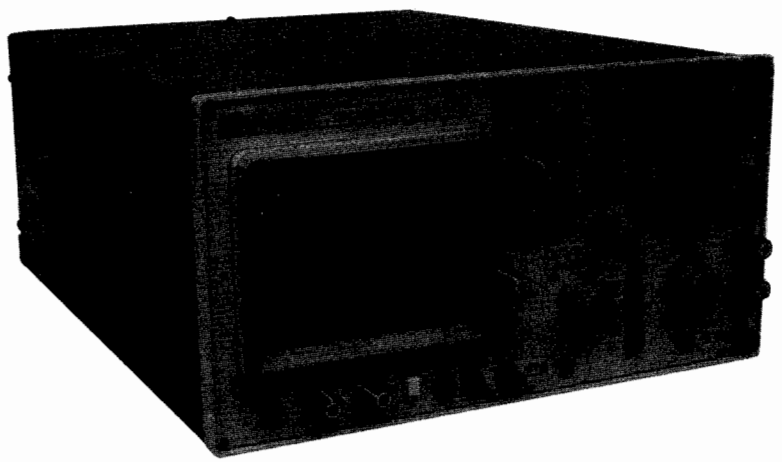
USER'S MANUAL

SAMPO®

OSCILLOSCOPE SS 2020



SAMPO CORPORATION

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service and repair of this instrument. Operators must comply with these precautions and follow the normally operating procedures as mentioned in this manual. SAMPO CORPORATION assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. This instrument is equipped with a three-conductor AC power cord. The power cord must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the ground wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power cord and AC outlet meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cord connected. Under certain conditions, dangerous voltages may exist even with the power cord removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument.

X-RAY RADIATION NOTICE

MODEL: OSCILLOSCOPE SS2020

When operating this instrument emits x-rays; however, it is well shielded and meets safety and health requirements of IEC 348.

Radiation emitted by this instrument is less than 0.5mR/hr at a distance of Five (5) centimeters from the surface of the cathode-ray tube. The x-ray radiation primarily depends on the characteristics of the cathode-ray tube and its associated low voltage and high voltage circuitry. To ensure safe operation of the instrument, adjust both the low voltage and high voltage power supplies as mentioned in adjustments of this manual.

Replace the cathode-ray tube with an identical CRT only.

CONTENTS

1. GENERAL

1.1 Description:

2020 Oscilloscope is a dual – channel oscilloscope with frequency bandwidth DC – 20MHz (-3dB), Multitude operation modes. Trigger facilities and Maximum sweep time up 50ns/div. The oscilloscope employs an 140mm rectangular screen cathode ray tube with internal graticule. The Oscilloscope is rugged, ease to operate and high reliability. It is incorporated with sweep delay, single sweep, hold off, component tester and excellent functions, making itself an ideal instrument for diversified types of Research, Education, Production and Development work of electronic devices and Equipment.

1.2 Operating Mode:

The 2020 can be operated as a Single or Dual trace Oscilloscope. In single trace mode, it can perform CHI or CHII, in dual mode (ALT/CHOP) the channels can be added or subtracted (differential measurement). In the CHOP operation, the trigger signal derived from one of the channels, in the ALT operation the trigger signal derived from both channels alternatively. X-Y operation is obtained by switching CHI into vertical system and CHII into horizontal system, the CHI (Vertical) and CHII (Horizontal) have the same input impedance and sensitivity ranges.

1.3 Vertical Deflection:

The preamplifiers in both channels of the 2020 have diodes protected FET inputs. Both channel's Signal are electronically switched by diode gates either individually or alternatively to the final Vertical amplifier in either CHOP or ALT mode. Control for CHOP mode is effected by a 500KHz square wave, which is generated by a bistable multivibrator, for ALT mode is controlled by a blanking pulse which derived from sweep generator, the pulses is divided by TWO then provided to switching diode gates. The preamplifiers input stages utilize Dual FET and Monolithic Integrated circuits to minimize drift which is caused by environmental conditions. The input attenuators have 10 – steps frequency compensated R – C network, it can be easily achieved exact measurement of the displayed waveform.

1.4 Time base:

The Time base of 2020 has 20calibrated sweep speeds from 0.1us to 0.2s with Variable control for continuously adjust sweep rate. The X10 Magnifier increase the displayed sweep rate by a factor of 10. The HOLD OFF controls the hold off time between sweeps is used for triggering an aperiodic signals which is complex and stable triggering can not be attained with LEVEL knob alone. A Single sweep and Reset function used to display non-recurrent events is possible, a LED indicated that sweep is ready to wait a trigger signal. A simple sweep delay has 6 decade ranges from 100ns to 0.1s for expansion of a signal interval by 100 Times, it is easy operation. The N.S.D is for selecting of sweep mode. Delay is for selection of proper delay time and multiplier is a fine adjust of delay time for shifting continuously of starting point of the expansion. When Delay Function is set completely then increase sweep rate for expanding the desired interval of signal. The triggering system has high reliability and sensitivity. Signal up to 40MHz at a display height 5mm ensure reliable triggering. The Trigger mode can be selected from Automatic Peak to Peak Level or Normal Triggering. Trigger Coupling and Source are switchable with many variants providing the stable waveform of even very complex signals. An LED indicates the trigger system received a trigger signal and sweep is running.

1.5 Miscellaneous

A filter in front of CRT can be easily removeable for cleaning with a soft cloth. A power source selector and Two BNC connector are provided on the rear panel, the power source selector combined with fuse holder is used to select correct Line Voltage. One of the BNC is for Z – modulation, the other is providing sweep ramp output (about 5Vp-p). The upper right corner of front panel has a built-in Calibrator with 0.2Vp-p Square wave about 1KHz for probe compensation. A trace rotation in the internal board On the right side is used to adjust timebase coincide to the CRT internal graticule.

OSCILLOSCOPE

MODEL 2020 SPECIFICATIONS

1. VERTICAL DEFLECTION:

Bandwidth	:	DC –20MHz (–3dB)
Risetime	:	Less than 17.5ns
Overshoot	:	Less than 3%
Deflection Factor	:	10 Calibrated steps 5mV/div – 5V/div, 1–2–5 Sequence
Accuracy	:	+/– 3% (10°c – 35°c)
Variable Control	:	5:1, Max Clockwise Increase Sensitivity Five Times to 1mv/div, 10MHz(–3dB) Approx. 5% error.
Input Impedance	:	1M ohm // 25PF, (2%)
Input Max. Voltage	:	400v (DC +peak AC) or 500Vp–pAC at 1KHz or Less
Operation Modes	:	CHI, CHII, CHI & CHII, Alternate, chopped (Approx. 500KHz)
Algebraic Addition	:	CHI + CHII, –CHI + CHII
Inverter	:	CHI only

2. TIMEBASE

Deflection Factor	:	20 Calibrated Steps, 0.1us/div –0.2s/div, 1–2–5 Sequence, Uncalibrated Continuously Control extend deflection factor at least to 0.5s/div.
Accuracy	:	Less than 3% (10°c – 35°c)
Expansion	:	x10, Accuracy Less than 5% (0.2us, 0.1us Uncalibrated)
Single Sweep	:	Single – Reset buttons with LED
Holdoff	:	10:1, variable control increase Holdoff time.

3. TRIGGER

Triggering Modes	:	Peak (Auto) or Normal
Source	:	CHI, CHII, CHI/CHII, EXT.
Coupling	:	AC, DC, LF, HF
Slope	:	+/–
Sensitivity	:	Internal 0.5div (20Hz – 20MHz), External 0.5Volts (min)
Bandwidth	:	DC – 30MHz
Trigger Action	:	Indicated by LED

4. SWEEP DELAY

Ranges	:	6 steps, 0.1us – 10ms, Decade Sequence
Mode	:	N–S–D (Normal, Search, Delayed)
Multiplier	:	Delay Time Variable Adjust, (10 Turns)

5. X – Y OPERATION

X–Y Mode	:	Selected by X–Y Push button switch
Bandwidth	:	DC – 2MHz (3dB), Y by CHI, X by CHII
Phase Shift	:	Less than 3°(100KHz)

6. COMPONENT TESTER

Test Voltage	:	8.6Vrms (Max., Open circuit)
Test Current	:	Max. 28mA (shorted)
Test Frequency	:	Same as Main Power Frequency (50Hz/60Hz)
Components	:	Capacitor, Inductor, Diode, Transistor, Zener, etc.

7. GENERAL

CRT	:	140mm Rectangular Screen with 8x10 div Internal graticule, Approximately 2KV acceleration Potential. Phosphor P31.
Trace Rotation	:	Correct Tilt Trace, Adjust on Right side
Beam Finder	:	Returns trace to CRT viewing area regardless of setting horizontal, Vertical or intensity controls.
Z-Modulation	:	Positive TTL level, ⩾50ns width pulse blanks trace of any intensity.
Ramp Output	:	Sawtooth wave Appox. 5V p-p
Calibrator	:	1KHz (5%), 0.2V p-p (2%) Square Wave
Power Consumption	:	Appox. 35 Watts
Dimension (mm)	:	310 (w) x 160 (H) x 400 (D)
Weight	:	9Kg
Accessories	:	Power Cord, User's Manual
Option	:	Probe (1:10/1:1) Ordered.

Operation Condition:

Normal Range: 10°C–35°C, ⩽10% ~ 80% R.H.

Limited Range: 0°C–50°C, ⩽10% ~ 80% R.H.

PRECAUTIONS BEFORE OPERATING THE OSCILLOSCOPE

3.1 Unpacking The Oscilloscope

The oscilloscope is shipped from the factory after being fully inspected and tested upon receipt of the instrument immediately unpack and inspect it for any defect which might have been sustained when in transportation. If any sign of defect is found immediately notify the bearer and/or the dealer.

3.2 Checking The Line Voltage

The oscilloscope can operate on any one of the Line Voltages shown in the below table, by inserting the voltage selector plug in the corresponding position indicated on the receptacle frame. Before selecting line voltage, remove AC power cord out of receptacle. There is a square hole in the right side of voltage selector, use a small screw driver insert into the square hole, the Voltage selector plug can be easily pull out. Note the oscilloscope may not operate or may be defected if it is connected to a wrong Voltage AC Line. When Line voltages are changed, replace fuse is also required.

Voltage Indicated On Selector Plug	Voltage tolerance	Fuse
110 V	110V – 120V	0.63A
125V	112V – 135V	0.63A
220V	200V – 240V	0.315A
240V	220V – 260V	0.315A

3.3 Environments

The normal ambient temperature range of this oscilloscope is 0° to 40°C (32° to 104°F). Operation of the oscilloscope outside of this temperature range may cause defect to the circuits. Do not use the oscilloscope in a place where exists strong magnetic or electric field. Such fields may interfere the measurement.

3.4 CRT Intensity

In order to protect your eyes and CRT phosphor, do not increase the intensity of the spot or trace too much.

3.5 Maximum Input

The input maximum voltage of each input connector and probe input is shown as below. Never apply a voltage higher than specified.

Input Connector	Maximum Input Voltage
CHI, CHII inputs	400Vp-p (DC+AC peak)
EXT TRIG inputs	100Vp-p (DC+AC peak)
Probe input	500Vp-p (DC+AC peak)
Z - Modulation	30Vp-p (DC+AC peak)

3.6 Handling

Do not put a heavy objects on the instrument

Do not apply a strong shock to the instrument

Do not insert a wire, pin or metal, etc into the ventilation hole

Do not put a hot soldering iron on the cabinet or screen

Do not put a magnet near the cabinet

Do not drag the set, when the probe and cable are attached.

INSTALLATION

4.1 Installation Site

The instrument should be placed in a clean and dry room and must not be put into operation in explosive, corrosive, dusty, or moist environments. The instrument is capable of operating in any position, but it must keep away from heating device, equipment generating strong magnetic force or vibrating location.

4.2 Power Requirements

The instrument requires a power sources of 110/120/220/240 Vrms (±10%) at a frequency of 50/60 Hz single phase. Power Source is mentioned in "Precaution" section.

4.3 Line Voltage Selection

Before switching on this instrument, make sure that the instrument is set to the local line voltage. Fig. 4.1 provides information for line voltage and fuse selection.

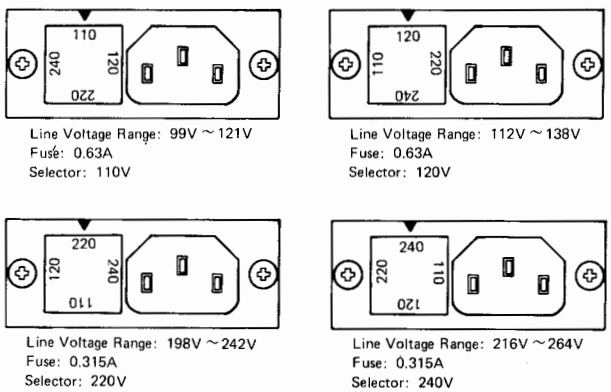


Fig. 4.1

4.4 Power Cord

Fig. 4.2 illustrates the configurations used for three contact Power Cord. The number directly above each drawing is the international part code for the power cord. One of the illustrated type is equiped with the instrument. Other plug type (not illustrated) is available for option.

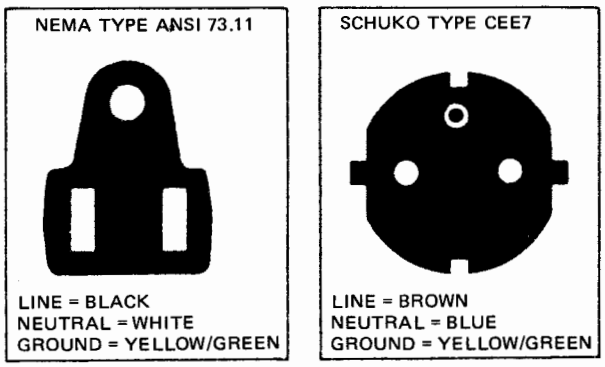


Fig. 4.2

4.5 Cushion

Additional cushions are packed with the manual's bag. The cushions, if necessary, can be attached fixedly on four conner of the right side of the oscilloscope as shown in Fig. 4.3

Fig. 4.3

CONTROLS AND CONNECTORS

(Refer to Fig. 5.1, 5.2)

1. POWER

Turns instrument power on and off. LED light indicates instrument power on.

2. INTENSITY

The knob controls brightness of the display, the brightness is increased clockwise.

3. FOCUS

After obtaining an appropriate brightness by operating intensity then adjust focus until the bright line is clearest.

4. BEAM FIND

As the pushbotton is pressed, the beam trace can be limitted in the center area of screen, if the trace is out of the screen, press this button and the beam trace can be found.

5. COMP TEST

Component tester input banana jacks are used in component test function refer item 20. The black jack is connected to chassis ground.

6. CHI OR Y

Input BNC connector for channel I deflection signals or Y – axis deflection in the X – Y mode operation The input resistance is 1 megohm paralled with 25 picofarads capacitance.

7.8. DC-GND-AC: Input Coupling Switch

Selecting input connection mode for CHI(7), CHII(8)

DC: dc coupling, all signal are directly connected to attenuator.

GND: ground, the input signal is switched off and the attenuator is short to ground.

AC: ac coupling, block the DC signal of input signal only AC signal pass into attenuator.

9. CHII OR X

Input BNC connector for channel II deflection signals or X-axis deflection in the x-y mode operation. The input resistance is 1 megohm paralled with 25 picofarads capacitance.

10.11. CHI VOLT/DIV. CHII VOLT/DIV

Attenuator for chI and chII The attenuator selects deflection factor from 5v/div to 5mv/div in 1-2-5 sequence. 10 positions. VAR control must be in the calibrated position.

12.14 VAR

VAR for CHI (12).CHII(14) provides continuously variable uncalibrated deflection factors between the calibrated setting of volt/div switch. Turns VAR knobs to maximum counterclockwise is in CAL position, to maximum clockwise will increase sensitivity five times.

13. 15 Y-POSI, Y-POSII

Position adjusting for CHI (13). CHII (15) The X-Y mode of operation, the CHI controls y-axis (vertically), the X-POS controls x-axis (horizontally) position.

16. CHI/CHII

Selects CHI or CHII vertical operation, released pushbotton is CHI operation and pressed is CHII.

17. MONO/DUAL

Select dual traces or single trace of vertical operation mode

Released pushbotton: single trace (MONO)
Pressed pushbotton: dual traces (DUAL)

18. ALT/CHOP

The ALT/CHOP pushbotton has two functions as pushbotton is pressed only others push botton in the vertical section are all released. CHI and CHII will be added this function is marked in the right side of button when push botton is used in dual trace of vartical operation

mode (mono/dual pressed) the button selects the dual traces mode operating in alternative or chop form.

19. NORM/INVERT

Selects CHI operating in normal or inverted form, this combined with I + II can operate add or subtract for input signals.

20. C.T.

C.T. is the abbreviation of component test, it is an application of oscilloscope for testing FET, Transistor. Diode, Zener, Inductor, Capacitor etc. which are in working or damaged.

On this oscilloscope the tested component is connected in component test jacks(5), press C.T. button, the trace on CRT of tested component should be displayed the characteristic trace of components are listed in appendix.

21. TIME/DIV

Has 20 steps which ranges are from 0.2 sec/div to 0.1 us/div in 1:2:5 sequence.

22. X-Y

Pressing the X-Y button apply the vertical signal to the CHI or Y input connector and the horizontal signal to the CHII or X input connector and the positioning on the screen can been vertically controlled by CHI position control knob.

23. HOLD OFF

Provides controls of hold off time between sweep signals to obtain stable display when triggering an aperiodic signal. The control hold off time ranges is from 1 to 10 times of timebase.

24. VAR

1. Provides continuously variable sweep rate by a factor of 2.5.
2. Light is turned on when VAR is not at cal position.

25. X-POS (PULL X 10)

1. Positions the display horizontally.
2. Pull 10: increases the displayed sweep rate by a factor of 10.

26. CALIBRATION (CAL)

Provides about 1 KHz 0.2v square wave to calibrate probe frequency compensation.

27. SINGLE

Provides single sweep function after a sweep is displayed, further sweeps can't be presented until reset button is pressed again, during sweep is triggered.

28. RESET: (Reference item 27)

1. In single sweep waiting for a coming sweep and sweep is triggered, pressed reset button to obtain a single sweep.
2. An LED located above reset button indicate single sweep is operating.

29. EXT TRIG

From the connector the outside signal can be input which is taken for a trigger signal.

30. TRIG SELECTOR

1. I: A sample of the signal derived from the CHI input connector is used as a trig signal.
2. II: A sample of the signal derived from the CHII input connector is used as a trig signal.
3. I/II: Alternative trigger which can triggter I and II alternatively. The function is used in alternative dual trace of vertical mode operation.
4. EXT: Trigger signal is obtained from EXT TRIG connector.

31. TRIG COUPLE

1. AC – Rejects dc and attenuates signal about 100Hz, accepts signals above 100Hz.
2. LF – Accepts signals below about 10Hz.
3. HF – Accepts signals above 10Hz.

4. DC – Accepts all trigger signals from DC to 20MHz or greater.

32. AUTO/NORM

1. The button chooses trigger form.
2. AUTO: In the AUTO mode automatically operate trigger action. The trigger level is obtained from trig signal's peak to peak Value. Operating TRIG LEVEL knob can be adjusted it's level within signal's peak range.
3. NORM: The trigger level range is obtainned from +5v to -5v by adjust TRIG LEVEL knob.

33. +/–

The trigger level is chosen on trigger signal slope side when the button is pressed.

34. TRIG LEVEL

It chooses a level within signal peak range from which the sweep can be selected at a properly starting edge of the input signal.

35. DELAY SELECTOR

1. N (NORMAL) – for main sweep.
2. S (SEARCH) – searches a point at which the sweep will be delayed.
3. D (DELAY) – by way of item 36 delayed signal is displayed by increasing sweep rate of timebase.

36. DELAY TIME

Selected delay time after trigger point.

37. MULTIPLIER

Provides continuously variable delay time after trigger point.

38. CRT

140mm rectangular screen with internal graticule 8 x 10 div, a blue acric filter placed in front of CRT.

39. FRAME

A plastic frame placed on the front panel to hold acric filter, it can easily be removed by slightly pressing down the upper edge of the plastic frame and pull out, then the acric filter can be taken for cleaning the CRT screen.

40. Receptacle and Fuse Holder

Receptacle for AC power input.
Fuse Holder is used as a power source selector.

41. S – output

Provide ramp (Sawtooth wave) output about 5Vp-p, which is internal sweep signal.

42. Z – Modulation

Input terminal for external intensity modulation signal.

43. Studs

Studs for laying the oscilloscope on its back to operate it in the upward posture. Also used to take up the power cord.

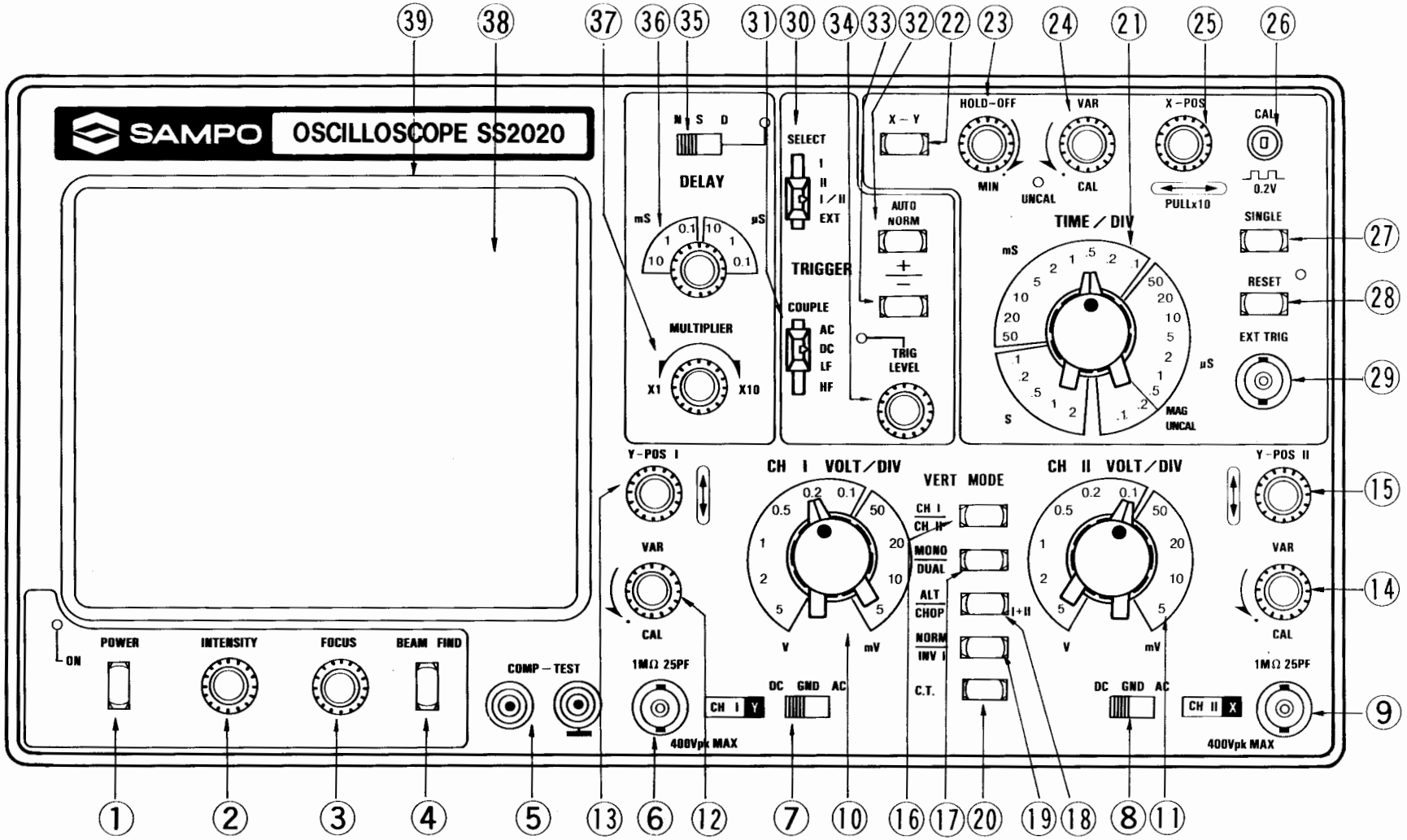


Fig. 5.1 Front Panel

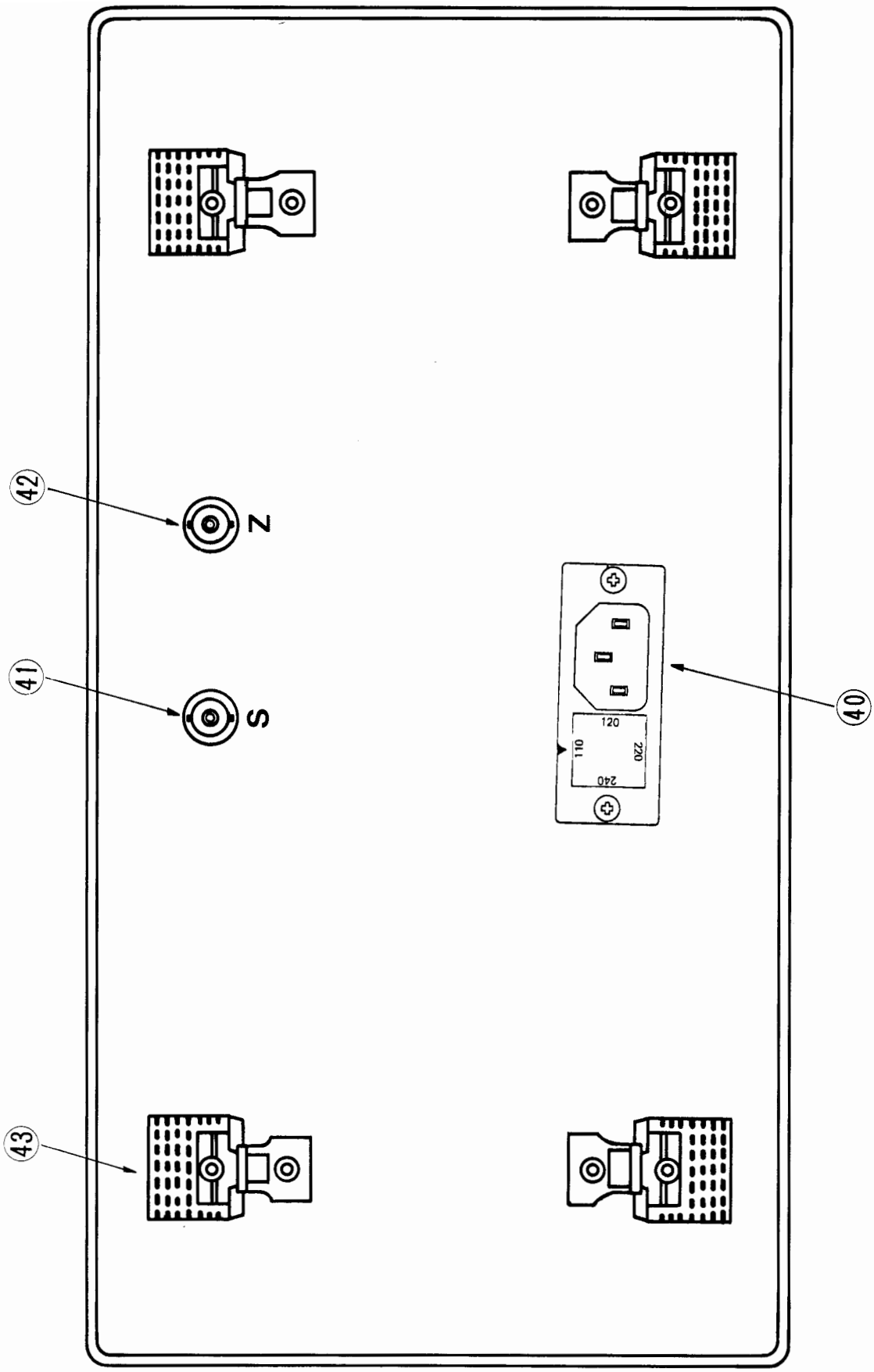


Fig. 5.2 Rear Panel

OPERATING INSTRUCTION

6.1 Initial Power-ON

Power ON the instrument into operation, perform the following steps: (All push button switches in OUT Position, except DUAL/MONO)

a. Make sure power supply voltage.
b. Set INTENSITY fully counter clock wise.
c. Set vert mode to DUAL, (ALT mode).
d. Set TRIGGER SELECT to I/II
e. Set vertical variable control to CAL
f. Set vertical couple to GND
g. Set Y-POS and X-POS to midrange
h. Set TIME/DIV to .5ms/DIV
i. Set DELAY N-S-D to N position
j. Set sweep variable to CAL
k. Set TRIGGER AUTO/NORM to AUTO
l. SINGLE sweep switch in OUT position
m. Power ON the Instrument
n. Adjust INTENSITY control for just visible trace.

CAUTION: If it can not be found base lines, push BEAM FIND button to relocate X, Y positions.

6.2 Operator Check.

Operation may be checked without additional test equipment by using the CAL .2V, 1KHz output as a signal source. The following procedures functionally check each display mode and operation of the front panel controls.

a. Set the instrument controls as follows

CHANNEL I
VOLT/DIV . . . 50mV/DIV
DC-GND-AC . . AC
VAR . . . . . CAL
Y-POS . . . . . Center
VERT MODE. I (push button all OUT)

TIME BASE
X-POS . . . . . Center (push IN)
Sweep VAR . . CAL
TIME/DIV . . . 0.5ms/DIV
HOLDOFF . . . MIN
SINGLE . . . . . OUT
Delay N-S-D . . N position

TRIGGER
AUTO/NORM AUTO
Slope +/- . . . . +
TRIG LEVEL Center
SELECT I
COUPLE . . . . AC

b. Power ON and set INTENSITY and FOCUS controls for desired baseline display.

c. Apply CAL .2V output directly to CHI Input.

d. Adjust TRIG LEVEL for stable display. (Adjust X-POS for sweep baseline starting at first graticule line)

Verify six pulses with leading edge of first and sixth pulse on first and eleventh vertical graticule lines respectively (± 10%), as shown in Fig. 6.1

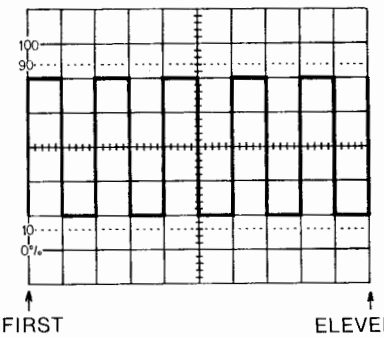


FIG. 6.1 SIX LEADING EDGE ON FIRST AND ELEVENTH GRATICULE LINES

e. Set Y-POS control for vertical amplitude about 4 divisions (± 5%) to coincide with horizontal graticule lines, as shown in Fig. 6.1

f. Rotate sweep variable control clockwise to stop.

Verify 12 or more pulses between first

and eleventh graticule lines. Then Rotate to CAL position.

g. Set VOLT/DIV to 0.2V/DIV.

Verify vertical amplitude in one division.

h. Rotate amplitude variable control clockwise to stop.

Verify amplitude about five divisions (± 10%). The amplitude Variable control increase sensitivity to five times. Then rotate variable control to CAL position, and set VOLT/DIV to 50 mV/DIV.

i. Set TRIG LEVEL control to fully clockwise position.

j. Set AUTO/NORM switch to NORM (push IN).

k. Select SINGLE operation (SINGLE switch push IN).

Verify no sweep.

l. Press RESET pushbutton switch. Verify no sweep and RESET indicator (LED) is lit.

m. Rotate TRIG LEVEL fully counterclockwise.

Verify one sweep, RESET indicator (LED) goes off after sweep.

n. Set AUTO/NORM switch to AUTO and TRIG LEVEL to center position.

o. Press RESET push button, Verify one sweep.

p. Disable SINGLE sweep, (SINGLE switch in OUT position)

q. Set delay mode switch N-S-D to S position.

r. Select DELAY TIME switch to 1ms/DIV.

Verify a portion of the displayed trace on the left screen is blanked, as shown in Fig. 6.2

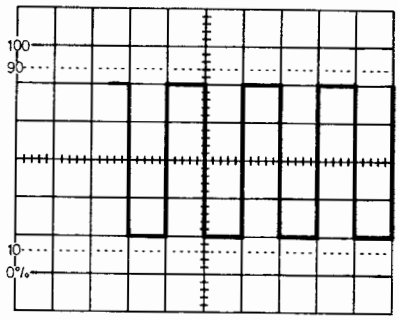


FIG 6.2 LEFT PORTION OF THE WAVEFORM IS BLANKED

s. Rotate MULTIPLIER (10 Turns) to increase (or decrease) the blanked portion about 2~5 divisions at a desired rising or falling edge.

CAUTION: If the DELAY TIME is set too short, the blanked portion will very short. If the the DELAY TIME is set too long, the waveform will be all blanked.

t. Set delay mode swith N-S-D to D position.

u. Set TIME/DIV to 50μs/DIV (or higher sweep rate).

v. Slightly adjust MULTIPLIER to locating rise or fall edge in the center of the screen.

Verify waveform is expanded as shown in Fig. 6.3

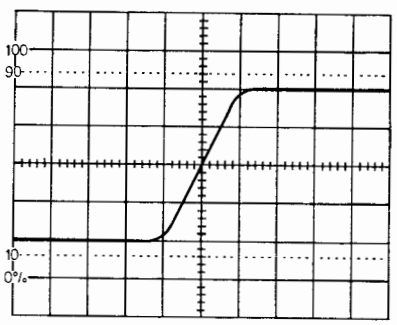


FIG 6.3 SWEEP DELAY FUNCTION EXPAND A DESIRED INTERVAL OF THE INPUT SIGNAL

w. Set delay mode switch N-S-D to N position and TIME/DIV to 1 ms/DIV.

x. Pull out X-POS (magnify 10 times). Verify two pulses with leading edge of first and second pulse on first and eleventh vertical graticule lines respectively (± 10%)

y. Push in X-POS

z. Channel II check procedures same as channel I.

aa. Dual trace, ALTernative operation performs as follows

Connect 0.2V CAL output to both channel input
MONO/DUAL ..... DUAL (push IN)
TRIG SELECT..... I/II
Operating Timebase function is same as mentioned above.

ab. Dual trace, CHOPped operation performs as follows

Connect 0.2V CAL output to both channel input
MONO/DUAL ..... DUAL (push IN)
ALT/CHOP ..... CHOP (push IN)
TRIG SELECT..... I or II

cc. Component Tester (C. T.) check procedures, Push IN C.T. pushbutton switch on Vert mode. Disconnects CHI and CHII input connectors. Insert a diode (or zener diode, LED, capacitor . . .) to the COMP-TEST banana jack.

Verify the displayed waveform is similar to the Test Patterns shown in Page

dd. Disable C.T.

6.3. Operation Information.

6.3.1 AC/DC/LF/HF Coupling

AC coupling removes the DC level from trigger signals and attenuates signals below 10Hz. DC coupling connects input signals directly to the input amplifier. With DC coupling selected, a large DC voltage component in an input signal can offset the input signal outside the trigger level range of the instrument and cause the oscilloscope to lose trigger. HF and LF coupling are both ac coupling function. In an occasion when AC coupling is difficult to get stable waveform by rotating TRIG LEVEL, either HF or LF must be selected to block low frequency or bypass high frequency of trigger signal, that can easily achieve a stable triggering operation.

6.3.2 AUTO/NORM

In AUTO operation, the trig level is automatically set within the signal's peak to peak range, a bright baseline will be displayed in the absence of a trigger signal. A trigger of 30Hz or higher overrides AUTO operation and produces a presentation. Adjustment of TRIG LEVEL control may be necessary for a stable display. If the trigger is less than 30Hz, NORM operation must be used. A trigger signal is always needed in NORM operation to generate sweep.

6.3.3 TRIG SELECT I, II, I/II, EXT

Trigger select switch selects trigger source from CHI, CHII, CHI/CHII alternatively or external. The mark I/II is an ALT (alternative) trigger, it derive trigger source from both channel alternatively. When dual trace ALT is selected in vertical mode, in order to obtain both channel's signal are stable display, the TRIG SELECT must be set to I/II position.

CAUTION: In the I/II trigger operation, if input frequency of CHI is different from CHII's frequency very much. The displayed waveforms may be dim or unstable.

6.3.4 HOLDOFF

When trigger signal is a complex or an aperiodic waveform, the stably displayed wave-

form can not be obtained by TRIG LEVEL only. Rotate HOLDOFF control to get a more stable waveform.

6.3.5 Sweep Delay

With the sweep delay the start of the sweep can be delayed from the trigger instant by a selectable time from .1 μs to maximum 10ms. It is therefore possible to start the sweep at practically any point of a waveform. The interval, which follows the start of the sweep, can be greatly expanded by the increase of the sweep speed. It can expand of at least 100 times, and with the aid of the X-MAGN. (X10), expansion of even 1000 times. However, with increasing the expansion, the display brightness decreases.

CAUTION: If the input signal exists inherent jitter, it is some difficulties with higher expansions.

Operation of the sweep delay is easy, only three controls in the DELAY section need to be operated: the delay mode slide switch N-S-D (Normal—search—Delay), the Delay time rotary switch (selection of delay time range), and the MULTIPLIER variable control (10 Turns, fine control).

6.3.6 Component Tester

With the built-in component-Tester, semiconductor, capacitors, inductors, resistors; R-L-C network or even combination of R.L.C and semiconductors can be every easily tested. Also, integrated circuits may be checked to some extend. The tested result is displayed on the screen of the oscilloscope. The device under test can be either in or out of a circuit. When the device under test is situated in highly complex circuitry the test result may not be clear, this is due to the effects of the components, and the stray capacitance in the test circuit. This problem may be overcome by comparing the result obtained from the circuit under test with the result obtained from a similar circuit which is known to be fully operative.

MEASURING INSTRUCTION

7.1 Preparation

Before pushing ON the power, make sure the power supply voltage is within the selected voltage range. The rated voltage and fuse are labelled on rear panel. Then insert the plug of the power cord into the outlet and set controls as follows:

POWER	OFF
INTENSITY	midrange
FOCUS	midrange
AC-GND-DC	GND
Y-POS	midrange
VERT MODE	CHI (buttons all OUT)
TRIG	AUTO
SELECT	I
COUPLE	AC
TIME/DIV	50μs/DIV
X-POS	midrange (push IN)
VAR	CAL
DELAY N-S-D	N

All push buttons in OUT position.

After setting the controls as above mentioned, then pushing ON the power and, 30 second later, rotate INTENSITY control for proper brightness, and set FOCUS control at a position where the bright baseline is clearest.

7.2 DC Voltage Measurement

Measuring DC voltage perform as follows:

a. Connect DC voltage direct to CHI input.
b. Set AC-GND-DC to GND.
c. Adjust Y-POS let the baseline coincide to one of the horizontal graticule line which is used for the zero level (reference level).
d. Set VOLT/DIV to an appropriate range.

e. Set AC-GND-DC to DC

Since the bright baseline shifts here by

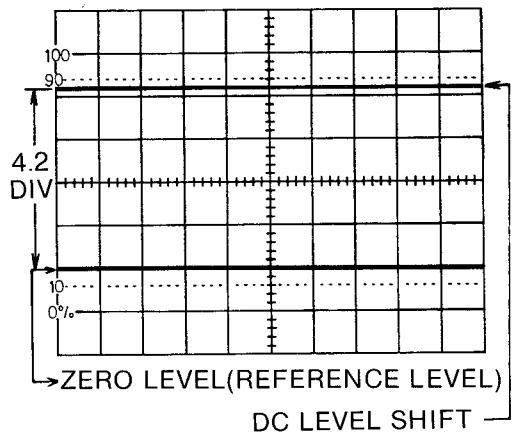


FIG. 7.2 DC VOLTAGE MEASUREMENT

the amount of DC voltage, the DC voltage of the input signal can be obtained by multiplying the shift division by the indicated value of VOLT/DIV. For example, shown in Fig. 7.2, when VOLT/DIV is 50mV/DIV, the shift division is 4.1DIV, then the DC voltage is: 50mV/DIV x 4.1DIV = 205 mVdc.

If the X10 attenuation probe is in use, the true value of the signal becomes 10 times the calculated value, or 50mV/DIV x 4.1 DIV x 10 = 2.05 Vdc.

7.3 AC Voltage Measurement:

a. Connect signal direct to channel input.
b. Set VOLT/DIV to anappropriaterange.
c. Set AC-GND-DC to AC.
d. Adjust Y-POS, let the lowest waveform to coincide with one of the horizontal graticule line which is used for scale line.

The AC peak to peak voltage (Vp-p) can be obtained. For example, showning Fig. 7.3, when VOLT/DIV is 0.1V/DIV, the amplitude of waveform is 4.5 DIV, then Vp-p = 0.1 V/DIV x 4.5DIV = 0.45Vp-p

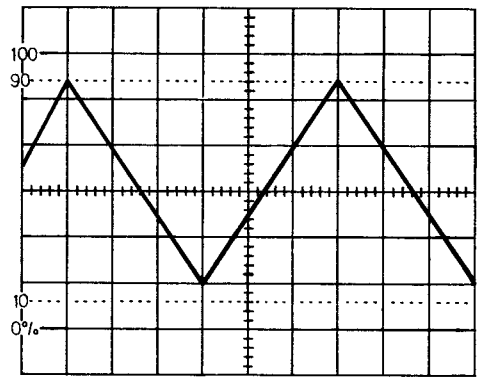


FIG 7.3 AC MEASUREMENT

7.4 Period Measurement

The duration of a signal period or a portion of the waveform is ascertained by multiplying the relevant division (horizontal distance in division) by the time coefficient selected on the TIME/DIV switch. This will be explained by the example, shown in Fig. 7.4

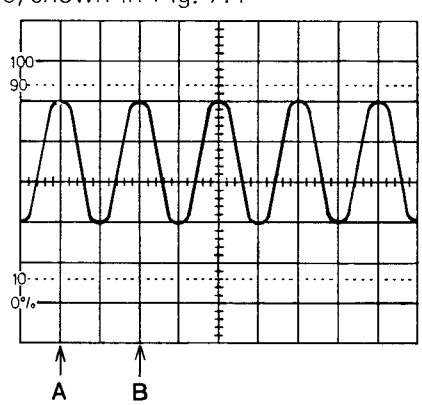


FIG 7.4 PERIOD MEASUREMENT

In Fig. 7.4, the waveform which starts from A to B is equal to one period. From A point to B point covers 2.0 division on the screen. When TIME/DIV is 0.5 ms/DIV, then the period (or A to B interval) is calculated by

0.5 ms/DIV x 2.0 DIV = 1.0 mS = 1.0×10^{-3} S.

Accordingly, the signal's frequency is

$1/1.0 \times 10^{-3}$ S = 1000Hz = 1 KHz

7.5 Time Difference Measurmenet

This oscilloscope can perform the time difference measurement in dual trace operation. Trigger source selecting switch SELECT is selected as offering reference signal, when measuring the time difference between two signals. Assume that signals as shown in Fig. 7.5.a.

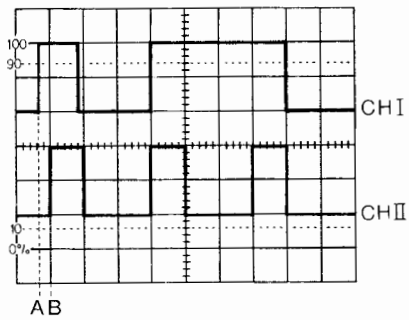


FIG 7.5.a. WAVEFORM FOR TIME DIFFERENCE MEASUREMENT

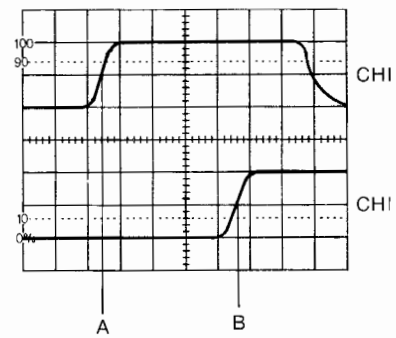


FIG. 7.5.b EXPANDED WAVEFORM OF THE TIME DIFFERENCE MEASUREMENT (TRIG SELECT SET TO CHI)

In Fig. 7.5.b. illustrates an expanded waveform of Fig. 7.5.a.,which trigger source is CHI. Therefore, it can easily ascertained the horizontal divisions from A point to B point shown in Fig. 7.5.b.. The time difference is obtained by multiplying the interval of A to B by sweep speed. Fig. 7.4.c. illustrates the waveform that is trigged by CHII signal which is not reference signal. However, it is not possible to measure time difference.

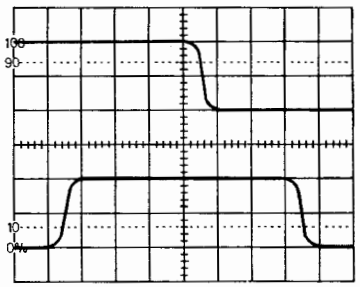


FIG. 7.5.C. INADEQUATELY EXPANDED WAVEFORM, THE TRIG SELECT IS SET TO CHII

A more precise method to measure time difference is shown in Fig. 7.5.d and 7.5.e., Fig. 7.5.d is the equal amplitude measuring method, by rotating amplitude variable controls and Y-POS to equalize amplitude for both channels. Fig. 7.5.e. is the superposition measuring method, by adjusting the Y-POS of the smaller amplitude to the center of the larger amplitude.

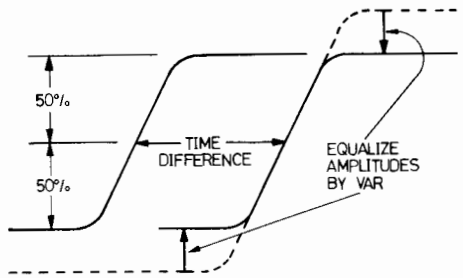


FIG. 7.5.d EQUAL AMPLITUDE MEASURING METHOD

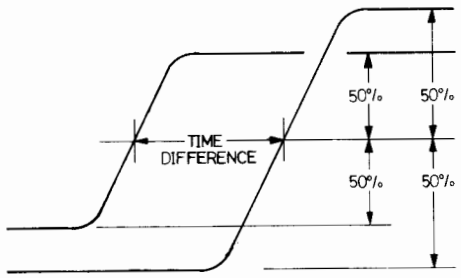


FIG 7.5.e SUPPERPOSITION MEASURING METHOD

7.6 Rise (Fall) Time Measurement

When investigating pulse or square waveforms, the critical feature is the risetime of the voltage step. The rise time is generally measured between 10% and 90% of the vertical pulse height. For setting signal peak to peak amplitudes in six division height, which are symmetrically adjusted to the horizontal center line, match the internal graticule of the CRT'S two horizontal dotted lines with ±2.4 division from center line. The CRT graticule is shown in Fig. 7.6.

To measure the rise time, adjust the VOLT/DIV switch with Variable control and Y-POS control so that the waveform amplitude is precisely coincided with 0% and 100% lines on CRT gratidule, as shown in Fig. 7.6.

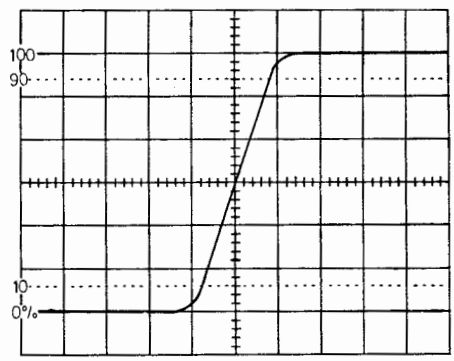


FIG 7.6. RISE(FALL) TIME MEASUREMENT

The risetime is defined by the product of the horizontal divisions between the waveform intersection to 10% and 90% dotted lines and the sweep time. If the magnification is used, this product must be divided by 10. The fall time of a square wave can also be measured by using this method.

The risetime contained two parameters when it is measured directly from the displayed waveform on the screen. One of the parameter is the true risetime of the measured signal, the other is the risetime of the oscilloscope. For example, as shown in Fig. 7.6, tro is the measured risetime from the screen, to is the risetime of the oscilloscope, tr is the risetime of the measured signal.

The risetime displayed on Fig. 7.6. tro has following relationship,

$$tro = \sqrt{tr^2 + to^2}$$

Actually, the signal's true risetime is given by

$$tr = \sqrt{tro^2 - to^2}$$

7.7 How to Get Stable Display

7.7.1 Synchronization of complex waveform

In the case shown in the Fig. 7.7.1, the waveform containes two peaks that greatly different in amplitude alternate, that waveform will display double peak on the screen, if the trigger level is not set properly.

In Fig. 7.7.1, if the TRIG LEVEL is set to L1, the waveform maybe doubled, or even unstable. Operators should adjust TRIG LEVEL control until the trigger level comes to L2 line, then the display on the screen will synchronize.

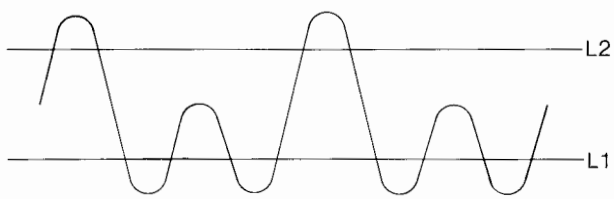


FIG 7.7.1 DOUBLE PEAK WAVEFORM, IF TRIG LEVEL SET TO L1, DISPLAYED WAVEFORM WILL BE DOUBLE PEAK. IF TRIG LEVEL SET TO L2, DISPLAYED WAVEFORM IS SAME AS FIGURE SHOWN.

7.7.2 Aperiodic Waveform

In the case shown in the Fig. 7.7.2, where waveforms greatly different in width alternate. In such waveform, obtaining a stable display is difficult to adjust TRIG LEVEL

only, the HOLD OFF function will improve synchronization.

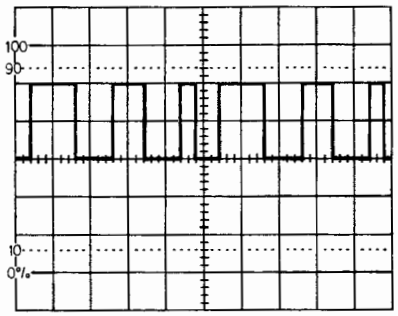


FIG 7.7.2 APERIODIC SQUARE WAVE, PROPELY ADJUSTING HOLD OFF CAN IMPROVE TRIGGERRING OPERATION

When input signal is an aperiodic waveform, adjusting HOLDOFF control is necessary that will increase hold off time between two sweeps. If the hold off time is increased to a proper range, the undesired trig action can not generate sweep, therefore, the synchronized waveform can be attained. If rotation HOLDOFF and TRIG LEVEL controls can not get stable display, it requires to set TRIG COUPLE to HF position that may be an improvement.

7.8 Selection of Trigger

In order to attain easy operation and and obtain stable display. There is a recommended instruction as shown in the table.

VERT MODE	TRIG SELECT	TRIG COUPLE	AUTO NORM	HOLDOFF	TRIG LEVEL
CHI	I	AC	AUTO	Complex, Jitter	Complex
CHII	II	AC	AUTO	Complex, Jitter	Complex
DUAL ALT	I/II	AC, HF	AUTO NORM	if unstable	Complex
DUAL CHOP	I, II	AC, HF	AUTO		
ADD	I, II	AC	AUTO		

ADJUSTMENTS

8.1 DC Balance Adjustments

Each vertical amplifier contains an FET input amplifier, it is possible that over a long period of time the characteristics of the FET may drift. This occasion drifts the DC-balance of the vertical amplifier. If the vertical baseline position shifts considerably when the variable control on the input attenuator is rotated. It should be noted that if the shift is less than 1mm after a 30 minute warm-up interval then the instrument is within specification. Larger shifts than this can be corrected by adjusting the potentialmeter which is located on the bottom side where DC BALANCE is marked on each channel. Operator can use a non-metallic alignment tool to adjust the DC balance, the variable control should be continuously rotated while the potentialmeter is adjusted. **[CAUTION.]** Before adjusting, set VOLT/DIV to 5 mV/DIV, set input coupling to GND . The correct DC balance is obtained when the vertical baseline position remains steady while the variable control is varied. Channel I and channel II have the same procedures of the adjustments.

8.2 Trace Rotation Adjustments

The trace rotation adjustment compensates for external magnetic fields that may affect alignment of the horizontal baseline with respect to the CRT graticule. When the oscilloscope is moved to a new location, trace rotation adjustment should be checked and adjusted if necessary. To adjust the trace, proceed as follows:

a. Set input coupling to GND
b. Adjust Y-POS control until baseline is on the center of the horizontal graticule line.

c. Using a non-metallic alignment tool, adjust TRACE ROTATION control (which is located on the Right Side) until baseline aligns with horizontal graticule line.

8.3 Focus And Astigmatism Adjustments

Normally, the CRT of the Oscilloscope has very good brightness and sharpness. Any reduction of the brightness or sharpness can be corrected by the FOCUS and ASTIGMATISM controls. Adjustments of focus and astigmatism can perform as follows:

CAUTION: The brightness and sharpness can be lasting for very long interval. Do not adjust ASTIGMATISM, except necessary.

a. Turn INTENSITY control fully counter-clockwise
b. Set vertical and timebase controls as follows

VOLT/DIV	10mV/DIV
AC-GND-DC	GND
Vert Mode	I (push buttons all in OUT position)
VARiable	CAL
TRIGGER	I, AC couple
LEVEL	Center
X-Y deflection	X-Y button push IN

c. Set INTENSITY to observe spot.
d. Adjust FOCUS and ASTG controls for best defined spot. ASTG control is located on the Power Supply Board as shown in Fig. 8.1.

CAUTION: High Voltage exist near ASTG control. Carefully adjust.

8.4 Power Supply Adjustments

There are seven stably regulatted DC operating voltages which are +24V, +5V, -12V, +140V, +260V, -1900V and 33V for the unblanking circuit. The +24V +5V, -12V and 33V are fixed voltage within ±5% tolerance. The test points and adjust potentialmeters are shown in Fig. 8.4.

8.5 Probe Adjustments

Adjust probe frequency compensation, perform the following procedures: (Probe is in x 10 attenuation)

a. Connect the tip of the probe to the output of CAL 0.2V, 1KHz
b. Set VOLT/DIV to 5mV/DIV
c. Set AC-GND-DC to DC
d. Adjust frequency compensating trimmer on the probe until the displayed square wave is in optimum state as shown in Fig. 8.5.

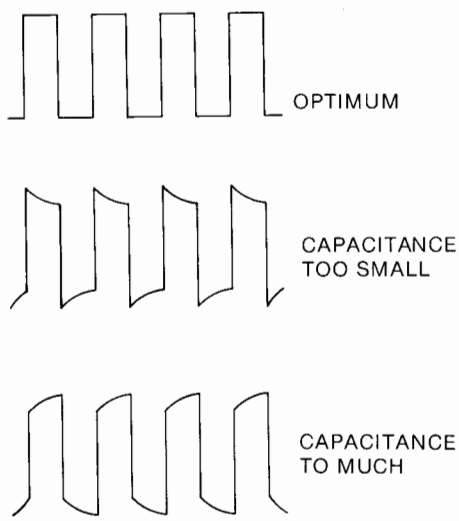


FIG 8.5 PROBE COMPENSATION

8.6 Calibration

To maintain the oscilloscope accuracy, perform the calibration of the oscilloscope at least every 1000 hours of operation, or every six months if used infrequently.

CAUTION: To avoid ELECTRIC HAZARD. It is recommended for safety that an isolation transformer be connected between the AC power source and the oscilloscope.

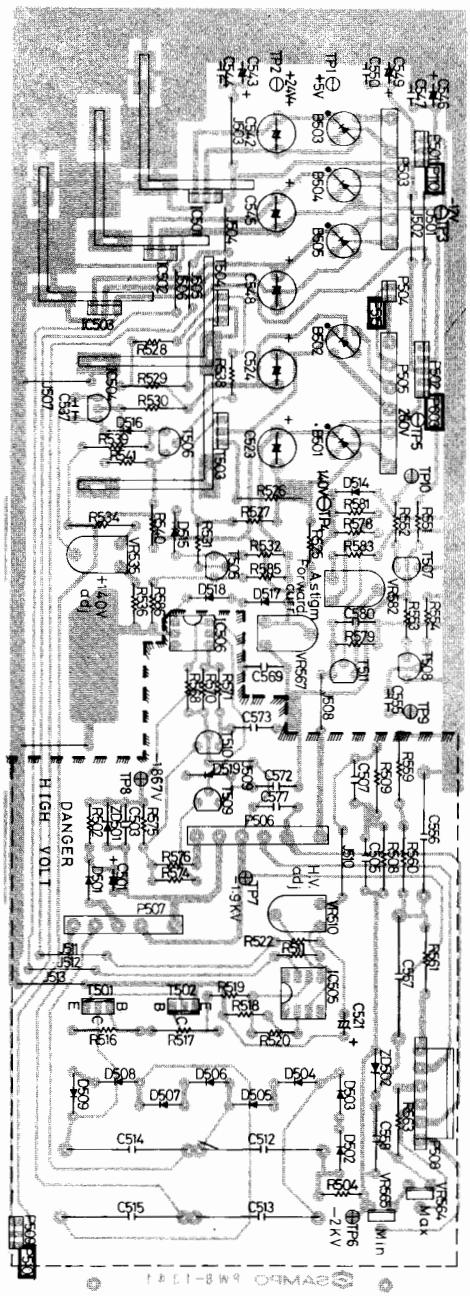
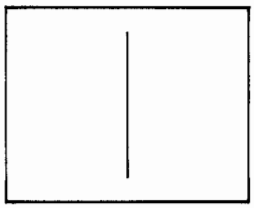


Fig. 8.1 Power Supply and Astigmatism Layout.

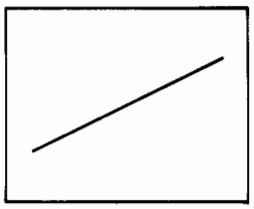
MAINTENANCE

1. Since semiconductors, precision components, static-sensitive device, etc. are employed in this oscilloscope, use at most care for operation and storage.
2. Clean the scale with soft tissue periodically.
3. Removing CRT filter should be careful.
4. Store this oscilloscope in the ambient temperature from -10°C to +60°C. and keep away from moisture.

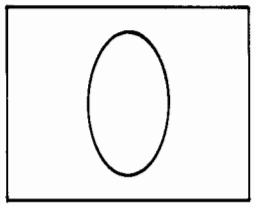
10. TEST PATTERNS (NEW)



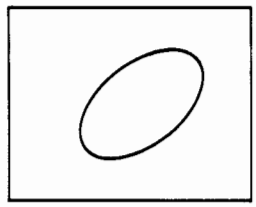
Short circuit



Resistor 680Ω

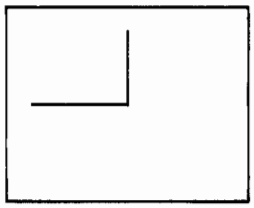


Capacitor 47μf

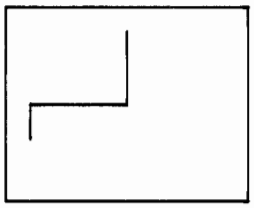


Power transformer primary

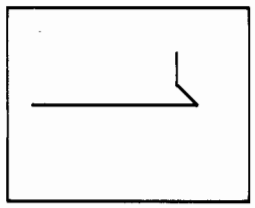
Single Transistor (for n-p-n type)



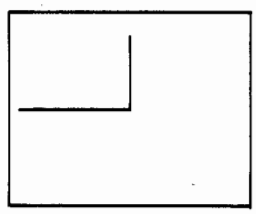
B-C junction



B-E junction

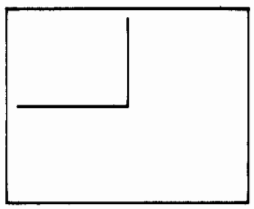


E-C barrier

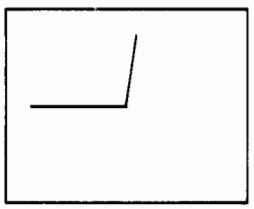


FET (between gate and source, with source grounded)

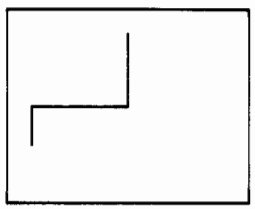
Single diode (with cathode grounded)



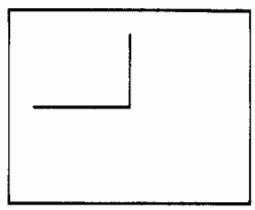
Silicone diode



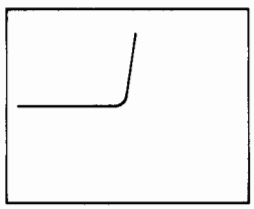
Germanium diode



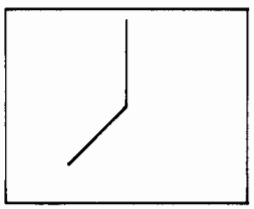
Zener diode under 8V



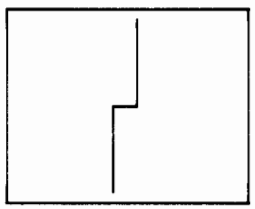
Zener diode beyond 12V



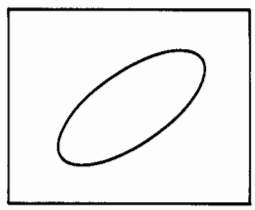
Rectifier



Diode // 680Ω

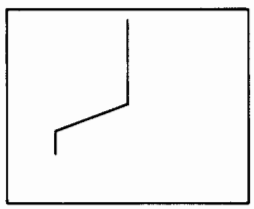


2 diodes antiparallel

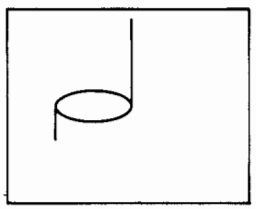


Capacitor 1μf // 1KΩ

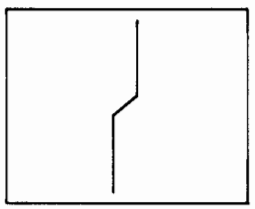
In-circuit component



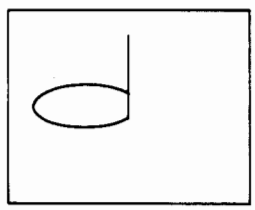
B-E junction // 680Ω



B-E junction // 0·1μf



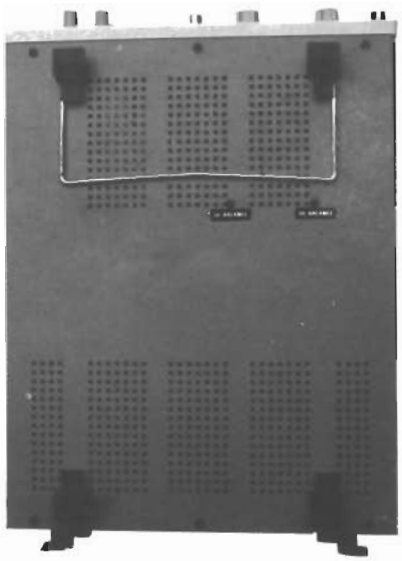
E-B junction // Diode // 1KΩ



Diode // 4·7μf

EXTERNAL VIEW

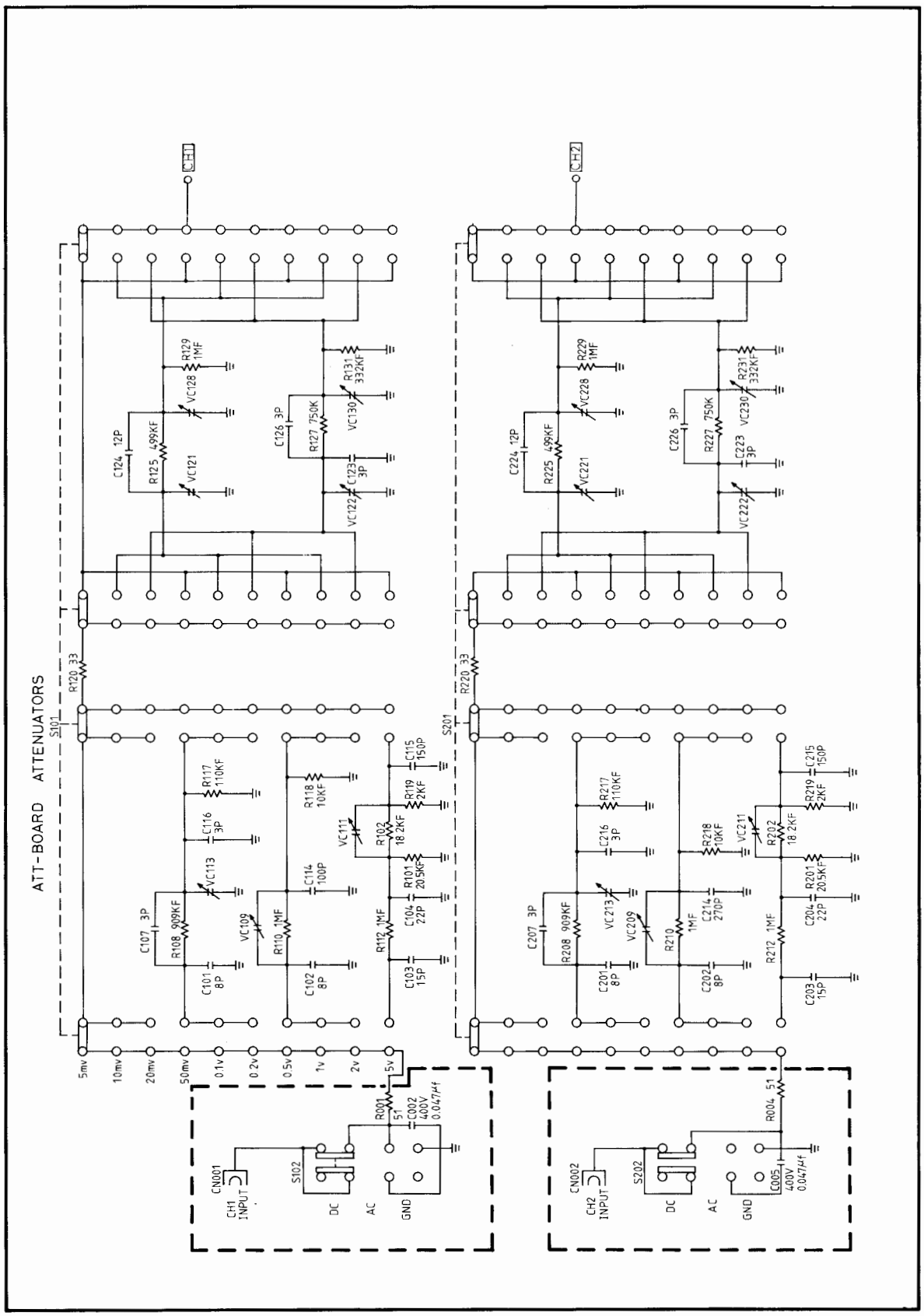
FRONT PANEL

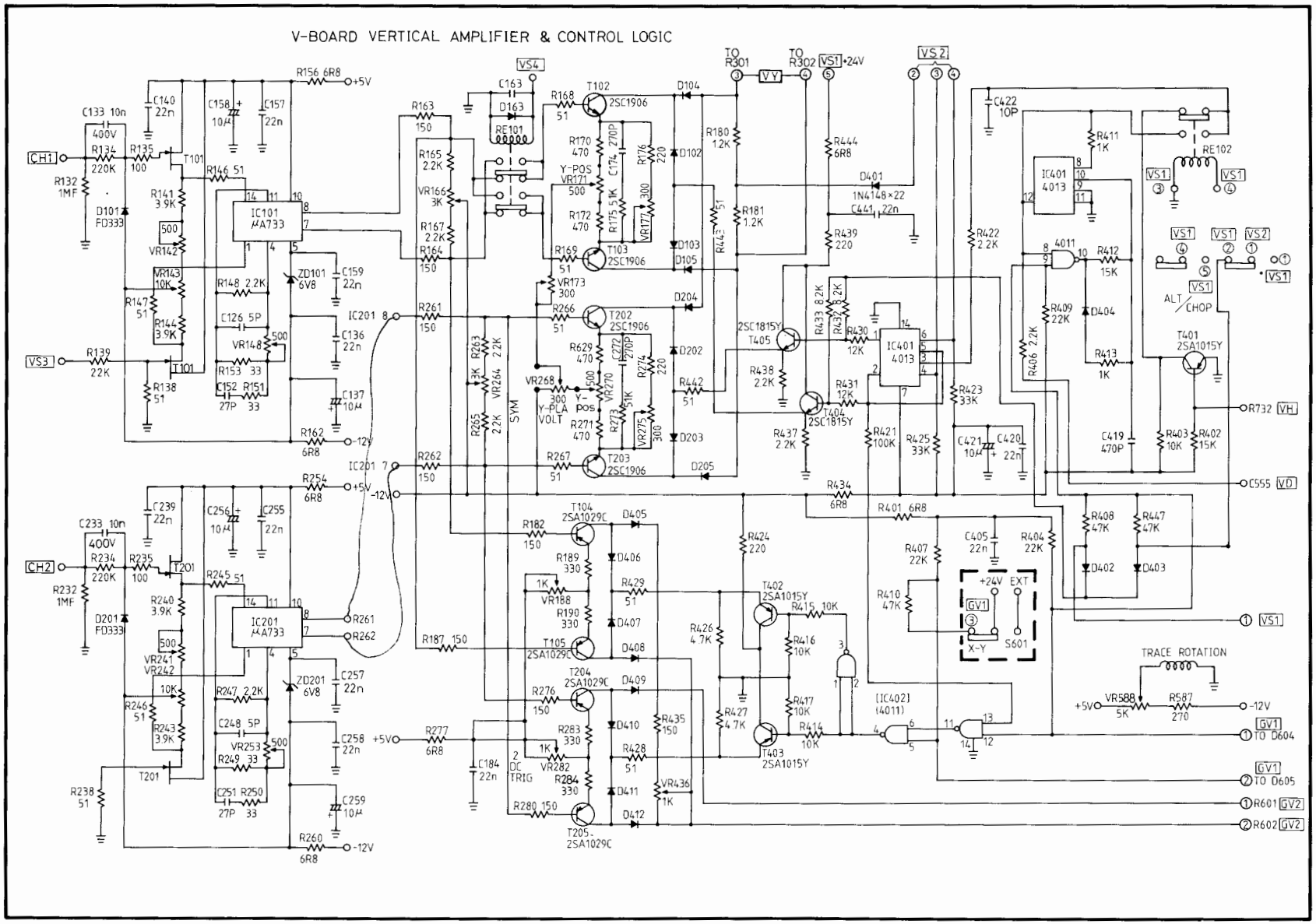


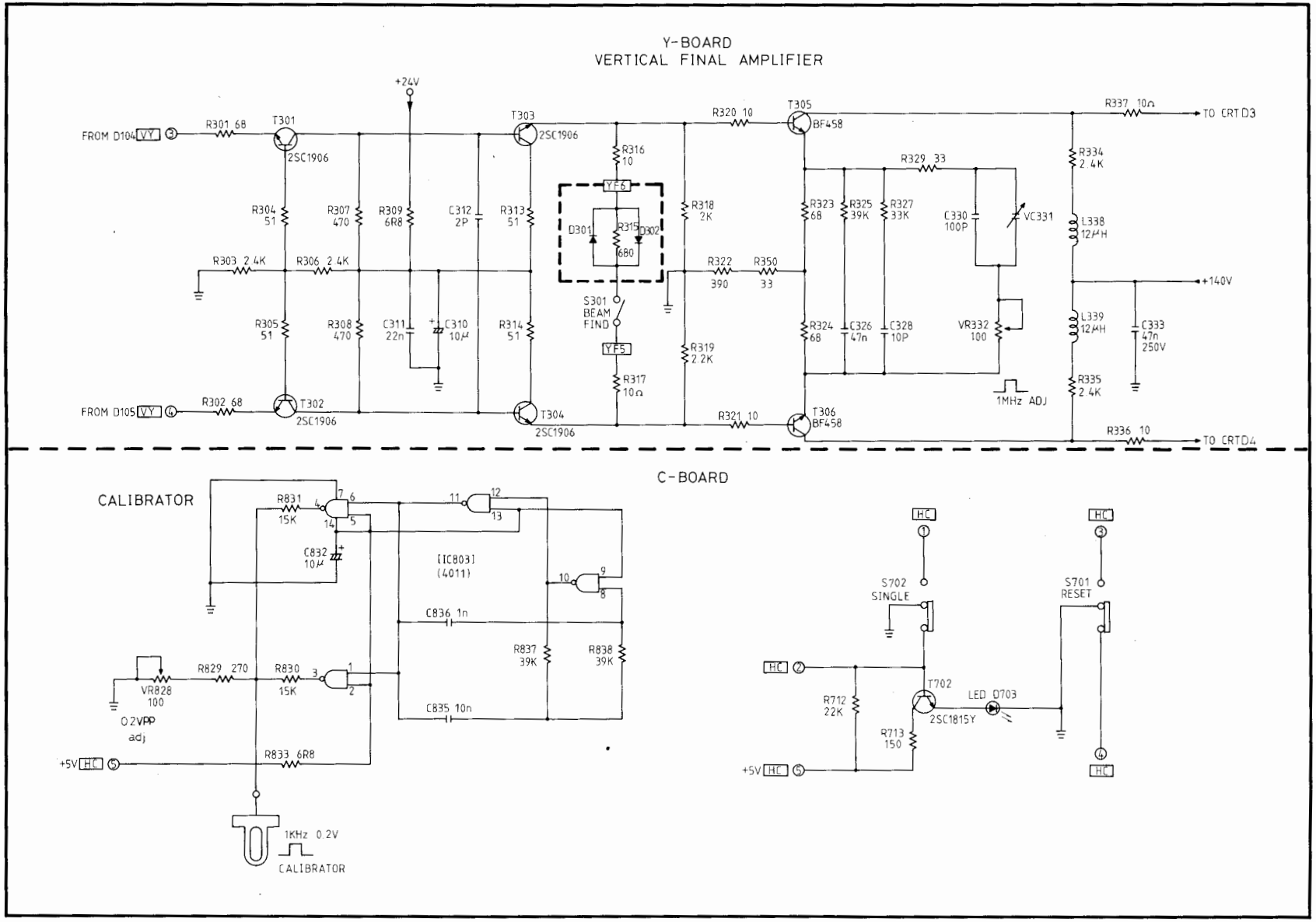
BOTTOM VIEW

SIDE VIEW

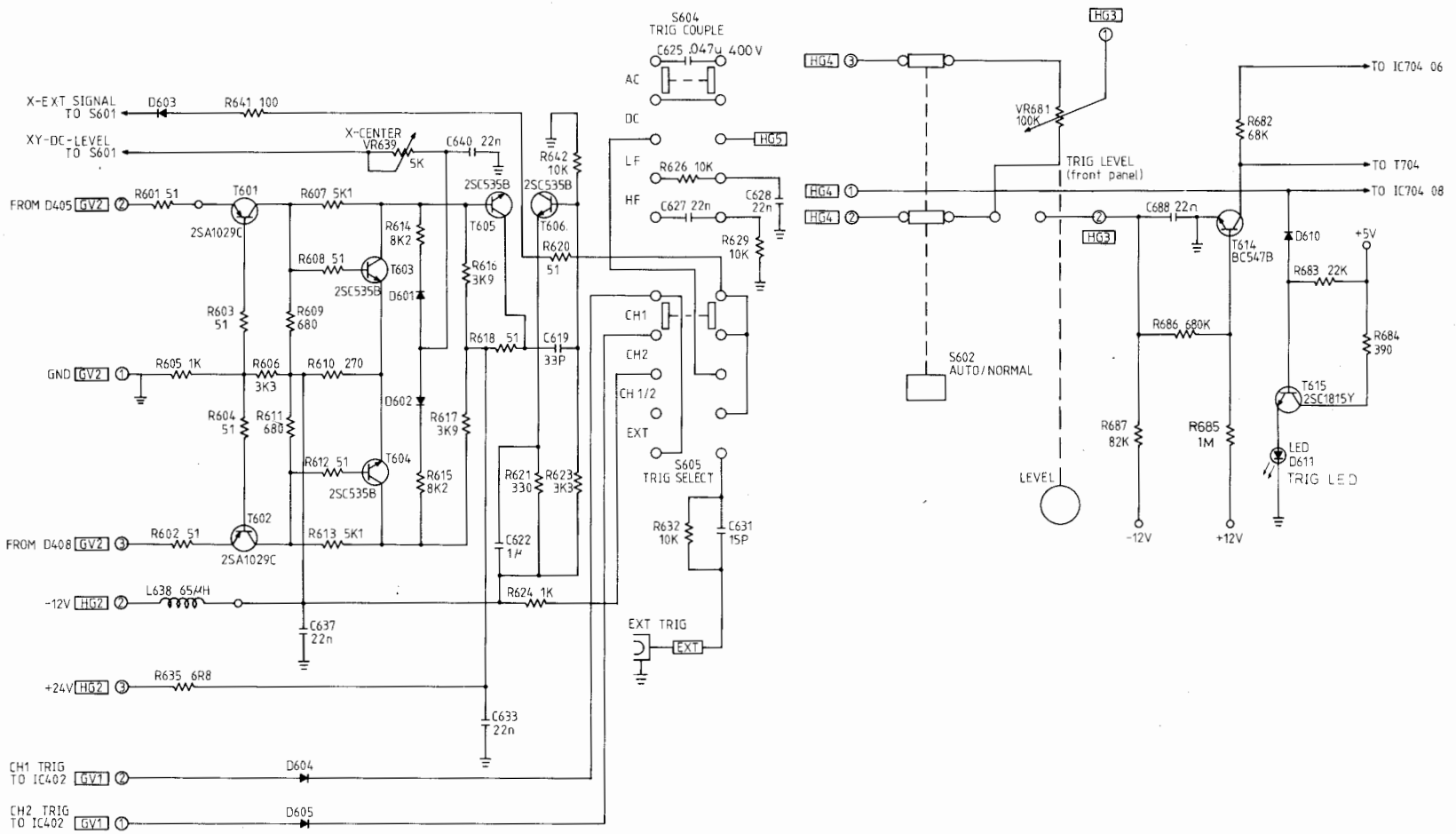
REAR PANEL

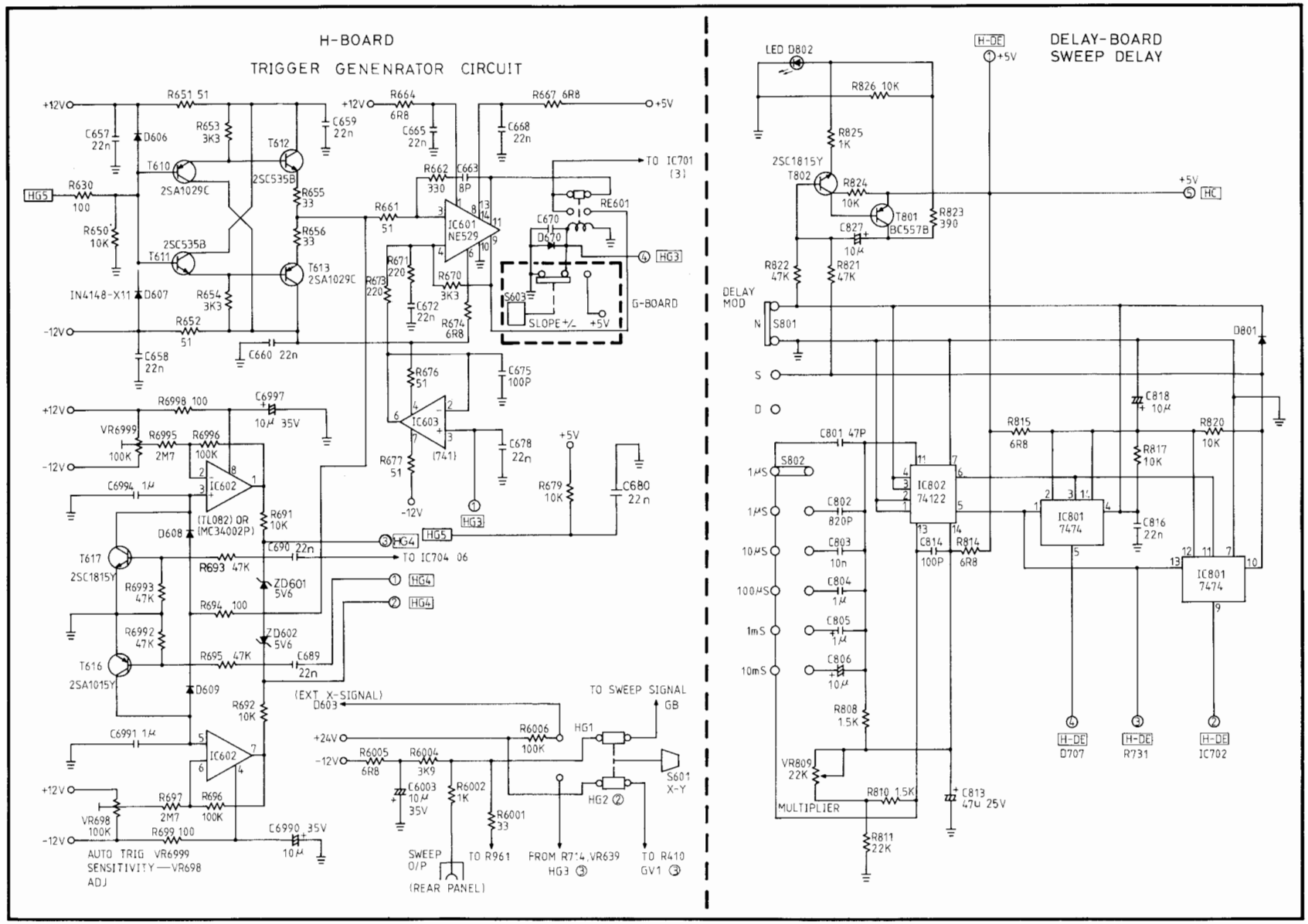

ATT-BOARD ATTENUATORS
CH1
CH2
S101
S201
R120 33
R220 33
5mv
10mv
20mv
50mv
0.1v
0.2v
0.5v
1v
2v
5v
C107 3P
R108 909KF
C101 8P
VC113
C116 3P
R117 110KF
VC109
R110 1MF
C102 8P
C114 100P
R118 10KF
VC111
R102 18.2KF
R101 20.5KF
R112 1MF
C103 15P
C104 22P
R119 2KF
C115 150P
C124 12P
R125 499KF
VC121
VC122
C123 3P
C126 3P
R127 750K
VC130
R131 332KF
R129 1MF
VC128
C207 3P
R208 909KF
C201 8P
VC213
VC209
R210 1MF
C202 8P
C214 270P
R218 10KF
VC211
R202 18.2KF
R212 1MF
C203 15P
C204 22P
R201 20.5KF
R219 2KF
C215 150P
R217 110KF
C216 3P
C224 12P
R225 499KF
VC221
VC222
C223 3P
C226 3P
R227 750K
VC230
R231 332KF
R229 1MF
VC228
CN001
CH1 INPUT
S102
DC
AC
GND
R001 51
C002 400V 0.047μf
CN002
CH2 INPUT
S202
DC
AC
GND
R004 51
C005 400V 0.047μf

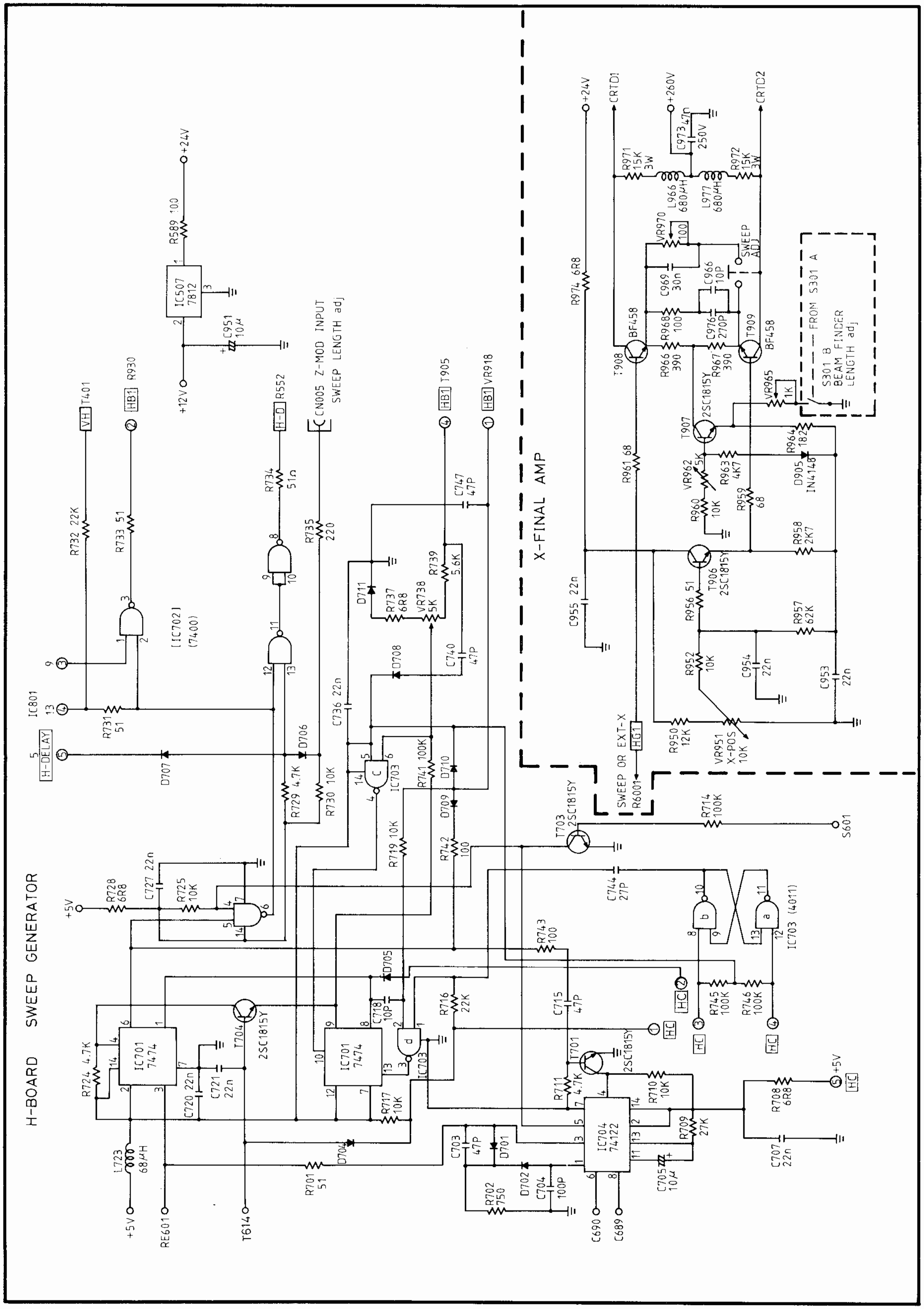

V-BOARD VERTICAL AMPLIFIER & CONTROL LOGIC
CH1
CH2
VS3
VS4
IC101 μA733
IC201 μA733
IC401 4013
IC402 (4011)
T101
T201
T102 2SC1906
T103 2SC1906
T202 2SC1906
T203 2SC1906
T104 2SA1029C
T105 2SA1029C
T204 2SA1029C
T205 2SA1029C
T401 2SA1015Y
T402 2SA1015Y
T403 2SA1015Y
T404 2SC1815Y
T405 2SC1815Y
D101 FD333
D201 FD333
D401 1N4148×22
ZD101 6V8
ZD201 6V8
RE101
RE102
TO R301
TO R302
VS1 +24V
VS2
VY
ALT / CHOP
TRACE ROTATION
X-Y
S601
+24V EXT
GV1
VR143 10K
VR242 10K
VR171 500
VR173 300
VR188 1K
VR282 1K
VR436 1K
VR588 5K
Y-POS
Y-PLA VOLT
Y-pos
SYM
DC TRIG
[IC402] (4011)
R732 VH
C555 VD
TO D604
TO D605
R601 GV2
R602 GV2

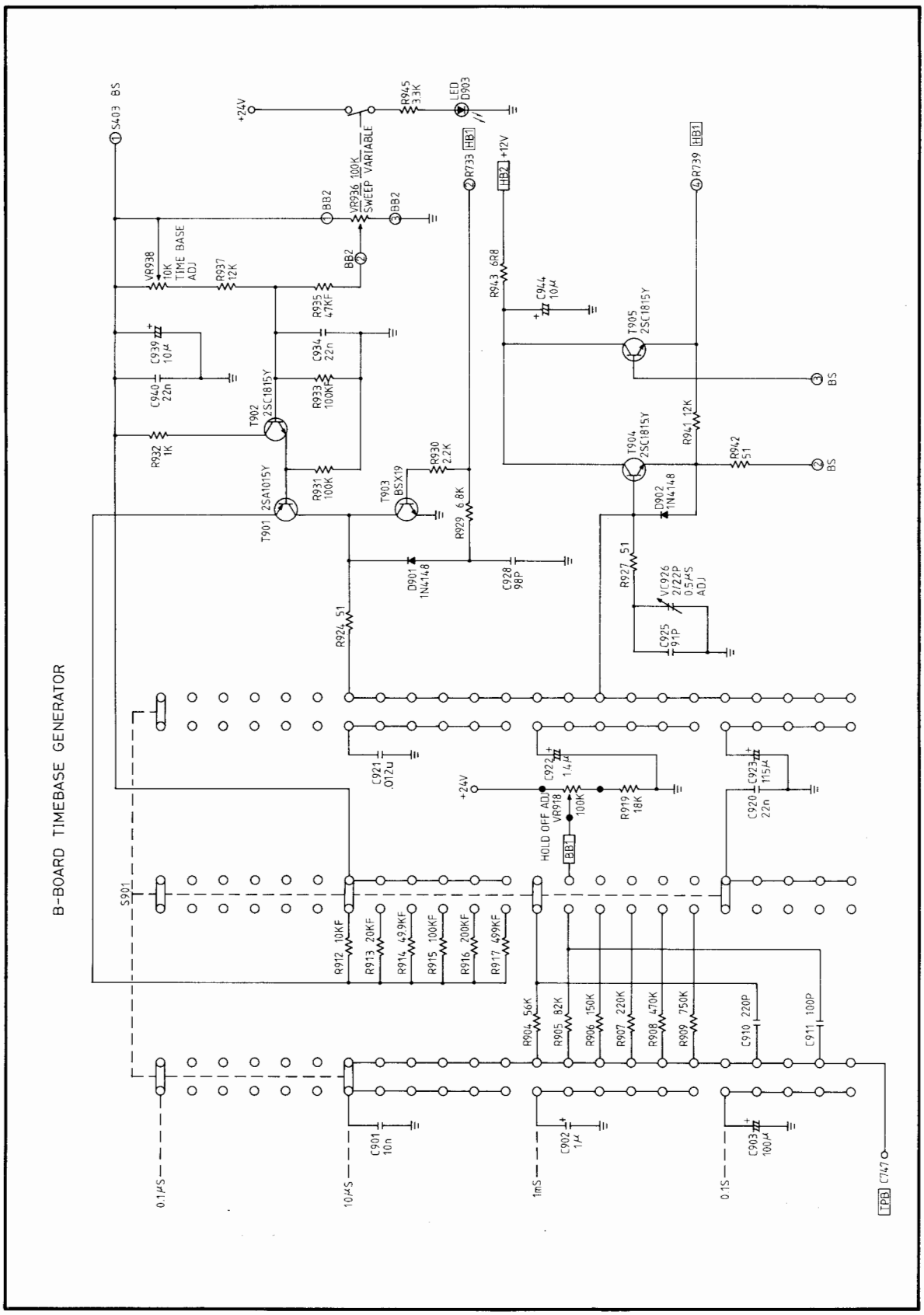

Y-BOARD
VERTICAL FINAL AMPLIFIER
+24V
FROM D104 VY
R301 68
T301
2SC1906
T303
2SC1906
R316 10
YF6
D301
R315 680
D302
R318 2K
R320 10
T305
BF458
R337 10Ω
TO CRT D3
R329 33
R334 2.4K
R304 51
R307 470
R309 6R8
C312 2P
R313 51
R323 68
R325 39K
R327 33K
C330 100P
VC331
L338 12μH
R303 2.4K
R306 2.4K
R322 390
R350 33
+140V
S301 BEAM FIND
R305 51
R308 470
C311 22n
C310 10μ
R314 51
R324 68
C326 47n
C328 10P
VR332 100
L339 12μH
C333 47n 250V
YF5
R319 2.2K
R317 10Ω
1MHz ADJ
R335 2.4K
FROM D105 VY
R302 68
T302
2SC1906
T304
2SC1906
R321 10
T306
BF458
R336 10
TO CRT D4
C-BOARD
CALIBRATOR
R831 15K
C832 10μ
[IC803] (4011)
C836 1n
R837 39K
R838 39K
R829 270
R830 15K
VR828 100
0.2VPP adj
C835 10n
+5V HC
R833 6R8
1KHz 0.2V
CALIBRATOR
HC
S702 SINGLE
S701 RESET
T702
2SC1815Y
LED D703
R712 22K
R713 150

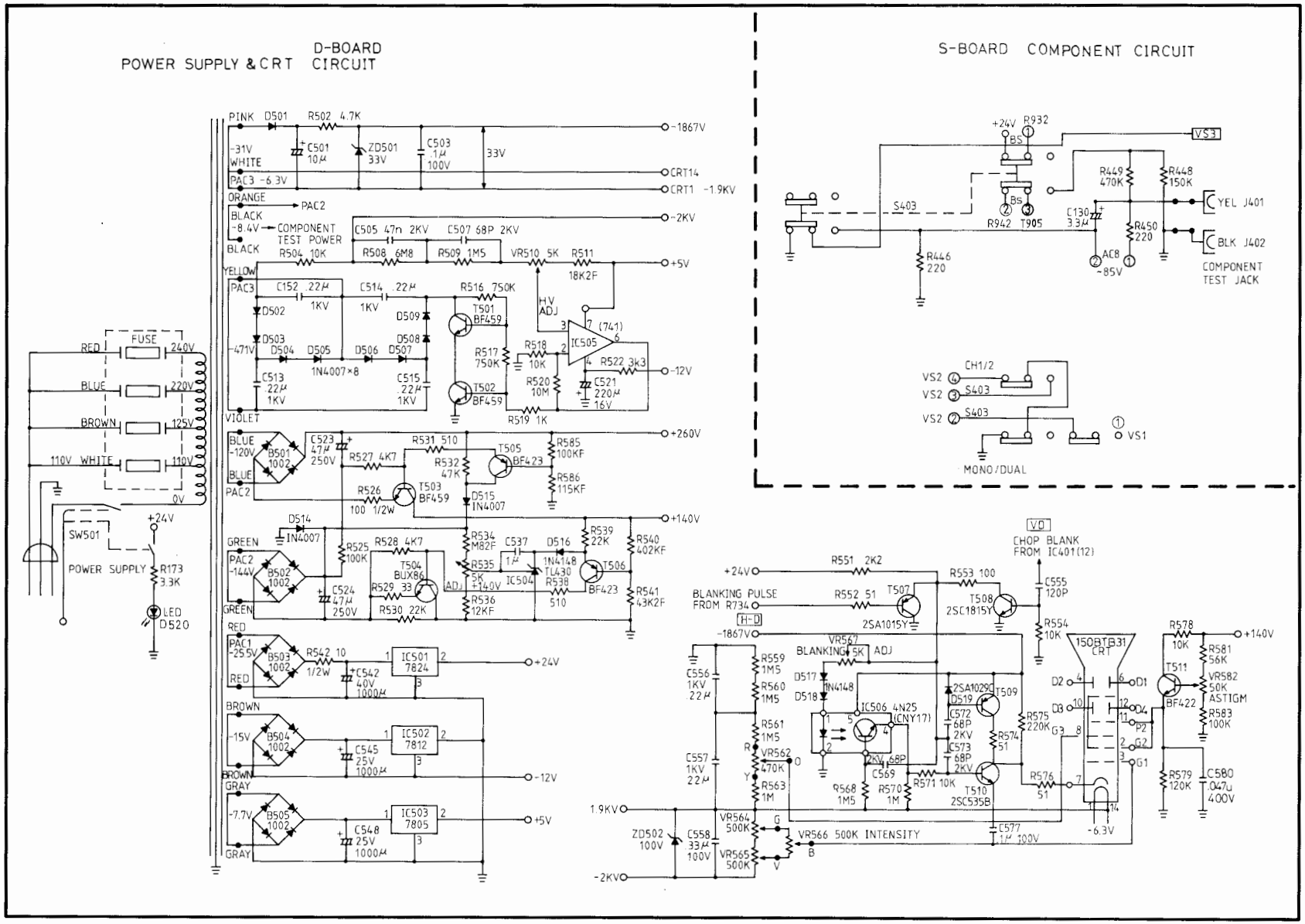
G-BOARD TRIGGER AMPLIFIER



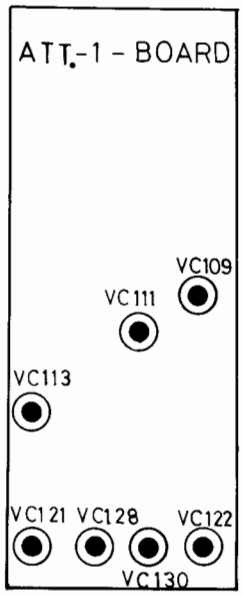

H-BOARD
TRIGGER GENENRATOR CIRCUIT
DELAY-BOARD
SWEEP DELAY
+12V
-12V
+5V
+24V
R651 51
R653 3K3
R654 3K3
R652 51
R630 100
R650 10K
R655 33
R656 33
R658 22n
R659 22n
R660 22n
R661 51
R662 330
R663 8P
R664 6R8
R665 22n
R667 6R8
R668 22n
R670 3K3
R671 220
R672 22n
R673 220
R674 6R8
R675 100P
R676 51
R677 51
R678 22n
R679 10K
C680 22n
C657 22n
C658 22n
C659 22n
C660 22n
C665 22n
C668 22n
C670
D606
D607
D608
D609
D670
T610 2SA1029C
T611 2SC535B
T612 2SC535B
T613 2SA1029C
IN4148-X11
IC601 NE529
IC603 (741)
RE601
S603 SLOPE +/-
G-BOARD
TO IC701 (3)
HG1
HG2
HG3
HG4
HG5
R6998 100
C6997 10µ 35V
VR6999 100K
R6995 2M7
R6996 100K
C6994 1µ
IC602 (TL082) OR (MC34002P)
R691 10K
C690 22n
TO IC704 06
T617 2SC1815Y
R6993 47K
R693 47K
ZD601 5V6
R694 100
R6992 47K
ZD602 5V6
T616 2SA1015Y
R695 47K
C689 22n
R692 10K
C6991 1µ
VR698 100K
R697 2M7
R696 100K
R699 100
C6990 35V
AUTO TRIG SENSITIVITY — VR698 ADJ
VR6999 ADJ
(EXT X-SIGNAL)
D603
TO SWEEP SIGNAL GB
R6006 100K
R6005 6R8
R6004 3K9
C6003 10µ 35V
R6002 1K
R6001 33
S601 X-Y
SWEEP O/P (REAR PANEL)
TO R961
FROM R714,VR639 HG3 ③
TO R410 GV1 ③
LED D802
R826 10K
R825 1K
2SC1815Y T802
R824 10K
T801 BC557B
R823 390
C827 10µ
R822 47K
R821 47K
DELAY MOD
S801
S802
1µS
10µS
100µS
1mS
10mS
C801 47P
C802 820P
C803 10n
C804 1µ
C805 1µ
C806 10µ
R808 1.5K
VR809 22K
MULTIPLIER
R810 1.5K
R811 22K
C813 47u 25V
IC802 74122
IC801 7474
C814 100P
R814 6R8
R815 6R8
R817 10K
C816 22n
C818 10µ
R820 10K
D801
H-DE
HC
D707
R731
IC702


H-BOARD SWEEP GENERATOR
X-FINAL AMP
CN005 Z-MOD INPUT
SWEEP LENGTH adj
SWEEP ADJ
FROM S301 A
S301 B
BEAM FINDER
LENGTH adj
SWEEP OR EXT-X
VR951
X-POS
IC701 7474
IC702 (7400)
IC703 (4011)
IC704 74122
IC507 7812
T704 2SC1815Y
T701 2SC1815Y
T703 2SC1815Y
T906 2SC1815Y
T907 2SC1815Y
T908 BF458
T909 BF458
H-DELAY
+5V
+12V
+24V
+260V
CRTD1
CRTD2
RE601
T614
C690
C689
S601

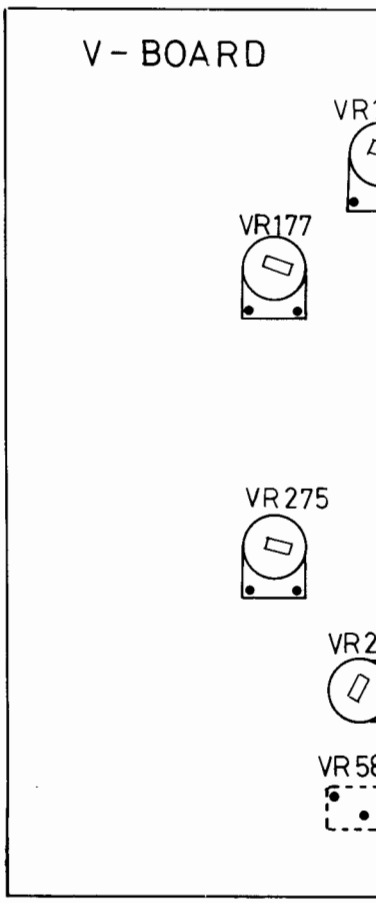

B-BOARD TIMEBASE GENERATOR
S403 BS
+24V
R945 3.3K
LED D903
R733 HB1
HB2 +12V
R739 HB1
VR936 100K SWEEP VARIABLE
BB2
VR938 10K TIME BASE ADJ
R937 12K
R935 47KF
C939 10μ
C940 22n
C934 22n
R933 100KF
T902 2SC1815Y
R932 1K
T901 2SA1015Y
R931 100K
T903 BSX19
R930 2.2K
R929 6.8K
D901 1N4148
C928 98P
R924 51
R943 6R8
C944 10μ
T905 2SC1815Y
T904 2SC1815Y
R941 12K
R942 51
D902 1N4148
R927 51
VC926 2/22P 0.5μS ADJ
C925 91P
BS
C921 .012u
C922 1.4μ
+24V
HOLD OFF ADJ VR918 100K
BB1
R919 18K
C923 115μ
C920 22n
S901
R912 10KF
R913 20KF
R914 49.9KF
R915 100KF
R916 200KF
R917 499KF
R904 56K
R905 82K
R906 150K
R907 220K
R908 470K
R909 750K
C910 220P
C911 100P
0.1μS
10μS
1mS
0.1S
C901 10n
C902 1μ
C903 100μ
TP8 C747

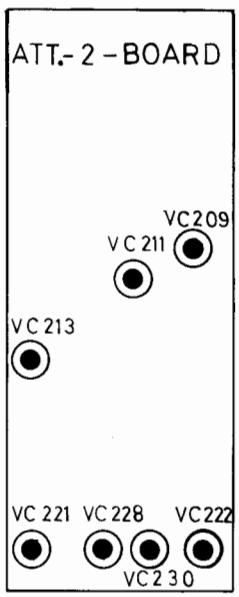

D-BOARD
POWER SUPPLY & CRT CIRCUIT
S-BOARD COMPONENT CIRCUIT
PINK D501 R502 4.7K
-31V WHITE
PAC3 -6.3V
ORANGE
PAC2
BLACK -8.4V
COMPONENT TEST POWER
BLACK
YELLOW
PAC3
VIOLET
-471V
C501 10µ
ZD501 33V
C503 .1µ 100V
33V
-1867V
CRT14
CRT1 -1.9KV
-2KV
C505 47n 2KV
C507 68P 2KV
R504 10K
R508 6M8
R509 1M5
VR510 5K
R511 18K2F
+5V
C152 .22µ 1KV
C514 .22µ 1KV
R516 750K
D502
D503
D504
D505
D506
D507
D508
D509
1N4007×8
C513 .22µ 1KV
C515 .22µ 1KV
T501 BF459
T502 BF459
R517 750K
R518 10K
R519 1K
R520 10M
IC505 (741)
R522 3k3
C521 220µ 16V
-12V
HV ADJ
FUSE
RED 240V
BLUE 220V
BROWN 125V
110V WHITE 110V
0V
SW501
+24V
POWER SUPPLY
R173 3.3K
LED D520
BLUE -120V
BLUE
PAC2
B501 1002
C523 47µ 250V
R527 4K7
R531 510
R532 47K
T505 BF423
R585 100KF
R586 115KF
R526 100 1/2W
T503 BF459
D515 1N4007
+260V
D514 IN4007
GREEN
PAC2 -144V
B502 1002
C524 47µ 250V
R525 100K
R528 4K7
T504 BUX86
R529 33
R530 22K
R534 M82F
R535 5K +140V ADJ
C537 1µ
D516 1N4148
IC504 TL430
R538 510
T506 BF423
R539 22K
R540 402KF
R541 43K2F
R536 12KF
+140V
RED
PAC1 -25.5V
B503 1002
R542 10 1/2W
C542 40V 1000µ
IC501 7824
+24V
BROWN -15V
B504 1002
C545 25V 1000µ
IC502 7812
-12V
GRAY -7.7V
B505 1002
C548 25V 1000µ
IC503 7805
+5V
+24V R932
BS
VS3
S403
R942 T905
R449 470K
R448 150K
C130 3.3µ
R450 220
YEL J401
BLK J402
COMPONENT TEST JACK
R446 220
AC8 ~85V
CH1/2
VS2
S403
VS1
MONO/DUAL
VD
CHOP BLANK FROM IC401(12)
+24V
R551 2K2
R553 100
C555 120P
BLANKING PULSE FROM R734
R552 51
T507 2SA1015Y
T508 2SC1815Y
H-D
-1867V
R554 10K
VR567 BLANKING 5K ADJ
C556 1KV 22µ
R559 1M5
R560 1M5
D517 1N4148
D518
IC506 4N25 (CNY17)
2SA1029 D519
T509
C572 68P 2KV
C573 68P 2KV
R575 220K
R574 51
C557 1KV 22µ
R561 1M5
VR562 470K
R563 1M
R568 1M5
C569 2KV 68P
R570 1M
R571 10K
T510 2SC535B
R576 51
C577 1µ 100V
-6.3V
1.9KV
ZD502 100V
-2KV
C558 33µ 100V
VR564 500K
VR565 500K
VR566 500K INTENSITY
150BTB31 CRT
D1
D2
D3
D4
G1
G2
G3
P2
R578 10K
T511
BF422
R581 56K
VR582 50K ASTIGM
R583 100K
R579 120K
C580 .047µ 400V
+140V

13. ALIGNMENT LOCATION

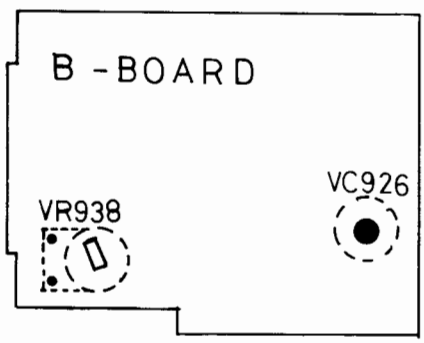


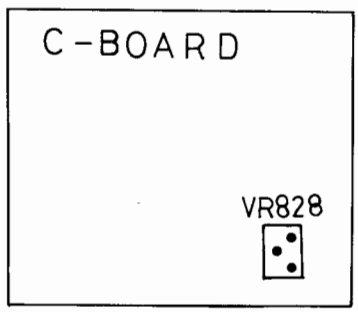
VC109 : 0.5V/DIV ⎍⎍ COMPENSATION ADJ.
VC111 : 5V/DIV ⎍⎍ COMPENSATION ADJ.
VC113 : 50mV/DIV ⎍⎍ COMPENSATION ADJ.
VC121 : 0.1V/DIV ⎍⎍ COMPENSATION ADJ.
VC128 : 10mV/DIV ⎍⎍ COMPENSATION ADJ.
VC130 : 20mV/DIV ⎍⎍ COMPENSATION ADJ.
VC122 : 0.2V/DIV ⎍⎍ COMPENSATION ADJ.





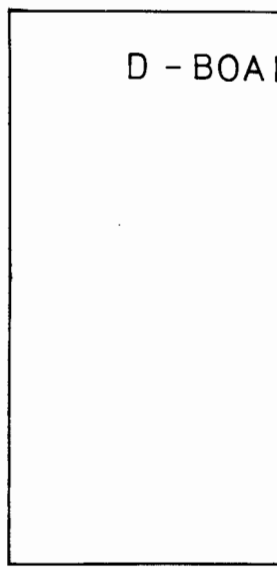
VC209 : 0.5V/DIV ⎍⎍ COMPENSATION ADJ.
VC211 : 5V/DIV ⎍⎍ COMPENSATION ADJ.
VC213 : 50mV/DIV ⎍⎍ COMPENSATION ADJ.
VC221 : 0.1V/DIV ⎍⎍ COMPENSATION ADJ.
VC228 : 10mV/DIV ⎍⎍ COMPENSATION ADJ.
VC230 : 20mV/DIV ⎍⎍ COMPENSATION ADJ.
VC222 : 0.2V/DIV ⎍⎍ COMPENSATION ADJ.

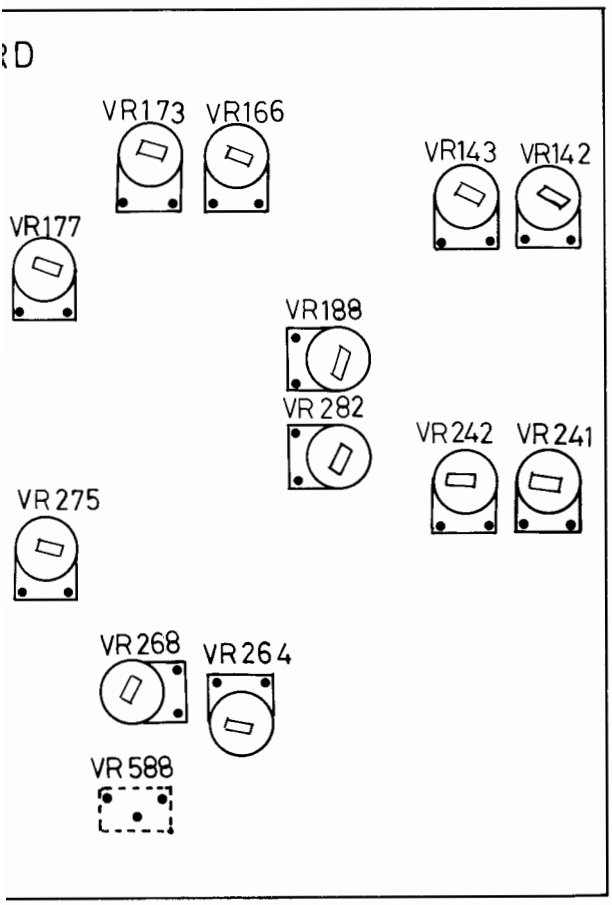




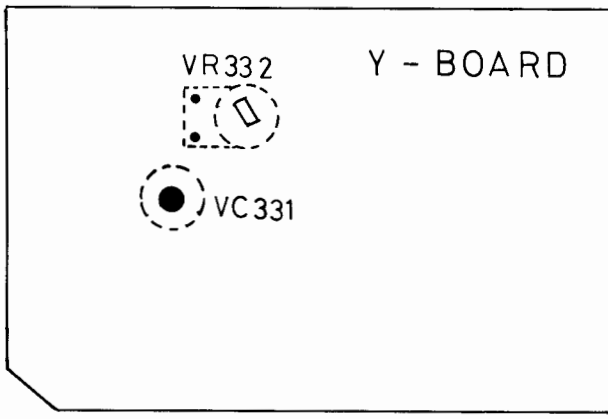
VR828 : ⎍⎍ ADJ.
($0.2V_{p\text{-}p}$ 1KHZ)

VR938 : CAL. 50us
VC926 : CAL. 0.5us

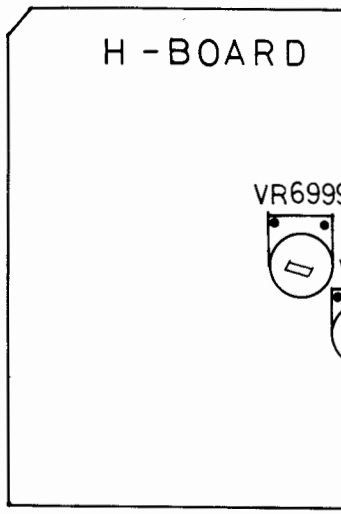




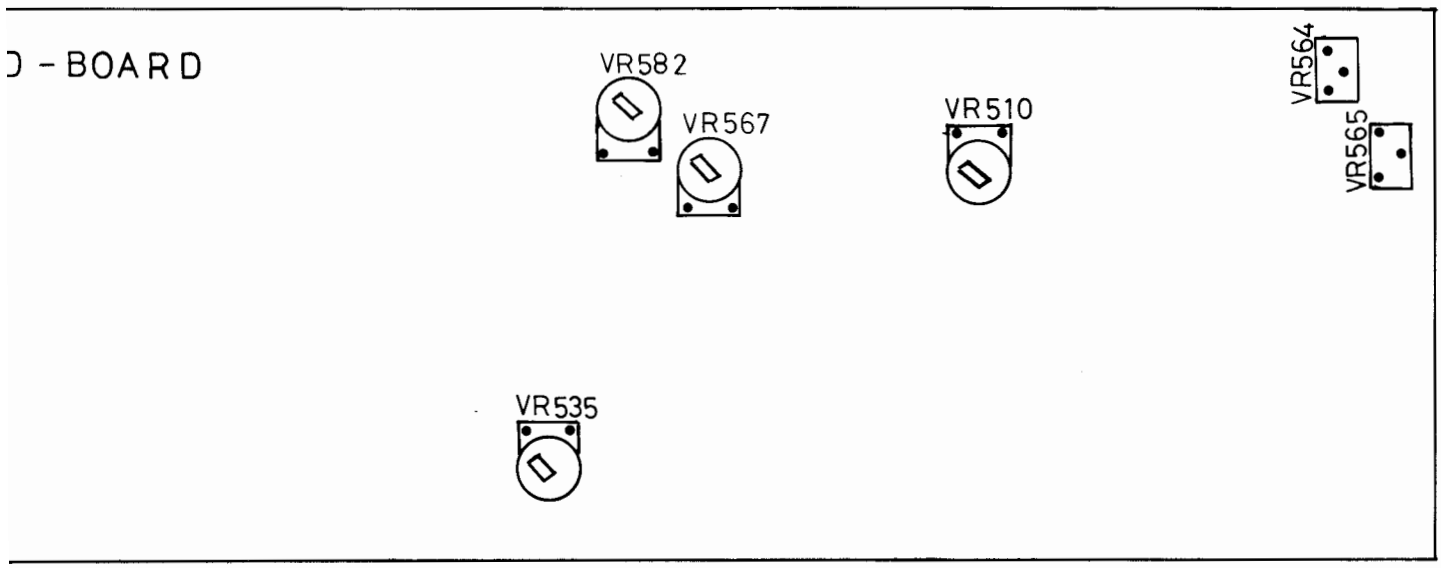
VR173 :Y-PLA.
VR166 :SYM.
VR143 :DC-BAL.
VR142 :DC-BAL.
VR177 :Y-GAIN.
VR188 :DC-TRIG.
VR282 :DC-TRIG.
VR242 :DC-BAL.
VR241 :DC-BAL.
VR275 :Y-GAIN.
VR268 :Y-PLA.
VR264 :SYM.
VR588 :TRACE ROTATION

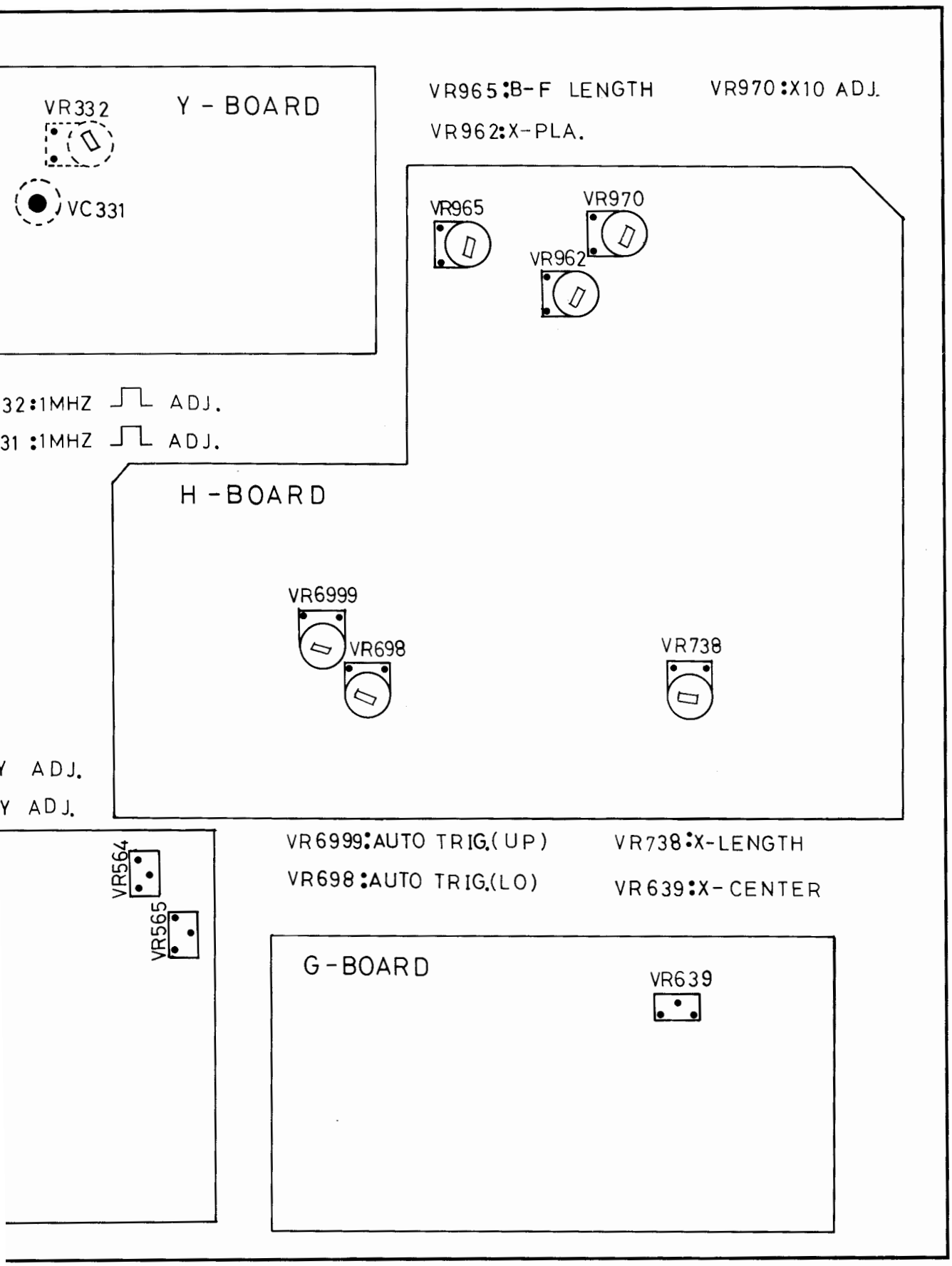


VR332 :1MHZ ⎍ ADJ.
VC 331 :1MHZ ⎍ ADJ.



VR582 :ASTIGM.
VR535 :+140V ADJ.
VR567 :BLANKING
VR510 :H.V. ADJ.
VR564 :MAX. INTENSITY ADJ.
VR565 :MIN. INTENSITY ADJ.




VR332
Y - BOARD
VC331
VR965:B-F LENGTH
VR970:X10 ADJ.
VR962:X-PLA.
VR965
VR970
VR962
32:1MHZ ADJ.
31 :1MHZ ADJ.
H - BOARD
VR6999
VR698
VR738
Y ADJ.
Y ADJ.
VR6999:AUTO TRIG.(UP)
VR738:X-LENGTH
VR698:AUTO TRIG.(LO)
VR639:X-CENTER
VR564
VR565
G - BOARD
VR639

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