

INSTRUCTION MANUAL

514° 10D26%

Model: 5510

3 Channel 8 Trace

100MHz

Oscilloscope

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT PRIOR
NOTICE AND SUBSEQUENT REVISIONS TO THIS DOCUMENT
MAY EXIST USE FOR GENERAL REFERENCE.

1. GENERAL

1.1 DESCRIPTION

This instrument meets the customers needs in quality of performance, efficiency, function, design, and cost. Being rugged, highly reliable and a multi-purpose 3-channel 8-trace oscilloscope with a 6-inch Domed mesh type 14KV post deflection acceleration cathode-ray tube and with fine red internal graticule.

The vertical axis has a maximum sensitivity of 1 mV/DIV, a frequency response of up to 100 MHz-3dB, and a maximum sweep speed of 2 ns/DIV. A waveform magnification function with sweep delay is incorporated for real A, B dual time-base, making this scope has many convenient features and special functions which make it an ideal instrument for diversified types of research and development of electronic equipment or circuitry. The most efficient applications are in production line, maintenance and service. The features of this Oscilloscope can be summarized as follows.

1.2 FEATURES

1) Compactness, light-weight, ruggedness and simple-design:

The diecast frame provides compactness light-weight and ruggedness.

2) Easy Operation

Light torque lever switches and pushbutton switches are used. These and other controls are laid out in the most convenient locations making the oscilloscope extremely easy to operate.

3) High-brightness CRT, high acceleration voltage. (about 14KV):

The high acceleration voltage and high beam-efficiency of the 150mm rectangular CRT ensures a bright trace for high speed sweep observation.

4) Multi-mode display system:

CH1, CH2, CH3, ADD any combination or all the channels may be viewed simultaneously. Maximum 8 trace displaying is possible with the ALT sweep function.

5) High sensitivity and wide frequency bandwidth:

The maximum vertical sensitivity is 1 mV/DIV (when x 5 MAG) at 20 MHz or greater-3dB and 5 mV/DIV at 100 MHz or greater -3 dB.

6) High input impedance:

The input impedance of CH1, CH2, CH3 is $1\text{ M}\Omega \pm 2\%$, $25\text{ pF} \pm 3\text{ pF}$, allowing the use of $\times 10$ probes.

7) Maximum sweep speed 2 ns/DIV:

With $\times 10\text{MAG}$ function the highest sweep speed of 20 ns/DIV can be multiplied by a factor of 10 to attain maximum sweep speed of 2 ns/DIV.

8) Alternate sweep:

The A sweep and the delayed sweep can be viewed simultaneously in the alternate mode.

9) 2 channel X-Y operation:

CH3 may be used as EXT HORIZONTAL input allowing CH1 and CH2 to be used as vertical inputs for DUAL channel X-Y displays.

10) Trigger level lock:

A new trigger level lock circuit which controls the trigger signal and performs automatic adjustments of the trigger level, even for VIDEO signals and signals of large duty cycles.

5. CIRCUIT DESCRIPTION.

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 4-7. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, anohorizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundred volts into a level suitable for handling by the subsequent stages. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1 and CH2 preamplifiers and the CH3 signal received from the trigger generator. The switched signal is fed via the delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the trigger generator.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

4.7. OPERATION OF VERTICAL AND TRIGGER SOURCE.

This instrument is the 3-channel oscilloscope and each channels is operated by 3 switches vertical Mode 16 Source 26 ,INT TRIG 18 , the functions of each switches are as following chart.

C-1 VERTICAL MODE SELECTS CHANNEL (ONE CHANNEL)

SWITCH	Signal on CRT			
	CH1	CH2	CH3	ADD
VERTICAL MODE	CH1			
	CH2			
	CH3			
	ADD			

C-2 VERTICAL MODE SELECTS CHANNEL (MULTI-CHANNELS)

SWITCH	Signal on CRT	Multi-channel			
		CH1, 2	CH1, 3	CH2, 3	CH1, 2, 3
VERTICAL MODE	CHOP				
VERTICAL MODE	ALT				

C-3 TRIGGER SOURCE SELECTS TRIGGER SIGNAL

SWITCH	Signal on CRT			
	CH1	CH2	DUAL CH1, CH2	CH3
SOURCE	INT	INT TRIG SWITCH		
	LINE	LINE		
	CH3/EXT CH3÷10/EXT÷10	EXT INPUT		

C-4 TRIGGER INT TRIG SWITCH SELECTS TRIGGER SIGNAL

SWITCH	Signal on CRT			
	CH1	CH2	DUAL CH1, CH2	ADD
INT TRIG	CH1	CH2	CH1	CH1
	CH2	CH2	CH2	CH2
	NORM	input signal of the channel on CRT		

11) TV sync. triggering:

This instrument has a sync separator circuit, which allows triggering for TV.V signal and TV.H signal. It is automatically switched with the TIME/DIV control.

12) Variable holdoff function:

Digital and other signals with complex repeating periods which resist triggering can be stably triggered with a simple adjustment of the hold off level.

13) Linear focus:

Once the beam focus is adjusted, it is automatically maintained in this state regardless of changes in intensity.

14) CH1 signal output:

The CH1 signal output allows connection to frequency counters and other devices at all levels.

2. SPECIFICATIONS

2.1 Vertical axis

ITEM	SPECIFICATION	REMARKS
CH1 and CH2 Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (when x 5 MAG)	1-2.5 sequence, 10 positions
Sensitivity accuracy	±3% ±5% (when x 5 MAG)	Variable knob at CAL position
Variable (vertical sensitivity)	To 1/2.5 or less of panel-indicated value	
Frequency bandwidth Rise time x 5 MAG	DC : DC-100MHz AC : 10Hz-100MHz tr ≤ 3.5ns ADD : DC-70MHz DC : DC-20MHz AC : 10Hz-20MHz tr ≤ 17.5ns	With signal impedance 50Ω, at the position of -3dB by 6 DIV Variable at CAL
Input Coupling	AC-GND-DC	
Input impedance	1 MΩ ± 2%, 25 pF ± 3 pF	
Maximum input voltage	400 V (DC + AC peak) within 10 sec	Frequency 1 KHz or lower
CH3 Sensitivity	EXT input terminal used in common. 0.1 V, 1 V/DIV	
Sensitivity accuracy	± 3%	10 - 35°C (50-95°F)
Frequency bandwidth	DC-100MHz (-3 dB) AC: 10Hz-100MHz	
Input impedance	1MΩ ± 2%, 25 pF ± 3 pF	
Maximum input voltage	100V (DC+AC peak) within 10sec	Frequency 1 KHz or Lower
Input coupling	AC, AC-LF, TV, DC	
Rise time	Approx. 3.5nsec (Approx. 17.5 nsec when x 5 MAG)	
Signal delay time	Approx. 20ns or more	The displayed portion preceding the triggering point
Polarity change	CH2 only	CH2 Invert
DC balance shift	± 0.5 DIV (± 2.0 DIV when in x 5 MAG)	
Display modes	CH1; only CH1 CH2; only CH2 CH3; only CH3 (Input signal displays with source switch at EXT). ADD, CH1 + CH2. ALT, CHOP, Switchable	

Therefore, even when the delay time is continuously varied by rotating the DELAY TIME MULTI dial, the starting point does not vary continuously but varies intermittently. This operation when in the ALT mode can be observed as the intensified section jumps from trigger point to trigger point on the A sweep waveform.

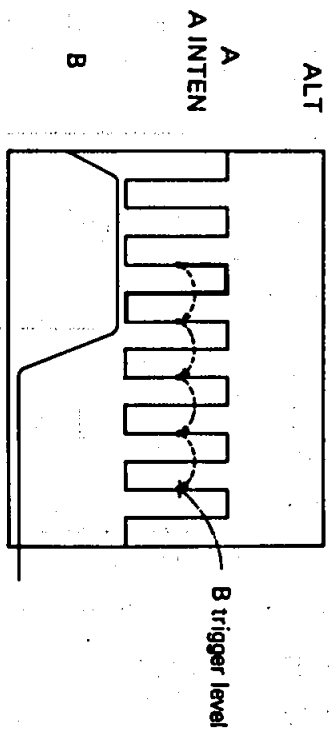


Figure 4-12.

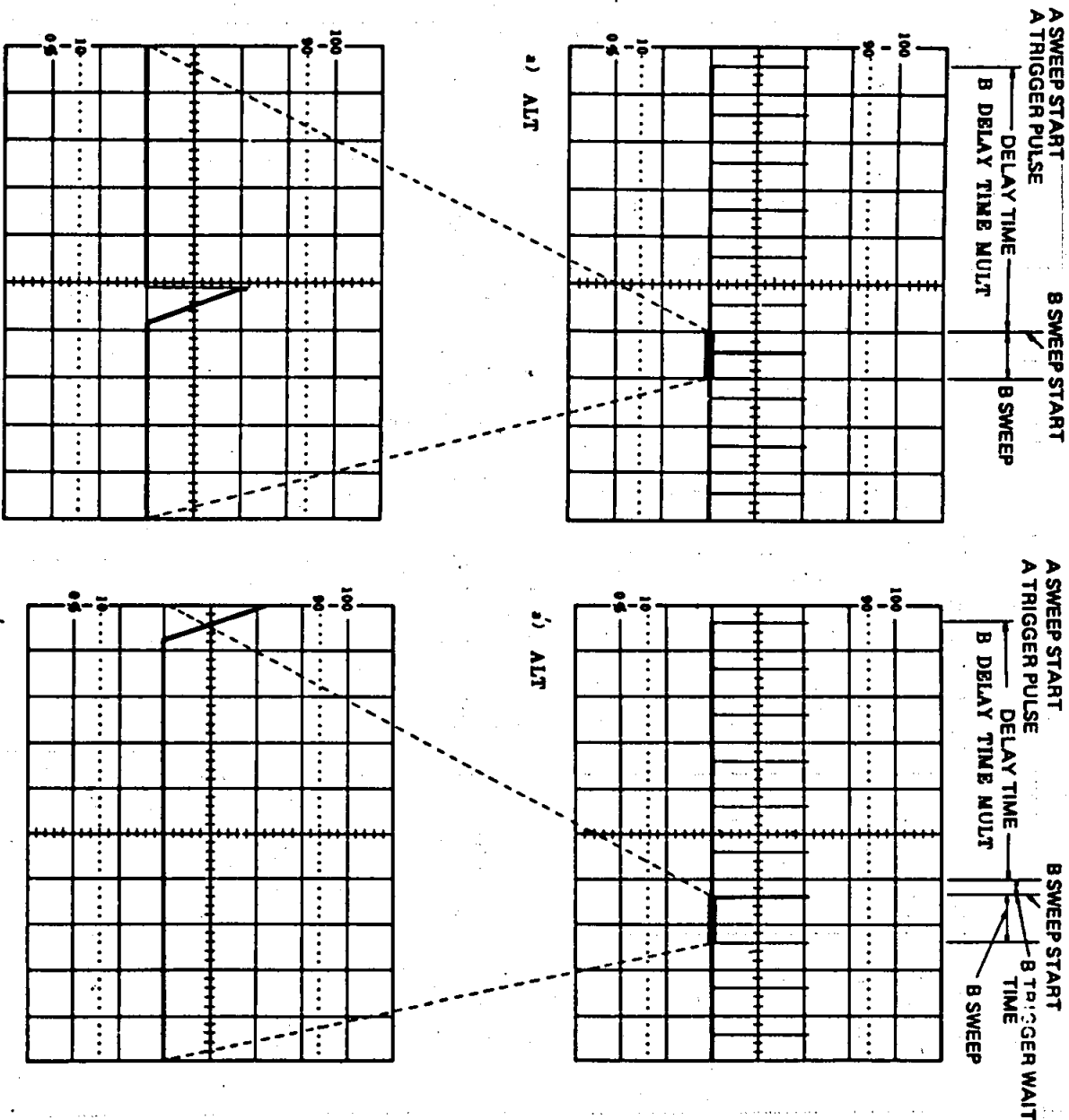


Figure 4-13

(1) B sweep (Continuous delay)

B sweep is operated by setting HORIZONTAL MODE SWITCH ⑩ in the ALT state (Both A and B depressed). In this case, A sweep displays the delay time who B sweep starts. B TIME/DIV switch ⑪ determines the sweep time of sweep started in delay. The example of the waveform gained by pressing A. B switch is shown as a) of Figure 4-11. The time From A sweep start to bright part is regarded as the time determined by A TIME/DIV ⑫ and the bright part of the trace shown in a) is displayed as B sweep.

(2) B TRIG'D Switch.

- a) When pressed B TRIG'D switch, B sweep starts right after delay time passes as the continuous delay status shown in Figure 4-12.
- b) When pressed B TRIG'D Switch, CRT screen displays the status of trigger delay as shown in a) b' of Figure 4-12. Operation method of B sweep triggering level is same as that of A sweep.

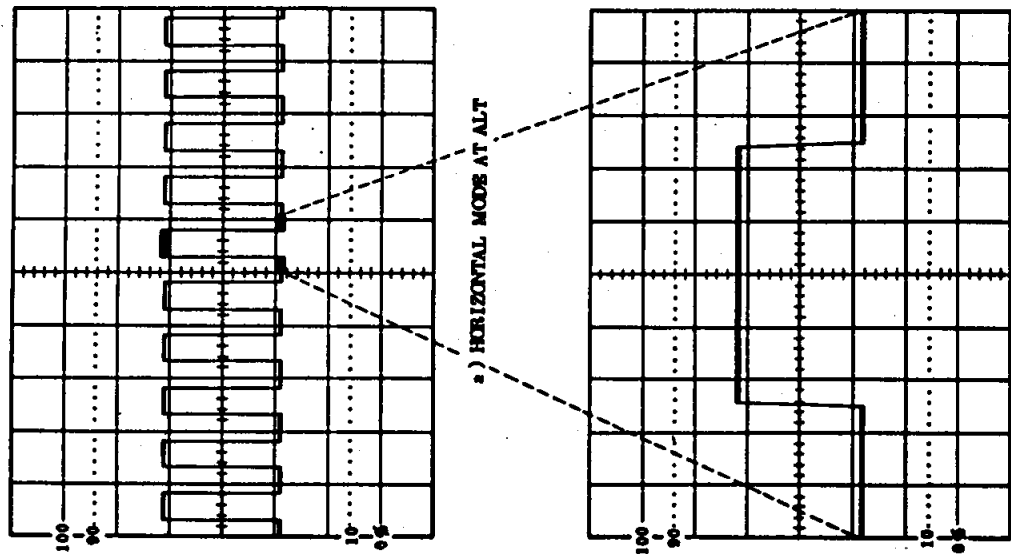


Figure 4-11.

ITEM	SPECIFICATION	REMARKS
Chop repetition frequency	300KHz $\pm$ 30%	at 2 Channels
Common mode rejection ratio	50:1 or better at 50 kHz, sinusoidal wave	When sensitivities of CH1 and CH2 are set equal
CH1 signal output	Approx. 100mV/DIV (at open) Approx. 50mV/DIV (at 50 Ω termination)	

2.2 Triggering

ITEM	SPECIFICATION	REMARKS
Signal source	INT; Signals CH1, CH2. Line: Check the frequency of main source voltage CH3/EXT; External Triggering Signal. CH3 $\div$ 10/EXT $\div$ 10; Devide Voltage of External Triggering signal to 1/10	
Coupling	AC, AC-LF, TV, DC	
Polarity	+ or -	
Sensitivity (1) NORM (INT)	AC : Attenuates signal components of Lower than 10 Hz. AC-LF : Attenuates signal components of higher than 40 kHz. TV : 2.0 div DC : DC-10MHz 0.4 div 10-100 MHz 2 div. TV : 0.2Vp-p DC : DC-10MHz 0.04 p-p 10-100 MHz 0.2 Vp-p	USE HOLD OFF FUNCTION
(EXT)	50Hz-10MHz 2 div 10MHz-100 MHz 3.0 div 50Hz-10MHz 200m Vp-p 10MHz-100MHz 300m Vp-p	
(2) FIX (INT) (EXT) (INT)		
Auto mode	Satisfies the trigger sensitivity (as shown above) for signal repetition frequency of 100Hz or over.	
EXT input Input impedance	1M Ω $\pm$ 2% 25pF $\pm$ 3pF	Frequency 1 KHz or Lower
Maximum input voltage	100V (DC + AC peak) within 10 sec	

2.3 Horizontal axis

ITEM	SPECIFICATION	REMARKS
Horizontal axis display	A, ALT (A INT), B (B TRIG'D)	
A sweep mode	AUTO, NORM, SINGLE	
Sweep time	0.02 μ sec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "x10 MAG")	1-2.5 sequence, 23 positions Variable knob at CAL position.
Sweep time accuracy	Under 3% $\pm 5\%$ (X10 MAG 0.2 μ S-0.5S) $\pm 8\%$ (X10 MAG 0.02 μ S-0.1 μ S)	
Variable sweep time	To 1/2.5 or lower than panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep length (time) at 0.02 μ sec/DIV-10 msec/DIV ranges	
B sweep Delay system	Continuous delay or triggered delay	
Sweep time	0.02 μ sec/DIV - 50 msec/DIV 2 nsec/DIV - 5 msec/DIV (when in "x10 MAG")	1-2.5 sequence, 20 positions
Sweep time accuracy	$\pm 3\%$ $\pm 5\%$ (X10 MAG 0.2 μ S-0.5S) $\pm 8\%$ (X10 MAG 0.02 μ S-0.1 μ S)	10 to 35°C (50 to 95°F)
Delay time	0.12 μ sec-5 sec	
Delay jitter	1/10,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{10 \text{ DIV}}$	Jitter width 1.0 DIV or less at A: 1 msec/DIV B: 1 μ sec/DIV
Sweep magnification	10 times (maximum sweep time 2 nsec/DIV)	Both A and B
Linearity	$\pm 3\%$ $\pm 5\%$ (when in "x 10 MAG)	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	5 mV - 5 V/DIV 1 mV - 1 V/DIV (x 5 MAG)	12.5 sequence, 10 positions
Frequency bandwidth	DC - 2 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 10 DIV
X-Y phase difference	Not greater than 30° at DC-100 kHz	

(4) Functions of the SLOPE switch:

This switch selects the slope (polarity) of the trigger signal.

"+" : When set in the "+" state, triggering occurs as the trigger signal crosses the trigger level in the positive-going direction.

"-" : When set in the "-" state, triggering occurs as the trigger signal crosses the trigger level in the negative-going direction.

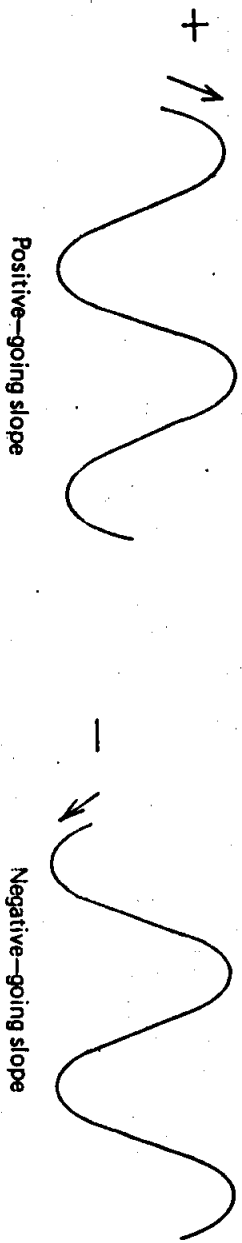


Figure 4-9

(5) Functions of LEVEL (LOCK) control:

The function of this control is to adjust the trigger level and display a stationary image. At the instant the trigger signal has crossed the trigger level set by this control, the sweep is triggered and a waveform is displayed on the screen.

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise, and it changes in the negative direction (downward) as the knob is turned counterclockwise.

4.6 DELAYED ALT SWEEP

In the Delayed ALT sweep mode, the A sweep and B sweep (delayed sweep) are displayed alternately on the screen, possible to observe at the same time the unmagnified waveform and magnified section.

To prevent the two waveforms from overlapping and to display them separately, adjusted the TRACE SEP control ⑪

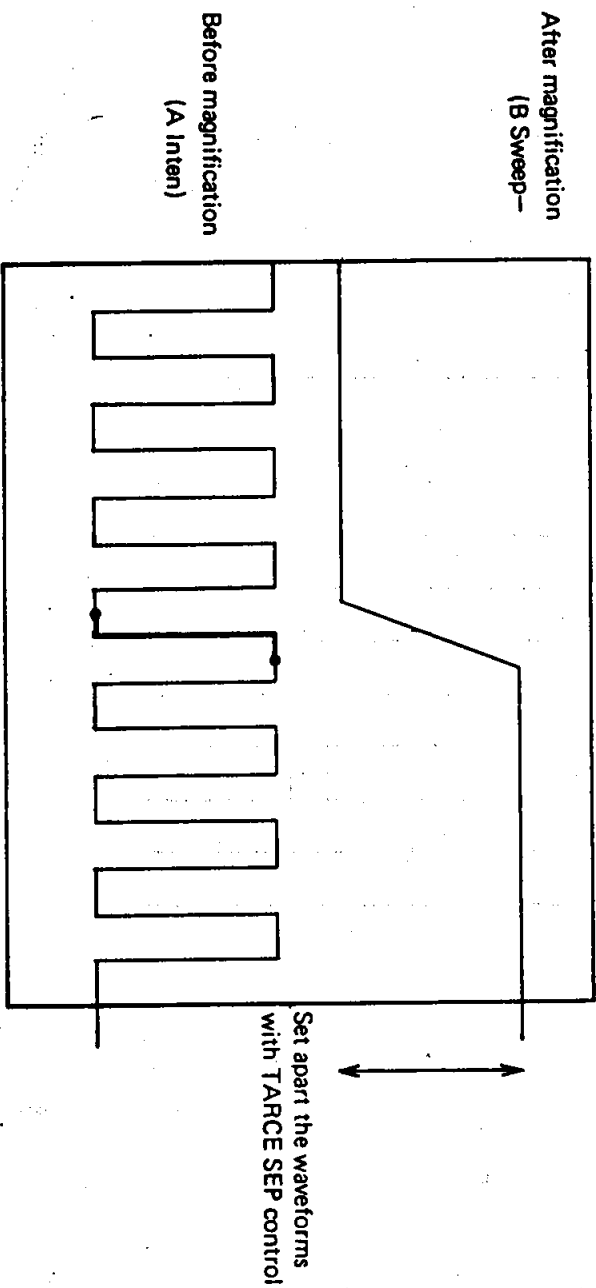


Figure 4-10.

NOTE: The delayed ALT sweep mode can be used in combination with the MULTI MODE (CHOP or ALT) of the vertical axis.

- NOTES:**
1. When in the VERT mode trigger function, signals of CH1, CH2 use the same trigger circuit alternately. Therefore, these signals must cross the same trigger level. Pay attention to the DC components of these signals. It is necessary to use TRIG LEVEL knob 21 and DC trig coupling for best triggering.
 2. Note that jitter may be produced when the sweep speed is slow if the SOURCE switch is set for AC coupling.
 3. The VERT MODE trigger function for vertical modes is effective only when in the single-channel operation and when in the ALT-mode multichannel operation. It is not effective when in the CHOP mode.
 4. 3 cycles or more on the CRT must be displayed to obtain complete triggering signal observation.

(2) Function of SOURCE Switch:

To display a stationary pattern on the CRT screen, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE switch selects such a trigger source.

INT : This internal trigger method is used most commonly. The signal applied to the vertical input terminal (the measured signal) is branched off from a point in the amplifier circuit and is fed to the trigger circuit through the INT TRIG switch. Since the trigger signal is the measured signal itself, a very stable waveform can be readily displayed on the CRT screen.

LINE : The AC power line frequency signal is used as the trigger signal. This method is effective when the measured signal has a relationship with the AC line frequency, especially for measurements of low level AC noise of audio circuits, thyristor circuits, etc.

EXT : The sweep is triggered with an external signal applied to the external trigger input terminal. An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal (vertical input signal) is not used as the trigger signal, the waveform display can be done independent of the measured signal.

EXT±10: The external trigger signal applied to the external trigger input terminal is attenuated into 1/10 before being applied to the trigger circuit. Operation is the same with those of the EXT trigger mode. This mode is used when the external trigger signal level is too high.

(3) Functions of the COUPLING switch:

This switch is used to select the coupling of the trigger signal to the trigger circuit in accordance with the characteristics of the measured signal.

AC : This coupling is for AC triggering which is used most commonly. As the trigger signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is an approx. 10 Hz (−3 dB).

When the VERT MODE trigger function is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

AC-LF : The trigger signal is fed to the trigger circuit through an AC coupling circuit and a low pass filter (approximately 50 kHz, −3 dB). The higher frequency components of the trigger signal are rejected. Only the lower frequency components of the trigger signal are applied to the trigger circuit.

TV : This coupling is triggering of TV video signals. The trigger signal is AC-coupled and fed via the trigger circuit (level circuit) to the TV sync separator circuit. The separator circuit picks off the sync signal, which is used to trigger the sweep. Thus, the video signal can be displayed very stably.

Being linked to the TIME/DIV switch, the sweep speed is switched for TV.V and TV.H as follows:

TV.V: 0.5 sec — 0.1 msec
TV.H: 50 μsec — 20 nsec

2.4 Z axis

ITEM	SPECIFICATION	REMARKS
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC — 5 MHz	
Input resistance	Approx. 5 KΩ	
Maximum input voltage	50V (DC + AC peak) within 10 sec	AC: 1 kHz or lower

2.5 EXT

ITEM	SPECIFICATION	REMARKS
Sensitivity	0.1 V/DIV, 1V/DIV	
Frequency bandwidth	DC-2MHz	
Phase difference	Not greater than 3° at DC-100 kHz	

2.6 Calibration voltage

ITEM	SPECIFICATION	REMARKS
Waveform	Positive-going square wave	
Frequency	Approx. 1 KHz	
Duty ratio	Within 45:55	
Output voltage	1V ± 2%	

2.7 Line power requirements

ITEM	SPECIFICATION	REMARKS
Voltage	100V, 117V, 220V, 240V Approx ±10% Selectable by connector change	
Frequency	50-60 Hz	
Wattage	Approx. 40VA.	

2.8 Operating environment

ITEM	SPECIFICATION	REMARKS
Operating Temperature	5-35°C (41-95°F)	
Operating Humidity	20-80% RH	

Storage Temperature	-20°C ~ +70°C	
Storage Humidity	20-80% RH.	

2.9 CRT

ITEM	SPECIFICATION	REMARKS
Type	6-Inch rectangular CRT,	6-Inch
Acceleration Voltage	Approx. 14KV	
Effective Screen Size	8 x 10 Div	1 Div = 10mm
Graticule	Internal graticule, continuously adjustable illumination	

2.10 Mechanical specifications

ITEM	SPECIFICATION	REMARKS
Dimensions of mainframe	146H x 360W x 384L (m/m)	5.74H x 14.17W x 15.11L (INCH)
Weight	Approx. 10kg	

2.11 Accessories

Power Cord	1
Probe (x1, x10)	2
Fuse (630mA 250V)	1
Instruction manual	1

* Specifications and Contents in this manual are subject to change without pre-notice.

(1) Functions of INT TRIG (internal trigger) switch:

The signals applied to the input terminals of CH1, CH2 are picked off from respective preamplifiers in order to be used as internal trigger signals. The INT TRIG switch selects these signals. The selected signals are sent to the A trigger circuit through the SOURCE switch. The relationships of these circuits are shown in the block diagram of Figure 4-8.

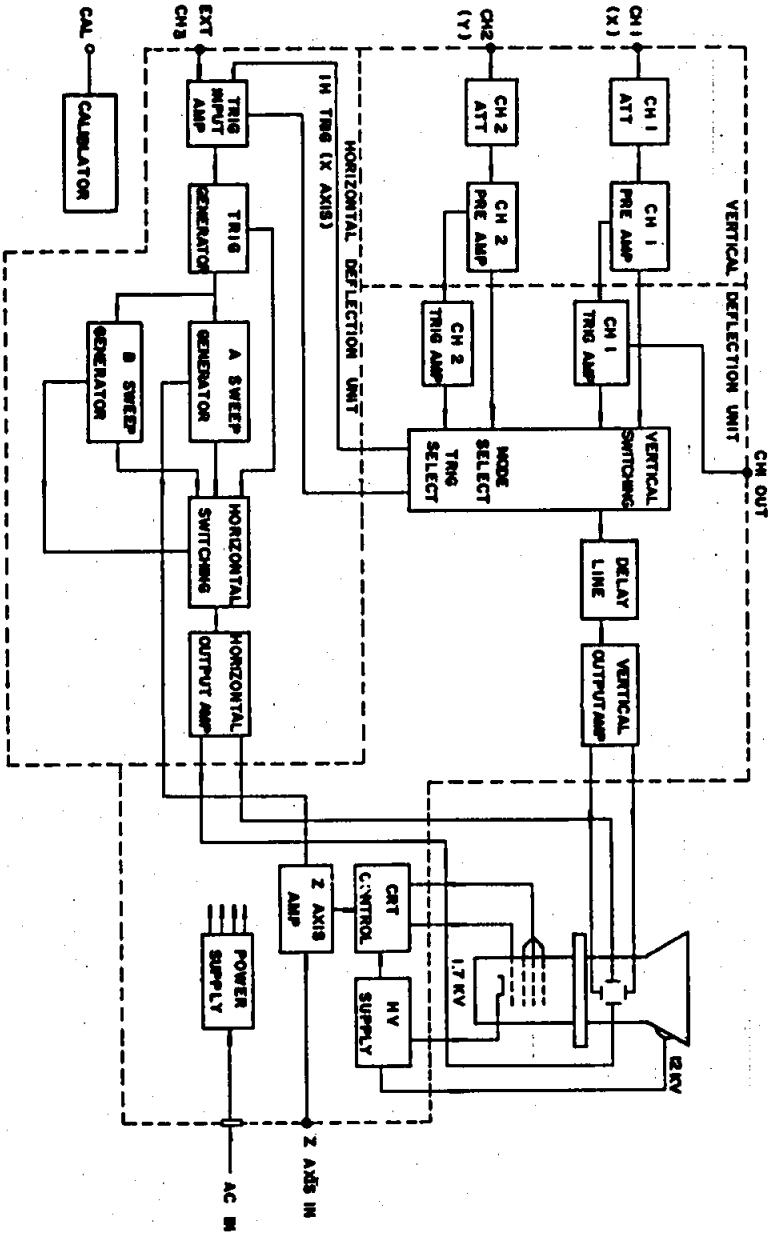


Figure 4-8. Block Diagram

With the INT TRIG switch the internal trigger signal can be selected as follows.

- CH1: Input signal of CH1
- CH2: Input signal of CH2
- VERT MODE: All signals being displayed on screen

As can be seen in the block diagram, the triggering circuits are designed with certain relationships to the vertical mode selector switches. These relationships are shown in the following table.

MODE	CH1	ADD	CH2	TRIG VIEW
INT TRIG	Trig by CH1			
CH1	Trig by CH1			
CH2	Trig by CH2			
VERT MODE	Trig by CH1	Trig by CH1	Trig by CH2	Trig by CH1

4.4 KNOBS POSITION BEFORE OPERATION

Before connecting the power cord to an AC line outlet, check that the AC line voltage selector plug on the rear panel of the instrument is correctly set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown in the following table.

ITEM	NO.	SETTING
POWER	1	OFF position
INTEN	4	Clockwise (3-o'clock position)
FOCUS	5	Mid-position
ILLUM	6	Counterclockwise position
VERT MODE	16	All buttons in ☐ state
POSITION	20	Mid-position
VOLTS/DIV	11, 19	50 mV
VARIABLE (x5 MAG)	15, 21	CAL'D (clockwise position) pulled-out state.
AC-GND-D $\bar{C}$	12	GND
INT TRIG	18	VERT MODE
SOURCE	26	INT
COUPLING	25	AC
LEVEL	32	"_"
HOLD OFF	33	counterclockwise
TRACE SEP	17	Mid-position
SWEEP MODE	34	AUTO
HOR MODE	30	A
A, B TIME/DIV	27 28	0.5 msec
$\leftrightarrow$ POSITION	31	Mid-position

4.5. TRIGGERING

Proper triggering is essential for efficient operation of an oscilloscope. The user of the oscilloscope must make himself thoroughly familiar with the triggering functions and procedures.

3. INSTALLATION & PRECAUTIONS

3-1. Unpacking

When you receive the instrument, please unpack and check it for any damage which might have been occurred during transportation if any fault is found, please notify the bearer or the dealer.

3-2. AC LINE VOLTAGE

AC line voltage for this instrument are shown on the following table. The required voltage can be selected by means of the voltage selector plug

NOMINAL	RANGE	FUSE
100V	90-112V	250V 630mA(T)
117V	108-132V	
220V	196-244V	250V 315mA(T)
240V	214-250V	

WARNING

If the Instrument voltage does not conform with the line voltage, the instrument may not operate normally or be permanently damaged.

3-3. Fuse

Before connecting the power cord to concent, please check the fuse which is built in the fuse holder on the rear side of this instrument. Take the fuse off, and check the specification 250V 630mA Also use same specified fuse when change if for repair.

WARNING

It is very dangerous or may be lethal to use different fuse or repaired fuse.

3-4. POWER CORD, PLUG, PROTECTION GROUNDING.

The power cord for this instrument is "INLET" type and consists of 3 pins including protection ground pin. Make sure to use same kind of this cord and do not use damaged cord.

CAUTION

Before power-in for test, make sure to ground the protection terminal which is are of the 3 pins on the plug. The power plug of this instrument should be connected to 3 pin-concent.
In case of using 2 pin-concent, please use the adaptor for grounding and insert a pin-plug of this instrument to the adaptor.

3.5. INSTALLATION.

When they install the instrument on desk, please use the handle on the side of the instrument adjusting angle for the best working position.

CAUTION

This instrument is designed for natural-aircooling through the holes on the cases but, in order to prevent upgoing temperature of inner side, following cautions are required.

1. There should be space at least 3cm from left, right side of the instrument.
2. Do not put other things on the upper case not to cover the holes.

4. OPERATING

4.1. GENERAL

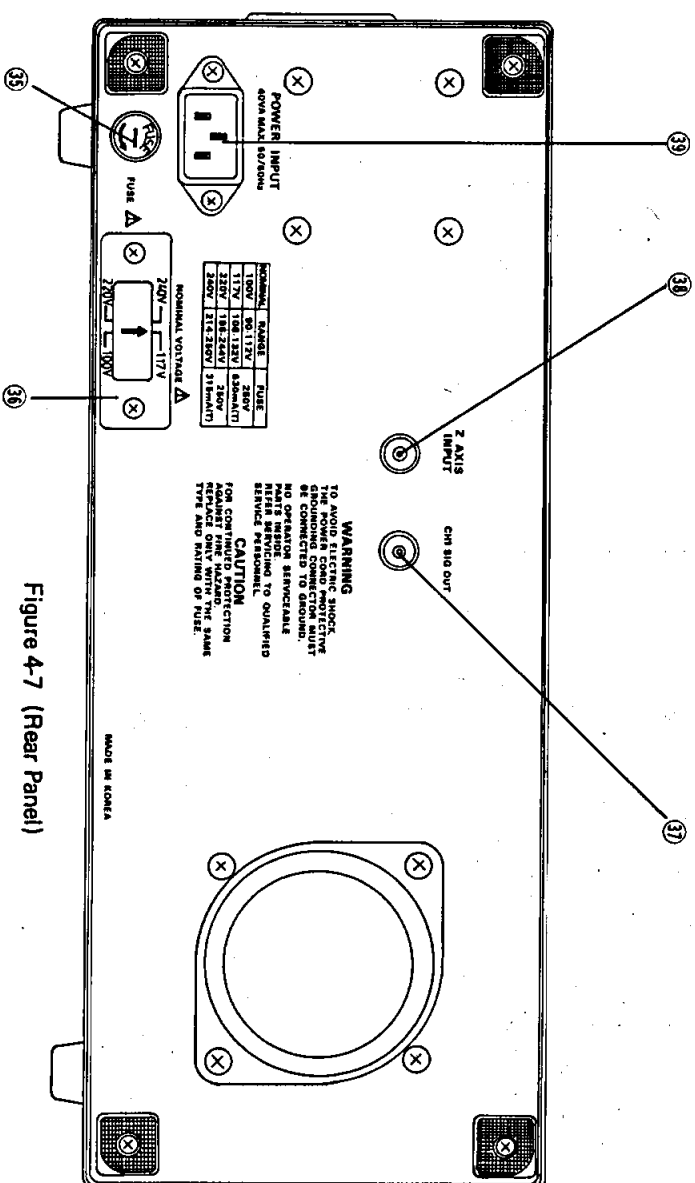
In this chapter, say some requisition before operating instrument, explain functions shown on the front-rear panel dividing by 3 parts, CRT, vertical and Horizontal.

4.2. REQUISITIONS BEFORE OPERATING.

Before operating the instrument, please do following acts which enables further operation correct and smooth. The numbers in O are function knob shown on the figures 4-4~6.

- 1) Before power-in, please locate function **knob** as follows.
 - a. Power switch ①..... OFF
 - b. ① ② ③ ④..... Center
 - c. Intensity knob ④..... Center
 - d. Trigger Level knob ③..... Turn to the left (FIX).
 - e. Sweep Mode Knob ③..... Auto
 - f. Pull x 10 MAG knob ③..... Pushed.
 - g. AC-GND-DC Switch ⑧ ⑫..... AC
- 2) Connect AC power cord to the Main input connector ⑬ of Rear panel and plug-in to the AC line outlet.
- 3) Turn-on the power switch ①, In about 20 seconds, a trace will appear on the CRT screen. If no trace in 60 seconds, turn the Intensity knob ④ to the right.
- 4) Adjust the trace to an appropriate brightness and sharpest image with the Inten control and Focus control, ④ ⑤
- 5) Align the trace to the center of the graticule by adjusting vertical position knob ⑩ (CH1) and Horizontal position knob ⑪
- 6) Set the AC-GND-DC switch ⑧ in the DC state, Vertical Mode Switch ⑫ in the CH1, Connect the probe to the CH1 Input Terminal ⑨ and apply the IV Calibrator ② to the probe tip.
- 7) Set the VOLTS/DIV Switch ⑬ (CH1) in 20mV/DIV, Turn the Variable knob ⑭ to the right-end, Triggering Switch ⑮ in INT, INT TRIG switch ⑮ in CH1
- 8) Make the trigger of CAL signal stable By adjusting Level Knob ⑯ Set Time/DIV knob in 1ms/Div. With above operations, 5 DIV square wave appears on the CRT screen.
- 9) When the displayed waveform (square) is distorted as Figure 4-1 please adjust trimmer on the probe until the waveform becomes as Figure 4-2.

- ⑰ B TIME/DIV — Sets sweep rate of B sweep by 20 ranged switch from 0.02μs/DIV to 50ms/DIV.
- ⑱ A TIME/DIV — Sets sweep rate of A sweep by 23 ranged switch from 0.02 μs/DIV to 0.5s/DIV and also used as X-Y operation.
- ⑲ VARIABLE — Continuously-variable adjustment of the A sweep rate. The value indicated by A TIME/DIV ⑲ can be reduced by a factor of 2.5 or more. sweep rate is adjusted at CAL position.
- ⑳ HORIZONTAL MODE — Selects A and B sweep mode as follows:
 - A : Main sweep mode (A sweep) for general waveform observation.
 - B : Displays the delayed sweep (B sweep) alone.
- ㉑ ALT (push Both A and B) — A sweep, AINT by B, and B sweep (delayed sweep) are displayed alternately.
- ㉒ B TRIGD: Selects between continuous delay and triggered delay.
 - ⏏ : For continuous delay. The sweep starts immediately after the sweep delay time determined by A TIME/DIV switch ⑲ and DELAY TIME MULT knob ㉒, irrespective of B trigger signal.
 - ⏏ : For triggered delay. Sweep starts with B trigger signal after the sweep delay time determined by A TIME/DIV Knob ⑲ and DELAY TIME MULT Knob ㉒
- ㉓ POSITION — Horizontal position control of spot or trace. When pull this knob, vertical amplifier's gain will be 10 times and sweep rate on the CRT screen will be expanded by 10 times
- ㉔ LEVEL — Controls the trigger level for setting the starting point of the displayed waveform. The start of Level is fixed at center position when the knob is in FIX position. When this knob is pulled out, the polarity of trigger signal will be inverted.
- ㉕ HOLD OFF — Complex repeating periods which resist triggering can be stably triggered with a simple adjustment of the hold off.
- ㉖ SWEEP MODE — Selects the desired sweep mode.
 - AUTO : When no triggering signal is applied or signal frequency is less than 50Hz, sweep runs auto matically (Free-run).
 - NORM : When adequate triggering signal is applied, sweep is in a ready state and the return trace is blanked out.
- SINGLE : Used for single sweep operation in conjunction with reset switch. The circuit is reset as this button is pressed. When the circuit is reset, the READY lamp turns on. The lamp goes off when the single sweep operation is over and the SINGL switch should be pressed again if the circuit has to be reset.



- ⑰ FUSE — Fuse holder for spare
- ⑱ Main power voltage selector — Selects according to voltage to be input
- ⑲ CH1 SIG OUT — output of pre-Amplifier.
- ⑳ Z AXIS INPUT — Terminal for external trace modulation.
- ㉑ MAIN INPUT — Connector For power cord.

10) Do the same operation (6)-(9) in CH2 and adjust probe. Set the Vertical Mode Switch ⑬ and INT TRIG with ⑮ in CH2.

11) Take the probe off From CAL IV ②, now ready for operating the instrument.

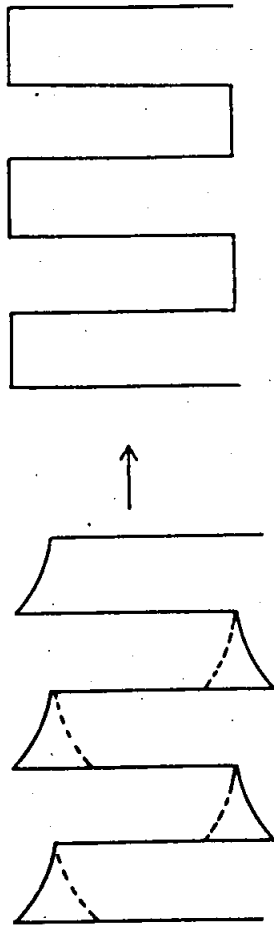
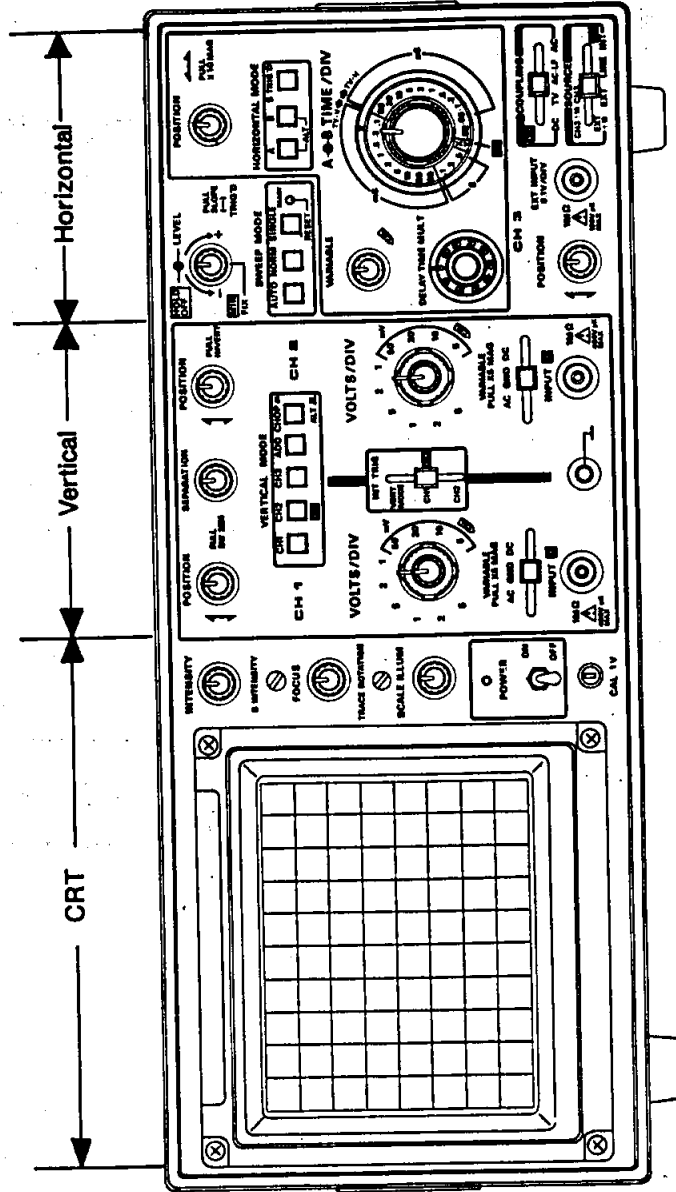


Figure 4-1

Figure 4-2

4.3. EXPLANATION OF PANEL.



CRT VERTICAL HORIZONTAL Figure 4-3. (Front Panel).

Part of CRT Figure 4-4.
Part of Vertical Figure 4-5.
Part of Horizontal Figure 4-6.
Part of Rear Panel Figure 4-7.

⑮ INT TRIG — Selects the internal trigger signal source. The signal selected by this switch is fed to the A trigger circuit if source switch ⑮ is set in the INT state.

CH1 : Signal of CH1 is used as the trigger signal and connected to the X axis during X-Y operation.

CH2 : Signal of CH2. Y axis during X-Y operation.

VERT MODE: Signal displayed on the CRT screen is used as trigger signal.

⑮ VOLTS/DIV — Same function as ⑮ of CH1.

⑮ POSITION — Adjusts vertical position of trace or spot of CH1.

⑮ VARIABLE PULL X 5 MAG — Same function as ⑮ of CH1.

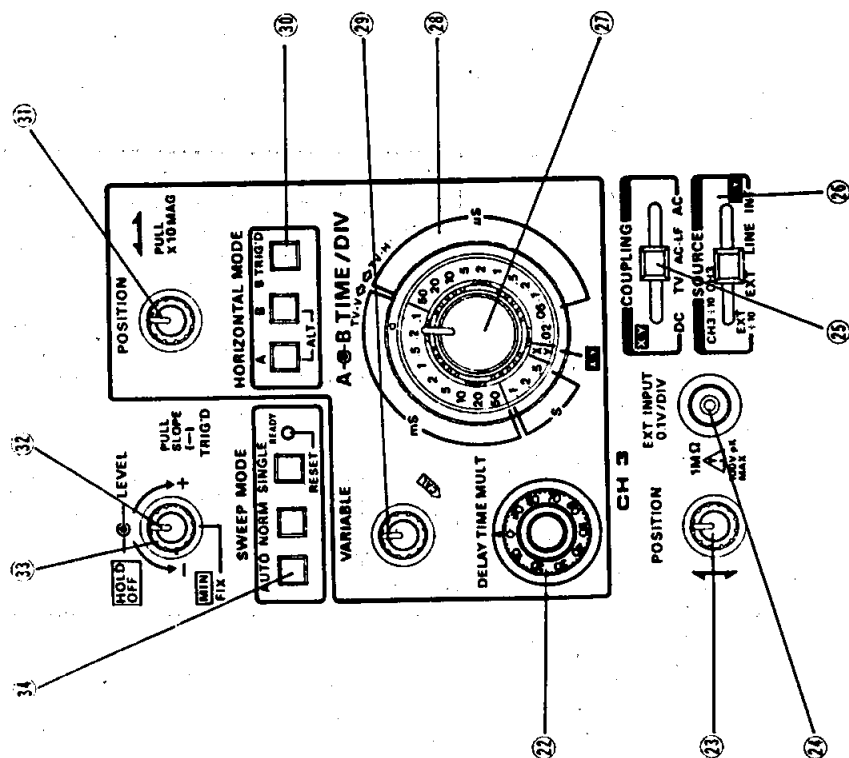


Figure 4-6 (Front Side of Horizontal)

⑮ DELAY TIME MULT — Multi-turn potentiometer for continuously variable adjustment of the delay time indicated by A TIME/DIV ⑮ in order to select the section of the A sweep to be expanded 0.3 — 10.3 times.

⑮ POSITION — Adjusts the vertical position of the trace or spot of CH3.

⑮ EXT INPUT — Input terminal for an external trigger signal, and also for CH3 input terminal.

⑮ COUPLING — Selects coupling mode of trigger source.

AC : Trigger signal is applied through an AC coupling circuit which attenuates signal lower than 10Hz.

AC-LF : Passes signal from 10Hz to 50kHz.

TV : TV sync, separation circuit is connected to the trigger circuit, and the sweep is triggered in synchronization with TV.V or TV.H signal at sweep speed selected by the A TIME/DIV ⑮

TV.V: 0.5 sec — 0.1 msec/DIV

TV.H: 50usec — 0.02 μsec/DIV

DC : Trigger signal is applied through a DC coupling circuit.

⑮ SOURCE — Selects signal source.

INT : Internal signal selected by INT TRIG switch ⑮ is used as the trigger signal and also connected signal when X-Y operation

LINE : AC line signal is used as the trigger signal

CH3/EXT: The input signal of EXT TRIG.

CH3+10/EXT+10 — The input signal of EXT TRIG INPUT terminal is attenuated by a factor of 1/10 and used as the trigger signal.

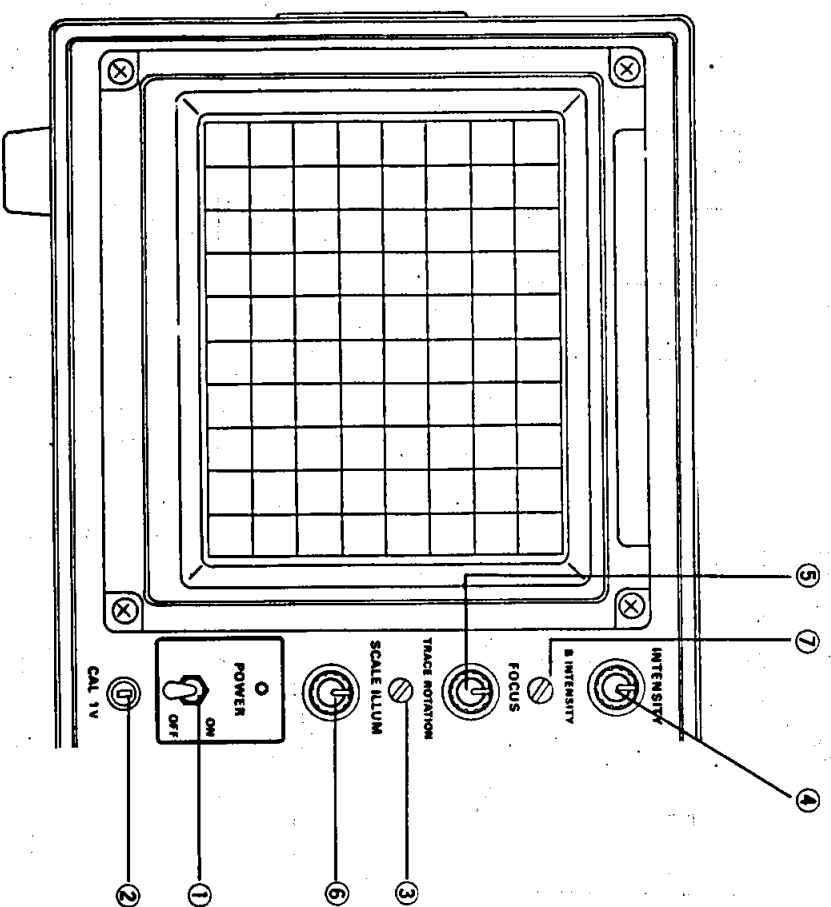


Figure 4-4 (Front side of CRT part).

- ① POWER — Main Power Switch. When this switch on, lamp indication operates.
- ② CAL IV — Terminal for 1V-p Calibration Voltage output.
- ③ TRACE ROTATION — Semi-fixed potentiometer for aligning the horizontal trace-in parallel with graticul lines.
- ④ INTENSITY — Controls the brightness of the spot or trace.
- ⑤ FOCUS — For focussing the trace to the sharpest image.
- ⑥ SCALE ILLUM — Graticule illumination adjustment.
- ⑦ B INTENSITY — Semi-fixed potentiometer for adjusting the intensified sweep or B sweep brightness.

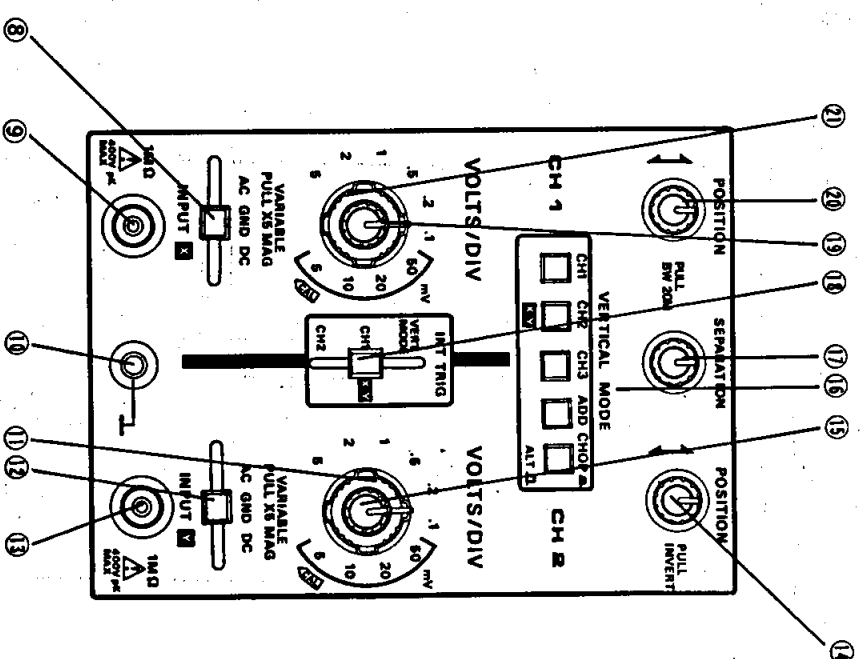


Figure 4-5. (Front side of vertical part)

- ⑧ AC-GND-DC — Switch for selecting connection mode between input signal and vertical amplifier. (CH1)
AC : AC coupling
GND : Input terminals are disconnected and vertical amplifier input is grounded.
DC : DC coupling.
- ⑨ INPUT X — Vertical input terminal of CH1. When in X-Y operation, X axis input terminal. In case of CH3 sweep, Y axis input terminal.
- ⑩ 1 — Ground terminal of instrument.
- ⑪ VOLTS/DIV — Selects the vertical axis sensitivity, from 5mV to 5V/DIV with 10 ranges.
- ⑫ AC-GND-DC — Same function as ⑧ (CH2). 1
- ⑬ INPUT Y — Vertical input terminal of CH2. When in X-Y operation, Y axis input terminal.
- ⑭ 1 — Position — Vertical position control of the trace or spot. When this knob is pulled out, the polarity of input signal of CH2 is inverted.
- ⑮ Variable Pull x 5. MAG — Fine adjustment of sensitivity. When this knob is pulled out, the sensitivity of the vertical amplifier is multiplied by 5 times of the panel indicated value.
- ⑯ Vertical MODE — Selects the operation mode of the vertical axis.
CH1 : CH1 operates alone.
CH2 : CH2 operates alone.
CH3 : By depressing the CH3 button and source switch ⑮ is positioned to INT, it is possible to look at TRIG View.
Source switch ⑮ is positioned to CH3/EXT or CH3 ÷ 10/EXT ÷ 10, it is possible to observe the EXT input signal of CH3 input terminal.
ADD : For measurement of algebraic sum or difference of CH1 and CH2 signals. Employing the function of CH2, pull the position knob ⑮
CHOP : The operation between channels (1.2.3) chopped at a frequency of approx. 300KHz/number of displayed channels. Suitable for observation with slow sweep speeds.
(Only time range 0.1ms-0.5s)
- ⑰ SEPARATION — Adjusting the vertical positions of B sweep when vertical Mode switch ⑮ is set in ALT. PULL BW20M-When the knob is pulled out, the frequency bandwidth of CH-2 result, in 20MHz.