

MODEL 554C
TRIGGER OSCILLOSCOPE
OPERATION MANUAL

印
刷
英
語
の
用
紙

KIKUSUI ELECTRONICS CORP.

MODEL 554C TRIGGER OSCILLOSCOPE

INSTRUCTION MANUAL

Model 554C Trigger Oscilloscope is a synchroscope employing a 133mm aperture cathode ray tube.

This model is provided with a trigger sweep oscillator which facilitates observing not only general waveforms but also the waveform of variable periods and the single transient phenomena of not being repetitive, and is equipped with the DC wide band amplifier of DC~5MC frequency range on the vertical axis, thus enabling the direct observation of higher quality waveforms on the calibrated graticule within the range of 20mV~300V and 0.2 μ sec~ 25sec, and is also equipped with terminals for external sweep and a square wave generator for voltage calibration. The application of printed circuit and rational mechanism as well as the above equipments feature this model as the oscilloscope of high reliability and versatile usability.

KIKUSUI ELECTRONICS CORPORATION

J A P A N

INSTRUCTION MANUAL

T A B L E O F C O N T E N T S

Specification	Page No. 3
	" 4
Description on Panel	" 5
	" 6
	" 7
	" 8
	" 9
Starting Operation	" 10
	" 11
How to Operate	" 11
	" 12
	" 13
	" 14
	" 15
	" 16
	" 17
Maintenance & Calibration	" 17
	" 18
	" 19
	" 20
	" 21
	" 22
	" 23
Repairing	" 24

S P E C I F I C A T I O N

Vertical Axis

Input Terminal	UHF receptacle (also M-type plugs acceptable)
Input Impedance	1 M Ω 37pF \pm 1 pF all ranges
Maximum Input Voltage	600V
Sensitivity	8 ranges 1, 2, 5 step 0.02V/cm ~ 10V/cm variable (0.02V/cm ~ about 30V/cm)
Calibration Accuracy	3 %
Frequency Characteristic	DC: 2 c/s ~ 5 MC DC: 0 ~ 5 MC
Rise Time	about 0.07 μ sec.
Over Shoot	3 %
Sag	1 %

Horizontal (Time) Axis

System	Trigger sweep and self sweep
Sweep Speed	19 ranges 1, 2, 5 step 1 μ sec/cm ~ 1 sec/cm variable (1 μ sec/cm about 2.5 sec/cm)
Calibration Accuracy	5 %
Magnifier	5 times
Magnification Accuracy	5 %
Trigger Input	AC coupling INT (+ -) LINE (+ -) EXT (+ -)
Trigger Range	50 c/s ~ 500 kc at 1 cm deflection on the scale (observable up to about 4 Mc)

External Sweep

Sensitivity less than 1V/cm (maximum input voltage 50V)

Frequency Characteristic DC ~ 500 kc.

Input Impedance 100 K Ω , less than 100 pF

Calibration Voltage

Output Voltage 0.05/0.5/5V p-p
square wave of about 1 kc

Accuracy 3 %

Cathode Ray Tube 5 U P 1 F

Intensity Modulation

Voltage more than about 10V p-p

Power Supply 100V 50/60 c/s approx. 140 VA

Dimensions (max. part)

230 (240) W, 310 (330) H, 450 (500) D mm

Weight approx. 16 kg

Accessories

Graticule (V x H - 8 cm x 10 cm + 43786) 1 pc.

Filter (any of G, O or B #43216) G is the standard 1 "

Low capacitance probe (-20 dB, 951A type) 1 "

Terminal adaptor (with 5 way terminal, 941 B type) 1 "

Short bar 1 "

Instruction manual 1 copy

Test record 1 "

DESCRIPTION on PANEL

「ILLUM
POWER OFF」 the knob for switching on-off the power and
for controlling the brightness of the scale
illuminating lamp, which becomes brightest
in the position of the knob having been ro-
-tated clockwise to the extreme.

「INTENSITY」 the knob for controlling the intensity of
the CRT (cathode ray tube), the intensity
of which becomes maximum by CW (clockwise
rotation) and disappears by CCW (counter-
clockwise rotation).

「FOCUS」 the knob for controlling the focus of CRT
image. The sharpest image can be observed
at the center position.

* * * * *

「VERTICAL
POSITION」 the knob to move the position of the CRT
image to the vertical direction (VERTICAL).
moves upwards by CW.

「HORIZONTAL
POSITION」 the knob to move the position of the CRT
image to the horizontal direction
(HORIZONTAL).
moves towards the right by CW.

* * * * *

「VERTICAL
INPUT」 the input terminals for waveforms to be
observed (UHF receptacle, also M-type plugs
acceptable).

The input impedance is constant in all ranges, and the resistance is 1 M Ω , and the parallel capacity is 37 pF. But, when the accessory 951A type low capacitance probe is applied, 10 M Ω and about 12 pF can be obtained though the sensitivity is decreased to 1/10.

┌ A C the switch to reject (AC) or let pass (DC)
└ D C the DC component of the waveform to be observed.

┌ VOLTS/CM the double knob for setting the sensitivity
└ VARIABLE of the vertical axis amplifier.

* Outer black knob (VOLTS/CM)

the knob to select the voltage sensitivity from 20mV/cm to 10V/cm by 1-2-5 steps, the sensitivity of which can be calibrated with the inner red knob rotated CW (CAL'D) to the extreme.

* Inner red knob (VARIABLE)

the knob to vary continuously the voltage sensitivity, which decreases to about 1/3 by rotating from the CW extreme to the CCW extreme.

┌ DC BAL the semi-fixed resistor for the balancing
└ control of the vertical DC amplifier; and
 corrects the vertical moving of the image
 when VOLTS/CM VARIABLE knob is rotated.

Adjust DC BAL knob so that the image is not moved by rotating the VARIABLE knob.

┌ CALIBRATOR ─┐ the square wave output of about 1,000 c/s to
└ ─┘ be used for the calibration of deflection
sensitivity and the adjustment of the low
capacitance probe, etc., enabling the use
of .05/.5/5Vp-p voltage and being stabilized
against the fluctuation of power supply
voltage.

┌ EXT TRIG IN ─┐ the input terminals of external signals for
└ ─┘ triggering. The input impedance is about
1 M Ω shunted by 20 pF, and a trigger voltage
higher than about 1 V p-p is needed.

┌ TRIGGER ─┐ the selector switch of trigger signals, and
└ ─┘ is divided into INT, which trigs the sweep
oscillator by a waveform to be observed,
EXT, which trigs by an external signal, and
the switch, which trigs by the positive go-
ing and negative going portions of the wave-
form.

┌ TRIGGER ─┐ the knob to control the level of signal to
└ ─┘
LEVEL ─┐ trig the sweep oscillator, enabling the
└ ─┘ automatic triggering in the position of
AUTO rotated CCW to the extreme.

┌ STABILITY ─┐ the knob to control the work level of the
└ ─┘
OR ─┐ sweep oscillator, which performs free running
└ ─┘
HOR. INPUT ─┐ by CW rotation, and the oscillation of which
└ ─┘
ATTEN. ─┐ is stopped by CCW rotation. The repose image
└ ─┘ is obtained at or near to the middle of rotation.

The sensitivity of the horizontal axis can be continuously adjusted when being used by the external sweep.

HORIZONTAL the dual knob to set the sweep speed and also
SWEEP TIME/CM to select the external sweep.

VARIABLE - * Outer black knob (SWEEP TIME/CM)

5X MAG the knob to select the sweep speed by 1-2-5 steps from 1 μ sec/cm to 1 sec/cm, and the calibration is performed when the inner red knob is rotated CW (CAL' D) to the extreme.

In the position of the outer black knob having been rotated CW to the extreme, the sweep oscillation stops and the horizontal axis amplifier is connected to the INPUT terminals. The horizontal axis amplifier is connected from the terminal to the DC-coupling.

* Inner red knob (VARIABLE)

HORIZONTAL (5X MAG)

VARIABLE the knob to continuously vary the sweep speed,
5X MAG and the speed is slowed to 1/2.5 by rotating from CW to CCW.

By pulling out this knob, the 5-times magnifier works so that the sweep width is enlarged to 50 cm, and the details of a waveform can be observed by rotating HORIZONTAL POSITION.

INTENSITY the terminals at the upper center on the rear
MODULATION of the casing to be used for intensity modula-

tion of the observed waveform.

The voltage required as the modulation signal is less than 10 V p-p.

STARTING OPERATION

The functions of each knob and terminal were explained in the preceding pages, but the following procedures can be taken first in view of an easier understanding.

- * ILLUM POWER.....POWER OFF
- * INTENSITY.....CW max.
- * FOCUS.....at or near center
- * POSITION (VERT).. "
- * " (HOR)... "
- * VOLTS/CM.....0.2V
- * VARIABLE.....CW max.
- * DC BAL.....as it is.
- * AC DC.....AC
- * SWEEP TIME/CM....0.5m Sec.
- * VARIABLE.....CW max.
- * STABILITY.....CW max.
- * TRIGGER LEVEL.....AUTO
- * TRIGGER.....INT +

After setting each knob as described above, begin the following operations.

-POWER SUPPLY-

Volts 50~60 c/s commercial power is applied.

This model runs in stable performance within $\pm 10\%$ fluctuation of the power supply voltage. But, in order to ensure a high reliability for a long time and the long life of the component parts, the power voltage must be within the range of 95~105% always during the time of operation. Furthermore, it is required that the operation is performed in the room temperature lower than 35°C and in the place of being avoided from the direct rays of the sun and from high humidity and of good ventilation.

-OPERATION-

Connect the plug of the line cord to a line outlet.

Rotate ILLUM POWER knob CW from the position of POWER OFF for switching in the power. By this action, the scale is illuminated and the switching-in of the power can be confirmed.

At about 20 seconds after the switching-in of the power, this instrument becomes ready for operation, and a horizontal bright line of about 10cm long appears on the CRT screen.

The bright line remains drifting for a few minutes thereafter due to

the DC-coupled circuit.

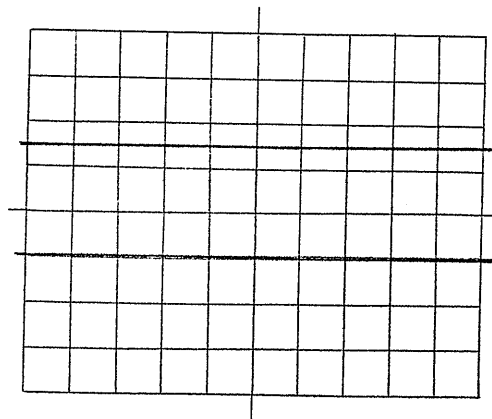
Adjust FOCUS knob so as to obtain a sharp bright line.

HOW TO OPERATE

-AUTO and TRIGGER-

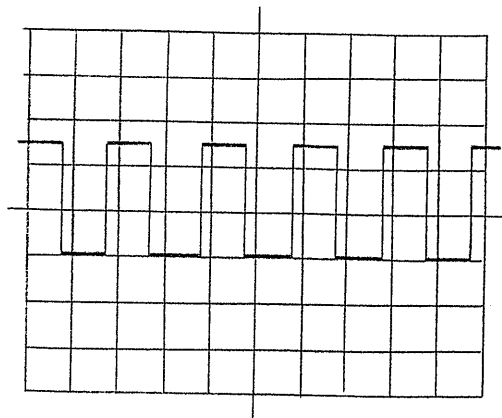
* Attach the accessory terminal adaptor (Type 941B) to VERTICAL INPUT terminal and connect by means of a proper conductor between VERTICAL INPUT and VOLTAGE CALIBRATOR .5V p-p.

* On the CRT screen, two horizontal bright lines appear as shown in the following figure which are of the square wave running horizontally.

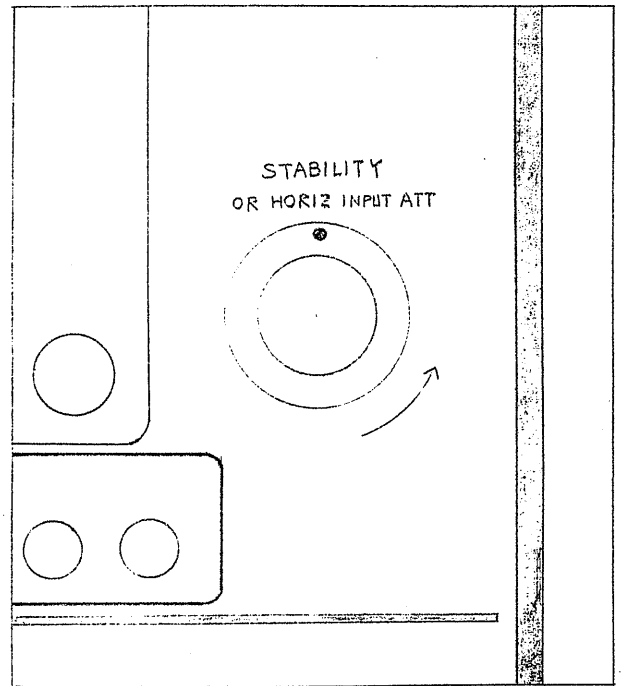


-STABILITY-

When the knob is rotated slowly from CW to CCW, the sweep oscillator in free running is synchronized and the stable image of the square wave can be observed as shown in the following figure.



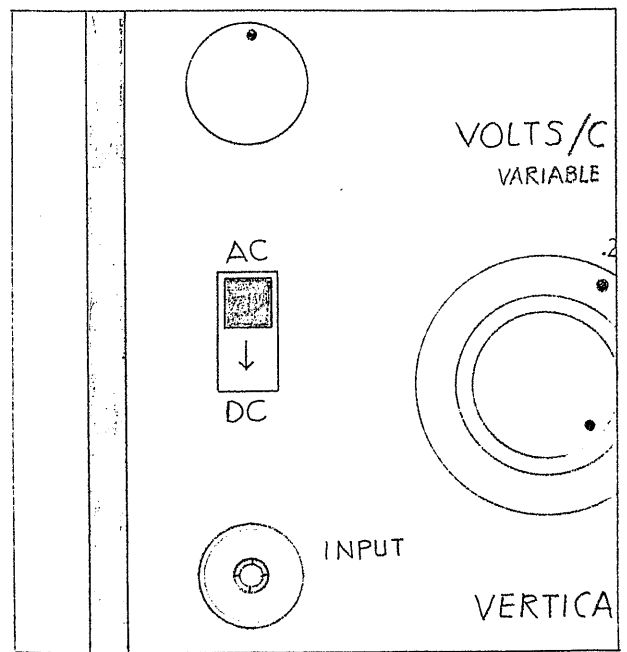
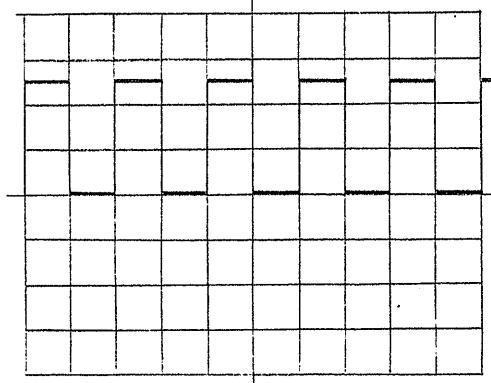
When this knob is rotated CCW further, the sweep oscillator stops the oscillation and the bright line disappears in passing a certain point of rotation.



* If the waveform on the screen is examined by the scale, the following characteristics can be observed as the vertical amplitude is 2.5cm and one cycle of the square wave is 2cm wide;

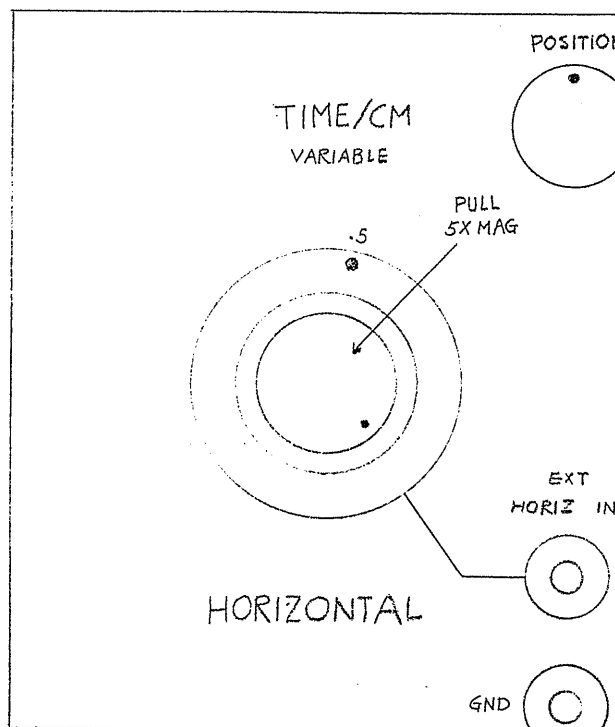
Voltage =
 $2.5 \text{ cm} \times .2\text{V/cm} = .5\text{V (p-p)}$
 Period = $2\text{cm} \times 0.5\text{ms/cm} = 1\text{ms}$
 (Frequency = $1/\text{period} = 1000\text{c/s}$)

* Set AC DC switch to DC, and only the DC component of the observed waveform is raised as shown in the following figure since the DC component passes.



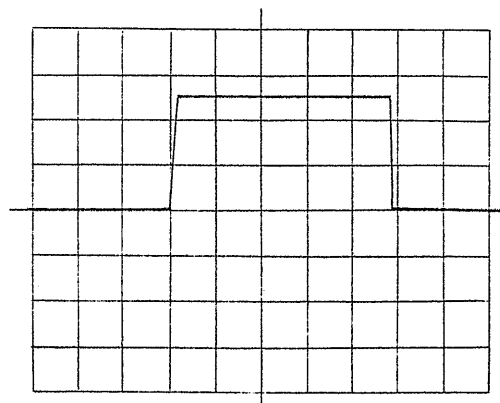
* When the slide switch of TRIGGER is turned to -, the polarity of the observed waveform to start is changed.

* When SWEEP TIME VARIABLE knob is pulled out and is set to the position of 5X MAG, the waveform is enlarged by 5 times to the horizontal direction as shown in the following figure, so that the detail of the waveform can be observed part by part with HORIZONTAL POSITION knob rotated.



* In adjusting VOLTS/CM and VARIABLE knobs, the trace in the scale is scarcely distorted and the synchronism is little disturbed so far as is not extremely large signal, even if the sensitivity is raised and the waveform is projected out of the screen.

When the sensitivity is lowered on the contrary, the minimum amplitude for stable synchronization is less than 10 m/m.



-TRIGGER LEVEL-

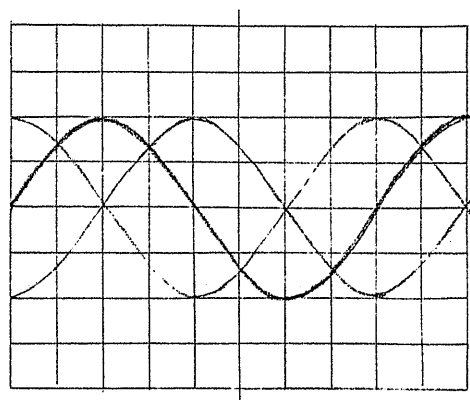
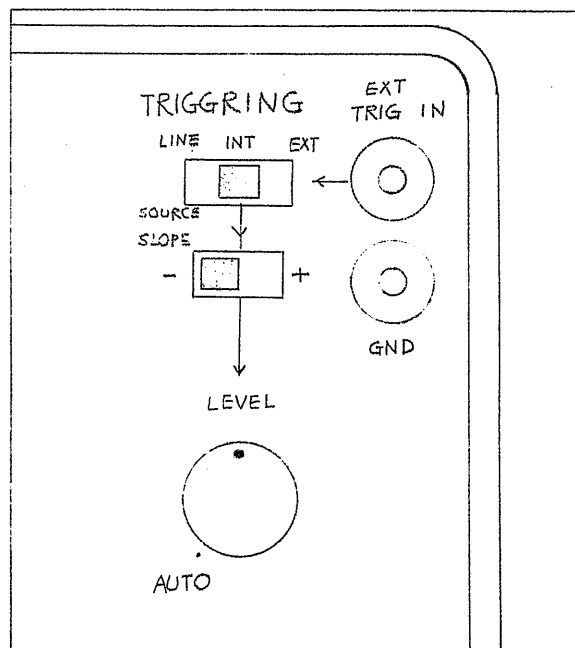
* The sweep oscillator can be started from an optional level of the signal by rotating TRIGGER LEVEL knob from CCW AUTO to CW.

When TRIGGER LEVEL knob is rotated, AUTO switch is turned off and the trace disappears once. And when rotated CW further, the waveform appears within a range of the knob and the trigger level can be adjusted by the knob.

The movement of the starting position of the waveform can be found clearly if a sine wave is observed, though a little indistinct with square waves.

-EXTERNAL SYNCHRONIZATION-

The above descriptions relate to the internal synchronization. Also, in case of the external synchronization, TRIGGER switch is set to EXT, and EXT TRIG IN terminal is provided with the observed signal as it is or with a sufficient voltage synchronized with the observed signal, and other operating methods are same as the case of the internal synchronization. The sufficient voltage in this case implies more than 1V p-p.



-EXTERNAL SWEEP-

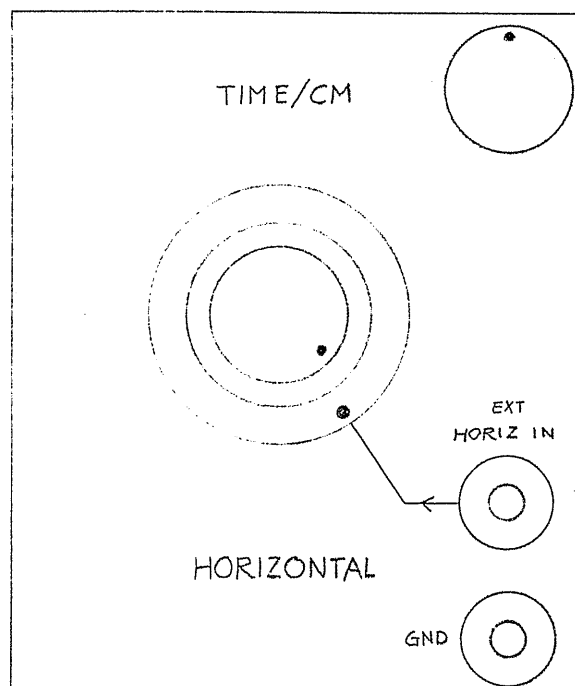
The measurement of frequency and phase utilizing Lissajous' figure and the direct viewing of the characteristics of a tuning amplifier applying the sweep generator are performed as being shown in the right side drawing: when 'SWEEP TIME/CM' black knob is rotated out CW to the position of EXT, the internal sweep stops and the trace on the CRT screen becomes a spot.

Then, give the external sweep signal to HORIZONTAL 'INPUT' terminal, and the horizontal trace appears on the CRT screen and the trace length can be varied by adjusting 'HOR INPUT ATTEN'.

This circuit is DC-coupled, so that, if DC is included in the external sweep signal, the DC component must be rejected by means of a capacitor.

-INTENSITY MODULATION-

The intensity modulation terminal is provided at the rear of the casing, which requires a voltage more than about 10 V p-p.



-SIGNAL POLARITY and MOVING DIRECTION of IMAGE-

As for the vertical axis, the image on the CRT moves upwards by applying a positive signal and moves downwards by applying a negative signal.

As for the horizontal axis, the image moves to the right by a positive signal and to the left by a negative signal.

-SYNCHRONIZABLE RANGE-

The specification prescribes by voltage level the synchronizing signal required for working the synchronizing circuit and similarly prescribes the synchronizable range to be 50 c/s ~ 500 kc.

This is the case of being shown as a sine wave, and implies the range within which the trigger sweep can be performed by 1cm deflection on the scale surface in case of the internal synchronization and by the synchronizing input of 1 V p-p in case of the external synchronization.

However, the vertical axis amplifier of this model has a band width up to 5 MC, so that the synchronous range must be spread further.

Therefore, if the condition of the synchronous range is mollified, for instance 4cm deflection is taken on the scale surface and 4V p-p is taken in case of the external synchronization and a sufficient signal to work the synchronizing circuit is given, the synchronous range is spread, thus enabling the observation up to about 4 MC.

* In case of the power supply voltage being unstable, be care-

ful to that a particularly high frequency may not be observed.

-MOUNTING of PHOTOGRAPHIC DEVICE-

Any of the specialized photographic cameras such as Nikon, Canon, Asahi-Pentax, Polaroid and Land Camera, etc., can be mounted by replacing the bezel of this model with that of '130C' type of CES (Rules by the Committee of Electronics Machinists' Society in Japan).

-SCALE ILLUMINATION-

Where the bezel is removed, the scale plate comes out, by the rotation by 180° of which the illumination for the scale can be changed from white colour to red.

-ADJUSTMENT of HORIZONTAL BRIGHT LINE on CRT-

The horizontal bright line is influenced by the earth magnetism, so that the line may be inclined depending upon the installed direction.

This can be adjusted by that the left side panel is opened, the fixing screw of CRT base is unscrewed and the handle attached to the socket is turned slowly.

Be fully careful not to touch

to the socket since it is supplied with the high tension voltage of about -1400V.

MAINTENANCE & CALIBRATION

When the characteristics of the vacuum tubes and other component parts are changed due to use for a long time and consequently error is caused in the measurement, the adjustment to put it back to the certain standard value is required.

The adjustment is performed by removing the left side or right side panel. For removing it, rotate the lock screw provided at the upper part of the side panel by about one revolution to the counterclockwise direction and draw the side panel outwards as it is.

In the chassis, the high voltage of -3000V is wired, of which the utmost care must be taken.

** CALIBRATION of VERTICAL AXIS and TIME BASE

Equipments required for the calibration.

1. A power supply source for voltage calibration.

1 kc square wave generator

which supplies with calibrated voltage is used.

2. A marker generator for time calibration
or the low frequency oscillator of definite frequency.
3. A square wave generator of very short rise-time and fall-time (about 25 m μ sec.) if possible.
4. A capacity meter which can measure 37 pF. Prior to beginning the adjustment, the warming up of about 30 minutes after switching-in the power is required, and it is to be performed after every part is sufficiently stabilized.

** SENSITIVITY CALIBRATION of VERTICAL AXIS.

1. Set 'VERTICAL VOLTS/CM' to 0.1V and 'VARIABLE' to CAL'D, the position of being rotated clockwise to the extreme.
2. Connect the output of the square wave generator for calibration to 'VERTICAL INPUT' terminal. As the output within the range of 0.1V p-p or 0.4V p-p is adequate at

this time, predetermine a firm output within this range.

3. If the output of the square wave generator is 0.1 V p-p, the square wave of 1 cm high can be observed on the CRT screen, and if 0.4 V p-p the height becomes 4 cm.

If the observed waveform does not fit to the scale and shows a error exceeding 3% against the standard value, calibrate the sensitivity by rotating the semi-fixed resistor for RV403 \uparrow VERT GAIN \downarrow adjustment making reference to the Component Part Disposition Diagram and Vertical Axis Circuit Diagram.

*ADJUSTMENT of INPUT ATTENUATOR of VERTICAL AXIS

(Adjustment of High-Frequency Compensation)

Rotate \uparrow VERTICAL VOLTS/CM \downarrow to 0.02 and 0.05, 0.1 . . . 10, and apply the output corresponding to the voltage sensitivity at each position by the square wave generator in order to confirm the accuracy.

If the waveform shows overshooting or roundness around the shoulder part on the contrary in any range other than 0.02 at this time, adjust the trimmer condenser \uparrow COMPEN \downarrow for high-freq compen-

sation as shown hereinafter so as to be the correct waveform.

The relationship between the range and trimmer condenser for compensation is as being described below.

Range (VOLTS/CM)	Trimmer Condenser for Compensation
0.05	CV405 1/2.5COMPEN
0.1	CV407 1/5 "
0.2	CV401 1/10 "
2	CV403 1/100 "

** Caution

The square wave generator to be used for sensitivity calibration and attenuator adjustment must be of no sag nor overshooting in the waveform of the output.

If a reliable device is not obtainable, do not follow to the above method but use 'CALIBRATOR', equipped inside the casing which brings far reliable results.

* ADJUSTMENT of INPUT ATTENUATOR
of VERTICAL AXIS

(Adjustment of input capacity)

The each range of 'VERTICAL VOLTS/CM' is adjusted to 37 pF.

The input capacity as well as the adjustment of the high-freq compensation described in the preceding section must be confirmed, and the re-adjustment is to be performed if the error exceeds ± 1 pF against 37 pF.

The adjustment is performed in the following order after the capacity meter is connected to 'VERTICAL INPUT' terminal.

Range (VOLTS/CM)	Trimmer Condenser for Input Capacity adjustment
0.02	CV409
0.05	CV406 1/2.5C IN
0.1	CV408 1/5 "
0.2	CV402 1/10 "
2	CV404 1/100 "

When the input capacity is adjusted, re-confirmation is required since the high-freq compensation described in the preceding section may be slipped out.

* Adjustment of High-Frequency Characteristics of Vertical Axis Amplifier

If the high-frequency characteristics of the amplifier is changed while the waveform of a very fast rise-time is observed, an error may be caused, so that the characteristics must be adjusted again.

Set \lceil VERTICAL VOLTS/CM \rfloor to 0.02 and connect the square wave generator of very fast rise-time (about 25 m μ sec.) to \lceil VERTICAL INPUT \rfloor , apply an output voltage within the limit of 0.05~ 0.4 V p-p.

The repetitive frequency of the square wave within 100 kc ~ 500 kc is suitable to use.

If the overshooting of the observed waveform is less than 3%, it is in the standard state. But, if more than 3%, adjust the peaking coils L402 L403 and L406 L407 and put the overshooting back to the standard state.

In this situation, the frequency band of the amplifier can be confirmed.

At this time, the rise-time of the square wave generator comes into question and is calculated by the following equation.

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

Tr ...observed time

Tr₁...rise-time of amp.

Tr₂...rise-time of osc.

Therefore, Tr₁ is obtained by

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

If Tr₁ is less than 0.07 μ sec., the square wave generator is good.

Besides the above, the frequency characteristics can be measured by using a signal generator. In this case, the signal generator to be used must be of as little distortion as possible. Care should be taken to the fact that an error is caused in the measurement unless the output level is adjusted by the high frequency voltmeter of p-p value indicating type when the distortion is considerable.

* CALIBRATION OF SWEEP SPEED OF TIME BASE

As for the sweep speed, all the ranges can be varied simultaneously by using RV303 'HOR GAIN', of the horizontal axis amplifier, and particular ranges can be further changed by R221H, C224A and C224D. These controls are correlated each other, so that the controls are to be performed in the following sequence.

1. Set 'SWEEP TIME/CM', range to 1 m sec.
2. Rotate 'SWEEP TIME VARIABLE', clockwise to the extreme.
3. Set the output of Marker Generator for time calibration (our Type 442 Time Mark Generator, etc.) to 1 m sec.
4. Connect the output of Time Mark Generator to 'VERTICAL INPUT', and synchronize.
5. If the value read by the CRT scale is of less than $\pm 5\%$ of the standard value, it is adequate. And, if more than $\pm 5\%$, adjust RV303 'HOR GAIN', of the horizontal axis amplifier to put it back to the standard value.

After then, RV303 should not be moved.

6. When 1 m sec. range is calibrated, other ranges are automatically calibrated, but particular ranges can be adjusted separately, so that the following are the description in this respect.

The individual adjusting ranges are calibrated respectively by the resistance or trimmer condenser at the three points of

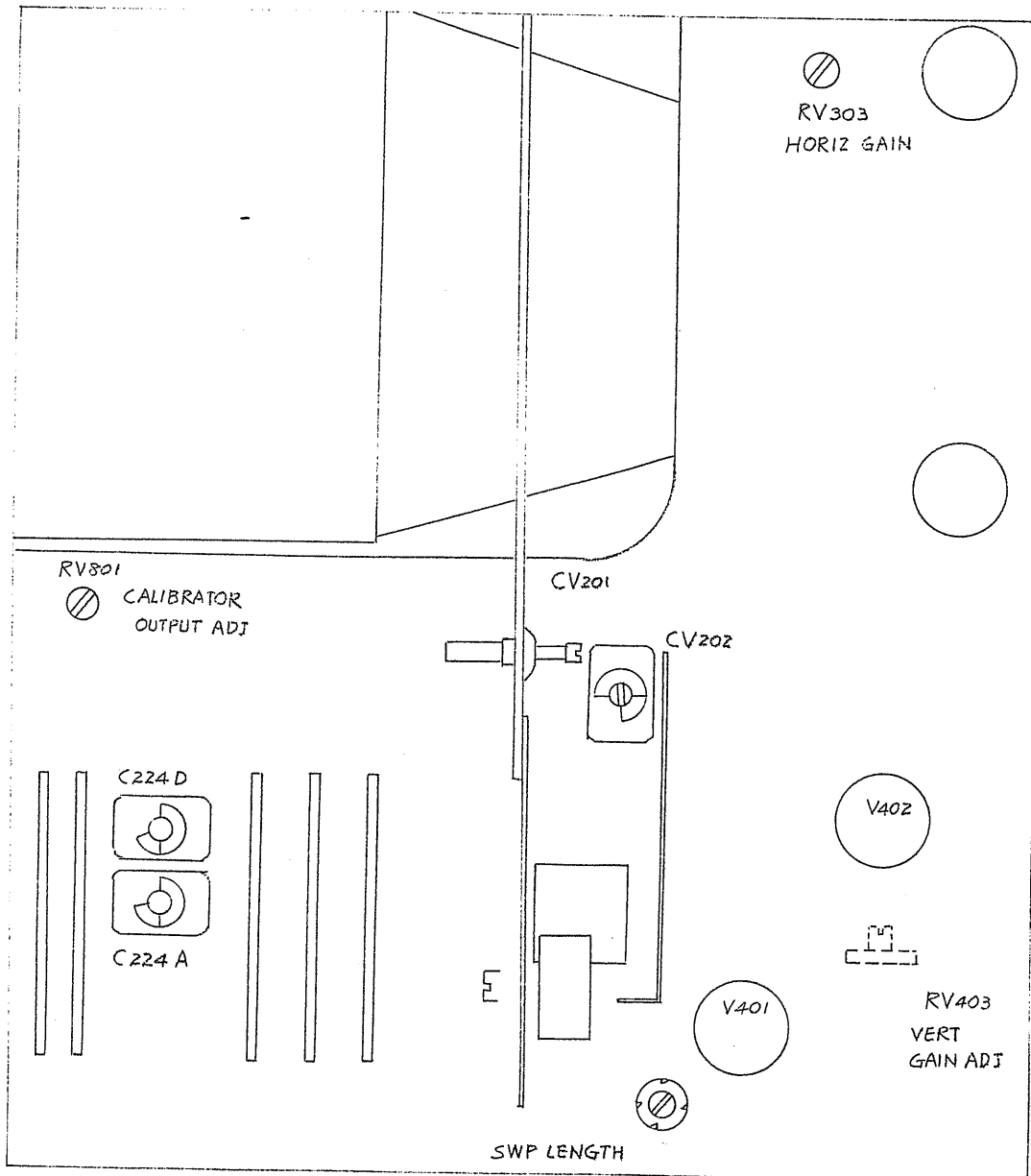
- 1 sec
- 10 μ sec
- 1 μ sec

Range	Adjustor
1 sec	R211H fixed resistor
50 μ sec 20 μ sec 10 μ sec	C224D trimmer condenser
5 μ sec 2 μ sec 1 μ sec	C224A trimmer condenser

7. Be careful of the sweep linearity of 1 μ sec ~ 5 μ sec ranges. In case of the linearity being unsatisfactory, adjust CV202 trimmer condenser.

8. Set to '5X MAG', as it is. The adjustment of the linearity is

performed by CV201 「MAG COMPEN」
trimmer condenser.



Component Parts Disposition Diagram at the Right Side

- * Disposition of the adjustor for time base calibration
- * Disposition of the adjustor for vertical axis sensitivity calibration
- * Disposition of the trimmer condenser for vertical axis sensitivity l/l input capacity adjustment

* Adjustment of SWP LENGTH

The standard sweep scale length is adjusted to 10.5cm ~ 11 cm by the semi-fixed resistor which adjusts the position of sweep ending.

When the horizontal bright line is shorter than 10cm in spite of the correct calibration of 「SWEEP TIME」, adjust to the standard length.

* Adjustment of ASTIG

This is a semi-fixed resistor to adjust the astigmatism of CRT.

It displays traces to spread over the entire area of the CRT screen, and adjustment is to be performed in co-operation with 「FOCUS」 knob so that the sharpest waveform is obtained.

This adjustor little requires adjustment except the time of CRT replacement.

* Adjustment of INTEN ADJ

This is a semi-fixed resistor by which the intensity control range of 「INTEN」 knob on the panel is set to the best position.

When the image does not disappear due to change in the characteristics of the CRT, etc., or the CRT is replaced, adjust the 「INTEN」 knob so that the image disappears right before the ext-

reme of the counterclockwise rotation.

* Adjustment of CALIBRATOR

Adjust RV801 CAL ADJ by using a calibrated reliable oscilloscope or using a calibrated square wave generator and oscilloscope for comparing the output.

Of course, it is convenient to use model 554C.

* Adjustment of the accessory low capacitance probe

Adjust the trimmer condenser of the probe by means of the square wave output of VOLTAGE CALIBRATOR so that the horizontal part of the waveform appeared on the CRT screen becomes straight.

R E P A I R I N G

Prior to delivery, an inspection is performed under strict management for each of our manufactured instruments, but if on earth a trouble happened, the cause must be found as quickly as possible.

First of all, try to operate the panel of this instrument, classify the circuit where the troubled part is involved, then take off the side board, and check the parts and wiring of the circuit suspected to be troubled.

In checking the circuit, refer to the attached drawings for confirming the working state of the circuit.

Trouble Shooting by Condition

Condition	Troubled Circuit	Circuit to be Checked
Trace does not appear on the CRT	<ul style="list-style-type: none"> *High tension voltage circuit *Intensity control circuit of the CRT *Stop of working of the time base *Extreme unbalance of the vertical axis *Trouble of the CRT 	Rectified output voltage Try to replace the voltage vacuum tube of the cathode and control grids of the CRT "
Sweep works but observed signal does not appear	<ul style="list-style-type: none"> *Vertical axis amplifier *Input circuit including the vertical axis voltage divider 	Try to replace the vacuum tubes
No synchronization	<ul style="list-style-type: none"> *V101 6U8 Circuit *V102 6AQ8 Circuit *V204 6AQ8 and related circuits 	Check the output of V102 multi-vibrator by using a oscilloscope