

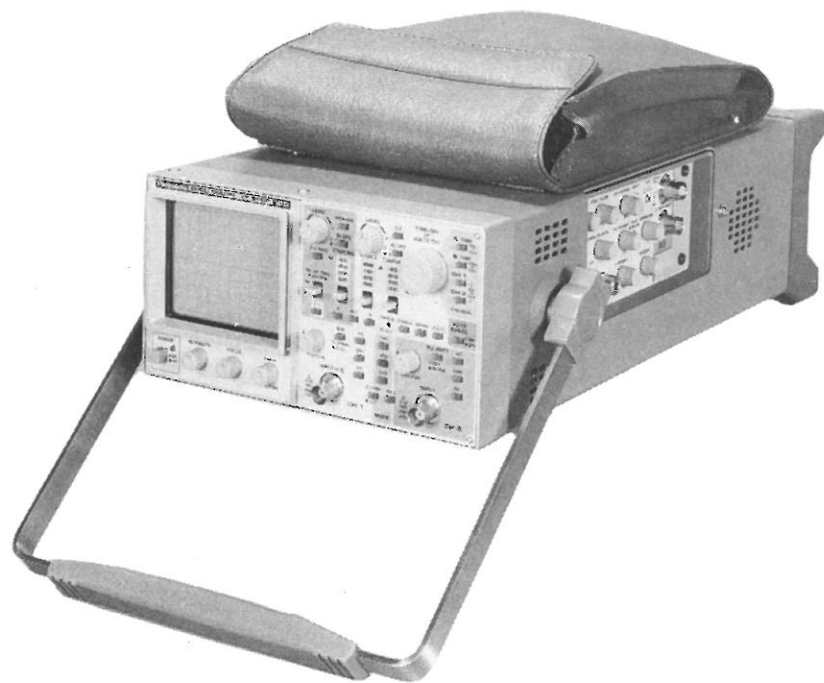
MANUAL PART NO.

MEP5610P-1

OSCILLOSCOPE

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***VP-5610P***



VP-5610P

## SAFETY PRECAUTIONS

### GENERAL

This instrument has been designed and tested to ensure reasonable personal protection and protection of the surrounding area against damage, and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the instrument in a safe condition.

### BEFORE SUPPLYING POWER

Verify that the instrument is set to suit the available mains voltage and that the correct fuse is installed.

### PROTECTIVE EARTH

The protective earth of the instrument must be connected to the earth before connecting the instrument to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cable is essential for safe operation.

The plug shall only be inserted into a socket outlet provided with a protective earth contact.

## SAFETY SYMBOLS



Instruction manual symbol : The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual for safety.



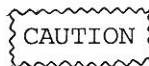
High voltage symbol : Dangerous voltage exceeding 1 kV is indicated by this symbol.



Protective earth terminal.



The WARNING sign is a heading of the requirement(s) that should be observed to avoid personal or fire hazards.



The CAUTION sign leads the precaution(s) that should be observed to avoid damage or destruction of the instrument.



#### POWER SOURCE

This instrument is intended to operate from a mains supply that will not be more than 250 volts rms.

For suitable voltage selection, see the INSTALLATION paragraph in this manual.

#### HAZARD ARISING FROM LOSS OF GROUND

The protective action must not be negated by the use of an extension cord without protective conductor. If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminals is connected to the earth terminal of the power source.

#### DAMAGE IN TRANSPORT OR STORAGE

Whenever it is likely that protection has been impaired, for example as a result of damage caused by abnormal stresses in transport or storage, the instrument shall be made inoperative and be secured against any unintended operation.

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#### USE OF PROPER FUSE

Use only the fuse of correct type, voltage rating and current rating as specified in the INSTALLATION paragraph in this manual.

#### REMOVAL OF COVERS

Removal of covers is likely to expose live parts although reasonable precautions have been taken in the design of the instrument to shield such parts. The instrument shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the instrument shall be opened.

If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a qualified personnel who is aware of the hazard involved.

#### DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate the instrument in an explosive atmosphere.

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## SECTION I GENERAL

### 1-1 DESCRIPTION

The PANASONIC Model VP-5610P oscilloscope is a 3-channel, 6-trace 100 MHz compact oscilloscope featuring a rectangular internal-graticule CRT.

The VP-5610P includes not only a 100 MHz bandwidth oscilloscope function but also an auto ranging function for both the X and Y axes to make waveform observations simple and easy.

The maximum sensitivity of the vertical-axis is 5mV/div and the maximum time coefficient of the horizontal-axis sweep is 5ns/div. The Auto Fix triggering mode provides stable waveform measurements and the hold-off function enables easy triggering of even complicated (e.g., aperiodic) signals.

The three channels are designated CH1-X, CH2-Y, and CH3-Y to enable two channels X-Y operation. The switching regulator allows operation on a wide power-source voltage range of 90V to 250V. DC operation is optionally available.

The VP-5610P is the first in its class as a compact oscilloscope to feature an alphanumeric CRT display of scale factors and delay time parameters.

## 1-2 CONTENTS OF THIS MANUAL

The VP-5610P's specifications are described in Section II. Section III explains the equipment's installation and preparation and offers a few safety tips. For a complete summary of safety considerations, please see the safety precautions listed at the front of this manual. Operation instructions for the VP-5610P are provided in Section IV.

## SECTION II SPECIFICATIONS

## 2-1 Vertical axis (CH1, CH2, CH3)

Designation	Performance	Conditions or remarks
Deflection coefficients (CH1, CH2)	5mV/div to 10V/div	11 calibrated ranges in a 1-2-5 sequence VOLTS/DIV displayed on CRT.
Error limits	When calibrated correctly at 5mV/div with VAR control at maximum clockwise position. ±2% ±4%	+10°C to +35°C 0°C to +50°C
Uncalibrated variable range	Continuously variable between settings Increases deflection factor by at least 2.5 to 1.	
Deflection coefficients (CH3)	0.1V/div, 0.5V/div	
Error limits	±5%	
Position	Controls vertical position of CH3 trace on CRT	
CH2 SIGNAL OUT	25mV/div ±10%	

Designation	Performance	Conditions or remarks
Response Frequency range and rise time CH2 SIGNAL OUT  CH1, CH2 5mV/div to 10V/div CH3 0.1V/div, 0.5v/div	DC to 10MHz or more (35ns)  DC to 100MHz (3.5ns) -3dB bandwith DC coupled DC to 100MHz (3.5ns)	Measured with a 25 $\Omega$ signal source with a 6div ampli- tude VARIABLE position to CAL Rise time is calculated from the formual:  $\text{Rise Time} = \frac{0.35}{\text{BW (in MHz)}}$
Input impedance	1M $\Omega$ 25pF	CH1, CH2
Max. permissible input voltage	200V (DC+AC peak) 10 second.	DC+ACpeak, below 1kHz.
Input coupling	AC, DC and GND	CH1, CH2
AC low-frequency response	Approx. 4Hz (-3dB)	AC-GND-DC switch positioned to AC.
Vertical Display modes	CH1, CH2, CH3, CHOP, ALT and ADD	



Designation	Performance	Conditions or remarks
Bandwidth limiter	20MHz or less	-3dB bandwidth
Switching rate in CHOP mode	500kHz	
Attenuator interference	5,000:1 from DC to 20MHz	
Polarity inversion	Displayed signal on CH2 can be inverted.	
Vertical linearity	0.15div or less, compression or expansion of a 2div display (at center screen) when positioned to the vertical extremes of the graticule area.	By 50kHz sine wave.
Instability of the trace position Drift by temperature 5mV/div to 10v/div Drift by term 5mV/div to 10v/div	0.1div/°C or less  0.5div/H or less	Needs 15 minutes warm up time.

Designation	Performance	Conditions or remarks
Auto range function	<p>For channels 1 and 2, a range satisfying the set value is selected according to input signal. Set value between 1 and 3 manually selectable and specified by 50kHz sinewave.</p> <p>Deflections specified are:</p> <p>1 .... 4div 2 .... 6div 3 .... 8div</p>	Operates when AUTO RANGE is on and switched each time from freerun sweep to triggered sweep.
Operational frequency range	200Hz to 10MHz	

## 2-2 Horizontal axis (A and B triggering)

Designation	Performance			Conditions or remarks
Trigger mode	NORM, Auto Fix			
Trigger source	NORM, CH1, CH2, CH3, LINE			LINE source is available for A triggering.
Trigger coupling	AC, DC-LF, TV, DC			TV(V): A Triggering operation. TV(H): B Triggering operation.
Trigger slope	+ or -			
Trigger thresholds in normal mode				Polarity: sync negative
		Frequency	Source	
	AC	30Hz to 5MHz	0.5div	
		30Hz to 100MHz	2.5div	
	DC-LF	DC to 50kHz	0.6div	
	DC	DC to 5MHz	0.5div	
		DC to 100MHz	2.5div	
	TV	TV sync signal	1.0div	

Designation	Performance			Conditions or remarks
Trigger thresholds in Fix mode (for A triggering only)				Triggerable on the waveform with duty factor between 1:10 and 10:1.
		Frequency	Source	
	AC	400Hz to 5MHz	1.0div	
		400Hz to 100MHz	3.5div	
	DC-LF	400Hz to 50kHz	1.2div	
	DC	400Hz to 5MHz	1.0div	
		to 100MHz	3.5div	
Trigger level selectable area	±4div or more			At 50kHz sine wave.
AUTO sweep operation Frequency	50Hz or more			A sweep only.

## 2-3 Horizontal axis (Time base-Main A sweep and delayed B sweep)

Designation	Performance	Conditions or remarks
Time coefficients		
Main A sweep	50ns/div to 0.5s/div	22 calibrated ranges in a 1-2-5 sequence.
Delayed B sweep	50ns/div to 50ms/div	19 calibrated ranges in a 1-2-5 sequence.
Error limits		
0.1 $\mu$ s/div to 0.2s/div	$\pm 2\%$ $\pm 4\%$	+10°C to +35°C 0°C to +50°C
50ns/div, 0.5s/div	$\pm 5\%$ $\pm 7\%$	+10°C to +35°C 0°C to +50°C
Variable	1:2.5 or more	A sweep only
Main A sweep modes	AUTO, NORM, SINGLE	
Display modes	A, ALT, B	
Single sweep	Possible	
Hold off	Continuously variable	

Designation	Performance	Conditions or remarks
Horizontal Auto range	For A sweep, a range satisfying the set value shown in number of periods is selected according to input frequency. Set value between 1 and 9 manually selectable and specified by 50kHz sine wave B sweep range is selected at ten times speed of A.	50ns/div max Operates when AUTO RANGE is on and the sweep is switched each time from freerun to triggered.
Operational frequency range	200Hz to 10MHz	
Magnifier Magnification  Max. effective time coefficient Error limits	Display is magnified 10 times at center screen.  5ns/div  Add $\pm 1\%$ to normal error limits.	Within middle 8div of the display, Exclude first and last 50ns.

Designation	Performance	Conditions or remarks
Linearity		
0.1us/div to 0.5s/div	$\pm 1.5\%$	+10°C to +35°C
	$\pm 3\%$	0°C to +50°C
50ns/div	$\pm 3\%$	+10°C to +35°C
	$\pm 4.5\%$	0°C to +50°C

## 2-4 Sweep delay

Designation	Performance	Conditions or remarks
Delay time		
Delay time range	Continuous from 5s to 1 $\mu$ s	A VARIABLE set to CAL position
Multiplier linearity		
0.1s/div to 0.5s/div	$\pm 3\%$	+10°C to +35°C
	$\pm 5\%$	0°C to +50°C
1 $\mu$ s/div to 50ms/div	$\pm 2\%$	+10°C to +35°C
	$\pm 4\%$	0°C to +50°C
Delay Time Position	0.3div to 10div	Delayed time displayed 30 to 999 on CRT (1div=100)
Jitter	10,000:1	A sweep: At 1ms/div B sweep: At 1 $\mu$ s/div



## 2-5 X-Y operation (CH1-X, CH2-Y, CH3-Y)

Designation	Performance	Conditions or remarks
X-Y inputs	CH1 VOLTS/div for X axis deflection, CH2, CH3 VOLTS/div for Y axis deflection.	X: At H POSITION. Y: At each CH2 or CH3 POSITION.
X and Y deflection coefficients	CH1, CH2 5mV/div to 10V/div CH3 0.1V/div, 0.5V/div	11 calibrated positions in a 1-2-5 sequence.
Error limits	$\pm 5\%$ $\pm 6\%$	$+10^{\circ}\text{C}$ to $+35^{\circ}\text{C}$ $0^{\circ}\text{C}$ to $+50^{\circ}\text{C}$
X and Y frequency range	DC to 1MHz	
X and Y input impedance	$1\text{M}\Omega \pm 2\%$ , $25\text{pF} \pm 2\text{pF}$	Except CH3-Y
X and Y phase difference	$3^{\circ}$ or less, DC to 1MHz	

## 2-6 Z axis

Designation	Performance	Conditions or remarks
Intensity modulation	+5V signal produces noticeable modulation at normal intensity.	
Frequency range	DC to 20MHz	
Input resistance	Approx. 47k $\Omega$	
Max. permissible input voltage	50V	DC+AC <sub>peak</sub> , DC to 1kHz

## 2-7 Calibrator

Designation	Performance	Conditions or remarks
Waveform	Square-wave	Duty factor: 40 to 60%
Output voltage	0.3V	
Error limit	$\pm 1\%$ $\pm 1.5\%$	+10°C to +35°C 0°C to +50°C
Frequency	1kHz $\pm 3\%$	
Rise time	10 $\mu$ s or less	

## 2-8 Power supply

Designation	Performance	Conditions or remarks
Mains voltage	AC90V to 250V	Needs to exchange mains power supply cord.
Mains frequency	50/60Hz	
Power consumption	80VA or less (45W or less)	

## 2-9 CRT

Designation	Performance	Conditions or remarks
Type	Rectangular, internal graticule.	
Total acceleration voltage	Approx. 16kV	
Measuring area		8×10div (1div ≒ 6.35mm)

## 2-10 Environmental characteristics

Designation	Performance	Conditions or remarks
Ambient temperature	0°C to +50°C -20°C to +70°C	Limit range of operation Storage and transportation.
Humidity (R.H.)	10 to 80% 0 to 80%	Limit range of operation Storage and transportation.
Vibration	15 minutes along each of the three major axes at a total displacement of 0.6mm peak-to-peak with frequency varia- tion of 600-3300-600 r.p.m. in one-minute cycles.	
Shock	2 chocks of 30G, one- half sine, to each surface.	Total 12 shocks.
Drop test	75cm drop on any cor- ner, edge or flat surface.	Packed in a shipping carton. Total 10 drops.

## 2-11 Mechanical characteristics

## Dimensions

	Height (mm)	Width (mm)	Depth (mm)
Frame	*140 or less	245 or less	415 or less
Overall (max. points)	102	194	363
Weight	Approx. 5 kg		

\* Include feet, handle and optional front cover. Without accessories.

## 2-12 Accessories furnished

Accessory soft carrying case	1
Probe	2
Front cover	1
Viewing hood	1
BNC adaptor	2
Fuse 1.6A(T)	1
Scale lamp	1
Mains power cord	1
Instruction manual	1

## 3-1    POWER REQUIREMENTS

The Model VP-5610P can be operated from any power source supplying from 100 V to 250 V, 50 or 60 Hz. Power consumption is less than 80 VA.

## 3-2    FUSE

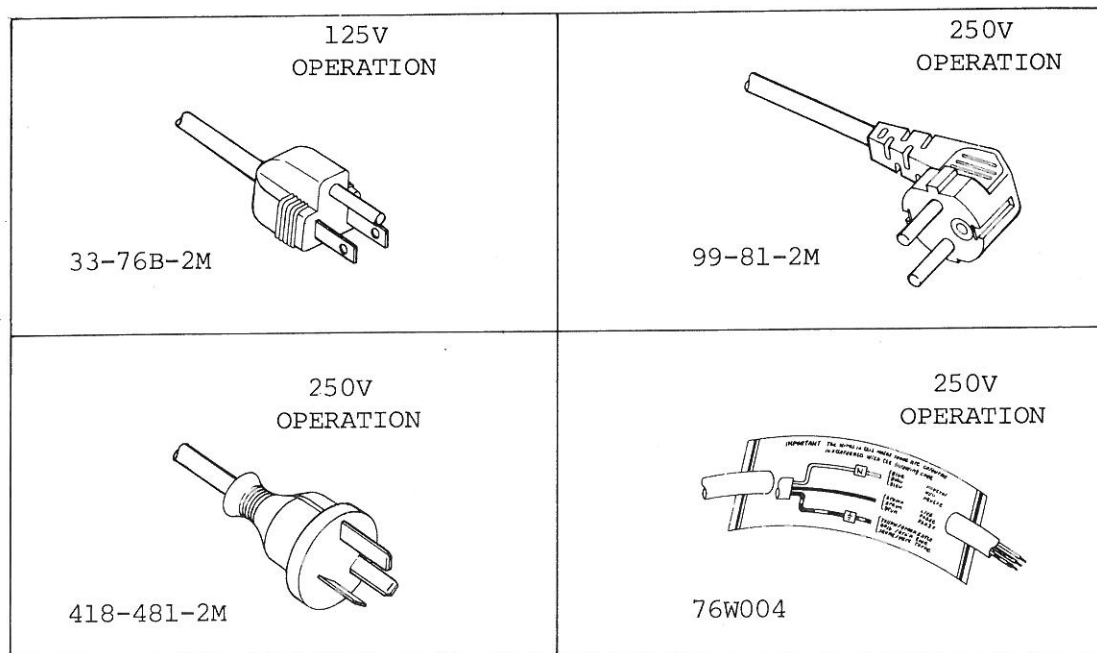
Verify that the proper fuse is installed in the fuse holder. Ratings of the fuse are 250V, 1.6A (time lag) as noted on the rear panel.

— WARNING —

Make sure that only fuse with the required rated current and of the specified type is used for replacement. The use of makeshift fuse and the short-circuiting of fuse holder are prohibited.

### 3-3 POWER CABLE

The VP-5610P is equipped with a detachable power cable assembly. The type of the plug shipped with each instrument depends on the country of destination. The figure below illustrates the power cables available with Panasonic part numbers.



### 3-4 MOUNTING CONSIDERATIONS

The handle of the VP-5610P can be positioned for carrying or as a tilt-stand for the instrument. To position the handle, press in at both pivot points and turn the handle to the desired position.

The instrument may also be set on the rear feet either for operation or storage.

#### CAUTION

Since the VP-5610P is cooled by air through hole in the top and bottom covers, the following cautions should be observed during the operation period of the instrument.

1. Allow at least 3 cm clearance on both sides.
2. Do not block the airflow from the holes on the top cover.



### 3-5 INTERCONNECTION WITH OTHER EQUIPMENT

Plug the power cable into a properly wired receptacle before connecting the instrument to the other equipment with probes or BNC cables.

Since the outer metal shell of the CH2 SIG OUT connector on the right side panel is connected to the chassis through a 5-ohm resistor, it cannot be floated and should be regarded as directly grounded point for actual applications.

The metal terminal on the side panel is a measuring earth terminal directly connected to the chassis. It may be used to connect the outer braids of shielded wires or other lead wires to be grounded.

Note: Two BNC receptacles on the front panel of this instrument are mounted with a slight tilt. The operational ease of the front panel controls will be found when probes and cables are connected to these receptacles.

### 3-6 BATTERY REPLACEMENT

The memory backup battery of this instrument is a non-rechargeable lithium battery.

- CAUTION -

1. Battery life is approximately three years in a normal operating environment. The life may decrease to one year if the instrument is exposed to high temperature near the upper limit of the instrument for long period.

If the front panel setup is not retained when the power is turned off, battery replacement is required.

Contact your nearest Panasonic representative for assistance in changing the battery.

2. Do not short-circuit the battery.
3. Do not dispose of the battery in fire.

## (INITIALIZATION RESETTING FROM FAULTY OPERATION)

A Major part of the internal circuits are controlled indirectly by the front panel controls through the operation of a microprocessor. The internal control circuit may sometimes fails because of noise disturbances from the power supply line of repeated, rapid power on/off. This results in:

- 1) Contradictory setting (for example: more than one trigger source selected)
- 2) Keys inoperative

To recover from such faulty operation:

- 1) Turn power off
- 2) Turn power on while pressing the GND Keys of both CH1 and CH2 AC-GND-DC selectors. Hold the GND Keys for at least 1 sec.
- 3) Release the keys and select the desired operating mode.

Note: If faulty operation continues, connect the oscilloscope to a different power line. If this does not correct the problem, contact your nearest Panasonic representative.

#### 4-1 GENERAL

This section gives several basic operation procedures for this instrument, and provides a simple explanation of the operation of the front-panel, side panel, rear-panel, and bottom controls. It also explains the operation of each section's functions.

#### 4-2 OPERATING CONSIDERATIONS

##### (1) Intensity

Intensity that has been set unnecessarily high can damage the CRT. Be sure to turn the INTENSITY control down when the sweep speed is reduced or when the spot is stopped at one place for a long time.

## (2) Trace Gradient

Strong magnetic fields and/or earth magnetism can cause the trace lines to have a different gradient than the horizontal graticule lines. In such cases, turn the TRACE ROTATION control on the right side panel to align the trace line with the horizontal graticule lines.

## (3) Scale Illumination

Illumination of the graticule lines can be adjusted as desired by using the SCALE ILLUM control on the right side panel. This control can also be used for adjusting graticule illumination for photographing.

#### (4) Intensity (Z-axis) modulation

Intensity modulation is made possible by increasing the input signal via the Z AXIS INPUT connector on the right side panel. The Z-axis signals must be time-related to the displayed waveform to obtain a stable display. The voltage amplitude required for visible trace modulation depends on the INTENSITY control setting. At normal intensity level, a 5V peak-to-peak positive signal will produce a visible modulation to darkness in brightness.

#### (5) Calibrator

The side panel CAL 0.3 V terminal provides 0.3 V peak-to-peak positive square-wave output with a frequency of approximately 1 kHz. The output signal is used for checking basic vertical gain or for adjusting probe compensation. Output impedance is 100 ohms or less.

#### 4-3 CONTROLS AND CONNECTORS

The following is a brief description of the function and operation of the various keys, control knobs, connectors, terminals, lights, and other control features on this instrument's panels.

This explanation is broken down into panel sections, with figures provided for each section as listed below.

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Right side panel	4-5	4-23
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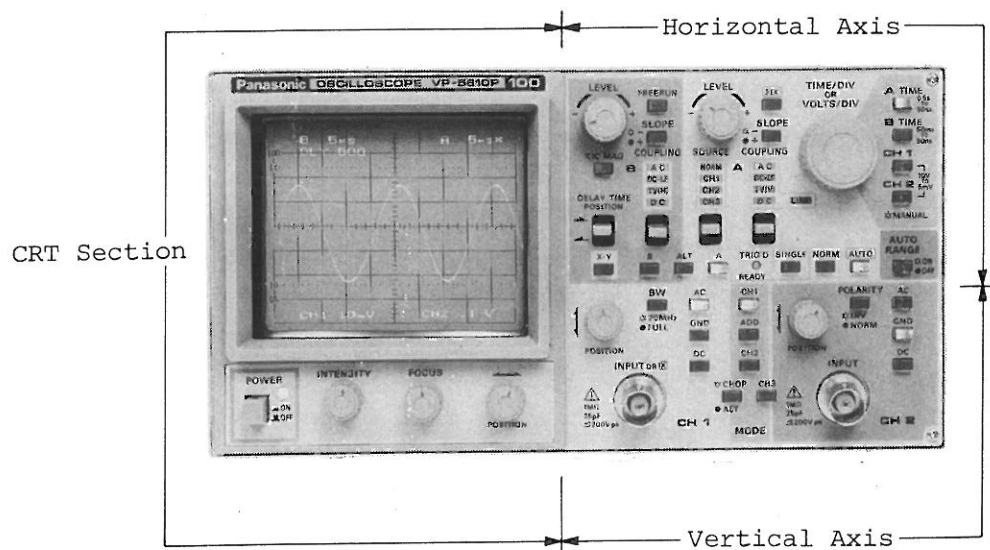


Fig. 4-1 Front Panel

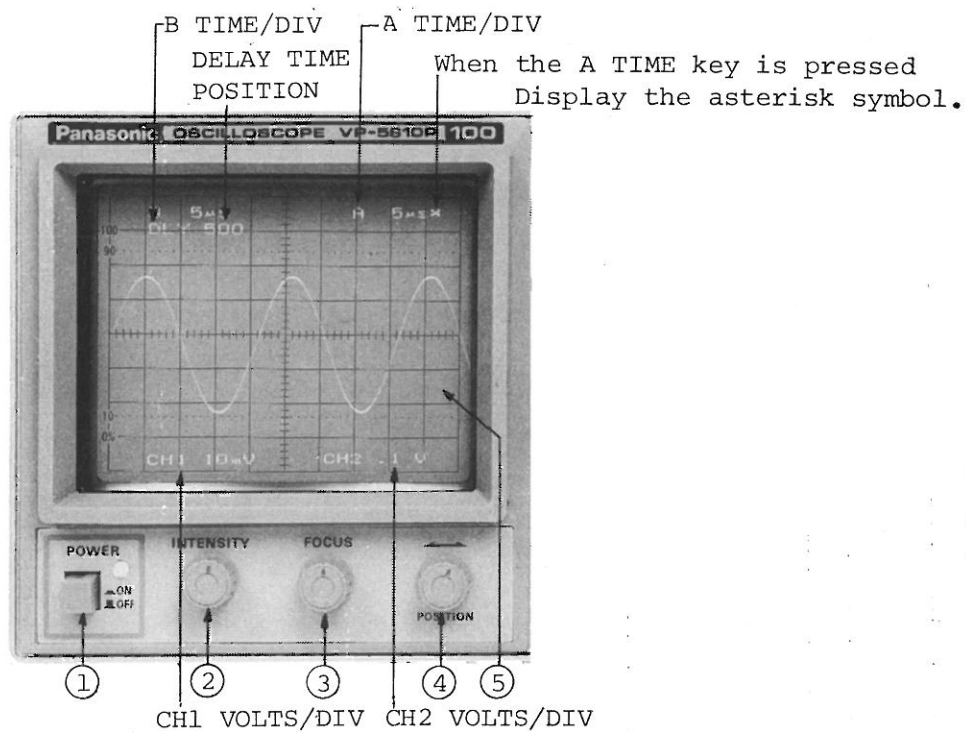
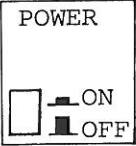


Fig. 4-2 CRT Section

- ①  ..... Press this switch to turn the power on.  
The adjacent light is lit when power is on.

- ② INTENSITY ..... This knob is used to adjust the trace intensity on the CRT screen.
- ③ FOCUS ..... This knob adjusts the display for optimum definition.
- ④ ← POSITION.... This knob controls the horizontal position of the trace.
- ⑤ CRT screen ... Displays the selected traces, channel 1 and 2 vertical amplitude, A and B sweep times, and delay time position.

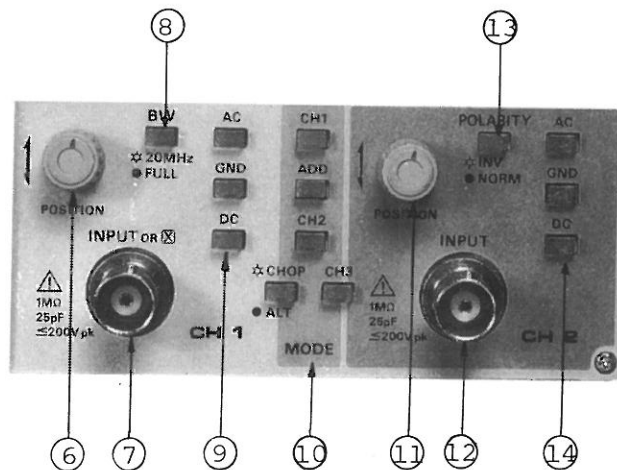


Fig. 4-3 Vertical Axis

- 39
- ⑥ **POSITION.....** This knob controls the vertical position of the CH1 trace.
  - ⑦ **INPUT or X.....** Input connector for CH1 input signals or X-axis signals in the X-Y operation mode.

- ⑧      BW ..... Push this switch to select bandwidth of 20 MHz or 100 MHz.  
         ☐      (The light goes on the indicate limited bandwidth of 20 MHz)  
★ 20MHz  
• FULL

- ⑨ AC-GND-DC ..... Used to select the method of coupling input CH1 signals to the vertical deflection system.

AC ..... Used to select AC coupling (light goes on when pressed).  
☐

The input signal is capacitively coupled to the vertical amplifier and the DC component of the input signal is blocked. When square waves of less than about 1 kHz are AC coupled, the SAG of square waves becomes apparent.

The low-frequency limit (-3 dB point) is approximately 4 Hz.

GND ..... Light goes on when the key is pressed indicating that the input circuit of amplifier is grounded.  
☐

DC ..... Light goes on when the key is pressed indicating that the input signal is direct-coupled to the amplifier.  
☐

⑩ MODE ..... Used to select the operation mode for the vertical deflection system. At least one channel must be selected at all times.

CH1  
☐ ..... Pressing this key turns the light on and selects CH1 for display on the CRT.

CH2  
☐ ..... Pressing this key turns the light on and selects CH2 for on the CRT.

CH3  
☐ ..... Pressing this key turns the light on and selects CH3 for display on the CRT.

41. ★CHOP  
    ☐  
    • ALT ... The light goes on when this key is pressed indicating that the CHOP (chopped display) operation is activated.

This multi-trace display switches between channels at a repetition rate of 500 kHz regardless of sweep speed. Normally this mode is used for slow sweep speed monitoring. Pressing the CHOP/ALT key again turns the light off and selects the ALT (alternate trace) mode, which alternately displays multiple input signals during retrace at the end of each sweep. Normally this mode is used for rapid sweep monitoring.

**ADD**  
☐ ..... Light goes on when key is pressed to indicate that ADD is selected. This mode defaults to CHOP, but ALT can be selected. This mode displays the algebraic sum of CH1 and CH2 input signals. Pressing the ADD key again turns the light off, erases the CH1/CH2 ADD display.

⑪ | POSITION..This knob controls the vertical position of the CH2 trace.

⑫ INPUT ... Has the same function for CH2 as ⑦ has for CH1. This is the input connector for Y-axis signals in the X-Y operation mode.

⑬ **POLARITY** .... Inverts the CH2 display. When this key is pressed, the key light goes on and INV is selected.  
☐  
★ INV  
• NORM  
When the key is pressed again, the light goes out and NORM is selected.

- ⑭ AC-GND-DC ..... Has the same function for CH2 as ⑨ has for CH1.

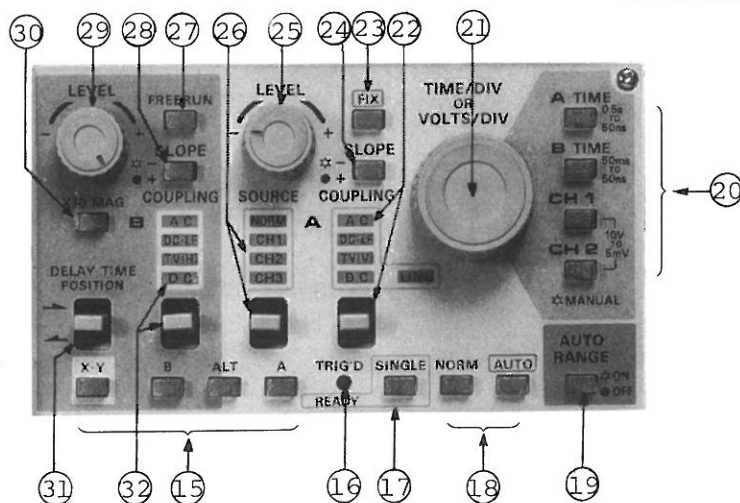


Fig. 4.4 Horizontal Axis

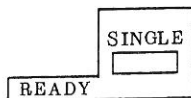
- ⑮ Sweep display mode ..... Used to select or cancel the operation mode for the horizontal deflection system.



- ☐ A ..... The light in this key goes on when pressed indicating that the main A sweep display mode is selected.
- ☐ ALT ..... The light in this key goes on when pressed indicating that the alternate display mode is selected. Main A sweep and delayed B sweep are alternately displayed on the CRT.
- ☐ B ..... The light in this key goes on when pressed indicating that the delayed B sweep mode is selected. The sweep time is determined by the B sweep range display.
- ☐ X-Y ..... The light in this key goes on when pressed indicating that the X-Y oscilloscope mode of operation is selected.  
Select any other key in this group to cancel this operation mode.

- ①⑥ TRIG'D ..... This green light indicates a READY status (waiting for the triggering signal) for single sweeps. In other sweeps, the light indicates that the A sweep is triggered.

①⑦



.. Light goes on when this key is pressed, indicating that single sweep mode is selected. This key is also used to reset the single sweep ready. This selection is automatically canceled when the AUTO key ( ①⑧ ) is pressed.

①⑧

AUTO



..... Light goes on when this key is pressed indicating that the auto sweep mode is selected. In a trigger condition, a stationary waveform is displayed. When there is no trigger signal, or when the triggering level is off, the sweep is in a freerun condition.

**NORM** .... Light goes on when this key is pressed indicating that the NORM sweep mode is selected. Waveforms are displayed only when the sweep is triggered. When there is no triggering signal, or when the triggering level is off, no trace will be displayed.

- ①9 **AUTO RANGE** ..... Pressing this key causes both the AUTO, AC of triggering source and FIX lights to go on and selects the auto range operation mode. When this function is selected, VOLTS/DIV and TIME/DIV settings are automatically made for input signals from either CH1 or CH2 (CH1 has priority). When in the auto-range mode, the switches for A TIME, B TIME, CH1, and CH2 are all turned off to indicate auto range operation. The B TIME is not found directly by the auto range function but is derived as 1/10 of the A TIME. Pressing the A TIME key causes its light to go on and switches only the A TIME from auto ranging to manual ranging.

B TIME, CH1 and CH2 can also be switched between auto and manual ranging. When canceling auto ranging, pressing the key again turns the AUTO RANGE light off and selects the manual mode.

②① A TIME, B TIME, CH1, & CH2

Pressing the CH1 key turns on its light and enables the VOLTS/DIV control for CH1. This value is adjusted using the rotary control explained in ②① .

Pressing the CH2 key turns on its light and enables VOLTS/DIV control for CH2. This value is adjusted using the rotary control explained in ②① .

Pressing the A TIME key turns on its light and enables TIME/DIV switching for the A sweep. This value is adjusted using the rotary control explained in ②① .

Pressing the B TIME key turns on its light and enables TIME/DIV switching for the B sweep. This value is adjusted using the rotary control explained in ②① .

- ②1 The rotary control labeled TIME/DIV OR VOLTS/DIV is turned to select TIME/DIV for A and B sweeps and VOLTS/DIV for CH1 and CH2.
- ②2 A TRIG COUPLING ..... This switch selects the coupling for the A trigger signals. The lever (below the LED displays labeled AC, DC-LF, TV(V), DC, and LINE) can be moved up or down to light any of these five LED displays. Reselection is done by moving the lever to light the new setting.


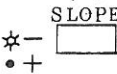
AC ..... Blocks DC via a capacitor and attenuates signals of 30 Hz or less.

DC-LF ..... Accepts DC signals to 50 kHz.

TV(V) ..... Separates TV vertical sync signals from TV signals and connects them to the trigger circuit.

DC ..... Accepts all trigger signals and connects them to the trigger circuit.

LINE ..... Used for triggering from the mains power line frequencies.

- ②③  ..... Switches between AUTO FIX triggering and ordinary triggering using the trigger level rotary control explained in ②⑤ . Pressing the FIX key turns on its light and designates AUTO FIX, in which sweep triggering level is automatically set for bottom peak.
- ②④  ..... Used to select the A sweep trigger slope. When the SLOPE key is pressed, its light goes on to indicate negative-slope sweep triggering and when the SLOPE is pressed again, its light goes off to indicate positive-slope sweep triggering.
- Selects the threshold level on the trigger signal at which the sweep is triggered.
- ②⑤ LEVEL ..... This level selection control does not operate when the AUTO FIX operate. ( ②③ ).
- ②⑥ TRIGGER SOURCE ..... This control is used to select the signal source for either A sweep or B sweeps. The lever (below the LED displays labeled NORM, CH1, CH2, and CH3) is moved up or down to light any one of these four LED displays. Reselection is done by moving the lever to light the new setting.

**NORM** ..... The signal displayed on the CRT is used as the trigger signal. This trigger source cannot be selected for multi-channel operation in CHOP mode.

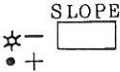

**CH1** ..... Enables triggering from the CH1 input signal.

**CH2** ..... Enables triggering from the CH2 input signal.

**CH3** ..... Enables triggering from the CH3 input signal.

- ②7 **FREERUN** ..... Used to switch between triggered sweep and freerun sweep for ☐ B sweep. When the FREERUN key is pressed, its light goes on to indicate selection of freerun sweep mode. The B sweep starts at the delay time position set with control ③1 and sweeps at the delayed sweep rate set with control ②1. When the FREERUN key is pressed again, its light goes off to indicate triggering using the trigger level control ( ②9 ).

In this triggering signals are ignored which occur before the delay time set with control ③1. After this delay, the delayed sweep start depends on conditions set with controls ②8, ②9 and ③2.

- ②⑧  ..... Used to select the B sweep trigger slope.  
Operation is the same as for B sweep SLOPE control (②④).
- ②⑨ LEVEL ..... Used to select the B sweep trigger level. This function is canceled when the freerun mode has been selected via control (②⑦).
- ③①  .... When the x10 MAG key is pressed, its light goes on to indicate horizontal magnification of the CRT-displayed waveforms and a ten-fold increase in the sweep speeds for both A and B sweeps. When this key is pressed again, the light goes off and the x10 magnification function is canceled.
- ③② DELAY TIME POSITION ..... Used to set the start point for B sweeps. When this switch is pushed to the upper position (→) the start point of B sweep moves to the right side of the CRT screen and when it is pushed to the lower position (←) the start point of B sweep moves to the left side of the screen. The start point is variable from 0.3 div to 10 div. To calculate the delay time the three-digit figure shown on the CRT is divided by 100 and then multiplied by the A sweep time.



- ③② B TRIG COUPLING ..... This switch is used for selecting the B-sweep trigger coupling method. Operation is the same as for control ②② except as follows. When control ②② has been set on LINE, the signal indicated by the trigger signal source switch ( ②⑥ ) is connected to the B-sweep trigger circuit.
- When control ②② has been set on TV-(H), separates TV horizontal signals from TV signals and connects them to the trigger circuit.

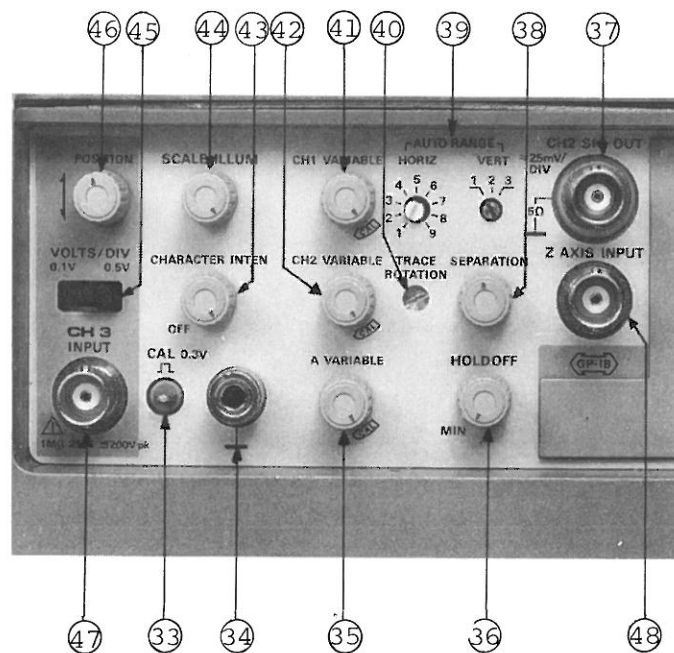

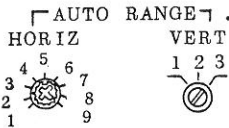


Fig. 4-5 Side Panel

- ③③ CAL 0.3V ..... Calibrated voltage output terminal; a 0 to 0.3 Vp-p square wave at 1 KHz.
- ③④  ..... Earth terminal for measurements.
- ③⑤ A VARIABLE ..... Continuously varies the A sweep time from 1 to 2.5 times the selected scale factor. When set on CAL, the sweep time is the value displayed on the screen. For all uncalibrated settings, there is a > mark displayed on the CRT screen.
- ③⑥ HOLDOFF ..... Used for monitoring complicated waveforms not able to be stabilized using only the front panel LEVEL controls ( ②③ and ②⑤ ). When turned clockwise, the HOLDOFF control lengthens the holdoff time and decreases the screen display intensity. For normal conditions, this rotary control is left on the MIN setting.

- ③⑦ CH2 SIG OUT ..... Output terminal for CH2 signal.
- ③⑧ SEPARATION ..... Adjusts the relative X-axis position of the B sweep for ALT sweep mode. Does not operate for other sweep modes.
- ③⑨  ..... Used to set the amplitude and period of waveforms selected via the AUTO RANGE control ( ①⑨ ). The HORIZ control has nine settings indicating the number of periods for which the A TIME/DIV is made.
- ④⑩ TRACE ROTATION ..... Used to adjust the trace angle when mis aligned by external magnetic fields, etc. (Semi-fixed).
- ④① CH1 VARIABLE ..... Continuously reduces the CH1 sensitivity to a minimum value of 1/2.5.
- ④② CH2 VARIABLE ..... Has the same function for CH2 as control ④① has for CH1.
- ④③ CHARACTER INTEN ..... Used to adjust the trace for characters displayed on the CRT screen. (Brightens the character display when turned clockwise.) When this rotary control is fully turned counter-clockwise, the character display is switched off.

- ④④ SCALE ILLUM ..... Use to adjust the brightness of the on-screen graticule.  
(Brightens the graticule when turned clockwise.)
- ④⑤ VOLTS/DIV  
0.1V 0.5V ..... Attenuator for CH3 input signal.
- ④⑥ ↓ POSITION ..... Used to adjust the Y-axis position of CH3 trace.
- ④⑦ CH3 INPUT ..... Has the same operation for CH3 as control ①② has for CH2.  
During X-Y operation, it displays the Y axis for the vertical deflection mode  
setting made with control ①⑩ .
- ④⑧ Z AXIS INPUT ..... Input connector for CRT display intensity modulation  
signal.

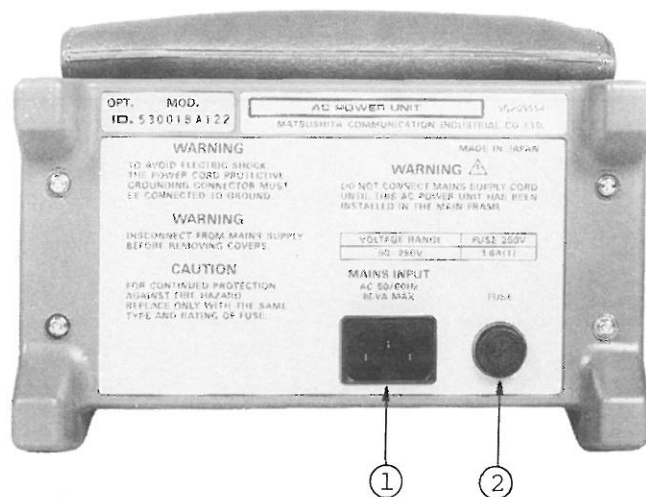




Fig. 4-6 Rear Panel

- ①  ..... Mains power input socket (Plug receptacle)
- ② FUSE .... Holds 1.6A(T) fuse
- 

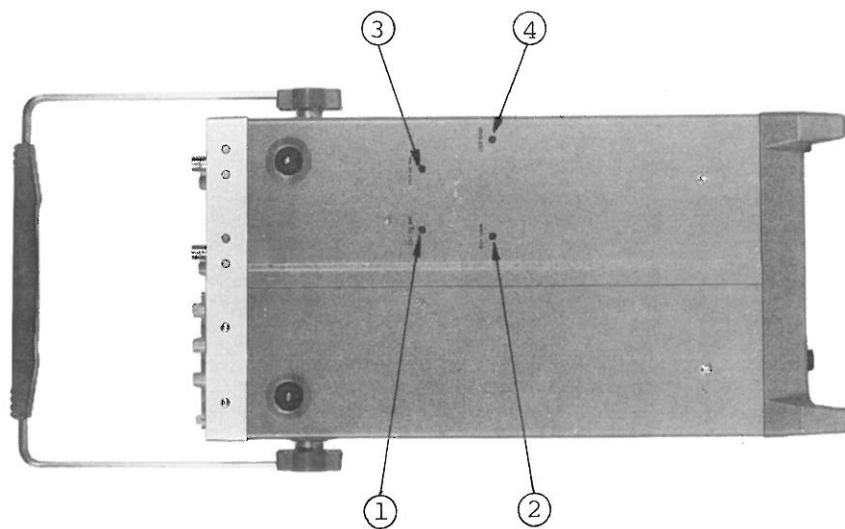


Fig. 4-7 Bottom

- ① CH1 DC BAL ..... Used for CH1 (or X) amplifier DC balance adjustment. Adjust this until turning the CH1 VOLTS/DIV control from 5 mV to 10 mV or 20 mV does not move the trace up and down on the CRT.
- ② CH1 GAIN ..... Used to adjust the gain for CH1. Adjusted with the CH1 VOLTS/DIV control set at 5 mV/DIV.
- ③ CH2 DC BAL ..... Used to adjust CH2 (or Y) amplifier DC balance. The adjustment operation is similar to that for CH1 DC BAL.
- ④ CH2 GAIN ..... Used to adjust the gain for CH2. Adjusted with the CH2 VOLTS/DIV control set at 5 mV/DIV.

#### 4-4 OPERATION OF VERTICAL SECTION

##### (1) Mode Switch

Mode switches CH1, CH2, and CH3 are used for selection and indication of operation modes for CH1, CH2, and CH3. In addition, the CHOP and ALT switches are used to select multitrace operation modes.

- ☐ : Alternates between CH1 and CH2 at the end of each sweep. For sweep time coefficients of 0.2 ms/div or less, the CHOP mode is a more effective observation method.
- ALT



★ ☐ CHOP : The CHOP (chopped) mode is usually used for multi-trace operation with sweep time coefficients of 0.5 ms/div or less and for multi-trace single sweeps. Inter-channel switching is independent of sweeps and has a rate of 500 kHz. The trigger signal source switch cannot be set on NORM when CHOP mode operates.

☐ ADD : The ADD mode is used to display the sum or difference of CH1 and CH2 signals. The following general cautions should be observed when using the ADD mode.

- (a) Do not exceed the maximum input voltage.
- (b) Do not apply voltage in excess of eight times the VOLTS/DIV setting.
- (c) Use the vertical position controls to set both channels' signals as close as possible to the center of the screen.

(2) Input Signal Connections (See controls ⑦ and ⑫)

For ordinary applications, a 10:1 probe is provided. Although the 10:1 probe attenuates the signal by 1/10, its 10 MΩ input impedance provides low-pass characteristics of up to 0.4 Hz (-3 dB) for AC coupling.

To obtain optimum high-frequency characteristics, a coaxial cable should be used to carry the signal to the input connector, with the input connection terminated according to the coaxial cable's characteristic impedance.

For observation of low-frequency signals, ordinary leads can be used to connect signals but since this runs the risk of static noise from outside, use of a shielding wire is recommended.

The oscilloscope's input circuit can be grounded by setting the probe switch on REF.

Signal observation is performed with the switch in the X10 position.

- (3) Input coupling (AC-GND-DC switches -- see controls ⑨ and ⑭).

DC coupling is used for most applications. AC coupling blocks the DC component of the signal. The low-frequency cutoff point is at 4 Hz (-3 dB).

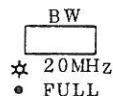
The GND position provides a ground reference at the oscilloscope's input circuit by holding the input circuit at ground potential. The signal applied to the INPUT connector is internally disconnected but not grounded. This is used for many purposes such as checking the base line position.

- (4) Deflection sensitivity

Deflection sensitivity is determined by the attenuation factor of the probe, the VOLTS/DIV control settings, and the VARIABLE control setting. The calibrated deflection sensitivity indicated by the VOLTS/DIV display applies only when each VARIABLE control is set to CAL position.

The VARIABLE control provides variable, uncalibrated, and continuous vertical sensitivity between the calibrated VOLTS/DIV settings and extends the uncalibrated sensitivity to 25 V/DIV at the 10 V/DIV range.

(5) Bandwidth limiter (See control (8))



The BW (bandwidth limiter) switch reduces the frequency bandwidth to 20 MHz to block out undesirable high-frequency signals when viewing low-frequency signals. Pressing the switch (20 MHz setting) turns on the switch light to indicate 20 MHz limited bandwidth mode. Pressing the switch again (FULL setting) turns off the switch light and returns signal monitoring to the full-bandwidth mode.

---

[Trigger-related operations]

- (1) Trigger source switch (SOURCE, ② )
- (a) **SOURCE** ..... The horizontal trigger signal is obtained from the vertical deflection system's signal. The trigger source switch also selects which channel the trigger signal is to be obtained from.

The trigger source switch has the following settings.

**CH1** : Only CH1 signal is used as trigger signal.

**CH2** : Only CH2 signal is used as trigger signal.

**CH3** : Only CH3 signal is used as trigger signal.

**NORM** : A signal corresponding to the waveform displayed on the CRT is used as the trigger signal.

The following table shows the trigger source switches in combination with the vertical axis MODE switches.

T.MODE \ V.MODE	CH1	CH2	CH3	ALT	CHOP	ADD
CH1	○	○	○	○	○	○
CH2	○	○	○	○	○	○
CH3	○	○	○	○	○	○
NORM	○	○	○	○ (Note)		○

In the table, T designates trigger source switches and V designates the vertical axis MODE switches. The circles indicate enabled status.

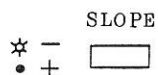
Note: This combination can be used but it will not indicate the time relationship between channels.

(2) Trigger signal coupling switches (COUPLING, ②② & ③③ )

(a) **AC** : Uses a capacitor to block the DC component of the trigger signal while also attenuating signals of 30 Hz or less. The AC setting is used for most applications. However, with the AC setting there can be unstable triggering due to random pulse waveforms. In such cases, DC coupling should be used.

- (b) **DC-LF** : Accepts signals with DC components and frequencies in the Less-than-50-kHz range. When triggering with complex waveforms, this switch setting is useful for providing stable triggering when viewing low-frequency signals.
- (c) **TV(V)**, **TV(H)** : Used for video-signal sync, this function is explained in paragraph 4-28.
- (d) **DC** : DC coupling may be used to provide stable triggering from low-frequency signals which would be attenuated if the AC setting were used and for triggering from low repetition-rate signals.
- (e) **LINE** : The trigger signal is obtained from the mains power supply. Line triggering is useful when the input signal is time-related to the mains frequency.

## (3) SLOPE +, -



This switch selects whether the triggered sweep starts on the positive-going or negative-going sweep portions.

When the switch's light is off, the setting is positive

(+) and the sweep starts on the positive going part of the signal. Conversely, when the switch is pressed to turn the switch's light on, the setting is negative (-) and the sweep starts on the negative-going part of the signal.

## (4) LEVEL controls

These controls set the voltage levels on the triggering waveform at which the sweep is triggered. When the LEVEL control is set in the positive (+) region, the sweep is started at a more positive point on the waveform. When the control is set in the negative (-) region, the sweep is started at a more negative point on the waveform.



## (5) HOLDOFF control

The HOLDOFF control is used to vary the holdoff time between sweeps and to enhance the triggering capability for aperiodic signals, as shown in Fig. 4-8.

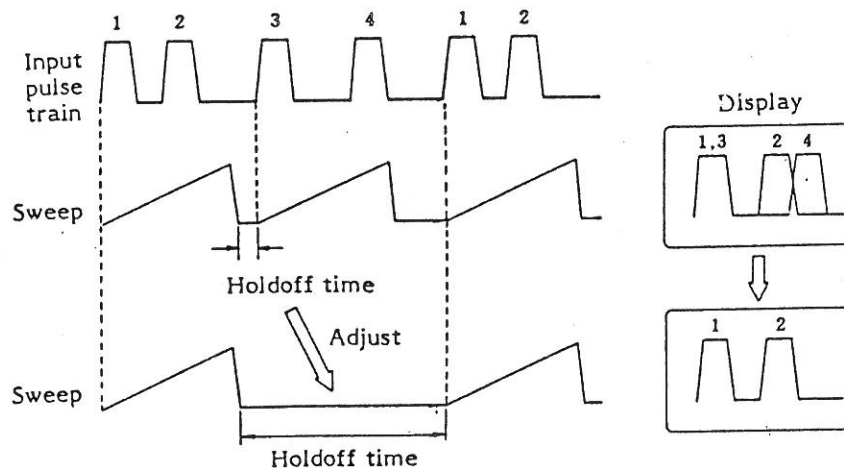


Fig. 4-8 Holdoff Time Adjustment Function

Clockwise rotation increases the holdoff time, causing a dim trace display. For ordinary waveform observations, the control should be kept at the fully counterclockwise position labeled MIN.

[Sweep-related operations]

(6) A sweep mode (controls ①⑦ and ①⑧ )

(a) AUTO : The AUTO setting is very useful for most applications. When there is no trigger signal, this setting maintains the current trace display and thus is useful for checking the trace position. When there is a trigger signal and the LEVEL control has been properly adjusted, stable waveforms can be obtained for observation.

The TRIG'D light goes on during A sweep triggering. When the trigger repetition rate is 50 Hz or less, or when there is no trigger signal, the A sweep becomes a freerun sweep.

(b) NORM : Operation in the NORM setting is the same as in the AUTO setting when a trigger signal is applied. However, when there is no trigger signal, the A sweep remains off and there is no trace display.

This operation is used to clear the trace display when a trigger repetition rate of 50 Hz or less has caused unstable triggering or when there is no trigger signal.

- (c) **SINGLE** : This setting is used when only one sweep is required.

It is useful for observation of single-sweep and random-signal traces.

To use the single sweep mode, first check that the trigger circuit will respond to the event to be displayed. Set the A SWEEP MODE switch to AUTO or NORM and obtain a display in the normal manner. Then press the SINGLE key. The READY light will go on to indicate that the sweep generator has been reset and is ready to produce a sweep. The next trigger pulse initiates the sweep and a single trace will be displayed. After this sweep, the READY light goes off and the A sweep generator is locked off until it is reset. To reset the sweep trigger, press the SINGLE key again.

AUTO RANGE ON/OFF ..... Pressing this key causes both the AUTO and FIX lights to go on and selects the auto range operation mode. In this mode, periodic VOLTS/DIV and TIME/DIV settings are automatically made for input signals from either CH1 or CH2.

When in auto-range mode, the switches for A TIME, B TIME, CH1, and CH2 are all turned off to indicate auto range operation. The B TIME automatically defaults to 1/10 of the A TIME.

Pressing the A TIME key causes its light to go on and switches only the A TIME from auto ranging to manual ranging. B TIME, CH1 and CH2 can also be switched between auto and manual ranging.

When switching completely from AUTO RANGE to manual ranging, press the key again to turn off the light and select the manual mode.

- (7) Sweep time settings (controls ②① and ②② )

The calibrated sweep times for A sweep and B sweep are displayed on the CRT.

To select a setting, press one of the TIME keys and turn the TIME/DIV rotary control.

---

The A VARIABLE control is used to obtain an uncalibrated continuously variable range for the A sweep. Turn this rotary control fully clockwise for the CAL (calibrated) setting in which the calibrated coefficient for the A sweep is displayed on the CRT screen.

For time measurements, the outermost left and right graticule divisions should be excluded. Reliable time measurements must be made in the central eight graticule divisions as shown in Fig. 4-9.

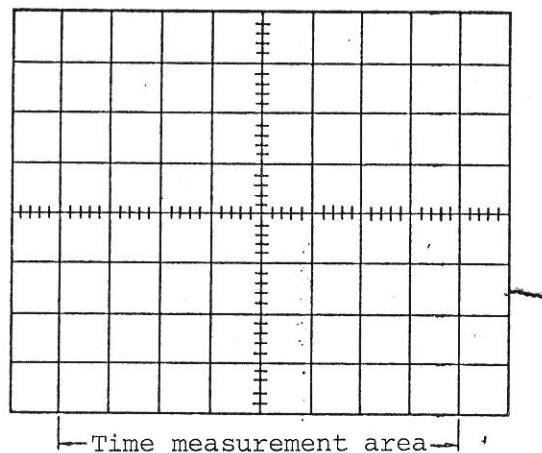


Fig. 4-9 Graticule

(8) Sweep magnification ( $\times 10$  MAG, control ③ )

The sweep magnifier is used to reduce the sweep time to  $1/10$  the previously selected value. Position that part of the displayed waveform to be magnified on the central screen graticule division and press the  $\times 10$  MAG key.

The waveform segment shown in the central graticule division is then magnified by a factor of ten to fill the entire graticule. At this point, the  $\times 10$  MAG light goes on. The displayed value is  $1/10$  of the unmagnified value.

To adjust

To adjust the horizontal position of the magnified display, use the  $\longleftrightarrow$  POSITION control.

#### (9) Delayed B sweep

The delayed B sweep operates in the ALT and B settings of the sweep display mode switch (control ①9 ). These settings cause the A sweep to be delayed until the start of the B sweep. The B TIME key is used to determine the sweep time for the B sweep.

An example of a waveform display obtained using the ALT key is shown in Fig. 4-10 (a). In this figure, the time delay between the start of the A sweep and the intensified portion is determined by the A TIME. The intensified portion of the display is determined by the B sweep time.

When the sweep display mode's B setting is selected, the display changes to show only the intensified portion. (See Fig. 4-10 (b)). The B sweep time is displayed in the upper left corner of the CRT screen.



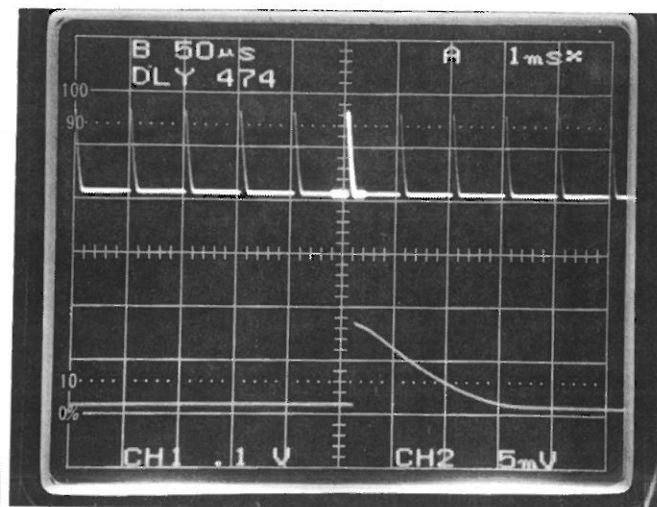


Fig. 4-10 Operation of Delayed Sweep

(10) B sweep triggering level (controls ②⑦ , ②⑧ , and ②⑨ )

- (a) When the FREERUN key on the B sweep section of the control panel is pressed, the light goes on and a display similar to the ones shown in Fig. 4-11(a) and (b) is obtained. (In (b), the B sweep starts after the delay time.)

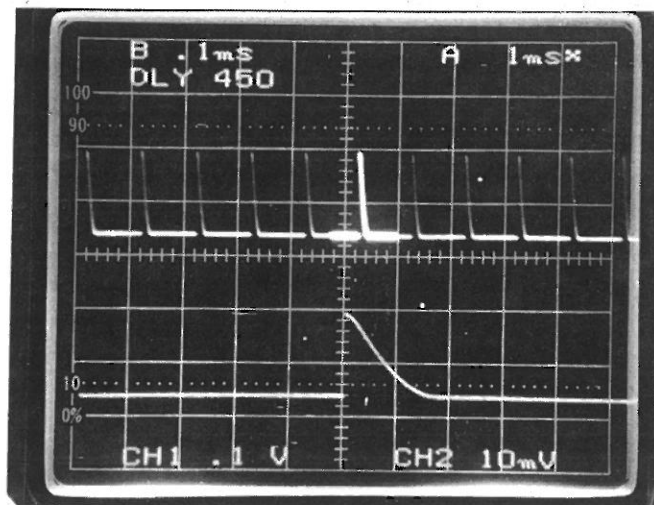
The B sweep starts immediately after the delay time has passed. The delay time is derived by multiplying the A sweep time (A TIME/DIV) by the delay time position and then multiplying the product by .01.

- (b) When the FREERUN switch is turned off to select the B sweep triggering mode, a display similar to the ones shown in Fig. 4-11 (a') and (b') is obtained. (B is triggerable after delay time.)

Following the delay time the first B sweep trigger signal starts the B sweep.

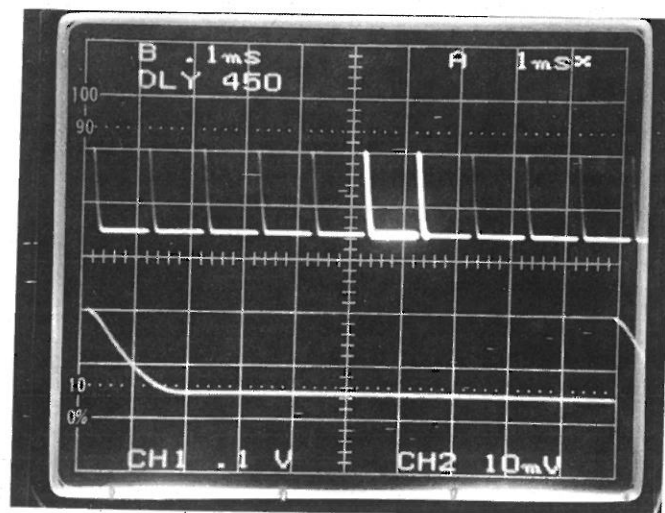
The trigger level-setting procedure is the same for B triggering as for A triggering. When the delay time position is set at ALT as in Figure 4-11 (a'), the intensified portion does not move continuously but instead appears to jump from one trigger level to the next.

One of the special features of this operation method is that it minimizes delay time jitter.



[B starts after delay time]

(Key condition: FREERUN status, light on)



[B triggerable after delay time]

(Key condition: FREERUN status off)

Fig. 4-11 Two Delayed Sweep Operations

(11) Alternate sweeps (A/B alternation, control ①⑤ )

When the sweep display mode's ALT key is pressed, its light goes on to indicate the alternating A/B display mode. This function alternates the CRT display between the A sweep display (including an intensified portion of the trace to indicate the B sweep) and the B sweep (delayed sweep) display. As a result, two waveforms are displayed simultaneously. The unmagnified waveform is shown in Fig. 4-11 (a) and (b) and the magnified waveform is shown in Fig. 4-11 (a') and (b').

The B sweep's vertical position can be adjusted using the SEPARATION control.

(12) TV(V), TV(H) (controls ②② and ③② )

When observing video signals, the trigger signal source switch settings for the A sweep portion and B sweep portion are kept at TV(V) and TV(H) respectively.

79 The only stably triggerable video signals are negative-polarity sync signals with a sync amplitude as described in paragraph 2-2 of the specification. (Image has normal polarity.) 4-49

Since the A sweep function includes a trigger function for vertical triggering, the A sweep is used for field-related observation. AUTO FIX cannot be used.

With the TIME/DIV A TIME control set at 2 ms, two frames can be observed by turning the A VARIABLE control. The vertical sync pulse can be observed in more detail by selecting a faster A sweep speed. However, there is no random selection of frames for observation.

The B sweep (delayed sweep) is used for line-related observation of horizontally triggered signals. With the TIME/DIV B/TIME control set at 10 microseconds and ALT status selected, position the intensified portion so that it includes the portion to be observed. Then select B sweep to obtain a display of that specific line. This video sync signal can be seen in greater detail by selecting a faster B sweep speed.

The A TIME/DIV operation can be used with the HOLDOFF operation to avoid displaying a duplicated waveform caused by interlaced scanning. Although a stable and jitter-free display can be obtained as is shown in Fig. 4-11 (a') and (b'), the observable portion is limited to the front edge of the horizontal sync pulse.

(13) X-Y operation (control ⑮ )

For this operation, the sweep display mode's X-Y key is pressed and the vertical deflection is selected from CH2 or CH3. The signal applied to the CH1 input provide the X-axis deflection. The position can be adjusted using the horizontal and vertical position controls.

Y-axis deflection can be obtained from the signal applied to the CH2 input, enabling this instrument to be used as an X-Y oscilloscope.

X-axis and Y-axis sensitivity is calibrated using the VOLTS/DIV values of CH1, CH2, and CH3.

For dual-trace X-Y operation, vertical deflection is from both CH2 and CH3. (See Table 4-1.)

When the CH2 key is pressed again, CH2 is canceled and the instrument can be then used as an X-Y oscilloscope in which CH1 = X and CH3 = Y.

V- MODE	CH1	X Axis	X Axis	X Axis
	CH2	o		o
	CH3		o	o
	ADD	NG	NG	NG
		X ..CH1 Y ..CH2 Single- trace X-Y	X ..CH1 Y ..CH3 Single- trace X-Y	X ..CH1 Y ..CH2 CH3 Dual- trace X-Y CHOP operation

Table 4-1

## 4-5 Auto ranging

### 4.5.1 General description

The auto ranging function of the VP-5610P oscilloscope produces an easy-to-evaluate waveform on the CRT by just applying input signals. Setting of the vertical axis sensitivity and horizontal axis sweep time are automatically carried out. Even various unknown input signals can be quickly and clearly displayed on the CRT, as long as they are within the specified trigger frequency range. The VP-5610P selects the closest calibrated sensitivity range and sweep time range available for a clear display. The number of cycles and the vertical amplitude for the trace display can be preset.

The auto ranging function selects a vertical axis sensitivity and A sweep time appropriate to each input signal being measured:

- o vertical axis sensitivity from among 11 ranges (5 mV/div to 10 v/div).
- o sweep time of A sweep from among 22 ranges (50 ns/div to 0.5 s/div).

Display controls other than these require normal manual operation.

Selecting a channel for vertical axis, magnifying the A sweep, using the B sweep, or adjusting the vertical or horizontal position should be done in advance or corrected afterwards.



#### 4.5.2 Theory of operation

When the VP-5610P is switched from manual ranging mode to auto ranging mode, the vertical axis channel currently specified is AC coupled with the maximum sensitivity of 5mV/div. the oscilloscope then waits for an input signal. Upon receiving an input signal, the oscilloscope automatically selects the appropriate sensitivity range for the preset trace amplitude. If the time axis is triggerable, the appropriate A sweep time range will be selected to display the specified number of waveform cycles on the CRT. If more than one channel is selected, auto ranging will select an appropriate sensitivity for each channel and will select a time range based on the signal frequency of the lowest numbered channel. Since stable triggering is essential for auto ranging to function properly, the oscilloscope will automatically switch to "AUTO" for the A sweep mode and "AUTO FIX" for triggering when it is switched to the auto ranging mode. The trigger signal source will automatically select the same channel as the currently specified vertical axis. The settings for all other operations will be left as they are.

The available triggering frequency range for the AUTO RANGE function is from 200 Hz to 10MHz. The auto ranging function is applicable to any input signal within the above mentioned frequency that has sufficient amplitude to be stably triggered at the oscilloscope's peak sensitivity of 5mV/div. The B sweep time range (50ns/div to 50mV/div) is automatically determined by the A sweep time. (explained later in detail.)

The vertical axis sensitivities and the sweep times selected by the auto ranging function will be digitally displayed on the CRT.

Auto ranging thus performs simultaneous selection of four kind of ranges; the sensitivity of CH1 and CH2 and the A and B sweep time. Each of the above four ranges can be picked up and switched to manual operation.

This is called semi-auto ranging.

#### 4.5.3 Operating procedure

##### (1) Preparation

It is recommended to pre-adjust some controls before switching to the auto ranging mode.

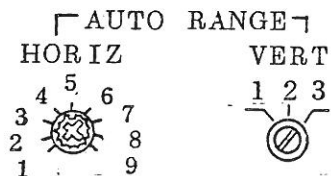
- a) Adjust vertical and horizontal position to position the trace to approximately the center of the CRT with the signal inputs AC coupled.
- b) Select the type of trigger coupling and the desired operation mode of vertical axis.
- c) Turn off the  $\times 10$  magnification of sweep.
- d) Set each "VARIABLE" control to "CAL" and "HOLD OFF" control to "MIN".
- e) Specify the A sweep mode and temporarily turn off the B sweep.

- (2) Range switching point - setting the desired amplitude level and number of cycles to be displayed.

This operation selects the sensitivity range switching point, specifying the vertical trace amplitude at which a different range will be used.

It is also used to specify the number of cycles at which a time range will be used.

Use a screw driver to adjust VERT and HORIZ, the two semi-fixed "AUTO RANGE" switches in order to make the setting.



#### Number of cycles of a waveform

The numbers 1 to 9 indicate the minimum number of cycles of a trace, since they serve only as a reference based on a sine wave signal with the range coarsely graduated, (1-2-5 sequence) the exact number of cycles to be displayed will vary.

#### Vertical reference amplitude level

Set the approximate value for the reference amplitude level at 1 to 3 as follows:

1 ..... 4 div.

2 ..... 6 div.

3 ..... 8 div.

Since these serve only as a reference based on a sine wave, (with the range selectable in steps of 1-2-5) the exact number of divisions for each waveform will depend on the signal shape and strength.

### (3) Starting auto ranging

Press the AUTO RANGE key on the front panel to ON turning its light on. The oscilloscope will change its mode from manual ranging to auto ranging. All four keys located in a line at the top will go off and the manual range controls (TIME/DIV or VOLTS/DIV) will become inoperative.

At the same time the AUTO key for selecting the A sweep mode will turn on and the FIX key for selecting triggering will also turn on to show that AUTO FIX is selected.

Next, one of four lights (trigger signal SOURCE) turns on to show the available signal source for triggering. This selection is based on vertical mode. Then AC input coupling for the vertical channel in use will be selected and the AC key light will turn on.

If the input signal to be measured falls within the AUTO RANGE capability of AUTO FIX triggering auto ranging will provide a stable trace.

#### (4) Auto ranging and trigger source in multi-trace operation

If auto ranging is started in a multi-trace operation, the trigger signal source will automatically be selected as shown in the table below.

Vertical channels in use	CH1	CH1	CH2	CH1, CH2
	CH2	CH3	CH3	CH3
Trigger signal source	CH1	CH1	CH2	CH1

The number of signal cycles to be displayed depends on the signal from the trigger signal source.

The source can be changed manually even after auto ranging is started, provided that a signal has been applied to the selected channel and triggering is possible.

CH3 can only be ranged manually and is used for multi trace operation and external trigger signal input.

(5) Changing settings and displaying the B sweep

Each setting described so far can be changed while the AUTO RANGE function is operating. However, the settings for the range switching point discussed in (2) cannot be changed during the AUTO RANGE operation. In this case, it is necessary to remove the signal input momentarily so that the sweep will freerun and then to apply it again. To remove the vertical axis signal input, any of the following will suffice:

- o Disconnect the probe
- o Select GND momentarily from the front panel
- o Select REF momentarily at the attached probe

Pressing the AUTO RANGE key to ON will also cause re-triggering, but the oscilloscope will return to the initial setting of the auto ranging mode.

B sweep and  $\times 10$  magnification are also available. The number of cycles of signal to be displayed does not consider sweep magnification.

If the B sweep is selected after auto ranging has been started, the B sweep time is automatically set to one-tenth of the A sweep time (the B sweep rate is ten times faster). The fastest B sweep selectable by auto ranging is 50ns/div. To manually change the B sweep time setting, press the B TIME key of the four MANUAL keys, turning the key light on. Then operate the manual range control to select the desired B sweep time.

(6) Semi-auto ranging

The manual selection of the B sweep time discussed in the last part of the preceeding paragraph (5) is an application of semi-auto ranging. The other three ranges, CH1·CH2 sensitivity range and the A sweep time range, are also available one at a time, for manual ranging.

To select the semi-auto ranging leave the AUTO RANGE key ON with its light on and press one of the four MANUAL keys turning its light on.

All the ranges are manually selected with the manual range control (TIME/DIV or VOLTS/DIV).



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(7) Releasing the auto ranging mode

To change the auto ranging to the manual ranging mode, press the AUTO RANGE key turning its light off. This leaves all the settings as they are. The A TIME key of the four MANUAL keys will light to return the oscilloscope to the state in which the A sweep time can be selected with the manual range control.

(8) Notes

- o X-Y operation is not compatible with the AUTO RANGE function.
- o NORM and SINGLE sweep modes are not selectable.

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