
Operation Manual

Oscilloscope **LA314H**

LeCroy



Innovators in Instrumentation

CE



Introduction

- ◇ Thank you very much for your purchase of LaCroy electronic measuring instruments. We appreciate your continued patronage of LeCroy electronic measuring instruments.
- ◇ Please use your instrument after thoroughly reading this manual and understanding its contents. After reading this manual, please keep it in a safe place for future reference.
- ◇ This Oscilloscope meets CE requirements per the Council Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety.
- ◇ This Oscilloscope conforms to product safety requirements per UL3111 (as Pollution Degree 2 and Installation Category II) under file E183826.






Cautions for safe use

Matters that must be observed for safe operation of this instrument and for prevention of injury to humans and damage to property are described as “ warnings” and “ cautions” in this manual. The symbol to invoke caution is marked on the panel.

Explanation of “ warnings” and “ cautions” columns in this manual

 Warning	Incorrect operation or failure to heed warnings may result in death or serious injury.
 Caution	Incorrect operation or failure to heed cautions may result in injury or damage to equipment.

Explanation of the symbols on the panel

Symbol	Meaning
	This a symbol used in reference with the statements in the manual to protect the user against injury and protect this instrument against damage.
	Frame or chassis Terminal
	Risk of electric shock
	Earth (Ground) Terminal
	Protective Conductor Terminal

Cautions

- ◇ Parts of the contents of this manual may be modified without notice to accommodate improvements in performance and function.
- ◇ Reproduction of the contents of this manual without previous consent is prohibited.

History

- ◇ March 1998 : Issue of the 1st edition

Warnings

- **Do not use this instrument in a location where there is explosive gas in the vicinity.**

The use of this instrument in a location where there is explosive gas could result in explosion.

- **If there is any smoke, abnormal odor, or abnormal sound coming from this instrument, immediately set the power switch to STBY and disconnect the power cord.**

Use of this instrument under these conditions could result in electrical shock or fire. After setting the power switch to STBY and disconnecting the power cord, contact one of our service offices for repair. Repair by the user is dangerous and should be strictly avoided.

- **Take care to not allow water to get into this instrument or the wetting of this instrument.**

The use of this instrument in a wet state could result in electrical shock or fire. If water or other foreign matter has gotten into this instrument, first set the power switch to STBY and remove the power cord and then contact one of our service offices for repair.

- **Do not place this instrument on an unstable place such as on a shaky stand or on a slant.**

The dropping or turning over of this instrument could result in electrical shock, injury, or fire. If this instrument has dropped or its cover has been damaged, first set the power switch to STBY and remove the power cord and then contact one of our service offices for repair.

- **Do not allow any foreign matter such as metal or inflammable substance to get in from the air hole, etc.**

The entrance of any foreign matter from the ventilation port, etc., could result in fire, electrical shock, or power failure. If any foreign matter has entered, first set the power switch to STBY and remove the power cord and then contact one of our service offices for repair.

Warnings (cont'd)

● Be sure to use a 3-core power cord.

Failure to use a 3-core power cord could result in electrical shock or power failure.

- When supplying power from a 2-wire receptacle using a 3-core/2-core conversion adapter, be sure to connect the grounding terminal of the 3-core/2-core conversion adapter to ground.
- When supplying power from a 3-wire receptacle using the attached 3-core power cord, the grounding wire of the power cord is connected to ground.

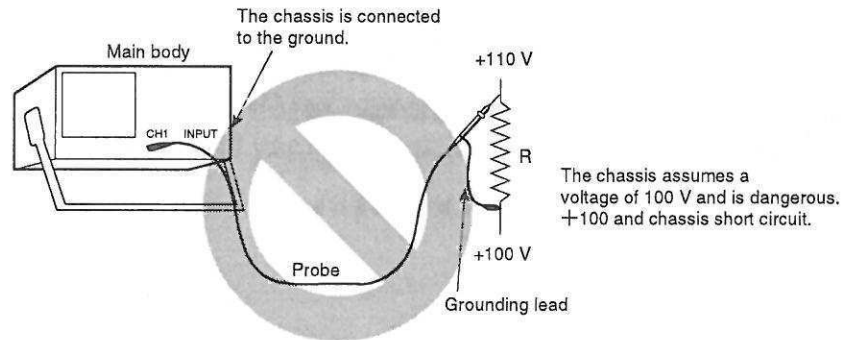
● Use this instrument with the rated AC (\sim) power supply.

Use of this instrument with a voltage other than specified could result in electrical shock, fire, or power failure. The usable power voltage range (100 to 240 VAC) is marked on the rear panel.

● Be sure to connect the ground side of probes and input connectors to the grounding potential of the object being measured.

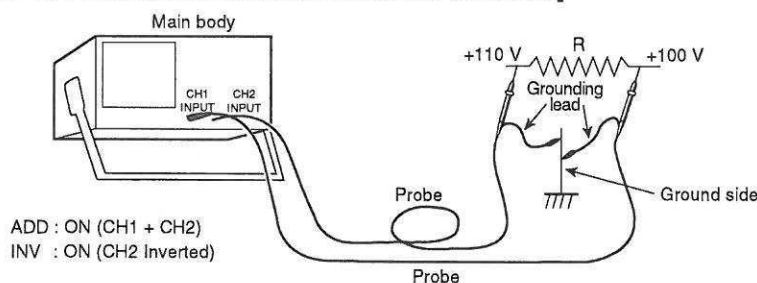
If the grounding lead is connected to potential other than the ground, electrical shock or other accidents (damages to the object being measured, the instrument itself or other units connected to the instrument) may occur (refer to the "Example of improper configuration" shown below).

[Example of improper configuration]



When measuring the floating potential, measurement by the differential method (CH1 and CH2 input) is recommended (refer to the example shown below).

[Example of recommended measurement method]



 **Warnings** (cont'd)

● **Do not remove either the cover or panel.**

There are high-voltage parts inside the cover and panel and touching any of them could result in electrical shock. Please contact one of our service offices for any inspection, calibration, or repair.

● **Take sufficient care when measuring high voltages.**

Touching a high-voltage part during measurement could result in electrical shock.

● **When handling the power cord, strictly observe the following:**

Failure to heed this inspection could result in fire or electrical shock. If the power cord has been damaged, contact one of our service offices (at the end of this volume) for repair.

- Do not modify the power cord.
- Do not bend the power cord forcibly.
- Do not twist the power cord.
- Do not bundle the power cord.
- Do not pull the power cord.
- Do not heat the power cord.
- Do not moisten the power cord.
- Do not place a heavy object on the power cord.

● **Do not modify this instrument.**

Modification of this instrument could result in electrical shock, fire, or power failure. Repair of a modified instrument may be refused.

Be sure to read this page to assure safety. Read the next page also.

Cautions

- **Be sure to use a specified fuse (ϕ 5 x 20 mm, 250 V, T5A) when replacing the fuse.**
The use of a fuse other than a specified one could result in fire or power failure. Disconnect the power cord when replacing the fuse.
- **Be sure to use a three-core power cord suitable for the supply voltage.**
The use of a cord that is not suitable for the supply voltage may cause fire. Also, the use of a two-core power cord may cause electrical shock.
- **Be sure to connect and disconnect the power cord after setting the power switch to STBY.**
Connection and disconnection of the power cord with power supplied could result in electrical shock or power failure.
- **When disconnecting the power cord from the receptacle, pull it by holding the plug.**
Pulling by the cord may damage the cord and could result in fire or electrical shock.
- **Avoid use of any damaged cable or adapter.**
The use of any damaged cable or adapter could result in fire or electrical shock.
- **Avoid placing any object on this instrument.**
If any object is placed on this instrument, the cover may contact the internal circuitry and could result in electrical shock, fire, or power failure.
- **Do not place any object in the vicinity of the air hole or fan of this instrument.**
Placing any object in the vicinity of the air hole or fan may generate internal heat and could result in fire or electrical shock.
- **Do not place this instrument in a location with a high degree of moisture or dust.**
Placing this instrument in a location with a high degree of moisture or dust could result in fire or electrical shock.
- **When using this instrument in an upright position, take care not to allow it fall over.**
The falling over of this instrument could result in injury, fire, or electrical shock.
- **When probes or measuring cables, etc. are connected to this instrument, take care not to cause this instrument to fall over by pulling them.**
The falling over of this instrument could result in injury, fire, or electrical shock.
- **Do not use this instrument if it has failed.**
The use of this instrument in a state of failure could result in fire or electrical shock. In the case of failure, contact one of our service offices for repair.

Be sure to read this page to assure safety.

Cautions (cont'd)

- **Always use this instrument only within the rated operating range.**

The use of this instruction out of the rated operating range could result in power failure. The temperature and humidity ranges that allow the use of this instrument are as follows:

 - Temperature : 0 °C to +40°C
 - Relative humidity : 90% or less (at 0°C to +40°C)
 - Operation : Indoor use only
- **Do not apply voltage to an input terminal (CH1, CH2, CH3, CH4 and Z AXIS IN) exceeding the posted rating.**

Applying a voltage exceeding the posted rating could result in power failure. The maximum voltage than can be applied is as follows:

 - CH1, CH2, CH3, CH4 input
 - Direct
 - At 1 MΩ : ±400 V MAX.
 - At 50 Ω (CH1, CH2) : 5 V rms MAX.
 - With PP005 (10:1) or equivalent : ±500 V MAX.
 - Z AXIS IN : ±40 V MAX.

[Note] The maximum input voltage derates depending on frequency and high voltage pulse of an input signal. (refer to page 53)
- **Do not raise trace or character intensity beyond what is necessary.**

The use of an intensity beyond what is necessary could result in eye fatigue or burn in of the CRT.
- **To assure safety, be sure to disconnect the power cord if the instrument is not to be used for a long period.**
- **When transporting this instrument, be sure to use the original packing material that came with the instrument or other packing material that is equal or superior.**

Large vibrations and/or shocks applied to the instrument during transportation could result in power failure and fire. If there is no appropriate packing material and/or cushion material, consult one of our service offices.

When using a carrier, label "precision machine" on each face of the packing box.
- **Cleaning should be limited to the exterior of the instrument only, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances should moisture be allowed to penetrate the oscilloscope. To avoid electric shocks, disconnect the instrument from the power supply before cleaning.**

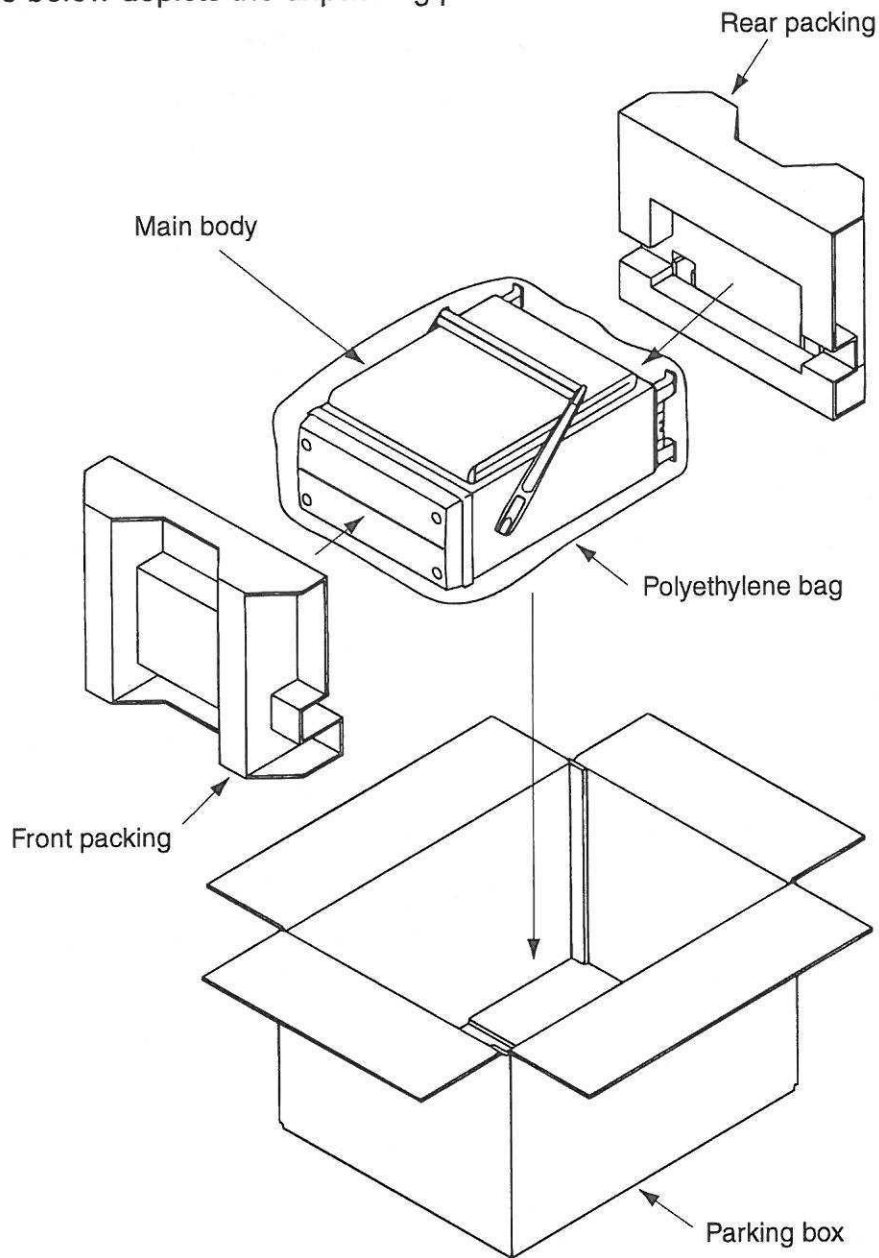
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Unpacking

The figure below depicts the unpacking procedure.



Components

Check that the following items are included:

- LA314H 1
 - Accessories
 - Power cord (three-core type) 1
 - Panel cover 1
 - Fuse 2
 - Operation manual 1
 - Accessory bag 1
 - Probe PP005 2
- (Probe accessories are included)

Explanations of terms

A sweep	: Ordinary sweep system
ADD	: Display of the sum of CH1 waveform and CH2 waveform (abbreviation from ADDITION)
AC (input coupling)	: An input coupling system where a filter is applied to the input circuit so that the DC (direct current) component is removed from the signal
AC (trigger coupling)	: A trigger coupling system where a filter is applied to the trigger circuit so that the DC (direct current) component is removed from the signal
ALT (vertical)	: Mutually switched sweep of multiple waveforms on the same screen (abbreviation from ALTERNATE)
ALT (horizontal)	: Display of A sweep and B sweep on the same screen (abbreviation from ALTERNATE)
ATTACH	: Selection of the object channel for cursor measurement or offset
B sweep	: The sweep system used for delayed sweep
BEAM FIND	: Display of the waveform that was outside the screen in the screen (abbreviation from BEAM FINDER)
B ENDS A	: To increase the intensity by shortening A sweep with delayed sweep (refer to "2.12 Delayed Sweep").
BOTH	: Both of the odd- and even-numbered fields of the vertical synchronizing TV signals
BURST	: One of event triggers, where a triggering is set when the time interval of the trigger signal exceeds the specified length (refer to "2.9.6 Event Trigger").
BWL	: Limitation on the vertical bandwidth (abbreviation from BANDWIDTH LIMITATION)
CAL	: A signal for calibration, which is used for calibration of deflection factor and the check of the operation of this instrument (abbreviation from CALIBRATION)
CH	: Channel (abbreviation from CHANNEL)
CHOP	: Mutually switched display of multiple waveforms on the same screen
CLAMP	: Display of the back porch of TV signals as converted into that on the reference level (ground level)
COUPLE	: Synchronous coupling system (abbreviation from COUPLING)
COUNT	: One of event triggers, where a triggering is set when the specified number of B trigger signals are counted after the A trigger signal occurred (refer to "2.9.6 Event Trigger").
CRT	: Cathode ray tube
DC (input coupling)	: The input coupling system that allows the passage of both DC and AC signals
DC (trigger coupling)	: The trigger coupling system that allows the passage of both DC and AC signals
DIV	: Division
EVEN	: Even-numbered fields of vertical synchronizing TV signals

EVENT	: Event trigger (this unit has the COUNT and BURST types)
FET	: Field effect transistor
FET probe	: An active probe with an FET at the tip
GND	: Grounding
H cursor	: The cursor used for measuring time by moving in the horizontal direction
HD TV	: TV system of high-definition type (abbreviation from HIGH DEFINITION TELEVISION)
HF REJ	: Low-pass filter for removing high-frequency bands (abbreviation from HIGH FREQUENCY REJECTION)
HOLDOFF	: Holdoff time (facilitate the observation of complex pulse signals by adjusting the holdoff time)
HORIZ	: Horizontal
INDEP	: Move the cursor independently (abbreviation from INDEPENDENCE)
INTEN	: Intensity, brightness of the screen (abbreviation from INTENSITY)
INV	: Inverting the vertical display on the screen (abbreviation from INVERSION)
LF REJ	: High-pass filter for removing low-frequency bands (abbreviation from LOW FREQUENCY REJECTION)
LINE (trigger signal source)	: One of trigger signal sources. A power line is used as a trigger signal source.
LINE (TV)	: Line No. of horizontal synchronization signal
MAG	: Magnifying waveform in the horizontal direction (abbreviation from MAGNIFY)
MAX	: Maximum value
NTSC	: A color television system (abbreviation from NATIONAL TELEVISION SYSTEM COMMITTEE)
ODD	: Odd-numbered fields of vertical synchronizing TV signals
PAL	: A color television system (abbreviation from PHASE ALTERNATION BY LINE)
READOUT	: Intensity of characters displayed (abbreviation from READOUT INTEN)
RH	: Relative humidity
RECALL	: Recalling the setting conditions saved in the built-in memory
RST	: Reset
SAVE	: Saving the panel key setting conditions in the built-in memory
SCALE	: Illumination of the scale on the CRT (abbreviation from SCALE ILLUMINATION)
SECAM	: A color television system (abbreviation from SEQUENTIEAL COULEUR A MEMOIRE in French)
SEP	: Separating A sweep and B sweep from each other (abbreviation from SEPARATION)

SGL	: Sweeping only once (abbreviation from SINGLE)
SLOPE	: Trigger slope
SOURCE	: Trigger signal source
STBY	: Stand-by
TCK	: Moving cursors while maintaining the intervals between them (abbreviation from TRACK)
TRACE ROTATION	: Adjusting the inclination of a trace so that it matches with the horizontal division
TRIG	: Trigger
Tr (rise time)	: A pulse response characteristic - the time during which the momentary value of the rise portion is 10 to 90% of the basic amplitude
TV-H	: Horizontal synchronizing TV signals
TV-V	: Vertical synchronizing TV signals
V cursor	: The cursor used for measuring voltage by moving in the vertical direction
VSWR	: Voltage standing wave ratio
X-Y	: A system where different signals are input and displayed on the X and Y axes so as to observe the frequency ratio and/or phase difference between two signals

Memo

LA314H Bandwidth

- ◇ The LA314H oscilloscope has a vertical axis range of 5 mV/div to 50 mV/div and a bandwidth of 470 MHz for both CH1 and CH2.
- ◇ Since the above range is three times the bandwidth of 156 MHz, it is ideal for observing ITU-T (formerly CCITT), G.703 and other high-speed communications networks.
- ◇ In a vertical axis range of 2 mV/div and 100 mV/div to 5 V/div for CH1 and CH2 the bandwidth is 440 MHz.
- ◇ The total range of CH3 and CH4 is 400 MHz.
- ◇ When an PP005 probe is used, the bandwidth is 400 MHz.
- ◇ Maximum frequencies for the A sync and B sync are 400 MHz and 250 MHz respectively.

Range	Bandwidth (MHz)			Maximum Frequency (MHz)	
	CH1/CH2	CH3/CH4	PP005 Probe	A Sync	B Sync
2 mV/div	440 MHz	—	400 MHz	400 MHz	250 MHz
5 mV/div	470 MHz				
10 mV/div					
20 mV/div					
50 mV/div					
0.1 V/div	440 MHz	400 MHz			
0.2 V/div		—			
0.5 V/div		400 MHz			
1 V/div		—			
2 V/div					
5 V/div					

Section 1. Operating Points

1.1 Front panel

Figure 1.1.1 shows the overall view. Refer to page 2 and the pages that follow for details.

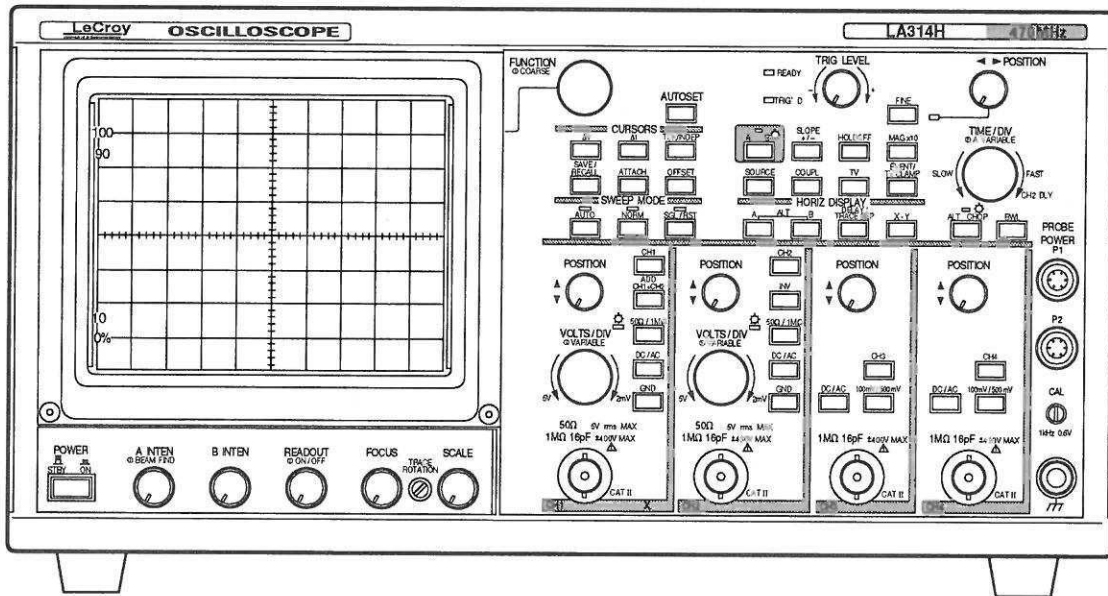


Figure 1.1.1 Front Panel I (Overall view)

Symbols on the panel

Warning symbol

This symbol calls the user's attention to the descriptions in the instruction manual. This symbol is marked near the CH1 to CH4 INPUT terminals.

Symbols in the instruction manual.

◇ Expression of keys and knobs

: Indicates a key.

: Indicates a knob. There are two types of knobs as follows:

- To be operated by turning.
- To be operated by turning and pressing.

◇ When two switches are pressed simultaneously, they are expressed with a symbol of "+" inserted between them.

[Example] : +

1.1.1 The power source and screen

See Figure 1.1.2.

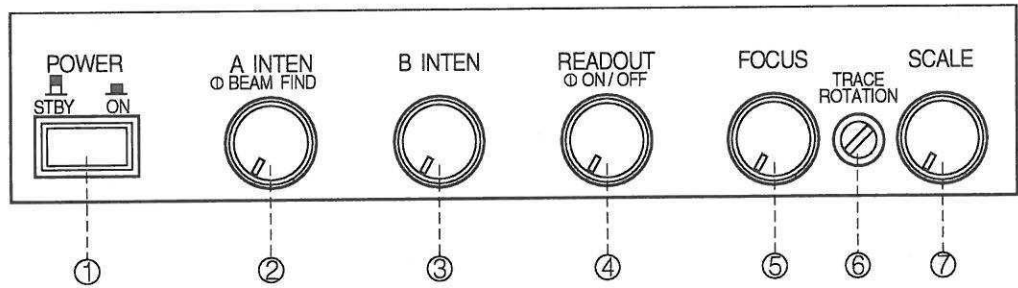
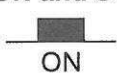


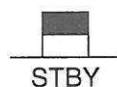
Figure 1.1.2 Front Panel I

- ① **POWER** key
Sets the AC power source to ON or STBY. Refer to the column shown below.
- ② **[A INTEN (BEAM FIND)] knob**
 - A INTEN volume knob: Adjusts the trace intensity of A sweep (refer to “2.3 Adjustment of the Screen”).
 - BEAM FIND switch: Displays a compressed waveform on the screen (refer to “2.3 Adjustment of the Screen”).
- ③ **[B INTEN] knob:**
Adjusts the trace intensity of B sweep (refer to “2.3 Adjustment of the Screen”).
- ④ **[READOUT (ON/OFF)] knob**
 - READOUT volume knob: Adjusts the intensity of characters (refer to “2.3 Adjustment of the Screen”).
 - ON/OFF switch: Selects ON (display) or OFF (non-display) of characters (refer to “2.3 Adjustment of the Screen”).
- ⑤ **[FOCUS] knob**
Adjusts the focus (refer to “2.3 Adjustment of the Screen”).
- ⑥ **TRACE ROTATION**
Adjusts the intensity of the trace using the driver (refer to “2.3 Adjustment of the Screen”).
- ⑦ **[SCALE] knob**
Adjusts the intensity of the scale (refer to “2.3 Adjustment of the Screen”).

ON and STBY of the POWER switch.



: Indicates a state wherein this instrument is ready for ON operation with power supplied to every circuit.



: Indicates a standby state of this instrument wherein the STBY main power supply is off. When AC power is connected to AC LINE INPUT, power is supplied to the only microprocessor in this instrument. When AC power is not connected to AC LINE INPUT, panel setup conditions are backed up by the built-in battery.

1.1.2 Vertical axis

See Figure 1.1.3.

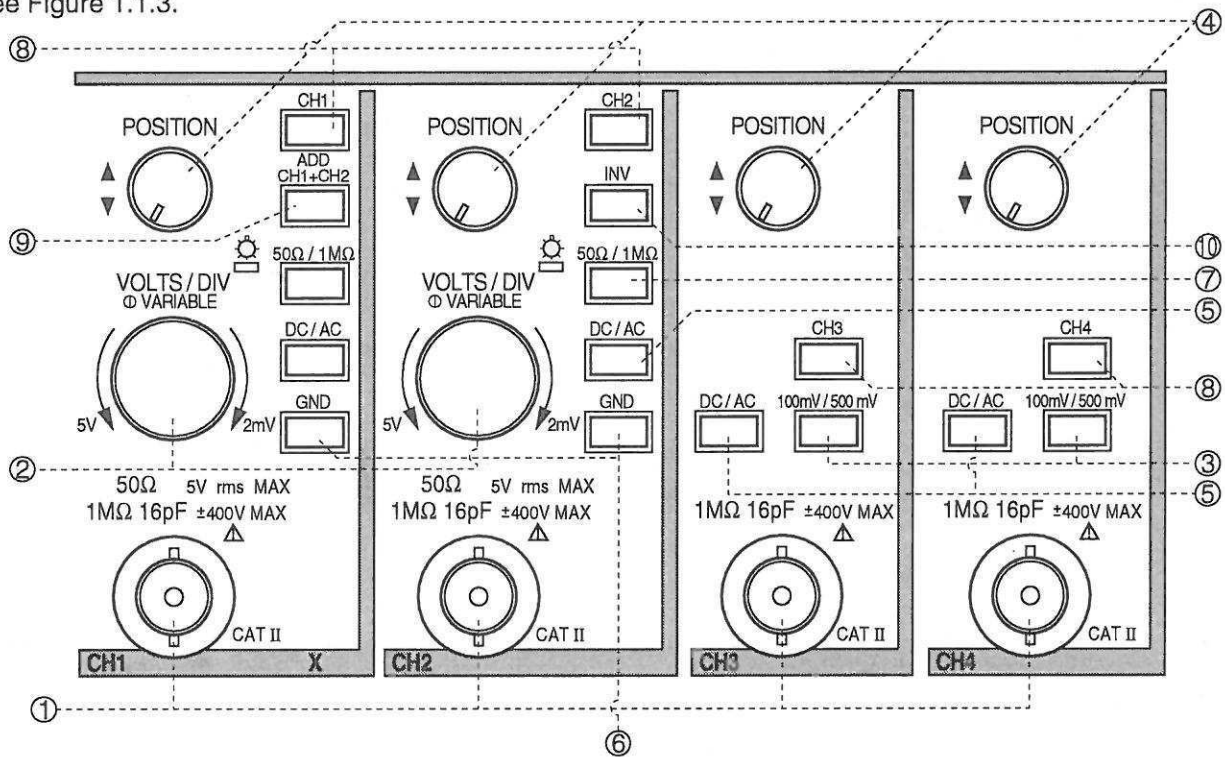


Figure 1.1.3 Front Panel II

- ① **INPUT connectors (CH1 to CH4):**
Connections for input signals.
[Note] Strictly observe the maximum limit on the input voltage as displayed on the panel.
- ② **[VOLTS/DIV (VARIABLE)] (CH1, CH2) knob:**
VOLT/DIV switch: Selects the deflection factor in 1-2-5 setps (refer to “2.5.1 Deflection Factor”).
VARIABLE switch: Finely adjusts the deflection factor (refer to “2.5.1 Deflection Factor”).
- ③ **100mV/500mV (CH3, CH4) key:**
Select the deflection factor (refer to “2.5.1 Deflection Factor”).
- ④ **[▲POSITION▼] (CH1 to CH4) knob:**
Move the position in the vertical direction (refer to “2.4 Vertical and Horizontal Positioning”).
- ⑤ **DC/AC (CH1 to CH4) key:**
Select the input coupling (refer to “2.5.2 Input Coupling”).
- ⑥ **GND (CH1, CH2) key:**
Connect the input coupling to the GND (refer to “2.5.2 Input Coupling”).
- ⑦ **50Ω/1MΩ (CH1, CH2) key:**
Select the input resistance. The indicator lights when 50Ω is selected (refer to “2.5.3 Input Resistance”).
- ⑧ **CH1, CH2, CH3, CH4 key:**
Select the channel to be displayed on the screen (refer to “2.5.4 Display Channels”).
- ⑨ **ADD CH1 + CH2 key:**
Displays the sum of CH1 and CH2 (refer to “2.5.6 Sum and Difference”).
- ⑩ **INV key:**
Displays the input of CH2 in reversal (refer to “2.5.6 Sum and Difference”).

1.1.3 Horizontal Axis, etc.

See Figure 1.1.4.

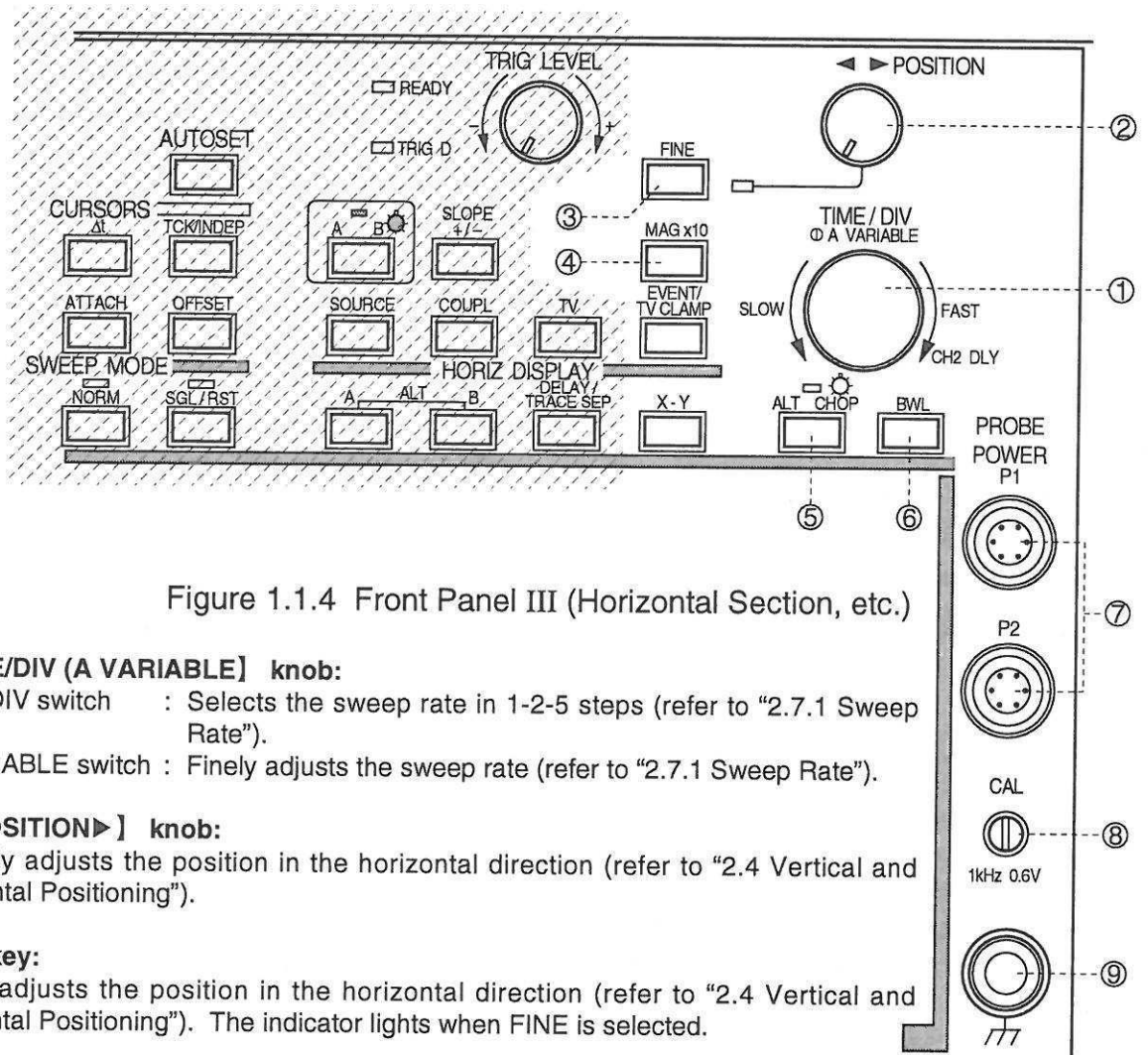


Figure 1.1.4 Front Panel III (Horizontal Section, etc.)

- ① **[TIME/DIV (A VARIABLE)] knob:**
 TIME/DIV switch : Selects the sweep rate in 1-2-5 steps (refer to "2.7.1 Sweep Rate").
 A VARIABLE switch : Finely adjusts the sweep rate (refer to "2.7.1 Sweep Rate").
- ② **[◀POSITION▶] knob:**
 Roughly adjusts the position in the horizontal direction (refer to "2.4 Vertical and Horizontal Positioning").
- ③ **[FINE] key:**
 Finely adjusts the position in the horizontal direction (refer to "2.4 Vertical and Horizontal Positioning"). The indicator lights when FINE is selected.
- ④ **[MAG X 10] key:**
 Magnifies the waveform (x 10) in the horizontal direction (refer to "2.7.2 Magnification").
- ⑤ **[ALT CHOP] key:**
 Selects ALT or CHOP (refer to "2.5.5 ALT and CHOP"). The indicator lights when CHOP is selected.
- ⑥ **[BWL] key:**
 Selects the frequency band (refer to "2.5.7 Bandwidth limiter").
- ⑦ **PROBE POWER P1, P2 terminals:**
 Supply power to FET probes.
- ⑧ **CAL terminal:**
 Outputs calibration voltage signals. Used for operation check of this unit and the adjustment of the probe waveform (refer to "2.1 Display of CAL Waveform With AUTO SET").
- ⑨ **⏏ (grounding) connector:**
 This is the grounding for measurement.

1.1.4 Trigger Section and Display Mode Section

See Figure 1.1.5.

- ① **[TRIG LEVEL] knob:**
Selects the trigger level (refer to "2.9.4 Trigger Level").
- ② **READY indicator:**
Lights while waiting for signals.
- ③ **TRIG'D indicator:**
Lights when a trigger pulse has been generated.
- ④ **[A B] key:**
Selects A (sweep and trigger) or B (sweep and trigger) (refer to "2.12 Delayed Sweep").
The indicator lights when B is selected.

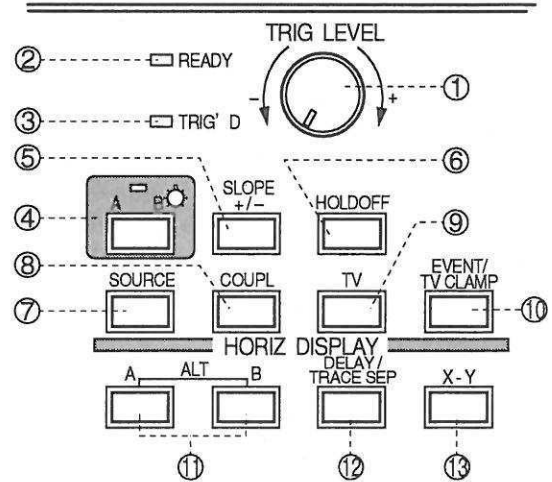


Figure 1.1.5 Front Panel IV (Trigger Section and Display Mode Section)

- ⑤ **[SLOPE] key:**
Select the trigger slope (+, -) (refer to "2.9.3 Trigger Slope").
 - ⑥ **[HOLDOFF] key:**
Selects the holdoff time (refer to "2.13 Holdoff").
 - ⑦ **[SOURCE] key:**
Select the trigger signal source (CH1, CH2, CH3, or LINE) (refer to "2.9.1 Trigger Source").
 - ⑧ **[COUPL] key:**
Select the trigger coupling mode (AC, DC, HF REJ, or LF REJ) (refer to "2.9.2 Trigger Coupling").
 - ⑨ **[TV] key:**
Selects triggering with TV (BOTH, ODD, EVEN, or TV-H) (refer to "2.9.5.1 TV Signal").
 - ⑩ **[EVENT/TV CLAMP] key:**
Selects event (refer to "2.9.6 Event Trigger") or TV clamp (refer to "2.9.5.2 TV Clamp").
- HORIZ DISPLAY (display mode) –
- ⑪ **[A] or [B] key:**
Displays A sweep or B sweep (refer to "2.10 Horizontal Display"). Simultaneous depression of [A] and [B] selects ALT sweep.
 - ⑫ **[X-Y] key:**
Effects X-Y display (refer to "2.10 Horizontal Display").
 - ⑬ **[DELAY/TRACE SEP] key:**
Selects DELAY (refer to "2.12 Delayed Sweep") or TRACE SEP (refer to "2.11 Trace Separation").

1.1.5 Functions, Cursors, Sweep Modes, etc.

See Figure 1.1.6.

① **FUNCTION** pulse switch:

The delay time, cursor position, etc. can be set by turning or pressing this knob. Fine adjustment can be effected by turning this knob. Coarse adjustment in the direction this knob has been turned so far can be effected each time this knob is pressed or continuously held down.

② **AUTO SET** key:

Measuring conditions are set automatically. (refer to "2.1 CAL wave display with AUTO SET").

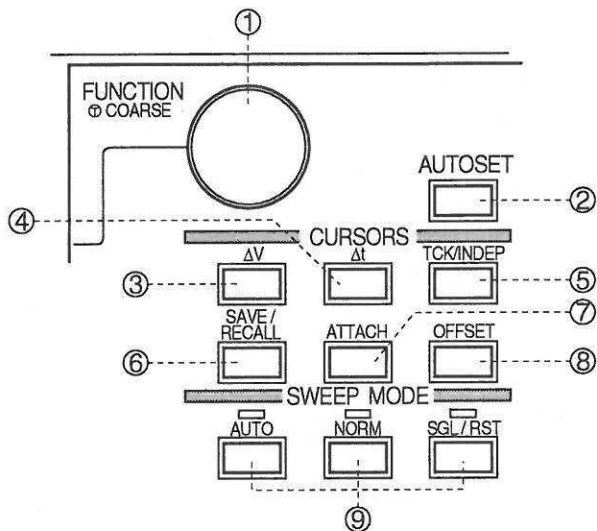


Figure 1.1.6 Front Panel IV (Functions, Cursors, Sweep Modes, etc.)

– CURSORS –

③ **ΔV** key:

Measures the voltage using a cursor (refer to "Section 3 Cursor Measurement and Counter").

④ **Δt** key:

Measures the time using a cursor (refer to "Section 3 Cursor Measurement and Counter").

⑤ **TCK/INDEP** key:

Selects the type of cursor to be moved (C1, C2, or tracking) (refer to "Section 3 Cursor Measurement and Counter").

⑥ **SAVE/RECALL** key:

Selects Save or Recall (refer to "Section 4 Save/Recall").

⑦ **ATTACH** key:

- Selects the measurement object channel for the measurement with a cursor (refer to "3.2 Voltage Difference").
- Selects the channel (CH1/CH2) or terminal (P1/P2) for the offset (refer to "2.5.8 Offset").

⑧ **OFFSET** key:

Set the offset of CH1/CH2 or FET probe (refer to "2.5.8 Offset").

– SWEEP MODE –

⑨ **AUTO**, **NORM**, or **SGL/RST** key:

- Selects repetitive sweep (AUTO, NORM) or single sweep (SGL) (refer to "2.8 Sweep Mode").
- The indicator corresponding to the sweep mode that is selected lights.

1.2 Rear panel

See Figure 1.2.1.

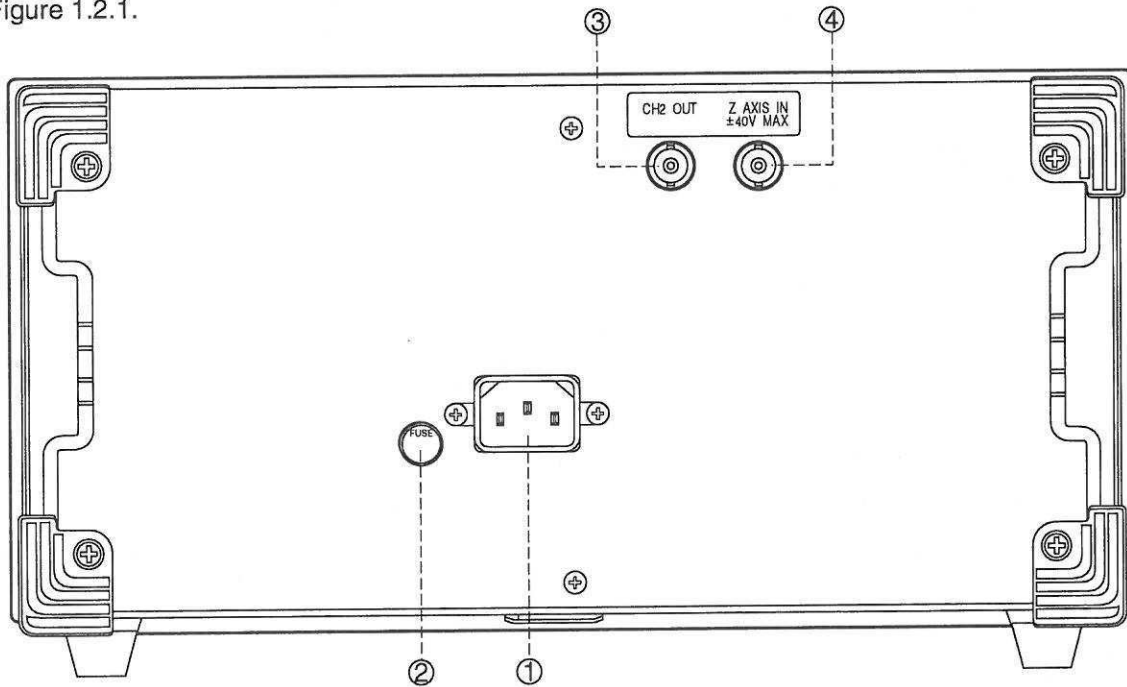


Figure 1.2.1 Rear Panel

- ① **AC LINE INPUT**
Connect the power cord to this receptacle.
- ② **FUSE**
 ϕ 5 x 20 mm, 250 V, T5A fuse.
- ③ **CH2 OUTPUT terminal**
Outputs the signal input to CH2 INPUT.
Amplitude of output signal = Amplitude on the screen x output voltage
- ④ **Z AXIS IN terminal**
Inputs the intensity modulation signal.

Section 2. Basic Operation

Cautions

- **Be sure to connect or remove the power cord after setting the power switch to STBY.**
- **Use this instrument with the rated AC power supply.**
 - Voltage range : 100 to 240 VAC
 - Frequency : 50/60 Hz
 - Power consumption : 110 VA max.
- **Be sure to use a 3-core power cord appropriate to the supply voltage.**
- **Do not place any object in the vicinity of the air hole or fan of this instrument.**
- **Use this instrument within the rated operating range. (Indoor use only)**
 - Temperature: 0 to +40 °C, humidity: 90%RH (at 40 °C)
- **Power is applied to this instrument if the power switch is set to STBY. Disconnect the power cord from the receptacle if the instrument is not to be used for a long time.**
- **Do not apply voltage to the input terminal exceeding the posted rating.**
 - CH1, CH2, CH3, CH4 input at 1 M Ω
 - Direct : ± 400 V MAX.
 - With the PP005 or equivalent : ± 500 V MAX.
 - CH1, CH2 at 50 Ω : 5 Vrms MAX.

[Note] The maximum input voltage derates depending on frequency and high voltage pulse of an input signal. (refer to page 53)
- **Do not raise trace or character intensity beyond what is necessary.**
 - This instruction is for two purposes: 1) to protect the user's eyes from eye strain and fatigue, and 2) to protect the CRT from burn-in.

General

Perform basic operation using CAL output and a signal generator so as to become familiar with this instrument. The Iwatsu FG-350 is used for the signal generator.

◇ Grounding

Connect the measurement grounding terminal (Right side of CH4 INPUT) to GND of the circuit being measured. Grounding is particularly important to measure high-frequency signals accurately. Connect the grounding lead of the probe as closely as possible to the grounding terminal near the signals.

◇ Settings when power is set STBY or OFF *1

When power is set STBY or OFF, the panel setup immediately before such setting is stored. When power is turned on again, operation restarts with the panel setup immediately before the setting to STBY or OFF. When power is set to OFF, the panel setup is backed up by the built-in batteries.

*1 The state where the power cord is disconnected.

◇ Built-in battery

- When the built-in battery has been consumed, the setup conditions are initialized when power has been turned on.
- The built-in battery is not sold in the market. When replacing it, please contact your nearest marketing office.

◇ How to read the screen

- Main contents of display

A SWEEP RATE		A TRIGGER SOURCE		A TRIGGER SLOPE		A TRIGGER COUPLE		A TRIGGER LEVEL		Sweep magnification		HOLDOFF TIME		
B SWEEP RATE		B TRIGGER SOURCE		B TRIGGER SLOPE		B TRIGGER COUPLE		B TRIGGER LEVEL				DELAY TIME		
												FUNCTION MODE		
Measurement of ΔV or Δt										Frequency measured				
CH1	Range	Coupling	ADD	CH2	INV	Range	Coupling	CH3	Range	Coupling	CH4	Range	Coupling	Bandwidth limiter

- An example of the display

A	10 μs	CH1	+ DC	- 1.00mV	MAG	HO : 100%
B	1 μs	CH2	- DC	3.00mV		DLY 99.00 μs f:B-DELAY
A	$\Delta t = 5.00 \mu s$	$1/\Delta t = 200.0 kHz$			$f = 200.00 kHz$	
1:	100mV	+ 2: ↓	200mV	3:	500mV	4: 500mV BW20

2.1 Displaying CAL Signal with AUTO SET

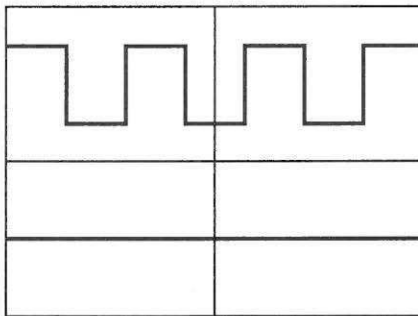
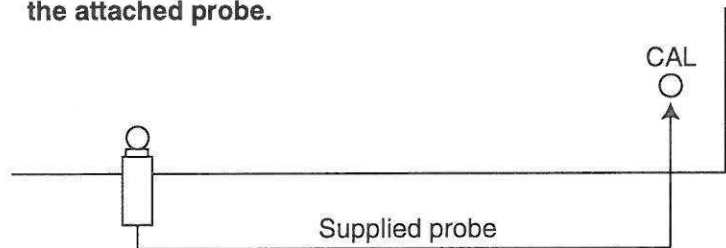
Display the CAL waveform (1 kHz, 0.6 V square wave) on CH1 using the AUTO SET function of this instrument.

Operating method

Procedures

Turning power on

- ① Set power to STBY BY PRESSING **POWER**.
- ② Connect the power cord to the AC LINE INPUT on the rear panel and to the AC power source.
- ③ Press **POWER** to turn on the power.
 - Traces, characters, or both are displayed on the screen.
- ④ Connect the CH1 input connector and CAL connector with the attached probe.



- ← ⑤ Press **AUTO SET**.
 - The CAL waveform is displayed on the screen.
 - If the CAL waveform does not appear, adjust the intensity (refer to "2.3 Adjustment of the screen").

AUTO SET function

- Press **AUTO SET** in a state such that "the size of signal is unknown, frequency is unknown, or operation mode is unknown". This instrument automatically selects the measurement conditions suitable for observation (See Table 2.1.1 Measurement conditions of AUTO), based on the amplitude and/or frequency of the input signal and the waveform is displayed on the screen.
- Sometimes suitable measurement conditions cannot be found depending on the frequency, amplitude, and/or duty ratio of the input signal.

Table 2.1.1 Measurement conditions of AUTO SET

Vertical deflection system	Triggering
Deflection factor VOLTS/DIV : When the frequency is between 50 Hz and 100 MHz, 2 mV to 5 V/div with an amplitude of 1.5 to 8 div VARIABLE : OFF (CAL)	A/B : A SOURCE : Detected in the order of CH1 and CH2 COUPL : DC TV : When the former setting is TV MODE, whether it was TV-H, NTSC, PAL, or HDTV is automatically judged. When there is no corresponding TV-MODE, TV is released. SLOPE : + ("-" in the case of TV mode) LEVEL : About 0 div
Display channel CH1 : Former setting *1 CH2 : Former setting *1 CH3 : OFF (non display) CH4 : OFF (non display) *1 CH1 alone is set to ON if both CH1 and CH2 have been set to OFF.	
POSITION In case of 1-channel display : In the middle In case of 2-channel display CH1 : About + 2 div CH2 : About - 2 div	Horizontal deflection system HORIZ DISPLAY : A TIME/DIV : 50 ms to 10 ns/div, approx. 2 to 5 cycles VARIABLE : OFF
AC/DC : Former setting *2 50Ω/1MΩ : Former setting *3 GND : OFF (GND released) ALT/CHOP : CHOP CH2 INV : OFF BWL : OFF (no Bandwidth limiter) ADD : OFF	SWEEP MODE : AUTO POSITION : Sweep starts from a position near the left end of the screen. READ OUT : ON

*1 When both CH1 and CH2 are OFF, CH1 is set to ON.

*2 When this is set to DC, AC coupling occurs when the waveform goes outside the moving range of the position.

*3 When this is set to 50Ω, it becomes 1 MΩ when the waveform goes outside the moving range of the position.
 When 1 MΩ is set, the setting of input coupling (AC/DC) becomes AC.

[Note] When an adequate amplitude cannot be detected, the following will be set on that channel:

VOLTS/DIV : 10mV/DIV
 50Ω/1MΩ : 1MΩ
 AC/DC : AC

2.2 Probe Compensation

Adjust the waveform on the attached probe. Be sure to confirm that the waveform of the probe is compensated correctly before using the probe.

Operating method

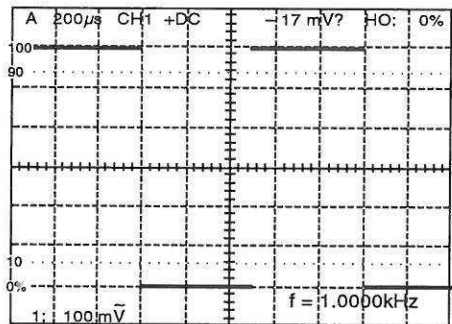
Procedures

① **Set this unit as follows:**

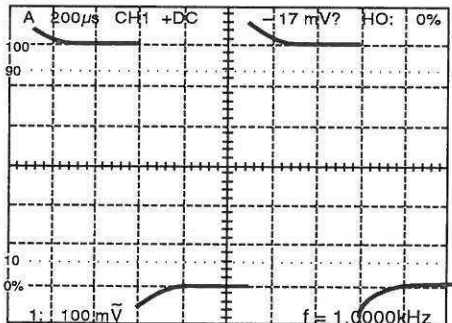
CH1 VOLTS/DIV : 10 mV
 GND : OFF (GND released)
 AC/DC : DC
 SOURCE : CH1
 SEC : 200 μ s

② **Take triggering by turning [TRIG LEVEL] .**

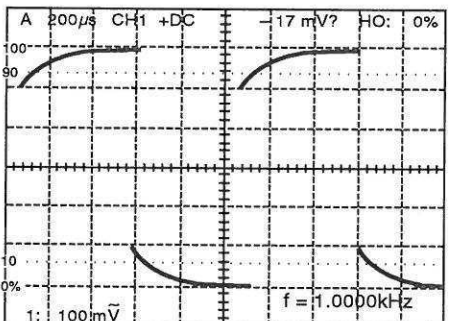
③ **Adjust the waveform by turning the variable capacitor of the probe with a screwdriver.**



← • Correctly compensated waveform



← • Over compensated waveform



← • Under compensated waveform

◇ **Probe sense (display of deflection factor)**

When the probe has a probe sense function, the voltage as compensated by the attenuation ratio of the probe is displayed.

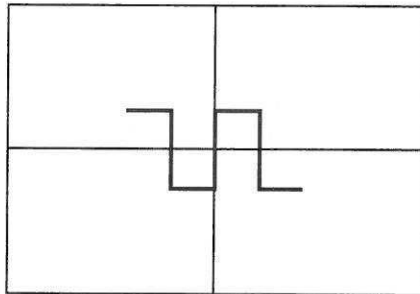
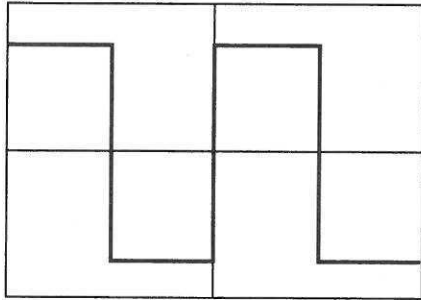
◇ **Releasing the loading effect by a probe**

If a cable, etc. is directly connected to the circuit under measurement, observation may be disturbed by the load applied by the input impedance of the measuring equipment. The input RC of this unit is "1 M Ω , 16 pF." If a 10 : 1 probe is used, the input RC becomes "10 M Ω , 13 pF" and thus the loading effect is largely released enabling the measurement with a high accuracy.

2.3 Adjustment of the screen

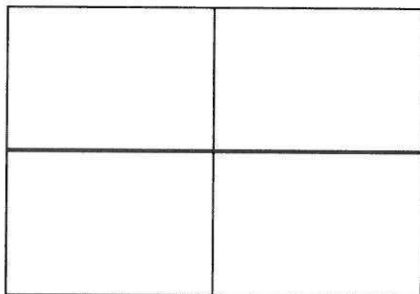
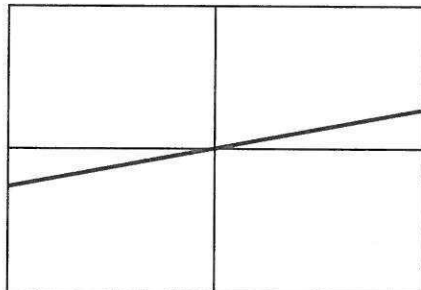
Adjust the brightness (**A INTEN**), displayed characters (**READOUT**), focus (**FOCUS**), intensity of scales (**SCALE**), and rotation of traces (**TRACE ROTATION**).

Operating method



A 5 ms CH 1 + AC

1 : 5 mV



Procedures

- ← ① Adjust the A sweep brightness of traces by turning **[A INTEN]** .

- ← ② Press **[A INTEN (BEAM FIND)]** .
 - Compresses the vertical and horizontal deflection to within the graticule area.
 - Return to the original state after confirmation.

- ← ③ Adjust the brightness of displayed characters by turning **[READ OUT]** .
 - ON/OFF is switched each time **[READ OUT]** is pressed.
- ← ④ Adjust the focus of traces and displayed characters by turning **[FOCUS]** .
- ← ⑤ Adjust graticule illumination by turning **[SCALE]** .
 - Perform step ⑥ and ⑦ if trace is inclining due to earth magnetism, etc.
- ← ⑥ Set the input coupling of CH1 to GND by pressing **[GND]** .

- ← ⑦ Correct the inclination of the trace by turning **TRACE ROTATION** on the front panel with the attached adjustment screwdriver.
 - Return the input coupling to the original setting after correcting the inclination.

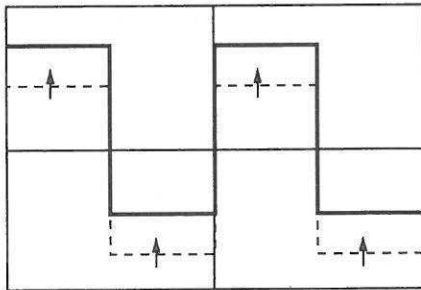
B INTEN

Turn **[B INTEN]** when adjusting the trace intensity of B sweep.
Refer to "2.10 Horizontal Display" for B sweep.

2.4 Vertical and Horizontal Positioning

Adjust the vertical and horizontal positions. This function is used to move the waveform to a position where it can be observed easily or when performing comparative measurement of two or more waveforms by laying one waveform on another.

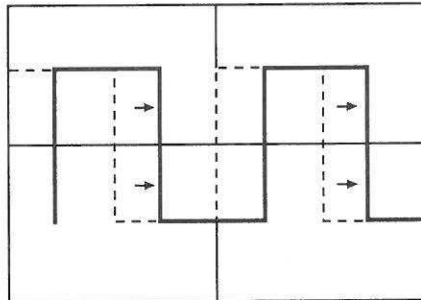
Operating method



Procedures

Moving vertical positions

- ← ① Turn [▲POSITION▼] of CH1 to the right; the waveform moves upward.
- ② Turn [▲POSITION▼] of CH1 to the left; the waveform moves downward.
- ◇ Perform the same operation on CH2 and CH4 as well.



Moving horizontal positions

- ← ① Turn [◀POSITION▶] to the right; the waveform moves to the right.
- ② Turn [◀POSITION▶] to the left; the waveform moves to the left.
- ③ The FINE indicator lights or goes off every time [FINE] is pressed.
 - Fine adjustment is accomplished when [◀POSITION▶] is turned while the FINE indicator is lighted. If [◀POSITION▶] is fully turned in this case, the waveform scrolls. To stop scrolling in the middle, return [◀POSITION▶] slightly.

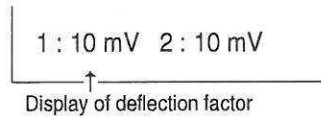
2.5 Vertical Deflection System

2.5.1 Deflection Factor

Set the amplitude of waveform to a size suitable for viewing.

a. CH1 and CH2

Operating method



Procedures

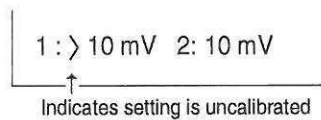
Setting the TIME/DIV

① Select the deflection factor by turning **[VOLTS/DIV]** of CH1.

- The deflection factor can be selected with a range of 2 mV/div to 5 V/div (in 1-2-5 steps).
- The deflection factor is displayed in the lower lefthand corner of the screen.

[Note] Do automatic calibration if traces move upward or downward when the range has been switched (refer to "Section 5. Daily Inspection").

Setting the VARIABLE



② Press **[VOLTS/DIV]** of CH1; the deflection factor is displayed with ">" mark.

- Fine adjustment can be performed using this screen.

③ Turn **[VOLTS/DIV]** of CH1; the deflection factor varies continuously between steps .

- While **[VOLTS/DIV]** is turned, the rough ratio to the original display is displayed.
- To release the variable setting mode, delete ">" by pressing **[VOLTS/DIV]** again.

◇ Perform the same operation on CH2 as well.

b. CH3 and CH4



Procedures

① Select the deflection factor by pressing **100 mV/500 mV** .

- One of the three ranges of 100 mV/div, or 500 mV/div can be selected. Fine adjustment is not available.

◇ Perform the same operation on CH4 as well.

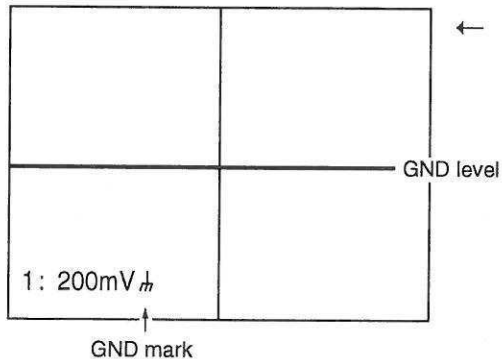
2.5.2 Input coupling

Select a coupling mode suitable for observation according to the type of input signal.

Operating method

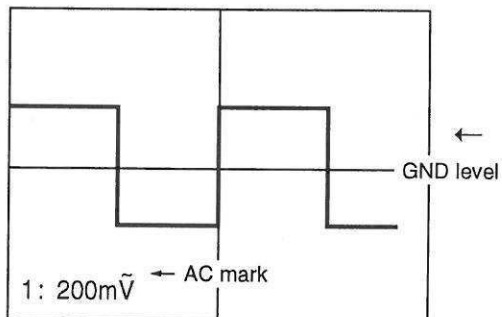
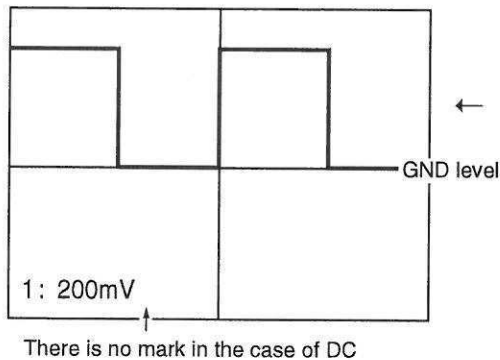
Procedures

Selecting GND



Selecting DC or AC

- ① Set GND to OFF (GND released) by pressing **GND** of CH1.
- ② Set DC or AC by pressing **DC/AC** of CH1.
 - Cannot be set to AC when the input resistance is 50 Ω. When AC is selected the 50 MΩ indicator goes off and the input resistance becomes 1 Ω.
 - Perform the same operation on CH2 as well.



2.5.3 Input resistance

This is the function to select the input resistance.

Operating method

FOR 50 Ω , KEEP ON PRESSING

Procedures

① Select 50 Ω or 1 M Ω by pressing **50 Ω /1 M Ω** .

- To select 50 Ω , keep **50 Ω /1 M Ω** pressed for a while.
- When 50 Ω cannot be selected because the duration of pressing is too short, the message on the left is displayed.
- When 50 Ω is selected, the indicator lights.

[Note] When 50 Ω is selected, the input coupling is automatically set to DC. AC cannot be set.

◇ Use this unit with the input resistance set to 1 M Ω in usual cases.

◇ How to use 50 Ω

- When measuring the signals in a high frequency band, connect this unit and the signal source with a coaxial cable having a characteristic impedance of 50 Ω and set the input resistance of this unit to 50 Ω .
- When the input resistance is set to 50 Ω , the VSWR (voltage standing wave ratio) becomes 1.35 or less, where a waveform with few reflection can be observed.

Cautions

When the input resistance is set to 50 Ω , do not apply too large signals of 5 VRMS or more.

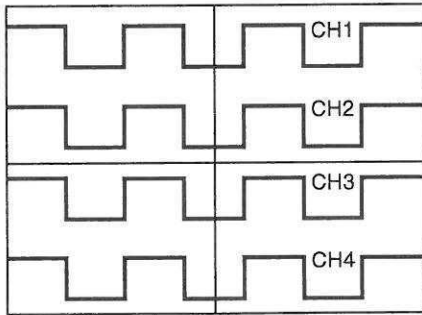
When a DC voltage of ± 10 V or more has been detected, the following message is displayed for safety and the setting changes from 50 Ω to 1 M Ω .

"INPUT OVERLOADED AND REVERTED TO 1 M Ω "

2.5.4 Display channels

Signals input to CH1, CH2, CH3 or CH4 are displayed.

Operating method



1: 10 mV $\tilde{}$

Procedures

① Select ON (display) or OFF (non display) of each channel by pressing **CH1**, **CH2**, **CH3** or **CH4**.

- An example where **CH1**, **CH2**, **CH3** and **CH4** are set to ON is shown on the left.

◇ The signals applied to INPUT of the channels set to ON are displayed on the screen. The signal applied to a channel that is set to OFF disappears from the screen.

◇ The channel No., VOLTS/DIV, and input coupling of the channels set to ON are displayed in the lower left corner of the screen. Those of a channel that is set to OFF disappear from the screen.

[Note] When all channels (CH1, CH2, CH3, CH4 and ADD) are set to OFF, CH1 is displayed.

2.5.5 ALT and CHOP

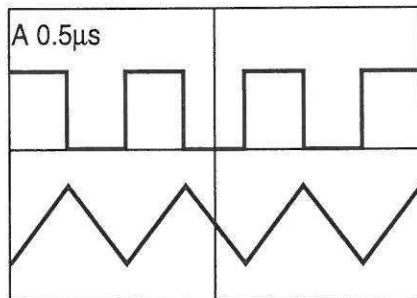
Select the display mode (ALT, CHOP) when two or more channels are displayed.

Operating method

Procedures

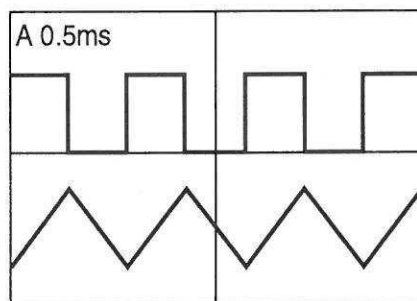
① Select two or more channels from CH1, CH2, CH3 and CH4 (refer to "2.5.4 Display Channels").

② Select ALT or CHOP (the indicator lights) by pressing **ALT CHOP**.



◇ ALT (alternate)

- Two or more input signals are swept alternately.
- This mode is suitable for observing high-frequency signals on two or more channels.



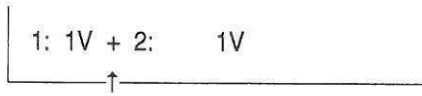
◇ CHOP (chop)

- Two or more input signals are switched at frequency of approx. 555 kHz.
- This mode is suitable for observing low-frequency signals on two or more channels.

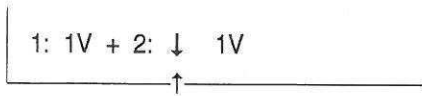
2.5.6 Sum and difference

Add two channels (CH1 + CH2) or subtract one channel from another (CH1 - CH2). Addition or subtraction can be selected by selecting ADD and then setting INV.

Operating method



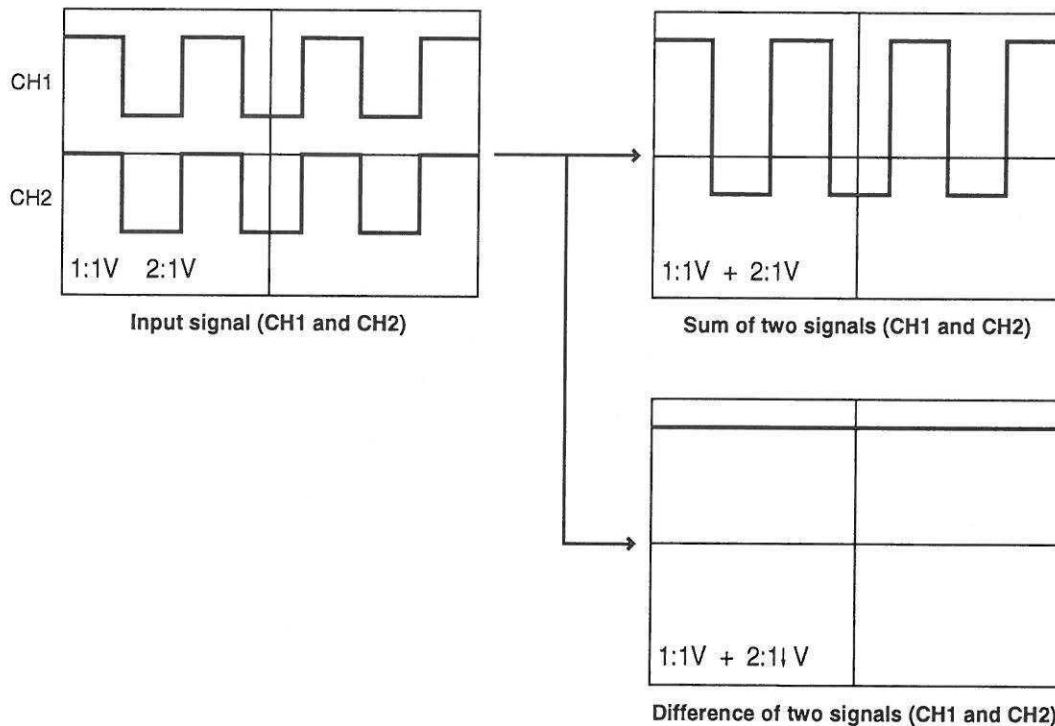
When ADD is set to ON



When CH2 INV is set to ON

Procedures

- ① Set CH1 and CH2 to ON (display) (refer to "2.5.4 Display Channels").
- ← ② Set ADD to ON by pressing **ADD** ("+" is displayed in the lower left corner of the screen).
 - A waveform in which two signals are added (CH1 + CH2) is displayed on the screen.
- ← ③ Set INV to ON by pressing **INV** ("↓" is displayed in the lower left corner of the screen).
 - The polarity of CH2 is inverted and a waveform in which one signal is subtracted from another (CH1 - CH2) is displayed on the screen.



2.5.7 Bandwidth limiter

When observing those signals containing much high-frequency noises, the noises can be suppressed. However the frequency band is limited to about 20 MHz or about 100 MHz.

Operating method



Procedures

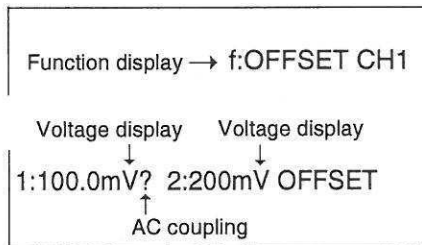
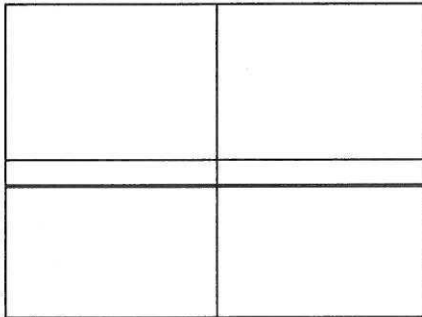
- ① Select 100, 20, or OFF by pressing **BWL**.
 - The bandwidth is displayed in the lower right corner of the screen. There is no display when OFF is selected.
 - 100 : The bandwidth is limited to 100 MHz.
 - 20 : The bandwidth is limited to 20 MHz.
 - OFF : No limitation is imposed on the bandwidth.

2.5.8 Offset

2.5.8.1 CH1/CH2 offset

This is the function to adjust the CH1/CH2 offset voltage.

Operating method



Procedures

Selecting the reference position

① Set GND to ON by pressing **GND** (refer to "2.5.2. Input Coupling").

② Set the reference position for offset by turning **[POSITION]**.

← • An example of setting the reference position is shown on the left.

Selecting the offset voltage

③ Set GND to OFF by pressing **GND**.

④ Select DC by pressing **DC/AC**.

← ⑤ Select OFFSET CH1/CH2 by pressing **OFFSET**.

• Function display changes into f:OFFSET CH1.

← ⑥ Set the offset VOLTAGE (CH1/CH2) by turning **[FUNCTION]**.

• The reference position set in procedure ② becomes the offset voltage value.

• When the input coupling is set to AC, the display is followed by ?.

• The display of trigger level does not include the offset value.

◇ Selecting the object channel

The channel as the object of setting (CH1 or CH2) can be selected by pressing **ATTACH**.

◇ Releasing CH1/CH2 offset

Select OFF (without the display of OFFSET) by pressing **OFFSET**.

FET probe

A probe with an FET attached to the tip is called an active probe.

• This is a probe with a high impedance and low input capacitance.

• When a probe for common oscilloscopes is connected, the circuit under measurement may be affected (such as oscillation) by the input capacitance of the probe. In this case, the effect on the circuit under measurement can be suppressed by the use of an FET probe.

• Main performance of the SPF-5A/4A probe are as follows:

Input impedance : 1 MΩ, approx. 1.9 pF (SFP-5A)/1 MΩ, approx. 2.15 pF (SFP-4A)


Attenuation ratio : 10:1

Bandwidth : DC to 1 GHz (SFP-5A)/DC to 800 MHz (SFP-4A)

2.5.8.2 PROBE P1/P2 offset

This is the function to set the offset voltage of the FET probe to be connected to the PROBE POWER terminal (P1/P2) of this unit.

Operating method

No function display → 

Function display → f:SYS-MENU

PROBE OFFSET DISABLE
ENABLE: [NORM] EXIT: [SGL/RST]

Function display → f:OFFSET P1

Percent display Percent display
↓ ↓
P1:100.0% P2:20.00% OFFSET

Procedures

Selecting on SYS-MENU

- ← ① **Set all function to OFF and set the [FUNCTION] key to the invalid state *1.**
*1 The state where f:XXXXX is not displayed on the upper right corner of the screen.
- ← ② **Select OFF (non-display) by pressing [READOUT] .**
- ← ③ **Press [FUNCTION] for 3 sec, then the system menu (SYS-MENU) is displayed.**
- ← ④ **Select PROBE OFFSET by turning [FUNCTION] .**
- The message on the left is displayed at the center of the screen.
 - ENABLE/DISABLE can be switched alternately by pressing [NORM] .
ENABLE : The offset voltage can be set.
DISABLE : The offset voltage cannot be set.
- ← ⑤ **Select ENABLE by pressing [NORM] .**

Releasing SYS-MENU

- ← ⑥ **Release the system menu by pressing [SGL/RST] .**

Setting PROBE offset

- ← ⑦ **Select OFFSET P1/P2 by pressing [OFFSET] twice.**
- Function display changes into f:OFFSET P1.
- ← ⑧ **Set the offset voltage (P1/P2) by turning [FUNCTION] .**
- This is the ratio (%) to the offset variable range of the FET probe.
 - This is valid with the SFP-5A/4A probe made by Iwatsu.

◇ Selection of the object terminal

The terminal as the object of setting (P1 or P2) can be selected by pressing [ATTACH] .

- ◇ **Once procedures ① to ⑥ have been performed, they may be omitted on the next and following occasions. The settings are maintained after power has been turned off.**

- ◇ **Refer to page 20 for the FET probe.**

2.6 A Sweep and B Sweep

This is the function to select A sweep or B sweep.

Operating method

Procedures

① Select A or B by pressing **[A B]**.

- The indicator lights when B is selected.

A : For setting the sweep rate and trigger for normal sweep

B : For setting the sweep rate and trigger for delayed sweep

	Sweep rate	Signal source	Slope	Coupling	Level
A	5ms	CH1	+	DC	200mV
B	1ms	CH1	-	AC	20mV

← ◇ Select A for setting the following items.

- A sweep rate
- Trigger signal source for A trigger
- Trigger slope for A trigger
- Trigger coupling for A trigger
- Trigger level for A trigger

A	5ms	CH1	+	DC	200mV
B	1ms	CH1	-	AC	20mV

↑ Signal source ↑ Slope ↑ Coupling ↑ Level

Sweep rate

← ◇ Select B for setting the following items.

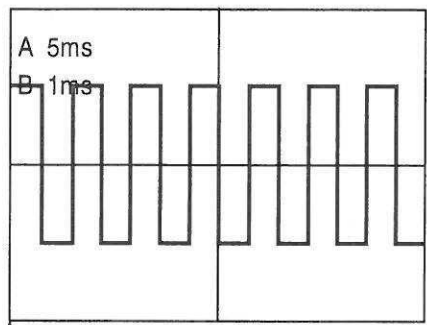
- B sweep rate
- Trigger signal source for B trigger
- Trigger slope for B trigger
- Trigger coupling for B trigger
- Trigger level for B trigger

2.7 Sweep Rate and Magnification

2.7.1 Sweep Rate

Select the sweep rate (TIME/DIV) of A sweep or B sweep.

Operating method



Sweep start point (for magnification/reduction reference point)

Procedures

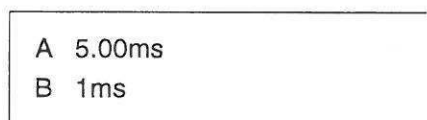
Selecting *A/B sweep*

- ① Select A sweep or B sweep (the indicator lights) by pressing **A B**.

Setting the TIME/DIV

- ② Select the sweep rate by turning **[TIME/DIV]**.

- The sweep rate is displayed in the upper lefthand corner of the screen.
- The waveform is magnified or reduced on the basis of the sweep start point.
- Proceed to step ③ for performing fine adjustment (on A sweep rate alone).



Setting the VARIABLE

- ③ Press **[TIME/DIV]**; the uncalibrated ">" sweep rate is displayed in the upper left corner of the screen.

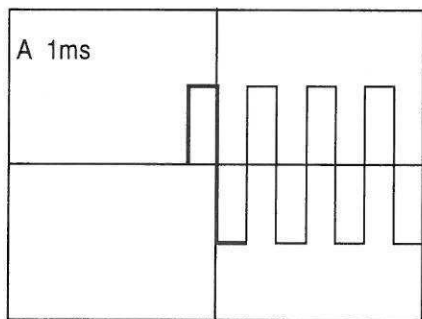
- ④ Turn **[TIME/DIV]**; the sweep rate varies continuously between steps.

- "VAR LIMIT" is displayed when the set value reaches the maximum or minimum value.
- To release the variable setting mode, press **[TIME/DIV]** again to delete ">".

2.7.2 Magnification (MAG x 10)

Magnify the waveform by 10 times as the reference on the center line.

Operating method



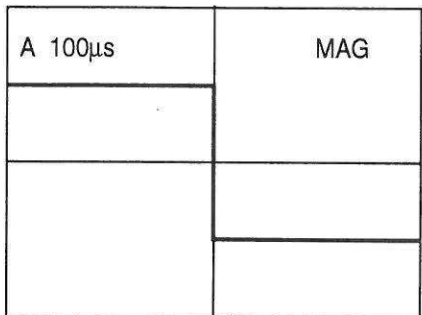
Center line (magnification reference point)

Procedures

- ① Set the sweep rate using **[TIME/DIV]**. (refer to "2.7.1 Sweep Rate").

- ② Set the position of the waveform to be magnified to the center of the screen.

- The portion indicated by thick lines is magnified.



- ③ Press **MAG x 10**.

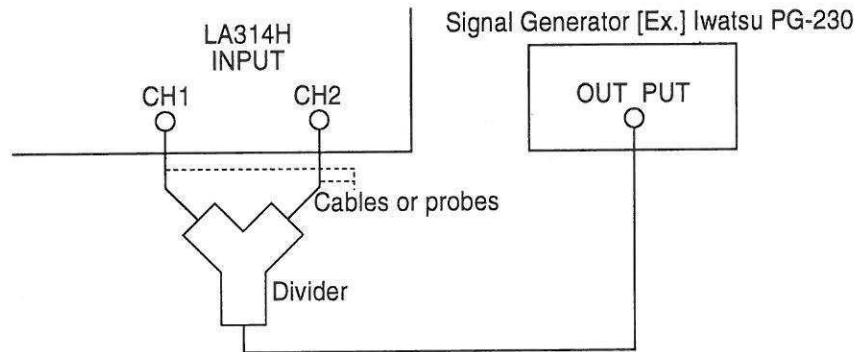
- The sweep rate is increased by 10 times and the waveform is magnified to the left and right from the center line of the screen.
- MAG is displayed in the lower right corner of the screen.

2.7.3 CH2 Delay Adjust (CH2 DLY)

When measuring the time difference between two channels (CH1 and CH2), preliminary adjustment of the time lag between channels enables highly accurate measurement. The lag of delay time including the two connection cables or probes can also be adjusted.

Connection

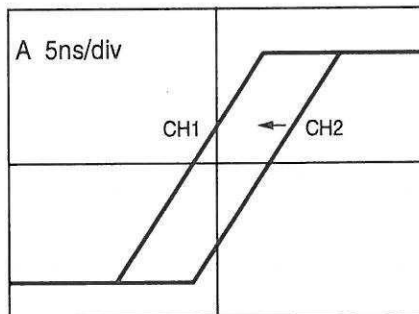
Connect cables as follows:



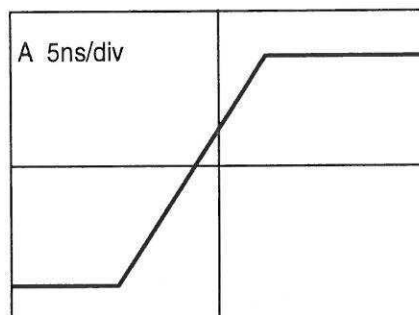
Operating method

Procedures

- ① Turn on the display of CH1 and CH2.
- ② Connect a pulse with a rise time faster than 5 ns to both channels.
- ③ Set A sweep rate to 5 ns/div or 500 ps/div (x 10 MAG ON).
- ④ Select ALT by simultaneously pressing **A** and **B** of HORIZ DISPLAY.
 - The screen displays A sweep alone.
- ⑤ Adjust the waveform of CH2 to that of CH1 by turning **[FUNCTION]**.



← ◇ **Waveform before the adjustment**
Adjust the waveform of CH2 to that of CH1.



← ◇ **Waveform after the adjustment**

2.8 Sweep Mode

Select the sweep mode (AUTO, NORM, or SINGLE).

2.8.1 Repetitive sweep

Select AUTO or NORM.

Operating method

Procedures

① **Select repetitive sweep by pressing **AUTO** or **NORM** in the SWEEP MODE.**

- The AUTO indicator lights when AUTO is selected and NORM indicator, when NORM is selected.
- If triggering is not set, set triggering by adjusting **TRIG LEVEL** , etc.
Refer to “2.9 Triggering” for details.

AUTO (automatic sweep)

- Take triggering by adjusting the trigger level. If no triggering is set, automatic sweep takes place.
- When the frequency of the trigger signal is approx. 10 Hz or less at a sweep time between 500 ms and 10 ms/DIV, or approx. 50 Hz or less at a sweep time of 5 ms/DIV or more, triggering may become unstable. In this case, take triggering by NORM.

NORM (normal sweep)

- Take triggering by adjusting the trigger level. If no triggering is set, no sweep occurs.
- Only when the trigger source is CH1 or CH2 and the input coupling is GND at the same time, automatic sweep takes place.
With this function, the position of GND can be confirmed easily.

2.8.2 Single sweep

Select single sweep.

Operating method

Procedures

① **Select single sweep by pressing **SGL/RST** in the SWEEP MODE (the SGL/RST indicator lights).**

- The READY indicator lights to indicate the state waiting for signal input.
- ◇ Sweep is effected once when a trigger signal is generated.
 - The READY indicator goes off.
 - In the CHOP mode, all channels are swept simultaneously.
 - In the ALT mode, only one channel is swept.

② **To perform another single sweep, press **SGL/RST** again.**

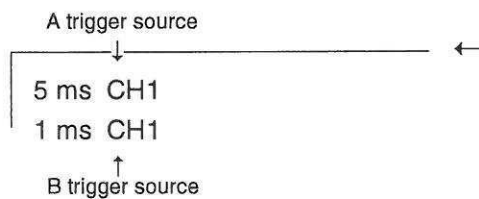
2.9 Triggering

This is the operation to enable observation of input signals in a stable state on the screen.

2.9.1 Trigger Source

Select the trigger source.

Operating method



Procedures

① Select A sweep or B sweep (the indicator lights) by pressing **AB**.

- B trigger is set when performing a delayed sweep (refer to "2.12 Delayed Sweep").

② Select the trigger source (CH1, CH2, CH3, or LINE) by pressing **SOURCE**.

- Line is for A sweep alone.

CH1 : Use the signal input to CH1 as the trigger source.

CH2 : Use the signal input to CH2 as the trigger source.

CH3 : Use the signal input to CH3 as the trigger source.

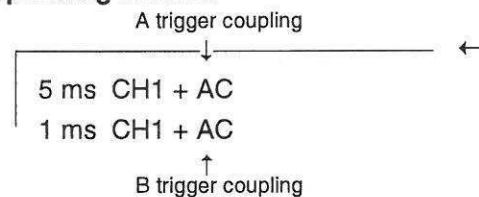
CH4 : Use the signal input to CH4 as the trigger source.

LINE (for A sweep alone) : The power source is used as the trigger source. This is suitable for observation of signals triggered with the power frequency.

2.9.2 Trigger Coupling

Select the trigger coupling.

Operating method



Procedures

① Select A sweep or B sweep (the indicator lights) by pressing **AB**.

- B trigger is set when performing a delayed sweep (refer to "2.12 Delayed Sweep").

② Select the trigger coupling (AC, DC, HF REJ, or LF REJ) by pressing **COUPL**.

AC : Blocks the DC component of the trigger signal. The lower limit of frequency is 100 Hz.

DC : Pass all the signal components.

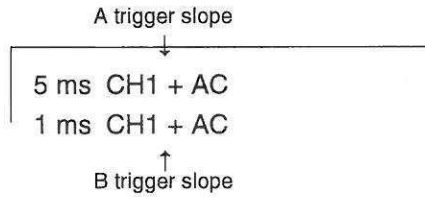
HF REJ : Attenuates the high frequency component (above 10 kHz). This mode is used when high-frequency noises are contained in the trigger source and the trigger may become unstable due to such noises.

LF REJ : Attenuates the low frequency component (below 10 kHz). This mode is used when low-frequency noises (hum of power frequency, etc.) are contained in the trigger source and the trigger may become unstable due to such noises.

2.9.3 Trigger Slope (SLOPE)

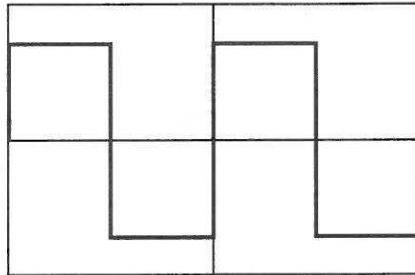
Select the trigger slope.

Operating method

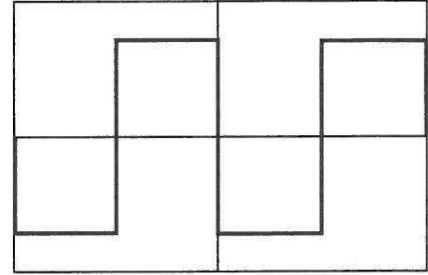


Procedures

- ① Select A sweep or B sweep (the indicator lights) by pressing **AB**.
 - B trigger is set when performing a delayed sweep (refer to "2.12 Delayed Sweep").
- ② Select the slope (+ or -) by pressing **SLOPE**.



+
(Sweep starts at the rising edge of the waveform.)

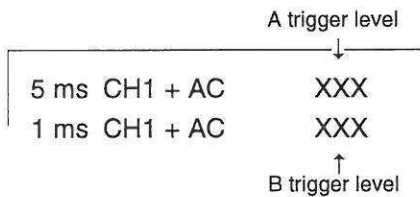


-
(Sweep starts at the falling edge of the waveform.)

2.9.4 Trigger Level

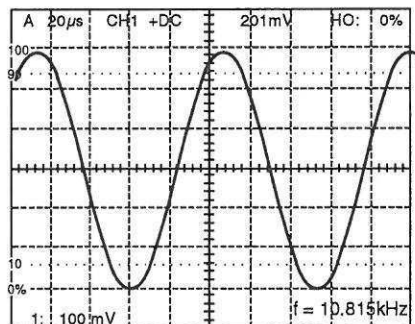
Adjust the amplitude point on the trigger level.

Operating method

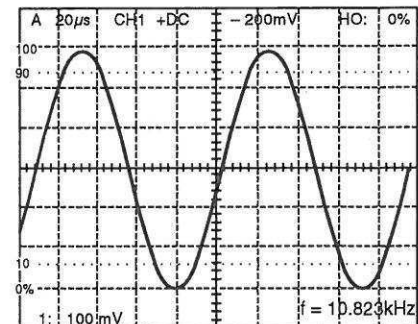


Procedures

- ① Select A sweep or B sweep (the indicator lights) by pressing **AB**.
 - B trigger is set when performing a delayed sweep (refer to "2.12 Delayed Sweep").
- ② Adjust the trigger level by tuning **TRIG LEVEL**.
 - The TRIG'D indicator lights when the trigger signal is generated.
 - Sometimes "?" is displayed to the right of the value displayed. This indicates that direct reading is impossible if AC coupling or VARIABLE is set.



Turning **TRIG LEVEL** to right from the midrange



Turning **TRIG LEVEL** to left from the midrange

2.9.5 TV Signal

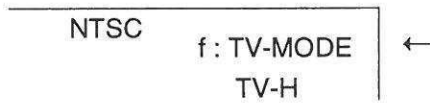
2.9.5.1 TV signal modes and the number of lines

This is the function to set the TV signal mode and the number of lines.

Operating method

Procedures

- ① Select the TV trigger mode (BOTH, ODD, EVEN, or TV-H) by pressing **TV**.

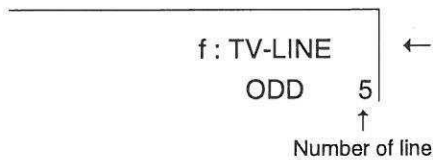


◇ When TV-H is selected

- The function display changes into f:TV-MODE.

- ② Select NTSC, PAL (SECAM), or HDTV by turning **FUNCTION**.

- Refer to "Table 2.9.1 TV modes and their features" for the details of TV modes.



◇ When BOTH, ODD, or EVEN is selected

- The function display changes into f:TV-LINE.

- ③ Select the line number by turning **FUNCTION**.

- Coarse adjustment in the direction it has so far been turned can be effected each time **FUNCTION** is pressed or when it is pressed continuously.
- The allowable range of setting is shown in "Table 2.9.2 Number of lines that can be set".
- Operate the procedure ③ when ODD or EVEN is selected.

- ④ Select either ODD or EVEN by pressing **COUPL**.

- ODD and EVEN waveform can be observed on the field by switching them mutually while selecting the line number.

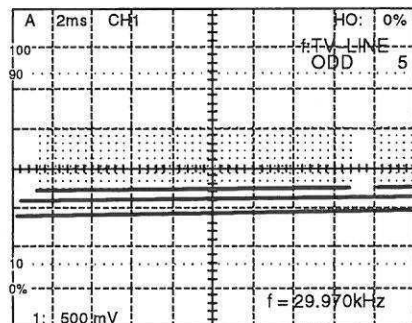
ODD : Triggering is set by selecting the number of horizontal synchronization signal from the vertical synchronization signals of odd-numbered fields.

EVEN : Triggering is set by selecting the number of horizontal synchronization signal from the vertical synchronization signals of even-numbered fields.

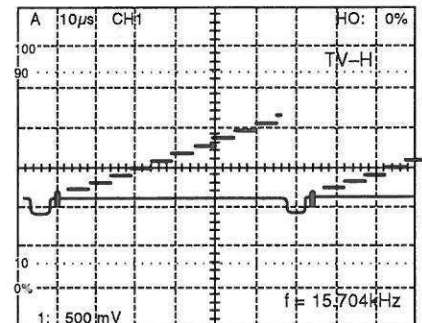
BOTH : Triggering is set by selecting the number of horizontal synchronization signal from the vertical synchronization signals of odd-numbered or even-numbered fields.

TV-H : Triggering is set on a horizontal synchronization pulse.

OFF : The TV mode is released.



Triggering on a vertical synchronization pulse



Triggering on a horizontal synchronization pulse

Table 2.9.1 TV modes and their features

Mode	Number of scanning lines	Field frequency	Video signal bandwidth	Countries in which the mode is used	Remarks
NTSC	525	Approx. 60 Hz	4.2 MHz	U.S.A., Canada, Japan	
SECAM	625	Approx. 50 Hz	6 MHz	France, Russia	
PAL	625	Approx. 50 Hz	5 MHz	Europe, etc.	
HDTV	1125	Approx. 60 Hz	20 MHz		High definition type

Table 2.9.2 Number of lines that can be set

Mode	Number of lines		
	BOTH	ODD	EVEN
NTSC	1 to 525	1 to 263	264 to 525
PAL (SECAM)	1 to 625	1 to 313	314 to 625
HDTV	1 to 1125	1 to 563	564 to 1125

[Note] NTSC displays with the M mode and PAL (SECAM), with other modes than M.
 M mode : Sequential numbers are assigned to scanning lines beginning with that just after the start of the vertical blanking period of each field.
 Other modes than M : The start point is set to the beginning of the vertical synchronizing signal of the first field.

2.9.5.2 TV Clamp

This is the function to clamp the back porch section of composite signals to the reference level (ground level). This procedure enables stable observation of those TV signals of which the average voltage fluctuates.

Operating method

Procedures

- ① Select the Formats by pressing **TV** .
 - Refer to “2.9.5.1 TV signal modes and the number of lines” for TV modes.
- ② Select the clamp (CLAMP CH1, CLAMP CH2, OFF) by pressing **EVENT/TV CLAMP** .
 - The selected clamp is displayed at the bottom of the screen.
 Shows the example of CLAMP CH1.
 CLAMP CH1 : CH1 is clamped.
 CLAMP CH2 : CH2 is clamped.
 OFF : Clamp is released.

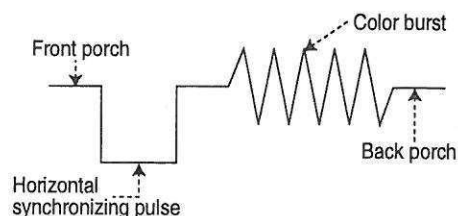


[Note 1] During the V synchronizing period of HDTV, waveform may be distorted due to the disabled clamp operation.

[Note 2] The reference level may not become stable if the TV signals are not synchronized.

Back porch

The position of the back porch is shown in the figure on the right. Because the waveform is displayed with its back porch clamped to the ground level, a stable observation of fluctuating signals can be obtained.



2.9.6 Event Trigger

This is the function to select the event trigger (count or burst).

Operating method

Procedures

① **Set the Formats to OFF.**

- Refer to “2.9.5.1 TV signal modes and the number of lines” for the setting method.

② **Select COUNT, BURST, or OFF by pressing**

EVENT/TV CLAMP.

- Operations in and after procedure ③ vary depending on the item selected.

f:EVENT
COUNT nnnn



When COUNT was selected

- Function display changes into f:EVENT.

③ **Set the number of counts by turning [FUNCTION] .**

- The range of the number of counts that can be set is 1 to 65535.
- Refer to the following page for the details of count trigger.

f:EVENT
BURST n.nns



When BURST was selected

- Function display changes into f:EVENT.

④ **Set the Burst signal interval by turning [FUNCTION] .**

- The range of the time that can be set is 0.18 μ s to 9.99 s.
- Refer to the following page for the details of burst trigger.



When OFF was selected

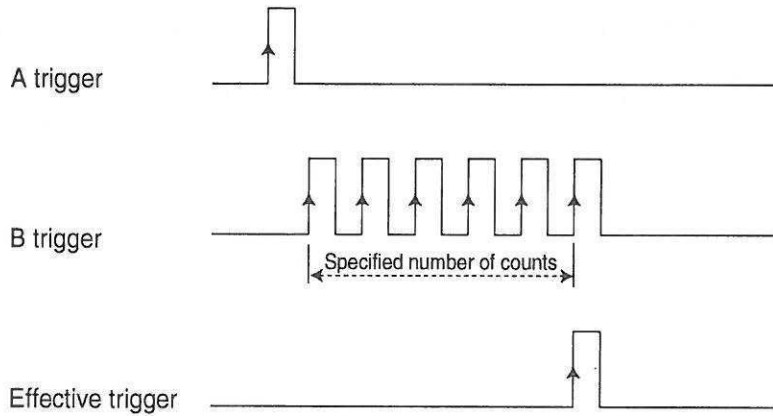
- Function display does not appear.

Count

Triggering is set when the specified number of B trigger signals have been counted after the occurrence of A trigger.

This function is suitable for confirming the operation of a counter circuit and so on.

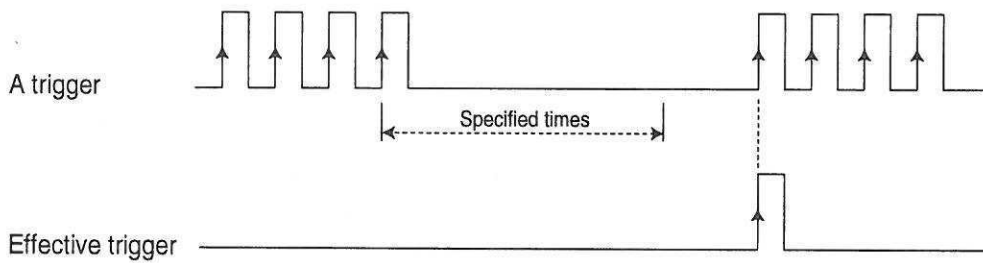
[Example] An example where the count is set to 6 is shown in the figure below.



Burst

When the time interval of A trigger exceeds the specified length of time, the next A trigger is deemed as the effective trigger.

This function is suitable for observing a burst waveform.



2.10 Horizontal Display

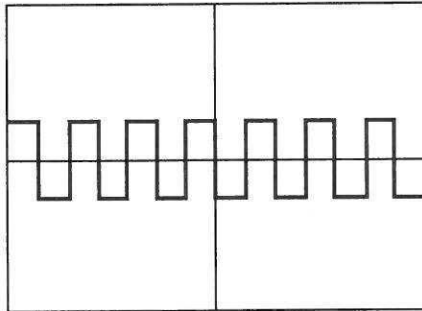
Select the horizontal display.

Operating method

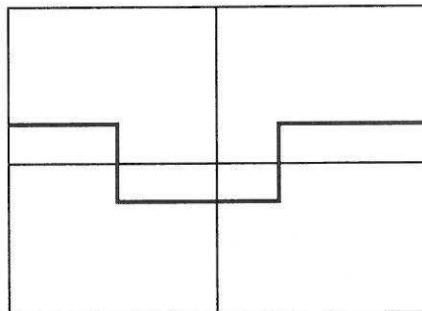
Procedures

① Select A, B, ALT, or X-Y by pressing [A], [B], or [X-Y] in the HORIZ DISPLAY mode.

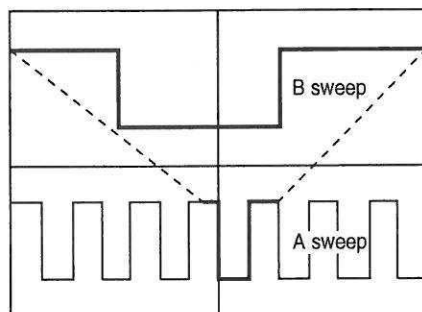
- To select ALT, press [A] and [B] simultaneously.



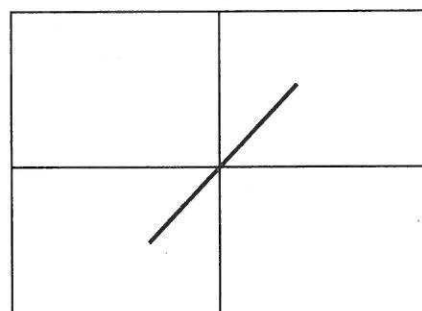
← ◇ A
A sweep is displayed.



← ◇ B
• B sweep (magnified waveform in ALT) is displayed.
• Refer to "2.12 Delayed Sweep" for details.



← ◇ ALT
• A sweep (not magnified waveform) and B sweep (magnified waveform) are displayed simultaneously.
• Refer to "2.12 Delayed Sweep" for details.
• Vertical position of B sweep can be adjusted. B sweep is moved upward with respect to A sweep (refer to "2.11 Trace Separation").



← ◇ X-Y
• An X-Y display in which CH1 input is taken on the X axis and each channel (CH1, CH2, CH3, CH4, ADD) is taken on the Y axis is obtained.
• This mode is used for observation of hysteresis curves, Lissajous waveforms, etc.

2.11 Trace Separation

During ALT sweep, move the B-sweep waveform to a position suitable for observation.

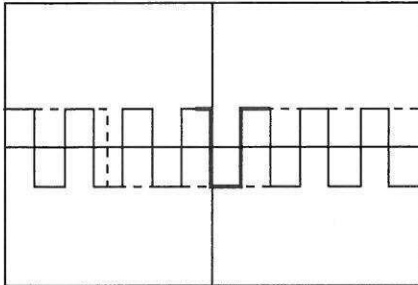
Operating method

Procedures

Selecting ALT sweep

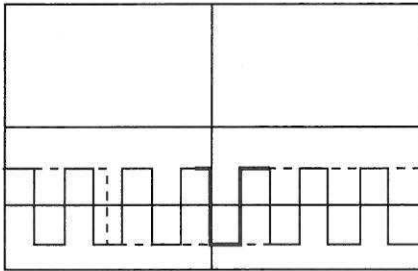
① Select ALT by pressing **[A]** and **[B]** in the **HORIZ DISPLAY** mode.

- A-sweep waveform and B-sweep waveform are displayed so that one is laid upon the other.
- A sweep: ————
B sweep: - - - - -



Moving the position of A and B waveform

② Move the position of waveform to the lower area of the screen by turning **[ΔPOSITION]**.



Selecting TRACE SEP

③ Select **TRACE SEP** by pressing **[DELAY/TRACE SEP]**.

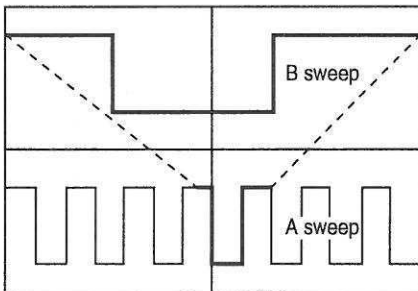
- The function display changes into **f : TR-SEP**.

Function display → f : TR-SEP

Moving B waveform

④ Move the vertical position of the B-sweep waveform by turning **[FUNCTION]** (only upward movement is available).

- Coarse adjustment in the direction it has so far been turned can be effected each time **[FUNCTION]** is pressed or when it is pressed continuously.



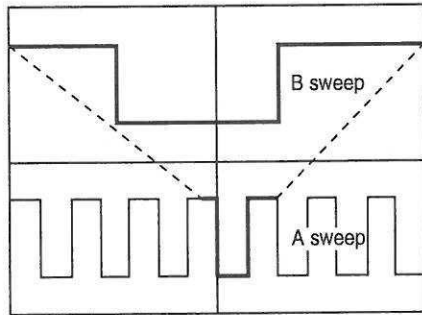
2.12 Delayed Sweep

Select the delayed sweep mode (continuous delay, triggered delay).

2.12.1 Continuous Delay

B sweep starts after a specified delay time has elapsed from the sweep start point of A sweep. The desired portion of the waveform displayed can be displayed in magnified form. This function is valid when HORIZ DISPLAY is set to ALT or B.

Operating method



Procedures

Selecting ALT sweep

① Select ALT by pressing **A** and **B** in the HORIZ DISPLAY mode.

- A sweep and B sweep are displayed.
- The intensity-modulated portion of A sweep (in the lower area of the screen) is magnified and displayed as B sweep (in the upper area of the screen).
- A sweep and B sweep are separated from each other for convenience of explanation. For the method of separation, refer to "2.11 Trace Separation".

Selecting the B-sweep rate

② Select B by pressing **A B** (the B indicator lights).

③ Select the B-sweep rate by turning **[TIME/DIV]**.

- The ratio between A sweep and B sweep varies.
- The B-sweep rate cannot be set to a value slower than the A-sweep rate.

Selecting of continuous delay

④ Select the screen with no display of trigger source B by pressing **SOURCE**.

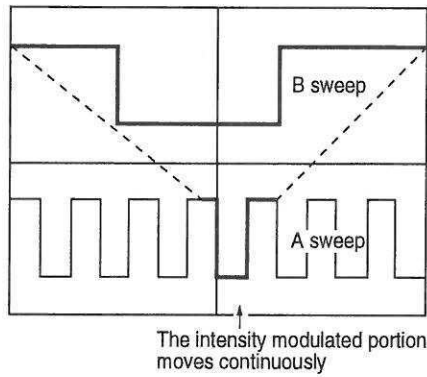
Selecting the delay time

⑤ Select DELAY by pressing **DELAY/TRACE SEP**.

- Function display changes into f : B-DELAY

A 5ms CH1 + DC A level
 B 1ms ↑ - AC B level
 No display of trigger source B

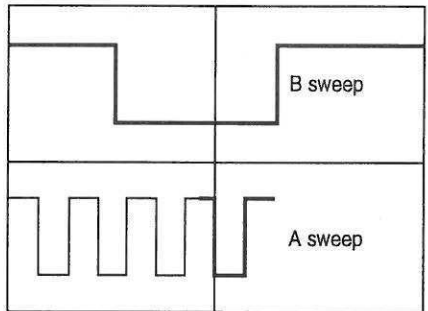
Delay time → DLY nnn
 Function display → f : B-DELAY



- ← ⑥ **Adjust the delay time by turning [FUNCTION] .**
- Coarse adjustment in the direction it has so far been turned can be effected each time [FUNCTION] is pressed or when it is pressed continuously.
 - Proceed to step ⑦ when performing B ENDS A.

Selecting B ENDS A

- ⑦ **Select [HOLDOFF] by pressing HOLDOFF.**
- For details of HOLDOFF, refer to "2.13 Holdoff".



- ← ⑧ **Set the hold-off time to a value larger than 100% by turning [FUNCTION] ; the B ENDS A mode is set.**
- B ENDS A
The portion of A sweep following the intensity-modulated portion (B sweep) is deleted. The frequency of sweep increases in proportion to the length of the deleted time and the intensity increases.

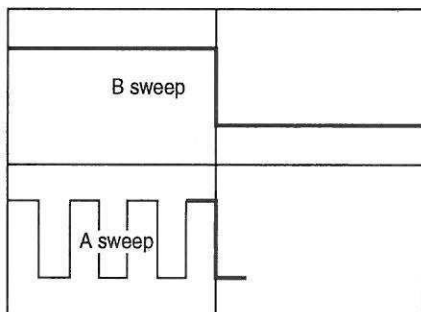
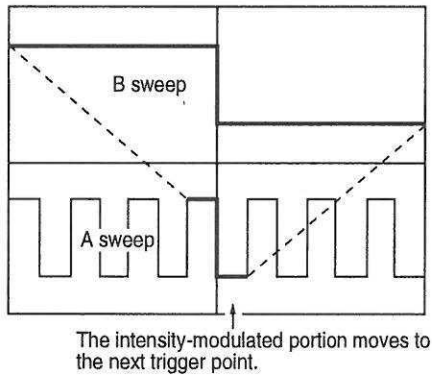
2.12.2 Triggered Delay

B sweep starts at the trigger point of B sweep after a specified delay time set from the sweep start point of A sweep. Although the delay pick off jitter can be reduced in this mode, the start point of B sweep is limited to the B trigger point.

Operating method

```
A 5ms CH1 + DC A level
B 1ms CH1 - AC B level
      ↑
      Trigger source B
```

```
Delay time → DLY>nnn
Function display → f : B-DELAY
```



Procedures

① to ③ Same as those in “2.12.1 Continuous Delay”.

Selecting of trigger delay

← ④ Select trigger source B by pressing **[SOURCE]**.

Triggering of B sweep

⑤ Take triggering of B sweep.

- The method for taking triggering is the same as that for A sweep (refer to “2.9 Triggering”).

Selecting the delay time

← ⑥ Select **DELAY** by pressing **[DELAY/TRACE SEP]**.

- Function display changes into f : B-DELAY.

← ⑦ Adjust the delay time by turning **[FUNCTION]**.

- Coarse adjustment in the direction it has so far been turned can be effected each time **[FUNCTION]** is pressed or when it is pressed continuously.
- Although the DLY value varies continuously in the case of trigger delay, it is not in accord with the actual delay time. “<” is attached to the DLY value.
- Proceed to step ⑧ when performing B ENDS A.

Selecting B ENDS A

← ⑧ Select **HOLDOFF** by pressing **[HOLDOFF]**.

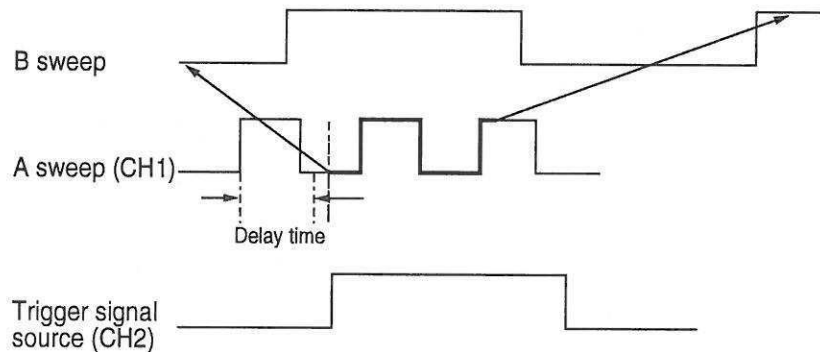
- For details of HOLDOFF, refer to “2.13 Holdoff”.

← ⑨ Set the hold-off time to a value larger than 100% by turning **[FUNCTION]**; the B ENDS A mode is set.

- B ENDS A

The portion of A sweep following the intensity-modulated portion (B sweep) is deleted. The frequency of sweep increases in proportion with the length of the deleted time and the intensity increases.

The figure below shows the time relations for the case where CH2 is specified as the trigger source for B sweep in the triggered delay mode.



2.13 Holdoff

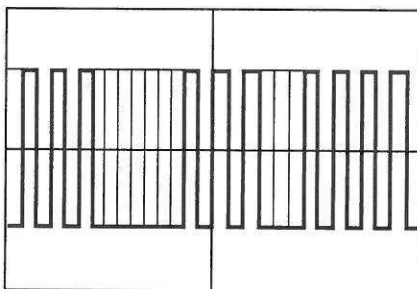
Sometimes triggering cannot be set in a stable manner when observing a pulse train made of complex combinations. In this case, adjust the holdoff (sweep pause) time so that a stable waveform can be obtained.

Operating method

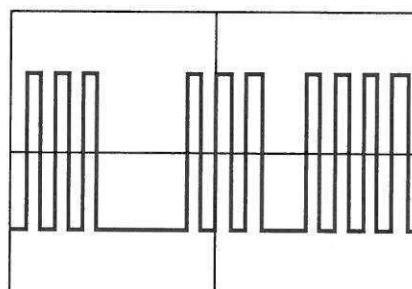
HO : nn%
f : HOLDOFF

Procedures

- ① **Select HOLDOFF by pressing **HOLDOFF**** .
 - Function display changes into f : HOLDOFF.
- ② **Adjust the holdoff time by turning **FUNCTION**** .
 - Coarse adjustment in the direction it has so far been turned can be effected each time **FUNCTION** is pressed or when it is pressed continuously.
 - The holdoff time becomes the maximum value (100%) when **FUNCTION** is fully turned clockwise, and the minimum value (0%) when fully turned counterclockwise.
 - Usually, the holdoff time is set to 0%.



Waveform before adjustment (duplicated display)



Waveform after adjustment

Adjustment of the hold-off (sweep halting) time

Adjust the interval from a trigger point to the waiting start point of the next trigger (hold-off time) so as to prevent any triggering from being set by an unnecessary pulse.

Section 3. Cursors Measurement and Counter

Measure the time difference and frequency (Δt , $1/\Delta t$) or voltage difference (ΔV) using cursors.

◇ Selecting of the measurement item

- Select ΔV (voltage measurement) by pressing ΔV or select Δt (time measurement) by pressing Δt .

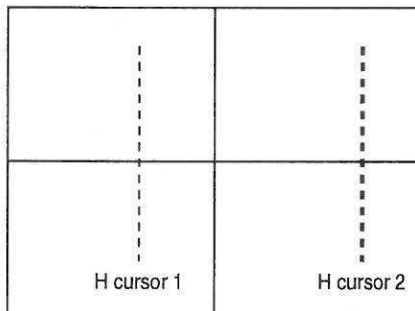
◇ Methods for measurement using cursors.

- When Δt or ΔV has been selected, two cursors for measurement are displayed.
- Adjust the cursor positions by turning **[FUNCTION]**. Coarse adjustment in the direction it has so far been turned can be effected each time **[FUNCTION]** is pressed or when it is pressed continuously.

3.1 Time Difference (Δt) and Frequency ($1/\Delta t$) Measurement

Measure the time difference (Δt) and frequency ($1/\Delta t$) between the cursors.

Operating method



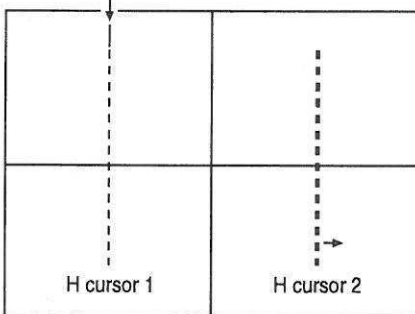
Procedures

- ← ① Select Δt by pressing Δt .
 - H cursor 1 and H cursor 2 are displayed.
 - The results of measurement of Δt (time difference) and $1/\Delta t$ (frequency) between cursor 1 and cursor 2 are displayed in the lower left corner of the screen.
 - Move cursor 1 and cursor 2 to the measurement points and then perform measurement.


Setting cursor 1

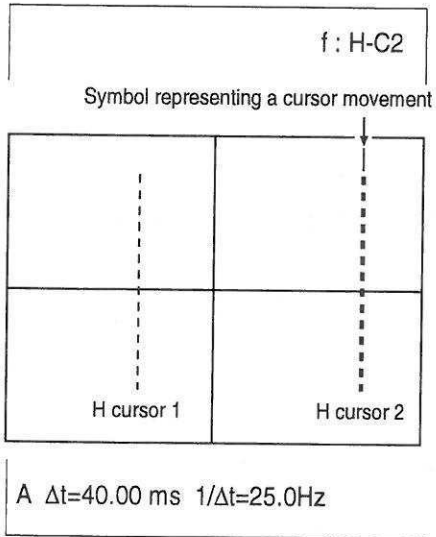
- ← ② Select C1 (cursor 1) by pressing **TCK/INDEP**.
 - The function display changes into f : H-C1.

Symbol representing a cursor movement



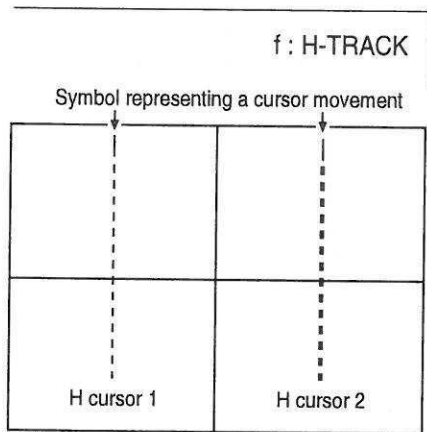
- ← • Symbol "I" displayed above H cursor 1 indicates that H cursor 1 is movable.

- ← ③ Move H cursor 1 (I) to the other measurement point by turning. 



Setting cursor 2

- ← ④ **Select C2 (cursor 2) by pressing TCK/INDEP** .
- The function display changes into f : H-C2.
- ← • Symbol "I" appears above H cursor 2 indicating that cursor 2 is movable.
- ← ⑤ **Move H cursor 2 (I) to the other measurement point by turning [FUNCTION]** .
- ← • The results of measurement of Δt (time difference) and $1/\Delta t$ (frequency) between newly set cursor 1 and cursor 2 are displayed in the lower left corner of the screen.



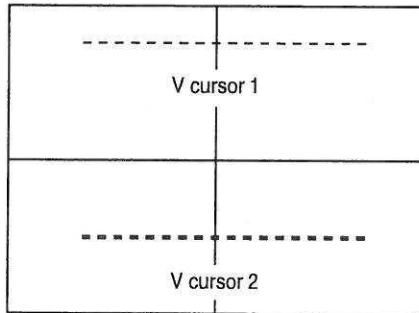
Setting the tracking

- ← ⑥ **Select TCK (tracking) by pressing TCK/INDEP** .
- Function display changes into f:H-TRACK.
- ← • Symbol "I" appears above H cursor 1 and H cursor 2 indicating that both cursors are movable.
- ⑦ **Turn [FUNCTION] , then H cursor 1 and H cursor 2 move together while maintaining the interval between them.**
- ◇ **Releasing Δt measurement**
 Select OFF (no cursor display) by pressing Δt .

3.2 Voltage Difference (ΔV) Measurement

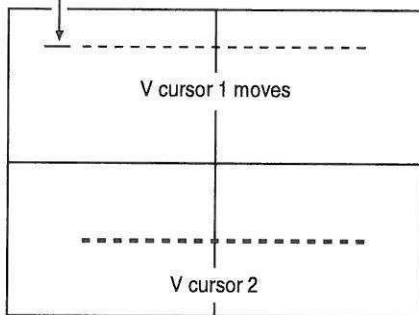
Measure the voltage between the cursors.

Operating method

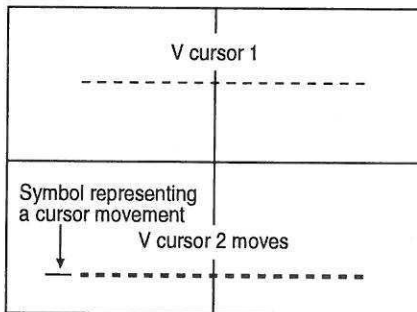


f : V-C1

Symbol representing a cursor movement



f : V-C2



$\Delta V1=59.2 \text{ mV}$ $\Delta V2=-0.592 \text{ Hz}$

Procedures

← ① Select ΔV by pressing ΔV .

- V cursor 1 and V cursor 2 are displayed.
- The results of measurement of $\Delta V1$ (CH1) and $\Delta V2$ (CH2) between cursor 1 and cursor 2 are displayed in the lower lefthand corner of the screen.
- Move cursor 1 and cursor 2 to the measurement points and then perform measurement.

Setting cursor 1

← ② Select V-TRACK by pressing TCK/INDEP.

- The function display changes into f : V-C1.

← • Symbol “—” appears to the left of V cursor 1 indicating that V cursor 1 is movable.

← ③ Move V cursor 1 (----) to a measurement point by turning [FUNCTION].

- V cursor 1 and V cursor 2 move simultaneously.

Setting cursor 2

← ④ Select f : V-C2 by pressing TCK/INDEP.

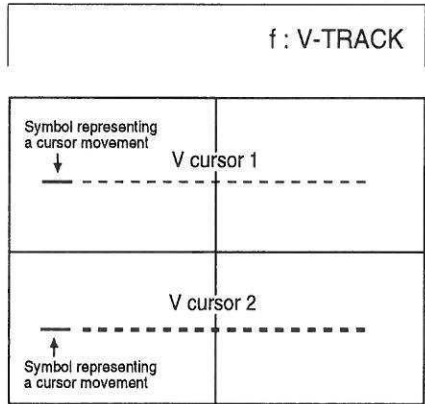
- The function display changes into f : V-C2.

← • Symbol “—” appears to the left of V cursor 2 indicating that V cursor 2 is movable.

← ⑤ Move V cursor 2 (----) to the other measurement point by turning [FUNCTION].

- The results of measurement of the voltage differences between the newly set cursors are displayed in the lower lefthand corner of the screen.

- When two or more channels of waveforms are displayed, select the channel to measure by pressing ATTACH.



Setting the tracking

- ← ⑥ **Select TCK (tracking) by pressing TCK/INDEP .**
 - Function display changes into f:V-TRACK.
- ← • Symbol “I” appears to the left of V cursor 1 and V cursor 2 indicating that both cursors are movable.
- ⑦ **Turn [FUNCTION] , then V cursor 1 and V cursor 2 move together while maintaining the interval between them.**

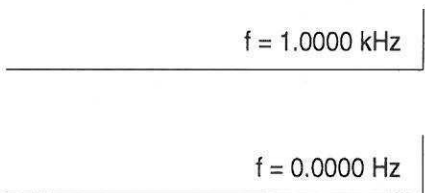
◇ Release ΔV measurement

Select OFF (no cursor display) by pressing ΔV .

3.3 Counter

Measure the frequency of the input signal on the counter.

Operating method



Procedures

- ① **Take A triggering (refer to “2.9 Triggering”)**
 - When A triggering is set, the result of measurement is constantly displayed in the lower righthand corner of the screen.
 - The specified A trigger source is the object of measurement.
 - The measurement range is 2 Hz to 400 MHz.
 - When A triggering is not set or the input signal exceeds the measurable frequency range, 0 Hz is displayed.

Section 4. Save/Recall

Panel setup conditions can be saved and/or recalled.

4.1 Save

This is the function to save panel setup conditions.

Operating method

f : SAVE nn

Register No.
f : SAVE 32

[002: :] Save f : SAVE 32
Comment display field

Example of input

[LA314.H] Save f : SAVE 32

[LA314H] Save f : SAVE 32
Cursor
SAVED.

Procedures

① Set the panel setup conditions.

Setting the register number

② Set to the save mode by pressing **SAVE/RECALL** .

- Function display changes into f:SAVE nn.
- nn: Register number

③ Select the register number to be saved by turning **[FUNCTION]** .

- The range of register numbers that can be saved *1 is 1 to 32.

Input of a comment

④ Press **[FUNCTION]** .

- The comment input screen is displayed.

⑤ Input the comment by pressing **[FUNCTION]** and turning **[FUNCTION]** .

- Up to 12 characters can be input.
- Refer to the following page for the details of the method to input the comment.
- An example where comment "LA314H" is input is shown.
- The comment is saved immediately when it has been input.

Executing save

⑥ Move the cursor to below S of Save by turning **[FUNCTION]** .

⑦ Press **[FUNCTION]** .

- SAVED is displayed in the lower left corner of the screen.
- The setup conditions is saved in the register of which number is displayed and then the save mode is released.

⑧ When saving multiple setup conditions, repeat procedures ① to ⑦.

◇ Releasing the save mode

- The **SAVE/RECALL** key

The mode is switched as follows each time **SAVE/RECALL** is pressed.

SAVE → RECALL → OFF (release of the SAVE/RECALL mode) → SAVE

However, because the release occurs once after entering the RECALL mode, the settings change into those that are newly recalled.

- Another function key

When another function key (Ex.: the **HOLDOFF** key) is pressed, it is possible to exit the SAVE mode without changing the settings.

◇ Register number *1

When the unit is shipped from the factory, the maximum value is set to 32. The maximum value can be expanded to 256 using the system menu (refer to "Setting the maximum value of SAVE/RECALL" on page 44).

Comment input method

Operating method

[] Save f: SAVE 32
 ↑
 Changes from to :: and vice versa each time the button is pressed.

[] Save f: SAVE 32
 ↑
 Thick cursor (cursor moving mode)

[] Save f: SAVE 32
 ↑
 Character input position

[::] Save f: SAVE 32
 ↑
 Thick cursor (character selection mode)

[:S] Save f: SAVE 32
 ↑
 Select characters

xxxxxxx !
 ↑
 Input as the 12th character

[S] Save f: SAVE 32
 ↑
 Thick cursor (cursor moving mode)

Procedures

- ← ① **The thickness of the cursor is switched each time [FUNCTION] is pressed.**
 - Thick cursor display (cursor moving mode)
The cursor moves to left or right as [FUNCTION] is turned.
 - Thin cursor display (character selection mode)
Characters can be selected as [FUNCTION] is turned.
- ← ② **Set the cursor moving mode by pressing [FUNCTION] .**
- ← ③ **Move the cursor to the character input position by turning [FUNCTION] .**
- ← ④ **Set the character selection mode by pressing [FUNCTION] .**
- ← ⑤ **Select characters by turning [FUNCTION] .**
 - Characters can be selected among from numerals, capital letters, and 28 symbols.
Space, ! " # \$ % & ' () * + , - . / : ; < = > ? @ [¥] ^ _
 - If "!" is input as the 12th character of the comment, the register number is skipped in the recall mode. To release the skip function, delete "!".
- ← ⑥ **Confirm the selected characters by pressing [FUNCTION] .**
 - The cursor moving mode is set.
- ⑦ **Repeat procedures ③ to ⑥ .**

Setting and releasing a skip

When a comment has been input, that comment is immediately saved, so there is no need to save the once input comment. After the comment is input, release the save mode by pressing [SAVE/RECALL] or another function key.

The comment alone can be changed without affecting the setup conditions that are saved.

4.2 Recall

Operating method

f : RECALL nn

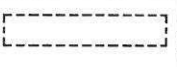
Procedures

- ← ① **Set the recall mode by pressing [SAVE/RECALL] twice.**
- Function display changes into f : RECALL nn.
 - nn : The register No. from which the setup conditions are to be recalled.
- ② **Select the register no. by turning [FUNCTION] .**
- The setup conditions are recalled from the register of the selected no.
 - If "!" is written at the 12th character of the comment, that register number will be skipped. To release the skip, delete the "!" at the 12th character on the comment input screen.
(Refer to "Comment Input Method" on page 43.)
- ◇ **Releasing the recall mode**
- Press [SAVE/RECALL] .

Setting the maximum value of SAVE/RECALL (SAVE/RECALL MAX)

The maximum value for the register number in the SAVE/RECALL mode can be expanded using the system menu.

Operating method

Not function display → 

Function displayed → f : SYS-MENU

SAVE/RECALL MAX : 32
+:[AUTO]-:[NORM] EXIT:[SGL/RST]

Procedures

- ← ① **Set all functions to OFF and set the [FUNCTION] key to an invalid state *1.**
- *1 The state where no f:XXXXX is displayed on the upper right corner of the screen.
- ← ② **Select OFF (non-display) by pressing [READOUT] .**
- ← ③ **Press [FUNCTION] for 3 sec, then the system menu is displayed.**
- ← ④ **Select SAVE/RECALL MAX by turning [FUNCTION] .**
- ⑤ **Set the maximum value for the register number using [AUTO] and [NORM] .**
- The range for setting is 1 to 126.
 - AUTO : Increases the register number.
 - NORM : Decreases the register number.
- ◇ **Press [SGL/RST] to release the system menu.**

Section 5. Daily Inspections

a. Methods for servicing

◇ Cleaning

Wipe off the stains on the casing and cover with soft cloth dampened with a small volume of water or diluted neutral cleanser. If any solvent or cleanser not suitable for cleaning is used, it may cause discoloration or an unexpected fault.

- Solvent or cleanser that can be used : Water and neutral cleanser
- Solvent or cleanser that cannot be used : Alcohol, gasoline, acetone, lacquer, ether, thinner, and cleansers containing ketone

◇ Stains on the CRT

Remove stains in the following manner:

- Wipe off ordinary stains with a soft cloth.
- Wipe off stubborn stains with a cloth dampened with neutral cleanser.

b. Cycles of periodical calibration

To ensure instrument accuracy calibrate once every year or, every 2000 hours in ordinary use.

Calibration cycle may be reduction if the instrument is heavy use or harsh environment.

c. Automatic calibration

The following items are calibrated automatically:

- Changes in vertical position of traces after switching the voltage deflection factor.
- GND position.
- Vertical position.

Cautions

- Perform calibration with BEAM FIND released.
Automatic calibration is not accomplished correctly if BEAM FIND is pressed.
- Perform calibration with no signal input.
Automatic calibration is not accomplished correctly if there are signals input to any INPUT (CH1, CH2, CH3, CH4).

Operating method

Not function display →

Function displayed → f : SYS-MENU

CALIBRATE
GO:[NORM] EXITP:[SGL/RST]

COMPLETE

Procedures

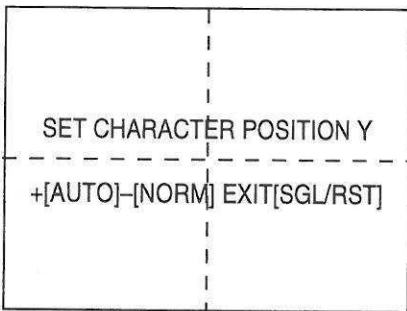
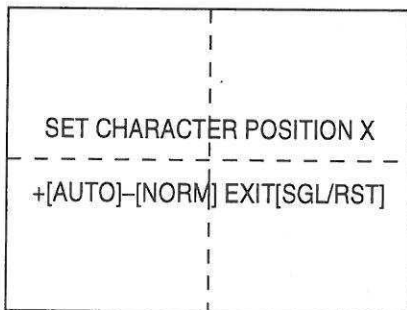
- ← ① Set all functions to OFF and set the [FUNCTION] key to an invalid state *1.
*1 The state where no f:XXXXX is displayed on the upper right corner of the screen.
- ← ② Select OFF (non-display) by pressing [READOUT] .
- ← ③ Press [FUNCTION] for 3 sec, then the system menu is displayed.
- ← ④ Select CALIBRATE by turning [FUNCTION] .
 - The message on the left is displayed at the center of the screen.
 - Press [SGL/RST] to release the system menu.
- ← ⑤ Press [NORM] , then automatic calibration starts.
 - In the case of normal completion, the message on the left is displayed momentarily and exit from the system menu occurs.

- ◇ If automatic calibration does not complete normally, an error message is displayed. When an error message is displayed after executing automatic calibration several times while it is confirmed that there is no input of signals, contact one of our service stations.

d. Calibration of the character center

Character positions can be calibrated if they have deviated due to the influence of earth magnetism.

Operating method



Procedures

- ① to ③ Same as those for “c. Automatic calibration”.

Adjustment of the horizontal position

- ← ④ Select SET CHARACTER POSITION X by turning [FUNCTION] .

- ⑤ Adjust the character position to the center in the horizontal direction using [AUTO] and [NORM] .

- To release the system menu, press [SGL/RST] .

Adjustment of the vertical position

- ← ⑥ Select SET CHARACTER POSITION Y by turning [FUNCTION] .

- ⑦ Adjust the character position to the center in the vertical direction using [AUTO] and [NORM] .

- To release the system menu, press [SGL/RST] .

e. Guide to diagnosing

When this instrument does not operate or seems to be experiencing some abnormality, confirm the contents shown in Table 5.1.1.

f. Storage and transportation

◇ Storage

Avoid storage in the following places:

- In locations exposed to direct sunlight
- In locations where there is a large amount of dust
- In locations exposed to corrosive gas

The conditions for storage of this instrument are as follows:

Storage temperature : - 20 to +70 °C

Storage humidity : 80 %RH or less (at 70 °C)

◇ Transportation

When transporting this instrument, use packaging materials equal or superior to those used when this instrument was purchased.

Table 5.1.1 Guide to Diagnosing Faults

Phenomenon	Confirmation items	Remedy
Traces or luminescent spots do not appear.	Check that the power cord plug is connected to the AC receptacle.	Connect the plug to the AC receptacle.
	Check that the power switch is set to ON.	Set the power switch to ON.
	Check that INTEN is turned counterclockwise.	Turn INTEN clockwise until an adequate intensity is obtained.
	Check that SWEEP MODE is set to SINGLE.	Set SWEEP MODE to AUTO.
Scales on the screen are not clearly displayed.	Check that SCALE is turned counterclockwise.	Turn INTEN clockwise until an adequate intensity is obtained.
	Check that the illumination lamp is disconnected.	Contact your nearest Iwatsu sales agent.
Characters are not displayed.	Check that READOUT is turned counterclockwise.	Turn INTEN clockwise until an adequate intensity is obtained.
Focus of traces and characters is not clear.	Check whether the adjustment of FOCUS is deviated.	Adjust FOCUS so that it becomes clear.
Waveform does not appear when signals are input.	Check that the probe is disconnected.	Replace the probe.
	Check that the input coupling is set to GND.	Release GND.
	Check whether a wrong channel is selected.	Set the channel to which input signals are connected to ON.
	Check whether the voltage sensitivity is too low.	Increase the sensitivity.
Triggering cannot be set.		Press AUTO SET.
	Check whether the wrong trigger source is selected.	Select the channel to which trigger are input.
	Check whether the wrong trigger coupling mode is selected.	Set the trigger coupling mode suitable for input signals again.
Waveform is unstable.	Check whether the level is set to an inadequate position.	Adjust the level to the position where triggering is set.
	Check whether the AC supply voltage is too low.	Use an AC power supply within the rating.
Original settings are not restored when power is turned on again.		Replace the battery by contacting your nearest Iwatsu sales agent.

Section 6. Specifications

CRT

Type 6 inch, diagonal rectangular flat face, internal graticule, meshless CRT with graticule illumination
 Display area 8 div x 10 div (1 div=10 mm)
 Acceleration voltage Approx. 20 kV

Vertical deflection system (Y axis)

Vertical mode CH1, CH2, CH3, CH4, ADD (CH1+CH2), ALT/CHOP
 CH1, CH2 CHOP mode switching rate 555 kHz \pm 1 %.

Deflection factor

Range 2 mV/div to 5 V/div, 1-2-5 sequence, 11 steps
 Variable control range 2 mV/div to 12.5 V/div continuously variable
 Accuracy \pm 2%

Frequency characteristics

Bandwidth

5 mV/div to 50 mV/div DC to 470 MHz – 3 dB
 2 mV/div, 100 mV/div to 5 V/div DC to 440 MHz – 3 dB

Bandwidth limiter

DC to approx. 20 MHz or DC to approx. 100 MHz can be selected
 [Note] AC coupled low cutoff frequency (–3 dB) is 10 Hz.

Rise time

Approx. 745 ps (5 mV/div to 50 mV/div)
 [Note] Rise time T_r is calculate from:

$$T_r = \frac{350}{\text{Bandwidth [MHz]}} \text{ [ns]}$$

Signal delay

At least 20 ns of the sweep is displayed before the triggering event.

Input coupling

AC, DC, GND

Input RC

1 M Ω \pm 1.5 % // 16 pF \pm 2 pF, 50 Ω \pm 1 %

Maximum input voltage



1 M Ω

\pm 400 V (DC+ACpeak)

50 Ω

5 V rms

VSWR

1.35 MAX (50 Ω : DC to 400 MHz)

Offset voltage control range

Vertical deflection range	Offset voltage
2 mV/div to 50 mV/div	\pm 1 V
0.1 V/div to 0.5 V/div	\pm 10 V
1 V/div to 5 V/div	\pm 100 V

Position control range

Approx. \pm 10 div from the center line of the screen

Invert

Available on CH2

ADD

Accuracy of sum (at 1 kHz)

\pm 3 %

Frequency characteristics

DC to 400 MHz – 3 dB

Common-mode rejection ratio

at 10 mV/div, CH2 inverted

1 kHz sine wave

50 : 1

20 MHz sine wave

15 : 1

Dynamic range

8 div or more 400 MHz input signal at 10 mV/div full bandwidth

Probe sense

10 : 1, 100 : 1 detection

CH3, CH4

Deflection factor
Range
Accuracy
Bandwidth

100 mV/div, 500 mV/div

± 3 %

DC to 400 MHz -3dB

[Note] AC coupled low cutoff frequency (-3 dB) is 10 Hz

1 MΩ ± 1.5 % // 16 pF ± 3 pF

Input RC
⚠ Maximum input voltage
Position control range
Dynamic range
Probe sense

± 400 V (DC+ACpeak)

Approx. ± 10 div from the center line of the screen

8 div or more 400 MHz input signal full bandwidth

10:1, 100:1 detection

Triggering

A triggering
Trigger sensitivity

Frequency	P. P signal amplitude
DC to 10 MHz	0.4 div
10 MHz to 100 MHz	1.0 div
10 MHz to 400 MHz	2.0 div

[Note] TV : The ratio between the composite video signal and synchronization signal is 7:3 and synchronization signal amplitude is 1.5 div or more.

HF-REJ : Attenuates at 10 kHz or more

LF-REJ : Attenuates at 10 kHz or less

Signal source
Coupling
Slope

CH1, CH2, CH3, CH4, LINE

AC, DC, HF-REJ, LF-REJ

+, -

B triggering
Trigger sensitivity

Frequency	P. P signal amplitude
DC to 10 MHz	0.4 div
10 MHz to 100 MHz	1.0 div
10 MHz to 250 MHz	2.0 div

[Note] HF-REJ : Attenuates at 10 kHz or more

LF-REJ : Attenuates at 10 kHz or less

Signal source
Coupling
Slope

CH1, CH2, CH3, CH4

AC, DC, HF-REJ, LF-REJ

+, -

TV triggering

Mode
Formats
Field and line selection
NTSC
PAL (SECAM)
HDTV

ODD, EVEN, BOTH, TR-H

NTSC, PAL (SECAM), HDTV

ODD, EVEN, or BOTH can be selected

1 H to 525 H

1 H to 625 H

1 H to 1125 H

TV clamp

Clamp position
Back porch reference
Signal amplitude range

Back porch level

± 1 div or less from ground reference

1.5 to 8 div

Event trigger	
Count mode	
Event count range	1 to 65535
Maximum frequency	50 MHz
Burst mode	
Burst signal interval time	0.15 μ s to 9.99 s
AUTO SETUP	
Channels	Available CH1 and CH2
Frequency	50 Hz to 100 MHz
Horizontal deflection system (X axis)	
Horiz display	A, ALT, B, X-Y
A sweep	
Sweep mode	AUTO, NORMAL, SINGLE
Sweep rates	
Maximum sweep	500 ps/div
Range	5 ns to 500 ms/div 1-2-5 sequence, 25 steps
Variable range	5 ns to 1.5 s/div
Accuracy I	$\pm 2\%$ ^{*1} over center 8 div
Accuracy II	$\pm 5\%$ ^{*1} over any 2 div within center 8 div
	^{*1} Add 1 % in case of VARIABLE ON
Hold-off time	Continuously variable
B sweep	
Delay	Triggered delay or continuous delay (RUNS AFTER)
Sweep rates	
Maximum sweep	500 ps/div
Range	5 ns to 20 ms/div 1-2-5 sequence, 21 steps
Accuracy I	$\pm 2\%$ over center 8 div
Accuracy II	$\pm 5\%$ over any 2 div within center 8 div
Delay time	
Position control range	0.2 to 10.2 div
Accuracy	$\pm [(set\ value \times 0.005) + (sweep\ rate \times 0.1)] - 55ns$ within the range of 1 μ s/div to 500 ms/div
	1/20000, at 1 ms/div of A sweep:, at 500 ns/div of B sweep
Delay pickoff jitter	
Sweep magnification	
Magnifying ratio	10 times
Accuracy I ^{*2}	over center 8 div
10 ns/div, 50 ns/div	$\pm 5\%$
100 ns/div to 500 ms/div	$\pm 3\%$
Accuracy II ^{*1*2}	over any 2 div within center 8 div
5 ns/div, 50 ns/div	$\pm 10\%$
100 ns/div to 500 ms/div	$\pm 5\%$
	^{*1} 20 ns or 1 div at the beginning of sweep and 20 ns at the end of sweep are excluded.
	^{*2} Add 1 % in case of VARIABLE ON
X-Y operation	
X axis (CH1)	
Deflection factor	Same as CH1.
Accuracy	$\pm 2\%$
Bandwidth	DC to 2 MHz, - 3 dB
Y axis	CH1, CH2, CH3, CH4, ADD
Phase difference between X axis and Y axis	3° or less (DC to 200 kHz)

CAL (Probe calibration signal)

Waveform	Rectangular wave
Frequency	1 kHz \pm 0.1 %
Duty ratio	49 to 51 %
Output voltage	0.6 V \pm 1 %

CH2 OUT

Output voltage	20 mV/div \pm 30 % (into 50 Ω)
Output dynamic range	\pm 100 mV (50 Ω)
Output coupling	DC coupling
Frequency band width	200 MHz – 3dB (into 50 Ω)
Output resistance	50 Ω \pm 20 %

Z AXIS IN

Sensitivity	0.5 Vp-p or more Positive-going input decreases intensity.
Frequency range	DC to 5 MHz
Input resistance	5 k Ω \pm 20 %
Maximum input voltage	\pm 40 V (DC+ACpeak)

Measurement with cursors and counter

Measurement with cursors	
Type of measurement	Time difference (Δt), voltage difference (ΔV)
Cursor position control range	
X axis	\pm (5 \pm 0.2) div from the center line of the screen
Y axis	\pm (4 \pm 0.2) div from the center line of the screen

Accuracy

Voltage difference (ΔV)	\pm [(2 % of reading) + (0.3 % of full scale)]
Time difference (Δt)	
MAG OFF	\pm [(2 % of reading) + (0.3 % of full scale)]
MAG ON (MAG x 10)	
500 ms to 100 ns/div	\pm [(3 % of reading) + (0.3 % of full scale)]
50 ns, 5 ns/div	\pm [(5 % of reading) + (0.3 % of full scale)]

[Note] Fullscale : Voltage 8 div, Time 10 div

Counter

Number of digits displayed	5 digits
Accuracy	\pm 0.01%
Frequency measurement range	2 Hz to 400 MHz

Saving data

Type of data to be saved	Backup by built-in battery Panel setup conditions immediately before turning power off ¹ Storing of panel setup conditions
Data retention time	Approx. 30,000 H (at approx. 25°C) [Note] The state where the power cord is disconnected.

Power source

Voltage range	100 to 240 VAC
Frequency range	50/60 Hz
Power consumption	110 VA

Mass and Dimension

Mass	Approx. 8.5 kg (without accessories)
Dimension	320 \pm 2W x 160 \pm 2H x 406 \pm 2D [mm] [Note] Without accessories, and projections.

Environmental conditions

Specification assurance temperature	10 to 35°C
Operating	
Temperature	0 to 40°C
Humidity	90 % RH or less (at 40°C)
Storage	
Temperature	- 20 to 70 °C
Humidity	80 % RH or less (at 70°C)
Altitude	
Operating	2,000 m, atmospheric pressure : Approx. 79 kPa
Nonoperating	15,000 m, atmospheric pressure : Approx. 12 kPa
Vibration	15 minutes along each of three axes at a total displacement of 0.67 mm p.p with frequency varied from 10 Hz to 55 Hz in 1 minute sweep.
Shock	Lifting a side to height of 10 cm and dropping it naturally onto hard wood; 4 times on each side.
Dropping packaged	Dropping an instrument packaged for transportation from a height of 90 cm.
Warm up time	The specifications for this instrument are the assured values after more than 30 min of power on.
CE Declaration of Conformity	The Oscilloscope meets requirements of the Council Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/ECC for Product Safety.
Electromagnetic Emission	
EN55011:1991	
EN55011:1991	Class B Radiated and Conducted Emissions
EN61000-3-2:1995	AC Power Line Harmonic Current Emissions
EN61000-3-3:1995	Voltage Fluctuations and Flicker
Electromagnetic Susceptibility	
EN50082-2:1995	
EN61000-4-2:1995	Electrostatic Discharge Immunity
ENV50140:1993	RF Field Strength Susceptibility (Amplitude Moduration)
ENV50204:1995	RF Field Strength Susceptibility (Pulse Moduration)
EN61000-4-4:1995	Electrical Fast Transient/Burst Immunity
ENV50141:1993	Conducted Susceptibility
Low Voltage Directive	
EN61010-1:1993+Amd.2:1995	Safety requirement for electrical equipment for measurement, control, and laboratory use.

The oscilloscope has been qualified to the following EN61010-1 category:

Installation (Overvoltage) Category II	Pollution Degree 2
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.
Installation (Overvoltage) Category II	Local Level mains, appliances, portable equipment.

PP005 PROBE

INSTRUCTION MANUAL

General

The PP005 is a passive probe to use with the LA314/LA314H oscilloscope which has frequency response from DC to 400 MHz.

Composition

The probe PP005 is composed of a probe body and accessories.

Probe body

Accessories

- Ground lead 11 cm 1
- Ground lead short on probe tip 1
- IC insulation tip (black) 2
- Spring tip 0.8 mm 1
- Straight tip 1
- BNC adapter 1
- Sprung hook (black) 1
- Trimmer tool 1
- Probe 1
- Color rings 10

Specification (combined PP005 and LA314/LA314H)

Input RC	10 MΩ ± 3 %//11 pF ± 2 pF ^Δ
Attenuation ratio	10:1 within ± 2 % ^Δ
Frequency response	DC to 400 MHz – 3 dB ^Δ • LA314/LA314H 10mV/div • at the tip of probe
Input capacitance of applicable oscilloscope	10 to 20 pF
Maximum safety input voltage	500V (DC + peak AC)
Probe length	Approximately 1.2 m
Connector type	BNC type
Read-out compensating function	Provided

^Δ For LA314/LA314H oscilloscope.
The specification of the probe only describes the attached PP005 manual.

Cautions

● Figure 1 shows maximum input voltage. Do not apply excessive voltage.

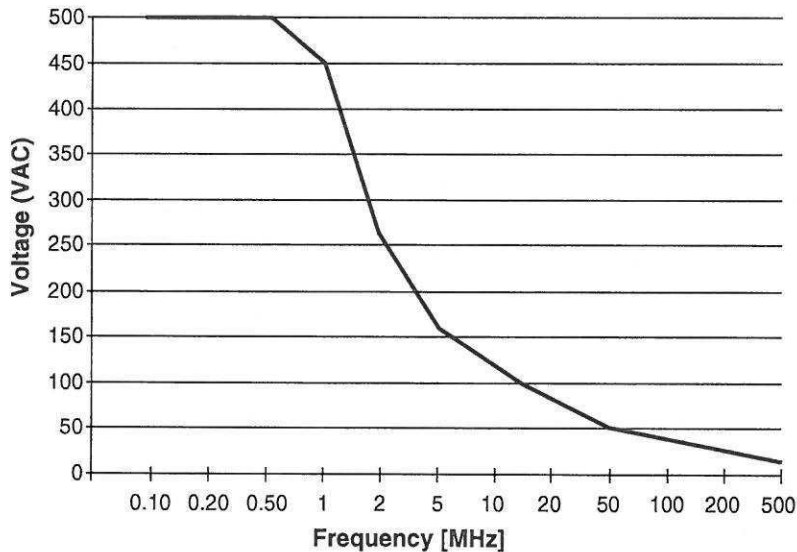


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