MODEL 555G

OSCILLOSCOPE

OPERATION MANUAL

KIKUSUI ELECTRONICS CORP.

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1. INTRODUCTION

Kikusui Electronics' Model 555G Oscilloscope is used for the observation and measurement of signal waveforms on the cathode ray tube of 5 inch diameter. It provies two ranges of TV.H and TV.V in the time base for signal waveforms on horizontal and vertical circuits of TV receivers.

The use of many semi-conductors permits compact size, light weight, high reliability, and easy maintenance and operation.

The vertical axis provides bandwidth from DC to 7 MHz, and sensitivity of 0.02V/cm.

The trigger circuit operates stably over range from 20 Hz to 7 MHz.

The horizontal axis provides sweep range from 1 sec/cm to 1 μs/cm and TV.H and TV.V. When using a sweep extension device, the 0.2 μs/cm range is abailable. Also, line sweep operation is possible with power frequency.

The 555G provides horizontal axis input terminals and a calibration voltage device of 1 KHz square waves which maintains a stable output when line voltage or frequency fluctuates.

2. SPECIFICATIONS

Vertical Axis

Sensitivity:	0.02 V/cm to 10 V/cm in 9 steps (1 - 2 - 5 sequence)
Calibration Accuracy:	±3% (at correct line voltage)
Bandwidth (-3 dB) :	DC to 7 MHz
Rise Time:	50 nS
Input Impedance:	1 Megohm 33pF
Max allowable input Voltage:	600 V p-p

Triggering

Synchronous System:	Self-excited sweep and trigger sweep.
Triggering Signal:	Internal, external, line frequency.
Trigger Range	Internal 50 Hz to 5 MHz for 10 mm trace on CRT. 20 Hz to 7 MHz for 20 mm trace on CRT. External 50 Hz to 5 MHz 1 V p-p 20 Hz to 7 MHz 2 V p-p

Horizontal Axis

Sweep Range:	1 µs/cm to 1 sec/cm (1 - 2 - 5 sequence) and TV.H, TV.V in 21 steps.
Line Sweep:	Sine wave sweep. Makes possible phase adjustment
Accuracy:	±5% (at correct line voltage)

Magnifier	5 times ±5% accuracy (at correct line voltage)
External Sweep Sensitivity:	1 V p-p/cm. 200 mV p-p/cm using 5 times magnifier. 200 mV to 10 V/cm adjustable continuously in conjunction with AMPLITUDE control.
	Frequency Response (-3 db): 2 Hz to 200 KHz
	Input Impedance: 1 Megohm 40pF

Calibration

Output Wave-form:	1 kHz square wave (approx)
Voltage:	5, 0.5, 0.05 Vp-p
Accuracy:	±3%

Power Requirement	________Volts 50/60 Hz Approx. 40VA
Dimensions	205W x 295H x 450L mm
Weight	Approx. 11 kg
Cathode-Ray-Tube	5 UP1F
Accelerating Voltage	Approx. 1.6 kV
Z Axis Modulation	≥ 10Vp-p
Effective Surface Viewing area	10 x 8cm

Accessories

Low capacitance probe (X 10 magnification)	Type 957M	1
Terminal Adaptor	Type 941B	1
Operation Manual		1
Test Data		1
Short Bar		1

3. OPERATION

3-1 Caution

Power Supply Voltage

The standard power voltage for Model 555G is Rated value. If the power voltage is within ±10% of Rated value, it can be used as it is. If the oscilloscope is not used within the specified range of voltage, poor action or malfunction will be caused.

Accordingly, adjust the voltage correctly.

Installation Place

The ambient temperature of the installation place must be within 0°C~40°C.

Be sure to avoid selecting a dusty place. If this unit is used near the machines and apparatuses generating heat, appropriate drafting must be provided. Be sure to avoid selecting places where there exists a strong magnetic field or corrosive gas when installing this unit.

Correct Voltage should be applied to the terminal

If overvoltage is applied to the terminal, it is possible that the interior circuit parts will be damaged seriously.

Accordingly, pay attention to the following points.

- o 600V for vertical axis input terminal (peak value containing DC component)
- o 100V for horizontal axis input terminal (peak value containing DC component)

Voltages higher than the above should not be applied to the terminals. Take care to prevent the voltages higher than 600V (peak value containing DC component) from being applied to the low capacitance probe of the 957 M type attachment.

Deflection Characteristics-Limitation

Vertical axis

Frequencies higher than 4 MHz tend to be distorted. Trances on the CRT face should therefore be kept below 4 cm in amplitude.

External sweep

It is considered that imput signals of more than 10 V p-p may produce distortion in waveform.

3-2 Explanation of Panel

POWER ON/OFF	Power ON OFF switch
ILLUM ON/OFF.	Illuminates the graticules on the dial.
CALIB	Output terminal for sensitivity calibration.
FOCUS	For focussing the spot to point.
INTENSITY	For adjusting the brilliance of the spot.

VERTICAL

VOLT/CM:	Nine position sensitivity selector in nine ranges from 0.02 to 10 V/cm.
VARIABLE:	This is in tandem with the VOLT/CM selector and is a fine adjustment for the same. Calibration over the nine ranges selected by the VOLT/CM selector switch is made when the VARIABLE control is set at CAL'D.
POSITION:	Controls the vertical movement of the trace.
INPUT	Input terminal of vertical axis.
AC DC:	Used for selection of input. To AC when the wave-form has no DC component is present.
DC BAL.	Slotted pre-set potentiometer for adjusting DC balance of the vertical amplifier.

HORIZONTAL

TIME/CM: This is a time selector switch for horizontal sweep. When turning the VARIABLE knob to CAL'D, sweep time can be calibrated. Turn the VARIABLE knob to CAL'D in the TV.H or TV.V range, and two cycles of signal wareforms on horizontal or vertical circuits in TV receivers are displayed alternatively. When turning the TIME/CM switch to EXT, sweeping ceases, and the input terminal of the horizontal axis amplifier is connected to the EXT HOR IN terminal The VARIABLE control serves then as a sensitivity control of the horizontal axis.

VERIABLE: This is in tandem with the TIME/CM selector and is used as a fine adjustment for the same. Calibration is carried out when the VARIABLE control is set at CAL'D. When an external sweep is used the VARIABLE control regulates the sensitivity of the Horizontal.

EXT HOR IN: Input terminal of amplifier horizontal axis.

STABILITY: Slotted pre-set potentiometer adjusts the stability of the time base Generator.

HORIZ. POSITION: Controls the lateral movement of the trace.

PULL 5 X MAG: A Pull-ON switch mounted on the same shaft as the HORIZ POSITION control. Expands the horizontal sweep five times and consequently increases the sensitivity of the horizontal (time base) amplifier five times. Effective also when the EXT HORIZ IN terminal is used.

TRIGGERING

SOURCE:	Selects triggering source
	LINE — Lines frequency used for triggering
	INT — Wave-form under observation used for triggering
-	EXT — External source applied to EXT TRIG IN terminal used for triggering.
LEVEL:	In tandem with the LINE-INT-EXT control.. Adjusts the triggering level. When set in the fully anti-clockwise position at AUTO, no trigger sampling is done and sweeping is done automatically.
EXT TRIG IN	External trig. input terminal.

3-3 Explanation of Back Panel

EXTERNAL CRT CATHODE	Brightness modulation terminal
FUSE	Fuse holder. 1A fuse
ASTIG	Astigmatism regulation of CRT.

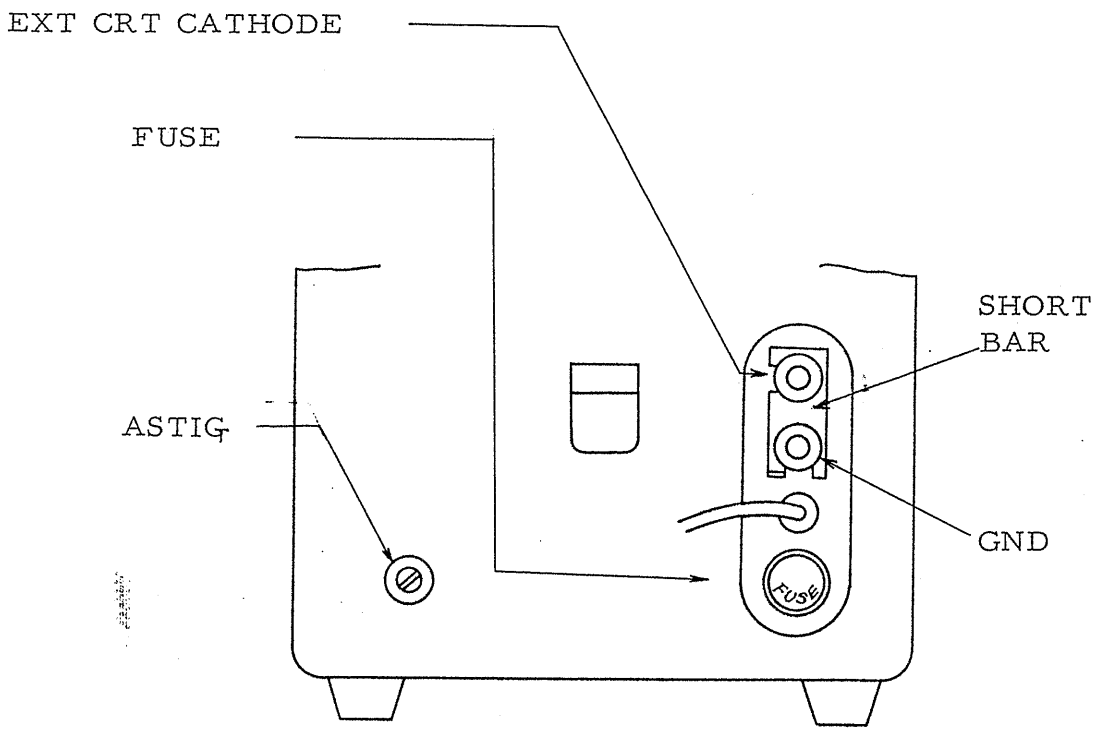


Fig. 1

3-4 First Time Operation

1. Unit the user is familiar with the operation of the oscilloscope it is recommended that the controls be set as follows:-

INTENSITY	mid-point
FOCUS	mid-point
ILLUM	ON
VOLTS/CM	0.02
VARIABLE	CAL'D
AC DC	DC
TRIGGERING	
SOURCE	INT +
LEVEL	AUTO
TIME/CM	1mS
VARIABLE	CAL'D
POSITION	Mid point
POWER	OFF

The drill as set out in the following paragraphs will familiarise the user with all the controls.

2. After setting the controls as indicated above check that the power source is of the correct voltage and frequency.

3. Throw the POWER switch ON and after a brief warm-up period, a bright horizontal line will appear on the CRT face.

4. Adjust the brilliance of the trace with the INTENSITY control. A too brilliant trace will cause damage to the phosphor on the tube face. Briliance should therefore be adjusted just enough for adequate viewing.

5. Connect the coaxial VERTICAL INPUT terminal to the 0.05 V CALIB socket.

   A wave-form with an amplitude of 2.5 cm. as illustrated in Figure 2, will appear on the screen.

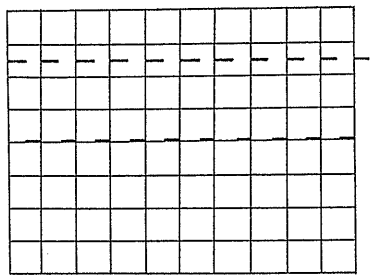


Fig. 2

6. Adjust the position of the trace on the screen with the help of the VERTICAL POSITION and HORIZONTAL POSITION controls.

7. Turn the VOLTS/CM VARIABLE control counterclockwise and the amplitude of the trace will decrease.

8. Turn the TIME/CM VARIABLE control and notice a change in sweep time.

9. Throw the TRIGGERING SOURCE switch to INT- and notice that sweeping takes place from the negative part of the square wave. Note the difference when the switch is restored to INT.+.

10. Turn the LEVEL control clockwise away from AUTO and note the temporary disappearance of the trace which, however, reappears in the middle of the screen. Sweeping will cease on the disconnection of the VERTICAL INPUT.

11. Restore the LEVEL control to AUTO, put the 5 x MAG switch ON and note a five-fold expansion of the width of the trace.

12. Put the TIME/CM switch to EXT and connect the EXT HORIZ IN terminal to the CALIB 5 V socket. The TIME/CM VARIABLE control now serves as horizontal axis sensitivity adjustor. Sensitivity is equal to or better than 0.2V_{p-p}/cm with 5 x Mag. ON and equal to or better than 1V_{p-p}/cm with it OFF.

The foregoing drill should have now familiarised the user with all the controls.

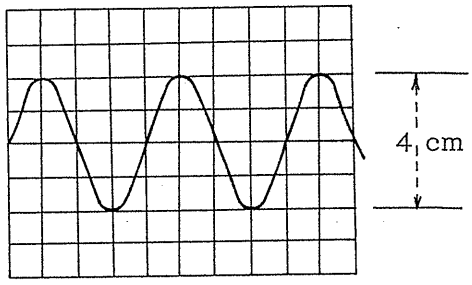
4. MEASUREMENTS

Measurement of AC Voltage.

1. Apply the unknown voltage under investigation to the INPUT terminal through the low capacity probe Type 957 M.

2. Throw the AC DC switch to AC, the VOLTS/CM VARIABLE switch to CAL'D and the VOLTS/CM Selector to a setting that will allow a few cycles of the wave form to be displayed on the screen.

3. Read off the amplitude of the wave form in cm against the graticules. The Voltage of the source under investigation is then equal to Vertical Amplitude x VOLTS/CM setting x magnification of the probe. See example below.



Vertical amplitude = 4 cm

VOLTS/CM setting = 0.5

Probe magnification = 10
(Type 957M)

Unknown Voltage = 4 x 0.5 x 10
= 20V p-p

Fig. 3

Measurement of Voltage with a DC Component.

1. Connect the probe to the INPUT terminal.

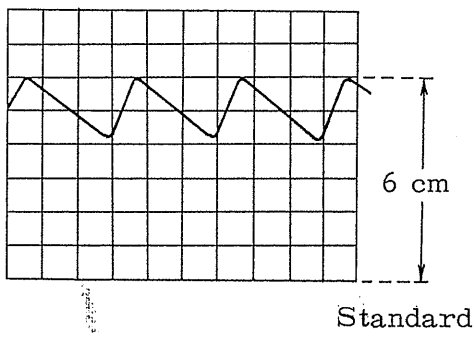
2. Set the AC DC switch to DC.

3. TRIGGER LEVEL to AUTO.

4. A reference line now has to be arbitrarily fixed. Apply the probe to the ground terminal and bring the straight-line horizontal trace to the lower limit of the dial. If the unknown voltage has a negative DC component, then the reference line will have to be moved to the upper limit of the dial. Once this reference has been fixed, the VERTICAL POSITION control should not be touched while the measurement is being made.

5. Apply the probe to the voltage to be measured.

6. Read off the amplitude of the wave-form with reference to the reference line and its value is now equal to Vertical amplitude from reference line × VOLTS/CM setting × magnification of probe. See example below.



Vertical amplitude = 6 cm

VOLTS/CM setting = 1

Probe magnification = 10

Unknown Voltage 6 x 1 x 10 = 60 V.

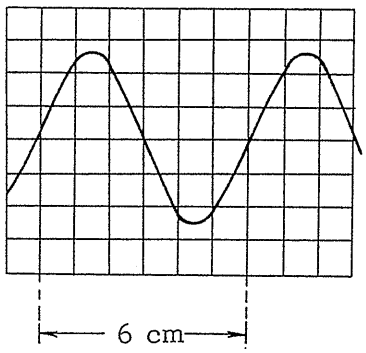
Fig. 4

Measurement of Time (Period)

1. Set the TIME/CM VARIABLE control to CAL'D.

2. Set TIME/CM Selector to a range so that at least one complete waveform is displayed.

3. Use the Vertical and Horizontal POSITION controls to get the trance into a suitable position for taking measurements. See Fig. 5 below. An example of how the measurement is now made is given below.



Length of one wave form = 6 cm

TIME/CM setting = 1m Sec.

Time (Period) 6 x 1 = 6m Sec.

Fig. 5

With the 5 × MAG switched ON, the measurement is modified as follows:-

$$\text{Time (period)} = \frac{\text{Length of one waveform} \times \text{TIME/CM setting.}}{5}$$

Measurement of Frequency.

Having measured the time (period) of one cycle as above the frequency is deduced as follows:-

$$\text{Frequency} = \frac{1}{\text{Time of one cycle}}$$

Using the same example as given above

$$\text{Frequency} = \frac{1}{6 \text{ m Sec.}} = 167 \text{ Hz}$$

Phase Measurement

Lissajou figures are used for measuring the phase difference between two signals of the same frequency. The inherent phase difference between the vertical and horizontal amplifiers must first be ascertained before any other phase measurements are made:

The procedure for phase measurement is as follows:-

1. TIME/CM switch to EXT.

2. The two signals to be compared are applied to VERTICAL INPUT and EXT HOR IN terminals respectively.

A lissajou figure will appear on the tube face. One example of how phase angle can be measured is given below:

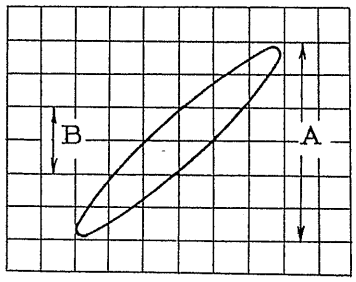


Fig. 6

Measure A and B

Phase angle $\theta = \sin^{-1} \frac{B}{A}$

Actual phase difference between the two signals is:

θ - inherent phase angle between vertical & Horizontal amplifiers.

5. MAINTENANCE

5-1 Removal of the instrument from its cabinet.

CAUTION. Do NOT attempt to remove the outer case with the power connected.

Remove the three screws as indicated in the diagram (two in the rear and one in the underside). This loosens the outer cover which may now be pulled off.

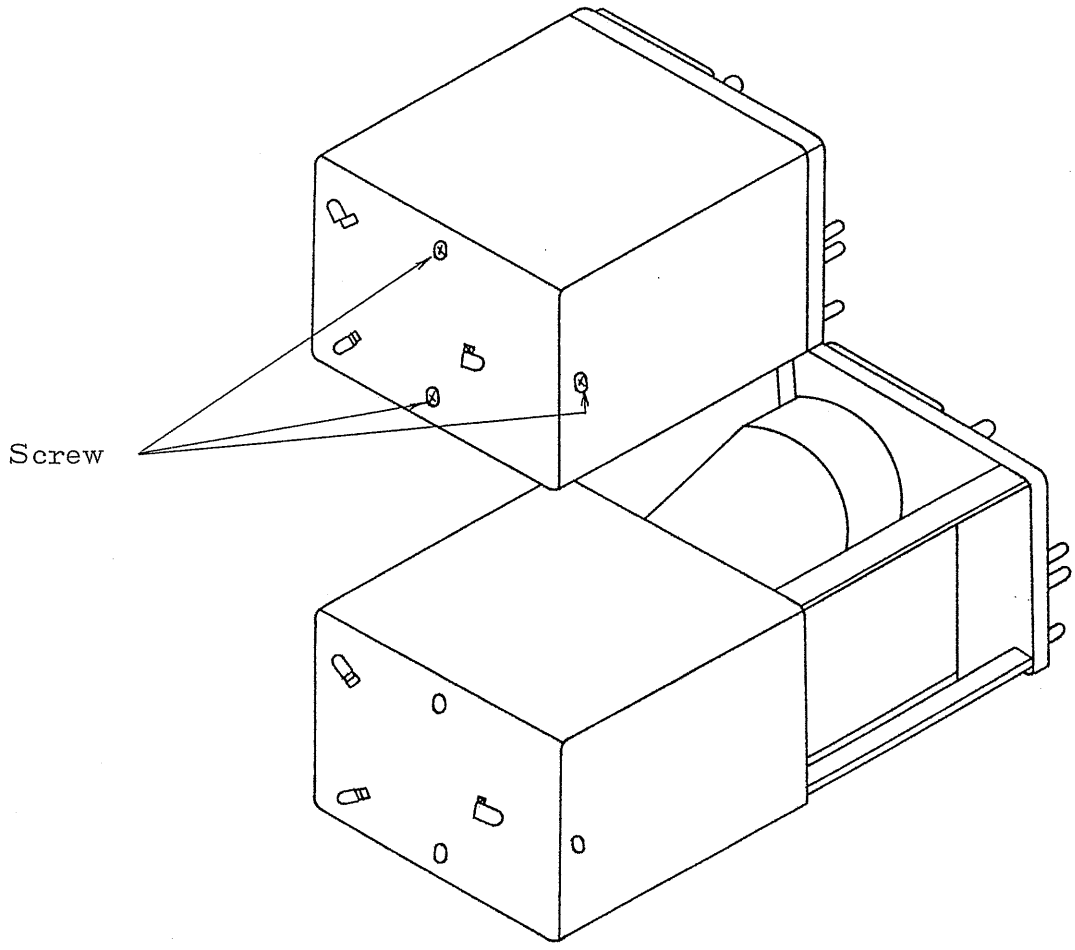


Fig. 7

5-2 Adjustment

DC BAL Adjustment.

1. Set all controls as indicated in the Initial Setting-up Procedure (Part 3-3)

2. Short circuit the VERTICAL INPUT terminals.

3. Bring the trace to the centre of the scale using the VERTICAL POSITION control.

4. Turn the VOLTS/CM VARIABLE control and if the base moves then DC BAL needs adjusting. Adjust DC BAL (slotted preset potentiometer) and VOLTS/CM VARIABLE control in turn until the latter finally has no effect on the movement of the base.

   It may also be necessary, during this adjustment, to use the POSITION control from time to time.

5. Remove the short circuit from the VERTICAL INPUT

STABILITY Adjustment.

1. Apply sine wave input in the range 10 kHz to 50 kHz to the VERT INPUT.

2. Set the VOLTS/CM switch to 1 and by adjustment of the TIME/CM control produce one or two complete wave-forms on the screen.

3. Set TRIGGERING LEVEL control to AUTO and TRIGGERING SOURCE to INT.+.

4. If STABILITY (slotted pre-set potentiometer) is now turned counterclockwise, sweeping will stop. The control should be set to a point at which sweep action just begins.

5. Turn TIME/CM and VARIABLE controls alternately and confirm that synchronisation is stable over all ranges.

6. Extend the frequency input from 20 Hz to 7 MHz and confirm that synchronisation is stable over the whole range.
If found unstable re-adjust STABILITY.

ASTIGMATISM Adjustment.

(This is a slotted pre-set potentiometer accessible at the rear of the instrument)

Produce a sine-wave on the tube display, adjust ASTIG and FOCUS until the trace is of uniform thickness throughout.

Note: Subsequent adjustments are carried out with the cover removed. Due care should be exercised as dangerously high voltages are used in the CRT.

Calibration of the Deflection Sensitivity of the Vertical Amplifier.

1. Set VOLTS/CM to 0.02

2. Set VARIABLE to CALD

3. Feed a square wave 0.05Vp-p to VERTICAL INPUT.

4. Adjust RV 202 (slotted pre-set potentiometer) until the wave form has an amplitude of 2.5 cm. RV 202 is located on the vertical amplifier chassis.

Calibration of VOLTS/CM Control.

The following procedure is required for adjusting the input capacitance to the correct value which is 33pF.

1. Connect a capacitance bridge across the VERTICAL INPUT terminals.

2. Set VOLTS/CM to 0.02 and adjust trimmer CV206 until the input capacitance as measured on the bridge is 33pF.

3. Set VOLTS/CM to 0.05 and in the same way adjust input capacitance to 33pF with the use of trinner CV202B.

4. Carry out the same procedure for all the other ranges of the VOLTS/CM switch in accordance with the table below.

VOLTS/CM Switch	Trimmer Capacitor	Adjustment
0.02	CV 206	33pF
0.05	CV 202B	33pF
0.1	CV 203B	33pF
0.2	CV 204C	33pF
1		
2	CV 205C	33pF
5		
10		

These trimmer capacitors are located on the Vertical Amplifier Chassis and are grouped together as shown in Figure 8.

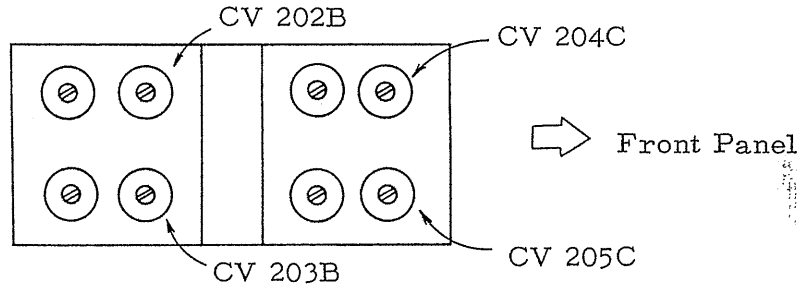


Fig. 8

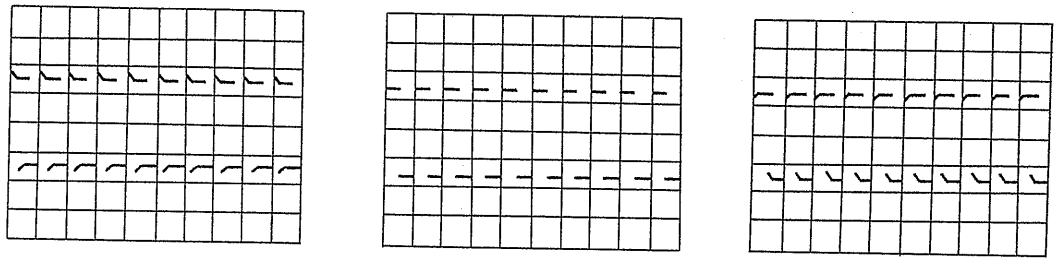
5-3 Frequency Characteristic

1. Apply a 1 kHz square waveform to the VERTICAL INPUT. The square-wave source should be high grade and capable of giving an output voltage variable from 0.05 V to 100 V p-p.

2. Set VOLTS/CM to 0.05.

3. Adjust trimmer capacitors for the respective range (see table below) so that a proper square-wave form is produced on the scale (See Fig. 10).

VOLTS/CM Switch	TRIMMER CAPACITOR
0.02	
0.05	CV202A
0.1	CV203A
0.2	CV204A
0.5	
1	
2	CV205A
5	
10	



Incorrect Correct Incorrect

Fig. 10

Trimmer capacitors CV202A to 205A are located on the VOLTS/CM switch. See Figure 11.

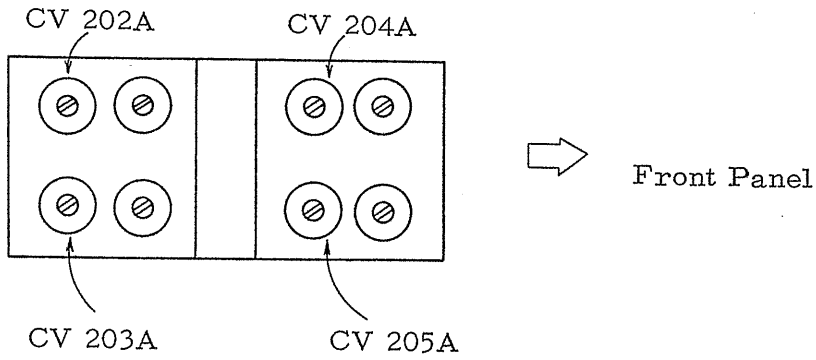


Fig. 11

After these adjustments have been made the input capacitance may have changed. Re-adjust if necessary.

Sweep Time Calibration.

1. Apply a time mark generator output (set at 1mS) to the VERTICAL INPUT Terminal.

2. Set TIME/CM to 1mS and VARIABLE to CAL'D.

3. Adjust RV602 (slotted pre-set potentiometer) until the m marker signal coincides with the appropriate marking on the dial.

4. Pull 5 x MAG ON and adjust RV603 so that five times the number of markers appear on the scale as seen when RV602 was adjusted.

5. The above adjustments are adequate in the 1 sec. to 50 µsec range. Adjustments are made to trimmer condensers C501E and C501G in accordance with the table below the 20 µsec. to 1 µsec. range.

TIME/CM	CONTROL	REMARKS
1 msec.	RV 602	
10 µsec.	C501E	To be done only after 1 msec. range adjustment has been made.
1 µsec.	C501G	

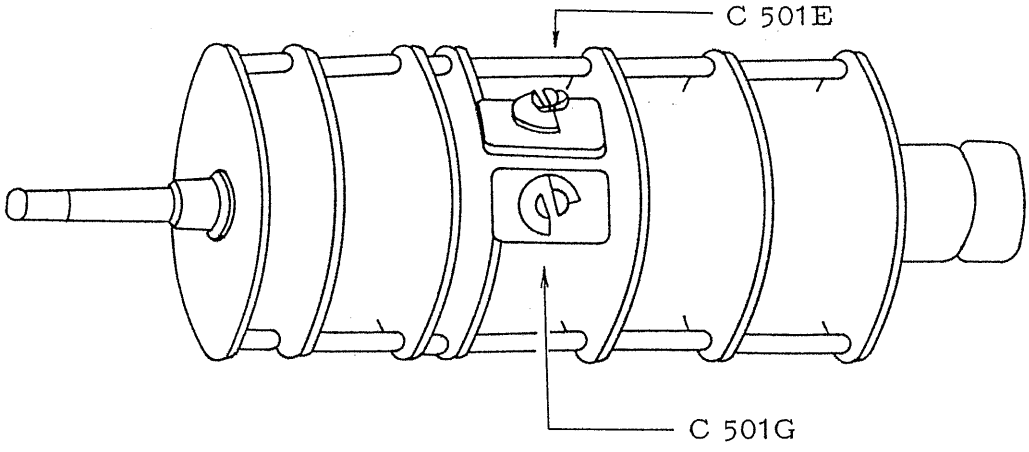


Fig. 9

Adjustment of Sweep length

The length of the sweep line is approximately 10.5 cm with 5 x MAG OFF.

This adjustment is not essential unless the sweep line is less than 10 cm. If necessary the width is increased by adjusting RV 403, located on the Time-Base Generator chassis and labelled SWP LENGTH. This adjustment is made only after Sweep Time Calibration has been completed.

Adjustment of Horizontal DC BAL

1. Set TIME/CM switch to EXT
2. Adjust slotted pre-set potentiometer RV-702 (found on Horizontal Amplifier Chassis and labelled HOR BAL) such that any movement of TIME/CM VARIABLE control does not cause the spot to move laterally.