MODEL 5510PR

OSCILLOSCOPE

INSTRUCTION MANUAL

KIKUSUI ELECTRONICS CORP.

CONTENTS

1. GENERAL

MODEL 5510PR is a portable triggered type oscilloscope designed compact and light weight using a 133 mm round post-acceleration CRT which brightness is excellent.

The vertical system provides deflection sensitivity of 10 mV/cm and a bandwidth of DC to 10MHz. The horizontal deflection system provides sweep rate from 1μs/cm to 0.5s/cm, and five times horizontal magnifier allows each rate to be increased 5 times. The ranges of TV.V and TV.H allow TV signal to be easily observed.

Using semiconductor elements in all circuits, MODEL 5510PR stably operates for very low drift and noise level. Vertical and horizontal deflection sensitivity are little affected by change of power source, for high voltage source is regulated.

MODEL 5510PR also provides the terminals on the front panel with regulated 1 kHz square waves to calibrate the deflection sensitivity and the probe.

MODEL 5510PR can be mounted on a standard rack by using a rack mount adaptor RMAP-5510PR (Optional adaptor).

Accessories

MODEL 959M probe	1
MODEL 941B terminal adaptor	1
Instruction Manual	1

Optional Accessory

RMAP-5510PR rack mount adaptor

2. SPECIFICATIONS

Vertical Deflection

Item	Specifications	Remarks
Sensitivity	10mV/cm to 10V in 10 steps	1.2.5 step
Attenuator accuracy	Within ± 3%	
Sensitivity variable	Variable to 1/2.5 or less of VOLTS/CM indication.	
Frequency bandwidth	DC coupling: DC ~ 10MHz AC coupling: 2Hz ~ 10MHz	4 cm amplitude reference Within ± 3dB
Rise time	Approx. 35 ns	Calculated value
Input impedance	1MΩ ±2% with 38pF ±2pF	
Input terminal	UHF type receptacle	M type is also applicable.
Maximum allowable input voltage	400 Vp-p at 10 mV/CM range 600 Vp-p at other ranges	DC + ACp-p AC : less than 1 kHz
Input coupling modes	AC and DC	
Trace shift by DC offset	Within 2mm on CRT screen at 10mV/CM range.	

Horizontal Deflection

Item	Specifications	Remarks
Sweep time	1μs/cm to 0.5s/cm, TV.H and TV.V in 20 steps.	1.2.5 step
Sweep time variable	Continuously variable to 1/2.5 or less of TIME/CM indication. Slowest uncalibrated sweep rate is at least 1.25s/cm.	
Sweep time accuracy	Within ±5% of indicated sweep rate, when VARIABLE knob is set in CAL'D position.	
Sweep magnifier	5 times	
Sweep magnification accuracy	Within ±5% + sweep time accuracy	
Horizontal trace shift by mag.	Within 10mm at center of screen.	

Triggering

Item	Specifications	Remarks
Trigger signal source	INT : internal EXT: external	INT includes TV.V and TV.H.
Trigger coupling	AC	
Trigger polarity	+ or -	
Internal trigger sensitivity	Within 50Hz to 5MHz for 10mm amplitude on CRT screen. Within 20Hz to 10MHz for 20mm amplitude on CRT screen.	
External trigger sensitivity	50Hz ~ 5MHz : 1Vp-p 20Hz ~ 10MHz : 2Vp-p	
AUTO (Automatic trigger)	Rated trigger sensitivity is satisfied with respect to more than 50Hz.	
Triggering mode	Trigger sweep and automatic trigger sweep.	
External trigger input impedance	Approx. 100kΩ with 50pF or less.	
Maximum allowable input voltage	100Vp-p	DC + ACp-p ACp-p : 1kHz or less
Input terminal	Binding-post (It is used for external trigger input and external sweep.)	

External Horizontal Sweep

Item	Specifications	Remarks
Sensitivity	More than 1.5V/cm (More than 300mV in sweep magnification mode.)	
Sensitivity variable	Continuously variable to approx. 1/10.	
Frequency bandwidth	DC ~ 200kHz	Within - 3dB at maximum position of VARIABLE knob.

Item	Specifications	Remarks
Input impedance	Approx. 220kΩ with 50pF or less.	
Maximum allowable input voltage	100 Vp-p	DC+ACp-p AC : 1kHz or less
Input terminal	Binding-post (It is used for external trigger input and external sweep.)	

Calibration Voltage

Waveform	Square wave of approx. 1kHz.	
Polarity	Positive-going with base line at 0 volts.	
Output voltage	50mVp-p and 500mVp-p	Output voltage is regulated.
Output voltage accuracy	Within ± 3 %	

CRT

Item	Specifications	Remarks
Type	133mm, circular type, post-acceleration	
Acceleration voltage	Approx. 2600V	
Effective area	10cm (Horizontal) x 8cm (Vertical)	
Unblanking	DC coupled	

Power Supply

Item	Specification	Remarks
Voltage	90V ~ 110V	
Frequency	50Hz ~ 60Hz	
Power Consumption	Approx. 25VA	

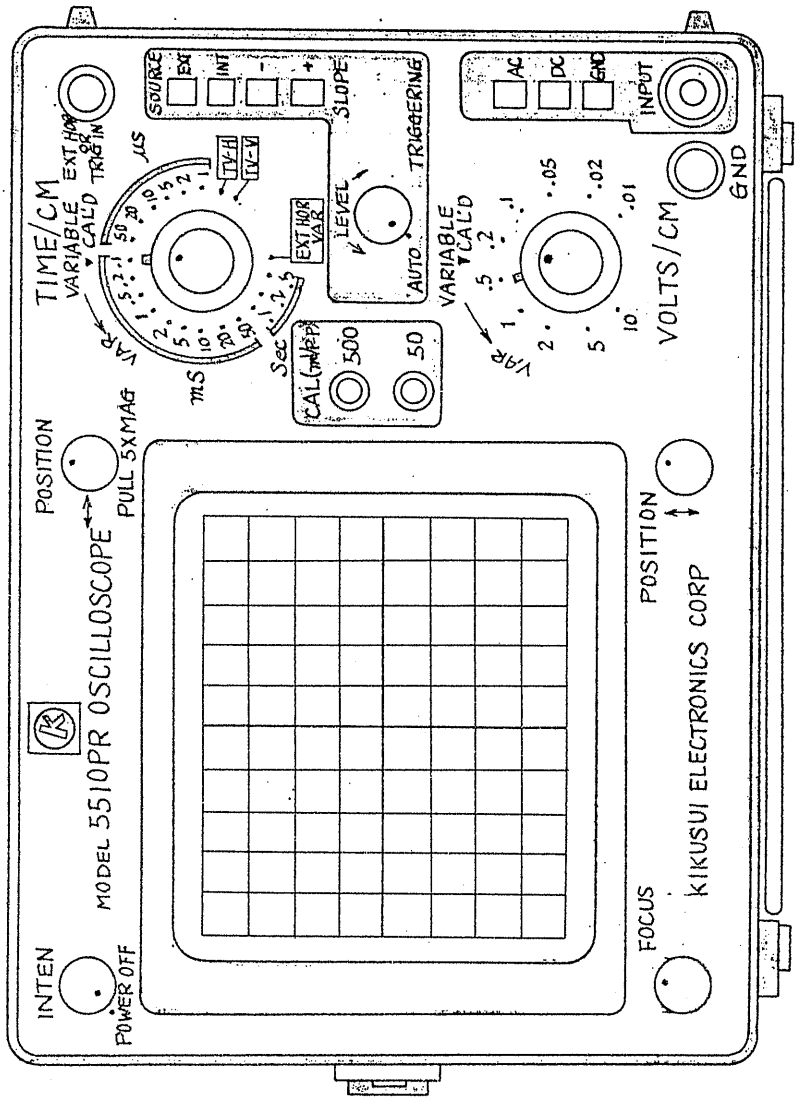
Cabinet

Item	Specifications	Remarks
Dimensions	185 H x 255 W x 455 D	Maximum
	165 H x 235 W x 405 D	Cabinet only
Weight	Approx. 7.3kg	

Accessories

MODEL 959M probe	1
MODEL 941B terminal adaptor	1
Instruction manual	1

3. OPERATION


TIME/CM
VARIABLE
CAL'D
EXT HOR
OR
TRIG IN
SOURCE
EXT
INT
SLOPE
TRIGGERING
AC
DC
GND
INPUT
LEVEL
AUTO
EXT HOR
VAR
CAL(mA/pp)
500
50
VARIABLE
CAL'D
VOLTS/CM
GND
POSITION
PULL 5XMAG
MODEL 5510PR OSCILLOSCOPE
INTEN
POWER OFF
FOCUS
POSITION
KIKUSUI ELECTRONICS CORP

3.1 Explanation of Panel

INTEN	Knob for adjusting brightness of trace or spot. It also serves as a power switch.
POWER OFF	When this knob is set to POWER OFF position, power is turned off.
FOCUS	Knob for adjusting so that the well defined spot or trace is obtained.
CALIBRATOR	Square wave generator for calibrating the sensitivity and the probe. Positive-going with base line at 0 volts. Frequency is approx. 1kHz, and output voltage is 50mVp-p and 500mVp-p.

Vertical Deflection

INPUT	Input terminal for vertical axis. It is the UHF type receptacle, to which input signal or the probe is connected.
GND	Terminal connected with cabinet and panel.
AC DC GND	Switch for selecting input coupling mode. When the GND button is pushed, the input terminal is separated from the vertical amplifier, and the input of the vertical amplifier is grounded. The DC button allows the DC coupling mode, and input signal is observed including the DC component. In this case, the position of the trace in the GND mode is 0 volts. The AC button allows the input terminal of the vertical amplifier to be AC coupled, and the AC component only is observed with the DC component cut off.
VOLTS/CM	Switch for changing over vertical deflection sensitivity within 10mV/CM ~ 10V/CM in ten steps. An indication value in each range shows voltage per 1 cm vertical amplitude on the CRT screen with the VARIABLE knob turned fully clockwise to the CAL'D position.

VARIABLE — Knob for attenuating input signal continuously. The input signal is attenuated less than 1/2.5 of the level at the CAL'D position in the extremely counterclockwise position. Therefore, in each interrange of VOLTS/CM, the input level can be continuously adjusted.

POSITION — Knob for shifting vertical position of trace to a position allowing easy measurement.

Horizontal Deflection

TIME/CM — Switch for changing over sweep time within 1μS/CM to 0.5 S/CM including TV.H, TV.V and EXT HOR in 21-step. Each indication value in a range of 1μS/CM to 0.5 S/CM is sweep time per 1 cm on the CRT screen with VARIABLE knob turned fully clockwise to the CAL'D position. The TV.H and TV.V positions allow two cycles of TV video signals to be displayed.

EXT HOR — When the TIME/CM switch is set to EXT HOR, internal sweeping stops and the external sweep state is brought about. The spot deflects in the horizontal direction in proportion to voltage applied to the EXT HOR OR TRIG IN input terminal (red binding-post).

VARIABLE — Knob for varying sweep time continuously in internal sweeping mode. Extremely counterclockwise position allows less than 1/2.5 of the sweep time in the CAL'D position. Therefore, sweep time in each interrange can be continuously adjusted. The lowest speed is less than 1.25s/cm. In external sweeping mode, this serves as an attenuator for horizontal input signal applied to the EXT HOR OR TRIG IN input terminal. The CAL'D position allows the maximum deflection sensitivity (more than 1.5V/cm), and in the extremely counterclockwise position, sensitivity is reduced down to about 1/10. (Deflection sensitivity can be boosted five times further by pulling out the horizontal POSITION knob.)

TRIGGERING LEVEL	Knob for selecting sweep time and adjusting trigger level. When this knob is turned to the AUTO position, sweeping is automatically made. Sweeping is kept with no signal applied. Whenever input signal of more than 50 Hz is applied, sweeping synchronizes with it. When the knob is turned clockwise from the AUTO position, the trigger sweep state is brought out, and spot is ready at the left edge of the screen with no input signal. Whenever input signal is applied, the oscilloscope starts sweeping. A sweep starting point on input waveform can be selected by adjusting the knob.
SOURCE	Switch for selectively setting type of trigger signal. When the INT switch is pushed, waveform displayed on the screen is used as a trigger signal source. When the EXT switch is pushed, the external signal applied to the EXT HOR OR TRIG IN input terminal is used as a trigger signal.
SLOPE	Switch for selectively setting slope of sweep starting point of trigger signal waveform. When the + button is pushed, triggering is made with the ascending slope of waveform. Pushing the - button permits triggering with the descending slope.
EXT HOR OR TRIG IN	In internal sweep mode, this is used as an input terminal for external trigger signal. In external sweep mode, it is used as a horizontal axis input terminal, DC-coupled to the horizontal amplifier.
POSITION	Knob for shifting horizontal position of spot or trace.
PULL 5 x MAG	Sweep can be magnified five times by pulling out the POSITION knob.

3.2 Explanation of Cabinet Side Face

The cabinet is provided with three adjusting holes for semi-fixed resistors on the bottom and with one hole on the top. These holes allow adjustment with a screwdriver.

(Bottom)

DC BALANCE — Semi-fixed resistor for adjusting DC balance of vertical axis. Adjust this until the trace does not shift up and down by turning the VARIABLE knob.

GAIN CAL — Semi-fixed resistor for calibrating vertical axis sensitivity. Calibration is made by using the output voltage from the CALIBRATOR terminal.

ASTIG — Semi-fixed resistor for adjusting together with the FOCUS knob so that the spot or trace becomes well defined on the screen.

(Top)

STABILITY — Semi-fixed resistor for adjusting stability of horizontal sweep generator. Once it is adjusted, there is little fluctuation. However, if horizontal sweeping fluctuates due to variation in the ambient temperature and so on, readjust this resistor as follows;

1. Push the GND button with no input signal applied.
2. Turn the TRIGGERING LEVEL knob fully clockwise (opposite side of AUTO).
3. Set the TIME/CM switch to 1mS.
4. Set the SOURCE switch to INT.
5. Turn the STABILITY resistor fully counter-clockwise, and the free running state is brought about. The free running is the state where the sweep generator operates automatically for sweeping. Unlike auto-sweep, synchronization cannot then be attained, and the trace remains bright even if sweep speed increases.

6. Next, slowly turn the STABILITY knob clockwise, and the free running stops. This point is the optimum point of stabilty.
7. Check synchronization by means of a sine wave signal generator within 50Hz to 10MHz. (The CALIBRATOR signal of MODEL 5510PR may be used instead of that signal generator.) Set the TRIGGERING LEVEL knob to AUTO position. Connect the output of the generator to the vertical axis INPUT terminal. Set amplitude on the CRT screen to approx. 2cm, using three frequencies of 50Hz, 10kHz and 10MHz. Check the synchronization when the TIME/CM or VARIABLE knob is changed. If the waveform is doubled, turn the STABILITY knob slightly clockwise. However, be carefull not to turn it too far. Otherwise, synchronization may not be attained at 10MHz, even if it is attained at 50Hz and 10kHz.

3.3 Precaution

Primary supply voltage

MODEL 5510PR operates safely within a primary supply voltage range of 100V ± 10%. Maintain that range by suitable means, since an input voltage above this range causes trouble.

Fuse

MODEL 5510PR uses a time lag fuse of 0.5A. Be sure to use the same type fuse for replacement.

Ambient temperature

MODEL 5510PR operates properly within an ambient temperature range of 0 to +40C. To satisfy the specifications sufficiently, a range of +10 to +35C is recommended.

Withstand voltage of each input terminal

For each input terminal and accessory probe, the maximum allowable input voltages are specified as follows;

Vertical axis input terminal	400Vp-p in 0.01V/CM position of VOLTS/CM 600Vp-p in ranges other than 0.01V/CM
Accessory probe	600Vp-p
EXT HOR OR TRIG IN terminal	100Vp-p

Brightness of CRT

Avoid increasing brightness of CRT too much. Also avoid leaving the spot for a long time as it is. Otherwise, the phosphor of the CRT screen may be burnt.

3.4 Operation

Before switching on power, set each knob on the front panel as follows;

INTENSITY	POWER OFF position
FOCUS	Center
POSITION ↕	Center
POSITION ↔	Center
TIME/CM	1 mS/CM
TRIGGERING LEVEL	AUTO position

Connect the power cord to 100V line supply. Turn the INTENSITY knob fully clockwise. About ten seconds later, the bright trace appears on the CRT screen. Turn the INTENSITY knob counterclockwise until optimum brightness is obtained. Next, turn the FOCUS knob until the trace is well defined.

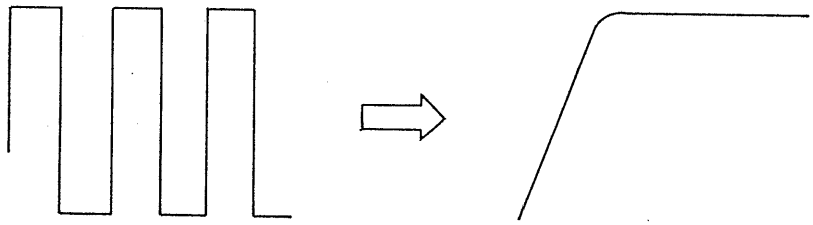
Feed MODEL 5510PR's CALIBRATION signal to the vertical axis input terminal. The waveform will appear on the CRT screen.
In this case, use the 50 mV calibration voltage, and set each switch and knob as follows;

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

The above-shown setting permits observing a square wave of 5 cm vertical amplitude.
As the VOLTS/CM switch is changed over counterclockwise, vertical amplitude attenuates step by step. Also counterclockwise turning the VARIABLE kmob attenuates amplitude continuously. As described above, input signal can be optionally adjusted by means of the VOLTS/CM switch and VARIABLE knob.

Time base and triggering

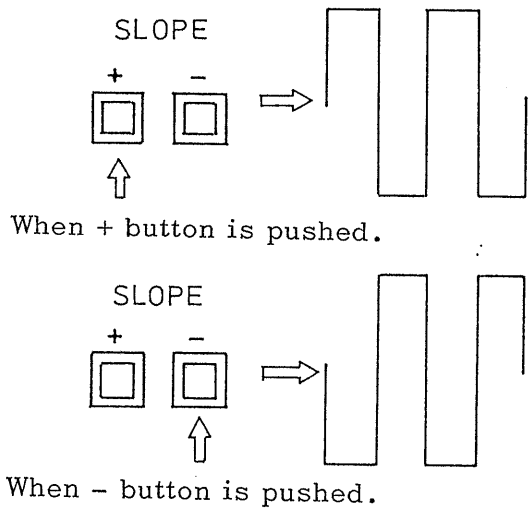
Since the calibration voltage is 1kHz square wave, with the TIME/CM knob in the 1mS range, one cycle of square waves can be displayed in about 1cm length horizontally.
As the TIME/CM switch is changed over clockwise step by step, the sweep time of the time base becomes shorter. Also, the sweep time can be varied continuously by means of the VARIABLE knob. Therefore, part of square wave as well as the entire wave of calibration voltage can be measured. Namely, when the TIME/CM knob is switched clockwise, the leading edge of square wave is magnified as shown in Fig. 3-1.



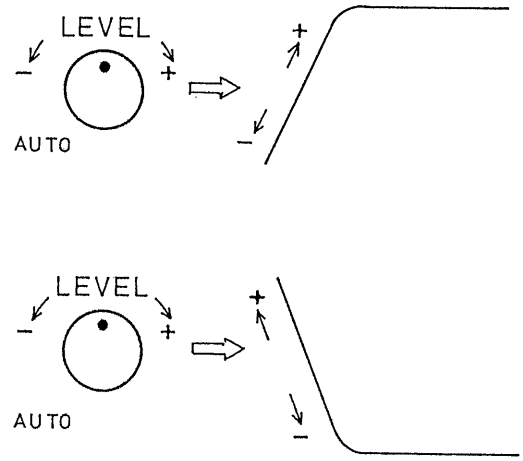
Variation of waveform on CRT screen by switching sweep time.

Fig. 3-1

To observe variation of triggering points, while reffering to Fig. 3-2, first, push the + button of SLOPE and then push the - button. Also, turn the LEVEL knob. By turning the LEVEL knob, let sweeping start from the desired point on the leading or trailing edge of square wave.



SLOPE selection and waveform on CRT screen



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

Fig. 3-2

Triggering signal source

To hold input signal waveform on the CRT screen, it is necessary to feed the input signal waveform or signal having a constant timing with the input signal to the trigger circuit of the time base.

Internal trigger

When the INT button of the TRIGGERING SOURCE is pushed, input signal is amplifiered by the vertical axis amplifier up to a suitable level, and is fed to the trigger circuit. Therefore, very stable synchronization is attained and operation is also easy. This is called the internal trigger.

External trigger

When the EXT button of the TRIGGERING SOURCE is pushed, the input of the trigger circuit is connected to the EXT HOR OR TRIG IN terminal, through which external trigger signal is fed to the trigger circuit. This is called external trigger. The external trigger actuates the trigger circuit, unaffected by the vertical deflection system. Therefore, this is effective to measure the waveform of ripples superimposed on HF signal or irregularly changing pulses which do not allow easy synchronizing.

4. MEASUREMENT

4.1 Connection of input signal

Input impedance of MODEL 5510PR as viewed from the vertical input terminal side is 1MΩ with 38pF in parallel. When the accessory probe is used, it is 10MΩ with less than 14pF in parallel.
There are various methods for connecting MODEL 5510PR with a signal source to be measured, such of use of ordinary covered wire, shielded wire, coaxial cable and the probe. These methods should be selected according to the following given conditions;

Level of output impedance of input signal source
Input signal level and frequency
Induction from outside
Distance between input signal source and oscilloscope

Table 4-1 shows connection methods classified according to the type of input signal.

Type of input signal \ Connection method			Covered wire	Shielded wire	Probe	Coaxial cable
Low freq.	Low impedance	Near	○	○	○	○
		Far		○		○
	High impedance	Near		○	○	
		Far		○		
Low freq.	Low impedance	Near			○	○
		Far				○
	High impedance	Near			○	
		Far				

Table 4-1

Method with covered wire

Attach the M type accessory terminal adaptor to the input terminal of the vertical axis, and connect covered wire to this adaptor. This method is simple and has an advantage that there is not attenuation of input signal.
However, if covered wire is long or the output impedance of the input signal source is high, this method is affected by induction from the outside, resulting in incorrect measurement. Since its stray capacity with respect to the ground is also large, the circuit to be measured is affected considerably as compared with measurement with the accessory probe of 10:1 in attenuation ratio.

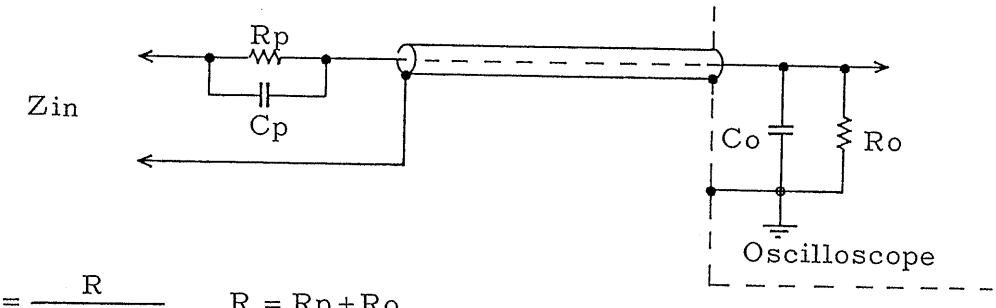
Method with shielded wire

Use of shielded wire avoids induction from the outside. However, since the capacitance of shielded wire is considerably high, (50pF/m ~ 100pF/m), this method is unsuitable for the input signal source of high output impedance or for high frequency signal source.

Methode with probe

Use the accessory probe of 10:1 in attenuation ratio. As shown in Fig. 4-1, since its lead itself is shielded, and attenuating resistor Rp and its parallel capacitance Cp compose a wide band attenuator, this is suitable for the input signal source with high output impedance or of high frequency.

Input impedance with probe used



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

$$R = Rp + Ro$$

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

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

(Co includes cable capacitance.)

Fig. 4-1

Method with coaxial cable

When the output impedance of the input signal source is 50Ω or 75Ω, etc., use coaxial cable having a corresponding impedance and let both impedance match. The output signal from the circuit to be measured can then be transmitted without attenuating over a high frequency range. As shown in Fig. 4-2, perform impedance matching on the oscilloscope side.

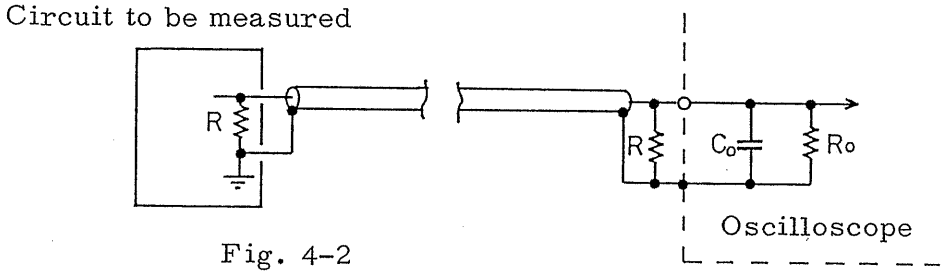


Fig. 4-2

4.2 Voltage Measurement

DC voltage measurement

Set the time base to the auto-sweep mode. Set the TIME/CM switch to 1 mS/CM and display the sweep line on the CRT screen. Next, set the AC DC GND switch of the vertical axis to GND. Since the vertical position of the sweep line then is the 0 V level of the vertical input as shown in Fig. 4-3, set it to a position allowing easy measurement on the CRT screen.
Then, change over the AC DC GND switch to DC. Feed the voltage of the point to be measured to the vertical axis input, and read with the scale on the CRT screen how much the sweep line deviates. If the sweep line is spread out of the screen, switch the VOLTS/CM knob counterclockwise until the sweep line is shifted sweep line is positioned on the upper side of the first position, the input voltage is in positive polarity. If it is positioned on the lower side, the input is negative.
The input voltage can be found by apply ing vertical amplitude (.cm) measured by means of the scale on the CRT screen to formulas 4-1 and 4-2.

With probe of 10:1 in attenuation ratio used

Voltage V = Indication value of VOLTS/CM x Amplitude x 10

..... 4-1

Without probe

Voltage V = Indication value of VOLTS/CM x Amplitude

..... 4-2

AC voltage measurement

As shown in Fig. 4-3, when AC voltage is superimposed on DC voltage, with the AC DC GND switch set to DC, the trace is spread out of the CRT screen by the DC voltage, if it is higher than the AC voltage. Thus, the AC voltage component cannot be measured. In such cases, the AC voltage component may be restored into the screen by the vertical POSITION knob. However, this method cannot be recommended since it results in a measurement error. Also, although the AC voltage component can be restored in the CRT screen by changing over the VOLTS/CM switch, amplitude becomes smaller, causing the input voltage not to be measured. In such cases, set the AC DC GND switch to AC. The capacitor is then connected in series with the vertical input, and the DC voltage is cut off. Therefore, the AC voltage component only can be magnified enough to be measured.

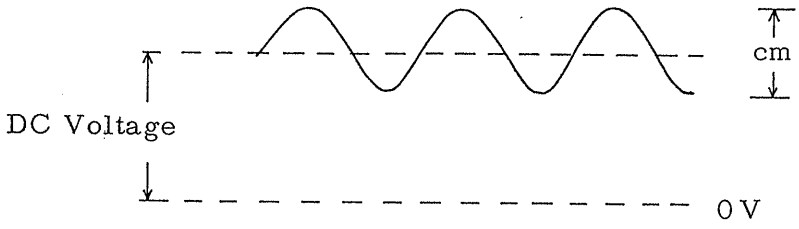


Fig. 4-3

The input voltage can then be calculated by applying amplitude (cm) to formulas 4-1 and 4-2. (Measurement in the AC position results in 3 dB attenuation in a low frequency range less than 2 Hz). The AC voltage calculated from formulas 4-1 and 4-2 is a peak to peak value (Vp-p). The effective value (Vrms) of sinewave is calculated from the following formula 4-3.

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

4.3 Time Measurement

Time interval measurement

To measure time interval between two optional points on the waveform, set the VARIABLE knob for TIME/CM to CAL'D. The time interval will then be directly shown with an indication value on TIME/CM.

First, set the TRIGGERING LEVEL knob to AUTO.

Next, change over the TIME/CM switch until the interval between two points on the waveform can be easily measured.

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

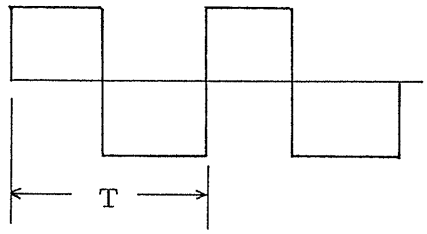


Fig. 4-4

4.4 Frequency Measurement

There are three frequency measuring methods.

The first is the method that time per one cycle is found from formula 4-4 and frequency is calculated with the following formula 4-4.

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

In the second method, time per several ten cycles (10 ~ 20 cycles) is found. Namely, count the number N of cycles contained within 10 cm divisions on the horizontal scale, and find frequency by applying N to the following formula 4-6;

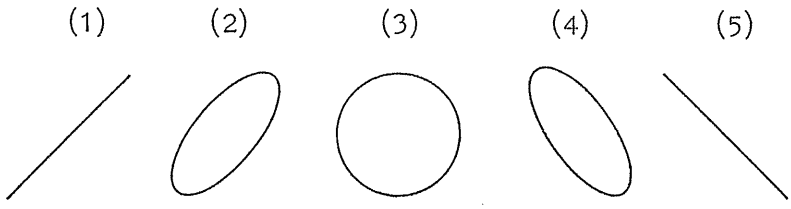
$$\text{Frequency (Hz)} = \frac{N}{\text{Value of TIME/CM (sec)} \times 10} \quad \ldots\ldots 4\text{-}6$$

This method enables measurement error to be smaller than in the first method by making N large.

The previous mentioned two are methods that frequency is found by measuring time. With simple waveform such as sine wave in a frequency range less than 5 kHz, frequency can be measured by displaying Lissajous figure in the X-Y scope mode. To set the X-Y scope, change over the TIME/CM switch to EXT HOR. Feed unknown signal to the vertical axis INPUT terminal and reference signal to the EXT HOR OR TRIG IN terminal. Adjust the VOLTS/CM switch and the VARIABLE knob of TIME/CM until both vertical and horizontal amplitudes become 4 cm.

Next, vary the frequency of the reference signal until the Lissajous' figure of 1 : 1 in frequency ratio shown in Fig. 4-5 is displayed. The Lissajous' figure of 1 : 1 in frequency ratio is one of a cycle, ellipse or linear line. When frequency ratio is around 1 : 1, the figure varies continuously and repeatedly from (1) to (5). As frequency ratio becomes closer to 1 : 1, motion is slow. When both frequencies coincide completely, the figure becomes still in either shape. The unknown frequency then is equal to the reference frequency.

With various frequency ratio, unknown frequency can be found from the figure. However, it is easiest and most accurate to use the figure of 1 : 1 in frequency ratio by means of a signal generator which allows a wide range of frequencies to be varied continuously.



Phase Difference	0° 360°	45° 315°	90° 270°	135° 225°	180°

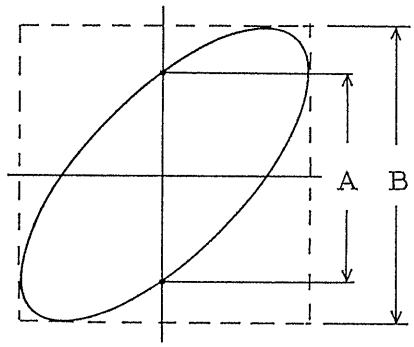
Fig. 4-5

4.5 Phase difference measurement

Measurement by means of Lissajous' figure (between two signals having the same frequency)

As explained in the frequency measurement item , display the Lissajous' figure on the screen in the X-Y scope mode. In Fig. 4-6, phase difference is obtained from the following formula;

$$\text{Sine } \theta = \frac{A}{B} \qquad \ldots\ldots\ldots 4\text{-}7$$



Caution: Since in a high frequency range, the phase difference of MODEL 5510PR itself causes an error, operate MODEL 5510PR below 5 kHz.

(The phase difference of MODEL 5510PR itself is less than 3 below 5 kHz. However, since it is below 3 at 20 kHz with the VARIABLE knob for controlling the horizontal axis sensitivity set to CAL'D, a utilizing range will be expanded.)

4.6 TV signal observation

To observe composite video signal, set the TIME/CM switch to the TV.H or TV.V range. The synchronizing separator circuit is energized, and the video signal can be easily observed.
When the synchronizing signal is negative as shown in Fig. 4-7, push the - SLOPE button. When the synchronizing signal is positive, push the + SLOPE button. Stable synchronization is attained. When the VARIABLE knob is set to CAL'D, two cycles of horizontal or vertical video signals appear on the screen in the TV.H or TV.V position respectively.

Other signal in every TV circuit than composite video signal, if it has a constant repetition rate, can be easily synchronized in TV.H and TV.V ranges.

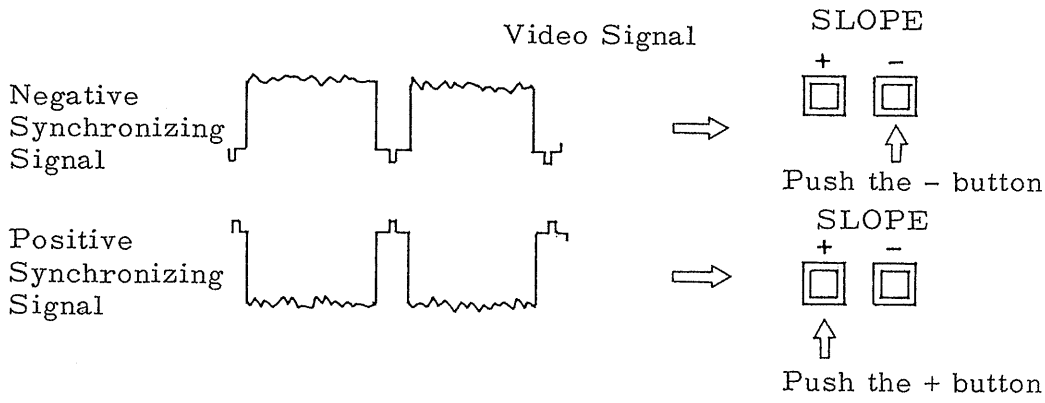


Fig. 4-7

5. CALIBRATION

After using MODEL 5510PR for a some term, be sure to calibrate it. During repair of precise parts, calibration is also necessary.

5.1 How to remove covers

Almost all adjustment parts requiring calibration are located inside the cabinet. As shown in Fig. 5-1, remove the top cover plate and bottom plate prior to calibration. Remove twelve screws from the top cover plate and four screws from the bottom plate, which are shown with the arrow marks.

During calibration, be sure to maintain the AC power supply at 100 V.

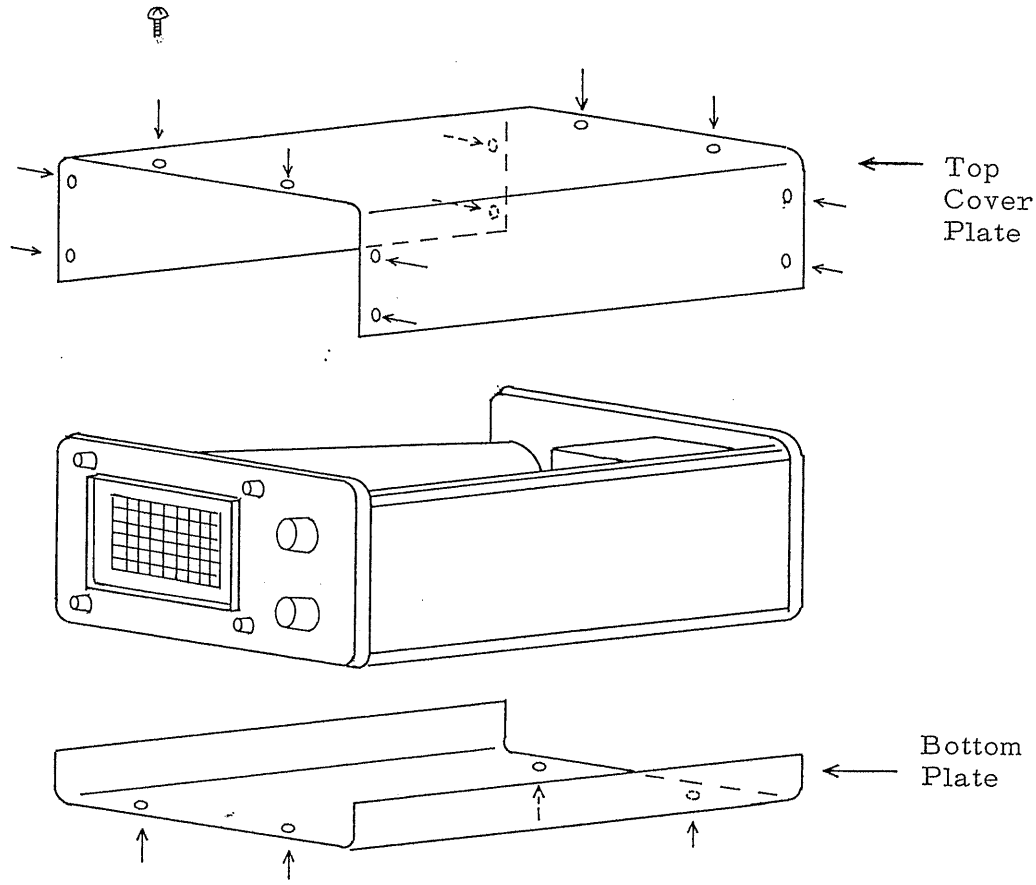


Fig. 5-1

5.2 Power supply

Fig. 5-2 shows the power supply system of MODEL 5510PR.
In this system, regulated +15V and -15V require calibration.

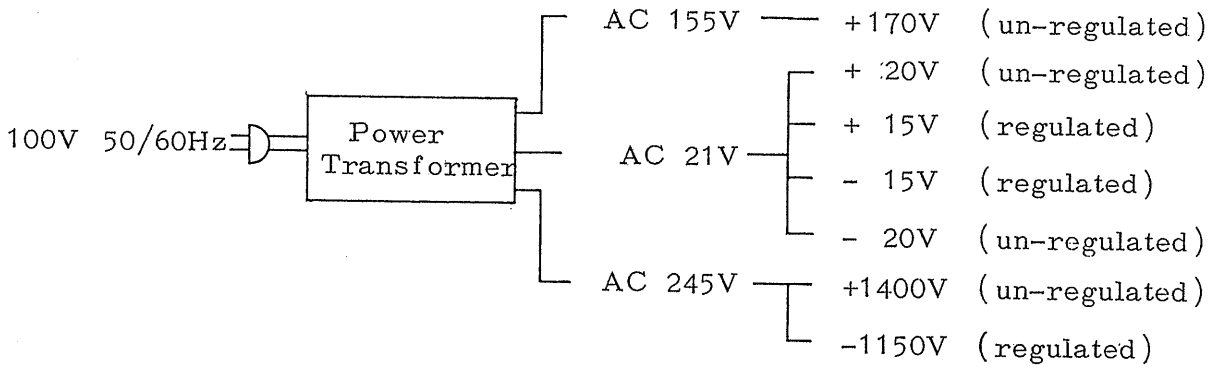


Fig. 5-2

First, adjust R117 (Shown in Fig. 5-4) for -15V with a screwdriver.
Next, turn R113 until +15V is obtained.
Since turning R117 (for -15V) causes +15V to be changed, be sure to start with -15V adjustment.

5.3 H.V ADJ and INTEN ADJ

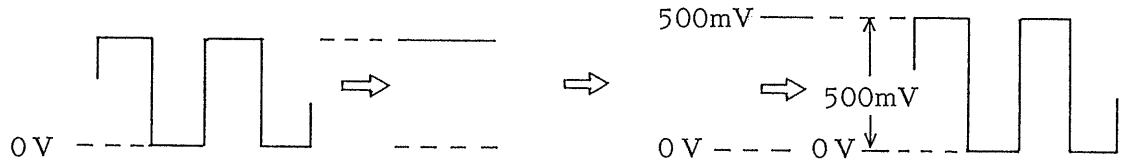
(1) Turn R843 (INTEN ADJ) in Fig. 5-4 fully clockwise.
(2) Adjust the voltage at the test point TP 1 or TP 2 to be -1150V by rotating R830 (HV ADJ).
(3) Turn the INTENSITY knob on the front panel fully clockwise. (maximum intensity position)
(4) Adjust R843 (INTEN ADJ) to make the voltage between TP 1 and TP 2 1.5V.

CAUTION : Be carefull of the high voltage (-1150V) on the test points.

5.4 CAL (calibration voltage)

R127 shown in Fig. 5-4 is a semi-fixed resistor for adjusting output voltage at CALIBRATOR terminal. When the test point TP 3 (Fig. 5-4) is connected to the chassis or the GND terminal, 1 kHz generator stops, and DC voltage only is obtained at the CALIBRATOR output terminal. Adjust R127 for 500mV by means of an accurate voltmeter, and 50mV adjustment is also automatically attained.

Next, disconnect the test point from the GND terminal, and the square waves of 500mVp-p and 50mVp-p are obtained at the CALIBRATOR output voltage terminal respectively (Fig. 5-3).



Connect the test point to the GND terminal to obtain DC voltage.

Set the DC voltage to 500mV.

Disconnect the test point from the GND terminal, and 500mVp-p square wave obtained.

Fig. 5-3

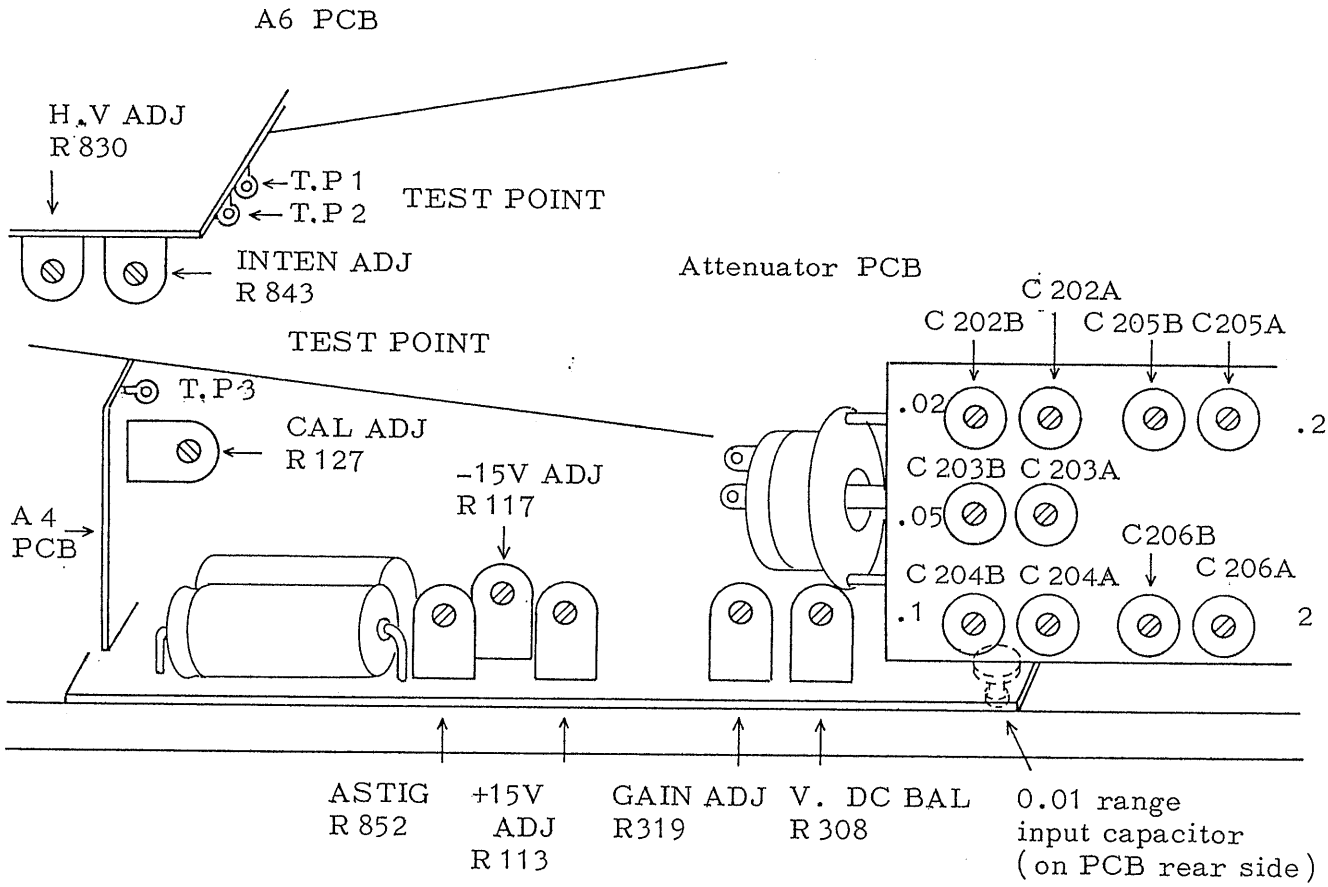


Fig. 5-4

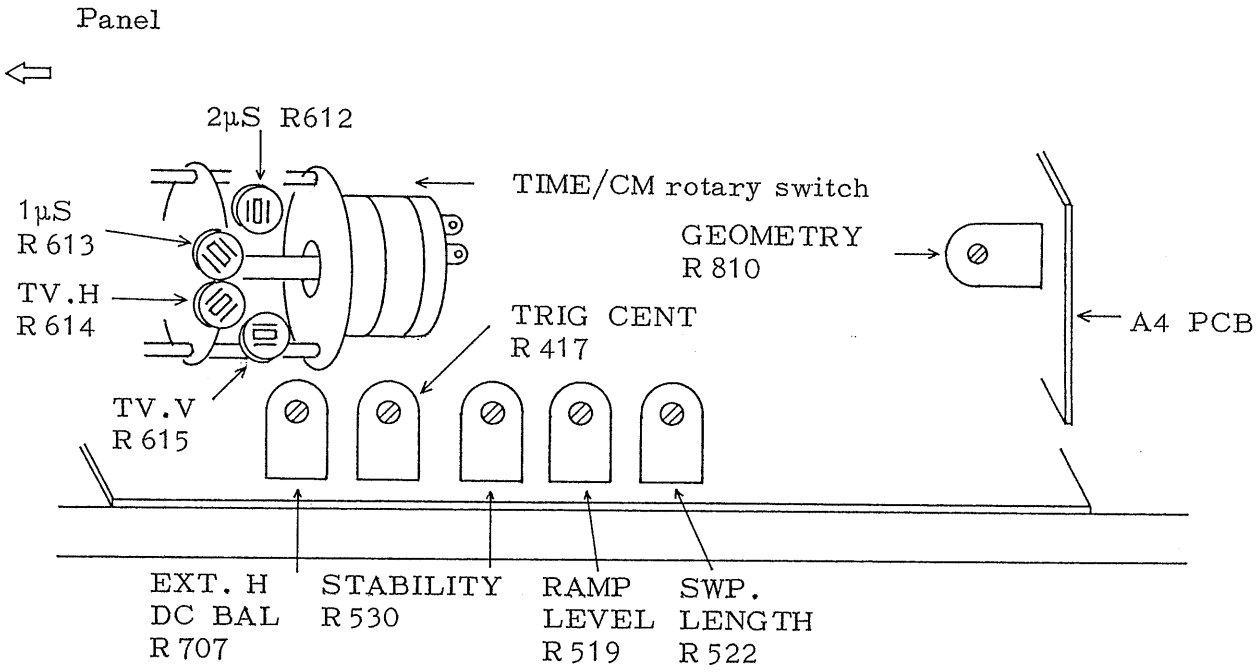


Fig. 5-5

5.5 Vertical axis deflection sensitivity

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

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

(3) Feed a 1 kHz square wave of 50mVp-p (or calibrated signal from CALIBRATOR terminal) to the vertical input terminal.

(4) Adjust R319 shown in Fig. 5-4 so that vertical amplitude is 5 cm.

5.6 VOLTS/CM switch adjustment

For this switch, adjust input capacitance and phase characteristic simultaneously by turning the trimmer capacitor on the attenuator PCB (Shown in Fig. 5-4) by means of a screwdriver.

(1) Connect a capacitor meter allowing 40pF measuremnet to the vertical axis INPUT terminal.

(2) Set the VOLTS/CM switch to 0.01. Adjust C301 so that input capacitance in this range is 38pF.

(3) Feed 1kHz square wave having less than 0.01μs rise time to the vertical INPUT terminal.

(4) Set the VOLTS/CM switch to 0.02. Perform phase adjustment by turning C202B until the upper portion of the square wave is level (Refer to Fig. 5-6).

(5) As with (4) above, adjust phase in the 0.05 and 0.1 ranges by turning C203B and C204B respectively.

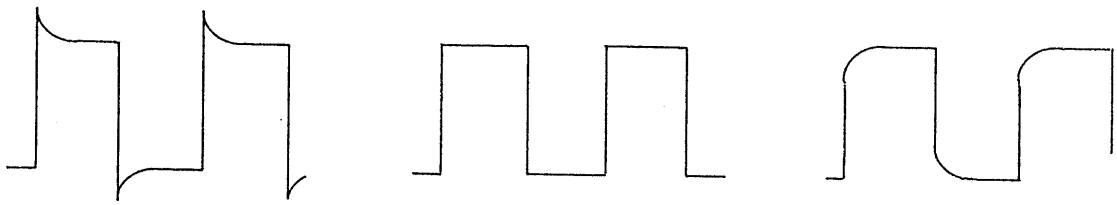
(6) Connect the capacitor meter to the vertical INPUT terminal again. Adjust input capacitance in the 0.02, 0.05 and 0.1 ranges for 38pF by turning C202A, C203A and C204A respectively.

(7) As with (4) above, perform phase adjustment in the 0.2 and 2 ranges by turning C205B and C206B respectively.

(8) As with (6) above, turn C205A and C206A until input capacitance is 38pF in the 0.2 and 2 ranges respectively.

(9) Recheck the procedures of (1) through (8).

(10) The other ranges are automatically adjusted through the procedures of (1) through (8).



Incorrect Correct Incorrect

Fig. 5-6

5.7 TIME/CM adjustment

(1) Connect a time mark generator to the vertical INPUT terminal.

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

(3) Set the TIME/CM switch to 1mS. Make marker signal conform with the scale divisions by turning semi-fixed resistor R723 (Refer to Fig. 5-7), and the ranges of 0.5S ~ 5μS are automatically adjusted.

(4) As with (3) above, adjust the 2μS and 1μS ranges by turning semi-fixed resistor R612 and R613 on the TIME/CM rotary switch (Refer to Fig. 5-5).

(5) Adjust the TV.H and TV.V ranges by turning R614 and R615 on the TIME/CM rotary switch until two cycles of vertical and horizontal video signal waveforms appear on the screen respectively.

(6) Reset the TIME/CM switch to 1mS. Adjust MAG ADJ semi-fixed resistor R724 (Refer to Fig. 5-7) so that magnification becomes five times when sweep is magnified by pulling the horizontal POSITION knob.

(7) Adjust MAG REGIS semi-fixed resistor R733 (Refer to 5-7) until the trace located at the center of the screen does not deviate due to magnified sweeping.

(8) Recheck the procedure of (1) through (7).

5.8 Sweep amplitude adjustment

Adjust SWP. LENGTH semi-fixed resistor R522 (Refer to Fig. 5-5) so that amplitude of the trace is 10.5cm in the 1mS range.
For sweep amplitude, strict adjustment is not always necessary. However, if there is excessive deviation, stable operation cannot be obtained. Rechecking is advisable.

5.9 STABILITY and vertical DC BAL

For adjustment of the STABILITY and vertical DC BAL semi-fixed resistors, refer to Paragraph 3.2 (Explanation of Cabinet Side Face). These can be adjusted from the outside of the cabinet.

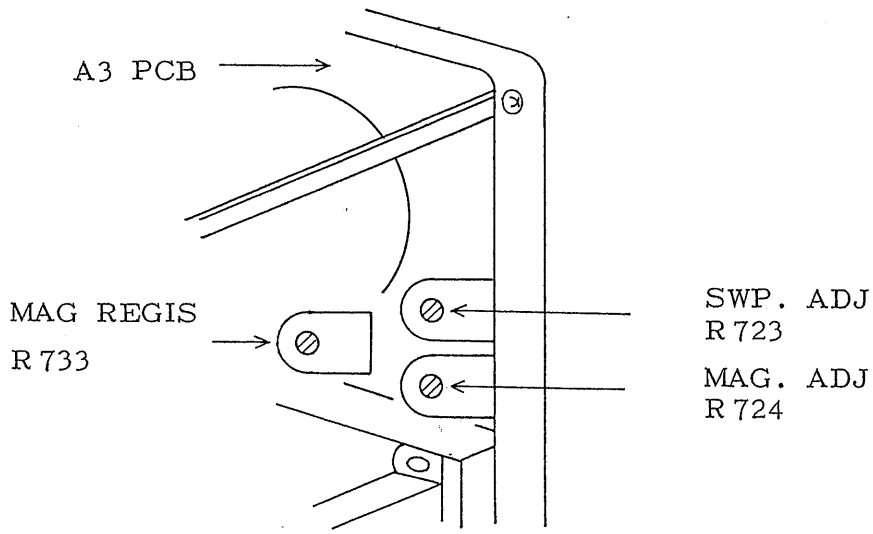
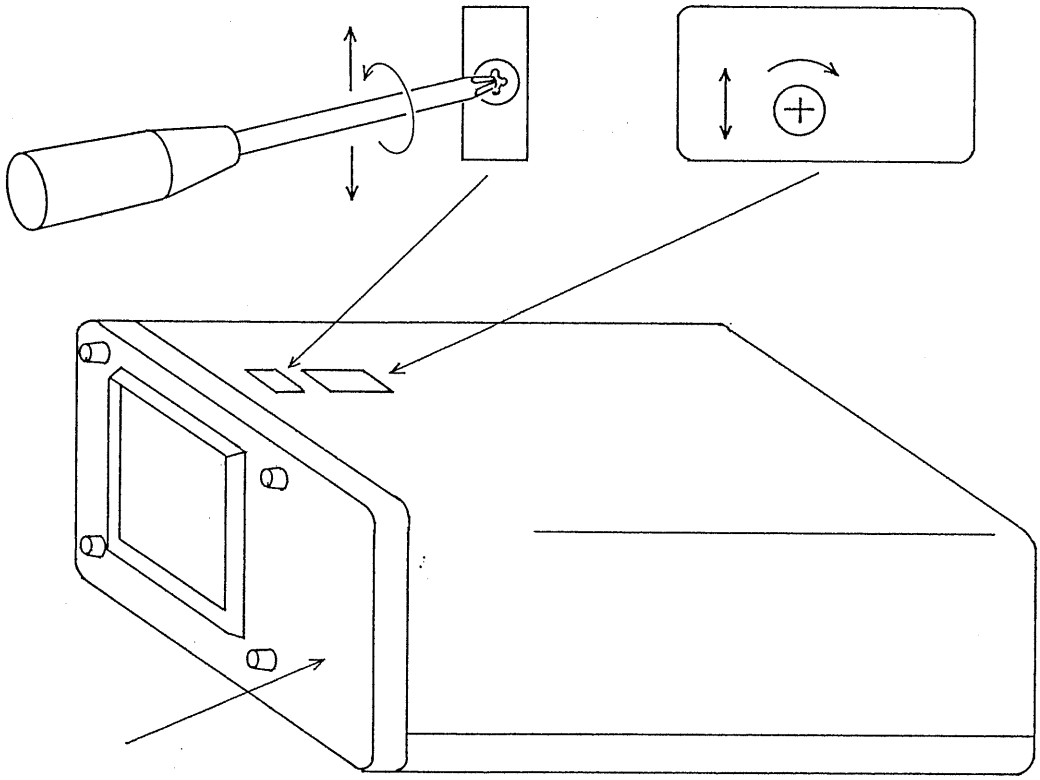


Fig. 5-7

5.10 CRT ROTATOR (Cathode-ray tube rotating mechanism)

The function of the CRT ROTATOR is to rotate the CRT mechanically for fine adjustment so that the horizontal trace on the CRT screen is made parallel with the horizontal scale lines of 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 top panel as shown in Fig. 5-8. This adjustment should be made when the horizontal trace apparently is not parallel with the horizontal scale lines of the graticule.

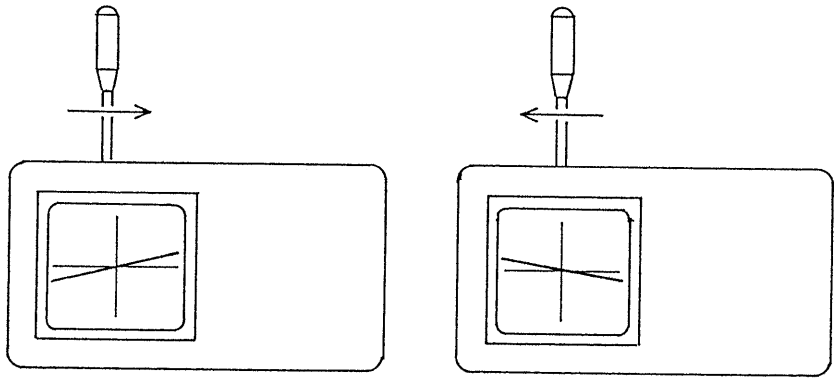


Using a screwdriver, move the 4mm screw rightward or leftward so that the horizontal trace is made parallel with the horizontal scale lines of the graticule.

Adjusting procedure

1. With a screwdriver (+), rotate the 4 mm 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 rightward and leftward. The CRT lightly rotated and thus the horizontal trace incline 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.



3. Fig. 2 illustrates the case the right-hand side of the trace is high. In this case, move the 4 mm screw rightward so that the trace is made parallel with the graticule. The 4 mm screw is heavy and should be pushed leftward strongly.

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

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

The adjusting procedure is complete by the above.