

## MODEL 554B TRIGGER OSCILLOSCOPE

### INSTRUCTION MANUAL

Model 554B is an oscilloscope with a 5 - inch aperture cathode ray tube. It is equipped with a trigger sweep oscillator which permits the observations not only of usual waveforms but also of signals with varying periods or one shot transient phenomena, and has a DC wide band vertical amplifier with DC - 5 MC frequency range. Using this model, waveforms can be observed directly on calibrated graticule within following ranges ;

amplitude	0.1 - 500 V
time	0.2 $\mu$ sec. - 2.5 sec.

This model is also equipped with terminals for external sweeping and a square wave generator for amplitude calibration.

Kikusui Electronics Corporation

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## Specifications

### Vertical Axis

Input Terminals	UHF receptacle (acceptable for M-type plugs)
Input Impedance	1 M $\Omega$ , 30 $\pm$ 1 PF
Maximum Input Vtg.	Combined DC and AC peak, 600V
Sensitivity	8 ranges, 1-2-5 step. 0.1V/cm to 20V/cm. Vernier permits continuous adjustment between steps and extends 0.1 V/cm to about 60 V/cm.
Calibration Accuracy	3 %
Frequency Response	AC. 2 c/s - 5 Mc/sec. DC. 0 - 5 Mc/sec.
Rise Time	0.07 $\mu$ sec.
Over Shoot	3 %
Sag.	1 %

### Horizontal Axis

System	Trigger and self oscillation sweeping.
Sweep Time	19 ranges ; 1-2-5 step. 1 $\mu$ sec/cm - 1 sec/cm. Continuously variable (by vernier) 1 $\mu$ sec/cm - 2.5 sec/cm.
Calibration Accuracy	5 %
Magnifier	5 times
Magnification Accuracy	5 %

Trigger Input	AC coupling INT (+ -) EXT (+ -)	
Trigger Range	50 c/sec. to 500 kc. at 1 cm deflection (observable up to 4 MC)	
External Sweep		
Sensitivity	less than 1 v/cm. (Max. input volt. 50 V)	
Frequency Response	DC to 500 kc.	
Input Impedance	100 K $\Omega$ , less than 100 PF.	
Calibrating Voltage		
Output Voltage	1/2/5 V p-p; square wave of about 1 kc.	
Accuracy	3 %	
Intensity Modulation		
Voltage	more than 10V p-p.	
Power Supply	220V, 50 - 60 c/sec. Approx. 140vA.	
Dimensions (Max.)	Width 230 (240) mm Height 310 (330) mm Depth 450 (500) mm	
Weight	Approx. 16Kg.	
Accessories		Number
Graticule (8 x 10 cm <sup>2</sup> )		1
Filter G used conventionally but available one of other O. and B #43216		1
Low capacitance probe (-20 db, 951A)		1
Terminal adapter (941B with 5-way terminal)		1
Short bar		1
Instruction		1
Test Record		1

## Explanation on Panel

### Uses

ILLUM POWER OFF	Power switch and can control the brightness of the lamp of the scale panel ; brightest at full CW turning.
INTENSITY	Controls brightness of CRT (Cathode Ray Tube) ; brighter with CW turning and diminishes at full CCW turning.
FOCUS	Focus control of CRT image. You can observe the sharpest image at the center position.
x	x x x x
VERTICAL POSITION	Varies the vertical position of the screen image.
HORIZONTAL POSITION	Varies the horizontal position of the screen image.
x	x x x x
VERTICAL INPUT	Input terminals for a signal to be observed. (UHF receptacle, acceptable for M-type plug) Input impedance (1 MΩ shunted by approximately 30 pF) is constant on all ranges, moreover using 951A low capacitance probe, 10 MΩ. 12 pF can be got, but in this case sensitivity decreases to 1/10.
AC. DC.	Switch of rejecting (AC) or passing (DC) DC component of the signal to be observed.

VOLTS/cm            A dual knob for setting the sensitivity of vertical  
VARIABLE            amplifier.

\* VOLTS/cm (outer black knob)

Selects vertical amplifier sensitivity from 0.1 V/cm to 20 V/cm with 1-2-5 steps. Sensitivity can be calibrated at full CW turning of the inner red knob.

\* VARIABLE (inner red knob)

Permits continuous adjustment of sensitivity. At full CW turning, sensitivity gets 3 times high compared with that at full CCW.

DC BAL            Semi-fixed resistor for balance control of vertical DC amplifier ; controls vertical position of image when [ VARIABLE ] knob above mentioned is turned. Adjust [ DC BAL ] knob so that image does not move with turning [ VARIABLE ] knob.

~~VOLTAGE~~  
CALIBRATOR        To be used for calibration of deflection sensitivity and adjustment of the low capacitance probe etc.  
Output voltage ; 1,000 c/sec. square wave. 1-2-5 V p-p steps. Stabilized against fluctuation of power supply voltage.

EXT TRIG IN        Input terminals for external triggering signal.  
Input impedance is approx. 1 MΩ shunted by 20 pF, and more than 1 V p-p trigger level is needed.

TRIGGER Selection switch of trigger.

INT ; Sweep oscillator is triggered by signal to be observed.

EXT ; Sweep oscillator is triggered by external signal.

+(-); Triggered by positive (negative) going of waveform to be observed.

TRIGGER Controls trigger level of signal. Permits automatic  
LEVEL triggering at fully CCW.

STABILITY \* Controls operating level of sweep oscillator.  
OR  
HOR. INPUT Free running at CW turning. Oscillation stops at  
ATTEN. CCW turning. Image is stable at about a half of full turning.

\* Permits continuous adjustment of horizontal sensitivity when external sweep is used.

HORIZONTAL  
SWEEP TIME/cm  
VARIABLE  
5 X MAG

\* SWEEP TIME/cm

Selects sweep time 1  $\mu$  sec/cm to 1 sec/cm with 1-2-5 steps. Sweep time can be calibrated when inner red knob is fully CW (to the position of "CAL'D").

Sweep oscillator stops its oscillation when  
outer black knob is fully CW, and horizontal  
amplifier is connected to input terminals.  
Horizontal amplifier is also connected to  
- DC-coupled.

\* VARIABLE

Permits continuous change of sweep rate.

Rate change is about 2.5 times. (CCW slow, CW fast)

\* 5 X MAG.

Pull out this knob, and magnifier operates and  
the sweep is expanded to 50 cm.

Turning [ HORIZONTAL POSITION ] makes capable of  
observing waveform in detail.

INTENSITY  
MODULATION

Terminals at the upper center of the back case ;  
are used for intensity modulation of the observed  
waveform.

Voltage of modulating signal must be more than  
10 V p-p.



## First time operation

Function of each part on panel are explained above. You had better follow next procedures to get an easier understanding.

ILLUM.POWER	POWER OFF
INTENSITY	CW max
FOCUS	Center
VERT.POSITION	Center
HOR. POSITION	Center
VOLTS/CM	1 V
VARIABLE	CW max
DC BAL	Leave as it is
AC DC	AC
SWEEP TIME/CM	.5m sec
VARIABLE	CW max
STABILITY	CW max
TRIGGER LEVEL	Auto
TRIGGER	INT +

After these procedures, following preparation are to be done.

### POWER SUPPLY

220 Volts, 50 or 60 c/s, is to be used. This model can operate stable within  $\pm 10\%$  fluctuation of power supply voltage. However, to keep high reliability for a long time, fluctuation should be within  $\pm 5\%$ .

Keep room temperature lower than  $35^{\circ}\text{C}$ .

Avoid direct sunlight and be careful of ventilation of the room.

## Operation

Connect the power code to line outlet.

Turn ILLUM.POWER knob CW, from the position POWER OFF, and power is supplied. You can check this with illumination light.

About 25 seconds later, the oscilloscope gets in to operation, and a horizontal bright line about 10cm long appears on CRT screen.

Drift of the bright line due to DC-coupled circuit remains for a several minutes.

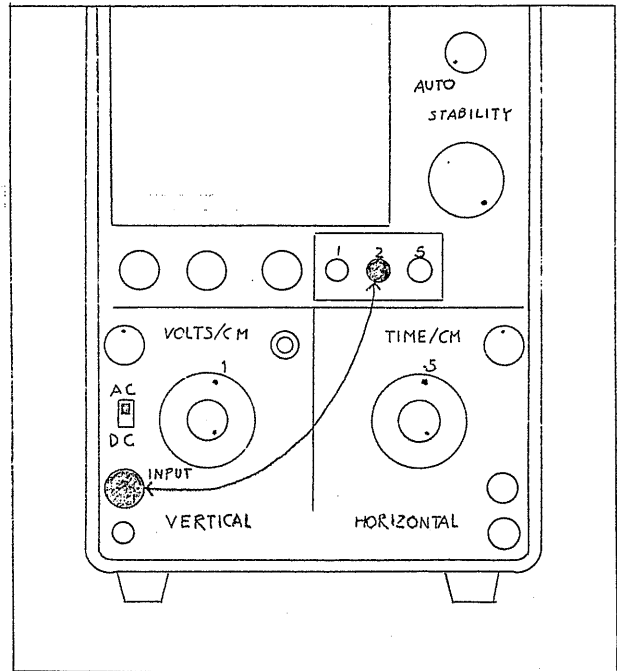
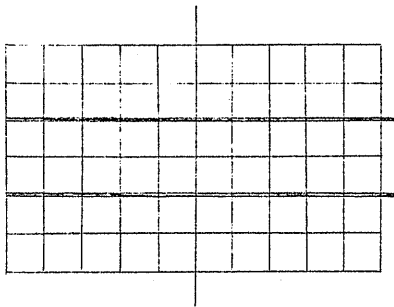
Control FOCUS knob to get sharp line.

Using

### AUTO and TRIGGER

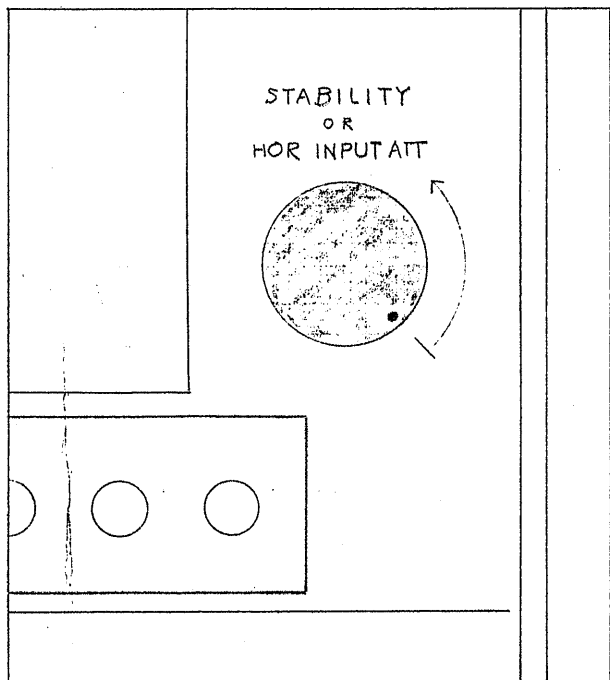
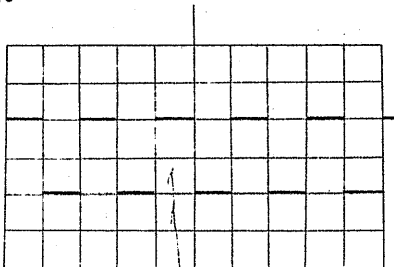
Install an accessory terminals adaptor Model 941B to VERTICAL INPUT terminals and connect with a proper conductor between VERTICAL INPUT and ~~VOLTAGE~~ CALIBRATOR 2V p-p terminal.

On CRT screen, two bright horizontal lines appear as the result of square wave free running as is shown in the following figure.



### STABILITY

Turn STABILITY knob CCW gradually, the sweep oscillator synchronizes with the input signal (2Vp-p square wave) and a stable image of square wave can be observed.



More turning CCW diminishes the image, sweep oscillator stops its oscillation.

The waveforms on the screen can be characterized as following,

voltage amplitude

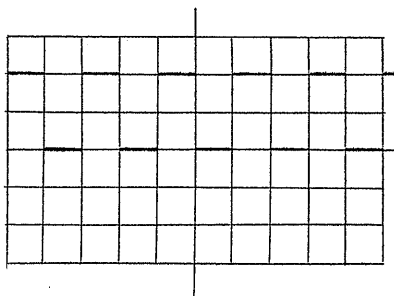
$$= 2\text{cm} \times 0\text{v/cm/cm} = \text{volt p-p}$$

$$\text{period} = 2\text{cm} \times 0.5\text{ms/cm}$$

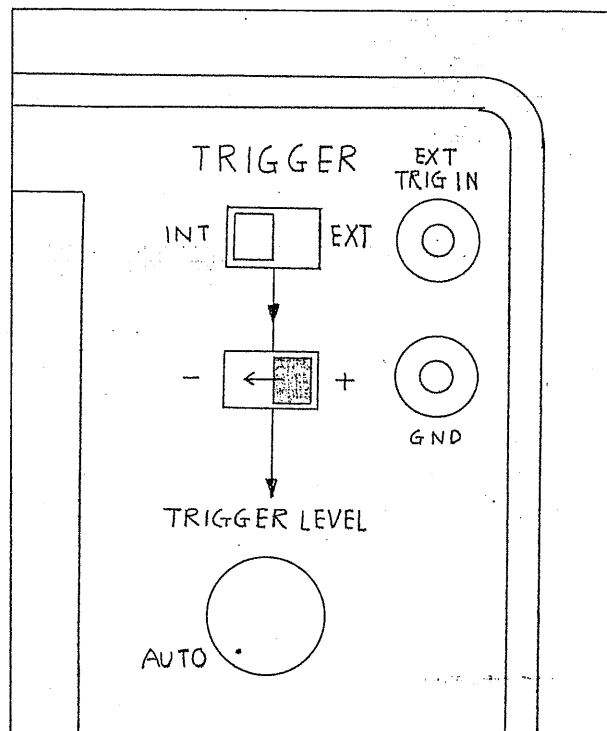
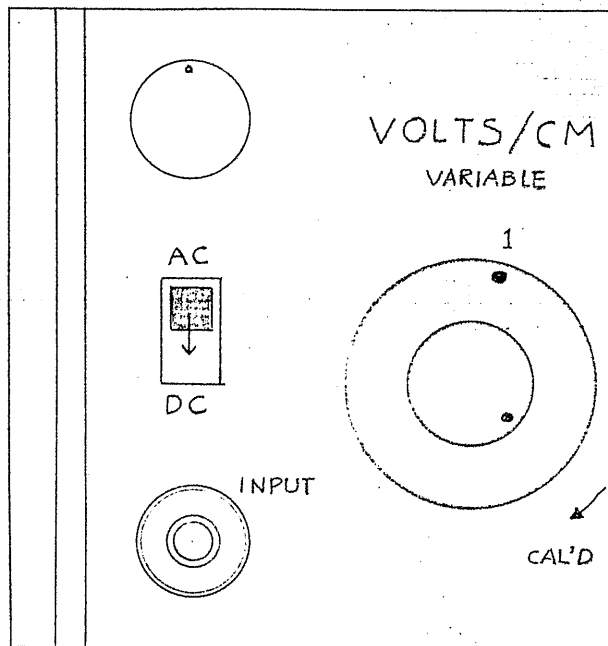
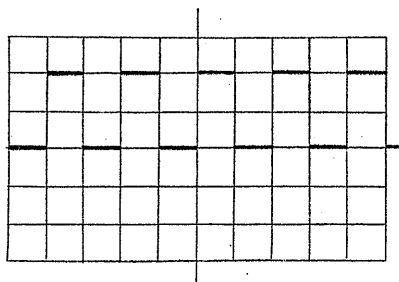
$$= 1\text{ms}$$

$$\text{frequency} = 1/\text{period} = 1\text{kc}$$

Set AC DC switch to DC Position and the DC component of signal passes and the image is removed upward by the value of DC component.

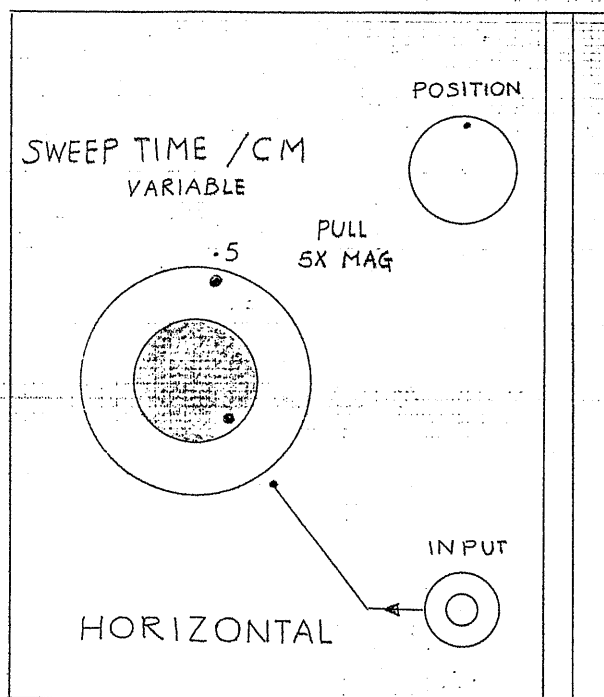
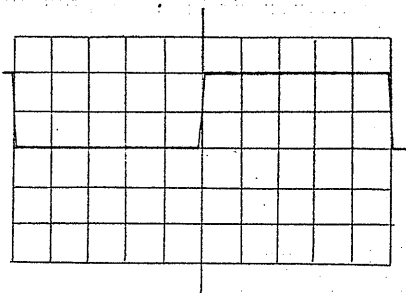


If you put the slideswitch on (-) side, the polarity of the wave form is changed.



Pull out SWEEP TIME VARIABLE knob, and adjust it to 5X MAG position, A magnified waveforms by 5 times in horizontal direction can be observed.

Turning HORIZONTAL POSITION knob makes part-by-part observation available.



Control VOLTS/CM VARIABLE knob for desired sensitivity.

Even if the image protrudes from CRT screen, the trace within the scale is hardly distorted and synchronization is little disturbed.

For low sensitivity, the minimum amplitude for stable synchronization is less than 10m/m.

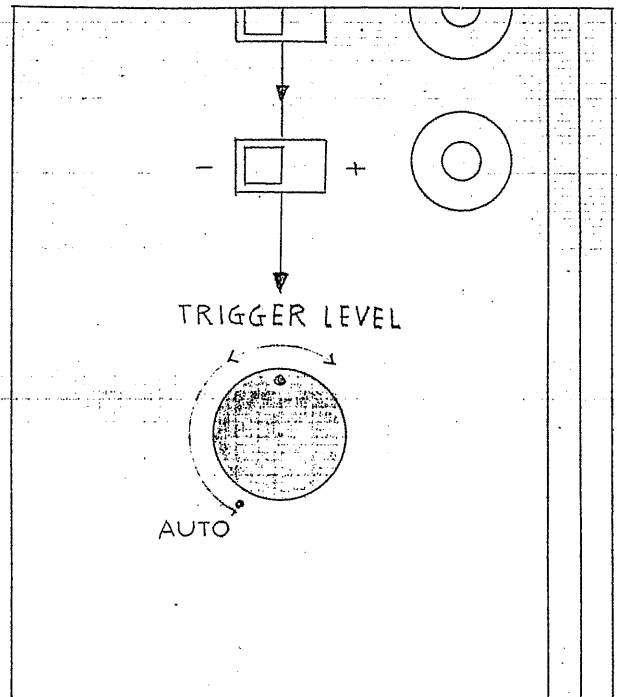
### Trigger level

Turn the TRIGGER LEVEL knob clockwise from AUTO, and you can start the sweep at any level the signal.

Turn the TRIGGER LEVEL knob, and the trace once disappeared.

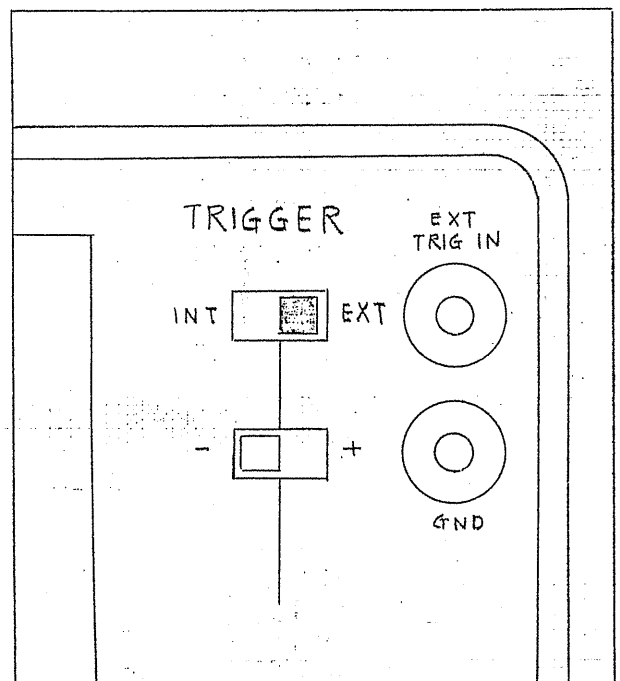
Turn is clockwise still more, and waveform appears at some position of the knob and the trigger level can be varied by the adjustment of the knob.

The shift of the starting position of waveforms by the rotation of the knob is observed more distinctly when the signal is sine wave.



### External Synchronization

In case of External sync. set the TRIGGER switch to EXT, and apply signals to be observed or voltages 1 (over 1Vp-p) synchronous with the signal to EXT TRIG IN terminals, and the setting of other control are the same as in the case of internal sync.



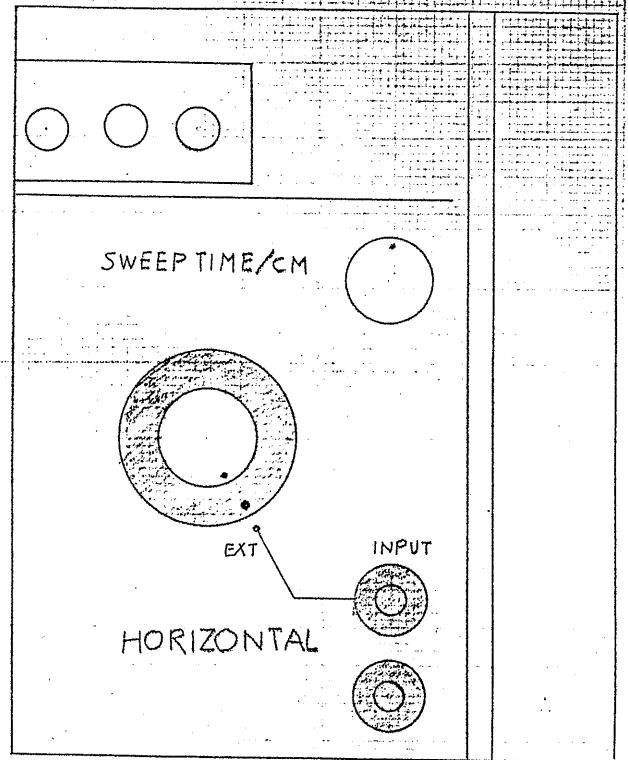
## External Sweep

The measurement of frequency or phase by use of lissajous pattern and the direct viewing of characteristics of a tuned amplifier by use of sweep generator is carried out in the following way. In order to stop internal sweep, set the black knob SWEEP TIME/CM to EXT, and the trace on CRT becomes a spot. Then apply to horizontal INPUT terminals, and the horizontal trace appears on the CRT screen. The trace length is controlled by the position of HOR INPUT ATTEN.

This circuit is dc-coupled and if the external sweep signal contains dc-component, it must be rejected by a capacitor.

## Intensity Modulation

The intensity modulation terminal is mounted on the back of the case and the voltage over about 10 Vp-p is required.



## Signal Polarity and Shift

Direction of pattern on CRT.

The pattern moves upward by applying a positive signal and downward by a negative signal on vertical axis.

The spot moves right by a positive signal and left by a negative signal on horizontal axis.

### Synckronizable Range

The specification assures steady display of sine wave signals of 50 c/s to 500Kc when an internal signal large enough to cause more than deflection, or an external signal of about 1 volt p-p is applied to the EXT TRIG IN terminals.

But vertical axis amplifier of this model has a bandwidth of 5Mc so the synchronous range must be expanded.

Applying a signal large enough for operation of the synckronizing circuit permits the extension of the range.

For example a signal of 4cm, amplitude on the scale for the internal sync, a signal of 4Vp-p can extend it to about 4Mc.

Note that a HF signal can not be observed because of an unstable line voltage.

### Camera Mounting

Trace recording cameras NIKON, CANON, ASAHI, PENTAX, POLAROID LAND CAMERA, can be mounted by exchanging the bezel of this model with 180C type.

### Scale Illumination

Take off the bezel, and the scale board appears. Rotate it half a turn 180°, and scale illumination can be changed from white to red.

### Adjustment of Horizontal Bright line

The horizontal bright line may be affected by the earth magnetism and may tilt. This adjustment is carried out by opening the left side board, loosening the screw which fixes the base and rotating the handle on the socket softly.

Caution : High tension voltage of about -1400V is applied to the socket.

Do not touch it with your hand.

## Maintenance and Calibration

The characteristics of vacuum tubes or other parts may change by long use.

In that case, adjust and return the measured value to the standard value.

Take off the left or right side board. The detaching can be done by rotating the lock screw on the upper of the side board counter-clockwise about one turn and pulling out the side board.

At this time, pay close attention, for the high voltage of -3000V is wired in this chassis.

### Calibration of Voltage

Axis and time axis (Requisite devices for calibration)

1. Power source for voltage calibration  
1Kc square wave generator which supplies calibrated voltage.
2. marker generator for time calibration or LF generator which.
3. Square wave generator which short rise-time and fall-time
4. capacity meter which can measure 30pF, Warmingup of about 30 minutes is needed for adjustment.

### Time Axis

1. Set VERTICAL VOLTS/CM to 0.1 and turn VARIABLE fully clockwise.
2. Connect the output of the square wave generator for calibration to VERTICAL INPUT terminals.

The generator is adequate if the output voltage is within the limits from 0.1 Vp-p to 0.4Vp-p.

Set the output voltage.

3. If the output voltage of the square wave generator is 0.1Vp-p, square wave of 1cm amplitude are observed on the CRT screen and for 0.4Vp-p, the image amplitude is 4cm.

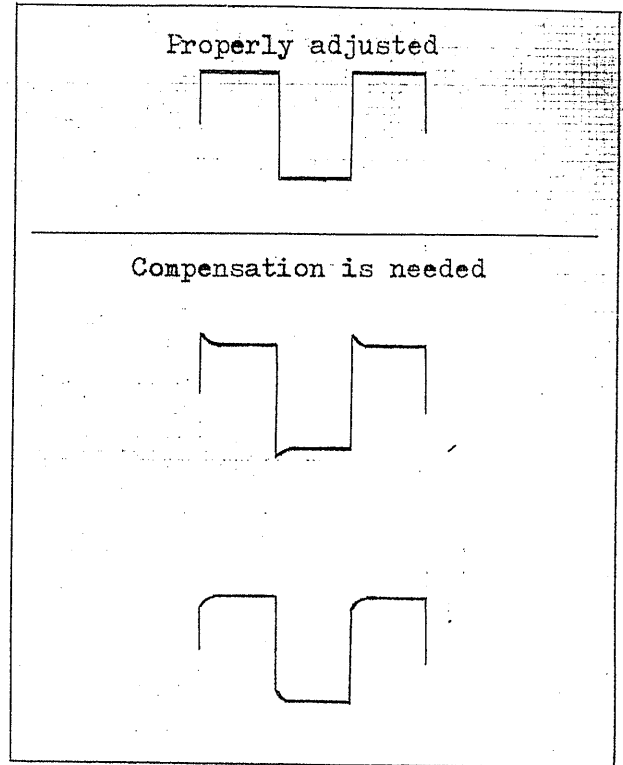
If the error of the observed waves is over 3%, calibrate the sensitivity by tuning the semi-fixed resistor for RV403 VERT GAIN adjustment.



Adjustment of Input Attenuator  
of Vertical Axis  
(Adjustment of HF Compensation)  
Confirm waveforms for each range  
of VERTICAL VOLTS/CM by use of a  
square wave generator.

When waveforms shown in the right  
figure is observed for ranges  
except 0.1, you must adjust the  
trimmer condenser COMPEN for HF  
compensation.

The relation between the range  
and the trimmer condenser is shown  
next.



Range (VOLTS/CM)	Trimmer Condenser for Compen.
0.2	CV 405 1/2 Compen
0.5	CV 407 1/5 Compen
1	CV 401 1/10 Compen
10	CV 403 1/100 Compen

**Caution**

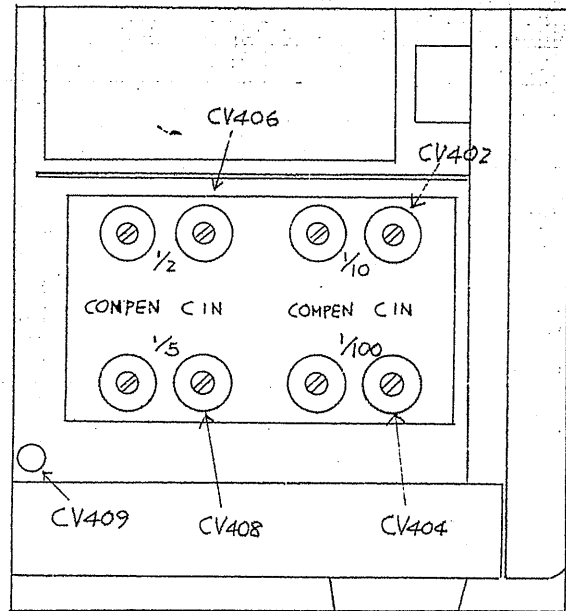
The square wave generator for sensitivity calibration or attenuator adjustment must be free from sag or overshoot.

If the square wave generator is not reliable, ~~VOLTAGE~~ CALIBRATOR equipped in this model is to be used.

### Adjustment of Input Capacitance

Input capacitance of each range of VERTICAL VOLTS/CM is adjusted to 30 pF. But confirm the input capacitance, and readjust simultaneously with adjustment of HF compensation when the error is over 1 pF for 30 pF.

Adjustment is carried out in the following order by connecting the capacity meter to VERTICAL INPUT terminals.



Range (VOLTS/CM)	Trimmer Condenser for input capacitance adjustment		
0.1	CV 409	1/1	C in
0.2	CV 406	1/2	C in
0.5	CV408	1/5	C in
1	CV 402	1/10	C in
10	CV 404	1/100	C in

When input capacitances are adjusted, HF compensation requires reconfirmation.

## Adjustment of HF Characteristics of Vertical Axis Amp.

When fast rise-time waveforms are observed, the error can arise by change of HF characteristics of the amplifier.

So readjustment of characteristics is necessary.

Set the VERTICAL VOLTS/CN knob to 0.1 and connect the fast rise-time square wave generator to the VERTICAL INPUT terminals and apply the output voltage within the limits of 0.2 to 0.4 Vp-p.

Repetition frequency within the limits of 100Kc to 500Kc is suitable.

If the overshoot of the observed waveforms is within 3%, adjust the peaking coil L402, L403, L406 and L407.

At this time the risetime of the square wave generator comes into question.

It is calculated by the following equation.

$$Tr = \sqrt{Tr_1^2 + Tr_2^2}$$

Tr observed time

Tr<sub>1</sub> risetime of the amp.

Tr<sub>2</sub> risetime of the osc.

$$\therefore Tr_1 = \sqrt{Tr^2 - Tr_2^2}$$

If Tr<sub>1</sub> is less than 0.07 $\mu$ sec, the square wave generator is in good condition.

The frequency characteristics of the amplifiers can be measured by use of a signal generator, too. In this case, you must use a signal generator which has little distortion.

Generator with much distortion causes errors of RF volt-meter unless the output level is adjusted.

Calibration of Sweep Speed  
of Time Axis

The control of sweep speed is capable by using RV303 HOR GAIN of horizontal amplifier and controls of sweep speeds of particular ranges are capable by using R221H, C224A and C224D.

Both controls are corelative.

So they are carried out in the following ways.

1. Set the range of SWEEPTIME/CM to 1m sec.
2. Rotate SWEEP TIME VARIABLE fully clockwise.
3. Set the output of TIME MARKER GENERATOR to 1m sec.
4. Connect the output of TIME MAKER GENERATOR to VERTICAL INPUT and synchronize it.
5. Adjust RV303 HOR GAIN of horizontal axis amplifier if the error on the scale of CRT is over 5% of standard values.

After this, dont move RV303.

6. If the range of 1m sec is calibrated automatically.

But particular range can be adjusted separately. They are

1 sec

10  $\mu$  sec

1  $\mu$  sec

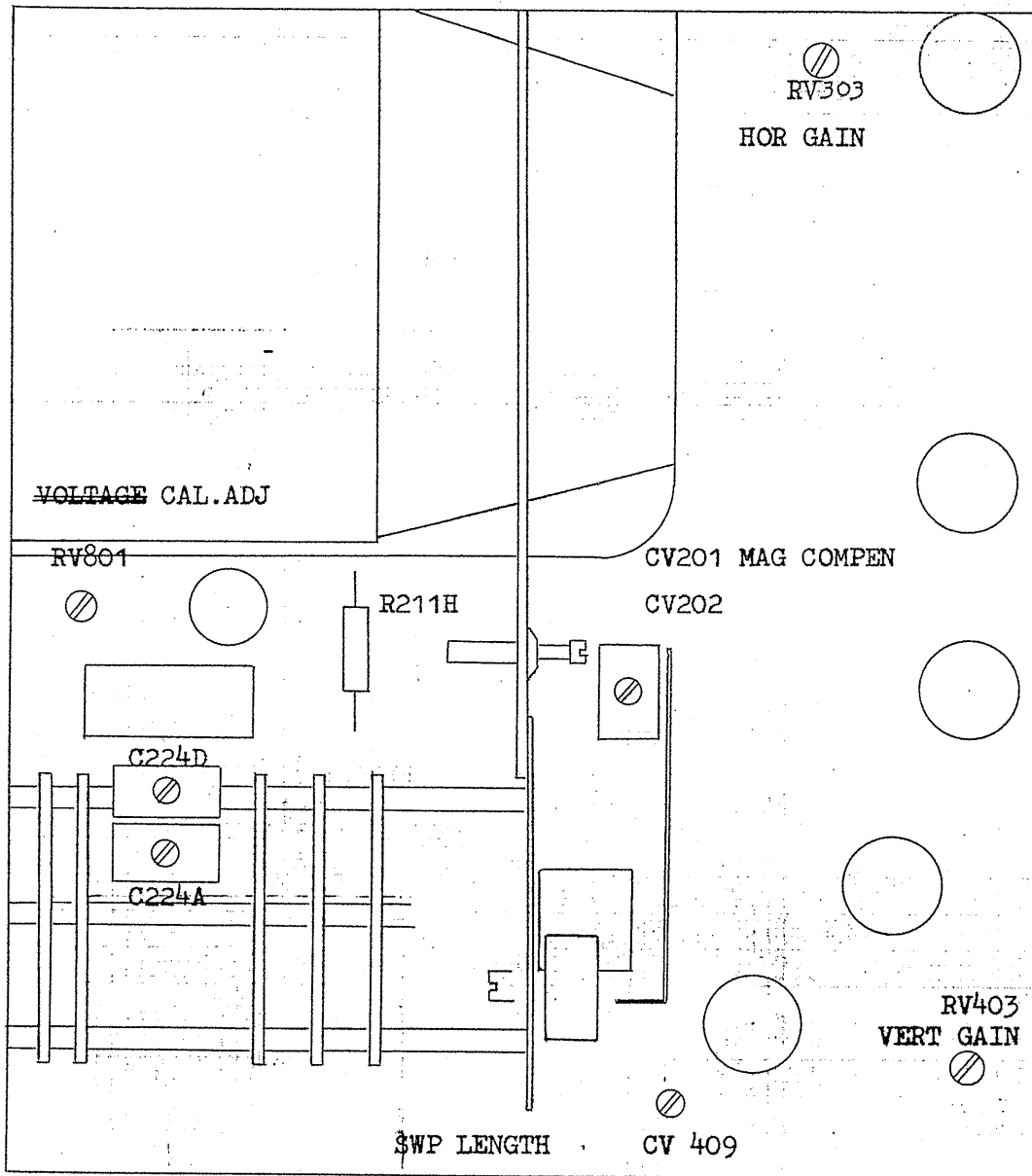
and can be calibrated by each resistor or trimmer condenser.

Range	Adjuster
1 sec	R211H fixed resistor
50 $\mu$ sec	C224D trimmer condenser
20 $\mu$ sec	
10 $\mu$ sec	
5 $\mu$ sec	C224A trimmer condenser
2 $\mu$ sec	
1 $\mu$ sec	

7. Note of the lenearity of sweep at ranges of 1 sec to 5 sec.

Adjust CV 202 trimmer condenser in case of bad linearity.

8. Then set a 5X MAG adjustment of linearity is carried out by CV 201 MAG COMPEN trimmer condenser.



Right side parts distribution diagram

Adjustor for time axis calibration

Adjustor for vertical axis sensitivity calibration

trimmer condenser for input capacitance adjustment of vertical axis

## Maintenance and Calibration

Adjustment of sweep length

Adjustment of the position

where the sweep ends is carried out by use of semifixed resistor.

Standard sweep length is 10.5 cm or 11cm.

When the sweep length is shorter than 10 cm in spite of the calibrating SWEEP TIME adjust and return to standard length.

Adjustment of Astigmatism

Manipulate the semi-fixed resistor in order to adjust the astigmatism of CRT.

Adjust it in conjunction with the FOCUS knob so that the sharpest waveforms are displayed.

This adjuster only requires adjustment in case of the replacement of CRT.

Adjustment of INTEN ADJ

Manipulate the semi-fixed resistor so that the intensity adjustment range of the INTEN knob on the panel is adequate, adjust it so that the image disappears just before the INTEN knob rotates fully <sup>counter</sup> clockwise,

When the image does not disappear by change of characteristics of CRT or by exchange of CRT.

Adjustment of ~~Voltage~~ Calibrator

Adjust RV 801 CAL ADJ by use of a calibrated

Oscilloscope (it is convenient to use the model 554B) or the calibrated square wave generator.

Adjustment of Low Capacitance Probe

Adjust the trimmer condenser by use of square wave of ~~VOLTAGE~~ CALIBRATOR so that the probe is free from overshoot and has a uniform frequency response.