

Instruction Manual

OSCILLOSCOPE

VP-5516A

Panasonic

ID NUMBERS

This manual applies directly to the products with ID numbers suffixed 122,125,126.

For additional information on ID numbers refer to 1-2 ID NUMBER in SECTION I.

OSCILLOSCOPE

VP-5516A

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.

WARNING

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

CAUTION

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.

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 INTRODUCTION

This model VP-5516A is a 100-MHz, four-channel oscilloscope with CRT readout incorporated. The vertical axis provides deflection coefficients from 2 mV/division to 5 V/division. A $\times 2$ magnifier enables the deflection coefficient down to 1 mV/division. The frequency bandwidth is from DC to 100 MHz at 5 mV/division.

The automatic triggering ("Auto Fix") feature employed in the instrument provides simple and stable operation. The sync separator provides TV video signal display including the three-dimensional display with the new function 3D.

The horizontal axis provides calibrated time coefficients from 0.5 s/division to 20 ns/division (down to 2 ns/division by a $\times 10$ magnifier). Also available is the triple-trace X-Y operation with CH1-X, CH2-Y, CH3-Y, and CH4-Y.

The VP-5516A provides readout to display deflection coefficients, time coefficients, and delay time. Among twelve menu-applied functions are the cursor function enabling easy measurement of ΔV , ΔT or YES-NO judgment, and the label function to display up to 42 kinds of alphanumeric characters.

A switching regulator is employed as the mains power supply that allows the oscilloscope to be used in a wide range of 90 to 250V.

1-2 ID NUMBER

This instrument is numbered with a ten-character ID number. The first seven digits and letters are assigned uniquely for each product. The last three digits comprise the ID suffix which is the same for all identical products and changes when a change is made. All correspondence with the factory or representatives concerning this instrument should include the complete ten-character ID number.

The contents of this manual apply directly to products numbered with the same ID number suffix(es) as noted under the title of ID NUMBERS on the first page of the manual.

1-3 CONFIGURATION OF THIS MANUAL

This operation manual provides information as follows.

- (1) Section I - General
Gives brief introduction of the oscilloscope.

- (2) Section II - Specifications
Gives specifications of the oscilloscope.
- (3) Section III - Installation
Explains electrical and mechanical setup of the oscilloscope prior to use. Also discussed are the precautions required for safety handling and operation of the oscilloscope.
- (4) Section IV - Operation
Detailed description of each of the functions and their operation.
- (5) Section V - Menu-Applied Functions
Explains the menu-applied functions for various new applications.
- (6) Section VI - Maintenance
A bried description of daily maintenance.

SECTION II
SPECIFICATIONS

(Warm-up time for given performance is 15 minutes.)

2-1 ELECTRICAL CHARACTERISTICS

(1) Vertical axis

Designation	Performance		Supplemental information
Deflection coefficient CH1, CH2	2 mV/div to 5V/div, 11 calibrated positions in 1-2-5 sequence.		Each volts/div readout appears on screen. Deflection coefficients of all channels are halved.
CH3, CH4	0.1 V/div and 0.5 V/div, 2 positions.		
×2 magnification	2-time deflection can be obtained for all channels at the same time.		
Error limits	+15°C to +35°C	0°C to +50°C	VARIABLE control set at CAL position.
Normal	±2%	±3%	
×2	±5%	±6%	
VARIABLE control	Uncalibrated variable control between the positions and up to at least 12.5 V/div.		CH1, CH2 only.
CH2 signal output	10 mV/div, ±10%.		Across 1 MΩ load.
Response, rise time (tr)			BW: -3 dB bandwidth DC coupled VARIABLE control set at CAL position. Measured with 25 Ω source impedance, with reference to 6-div deflection.
CH1, CH2	BW	tr (calculated)	
2 mV/div	50 MHz	≤ 7 ns	
5mV/div to 2V/div	100 MHz	≤ 3.5 ns	
×2	Half of above	Twice of above	
CH3, CH4 0.1V/div, 0.5V/div	100 MHz	≤ 3.5 ns	
CH2 signal output	10 MHz	≤ 35 ns	
Input impedance	1 MΩ ±2%, 22 pF ± 3pF		
Max. permissible input voltage	200V, DC + AC peak		10 seconds or less.

Specifications

Designation	Performance		Supplemental information	
Input coupling	CH1, CH2: AC, DC, GND			
	CH3, CH4: DC coupled			
Display mode	Single or multiple-trace selected from CH1, CH2, CH3, CH4 and ADD. CHOP or ALT can be selected for multiple-trace display.		ADD: algebraic addition of CH1 and CH2. CHOP: chopped ALT: alternate	
Switching rate in CHOP mode	500 kHz \pm 30%			
Display polarity inversion	CH2 only			
Bandwidth limiter	Approx. 20 MHz		-3 dB bandwidth	
Apparent signal delay (Td)	\geq 10 ns			
Deflection linearity	\leq 0.1 div; deviation in vertical deflection for a signal set to 2 div at the center on the screen vertically.		Measured with a 50 kHz sine wave by moving the trace within full effective screen area.	
Instability of the spot position	Long-term drift	Temperature drift		
	2 mV/div	\leq 1.5 div/h		\leq 0.3 div/ $^{\circ}$ C
	5 mV/div to 5V/div	\leq 0.5 div/h		\leq 0.1 div/ $^{\circ}$ C
Interaction between circuits Decoupling factor between CH1 and CH2	\leq -50 dB at 10 MHz, \leq -34 dB at 50 MHz		Measured with the same deflection coefficient set for both channels within the range from 2 mV/div to 0.5 V/div.	
Automatic ranging	Automatically selects a deflection coefficient so as to obtain a trace within 8-div amplitude in response to the input signal level. Frequency range: 1 kHz to 30 MHz Input voltage range: 10 mV to 40V p-p		Measured with a sine wave.	

(2) Triggering

Designation	Performance			Supplemental information
Trigger source	CH1, CH2, CH3, CH4 NORM LINE (for A sweep trigger only)			From each channel selected. From the displayed channel(s). From mains power supply line.
Trigger coupling	AC, AC-LF, AC-HF, DC TV(V) TV(H)			For A sweep trigger only. For B sweep trigger only.
Trigger slope	+ or 1st field in TV(V) operation - or 2nd field in TV(V) operation			+: positive-going slope. -: negative-going slope.
A sweep triggering mode	Normal FIX			"Auto Fix" triggering
B sweep triggering mode	Normal FREERUN			
Trigger threshold in normal mode	Coupling	Frequency	Amplitude	Measured with 0.4-div amplitude. Polarity: sync negative.
	AC	50 Hz to 5 MHz up to 100 MHz	0.3 div 1.5 div	
	AC-LF	50 Hz to 50kHz above 500kHz	0.4 div Untriggerable	
	AC-HF	100kHz to 5MHz up to 100MHz	0.4 div 1.5 div	
	DC	DC to 5 MHz up to 100 MHz	0.3 div 1.5 div	
	TV(V), (H)	TV sync signal	1.0 div	
Trigger threshold in FIX mode	Coupling	Frequency	Amplitude	For A sweep triggering only.
	AC	400Hz to 5MHz up to 100MHz	0.5 div 2.0 div	
	AC-LF	400Hz to 50kHz	0.7 div	
	AC-HF	100kHz to 5MHz up to 100MHz	0.7 div 2.0 div	
	DC	400Hz to 5MHz up to 100 MHz	0.5 div 2.0 div	

Designation	Performance	Supplemental information
Triggering in AUTO of A sweep mode	Stable display presented with the same trigger thresholds for signals above 50 Hz.	Presents a freerunning display for lower frequency signals or in the absence of an adequate trigger signal.

(3) Sweep

Designation	Performance		Supplemental information	
A sweep mode	AUTO NORM SINGLE		Triggered or free running. Triggered. Single shot.	
Display mode	A A INTEN ALT B		Main A sweep. A intensified by B. Alternate sweep. Delayed B sweep.	
Time coefficient	A sweep		Each time/div readout appears on screen.	
	20ns/div to 0.5s/div, 23 calibrated positions in 1-2-5 sequence.			
	B sweep			
	20ns/div to 50ms/div, 20 calibrated positions in 1-2-5 sequence.			
Error limits	+15 °C to +35 °C	0 °C to +50 °C	A VARIABLE control set at CAL position. Measured over middle 8 div of display.	
	50ns/div to 0.2s/div	±2%		±4%
	20ns/div, 0.5s/div	±3%		±5%
VARIABLE control	Uncalibrated variable control between the positions and up to 1.25 s/div.		A sweep only.	
Sweep magnifier Magnification	×10 Extends minimum time coefficient to 2 ns/div.		Center division of display is expanded to provide magnified display.	

Designation	Performance		Supplemental information
Additional error	1%		Measured over middle 8 div of display excluding first 0.25 div and 50 ns portions, and the portion exceeding 100 div from the sweep start.
Magnified sweep linearity			
Normal sweep time/div	+15°C to +35°C	0°C to +50°C	
0.2µs/div to 0.5s/div	±2%	±3%	
20ns/div to 0.1µs/div	±3%	±3.5%	
A sweep holdoff time	Continuously variable to increase the time at least at a factor of 4.		
Automatic ranging	Automatically selects an appropriate time coefficient that will enable to display at least one cycle of waveform with the normal A sweep operation in response to the input signal frequency. Frequency range: 50Hz to 100MHz		

Specifications

(4) Delayed sweep

Designation	Performance		Supplemental information
Delay time (DLY) Control range	0.2 to 10 divisions in A sweep time/div settings from 0.5 μ s/div to 0.5 s/div. Calibrated in the range 0.5 μ s to 5 s with A VARIABLE control set at CAL position.		DLY readout on screen. DLY: Time from A sweep trigger point to start of B sweep.
Error limits			e: 1% of the time for 10 divisions in each A sweep time/div setting, plus 50 ns.
A sweep time/div	+15 °C to +35 °C	0 °C to +50 °C	
0.5 μ s/div, 0.1s/div to 0.5s/div	\pm (3% or DLY reading +e)	\pm (5% of DLY reading +e)	
1 μ s/div to 50ms/div	\pm (2% of DLY reading +e)	\pm (4% of DLY reading +e)	
Delay jitter	20,000 : 1 or less		0.5 div or less jitter measured for 2 seconds with A sweep set to 1 ms/div and B sweep to 1 μ s/div.

(5) 3D

Designation	Performance	Supplemental information
3D: 3-dimensional display	Repetitively displays triggered delayed sweep trace of the line waveform of TV composite signal during A sweep with ALT mode, gradually shifting the trace at every repetition toward the lower-right part of screen. Maximum number of repetition: 255	

1

(6) X-Y operation

Designation	Performance		Supplemental information
Operations Inputs	X-axis: CH1 Y-axes: CH2, CH3, CH4		Multi-trace operation is made in CHOP mode.
Positioning	X-axis: Horizontal POSITION control. Y-axes: CH2, CH3, CH4 POSITION controls.		
Deflection coefficients CH1, CH2	2mV/div to 5V/div, 11 calibrated positions in 1-2-5 sequence.		Each volts/div readout appears on screen.
CH3, CH4	0.1V/div and 0.5V/div, 2 positions.		
Error limits	+15 °C to +35 °C	0 °C to +50 °C	CH1, CH2 VARIABLE controls set at each CAL position.
X-axis	$\pm 3\%$	$\pm 4\%$	
Y-axis Normal	$\pm 2\%$	$\pm 3\%$	
Input impedance	1 M Ω $\pm 2\%$, 22 pF ± 3 pF		
X and Y phase difference	$\leq 3^\circ$, DC to 1 MHz		

(7) Z-axis

Designation	Performance	Supplemental information
Intensity modulation	5Vp-p signal produces noticeable modulation at normal intensity.	Positive-going signal decreases trace intensity.
Frequency range	DC to 20 MHz	
Input resistance	Approx. 47 k Ω	
Max. permissible input voltage	50V, DC+AC peak	

Specifications

(8) Calibrator

Designation	Performance		Supplemental information
Waveform	Positive square wave		Duty factor: 45 to 55%
Voltage and error limits	+15 °C to +35 °C	0 °C to +50 °C	Across 1 MΩ load.
	0.3 Vp-p ±1%	0.3 Vp-p ±1.5%	
Frequency	1 kHz ±10%		

(9) General readout display

Designation	Performance	Supplemental information
Vartical axis	Deflection coefficients: mV, V (/div) Uncalibrated symbol: > Inverted polarity: - Input coupling: AC, GND, DC	CH1, CH2, CH3, CH4 CH1, CH2 CH2 CH1, CH2
Horizontal axis	Time coefficients: ns, ms, s(/div) Uncalibrated symbol: > Delay time: DLY ns, ms, s Trigger sources: CH1, CH2, CH3, CH4, NORM, LINE Trigger couplings: AC, AC-LF, AC-HF DC, TV(V), TV(H) Trigger slope: ↗(+), ↘(-)	A sweep, B sweep. A sweep. LINE for A sweep only. TV(V) for A sweep only. TV(H) for B sweep only.

(10) Menu application functions

Designation	Performance	Supplemental information
Cursor measurement GND-V Readout	Voltage from the ground level.	Cursor movable range Voltage cursor: 0 to 7.992 div Time cursor: 0 to 10 div rdg: reading fsd: full-scale deflection T-Y reference: 360 degrees X-Y reference: 90 degrees Tr: rise time Tf: fall time
Error limits	$\pm(0.8\% \text{ of rdg} + 3.12\% \text{ of fsd})$	
ΔV Readout	Voltage difference between two voltage cursors (V1, V2).	
Error limits	$\pm(0.8\% \text{ of rdg} + 2\% \text{ of fsd})$	
$\Delta T, 1/\Delta T$ Readout	Time difference between two time cursors (T1, T2) and its reciprocal.	
Error limits	$\pm(1\% \text{ of rdg} + 0.8\% \text{ of fsd})$	
PHASE (T-Y and X-Y) Readout	Phase difference measurement in degrees for optionally set reference using two cursor lines.	
Error limits	$\pm(1\% \text{ of rdg} + 0.8\% \text{ of fsd})$	
Tr, Tf Readout	Rise time and fall time measurements using four cursor lines.	
Error limits	$\pm(1\% \text{ of rdg} + 0.8\% \text{ of fsd})$	
Peak detection TRACE readout	Repetitively detects +/- peak values of the input waveform.	Available only in single-trace operation by CH1 or CH2 with NORM trigger source selection. Specified for sine wave input. Required for B sweep operation are: 1) A sweep repetition period ≤ 6.5 ms, or A time coefficient ≥ 0.5 $\mu\text{s}/\text{div}$, and 2) A and B time coefficients $A : B \leq 10 : 1$.
MAX readout	Detects and holds the maximum +/- peak values of the input waveform.	
Error limits	$\pm(0.8\% \text{ of rdg} + 10\% \text{ of fsd})$	
Frequency range	TRACE: 100 Hz to 3 MHz MAX: DC to 3 MHz	
YES/NO amplitude judgment	OVER message appears for a waveform exceeding optionally set limit cursor line.	
Error limits	$\pm(0.8\% \text{ of rdg} + 10\% \text{ of fsd})$	Accuracy of cursor position.
Frequency range	DC to 3 MHz	

Specifications

Designation	Performance	Supplemental information
Ground level cursor line	Indicates ground level.	Available only for CH1 and CH2 displays. To be used after performing the SELF CAL operation.
Movable range	0 to 7.992 div	
Trigger level cursor lines	Indicate A and B trigger levels.	
Movable range	± 4 div, measured with 1 kHz sine wave.	
REF WAVE	Stores peak-sampled data of input waveform and displays it for use as a reference waveform.	A sweep range: 0.5 μ s/div to 0.2 ms/div. Specified for sine wave input.
Memory capacity	128 bytes	
Resolution	≥ 7 bits	
Frequency range	DC, and from 5 kHz to 1 MHz.	
Labeling Writing position	16 lines within effective screen area.	8 x 10 div.
Number of characters	Maximum 50 total characters. Maximum 31 characters per line.	
Characters available	42 (0 to 9, A to Z and six symbols)	+, -, *, /, \square (space), .
Trace identification	Affixes given names to trace and cursors.	Affixed name follows the movement of the named trace except for CH3 and CH4 display.
Names	CH1A, CH1B, CH2A, CH2B, CH3A, CH3B, CH4A, CH4B, V1, V2, T1, T2, 1G, 2G, A, B.	
Position	Same as the label writing position.	
Movement following area	16 lines of 31-character length within effective screen area.	

(11) Power requirements

Designation	Performance	Supplemental information
Mains voltage	90V to 250V	
Mains frequency	48 Hz to 440 Hz	
Power consumption	100 VA or less	

(12) CRT

Designation	Performance	Supplemental information
Type	Rectangular, internal graticule.	
Total accelerating voltage	Approximately 17 kV.	
Effective area	8 x 10 div	1 div \approx 10 mm.

2-2 ENVIRONMENTAL CHARACTERISTICS

Designation	Performance	Supplemental information
Ambient temperature	0 °C to +50 °C	Limit range of operation.
	-20 °C to +70 °C	Storage and transportation.
Humidity (R.H.)	20% to 80%	Limit range of operation, and storage and transportation.
Vibration test*	15 minutes along each of the three major axes at a total displacement of 0.6 mm peak-to-peak with frequency variation of 10-55-10 Hz in 1-minute cycles. Hold at 55 Hz for 3 minutes on each axis.	Total test time: 54 minutes.
Shock test*	The oscilloscope standing in its normal position of use on a smooth hardwood surface is tilted about one bottom edge so that the distance between the opposite edge and the test surface is 10 cm. It is then to fall freely onto the test surface. Three drops about each of the four bottom edges.	Total of 12 drops.
Package drop*	75 cm drop on one corner, three edges radiating from that corner and all flat surfaces.	Total of 10 drops.
*Note: The oscilloscope will endure one round of these tests. Repeated tests, however, may cause a partial damage to the instrument.		

2-3 MECHANICAL CHARACTERISTICS

Designation	Information			Supplement
	Height(mm)	Width(mm)	Depth (mm)	
Dimensions				
Frame	160 ± 3	310 ± 3	455 ± 3	
Overall (max. values)	210	365	520	Include feet and handle.
Mass	Approximately 10 kg.			

2-4 ACCESSORIES FURNISHED

Designation	Quantity	Supplemental information
Probe	2	10:1
Power cable	1	
Spare fuse	1	1.6A, Time lag
Spare lamp	1	Scale illumination
Instruction manual	1	

2-5 OPTIONAL ACCESSORIES

Optional accessories available for use with this oscilloscope include a front cover, accessory punch, mobile cart, binding post adapter and oscilloscope camera.

SECTION III INSTALLATION

3-1 POWER REQUIREMENTS

The Model VP-5516A can be operated from any power source supplying from 100 V to 250 V, 48 Hz to 440 Hz. Power consumption is less than 100 VA.

3-2 FUSE



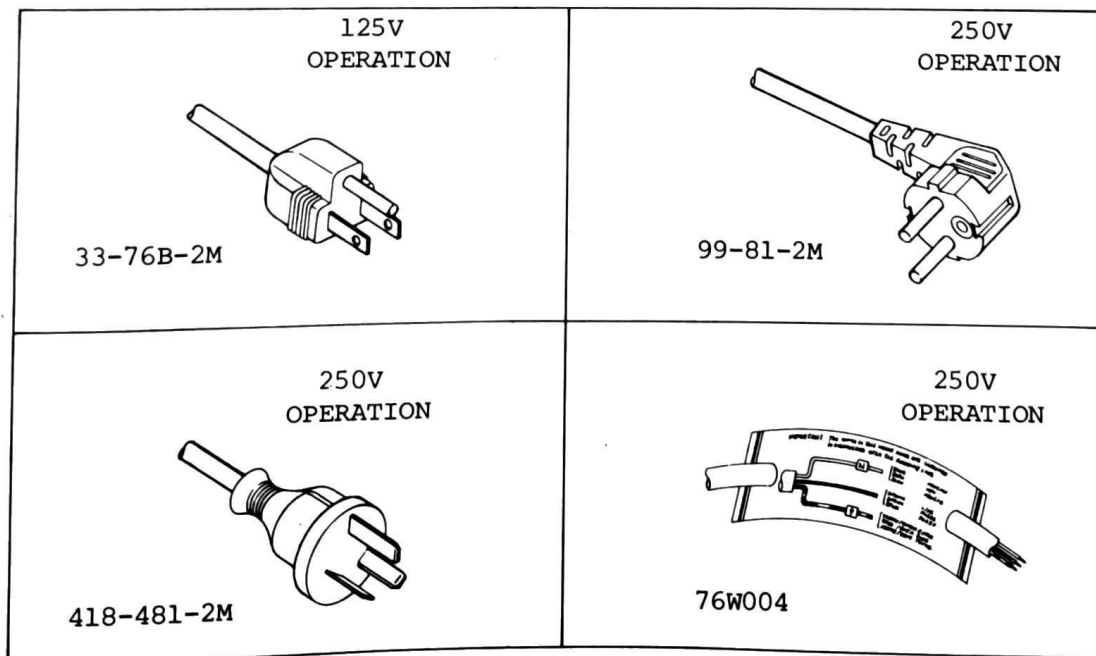
Verify that the proper fuse is installed in the fuse holder. Ratings of the fuse are 250V, 1.6A (time lag) as noted on the rear panel.

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-5516A 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-5516A 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.

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 rear 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 front 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.

Note

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.

WARNING

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

3-7 INITIALIZATION RESETTING

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 fail because of noise disturbances from the power supply line by 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 and holding the GND key of either CH1 or CH2.
- 3) Release the key and select the desired operating mode.

Note

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

SECTION IV OPERATION

4-1 INTRODUCTION

Given in this section are the general information for using the oscilloscope, brief description of the controls and connectors on the front and rear panels, and the explanation for operating each function.

4-2 GENERAL INFORMATION

(1) Instrument start-up

The oscilloscope displays the message "CAL REQUEST" for about 30 seconds each time the instrument is turned on. After the period or by pressing any front panel key, the instrument will enter the normal operating mode.

The message advises the operator to make calibration (scale factor correction using CAL terminal) explained in paragraph (6) below. If it is not required to modify the scale factor correction, the message is to be ignored.

(2) Intensity of the trace

Intensity set too high can damage the CRT. Reduce the intensity when the sweep speed is changed from high to low, or when a trace is kept still at a same position for a long while.

(3) Gradient of the trace

A freerunning trace may not be in parallel with the scale line due to a high magnetic field or terrestrial magnetism. In such a case, adjust the trace with the menu-applied function explained in Section V of this manual.

(4) Scale illumination

The graticule lines can be illuminated as desired by rotating the SCALE ILLUM control on the front panel. For photographing a waveform with the scale graticules, adjust the control to obtain required brightness.

(5) Intensity modulation (Z-axis input)

Intensity can be modulated by applying a signal to the Z AXIS INPUT connector on the rear panel. The Z axis signals must be time-related to the displayed waveform for obtaining a stable presentation on the CRT.

The voltage amplitude of the signal required for intensity modulation depends on the setting of the INTEN control. At normal intensity level, a 5V peak-to-peak positive signal will produce a visible modulation in brightness.

(6) Calibrator

(CAL output)

The CAL terminal on the front panel provides 0.3 V_{p-p} positive square-wave output with frequency of approximately 1 kHz. The output signal is used for checking deflection coefficient of the vertical axis or for adjusting probe compensation. The signal source impedance of this output is less than 100 ohms. When connecting a probe to the CAL terminal, be sure to connect the ground lead of the probe to the measuring earth terminal beneath the CAL terminal.

(Scale factor correction)

If the CAL terminal is pressed with the CH1 probe tip connected to the terminal for about one second or longer, the oscilloscope automatically detects the attenuation ratio of the probe to correct the deflection coefficient to be read directly. Note that all the other channels are corrected at the same time assuming to have the same type of probes.

(7) Balance compensation

This function automatically adjusts the attenuator balance, DC balance, and VARIABLE control balance. Press the SELECT key to call the MAIN MENU, select DC BALANCE on the menu with the ↑ or ↓ key, and press the SELECT key again to activate the function.

(8) Drift compensation of the ground cursor lines

The drift of the ground cursor lines can be automatically compensated. Use this function for more accurate result before performing measurement with such cursor measurement functions as VOLTAGE, PEAK, or GROUND LEVEL.

Select SELF CAL on the CURSOR menu to bring a → mark on the CRT. Position the CH1 and CH2 trances on the → mark and press the SELECT key to activate the function.

4-3 PANEL FEATURES

Explained in this paragraph are keys, controls, connectors, terminals, and indicator lights. The explanation together with figures will be given for each section as shown below.

Section	Figure	Page
CRT section	Fig. 4-2	4-4
Vertical axis	Fig. 4-4	4-6
Horizontal axis	Fig. 4-5	4-9
Rear panel	Fig. 4-6	4-14

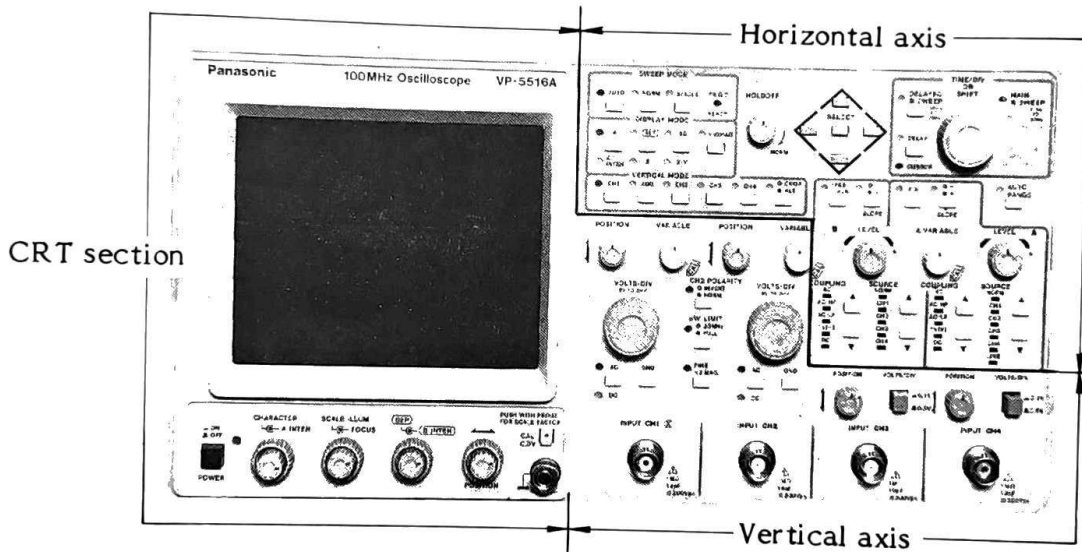


Fig. 4-1 Front Panel

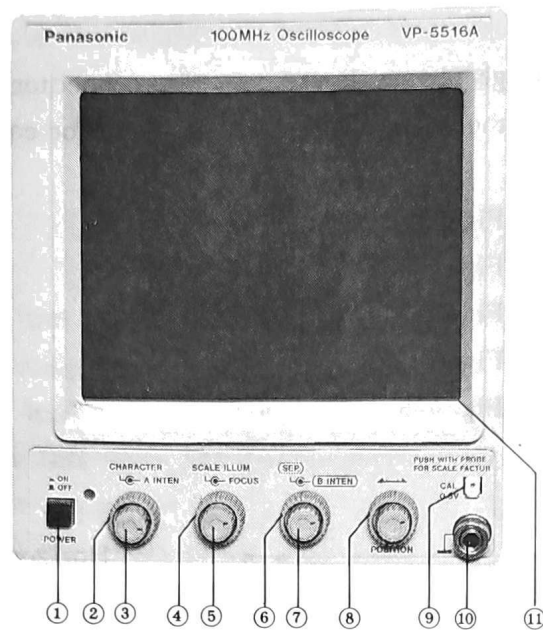


Fig. 4-2 CRT Section

- ① **POWER**
Controls power to the instrument. The light on the upper right of the switch turns on to indicate the power is supplied.
- ② **CHARACTER (outer)**
Controls intensity of characters displayed on the CRT. Rotating the control clockwise increases brightness. Rotating it counter clockwise decreases brightness until it is fully rotated to stop the readout display function. To stop the readout function will eliminate flicker of readout characters.
- ③ **A INTEN (inner)**
Controls brightness of the trace on the CRT.
- ④ **SCALE ILLUM (outer)**
Controls graticule illumination. Rotating it clockwise increases brightness.
- ⑤ **FOCUS (inner)**
Adjusts display for optimum definition.
- ⑥ **SEP (outer)**
Adjusts the vertical position of the B sweep in the ALT display mode. Ineffective in other display modes.
- ⑦ **B INTEN (inner)**
Controls brightness of the B sweep in the display mode ALT or B.

⑧ POSITION (dual)

Control the horizontal position of the trace. The inner knob is used for fine adjustment.

⑨ CAL 0.3V

Provides 0.3 Vp-p square-wave output with frequency around 1 kHz. See paragraph 4-2(5) for the scale factor correction.

⑩ ⊥

Measuring earth terminal.

⑪ CRT screen

Displays waveforms together with various kind of readout shown in Fig. 4-3.

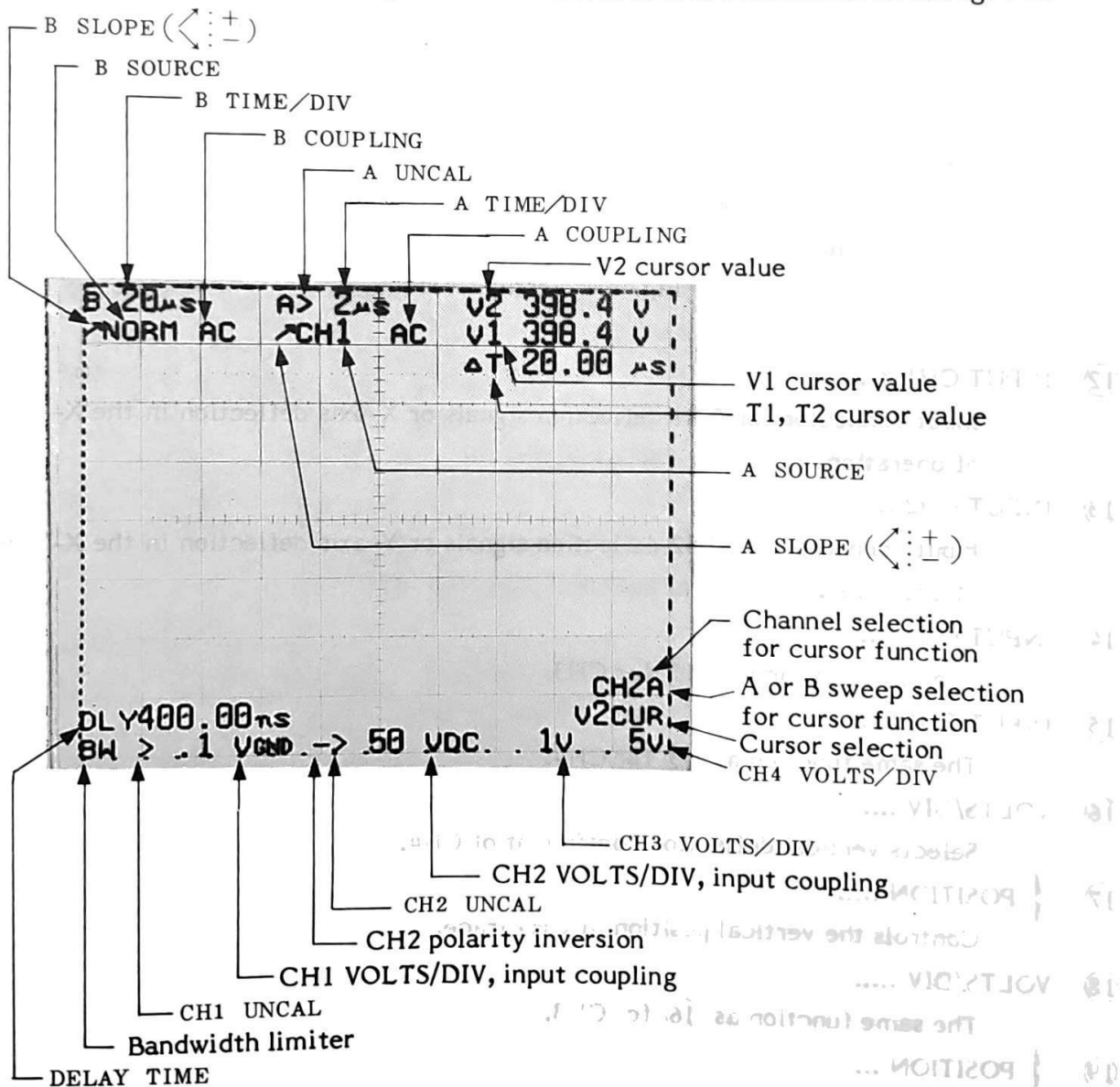


Fig. 4-3: CRT Readout

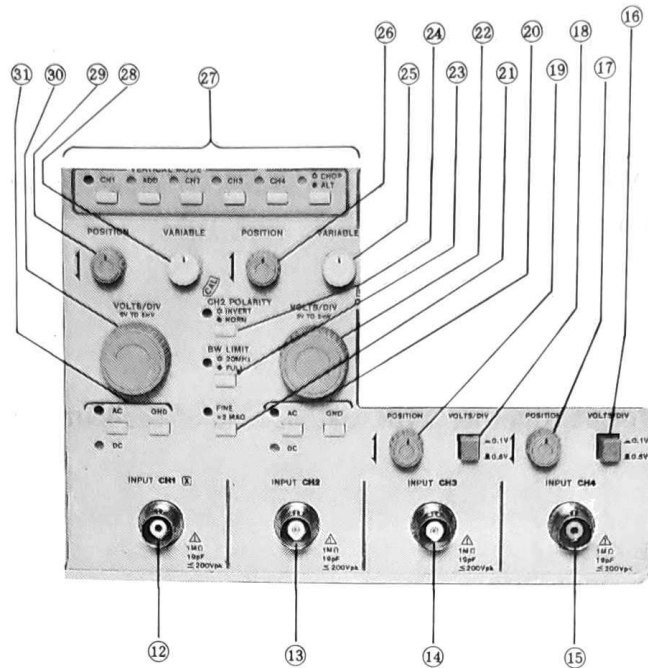


Fig. 4-4 Vertical Axis

- ⑫ INPUT CH1
Input connector for CH1 deflection signals or X-axis deflection in the X-Y mode of operation.
- ⑬ INPUT CH2
Input connector for CH2 deflection signals or Y-axis deflection in the X-Y mode of operation.
- ⑭ INPUT CH3
The same function as ⑬ for CH3.
- ⑮ INPUT CH4
The same function as ⑬ for CH4.
- ⑯ VOLTS/DIV
Selects vertical deflection coefficient of CH4.
- ⑰ POSITION.....
Controls the vertical position of CH4 trace.
- ⑱ VOLTS/DIV
The same function as ⑯ for CH3.
- ⑲ POSITION...
Adjusts the vertical position of CH3 trace.

②0 AC-DC-GND

Selects method of coupling input signal to the vertical deflection system.

AC, DC

A key for selecting AC or DC coupling.

Pressing the key turning the AC light on selects the AC coupling. DC component of input signal is blocked. Low frequency limit (-3 dB point) is about 4 Hz. Note that square wave display below 1 kHz shows noticeable sag. Pressing the key turning the DC light on selects the DC coupling. All the frequency components of the input signal are coupled to the vertical deflection system.

GND

Pressing the key turns the AC or DC light off to select GND. The input circuit is grounded (does not ground the applied signal).

②1 FINE $\times 2$ MAG

Pressing the key turning the key light on halves the deflection coefficients of all channels by expanding center ± 2 divisions of the display to full screen vertically. Pressing the key again turns off the key light and the magnification is released.

②2 VOLTS/DIV

Selects VOLTS/DIV for CH2 by rotating the control.

②3 BW LIMIT

Limits the bandwidth of complete vertical deflection system. Pressing the key turns the key light on to set the bandwidth to less than 20 MHz.

②4 CH2 POLARITY

Inverts the CH2 display. Pressing the key turns the key light on and INVERT is selected. Pressing the key again turns the light off and NORM is selected.

②5 VARIABLE

Provides continuously variable uncalibrated deflection coefficient of CH2 to at least 2.5 times setting of the VOLTS/DIV.

②6 | POSITION

Controls the vertical position of CH2 trace.

②⑦ VERTICAL MODE

Selects vertical mode of operation.

The CH1 through CH4 keys with the light turned on indicate that the channel are activated. Pressing the key again cancels the mode.

CH1

Displays the CH1 signal on the CRT.

CH2

Displays the CH2 signal on the CRT.

ADD

CH1 and CH2 signals are algebraically added and the algebraic sum is displayed on the CRT.

CH3

Displays the CH3 signal on the CRT.

CH4

Displays the CH4 signal on the CRT.

CHOP, ALT

Pressing the key turning the light on selects CHOP mode. It is a multi-trace display of signals on all the activated channels. Channel switching is made at a repetition rate of about 500 kHz. This mode is used for measurement in slower sweeps.

Pressing the key again turns the light off and ALT mode is selected. It is a multi-trace display of signals on all the activated channels. Display is switched between channels at the end of each sweep. This mode is used for measurement in faster sweeps. This key is disabled when a single-trace or ADD alone is selected.

②⑧ VARIABLE

The same function as ②⑤ for CH1.

②⑨ POSITION

The same function as ②⑥ for CH1.

③⑩ VOLTS/DIV

The same function as ②② for CH1.

③① AC-DC-GND

The same function as ②⑩ for CH1.

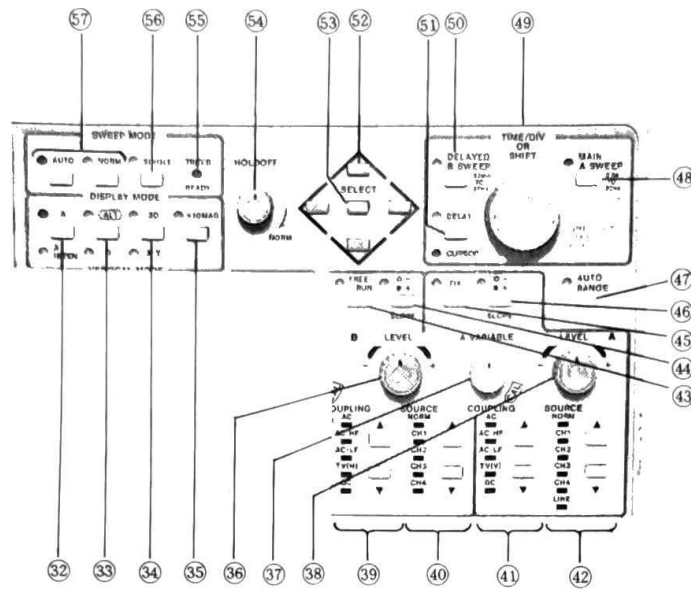


Fig. 4-5 Horizontal Axis

③② to ③⑤ DISPLAY MODE

Select horizontal mode of operation.

③② A/A INTEN

Pressing the key turning light A on displays a waveform by the A sweep. The B sweep is inoperative.

Pressing the key again turning light A INTEN on displays a waveform by the A sweep. The intensified portion of the trace indicates the sweep duration of the B sweep which corresponds to the portion to be magnified by the delayed sweep.

③③ ALT/B

Pressing the key turning light ALT sets the alternate display mode between the A and B sweeps. In this mode, the A and B (delayed) sweeps can be switched and displayed alternately on the CRT.

Pressing the key again turning light B on displays a waveform by the B sweep. The A sweep determines the delay time.

③④ 3D/X-Y

Pressing the key turning light 3D displays the B sweep waveforms overlapped with a time lag between each sweep.

Pressing the key again turning light X-Y sets the VP-5516A as an X-Y oscilloscope.

- ③⑤ ×10MAG
Pressing the key turning the light on decreases 10 times the sweep time coefficients of the A and B sweeps by expanding center division of the display. Pressing the key again turns off the light and the magnification is released.
- ③⑥ B LEVEL
Selects trigger level for the B sweep. This control is ineffective when FREERUN key ④③ is on.
- ③⑦ A VARIABLE
Provides continuously variable A sweep time coefficient to at least 2.5 times setting of the TIME/DIV. The sweep time coefficient is calibrated at the CAL position (when the control is rotated fully clockwise).
- ③⑧ A LEVEL
The same function as ③⑥ for the A trigger level. This control is ineffective when the FIX key ④⑤ is on.
- ③⑨ B TRIG COUPLING
Determines method of coupling B sweep trigger signal. Pressing the ▼ key turns the lights on sequentially from the top to the bottom. Pressing the ▲ key turns the lights on sequentially from the bottom to the top.
- AC
Rejects DC component and attenuates signals below about 30 Hz.
- AC-HF
Rejects DC and attenuates signals below about 100 kHz.
- AC-LF
Rejects DC and attenuates signals below about 30 Hz and above about 50 kHz.
- TV(V)
Separates the TV horizontal sync signal from the TV signal and feeds the separated signal to the trigger circuit.
- DC
Trigger signal is directly connected to the circuit.
- ④① B SOURCE
Selects source of B trigger signal. The ▲ and ▼ keys function the same as for ③⑨.
- NORM
The trigger signal is obtained from the displayed channel(s).
- CH1
The trigger signal is obtained only from the CH1 input signal.

CH2

The trigger signal is obtained only from the CH2 input signal.

CH3

The trigger signal is obtained only from the CH3 input signal.

CH4

The trigger signal is obtained only from the CH4 input signal.

④① A TRIG COUPLING

Determines method of coupling A sweep trigger signal. The same function as ③⑨ except TV(V) is as explained below.

TV(V)

Feeds the separated TV vertical sync signal with field selection facilities to the trigger circuit.

④② A SOURCE

Selects source of A trigger signal. The same function as ④① except LINE is as explained below.

LINE

The trigger signal is obtained from a sample of the mains power line voltage applied to this instrument.

④③ FREERUN

Switches between triggered sweep and freerun sweep of the B sweep operation. When the FREERUN light is turned on, the B sweep runs immediately following the delay time.

Pressing the key turning the light off causes the triggered sweep. The B sweep will not run until a trigger pulse is received after the delay time.

④④ SLOPE +/-

Selects the B trigger slope. Pressing the key turning the light on the sweep can be triggered from negative-going portion of trigger signal. Pressing the key again turning the light off the sweep can be triggered from positive-going portion of trigger signal.

For TV signals, the key selects the first field at its + position, and the second field at its - position.

④⑤ FIX

Switches the A triggering between "Auto Fix" and normal. Pressing the key turning the FIX light on selects the "Auto Fix" triggering which causes the A sweep to be automatically triggered for signals over a certain level.

Pressing the key turning the light off causes the normal triggering in which a trigger level is to be adjusted by the A LEVEL control ③⑧.

- ④⑥ SLOPE +/-
Selects the A trigger slope. The same function as ④④ for the A sweep.
- ④⑦ AUTO RANGE
Pressing the key turning the light on initiates the auto ranging or auto set operation.
To release the auto ranging operation, press the key again making the light off. The key is automatically turned off after performing the auto set operation. See paragraph 4-5 for details.
- ④⑧ MAIN A SWEEP
Pressing the key turning the light on enables the TIME/DIV OR SHIFT knob ④⑨ to select the A sweep time coefficient (TIME/DIV range).
- ④⑨ TIME/DIV OR SHIFT
A multi-purpose rotary knob to control the functions assigned by keys ④⑧, ⑤① and ⑤①.
- ⑤① DELAYED B SWEEP
Pressing the key turning the light on enables the TIME/DIV OR SHIFT knob ④⑨ to select the B sweep time coefficient (TIME/DIV range).
- ⑤① DELAY/CURSOR
Pressing the key turning the DELAY light on enables the TIME/DIV OR SHIFT knob ④⑨ to set the sweep delay time in the range from 0.5 μ s to 5 s.
Pressing the key again turning the CURSOR light on enables the knob to shift the cursors.
- ⑤② $\uparrow, \downarrow, \leftarrow, \rightarrow$ keys
Four arrow keys used for shifting the cursors. \leftarrow and \rightarrow keys are used for coarse control of the sweep delay time. \uparrow and \downarrow keys are used for item selection on a menu.
- ⑤③ SELECT key
Pressing the key in normal measurement mode will cause the menu mode and display the MAIN MENU on the screen.
The key is used for various selection purpose in the menu-applied functions. See Section V for details.
- ⑤④ HOLDOFF
Provides continuous control of holdoff time between sweeps to permit the stable display of a complicated repetitive waveform. For normal operation, turn the control fully clockwise to NORM.

⑤⑤ to ⑤⑦ SWEEP MODE

Select or indicate A sweep operation mode.

⑤⑤ TRIG'D/READY

A green light. In the single sweep mode the light turns on to indicate the oscilloscope is waiting for a trigger signal (READY).

In other sweeps, it indicates that the A sweep is triggered (TRIG'D).

⑤⑥ SINGLE

Pressing the key turning the light on causes the single sweep mode and allows the key to be used as a reset key.

⑤⑦ AUTO, NORM

Pressing the AUTO key turning the light on selects AUTO sweep mode. In a trigger condition, a stationary waveform is displayed. When there is no trigger signal or the triggering level is off, sweep freeruns to produce a bright reference trace. Pressing the NORM key turning the light on select NORM sweep mode. A waveform is displayed on the CRT only in a triggered condition. When there is no trigger signal or when the triggering level is off, no trace will appear.

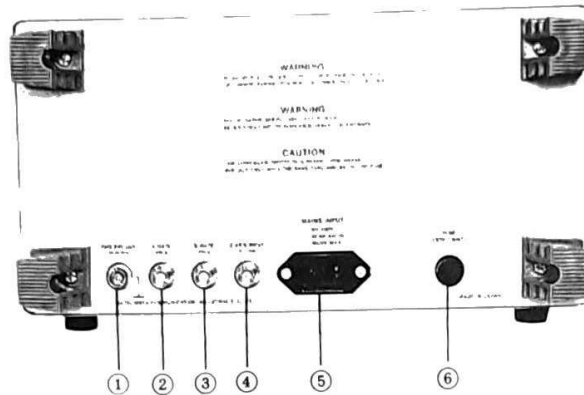


Fig. 4-6 Rear Panel Note: Actual design is different from this picture for the improvement of performance.

- ① CH2 SIG OUT
Output terminal for the CH2 signal.
- ② A GATE
Output connector providing a positive rectangular pulse coincident with the A sweep.
- ③ B GATE
Output connector providing a positive rectangular pulse coincident with the B sweep.
- ④ Z AXIS INPUT
Input connector for intensity modulation of the CRT display.
- ⑤ MAINS INPUT
Inlet socket for power cable.
- ⑥ FUSE
Fuse holder provided with a 1.6A fuse.

4-4 ORDINARY OPERATIONS

(Vertical axis)

(1) VERTICAL MODE keys

CH1, CH2, CH3, CH4

Assign channel(s) to be activated.

For multi-trace operation, select ALT or CHOP explained below.

ALT (alternate)

Produces a multi-trace display that alternates between activated channels with each sweep. Although the ALT mode can operate in all sweep time ranges, it is suitable for measurement in faster sweeps (time coefficients 0.2 ms/div or less).

CHOP (Chopped)

Used in the multi-trace operation for slower sweeps (time coefficients 0.5 ms/div or greater), or for multi-trace single sweep operation. Display is switched between activated channels at about 500 kHz rate independent of sweeps. The NORM setting of the trigger signal SOURCE selector is not available.

ADD (Algebraic Addition)

Displays the sum or difference of the CH1 and CH2 signals.

Note the following points:

- (a) Do not exceed the input voltage rating of the oscilloscope.
- (b) Do not apply voltages that exceed an equivalent of about eight times the VOLTS/DIV setting.
- (c) Set the vertical position controls of both CH1 and CH2 so that the trace of each channel will be placed as nearer to the center of the CRT as possible when viewed in either CH1 or CH2 single-trace setting.

(2) Input signal connections

The 10:1 probe provided with the oscilloscope is the most convenient means for applying signals to the oscilloscope. Although the probe attenuates a signal by 1/10, it offers a high input impedance of 10 M Ω . Moreover, the low-frequency response in the AC coupling expands to about 0.4 Hz (-3 dB).

To obtain the best high-frequency response employ a coaxial cable to introduce the signal to the INPUT connector and terminate the cable at both ends with the characteristic impedance of the coaxial cable.

For a low-frequency measurement, lead wires can be used to connect signals. In that case, however, use shielded wires to avoid induction from outside.

(3) Input coupling (AC-DC-GND)

The DC coupling is used for most applications. The AC coupling can be used if the DC component of the input signals is much larger than the AC component.

In the AC coupling, the DC component of the signal is blocked by a capacitor in the input circuit. The low-frequency response falls 3 dB at about 4 Hz in the AC position.

The GND setting provides a ground reference at the input of the oscilloscope by holding the input circuit at ground potential. The signal applied to the INPUT connector is internally disconnected but not grounded.

(4) Deflection coefficient

The deflection coefficient is determined by the attenuation factor of the probe, the VOLTS/DIV readout value, and the setting of the VARIABLE control. The calibrated deflection coefficients indicated by the VOLTS/DIV readout apply only when each VARIABLE control is set to the CAL position. The VARIABLE controls provide variable, uncalibrated vertical deflection between the calibrated settings of the VOLTS/DIV switches. They also extend the uncalibrated deflection coefficient to about 12.5 V/DIV in the 5 V/DIV range.

(5) 20 MHz bandwidth limiter

The BW LIMIT key limits the frequency bandwidth of the vertical axis to below 20 MHz. This limitation prevents the interference from unwanted high-frequency signals involved in the measurement of low-frequency signals. Pressing the key turns the light on and the bandwidth is limited to below 20 MHz. Pressing the key again turns the light off to cancel the limitation and the frequency bandwidth returns to FULL (the full bandwidth capabilities).

(Triggering)

(1) Trigger signal SOURCE selector

Selects as a horizontal sweep trigger signal the trigger signal derived from signals applied to the vertical axes.

The SOURCE selector functions as follows.

CH1 to CH4:

Only a signal derived from the selected channel is used as the trigger signal.

NORM:

The trigger signal is obtained from the displayed signal. For single-trace displays of each channel, the NORM selection provides the most convenient operation.

LINE (A SOURCE only):

The trigger signal is obtained from the mains power line. It is useful when the input signal is time-related to the mains frequency.

The following table shows the combination of the SOURCE selector with the VERTICAL MODE keys.

V. MODE T. MODE	CH1	CH2	CH3	CH4	ALT	CHOP	ADD
CH1	X	X	X	X	X	X	X
CH2	X	X	X	X	X	X	X
CH3	X	X	X	X	X	X	X
CH4	X	X	X	X	X	X	X
NORM	X	X	X	X	X (Note)		X

T. MODE indicates the trigger signal SOURCE selector and V. MODE indicates the VERTICAL MODE keys.

X: Available

Note: Does not indicate the time relationship between the signals.

(2) Trigger signal COUPLING selector

AC: This coupling is used in most applications. Since the trigger point depends on the average voltage level, random trigger pulses may cause unstable display. In such cases, use DC coupling.

AC-HF:

Useful for providing a stable display triggered only by the high-frequency components of the trigger signal.

AC-LF:

Useful for providing a stable display of a complex waveform triggered only by the low-frequency components of the trigger signal.

TV(H), TV(V):

For display TV video signals. The detailed description is given in Paragraph (12) on the later page.

DC: Effective for low-frequency signals that would be attenuated if AC is selected. Also effective for low-repetition rate signals.

(3) SLOPE +/-

Selects to start the sweep either at the positive-going portion or negative-going portion of the trigger signal. Pressing the key turning the light off selects + (plus) to start the waveform on the CRT at the positive-going portion of the trigger signal. Pressing the key again turning the light on selects - (minus) to start the trace at the negative-going portion. For TV signals, selecting + in turn selects the first field while selecting - in turn selects the second field.

(4) LEVEL controls

Set the voltage level for the trigger signal at which the sweep is triggered. If the control is set in the + region, the sweep starts at a positive point on the waveform. If it is set in the - region, the sweep starts at a negative point on the waveform.

(5) HOLDOFF control

Useful for the waveform measurement of a portion of the aperiodic pulse train as shown in Fig. 4-7.

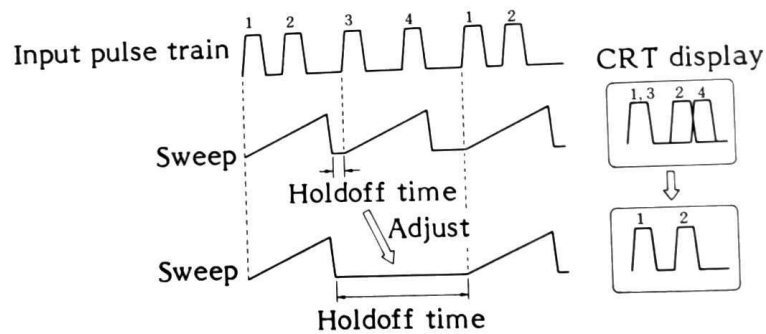


Fig. 4-7 HOLDOFF Function

Rotating the HOLDOFF control counterclockwise prolongs the holdoff time. Since the longer holdoff time provides the darker traces, rotate the control fully clockwise to NORM position for general waveform observations.

(Horizontal axis)

(6) A SWEEP MODE

AUTO:

The AUTO setting provides a stable display when the A trigger LEVEL control is correctly set and a trigger signal is available. The TRIG'D light indicates when the A sweep is triggered.

When the trigger repetition rate is less than 50 Hz, or in the absence of an adequate trigger signal, the A sweep freeruns to produce a reference trace. In general, the AUTO setting is used for most applications.

NORM:

Operation in the NORM setting is the same as in the AUTO setting when a trigger signal is applied. However, when a trigger signal is not present, the A sweep remains off and there is no display. The TRIG'D light indicates when the A sweep is triggered.

This mode is used to display signals with repetition rates below 50 Hz, or when it is desirable to obtain no trace in the absence of a trigger signal.

SINGLE:

When the signal to be displayed is not repetitive, or varies in amplitude, shape or time, the single sweep feature is used. The single sweep mode can also be used to photograph a non-repetitive signal.

To use the single sweep mode, first make sure that trigger circuit will respond to the event to be displayed. Set the A SWEEP MODE selector to AUTO or NORM and obtain the best possible display in the normal manner. Then, press the SINGLE key. The READY light will be on indicating 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 presented on the screen. After this sweep is complete, the READY light goes out and the A sweep generator is locked out until reset.

To prepare the circuit for another single sweep display, press the SINGLE key again.

Note that the single sweep trace may sometimes have noticeable drop-out portions caused by the readout characters depending on the sweep speed. To avoid it, rotate the CHARACTER control fully counterclockwise to stop the readout display function.

(7) Sweep TIME/DIV

The selected sweep time coefficients for the A and B sweeps are shown in the CRT readout. Selection is made by rotating the TIME/DIV OR SHIFT knob with the MAIN A SWEEP key turned on for A sweep, or the DELAYED B SWEEP key turned on for B sweep. The A sweep is calibrated only when the A VARIABLE control is turned fully clockwise to CAL position. The uncalibrated state is shown in the readout with a > mark to the left of A sweep TIME/DIV value.

To obtain the most accurate result in time measurement, perform measurement within the 8-division range at the center leaving 1 division each on both the right and left ends (see Fig. 4-8).

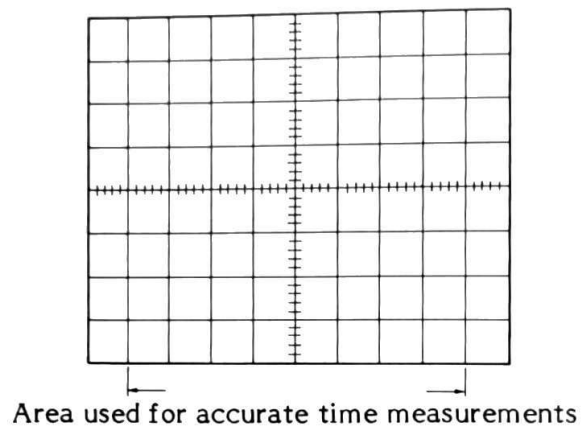


Fig. 4-8 Graticule on the CRT

(8) Sweep magnification $\times 10$ MAG

The sweep magnifier expands the sweep 10 times. To use the magnified sweep, first move the portion of the display to be expanded to the center of the graticule. Pressing the $\times 10$ MAG key magnifies the waveform of 1 division at the CRT center to 10 divisions on the horizontal graticule. The $\times 10$ MAG light turns on and the TIME/DIV readout changes the value to 1/10.

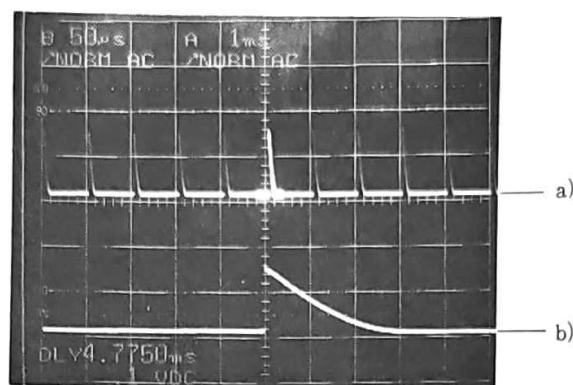
(9) DELAYED B SWEEP

Fig. 4-9 Operation of Delayed B Sweep

The B sweep is operable when A INTEN or B mode is selected with the sweep DISPLAY MODE keys. The delay time is controlled by the TIME/DIV OR SHIFT knob with the DELAY key turned on, and is shown in the CRT readout following letters DLY. The B sweep acts as the delayed sweep.

Fig. 4-9 a) shows an example of waveform obtained on the CRT when A INTEN is selected. In the figure, the time from the start of the A sweep to the intensified portion is the delay time (DLY). The intensified portion on the trace in figure a) is produced by the B sweep. The time length of this portion is given by the time determined by the B sweep.

When the B key of the sweep display mode is selected, only the intensified portion of the figure a) is magnified on the CRT as shown in Fig. 4-9 b). The sweep time coefficient is shown in the CRT readout following letter B.

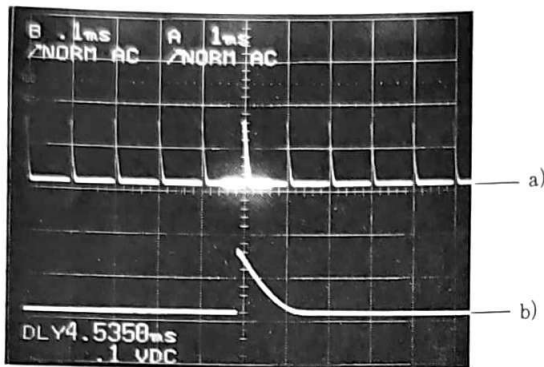
(10) B sweep triggering level

- (a) Pressing the FREERUN key turning the light on sets the oscilloscope in the state shown in Fig. 4-10 a) and b) (B starts after delay time).

The B sweep starts immediately after the delay time.

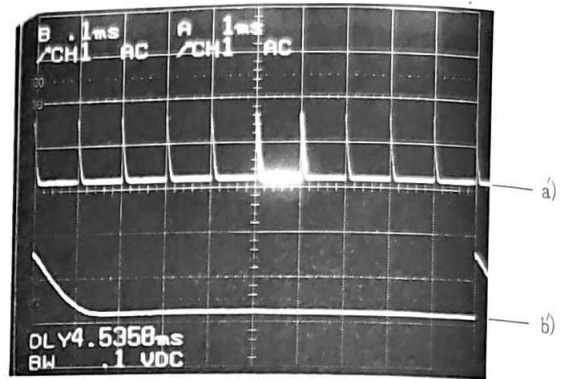
- (b) Pressing the FREERUN key turning the light off and turning the B LEVEL control for normal triggering operation sets the oscilloscope in the state shown in Fig. 4-10 a') and b') (B triggerable after delay time). The B sweep starts with the first trigger signal after the delay time. In the setting of Fig. 4-10 a'), the intensified portion appears to jump between positive slopes of the display by rotating the delay time control knob. The display jitter is minimized in this mode of operation.

The oscilloscope is so designed that the trigger signal sources for the A and B sweeps can be selected independently from each other by switching the trigger signal sources after the delay time. Therefore, when performing delay measurement with the A and B sweep trigger signal sources different from each other, a stable trigger operation is available by selecting the signal source corresponding to the desired channel. Do not use NORM trigger signal source in this type of operation.



(B starts after delay time)

(FREERUN key is on)



(B triggerable after delay time)

(B LEVEL control: normal triggering state, FREERUN key is off)

Fig. 4-10 B Sweep Modes

(11) ALT (alternate A and B) display mode

Pressing the ALT key of the sweep DISPLAY MODE turns the light on to select the alternate A and B sweep display. The A sweep with an intensified portion will be alternately displayed with the B sweep as shown in Fig. 4-10.

The SEP (separation) control provides for vertical positioning of the B trace with respect to the A trace only in this alternate display mode.

The display filter is minimized in this operation.

(12) TV signal displays

Television composite video signals or composite sync signals can be stably displayed with horizontal and vertical sync separator circuits within the instrument. The composite signals with normal polarity (picture positive, sync negative) are observed with any channels. However, for reversed video signals it is required to apply an external composite video or sync signal with negative sync polarity to CH3 or CH4, and to select the trigger source of the applied channel. The polarity inversion feature of CH2 is not effective for this purpose since it does not change the polarity of the trigger signal but inverts merely the display on CRT screen.

Set A and B Trigger COUPLING selector at TV(V) and TV(H) respectively.

A TV field-rate signal is displayed by triggering operation of A sweep. The "FIX" and "AUTO" features are also available. Set the A sweep TIME/DIV at 2 ms, and two fields can be observed by rotating the A VARIABLE control. Select faster A sweep speed to observe a portion of vertical sync pulse in detail. To change the field that is displayed, set the A SLOPE key at + (light: off) for the first field and at - (light: on) for the second field.

A TV line-rate signal is displayed by triggering operation of B sweep. Set the B sweep TIME/DIV at 10 μ s and select the desired line to be displayed so that the line is intensified with the Sweep DISPLAY MODE set to A INTEN. Then set the mode to B. Select faster B sweep speed to observe a portion of the line in detail. Although a stable, jitter-free display is obtained by setting to "B triggerable after delay time" mode, the observable portion is restricted to the front edge of the horizontal sync pulse. Use, therefore, the "B starts after delay time" mode for selecting any desired portion to be displayed.

$\times 10$ MAG function may be employed any time. The HOLDOFF control can be used to obtain clearer display avoiding the duplicated waveform caused by the interlaced scanning in conjunction with the adjustment of the A sweep time coefficient.

(13) X-Y operation

Turn on the X-Y light of the sweep DISPLAY MODE with the VERTICAL MODE selecting CH2, CH3, or CH4. The horizontal (X-axis) deflection is provided by the signal applied to the CH1 INPUT connector. The X-axis positioning is made with the horizontal POSITION control.

The vertical (Y-axis) deflection is provided by the signal applied to the CH2 INPUT connector. Now the instrument can be used as an X-Y oscilloscope.

To obtain dual-trace X-Y display or the triple-trace X-Y display, add CH3 and CH4 with the VERTICAL MODE selector.

The deflection coefficients of the X- and Y-axes are calibrated to each value of VOLTS/DIV.

Table 4-1 shows the combination of CH1 and other channel or channels to obtain three types of display.

Table 4-1

		Single-trace X-Y			Dual-trace X-Y			Three-trace X-Y
X-axis	CH1	X	X	X	X	X	X	X
Y-axis	CH2	X			X	X		X
	CH3		X		X		X	X
	CH4			X		X	X	X

4-5 AUTO RANGING

(General)

The auto ranging function of the VP-5516A oscilloscope produces an easy-to-observe waveform on the CRT in response to the amplitude and frequency of the input signal. Setting of the vertical deflection coefficient and sweep time coefficient are automatically carried out according to the amplitude and frequency of the CH1 and CH2 input signals. The function is helpful in frequent observation of the signals having unknown amplitude and frequency.

Auto ranging performed on a sine wave input selects:

The highest sensitivity range to display a waveform not exceeding 8 div. for CH1 and CH2.

The fastest sweep range that allows at least one period of waveform to be displayed on the CRT for A sweep.

(The oscilloscope may, however, select a range one step lower than the above under some operating conditions.)

Auto ranging is performed for both vertical deflection coefficient and sweep time coefficient, but it is also possible to have it performed only for either one.

The range is automatically selected only once upon the establishment of triggering on the oscilloscope, and the auto ranging will not take place while the triggering state lasts. Manual operation is available if any range selection is required during this time. Auto ranging requires the condition that the oscilloscope is triggerable, and that it must be changed from non-triggered to triggered state.

The oscilloscope provides two kinds of auto ranging as discussed below.

(1) Normal auto ranging

Setting the AUTO RANGE key on causes the ranges to be automatically selected every time the oscilloscope is triggered by an input signal. This is suitable for observing various signals by moving the probe from a test point to another.

(2) Auto setting

Setting the AUTO RANGE key on causes the auto ranging to be canceled (the AUTO RANGE key turned off) after the range was automatically selected upon triggering on an input signal. No more auto ranging takes place upon any triggering till the AUTO RANGE key is turned on again.

This function allows the user to simplify the operation of displaying the signal before starting the observation of signals having unknown amplitude and frequency.

(OPERATION)

(1) Preparation

Before starting auto ranging operation some preliminary steps are required. Follow the procedure below.

1) Selecting conditions on the menus as for:

- a. whether auto range or auto set function is set,
- b. whether auto range selection is made for both the vertical deflection coefficient (VOLTS/DIV) and sweep time coefficient (TIME/DIV) or either of the two.

The menu selection procedure is summarized below. (All menu items are explained in paragraph 5-10.)

Press the SELECT key.



(Primary menu) MAIN MENU
Select AUTO RANGE MODE



(Secondary menu) AUTO RANGE MODE

(Normal auto ranging)
Select AUTO RANGE



(Tertiary menu) AUTO RANGE

■ (Auto ranging for V and T)
Select VOLTS/DIV and TIME/DIV

■ (Auto ranging for V only)
Select VOLTS/DIV

■ (Auto ranging for T only)
Select TIME/DIV



Press the SELECT key

(Auto setting)
Select AUTO SET



(Tertiary menu) AUTO SET

■ (Auto ranging for V and T)
Selects VOLTS/DIV and TIME/DIV

■ (Auto ranging for V only)
Select VOLTS/DIV

■ (Auto ranging for T only)
Select TIME/DIV



Press the SELECT key

Note

V stands for vertical deflection coefficient and T stands for sweep time coefficient.

2) Setting other conditions

- a. Select the vertical channel to be used.
- b. Adjust the vertical and horizontal position to place the trace at about the center of the CRT.
- c. Select the trigger coupling as required.
- d. Turn off the $\times 10$ sweep magnification
- e. Set each VARIABLE control at CAL position.
- f. Set the HOLDOFF control at NORM.
- g. Select A sweep tentatively for the sweep display mode.

(2) Starting auto ranging

Press the AUTO RANGE key on the panel to on. Now, AUTO is selected for the A sweep mode, the input coupling of the vertical channel being used is switched to AC, and auto ranging starts.

In the auto ranging operation the trigger signal source is selected to suit the vertical channel in use, and the triggering is set in the AUTO FIX mode.

So far as the input signal under measurement satisfies the required condition for auto ranging, the ranges are automatically selected and the waveform is displayed on the CRT. The manual panel operation is now enabled again.

When AUTO SET is selected on the menu, the auto range operation is completed upon displaying of the waveform on the CRT. The AUTO RANGE key is turned off.

When AUTO RANGE is selected on the menu instead of AUTO SET, the AUTO RANGE key remains turned on to repeat the same operation; the range is automatically selected again to display the waveform on the CRT upon another triggering.

(3) Canceling auto ranging

In the auto set operation the function will automatically be canceled as discussed above.

In the normal auto ranging operation pressing the AUTO RANGE key turning the light off cancels the function.

[Notes]

(1) VARIABLE controls

Rotate the CH1 and CH2 VARIABLE controls and the A VARIABLE control of the A sweep fully to the CAL position. If these controls are set at uncalibrated position, the auto ranging works in a narrower range. Use the VARIABLE control, if necessary, after the completion of the automatic range selection.

(2) $\times 2$ magnification of the vertical axis

The $\times 2$ magnification cannot be turned on or off automatically. Auto ranging works on the result of manual selection of the $\times 2$ magnification; the deflection coefficient will automatically be selected from 2 mV/div to 5 V/div ranges with the FINE $\times 2$ MAG key turned off and from the magnified ranges of 1 mV/div to 2.5 V/div with the key turned on. The selected range will be displayed in the CRT readout.

- (3) **×10 sweep magnification of the time axis**

The ×10 magnification cannot be turned on or off automatically. Auto ranging works on the waveform before magnification even if magnification has been executed. If ×10 MAG key is turned on manually, the waveform obtained after auto ranging will be magnified by ten times to be displayed on the CRT. The CRT readout displays the resultant sweep time range for the waveform actually displayed on the CRT. ×10 magnification may be used optionally by manual selection, but it is recommended to turn off and execute magnification after the range has been selected.
- (4) **Available input signal range**

Auto range operation accepts a signal in the range from 1 kHz to 30 MHz and 10 mV to 40 Vp-p. For auto ranging for sweep time only, the available range will be widened to 50 Hz to 100 MHz. An input of about 2-div amplitude can cause one triggering necessary for auto ranging.
- (5) **B sweep**

When auto ranging is performed on the A sweep, the B sweep range is automatically determined so that the B sweep will be ten times faster than the A sweep; the value of TIME/DIV of the B sweep will be 1/10 of the A sweep. The B sweep, however, will not be faster than 20 ns/div. Auto ranging works to display the waveform according to the A sweep independently of the B sweep. Since the display on the CRT may vary with the DISPLAY MODE key setting, first select either A or A INTEN to turn off the B sweep. Use the B sweep function, if necessary, after the completion of the automatic range selection.
- (6) **Multi-trace operation**

Auto ranging is also available in the dual-trace operation of the CH1 and CH2 on the vertical axis. The trigger signal source for auto ranging will be selected automatically in the sequence from CH1 to CH2. After the completion of range selection the oscilloscope reselect the trigger signal source selected before the start of auto ranging. It is the CH1 signal that displays on the CRT a waveform having the specified number of cycles. Auto ranging is also available in the triple- and quadruple-trace operation with CH3 and CH4. Note, however, that the deflection coefficient ranges for CH3 and CH4 can only be selected manually.

In a multi-trace operation, displayed with specified number of cycles is the signal applied to the channel having to smallest number (e.g. CH1 in a quadruple-trace operation of CH1 to CH4, or CH2 in a triple-trace operation of CH2 to CH4).
- (7) **Others**

Auto ranging is not available for the X-Y operation.

SECTION V MENU-APPLIED FUNCTIONS

5-1 INTRODUCTION

The oscilloscope has the following menu-applied functions.

(1) CURSOR Measurements

The voltage cursor lines, ground level cursor lines and the time cursor lines on the screen are used for measuring various voltage, time and phase values of the displayed waveform. They are also applied to YES/NO judgment function.

(2) SCALE FACTOR Correction

Corrects the attenuation factor of the probe to be used and allows the direct reading of the vertical deflection coefficients and voltage cursor measurement values in the CRT readout.

(3) LABELING

Gives desired labels to the waveforms being displayed.

(4) TRACE IDENTIFICATION

Provides ID labels for the displayed traces and the cursor lines. The labels follow the movement of the traces and cursor lines.

(5) V-MODE (Selection of the relationship between the trigger signal source and vertical-axis mode)

Selects whether the trigger signal source will be automatically determined or arbitrarily determined.

(6) TRIGGER (Interlocked operation of the trigger coupling and trigger signal source of the A and B sweeps)

Selects whether the trigger coupling and trigger source of the A and B sweeps are interlocked or set independently.

(7) TIME/DIV (Interlocked sweep time for the A and B sweeps)

Selects whether the sweep time coefficients of the A and B sweeps are interlocked or set independently.

(8) AUTO RANGING

Automatically selects a deflection coefficient and/or a sweep time coefficient for easy-to-observe waveform display in response to the input signal.

(9) BEEPER

Selects whether the beeper activates upon key entries and error detections. Also sets the length of the beep sound.

(10) TRACE ROTATION

Adjusts the gradient of the trace if it is not parallel to the horizontal graticule lines.

(11) PANEL MEMORY (Setup programming)

Stores programmed front panel setups. Total of ten setups can be stored.

(12) DC BALANCE

Automatically adjusts the ATT balance, amplifier DC balance and VARIABLE control balance.

Menus are used to make selection of the above-mentioned functions and setting up of conditions for each function.

Fold-out pages, Appendix 1 "QUICK REFERENCE" and Appendix 2 "MENU MAP" are located at the back of this manual for easy reference.

5-2 MENU CONFIGURATION

The menus are configured as shown on the "MENU MAP". All the applied operations start with the primary menu named MAIN MENU which is shown at the upper left on the map and also shown in Fig. 5-2.

5-3 BASIC OPERATION OF THE MENU

The menu operation is made with the keys shown in Fig. 5-1. Key names are also given in the figure.

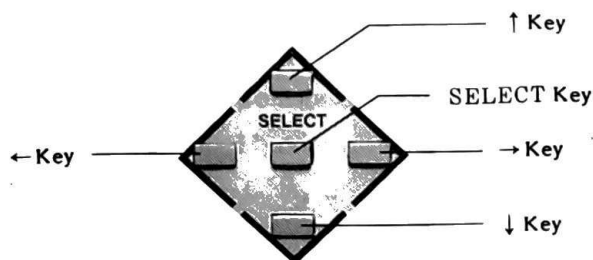


Fig. 5-1 Menu Operation Keys

(1) How to display the MAIN MENU

When using the instrument as an ordinary oscilloscope, pressing the SELECT key brings the MAIN MENU on the CRT as shown in Fig. 5-2.

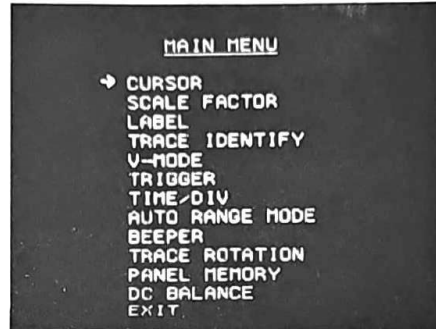


Fig. 5-2 MAIN MENU Display

(2) Item selection on the menu

An item selection arrow mark (→) is displayed to the left of an item on the menu. Press the ↑ or ↓ key to shift the arrow mark till it points the desired item and press the SELECT key. If the item has no secondary menu, the selection is completed and a function is selected. If the item has any succeeding menus, the secondary menu appears and another item can be selected. In the similar manner, succeeding tertiary and quartic menus can be obtained, and the desired item can be selected.

(3) How to return to the preceding menu

Place the arrow mark at QUIT on each menu and press the SELECT key. Now the display is returned to the preceding menu.

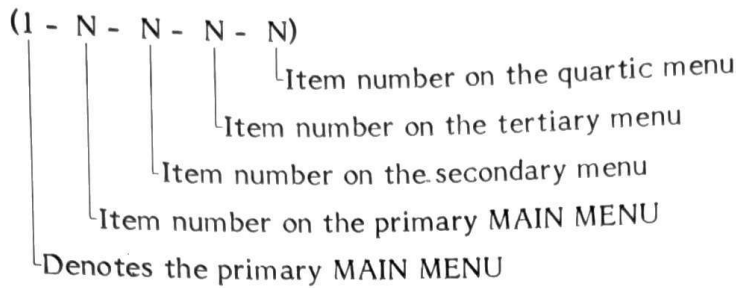
Example: Place the arrow mark at QUIT on the CURSOR secondary menu and press the SELECT key. Now the MAIN MENU (the primary menu) is back on the CRT.

(4) How to return to the state before the MAIN MENU is displayed

Place the arrow mark at EXIT of each menu and press the SELECT key. Now the menu mode is canceled and the measurement mode is resumed.

5-4 MENU ITEM NUMBER

The menu items are numbered as shown below. On the menu map the numbers are given at the upper left of each menu to show that the menu is obtained when the item of the given number is selected.



Example: (1-3) represents item 3 (LABEL) on the MAIN MENU indicating the item is for introducing the secondary menu LABEL.

Note

The numbers are given only for explanation purpose and are not shown on actual menus.

5-5 CURSOR FUNCTION

(1) Cursor display

Eight types of cursors are available and their displays are given in Fig. 5-3.

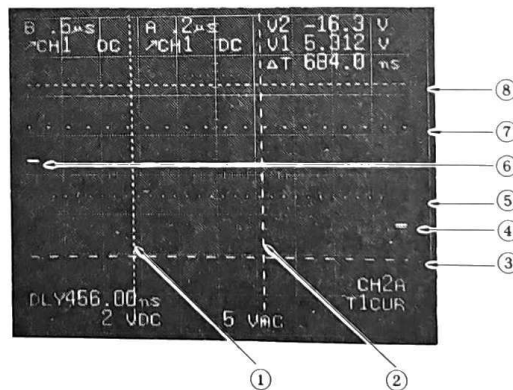


Fig. 5-3 Cursor Displays

- | | |
|----------------|-----------------|
| ① T1 CUR | ⑤ CH1 GND level |
| ② T2 CUR | ⑥ B TRIG level |
| ③ V2 CUR | ⑦ CH2 GND level |
| ④ A TRIG level | ⑧ V1 CUR |

(2) Basic operation of the voltage and time cursor lines

Two voltage cursor lines (V1 CUR and V2 CUR) and two time cursor lines (T1 CUR and T2 CUR) are used for most measurements. One of these four cursor lines can be selected and moved on the screen. The selected one is indicated at the right bottom corner of the CRT screen (e.g. TICUR in Fig. 5-3).

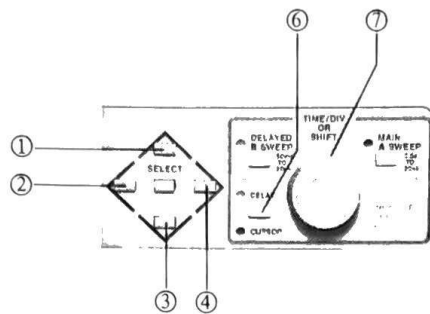


Fig. 5-4 Keys and Control to Move

① ↑ key, ② ← key, ③ ↓ key, ④ → Key: Move the cursor lines in each direction.

⑦ SHIFT knob: Moves a cursor line up, down, to the left, or to the right in fine steps when the DELAY/CURSOR key ⑥ is pressed to turn on the CURSOR light.

Clockwise rotation ----- Moves a cursor up or to the right.

Counterclockwise rotation ----- Moves a cursor down or to the left.

(3) Selecting a cursor line to be moved

Movable cursor lines can be re-selected from a cursor line to another by using the arrow keys ① to ④ and the SELECT key ⑤.

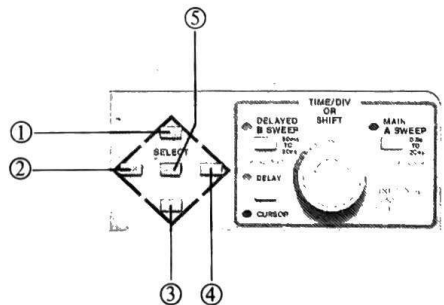


Fig. 5-5 Keys to Select a Cursor Line to be Moved

(a) V2 CUR ↔ V1 CUR

T2 CUR ↔ T1 CUR

Press SELECT key ⑤.

(b) V1 CUR ↘ T1 CUR
V2 CUR ↗ T1 CUR

Press ← key ②.

(c) V1 CUR ↘ T2 CUR
V2 CUR ↗ T2 CUR

Press → key ④.

- (d) T1 CUR → V1 CUR Press ↑ key ①.
 T2 CUR →
- (e) T1 CUR → V2 CUR Press ↓ key ③.
 T2 CUR →

(4) Cursor value readout

The measurement values using cursors are indicated at the right top corner of the CRT screen (e.g. V2, V1 and ΔT in Fig. 5-3).

Note that the readout values are effective only for the designated channel and sweep which are indicated just above the movable cursor indication at the right bottom corner of the CRT screen. In Fig. 5-3, CH2A above T1CUR indicates that CH2 and A sweep are designated.

The channel and sweep designation can be modified by the VERTICAL MODE keys and DISPLAY MODE keys. Note in channel modification that the CH1 or CH2 key must be pressed twice in multi-channel operation mode.

The cursor value readout is obtained only when the VARIABLE control of the designated channel or sweep is set to its CAL position.

(5) End of cursor measurement

To end the cursor mode, press and hold the SELECT key for more than one second. Select EXIT on the menu and press the SELECT key.

(6) Menu item selection and operating procedure

(1-1) **CURSOR** (on the **MAIN MENU**)

Introduces the CURSOR secondary menu for selecting type of cursor application among eleven items.

(1-1-1) **VOLTAGE** (on the **CURSOR** menu)

Introduces the VOLTAGE tertiary menu for selecting type of voltage measurement using the voltage cursor lines.

(1-1-1-1) **GND-V** (on the **VOLTAGE** menu)

Provides ground-level-referenced two-voltage (V1 and V2) measurement with three cursor lines. See Fig. 5-6. Turn off the FINE ×2 MAG function in this operation.

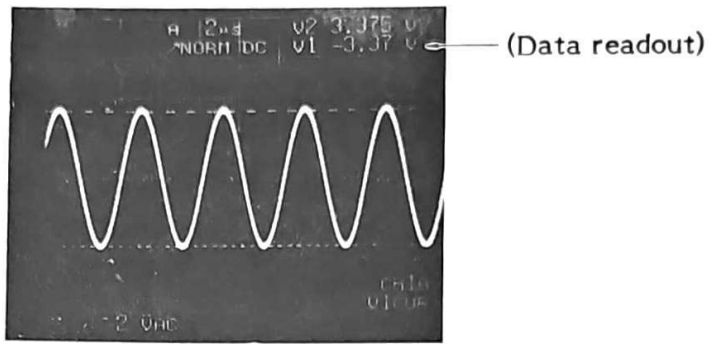


Fig. 5-6 GND-V Measurement

(1-1-1-2) ΔV (on the **VOLTAGE** menu)

Provides voltage difference ($\Delta V = V1 - V2$) measurement with two cursor lines. See Fig. 5-7.

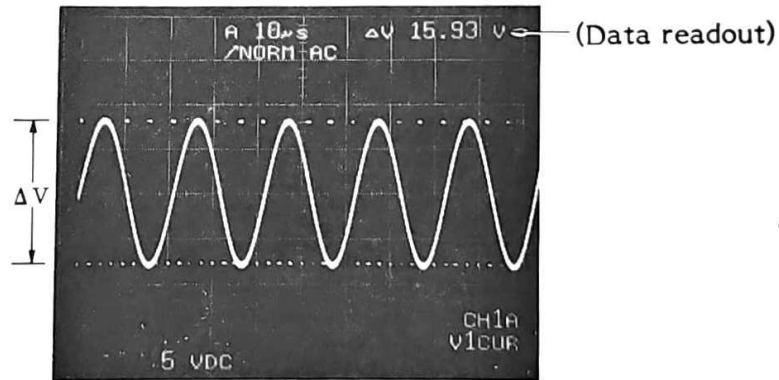


Fig. 5-7 ΔV Measurement

(1-1-2) **TIME. 1/ΔT** (on the **CURSOR** menu)

Provides time difference ($\Delta T = T2 - T1$) and $1/\Delta T$ measurements with two time cursor lines. See Fig. 5-8.

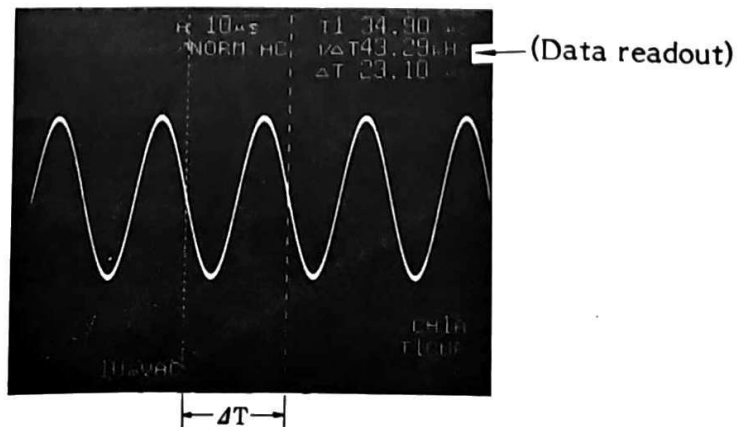


Fig. 5-8 ΔT , $1/\Delta T$ measurement

(1-1-3) **VOLTS. TIME. 1/ΔT** (on the **CURSOR** menu)

Introduces the **VOLTS. TIME. 1/ΔT** tertiary menu for selecting type of combined voltage and time measurement using both the voltage and time cursor lines.

(1-1-3-1) **GND-V** (on the **VOLTS. TIME. 1/ΔT** menu)

Provides combined measurements of V_1 , V_2 and ΔT with five cursor lines. Turn off the **FINE** $\times 2$ **MAG** function in this operation.

(1-1-3-2) ΔV (on the **VOLTS. TIME. 1/ΔT** menu)

Provides combined measurements of ΔV , ΔT and $1/\Delta T$ with four cursor lines. See Fig. 5-9.

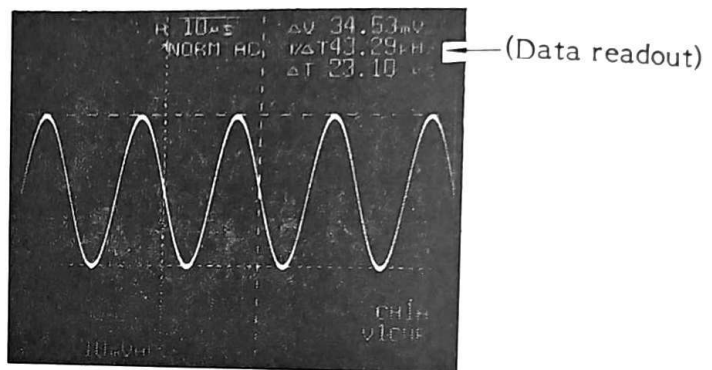


Fig. 5-9 $\Delta V, \Delta T, 1/\Delta T$ Measurement

(1-1-4) **PHASE** (on the **CURSOR** menu)

Introduces the **PHASE** tertiary menu for selecting type of phase measurement using the time cursor lines.

(1-1-4-1) **T-Y** (on the **PHASE** menu)

Provides phase difference measurement in degrees for a periodic waveform with two time cursor lines.

This function is available when a sweep display mode other than X-Y is selected. Set the cursor lines T1 and T2 to match one cycle of waveform and press the \uparrow key. This sets the readout value to 360.0 DEG. Then move T2 cursor to measure phase difference from T1.

Fig. 5-10 shows two cursor lines for phase measurement.

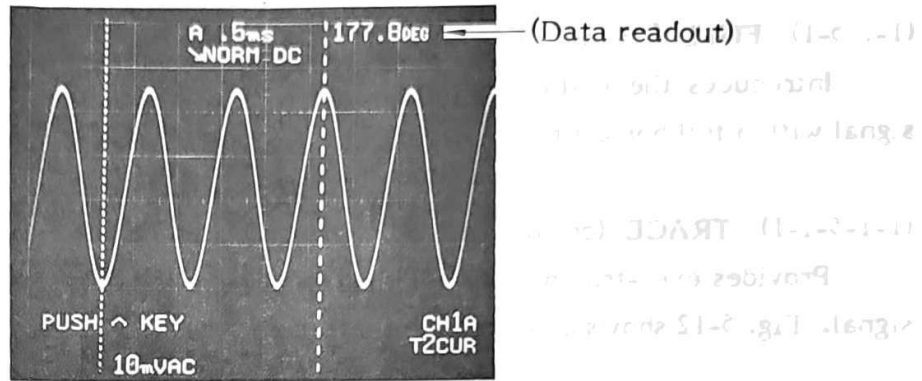


Fig. 5-10 T-Y Phase Measurement

(1-1-4-2) X-Y (on the PHASE menu)

Provides phase relationship measurement on a Lissajous figure (Y-axis leading value in degrees relative to X-axis) with two time cursor lines. This is available only in the X-Y mode of operation. Set the cursor lines T1 and T2 to match the left and right edges of a Lissajous figure positioned at the center of the screen and press the \uparrow key. This sets the readout value to 90.0 DEG. Then move T2 cursor toward the left until it matches the first zero-crossing of the figure and read the readout value. See Fig. 5-11.

Note

When TICUR is assigned to be movable, T2 CUR tracks the T1 CUR movement. Ignore in this case the movement of T2 CUR

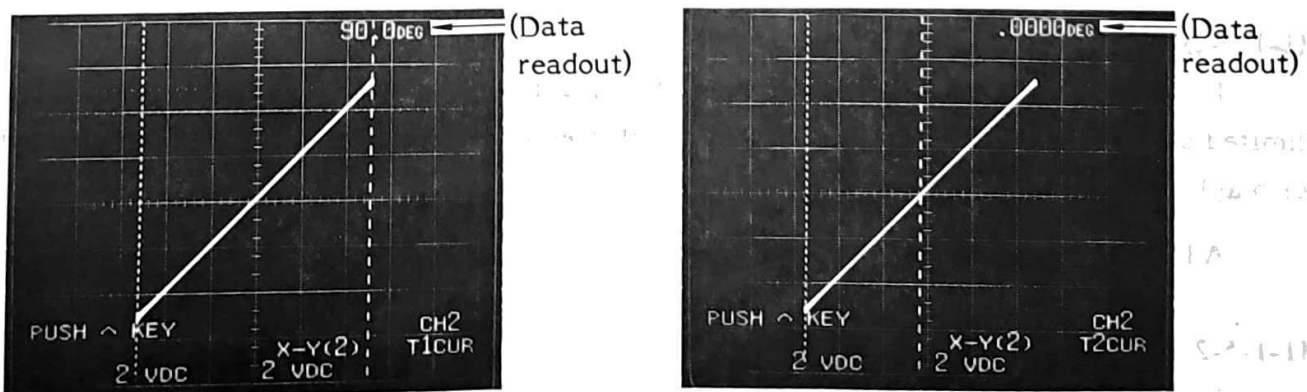


Fig. 5-11 X-Y Phase Measurement

(1-1-5) PEAK (on the CURSOR menu)

Introduces the PEAK tertiary menu for selecting type of peak detection (i.e. detection of both positive peak value V2 and negative peak value V1 for a waveform) with two voltage cursor lines.

The function is available only in a single-trace operation of either CH1 or CH2 with NORM trigger source selection.

(1-1-5-1) **FULL** (on the **PEAK** menu)

Introduces the FULL quartic menu for selecting type of peak detection for an input signal within full horizontal area.

(1-1-5-1-1) **TRACE** (on the **FULL** menu)

Provides ever-tracing (periodically renewed) peak detection for currently applied input signal. Fig. 5-12 shows an example of detected peaks.

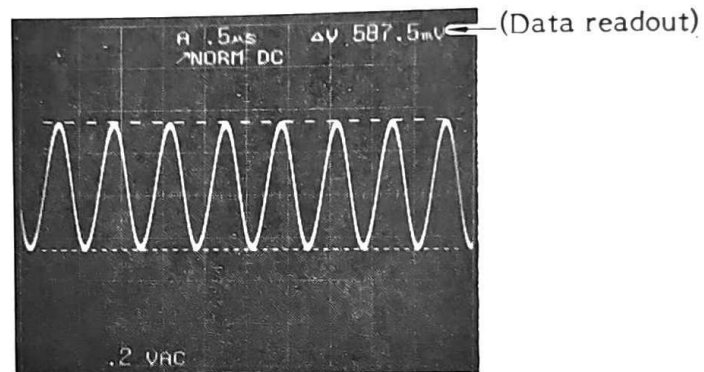


Fig. 5-12 Peak Trace in FULL Mode

(1-1-5-1-2) **MAX** (on the **FULL** menu)

Provides maximum peak detection for all input signals and holds the value. Pressing the SELECT key cancels the detected peak value and restarts the maximum peak detection.

(1-1-5-2) **PARTIAL** (on the **PEAK** menu)

Introduces the PARTIAL quartic menu for selecting type of peak detection within the limited part of horizontal area (i.e. within the B sweep duration on the "A intensified by B" display).

A INTEN is automatically selected in this mode.

(1-1-5-2-1) **TRACE** (on the **PARTIAL** menu)

Provides ever-tracing peak detection for a waveform currently displayed within the B sweep duration. See Fig. 5-13.

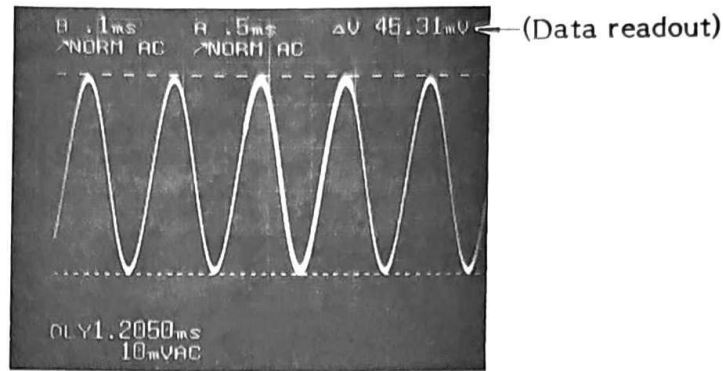


Fig. 5-13 Peak Trace in PARTIAL Mode

(1-1-5-2-2) **MAX** (on the **PARTIAL** menu)

Provides maximum peak detection for all waveforms appearing within the B sweep duration and holds the value. Pressing the SELECT key cancels the detected peak value and restarts the maximum peak detection.

(1-1-6) **YES-NO** (on the **CURSOR** menu)

Introduces the YES-NO tertiary menu for selecting type of YES/NO judgment ("OVER" indication of detected peak value exceeding the limit set by the voltage cursor line). The function is available only in single-trace operation of either CH1 or CH2 with NORM trigger source selection. Turn off the FINE $\times 2$ MAG function in this operation.

(1-1-6-1) **FULL** (on the **YES-NO** menu)

Introduces the FULL quartic menu for selecting the type of limit for judgment of an input signal within full horizontal area.

(1-1-6-1-1) **UPPER LIMIT** (on the **FULL** menu)

Provides "OVER" indication with a beep for input signal having a peak value more positive than the upper limit value V2. See Fig. 5-14.

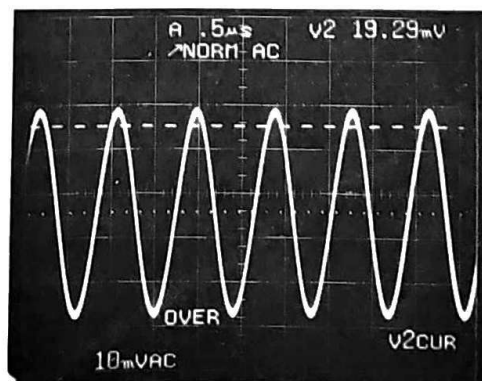


Fig. 5-14 Upper Limit "OVER" in FULL Mode

(1-1-6-1-2) **LOWER LIMIT** (on the **FULL** menu)

Provides "OVER" indication with a beep for input signal having a peak value more negative than the lower limit value V1. See Fig. 5-15.

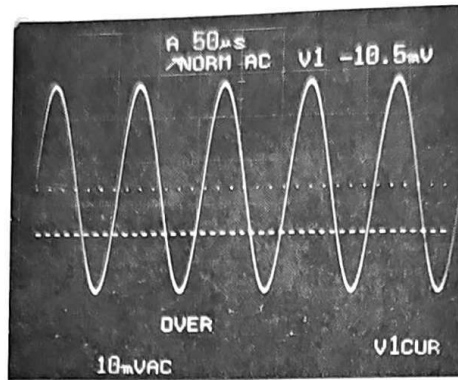


Fig. 5-15 Lower Limit "OVER" in FULL Mode

(1-1-6-1-3) **EITHER LIMIT** (on the **FULL** menu)

Provides "OVER" indication with a beep for input signal having a peak value exceeding either upper or lower limit (more positive than V2 or more negative than V1). See Fig. 5-16.

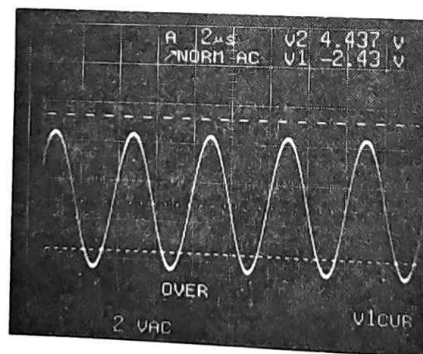


Fig. 5-16 Either Limit "OVER" in FULL Mode

(1-1-6-2) **PARTIAL** (on the **YES-NO** menu)

Introduces the **PARTIAL** quartic menu for selecting type of limit for judgement within the limited part of horizontal area (i.e. within the B sweep duration on the "A intensified by B" display).

(1-1-6-2-1) UPPER LIMIT (on the **PARTIAL** menu)

Provides the upper limit judgment for a waveform displayed within the B sweep duration. See Fig. 5-17.

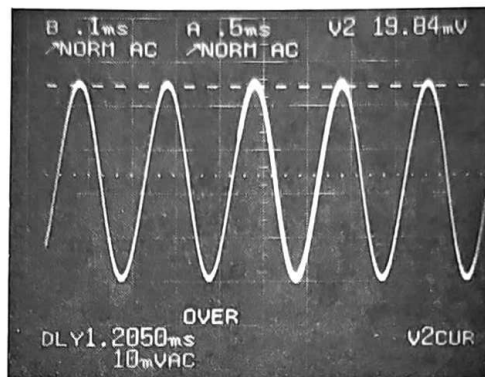


Fig. 5-17 Upper Limit "OVER" in PARTIAL Mode

(1-1-6-2-2) LOWER LIMIT (on the **PARTIAL** menu)

Provides the lower limit judgment for a waveform displayed within the B sweep duration. See Fig. 5-18.

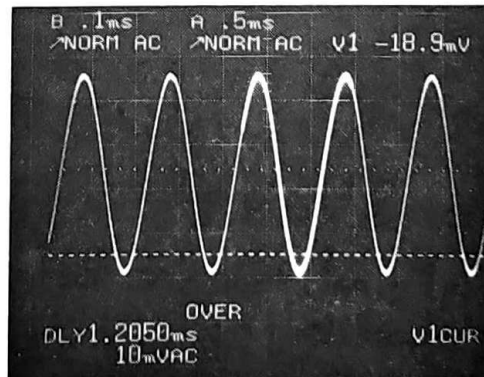


Fig. 5-18 Lower Limit "OVER" in PARTIAL Mode

(1-1-6-2-3) EITHER LIMIT (on the **PARTIAL** menu)

Provides either (upper or lower) limit judgment for a waveform displayed within the B sweep duration. See Fig. 5-19.

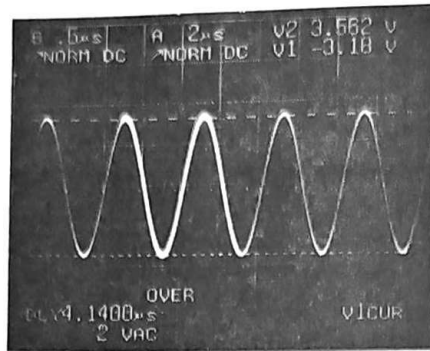


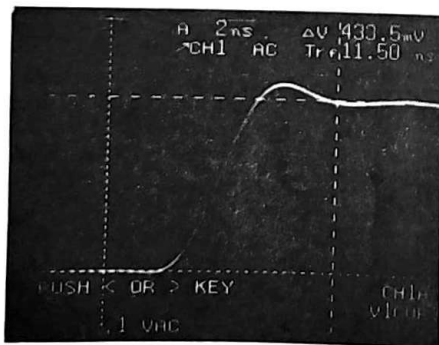
Fig. 5-19 Either Limit "OVER" in PARTIAL Mode

(1-1-7) **Tr. Tf** (on the **CURSOR** menu)

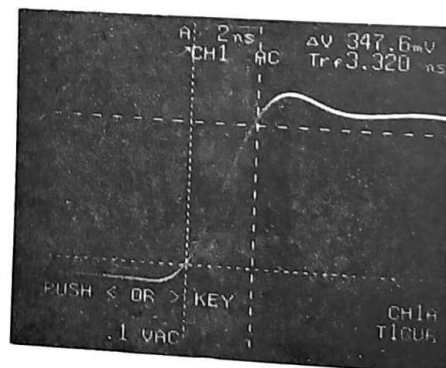
Provides Tr (rise time) or Tf (fall time) measurement using both the voltage and time cursor lines. The function is available in CH1 and/or CH2 operation.

An example is shown in Fig. 5-20 (a) and (b).

First, align the V1 CUR with the bottom of the waveform and align the V2 CUR with the top of the waveform as shown in Fig. 5-20 (a). Then, change the movable cursor from V1 or V2 to T1 or T2. V1 CUR and V2 CUR will automatically be aligned to the 10% and 90% points on the waveform as shown in Fig. 5-20 (b). Move T1 CUR and T2 CUR to measure the time between two intersections. The readout is Tr or Tf.



(a)



(b)

(Data readout)

Fig. 5-20 Tr. Tf

(1-1-8) **GND LEVEL** (on the **CURSOR** menu)

Displays the CH1 and CH2 ground level cursor lines. Note that no ground level cursor line is obtained for the trace by ADD mode of operation and the B sweep trace in ALT display mode.

Fig. 5-21 shows an example of CH1 ground level indication.

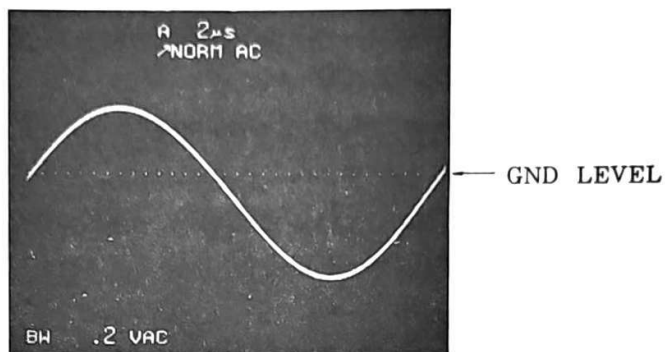


Fig. 5-21 GND Level Indication

(1-1-9) TRIGGER LEVEL (on the **CURSOR** menu)

Introduces the TRIGGER LEVEL tertiary menu for turning on or off the A and B sweep trigger level cursor lines. See Fig. 5-22.

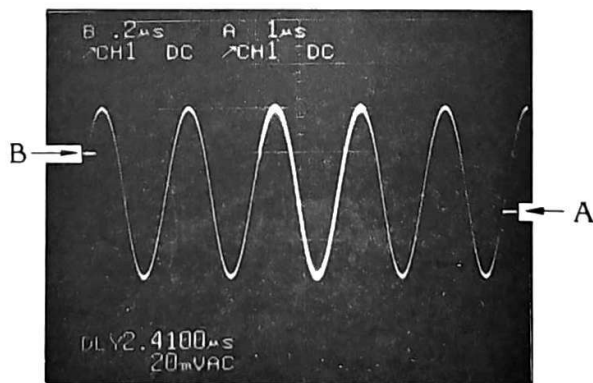


Fig. 5-22 Trigger Level Indication

(1-1-9-1) OFF (on the **TRIGGER LEVEL** menu)

Turns off the trigger level cursor lines.

(1-1-9-2) ON (on the **TRIGGER LEVEL** menu)

Turns on the trigger level cursor lines. Select DC for trigger coupling in this operation.

(1-1-10) **REF WAVE** (on the **CURSOR** menu)

Introduces the REF WAVE tertiary menu for activating or canceling the reference waveform storage function. The function is available only in a single-trace operation of either CH1 or CH2.

(1-1-10-1) **SAMPLE** (on the **REF WAVE** menu)

Selecting this item on the menu and pressing the SELECT key will cause; (1) recalling of reference waveform sampled and stored previously, or (2) getting ready to sample and store the currently displayed waveform if the stored data has been erased by CLEAR function discussed below. To perform sampling and data storage for a new reference waveform, press SELECT key again in the state (2) above.

Fig. 5-23 shows the stored reference waveform on the upper part of the screen with the realtime input waveform positioned downward after finishing the sampling and storage.

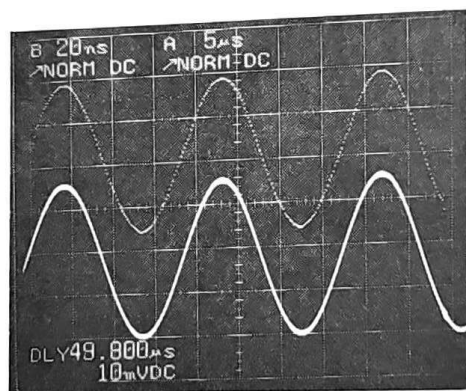


Fig. 5-23 REF WAVE Function

(1-1-10-2) **CLEAR** (on the **REF WAVE** menu)

Erases the sampled and stored reference waveform data.

(1-1-11) **SELF CAL** (on the **CURSOR** menu)

Provides drift compensation means for CH1 and CH2 ground level. See paragraph 4-2 (8) for usage.

5-6 SCALE FACTOR CORRECTION

(1) Scale factor correction on menu

$\times 1$, $\times 10$, $\times 100$ corrections are made separately for each of four input channels 1 to 4 to obtain direct-reading readout of VOLTS/DIV and voltage cursor values.

Note that another correction by means of CAL terminal (discussed in paragraph 4-2

(6)) affects the settings on menu. The actual current settings are known by the arrow mark indication on the menus.

(2) Menu item selection

(1-2) **SCALE FACTOR** (on the **MAIN MENU**)

Introduces the SCALE FACTOR secondary menu for selecting a channel to be corrected. See Fig. 5-24.

(1-2-1) **CHI** (on the **SCALE FACTOR** menu)

Introduces the CHI tertiary menu for selecting a correction factor among three factors. See Fig. 5-24.

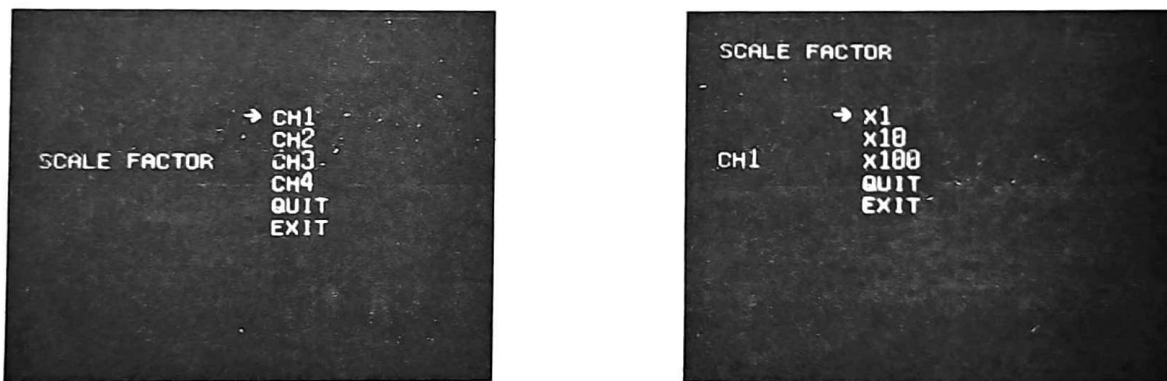


Fig. 5-24 Scale Factor Correction Menus

(1-2-1-1) **×1** (on the **CHI** menu)

×1 correction, i.e. no correction is set for CHI. Applicable when a 1 : 1 probe or direct cable connection is used.

(1-2-1-2) **×10** (on the **CHI** menu)

×10 correction for 10 : 1 probe is set for CHI.

(1-2-1-3) **×100** (on the **CHI** menu)

×100 correction for 100 : 1 probe is set for CHI.

(1-2-2) to (1-2-4) and their tertiary menus

Same as above except the channel number.

5-7 LABEL FUNCTION

(1) Function

Displays on the CRT screen the desired information (such as the date of measurement) for photographing purpose. Alphanumeric characters 0 to 9 and A to Z, and six signs +, -, *, /, ., \square (space) are available for labeling.

(2) Menu item selection and operating procedure

(1-3) LABEL (on the MAIN MENU)

Introduces the LABEL secondary menu for selecting either write or erase mode of the labeling function.

(1-3-1) WRITE (on the LABEL menu)

Provides the label writing function.

First, the labeling cursor (underline) appears at the home position as shown in Fig. 5-25. Move the cursor to the desired position with four arrow keys. Rotating the SHIFT knob selects a character to display in the following sequence.

0 to 9, A to Z, +, -, *, /, ., \square (space)

→ Clockwise rotation →

← Counterclockwise rotation ←

Press the SELECT key to enter the character.

Repeat the procedure to complete desired labels.

The SPACE \blacktriangleright key (function shifted from the MAIN A SWEEP key) and the \blacktriangleleft DELETE key (function shifted from the DELAYED B SWEEP key) can be used only in this mode of operation for modifying the entered label characters.

To end the label writing mode, press and hold the SELECT key for more than one second. Select EXIT on the menu and press the SELECT key.

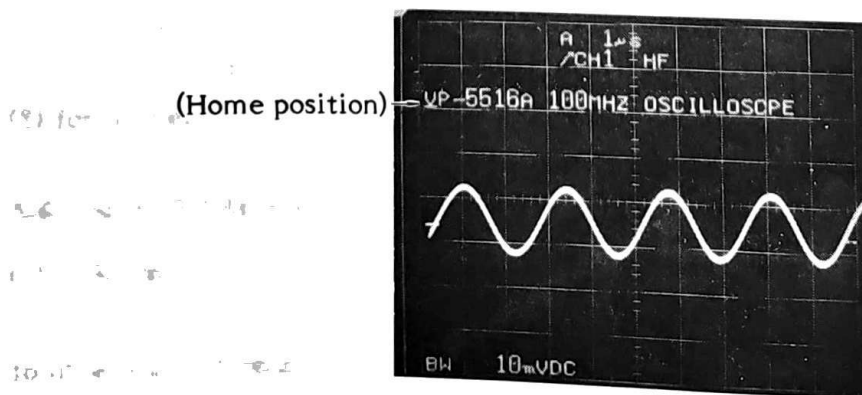


Fig. 5-25 Label Writing

(1-3-2) ERASE (on the **LABEL** menu)

Erases all label characters and cancels the menu mode.

5-8 TRACE IDENTIFICATION**(1) Function**

Provides ID labels for the displayed traces and the cursor lines. The prepared sixteen ID labels are used as shown below.

ID label	To be given to:	Can be moved by:
CH1A	CH1, A sweep trace	CH1 POSITION control
CH1B	CH1, B sweep trace	CH1 POSITION and SEP controls
CH2A	CH2, A sweep trace	CH2 POSITION control
CH2B	CH2, B sweep trace	CH2 POSITION and SEP controls
CH3A	CH3, A sweep trace	Cannot be moved
CH3B	CH3, B sweep trace	Cannot be moved
CH4A	CH4, A sweep trace	Cannot be moved
CH4B	CH4, B sweep trace	Cannot be moved
V1	V1 cursor line	↑, ↓ keys and SHIFT knob
V2	V2 cursor line	↑, ↓ keys and SHIFT knob
T1	T1 cursor line	←, → keys and SHIFT knob
T2	T2 cursor line	←, → keys and SHIFT knob
1G	CH1 GND level cursor	CH1 POSITION control
2G	CH2 GND level cursor	CH2 POSITION control
A	A trigger level cursor	A trigger LEVEL control
B	B trigger level cursor	B trigger LEVEL control

(2) Menu item selection and operating procedure**(1-4) TRACE IDENTIFY** (on the **MAIN MENU**)

Introduces the TRACE IDENTIFY secondary menu for selecting either write or erase mode of the ID labeling function.

(1-4-1) WRITE (on the **TRACE IDENTIFY** menu)

Provides the ID label writing function.

First, the ID label erasing cursor (long underline) appears at the home position. Rotating the SHIFT knob one step clockwise changes the erasing cursor to CH1A (see Fig. 5-26). Succeeding rotation will select other ID labels in the sequence as listed in paragraph (1) above. Select a desired ID label and move it to the desired position with four arrow keys.

Then press the SELECT key to enter the ID label.

The erasing cursor (long underline) is used to erase an entered ID label on the screen. Move it to the ID label to be erased with four arrow keys and press the SELECT key.

To end the ID label writing mode, press and hold the SELECT key for more than one second. Select EXIT on the menu and press the SELECT key.

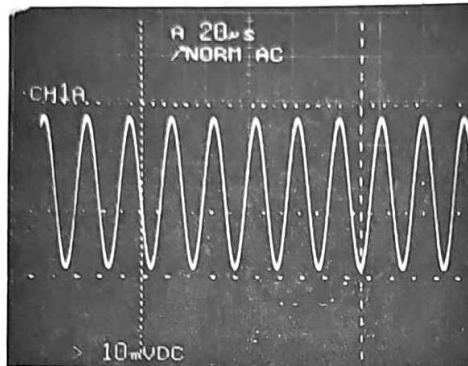


Fig. 5-26 ID Label Writing

(1-3-2) **ERASE** (on the **TRACE IDENTIFY** menu)

Erases all ID labels on the screen and cancels the menu mode.

5-9 INTERLOCKED OPERATIONS

Available are three types of interlocked operations; (1) trigger source selection interlocked with vertical-mode selection, (2) interlocked A and B trigger coupling and source selections, and (3) partially interlocked A and B sweep time coefficient selection.

Each function will be understood in the following explanation of the menu items.

(1-5) **V-MODE** (on the **MAIN MENU**)

Introduced the V-MODE secondary menu for setting or canceling the interlocked selection of the trigger source.

(1-5-1) **NORM** (on the **V-MODE** menu)

Used to cancel the interlocked selection setting. It provides normal oscilloscope operation with trigger source selection independent of the vertical mode.

(1-5-2) **TRIG SOURCE** \Rightarrow **V-MODE** (on the **V-MODE** menu)

Provides the interlocked trigger source selection depending on the vertical mode selection.

For single-trace selection of any channel, the trigger source NORM is selected. In multi-trace operation, the channel selected last for vertical axis is used as the trigger source.

(1-6) **TRIGGER** (on the **MAIN MENU**)

Introduces the TRIGGER secondary menu for arranging either trigger coupling or trigger source selection.

(1-6-1) **COUPLING** (on the **TRIGGER** menu)

Introduces the COUPLING tertiary menu for setting or canceling the interlocked A and B trigger coupling selection.

(1-6-1-1) **NORM** (on the **COUPLING** menu)

Used to cancel the interlocked A and B trigger coupling selection setting. It provides normal oscilloscope operation with A or B trigger source selection independent of each other.

(1-6-1-2) **A = B** on the **COUPLING** menu)

Provides the interlocked A and B trigger coupling selection. The same coupling is selected for both A and B trigger circuits at the same time.

(1-6-2) **SOURCE** (on the **TRIGGER** menu)

Introduces SOURCE tertiary menu for setting or canceling the interlocked A and B trigger source selection.

(1-6-2-1) **NORM** (on the **SOURCE** menu)

Used to cancel the interlocked A and B trigger source selection setting. It provides normal oscilloscope operation with A or B trigger source selection independent of each other.

(1-6-2-2) **A = B** (on the **SOURCE** menu)

Provides the interlocked A and B trigger source selection. The same source is selected for both A and B trigger circuits at the same time.

(1-7) **TIME/DIV** (on the **MAIN MENU**)

Introduces the TIME/DIV secondary menu for setting or canceling the partially interlocked A and B sweep time coefficient selection.

(1-7-1) NORM (on the **TIME/DIV** menu)

Used to cancel the partially interlocked A and B sweep time coefficient selection. It provides normal oscilloscope operation with A or B sweep time coefficient selection independent of each other.

(1-7-2) A WITH B (on the **TIME/DIV** menu)

Provides the partially interlocked A and B sweep time coefficient (value of TIME/DIV) selection. The A and B TIME/DIV settings are interlocked to prevent; (1) the A sweep from ever being set to a faster sweep than the B sweep, and (2) the B sweep from ever being set to a slower sweep than the A sweep.

5-10 AUTO RANGING

(1) Function and operation procedure

See detailed explanation given in paragraph 4-5.

(2) Menu item selection

(1-8) AUTO RANGE MODE (on the **MAIN MENU**)

Introduces the AUTO RANGE MODE secondary menu for selecting either "Normal auto ranging" or "Auto setting" operation.

(1-8-1) AUTO RANGE (on the **AUTO RANGE MODE** menu)

Introduces the AUTO RANGE tertiary menu for selecting item(s) to be controlled by the normal auto ranging function.

(1-8-1-1) VOLTS/DIV. TIME/DIV (on the **AUTO RANGE** menu)

Provides the normal auto ranging for both vertical deflection coefficient (VOLTS/DIV) and sweep time coefficient (TIME/DIV) selection.

(1-8-1-2) VOLTS/DIV (on the **AUTO RANGE** menu)

Provides the normal auto ranging for only vertical deflection coefficient selection.

(1-8-1-3) TIME/DIV (on the **AUTO RANGE** menu)

Provides the normal auto ranging for only sweep time coefficient selection.

(1-8-2) AUTO SET (on the **AUTO RANGE MODE** menu)

Introduces the AUTO SET tertiary menu for selecting item(s) to be controlled by the auto setting function.

(1-8-2-1) **VOLTS/DIV. TIME/DIV** (on the **AUTO SET** menu)

Provides the auto setting for both vertical deflection coefficient and sweep time coefficient selection.

(1-8-2-2) **VOLTS/DIV** (on the **AUTO SET** menu)

Provides the auto setting for only vertical deflection coefficient selection.

(1-8-2-3) **TIME/DIV** (on the **AUTO SET** menu)

Provides the auto setting for only sweep time coefficient selection.

5-11 BEEPER FUNCTION

The function will be shown in the following explanation of the menu items.

(1-9) **BEEPER** (on the **MAIN MENU**)

Introduces the BEEPER secondary menu for selecting items of operation to which the beeper sound is given.

(1-9-1) **KEY ENTRY** (on the **BEEPER** menu)

Introduces the KEY ENTRY secondary menu for selecting duration of a beep or turning off the beeper for key entry operation.

(1-9-1-1) **SHORT** (on the **KEY ENTRY** menu)

Turns on the beeper for key entry operation and sets the duration of a beep to about 0.2 seconds.

(1-9-1-2) **LONG** (on the **KEY ENTRY** menu)

Turns on the beeper for key entry operation and sets the duration of a beep to about 0.5 seconds.

(1-9-1-3) **OFF** (on the **KEY ENTRY** menu)

Turns off the beeper for key entry operation.

(1-9-2) **ERROR** (on the **BEEPER** menu)

Introduces the ERROR secondary menu for selecting duration of a beep or turning off the beeper for error detection.

(1-9-2-1) **SHORT** (on the **ERROR** menu)

Turns on the beeper for error detection and sets the duration of a beep to about 0.2

seconds.

(1-9-2-2) **LONG** (on the **ERROR** menu)

Turns on the beeper for error detection and sets the duration of a beep to about 0.5 seconds.

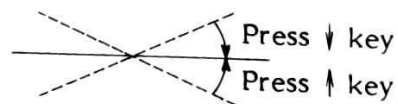
(1-9-2-3) **OFF** (on the **ERROR** menu)

Turns off the beeper for error detection. This also disables the beep sound at recalling of M1 explained in paragraph 5-13 below.

5-12 TRACE ROTATION

Selecting TRACE ROTATION (1-10) on the MAIN MENU directly provides the trace rotation function.

The screen displays a freerunning trace of CH1 with GND input coupling. If the trace is not parallel to the horizontal graticule line, press \uparrow or \downarrow key to align as illustrated below.



To end the function and resume the original display, press the SELECT key.

5-13 PANEL MEMORY FUNCTION

(1) Function

Up to ten kinds of front panel setups can be stored and recalled. Fig. 5-27 shows front panel keys and controls available for this memory function. (Keys and controls within the hatched area are not available.)

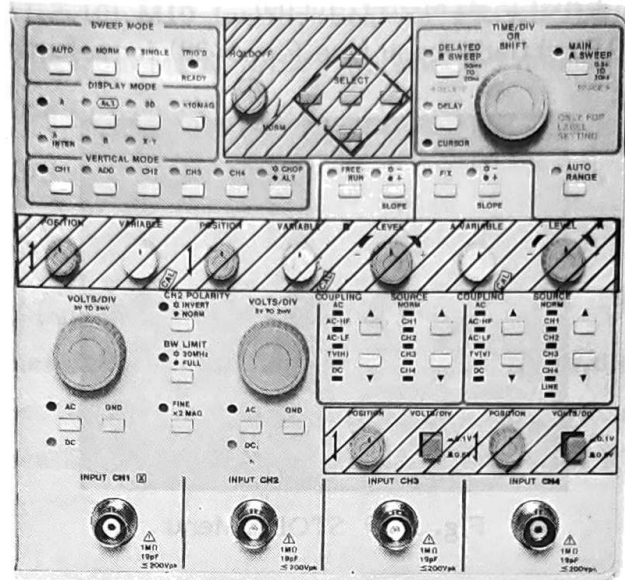


Fig. 5-27 Keys and Controls Available

Address numbers M1 to M10 are assigned for stored ten setups and they are recalled sequentially by every pressing of the ↓ key in normal measurement mode. The sequential recalling from the start address M1 to the end address M10 repeats cyclically by pressing the ↓ key repeatedly. The end address, however, can be modified optionally to any number below M10 so that the sequence turns back at the number. For example, if M3 is assigned for the end address, the sequential recalling repeats from M1 to M3 cyclically.

The recalled address number is momentarily indicated at the lower part near center of the screen and recalling of the start address M1 accompanies a beep sound unless the error detection beeper function has been turned off.

(2) Menu item selection

(1-11) PANEL MEMORY (on the MAIN MENU)

Introduces the PANEL MEMORY secondary menu for selecting a desired operation mode in the panel memory function. See Fig. 5-28.

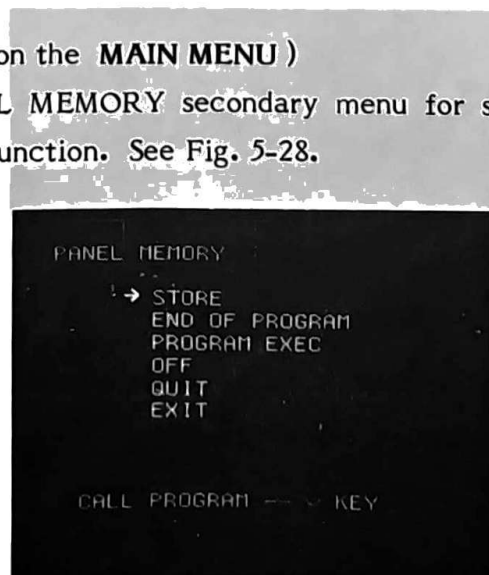


Fig. 5-28 PANEL MEMORY Menu

(1-11-1) **STORE** (on the **PANEL MEMORY** menu)

Introduces the STORE tertiary menu (see Fig. 5-29) for selecting an address number in the STORE mode.

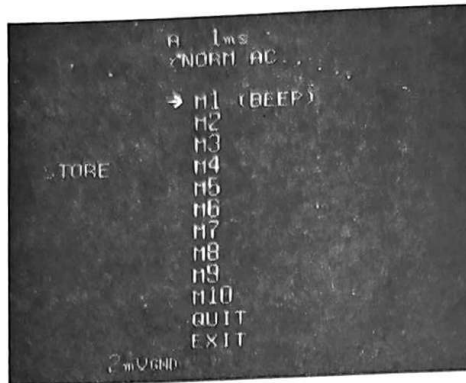


Fig. 5-29 STORE Menu

(1-11-1-1) **M1** to (1-11-1-10) **M10** (on the **STORE** menu)

Provide ten choices from M1 to M10 for addressing in the STORE mode of operation.

First, select M1 and make a desired front panel setup. Then press the SELECT key. This completes the storing operation for M1. Proceed to store other desired setups for M2 to M10 in the similar manner.

To change the stored content, simply repeat the same procedure selecting the address number for which the change is to be made. The new setup will be entered deleting the former one.

(1-11-2) **END OF PROGRAM** (on the **PANEL MEMORY** menu)

Introduces the END OF PROGRAM tertiary menu (Fig. 5-30) for selecting an address number to be used as the end address.

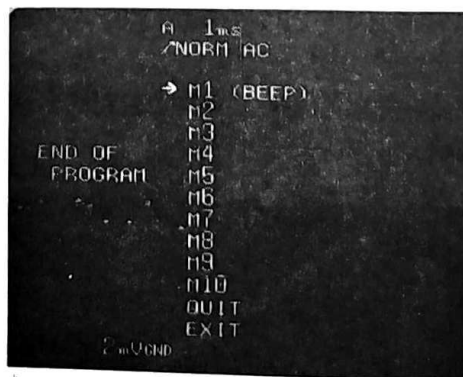


Fig. 5-30 END OF PROG Menu

(1-11-2-1) **M1** to (1-11-2-10) **M10** (on the **END OF PROGRAM** menu)

Provide ten choices from M1 to M10. The selected number will be the end address at which the recall sequence turns back to M1.

Select M10 for full use of ten setups. If M1 is selected, the sequential recalling is disabled and only M1 can be recalled.

(1-11-3) **PROG EXEC** (on the **PANEL MEMORY** menu)

Activates the panel memory function. This is used for turning on the function that has been turned off (by selecting OFF on this menu) to enable the recalling operation. This need not be selected for recalling operation after finishing the STORE or END OF PROGRAM setting.

(1-11-4) **OFF** (on the **PANEL MEMORY** menu)

Turns off the panel memory function.

5-14 DC BALANCE

Selecting DC BALANCE (1-12) on the MAIN MENU provides the automatic dc balance function including the attenuator balance and VARIABLE control balance as explained in paragraph 4-2 (7).

SECTION VI MAINTENANCE

6-1 GENERAL



This section contains information for performing routine maintenance and lamp replacement. Some of the procedures described below require servicing with instrument covers removed. Therefore, the following precautions should be observed for safety.

WARNING

1. Dangerous voltages exist at several points in this instrument. Internal servicing must be made by qualified maintenance personnel.
2. Disconnect the power cable from mains supply before removing covers.

6-2 ROUTINE MAINTENANCE

The VP-5516A has no moving parts that require lubrication or inspection, so no daily maintenance other than cleaning is necessary.

(1) Cleaning of outer surface

Dust on the outside of the instrument can be removed with a soft dry cloth. Dirt that remains can be removed with a soft cloth dampened with a solution of mild detergent and water. Never use volatile detergent such as benzine or lacquer thinner.

(2) CRT screen

- (a) Disconnect the power cable from the instrument.
- (b) Remove two screws from the top cover and pull up the cover off the instrument.
- (c) Remove nine screws from the bottom and remove the bottom cover.
- (d) Remove eight control knobs (see Fig. 6-1) by hand.
- (e) Remove four screws around the bezel (see Fig. 6-1) and remove the bezel with the tinted light filter.
- (f) Clean the CRT surface with a soft cloth dampened with either denatured alcohol or a solution of mild detergent and water.
It is advisable not to clean the tinted light filter because it is liable to be hurt with a slight scratch.

- (g) Refit all the components in the reverse sequence.

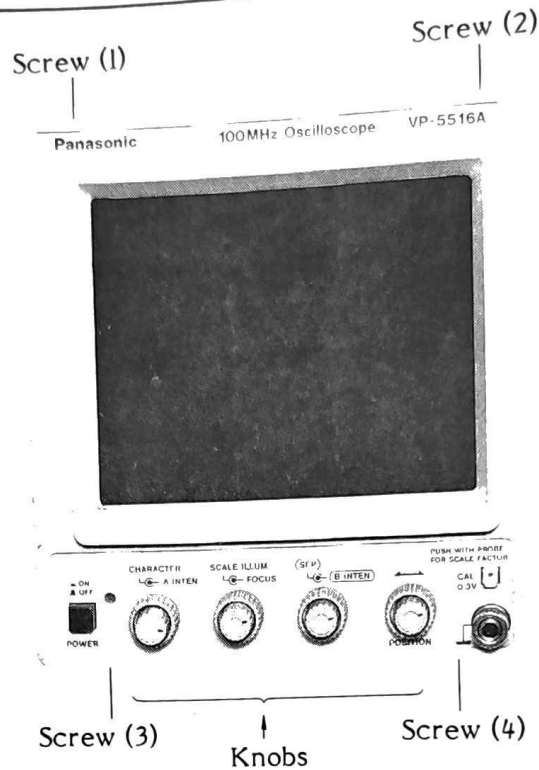


Fig. 6-1 Removal of Bazel

6-3 SCALE ILLUM LAMP REPLACEMENT

Three lamps are located on the upper edge of the CRT screen for scale illumination. The lamp supplied with the instrument as an accessory can be used to replace one of them.

- (1) Disconnect the power cable from the instrument.
- (2) Remove two screws from the top cover and pull up the cover off the instrument.
- (3) Remove a screw that retains the lamp housing located between front panel and CRT shield.
- (4) Pull the lamp housing slightly backward and the lamp can be replaced.
- (5) Reinstall the housing and secure it with the screw removed in step (3).
- (6) Refit the top cover.

QUICK REFERENCE FOR MENU APPLICATIONS

<p><u>To enter the menu mode</u> Press SELECT key MAIN MENU appears as shown on the right.</p>	<p>MAIN MENU</p> <p>→ CURSOR</p> <p>SCALE FACTOR</p> <p>LABEL</p> <p>TRACE IDENTIFY</p> <p>V-MODE</p> <p>TRIGGER</p> <p>TIME/DIV</p> <p>AUTO RANGE MODE</p> <p>BEEPER</p> <p>TRACE ROTATION</p> <p>PANEL MEMORY</p> <p>DC BALANCE</p> <p>EXIT</p>
<p><u>To select a menu-applied function</u> Shift the arrow mark on the menu to the desired item using ↓ or ↑ key and press SELECT key. The item having any succeeding menus will introduce the secondary menu on which another item can be selected. Similarly the tertiary and quartic menus may follow.</p>	
<p><u>To return to the preceding menu</u> Place the arrow mark at QUIT on each menu and press SELECT key.</p>	
<p><u>To cancel the menu mode</u></p> <ul style="list-style-type: none"> During a menu display Place the arrow mark at EXIT on each menu and press SELECT key. After a menu-applied function is selected Press and hold SELECT key for more than one second to obtain a menu. Shift the arrow mark to EXIT on the menu and press SELECT key. This procedure is stated as "[Cancel] SELECT (hold) → EXIT". 	

REFERENCE WAVEFORM (Available only in a single-trace operation of CH1 or CH2)

- Storing a waveform for reference
Menu selection → CURSOR → REF WAVE → SAMPLE [Cancel] SELECT (hold) → EXIT



Press SELECT key

Intensified portion scans the waveform



Clearing operation is required for storing another waveform as a new reference.

- Clearing the reference waveform stored
Menu selection → CURSOR → REF WAVE → CLEAR

TRIGGER LEVEL INDICATION

- Displaying A and B trigger level cursor lines
Menu selection → CURSOR → TRIGGER LEVEL → ON

GND LEVEL INDICATION (Self-canceled by selecting any other functions)

- Displaying CH1 and CH2 GND level cursor lines
Menu selection → CURSOR → GND LEVEL [Cancel] SELECT (hold) → EXIT

SCALE FACTOR CORRECTION

- Example: ×10 correction for 10:1 probe used for CH1.
- Menu selection → SCALE FACTOR → CH1 → ×10 → EXIT

Note: The front panel CAL terminal provides another correction means. Pressing the terminal with the CH1 probe connected to the terminal will automatically detect the attenuation ratio of the CH1 probe to make correction for direct reading. Note that all the other channels are corrected with the same ratio and the settings on the menus are also changed to meet the correction.

AUTO RANGING

- Example: Auto ranging for both volts/div and time/div.
- Normal auto ranging operation
Menu selection → AUTO RANGE MODE → AUTO RANGE → VOLTS/DIV, TIME/DIV
 - Auto setting operation
Menu selection → AUTO RANGE MODE → AUTO SET → VOLTS/DIV, TIME/DIV

INTERLOCKED OPERATIONS FOR BETTER USABILITY

- Automatic trigger source selection to the channel selected last with VERTICAL MODE keys
Menu selection → V-MODE → TRIGGER SOURCE = V-MODE
- The same trigger coupling selection for both A and B trigger circuits at a time
Menu selection → TRIGGER → COUPLING → A=B
- The same trigger source selection for both A and B trigger circuits at a time
Menu selection → TRIGGER → SOURCE → A=B
- Partially interlocked A and B sweep time/div settings to prevent the A sweep from ever being set to a faster sweep than the B sweep.
Menu selection → TIME/DIV → A WITH B

COMPENSATION

- DC balance compensation
Menu selection → DC BALANCE (Allow about ten seconds.)
- Gradient of the trace
Menu selection → TRACE ROTATION (Adjust with ↑ or ↓ key) → SELECT → EXIT

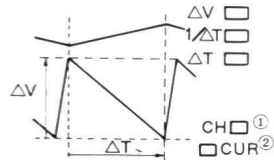
TYPICAL CURSOR MEASUREMENTS

Note: Before reading the readout values, verify scale factors and effective trace.

ΔV, ΔT and 1/ΔT measurements using four cursor lines

[Cancel] SELECT (hold) → EXIT

Menu selection → CURSOR → VOLTS, TIME, 1/ΔT → ΔV



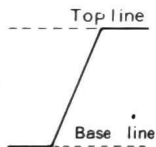
- Selected trace (channel 1 or 2, and A or B sweep) for which the readout values are effective. Use VERTICAL MODE and DISPLAY MODE keys for selection.
- Selected cursor line to be moved. Use ↑, ↓, ←, → SELECT keys for selection. The selected cursor line can be moved with ↑, ↓, ←, → keys and SHIFT knob.

Rise or fall time measurement

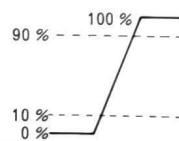
[Cancel] SELECT (hold) → EXIT

Menu selection → CURSOR → Tr, Tf

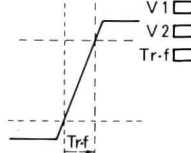
Set V1 and V2 to match base and top lines of the waveform.



Press ← or → key



Move T1 and T2 to the intersections

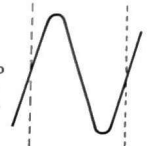


Phase measurement

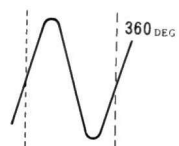
[Cancel] SELECT (hold) → EXIT

Menu selection → CURSOR → PHASE → T-Y

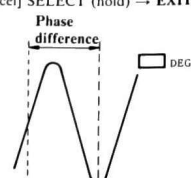
Set T1 and T2 to match one cycle of the waveform.



Press ↑ key



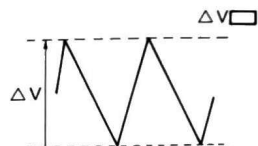
Move T1 and T2 for measurement



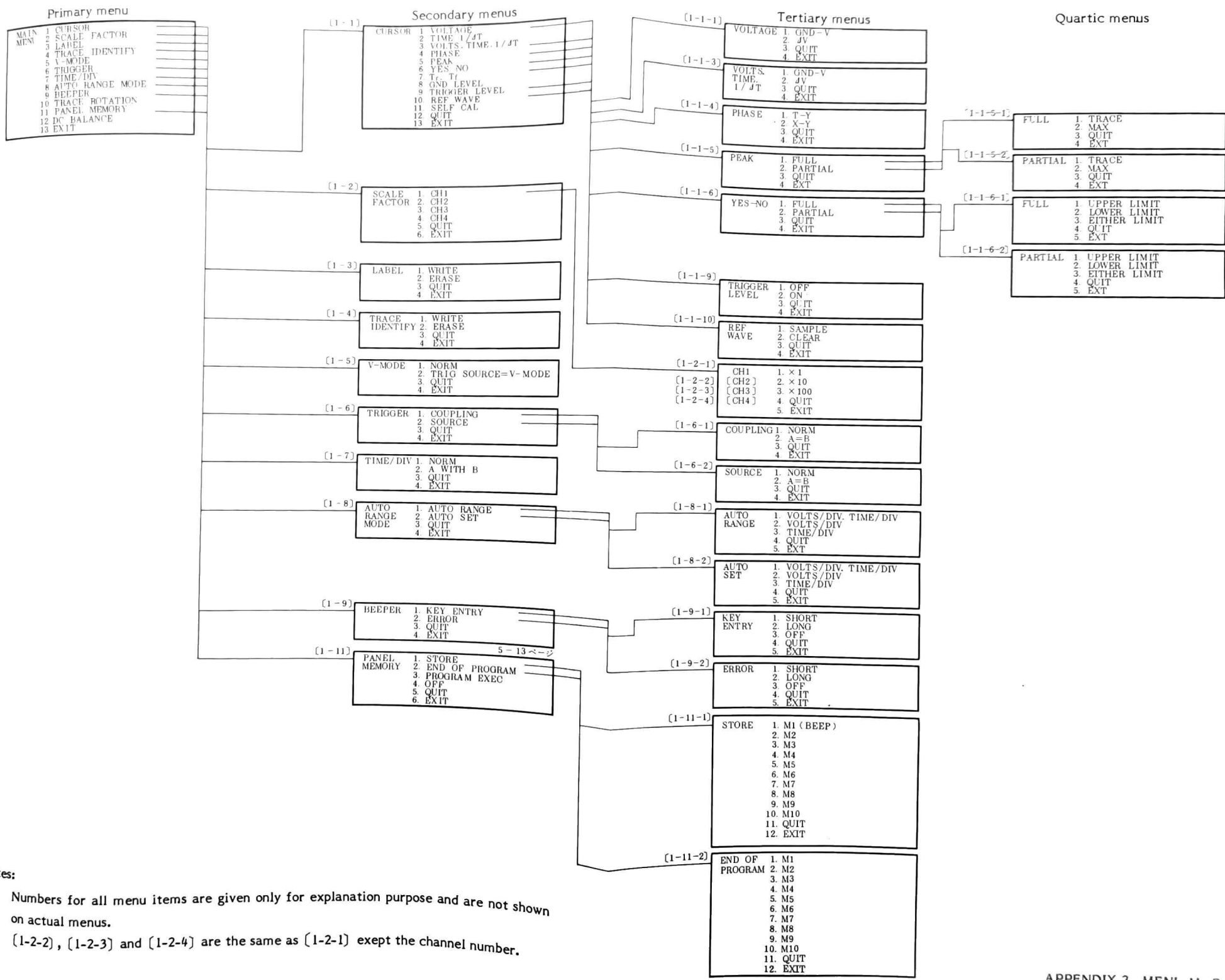
Peak detection

[Cancel] SELECT (hold) → EXIT

Menu selection → CURSOR → PEAK → FULL → TRACE



- Replacing TRACE with MAX provides maximum peak detection for all input signals and holds the peak value. Pressing SELECT key cancels the detection and restarts the maximum peak detection.



Notes:

- (1) Numbers for all menu items are given only for explanation purpose and are not shown on actual menus.
- (2) [1-2-2], [1-2-3] and [1-2-4] are the same as [1-2-1] except the channel number.

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