DL 2100A

Model 7002
DL2100A
Digital Oscilloscope

IM 7002 - 01E
1st Edition

FOREWORD

Thank you for purchasing this DL2100A Series digital oscilloscope.

Please read this operation manual through before operating the unit so that you will be able to use all of its functions efficiently and correctly. A thorough understanding of its functions and operations is essential if full justice is to be done to the unit's performance.

FD No. 10003 - Q

OVERVIEW & FEATURES

The DL2100A Series is a digital oscilloscope whose basic performance provides two channels with simultaneous high-speed 200M sample/s operation, 8-bit vertical resolution, and 300MHz frequency bandwidth for repetitive waveforms.

FEATURES

1. 128kW/CH large memory
2. New trigger detection circuitry (enhanced trigger setting)
3. Abundant high-speed computing functions made possible by a 32-bit RISC architecture signal processor.

* There are slight differences in the functions among individual models (DL2110A to DL2140A). Refer to the specifications in Chapter 7 for further details.

CONTENTS

Chapter 7. SPECIFICATIONS

APPENDIX

Chapter 1. BEFORE OPERATION

This chapter describes preparations to be made before starting the operation of this DL2100A Series digital oscilloscope.

Anyone who has not used this unit before is urged to read this chapter before commencing operation.

ITEMS

1.1 When the Instrument Arrives

When you receive the unit, check that all the accessories are accounted for, and that it has sustained no damage.

1.1.1 Accessories

This unit comes with accessories shown in Figure 1.1 and listed in Table 1.1. Check to see that they are all properly included. If some are found to be missing or there is a problem with their operation, contact your dealer or nearest Yokogawa service center. (See back cover.)

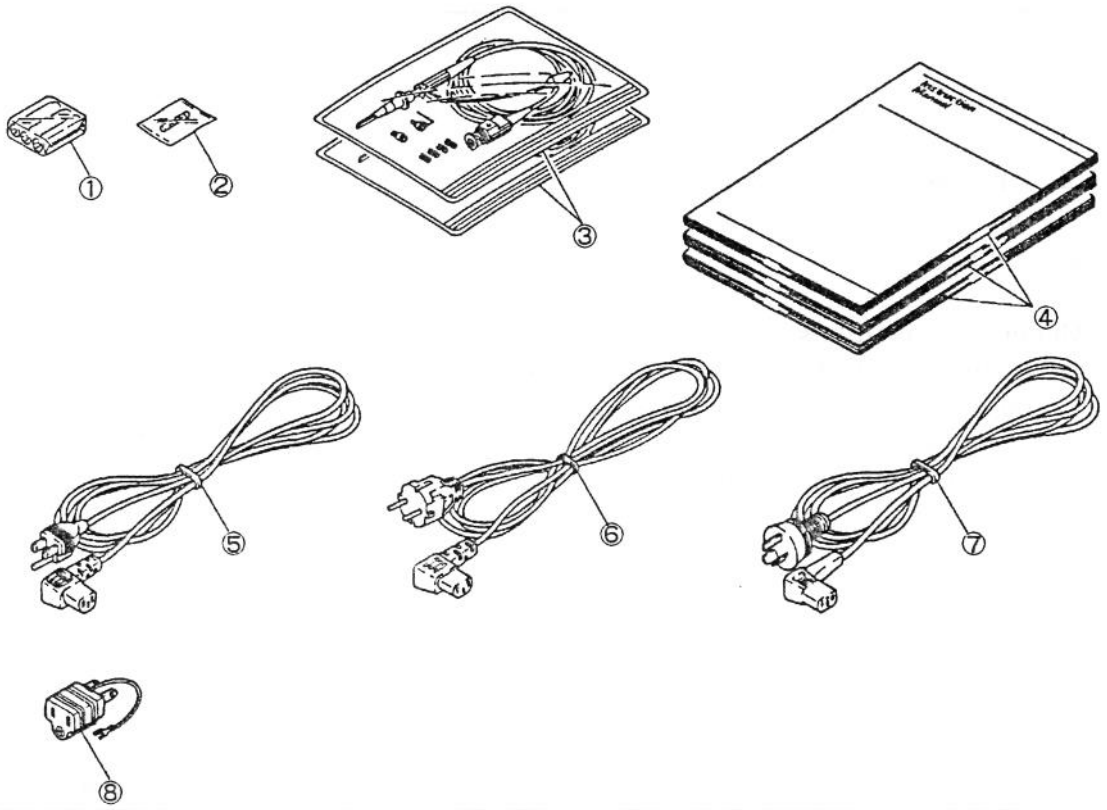


Figure 1.1 Accessories

Table 1.1 Accessories

Number	Item	Part Number	Quantity	Remarks
①	Dry cell	A 9005ED	3	UM3 (SUM-3)
②	Fuse	A 9189KF	1	250V 6A time-lag fuse } Specified
		A 9123KF	1	250V 3A time-lag fuse } one
③	10 : 1 voltage probe (10MΩ, 1.5m)	700951	2	Refer to operating instructions provided.
④	Instruction manual		1	Manual for this unit, communication manual, and operator guide
⑤	Power cord	A 9008WD	1	UL standard } Specified one
⑥	Power cord	A 9011WD	1	VDE standard } Specified one
⑦	Power cord	A 9026WD	1	SAA standard } Specified one
⑧	Adapter	A 9508KC	1	JIS standard

Note: When a printer (option) is added to the unit, a roll of printing paper will be provided as an accessory.
If JIS standard grounded cable was specified, UL power code ⑤ with 3 pin to 2 pin adapter ⑧ would be supplied.

1.1.2 Precautions for Operation

The following items must be complied with if correct and safe operation of this unit is to be ensured.

(1) General Precautions

(a) Keep the top of the unit free from objects.

Do not place any object containing water on top of the unit. In the event that water has seeped into the unit, disconnect it immediately from the power outlet and contact your dealer or the nearest Service Center. Also, do not place any heavy or large objects on the unit.

(b) Before carrying or moving this unit

Ensure that it has been disconnected from the power outlet and that its external connecting cables have also been disconnected.
Be careful when carrying the unit since it weighs about 20kg.

(c) Maintenance

Do not use benzene, paint thinner or a chemically treated duster to clean the unit's cabinet or control panel since these parts are composed mainly of plastic materials. Instead, use a soft cloth and gently wipe away any dirt or dust.
With stubborn dirt, soak a cloth in a diluted solution of neutral detergent, wring it out and clean. Then take up any remaining moisture with a dry cloth.

(d) Static electricity

Do not bring any object charged with static electricity near the signal connectors.

(e) Insecticide sprays

Do not spray the cabinet or control panel with insecticides or other such volatile substances. Do not allow rubber or vinyl products to remain in contact with them for long periods.

(f) After use

Ensure that the power switch is set to the OFF position.

(g) **Long-term suspension of use**

Keep the unit disconnected from the power outlet.
Remove the internal batteries if the unit is to be stored for a prolonged period.

(h) **Avoid shocks to input connectors and probe**

If a shock is sustained by the input connectors or other such parts, it may be converted into electrical noise and observed as such. Be sure not to administer any shocks while the unit is operating.

(2) **Safety Precautions**

(a) **Do not touch the inside parts.**

Do not remove the unit's upper cabinet. Inside are high-voltage areas and any contact with these parts is not only dangerous but could cause malfunction.
Contact your dealer or nearest service center for all servicing and adjustments.

(b) **In case of malfunction**

It is dangerous to continue using the unit if it emits smoke, abnormal noises or odors or otherwise shows any symptoms of malfunction. Disconnect it immediately from the power outlet and discontinue its use. Contact your dealer or nearest service center.

(c) **Fan**

A fan is mounted at the rear of the unit to reduce the internal temperature rise. Take care not to obstruct the fan.
If the fan has stopped due to malfunction, the "fan stopped" warning message will appear on the CRT. When this happens, immediately disconnect the unit from the power outlet and contact your dealer or nearest service center.

(d) **Grounding**

To ensure safety, ground the unit before use. The low sides of the input connectors on the front panel have the same potential as the cabinet.

(e) **Power cord**

Avoid placing heavy objects on the power cord and allowing it to touch any heating device. If the cord is damaged, contact your dealer. The part number of the power cord should be specified. (See page 1-2.)
When disconnecting the power cord plug from a power outlet, do not tug at the cord but take a firm hold of the plug instead and pull.

(3) Installation Location

Avoid installing this unit in the following locations.

(a) **Poor ventilation**

Ventilation openings are provided in the cabinet to prevent the temperature inside the unit from rising too high. Do not install the unit where it will be poorly ventilated.

(b) **Exposure to direct sunlight or near heaters**

The cabinet and internals will be adversely affected if the unit is exposed to direct sunlight or installed near a heater.
Choose a location where the temperature changes minimally and where it is as close to 23°C as possible.

(c) **Excessive soot, steam, moisture, dust, corrosive gases, etc.**
Soot, steam, moisture, dust, corrosive gasses, etc. will adversely affect the unit. Avoid locations where they are present.

(d) **Near electromagnetic fields**
Use of this unit near strong electromagnetic fields may cause distortion in the CRT display. Do not bring magnets or any other device that generates magnetic fields near this unit.

(e) **Mechanical vibration**
Installing this unit in a location susceptible to a great deal of mechanical vibration will adversely affect the mechanical parts of the unit. It may also prevent the printer (option) from recording properly. Select a location characterized by minimal mechanical vibration.

(f) **Unstable surfaces**
Choose a flat, stable surface to install this unit. Using the unit at an angle or on an unstable surface will adversely affect the recording results. If the unit falls from a height or is dropped, it will be damaged.

1.2 Preparations

1.2.1 Battery Installation and Replacement

The batteries are installed under the panel at the rear of the main unit.

① Pull the knob at the top of the battery cover and remove the cover.

② Insert three dry cells (SUM-3) and ensure that their polarities are aligned properly.

③ Return the battery cover and lock it into place by pushing in the knob.

When the battery voltage falls below the rating, "Battery failure" will appear on the CRT when the power is turned ON, and "NO" will be indicated for "Battery" on the overview screen. (See page 3-155.)

When replacing the batteries, leave the power switch ON.

If the power switch is OFF, the unit will be initialized. (See page 3-177.)

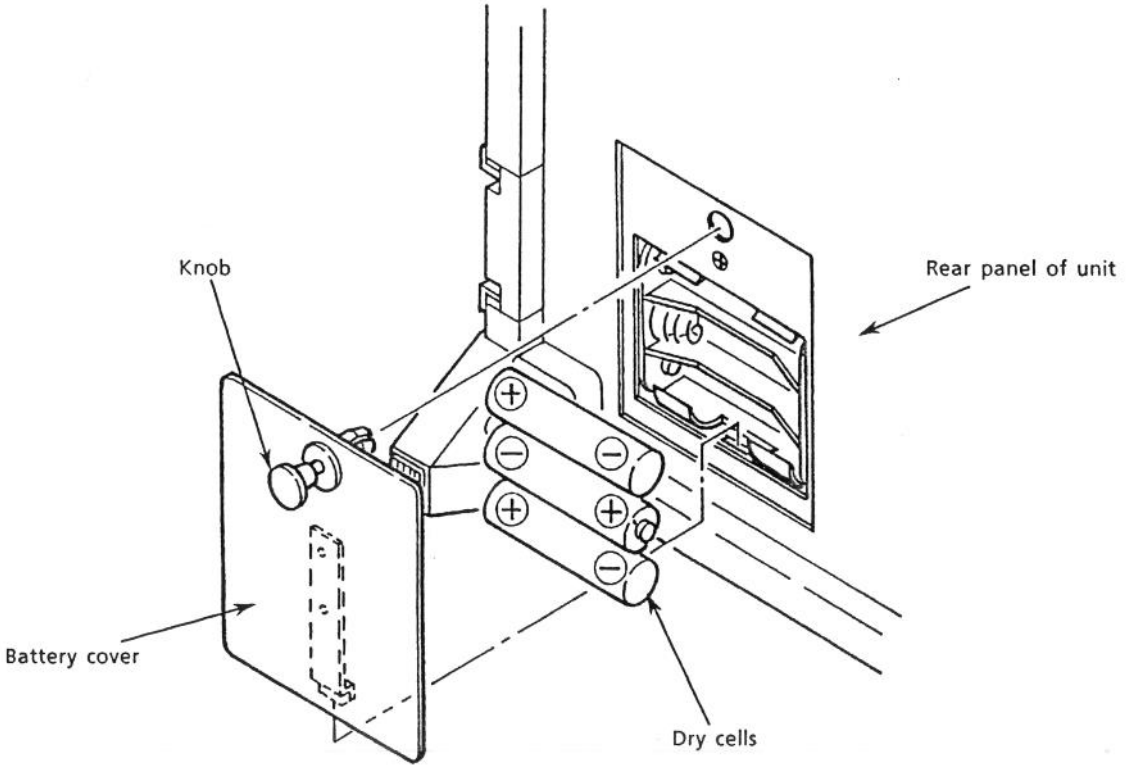
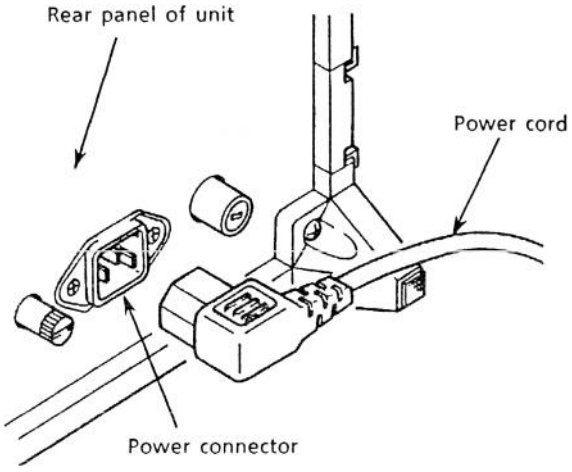


Figure 1.2 Installing the Batteries

1.2.2 Connection with Power Supply

Once the installation location has been determined, connect the accessory power cord to the power connector on the rear panel of the unit as shown in the figure below.



CAUTION

An improper power voltage will damage the instrument. Be sure to use a source voltage within the voltage range printed near the instrument power connector.

Figure 1.3 Connection with Power Supply

Note: Before connecting the cord to the power connector, make sure that the power switch on the main unit has been set to OFF.

OPERATORS SAFETY

A grounding conductor in the power cord is provided to protect the operator from electric shock.

The power cord must be plugged into a properly wired receptacle before connections are made to the input or output terminals.

1.2.3 Turning the Power Switch ON and OFF

The power switch is located at the bottom left of the front panel, as shown in the figure below. Pressing it firmly once turns power ON, and pressing it again turns power OFF.

Once the power has been turned ON, waveforms will appear on the screen, provided that the unit is functioning properly.

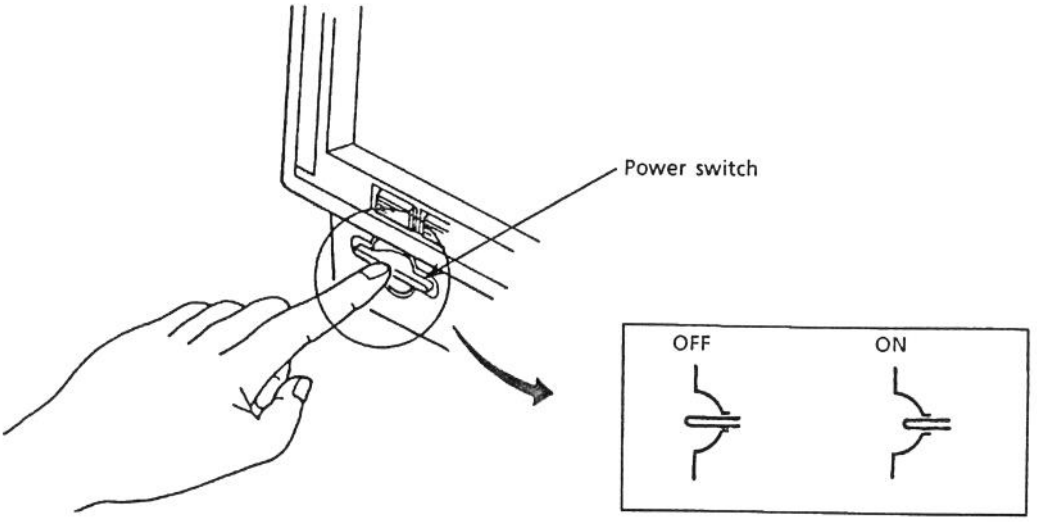


Figure 1.4 Power Switch

If power to the unit is interrupted, the panel setup parameters immediately before the power failure will be retained in the main unit memory by the battery back-up function. When the power is subsequently restored, measurement will commence under the same panel setup parameters as were immediately before the power failure. If you wish to set parameters from the initialized state (see page 3-177), press the SHIFT key followed by the INITIAL key.

Note: The unit is shipped from the factory in the initialized status.

Chapter 2. COMPONENT NAMES AND CRT DISPLAYS

ITEMS

2.1 Component Names and Functions

2.1.1 Front Panel

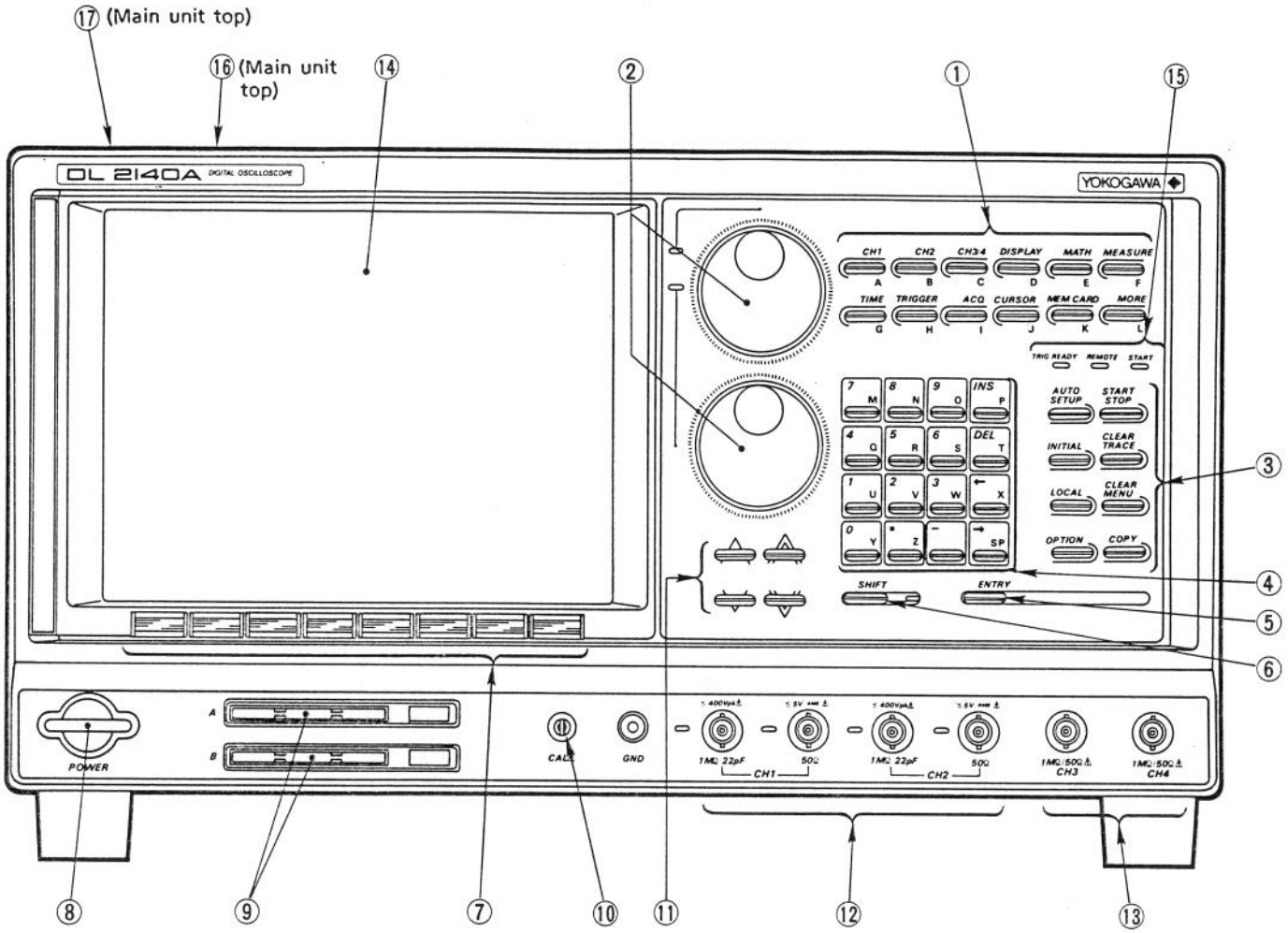


Figure 2.1 Front Panel Components

① **Menu keys**

CH1	:	Channel 1 setup parameters (volt/div., offset, coupling, etc.)
CH2	:	Channel 2 setup parameters (volt/div., offset, coupling, etc.)
CH3/4	:	Channels 3 and 4 setup parameters
DISPLAY	:	Display format (including scroll and window settings)
MATH	:	Computation operations between channels, digital filtering and other waveform analysis items
MEASURE	:	Waveform parameter item settings
TIME	:	Time axis settings (time/div., position, etc.)
TRIGGER	:	Simple trigger (level trigger) settings
ACQ	:	Record length, averaging, accumulate display and sequential store settings
CURSOR	:	Cursor control
MEM CARD	:	IC card control
MORE	:	Expanded functions

- Enhanced trigger set settings
- Communications (GP-IB, RS-232C (option)) settings
- Auto sequence, pattern search and compare mode settings
- Brightness adjustment, date and time settings

② **Rotary knobs**

Rotary knobs are used for the settings listed below. Settings go into effect when the LED's on the left of the knobs and keys light.

Rotary knob 1 (upper) : Volt/div (CH1, CH2), Time/div, Trigger level, ↔ Zoom, ↔ Scroll, ↔ Marker 1, ↕ CURSOR1, ↔ CURSOR1, etc.

Rotary knob 2 (lower) : Offset (CH1, CH2), Position (TIME), Trigger delay, ↕ Zoom, ↕ Scroll, ↔ Marker 2, ↕ CURSOR2, ↔ CURSOR2, etc.

③ **Function keys**

AUTO SETUP	:	Automatically sets the instrument for optimum.
START/STOP	:	Controls the starting and stopping of the measurement operations. (While the data is being acquired, the green START LED lamp will be ON, and will go out when acquisition stops.)
INITIAL	:	Sets all the settings to the initialized status. (Refer to page 3-177 for details of this status.) This initialize key is activated by pressing the SHIFT key (SHIFT LED lights) and the INITIAL key.
CLEAR TRACE	:	Clears the waveform display.
LOCAL	:	Switches from the GP-IB remote mode to the local mode. In the local mode, the green remote LED goes OFF.
CLEAR MENU	:	Clears the menu to leave only the waveform display. The menu reappears when the menu key is pressed.
OPTION	:	Selects optional functions (not used at present).

COPY : Enables hard copies to be made simply.

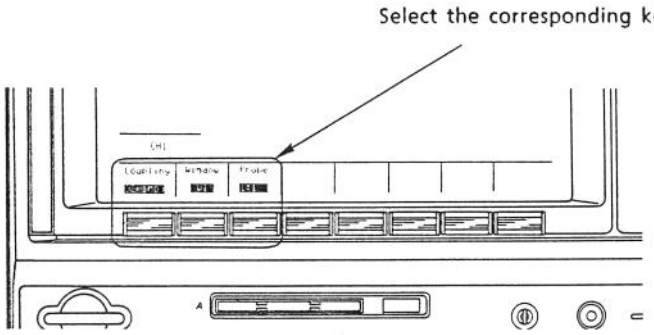
Note: A hard copy cannot be made while data is being acquired. Press the START/STOP key once to stop acquisition and then press the COPY key. While making a hard copy, you cannot change settings, acquire waveforms or perform computational operations.

④ **Numeric entry keypad** : Used for the trigger delay, time-axis scrolling and other settings which can be directly entered as numeric values or which involve user-defined computational expressions or constants. The letter keys can also be used by pressing the shift key.

⑤ **Entry key *(ENTRY)*** : Values input through the numeric or letter keys are registered by pressing the entry key. When the entry key is pressed, the shift key is released.

⑥ **Shift key *(SHIFT)*** : Pressing the shift key shifts the blue letters on the keys into effect; pressing it again cancels the shift.

⑦ **Soft keys** : These select the soft key menu items indicated above the soft keys. The items associated with the soft keys change depending on which menu key is pressed.



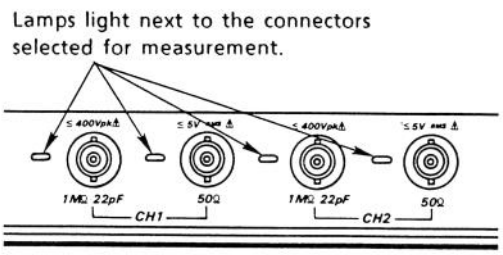
⑧ Power switch *(POWER)* : Power ON/OFF switch

⑨ IC card slots *(A, B)* : The IC cards are inserted into these slots for use. The upper slot corresponds to drive A and the lower slot to drive B.

⑩ *CAL* signal output connector : This normally outputs a 1kHz, 0 to 4V square wave. It is used for probe adjustments.
To change the output waveform, use CALIBRATOR in the MORE menu.

⑪ **Select keys** : Used to select items from the menu area.

⑫ ***CH1, CH2*** **input connectors** :



CH1 and CH2 each have two input connectors (1MΩ and 50Ω). The selection as to which is to be used for measurement is made using the CH1 or CH2 menu key. The LED lamp on the left side of the connector corresponding to the selected input comes ON, indicating that the signal supplied through that connector can be measured. The frequency bands of the 1MΩ and 50Ω connectors are DC to 200MHz (when the accessory 10 : 1 probe is used.) and DC to 300MHz, respectively.

⑬ ***CH3, CH4*** **input connectors** : These are trigger input connectors, with signal input impedances which can be switched between 1MΩ and 50Ω by means of the CH3/4 menu key, which selects the type of connector.

⑭ **9-inch CRT** : This CRT has a resolution of 800×576 dots. The waveform display area has 500×500 dots. Messages are displayed outside this area.

⑮ ***TRIG READY*** **lamp** : Lights to indicate that the unit is in the trigger ready status.

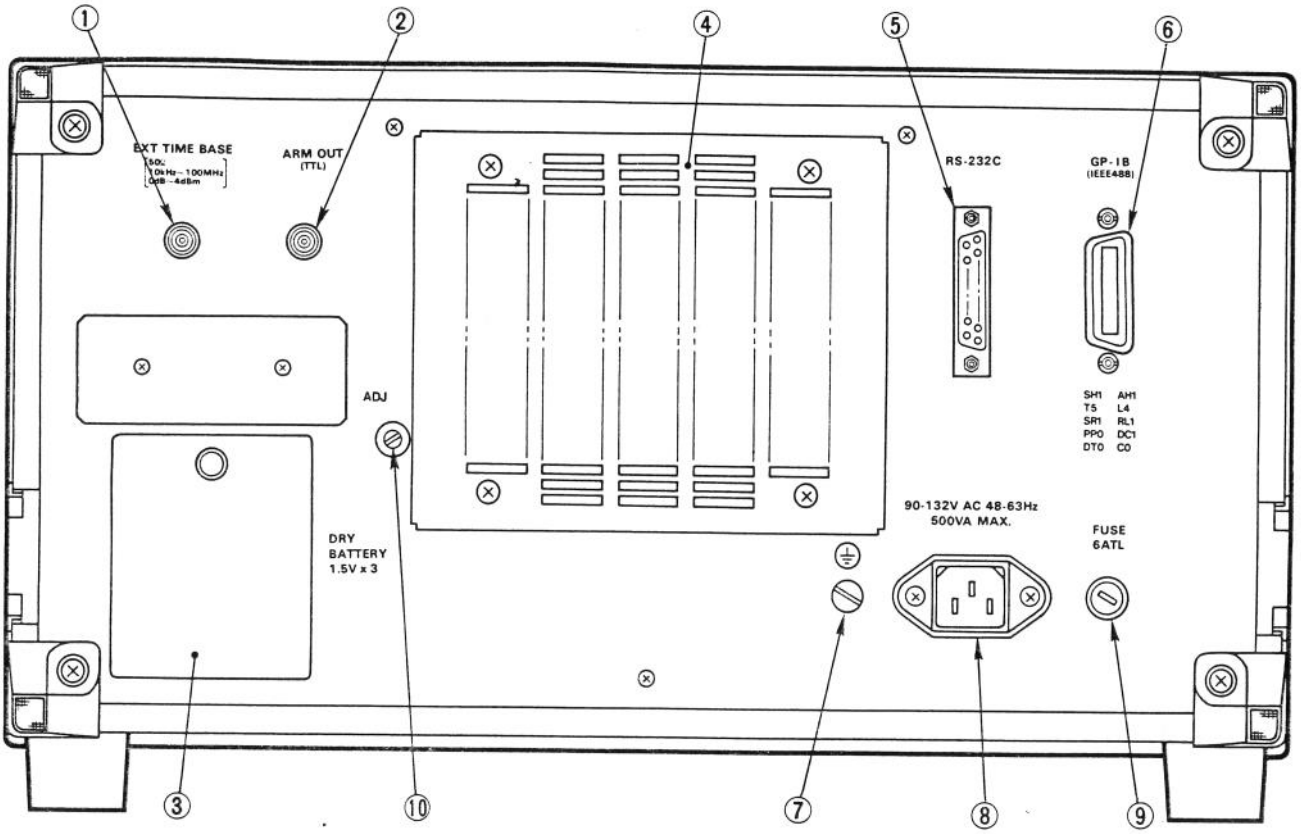
REMOTE **lamp** : Lights to indicate that the unit is in the GP-IB remote mode.

START / STOP **lamp** : Lights to inidcate that data is being acquired.

⑯ **Built-in printer (option)** (Top part of main unit) : A hard copy of the CRT screen can be obtained by pressing the front panel COPY key.

⑰ FEED **key** (Top part of main unit) : Can be used to feed roll paper.

2.1.2 Rear Panel



Note: For 200V power system, line voltage is shown as 180—250V AC 48—63Hz 500VA MAX 3ATL FUSE.

Figure 2.2 Rear Panel Components (for 100V power system)

① **EXT TIME BASE (External reference sine wave input connector)**

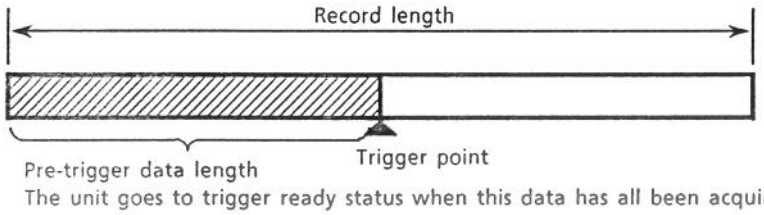
Supplying a reference sine wave signal is supplied to this connector using an external reference signal generator enables sampling according to the frequency of that signal. The input impedance is 50Ω.

Input frequency : 1MHz to 100MHz
Input level : 0 to 4dBm (0dBm is approximately 0.2236Vrms.)

② **ARM OUT connector**

The logic level at this connector is set high when the A / D converter begins to operate and low when the unit is in the trigger ready status. Since with a post-trigger (positive delay) setting, the operation of the A / D converter and establishment of the trigger-ready status are almost simultaneous, the high state duration is the minimum of 200ns.

With a pre-trigger (negative delay) setting, the unit is set to the trigger ready status when all the data has been acquired into the pre-trigger part of the memory record length, so the pulse width varies with the pre-trigger delay time (but minimum width is 200ns.)



The output is a TTL level. An output section circuit diagram is shown below.

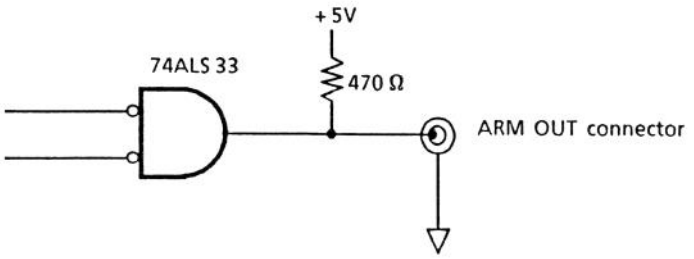


Figure 2.3 ARM OUT Circuit Diagram

③ **Dry cells for panel setup parameter information backup**
Three SUM-3D dry cells are used. New cells will back up the panel setup parameters for about one year.

④ **Fan cover**
The fan is used to ventilate the unit. Ensure that its cover is not blocked or obstructed.

⑤ **RS-232C connector (option)**
25-pin connector for RS-232C (EIA RS-232C standard) interface connections.

⑥ **GP-IB connector**
24-pin connector for GP-IB (IEEE Standard 488-1978) interface.

⑦ **Grounding terminal**
Grounding terminal for cabinet. When the unit is to be grounded for safety, make sure that the ground is of good quality. If the unit is to share a common ground with other equipment, consideration must be given to counter noise traveling along the ground wiring. (The low side of the front panel input connectors has the same potential as the cabinet.)

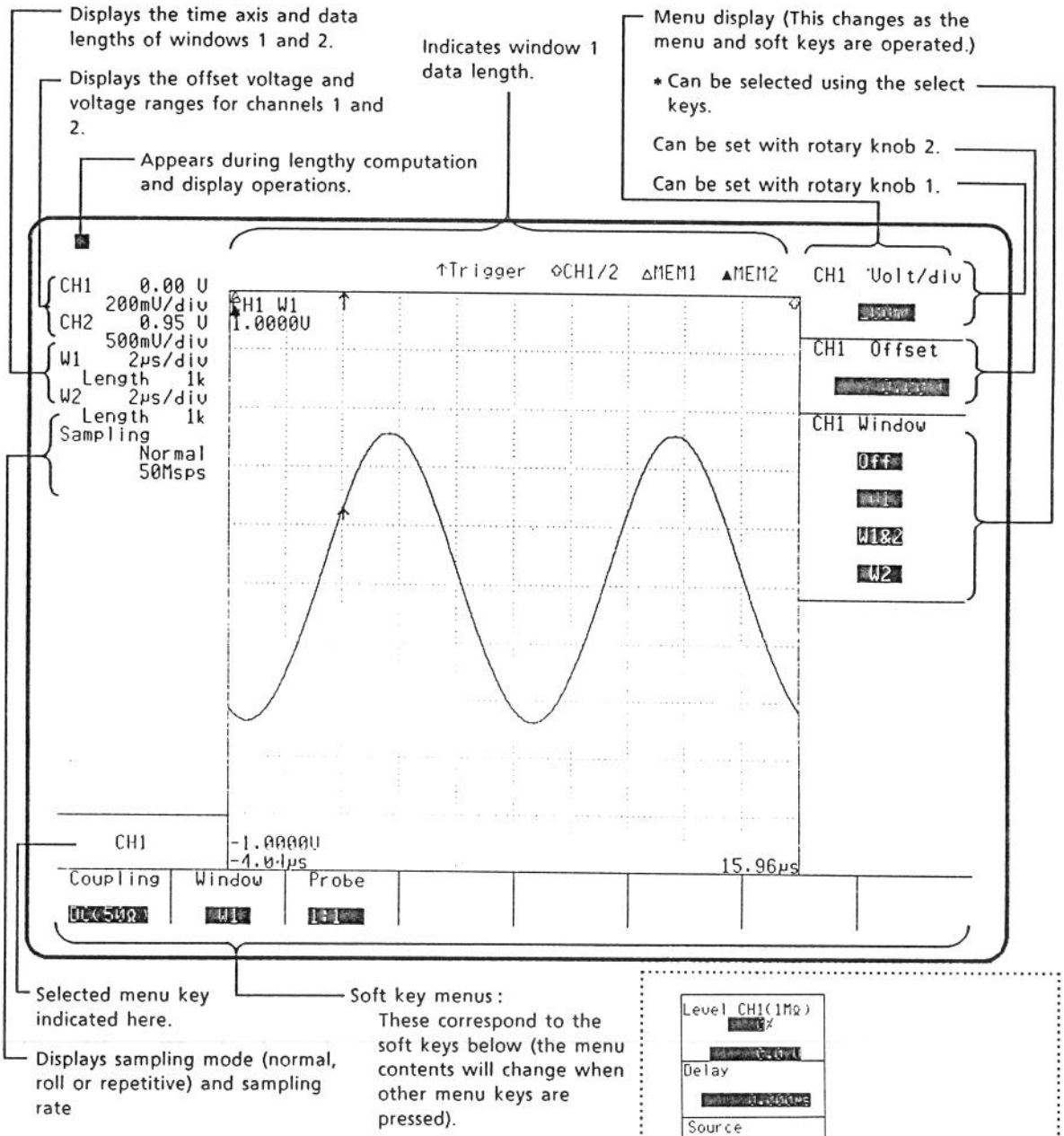
⑧ **Power connector**
Connect the accessory power cord to this connector.

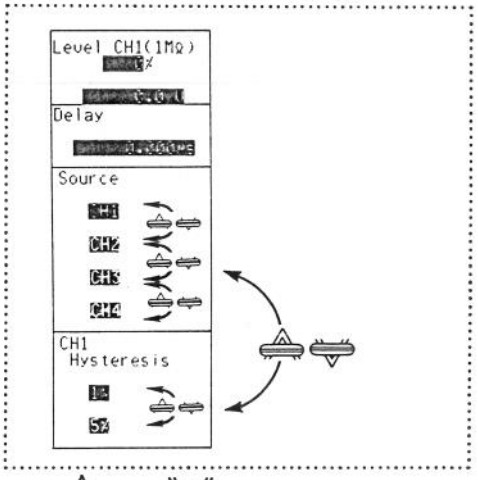
⑨ **Power fuse**
Use a 250V 6A rated time lag fuse (Yokogawa Part No.A9189KF) or 250V 3A rated time lag fuse (YOKOGAWA Part No. 9123KF) for 100V or 200V power system respectively.

⑩ **DIP switch for adjusting printer contrast**
Use this DIP switch to adjust the contrast of the printer. Normally, adjustment is not needed. See page 5-5 for details.

2.2 CRT Display

2.2.1 CRT Display

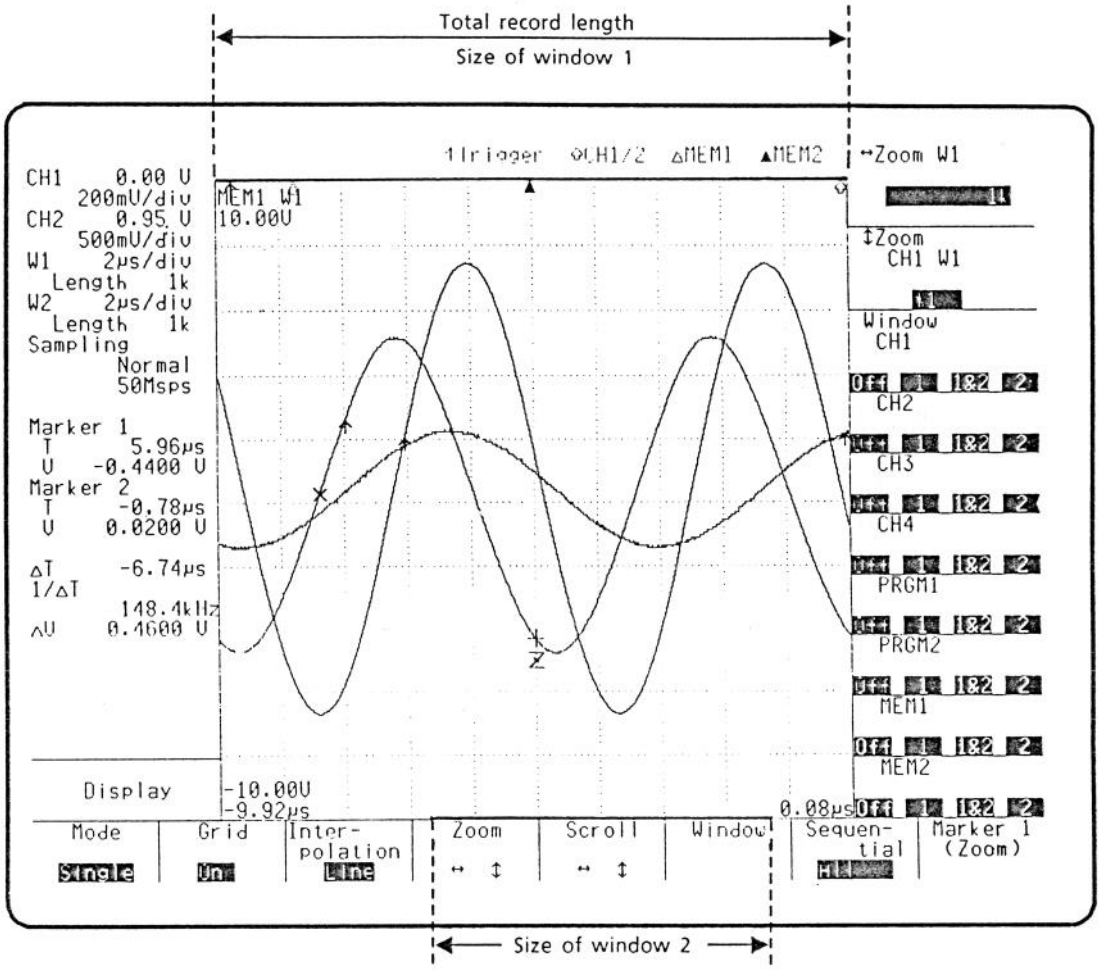




The and select keys are used to select items from the menus.

- **Select keys**
  The and keys select the setup items from the menu displays; the and keys can be used to select values within those items.

2.2.2 Window and Trigger Point Displays



(1) Windows

The positions and sizes of windows 1 and 2 are displayed in the top and bottom frames of the waveform display area. (See page 3-4.)

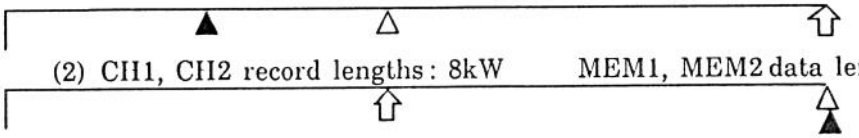
(2) The ↑ Symbol

↑ indicates the trigger point position. The position appears in the top frame where the total record length is indicated and in the waveform. Exactly where the trigger point is in the total record length can be ascertained by the ↑ symbol which appears in the top frame. In the above figure, it is at approximately the 2% position (though this is varied by changing the trigger delay value).

(3) The △, ▲ and ⇧ Symbols

When the CH1, CH2, MEM1 and MEM2 (MEM1 and MEM2 are data loaded from the IC cards) data is displayed, their respective record lengths may differ. Assuming that the record length in the waveform display area represents the longest waveform, the relationships between the different record lengths are indicated using the ⇧ (CH1, CH2), △ (MEM1) and ▲ (MEM2) symbols.

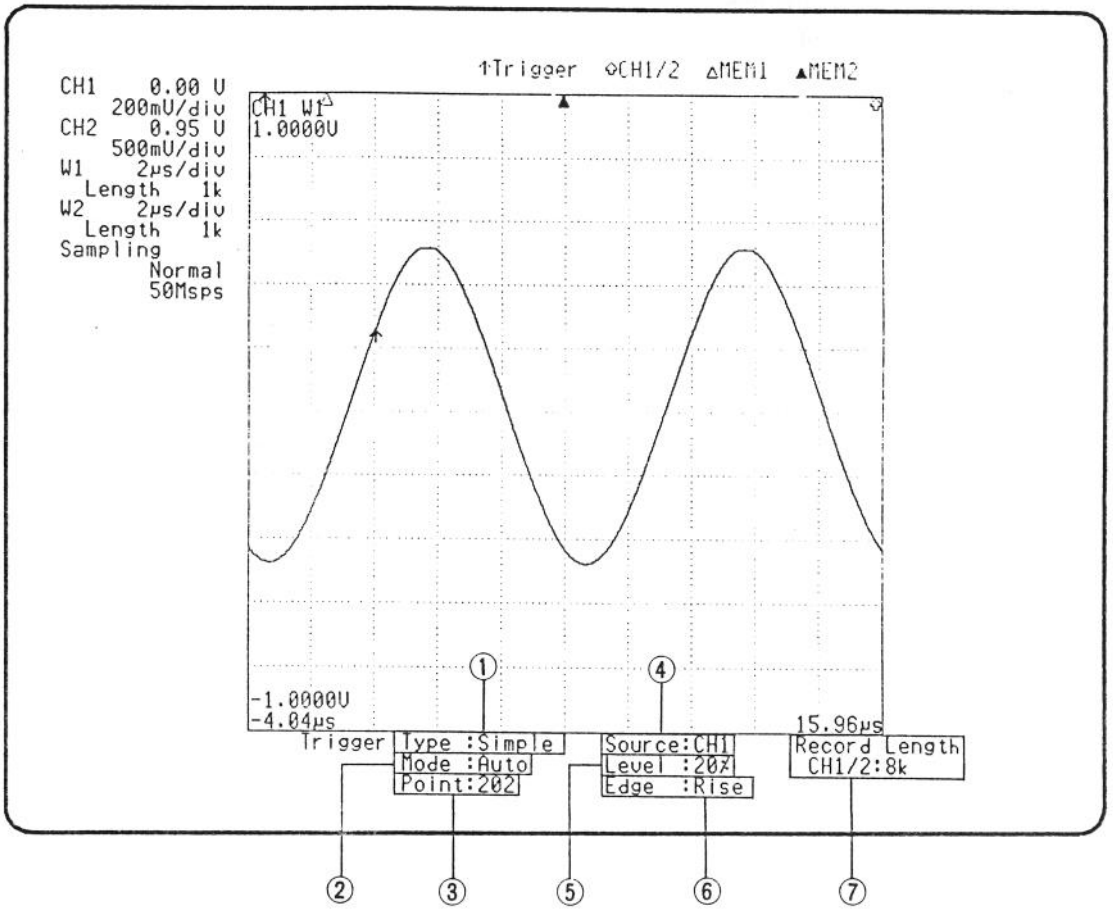
Examples: (1) CH1, CH2 record lengths: 64kW MEM1 data length: 32kW
MEM2 data length: 16kW



(2) CH1, CH2 record lengths: 8kW MEM1, MEM2 data lengths: 16kW

2.2.3 Status Display Screen

Pressing the same menu key twice in succession causes the status display screen to appear. This screen shows the triggering conditions and record lengths currently in use.



① **Trigger type** : Indicates the type of trigger used (simple, combination, multi-gate, glitch or IPD trigger).

② **Trigger mode** : Indicates the current trigger mode (auto, normal, free or single).

③ Trigger point : Indicates the position of the trigger point in the record length (point 202 in the example).

④ Trigger source : Indicates the trigger source (CH1, CH2, CH3 or CH4). (CH1 in the example.)

⑤ Trigger level : Indicates the trigger level as a percentage of the range.

⑥ Trigger edge : Indicates the trigger edge (rise, fall or both).

⑦ Record length : Indicates the record length. (8k in the example)

Note: Source, level and edge are not displayed for trigger types other than simple trigger.

2.2.4 CRT Brightness Levels

This section explains the CRT brightness levels.

Note: The brightness of the whole screen can be changed. (See page 3 - 154.)

(1) Waveform Brightness Levels

The brightness of the waveforms changes in accordance with the operating mode. There are three levels of brightness as shown in Table 2.2.1.

Table 2.2.1 Waveform Brightness

Brightness Level	Brightness	Type of Waveform Display
1	Dim	Usual waveform display
2	Normal	Selected waveform * Waveform areas where windows 1 and 2 overlap
3	Bright	Areas where windows 1 and 2 overlap for selected waveform.

* The "selected waveform" is that waveform which is selected from among the waveforms displayed when a certain process is to be performed.
Example: When CH1 W1 is selected by the cursor.

During waveform parameter measurements the areas where windows overlap is not displayed at higher brightness. The brightness usage during waveform parameter measurement is shown in Table 2.2.2.

Table 2.2.2 Brightness During Waveform Parameter Display

Brightness Level	Brightness	Type of Waveform Display
2	Normal	Target waveform in waveform parameter measurement
3	Bright	Area of waveform parameter measurement

Note: When the printer (option) is used, brightness levels 1 and 2 will be identical; level 3 will come out darker.

(2) Character Display

Characters are displayed with two brightness levels: either they maintain the same brightness at all times or they change their brightness when selected (menu section).

Table 2.2.3 Character Screen Brightness Levels

Brightness Level	Brightness	Type of Waveform Display	
1	Dim	Menu area	• Items which cannot be selected • Background of menu item selected • Background of soft key menu selected
2	Normal	Menu area	• Values of menu items not selected • Values set for items which cannot be selected
			• Waveform display area frame • Grid • ↑, ⇧, △ and ▲ makes displayed at bottom of upper waveform display area frame.
3	Bright		• Values continuously displayed at left top of CRT • Cursor values, measurement values, ACQ key parameters (averaging times, sequential store count number, etc.) • Trigger conditions for status display screen
		Menu area	• Soft key menus currently selectable • Menu item values currently selectable

Note: Brightness levels 2 and 3 are printed by the printer (option). Level 1 is not printed. Level 3 will appear darker than level 2. Table 2.2.4 shows the contrast for the waveforms and character printer output.

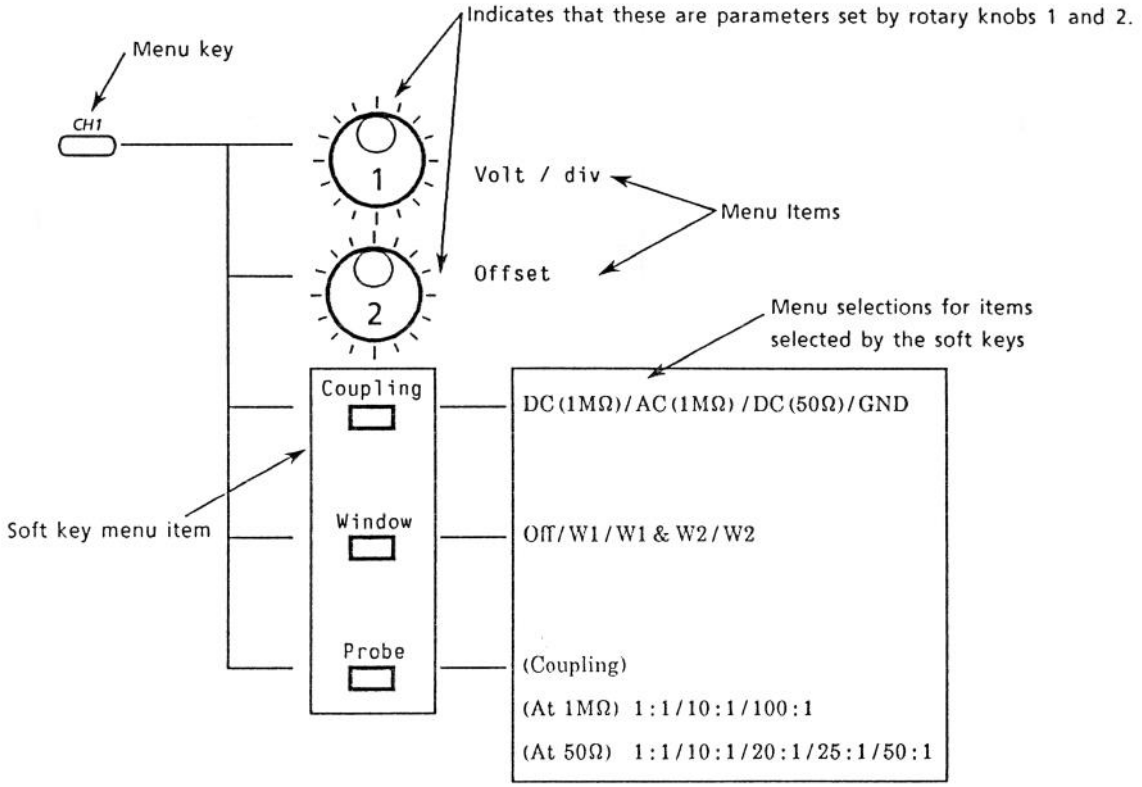
Table 2.2.4 CRT Screen Brightness Levels and Printer Contrast

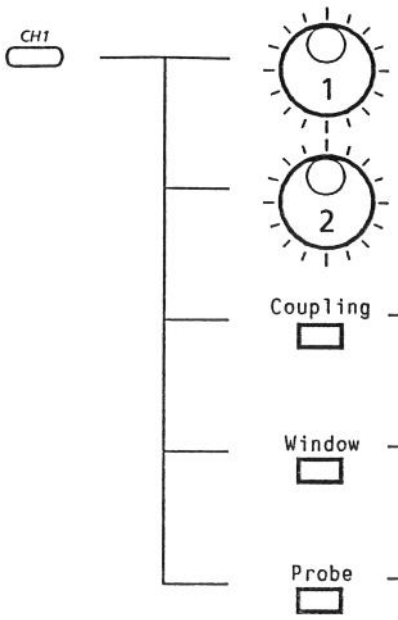
Printer Contrast	Type of Waveform Display
Dark	Waveform brightness level 3, character brightness level 3
Light	Waveform brightness level 1, waveform brightness level 2, character brightness level 2
No printing	Character brightness level 1

2.3 Hierarchical Structure of Menus

This section describes the hierarchical structure of the menus for each menu key. We suggest that you use this information as an index to Chapter 3, which details the unit's operations.

How to Read the Hierarchical Menu Structures





Volt / div ..... (See page 3 - 6.)

Offset ..... (See page 3 - 7.)

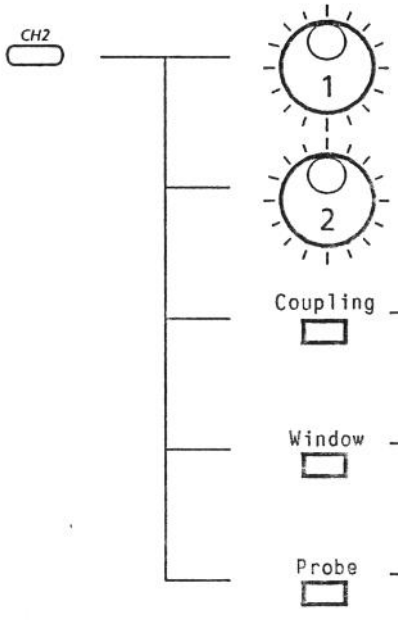
Coupling —— DC (1MΩ) / AC (1MΩ) / DC (50Ω) / GND ..... (See page 3 - 2.)

Window —— Off / W1 / W1 & W2 / W2 ..... (See page 3 - 4.)

Probe —— (Coupling)

(At 1MΩ) 1 : 1 / 10 : 1 / 100 : 1 ..... (See page 3 - 3.)

(At 50Ω) 1 : 1 / 10 : 1 / 20 : 1 / 25 : 1 / 50 : 1



Volt / div ..... (See page 3 - 6.)

Offset ..... (See page 3 - 7.)

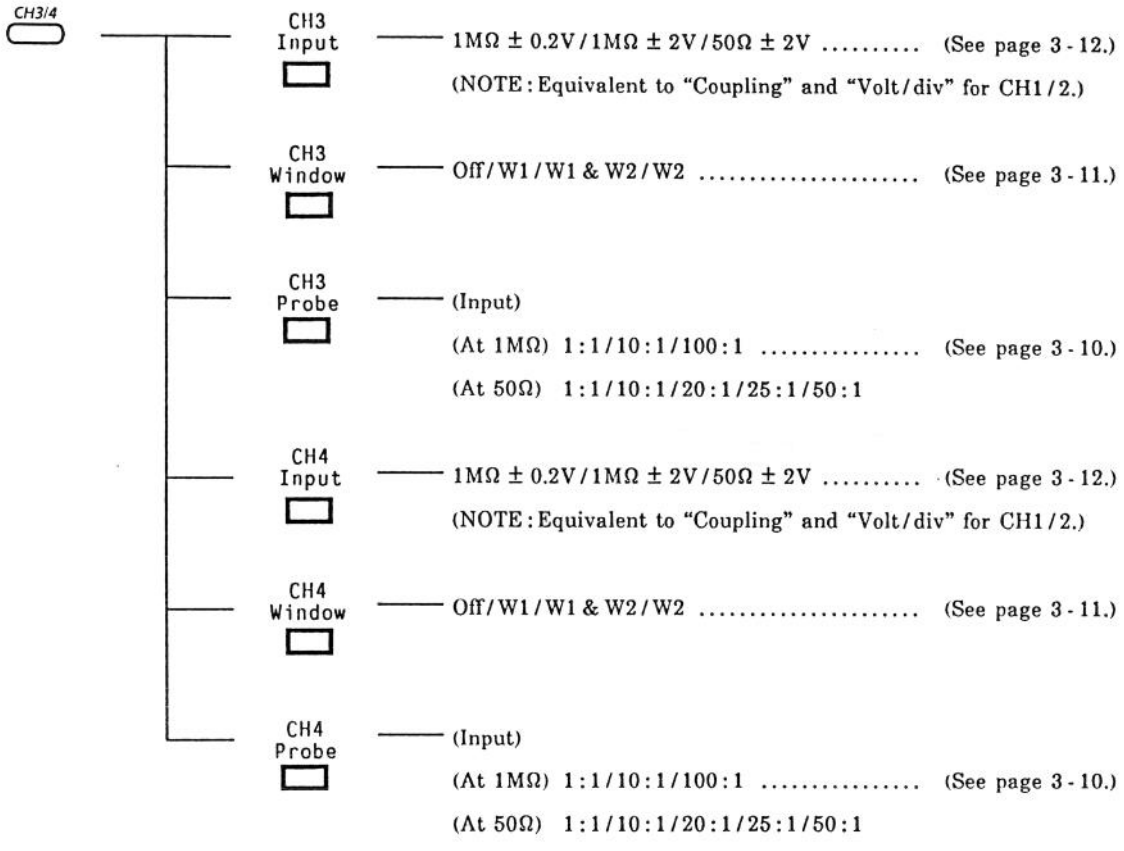
Coupling —— DC (1MΩ) / AC (1MΩ) / DC (50Ω) / GND ..... (See page 3 - 2.)

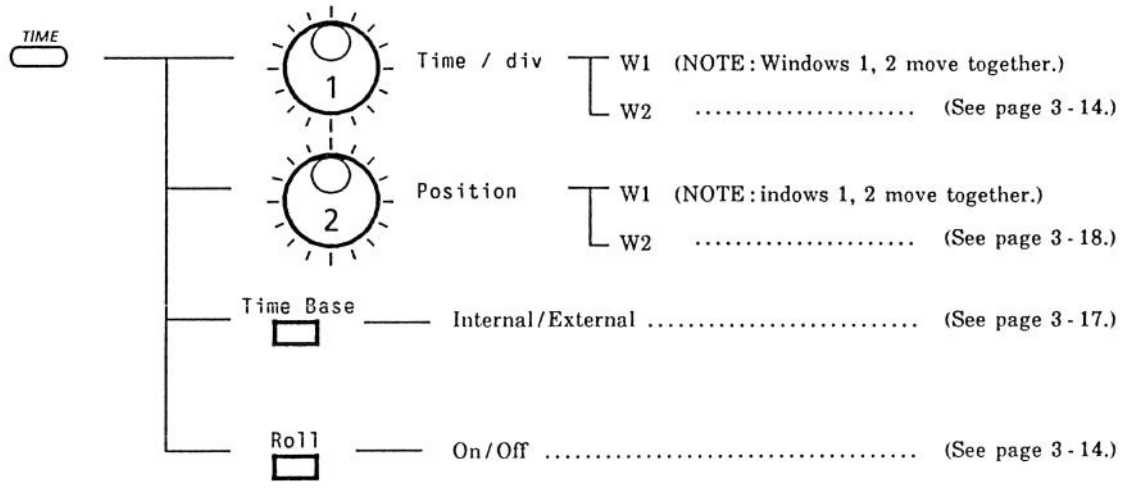
Window —— Off / W1 / W1 & W2 / W2 ..... (See page 3 - 4.)

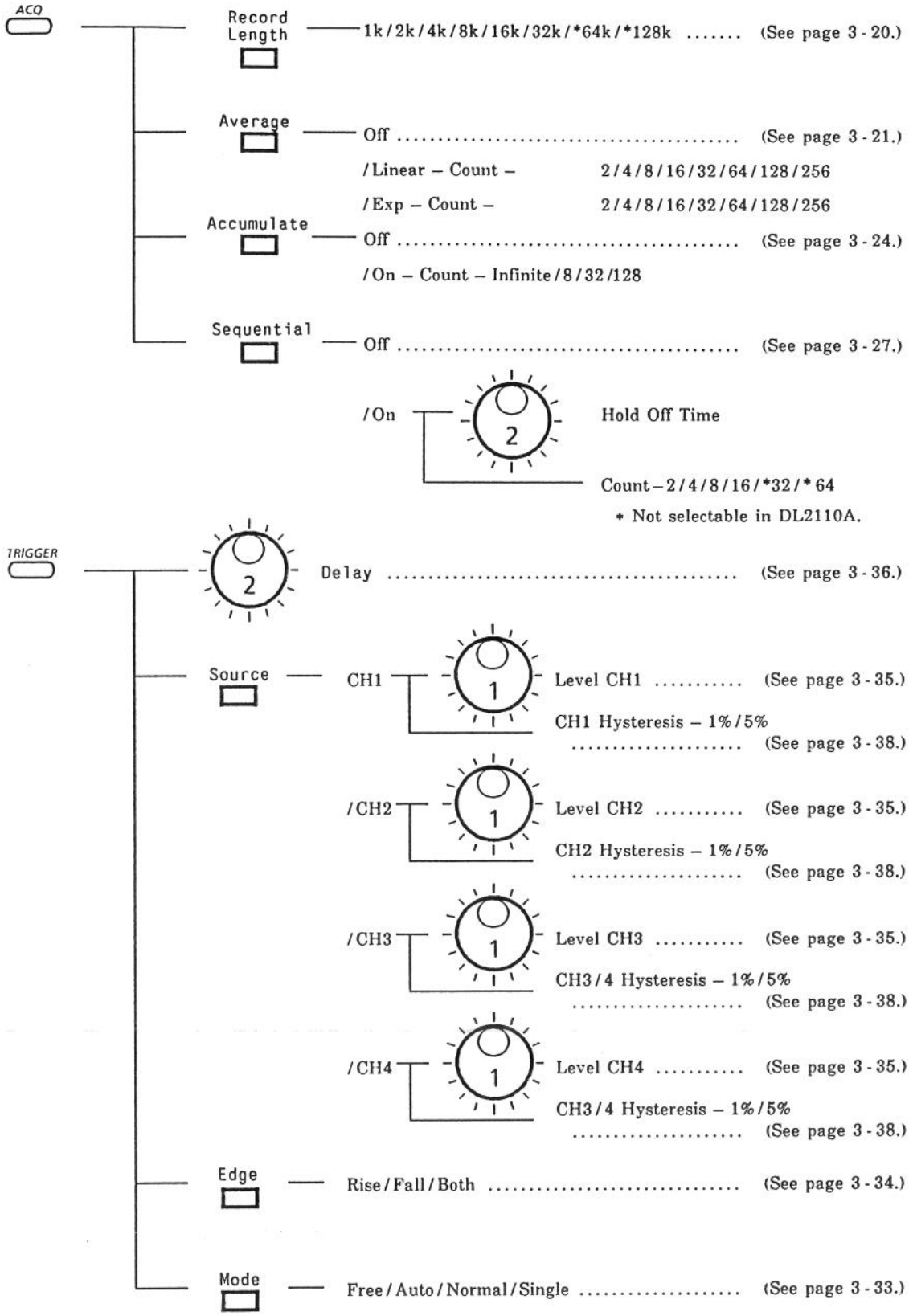
Probe —— (Coupling)

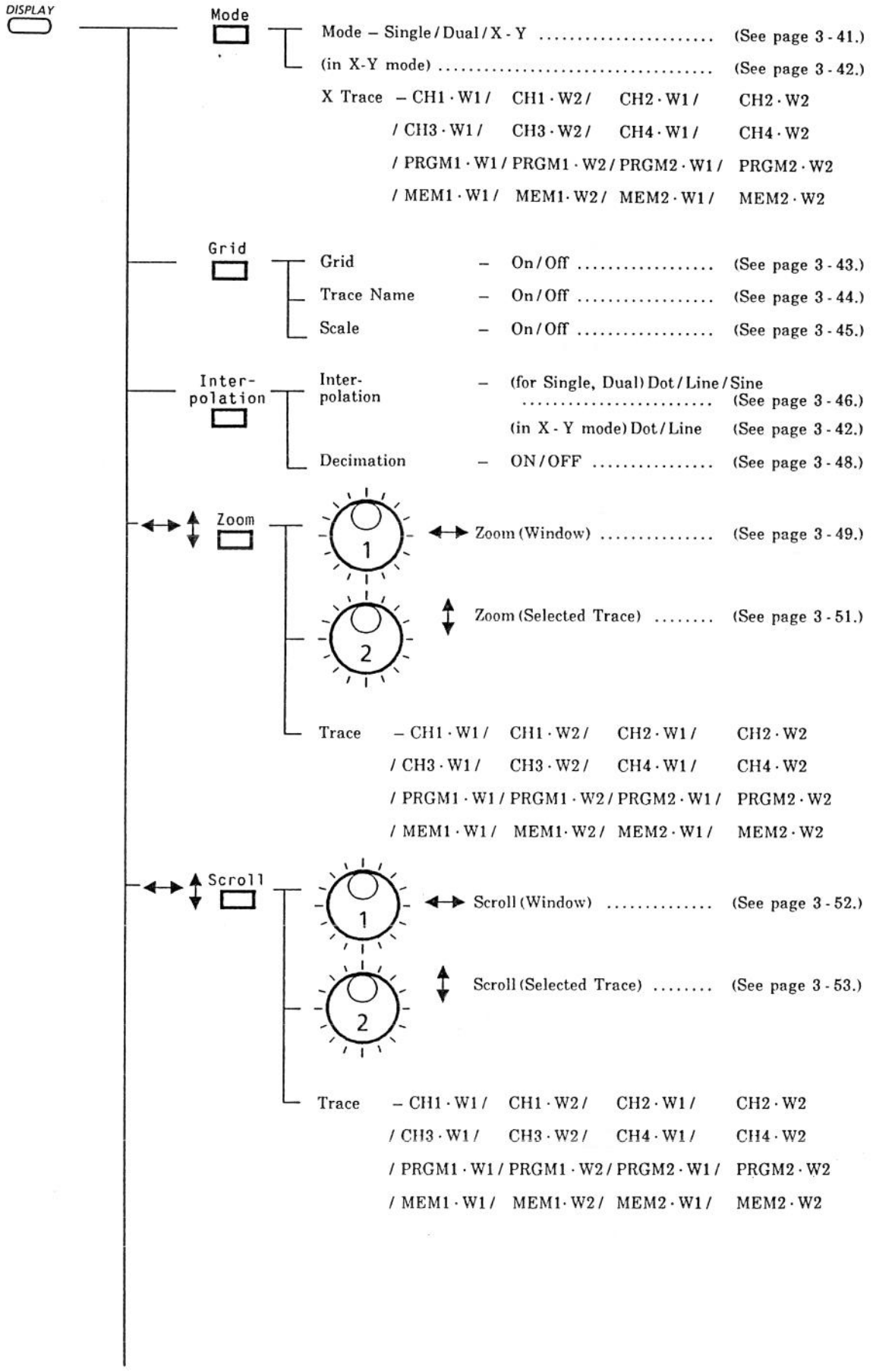
(At 1MΩ) 1 : 1 / 10 : 1 / 100 : 1 ..... (See page 3 - 3.)

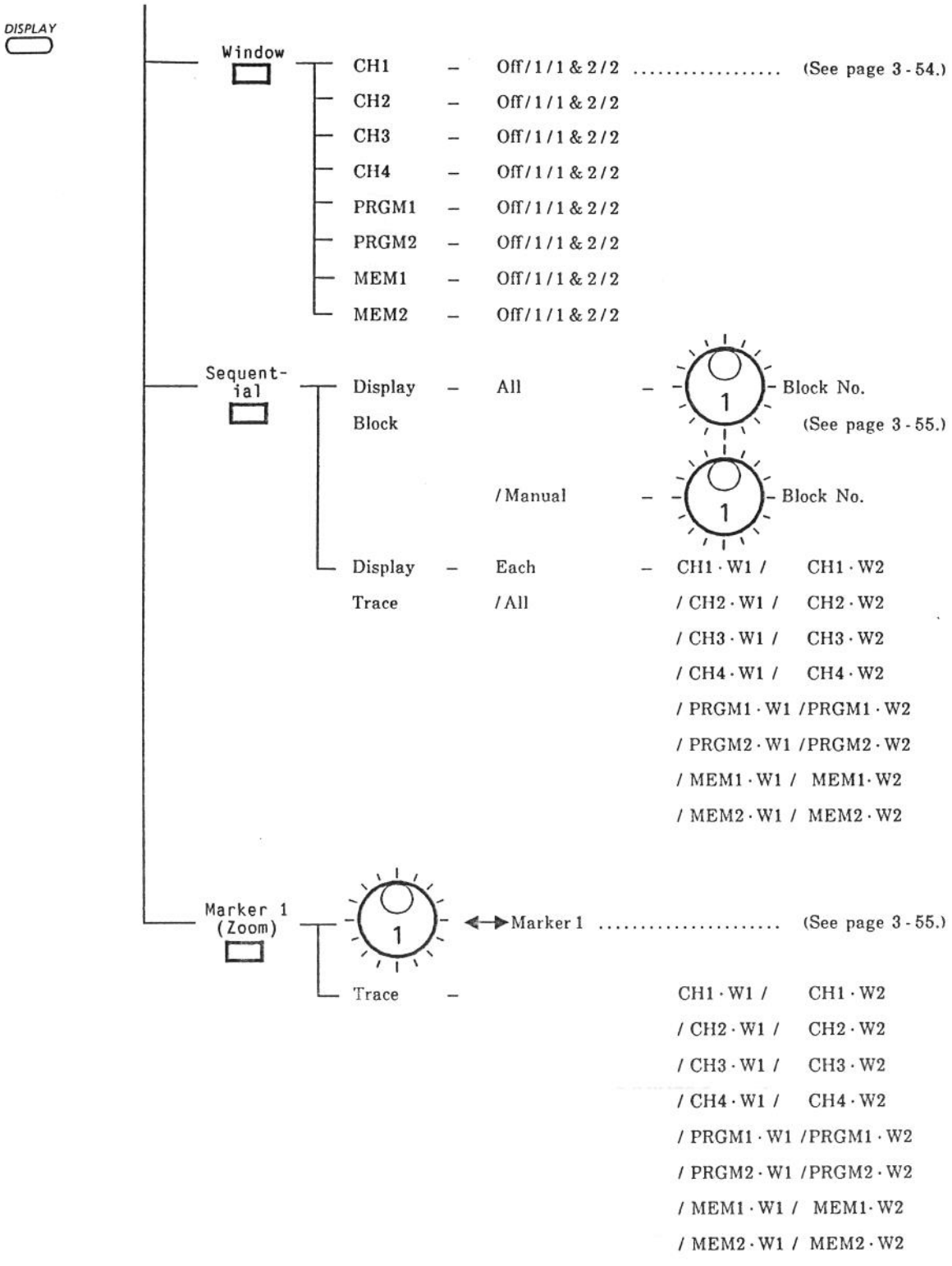
(At 50Ω) 1 : 1 / 10 : 1 / 20 : 1 / 25 : 1 / 50 : 1

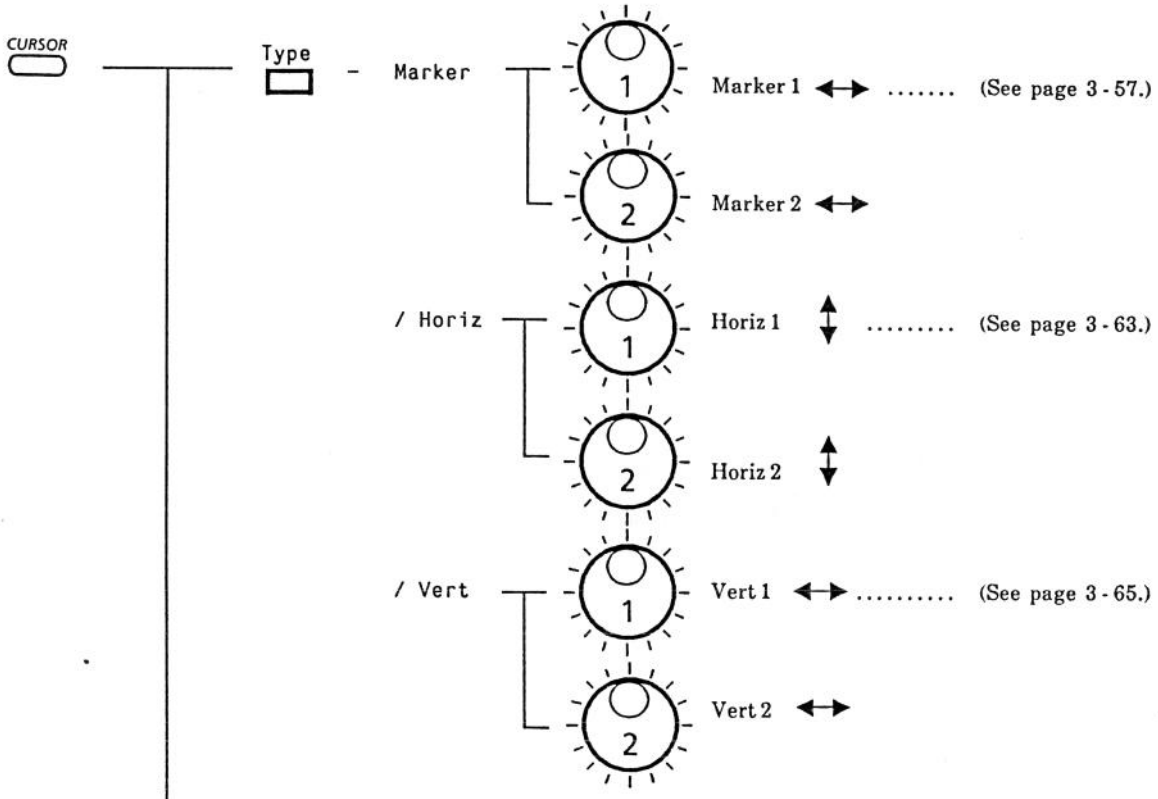

CH3/4
CH3 Input
1MΩ ± 0.2V/1MΩ ± 2V/50Ω ± 2V ..... (See page 3 - 12.)
(NOTE : Equivalent to "Coupling" and "Volt/div" for CH1/2.)
CH3 Window
Off/W1/W1 & W2/W2 ..... (See page 3 - 11.)
CH3 Probe
(Input)
(At 1MΩ) 1 : 1/10 : 1/100 : 1 ..... (See page 3 - 10.)
(At 50Ω) 1 : 1/10 : 1/20 : 1/25 : 1/50 : 1
CH4 Input
1MΩ ± 0.2V/1MΩ ± 2V/50Ω ± 2V ..... (See page 3 - 12.)
(NOTE : Equivalent to "Coupling" and "Volt/div" for CH1/2.)
CH4 Window
Off/W1/W1 & W2/W2 ..... (See page 3 - 11.)
CH4 Probe
(Input)
(At 1MΩ) 1 : 1/10 : 1/100 : 1 ..... (See page 3 - 10.)
(At 50Ω) 1 : 1/10 : 1/20 : 1/25 : 1/50 : 1


TIME
1
Time / div
W1 (NOTE : Windows 1, 2 move together.)
W2 ..... (See page 3 - 14.)
2
Position
W1 (NOTE : indows 1, 2 move together.)
W2 ..... (See page 3 - 18.)
Time Base
Internal/External ..... (See page 3 - 17.)
Roll
On/Off ..... (See page 3 - 14.)


ACQ
Record Length
1k/2k/4k/8k/16k/32k/*64k/*128k ..... (See page 3 - 20.)
Average
Off ..... (See page 3 - 21.)
/Linear – Count – 2/4/8/16/32/64/128/256
/Exp – Count – 2/4/8/16/32/64/128/256
Accumulate
Off ..... (See page 3 - 24.)
/On – Count – Infinite/8/32/128
Sequential
Off ..... (See page 3 - 27.)
/On
2
Hold Off Time
Count–2/4/8/16/*32/*64
* Not selectable in DL2110A.
TRIGGER
2
Delay ..... (See page 3 - 36.)
Source
CH1
1
Level CH1 ..... (See page 3 - 35.)
CH1 Hysteresis – 1%/5%
..... (See page 3 - 38.)
/CH2
1
Level CH2 ..... (See page 3 - 35.)
CH2 Hysteresis – 1%/5%
..... (See page 3 - 38.)
/CH3
1
Level CH3 ..... (See page 3 - 35.)
CH3/4 Hysteresis – 1%/5%
..... (See page 3 - 38.)
/CH4
1
Level CH4 ..... (See page 3 - 35.)
CH3/4 Hysteresis – 1%/5%
..... (See page 3 - 38.)
Edge
Rise/Fall/Both ..... (See page 3 - 34.)
Mode
Free/Auto/Normal/Single ..... (See page 3 - 33.)


DISPLAY
Mode
Mode – Single / Dual / X - Y ..... (See page 3 - 41.)
(in X-Y mode) ..... (See page 3 - 42.)
X Trace – CH1 · W1 / CH1 · W2 / CH2 · W1 / CH2 · W2
/ CH3 · W1 / CH3 · W2 / CH4 · W1 / CH4 · W2
/ PRGM1 · W1 / PRGM1 · W2 / PRGM2 · W1 / PRGM2 · W2
/ MEM1 · W1 / MEM1 · W2 / MEM2 · W1 / MEM2 · W2
Grid
Grid – On / Off ..... (See page 3 - 43.)
Trace Name – On / Off ..... (See page 3 - 44.)
Scale – On / Off ..... (See page 3 - 45.)
Inter-polation
Inter-polation – (for Single, Dual) Dot / Line / Sine ..... (See page 3 - 46.)
(in X - Y mode) Dot / Line (See page 3 - 42.)
Decimation – ON / OFF ..... (See page 3 - 48.)
Zoom
1
Zoom (Window) ..... (See page 3 - 49.)
2
Zoom (Selected Trace) ..... (See page 3 - 51.)
Trace – CH1 · W1 / CH1 · W2 / CH2 · W1 / CH2 · W2
/ CH3 · W1 / CH3 · W2 / CH4 · W1 / CH4 · W2
/ PRGM1 · W1 / PRGM1 · W2 / PRGM2 · W1 / PRGM2 · W2
/ MEM1 · W1 / MEM1 · W2 / MEM2 · W1 / MEM2 · W2
Scroll
1
Scroll (Window) ..... (See page 3 - 52.)
2
Scroll (Selected Trace) ..... (See page 3 - 53.)
Trace – CH1 · W1 / CH1 · W2 / CH2 · W1 / CH2 · W2
/ CH3 · W1 / CH3 · W2 / CH4 · W1 / CH4 · W2
/ PRGM1 · W1 / PRGM1 · W2 / PRGM2 · W1 / PRGM2 · W2
/ MEM1 · W1 / MEM1 · W2 / MEM2 · W1 / MEM2 · W2


DISPLAY
Window
CH1 – Off/1/1&2/2 ..... (See page 3-54.)
CH2 – Off/1/1&2/2
CH3 – Off/1/1&2/2
CH4 – Off/1/1&2/2
PRGM1 – Off/1/1&2/2
PRGM2 – Off/1/1&2/2
MEM1 – Off/1/1&2/2
MEM2 – Off/1/1&2/2
Sequential
Display Block – All – 1 – Block No.
(See page 3-55.)
/Manual – 1 – Block No.
Display Trace – Each /All – CH1·W1 / CH1·W2 / CH2·W1 / CH2·W2 / CH3·W1 / CH3·W2 / CH4·W1 / CH4·W2 / PRGM1·W1 / PRGM1·W2 / PRGM2·W1 / PRGM2·W2 / MEM1·W1 / MEM1·W2 / MEM2·W1 / MEM2·W2
Marker 1 (Zoom)
1 ↔ Marker 1 ..... (See page 3-55.)
Trace – CH1·W1 / CH1·W2 / CH2·W1 / CH2·W2 / CH3·W1 / CH3·W2 / CH4·W1 / CH4·W2 / PRGM1·W1 / PRGM1·W2 / PRGM2·W1 / PRGM2·W2 / MEM1·W1 / MEM1·W2 / MEM2·W1 / MEM2·W2



Trace 1 – CH1 · W1 / CH1 · W2 / CH2 · W1 / CH2 · W2 .... (See page 3 - 57, 63, 65.)
/ CH3 · W1 / CH3 · W2 / CH4 · W1 / CH4 · W2
/ PRGM1 · W1 / PRGM1 · W2 / PRGM2 · W1 / PRGM2 · W2
/ MEM1 · W1 / MEM1 · W2 / MEM2 · W1 / MEM2 · W2

Trace 2 (Marker only) – CH1 · W1 / CH1 · W2 / CH2 · W1 / CH2 · W2
/ CH3 · W1 / CH3 · W2 / CH4 · W1 / CH4 · W2
/ PRGM1 · W1 / PRGM1 · W2 / PRGM2 · W1 / PRGM2 · W2
/ MEM1 · W1 / MEM1 · W2 / MEM2 · W1 / MEM2 · W2

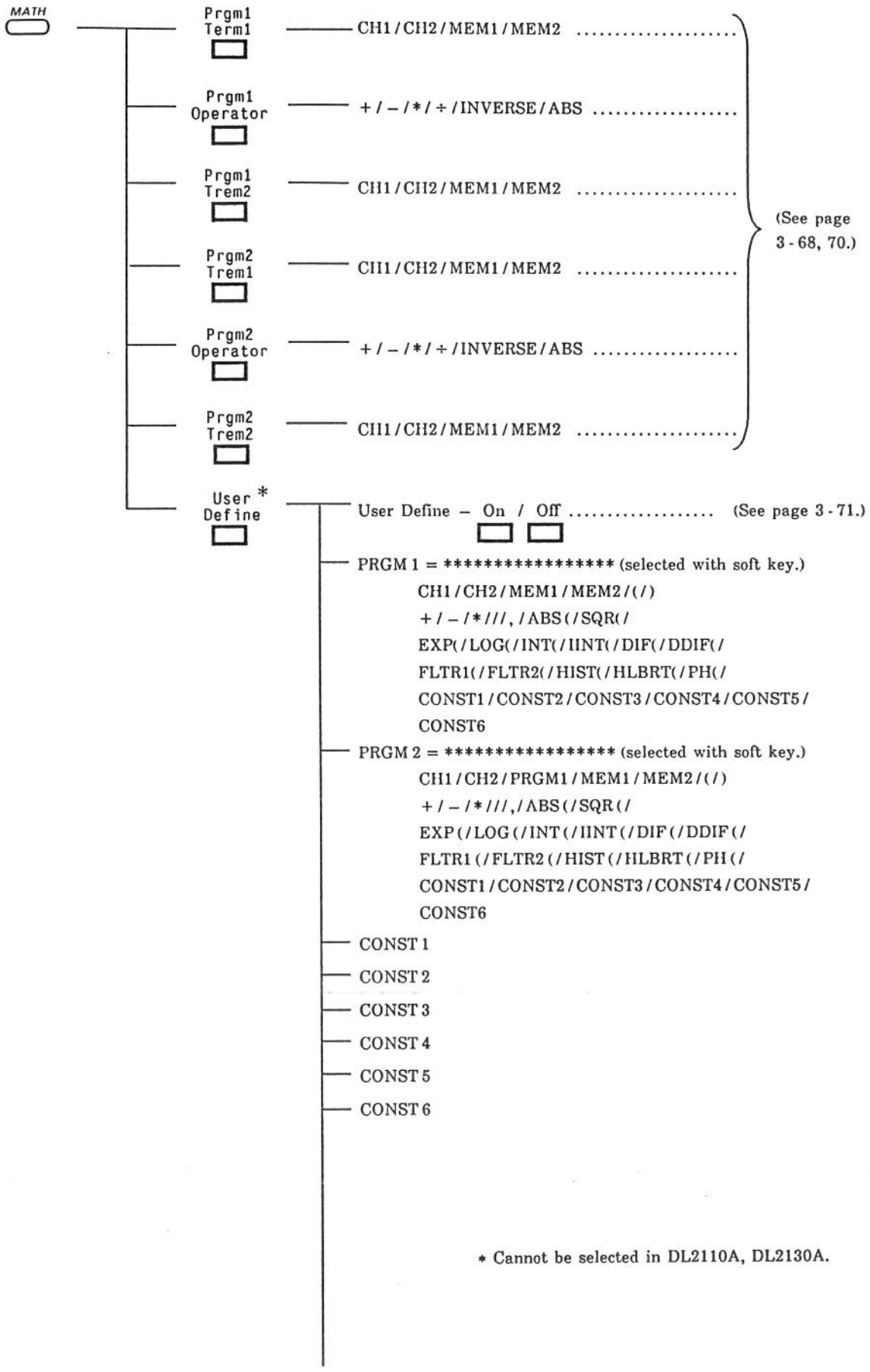
Linkage – Off / On ..... (See page 3 - 57, 63, 65.)

<Return> Marker 1 ..... (See page 3 - 61.)

<Return> Marker 2 ..... (See page 3 - 61.)

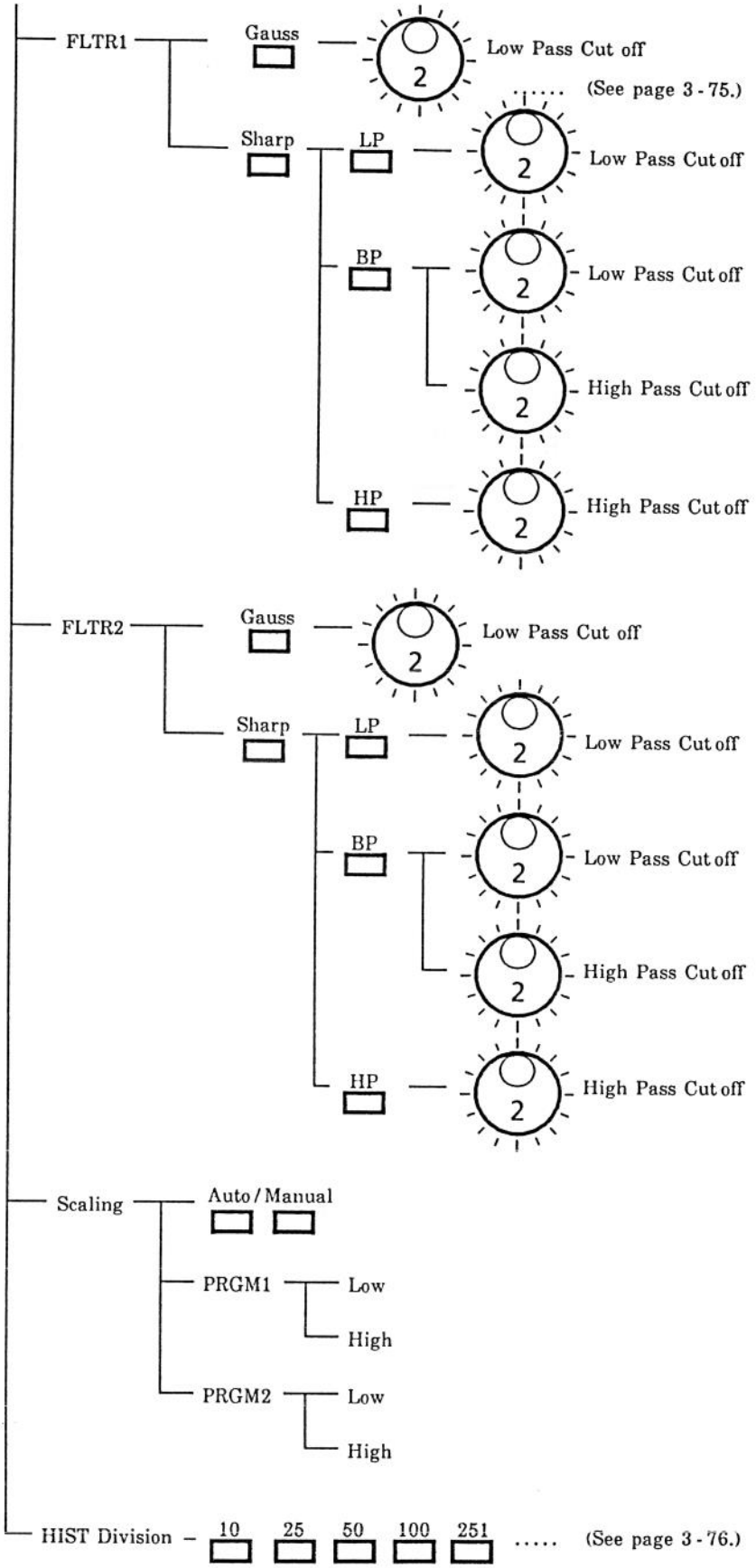
<Return> W1 ..... (See page 3 - 62.)

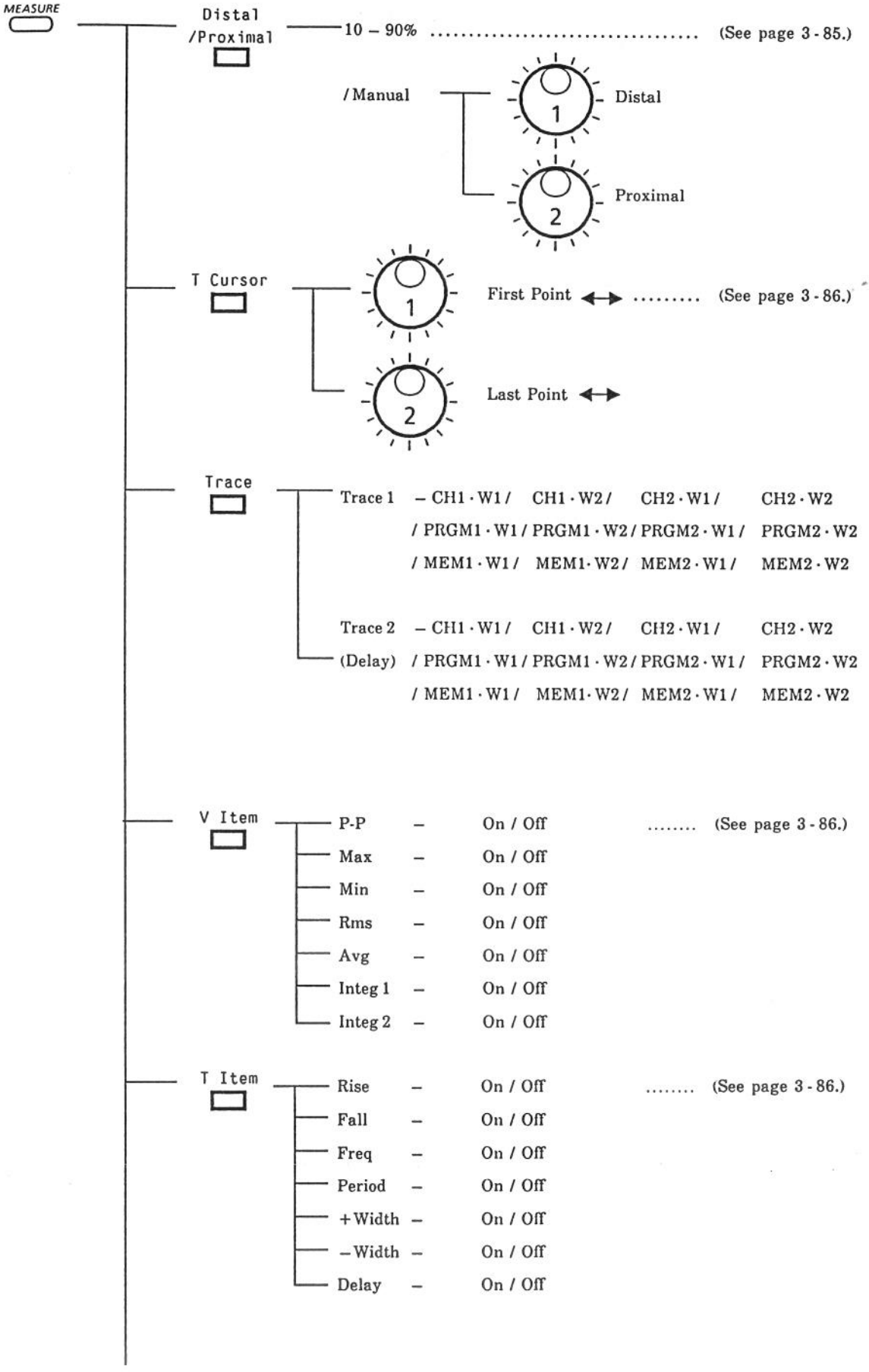
<Return> W2 ..... (See page 3 - 62.)

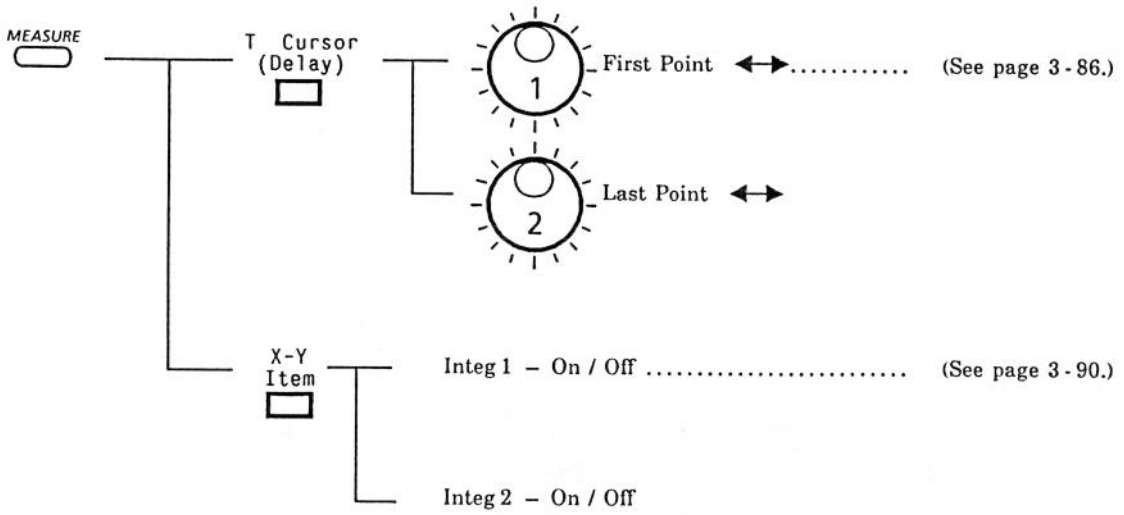


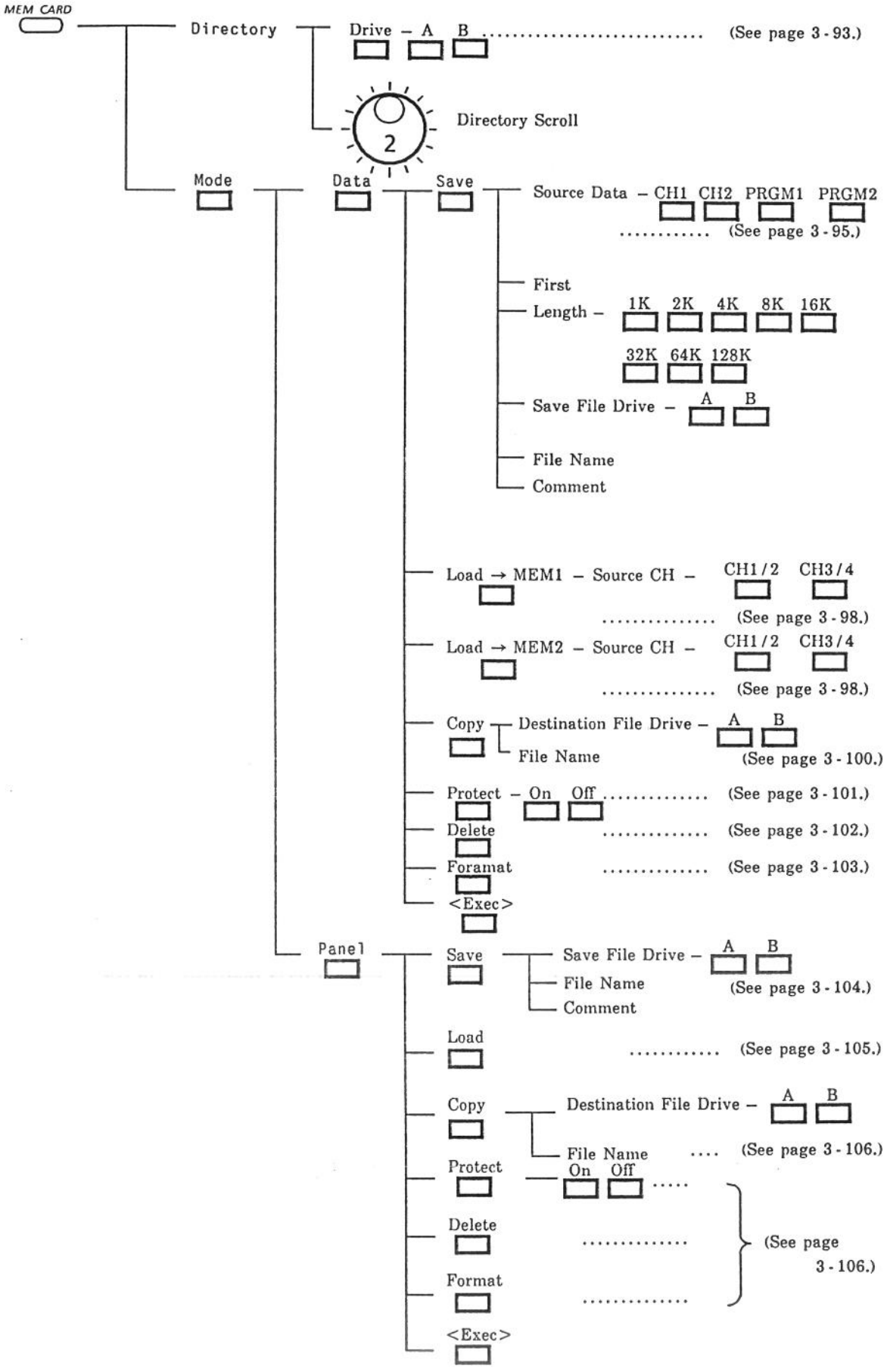
* Cannot be selected in DL2110A, DL2130A.

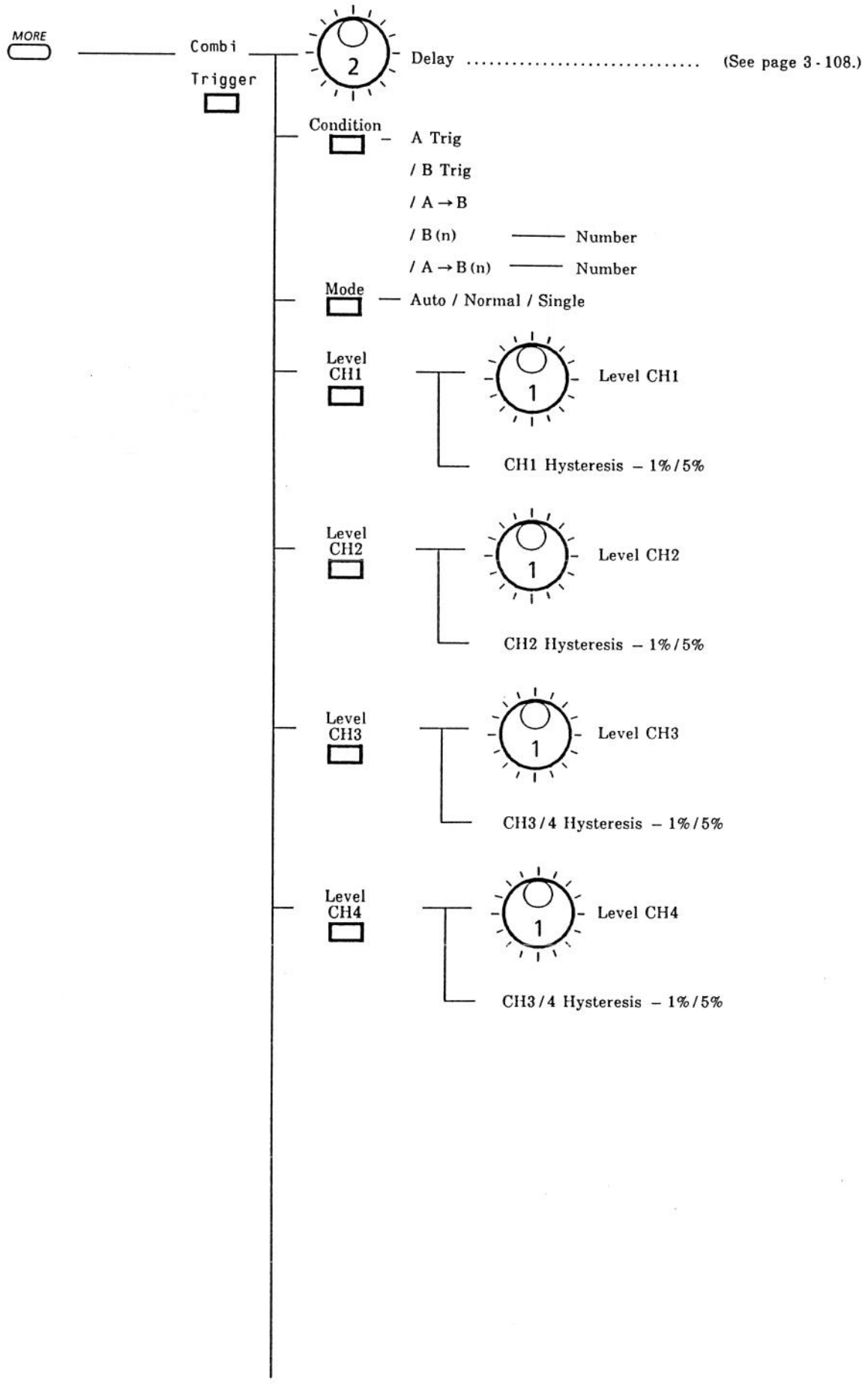
MATH

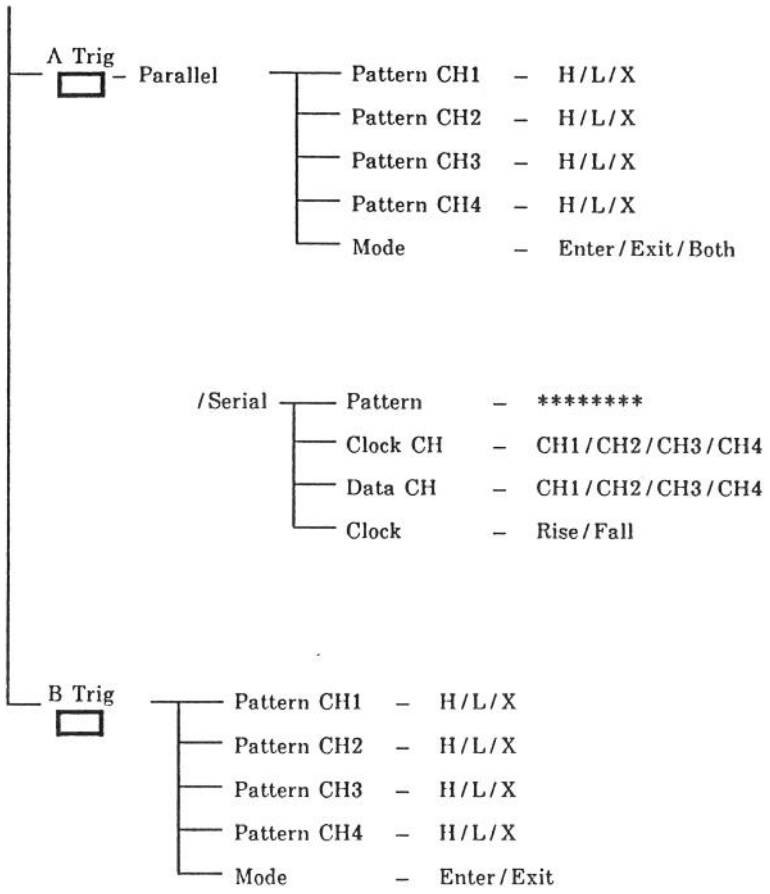

FLTR1
Gauss
2
Low Pass Cut off
(See page 3 - 75.)
Sharp
LP
2
Low Pass Cut off
BP
2
Low Pass Cut off
2
High Pass Cut off
HP
2
High Pass Cut off
FLTR2
Gauss
2
Low Pass Cut off
Sharp
LP
2
Low Pass Cut off
BP
2
Low Pass Cut off
2
High Pass Cut off
HP
2
High Pass Cut off
Scaling
Auto / Manual
PRGM1
Low
High
PRGM2
Low
High
HIST Division
10
25
50
100
251
(See page 3 - 76.)

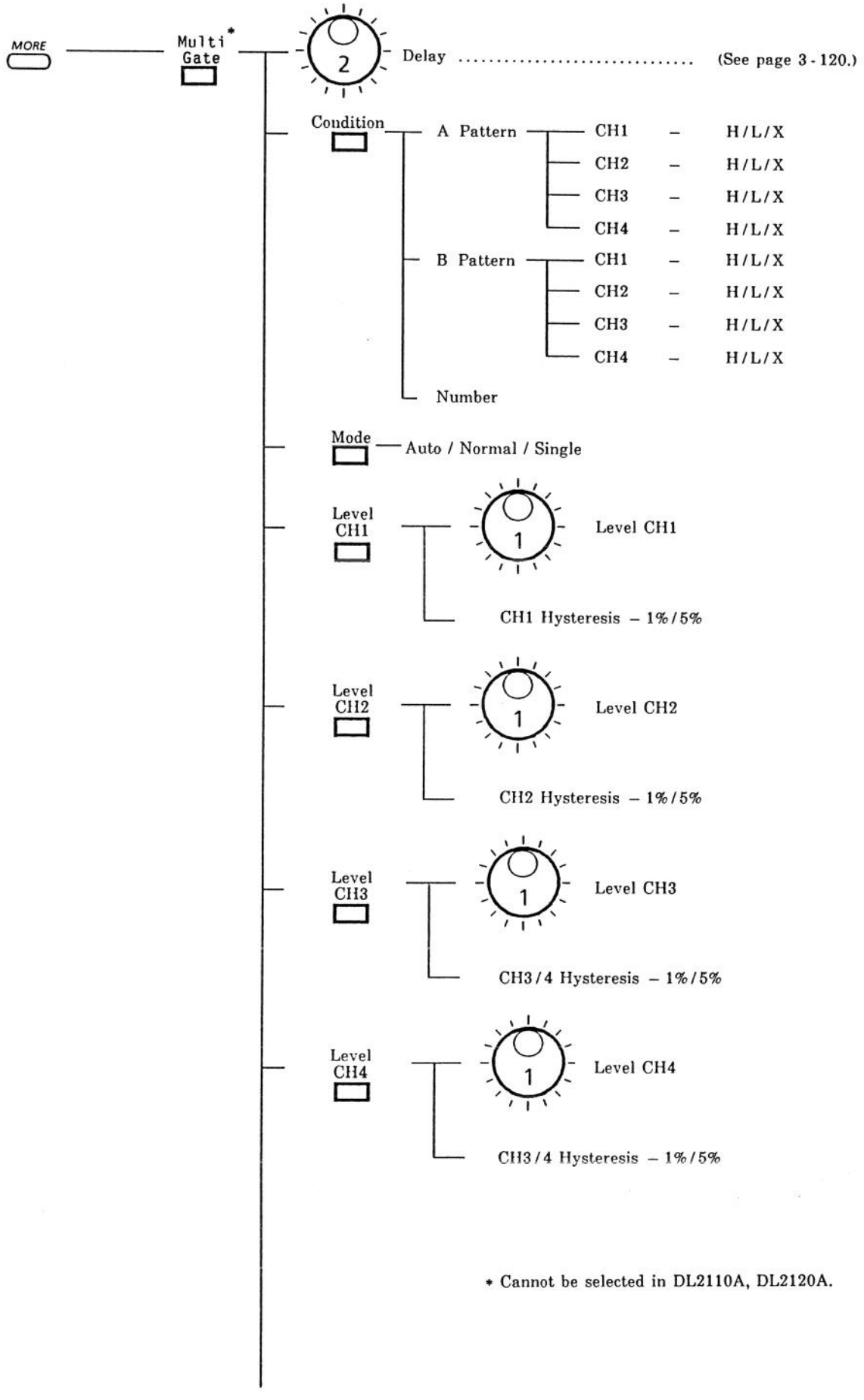

MEASURE
Distal /Proximal
10 – 90% ..... (See page 3-85.)
/Manual
1
Distal
2
Proximal
T Cursor
1
First Point ◄► ..... (See page 3-86.)
2
Last Point ◄►
Trace
Trace 1 – CH1·W1 / CH1·W2 / CH2·W1 / CH2·W2
/ PRGM1·W1 / PRGM1·W2 / PRGM2·W1 / PRGM2·W2
/ MEM1·W1 / MEM1·W2 / MEM2·W1 / MEM2·W2
Trace 2 – CH1·W1 / CH1·W2 / CH2·W1 / CH2·W2
(Delay) / PRGM1·W1 / PRGM1·W2 / PRGM2·W1 / PRGM2·W2
/ MEM1·W1 / MEM1·W2 / MEM2·W1 / MEM2·W2
V Item
P-P – On / Off ..... (See page 3-86.)
Max – On / Off
Min – On / Off
Rms – On / Off
Avg – On / Off
Integ 1 – On / Off
Integ 2 – On / Off
T Item
Rise – On / Off ..... (See page 3-86.)
Fall – On / Off
Freq – On / Off
Period – On / Off
+Width – On / Off
–Width – On / Off
Delay – On / Off


MEASURE
T Cursor
(Delay)
1
First Point ◄►.....
(See page 3 - 86.)
2
Last Point ◄►
X-Y
Item
Integ 1 – On / Off .....
(See page 3 - 90.)
Integ 2 – On / Off


MEM CARD
Directory
Drive – A B ..... (See page 3-93.)
2
Directory Scroll
Mode
Data
Save
Source Data – CH1 CH2 PRGM1 PRGM2
..... (See page 3-95.)
First
Length – 1K 2K 4K 8K 16K
32K 64K 128K
Save File Drive – A B
File Name
Comment
Load → MEM1 – Source CH – CH1/2 CH3/4
..... (See page 3-98.)
Load → MEM2 – Source CH – CH1/2 CH3/4
..... (See page 3-98.)
Copy
Destination File Drive – A B
File Name
(See page 3-100.)
Protect – On Off ..... (See page 3-101.)
Delete ..... (See page 3-102.)
Foramat ..... (See page 3-103.)
<Exec>
Panel
Save
Save File Drive – A B
File Name
Comment
(See page 3-104.)
Load ..... (See page 3-105.)
Copy
Destination File Drive – A B
File Name .... (See page 3-106.)
Protect
On Off .....
Delete .....
Format .....
(See page 3-106.)
<Exec>

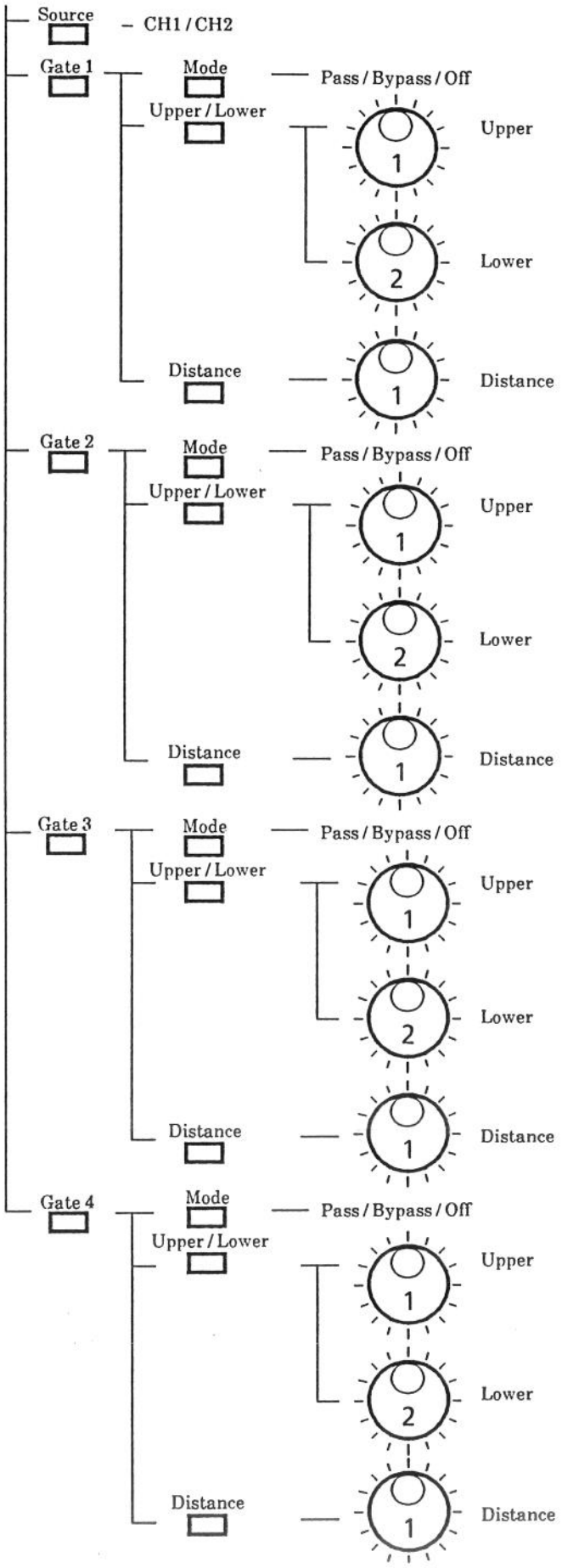

MORE
Combi
Trigger
2
Delay ..... (See page 3 - 108.)
Condition
A Trig
/ B Trig
/ A → B
/ B (n)
Number
/ A → B (n)
Number
Mode
Auto / Normal / Single
Level CH1
1
Level CH1
CH1 Hysteresis – 1% / 5%
Level CH2
1
Level CH2
CH2 Hysteresis – 1% / 5%
Level CH3
1
Level CH3
CH3 / 4 Hysteresis – 1% / 5%
Level CH4
1
Level CH4
CH3 / 4 Hysteresis – 1% / 5%

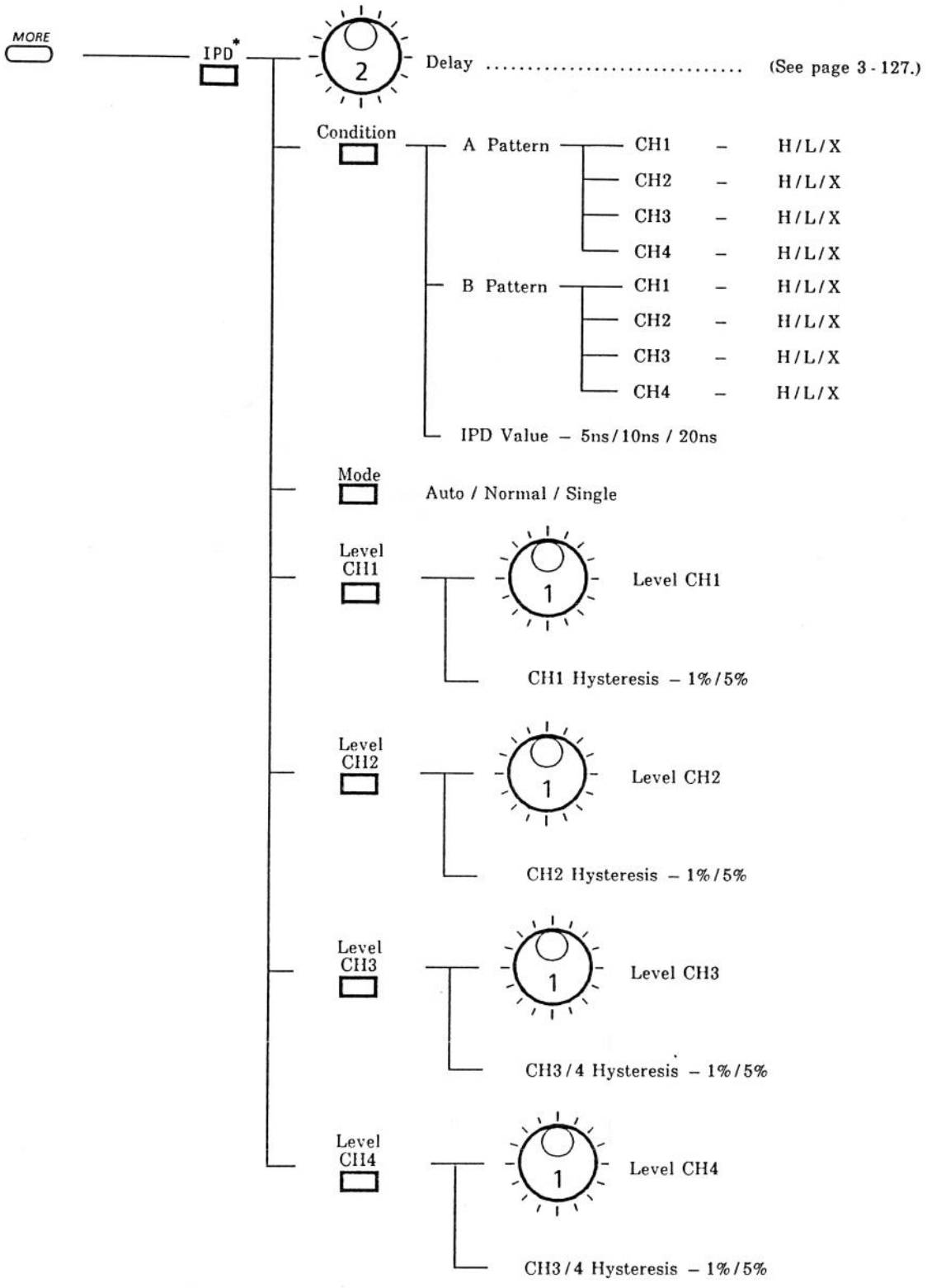

A Trig
Parallel
Pattern CH1 – H/L/X
Pattern CH2 – H/L/X
Pattern CH3 – H/L/X
Pattern CH4 – H/L/X
Mode – Enter/Exit/Both
/Serial
Pattern – ********
Clock CH – CH1/CH2/CH3/CH4
Data CH – CH1/CH2/CH3/CH4
Clock – Rise/Fall
B Trig
Pattern CH1 – H/L/X
Pattern CH2 – H/L/X
Pattern CH3 – H/L/X
Pattern CH4 – H/L/X
Mode – Enter/Exit



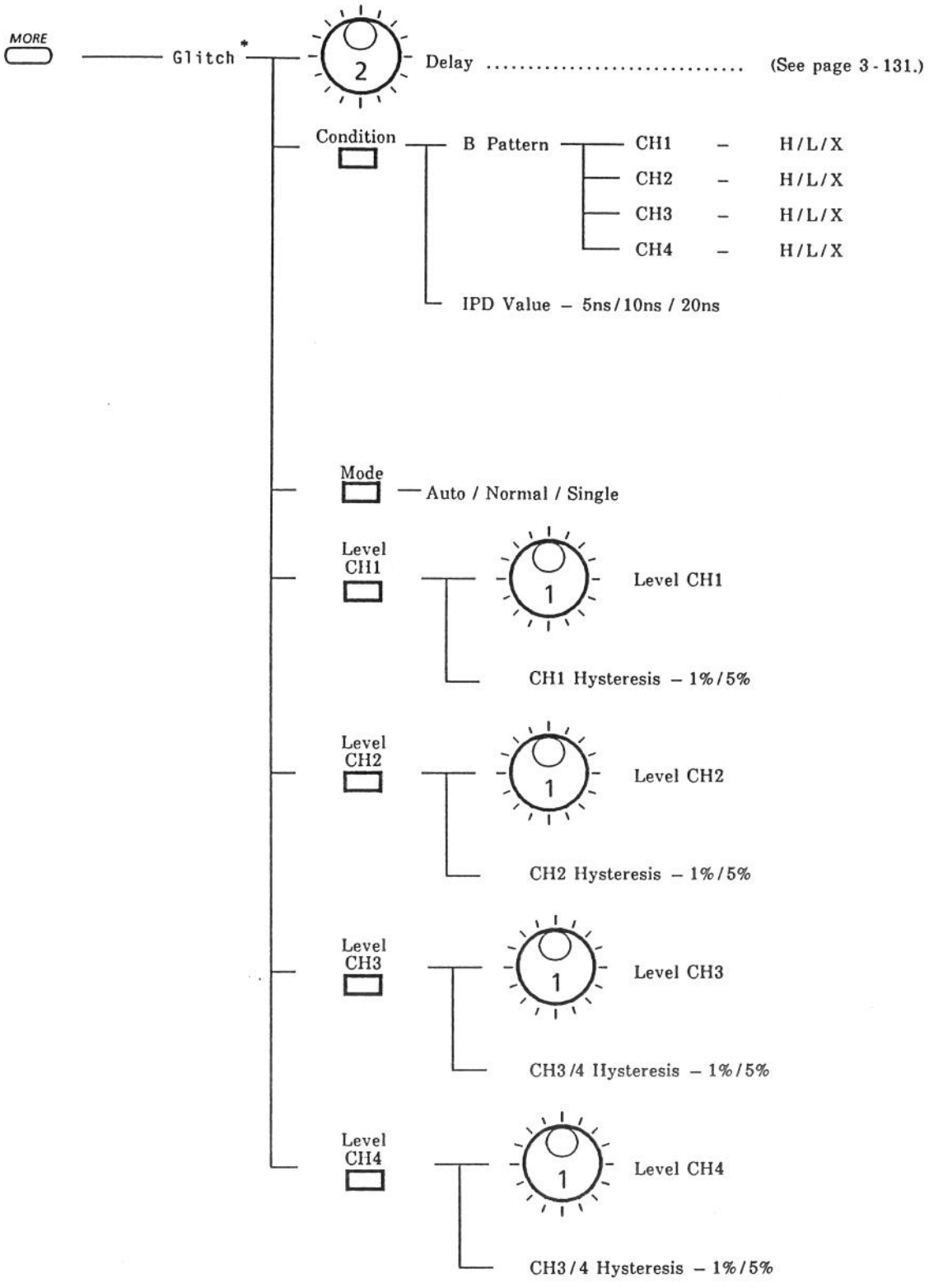
* Cannot be selected in DL2110A, DL2120A.

(Multi Gate)

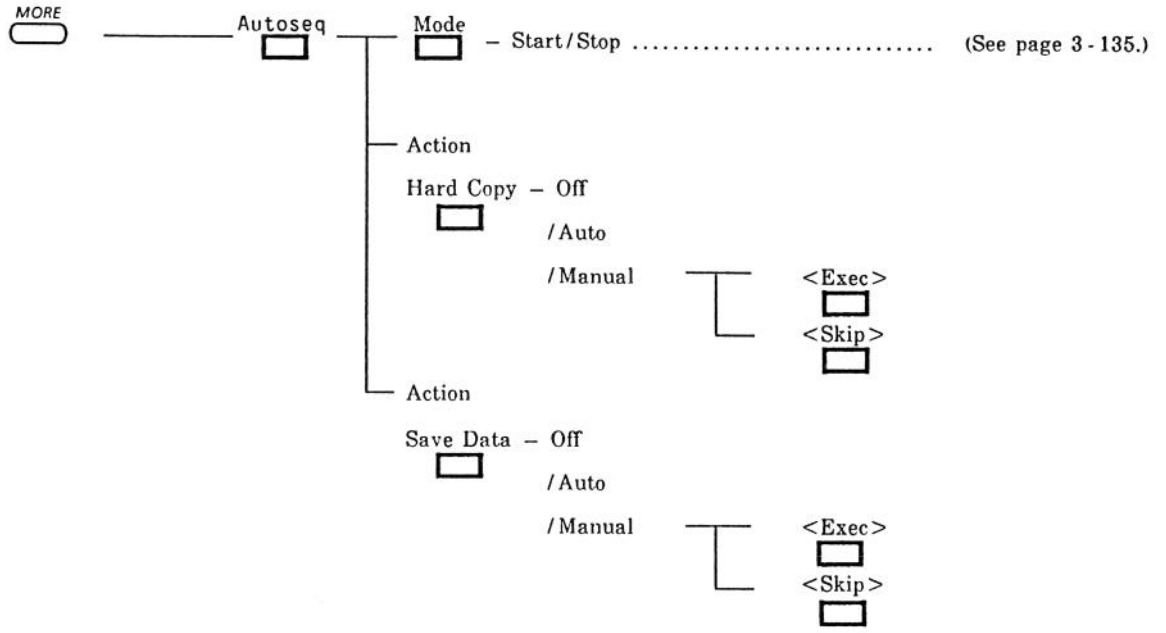

Source
– CH1 / CH2
Gate 1
Mode
Pass / Bypass / Off
Upper / Lower
Upper
1
Lower
2
Distance
1
Distance
Gate 2
Mode
Pass / Bypass / Off
Upper / Lower
Upper
1
Lower
2
Distance
1
Distance
Gate 3
Mode
Pass / Bypass / Off
Upper / Lower
Upper
1
Lower
2
Distance
1
Distance
Gate 4
Mode
Pass / Bypass / Off
Upper / Lower
Upper
1
Lower
2
Distance
1
Distance

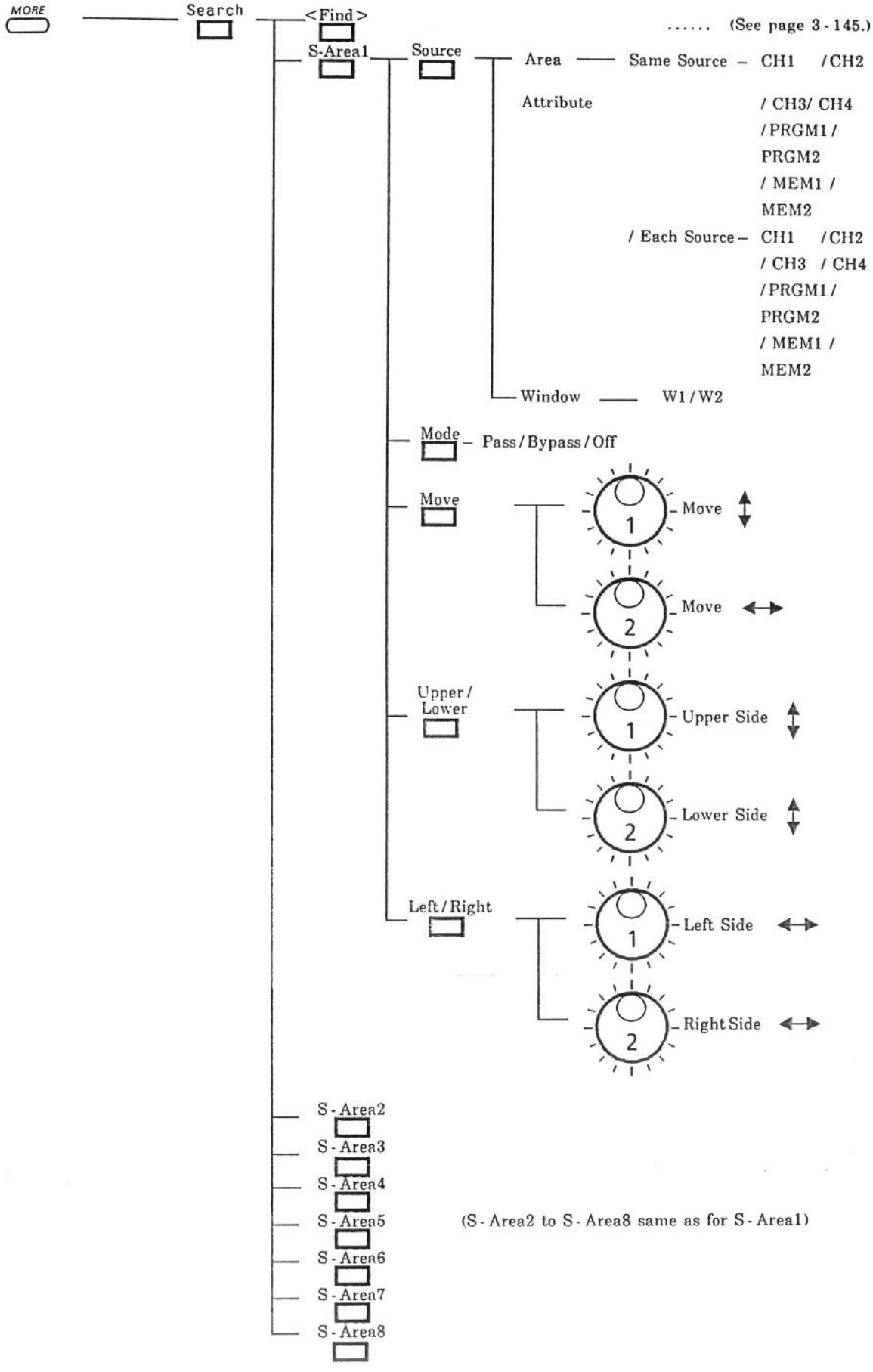


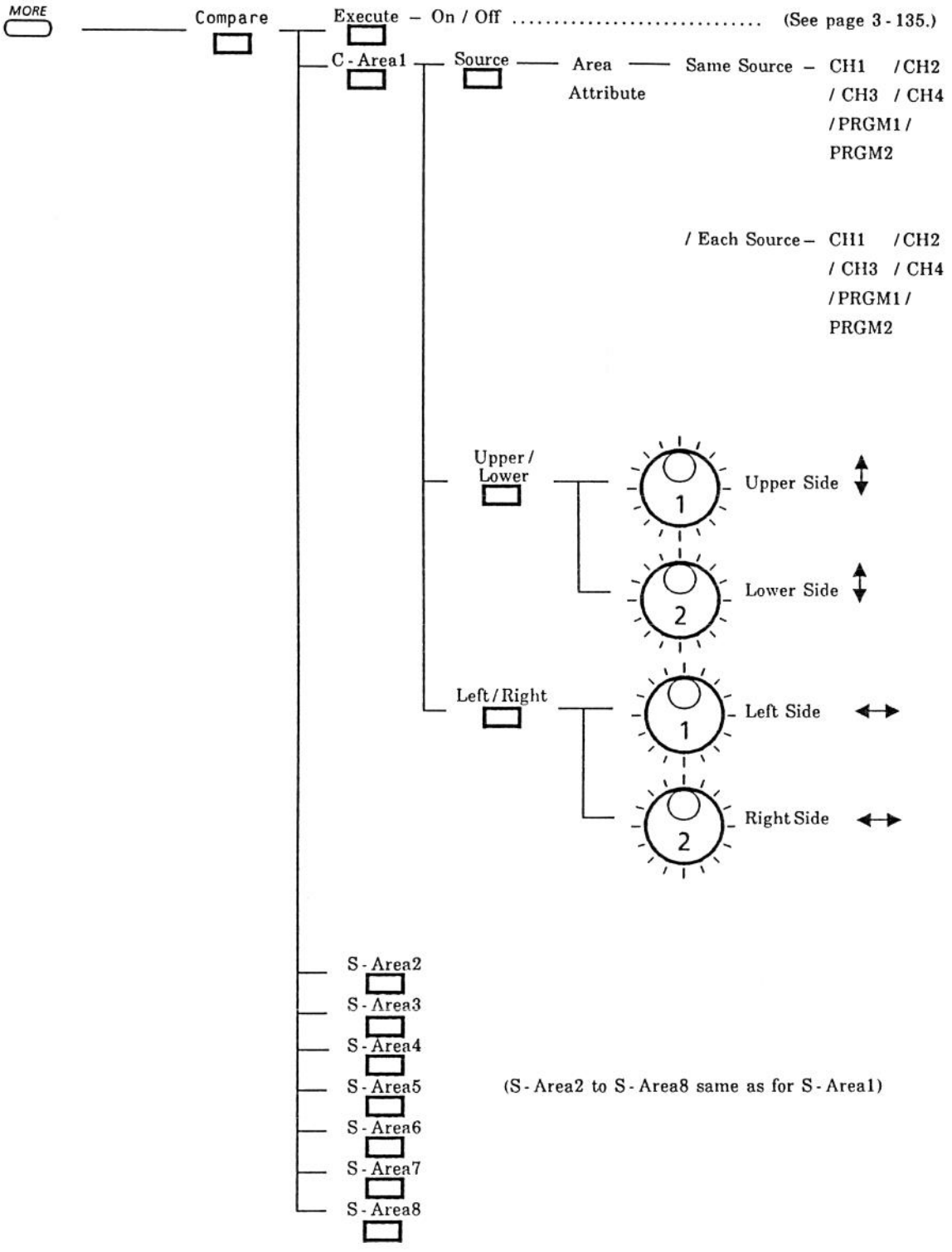
* Cannot be selected in DL2110A, DL2120A.

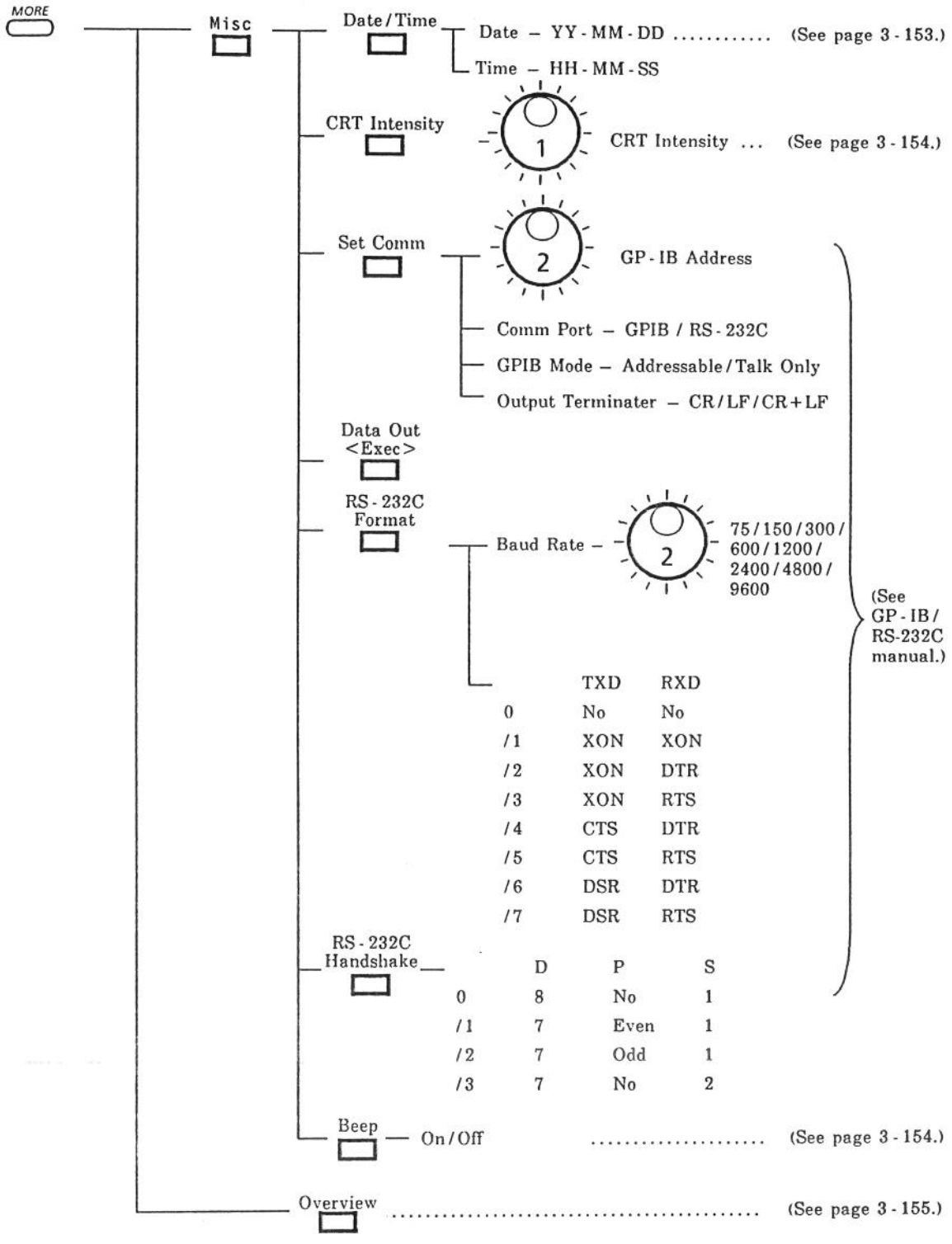


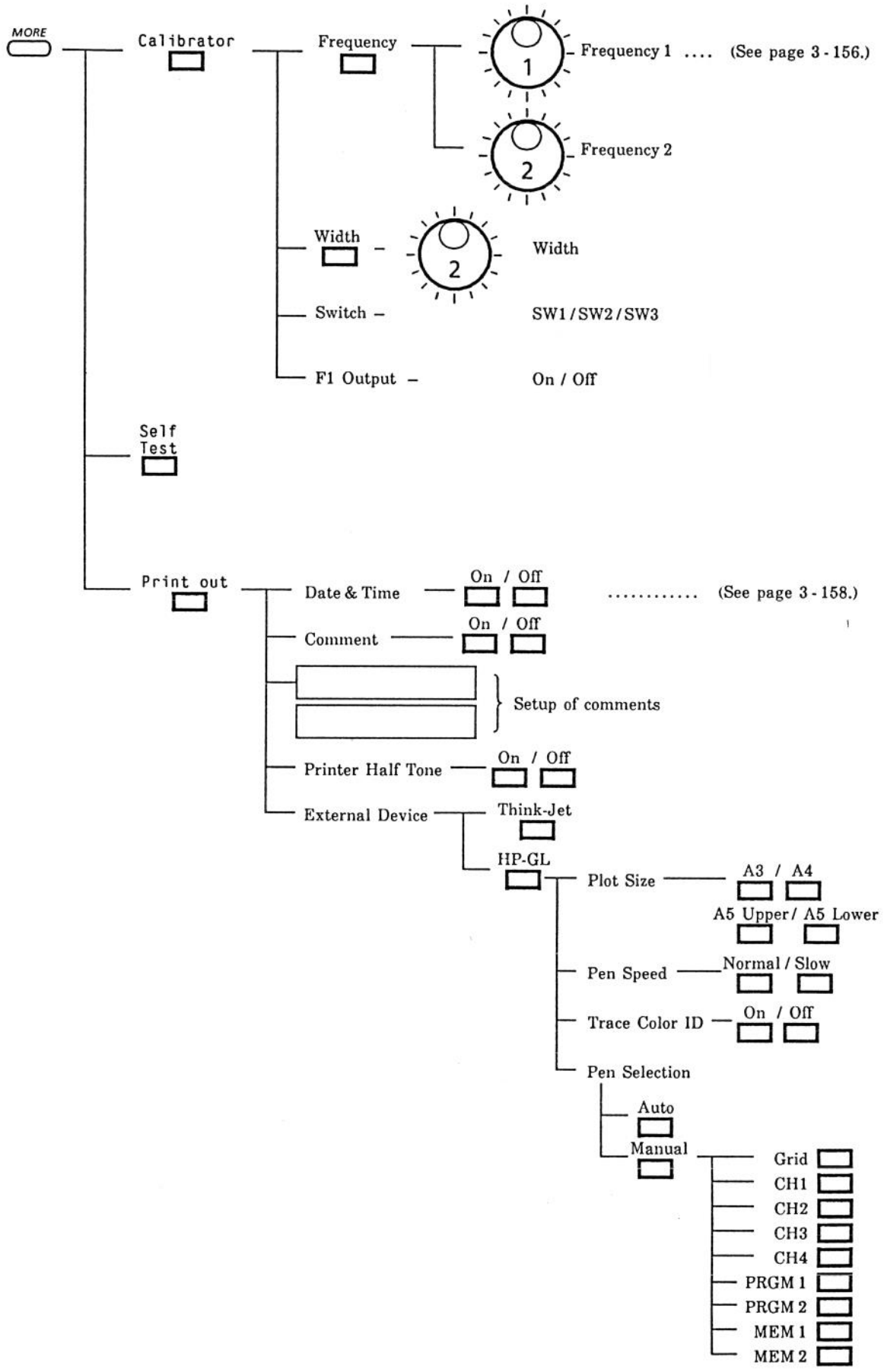
* Cannot be selected in DL2110A, DL2120A.


MORE
Autoseq
Mode
– Start/Stop .....
(See page 3-135.)
Action
Hard Copy – Off
/Auto
/Manual
<Exec>
<Skip>
Action
Save Data – Off
/Auto
/Manual
<Exec>
<Skip>


MORE
Search
<Find>
..... (See page 3-145.)
S-Area1
Source
Area — Same Source – CH1 /CH2
Attribute
/ CH3/ CH4
/PRGM1/
PRGM2
/ MEM1 /
MEM2
/ Each Source – CH1 /CH2
/ CH3 / CH4
/PRGM1/
PRGM2
/ MEM1 /
MEM2
Window — W1/W2
Mode – Pass/Bypass/Off
Move
1 – Move
2 – Move
Upper/
Lower
1 – Upper Side
2 – Lower Side
Left/Right
1 – Left Side
2 – Right Side
S-Area2
S-Area3
S-Area4
S-Area5
S-Area6
S-Area7
S-Area8
(S-Area2 to S-Area8 same as for S-Area1)


MORE
Compare
Execute – On / Off ..... (See page 3 - 135.)
C - Area1
Source
Area Attribute
Same Source – CH1 /CH2 / CH3 / CH4 /PRGM1 / PRGM2
/ Each Source – CH1 /CH2 / CH3 / CH4 /PRGM1 / PRGM2
Upper / Lower
1
Upper Side
2
Lower Side
Left / Right
1
Left Side
2
Right Side
S - Area2
S - Area3
S - Area4
S - Area5
S - Area6
S - Area7
S - Area8
(S - Area2 to S - Area8 same as for S - Area1)


MORE
Misc
Date/Time
Date – YY-MM-DD ..... (See page 3-153.)
Time – HH-MM-SS
CRT Intensity
1
CRT Intensity ... (See page 3-154.)
Set Comm
2
GP-IB Address
Comm Port – GPIB / RS-232C
GPIB Mode – Addressable/Talk Only
Output Terminater – CR/LF/CR+LF
Data Out <Exec>
RS-232C Format
Baud Rate –
2
75/150/300/600/1200/2400/4800/9600
(See GP-IB/RS-232C manual.)
TXD RXD
0 No No
/1 XON XON
/2 XON DTR
/3 XON RTS
/4 CTS DTR
/5 CTS RTS
/6 DSR DTR
/7 DSR RTS
RS-232C Handshake
D P S
0 8 No 1
/1 7 Even 1
/2 7 Odd 1
/3 7 No 2
Beep
On/Off ..... (See page 3-154.)
Overview ..... (See page 3-155.)


MORE
Calibrator
Frequency
1
Frequency 1 .... (See page 3 - 156.)
2
Frequency 2
Width
2
Width
Switch – SW1 / SW2 / SW3
F1 Output – On / Off
Self Test
Print out
Date & Time On / Off ..... (See page 3 - 158.)
Comment On / Off
Setup of comments
Printer Half Tone On / Off
External Device
Think-Jet
HP-GL
Plot Size A3 / A4
A5 Upper / A5 Lower
Pen Speed Normal / Slow
Trace Color ID On / Off
Pen Selection
Auto
Manual
Grid
CH1
CH2
CH3
CH4
PRGM 1
PRGM 2
MEM 1
MEM 2

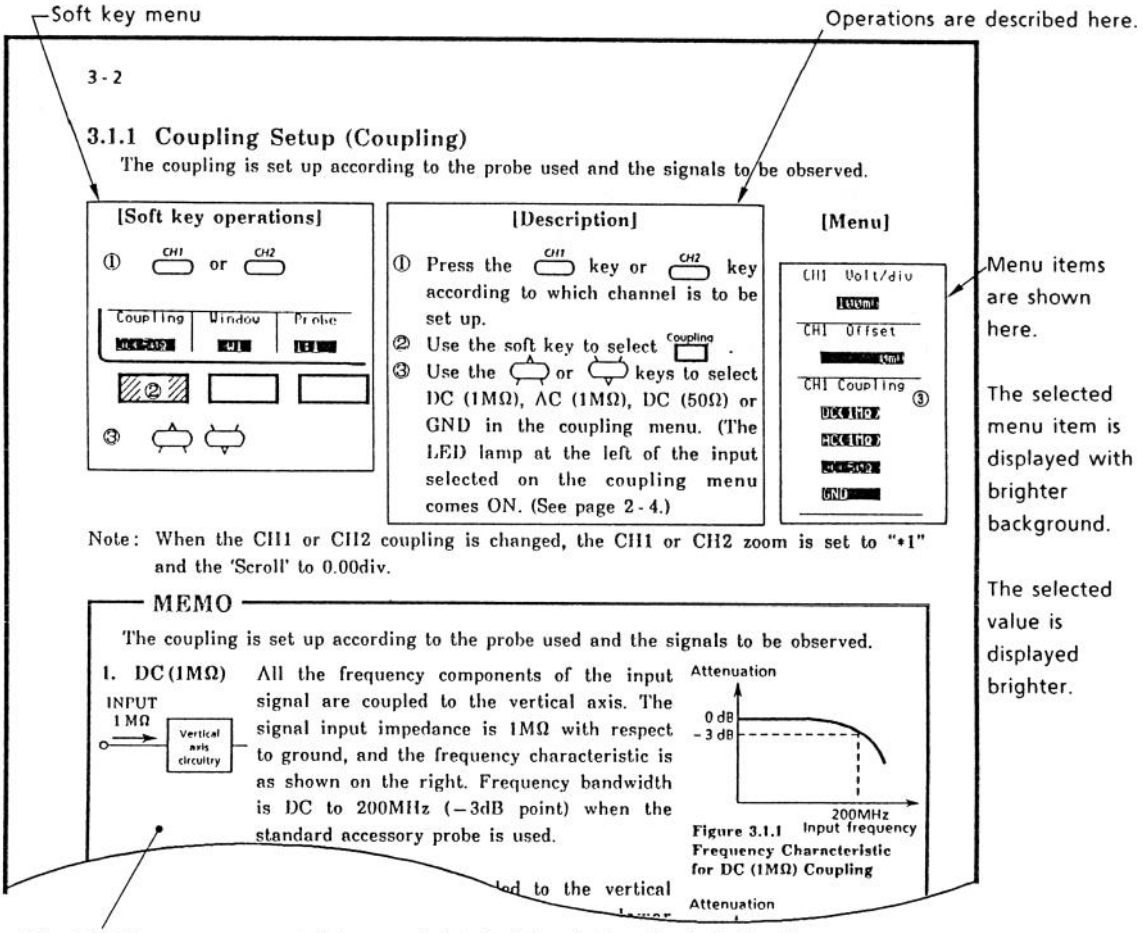
Chapter 3. OPERATION

This chapter gives detailed descriptions of the DL2100A digital oscilloscope operating procedures. We suggest that you read this chapter carefully in order to exploit to the fullest the functions of the instrument.

ITEMS

NOTES

※ **The following explains how to read this operation section.**



LEGEND

※ **The keys are indicated by the symbols shown below.**

: Menu keys, function keys

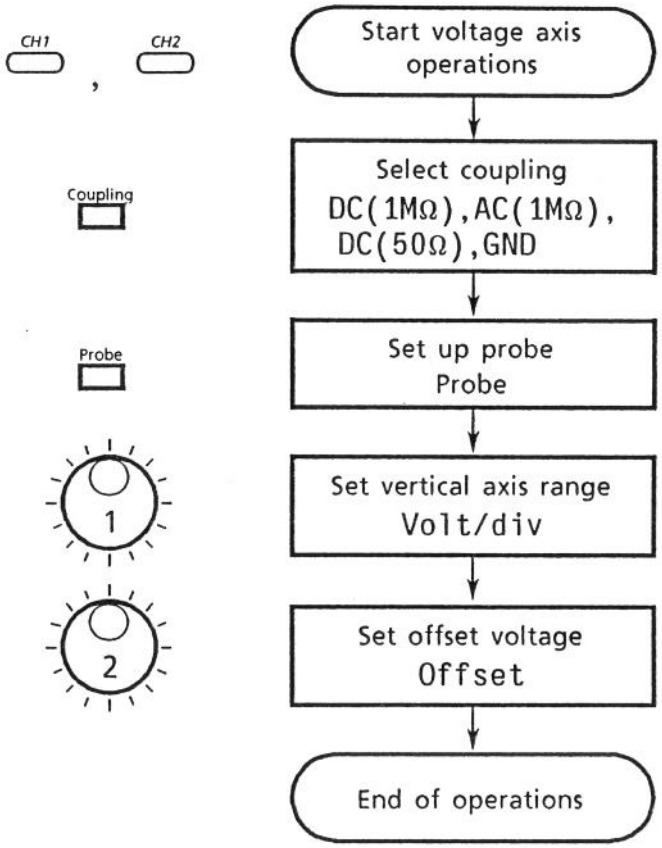
: Soft keys

: Select keys

: Rotary knobs (number indicates rotary knob number; upper knob is 1 and lower knob is 2.)

3.1 Voltage Axis Operation (1) CH1 , CH2

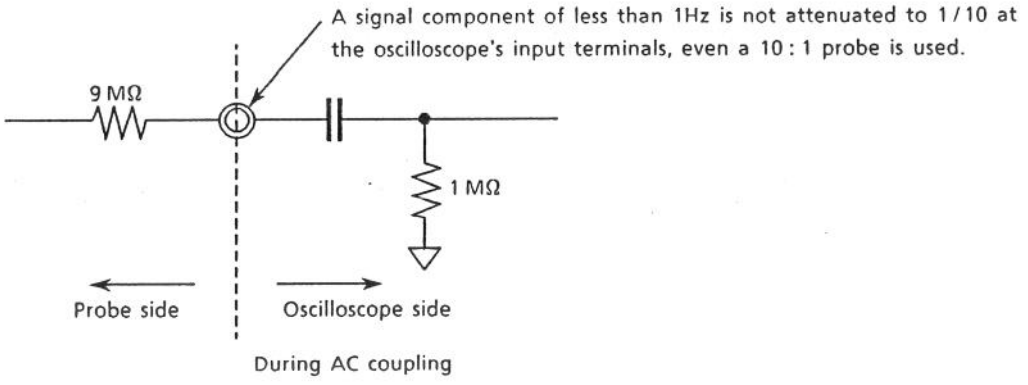
The procedure for voltage axis operations is as follows:



See page 3-2.
See page 3-3.
See page 3-6.
See page 3-7.

⚠ Note

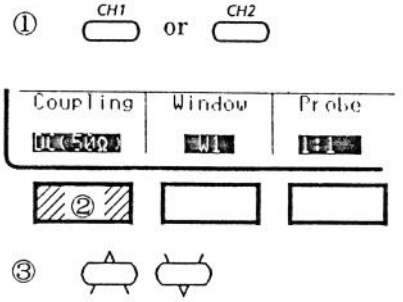
During AC coupling, input signals of less than 1Hz are not attenuated to 1/10 at the oscilloscope's input terminals, even if measurement is performed with a 10MΩ 10:1 probe. Therefore, make sure that signal components of less than 1Hz do not exceed 250V (DC + AC peak) of the maximum input voltage at the end of the probe.



3.1.1 Coupling Setup (Coupling)

The coupling is set up according to the probe used and the signals to be observed.

[Soft key operations]



[Description]

① Press the CH1 key or CH2 key according to which channel is to be set up.

② Use the soft key to select Coupling.

③ Use the ◁ or ▷ keys to select DC (1MΩ), AC (1MΩ), DC (50Ω) or GND in the coupling menu. (The LED lamp at the left of the input selected on the coupling menu comes ON. (See page 2-4.)

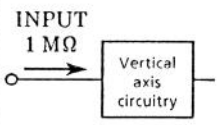
[Menu]

Note: When the CH1 or CH2 coupling is changed, the CH1 or CH2 zoom is set to "*1" and the 'Scroll' to 0.00div.

MEMO

The coupling is set up according to the probe used and the signals to be observed.

1. DC (1MΩ)



All the frequency components of the input signal are coupled to the vertical axis. The signal input impedance is 1MΩ with respect to ground, and the frequency characteristic is as shown on the right. Frequency bandwidth is DC to 200MHz (−3dB point) when the standard accessory probe is used.

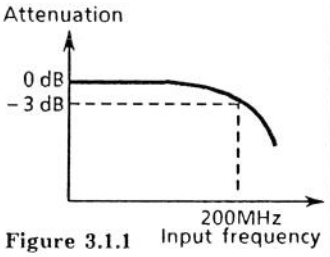
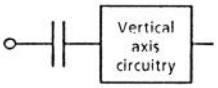


Figure 3.1.1 Frequency Characteristic for DC (1MΩ) Coupling

2. AC (1MΩ)



The input signal is coupled to the vertical axis through a capacitor. The lower frequency characteristics give −3dB at or below 10Hz when a 1 : 1 probe is used, and −3dB at 1Hz or below when the standard accessory 10 : 1 probe is used.

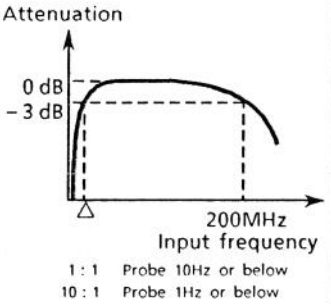
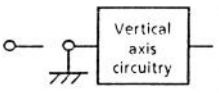


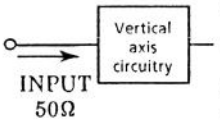
Figure 3.1.2 Frequency Characteristic for AC (1MΩ)

3. GND



The vertical axis circuit is coupled to ground, and the ground level appears on CRT. (If the normal trigger mode is used, triggering does not occur and nothing appears on the CRT). Ground is linked to the vertical axis circuit in the 1MΩ path.

4. DC (50Ω)



All the frequency components of the input signal are terminated to ground by 50Ω and coupled to the vertical axis circuit. The frequency bandwidth of the input signal is 0 to 300MHz (−3dB point).

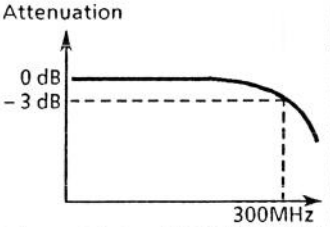


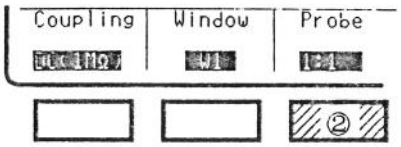
Figure 3.1.3 Frequency Characteristic with DC (50Ω)

3.1.2 Matching Oscilloscope and Probe (Probe)

Sets up the instrument for the attenuation ratio of the probe used.
Selection can be made, 1MΩ input: 1:1, 10:1, 100:1
50Ω input : 1:1, 10:1, 20:1, 25:1, 50:1

[Soft key operations]

① CH1 or CH2



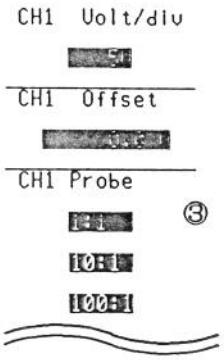
③

[Description]

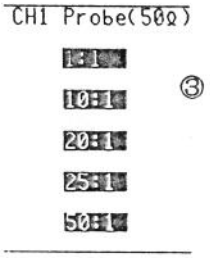
① Press the CH1 key or CH2 key according to which channel is to be set up.
② Use the soft key to select Probe .
③ Use the ⟨ ⟩ or ⟨ ⟩ keys to select the vlaue corresponding to the probe. (This setting ensures that the screen read-out values match the input value.)

[Menu]

When the coupling is set to DC(1MΩ), AC(1MΩ) or GND

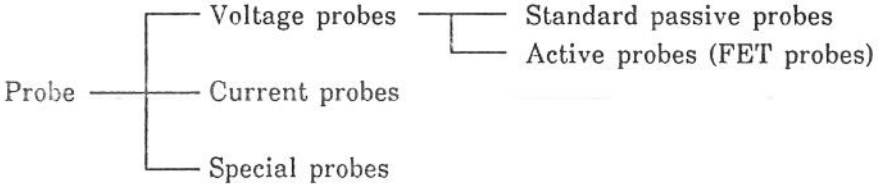


When the coupling is set to DC(50Ω)



MEMO

The following oscilloscope probes are available.



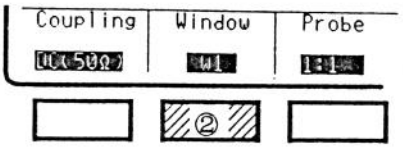
- Standard passive probes are connected to the 1MΩ input terminal. The 'Probe' value in the menu is selected according to the attenuation ratio. (When connecting the accessory probe to the 1MΩ input connector, set it to 10:1.) Refer to the accessory operation manual for details on other probes.

3.1.3 Input Waveform Display (Window)

Waveforms can be displayed in a window by selecting W1 or W2.

[Soft key operations]

① CH1 or CH2



③

[Description]

① Press the CH1 key or CH2 key according to which channel is to be set up.

② Select Window with the soft key.

③ Using the ↑ or ↓ keys, select the windows to display. (Selecting 'OFF' clears that signal's waveform from the display.
"W1," "W1&W2" and "W2" denote "Window1 and Window2" and "Window2" respectively.

[Menu]

MEMO

- **Windows**
  The window setup determines where on the display the acquired waveform data will be displayed. It also is used to set up the size and position of the window. Up to two windows may be set up for each channel.

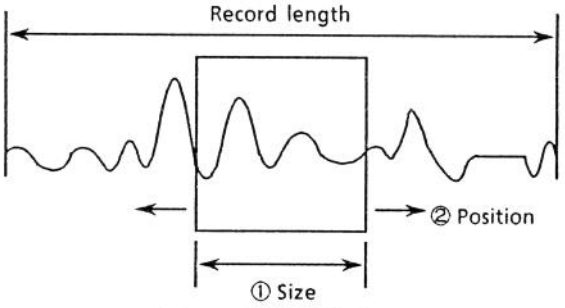
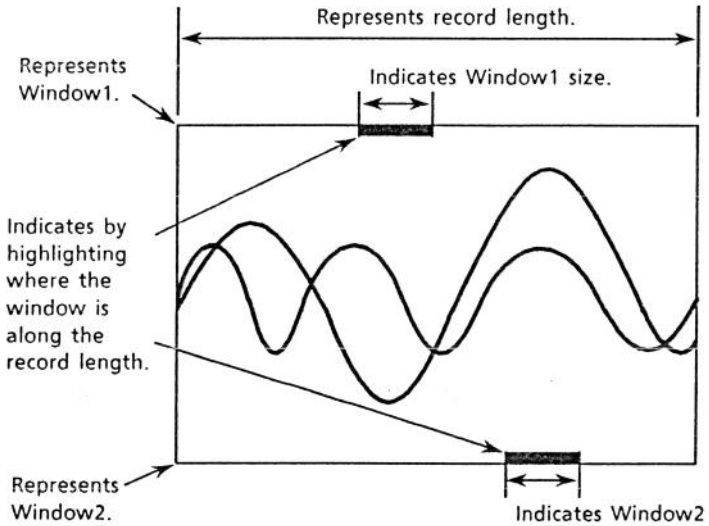


Figure 3.1.4 Window

CRT Display

Window1 and Window2 are displayed on CRT as in the figure below.



The highlighted line at the top of the waveform display area indicates the size and the position of Window1 within the record length.
The highlighted line at the bottom indicates the size and position of Window2.

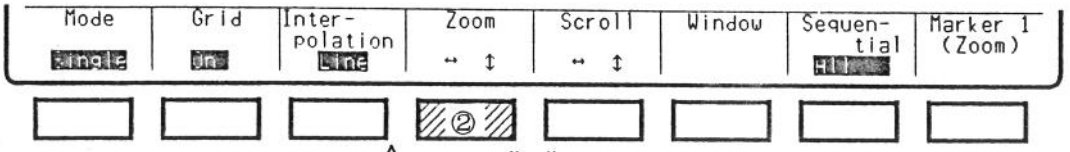
Figure 3.1.5 Window Size and Position

(1) Window Size Setting

The window size is set using 'Zoom'.

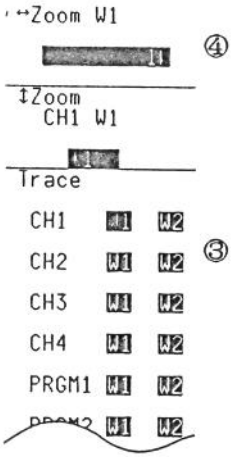
① Press the DISPLAY key.

② Select Zoom with the soft key.



③ Select Trace with the ↑ and ↓ keys, and select the name of the window to be changed with the ← and → keys.

④ The number of data to be displayed in the window is determined by rotary knob 1. The setting can range from a minimum of 4 or 5 data up to a maximum of about twice the total data length. (◄► Zoom indicates the number of points shown on the waveform display.



* A change in the Time / div value accompanies any change in the window size.

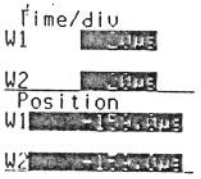
(2) Window Position Setting

The position of the window is set with Time Position or Display Scroll. The scroll and position values are indicated in terms of time from the trigger point to the left edge of the window which can be moved in the record length.

◦ Setting with Time Position:

① Press the TIME key.

② Move the position with rotary knob 2. Windows 1 and 2 will move simultaneously.



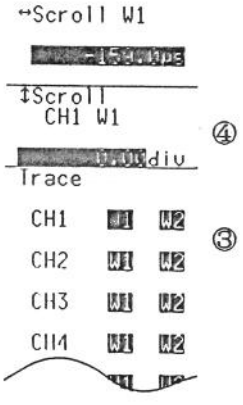
◦ With Display Scroll:

① Press the DISPLAY key.

② Select Scroll with the soft key.

③ Select trace with the ↑ and ↓ keys, and the waveform to be scrolled with the ← and → keys. (Select W1 or W2).

④ Move the window position with rotary knob 1.



* When Windows 1 and 2 overlap, the areas of overlap are highlighted.

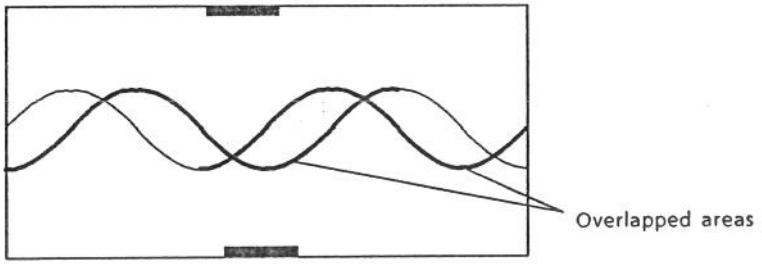


Figure 3.1.6 When Windows Overlap

3.1.4 Vertical Axis Sensitivity Setting (Volt/div)

[Soft key operations]

① CH1 or CH2

②

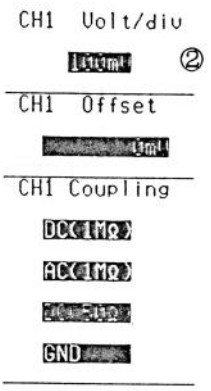
Ratary knob 1

[Description]

① Press the CH1 key or CH2 key according to which channel is to be set up.

② The vertical axis sensitivity can be changed by turning rotary knob 1.
The sensitivity ranges are:
1MΩ input: 5mV/div to 5V/div
50Ω input : 20mV/div to 1V/div
Sensitivity changes in increments of 1, 2 or 5.
Turn the knob clockwise to select higher ranges.

[Menu]



Note 1: When the CH1 or CH2 vertical axis sensitivity is changed, the CH1 or CH2 display settings also change as follows:

▲▼ Zoom value : *1

▲▼ Scroll value : 0.00div

Note 2: Even though CH1 and CH2 measure the same signal in the same range, waveform amplitude between CH1 and CH2 may vary due to input circuit characteristics. When the waveform amplitudes between the two channels agree, carry out constant multiplication using the User-Defined functions. (See page 3-76.)
User Define can function with DL2120A and DL2140A.

3.1.5 Offset Voltage Addition (Offset)

[Soft key operations] **[Description]** **[Menu]**

① CH1 or CH2

② 

① Press the CH1 key or CH2 key according to which channel is to be set up.

② The offset voltage is added by turning rotary knob 2.
Refer to the table below for the offset voltage ranges.

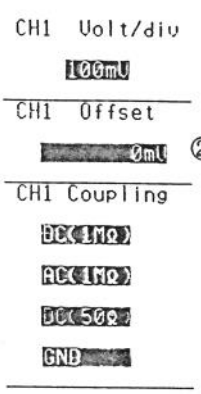


Table 3.1.1 Possible Ranges of Input DC Offset Voltage

Voltage Range	Possible Input DC Offset Voltage Range	
	1 MΩ Input	50Ω Input
5 mV / div	−50mV to +50mV	———
10mV / div	−100mV to +100mV	———
20mV / div	−200mV to +200mV	−400mV to +400mV
50mV / div	−500mV to +500mV	− 1 V to + 1 V
100mV/ div	− 1 V to + 1 V	− 2 V to + 2 V
200mV / div	− 2 V to + 2 V	− 4 V to + 4 V
500mV / div	− 5 V to + 5 V	− 5 V to + 5 V
1 V / div	−10V to +10V	− 5 V to + 5 V
2 V / div	−20V to +20V	———
5 V / div	−20V to +20V	———

Note: The ranges in the table apply when a 1 : 1 probe is used. If the accessory 10 : 1 probe is used, the ranges will increase 10-fold over the figures given for the 1MΩ input.

MEMO

Since the waveform position will change when the offset voltage is added, it is used as the voltage axis position.

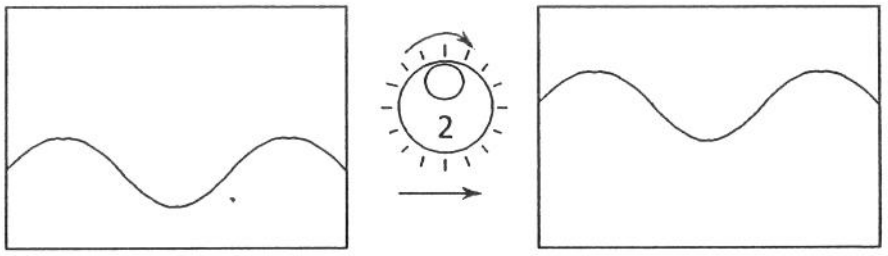
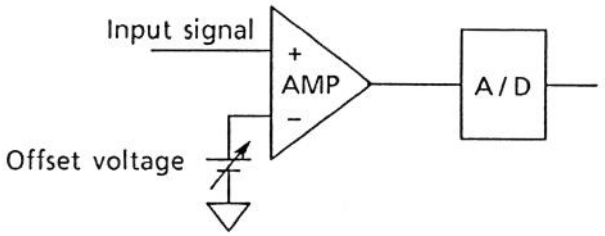


Figure 3.1.7 Offset Voltage

Since the offset voltage is supplied directly to the input signals, it can be conveniently used when part of a waveform needs to be enlarged for observation. This voltage does not affect the values applying when a computation operation or waveform parameter measurement is conducted.

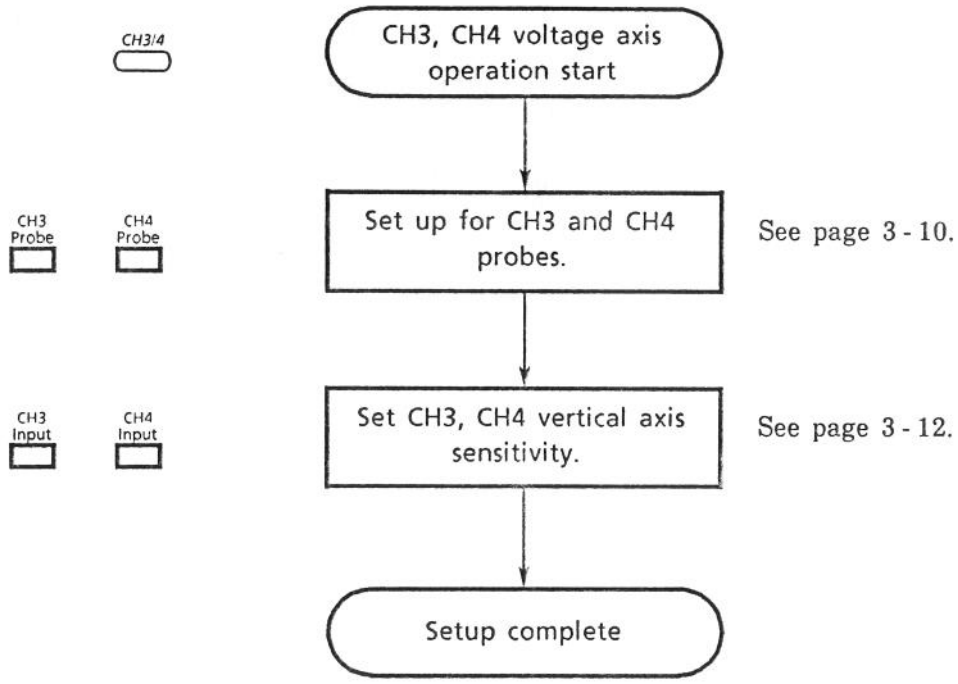
Note: Offset voltage is given before A/D converter. Therefore, if the difference between offset voltage and input signal exceeds the full scale range (10div) of A-D converter, A-D converter outputs abnormal data.



Note that in this case operation cannot be carried out precisely.

3.2 Voltage Axis Operation (2) CH3/4

CH3 and CH4 are primarily used as trigger inputs.
The procedure for CH3 and CH4 voltage axis operations is as follows:



Note: Do not make changes to the vertical axis sensitivity if the input voltage exceeds 250V (DC+AC peak).

MEMO

Although CH3 and CH4 are used as trigger input terminal, functions are provided to place them on the display as 1-bit logic patterns showing whether they are higher or lower than the trigger levels set.

Note that in this mode the CH1 and CH2 vertical resolutions are reduced to 7 bits. (See Table 3.2.1.)

To observe the 1-bit pattern, set Window to ON status (W1, W1 & W2 or W2).

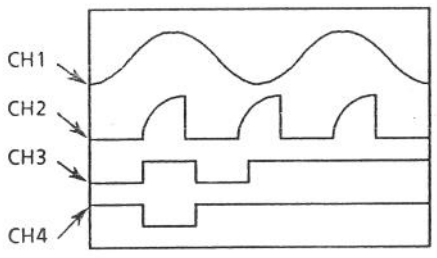


Figure 3.2.1 4-channel Display

Table 3.2.1 CH1, CH2 Bit Length when CH3, CH4 Window is ON/OFF

Window	CH3 Window	CH4 Window	CH1 Bit Length	CH2 Bit Length
ON/OFF	ON	ON	7	7
	ON	OFF	7	8
	OFF	ON	8	7
	OFF	OFF	8	8

3.2.1 Probe Matching for CH3 and CH4 Inputs (Probe)

Sets the attenuation ratio according to the probe used. The probe values which can be selected are the same as those for CH1 and CH2. (See page 3 - 3.)

[Soft key operations]

① CH3/4

② CH3 Probe CH4 Probe

③

[Description]

① Press the CH3/4 key.

② Select CH3 Probe or CH4 Probe with the soft keys.

③ Select the values matching the probes to be connected using the ↑ and ↓ keys. (Same funciton as for the CH1 and CH2 probes.)

[Menu]

For 1MΩ input

CH3 Probe
1:1
10:1
100:1
③

For 50Ω input

CH3 Probe(50Ω)
1:1
10:1
20:1
25:1
50:1
③

Soft keys

CH3 Input	CH3 Window	CH3 Probe	CH4 Input	CH4 Window	CH4 Probe		
50Ω ±4.2V	Off	1:1	1MΩ ±0.2V	Off	1:1		
		②			②		

3.2.2 CH3 or CH4 Display (Window)

[Soft key operations]

① CH3/4

② CH3 Window CH4 Window

③

[Description]

① Press the CH3/4 key.

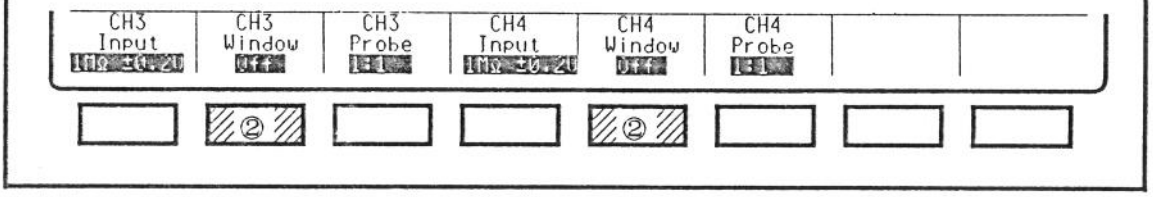
② Select CH3 Window or CH4 Window with the soft keys.

③ Select the window(s) using the and keys. (Window selection is the same as for CH1 and CH2.)

[Menu]

CH3 Window
Off
W1
W1&2
W2
③

Soft keys



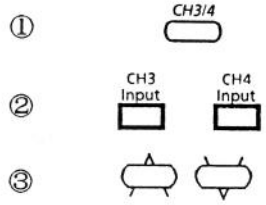
MEMO

Turning ON the window results in 1-bit data acquisition and display.

3.2.3 Vertical Axis Sensitivity Setting (Input)

For CH3 and CH4 there are two voltage ranges (±0.2V and ±2.0V) for 1MΩ inputs, and one voltage range (±0.2V) for 50Ω inputs.

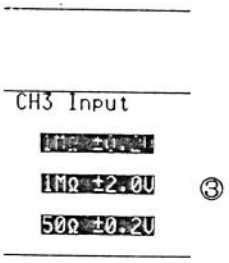
[Soft key operations]

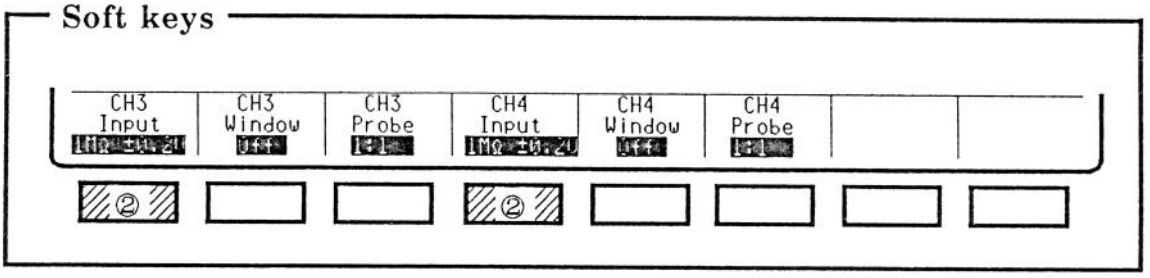


[Description]

① Press the CH3/4 key.
② Select CH3 Input or CH4 Input with the soft keys.
③ Set the range for the input signal using the ▲ and ▼ keys. (Ranges of ±0.2V and ±2V apply to the 1MΩ input : a range of ±0.2V range applies to the 50Ω input.)

[Menu]





Note: Any change in the CH3 or CH4 input is accompanied by a change in the display ↕ Zoom and ↔ Scroll values as follows:

Table 3.3.3 Display Change

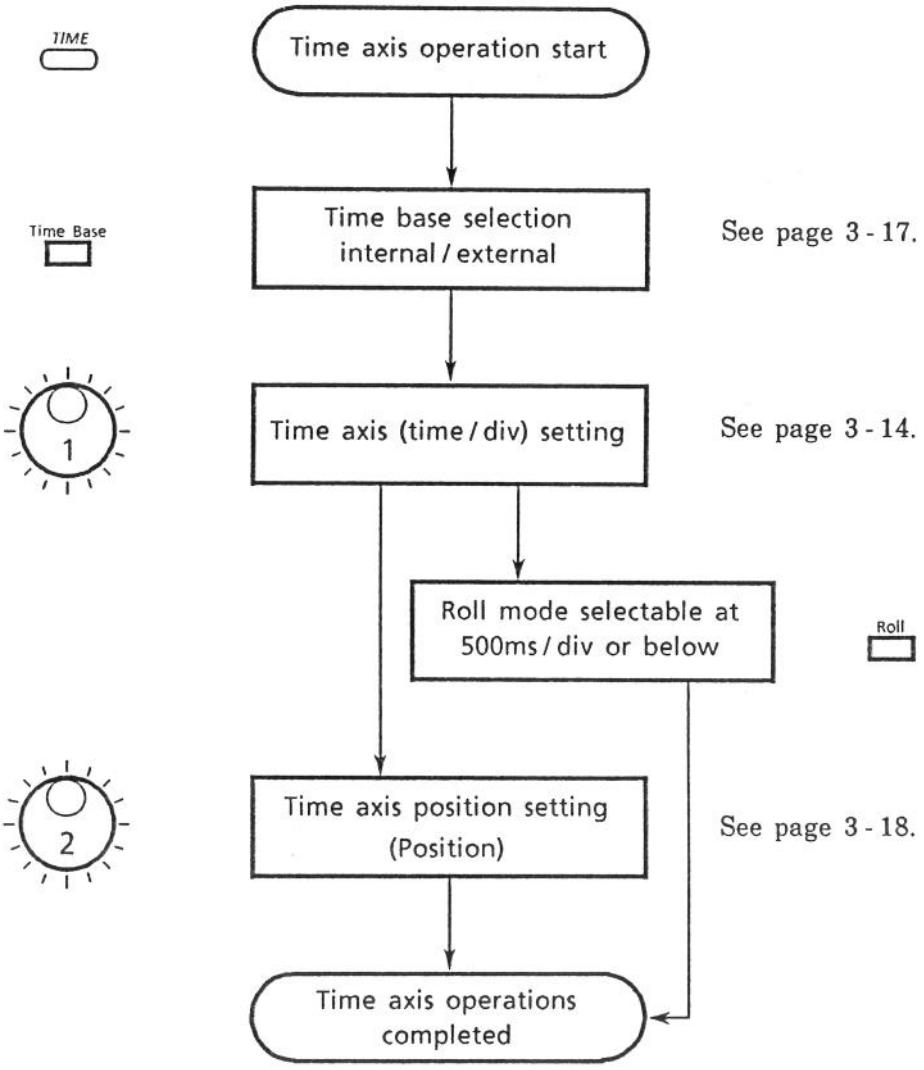
	↕ Zoom	↔ Scroll
CH3	*1	−3.8 div
CH4	*1	−4.8 div

MEMO

The ±0.2V and ±2.0V ranges for the 1MΩ system become ±2V and ±20V ranges, respectively, when the accessory 10 : 1 probe is used. (The ±2V and ±20V ranges are equivalent to 0.4V / div and 4V / div, respectively).

3.3 Time Axis Operation TIME

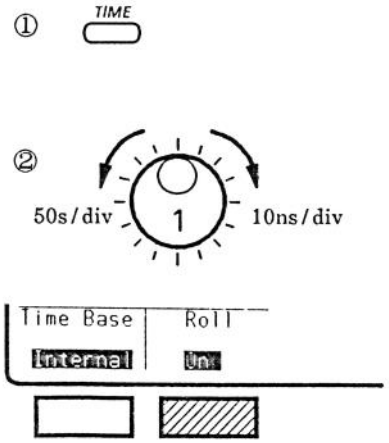
The procedure for time axis operations is as follows:



3.3.1 Time Axis Settings (Time / div)

Sets up the time axis. Although the number of displayed data samples changes along with the time axis (see Column), here we will take as a reference the Time / div values when 1k points are displayed.

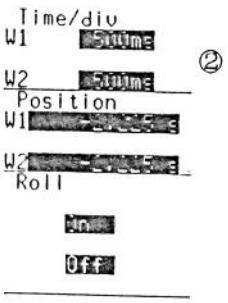
[Soft key operations] **[Description]** **[Menu]**

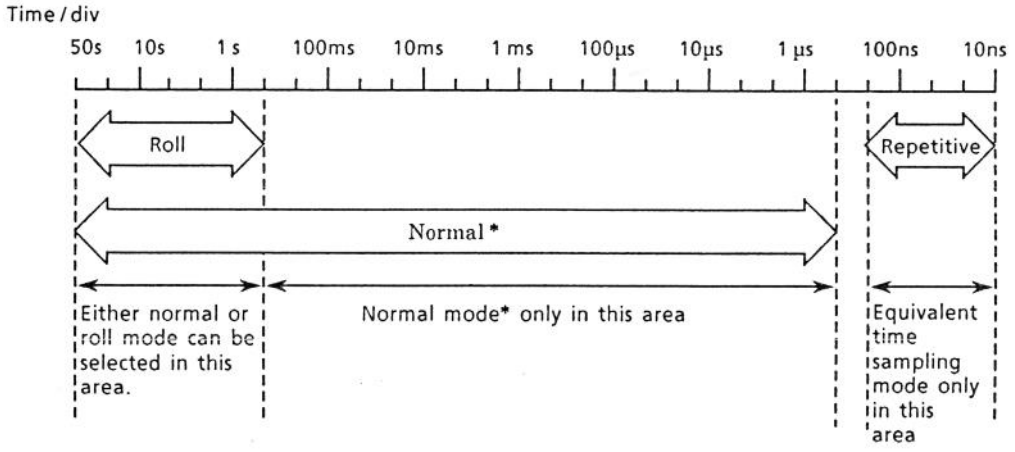


① Press the TIME key.

② Set the time per division by turning rotary knob 1. The time can be switched in steps of 1, 2 and 5 over the range from 10ns / div to 50s / div.

- When the time axis is faster than 200ns / div, the equivalent time sampling mode is automatically selected.
- When the time axis is slower than 500ms / div, the roll mode can be selected. (The roll soft key menu will be highlighted.) To select Roll mode, use the Roll key to display the roll mode menu and operate the ↑ and ↓ keys to select ON or OFF. Figure 3.1 shows the relationship between the equivalent time sampling, roll and normal modes, and the time axis. (Sampling mode (normal, roll) and sampling rate appear at the left center of the screen. (See page 2 - 8.))





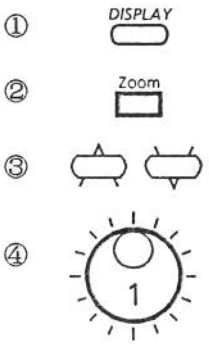
* Normal mode: This is the usual sampling mode. For details, see MEMO on page 3 - 16.

Figure 3.1 Relationship Between Time Axis and Sampling Modes when 1k Data Points are Displayed

Column

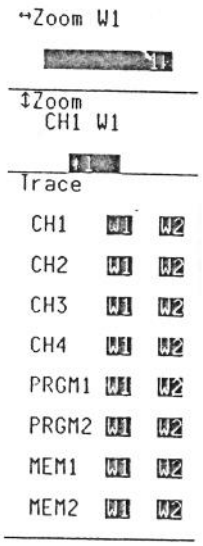
Alternative Time Axis Setting Method

Time axis settings using TIME are done by changing the time base (changing the sampling rate of the A / D converter). Therefore, this method cannot be used to expand data that has once been stored. This section describes how to change the time axis by changing the size of the window with the DISPLAY Zoom key.

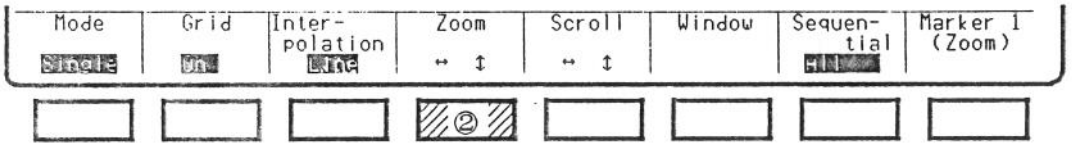


Procedure:

① Press the DISPLAY key.
② Press the Zoom soft key.
③ Determine the window to be set using the ⇦ and ⇨ keys from the Trace menu.
④ Change the window size with rotary knob (1) (↔ Zoom). The Time / div value changes simultaneously (for example, doubling the window length (the number of zoom points) will double the Time / div).
The ↔ Zoom value indicates the number of points displayed in the window. (↔ Zoom is mainly done using the zoom cursor. (See page 3 - 49.))



Soft keys



The Time / div value can thus be changed as described above.

Note: The time axis setting is changed in steps of 1, 2 and 5. This means that the number of points displayed when the Time / div value is moved to the next range, is multiplied either by 2 or 1 / 2, or by 2.5 or 2 / 5 according to the above steps of 1, 2 and 5. Therefore, both values will be displayed for the Zoom value.

Example: With 1k point display;

at 10ms / div, changing to 5ms / div results in 500 points

at 5ms / div, changing to 2ms / div results in 400 points

In both cases, the number-of-points display for Zoom is the same '500 (400)'.

MEMO

1. Real-time Sampling Mode (Normal Mode)

The analog input signals are converted into digital data and displayed on the screen. One-shot and repetitive signals up to 80MHz (−3dB point) can be observed (when sine interpolation is used).

2. Equivalent Time Sampling Mode (Repetitive Mode)

When the input is a repetitive signal, a single display waveform is built up from a number of repeat waveforms. (This mode cannot be used for one-shot waveforms.) Repetitive signals can be observed up to 300MHz (−3dB point) with the 50Ω input, and up to 200MHz (−3dB point) with the 1MΩ input.

Bear in mind that this mode is subject to the following restrictions:

(1) Sequential store is not possible.

(2) The multi-gate triggering function cannot be used. (Entering the equivalent time sampling mode when multi-gate triggering is in use will result in unstable operation.)

3. Roll Mode

The roll mode can be used when the time axis is slow.

In this mode, the waveforms flow across the display without relation to triggering.

Bear in mind that this mode is subject to the following restrictions.

(1) The size of the window will be 1k. Upon completion of the measurement, data equivalent to the last 1k acquired is displayed.

(2) Computing operations cannot be performed in the roll mode.

(3) Only CH1 and CH2 waveforms are displayed.

(4) Averaging, sequential storage and accumulation operations cannot be undertaken.

(5) Measurements cannot be conducted in the roll mode.

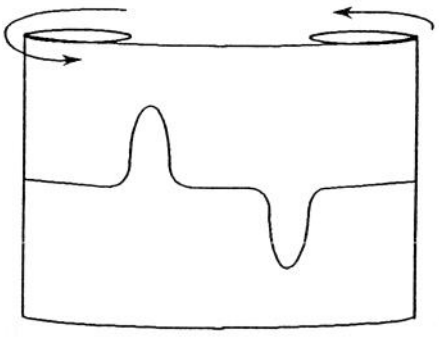
(6) If the Time / div is accelerated after the roll mode has been set ON, the mode will be set OFF. To use the mode again you must turn it ON again.

(7) The time elapsing from turning roll mode to ON until the waveform is displayed is:

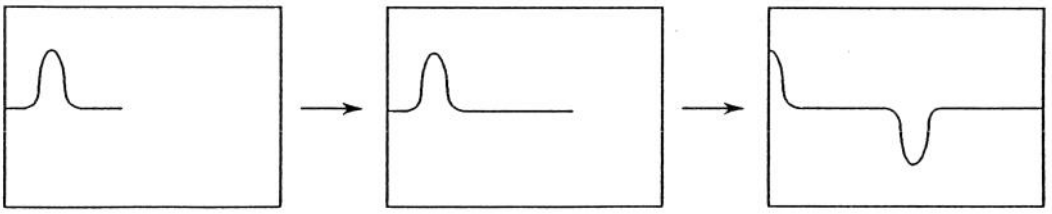
$$48 \times \frac{1}{\text{Sampling frequency (Hz)}}$$

Example: 20Hz sampling frequency

$$48 \times \frac{1}{20\,(\text{Hz})} = 2.4 \text{ sec}$$



In the roll mode, the screen appears like a scroll being turned.

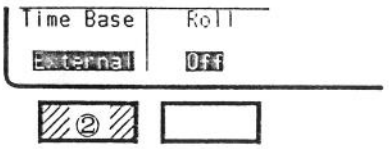


3.3.2 To Use an External Time Base (Time Base)

An external time base can be used by applying as input a sine wave of frequency from 1MHz to 100MHz. The input frequency is used as the sampling frequency of the A/D converter. The signal level should be between 0dBm and 4dBm. Input impedance is 50Ω. The external clock signal is input to the EXT TIME BASE connector on the rear panel.

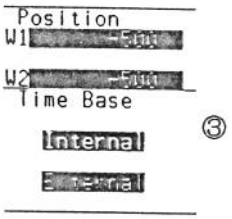
[Soft key operations] **[Description]** **[Menu]**

① TIME



③

① Press the TIME key.
② Select Time Base .

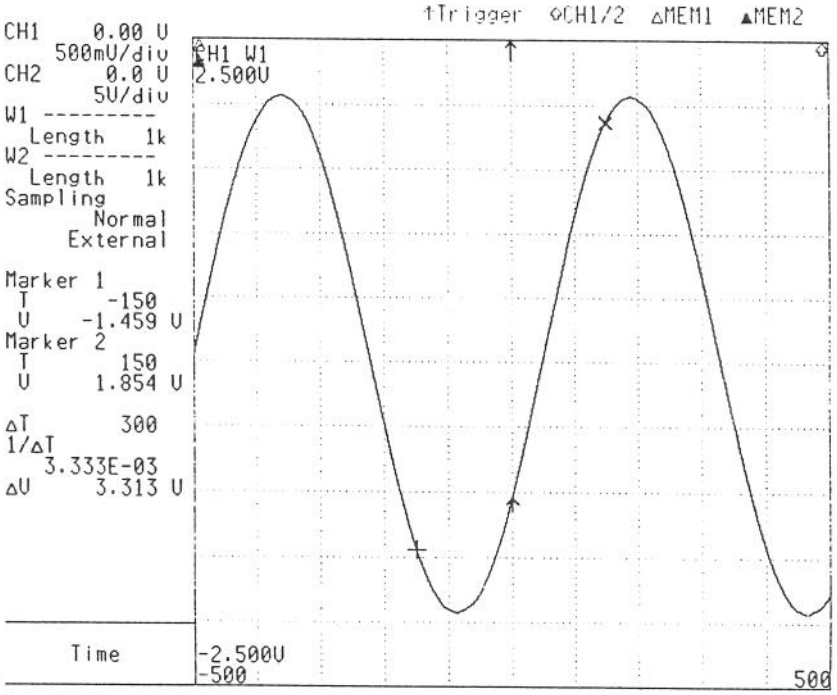


③ Select External with the and keys.

MEMO

When an external time base is used, the time axis is displayed in terms of number of points.

The following is an example of the display when using an external time base.



3.3.3 Time Axis Position Setting (Position)

Sets the time base position.

[Soft key operations]

① TIME

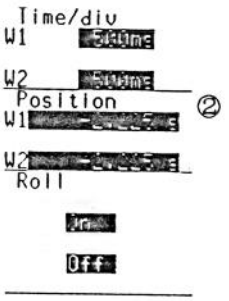
②

[Description]

① Press the TIME key.

② Set the time axis position with rotary knob 2. (See page 3 - 5.)

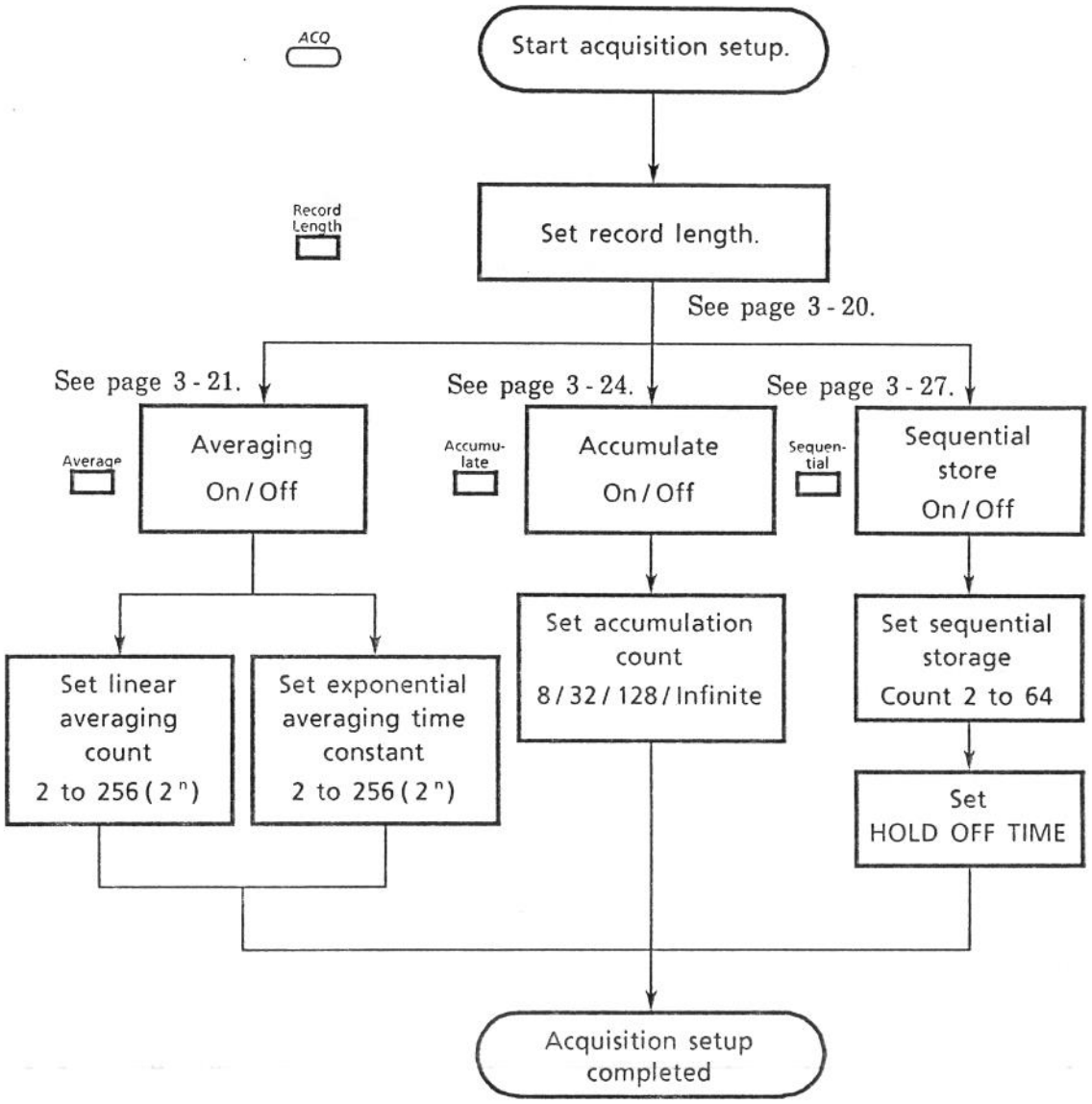
[Menu]



3.4 Data Acquisition ACQ

This section describes how to acquire data to memory.

Acquisition Setup Procedures



MEMO

Averaging, accumulation and sequential storage cannot be conducted simultaneously. This means that if one of these operations is selected while another mode is already ON, that mode will be automatically turned OFF and the instrument will switch to the newly selected mode. For example, if averaging is selected while the accumulate mode is ON, that mode will be automatically turned OFF, and averaging will start. All functions discussed here are performed simultaneously for CH1 and CH2.

3.4.1 Determining the Length of Waveform Data to be Acquired (Record Length)

The record length is set by selecting the amount of memory to be used.

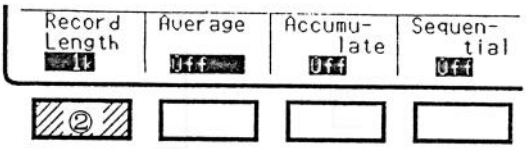
[Soft key operations] **[Description]** **[Menu]**

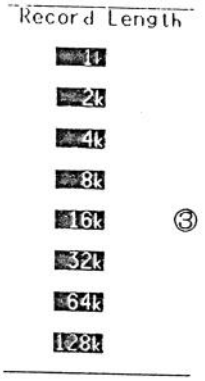
① ACQ

① Press the ACQ key.

② Record Length

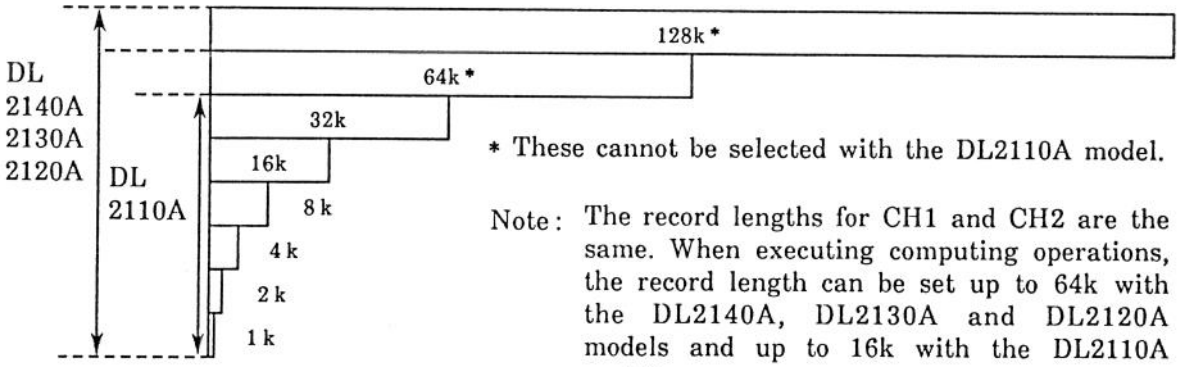
② Select Record Length with the soft keys.





③

③ Select the record length with the ◁ and ▷ keys.
The record length can be set to 1k, 2k, 4k, 8k, 16k, 32k, 64k* or 128k* (where "k" denotes "kilo" or 1000).



* These cannot be selected with the DL2110A model.

Note: The record lengths for CH1 and CH2 are the same. When executing computing operations, the record length can be set up to 64k with the DL2140A, DL2130A and DL2120A models and up to 16k with the DL2110A model.

MEMO

Bear in mind the following points since the record length greatly affects the trace update speed and computation operations.

1. With simple repetitive waveforms, a short record length generally yields speedy waveform update and computation operations, which simplifies observation. (Waveforms can be adequately observed even with a 1k length.)
2. With complicated repetitive waveforms, select the record length according to the waveform frequency. Increasing the record length enables repeating waveforms with long periods to be observed easily. (Use the zoom function to expand any portion of a waveform.)
3. When it comes to one-shot signals, even those of long duration can be captured if the maximum record length is used.
   With a 128k memory and 200M sample/s setting, you can capture signals of 640µs duration. (One-shot signals with an even longer duration can be observed if the sample rate is reduced, although this will also reduce the time resolution).

3.4.2 Averaging (Average)

The averaging functions are used to eliminate noise (random noise affecting repetitive waveforms) superimposed on the input signals.

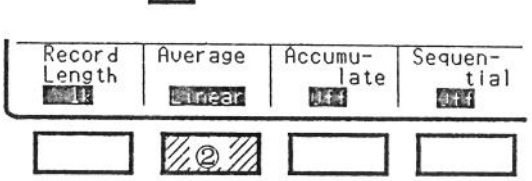
There are two types of averaging : linear and exponential. During averaging the count of the number of cycles executed is displayed at the left center of the screen.

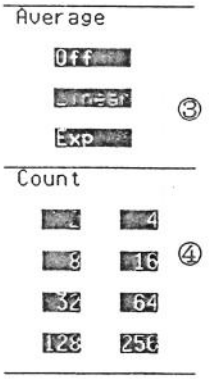
[Soft key operations] **[Description]** **[Menu]**

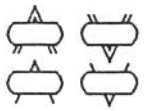
① ACQ

① Press the ACQ key.

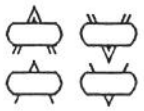
② Select Average with the soft key.





③ 

③ Select Average from the menu using the ▲ or ▼ keys, and select Linear (for linear averaging) or Exp (for exponential averaging) using the ◀ or ▶ keys.

④ 

④ Next, use the ▲ and ▼ keys to select Count (the averaging cycle count for linear averaging ; the time constant for exponential averaging) from the menu, and use the ◀ and ▶ keys to set the value.

CLEAR TRACE

Pressing the CLEAR TRACE key during averaging clears the waveform causes the operation to be repeated from the start. Averaging can be stopped at any time by pressing the START STOP key and then resumed by pressing the same key again.

START STOP

MEMO

About linear averaging and exponential averaging :

(1) **Linear Averaging**

With each measurement the linearly averaged data appears on the screen. This continues until the assigned count is reached.

The linear averaging algorithm is :

$$An=\frac{1}{n}\{(n-1)A_{n-1}+Zn\}$$

Where, An : Average value (averaging waveform) on nth cycle

Zn : Measurement value on nth cycle

Due to the nature of the internal processing, "n" in the ~~~~ section is a power of 2, and so the average is computed as :

$$An=\frac{1}{2^m}\{(N-1)A_{n-1}+Xn\}$$

Where, $n-1<2^m \leqq n$

Table 3.4.1 gives the signal-to-noise ratio improvement rates yielded by linear averaging.

Table 3.4.1 Signal-to-Noise Improvement

Assigned Count	S/N Improvement (dB)
2	3.0
4	5.9
8	8.8
16	11.7
32	14.6
64	17.5
128	20.5
256	23.4

For linear averaging, use the Normal or Single trigger mode. (Averaging is not possible in Free mode since there is no triggering. The same applies under free-run conditions in Auto mode.)

In the Single mode, averaging stops when the assigned count is reached. In Normal mode, when averaging has been performed for the assigned count, it will be repeated again from the start.

(2) Exponential Averaging

The highest weighting is given to the newest data by the assigned time constant, and the weighting is reduced exponentially and averaged for the past data in sequence.

The exponential averaging algorithm is:

$$An=\frac{1}{N}\{(N-1)A_{n-1}+Xn\}$$

Where, An : Average value on nth cycle
Xn : Measurement value on nth cycle
N : Time constant

Use the Normal or Single trigger mode for exponential averaging. (In Single mode, it will stop after 65535 cycles; in Normal mode, the count display will revert to 1 but averaging continues past 65535 cycles.)

(3) Precautions for Averaging

Averaging is effective in countering noise of an irregular nature. Since the measurement values used in averaging are spaced out in time, this reduces the correlation between them and enables them to be treated as virtually independent entities. Thus averaging can also be applied to correlative noise.

However, averaging is only effective for repetitive waveforms, and signal waveforms tend to be distorted when measurements are not completely synchronized. To conduct averaging properly, it is necessary to supply a sync input signal from another channel to synchronize the measurements.

(4) **Relationship between Averaging and Record Length**

Averaging can be conducted up to the maximum record length (32kW for the DL2110A, and 128kW for the DL2120A, DL2130A and DL2140A). However, when computational operations are executing, record length restrictions applying under those conditions reduce the length to 16kW for the DL2100A, and 32kW for the DL2120A, DL2130A and DL2140A. (Depending on the type of computation set up on the user-defined computation screen, it may not be possible to set the length up to 64kW for the DL2120A and DL2140A.)

(5) **Waveform Parameter Display for Averaged Waveforms**

For the values displayed for waveform parameters of waveforms subjected to averaging on channels 1 and 2, the scaling values are increased by one digit over the normal waveform scaling values.

3.4.3 Waveform Overwrite (Accumulate)

In the accumulate mode, the oscilloscope repeatedly overwrites the waveform the specified number of times. The number of accumulation cycles executed is displayed in the left center of the screen. (This number is the number of times that the waveform has been acquired since accumulate mode was turned On.)

[Soft key operations] **[Description]** **[Menu]**

① ACQ

② Accumu-late

③

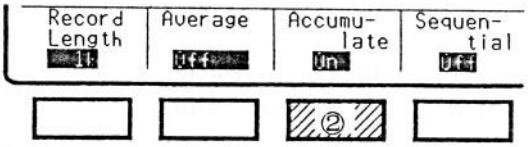
④

START STOP

CLEAR TRACE

① Press the ACQ key.

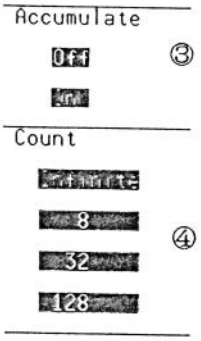
② Select Accumu-late with the soft key.



③ Select Accumulate from the menu using the ↑ and ↓ keys, and use the ↑ and ↓ keys to turn On accumulate mode.

④ Select Count using the ↑ and ↓ keys, and select the waveform count to be displayed using the ↑ and ↓ keys. (With Infinite the accumulation will continue until the START STOP key is pressed.)

Press the START STOP key to suspend accumulation at any time. Press it again to resume operation. Pressing the CLEAR TRACE key erase the waveform and restarts the writing starts from the first cycle.

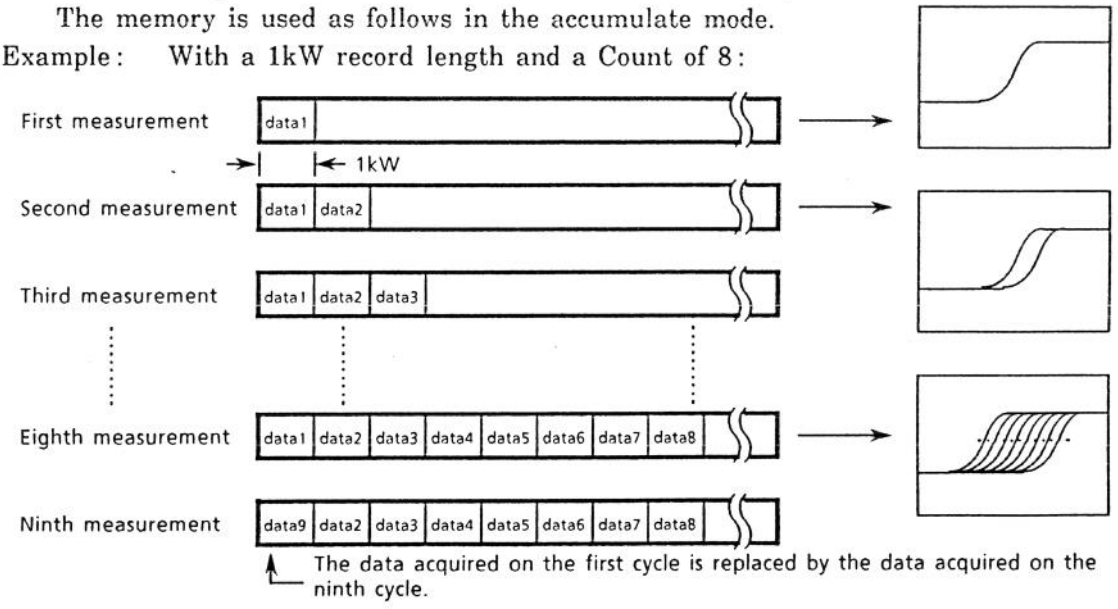


MEMO

(1) Relationship between Accumulate Mode and Memory

The memory is used as follows in the accumulate mode.

Example: With a 1kW record length and a Count of 8:



If a 1kW record length and a Count of 8 are set, only a memory area equivalent to 8 kW is used.

The 8kW memory is divided into 8 blocks in which the waveform data is stored in sequence with each measurement. (See figures on the previous page.) After eight measurement cycles have been acquired to memory, the data of the ninth cycle will replace that of the first in memory. Thus the memory always contains the data from the last eight measurement cycles.

(2) Relationship between Record Length and Waveform Count

Table 3.4.2 shows the relationship between the record length and accumulate waveform count.

Table 3.4.3 shows the same relationship applying during computation operations. (The memory used for accumulation operations is the system memory used for executing computation operations, not the acquisition memory used to acquire the waveforms.)

Table 3.4.2 Relationship Between Record Length and Waveform Display Count for Accumulate

Waveform Count \ Record Length kW	1	2	4	8	16	32	64	128
8	○	○	○	○	○	○*	○*	×
32	○	○	○	○*	○*	×	×	×
128	○	○*	○*	×	×	×	×	×
Infinite**	○	○	○	○	○	○	○*	○*

Table 3.4.3 Relationship Between Record Length and Waveform Display Count for Accumulate during Computation Execution

Waveform Count \ Record Length kW	1	2	4	8	16	32	64	128
8	○	○	○*	○*	×	×	×	×
32	○*	○*	×	×	×	×	×	×
128	×	×	×	×	×	×	×	×
Infinite**	○	○	○	○	○	○*	○*	×

○ : Selectable combination

× : Combination not available

* : Not with model DL2110A.

** : When Infinite has been selected for the waveform count, the waveforms are accumulated only on the bit-map memory of the waveform display, so acquisition memory is consumed only to the extent of the data length. Due to this, only the data last displayed remains in the memory.

(3) About Infinite Accumulate Count

If ↕ Scroll, ↔ Scroll, ↔ Zoom or ↕ Zoom operations are performed when the accumulate setting is Infinite, those waveforms acquired up through the last preceding cycle will not move on the screen.

Press the CLEAR TRACE key if you wish to clear the display.

(4) Waveform Update Rate During Accumulate

In accumulate mode, waveform update will slow once the waveform has been acquired the assigned number of cycles, since replacement begins from the oldest data.

(5) Accumulate Mode and IC Cards

In order for the data acquired in the accumulate mode to be saved, loaded again into MEM1 or MEM2 and displayed as accumulated waveforms, measurement must proceed with the accumulate mode established and both the CH1 and CH2 accumulated waveforms displayed. When the MEM1 or MEM2 accumulated waveforms are displayed, only the most recent single waveform is displayed.

3.4.4 Partitioning the Memory for Use (Sequential Store)

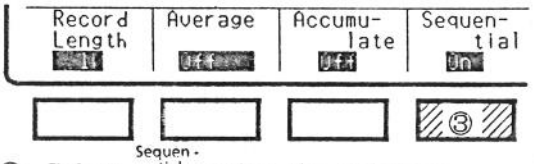
In the sequential store mode the acquisition memory is divided into the assigned number of blocks, and the waveform data is saved in the next sequential block each time a trigger is generated.

[Soft key operations] **[Description]** **[Menu]**

① ACQ

① Press the ACQ key.

② Select the display mode beforehand, referring to the description of waveform display methods. (See page 3-28.)



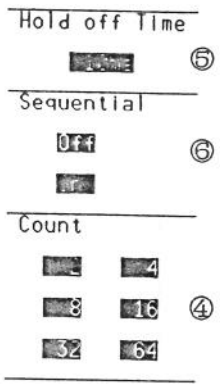
③ Select Sequential using the soft keys.

④ Select Count using the ↑ and ↓ keys, and set the Count using the ← and → keys.

⑤ Use rotary knob 2 to set the hold-off time to 10ms, 25ms, 50ms, 75ms, 100ms, 250ms, 500ms, 750ms, 1s, 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s or 10s.

⑥ Select Sequential from the menu using the ← and → keys, and set it ON using the ↑ and ↓ keys. (Measurement starts automatically when the mode is On.)

Press the START STOP key to repeat data acquisition from the start. In the Single trigger mode the waveform data is acquired once each time the START STOP key is pressed. When doing this you should set up a trigger-ready state (TRIG READY LED lit) and acquire the next data series. When the START STOP key is pressed more than the specified number of times, only the last data will be updated.



④ ↑ ↓

⑤ 2

⑥ ↑ ↓

START STOP

In the sequential store mode the waveforms will not appear on the CRT while acquisition is in progress. They are displayed as a group after data acquisition has been performed the specified number of times.

Waveform Display Methods

You will use the DISPLAY and Sequential keys to display the waveforms.

① DISPLAY

② Sequen-tial

③

④

1

① Press the DISPLAY key.

② Select Sequen-tial using the soft keys.

③ Select Display Trace from the menu using the ↑ and ↓ keys, and select Each / All using the ← and → keys.

Each: Only the waveform selected from Trace is displayed. The block number of the block to be displayed is set with rotary knob 1.

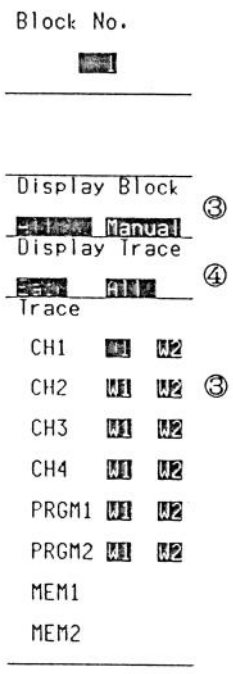
All : All the waveforms from CH1 W1 to MEM2 W2 are displayed. The block number of the blocks to be displayed is set with rotary knob 1.

④ Select Display Block from the menu with the ← and → keys.
Select All / Manual using the ↑ and ↓ keys.

All : All the data measured in the sequential store mode is displayed. The waveforms for the block number selected by rotary knob 1 (*) are highlighted.

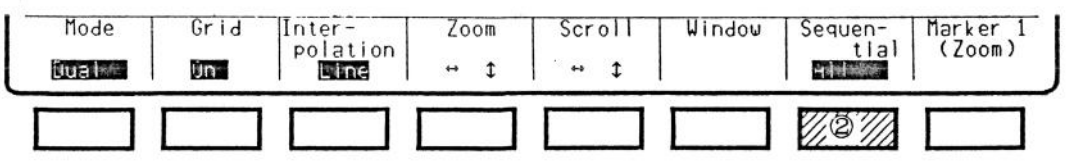
Manual : Only the waveforms in the block number selected by rotary knob 1 (*) are displayed.

* As rotary knob 1 is turned the block number changes, up to the specified count. When the data acquired in the sequential store mode is saved onto the IC card and displayed in MEM1 or MEM2, the block number changes within the range of waveform block count selected by Display Trace.



Note: Block number reverts to 1 whenever the Count value is changed, when Sequential is switched from On to Off, or when the START STOP key is pressed.

Soft keys

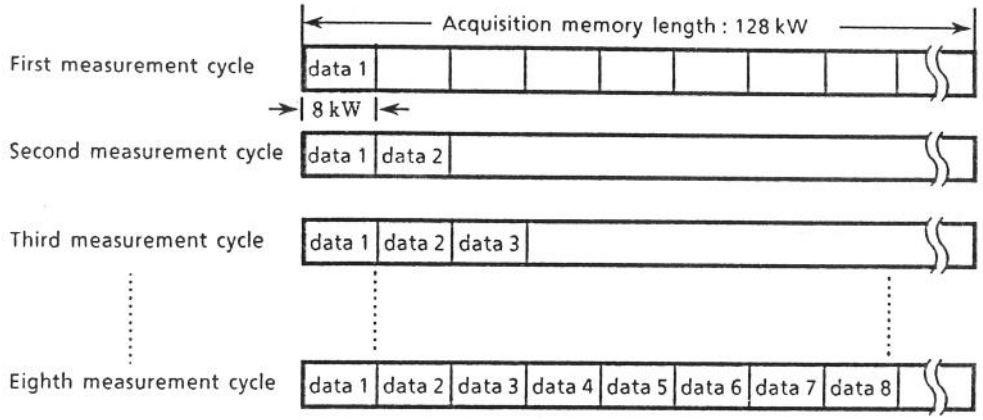


MEMO 1

(1) Relationship between Sequential Store and Memory

The waveform data is stored as follows in the sequential store mode.

Example: Assume a data length of 8kW and a count of 8 (with the DL2120A, DL2130A or DL2140A model)



The waveform data enters 8 blocks 8kW at a time.
In Normal trigger mode the sequential acquisition of waveform data proceeds automatically. (If the trigger mode is Auto, it will automatically switch to Normal, but the trigger mode setting will remain unchanged.)

(2) Relationship between Record Length and Store Count

Table 3.4.4 shows the relationship between the record length and sequential store count.

Table 3.4.4 Relationship Between Record Length and Sequential Store Count

Store Count \ Record Length kW	1	2	4	8	16	32	64	128
2	○	○	○	○	○	○*	○*	×
4	○	○	○	○	○*	○*	×	×
8	○	○	○	○*	○*	×	×	×
16	○	○	○*	○*	×	×	×	×
32	○*	○*	○*	×	×	×	×	×
64	○*	○*	×	×	×	×	×	×

○ : Selectable combination
× : Combination not available

An asterisk (*) denotes that the combination is not selectable for the model DL2110A.

Table 3.4.5 Relationship Between Record Length and Sequential Store Count during Computation Operations

Store Count \ Record Length kW	1	2	4	8	16	32	64
2	○	○	○	○	○*	○*	×
4	○	○	○	○*	○*	×	×
8	○	○	○*	○*	×	×	×
16	○	○*	○*	×	×	×	×
32	○*	○*	×	×	×	×	×
64	○*	×	×	×	×	×	×

○ : Selectable combination
× : Combination not available

An asterisk (*) denotes that the combination is not selectable for the model DL2110A.

(3) Sequential Store and IC Card

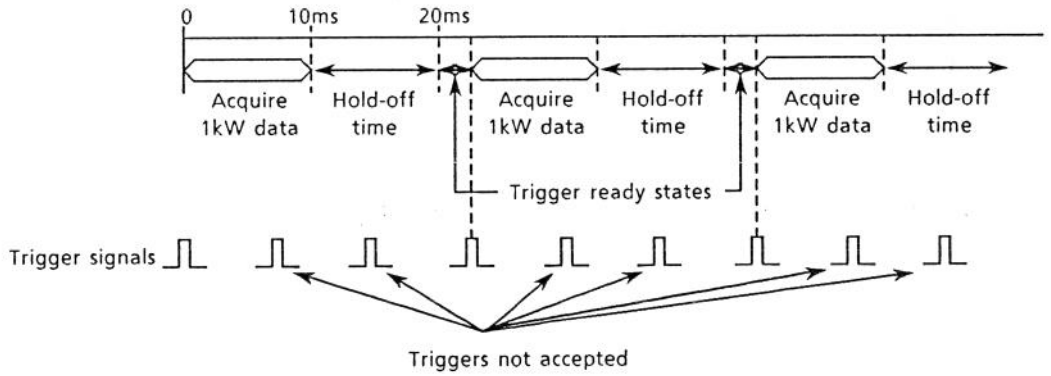
In order to save the data acquired in the sequential store mode onto an IC card, and then reload it into MEM1 or MEM2 for display as a sequential store waveform, you must first perform the measurements with sequential store mode set On and display the CH1 and CH2 sequential store waveforms.

MEMO 2

Hold-off Time Setting

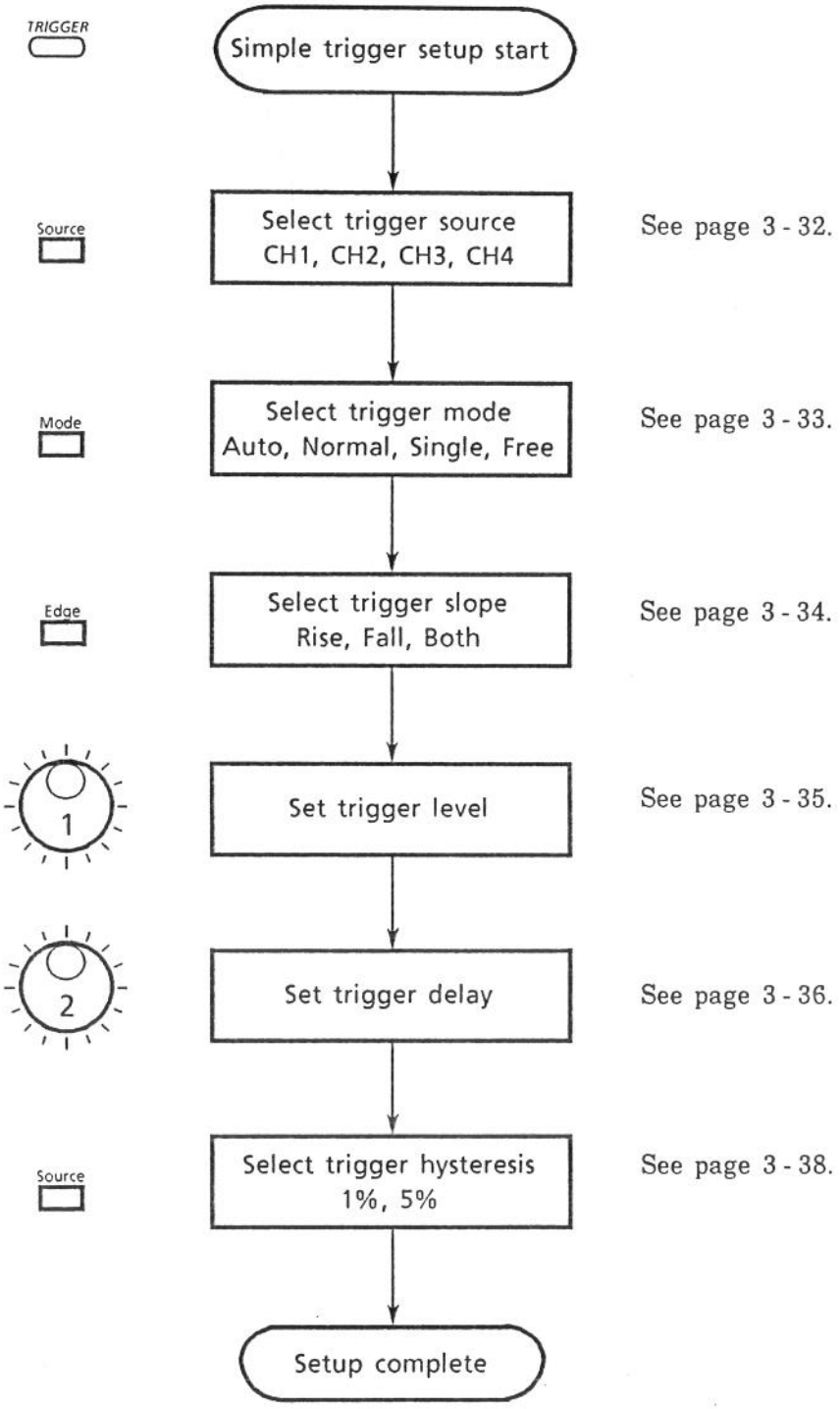
When data is stored block by block, the hold-off time serves to set a specific time (called the "hold-off" time) between blocks during which data is not acquired even if a trigger should occur during that time. The A / D converter starts operating after the set time. Since the trigger ready state is established when all the waveform data is in the acquisition memory pretrigger area, data is acquired only when triggering occurs in the trigger ready state.

Example: The figure below is a "time table" for the case of a record length of 1kW, sample speed of 100kS / s and hold-off time of 10ms (trigger delay value of 0s).



3.5 Simple Trigger Setup TRIGGER

The following describes the procedure for simple trigger setup.

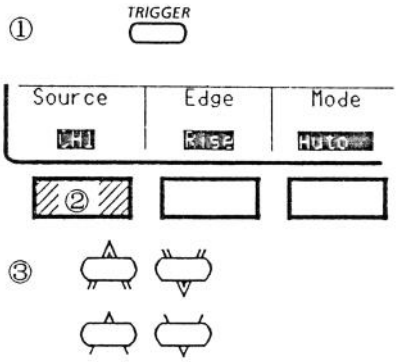


* "Simple trigger" is a level trigger function identical to the trigger of a conventional oscilloscope.

3.5.1 Trigger Source Selection for Simple Trigger (Source)

Select the source for the trigger signal.

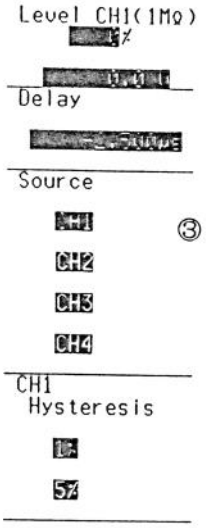
[Soft key operations]



[Description]

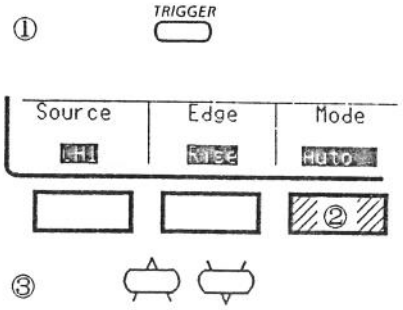
① Press the Trigger key.
② Select Source using the soft keys.
③ Select Source from the menu using the ▲ and ▼ keys.
Select the trigger source using the ▲ and ▼ keys. The source can be selected from CH1 through CH4.

[Menu]



3.5.2 Trigger Mode Selection for Simple Trigger (Mode)

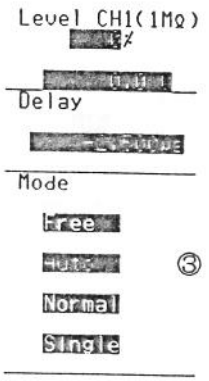
[Soft key operations]



[Description]

① Press the TRIGGER key.
② Select Mode using the soft keys.
③ Select the trigger mode (Free, Auto, Normal, Single) using the ▲ and ▼ keys.

[Menu]



MEMO

Trigger Mode

(1) Free

The waveforms are acquired and displayed at all times regardless of the trigger signal. This means that the oscilloscope is always in the free-running state.

(2) Auto

If the trigger signal occurs within a fixed time (called the "time-out" time), the waveforms are displayed in synchronization with the trigger signal, and after the time-out time (50 to 100ms) they are acquired and displayed automatically. Since it is not possible in the Auto mode to observe waveforms which have a period in excess of the time-out time, they should be measured in the Normal mode.

(3) Normal

Waveforms are acquired and displayed only if a trigger signal is present. Nothing is displayed if there is no trigger signal.

(4) Single

As in the Normal mode, waveforms are acquired and displayed only if a trigger signal is present. However, the trigger signal is accepted only once.

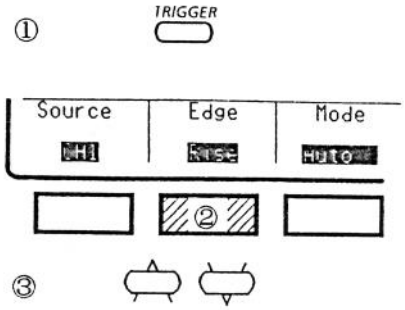
The waveforms remain on display until the CLEAR TRACE key is pressed. To resume acquisition and display, press the START STOP key and reset the trigger ready status. (In the trigger ready state the TRIG READY lamp lights.)

Measurement starts automatically when you return the instrument from the Single mode to the Normal mode.

3.5.3 Simple Trigger Slope Selection (Edge)

[Soft key operations]

①



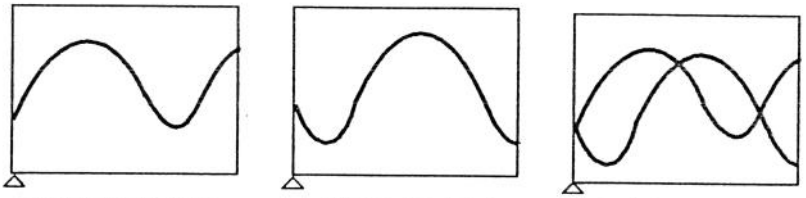
[Description]

① Press the TRIGGER key.

② Select Edge using the soft key.

③ Select Rise, Fall or Both as the trigger slope using the ▲ and ▼ keys.

[Menu]



MEMO

Rise, Fall and Both are available as trigger slope settings. In Both, triggering occurs on both rising and falling edges. This comes in handy for observing one-shot waveforms if it is unclear whether Rise or Fall should be selected for the trigger slope.

3.5.4 Simple Trigger Level Setting (Level)

The trigger level is set for the signal source selected as the trigger source.

[Soft key operations]

① TRIGGER

② 

[Description]

① Press the TRIGGER key.

② Set the level with rotary knob 1. The setting range for the trigger level is ±5div. (See Tables 3.5.1 and 3.5.2) The trigger level resolution is 0.1div.

[Menu]

Table 3.5.1 Trigger Level Setting Range When 1:1 Probe is Used for CH1 and CH2

Voltage Range	Setting Range of Trigger Level
*5mV/div	−25mV to +25mV
*10mV/div	−50mV to +50mV
20mV/div	−100mV to +100mV
50mV/div	−250mV to +250mV
100mV/div	−500mV to +500mV
200mV/div	−1V to +1V
500mV/div	−2.5V to +2.5V
1V/div	−5V to +5V
*2V/div	−10V to +10V
*5V/div	−25V to +25V

* applies only when 1MΩ input is used.

Table 3.5.2 Trigger Level Setting Range When 1:1 Probe is Used for CH3 and CH4

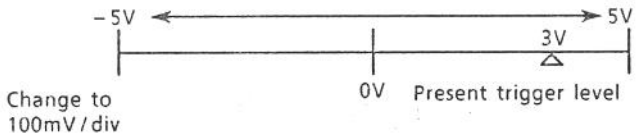
Voltage Range	Setting Range of Trigger Level
±0.2V	−100mV to +100mV
*±2V	−1V to +1V

MEMO

The trigger level remains unchanged as a rule even when the voltage range is changed. However, if the set level has exceeded the range which can be set for the corresponding voltage range when the voltage range is changed, the level will be automatically reset to the value closest to the level which can be set.

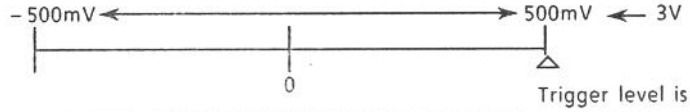
Example: 3V trigger level setting in 1V/div range

Trigger Level Setting Range for 1V/div Range



Change to 100mV/div

Possible Setting Range for Trigger Level for 100mV/div Range



Trigger level is automatically set to 500mV.

3.5.5 Trigger Delay Setting (Delay)

The trigger delay for the record length is set in this section.

[Soft key operations]

① TRIGGER

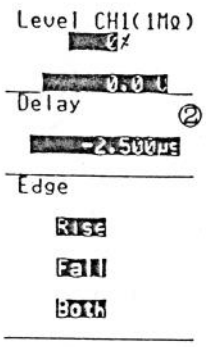
② 2

[Description]

① Press the TRIGGER key.

② Set the delay with rotary knob 2. A time setting is used for the delay. A value can be entered directly using the numeric keypad when Delay is set from the menu using the ▲ and ▼ keys (See page 3-180).

[Menu]



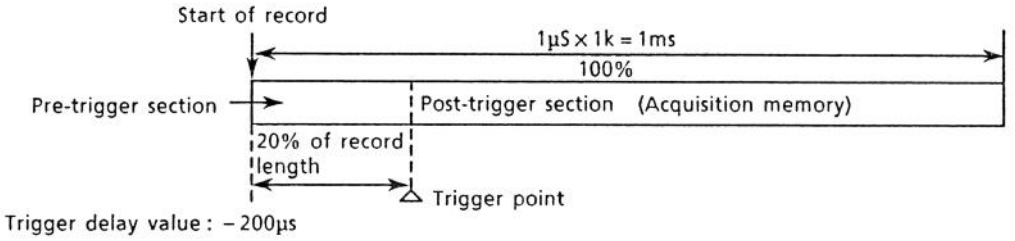
MEMO 1

Trigger Delay

The trigger delay determines where the record starting point is positioned relative to the trigger point.

Setting Example 1: Trigger delay setting with a 1MS/s sampling rate and 1kW record length

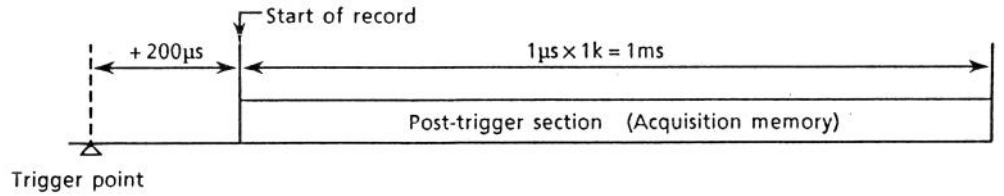
To apply the trigger at a position 20% along the record length:



The trigger delay is set to −200µs, as shown in the figure above.

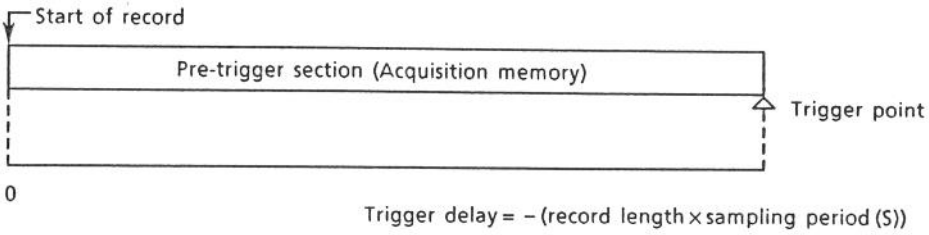
The acquisition memory stores both 200µs of the waveform prior to the trigger point (pre-trigger) and 800µs of the waveform after the trigger point (post-trigger).

Setting Example 2: If the trigger delay is set to +200µs with a 1MS/s sampling rate and 1kW record length, 1ms of data starting from 200µs after the trigger point is stored in the memory, as shown in the figure below.



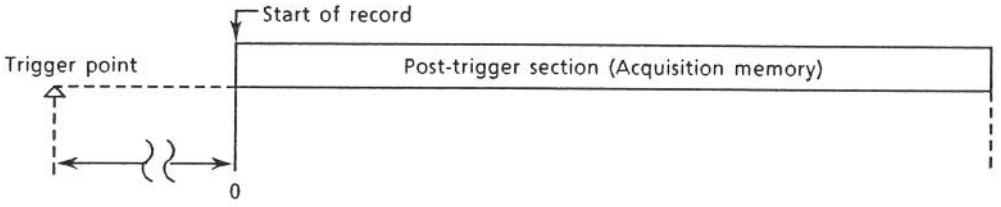
Setting Example 3: The selectable range for the trigger delay extends to −100% of the data length for the pre-trigger and to 16×10^6 Data samples for the post-trigger. The figures below show the delays when the pre-trigger and post-trigger have been set to the maximum.

Maximum Pre-trigger



Trigger delay = −(record length × sampling period (S))

Maximum Post-trigger



Trigger delay = $16 \times 10^6 \times$ sampling period (S)

MEMO 2

- **Relationship between Trigger Point and Time**

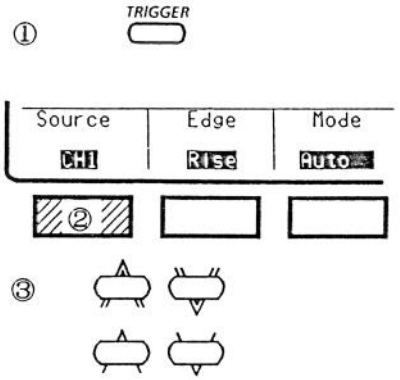
Since the trigger point is determined by where it is set relative to the record length, this means that even if the time/div changes, the position within the record length will remain unchanged, although the trigger delay value will change.

Example: If the trigger delay is −4ms with 2ms/div, it will be set to −2ms if the time/div is changed to 1ms/div.

3.5.6 Simple Trigger Hysteresis Setting (Hysteresis)

Trigger hysteresis is a function used when unwanted triggering is occurring on signal edge reversals when measuring repetitive signals having high noise levels.

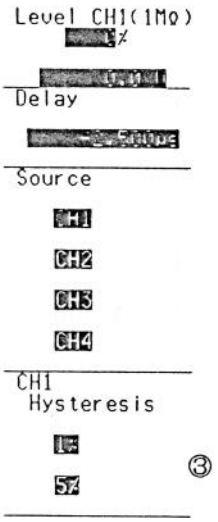
[Soft key operations]



[Description]

① Press the TRIGGER key.
② Select Source using the soft key.
③ Select Hysteresis using the ▲ and ▼ keys. (Set the hysteresis in the channel selected by Source.) Select the 1% or 5% hysteresis value using the ▲ an ▼ keys. These values are relative to voltage range full scale (10div).

[Menu]



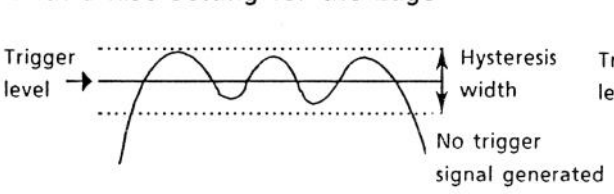
MEMO

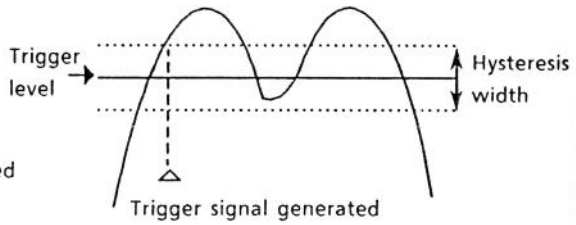
When repetitive signals having high noise levels are measured, the noise will make it difficult to achieve synchronization between the trigger level and waveform, causing jitter.

Hysteresis is selected in cases like this.

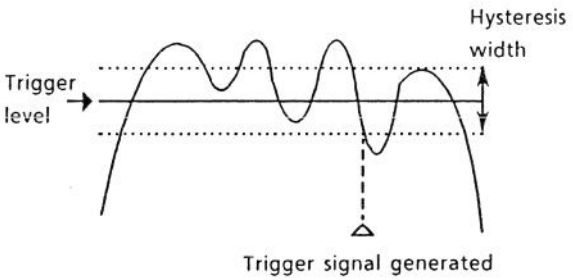
Trigger hysteresis does not generate a trigger signal unless the waveform crosses the entire band set for hysteresis.

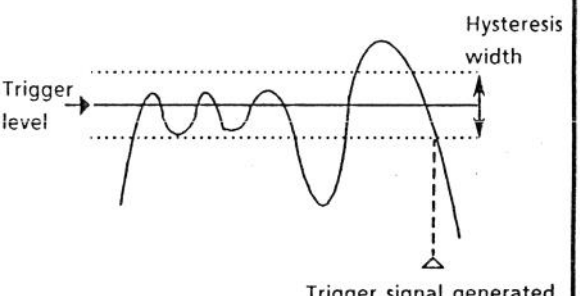
With a Rise Setting for the Edge





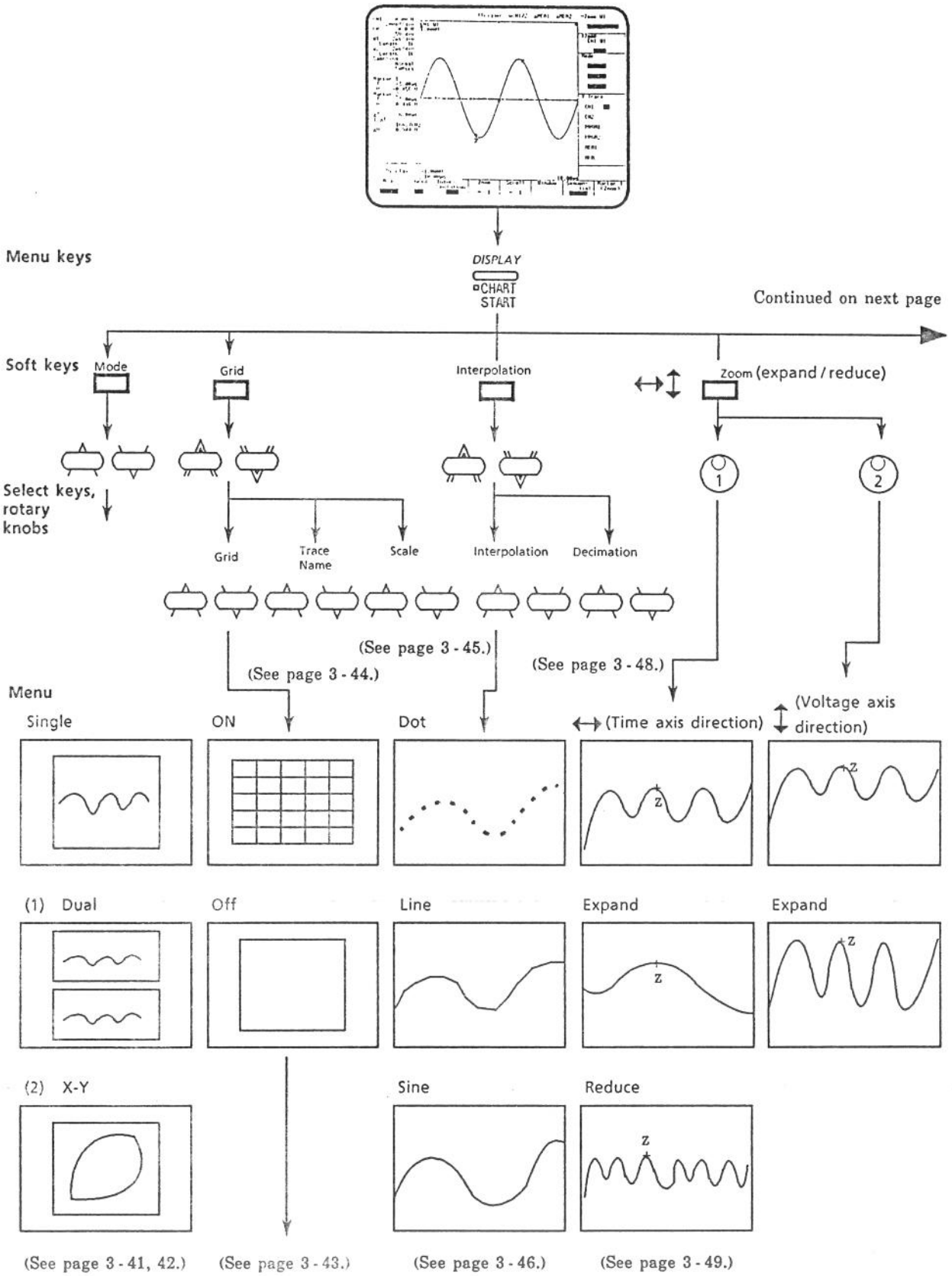
With a Fall Setting for the Edge



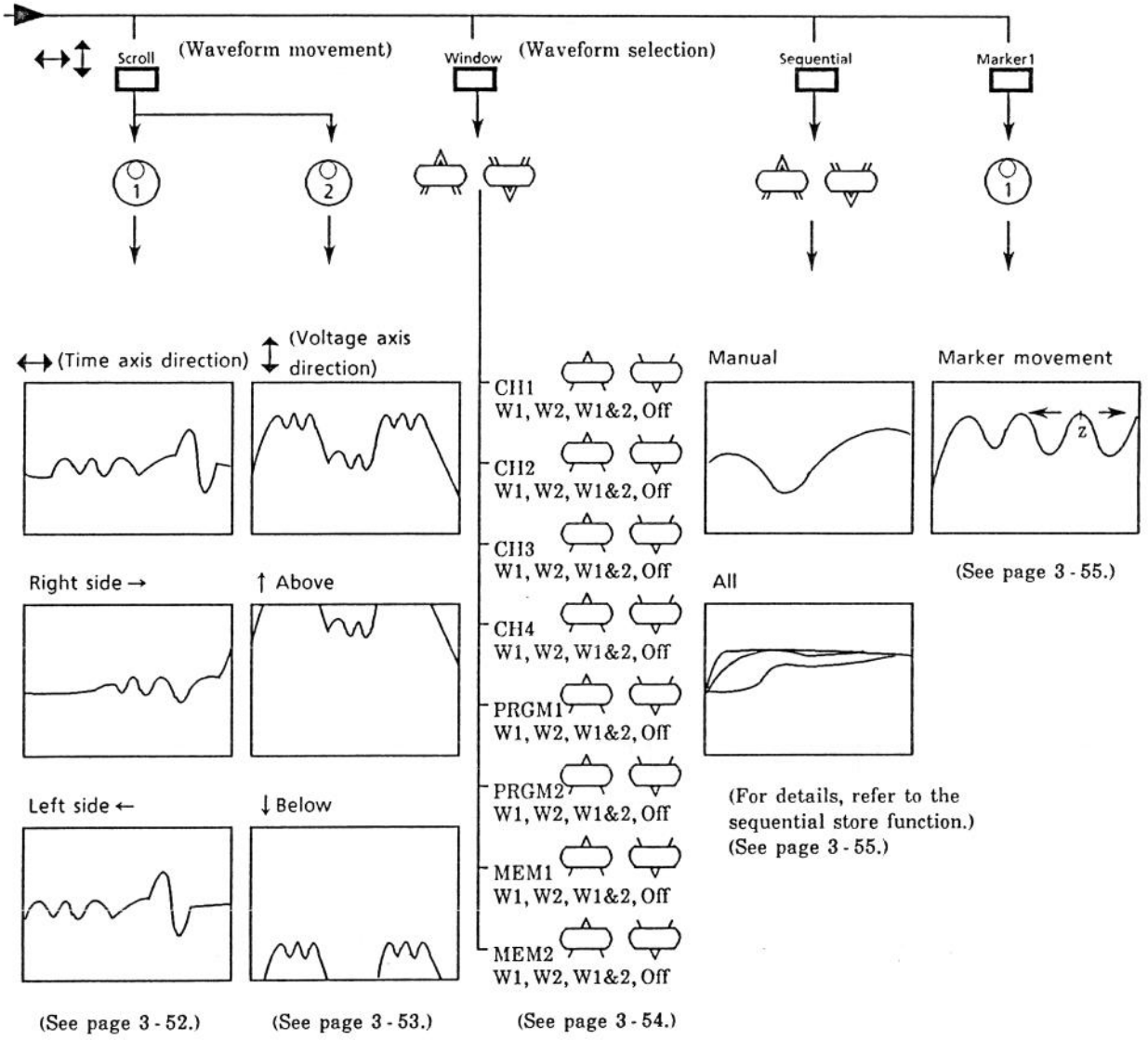


3.6 Display Setup

The DISPLAY key is used for the setup related to the waveform display.



From previous page



(See page 3 - 52.)

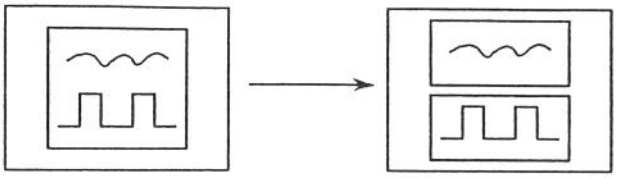
(See page 3 - 53.)

(See page 3 - 54.)

(For details, refer to the sequential store function.)
(See page 3 - 55.)

(See page 3 - 55.)

3.6.1 Screen Division and Display (Dual)



[Soft key operations]

① DISPLAY

② Mode

③

[Description]

① Press the DISPLAY key.

② Select the Mode using the soft key.

③ Select the menu mode to Dual using the ↑ and ↓ keys.

[Menu]

Mode
Single
Dual
X-Y ③

X Trace
CH1 W1
CH2
PRGM1
PRGM2
MEM1
MEM2

Soft keys

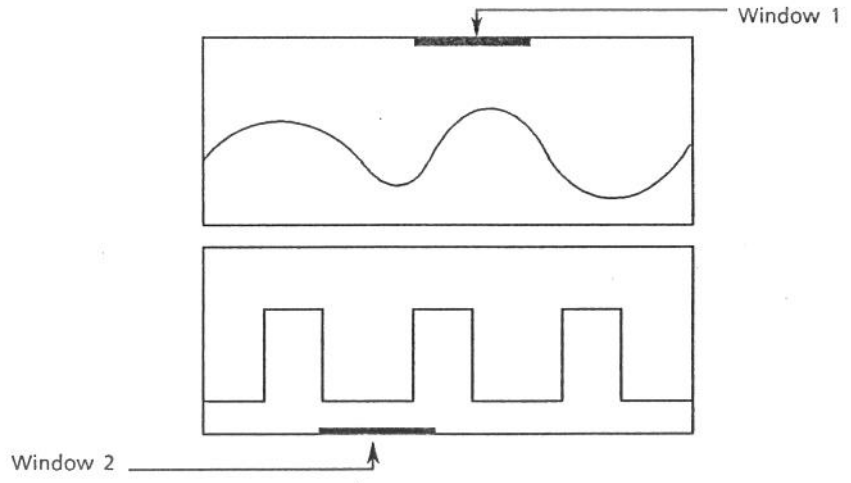
Mode	Grid	Inter-polation	Zoom	Scroll	Window	Sequen-tial	Marker 1 (Zoom)
Single	On	Line	↔ ↕	↔ ↕			

②

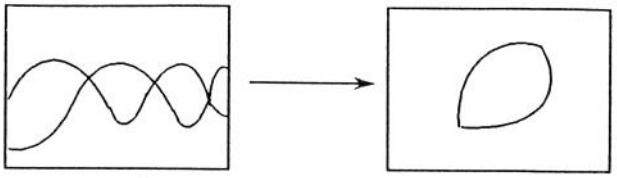
* In the Dual display mode window 1 appears above and window 2 below.

MEMO

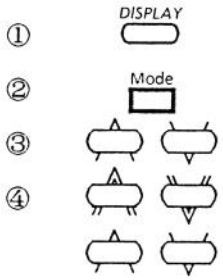
Windows 1 and 2 appear as shown below when the screen is split.



3.6.2 X-Y Mode Display (X-Y Mode)



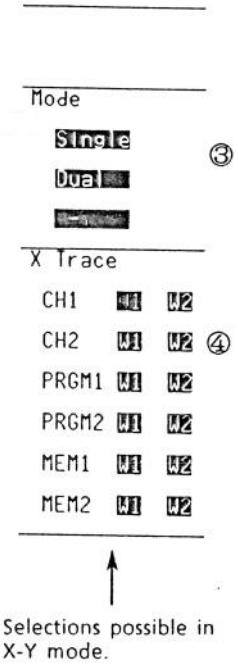
[Soft key operations]



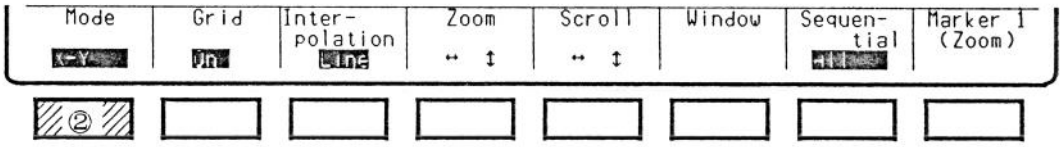
[Description]

① Press the DISPLAY key.
② Select Mode using the soft key.
③ Select X-Y from the Mode menu using the ◁ and ▷ keys.
④ Select X Trace from the menu with the ◁ and ▷ keys, and select the waveform which will serve fro the X-axis. (The waveform in the window which is On serves for the Y-axis.)

[Menu]



Soft keys

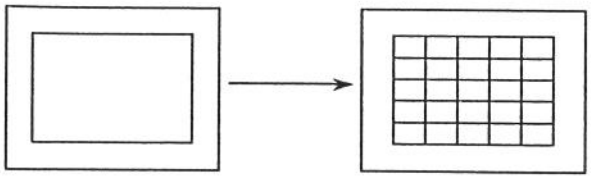


MEMO

The X-Y mode is subject to the following restrictions:

(1) The positions of the windows cannot be changed. (To change these positions, first exit from the X-Y mode.)
(2) There is no sine interpolation.
(3) The roll mode cannot be used.
(4) The only MEASURE operations possible in the X-Y mode only are Integ 1 and 2. (For details, refer to the MEASURE section.)
(5) When setting PRGM1 or PRGM2 to X Trace, first turn the window of PRGM1 and PRGM2 to On (by selecting W1, W1&W2, W2).
(6) The search and compare functions cannot be used.

3.6.3 Grid On / Off (Grid)



[Soft key operations]

① DISPLAY

② Grid

③

[Description]

① Press the DISPLAY key.

② Select Grid using the soft key.

③ Select Grid from the menu using the and keys, and set it On or Off using the and keys,.

[Menu]

Grid
On
Off
Trace Name
On
Off
Scale
On
Off

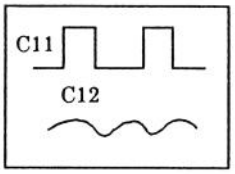
③

Soft keys

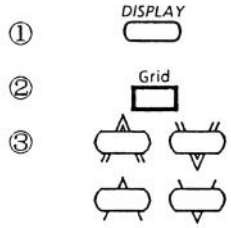
Mode	Grid	Inter-polation	Zoom	Scroll	Window	Sequen-tial	Marker 1 (Zoom)
X-Y	On	Line	↔ ↕	↔ ↕		All	

②

3.6.4 Waveform Label Display (Trace Name)



[Soft key operations]



[Description]

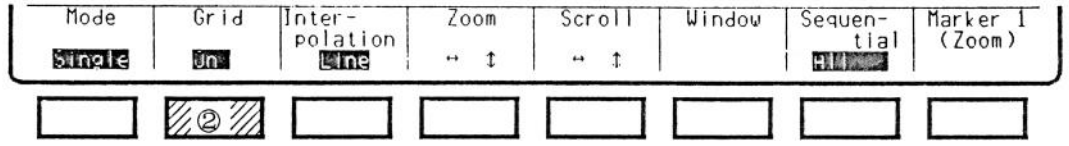
① Press the DISPLAY key.
② Select Grid using the soft key.
③ Select Trace Name from the menu using the ◁ and ▷ keys, and set it to On using the ▽ and △ keys.

[Menu]

Grid
On
Off
Trace Name
On
Off
Scale
On
Off

③

Soft keys



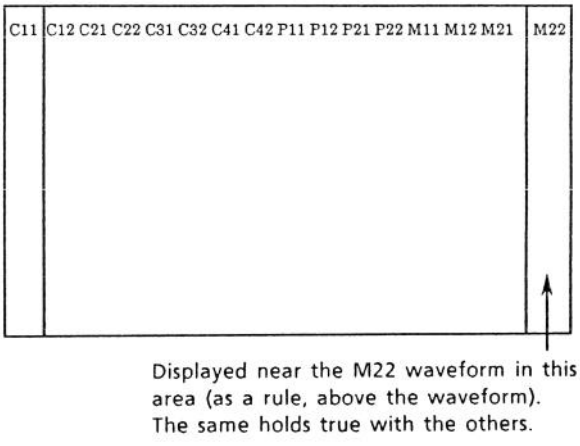
MEMO

The window, program and memory waveform names are displayed. The display is abbreviated, as shown in Table 3.6.1.

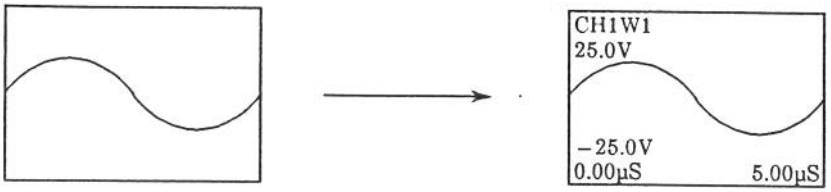
Example: CH1 window 1 appears as C11. The display position is shown near the graph with the waveform display area divided into 16 sections. (In the X-Y display mode, it appears near the first data.)

Table 3.6.1 Simplified Display of Labels

Window / Waveform	Window1	Window2
CH1	C11	C12
CH2	C21	C22
CH3	C31	C32
CH4	C41	C42
PRGM1	P11	P12
PRGM2	P21	P22
MEM1	M11	M12
MEM2	M21	M22



3.6.5 Scale Value Display (Scale)



[Soft key operations]

① DISPLAY

② Grid

③

[Description]

① Press the DISPLAY key.
② Select Grid using the soft key.
③ Select Scale from menu using the and keys, and set it to On using the and keys.

[Menu]

Grid
On
Off

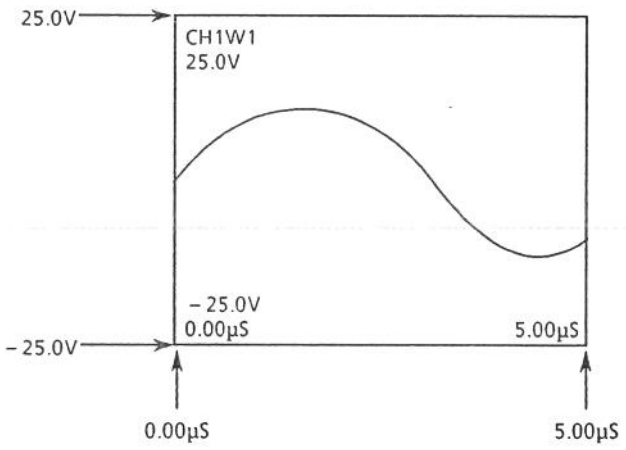
Trace Name
On
Off

Scale
On
Off
③

Note: The trigger point serves as a reference for the scale time scale value.

MEMO

This figure shows scale parameters.



3.6.6 Interpolation

There are three types of interpolation : Dot, Line and Sine (Dot and Line only, in the X-Y mode).

[Soft key operations] **[Description]** **[Menu]**

① DISPLAY

② Inter-polation

③

① Press the DISPLAY key.

② Select Inter-polation using the soft keys.

③ Select Interpolation from the menu using the ↑ and ↓ keys, and set the type of interpolation (Dot, Line or Sine) using the ← and → keys.

[Menu]

Interpolation
Dot
Line ③
Sine
Decimation
On
Off

Soft keys

Mode	Grid	Inter-polation	Zoom	Scroll	Window	Sequen-tial	Marker 1 (Zoom)
Single	On	Line	↔ ↕	↔ ↕		Hi	

②

MEMO

Dot display, linear interpolation and sine interpolation:

The interpolation method changes according to whether the number of data-samples is greater or less than 500. (The horizontal resolution of the waveform display area is 500 dots.)

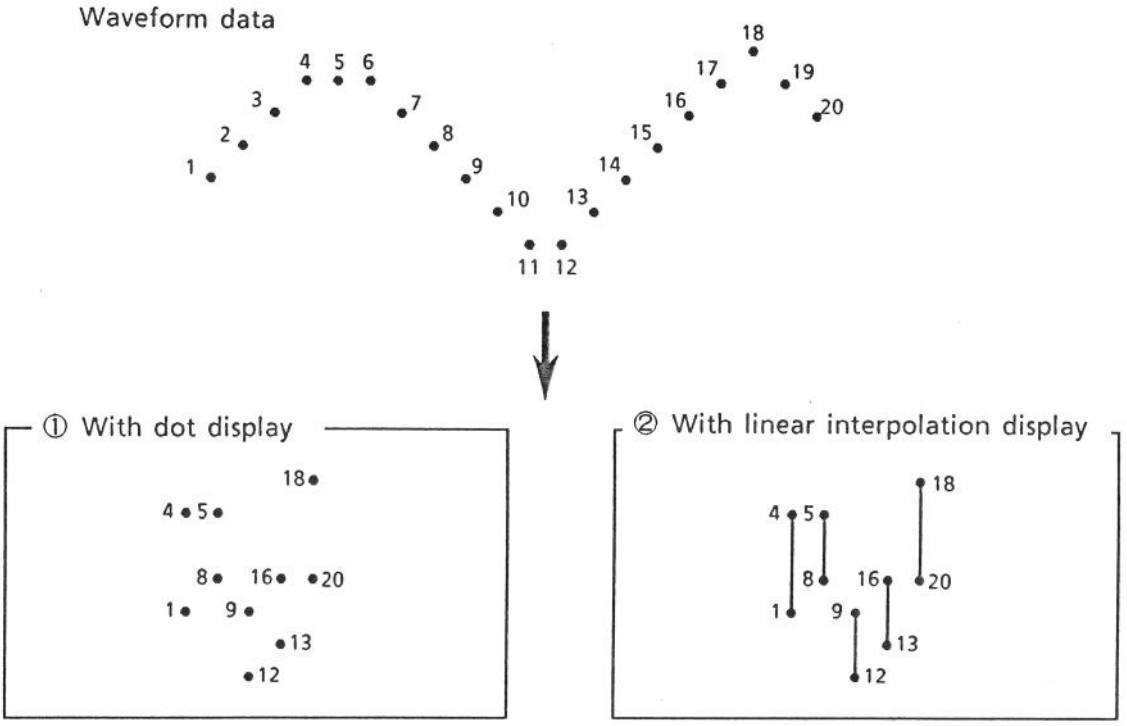
(1) When the number of displayed waveform data samples is 500 or more:

For this example we will assume that the number of data samples is 2,000 dots.

① **Dot Display (Dot)**
Since the displayed data samples number 2000, and 2000 divided by 500 is 4, the maximum and minimum values at every 4 dots are displayed on the same vertical line.

② **Linear Interpolation (Line)**
Each of the dot data values is connected with lines for display.

③ **Sine Interpolation (Sine)**
Sine interpolation is not conducted with 500 dots or more.
The same display is used as for linear interpolation.



With other data counts, the data is displayed using the maximum and minimum values for each set of data obtained through division by 500.

(2) When the waveform display data numbers less than 500 dots:

① Dot Interpolation (Dot)

If the data points are fewer than 500 dots, it is displayed with dots alone.

② Linear Interpolation (Line)

The dots are connected by straight lines.

③ Sine Interpolation (Sine)

The original waveforms are restored from the dots using the $\frac{\sin x}{x}$ function. When sine interpolation is used, a single waveform up to 80MHz can be restored in the normal mode (at 200MS/s).

Note: The waveform display data count is the same as the size of the window.

3.6.7 Waveform Decimation and Display

When Decimation is selected the waveform is "thinned out" for display. (The data for each point obtained after dividing the window size by 1000 is displayed.)
Example: If the window size is 2k, a dot is displayed at every second point.

[Soft key operations] **[Description]** **[Menu]**

① DISPLAY

② Inter-Polation

③

① Press the DISPLAY key.

② Select Inter-Polation using the soft key.

③ Select Decimation from the menu using the and keys, and set it to On using the and keys.

Interpolation
Dot
Line
Sine
Decimation
On ③
Off

Soft keys

Mode	Grid	Inter-polation	Zoom	Scroll	Window	Sequen-tial	Marker 1 (Zoom)
Single	On	Line	↔ ↕	↔ ↕		Hi-res	

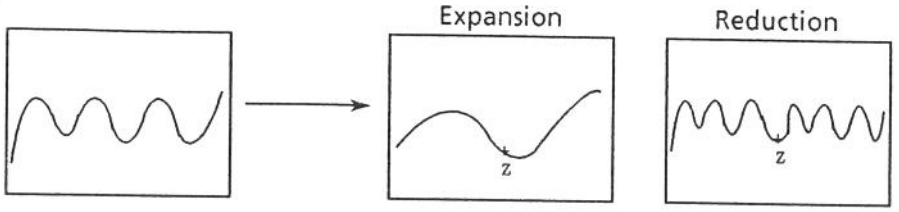
②

MEMO

Setting Decimation On increases the update rate for waveform displays when there are many data dots, but there are cases where the display will appear different from the actual waveform since the data is displayed after "thinning out".

3.6.8 Waveform Expansion and Reduction ((1) Time Axis: ↔Zoom)

Waveforms are expanded and reduced centering on the zoom cursor (Marker 1 (+) and Z).



[Soft key operations] **[Description]** **[Menu]**

① DISPLAY

② Zoom

③

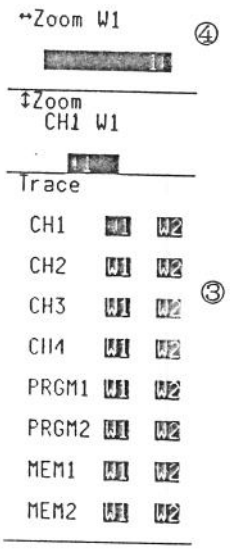
④

① Press the DISPLAY key.

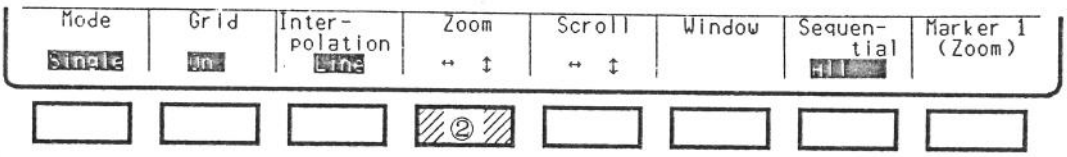
② Select Zoom using the soft key. Marker 1 (+) and Z appear. The waveform is expanded or reduced centering on them. (Refer to 3.6.14 on cursor movements with Zoom and Cursor for details on moving the marker.)
If marker 1 is already displayed, the waveform will be expanded or reduced centering on this marker.

③ Select the waveform to be expanded or reduced from Trace using the ↑ and ↓ keys.

④ The waveform is expanded or reduced by turning rotary knob 1. The value of Zoom serves as the size of the window (and also as the waveform display data count).



Soft keys



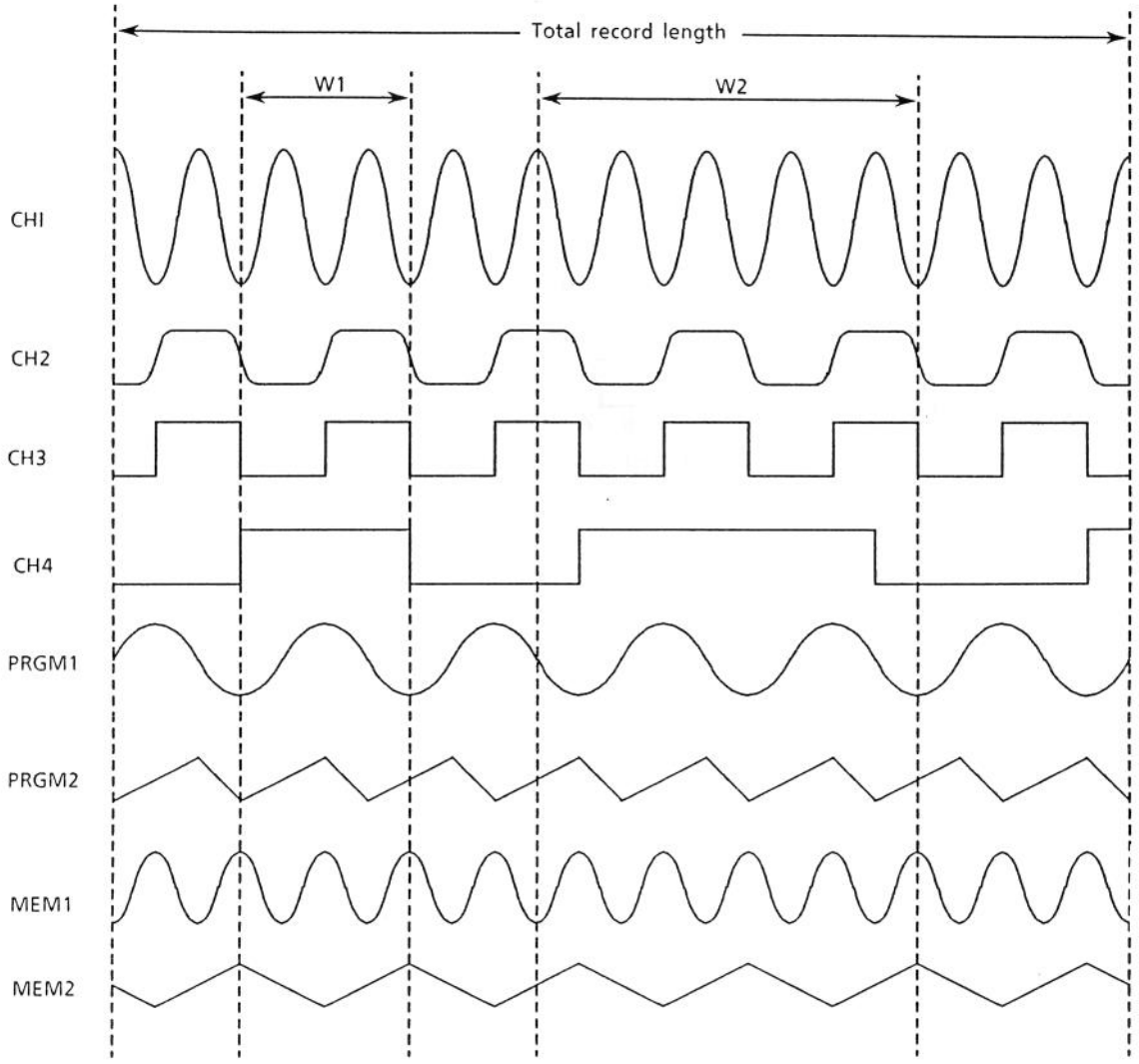
Note: Expanding the waveform in the X-Y mode involves an expansion of the voltage axis. Histogram displays cannot be expanded.

MEMO

When a waveform is expanded with ↔Zoom, the expansion is performed by changing the data count (window size) of the waveform displayed. When the count falls below 500 for the horizontal resolution, interpolation is performed on the display. (See 3.6.6 on using the interpolation functions.)

Expansion can be continued until the waveform display data count reaches 4 or 5 dots. (See page 3-15.) Reduction can be performed up to approximately twice the CH1 or CH2 record length. (If the record length is 128kW, for example, 200kW will be displayed.) When the CH1 or CH2 and MEM1 or MEM2 record lengths differ, the window size can be reduced to approximately twice the longest record length of those data displayed. That expansion or reduction is taking place can be determined by the changing lengths of the highlighted sections at the top and bottom boundaries of the waveform display area.

Window Display and Setup Methods

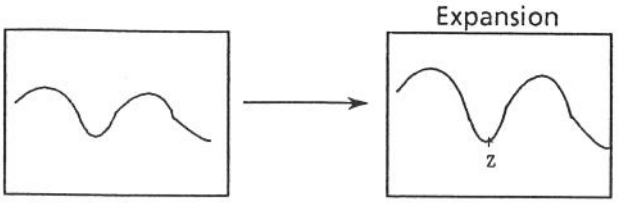


The positions and sizes of W1 and W2 are the same for CH1 to CH4, PRGM1, PGRM2, MEM1 and MEM2. Therefore, if the position or size of window 1 is changed for channel 1, all the window 1 positions or sizes (for channel 2, channel 3, etc.) will also be changed. The same holds true with window 2.

(The settings for expanding (⇕ Zoom) or moving (⇕ Scroll) the voltage axis can be changed independently for each channel and each window, since they are unrelated to the window position or size.)

3.6.9 Waveform Expansion ((2) Voltage Axis: ↕ Zoom)

The waveform is expanded or reduced centering on the zoom cursor (Marker 1 (+) and Z).



[Soft key operations] **[Description]** **[Menu]**

① DISPLAY

② Zoom

③

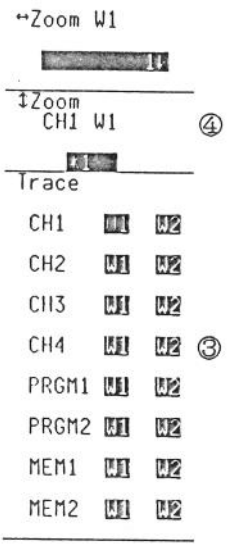
④

① Press the DISPLAY key.

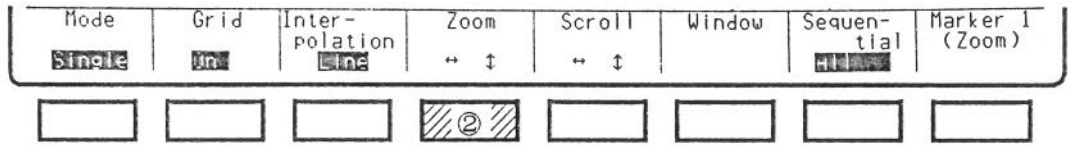
② Select Zoom using the soft key. The Marker 1 and Z characters will appear. (See 3.6.14 on cursor movements with the zoom cursor for further details on moving marker 1.) If the marker is already displayed, the waveform will be expanded or reduced centering on this marker.

③ Select the waveform to be expanded using the ◁ and ▷ keys.

④ Expand the waveform by turning rotary knob 2. Turning it in the opposite direction will restore the waveform to its original size. The waveform is expanded centering on Marker 1 (+).



Soft keys



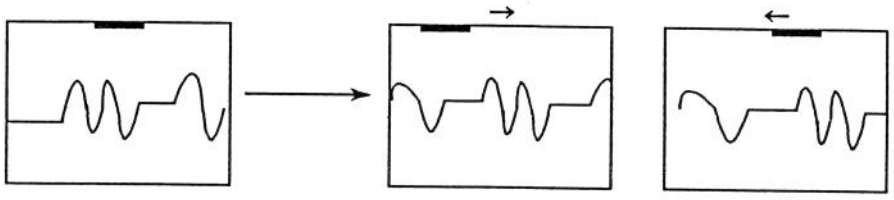
Note 1: Since the cursor position data value will change while data is being acquired, the waveform may not return to the original position even when ↕ Zoom is set to its original value. If the waveform is expanded on a dual screen, its position may deviate by one dot. In cases like this, a deviation of ±0.02div may remain even when the expansion ratio is restored to its original value. The relationship between the scaling value and waveform position, however, remains normal.

Note 2: Histogram displays cannot be expanded.

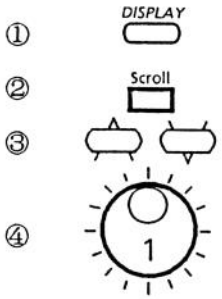
MEMO

Waveforms can be expanded up to a maximum of 10-fold. To view any part of the waveform, shift the display with ↕Scroll and expand the waveform. See 3.6.11 on shifting waveforms for further details on the ↕ Scroll function.

3.6.10 Moving a Waveform ((1) Time Axis Direction: ↔Scroll)



[Soft key operations] **[Description]** **[Menu]**



There are two scrolling methods.

· Using ↔ Scroll

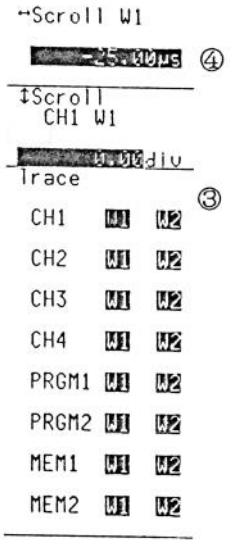
① Press the DISPLAY key.

② Select Scroll using the soft keys.

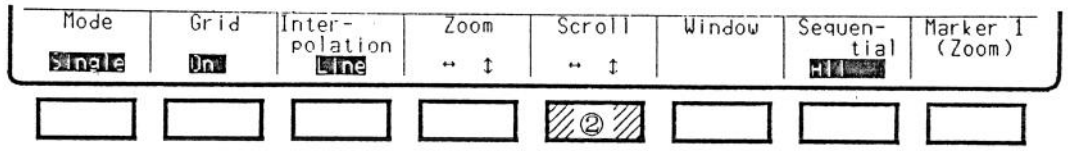
③ Select the waveform to be scrolled from the Trace menu using the ◁ and ▷ keys.

④ Turn rotary knob 1.

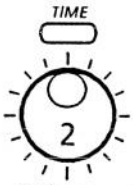
It is also possible to select ↔ Scroll from the menu using the △ and ▽ keys and to input the values directly using the numeric keypad for scrolling the waveform. (See page 3-180.)



Soft keys



Note: Scrolling is not possible with histogram displays.



· Using the TIME key

① Press the TIME key.

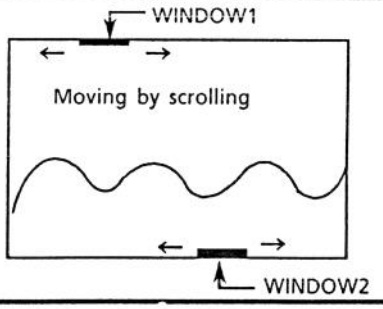
② Turn rotary knob 2. (See page 3-18.)

Note: When waveforms with different data lengths are displayed, they can be scrolled within the range of the longer of the data lengths.

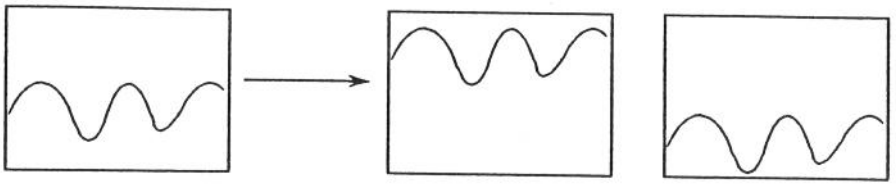
MEMO

The way in which the window position changes can be determined by observing how the highlighted lines move at the top and bottom edges of the waveform display area. (See page 3-5.)

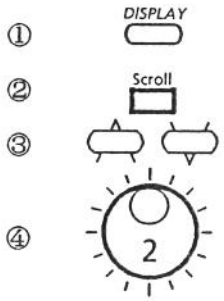
When the Time key is used, Window 1 and Window 2 move together.



3.6.11 Moving a Waveform ((2) Voltage Axis Direction: ↕Scroll)



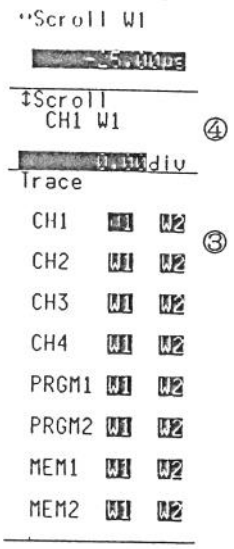
[Soft key operations] [Description] [Menu]



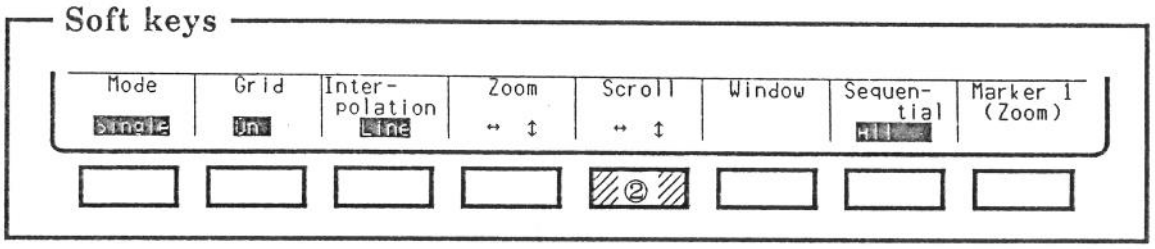
There are two scrolling methods.

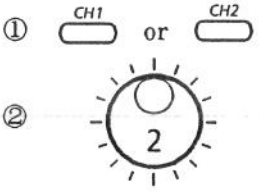
· Using ↕ Scroll

① Press the DISPLAY key.
② Select Scroll using the soft keys.
③ Select the waveform to be scrolled from the Trace menu using the ◁ and ▷ keys.
④ Turn rotary knob 2 to move the waveform.



Note: Switching a single display to a dual display may cause the waveform position to shift by one dot owing to the different resolutions for single and dual displays (500 dots for single and 250 dots for dual). (This means that 0.02div or −0.02div will apply instead of 0.00div.)





· Using CH1 , CH2

① Select the waveform to be moved by pressing the CH1 or CH2 key.
② Move the waveform by turning rotary knob 2. (See page 3-7.)

MEMO

The ↕ Scroll range differs depending on the magnification of ↕ Zoom expansion. Although it is possible to move waveforms beyond the display range allowed with each magnification rate, the waveforms will not be displayed if they are moved in this way.

Example: *1

↕ Zoom Magnification Rate	↕ Scroll Range
*1	±10 div
*2	±20 div
*2.5	±25 div
*4	±40 div
*5	±50 div
*10	±100 div

3.6.12 Display Waveform Selection (Window)

[Soft key operations]

① DISPLAY

② Window

③

④

[Description]

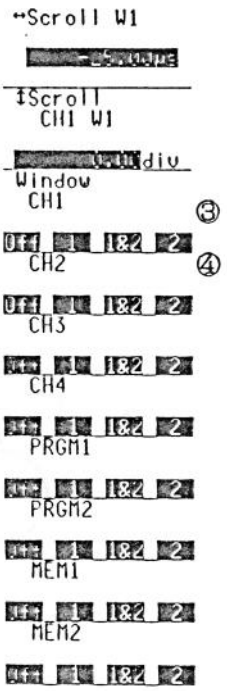
① Press the DISPLAY key.

② Select Window using the soft key.

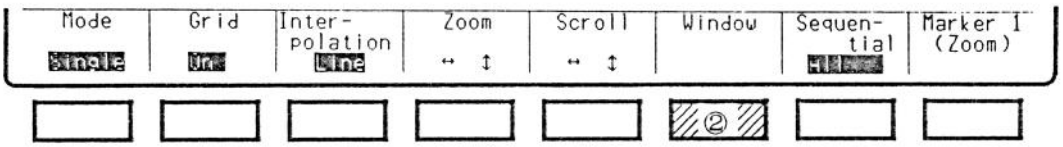
③ Use the ▲ and ▼ keys to select from the menu the waveform(s) to be displayed from among the input channel waveforms, the waveforms for computations (PRGM1, 2), and the waveforms loaded from the memory card (MEM1, 2).

④ Select W1, W1 & W2 or W2 using the ◀ and ▶ keys.
(W1 denotes Window 1, W2 denotes Window 2, and W1 & W2 denotes both windows.)

[Menu]



Soft keys



MEMO

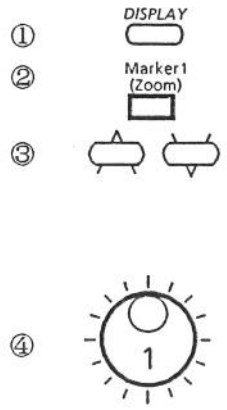
When the window for PRGM1 or PRGM2 is set On (when W1 or W2 is selected), the parameters governing record length, averaging, accumulate and sequential store may be modified since the combination of the record length, averaging, accumulate and sequential store may not be appropriate. (If the parameters are modified a message to that effect appears at the top of the screen.)

3.6.13 Displaying a Waveform Stored with Sequential Store (Display Sequential)

Refer to the section (see page 3 - 28.) on how the sequential store waveforms are displayed.

3.6.14 Zoom Marker Movement (Zoom Marker)

[Soft key operations] [Description] [Menu]



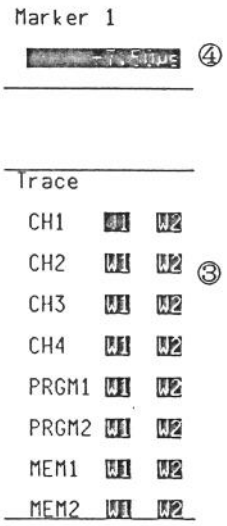
① Press the DISPLAY key.

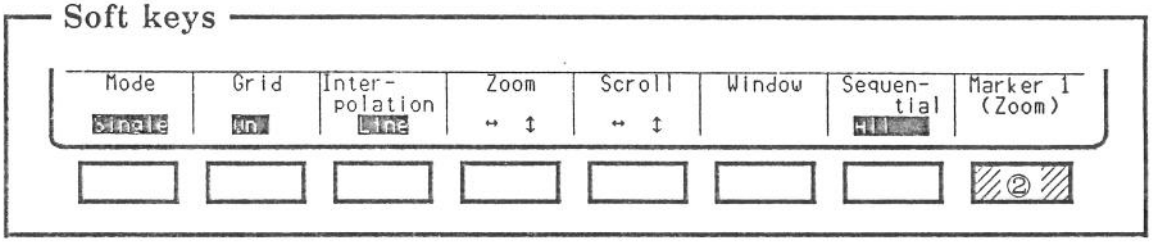
② Select Marker1 (Zoom) Cursor using the soft keys.

③ Use the ◁ and ▷ keys to select from the waveform which is to be expanded or reduced.
Marker 1 (+) appears on the selected waveform.

④ Turn rotary knob 1.
The marker will move.
Using Zoom , the waveform can be expanded centering on the marker. (See 3.6.8 on how to expand or reduce waveforms.)

Note: The marker may also be moved using the CURSOR key. (See the section on how to move the marker with the cursor.)

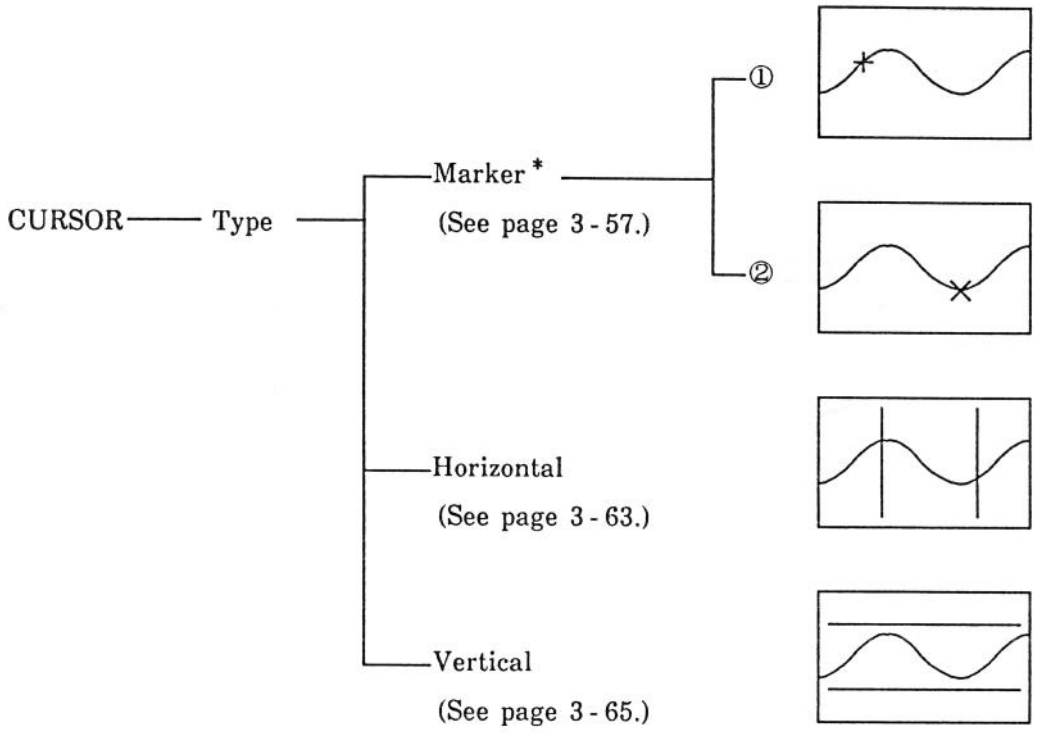




3.7 Cursor Operation CURSOR

Both the voltage of the waveform displayed and the time can be read out using the cursors.

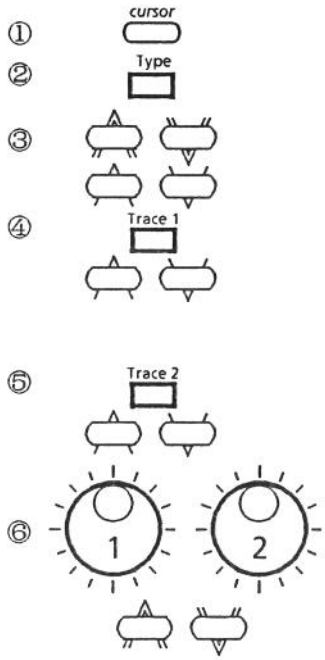
The following types of cursors are available.



* Marker 1 is indicated on the waveform by "+" and Marker 2 by "×".

3.7.1 Marker Operation (Marker)

[Soft key operations]



[Description]

① Press the CURSOR key.

② Select Type using the soft key.

③ Select Cursor Type using the ▲ and ▼ keys, and set Marker using the ◀ and ▶ keys.

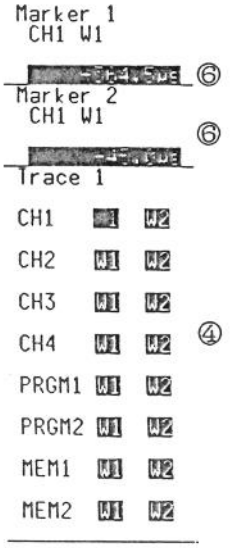
④ Select Trace 1 using the the soft keys. Select the waveform on which marker 1 is to be placed using the ◀ and ▶ keys.

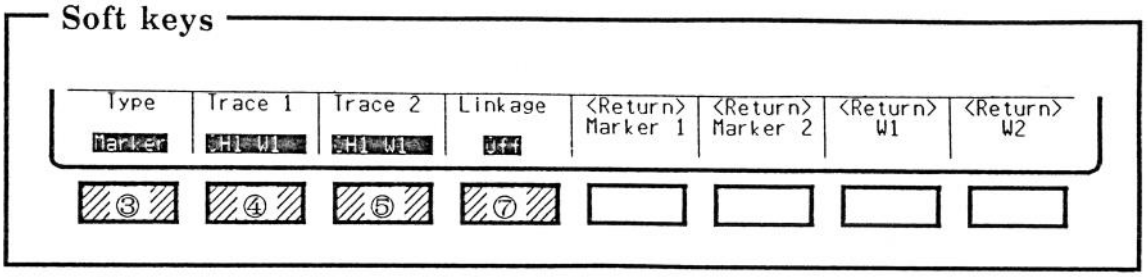
⑤ Select Trace 2 using the soft keys. Select the waveform on which marker 2 is to be placed using the ◀ and ▶ keys.

⑥ Marker 1 (+) and marker 2 (×) can be moved by rotary knobs 1 and 2, respectively.
It is also possible to select marker 1 or marker 2 using the ▲ and ▼ keys, and to input the numerical values directly using the numeric keypad. (See page 3 - 180 for the input method.)

⑦ Select Linkage using the soft keys. If you wish markers 1 and 2 to move together, use the ▲ and ▼ keys to set Linkage to On, and if they are to be moved separately, use the keys to set it to Off. If On is selected, either of the two rotary knobs can be used to move both markers. Press the CLEAR MENU key to erase the cursors.

[Menu]





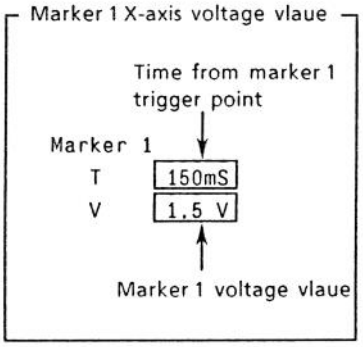
Note 1: When a marker is positioned off the waveform, it will be displayed as a and mark.

Note 2: If histogram waveforms are being displayed, Linkage will be set Off or will not operate.

Note 3: The cursor cannot be moved when it is outside the window. (It may go beyond the window when the waveform is moved laterally or when the record length is changed.)

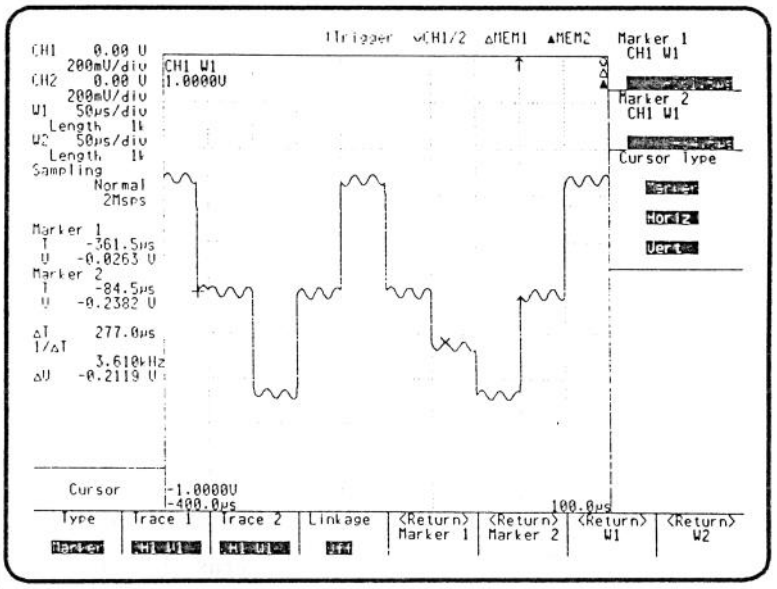
The marker display vlaues are as follows.

(1) In Y-T Mode (Dual or Single Mode)



(Marker 2 is similarly displayed.)

ΔT	:	Time for marker 2 – time for marker 1
1/ΔT	:	Frequency between markers
ΔV	:	Marker 2 voltage – marker 1 voltage



Note: Marker 1 (+) is automatically displayed by the DISPLAY key Zoom. The waveform is expanded centering on the marker and the letter Z will appear. (See Zoom for details.)