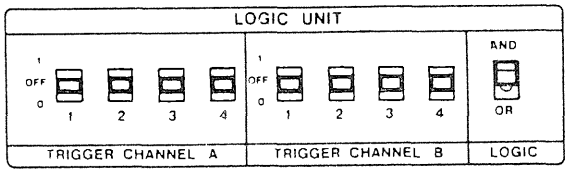
〔Example〕 Since the unit's input impedance is 1 MΩ, a source impedance of 1 kΩ will cause an error of approx. 0.1%.

⚠ WARNING

- Each 8815 input unit is floating independently.
- The maximum floating voltage between the 8815 case and the probe input, or between a probe input and an analog input terminal, is 250 V AC/DC. Take care to avoid voltages over this limit.
- Up to two probes can be connected to each logic unit, but there is not mutual floating between probes (common ground).



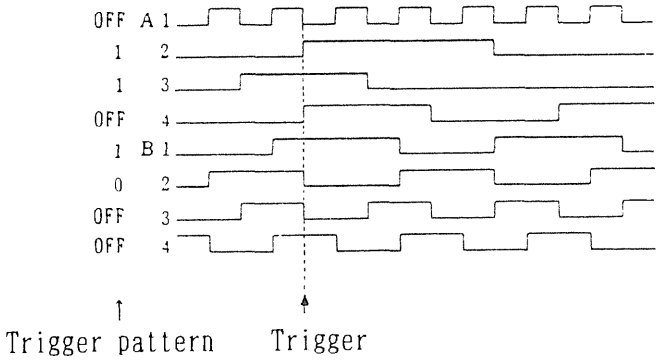
5 – 2 – 1. TRIGGER CHANNEL



Used when triggering the logic unit. It consists of a logic pattern which is compared to the input signal.

Note: The starting point setting is valid throughout the start operation, and cannot be changed halfway.

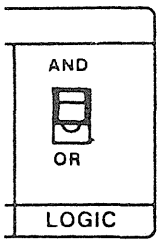
"1" indicates "high", "0" indicates "low", and "OFF" indicates "bypass".



Recognition of "1" and "0" is performed with a logic probe for signal detection.
The actual values of high and low levels depend on the probe specifications.

Notes:
- Set to OFF all unused channels. Recognition is performed even if there is no probe connected.
- In case the input signal already matches trigger conditions at the starting point, recording will not be triggered unless the signal is deviated from trigger conditions once.

5－2－2. LOGIC AND/OR

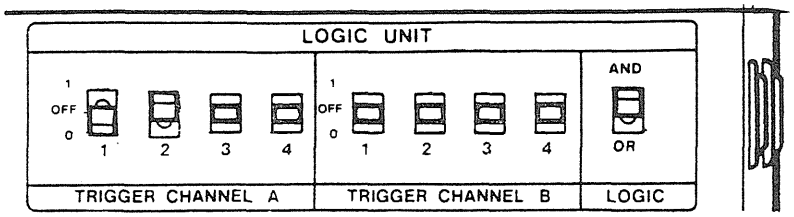


Use when triggering the logic unit. A logic AND or OR operation can be applied between the selected TRIGGER CHANNELs.

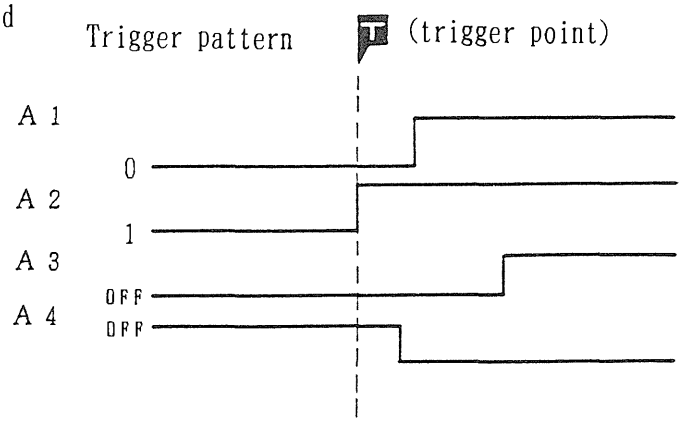
Notes: ● In case the input signal already matches trigger conditions at the starting point, recording will not be triggered unless the signal is deviated from trigger conditions once.

● The starting point setting is valid throughout the start operation, and cannot be changed halfway.

Example: Probe A channel "0"
Probe B channel "1"
Other channels "OFF"

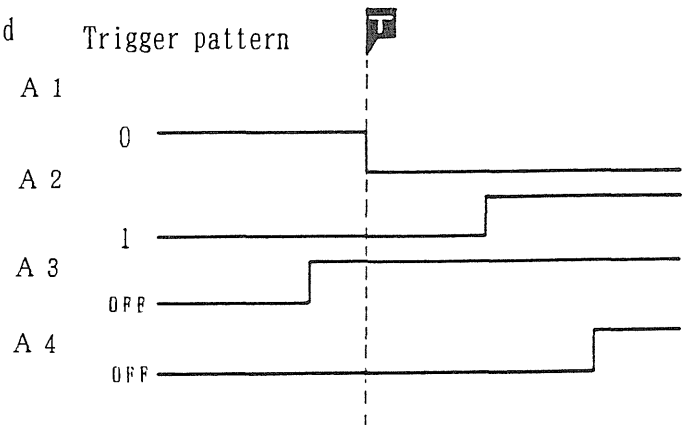


When AND is applied



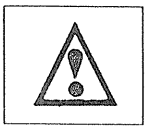
Operation is triggered when all signals match the trigger pattern.

When OR is applied



Operation is triggered when at least one signal matches the trigger pattern.

5 − 3. Logic Probes



5 − 3 − 1. Using the 9306 Logic Probe

This probe can be switched between voltage input and contact input, allowing for a wide range of applications from electronic circuits to relay operation timing measurement.

CAUTION

- Two 9306 probes can be connected to one logic unit, but they will have a common ground.
- Please read the 9306 instruction manual thoroughly before use.

5 − 3 − 2. Using the 9307 Line Logic Probe

Allows for detection of AC line voltage on/off switching. High voltages up to 250 V can be input, making it suitable for relay sequencer timing measurement, etc.

CAUTION

- Input channels are insulated, both mutually and from the outputs. Do not apply voltages over the maximum floating voltage.
- Please read the 9307 instruction manual thoroughly before use.

5 − 3 − 3. Using the 9308 Line Dip Detector

Detects transient drops in commercial (AC 100/120 V) line voltage. Dip level can be set to either approx. 80% or 90%.

CAUTION

- The low clip (black) is common with the input clip (black).
- An 8932 input unit is required.
- Please read the 9308 instruction manual thoroughly before use.

5－4. Unit Replacement

The input unit removal method will be explained next. For unit installation, reverse this procedure.

① Remove input cords from all input units.

② Turn the main unit power off and unplug its power cord.

CAUTION

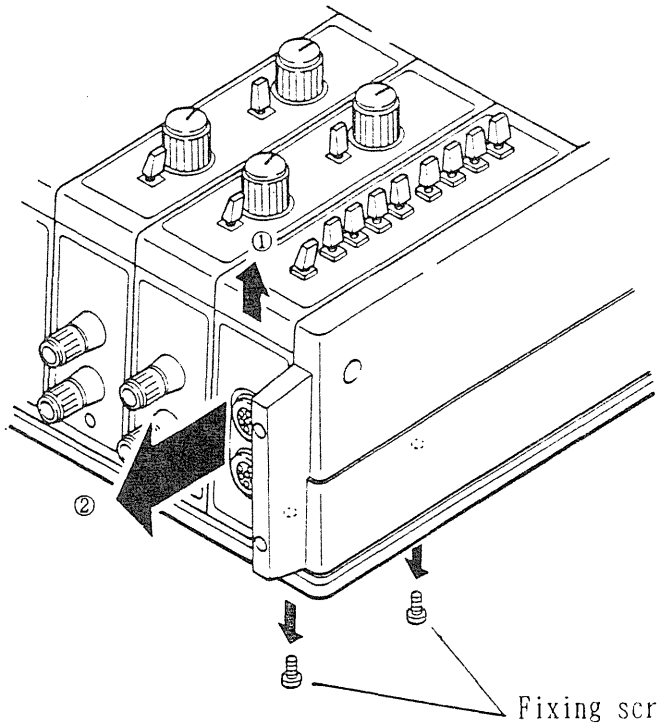
Always confirm that input cords are disconnected and turn power off before detaching the input unit.

③ Remove the two fixing screws securing the input unit with a Phillips-head screwdriver as shown in the figure.

④ Push the input unit up a little in the direction of arrow ①, then put your fingers in the gap between the input and main units and pull in the direction of arrow ② to remove.

CAUTION

When pulling the input unit off, do not force the knobs and switches on its top panel.



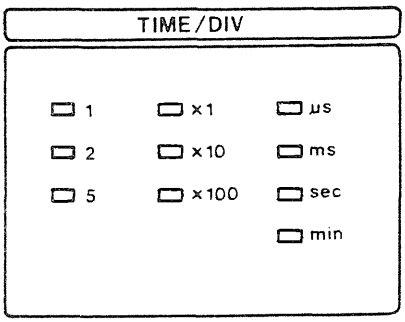
CAUTION

- Never use the recorder with an input unit removed.
- If the recorder has to be used with an input unit removed, install a 9508 blank panel (optional accessory) in its place.

CHAPTER 6

TIME AXIS SETTING

6. TIME AXIS SETTING



The TIME/DIV indicator shows the time corresponding to one square (1 division) in the time-axis direction.

Note: This setting is not necessary in the XY_{CONT} mode.

6 − 1. Memory Recorder and High-speed XY Recorder Functions

Setting is possible in 15 steps from 100 μs to 5 s/DIV. In the XY $_{MEM}$ mode, this determines the sampling interval.

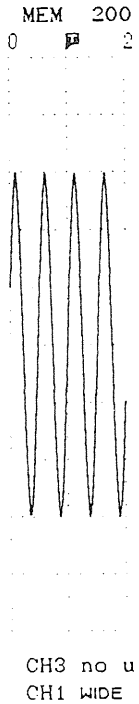
- **Calculating the Sampling Interval**

  50 data units are read per square (division). Therefore, the sampling interval can be calculated as follows:

  Sampling interval = TIME/DIV setting/50

Notes: • In the reduction mode (MAG1/10), time per square is ten times longer.
• Take care of aliasing distortion when recording high-frequency waveforms.

×1/10 chart
Shot length: 20 DIV



6－1－1. Automatic Time Axis Setting

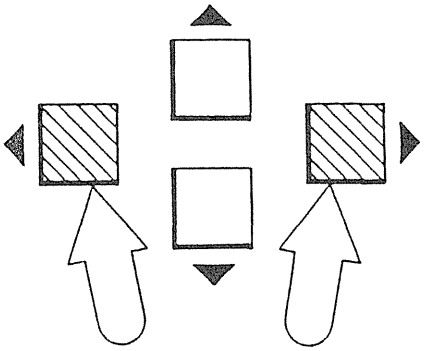
The memory recorder and high-speed XY recorder functions allow for automatic setting of the time axis so that 1 to 2.5 cycles of the waveform are recorded on 10 divisions.

Setting Procedure

① Set a trigger for the signal to be measured. Internal triggering may be used.

② Press the right and left SELECT keys simultaneously. TIME/DIV LEDs will go out, and the appropriate time axis setting will be determined from the trigger signal cycle.

③ Maximum trigger signal searching time is 20 seconds. If triggering is not applied twice during this period, the time axis setting remains unchanged. To stop operation halfway, press the STOP key.



Notes: ● This function cannot be used with the trigger function off. The trigger is used to calculate the waveform cycle. Set an adequate trigger.

● This feature cannot be used with the REC and XY_{CONT} functions.

● When automatic time axis setting is used, the trigger output signal is delivered through the TRIG OUT terminal. Pay attention to this when using this terminal.

6 — 2. Recorder Function

Chart speed can be set in 12 steps from 1 s to 50 min./DIV.

Recorder Function

TIME/DIV	Chart Speed	Time Axis Resolution
1 s/DIV	501 mm/min	1/50 DIV
2	250.5	1/100DIV
5	100.2	
10	50.1	
20	25.1	
50	10.0	
1 min/DIV	501 mm/h	
2	250.5	
5	100.2	
10	50.1	
20	25.1	
50	10.0	

● The Sampling Interval

The sampling interval depends on the total number of channels used.

Note: Take care of aliasing distortion when recording high-frequency waveforms.

No. of Channels Used	Sampling Rate	Sampling Interval
1	12.50 kS/s	80 μs
2	11.11 kS/s	90 μs
3	10.00 kS/s	100 μs
4	8.33 kS/s	120 μs

● On the Continuous XY Recorder Function

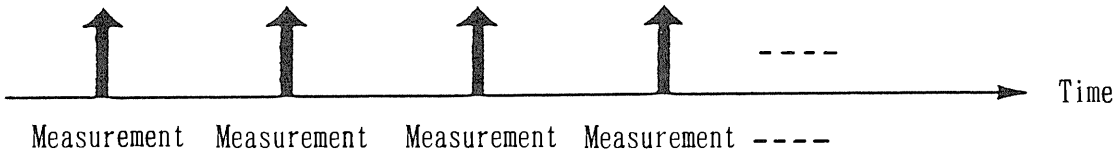
Time axis setting is not possible with the Continuous XY recorder function. The sampling interval is determined by the total number of channels used. When in the line mode, the sampling interval also depends on the recorded waveform.

	Dot Mode		Line Mode
No. of Channels Used	Sampling Rate	Sampling Interval	Sampling Interval Range
1	20.00 kS/s	50 μs	180 μs ~ 8 ms
2	16.67 kS/s	60 μs	270 μs ~ 14 ms
3	14.29 kS/s	70 μs	360 μs ~ 19 ms

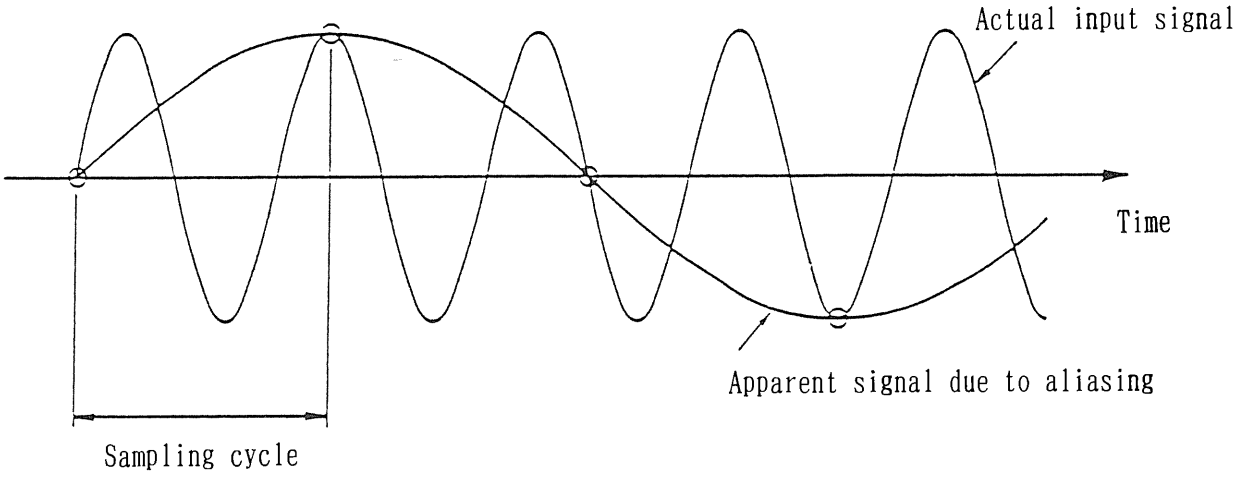
6－3. Aliasing Distortion

- The 8815 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.

- This sampling process measures signal size at fixed intervals.



- When signal fluctuations are faster than the sampling cycle above, non-existent signal changes may be recorded. This is known as aliasing distortion.

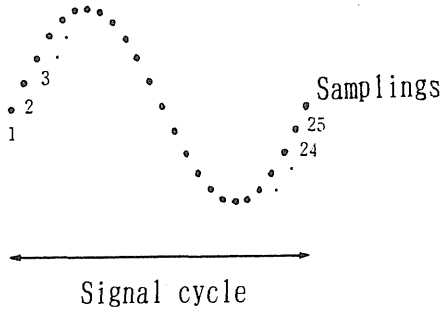


- With measurement methods such as the memory recorder function, in which the sampling interval depends largely on the time-axis setting, aliasing distortion cannot be avoided.

- In the memory and high-speed XY recorder modes, the limit measurement frequency is determined by the time-axis setting. Therefore, it is advisable to start measuring from higher speed settings.

- When recording a repeating signal, the AUTO TIME/DIV function is also effective. Refer to 6-1-2 Automatic Time Axis Setting.

● To reproduce a sine wave, for example, using the sampled values without missing signal peaks, about 25 samplings per cycle are required.

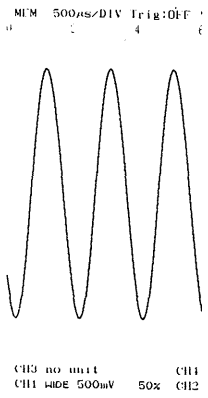


Memory and high-speed XY recorder functions

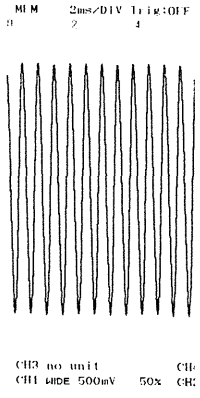
TIME/DIV	TIME/WORD	Measurement limit f
100μs/DIV	2 μs	20kHz
200	4	10
500	10	4
1ms/DIV	20	2
2	40	1
5	100	400Hz
10	200	200
20	400	100
50	1ms	40
100	2	20
200	4	10
500	10	4
1s/DIV	20	2
2	40	1
5	100	0.4

↑
(Frequencies for each range when setting a limit of 25 samplings per cycle.)

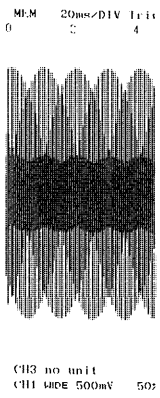
〔Example〕 Recording a 1,010-Hz sine wave at different time axis settings.



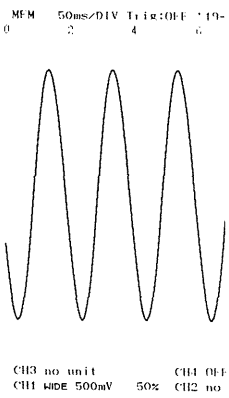
500 μs/DIV
Correct waveform



2 ms/DIV
Close to the measurement limit frequency



20 ms/DIV
Peaks are lost.

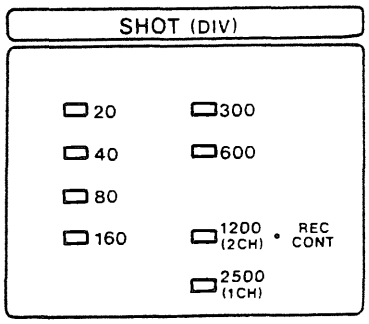


50 ms/DIV
Aliasing error
(taken for a 10-Hz signal)

CHAPTER 7

RECORDING LENGTH SETTING

7. RECORDING LENGTH SETTING



The SHOT (DIV) indicator shows the length of recording paper printed in one recording operation. 1 DIV is equivalent to one square on the paper grid.

Note: This setting is not necessary in the XY_{CONT} mode.

7 − 1. Memory Recorder and High-speed XY Recorder Functions

Recording length can be selected from among the following settings: 20, 40, 80, 160, 300, 600, 1200*1, 2500*1 DIV.
*1 The number of channels is limited.

Note: The 2500 DIV setting can be selected only in the MEM mode.

7 − 1 − 1. The 1200 DIV Setting

When recording length is set to 1200 DIV, only two input channels can be used. The two channels with the smaller numbers among those whose printing switch is ON are selected automatically. Remember this when three or all channels are ON.

	CH1	CH2	CH3	CH4	Selected Channels
Three Channels ON	ON	ON	ON	OFF	CH1, CH2
	ON	ON	OFF	ON	CH1, CH2
	ON	OFF	ON	ON	CH1, CH3
	OFF	ON	ON	ON	CH2, CH3
All Channels ON	ON	ON	ON	ON	CH1, CH2

Notes on the 1200 DIV Setting

- When the printing switches of more than two channels are ON, no waveforms will be read through channels that are not selected. Channels cannot be changed during the start or reprint operation.
- When only one channel has its printing switch ON, the channel with the smallest number among the remaining three is also activated automatically.
- In the high-speed recorder mode (XY_{MEM}), channel 1 is always ON regardless of the printing switch position.

7 − 1 − 2. The 2500 DIV Setting

When recording length is set to 2500 DIV, only one input channel can be used. The channel with the smallest number among those whose printing switch is ON is selected automatically.

Example: If the printing switches of channels 2 and 4 are ON, channel 2 will be selected. No waveform will be read through channel 4.

Notes on the 2500 DIV Setting

- No waveforms will be read through channels that are not selected.
- Waveforms from other channels cannot either be printed by changing the position of printing switches after waveform read-in. The selected channel printing switch, however, can be turned ON/OFF.
- Waveforms from other channels cannot either be printed by changing the position of printing switches during the start operation. The selected channel printing switch, however, can be turned ON/OFF.

7 − 2. Recorder Function

Recording length can be selected from among the following settings: 20, 40, 80, 160, 300, 600, CONT. If CONT is selected, recording will continue until the STOP key is pressed.

CHAPTER 8

USING THE TRIGGER FUNCTION

8. USING THE TRIGGER FUNCTION

8 − 1. On the Trigger

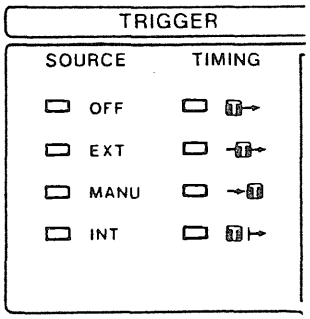
(1) The trigger function makes waveform recording or memory storage start or stop under control of a certain signal.
For repeated recording, select the REPEAT trigger mode. Refer to 10-3. Repeated Recording (TRIG MODE).

(2) Triggering SOURCE
The triggering signal source can be selected from among the following three:

[EXT] : External trigger (see 8-2.)
- Operation is triggered when the TRIG IN terminal is short-circuited or an approx. 2.5-V falling signal is applied to it.
- Use this mode when synchronizing operation with other units, and for parallel sync operation using several 8815 units.

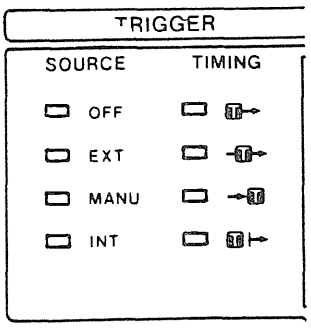
[MANU] : Manual trigger (see 8-3.)
- Operation is triggered by pressing the MANU key.
- Start operation speed is higher than when the START key is used.

[INT] : Internal trigger (see 8-4.)
- Operation is triggered by the signal from one of the channels 1 to 4.
- Used to monitor the signal and start recording when it reaches a specified condition.



(3) Trigger TIMING setting

The waveform can be recorded not only after triggering, but also before it.



In the [MEM] and [XY_{MEM}] modes

[ ]: 95% of the shot length covers the waveform before the trigger point.

[ ]: Equal portions before and after the trigger point are recorded.

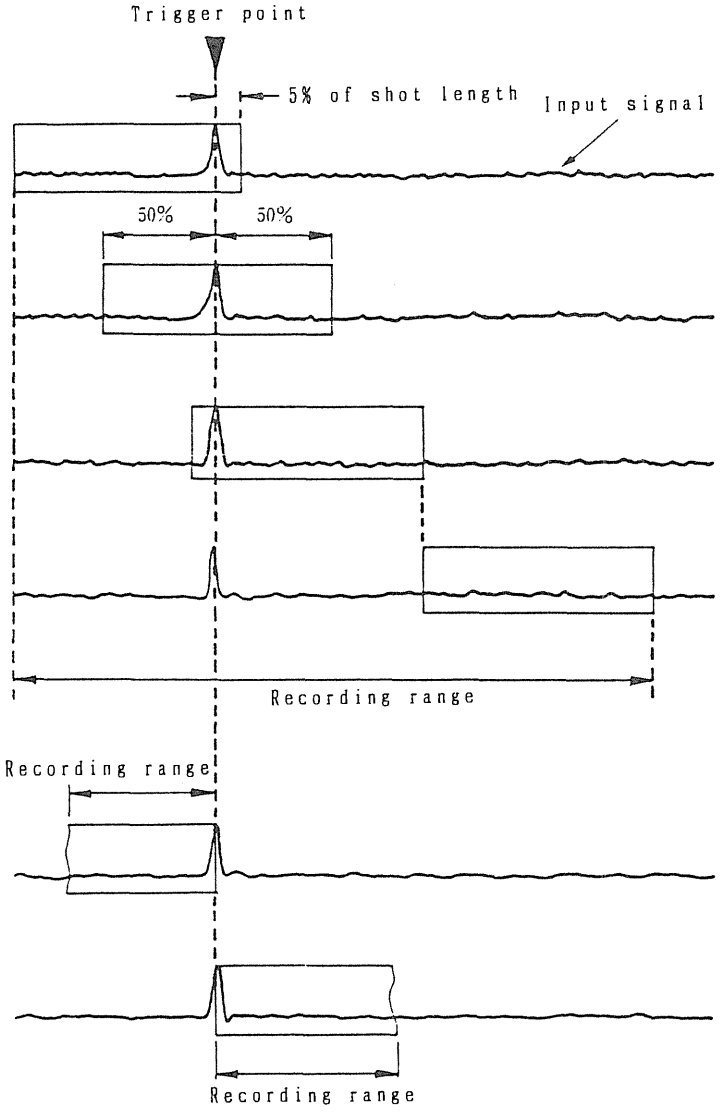
[ ]: 95% of the shot length covers the waveform after the trigger point.

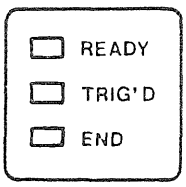
[ ]: The waveform is recorded from a point located 1 shot after the trigger point.

In the [REC] and [XY_{CONT}] modes

[ ]: Triggered stop

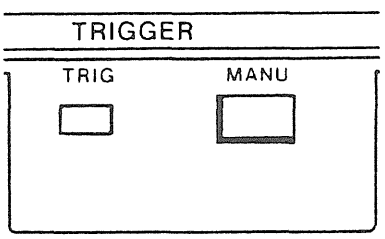
[ ]: Triggered start





(4) Trigger condition during the start operation can be checked on the LED panel.

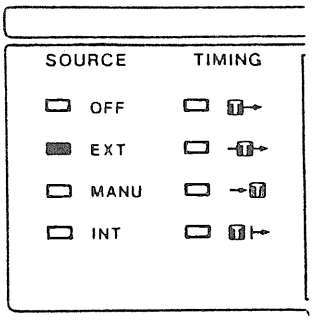
Operation	Unit Condition	LED Indicating the Trigger Condition
① Set the trigger.		READY ☐ TRIG'D ☐ END ☐
② Press the START key.	● The start operation begins. ● The unit stands by for the trigger signal.	READY ■ TRIG'D ☐ END ☐
③ The trigger signal is received.	● The waveform read-in operation starts. in→T mode, waveform read-in is finished.	READY ☐ TRIG'D ■ END ☐
	● Waveform read-in is finished. In the MEM and XY_{MEM} modes, reprint is possible.	READY ☐ TRIG'D ☐ END ■



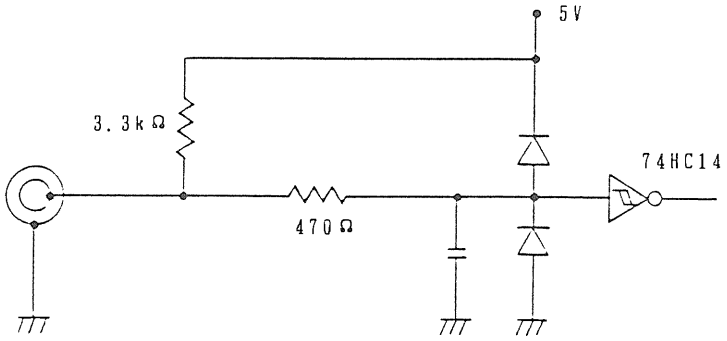
The TRIG LED keeps blinking while trigger conditions are satisfied, even not during the start operation. Use it to confirm trigger settings.

8 − 2. EXTernal Trigger

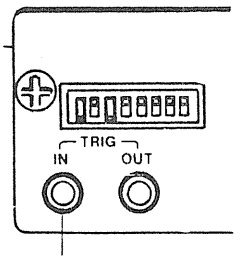
Operation is triggered when the TRIG IN terminal is short-circuited or an approx. 2.5-V falling signal is applied to it.



Trigger Input Circuit



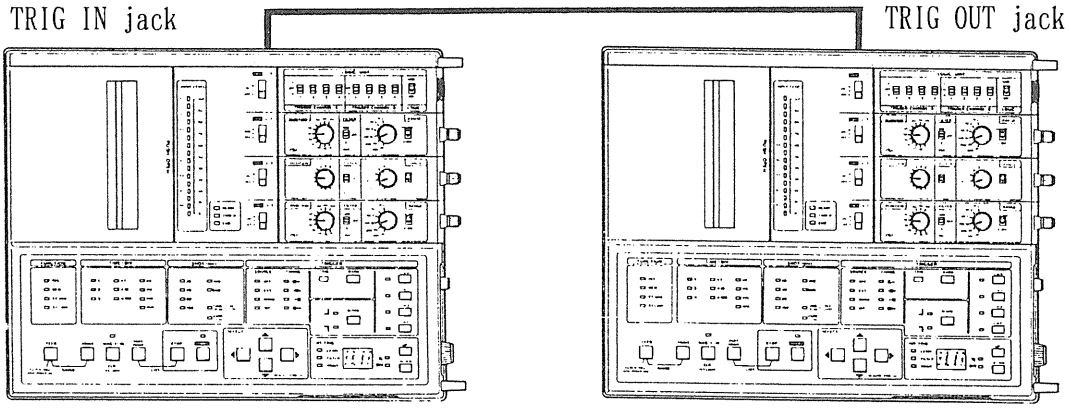
Input voltage: -5V to +10 V



TRIG IN jack

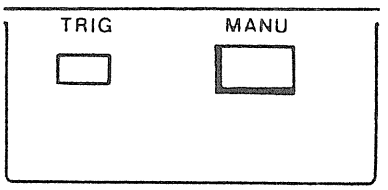
Parallel synchronized operation is possible using two or more 8815 units.

Parallel synchronized operation



8 − 3. MANUal Trigger

Operation is triggered by pressing the MANU key.



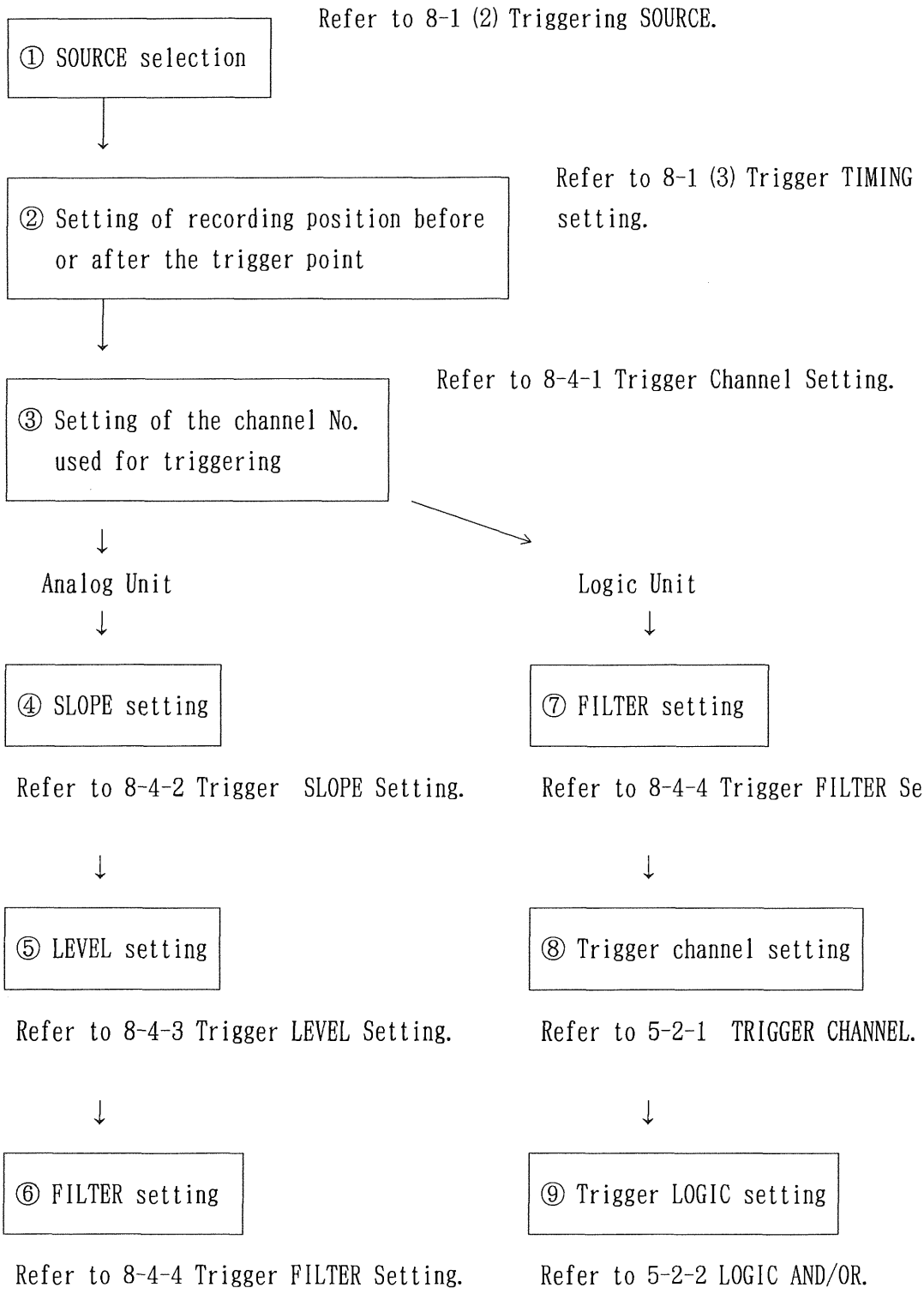
Start operation speed is higher than when the START key is used.

Example: Start timing comparison using the recorder function

Using the START key ····· 16 ms
Using the MANU key ····· 0 s (min.) to sampling interval (max.)

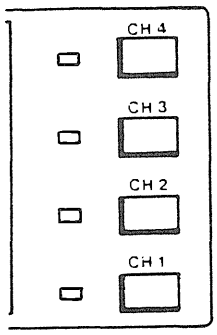
8－4. INTernal Triggers

Operation is triggered by the signal from one of the channels 1 to 4. Set the following items for internal triggering.

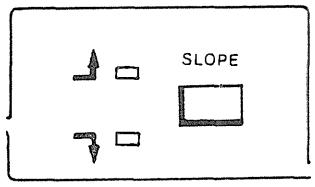


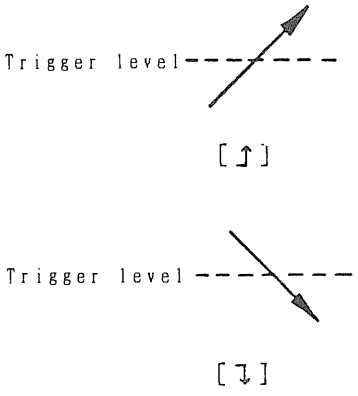
8－4－1. Trigger Channel Setting

When using internal triggering, press the key corresponding to the channel you want to use. Even when internal triggering is not used, these keys select the channel to be indicated by the input level meter.



8－4－2. Trigger SLOPE Setting (only for internal trigger)



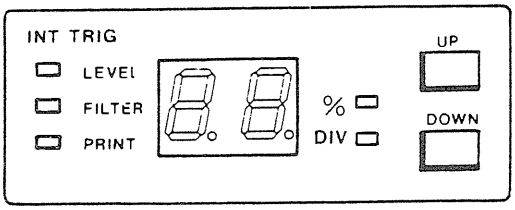


Recording is triggered when the signal crosses the trigger level upwards.

Recording is triggered when the signal crosses the trigger level downwards.

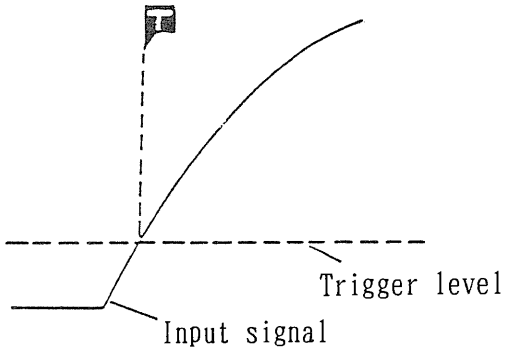
Note: ● This setting is possible only when an analog unit has been selected as trigger channel.

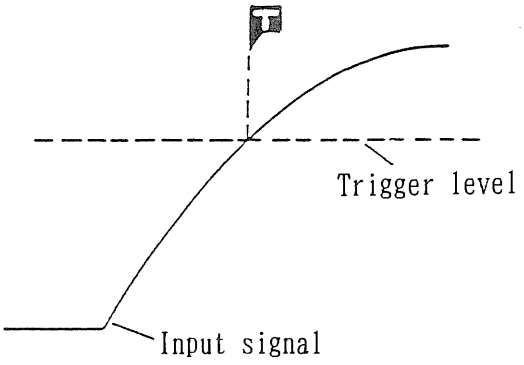
8 – 4 – 3. Trigger LEVEL Setting (only for internal trigger)



The input signal trigger level can be set between 0% and 99% in 1% steps.

● Trigger level [0% to 99%]



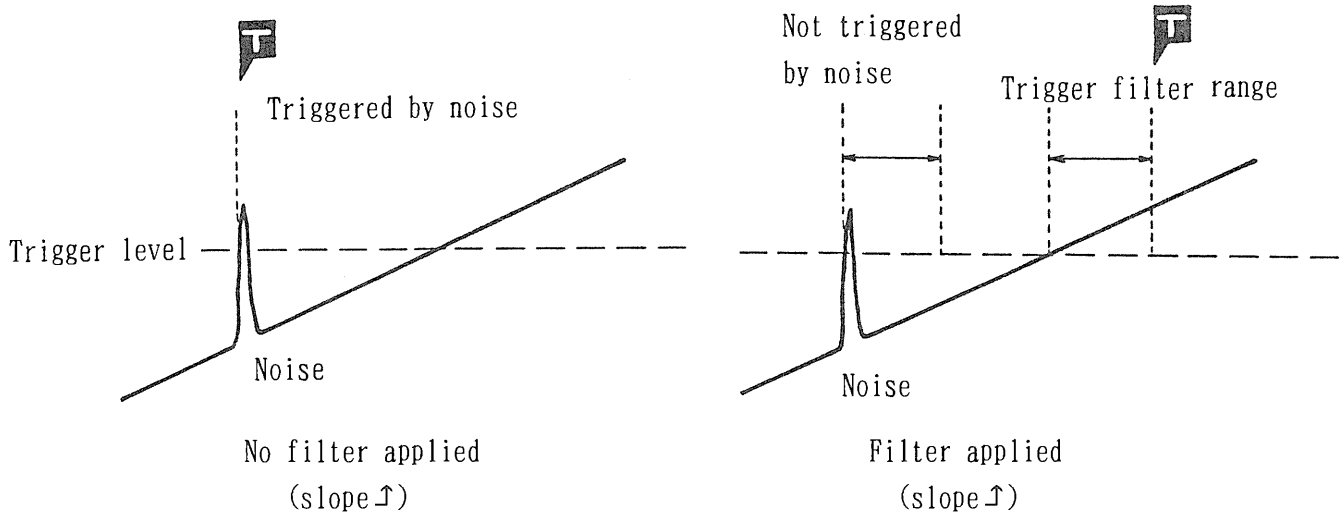


Notes: ● This setting is possible only when an analog unit has been selected as trigger channel.

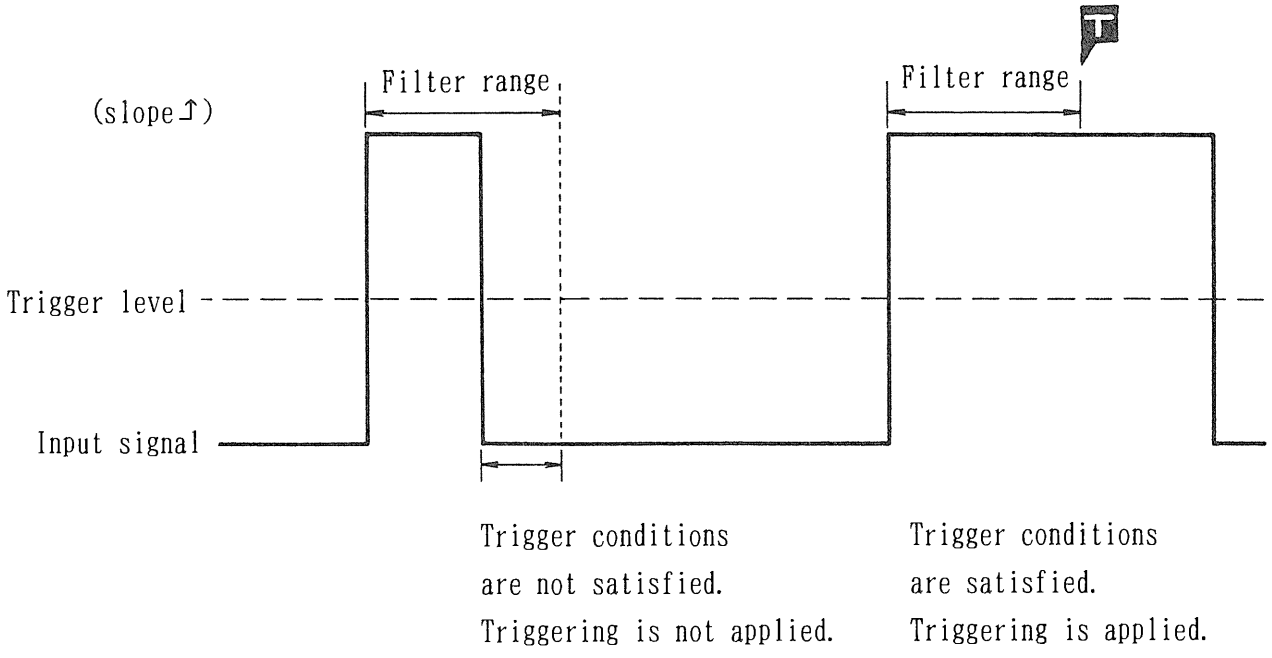
● For logic units, use the filter setting instead.

8－4－4. Trigger FILTER Setting (only for internal trigger)

The filter prevents accidental triggering caused by noise or chatter in the input signal.



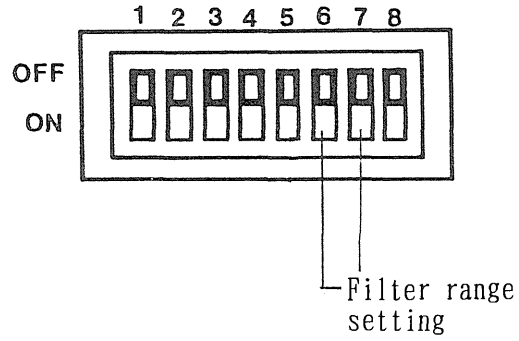
Triggering is performed when trigger conditions are met within the specified filter range.



Note: In the recorder and continuous XY recorder modes, the filter range depends on data sampling speed. In these modes, the filter can only be set to on or off.

(1) Analog Units

Filter range is set using the DIP switch on the rear panel of the unit. In the MEM and XY_{MEM} modes, filter range is expressed as a number of squares (DIV) on the grid. Available settings are OFF, 0.2, 0.6 and 2.6 DIV (these values are divided by ten in the MAG1/10 mode). In the REC and XY $_{CONT}$ modes, the filter can only be set to ON or OFF.



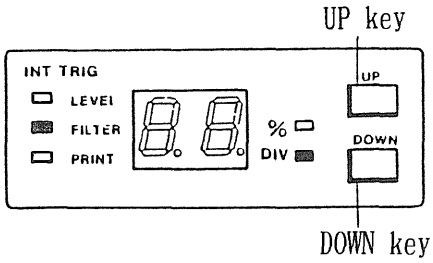
DIP Switch Number		MEM, XY_{MEM} (DIV)	REC, XY_{CONT}
6	7		
OFF	OFF	OFF	OFF
OFF	ON	0.2	ON
ON	OFF	0.6	ON
ON	ON	2.6	ON

Filter Range in the REC and XY_{CONT} Modes

When the filter is set to ON in the recorder and continuous XY recorder modes, the filter range is automatically set to 128 samples. In these modes, the sampling interval depends on the position of the printing switch. Since filter range is not constant as in the MEM and XY_{MEM} modes, proper care must be taken.

(2) Logic Units

If a logic unit is chosen as trigger channel, the current filter range is shown on the LED display. Use the UP and DOWN keys to adjust the reading.



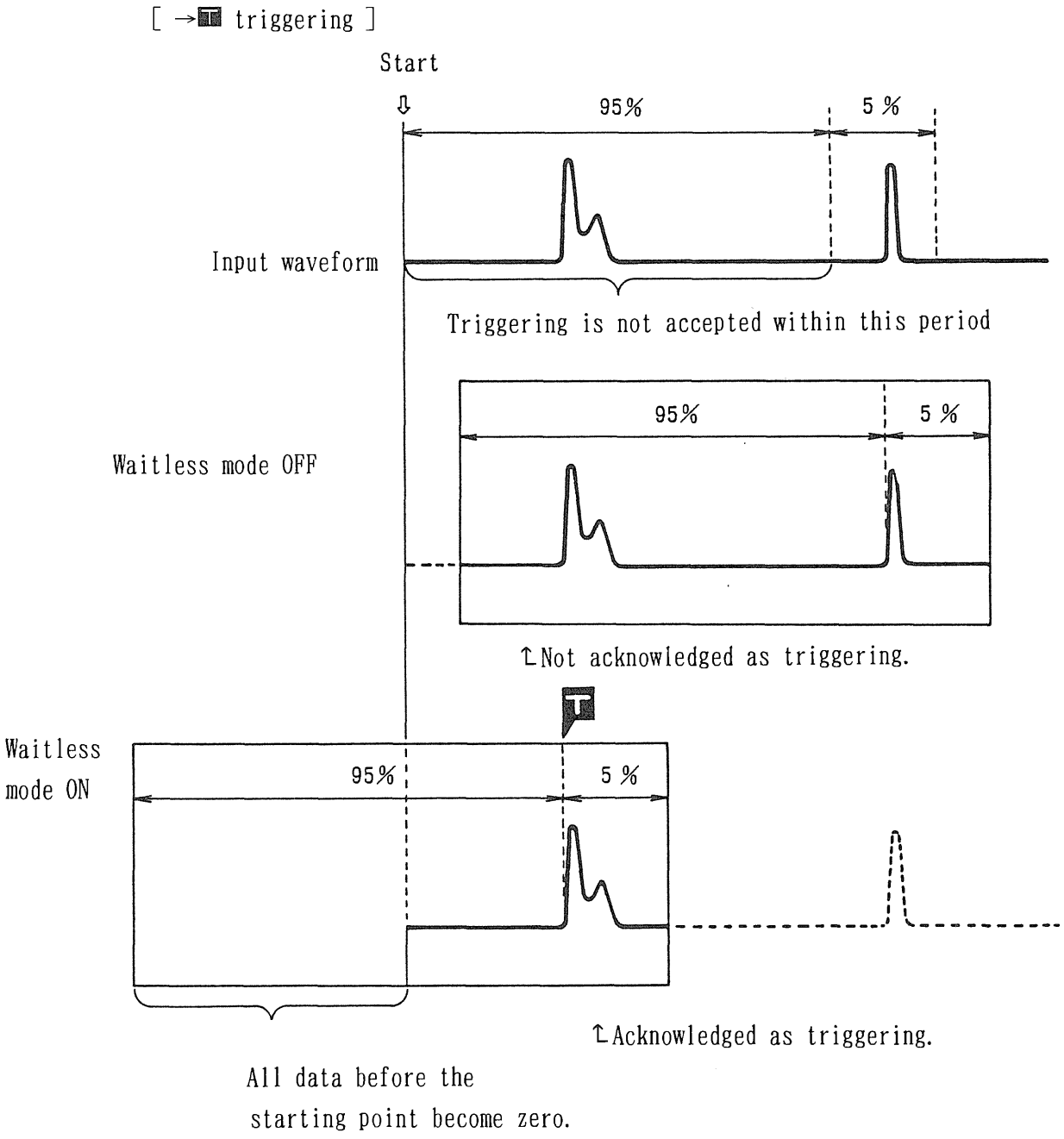
In the MEM and XY_{MEM} modes, filter range is expressed as a number of squares (DIV) on the grid. Available settings are OFF, 0.1, 0.2, 0.3, 0.6, 1.3 and 2.6 DIV (shown as OF, 0.1, 0.2, 0.3, 0.6, 1.3 and 2.6 on the LED display).

In the REC and XY_{CONT} modes, the filter can only be set to ON or OFF (shown as ON and OF on the LED display). When the filter is set to ON in these modes, the filter range is automatically set to 128 samples. In these modes, the sampling interval depends on the position of the printing switch. Since filter range is not constant as in the MEM and XY $_{MEM}$ modes, proper care must be taken.

8 − 5. Waitless Mode

The waitless mode can be used in two ways:

(1) When triggering is applied before of after recording (refer to 8-1. (3)), triggering is not acknowledged for a certain time after the START key is pressed. If the waitless mode is set, triggering is accepted even within that period.

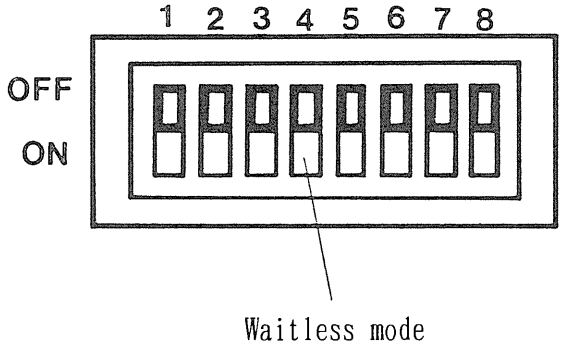


Note: Data before the starting point are not printed as a waveform.

(2) When the waveform is recorded repeatedly (see 10-3.), new waveforms are accepted even during printing. Periods on which a new waveform cannot be accepted during printing can be eliminated by dividing the memory in two sections and using them alternately. This function works along with that described in (1) above when all the following conditions are met:

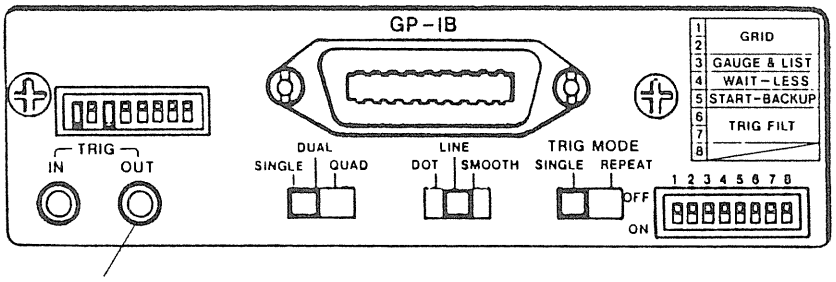
- Trigger mode is set to REPEAT.
- The MEM or XY_{MEM} function is used.
- TIME/DIV is within 1 ms to 5 s/DIV.
- Shot length is below 300 divisions.

Waitless mode is set using the DIP switch on the rear panel.



8－6. The Trigger Output Terminal

The TRIG OUT terminal delivers the trigger output signal.

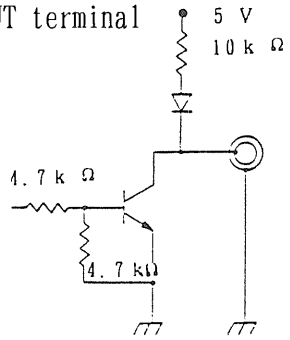


TRIG OUT terminal

Open collector (with voltage output)　　Pulse width approx. 1.5 ms

3.5-mm-dia. minijack

TRIG OUT terminal



Load voltage　-20 to +30 V

Max. load current　300 mA

Max. load power　200 mW

Note: The trigger output signal is delivered when automatic time axis setting is performed. Take this into consideration when performing automatic time axis setting while using the trigger output terminal.

CHAPTER 9

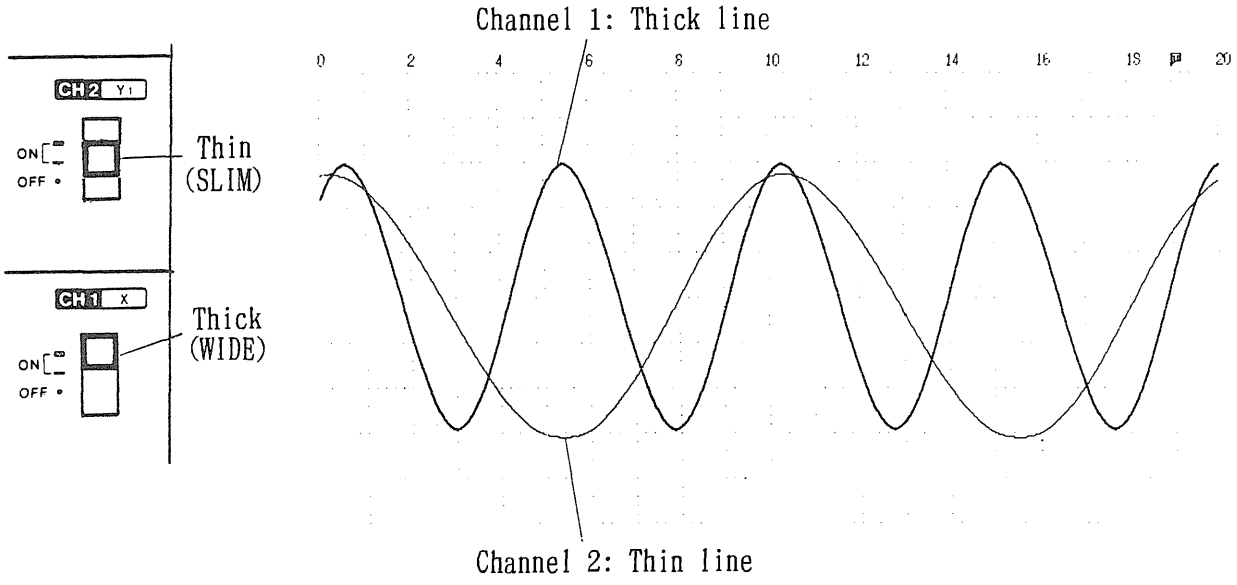
THE CONTROL PANEL

9. THE CONTROL PANEL

9－1. Printing Switches

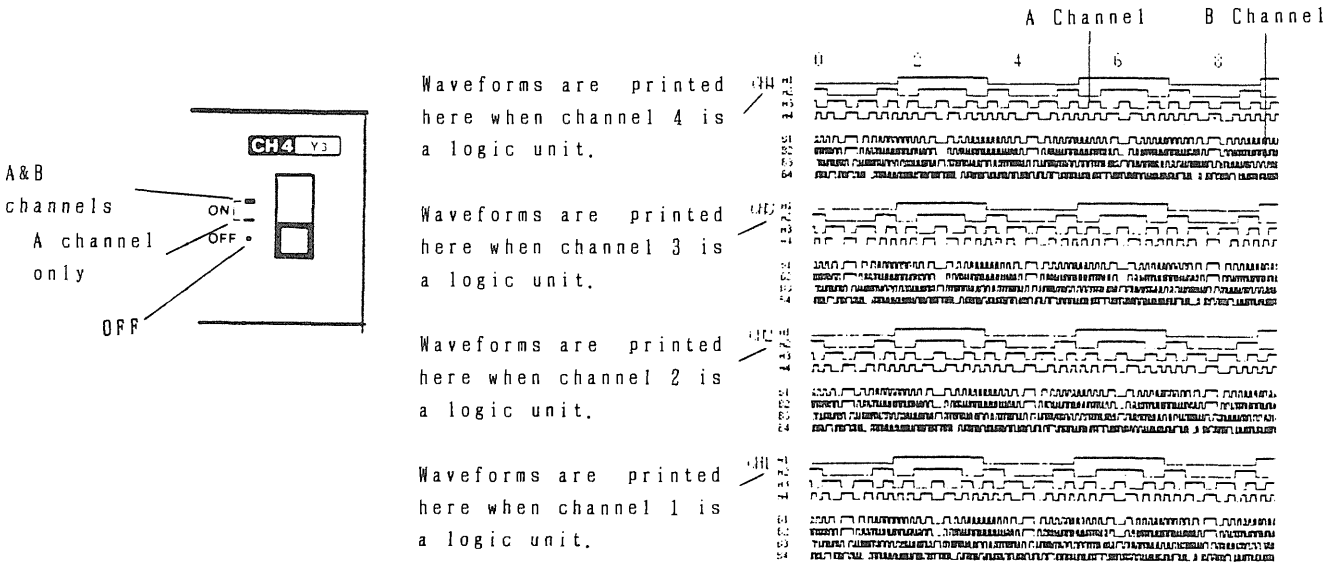
(1) Analog Units

For analog units, the printing switches turn waveform printout on and off and select line thickness for each channel.



(2) Logic Units

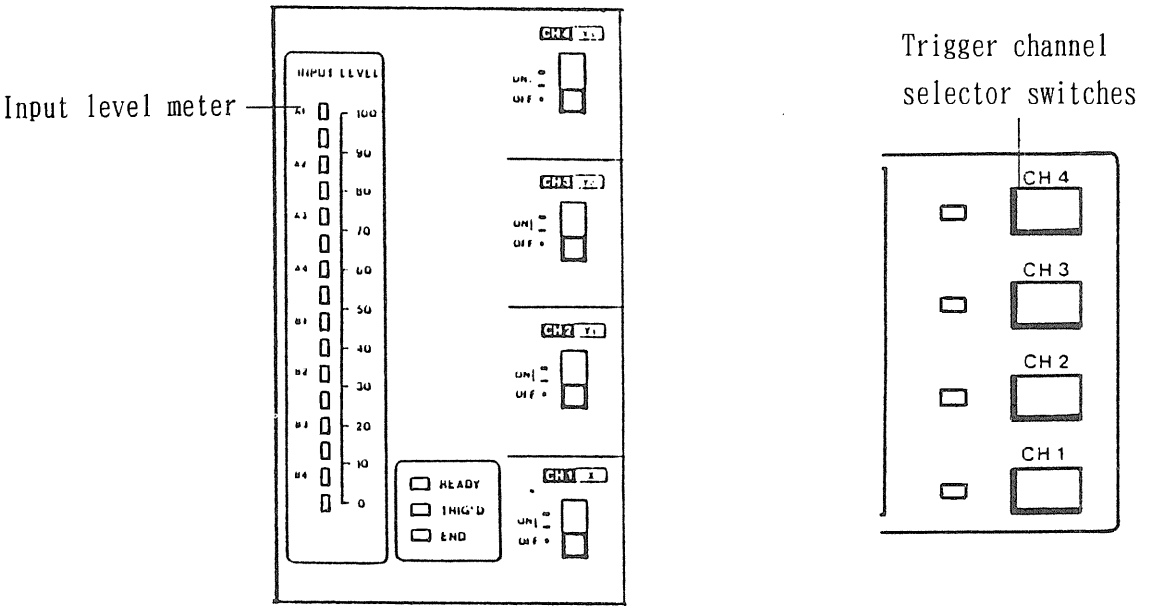
The printing switches turn waveform printout on and off and select the number of recording channels between 8 [A&B] and 4 [A] for each logic unit.



Note: If a recording length of 1200 DIV or over is selected in the memory recorder or high-speed XY recorder mode, the total number of usable channels is limited. For details, refer to Chapter 7. RECORDING LENGTH SETTING.

9－2. Input Level Meter

This meter shows the input level of the channel selected with the trigger channel selector switches. Since it permits checking the input condition even when recording is not taking place, it can be used when adjusting measurement ranges, etc.

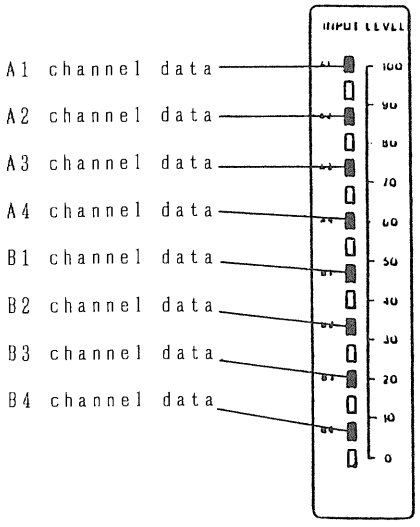


Input level of the channel selected with the trigger channel selector switches is displayed even when triggering is not applied.

Notes: ●This indication is unrelated to the channel that is output to the printer.

●Only the level of one channel can be displayed.

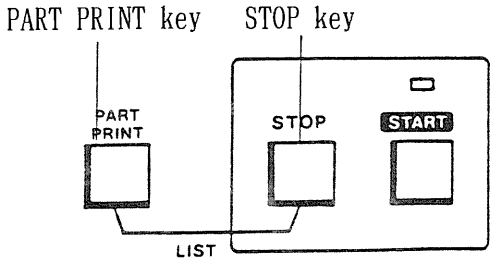
For logic input units, the indication below is obtained (lighted segments indicate a high level, and extinguished segments a low level).

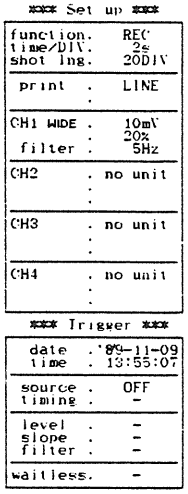


9 — 3. Gauge and List Printout

9 — 3 — 1. Printing the Gauge and the Lists Only

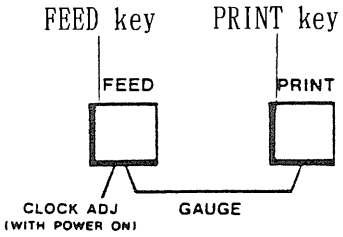
Press the PART PRINT and STOP keys simultaneously, and only the lists will be printed. For details on listed contents, refer to the instructions on each function in Chapter 4.

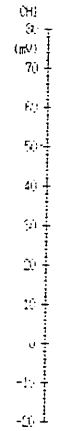




Lists

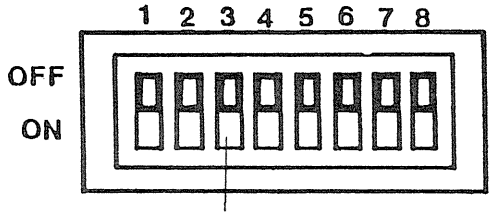
Press the FEED and PRINT keys simultaneously, and only the gauge will be printed.





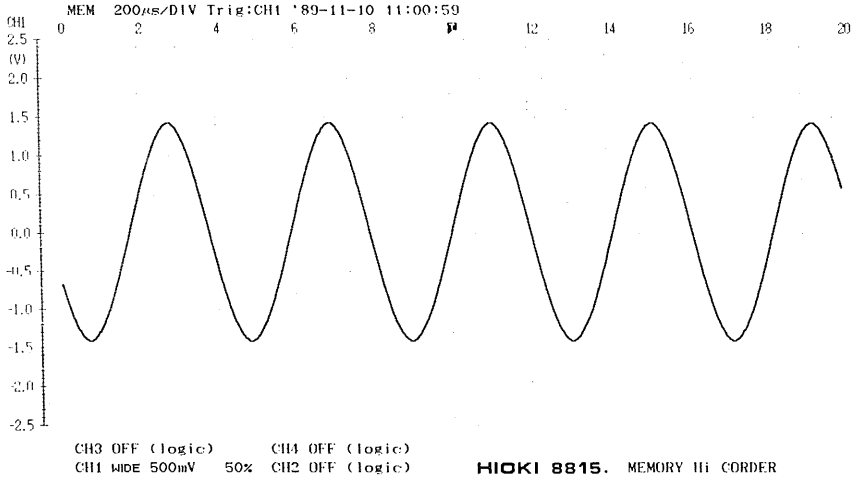
Gauge

9 — 3 — 2. Automatic Gauge and List Printing

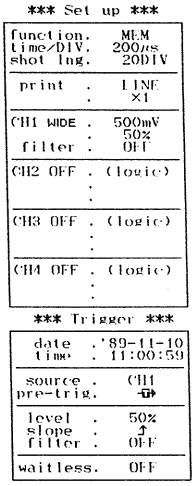


Automatic Gauge and List Printing Gauge

If the 3rd DIP switch is set to ON, the gauge will be printed before, and the lists after the waveform during recording.



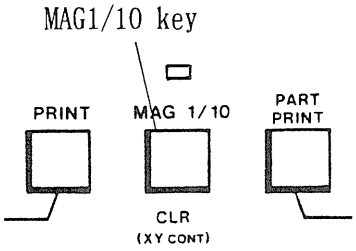
Gauge



Lists

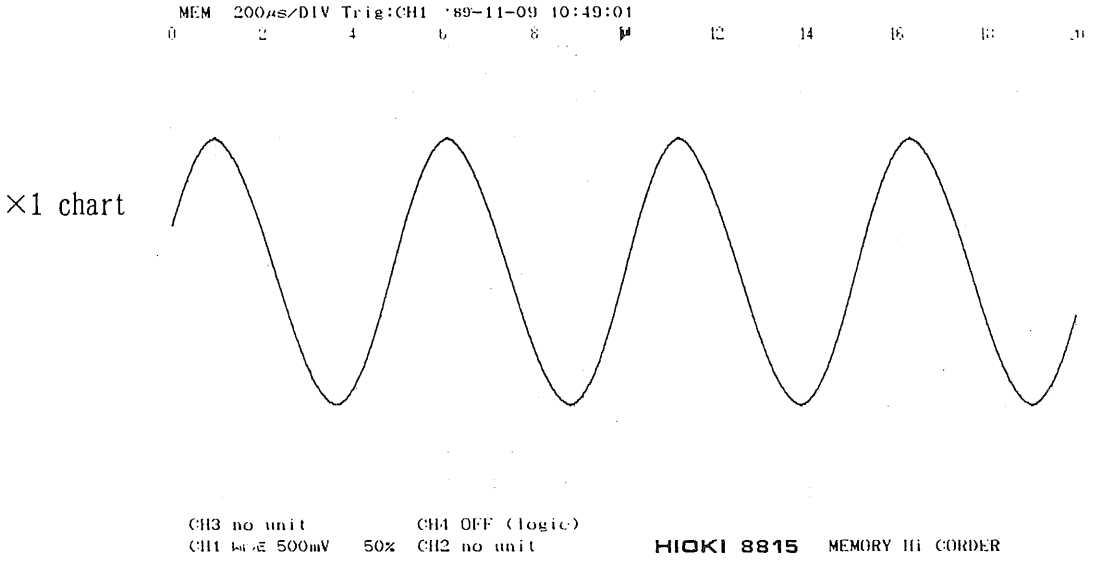
9－4. Reduced Printing (only MEM)

In the memory recorder mode, the waveform can be reduced to 1/10 in the time-axis direction for printout. Use this function to save paper when checking whether the desired waveform has been captured.



Press the MAG1/10 key. The LED above the key will light.

×1 chart



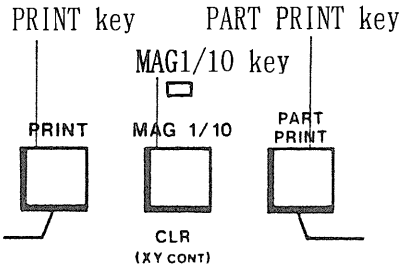
×10 chart

9－5. Partial Printing (only MEM)

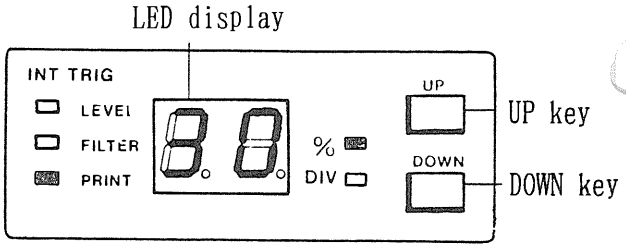
In the memory recorder mode it is possible to print out only a part of the waveform.

① Print the waveform reduced to 1/10 with the MAG1/10 key. Observe the chart and determine (in %) the point from which you want to print the waveform (refer to 9-4. Reduced Printing).

② Press the PART PRINT key. The printout starting point will be shown in % on the LED display.

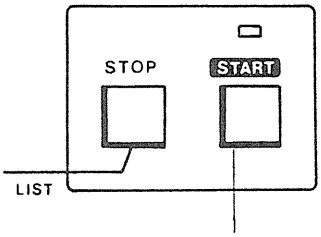


③ Change the starting point with the UP and DOWN keys.

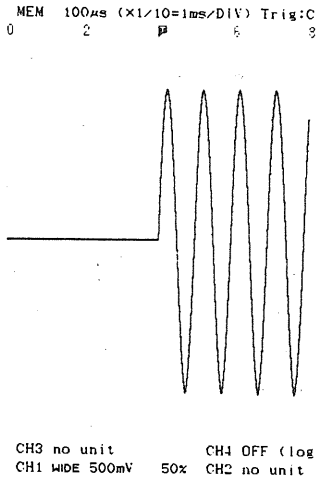


④ Press the PRINT key to obtain a 1/10 reduced waveform chart.

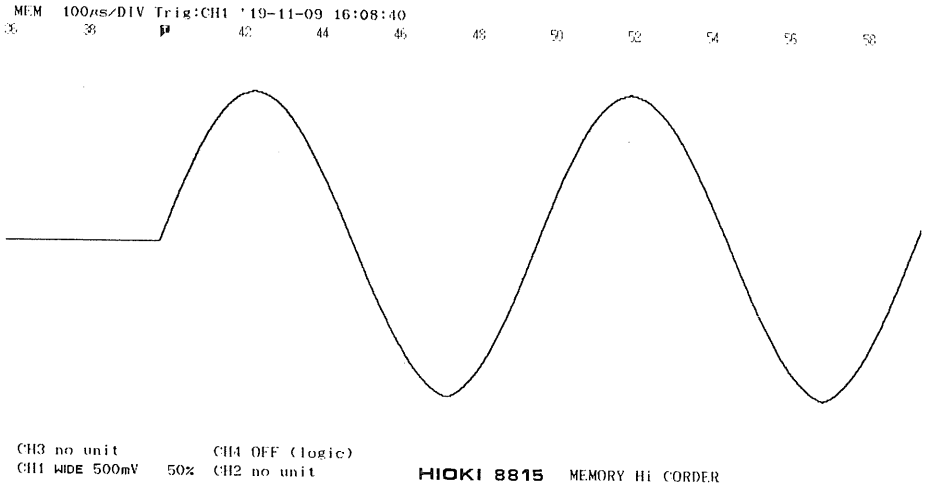
⑤ Confirm whether the desired area of the waveform is printed, then set scaling back to normal by pressing the MAG1/10 key and press the PRINT key again to print the waveform.



×1/10 waveform
(80 DIV)



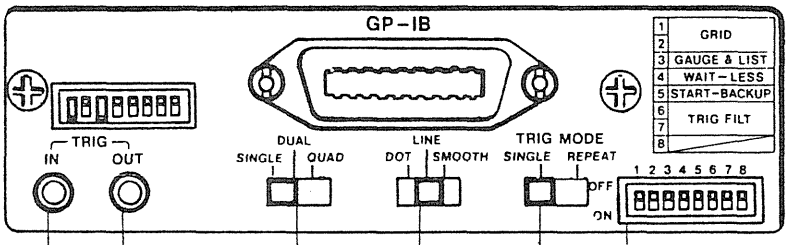
Printout of the 30% portion from the starting point (×1)



CHAPTER 10

THE REAR PANEL

10. THE REAR PANEL



External trigger input. Refer to 8-2.

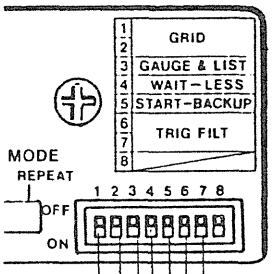
Trigger output. Refer to 8-6.

DIP switch

Repeated Recording. Refer to 10-3.

Interpolation function. Refer to 10-2.

Recording Width Setting. Refer to 10-1.



Analog unit trigger filter. Refer to 8-4-4.

Switch 6	Switch 7	Trigger Filter
OFF	OFF	OFF
ON	OFF	0.2DIV
OFF	ON	0.6DIV
ON	ON	2.6DIV

Start key backup. Refer to 10-5.

5	OFF	OFF
	ON	Start key backup

Waitless mode. Refer to 8-5.

4	OFF	OFF
	ON	Waitless mode

Auto gauge and list printing. Refer to 9-3.

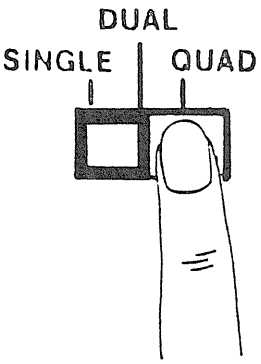
3	OFF	OFF
	ON	Auto gauge and list printing

Grid selection. Refer to 10-4.

Switch 1	Switch 2	Grid Setting
OFF	OFF	NORMAL
ON	OFF	FINE
OFF	ON	FINE
ON	ON	OFF

10－1. Recording Width Setting (only REC and MEM)

Three recording formats are available in the recorder and memory recorder modes.

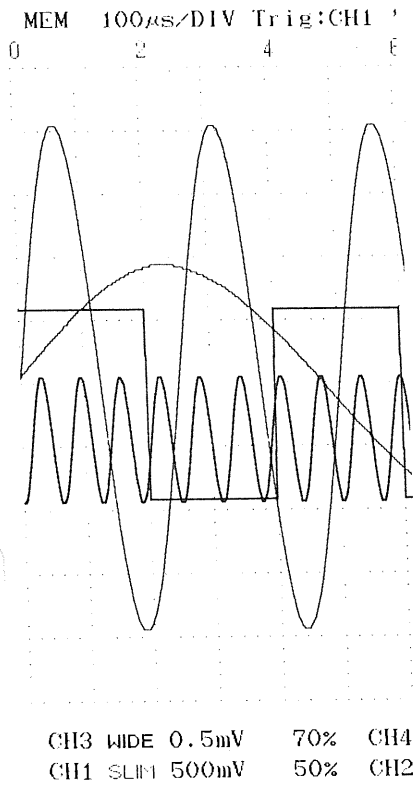


[SINGLE]…Waveforms from channel 1 to channel 4 are all recorded on the whole recording width.

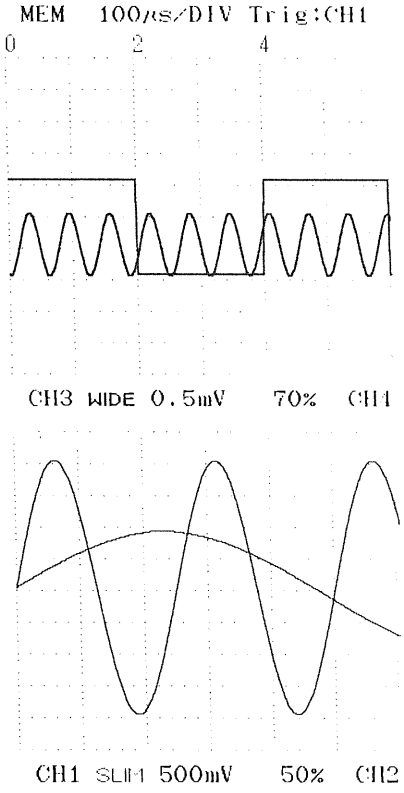
[DUAL]…Waveforms from channels 1 and 2 are recorded on the lower time axis, and waveforms from channels 3 and 4 on the upper time axis.

[QUAD]…Each channel is recorded on a different time axis.

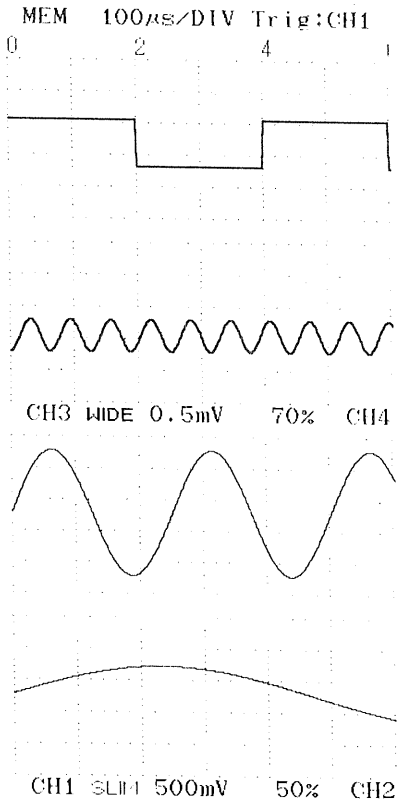
SINGLE



DUAL

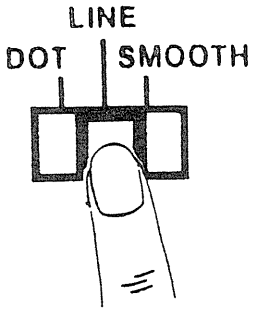


QUAD



10－2. Interpolation Function (DOT, LINE, SMOOTH)

Printout style for waveforms from channels using an analog unit can be selected among the following three settings:



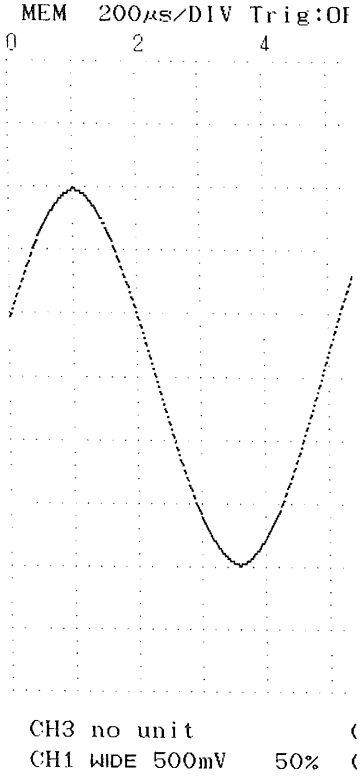
[DOT]…Line interpolation is not applied. Sampled points are printed as they are.

[LINE]…Line interpolation is applied. Sampled points are connected with straight lines for a clear printout.

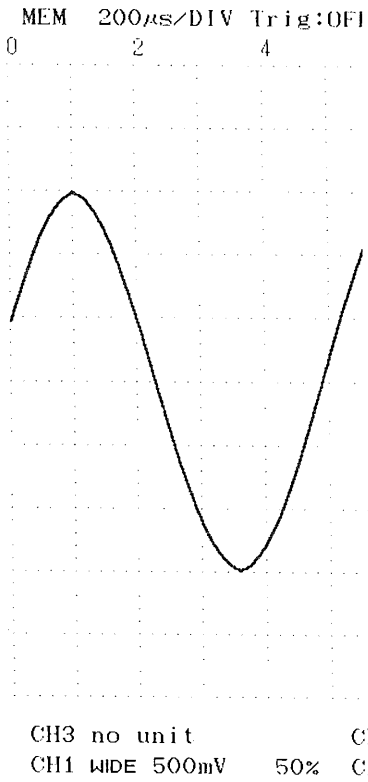
[SMOOTH]…A smoother waveform than in the LINE mode is output to the printer. It can only be used in the memory recorder mode.

Note: Line interpolation is always applied to logic unit waveforms, regardless of the above setting.

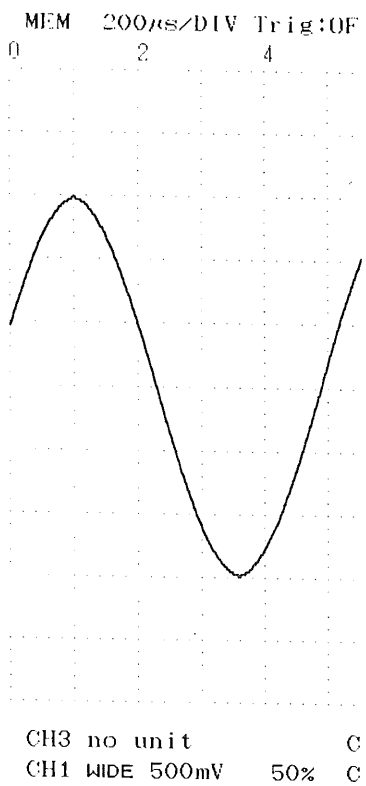
DOT



LINE

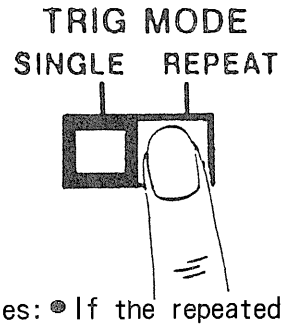


SMOOTH



10－3. Repeated Recording (TRIG MODE)

The TRIG MODE switch permits repeated recording of the waveform.



[SINGLE]…The waveform is read in and printed only once.

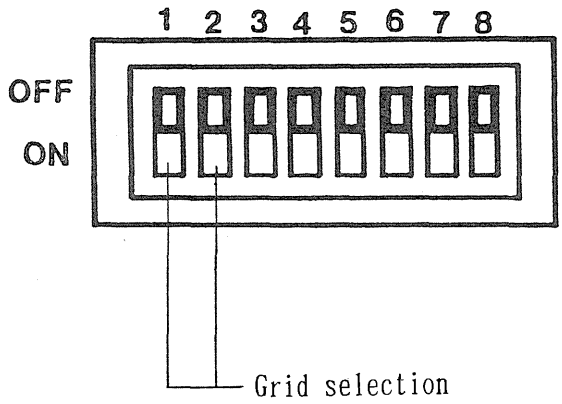
[REPEAT]…Waveform read-in and recording is repeated until the STOP key is pressed during the start operation.

Notes: ● If the repeated recording operation in the memory recorder or high-speed XY recorder mode is finished with the STOP key when recording length has reached 600 DIV or more, repeated printing may not be possible. If repeated printing is required at a recording length over 600 DIV, change the TRIG MODE switch to the SINGLE position during operation.

● When using the repeat function in the continuous XY recorder mode, set trigger timing to →▣. It will not work at any other setting.

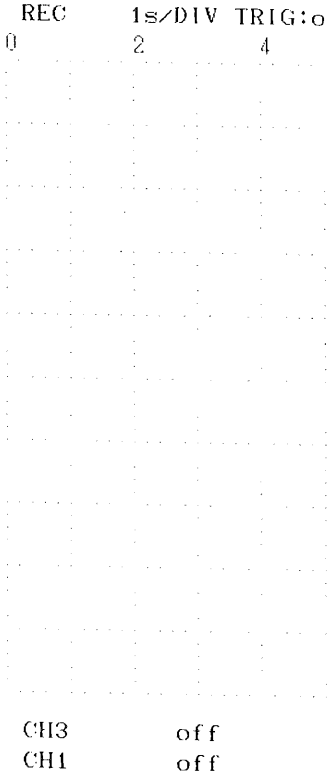
10－4. Selecting the Grid Type

The grid type can be selected with DIP switches No. 1 and 2.

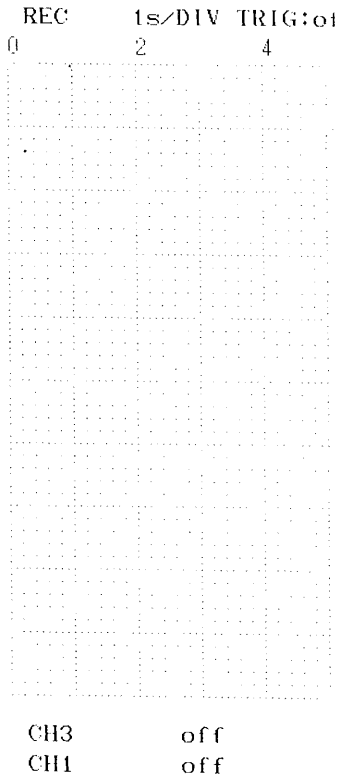


Switch No.		Grid Type
1	2	
OFF	OFF	NORMAL
ON	OFF	FINE
OFF	ON	FINE
ON	ON	OFF

①NORMAL



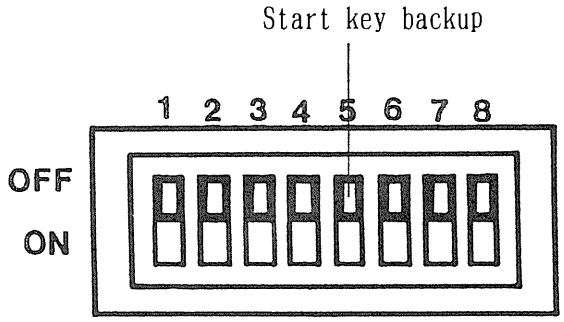
②FINE



③OFF

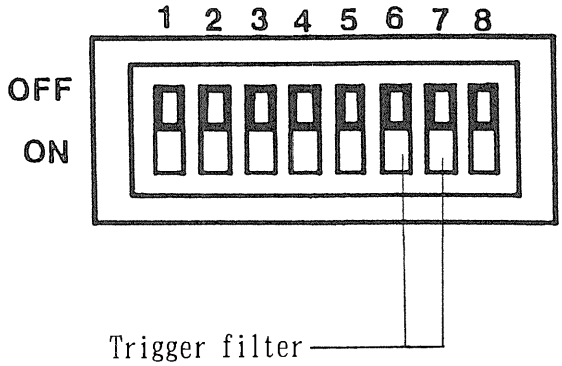
10－5. Start Key Backup

Set DIP switch No. 5 to ON to activate the start key backup function. In case power supply is interrupted during recording (with the LED above the START key lit), recording can be restarted immediately when power supply is restored. This function is convenient when power is temporarily cut due to power failures, etc.
If start key backup is off, operation will not restarted when power is restored.
Other settings are always backed up, and they are not affected when power is turned off.



10－6. Trigger Filter Selection for Analog Units

The trigger filter can be selected with DIP switches No. 6 and 7 for analog input units.



Switch No.		Trigger Filter
6	7	
OFF	OFF	OFF
ON	OFF	0.2DIV(8dot)
OFF	ON	0.6DIV(32dot)
ON	ON	2.6DIV(128dot)

For details, refer to 8-4-4 Trigger FILTER Setting.

CHAPTER 11

ADDITIONAL INSTRUCTIONS

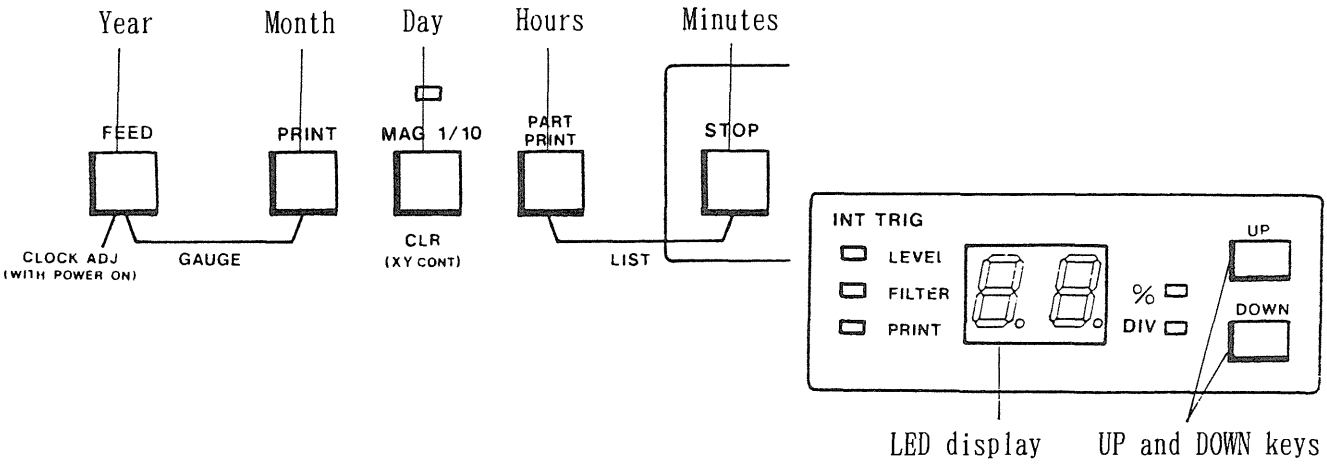
11. ADDITIONAL INSTRUCTIONS

11－1. Time Setting

Use this procedure to adjust the built-in clock. This clock is backed up by a lithium battery, and it keeps running when power is off.

① Turn power on while pressing the FEED key. This will set the clock adjusting mode.

② Press the key corresponding to the item you want to change (year, month, day, hours or minutes). The current setting will be shown on the LED display.



③ Adjust the reading as desired with the UP and DOWN keys.

④ Repeat steps ② and ③ to set the desired date and time.

⑤ Press the START key. The seconds indication will be reset to 0, completing the setting. Then the set date and time will be printed out.

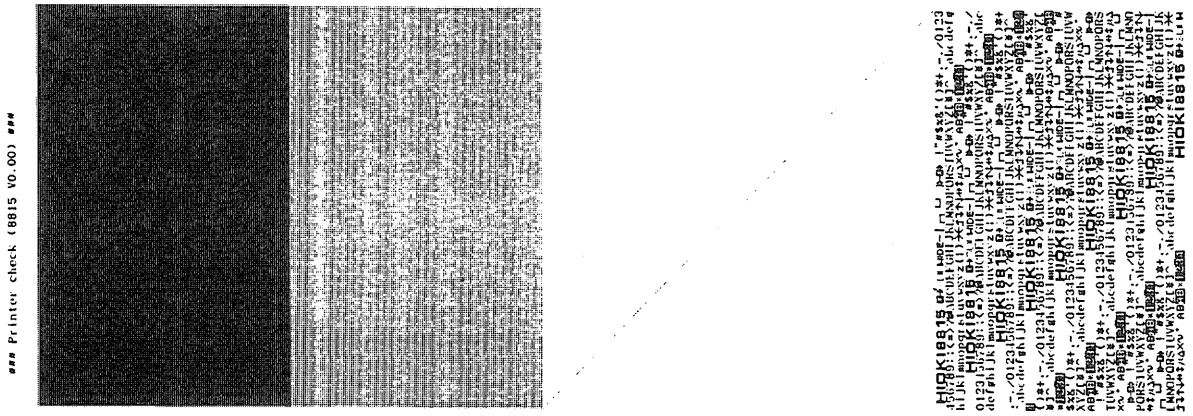
11－2. System Reset

Turn power on while pressing the STOP key. The unit will be reset to its default settings.

11－3. Operation Check

11－3－1. Printer Check

To check printer operation, turn power on while pressing the PRINT key. The test pattern below will be printed. To stop printout halfway, press the STOP key.



11－3－2. LED Check

Turn power on while pressing the MAG1/10 key. All LEDs will start blinking, allowing you to confirm they are in good condition. To leave the check mode, press the STOP key.

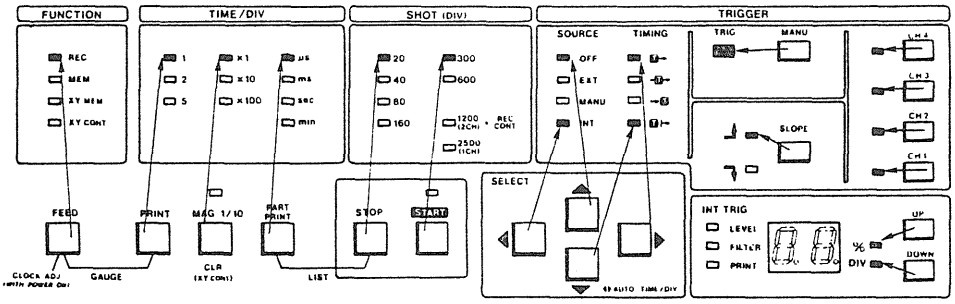
11－3－3. Key Check

Turn power on while pressing the PART PRINT key. The prompt

Key check operation

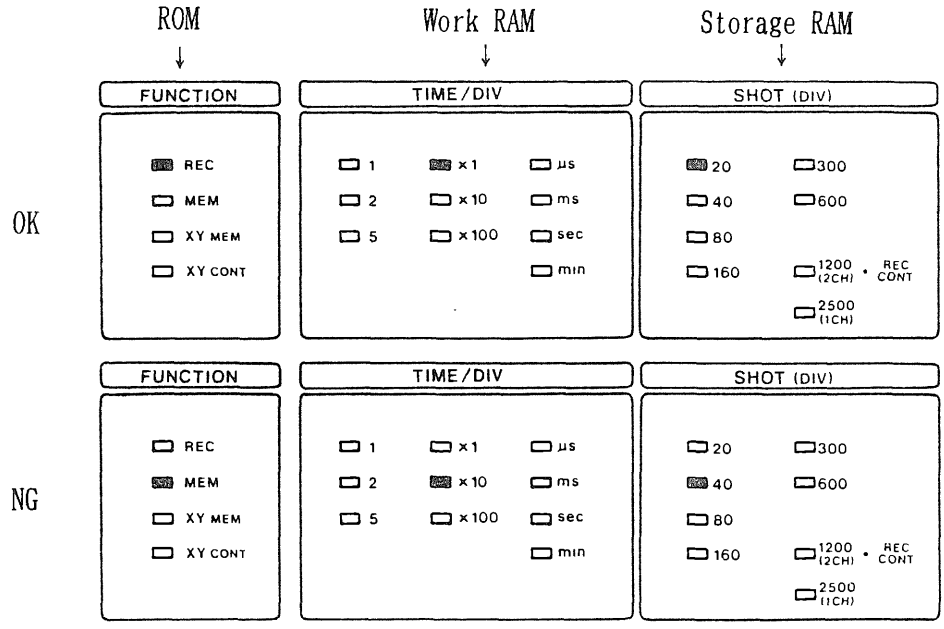
Please push all keys

will be printed. Try pressing all the keys, one by one, and confirm that the corresponding LEDs light as shown below.



11－3－4. ROM/RAM Check

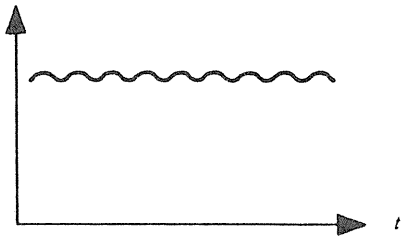
To check the internal memories (ROM and RAM), turn power on while pressing the START key. The LEDs below will blink to indicate check results.



Press the STOP key to leave the check mode.

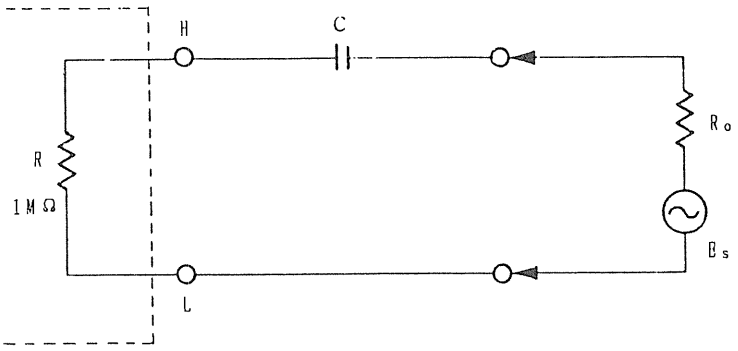
11－4. DC Components Superposed to the Input Signal

In case a DC component is superposed to the signal as shown below, peak values may go beyond the scale limit if input unit sensitivity is increased.



Waveform with superposed DC component

The AC component of such a waveform can be magnified for observation by including the circuit below at the input.



High-pass filter

Cutoff frequency

$$fc = \frac{1}{2\pi CR}$$

R: Input impedance

R_o: Negligible compared with R

This method cuts off the input signal DC component, allowing for measurement of the AC component only. For example, if C = 0.1 μf, R_o = 1 MΩ, therefore

$$fc = \frac{1}{2\pi \times 0.1 \times 10^{-6} \times 1 \times 10^{6}} \fallingdotseq 1.59(Hz)$$

CHAPTER 12

MAINTENANCE AND SERVICE

12－1. Fuse Replacement

⚠ WARNING

To prevent electric shocks, always unplug input cords and the power cord before removing or installing input units or opening the case. Also, be sure to close the case before use. To prevent fire hazard, etc., use a fuse that meets the ratings indicated on the side panel.

CAUTION

- Before replacing the fuse, be sure to disconnect the power cord from the AC power connector and the input cords from the input terminals.
- Be sure to use a new fuse of the specified rating.

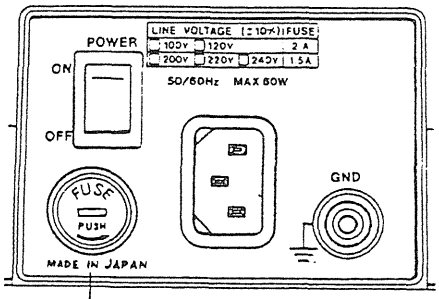
Fuse for 8815

LINE	VOLTAGE (±10%)		FUSE	SIZE
☐ 100 V	☐ 120 V		2.0 A/250 V	5.2 (dia.) ×20 mm
☐ 200 V	☐ 220 V	☐ 240 V	1.5 A/250 V	5.2 (dia.) ×20 mm

- If the 8815's fuse blows, identify and remedy the cause before replacing it.

① Turn the POWER switch off.
② Unplug the power cord.
③ Remove the old fuse from the fuse holder, using a screwdriver.
④ Install a new fuse of the specified rating.
⑤ Reconnect the power cord.

8815 Power unit panel



Fuse holder

12－2. Troubleshooting

If the unit does not operate normally, check the following.

Indicator lamps do not light when power is turned on.	●The power cord is not properly connected. ●The fuse is blown.
The paper starts moving when power is turned on.	●The POWER switch was turned off during the recording operation. Operation starts automatically when turning power on again after turning it off with the start key backup function ON.
No key entries are accepted.	●The unit is being remote-controlled from the optional GP-IB, and RS-232C
The printer does not work.	●No printer paper is loaded. ●The head is up.
The recording paper does not come out when pressing the START key.	●Check trigger settings. When performing memory recording before the trigger point, triggering is not acknowledged during that recording period.
LED indicator lamps do not respond to the operation of the SELECT keys.	●The misoperation protection function is working. Since setting ranges depend on the particular situations, the 8815 determines the validity of entries.
Nothing is printed on the recording paper, or print out is too light.	●The recording paper has been loaded upside down. ●You are not using genuine Hioki recording paper.
The recorded waveform does not change at all.	●Check the measurement range. ●The low-pass filter is on.
The waveform run away from the recording paper.	●Check the range and the zero position.
Recording line too thick in the recorder mode.	●The signal contains a ripple component. Set the input unit filter setting to ON.

The recording paper advances intermittently.	● Paper feed is normally intermittent in the recorder mode.
The waveform is displayed at a frequency much lower than the real one in memory recorder mode.	● Aliasing error is occurring. Select a faster recording speed.
The waveform is not printed in the XY_{MEM} or XY_{CONT} mode.	● No Y-axis (channels 2-4) printout is performed if the channel switch is OFF. ● In the XY_{MEM} mode, printout is not performed if there are no data in channel 1.
The recording paper does not move when pressing the START key in XY_{CONT} mode.	● The proper procedure is: Press the STOP key, then press the PRINT key.
In XY_{CONT} mode, the previous waveform remains on the display.	● Overlapped display is possible in this mode. To clear the waveform, press the MAG1/10 (CLR) key.
An external device connected to the TRIG OUT jack misoperated when pressing the AUTO TIME/DIV keys.	● The trigger signal is output through the TRIG OUT jack when the AUTO TIME/DIV keys are pressed. This is normal.

In case the cause of trouble cannot be detected, try resetting the system. All settings will be reset, so enter them again.

System Reset
Turn power on while pressing the STOP key.

12－3. Printer Maintenance

12－3－1. Printer Head Cleaning

Normally, the printer does not require maintenance. Depending on use conditions, however, particles and paper dust may adhere to the thermal head after long periods of use. This may cause printouts to become lighter or blurred. In such a case, clean the head using one of the following methods:

(1) Make a recording of input noise in the recorder mode at a range of 1 s/DIV, printing 100% black for at least 10 seconds. If this does not improve printing quality sufficiently, proceed with step 2 below.

(2) Pour anhydrous alcohol, freon or normal hexane onto the recording paper, lower the head-up lever, and clean the head manually by sliding the recording paper back and forth.

Alcohol will discolor recording paper, so use it upside down.

⚠ CAUTION

- Never use thinner or benzene.
- After using a solvent for cleaning, let the printer dry thoroughly before use.

12－3－2. Head Temperature Protection

The printer is provided with a head temperature protection circuit. When head temperature goes beyond a certain limit, printing is interrupted. Therefore, depending on use conditions, printout may be temporarily stopped, with only blank paper being advanced.

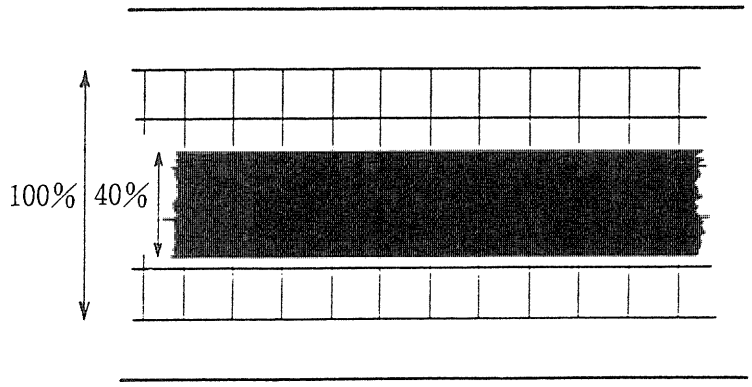
Head temperature tends to increase with the area of black printed portions and with paper feed speed. For example, if recording is performed in the recorder mode for several minutes with a black area beyond the ranges shown in the table below, printout will be interrupted. Printout may be interrupted even within those ranges if ambient temperature is high.

After the protection circuit works, printing will be restarted automatically when the head cools down. If printing is interrupted too frequently, try adjusting the input unit range so as to reduce the black area, setting the printing style to [SLIM] or [DOT], etc.

Permissible Black Area Ratio for Continuous Printing (recorder function, 23℃)

TIME/DIV	Black Area Ratio
1s	Approx. 100%
2s	Approx. 85%
5s	100%

Note: Figures on this table depend heavily on actual conditions. They are included just for reference.

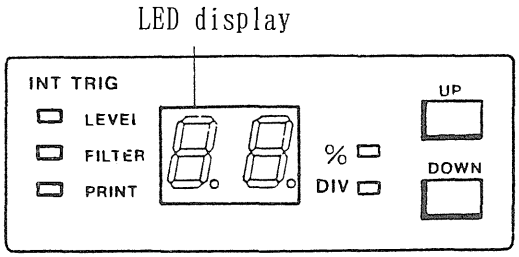


Printout example

APPENDICES

1. Error Codes

In case of error, the following indications are shown on the LED display.



Error Code	Meaning	Action
H.U	The head-up lever is in the up position.	Lower the head-up lever.
P.E	No recording paper is loaded.	Load recording paper.
E.1	There is no analog input unit mounted for channel 1 (XY_{MEM}, XY_{CONT}).	In the XY_{MEM} and XY_{CONT}, use an analog input unit for channel 1. This error condition can be released by pressing the STOP key.
E.2	No waveform data in channel 1 (XY_{MEM})	Reset the recording length and read data into channel 1 before performing XY composition. This error condition can be released by pressing the STOP key.

2. Terminology

Adapter : The temperature adapter is a device to convert temperature into voltage.

Aliasing error : Inability to obtain an accurate waveform due to aliasing distortion (see Appendix 2).

Analog : Continuous physical quantity such as voltage, current, etc.

Attenuator : Divider that reduces signal amplitude.

A/C power : AC power source such as commercial power.

A/D : Analog-to-digital conversion.

Bit : Minimum binary unit. Takes values of 0 and 1.

Byte : Binary unit. Usually composed of 8 bits.

Case : Metallic chassis of the unit.

Channel (CH) : Signal path into the input unit.

Coment : Measurement conditions and function status printed on the chart, or user-entered comments printed on the chart.

Common-mode : Capability of a differential device to cancel the effect of a (in-phase) signal equally applied to two inputs of the device.

Cutoff frequency : Frequency at which filter output amplitude becomes $1/\sqrt{2}$ of the input.

Digital : A quantity that can be expressed in numbers.

Division (DIV) : Unit equivalent to one square of the recording paper grid.

LED : Light-Emitting Diode

Line dip detector : Power supply failure detector.

Logic signal : Binary expression of the input signal consisting of high and low levels.

Low-pass filter : A filter that allows only frequencies below a certain threshold to pass.

Maximum floating voltage : Maximum voltage that can be applied between the ground terminal and an input unit.

PT : Voltage converter

Ripple component : AC noise component.

Sampling : Conversion from an analog waveform to a digital string.

Sampling rate : Speed at which sampling is repeated.

Shot length : Total sampling length expressed in number of divisions. (recording lenght)

Trigger : Signal condition that makes operation start.

Unbalanced input : Signal input method that uses one of the two input terminals as reference.

Word : Digital data unit. Amount of data obtained by sampling the input signal once, converting it into digital.

XY matrix RAM : Memory area used to display XY waveforms.

Zero position : 0-V position on the chart grid.

A

8 9 3 4

ANALOG UNIT(RMS TYPE)

INSTRUCTION MANUAL

— TABLE OF CONTENTS —

SAFETY PRECAUTIONS

- This manual contains information and precautions intended to ensure a safe operation of the unit and to keep it in a safe condition. Please read the following notes on safety before using the unit.

Safety Symbols

⚠	Refer to the related section(s) of the manual when handling a part of the unit bearing this symbol. When found in this manual, read the accompanying explanation.
⏚	Indicates a protective ground terminal.

⚠ DANGER

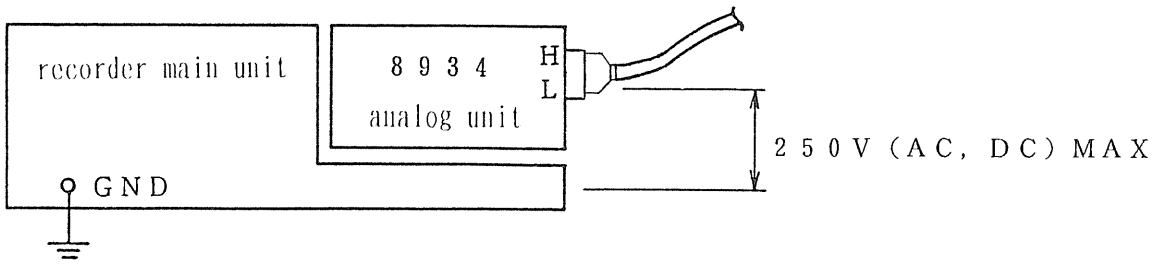
- To prevent electric shocks and unit damage, do not apply an AC or DC voltage over 250 V between an input unit and the main unit case or between input units. In particular, prevent voltage from large-current power lines from being applied. Otherwise, a short-circuit accident may occur.
- Do never connect the input terminal to an AC power line over 250 V or a ungrounded DC power line over 250 V.
- Use the unit with all input units installed. If measurement is performed with an input unit missing, you may suffer an electric shock.

CAUTION

- The maximum permissible input voltage for the input terminal is 500 Vdc, 250 Vac. Take care to avoid voltage levels this limit.
- Use only the attached 9152 input cord.

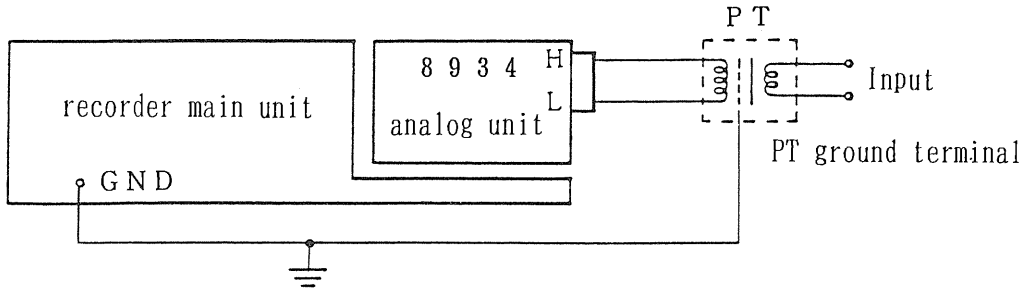
CAUTION

Recorder main unit and 8934 analog unit are mutually insulated.

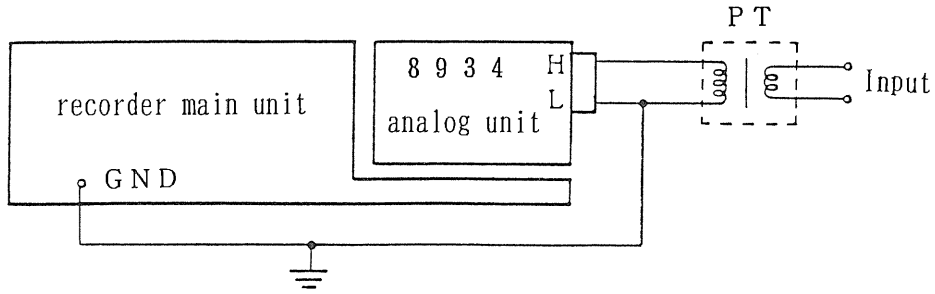


CAUTION

- Always use a PT when measuring over floating voltage.
- When using a PT for measurement of AC power lines, etc., be sure to ground it.



(a) PT with ground terminal



(b) PT without ground terminal

2. Specifications

8934 Analog Unit (at 23 ℃± 5 ℃) Accuracy assurance period : 6 months

Input method : Balanced input
(Differential input, input and output mutually insulated)

Measurement ranges : 2, 5, 10, 20, 50, 100V/DIV

DC amplitude accuracy : ± 1 % f. s.

RMS accuracy : ± 2 % f. s. (DC, 40～ 1 kHz)
± 8 % f. s. (1 kHz～100kHz } 10%～200% of effective input range

Zero position adjustment : 21 settings, placed at 10 % intervals on the 100 % recording width and fine adjustment
When the zero position is set between 0 and -100 %, input levels up to twice the set range level can be recorded in wither the DC or RMS mode. However, the input level must not exceed the rated input voltage.

Zero position accuracy : ± 1 % f. s.

Frequency characteristic : DC to 200kHz (-3dB)

RMS response time : ↥100ms (TYP.) (0→90% f. s) ↧200ms (TYP.) (100 →10% f. s)

RMS crest-factor : 4 (The input level must not exceed the exceed the rated input voltuge in maximum peak voltage.)

Input RC : 2MΩ approx. 2pF at 100 kHz

Low-pass filter : Cutoff frequency (-3dB) approx. 5Hz, approx. 500Hz, and OFF setting
Add 100 msec to the response time when the 5Hz filter is ON
(0→90% f. s., 100→10% f. s);
Add 1 msec to the response time when the 500Hz filter is ON
(0→90% f. s., 100→10% f. s).

A/D conversion resolution : 8 bits

Maximum sampling speed : 500kS/s (sampling interval 2μs)

Permissible input voltage : AC 250V, DC 500V Continuous

Maximum floating voltage : AC/DC 250V (between input unit and case, and between input units)

Insulation resistance 100MΩ minimum/DC 500V, AC 1.5kV/1 minute
and dielectric strength : (between input unit and case, and between input units)

Common mode masking ratio : 80dB min. (s ource impedance 100 Ωmax. at 50 or 60 Hz)

Temperature characteristic : ±0.1% f. s./ ℃ (for both zero position and gain)

Operation environment : Temperature 0℃ to 40℃ Humidity 35% to 80% (no condensation)

Storage environment : Temperature -10℃ to 50℃ Humidity 10% to 80% (no condensation)

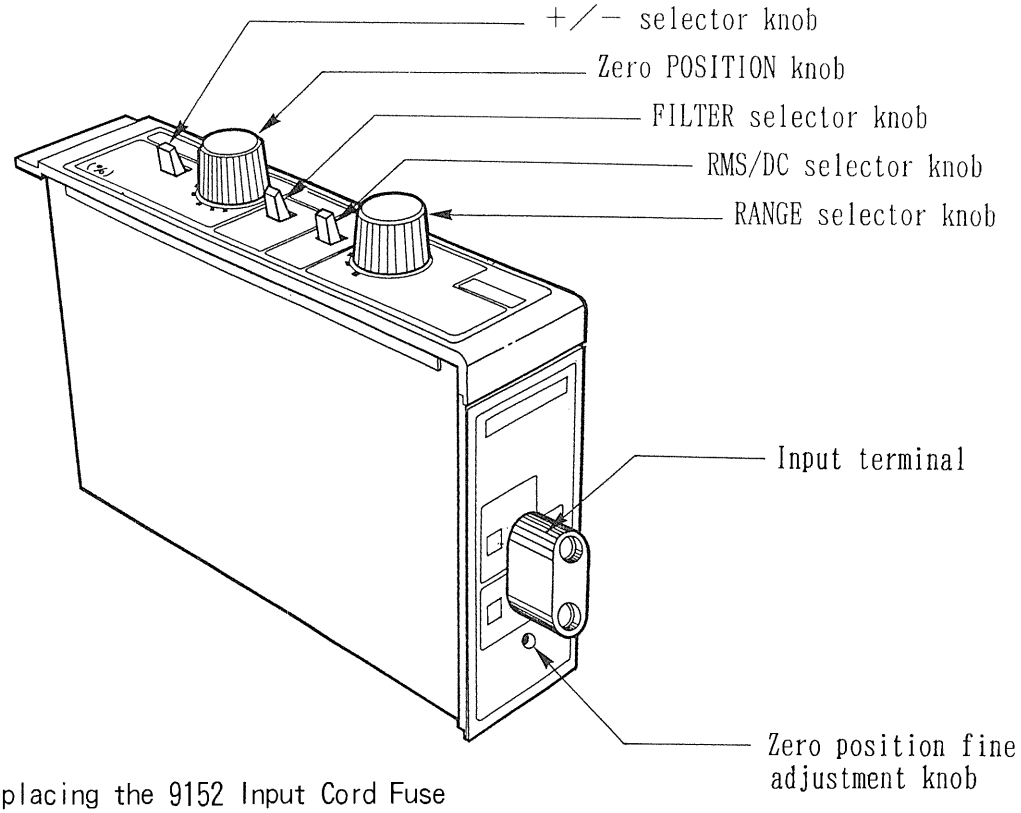
Dimensions and weight : Approx. 34H×124W×82D(mm) (excluding protrusions) ; approx. 230g

Accessories : 9152 input cord
Fixing screws of input unit 2
Spare fuse (0.5A/250V non-arcing type 5.2 dia×20mm)2

3. Outlint

This is an analog unit for the 8815 and 8830 series Memory Hi-corders. It makes it possible to use the recorder for direct recording of voltage waveforms on 200 Vac lines. It also allows recording of RMS voltage levels.

4. Part Names

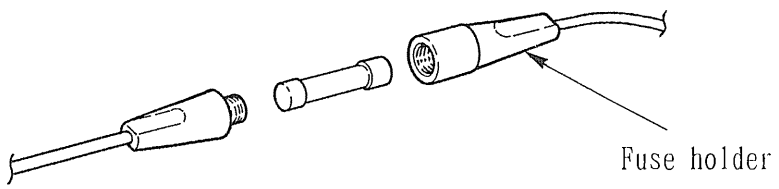


5. Replacing the 9152 Input Cord Fuse

CAUTION

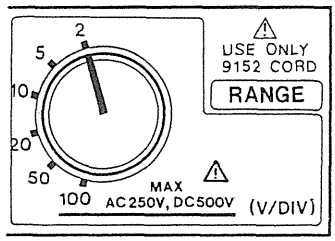
- When replacing the fuse, be sure to disconnect the input cord from both the measurement object and analog unit.
- The new fuse must be of the specified rating.

  0.5A 250V, with non-arcing type 5.2 dia × 20mm



6. Operations

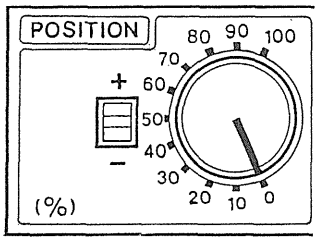
6 − 1. Measurement RANGE



Sets the voltage corresponding to one square (1 division) on the recording paper voltage axis. Since the voltage axis is ten-squares long, the maximum voltage that can be recorded is equal to ten times this setting.
However, the maximum voltage must not exceed 500 Vdc 250 Vac.

[Setting Range]
10mV to 50V (12 settings)

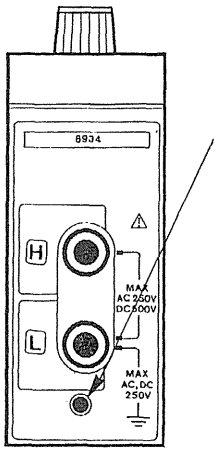
6 − 2. Zero POSITION



Selects the 0 V position on the recording paper.
The zero position can be set at 10% intervals over the range from −100% to +100%.

[Setting Range]

(+ side) 0 % to +100%
(− side) 0 % to −100% } 22 settings



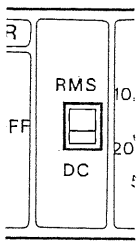
Zero position fine adjustment knob

When the zero position does not coincide with a square on the recording paper, turn the fine adjustment potentiometer with a flathead screw-driver until they align. If this adjustment does not wark, contact your dealer.

NOTE

- During waveform recording do not change the setting of the POSITION switch rapidly or set the switch to a position between the clicks. Doing so may result in display of erroneous values; however, such errors are not a sign of trouble with the instrument.

6 − 3. RMS/DC Selector



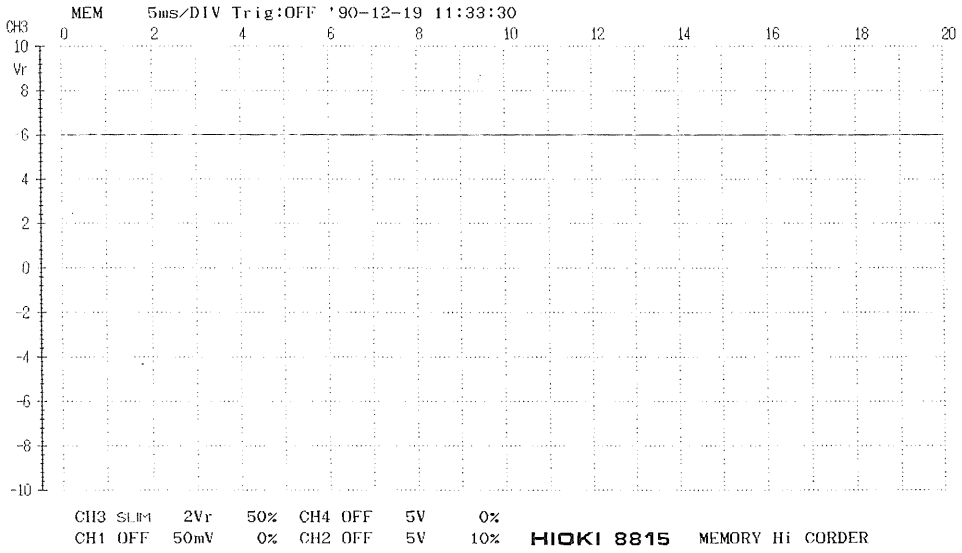
RMS : The input voltage is converted to true RMS value before recording.

DC : The input voltage is recorded as is.

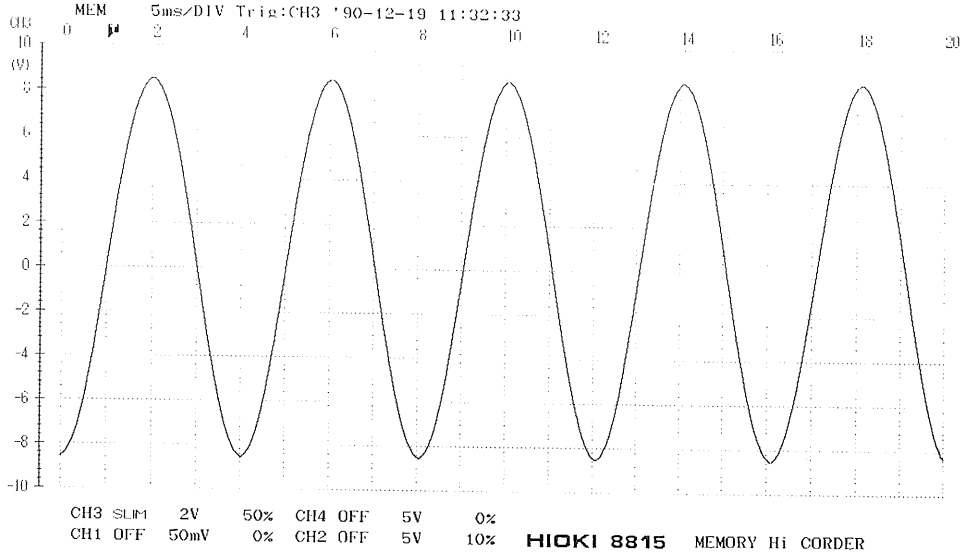
Note: The symbol Vr is displayed during RMS measurement.

[Waveform Example]

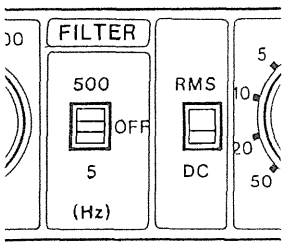
RMS mord



DC mord



6 – 4. FILTER



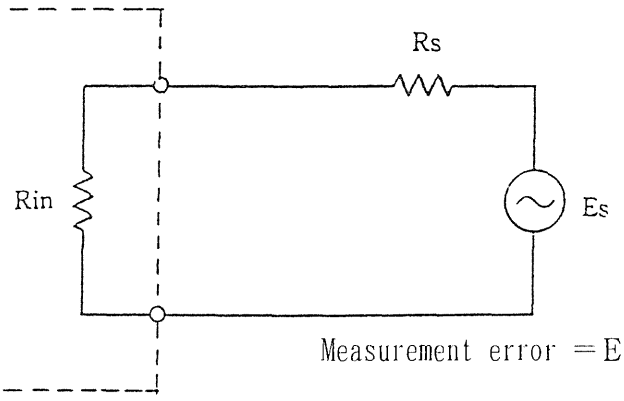
The frequency band is limited by the built-in low-pass filter.
Attenuation gradient: -6 dB/oct.
Cutoff frequency: Approx. 5 Hz/500 Hz

This filter is effective for preventing the following phenomena:

- Thickening of the recording line caused by signal ripple components and noise during level recording in the recorder mode, because of the use of high-speed sampling and a high-frequency amplifier.
- Thickening of the recording line due to ripple contained in the output from a transducer, etc.
- The filter also prevents pulse noise from affecting RMS measurements.

6 – 5. Measurement Error Due to Source Impedance

- Source impedance is not a problem when sufficiently low compared to the unit's input impedance. It affects measurement, however, if it is above a certain level.



E_S : Signal voltage
R_S : Source impedance
R_{in} : Input impedance

$$\text{Measurement error} = E_S \left(1 - \frac{R_{in}}{R_S + R_{in}} \right)$$

[Example] Since the unit's input impedance is 2MΩ, a source impedance of 10 kΩ will cause an error of approx. 0.5%.

7. Unit Replacement

The input unit removal method will be explained next. For unit installation, reverse this procedure.

① Remove input cords from all input units.

② Turn the main unit power off and unplug its power cord.

CAUTION

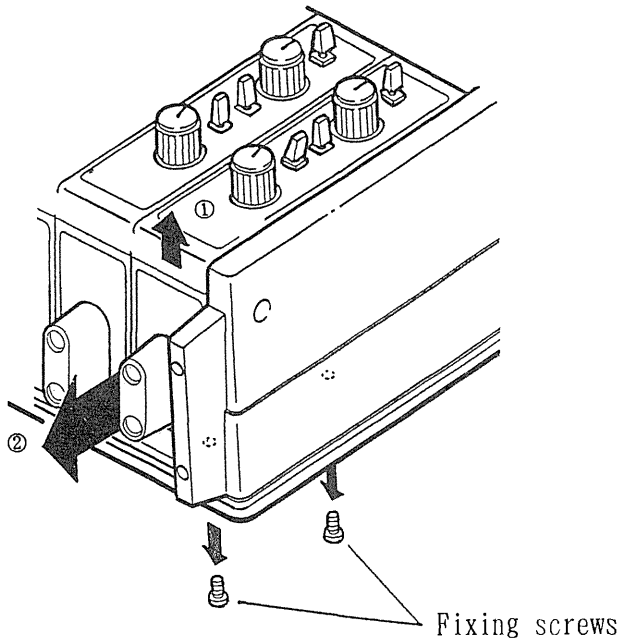
Always confirm that input cords are disconnected and turn power off before detaching the input unit.

③ Remove the two fixing screws securing the input unit with a Phillips-head screwdriver as shown in the figure.

④ Push the input unit up a little in the direction of arrow ①, then put your fingers in the gap between the input and main units and pull in the direction of arrow ② to remove.

CAUTION

When pulling the input unit off, do not force the knobs and switches on its top panel.



CAUTION

- Never use the recorder with an input unit removed. If measurement is performed with an input unit missing, you may suffer an electric shock.
- If the recorder has to be used with an input unit removed, install a 9508 blank panel (optional accessory) in its place.

B

8935

TEMPERATURE UNIT

INSTRUCTION MANUAL

— TABLE OF CONTENTS —

SAFETY PRECAUTIONS

- This manual contains information and precautions intended to ensure a safe operation of the unit and to keep it in a safe condition. Please read the following notes on safety before using the unit.

Safety Symbols

⚠	Refer to the related section(s) of the manual when handling a part of the unit bearing this symbol. When found in this manual, read the accompanying explanation.
⏚	Indicates a protective ground terminal.

⚠ DANGER

- To prevent electric shocks and unit damage, do not apply an AC or DC voltage over 250 V between an input unit and the main unit case or between input units. In particular, prevent voltage from large-current power lines from being applied. Otherwise, a short-circuit accident may occur.
- Use the unit with all input units installed. If measurement is performed with an input unit missing, you may suffer an electric shock.

The following symbols appear in the manual where wrong operation can lead to a serious accident. Always follow the directions.

⚠ Danger	Wrong operation or handling may cause danger of personal injury.
NOTE	Important matter in the operation.

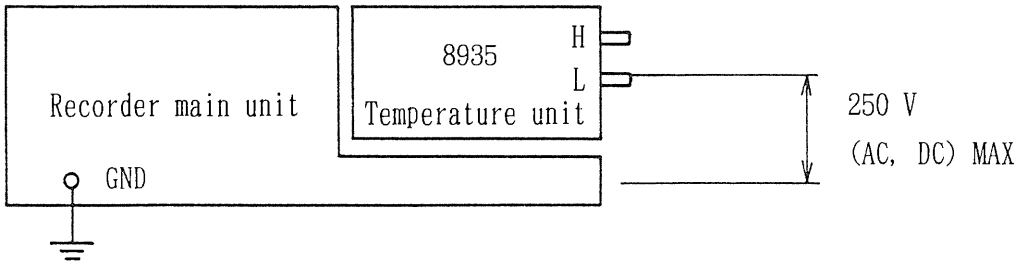
1. Safety Precautions

CAUTION

- Input of this unit is for the only thermocouple.
  Never apply any voltage except the thermocouple.
- Up to 100 V the circuit of AC and DC can be protected.
  Never apply exceeded 100 V voltage.

CAUTION

- The recorder main unit and the 8935 temperature unit are floated.



2. Specifications

8935 Temperature Unit (at 23℃± 5 ℃) Accuracy assurance period : 6 months

Input method : Balanced input (Input and output mutually insulated)

Measurement levels : 10, 20, 50, 100℃/DIV

(Minimum resolution) : (0.4) (0.8) (2.0) (4.0℃)

Measurement input levels : K (CA) -50℃～1100℃

J (IC) -50℃～800℃

T (CC) -50℃～400℃

Standard contact compensation : Autmatic compensation (temperature IC)

Accuracy : ±1%f.s. ±2℃

(Including standard contact compensation accuracy)

Zero position adjustment : 21 settings, placed at 10% intervals on the -100% to 100% recording width.

When the zero position is set between 0 and -100%, measurement levels up to twice the set range level can be recorded. However, the input level must not exceed the rated input measurement).

Input resistance : 5MΩ approx. (OFF setting approx. 20kΩ)

Frequeucy characteristic : DC to 500Hz (-3dB, typ.)

Low poss filter : Cutoff frequency approx. 5Hz (-3dB, typ.), OFF

Response time : ↗ 1ms (typ.) (0 →90% f.s.)

↘ 1ms (typ.) (100→10% f.s.)

When low pass filter is on ↗100ms (typ.)(0→90%f.s.)

↘100ms (typ.)(100→10%f.s)

A/D conversion resolution : 8 bits

Meximum sampling speed : 50kS/s (sampling interval 20μs)

Permissible input voltage : AC/DC 100V

Maximum floating voltage : AC/DC 250V (between input unit and case, and between input units)

Insulation resistance and dielectric strength : 100MΩ minimum/DC 500V, AC 1.5kV/1 minute

Common mode masking ratio : 80dB minimum (Source impedance 100Ω maximum at 50 or 60 Hz)

Temperature characteristic : ±0.1% f.s./ ℃

Input terminal : Two terminals

Operation environment : Temperature 5℃ to 40℃ Humidity 70% PH maximum (no condensation)

Storage environment : Temperature -10℃ to 50℃

Humidity 70% PH maximum (no condensation)

Dimensions and weight : Approx. 34H×124W×82D(mm) (excluding protrusions) ;

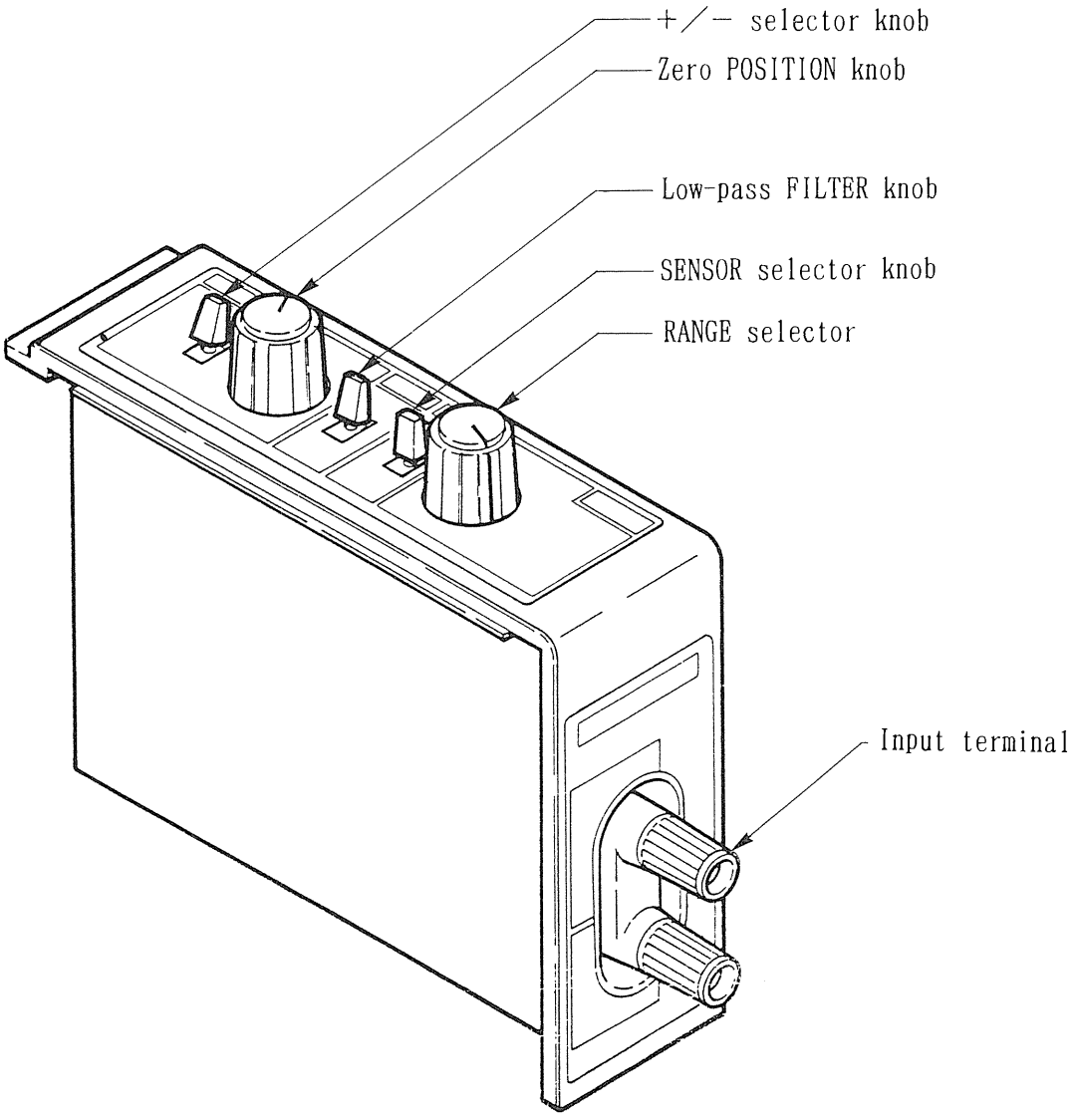
approx. 200g

Accessories : Fixing screws of input unit 2

3. Outline

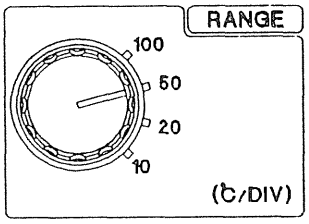
This is a thermocouple input unit for temperature measurement of the 8815 and 8830 series Memory Hi-corders. It makes it possible to use the recorder for direct connecting three kinds of temperature and temperature measurement.

4. Part Names



5. Operations

5－1. Measurement RANGE



Sets the voltage corresponding to one square (1 division) on the recording paper voltage axis. Since the voltage axis is ten-squares long, the maximum voltage that can be recorded is equal to ten times this setting.

However, if the temperature lower the measurement input range lower limit, it is recorded to the lower of the recording paper. If the temperature exceed the measurement input range higher limit, or the thermocouple is burnt out, it is recorded to the upper of the recording paper.

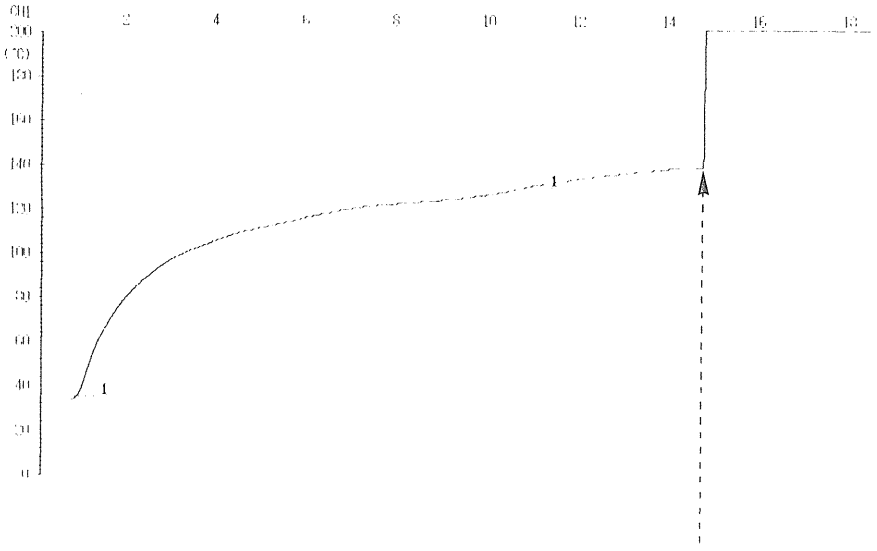
〔Setting range〕

10℃, 20℃, 50℃, 100℃／ＤＩＶ

〔Measurement input range〕

Ｋ（ＣＡ）	－５０℃～１１００℃
Ｊ（ＩＣ）	－５０℃～８００℃
Ｔ（ＣＣ）	－５０℃～４００℃

〔Weveform example〕



Burnt out thermocouple

NOTE

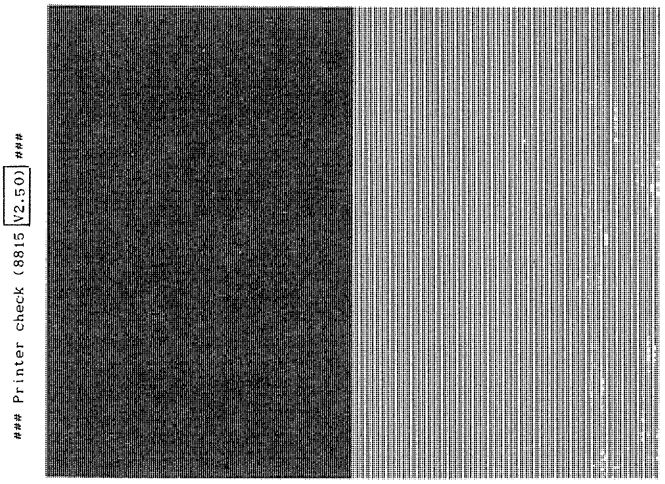
● The gauge in the 8815, 8830 series which has ROM virsion after the following are corresponded with the all measurement range. However, in the virsion before the following 8815, 8830 series, the gauge dose not correspond with 100 ℃/DIV range.

8815	V 2. 50
8830, 8831 (standard, internal GP-IB)	V 1. 50
8830, 8831 (internal RS-232C)	V 5. 50
8832, 8833	V 1. 50

Rom virsion of the 8815, 8830 series main unit is checked by the following method.

①8815 ·····Turn the power on pressing PRINT key.

Display the version next Printer check



②8830, 8831, 8832, 8833·····

Set SYSTEM mode and check ROM/RAM.

Display a virsion next to *** ROM/RAM check ***.

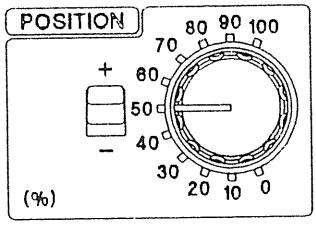
(8832 example)

```
*** ROM/RAM check *** V1.50

                          FEDCBA9876543210
   * Storage bus          oooooooooooooo   OK.
   * Bank                      ooooo       OK.
   * Work bus              oooooooooooooo   OK.

   * ROM                  OK.
   * V-RAM1                OK.
   * V-RAM2                OK.
   * Storage RAM           OK.
   * Work RAM              OK.
```

5 - 2. Zero POSITION



Selects the 0℃ position on the recording paper. The zero position can be set at 10% intervals over the range from -100%to + 100%.

〔Setting range〕

(+ side) 0～+100%

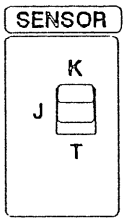
(− side) 0～+100%

} 21 Positions

NOTE

- During waveform recording do not change the setting of the POSITION switch rapidly or set the switch to a position between the clicks. Doing so may result in display of erroneous values; however, such errors are not a sign of trouble with the instrument.

5 − 3. Sensor selector

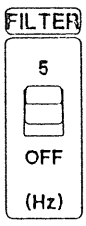


This unit corresponds three kinds of thermocouple, K(CA), J(IC), T(CC). Set the thermocouple for using.

NOTE

- If setting of the sensor selector switch and using thermocouple are different, erroneous values are displayed. Note that the sort of sensor is not displayed on the recording paper.

5 − 4. FILTER



The frequency band of the input signal is limited by built-in low-pass filter.

Attenuation gradient : −6dB/oct.

Cutoff frequency : Approx. 5Hz

This filter is effective for preventing the following phenomena.

- Influence of the ripple contained or noise of the signal in level recording (high-speed sampling) by the recorder.

6. Setting site

NOTE

- If the input terminal is exposed to a high wind, heat balance may be unstable, and it may cause an error. When making measurement in such a condition, arrange the unit or so forth to not be exposed to a high wind directly.
- Sudden changing the temperature may be cause unstable heat balance, and it may cause error. Leave around 30 minutes before making measurement.

7. Using GP-IB interface

Responded value is 6 by executing GP-IB command "QAM" (a sort of input unit).
Refer to "GP-IB interface" instruction manual for details.

8. Unit Replacement

The input unit removal method will be explained next, For unit installation, reverse this procedure.

① Turn the main unit power off and unplug its power cord.

CAUTION

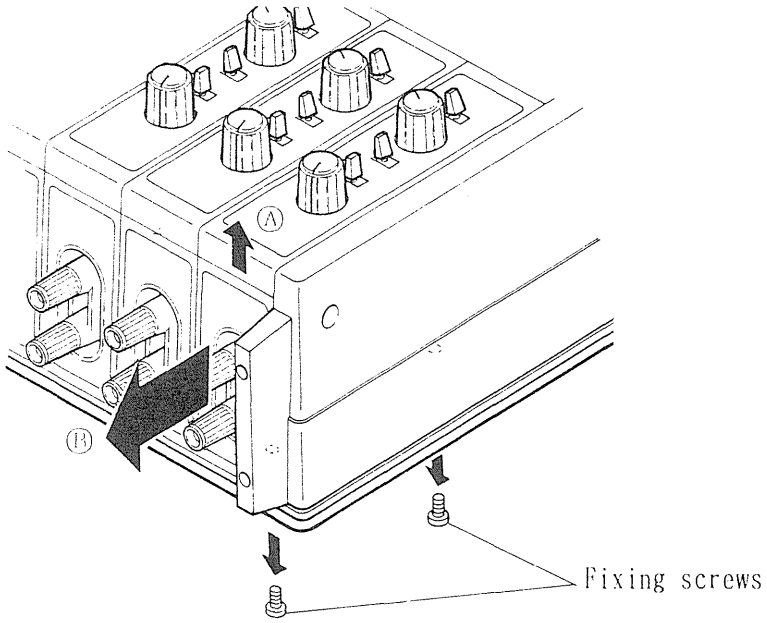
- Always confirm that input cords are disconnected and turn power off before detaching the input unit.

② Remove the two fixing screws securing the input unit a phillips + head screwdriver as shown in the figure.

③ Push the input unit up a little in the direction of arrow Ⓐ, then put your fingers in the gap between the input and main units and pull in the direction of arrow Ⓑ to remove.

CAUTION

- When pulling the input unit off, do not force the knows and switches on its top panel.



⚠ DANGER

- Never use the recorder with an input unit removed. If measurement is performed with an input unit missing, you may suffer an electric chock.
- If the recorder has to be used with an input unit removed, install a 9508 blank panel (optional accessory) in its place.

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A 8934 ANALOG UNIT (RMS Type)

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