

MODEL 555RM OSCILLOSCOPE

OPERATION MANUAL

KIKUSUI ELECTRONICS CORP. -

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## 1. Characteristics

### OUTLINE

Kikusui Electronics Type Trigger Oscilloscope Model 555 RM is a rack-mounting type oscilloscope for observation of waveform employing a Braun tube with an aperture of 133mm.

In vertical axis, it is up to DC - 7 MHz band and its sensitivity is max. 0.02 V/cm.

The trigger circuit is operated stably in a range of 20 Hz - 7 MHz. In sweeping, it is 1 sec/cm - 1  $\mu$ s/cm. Max. 0.2  $\mu$ s/cm can be obtained if sweeping enlargement is employed.

It is provided with horizontal axis input terminal and calibration voltage.

The calibration voltage is high quality square wave of approx. 1 KHz. It is stabilized against fluctuation in power source.

### SPECIFICATION

Vertical axis	Sensitivity	0.02V/cm - 10V/cm
		1 - 2 - 5 step 9 ranges
	Calibration precision	+3% (at _____ power voltage)
	Frequency characteristics	DC - 7 MHz - 3dB or below
		When connected with AC
		2 Hz - 7 MHz - 3 dB or below
	Rise Time.	Approx. 0.05 $\mu$ S

Input impedance 1 M $\Omega$ , parallel capacity  
33 pF

Input terminal UHF type receptacle  
(Suitable for M Type)

Max. allowable  
Input voltage 600V (peak value incl.  
D-C component)

Synchronization

Synchronizing system Trigger sweep, self-sweeping sweep

Synchronizing signal Inside, outside, power source POSITIVE, NEGATIVE respectively

Trigger range Inside  
30 Hz - 5 MHz with tube inside amplitude of 10 mm  
20 Hz - 7 MHz with tube inside amplitude of 20 mm  
Outside  
30 Hz - 5 MHz with 1 Vp-p  
20 Hz - 7 MHz with 2 Vp-p

Horizontal Axis Sweeping Time 1,2,5, 10,20,50  $\mu$ s/cm  
1,2,5,1,2,5,10, 20,50 ms/cm  
0.1,0.2,0.5,1 sec/cm  
--- 19 ranges as above ---

Precision  $\pm 5\%$  (at power voltage of      V)

Sweeping enlargement 5 times Precision 5 %  
(at power voltage      V)

Sensitivity of external sweeping

At the condition of exthorizing of approx. 0.2Vp-p/cm TIME/CM upon operating approx. 1 Vp-p/cm x 5 MAG, the sensitivity can be adjusted continuously up to approx. 1/10 with the EXT.HOR ATT.

Frequency characteristics 2Hz - 200 KHz - 3 dB

Input impedance Approx. 1 MΩ  
40 pF or below

Calibration voltage	Output waveform	Waveform of approx. 1 KHz
	Voltage	5, 0.5, 0.05 Vp-p
	Precision	±3%
Others	Braun tube	5 UP1F or 5 UP7F
	Accelerating voltage	Approx. 1500V
	Effective area	10 x 8 cm
	Brightness modulation	Brightness increases with negative polarity Voltage 10 Vp-p or above
	Power source	<u>100V ±V</u> 50/60Hz Approx. 40VA
	Dimensions	
	Largest part:	(W) 450 (H) 174 (L) 450 mm
	Weight:	Approx. 9.2 Kg.
	Accessories:	

95YM type low capacity probe	1
941B type terminal adaptor	1
Short bar	1
Operation Manual	1
Test Data	1
Rack mount bracket	2

## 2. Operation

### Power voltage

This unit can be operated very safely in a range of primary supply voltage of  $\pm 10\%$ .

However, for the purpose of assurance of highest reliability and long life of parts, we recommend you to use this unit at the specified voltage.

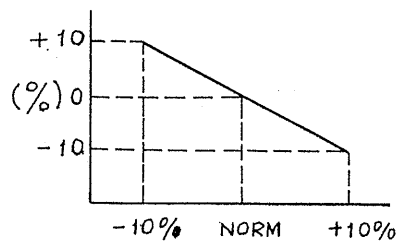
As shown in the following sketch, the deflection sensitivity of the Braun tube is influenced by primary supply voltage.

For this reason, when quantitative measurement is made, if the primary supply voltage is adjusted at fixed level by employing the sliding voltage regulator (SLIDAC) or automatic voltage regulator, correct measurement can be made.

If the primary supply voltage can not be adjusted, if the sensitivity of the vertical axis is calibrated by employing the square wave generator for sensitivity calibration, correct quantitative measurement can be made.

However, in this case, the sweeping time scale for time base can not be calibrated. For this reason, pay attention to the quantitative measurement of time.

Changing ratio  
of deflection  
sensitivity  
of X, Y axes



Primary supply voltage V

In this unit, deflection sensitivity is not changed by adjusting the INTENSITY knob of the Braun tube which is often seen in conventional types of oscilloscopes.

For this reason, the brightness can be changed very freely in measurement.

#### INSTALLING PLACE

Operate this unit in the range of ambient temperatures of  $0^{\circ}\text{C}$  -  $40^{\circ}\text{C}$ .

Avoid installing this unit in a dusty place. If this unit is obliged to be installed near the machines which generate heat, consideration must be paid to appropriate ventilation.

Be sure to avoid installing it near strong magnetic field or at such a place where there exists corrosive gas.

#### Allowable voltage of Respective Terminals

If excess voltage is added, there will be a possibility that the internal circuit parts might be damaged.

Be sure to avoid applying voltage higher than 600V (peak value including D-C component) to the input terminal for vertical axis. Be sure to avoid applying voltage higher than 100V (peak value including D-C component) to the input terminal for horizontal axis.

Incidentally, be sure to avoid applying the voltage higher than 600V (peak value including D-C component) to the low capacity probe of attached 951A type.

#### Cautions for Deflection Characteristics

As for observation of high frequencies of 4 - 5 MHz or above, as there appears amplitude distortion, operate it

with amplitude smaller than 4cm.

FUNCTIONS OF KNOBS & TERMINALS

POWER ON OFF	This is a power switch.
SCALE ILLUM	This is a knob for adjustment of illumination of dial of Braun tube.
INTENSITY	This is a knob for adjustment of brightness of Braun tube.
FOCUS	This is a focusing knob for Braun tube.
CALIB	This is an output terminal for sensitivity calibration voltage.
(VERTICAL) VOLTS/CM	This is a sensitivity change-over switch for vertical axis. When the knob for VARIABLE is adjusted to position CAL'D, sensitivity will be calibrated to such 9 ranges of 0.02 - 10V/cm
VARIABLE	This is a knob for fine adjustment for VOLTS/CM switch.
CAL'D	Sensitivity is adjusted to the position of CAL'D of VARIABLE KNOB.
POSITION	This is a knob for vertical movement of trace.
INPUT	This is an input terminal of vertical axis.



AC GND DC

This is a coupling change-over switch for input circuit. Selection can be made on AC coupling and DC coupling. At GND position, the connection of INPUT is separated at inside and the input of vertical axis, grounded.

DC BAL

This is a semi-fixed resistor for adjustment of D-C balance of the vertical axis amplifier.

TIME/CM

This is a time change-over switch for horizontal sweeping.

TIME-BASE

Sweeping time is calibrated where the knob for VARIABLE is positioned at CAL'D.

When this switch is positioned at EXT HORIZ, sweeping will stop and the input of the amplifier of horizontal axis, be connected with EXT HORIZ IN terminal.

Then, the knob of VARIABLE will be the sensitivity regulator for horizontal axis of EXT HORIZ.

VARIABLE

This is a fine adjusting knob for horizontal sweeping. This knob serves also as the sensitivity regulator for horizontal axis amplifier.

EXT TRIGGERING  
OR HORIZ IN

This is an input terminal for external trigger and horizontal axis amplifier.

When the SOURCE knob is positioned at EXT, external trigger condition will be attained.

STABILITY

This is a semi-fixed resistor for adjustment of stability of horizontal sweeping oscillator.

POSITION  
PULL 5X MAG.

This is a knob for horizontal movement of trace.

POSITION  
PULL 5X MAG.

When this knob is pulled toward the side, the amplitude of horizontal sweep will be spread 5 times.

As the sensitivity of horizontal axis amplifier is enlarged, when EXT HORIZ IN terminal is used, the sensitivity will be approx. 0.2Vp-p/cm at pulled position and approx. 1 Vp-p/cm at pushed-in position.

SOURCE

This is a selective switch for trigger signal source.

TRIGGERING

LINE: It is triggered with

frequency of power source.

SLOPE  LEVEL  AUTO	<p>INT: It is triggered internally according to waveform in observation.</p> <p>EXT: It is triggered with the signal applied to EXT TRIGGERING IN terminal.</p> <p>This is a change-over switch of polarity.</p> <p>This is a trigger level adjustment knob.</p> <p>This regulator fixes from which point of trigger signal waveform sweeping starts.</p> <p>When turned fully counterclockwise at AUTO position, no selection will be made on trigger level and automatic sweeping will be done.</p>
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REAR PANEL

EXT CRT CATHODE

(See REAR PANEL VIEW. Page -25-)

This is a brightness modulation terminal.

FUSE

This is a fuse holder. 1A fuse is used.

Initial Operation

This procedure is very useful for accustoming yourself to operation of 555 RM Type.

1. Adjust the respective knobs as mentioned hereunder.

INTENSITY

Almost center

FOCUS

"

SCALE ILLUM	"
VOLTS/CM	0.02
" VARIABLE	CAL'D
POSITION	Almost center
AC GND DC	DC
TRIGGERING SOURCE	INT
" SLOPE	+
" LEVEL	AUTO
TIME/CM	1 mS
" VARIABLE	CAL'D
POSITION	Almost center
- POWER	OFF

2. After adjusting the respective knobs, connect the power cord with the specified power source.

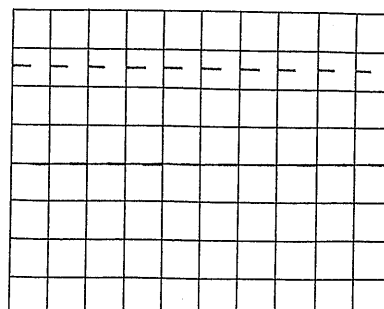
3. POWER ON

After turning on power source, in several tens of seconds, a bright line will appear in the screen of Braun tube.

4. By turning INTENSITY, adjust the brightness appropriately.

5. When VERTICAL INPUT and 0.05V of CALIBRATOR are connected, a square with 2.5 cm amplitude shown in Fig.2 will appear.

Fig.2



6. Move the trace vertically with the knob VERTICAL POSITION.
7. When VOLTS/CM switch and VARIABLE knob are turned counterclockwise, the waveform amplitude shown in Fig.2 will be decreased.
8. Confirm that the sweeping time is changed by turning the TIME/CM switch and VARIABLE knob.
9. When the SLOPE switch for TRIGGERING is changed over to -, the sweeping will start from the negative part of the square wave.  
When changed over to +, the sweeping will start from the positive part of the square wave.
10. When the knob for TRIGGERING LEVEL is turned clockwise from AUTO, trace will disappear temporarily and trace will appear in the middle part.  
Under such conditions, if the input of VERTICAL INPUT is separated, sweeping will stop.
11. After returning the LEVEL knob to AUTO, pull out the POSITION KNOB for horizontal axis toward the side.  
Under this condition, a magnifier of 5 magnifications will be operated and the trace width, be enlarged 5 times.
12. Change over the TIME/CM switch to EXT HORIZ and add 5V of CALIBRATOR to the EXT HORIZ IN terminal.  
The VARIABLE knob of TIME/CM serves as regulator for horizontal axis sensitivity.  
As for the sensitivity of horizontal axis, when the magnifier is ON, it will be 0.2 Vp-p/cm or above.  
When it is turned OFF, it will be 1 Vp-p/cm or above.

The above is the basic sequence of operation procedure.

### 3. Basic Operation Procedure

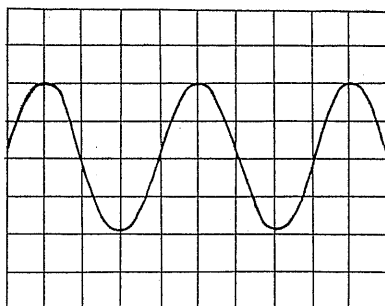
#### Measurement on A-C VOLTAGE

For observation on only the A-C component from the A-C waveform free from D-C component and waveform which is overlapped with D-C, place the change-over switch for vertical input at position AC.

1. Place the AC GND DC switch at position AC and the vertical VARIABLE at CAL'D. Then, fix the VOLTS/CM appropriately in such a way that the waveform has an appropriate amplitude in the scale.
2. Read off the vertical amplitude of waveform by cm, calculation must be made as follows:

$$\text{Voltage to be sought} = \text{Vertical amplitude} \times \text{VOLTS/CM} \times \text{Magnification of probe}$$

Incidentally, the magnification of the attached 957M probe is 10.



Vertical amplitude : 4cm

VOLTS/CM : .5

PROBE : 10

Voltage to be sought:

$$= 4 \times 0.5 \times 10 = 20 \text{ Vp-p}$$

#### Measurement on Instantaneous Voltage:

For measurement on DC level at optional point of waveform, do so in the following sequence.

1. Place AC, GND, DC switches at position DC.
2. Place the TRIGGER LEVEL at position AUTO.

3. For fixing the reference line on the dial, place the AC, GND, DC switch at position GND. Then, adjust the bright line at the lowermost part of scale.

If the voltage to be measured is more negative as compared with reference voltage, adjust it up. The reference line thus set becomes the reference for measurement on D-C.

Accordingly, be sure to avoid moving the vertical POSITION in measurement.

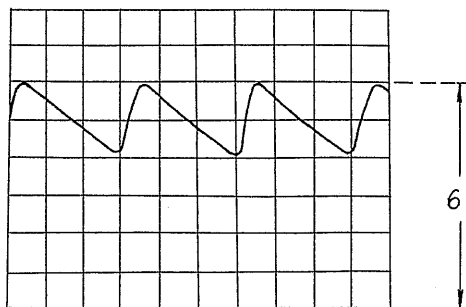
4. Add the voltage wanted to be measured to the vertical input.

As for reading of voltage, read up to the position to be read from the reference line by cm.

Then, calculation must be made as follows:

$$\text{Instantaneous voltage} = \text{Vertical amplitude from reference line} \times \text{VOLTS/CM} \times \text{Probe magnification}$$

As for the polarity of voltage, the upper side from the reference line is positive and the under side, negative.



Vertical amplitude : 6 cm  
VOLTS/CM : 1  
Probe : 10  
Voltage to be sought  
= 6 x 1 x 10 = 60V

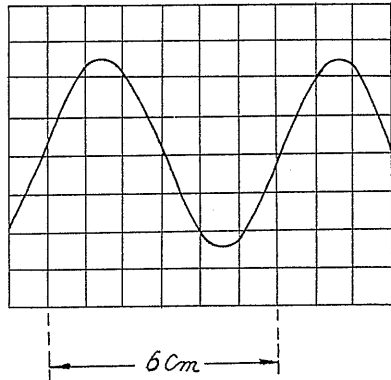
Time Measurement

For measurement on time between 2 points of waveform, do so in the following sequence.

1. Set the TIME/CM at the most rapid range in such a way that the section between two points to be measured is within the scale.
2. Adjust the section between two points to the center of horizontal with VERTICAL POSITION.

With horizontal position, adjust the starting point to be measured to the scale line.

In this case, use the VARIABLE at CAL'D position.



Length of horizontal direction : 6cm

TIME/CM : 1 mS

TIME = 6 x 1 = 6 mS

When MAGNIFIER PULL 5X MAG is used, the value shown with TIME/CM will be changed as follows:

$$\text{Time interval} = \frac{\text{Length of horizontal direction} \times \text{TIME/CM}}{5}$$

#### Measurement on Frequency

As for the frequency of repetitive waveform, measurement must be made on time interval of 1 cycle of waveform by means of the aforementioned measuring method. Then, calculation must be as follows:

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

Length in horizontal direction of one cycle : 6 cm

TIME/CM : 1 mS



Magnifier : X 1

Frequency =  $1/6\text{mS} \doteq 167 \text{ Hz}$

### Measurement on Phase

As for the difference in phase between two signals of the same frequency, measurement is made on it by taking advantage of Lissajous' figure.

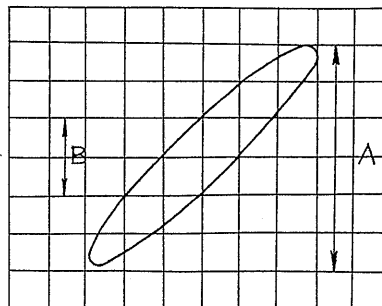
In this measuring method, attention must be paid to the following point. As the difference in phase between vertical and horizontal axis amplifiers of the oscilloscope body can not be neglected, do so after measurement on the inherent phase difference.

1. Place the TIME/CM switch at position EXT.
2. Add the signal to be measured to vertical input and EXT HOR IN terminal respectively.

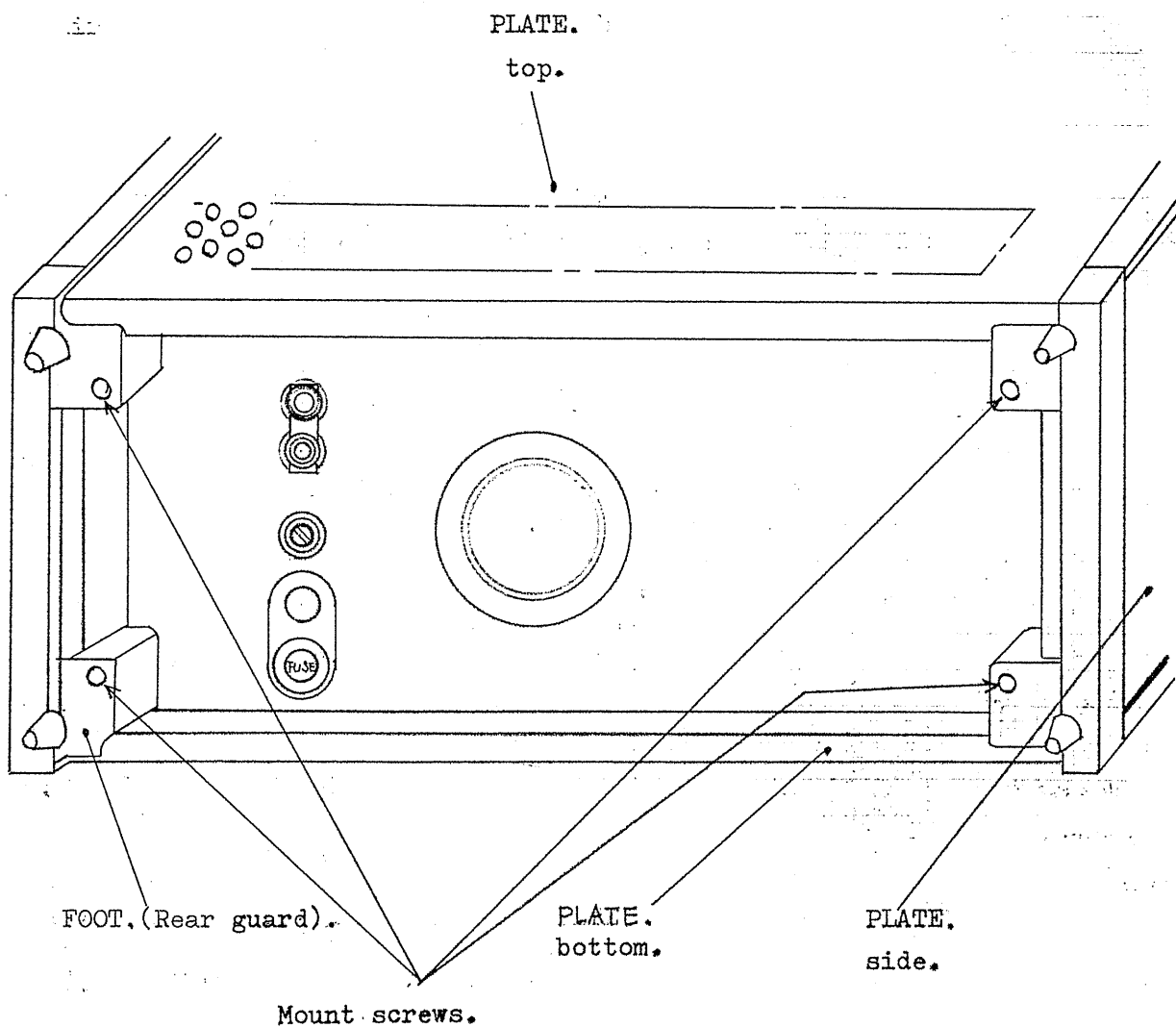
As shown in the Figure, adjust the horizontal and vertical amplitude to the scale and measure the dimensions A and B.

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

Actual phase angle =  $\theta$  - inherent phase angle of amplifier



4. Maintenance  
Inspection of Inside.



For checking the interior of the instrument,  
Loosen the four screws and remove each FOOT (rear guard),  
then all the plates. (top, bottom and both sides).

**CAUTION:**  
High voltage is very dangerous. Be sure to carry out  
the aforementioned operations after turning off the power switch.  
switch.

### Adjustment

#### Adjustment of DC BAL

1. Place the AC, GND, DC change-over switch for vertical input at GND.
2. Turn the vertical POSITION and adjust the bright line to the center of the scale.
3. Turn the VARIABLE of VOLTS/CM.

If the bright line is moved vertically when this knob is turned, adjust it in such a way that it is not moved with DC BAL.

When the DC BAL is turned, the vertical position of bright line is moved vertically. Accordingly, adjust it to the center of scale with the VERTICAL POSITION.

### Stability

1. Add the sine wave to the vertical input terminal in a range of 10 KHz - 50 KHz.
2. With VOLTS/CM switch, one cycle portion of waveform is drawn with TIME/CM for vertical amplitude 1 cm.
3. Set the TRIGGERING LEVEL at AUTO position and SOURCE at INT. Set the SLOPE at +.
4. When STABILITY is turned counterclockwise, sweeping will stop.

Accordingly, set it at the position little before stopping.

5. Turn the TIME/CM and VARIABLE alternately and confirm that synchronization is very stable in any range.

6. Extend the observing frequency to 20 Hz - 7 MHz and confirm the synchronization within this range. If unstable, adjust the STABILITY once again.

#### Adjustment of ASTIG

The following is the semi-fixed resistor located at the rear of case.

- 1) The sine wave is drawn all over the scale.
- 2) Adjust the ASTIG in cooperation with the FOCUS knob in such a way that the brightness is the same size all over the surface.

#### Adjustment on Deflection Sensitivity of VERTICAL AXIS

1. Adjust the VOLTS/CM to 0.02.
2. Adjust the VARIABLE to CAL'D.
3. Add the square wave of 0.05 V<sub>p-p</sub> to the vertical input.
4. Adjust R 221 in such a way that the vertical amplitude is 2.5 cm.

#### Adjustment of VOLTS/CM switch

This switch is used for adjustment on input capacity and frequency characteristics.

#### Input Capacity

1. Connect a capacity meter by which capacity of 30 pF can be measured with the vertical input terminal.
2. Adjust the VOLTS/CM to 0.02.
3. Adjust the input capacity to 33 pF with C 206 .
4. Adjust VOLTS/CM to 0.05.
5. Adjust input capacity to 33 pF with C 202B.








Hereafter, adjust it in the order mentioned in the following table.

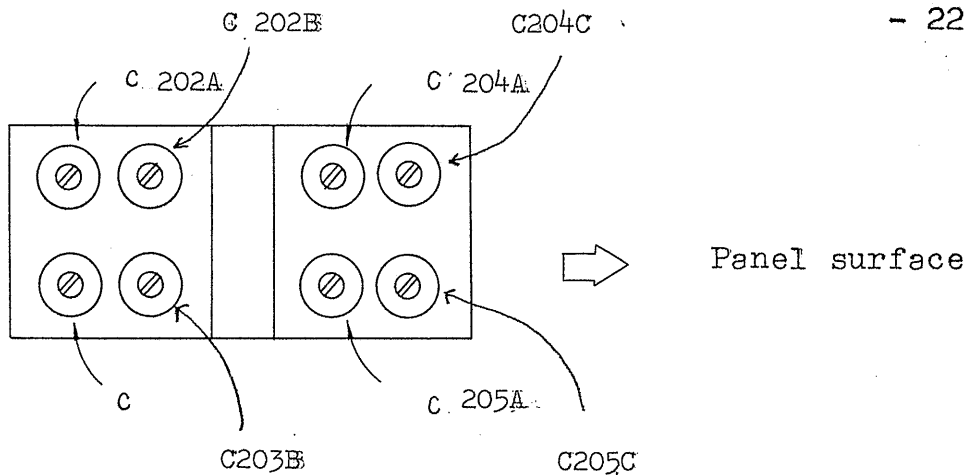
VOLTS/CM	Trimmer Condenser	Adjusted value
0.02	C 206	33 pF
0.05	C 202B	"
0.1	C 203B	"
0.2	C 204C	"
0.5		
1		
2	C 205C	33 pF
5		
10		

Frequency Characteristics (Compensator)

1. Add the high quality square generator covering a range of repetitive frequency 1 KHz and output voltage 0.05V - 100 Vp-p to the vertical input terminal.
2. Adjust VOLTS/CM to 0.05.
3. Adjust the wave form as shown in the following figure with C 202~205.

Hereafter, adjustment must be made in the following order.

VOLTS/CM	Trimmer condenser	Waveform	Quality
0.02			N.G X
0.05	C 202A		
0.1	C 203B		Good
0.2			
0.5	C 204A		
1			
2	C 205A		N.G X
5			
10			



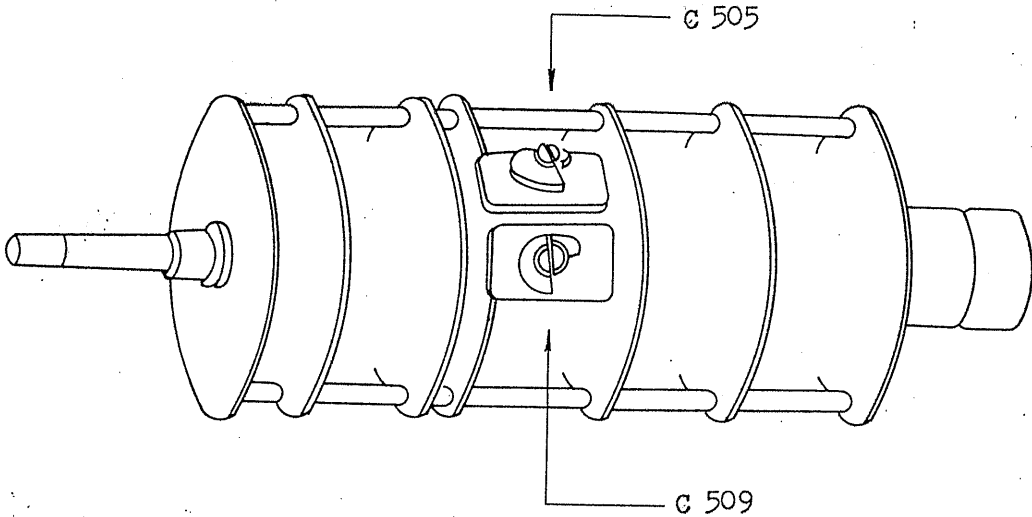
When this adjustment is made, a slight change takes place in input capacity. Accordingly, readjust the input capacity.

Adjustment on Sweeping Time

1. Add the time mark generator to the vertical input terminal.
2. Adjust and set the TIME/CM at 1 mS and VARIABLE at CAL'D.
3. Set the output of time mark generator at 1 mS.
4. Adjust the marker signal to the scale with the R 614 semi-fixed resistor.
5. Pull out the PULL 5X MAG toward the side. And, adjust the magnifier with R 617.

The aforementioned adjustment is enough for the range of 1 sec. - 50  $\mu$ S ranges. However, as for 20  $\mu$ S - 1  $\mu$ S range, adjust the scale with the trimmer condenser separately.

TIME/CM	Regulator	
1 mS	R 614	
10 $\mu$ S	C 505	Do so after adjusting 1 mS range.
1 $\mu$ S	C 509	



Adjustment on Sweep Amplitude

As for the amplitude of bright line, it is approx. 10.5cm with MAG OFF. This adjustment is made after finishing the adjustment of sweeping time. As it is not precise adjustment, there will be no problem if confirmation is made.

However, in case the width is 10cm or below, readjust it with the SWP LENGTH of the semi-fixed resistor of R Adjustment of Horizontal DC BAL.

1. Place the TIME/CM switch at position EXT.
2. Adjust the horizontal DC BAL in such a way that bright spot is not moved at both sides when the TIME/CM VARIABLE is turned.

REAR PANEL VIEW.

ASTIG: This is a semi-fixed resistor for adjustment of astigmatism of Brauntube.

