Model 556

OSCILLOSCOPE

INSTRUCTION MANUAL

KIKUSUI ELECTRONIC CO., LTD.

Japan

Model 556 Oscilloscope is a high class oscilloscope for general use in which the cathode-ray tube of 133 mm in diameter and push-pull type DC amplifier of broad-bank to vertical axis are used and furthermore the bootstrap type time-base oscillator is provided.

Also, this is an oscilloscope suitable to measurements covering an extensive range to the effect that, particularly as for the vertical axis, the sensitivity is calibrated by the voltage value, so that quantitative measurement can readily be performed, and also such devices can be attached as the time-base sweep oscillator of good linearity ranging from 1 c/s to 100 kc, external sweep terminal, intensity modulation terminal, scale illumination of which intensity can continuously be varied, and photographic equipment applying CES 130C type cathode ray tube bezel, etc.

Adjusting the calibration voltage

Adjusting the vertical axis input attenuator

Adjusting the low capacitance probe

Adjusting the DC balance of the horizontal axis amplifier

Repair

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

Vertical Axis

Input terminal

UHF Type receptacle (also applicable to M type plug)

Input impedance

1 MΩ 30 PF ± 1 PF

Maximum input voltage

600 V

Sensitivity

5 ranges 1 - 3 step

Q1V/cm ~ 10V/cm

Variable (Q1V/cm ~ about 30V/cm)

Calibration accuracy

5 % (at 100V power supply voltage)

Frequency characteristic

AC: 2 c/s ~ 2.5 MC within -3 dB

DC: 0 ~ 2.5 MC within -3 dB

Overshoot 3%

Sag 1%

Time Base

Sweep frequency	Range	1 c/s ~ 10 c/s
		10 c/s ~ 100 c/s
		100 c/s ~ 1 kc
		1 kc ~ 10 kc
		10 kc ~ 100 kc
	Variable	Continuously variable between the respective ranges.

Synchronism

Internal (positive or negative)

External (synchronous signal voltage more than 2^{Vp-p})

Line

External Sweep

Sensitivity	More than 0.9V/cm	
	DC ~ 350 kc	- 3 dB
Input impedance	100 kΩ	less than 70 PF

Calibration Voltage

Output	0.3^{V} p-p	3^{V} p-p	square wave
Accuracy	3 %		

External Intensity Modulation

Voltage	More than 10^{V} p-p

Power Supply	Voltage	100V	50 ~ 60 c/s
	Power consumption	Approx. 90VA	

Dimension (the maximum part)

230 (240) W x 310 (330) H x 400 (448) D mm

Weight Approx. 13 kg

Accessories	Scale plate (8 x 10 cm 43786)	1
	Filter (G, O, or B 43216) G is standard	1
	Low capacitance probe (Type 951A -20 dB)	1
	Terminal adapter (Type 941B with 5 way terminal)	1
	Instruction manual	1
	Test data	1
	Short bar	1

Description of Panel Face

ILLUM POWER OFF

This is the knob for switching on and off the power supply and for controlling the brightness of the CRT (cathode-ray tube) scale illumination lamp, the brightness of which becomes maximum at the position being rotated clockwise to the extreme.

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Power supply cathode-ray tube

INTENSITY

This is the intensity control knob of CRT, the intensity of which becomes maximum by CW (clockwise rotation), and becomes extinct by CCW (counterclockwise rotation).

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FOCUS

This is the focus control knob of CRT bright point.

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VERT POSITION

This is the knob for moving the rest position of the bright line to the vertical (VERTICAL) direction, the position of which is moved upwards by CW.

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VERT INPUT

This is the input terminal of the observation signal (also applicable to M type plug using UHF type receptacle).

The input impedance is constant for all the ranges, the resistance 1 MΩ, and the parallel capacity 30 PF.

Where the accessory 951A type low capacitance probe is applied, the sensi-

Vertical axis

VERT INPUT (cont'd)	tivity lowers down to 1/10, but the input impedance rises to 10 MΩ and the capacity to about 12 PF.
AC - DC	This is the switch for checking (AC) the DC portion of the observation wave-form or for letting it pass through (DC).
VOLTS/CM	This is the double knob for setting the sensitivity of the vertical axis amplifier. *External black knob (VOLTS/CM)
VARIABLE	This is the knob for turning the sensitivity from 0.1V/CM to 10V/CM, and the sensitivity is calibrated at the state of the internal red knob being rotated up to CW (CAL D). *Internal red knob (VARIABLE) This is the knob to vary the sensitivity continuously, and the sensitivity becomes about 1/3 by rotating from CW to CCW.
DC BAL	This is the semi-fixed resistor for adjusting the DC balance of the vertical axis DC amplifier. This corrects the movement of the bright line to the vertical direction which occurs when the VARIABLE knob of the vertical sensitivity is rotated.

	This is the square wave output of the power supply frequency to be used for the
CALIBRATOR	calibration of the deflection sensitivity, and is stabilized against the fluctuation of the power supply voltage.
	This is the double knob for setting the internal sweep frequency.
	*External black knob (SWEEP RANGE)
SWEEP RANGE	This is the knob for turning the sweep frequency from 1 c/s to 100 kc, and is turned
VARIABLE	to the external sweep at the position of EXT being rotated up clockwise.
	*Internal red knob (VARIABLE)
Horizontal axis	This is the knob for varying continuously the sweep frequency between ranges which is shown at the external black knob.
	This is the external sweep terminal.
EXT INPUT	The tuning circuit observation of television receiver and the like is performed by applying this terminal for combining with Lissajous' figure or the sweep generator.
	This is the knob for moving the rest position of the bright point to the horizon-
HOR POSITION	tal (HORIZONTAL) direction, the position of which is moved to the right by CW.

HORIZONTAL GAIN

This is the knob for adjusting the sensitivity of the horizontal axis amplifier.

This can be used for both the internal sweep and external sweep, and the sensitivity is increased by CW.

Synchronism

SYNC SELECT

This is the synchronous switch of the internal sweep, and can be turned to the internal synchronous positive, negative, and power supply, and to the external synchronism.

SYNC ADJ

This is the knob for adjusting the strength of synchronism, and the strength of the synchronism is increased by CW.

EXT SYNC IN

This is the input terminal of the external synchronism.

The input impedance is about 200 KΩ , and the signal voltage required for the synchronism is 2^{V} p-p or above.

Description of Back Panel

CRT G

This is the external intensity modulation terminal of CRT.

The accessory short bar is removed, and the intensity modulation signal is provided.

The signal voltage is required to be

more than 10^{V} p-p.

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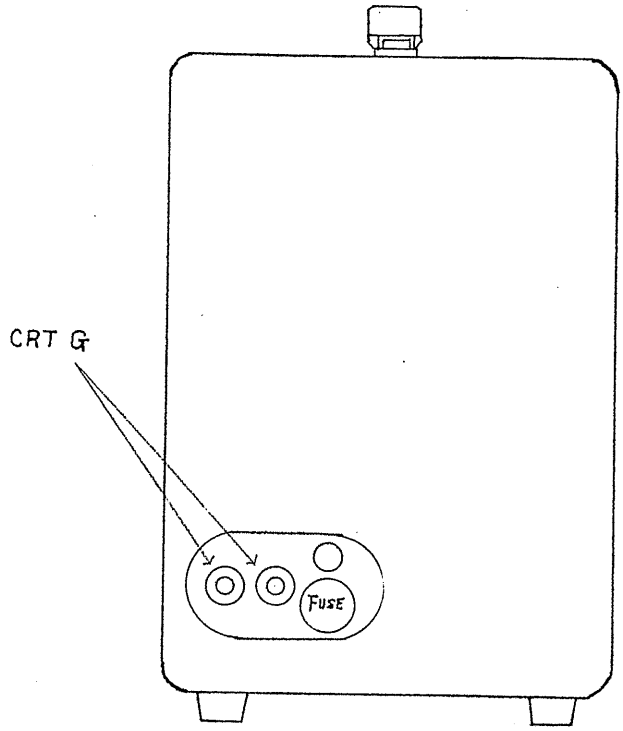
FUSE

This is the fuse for the power supply.

The fuse of 1A as current value and of slow blow type is used.



Description of Operating Method

Remarks on Setting Position

This shall be used at the place where the room temperature is below 40°C and the direct sun rays, high humidity and dust are little, and particularly in the case of being simultaneously used with the heat radiating instruments, this shall be carefully placed so as not to closely contact with such other instruments.

Remarks on Power Supply

The voltage range of the power supply within which this works safely is between 90 ~ 110V, but it is preferred to be used within the range of 95 ~ 105V in order to ensure the high dependability for a long time and the long life of the parts.

First Operation

Setting the knobs

The knobs shall be set as being described below in order that the CRT screen figures are traced and the functions of the knobs are certainly understood.

INTENSITY	CW max
FOCUS	approx. at the center
VOLTS/CM	1V
VARIABLE	CM max (CAL 'D)
VERT POSITION	approx. at the center
SWEEP RANGE	10 ~ 100
VARIABLE	approx. at the center

HOR POSITION	approx. at the center
HOR GAIN	approx. at the center
SYNC SELECT	INT +
SYNC ADJ	approx. at the center
ILLUM POWER OFF	OFF

After setting the respective knobs to the positions as being described above, the power supply cord is connected to the commercial power supply line of 100V.

Switching on the Power Supply

Rotate the ILLUM POWER OFF knob to CW, and the power supply switch becomes "ON" and the power supply is made.

Where this knob is further rotated to CW, the CRT scale illumination works to illuminate the scale.

At about 20 seconds after the power supply being made, the horizontal bright line appears on the CRT screen, and enters into the working state, but for a few minutes after then, the horizontal bright line moves because of the DC coupling at the amplifier, so that it shall be reset approximately to the center of the CRT screen by means of the POSITION knob.

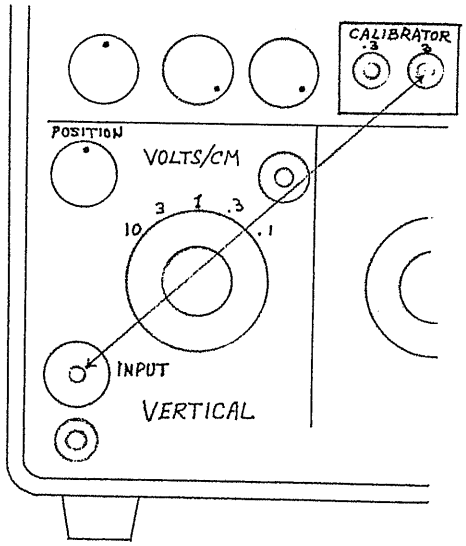
Observing the Wave-forms

When the output 3V p-p of the CALIBRATOR is supplied to the VERT INPUT terminal, the square wave of the power supply frequency can be viewed on the CRT screen. If the synchronism is not attained and

the wave-form is moving to the horizontal direction,

1) Try to rotate slowly the VARIABLE knob of the SWEEP RANGE.

2) Adjust the VARIABLE knob of the SWEEP RANGE after rotating the SYNC ADJ knob clockwise further, and the synchronism is attained and the repose figure of the square wave can be viewed.



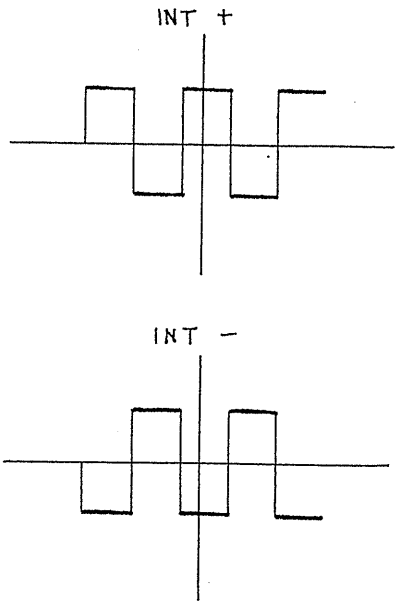
3) Try to adjust the amplitude of the horizontal direction by rotating the HORIZONTAL GAIN knob.

4) Try to adjust the vertical amplitude of the wave-form by rotating the knobs of VOLTS/CM and VARIABLE.

5) Where the vertical amplitude is varied, the synchronism may come off, so that in such a case the synchronism is taken again by re-adjusting the VARIABLE knob of the SWEEP RANGE.

6) Try to turn the SYNC SELECT knob. At the position of EXT,

the synchronism becomes unattainable, and at the position of INT-, the advancing direction of the wave-form varies as being shown at the drawing on the right side, and at the position of LINE, since the wave-form under observation is the power supply frequency, the synchronism is attained most effectively and is always stable even if the vertical amplitude is varied.



7) Adjust the FOCUS knob so as to obtain the sharpest figure.

OBSERVATION

Remarks

The operation shall be performed in the order which was described in the paragraph of Description of First Operation, but your attention shall be called to that the maximum input voltage for this instrument is prescribed to be 600V.

Particularly in the case of such a wave-form as ripple voltage, etc., in the DC of which the AC portion is included, it shall be deemed dangeous if

the total of the DC value and AC value exceeds 600V.

Similarly, use this instrument at or below 600V which is the maximum input voltage also at the time of applying the accessory 951A type low capacitance probe.

Measuring the voltage

Set the VOLTS/CM knob to 10, turn the AC DC slide switch to the AC side, and provide the VERT INPUT terminal with the signal intended for measurement.

The numerals of the range being shown at the VOLTS/CM knob indicate the voltage value per one division (1 cm) of the CRT scale, so that, if the vertical amplitude of the wave-form being observed is 3 cm, it is understood that 10V x 3 = 30V p-p.

But, if the VARIABLE (red) knob of the VOLTS/CM is rotated, the sensitivity varies, so that the voltage shall be measured at the position of this knob being rotated up to CW.

In the case of the accessory 951A type probe being applied, the sensitivity becomes 1/10, so that the voltage value being shown at the VOLTS/CM knob becomes 10 times.

Observing the wave-form in which DC portion is included

For instance, in the case of observing the low square wave of repeated frequency, if the vertical axis amplifier is AC coupled, the wave-form is dis-

torted, so that the wave-form can not be measured correctly.

In such a case, if the AC ⇔ DC slide switch is turned to DC, it comes to be DC coupled and even the DC component is completely amplified, so that the correct wave-form with no distortion can be measured.

When the small ripple wave-form being included in such a comparatively higher DC voltage as ripple voltage, etc., if this is used in DC coupling, CRT is largely deflected by the DC portion and the measurement-intended part disappears, so that it shall be AC coupled and be used preferably by raising the sensitivity.

How to use the low capacitance probe

When the observing cord is connected to the high impedance circuit, the accurate wave-form may become invisible under the influence of the capacitance, but the input impedance is raised to 10 MΩ of the resistance and to about 12 PF of the capacitance for raising the precision of the observation by applying the 951A type low capacitance probe which is accessory to this instrument.

The low capacitance probe is used by connecting to the VERT INPUT terminal.

How to use the external sweep terminal

This terminal is used for measuring the frequency applying Lissajous' figure, for measuring the phase difference, and for direct viewing the tuning amplifier and the like by combining with the sweep generator.

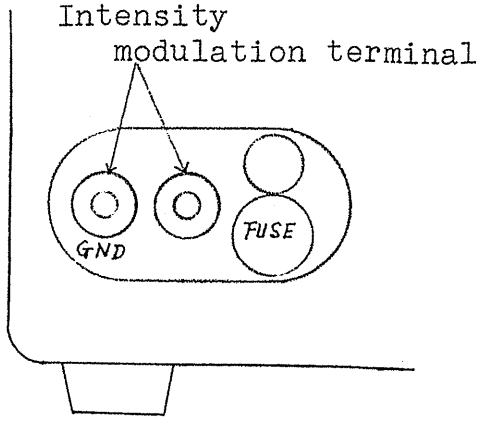
When the SWEEP RANGE knob is rotated up to CW, the time base sweep scillator ceases the motion, and the horizontal axis amplifier is connected to the HOR INPUT terminal.

The adjustment of the sensitivity is continuously changeable from 0 to the maximum by means of the HORIZONTAL GAIN knob, and the maximum sensitivity is prescribed to be more than 0.9 V/cm.

As this circuit is all DC coupled, when a signal including DC portion is provided, it shall be used by inserting the condenser of more than 0.1μF in series between the HOR INPUT terminal and signal source.

How to use the intensity modulation terminal

The intensity modulation signal is provided by removing the short bar of the terminal at the back of the case. The voltage required for the modulation is prescribed to be more than 10V p-p, but the input impedance of this terminal is about 100 KΩ , so that, if this is connected to an



instrument having the input impedance which is too high or is used with the intensity of the oscilloscope being raised too much, the modulation may hardly be visible.

Maintenance and Calibration

When the characteristics of the vacuum tube and other parts change and error is caused in the measurement from the long period of use, an adjustment is required for returning them to the definite standard values.

At the time of adjustment, remove the two screws at the upper and central parts of the back of the case and one screw at the rear part of the bottom of the case, and then draw out the panel slowly from the case, by which the internal inspection can be performed.

Calibrating the sensitivity of the vertical axis amplifier

This adjustment can be performed without removing the case.

At the lower part of the left side of the case, there is the semi-fixed resistor for adjusting the sensitivity of the vertical axis amplifier.

Be sure to rotate up the VARIABLE knob of VOLTS/CM at the panel face to CW (CAL'D), and provide the VERT IN terminal with the accurate voltage.

For instance, if the range of VOLTS/CM knob indicates 1V by the input voltage of 3V p-p, the trace is to be at 3cm above the scale, but if the error is

more than ± 5 % of 3 cm, the sensitivity shall be calibrated by rotating the semi-fixed resistor for sensitivity adjustment.

Adjusting the DC balance of the vertical axis amplifier

Adjustment shall be performed so as the trace on CRT not to fluctuate when the VARIABLE knob of VOLTS/CM is rotated.

When this adjuster is rotated, the trace on CRT fluctuates, but the balance shall be taken again by adjusting the VERT POSITION at each time of such fluctuation.

Calibrating the calibration voltage

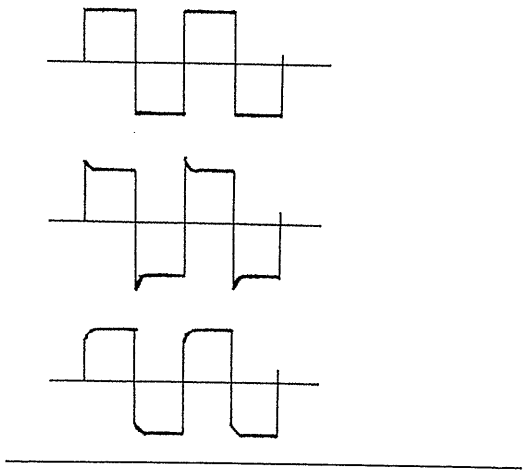
The square wave output for voltage calibration of 0.3Vp-p and 3Vp-p at the panel face is of being stabilized by zenor diodes, but if the output deviates from the prescribed value, it can be adjusted finely by the semi-fixed resistor which is inside the case.

In order to calibrate this output, the comparison voltage of an accuracy at least at or lower than 3 % is required.

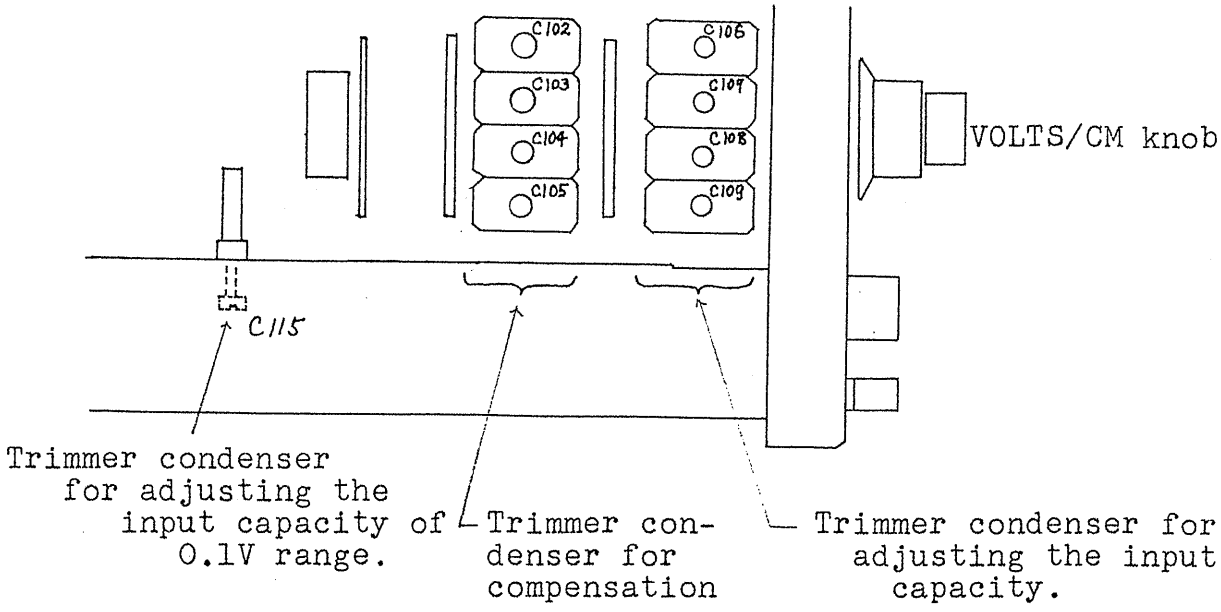
Adjusting the vertical axis input attenuator

In order to confirm the sensitivity, rotate the VOLTS/CM knob from 0.1 to 0.3, 1,. . . . 10, and provide with the output corresponding to the voltage sensitivity of the each range by means of the high quality square-wave generator (about 1 kc).

At this time, if the observed wave-form is over-shot or is somewhat round at its shoulder in the case of ranges other than 0.1, the correct wave-form shall be obtained by adjusting the trimmer condenser which is shown in the circuit diagrams C 102 ~ 105. The relation between the ranges and trimmer condensers for high-pass compensation is as per the following table.



Range (VOLTS/CM)	Trimmer condenser for compensation
0.3	C 102
1	C 103
3	C 104
10	C 105



The input capacity of the vertical axis amplifier is adjusted to 30 PF ± 1 PF as to the each range of the VOLTS/CM knob.

The input capacity shall be confirmed as well as the adjustment of the high-pass compensation which is described above, and if the error exceeds 30 PF ± 1 PF, re-adjustment is performed by the trimmer condenser.

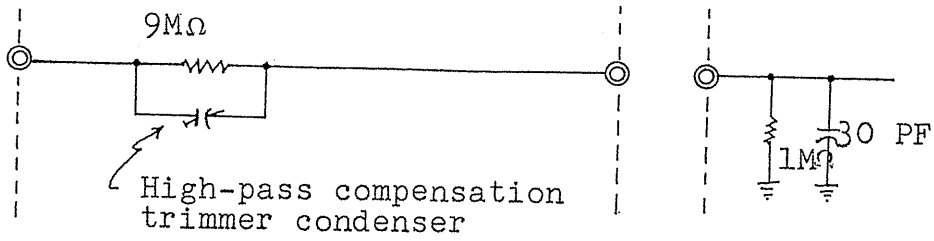
The adjustment is performed in the order of connecting a capacity meter between the VERT IN terminal and GND terminal first, and then the following manner.

Range (VOLTS/CM)	Input capacity adjustment trimmer condenser
0.1	C 115
0.3	C 106
1	C 107
3	C 108
10	C 109

Adjusting the low capacitance probe

951A type low capacitance probe contains the trimmer condenser for high-pass compensation.

When the circuit is combined with Model 556 Oscilloscope as being shown at the following drawing, the attenuation ratio becomes 1/10, and the high-pass compensation is adjusted by the input capacity 30 PF of the oscilloscope as well.



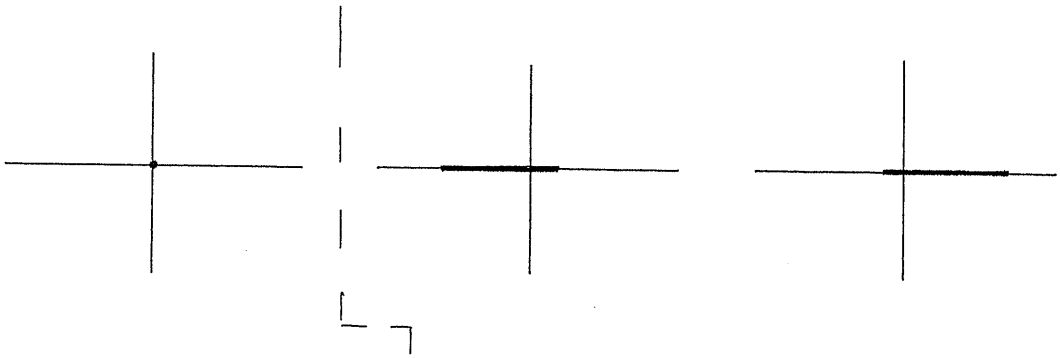
Probe

The adjustment of the high-pass compensation trimmer condenser is performed by providing the probe with the square wave of high quality so as that the observed wave-form is not overshot nor shaped round at its shoulder.

Adjusting the DC balance of the horizontal axis amplifier

The horizontal axis amplifier and time-base sweep oscillator of this instrument are all DC coupled in order to improve the sweep linearity.

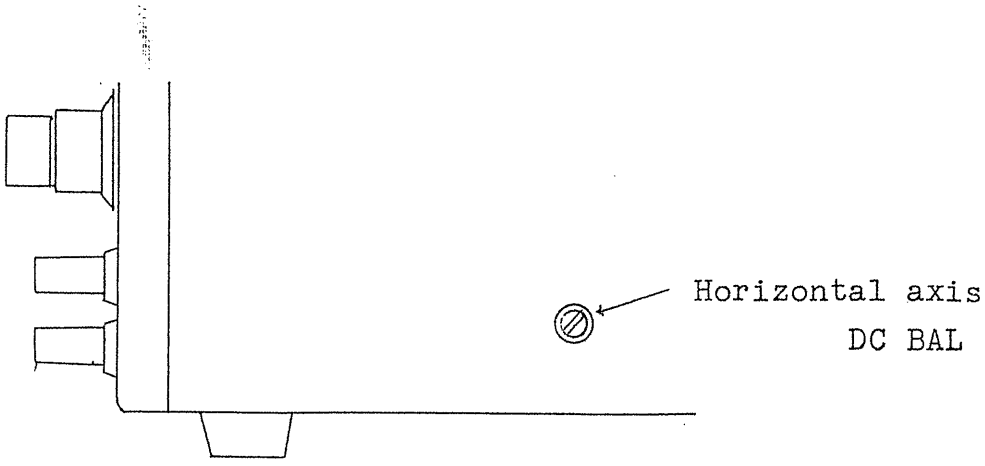
Where the DC balance is lost mainly by the change in the characteristic of the vacuum tube and by the replacement of the vacuum tube, etc., from the use of a long period, the amplitude of the internal sweep is adjusted by the HORIZONTAL GAIN knob as being shown at the following drawings. However, in the case of this adjustment, the POSITION of the horizontal direction may happen to vary, so that the semi-fixed resistor at the lower part of the right side of the case shall be adjusted as follows.



Make the trace a point by minimizing the HORIZONTAL GAIN, and put at the center of the scale by means of the POSITION knob.

And then, adjust the DC balance in the case that, if the HORIZONTAL GAIN is increased, the trade does not extend evenly to the right and left directions as being shown at the above drawings. (As the trace can be moved to the right and left by rotating the horizontal axis DC balance, put the trace at the center.)

Try to turn the SWEEP RANGE, and if being almost balanced at the each range, the adjustment is finished.



Right Side View Diagram

R e p a i r

Prior to the delivery, an inspection is performed under the severe administration, but if by any chance a trouble occurs, the checking of the trouble spot shall be performed in the following order.

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The trace (bright line) does not appear on the cathode ray tube.

If the trace does not appear on the screen of the cathode ray tube, the following three conditions can be supposed.

1. Trouble in the cathode ray tube circuit
2. Trouble in the vertical axis amplifier
3. Trouble in the horizontal axis amplifier

As for (1.), check the high voltage power supply for cathode-ray tube acceleration. The DC output of the high voltage rectifier tube V 303 1x2B is about -1500V, and the cathode (pin #2) of the cathode-ray tube is about -1300V.

If the output of 1x2B is normal but the high voltage is not supplied to the cathode or first grid (pin #2) of the cathode-ray tube, adjust the circuits of R306, R309, R310 and RV303 (INTENSITY).

(2.) and (3.) occur when the balance of the amplifier is extremely lost.

The checking of the vertical axis is performed by short-circuiting between the plates of the final stage amplifier, V103 12BH7-A.

If the trace appears on the cathode-ray tube by short-circuiting, it is caused by the unbalance of the vertical axis amplifier, so that the plate of each vacuum tube and the cathode resistance shall be checked. If nothing unusual is found in the resistance, try to replace the vacuum tube.

The horizontal axis can be checked in the same method with the vertical axis.