INSTRUCTION MANUAL

MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.

OSCILLOSCOPE

VP - 525A

CONTENTS

Page

Chapter 1 OPERATIONAL INSTRUCTIONS

1. Description and Specifications 1

Glossary of Oscilloscope Terms 6

2. Operation 9

3. Measurement Techniques 27

4. Circuit Description 54

5. Schematic Diagrams 83

6. Maintenance and Calibration 98

Chapter 2 APPENDIX

1. Components and Accessories of Model VP-525A 121

CHAPTER 1 OPERATIONAL INSTRUCTIONS

This manual describes features, specifications, and circuit theory of the Model-VP-525A oscilloscope. In addition, it includes operating, maintenance, and calibration instructions.

1. DESCRIPTION AND SPECIFICATIONS

1.1 Description

The Model-VP-525A is a highly reliable oscilloscope and features high sensitivity, wide bandwidth, and a bright display. Designed for multi-purpose use, it is completely transistorized, making it compact and light-weight, as well as stable.

Features:

- o Stabilized power supply
- o Wide bandwidth DC to 10 MHz each channel
- o High sensitivity 2mV/cm (even in X-Y mode)
- o Completely transistorized for high reliability
- o Bright display through the use of a newly designed CRT.
- o Many operating modes, including Z-axis amplifier.

1.2 Specifications

- o Vertical Amplifiers

  (Specifications apply to each vertical channel)

  Deflection factor (sensitivity): 2mV/cm to 25V/cm.
  with MAG x 1 : From 20mV/cm to 10V/cm (9 steps)
  with MAG x 10 : From 2mV/cm to 1V/cm (9 steps) in 1, 2, 5 sequence, ±3% accuracy with VAR control in calibrated position (when correctly adjusted at highest sensitivities)

VAR control: Continuously variable between all ranges; extends maximum deflection factor to at least 25V/cm.

Maximum Input Voltage: 600V (DC + AC peak)

Bandwidth: DC to 10 MHz/-3db (MAG x 1, MAG x 10)

INPUT COUPLING	BANDWIDTH
DC	DC-10MHz/-3dB
AC	3Hz-10MHz/-3dB

(6cm deflection on CRT screen)

Rise time: 35nS (35×10^{-9} Sec)

Input impedance: 1MΩ, shunted by 35pF (direct)
10MΩ shunted by less than 15pF (with probe)

Input Coupling: AC, GND, DC

Input Connector: BNC

Modes of operation: CH1 only, CH2 only, CH1 and CH2 displayed alternately on successive sweeps (ALT), CH1 and CH2 displayed by switching between channels at approx. 200 KHz rate (CHOP), algebraic sum of CH1 and CH2 (ADD), and X-Y (CH1→X, CH2→Y).

Polarity Inversion: CH2 only

o Time Base

Sweep rate: 0.1μs/cm to 1.25s/cm

Ranges: From 0.5μs/cm to 0.5s/cm (21 steps) in 1, 2, 5 sequence, ±3% accuracy (at 25°C) with VAR control in calibrated position.

VAR Control: Continuously variable between all ranges, extends slowest sweep to at least 1.25s/cm.

Magnifier: X5

o Trigger Source: Internal (NORM or CH1), external, or line.

Trigger Coupling: AC, DC, TV(V)

Trigger Slope: + or -

Sweep Mode: Triggered Sweep (trigger level-variable and fixed 〈Fix〉)

Trigger Bandwidth and Minimum Trigger Level:

Internal		
DC	10Hz - 3MHz	3mm
	DC - 10MHz	10mm
AC	100Hz - 3MHz	3mm
	10Hz - 10MHz	10mm
TV (Video Signal Amplitude)		5mm p-p (negative)
External		
DC	10Hz - 3MHz	0.3V
	DC - 10MHz	1V
AC	100Hz - 3MHz	0.3V
	10Hz - 10MHz	1V
TV (Video signal amplitude)		0.5Vp-p (negative)

FIX: Same as AC

Trigger Modes: Auto, Norm and Single

o External Horizontal Amplifier:

(Used to amplify external trigger and sweep signal applied to EXT HORIZ terminal.)

Bandwidth: DC to 1MHz (For 10cm deflection)

Sensitivity: 0.75V/cm ±20%

Maximum Input Voltage: 600V (DC + AC Peak)

Input Impedance: 1MΩ shunted by less than 35pF

X - Y Phase Difference: 3 degrees max. at 50KHz

o Intensity Modulation

Input Coupling:	DC
Blanking Sensitivity:	Approximately 5V
Polarity:	Brightness decreases with + signal
Input Impedance:	Approximately 50 KΩ
Maximum Input Voltage:	25V (DC ±AC peak)

o Calibration Signal:

Waveform:	Approximately 1KHz square wave
Output Voltages:	0.01V, 0.1V, and 1V
Accuracy:	±2%

o CRT:

Model:	130 AWB 31
Type:	High intensity type
Effective Display Area:	80mm x 100mm
Acceleration Voltage:	Approximately 2.2KV
Phosphor:	p31

Note: A CRT with a longer persistence phosphor is available upon request. p31 phosphor has persistence of 1 to 10ms for decay 50 1/100.
Whereas p7 phosphor has persistence of a few 10ms to 1s for decay to 1/100.

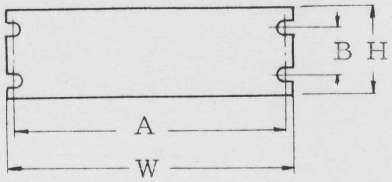
o Power

Voltage:	AC: 100V (90 to 110V)
	120V (108 to 132V)
	220V (198 to 242V)
	240V (216 to 264V)
Frequency:	50Hz to 400Hz
Power Consumption:	Approx. 40W

o Mechanical:

Dimensions:

Cabinet:	200(H) x 285(W) x 410(D)mm
	(7 7/8" x 11 1/4" x 16 1/8")
	(including controls and handles)
Rack mount:	177(H), 482(W), 465(A), 102(B)mm
	(7"(H), 19"(W), 18 1/4"(A), 4"(B))



Weight: Approximately 7.5 kg. (16.5lbs)

o Ambient Conditions

Operating Temperature:	$-10^{\circ}C$ to $+50^{\circ}C$
Operating Humidity:	20% to 80%

o Glossary of Oscilloscope Terms:

(in alphabetical order)

AC:	(1) Alternating current (2) Designation for AC only
AC peak:	Crest value of one alternation of a sine wave (amplitude, or distance from node to natinode)
AC peak to peak:	Two times the crest value above, or peak to peak value of an AC signal
Acceleration Voltage:	The voltage used to accelerate the electron beam in the CRT.
ADD:	To add. The algebraic sum of two or more signals. (In this equipment, CH1 and CH2)
ADD Common Mode Rejection	The cancellation of the common mode components of two signals (CH1 and CH2) when they are algebraically subtracted. In this equipment, this occurs in the ADD mode with the CH2 POLARITY control in INV. CH1 + (- CH2) = CH1 - CH2.
ALT:	The alternate display of CH1 and CH2 signals on successive sweeps.
AUTO:	Automatic.
Blanking Sensitivity:	Minimum input voltage required to blank the trace in the intensity modulation mode.
BNC:	A type of connectors, for coaxial cables
Brightness (or intensity)	Brightness of the waveform displayed on the CRT screen.
Calibration Voltage:	Voltage used to calibrate the vertical sensitivities.
CHOP:	The alternate display of CH1 and CH2 signals switched at a fixed frequency.
CHOP Frequency:	The CHOP mode signal switching frequency.
CH1:	Channel 1. One of two vertical deflection systems.

CH2:	Channel 2. One of two vertical deflection systems.
DC:	(1) Direct current (2) Direct coupling
Drift:	Drift of the displayed waveform after the warm-up period is over.
Effective Display Area:	Area on the CRT screen within which the oscilloscope characteristics are guranteed.
EXT:	External.
External Sweep:	Operating mode in which the sweep signal is supplied from an external source rather than being generated internally.
External Trigger:	The use of an external signal, from the external horizontal terminal (EXT), as the trigger signal. (See "Internal Trigger")
External Trigger:	The external signal used for external trigger.
FIX:	The use of the average DC level of the trigger signal as the trigger level.
Frequency Range:	3dB frequency response range.
HORIZ:	Horizontal axis.
Input Connector:	Connector used input terminals.
Input Coupling:	Coupling of signal to the input circuit.
Intensity Modulation:	Variation of the brightness of the displayed
Internal Trigger:	The use of the vertical inpat signal as the trigger signal.
Input Impedance:	Resistive and capacitive impedance of the input circuit.
Input Interference:	Interference in the input circuits caused by the CH1 and CH2 signals.
Maximum Input Voltage:	Maximum voltage that can be safely applied to the oscilloscope input terminals.
NORM:	Normal.

Persistence Time:	Length of time while trance is on after the fluorescent screen has been excited by electron beam.
Probe:	Type of test lead used to connect the signal to the input terminals.
SINGLE:	Single sweep
Single Sweep:	Operating mode in which the sweep must be manually reset before each operation of Single Sweep.
Spot:	A bright spot formed on the fluorescent screen when it is hit by a focussed electron beam.
Sweep Rate:	Time required for the sweep to travel 1 cm on the CRT screen.
Trace:	Path of the spot.
Trigger:	The use of a trigger to start the sweep.
Trigger Level:	Level of the trigger signal at which the sweep is triggered.
Trigger Sensitivity:	The minimum trigger signal amplitude required for triggering
Trigger Signal:	The signal used to trigger the sweep.
Triggered Sweep System:	One type of oscilloscope system. A system in which the sweep generator is triggered by the trigger signal. (Sawtooth generator system)
Video Signal:	TV video signal.
X-Y Operation:	Operating mode in which signals applied to vertical and horizontal axes are displayed two dimensionally.
X-Y Phase Difference:	Difference between the phase characteristics of the horizontal and vertical axes in the X-Y mode.

2. OPERATION

		Page
2.1	Description of Panel Controls and Indicators	9
2.2	Basic Operational Procedures	18
2.3	Operating Precautions	23

2.1 Description of Panel Controls and Indicators

All of the panel controls and indicators for the VP-525A oscilloscope are functionally arranged to facilitate operation.

2.1.1	Power Supply and CRT	P. 9 - P. 10
2.1.2	Vertical Deflection System	P. 10 - P. 13
2.1.3	Horizontal Deflection System	P. 13 - P. 16
2.1.4	Rear Panel	P. 16 - P. 17

2.1.1 Power Supply and CRT

Item numbers correspond to those in Figures 2-7 and 2-8. Symbol ⊘ denotes a screwdrive control.

① SCALE ILLUM: Controls power and CRT graticule illumination; CW rotation from maximum CCW position turns power on; Continued CW rotation increases brightness of the graticule. This control is useful when taking oscilloscope photographs in dark areas.

② POWER: Pilot lamp which indicates status ON or OFF of the power supply.

③ INTEN: Adjusts the brightness of the display. This control should be kept turned fully CCW when oscilloscope is not in use.

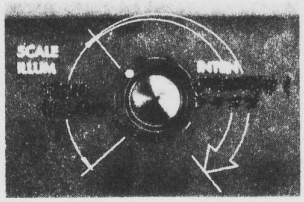


Fig. 2.1

④ FOCUS: Adjusts the focus of the display. If display cannot be fully focussed with this control, adjust the ASTIG control on the PC board in the rear of the oscilloscope.

⑤ ROTATION⫽: Adjusted to keep the base line horizontal.

⑥ CALIB: Selects calibration output voltage (1KHz square wave).

⑦ OUTPUT: Calibration voltage output terminal.

2.1.2 Vertical Deflection System controls the movement of the spot in the Y-axis. Two identical amplifiers, CH1 and CH2, are provided. Items ⑩ to ⑭ are provided for each channel.

⑧ INPUT (X): Vertical Input Connector.
When non-coaxial lead is used, the adapter shown in Figure 2-10, and a ground lead, should be used.
Signal applied to this terminal serves as X-signal in X-Y operation.

⑨ INPUT (Y): Same as ⑧ except that the applied signal serves as the Y-signal in X-Y operation.

⑩ AC-GND-DC: Selects coupling method between input signal connector and the vertical amplifier.
AC – Connection is made through a capacitor which blocks DC components of the signal.
DC – Direct coupling. Entire input signal is coupled to amplifier.
GND – The amplifier is grounded at the input terminal, and the input signal is opened. May be used for "OV" position and DC BAL adjustment.

⑪ VOLTS/CM: Selects the vertical deflection sensitivity of the input signal. Each setting indicates

the voltage required for 1 cm vertical deflection of the display.
[Switch settings will be calibrated only when the concentric VAR knob is turned fully CW.]
[Since the probe attenuates the signal by 10, pull the concentric VAR knob out, or multiply the switch setting by 10 when making measurements with the probe.]

VAR PULL X 10. Inner knob concentric with VOLTS/CM control. With knob fully CW, or in CAL position, sensitivity corresponds to the setting of the VOLTS/CM switch. CCW rotation from the CAL position gradually reduces the amplitude of the displayed waveform, providing uncalibrated continuous adjustment of sensitivity between VOLTS/CM switch settings. Attenuation at maximum CCW position is greater than 2.5, making it useful for dual-trace waveform comparisons. Pulling the knob out magnifies the vertical gain by 10. Since the input signal is attenuated by a factor of 10 when the probe is employed, the use of this magnification feature will permit vertical measurements to be made using the VOLTS/CM switch setting as a direct reference.

⑫ POSITION ↕: Controls vertical (Y-axis) position of display. CW rotation moves the display up, and CCW rotation moves the display down.

⑬ GAIN ⊘: Screwdriver gain control used to calibrate the settings of the VOLTS/CM switch.
(See maintenance and calibration on P. 102)

⑭ DC BAL⊘: Screw driver control used to adjust amplifier balance to prevent vertical shifting of the display as the VOLTS/CM and VAR controls are rotated.

(See maintenance and calibration on P. 103)

⑮ MODE: Determines operating mode of the vertical deflection system.

- o CH 1 - Channel 1 signals alone are displayed.
- o CH 2 - Channel 2 signals alone are displayed.

(Set TRIG control to NORM)

In X-Y mode, set TRIG control to CH1.

- o ALT - CH1 and CH2 signals are displayed on alternate sweeps. Used for observation of high frequency dual trade signals.
  (Set TRIG control to CH1)
- o CHOP - CH1 and CH2 signals are alternately displayed at a repetition rate of about 200KHz. Used for observation of low frequency dual trace signals.
  (Set TRIG control to CH1)
- o ADD - Algebraic sum of CH1 and CH2 signals is displayed. With POLARITY control of CH2 set to INV, the algebraic sum of [CH1]-[CH2] be displayed.

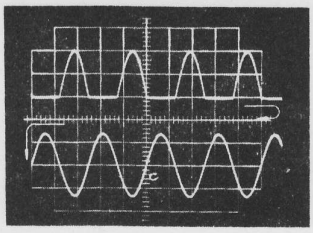


Fig. 2-2 Alt Operation

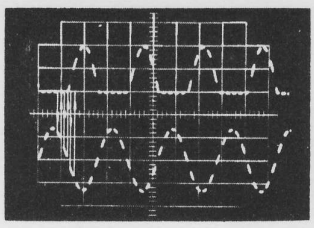


Fig. 2-3 Chop Operation

⑯ POLARITY: Reverses the polarity of CH2 signal. With switch in INV position, positive direction is downward. Used for comparison of two waveforms of opposite polarity, or for displaying [CH1] - [CH2] signal in ADD mode.

⑰ TRIG: Selects internal sync trigger signal.

NORM - Signal from the vertical amplifier is selected as the sync signal. Used in CH1, CH2 and ADD modes. In ALT and CHOP modes, control should be set to CH1 because unwanted signal may be applied.

CH1 - (X-Y) CH1 signal is selected as sync signal. Used in ALT and CHOP modes. (In X-Y operation, should be set to CH1 (X-Y). The CH1 input signal is then connected to the horizontal deflection system as the X-signal.)

2.1.3 Horizontal Deflection System (Controls the movement of the spot on the X axis, also called the time axis).

⑱ INT-LINE-EXT: (X-Y) Selects horizontal input signal.

INT - (X-Y) Signal from vertical deflection system is selected as the horizontal input signal.

LINE - Signal from power supply (AC POWER LINE) is selected as sync signal. This is useful for observing the hum and ripple components of a signal. [See "Special Applications" on Page 49 |

EXT - External signal is selected as the horizontal input signal.

(19) EXT INPUT: Input terminal for external signal.

(20) GND: Ground terminal for oscilloscope.

(21) AC-TV-DC: Selects coupling method between INT-LINE-SWITCH and horizontal circuits.

AC - AC signal components only are coupled.

TV - The vertical sync signal of TV video composite signal is extracted useful for TV receiver adjustment and repair.

DC - Essential for proper triggering of super low frequency signals, and for operations in the X-Y mode.

(22) LEVEL: Selects the voltage level on the input signal waveform at which the sweep will be triggered. For normal operations, control should be left in the FIX (fully CCW) position.

[See "Citcuit description" on Page 68]

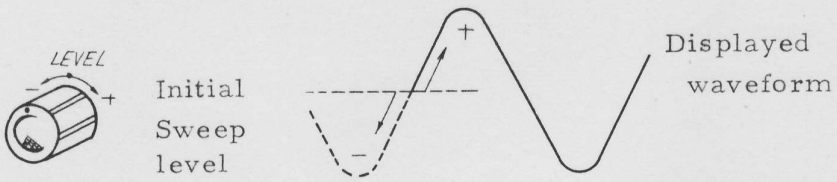


Fig. 2-4

(23) SLOPE: Selects the portion of the triggering waveform which triggers the sweep: + (positive-going slope) or - (negative-going slope). Selection of slope is needed since, as Figure 2-5 shows, two possible trigger points exist on a repetitive waveform for every trigger level selected by the level control.

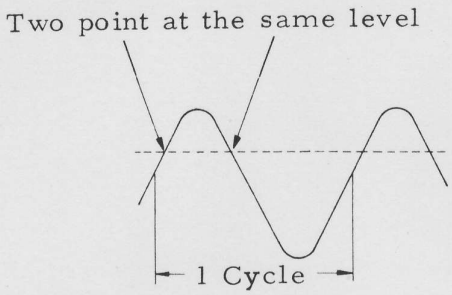


Fig. 2-5

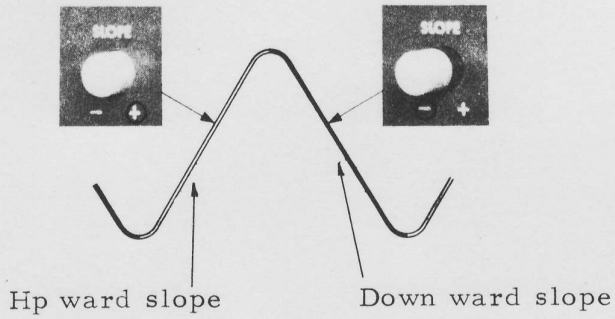


Fig. 2-6

(24) SWEEP MODE: Selects sweep mode

AUTO - Baseline is continuously displayed. Stable waveform will be displayed upon being triggered. [Control is usually set to this position]

NORM - Sweep will be generated only upon being triggered. Baseline is not displayed when not triggered.

SINGLE - Only one triggered sweep is generated. Before a sweep, the RESET switch is closed to light the lamp on the right. When the lamp is lit, the system is ready to generate a sweep upon application of a trigger.

(25) VAR PULL x 5 TIME/CM Selects sweep speeds.

TIME/CM - Outer knob selects the basic sweep speeds.

VAR PULL X 5 - Inner knob concentric with TIME/CM control. At fully CW (CAL) position, sweep speed corresponds to setting of TIME/CM switch.

CCW rotation decreases sweep speed, providing uncalibrated continuous adjustment of the sweep speed between TIME/CM switch settings. Pulling the knob out magnifies the sweep speed by 5.

EXT (X-Y) - Used for external sweep and X-Y mode operations.

(26) POSITION ↔: Controls horizontal (X-axis) position of display. Essential for time measurements.

CW rotation moves display to right, and CCW rotation moves it to the left.

2.1.4 Rear Panel (See Page 17)

(27) Z AXIS INPUT: Used as Z input terminal.

Application of approximately +5V will blank the display.

(28) LINE VOLTAGE RANGE: Used to adjust oscilloscope to line voltage.

Four positions, corresponding to the following voltage ranges, are provided.

90V - 100V (100V ± 10%)

108V - 132V (120V ± 10%)

198V - 242V (220V ± 10%)

216V - 264V (240V ± 10%)

29 FUSE: Protects the power supply primary.

Different fuse is used depending on line voltage.

90V - 132V 1A

198V - 264V 0.5A

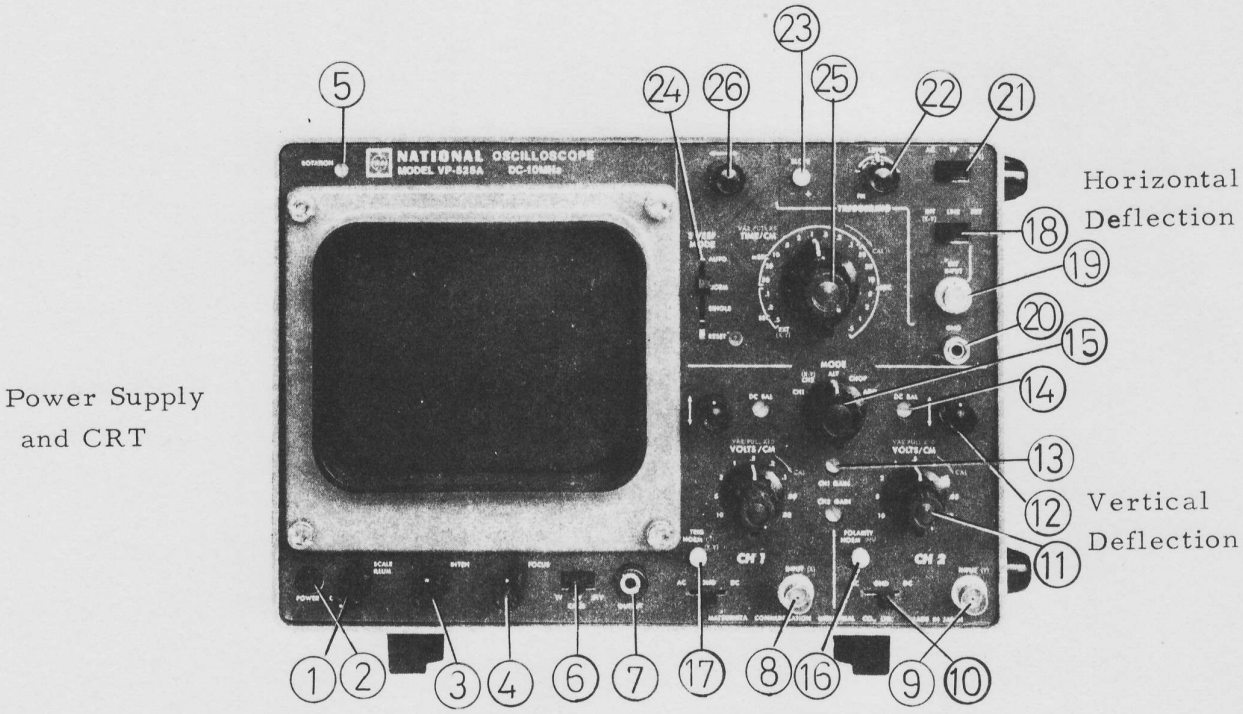


Fig. 2-7 Panel Arrangement

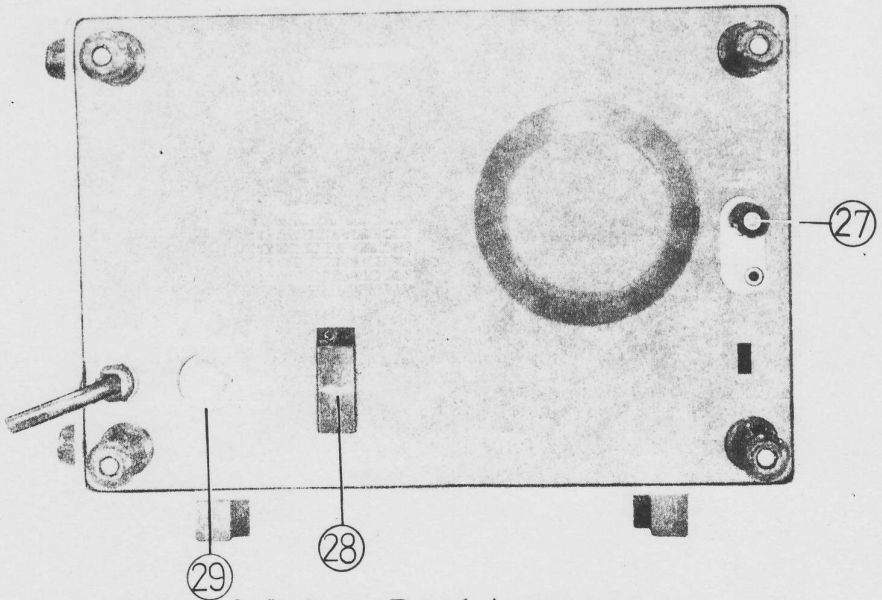


Fig. 2-8 Rear Panel Arrangement

2.2 Basic Operational Procedures

The highly accurate performance of Model VP-525A oscilloscope requires only simplified operations. It is advisable also for expert operators to read through this section, before starting the instrument.

2.2.1 Prior to Switch on ..... P. 18

2.2.2 Display of Baseline ..... P. 18 - P. 19

2.2.3 Observation of Waveforms ..... P. 19 - P. 21

2.2.4 Dual Trace Operations ..... P. 21 - P. 22

2.2.5 Application as X-Y Oscilloscope ..... P. 22 - P. 23

2.2.1 Before Switch On

Check line voltage

Align the arrow on the Line Voltage Range Plug on the rear panel to the proper voltage. (See Figure 2-9) Install a 1-A fuse (for 90V to 132V) or a 0.5A fuse (for 198V to 264V).

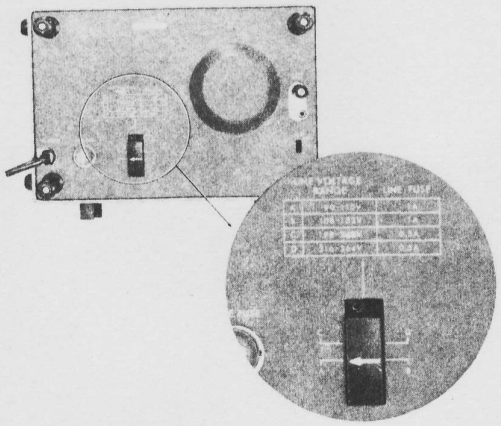


Fig. 2-9 Line voltage adjustment

Turn the power scale illum switch on.

2.2.2 Display of Baseline Trace

Set the following controls to the positions indicated:

INTENSITY

FOCUS mid range

POSITION ↕

POSITION ↔

SWEEP MODE AUTO

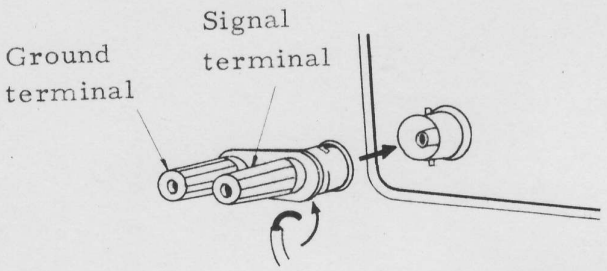
TIME/CM mid range

AC-GND-DC GND

Turn the POWER Switch clockwise. A baseline should appear after approximately 10 seconds. When it appears, adjust the FOCUS control to focus the baseline. If the switched-on oscilloscope is not to be used immediately, lower the intensity with the INTENSITY control and defocus the line with the FOCUS control. Damage to the phosphor screen of the CRT will occur if the focussed trace is left stationary for a long period of time.

2.2.3 Observation of Waveforms

Couple the signal to be observed to the CH1 or CH2 terminal. Be sure to complete the ground connection. Set the VOLTS/CM control to a setting that is greater than the amplitude of the signal.



Use when probe is not required

(In case the accessory VQ-036B adapter, with ground terminal, is used)

Fig. 2-10 Use of Adaptor with Ground Terminal

Set the AC-GND-DC switch to AC or DC. The signal waveform will then be displayed.

In the AC position, only the AC components of the signal will be displayed.

In the DC position, the complete signal will be displayed. Adjust the VOLTS/CM control for the desired signal amplitude. To measure signal amplitude or period, the signal must remain stationary. Set the INT-LINE-EXT switch to INT, and adjust the LEVEL control in either direction until the displayed waveform remains stationary.

When the knob is slightly turned CW or CCW, the left portion of the display will move along the waveform.

Adjust the horizontal POSITION control to position the display for convenient viewing.

[If the starting point of the displayed waveform is not important, turn the LEVEL control fully CCW and set it to the FIX position. The displayed waveform will then remain stationary regardless of the signal amplitude.]

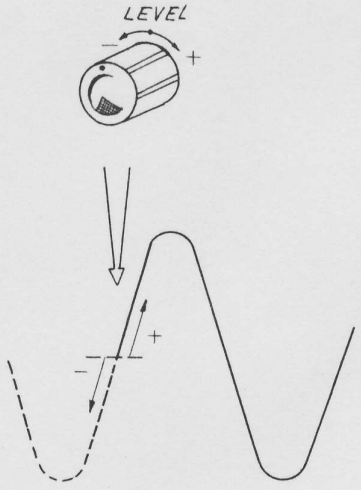


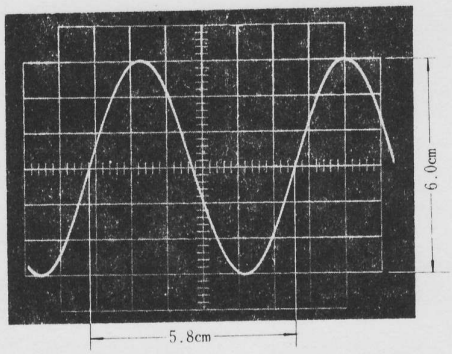
Fig. 2-11 Adjustment of Synchronization Level

NOTE: When the CH2 signal only is to be displayed, set the TRIG control to NORM. The signal will not be displayed if this control is in the CH1 position.

Set the TIME/CM control for proper waveform width.

Signal amplitude and period are measured as follows:

NOTE: Turn both VAR knobs fully CW to the CAL position. The settings of the VOLTS/CM and TIME/CM can then be used to determine amplitude and period.



0.5 V x 6.0 → 3.0 V
where VOLTS/CM setting is 0.5

0.1 Sec x 5.8 → 0.58 Sec
where TIME/CM setting is 0.1 Sec.

Fig. 2-12 Example of Voltage and Period Measurement

2.2.4 Dual Trace Operations (Fig. 2-13)

(Used for the simultaneous observation of two signals)

Set the following vertical controls to the positions indicated:

MODE	ALT or CHOP
TRIG	CH1

[Normally, CHOP should be used for low frequency signals and ALT for high frequency signals.]

[Since the dual-trace display is triggered by CH1 signal, be careful for application of CH1 and CH2 signals.]

Except for these steps, operation is the same as for single trace.

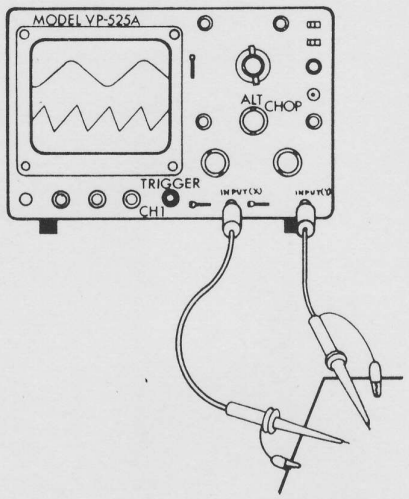


Fig. 2-13

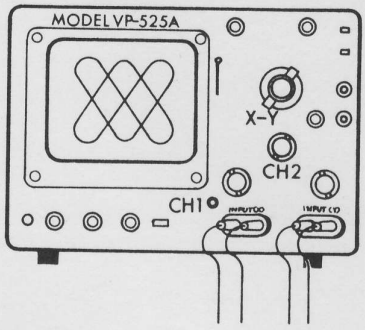


Fig. 2-14

2.2.5 Application as X-Y Oscilloscope

1 Single trace X-Y: (Fig. 2-14)

Set the following panel controls to the positions indicated:

MODE	CH2
TRIG	CH1
INT-LINE-EXT	INT
AC-TV-DC	DC (or AC)
TIME/CM	EXT (X - Y)

The oscilloscope is now set up as an X - Y oscilloscope with a maximum sensitivity of 2 mV/cm for each X - and Y - axis.

Input coupling is as follows:

X-signal (horizontal)	CH1 INPUT
X-signal (vertical)	CH2 INPUT

2 Dual trace X-Y:(Fig. 2-15)

Set the following panel controls to the positions indicated.

MODE	CHOP
INT-LINE-EXT	EXT
TIME/CM	EXT (X - Y)

The oscilloscope is now set up as a dual-trace X - Y oscilloscope.

Input coupling is as follows:

Y - signal (vertical)	CH1, CH2
X - signal (horizontal)	EXT INPUT

This set up is useful for the observation of stereo signals, and others.

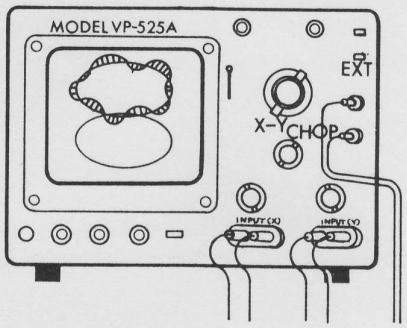


Fig. 2-15

2.3 Operating Precautions

If the VP-525A is handled and operated properly, its operating life is limited only by the lifetime of the CRT.

The following precautions should be carefully observed to maintain the operability of this oscilloscope.

2.3.1 CRT ..... P. 23

2.3.2 Excessive Input Voltages ..... P. 24

2.3.3 Oscilloscope Positioning ..... P. 24 - P. 25

2.3.4 Environmental Conditions ..... P. 25 - P. 26

2.3.1 CRT

The model VP-525A oscilloscope is equipped with a high intensity CRT, 130AWB31.

Although the phosphor screen of this CRT is very burn resistant, it can be damaged if a high intensity or sharply focussed spot or line is kept stationary for a long time.

Do not increase intensity more than necessary. Excessive intensity will cause eye strain.
Lower the intensity and defocus the display when the instrument is left unused with spot on the CRT screen.
Keep the CRT graticule clean with a chemically neutral liquid cleanser and dry it carefully. Rubbing the surface with a cloth will scratch the graticule.

2. 3. 2 Excessive Input Voltages

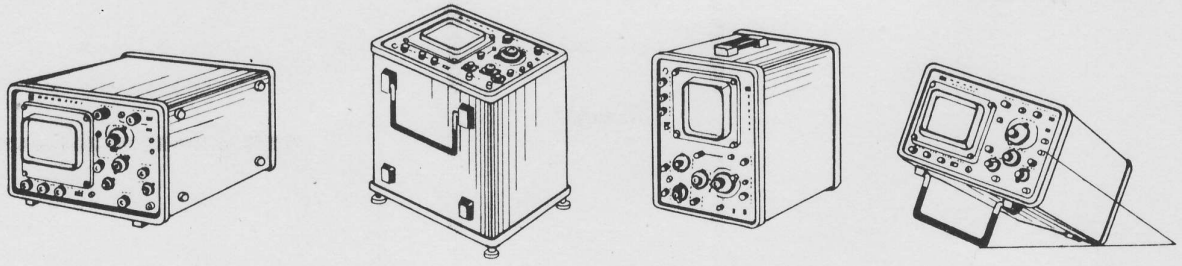
Maximum input signal voltages (DC Voltage + AC Voltage) are specified for each terminal.

Applying a signal greater than the specified maximum value may damage circuit components.

Vertical input terminal	600 Vp-p
Horizontal input terminal	600 Vp-p
Probe tip	600 Vp-p
Z Axis Input	0V～25V

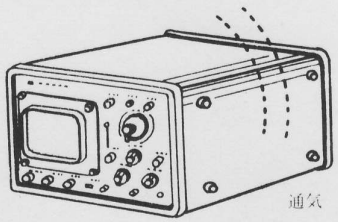
2. 3. 3 Oscilloscope Positioning

The oscilloscope can be operated in a number of positions:

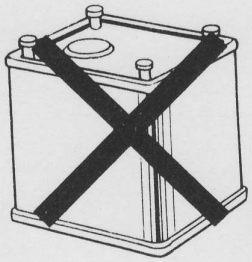


Vertical, horizontal and tilted. However, the following positions should be avoided.

Any position which will tend to clog the vents:
Overheating will result.



Face down on a surface: Damage to the various switches, and the bezel, will result.



The oscilloscope should be stored in a dust-free location that has low temperature and humidity. It should be covered to protect it from being scratched.

2.3.4 Environmental Conditions

This oscilloscope has been designed for world-wide operation. However, its life time will be shortened if it is operated under severe ambient conditions. The following environmental conditions should be observed:

Temperature and humidity:

Operation:	-10°C to +50°C
	10% to 70%
Storage:	-20°C to +70°C
	0% to 80%

Atmospheric Pressure:

When the instrument is used at high altitudes (e.g., in an airplane or on top of a mountain), failures are liable to occur because of the decreased insulation resistance of air.

Upper altitude limit	5,000m (15,000ft)
Lower pressure limit	430mmHg (0.6 atm – 40°C max)

When operating this instrument at an altitude of 5,000 ft or more, the upper limit of the operating temperature should be decreased 1°C for each 1,000 ft step up.

Magnetism:

Constant Magnetic Field:

Up to 5 Gauss trace is correctable with the rotation control.

Alternating Magnetic Field:

Maximum deflection of 2mm per Gauss will occur. (Effect will be different in each part of the screen).

For your information, the terrestrial magnetism in Japan measures approximately 0.46 gauss.

If the instrument is accidentally dropped in water, immediately wash it in fresh water and contact our nearest Service Station as soon as possible.

3. MEASUREMENT TECHNIQUES

		Page
3.1	Pre-Operational Adjustments	27
3.2	Signal Coupling	29
3.3	General Measurements	32
3.4	Special Applications	42

3.1 Pre-Operational Adjustments

The following adjustments must be performed before precision measurements can be taken.

3.1.1	Probe Adjustment	P. 27 - P. 28
3.1.2	Gain Adjustment	P. 29
3.1.3	DC BAL Adjustment	P. 29

3.1.1 Probe Adjustment

When small signals in high impedance circuits are to be observed, the oscilloscope's input impedance, the stray capacitance of the connecting cable, induced noise, etc. will all affect both signal source of the circuit under test, and displayed waveform, causing measurement errors.

In such a case, high impedance attenuator probe should be used to reduce these influences. Since the probe will attenuate the amplitude of the signal, high amplitude signals can be observed.

The basic circuit of the attenuator probe is shown in Figure 3-1. When the circuit constants are adjusted to agree with the following formula:

$$R_1 \times C_1 = R_2 \times C_t \ (C_t = C_2 + C_3),$$

the probe will be properly compensated. This adjustment is made by adjusting the variable capacitor C_2 in the probe connector with a small screwdriver for a perfect square wave. The setup for using the calibration voltage output of the oscilloscope as the signal source is shown in Figure 3-2.

Figure 3-3 illustrates both correct and incorrect waveforms for this adjustment.

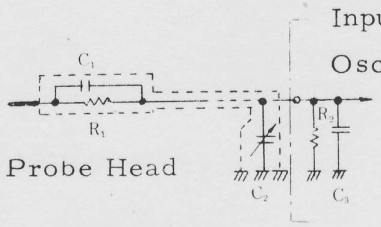
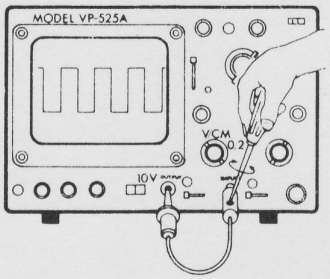


Fig. 3-1 Probe Circuit



CAL-10V
VOLTS/CM-0.2V/CM
TIME/CM-0.5ms
MODE-CH1orCH2

Fig. 3-2 Probe Compensation

Insufficient

Correct

Overcompensated

CAL--10V

VOLTS/CM--0.2V/CM

MODE--CH1 or CH2

TIME/CM--0.5mS

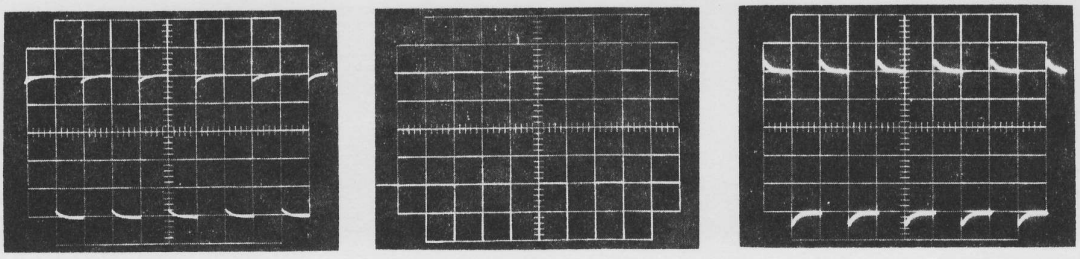


Fig. 3-3 Compensation of Probe Capacitance

3.1.2 Gain Adjustment

After the probe adjustment described in para 3.1.1 is completed, leave the probe connected to the CAL terminal and set the VOLTS/CM control at 0.2 V/cm, with the VAR control to CAL. Then adjust the GAIN control with a screwdriver for a display amplitude of 50mm.

(This adjustment should be made for both CH1 and CH2. Be sure to use different probes for CH1 and CH2.)

3.1.3 DC BAL Adjustment

Adjust the DC balance of the vertical amplifier. Adjustment should be carried out only after a warm-up period of 15 minutes.

* AC - GND - DC ..... GND
  VAR of VOLTS/CM ..... Pushed in
  POSITION ..... Mid-position
* Adjust the DC BAL control with a screwdriver to center the display.
* Pull the VOLTS/CM Switch's VAR control out, (i.e., set it at x 10). Adjust the DC BAL control until the position of the display remains stationary when the VAR control is pushed in and pulled out with each other both at x 10 and x 1.

3.2 Signal Coupling

There are two ways to connect signals to the oscilloscope, direct coupling and probe coupling. The following instructions should be followed when using one of these methods.

3.2.1 Direct Coupling ..... P. 30
3.2.2 Probe Coupling ..... P. 30
3.2.3 Ground Connections ..... P. 30 - P. 31

3. 2. 1 Direct Connection

When a signal is coupled directly to the oscilloscope, external noise interference effects and circuit loading effects caused by the oscilloscope should be considered.

① Special care must be taken when observing small signals generated by a high impedance circuit since errors are liable to be caused by noise induced on the coupling cable and by the paralled coupling capacitance. The use of shielded cables, such as coaxial cable, is recommended, except when testing low impedance circuits. If an unshielded cable is to be used, it should be as short as possible.

② When a signal from a high impedance circuit is coupled to the oscilloscope, care must also be taken to insure that the circuit under test is not loaded by the input impedance of the oscilloscope. A capacitance of about 35 pF exists in parallel with a 1MΩ resistance at the input terminal of the oscilloscope. In addition, shielded cable has a stray capacitance of 30 to 50 pF per one meter. If this capacitance is not negligible, a probe connection should be used. (For direct connection, use a cable with a BNC connector, or an adaptor with a ground terminal. See Figure 2-10.)

3. 2. 2 Probe Connection

Probe connection should be used to avoid the problems described in section 3. 1. 1. However, it attenuates all signals by a factor of 10, making its use disadvantageous when very small signals are to be viewed.
The highest sensitivity of this oscilloscope is 2 mV/cm, or 20 mV/cm when the probe is used.
(Do not apply voltages in excess of 600V to the probe.)

3. 2. 3 Ground Connections

If a signal is to be displayed free from induced noise, long ground leads, such as that shown in Figure 3-4, should not be used. The ground lead attached to the probe should be used instead. It should be connected to

a circuit ground in close vicinity to the point under measurement.

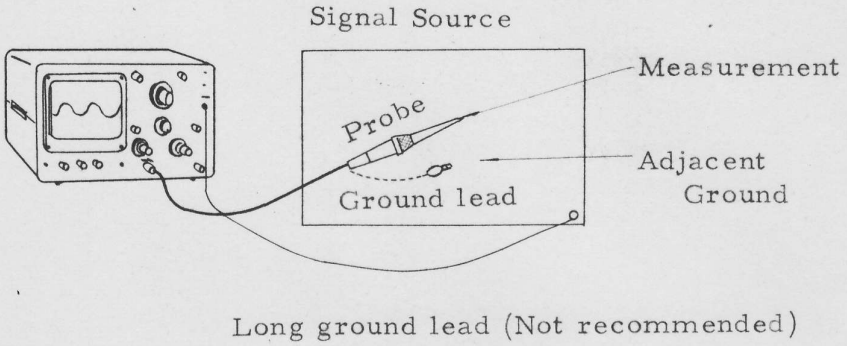


Fig. 3-4 Ground Connection

3.3 General Measurements

Measurement principles

* Adjust the intensity and focus of the display for convenient viewing.
* Set the instrument at the position aligned with the operator's eyes.
* Make the displayed waveform as large as possible to minimize reading errors.
* Set both VAR controls to CAL.

3.3.1 Measurement of DC voltages ..... P. 31
3.3.2 Measurement of AC voltages ..... P. 32 - P. 33
3.3.3 Time (Period) Measurement ..... P. 33 - P. 34
3.3.4 Measurement of Non-sinusoidal Waveforms P. 34 - P. 40

3.3.1 Measurement of DC Voltages

Set the AC-GND-DC control to GND, and establish a proper zero level. The position of the level need not be in the center of the display area. With the VOLTS/CM control set to a proper range, and the AC-GND-DC control set to DC, the vertical position of the baseline will vary with the applied DC voltage. The value of the voltage can be determined by multiplying the distance the baseline moves from the zero level by the setting of the VOLTS/CM control.

If VOLTS/CM setting is 5 VOLTS/CM, 5 V/cm x 3.5 cm = 17.5 V

(When the probe is used, readings should be multiplied by 10 to get the actual value. In this case: 17.5 V x 10 = 175 V)

3.3.2 Measurement of AC Voltages

An example of an AC measurement is shown in Figure 3-6. If the VOLTS/CM setting is 0.2 VOLTS/CM, 0.2 V/cm x 4.6 cm = 0.92 V.

This is the P-P value of the signal (0.92 Vp-p).

If the signal waveform is horizontally symmetrical, the readings can be converted into effective values.

DC Voltage

Zero level

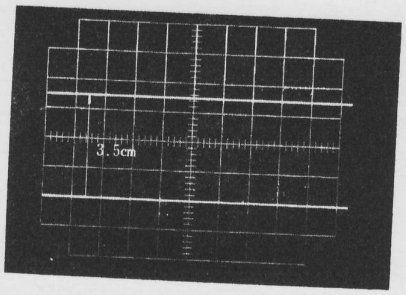
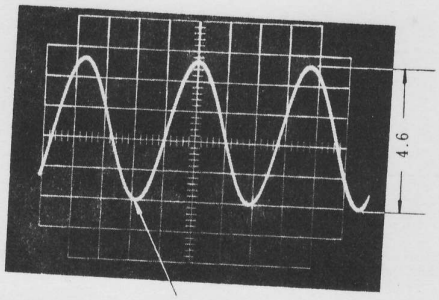


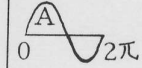
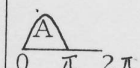
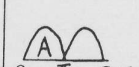
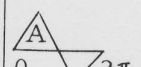
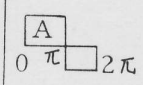
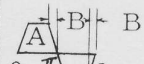
Fig. 3-5



Align either the upper or the lower peak with a horizontal line of the graticule.

Fig. 3-6

(The following provides conversion formulas for the effective values for several types of waveforms.)

Type of Wave	Waveform	Effective Value	Form Factor	Crest Factor
Sine Wave		$\frac{A}{\sqrt{2}}=0.707A$	$\frac{\pi}{2\sqrt{2}}=1.11$	$\sqrt{2}=1.414$
Half Wave Rectified Sine Wave		$\frac{A}{2}=0.5A$	$\frac{\pi}{2}=1.571$	
Full Wave Rectified Sine Wave		$\frac{A}{\sqrt{2}}=0.707A$	$\frac{\pi}{2\sqrt{2}}=1.11$	$\sqrt{2}=1.414$
Triangular Wave		$\frac{A}{\sqrt{3}}=0.577A$	$\frac{2}{\sqrt{3}}=1.155$	$\sqrt{3}=1.732$
Square Wave		A	1	1
Trapezoidal Wave		$A\sqrt{1-\frac{4A}{3}}$	$A\sqrt{1-\frac{4B}{3\pi}}/(1-\frac{B}{\pi})$	$1/\sqrt{1-\frac{4B}{3\pi}}$

When the AC-GND-DC control is set to AC, the DC component of the input signal is blocked by a capacitor in the input circuit of the oscilloscope, and only the AC component is displayed. A small signal superimposed on a high DC voltage can therefore be magnified and measured after the DC component is removed.

3.3.3 Time (Period) Measurements

Since the sweep rate speed controls are accurately calibrated, time, period, and frequency measurements can be easily made. An example is given for the waveform shown in Figure 3-8. Assume that the TIME/CM control is set to 1 ms/cm. The distance from point A to point B is 2 cm. This is then equivalent to 2 ms as indicated by the following formula;

$1 \text{ ms/cm} \times 2.0 \text{ cm} = 2 \text{ ms} \ (2 \times 10^{-3}\text{s})$

Since the distance from point A to point B represents one cycle for this waveform, this signal has a period of 2 ms.

The signal frequency, therefore, is:

$1 \div (2 \times 10^{-3}) = 500 \text{ (Hz)}$

(For periodic signals, measurement errors can be reduced by expanding the display to show only one cycle of the display or by measuring several cycles.)

Example:

The five cycles displayed in the photograph have a total width of 10 cm.

Thus, 1 period = 1 ms/cm x 10.0 cm x 1/5 = 2.0 ms

〈More significant figures are available.〉

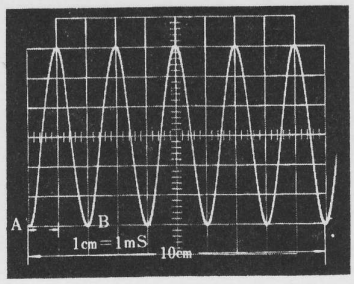


Fig. 3-8

[When the VAR knob of the TIME/CM control is pulled, only the sweep speed is multplied by 5. TIME/CM control settings should therefore be multiplied by 1/5 in this case.)

3.3.4 Measurement of Non-sinusoidal Waveforms

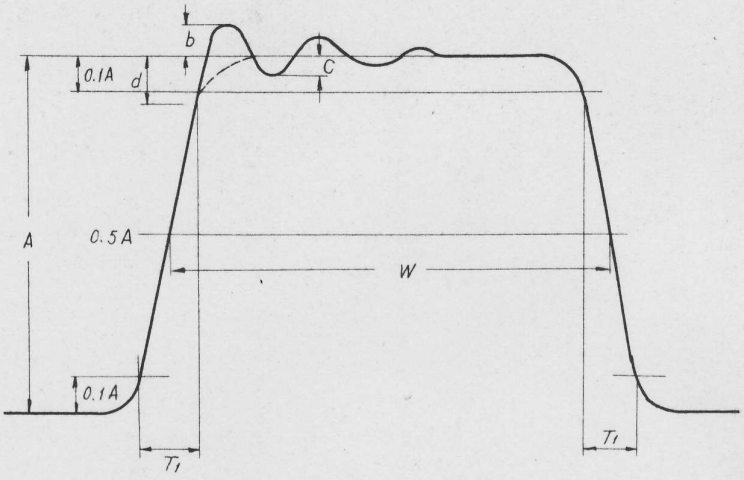
There are various factors to be considered when measuring waveforms, particularly those that are non-sinusoidal. The previous sections have described measurement techniques for sine waves, the most basic type of signal. This section will thus concentrate on non-sinusoidal waveforms, principally square waves.

Since an ideal square wave is composed of an infinite number of harmonics, it is useful for checking the various characteristics of any circuit, and is the reason why the calibration voltage waveform of this oscilloscope is a square wave.

(However, the calibration voltage signal is not suitable for use as a signal source for experimental purposes because of the high output impedance of the calibrator circuit.) In addition, digital circuit signals are all square waves.

Square wave definitions: (EIAJ's definition)

①	Overshoot:	Unwanted pulses superimposed on the basic pulses.
②	Ringing:	Beat wave following the rising portion of a square wave.
③	Tilt:	Slope of the top of a pulse; the top should ideally be horizontal.
④	Rounding:	Extremely round top of the rising portion of a pulse.
⑤	Rise time, Fall time:	Time required for voltage to rise from 10% to 90%, or fall from 90% to 10%, of the base amplitude.
⑥	Pulse width:	Time interval between the 50% points leading and trailling edges of the pulse of the base amplitude.



A: Base Amplitude

$\frac{b}{A}$: Overshoot

$\frac{c}{A}$: Ringing

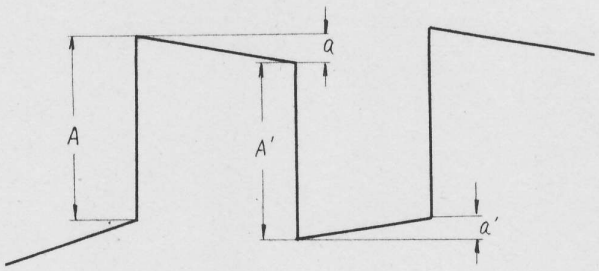
W: Pulse Width

Tr: Rise Time

Tf: Fall Time

$\frac{d}{A}$: Rounding

Fig. 3-9 Square Wave Characteristics



A: Waveform Height

a: Tilt

$\text{Tilt} = \frac{a}{A} \left(\text{or } \frac{a'}{A'}\right) \times 100\ \%$

Use $\frac{a}{A}$, or $\frac{a'}{A'}$, whichever longer.

Fig. 3-10 Tilted Waveform

Rise Time Measurements

As defined above, the rise time of a pulse is the time required for the leading edge of the pulse to increase from 10% to 90% of its base amplitude. Rise time measurement techniques can be illustrated using the calibration voltage signal as an example:

Couple the output of the calibration voltage signal to the CH1 INPUT, and adjust for a signal amplitude of about 5 cm.

Adjust the following controls to the positions indicated:

SWEEP MODE ---------- AUTO
TIME/CM ---------- 1 ms
SLOPE ---------- +
LEVEL ---------- FIX
AC-TV-DC ---------- AC
INT-LINE-EXT ---------- INT

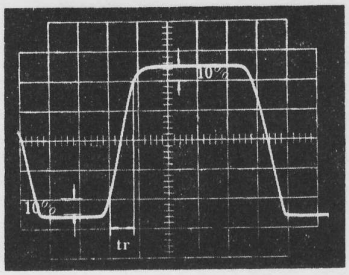


Fig. 3-11

Adjust the Vertical and Horizontal POSITION Controls and to Set the waveform as shown in Figure 3-11.

The rise time is determined by measuring the time required for the leading edge to rise from 10% to 90% of the base amplitude. When the rise time is too steep for easy reading, adjust the TIME/CM control, or pull the VAR FULL x 5 knob out before taking readings. To determine the 10% and 90% points of the base amplitude, obtain a display of 5 cm, as shown in Figure 3-11, and place its central 80% portion in an exact scale of 4 cm (four squares) for ease of reading.

Fall Time Measurements

To measure fall time, set the SLOPE control to - . Fall time can then be measured in the same way as rise time. See Figure 3-12.

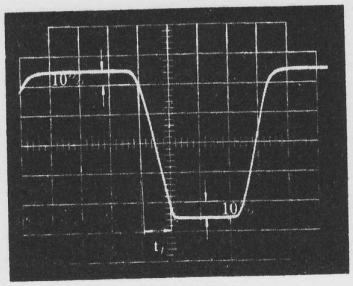


Fig. 3-12 Fall Time Measurement

Pulse Width Measurements

As shown in Figure 3-13, pulse width W is the time interval between the 50% points of the leading and the trailing edges of the pulse. Set the SLOPE control to a position corresponding to the polarity of pulse. The time interval can then be conveniently measured. For high accuracy measurements, expand the displayed waveform as much as possible before conducting measurements.

Time Difference Measurements

The time difference between two signals, can be measured in the dual trace mode. The measurement procedure can be illustrated by considering Figure 3-14. When a signal passes through a circuit, the output will always lag the input. This lag is called the time delay of the circuit. To measure this time delay, couple the input signal (A) to the CH1 INPUT, and the output signal (B) to the CH2 INPUT. Set the MODE control to CHOP or ALT, and the TRIG control to CH1. Equalize the displayed amplitudes of both signals. The time difference between the two signals can then be read at the 50% point (See Figure 3-15).

(The lading signal should always be coupled to CH1. Both signals will not be displayed otherwise.)

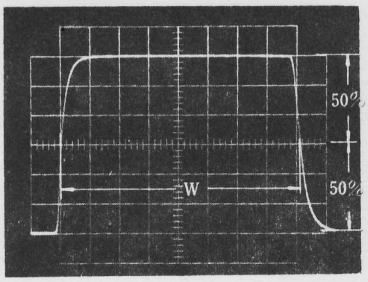


Fig. 3-13 Pulse Width Measurement

Fig. 3-14

o Pulse Handling Precautions

Since a pulse signal has frequency components that are higher than the frequency corresponding to the width or period of the pulse, the signal should be handled as a high frequency signal.

[Use a coaxial cable or a probe for signal coupling.]

[Ensure that the ground lead is as short as possible.]

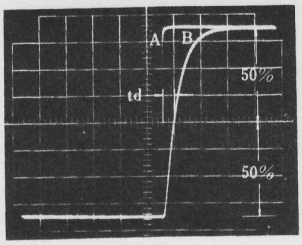


Fig. 3-15

Effect of Oscilloscope Rise Time

Correct measurement of rise time

When measuring pulse rise time, attention should be paid not only to the procedures given above, but also to the following points.

The rise time specification for this oscilloscope, 35nS is its own rise time that will be observed when an ideal signal with zero rise time is applied.

The relation between the rise time and bandwidth of the oscilloscope is as follows:

$$tr \times BW = 350$$

where tr: rise time (nS)

Bw: bandwidth (MHz)

Thus, this oscilloscope has a specific rise time, and it is one of the more important specifications.

When the rise time of a displayed signal is much greater than that of the oscilloscope, the oscilloscope's rise time will have negligible

influence on rise time measurements. However, if the signal rise time approaches that of the oscilloscope the measurement error will be appreciable.

The exact relation is as follows:

Assuming that the rise time of a displayed signal is tr1, and that of the oscilloscope is tr2, the observed rise time T will be

$$T = \sqrt{tr_1^2 + tr_2^2}$$

If a signal with a rise time three times as large (105 nS) as that of the oscilloscope is observed,

$$T = \sqrt{35^2 + 105^2} = 110 \text{ nS}$$

In this case the measurement error is about 5% which, in most cases, is negligible.

Generally, when a pulse whose rise time is more than three times as great as that of the oscilloscope is observed, the rise time measurement error will be negligible. For pulses of the smaller rise times, however, the following conversion formula should be used for accuracy:

$$\text{Rise time of pulse} = tr1 = \sqrt{T^2 - tr_2^2}$$

It should also be noted that if the rise time of a circuit is t (sec), the upper frequency limit, f_o(Hz), of the circuit under test is $f_o = \frac{0.35}{t}$ that is, circuit frequency response will be down 3 dB at f_o.

NOTE: In order to display the whole leading edge of a pulse as shown in Figure 3-16, a time delay circuit must be used with the oscilloscope.

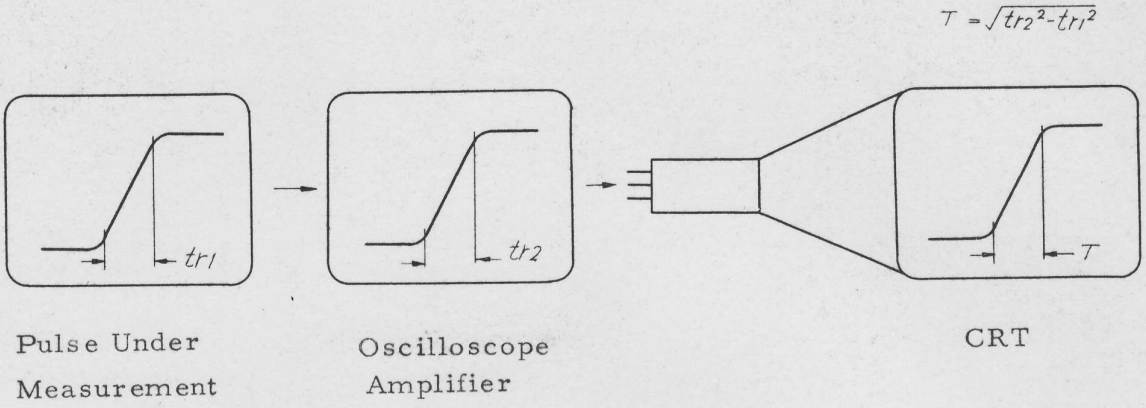


Fig. 3-16 Rise Time Correction

3.4 Special Applications

The Model VP-525A oscilloscope has X-Y operation, TV signal sync circuit, and single sweep capabilities.

This section will describe some applications of these features.

3.4.1 Lissajous Figure Frequency Measurements P.41-P.42

3.4.2 Lissajous Figure Phase Measurements P.42-P.43

3.4.3 Degree of Modulation (AM) Measurements P.43

3.4.4 Observation of TV Signals P.44-P.48

3.4.5 Measurement of Transistor Vc - Ic Characteristics .. P.48-P.49

3.4.6 Signal Hum and Ripple Measurements P.49-P.50

3.4.7 Oscilloscope Photography Procedures P.50-P.53

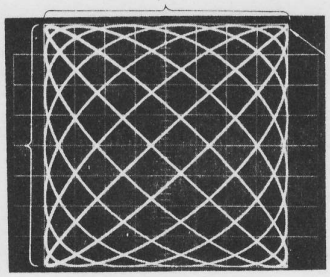
3.4.1 Lissajous Pattern Frequency Measurements

With the oscilloscope set up for X - Y display, couple a known signal and an unknown signal to the X - axis and Y - axis, respectively. A Lissajous pattern will then be displayed. The shape of the figure will depend on the frequency ratio and phase difference of the signals. The frequency of the unknown signal can be determined from the following formula: (Refer to Figure 3-17)

$$\frac{\text{Y - Frequency}}{\text{X - Frequency}} = \frac{m}{n}$$

m: Number of Times Pattern Touches horizontal line

n: Number of times Pattern Touches Vertical line.



In this example

$\frac{m}{n} = 0.5$

Fig. 3-17

The Lissajous pattern will vary with the phase difference between the two signals. If the phase of the reference signal can be changed, the phase difference can be easily determined. If the ratio of the frequencies of the two signals is not integral, the displayed pattern will not remain stationary.

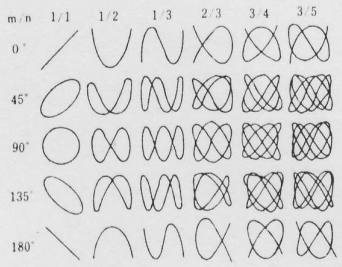


Fig. 3-18 Lissajous Figure and Frequency Ratio

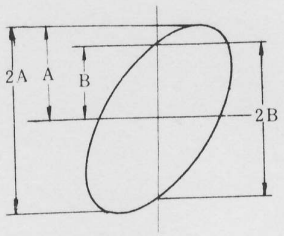


Fig. 3-19 Phase Measurement

3.4.2 Lissajous Pattern Phase Measurements

The phase difference between two signals of the same frequency can be measured as follows:

Couple the two signals to the X - and Y- axis inputs. The phase difference, θ, can then be determined from the following formula: (Refer to Figure 3-19).

$$\sin \theta = \frac{B}{A}$$

(For higher accuracy, use $\frac{2B}{2A}$)

Refer to Figures 3-18 and 3-20 for examples of Lissajous figures for certain phase differences.

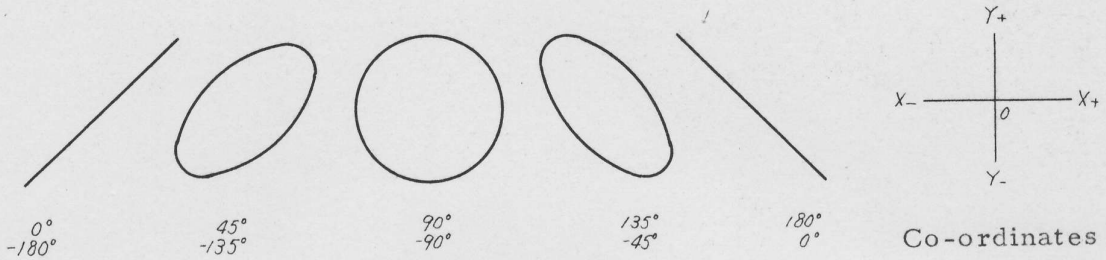


Fig. 3-20 Phase Difference Between Two Signals
(m/n = 1/1)

3.4.3 Degree of Modulation (AM) Measurements

The following formula will give the degree of modulation for an amplitude modulated signal: (Refer to Figure 3-21)

$$\text{Degree of Modulation} = \frac{A - B}{A + B} \times 100\%$$

When the modulating signal is complex, couple the modulating signal to the X - axis and the modulated signal to the Y - axis with the oscilloscope set for X - Y display. A trapezoidal waveform of the type shown in Figure 3-22 will then be displayed. The degree of modulation can be determined from the above formula.

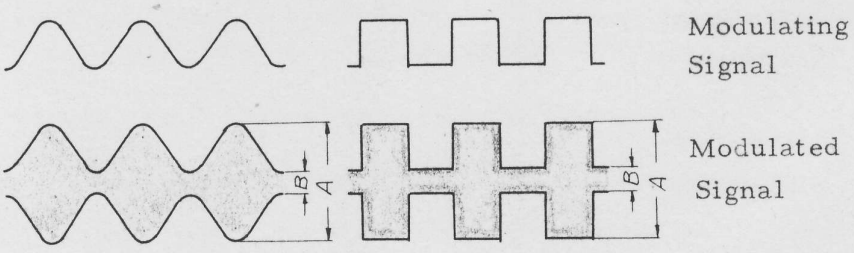


Fig. 3-21 Measurement of Degree of Modulation

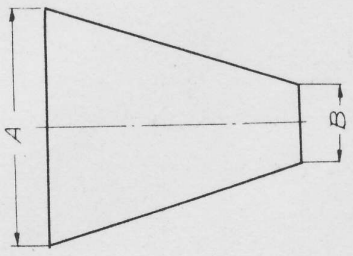


Fig. 3-22

3.4.4 Observation of TV signals

- Synchronization:

AC-TV-DC	AC : for triggering with horizontal sync signal.
	TV : for triggering with vertical sync signal.
LEVEL	FIX
Signal Polarity	Negative when vertical sync signal is used.

- Black - and - White TV Waveforms

  See Figures 3-23 and 3-24

- Color TV Waveforms

  See Figures 3-25 and 3-26

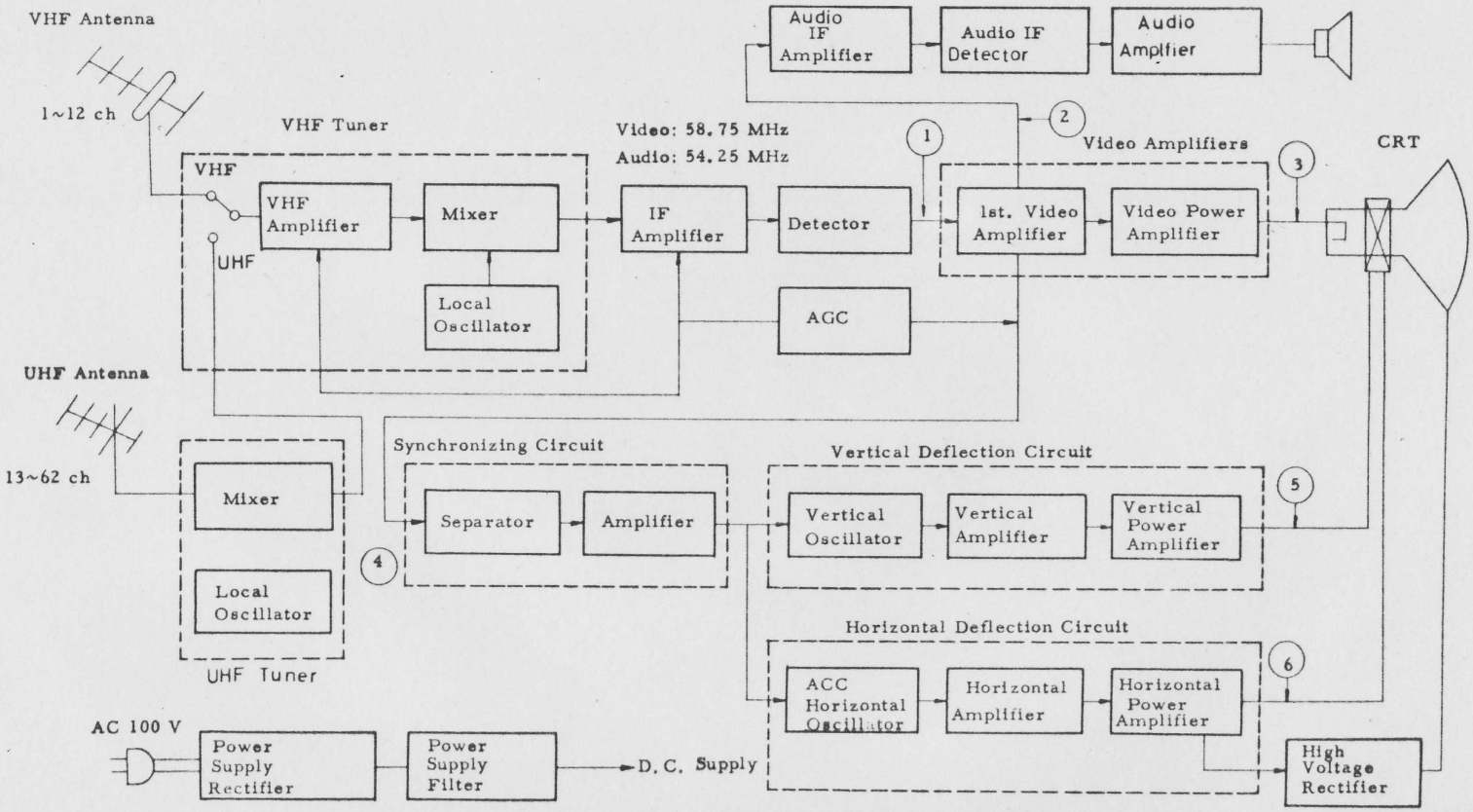
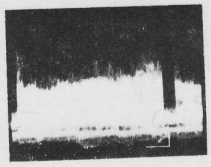
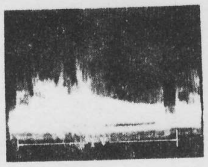


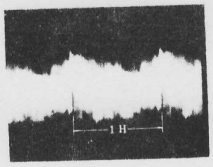
FIGURE 3-23 BLOCK DIAGRAM OF BLACK - AND - WHITE TV SET



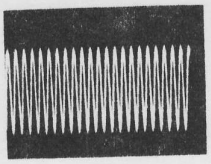
For triggering a video signal with the vertical sync signal, apply the input signal of negative polarity as shown in the left picture. The polarity conversion will be easy if connected to CH2.



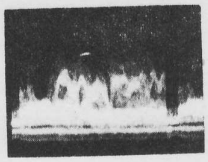
① Video Detector (1V)



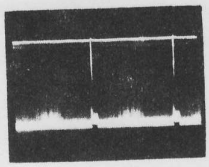
① Video Detector(1H)



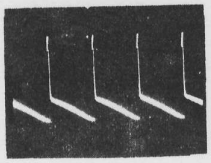
② 4.5MHz Audio FM Signal



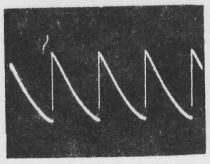
③ Video Output



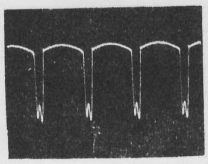
④ Sync Signal



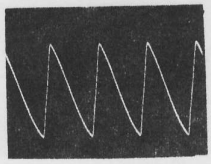
⑤ Vertical Deflection Output (Voltage waveform)



⑤ Vertical Deflection Output (Current waveform)



⑥ Horizontal Deflection Output (Voltage waveform)



⑥ Horizontal Deflection Output (Current waveform)

Fig. 3-24 TV Set Waveforms

(The numbers correspond to those in Figure 3-23)

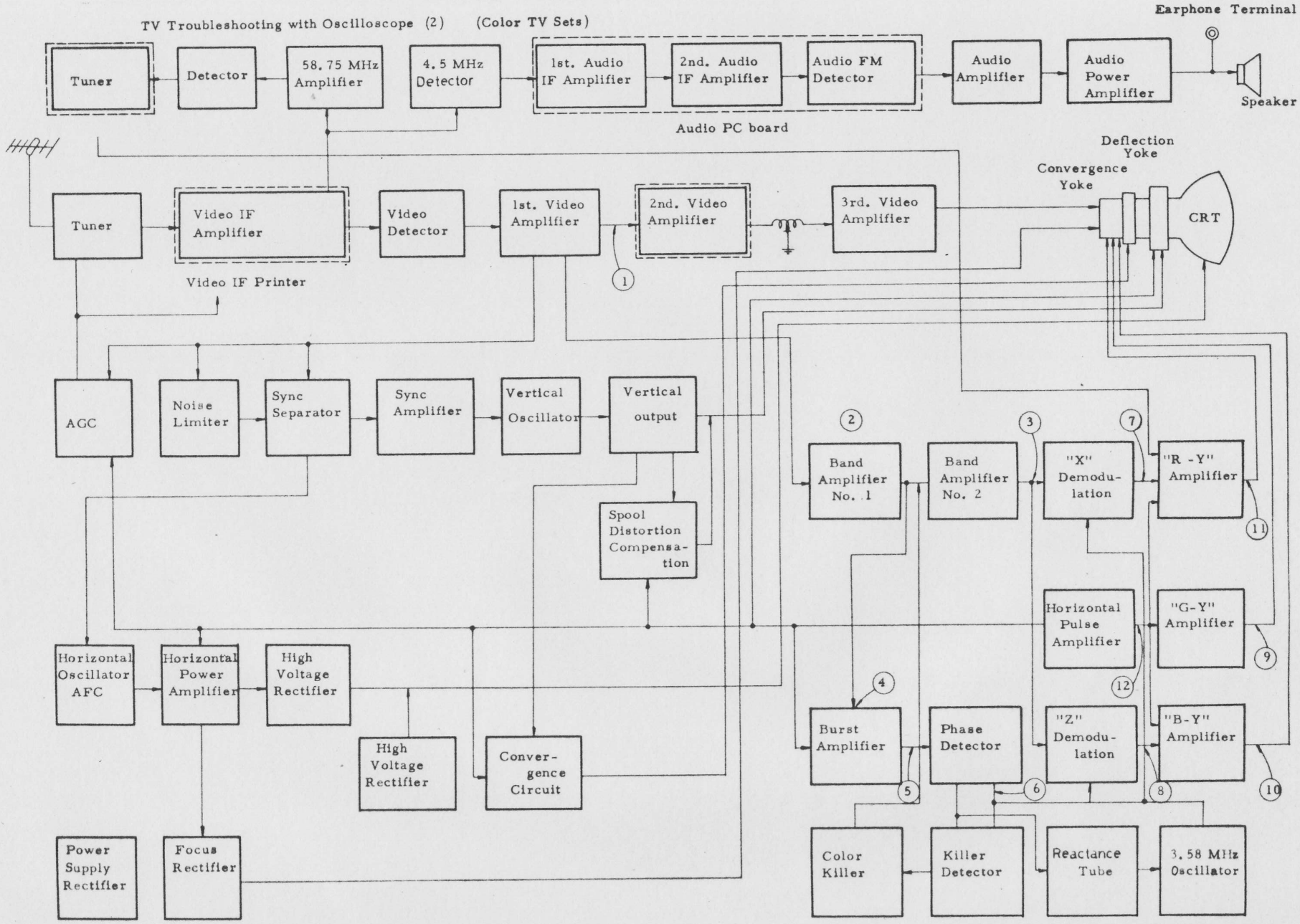
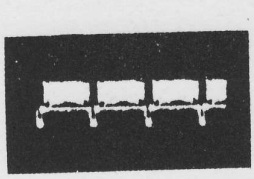
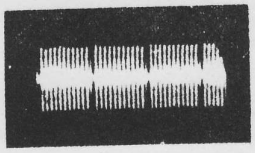


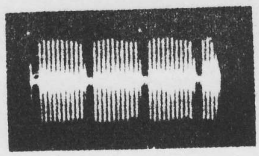
FIGURE 3-25 BLOCK DIAGRAM OF COLOR TV SET



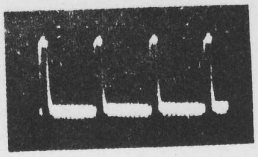
① 1st Video Amplifier



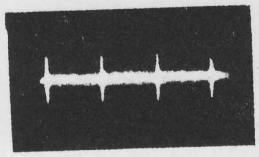
② 1st Band Amplifier plate



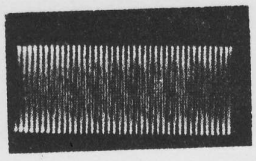
③ Color Demodulator Grid



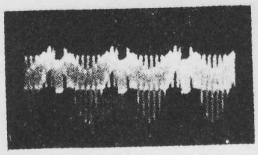
④ 2nd Band Amplifier Cathode



⑤ Burst Signal Amplifier Plate

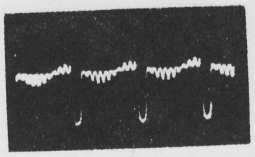


⑥ Phase Detector PK

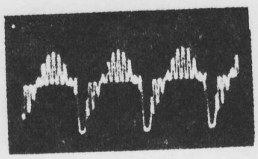


⑦ X Demodulator Plate

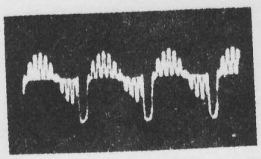
⑧ Z Demodulator Plate



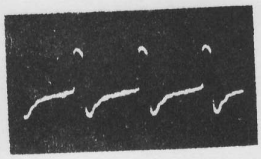
⑨ G-Y Amplifier Plate



⑩ B-Y Amplifier Plate



⑪ R-Y Amplifier Plate



⑫ Horizontal Pulse Amplifier Plate

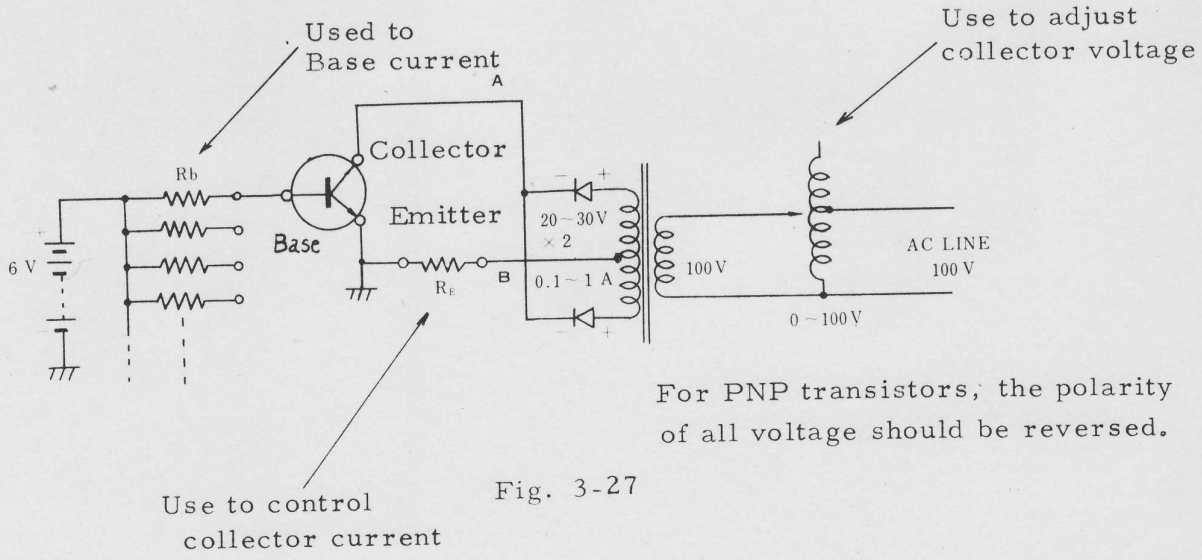
(Color Generator Signal of Waveforms)

Fig. 3-26 Color TV Set Waveforms

(The numbers correspond to those in Figure 3-25)

3.4.5 Measurement of Transistor Vc - Ic Characteristics

The Vc - Ic characteristics of a transistor can be measured as follows:



For PNP transistors, the polarity of all voltage should be reversed.

Fig. 3-27

With the oscilloscope set up for X - Y display, connect the transistor to the oscilloscope as follows:

Point A : X - input

Point B : Y - input (POLARITY INV)

The point A signal represents the collector - emitter voltage Vc, and point B represents the voltage drop caused by the collector current Ic, the displayed waveform will thus represent the transistor's Vc - Ic characteristics.

3.4.6 Hum and Ripple Components Measurements

There are two ways to check the amount of hum and ripple present in a signal.

o When synchronized with the signal

When the display is synchronized with the signal, hum or ripple component is out of sync.

This component can be determined as shown in Figure 3-29.

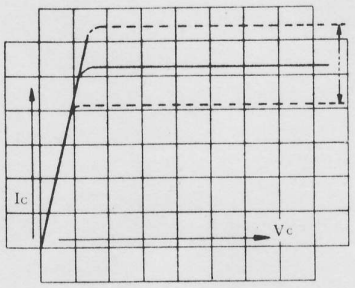
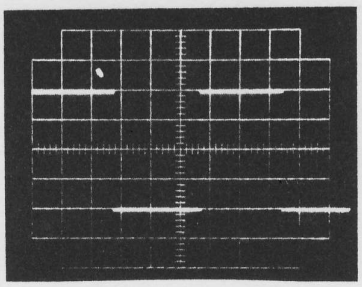


Fig. 3-28



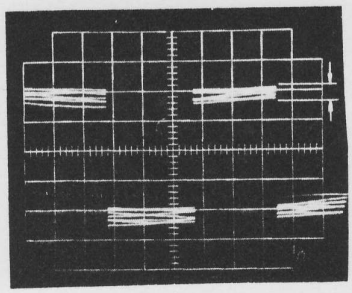
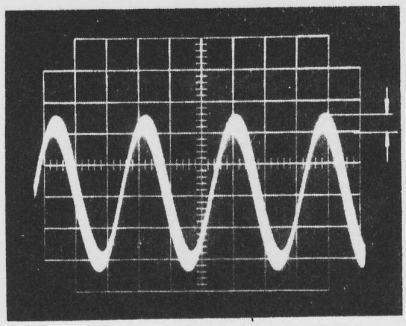


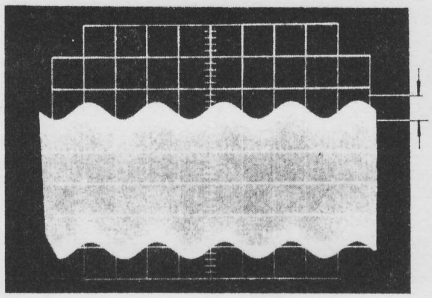
Fig. 3-29

o When line frequency synchronization is used (INT - LINE EXT control set at LINE), only the hum and ripple components will remain stationary.



Hum component

Waveform with internal (signal) Synchronization



Hum component

Waveform with line Synchronization

Fig. 3-30

3.4.7 Oscilloscope Photography Procedures

The taking of photographs is the most common way of recording waveform data. Although a regular one-shot camera or Polaroid camera is usually used, a special camera is sometimes used for taking a long series of photographs.

In this case, the vertical signal is first displayed without sweep, and the film is advanced.

A series of waveforms are then recorded on the roll of film. This method can be employed for the recording of low speed phenomena.

Generally, there are two ways to take photographs. One is used for the recording of periodic waveforms. In this method, photographs are taken with the SWEEP MODE control set at AUTO or NORM (recurring sweep). The other method is used for the recording of irregularly occurring waveforms. In this method, the SWEEP MODE control is set at SINGLE, and the camera shutter is opened. The photograph is then taken as soon as the signal appears.

Procedural details are as follows:

① Mounting of camera

Figure 3-31 illustrates one way to mount the camera and hood. Refer to the section on accessories for a description of photographic equipment.

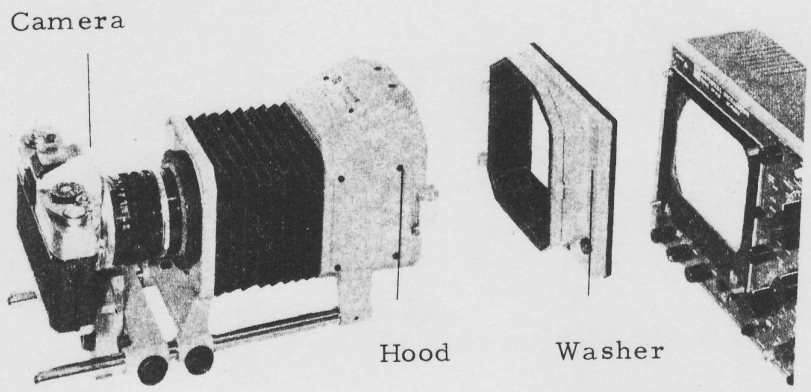


Fig. 3-31 Photographic Equipment Mounting (VQ - 034A)

② Preparation for triggering and others.

For reliable results, use the following procedure:

① Display the waveform, and adjust for optimum signal amplitude and position.

② Adjust the INTEN and FOCUS controls for a bright and well-focussed display. Too much intensity will cause halation.

③ Adjust the graticule illumination until it is half as bright as the displayed waveform.

④ Ensure that the camera is properly mounted.

⑤ Focus the camera and set the aperture.

③ Camera operation

For periodic waveforms

⑥ Set the shutter speed.

(The period that the shutter is open should be longer than the sweep period.)

⑦ Close the shutter

For single sweep

⑥ Set the SWEEP MODE controls to SINGLE and READY.

Ensure that the sweep occurs as soon as the signal is applied.

⑦ Open the shutter.

⑧ With the SWEEP MODE control at READY, release it slowly. (The red READY lamp will go out as soon as the sweep starts, and will flash at the instant the sweep ends.)

⑨ Close the shutter.

Determination of exposure time and shutter speed. The proper shutter speed will depend on various factors such as the type of sweep, sweep time, film sensitivity.

The following table shows relationships between these factors. Exposure time and shutter speed data for certain types of film are tabulated below.

o FOR recurring sweep:

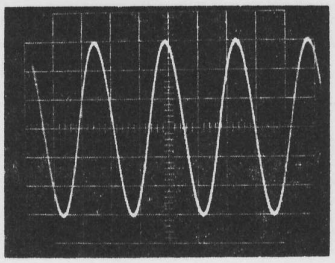
	Film Sensitivity	F-STOP Setting	Reduced Scale Ratio	Aperture Setting	Shutter Speed
Ex. 1	35mm Film ASA 100	F 1.4	Less Than 1 : 0.4	5.6	$\frac{1}{8}$ to $\frac{1}{15}$ sec.
Ex. 11	Plaroid Rand ® pack film 3000 TYPE 107	F 2.8	1 : 0.8 (Area ratio = 1 : 0.64)	5.6	$\frac{1}{8}$ to $\frac{1}{15}$ sec.
Remarks	o ASA numerals proportional to film sensitivity. o The higher the sensitivity, the coarser the display.	F-stop squared is inversely proportional to brightness.	Brightness is inversely proportional to square of scale ratio (area ratio)		o Shutter speed is proportional to brightness. o When using low shutter speeds, keep the graticule illumination low.

Conditions:

Filter	Without (With Filter, open aperture is 1 or 2 stops).
Brightness	Same as that for naked eye observation.
Waveform	Sine wave with 60 mm period and 30 mm amplitude (60 mm p-p).

o For single sweep:

Since the exposure time is controlled by the sweep time, the camera aperture is setting and film sensitivity should be selected in accordance with the TIME/CM control setting. Extremely large or small waveform display will be inconvenient for accurate measurement.

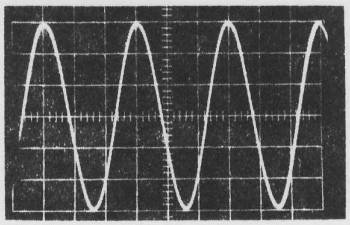


Single Sweep Example I

TIME/CM ----- 1 msec/cm

Lens ---------- F 2.8

Film ----- Poloroid ® Roll 3000 TYPE 47



Single Sweep Example II

TIME/CM ----- 1 msec/cm

Lens ---------- F 1.4

Film ------ 35 mm ASA 100

4. CIRCUIT DESCRIPTION

4.1 Oscilloscope Fundamentals P.54

4.1.1 Purpose P.54

4.1.2 Oscilloscope Circuits ..... P.54 - P.59

4.1.3 Types of Oscilloscopes ..... P.59 - P.61

4.2 Model VP-525A Oscilloscope Circuit Description ... P.62

4.2.1 Vertical Deflection System ..... P.64 - P.68

4.2.2 Horizontal Deflection System ..... P.68 - P.76

4.2.3 Cathode-ray Tube Circuit ..... P.76 - P.78

4.2.4 Calibration Signal Circuit ..... P.78 - P.79

4.2.5 Power Supply Circuit ..... P.79 - P.81

4.2.6 Accessories ..... P.81 - P.83

4.1 Oscilloscope Fundamentals

4.1.1 Purpose

Almost all electric phenomena vary with time, and it is this variation that causes the pointer of a voltmeter or ammeter to move. However, the characteristic shape (waveform) of such phenomena cannot be accurately determined by observing these instruments, nor can one waveform be compared with another with these instruments.

The oscilloscope is a device that is capable of graphically plotting such changes in voltage or current levels.

4.1.2 Oscilloscope Circuits

An oscilloscope requires a time generating function for the purpose of plotting signal changes. Oscilloscopes are, therefore, provided with three different basic circuits. The first circuit is an amplifier used to adjust the size of the signal under observation to a suitable amplitude. The second circuit is used to generate the reference timing signal and the third includes a power supply and a means of combining the two signals into one graph.

For rough plotting purposes, the toy device shown in the figure could be used as an oscilloscope, although it cannot plot fast changing signals. Precisely speaking, the device used to plot a waveform on paper is referred to as an oscillograph. A good example of an oscillograph is the electrocardiograph. In addition, the device known as a pen-recorder is also an oscillograph. The oscilloscope is generally considered to be a device in which the recording medium is a cathode-ray tube rather than a pen and paper. Unlike the oscillograph, electrons are used for plotting, oscilloscopes therefore can be used to plot very fast changing signals.

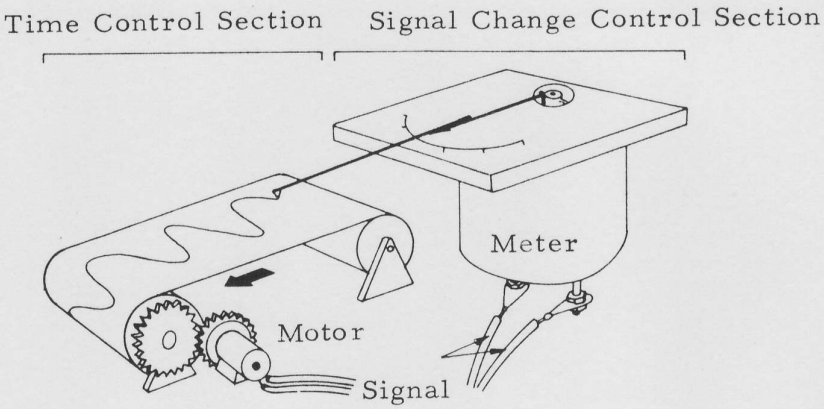


Fig. 4-1

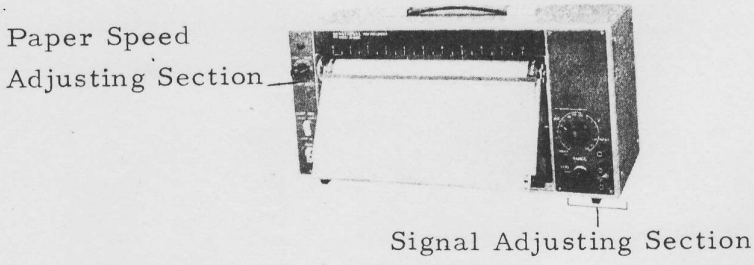


Fig. 4-2 One Type of Oscillograph (Pen-Recorder)

An oscillograph generally takes more than 0.1 seconds to plot a 10 cm line. Among oscilloscopes on the other hand, there is a type of oscillo-

scope capable of plotting the same line in one-hundred millionth of a second.

A brief description of the cathode-ray tube will now be given.

The cathode-ray tube functions to plot a picture by having a controlled electron beam strike a fluorescent screen.

The electrons in the beam are thermally emitted from the cathode as in an ordinary vacuum tube. The cathode-ray tube is also provided with grids and an anode, and these function to control the number of electrons in the beam and to focus scattered electrons. Four of electrode plates are provided to control the direction of the electron beam. When voltage and time signals are applied to these electrodes a graphical plot will result. These electrodes are therefore referred to as deflection plates. When the electron beam passes through the space between two deflection plates, they are attracted to the plate with the higher potential, and its direction is changed.

As noted above, an oscilloscope is provided with three different circuits. Normally, the waveform of a signal is plotted on the phosphor screen of the cathode-ray tube, as shown in Figure 4-4.

Circuit for Controlling Signal Size ------- Vertical (Deflection) System

Circuit for Generating Time Signal ------ Horizontal (Deflection) System or Time Base System

In addition, a Cathode-ray Tube circuit for plotting a graph of those signals is incorporated.

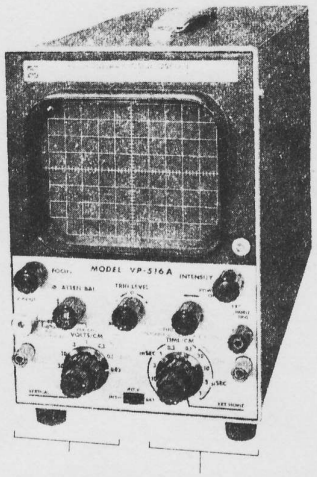


Fig. 4-3 Example of an Oscilloscope

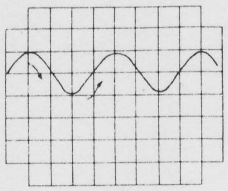


Fig. 4-4

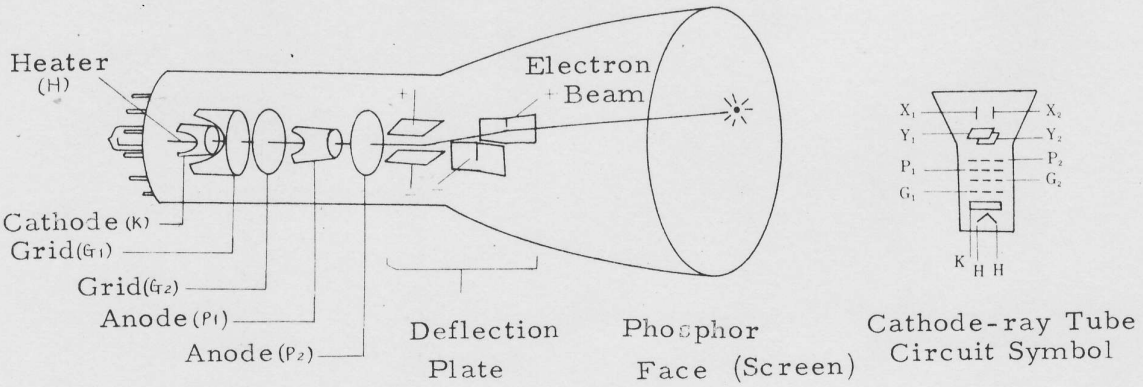


Fig. 4-5 Cathode-Ray Tube Construction and Circuit Symbol
(130AWB31)

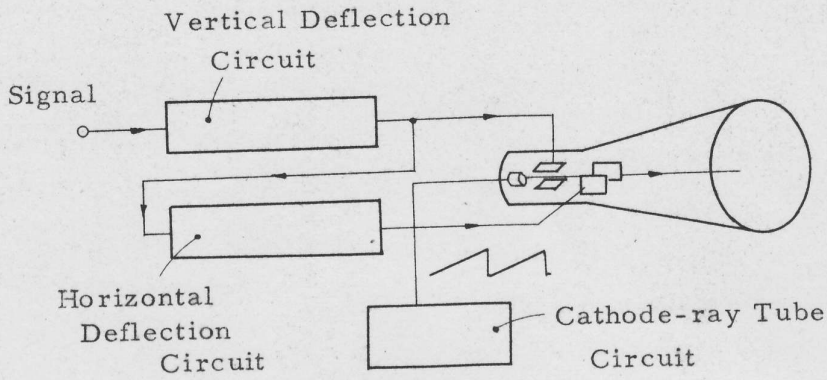


Fig. 4-6 Major Oscilloscope Circuits

Oscilloscopes are generally classified by the type of horizontal deflection system used. The time base signal waveform looks like a sawtooth and increases in amplitude at a certain constant rate. It is generally necessary that the oscilloscope produce (generate) this signal itself. Two types of sawtooth generators can be used; one using multivibrators or discharge tubes, and one using a Miller integrator circuit. The major difference between these circuits is that the former is always oscillating, while the latter can be triggered at will. They are referred to as Recurring Sweep System and Triggered Sweep System, respectively. The following figure illustrates the differences. As can be seen, the triggered sweep system using the Miller integrator circuit is much superior to the recurring sweep system.

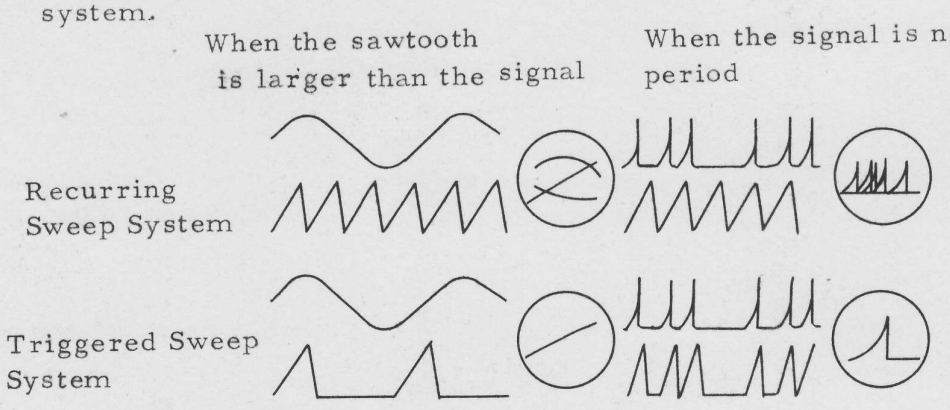


Fig. 4-7 Differences in Display Due to Sweep Systems

The VP-525A oscilloscope uses the triggered sweep system. Block diagrams of the recurring sweep system and the triggered sweep system are shown below:

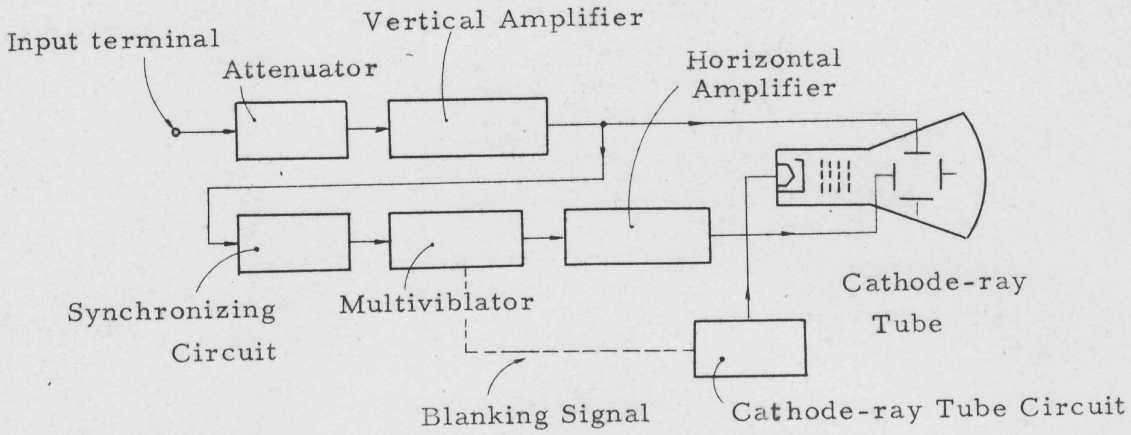


Fig. 4-8 Recurring Sweep System Oscilloscope

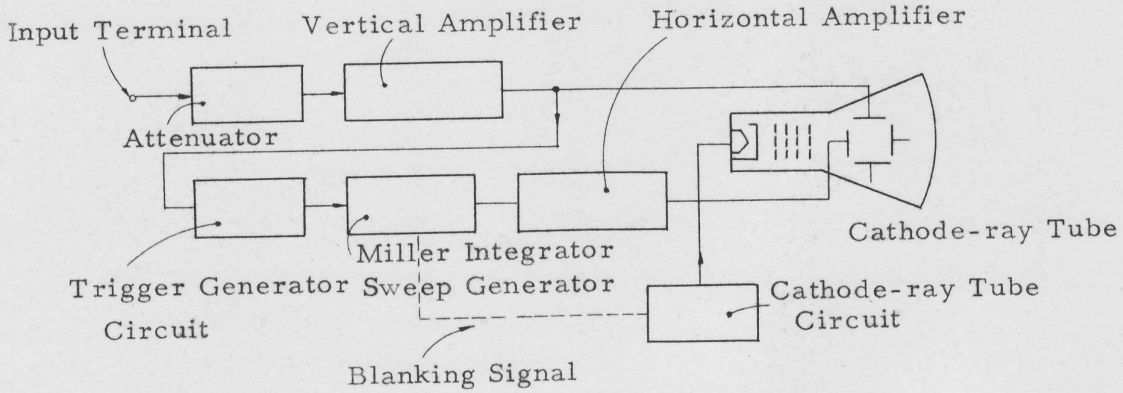


Fig. 4-9 Triggered Sweep System Oscilloscope

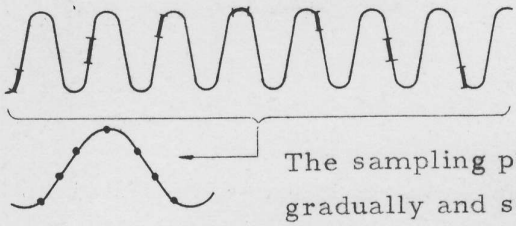
The term "trigger" normally means the part of a gun used to fire it. But in oscilloscopes, it refers to the pulse used to start a sweep when the signal is applied.

4. 1. 3 Type of Oscilloscopes

In addition to general-purpose oscilloscopes, special oscilloscopes are available for various functions and purposes.

General-Purpose Oscilloscope ---- Used for general observations (like VP-525A).

Sampling Oscilloscope ---------- A very high frequency signal cannot be viewed accurately on an ordinary oscilloscope because of electron speed problems. This oscilloscopes capable of instantly sampling such a signal and displaying it.



The sampling point are shifted gradually and sample collected to reproduce the original waveform.

Fig. 4-10

Storage-scope ---------- This oscilloscope uses a special cathode-ray tube to preserve the display, in some cases, waveforms can be stored for several days.

Traveling wave oscilloscope ----- This oscilloscope uses a special cathode-ray tube capable of displaying very high frequency signals.

Two-gun oscilloscope ---------- This oscilloscope uses a cathode-ray tube in which two electron guns are installed to permit the display of two independent waveforms.

Vector-scope ---------- This oscilloscope is designed for the vector display of color television chromatic signals.

Circular sweep oscilloscope ----- This oscilloscope utilizes a circular sweep to permit observation of the signal as a circular pattern.

Television waveform monitor ----- This oscilloscope has special circuits to facilitate the observation of television signals.

Curve tracer ---------- This is a measuring instrument capable of graphically displaying the characteristics of transistors or electrical components.

4.2 Model VP-525A Oscilloscope Circuit Description

The VP-525A is a dual-trace oscilloscope and includes the following circuits:
(Refer to Figure 4-11)

		Page
Vertical Deflection Circuits	Input Switch	64
	Attenuator	62
	FET Input Circuit	64
	Preamplifier	65
	Vertical Mode Selection Circuit	65
	Main Amplifier	67
Horizontal Deflection Circuits	Input Circuit	68
	Sync FIX Circuit	68
	TV Signal Sync Circuit	70
	Sweep Trigger Circuit	71
	Sweep Generator	71
	Automatic Sweep Circuit	73
	Single Sweep Circuit	75
	Horizontal Amplifier	76
Cathode-ray Tube Circuits	High Voltage Generator Circuit	76
	Intensity Modulation (Z axis) Circuit	77
	Focus Adjustment Circuit	77
	Astigmatism Adjustment Circuit	78
	Trace Rotation Compensation Circuit	78
Calibration Signal Circuits		78
Power Supply Circuits	High Voltage Supply Circuit	79
	Constant Low Voltage Circuit	79
	6.3V Line	80
Accessory Circuits	Probe	81
	Time Meter	82

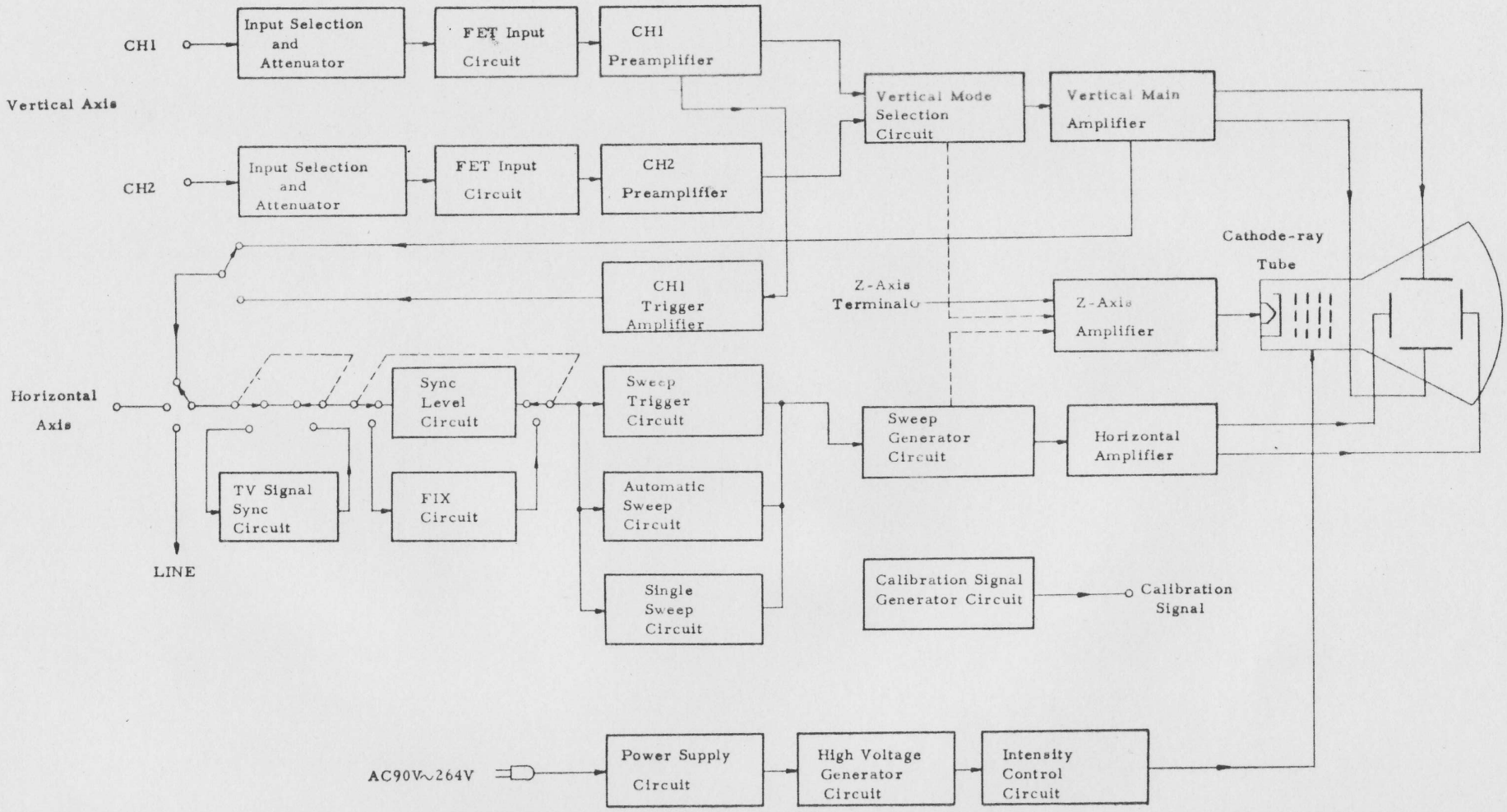


FIGURE 4-11 MODEL VP-525A BLOCK DIAGRAM

4.2.1 Vertical Deflection System

This system amplifies the two input signals to suitable amplitudes and then applies them to the cathode-ray tube for display.

Since the input switch, attenuator, and preamplifier circuits used for each signal channel are identical, only those circuits for one channel will be described.

- o Input Switch:

  This switch functions to couple the input signal to the oscilloscope either directly or through a capacitor C101, which serves to allow only the AC portion of the signal to pass. When the switch is set to GND, the amplifier input circuit is grounded, and a "zero-level" signal is displayed.

- o Attenuator:

  This circuit functions to attenuate the input signal to a suitable amplitude. The capacitors in the circuit are used to keep the input capacitance constant and for high-frequency compensation.

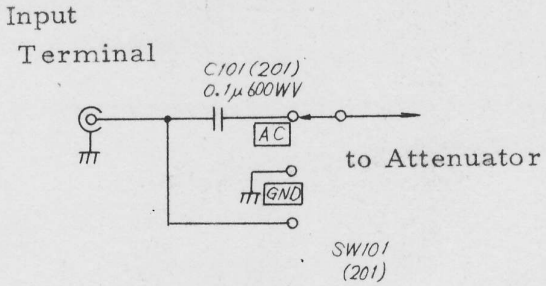


Fig. 4-12 Input Switch

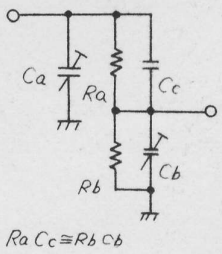


Fig. 4-13 Attenuator

- o FET Input Circuit:

  A Field Effect Transistor (FET) Q101 is used in this circuit for high-to-low impedance signal conversion. D101, D102, and V11 are included for protection against excessive signals. D101 serves to clamp positive-going signals to +6 V, while D102 clamps negative-going signals to 0 V. Neon tube V11 conducts when signals greater than ±70V are applied, thereby protecting Q101.

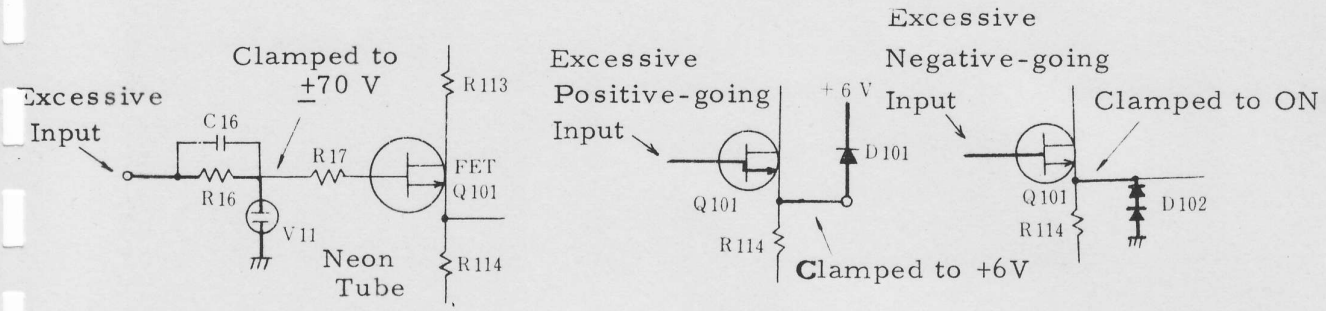


Fig. 4-14 Input Circuit Protection

o Preamplifier: (See pages 85 and 87)

Balanced amplifiers are used in this circuit (and elsewhere) as they provide stable amplification with low distortion. R105 and R106 (DC BALANCE) are used to adjust the DC balance points.

Emitter-follower Q103 is used to lower the output impedance.

The gain of expander amplifiers Q105 and Q106 is multiplied by 10 when S102 is closed; R123 is then adjusted to prevent DC level variations.

R135 (VAR) provides for continuous control of the gain of the preamplifier.

In the CH1 preamplifier, the output from the emitters at Q107 and Q108 is tapped off and fed to the Q116-Q117 amplifier as the sync signal. The Q109-Q110 common-base amplifier between Q107-108 and the vertical mode selection circuit serves to isolate the sync signal from the mode switching signals. R142 (POSITION ↕) controls the vertical position of the displayed signal by varying the DC level of the signal.

o Vertical Mode Selection Circuit:

As shown in Figure 4-15, the CH1 and CH2 signals are coupled through diode gates to points A and A'. Since the next stage is a feedback amplifier, these points are held constant at approximately

+ 12V. By making the potential at point B (or C) lower than that of point A, diodes D104 and D107 (or D204 and D207) will be cut off blocking the CH1 (or CH2) signal. The diode gates thus permit the electrical switching of the signals.

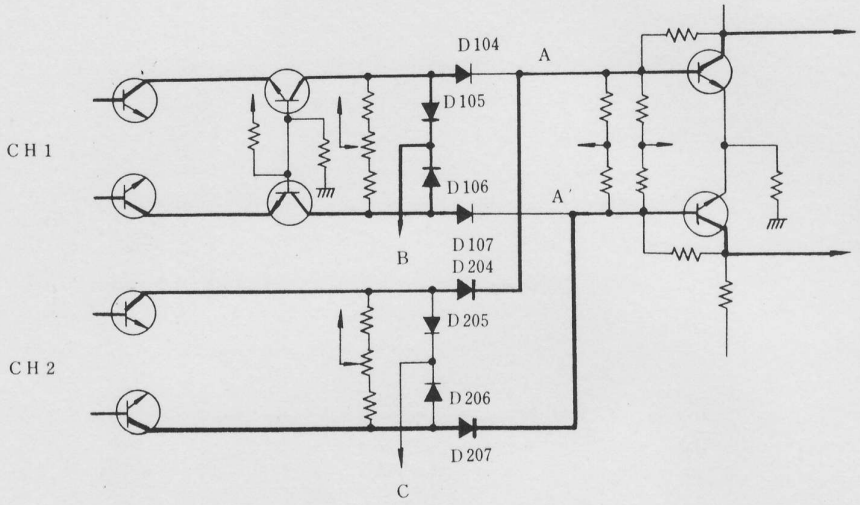


Fig. 4-15 Channel Selection

Points B and C are connected to the collectors of the flip-flop shown in Figure 4-16. When the MODE switch is set to the CH1 or CH2 position, one collector is clamped at a high potential and the other is clamped to a low potential. This action, which closes one diode gate and opens the other, provides for single-trace operation.
When the MODE switch is set to ALT, an external sweep start pulse is fed in through D254 and Q253 to drive the flip-flop.
The flip-flop is thus switched once for each sweep, providing for display of the CH1 and CH2 signals on alternate sweeps.
When the MODE switch is set to CHOP, a 200 KHz blocking oscillator is triggered into operation.
The output of the oscillator is fed to the flip-flop, through Q253, causing it, and in turn, the CH1 and CH2 diode gates, to switch at the chop frequency.

When the MODE switch is set to ADD, the common point between R144 and R145 is grounded, lower the potential of points A & A'. (See Figure 4-17) This closes both diode gates, allowing the CH1 and CH2 signals to both pass.

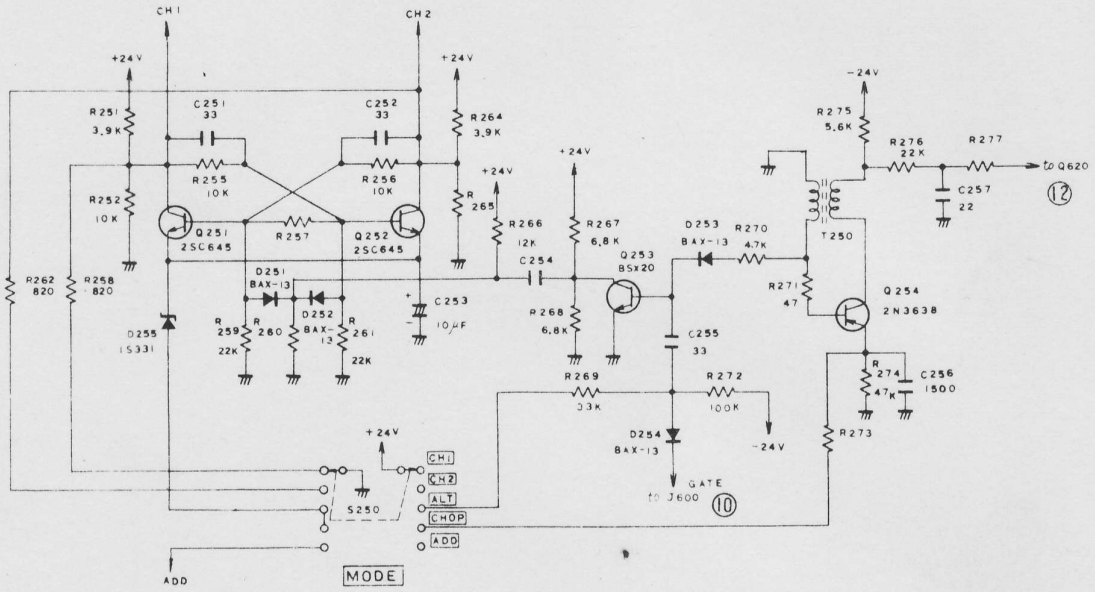


Fig. 4-16 Channel Selection Control Circuit

o Main Amplifier:

The signal from the mode selection circuit is amplified by Q111 and Q112 (current feedback amplifiers), Q113 and Q114, and Q614 and Q615 (two-stage cascade amplifiers). The signal is then fed to the cathode-ray tube.

A portion of the signal is tapped off at the collector of Q113 and used for the horizontal signal.

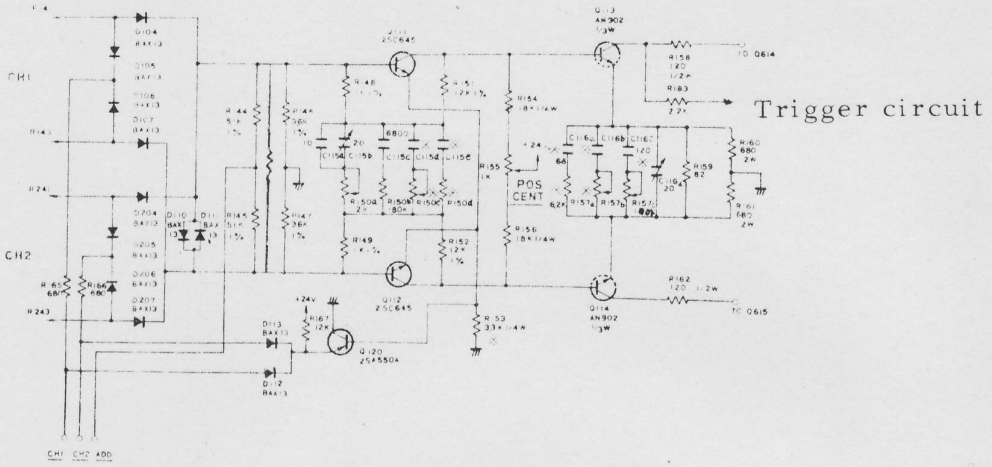


Fig. 4-17 Main Amplifier

4.2.2 Horizontal Deflection System

This system functions to amplify the horizontal input signal, and to generate the sweep waveform.

o Input Circuit: (Page 125)

This circuit, which includes an AC-DC input switch, functions similarly to the vertical input circuit.

o Sync Level Circuit:

As shown in Figure 4-18, Q305 and Q306 function together as a differential amplifier.

With the controls set as shown, the horizontal signal will be applied to the base of Q306, point B, and the reference signal from R343 (LEVEL) will be applied to the base of Q305, point A. In this case the output of Q306 will vary as shown in the upper diagram of Figure 4-19, when R343 is rotated.

When S303 is set to [-], the input and reference signals are interchanged, and the output of Q306 will vary as shown in the lower diagram of Figure 4-19.

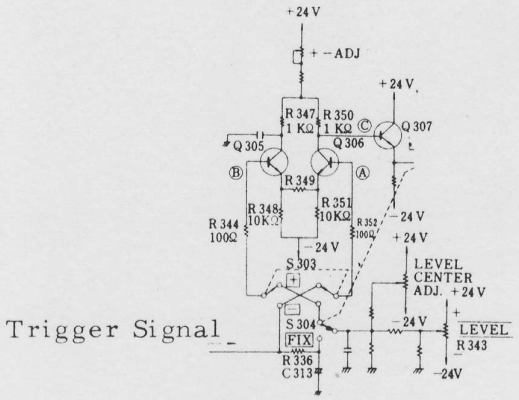


Fig. 4-18 Sync Level Circuit

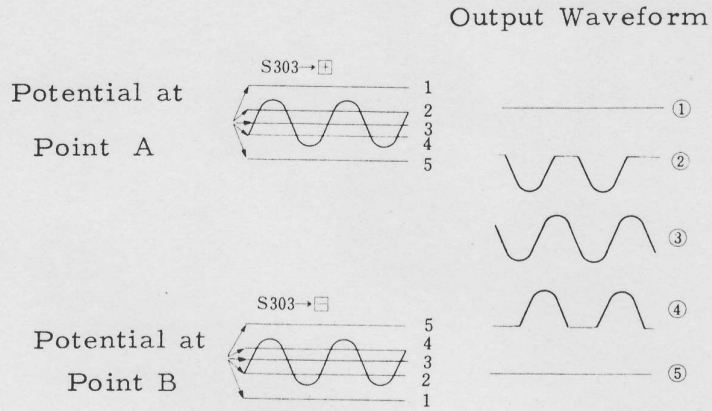


Fig. 4-19 Operation of Sync Level Circuit

o Fix Circuit: (patent pending)

This circuit, which is unique, functions to set the horizontal trigger level to the optimum point. With S304 set as shown in Figure 4-20, R336 and C313 function to remove the AC component of the sync signal before it is applied to one input of the sync level differential amplifier. The other input is the complete sync signal and includes the AC components. The amplified output of the amplifier thus consists of only the AC component of the sync signal.

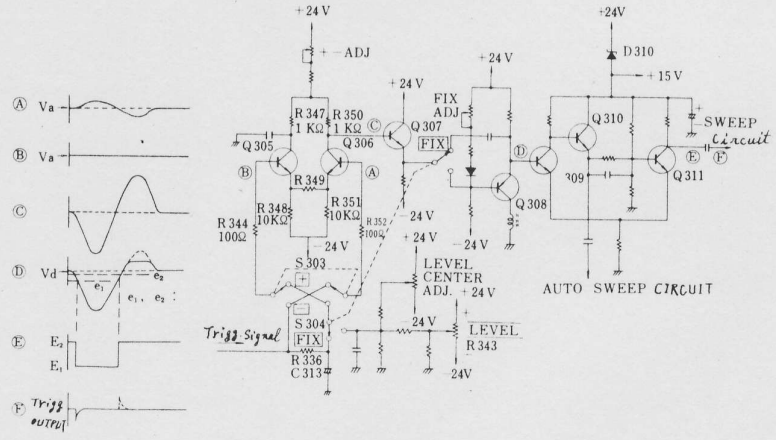


Fig. 4-20 Fix Circuit

This output is applied to the base of Q309 together with the emitter voltage of emitter follower Q308. Since the Q308 emitter voltage is adjusted close to the e2 firing level of the Q309-Q311 Schmitt trigger circuit, even small sync signals will fire the Schmitt trigger into operation.

The output of the Schmitt trigger is differentiated and fed to the sweep generator circuit as the sweep trigger signal.

o TV Signal Sync Circuit:

The standard TV signal includes both horizontal and vertical sync signals. While the horizontal sync signal can be easily extracted, the vertical sync signal is buried in the video signal and must be removed by filtering.

As shown in Figure 4-21, the video signal is amplified by Q302 and Q303 and then fed to a filter consisting of R315, R316 and C308, D303 acts as a slicer to remove the video signal. Figure 4-22 illustrates the waveforms in this circuit.

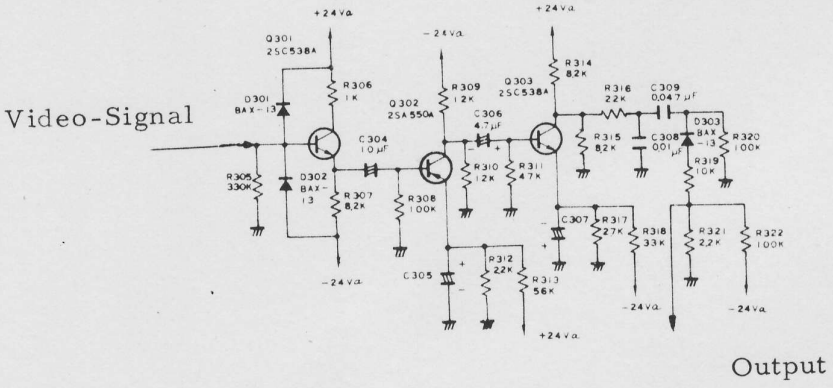


Fig. 4-21

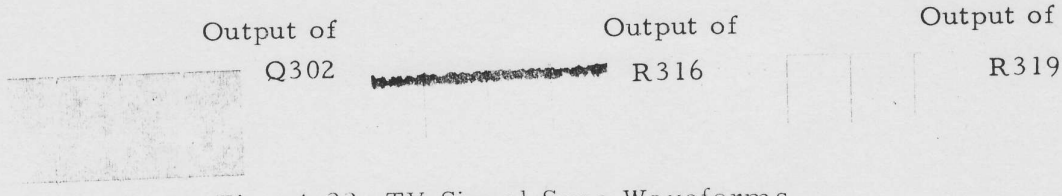


Fig. 4-22 TV Signal Sync Waveforms

o Sweep Trigger Circuit:

Q309 and Q311 act as a Schmitt trigger circuit, and alternately conduct and cutoff, depending on the input signal level. The signal is thus converted to a square wave. Emitter-follower Q310 is used to improve the frequency response characteristics.

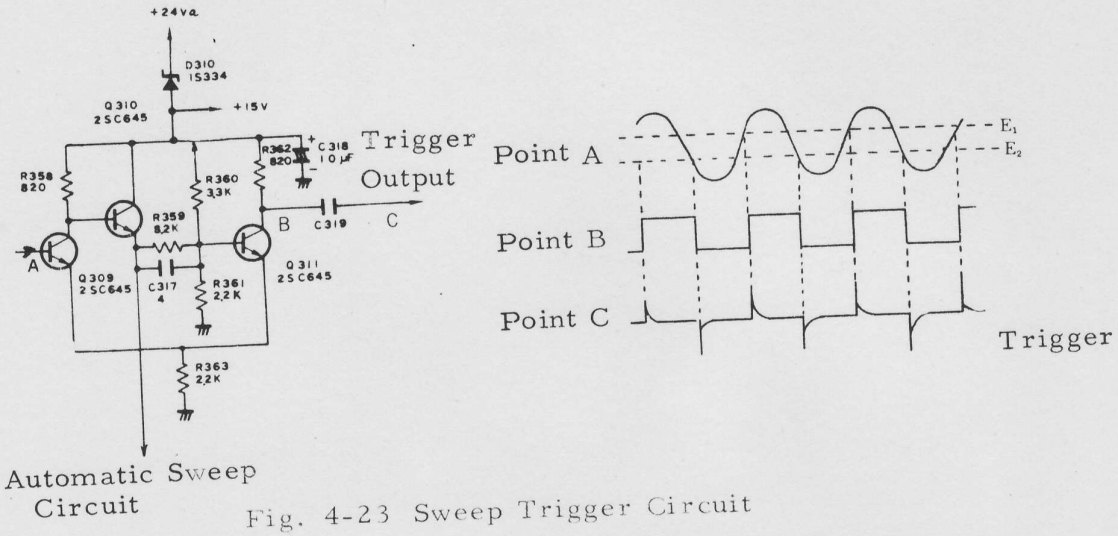


Fig. 4-23 Sweep Trigger Circuit

o Sweep Generator:

The sawtooth time base signal is generated by the three circuits shown below and in Figure 4-26. The trigger gate circuit is composed of a Schmitt trigger circuit identical to that used in the sweep circuit. The circuit is designed to cause the state of the Schmitt trigger circuit to reverse when the sweep trigger input is superimposed on the pre-sweep potential at point A. When a trigger is applied and the Schmitt trigger circuit switches states, the potential at point B drops abruptly, and at the same time, the potential at point C also drops. Because of large amount of feedback in the Q406-Q407 Miller integrator circuit, the potential at D remains constant. As a result, D405 is cutoff. D404 is also cutoff at the same time allowing Miller integrator circuit to start operating. The potential at point F (and point G) thus starts to rise at a rate determined by time constant of C1 and R1. The potential of point H starts to rise at the same time, but when it exceeds

a certain level, D406 conducts. When D406 conducts, the potential at point J (and point K) starts to rise, increasing the potential of point A. Q403, which had been cutoff, starts to conduct when the potential at point A exceeds a certain level.

As a result, the state of the Schmitt trigger circuit reverses, causing the potential at point B to increase abruptly. The potential at point C rises proportionally, bringing D404 and D405 into conduction. This, in turn, causes capacitor C in the Miller integrator circuit to discharge. As a result, the potential at point F (and point G) abruptly drops and returns to the pre-sweep level.

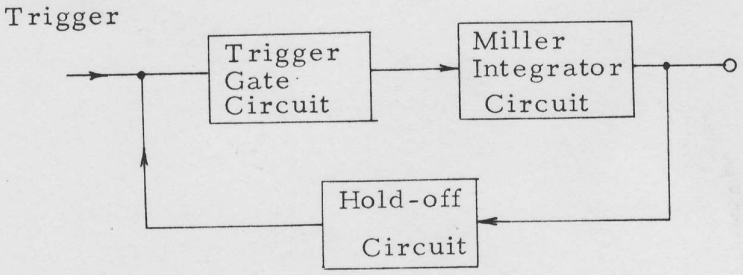


Fig. 4-24 Sweep Generator Circuit (Block Diagram)

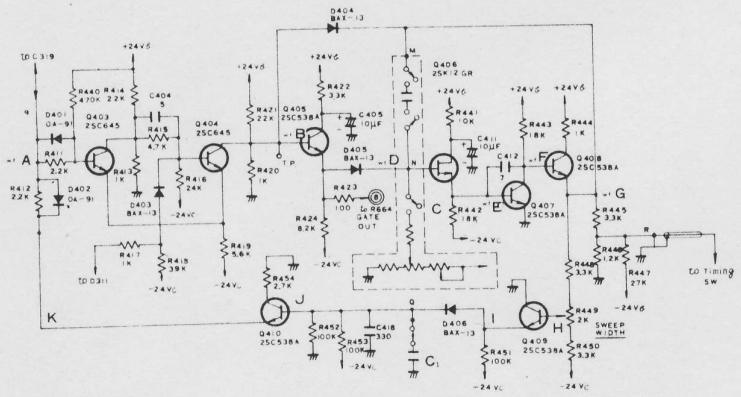


Fig. 4-25 Sweep Generator Circuit

This cycle completes one sweep.

During the sweep, Q403 is cutoff by the potential at point A which in turn is controlled by the potential at point J, so that even if a trigger

signal is applied, Q403 cannot be triggered.

Accordingly, Q403 is not affected by undesired triggers during the sweep, ensuring a stable sweep.

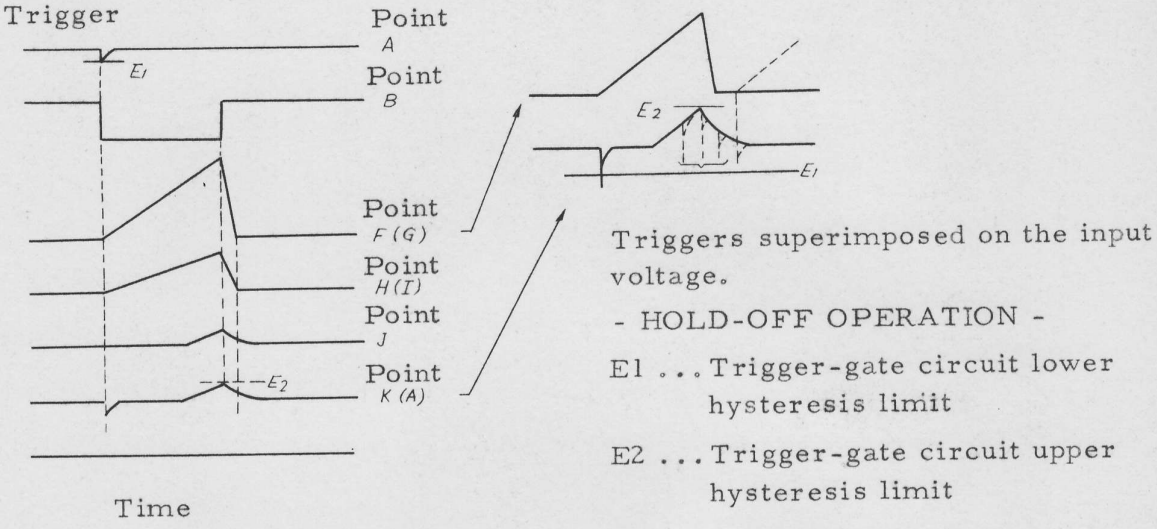


Fig. 4-26 Potential at Each Stage During Sweep

The hold-off circuit, shown in Figure 4-24 functions to prevent the sweep from recurring until point F returns to its pre-sweep level after completion of a sweep. As shown in Figure 4-26, the sweep voltage at points F and G starts to drop at the instant the sweep ends. This drop is coupled through Q409 to the base of Q410. Because of the long time constant of the C1, C418, R452, R453 circuit, the voltage level decreases very slowly. This slow change is coupled through Q410 back to point A. The slowly decreasing voltage at point A thus prevents incoming triggers from triggering Q403. This is referred to as the hold-off operation.

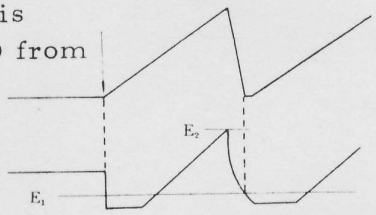
o Automatic Sweep Circuit (Free-Run):

When a signal is not applied, triggers are not generated, and as a result, sweeps do not occur. Since this feature is occasionally inconvenient an automatic sweep circuit is included. When S305 is set to the AUTO position, the trigger-gate bias is automatically reduced to a level that is lower than the lower hysteresis limit (E1).

Thus as the hold-off level drops it lets the trigger-gate bias (point A) fall all the way down to the lower hysteresis limit, and another sweep starts automatically. This automatic operation is also referred to as FREE RUN operation.

Refer to Figure 4-27.

SWEEP MODE is turned to AUTO from NORM



E1....Trigger-gate circuit lower hysteresis limit.

E2....Trigger-gate circuit upper hysteresis limit.

Fig. 4-27 Potentials During Free-Run Operation

However, the waveform will not be stationary when the trigger signal is connected. To avoid this, the one shot multivibrator operation by trigger signals is required of this circuit.

The potential of point K will be increased by integrating this output, so that the circuit returns to the normal operation status.

Thus, the trace develops and the waveform is sure to become stabilized.

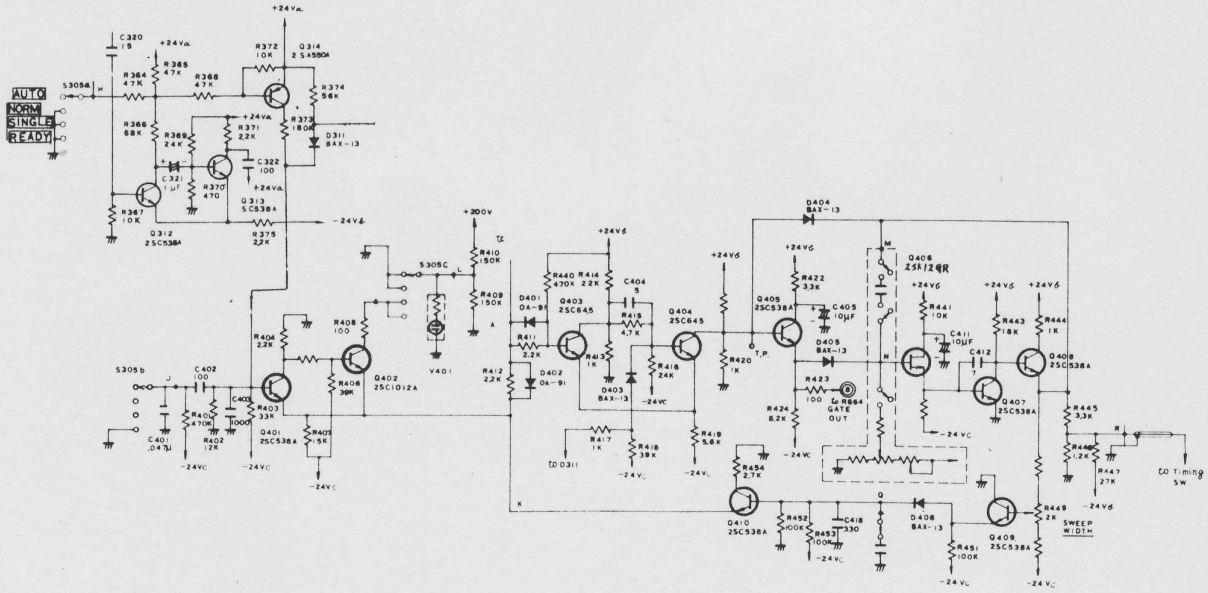


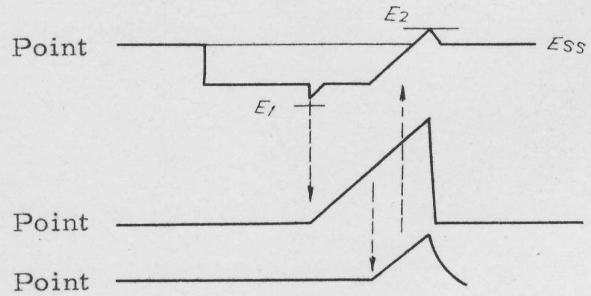
Fig. 4-28 Automatic Sweep (Free-Run) Circuit

o Single Sweep Circuit:

In order to view transients or other one-shot signals and periodic signals, a single sweep capability is required. In single sweep operation, the sweep generator is disabled at the end of each sweep and must be armed before it can generate another.

When S305 is first set to the READY position, Q401 conducts, cutting Q402 off. The Q401 emitter potential drops to and remains at a low potential, causing a similar drop at point A, as shown in Figure 4-29. Point A remains at a level close to E1 until a trigger is applied at which time a sweep is generated.

As the sweep ends, the increasing voltage from the hold-off circuit is coupled back to the emitter of Q401. When the potential at this point reaches the E2 level, Q401 cuts off, Q402 turns on, and the sweep ends. Since the high static Q402 emitter potential (ESS) prevents succeeding trigger signals.



E1 and E2 ... Refer to Fig. 4-26
ESS : TR cut-off potential

Fig. 4-29 Single Sweep Waveforms

From triggering Q403, further sweeps are not generated. This condition continues until the circuit is reset, i.e., until the potential at point K is lowered. The circuit is reset by momentarily turning S305 to the RESET position. This action turns Q401 on, which cuts Q402 off. At the same time the emitter potential of Q401 is lowered, readying the circuit for another trigger.

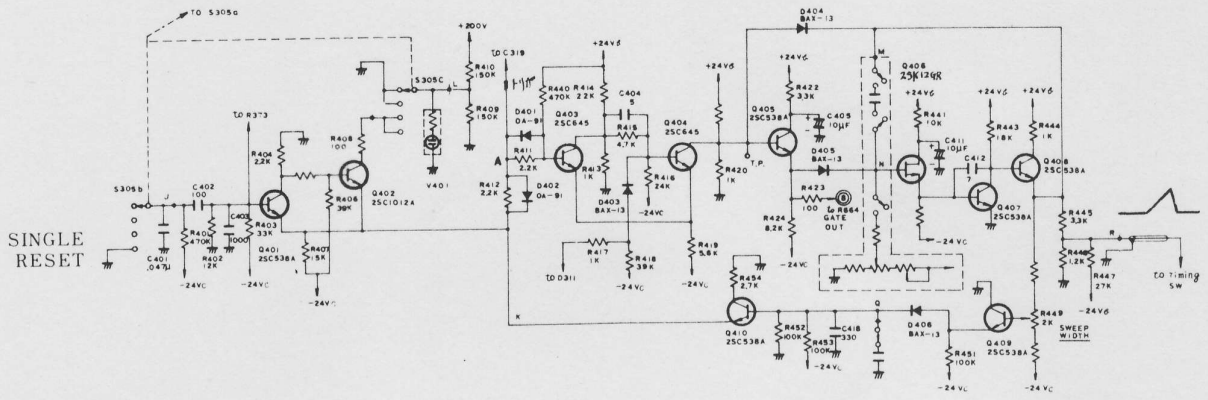


Fig. 4-30 Single Sweep Circuit

o Horizontal Amplifier: (page)

The horizontal amplifier functions to amplify the sweep or external signals before they are applied to the CRT. It operates in a manner similar to the main vertical amplifier. A balanced amplifier circuit is used, with one input a variable DC voltage used to control the horizontal position of the display. This voltage is controlled by R507 (position).

4.2.3. Cathode-ray Tube Circuit

This circuit generates the various CRT supply voltages and applies these voltages, and the signal voltages to the CRT.

o High Voltages Power Supply Circuit:

Q616 and T602 comprise a basic transformer-coupled RF oscillator, the HV output of which is rectified by D609. A sample of the signal is coupled to amplifier Q617 and then to Q618 which controls the base current of Q616. As a result, the oscillator output is kept constant. The HV voltage is fed through regulator Q619 to grid ③ of the CRT, R652a (INTENSITY) functions to adjust the intensity of the trace.

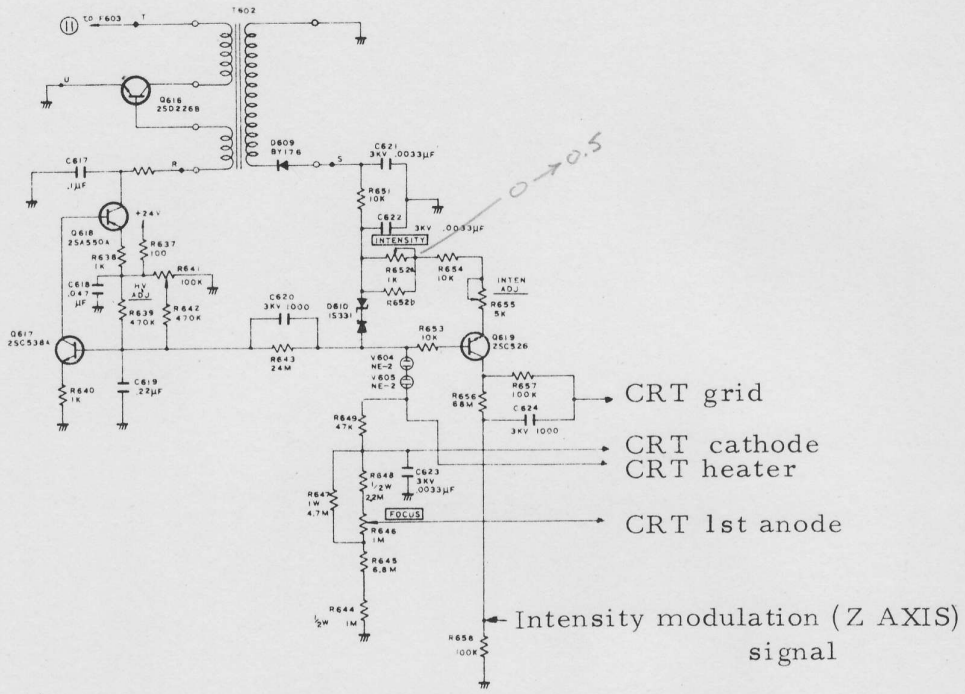


Fig. 4-32 High Voltage Circuit

o Intensity Modulation (Z Axis) Circuit:

As shown in Figure 4-33, the signal applied to the Z AXIS INPUT terminal is amplified by Q620 and Q621 (casecode amplifier) and fed to the grid (3) of the cathode-ray tube as the emitter-follower output of Q622. The signal thus functions to control the brightness of the trace. The internal signal connected to the base of Q620 functions to blank the display during retrace time and switching transients during CHOP mode operation.

o Focus Adjustment Circuit:

R646 (FOCUS) functions to adjust the voltage applied to the CRT focus anode, so as to ensure focusing of the electron beam on the phosphor screen.

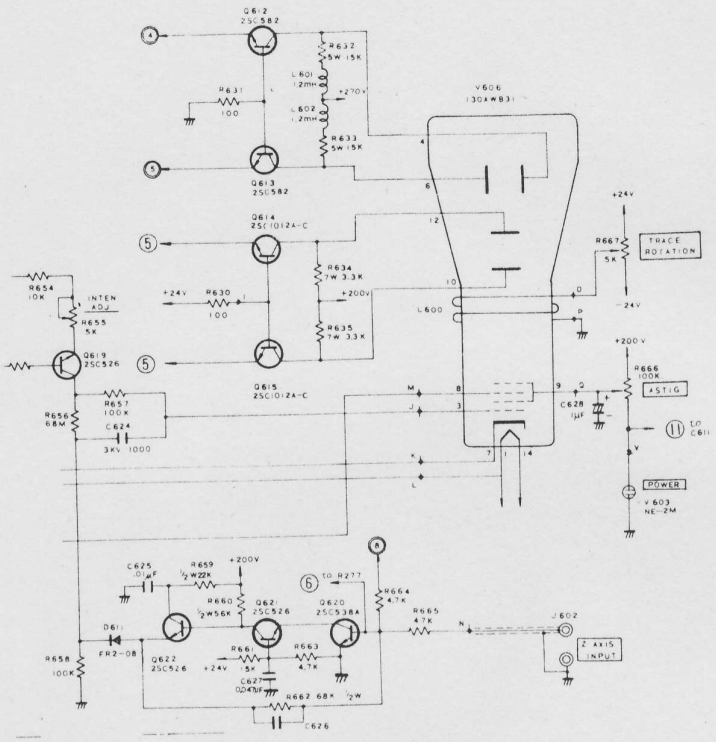


Fig. 4-33 CRT Circuit

o Astigmatism Adjustment Circuit:

R666 (ASTIG) functions to adjust the potential of the second anode 9 to compensate for the defocusing effect of the deflection plate electric fields. This effect is referred to as "Astigmatism".

o Trace Rotation Compensation:

The earth's magnetic field, although weak, causes noticeable deflection of the electron beam. As a consequence, the displayed signals will be distorted. To compensate for this effect, current is fed through coils around the outside of the CRT. R667 (TRACE ROTATION) controls the amplitude and polarity of the current in the coils.

4.2.4. Calibration Signal Generator Circuit

The calibration square wave signal, used for vertical sensitivity calibration and probe compensation, is generated by the 1 kHz

multivibrator-amplifier circuit shown in Figure 4-34. The output voltage dividers, R608, R609 and R610, also function as load resistors for the circuit.

4.2.5. Power Supply Circuit (Figure 4-35)

The input line voltage is applied to T601, a transformer with five secondary windings.

o High Voltage Power Supply Circuit:

The 150 V AC output from L9-10 is rectified by the 200 V DC bridge type rectifier. The 80 V output from L7-8 which is connected to 200 V DC line at its one terminal, is rectified for 270 V.

These voltages are fed to the final stages of the horizontal and vertical amplifiers.

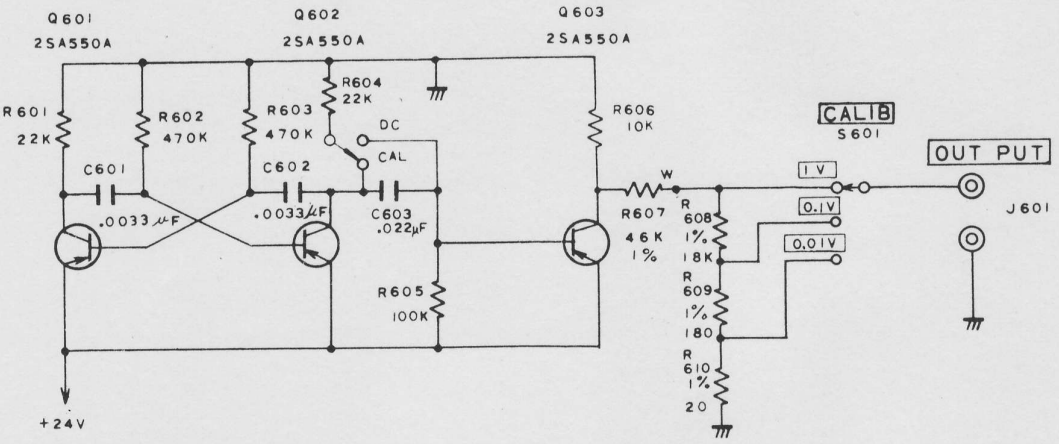


Fig. 4-34 Calibration Signal Circuit

o Constant Low Voltage Circuit:

The 28 V AC output from L11-12 is rectified by bridge rectifiers, producing outputs voltages of +35 V and -35 V.

The -35 V rectifier output is applied to the -24 V power supply. The output of this supply is controlled by series regulator Q608 in the power supply ground path. Resistors R622, R623, and 624 sample the

output voltage and a variable top on R624 (-6V) provides a control voltage to the base of Q611. Any change in the output voltage, whether caused by a change in the load or by a change in the input voltage is thus sensed by Q611. At the same time the base of Q611 is held constant at -6 V by reference diode D608. The difference voltage output of the Q610-Q611 voltage comporator is coupled from the collector of Q611 to the base of driver Q609.

The output of Q609 is coupled to regulator Q608 which functions to return the output of the supply to normal.

The +24 V power supply operates in a similar manner. Since the +24 V output voltage is used as the reference voltage for this supply, R624 (-6 V) functions to control both supplies.

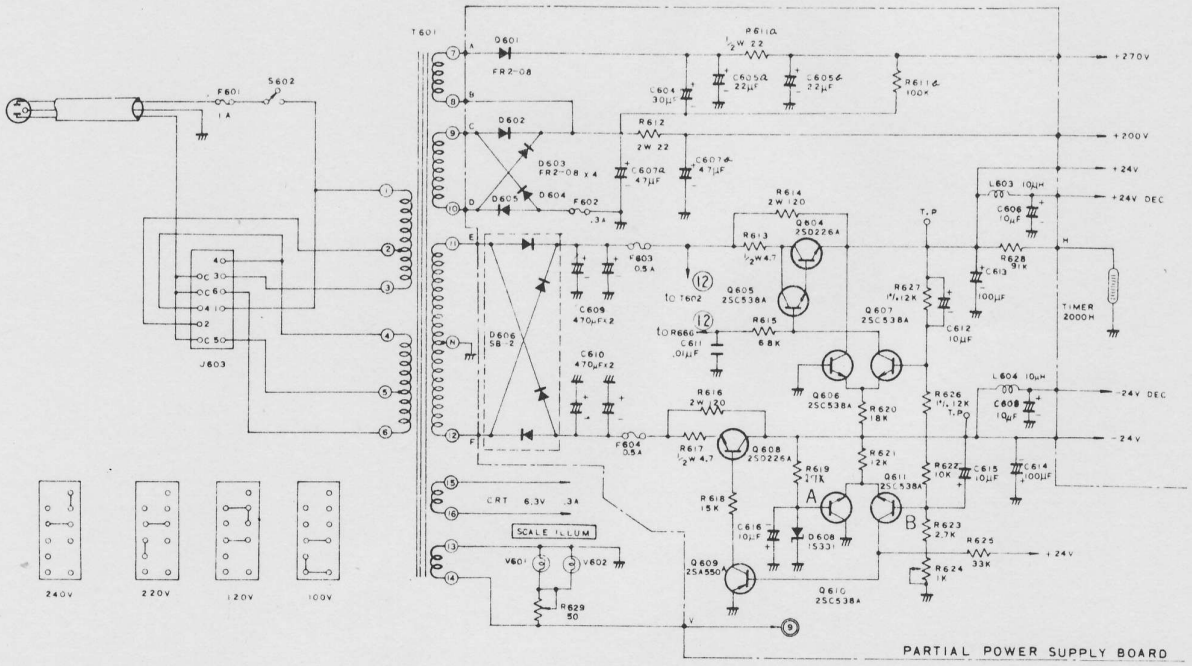


Fig. 4-35 Power Circuit

o 6.3 V AC:

The 6.3 V output from L13-14 is used for lamp for lightening the CRT scale illumination circuit. The illumination for the scale is required

in the dark place and for taking a picture.

The 6.3 V output from L15-16 is fed to the heater of the cathode-ray tube. Since the DC voltage on this line exceeds -2000 V, the appropriate safety precautions should be observed when working near this circuit.

4.2.6. Accessories:

o Probe:

The probe increases the input impedance of the oscilloscope to 10 megohm, in parallel with 15 pF. This reduces the loading influence of the oscilloscope on circuits under test to negligible proportions.

As shown in Figure 4-36, the 9 megohm resistor built into the probe combines the 1 megohm input resistor of the oscilloscope to provide a total resistance of 10 megohms.

In addition, two capacitors are included to provide frequency compensation for the oscilloscope's input capacitance of 35 pF. Although either capacitor could be made adjustable for compensation purposes, C1 is fixed to keep the probe input capacitance constant at approximately 15 pF.

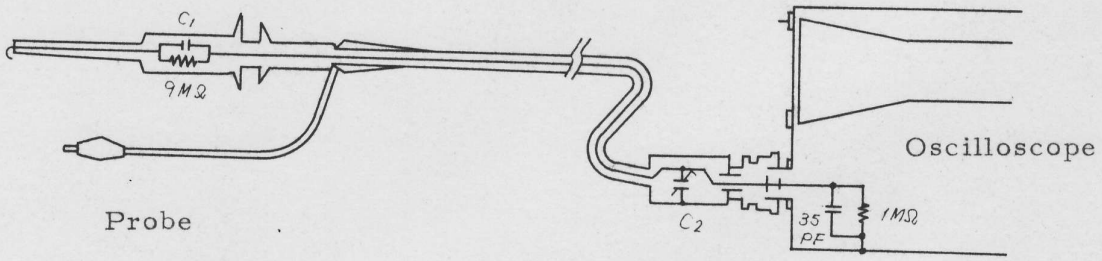


Fig. 4-36 Probe Circuit

Capacitor C2 acts to compensate the input capacity for variations in the input circuit's cabling and stray capacitances, such as Ca and Cb shown in Figure 4-37.

Ca and Cb -- Stray Capacitance

$$\text{Probe Input Capacitance (pF)} \sim Ca + \frac{C1\ (C2 + Cb)}{C1 + C2 + Cb}$$

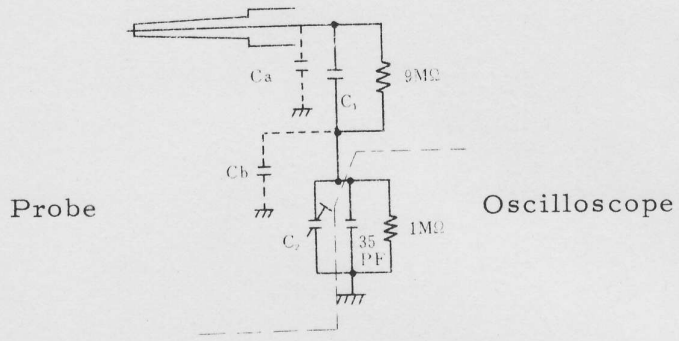


Fig. 4-37

o Time Meter:

The electrolytic time meter is used to record the cumulative operating time of the oscilloscope. Electrolysis in the unit, which proceeds at a constant rate, is started by the application of DC voltage, and stops when the voltage is removed.

The electrolyte is rated for about 2,000 hours, corresponding to the specified MTBF for this oscilloscope.

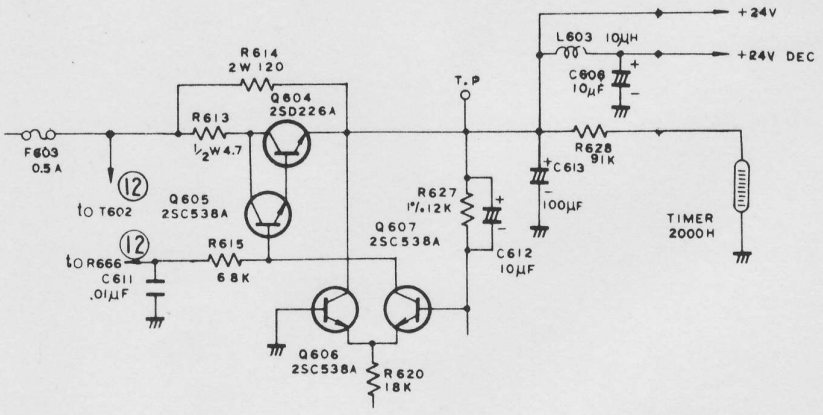


Fig. 4-38

5. MODEL VP-525A SCHEMATICS

5.1 Circuit Diagrams ..... P. 84 ~ 95

1 CH 1 Input Attenuator 84

2 Vertical Pre-Amp (CH 1) 85

3 CH 2 Input Attenuator 86

4 Vertical Pre-Amp (CH 1) 87

5 Vertical Drive-Amp 88

6 Vertical Switching 89

7 Trigger Circuit 90

8 Sweep Generator 91

9 Horizontal Amplifier 92

10 Calibrater 93

11 Low Voltage Circuit 94

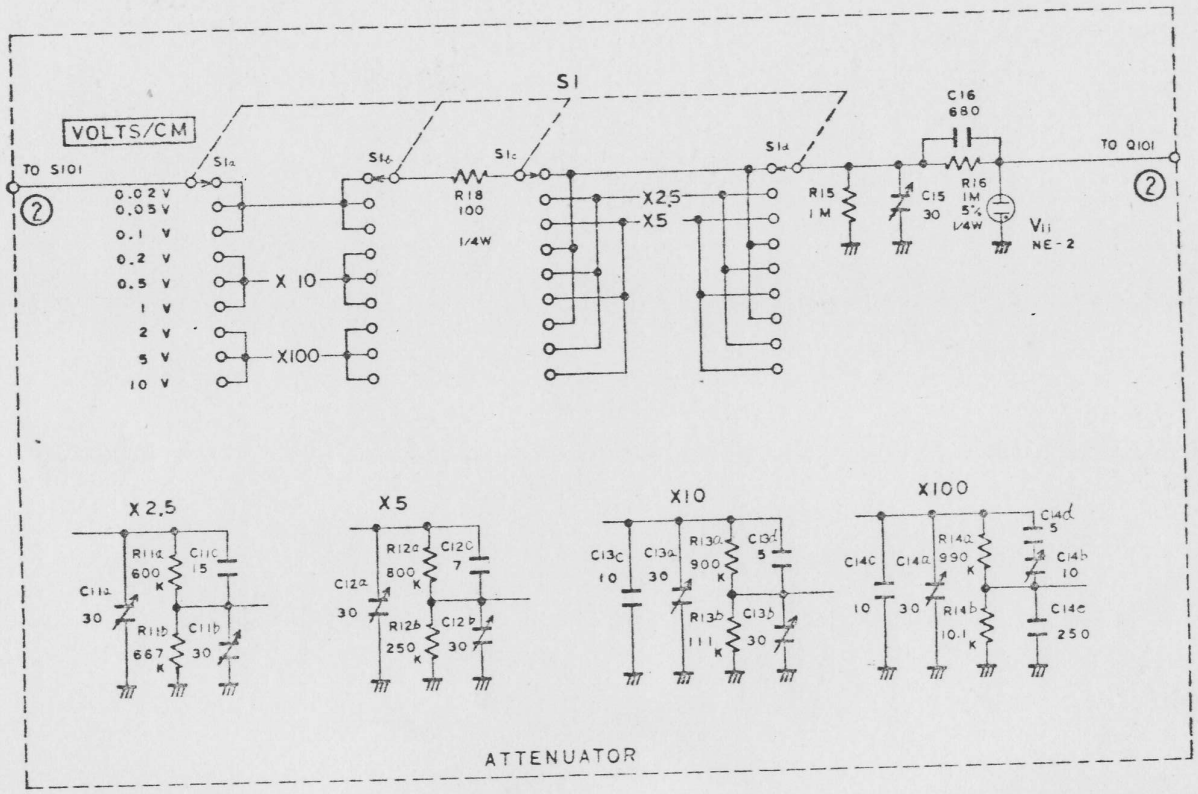
12 CRT Circuit 95

5.2 Structural Views ..... P. 96 ~ 97

Assembly Diagram (I) 96

Assembly Diagram (II) 97

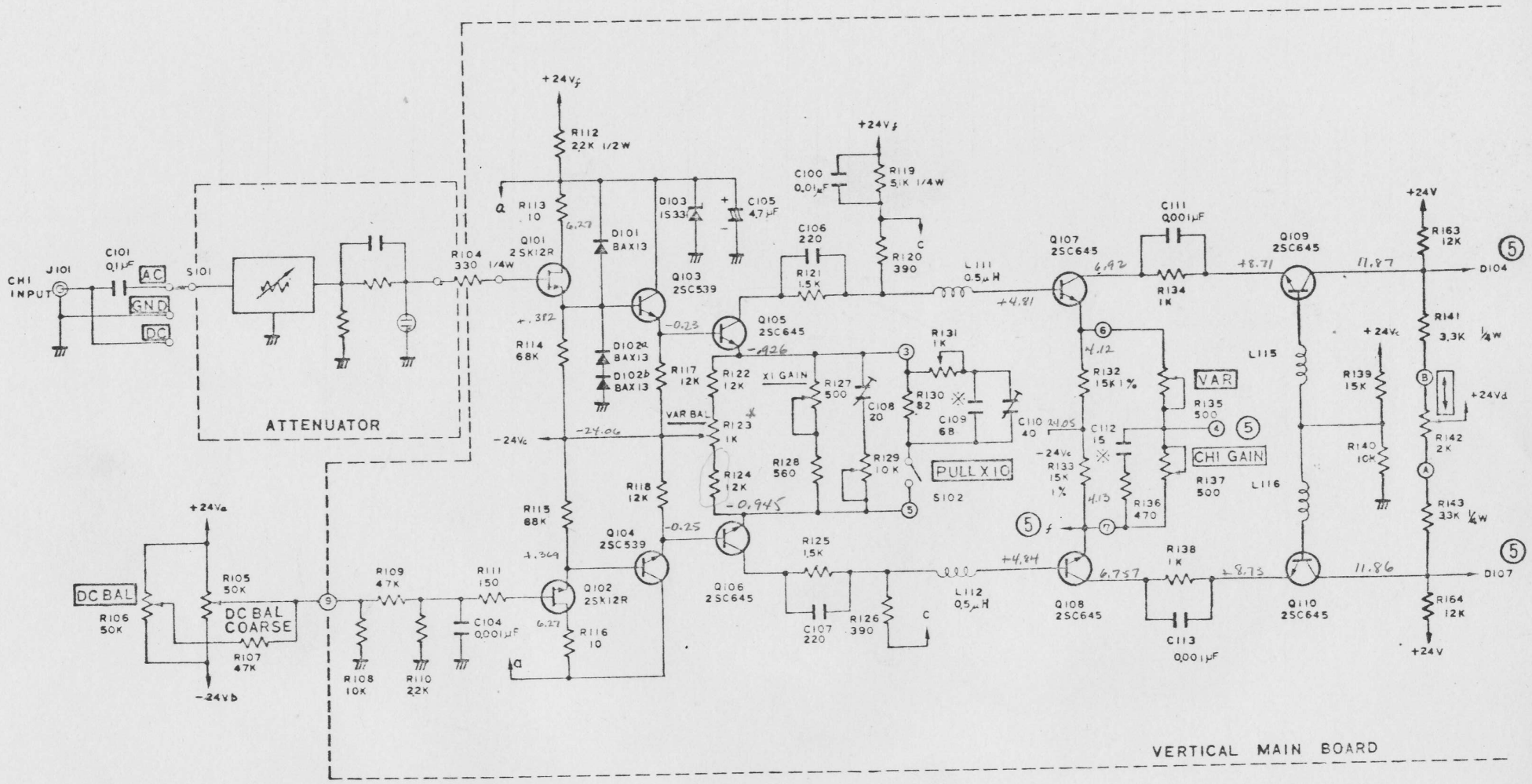
Arrangement of Electrical Components 97



RESISTANCE VALUES IN Ω ±1%, ½ WATT
AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.

VP-525A

CH I INPUT ATTENUATOR (1)



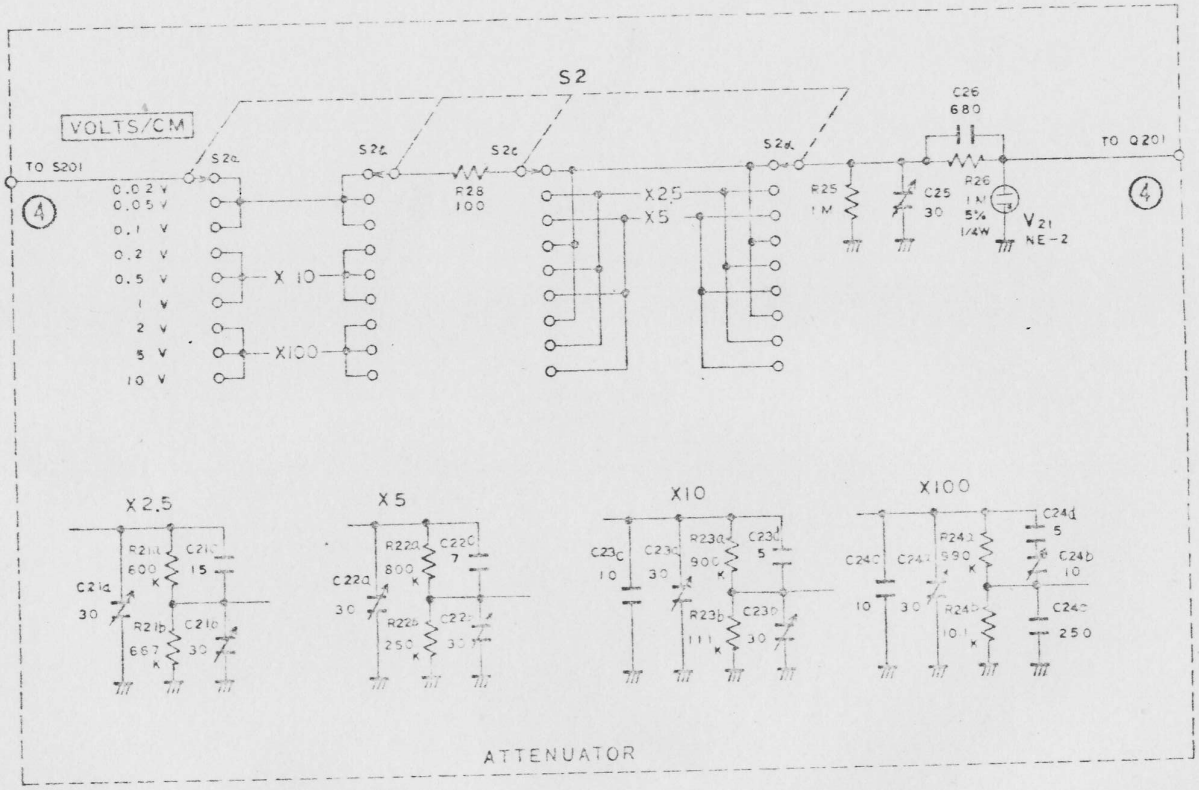
* replaced 3/1/76

R124 Previous

1. RESISTANCE VALUES IN Ω, 1/8 WATT AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.
2. ※ ADJUSTED.
3. —○— CONNECTION WITH VERTICAL SUB-BOARD AND ITS PIN NUMBER.

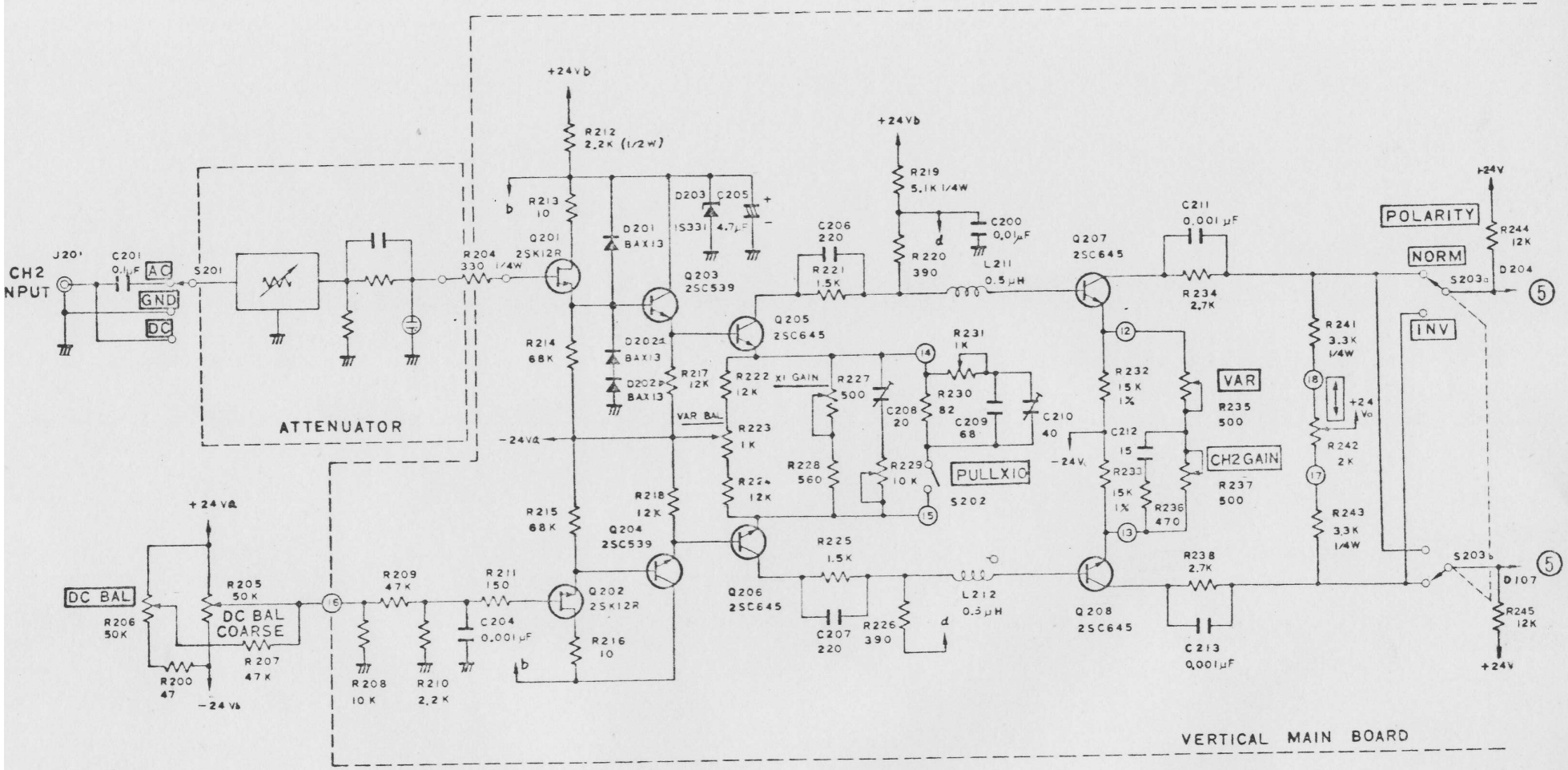
VERTICAL PRE-AMP (CH-1)

2



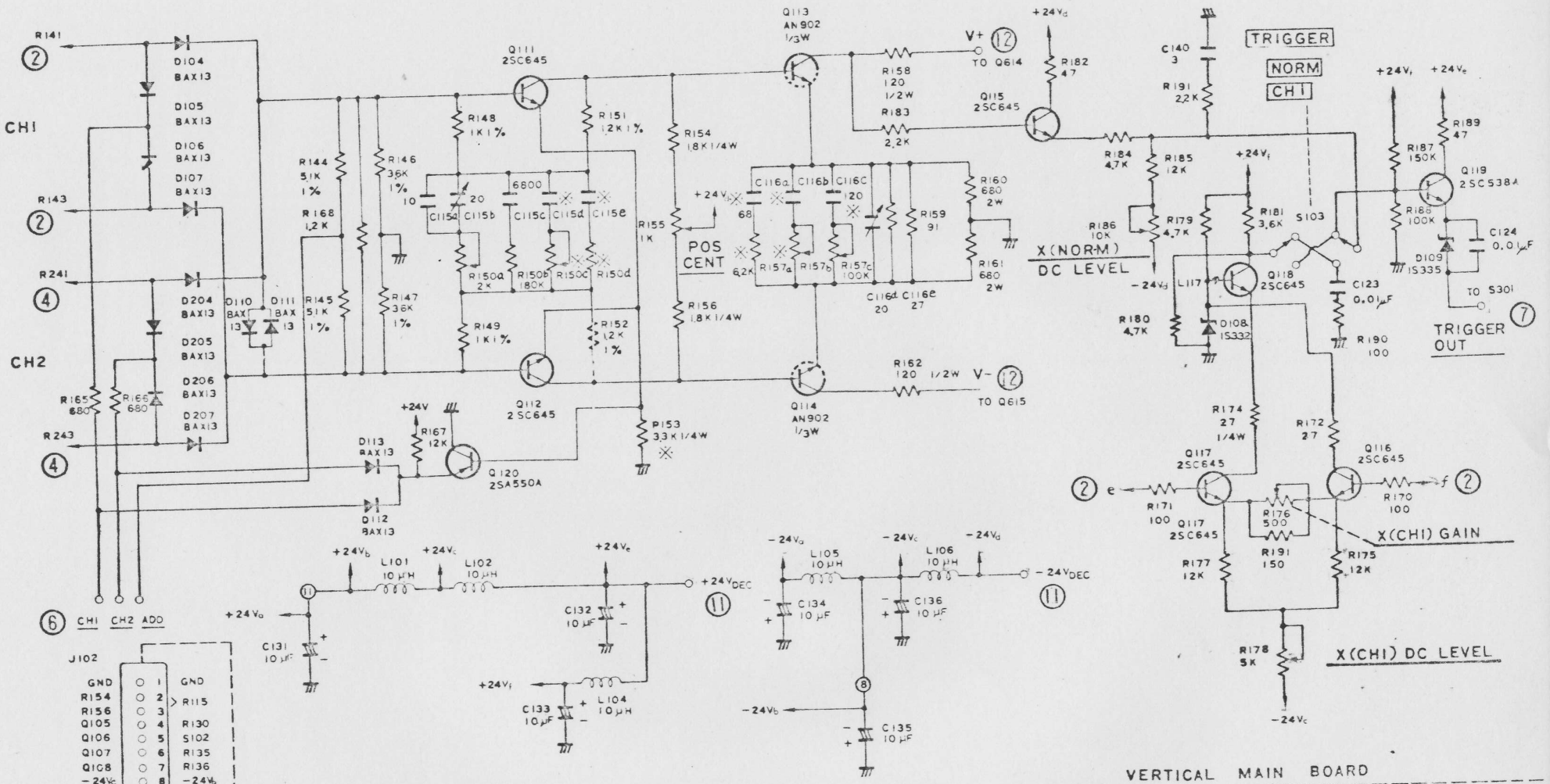
RESISTANCE VALUES IN Ω ±1%, ½ WATT
AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.

CH2 INPUT ATTENUATOR (3)



1. RESISTANCE VALUES IN Ω, 1/8 WATT AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.
2. ※ ADJUSTED.
3. —○— CONNECTION WITH VERTICAL SUB-BOARD AND ITS PIN NUMBER.

VERTICAL PRE-AMP (CH-2)

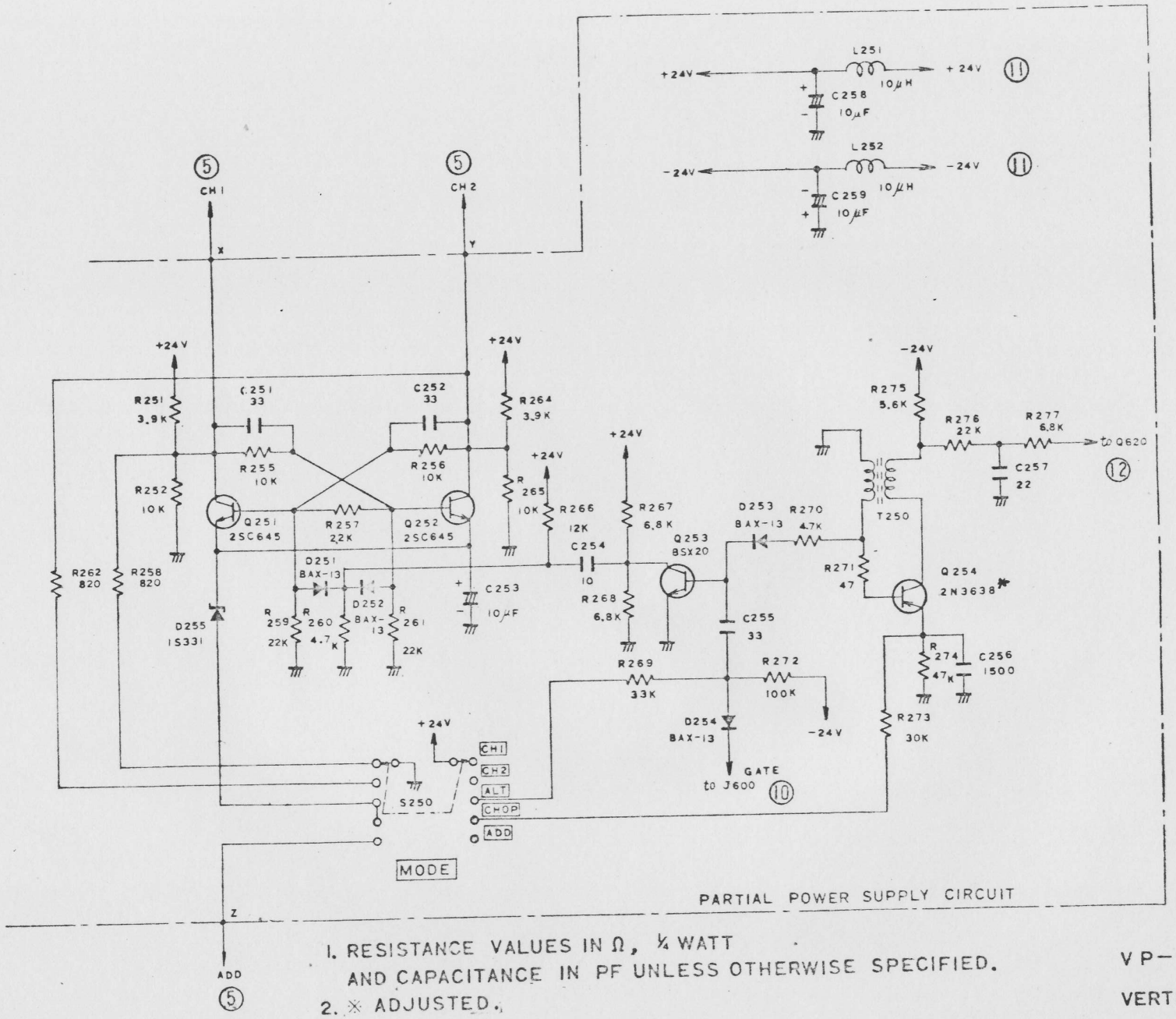


VERTICAL MAIN BOARD

1. RESISTANCE VALUES IN Ω, 1/8 WATT AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.
2. ※ ADJUSTED.
3. —○— CONNECTION WITH VERTICAL SUB-BOARD AND ITS PIN NUMBER.

VP-525A

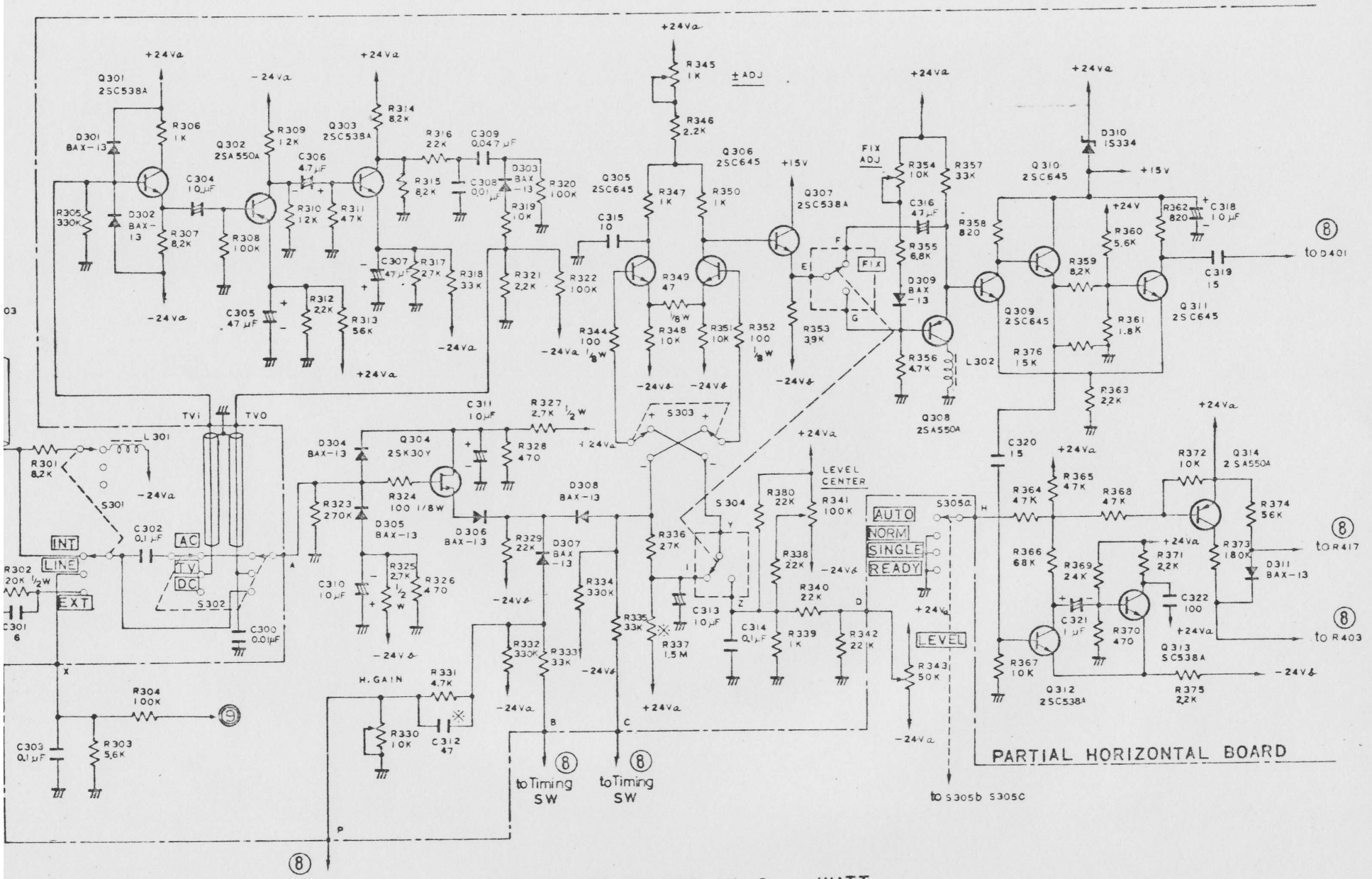
VERTICAL DRIVE-AMP (5)



* replaced 17 May 1978

1. RESISTANCE VALUES IN Ω, ¼ WATT AND CAPACITANCE IN PF UNLESS OTHERWISE SPECIFIED.
2. ※ ADJUSTED.

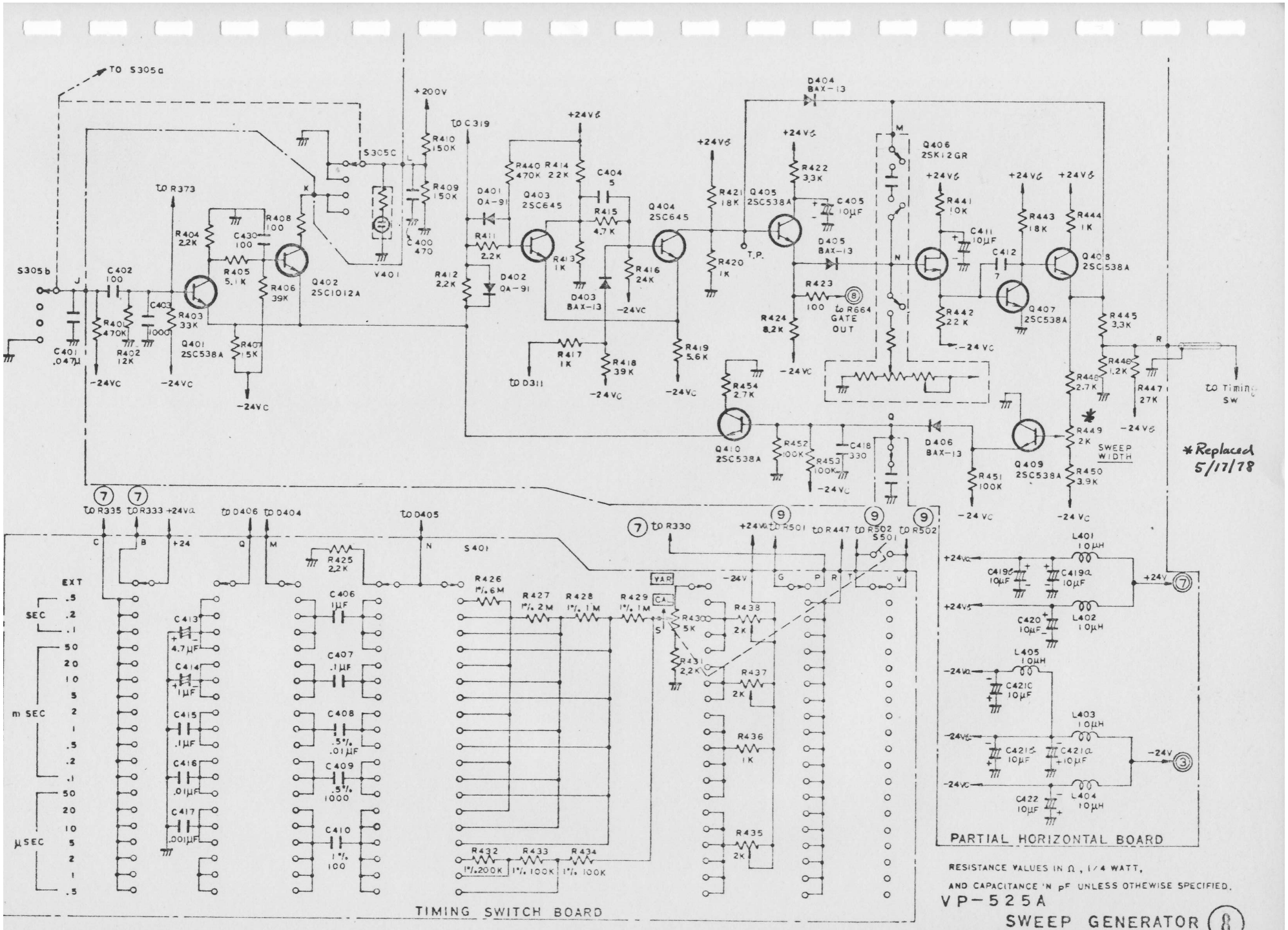
VP-525A
VERTICAL SWITCHING

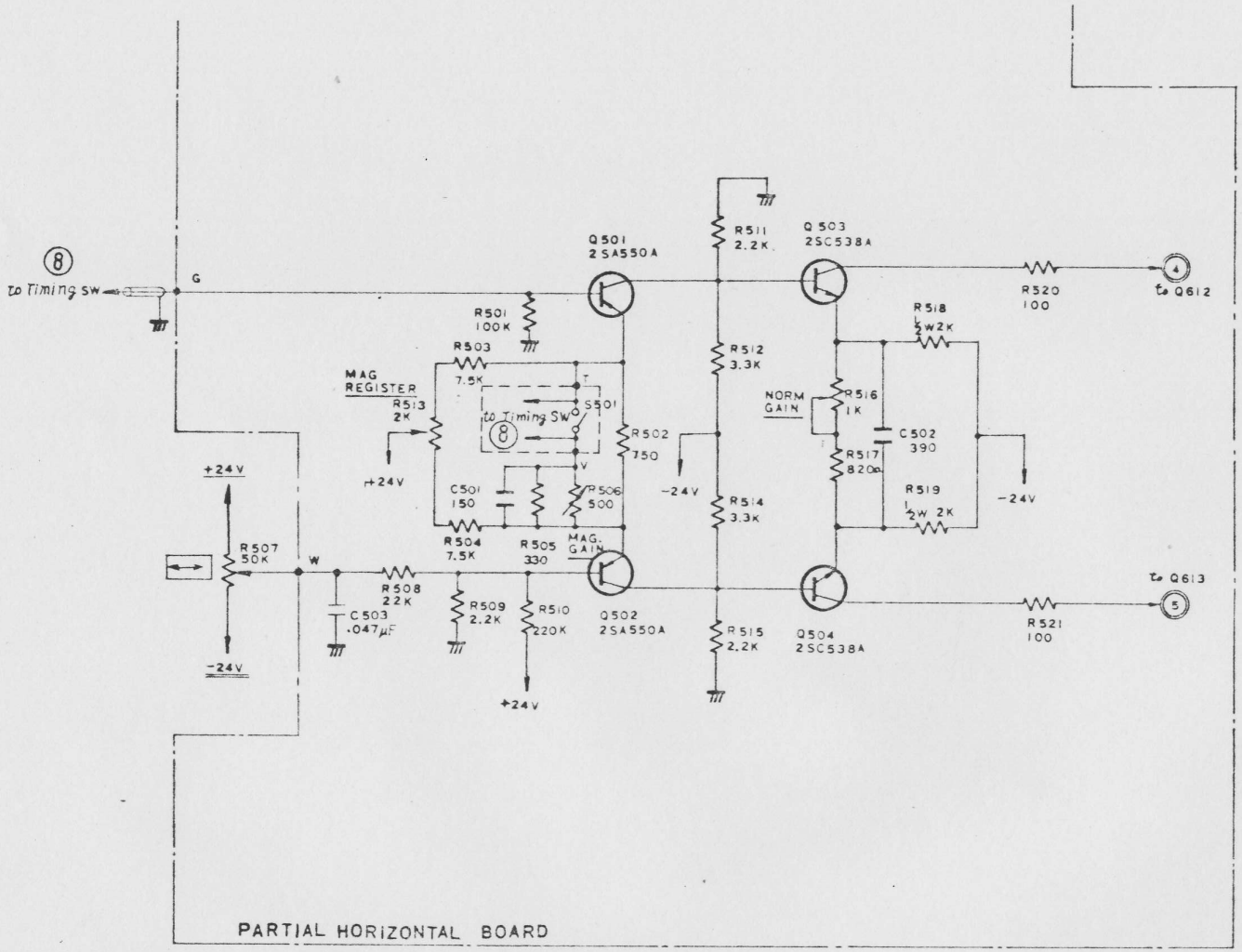


1. RESISTANCE VALUES IN Ω, ¼ WATT, AND CAPACITANCE IN pF UNLESS OTHERWISE SPECIFIED.
2. ※ ADJUSTED.

VP-525A

TRIGGER CIRCUIT (7)

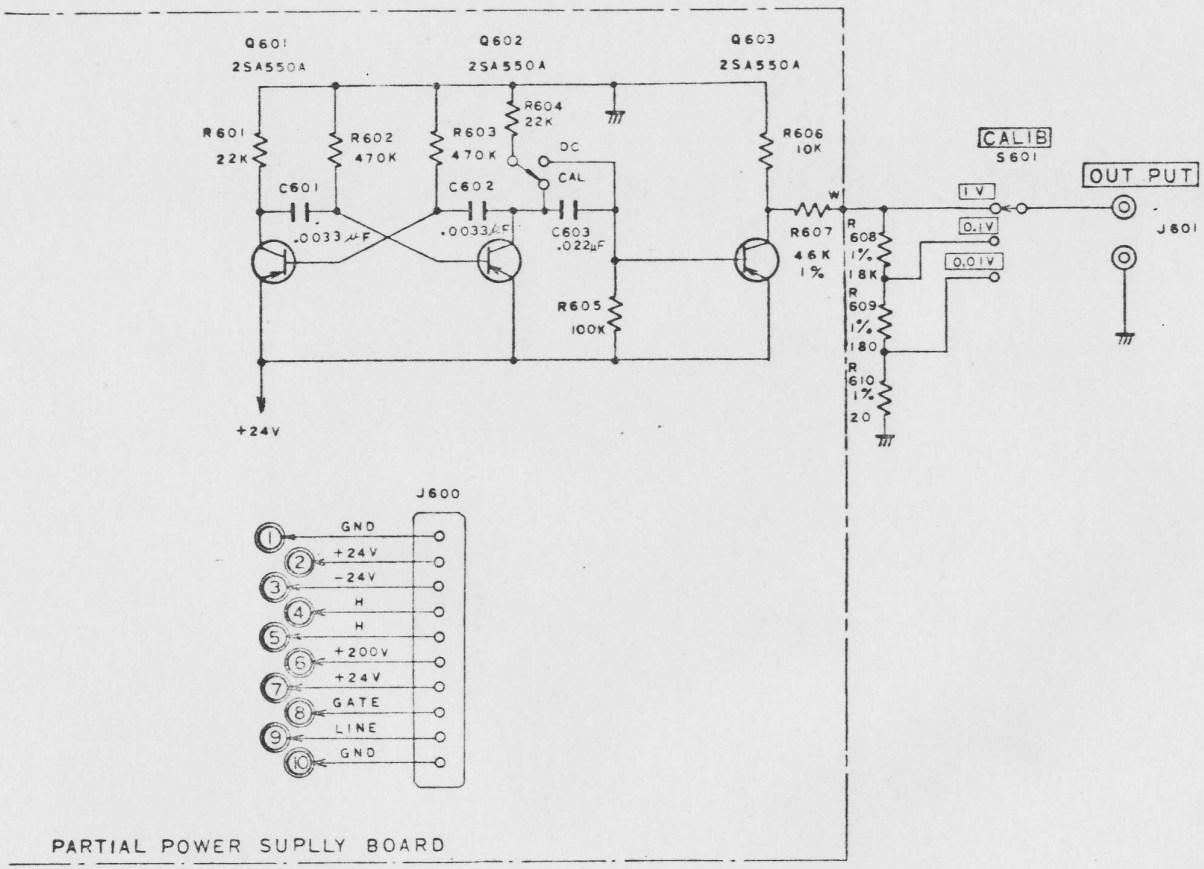

TO S305a
+200V
to C319
+24Vc
S305b
S305c
to R373
V401
C401 .047μ
C402 100
R404 2.2K
R405 5.1K
C430 100
R408 100
R406 39K
Q402 2SC1012A
C403 1000
R403 33K
R401 470K
R402 12K
Q401 2SC538A
R407 15K
-24Vc
R410 150K
R409 150K
C400 470
R440 470K
R414 22K
C404 5
D401 0A-91
Q403 2SC645
R411 2.2K
R415 4.7K
R413 1K
D403 BAX-13
R416 24K
Q404 2SC645
R412 2.2K
D402 0A-91
R417 1K
R418 39K
R419 5.6K
to D311
D404 BAX-13
R421 18K
Q405 2SC538A
R420 1K
T.P.
R422 3.3K
C405 10μF
D405 BAX-13
R423 100
to R664 GATE OUT
R424 8.2K
Q406 2SK12GR
R441 10K
C411 10μF
R442 22K
C412 7
Q407 2SC538A
R443 18K
R444 1K
Q408 2SC538A
R445 3.3K
R446 1.2K
R447 27K
R448 2.7K
R449 2K
SWEEP WIDTH
R450 3.9K
R451 100K
Q409 2SC538A
D406 BAX-13
R452 100K
R453 100K
C418 330
R454 2.7K
Q410 2SC538A
to Timing Sw
*Replaced 5/17/78
to R335
to R333
+24Va
to D406
to D404
to D405
S401
EXT
SEC .5 .2 .1
50 20 10 5
m SEC 2 1 .5 .2 .1
50 20 10 5
μSEC 2 1 .5
C413 4.7μF
C414 1μF
C415 .1μF
C416 .01μF
C417 .001μF
R425 2.2K
C406 1μF
C407 .1μF
C408 .5% .01μF
C409 .5% 1000
C410 1% 100
R426 1%.6M
R427 1%.2M
R428 1%.1M
R429 1%.1M
R430 5K
R431 2.2K
R438 2K
R437 2K
R436 1K
R435 2K
R432 1%.200K
R433 1%.100K
R434 1%.100K
TIMING SWITCH BOARD
to R330
+24Vb
to R501
to R447
to R502
S501
to R502
L401 10μH
C419b 10μF
C419a 10μF
C420 10μF
L402 10μH
L405 10μH
C421b 10μF
L403 10μH
C421a 10μF
C422 10μF
L404 10μH
PARTIAL HORIZONTAL BOARD
RESISTANCE VALUES IN Ω, 1/4 WATT,
AND CAPACITANCE IN pF UNLESS OTHEWISE SPECIFIED.
VP-525A
SWEEP GENERATOR
8



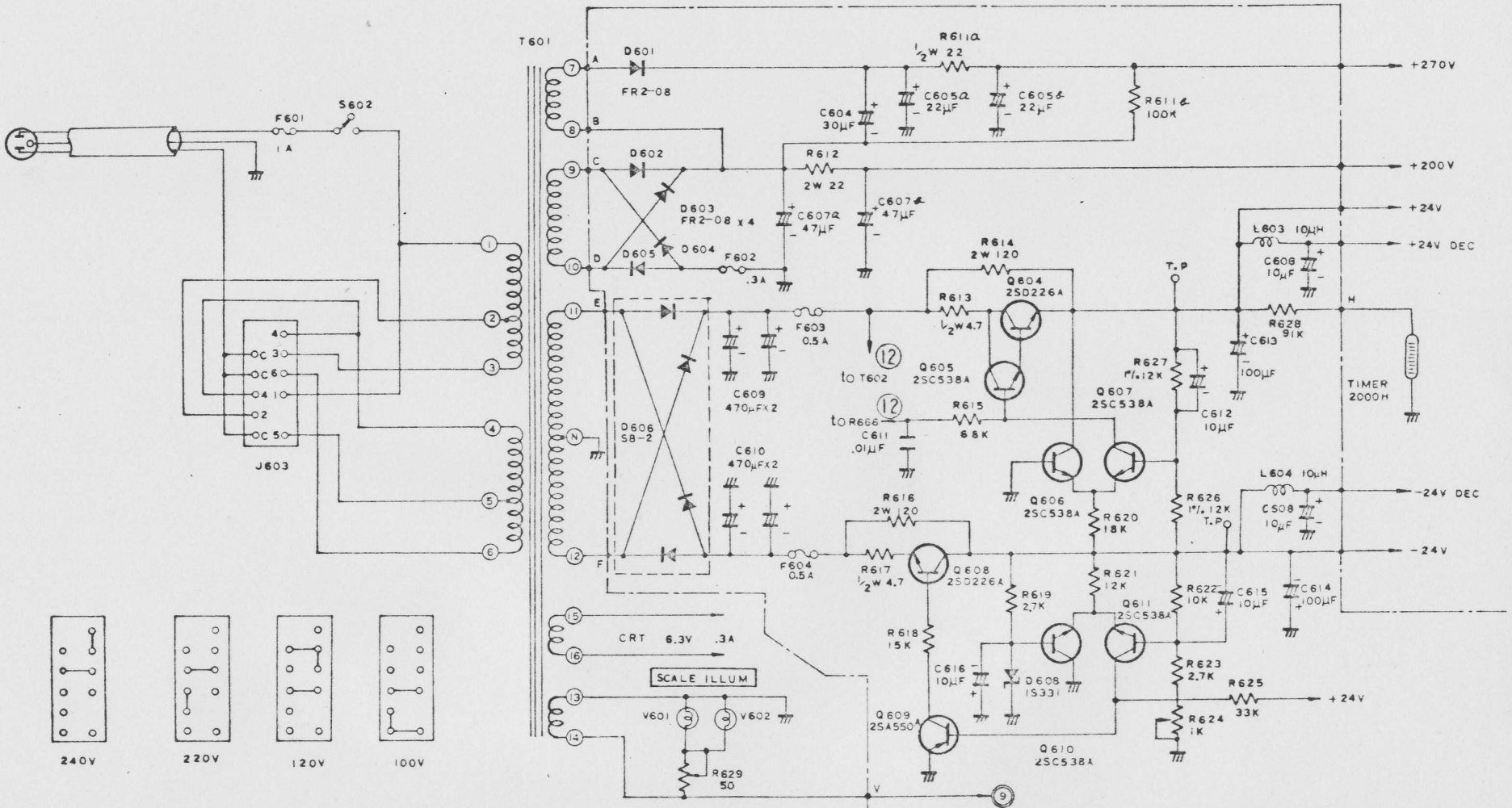
PIN NO.	NOTE
①	GND
②	+24V
③	−24V
④	H1
⑤	H2
⑥	+200V
⑦	+24V
⑧	GATE
⑨	LINE
⑩	GND

RESISTANCE VALUES IN Ω, ¼ WATT,
AND CAPACITANCE IN pF UNLESS OTHERWISE
SPECIFIED.

VP−525A
HORIZONTAL AMPLIFIER ⑨



RESISTANCE VALUES IN Ω, ¼ W AND CAPACITANCE IN pF UNLESS OTHERWISE SPECIFIED.

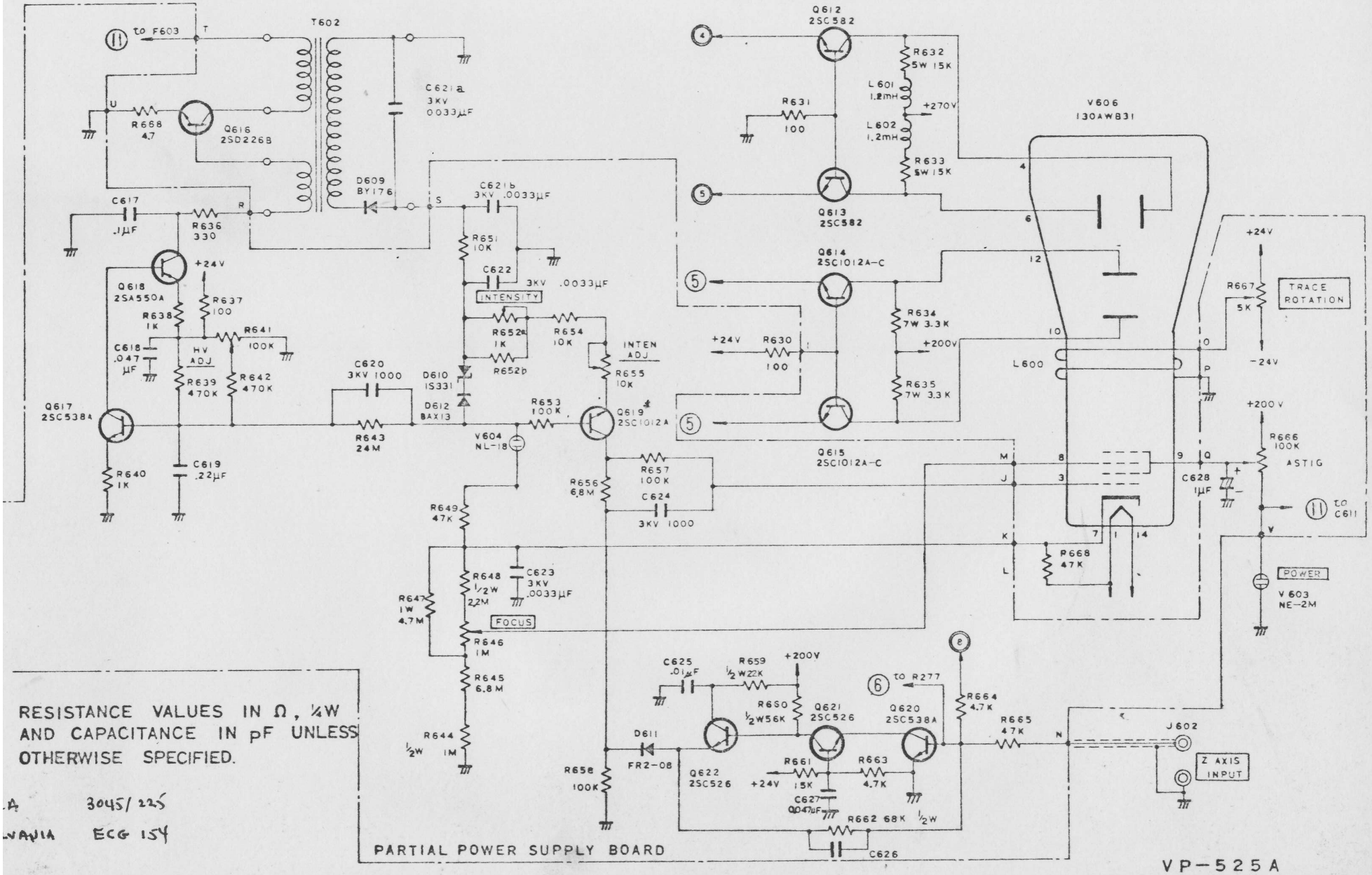


RESISTANCE VALUES IN Ω, ¼ WATT AND CAPACITANCE IN pF UNLESS OTHERWISE SPECIFIED.

PARTIAL POWER SUPPLY BOARD

(11)

LOW VOLTAGE CIRCUIT



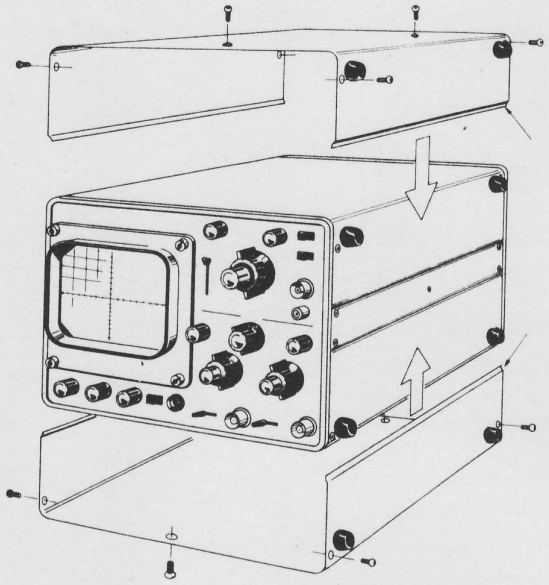
RESISTANCE VALUES IN Ω, ¼W AND CAPACITANCE IN pF UNLESS OTHERWISE SPECIFIED.

A 3045/225

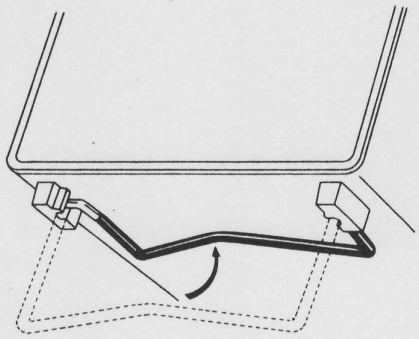
VANIA ECG 154

VP-525A

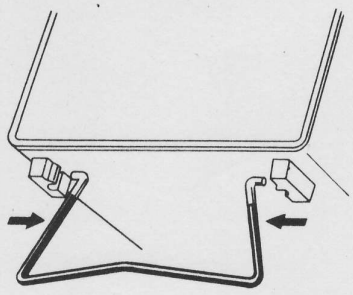
CRT CIRCUIT (12)



Removal of covers

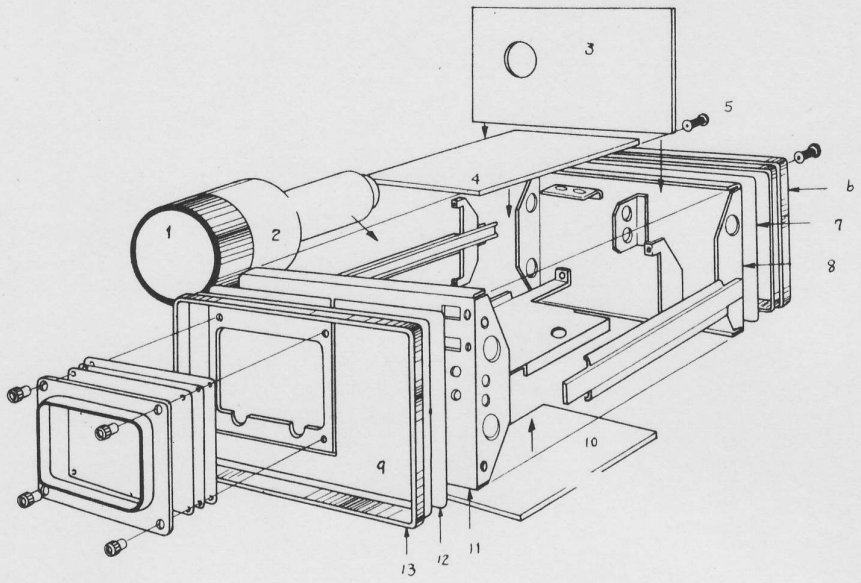


Stand (folded)



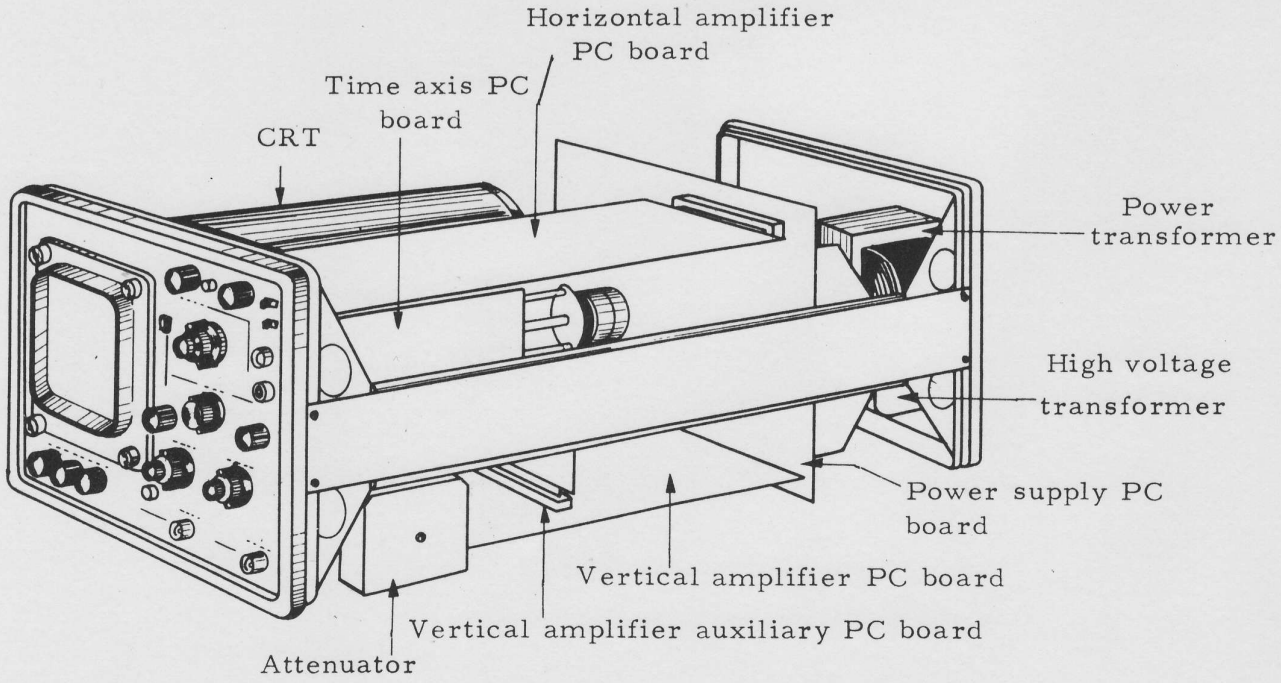
Stand (un folded)

Assembly Diagram (I)



1	CRT	8	Rear baseplate
2	CRT shield	9	Panel plate
3	Power Supply PC board	10	Vertical amplifier PC board
4	Horizontal amplifier PC board	11	Front panel baseplate
5	Rubber base	12	Front panel plate
6	Rear panel frame	13	Front panel frame
7	Rear panel plate		

Assembly Diagram (II)



Arrangement of Electrical Components

6. MAINTENANCE AND CALIBRATION

Proper maintenance and calibration must be performed if this oscilloscope is to continue to operate within its specifications.

		Page
6.1	Cleaning	99
6.2	Cleaning of CRT screen ..... Replacement of lamps	99
6.3	Supply voltage calibration	100
6.4	Vertical amplifier calibration	102
6.5	Input attenuator calibration	107
6.6	Triggering circuit adjustment	110
6.7	Horizontal amplifier calibration	113

Appendix: Troubleshooting 117

6.1 Cleaning

- When the outside of the case becomes dirty, clean it with a neutral cleaner or alcohol applied with a damp cloth. Afterwards, dry it with a clean, dry cloth. Never use strong volatile cleaners such as benzene or thinner on this instrument.
- A dry brush or compressed air should be used to remove any dust or dirt deposited inside the oscilloscope. Be **usre** to remove the power plug from the line voltage source before opening the case.
  When cleaning, be careful of charged capacitors in the power supply section. (Voltages of more than 2 kV exist in the area around the CRT.)

6.2 Cleaning of CRT screen

A dirty screen will contribute to faulty measurements and should therefore be cleaned often. For cleaning the CRT, remove the bezel, filter, light shield, and graticule. After dust is removed from the screen, wipe it with a clean, dry lint-free cloth. Clean the graticule and filter with a neutral cleaner taking care not to scratch them.

The units should be allowed to air to dry them. Do not wipe them with a cloth.

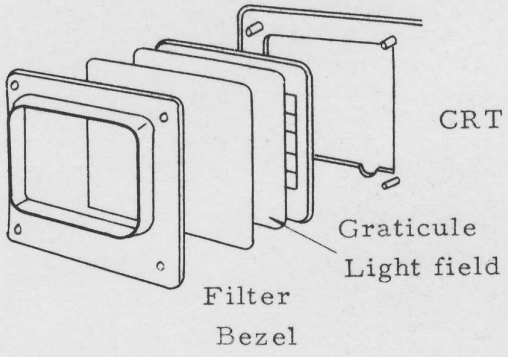
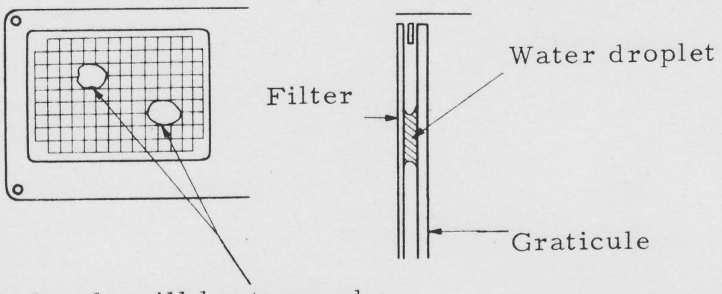


Fig. 6-1 Removal of Filter



Water drople will be trapped between the graticule and filter if they are assembled while they are still damp, making observarious difficult.

Fig. 6-2 Filter and Water Droplets

o Lamp Replacement

Refer to Fig. 6-3 for lamp replacement procedures.

Removal: Turn CCW Replacement: Push in and turn CW.

Fig. 6-3 Lamp Replacement

6.3 Supply voltage calibration

(CAUTION: High voltages exist at points marked with an asterisk *. Be extremely careful not to come into bodily contact with these voltages.) .

Prior to calibration, set the line voltage selector for the proper line voltage. (Also check the socket for power supply on the rear panel.)

o Low voltage

Remove the left side plate, and connect a DC voltmeter between points A and G (ground potential). The voltmeter used should have an accuracy of at least ±0.5%. Adjust R624 (+24 VADJ) for voltmeter reading of +24 V. Refer to Fig. 6.4.

o High voltage

Connect an electrostatic voltmeter with a range of at lease 3 kV DC between points C and D (ground potential). Adjust R641 〈HV ADJ〉 until the spot on the CRT screen is just visible. (Refer to Figures 6.5 and 6.6.)

o Other voltages

Check at the following points for the voltages indicated: (point G is at circuit ground)

-24 V supply ..... E-G (-24 V ±1%)

+200 V supply (*) ..... F-G (approximately 210 V)

+270 V supply (*) ..... J-G (approximately 320 V)

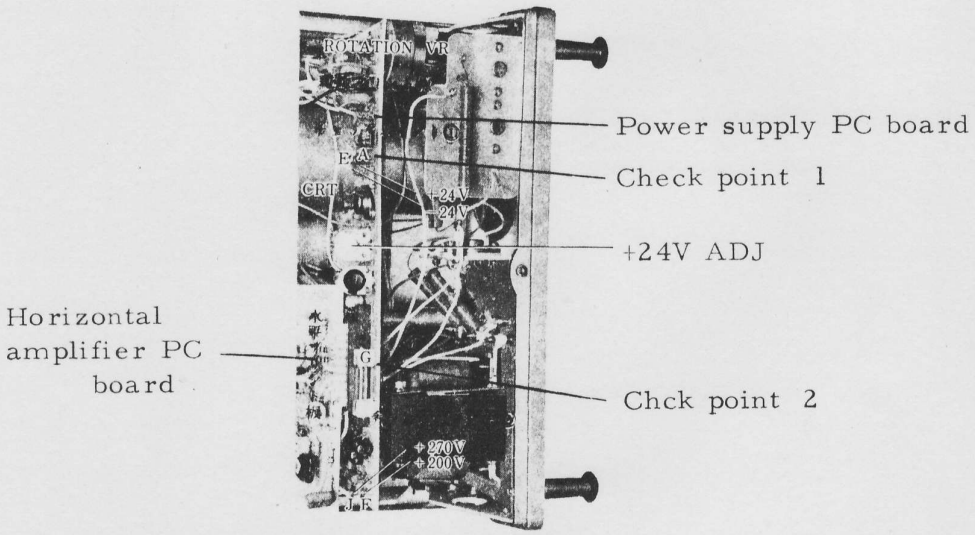


Fig. 6.4

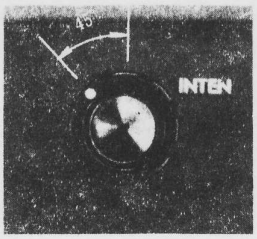


Fig. 6.5 Control Position

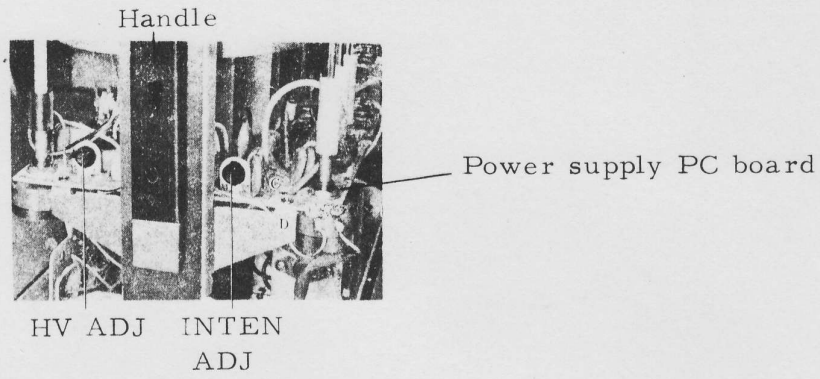


Fig. 6.6 High Voltage Adjustment Points

- o TRACE ROTATION Adjustment

  If the baseline is not parallel to a horizontal graticule line, turn the TRACE ROTATION control on the upper part of the panel until the trace is horixontal. Since influence of the earth's magnetism will vary with the position of the oscilloscope, keep the instrument in one position during adjustment.

- o ASTIG Adjustment (*)

  Display a pulse (or square wave) with a 1-cm pulse width and adjust for a steady trace with an amplitude of 8 cm. Adjust the FOCUS and ASTIG controls for even focus throughout entire display area.

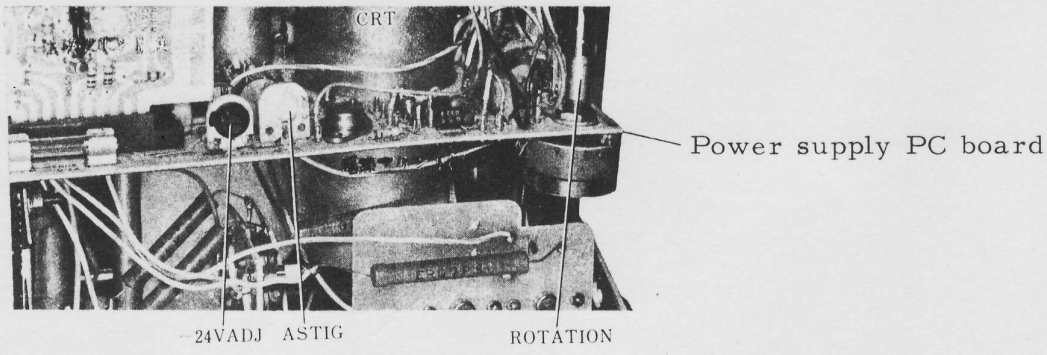


Fig. 6.7 ASTIG and Rotation

6.4 Vertical amplifier calibration

Calibration of the vertical amplifier involves adjustment of the gain DC balance, and frequency response characteristics of the amplifier.

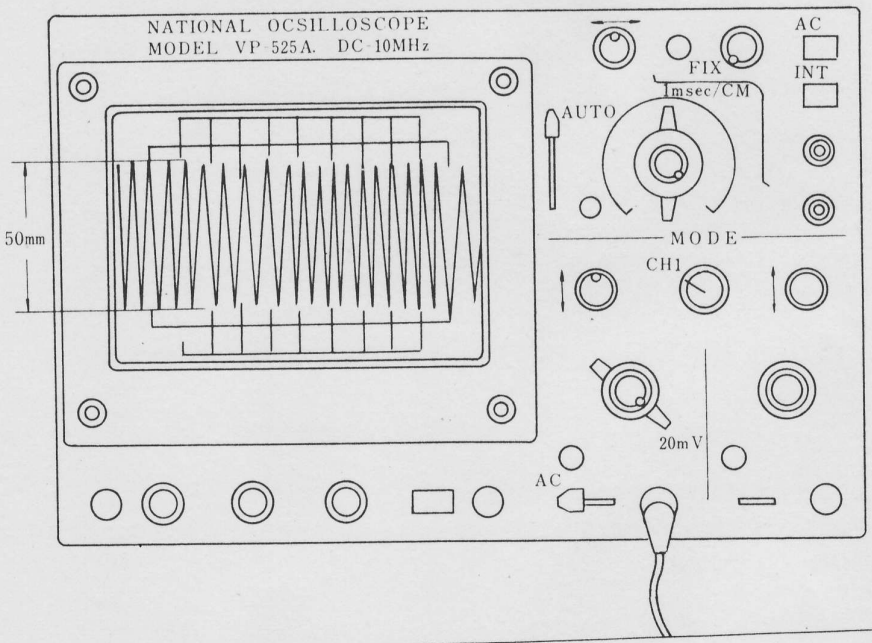
o Gain

Couple an accurate 10 mVp-p (±1%) 1 kHz signal from a sine-wave generator to the CH1 input terminal, and set the following controls to the position indicated;

VOLTS/CM 0.02

VAR PULL x 10 ..... CAL, x 10

Adjust the CH1 GAIN control for a display amplitude of 50 mm. Reduce the generator output to 100 mVp-p and push the VAR PULL in. Adjust R127 (x 1 GAIN) for a display amplitude of 50 mm. Since these adjustments interact, repeat as necessary. Couple the signal to the CH2 input terminal and repeat the above adjustment sequence.



Constant amplitude signal generator:
Set for frequency output of about 50kHz and output voltage of 100mVp-p.

Fig. 6.8

o DC Balance (DC-BALANCE)

With the panel controls set as indicated in Fig. 6.8, but with no signal applied, adjust the CH1 DC BAL control until the baseline

display remains stationary when the VAR x10 control is switched between x1 and x10.

If the baseline shifts vertically when the VAR x10 control is rotated CW or CCW, adjust R123 (VAR BAL) until the trace remains stationary.

Repeat these adjustments as necessary.

If the DC BAL control does not have an adequate range, set it to the mid-position and adjust the DC BAL (COARSE) instead. (See Fig. 6.9.)

When the coarse adjustment is complete, repeat the entire adjustment sequence. Repeat the above adjustments for CH2.

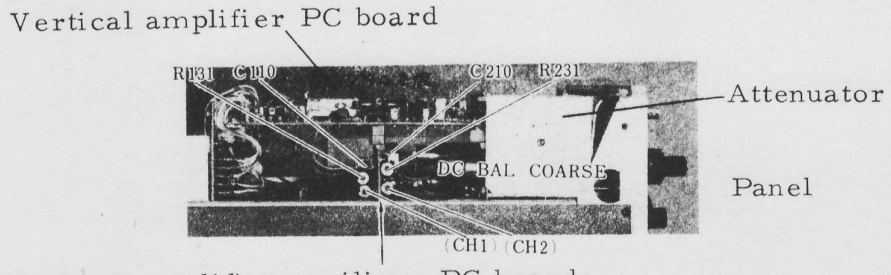


Fig. 6.9 DC BAL COARSE

o Bandwidth adjustment

The frequency response adjustments given in this section involve adjustment of the two vertical preamplifiers and the main amplifier. For proper calibration, it is mandatory that all adjustments be performed in the proper sequence.

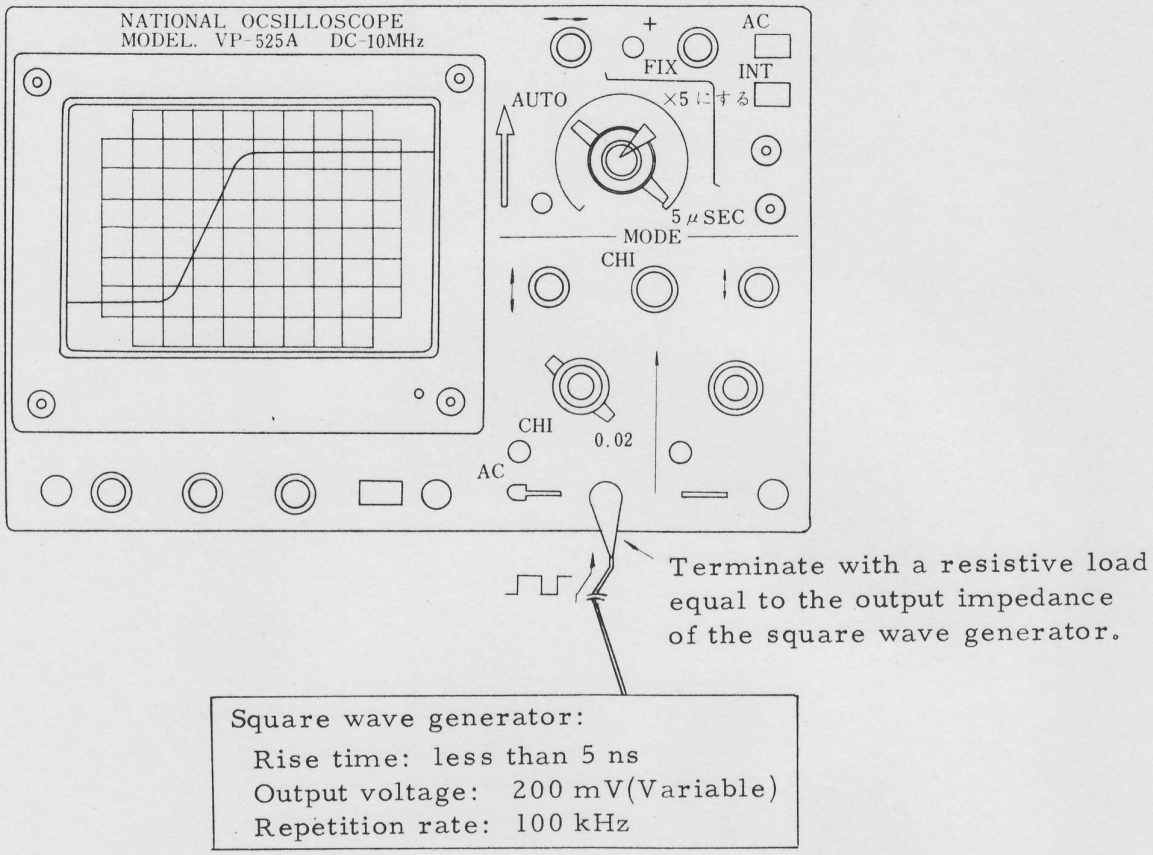


Fig. 6-10

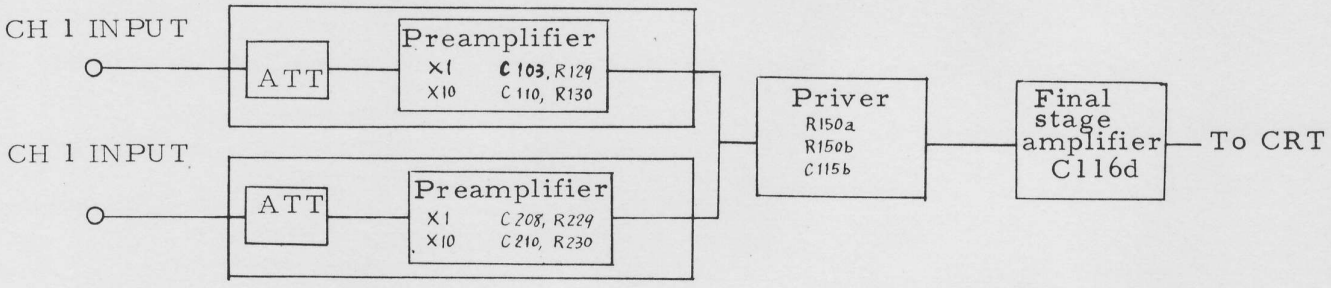


Fig. 6-11

Adjustment procedure:

Set the panel controls to the positions shown in Fig. 6-10 and couple the square signal to the CH1 input terminal.

1 Push CH1 to VAR PULL x10 control in and set it to the CAL position. Adjust the generator output for a display amplitude of 60 mmp-p. Adjust the controls listed in Fig. 6-12 in the sequence indicated,

until the rise time of the square wave display is less than 35 ns.

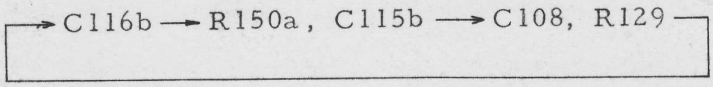


Fig. 6-12 Adjustment Sequence (to be repeated until best waveform is obtained.)

② Apply the signal to the CH2 input terminal and adjust the controls indicated in Fig. 6-13 in a similar manner.

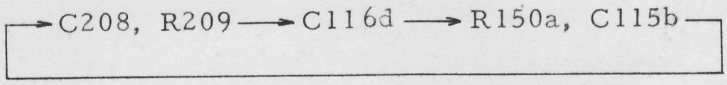


Fig. 6-13

③ Repeat steps ① and ② until the adjustments have no further effect.

④ Apply the signal to the CH1 input terminal and pull the VAR x10 control out (leave it in the CAL position). Adjust the controls listed in Fig. 6-14, in the sequence indicated until the rise time of the square wave display is less than 35 ns.

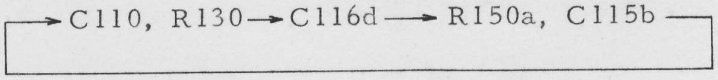


Fig. 6-14

Do not adjust R , C , and C of the final stage. If they are adjusted, repeat steps ① to ④.

⑤ Apply the signal to the CH2 input terminal. Turn the VAR x10 control maximum CCW (leave it in the x1 position) and adjust the controls indicated in Fig. 6-15 in a similar manner.

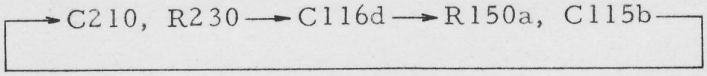


Fig. 6-15

NOTE: Since adjustments other than those described above affect other circuit characteristics besides frequency response, they should not be touched.

6 Repeat steps 1 to 5, and check the waveform during each adjustment, noting not only the rise time but also overshoot and ringing. Overshoot and ringing should be less than 3% (of the base amplitude).

7 Post calibration: bandwidth check

Apply a 50 kHz sine wave signal from a constant amplitude signal generator. Adjust the generator output for a display amplitude of at least 80 mm (peak to peak). Note the generator output voltage. Change the generator frequency to 10 MHz and adjust for the same output voltage. If the display amplitude of the 10 MHz signal is at least 56 mm, the calibration is complete. (Perform the check for both CH1 and CH2, and for the x1, x10, CAL and maximum CCW positions of the VAR x10 controls.)

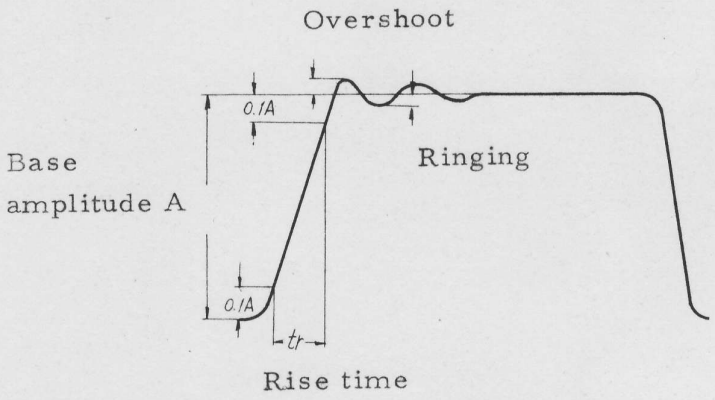


Fig. 6-16 Overshoot and Ringing

6.5 Input attenuator calibration

Since the input attenuator is frequency compensated, recalibration will be required when any component in the attenuator is replaced. For this calibration, a square wave signal generator and a capacity meter with the specifications listed below will be required.

NOTE: Perform the calibration given in this section for both CH1 and CH2.

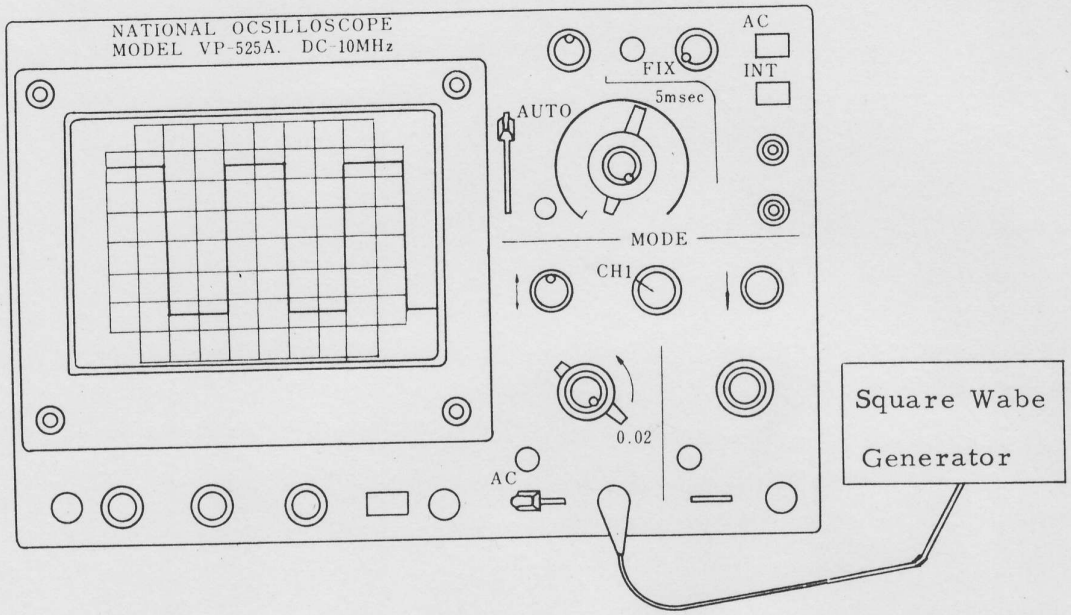


Fig. 6-17 Attenuator Calibration

Square wave generator specifications:

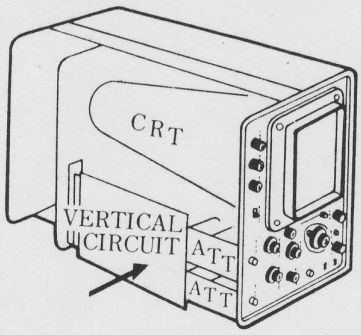
Repetition rate ..... approx. 10 kHz

Rise time ..... less than 10 ns

Output voltage ..... 0 to 50 V

Capacity meter specifications:

Accuracy to be better than 1% at 50 pF



Lay the oscilloscope on it side with the bottom plate removed.

Fig. 6-18

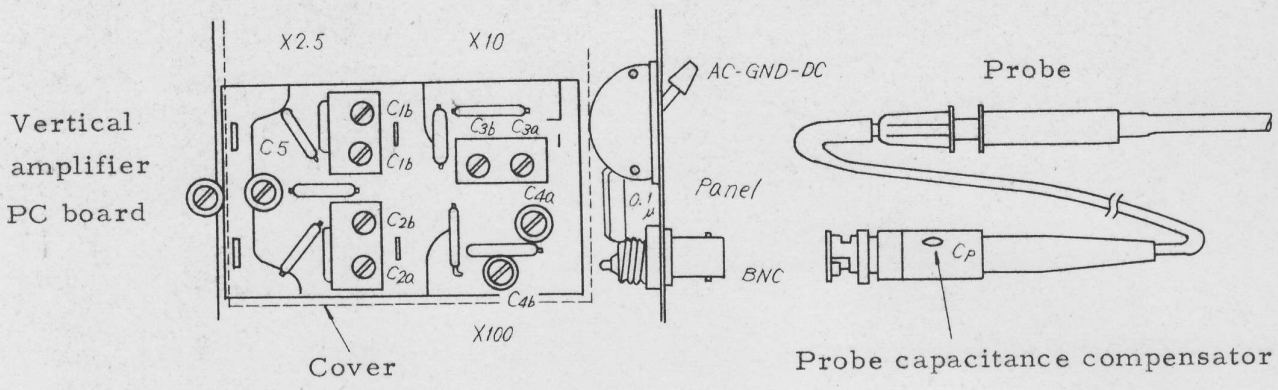


Fig. 6-19 Attenuator Adjustment

Adjustment procedure:

Make the adjustments indicated in the following table. Adjustments should be made in sequence, starting at the top and going from left to right.

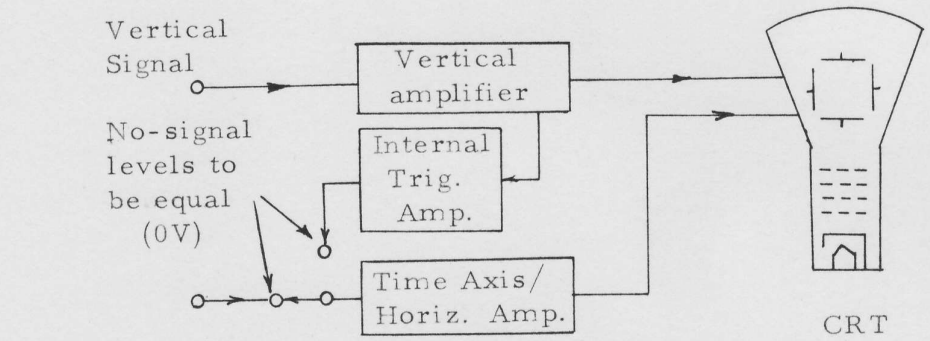
Range	Attenuator compensation adjustment		Input capacitance adjustment
0.02 V/cm			C5 Connect capacity meter to the input terminal and adjust C5 for 35 pF.
	Observe square wave with proble and adjust Cp for best wave.		
0.05 V/cm	C_{1b}	C_{1a}	Observe square wave with probe and adjust C_{1a} to C_{4a} for best waveform.
0.1 V/cm	C_{2b}	C_{2a}	
0.2 V/cm	C_{3b}	C_{3a}	
2 V/cm	C_{4b}	C_{4a}	

(Square wave amplitude to be 60 mmp-p.)

6.6 Triggering Circuit Adjustment

Internal trigger amplifier DC level adjustment:

The internal trigger amplifier also serves as the X-signal channel in the X-Y mode. Therefore, the no-signal output level of the amplifier should be zero (earth potential) in order to ensure that no difference develops between the reference potentials when the internal triggering is switched over to external triggering or external horizontal signal.



Set the following controls to the positions indicated:

AC-GND-DC ..... GND

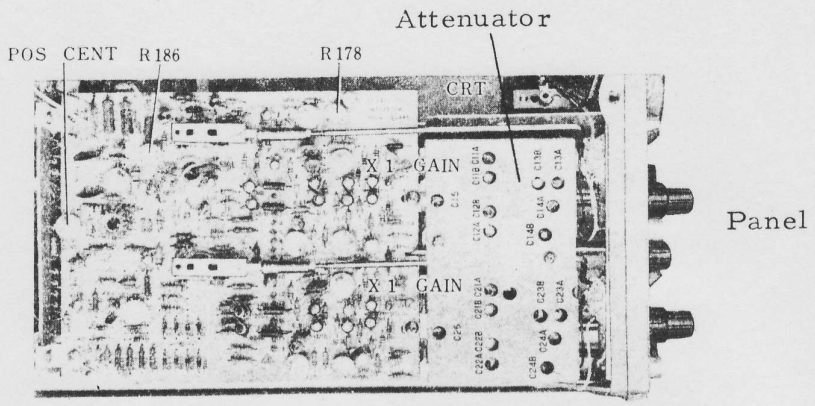
TIME/CM ..... EXT (X-Y)

AC-TV-DC ..... DC

With the TRIG control at NORM, display the spot in the center of the CRT screen.

The spot should not move when the INT-LINE-EXT control is switched between the INT and EXT position. If it moves, adjust R186 〈X (NORM) DC LEVEL〉.

With the TRIG control at CH1, repeat the above check. If the spot moves, adjust R178 〈X (CH1) DC LEVEL〉.



Vertical amplifier PC board

Fig. 6-20

- Trigger level center adjustment:

  Couple a 50 kHz 3 Vp-p sine-wave signal to the CH1 input terminal and adjust for a 60 mm(p-p) display. Center the display vertically and adjust R341 <LEVEL CENTER> for a stable presentation that starts at zero level on the sine wave. Zero level is the center horizontal graticule if trace was centered exactly.

- SLOPE circuit adjustment:

  Couple a 50 kHz zine wave to the horizontal input terminal and adjust for a 5 mm (p-p) display. Switch the SLOPE control between + and - and verify that the trigger point does not move. If it does move, adjust <$\pm$ ADJ> control. (Refer to Figures 6-21 through 6-24.)

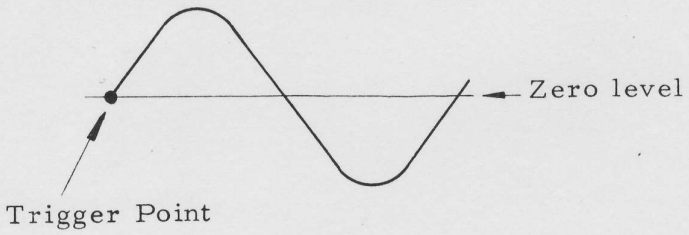


Fig. 6-21

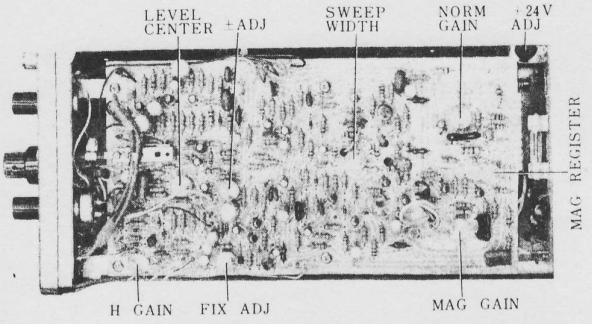
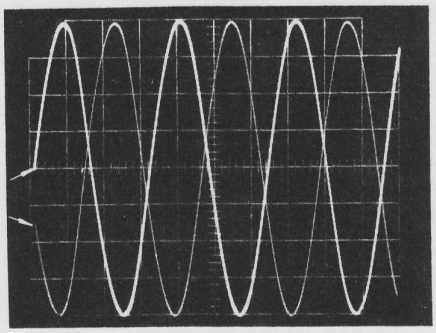
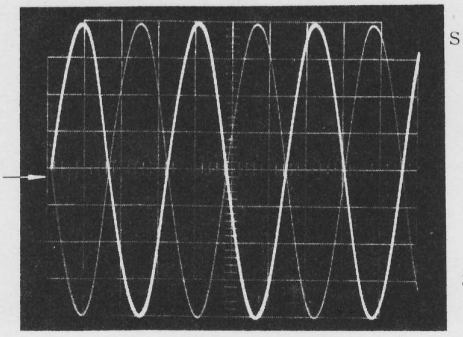


Fig. 6-22 Horizontal Amplifier PC Board



Trigger point do not coincide in + and -

Fig. 6-23



Trigger point coincide in + and -

Fig. 6-24

o FIX Sensitivity Adjustment:

Couple a 50 kHz sine wave signal to the CH1 input terminal and adjust for a 3 mm (p-p) display. With the LEVEL control set at FIX, adjust <FIX ADJ> until the signal is synchronized.

Check to ensure that the signal remains synchronized regardless of the position of the SLOPE control.

6.7 Calibration of Horizontal Amplifier

o Horizontal amplifier gain adjustment:

With the TIME/CM control set at 1 ms/cm, couple a 1 ms signal from a pulse generator to a vertical input terminal. With the display synchronized, adjust R516 〈NORM GAIN〉 until the pulses coincide with the 1-mm vertical graduations on the graticule. Pull out the VAR PULL X 5 knob from the TIME/CM control and repeat the same adjustment using 0.2 ms pulses. (Refer to Figures 6-25 and 6-27.)

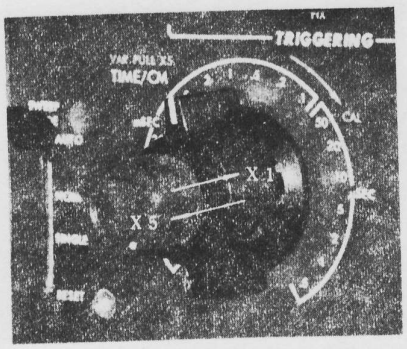
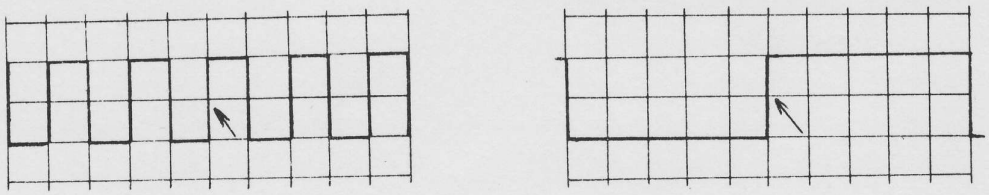


Fig. 6-25

o MAG REGISTER Adjustment:

Couple a stable square-wave signal to a vertical input terminal and adjust for a display as shown in Fig. 6-26.

Adjust R513 〈MAG REGISTER〉 until the center of the signal remains stationary when the VAR is pushed in and pulled out.



VARs pushed VAR is pulled (x5)

Fig. 6-26 MAG REGISTER Adjustment

o Sweep Rate Calibration:

A high precision time marker generator with the following specifications is required for calibration of the sweep rate circuits:

Repetition rate; From 0.5 sec to at least 0.1 μsec

Risetime; 10 ns or less

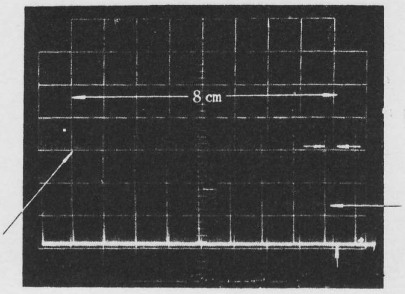
Accuracy; Better than 0.1 %

With the time marker signal coupled to a vertical input terminal, adjust the controls indicated in Table 6-2. (Refer to Fig. 6-27.)

[Keep the TIME/CM control's VAR knob at the CAL position.]

Table 6-2 Sweep Rate Calibration Procedure

Adjustment	Time marker rep rate and TIME/CM control setting	Calibration procedure	Remarks
1	2m sec 1m sec 0.5 m sec 0.2 m sec 0.1 m sec 50 μ sec	Adjust R516 for 1 maker/cm. Error to be within ±3% in any of the 6 ranges.	The 2μsec should be carefully adjusted as it is a standard for all of the other range
2	20 μ sec 10 μ sec 5 μ sec 2 μ sec 1 μ sec 0.5 μ sec	Adjust R435 for 1 maker/cm. Error to be within ±3% in any of the 6 ranges.	
3	5 m sec 10 m sec 20 m sec	Adjust R437 for 1 maker/cm. Error to be within ±3% in any of the 3 ranges.	
4	50 m sec 0.1 sec 0.2 sec 0.5 sec	Adjust R438 for 1 maker/cm. Error to be within ±3% in any of the 4 ranges.	



Error

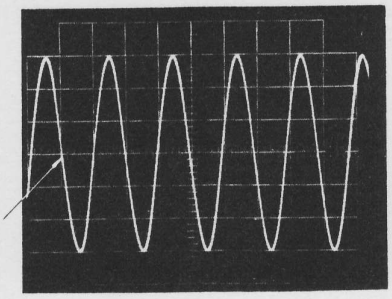
The tenth leading edge (pulse) from the lift.

Should coincide with graduation

Error is read on this graduation

Fig. 6-27 Sweep Rate Error

If a time marker generator of the required accuracy is not available, sine-wave signals with periods equivalent to the marker signals can be used. (See Fig. 6-28.) The frequency accuracy of the signals should be within 0.5%.



Error

Position over a graticule crosspoint

Fig. 6-28

o Sweep Width Adjustment: < WEEP WIDTH >

Couple a 1-ms marker pulse signal to a vertical input terminal and adjust for a stable display. Rotate the TIME/CM control's VAR knob, and adjust R449 <SWEEP WIDTH> for a sweep width of at least 105 mm (maximum 120 mm). Change the marker pulse repetition rate to 0.5μsec and check that the sweep width is between 105 and 120 mm for settings of the TIME/CM control.

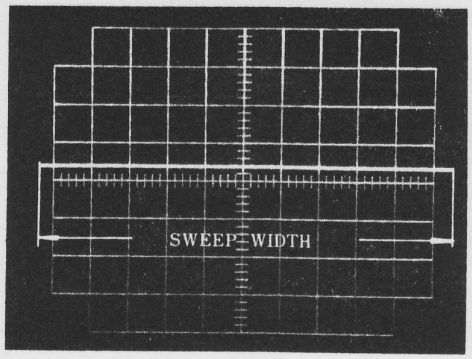


Fig. 6-29 Sweep Width

o Horizontal Sensitivity Adjustment:

① With the TIME/CM control set at EXT, couple a 1 kHz sine wave signal to the CH1 input terminal. Set the CH1 VOLTS/CM control to 0.1.
Adjust R176 <X (CH1) GAIN> until signal amplitude remains constant when the TRIG control is switched from NORM to CH1.

② Adjust R330 <H GAIN> for a signal amplitude of 50 mm.

③ Set the INT-LINE-EXT control to EXT and couple a 3 Vp-p signal to the EXT terminal. Check for a signal amplitude of 40 mm.

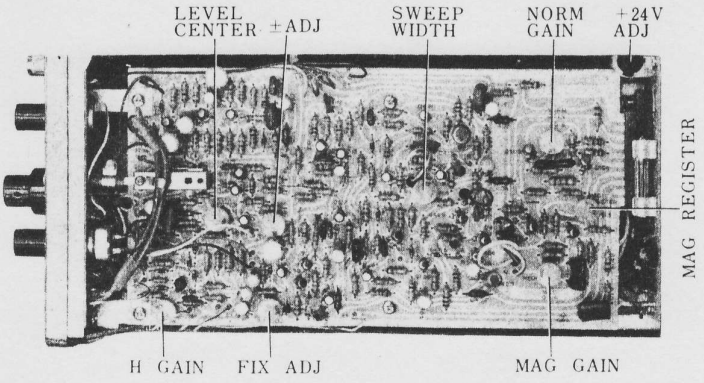


Fig. 6-30 Horizontal Amplifier PC Board

This completes the equipment calibration and adjustment.

II TROUBLESHOOTING

Refer to the following table if a malfunction is observed during the operation of this oscilloscope. If a particular trouble cannot be repaired locally, contact our nearest service station.

(Symptoms whose possible causes are easily determined are omitted in this troubleshooting chart.)

Symptom	Operation	Possible Cause
No Spot: • Pilot lamp does not light Something burns.	• Check fuse and line voltage • Check for excessive line voltage	• Improper line voltage. • Blown fuse • Broken power cord • Fault in power supply
No Sweep: • Pilot lamp lights	• Check the positions of the various panel control including INTEN, etc. • Check the position of the DC BAL control. (If the base line does not appear when the controls are in the positions shown in Fig. 7-1, the trouble is internal.) • Check for excessive signal input to the vertical, horizontal or intensity modulation (Z) input terminals. • Check for synchronizing signal • Check the synchronizing signal level. (If no sweep appears when the controls are in the positions shown in Fig. 7-2 the trouble is internal.)	• Trouble in vertical or horizontal amplifier circuit. (If one edge of the screen becomes brights with the INTEN control set at the maximum CW position.) • Troble in high voltage supply • Troble in CRT circuit • Troble in synchronizing circuit. • Troble in sweep circuit.

Symptom	Operation	Possible Cause
No Triggering: • Signal does not remain stationary regardless of the position of the LEVEL control. • Signal is triggered only occasionally.	• Check for trigger signal • Check the position of the controls for the type of signal under observation. (A TV video signal can be triggered only when the control is in the TV position.) (If the signal does not remain stationary with controls in the positions shown in Fig. 7-3, the trouble is internal).	• Trouble in trigger system. • Trouble in sweep circuit. • Trouble in triggering circuit.
No Dual Trace: • No CHOP operation • No ALT operation	• Check signals trace operation of both CH1 and CH2 vertical amplifiers. • Check operation of the trigger system. See Page _____	• Trouble in vertical circuit. • Trouble in blocking oscillator. • Trouble in channel selector circuit. • Trouble in horizontal gate circuit.
No Signals Sweep: • READY lamp light • READY lamp does not light	• Check operation of the trigger system. See Page _____	• Trouble in signal sweep circuit. • Trouble in triggering gate circuit.

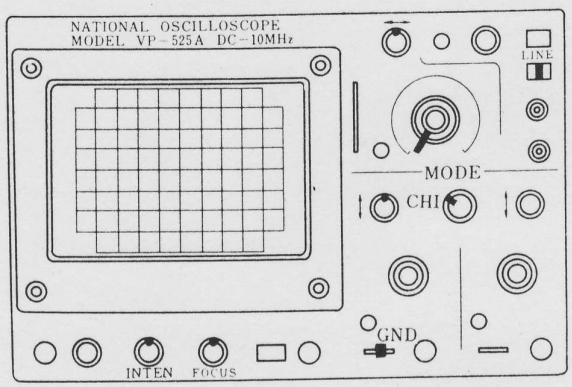


Fig. 7-1

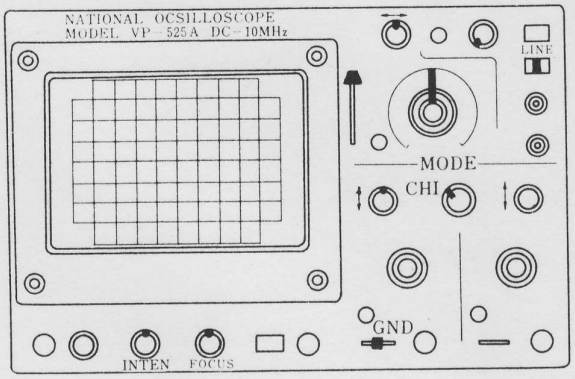


Fig. 7-2

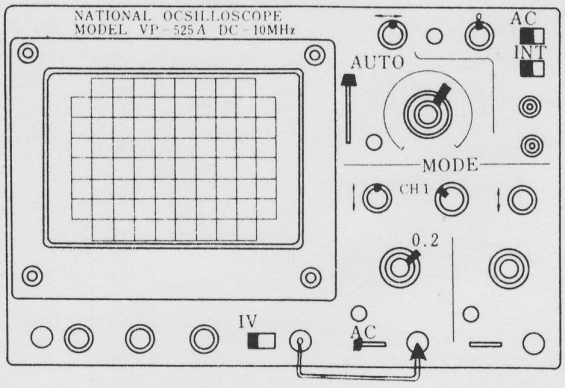


Fig. 7-3

Chapter 2. Appendix

§ 1. Composition and Accessories of Model VP-525A

A. Composition

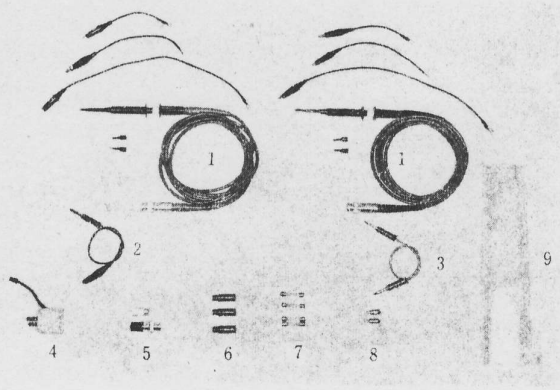
o Main equipment

o Accessories

1.	Protective cover	1
2.	Probe VQ-096K30B2	1
3.	Probe VQ-096K30G2	1
4.	Spare fuses 1A(x1), 0.5A(x2), 0.3A(x1)	4
5.	Spare lamps	2
6.	Calibration Lead VQ-020N	1
7.	Ground Lead VQ-020BR	1
8.	BNC to Banana Jack Adapter	3
9.	BNC to Binding Post Adaptor VQ-036B	1
10.	2-Wire Power Cord Adaptor	1
11.	Instruction Manual	1

B. Accessories

The following accessories are provided with the Model VP-525A.



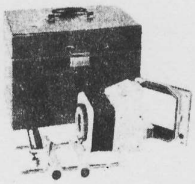
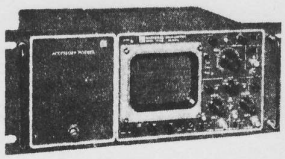
No.	Name	Model	Q'ty	Remarks
1	Probe	VQ-096K30G2	1	10:1, 2m, Gray
1	Probe	VQ-096K30B2	1	10:1, 2m, Black
2	Ground lead	VQ-020BR	1	
3	Calibration lead	VQ-020N	1	
4	2-Wire power cord adaptor			
5	BNC to binding post adaptor	VQ-036B	1	BNC to binding post
6	BNC to banana jack adaptor		3	BNC to banana jack
7	Spare fuses		4	1A(x1), 0.5A(x2) 0.3A(x1)
8	Spare lamps		2	
9	Protective cover		1	
	Instruction Manual		1	This instruction manual

These accessories are all available separately.

In addition, a variety of optional accessories are also available.

C. OPTIONAL ACCESSORIES

The available optional accessories described below have all been especially designed to increase the versatility and usefulness of the Model VP-525A.

Name Appearance	Model	Remarks	Price
Termination	50 termination VQ-083Z 75 termination VQ-083W		
Oscilloscope hood	VQ-035D	Applicable to VP-508A VP-549A VP-551A VP-552A VP-556A VP-593A, B	
Photographic equipment 	VQ-034A	Applicable to VP-508A VP-551A VP-593A, B Compatible with other models by changing the camera mounting bezel	(inclusive of bezel)
Rack adaptor 	VQ-039J for 480 mm rack VQ-039A for 19 inch rack	For 480 mm rack A 465 mm W 480mm B 150 mm H 198 mm For 19 inch rack A 465 mm W 482 mm B 102 mm H 177 mm	

Cart for VP-525A 	VQ-148D	Dimensions: Height (variable) 650 to 750 mm Tilt angle (variable) -5 to +30 degrees Weight: Approx. 8.5kg	

INSTRUCTION MANUAL

MATSUSHITA COMMUNICATION INDUSTRIAL CO., LTD.

880, TSUNASHIMA-CHO. KOHOKU-KU, YOKOHAMA, JAPAN