MODEL 5505D

OSCILLOSCOPE

INSTRUCTION MANUAL

KIKUSUI ELECTRONICS CORP.

CONTENTS

1. GENERAL

MODEL 5505D is a triggered type oscilloscope designed compact and light weight, using a 133mm round type cathode ray tube. UHF receptacles for monitoring transmission signal waveform of CB transceiver and so on are provided on the rear panel. The signal is directly applied to the deflection plate of CRT through them. Since quality of transmission signal waveform and modulation factor in amplitude modulation are easily observed, MODEL 5505D is suitable for monotoring in production line of transceiver. In amplitude modulation signal, triggering can easily be performed, since a signal of amplitude modulation detector is provided with the terminal on the rear panel.

The vertical axis has a 10mV maximum sensitivity and a bandwidth of DC to 4MHz, and the horizontal axis provides with a time base generator of 1μs/cm to 0.1s/cm.

Since semi-conductor elements are used in all circuits and a dual FET are used in first stage of vertical axis amplifier, MODEL 5505D minimizes drift and noise level. The all switches in vertical and horizontal axis are push button type, and the pushed buttons light. This permits the user to check a selector range from the remote side, and simplifies operation of the oscilloscope.

MODEL 5505D also provides with the terminals on the front panel from which regulated 1kHz square waves can be taken off to calibrate the sensitivity of the vertical axis or probe.

Construction

The MODEL 5505D consists of the main unit and accessories as follows.

Main unit

Accessories

MODEL 957M or 957A(M) probe	1
MODEL 941B terminal adaptor	1
Instruction manual	1

2. SPECIFICATIONS

Direct Deflection (Rear panel)

Item	Specification	Remarks
Frequency bandwidth	100kHz ~ 250MHz ±2 dB 100kHz ~ 100MHz ±5 dB	Terminated by 50Ω.
Deflection factor	Approx. 10V/cm	
VSWR	Less than 1.2	
ANT & TX terminals	M type (UHF)	
Synchronous output (TRIG OUT)	0.5Vp-p or more at approx. 1cm of modulated amplitude on the CRT screen.	
Maximum allowable input voltage	ANT & TX terminals 100Vp-p	DC+ACp-p (AC : less than 1kHz)

Vertical Deflection

Item	Specification	Remarks
Sensitivity	10mV/CM~10V/CM 4 ranges	1,10 step
Attenuator accuracy	Within ±3%	
Continuously variable sensitivity	Sensitivity can be continuously attenuated below 1/10 of VOLTS/CM indicated value. At 10V/CM range, less than 100V/CM obtainable.	
Frequency bandwidth	DC coupling: DC ~4MHz AC coupling: 2Hz~4MHz	Within -3 dB Reference: 4cm amplitude
Rise time	Approx. 88ns (Calculated value)	
Input impedance	1MΩ ± 2% with 38pF ± 2pF in parallel	

Input terminal	UHF type receptacle	M type applicable
Maximum allowable input voltage	400Vp-p at 10mV/CM range 600Vp-p at other ranges	DC+ACp-p (AC: less than 1 kHz)
Input coupling mode	AC and DC	
Trace shift by DC offset	Within 2mm at 10mV/CM range.	

Horizontal Deflection

Item	Specification	Remarks
Sweep time	1μs/CM~100mS/CM 6 ranges	1,10 step
Continuously variable sweep time	Sweep time can be continuously variable more than 10 times of TIME/CM indicated value.	
Sweep time accuracy	Within ±5% of TIME/CM indication value with VARIABLE at CAL'D.	At 100V of power supply voltage.

Triggering

Item	Specification	Remarks
Trigger signal source	INT : Waveform on the CRT screen, EXT: External signal	
Coupling	AC	
Polarity	+ and -	
Internal trigger sensitivity	5mm : 50Hz ~ 1MHz 10mm : 20Hz ~ 4MHz	
External trigger sensitivity	0.5Vp-p : at 50Hz ~ 1MHz 1Vp-p : at 20Hz ~ 4MHz	
AUTO	Trigger sensitivity is satisfied at 50Hz or more signal.	
Triggering mode	Trigger sweep and self-exciting sweep.	

External trigger input impedance	Approx. 100kΩ with approx. 100pF in parallel	
Maximum allowable input voltage	100Vp-p	DC+ACp-p (AC : 1 kHz or less)
Input terminal	Binding-post (Common to external sweep)	

External Sweep

Item	Specification	Remarks
Sensitivity	500mV/CM or more	
Continuously variable sensitivity	Sensitivity can be attenuated to 1/10 or less.	
Frequency bandwidth	DC ~ 200 kHz	Within -3 dB, at maximum position of sensitivity continuously variable control.
Input impedance	Approx. 220 kΩ with approx. 40pF in parallel.	
Maximum allowable input voltage	100Vp-p	DC+ACp-p (AC : 1 kHz or less)
Input terminal	Binding-post (Common to external trigger.)	

Calibration Voltage

Item	Specification	Remarks
Waveform	Approx. 1 kHz square wave	
Polarity	Positive-going Reference level : 0 V	
Output voltage	50mVp-p and 500mVp-p	
Output voltage accuracy	Within ± 3 %	

CRT

Item	Specification	Remarks
Type	133mm round type	
Accelerating voltage	Approx. 1600V	
Effective area	10cm (horizontal) 8cm (vertical)	

Power Requirement

Item	Specification	Remarks
Voltage	90V ~ 110V	
Frequency	50Hz ~ 60Hz	
Power consumption	Approx. 24VA	

Mechanical characteristics

Dimensions	260 (H) x 175 (W) x 445 (D) mm Maximum 235 (H) x 165 (W) x 406 (D) mm Cabinet only
Weight	Approx. 5.9kg

Accessories

MODEL 957M or 957A(M) probe	1
MODEL 941B terminal adaptor	1
Instruction manual	1

3. OPERATION

3.1 Explanation of front panel

INTEN POWER OFF	Knob for adjusting brightness of trace. It also serves as a power switch. Power is turned off at the POWER OFF position. Power is turned on by rotating this knob clockwise. Brightness becomes maximum at the extreme clockwise position.
FOCUS	Knob for making the spot or trace on the CRT screen well-defined.
CALIBRATOR	Square wave generator for calibrating sensitivity and probe. Output is a positive-going waveform with reference of 0V and fast rise time. The frequency is approximately 1kHz and the output voltage is 50mVp-p and 500mVp-p.
Vertical deflection	
INPUT	Vertical input terminal. It is a UHF type receptacle which is connected to input signal or probe.
GND	Terminal which is connected to cabinet and panel.
GND DC AC	Switch for selecting input coupling mode. By depressing the GND button, the input terminal disconnected from the vertical amplifier, and grounded. By depressing the DC button, the input signal including all components can be observed. The position of the trace in the GND mode is then 0V. By depressing the AC button, only the AC components can be displayed, with the DC components cut off.

VOLTS/CM

Switch for selecting the deflection sensitivity of the vertical axis from 0.01V/CM to 10V/CM in 4 steps. The indicated value of each range shows a voltage per 1cm vertical amplitude on the CRT screen at the extremely clockwise position (CAL'D position) of the VERTICAL knob.

VARIABLE

Knob for attenuating the input signal continuously. By turning the knob fully counterclockwise, the signal amplitude becomes less than 1/10 of value at the CAL'D position. Thus, a voltage in each range of the VOLTS/CM can be varied ~~continuously~~ continuously.

POSITION

Knob for shifting trace vertically.

Horizontal deflection

TIME/CM

Switch for selecting sweep time within a range of 1μS/CM ~ 0.1S/CM in 6 steps. The indicated value at each range is a sweep time per 1cm on the CRT screen at the extremely clockwise position (CAL'D position).

EXT HOR

By depressing this switch, sweep mode is changed to external sweep from internal sweep. The spot is then shifted horizontally in proportion to the voltage applied to the EXT HOR OR TRIG IN input terminal (red binding-post).

VARIABLE

Knob for varying sweep time continuously in internal sweep mode. By turning it fully counterclockwise, the sweep becomes slower than 1/10 of the value at the CAL'D position. Thus, sweep time in each range of the TIME/CM can be continuously varied. The lowest speed is 1s/cm or less. In external sweep mode, this is used an attenuator for the horizontal input signal applied to the EXT HOR OR TRIG IN input terminal. Deflection sensitivity is maximum

(0.5V/CM or more) at the CAL'D position, and approximately 1/10 of the CAL'D position at extremely counterclockwise position.

TRIGGERING LEVEL — Knob for selecting trigger mode and adjusting trigger level. The sweep is excited by itself at the AUTO position (extremely counterclockwise position), and the sweep is maintained even when there is no signal input. Whenever input signal more than 50Hz is applied, sweeping synchronizes with it.
Sweep mode becomes trigger sweep mode with turning the knob from the AUTO position clockwise. A spot stays at the left edge of the screen. Whenever input signal is applied, sweeping starts. The sweep starting point of the input waveform can be set by adjusting the knob.

SOURCE — Switch for selecting trigger signal . With the INT button depressed, waveform displayed on the CRT screen is used as the trigger signal.
When the EXT button is depressed, external signal applied to the EXT HOR OR TRIG IN input terminal are used as a trigger signal.

SLOPE — Switch for selecting types of slope at sweep starting point of trigger signal waveform. By depressing the + button, the sweep is triggered at the positive-going slope of the waveform. By depressing the - button, the sweep is triggered at the negative-going slope of the waveform.

EXT HOR OR TRIG IN — In internal sweep mode, this terminal is used as an input terminal for external trigger signal.
In external sweep mode, it is DC coupled to the horizontal amplifier as a horizontal axis input terminal.

POSITION — Knob for shifting spot or trace horizontally.

3.2 Explanation of cabinet side

The sides of the cabinet provide three holes on the left side and one hole on the right side for adjusting semi-fixed resistors by means of a screwdriver.

(Left side)

DC BAL — Semi-fixed resistor for adjusting DC balance in vertical axis, This should be adjusted so that the vertical position of the trace is not shifted by turning the VARIABLE knob.

GAIN CAL — Semi-fixed resistor for adjusting vertical sensitivity. This should be adjusted by using the output of the CALIBRATOR terminal.

ASTIG — Semi-fixed resistor for adjusting so that the spot or trace on the CRT screen is well-defined in conjunction with the FOCUS knob.

(Right side)

STABILITY — Semi-fixed resitor for adjusting the stability of the horizontal sweep generator. Readjustment is almost not requested, after once it is adjusted. But it may be requested for the variation of ambient temperature. In such a case, adjust this semi-fixed resistor as following procedure.

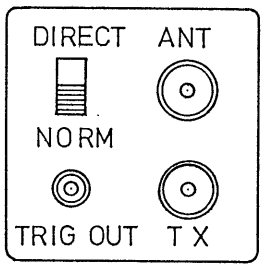
(1) Set the vertical mode selector to the GND with no input signal.
(2) Turn the TRIGGERING LEVEL knob fully clockwise (Opposite position of the AUTO).
(3) Set the TIME/CM switch to the 1mS.
(4) Set the SOURCE switch to the INT.
(5) Turn the STABILITY knob fully clockwise, and the sweep free runs. Free running is a state in which the sweep generator sweeps automatically. Free running is unlike self exciting sweep. Even when sweep speed is high, the trace remains bright.

(6) Slowly turn the STABILITY counterclockwise, and free running is stopped. At this position, optimum stability is obtained.

(7) Check sychronizing by means of a sine wave generator of a range of 50Hz ~ 5MHz. (CALIBRATOR might be used instead of the sine wave generator.)
Set the TRIGGERING LEVEL to the AUTO. Connect the output of the sine wave generator to the vertical INPUT, and display the waveform with the amplitude of approximately 2cm on the CRT screen at 50Hz, 10kHz and 4MHz. Check if the sweep remains in synchronized state, when turning the TIME/CM switch or VARIABLE knob. If the waveform is duplicated, it is corrected by turning the STABILITY slightly counterclockwise. Be carefull not to turn it too far, otherwise, synchronization may not be attained at 4MHz even if it is attained at 50Hz and 10kHz.

3.3 Explanation of rear panel

A DIRECT/NORMAL selector switch, UHF receptacles (M types are applicable.) for connecting the ANT and TX, a TRIG OUT terminal, a fuse and a power cord are provided on the rear panel. Located parts except fuse and power cord are indicated by a name plate.



ANT — UHF receptacle (M type is applicable.) for connecting antenna which is connected to a transceiver or dummy load.

TX — UHF receptacle for connecting output of transceiver.

DIRECT
NORM

For general use, this switch is set to the NORM position, and input signal is applied the INPUT terminal on the front panel. For observing the transmission output waveform, this switch is set to the DIRECT position, and antenna or dummy load is connected to the ANT input. Output of transceiver is connected to the TX input.

TRIG OUT

Trigger signal output terminal. Output signal of transceiver is detected, and detected signal is provided to this terminal. When amplitude modulated output signal is observed, modulating signal is easily obtained. Horizontal sweep can be triggered by connecting the modulating signal to the EXT TRIG IN terminal on the front panel and depressing the EXT button.

3.4 Caution on operation

Power supply voltage

MODEL 5505D is normally operated on a power supply within a range of 100V ±10%. Since a supply voltage above this range causes trouble, maintain the voltage within 100V ±10% by a suitable method.

Ambient temperature

MODEL 5505D normally operates within an ambient temperature of 0 C ~ +40°C. However, a range of +15°C ~ +35°C is advisable to satisfy the specifications perfectly.

Maximum allowable input voltage

The maximum allowable input voltage in each terminal and accessory probe are specified as follows.

V	Vertical axis input terminal	400Vp-p at 0.01V/CM range of VOLTS/CM. 600Vp-p at other ranges.
	Accessory probe	600Vp-p
	EXT HOR OR TRIG IN terminal	100Vp-p
	ANT terminal and TX terminal	100Vp-p
	TRIG OUT terminal	Do not apply voltage.

Brightness of CRT

A Avoid increasing brightness excessively or leaving a spot on the CRT screen for a long time. Otherwise, the phosphor of CRT may be burnt.

3.5 Operation

Before turning on the power, set the switches and knobs as follows.

INTEN	POWER OFF position
FOCUS	Approximately center
POSITION ↕	Approximately center
POSITION ↔	Approximately center
TIME/CM	1mS/CM
TRIGGERING LEVEL	AUTO

Connect the power cord to the 100V power source, and turn the INTEN knob fully clockwise. A bright trace is displayed on the CRT screen approximately 10 seconds late. Turn the INTEN knob counterclockwise, until the appropriate bright trace is obtained. Adjust the FOCUS knob so that the most well defined trace is displayed.

How to display the waveform

Waveform is displayed on the CRT screen by applying the CALIBRATOR voltage to the vertical INPUT. Use 50mVp-p output as the CALIBRATOR voltage, and set the switches and knobs as follows.

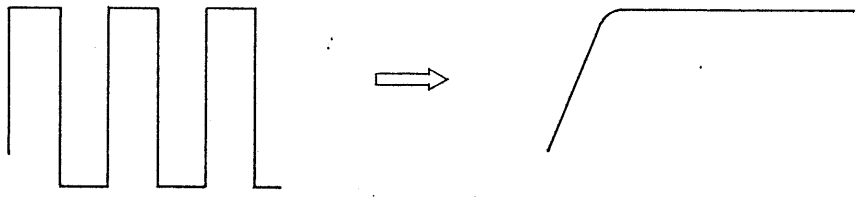
AC DC GND	DC
VOLTS/CM	0.01V/CM
VARIABLE	CAL'D
TIME/CM	1mS/CM
VARIABLE	CAL'D
TRIGGERING LEVEL	AUTO
SOURCE	INT
SLOPE	+

Square wave having 5cm amplitude is displayed on the CRT screen. As the VOLTS/CM switch is changed over step by step, vertical amplitude is attenuated. The amplitude is also attenuated continuously by turning the VARIABLE counterclockwise.

Through the above operation, relation between input signal and, the VOLTS/CM and VARIABLE can be checked.

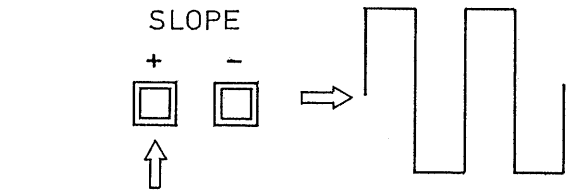
Time base and triggering

Since the calibrating voltage is a square wave of approximately 1kHz, one cycle of square wave can be displayed in 1cm length horizontally with the TIME/CM at the 1mS. As the TIME/CM switch is changed over step by step clockwise, sweeping of the time base becomes faster. Sweep time can also be varied continuously by means of the VARIABLE knob. Therefore, the square waveform of calibrating voltage can be displayed in many cycles or part of one cycle. Namely, the square wave can be observed as Fig. 3-1 with the leading edge enlarged with turning the TIME/CM switch clockwise.

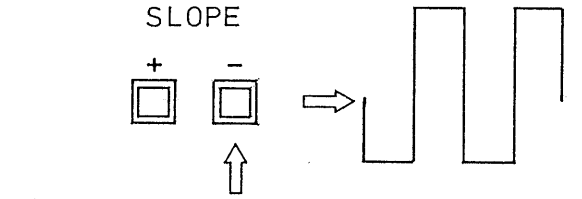


Variation in waveform on the CRT screen by means of sweep time switching.

Fig. 3-1

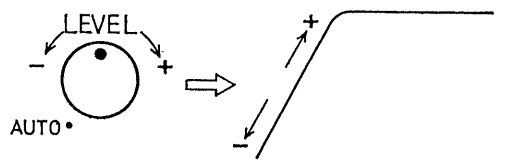


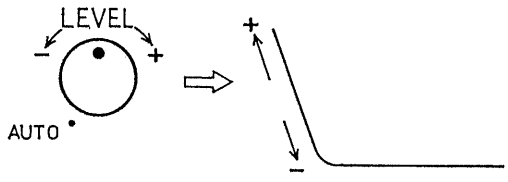
With + button depressed



With − button depressed

SLOPE selection and wave form on screen





Turning direction of LEVEL knob and variation in triggering point on waveform

Fig. 3-2

Refering to Fig. 3-2, observe variation in the triggering point by depressing the + or - SLOPE button and turning the VARIABLE knob clockwise or counterclockwise. By turning the LEVEL knob, sweep will start from a selected point on the leading edge or trailing edge of the square wave.

Trigger signal source

To display the still waveform of input signal on the CRT screen, the input signal waveform or a signal with a certain timing relationship with the input signal must be applied to the trigger circuit of the time base.

Internal trigger

By depressing the INT button of the TRIGGERING SOURCE, input signal is amplified by the vertical axis amplifier to a sufficient level, and is applied to the trigger circuit. Therefore, stable synchronization is attained, and operation is easy. This is called internal trigger.

External trigger

The input of the trigger circuit is connected to the EXT HOR OR TRIG IN terminal by depressing the EXT button of the TRIGGERING SOURCE. External trigger signal is applied to the trigger circuit through the terminal. This is called external trigger.
In the external trigger mode, the trigger circuit is triggered without being effected by the vertical deflection system. Therefore, it is effective to measure ripple waveforms superimposed on high frequency signals or complexly variable TV video signals, etc., whose waveforms are not easily held.

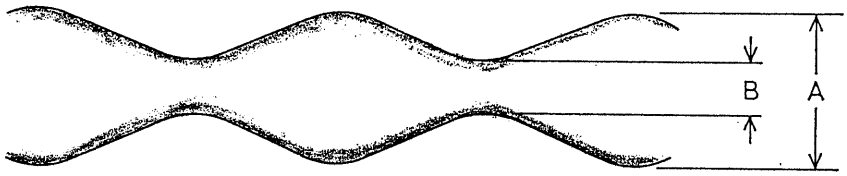
3.6 Operation method as a monitor oscilloscope

1. Connect antenna or dummy load to the ANT UHF receptacle (M type is applicable) and transmitter to the TX receptacle on the rear panel.
2. Set the DIRECT/NORMAL selector to the DIRECT.
3. Connect the TRIG OUT terminal on the rear panel to the EXT HOR OR TRIG IN terminal on the front panel, and depress the EXT button of the TRIG SOURCE switch on the front panel.

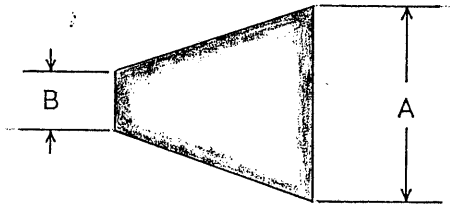
4. Set the vertical input selector on the front panel to the GND.

5. Amplitude modulated waveform synchronizing with modulating waveform is observed with operating transmitter.

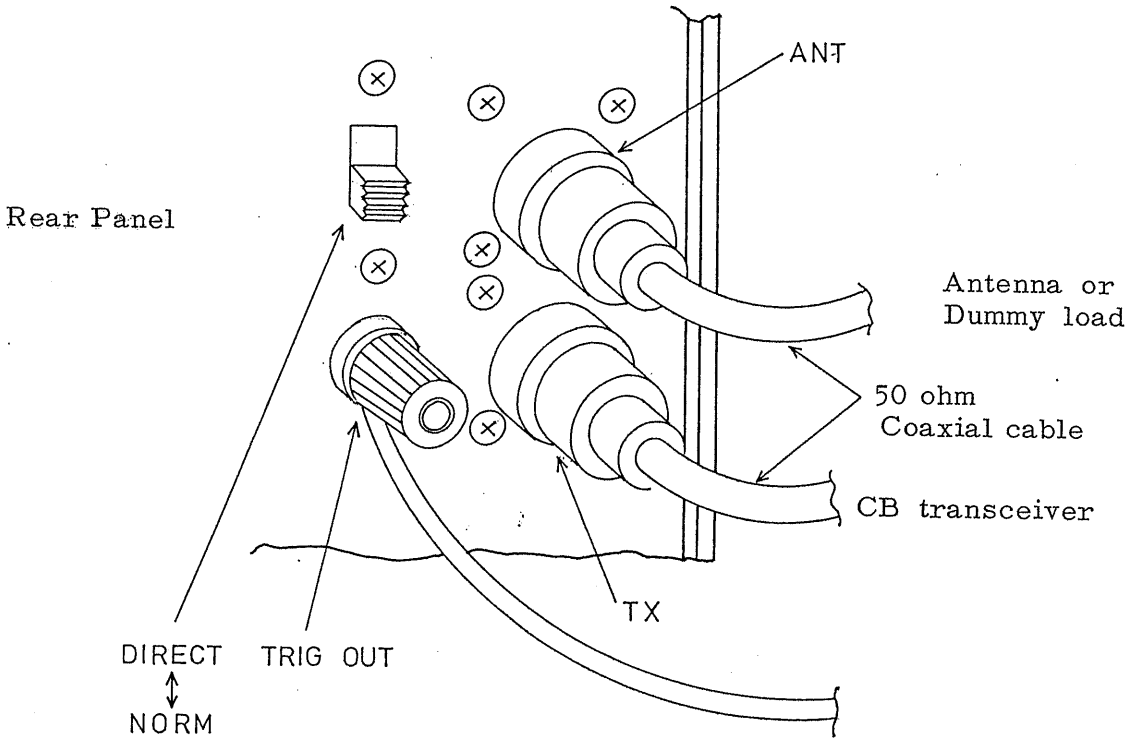
6. Vertical and horizontal positioning is made with each POSITION knob on the front panel.

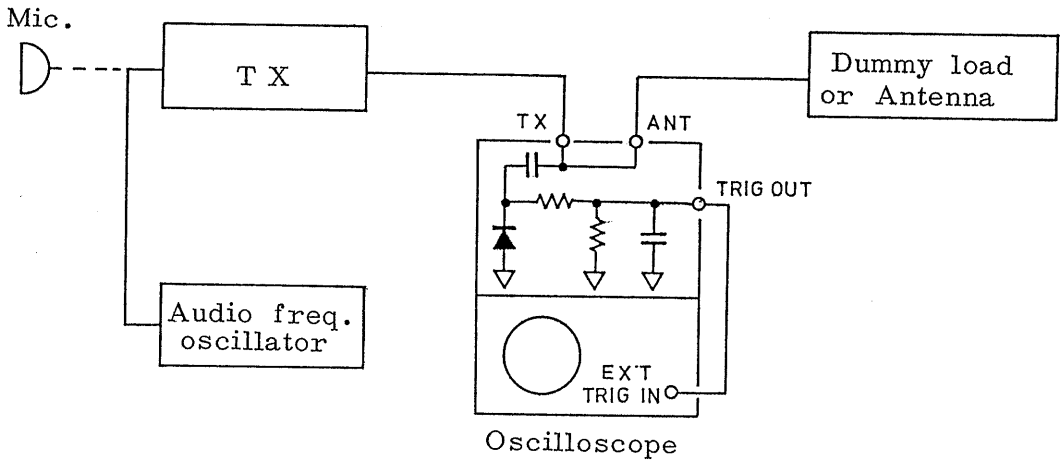


7. Trapezoid figure by modulated waveform can be displayed by depressing the EXT HOR button. For this display, the TRIG OUT terminal on the rear panel is connected to the EXT HOR OR TRIG IN terminal on the front panel.



8. Modulation factor is obtained from the figures shown in item 6. and 7. by a formula of $M = \frac{A-B}{A+B} \times 10\%$.





Connection diagram

4. MEASUREMENT

4.1 Application method of vertical input signal

Vertical impedance is 1MΩ ± 38pF in parallel without probe and 10MΩ ± 14pF in parallel with a probe. Connection between signal source and the oscilloscope is made by various method. Covered wires, shielded cable, probe and coaxial cable are used for the connection.
One of these methods is selected for following conditions.

Output impedance of signal source
Amplitude and frequency of input signal
Induction from external source
Distance between input signal source and oscilloscope

Connection methods are represented as following table by characteristics of input signal.

Input signal \ Connection method			Covered wire	Shielded cable	Probe	Coaxial cable	Others
Low frequency	Low impedance	near	○	○	○	○	
		far		○		○	
	High impedance	near		○	○		
		far		○			
High frequency	Low impedance	near			○	○	
		far				○	
	High impedance	near			○		
		far					

With covered wires

Attach the M type terminal adaptor provided as an accessary to the vertical input terminal, and connect the covered wires to the adaptor. The input signal can be connected without attenuation. However, measurement under this method may be unstable, because the input wires are susceptible to induction noise interference when they are long or when the input signal source impedance is high, and also the stray capacitance with respect to the ground is large. As compared with the case the 10:1 probe is used,

this method is susceptible to interference with the measured circuit.

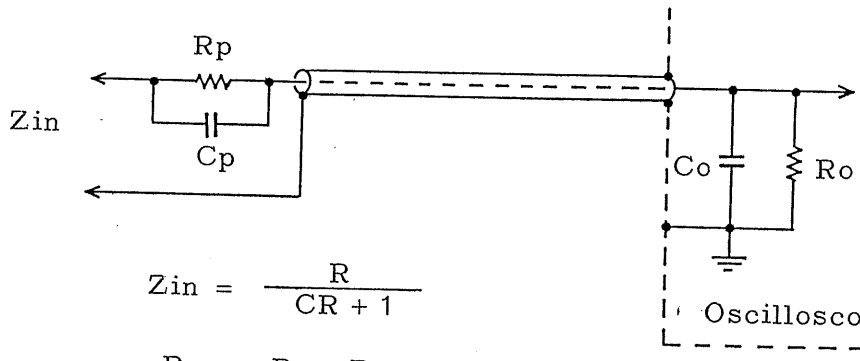
With shielded cable

By the use of a shielded cable, external noise introduced in the input connection can be eliminated. However, the use of a shielded cable is disadvantageous in that the capacitance between signal source and ground becomes large (50pF/m ~ 100pF/m). Therefore, the use is not suitable for input connection when the signal source impedance is substantially high or when a signal which includes higher frequency components is to be measured.

Use of probe

The probe with 10 : 1 attenuation ratio which is supplied as an accessory of the oscilloscope is used. The lead wire is shielded, and the probe itself makes up a wide band attenuator with the attenuation resistor Rp and parallel capacitance Cp as Fig. 4-1. Use of probe is the most suitable method, when the input signal source impedance is high or the input signal includes high frequency components.

Input impedance with probe



$$Zin = \frac{R}{CR + 1}$$

$$R = Rp + Ro$$

$$C = \frac{Cp \times Co}{Cp + Co}$$

(Co includes cable capacitance)

$$Cp = \frac{Co \times Ro}{Rp}$$

Fig. 4-1

With coaxial cable

When the signal source impedance is 50Ω or 75Ω, a coaxial cable of the matched impedance may be used for input signal connection. When an impedance matched coaxial cable is used, the input signal can be connected without attenuation for high frequency components also. Impedance matching must be made at the input side.

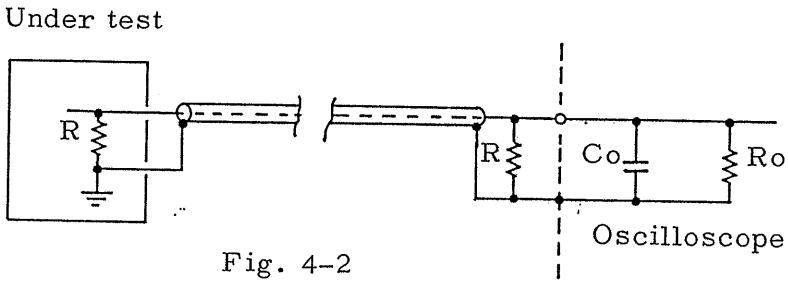


Fig. 4-2

4.2 Voltage measurement

DC voltage measurement

With the time base in the self exciting mode, set the TIME/CM switch to the 1mS/CM or near position to display the sweep line on the CRT screen. Depress the GND button of the vertical input coupling mode selector AC DC GND. Since the sweep line is then located at the 0V position of vertical input as shown in Fig. 4-3, shift the sweep line to an easily measurable position. Depress the DC button. Apply a voltage of the point to be measured to the vertical axis input. Then, by means of the scale on the CRT screen, read the shifted value of the sweep line.

If the sweep line is extended beyond the screen, switch the VOLTS/CM to a lower range so that the sweep line is shifted to the position measured easily. When the sweep line is shifted to the upper position than the former position, voltage polarity is negative. Input voltage is obtained by a formula of the following (4-1) or (4-2) with the reading (cm) of vertical amplitude on the CRT screen.

In case of method using probe of 10:1 attenuation ratio.

Voltage (V) = Indicated value of VOLTS/CM x Amplitude (cm) x 10 ..... (4-1)

In case of directly applying input signal to vertical input terminal.

$$\text{Voltage (V)} = \text{Indication value of VOLTS/CM} \times \text{Amplitude} \qquad (4\text{-}2)$$

AC voltage measurement

If as shown in Fig. 4-3, the DC voltage is higher than its superimposed AC voltage to be measured, the sweep line disappears from the screen due to DC voltage with the vertical input coupling mode selector AC DC GND set to the DC. Although the AC component may be shifted within the screen, avoid this method since it tends to cause measurement error. The AC component waveform can also be shifted within the screen by switching the VOLTS/CM to a lower range. However, amplitude becomes too small to allow accurate measurement. In such cases, depress the AC button of the vertical input coupling mode selector AC DC GND. A capacitor is then connected to the vertical input terminal in series, and the DC component is cut off. Thus, AC voltage only is enlarged enough to be displayed on the screen.

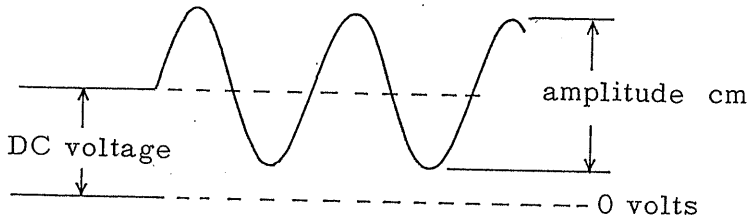


Fig. 4-3

The AC voltage can be calculated from the amplitude (cm) by using (4-1) and (4-2) formulas. (The AC measurement mode causes input signal voltage to be -3 dB attenuated at 2 Hz or less.) The AC voltages calculated by using (4-1) and (4-2) formulas are peak to peak values (Vp-p). The effective values (Vrms) of sine wave are obtained from the following (4-3) formula.

$$\text{Voltage (Vrms)} = \frac{\text{Voltage (Vp-p)}}{2\sqrt{2}} \qquad (4\text{-}3)$$

4.3 Time measurement

Time interval measurement

Time interval between two optional points on a waveform can be measured by setting the VARIABLE knob of the TIME/CM switch to the CAL'D position and reading indication value of the TIME/CM. First, set the TRIGGERING LEVEL knob to the AUTO. Then, as shown in Fig. 4-4, switch the TIME/CM so that interval between two points on the waveform is easy to measure. Time interval between two points is obtained from the following formula.

$$\text{Time } T\,(\text{sec}) = \text{TIME/CM}\,(\text{sec}) \times \text{Length on screen}\,(\text{cm}) \qquad (4\text{-}4)$$

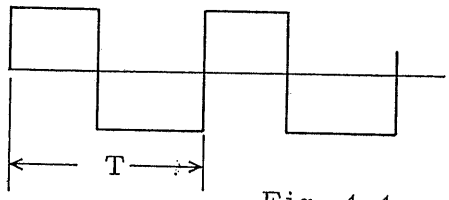


Fig. 4-4

Frequency measurement

To measure frequency, there are the following three methods. In the first method, frequency is calculated from time per cycle obtained from (4-4) formula by using the following (4-5) formula.

$$\text{Frequency}\,(\text{Hz}) = \frac{1}{\text{Period } T\,(\text{sec})} \qquad (4\text{-}5)$$

In the second method, frequency is calculated from time per cycles within 10 to 20. Frequency is calculated from the number (N) of cycles contained within 10 cm divisions on the horizontal scale by using the following (4-6) formula.

$$\text{Frequency}\,(\text{Hz}) = \frac{N}{\text{Indicated value of TIME/CM}\,(\text{sec}) \times 10} \qquad (4\text{-}6)$$

This method allows smaller measurement error than in the first method by giving a large value to N.

In the above two methods, frequency is calculated from time. When frequency is less than 5 kHz and waveform is simple such as sine wave, frequency can be measured by means of Lissajous' figure displayed in the X Y scole mode. To set to the X Y scope mode, depress the EXT HOR switch.

Apply unknown signal to the vertical INPUT terminal and given signal to the EXT HOR OR TRIG IN terminal respectively. Adjust the VOLTS/CM and horizontal VARIABLE until both vertical and horizontal amplitudes are 4 cm. Next, as the frequency of the given signal is varied, the Lissajous' figure of 1 : 1 are displayed as shown in Fig. 4-5.

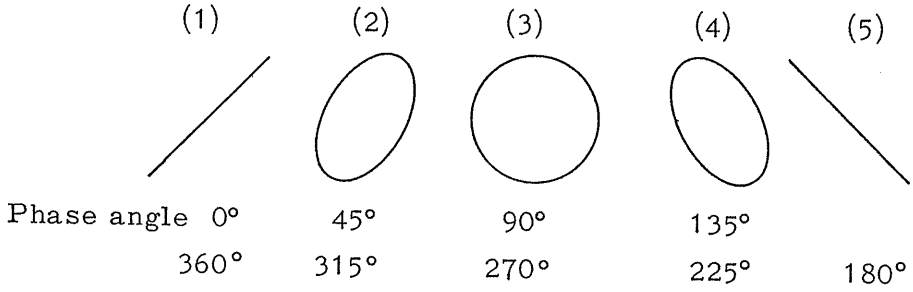


Fig. 4-3

The Lissajous' figure of 1 : 1 frequency ratio is either a circle, an ellipse, or linear line. When frequency ratio gets near 1 : 1, the figure varies continuously in the sequential order of (1) - (5) - (1). The sequential variation becomes slow, as difference between both frequencies is smaller. When both coincide with each other, the figure stops in either form.
Unknown frequency equals the frequency given in this time. Although in case of various frequency ratio, unknown frequency can be found from Lissajous' figure, utilize the figure of 1 : 1 frequency ratio by means of generator allowing a wide range of continuously variable frequencies. This method is easiest and most accurate.

Phase difference measurement

Measurement by means of Lissajous' figure between two signals having the same frequency.
As described in the section dealing with frequency measurement, make the oscilloscope displayed Lissajous' figure in the X Y scope mode. In Fig. 4-6, phase angle is obtained from the following formula.

$$\text{Sine } \Theta = \frac{A}{B} \quad \cdots\cdots\cdots \quad (4\text{-}7)$$

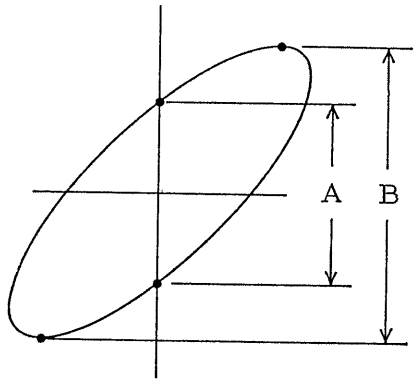


Fig. 4-6

Caution : Since error may result from phase difference of the oscilloscope in a high frequency range, use less than 5 kHz frequency for measuring phase difference. (Phase difference of the oscilloscope is less than 3 at 5 kHz. However, when the horizontal VARIABLE knob is set to the CAL'D position, phase difference becomes less than 3 at 20 kHz, and the available range is expanded.)

5. CALIBRATION

After operating MODEL 5505D for a certain length of time, be sure to calibrate it. After repairing it, also calibrate it according to repair contents.

5.1 How to remove covers

Since almost all adjusting points for calibration are provided inside the cabinet, remove the top cover and bottom plate.
Be sure to maintain AC power supply at 100V during calibration.

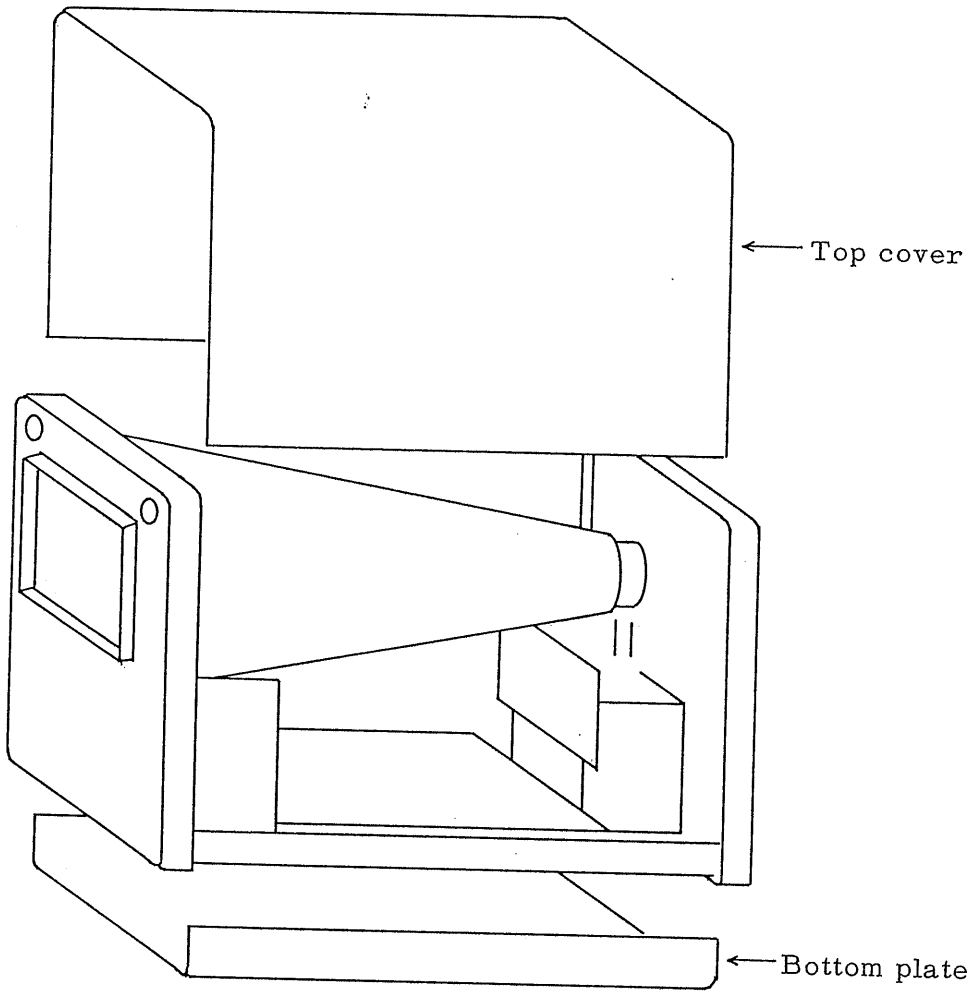


Fig. 5-1

5.2 Power supply system

The power system of MODEL 5505D is shown in Fig. 5-2.
Since +15V and -15V in the figure should be regulated, occasional calibration is needed for them.

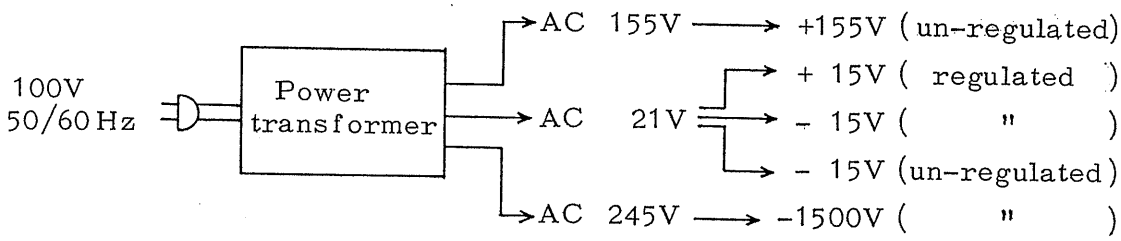


Fig. 5-2

First, turn R114 shown in Fig. 5-4 with a screwdriver, until -15V is obtained. Then, turn R111 for +15V.
Be sure to start from -15V, since +15V deviates by adjusting for -15V.

5.3 INTEN ADJ

A variable range of the INTEN knob is adjusted with the INTEN ADJ semi-fixed resistor (R174 shown in Fig. 5-4). Adjust it until the trace disappears when setting the INTEN knob on the front panel at angle of 45 rightward.

5.4 CAL

Output voltage of the CALIBRATOR is adjusted with the CAL semi-fixed resistor (R708 in Fig. 5-5). Connect the test point (T.P shown in Fig. 5-5) to the chassis or the GND terminal. 1 kHz oscillation stops and DC voltages are obtained at the CALIBRATOR output terminals on the panel. Using an accurate voltmeter, set one voltage to 500mV. The other output will then be set to 50mV automatically. Disconnect the test point from the GND. Square waves of 500mVp-p and 50mVp-p are obtained respectively. (Refer to Fig. 5-3.)

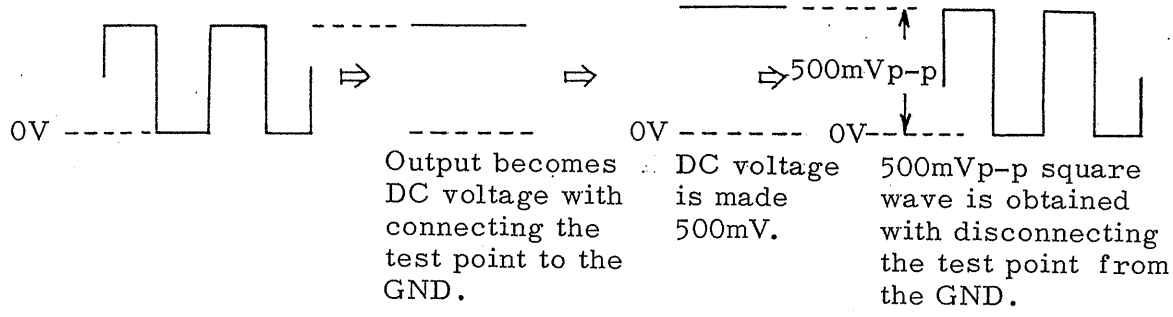


Fig. 5-3

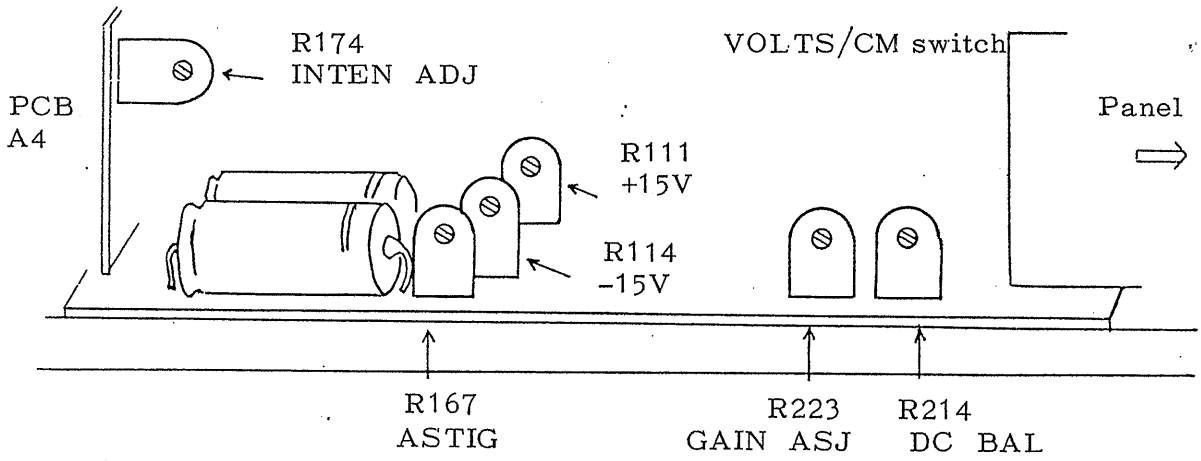


Fig. 5-4

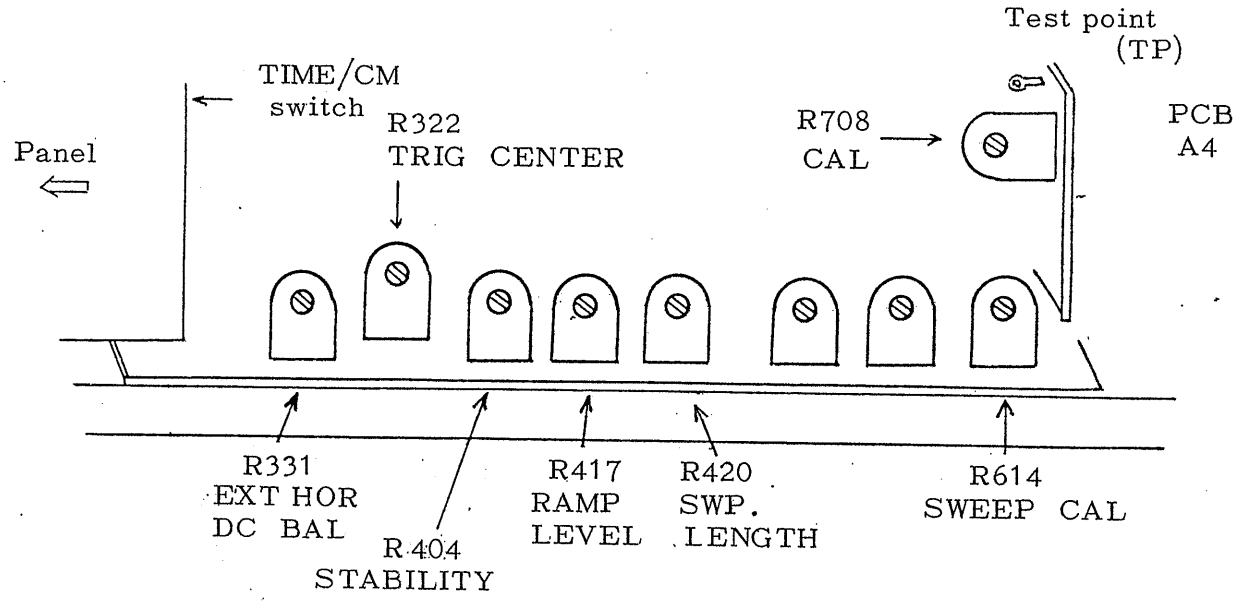


Fig.5-5

5.5 Vertical deflection sensitivity

(1) Set the VOLTS/CM to the 0.01V.

(2) Set the VARIABLE to the CAL'D.

(3) Apply a square wave of 1 kHz and 50mVp-p (Properly calibrated CALIBRATOR may be used.) to the vertical input terminal.

(4) Adjust R223 shown in Fig. 5-4 so that vertical amplitude is 5cm.

5.6 VOLTS/CM switch

Input capacitance and phase charateristic are adjusted with capacitors on this assembly. (Refer to Fig. 5-6.)

(1) Connect a capacitance meter measuring about 40pF to the vertical input terminal.

(2) Set the VOLTS/CM switch to the 0.01V, and adjust the C211 for 38pF input capacitance.

(3) Apply a 1 kHz square wave having a rise time of less than 0.1μs to the vertical input terminal.

(4) Set the VOLTS/CM switch to the 0.1V for phase adjustment. Adjust C203 until the upper part of square wave is flat.

(5) Make phase adjustment by turning C206 and C209 in the 1V and 10V ranges respectively by the same procedure as (4) above.

(6) Connect the capacitance meter to the vertical input terminal again. Adjust C202, C205 and C208 so that input capacitance is 38pF in the 0.1V, 1V and 10V ranges respectively.

(7) Repeat adjustment from (1) through (6).

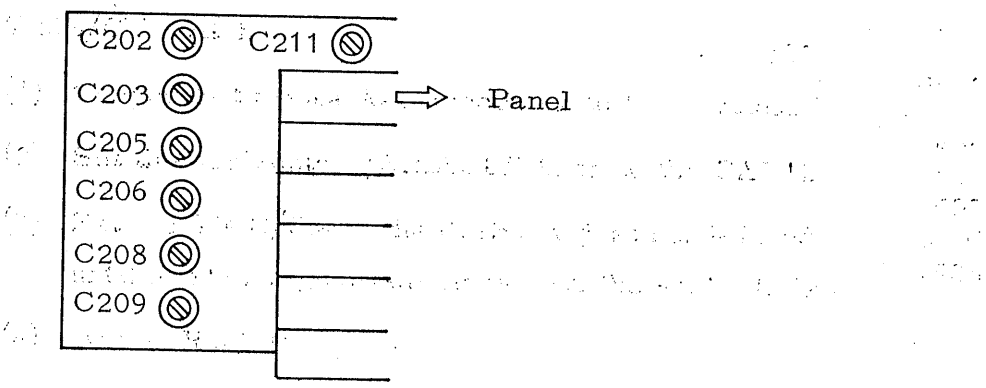


Fig. 5-6 VOLTS/CM switch

5.7 TIME/CM switch

(1) Connect a time marker generator to the vertical input terminal.

(2) Set the horizontal VARIABLE knob to the CAL'D position.

(3) Set the TIME/CM to the 0.1S. Adjust the semi-fixed resistor R510, until marker signal coincides with the scale divisions.

(4) Adjust R508, R507, R505, R503 and R501 in the 10mS, 1mS, 0.1mS, 10μS and 1μS ranges respectively by the same procedure as (3) above.

(5) Repeat adjustment from (1) through (4).

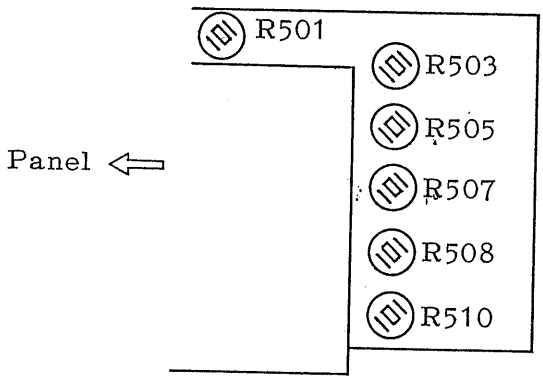


Fig. 5-7 TIME/CM switch

5.8 Sweep amplitude adjustment

Adjust R420 (SWP. LENGTH shown in Fig. 5-5) so that the amplitude of the trace is 11cm. In this case, strict adjustment is unneccessary, and rough checking is enough. However, since too much deviation affects stability in operation, readjustment is advisable.

5.9 Note

For adjustment of the STABILITY and vertical DC BAL, see item 3.2 Explanation of cabinet side plate. These resistors can be adjusted from the outside of the cabinet.

ADJUSTING PROCEDURE

1. With a screwdriver (+), rotate the 4mm screw counterclockwise for approximately 3 turns to loosen it. Note that the screw will come off if it is turned further.

2. When the screw is loosened, it can be moved upward and downward, and in response the CRT is slightly rotated, and thus the horizontal trace angle is adjustable. This adjustment should be made under the state that the power of the oscilloscope is turned on, and it is displaying its horizontal trace.

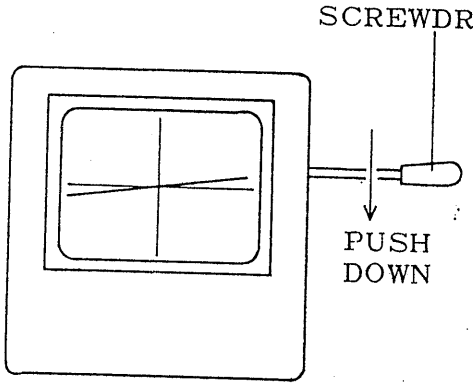


Fig. 2

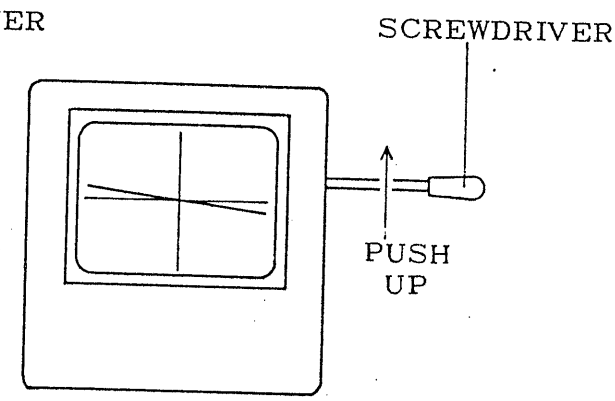


Fig. 3

3. Fig. 2 illustrates the case the right-hand side of the trace is high. In this case, set the screwdriver to the 4mm screw and move it downward so that the trace is made parallel with the graticule. As the 4mm screw is heavy, it should be pushed downward strongly.

4. Fig. 3 illustrates the case the left-hand side of the trace is high. In this case, move the 4mm screw upward.

5. When the trace is made parallel with the graticule, lock tightly the 4mm screw by turning it clockwise (LOCK) with the screwdriver.

The adjustment is complete by the above procedure.

CRT ROTATOR (CRT rotating mechanism)

The function of the CRT rotator is to rotate the CRT mechanically for fine adjustment so that the horizontal trace of the CRT is made parallel with the horizontal scale lines of the graticule. An outstanding feature of the CRT ROTATOR is that the adjustment can be made without removing the casing.

The adjusting provision is located on the right-hand side panel (as viewed from the oscilloscope front) as shown in Fig. 1. This adjustment should be made when the horizontal trace apparently is not parallel with the horizontal scale lines of the graticule.

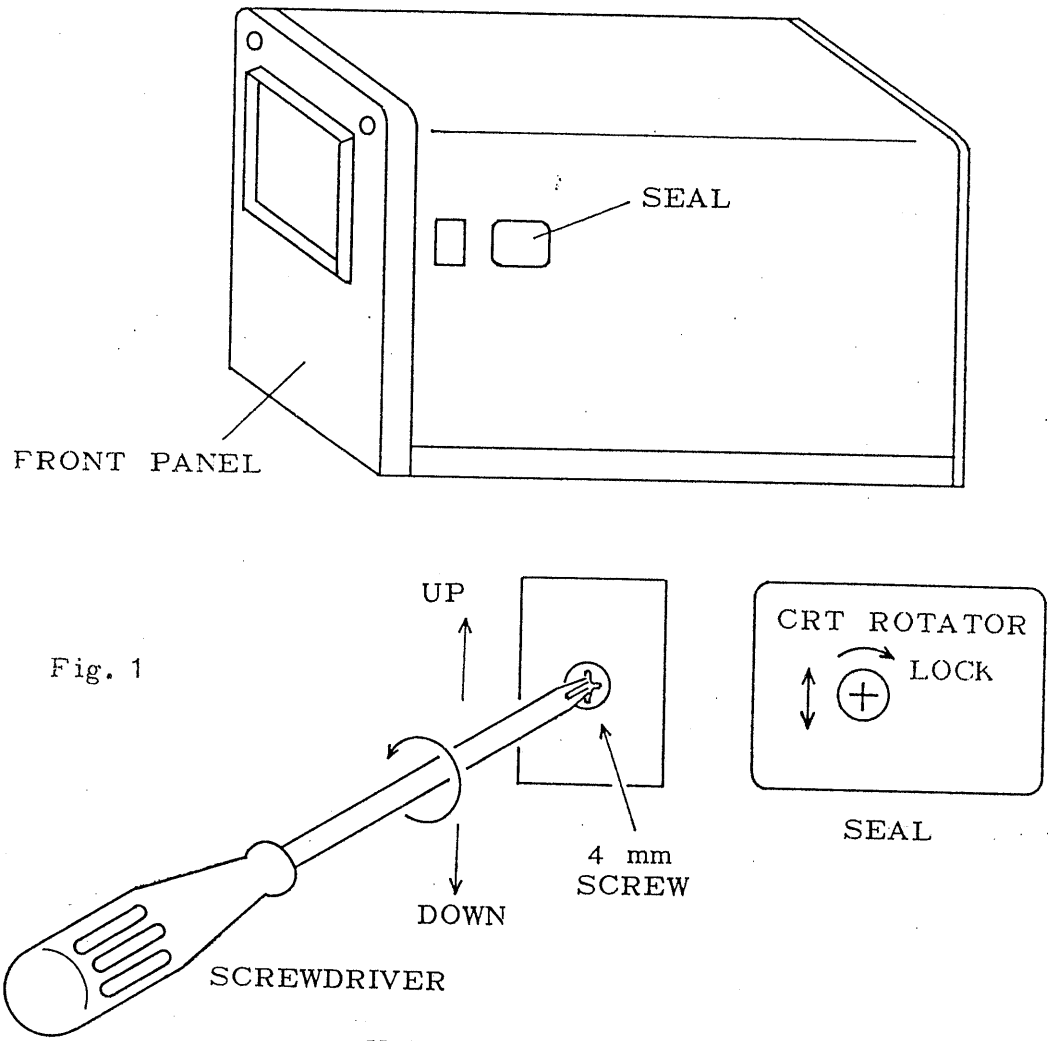


Fig. 1

Using a screwdriver, move the 4mm screw upward or downward so that the horizontal trace is made parallel with the horizontal scale lines of the graticule.